SAFETY IN MINES RESEARCH ADVISORY COMMITTEE

SIMRAC

Final Report

Title: DEVELOP MEANS TO ENHANCE THE EFFECTIVENESS OF EXISTING HEARING CONSERVATION PROGRAMMES

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Research Agency: CSIR : Division of Mining Technology

Project No.: GEN 011

Date: November 1997

Executive summary

This report should be of interest to engineering and environmental engineering consultants at Group level, as well as to management, environmental engineering, safety/loss control, training, human resources and medical personnel at mine level.

General recognition of the noise hazard as a significant health and safety risk to workers and financial risk to employers indicated a need for this programme of work. Accordingly, this project was aimed at providing means to enhance the effectiveness of mines' hearing conservation programmes and thereby limit the detrimental effects of noise.

The project outputs documented in the present report include:

- Determination of noise emission and exposure levels, with and without hearing protection. This aspect is essentially a risk assessment process.
- Characterization of frequency spectra characteristics for machinery noise and means of communication.
- The development of educational/motivational materials for use in mines' hearing conservation programmes, including video programmes, handouts for trainees and guidelines for trainers.
- The development of computer software for monitoring and evaluating mines' hearing conservation programmes.
- The provision of reference materials for the safe allocation of hearing-impaired workers.
- The formulation of recommendations for long-term noise control policy.

Results of the risk assessment process indicated that the majority of mineworkers are subjected to noise at levels capable of causing hearing impairment. In some instances these exceed the potential for exposure reduction to safe levels by means of conventional personal protection. Strategies for controlling exposure levels were evaluated and appropriate recommendations are offered. Despite their limitations, personal protection strategies offer a means of controlling exposure, at least in part, while engineering solutions are developed and implemented. Appended tabulations provide information on the selection of hearing protection devices (HPD) for specific occupations and workplaces. The efficacy of personal protection strategies is reliant on workers' appreciation of the noise hazard and their motivation

to protect themselves. Accordingly, educational and motivational training materials were required and these were developed specifically to reach the mineworker.

Computer software for the monitoring and evaluation of mines' hearing conservation programmes (HCP) was required as a management tool to address the need for regular programme monitoring and review. This is a stated requirement of SABS 083 and one that is not adequately addressed at many mines. The use of the software developed for this purpose should facilitate the review process and identify areas for enhancements to improve HCP efficacy.

The need to ensure that the allocation of hearing-impaired workers, particularly in critical occupations, does not compromise safety is an important issue. The approach adopted was primarily based on the audible signals emitted by commonly used warning devices and existing standards relating to their performance. A merit-based method of individualised assessments is proposed as an alternative to arbitrary action levels for hearing loss. If deemed appropriate, such an approach could enable the retention of many of Industry's most experienced personnel, in many cases obviating the need for re-allocation or termination with concomitant retraining and productivity implications, although such actions will be required in some instances and should be provided for. While administratively more cumbersome than arbitrary action levels, the proposed method could be automated with appropriate computer software applied at the point of routine audiometry.

Recommendations on short-, medium- and long-term strategies for addressing the noise hazard are offered, which should enlist the involvement and support of workers and co-operative partnerships with equipment manufacturers. The medium- to long-term strategies are founded on engineering solutions, which should be regarded as the most important aspect of a hearing conservation programme and as an Industry issue to be addressed on a co-ordinated basis.

A recommendation is made for the establishment of an industry-wide database for compiling data on noise emission and exposure levels, the prevalence of hearing loss and sound power levels of available mining equipment. The absence of such a facility was a major criticism of Industry by the Leon Commission and has made it impossible to validly assess risk to mineworkers and future financial exposure from compensation claims.

While the implementation of these rather broadly-based recommendations will require the commitment of considerable resources which Industry can ill-afford, the ultimate costs

associated with maintaining the status quo are even less affordable. The findings of this report, as well as the scope thereof, underscore the complexity of effectively dealing with noise as a health and safety hazard. The challenges associated with implementing the recommendations made are substantial and, accordingly, a general framework is offered for consideration in Chapter 5. In essence, the proposal recognises the value of tripartite input but suggests that the primary impetus should come from Industry itself. Noise is a significant health and safety hazard common to all types of mining operations irrespective of commodity, affecting the vast majority of employees and having the potential to threaten the industry's viability. It therefore follows that the noise hazard should be treated as an Industry issue.

Preface

Exposure of workers to excessive noise can limit their ability to communicate and hear warning signals, with the potential for immediate impact on safety and productivity. Of greater concern is that long-term exposure increases the risk of hearing loss, with implications for workers' health, employment prospects and overall quality of life.

The South African mining industry, through its introduction of hearing conservation programmes (HCP), has sought to limit the detrimental effects of noise, with particular emphasis on noise-induced hearing loss. A fundamental and, as yet, largely unrealized aim of these programmes is to reduce noise emissions at source by means of retrofits for existing machinery and the development of quieter designs for new equipment. Limited progress in this regard has extended the mining industry's reliance on personal protection strategies to control worker exposure. The limitations of this approach have led to a need for dealing with the issues of worker re-allocation and compensation.

This programme of work was intended to develop means for enhancing the effectiveness of mines' hearing conservation programmes. The present report documents the outcomes which are:

- the characterization and quantification of noise emissions and resultant worker exposure (with and without protection) for a broad range of equipment, workplaces and occupations,
- educational/motivational training materials for use in mines' HCPs,
- computer software for use in monitoring and evaluating mines' HCPs,
- reference material for the safe allocation of hearing-impaired workers; and
- recommendations on long-term noise reduction policy.

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Glossary of Abbreviations, Symbols and Terminology

Abbreviations

Decibel	dB
A-weighted decibel	dB(A)
Carbon-in-pulp	CIP
Cyanide	[CN]
Front-end loader	FEL
Hearing conservation programme	HCP
Hearing protection device	HPD
Hearing threshold level	HTL
Equivalent continuous A-weighted sound pressure level	L_{Aeq}
Load-haul-dump vehicle	LHD
A-weighted sound pressure level	L_{pA}
Noise control engineering	NCE
Equivalent noise exposure	N_{eq}
Noise-induced hearing loss	NIHL
Personal protective equipment	PPE
Personal protection strategy	PPS
Rockdrill operator	RDO
Sound level meter	SLM
Sound pressure level	SPL
Time-weighted average	TWA

Symbols

Exchange or doubling rate in dB	*ER*
(in terms of SABS 083, 3 dB is applicable)	
Measurement time interval	τ
Time criterion of 8 h expressed in seconds	*TC*
Instantaneous A-weighted sound pressure level at time t	$p_A^{(t)}$

Terminology

Hearing impairment

A condition characterized by an average binaural hearing threshold level for the frequencies of 500, 1000 and 2000 Hz that exceeds 25 dB.

Hearing threshold level

The minimum effective sound pressure level for a given frequency audible to the listener.

Noise immission

The total energy incident on the ear over a specified period of time.

Noise emission

The total sound energy produced by a source.

1 Introduction

The South African Mining Industry introduced hearing conservation on an industry-wide basis in September 1988, some nine months in advance of the legislation requiring it. Concern in the industry over the noise hazard and attempts to quantify it preceded these events by some 25 years, with noise assessments conducted on gold mines from the mid-1960s (Botha and Becker, 1965) and on collieries some ten years later (Vosloo, van Graan, Schutte and Strydom, 1975). Industry's most comprehensive investigation of noise emission and exposure to date was conducted by van Rensburg, Schutte, Strydom, Jooste and Schoeman (1980) but this was limited to gold mines.

The present report documents, among others, the results of an extensive study of noise emission and worker exposure on gold, platinum and coal mines, with consideration of surface and underground operations. Coal mining operations surveyed include bord and pillar mining using conventional, continuous and mechanized longwall methods, as well as opencast mining. With regard to the latter, the present results should be relevant to opencast base-metal operations employing methods and equipment similar to those at opencast collieries. The survey of gold and platinum mines included occupations and machinery in both conventional and mechanized sections.

In addition to determining machinery emission and worker exposure levels (the latter with and without hearing protection), the current programme of work was aimed at producing educational/motivational training materials for use in mines' hearing conservation programmes (HCP), specifically to raise workers' awareness and understanding of the noise hazard, and improve their compliance with employers' personal protection strategies (PPS).

Other outputs aimed at addressing the immediate and long-term needs of hearing conservation were:

- purpose-designed computer software for monitoring and evaluating HCPs on the basis of systems and criteria introduced in "Guidelines for the Implementation and Control of a Hearing Conservation Programme in the South African Mining Industry (COMRO, 1988),
- reference material and recommendations on the safe allocation of hearing-impaired workers, and
- recommendations on the formulation of long-term noise reduction policy.

With regard to the nature and extent of the noise hazard, surface operations were examined first, followed by coal and then gold and platinum mining. The significance of the hand-held rockdrill as a source of noise in conventional gold and platinum operations demanded a detailed study of these machines, the results of which are reported in a separate section. In order to provide assistance with the selection of appropriate hearing protection devices (HPD), tables have been appended for occupations or workplaces surveyed. These consider a total of 83 configurations of conventional or passive devices and encompass most locally available HPDs.

Remaining project outputs, viz. educational/motivational training materials, HCP monitoring computer software and the safe allocation of hearing-impaired workers are presented in subsequent sections, followed by conclusions and recommendations.

2 Methods

This chapter provides information on the instrumentation and measurement procedures employed for frequency analysis and noise exposure determinations, as well as the analytical procedures applied to the results. With regard to frequency analysis, differences in measurement methodology required separate descriptions for coal mining, gold/platinum mining, ventilation fans, hand-held rockdrills and warning signals. The methods for determining equivalent noise exposure were uniform across coal mining and gold/platinum mining.

2.1 Instrumentation and measurement procedures

The methods described below were applied to both the coal and the gold/platinum surveys. There were differences in the instrumentation employed for frequency spectra determinations, mainly as a result of the need to comply with strict intrinsic safety requirements on collieries.

2.1.1 Frequency spectra

Details of all instrumentation used for frequency spectra determinations are provided in Table 2.1.1.

Table 2.1.1

Instrumentation used for frequency analysis

Instrument	Manufacturer and Model	Serial No.
Coal:		
Sound Level Meter	Scott Type 452 with integrated microphone	733483
Octave Band Analyser	Scott Type 462	0157
Sound Level Calibrator	Scott Type 457-1	1856
Gold/Platinum and Rockdrills:		
Sound Level Meter	Larson-Davis 800B	0486B0550
Microphone	Brüel & Kjær 4165	947617
Microphone Windscreen	Brüel & Kjær UA0237	N/A
Sound Level Calibrator	Brüel & Kjær 4230	782173
FFT Spectrum Analyser	Diagnostic Instruments PL22/BL	637

2.1.1.1 Coal mining

In order to determine the nature as well as the level of noise emissions, frequency analyses were performed for all occupations and noise sources considered. For the coal survey a Scott 452 sound level meter (SLM) was used with an integrated microphone and Scott 462 octave band analyser. This configuration complies with the requirements of IEC publication 651 for Type 2 (survey grade) SLMs. A-weighting was applied and the SLM's detection mode was set to "fast", in accordance with SABS 083: 1983 (as amended). Calibration was confirmed immediately before and after each series of measurements with a Scott 457-1 acoustic calibrator.

2.1.1.2 Gold/platinum mining

For the gold/platinum survey and rockdrill study, frequency analyses were performed by means of a Larson-Davis 800B sound analyser, fitted with a Brüel & Kjær (B&K) 4165 one-half inch condenser microphone and a B&K UA0237 windscreen. This configuration complies with the requirements of IEC Publications 651 and 804 for Type 1 (precision grade) sound level meters (SLM). The SLM's internal octave and one-third octave filters were disabled, A-weighting was applied and the instrument's detection mode set to "fast". The unfiltered, A-weighted signal was conveyed, via the SLM's AC output, to a Diagnostic Instruments PL-22 FFT (fast fourier fortran) spectrum analyser for the purpose of data logging and frequency analysis. In order to ensure satisfactory frequency resolution and amplitude accuracy, the spectrum analyser's anti-aliasing filters and Hanning Window were employed. The SLM and spectrum analyser were calibrated immediately before each series of measurements and calibration continuity confirmed on completion, by means of a B&K 4230 sound level calibrator.

In order to ensure that sound measurements would be representative, the microphone of the SLM was placed at the employee's normal working position, as near to the ear as practicable without impeding normal operations. Where workers performed their duties at a fixed location, this was accomplished through the use of a photographer's tripod. In situations where the individual moved about within a confined space, the microphone/pre-amplifier assembly was connected to the SLM via a 3 m or 5 m extension cable. This arrangement enabled observers to manually maintain a suitable microphone position while the worker performed his duties. Where noise emissions from mobile equipment were measured, depending on which instrumentation was used, the observer either rode on the machinery (where possible) or, alternatively, the SLM and FFT analyser were mechanically attached to the machinery inside vibration damped and waterproof enclosures. In either situation the microphone was positioned as near to the operator's ear as practicable, and observations recorded for a representative period of time, normally over several complete cycles of operation.

2.1.1.3 Ventilation fans

To assess the potential impact of noise emissions from fans with particular reference to the attenuation affect of increased distance from the source, a number of ventilation fans were surveyed in conventional and mechanized sections of gold mines. These included main and auxiliary or in-line fans of various sizes and power ratings, all of which were axial-type appliances. The criteria for inclusion were, firstly, that the type of fan and its method of installation be representative of those used in gold and platinum mines and, secondly, that it be possible to measure noise emissions without interference from other sources.

The tripod-mounted SLM/microphone assembly was positioned at a height of 1,2 m and at a minimum distance of 1,5 m from any reflective surfaces. Inside main fan chambers, measurements were made at locations where fan attendants or maintenance personnel would likely perform their duties. These included control panels, inspection points and meter displays, resulting in six to ten measurement sites inside each fan chamber. In haulages the microphone was centrally positioned between the sidewalls and directed towards the source, at a point 1,2 m above the footwall or rails. This invariably resulted in a minimum distance of 1,5 m between the microphone and sidewalls, as none of the haulages was less than 3 m in width. The SLM/microphone assembly was incrementally moved from distant positions upstream of the fan, towards the source and, in the case of auxiliary fans, to increasingly distant positions downstream. Values tabulated for 0 m (at the fan) were made at a position directly opposite the fan but at a lateral distance of 1,5 m. The range of distances over which measurements were made was such that emission levels were observed to diminish to a level of 85 dB or below at the two most distant points. A minimum of three readings was recorded at each measuring position, each comprising five process averages. This equates to approximately two-and-a-half minutes of sampling time at each position. Measurement procedures were halted and data discarded in instances of interference, e.g. the passing of equipment or personnel. Results for fans of similar size and power rating were pooled and used to determine mean L_{pA} and L_{Aeq} values for each measurement position.

Although some of the fans included were nominally classified as "silenced" and had been fitted with attenuator pods at the time of installation, in some instances these or their sound absorbant baffles had subsequently been removed. In other cases the apparent accumulation of air-borne dust and moisture in the sound absorbing components had largely negated any noise reduction measures incorporated into the original installation. On the basis of observed sound pressure levels alone, it was generally impossible to distinguish between "silenced" and "standard" fans.

2.1.1.4 Hand-held rockdrills

This section describes the procedures applied during a detailed assessment of noise emissions from hand-held rockdrills. Two underground test sites were selected, one for development drilling and one for stoping. The criteria for site selection were to simulate a typical mining situation in terms of the confined, reverberant acoustic conditions that exist underground, as well as to allow measurements to be made without interference from or with other mining operations. Pneumatic drills were powered by an established air line from compressors on surface and the water-hydraulic machines by an electro-hydraulic power pack, remotely situated to prevent acoustic interference.

A total of 14 different rockdrills from six manufacturers, comprising seven silenced pneumatics, four unsilenced pneumatics and three water-powered hydraulics were evaluated in a development and/or stoping situation. These machines were selected as a representative cross-section of the hand-held rockdrills used on South African gold and platinum mines. Two operating pressures, 400 and 600 kPa, were used for the pneumatic drills, with the exception of one unsilenced machine which was also tested at 500 kPa in the stope. These pressures were selected to cover the normal range of operating pressures underground. Operating pressure for water-hydraulic drills was uniform at 17 MPa for both stoping and development.

The various combinations of drill type, operating pressure and working environment produced a total of 33 different test conditions, of which 32 yielded useful results. For tests at 400 kPa in the development end and in the stope, pneumatic machines were equipped with the thrustleg supplied by their respective manufacturers as standard. At 600 kPa, in both working environments, pneumatic drills were all fitted with the same thrustleg, chosen for its ease of operation and handling. The only exception was the imported development drill with its own integrated thrustleg. Water-hydraulic machines were equipped with the thrustleg supplied by their respective manufacturers.

Five standard holes (2,3 m deep x 38 mm for development and 1,2 m deep x 36 mm for stoping) were drilled for each of the 33 test conditions, with new drillsteel fitted at the start of each condition. The time required to perform each stage (collar, drill and move) of every drilling cycle was measured with a stopwatch and manually recorded. Operating pressure was monitored continuously during the drilling process by means of a calibrated, in-line pressure gauge upstream from the drill. Immediately after the completion of drilling for each test condition, the depth of each hole was measured and recorded, in order to ensure uniformity and enable the calculation of drill performance.

The position of the SLM microphone/pre-amplifier assembly was maintained at a point midway between the ears of the drill operator and the assistant. This was facilitated by the use of a 3 m extension cable (supplied by the SLM manufacturer) to connect the microphone/pre-amplifier assembly with the SLM. In order to obtain information on the attenuation of rockdrill noise with increased distance, a series of measurements was performed in the development end and in the stope where microphone position was varied relative to the operators' position. Observations were made at incremental distances up to a maximum of 20 m in the development end and 10 m in the stope, drilling one hole for each measurement position.

2.1.1.5 Warning signals

Frequency spectra were determined for an assortment of signalling devices, to enable an evaluation of their suitability for use in a given acoustic environment and establish which frequencies are critical to warning signal perception. The Larson-Davis SLM and Diagnostic Instruments FFT analyser were used for measurement procedures. Signalling devices were mounted on a free-standing wooden test board (1,5 m x 1,5 m), the centre of which was 1,5 m above ground level. Tests were conducted in a disused haulage (3,5 m wide x 3,2 m high) in order to avoid interference to and from normal operations. The haulage served as a fresh air intake and air velocity ranged from 4,2-4,6 m/sec.

Sound measurements were made at various distances upstream and downstream from the test board for six types of signalling devices. These included electrical sounders (three size categories), electronic and electro-mechanical sirens, "Klaxon-type" hooters, electro-magnetic buzzers and station bells.

2.1.2 Equivalent noise exposure

Workers' equivalent noise exposures were measured by means of personal dosimetry, using Quest Micro-15 Personal Noise Dosimeters, which satisfy the requirements of IEC Publication 651 for Type 2 (survey grade) sound measuring devices. In accordance with SABS 083, the dosimeters were set for a criterion level of 85 dB(A) with a low threshold of 80 dB and a 3 dB exchange or doubling rate. Details of these instruments are provided in Table 2.1.2a.

Table 2.1.2a

Instrumentation used for personal noise dosimetry

Instrument	Manufacturer and Model No.	Serial No.
Dosimeter No. 1	Quest Micro-15	EV 7060032
Dosimeter No. 2	Quest Micro-15	EV 7060039
Dosimeter No. 3	Quest Micro-15	EV 7060038
Dosimeter No. 4	Quest Micro-15	EV 7050023
Dosimeter No. 5	Quest Micro-15	EV 7060040
Dosimeter No. 6	Quest Micro-15	EV 8030103
Sound Level Calibrator	Quest CA-12B	U 7070047

Dosimeters were calibrated in accordance with the manufacturers' instructions immediately before being fitted to workers, prior to commencement of their shift. Instruments were issued at the lamphouse in the case of underground workers, or at the point of clocking-in for surface employees. Microphones were positioned above the shoulder on the collar, as close to the ear as possible. Workers participating in the survey were informed of the purpose of the measurements, in order to gain their informed cooperation and confirm their willingness to participate. They were asked to refrain from donning additional garments which might occlude the microphones, and instructed not to remove or tamper with the dosimeters. Instruments were recovered at the point of issue on completion of the shift. Information recorded for each dosimetry sample is indicated in Table 2.1.2b. In instances where the post-shift calibration reading was at variance with the pre-shift setting by more than 1,0 dB the results were discarded. Similarly, if the worker indicated that the nature of his activities during the shift were atypical (e.g. idle due to inoperative machinery) the sample was discarded as unrepresentative.

In order to consider the findings of previous research, in accordance with the accepted project proposal, dosimetry results from van Rensburg, Schutte, Strydom, Jooste and Schoeman (1980) were incorporated with those from the current programme of work. Although there were differences between the current and previous surveys in the instrumentation used and the duration of some samples, van Rensburg et al. applied the same relations and criteria in determining equivalent noise exposure and their results generally corresponded with those of the current survey.

Table 2.1.2b

Information recorded in respect of personal noise dosimetry

Instrument Details	Employee Details	Results
Dosimeter ID No.	Occupation	Peak Level (dB)
Pre-shift Calibration Value	Shaft/Level/Section	Overload Period (mm:ss)
Post-shift Calibration Value	Company No.	Sampling Period (hh:mm)
Time ON and OFF	Characterization of Activities	*Equivalent Noise Exposure (dB)

* Relative to 8 h shift / 40 h week.

2.2 Analysis

2.2.1 Frequency spectra

Individual records of frequency analysis for each occupation or noise source comprised values for A-weighted sound pressure level (L_{pA}) at each centre frequency, over the range of 31,5 to 16 000 Hz or, where the Scott instruments were used, to 8 000 Hz. In order to eliminate the effects of electronic "noise" at the extremes of this range and to avoid the presentation of extraneous information, only the L_{pA} values for 63 or 125 Hz to 8 000 Hz were used to determine a logarithmically averaged or, alternatively, a composite maximal spectrogram. Mean (or maximal) equivalent continuous A-weighted sound pressure level (L_{Aeq}) was calculated according to the relation (from SABS 083):

$$L_{Aeq} = 10 \log \left[\left(\frac{1}{\tau} \int_o^{\tau} p_A^{(t)}/p_o \right)^2 dt \right] \; dB$$

where τ = the measurement time interval, and

$p_A^{(t)}$ = the instantaneous A-weighted sound pressure level at time t.

2.2.1.1 Effect of hearing protection on frequency spectra

In order to quantify the effect of hearing protection on the frequency spectra determined for various occupations and workplaces, information on the attenuation performance of most locally available HPDs was gathered from manufacturers and suppliers. This information, in tabular form, is appended in Table A-1.1, along with explanatory notes to assist with HPD selection. The criterion for inclusion in the present report was that devices' performance

evaluations be documented in accordance with at least one recognized standard, e.g. SABS 1451, SABS 572, BS 5108, ISO 4869, ANSI S3.19/S12.6, or DIN 45611.

Expected attenuation values for each HPD were determined by subtracting two standard deviation units from the mean attenuation reported for each centre frequency. These expected attenuation values were then subtracted from the corresponding L_{pA} values determined during frequency analysis procedures, to yield an effective L_{pA}. Finally, effective L_{pA} values for each occupation or workplace were logarithmically summed in accordance with the previously stated relation for L_{Aeq}, to derive the effective (with protection) L_{Aeq} for each HPD considered.

2.2.2 Equivalent noise exposure

Equivalent noise exposure determinations were based on a representative number of samples for each occupation considered. The instruments accumulated and integrated data for all sound emissions detected during the shift, to determine a time-weighted average or N_{eq}, in accordance with the following relations:

$$N_{eq} = L_{Aeq} + C_i \quad \text{(from SABS 083)}$$

where it is assumed that the correction factor for impulse noise, C_i, equals 0, and

$$N_{eq} = ER\left[\log_2 \int_o^{\tau} 2^{(L_{Aeq}/ER)}\, dt - Log_2\,(TC)\right]$$

where ER = the applicable exchange or doubling rate in dB (in terms of SABS 083, 3 dB is applicable),

τ = the measurement time interval, and

TC = the time criterion of 8 h expressed in seconds.

(Adapted from Quest Micro-15 Noise Dosimeter Instruction Manual)

Each N_{eq} value was derived as a continuous energy level equivalent, relative to an eight-hour shift and a 40-hour week. N_{eq} values thus derived from current samples and those from van Rensburg et al. were used to calculate a logarithmic mean for occupations surveyed.

2.2.2.1 Effect of hearing protection on equivalent noise exposure

The effect of conventional passive hearing protection in reducing equivalent noise exposure was determined for all combinations of occupations surveyed and HPDs considered. Where the machinery associated with a particular occupation or workplace is the principal source of workers' noise exposure, the same level of reduction in L_{Aeq} that results from the use of hearing protection can be expected for N_{eq}. Accordingly, the difference between the unattenuated L_{Aeq} and the effective L_{Aeq} (attenuated by HPDs) was subtracted from the mean N_{eq} (determined by dosimetry), to yield the effective N_{eq} expected for individuals using a particular HPD. Tables to assist with HPD selection for individuals in specific occupations or workplaces are appended, and references to them made in Section 3, Results.

3 Results

Results of noise emission and worker exposure surveys are presented in the sections that follow, the first of which considers surface workshops. Owing to similarities in operations and processes employed, the results from workshops on collieries were combined with those from workshops on gold and platinum mines. The only workshop category included here that bears specific relevance to the type of mining is rockdrill repair. Subsequent sections present results for coal mining and gold/platinum mining operations, and for the rockdrill study.

3.1 Surface workshops

Workshops were grouped into specific categories, e.g. boilermaking, carpentry etc, and one miscellaneous category. Mean, maximal and minimal L_{pA}, L_{Aeq} and N_{eq} values in respect of these are presented in Table 3.1. The tabulated L_{pA} and resulting L_{Aeq} values are based on current results, while entries in respect of N_{eq} consider current results as well as those of van Rensburg et al. (1980). Dosimetry results for N_{eq} are presented in two pairs of columns at the right side of the table. The first two of these reflect the results of the current survey combined with those of van Rensburg et al., while the last two columns summarize the dosimetry results of van Rensburg et al. separately, under the heading CoM RR 10/80 (Chamber of Mines Research Report No 10/80). Emission and exposure levels for surface workshops are graphically summarized in Figure 3.1. In workshops the nature of activities is such that excessive noise is generated but only intermittently and workers generally tend to wear HPDs only during periods of productive activity, if at all. Therefore, protective equipment should cater for maximal emissions and accordingly, Figure 3.1 reflects maximal L_{Aeq} values. This principle was not extended to N_{eq}, where the need to quantify workers' exposure levels dictated that reference be made to mean values.

In workshops, the greatest exposure levels were observed in the boilermaking or plating sections, where the current combined mean N_{eq} is 98,9 dB, followed by rockdrill repair at 98,0 dB. Van Rensburg et al. reported corresponding values of 95,6 dB and 96,2 dB, respectively. Current L_{Aeq} determinations for these two types of workshops were also similar. Rockdrill repair yielded mean and maximal values of 109,0 dB and 114,8 dB, respectively, while corresponding results for boilermaking/plating workshops were 107,2 dB and 116,6 dB.

Table 3.1

L_{pA} at the given centre frequency with L_{Aeq} and N_{eq} values for surface workshops

	Current Frequency Analysis								N_{eq}			
	L_{pA} (dB) at the Given Centre Frequency (Hz)							L_{Aeq} (dB)	Combined		CoM RR 10/80	
Surface Workshops	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**		**(dB)**	**(n)**	**(dB)**	**(n)**
Boilermaking/Plating										67		32
Mean	78,7	81,4	95,8	101,4	101,9	102,0	95,4	107,2	98,9		95,6	
Maximal	81,9	88,0	105,1	110,8	111,3	111,4	104,7	116,6	109		109	
Minimal	72,8	70,0	71,3	76,9	70,6	62,6	61,3	80,3	80		82	
Carpentry										43		21
Mean	75,0	81,9	82,5	94,9	97,8	96,5	90,8	101,8	95,9		91,9	
Maximal	76,2	87,9	85,0	100,8	103,2	101,5	95,7	107,1	109		109	
Minimal	74,1	69,7	71,2	82,2	84,2	84,5	66,8	88,8	80		80	
Fitting and Turning										36		23
Mean	73,0	71,8	72,4	78,6	79,9	73,8	68,3	84,0	90,8		89,3	
Maximal	74,7	73,8	74,1	79,2	81,5	75,8	71,3	85,5	105		103	
Minimal	70,4	69,2	70,2	77,3	75,7	64,4	61,3	81,0	75		75	
Rockdrill Repair										42		19
Mean	78,2	88,6	97,3	102,0	105,5	101,7	99,2	109,0	98,0		96,2	
Maximal	84,0	94,5	103,2	107,7	111,4	107,3	104,4	114,8	110		106	
Minimal	63,2	72,8	81,2	83,8	82,6	79,5	67,9	88,3	82		86	
Miscellaneous incl loco/equip repair, blacksmithing, welding, plumbing and electrical work										5		-
Mean	79,9	87,4	95,8	110,0	108,2	100,0	90,9	112,6	93,6		90,3	
Maximal	82,9	90,4	98,8	113,0	111,2	103,0	93,9	115,6	108		102	
Minimal	57,9	68,4	75,8	77,0	81,2	80,0	71,9	85,4	74		74	

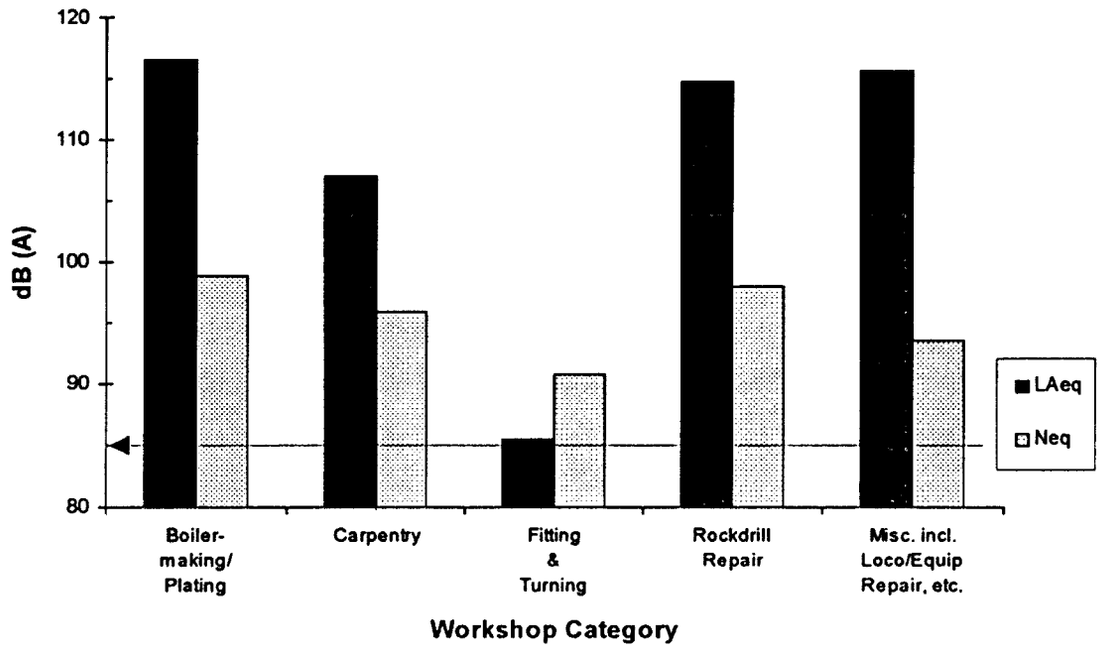

Figure 3.1 Maximal emission and mean exposure levels for surface workshops

Mean L_{Aeq} / N_{eq} values for carpentry and for fitting & turning were 101,8 dB / 95,9 dB and 84,0 dB / 90,8 dB, respectively, while corresponding maximal emission levels were 107,1 dB and 85,5 dB. Means for N_{eq} determined for these two occupations by van Rensburg et al. were 91,9 dB and 89,3 dB, respectively. In the case of carpenters, the mean N_{eq} of 95,9 dB from the combined results indicates an upward trend in exposure levels when compared with the separate value of 91,9 dB from van Rensburg et al. This trend was less pronounced among fitters and turners, where the difference in exposure level amounted to an overall increase of 1,5 dB.

Values for N_{eq} would normally be less than for L_{Aeq}, due to periods of reduced activity and/or workers' occasional absence from their stations. Where machinery associated with a particular occupation is the principal source of exposure, the only instances where N_{eq} values would equal those for L_{Aeq} would be where workers are engaged in 8 h or more of continuous operation. The apparent anomaly for fitters and turners (whose mean N_{eq} was 6,8 dB greater than the mean L_{Aeq} determined for their operations) can be attributed to noisier activities in adjacent areas of the workshops, as well as to the fact these individuals often perform installation and repair operations in noisier areas, e.g. plants. In general, where N_{eq} values for an occupation approach or exceed those for L_{Aeq}, the cause would either be nearly continuous

operations over the 8 h shift, more than 8 h of exposure, exposure to emissions from noisier operations, or some combination of these factors.

In the final workshop category from Table 3.1, miscellaneous, which includes blacksmithing, loco and equipment repair, welding, plumbing and electrical, a different situation prevailed. Here the mean value of 93,6 dB for N_{eq} was considerably less than the mean and maximal values of 112,6 dB and 115,6 dB, respectively, determined for L_{Aeq}. This is indicative of some intermittency in operations and/or periods of worker absence from normal stations. Van Rensburg et al. determined a mean N_{eq} of 90,3 dB for this group of occupations, which is 3,3 dB less than the current combined mean. The apparent upward trend in exposure level may indicate a shift towards more continuous activity by workers, possibly as a result of a reduction in the number of persons being employed in these workshops.

Information to assist with HPD selection for individuals in workshops is tabulated in Appendix 2. In workshops, where activities and noise emissions are variable, selection of HPDs on the basis of mean L_{pA} values could result in underprotection during periods of productive activity. Accordingly, Tables A-2.1 to A-2.5 are based on maximal L_{pA} values from Table 3.1. It is reasonable to expect that employees in a workshop situation would tend to wear HPDs only while operations that generate excessive noise are in progress, and protection against maximal noise emissions would therefore be appropriate.

3.2 Coal mining

The results presented in this section are based on measurements from the current survey only, due mainly to the omission of worker exposure measurements during previous work.

3.2.1 Underground operations

3.2.1.1 Conventional mining

Machinery considered here includes coal cutters, coal loaders, roofbolters and electric hand drills. For each occupation associated with these machines, L_{pA}, L_{Aeq} and N_{eq} results are summarized in Table 3.2.1a. Also included are results for team leaders but, owing to variations in activities and the wide variety of noise sources that individuals in this work category are exposed to, valid means for L_{pA} and L_{Aeq} could not be determined with confidence.

Accordingly, and since the use of minimal values would underestimate the noise hazard, L_{Aeq} for team leaders was based on maximal L_{pA} values observed at each centre frequency. It was possible, through personal dosimetry, to determine team leaders' mean N_{eq}, which is included

in Figure 3.2.1a, along with maximal L_{Aeq} and means for L_{Aeq} and N_{eq} relative to other occupations in conventional coal mining.

Table 3.2.1a

L_{pA} at the given centre frequency with L_{Aeq} and N_{eq} values for conventional coal mining

	L_{pA} (dB) at the Given Centre Frequency (Hz)							L_{Aeq} (dB)	N_{eq}	
Occupation	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**		**(dB)**	**(n)**
Coal Cutter Operators										28
Mean	68,5	76,5	86,5	88,5	88,5	85,0	78,5	93,6	95,3	
Maximal	70,0	80,0	89,0	90,0	89,0	85,0	79,0	94,9	103	
Minimal	67,0	73,0	84,0	87,0	88,0	85,0	78,0	92,5	81	
Coal Cutter Assistants										28
Mean	69,5	77,3	87,7	90,1	89,9	85,9	78,9	94,9	92,6	
Maximal	71,9	81,8	91,5	92,4	91,8	86,5	79,8	97,3	102	
Minimal	66,5	72,8	84,1	86,9	88,7	85,3	78,3	92,8	83	
Coal Loader Operators										27
Mean	77,3	81,5	88,0	90,3	85,3	82,3	75,0	93,9	96,2	
Maximal	80,0	84,0	90,0	93,0	88,0	85,0	76,0	96,4	104	
Minimal	75,0	80,0	86,0	89,0	83,0	79,0	74,0	92,1	81	
Roofbolter Operators										22
Mean	65,0	66,0	77,0	72,0	69,0	68,0	59,0	79,5	89,1	
Maximal	66,0	72,0	78,0	73,0	70,0	72,0	64,0	81,2	91	
Minimal	63,0	59,0	75,0	71,0	67,0	63,0	54,0	77,3	83	
Electric Hand Drill Operators										21
Mean	60,5	66,0	77,0	82,5	89,5	90,0	83,0	93,7	90,7	
Maximal	62,0	67,0	77,0	83,0	90,0	91,0	83,0	94,3	96	
Minimal	59,0	65,0	77,0	82,0	89,0	89,0	83,0	93,0	83	
Team Leaders										20
Mean									95,7	
Maximal	81,9	90,4	98,8	98,0	96,2	92,0	81,9	103,2	102	
Minimal									83	

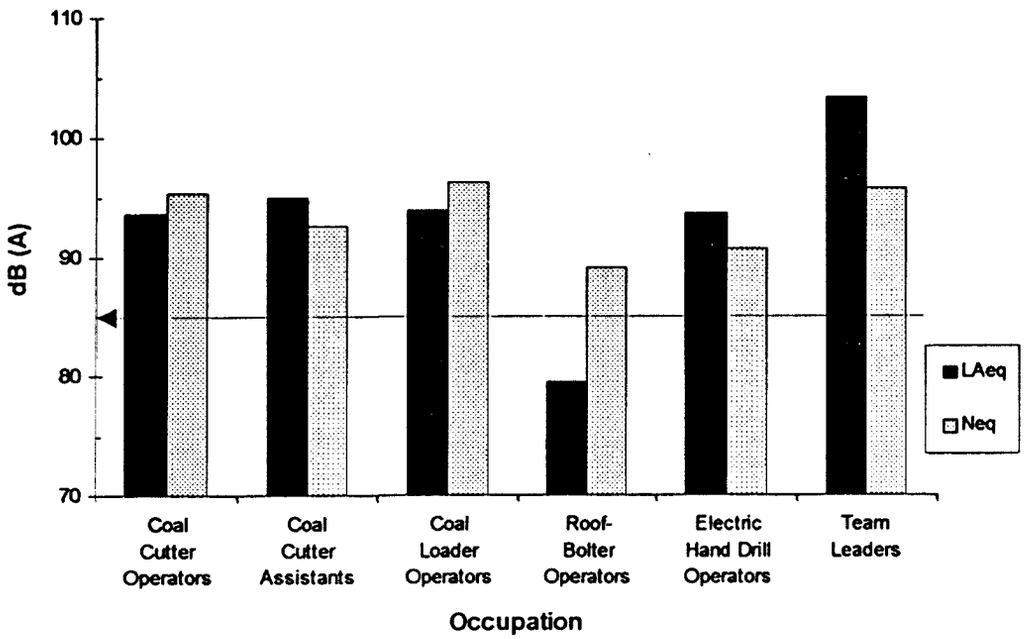

Figure 3.2.1a Emission and exposure levels for occupations in conventional coal mining

For operators of coal cutters, coal loaders and particularly roofbolters, mean N_{eq} values were greater than the mean L_{Aeq} values determined for the machines they operated. For roofbolters, the mean L_{Aeq} was 79,5 dB, while operators' N_{eq} averaged 89,1 dB. Unless additional and louder sources contribute to an operator's N_{eq}, its value for an 8 h shift can never exceed that of the L_{Aeq} for his machine, and can only be equal to L_{Aeq} in cases of uninterrupted exposure for 8 h. In the case of roofbolter operators, a considerable portion of their exposure apparently resulted from noisier machinery working nearby or passing. In addition, it was observed that roofbolter operators were often called upon to assist where noisier machinery was operating.

Information to assist with the selection of HPDs for occupations in conventional mining sections is tabulated in Appendix 3, Tables A-3.1 to A-3.6. Inasmuch as exposure levels exceeded corresponding emission levels for coal cutter, coal loader and roofbolter operators, as well as team leaders, their respective tables for HPD selection (Tables A-3.1, A-3.3, A-3.4 and A-3.6) are based on maximal emission and exposure levels observed, in order to avoid the risks associated with under-protection.

3.2.1.2 Continuous mining

The results of noise measurements for continuous mining operations are summarized in Table 3.2.1b. If the mean N_{eq} values for continuous miner operators and their assistants are compared, it is clear that operators' mean exposure level was greater than that for assistants (95,5 and 94,7 dB, respectively). However, in terms of L_{Aeq}, the noise levels assistants were exposed to slightly exceeded those for operators. This apparent discrepancy can be explained by observations that assistants sometimes moved away from the front of the continuous miner, possibly to escape the discomfort caused by dust and noise. As was the case for team leaders in conventional mining (Section 3.2.1.1), team leaders and miners in continuous sections were exposed to such a variety of noise sources that means for L_{pA} and L_{Aeq} could not be confidently determined. Accordingly, L_{Aeq} vaues for these occupations are based on maximal L_{pA} values observed at each centre frequency. Means for N_{eq} were determined for these occupations and, as for other occupations in continuous mining, these are graphically displayed with corresponding L_{Aeq} values in Figure 3.2.1b.

Information on HPD selection for occupations in continuous mining sections is presented in Tables A-3.7 to A-3.11. The tables for shuttle car operators, miners and team leaders (Table A-3.9 to A-3.11, respectively) are based on maximal emission and exposure levels, in order to avoid the risks associated with under-protection.

Table 3.2.1b

L_{pA} at the given centre frequency with L_{Aeq} and N_{eq} values for occupations in continuous coal mining

Occupation	L_{pA} (dB) at the Given Centre Frequency (Hz)							L_{Aeq} (dB)	N_{eq}	
	125	250	500	1k	2k	4k	8k		(dB)	(n)
Continuous Miner Operators										16
Mean	89,0	93,0	97,0	98,0	93,0	90,0	81,0	102,4	95,5	
Maximal	96,0	99,0	101,0	100,0	96,0	93,0	83,0	106,1	103	
Minimal	80,0	86,0	91,0	95,0	90,0	87,0	78,0	98,1	88	
Continuous Miner Assistants										15
Mean	92,0	95,0	99,0	96,0	95,0	91,0	83,0	103,3	94,7	
Maximal	98,0	99,0	102,0	101,0	98,0	97,0	85,0	107,4	102	
Minimal	88,0	94,0	96,0	95,0	93,0	83,0	81,0	101,0	89	
Shuttle Car Operators										19
Mean	78,0	85,0	88,0	86,0	84,0	78,0	70,0	92,4	93,7	
Maximal	84,0	89,0	90,0	93,0	88,0	81,0	78,0	96,9	101	
Minimal	68,0	76,0	86,0	80,0	83,0	76,0	68,0	89,0	85	
Miners										12
Mean									94,2	
Maximal	81,9	90,4	98,8	98,0	96,2	92,0	81,9	103,2	101	
Minimal									85	
Team Leaders										
Mean									96,4	15
Maximal	84,9	91,4	100,0	100,1	104,0	99,0	89,0	107,7	103	
Minimal									86	

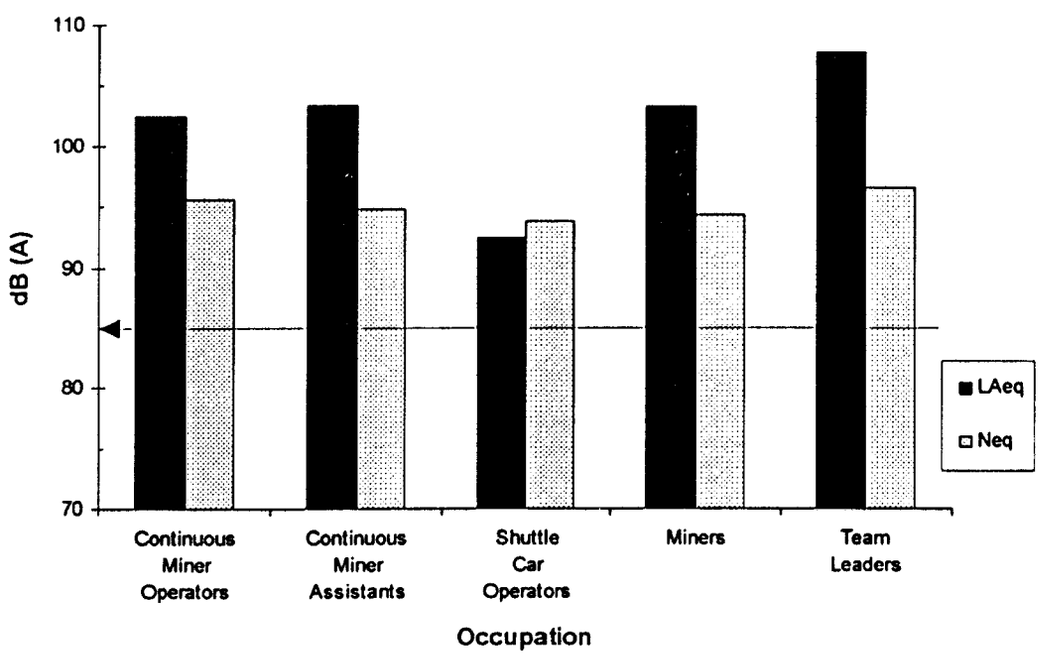

Figure 3.2.1b Emission and exposure levels for occupations in continuous coal mining

3.2.1.3 Longwall mining

The mechanized longwall system surveyed consisted of a double-ended ranging drum shearer to cut the coal, and 140 hydraulic roof supports installed over a distance of 200 m. The results of noise measurements are summarized in Table 3.2.1c. All readings were taken in the walkway beneath the shields. Readings at the shearer operator's position were taken while the shearer was moving in both directions. The shearer assistant was usually at a position 5-10 m ahead of the front cutter, where noise levels were considerably lower. L_{Aeq} values for team leaders were calculated on the basis of maximal L_{pA} values, as for team leaders and miners in the two preceding sections.

In addition to measurements made at workers' positions and summarized in Table 3.2.1c, a number of L_{Aeq} measurements without frequency analysis were made in the walkway. These measurements included those with the longwall chain conveyor operating (97 dB) and the chain conveyor not operating with the shearer running in the distance (87 dB).

Figure 3.2.1c displays values determined for L_{Aeq} / N_{eq} in longwall mining, which ranged from 86,7 dB / 93,1 dB for shield support operators to 104,1 dB / 100,8 dB for shearer operators. The shield support operators' mean N_{eq} was 6,4 dB greater than mean L_{Aeq} at the shield supports with the longwall shearer running in the distance. As was the case for roofbolter operators (Section 3.2.1.1), the apparent anomaly is attributable to emissions from noisier machinery, in this instance the shearer as it passes the shield support operator.

Information on HPD selection for occupations in longwall mining is appended in Tables A-3.12 to A-3.16. The tabulations for shearer assistants, shield support operators, crusher attendants and team leaders (Tables A-3.13 to A-3.16) are based on the maximal emission and exposure levels observed.

Table 3.2.1c

L_{pA} at the given centre frequency with L_{Aeq} and N_{eq} values for occupations in longwall coal mining

Occupation	L_{pA} (dB) at the Given Centre Frequency (Hz)							L_{Aeq} (dB)	N_{eq}	
	125	250	500	1k	2k	4k	8k		(dB)	(n)
Shearer Operators										18
Mean	85,0	93,0	98,0	100,0	96,0	94,0	85,0	104,1	100,8	
Maximal	90,0	97,0	100,0	106,0	103,0	101,0	94,0	109,6	107	
Minimal	77,0	88,0	93,0	95,0	88,0	85,0	77,0	98,3	90	
Shearer Assistants										18
Mean	79,0	86,0	93,0	96,0	93,0	90,0	85,0	99,9	100,3	
Maximal	82,0	87,0	95,0	99,0	97,0	96,0	92,0	103,5	106	
Minimal	71,0	76,0	84,0	87,0	85,0	81,0	77,0	91,1	86	
Shield Support Operators										15
Mean	78,0	80,0	80,0	79,0	78,0	77,0	71,0	86,7	93,1	
Maximal	83,0	86,0	89,0	88,0	88,0	83,0	79,0	94,7	96	
Minimal	71,0	73,0	74,0	76,0	74,0	72,0	68,0	81,6	85	
Crusher Attendants										16
Mean	73,0	82,0	84,0	87,0	86,0	84,0	82,0	92,4	97,5	
Maximal	81,0	87,0	91,0	96,0	92,0	89,0	84,0	99,3	101	
Minimal	69,0	77,0	80,0	82,0	81,0	79,0	74,0	87,4	94	
Team Leaders										14
Mean									96,6	
Maximal	81,9	90,4	98,8	98,0	96,2	92,0	81,9	103,2	98	
Minimal									91	

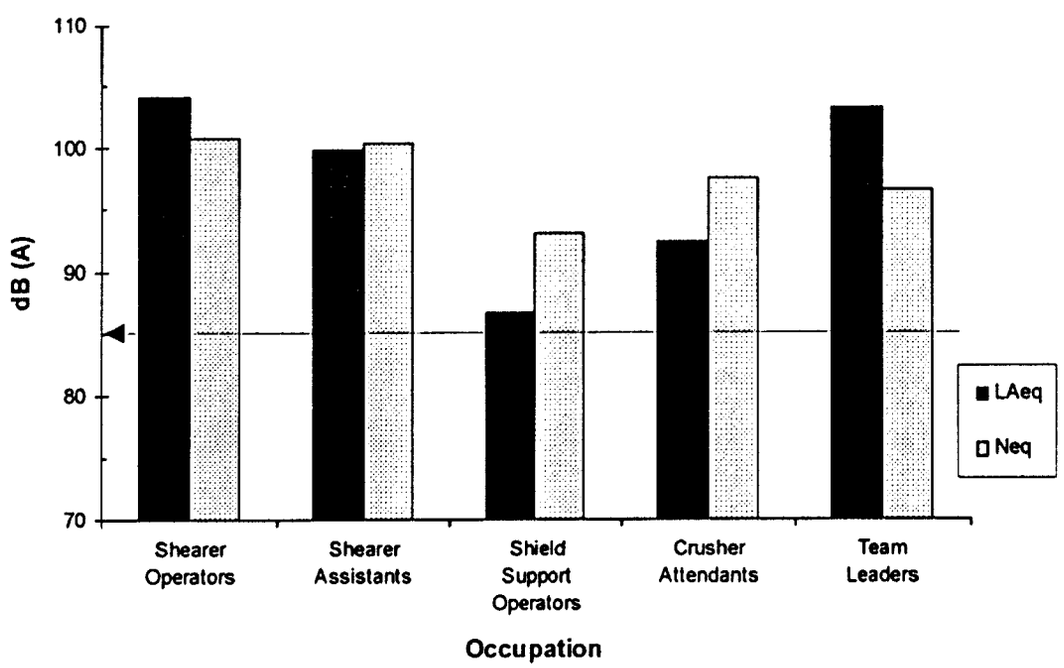

Figure 3.2.1c Emission and exposure levels for occupations in longwall coal mining

3.2.1.4 Underground vehicles

Results for underground transport vehicles as determined at the operator's position are summarized in Table 3.2.1d. Mean L_{Aeq} values ranged from 88,6 dB for buses to 102,2 dB for tractors. Underground buses and Landcruisers were operated by a number of drivers and, accordingly, no determinations for N_{eq} relative to an 8 h shift were made. Mean N_{eq} values for dedicated operators of other transport vehicles ranged from 93,0 dB for utility vehicles to 99,0 dB for LHDs. These, along with corresponding L_{Aeq} values, are presented in Figure 3.2.1d, with an indication for buses and Landcruisers of the likely equivalent noise exposure level in the event of a single individual operating one of these vehicles for a continuous 8 h period.

Table 3.2.1d

L_{pA} at the given centre frequency with L_{Aeq} and N_{eq} values for operators of underground vehicles

	L_{pA} (dB) at the Given Centre Frequency (Hz)							L_{Aeq}	N_{eq}	
Occupation/Vehicle	125	250	500	1k	2k	4k	8k	(dB)	(dB)	(n)
Tractor Drivers										13
Mean	85,0	86,0	91,0	95,0	98,0	96,0	91,0	102,2	97,0	
Maximal	94,0	88,0	92,0	98,0	101,0	99,0	101,0	106,5	99	
Minimal	80,0	83,0	90,0	93,0	94,0	93,0	83,0	99,0	89	
LHD Drivers										19
Mean	80,0	84,0	90,0	94,0	95,0	95,0	83,0	100,2	99,0	
Maximal	85,0	89,0	94,0	99,0	101,0	97,0	89,0	104,8	102	
Minimal	77,0	81,0	86,0	89,0	89,0	86,0	77,0	94,2	89	
Utility Vehicle Drivers										18
Mean	86,0	87,0	91,0	97,0	95,0	93,0	85,0	101,0	93,0	
Maximal	88,0	90,0	93,0	99,0	97,0	95,0	88,0	103,1	96	
Minimal	70,0	73,0	79,0	85,0	82,0	77,0	68,0	88,1	89	
Underground Buses										N/A
Mean	71,0	77,0	79,0	83,0	84,0	81,0	69,0	88,6	N/A	
Maximal	75,0	84,0	82,0	86,0	87,0	84,0	70,0	92,0		
Minimal	66,0	71,0	73,0	77,0	78,0	75,0	68,0	82,7		
Landcruisers										N/A
Mean	77,0	81,0	92,0	94,0	96,0	91,0	83,0	99,9	N/A	
Maximal	79,0	82,0	95,0	96,0	98,0	93,0	85,0	102,0		
Minimal	66,0	66,0	71,0	80,0	80,0	75,0	68,0	84,1		

N/A: Underground buses and Landcruisers were operated by several individuals during the course of each shift, with no single operator for a full 8 h shift.

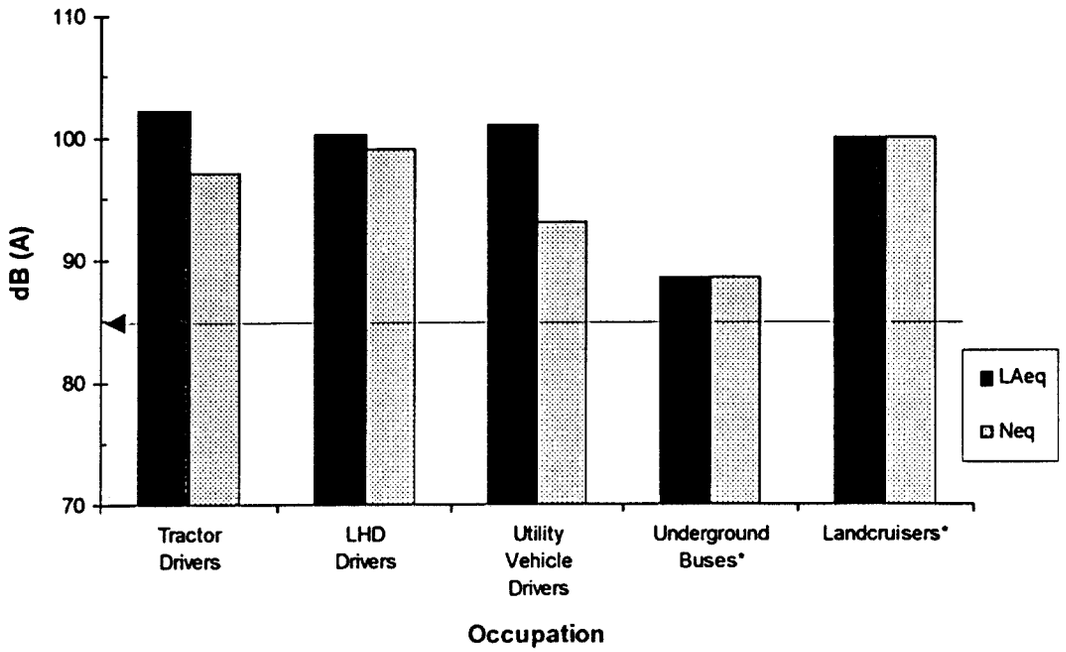

Figure 3.2.1d Mean emission and exposure levels for underground vehicle operators

Information on HPD selection for operators of underground transport vehicles is appended in Tables A-3.17 to A-3.21.

3.2.2 Opencast operations

3.2.2.1 Draglines

L_{Aeq} in dragline operator's cabins averaged 76,2 dB, while the mean N_{eq} for dragline operators was 74,5 dB. The slight difference is attributable to the occurrence of brief interruptions and delays during the course of operations. L_{Aeq} measured in dragline machine rooms ranged from 93,0 dB to 103,3 dB, with a mean value of 97,4 dB. N_{eq} for machine room attendants averaged 86,5 dB. The rather large difference between the mean values for these two parameters is attributable to the fact that these attendants spent a relatively small portion of their shift inside the machine room. Results for dragline workers including overburden drill operators are summarized in Table 3.2.2a and graphically displayed in Figure 3.2.2a.

Table 3.2.2a

L_{pA} at the given centre frequency with L_{Aeq} and N_{eq} values for dragline workers

Occupation	L_{pA} (dB) at the Given Centre Frequency (Hz)							L_{Aeq}	N_{eq}	
	125	250	500	1k	2k	4k	8k	(dB)	(dB)	(n)
Dragline Machine Room Attendants										8
Mean	82,0	90,0	91,0	93,0	88,0	86,0	76,0	97,4	86,5	
Maximal	86,0	95,0	96,0	100,0	94,0	91,0	82,0	103,3	89	
Minimal	80,0	83,0	86,0	90,0	83,0	80,0	70,0	93,0	79	
Dragline Operators										10
Mean	59,0	61,0	66,0	75,0	65,0	59,0	52,0	76,2	74,5	
Maximal	61,0	65,0	71,0	78,0	73,0	69,0	61,0	80,4	78	
Minimal	52,0	54,0	58,0	66,0	56,0	52,0	45,0	67,5	72	
Overburden Drill Operators										8
Mean	67,0	80,0	82,0	83,0	77,0	71,0	65,0	87,2	88,0	
Maximal	70,0	87,0	88,0	89,0	85,0	79,0	70,0	93,7	91	
Minimal	61,0	72,0	70,0	62,0	63,0	56,0	49,0	74,9	81	

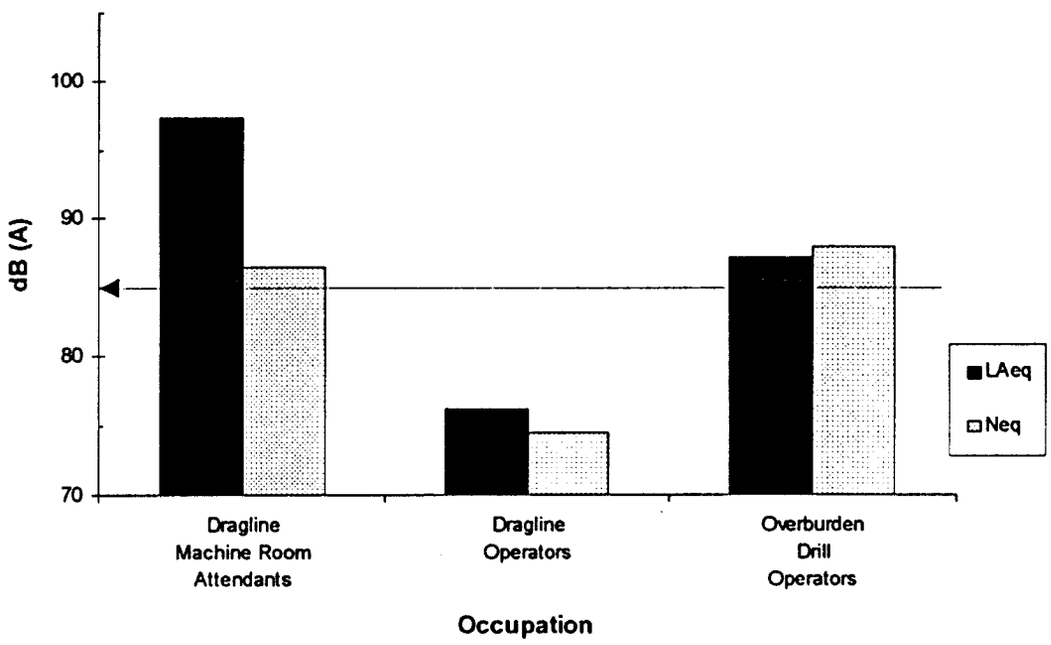

Figure 3.2.2a Mean emission and exposure levels for dragline workers

Information on HPD selection for occupations associated with dragline operations is appended in Tables A-3.22 and A-3.23. The second of these tabulations relates to overburden drill operators, whose mean exposure level exceeded the corresponding value for emission level. Accordingly, Table A-3.23 is based on the maximal emission and exposure levels observed.

No such tabulation is provided for dragline operators owing to the safe levels of emission and exposure observed for this category.

3.2.2.2 Production

Results for the four types of machines investigated in the pit are summarized in Table 3.2.2b and illustrated in Figure 3.2.2b. Mean L_{Aeq} values ranged from 86,8 dB for tyre dozers to 96,5 dB for 120 t coal trucks (Euclid CH120). Operators' mean equivalent noise exposures ranged from 87,3 dB for backactor operators to 95,7 dB for coal truck drivers. A comparison of L_{Aeq} values for production machines with corresponding operator exposure levels appears to indicate periods of reduced activity for backactors and front-end loaders, and nearly continuous operation for coal trucks. Tyre dozer operators' mean N_{eq} exceeded the mean L_{Aeq} value for their machines by 2,9 dB. This is a result of the fact that they were nearly continuously loading coal trucks and, without any effective enclosures to protect them, they were exposed to the considerably greater noise emissions from the trucks.

Table 3.2.2b

L_{pA} at the given centre frequency with L_{Aeq} and N_{eq} values for operators of opencast production machinery

	L_{pA} (dB) at the Given Centre Frequency (Hz)							L_{Aeq} (dB)	N_{eq}	
Occupation/Equipment	125	250	500	1k	2k	4k	8k		(dB)	(n)
Backactor Operators (P&H)										17
Mean	81,0	83,0	89,0	87,0	85,0	81,0	75,0	93,2	87,3	
Maximal	87,0	90,0	100,0	98,0	96,0	94,0	86,0	96,5	89	
Minimal	70,0	72,0	74,0	77,0	75,0	72,0	62,0	81,8	81	
Coal Truck Drivers (Euclid CH120)										26
Mean	82,0	85,0	87,0	92,0	91,0	87,0	82,0	96,5	95,7	
Maximal	87,0	90,0	100,0	98,0	96,0	94,0	90,0	104,0	99	
Minimal	81,0	82,0	82,0	82,0	82,0	79,0	74,0	89,4	89	
FEL Operators (Caterpillar 992)										14
Mean	78,0	83,0	85,0	88,0	87,0	82,0	78,0	92,9	87,9	
Maximal	81,0	89,0	90,0	93,0	94,0	90,0	87,0	99,0	92	
Minimal	72,0	75,0	73,0	74,0	70,0	66,0	60,0	80,3	84	
Tyre Dozer Operators (Cat 824)										16
Mean	73,0	77,0	79,0	82,0	81,0	76,0	69,0	86,8	88,9	
Maximal	78,0	84,0	84,0	86,0	84,0	82,0	76,0	91,5	96	
Minimal	63,0	68,0	72,0	74,0	67,0	62,0	56,0	77,5	86	

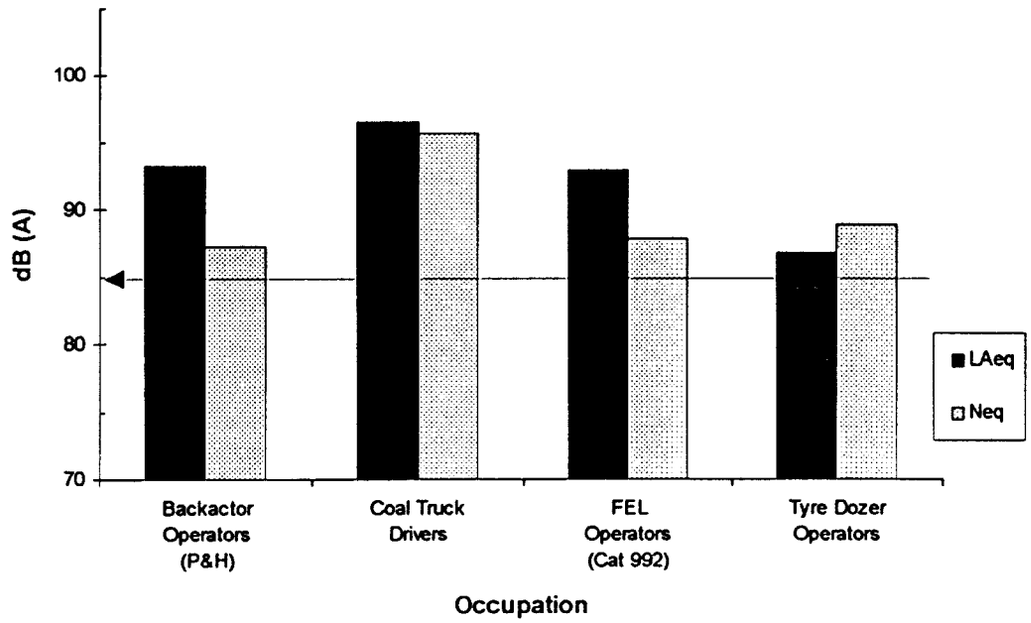

Figure 3.2.2b Mean emission and exposure levels for operators of opencast production machnery

Information to assist with the selection of HPDs for operators of opencast production machinery is appended in Table A-3.24 to A-3.27. The last of these relates to tyre dozer operators, whose exposure levels exceeded corresponding emission levels. Accordingly, Table A-3.27 is based on maximal emission and exposure levels.

3.2.2.3 Rehabilitation

The results of noise measurements for pit rehabilitation machinery are summarized in Table 3.2.2c and graphically displayed in Figure 3.2.2c. Mean L_{Aeq} values ranged from 82,9 dB for backactors to 98,9 dB for large bulldozers. Pit rehabilitation backactor operation, with a mean N_{eq} of 82,9 dB, was one of the two occupations where mean N_{eq} did not exceed 85 dB. Values for L_{Aeq} and corresponding operator exposure levels were similar, particularly in the case of rear dumpers, where means for these two parameters were identical. This indicates nearly continuous activity in pit rehabilitation operations.

Table 3.2.2c

L_{pA} *at the given centre frequency with* L_{Aeq} *and* N_{eq} *for operators of pit rehabilitation machinery*

Occupation/Equipment	L_{pA} (dB) at the Given Centre Frequency (Hz)							L_{Aeq} (dB)	N_{eq}	
	125	250	500	1k	2k	4k	8k		(dB)	(n)
Bulldozer Operators (Cat D10)										21
Mean	73,9	85,0	90,0	92,0	94,0	91,0	90,0	98,9	95,5	
Maximal	77,0	85,4	92,8	95,0	103,2	106,0	100,9	109,0	102	
Minimal	67,0	74,0	85,0	87,0	90,0	89,0	81,0	94,4	76	
Backactor Operators (Komatsu)										17
Mean	69,0	71,0	73,0	73,0	79,0	77,0	67,0	82,9	82,0	
Maximal	75,0	77,0	79,0	82,0	87,0	82,0	74,0	90,0	86	
Minimal	62,0	67,0	71,0	70,0	73,0	72,0	59,0	78,2	79	
Rear Dumper Operators (Cat 773)										15
Mean	76,0	78,0	80,0	83,0	83,0	81,0	78,0	89,0	89,0	
Maximal	79,0	81,0	84,0	86,0	89,0	87,0	81,0	93,6	94	
Minimal	71,0	73,0	75,0	76,0	77,0	75,0	71,0	83,0	85	

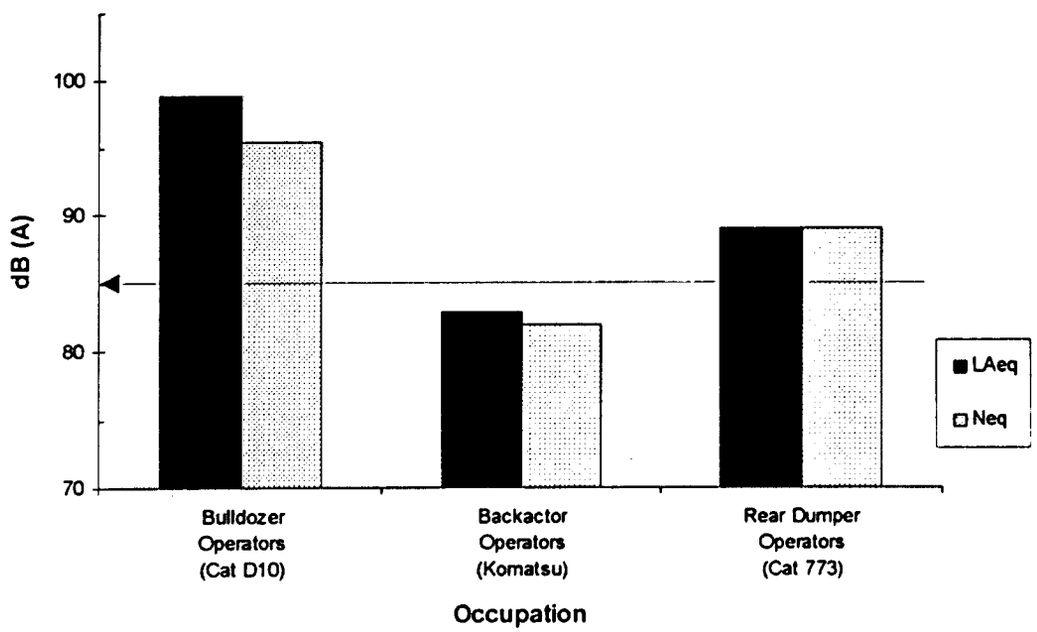

Figure 3.2.2c Mean emission and exposure levels for operators of pit rehabilitation machinery

Information to assist with HPD selection for operators of rehabilitation equipment is appended in Tables A-3.28 to A-3.30.

3.2.3 Coal processing

Table 3.2.3 summarizes the results of noise emission and exposure measurements in four areas of coal processing. Mean L_{Aeq} values ranged from 94,2 dB for preparation plant attendants to 99,2 dB for primary breaker attendants.

Mean values for N_{eq} ranged from 86,0 dB for raw coal screening house attendants to 92,3 dB for primary breaker attendants. Mean emission and exposure levels are graphically displayed in Figure 3.2.3. Preparation plant attendants' mean N_{eq} was 92,0 dB, as compared with a mean L_{Aeq} of 94,2 dB at preparation plant work stations. The difference of 2,2 dB indicates that these workers spend the greater part of their shift in the preparation plant building, at or near their work stations. In the case of the raw coal screening house, the difference between the mean values for L_{Aeq} and N_{eq} was 12,0 dB. These workers were observed to leave the screening house at frequent intervals, possibly as a result of the uncomfortable levels of noise and dust prevailing there. This appears to be the basis for the large difference between means for emission and exposure levels.

Table 3.2.3

L_{pA} at the given centre frequency with L_{Aeq} and N_{eq} values for occupations in coal processing

	L_{pA} (dB) at the Given Centre Frequency (Hz)							L_{Aeq} (dB)	N_{eq}	
Occupation	125	250	500	1k	2k	4k	8k		(dB)	(n)
Primary/Bradford Breaker Attendants										8
Mean	62,9	75,4	85,8	92,0	95,2	94,0	86,9	99,2	92,3	
Maximal	69,0	78,0	89,0	95,0	98,0	97,0	88,0	102,0	98	
Minimal	59,0	69,0	78,0	85,0	89,0	87,0	81,0	92,6	79	
Raw Coal Screening House Attendants										15
Mean	66,9	78,4	85,8	92,0	94,2	92,0	80,9	98,0	86,0	
Maximal	78,2	85,4	91,7	100,5	103,3	99,8	89,7	106,5	100	
Minimal	65,7	77,0	84,6	90,3	92,8	89,8	78,5	96,4	83	
Crushing & Screening House Attendants										9
Mean	80,0	84,0	87,0	89,0	89,0	86,0	77,0	94,6	89,0	
Maximal	83,0	87,0	89,0	92,0	93,0	91,0	80,0	98,1	91	
Minimal	69,0	77,0	80,0	82,0	82,0	81,0	71,0	87,9	86	
Coal Preparation Plant Attendants										11
Mean	77,0	82,0	85,0	88,0	88,0	87,0	85,0	94,2	92,0	
Maximal	79,0	86,0	87,0	90,0	90,0	89,0	86,0	96,2	95	
Minimal	75,0	79,0	83,0	85,0	86,0	85,0	81,0	91,7	90	

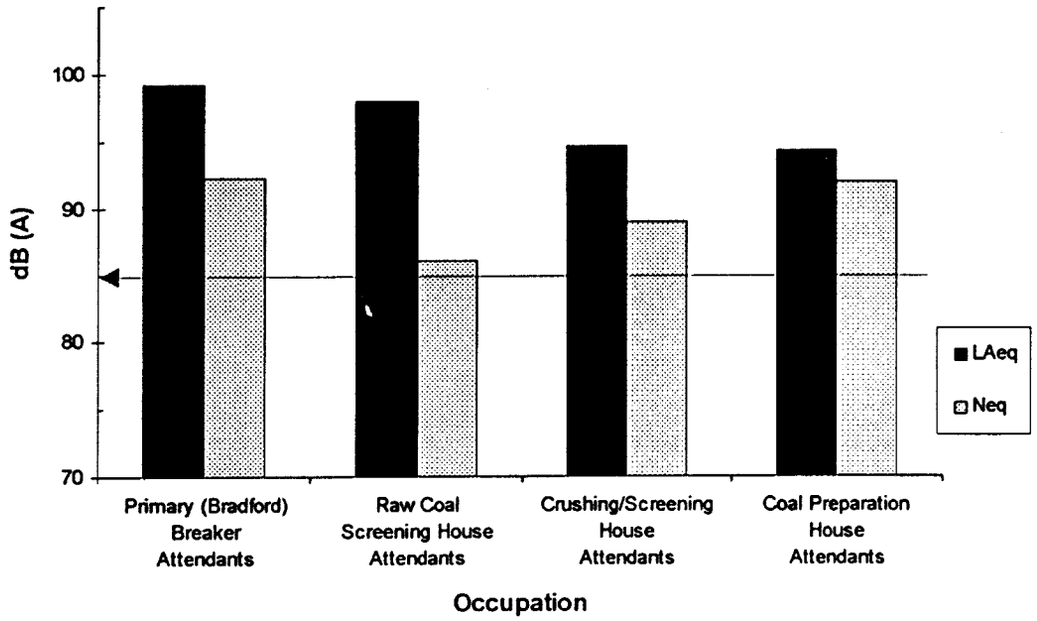

Figure 3.2.3 Mean emission and exposure levels for occupations in coal processing

Information to assist with the selection of HPDs for occupations in coal processing is appended in Tables A-3.31 to A-3.34.

3.3 Gold and platinum mining

This section presents the results of measurements made in surface plants and works, as well as in conventional and mechanized sections of underground workings.

3.3.1 Surface plants and works

Extraction plants surveyed included two gold plants using the cyanide method and one using the carbon-in-pulp process, while other surface works encompassed assay, compressors, smelt houses and winding engines. Results for surface plants and works are summarized in Table 3.3.1 and Figures 3.3.1a and 3.3.1b.

Table 3.3.1

L_{pA} at the given centre frequency with L_{Aeq} and N_{eq} values for reducton plants and surface works

	Current Frequency Analysis								N_{eq}			
	L_{pA} (dB) at the Given Centre Frequency (Hz)							L_{Aeq} (dB)	Combined		CoM RR 10/80	
Location	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**		**(dB)**	**(n)**	**(dB)**	**(n)**
Cyanide Plants												
Conveyors, incl. drives, tips, chutes										19		-
Mean	78,6	81,7	83,6	84,2	80,7	68,7	61,3	89,2	87,3			
Maximal	81,8	86,8	89,7	89,6	87,4	78,1	66,7	94,9	93			
Minimal	73,7	73,4	77,1	78,7	71,9	61,9	58,9	82,8	84			
Crusher Sections										46		17
Mean	79,1	82,8	86,3	88,6	88,9	85,1	71,9	94,1	92,0		97,7	
Maximal	86,9	93,0	100,8	106,0	103,2	100,0	86,9	109,3	106		106	
Minimal	73,1	74,5	70,8	78,2	72,0	71,9	61,3	82,0	83		92	
Mill Sections										45		21
Mean	79,3	83,8	87,5	87,3	84,6	78,0	62,4	92,5	91,0		96,9	
Maximal	81,4	86,5	91,7	91,9	90,4	84,9	64,1	97,0	100		100	
Minimal	75,5	73,7	75,5	76,3	72,2	64,8	61,3	82,0	85		91	
Filter Sections										35		16
Mean	77,9	82,3	84,9	84,3	81,4	74,6	63,1	89,9	87,8		87,9	
Maximal	82,8	90,8	94,8	91,3	88,0	80,8	70,5	98,1	103		103	
Minimal	74,7	74,1	72,5	77,8	72,5	71,6	61,3	82,2	78		78	
Carbon-in-Pulp Plant												
Conveyors, incl. drives, tips, chutes										5		-
Mean	70,6	76,2	78,4	81,2	79,8	75,6	67,1	85,9	84,1			
Maximal	81,4	85,1	89,7	93,7	88,0	80,2	74,9	96,5	89			
Minimal	52,3	64,9	68,1	71,7	66,8	61,3	54,8	74,9	80			

Table 3.3.1 *(continued)*

Location	Current Frequency Analysis								N_{eq}			
	L_{pA} (dB) at the Given Centre Frequency (Hz)							L_{Aeq} (dB)	Combined		CoM RR 10/80	
	125	250	500	1k	2k	4k	8k		(dB)	(n)	(dB)	(n)
Milling										7		-
Mean	78,9	85,7	88,3	88,0	84,9	78,9	66,8	93,3	91,5			
Maximal	83,9	90,6	93,0	91,4	90,5	85,4	80,0	98,0	95			
Minimal	74,6	82,0	85,2	82,4	79,8	73,3	60,1	89,1	86			
Tanks												
Feeds										-		-
Mean	61,5	67,7	72,7	77,8	78,1	77,0	73,6	83,5				
Maximal	64,4	69,4	74,6	82,7	80,8	81,6	77,9	87,4				
Minimal	58,9	67,1	71,9	73,8	75,9	73,5	70,5	80,7				
Agitators										-		-
Mean	60,9	76,1	82,4	86,9	80,0	72,8	64,1	89,2				
Maximal	63,0	78,8	84,1	88,7	81,6	74,4	66,5	91,0				
Minimal	59,7	74,5	81,6	86,1	79,4	72,1	62,7	88,4				
Pumps at:												
Flocculent tanks										-		-
Mean	58,6	61,0	66,6	71,0	65,8	70,9	66,1	76,0				
Maximal	60,3	62,9	67,6	73,0	67,0	75,0	68,6	78,6				
Minimal	55,6	58,7	64,8	68,6	64,1	66,4	63,2	73,1				
Leach & adsorption tanks										-		-
Mean	74,5	82,9	88,7	88,8	88,5	84,6	71,7	94,4				
Maximal	77,6	85,6	90,1	91,0	90,7	86,7	78,0	96,4				
Minimal	73,3	82,1	87,9	87,6	87,1	83,5	66,5	93,3				
Residue & tailings										-		-
Mean	57,9	67,5	78,5	84,1	84,2	75,6	64,5	88,0				
Maximal	64,9	76,2	77,8	88,8	87,0	82,9	69,1	91,9				
Minimal	51,5	64,4	80,3	81,8	83,1	72,7	59,6	86,9				

Table 3.3.1 *(continued)*

Location	Current Frequency Analysis								N_{eq}			
	L_{pA} (dB) at the Given Centre Frequency (Hz)							L_{Aeq} (dB)	Combined		CoM RR 10/80	
	125	250	500	1k	2k	4k	8k		(dB)	(n)	(dB)	(n)
Sumps										-		-
Mean	70,7	72,2	77,9	83,6	82,8	77,2	66,9	87,5				
Maximal	73,6	74,2	79,4	86,0	84,6	79,4	68,5	89,6				
Minimal	68,8	71,2	77,4	82,2	82,0	75,9	66,3	86,5				
Vibrating Screens Wood chips										-	-	-
Mean	82,9	82,6	90,2	94,6	90,0	84,5	72,5	97,5				
Maximal	85,0	84,6	92,7	96,7	91,9	86,9	74,9	99,6				
Minimal	82,0	81,6	89,0	93,3	89,3	83,2	71,1	96,3				
Carbon-sizing										-	-	-
Mean	63,4	67,5	70,0	72,9	76,2	76,5	73,2	81,6				
Maximal	66,2	69,1	71,8	74,8	77,9	78,0	75,1	83,3				
Minimal	61,7	67,0	69,0	72,2	75,3	76,1	72,2	80,9				
Tailings and eluted carbon										-	-	-
Mean	71,6	73,1	74,7	81,5	78,6	76,0	69,1	85,1				
Maximal	74,0	76,8	75,5	83,8	82,8	80,5	73,1	88,3				
Minimal	68,5	70,5	72,7	78,5	75,5	73,2	60,1	82,2				
Kiln										-	-	-
Mean	60,1	68,7	73,0	77,0	72,8	67,6	59,8	80,2				
Maximal	63,1	72,1	74,5	78,8	75,0	69,4	61,7	82,2				
Minimal	58,1	66,3	72,5	76,1	71,5	66,9	58,9	79,2				
Assay Departments										40		17
Mean	63,0	71,6	82,1	85,2	81,3	79,0	67,9	88,6	87,3		86,3	
Maximal	63,9	73,4	84,8	88,0	84,2	82,0	70,9	91,4	97		97	
Minimal	61,9	68,4	72,8	74,0	69,2	61,0	50,9	77,9	72		72	

Table 3.3.1 (continued)

Location	Current Frequency Analysis								N_{eq}			
	L_{pA} (dB) at the Given Centre Frequency (Hz)							L_{Aeq} (dB)	Combined		CoM RR 10/80	
	125	250	500	1k	2k	4k	8k		(dB)	(n)	(dB)	(n)
Compressor Houses										21		11
Mean	72,5	77,9	82,8	93,5	95,1	86,4	73,3	97,9	96,6		100,6	
Maximal	76,9	81,2	86,9	99,0	99,6	91,6	80,0	102,8	113		113	
Minimal	66,7	73,1	72,8	82,0	90,1	82,6	61,3	91,5	82		87	
Smelt Houses										15		7
Mean	74,0	75,2	76,5	83,5	79,3	68,0	61,4	86,2	85,7		86,2	
Maximal	74,7	76,1	78,5	84,9	80,8	68,8	61,6	87,6	89		89	
Minimal	73,2	74,1	72,5	81,6	76,8	67,0	61,3	84,2	82		82	
Winding Engine Cabins										32		11
Mean	74,9	78,0	70,0	76,0	70,6	65,1	59,6	82,0	80,4		77,6	
Maximal	79,6	82,7	73,5	78,9	73,8	68,3	62,3	86,1	87		85	
Minimal	33,5	35,7	35,0	45,1	37,9	37,5	31,3	47,4	74		74	

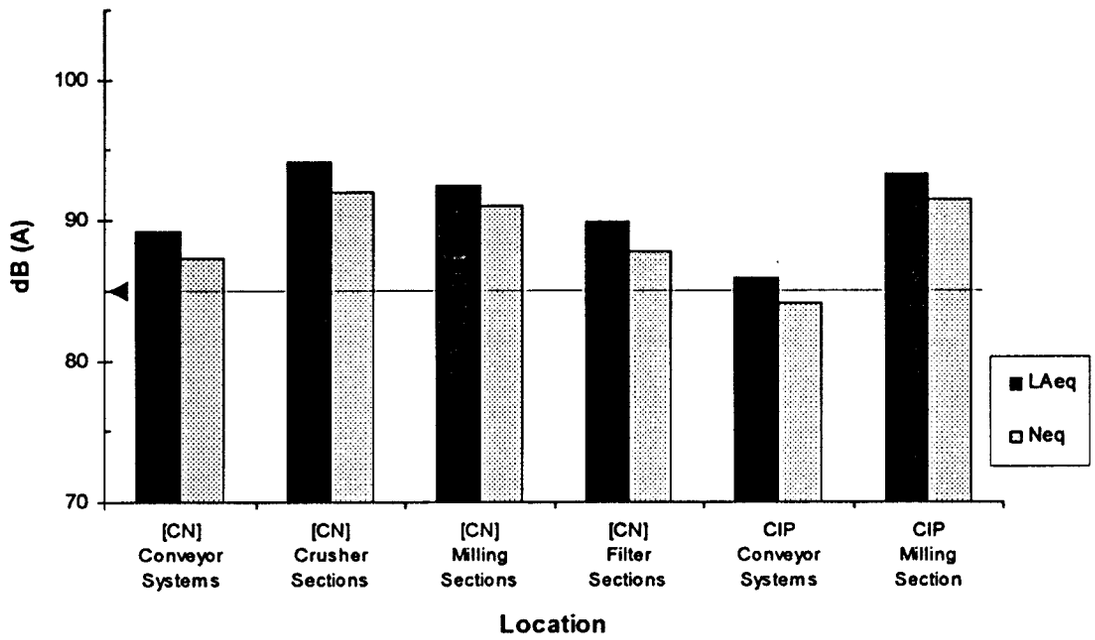

Figure 3.3.1a Mean emission and exposure levels for reduction plants

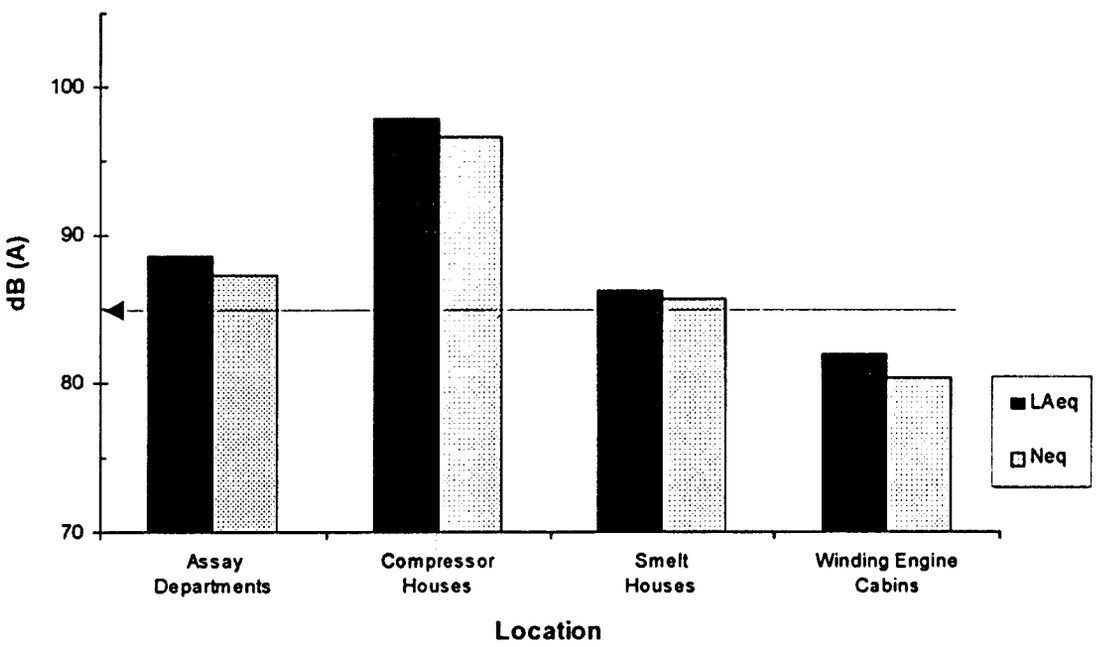

Figure 3.3.1b Mean emission and exposure levels for assay departments, compressors, smelt houses and hoists

For cyanide plants, L_{Aeq} and N_{eq} values were greatest in crusher sections with means of 94,1 dB and 92,0 dB, respectively, followed by mill sections (corresponding values of 92,5 dB and 91,0 dB) and filter sections (89,9 dB and 87,8 dB). The mean N_{eq} for these three plant sections as determined by van Rensburg et al. were 0,1 to 5,9 dB less than the current combined results, indicating an apparent shift towards higher exposure levels, at least in crushing and milling sections. Mean L_{Aeq} and N_{eq} for conveyor belts and tips were 89,2 dB and 87,3 dB, respectively. Van Rensburg et al. did not specifically consider conveyor systems in their survey.

In the carbon-in-pulp (CIP) plant surveyed, the greatest noise emissions occurred in the milling section, where L_{Aeq} averaged 93,3 dB. This value was midway between the corresponding means for crusher and mill sections in cyanide plants (94,1 and 92,5 dB, respectively). Similarly, mean N_{eq} in the CIP milling section, at 91,5 dB, was midway between the corresponding values for crushing and milling in cyanide plants (92,0 and 91,0 dB, respectively). CIP plant conveyor belts, which included tips, chutes, drive motors and gearboxes, yielded a mean L_{Aeq} of 85,9 dB, which was 3,3 dB lower than the 89,2 dB determined for conveyor systems in the older cyanide plants. A comparison of mean N_{eq} values for conveyor belt attendants in the two types of plants indicated a similar difference: 84,1 dB for CIP plants and 87,3 dB for cyanide plants. The lower levels observed in the CIP plant appear to be attributable to the conveyance system being of newer design, resulting in improved operating efficiency, and a higher standard of maintenance.

Other significant noise sources in the CIP plant included agitators and pumps at leach and adsorption tanks, as well as vibrating screens for wood chips, carbon and tailings. Emission levels for pumps ranged from 76,0 dB for those at floculent tanks, to 94,4 dB for those at leach and adsorption tanks. Noise levels at screens ranged from 81,6 dB for carbon-sizing, to 97,5 dB for wood chip screens. Most of this plant machinery was not manned on a dedicated basis and accordingly, no N_{eq} determinations were made. CIP plants were not included in the survey by van Rensburg et al.

L_{Aeq} / N_{eq} values in assay departments and smelt houses averaged 88,6 / 87,3 dB and 86,2 / 85,7 dB, respectively. These mean N_{eq} values were both within 1 dB of those determined by van Rensburg et al. Among employees working in surface plants, compressor attendants were exposed to the greatest emissions (mean L_{Aeq} of 97,9 dB) and had the highest exposure levels, with a current combined mean of 96,6 dB. This value was 4,0 dB lower than that determined by van Rensburg et al. The lowest values observed in surface occupations

were for winding engine drivers, where L_{Aeq} and N_{eq} values averaged 82,0 dB and 80,4 dB, respectively, the latter being 2,8 dB greater than that determined by van Rensburg et al.

For plant sections manned on a dedicated basis, information on HPD selection has been appended in Tables A-4.1 to A-4.6. For other surface operations, viz. assay, smelt houses and compressors, HPD selection is dealt with in Tables A-4.7 to A-4.9. It will be noted that no table for HPD selection has been appended in respect of winding engine drivers, owing to the safe (< 85 dB) levels of emission and exposure generally observed for these individuals.

3.3.2 Underground occupations and workplaces in conventional mining

3.3.2.1 Hand-held drill crews

Section 3.4 presents results from a detailed study of hand-held rockdrills which do not lend themselves to complete incorporation with the current section on conventional mining. However, to put the hand-held rockdrill into the current context, summary information has been extracted from Section 3.4 and is presented below.

Mean L_{pA}, L_{Aeq} and N_{eq} values determined for hand-held rockdrills, during the current study are summarized in Table 3.3.2a. Results are categorized under development and stoping, with mean values for each type of drill. Values tabulated in respect of pneumatic drills are, in fact, means based on determinations for the two operating pressures considered in Section 3.4, namely 600 kPa and 400 kPa. Included are data on noise exposure for operators of unsilenced pneumatic rockdrills in stopes, as determined by van Rensburg et al. (1980), along with L_{pA}, L_{Aeq} and N_{eq} values for emulsion-hydraulic drills in stopes from van Rensburg, Kielblock and Marx (1989).

Table 3.3.2a

Mean L_{pA} at the given centre frequency with L_{Aeq} and N_{eq} values for drilling crews in conventional mining

Drill Operators and Assistants	L_{pA} (dB) at the Given Centre Frequency (Hz)							L_{Aeq} (dB)	N_{eq}		
	125	250	500	1k	2k	4k	8k		Range (dB)	Mean (dB)	(n)
Development											
Silenced Pneumatic	89,1	94,2	96,7	100,0	102,6	103,6	99,8	108,4	102-105	103,6	35
Unsilenced Pneumatic	94,0	102,1	108,3	109,1	111,0	108,4	105,9	116,0	109-113	111,2	20
Water-Hydraulic	76,6	78,9	84,8	95,6	100,0	101,9	98,2	105,6	100-102	100,7	15
Stoping											
Silenced Pneumatic	87,9	89,7	94,6	99,9	103,8	105,2	102,6	109,5	102-108	104,6	40
Unsilenced Pneumatic											
Current Results Only	94,6	101,1	108,2	110,2	111,8	110,7	109,3	117,3	110-114	112,3	30
CoM RR 10/80	-	-	-	-	-	-	-	-	104-119	111,4	23
Hydraulic	75,1	76,9	86,7	98,2	104,7	107,2	103,2	110,4	105-106	105,4	15
Water: Current	75,1	76,9	86,7	98,2	104,7	107,2	103,2	110,4	105-106	105,4	15
Emulsion CoM RR 12/89	87,5	95,4	98,9	103,4	107,7	106,5	104,9	112,3	105-108	106,5	78

The summarized results from the current study are graphically presented in Figure 3.3.2a in order to provide visual reference for comparisons drawn below.

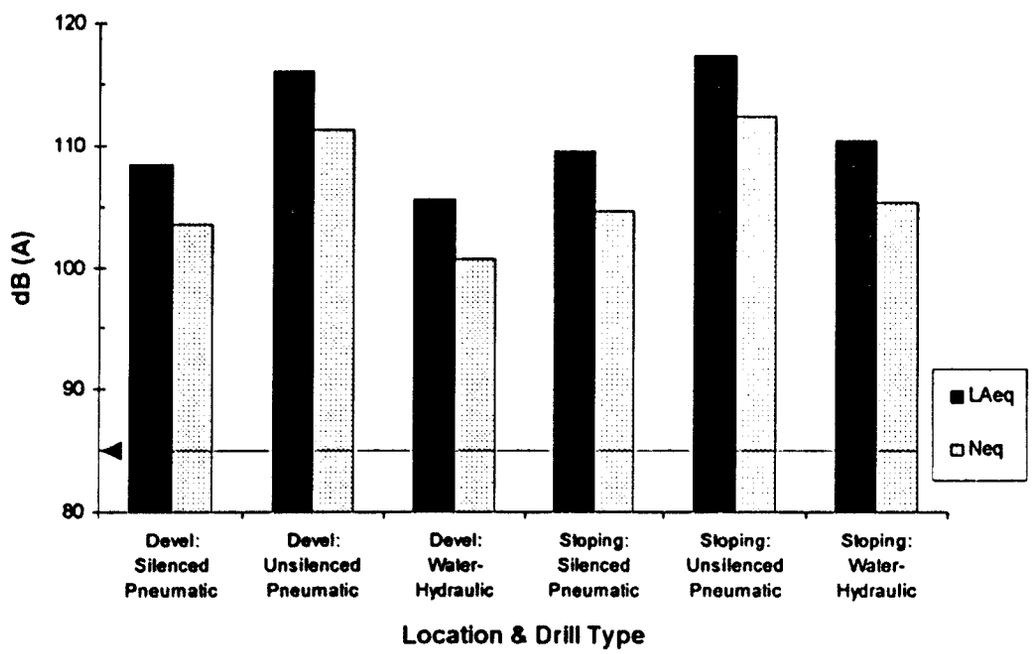

Figure 3.3.2a Mean emission and exposure levels for hand-held rockdrills

A comparison of mean L_{Aeq} values from the current survey for stopes with those for development ends reveals differences ranging from 1,1 dB for silenced pneumatic drills to 4,8 dB for water-hydraulic machines, with values for stopes always being greater. On average, hand-held rockdrills were 2,4 dB louder in stopes than in development ends. Mean N_{eq} values for operators displayed a similar pattern, ranging from 1,0 dB greater for operators of silenced pneumatics in stopes, to 4,7 dB greater for water-hydraulic drill operators in stopes, the average difference being 2,3 dB.

Comparisons among drill types operating in the same environment indicate that the mean L_{Aeq} for silenced pneumatics in development ends, at 108,4 dB, was 7,6 dB lower than the corresponding value for unsilenced pneumatics. In stopes the difference was 7,8 dB (109,5 dB for silenced vs 117,3 dB for unsilenced). The mean L_{Aeq} for water-hydraulic drills operating in development ends was 105,6 dB, which was 2,8 dB less than for silenced pneumatics and 10,4 dB less than for unsilenced pneumatics. In stopes the mean L_{Aeq} for water-hydraulic drills, at 110,4 dB, was actually 0,9 dB greater than for silenced pneumatics, and only 6,9 dB less than for unsilenced pneumatics. The unexpectedly high emission levels observed for the water hydraulic machines cannot be satisfactorily accounted for. The only factor identified as a possible contributor was the apparently greater age of these machines, as compared with the pneumatic drills that were observed. Van Rensburg et al. (1989) found the mean emission level for hydraulic emulsion drills in stopes to be 112,3 dB, 1,9 dB greater than the corresponding value determined for water-hydraulics during the current study.

Owing to the fact that N_{eq} values were calculated on the basis of 150 minutes of exposure to the measured emission levels, the differences in operator N_{eq} among the various types of rockdrills corresponded with differences in L_{Aeq}. Van Rensburg et al. determined the mean exposure level for hydraulic emulsion drill crews in stopes to be 106,5 dB, 1,1 dB greater than the corresponding value for water-hydraulic crews from the current study.

Information on HPD selection for drill crews in development and stoping, relative to drill type and, in the case of pneumatic machines, operating pressure, has been appended in Tables A-7.12 to A-7.21 (Appendix 7). These tabulations are based on results from the comprehensive study of hand-held rockdrills reported on in detail in Section 3.4.

3.3.2.2 Development ends and stopes excluding drill crews

Results for development and stoping activities other than drilling are presented in Table 3.3.2b, and graphically illustrated in Figures 3.3.2b to 3.3.2d. These encompass specialist occupations, as well as general categories (e.g. development and stope teams), in accordance

Table 3.3.2b

L_{pA} at the given centre frequency with L_{Aeq} and N_{eq} values for development ends and stopes in conventional mining

	CURRENT FREQUENCY ANALYSIS								N_{eq}			
	L_{pA} (dB) at the Given Centre Frequency (Hz)							L_{Aeq} (dB)	Combined		CoM RR 10/80	
Occupation	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**		**(dB)**	**(n)**	**(dB)**	**(n)**
Development Teams (excl. Drill Crews)										65		22
Mean	89,8	99,3	100,6	103,9	105,3	103,8	101,9	110,8	102,8		99,0	
Maximal	91,9	101,5	101,7	103,8	109,1	105,8	104,7	113,1	112		110	
Minimal	83,4	89,1	96,2	98,5	100,2	98,7	94,4	105,2	85		85	
Pneumatic Loader Operators										28		7
Mean	87,0	93,9	96,1	97,8	99,7	101,4	99,8	106,6	105,6		107,1	
Maximal	88,0	95,8	97,2	98,2	100,3	101,6	101,3	107,4	112		112	
Minimal	85,7	90,5	94,7	97,3	99,0	101,1	97,3	105,6	87		100	
Pipes, Tracks and Ventilation Teams										32		-
Mean	85,5	91,9	95,2	96,8	98,3	93,5	99,9	104,6	99,3			
Maximal	92,1	101,8	108,1	109,6	110,8	102,5	106,9	115,6	107			
Minimal	73,3	73,5	74,4	77,5	73,1	68,1	62,1	81,9	83			
Stope Teams (excl. Drill Crews)										74		7
Mean	91,9	102,0	105,5	107,7	109,1	106,9	103,9	114,3	102,3		101,1	
Maximal	93,9	102,5	106,7	109,3	110,3	107,3	105,8	115,5	115		108	
Minimal	86,7	93,9	97,7	100,5	102,6	100,9	96,7	107,4	80		88	
Hydrojet Operators										11		-
Mean	78,2	84,0	91,0	94,3	96,8	98,9	95,5	103,0	95,4			
Maximal	79,4	86,3	92,4	95,8	102,4	102,5	99,0	106,9	101			
Minimal	76,0	79,9	87,4	91,1	92,8	93,2	90,8	98,5	91			
Winch Drivers										50		17
Mean	76,4	80,3	79,6	85,0	83,1	78,8	65,3	89,3	98,3		97,1	
Maximal	77,5	83,8	82,9	91,8	87,8	89,1	76,5	95,4	109		109	
Minimal	68,9	72,8	68,3	74,1	80,3	70,0	61,3	82,4	84		89	

Table 3.3.2b *(continued)*

Occupation	Current Frequency Analysis: L_{pA} (dB) at the Given Centre Frequency (Hz) 125	250	500	1k	2k	4k	8k	L_{Aeq} (dB)	N_{eq} Combined (dB)	(n)	CoM RR 10/80 (dB)	(n)
Winch Bell Operators										22		-
Mean	76,2	77,0	77,6	84,0	82,0	75,6	64,7	87,8	96,5			
Maximal	84,5	86,9	89,0	92,5	89,8	86,1	87,3	97,2	106			
Minimal	73,1	72,1	65,6	79,0	76,0	64,7	61,3	82,1	83			
Surveyers, Samplers and Ventilation										71		38
Mean	91,2	100,1	101,6	104,5	108,7	105,4	103,1	112,6	98,0		96,1	
Maximal	92,6	102,5	103,3	105,8	109,9	107,0	105,5	114,2	105		105	
Minimal	84,6	92,0	95,1	97,3	102,1	100,2	95,3	106,1	79		79	
Timber Crews										26		10
Mean	92,5	99,2	103,2	105,9	109,3	105,8	103,0	113,3	97,8		99,1	
Maximal	93,2	101,6	105,0	107,0	110,1	107,2	105,1	114,6	104		104	
Minimal	85,9	92,7	96,9	99,7	103,0	101,4	95,8	107,3	80		90	
Stope Teams: Night Shift										39		17
Mean	85,8	88,4	93,1	95,6	92,3	88,2	80,1	99,6	91,4		86,8	
Maximal	91,3	93,8	96,3	99,0	96,5	93,0	85,2	103,6	102		99	
Minimal	75,6	78,5	81,3	83,8	80,9	77,1	70,9	88,3	75		75	
Supervisory Personnel												
Mine Overseers										57		23
Mean	90,1	96,9	101,6	104,4	106,5	102,6	100,8	110,9	96,2		94,3	
Maximal	91,8	100,6	104,2	105,7	109,4	105,6	104,7	113,6	106		105	
Minimal	84,3	89,2	97,4	99,8	100,3	97,9	92,8	105,4	89		87	
Shift Supervisors: Day Shift										66		26
Mean	90,3	95,7	101,7	104,5	107,1	103,0	101,0	111,4	100,3		99,5	
Maximal	92,1	100,9	104,2	105,9	109,6	106,0	104,8	113,8	110		110	
Minimal	84,7	91,3	97,5	99,8	101,5	98,6	94,1	106,1	87		91	

Table 3.3.2b *(continued)*

Occupation	Current Frequency Analysis: L_{pA} (dB) at the Given Centre Frequency (Hz) 125	250	500	1k	2k	4k	8k	L_{Aeq} (dB)	N_{eq} Combined (dB)	Combined (n)	CoM RR 10/80 (dB)	CoM RR 10/80 (n)
Shift Supervisors: Night Shift										7		-
Mean	85,5	87,5	91,9	93,9	91,4	87,2	80,0	98,4	89,5			
Maximal	91,0	92,9	95,1	97,3	95,6	92,0	85,1	102,4	92			
Minimal	75,3	77,6	80,1	82,1	80,0	76,1	70,8	87,1	81			
Miners										49		19
Mean	90,9	99,8	102,0	104,7	107,9	103,6	101,2	111,9	103,2		102,9	
Maximal	92,4	102,1	102,8	105,5	110,3	107,0	105,6	114,2	113		113	
Minimal	85,2	93,5	97,8	100,1	102,6	99,6	96,3	107,0	85		91	
Team Leaders										36		7
Mean	91,1	100,5	102,9	105,3	108,9	105,8	103,0	113,0	104,9		97,4	
Maximal	92,9	102,8	104,1	106,4	110,3	107,1	105,3	114,5	116		108	
Minimal	86,1	93,5	98,9	102,0	103,6	100,9	98,0	108,3	86		87	

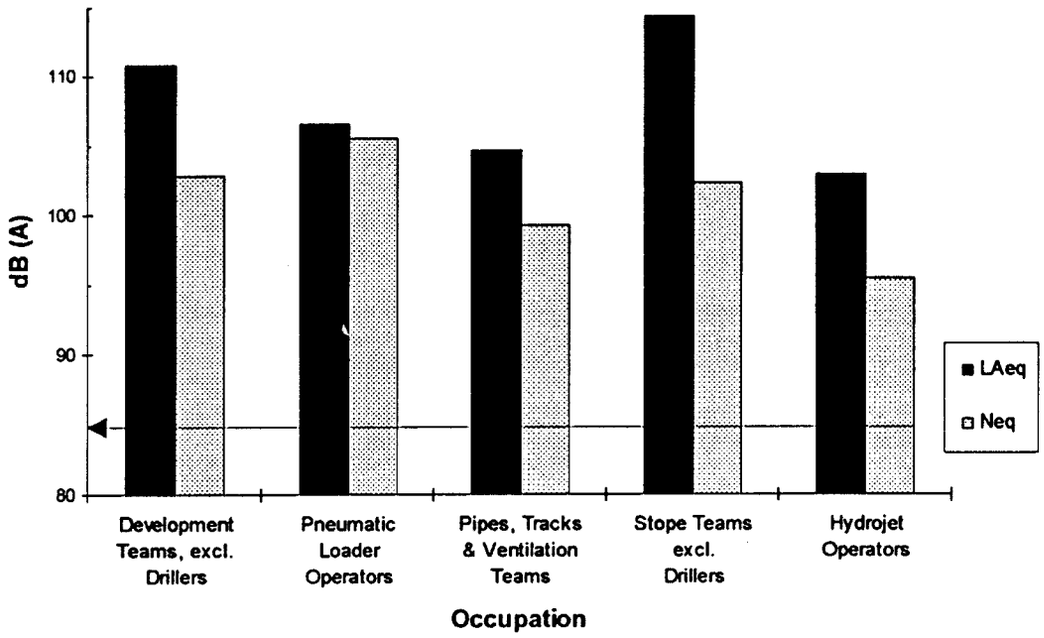

Figure 3.3.2b Mean emission and exposure levels for personnel in development ends and stopes : conventional mining

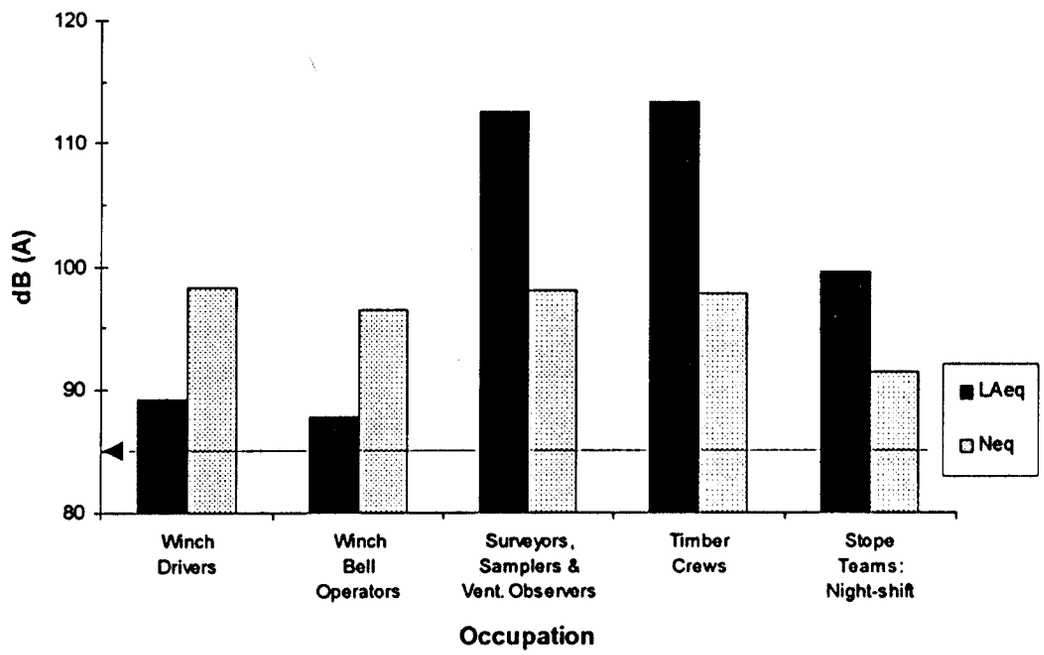

Figure 3.3.2c Mean emission and exposure levels for additional personnel in development ends and stopes : conventional mining

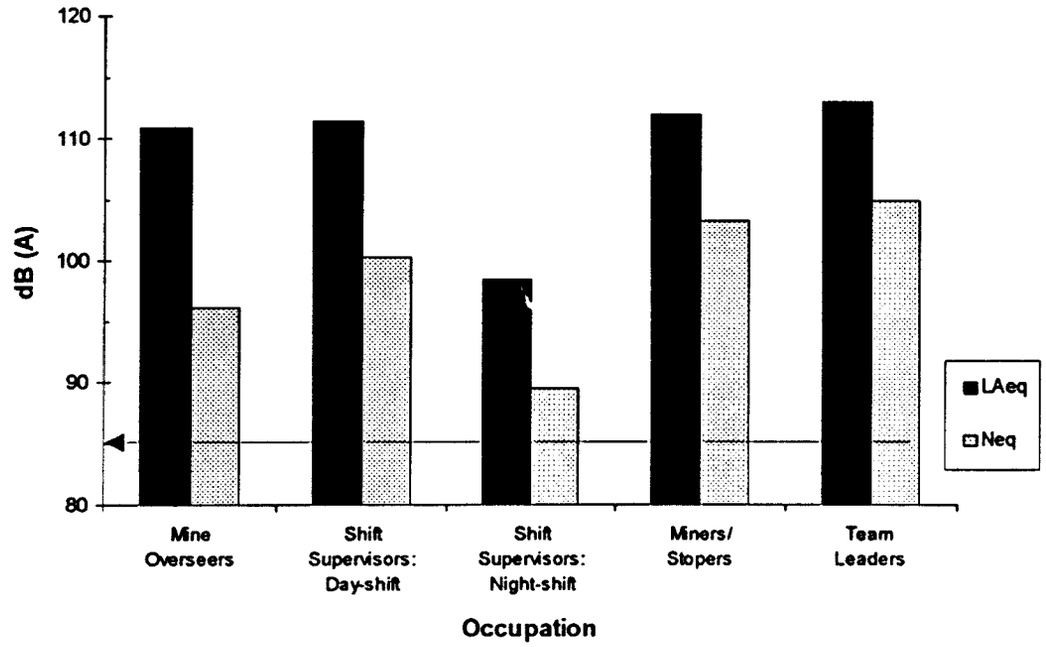

Figure 3.3.2d Mean emission and exposure levels for supervisory personnel in conventional mining

with the way in which labour was deployed. Although drill crews are excluded from this section on the basis of their separate treatment, the effect of drilling operations is very much apparent in the L_{pA} and L_{Aeq} values determined for development and stope teams. The considerable difference of 12,6 dB between mean values for L_{Aeq} (114,3 dB) and N_{eq} (102,3 dB) in respect of stope workers, as compared with a corresponding difference of 8,2 dB for development ends (L_{Aeq} of 110,8 dB and N_{eq} of 102,8 dB), would appear to indicate that stope workers are more often away from the face while drilling is in progress. It may, in some instances, also be indicative of intermittent or more dispersed drilling operations in stopes. Mean N_{eq} values reported by van Rensburg et al. (1980) for development teams and stope workers (lashers) were 99,0 dB and 101,1 dB, respectively. A comparison of these values with the combined means from the current report appears to indicate an upward trend in exposure level among stope and development workers.

Considerable differences between emisson and exposure levels were also observed for the category that included surveyors, samplers and ventilation observers (112,6 dB vs. 98,0 dB), as well as for timber crews (113,3 dB vs. 97,8 dB). The differences between mean L_{Aeq} and N_{eq} values for these two groups (14,6 dB and 15,5 dB, respectively), appear to be attributable

to relatively limited periods of exposure to drill emissions. The results of van Rensburg et al. indicate mean N_{eq} values of 96,1 dB for survey/sample/ventilation and 99,1 dB for timber crews, 1,9 dB and 1,7 dB less, respectively, than their corresponding current combined means.

Hydrojet operators' mean N_{eq} of 95,4 dB was 7,6 dB lower than the mean L_{Aeq} of 103,0 dB determined for hydrojetting operations, indicating intermittent operation and limited periods of exposure to noise emissions in stopes. This was not the case for winch drivers and bell operators, whose duties normally prevented them from avoiding exposure to noise from stoping activities. The mean N_{eq} values for these two occupations (98,3 dB and 96,5 dB, respectively), both exceeded the corresponding means for L_{Aeq} (89,3 dB and 87,8 dB) determined for their activities. Van Rensburg et al. determined the mean N_{eq} for winch drivers to be 97,1 dB, 1,2 dB lower than the current combined mean. Winch bell operators were not included in the earlier survey.

Mean L_{Aeq} and N_{eq} values for pneumatic loader operators were 106,6 dB and 105,6 dB, respectively. The 1,0 dB difference is indicative of relatively continuous operation and perhaps more significantly, of exposure to rockdrill noise. Van Rensburg et al. reported a mean N_{eq} of 107,1 dB, 1,5 dB less than the current combined mean. Pipes, tracks and ventilation teams yielded means for L_{Aeq} and N_{eq} of 104,6 dB and 99,3 dB, respectively. The lower value for L_{Aeq}, in comparison with that for loader operators, is the result of their being somewhat farther away from development operations, while the 5,3 dB difference between PTV teams' means for L_{Aeq} and N_{eq} appears to have resulted from periods of absence from development ends, particularly while fetching or transporting material. This work category was not considered by van Rensburg et al. in their 1980 report.

Mean exposure levels for supervisory personnel ranged from 89,5 dB for night-shift supervisors to 104,9 dB for team leaders. A comparison of mean N_{eq} for shift supervisors on night-shift with the corresponding value of 100,1 dB for shift supervisors on day-shift highlights the differences in operations and equipment used. These are also apparent in comparing mean N_{eq} for day-shift and night-shift stope teams (102,3 dB and 91,4 dB, respectively). Mean values for L_{Aeq} and N_{eq} were considerably greater for the main shift (22,9 dB and 10,9 dB greater, respectively). Furthermore, the differences between L_{Aeq} and N_{eq} (12,0 dB for day-shift and 8,2 dB for night-shift) may result from night-shift workers performing their duties on a somewhat more continuous basis, with fewer and shorter periods of absence from the workplace. Alternatively, the differences could be attributed to a reduced prevalence of noisy

operations during the night shift, with fixed noise sources (e.g. fans) accounting for a greater portion of workers' exposure.

The survey by van Rensburg et al. found exposure levels for mine overseers, shift supervisors (day shift) and miners to be marginally lower than the current combined results, by 1,9 dB, 0,8 dB and 0,3 dB, respectively. Their mean N_{eq} for team leaders, at 97,4 dB, was 7,5 dB lower than the current combined results, and although the earlier mean was based on only seven observations, it would appear that exposure levels for team leaders may have increased from what they were at the time of the previous survey.

Information to assist in the selection of appropriate hearing protection for development and stope workers, including supervisory personnel but excluding drill crews, is appended in Tables A-5.1 to A-5.15. The negative differences between L_{Aeq} and N_{eq} for winch drivers and bell operators (9,0 dB and 8,7 dB, respectively), indicate that HPD selection based on mean L_{pA} values would likely result in underprotection. Accordingly, the relevant appended tables (Tables A-5.6 and A-5.7) are based on maximal L_{pA} values observed.

3.3.2.3 Transport and haulages

Results for transport and haulages are summarized in Table 3.3.2c and displayed in Figure 3.3.2e. Noise emission and exposure levels in this group were greatest for individuals involved in tramming and working at tips, with L_{Aeq} / N_{eq} means of 98,1 dB / 96,6 dB and 97,6 dB / 94,7 dB, respectively. Van Rensburg et al. (1980) did not consider tips but they reported a mean N_{eq} of 96,0 dB for tramming, 0,6 dB less than the current combined value. Mean values for diesel locomotive crews, at 95,8 dB / 94,1 dB, were somewhat greater than for electric loco crews, where corresponding means of 92,4 dB / 92,7 dB were determined. The survey by van Rensburg et al. only included diesel locos, which yielded a mean N_{eq} of 95,0 dB, 0,9 dB greater than the current combined mean. The fact that electric loco crews' mean N_{eq} exceeded the corresponding L_{Aeq} for their machines by 0,3 dB indicates that these individuals are exposed to emissions from other, noisier activities, including, but not necessarily limited to, operations at tips. Although emission levels at tips were, on average, 5,2 dB higher than those of electric locos, the relatively short periods that loco crews spend there would limit the effect on N_{eq}, possibly accounting for the fact that their mean N_{eq} did not exceed L_{Aeq} by more than the 0,3 dB observed. L_{pA} values at frequencies from 1 kHz to 8 kHz were greater for diesel locos than for electrics, but the electrics were louder from 125 Hz to 500 Hz.

Onsetters' teams' current combined mean for N_{eq} at 92,1 dB, was 7,9 dB lower than the corresponding value for L_{Aeq}, and 2,9 dB less than the mean exposure determined by van Rensburg et al. As is generally the case where considerable positive differences exist between emission and exposure levels, intermittent activity accounts for the disparity. The lowest emission and exposure levels among transport and haulage workers were observed for underground hoist drivers, where mean values of 82,2 dB and 81,9 dB were observed, respectively, followed by banksmen with corresponding values of 90,5 dB and 88,3 dB. Mean exposure levels reported by van Rensburg et al. for underground hoist drivers and banksmen were 81,8 dB and 87,8 dB, respectively.

Table 3.3.2c

L_{pA} at the given centre frequency with L_{Aeq} and N_{eq} values for transport and haulages in conventional mining

	Current Frequency Analysis								N_{eq}			
	L_{pA} (dB) at the Given Centre Frequency (Hz)							L_{Aeq}	Combined		CoM RR 10/80	
Occupation/Activity	125	250	500	1k	2k	4k	8k	(dB)	(dB)	(n)	(dB)	(n)
Banksmen										47		7
Mean	78,4	80,0	81,6	85,9	84,3	80,8	75,6	90,5	88,3		87,8	
Maximal	82,3	84,9	86,2	89,7	87,0	84,2	79,9	94,3	98		96	
Minimal	74,5	76,1	78,9	79,6	79,0	76,3	71,0	85,7	75		81	
Diesel Loco Crews										31		22
Mean	78,4	81,9	85,7	91,6	89,6	88,8	79,5	95,8	94,1		95,0	
Maximal	80,1	83,3	88,2	94,0	92,8	91,0	82,7	98,4	106		106	
Minimal	75,2	77,4	79,5	86,1	85,7	83,8	75,6	90,9	82		86	
Electric Loco Crews										22		-
Mean	81,9	84,5	86,0	85,8	85,6	81,7	73,0	92,4	92,7			
Maximal	85,7	87,7	88,9	88,2	89,4	86,5	78,6	95,8	104			
Minimal	76,8	76,6	76,6	81,2	81,5	75,3	62,9	86,5	80			
Tramming										23		13
Mean	78,4	83,2	88,9	91,3	95,1	88,8	73,7	98,1	96,6		96,0	
Maximal	85,6	93,6	99,5	96,7	98,4	92,5	81,6	104,0	103		103	
Minimal	71,2	77,7	83,4	78,9	81,8	79,9	66,4	87,9	92		92	
Tips Labour										16		-
Mean	80,0	85,2	89,7	92,8	92,3	88,1	81,2	97,6	94,7			
Maximal	81,5	89,0	95,4	99,3	98,9	95,0	92,3	104,1	103			
Minimal	78,4	81,4	84,0	86,4	85,7	81,3	70,2	91,5	80			
Onsetters' Teams										21		10
Mean	82,6	86,4	89,9	93,6	95,3	93,3	88,4	100,0	92,1		89,2	
Maximal	88,1	93,1	96,7	97,5	98,9	97,5	94,8	104,7	102		94	
Minimal	76,5	77,2	80,0	88,5	91,7	88,2	79,7	95,0	81		84	
Underground Hoists										13		8
Mean	74,2	73,5	73,3	78,2	73,4	68,4	62,8	82,2	81,9		81,8	
Maximal	78,2	81,3	80,3	81,6	83,7	83,0	72,9	89,6	87		86	
Minimal	61,3	64,7	61,3	73,8	69,8	63,3	61,3	76,3	73		73	

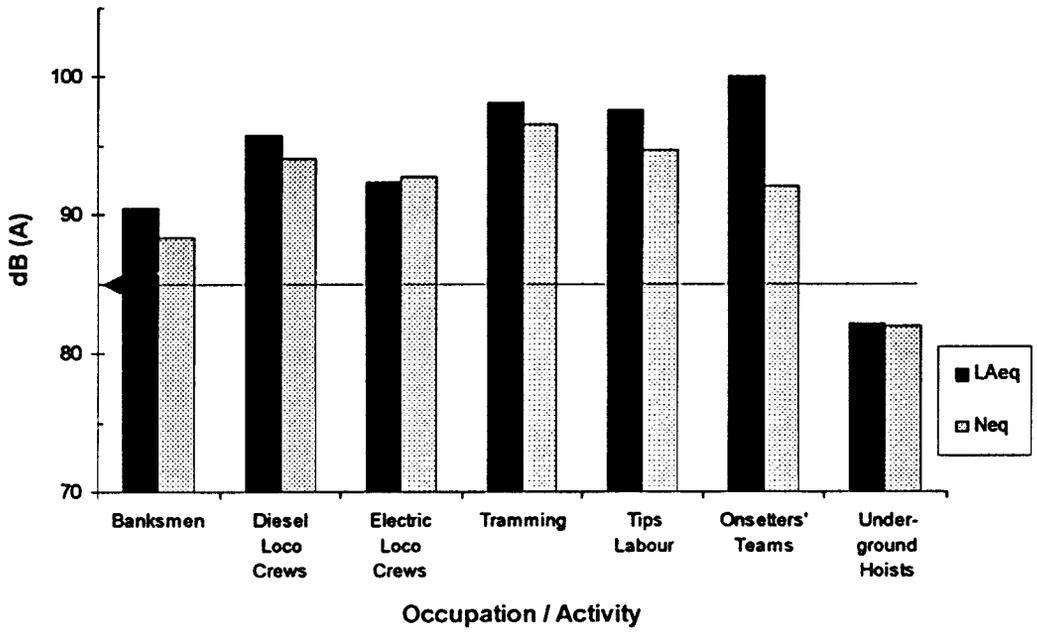

Figure 3.3.2e Mean emission and exposure levels for transport and haulages in conventional mining

HPD selection for transport and haulage workers should be based on information appended in Tables A-5.16 to A-5.21. No such tabulation is included for underground hoist drivers, owing to the safe (< 85 dB) levels of emission and exposure generally observed for these individuals.

3.3.2.4 Technical services

Results for technical services, which include artisans, main fan, pump and refrigeration plant attendants are presented in Table 3.3.2d and illustrated in Figure 3.3.2f. Determinations for artisans working underground, as was the case for those on surface, displayed a considerable difference (8,8 dB for underground) between mean values for L_{Aeq} determined in workshops (102,5 dB) and N_{eq} measured by dosimetry (93,7 dB). Van Rensburg et al. (1980) found the mean N_{eq} for this category to be 92,8 dB. Differences between means for L_{Aeq} and N_{eq} among main fan, refrigeration plant and pump attendants were less (2,6 dB, 0,9 dB and 0,6 dB, respectively), indicating more continuous exposure to principal noise sources. The current combined mean exposure levels for these same three occupations, at 109,0 dB, 101,2 dB and 94,9 dB, were lower than reported by van Rensburg et al. by 3,0 dB, 0,8 dB and 5,6 dB, respectively.

Table 3.3.2d

L_{pA} at the given centre frequency with L_{Aeq} and N_{eq} values for technical services in conventional mining

	CURRENT FREQUENCY ANALYSIS								N_{eq}			
	L_{pA} (dB) at the Given Centre Frequency (Hz)							L_{Aeq} (dB)	Combined		CoM RR 10/80	
Occupation/Location	125	250	500	1k	2k	4k	8k		(dB)	(n)	(dB)	(n)
Artisans										41		10
Mean	77,0	82,2	88,8	97,4	98,7	94,8	83,9	102,5	93,7		92,8	
Maximal	79,9	86,9	93,2	102,3	103,7	99,8	94,0	107,4	101		101	
Minimal	67,7	70,0	73,9	79,4	78,9	74,2	65,8	83,7	82		87	
Main Fan Chambers										6		1
Mean	92,8	105,1	105,7	105,0	102,2	102,9	97,7	111,6	109,0		112,0	
Maximal	96,1	109,1	107,4	107,4	103,7	106,6	101,4	114,4	112		112	
Minimal	90,5	102,1	104,6	102,6	99,0	95,2	88,0	108,8	86		112	
Pump Chambers										17		4
Mean	78,3	85,7	88,3	89,5	91,1	82,5	77,9	95,5	94,9		100,5	
Maximal	82,9	88,1	89,8	91,2	93,1	84,2	80,8	97,4	114		114	
Minimal	73,7	80,3	82,6	83,8	84,9	75,8	62,1	89,5	82		87	
Refrigeration Plants										8		2
Mean	83,3	88,9	93,6	97,4	99,3	94,2	84,5	103,1	101,2		102,0	
Maximal	86,9	92,1	96,9	100,2	103,1	96,7	88,8	106,4	111		111	
Minimal	74,7	80,3	85,6	88,8	90,9	85,8	75,1	94,6	91		93	
Refuge Bays										-		-
Mean	75,5	75,6	72,2	87,7	94,3	95,3	89,3	98,8	98,8*			
Maximal	75,5	78,2	86,0	96,6	105,2	110,7	111,7	114,8	115*			
Minimal	53,3	67,3	72,2	87,7	92,4	95,3	89,3	98,2	98*			

*Calculated equivalent noise exposure based on 8 h exposure time

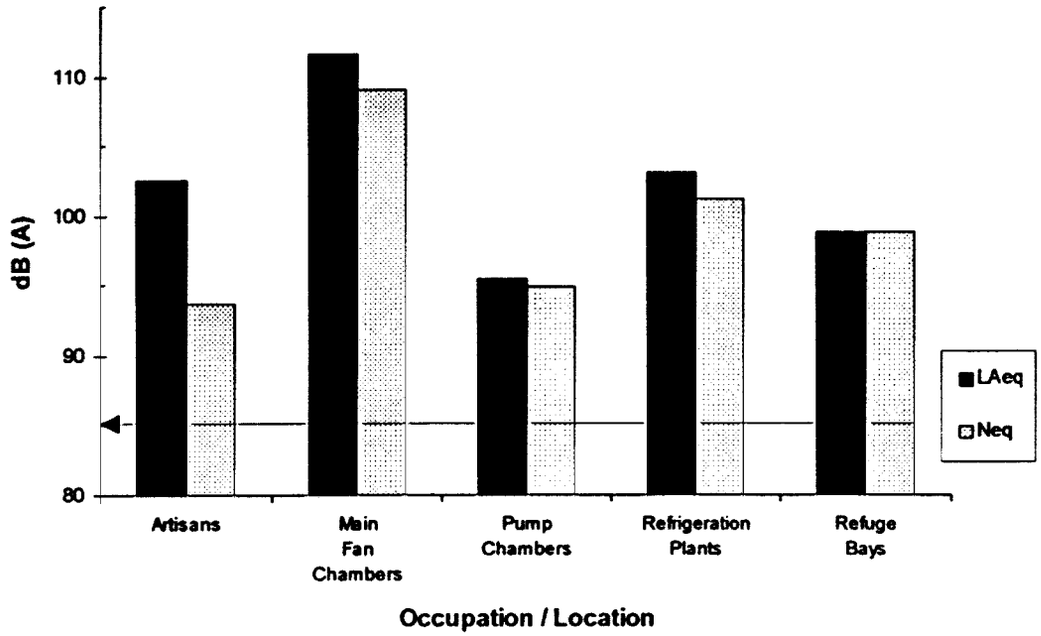

Figure 3.3.2f ***Mean emission and exposure levels for technical services in conventional mining***

The apparently continuous exposure to principal noise sources among fan, refrigeration plant and pump attendants highlights the importance of "full-time" use of hearing protection for these individuals. Information for use in selecting HPDs for technical services personnel is appended in Tables A-5.22 to A-5.25. The table relating to artisans (Table A-5.22) is based on maximal L_{pA} values from Table 3.3.2d, in order to reduce the likelihood of underprotection during the intermittent periods of intense noise that are typical for these workers.

Table 3.3.2d and Figure 3.3.2f include the summarized results of noise measurements in three refuge bays. There were no workers inside during observations, but compressed air lines were opened in an attempt to simulate refuge bay conditions as closely as possible. Although emission levels would have been attenuated and the resulting L_{Aeq} (98,8 dB) reduced somewhat had the refuge bays been occupied, these results still indicate that noise from compressed air outlets in refuge bays is excessive, underscoring the importance of reducing exposure for occupants. Kielblock, van Rensburg, van der Linde, van Rensburg and Russell (1988) found that noise levels in a refuge bay of standard design ranged from 100,1 dB to 104,9 dB with the compressed air on. They acknowledged the potential of HPDs to reduce occupants' exposure by some 20 dB but suggested engineering solutions as a preferable

means of reducing noise and its impact on communication. Information relevant to the selection of HPDs for use in refuge bays is appended in Table A-5.26. It should be noted that the table uses calculated N_{eq} values based on an assumed exposure period of 8 h. As stated previously, no dosimetry samples were taken for occupants of refuge bays, currently or previously.

3.3.3 Underground occupations and workplaces in mechanized mining

Results of noise measurements for mechanized gold and platinum mining during the current survey are presented in three sections, the first of which relates to specific equipment and machinery, while the second and third encompass production and service activities, respectively. The 1980 report of van Rensburg et al. did not consider mechanized mining operations.

3.3.3.1 Equipment and machinery operators

Mean, maximal and minimal L_{pA}, L_{Aeq} and N_{eq} values relating to equipment and machinery operators are presented in Table 3.3.3a, with means for the latter two parameters illustrated in Figures 3.3.3a and 3.3.3b. Production, ore transport and service machinery are included. Emission and exposure levels were greatest for diamond drills, where mean values were determined to be 108,7 dB and 106,3 dB, respectively. Mobile scalers were also found to be significant sources of noise, with mean L_{Aeq} and N_{eq} values of 107,0 dB and 98,2 dB, respectively. Jumbo drill rigs, load-haul-dump vehicles (LHDs) and utility vehicles, all yielded a mean L_{Aeq} value of 103,9 dB, while mean exposure levels for operators of these machines were 100,7 dB, 99,3 dB and 95,4 dB, respectively. Other equipment for which emission levels exceeded 100 dB (with mean L_{Aeq} / N_{eq} values) were dump trucks (103,6 dB / 99,9 dB), front-end loaders (102,8 dB / 97,8 dB), tip impact breakers (101,6 dB / 89,0 dB) and bulldozers (100,5 dB / 100,4 dB). The only equipment closely associated with production activities having a mean L_{Aeq} below 100 dB was roofbolters at 98,6 dB, for which operators' mean exposure level was 94,3 dB.

The remaining types of equipment considered in Table 3.3.3a are associated with service activities, and all yielded mean L_{Aeq} values below 100 dB. These machines (with mean L_{Aeq} / N_{eq} values) are roadway graders (97,0 dB / 95,0 dB), vibromax compactor rollers (94,5 dB / 92,3 dB) and jeeps/4x4s (L_{Aeq} of 90,2 dB). No N_{eq} determinations were made for operators or passengers in jeeps/4x4s, as these are means of conveyance not operated or occupied on a dedicated basis.

Table 3.3.3a

L_{pA} *at the given centre frequency with* L_{Aeq} *and* N_{eq} *values for equipment and machinery in mechanized mining*

	L_{pA} (dB) at the Given Centre Frequency (Hz)							L_{Aeq} (dB)	N_{eq}	
Machinery / Equipment	125	250	500	1k	2k	4k	8k		(dB)	(n)
Bulldozers										12
Mean	81,6	85,2	89,2	97,2	95,4	90,1	78,4	100,5	100,4	
Maximal	87,6	89,4	95,3	99,0	101,4	91,8	86,1	104,5	104	
Minimal	74,6	76,7	71,5	73,4	76,2	74,1	61,3	82,6	86	
Diamond Drills										18
Mean	86,1	92,4	95,6	98,2	104,0	102,6	102,8	108,7	106,3	
Maximal	90,3	96,7	98,9	100,3	106,1	104,4	104,9	110,9	110	
Minimal	80,0	86,6	89,0	94,3	98,3	97,9	96,8	103,3	102	
Dump Trucks										14
Mean	87,3	100,7	92,7	97,4	93,2	90,1	81,7	103,6	99,9	
Maximal	89,6	102,9	94,8	99,6	96,0	93,4	89,2	106,0	102	
Minimal	78,0	79,1	73,8	78,5	81,3	80,0	71,3	86,9	95	
Front-end Loaders										11
Mean	93,8	94,8	98,1	97,2	92,3	82,1	81,1	102,8	97,8	
Maximal	102,7	96,4	104,1	106,0	107,0	100,8	89,1	111,8	101	
Minimal	75,2	74,4	80,8	82,7	79,4	75,0	61,1	86,9	93	
Jeeps and 4x4s										-
Mean	81,8	80,9	80,1	83,9	85,3	78,8	62,4	90,2	-	
Maximal	83,3	86,3	83,6	89,3	90,8	86,9	73,2	95,3	-	
Minimal	77,7	77,7	73,1	81,5	82,8	72,8	61,3	86,9	-	
Jumbo Drill Rigs										16
Mean	79,4	85,9	91,7	96,0	98,3	98,4	96,8	103,9	100,7	
Maximal	81,3	89,0	95,2	98,3	99,4	100,0	97,5	105,5	108	
Minimal	75,5	76,5	75,5	81,4	80,9	78,2	72,9	86,6	88	
Load-Haul-Dump Vehicles										21
Mean	90,0	91,4	95,0	100,2	98,1	92,4	82,8	103,9	99,3	
Maximal	90,0	91,9	101,9	103,2	112,5	105,2	90,9	114,0	104	
Minimal	68,2	71,4	75,6	75,7	71,5	64,5	57,6	80,5	89	
Mobile Scalers										13
Mean	86,7	91,8	82,5	89,4	91,8	106,5	86,9	107,0	98,2	
Maximal	91,5	99,2	87,7	92,9	98,4	113,2	94,3	113,6	101	
Minimal	75,9	70,9	61,7	78,1	75,1	63,9	60,1	81,8	95	
Roadway Graders										9
Mean	85,2	86,8	89,3	92,8	90,5	84,7	72,5	97,0	95,0	
Maximal	91,6	93,7	95,6	98,6	97,7	107,3	87,9	108,7	98	
Minimal	69,2	70,8	67,3	75,9	75,5	64,3	61,1	80,2	87	
Roofbolters										13
Mean	84,5	90,2	92,1	93,7	90,6	88,0	80,1	98,6	94,3	
Maximal	95,2	105,7	102,9	104,8	101,8	98,8	91,6	110,6	98	
Minimal	72,3	77,2	70,4	77,3	75,0	61,3	61,3	82,2	89	
Tip Impact Breakers										10
Mean	77,5	82,9	93,6	96,3	97,0	93,6	84,3	101,6	89,0	
Maximal	78,8	84,4	96,8	98,2	99,7	94,1	85,3	103,8	95	
Minimal	73,1	77,1	83,1	85,2	89,3	79,0	68,3	91,9	87	
Utility Vehicles										13
Mean	89,6	92,5	94,9	98,8	98,0	95,6	91,0	103,9	95,4	
Maximal	93,3	95,4	97,1	99,9	98,9	98,3	92,1	105,6	99	
Minimal	61,6	71,1	64,3	76,1	74,3	66,3	61,1	79,5	86	
Vibromax Compactor/Rollers										7
Mean	83,1	82,2	86,2	90,7	88,3	82,2	68,3	94,5	92,3	
Maximal	84,7	84,6	88,5	92,5	91,1	86,5	72,5	96,8	96	
Minimal	77,3	77,0	78,6	79,4	76,1	68,4	61,3	84,9	86	

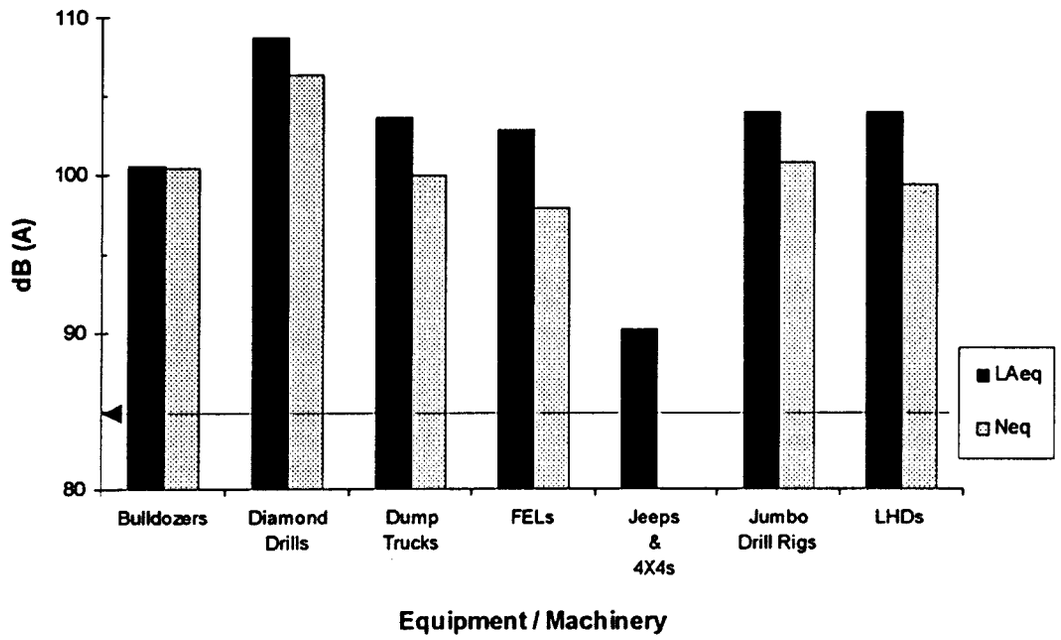

Figure 3.3.3a Mean emission and exposure levels for equipment and machinery in mechanized mining

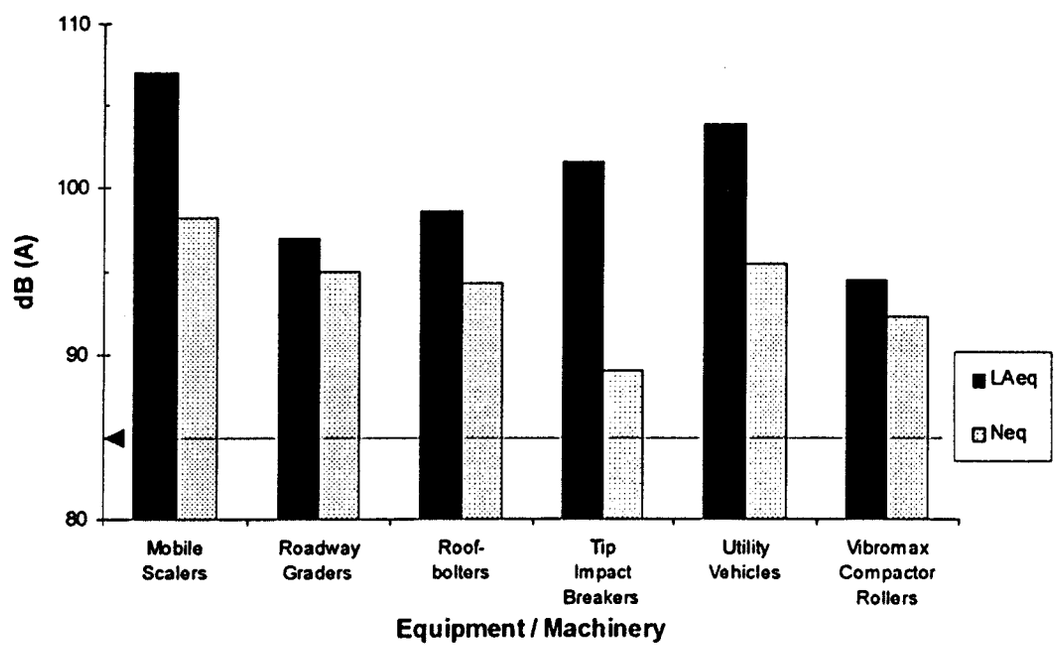

Figure 3.3.3b Mean emission and exposure levels for additional equipment and machinery in mechanized mining

All of the equipment represented in Table 3.3.3a yielded mean emission levels in excess of 90 dB, and only tip impact breaker operators had a mean exposure below this value. Mean emission levels were all greater than their corresponding exposure levels, the differences ranging from 0,1 dB (bulldozers) to 12,6 dB (tip impact breakers). Intermittent operation accounts for the greater differences, particularly in the case of tip impact breakers. It should be noted that operators of these machines have brief periods of exposure to other, slightly noisier machinery, e.g. dump trucks and LHDs, further indicating periods of limited activity. In the case of bulldozer operators (mean L_{Aeq} of 100,5 dB and mean N_{eq} of 100,4 dB), continuous operation may partially account for the similar means, but it is likely that much of the bulldozer operators' exposure is attributable to emissions from other, noisier machines operating in close proximity to them. These would include tip impact breakers, mobile scalers, front-end loaders, LHDs and dump trucks. This explanation appears to be supported by the emission and operator exposure levels determined for these other machines.

Where operators' mean exposure levels do not exceed 95 dB, as is the case for roadway graders, roofbolters, vibromax compactor rollers and tip impact breakers, the relevant source can be regarded as less significant than other machinery considered above. Although unprotected operators would certainly be at risk, adequate attenuation would be readily achievable with many HPDs. The foregoing statement notwithstanding, operators of tip impact breakers are exposed to considerable noise emissions from their own and other machinery, albeit intermittently. Where operations are more continuous than current dosimetry results would appear to indicate, these individuals could be exposed at levels approaching 100 dB. Accordingly, hearing protection for these individuals should be selected with reference to maximal L_{pA} values. Information on HPD selection for operators of equipment and machinery in mechanized mining is presented in Tables A-6.1 to A-6.13. It should be noted that Table A-6.5, which relates to drivers and passengers in jeeps/4x4s, does not include dosimetry results. Since these vehicles are only operated and occupied intermittently, it would not have been appropriate to determine an 8 h time-weighted average or N_{eq}. Nevertheless, for the purpose of HPD selection, a calculated N_{eq} value has been included, which assumes 8 h of exposure to the mean sound pressure levels observed for jeeps/4x4s. Table A-6.11, which relates to HPD selection for operators of tip impact breakers, incorporates maximal L_{pA} values from Table 3.3.3a, for reasons explained above.

3.3.3.2 Production personnel

The results of measurements made for production-related occupations are summarized in Table 3.3.3b, while mean L_{Aeq} and N_{eq} values are graphically illustrated in Figure 3.3.3c. Mean L_{Aeq} / N_{eq} values ranged from 99,3 dB / 89,9 dB for mine overseers, to 108,8 dB / 102,5 dB for team leaders. Occupations with results within these extremes were shift supervisors (101,1 dB / 91,9 dB), miners (103,0 dB / 96,6 dB), miner's assistants (104,1 dB / 98,3 dB), tips labour (102,2 dB / 93,7 dB), and surveyors and samplers (100,3 dB / 93,4 dB). Within this group of occupations mean exposure levels were generally proportional to corresponding emission levels. Information to assist with the selection of HPDs for personnel involved or associated with production activities is appended in Tables A-6.14 to A-6.20.

Table 3.3.3b

L_{pA} at the given centre frequency with L_{Aeq} and N_{eq} values for production personnel in mechanized mining

	L_{pA} (dB) at the Given Centre Frequency (Hz)							L_{Aeq} (dB)	N_{eq}	
Occupation / Activity	125	250	500	1k	2k	4k	8k		(dB)	(n)
Mine Overseers										11
Mean	85,3	88,1	89,8	93,6	94,8	90,2	81,2	99,3	89,9	
Maximal	87,6	93,3	91,7	96,0	99,4	95,8	88,4	103,3	92	
Minimal	80,0	82,9	84,1	89,5	91,0	85,2	77,3	94,9	87	
Miners										16
Mean	88,9	90,2	94,7	96,4	97,5	95,6	92,3	103,0	96,6	
Maximal	91,5	93,6	96,5	98,4	100,0	98,4	96,5	105,6	104	
Minimal	73,8	78,0	81,3	86,6	89,0	87,7	85,4	93,8	85	
Miner's Assistants										14
Mean	89,7	91,3	95,6	97,6	98,3	96,7	94,1	104,1	98,3	
Maximal	92,8	95,2	98,6	100,4	102,1	100,5	98,2	107,6	103	
Minimal	76,0	79,9	83,1	88,2	90,9	89,5	87,3	95,6	84	
Shift Supervisors										12
Mean	87,1	89,1	92,2	95,0	96,2	92,9	86,7	101,1	91,9	
Maximal	89,6	93,5	94,1	97,2	99,7	97,1	92,4	104,3	94	
Minimal	76,9	80,5	82,7	88,0	90,0	86,4	81,4	94,1	85	
Surveyors and Samplers										21
Mean	86,1	90,6	91,2	95,7	94,6	90,8	81,4	100,3	93,4	
Maximal	89,2	95,1	96,3	100,3	100,8	96,2	86,3	105,5	99	
Minimal	83,0	82,5	83,3	87,5	88,1	84,8	77,2	93,3	81	
Team Leaders										19
Mean	90,4	95,7	98,9	102,5	104,8	100,3	97,5	108,8	102,5	
Maximal	93,9	98,4	100,6	105,6	106,5	103,8	98,3	111,2	116	
Minimal	78,8	80,6	84,0	88,5	91,0	85,9	84,8	94,9	87	
Tips Labour										17
Mean	82,1	87,3	88,1	92,9	94,4	100,1	85,6	102,2	93,7	
Maximal	85,1	91,8	92,3	95,6	99,0	103,7	89,8	105,9	97	
Minimal	74,5	74,0	72,4	81,6	82,2	71,5	64,2	86,0	86	

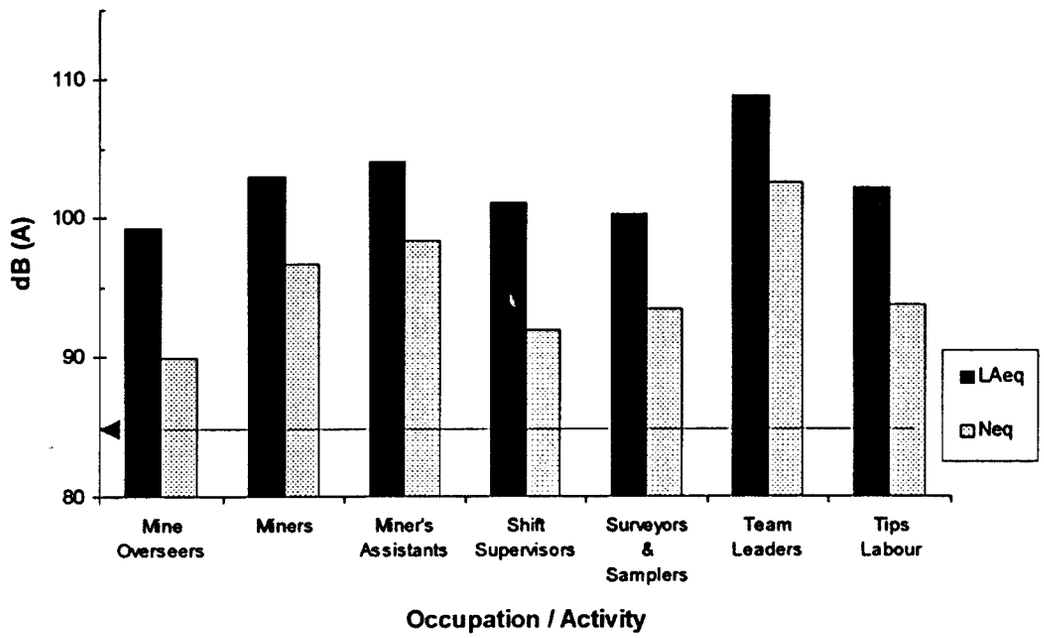

Figure 3.3.3c Mean emission and exposure levels for production personnel in mechanized mining

3.3.3.3 Service personnel

Results for service-related occupations are presented in Table 3.3.3c and summarized in Figure 3.3.3d. Here the relationship between L_{Aeq} and N_{eq} was not quite as uniform as for production activities. Mean L_{Aeq} values ranged from 81,1 dB for electricians, to 104,0 dB for individuals installing wire mesh, lacing and barricades. Within this range were diesel fitters/mechanics (92,1 dB), backfill labour (93,4 dB), reclaiming and salvage (97,1 dB), diesel fuel bay attendants (99,4 dB) and boilermakers/platers (100,9 dB). The range for mean exposure levels was from 90,2 dB for backfill labour to 102,7 dB for wire mesh/lacing/barricades. Occupations with mean N_{eq} values within these extremes were diesel fuel bay attendants (90,5 dB), boilermakers/platers (90,6 dB), diesel fitters/mechanics (91,8 dB), electricians (92,5 dB) and reclaiming/salvage (92,7 dB).

Table 3.3.3c

L_{pA} *at the given centre frequency with* L_{Aeq} *and* N_{eq} *values for service personnel in mechanized mining*

Occupation / Activity	L_{pA} (dB) at the Given Centre Frequency (Hz)							L_{Aeq} (dB)	N_{eq}	
	125	250	500	1k	2k	4k	8k		(dB)	(n)
Backfill Labour										19
Mean	80,1	82,6	85,9	88,1	87,8	82,0	80,7	93,4	90,2	
Maximal	84,1	86,9	90,3	92,6	93,2	86,5	83,4	98,1	94	
Minimal	63,2	64,2	69,2	71,2	71,1	67,9	66,7	77,0	83	
Boilermakers/Platers										16
Mean	77,6	79,5	85,4	90,0	95,4	98,5	79,0	100,9	90,6	
Maximal	84,1	87,9	99,7	106,2	115,5	117,5	105,4	120,0	96	
Minimal	55,2	56,2	61,2	62,2	59,5	59,9	49,7	67,6	81	
Diesel Fitters/Mechanics										17
Mean	78,4	79,9	81,3	86,0	88,9	81,3	69,0	92,1	91,8	
Maximal	93,2	92,0	95,4	103,2	102,7	97,2	89,7	107,2	94	
Minimal	63,9	67,5	63,8	70,1	71,8	68,6	59,2	76,4	87	
Diesel Fuel Attendants										6
Mean	84,6	84,8	88,0	94,6	95,6	88,9	80,6	99,4	90,5	
Maximal	93,2	92,0	95,4	103,2	102,7	97,2	89,7	107,2	92	
Minimal	77,0	77,0	71,7	82,2	81,8	73,1	61,3	86,5	89	
Electricians										16
Mean	70,8	72,6	74,9	75,2	74,3	68,0	53,7	81,1	92,5	
Maximal	74,5	74,1	75,9	81,3	81,9	81,5	76,6	87,6	96	
Minimal	61,4	65,4	68,3	66,8	66,3	64,4	50,3	73,7	83	
Reclaiming and Salvage										13
Mean	77,8	82,9	87,0	90,4	93,0	90,7	81,8	97,1	92,7	
Maximal	80,8	87,4	90,3	90,2	100,4	97,4	91,8	103,2	106	
Minimal	70,7	73,0	76,9	79,5	80,0	77,6	73,1	85,4	87	
Wire Mesh/Lacing/Barricades										23
Mean	86,4	93,0	96,1	97,9	99,4	94,4	90,9	104,0	102,7	
Maximal	93,2	102,9	109,0	110,5	111,7	103,4	100,0	115,9	106	
Minimal	74,5	74,9	75,3	77,8	78,2	75,0	72,5	84,3	92	

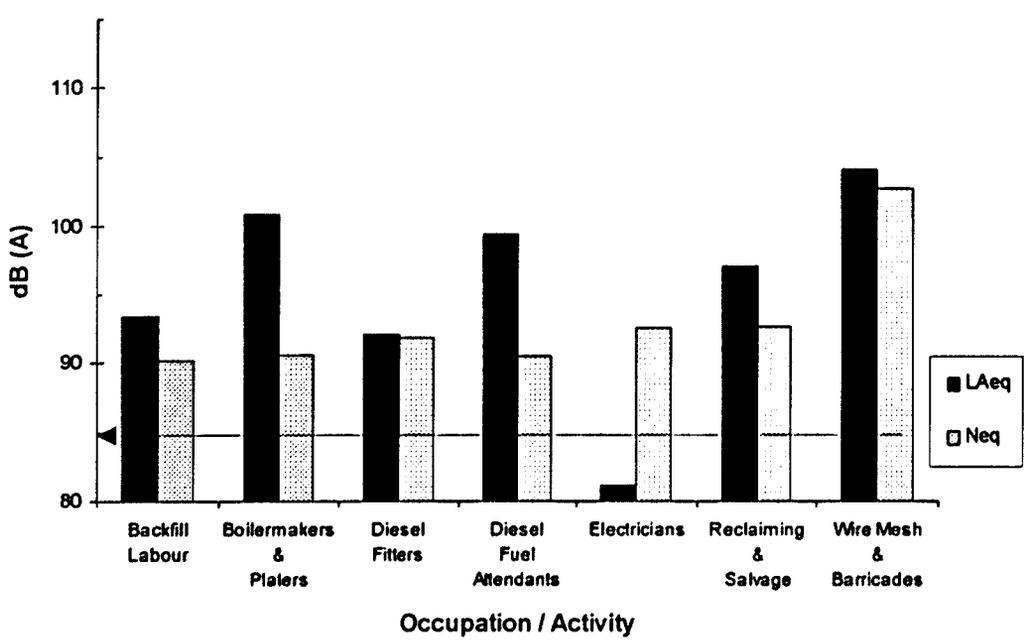

Figure 3.3.3d Mean emission and exposure levels for service personnel in mechanized mining

The greatest difference between means for L_{Aeq} and N_{eq} occurred among electricians, where a negative difference of 11,4 dB was observed. This indicates exposure to emissions from other operations considerably noisier then their own. Among the remaining occupations considered in Figure 3.3.3d, mean L_{Aeq} exceeded mean N_{eq} by differences ranging from 0,3 dB for diesel fitters/mechanics to 10,3 dB for boilermakers/platers. Greater positive differences between these two parameters would normally indicate intermittent operation, while smaller differences and negative differences (where N_{eq} exceeds L_{Aeq}, e.g. electricians) would indicate continuous activity, extended periods of exposure (beyond 8 h), exposure to emissions from noisier operations or some combination of these factors.

Information to assist with the selection of HPDs for personnel involved in service operations is appended in Tables A-6.21 to A-6.27. To accommodate the excessive but intermittent noise emissions that individuals in some occupations are exposed to, Tables A-6.22 to A-6.26 (boilermakers/platers, diesel fitters/mechanics, diesel fuel attendants, electricians and reclaiming/salvage, respectively) are based on maximal L_{pA} and L_{Aeq} determinations from Table 3.3.3c. This caters for the likelihood of such individuals only wearing their HPDs while involved in or exposed to emissions from noisy operations, and provides for the maximum levels they would be likely to encounter.

3.3.4 Ventilation fans

3.3.4.1 Main fans

Mean L_{pA} and resulting L_{Aeq} values in respect of main fans are presented in Table 3.3.4a and illustrated in Figures 3.3.4a and 3.3.4b. These are based on observations of three main fan installations, inside fan chambers and in associated haulages at various distances from fan intakes. Emission levels in fan chambers were considerable, averaging 111,6 dB. Table 3.3i and Figure 3.3m indicate a very flat emission spectrum, particularly at the frequencies of 250 to 1 000 Hz, where most of the sound energy was emitted. Although few workers would be exposed to noise inside main fan chambers, the levels observed for these installations indicate the importance of hearing protection. As stated previously, information relating to the selection of appropriate HPDs for individuals working in main fan chambers is appended in Table A-5.23.

Measurements in haulages serving as airways to main fans revealed an attenuation effect with increasing distance which was most apparent at frequencies from 1 kHz to 2 kHz. The results also indicate that most of the sound energy was concentrated at frequencies from 125 Hz to 1 kHz. The uniform value of 61,2 dB for L_{pA} at 8 kHz, regardless of distance, was the result

of the SLM's range having been set to accommodate the greater sound pressures being generated at the lower frequencies, where sound energy was concentrated. Although it is quite apparent that actual L_{pA} values for 8 kHz were below the threshold of 61,2 dB, this had no effect on resulting L_{Aeq} values, owing to the logarithmic summation used in deriving them, and the much greater sound pressures being generated at other frequencies. Had an octave or 1/3 octave filter been used to exclude other frequencies and the SLM's range been set lower, a strong distance-attenuation effect should have been observed for 8 kHz, but omitting this procedure had no impact on the overall noise levels determined. Perhaps the most relevant observation to be made from these results is that mean L_{Aeq} only diminished to 85 dB or below at distances of 50 m or more from main fan intakes.

Table 3.3.4a

Mean L_{pA} at the given centre frequency and L_{Aeq} for main fan chambers and haulages serving as airways to main fans

Location/ Distance from Intake (m)	Mean L_{pA} (dB) at Given Centre Frequency (Hz)							L_{Aeq} (dB)
	125	250	500	1 k	2 k	4 k	8 k	
Inside Chamber	92,8	105,1	105,7	105,0	102,2	102,9	97,7	111,6
0	87,4	95,3	93,6	89,8	81,6	67,5	61,2	98,7
5	85,4	93,4	91,7	86,3	78,6	66,3	61,2	96,6
10	83,6	92,2	89,8	83,7	74,3	65,4	61,2	95,0
15	83,1	91,2	87,1	82,2	72,7	64,2	61,2	93,4
20	83,0	89,5	85,3	79,6	71,0	63,9	61,2	91,9
25	81,9	88,2	82,5	78,1	69,7	63,7	61,2	90,3
30	81,7	87,1	80,4	76,4	69,6	63,4	61,2	89,2
35	81,0	85,7	78,9	75,8	68,7	63,3	61,2	88,0
40	80,2	84,0	77,2	74,4	68,4	63,0	61,2	86,5
45	80,0	83,0	74,4	73,8	68,3	62,7	61,2	85,6
50	79,5	82,5	73,4	73,5	67,6	62,6	61,2	85,0
55	78,5	81,9	71,8	71,3	66,9	62,6	61,2	84,2
60	78,1	81,8	70,3	71,0	66,2	61,9	61,2	83,9

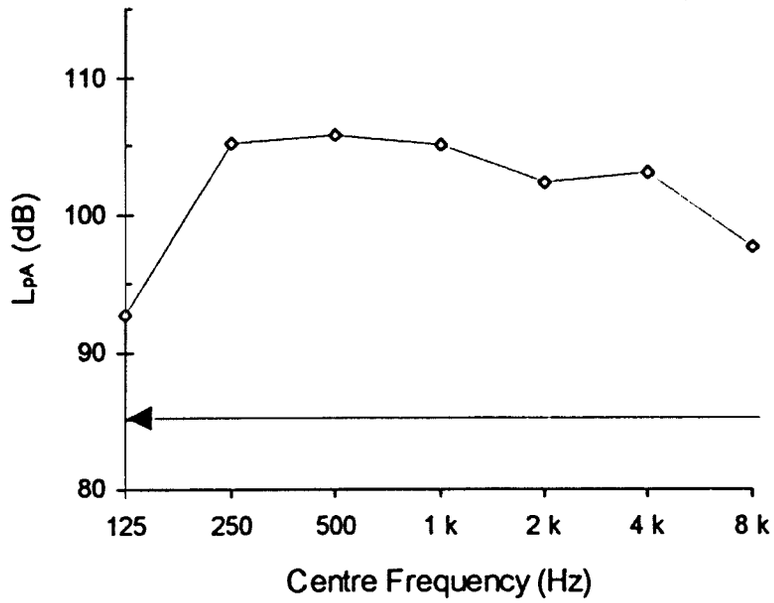

Figure 3.3.4a ***Averaged spectogram of noise measured inside main fan chambers***

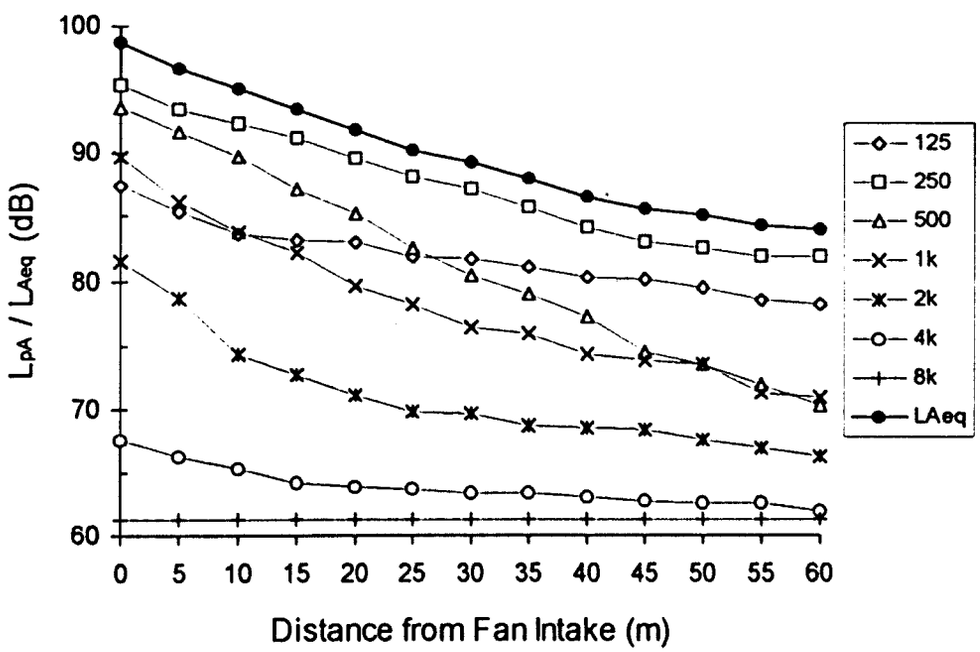

Figure 3.3.4b ***Mean L_{pA} at given centre frequency and L_{Aeq} at various distances upstream from main fan intakes***

3.3.4.2 Auxiliary fans

As stated under methods (Section 2.1.1.3) both "silenced" and "standard" auxiliary fans were measured for noise emission, but due to environmental and maintenance factors, silenced fans were generally indistinguishable from the standard units in terms of noise emission levels. Accordingly, the results presented in this section make no distinction between the two types.

Auxiliary fans with power ratings ranging from 40 to 50 kW were observed over a range of distances upstream and downstream such that L_{Aeq} was observed to diminish to 85 dB or below at the two extreme positions. Table 3.3.4b summarizes these results for duct-mounted or in-line 40 to 50 kW fans, while Table 3.3.4c considers fans of similar sizes, but installed in fan chambers. Mean L_{Aeq} for both types of installation are compared in Figure 3.3.4c, while mean L_{pA} and resulting L_{Aeq} values are illustrated in Figure 3.3.4d (duct-mounted) and Figure 3.3.4e (chamber-mounted). Duct-mounted fans were observed to be somewhat noisier, both at the fans, as well as at more distant measurement positions. Both types of installations emitted the greatest levels of sound energy at frequencies from 500 Hz to 2 000 Hz. The major difference in emission patterns was that duct-mounted fans emitted more sound energy at 4 kHz than at 250 Hz, which may be partially attributable to duct resonance originating at 2 kHz. For chamber-mounted installations the reverse was true. Directly opposite the fans, mean L_{pA} values for duct-mounted appliances at 8 kHz exceeded those at 125 Hz, but this may be attributable to primary resonance at 2 kHz and primary/secondary resonance at 4 kHz.

In general, higher frequency emissions displayed a more pronounced distance-attenuation effect, while sound pressure levels at 250 Hz and, in particular, at 125 Hz were less influenced by distance. Among the duct-mounted devices, mean L_{pA} at 125 Hz was virtually unchanged as distance increased, as a result of fan noise being transmitted along and radiating from the steel ducting. The below-threshold effect at 8 kHz observed in haulages for main fans was also apparent among the 40-50 kW auxiliary fans, but only after distance had increased to between 3 m and 15 m.

Mean L_{Aeq} for 40-50 kW duct-mounted fans diminished to 85 dB or below at distances of 40 m on the intake side and beyond 25 m on the exhaust side. Emissions from chamber-mounted units reached this level at distances beyond 30 m on the intake side and at 20 m on the exhaust or delivery side.

Table 3.3.4b

Mean L_{pA} at the given centre frequency and L_{Aeq} at various distances upstream and downstream from 40-50 kW duct-mounted auxiliary fans

Distance from Fan (m)	Mean L_{pA} (dB) at Given Centre Frequency (Hz)							L_{Aeq} (dB)
	125	250	500	1 k	2 k	4 k	8 k	
40 u/s	73,4	73,0	80,8	80,6	75,3	65,0	61,3	85,0
35 u/s	74,0	73,7	81,2	84,0	77,8	65,6	61,3	86,9
30 u/s	74,1	73,7	83,1	85,7	79,5	65,8	61,3	88,6
25 u/s	74,2	75,9	87,1	86,6	82,0	71,1	61,3	90,8
20 u/s	76,0	78,3	91,7	89,8	85,3	76,5	61,3	94,7
15 u/s	78,3	84,1	93,2	94,3	91,2	85,1	62,5	98,3
10 u/s	78,6	85,9	97,9	99,2	94,0	86,5	66,8	102,5
7 u/s	78,7	86,1	98,3	99,6	94,9	87,7	68,0	103,0
5 /us	78,9	86,5	99,0	100,5	96,8	90,1	70,5	104,1
3 u/s	79,0	87,0	100,8	101,8	98,1	91,5	74,0	105,5
0	79,1	87,8	104,5	104,3	100,7	94,2	81,1	108,5
2 d/s	77,9	83,9	97,3	97,9	93,4	85,3	67,9	101,5
3 d/s	77,4	81,9	93,6	94,7	89,8	80,8	61,3	98,1
5 d/s	76,1	80,2	92,2	91,5	85,8	74,2	61,3	95,6
7 d/s	76,0	79,3	89,5	88,2	83,2	71,1	61,3	92,8
10 d/s	76,0	78,0	88,1	86,6	81,9	69,6	61,3	91,4
15 d/s	75,5	76,3	86,6	84,1	79,7	67,3	61,3	89,5
20 d/s	75,5	75,8	82,6	83,5	77,9	66,9	61,3	87,4
25 d/s	74,9	75,0	82,1	81,6	75,7	64,1	61,3	86,1
30 d/s	74,3	73,9	77,5	79,7	73,7	62,3	61,3	83,6

Table 3.3.4c

Mean L_{pA} at the given centre frequency and L_{Aeq} at various distances upstream and downstream from 40-50 kW chamber-mounted auxiliary fans

Distance from Fan (m)	Mean L_{pA} (dB) at Given Centre Frequency (Hz)							L_{Aeq} (dB)
	125	250	500	1 k	2 k	4 k	8 k	
35 u/s	74,8	77,3	79,5	78,0	73,0	62,5	61,2	84,1
30 u/s	75,2	78,1	82,1	80,5	74,8	62,7	61,2	86,1
25 u/s	75,4	78,7	83,8	82,4	76,1	63,1	61,2	87,6
20 u/s	75,5	79,5	85,1	84,3	78,0	65,8	61,2	89,0
15 u/s	75,6	80,0	87,7	86,5	81,0	71,1	61,2	91,2
10 u/s	77,1	81,4	89,7	88,3	84,1	75,4	61,2	93,2
7 u/s	78,1	83,3	91,4	92,3	86,5	79,8	61,2	95,9
5 u/s	78,7	85,2	94,9	95,7	89,4	82,8	61,9	99,2
3 u/s	81,3	88,0	98,5	98,7	92,1	84,5	65,8	102,3
0	83,2	90,2	101,5	102,8	94,1	87,6	69,8	105,8
2 d/s	82,0	86,2	94,5	96,1	87,4	78,6	65,9	99,1
3 d/s	81,5	84,0	90,6	92,6	82,8	74,1	61,3	95,5
5 d/s	80,2	82,5	88,0	89,5	78,8	67,6	61,3	92,8
7 d/s	80,1	81,8	84,9	86,2	76,1	64,7	61,3	90,1
10 d/s	80,1	80,4	83,5	84,4	74,6	63,1	61,3	88,7
15 d/s	79,6	78,6	81,4	82,5	72,8	61,0	61,3	87,0
20 d/s	78,6	77,8	78,1	79,0	71,3	60,5	61,3	84,7
25 d/s	78,1	76,3	77,0	77,7	69,2	58,0	61,3	83,5
30 d/s	77,4	75,0	75,1	75,5	67,9	56,6	61,3	82,1

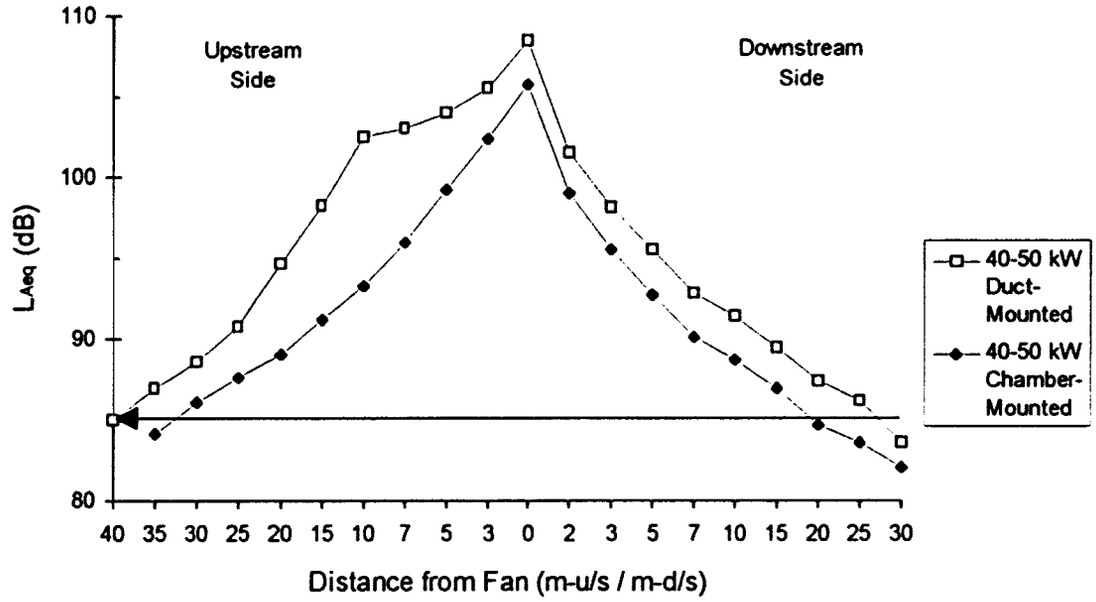

Figure 3.3.4c ***Mean L_{Aeq} at various distances upstream and downstream from 40-50 kW auxiliary fans***

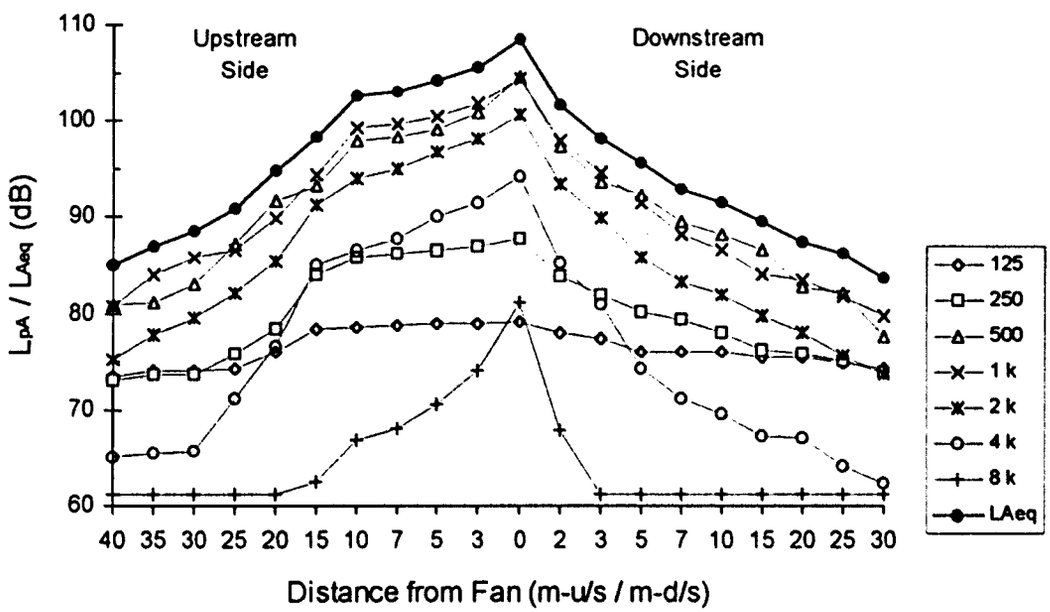

Figure 3.3.4d ***Mean L_{pA} at given centre frequency and L_{Aeq} at various distances upstream and downstream from 40-50 kW duct-mounted auxiliary fans***

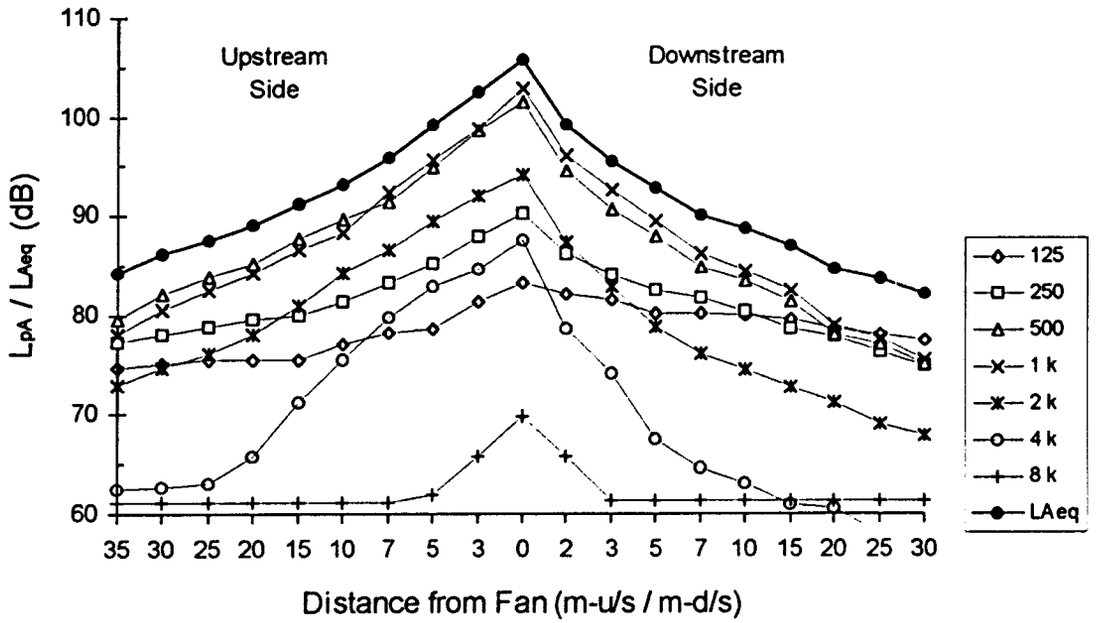

Figure 3.3.4e ***Mean L_{pA} at given centre frequency and L_{Aeq} at various distances upstream and downstream from 40-50 kW chamber-mounted auxiliary fans***

Table 3.3.4d summarizes the results of noise measurements for fans ranging from 6,1 kW to 10,0 kW, while Table 3.3.4e considers those rated from 4,0 kW to 6,0 kW. Mean L_{Aeq} at various distances for both sizes are compared in Figure 3.3.4f. Mean L_{Aeq} at fans was 99,5 dB for the larger units and 98,7 dB for the 4,0-6,0 kW devices. Mean L_{pA} and resulting L_{Aeq} values at various distances upstream and downstream are illustrated in Figure 3.3.4g (6,1-10 kW) and Figure 3.3.4h (4,0-6,0 kW).

Attenuation with increased distance was more pronounced among the smaller units, with their mean L_{Aeq} reaching a level of 85 dB or less at 15 m on the intake side and at 25 m on the exhaust side. This level was reached for 6,1-10 kW fans at 20 m upstream and 25 m downstream. Although the "safe distance" downstream was identical for both size ranges, Figure 3.3.4f indicates that mean L_{Aeq} for the smaller units actually reached 85 dB at a downstream distance of approximately 22 m.

Table 3.3.4d

Mean L_{pA} at the given centre frequency and L_{Aeq} at various distances upstream and downstream from 6,1-10,0 kW auxiliary fans

Distance from Fan (m)	Mean L_{pA} (dB) at Given Centre Frequency (Hz)							L_{Aeq} (dB)
	125	250	500	1 k	2 k	4 k	8 k	
20 u/s	69,5	69,0	67,2	78,5	76,1	68,2	61,4	81,5
15 u/s	73,6	70,5	67,6	82,4	79,9	69,1	61,4	85,0
10 u/s	75,3	72,9	73,5	84,4	83,3	76,9	61,4	87,9
7 u/s	75,3	74,3	75,1	86,3	84,9	80,4	61,4	90,1
5 u/s	75,7	75,2	79,5	89,3	88,3	83,4	61,4	92,8
3 u/s	75,7	76,7	80,9	92,6	90,5	86,2	62,3	95,5
0	76,6	79,9	88,3	96,5	93,9	90,8	76,1	99,5
2 d/s	75,7	75,9	79,0	90,1	88,9	83,7	61,9	93,4
3 d/s	75,7	75,7	78,9	88,6	87,4	82,7	61,9	92,1
5 d/s	75,0	74,7	78,5	87,8	86,6	81,2	61,4	91,2
7 d/s	75,0	74,1	78,2	87,3	86,3	80,1	61,4	90,8
10 d/s	75,0	73,5	78,0	86,8	86,0	79,0	61,4	90,3
15 d/s	74,8	72,3	75,5	85,9	84,8	76,7	61,4	89,1
20 d/s	74,8	70,5	69,8	83,8	82,1	72,5	61,4	86,7
25 d/s	74,7	69,3	66,8	80,1	77,9	67,3	61,4	83,3

Table 3.3.4e

Mean L_{pA} at the given centre frequency and L_{Aeq} at various distances upstream and downstream from 4,0-6,0 kW auxiliary fans

Distance from Fan (m)	Mean L_{pA} (dB) at Given Centre Frequency (Hz)							L_{Aeq} (dB)
	125	250	500	1 k	2 k	4 k	8 k	
25 u/s	73,2	68,2	67,7	79,1	73,5	66,0	61,4	81,6
20 u/s	73,7	71,9	70,0	80,9	76,1	67,2	61,4	83,4
15 u/s	74,0	73,9	77,4	84,0	81,3	72,7	61,4	87,1
10 u/s	74,8	77,3	80,4	86,6	84,7	77,0	61,4	90,0
7 u/s	75,4	77,8	82,6	88,9	87,0	79,1	61,4	92,1
20 u/s	76,3	78,6	84,3	91,2	88,0	79,9	61,4	93,9
3 u/s	76,8	80,2	86,6	92,7	89,9	82,3	65,4	95,6
0	79,0	83,3	89,6	95,9	93,1	83,9	69,9	98,7
2 d/s	77,9	80,5	85,5	92,5	90,1	82,8	67,0	95,4
3 d/s	77,1	79,7	83,9	89,7	87,5	82,2	66,1	93,1
5 d/s	76,6	78,1	81,9	87,0	85,9	81,3	64,5	91,1
7 d/s	76,1	77,3	81,8	86,7	85,5	79,7	63,3	90,7
10 d/s	76,1	76,8	80,9	86,7	84,7	77,9	62,1	90,2
15 d/s	75,3	76,3	78,8	85,9	83,6	75,7	62,0	89,1
20 d/s	75,2	74,4	76,9	84,8	81,6	73,5	61,6	87,7
25 d/s	75,0	72,6	71,7	81,8	79,4	69,9	61,6	85,0
30 d/s	73,1	70,7	67,6	79,9	77,5	67,3	61,4	83,0

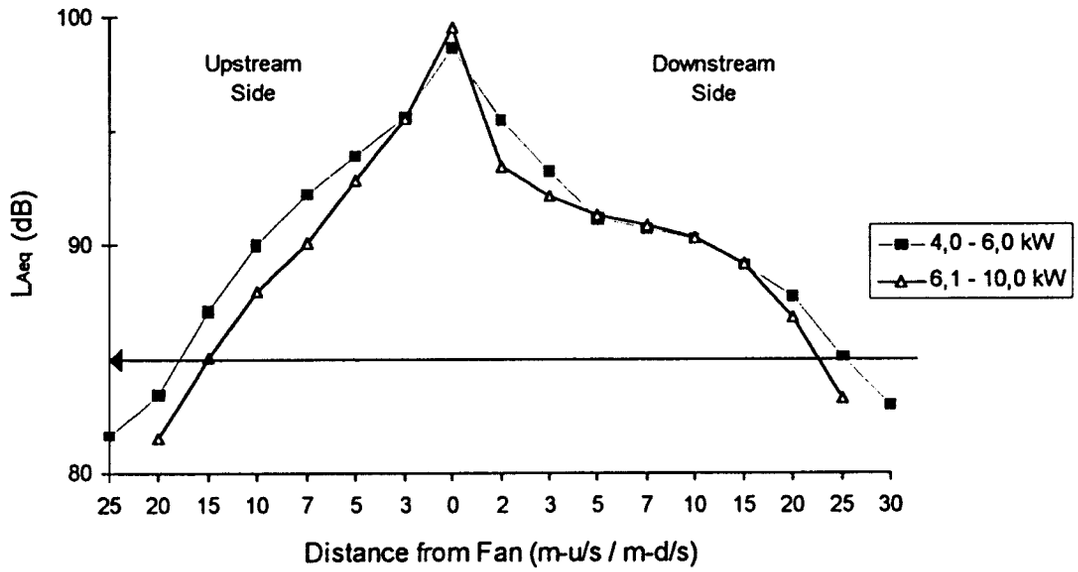

Figure 3.3.4f ***Mean L_{Aeq} at various distances upstream and downstream from small auxiliary fans***

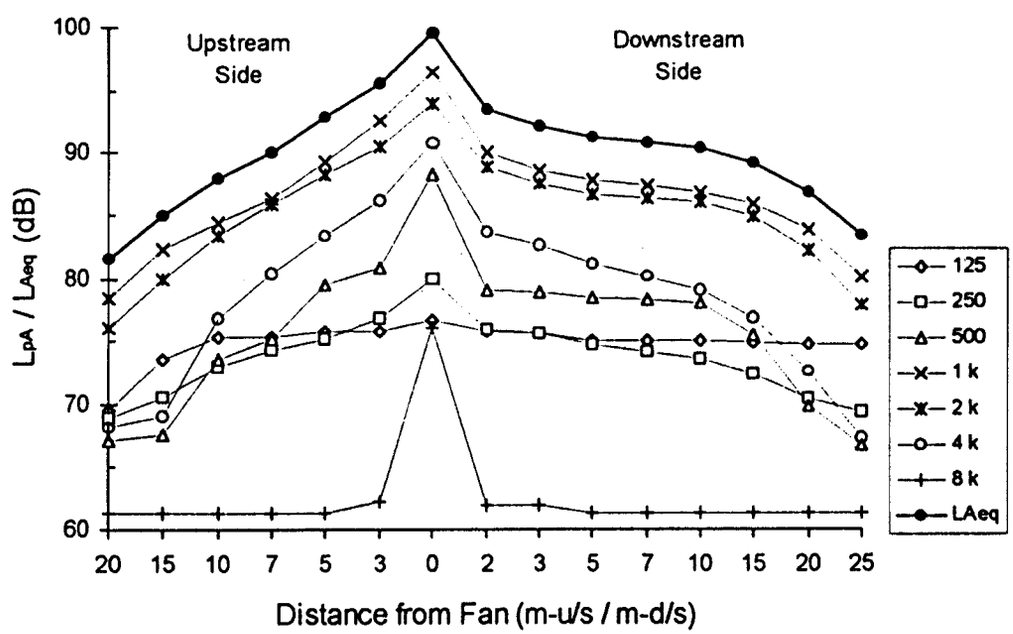

Figure 3.3.4g ***Mean L_{pA} at given centre frequency and L_{Aeq} at various distances upstream and downstream from 6,1-10,0 kW auxiliary fans***

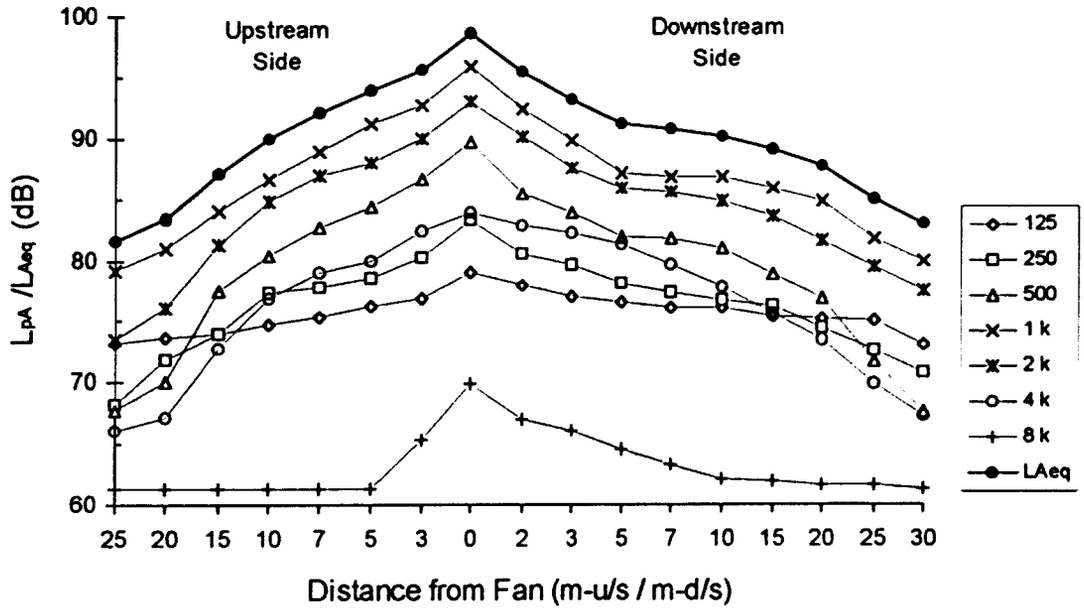

Figure 3.3.4h ***Mean L_{pA} at given centre frequency and L_{Aeq} at various distances upstream and downstream from 4,0-6,0 kW auxiliary fans***

Most individuals' exposure to fan noise in haulages would be intermittent and, for many of those exposed more continuously, their position relative to fans would vary with their activities. Accordingly, no tabulations for HPD selection have been provided in respect of fan noise in haulages. A more appropriate strategy for reducing the health, safety and productivity impact of emissions from auxiliary fans, particularly in-line units, would be to install these devices as far away as practicable from places where workers normally perform their duties. Critical locations such as boxholes, cross-cuts and tips are among those where the effects of fan noise should be controlled in order to reduce the risk of hearing loss, and that of accidents caused by interference with communication during critical operations.

3.4 Hand-held rockdrills

The detailed study of hand-held rockdrills was intended to provide underground determinations of emission and operator exposure levels for the various types of drills used in conventional mining operations. The following sections present results for silenced and unsilenced pneumatic machines and for water-hydraulic drills tested in both development and stoping situations. Descriptions of the drills tested and their designations used in the present report are listed in Table 3.4.

Table 3.4

Designations and descriptions of drills tested

Drills Tested : Development and Stoping	
Designation*	**Description of Drills : Development**
P-1/Ds	Pneumatic Development Drill with Exhaust Silencer
P-1/Ds-I	Imported Pneumatic Development Drill with Exhaust Silencer
P-2/Ds	Pneumatic Development Drill with Silenced Cylinder
P-2/Du	Pneumatic Development Drill with Unsilenced Cylinder
P-3/Ds	Dual-Purpose Pneumatic Drill with Silenced Cylinder
P-3/Du	Dual-Purpose Pneumatic Drill with Unsilenced Cylinder
WH-1/D	Dual-Purpose Water-powered Hydraulic Drill
WH-2/D	Dual-Purpose Water-powered Hydraulic Drill
WH-3/D	Dual-Purpose Water-powered Hydraulic Drill
	Description of Drills : Stoping
P-1/Ss	Pneumatic Stope Drill with Exhaust Silencer
P-2/Ss	Pneumatic Stope Drill with Silenced Cylinder
P-2/Su	Pneumatic Stope Drill with Unsilenced Cylinder
P-3/DSs	Same Drill as P-3/Ds
P-3/DSu	Same Drill as P-3/Du
P-3/Ss	Pneumatic Stope Drill with Silenced Cylinder
P-3/Su	Pneumatic Stope Drill with Unsilenced Cylinder
WH-1/S	Same Drill as WH-1/D
WH-2/S	Same Drill as WH-2/D
WH-3/S	Same Drill as WH-3/D

* P	=	Pneumatic	WH	=	Water Hydraulic
1, 2, 3	=	Manufacturer code			
D	=	Development	S	=	Stope
s	=	Silenced	u	=	Unsilenced

3.4.1 Development drilling

Details of the test site for development drilling are presented in Figure 3.4.1a.

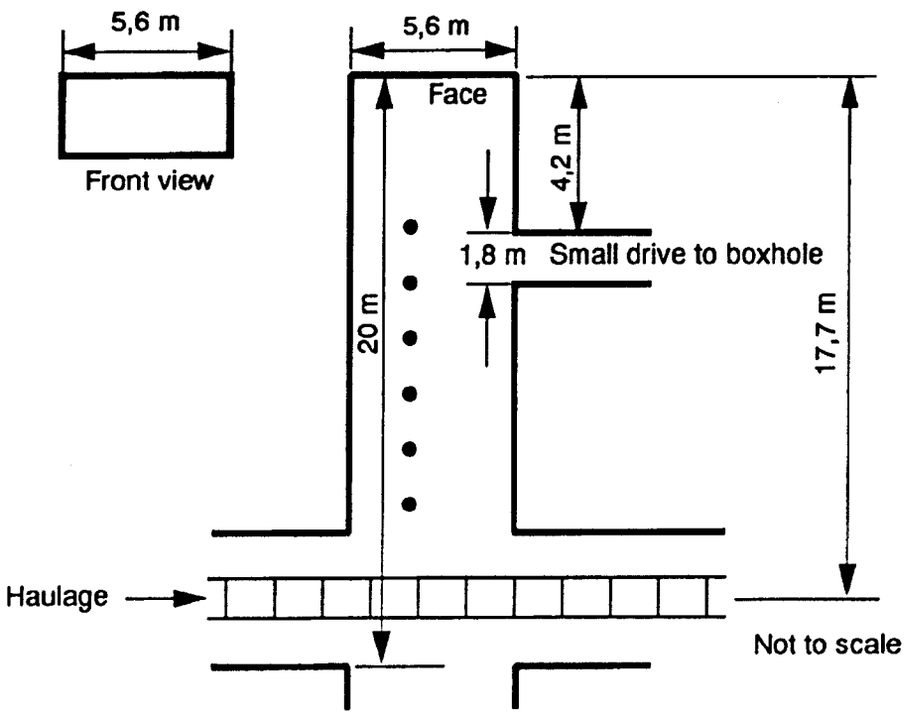

Figure 3.4.1a Site plan for development end

3.4.1.1 Noise emission and operator exposure

Mean L_{pA} values at the relevant centre frequencies and corresponding L_{Aeq} values for each type of drill and operating pressure are tabulated in Table 3.4.1a. These mean values are also presented as averaged spectrograms in Figure 3.4.1a. Results for individual drills on which these means are based are appended in Table A-7.1. It will be noted that this table contains no data for drill P-3/DS at 400 kPa, as a result of persistent microphone misting making reliable results unobtainable, despite repeated attempts. Accordingly, mean values for silenced pneumatic machines operating at 400 kPa in the development end are based on results from three drills rather than four.

Table 3.4.1a

Mean L_{pA} at the given centre frequency and mean L_{Aeq} for three types of hand-held rockdrills : development

Drill Type	Operating Pressure	Mean L_{pA} (dB) at the Given Centre Frequency (Hz)								L_{Aeq} (dB)
		63	125	250	500	1 k	2 k	4 k	8 k	
Silenced Pneumatic	400 kPa	79,5	88,6	93,4	95,1	98,6	102,1	103,1	99,3	107,7
	600 kPa	82,3	89,6	95,0	98,3	101,4	103,2	104,1	100,2	109,1
Unsilenced Pneumatic	400 kPa	79,5	93,9	101,2	106,7	108,3	110,3	107,3	104,8	115,1
	600 kPa	85,6	94,1	103,0	109,9	109,8	111,7	109,4	107,0	117,0
Water-hydraulic	17 MPa	77,3	76,6	78,9	84,8	95,6	100,0	101,9	98,2	105,6

As expected, mean L_{pA} and L_{Aeq} values were highest for unsilenced pneumatic drills operating at 600 kPa, followed by the same machines at 400 kPa, then the silenced pneumatics at 600 and at 400 kPa. The water-powered hydraulic machines were shown to have the lowest mean L_{Aeq}, i.e. 2,1 dB below that of silenced pneumatics operating at 400 kPa and 11,4 dB lower than for unsilenced pneumatics at 600 kPa. Pneumatic drills generally emitted their greatest sound energy over the frequency range of 1 000 to 4 000 Hz, while the water-hydraulic drills were loudest from 2 000 to 8 000 Hz and dramatically quieter than the pneumatics at frequencies of 500 Hz and below.

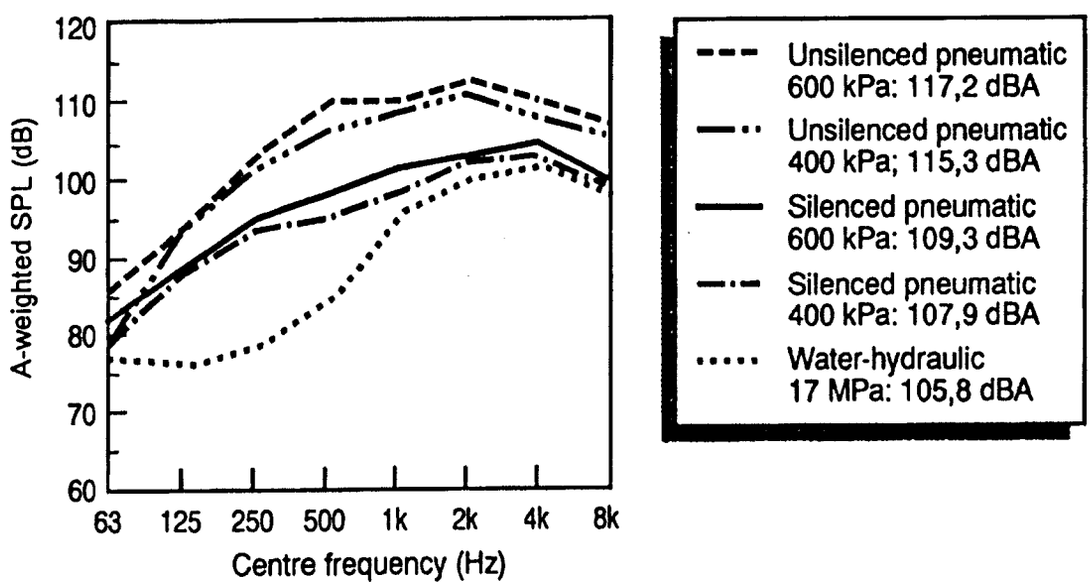

***Figure 3.4.1b** Averaged spectrograms for silenced and unsilenced pneumatic drills at 400 kPa and 600 kPa and for water-hydraulic drills at 17 MPa : development drilling*

Mean calculated N_{eq} values for unprotected operators, relative to actual drilling time for each type of drill and operating pressure, are tabulated in Table 3.4.1b. Calculated N_{eq} values for operators of the individual drills on which these means are based are appended in Table A-7.2. As stated previously, N_{eq} comparisons were based primarily on drilling time and L_{Aeq} rather than number of holes drilled and L_{Aeq}, in order to enable the application of findings to the majority of mining conditions. Where it is desirable to determine N_{eq} for a particular number of holes drilled, the most accurate method would be to establish the typical time requirement by direct observation in the development situation being considered, and relate it to actual drilling time for the relevant type of drill/operating pressure in Table 3.4.1b. Interpolations for drilling time and N_{eq} should be linear, as the two are directly proportional. Alternatively, one could calculate N_{eq} directly using the formulae for L_{Aeq} and N_{eq} from Section 2.2.

Table 3.4.1b

Mean N_{eq} as a function of drilling time for unprotected operators of three types of hand-held rockdrills : development

Drill Type	Operating Pressure	L_{Aeq} (dB)	Mean N_{eq} (dB) for Stated Drilling Time Per Shift (min)									
			30	60	90	120	150	180	210	240	270	300
Silenced	400 kPa	107,7	95,8	98,8	100,6	101,8	102,8	103,6	104,3	104,8	105,4	105,8
Pneumatic	600 kPa	109,1	97,3	100,3	102,0	103,3	104,3	105,0	105,7	106,3	106,8	107,3
Unsilenced	400 kPa	115,1	103,2	106,2	108,0	109,2	110,2	111,0	111,7	112,3	112,8	113,2
Pneumatic	600 kPa	117,0	105,1	108,1	109,9	111,2	112,1	112,9	113,6	114,2	114,7	115,1
Water-hydraulic	17 MPa	105,6	93,8	96,8	98,5	99,8	100,7	101,5	102,2	102,8	103,3	103,8

3.4.1.2 Hearing protection

To evaluate the potential benefits of conventional hearing protection for development drill operators, seven configurations of HPDs were selected, representing all types generally available. The criteria for selection were local availability and attenuation performance documented in accordance with mutually comparable standards (SABS 1451, BS 5108 or ISO 4869). Representative HPDs are listed in Table 3.4.1c with their designations as used in the present report and the standards applied during performance evaluations. Frequency-specific mean attenuation and standard deviation values for the seven representative HPDs are appended in Table A-7.3.

Table 3.4.1c

Representative hearing protection devices considered in estimating effective N_{eq} for protected rockdrill operators

Designation	HPD Type and Model	Test Standard
	Muffs and Band-mounted plugs/caps	
HPD1	EAR 1000 Conventional Muff	BS 5108: 1983
HPD2	EAR 1000 Helmet-mounted Muff	BS 5108: 1983
HPD3	EAR Caps Semi-aural, band worn under chin	BS 5108: 1983
	Muffs worn over plugs	
HPD4	EAR 1000 Muffs with EAR Foam Plugs	BS 5108: 1983
	Reusable Plugs	
HPD5	RACAL DBA 2638 Plugs	BS 5108: 1983
	Disposable Plugs	
HPD6	EAR Foam Plugs	BS 5108: 1974
	Custom-moulded Plugs	
HPD7	Varifoon adjusted to maximum attenuation	SABS 1451: 1988/ ISO 4869

The average overall levels of attenuation that can be expected from these devices when worn by operators of each type of drill under the conditions tested are reflected in Table 3.4.1d. Attenuation values applicable to individual drills are appended in Table A-7.4. The attenuation value for a HPD relevant to a particular type of drill and condition should be subtracted from the corresponding N_{eq} for a given drilling time in Table 3.4.1b, to determine protected operators' effective N_{eq}.

Table 3.4.1d

Attenuation provided by representative HPDs for operators of three types of hand-held rockdrills : development drilling

Drill Type	Operating Pressure	Overall Attenuation (dB)* Provided by Representative HPDs						
		HPD 1	HPD 2	HPD 3	HPD 4	HPD 5	HPD 6	HPD 7
Silenced Pneumatic	400 kPa	20,7	19,9	20,0	31,1	17,2	20,6	33,5
	600 kPa	20,4	19,8	19,0	31,1	16,3	20,0	32,8
Unsilenced Pneumatic	400 kPa	20,2	19,7	17,8	30,8	14,9	19,0	31,5
	600 kPa	20,1	19,8	17,6	31,1	14,5	18,7	31,3
Water-hydraulic	17 MPa	27,1	26,5	23,0	33,4	20,3	24,5	34,5

* Attenuation calculated on the basis of the frequency spectrum for each drill/condition (Table 3.4.1a) and the frequency-specific attenuation performance of each HPD (Table A-7.3).

A comparison of N_{eq} is made among unprotected and variously protected operators of the three types of drills in Table 3.4.1e. The comparison assumes a uniform drilling time of 150 minutes per shift for each type of machine. Average effective N_{eq} for protected operators of unsilenced pneumatics ranged from 78,7 to 97,6 dB, depending on choice of hearing protection and, to a lesser extent, operating pressure. For protected operators of silenced

Table 3.4.1e

Mean N_{eq} for unprotected and variously protected operators of three types of hand-held rockdrills : 150 minutes of development drilling

Drill Type	Operating Pressure	L_{Aeq} (dB)	Mean N_{eq} (dB) for 150 min of Development Drilling with Hearing Protection as Indicated							
			Without HPDs	With HPD 1	With HPD 2	With HPD 3	With HPD 4	With HPD 5	With HPD 6	With HPD 7
Silenced Pneumatic	400 kPa	107,7	102,8	82,1	82,9	82,8	71,7	85,6	82,2	69,3
	600 kPa	109,1	104,3	83,9	84,5	85,3	73,2	88,0	84,3	71,5
Unsilenced Pneumatic	400 kPa	115,1	110,2	90,0	90,5	92,4	79,4	95,3	91,2	78,7
	600 kPa	117,0	112,1	92,0	92,3	94,5	81,0	97,6	93,4	80,8
Water-hydraulic	17 MPa	105,6	100,7	73,6	74,2	77,7	77,3	80,4	76,2	66,2

pneumatics, N_{eq} ranged from 69,3 to 88,0 dB, with only HPD 5 failing to provide adequate protection at both operating pressures, and HPD 3 failing marginally at 600 kPa. Average effective N_{eq} for protected operators of water-hydraulic drills ranged from 66,2 to 80,4 dB. Any change in actual drilling time from the 150 minutes assumed in Table 3.4.1e would affect N_{eq}, the extent to which can be determined by referring to Table 3.4.1b.

3.4.1.3 Operator exposure based on number of holes drilled

Although N_{eq} determinations based on actual drilling time provide a more accurate and widely applicable indication of noise exposure, those based on a particular number of holes drilled can be useful in comparing machines, since drill performance is taken directly into account. However, such determinations are also directly influenced by mining conditions as they affect drilling time and, accordingly, require representative conditions. Attempts to consider N_{eq} for operators of the various types of drills on this basis failed to provide meaningful comparisons, owing to two important factors. Firstly, development drilling tests were conducted at a depth of 95 m in unfractured ground, where the pneumatic machines performed much better than they would have at typical mining depths. In the fractured ground normally encountered at depths greater than 1 000 m, the performance of the pneumatic machines would be considerably poorer than observed in the present study. In addition to the atypically high levels of performance observed for pneumatic machines, the water-hydraulic drills'

performance was adversely affected by the fact that the drill operators were less experienced with these machines than with the pneumatics, and had considerable difficulty in controlling the power of the drills and thrustlegs. It is reasonable to expect that, at the greater working depths for which the water-hydraulic machines were designed, there would have been no significant reduction in their performance in comparison with observations made during the present study. On the contrary, with operators experienced in the use of these machines, it would be reasonable to expect better performance than observed during the present study.

The combined effect of the atypically high levels of performance observed for pneumatic machines and the atypically low levels observed for water-hydraulic drills resulted in misleading comparisons between the two types of pneumatic and the water-hydraulic machines. The average values for observed drilling time and drill performance presented in Table 3.4.1f should be considered with due cognisance of their anomalous nature. In order to at least partially address this shortcoming, estimates were made for typical drilling time and drill performance. These estimated typical values, included with their corresponding observed values in Table 3.4.1f, were determined by assuming the same percentage differences in performance between stope drilling during the present study and observations from deep level production stopes (see Section 3.4.2.3). Although the basis for these estimates is far from ideal, as stated previously, no information on direct observations of drill performance in actual development ends was available, and the estimated values have been included to provide an indication of what could be more reasonably expected in deep level development ends. To avoid inaccuracies likely to result from the use of estimated typical values, it would be preferable to determine N_{eq} on the basis of actual drilling time, by establishing the time requirement for a particular number of holes by direct observation in the development situation being considered, and then referring to Table 3.4.1b.

Table 3.4.1f

Average drilling time per hole and drill performance for three types of hand-held rockdrills : development

Drill Type	Average Drilling Time Per 2,3 m x 38 mm Hole (min)*		Average Drill Performance (m/hr)*	
	Observed	Estimated Typical	Observed	Estimated Typical
Silenced Pneumatic at 600 kPa	4,18	6,97	34,13	20,47
Unsilenced Pneumatic at 600 kPa	3,87	6,45	37,83	22,91
Water-hydraulic at 17 MPa	5,76	5,07	24,49	26,50

* Observed drilling times per hole and drill performance values are not typical of deep level mining, for reasons explained in the text. Accordingly, estimated typical values are included in the table.

It will be noted that Table 3.4.1f does not consider the performance of the pneumatic machines at 400 kPa, but only at 600 kPa. The higher pressure was chosen for performance comparisons because at 400 kPa these machines were tested with the thrustlegs supplied by their respective manufacturers, while at 600 kPa all pneumatics but one were fitted with the same thrustleg. This thrustleg was selected for its ease of operation, to eliminate the effect of handling difficulties encountered with some of the other thrustlegs. Drill P-1/Ds-I, the imported machine with its own integrated thrustleg, was not fitted with the selected thrustleg, nor were the three water-hydraulic drills. The values for individual machines on which the averages in Table 3.4.1f are based have been appended in Table A-7.5, which also includes observed values for individual pneumatics operating at 400 kPa. However, the accuracy of these values was negatively influenced by the effect of handling difficulties encountered with some of the drills' thrustlegs and, accordingly, no estimated means for typical drilling time and drill performance at 400 kPa have been included in Table 3.4.1f.

The average time observed for silenced and unsilenced pneumatics at 600 kPa and for water hydraulic machines to drill one hole was used to calculate total drilling time for 20 holes and determine the corresponding operator N_{eq}. This information is presented in Table 3.4.1g, but since it is based on atypical drill performance observations, estimated typical values have been added, determined on the same basis as those in Table 3.4.1f.

Table 3.4.1g

Drilling time and N_{eq} for unprotected operators of three types of hand-held rockdrills : 20 development holes 2,3 m x 38 mm

Drill Type	min/hole	Total Time (min)	N_{eq} (dB)
Silenced Pneumatic 600 kPa: L_{Aeq} 109,1 dB			
Observed	4,18	83,6	101,6
Estimated Typical	6,97	139,4	103,9
Unsilenced Pneumatic 600 kPa: L_{Aeq} 117,0 dB			
Observed	3,87	77,4	109,1
Estimated Typical	6,45	129,0	111,5
Water-hydraulic 17 MPa: L_{Aeq} 105,6 dB			
Observed	5,76	115,2	99,6
Estimated Typical	5,07	101,4	99,0

Owing to their high levels of noise emission, unsilenced pneumatics yielded the greatest N_{eq} for 20 development holes: 109,1 dB observed/111,5 dB estimated typical (drilling times of 77,4 min. and 129,0 min., respectively). Water-hydraulic machines with their lower levels of emission, yielded the lowest N_{eq} for 20 development holes: 99,6 dB observed/99,0 dB estimated typical (drilling times of 115,2 min. and 101,4 min., respectively).

Should one wish to consider the effect on N_{eq} of any of the seven representative HPDs from Table 3.4.1c, the applicable attenuation value from Table 3.4.1d should be subtracted from the N_{eq} value in Table 3.4.1g to determine effective N_{eq} for operators completing 20 development holes. The estimated typical N_{eq} values should provide a more accurate basis for determining effective operator exposure than values based on observations during the present study.

3.4.1.4 Attenuation with increased distance from source

In order to determine the attenuation effect of increased distance from the source, a series of measurements was made at incremental distances up to a maximum of 20 m along a line perpendicular to the development face. One hole was drilled for each measuring position using drill P-2/Du, an unsilenced pneumatic development machine operating at a pressure of 600 kPa. The results are tabulated in Table 3.4.1h and presented as frequency spectra in Figure 3.4.1c. Average L_{Aeq} values ranged from a maximum of 117,5 dB at the operators' position down to 93,5 dB at a distance of 20 m. Only from 10 m and beyond did L_{Aeq} diminish to 105 dB and below for this unsilenced machine.

L_{Aeq} for the same drill at the operators' position diminished by 1,4 dB when operating pressure was reduced from 600 kPa to 400 kPa (Table A-7.1). This difference was subtracted from the observed L_{Aeq} values tabulated in Table 3.4.1h to estimate L_{Aeq} values for the lower pressure. These estimated values are included in Table 3.4.1h and presented graphically in Figure 3.4.1d. Estimated L_{Aeq} values for 400 kPa diminish to 105,4 dB at a distance of 8 m and to 103,6 dB at 10 m, indicating that L_{Aeq} would reach 105 dB at a distance of 8,5 m.

Similar estimates of average L_{Aeq} at various distances can be made for unsilenced and silenced pneumatics in the development end, on the basis of the difference between their average L_{Aeq} at the operators' position and that of drill P-2/Du for 600 kPa (refer to Table 3.4.1a). Unsilenced and silenced machines were, on average, 0,5 and 8,4 dB quieter, respectively, when operating at 600 kPa, and 2,4 and 9,8 dB quieter, respectively, at 400 kPa, in comparison with drill P-2/Du. These differences have been subtracted from the observed L_{Aeq} values in Table 3.4.1h, to estimate L_{Aeq} at various distances from unsilenced and silenced pneumatics for both operating pressures. The estimated values, which are included in Table 3.4.1h and in Figure 3.4.1d, indicate that L_{Aeq} for unsilenced and silenced pneumatics in the development end can be expected to diminish to 105 dB at a distance of 2 m and 7 m, respectively, when operating at 400 kPa, or at a distance of 3 m and 9 m, respectively, when operating at 600 kPa.

Estimated L_{Aeq} values at various distances from water-hydraulic machines (also based on the difference between their average L_{Aeq} from Table 3.4.1a and the L_{Aeq} for drill P-2/Du operating at 600 kPa) are included in Table 3.4.1h and in Figure 3.4.1d. Their average observed L_{Aeq} was 105,6 dB at the operators' position and estimated to be 100,2 dB at 4 m, indicating that L_{Aeq} for water-hydraulic machines would reach 105 dB at a distance of only 0,5 m.

Table 3.4.1h

Mean L_{pA} and L_{Aeq} values observed at the stated distance from drill P-2/Du operating at 600 kPa, with estimated L_{Aeq} values for this drill at 400 kPa and for silenced pneumatic and water-hydraulic drills : development

Frequency (Hz)	L_{pA} (dB) at Stated Distance from Operators' Position (m)						
	0	4	6	8	10	15	20
	Means Based on Observations of Drill P-2/Du at 600 kPa						
63	83,2	82,2	82,0	80,5	79,8	78,5	76,9
125	95,9	92,8	89,7	87,3	86,2	83,7	81,1
250	103,9	100,3	97,1	95,4	93,6	87,6	82,4
500	110,2	104,7	101,7	100,1	98,8	93,4	87,2
1 000	108,5	102,9	100,0	97,7	95,9	91,5	86,2
2 000	112,8	107,5	103,5	101,8	100,0	92,6	88,2
4 000	109,8	104,7	101,0	98,9	97,2	89,2	83,9
8 000	108,3	102,3	98,8	96,1	93,7	83,3	76,0
L_{Aeq} (dB)	117,5	112,1	108,7	106,8	105,0	98,7	93,5
L_{Aeq} Drill P-2/Du at 400 kPa	116,1	110,7*	107,3*	105,4*	103,6*	97,3*	92,1*
Mean L_{Aeq} Unsilenced Pneumatic Drills							
400 kPa	115,1	109,7*	106,3*	104,4*	101,2*	94,9*	89,7*
600 kPa	117,0	111,6*	108,2*	106,3*	103,1*	96,8*	91,6*
Mean L_{Aeq} Silenced Pneumatic Drills							
400 kPa	107,7	102,3*	98,9*	97,0*	95,2*	88,9*	83,7*
600 kPa	109,1	103,7*	100,3*	98,4*	96,6*	90,3*	85,1*
Mean L_{Aeq} Water-hydraulic Drills 17 MPa	105,6	100,2*	96,8*	94,9*	93,1*	86,8*	81,6*

* Estimated values

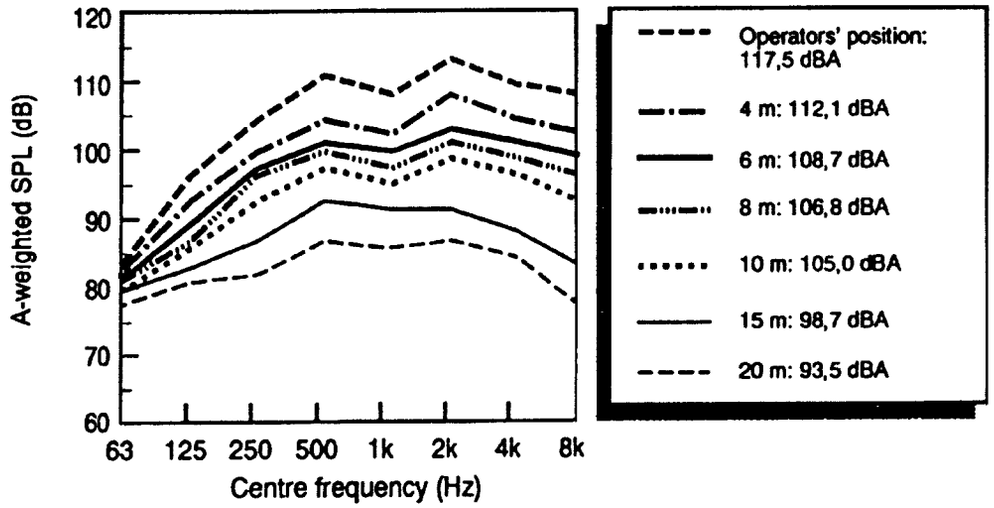

Figure 3.4.1c Frequency spectra determined at various distances from drill P-2/Du operating in the development end at 600 kPa

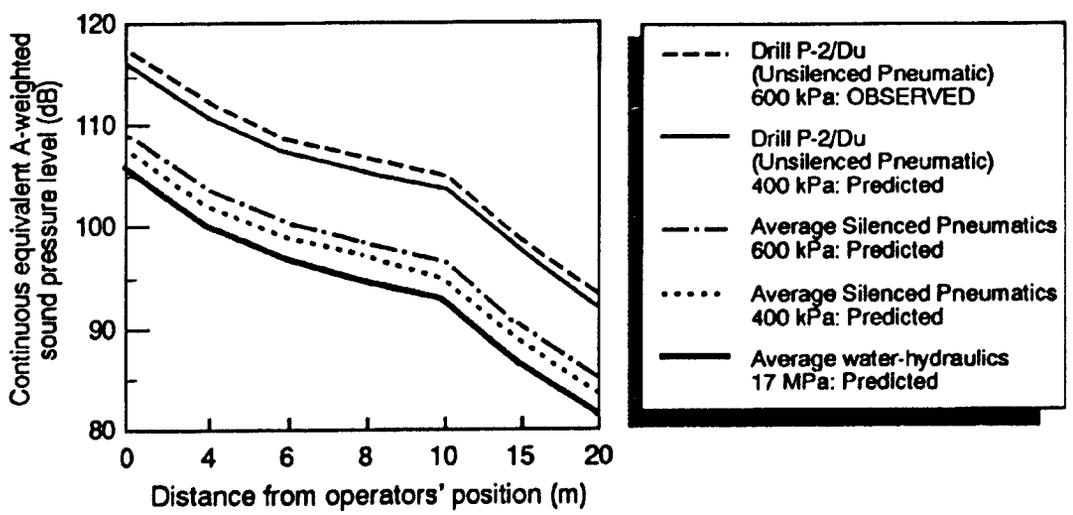

Figure 3.4.1d Estimated L_{Aeq} at various distances from three types of hand-held rockdrills : development

3.4.2 Stope drilling

Details of the test site used for stope drilling are presented in Figure 3.4.2a.

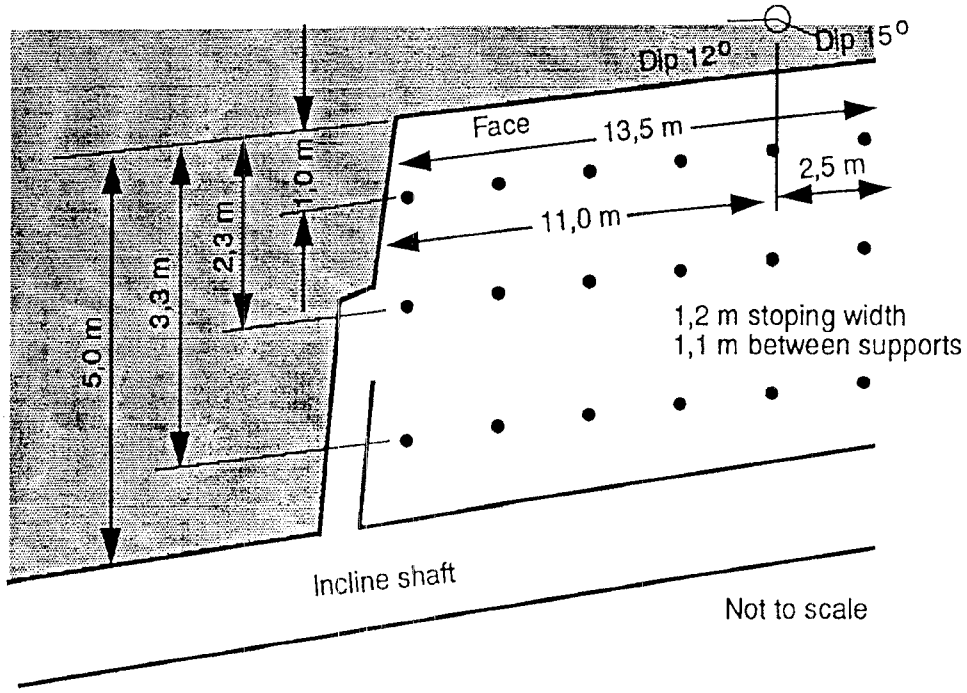

Figure 3.4.2a Site plan for stope

3.4.2.1 Noise emission and operator exposure

Mean L_{pA} values at the relevant centre frequencies and corresponding L_{Aeq} values for each type of drill and operating pressure are presented in Table 3.4.2a. These mean values are also represented as averaged spectrograms in Figure 3.4.2b. Values for individual drills on which these means are based are appended in Table A-7.6.

Table 3.4.2a

Mean L_{pA} at the given centre frequency and mean L_{Aeq} for three types of hand-held rockdrills : stoping

Drill Type	Operating Pressure	Mean L_{pA} (dB) at the Given Centre Frequency (Hz)								L_{Aeq} (dB)
		63	125	250	500	1 k	2 k	4 k	8 k	
Silenced Pneumatic	400 kPa	79,0	86,3	86,5	92,2	97,4	102,2	103,1	100,1	107,4
	600 kPa	82,6	89,4	92,9	97,0	102,3	105,5	107,3	105,0	111,6
Unsilenced Pneumatic	400 kPa	79,7	90,9	99,2	106,7	108,9	110,4	109,1	107,4	115,8
	600 kPa	88,0	98,2	103,0	109,7	111,5	113,1	112,3	111,1	118,8
Water-hydraulic	17 MPa	76,8	75,1	76,9	86,7	98,2	104,7	107,2	103,2	110,4

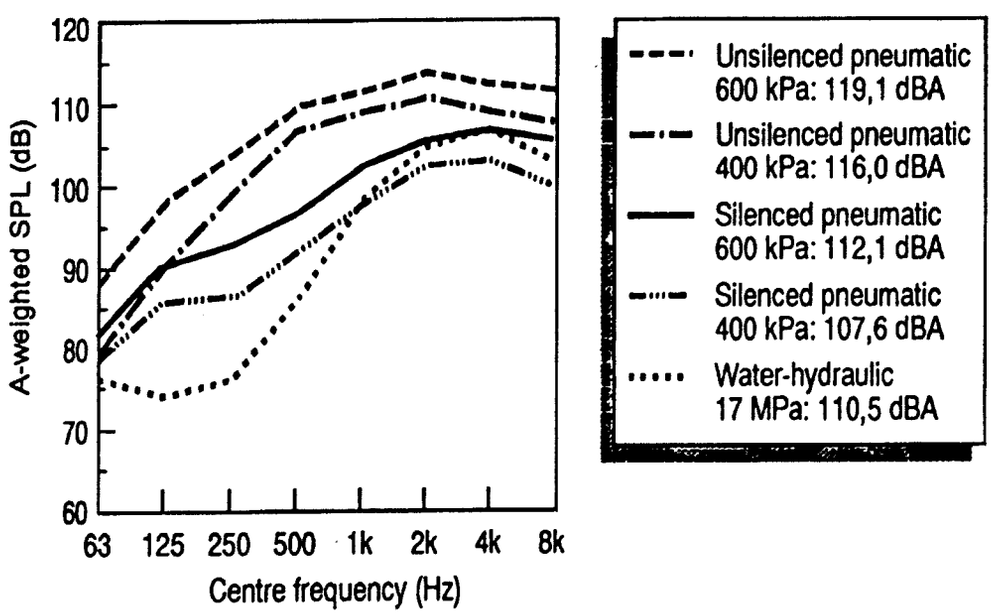

***Figure 3.4.2b** Averaged spectrograms for silenced and unsilenced pneumatic drills at 400 kPa and 600 kPa and for water-hydraulic drills at 17 MPa : stope drilling*

Noise levels in the stope followed a somewhat similar pattern to those observed in the development end. Unsilenced pneumatic drills proved loudest with mean L_{Aeq} values of 118,8 dB and 115,8 dB at 600 and 400 kPa, respectively. Corresponding values for silenced pneumatics were 111,6 dB and 107,4 dB, which compared favourably with the water-hydraulic machines' average of 110,4 dB. Water-hydraulic machines, as in development drilling, emitted most of their sound energy from 2 000 to 8 000 Hz but the pneumatic machines extended their dominant frequency spectrum by one octave beyond that observed in development, to include 8 000 Hz.

Mean calculated N_{eq} values for unprotected operators, relative to actual drilling time for each type of machine and operating pressure, are tabulated in Table 3.4.2b. Calculated N_{eq} values for individual drills on which these means are based are appended in Table A-7.7.

Table 3.4.2b

Mean N_{eq} as a function of drilling time for unprotected operators of three types of hand-held rockdrills : stoping

Drill Type	Operating Pressure	L_{Aeq} (dB)	Mean N_{eq} (dB) for Stated Drilling Time Per Shift (min)									
			30	60	90	120	150	180	210	240	270	300
Silenced	400 kPa	107,4	95,4	98,4	100,2	101,4	102,4	103,2	103,8	104,4	104,9	105,4
Pneumatic	600 kPa	111,6	99,6	102,6	104,4	105,6	106,6	107,4	108,0	108,6	109,1	109,6
Unsilenced	400 kPa	115,8	103,8	106,8	108,5	109,8	110,7	111,5	112,2	112,8	113,3	113,8
Pneumatic	600 kPa	118,8	106,8	109,8	111,6	112,8	113,8	114,6	115,2	115,8	116,3	116,8
Water-hydraulic	17 MPa	110,4	98,4	101,4	103,1	104,4	105,4	106,2	106,8	107,4	107,9	108,4

3.4.2.2 Hearing protection

The same seven representative HPDs from Table 3.4.1c considered for development drill operators have been used as examples to evaluate the potential benefits of conventional hearing protection in a stoping situation. The average overall levels of attenuation that can be expected from these devices when worn by operators of each type of drill under the conditions tested are presented in Table 3.4.2c. Attenuation values applicable to individual drills are appended in Table A-7.8. The attenuation for a HPD relevant to a particular type of drill and condition should be subtracted from the corresponding N_{eq} for a given drilling time (Table 3.4.2b) to determine operators' effective N_{eq}.

Table 3.4.2c

Attenuation provided by representative HPDs for operators of three types of hand-held rockdrills : stoping

Drill Type	Operating Pressure	Overall Attenuation (dB)* from Representative HPDs						
		HPD 1	HPD 2	HPD 3	HPD 4	HPD 5	HPD 6	HPD 7
Silenced Pneumatic	400 kPa	23,9	22,9	21,9	32,2	19,0	22,8	34,1
	600 kPa	23,6	22,8	21,3	32,5	18,7	22,5	34,3
Unsilenced Pneumatic	400 kPa	21,9	21,5	18,5	31,8	15,7	20,0	32,0
	600 kPa	21,1	20,5	18,6	31,3	15,8	19,8	32,2
Water-hydraulic	17 MPa	28,7	28,2	24,8	33,9	21,6	25,7	35,2

* Attenuation calculated on the basis of the frequency spectrum for each drill/condition (Table 3.4.2a) and the frequency-specific attenuation performance of each HPD (Table A-7.3).

A comparison of N_{eq} is made between unprotected and variously protected operators of the three types of drills in Table 3.4.2d. The comparison assumes a uniform drilling time of 150 minutes per shift for each of the various types of machines. Average effective N_{eq} for protected operators of unsilenced pneumatics ranged from 78,7 to 98,0 dB, depending on choice of hearing protection and, to a lesser extent, operating pressure. For operators of silenced pneumatics the range was from 68,3 to 87,9 dB, with five of the seven HPDs yielding an effective N_{eq} below 85 dB regardless of operating pressure. The two remaining HPDs would fail to provide adequate protection at a pressure of 600 kPa but would be adequate at 400 kPa. The average effective N_{eq} for protected operators of water-hydraulic drills ranged from 70,2 to 83,8 dB. Any change in drilling time from the 150 minutes assumed in Table 3.4.2d would alter effective N_{eq}, the extent to which can be determined by referring to Table 3.4.2b.

Table 3.4.2d

Mean N_{eq} for unprotected and variously protected operators of three types of hand-held rockdrills : 150 minutes of stope drilling

Drill Type	Operating Pressure	L_{Aeq} (dB)	Mean N_{eq} (dB) for 150 min of Stope Drilling with Hearing Protection as Indicated							
			Without HPDs	With HPD 1	With HPD 2	With HPD 3	With HPD 4	With HPD 5	With HPD 6	With HPD 7
Silenced Pneumatic	400 kPa	107,4	102,4	78,5	79,5	80,5	70,2	83,4	79,6	68,3
	600 kPa	111,6	106,6	83,0	83,8	85,3	74,1	87,9	84,1	72,3
Unsilenced Pneumatic	400 kPa	115,8	110,7	88,8	89,2	92,2	78,9	95,0	90,7	78,7
	600 kPa	118,8	113,8	92,7	93,3	95,2	82,5	98,0	94,0	81,6
Water-hydraulic	17 MPa	110,4	105,4	76,7	77,2	80,6	71,5	83,8	79,7	70,2

3.4.2.3 Operator exposure based on number of holes drilled

A comparison was made of N_{eq} for operators of the various types of machines in a stoping situation, based on the completion of 35 holes. An operating pressure of 600 kPa was assumed for pneumatic drills (since all pneumatics were fitted with the identical thrustleg when tested at this pressure) and 17 MPa for water-hydraulic machines. The atypical levels of drill performance observed during the present study necessitated the inclusion of additional information obtained during observations in deep level stopes, as explained below.

The average time for each type of drill to complete a 1,2 m x 36 mm hole during the present study and in deep level stopes is presented in Table 3.4.2e, along with corresponding drill performance values. Means from the present study are based on observations of individual drills (appended in Table A-7.9), while means from deep level stopes are based on observations made in representative production stopes. These values were used to calculate drilling time for 35 holes and corresponding operator N_{eq}, as listed in Table 3.4.2f. As a result of their high noise emission, unsilenced pneumatic drills yielded the highest average N_{eq}, while average N_{eq} for silenced pneumatics was less, even though their average drilling time was longer. As one would expect, the water-hydraulic machines yielded the lowest average N_{eq}, even when based on the atypically long average drilling time from the present study. The findings of van Rensburg et al. (1989) would lead one to expect hydraulically powered drills to outperform pneumatics. The anomalies observed during the present study are, as stated in Section 3.4.1.3, attributable to the fact that drilling was in unfractured ground, which enhanced the performance of pneumatic drills, and to the operators' inability to effectively control the thrustlegs of the more powerful water-hydraulic machines, which reduced the performance of these drills. At greater depths and with seasoned operators, the expected improvement in performance from these machines would reduce drilling times and, for the same number of holes, result in a lower N_{eq} than that indicated for the present study in Table 3.4.2f.

It was for this reason, and to more accurately compare operator N_{eq} based on number of holes drilled, that information was obtained on drill performance in representative deep level stoping operations. This previously unpublished information was extracted from records of COMRO studies undertaken during the development of the water-hydraulic rockdrill (Hind, 1995). They were conducted at depths ranging from 1,8 to 2,4 km below surface, the average depth being 2,2 km. Observations were made for more than 47 000 stoping holes drilled with two models of water-hydraulic machines operating at 16-18 MPa, and approximately 750 holes drilled with various models of unsilenced pneumatics operating at 550 kPa.

Observed drilling times were corrected to standardize blast hole depth to 1,2 m. No correction for the 50 kPa difference in operating pressure (as compared with 600 kPa for the present study) was applied to L_{Aeq} values, i.e., the L_{Aeq} values observed during the present study were applied in determining N_{eq} values for deep level stopes. Mean values for drill performance and time required to drill one hole in the deep level stopes have been included in Table 3.4.2e, and calculated drilling times for 35 holes and resultant N_{eq} values are included in Table 3.4.2f. No silenced pneumatic drills were observed during these deep level studies, making it necessary to estimate performance values on the basis of the performance of unsilenced machines in deep level stopes, and the losses in performance observed for silenced machines (as compared with unsilenced drills) during the present study.

Observations and estimates of drill performance in deep level stopes yielded N_{eq} values that range from 0,6 dB less for water-hydraulic machines, to 2,2 dB and 2,3 dB greater for silenced and unsilenced pneumatics, respectively, in comparison with values derived from the present study.

Table 3.4.2e

Average drilling time per hole and drill performance for three types of hand-held rockdrills : stoping

Drill Type	Average Time Required to Drill One Hole 1,2 m x 36 mm (min)		Average Drill Performance (m/hr)	
	Present Study	Deep Stopes	Present Study	Deep Stopes
Silenced Pneumatic	3,97	6,62*	18,49	11,09*
Unsilenced Pneumatic	3,16	5,27	22,89	13,86
Water-hydraulic	3,50	3,08	20,59	22,28

* Estimates for silenced drills in deep level stopes are based on performance comparisons of silenced with unsilenced pneumatic machines from the present study, and on observations of unsilenced machines in deep level stopes.

Table 3.4.2f

Drilling time and N_{eq} for unprotected operators of three types of hand-held rockdrills : 35 stoping holes 1,2 m x 36 mm

Drill Type	min/hole	Total Time (min)	N_{eq} (dB)
Silenced Pneumatic: L_{Aeq} 111,6 dB			
Present Study	3,97	138,9	106,2
Deep Level Stopes	6,62*	231,7	108,4
Unsilenced Pneumatic: L_{Aeq} 118,8 dB			
Present Study	3,16	110,6	112,4
Deep Level Stopes	5,27	184,5	114,7
Water-hydraulic: L_{Aeq} 110,4 dB			
Present Study	3,50	122,5	104,5
Deep Level Stopes	3,08	107,8	103,9

* Estimated value.

Should one wish to consider the effect on N_{eq} of any of the seven representative HPDs from Table 3.4.1c, the applicable attenuation value from Table 3.4.2c should be subtracted from the N_{eq} value in Table 3.4.2f to determine effective N_{eq}. For reasons explained in the preceding paragraphs, the N_{eq} value used from Table 3.4.2f should be that based on observations in deep level stopes, where drill performance and drilling time can be regarded as more representative than values derived from the present study.

3.4.2.4 Attenuation with increased distance from source

In order to determine the attenuation effect of increased distance from the source, a series of measurements was made at incremental distances from the operators' position up to a maximum of 10 m, along a line parallel to the stope face. One hole was drilled for each position, using drill P-3/DSs, a silenced, dual-purpose pneumatic machine, operating at a pressure of 600 kPa. The results are tabulated in Table 3.4.2g and presented as frequency spectra in Figure 3.4.2c. Average L_{Aeq} values ranged from a maximum of 113,3 dB at the operators' position down to 94,2 dB at a distance of 10 m. Only at a distance of 4 m and beyond did L_{Aeq} diminish to 105 dB and below for this silenced pneumatic drill. The L_{Aeq} for this particular machine measured at the operators' position was 5,6 dB lower when the operating pressure was reduced from 600 kPa to 400 kPa (Table A-7.6), a difference that can be expected at other distances as well. Accordingly, Table 3.4.2g includes estimated L_{Aeq} values for various distances from this drill at the lower operating pressure. Estimated L_{Aeq} for this machine operating at 400 kPa diminishes to below 105 dB at a distance of only 1 m, as indicated in Figure 3.4.2d.

Similar estimates of average L_{Aeq} at various distances can be made for silenced and unsilenced pneumatics, on the basis of the difference between their average L_{Aeq} at the operators' position and that of drill P-3/DSs for 600 kPa (refer to Table 3.4.2a). The silenced machines were, on average, 0,3 dB and 1,7 dB quieter than drill P-3/DSs for operating pressures of 400 kPa and 600 kPa, respectively. Unsilenced machines were, on average, 8,1 dB louder when operating at 400 kPa and 11,1 dB louder at 600 kPa, as compared with drill P-3/DSs. These differences have been added to or subtracted from (as appropriate) the observed L_{Aeq} values in Table 3.4.2g, to estimate L_{Aeq} at various distances from silenced and unsilenced pneumatics for both operating pressures. These estimated values are included in Table 3.4.2g and Figure 3.4.2d. This exercise indicates that L_{Aeq} for silenced pneumatics would diminish to 105 dB at average distances of approximately 0,6 m and 2,6 m for operating pressures of 400 kPa and 600 kPa, respectively. L_{Aeq} for unsilenced pneumatics can only be expected to diminish to 105 dB at an average distance of 5 m when operating at 400 kPa, or at 7 m for a pressure of 600 kPa.

Estimated L_{Aeq} values for various distances from water-hydraulic machines (also based on the difference between their average L_{Aeq} from Table 3.4.2a and the L_{Aeq} for drill P-3/DSs operating at 600 kPa) are included in Table 3.4.2g and Figure 3.4.2d. They diminish to 105,1 dB at a distance of 2 m and to 103,4 dB at 3 m.

Table 3.4.2g

Mean L_{pA} and L_{Aeq} values observed at the stated distance from drill P-3/DSs operating at 600 kPa with estimated L_{Aeq} values for this drill at 400 kPa and for unsilenced pneumatic and water-hydraulic drills : stoping

Frequency (Hz)	L_{pA} (dB) at Stated Distance from Operators' Position (m)							
	0	1	2	3	4	5	7	10
	Means Based on Observations of Drill P-3/DSs at 600 kPa							
63	83,7	81,8	80,5	79,4	78,3	77,4	77,0	76,7
125	92,4	90,6	89,0	87,5	86,4	84,6	83,2	81,8
250	95,9	94,9	93,2	91,4	90,5	89,3	88,1	86,9
500	100,9	100,5	99,8	98,6	97,7	94,5	90,4	85,8
1000	106,7	103,5	102,2	100,8	99,8	96,6	91,3	86,1
2000	106,8	103,0	101,0	99,0	97,0	95,2	91,1	87,0
4000	108,6	103,3	101,1	99,1	97,2	95,0	91,0	87,0
8000	104,6	100,5	99,1	97,4	96,2	94,5	88,3	82,1
L_{Aeq}	113,3	109,6	108,0	106,3	105,0	102,5	98,2	94,2
Mean L_{Aeq} for Drill P-3/DSs at 400 kPa	107,7	104,0*	102,4*	100,7*	99,4*	96,9*	92,6*	88,6*
Mean L_{Aeq} for Silenced Pneumatic Drills								
400 kPa	107,4	103,7*	102,1*	100,4*	99,1*	96,6*	92,3*	86,3*
600 kPa	111,6	107,9*	106,3*	104,6*	103,3*	100,8*	96,5*	92,5*
Mean L_{Aeq} for Unsilenced Pneumatic Drills								
400 kPa	115,8	112,1*	110,5*	108,8*	107,5*	105,0*	100,7*	96,7*
600 kPa	118,8	115,1*	113,5*	111,8*	110,5*	108,0*	103,7*	99,7*
Mean L_{Aeq} Water-hydraulic Drills 17 MPa	110,4	106,7*	105,1*	103,4*	102,1*	99,6*	95,3*	91,3*

* Estimated values.

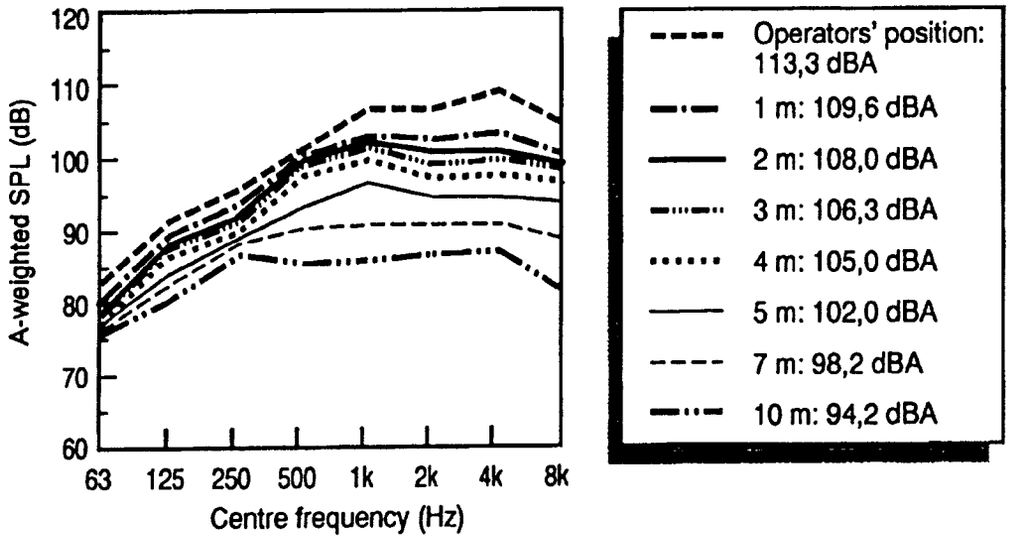

Figure 3.4.2c Frequency spectra determined at various distances from drill P-3/DSs operating in the stope at 600 kPa

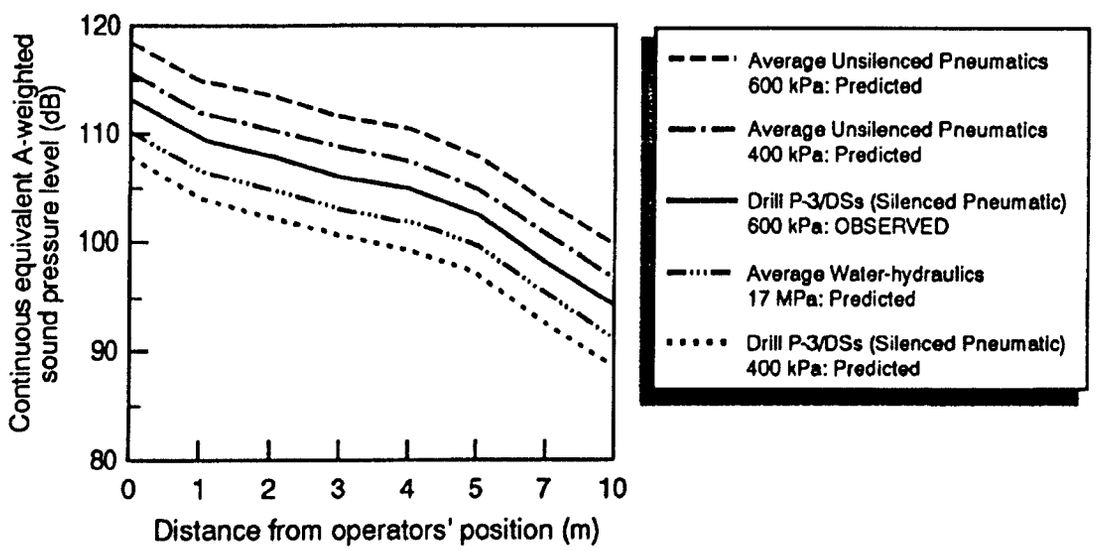

Figure 3.4.2d Estimated L_{Aeq} at various distances from three types of hand-held rockdrills : stoping

3.5 Warning signals

In order to determine the frequency spectra for a range of commonly used signalling devices, a number of manufacturers were asked to provide samples of their products for testing. Although most of these devices or their accompanying literature provided an indication of A-weighted sound level (normally determined in a free-field at a distance of 1 m) frequency spectra were not specified. A total of 21 signalling devices were tested, which could be categorized into six groups. There were electronic sounders (in three sub-groups according to their relative size and output), electronic and electro-mechanical sirens, "Klaxon-type" hooters, electro-magnetic buzzers and station bells. The decision to conduct the testing underground was based on the need to characterize the devices' frequency spectra under conditions that approach those of actual use in mining.

The results summarized in Table 3.5 consist of mean values for L_{pA} and L_{Aeq} determined by frequency analysis at various distances from the signalling devices. Data for devices of common type were logarithmically averaged in order to determine mean L_{pA} values at various distances, upstream and downstream relative to the intake ventilation. Air velocity in the intake haulage where tests were conducted ranged from 4,2 - 4,6 m/sec and did not noticeably affect L_{pA} until greater distances (> 50 m) were reached. Differences between upstream and downstream results would be significant in a return air haulage where velocity is greater.

Most of the devices tested produced their greatest output at 1-2 kHz, while station bells reached their highest levels at 8 kHz. Large electronic sounders emitted their greatest sound pressure at 1 kHz, as did electronic sirens and "Klaxon-type" hooters. The strongest signals in the 2 kHz octave band were produced by medium electronic sounders, electro-mechanical sirens and electro-magnetic buzzers. Although most devices' emission spectra displayed a peak at one centre frequency that was, to a greater or lesser extent, distinct from emissions at adjacent frequencies, all devices except the medium electronic sounders generated significant sound pressures at adjacent octave bands.

L_{pA} values in Table 3.5 that exceed 95 dB have been emboldened. Among the eight types of devices tabulated, seven produced significant sound pressures at more than one centre frequency. Secondary peaks were one octave higher for large and small electronic sounders, electronic sirens and station bells. Electro-mechanical sirens and electro-magnetic buzzers had secondary peaks at higher and lower frequency bands, enabling them to produce significant signal levels across three octaves. The "Klaxon-type" hooters were unique in that they emitted distinctly strong signals at two centre frequencies (1 kHz and 4 kHz). This

Table 3.5

Mean L_{pA} and L_{Aeq} at increasing distances from various signalling devices

Device Type	Distance (m)	Mean L_{pA} (dB) at the Given Centre Frequency (Hz)							L_{Aeq} (dB)
		125	250	500	1 k	2 k	4 k	8 k	
Large Electronic Sounders (n=6)	1	56,8	54,2	77,8	111,5	109,5	92,7	79,6	113,7
	3	55,0	52,5	75,7	101,6	99,5	91,3	69,4	103,9
	7	54,2	51,5	73,2	98,8	98,3	90,5	66,4	101,9
	20	46,1	41,4	67,3	95,1	87,1	76,1	54,5	95,8
	50	38,3	35,5	56,5	83,2	77,3	68,9	39,5	84,3
Medium Electronic Sounders (n=3)	1	55,8	48,7	52,2	89,5	101,1	94,1	67,3	102,2
	3	54,0	48,4	46,7	86,7	95,8	83,5	54,8	96,5
	7	52,1	47,6	45,9	85,8	93,4	79,1	47,9	94,2
	20	48,0	38,9	39,9	80,9	92,2	76,9	45,7	92,7
	50	39,2	30,6	25,8	70,6	79,6	62.6	33,4	80,2
Small Electronic Sounders (n=2)	1	53,4	54,5	43,5	62,0	93,8	95,8	67,4	97,9
	3	53,2	43,5	43,5	60,5	89,8	94,1	60,4	95,5
	7	53,0	43,5	43,5	60,1	88,0	87,8	57,5	90,9
	20	47,1	33,4	33,4	58,4	80,5	79,9	52,2	83,2
	50	40,3	30,1	33,4	52,7	64,8	67,6	35,4	69,5
Electronic Sirens (n=2)	1	65,8	63,9	76,9	106,9	104,4	89,0	72,6	108,8
	3	55,1	47,8	74,7	104,1	96,1	82,1	61,4	104,7
	7	55,0	43,7	71,8	103,5	93,8	78,1	53,1	103,9
	20	48,5	43,5	69,6	97,4	88,4	71,8	48,9	97,9
	50	37,6	43,4	58,2	81,3	76,2	64,2	40,5	82,6
Electro-mechanical Sirens (n=2)	1	55,9	52,7	68,9	100,1	107,9	100,2	73,3	109,2
	3	54,7	50,8	65,2	93,6	103,8	97,1	62,1	105,0
	7	50,2	44,2	57,0	89,1	93,2	94,6	58,6	97,6
	20	47,6	43,5	54,7	79,2	92,8	86,0	49,0	93,8
	50	39,5	40,5	38,5	63,8	84,5	70,0	37,9	84,7
Klaxon-type Hooters (n=2)	1	61,8	73,8	103,6	112,1	99,4	110,5	97,9	114,9
	3	56,7	71,3	97,8	111,1	97,2	105,2	92,7	112,5
	7	54,5	70,2	96,9	106,4	95,3	102,2	88,2	108,4
	20	47,5	63,0	92,1	100,6	87,4	91,8	77,6	101,8
	50	40,6	61,5	85,0	85,4	73,3	81,9	68,3	89,3
Electro-magnetic Buzzers (n=2)	1	55,7	79,2	84,2	104,4	108,2	99,9	90,5	110,2
	3	55,7	78,2	81,9	97,3	104,6	96,1	84,5	105,9
	7	55,1	73,3	80,0	94,2	102,2	92,5	80,2	103,3
	20	46,5	71,0	74,1	87,6	95,9	86,2	72,6	97,0
	50	40,8	59,2	64,7	78,9	80,8	71,1	54,4	83,3
Station Bells (n=2)	1	57,4	62,8	73,3	73,1	90,1	100,0	102,2	104,4
	3	55,2	60,6	70,8	70,5	87,2	95,8	98,6	100,6
	7	54,5	58,1	69,0	68,2	82,4	86,5	87,4	90,7
	20	45,7	54,1	68,5	63,4	76,7	79,8	82,7	85,3
	50	38,2	48,0	53,0	51,5	60,0	59,3	65,5	67,6

together with the fact that a strong secondary signal was produced at adjacent frequencies on both sides of the two primary signals enabled these devices to produce a strong signal across five octave bands.

Figure 3.5a compares mean L_{Aeq} for the three classes of electronic sounders relative to distance from the source, while Figures 3.5b, 3.5c and 3.5d illustrate mean L_{pA} and L_{Aeq} at various distances for large, medium and small electronic sounders, respectively. The reference line at 95 dB (85 + 10) provides an empirical indicator for comparing relative audibility where noise levels reach 85 dB. Figures 3.5b-3.5d employ broken lines to depict L_{pA} at frequencies outside the devices' range of significant signal output.

L_{Aeq} values for the remaining devices are compared relative to distance in Figure 3.5e, while Figures 3.5f to 3.5j depict their means for L_{pA} and L_{Aeq} at various distances. These figures apply the same notation conventions as Figures 3.5a and 3.5b-3.5d.

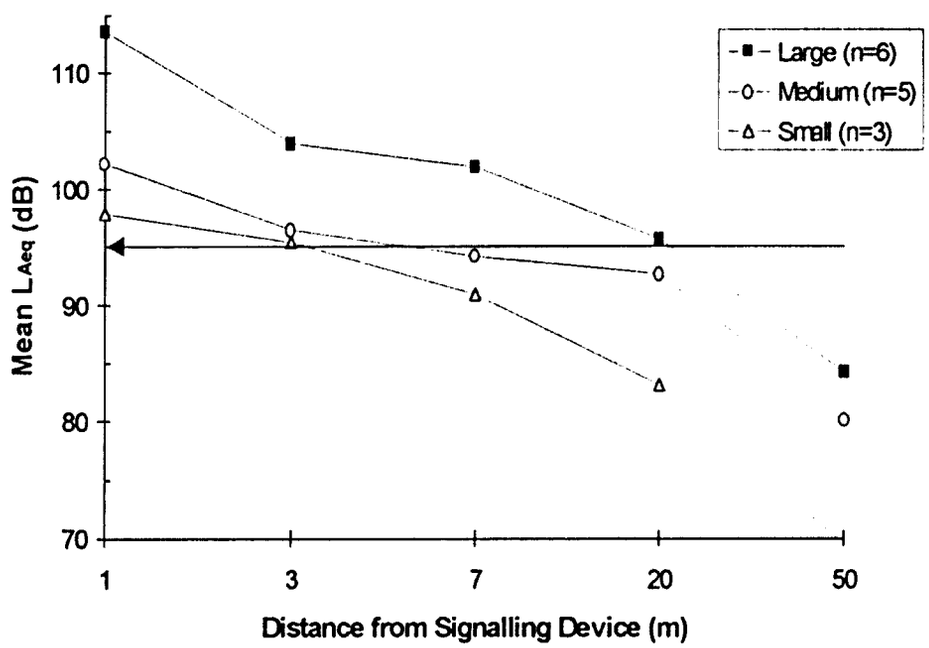

Figure 3.5a Mean L_{Aeq} at various distances from electronic sounders

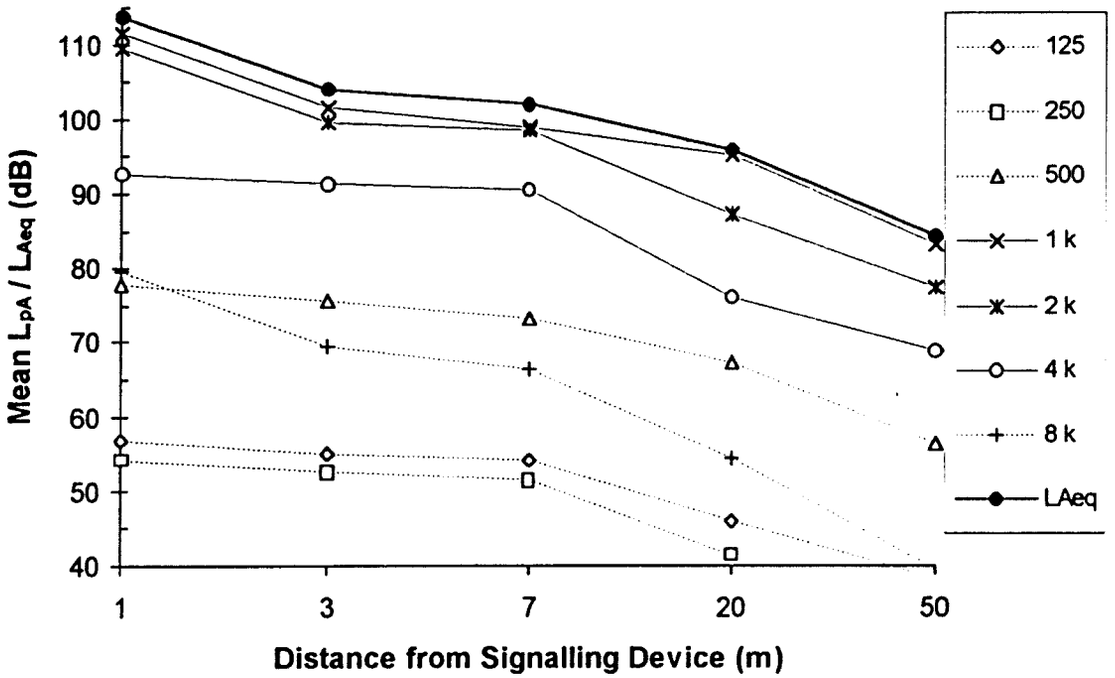

Figure 3.5b Mean L_{pA} and L_{Aeq} at various distances from large electronic sounders

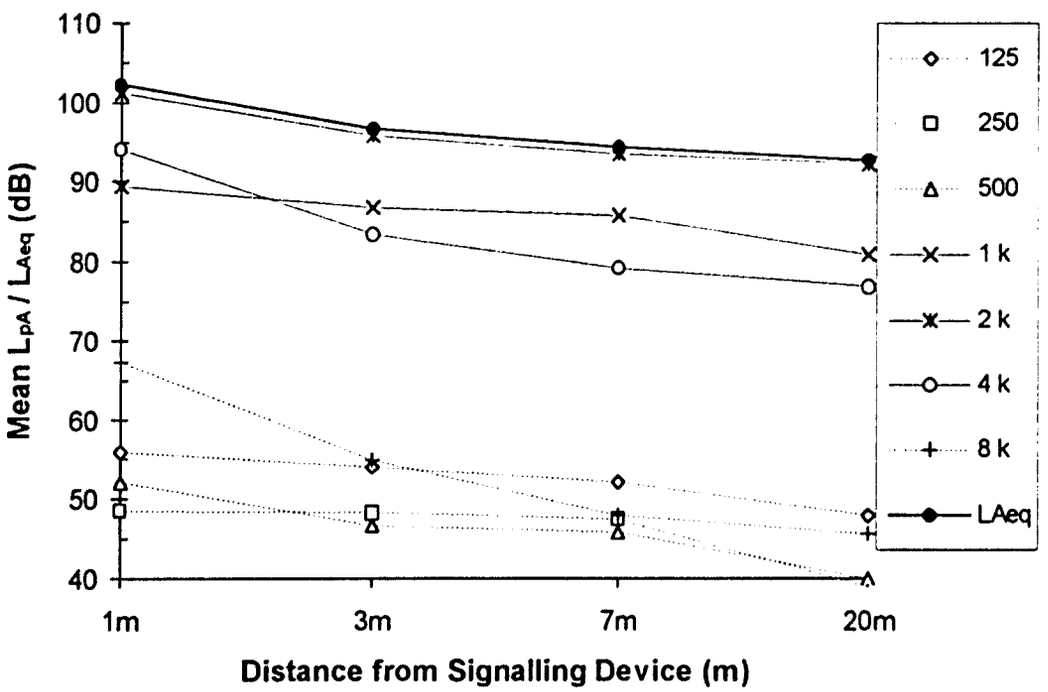

Figure 3.5c Mean L_{pA} and L_{Aeq} at various distances from medium electronic sounders

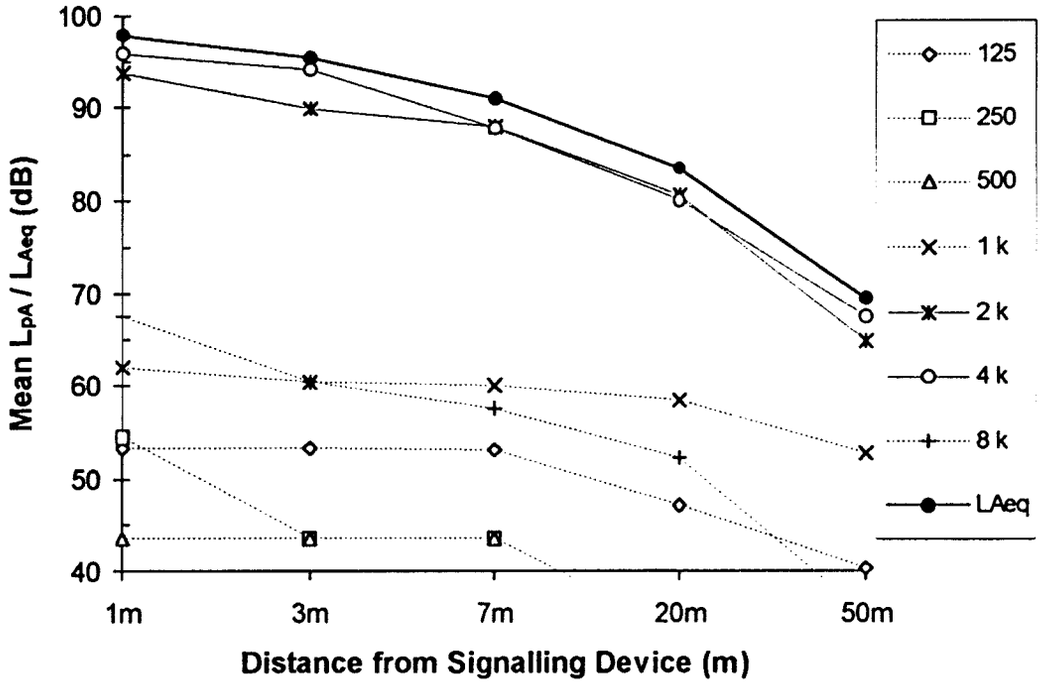

Figure 3.5d Mean L_{pA} and L_{Aeq} at various distances from small electronic sounders

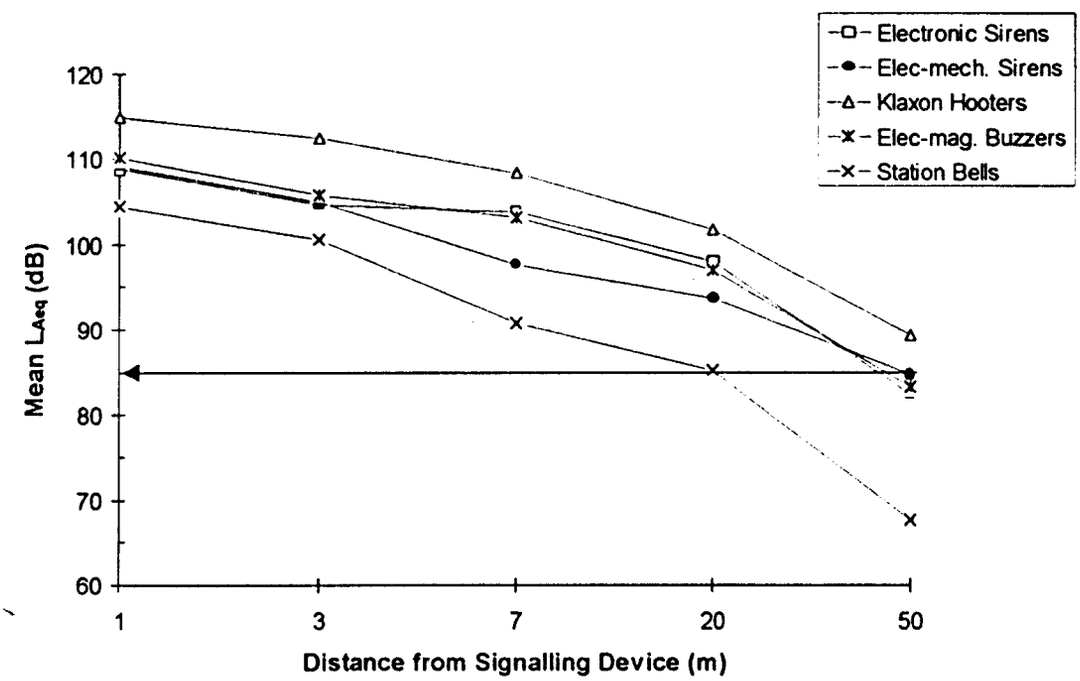

Figure 3.5e Mean L_{Aeq} at various distances from miscellaneous signalling devices

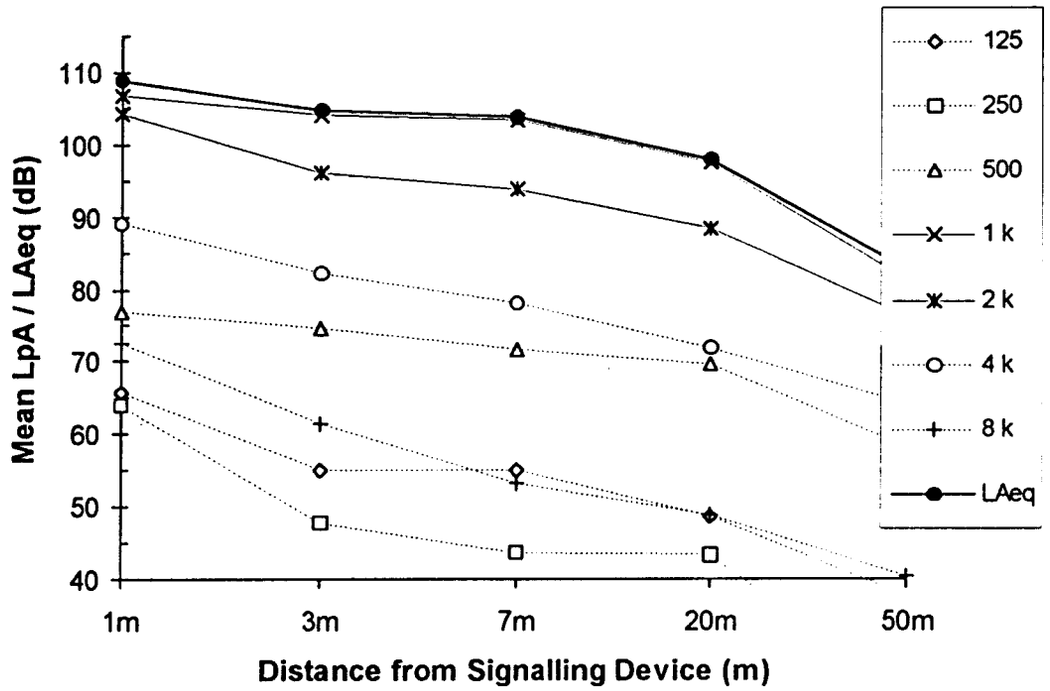

Figure 3.5f Mean L_{pA} and L_{Aeq} at various distances from electronic sirens

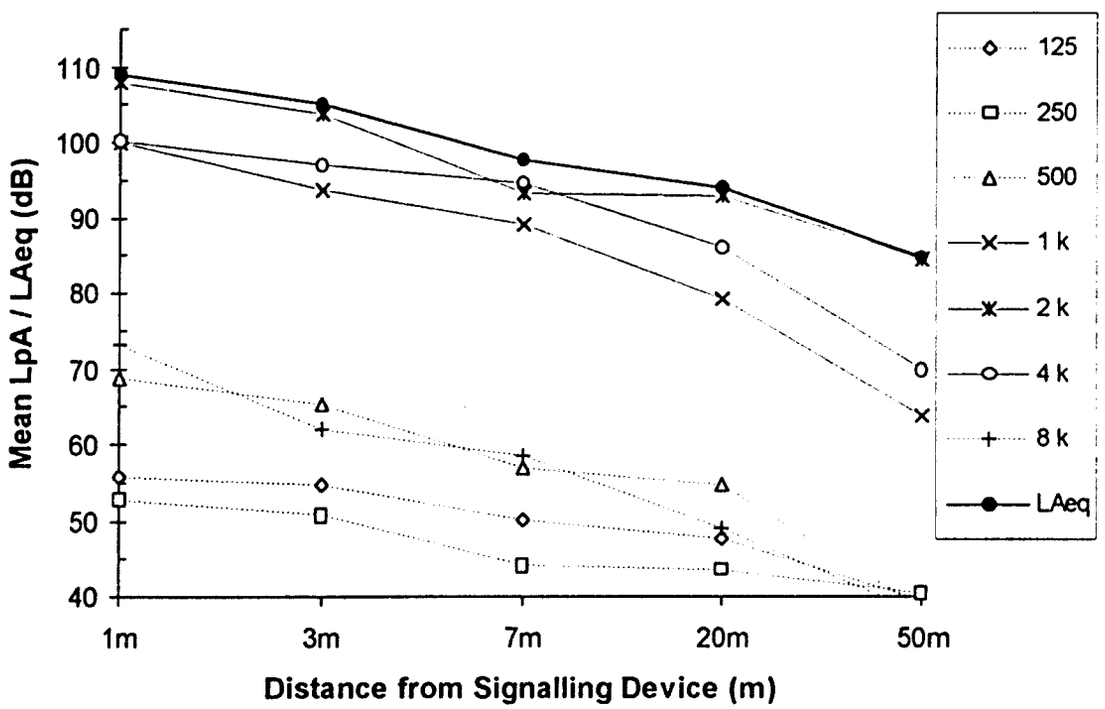

Figure 3.5g Mean L_{pA} and L_{Aeq} at various distances from electro-mechanical sirens

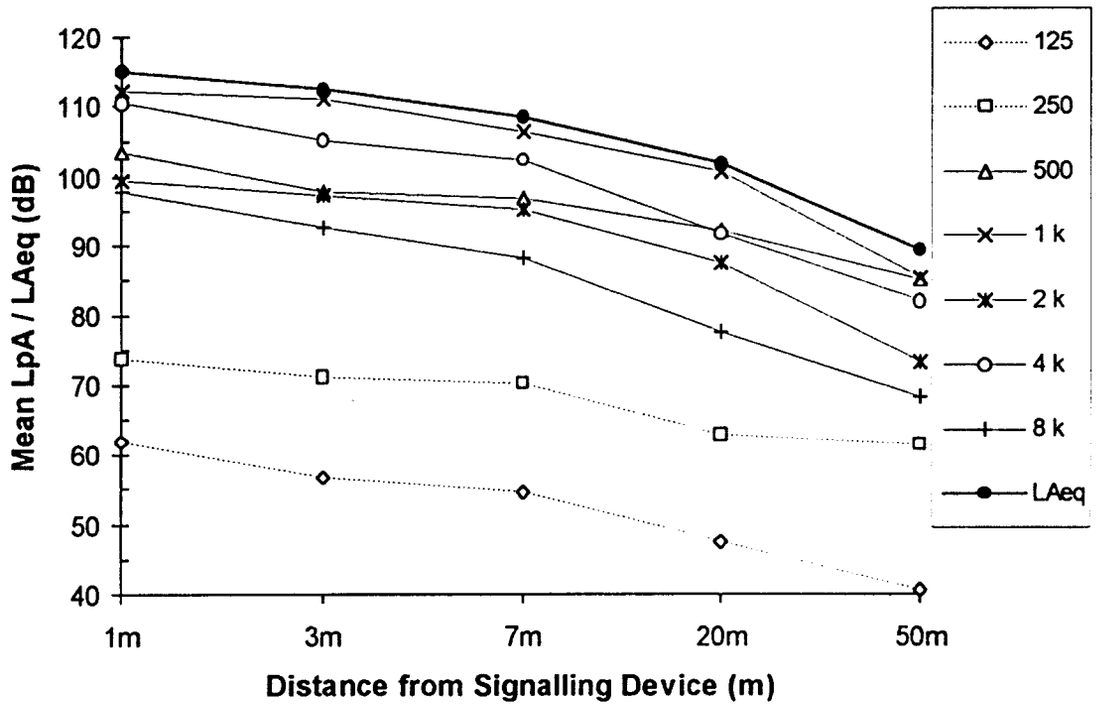

Figure 3.5h Mean L_{pA} and L_{Aeq} at various distances from Klaxon-type hooters

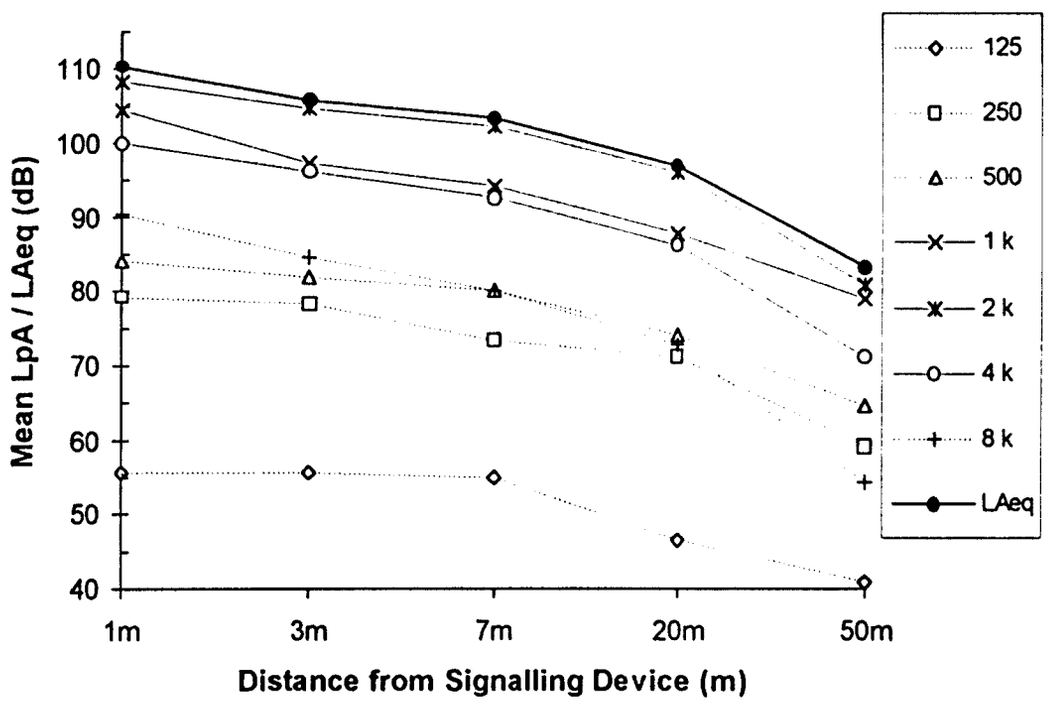

Figure 3.5i Mean L_{pA} and L_{Aeq} at various distances from electro-magnetic buzzers

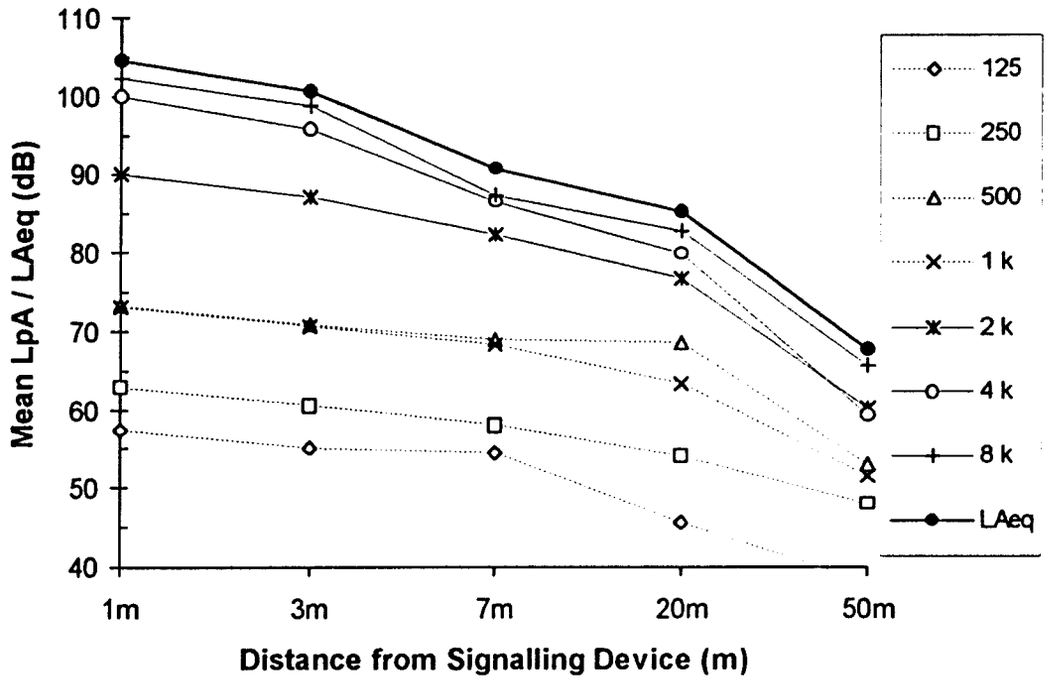

Figure 3.5j Mean L_{pA} and L_{Aeq} at various distances from station bells

3.6 Additional enabling outputs for use in mines' HCPs

3.6.1 Educational/motivational materials

3.6.1.1 Video programmes

The unavailability of video programmes which would be regarded as relevant by local mineworkers, together with the need to increase workers' awareness and understanding of the noise hazard, necessitated the local production of a video programme within the mining context. Footage of various mining operations was used for visual impact, while an on-screen presenter in the role of a team leader was used for addressing important points of information and providing explanations. In addition, graphic animations were employed to illustrate certain explanations, e.g. the mechanism by which loud noise damages the inner ear and the effect of a poorly fitted earplug.

A professional script writer was commissioned to produce a script, which served as the basis for the programme. In addition, valuable input to ensure effectiveness was provided at various stages of the production by committees within the SIMRAC system. The draft English language version was screened to groups of trainees from three mines over a period of several weeks, in order to identify areas for improvement. Feedback thus obtained was incorporated into the final edit before applying the professional sound mix with effects and music.

The programme was produced in two modules, in order to provide for different training needs and possible time constraints during training and induction. The first module is educational and motivational in nature and aimed at raising awareness and understanding. Personal relevance to workers regarding the consequences of hearing loss was a major thrust of the programme and, accordingly, interviews with hearing impaired workers and affected family members are utilized. Practical means are described for recognising situations where HPDs should be used, and the advantages of doing so are explained. The run-time for the educational/motivational module is approximately 15 minutes.

The HPD training module assumes a certain level of existing audience awareness of the noise hazard, but does specifically reinforce the major points of the first module. This part of the video programme could be characterized as the "how to" of personal protection against noise. It considers the various types of HPDs that are available and examines the advantages and disadvantages of each, relative to the user's work environment and the nature of his duties. The correct use and care of each type of HPD are explained by the presenter and illustrated with on-camera demonstrations.

In order to take advantage of the dichotomous structure of the video programme and facilitate the trainer's role, the modules were recorded onto separate VHS cassettes. The intention was to enable the convenient use of either or both modules, in accordance with audience needs and available time.

To reinforce personal relevance and improve audience acceptance, two versions for the major types of mining were produced, viz. coal and gold/platinum. Although there are minor differences in content between the two, the major distinction is in the visual material depicting mining operations and equipment.

The importance of language in conveying an important message is obvious and it was for this reason that more than one language version was produced. However, budget constraints limited these to two, and English and Zulu were chosen for their combined potential to reach the majority of mineworkers. Nevertheless, some trainers have expressed interest in obtaining other language versions, including but certainly not limited to Xhosa, Tswana, South and North Sotho, Shangaan and Fanakalo. With regard to the latter, although unacceptable in terms of socio-political considerations and the limitations of the language in dealing with complex issues, some would argue that the challenges of communicating with a diverse workforce can best be met through a common medium. Initiatives aimed at improving workers' competency in other languages will eventually prove beneficial but in the interim, there is a need to convey the message by any means available. Some trainers have gone so far as to screen the video with the sound turned off, while reading a Fanakalo translation of the script (Section 3.6.1.2) aloud to the group. While this provides for certain workers' language limitations, it is not an ideal means of communicating important information. If it were deemed advantageous (as a number of trainers have already indicated), the production of additional language versions could increase audience reach and improve workers' appreciation of the noise hazard.

3.6.1.2 Handouts for trainees

The use of training material that trainees can retain as their own offers the advantage of continued learning beyond the confines of the lecture room. Not only are trainees able to review the material at their leisure and reconsider issues of concern, but they can also share the material with others who may not have attended a structured training or induction session. Effective training material should elicit further interest and precipitate discussion among those who are exposed to it. For these reasons handouts for trainees were produced as a means of supplementing structured training sessions. Like the video, the handouts were produced in English and Zulu.

The handouts consist of a 16 page A-5 landscape booklet, in what might be termed a "comic book" format, and incorporate an "off-panel presenter" modelled after the presenter in the video programme described above. The illustrated format was chosen for its potential to combine visual and textual information in a way that reaches people across a broad range of literacy levels, without alienating the more skilled reader.

The booklet introduces noise as a hazard and illustrates the ensuing impact of noise-induced hearing loss on a worker who disregards the use of hearing protection. It also points out the benefits of using HPDs in loud noise. The various types of HPDs are examined and their advantages and disadvantages considered, with illustrations of how a badly-fitted earplug affords insufficient protection. Detailed instructions in the use and care of each type of HPD are provided, along with safety and hygiene tips for users of earplugs.

3.6.1.3 Guidelines for trainers

In order to contribute to the effectiveness of training with regard to the noise hazard, a 4-part series of guidelines for trainers was produced and these are appended (Appendix 8). Part 1 is entitled "Hearing Protection Devices : Induction talk for Employees in Noisy Occupations." It is essentially a suggested script for induction talks with training objectives and notes for presenters, intended to enable a higher level of performance by trainers. It makes reference to overhead transparencies (Appendix 8) which are provided with the guidelines for use during presentations. The topics covered include the recognition of dangerous noise, types of HPDs, their correct use and care, and adapting to HPDs. A suggested learning activity is outlined for demonstrating the ability of HPDs to improve speech discrimination in loud nose, and an introduction to audiometry is provided. This final topic was included to explain the purpose of audiometry and instruct workers on how to respond during audiometric testing.

Part 2 of the guidelines for trainers was designed to enable optimal use of the video programme described above. It includes training objectives and learning outcomes for the video, and guidance for facilitating pre- and post-screening group discussions on noise and the benefits of hearing protection. In order that the trainer can better prepare himself and the group for discussions intended to reinforce the message of the video, hard copies of the video's English and Zulu scripts are included in the guidelines.

Part 3 of the guidelines is intended to assist the trainer in dealing with the negative attitudes and beliefs that workers often hold regarding hearing protection. Following a general introduction for trainers, the questions, concerns and objections commonly raised by workers with regard to HPDs are presented, along with suggestions for resolving them. It is envisaged

that such issues would be raised during training or induction sessions, and it is suggested that the trainer assume a facilitating role rather than lecturing the group, in order to elicit participation in arriving at a favourable group consensus.

The final volume of the guidelines for trainers, Part 4, is intended to maximize benefits from the use of the handout for trainees described in the preceding Section (3.6.1.2). The introduction provides the trainer with general information relating to handouts for trainees and introduces the topics dealt with therein. Three different strategies for introducing the handouts are discussed, along with criteria for selecting the one most appropriate for a given group of trainees. The notes for trainers consist of a detailed, page-by-page description and explanation of the handout's content, with suggestions to the trainer for emphasising pertinent points of information.

3.6.2 Computer software for monitoring and evaluating HCPs

In order to achieve their intended purpose, mines' hearing conservation programmes require the co-ordinated input of a broad range of disciplines and departments. In the first instance these include engineering, ventilation/environmental control, manpower/personnel, medical, safety/loss control, training and mining. Eliciting active participation and positive input from such diverse groupings of expertise demands the application of considerable management skills. The general perception is that mines' hearing conservation programmes vary widely in their level of effectiveness, but all include aspects that could benefit from improvement. It is normally the case that some aspects of the programme are addressed with considerable success, while others are not. This invariably limits overall programme effectiveness.

Regular management review and evaluation of hearing conservation programmes against established criteria would serve to identify areas for improvement and enable the formulation of appropriate measures. Against this background the development of purpose-designed computer software was undertaken to provide management with tools for HCP monitoring and review. The "Hearbase" program was based on the criteria put forth in COMRO (1988), with a number of revisions and enhancements. It is DOS-based and designed to operate on an IBM-compatible microcomputer with 80386 CPU, DOS 5,0, 4 Mb of RAM, at least 1,4 Mb of disk space and a colour monitor. A Microsoft-compatible mouse and printer are optional.

With regard to security of the system, three levels of access are provided for. These relate to data input, generation of summary/management reports and system administration. At the lowest level, data input, users' access is limited in accordance with the type of data they would

be expected to enter, viz. results of noise emission and exposure surveys, HPD monitoring, audiometric testing and training/reinforcement initiatives. Data entry routines follow the Clarion format, i.e. by browsing a table of records and responding to prompts for the entry or editing of data within a field of records. Look-up tables are provided for reference and to facilitate the maintenance of data integrity. Further control of data quality and integrity is provided for through the comparison of values entered with specified ranges, and the provision of a register for surveyors' and audiometrists' competency and the calibration status or condition of instrumentation and equipment used.

The various parameters and indicators are compared with previous results in order to identify trends. Based on progress or improvements within the constituent aspects of the HCP over the period of review, an overall rating is calculated. Where this is unfavourable, problem areas can be identified by referring back to results for the constituent aspects of the HCP, thereby enabling the formulation of corrective measures. Two documents relating to the Hearbase program are appended (Appendix 9), viz. A Functional Design of the Hearbase HCP Software (A-9.1) and the Hearbase User's Guide (A-9.2).

4 DISCUSSION

An important aspect of this programme of work was to determine the nature and levels of noise emitted by machinery during various mining operations and to establish the corresponding levels of exposure for workers, with and without the benefit of hearing protection. In essence, this amounts to an assessment of risk posed by the noise hazard, which should be useful to mine managements in identifying critical machinery and occupations for the purpose of optimizing their hearing conservation programmes. A wide variety of work categories was surveyed for various types of mining, and although noise emission and exposure levels may vary somewhat from mine to mine, localized surveys should produce results substantially similar to those determined during the current survey. In this regard, it would be advantageous to establish an industry-wide database, which could serve as a means of compiling the results of worker exposure surveys on individual mines. The benefit of such a facility would be to enable the determination of risk associated with noise on a broad and on-going basis. Furthermore, it would make it possible to demonstrate the benefits of engineering solutions that are implemented and to make adequate financial provision for future compensation claims.

4.1 Surface workshops

Results of measurements in surface workshops generally indicated that noise was generated intermittently, but sometimes at high intensity levels. This is in agreement with subjective observations that employees often spent considerable time preparing equipment and machinery for specific operations or fetching tools and material. Furthermore, some aspects of their work were less noisy than others, e.g. measuring and indexing material or using handtools. Accordingly, reference is made to maximal values rather than means in considering the selection of HPDs for use in workshops.

The intermittent nature of noise emission in workshops may have been a factor in limiting worker compliance with employers' personal protection policies. Although these areas were invariably demarcated as noise zones and HPDs were readily available, protection was generally worn only during the noisiest operations, often by workshop assistants only and not by artisans. This was in contrast to the use of eye protection, which was nearly always worn where appropriate.

Failure to apply hearing protection was most apparent in the boilermaking or plating workshops. This is of particular concern in view of the fact that emission and exposure levels

in these areas were consistently greater than in any of the other types of workshops. Furthermore, the impulse noise generated by activities such as hammering and rivetting, which are common in plating sections, causes far more destruction to the human hearing mechanism than noise emitted on a more continuous basis. Clearly, there is a need for education with regard to the hazards of noise exposure and the value of hearing protection.

Although the presence of noise and employees' failure to apply hearing protection were most apparent in boilermaking/plating sections, this situation existed in other workshops, albeit to a lesser extent. Results for the miscellaneous workshop category, which encompassed such activities as equipment repair, welding, plumbing and electrical work, also indicated intermittent but excessive noise emission. Here too, the use of hearing protection was observed to be limited.

Rockdrill repair was the only type of workshop where HPDs were commonly used. Despite the slightly lower maximal value for emissions here, in comparison with the miscellaneous category (114,8 dB and 115,6 dB, respectively), the mean exposure level for rockdrill repair personnel, at 98,0 dB, was higher than in miscellaneous workshops, where the corresponding value was 93,6 dB. This is indicative of more continuous activity, which is to be expected where the tasks performed are more uniform and repetitive, and also a result of the excessive noise emitted by rockdrills when they are tested.

The mean exposure level in carpentry workshops, at 91,9 dB, was midway between corresponding values for rockdrill repair and miscellaneous workshops. This was despite maximal emission levels in the carpentry shops being considerably lower than in either of the other two sections. This would indicate more continuous use of noisy machinery in carpentry than in the miscellaneous workshops, but with lower emission levels than in rockdrill repair. The use of hearing protection among workers in carpentry shops was generally observed to be good, although not as uniform as that observed in rockdrill shops.

Perhaps as a result of a perception that their work is not noisy, fitter/turners generally displayed a disregard for hearing protection, second only to that of boilermaker/platers. Emission and exposure levels for fitting and turning sections were considerably lower than in other workshops, but fitter/turners' mean exposure was 5,3 dB greater than even the maximal emission level determined for their activities. This is clearly the result of exposure to machinery and operations noisier than their own and illustrates the importance of protection for workshop personnel that is appropriate for the greatest emissions likely to be encountered. This is relevant in virtually all workshops and the principle has been applied in using maximal

L_{pA} and L_{Aeq} values to compare the relative effectiveness of HPDs for workshop situations (appended Tables A-2.1 to A-2.5).

4.2 Coal mining

Emission and exposure levels were determined for 35 work categories in underground and surface coal mining operations. These ranged from 74,5 dB for dragline operators to 100,8 dB for longwall shearer operators. In only two work categories was mean N_{eq} below 85 dB. Although these exposure levels may not be as high as in other industries (e.g. pneumatic rockdrill operators in gold and platinum mining), the fact remains that the majority of production workers in South African coal mines are exposed to noise levels capable of causing hearing impairment.

4.2.1 Reducing worker exposure to noise

It is widely agreed that the only certain way to prevent occupational hearing loss from noise exposure is through the implementation of at-source noise control engineering (NCE) solutions. Experience has shown that noise is among the hazards that workers are least likely to appreciate and it is therefore unlikely that a HCP based on personal protection will be as effective as one based on the implementation of NCE solutions. Accordingly, personal protection strategies should be regarded as a last resort and applied only as an interim measure, until such time as engineering solutions have been implemented, either at or as near to the source as possible.

4.2.1.1 Noise control engineering

It was demonstrated by Bartholomae and Parker (1983) that NCE can be applied with considerable success to coal mining machinery. Information extracted from their work is summarized in Table 4.2.1a, and provides several examples of successful NCE. Although a noise level of 85 dB was not achieved in all instances, levels were decreased by as much as 17 dB. A reduction in the L_{Aeq} of the principal source of exposure generally yields similar reductions in N_{eq}. Even a reduction of 3 dB is significant and worth the effort required to achieve it, since it would reduce worker exposure by half and thus, double the permissible period of exposure per day or per week. More importantly, reducing exposure diminishes the risk of occupational hearing impairment.

Table 4.2.1a

Noise emission levels for coal mining machinery before and after noise control engineering measures

Machinery	Range of L_{Aeq} Observed (dB)		Average Reduction (dB) (rounded to nearest integer)
	Before NCE Treatment	After NCE Treatment	
Coal Loaders	95 - 100	93 - 95	4
Continuous Miners	97 - 103	94 - 100	3
Longwall Shearers	98 - 101	90 - 94	8
Roof Bolters	85 - 95	85 - 90	3
Load Haul Dumpers	97 - 102	80 - 88	16
Haulage Trucks/Personnel Carriers	90 - 100	80 - 85	13
Diesel Buses	80 - 100	80 - 85	8
Crushing and Breaking Mills	90 - 100	75 - 95	10
Screening Plants	90 - 100	85 - 95	5

From Bartholomae and Parker (1983).

Table 4.2.1b provides somewhat more detail of the NCE treatments summarized in Table 4.2.1a. Although the costs of such treatments vary according to the extent of the modifications applied and whether equipment manufacturers have already developed retro-fit designs, costs should be assessed in terms of the level of reduction likely to be achieved and the number of workers who would benefit.

Table 4.2.1b

Description of NCE treatment applied to various coal mining machinery

Machine	NCE Treatment(s) Applied	Reduction (dB(A))
Coal Loaders	Isolate and damp conveyor pan components; enclose hydraulic pump and motor with absorptive material	2 - 5
Drum-Type Continuous Miners	Isolate and damp conveyor and pan components; fit isolated bit blocks; enclose hydraulic pump motor with absorptive material	3
Longwall Shearers	Isolate shearer bit blocks, enclose hydraulic components with absorptive material and apply vibration isolation damping	7 - 8

Table 4.2.1b ***(continued)***

Machine	NCE Treatment(s) Applied	Reduction (dB(A))
Roofbolters	Acoustic treatment of dust collection blower; enclose hydraulic components with absorptive material; seal motor and pump-blower drive enclosures	0 - 5
Diesel-powered Load Haul Dumpers	Apply exhaust silencing	2 - 4
	Fit partially-sealed acoustic barriers around operator with exhaust silencing	5 - 6
	Fit engine and gearbox enclosures and vibration isolation damping with partially-sealed barriers around operator and apply exhaust silencing	7
	Install sealed acoustic operator enclosure	14 - 17
Diesel-powered Haulage Trucks and Personnel Carriers	Apply exhaust silencing	5
	Fit partially-sealed acoustic barriers around operator and apply exhaust silencing	5 - 10
	Fit engine and gearbox enclosures and vibration isolation damping with partially-sealed barriers around operator and apply exhaust silencing	10
	Install sealed acoustic operator enclosure	10 - 15
Crushing and Breaking Mills	Install resilient damping behind mill liners (Autogenous mills)	5
	Install acoustic enclosure around mill	5 - 10
	Install acoustic barrier curtains around mill	5
	Install acoustic control booth for operators	10 - 20
Screening Plants	Install resilient decking and bottoms	0 - 7
	Install acoustic enclosure around screen and drive components	5 - 10
	Fit acoustic barrier curtains around screen and drive components	5 - 10
	Install acoustic enclosure around drive components	0 - 3

From Bartholomae and Parker (1983).

4.2.1.2 Administrative control

Until such time as widespread implementation of NCE becomes a reality in the coal mining industry, other measures will have to be applied in addressing the noise hazard. An alternative to NCE is the reduction of equivalent noise exposure to 85 dB through administrative controls, which limit exposure time to reduce worker exposure levels. For example, machinery emitting noise at a level of 95 dB would not pose a risk to operators' hearing or contravene the

requirements of legislation, provided operators were exposed at that level for a maximum of four hours per week rather than the normal 40 hours. Limiting the use of expensive capital equipment to four hours per week would be unacceptable, but training workers for multiple occupations would also have considerable financial implications. These factors, together with the likely negative effects of job rotation on productivity and safety, virtually preclude administrative control as a viable strategy for reducing worker exposure to noise.

4.2.1.3 Personal protection

As a last resort and then only as an interim measure, the implementation of personal protection strategies should be considered. Hearing protection devices, although inherently less effective than engineering solutions, have the potential to reduce exposure to safe levels, until such time as NCE has been implemented effectively. The emission and exposure levels determined during the present study indicate that quality hearing protection devices can reduce effective exposure for all occupations in coal mining to safe levels. Therefore, Industry does have scope to pursue genuine solutions while temporarily controlling worker exposure by means of personal protection.

Table A-1.1 (appended) lists most HPDs currently available in South Africa, and includes information on their attenuation performance at each centre frequency. This allows calculation of the attenuation effect of a particular HPD when worn by individuals in a specific work category, in order to determine which HPDs would be appropriate. Each of Tables A-3.1 to A-3.34 (appended) addresses a particular occupation or workplace in coal mining and considers the expected attenuation for 83 configurations of HPDs. One should consider these tabulations for HPD selection with circumspection. Effective L_{pA}, L_{Aeq}, and N_{eq} values are based on noise and exposure levels observed during the present study, as well as on mean attenuation and standard deviation values provided by HPD manufacturers or suppliers. The latter were determined in accordance with various standards, not all of which are comparable as apparent from those HPDs evaluated in terms of more than one standard. Of particular concern are the much higher levels of protection that ANSI-based and certain other evaluations indicate. Such evaluations should not be considered an accurate indication of effectiveness, as tests conducted in accordance with these standards appear to overestimate HPD protection levels.

4.3 Gold and platinum mining

4.3.1 Surface plants and works

Among the surface occupations and workplaces surveyed, the only area where both emission and exposure levels could be regarded as consistently safe (< 85 dB) was in winding engine cabins. Although there were occasional instances where observations exceeded this level, the mean L_{Aeq} of 82,0 dB together with the current combined mean exposure level of 80,4 dB indicates a safe work envirionment, in terms of noise, for surface winding engine drivers. Although this current combined mean is 2,8 dB greater than that determined by van Rensburg et al. (1980), current exposure levels are still within safe limits.

In extraction plants, crusher sections yielded the highest emission and exposure levels, although the means were only 1 to 2 dB greater than those determined in milling sections. In the CIP plant surveyed, where there was no crusher section, means for emission and exposure levels were greatest in the milling section: 93,3 dB and 91,5 dB, respectively. These were midway between the corresponding values determined for crushing (94,1 dB and 92,0 dB) and milling (92,5 dB and 91,0 dB) in cyanide plants. It would be reasonable to expect similar levels in milling sections of cyanide plants that do not have crusher sections.

In comparing emission and exposure levels determined in the two types of extraction plants, the greatest differences were observed for conveyor systems. These included belts, drives/gearboxes and tips/transfer points. Emission and exposure levels in these areas of the CIP plant were 3,3 dB and 3,2 dB lower, respectively, than for conveyor systems in cyanide plants. The principal reason for the quieter operation of the CIP conveyor system appeared to be that it was of a more modern design and functioned more efficiently than those in the older plants. This explanation is supported by subjective observations that belts, rollers and drives ran more smoothly and quietly in the CIP plant, and that there were fewer tips and transfer points than in the older cyanide plants. Through its more efficient operation, fewer blockages and spillages of material occurred with the CIP conveyor system, limiting stoppages and reducing labour requirements. This not only implies enhanced productivity, but a reduction in the number of persons exposed to noise. It also seems reasonable to infer that higher standards of maintenance were achievable with the more modern conveyor system, a point which bears relevance to all plant and machinery.

Examples of NCE treatments that have been applied to various machinery in mineral processing plants are presented in Table 4.3.1.

Table 4.3.1

NCE measures for surface plants

Type of Equipment	NCE Treatment(s) Applied	Average Reduction (dB(A))
Chutes and Hoppers	Rubber lining and damping	7,5
Crushers	Acoustic machinery enclosure	7
	Isolation-mounted acoustic operator enclosure	17
Rod/ball Mills	Acoustic barrier panels along sides of mill	8
Semi-autogenous Mills	Rubber mill lining	5
Screens	Resilient screen components	3
	Acoustic screen enclosure	7,5
	Acoustic barrier curtains	5
	Acoustic drive enclosure	1,5

From Aljoe, Bobick, Redmond and Bartholomae (1985) and Bartholomae and Parker (1983).

Mean emission and exposure levels in assay departments and smelt houses exceeded 85 dB, but excesses were limited to no more than 3,6 dB for L_{Aeq} and 2,3 dB for N_{eq}. Of some concern is the fact that emission levels in compressor houses averaged 97,9 dB, while the mean exposure level for compressor attendants was 96,6 dB. Although these values indicate a favourable trend in comparison with the findings of van Rensburg et al. (who observed L_{Aeq} values of 109 dB and 94 dB, and determined a mean exposure level of 100,6 dB for compressor attendants), current levels are still excessive. Compressor houses were generally situated so as to limit noise impact on other facilities, but this was obviously of no benefit to those working inside. Although compressor houses often contained an enclosed office or control room, the benefit was limited by the ability of such enclosures to exclude compressor noise and the extent to which remote monitoring and control systems had been provided. Compressor attendants' mean exposure was only 1,3 dB less than the mean emission level for compressor houses, indicating nearly continuous exposure and highlighting the potential for remote monitoring and control systems to reduce worker exposure. Although compressor maintenance and adjustments require direct contact with the machinery, routine monitoring operations occupied a considerable portion of compressor attendants' time. Greater levels of remote monitoring and automation with acoustically isolated control rooms would enable reductions in exposure levels and manpower requirements, serving to limit the number of individuals affected by noise.

4.3.2 Underground occupations and workplaces in conventional mining

Although Section 3.3.2.1 of the present report contain results extracted from the detailed study of rockdrills (Section 3.4), the discussion of these results is presented in Section 4.4.

4.3.2.1 Development ends and stopes excluding drill crews

Comparisons of emission and exposure levels indicate some differences in the nature and continuity of operations between development ends and stopes, as well as between main and night shifts but it is apparent, to a greater or lesser extent, that all production personnel are at considerable risk with regard to noise exposure. This is particularly true where workers do not make use of hearing protection, which was all too often observed to be the case.

Possibly as a result of rationalization, more efficient deployment of labour and greater continuity of operations, noise emissions and, particularly, worker exposure levels in conventional gold and platinum mining appear to have increased slightly in comparison to the results of van Rensburg et al. (1980). If these factors have, in fact, contributed to the apparent upward trend, then it must be accepted that enhanced productivity based solely on the expanded use of existing methods and machinery is not without disadvantage. Ore distribution and other geological constraints are principal determinants in the choice of extraction method, but additional limitations are imposed by the technologies available. Industry's response to the need for increased productivity appears to have been an adherence to and an expansion of established methods, resulting in increased risk for production personnel.

Initiatives to develop alternative methods of rockbreaking and reduce the hazards and limitations of the conventional drill and blast cycle have indicated some scope for future improvements. These will require further development and even those that prove viable would likely be appropriate only under specific circumstances. It is quite clear that gold and platinum mines will continue to employ present methods for some time but in the interim, should make greater use of available emission reducing techniques. Although silenced pneumatic and even water-hydraulic rockdrills do not totally eliminate risk, they greatly enhance the potential for personal protection to reduce effective exposure to safe levels and also limit risk for those failing to apply it.

4.3.2.2 Transport and haulages

With regard to exposure levels for transport workers, no uniform trend emerged from comparisons between current and previous results. Slight increases in exposure were observed for tramming, banksmen and underground hoist operators, with differences in means between current combined and previous results limited to no more than 0,6 dB. Decreases in exposure were apparent for diesel loco crews and onsetters' teams, with current combined means being lower than reported by van Rensburg et al. by 0,9 and 2,9 dB, respectively.

While mean emission levels for all transport operations considered were less than 100 dB, the only category with a mean L_{Aeq} below 90 dB was underground hoists. Mean exposure levels, with the exception of hoist drivers, all exceeded 85 dB, with banksmen being the only other category having a mean N_{eq} below 90 dB. Noise emissions in transport operations are such that many HPDs could limit effective exposure to safe levels and virtually eliminate the risk of noise induced hearing loss (NIHL). However, these workers are subject to certain unique safety risks which could be exacerbated by the use of inappropriate hearing protection. Ensuring that HPDs are appropriate in terms of the attenuation they provide is essential but, in the medium- to long-term, there is a greater need to reduce present noise levels, particularly where they impede communication during critical operations.

4.3.2.3 Technical services

Among the four work categories considered under technical services in conventional gold and platinum mining, mean emission levels all exceeded 95 dB and three exceeded 100 dB. With the exception of artisans, where mean exposure was 8,8 dB less than mean emission level, the results indicate considerable periods of exposure to principal noise sources. Differences between means for L_{Aeq} and N_{eq} ranged from 0,6 to 2,6 dB, suggesting that individuals involved in technical services should be using HPDs for most of their shift. Nearly continuous exposure also indicates that considerable benefit could be gained from source control measures. Where exposure periods are brief and intermittent, source control would be of limited value, but in the case of most technical service personnel, their nearly continuous exposure suggests that the only factor weighing against the implementation of source control measures would be the number of persons who would benefit. Source control, at least initially, need not extend to the absolute source where possibilities exist for isolating or enclosing the source or individuals exposed. As suggested for compressor houses, greater use of remote monitoring and control systems in conjunction with acoustically isolated control booths would not only limit the exposure of fan, pump and refrigeration plant attendants, but reduce manpower requirements as well. While such provision would not totally eliminate direct exposure to noise emissions,

routine monitoring and many other control operations could be performed from the relative safety of an acoustically isolated control room.

In the case of artisans, whose activities generate intense noise but on a more intermittent basis, personal protection would be required mainly during noisy operations and while in close proximity to any noisy production machinery. The protection applied in workshops should provide for the most intense emissions likely to be encountered, indicating that HPD selection should be based on maximal L_{pA} and L_{Aeq} values, implying a possible need for alternative HPDs for use outside workshops.

Refuge bays, while not within the realm of technical services, were included in this category as part of supporting infrastructure. These facilities are essential in the event of an emergency, but would only be utilized on rare occasions. Accordingly, they may not warrant special treatment for the control of noise emissions other than the provision of HPDs, which nearly all underground workers should already be issued with for use during normal duties. While all devices issued across the range of occupations would not necessarily be fully appropriate for use in refuge bays, the number of instances in which these facilities would be likely to be utilized does not indicate a need for special provision. Should mine managements wish to equip refuge bays with (disposable) HPDs for emergency use, reference should be made to Table A-5.26 (appended). With regard to possible engineering measures for controlling compressed air noise, Kielblock et al. (1988) suggested a reduction in air velocity and the use of baffling to limit worker anxiety and minimise interference with communication.

4.3.3 Mechanized mining

4.3.3.1 Equipment and machinery operators

Of the 13 types of equipment surveyed in mechanized gold and platinum mines, nine yielded mean emission levels in excess of 100 dB, while values for the remaining four all exceeded 90 dB. In terms of operator exposure, levels were greatest for the seven types of machinery directly associated with production and ore transport. Operators' mean N_{eq} for all of these exceeded or closely approached (within 2,2 dB) a level of 100 dB, with diamond drill operators being the only category having a mean N_{eq} in excess of 105 dB. Among the remaining six types of machinery, operators' mean exposure levels ranged from 89,0 dB to 95,4 dB.

While exposure levels of 100 dB or less can be readily reduced to 85 dB through personal protection, such an approach may lead to increased safety risks, particularly when applied to mobile equipment operators. For individuals with normal hearing, the use of HPDs in loud

noise enhances the perception of warning signals but, depending on the type of signal and HPD employed, may cause some difficulty in "localizing" or identifying the source. For individuals already exhibiting considerable hearing loss, the use of HPDs can greatly reduce the audibility of some signals and in those instances, HPD selection should be matched to the individual's hearing loss as well as his workplace, choosing from "low-and-flat attenuation" devices which provide less attenuation, particularly at the higher frequencies where ordinary devices are most effective.

Measures to reduce noise are always preferable to personal protection, particularly where safety can be compromised by the latter. The greatest obstacles to source control are normally cost, the time required for implementation and the potential for interference with normal equipment operation and maintenance. In the case of diesel-powered equipment in mechanized mining, much of the noise originates in engines and transmissions. The observed lack of exhaust silencing and enclosures for noisy components on most of this machinery, while simplifying maintenance operations, results in unnecessary noise emission. This impedes communication, with implications for safety and productivity, and increases the risk of hearing loss. There are many noise sources for which practical solutions are unaffordable, elusive or even unachievable in the short-term, but this is not the case with diesel-powered machinery. The universal application of conventional exhaust silencing would provide immediate and cost-effective control for a significant contributor to noise emitted by this equipment. The application of additional NCE treatments as listed in Table 4.3.3 would serve to considerably reduce operator exposure, enhance communication to the benefit of safety and productivity, and limit the risk of hearing impairment among workers in mechanized mining sections.

In considering the noise reductions from sequential NCE treatments in Table 4.3.3, it will be noted that the combined reduction realised after a number of individual treatments does not necessarily equal the sum of reductions from those individual modifications. Where the combined reductions are greater than the sum, this is a result of a synergistic effect from combining individual steps. This illustrates the need to apply the most necessary treatments first, in order to address the principal sources or transmission paths, as well as to enable further reductions from subsequent measures. As an example, the application of sound-absorptive lining to a bulldozer canopy would not result in a 1,5 dB reduction for the operator without a windscreen to help exclude engine noise, and a silencer to muffle the exhaust. Conversely, while exhaust silencing alone may reduce noise at the operator's position by 5 dB, when applied subsequent to an acoustic treatment of the operator's cabin it may only yield a further reduction of less than 2 dB.

Table 4.3.3

Analysis of NCE treatments for mechanized mining equipment

Type of Machinery	NCE Treatment(s) Applied	Average Reduction (dB(A))
Bulldozers	1. Windscreen	4,3
	2. Sound-absorptive lining inside overhead canopy	1,5
	3. Acoustic treatment of existing operator enclosure	9,5
	4. Installation of acoustic operator enclosure where none exists	15,0
	5. Exhaust silencer	1,3
	6. Vibration isolation between engine compartment and dashboard	3,0
	7. Absorptive floor mat and seat seals	1,0
	Combination of 1 to 7, as applicable	15,0
Dump Trucks	1. Exhaust silencer	7,5
	2. Acoustic treatment of cab	12,5
	3. Modification and acoustic treatment of cooling fan	7,5
	Combination of 1 to 3	20,0
FELs with existing non-acoustic operator cabs and exhaust silencers	1. Seals for cab, doors, set and floor	2,5
	2. Sound-absorptive lining of all interior cab surfaces	4,0
	3. Sound-absorptive floor mat	1,5
	4. Seals for control pedestal	2,5
	Combination of 1 to 4	11,8
Graders	1. Exhaust silencer	1,5
	2. Acoustic operator enclosure	6,5
	3. Acoustic treatment of existing operator enclosure	6,5
	Combination of 1 to 3	10,0
Jumbo Drill Rigs	1. Muffling enclosure for pneumatic drill	9,1
	2. Shroud tube around drill steel	4,7
	Combination of 1 and 2	13,8
LHDs	1. Foam-and-plate lining in transmission compartment and anti-vibration transmission mounts	ND
	2. Acoustic enclosure around engine lined with polyurethane foam, stiffen engine-mounting rails and install exhaust silencers	7,0
	3. Foam-and-plate lining around cooling fan	ND
	4. Foam-and-plate lining in torque converter, water tank and fuel tank compartments	ND
	5. Acoustic operator enclosure	9,0
	Combination of 1 to 5	17,0

ND : Not determined
From Aljoe, Bobick, Redmond and Bartholomae (1985) and Bartholomae and Parker (1983).

In planning for the acoustic treatment of mechanized mining equipment, it should be borne in mind that provision of acoustic enclosures for operators will only benefit operators and not other exposed personnel. Furthermore, an acoustic operator cabin implies the need for airconditioning, which would require adequate financial provision, both initially and in terms of ongoing maintenance.

4 3.3.2 Production personnel

Mean emission levels for the seven occupations considered in this category of mechanized mining personnel ranged from 99,3 dB for mine overseers (the only occupation where mean L_{Aeq} did not exceed 100 dB) to 108,8 dB for team leaders. These same two occupations were also at the extremes for mean exposure level (89,9 dB and 102,5 dB, respectively). Since greater differences between emission and exposure levels are indicative of intermittent or limited periods of exposure, it is to be expected that miners' assistants, whose duties are more routine and repetitive, would show the smallest difference (5,8 dB) between these parameters, and that mine overseers' more variable activities would result in the greatest difference (9,4 dB).

The fact that mean exposure level exceeded 95 dB in three of these seven occupations and exceeded 90 dB in three more indicates considerable risk to production workers' hearing. The average exposure level for this group of occupations, at approximately 95 dB, implies an average safe exposure period of 50 minutes per 8 h shift or 4 h 10 min per 40 h week for unprotected production personnel in mechanized mining sections.

4.3.3.3 Service personnel

Although emission and exposure levels in this group of occupations were, on average, somewhat lower than for production personnel, mean N_{eq} exceeded 90 dB in all of the seven categories considered. The mean exposure level for wire mesh / lacing / barricades, at 102,7 dB, was the only instance in this group of occupations where N_{eq} exceeded 95 dB, but this value was even greater than that determined for production team leaders, who had the highest exposure levels among production workers.

The average exposure level among all types of service personnel considered, at approximately 93 dB, was 2 dB lower than for production employees. However, even at this lower level, the safe exposure period is only 1 h 20 min per 8 h shift or 6 h 40 min per 40 h week for unprotected service personnel in mechanized mining sections. Exposure beyond these limits would result in an increased risk of hearing loss.

4.3.4 Ventilation fans

4.3.4.1 Main fans

The intensity of noise emitted by main fans certainly exceeds that from auxiliary units, but the limited number of people directly affected by the larger installations is sometimes regarded as an indication of reduced significance. Nevertheless, for those individuals in close contact with main fans, i.e. ventilation and engineering personnel, exposure levels, even over brief periods, can be considerable. Subjecting unprotected individuals to the average level of emissions determined in main fan chambers during the present study (111,6 dB) would result in their overexposure (relative to 8 h) after less than 64 seconds. This indicates that unprotected personnel should not spend more than 5½ min per week inside main fan chambers. The emission levels inside these facilities are such that only a limited number of conventional HPDs would provide adequate protection for an 8 h shift or a 40 h work week (Table A-5.23).

The possibilities for retrofitting conventional noise control measures to existing main fans would be mainly limited to the provision of sound-absorbing panels and barriers inside fan chambers. This would not reduce emissions but serve to control their effects inside highly reverberant fan chambers. Such measures are generally effective in controlling higher frequency noise, but increasing the size and mass of acoustic barriers and absorbing panels can improve the control of lower frequency emissions to some extent.

Greater reductions in fan noise would be possible through certain provisions at the time of installation. These might include the use of isolated or "floating" foundations and anti-vibration mountings for fans and drives to reduce structurally-transmitted low frequency noise. The use of pre-conditioning control vanes (as opposed to guide vanes) on the intake side can reduce air turbulence, a significant source of air-borne noise from fans, and thus improve overall efficiency. Further reductions in air-borne noise could be achieved by increasing the number of fan blades and reducing fan speed. This would not only reduce noise from drive motors, but shift the lower frequency fan emissions to higher frequencies. Although human hearing is more sensitive to high frequency sounds which implies their increased potential for causing inner ear damage, high frequency emissions are easier to control through exclusion and absorption techniques and the use of HPDs. In the event that altering fan speed would be impractical, controlling low frequency emissions by means of noise cancellation techniques could be considered. This technology is best suited to the control of noise at frequencies below 1500 Hz, particularly when emissions are of a continuous nature (Berkman and Bender, 1997 and Pelton et al., 1994).

4.3.4.2 Auxiliary fans

Sound energy emitted by fans has its origins in the mechanical components of the appliance and their interaction with the air being moved. Transmission is either air-borne or structurally-borne, through the ventilation ducting. Control over both transmission paths can be exercised, in part, through the use of fan attenuators or silencers. However, the service life of conventional attenuator pods is severely limited by the accumulation of dust, moisture and other contaminants in the fabric of sound absorbing components. It was apparent from observations of fans fitted with attenuators and from the experiences related by ventilation personnel, that the long-term efficacy of conventional silencers in humid, dusty conditions fails to meet the demands posed by high performance ventilation fans.

Control of structurally-borne sound transmission was generally not provided for in the duct and pipe installations observed. Greater use of flexible duct sections and resilient components in support and attachment devices would reduce structurally transmitted noise. Such measures lend themselves to retrofitting and would be largely resistant to the deteriorating effects of time and the environment. Far greater benefits would be derived from these modifications if they were combined with the selective siting of the fans themselves. While present practice in determining a fan's location takes due cognisance of ventilation requirements and efficient use of materials, it does not necessarily consider the acoustic effects of fan placement. In many instances the repositioning of a fan to a more distant location (relative to workers) could reduce the noise hazard for employees, with manageable impact on ventilation performance, albeit at the cost of additional ducting and labour for installation. The benefits of selective siting for fans could be maximized through the use of structural transmission control measures referred to above and, under favourable circumstances, possibly eliminate the need for costly fan attenuators. The alternative siting of auxiliary fans would be particularly beneficial in areas where critical operations are performed and effective communication is essential to safety.

4.4 Hand-held rockdrills

4.4.1 Development drilling

In considering unsilenced pneumatic rockdrills for noise emission and operator exposure, it is apparent that, for a drilling time of 150 minutes per shift (Table 3.4.1b and 3.4.1e) or even for the time required to drill 20 holes at a pressure of 600 kPa (77,4 min observed/129,0 min estimated typical from Table 3.4.1g), noise immission* attributable to these machines is

* Noise immission is a function of the total energy incident on the ear over a specified period of time (SABS 083).

beyond most conventional HPDs' capability to provide adequate protection. Of the seven representative HPDs considered, only HPD 4, a combination of high-quality muffs and plugs, and HPD 7, custom-moulded plugs set for maximum attenuation, can be expected to reduce N_{eq} to 85 dB or below for operators of unsilenced pneumatics, even at an operating pressure of 400 kPa. HPD 4 (muffs and plugs combined) would be unlikely to gain widespread user acceptance, particularly in hot, humid work places, while HPD 7 would be relatively expensive, at least in terms of the intitial cost.

In contrast, crews operating silenced pneumatic machines for 150 minutes per shift, as assumed in Table 3.4.1e, can be adequately protected with six of the seven representative HPDs when operating at 400 kPa, and with five of the seven when operating at 600 kPa. Table 3.4.1g indicates that at 600 kPa, operators completing 20 holes in 83,6 minutes (observed) and even in the more likely time of 139,4 minutes (estimated typical) would be adequately protected by six of the seven HPDs. HPD 5 is the exception, exceeding the 85 dB limit by only 0,2 dB for the observed drilling time but by 2,6 dB for the estimated typical time. This device is a low-attenuation reusable plug, which would also fail to provide adequate protection against the emissions of silenced pneumatics operating at 400 kPa for 150 minutes per shift. HPD 3, band-mounted semi-aural caps, would be marginally inadequate for 150 minutes of drilling with these machines at 600 kPa, yielding an effective N_{eq} of 85,3 dB. At 400 kPa the use of this device would result in an effective N_{eq} of 82,8 dB for the same period of exposure.

Operators of water-hydraulic machines would be adequately protected by any of the seven representative HPDs considered. Effective N_{eq}, whether for an assumed drilling time of 150 minutes per shift (Table 3.4.1e), for the estimated typical time of 101,4 minutes to drill 20 holes, or for the atypically long observed time of 115,2 minutes (Table 3.4.1g), would be less than 80 dB with any of the seven representative HPDs. This is primarily due to the water-hydraulics' dramatically lower levels of noise emission at frequencies from 500 Hz and below, where conventional HPDs are least effective.

Although drill crews face the greatest exposure to rockdrill noise, other members of the development team are also at risk. The attenuation of rockdrill noise with increased distance observed for drill P-2/Du, an unsilenced development machine operating at 600 kPa (Table 3.4.1h and Figure 3.4.1c), indicates that only at 10 m and beyond were noise levels from this drill low enough ($\leq$ 105 dB) to allow confidence that conventional HPDs would provide adequate protection. Estimated L_{Aeq} values for this drill operating at 400 kPa indicate that noise would reach readily-protectable levels at a distance of 8,5 m. For silenced

pneumatics, estimated noise levels diminish to 105 dB at distances of 2 m and 3 m for operating pressures of 400 kPa and 600 kPa, respectively. L_{Aeq} values observed for water-hydraulic machines were at readily-protectable levels virtually from the operators' position.

Notwithstanding the fact that a given drill would be unlikely to operate continuously for the entire shift, members of the development team would also be within close proximity to other drills and, in some instances, to the pneumatic loader, another source of considerable noise emission. Accordingly, all members of the development team can be regarded as requiring a similar level of protection as drill operators, which should be determined in accordance with the type(s) and number of drills. (Determination of total L_{Aeq} for multiple noise sources is detailed in Section 4.4.2, Stope Drilling.) This would imply that, like drillers, other development crew members would not be adequately protected by most conventional HPDs where unsilenced pneumatic machines were used. However, where silenced pneumatics are employed, it is entirely possible to reduce N_{eq} for members of the development crew to safe levels through the application of appropriate HPDs. In the case of water-hydraulic machines, most well-designed HPDs should adequately protect development crew members by a comfortable margin, regardless of proximity to the drill.

4.4.2 Stope drilling

As in development drilling, emissions from unsilenced pneumatic machines operating in the stope were at levels beyond the capability of most conventional HPDs to provide adequate protection. This would be the case for a drilling time of 150 minutes per shift at an operating pressure of 400 kPa or 600 kPa (Table 3.4.2d), for the 184,5 minutes of drilling time for 35 holes calculated on the basis of performance observations in deep level stopes, as well as for the atypically short drilling time of 110,6 minutes for 35 holes calculated on the basis of performance observations during the present study (Table 3.4.2f). Of the seven representative HPDs considered, only HPD 4 (muffs and plugs combined) and HPD 7 (custom-moulded plugs) could be expected to reduce N_{eq} to levels of 85 dB or below for operators of unsilenced pneumatic machines.

Where silenced pneumatics are used, five of the seven representative HPDs could be expected to adequately protect operators for 150 minutes per shift, regardless of operating pressure. Of the two remaining devices, both would be adequate for 150 minutes at a pressure of 400 kPa, while one would be marginally inadequate at 600 kPa, yielding an effective operator N_{eq} of 85,3 dB for 150 minutes of drilling, at 600 kPa. For the 138,9 minutes of drilling time for 35 holes at 600 kPa calculated on the basis of the atypically high

performance levels observed during the present study, six of the seven representative HPDs would provide adequate protection for operators. However, for the more realistic drilling time of 231,7 minutes for 35 holes (based on performance observations in deep level stopes), only three of the seven representative HPDs would result in effective exposure levels of 85 dB or less.

Noise emissions from the water-hydraulic machines were such that all seven representative HPDs could reduce operator N_{eq} to safe levels. This would be the case regardless of whether N_{eq} were to be based on a drilling time of 150 minutes, on the 107,8 minutes for drilling 35 holes calculated on the basis of performance observations in deep level stopes, or even on the 122,5 minutes based on the atypically low levels of performance observed during the present study.

In stopes, where the number of workers exposed to rockdrill noise is far greater than in development ends, attenuation with increased distance is of greater concern. The silenced pneumatic machine operating at 600 kPa that was observed at various distances (Table 3.4.2g) yielded L_{Aeq} values that diminished to the readily-protectable level of 105 dB at a distance of 4 m from the operators' position. Reducing the operating pressure to 400 kPa would result in similar noise levels at a distance of only 1 m from the operators. Corresponding averages for silenced pneumatics were 0,6 m for 400 kPa and 2,6 m for 600 kPa. Noise levels from unsilenced pneumatics operating at 600 kPa can be expected to diminish to 105 dB only at a distance of 7 m, or at 5 m when operating at 400 kPa. Estimated noise levels for water-hydraulic machines reach 105,1 dB at a distance of 2 m from the operators' position.

The reality of the stoping situation is that, for most members of the production team, moving farther away from one drill often brings them closer to another, simultaneously exposing them to noise emissions from more than one machine. The methods employed during the present study were designed to provide controlled conditions for the purpose of obtaining comparable data for various types of drills. This effectively precluded the investigation of multiple noise sources. Where one wishes to consider the effect of two or more drills operating simultaneously, a determination of the total L_{Aeq} can be readily made. For a particular position one would determine the L_{Aeq} attributable to each drill in turn, and to the greatest value (attributable to the principal source, which is normally the nearest drill) add the appropriate correction factor for each additional machine, in accordance with Table 4.4.3. This method can also be used in any other situation where multiple noise sources operate, e.g. in development ends.

Table 4.4.3

Correction factors to determine total L_{Aeq} for multiple noise sources*

Difference in L_{Aeq} between Principal Noise Source and Secondary Source(s) (dB)	Correction Factor(s) to be Added to L_{Aeq} of Principal Noise Source (dB)
0 - 3	3
4 - 5	2
6 - 9	1
≥ 10	0

* Adapted from SABS 083: 1983. For three or more noise sources, rank the L_{Aeq} values in descending order and apply the appropriate correction factor to determine the combined L_{Aeq} of the two loudest sources. The resulting sum is then regarded as the L_{Aeq} of the principal noise source in determining and applying each subsequent correction. Once differences of 10 dB or more occur between the preceding sum and the next L_{Aeq}, additional noise sources should be disregarded as inconsequential.

The confined, reverberant nature of the stoping environment and the possibility of stope team personnel being exposed to noise emissions from multiple drills would indicate that a level of protection similar to that required for drill operators is appropriate. Mean equivalent noise exposure for stope teams in general has been found to be no more than 5,6 dB less than for drill operators where unsilenced pneumatic drills are employed (106,9 dB for stope teams vs. 112,5 dB for drill operators, Section 3.3.2.2). In fact, individual N_{eq} results for some lashers were found to exceed the mean value for drill operators. Variations in stope team exposure levels can be attributed, on the one hand, to simultaneous exposure to multiple noise sources, and on the other, to intervals of absence from the stope for the purpose of fetching material, etc. In general, it would be prudent to provide protection that is adequate for the greatest emission levels likely to be encountered, i.e. the same as for drill operators.

4.4.3 Hearing protection

Personal protection against any hazard should be regarded as an interim measure to be applied only until engineering solutions have been implemented, or as a last resort where such solutions are not feasible. The major weakness inherent in personal protection strategies (PPS) is that they rely on the individual being sufficiently motivated and trained to use protective equipment effectively. This implies a need for workers to understand the nature of the hazard and how it can affect them. Achieving these prerequisites entails the ongoing investment of considerable resources in education and training programmes. A PPS also requires significant expenditure in issuing and replacing personal protective equipment (PPE). However, where engineering solutions have not yet been developed or implemented, PPS can

be a viable means of reducing worker exposure levels, particularly when applied together with interim engineering measures.

The results of the present study indicate that worker protection through the use of HPDs has the potential to reduce N_{eq}, possibly to safe levels where measures such as exhaust silencing have been implemented. This should afford Industry the opportunity to minimize hearing loss while pursuing genuine solutions. Tables A-7.12 to A-7.21 have been appended to assist with HPD selection for drill crews. These tables consider N_{eq} on the basis of 150 minutes of drilling time per shift. Where drilling times vary from that assumed in the appended tables, effective N_{eq} should be corrected by the difference between N_{eq} for actual drilling time and that for 150 minutes (Tables 3.4.1b and 3.4.2b, development and stoping, respectively).

4.4.4 Comparisons between underground and surface results

In order to characterize rockdrill noise emissions and resultant worker exposure in gold and platinum mining, this study was conducted underground. There was concern that surface measurements under essentially free-field conditions would not provide an accurate indication of noise emission and worker exposure in the highly reverberant underground environment. At the conclusion of the underground testing programme, results of noise measurements for four of the drills tested (two silenced and two unsilenced) were obtained from the manufacturer. These measurements had been conducted on surface in accordance with the CAGI-Pneurop test code (for measurement of sound from pneumatic equipment), at 400 kPa and 600 kPa. These results are appended in Tables A-7.10 and A-7.11, along with corresponding results for the same drills as determined in the stope during the present study (from Table A-7.6).

The greatest difference between underground and surface results for an individual machine occurred with drill P-3/Ss operating at 400 kPa, where the underground L_{Aeq} value was actually 2,1 dB lower than that from surface tests. (This same drill was 0,2 dB louder underground at an operating pressure of 600 kPa.) The next greatest difference occurred with drill P-3/Su at 600 kPa, where the underground L_{Aeq} was 1,9 dB greater. If one were to disregard (as a possible anomaly) the instance where the underground L_{Aeq} was 2,1 dB less than on surface, differences for individual drills at either operating pressure would range from 0,2 dB to 1,9 dB, the underground values all being greater. Averaging the differences in L_{Aeq} for both operating pressures indicates that individual drills were 0,5 dB to 1,2 dB louder in the underground stope. Considering both pressures, the two silenced machines were, on average, 0,4 dB louder underground, while the two unsilenced drills were 1,0 dB louder underground. If

silenced and unsilenced drills are treated collectively and both operating pressures considered, these four pneumatic machines were, on average, 0,7 dB louder underground than on surface.

The minor differences between L_{Aeq} values determined underground and those determined during surface tests are all attributable to variances in L_{pA} at the lower frequencies (63-125 Hz), and call into question the need for underground measurements as opposed to surface tests. It could be argued that the costs of overcoming the logistical obstacles associated with underground testing and the difficulties encountered with microphone response in hot, humid conditions outweigh the questionable difference in representativeness between surface and underground measurements. Noise emissions from rockdrills could be better evaluated by means of intensity-based determinations of sound power level in accordance with ISO 9614: 1993. Sound power is an absolute parameter independent of environmental factors and can be used to accurately predict sound pressure levels and workers' equivalent noise exposure for a given acoustic environment. Accordingly, the determination of sound power level would allay all concerns surrounding noise measurements conducted on surface. However, even where the means for applying these techniques are not available, resulting in reliance on traditional sound pressure level determinations, where noise measurements are the only requirement, a strong case can be made for surface testing.

4.5 Risk of hearing impairment

Although age, individual susceptibility, medication, disease and congenital factors can all play a role in the development of hearing impairment, these are outside the scope and influences of the workplace and, in any case, the principal determinants of occupational hearing loss for a population of workers are the level and the period of exposure. The importance of reducing N_{eq} can be demonstrated by considering how it influences the risk of hearing impairment. Reference to Table 4.6 and Figure 4.6 indicates that for an N_{eq} of 105 dB, 15 years of exposure would carry a 52 per cent risk of occupational hearing impairment (defined as a binaural average hearing threshold level exceeding 25 dB for an agreed range of test frequencies). Reducing N_{eq} to 85 dB for the same period, through the use of suitable hearing protection devices or by any other means, would diminish the risk to four per cent, while an N_{eq} of 80 dB would carry a risk of 0 per cent. This indicates that compliance with the legal limit of 85 dB does not eliminate all risk, particularly for individuals more susceptible to the development of hearing loss.

It will be noted in Table 4.6 and in Figure 4.6 that, depending on the level of N_{eq}, after 20 to 40 years of exposure the risk of occupational hearing impairment actually diminishes. This is due to an increasing influence of age on hearing, which limits the potential for noise exposure to contribute to the development of hearing impairment. Risk of developing occupational hearing impairment is defined as the difference in prevalence (per cent) of hearing impairment between a noise-exposed population and a non-noise-exposed but otherwise equivalent population. As advancing age begins to affect the non-noise-exposed population, the differences between the exposed and non-exposed groups diminish. Hearing impairment is defined as a condition that exists when the arithmetic mean of a subject's permanent hearing threshold levels at 500 Hz, 1 000 Hz and 2 000 Hz exceeds 25 dB (SABS 083: 1983).

It is apparent that reducing N_{eq} to safe levels by any means yields significant reductions in the risk of hearing impairment. One could expect that such reductions would also result in improved communication, not only by limiting the occurrence of hearing impairment but also through reduced interference for all workers, impaired or unimpaired. This should serve to enhance overall productivity through improved efficiency and a decreased incidence of accidents.

Table 4.5

Estimated risk of occupational hearing impairment based on N_{eq} and years of exposure

Years of Exposure	Risk (per cent) of Occupational Hearing Impairment for an Equivalent Noise Exposure (dB) of:							
	80	85	90	95	100	105	110	115
0	0	0	0	0	0	0	0	0
5	0	1	4	7	12	18	26	36
10	0	3	10	17	29	42	55	71
15	0	4	13	23	37	52	70	82
20	0	6	15	27	41	57	77	86
25	0	7	16	29	43	60	78	84
30	0	8	18	31	44	62	77	81
35	0	9	20	32	44	61	72	75
40	0	10	21	29	41	54	62	64
45	0	7	15	23	33	41	45	47

Adapted from ISO 1999 : 1975 Annex B.

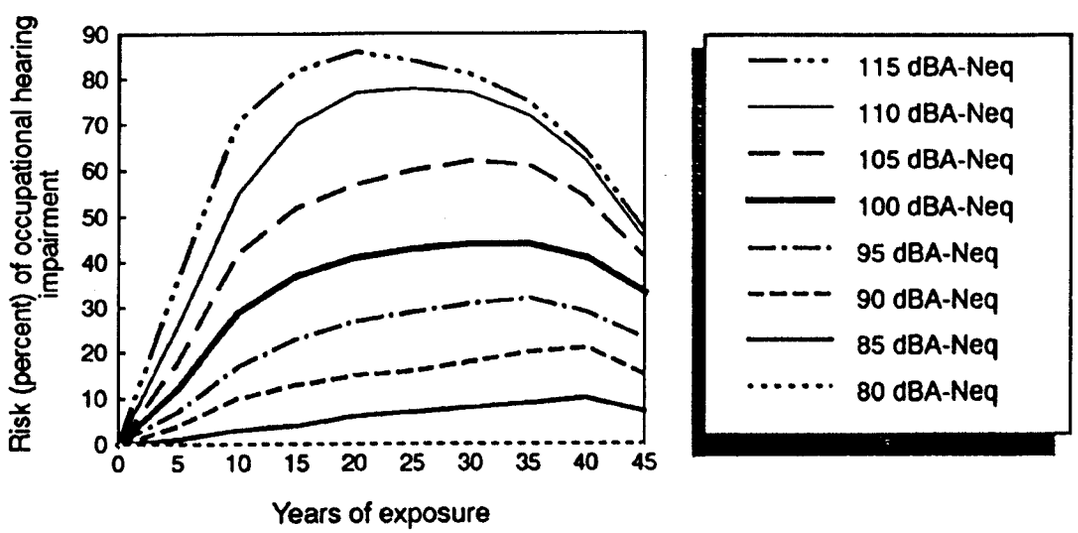

Figure 4.5 Estimated risk of occupational hearing impairment

In the short-term use of noisy machinery is likely to continue. Furthermore, in some cases excessive emissions will severely limit the potential for conventional HPDs to control worker exposure to safe levels. Perhaps the most extreme example would be the unsilenced pneumatic rockdrill in gold and platinum mines. At an operating pressure of 600 kPa, the number of conventional HPDs capable of reducing operator exposure to 85 dB or below is extremely limited. Among those devices that have been evaluated in terms of SABS 1451 or equivalent, only three configurations of HPD would provide adequate protection. These are two combinations of high-quality muffs and earplugs, and one custom-moulded insertable device set to maximum attenuation. It is unlikely that drill operators in hot stopes would find earmuffs acceptable, particularly in combination with earplugs, and the cost of the custom-moulded device could well be prohibitive. The number of HPDs that would be adequate for an operating pressure of 400 kPa is only slightly greater. In this case four additional devices would be suitable but three of these are earmuffs.

From the above it would appear that operators of unsilenced pneumatic rockdrills (and others working nearby) are likely to be over-exposed even when wearing HPDs. Nevertheless, there is considerable advantage to be gained from providing any reasonable level of protection, even if effective N_{eq} still exceeds 85 dB. Further reference to Table 4.5 and Figure 4.5 indicates that, over a period of 15 years, reducing N_{eq} from 110 dB (unprotected level) to 90 dB decreases the risk of compensable hearing impairment from 70 per cent to 13 per cent. Therefore, the use of hearing protection that reduces effective N_{eq} to 90 dB, while inadequate in that it would fail to control risk to the legal limit, would still offer a considerable reduction in the risk of compensable hearing impairment.

The adoption of 85 dB as the exposure limit locally and by most industrialized nations, together with emerging support for a further reduction to 80 dB precludes any consideration of a limit greater than 85 dB. However, industry could limit the development of NIHL and future financial impact by implementing effective personal protection strategies together with interim engineering measures. Although N_{eq} can be controlled through the application of personal protection, this relies on effective education and training to ensure individual compliance and can, in certain situations, result in impeded communication. The systematic approach of reducing noise at or near the source through effective engineering solutions would prove more beneficial in the long term.

4.6 Warning signals and safe allocation of hearing-impaired workers

The results of warning signal output measurements in the underground haulage for a range of commonly used signalling devices indicated considerable differences in the devices' output levels and frequency spectra. Each of the types considered would prove beneficial given their use in an appropriate acoustic environment. Conversely, a number of them would be a less than ideal choice in other situations. The absence of sufficient labelling or accompanying technical information on the emission spectra of most signalling devices forces the user to rely on subjective experience to determine which device would be appropriate in a given situation. Considering that excessive noise levels prevail in mining and are commonly known to result in significant hearing loss among mineworkers, the choice of appropriate signalling devices is critical to safety and, for that matter, productivity.

4.6.1 Selection of signalling devices

The choice of signalling device should be based, in the first instance, on determinations of noise spectra and emission patterns (continuous, regular, intermittent) in the place of intended application and the frequency spectrum of the signal produced by the device being considered. The first requirement is easily met, either by direct observation with a SLM and octave analyser or by reference to the relevant tabulation in the present report. Knowledge of the frequency spectrum for the signalling device should be provided by the manufacturer or supplier but, as stated previously, this is generally not the case. One could, given the necessary instrumentation and samples of devices being considered, analyse signal outputs directly, but it would be more practical to compel the supplier to provide the required information, preferably determined by a recognized authority or organization.

Criteria for determining a signalling device's suitability in a given acoustic environment are reasonably straightforward. An initial indication of suitability is that the device's A-weighted sound level be at least 15 dB greater than that of prevailing machinery or background noise (ISO, 1986). More specifically, the device's primary (and secondary, if it exists) signal should be at least 10 dB greater than background emissions at the frequency/frequencies of the signal. Clearly, a device with a pronounced signal output in two or more octave bands would be preferable to single-frequency devices. In addition, the frequency distribution of the signal's output should differ from that of the background in order to enable its identification against prevailing machinery noise. In other words, where high frequency machinery noise prevails, the signal should be produced at lower frequencies, preferably two or more octave bands

removed from background. Conversely, where low frequency noise predominates, an appropriate signal would be one that is two or more octave bands higher in frequency than the background noise. In the latter situation it is important to consider that signals at frequencies of 3 kHz and above would be less audible to individuals exhibiting NIHL, which initially manifests itself at 4 kHz and, progressively, at both higher and lower frequencies (Ward, 1986). Higher frequency signals would also be attenuated to a greater extent by most conventional HPDs, as well as by increased distance from the source. Another requirement is that the emission pattern of the signalling device should differ from that of the background noise. Where continuous noise prevails the signal should be of a non-continuous nature, i.e. switching on and off at one to two second intervals.

A more difficult issue bearing on the selection of signalling devices is the hearing threshold levels of workers required to hear the signal. Consideration of specific workers' hearing levels is possible by direct reference to recent audiometric tests results, but it is not always possible to access such information owing to administrative bottlenecks or the enforcement of medical confidentiality. Where such impediments do not exist or can be overcome, one must still consider the effect of hearing protection on a worker's hearing threshold levels (HTL). This would be greatly influenced by the choice of HPD.

Given the availability of attenuation test results for a particular HPD (a requirement in terms of SABS 083), means should be reduced by one or two standard deviation units, depending on the capability or likelihood of the individual correctly applying the device. The result is the effective (with HPDs) attenuation of the HPD at the relevant centre frequency. This procedure is repeated for all frequencies of concern, which would include those at which the intended warning device emits its signal. Once effective attenuation has been calculated for all frequencies of concern, the values are added to their corresponding HTLs determined by audiometry. This yields effective (with that specific HPD) HTLs which are then compared with corresponding L_{pA} values for the signalling device. If effective HTL at the frequency/frequencies of concern is 10 dB or more below signal level the device should be audible, provided it is distinct (in terms of frequency and level) from prevailing background noise. Where effective HTL approaches or exceeds the signal level an alternative signalling device could be considered, possibly a visible or audible/visible signalling device. In some instances a different choice of HPD would have less effect on HTL at the frequency/frequencies of concern and result in improved signal audibility.

4.6.2 Safe allocation of hearing-impaired workers

Concern over the performance of signalling devices and the concomitant safety implications is directly related to the issue of hearing-impaired workers and devising means of evaluating their competency for allocation, particularly where an ability to hear critical warning signals is required. In this regard there are no less than four important issues to be considered:

- the safety of the individual and of his co-workers,
- the financial needs of the individual,
- the long-term health of the individual with specific reference to hearing loss, and
- the employer's need to ensure safety and productivity, both of which impact on profitability.

In order to address the first issue, some mines have taken the position that individuals in "critical occupations", i.e. occupations where perception of warning signals is imperative (e.g. vehicle and mobile equipment operators) should not have an average hearing loss in the speech zone (500, 1000 and 2000 Hz) that exceeds 25 dB.

In an attempt to address the first and second issues together, some mines have decided to allow individuals with an average hearing loss of 40 dB (or more for non-critical occupations) to continue in their present occupation. This higher action level is intended to close the gap between the point at which an individual is declared unfit for duty in a particular occupation (e.g. > 25 dB) and that at which he becomes eligible for compensation (previously 42 dB). The higher action level may be more defensible in moral and industrial relations terms, but without special precautions, it could result in an increased safety risk. Special precautions could include the repositioning of existing signals to improve audibility, the installation of alternative audible signals or visible signalling devices to complement conventional audible signals, and special training for the hearing-impaired individuals.

The long-term health of hearing-impaired workers is perhaps the most difficult issue, particularly where measures aimed at preserving the individual's remaining hearing impact negatively on his earnings. Transferring the employee to a quieter work environment may prevent further hearing loss, but may result in a reduced pay packet. Furthermore, such a course of action implies that a healthy individual would have to be trained and then put to work in the noisy job and be exposed to a significant risk of incurring hearing loss. Retraining, re-allocation and the time required for new incumbents to become productive all bear on the

employer's need to ensure productivity, while retaining a hearing-impaired individual in a critical occupation may impact on safety.

There is, as yet, no industry-wide policy or guideline regarding the safe allocation of hearing-impaired workers. The formulation of such a policy should, ideally, consider input from medical/audiological, safety and personnel experts, as well as employee representative organizations. It would be to the employer's advantage to have such a policy with guidelines in place before re-allocating individuals for reasons of hearing loss, at least at mine level. In any event, consultation with the affected employee would be essential.

In instances where the individual is involved in tasks where perception of warning signals would not be essential, or if essential but alternative means of signalling (e.g. visible signals) could be provided, a decision on re-allocation could be based on the workers' informed preference. Where perception of warning signals would be essential and no practicable alternative to audible signalling exists, the decision would have to be based on the employer's need to ensure the safety of the individual and his co-workers, as well as productivity considerations. In such instances, every effort should be made to limit financial impact on the hearing-impaired employee. Failure to address this issue would not only be regarded as unfair to the individual, but could result in opposition from employee representative organizations.

In considering the criteria applied in deciding on an individual's fitness for work, use of an arbitrary action level (> 25 dB or > 40 dB) may have administrative advantages but these are at the expense of a comprehensive evaluation of specific requirements. As an alternative, assessments could be based on a frequency analysis of noise prevailing in the individual's workplace, including audible signals to which he is expected to respond, and on his hearing threshold levels (HTL) as determined during audiometry. By comparing frequency-specific sound pressure levels with the individual's frequency-specific HTLs, it is possible to determine whether he would be able to hear the signal(s) used in his workplace. It would also be possible to consider his effective HTLs while wearing a particular hearing protection device. As stated previously, effective HTLs are determined by increasing the values of the individual's HTLs (left and right ear) at each frequency by the number of decibels of effective attenuation provided by the HPD at that frequency.

To consider this method by way of an example, if an audible warning device emits its principal signal at a frequency of 2 000 Hz and a level of 87 dB as measured at the individual's work station, his effective HTL at 2 000 Hz would need to be 77 dB or less, in order to ensure his ability to hear the warning. If his left and right ear HTLs at 2 000 Hz were determined by

audiometry to be 50 and 55 dB, respectively, and he were to be fitted with HPDs that provide 21,9 dB of effective attenuation at 2 000 Hz, his effective left and right ear HTLs would be 71,9 and 76,9 dB, respectively. Since the level of the signal as measured at the man's work station would be greater than either of his effective HTLs at 2 000 Hz, it would be reasonable to expect him to hear the warning. Where effective HTLs do not meet this criterion, an alternative HPD that provides less attenuation at the frequency of concern could be considered, or perhaps the installation of a device that emits a louder signal or a signal at 1 000 Hz (where the individual's hearing would be likely to be better) would be possible. Visible and audible/visible signalling devices could also be considered.

The method of assessment described above would rely, in part, on information from *in situ* frequency analyses of machinery noise or reference to the relevant tabulations in the present report. It would also depend on the availability of the frequency spectrum for any signalling device(s) being considered.

In evaluating an individual's competency for employment in critical occupations the assessor would need to consider the frequency spectra for noise and signals, the individual's audiometric test results and the effect that various HPDs would have on hearing levels. This would be a far more difficult method to administer, but it would enable many hearing-impaired workers, who would otherwise be excluded, to continue in their present jobs. It would also enable the employer to retain the services of his most experienced employees, maintaining productivity and the limiting costs associated with training and retraining. It would also serve to limit the incidence of industrial relations disputes and avoid the exposure of unimpaired individuals to dangerous noise.

In order to address the administrative burden that would be imposed by adopting a merit-based assessment procedure, it would be essential to develop appropriate computer software. With databases of frequency spectra for various workplaces and audible signalling devices and for attenuation performance of HPDs, purpose-designed software could be used to assess worker competency at the point of routine audiometry.

5 CONCLUSIONS AND RECOMMENDATIONS

The identification of noise as a predominant health and safety hazard, not only by Industry itself but by employee representative organizations and the Leon Commission (1995), has served to raise questions around the extent to which it has been addressed in the past. The financial implications of Internal Instruction 168 from the Workmen's Compensation Commissioner and results of risk assessments conducted in terms of the Mines' Health and Safety Act have served to re-identify the issue of noise and the adequacy of initiatives to address it. Industry's concern with the detrimental effects of noise on workers and on mines' productivity and profitability was the impetus behind the current programme of work. Its overall purpose, as its title implies, is to improve the effectiveness of hearing conservation programmes. To this end a number of conclusions and recommendations are appropriate, which focus on the following issues:

- the strategic priority of formulating plans for the development of mining equipment that will meet Industry's future needs, in terms of productivity and controlled health and safety risk,
- the interim need to balance the apparent tension between reduced productivity (resulting from measures such as retrofitting exhaust silencers to drills) and providing worker protection (with due consideration to the limitations of most HPDs),
- the need for re-emphasizing education and training as essential prerequisites where HCPs are reliant on personal protection,
- the benefits of a systematic, risk assessment-based approach to the selection of HPDs, and
- possible means to reduce logistical bottlenecks incident to the requirements of existing audiometric programmes and the expansion of the role of screening audiometry in assessing competency for critical occupations.

A review of prevailing emission and exposure levels indicates that, in terms of the number of work categories (if not the number of individuals), the majority of production workers in the South African mining industry are exposed to potentially damaging noise levels. In this regard a number of recommendations are made and grouped into the sections that follow.

5.1 Hearing conservation programmes

Hearing conservation programmes are required for underground and surface workers, both in terms of risk control and the legislative requirements promulgated in 1989. HCPs should be implemented as an urgent priority where none presently exist, encompassing both noise control engineering initiatives and the provision of personal protection as an integrated risk control strategy.

Existing HCPs require regular review and optimization in accordance with prevailing noise levels and the results of employees' audiometric tests, particularly where the HCP is shown to be less than effective. In order to more satisfactorily evaluate and revise hearing conservation programmes, management tools and benchmarks for comparison are required. The first need could be addressed by the Hearbase computer software developed for this purpose during the current programme of work. Means of fulfilling the second need are discussed in the next section.

5.2 Industry-wide database

The need for benchmarks could be met through the publication of industry-wide information on noise levels, exposure levels and workers' hearing threshold levels. In order for such information to be useful it would need to be accumulated in a database from as many sources as possible and reported on at regular intervals. This could be best accomplished through the establishment of regular reporting requirements for noise emission and particularly noise exposure levels, the extent of hearing loss recorded and the rated sound power levels of new machinery purchased. Not only would the dissemination of such information allow mine managements to compare their HCPs' effectiveness with those in the rest of Industry, but it would enable the identification of trends to be used in revising research strategies and noise control policy. Finally, it would make it possible for the mining industry to determine risk levels based on numbers of employees exposed to various levels of noise for varying periods of time (years), to ensure that adequate financial provision is made for future compensation claims.

5.3 Noise control engineering

A study should be undertaken to investigate the efficacy and feasibility of NCE measures for mining equipment. This study should draw from the experiences of other mining industries and consider the costs of applying NCE to machines presently in use, as well as that of incorporating NCE into designs for new machinery. Processes and machinery requiring NCE

should be prioritised in terms of the risks they present, considering noise emission levels and the number of workers affected.

New machines should be designed in such a way as to allow compliance with noise limits, with reduced reliance on HPDs and the ultimate goal of eliminating the need for personal protection. This process could be initiated by Industry setting limits for maximum noise levels, which would be best specified in terms of sound power level, since it is an absolute value independent of environmental factors. Manufacturers and suppliers should be directly involved in the setting of these limits and the target dates for their achievement, as should all other stakeholders. The limits should then be applied as criteria during the procurement process, a strategy which would encourage manufacturers and suppliers to address the noise hazard. Limits should be reduced incrementally in accordance with agreed schedules based on risk, until noise emissions have been controlled to safe levels. Cooperative decisions involving Industry, manufacturers, government and employees should result in agreement on initial limits and eventual targets, as well as the increments and time scales for achieving them. This process and the development, of new machinery designs that result from it will require considerable time to yield benefits and, accordingly, current initiatives should be expanded and coordinated through an industry-wide approach as suggested by Murray-Smith (1989).

5.4 Personal protection

Until such time as safe emission levels are a reality, workers should be educated to recognize noise as a hazard, to appreciate the impact that hearing loss can have on their health, safety and employment prospects, on their families and on their work and social relationships. Suitable educational initiatives would serve to gain workers' acceptance of and compliance with employers' hearing conservation policies and should include training in the correct use of HPDs. The utilization of educational and motivational materials developed under the current programme of work and the further development of such educational aids would contribute to these ends.

Personally applied hearing protection should be regarded as a legitimate hearing conservation strategy only until the benefits of noise control engineering can be realized. Only those devices that have been evaluated in accordance with SABS 1451 should be considered for use in mines' hearing conservation programmes. This is in order to ensure compliance with current legislation and SABS 083, as well as the validity of HPD comparisons during the selection process. Manufacturers and suppliers of HPDs should be encouraged, through the procurement process, to submit their products for evaluations conducted in accordance with

SABS 1451. Selection of HPDs for issue to noise-exposed workers should be made with due cognisance of the noise levels and other environmental conditions (e.g. dust and heat) prevailing in the individual's workplace, as well as any hearing loss the individual may already have incurred. The final choice, from those determined to be appropriate, should be made by the individuals expected to wear them, in order to improve compliance with the employer's PPS. In instances where N_{eq} exceeds the corresponding L_{Aeq} as a result of exposure to other noise sources, HPD selection should provide for the greater source of exposure. Individuals so affected could, in addition to the HPDs issued for normal use, be provided with higher attenuation devices for use in the high noise situations they encounter. Such provision would be particularly appropriate for (but not necessarily limited to) fitter/turners, other maintenance personnel and supervisors. Where high attenuation HPDs are provided for use in extreme noise situations, workers should be trained to recognize where these devices are to be used, where they would be inappropriate in terms of safety and why.

In order to facilitate the process of HPD selection, particularly where special problems exist (e.g. pre-existing hearing loss) the development of specialized computer software should be considered. The software should refer to L_{pA}, L_{Aeq} and N_{eq} levels in the workplace, frequency spectra for audible warning devices, mean attenuation and standard deviation values for HPDs being considered (determined in accordance with SABS 1451), as well as the individual's own hearing threshold levels. Rules and criteria should then be applied by the software, in order to determine appropriate combinations of warning signal and HPD. This procedure could, with the use of suitable software, be performed at the time of routine audiometric assessments for all noise-exposed workers, and particularly those in occupations where the perception of audible warning signals is critical.

5.5 Hand-held rockdrills

The significance of the hand-held rockdrill in terms of noise levels generated and number of people exposed warrants separate consideration. The results of the current programme of work indicate that noise immision attributable to unsilenced pneumatic rockdrills is beyond the capability of most conventional HPDs to provide adequate protection, while noise from silenced pneumatics, and particularly that from water-hydraulic machines, is within the limits of protectability by conventional means. Managements of established mines designed around compressed air reticulation systems may choose to continue using the pneumatic rockdrill but, as an interim strategy, should consider the retrofitting of exhaust silencing, either in the form of an external baffle chamber or an integrated silenced cylinder, depending on the make and model of rockdrill. A phased approach to this noise reduction programme could be adopted,

with machines being converted as they are returned for repairs. Integrating the conversion process with routine maintenance and repair would serve to control costs and minimize interference with production. It would, naturally, depend on halting further purchases of spares applicable only to the unsilenced machines, e.g. unsilenced replacement cylinders. The reductions in drill performance that would result and concomitant financial implications should be weighed against the costs of increased compensation, time lost for medical referrals/specialist evaluation, worker dissatisfaction and union pressure, as well as long term negative impact on productivity and safety resulting from cumulative hearing loss and interference with communication.

A decision to implement the silencing of pneumatic rockdrills should involve workers, in particular drilling crew members. Gaining their support will require an educational campaign promoting the benefits of reduced noise levels, since operator support and commitment are essential to minimizing impact on productivity. To this end, serious attention should be directed towards devising strategies that maintain profitability for both employers and employees. Implementation of exhaust silencing for pneumatic drills would not reduce emissions to safe levels and, accordingly, should be viewed only as an interim measure. It would, however, make adequate protection of operators and other exposed persons through the use of conventional HPDs more achievable. Ensuring that a personal protection strategy contributes positively to reducing noise exposure will require education and reinforcement, as well as the provision of acceptable hearing protection devices. A range of HPDs selected for their effectiveness in attenuating noise from silenced pneumatic machines should be made available, in order to allow exposed persons to choose the type they are most comfortable with. This approach would encourage compliance with the mine's personal protection strategy and ensure maximum benefit from the noise exposure reduction programme.

Where the use of unsilenced pneumatic machines is to continue, reducing noise exposure would be totally dependent on individuals using HPDs effectively, making education and training an issue of paramount importance. It would also be essential to ensure that only those HPDs with adequate attenuation capabilities are issued to exposed workers. These devices include, but are certainly not limited to, custom-moulded ear plugs, a combination of high-quality muffs and electronically operated active noise suppression or cancellation muffs. These devices would encounter varying levels of user resistance and, being relatively expensive, would impact on profitability. Cost is of particular concern when one considers that most members of the production team require levels of protection similar to those needed for drill operators. Although the continued use of unsilenced drills would maintain current levels of drill performance, any cost analysis comparing silenced and unsilenced machines should

consider the financial ramifications of issuing and maintaining suitable hearing protection for all those requiring it. From a risk control perspective, reliance on each individual to properly apply personal protection would be less effective than a systematic approach, i.e. a reduction of noise at source. Current initiatives in this regard, while promising, will require further development and, in the interim strategies to control worker exposure will be essential.

In order to pursue solutions presently under investigation and realize their full potential, it is recommended that manufacturers be involved as extensively as practicable, in order to forge a partnership in the full implementation of a safe and productive drilling system. The objective would be to enable Industry to utilize its considerable investment in compressed air reticulation systems and reduce noise emissions to a level where HPDs would be unnecessary, while maintaining or exceeding the levels of drill performance currently exhibited by unsilenced machines.

Evaluation of designs that hold promise should utilize sound intensity determinations in accordance with ISO 9614 or other relevant standards, rather than traditional sound pressure level measurements. This would allow components and assemblies within the machine to be evaluated individually and ranked for the purpose of prioritising corrective measures. Intensity-based sound power determinations would provide researchers and designers with an acoustic signature or "fingerprint" of the machine or assembly being considered, without the need to control the measuring environment through the use of anechoic or reverberation chambers. Sound power can be used to accurately predict sound pressure level in any acoustic environment, as well as resultant worker exposure, virtually eliminating the need for underground tests and their concomitant logistical and technical problems, provided noise measurements are the only requirement. In this regard, comparisons made between sound pressure levels determined underground and on surface in accordance with the CAGI-Pneurop test code (for measurement of sound from pneumatic equipment :1981) indicate minimal differences between the two methods. Accordingly and in view of the difficulties with microphone misting encountered underground, it is recommended that future noise measurements for evaluating acoustic improvements to rockdrills be performed on surface, even where sound pressure level measurements are to be employed.

On mines where water-hydraulic rockdrills are used, education of production team members, particularly drilling crews, should be treated as a priority. Although the spectra of emissions attributable to these machines readily allow attenuation to safe levels, exposed workers must be made to appreciate the importance of hearing protection in avoiding the detrimental effects of noise exposure. The spectral characteristics of noise emissions from water-hydraulic machines that facilitate adequate protection would also result in overprotection with many

HPDs. As a general rule, HPDs that yield an effective N_{eq} value below 70 dB should be avoided, in order to prevent the over-attenuation of communication means, including warning signals. Where overprotection interferes with communication, workers may be inclined to remove or incorrectly fit HPDs, exposing themselves to damaging noise in the process. If effective noise abatement at source is accepted as preferable to reliance on personal protection strategies, the water-hydraulic rockdrill should not be regarded as a final solution to the noise problem. Investigation of means to further reduce emissions from these drills to levels where personal hearing protection would be unnecessary should be pursued.

5.6 Other sources of noise

Other noise sources such as mechanized mining equipment and ventilation fans should be addressed, in the interim, through a programme of retrofits including but not limited to those described in Section 4. As for other significant noise sources, the development of quieter machinery designs should commence as soon as possible and comprise co-operative initiatives between manufacturers and Industry.

In the case of fans, the alternative siting of auxiliary units should become standard practice to reduce airborne noise affecting workers. This strategy should be combined with NCE measures at or subsequent to the time of installation to control structurally transmitted emissions. Here again, Section 4 of the present report provides general guidance in this regard. Successful implementation of these strategies could reduce requirements for costly fan attenuators.

Main fans cannot be relocated but NCE measures suggested in Section 4 should be evaluated for viability and practicability. Active noise control or noise cancellation should be considered for at-source control of main fans and, if viable, expanded to auxiliary units. The continuous and unvarying nature of fan emissions could enable implementation of active noise cancellation without expensive electronic control systems for noise cancellation actuators.

5.7 Audiometry

Effective N_{eq} for exposed workers will certainly diminish to safe levels where mines succeed in implementing noise exposure reduction programmes that include NCE retrofits for existing equipment and successful personal protection strategies employing appropriate HPDs acceptable to workers. In such instances it could be argued that six-monthly audiometric testing presently required for some occupations (N_{eq} > 105 dB) would be unnecessary. Accordingly, it is recommended that Industry approach the South African Bureau of Standards for an amendment to SABS 083, revising the requirement for six-monthly testing to consider

"*effective* N_{eq} exceeding 85 dB", in cases where cogent noise exposure reduction programmes are in place. If need be, individual mines could demonstrate the stabilization of workers' hearing levels determined by audiometric testing as motivation for discontinuing 6-monthly audiometry where presently required.

5.8 Summation of conclusions and recommendation with implementation considerations

From the conclusions and recommendations emanating from the current report, it is patently clear that the strategic approach required for dealing with noise as a health and safety hazard is quite complex. It therefore follows that implementation of the recommendations themselves would be equally complex unless addressed in a comprehensive and coordinated fashion.

A fundamental prerequisite is recognition of the impact that noise has on health, safety and, therefore, overall productivity and of its effects on the vast majority of employees, irrespective of occupation or commodity being mined. In essence, noise is an issue confronting the South African mining industry in its entirety and a consolidation of effort represents the only viable approach. The concept of a "Standing Committee on Hearing Conservation" with supporting working groups is proposed as a point of departure. The following issues should serve as terms of reference and provide the basis for the envisaged framework illustrated in Figure 5.8:

- central co-ordination,
- policy development and implementation,
- strategic direction, and
- identification of research and development needs, where indicated.

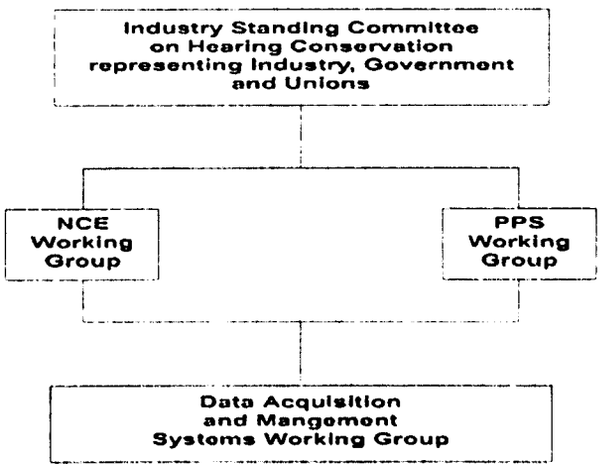

Figure 5.8 Proposed committee and working group structure for the implementation of findings generated by the current report

5.8.1 Noise control engineering

With regard to engineering measures for at-source noise control, there can be little doubt that these will be commodity-linked. This suggests the need for a specialist NCE working party at a second structural level as reflected in Figure 5.8. Conceivably, the working party mechanism could also be applied to common sources of noise, irrespective of commodity. Examples include fans, drills, heavy mobile equipment, etc. The specific approach is immaterial, provided that source control is recognised as the single most important strategy for dealing with noise in the medium- to long-term.

Within the preceding context it should be appreciated that the new Mine Health and Safety Act places ample onus on manufacturers' and suppliers' "duty of care", a principle which enjoys international acceptance. This principle is particularly relevant to the issue of noise control engineering which, to date, has certainly presented the most challenging obstacle to hearing conservation programmes. Figure 5.8.1 summarizes various strategies for the implementation of noise control engineering to be considered by the proposed NCE working group.

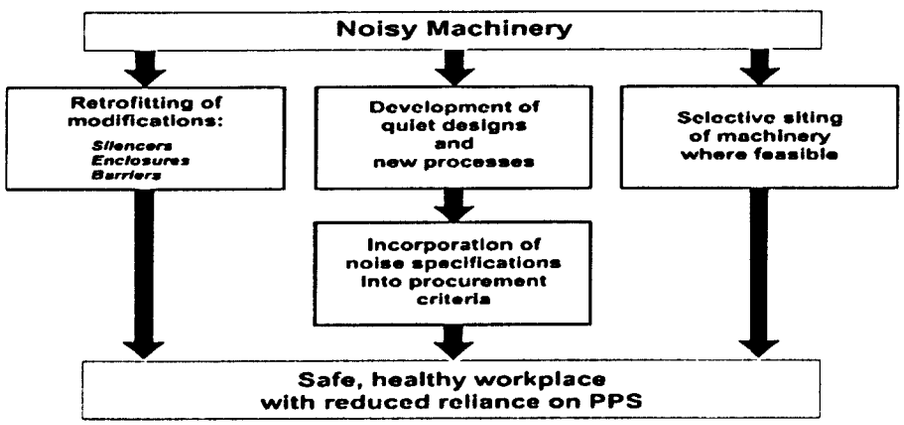

Figure 5.8.1 Strategies for the implementation of noise control engineering

5.8.2 Personal protection strategies

A parallel initiative to at-source noise reduction is the implementation of effective personal protection strategies, an issue for consideration by the proposed PPS working group (Figure 5.8). In this respect an essential requirement is that noise emission and noise exposure remain interlinked within an integrated HCP. (The relevant regulations of the Minerals Act, i.e. 4.17.1 and 4.17.2, seem to imply that noise control engineering and hearing conservation are separate issues.) While they may be pursued in totally different ways, they share a common objective, i.e. the establishment and maintenance of a beneficial and cost-

effective HCP. The elements of greatest importance to a PPS as identified in the current report and to be considered by the PPS working group are:

- education to engender an understanding and appreciation of noise as a health and safety hazard, contributing to worker motivation and compliance with HCP requirements,

- provision of appropriate (in terms of attenuation properties) HPDs with due cognisance of job-specific, environmental and ergonomic considerations, all of which help to determine worker acceptance and ultimate efficacy, and

- safe and/or alternative allocation criteria for workers with regard to occupation and hearing level, clearly an emotive and sensitive issue requiring the input and consensus of both management and workers.

5.8.3 Industry-wide database

The conclusions and recommendations emanating from the findings presented in the current report finally suggest that consideration be given to the establishment of a centralised industry-wide database. The present availability of information essential to valid industry-wide risk assessment and trend analysis can best be described as incomplete, inaccessible and unsuitable for formulating strategic direction.

The issue of a centralised database points to the establishment of an infrastructure which, in practice, could become part of an overall capability for dealing with other health and safety hazards. However, for present purposes it must be recognised that the issue of noise is somewhat unique and influenced by a multiplicity of organisational, engineering and human factors. It therefore follows that, if the concept of an infrastructural database is realistic, the establishment of a third working party is indicated. It is envisaged that such a body would interact closely with both the NCE and PPS working parties, as well as with the Standing Committee (Figure 5.8). In general terms, it would define the requirements of the data acquisition and management system with emphasis on:

- noise generation including emission levels and spectral characteristics,

- noise exposure by occupation or activity,

- noise reduction retrofits for existing equipment and the installation of quieter machinery when replacement becomes necessary,

- HPD attenuation characteristics for all locally available devices, and

- a comprehensive industry-wide audiometric database.

5.8.4 Consolidation and co-ordination of hearing conservation initiatives

While commodity-based differences in needs are evident, a synergy of effort with enhanced benefits would be likely to emerge through a co-ordinated Industry approach in which resources and expertise from broadly based sources are pooled. Here, once again, "duty of care" issues relating to manufacturers and suppliers of both mining and personal protective equipment would best be addressed from a position of strength founded on consensus across Industry. The proposals submitted are not intended to be definitive in nature or scope but represent a point of departure, should implementation of the recommendations made in the current report become a matter of serious consideration. Fundamentally, while consolidation of efforts and input from all stakeholders would be essential, the primary initiative to effectively address noise as a significant health and safety hazard remains with the South African mining industry, as indicated in Figure 5.8.4.

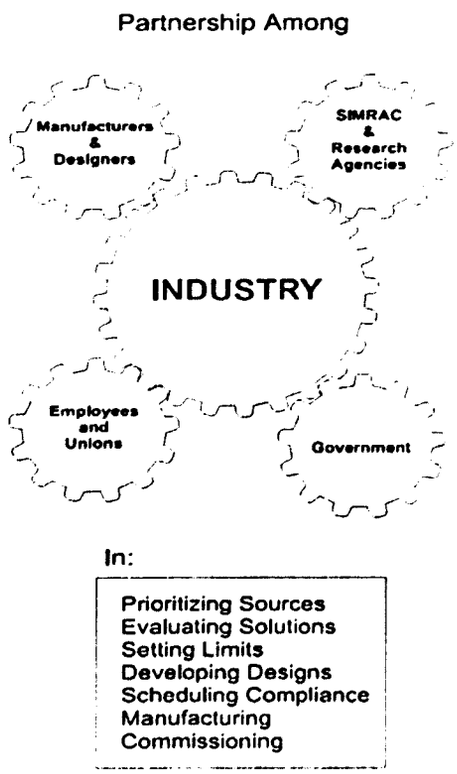

Figure 5.8.4 Industry initiative in a consolidated approach to noise control

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Appendix 1

HPD selection : general information

Page

A-1.1 Notes to assist with the use of tables for HPD selection in Appendices 2-7 . . 169

Table A-1.1 Details of hearing protection devices considered 172

A.1.1 Notes to assist with the use of tables for HPD selection in Appendices 2-7

Table A-1.1 contains frequency-specific mean attenuation and standard deviation values determined in accordance with various standards for each of 83 configurations of HPDs considered in subsequent Appendices (2-7), along with the HPD numbering codes used.

Each of the HPD selection tables relates to a specific occupation or workplace(e.g. Table A-7.12: operators of silenced pneumatic rockdrills in development ends at 400 kPa). Along the top row of each tabulation is a summary of personal noise dosimetry results for the occupation or workplace being considered. This summary includes mean, maximum and minimum N_{eq} values and the number of samples from which the values were derived. In instances where no dosimetry was performed the table includes calculated N_{eq} values.

Below each column heading for centre frequency, in the row labelled "w/o HPD", is the mean (or in some instances maximal) value for L_{pA} determined for that octave band. These are the A-weighted sound pressure levels to which unprotected workers in that occupation or workplace are likely to be exposed.

In the second-to-last column (labelled "L_{Aeq}") along the row labelled "w/o HPD", is the mean (or maximal) equivalent continuous A-weighted sound pressure level for the occupation or workplace being considered, calculated from L_{pA} values at the various centre frequencies, according to the formula for L_{Aeq} in Section 2.2. In the last column (labelled "N_{eq}") along the same row, is the expected equivalent noise exposure for unprotected operators, based on the dosimetry-derived (or calculated) N_{eq} rounded to the nearest integer.

The subsequent rows (labelled 1-83 as per Table A-1.1) display the effective L_{pA}, L_{Aeq} and N_{eq} values calculated for workers wearing the particular HPD being considered. For each HPD, the mean attenuation at each centre frequency (from Table A-1.1) was reduced by two standard deviation units, to determine the expected attenuation at that frequency. Two standard deviation units were subtracted rather than one, in order to avoid overestimating the level of protection. The L_{pA} at each frequency for unprotected workers was then reduced by the value of corresponding expected attenuation, resulting in the effective L_{pA}. Effective L_{pA} values at the various centre frequencies were logarithmically summed in accordance with the formula for L_{Aeq} (Section 2.2) to calculate effective L_{Aeq} for workers using the HPD being considered.

The reduction in L_{Aeq} provided by the HPD (L_{Aeq} without HPD minus L_{Aeq} with the HPD being considered) will result in a similar reduction in N_{eq}, provided L_{Aeq} values relate to the worker's principal source of noise exposure. The same reduction as calculated for L_{Aeq} has been applied to the value for N_{eq} without HPD, to determine effective N_{eq} for employees wearing the HPD being considered. This value is displayed in the last column of each row, rounded to the nearest integer. Where effective N_{eq} exceeds 85 dB, an indication that the particular HPD is inadequate for the occupation or workplace being considered, the value is displayed as >xx<. Where effective N_{eq} is less than 70 dB, an indication that the HPD may overprotect and interfere with communication, the value is displayed as ((xx)).

It will be noted that in the left column of the HPD selection tables some HPD codes are preceded and followed by asterisks (*n*). This is an indication that the HPD considered in that row was evaluated in accordance with a standard that may overestimate its effectiveness. For this reason, such devices should not be considered, unless they also appear in a different row, evaluated in accordance with a standard which provides a more realistic indication of effectiveness.

In general, it would be preferable to determine HPD suitability on the basis of evaluations made in accordance with SABS 1451. It would therefore follow that comparisons of HPD suitability should be limited to those devices evaluated in terms of this standard. Not only would such comparisons be more valid, but limiting the HPDs issued in terms of a Hearing Conservation Programme to those complying with SABS 1451 would satisfy the requirements of SABS 083 (as amended) and thus, current legislation. Suppliers of HPDs who have not already done so should be encouraged to arrange for evaluation of their products in accordance with SABS 1451, particularly where the results of other evaluations indicate that their product provides a reasonable level of protection.

The fact that a hearing protection device has met the requirements of SABS 1451, including those for minimum attenuation, does not in itself guarantee that the device will provide adequate protection against all noise sources. In the case of an extreme source, such as an unsilenced pneumatic rockdrill, many quality HPDs with reasonable levels of attenuation would not provide adequate protection. In such cases judicious selection with due cognisance of the

nature of the noise emitted and other environmental factors, e.g. temperature and humidity, will be essential in ensuring appropriate protection and acceptance by workers.

One final point is that the attenuation characteristics of HPDs listed in Table A-1.1 and applied in subsequent HPD selection tables were obtained directly from manufacturers/suppliers or their promotional literature. The attenuation characteristics were all documented as having been determined in accordance with one or more standards, some of which, as stated above, provide a more realistic indication than others of the level of protection that can be expected. These tabulations should not be interpreted as indicating that a particular HPD "passes" or "fails". They are, however, intended to provide a means of comparing the suitability of the various HPDs for a particular application. Devices that do not provide sufficient attenuation for an extreme noise source may well be suitable for more moderate applications and, in such cases, would be more appropriate than higher attenuation devices.

Table A-1.1
Details of hearing protection devices considered

Muffs (Band worn over head unless otherwise indicated)

Manufacturer and Model	HPD	Test Standard	Mean Attenuation and Std. Dev. (dB) at Given Centre Frequency (Hz)							
			Attenuation	125	250	500	1000	2000	4000	8000
AUTOMOULD TYPE EM62	1	SABS 1451 Pt 1:1988	Mean	10,1	14,9	23,0	31,0	32,5	36,7	31,8
Conventional			SD	3,6	5,0	4,0	3,9	2,2	2,8	3,4
			Mean-2SD	2,9	4,9	15,0	23,2	28,1	31,1	25,0
E.A.R. MODEL 9000	2	BS-5108:1983	Mean	9,7	17,9	23,8	22,4	24,5	27,4	24.6
Noise-Activated, Diaphragm-type			SD	2.5	2.5	2.5	1.9	2.4	2.2	3.5
			Mean-2SD	4.7	12.9	18.8	18.6	19.7	23.0	17.6
	3	ANSI S3.19 1974	Mean	12.3	17.0	24.4	22.9	23.8	25.0	25.6
			SD	2.9	2.4	2.4	2.3	2.2	3.1	2.6
			Mean-2SD	6.5	12.2	19.6	18.3	19.4	18.8	20.4
	4	ANSI S12.6:1984	Mean	10.7	15.4	26.4	24.1	23.3	25.6	24.4
			SD	3.9	3.1	2.7	2.7	2.4	3.0	2.4
			Mean-2SD	2.9	9.2	21.0	18.7	18.5	19.6	19.7
E.A.R. MODEL 4000	5	BS-5108:1983	Mean	11.1	15.2	21.7	24.6	32.7	38.2	37.6
Conventional			SD	3.4	2.9	2.9	3.2	2.5	2.8	4.1
			Mean-2SD	4.3	9.4	15.9	18.2	27.7	32.6	29.4
E.A.R. MODEL 1000	6	BS-5108:1983	Mean	14.8	15.2	24.3	34.4	34.7	36.7	38.3
Conventional			SD	3.7	2.8	2.9	5.8	3.2	2.7	3.0
			Mean-2SD	7.4	9.6	18.5	22.8	28.3	31.4	32.3
	7	ANSI S3.19 1974	Mean	11.7	16.2	26.5	31.6	32.5	38.1	41.8
			SD	3.3	2.7	2.7	2.6	3.0	2.5	3.8
			Mean-2SD	5.1	10.8	21.1	26.4	26.5	33.1	34.2
E.A.R. MODEL 1000-H	8	BS-5108:1983	Mean	8.4	11.8	23.4	28.4	29.9	36.7	37.5
Helmet-mounted			SD	1.5	1.2	2.4	2.7	1.7	2.2	3.2
			Mean-2SD	5.4	9.4	18.6	23.0	26.5	32.4	31.1
JAMES NORTH RB874	*9*	SABS 572:1973	Mean	11.9	18.1	23.0	33.0	33.0	34.0	27.0
UNIVERSAL HEARING PROTECTOR			SD	0.9	1.2	0.9	2.4	1.8	0.8	0.2
Conventional			Mean-2SD	10.1	15.7	21.2	28.2	29.4	32.4	26.6
JAMES NORTH SONOMUFF	10	BS-5108:1983	Mean	18.8	20.6	27.9	36.0	35.5	38.9	35.2
Conventional			SD	4.3	3.9	4.9	4.2	3.6	3.8	4.3
			Mean-2SD	10.2	12.8	18.1	27.6	28.3	31.3	26.6
RACAL CLASSIC 1	11	BS-5108:1983	Mean	9.5	14.9	23.2	32.9	33.7	37.1	35.1
Conventional			SD	2.9	2.0	3.0	3.4	3.0	2.3	4.6
			Mean-2SD	3.7	10.9	17.2	26.1	27.7	32.6	25.9
RACAL CLASSIC 2	12	BS-5108:1983	Mean	10.5	19.7	26.9	33.3	38.6	40.9	37.1
Conventional			SD	2.5	2.0	2.9	3.3	3.7	3.4	4.5
			Mean-2SD	5.5	15.7	21.1	26.7	31.2	34.1	28.1
RACAL CLASSIC 3	13	BS-5108:1983	Mean	15.9	22.4	28.8	38.0	38.0	43.5	40.6
Conventional			SD	2.5	2.3	3.0	2.8	3.3	3.0	3.1
			Mean-2SD	10.9	17.8	22.8	32.4	31.4	37.5	34.4
JAMES NORTH SILENTA POP 190 g	14	BS-5108:1974	Mean	11.2	15.6	21.3	30.8	33.1	40.1	35.4
Conventional			SD	2.7	3.1	3.7	3.5	3.7	3.9	4.9
			Mean-2SD	5.8	9.4	13.9	23.8	25.7	32.4	25.7
RACAL ULTRA MUFF	15	BS-5108:1974	Mean	9.6	14.6	22.7	31.3	30.8	31.3	28.1
Conventional			SD	4.9	3.4	4.3	4.9	3.5	3.3	4.9
			Mean-2SD	.0	7.8	14.1	21.5	23.8	24.7	18.3
BILSOM COMFORT 2420	16	BS-5108:1983	Mean	9.7	15.5	22.8	30.1	32.7	40.7	40.1
Conventional			SD	3.0	2.7	3.4	3.0	3.6	4.3	4.8
Over Head			Mean-2SD	3.7	10.1	16.0	24.1	25.5	32.1	30.5
	17	BS-5108:1983	Mean	8.7	13.0	21.7	29.2	31.4	39.2	39.5
Behind Head			SD	4.0	3.6	3.0	2.9	3.2	4.1	5.1
			Mean-2SD	0.7	5.8	15.7	23.4	25.0	31.0	29.3
BILSOM COMFORT 2440	18	BS-5108:1983	Mean	10.5	14.7	21.7	28.4	34.2	37.9	35.3
Helmet-mounted			SD	2.9	2.6	2.9	3.7	2.9	3.0	5.3
			Mean-2SD	4.7	9.5	15.9	21.0	28.4	31.9	24.7
BILSOM VIKING 2421	19	BS-5108:1983	Mean	14.2	19.1	30.0	34.2	33.0	42.4	43.7
Conventional			SD	3.2	2.6	3.2	2.7	2.9	3.2	3.7
Over Head			Mean-2SD	7.8	13.9	23.6	28.8	27.2	36.0	36.3
	20	BS-5108:1983	Mean	13.9	19.9	28.6	38.8	33.9	43.2	42.5
Behind Head			SD	4.6	3.4	3.7	5.8	6.6	6.2	5.5
			Mean-2SD	4.7	13.1	21.2	27.2	20.7	30.8	31.5
BILSOM VIKING 2314	21	BS-5108:1983	Mean	13.3	19.9	30.7	35.3	34.5	41.3	37.2
Helmet-mounted			SD	3.8	3.6	3.6	3.4	3.7	3.0	3.3
			Mean-2SD	5.7	12.7	23.5	28.5	27.1	35.3	30.6
BILSOM BLUE 2452	22	BS-5108:1983	Mean	10.6	13.8	21.9	30.7	33.6	33.8	37.5
Conventional			SD	4.0	2.8	3.6	3.6	3.3	3.9	4.6
			Mean-2SD	2.6	8.2	14.7	23.5	27.0	26.0	28.4
BILSOM BLUE 2431	23	BS-5108:1983	Mean	9.4	12.8	21.3	30.8	33.3	39.5	42.7
Helmet-mounted			SD	3.7	2.7	2.2	3.8	3.3	3.1	5.5
			Mean-2SD	2.0	7.4	16.9	23.2	26.7	33.3	31.7
BILSOM YELLOW 2453	24	BS-5108:1983	Mean	12.5	14.0	20.3	30.4	32.4	38.6	36.7
Conventional			SD	4.2	2.9	2.7	4.1	3.6	4.3	6.0
			Mean-2SD	4.1	8.2	14.9	22.2	25.2	30.0	24.7
BILSOM LOTON 2401	25	BS-5108:1983	Mean	11.0	12.7	21.6	30.0	31.1	32.2	34.8
Conventional			SD	3.4	3.5	3.5	3.4	3.3	4.4	3.9
			Mean-2SD	4.2	5.7	14.6	23.2	24.5	23.4	27.0
BILSOM COMPACT 2470	26	BS-5108:1983	Mean	9.4	11.4	19.2	26.4	30.8	38.1	37.2
Conventional			SD	3.5	2.6	3.2	2.8	2.9	3.5	4.3
			Mean-2SD	2.4	6.2	12.8	20.8	25.0	31.1	28.6
BILSOM POCKET 2428	27	BS-5108:1983	Mean	12.1	15.2	24.3	33.8	34.1	40.6	39.2
Conventional			SD	3.1	2.8	3.4	3.6	3.7	5.0	6.6
			Mean-2SD	5.9	9.6	17.5	26.6	26.7	30.6	26.0

n: Level of protection from these devices may be overestimated by the test standard applied. Supplier should be asked to provide results determined in accordance with SABS 1451. Apparent discrepancies between Mean and Mean-2SD are due to rounding errors.

Table A-1.1 (continued)

Muffs (Band worn over head unless otherwise indicated)

Manufacturer and Model	HPD	Test Standard	Mean Attenuation and Std. Dev. (dB) at Given Centre Frequency (Hz)							
			Attenuation	125	250	500	1000	2000	4000	8000
PELTOR H6A	28	BS-5108:1983	Mean	9.6	10.3	21.7	31.6	33.2	34.7	35.2
Folding Muff			SD	3.8	3.1	2.6	3.5	2.4	2.4	3.0
			Mean-2SD	2.0	4.1	16.5	24.6	28.4	30.0	29.3
PELTOR H6B	29	BS-5108:1983	Mean	9.6	11.8	22.2	32.0	31.9	35.8	36.4
Folding Muff			SD	3.7	3.1	3.2	2.9	3.0	2.4	3.3
			Mean-2SD	2.2	5.6	15.8	26.2	25.9	31.0	29.8
PELTOR H6P3E	"30"	DIN 45611	Mean	10.6	10.5	23.7	37.8	39.0	43.9	27.0
Helmet-mounted		(This Standard does	SD	-	-	-	-	-	-	-
		not provide for SD)	Mean-2SD	10.6	10.5	23.7	37.8	39.0	43.9	27.0
3M MODEL1400	"31"	ANSI S3.19 1974	Mean	18.0	21.0	27.0	34.0	38.0	37.5	37.5
Conventional			SD	2.9	2.8	3.0	2.3	2.5	2.9	3.2
			Mean-2SD	12.2	15.4	21.0	29.4	33.0	31.8	31.1
3M MODEL 1420	"32"	ANSI S3.19 1974	Mean	22.0	25.0	35.0	41.0	41.0	39.0	41.0
Conventional			SD	2.0	2.3	2.6	2.0	2.6	2.7	3.9
			Mean-2SD	18.0	20.4	29.8	37.0	35.8	33.6	33.2
BOART MSA NOISE FOE	33	SABS 1451 Pt 1:1988	Mean	14.7	20.7	28.3	41.3	32.3	33.7	36.7
Conventional			SD	2.5	1.7	2.1	1.2	1.2	1.7	3.1
			Mean-2SD	9.7	17.3	24.1	38.9	29.9	30.3	30.5

Muffs and Plugs Combined

Manufacturer and Model	HPD	Test Standard	Mean Attenuation and Std. Dev. (dB) at Given Centre Frequency (Hz)							
			Attenuation	125	250	500	1000	2000	4000	8000
E.A.R. MODEL 1000 Over Head	34	BS-5108:1983	Mean	31.6	37.2	46.3	42.7	39.0	47.8	47.9
with E.A.R. FOAM Plugs			SD	7.0	6.0	7.0	5.3	4.5	4.4	4.9
			Mean-2SD	17.6	25.2	32.3	32.1	30.0	39.1	38.2
BILSOM VIKING 2421 Over Head	35	BS-5108:1983	Mean	23.0	30.3	41.3	42.2	42.1	54.0	48.7
with BILSOM PREMIER POP Plugs			SD	6.9	6.9	6.2	6.1	3.3	4.6	5.0
			Mean-2SD	9.2	16.5	28.9	30.0	35.5	44.8	38.7
BILSOM COMPACT 2470 Over Head	36	BS-5108:1983	Mean	33.9	40.8	52.4	49.6	40.9	54.3	46.5
with BILSOM FORM Plugs			SD	9.6	7.6	7.0	3.8	5.6	5.7	6.3
			Mean-2SD	14.7	25.6	38.4	42.0	29.7	42.9	33.9

Band-Mounted Plugs/Caps

Manufacturer and Model	HPD	Test Standard	Mean Attenuation and Std. Dev. (dB) at Given Centre Frequency (Hz)							
			Attenuation	125	250	500	1000	2000	4000	8000
E.A.R. MODEL 600 CABOFLEX	37	BS-5108:1974	Mean	23.0	22.2	21.5	23.5	27.5	34.7	36.2
Behind Head			SD	5.3	3.7	5.0	4.4	5.0	5.9	6.6
			Mean-2SD	12.4	14.8	11.5	14.7	17.5	23.0	23.1
Under Chin	"38"	ANSI S3.19 1974	Mean	28.7	28.3	28.0	28.6	32.2	44.3	44.6
			SD	6.8	6.3	5.8	4.9	3.7	3.8	5.7
			Mean-2SD	15.0	15.7	16.4	18.8	24.8	36.7	33.2
Under Chin	39	BS-5108:1974	Mean	23.0	22.2	21.9	23.5	27.5	34.7	36.2
			SD	5.3	3.7	5.0	4.4	5.0	5.9	6.6
			Mean-2SD	12.4	14.8	11.9	14.7	17.5	23.0	23.1
E.A.R. MODEL 200 Semi-aural CAPS	40	BS-5108:1983	Mean	22.3	20.7	19.3	21.3	32.6	38.2	38.8
Under Chin			SD	4.7	4.0	2.6	3.4	2.9	2.5	3.5
			Mean-2SD	12.9	12.7	14.1	14.5	26.8	33.2	31.8
	"41"	ANSI S3.19 1974	Mean	22.7	21.1	19.4	21.1	31.1	38.1	39.2
			SD	4.4	4.1	3.3	2.5	3.1	2.5	4.2
			Mean-2SD	13.9	12.9	12.8	16.1	24.9	33.1	30.8
JAMES NORTH QB2 QUIET BAND	42	BS-5108:1983	Mean	20.1	17.5	17.0	21.5	30.4	36.9	35.9
Under Chin			SD	6.9	5.2	4.3	3.6	4.4	4.7	7.2
			Mean-2SD	6.3	7.1	8.4	14.3	21.6	27.6	21.6
Behind Head	43	BS-5108:1983	Mean	21.0	18.4	18.3	22.6	29.8	35.6	33.8
			SD	7.6	6.7	5.8	5.5	4.2	6.7	8.2
			Mean-2SD	5.8	5.0	6.7	11.6	21.4	22.3	17.4
RHINO SAFETY PRODUCTS	44	SABS 1451 Pt 2:1988	Mean	23.0	23.0	26.0	24.0	34.0	34.0	32.0
COMA-FLEX 760 with band			SD	7.7	7.1	8.6	5.2	3.1	3.1	7.0
Under Chin			Mean-2SD	7.6	8.8	8.8	13.6	27.8	27.8	18.0
BILSOM 5701/2 PER-FLEX	45	BS-5108:1983	Mean	29.2	28.8	28.2	27.7	30.3	30.8	37.1
Behind Head			SD	5.7	6.4	7.9	6.2	6.0	6.0	6.1
			Mean-2SD	17.8	16.0	12.4	15.3	18.3	18.8	24.9
Over Head	46	BS-5108:1983	Mean	25.6	24.3	23.7	24.1	28.2	29.8	33.6
			SD	4.8	3.7	5.2	4.0	3.8	4.5	7.4
			Mean-2SD	16.0	16.9	13.3	16.1	20.6	20.8	18.8
Under Chin	47	BS-5108:1983	Mean	25.2	25.8	23.2	26.4	27.8	28.7	37.0
			SD	5.0	4.7	5.5	4.0	4.7	5.5	6.5
			Mean-2SD	15.2	16.4	12.2	18.4	18.4	17.7	24.0
CAMPBELL/GARDWEL	"48"	SABS 572:1973	Mean	15.7	17.0	19.6	26.2	31.1	32.2	29.9
SWIVEL BAND			SD	2.4	2.8	3.2	3.2	2.7	1.9	3.7
Under Chin			Mean-2SD	10.9	11.4	13.2	19.8	25.7	28.4	22.5
CAMPBELL/GARDWEL	"49"	SABS 572:1973	Mean	10.3	15.4	17.0	20.3	31.5	30.8	31.2
ALICE BAND HEAD BAND			SD	2.0	2.0	1.8	1.9	2.8	2.0	3.4
Under Chin			Mean-2SD	6.3	11.4	13.4	16.5	25.9	26.8	24.4
3M 1300 HEADBAND	"50"	ANSI S3.19:1974	Mean	21.9	22.2	23.9	29.9	38.3	41.3	42.6
Behind Head			SD	3.1	3.0	2.2	2.1	2.6	3.6	4.9
			Mean-2SD	15.7	16.2	19.5	25.7	33.1	34.2	32.0
Under Chin	"51"	ANSI S3.19:1974	Mean	22.3	22.7	24.8	30.9	39.4	43.9	45.3
			SD	3.0	2.9	2.1	2.2	2.8	3.4	4.7
			Mean-2SD	16.3	16.9	20.6	26.5	33.8	37.1	35.9

"n": Level of protection from these devices may be overestimated by the test standard applied. Supplier should be asked to provide results determined in accordance with SABS 1451. Apparent discrepancies between Mean and Mean-2SD are due to rounding errors.

Table A-1.1 (continued)

Reusable Plugs

Manufacturer and Model	HPD	Test Standard	Mean Attenuation and Std. Dev. (dB) at Given Centre Frequency (Hz)							
			Attenuation	125	250	500	1000	2000	4000	8000
BILSOM 5601/2/3/4 PER-FIT SILICONE PLUGS	52	BS-5108:1983	Mean	24.3	23.8	25.3	25.1	30.8	30.5	30.1
			SD	9.8	10.2	10.5	9.0	6.9	6.8	10.3
			Mean-2SD	4.7	3.4	4.3	7.1	17.0	16.9	9.5
	53	ANSI S3.19:1974	Mean	29.1	29.4	30.5	31.8	37.2	41.6	36.7
			SD	3.7	3.8	3.2	2.1	2.5	4.1	3.9
			Mean-2SD	21.7	21.8	24.1	27.6	32.2	33.5	29.0
JAMES NORTH COMFIT-C	*54*	ANSI S3.19:1974	Mean	29.6	27.6	30.0	31.7	34.3	41.2	45.7
			SD	3.0	3.3	3.5	2.2	2.0	3.3	4.6
			Mean-2SD	23.6	21.0	23.0	27.3	30.3	34.6	36.6
3M 8776	*55*	SABS 572:1973	Mean	22.2	23.4	20.8	24.4	31.8	30.6	43.0
			SD	3.4	1.9	5.2	4.6	6.8	6.9	2.1
			Mean-2SD	15.4	19.6	10.4	15.2	18.2	16.8	38.8
3M 1220	*56*	ANSI S3.19:1974	Mean	22.9	24.0	20.9	31.0	35.4	40.1	39.1
			SD	1.6	1.7	2.0	2.0	2.7	2.5	3.1
			Mean-2SD	19.7	20.6	16.9	27.0	30.0	35.1	33.0
E.A.R. ULTRA-FIT	57	BS-5108:1983	Mean	22.4	21.7	22.5	23.3	27.0	29.5	37.4
			SD	8.7	7.7	7.6	7.0	6.5	7.9	8.6
			Mean-2SD	5.0	6.3	7.3	9.3	14.0	13.8	20.3
	58	SABS 1451 Pt 2:1988	Mean	21.0	24.0	25.0	25.0	32.0	38.0	41.0
			SD	5.4	4.3	5.8	6.0	2.4	7.1	7.0
			Mean-2SD	10.2	15.4	13.4	13.0	27.2	23.8	27.0
	59	ANSI S12.6:1984	Mean	37.3	38.7	41.1	37.5	33.5	40.6	47.0
			SD	4.9	5.0	4.5	4.3	3.5	5.5	3.8
			Mean-2SD	27.5	28.7	32.1	28.9	26.5	29.6	39.4
	60	ANSI S3.19 1974	Mean	33.6	33.0	34.4	31.2	33.3	37.6	45.3
			SD	5.9	6.0	5.6	5.8	5.0	7.4	3.6
			Mean-2SD	21.8	21.0	23.2	19.6	23.3	22.8	38.1
CAMPBELL/GARDWEL 30.204 RD1 PVC Plug / 30.205 RD1 Corded PVC Plugs	*61*	SABS 572:1973	Mean	27.2	27.2	38.3	32.2	37.4	38.5	34.3
			SD	3.4	3.4	4.4	3.4	2.8	4.6	3.6
			Mean-2SD	20.4	20.4	29.5	25.4	31.8	29.3	27.1
RACAL DBA 2638	62	BS-5108:1983	Mean	22.0	21.3	20.3	23.0	29.8	42.7	43.0
			SD	4.9	5.8	5.1	4.6	5.5	4.1	5.7
			Mean-2SD	12.2	9.7	10.1	13.8	18.8	34.6	31.7

Disposable Plugs

Manufacturer and Model	HPD	Test Standard	Mean Attenuation and Std. Dev. (dB) at Given Centre Frequency (Hz)							
			Attenuation	125	250	500	1000	2000	4000	8000
DECIDAMP FOAM	*63*	ANSI S3.19:1974	Mean	29.6	31.3	34.1	34.0	35.5	41.4	39.6
			SD	3.2	3.3	2.1	2.3	2.7	2.0	2.4
			Mean-2SD	23.2	24.7	29.9	29.4	30.1	37.5	34.8
CAMPBELL/GARDWEL 30.201 FOAM/30.202 CORDED FOAM	*64*	SABS 572:1973	Mean	28.7	34.7	40.3	40.8	39.1	42.9	45.0
			SD	5.5	5.1	3.3	2.5	2.3	2.9	3.7
			Mean-2SD	17.7	24.5	33.7	35.8	34.5	37.1	37.6
E.A.R. FOAM CLASSIC	65	SABS 1451 Pt 2:1988	Mean	25.0	28.0	30.0	30.0	34.0	45.0	45.0
			SD	6.2	5.6	6.7	8.3	2.4	3.9	1.9
			Mean-2SD	12.6	16.8	16.6	13.4	29.2	37.2	41.2
	66	BS-5108:1974	Mean	26.1	26.7	28.9	30.4	32.8	43.2	44.5
			SD	7.8	7.4	7.0	5.9	4.9	4.8	5.4
			Mean-2SD	10.5	11.9	14.9	18.6	23.0	33.6	33.8
	67	ANSI S3.19 1974	Mean	37.4	40.9	44.8	43.8	36.3	42.6	47.3
			SD	5.7	5.0	3.3	3.6	4.9	3.1	2.7
			Mean-2SD	26.0	30.9	38.2	36.6	26.5	36.4	41.9
E.A.R. CABOCORD	68	BS-5108:1983	Mean	26.1	26.7	28.9	30.4	32.8	43.2	44.5
			SD	7.8	7.4	7.0	5.9	4.9	4.8	5.4
			Mean-2SD	10.5	11.9	14.9	18.6	23.0	33.6	33.8
	69	ANSI S3.19 1974	Mean	37.4	40.9	44.8	43.8	36.3	42.6	47.3
			SD	5.7	5.0	3.3	3.6	4.9	3.1	2.7
			Mean-2SD	26.0	30.9	38.2	36.6	26.5	36.4	41.9
BILSOM FORM	70	ISO-4869	Mean	36.9	35.8	37.7	36.6	34.2	42.7	44.5
			SD	5.5	6.4	7.0	5.6	3.5	2.5	4.4
			Mean-2SD	25.9	23.0	23.7	25.4	27.2	37.7	35.7
	71	BS-5108:1983	Mean	19.9	20.0	22.2	24.1	30.7	40.1	41.2
			SD	7.8	6.4	4.9	3.5	4.3	4.6	5.2
			Mean-2SD	4.3	7.2	12.4	17.1	22.1	30.9	30.8
BILSOM POP	72	BS-5108:1983	Mean	15.4	16.8	18.8	19.9	25.0	31.5	33.5
			SD	6.1	6.2	6.8	6.6	4.8	6.7	6.4
			Mean-2SD	3.2	4.4	5.2	6.7	15.4	18.1	20.8
BILSOM PREMIER POP	73	BS-5108:1983	Mean	24.8	23.2	23.7	24.4	29.4	34.3	35.9
			SD	7.1	6.2	6.4	5.2	4.6	4.6	5.9
			Mean-2SD	10.6	10.8	10.9	14.0	20.2	25.1	24.1
BILSOM ECO	74	BS-5108:1983	Mean	23.1	23.8	23.7	24.1	29.1	36.6	37.5
			SD	4.4	4.8	4.7	3.6	4.0	3.6	5.3
			Mean-2SD	14.3	14.2	14.3	16.9	21.1	29.4	26.9
3M 1200 Foam	*75*	ANSI S3.19:1974	Mean	30.8	31.8	31.7	32.7	34.3	41.3	45.7
			SD	3.6	4.3	2.7	3.1	4.3	4.5	5.4
			Mean-2SD	23.6	23.2	26.3	26.5	25.7	32.4	35.0
3M 1210 Corded Foam	*76*	ANSI S3.19:1974	Mean	30.8	31.8	31.7	32.7	34.3	41.3	45.7
			SD	3.6	4.3	2.7	3.1	4.3	4.5	5.4
			Mean-2SD	23.6	23.2	26.3	26.5	25.7	32.4	35.0
3M 6300 Foam	*77*	SABS 572:1973	Mean	26.6	34.7	25.6	28.4	36.5	42.8	39.9
			SD	6.1	6.9	5.9	6.6	2.1	2.8	7.2
			Mean-2SD	14.4	20.9	13.8	15.2	32.3	37.2	25.5
3M 6310 Corded Foam	*78*	SABS 572:1973	Mean	21.0	22.9	23.7	24.0	33.7	40.3	39.1
			SD	4.9	4.4	4.1	3.6	2.2	2.8	5.1
			Mean-2SD	11.2	14.1	15.5	16.8	29.3	34.7	28.9

n: Level of protection from these devices may be overestimated by the test standard applied. Supplier should be asked to provide results determined in accordance with SABS 1451. Apparent discrepancies between Mean and Mean-2SD are due to rounding errors.

Table A-1.1 (continued)

Custom-Moulded Plugs

Manufacturer and Model	HPD	Test Standard	Mean Attenuation and Std. Dev. (dB) at Given Centre Frequency (Hz)							
			Attenuation	125	250	500	1000	2000	4000	8000
H.A.S.S. VARIFOON	79	SABS 1451 Pt 2:1988	Mean	16.4	19.6	21.4	25.4	31.6	34.6	41.0
Set at 90dB		ISO-4869	SD	4.3	4.6	2.1	1.7	1.0	3.5	3.5
			Mean-2SD	7.8	10.4	17.2	22.0	29.6	27.6	34.0
Set at 100dB	80	SABS 1451 Pt 2:1988	Mean	22.0	22.0	25.4	29.8	36.2	40.1	42.2
		ISO-4869	SD	3.8	2.6	2.8	3.7	2.7	3.1	5.5
			Mean-2SD	14.4	16.8	19.8	22.4	30.8	33.9	31.2
Set at Maximum Attenuation	81	SABS 1451 Pt 2:1988	Mean	30.5	28.8	30.7	34.8	39.0	42.5	44.5
		ISO-4869	SD	2.1	1.1	3.0	2.6	2.5	1.1	4.6
			Mean-2SD	26.3	26.6	24.7	29.6	34.0	40.3	35.3
RHINO SAFETY PRODUCTS	82	SABS 1451 Pt 2:1988	Mean	25.0	22.0	21.0	23.0	32.0	30.0	30.0
COMA-FLEX 759			SD	3.6	0.5	2.4	1.2	1.2	2.4	5.2
with or without cord			Mean-2SD	17.8	21.0	16.2	20.6	29.6	25.2	19.6
RHINO SAFETY PRODUCTS	83	SABS 1451 Pt 2:1988	Mean	23.0	23.0	26.0	24.0	34.0	34.0	32.0
COMA-FLEX 760			SD	7.7	7.1	8.6	5.2	3.1	3.1	7.0
with band			Mean-2SD	7.6	8.8	8.8	13.6	27.8	27.8	18.0

n: Level of protection from these devices may be overestimated by the test standard applied. Supplier should be asked to provide results determined in accordance with SABS 1451. Apparent discrepancies between Mean and Mean-2SD are due to rounding errors.

Appendix 2

HPD selection for surface workshops

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Table A-2.1
HPD selection for boilermaker/platers

	dB-Neq	Mean:	98.9	Max:	109	Min:	80	Obs (n):	67
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	81.9	88.0	105.1	110.8	111.3	111.4	104.7	116.6	109
with HPD									
1	79.0	83.1	90.1	87.6	83.2	80.3	79.7	93.6	>86<
2	77.2	75.1	86.3	88.4	91.6	88.4	87.1	95.9	>88<
"3"	75.4	75.8	85.5	92.5	91.9	92.6	84.3	97.7	>90<
"4"	79.0	78.8	84.1	92.1	92.8	91.8	85.0	97.6	>90<
5	77.6	78.6	89.2	92.6	83.6	78.8	75.3	94.9	>87<
6	74.5	78.4	86.6	88.0	83.0	80.0	72.4	91.8	84
"7"	76.8	77.2	84.0	84.4	84.8	78.3	70.5	90.0	82
8	76.5	78.6	86.5	87.8	84.8	79.0	73.6	92.0	84
"9"	71.8	72.3	83.9	82.6	81.9	79.0	78.1	88.8	81
10	71.7	75.2	87.0	83.2	83.0	80.1	78.1	90.5	83
11	78.2	77.1	87.9	84.7	83.6	78.8	78.8	91.5	84
12	76.4	72.3	84.0	84.1	80.1	77.3	76.6	88.9	81
13	71.0	70.2	82.3	78.4	79.9	73.9	70.3	86.0	78
14	76.1	78.6	91.2	87.0	85.6	79.0	79.0	93.9	>86<
15	81.9	80.2	91.0	89.3	87.5	86.7	86.4	95.8	>88<
16	78.2	77.9	89.1	86.7	85.8	79.3	74.2	92.8	85
17	81.2	82.2	89.4	87.4	86.3	80.4	75.4	93.6	>86<
18	77.2	78.5	89.2	89.8	82.9	79.5	80.0	93.6	>86<
19	74.1	74.1	81.5	82.0	84.1	75.4	68.4	88.1	81
20	77.2	74.9	83.9	83.6	90.6	80.6	73.2	92.7	85
21	76.2	75.3	81.6	82.3	84.2	76.1	74.1	88.6	81
22	79.3	79.8	90.4	87.3	84.3	85.4	76.3	93.9	>86<
23	79.9	80.6	88.2	87.6	84.6	78.1	73.0	92.6	85
24	77.8	79.8	90.2	88.6	86.1	81.4	80.0	94.1	>87<
25	77.7	82.3	90.5	87.6	86.8	88.0	77.7	94.9	>87<
26	79.5	81.8	92.3	90.0	86.3	80.3	76.1	95.5	>88<
27	76.0	78.4	87.6	84.2	84.6	80.8	78.7	91.6	84
28	79.9	83.9	88.6	86.2	82.9	81.4	75.4	92.7	85
29	79.7	82.4	89.3	84.6	85.4	80.4	74.9	92.8	85
"30"	71.3	77.5	81.4	73.0	72.3	67.5	77.7	84.9	77
"31"	69.7	72.6	84.1	81.4	78.3	79.6	73.6	87.8	80
"32"	63.9	67.6	75.3	73.8	75.5	77.8	71.5	82.5	75
33	72.2	70.7	81.0	71.9	81.4	81.1	74.2	86.7	79
34	64.3	62.8	72.8	78.7	81.3	72.3	66.5	84.1	76
35	72.7	71.5	76.2	80.8	75.8	66.6	66.0	83.8	76
36	67.2	62.4	66.7	68.8	81.6	68.5	70.8	82.6	75
37	69.5	73.2	93.6	96.1	93.8	88.4	81.6	99.8	>92<
"38"	66.9	72.3	88.7	92.0	86.5	74.7	71.5	94.5	>87<
39	69.5	73.2	93.2	96.1	93.8	88.4	81.6	99.7	>92<
40	69.0	75.3	91.0	96.3	84.5	78.2	72.9	97.7	>90<
"41"	68.0	75.1	92.3	94.7	86.4	78.3	73.9	97.2	>90<
42	75.6	80.9	96.7	96.5	89.7	83.8	83.1	100.3	>93<
43	76.1	83.0	98.4	99.2	89.9	89.1	87.3	102.5	>95<
44	74.3	79.2	96.3	97.2	83.5	83.6	86.7	100.2	>93<
45	64.1	72.0	92.7	95.5	93.0	92.6	79.8	99.7	>92<
46	65.9	71.1	91.8	94.7	90.7	90.6	85.9	98.6	>91<
47	66.7	71.6	92.9	92.4	92.9	93.7	80.7	99.1	>92<
"48"	71.0	76.6	91.9	91.0	85.6	83.0	82.2	95.6	>88<
"49"	75.6	76.6	91.7	94.3	85.4	84.6	80.3	97.0	>89<
"50"	66.2	71.8	85.6	85.1	78.2	77.2	71.8	89.2	82
"51"	65.6	71.1	84.5	84.3	77.5	74.3	68.8	88.2	81
52	77.2	84.6	100.8	103.7	94.3	94.5	95.2	106.5	>99<
"53"	60.2	66.2	81.0	83.2	79.1	77.9	75.7	87.2	80
"54"	58.3	67.0	82.1	83.5	80.9	76.8	68.1	87.6	80
"55"	66.5	68.4	94.7	95.6	93.1	94.6	65.9	100.6	>93<
"56"	62.2	67.4	88.2	83.8	81.3	76.3	71.7	90.4	83
57	76.9	81.7	97.8	101.5	97.3	97.6	84.4	105.0	>97<
58	71.7	72.6	91.7	97.8	84.1	87.6	77.7	99.3	>92<
"59"	54.4	59.3	73.0	81.9	84.8	81.8	65.3	88.0	80
"60"	60.1	67.0	102.9	91.2	88.0	88.6	66.6	103.5	>96<
"61"	61.5	67.6	75.6	85.4	79.5	82.1	77.6	88.4	81
62	69.7	78.3	95.0	97.0	92.5	76.8	73.0	100.0	>92<
"63"	58.7	63.3	75.2	81.4	81.2	73.9	69.9	85.3	78
"64"	64.2	63.5	71.4	75.0	76.8	74.3	67.1	81.1	74
65	69.3	71.2	88.5	97.4	82.2	74.2	63.5	98.1	>90<
66	71.4	76.1	90.2	92.2	88.3	77.8	70.9	95.5	>88<
"67"	55.9	57.1	66.9	74.2	84.8	75.0	62.8	85.7	78
68	71.4	76.1	90.2	92.2	88.3	77.8	70.9	95.5	>88<
"69"	55.9	57.1	66.9	74.2	84.8	75.0	62.8	85.7	78
70	56.0	65.0	81.4	85.4	84.1	73.7	69.0	88.9	81
71	77.6	80.8	92.7	93.7	89.2	80.5	73.9	97.3	>90<
72	78.7	83.6	99.9	104.1	95.9	93.3	83.9	106.2	>99<
73	71.3	77.2	94.2	96.8	91.1	86.3	80.6	99.7	>92<
74	67.6	73.8	90.8	93.9	90.2	82.0	77.8	96.9	>89<
"75"	58.3	64.8	78.8	84.3	85.6	79.0	69.7	89.0	81
"76"	58.3	64.8	78.8	84.3	85.6	79.0	69.7	89.0	81
"77"	67.5	67.1	91.3	95.6	79.0	74.2	79.2	97.1	>90<
"78"	70.7	73.9	89.6	94.0	82.0	76.7	75.8	95.7	>88<
79	74.1	77.6	87.9	88.8	81.7	83.8	70.7	92.7	85
80	67.5	71.2	85.3	88.4	80.5	77.5	73.5	90.9	83
81	55.6	61.4	80.4	81.2	77.3	71.1	69.4	85.0	77
82	64.1	67.0	88.9	90.2	81.7	86.2	85.1	94.3	>87<
83	74.3	79.2	96.3	97.2	83.5	83.6	86.7	100.2	>93<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
"n" These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-2.2
HPD selection for carpenters

	dB-Neq	Mean:	95.9	Max:	109	Min:	80	Obs (n):	43
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	76.2	87.9	85.0	100.8	103.2	101.5	95.7	107.1	109
with HPD									
1	73.3	83.0	70.0	77.6	75.1	70.4	70.7	85.4	>87<
2	71.5	75.0	66.2	78.4	83.5	78.5	78.1	86.8	>89<
3	69.7	75.7	65.4	82.5	83.8	82.7	75.3	88.4	>90<
4	73.3	78.7	64.0	82.1	84.7	81.9	76.0	88.8	>91<
5	71.9	78.5	69.1	82.6	75.5	68.9	66.3	85.1	>87<
6	68.8	78.3	66.5	78.0	74.9	70.1	63.4	82.7	85
7	71.1	77.1	63.9	74.4	76.7	68.4	61.5	81.7	84
8	70.8	78.5	66.4	77.8	76.7	69.1	64.6	83.1	85
9	66.1	72.2	63.8	72.6	73.8	69.1	69.1	79.1	81
10	66.0	75.1	66.9	73.2	74.9	70.2	69.1	80.5	82
11	72.5	77.0	67.8	74.7	75.5	68.9	69.8	81.9	84
12	70.7	72.2	63.9	74.1	72.0	67.4	67.6	79.2	81
13	65.3	70.1	62.2	68.4	71.8	64.0	61.3	76.1	78
14	70.4	78.5	71.1	77.0	77.5	69.1	70.0	83.4	85
15	76.2	80.1	70.9	79.3	79.4	76.8	77.4	86.3	>88<
16	72.5	77.8	69.0	76.7	77.7	69.4	65.2	83.1	85
17	75.5	82.1	69.3	77.4	78.2	70.5	66.4	85.4	>87<
18	71.5	78.4	69.1	79.8	74.8	69.6	71.0	83.8	>86<
19	68.4	74.0	61.4	72.0	76.0	65.5	59.4	79.7	82
20	71.5	74.8	63.8	73.6	82.5	70.7	64.2	84.2	>86<
21	70.5	75.2	61.5	72.3	76.1	66.2	65.1	80.4	82
22	73.6	79.7	70.3	77.3	76.2	75.5	67.3	84.2	>86<
23	74.2	80.5	68.1	77.6	76.5	68.2	64.0	84.1	>86<
24	72.1	79.7	70.1	78.6	78.0	71.5	71.0	84.5	>86<
25	72.0	82.2	70.4	77.6	78.7	78.1	68.7	86.0	>88<
26	73.8	81.7	72.2	80.0	78.2	70.4	67.1	85.7	>88<
27	70.3	78.3	67.5	74.2	76.5	70.9	69.7	82.5	84
28	74.2	83.8	68.5	76.2	74.8	71.5	66.4	85.6	>87<
29	74.0	82.3	69.2	74.6	77.3	70.5	65.9	84.8	>87<
30	65.6	77.4	61.3	63.0	64.2	57.6	68.7	78.6	80
31	64.0	72.5	64.0	71.4	70.2	69.7	64.6	77.7	80
32	58.2	67.5	55.2	63.8	67.4	67.9	62.5	73.5	75
33	66.5	70.6	60.9	61.9	73.3	71.2	65.2	77.5	79
34	58.6	62.7	52.7	68.7	73.2	62.4	57.5	75.2	77
35	67.0	71.4	56.1	70.8	67.7	56.7	57.0	75.8	78
36	61.5	62.3	46.6	58.8	73.5	58.6	61.8	74.6	76
37	63.8	73.1	73.5	86.1	85.7	78.5	72.6	89.6	>91<
38	61.2	72.2	68.6	82.0	78.4	64.8	62.5	84.1	>86<
39	63.8	73.1	73.1	86.1	85.7	78.5	72.6	89.6	>91<
40	63.3	75.2	70.9	86.3	76.4	68.3	63.9	87.2	>89<
41	62.3	75.0	72.2	84.7	78.3	68.4	64.9	86.3	>88<
42	69.9	80.8	76.6	86.5	81.6	73.9	74.1	89.1	>91<
43	70.4	82.9	78.3	89.2	81.8	79.2	78.3	91.5	>93<
44	68.6	79.1	76.2	87.2	75.4	73.7	77.7	88.9	>91<
45	58.4	71.9	72.6	85.5	84.9	82.7	70.8	89.5	>91<
46	60.2	71.0	71.7	84.7	82.6	80.7	76.9	88.3	>90<
47	61.0	71.5	72.8	82.4	84.8	83.8	71.7	88.8	>91<
48	65.3	76.5	71.8	81.0	77.5	73.1	73.2	84.6	>86<
49	69.9	76.5	71.6	84.3	77.3	74.7	71.3	86.4	>88<
50	60.5	71.7	65.5	75.1	70.1	67.3	62.8	78.4	80
51	59.9	71.0	64.4	74.3	69.4	64.4	59.8	77.5	79
52	71.5	84.5	80.7	93.7	86.2	84.6	86.2	95.9	>98<
53	54.5	66.1	60.9	73.2	71.0	68.0	66.7	77.0	79
54	52.6	66.9	62.0	73.5	72.8	66.9	59.1	77.3	79
55	60.8	68.3	74.6	85.6	85.0	84.7	56.9	90.1	>92<
56	56.5	67.3	68.1	73.8	73.2	66.4	62.7	78.0	80
57	71.2	81.6	77.7	91.5	89.2	87.7	75.4	94.9	>97<
58	66.0	72.5	71.6	87.8	76.0	77.7	68.7	88.7	>91<
59	48.7	59.2	52.9	71.9	76.7	71.9	56.3	79.0	81
60	54.4	66.9	82.8	81.2	79.9	78.7	57.6	87.0	>89<
61	55.8	67.5	55.5	75.4	71.4	72.2	68.6	79.0	81
62	64.0	78.2	74.9	87.0	84.4	66.9	64.0	89.5	>91<
63	53.0	63.2	55.1	71.4	73.1	64.0	60.9	76.1	78
64	58.5	63.4	51.3	65.0	68.7	64.4	58.1	72.3	74
65	63.6	71.1	68.4	87.4	74.1	64.3	54.5	87.8	>90<
66	65.7	76.0	70.1	82.2	80.2	67.9	61.9	85.2	>87<
67	50.2	57.0	46.8	64.2	76.7	65.1	53.8	77.3	79
68	65.7	76.0	70.1	82.2	80.2	67.9	61.9	85.2	>87<
69	50.2	57.0	46.8	64.2	76.7	65.1	53.8	77.3	79
70	50.3	64.9	61.3	75.4	76.0	63.8	60.0	79.2	81
71	71.9	80.7	72.6	83.7	81.1	70.6	64.9	87.2	>89<
72	73.0	83.5	79.8	94.1	87.8	83.4	74.9	95.8	>98<
73	65.6	77.1	74.1	86.8	83.0	76.4	71.6	89.1	>91<
74	61.9	73.7	70.7	83.9	82.1	72.1	68.8	86.7	>89<
75	52.6	64.7	58.7	74.3	77.5	69.1	60.7	79.8	82
76	52.6	64.7	58.7	74.3	77.5	69.1	60.7	79.8	82
77	61.8	67.0	71.2	85.6	70.9	64.3	70.2	86.1	>88<
78	65.0	73.8	69.5	84.0	73.9	66.8	66.8	85.1	>87<
79	68.4	77.5	67.8	78.8	73.6	73.9	61.7	82.9	85
80	61.8	71.1	65.2	78.4	72.4	67.6	64.5	80.5	82
81	49.9	61.3	60.3	71.2	69.2	61.2	60.4	74.2	76
82	58.4	66.9	68.8	80.2	73.6	76.3	76.1	83.5	85
83	68.6	79.1	76.2	87.2	75.4	73.7	77.7	88.9	>91<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-2.3
HPD selection for fitter/turners

	dB-Neq	Mean:	90.8	Max:	105	Min:	75	Obs (n):	36
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	74.7	73.8	74.1	79.2	81.5	75.8	71.3	85.5	103
with HPD									
1	71.8	68.9	59.1	56.0	53.4	44.7	46.3	73.9	>91<
2	70.0	60.9	55.3	56.8	61.8	52.8	53.7	71.5	>89<
"3"	68.2	61.6	54.5	60.9	62.1	57.0	50.9	70.7	>88<
"4"	71.8	64.6	53.1	60.5	63.0	56.2	51.6	73.4	>91<
5	70.4	64.4	58.2	61.0	53.8	43.2	41.9	72.0	>90<
6	67.3	64.2	55.6	56.4	53.2	44.4	39.0	69.6	>87<
"7"	69.6	63.0	53.0	52.8	55.0	42.7	37.1	70.7	>88<
8	69.3	64.4	55.5	56.2	55.0	43.4	40.2	70.9	>88<
"9"	64.6	58.1	52.9	51.0	52.1	43.4	44.7	66.1	84
10	64.5	61.0	56.0	51.6	53.2	44.5	44.7	66.9	84
11	71.0	62.9	56.9	53.1	53.8	43.2	45.4	71.9	>89<
12	69.2	58.1	53.0	52.5	50.3	41.7	43.2	69.8	>87<
13	63.8	56.0	51.3	46.8	50.1	38.3	36.9	64.9	82
14	68.9	64.4	60.2	55.4	55.8	43.4	45.6	70.9	>88<
15	74.7	66.0	60.0	57.7	57.7	51.1	53.0	75.6	>93<
16	71.0	63.7	58.1	55.1	56.0	43.7	40.8	72.1	>90<
17	74.0	68.0	58.4	55.8	56.5	44.8	42.0	75.2	>93<
18	70.0	64.3	58.2	58.2	53.1	43.9	46.6	71.5	>89<
19	66.9	59.9	50.5	50.4	54.3	39.8	35.0	68.0	>86<
20	70.0	60.7	52.9	52.0	60.8	45.0	39.8	71.1	>89<
21	69.0	61.1	50.6	50.7	54.4	40.5	40.7	69.9	>87<
22	72.1	65.6	59.4	55.7	54.5	49.8	42.9	73.3	>91<
23	72.7	66.4	57.2	56.0	54.8	42.5	39.6	73.8	>91<
24	70.6	65.6	59.2	57.0	56.3	45.8	46.6	72.3	>90<
25	70.5	68.1	59.5	56.0	57.0	52.4	44.3	72.9	>90<
26	72.3	67.6	61.3	58.4	56.5	44.7	42.7	74.0	>92<
27	68.8	64.2	56.6	52.6	54.8	45.2	45.3	70.5	>88<
28	72.7	69.7	57.6	54.6	53.1	45.8	42.0	74.6	>92<
29	72.5	68.2	58.3	53.0	55.6	44.8	41.5	74.1	>92<
"30"	64.1	63.3	50.4	41.4	42.5	31.9	44.3	66.9	84
"31"	62.5	58.4	53.1	49.8	48.5	44.0	40.2	64.6	82
"32"	56.7	53.4	44.3	42.2	45.7	42.2	38.1	59.0	76
33	65.0	56.5	50.0	40.3	51.6	45.5	40.8	65.9	83
34	57.1	48.6	41.8	47.1	51.5	36.7	33.1	59.0	77
35	65.5	57.3	45.2	49.2	46.0	31.0	32.6	66.3	84
36	60.0	48.2	35.7	37.2	51.8	32.9	37.4	60.9	78
37	62.3	59.0	62.6	64.5	64.0	52.8	48.2	70.0	>87<
"38"	59.7	58.1	57.7	60.4	56.7	39.1	38.1	65.7	83
39	62.3	59.0	62.2	64.5	64.0	52.8	48.2	69.9	>87<
40	61.8	61.1	60.0	64.7	54.7	42.6	39.5	68.5	>86<
"41"	60.8	60.9	61.3	63.1	56.6	42.7	40.5	68.0	>85<
42	68.4	66.7	65.7	64.9	59.9	48.2	49.7	72.9	>90<
43	68.9	68.8	67.4	67.6	60.1	53.5	53.9	74.5	>92<
44	67.1	65.0	65.3	65.6	53.7	48.0	53.3	72.0	>89<
45	56.9	57.8	61.7	63.9	63.2	57.0	46.4	68.8	>86<
46	58.7	56.9	60.8	63.1	60.9	55.0	52.5	67.9	85
47	59.5	57.4	61.9	60.8	63.1	58.1	47.3	68.4	>86<
"48"	63.8	62.4	60.9	59.4	55.8	47.4	48.8	68.3	>86<
"49"	68.4	62.4	60.7	62.7	55.6	49.0	46.9	70.9	>88<
"50"	59.0	57.6	54.6	53.5	48.4	41.6	38.4	63.0	80
"51"	58.4	56.9	53.5	52.7	47.7	38.7	35.4	62.2	80
52	70.0	70.4	69.8	72.1	64.5	58.9	61.8	77.1	>95<
"53"	53.0	52.0	50.0	51.6	49.3	42.3	42.3	58.6	76
"54"	51.1	52.8	51.1	51.9	51.1	41.2	34.7	58.7	76
"55"	59.3	54.2	63.7	64.0	63.3	59.0	32.5	69.5	>87<
"56"	55.0	53.2	57.2	52.2	51.5	40.7	38.3	61.4	79
57	69.7	67.5	66.8	69.9	67.5	62.0	51.0	75.7	>93<
58	64.5	58.4	60.7	66.2	54.3	52.0	44.3	69.7	>87<
"59"	47.2	45.1	42.0	50.3	55.0	46.2	31.9	57.5	75
"60"	52.9	52.8	71.9	59.6	58.2	53.0	33.2	72.5	>90<
"61"	54.3	53.4	44.6	53.8	49.7	46.5	44.2	59.6	77
62	62.5	64.1	64.0	65.4	62.7	41.2	39.6	70.9	>88<
"63"	51.5	49.1	44.2	49.8	51.4	38.3	36.5	56.9	74
"64"	57.0	49.3	40.4	43.4	47.0	38.7	33.7	58.3	76
65	62.1	57.0	57.5	65.8	52.4	38.6	30.1	68.2	>86<
66	64.2	61.9	59.2	60.6	58.5	42.2	37.5	68.4	>86<
"67"	48.7	42.9	35.9	42.6	55.0	39.4	29.4	56.4	74
68	64.2	61.9	59.2	60.6	58.5	42.2	37.5	68.4	>86<
"69"	48.7	42.9	35.9	42.6	55.0	39.4	29.4	56.4	74
70	48.8	50.8	50.4	53.8	54.3	38.1	35.6	59.2	77
71	70.4	66.6	61.7	62.1	59.4	44.9	40.5	72.9	>90<
72	71.5	69.4	68.9	72.5	66.1	57.7	50.5	77.3	>95<
73	64.1	63.0	63.2	65.2	61.3	50.7	47.2	70.6	>88<
74	60.4	59.6	59.8	62.3	60.4	46.4	44.4	67.7	85
"75"	51.1	50.6	47.8	52.7	55.8	43.4	36.3	59.5	77
"76"	51.1	50.6	47.8	52.7	55.8	43.4	36.3	59.5	77
"77"	60.3	52.9	60.3	64.0	49.2	38.6	45.8	67.0	84
"78"	63.5	59.7	58.6	62.4	52.2	41.1	42.4	67.7	85
79	66.9	63.4	56.9	57.2	51.9	48.2	37.3	69.2	>87<
80	60.3	57.0	54.3	56.8	50.7	41.9	40.1	63.9	81
81	48.4	47.2	49.4	49.6	47.5	35.5	36.0	55.6	73
82	56.9	52.8	57.9	58.6	51.9	50.6	51.7	63.9	81
83	67.1	65.0	65.3	65.6	53.7	48.0	53.3	72.0	>89<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
"n" These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-2.4

HPD selection for individuals in miscellaneous workshops

	dB-Neq	Mean:	93.6	Max:	108	Min:	74	Obs (n):	52
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	82.9	90.4	98.8	113.0	111.2	103.0	93.9	115.6	108
with HPD									
1	80.0	85.5	83.8	89.8	83.1	71.9	68.9	92.7	85
2	78.2	77.5	80.0	90.6	91.5	80.0	76.3	94.7	>87<
3	76.4	78.2	79.2	94.7	91.8	84.2	73.5	96.9	>89<
4	80.0	81.2	77.8	94.3	92.7	83.4	74.2	97.1	>89<
5	78.6	81.0	82.9	94.8	83.5	70.4	64.5	95.6	>88<
6	75.5	80.8	80.3	90.2	82.9	71.6	61.6	91.8	84
7	77.8	79.6	77.7	86.6	84.7	69.9	59.7	89.9	82
8	77.5	81.0	80.2	90.0	84.7	70.6	62.8	92.0	84
9	72.8	74.7	77.6	84.8	81.8	70.6	67.3	87.6	80
10	72.7	77.6	80.7	85.4	82.9	71.7	67.3	88.8	81
11	79.2	79.5	81.6	86.9	83.5	70.4	68.0	90.2	83
12	77.4	74.7	77.7	86.3	80.0	68.9	65.8	88.3	81
13	72.0	72.6	76.0	80.6	79.8	65.5	59.5	84.6	77
14	77.1	81.0	84.9	89.2	85.5	70.6	68.2	92.3	85
15	82.9	82.6	84.7	91.5	87.4	78.3	75.6	94.4	>87<
16	79.2	80.3	82.8	88.9	85.7	70.9	63.4	91.9	84
17	82.2	84.6	83.1	89.6	86.2	72.0	64.6	93.0	85
18	78.2	80.9	82.9	92.0	82.8	71.1	69.2	93.4	>86<
19	75.1	76.5	75.2	84.2	84.0	67.0	57.6	88.0	80
20	78.2	77.3	77.6	85.8	90.5	72.2	62.4	92.3	85
21	77.2	77.7	75.3	84.5	84.1	67.7	63.3	88.4	81
22	80.3	82.2	84.1	89.5	84.2	77.0	65.5	92.4	85
23	80.9	83.0	81.9	89.8	84.5	69.7	62.2	92.4	85
24	78.8	82.2	83.9	90.8	86.0	73.0	69.2	93.3	>86<
25	78.7	84.7	84.2	89.8	86.7	79.6	66.9	93.3	>86<
26	80.5	84.2	86.0	92.2	86.2	71.9	65.3	94.6	>87<
*27	77.0	80.8	81.3	86.4	84.5	72.4	67.9	90.2	83
28	80.9	86.3	82.3	88.4	82.8	73.0	64.6	92.1	85
29	80.7	84.8	83.0	86.8	85.3	72.0	64.1	91.6	84
30	72.3	79.9	75.1	75.2	72.2	59.1	66.9	83.1	75
31	70.7	75.0	77.8	83.6	78.2	71.2	62.8	86.2	79
32	64.9	70.0	69.0	76.0	75.4	69.4	60.7	80.2	73
33	73.2	73.1	74.7	74.1	81.3	72.7	63.4	84.0	76
34	65.3	65.2	66.5	80.9	81.2	63.9	55.7	84.3	77
35	73.7	73.9	69.9	83.0	75.7	58.2	55.2	84.7	77
36	68.2	64.8	60.4	71.0	81.5	60.1	60.0	82.2	75
37	70.5	75.6	87.3	98.3	93.7	80.0	70.8	99.9	>92<
38	67.9	74.7	82.4	94.2	86.4	66.3	60.7	95.2	>88<
39	70.5	75.6	86.9	98.3	93.7	80.0	70.8	99.9	>92<
40	70.0	77.7	84.7	98.5	84.4	69.8	62.1	98.9	>91<
41	69.0	77.5	86.0	96.9	86.3	69.9	63.1	97.6	>90<
42	76.6	83.3	90.4	98.7	89.6	75.4	72.3	99.9	>92<
43	77.1	85.4	92.1	101.4	89.8	80.7	76.5	102.3	>95<
44	75.3	81.6	90.0	99.4	83.4	75.2	75.9	100.1	>92<
45	65.1	74.4	86.4	97.7	92.9	84.2	69.0	99.3	>92<
46	66.9	73.5	85.5	96.9	90.6	82.2	75.1	98.2	>91<
47	67.7	74.0	86.6	94.6	92.8	85.3	69.9	97.5	>90<
48	72.0	79.0	85.6	93.2	85.5	74.6	71.4	94.7	>87<
49	76.6	79.0	85.4	96.5	85.3	76.2	69.5	97.3	>90<
50	67.2	74.2	79.3	87.3	78.1	68.8	61.0	88.6	81
51	66.6	73.5	78.2	86.5	77.4	65.9	58.0	87.8	80
52	78.2	87.0	94.5	105.9	94.2	86.1	84.4	106.6	>99<
53	61.2	68.6	74.7	85.4	79.0	69.5	64.9	86.8	79
54	59.3	69.4	75.8	85.7	80.8	68.4	57.3	87.4	80
55	67.5	70.8	88.4	97.8	93.0	86.2	55.1	99.6	>92<
56	63.2	69.8	81.9	86.0	81.2	67.9	60.9	88.5	81
57	77.9	84.1	91.5	103.7	97.2	89.2	73.6	105.0	>97<
58	72.7	75.0	85.4	100.0	84.0	79.2	66.9	100.3	>93<
59	55.4	61.7	66.7	84.1	84.7	73.4	54.5	87.6	80
60	61.1	69.4	96.6	93.4	87.9	80.2	55.8	98.7	>91<
61	62.5	70.0	69.3	87.6	79.4	73.7	66.8	88.5	81
62	70.7	80.7	88.7	99.2	92.4	68.4	62.2	100.4	>93<
63	59.7	65.7	68.9	83.6	81.1	65.5	59.1	85.7	78
64	65.2	65.9	65.1	77.2	76.7	65.9	56.3	80.6	73
65	70.3	73.6	82.2	99.6	82.1	65.8	52.7	99.8	>92<
66	72.4	78.5	83.9	94.4	88.2	69.4	60.1	95.7	>88<
67	56.9	59.5	60.6	76.4	84.7	66.6	52.0	85.4	78
68	72.4	78.5	83.9	94.4	88.2	69.4	60.1	95.7	>88<
69	56.9	59.5	60.6	76.4	84.7	66.6	52.0	85.4	78
70	57.0	67.4	75.1	87.6	84.0	65.3	58.2	89.4	82
71	78.6	83.2	86.4	95.9	89.1	72.1	63.1	97.4	>90<
72	79.7	86.0	93.6	106.3	95.8	84.9	73.1	107.0	>99<
73	72.3	79.6	87.9	99.0	91.0	77.9	69.8	100.0	>92<
74	68.6	76.2	84.5	96.1	90.1	73.6	67.0	97.4	>90<
75	59.3	67.2	72.5	86.5	85.5	70.6	58.9	89.2	82
76	59.3	67.2	72.5	86.5	85.5	70.6	58.9	89.2	82
77	68.5	69.5	85.0	97.8	78.9	65.8	68.4	98.1	>90<
78	71.7	76.3	83.3	96.2	81.9	68.3	65.0	96.6	>89<
79	75.1	80.0	81.6	91.0	81.6	75.4	59.9	92.3	85
80	68.5	73.6	79.0	90.6	80.4	69.1	62.7	91.4	84
81	56.6	63.8	74.1	83.4	77.2	62.7	58.6	84.8	77
82	65.1	69.4	82.6	92.4	81.6	77.8	74.3	93.4	>86<
83	75.3	81.6	90.0	99.4	83.4	75.2	75.9	100.1	>92<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-2.5

HPD selection for individuals in rockdrill repair workshops

	dB-Neq	Mean:	98.0	Max:	110	Min:	82	Obs (n):	42
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	84.0	94.5	103.2	107.7	111.4	107.3	104.4	114.8	110
with HPD									
1	81.1	89.6	88.2	84.5	83.3	76.2	79.4	93.7	>89<
2	79.3	81.6	84.4	85.3	91.7	84.3	86.8	94.9	>90<
"3"	77.5	82.3	83.6	89.4	92.0	88.5	84.0	95.9	>91<
"4"	81.1	85.3	82.2	89.0	92.9	87.7	84.7	96.3	>91<
5	79.7	85.1	87.3	89.5	83.7	74.7	75.0	93.3	>89<
6	76.6	84.9	84.7	84.9	83.1	75.9	72.1	90.9	>86<
"7"	78.9	83.7	82.1	81.3	84.9	74.2	70.2	89.8	85
8	78.6	85.1	84.6	84.7	84.9	74.9	73.3	91.3	>86<
"9"	73.9	78.8	82.0	79.5	82.0	74.9	77.8	87.8	83
10	73.8	81.7	85.1	80.1	83.1	76.0	77.8	89.6	85
11	80.3	83.6	86.0	81.6	83.7	74.7	78.5	90.8	>86<
12	78.5	78.8	82.1	81.0	80.2	73.2	76.3	87.8	83
13	73.1	76.7	80.4	75.3	80.0	69.8	70.0	85.2	80
14	78.2	85.1	89.3	83.9	85.7	74.9	78.7	92.9	>88<
15	84.0	86.7	89.1	86.2	87.6	82.6	86.1	94.9	>90<
16	80.3	84.4	87.2	83.6	85.9	75.2	73.9	92.0	>87<
17	83.3	88.7	87.5	84.3	86.4	76.3	75.1	93.6	>89<
18	79.3	85.0	87.3	86.7	83.0	75.4	79.7	92.4	>88<
19	76.2	80.6	79.6	78.9	84.2	71.3	68.1	87.8	83
20	79.3	81.4	82.0	80.5	90.7	76.5	72.9	92.4	>88<
21	78.3	81.8	79.7	79.2	84.3	72.0	73.8	88.5	84
22	81.4	86.3	88.5	84.2	84.4	81.3	76.0	93.0	>88<
23	82.0	87.1	86.3	84.5	84.7	74.0	72.7	92.4	>88<
24	79.9	86.3	88.3	85.5	86.2	77.3	79.7	93.3	>88<
25	79.8	88.8	88.6	84.5	86.9	83.9	77.4	94.2	>89<
26	81.6	88.3	90.4	86.9	86.4	76.2	75.8	94.7	>90<
27	78.1	84.9	85.7	81.1	84.7	76.7	78.4	91.1	>86<
28	82.0	90.4	86.7	83.1	83.0	77.3	75.1	93.4	>89<
29	81.8	88.9	87.4	81.5	85.5	76.3	74.6	93.1	>88<
"30"	73.4	84.0	79.5	69.9	72.4	63.4	77.4	86.5	82
"31"	71.8	79.1	82.2	78.3	78.4	75.5	73.3	86.6	82
"32"	66.0	74.1	73.4	70.7	75.6	73.7	71.2	81.3	77
33	74.3	77.2	79.1	68.8	81.5	77.0	73.9	85.8	81
34	66.4	69.3	70.9	75.6	81.4	68.2	66.2	83.2	78
35	74.8	78.0	74.3	77.7	75.9	62.5	65.7	83.5	79
36	69.3	68.9	64.8	65.7	81.7	64.4	70.5	82.7	78
37	71.6	79.7	91.7	93.0	93.9	84.3	81.3	98.1	>93<
"38"	69.0	78.8	86.8	88.9	86 6	70.6	71.2	92.6	>88<
39	71.6	79.7	91.3	93.0	93.9	84.3	81.3	98.0	>93<
40	71.1	81.8	89.1	93.2	84.6	74.1	72.6	95.3	>91<
"41"	70.1	81.6	90.4	91.6	86.5	74.2	73.6	95.0	>90<
42	77.7	87.4	94.8	93.4	89 8	79.7	82.8	98.5	>94<
43	78.2	89.5	96.5	96.1	90.0	85.0	87.0	100.5	>96<
44	76.4	85.7	94.4	94.1	83.6	79.5	86.4	98.1	>93<
45	66.2	78.5	90.8	92.4	93.1	88.5	79.5	97.7	>93<
46	68 0	77.6	89.9	91.6	90.8	86.5	85.6	96.5	>92<
47	68.8	78.1	91.0	89.3	93.0	89.6	80.4	97.2	>92<
"48"	73 1	83.1	90.0	87.9	85.7	78.9	81.9	93.9	>89<
"49"	77.7	83.1	89.8	91.2	85.5	80.5	80 0	94.9	>90<
"50"	68.3	78.3	83.7	82.0	78.3	73 1	71.5	87.6	83
"51"	67.7	77.6	82.6	81.2	77.6	70 2	68.5	86.6	82
52	79.3	91.1	98.9	100.6	94.4	90.4	94.9	104.4	>100<
"53"	62.3	72.7	79.1	80.1	79.2	73.8	75.4	85.4	81
"54"	60.4	73.5	80.2	80.4	81.0	72.7	67.8	85.9	81
"55"	68.6	74.9	92.8	92.5	93.2	90.5	65.6	98.4	>94<
"56"	64.3	73.9	86.3	80.7	81.4	72.2	71.4	88.7	84
57	79.0	88.2	95.9	98.4	97.4	93.5	84.1	102.9	>98<
58	73.8	79.1	89.8	94.7	84.2	83.5	77.4	96.6	>92<
"59"	56.5	65.8	71.1	78.8	84.9	77.7	65.0	86.7	82
"60"	62.2	73.5	101.0	88.1	88.1	84.5	66.3	101.5	>97<
"61"	63.6	74.1	73.7	82.3	79.6	78 0	77.3	86.3	82
62	71.8	84.8	93.1	93.9	92.6	72.7	72.7	98.2	>93<
"63"	60.8	69.8	73.3	78.3	81.3	69.8	69.6	84.0	79
"64"	66.3	70.0	69.5	71.9	76.9	70.2	66.8	80.1	75
65	71.4	77.7	86.6	94.3	82.3	70.1	63.2	95.3	>91<
66	73.5	82.6	88.3	89.1	88.4	73.7	70.6	93.8	>89<
"67"	58 0	63.6	65.0	71.1	84.9	70.9	62.5	85.3	81
68	73.5	82.6	88.3	89.1	88.4	73.7	70.6	93.8	>89<
"69"	58.0	63.6	65.0	71.1	84.9	70.9	62.5	85.3	81
70	58.1	71.5	79.5	82.3	84.2	69.6	68.7	87.4	83
71	79.7	87.3	90.8	90 6	89.3	76.4	73.6	95.9	>91<
72	80 8	90.1	98.0	101.0	96.0	89.2	83.6	104.0	>99<
73	73.4	83.7	92.3	93.7	91.2	82.2	80.3	97.7	>93<
74	69.7	80.3	88.9	90.8	90.3	77.9	77.5	95.2	>90<
"75"	60.4	71.3	76.9	81.2	85.7	74.9	69.4	87.8	83
"76"	60.4	71.3	76.9	81.2	85.7	74.9	69.4	87.8	83
"77"	69.6	73.6	89.4	92.5	79.1	70.1	78.9	94.5	>90<
"78"	72.8	80.4	87.7	90.9	82.1	72.6	75.5	93.4	>89<
79	76.2	84.1	86.0	85.7	81 8	79.7	70.4	91.2	>86<
80	69.6	77.7	83.4	85.3	80.6	73.4	73.2	88.9	84
81	57.7	67.9	78.5	78.1	77.4	67.0	69.1	83.2	78
82	66.2	73.5	87.0	87.1	81.8	82.1	84.8	92.2	>87<
83	76 4	85.7	94.4	94.1	83 6	79.5	86.4	98.1	>93<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
"n" These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1

Appendix 3

HPD selection for coal mining

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Table A-3.1
HPD selection for coal cutter operators

	dB-Neq	Mean:	95.3	Max:	103	Min:	81	Obs (n):	28
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	70.0	80.0	89.0	90.0	89.0	85.0	79.0	94.9	103
with HPD									
1	67.1	75.1	74.0	66.8	60.9	53.9	54.0	78.4	>86<
2	65.3	67.1	70.2	67.6	69.3	62.0	61.4	75.6	84
3	63.5	67.8	69.4	71.7	69.6	66.2	58.6	76.6	85
4	67.1	70.8	68.0	71.3	70.5	65.4	59.3	77.2	85
5	65.7	70.6	73.1	71.8	61.3	52.4	49.6	77.2	85
6	62.6	70.4	70.5	67.2	60.7	53.6	46.7	74.9	83
7	64.9	69.2	67.9	63.6	62.5	51.9	44.8	73.4	81
8	64.6	70.6	70.4	67.0	62.5	52.6	47.9	75.1	83
9	59.9	64.3	67.8	61.8	59.6	52.6	52.4	71.0	79
10	59.8	67.2	70.9	62.4	60.7	53.7	52.4	73.4	81
11	66.3	69.1	71.8	63.9	61.3	52.4	53.1	75.0	83
12	64.5	64.3	67.9	63.3	57.8	50.9	50.9	71.7	80
13	59.1	62.2	66.2	57.6	57.6	47.5	44.6	69.0	77
14	64.2	70.6	75.1	66.2	63.3	52.6	53.3	77.3	85
15	70.0	72.2	74.9	68.5	65.2	60.3	60.7	78.5	>87<
16	66.3	69.9	73.0	65.9	63.5	52.9	48.5	76.1	84
17	69.3	74.2	73.3	66.6	64.0	54.0	49.7	78.0	>86<
18	65.3	70.5	73.1	69.0	60.6	53.1	54.3	76.5	85
19	62.2	66.1	65.4	61.2	61.8	49.0	42.7	70.8	79
20	65.3	66.9	67.8	62.8	68.3	54.2	47.5	73.7	82
21	64.3	67.3	65.5	61.5	61.9	49.7	48.4	71.7	80
22	67.4	71.8	74.3	66.5	62.0	59.0	50.6	77.4	85
23	68.0	72.6	72.1	66.8	62.3	51.7	47.3	76.8	85
24	65.9	71.8	74.1	67.8	63.8	55.0	54.3	77.3	85
25	65.8	74.3	74.4	66.8	64.5	61.6	52.0	78.3	>86<
26	67.6	73.8	76.2	69.2	64.0	53.9	50.4	79.2	>87<
27	64.1	70.4	71.5	63.4	62.3	54.4	53.0	75.1	83
28	68.0	75.9	72.5	65.4	60.6	55.0	49.7	78.3	>86<
29	67.8	74.4	73.2	63.8	63.1	54.0	49.2	77.7	>86<
30	59.4	69.5	65.3	52.2	50.0	41.1	52.0	71.3	79
31	57.8	64.6	68.0	60.6	56.0	53.2	47.9	70.6	79
32	52.0	59.6	59.2	53.0	53.2	51.4	45.8	64.0	72
33	60.3	62.7	64.9	51.1	59.1	54.7	48.5	68.7	77
34	52.4	54.8	56.7	57.9	59.0	45.9	40.8	63.8	72
35	60.8	63.5	60.1	60.0	53.5	40.2	40.3	67.6	76
36	55.3	54.4	50.6	48.0	59.3	42.1	45.1	62.3	70
37	57.6	65.2	77.5	75.3	71.5	62.0	55.9	80.4	>89<
38	55.0	64.3	72.6	71.2	64.2	48.3	45.8	75.7	84
39	57.6	65.2	77.1	75.3	71.5	62.0	55.9	80.2	>88<
40	57.1	67.3	74.9	75.5	62.2	51.8	47.2	78.7	>87<
41	56.1	67.1	76.2	73.9	64.1	51.9	48.2	78.7	>87<
42	63.7	72.9	80.6	75.7	67.4	57.4	57.4	82.6	>91<
43	64.2	75.0	82.3	78.4	67.6	62.7	61.6	84.5	>93<
44	62.4	71.2	80.2	76.4	61.2	57.2	61.0	82.2	>90<
45	52.2	64.0	76.6	74.7	70.7	66.2	54.1	79.7	>88<
46	54.0	63.1	75.7	73.9	68.4	64.2	60.2	78.7	>87<
47	54.8	63.6	76.8	71.6	70.6	67.3	55.0	79.1	>87<
48	59.1	68.6	75.8	70.2	63.3	56.6	56.5	77.8	>86<
49	63.7	68.6	75.6	73.5	63.1	58.2	54.6	78.5	>87<
50	54.3	63.8	69.5	64.3	55.9	50.8	46.1	71.7	80
51	53.7	63.1	68.4	63.5	55.2	47.9	43.1	70.7	79
52	65.3	76.6	84.7	82.9	72.0	68.1	69.5	87.6	>96<
53	48.3	58.2	64.9	62.4	56.8	51.5	50.0	68.0	76
54	46.4	59.0	66.0	62.7	58.6	50.4	42.4	68.8	77
55	54.6	60.4	78.6	74.8	70.8	68.2	40.2	80.9	>89<
56	50.3	59.4	72.1	63.0	59.0	49.9	46.0	73.0	81
57	65.0	73.7	81.7	80.7	75.0	71.2	58.7	85.3	>93<
58	59.8	64.6	75.6	77.0	61.8	61.2	52.0	79.7	>88<
59	42.5	51.3	56.9	61.1	62.5	55.4	39.6	66.1	74
60	48.2	59.0	86.8	70.4	65.7	62.2	40.9	87.0	>95<
61	49.6	59.6	59.5	64.6	57.2	55.7	51.9	67.7	76
62	57.8	70.3	78.9	76.2	70.2	50.4	47.3	81.5	>90<
63	46.8	55.3	59.1	60.6	58.9	47.5	44.2	65.1	73
64	52.3	55.5	55.3	54.2	54.5	47.9	41.4	61.7	70
65	57.4	63.2	72.4	76.6	59.9	47.8	37.8	78.2	>86<
66	59.5	68.1	74.1	71.4	66.0	51.4	45.2	77.1	85
67	44.0	49.1	50.8	53.4	62.5	48.6	37.1	63.6	72
68	59.5	68.1	74.1	71.4	66.0	51.4	45.2	77.1	85
69	44.0	49.1	50.8	53.4	62.5	48.6	37.1	63.6	72
70	44.1	57.0	65.3	64.6	61.8	47.3	43.3	69.2	77
71	65.7	72.8	76.6	72.9	66.9	54.1	48.2	79.7	>88<
72	66.8	75.6	83.8	83.3	73.6	66.9	58.2	87.2	>95<
73	59.4	69.2	78.1	76.0	68.8	59.9	54.9	80.9	>89<
74	55.7	65.8	74.7	73.1	67.9	55.6	52.1	77.8	>86<
75	46.4	56.8	62.7	63.5	63.3	52.6	44.0	68.4	77
76	46.4	56.8	62.7	63.5	63.3	52.6	44.0	68.4	77
77	55.6	59.1	75.2	74.8	56.7	47.8	53.5	78.1	>86<
78	58.8	65.9	73.5	73.2	59.7	50.3	50.1	76.9	85
79	62.2	69.6	71.8	68.0	59.4	57.4	45.0	75.3	83
80	55.6	63.2	69.2	67.6	58.2	51.1	47.8	72.4	80
81	43.7	53.4	64.3	60.4	55.0	44.7	43.7	66.4	75
82	52.2	59.0	72.8	69.4	59.4	59.8	59.4	75.0	83
83	62.4	71.2	80.2	76.4	61.2	57.2	61.0	82.2	>90<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-3.2
HPD selection for coal cutter assistants

	dB-Neq	Mean:	92.6	Max:	102	Min:	83	Obs (n):	28
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	69.5	77.3	87.7	90.1	89.9	85.9	78.9	94.9	92.6
with HPD									
1	66.6	72.4	72.7	66.9	61.8	54.8	53.9	76.8	74
2	64.8	64.4	68.9	67.7	70.2	62.9	61.3	75.2	73
3	63.0	65.1	68.1	71.8	70.5	67.1	58.5	76.4	74
4	66.6	68.1	66.7	71.4	71.4	66.3	59.2	76.8	75
5	65.2	67.9	71.8	71.9	62.2	53.3	49.5	76.2	74
6	62.1	67.7	69.2	67.3	61.6	54.5	46.6	73.6	71
7	64.4	66.5	66.6	63.7	63.4	52.8	44.7	72.2	70
8	64.1	67.9	69.1	67.1	63.4	53.5	47.8	73.9	72
9	59.4	61.6	66.5	61.9	60.5	53.5	52.3	69.9	((68))
10	59.3	64.5	69.6	62.5	61.6	54.6	52.3	72.2	70
11	65.8	66.4	70.5	64.0	62.2	53.3	53.0	73.8	71
12	64.0	61.6	66.6	63.4	58.7	51.8	50.8	70.7	((68))
13	58.6	59.5	64.9	57.7	58.5	48.4	44.5	67.9	((66))
14	63.7	67.9	73.8	66.3	64.2	53.5	53.2	76.0	74
15	69.5	69.5	73.6	68.6	66.1	61.2	60.6	77.4	75
16	65.8	67.2	71.7	66.0	64.4	53.8	48.4	74.9	73
17	68.8	71.5	72.0	66.7	64.9	54.9	49.6	76.6	74
18	64.8	67.8	71.8	69.1	61.5	54.0	54.2	75.3	73
19	61.7	63.4	64.1	61.3	62.7	49.9	42.6	69.8	((67))
20	64.8	64.2	66.5	62.9	69.2	55.1	47.4	73.2	71
21	63.8	64.6	64.2	61.6	62.8	50.6	48.3	70.6	((68))
22	66.9	69.1	73.0	66.6	62.9	59.9	50.5	76.1	74
23	67.5	69.9	70.8	66.9	63.2	52.6	47.2	75.4	73
24	65.4	69.1	72.8	67.9	64.7	55.9	54.2	76.1	74
25	65.3	71.6	73.1	66.9	65.4	62.5	51.9	76.9	75
26	67.1	71.1	74.9	69.3	64.9	54.8	50.3	77.8	76
27	63.6	67.7	70.2	63.5	63.2	55.3	52.9	73.7	71
28	67.5	73.2	71.2	65.5	61.5	55.9	49.6	76.5	74
29	67.3	71.7	71.9	63.9	64.0	54.9	49.1	76.1	74
30	58.9	66.8	64.0	52.3	50.9	42.0	51.9	69.3	((67))
31	57.3	61.9	66.7	60.7	56.9	54.1	47.8	69.4	((67))
32	51.5	56.9	57.9	53.1	54.1	52.3	45.7	62.8	((60))
33	59.8	60.0	63.6	51.2	60.0	55.6	48.4	67.6	((65))
34	51.9	52.1	55.4	58.0	59.9	46.8	40.7	63.7	((61))
35	60.3	60.8	58.8	60.1	54.4	41.1	40.2	66.4	((64))
36	54.8	51.7	49.3	48.1	60.2	43.0	45.0	62.3	((60))
37	57.1	62.5	76.2	75.4	72.4	62.9	55.8	79.9	78
38	54.5	61.6	71.3	71.3	65.1	49.2	45.7	75.1	73
39	57.1	62.5	75.8	75.4	72.4	62.9	55.8	79.8	77
40	56.6	64.6	73.6	75.6	63.1	52.7	47.1	78.1	76
41	55.6	64.4	74.9	74.0	65.0	52.8	48.1	78.0	76
42	63.2	70.2	79.3	75.8	68.3	58.3	57.3	81.6	79
43	63.7	72.3	81.0	78.5	68.5	63.6	61.5	83.6	81
44	61.9	68.5	78.9	76.5	62.1	58.1	60.9	81.3	79
45	51.7	61.3	75.3	74.8	71.6	67.1	54.0	79.3	77
46	53.5	60.4	74.4	74.0	69.3	65.1	60.1	78.2	76
47	54.3	60.9	75.5	71.7	71.5	68.2	54.9	78.6	76
48	58.6	65.9	74.5	70.3	64.2	57.5	56.4	76.7	74
49	63.2	65.9	74.3	73.6	64.0	59.1	54.5	77.7	75
50	53.8	61.1	68.2	64.4	56.8	51.7	46.0	70.6	((68))
51	53.2	60.4	67.1	63.6	56.1	48.8	43.0	69.7	((67))
52	64.8	73.9	83.4	83.0	72.9	69.0	69.4	86.8	84
53	47.8	55.5	63.6	62.5	57.7	52.4	49.9	67.3	((65))
54	45.9	56.3	64.7	62.8	59.5	51.3	42.3	68.0	((66))
55	54.1	57.7	77.3	74.9	71.7	69.1	40.1	80.3	78
56	49.8	56.7	70.8	63.1	59.9	50.8	45.9	72.0	70
57	64.5	71.0	80.4	80.8	75.9	72.1	58.6	84.8	82
58	59.3	61.9	74.3	77.1	62.7	62.1	51.9	79.3	77
59	42.0	48.6	55.6	61.2	63.4	56.3	39.5	66.4	((64))
60	47.7	56.3	85.5	70.5	66.6	63.1	40.8	85.7	83
61	49.1	56.9	58.2	64.7	58.1	56.6	51.8	67.4	((65))
62	57.3	67.6	77.6	76.3	71.1	51.3	47.2	80.8	78
63	46.3	52.6	57.8	60.7	59.8	48.4	44.1	64.8	((63))
64	51.8	52.8	54.0	54.3	55.4	48.8	41.3	61.1	((59))
65	56.9	60.5	71.1	76.7	60.8	48.7	37.7	78.0	76
66	59.0	65.4	72.8	71.5	66.9	52.3	45.1	76.3	74
67	43.5	46.4	49.5	53.5	63.4	49.5	37.0	64.3	((62))
68	59.0	65.4	72.8	71.5	66.9	52.3	45.1	76.3	74
69	43.5	46.4	49.5	53.5	63.4	49.5	37.0	64.3	((62))
70	43.6	54.3	64.0	64.7	62.7	48.2	43.2	68.9	((67))
71	65.2	70.1	75.3	73.0	67.8	55.0	48.1	78.7	76
72	66.3	72.9	82.5	83.4	74.5	67.8	58.1	86.6	84
73	58.9	66.5	76.8	76.1	69.7	60.8	54.8	80.2	78
74	55.2	63.1	73.4	73.2	68.8	56.5	52.0	77.3	75
75	45.9	54.1	61.4	63.6	64.2	53.5	43.9	68.4	((66))
76	45.9	54.1	61.4	63.6	64.2	53.5	43.9	68.4	((66))
77	55.1	56.4	73.9	74.9	57.6	48.7	53.4	77.6	75
78	58.3	63.2	72.2	73.3	60.6	51.2	50.0	76.2	74
79	61.7	66.9	70.5	68.1	60.3	58.3	44.9	74.1	72
80	55.1	60.5	67.9	67.7	59.1	52.0	47.7	71.6	((69))
81	43.2	50.7	63.0	60.5	55.9	45.6	43.6	65.7	((63))
82	51.7	56.3	71.5	69.5	60.3	60.7	59.3	74.3	72
83	61.9	68.5	78.9	76.5	62.1	58.1	60.9	81.3	79

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-3.3
HPD selection for coal loader operators

	dB-Neq	Mean:	96.2	Max:	104	Min:	81	Obs (n):	27
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
v/o HPD	80.0	84.0	90.0	93.0	88.0	85.0	76.0	96.4	104
vith HPD									
1	77.1	79.1	75.0	69.8	59.9	53.9	51.0	82.4	>90<
2	75.3	71.1	71.2	70.6	68.3	62.0	58.4	79.1	>87<
3	73.5	71.8	70.4	74.7	68.6	66.2	55.6	79.5	>87<
4	77.1	74.8	69.0	74.3	69.5	65.4	56.3	81.1	>89<
5	75.7	74.6	74.1	74.8	60.3	52.4	46.6	80.9	>89<
6	72.6	74.4	71.5	70.2	59.7	53.6	43.7	78.5	>86<
7	74.9	73.2	68.9	66.6	61.5	51.9	41.8	78.2	>86<
8	74.6	74.6	71.4	70.0	61.5	52.6	44.9	79.2	>87<
9	69.9	68.3	68.8	64.8	58.6	52.6	49.4	74.5	82
10	69.8	71.2	71.9	65.4	59.7	53.7	49.4	76.3	84
11	76.3	73.1	72.8	66.9	60.3	52.4	50.1	79.5	>87<
12	74.5	68.3	68.9	66.3	56.8	50.9	47.9	76.8	84
13	69.1	66.2	67.2	60.6	56.6	47.5	41.6	72.8	80
14	74.2	74.6	76.1	69.2	62.3	52.6	50.3	80.3	>88<
15	80.0	76.2	75.9	71.5	64.2	60.3	57.7	83.0	>91<
16	76.3	73.9	74.0	68.9	62.5	52.9	45.5	80.1	>88<
17	79.3	78.2	74.3	69.6	63.0	54.0	46.7	82.8	>90<
18	75.3	74.5	74.1	72.0	59.6	53.1	51.3	80.2	>88<
19	72.2	70.1	66.4	64.2	60.8	49.0	39.7	75.5	83
20	75.3	70.9	68.8	65.8	67.3	54.2	44.5	78.0	>86<
21	74.3	71.3	66.5	64.5	60.9	49.7	45.4	76.9	85
22	77.4	75.8	75.3	69.5	61.0	59.0	47.6	81.4	>89<
23	78.0	76.6	73.1	69.8	61.3	51.7	44.3	81.5	>89<
24	75.9	75.8	75.1	70.8	62.8	55.0	51.3	80.9	>89<
25	75.8	78.3	75.4	69.8	63.5	61.6	49.0	81.9	>89<
26	77.6	77.8	77.2	72.2	63.0	53.9	47.4	82.8	>90<
27	74.1	74.4	72.5	66.4	61.3	54.4	50.0	78.9	>87<
28	78.0	79.9	73.5	68.4	59.6	55.0	46.7	82.8	>90<
29	77.8	78.4	74.2	66.8	62.1	54.0	46.2	82.1	>90<
30	69.4	73.5	66.3	55.2	49.0	41.1	49.0	75.5	83
31	67.8	68.6	69 0	63.6	55.0	53.2	44.9	73.8	81
32	62.0	63.6	60 2	56.0	52.2	51.4	42.8	67.5	75
33	70.3	66.7	65.9	54.1	58.1	54.7	45.5	73.1	81
34	62.4	58.8	57.7	60.9	58.0	45.9	37.8	67.0	75
35	70.8	67.5	61.1	63.0	52.5	40.2	37.3	73.2	81
36	65.3	58.4	51.6	51.0	58.3	42.1	42.1	67.0	75
37	67.6	69.2	78.5	78.3	70.5	62.0	52.9	82.2	>90<
38	65.0	68.3	73 6	74.2	63.2	48.3	42.8	77.9	>86<
39	67.6	69.2	78.1	78.3	70.5	62.0	52.9	82.0	>90<
40	67.1	71.3	75.9	78.5	61.2	51.8	44.2	81.1	>89<
41	66.1	71.1	77.2	76.9	63.1	51.9	45.2	80.8	>88<
42	73.7	76.9	81.6	78.7	66.4	57.4	54.4	84.7	>92<
43	74.2	79.0	83.3	81.4	66.6	62.7	58.6	86.7	>94<
44	72.4	75.2	81.2	79.4	60.2	57.2	58 0	84.3	>92<
45	62.2	68.0	77.6	77.7	69.7	66.2	51.1	81.4	>89<
46	64.0	67.1	76.7	76.9	67 4	64.2	57.2	80.5	>88<
47	64.8	67.6	77.8	74.6	69.6	67.3	52.0	80.5	>88<
48	69.1	72.6	76.8	73.2	62 3	56.6	53.5	79.9	>88<
49	73.7	72.6	76.6	76.5	62.1	58.2	51.6	81.3	>89<
50	64.3	67.8	70.5	67.3	54.9	50.8	43.1	74.1	82
51	63.7	67.1	69.4	66.5	54.2	47.9	40.1	73.2	81
52	75.3	80.6	85.7	85.9	71.0	68.1	66.5	89.7	>97<
53	58 3	62.2	65.9	65.4	55.8	51.5	47.0	70.1	78
54	56.4	63.0	67.0	65.7	57.6	50.4	39.4	70.7	78
55	64.6	64.4	79.6	77.8	69.8	68.2	37.2	82.4	>90<
56	60.3	63.4	73.1	66.0	58.0	49.9	43.0	74.5	82
57	75.0	77.7	82.7	83.7	74.0	71.2	55.7	87.4	>95<
58	69.8	68.6	76.6	80.0	60.8	61.2	49.0	82.2	>90<
59	52.5	55.3	57.9	64.1	61.5	55.4	36 6	67.4	75
60	58.2	63.0	87.8	73.4	64.7	62.2	37.9	88.0	>96<
61	59.6	63.6	60.5	67.6	56.2	55.7	48.9	70.4	78
62	67.8	74.3	79.9	79.2	69.2	50.4	44.3	83.5	>91<
63	56.8	59.3	60.1	63.6	57.9	47.5	41.2	67.3	75
64	62.3	59.5	56.3	57.2	53.5	47.9	38.4	65.8	73
65	67.4	67.2	73.4	79.6	58.9	47.8	34.8	81.0	>89<
66	69.5	72.1	75.1	74.4	65.0	51.4	42.2	79.5	>87<
67	54.0	53.1	51.8	56.4	61.5	48.6	34.1	64.0	72
68	69.5	72.1	75.1	74.4	65.0	51.4	42.2	79.5	>87<
69	54.0	53.1	51.8	56.4	61.5	48.6	34.1	64.0	72
70	54.1	61.0	66.3	67.6	60.8	47.3	40.3	71.1	79
71	75.7	76.8	77.6	75.9	65.9	54.1	45.2	82.7	>90<
72	76.8	79.6	84.8	86.3	72.6	66.9	55.2	89.5	>97<
73	69.4	73.2	79.1	79.0	67.8	59.9	51.9	83.0	>91<
74	65.7	69.8	75.7	76.1	66.9	55.6	49.1	79.8	>87<
75	56.4	60.8	63 7	66.5	62.3	52.6	41.0	70.1	78
76	56.4	60.8	63.7	66.5	62.3	52.6	41.0	70.1	78
77	65.6	63.1	76.2	77.8	55.7	47.8	50.5	80.3	>88<
78	68.8	69.9	74.5	76.2	58.7	50.3	47.1	79.5	>87<
79	72.2	73.6	72.8	71.0	58.4	57.4	42.0	78.6	>86<
80	65.6	67.2	70.2	70.6	57.2	51.1	44.8	75.0	83
81	53.7	57.4	65.3	63.4	54.0	44.7	40.7	68.2	76
82	62.2	63.0	73.8	72.4	58.4	59.8	56.4	76.7	84
83	72.4	75.2	81.2	79.4	60.2	57.2	58.0	84.3	>92<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-3.4
HPD selection for roofbolter operators

	dB-Neq	Mean:	89.1	Max:	91	Min:	83	Obs (n):	22
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	66.0	72.0	78.0	73.0	70.0	72.0	64.0	81.2	91
with HPD									
1	63.1	67.1	63.0	49.8	41.9	40.9	39.0	69.7	80
2	61.3	59.1	59.2	50.6	50.3	49.0	46.4	65.2	75
3	59.5	59.8	58.4	54.7	50.6	53.2	43.6	65.0	75
4	63.1	62.8	57.0	54.3	51.5	52.4	44.3	67.0	77
5	61.7	62.6	62.1	54.8	42.3	39.4	34.6	67.2	77
6	58.6	62.4	59.5	50.2	41.7	40.6	31.7	65.4	75
7	60.9	61.2	56.9	46.6	43.5	38.9	29.8	64.9	75
8	60.6	62.6	59.4	50.0	43.5	39.6	32.9	66.0	76
9	55.9	56.3	56.8	44.8	40.6	39.6	37.4	61.3	71
10	55.8	59.2	59.9	45.4	41.7	40.7	37.4	63.5	73
11	62.3	61.1	60.8	46.9	42.3	39.4	38.1	66.3	76
12	60.5	56.3	56.9	46.3	38.8	37.9	35.9	63.2	73
13	55.1	54.2	55.2	40.6	38.6	34.5	29.6	59.7	70
14	60.2	62.6	64.1	49.2	44.3	39.6	38.3	67.5	77
15	66.0	64.2	63.9	51.5	46.2	47.3	45.7	69.7	80
16	62.3	61.9	62.0	48.9	44.5	39.9	33.5	66.9	77
17	65.3	66.2	62.3	49.6	45.0	41.0	34.7	69.7	80
18	61.3	62.5	62.1	52.0	41.6	40.1	39.3	66.9	77
19	58.2	58.1	54.4	44.2	42.8	36.0	27.7	62.1	72
20	61.3	58.9	56.8	45.8	49.3	41.2	32.5	64.4	74
21	60.3	59.3	54.5	44.5	42.9	36.7	33.4	63.5	73
22	63.4	63.8	63.3	49.5	43.0	46.0	35.6	68.4	78
23	64.0	64.6	61.1	49.8	43.3	38.7	32.3	68.3	78
24	61.9	63.8	63.1	50.8	44.8	42.0	39.3	67.9	78
25	61.8	66.3	63.4	49.8	45.5	48.6	37.0	69.1	79
26	63.6	65.8	65.2	52.2	45.0	40.9	35.4	69.8	80
27	60.1	62.4	60.5	46.4	43.3	41.4	38.0	66.0	76
28	64.0	67.9	61.5	48.4	41.6	42.0	34.7	70.1	80
29	63.8	66.4	62.2	46.8	44.1	41.0	34.2	69.3	79
30	55.4	61.5	54.3	35.2	31.0	28.1	37.0	63.1	73
31	53.8	56.6	57.0	43.6	37.0	40.2	32.9	60.9	71
32	48.0	51.6	48.2	36.0	34.2	38.4	30.8	54.6	((64))
33	56.3	54.7	53.9	34.1	40.1	41.7	33.5	60.0	70
34	48.4	46.8	45.7	40.9	40.0	32.9	25.8	52.5	((62))
35	56.8	55.5	49.1	43.0	34.5	27.2	25.3	59.7	70
36	51.3	46.4	39.6	31.0	40.3	29.1	30.1	53.0	((63))
37	53.6	57.2	66.5	58.3	52.5	49.0	40.9	67.9	78
38	51.0	56.3	61.6	54.2	45.2	35.3	30.8	63.6	73
39	53.6	57.2	66.1	58.3	52.5	49.0	40.9	67.6	77
40	53.1	59.3	63.9	58.5	43.2	38.8	32.2	66.3	76
41	52.1	59.1	65.2	56.9	45.1	38.9	33.2	66.8	77
42	59.7	64.9	69.6	58.7	48.4	44.4	42.4	71.5	81
43	60.2	67.0	71.3	61.4	48.6	49.7	46.6	73.3	83
44	58.4	63.2	69.2	59.4	42.2	44.2	46.0	70.8	81
45	48.2	56.0	65.6	57.7	51.7	53.2	39.1	67.0	77
46	50.0	55.1	64.7	56.9	49.4	51.2	45.2	66.1	76
47	50.8	55.6	65.8	54.6	51.6	54.3	40.0	67.0	77
48	55.1	60.6	64.8	53.2	44.3	43.6	41.5	66.8	77
49	59.7	60.6	64.6	56.5	44.1	45.2	39.6	67.4	77
50	50.3	55.8	58.5	47.3	36.9	37.8	31.1	61.0	71
51	49.7	55.1	57.4	46.5	36.2	34.9	28.1	60.1	70
52	61.3	68.6	73.7	65.9	53.0	55.1	54.5	75.7	85
53	44.3	50.2	53.9	45.4	37.8	38.5	35.0	56.3	((66))
54	42.4	51.0	55.0	45.7	39.6	37.4	27.4	57.1	((67))
55	50.6	52.4	67.6	57.8	51.8	55.2	25.2	68.5	78
56	46.3	51.4	61.1	46.0	40.0	36.9	31.0	61.8	72
57	61.0	65.7	70.7	63.7	56.0	58.2	43.7	73.0	83
58	55.8	56.6	64.6	60.0	42.8	48.2	37.0	66.8	77
59	38.5	43.3	45.9	44.1	43.5	42.4	24.6	51.2	((61))
60	44.2	51.0	75.8	53.4	46.7	49.2	25.9	75.9	>86<
61	45.6	51.6	48.5	47.6	38.2	42.7	36.9	55.3	((65))
62	53.8	62.3	67.9	59.2	51.2	37.4	32.3	69.6	79
63	42.8	47.3	48.1	43.6	39.9	34.5	29.2	52.4	((62))
64	48.3	47.5	44.3	37.2	35.5	34.9	26.4	52.1	((62))
65	53.4	55.2	61.4	59.6	40.9	34.8	22.8	64.6	74
66	55.5	60.1	63.1	54.4	47.0	38.4	30.2	65.7	76
67	40.0	41.1	39.8	36.4	43.5	35.6	22.1	48.0	((58))
68	55.5	60.1	63.1	54.4	47.0	38.4	30.2	65.7	76
69	40.0	41.1	39.8	36.4	43.5	35.6	22.1	48.0	((58))
70	40.1	49.0	54.3	47.6	42.8	34.3	28.3	56.4	((66))
71	61.7	64.8	65.6	55.9	47.9	41.1	33.2	69.3	79
72	62.8	67.6	72.8	66.3	54.6	53.9	43.2	75.0	85
73	55.4	61.2	67.1	59.0	49.8	46.9	39.9	68.9	79
74	51.7	57.8	63.7	56.1	48.9	42.6	37.1	65.6	75
75	42.4	48.8	51.7	46.5	44.3	39.6	29.0	55.1	((65))
76	42.4	48.8	51.7	46.5	44.3	39.6	29.0	55.1	((65))
77	51.6	51.1	64.2	57.8	37.7	34.8	38.5	65.5	75
78	54.8	57.9	62.5	56.2	40.7	37.3	35.1	65.0	75
79	58.2	61.6	60.8	51.0	40.4	44.4	30.0	65.4	75
80	51.6	55.2	58.2	50.6	39.2	38.1	32.8	61.0	71
81	39.7	45.4	53.3	43.4	36.0	31.7	28.7	54.6	((64))
82	48.2	51.0	61.8	52.4	40.4	46.8	44.4	62.9	73
83	58.4	63.2	69.2	59.4	42.2	44.2	46.0	70.8	81

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-3.5

HPD selection for electric hand drill operators

	dB-Neq	Mean:	90.7	Max:	96	Min:	83	Obs (n):	21
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	60.5	66.0	77.0	82.5	89.5	90.0	83.0	93.7	90.7
with HPD									
1	57.6	61.1	62.0	59.3	61.4	58.9	58.0	68.5	((66))
2	55.8	53.1	58.2	60.1	69.8	67.0	65.4	73.1	70
3	54.0	53.8	57.4	64.2	70.1	71.2	62.6	74.6	72
4	57.6	56.8	56.0	63.8	71.0	70.4	63.3	74.7	72
5	56.2	56.6	61.1	64.3	61.8	57.4	53.6	68.5	((66))
6	53.1	56.4	58.5	59.7	61.2	58.6	50.7	66.5	((64))
7	55.4	55.2	55.9	56.1	63.0	56.9	48.8	66.1	((63))
8	55.1	56.6	58.4	59.5	63.0	57.6	51.9	67.1	((64))
9	50.4	50.3	55.8	54.3	60.1	57.6	56.4	64.6	((62))
10	50.3	53.2	58.9	54.9	61.2	58.7	56.4	65.9	((63))
11	56.8	55.1	59.8	56.4	61.8	57.4	57.1	66.8	((64))
12	55.0	50.3	55.9	55.8	58.3	55.9	54.9	64.1	((61))
13	49.6	48.2	54.2	50.1	58.1	52.5	48.6	61.5	((59))
14	54.7	56.6	63.1	58.7	63.8	57.6	57.3	68.5	((66))
15	60.5	58.2	62.9	61.0	65.7	65.3	64.7	71.8	((69))
16	56.8	55.9	61.0	58.4	64.0	57.9	52.5	67.9	((65))
17	59.8	60.2	61.3	59.1	64.5	59.0	53.7	69.0	((66))
18	55.8	56.5	61.1	61.5	61.1	58.1	58.3	67.9	((65))
19	52.7	52.1	53.4	53.7	62.3	54.0	46.7	64.5	((62))
20	55.8	52.9	55.8	55.3	68.8	59.2	51.5	69.9	((67))
21	54.8	53.3	53.5	54.0	62.4	54.7	52.4	65.0	((62))
22	57.9	57.8	62.3	59.0	62.5	64.0	54.6	69.2	((66))
23	58.5	58.6	60.1	59.3	62.8	56.7	51.3	67.6	((65))
24	56.4	57.8	62.1	60.3	64.3	60.0	58.3	69.1	((66))
25	56.3	60.3	62.4	59.3	65.0	66.6	56.0	70.9	((68))
26	58.1	59.8	64.2	61.7	64.5	58.9	54.4	69.8	((67))
27	54.6	56.4	59.5	55.9	62.8	59.4	57.0	67.2	((64))
28	58.5	61.9	60.5	57.9	61.1	60.0	53.7	68.1	((65))
29	58.3	60.4	61.2	56.3	63.6	59.0	53.2	68.3	((65))
30	49.9	55.5	53.3	44.7	50.5	46.1	56.0	61.0	((58))
31	48.3	50.6	56.0	53.1	56.5	58.2	51.9	63.1	((60))
32	42.5	45.6	47.2	45.5	53.7	56.4	49.8	59.6	((57))
33	50.8	48.7	52.9	43.6	59.6	59.7	52.5	63.9	((61))
34	42.9	40.8	44.7	50.4	59.5	50.9	44.8	60.8	((58))
35	51.3	49.5	48.1	52.5	54.0	45.2	44.3	58.9	((56))
36	45.8	40.4	38.6	40.5	59.8	47.1	49.1	60.6	((58))
37	48.1	51.2	65.5	67.8	72.0	67.0	59.9	75.0	72
38	45.5	50.3	60.6	63.7	64.7	53.3	49.8	68.4	((65))
39	48.1	51.2	65.1	67.8	72.0	67.0	59.9	75.0	72
40	47.6	53.3	62.9	68.0	62.7	56.8	51.2	70.4	((67))
41	46.6	53.1	64.2	66.4	64.6	56.9	52.2	70.3	((67))
42	54.2	58.9	68.6	68.2	67.9	62.4	61.4	73.8	71
43	54.7	61.0	70.3	70.9	68.1	67.7	65.6	76.1	73
44	52.9	57.2	68.2	68.9	61.7	62.2	65.0	73.3	70
45	42.7	50.0	64.6	67.2	71.2	71.2	58.1	75.5	73
46	44.5	49.1	63.7	66.4	68.9	69.2	64.2	74.1	71
47	45.3	49.6	64.8	64.1	71.1	72.3	59.0	75.6	73
48	49.6	54.6	63.8	62.7	63.8	61.6	60.5	69.8	((67))
49	54.2	54.6	63.6	66.0	63.6	63.2	58.6	70.8	((68))
50	44.8	49.8	57.5	56.8	56.4	55.8	50.1	63.2	((60))
51	44.2	49.1	56.4	56.0	55.7	52.9	47.1	61.9	((59))
52	55.8	62.6	72.7	75.4	72.5	73.1	73.5	80.6	78
53	38.8	44.2	52.9	54.9	57.3	56.5	54.0	62.5	((60))
54	36.9	45.0	54.0	55.2	59.1	55.4	46.4	62.6	((60))
55	45.1	46.4	66.6	67.3	71.3	73.2	44.2	76.5	74
56	40.8	45.4	60.1	55.5	59.5	54.9	50.0	64.4	((61))
57	55.5	59.7	69.7	73.2	75.5	76.2	62.7	80.4	77
58	50.3	50.6	63.6	69.5	62.3	66.2	56.0	72.5	70
59	33.0	37.3	44.9	53.6	63.0	60.4	43.6	65.3	((62))
60	38.7	45.0	74.8	62.9	66.2	67.2	44.9	76.2	73
61	40.1	45.6	47.5	57.1	57.7	60.7	55.9	64.4	((61))
62	48.3	56.3	66.9	68.7	70.7	55.4	51.3	74.0	71
63	37.3	41.3	47.1	53.1	59.4	52.5	48.2	61.4	((58))
64	42.8	41.5	43.3	46.7	55.0	52.9	45.4	58.1	((55))
65	47.9	49.2	60.4	69.1	60.4	52.8	41.8	70.3	((67))
66	50.0	54.1	62.1	63.9	66.5	56.4	49.2	69.7	((67))
67	34.5	35.1	38.8	45.9	63.0	53.6	41.1	63.6	((61))
68	50.0	54.1	62.1	63.9	66.5	56.4	49.2	69.7	((67))
69	34.5	35.1	38.8	45.9	63.0	53.6	41.1	63.6	((61))
70	34.6	43.0	53.3	57.1	62.3	52.3	47.3	64.3	((61))
71	56.2	58.8	64.6	65.4	67.4	59.1	52.2	71.5	((68))
72	57.3	61.6	71.8	75.8	74.1	71.9	62.2	79.9	77
73	49.9	55.2	66.1	68.5	69.3	64.9	58.9	73.8	71
74	46.2	51.8	62.7	65.6	68.4	60.6	56.1	71.5	((69))
75	36.9	42.8	50.7	56.0	63.8	57.6	48.0	65.5	((63))
76	36.9	42.8	50.7	56.0	63.8	57.6	48.0	65.5	((63))
77	46.1	45.1	63.2	67.3	57.2	52.8	57.5	69.4	((66))
78	49.3	51.9	61.5	65.7	60.2	55.3	54.1	68.5	((65))
79	52.7	55.6	59.8	60.5	59.9	62.4	49.0	67.3	((64))
80	46.1	49.2	57.2	60.1	58.7	56.1	51.8	64.7	((62))
81	34.2	39.4	52.3	52.9	55.5	49.7	47.7	59.5	((56))
82	42.7	45.0	60.8	61.9	59.9	64.8	63.4	69.5	((67))
83	52.9	57.2	68.2	68.9	61.7	62.2	65.0	73.3	70

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-3.6
HPD selection for team leaders in conventional mining

	dB-Neq	Mean:	95.7	Max:	102	Min:	83	Obs (n):	20
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	81.9	90.4	98.8	98.0	96.2	92.0	81.9	103.2	102
with HPD									
1	79.0	85.5	83.8	74.8	68.1	60.9	56.9	88.5	>87<
2	77.2	77.5	80.0	75.6	76.5	69.0	64.3	84.8	84
3	75.4	78.2	79.2	79.7	76.8	73.2	61.5	85.4	84
4	79.0	81.2	77.8	79.3	77.7	72.4	62.2	86.4	85
5	77.6	81.0	82.9	79.8	68.5	59.4	52.5	86.8	>86<
6	74.5	80.8	80.3	75.2	67.9	60.6	49.6	84.7	83
7	76.8	79.6	77.7	71.6	69.7	58.9	47.7	83.5	82
8	76.5	81.0	80.2	75.0	69.7	59.6	50.8	85.0	84
9	71.8	74.7	77.6	69.8	66.8	59.6	55.3	80.7	79
10	71.7	77.6	80.7	70.4	67.9	60.7	55.3	83.2	82
11	78.2	79.5	81.6	71.9	68.5	59.4	56.0	85.1	84
12	76.4	74.7	77.7	71.3	65.0	57.9	53.8	81.7	81
13	71.0	72.6	76.0	65.6	64.8	54.5	47.5	78.9	78
14	76.1	81.0	84.9	74.2	70.5	59.6	56.2	87.1	>86<
15	81.9	82.6	84.7	76.5	72.4	67.3	63.6	88.5	>87<
16	78.2	80.3	82.8	73.9	70.7	59.9	51.4	86.0	85
17	81.2	84.6	83.1	74.6	71.2	61.0	52.6	88.2	>87<
18	77.2	80.9	82.9	77.0	67.8	60.1	57.2	86.3	85
19	74.1	76.5	75.2	69.2	69.0	56.0	45.6	80.8	80
20	77.2	77.3	77.6	70.8	75.5	61.2	50.4	83.3	82
21	76.2	77.7	75.3	69.5	69.1	56.7	51.3	81.8	81
22	79.3	82.2	84.1	74.5	69.2	66.0	53.5	87.4	>86<
23	79.9	83.0	81.9	74.8	69.5	58.7	50.2	86.9	>86<
24	77.8	82.2	83.9	75.8	71.0	62.0	57.2	87.2	>86<
25	77.7	84.7	84.2	74.8	71.7	68.6	54.9	88.3	>87<
26	79.5	84.2	86.0	77.2	71.2	60.9	53.3	89.1	>88<
27	76.0	80.8	81.3	71.4	69.5	61.4	55.9	85.0	84
28	79.9	86.3	82.3	73.4	67.8	62.0	52.6	88.6	>87<
29	79.7	84.8	83.0	71.8	70.3	61.0	52.1	87.9	>87<
30	71.3	79.9	75.1	60.2	57.2	48.1	54.9	81.6	80
31	69.7	75.0	77.8	68.6	63.2	60.2	50.8	80.5	79
32	63.9	70.0	69.0	61.0	60.4	58.4	48.7	73.7	72
33	72.2	73.1	74.7	59.1	66.3	61.7	51.4	78.6	77
34	64.3	65.2	66.5	65.9	66.2	52.9	43.7	72.7	71
35	72.7	73.9	69.9	68.0	60.7	47.2	43.2	77.8	77
36	67.2	64.8	60.4	56.0	66.5	49.1	48.0	71.6	70
37	69.5	75.6	87.3	83.3	78.7	69.0	58.8	89.4	>88<
38	66.9	74.7	82.4	79.2	71.4	55.3	48.7	84.9	84
39	69.5	75.6	86.9	83.3	78.7	69.0	58.8	89.2	>88<
40	69.0	77.7	84.7	83.5	69.4	58.8	50.1	87.7	>87<
41	68.0	77.5	86.0	81.9	71.3	58.9	51.1	88.0	>87<
42	75.6	83.3	90.4	83.7	74.6	64.4	60.3	92.1	>91<
43	76.1	85.4	92.1	86.4	74.8	69.7	64.5	94.0	>93<
44	74.3	81.6	90.0	84.4	68.4	64.2	63.9	91.6	>90<
45	64.1	74.4	86.4	82.7	77.9	73.2	57.0	88.7	>87<
46	65.9	73.5	85.5	81.9	75.6	71.2	63.1	87.7	>86<
47	66.7	74.0	86.6	79.6	77.8	74.3	57.9	88.2	>87<
48	71.0	79.0	85.6	78.2	70.5	63.6	59.4	87.3	>86<
49	75.6	79.0	85.4	81.5	70.3	65.2	57.5	87.9	>87<
50	66.2	74.2	79.3	72.3	63.1	57.8	49.0	81.3	80
51	65.6	73.5	78.2	71.5	62.4	54.9	46.0	80.3	79
52	77.2	87.0	94.5	90.9	79.2	75.1	72.4	96.8	>96<
53	60.2	68.6	74.7	70.4	64.0	58.5	52.9	77.2	76
54	58.3	69.4	75.8	70.7	65.8	57.4	45.3	78.0	77
55	66.5	70.8	88.4	82.8	78.0	75.2	43.1	90.0	>89<
56	62.2	69.8	81.9	71.0	66.2	56.9	48.9	82.6	81
57	76.9	84.1	91.5	88.7	82.2	78.2	61.6	94.3	>93<
58	71.7	75.0	85.4	85.0	69.0	68.2	54.9	88.6	>87<
59	54.4	61.7	66.7	69.1	69.7	62.4	42.5	74.1	73
60	60.1	69.4	96.6	78.4	72.9	69.2	43.8	96.7	>95<
61	61.5	70.0	69.3	72.6	64.4	62.7	54.8	76.3	75
62	69.7	80.7	88.7	84.2	77.4	57.4	50.2	90.7	>90<
63	58.7	65.7	68.9	68.6	66.1	54.5	47.1	73.8	73
64	64.2	65.9	65.1	62.2	61.7	54.9	44.3	71.2	70
65	69.3	73.6	82.2	84.6	67.1	54.8	40.7	86.9	>86<
66	71.4	78.5	83.9	79.4	73.2	58.4	48.1	86.4	85
67	55.9	59.5	60.6	61.4	69.7	55.6	40.0	71.3	70
68	71.4	78.5	83.9	79.4	73.2	58.4	48.1	86.4	85
69	55.9	59.5	60.6	61.4	69.7	55.6	40.0	71.3	70
70	56.0	67.4	75.1	72.6	69.0	54.3	46.2	78.1	77
71	77.6	83.2	86.4	80.9	74.1	61.1	51.1	89.3	>88<
72	78.7	86.0	93.6	91.3	80.8	73.9	61.1	96.3	>95<
73	71.3	79.6	87.9	84.0	76.0	66.9	57.8	90.1	>89<
74	67.6	76.2	84.5	81.1	75.1	62.6	55.0	86.9	>86<
75	58.3	67.2	72.5	71.5	70.5	59.6	46.9	77.0	76
76	58.3	67.2	72.5	71.5	70.5	59.6	46.9	77.0	76
77	67.5	69.5	85.0	82.8	63.9	54.8	56.4	87.2	>86<
78	70.7	76.3	83.3	81.2	66.9	57.3	53.0	86.1	85
79	74.1	80.0	81.6	76.0	66.6	64.4	47.9	85.0	84
80	67.5	73.6	79.0	75.6	65.4	58.1	50.7	81.7	80
81	55.6	63.8	74.1	68.4	62.2	51.7	46.6	75.7	74
82	64.1	69.4	82.6	77.4	66.6	66.8	62.3	84.1	83
83	74.3	81.6	90.0	84.4	68.4	64.2	63.9	91.6	>90<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-3.7

HPD selection for continuous miner operators

	dB-Neq	Mean:	95.5	Max:	103	Min:	88	Obs (n):	16
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	89.0	93.0	97.0	98.0	93.0	90.0	81.0	102.4	95.5
with HPD									
1	86.1	88.1	82.0	74.8	64.9	58.9	56.0	91.0	84
2	84.3	80.1	78.2	75.6	73.3	67.0	63.4	87.0	80
"3"	82.5	80.8	77.4	79.7	73.6	71.2	60.6	86.8	80
"4"	86.1	83.8	76.0	79.3	74.5	70.4	61.3	89.1	82
5	84.7	83.6	81.1	79.8	65.3	57.4	51.6	88.8	82
6	81.6	83.4	78.5	75.2	64.7	58.6	48.7	86.7	80
"7"	83.9	82.2	75.9	71.6	66.5	56.9	46.8	86.7	80
8	83.6	83.6	78.4	75.0	66.5	57.6	49.9	87.5	81
"9"	78.9	77.3	75.8	69.8	63.6	57.6	54.4	82.6	76
10	78.8	80.2	78.9	70.4	64.7	58.7	54.4	84.4	78
11	85.3	82.1	79.8	71.9	65.3	57.4	55.1	87.9	81
12	83.5	77.3	75.9	71.3	61.8	55.9	52.9	85.2	78
13	78.1	75.2	74.2	65.6	61.6	52.5	46.6	81.1	74
14	83.2	83.6	83.1	74.2	67.3	57.6	55.3	88.3	81
15	89.0	85.2	82.9	76.5	69.2	65.3	62.7	91.4	85
16	85.3	82.9	81.0	73.9	67.5	57.9	50.5	88.4	82
17	88.3	87.2	81.3	74.6	68.0	59.0	51.7	91.4	85
18	84.3	83.5	81.1	77.0	64.6	58.1	56.3	88.3	81
19	81.2	79.1	73.4	69.2	65.8	54.0	44.7	83.9	77
20	84.3	79.9	75.8	70.8	72.3	59.2	49.5	86.4	80
21	83.3	80.3	73.5	69.5	65.9	54.7	50.4	85.5	79
22	86.4	84.8	82.3	74.5	66.0	64.0	52.6	89.7	83
23	87.0	85.6	80.1	74.8	66.3	56.7	49.3	90.0	83
24	84.9	84.8	82.1	75.8	67.8	60.0	56.3	89.1	82
25	84.8	87.3	82.4	74.8	68.5	66.6	54.0	90.2	83
26	86.6	86.8	84.2	77.2	68.0	58.9	52.4	91.0	84
27	83.1	83.4	79.5	71.4	66.3	59.4	55.0	87.3	80
28	87.0	88.9	80.5	73.4	64.6	60.0	51.7	91.5	85
29	86.8	87.4	81.2	71.8	67.1	59.0	51.2	90.7	84
"30"	78.4	82.5	73.3	60.2	54.0	46.1	54.0	84.3	77
"31"	76.8	77.6	76.0	68.6	60.0	58.2	49.9	81.9	75
"32"	71.0	72.6	67.2	61.0	57.2	56.4	47.8	75.8	((69))
33	79.3	75.7	72.9	59.1	63.1	59.7	50.5	81.6	75
34	71.4	67.8	64.7	65.9	63.0	50.9	42.8	74.6	((68))
35	79.8	76.5	68.1	68.0	57.5	45.2	42.3	81.9	75
36	74.3	67.4	58.6	56.0	63.3	47.1	47.1	75.5	((69))
37	76.6	78.2	85.5	83.3	75.5	67.0	57.9	88.6	82
"38"	74.0	77.3	80.6	79.2	68.2	53.3	47.8	84.5	78
39	76.6	78.2	85.1	83.3	75.5	67.0	57.9	88.4	82
40	76.1	80.3	82.9	83.5	66.2	56.8	49.2	87.6	81
"41"	75.1	80.1	84.2	81.9	68.1	56.9	50.2	87.5	81
42	82.7	85.9	88.6	83.7	71.4	62.4	59.4	91.9	85
43	83.2	88.0	90.3	86.4	71.6	67.7	63.6	93.7	>87<
44	81.4	84.2	88.2	84.4	65.2	62.2	63.0	91.3	84
45	71.2	77.0	84.6	82.7	74.7	71.2	56.1	87.6	81
46	73.0	76.1	83.7	81.9	72.4	69.2	62.2	86.8	80
47	73.8	76.6	84.8	79.6	74.6	72.3	57.0	87.1	80
"48"	78.1	81.6	83.8	78.2	67.3	61.6	58.5	87.2	80
"49"	82.7	81.6	83.6	81.5	67.1	63.2	56.6	88.5	82
"50"	73.3	76.8	77.5	72.3	59.9	55.8	48.1	81.6	75
"51"	72.7	76.1	76.4	71.5	59.2	52.9	45.1	80.7	74
52	84.3	89.6	92.7	90.9	76.0	73.1	71.5	96.4	>90<
"53"	67.3	71.2	72.9	70.4	60.8	56.5	52.0	77.1	70
"54"	65.4	72.0	74.0	70.7	62.6	55.4	44.4	77.7	71
"55"	73.6	73.4	86.6	82.8	74.8	73.2	42.2	88.7	82
"56"	69.3	72.4	80.1	71.0	63.0	54.9	48.0	81.6	75
57	84.0	86.7	89.7	88.7	79.0	76.2	60.7	94.0	>87<
58	78.8	77.6	83.6	85.0	65.8	66.2	54.0	88.4	82
"59"	61.5	64.3	64.9	69.1	66.5	60.4	41.6	73.2	((66))
"60"	67.2	72.0	94.8	78.4	69.7	67.2	42.9	94.9	>88<
"61"	68.6	72.6	67.5	72.6	61.2	60.7	53.9	77.2	70
62	76.8	83.3	86.9	84.2	74.2	55.4	49.3	90.2	83
"63"	65.8	68.3	67.1	68.6	62.9	52.5	46.2	74.0	((67))
"64"	71.3	68.5	63.3	62.2	58.5	52.9	43.4	74.0	((67))
65	76.4	76.2	80.4	84.6	63.9	52.8	39.8	86.9	80
66	78.5	81.1	82.1	79.4	70.0	56.4	47.2	86.6	80
"67"	63.0	62.1	58.8	61.4	66.5	53.6	39.1	70.2	((63))
68	78.5	81.1	82.1	79.4	70.0	56.4	47.2	86.6	80
"69"	63.0	62.1	58.8	61.4	66.5	53.6	39.1	70.2	((63))
70	63.1	70.0	73.3	72.6	65.8	52.3	45.3	77.5	71
71	84.7	85.8	84.6	80.9	70.9	59.1	50.2	90.4	84
72	85.8	88.6	91.8	91.3	77.6	71.9	60.2	96.1	>89<
73	78.4	82.2	86.1	84.0	72.8	64.9	56.9	89.6	83
74	74.7	78.8	82.7	81.1	71.9	60.6	54.1	86.4	80
"75"	65.4	69.8	70.7	71.5	67.3	57.6	46.0	76.5	70
"76"	65.4	69.8	70.7	71.5	67.3	57.6	46.0	76.5	70
"77"	74.6	72.1	83.2	82.8	60.7	52.8	55.5	86.5	80
"78"	77.8	78.9	81.5	81.2	63.7	55.3	52.1	86.2	79
79	81.2	82.6	79.8	76.0	63.4	62.4	47.0	86.6	80
80	74.6	76.2	77.2	75.6	62.2	56.1	49.8	82.1	75
81	62.7	66.4	72.3	68.4	59.0	49.7	45.7	74.9	((68))
82	71.2	72.0	80.8	77.4	63.4	64.8	61.4	83.2	76
83	81.4	84.2	88.2	84.4	65.2	62.2	63.0	91.3	84

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
"n" These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-3.8
HPD selection for continuous miner assistants

	dB-Neq	Mean:	94.7	Max:	102	Min:	89	Obs (n):	15
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1K	2K	4K	8k	(dB)	(dB)
w/o HPD	92.0	95.0	99.0	96.0	95.0	91.0	83.0	103.3	94.7
with HPD									
1	89.1	90.1	84.0	72.8	66.9	59.9	58.0	93.2	85
2	87.3	82.1	80.2	73.6	75.3	68.0	65.4	89.4	81
3	85.5	82.8	79.4	77.7	75.6	72.2	62.6	88.7	80
4	89.1	85.8	78.0	77.3	76.5	71.4	63.3	91.4	83
5	87.7	85.6	83.1	77.8	67.3	58.4	53.6	90.9	82
6	84.6	85.4	80.5	73.2	66.7	59.6	50.7	88.9	80
7	86.9	84.2	77.9	69.6	68.5	57.9	48.8	89.2	81
8	86.6	85.6	80.4	73.0	68.5	58.6	51.9	89.8	81
9	81.9	79.3	77.8	67.8	65.6	58.6	56.4	84.9	76
10	81.8	82.2	80.9	68.4	66.7	59.7	56.4	86.6	78
11	88.3	84.1	81.8	69.9	67.3	58.4	57.1	90.4	82
12	86.5	79.3	77.9	69.3	63.8	56.9	54.9	87.8	79
13	81.1	77.2	76.2	63.6	63.6	53.5	48.6	83.6	75
14	86.2	85.6	85.1	72.2	69.3	58.6	57.3	90.5	82
15	92.0	87.2	84.9	74.5	71.2	66.3	64.7	93.9	85
16	88.3	84.9	83.0	71.9	69.5	58.9	52.5	90.8	82
17	91.3	89.2	83.3	72.6	70.0	60.0	53.7	93.8	85
18	87.3	85.5	83.1	75.0	66.6	59.1	58.3	90.5	82
19	84.2	81.1	75.4	67.2	67.8	55.0	46.7	86.4	78
20	87.3	81.9	77.8	68.8	74.3	60.2	51.5	89.0	80
21	86.3	82.3	75.5	67.5	67.9	55.7	52.4	88.1	80
22	89.4	86.8	84.3	72.5	68.0	65.0	54.6	92.2	84
23	90.0	87.6	82.1	72.8	68.3	57.7	51.3	92.5	84
24	87.9	86.8	84.1	73.8	69.8	61.0	58.3	91.4	83
25	87.8	89.3	84.4	72.8	70.5	67.6	56.0	92.5	84
26	89.6	88.8	86.2	75.2	70.0	59.9	54.4	93.3	85
27	86.1	85.4	81.5	69.4	68.3	60.4	57.0	89.6	81
28	90.0	90.9	82.5	71.4	66.6	61.0	53.7	93.9	85
29	89.8	89.4	83.2	69.8	69.1	60.0	53.2	93.1	85
30	81.4	84.5	75.3	58.2	56.0	47.1	56.0	86.6	78
31	79.8	79.6	78.0	66.6	62.0	59.2	51.9	84.1	76
32	74.0	74.6	69.2	59.0	59.2	57.4	49.8	78.1	70
33	82.3	77.7	74.9	57.1	65.1	60.7	52.5	84.2	76
34	74.4	69.8	66.7	63.9	65.0	51.9	44.8	76.8	((68))
35	82.8	78.5	70.1	66.0	59.5	46.2	44.3	84.4	76
36	77.3	69.4	60.6	54.0	65.3	48.1	49.1	78.3	70
37	79.6	80.2	87.5	81.3	77.5	68.0	59.9	89.8	81
38	77.0	79.3	82.6	77.2	70.2	54.3	49.8	85.8	77
39	79.6	80.2	87.1	81.3	77.5	68.0	59.9	89.6	81
40	79.1	82.3	84.9	81.5	68.2	57.8	51.2	88.5	80
41	78.1	82.1	86.2	79.9	70.1	57.9	52.2	88.8	80
42	85.7	87.9	90.6	81.7	73.4	63.4	61.4	93.6	85
43	86.2	90.0	92.3	84.4	73.6	68.7	65.6	95.3	>87<
44	84.4	86.2	90.2	82.4	67.2	63.2	65.0	92.8	84
45	74.2	79.0	86.6	80.7	76.7	72.2	58.1	88.7	80
46	76.0	78.1	85.7	79.9	74.4	70.2	64.2	87.9	79
47	76.8	78.6	86.8	77.6	76.6	73.3	59.0	88.6	80
48	81.1	83.6	85.8	76.2	69.3	62.6	60.5	89.0	80
49	85.7	83.6	85.6	79.5	69.1	64.2	58.6	90.3	82
50	76.3	78.8	79.5	70.3	61.9	56.8	50.1	83.4	75
51	75.7	78.1	78.4	69.5	61.2	53.9	47.1	82.6	74
52	87.3	91.6	94.7	88.9	78.0	74.1	73.5	97.7	>89<
53	70.3	73.2	74.9	68.4	62.8	57.5	54.0	78.6	70
54	68.4	74.0	76.0	68.7	64.6	56.4	46.4	79.2	71
55	76.6	75.4	88.6	80.8	76.8	74.2	44.2	90.0	81
56	72.3	74.4	82.1	69.0	65.0	55.9	50.0	83.4	75
57	87.0	88.7	91.7	86.7	81.0	77.2	62.7	95.3	>87<
58	81.8	79.6	85.6	83.0	67.8	67.2	56.0	89.1	81
59	64.5	66.3	66.9	67.1	68.5	61.4	43.6	74.1	((65))
60	70.2	74.0	96.8	76.4	71.7	68.2	44.9	96.9	>88<
61	71.6	74.6	69.5	70.6	63.2	61.7	55.9	78.3	70
62	79.8	85.3	88.9	82.2	76.2	56.4	51.3	91.5	83
63	68.8	70.3	69.1	66.6	64.9	53.5	48.2	75.4	((67))
64	74.3	70.5	65.3	60.2	60.5	53.9	45.4	76.4	((68))
65	79.4	78.2	82.4	82.6	65.9	53.8	41.8	87.1	79
66	81.5	83.1	84.1	77.4	72.0	57.4	49.2	88.3	80
67	66.0	64.1	60.8	59.4	68.5	54.6	41.1	72.0	((63))
68	81.5	83.1	84.1	77.4	72.0	57.4	49.2	88.3	80
69	66.0	64.1	60.8	59.4	68.5	54.6	41.1	72.0	((63))
70	66.1	72.0	75.3	70.6	67.8	53.3	47.3	78.5	70
71	87.7	87.8	86.6	78.9	72.9	60.1	52.2	92.4	84
72	88.8	90.6	93.8	89.3	79.6	72.9	62.2	97.2	>89<
73	81.4	84.2	88.1	82.0	74.8	65.9	58.9	90.9	82
74	77.7	80.8	84.7	79.1	73.9	61.6	56.1	87.6	79
75	68.4	71.8	72.7	69.5	69.3	58.6	48.0	77.7	((69))
76	68.4	71.8	72.7	69.5	69.3	58.6	48.0	77.7	((69))
77	77.6	74.1	85.2	80.8	62.7	53.8	57.5	87.3	79
78	80.8	80.9	83.5	79.2	65.7	56.3	54.1	87.4	79
79	84.2	84.6	81.8	74.0	65.4	63.4	49.0	88.7	80
80	77.6	78.2	79.2	73.6	64.2	57.1	51.8	83.7	75
81	65.7	68.4	74.3	66.4	61.0	50.7	47.7	76.4	((68))
82	74.2	74.0	82.8	75.4	65.4	65.8	63.4	84.6	76
83	84.4	86.2	90.2	82.4	67.2	63.2	65.0	92.8	84

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated In Table A-1.1

Table A-3.9

HPD selection for shuttle car operators

	dB-Neq	Mean:	93.7	Max:	101	Min:	85	Obs (n):	19
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	84.0	89.0	90.0	93.0	88.0	81.0	78.0	96.9	101
with HPD									
1	81.1	84.1	75.0	69.8	59.9	49.9	53.0	86.3	>90<
2	79.3	76.1	71.2	70.6	68.3	58.0	60.4	82.0	>86<
3	77.5	76.8	70.4	74.7	68.6	62.2	57.6	81.9	>86<
4	81.1	79.8	69.0	74.3	69.5	61.4	58.3	84.3	>88<
5	79.7	79.6	74.1	74.8	60.3	48.4	48.6	83.8	>88<
6	76.6	79.4	71.5	70.2	59.7	49.6	45.7	82.0	>86<
7	78.9	78.2	68.9	66.6	61.5	47.9	43.8	82.0	>86<
8	78.6	79.6	71.4	70.0	61.5	48.6	46.9	82.8	>87<
9	73.9	73.3	68.8	64.8	58.6	48.6	51.4	77.6	82
10	73.8	76.2	71.9	65.4	59.7	49.7	51.4	79.3	83
11	80.3	78.1	72.8	66.9	60.3	48.4	52.1	82.9	>87<
12	78.5	73.3	68.9	66.3	56.8	46.9	49.9	80.2	84
13	73.1	71.2	67.2	60.6	56.6	43.5	43.6	76.1	80
14	78.2	79.6	76.1	69.2	62.3	48.6	52.3	83.2	>87<
15	84.0	81.2	75.9	71.5	64.2	56.3	59.7	86.4	>91<
16	80.3	78.9	74.0	68.9	62.5	48.9	47.5	83.4	>88<
17	83.3	83.2	74.3	69.6	63.0	50.0	48.7	86.6	>91<
18	79.3	79.5	74.1	72.0	59.6	49.1	53.3	83.4	>87<
19	76.2	75.1	66.4	64.2	60.8	45.0	41.7	79.2	83
20	79.3	75.9	68.8	65.8	67.3	50.2	46.5	81.5	>86<
21	78.3	76.3	66.5	64.5	60.9	45.7	47.4	80.8	85
22	81.4	80.8	75.3	69.5	61.0	55.0	49.6	84.8	>89<
23	82.0	81.6	73.1	69.8	61.3	47.7	46.3	85.2	>89<
24	79.9	80.8	75.1	70.8	62.8	51.0	53.3	84.2	>88<
25	79.8	83.3	75.4	69.8	63.5	57.6	51.0	85.5	>90<
26	81.6	82.8	77.2	72.2	63.0	49.9	49.4	86.1	>90<
27	78.1	79.4	72.5	66.4	61.3	50.4	52.0	82.4	>87<
28	82.0	84.9	73.5	68.4	59.6	51.0	48.7	87.0	>91<
29	81.8	83.4	74.2	66.8	62.1	50.0	48.2	86.1	>90<
30	73.4	78.5	66.3	55.2	49.0	37.1	51.0	79.9	84
31	71.8	73.6	69.0	63.6	55.0	49.2	46.9	76.9	81
32	66.0	68.6	60.2	56.0	52.2	47.4	44.8	71.1	75
33	74.3	71.7	65.9	54.1	58.1	50.7	47.5	76.7	81
34	66.4	63.8	57.7	60.9	58.0	41.9	39.8	69.7	74
35	74.8	72.5	61.1	63.0	52.5	36.2	39.3	77.1	81
36	69.3	63.4	51.6	51.0	58.3	38.1	44.1	70.7	75
37	71.6	74.2	78.5	78.3	70.5	58.0	54.9	82.8	>87<
38	69.0	73.3	73.6	74.2	63.2	44.3	44.8	79.1	83
39	71.6	74.2	78.1	78.3	70.5	58.0	54.9	82.7	>87<
40	71.1	76.3	75.9	78.5	61.2	47.8	46.2	82.2	>86<
41	70.1	76.1	77.2	76.9	63.1	47.9	47.2	81.9	>86<
42	77.7	81.9	81.6	78.7	66.4	53.4	56.4	86.4	>91<
43	78.2	84.0	83.3	81.4	66.6	58.7	60.6	88.3	>92<
44	76.4	80.2	81.2	79.4	60.2	53.2	60.0	85.7	>90<
45	66.2	73.0	77.6	77.7	69.7	62.2	53.1	81.8	>86<
46	68.0	72.1	76.7	76.9	67.4	60.2	59.2	81.0	85
47	68.8	72.6	77.8	74.6	69.6	63.3	54.0	81.0	85
48	73.1	77.6	76.8	73.2	62.3	52.6	55.5	81.7	>86<
49	77.7	77.6	76.6	76.5	62.1	54.2	53.6	83.2	>87<
50	68.3	72.8	70.5	67.3	54.9	46.8	45.1	76.3	80
51	67.7	72.1	69.4	66.5	54.2	43.9	42.1	75.5	80
52	79.3	85.6	85.7	85.9	71.0	64.1	68.5	90.9	>95<
53	62.3	67.2	65.9	65.4	55.8	47.5	49.0	71.7	76
54	60.4	68.0	67.0	65.7	57.6	46.4	41.4	72.2	76
55	68.6	69.4	79.6	77.8	69.8	64.2	39.2	82.5	>87<
56	64.3	68.4	73.1	66.0	58.0	45.9	45.0	75.4	80
57	79.0	82.7	82.7	83.7	74.0	67.2	57.7	88.6	>93<
58	73.8	73.6	76.6	80.0	60.8	57.2	51.0	82.9	>87<
59	56.5	60.3	57.9	64.1	61.5	51.4	38.6	68.0	72
60	62.2	68.0	87.8	73.4	64.7	58.2	39.9	88.0	>92<
61	63.6	68.6	60.5	67.6	56.2	51.7	50.9	72.3	76
62	71.8	79.3	79.9	79.2	69.2	46.4	46.3	84.6	>89<
63	60.8	64.3	60.1	63.6	57.9	43.5	43.2	69.0	73
64	66.3	64.5	56.3	57.2	53.5	43.9	40.4	69.2	73
65	71.4	72.2	73.4	79.6	58.9	43.8	36.8	81.6	>86<
66	73.5	77.1	75.1	74.4	65.0	47.4	44.2	81.4	>85<
67	58.0	58.1	51.8	56.4	61.5	44.6	36.1	65.2	((69))
68	73.5	77.1	75.1	74.4	65.0	47.4	44.2	81.4	>85<
69	58.0	58.1	51.8	56.4	61.5	44.6	36.1	65.2	((69))
70	58.1	66.0	66.3	67.6	60.8	43.3	42.3	72.0	76
71	79.7	81.8	77.6	75.9	65.9	50.1	47.2	85.4	>90<
72	80.8	84.6	84.8	86.3	72.6	62.9	57.2	90.6	>95<
73	73.4	78.2	79.1	79.0	67.8	55.9	53.9	84.1	>88<
74	69.7	74.8	75.7	76.1	66.9	51.6	51.1	80.9	85
75	60.4	65.8	63.7	66.5	62.3	48.6	43.0	71.3	75
76	60.4	65.8	63.7	66.5	62.3	48.6	43.0	71.3	75
77	69.6	68.1	76.2	77.8	55.7	43.8	52.5	80.7	85
78	72.8	74.9	74.5	76.2	58.7	46.3	49.1	80.8	85
79	76.2	78.6	72.8	71.0	58.4	53.4	44.0	81.7	>86<
80	69.6	72.2	70.2	70.6	57.2	47.1	46.8	76.8	81
81	57.7	62.4	65.3	63.4	54.0	40.7	42.7	69.1	73
82	66.2	68.0	73.8	72.4	58.4	55.8	58.4	77.3	81
83	76.4	80.2	81.2	79.4	60.2	53.2	60.0	85.7	>90<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-3.10
HPD selection for miners in continuous mining

	dB-Neq	Mean:	94.2	Max:	101	Min:	85	Obs (n):	12
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	81.9	90.4	98.8	98.0	96.2	92.0	81.9	103.2	101
with HPD									
1	79.0	85.5	83.8	74.8	68.1	60.9	56.9	88.5	>86<
2	77.2	77.5	80.0	75.6	76.5	69.0	64.3	84.8	83
3	75.4	78.2	79.2	79.7	76.8	73.2	61.5	85.4	83
4	79.0	81.2	77.8	79.3	77.7	72.4	62.2	86.4	84
5	77.6	81.0	82.9	79.8	68.5	59.4	52.5	86.8	85
6	74.5	80.8	80.3	75.2	67.9	60.6	49.6	84.7	82
7	76.8	79.6	77.7	71.6	69.7	58.9	47.7	83.5	81
8	76.5	81.0	80.2	75.0	69.7	59.6	50.8	85.0	83
9	71.8	74.7	77.6	69.8	66.8	59.6	55.3	80.7	78
10	71.7	77.6	80.7	70.4	67.9	60.7	55.3	83.2	81
11	78.2	79.5	81.6	71.9	68.5	59.4	56.0	85.1	83
12	76.4	74.7	77.7	71.3	65.0	57.9	53.8	81.7	80
13	71.0	72.6	76.0	65.6	64.8	54.5	47.5	78.9	77
14	76.1	81.0	84.9	74.2	70.5	59.6	56.2	87.1	85
15	81.9	82.6	84.7	76.5	72.4	67.3	63.6	88.5	>86<
16	78.2	80.3	82.8	73.9	70.7	59.9	51.4	86.0	84
17	81.2	84.6	83.1	74.6	71.2	61.0	52.6	88.2	>86<
18	77.2	80.9	82.9	77.0	67.8	60.1	57.2	86.3	84
19	74.1	76.5	75.2	69.2	69.0	56.0	45.6	80.8	79
20	77.2	77.3	77.6	70.8	75.5	61.2	50.4	83.3	81
21	76.2	77.7	75.3	69.5	69.1	56.7	51.3	81.8	80
22	79.3	82.2	84.1	74.5	69.2	66.0	53.5	87.4	85
23	79.9	83.0	81.9	74.8	69.5	58.7	50.2	86.9	85
24	77.8	82.2	83.9	75.8	71.0	62.0	57.2	87.2	85
25	77.7	84.7	84.2	74.8	71.7	68.6	54.9	88.3	>86<
26	79.5	84.2	86.0	77.2	71.2	60.9	53.3	89.1	>87<
27	76.0	80.8	81.3	71.4	69.5	61.4	55.9	85.0	83
28	79.9	86.3	82.3	73.4	67.8	62.0	52.6	88.6	>86<
29	79.7	84.8	83.0	71.8	70.3	61.0	52.1	87.9	>86<
30	71.3	79.9	75.1	60.2	57.2	48.1	54.9	81.6	79
31	69.7	75.0	77.8	68.6	63.2	60.2	50.8	80.5	78
32	63.9	70.0	69.0	61.0	60.4	58.4	48.7	73.7	71
33	72.2	73.1	74.7	59.1	66.3	61.7	51.4	78.6	76
34	64.3	65.2	66.5	65.9	66.2	52.9	43.7	72.7	70
35	72.7	73.9	69.9	68.0	60.7	47.2	43.2	77.8	76
36	67.2	64.8	60.4	56.0	66.5	49.1	48.0	71.6	((69))
37	69.5	75.6	87.3	83.3	78.7	69.0	58.8	89.4	>87<
38	66.9	74.7	82.4	79.2	71.4	55.3	48.7	84.9	83
39	69.5	75.6	86.9	83.3	78.7	69.0	58.8	89.2	>87<
40	69.0	77.7	84.7	83.5	69.4	58.8	50.1	87.7	>86<
41	68.0	77.5	86.0	81.9	71.3	58.9	51.1	88.0	>86<
42	75.6	83.3	90.4	83.7	74.6	64.4	60.3	92.1	>90<
43	76.1	85.4	92.1	86.4	74.8	69.7	64.5	94.0	>92<
44	74.3	81.6	90.0	84.4	68.4	64.2	63.9	91.6	>89<
45	64.1	74.4	86.4	82.7	77.9	73.2	57.0	88.7	>86<
46	65.9	73.5	85.5	81.9	75.6	71.2	63.1	87.7	85
47	66.7	74.0	86.6	79.6	77.8	74.3	57.9	88.2	>86<
48	71.0	79.0	85.6	78.2	70.5	63.6	59.4	87.3	85
49	75.6	79.0	85.4	81.5	70.3	65.2	57.5	87.9	>86<
50	66.2	74.2	79.3	72.3	63.1	57.8	49.0	81.3	79
51	65.6	73.5	78.2	71.5	62.4	54.9	46.0	80.3	78
52	77.2	87.0	94.5	90.9	79.2	75.1	72.4	96.8	>95<
53	60.2	68.6	74.7	70.4	64.0	58.5	52.9	77.2	75
54	58.3	69.4	75.8	70.7	65.8	57.4	45.3	78.0	76
55	66.5	70.8	88.4	82.8	78.0	75.2	43.1	90.0	>88<
56	62.2	69.8	81.9	71.0	66.2	56.9	48.9	82.6	80
57	76.9	84.1	91.5	88.7	82.2	78.2	61.6	94.3	>92<
58	71.7	75.0	85.4	85.0	69.0	68.2	54.9	88.6	>86<
59	54.4	61.7	66.7	69.1	69.7	62.4	42.5	74.1	72
60	60.1	69.4	96.6	78.4	72.9	69.2	43.8	96.7	>94<
61	61.5	70.0	69.3	72.6	64.4	62.7	54.8	76.3	74
62	69.7	80.7	88.7	84.2	77.4	57.4	50.2	90.7	>89<
63	58.7	65.7	68.9	68.6	66.1	54.5	47.1	73.8	72
64	64.2	65.9	65.1	62.2	61.7	54.9	44.3	71.2	((69))
65	69.3	73.6	82.2	84.6	67.1	54.8	40.7	86.9	85
66	71.4	78.5	83.9	79.4	73.2	58.4	48.1	86.4	84
67	55.9	59.5	60.6	61.4	69.7	55.6	40.0	71.3	((69))
68	71.4	78.5	83.9	79.4	73.2	58.4	48.1	86.4	84
69	55.9	59.5	60.6	61.4	69.7	55.6	40.0	71.3	((69))
70	56.0	67.4	75.1	72.6	69.0	54.3	46.2	78.1	76
71	77.6	83.2	86.4	80.9	74.1	61.1	51.1	89.3	>87<
72	78.7	86.0	93.6	91.3	80.8	73.9	61.1	96.3	>94<
73	71.3	79.6	87.9	84.0	76.0	66.9	57.8	90.1	>88<
74	67.6	76.2	84.5	81.1	75.1	62.6	55.0	86.9	85
75	58.3	67.2	72.5	71.5	70.5	59.6	46.9	77.0	75
76	58.3	67.2	72.5	71.5	70.5	59.6	46.9	77.0	75
77	67.5	69.5	85.0	82.8	63.9	54.8	56.4	87.2	85
78	70.7	76.3	83.3	81.2	66.9	57.3	53.0	86.1	84
79	74.1	80.0	81.6	76.0	66.6	64.4	47.9	85.0	83
80	67.5	73.6	79.0	75.6	65.4	58.1	50.7	81.7	79
81	55.6	63.8	74.1	68.4	62.2	51.7	46.6	75.7	73
82	64.1	69.4	82.6	77.4	66.6	66.8	62.3	84.1	82
83	74.3	81.6	90.0	84.4	68.4	64.2	63.9	91.6	>80<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-3.11
HPD selection for team leaders in continuous mining

	dB-Neq	Mean:	96.4	Max:	103	Min:	86	Obs (n):	15
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	84.9	96.4	100.0	100.1	104.0	99.0	89.0	107.7	103
with HPD									
1	82.0	91.5	85.0	76.9	75.9	67.9	64.0	93.0	>88<
2	80.2	83.5	81.2	77.7	84.3	76.0	71.4	89.3	85
3	78.4	84.2	80.4	81.8	84.6	80.2	68.6	90.0	85
4	82.0	87.2	79.0	81.4	85.5	79.4	69.3	91.3	>87<
5	80.6	87.0	84.1	81.9	76.3	66.4	59.6	90.3	>86<
6	77.5	86.8	81.5	77.3	75.7	67.6	56.7	88.9	84
7	79.8	85.6	78.9	73.7	77.5	65.9	54.8	87.9	83
8	79.5	87.0	81.4	77.1	77.5	66.6	57.9	89.2	85
9	74.8	80.7	78.8	71.9	74.6	66.6	62.4	84.4	80
10	74.7	83.6	81.9	72.5	75.7	67.7	62.4	86.8	82
11	81.2	85.5	82.8	74.0	76.3	66.4	63.1	88.8	84
12	79.4	80.7	78.9	73.4	72.8	64.9	60.9	85.2	80
13	74.0	78.6	77.2	67.7	72.6	61.5	54.6	82.5	78
14	79.1	87.0	86.1	76.3	78.3	66.6	63.3	90.4	>86<
15	84.9	88.6	85.9	78.6	80.2	74.3	70.7	92.1	>87<
16	81.2	86.3	84.0	76.0	78.5	66.9	58.5	89.7	85
17	84.2	90.6	84.3	76.7	79.0	68.0	59.7	92.6	>88<
18	80.2	86.9	84.1	79.1	75.6	67.1	64.3	89.9	85
19	77.1	82.5	76.4	71.3	76.8	63.0	52.7	85.3	81
20	80.2	83.3	78.8	72.9	83.3	68.2	57.5	88.0	83
21	79.2	83.7	76.5	71.6	76.9	63.7	58.4	86.3	82
22	82.3	88.2	85.3	76.6	77.0	73.0	60.6	91.1	>86<
23	82.9	89.0	83.1	76.9	77.3	65.7	57.3	91.1	>86<
24	80.8	88.2	85.1	77.9	78.8	69.0	64.3	91.0	>86<
25	80.7	90.7	85.4	76.9	79.5	75.6	62.0	92.6	>88<
26	82.5	90.2	87.2	79.3	79.0	67.9	60.4	92.8	>88<
27	79.0	86.8	82.5	73.5	77.3	68.4	63.0	89.1	84
28	82.9	92.3	83.5	75.5	75.6	69.0	59.7	93.4	>89<
29	82.7	90.8	84.2	73.9	78.1	68.0	59.2	92.4	>88<
30	74.3	85.9	76.3	62.3	65.0	55.1	62.0	86.7	82
31	72.7	81.0	79.0	70.7	71.0	67.2	57.9	84.1	79
32	66.9	76.0	70.2	63.1	68.2	65.4	55.8	78.3	74
33	75.2	79.1	75.9	61.2	74.1	68.7	58.5	82.8	78
34	67.3	71.2	67.7	68.0	74.0	59.9	50.8	77.6	73
35	75.7	79.9	71.1	70.1	68.5	54.2	50.3	82.2	77
36	70.2	70.8	61.6	58.1	74.3	56.1	55.1	77.2	72
37	72.5	81.6	88.5	85.4	86.5	76.0	65.9	92.3	>88<
38	69.9	80.7	83.6	81.3	79.2	62.3	55.8	87.6	83
39	72.5	81.6	88.1	85.4	86.5	76.0	65.9	92.2	>87<
40	72.0	83.7	85.9	85.6	77.2	65.8	57.2	90.2	>86<
41	71.0	83.5	87.2	84.0	79.1	65.9	58.2	90.4	>86<
42	78.6	89.3	91.6	85.8	82.4	71.4	67.4	94.7	>90<
43	79.1	91.4	93.3	88.5	82.6	76.7	71.6	96.6	>92<
44	77.3	87.6	91.2	86.5	76.2	71.2	71.0	93.9	>89<
45	67.1	80.4	87.6	84.8	85.7	80.2	64.1	91.7	>87<
46	68.9	79.5	86.7	84.0	83.4	78.2	70.2	90.5	>86<
47	69.7	80.0	87.8	81.7	85.6	81.3	65.0	91.3	>87<
48	74.0	85.0	86.8	80.3	78.3	70.6	66.5	90.0	85
49	78.6	85.0	86.6	83.6	78.1	72.2	64.6	90.6	>86<
50	69.2	80.2	80.5	74.4	70.9	64.8	56.1	84.3	80
51	68.6	79.5	79.4	73.6	70.2	61.9	53.1	83.4	79
52	80.2	93.0	95.7	93.0	87.0	82.1	79.5	99.3	>95<
53	63.2	74.6	75.9	72.5	71.8	65.5	60.0	80.3	76
54	61.3	75.4	77.0	72.8	73.6	64.4	52.4	81.2	76
55	69.5	76.8	89.6	84.9	85.8	82.2	50.2	92.6	>88<
56	65.2	75.8	83.1	73.1	74.0	63.9	56.0	84.7	80
57	79.9	90.1	92.7	90.8	90.0	85.2	68.7	97.4	>93<
58	74.7	81.0	86.6	87.1	76.8	75.2	62.0	90.8	>86<
59	57.4	67.7	67.9	71.2	77.5	69.4	49.6	79.6	75
60	63.1	75.4	97.8	80.5	80.7	76.2	50.9	98.0	>93<
61	64.5	76.0	70.5	74.7	72.2	69.7	61.9	80.4	76
62	72.7	86.7	89.9	86.3	85.2	64.4	57.3	93.5	>89<
63	61.7	71.7	70.1	70.7	73.9	61.5	54.2	78.1	73
64	67.2	71.9	66.3	64.3	69.5	61.9	51.4	75.8	71
65	72.3	79.6	83.4	86.7	74.9	61.8	47.8	89.2	84
66	74.4	84.5	85.1	81.5	81.0	65.4	55.2	89.6	85
67	58.9	65.5	61.8	63.5	77.5	62.6	47.1	78.2	74
68	74.4	84.5	85.1	81.5	81.0	65.4	55.2	89.6	85
69	58.9	65.5	61.8	63.5	77.5	62.6	47.1	78.2	74
70	59.0	73.4	76.3	74.7	76.8	61.3	53.3	81.6	77
71	80.6	89.2	87.6	83.0	81.9	68.1	58.2	92.7	>88<
72	81.7	92.0	94.8	93.4	88.6	80.9	68.2	98.9	>94<
73	74.3	85.6	89.1	86.1	83.8	73.9	64.9	92.7	>88<
74	70.6	82.2	85.7	83.2	82.9	69.6	62.1	89.8	85
75	61.3	73.2	73.7	73.6	78.3	66.6	54.0	81.5	77
76	61.3	73.2	73.7	73.6	78.3	66.6	54.0	81.5	77
77	70.5	75.5	86.2	84.9	71.7	61.8	63.5	89.0	84
78	73.7	82.3	84.5	83.3	74.7	64.3	60.1	88.6	84
79	77.1	86.0	82.8	78.1	74.4	71.4	55.0	88.7	84
80	70.5	79.6	80.2	77.7	73.2	65.1	57.8	84.6	80
81	58.6	69.8	75.3	70.5	70.0	58.7	53.7	78.2	74
82	67.1	75.4	83.8	79.5	74.4	73.8	69.4	86.3	82
83	77.3	87.6	91.2	86.5	76.2	71.2	71.0	93.9	>89<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-3.12
HPD selection for shearer operators

	dB-Neq	Mean:	100.8	Max:	107	Min:	90	Obs (n):	18
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	85.0	93.0	98.0	100.0	96.0	94.0	85.0	104.1	100.8
with HPD									
1	82.1	88.1	83.0	76.8	67.9	62.9	60.0	90.3	>87<
2	80.3	80.1	79.2	77.6	76.3	71.0	67.4	86.1	83
3	78.5	80.8	78.4	81.7	76.6	75.2	64.6	86.9	84
4	82.1	83.8	77.0	81.3	77.5	74.4	65.3	88.3	85
5	80.7	83.6	82.1	81.8	68.3	61.4	55.6	88.3	85
6	77.6	83.4	79.5	77.2	67.7	62.6	52.7	86.3	83
7	79.9	82.2	76.9	73.6	69.5	60.9	50.8	85.4	82
8	79.6	83.6	79.4	77.0	69.5	61.6	53.9	86.7	83
9	74.9	77.3	76.8	71.8	66.6	61.6	58.4	81.9	79
10	74.8	80.2	79.9	72.4	67.7	62.7	58.4	84.1	81
11	81.3	82.1	80.8	73.9	68.3	61.4	59.1	86.5	83
12	79.5	77.3	76.9	73.3	64.8	59.9	56.9	83.4	80
13	74.1	75.2	75.2	67.6	64.6	56.5	50.6	80.0	77
14	79.2	83.6	84.1	76.2	70.3	61.6	59.3	88.0	85
15	85.0	85.2	83.9	78.5	72.2	69.3	66.7	90.0	>87<
16	81.3	82.9	82.0	75.9	70.5	61.9	54.5	87.3	84
17	84.3	87.2	82.3	76.6	71.0	63.0	55.7	90.1	>87<
18	80.3	83.5	82.1	79.0	67.6	62.1	60.3	87.6	84
19	77.2	79.1	74.4	71.2	68.8	58.0	48.7	82.6	79
20	80.3	79.9	76.8	72.8	75.3	63.2	53.5	84.9	82
21	79.3	80.3	74.5	71.5	68.9	58.7	54.4	83.9	81
22	82.4	84.8	83.3	76.5	69.0	68.0	56.6	88.7	>85<
23	83.0	85.6	81.1	76.8	69.3	60.7	53.3	88.7	>85<
24	80.9	84.8	83.1	77.8	70.8	64.0	60.3	88.5	85
25	80.8	87.3	83.4	76.8	71.5	70.6	58.0	89.8	>87<
26	82.6	86.8	85.2	79.2	71.0	62.9	56.4	90.4	>87<
27	79.1	83.4	80.5	73.4	69.3	63.4	59.0	86.5	83
28	83.0	88.9	81.5	75.4	67.6	64.0	55.7	90.6	>87<
29	82.8	87.4	82.2	73.8	70.1	63.0	55.2	89.7	>86<
30	74.4	82.5	74.3	62.2	57.0	50.1	58.0	83.7	80
31	72.8	77.6	77.0	70.6	63.0	62.2	53.9	81.5	78
32	67.0	72.6	68.2	63.0	60.2	60.4	51.8	75.3	72
33	75.3	75.7	73.9	61.1	66.1	63.7	54.5	80.2	77
34	67.4	67.8	65.7	67.9	66.0	54.9	46.8	74.1	71
35	75.8	76.5	69.1	70.0	60.5	49.2	46.3	80.1	77
36	70.3	67.4	59.6	58.0	66.3	51.1	51.1	73.5	70
37	72.6	78.2	86.5	85.3	78.5	71.0	61.9	89.8	>87<
38	70.0	77.3	81.6	81.2	71.2	57.3	51.8	85.5	82
39	72.6	78.2	86.1	85.3	78.5	71.0	61.9	89.6	>86<
40	72.1	80.3	83.9	85.5	69.2	60.8	53.2	88.7	85
41	71.1	80.1	85.2	83.9	71.1	60.9	54.2	88.5	85
42	78.7	85.9	89.6	85.7	74.4	66.4	63.4	92.5	>89<
43	79.2	88.0	91.3	88.4	74.6	71.7	67.6	94.5	>91<
44	77.4	84.2	89.2	86.4	68.2	66.2	67.0	92.0	>89<
45	67.2	77.0	85.6	84.7	77.7	75.2	60.1	89.1	>86<
46	69.0	76.1	84.7	83.9	75.4	73.2	66.2	88.1	85
47	69.8	76.6	85.8	81.6	77.6	76.3	61.0	88.3	85
48	74.1	81.6	84.8	80.2	70.3	65.6	62.5	87.7	84
49	78.7	81.6	84.6	83.5	70.1	67.2	60.6	88.7	85
50	69.3	76.8	78.5	74.3	62.9	59.8	52.1	82.0	79
51	68.7	76.1	77.4	73.5	62.2	56.9	49.1	81.1	78
52	80.3	89.6	93.7	92.9	79.0	77.1	75.5	97.4	>94<
53	63.3	71.2	73.9	72.4	63.8	60.5	56.0	77.9	75
54	61.4	72.0	75.0	72.7	65.6	59.4	48.4	78.6	75
55	69.6	73.4	87.6	84.8	77.8	77.2	46.2	90.1	>87<
56	65.3	72.4	81.1	73.0	66.0	58.9	52.0	82.4	79
57	80.0	86.7	90.7	90.7	82.0	80.2	64.7	95.0	>92<
58	74.8	77.6	84.6	87.0	68.8	70.2	58.0	89.5	>86<
59	57.5	64.3	65.9	71.1	69.5	64.4	45.6	75.0	72
60	63.2	72.0	95.8	80.4	72.7	71.2	46.9	96.0	>93<
61	64.6	72.6	68.5	74.6	64.2	64.7	57.9	78.0	75
62	72.8	83.3	87.9	86.2	77.2	59.4	53.3	91.2	>88<
63	61.8	68.3	68.1	70.6	65.9	56.5	50.2	74.9	72
64	67.3	68.5	64.3	64.2	61.5	56.9	47.4	73.0	70
65	72.4	76.2	81.4	86.6	66.9	56.8	43.8	88.2	85
66	74.5	81.1	83.1	81.4	73.0	60.4	51.2	87.2	84
67	59.0	62.1	59.8	63.4	69.5	57.6	43.1	71.8	((69))
68	74.5	81.1	83.1	81.4	73.0	60.4	51.2	87.2	84
69	59.0	62.1	59.8	63.4	69.5	57.6	43.1	71.8	((69))
70	59.1	70.0	74.3	74.6	68.8	56.3	49.3	78.7	75
71	80.7	85.8	85.6	82.9	73.9	63.1	54.2	90.3	>87<
72	81.8	88.6	92.8	93.3	80.6	75.9	64.2	97.1	>94<
73	74.4	82.2	87.1	86.0	75.8	68.9	60.9	90.6	>87<
74	70.7	78.8	83.7	83.1	74.9	64.6	58.1	87.5	84
75	61.4	69.8	71.7	73.5	70.3	61.6	50.0	77.8	75
76	61.4	69.8	71.7	73.5	70.3	61.6	50.0	77.8	75
77	70.6	72.1	84.2	84.8	63.7	56.8	59.5	87.8	85
78	73.8	78.9	82.5	83.2	66.7	59.3	56.1	86.9	84
79	77.2	82.6	80.8	78.0	66.4	66.4	51.0	86.3	83
80	70.6	76.2	78.2	77.6	65.2	60.1	53.8	82.6	79
81	58.7	66.4	73.3	70.4	62.0	53.7	49.7	76.0	73
82	67.2	72.0	81.8	79.4	66.4	68.8	65.4	84.4	81
83	77.4	84.2	89.2	86.4	68.2	66.2	67.0	92.0	>89<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-3.13
HPD selection for shearer assistants

	dB-Neq	Mean:	100.3	Max:	106	Min:	86	Obs (n):	18
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	82.0	87.0	95.0	99.0	97.0	96.0	92.0	103.5	106
with HPD									
1	79.1	82.1	80.0	75.8	68.9	64.9	67.0	86.0	>89<
2	77.3	74.1	76.2	76.6	77.3	73.0	74.4	84.3	>87<
3	75.5	74.8	75.4	80.7	77.6	77.2	71.6	85.3	>88<
4	79.1	77.8	74.0	80.3	78.5	76.4	72.3	86.1	>89<
5	77.7	77.6	79.1	80.8	69.3	63.4	62.6	85.2	>88<
6	74.6	77.4	76.5	76.2	68.7	64.6	59.7	82.6	85
7	76.9	76.2	73.9	72.6	70.5	62.9	57.8	81.7	84
8	76.6	77.6	76.4	76.0	70.5	63.6	60.9	83.0	>86<
9	71.9	71.3	73.8	70.8	67.6	63.6	65.4	78.8	81
10	71.8	74.2	76.9	71.4	68.7	64.7	65.4	80.7	83
11	78.3	76.1	77.8	72.9	69.3	63.4	66.1	83.1	>86<
12	76.5	71.3	73.9	72.3	65.8	61.9	63.9	80.3	83
13	71.1	69.2	72.2	66.6	65.6	58.5	57.6	76.7	79
14	76.2	77.6	81.1	75.2	71.3	63.6	66.3	84.5	>87<
15	82.0	79.2	80.9	77.5	73.2	71.3	73.7	86.8	>89<
16	78.3	76.9	79.0	74.9	71.5	63.9	61.5	83.9	>86<
17	81.3	81.2	79.3	75.6	72.0	65.0	62.7	86.1	>89<
18	77.3	77.5	79.1	78.0	68.6	64.1	67.3	84.3	>87<
19	74.2	73.1	71.4	70.2	69.8	60.0	55.7	79.1	82
20	77.3	73.9	73.8	71.8	76.3	65.2	60.5	82.2	85
21	76.3	74.3	71.5	70.5	69.9	60.7	61.4	80.3	83
22	79.4	78.8	80.3	75.5	70.0	70.0	63.6	85.2	>88<
23	80.0	79.6	78.1	75.8	70.3	62.7	60.3	84.9	>87<
24	77.9	78.8	80.1	76.8	71.8	66.0	67.3	84.9	>87<
25	77.8	81.3	80.4	75.8	72.5	72.6	65.0	85.8	>88<
26	79.6	80.8	82.2	78.2	72.0	64.9	63.4	86.7	>89<
27	76.1	77.4	77.5	72.4	70.3	65.4	66.0	82.7	85
28	80.0	82.9	78.5	74.4	68.6	66.0	62.7	86.1	>89<
29	79.8	81.4	79.2	72.8	71.1	65.0	62.2	85.5	>88<
30	71.4	76.5	71.3	61.2	58.0	52.1	65.0	78.9	81
31	69.8	71.6	74.0	69.6	64.0	64.2	60.9	78.1	81
32	64.0	66.6	65.2	62.0	61.2	62.4	58.8	72.0	74
33	72.3	69.7	70.9	60.1	67.1	65.7	61.5	77.0	79
34	64.4	61.8	62.7	66.9	67.0	56.9	53.8	72.2	75
35	72.8	70.5	66.1	69.0	61.5	51.2	53.3	76.4	79
36	67.3	61.4	56.6	57.0	67.3	53.1	58.1	71.4	74
37	69.6	72.2	83.5	84.3	79.5	73.0	68.9	88.0	>91<
38	67.0	71.3	78.6	80.2	72.2	59.3	58.8	83.3	>86<
39	69.6	72.2	83.1	84.3	79.5	73.0	68.9	87.9	>90<
40	69.1	74.3	80.9	84.5	70.2	62.8	60.2	86.6	>89<
41	68.1	74.1	82.2	82.9	72.1	62.9	61.2	86.2	>89<
42	75.7	79.9	86.6	84.7	75.4	68.4	70.4	89.7	>92<
43	76.2	82.0	88.3	87.4	75.6	73.7	74.6	91.8	>94<
44	74.4	78.2	86.2	85.4	69.2	68.2	74.0	89.5	>92<
45	64.2	71.0	82.6	83.7	78.7	77.2	67.1	87.5	>90<
46	66.0	70.1	81.7	82.9	76.4	75.2	73.2	86.6	>89<
47	66.8	70.6	82.8	80.6	78.6	78.3	68.0	86.7	>89<
48	71.1	75.6	81.8	79.2	71.3	67.6	69.5	84.9	>87<
49	75.7	75.6	81.6	82.5	71.1	69.2	67.6	86.3	>89<
50	66.3	70.8	75.5	73.3	63.9	61.8	59.1	78.9	81
51	65.7	70.1	74.4	72.5	63.2	58.9	56.1	78.0	80
52	77.3	83.6	90.7	91.9	80.0	79.1	82.5	95.3	>98<
53	60.3	65.2	70.9	71.4	64.8	62.5	63.0	75.7	78
54	58.4	66.0	72.0	71.7	66.6	61.4	55.4	76.2	79
55	66.6	67.4	84.6	83.8	78.8	79.2	53.2	88.4	>91<
56	62.3	66.4	78.1	72.0	67.0	60.9	59.0	79.7	82
57	77.0	80.7	87.7	89.7	83.0	82.2	71.7	93.2	>96<
58	71.8	71.6	81.6	86.0	69.8	72.2	65.0	87.8	>90<
59	54.5	58.3	62.9	70.1	70.5	66.4	52.6	74.6	77
60	60.2	66.0	92.8	79.4	73.7	73.2	53.9	93.1	>96<
61	61.6	66.6	65.5	73.6	65.2	66.7	64.9	76.4	79
62	69.8	77.3	84.9	85.2	78.2	61.4	60.3	88.9	>91<
63	58.8	62.3	65.1	69.6	66.9	58.5	57.2	73.2	76
64	64.3	62.5	61.3	63.2	62.5	58.9	54.4	70.3	73
65	69.4	70.2	78.4	85.6	67.9	58.8	50.8	86.6	>89<
66	71.5	75.1	80.1	80.4	74.0	62.4	58.2	84.6	>87<
67	56.0	56.1	56.8	62.4	70.5	59.6	50.1	71.8	74
68	71.5	75.1	80.1	80.4	74.0	62.4	58.2	84.6	>87<
69	56.0	56.1	56.8	62.4	70.5	59.6	50.1	71.8	74
70	56.1	64.0	71.3	73.6	69.8	58.3	56.3	77.0	79
71	77.7	79.8	82.6	81.9	74.9	65.1	61.2	87.2	>90<
72	78.8	82.6	89.8	92.3	81.6	77.9	71.2	95.0	>97<
73	71.4	76.2	84.1	85.0	76.8	70.9	67.9	88.4	>91<
74	67.7	72.8	80.7	82.1	75.9	66.6	65.1	85.5	>88<
75	58.4	63.8	68.7	72.5	71.3	63.6	57.0	76.5	79
76	58.4	63.8	68.7	72.5	71.3	63.6	57.0	76.5	79
77	67.6	66.1	81.2	83.8	64.7	58.8	66.5	85.9	>88<
78	70.8	72.9	79.5	82.2	67.7	61.3	63.1	84.7	>87<
79	74.2	76.6	77.8	77.0	67.4	68.4	58.0	82.9	85
80	67.6	70.2	75.2	76.6	66.2	62.1	60.8	80.1	83
81	55.7	60.4	70.3	69.4	63.0	55.7	56.7	73.8	76
82	64.2	66.0	78.8	78.4	67.4	70.8	72.4	82.7	85
83	74.4	78.2	86.2	85.4	69.2	68.2	74.0	89.5	>92<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-3.14
HPD selection for shield support operators

	dB-Neq	Mean:	93.1	Max:	96	Min:	85	Obs (n):	15
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	83.0	86.0	89.0	88.0	88.0	83.0	79.0	94.7	96
with HPD									
1	80.1	81.1	74.0	64.8	59.9	51.9	54.0	84.2	85
2	78.3	73.1	70.2	65.6	68.3	60.0	61.4	80.5	82
3	76.5	73.8	69.4	69.7	68.6	64.2	58.6	79.9	81
4	80.1	76.8	68.0	69.3	69.5	63.4	59.3	82.5	84
5	78.7	76.6	73.1	69.8	60.3	50.4	49.6	81.8	83
6	75.6	76.4	70.5	65.2	59.7	51.6	46.7	79.8	81
7	77.9	75.2	67.9	61.6	61.5	49.9	44.8	80.2	81
8	77.6	76.6	70.4	65.0	61.5	50.6	47.9	80.8	82
9	72.9	70.3	67.8	59.8	58.6	50.6	52.4	75.8	77
10	72.8	73.2	70.9	60.4	59.7	51.7	52.4	77.4	79
11	79.3	75.1	71.8	61.9	60.3	50.4	53.1	81.3	83
12	77.5	70.3	67.9	61.3	56.8	48.9	50.9	78.8	80
13	72.1	68.2	66.2	55.6	56.6	45.5	44.6	74.5	76
14	77.2	76.6	75.1	64.2	62.3	50.6	53.3	81.3	83
15	83.0	78.2	74.9	66.5	64.2	58.3	60.7	84.8	>86<
16	79.3	75.9	73.0	63.9	62.5	50.9	48.5	81.7	83
17	82.3	80.2	73.3	64.6	63.0	52.0	49.7	84.8	>86<
18	78.3	76.5	73.1	67.0	59.6	51.1	54.3	81.4	83
19	75.2	72.1	65.4	59.2	60.8	47.0	42.7	77.4	79
20	78.3	72.9	67.8	60.8	67.3	52.2	47.5	80.0	81
21	77.3	73.3	65.5	59.5	60.9	47.7	48.4	79.1	80
22	80.4	77.8	74.3	64.5	61.0	57.0	50.6	83.0	84
23	81.0	78.6	72.1	64.8	61.3	49.7	47.3	83.4	85
24	78.9	77.8	74.1	65.8	62.8	53.0	54.3	82.3	84
25	78.8	80.3	74.4	64.8	63.5	59.6	52.0	83.4	85
26	80.6	79.8	76.2	67.2	63.0	51.9	50.4	84.1	85
27	77.1	76.4	71.5	61.4	61.3	52.4	53.0	80.5	82
28	81.0	81.9	72.5	63.4	59.6	53.0	49.7	84.8	>86<
29	80.8	80.4	73.2	61.8	62.1	52.0	49.2	84.1	85
30	72.4	75.5	65.3	50.2	49.0	39.1	52.0	77.5	79
31	70.8	70.6	68.0	58.6	55.0	51.2	47.9	74.9	76
32	65.0	65.6	59.7	51.0	52.2	49.4	45.8	69.1	70
33	73.3	68.7	64.9	49.1	58.1	52.7	48.5	75.2	76
34	65.4	60.8	56.7	55.9	58.0	43.9	40.8	67.9	((69))
35	73.8	69.5	60.1	58.0	52.5	38.2	40.3	75.4	77
36	68.3	60.4	50.6	46.0	58.3	40.1	45.1	69.4	71
37	70.6	71.2	77.5	73.3	70.5	60.0	55.9	80.6	82
38	68.0	70.3	72.6	69.2	63.2	46.3	45.8	76.6	78
39	70.6	71.2	77.1	73.3	70.5	60.0	55.9	80.4	82
40	70.1	73.3	74.9	73.5	61.2	49.8	47.2	79.4	81
41	69.1	73.1	76.2	71.9	63.1	49.9	48.2	79.4	81
42	76.7	78.9	80.6	73.7	66.4	55.4	57.4	84.3	>86<
43	77.2	81.0	82.3	76.4	66.6	60.7	61.6	86.0	>87<
44	75.4	77.2	80.2	74.4	60.2	55.2	61.0	83.5	85
45	65.2	70.0	76.6	72.7	69.7	64.2	54.1	79.5	81
46	67.0	69.1	75.7	71.9	67.4	62.2	60.2	78.7	80
47	67.8	69.6	76.8	69.6	69.6	65.3	55.0	79.3	81
48	72.1	74.6	75.8	68.2	62.3	54.6	56.5	79.6	81
49	76.7	74.6	75.6	71.5	62.1	56.2	54.6	81.1	82
50	67.3	69.8	69.5	62.3	54.9	48.8	46.1	74.1	75
51	66.7	69.1	68.4	61.5	54.2	45.9	43.1	73.3	75
52	78.3	82.6	84.7	80.9	71.0	66.1	69.5	88.4	>90<
53	61.3	64.2	64.9	60.4	55.8	49.5	50.0	69.4	71
54	59.4	65.0	66.0	60.7	57.6	48.4	42.4	69.9	71
55	67.6	66.4	78.6	72.8	69.8	66.2	40.2	80.6	82
56	63.3	65.4	72.1	61.0	58.0	47.9	46.0	73.8	75
57	78.0	79.7	81.7	78.7	74.0	69.2	58.7	86.2	>87<
58	72.8	70.6	75.6	75.0	60.8	59.2	52.0	80.0	81
59	55.5	57.3	56.9	59.1	61.5	53.4	39.6	65.8	((67))
60	61.2	65.0	86.8	68.4	64.7	60.2	40.9	86.9	>88<
61	62.6	65.6	59.5	62.6	56.2	53.7	51.9	69.5	71
62	70.8	76.3	78.9	74.2	69.2	48.4	47.3	82.2	84
63	59.8	61.3	59.1	58.6	57.9	45.5	44.2	66.6	((68))
64	65.3	61.5	55.3	52.2	53.5	45.9	41.4	67.5	((69))
65	70.4	69.2	72.4	74.6	58.9	45.8	37.8	78.2	80
66	72.5	74.1	74.1	69.4	65.0	49.4	45.2	79.1	80
67	57.0	55.1	50.8	51.4	61.5	46.6	37.1	64.1	((65))
68	72.5	74.1	74.1	69.4	65.0	49.4	45.2	79.1	80
69	57.0	55.1	50.8	51.4	61.5	46.6	37.1	64.1	((65))
70	57.1	63.0	65.3	62.6	60.8	45.3	43.3	69.5	71
71	78.7	78.8	76.6	70.9	65.9	52.1	48.2	83.3	85
72	79.8	81.6	83.8	81.3	72.6	64.9	58.2	88.0	>89<
73	72.4	75.2	78.1	74.0	67.8	57.9	54.9	81.7	83
74	68.7	71.8	74.7	71.1	66.9	53.6	52.1	78.5	80
75	59.4	62.8	62.7	61.5	62.3	50.6	44.0	69.0	70
76	59.4	62.8	62.7	61.5	62.3	50.6	44.0	69.0	70
77	68.6	65.1	75.2	72.8	55.7	45.8	53.5	78.0	79
78	71.8	71.9	73.5	71.2	58.7	48.3	50.1	78.3	80
79	75.2	75.6	71.8	66.0	58.4	55.4	45.0	79.5	81
80	68.6	69.2	69.2	65.6	57.2	49.1	47.8	74.5	76
81	56.7	59.4	64.3	58.4	54.0	42.7	43.7	67.0	((68))
82	65.2	65.0	72.8	67.4	58.4	57.8	59.4	75.2	77
83	75.4	77.2	80.2	74.4	60.2	55.2	61.0	83.5	85

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-3.15
HPD selection for crusher attendants

	dB-Neq	Mean:	97.5	Max:	101	Min:	94	Obs (n):	16
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
v/o HPD	81.0	87.0	91.0	96.0	92.0	89.0	84.0	99.3	101
with HPD									
1	78.1	82.1	76.0	72.8	63.9	57.9	59.0	84.6	>86<
2	76.3	74.1	72.2	73.6	72.3	66.0	66.4	81.2	83
3	74.5	74.8	71.4	77.7	72.6	70.2	63.6	82.1	84
4	78.1	77.8	70.0	77.3	73.5	69.4	64.3	83.5	85
5	76.7	77.6	75.1	77.8	64.3	56.4	54.6	83.0	85
6	73.6	77.4	72.5	73.2	63.7	57.6	51.7	80.8	82
7	75.9	76.2	69.9	69.6	65.5	55.9	49.8	80.2	82
8	75.6	77.6	72.4	73.0	65.5	56.6	52.9	81.3	83
9	70.9	71.3	69.8	67.8	62.6	56.6	57.4	76.5	78
10	70.8	74.2	72.9	68.4	63.7	57.7	57.4	78.3	80
11	77.3	76.1	73.8	69.9	64.3	56.4	58.1	81.2	83
12	75.5	71.3	69.9	69.3	60.8	54.9	55.9	78.4	80
13	70.1	69.2	68.2	63.6	60.6	51.5	49.6	74.6	76
14	75.2	77.6	77.1	72.2	66.3	56.6	58.3	82.1	84
15	81.0	79.2	76.9	74.5	68.2	64.3	65.7	84.8	>86<
16	77.3	76.9	75.0	71.9	66.5	56.9	53.5	81.9	84
17	80.3	81.2	75.3	72.6	67.0	58.0	54.7	84.7	>86<
18	76.3	77.5	75.1	75.0	63.6	57.1	59.3	82.2	84
19	73.2	73.1	67.4	67.2	64.8	53.0	47.7	77.4	79
20	76.3	73.9	69.8	68.8	71.3	58.2	52.5	79.9	82
21	75.3	74.3	67.5	67.5	64.9	53.7	53.4	78.8	80
22	78.4	78.8	76.3	72.5	65.0	63.0	55.6	83.2	85
23	79.0	79.6	74.1	72.8	65.3	55.7	52.3	83.4	85
24	76.9	78.8	76.1	73.8	66.8	59.0	59.3	82.9	85
25	76.8	81.3	76.4	72.8	67.5	65.6	57.0	84.1	>86<
26	78.6	80.8	78.2	75.2	67.0	57.9	55.4	84.7	>86<
27	75.1	77.4	73.5	69.4	65.3	58.4	58.0	80.9	83
28	79.0	82.9	74.5	71.4	63.6	59.0	54.7	85.0	>87<
29	78.8	81.4	75.2	69.8	66.1	58.0	54.2	84.2	>86<
30	70.4	76.5	67.3	58.2	53.0	45.1	57.0	78.0	80
31	68.8	71.6	70.0	66.6	59.0	57.2	52.9	75.8	78
32	63.0	66.6	61.2	59.0	56.2	55.4	50.8	69.8	72
33	71.3	69.7	66.9	57.1	62.1	58.7	53.5	74.9	77
34	63.4	61.8	58.7	63.9	62.0	49.9	45.8	69.4	71
35	71.8	70.5	62.1	66.0	56.5	44.2	45.3	75.1	77
36	66.3	61.4	52.6	54.0	62.3	46.1	50.1	69.0	71
37	68.6	72.2	79.5	81.3	74.5	66.0	60.9	84.5	>86<
38	66.0	71.3	74.6	77.2	67.2	52.3	50.8	80.2	82
39	68.6	72.2	79.1	81.3	74.5	66.0	60.9	84.4	>86<
40	68.1	74.3	76.9	81.5	65.2	55.8	52.2	83.6	85
41	67.1	74.1	78.2	79.9	67.1	55.9	53.2	83.0	85
42	74.7	79.9	82.6	81.7	70.4	61.4	62.4	86.7	>88<
43	75.2	82.0	84.3	84.4	70.6	66.7	66.6	88.8	>90<
44	73.4	78.2	82.2	82.4	64.2	61.2	66.0	86.4	>88<
45	63.2	71.0	78.6	80.7	73.7	70.2	59.1	83.8	>85<
46	65.0	70.1	77.7	79.9	71.4	68.2	65.2	82.9	85
47	65.8	70.6	78.8	77.6	73.6	71.3	60.0	82.7	84
48	70.1	75.6	77.8	76.2	66.3	60.6	61.5	81.9	84
49	74.7	75.6	77.6	79.5	66.1	62.2	59.6	83.4	85
50	65.3	70.8	71.5	70.3	58.9	54.8	51.1	76.2	78
51	64.7	70.1	70.4	69.5	58.2	51.9	48.1	75.3	77
52	76.3	83.6	86.7	88.9	75.0	72.1	74.5	92.0	>94<
53	59.3	65.2	66.9	68.4	59.8	55.5	55.0	72.5	74
54	57.4	66.0	68.0	68.7	61.6	54.4	47.4	73.0	75
55	65.6	67.4	80.6	80.8	73.8	72.2	45.2	84.5	>86<
56	61.3	66.4	74.1	69.0	62.0	53.9	51.0	76.2	78
57	76.0	80.7	83.7	86.7	78.0	75.2	63.7	89.8	>92<
58	70.8	71.6	77.6	83.0	64.8	65.2	57.0	84.6	>86<
59	53.5	58.3	58.9	67.1	65.5	59.4	44.6	70.5	72
60	59.2	66.0	88.8	76.4	68.7	66.2	45.9	89.1	>91<
61	60.6	66.6	61.5	70.6	60.2	59.7	56.9	73.2	75
62	68.8	77.3	80.9	82.2	73.2	54.4	52.3	85.7	>87<
63	57.8	62.3	61.1	66.6	61.9	51.5	49.2	70.0	72
64	63.3	62.5	57.3	60.2	57.5	51.9	46.4	68.0	70
65	68.4	70.2	74.4	82.6	62.9	51.8	42.8	83.6	85
66	70.5	75.1	76.1	77.4	69.0	55.4	50.2	81.7	83
67	55.0	56.1	52.8	59.4	65.5	52.6	42.1	67.4	((69))
68	70.5	75.1	76.1	77.4	69.0	55.4	50.2	81.7	83
69	55.0	56.1	52.8	59.4	65.5	52.6	42.1	67.4	((69))
70	55.1	64.0	67.3	70.6	64.8	51.3	48.3	73.6	75
71	76.7	79.8	78.6	78.9	69.9	58.1	53.2	84.8	>87<
72	77.8	82.6	85.8	89.3	76.6	70.9	63.2	91.9	>94<
73	70.4	76.2	80.1	82.0	71.8	63.9	59.9	85.2	>87<
74	66.7	72.8	76.7	79.1	70.9	59.6	57.1	82.2	84
75	57.4	63.8	64.7	69.5	66.3	56.6	49.0	72.9	75
76	57.4	63.8	64.7	69.5	66.3	56.6	49.0	72.9	75
77	66.6	66.1	77.2	80.8	59.7	51.8	58.5	82.6	84
78	69.8	72.9	75.5	79.2	62.7	54.3	55.1	81.8	83
79	73.2	76.6	73.8	74.0	62.4	61.4	50.0	80.8	82
80	66.6	70.2	71.2	73.6	61.2	55.1	52.8	77.2	79
81	54.7	60.4	66.3	66.4	58.0	48.7	48.7	70.3	72
82	63.2	66.0	74.8	75.4	62.4	63.8	64.4	78.9	81
83	73.4	78.2	82.2	82.4	64.2	61.2	66.0	86.4	>88<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-3.16
HPD selection for team leaders in longwall mining

	dB-Neq	Mean:	96.6	Max:	98	Min:	91	Obs (n):	14
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	81.9	90.4	98.8	98.0	96.2	92.0	81.9	103.2	98
with HPD									
1	79.0	85.5	83.8	74.8	68.1	60.9	56.9	88.5	83
2	77.2	77.5	80.0	75.6	76.5	69.0	64.3	84.8	80
"3"	75.4	78.2	79.2	79.7	76.8	73.2	61.5	85.4	80
"4"	79.0	81.2	77.8	79.3	77.7	72.4	62.2	86.4	81
5	77.6	81.0	82.9	79.8	68.5	59.4	52.5	86.8	82
6	74.5	80.8	80.3	75.2	67.9	60.6	49.6	84.7	79
"7"	76.8	79.6	77.7	71.6	69.7	58.9	47.7	83.5	78
8	76.5	81.0	80.2	75.0	69.7	59.6	50.8	85.0	80
"9"	71.8	74.7	77.6	69.8	66.8	59.6	55.3	80.7	75
10	71.7	77.6	80.7	70.4	67.9	60.7	55.3	83.2	78
11	78.2	79.5	81.6	71.9	68.5	59.4	56.0	85.1	80
12	76.4	74.7	77.7	71.3	65.0	57.9	53.8	81.7	77
13	71.0	72.6	76.0	65.6	64.8	54.5	47.5	78.9	74
14	76.1	81.0	84.9	74.2	70.5	59.6	56.2	87.1	82
15	81.9	82.6	84.7	76.5	72.4	67.3	63.6	88.5	83
16	78.2	80.3	82.8	73.9	70.7	59.9	51.4	86.0	81
17	81.2	84.6	83.1	74.6	71.2	61.0	52.6	88.2	83
18	77.2	80.9	82.9	77.0	67.8	60.1	57.2	86.3	81
19	74.1	76.5	75.2	69.2	69.0	56.0	45.6	80.8	76
20	77.2	77.3	77.6	70.8	75.5	61.2	50.4	83.3	78
21	76.2	77.7	75.3	69.5	69.1	56.7	51.3	81.8	77
22	79.3	82.2	84.1	74.5	69.2	66.0	53.5	87.4	82
23	79.9	83.0	81.9	74.8	69.5	58.7	50.2	86.9	82
24	77.8	82.2	83.9	75.8	71.0	62.0	57.2	87.2	82
25	77.7	84.7	84.2	74.8	71.7	68.6	54.9	88.3	83
26	79.5	84.2	86.0	77.2	71.2	60.9	53.3	89.1	84
27	76.0	80.8	81.3	71.4	69.5	61.4	55.9	85.0	80
28	79.9	86.3	82.3	73.4	67.8	62.0	52.6	88.6	83
29	79.7	84.8	83.0	71.8	70.3	61.0	52.1	87.9	83
"30"	71.3	79.9	75.1	60.2	57.2	48.1	54.9	81.6	76
"31"	69.7	75.0	77.8	68.6	63.2	60.2	50.8	80.5	75
"32"	63.9	70.0	69.0	61.0	60.4	58.4	48.7	73.7	((68))
33	72.2	73.1	74.7	59.1	66.3	61.7	51.4	78.6	73
34	64.3	65.2	66.5	65.9	66.2	52.9	43.7	72.7	((67))
35	72.7	73.9	69.9	68.0	60.7	47.2	43.2	77.8	73
36	67.2	64.8	60.4	56.0	66.5	49.1	48.0	71.6	((66))
37	69.5	75.6	87.3	83.3	78.7	69.0	58.8	89.4	84
"38"	66.9	74.7	82.4	79.2	71.4	55.3	48.7	84.9	80
39	69.5	75.6	86.9	83.3	78.7	69.0	58.8	89.2	84
40	69.0	77.7	84.7	83.5	69.4	58.8	50.1	87.7	83
"41"	68.0	77.5	86.0	81.9	71.3	58.9	51.1	88.0	83
42	75.6	83.3	90.4	83.7	74.6	64.4	60.3	92.1	>87<
43	76.1	85.4	92.1	86.4	74.8	69.7	64.5	94.0	>89<
44	74.3	81.6	90.0	84.4	68.4	64.2	63.9	91.6	>86<
45	64.1	74.4	86.4	82.7	77.9	73.2	57.0	88.7	83
46	65.9	73.5	85.5	81.9	75.6	71.2	63.1	87.7	82
47	66.7	74.0	86.6	79.6	77.8	74.3	57.9	88.2	83
"48"	71.0	79.0	85.6	78.2	70.5	63.6	59.4	87.3	82
"49"	75.6	79.0	85.4	81.5	70.3	65.2	57.5	87.9	83
"50"	66.2	74.2	79.3	72.3	63.1	57.8	49.0	81.3	76
"51"	65.6	73.5	78.2	71.5	62.4	54.9	46.0	80.3	75
52	77.2	87.0	94.5	90.9	79.2	75.1	72.4	96.8	>92<
"53"	60.2	68.6	74.7	70.4	64.0	58.5	52.9	77.2	72
"54"	58.3	69.4	75.8	70.7	65.8	57.4	45.3	78.0	73
"55"	66.5	70.8	88.4	82.8	78.0	75.2	43.1	90.0	85
"56"	62.2	69.8	81.9	71.0	66.2	56.9	48.9	82.6	77
57	76.9	84.1	91.5	88.7	82.2	78.2	61.6	94.3	>89<
58	71.7	75.0	85.4	85.0	69.0	68.2	54.9	88.6	83
"59"	54.4	61.7	66.7	69.1	69.7	62.4	42.5	74.1	((69))
"60"	60.1	69.4	96.6	78.4	72.9	69.2	43.8	96.7	>91<
"61"	61.5	70.0	69.3	72.6	64.4	62.7	54.8	76.3	71
62	69.7	80.7	88.7	84.2	77.4	57.4	50.2	90.7	>86<
"63"	58.7	65.7	68.9	68.6	66.1	54.5	47.1	73.8	((69))
"64"	64.2	65.9	65.1	62.2	61.7	54.9	44.3	71.2	((66))
65	69.3	73.6	82.2	84.6	67.1	54.8	40.7	86.9	82
66	71.4	78.5	83.9	79.4	73.2	58.4	48.1	86.4	81
"67"	55.9	59.5	60.6	61.4	69.7	55.6	40.0	71.3	((66))
68	71.4	78.5	83.9	79.4	73.2	58.4	48.1	86.4	81
"69"	55.9	59.5	60.6	61.4	69.7	55.6	40.0	71.3	((66))
70	56.0	67.4	75.1	72.6	69.0	54.3	46.2	78.1	73
71	77.6	83.2	86.4	80.9	74.1	61.1	51.1	89.3	84
72	78.7	86.0	93.6	91.3	80.8	73.9	61.1	96.3	>91<
73	71.3	79.6	87.9	84.0	76.0	66.9	57.8	90.1	85
74	67.6	76.2	84.5	81.1	75.1	62.6	55.0	86.9	82
"75"	58.3	67.2	72.5	71.5	70.5	59.6	46.9	77.0	72
"76"	58.3	67.2	72.5	71.5	70.5	59.6	46.9	77.0	72
"77"	67.5	69.5	85.0	82.8	63.9	54.8	56.4	87.2	82
"78"	70.7	76.3	83.3	81.2	66.9	57.3	53.0	86.1	81
79	74.1	80.0	81.6	76.0	66.6	64.4	47.9	85.0	80
80	67.5	73.6	79.0	75.6	65.4	58.1	50.7	81.7	76
81	55.6	63.8	74.1	68.4	62.2	51.7	46.6	75.7	70
82	64.1	69.4	82.6	77.4	66.6	66.8	62.3	84.1	79
83	74.3	81.6	90.0	84.4	68.4	64.2	63.9	91.6	>86<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
"n" These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-3.17
HPD selection for underground tractor drivers

	dB-Neq	Mean:	97.0	Max:	99	Min:	89	Obs (n):	13
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	85.0	86.0	91.0	95.0	98.0	96.0	91.0	102.2	97.0
with HPD									
1	82.1	81.1	76.0	71.8	69.9	64.9	66.0	85.6	80
2	80.3	73.1	72.2	72.6	78.3	73.0	73.4	84.3	79
3	78.5	73.8	71.4	76.7	78.6	77.2	70.6	84.6	79
4	82.1	76.8	70.0	76.3	79.5	76.4	71.3	86.1	81
5	80.7	76.6	75.1	76.8	70.3	63.4	61.6	84.1	79
6	77.6	76.4	72.5	72.2	69.7	64.6	58.7	81.7	76
7	79.9	75.2	69.9	68.6	71.5	62.9	56.8	82.2	77
8	79.6	76.6	72.4	72.0	71.5	63.6	59.9	82.7	78
9	74.9	70.3	69.8	66.8	68.6	63.6	64.4	78.3	73
10	74.8	73.2	72.9	67.4	69.7	64.7	64.4	79.6	74
11	81.3	75.1	73.8	68.9	70.3	63.4	65.1	83.3	78
12	79.5	70.3	69.9	68.3	66.8	61.9	62.9	81.0	76
13	74.1	68.2	68.2	62.6	66.6	58.5	56.6	76.7	71
14	79.2	76.6	77.1	71.2	72.3	63.6	65.3	83.3	78
15	85.0	78.2	76.9	73.5	74.2	71.3	72.7	87.1	82
16	81.3	75.9	75.0	70.9	72.5	63.9	60.5	83.8	79
17	84.3	80.2	75.3	71.6	73.0	65.0	61.7	86.5	81
18	80.3	76.5	75.1	74.0	69.6	64.1	66.3	83.5	78
19	77.2	72.1	67.4	66.2	70.8	60.0	54.7	79.6	74
20	80.3	72.9	69.8	67.8	77.3	65.2	59.5	83.0	78
21	79.3	73.3	67.5	66.5	70.9	60.7	60.4	81.2	76
22	82.4	77.8	76.3	71.5	71.0	70.0	62.6	85.0	80
23	83.0	78.6	74.1	71.8	71.3	62.7	59.3	85.2	80
24	80.9	77.8	76.1	72.8	72.8	66.0	66.3	84.3	79
25	80.8	80.3	76.4	71.8	73.5	72.6	64.0	85.2	80
26	82.6	79.8	78.2	74.2	73.0	64.9	62.4	86.0	81
27	79.1	76.4	73.5	68.4	71.3	65.4	65.0	82.4	77
28	83.0	81.9	74.5	70.4	69.6	66.0	61.7	86.1	81
29	82.8	80.4	75.2	68.8	72.1	65.0	61.2	85.6	80
30	74.4	75.5	67.3	57.2	59.0	52.1	64.0	78.6	73
31	72.8	70.6	70.0	65.6	65.0	64.2	59.9	77.1	72
32	67.0	65.6	61.2	58.0	62.2	62.4	57.8	71.6	((66))
33	75.3	68.7	66.9	56.1	68.1	65.7	60.5	77.6	72
34	67.4	60.8	58.7	62.9	68.0	56.9	52.8	72.1	((67))
35	75.8	69.5	62.1	65.0	62.5	51.2	52.3	77.3	72
36	70.3	60.4	52.6	53.0	68.3	53.1	57.1	72.9	((68))
37	72.6	71.2	79.5	80.3	80.5	73.0	67.9	85.6	80
38	70.0	70.3	74.6	76.2	73.2	59.3	57.8	80.6	75
39	72.6	71.2	79.1	80.3	80.5	73.0	67.9	85.5	80
40	72.1	73.3	76.9	80.5	71.2	62.8	59.2	83.3	78
41	71.1	73.	78.2	78.9	73.1	62.9	60.2	83.0	78
42	78.7	78.9	82.6	80.7	76.4	68.4	69.4	87.1	82
43	79.2	81.0	84.3	83.4	76.6	73.7	73.6	89.0	84
44	77.4	77.2	82.2	81.4	70.2	68.2	73.0	86.5	81
45	67.2	70.0	78.6	79.7	79.7	77.2	66.1	85.2	80
46	69.0	69.1	77.7	78.9	77.4	75.2	72.2	84.1	79
47	69.8	69.6	78.8	76.6	79.6	78.3	67.0	84.8	80
48	74.1	74.6	77.8	75.2	72.3	67.6	68.5	82.5	77
49	78.7	74.6	77.6	78.5	72.1	69.2	66.6	84.2	79
50	69.3	69.8	71.5	69.3	64.9	61.8	58.1	76.6	71
51	68.7	69.1	70.4	68.5	64.2	58.9	55.1	75.7	70
52	80.3	82.6	86.7	87.9	81.0	79.1	81.5	92.4	>87<
53	63.3	64.2	66.9	67.4	65.8	62.5	62.0	73.5	((68))
54	61.4	65.0	68.0	67.7	67.6	61.4	54.4	73.8	((69))
55	69.6	66.4	80.6	79.8	79.8	79.2	52.2	86.0	81
56	65.3	65.4	74.1	68.0	68.0	60.9	58.0	76.7	72
57	80.0	79.7	83.7	85.7	84.0	82.2	70.7	90.9	>86<
58	74.8	70.6	77.6	82.0	70.8	72.2	64.0	84.6	79
59	57.5	57.3	58.9	66.1	71.5	66.4	51.6	73.9	((69))
60	63.2	65.0	88.8	75.4	74.7	73.2	52.9	89.3	84
61	64.6	65.6	61.5	69.6	66.2	66.7	63.9	74.5	((69))
62	72.8	76.3	80.9	81.2	79.2	61.4	59.3	86.0	81
63	61.8	61.3	61.1	65.6	67.9	58.5	56.2	71.8	((67))
64	67.3	61.5	57.3	59.2	63.5	58.9	53.4	70.6	((65))
65	72.4	69.2	74.4	81.6	68.9	58.8	49.8	83.1	78
66	74.5	74.1	76.1	76.4	75.0	62.4	57.2	82.4	77
67	59.0	55.1	52.8	58.4	71.5	59.6	49.1	72.3	((67))
68	74.5	74.1	76.1	76.4	75.0	62.4	57.2	82.4	77
69	59.0	55.1	52.8	58.4	71.5	59.6	49.1	72.3	((67))
70	59.1	63.0	67.3	69.6	70.8	58.3	55.3	74.8	70
71	80.7	78.8	78.6	77.9	75.9	65.1	60.2	85.7	80
72	81.8	81.6	85.8	88.3	82.6	77.9	70.2	92.1	>87<
73	74.4	75.2	80.1	81.0	77.8	70.9	66.9	85.6	80
74	70.7	71.8	76.7	78.1	76.9	66.6	64.1	82.9	78
75	61.4	62.8	64.7	68.5	72.3	63.6	56.0	75.2	70
76	61.4	62.8	64.7	68.5	72.3	63.6	56.0	75.2	70
77	70.6	65.1	77.2	79.8	65.7	58.8	65.5	82.3	77
78	73.8	71.9	75.5	78.2	68.7	61.3	62.1	81.8	77
79	77.2	75.6	73.8	73.0	68.4	68.4	57.0	81.7	76
80	70.6	69.2	71.2	72.6	67.2	62.1	59.8	77.7	72
81	58.7	59.4	66.3	65.4	64.0	55.7	55.7	71.0	((66))
82	67.2	65.0	74.8	74.4	68.4	70.8	71.4	80.0	75
83	77.4	77.2	82.2	81.4	70.2	68.2	73.0	86.5	81

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-3.18
HPD selection for LHD operators

	dB-Neq	Mean:	99.0	Max:	102	Min:	89	Obs (n):	19
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	80.0	84.0	90.0	94.0	95.0	95.0	83.0	100.2	99.0
with HPD									
1	77.1	79.1	75.0	70.8	66.9	63.9	58.0	82.7	81
2	75.3	71.1	71.2	71.6	75.3	72.0	65.4	81.1	80
3	73.5	71.8	70.4	75.7	75.6	76.2	62.6	82.2	81
4	77.1	74.8	69.0	75.3	76.5	75.4	63.3	83.1	82
5	75.7	74.6	74.1	75.8	67.3	62.4	53.6	81.4	80
6	72.6	74.4	71.5	71.2	66.7	63.6	50.7	79.0	78
7	74.9	73.2	68.9	67.6	68.5	61.9	48.8	78.7	78
8	74.6	74.6	71.4	71.0	68.5	62.6	51.9	79.7	79
9	69.9	68.3	68.8	65.8	65.6	62.6	56.4	75.3	74
10	69.8	71.2	71.9	66.4	66.7	63.7	56.4	77.0	76
11	76.3	73.1	72.8	67.9	67.3	62.4	57.1	79.8	79
12	74.5	68.3	68.9	67.3	63.8	60.9	54.9	77.2	76
13	69.1	66.2	67.2	61.6	63.6	57.5	48.6	73.4	72
14	74.2	74.6	76.1	70.2	69.3	62.6	57.3	80.7	80
15	80.0	76.2	75.9	72.5	71.2	70.3	64.7	83.5	82
16	76.3	73.9	74.0	69.9	69.5	62.9	52.5	80.5	79
17	79.3	78.2	74.3	70.6	70.0	64.0	53.7	83.1	82
18	75.3	74.5	74.1	73.0	66.6	63.1	58.3	80.6	79
19	72.2	70.1	66.4	65.2	67.8	59.0	46.7	76.2	75
20	75.3	70.9	68.8	66.8	74.3	64.2	51.5	79.5	78
21	74.3	71.3	66.5	65.5	67.9	59.7	52.4	77.5	76
22	77.4	75.8	75.3	70.5	68.0	69.0	54.6	81.8	81
23	78.0	76.6	73.1	70.8	68.3	61.7	51.3	81.7	81
24	75.9	75.8	75.1	71.8	69.8	65.0	58.3	81.4	80
25	75.8	78.3	75.4	70.8	70.5	71.6	56.0	82.5	81
26	77.6	77.8	77.2	73.2	70.0	63.9	54.4	83.1	82
27	74.1	74.4	72.5	67.4	68.3	64.4	57.0	79.4	78
28	78.0	79.5	73.5	69.4	66.6	65.0	53.7	83.0	82
29	77.8	78.4	74.2	67.8	69.1	64.0	53.2	82.4	81
30	69.4	73.5	66.3	56.2	56.0	51.1	56.0	75.6	74
31	67.8	68.6	69.0	64.6	62.0	63.2	51.9	74.5	73
32	62.0	63.6	60.2	57.0	59.2	61.4	49.8	68.9	((68))
33	70.3	66.7	65.9	55.1	65.1	64.7	52.5	74.1	73
34	62.4	58.8	57.7	61.9	65.0	55.9	44.8	69.1	((68))
35	70.8	67.5	61.1	64.0	59.5	50.2	44.3	73.5	72
36	65.3	58.4	51.6	52.0	65.3	52.1	49.1	69.0	((68))
37	67.6	69.2	78.5	79.3	77.5	72.0	59.9	83.9	83
38	65.0	68.3	73.6	75.2	70.2	58.3	49.8	78.9	78
39	67.6	69.2	78.1	79.3	77.5	72.0	59.9	83.7	83
40	67.1	71.3	75.9	79.5	68.2	61.8	51.2	81.9	81
41	66.1	71.1	77.2	77.9	70.1	61.9	52.2	81.6	80
42	73.7	76.9	81.6	79.7	73.4	67.4	61.4	85.3	84
43	74.2	79.0	83.3	82.4	73.6	72.7	65.6	87.3	>86<
44	72.4	75.2	81.2	80.4	67.2	67.2	65.0	84.9	84
45	62.2	68.0	77.6	78.7	76.7	76.2	58.1	83.6	82
46	64.0	67.1	76.7	77.9	74.4	74.2	64.2	82.4	81
47	64.8	67.6	77.8	75.6	76.6	77.3	59.0	83.1	82
48	69.1	72.6	76.8	74.2	69.3	66.6	60.5	80.6	79
49	73.7	72.6	76.6	77.5	69.1	68.2	58.6	82.0	81
50	64.3	67.8	70.5	68.3	61.9	60.8	50.1	74.7	74
51	63.7	67.1	69.4	67.5	61.2	57.9	47.1	73.8	73
52	75.3	80.6	85.7	86.9	78.0	78.1	73.5	90.6	>89<
53	58.3	62.2	65.9	66.4	62.8	61.5	54.0	71.5	70
54	56.4	63.0	67.0	66.7	64.6	60.4	46.4	72.1	71
55	64.6	64.4	79.6	78.8	76.8	78.2	44.2	84.6	83
56	60.3	63.4	73.1	67.0	65.0	59.9	50.0	75.2	74
57	75.0	77.7	82.7	84.7	81.0	81.2	62.7	89.2	>88<
58	69.8	68.6	76.6	81.0	67.8	71.2	56.0	83.2	82
59	52.5	55.3	57.9	65.1	68.5	65.4	43.6	71.7	71
60	58.2	63.0	87.8	74.4	71.7	72.2	44.9	88.2	>87<
61	59.6	63.6	60.5	68.6	63.2	65.7	55.9	72.5	71
62	67.8	74.3	79.9	80.2	76.2	60.4	51.3	84.4	83
63	56.8	59.3	60.1	64.6	64.9	57.5	48.2	69.5	((68))
64	62.3	59.5	56.3	58.2	60.5	57.9	45.4	67.4	((66))
65	67.4	67.2	73.4	80.6	65.9	57.8	41.8	81.8	81
66	69.5	72.1	75.1	75.4	72.0	61.4	49.2	80.4	79
67	54.0	53.1	51.8	57.4	68.5	58.6	41.1	69.5	((68))
68	69.5	72.1	75.1	75.4	72.0	61.4	49.2	80.4	79
69	54.0	53.1	51.8	57.4	68.5	58.6	41.1	69.5	((68))
70	54.1	61.0	66.3	68.6	67.8	57.3	47.3	72.9	72
71	75.7	76.8	77.6	76.9	72.9	64.1	52.2	83.3	82
72	76.8	79.6	84.8	87.3	79.6	76.9	62.2	90.5	>89<
73	69.4	73.2	79.1	80.0	74.8	69.9	58.9	84.0	83
74	65.7	69.3	75.7	77.1	73.9	65.6	56.1	81.1	80
75	56.4	60.3	63.7	67.5	69.3	62.6	48.0	73.0	72
76	56.4	60.3	63.7	67.5	69.3	62.6	48.0	73.0	72
77	65.6	63.1	76.2	78.8	62.7	57.8	57.5	81.0	80
78	68.8	69.9	74.5	77.2	65.7	60.3	54.1	80.1	79
79	72.2	73.5	72.8	72.0	65.4	67.4	49.0	79.2	78
80	65.6	67.2	70.2	71.6	64.2	61.1	51.8	75.8	75
81	53.7	57.4	65.3	64.4	61.0	54.7	47.7	69.3	((68))
82	62.2	63.0	73.8	73.4	65.4	69.8	63.4	78.1	77
83	72.4	75.2	81.2	80.4	67.2	67.2	65.0	84.9	84

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-3.19
HPD selection for utility vehicle drivers

	dB-Neq	Mean:	93.0	Max:	96	Min:	89	Obs (n):	18
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	86.0	87.0	91.0	97.0	95.0	93.0	85.0	101.0	93.0
with HPD									
1	83.1	82.1	76.0	73.8	66.9	61.9	60.0	86.4	78
2	81.3	74.1	72.2	74.6	75.3	70.0	67.4	84.1	76
3	79.5	74.8	71.4	78.7	75.6	74.2	64.6	84.4	76
4	83.1	77.8	70.0	78.3	76.5	73.4	65.3	86.1	78
5	81.7	77.6	75.1	78.8	67.3	60.4	55.6	85.1	77
6	78.6	77.4	72.5	74.2	66.7	61.6	52.7	82.5	74
7	80.9	76.2	69.9	70.6	68.5	59.9	50.8	82.9	75
8	80.6	77.6	72.4	74.0	68.5	60.6	53.9	83.5	75
9	75.9	71.3	69.8	68.8	65.6	60.6	58.4	78.8	71
10	75.8	74.2	72.9	69.4	66.7	61.7	58.4	80.0	72
11	82.3	76.1	73.8	70.9	67.3	60.4	59.1	84.1	76
12	80.5	71.3	69.9	70.3	63.8	58.9	56.9	81.8	74
13	75.1	69.2	68.2	64.6	63.6	55.5	50.6	77.2	((69))
14	80.2	77.6	77.1	73.2	69.3	60.6	59.3	83.9	76
15	86.0	79.2	76.9	75.5	71.2	68.3	66.7	87.7	80
16	82.3	76.9	75.0	72.9	69.5	60.9	54.5	84.5	76
17	85.3	81.2	75.3	73.6	70.0	62.0	55.7	87.3	79
18	81.3	77.5	75.1	76.0	66.6	61.1	60.3	84.3	76
19	78.2	73.1	67.4	68.2	67.8	57.0	48.7	80.2	72
20	81.3	73.9	69.8	69.8	74.3	62.2	53.5	83.2	75
21	80.3	74.2	67.5	68.5	67.9	57.7	54.4	81.9	74
22	83.4	78.8	76.3	73.5	68.0	67.0	56.6	85.7	78
23	84.0	79.6	74.1	73.8	68.3	59.7	53.3	86.0	78
24	81.9	78.8	76.1	74.8	69.8	63.0	60.3	85.0	77
25	81.8	81.3	76.4	73.8	70.5	69.6	58.0	85.7	78
26	83.6	80.8	78.2	76.2	70.0	61.9	56.4	86.7	79
27	80.1	77.4	73.5	70.4	68.3	62.4	59.0	83.0	75
28	84.0	82.9	74.5	72.4	66.6	63.0	55.7	87.0	79
29	83.8	81.4	75.2	70.8	69.1	62.0	55.2	86.4	78
30	75.4	76.5	67.3	59.2	56.0	49.1	58.0	79.4	71
31	73.8	71.6	70.0	67.6	62.0	61.2	53.9	77.6	70
32	68.0	66.6	61.2	60.0	59.2	59.4	51.8	71.8	((64))
33	76.3	69.7	66.9	58.1	65.1	62.7	54.5	78.0	70
34	68.4	61.8	58.7	64.9	65.0	53.9	46.8	72.0	((64))
35	76.8	70.5	62.1	67.0	59.5	48.2	46.3	78.2	70
36	71.3	61.4	52.6	55.0	65.3	50.1	51.1	72.8	((65))
37	73.6	72.2	79.5	82.3	77.5	70.0	61.9	85.6	78
38	71.0	71.3	74.6	78.2	70.2	56.3	51.8	81.2	73
39	73.6	72.2	79.1	82.3	77.5	70.0	61.9	85.5	78
40	73.1	74.3	76.9	82.5	68.2	59.8	53.2	84.5	76
41	72.1	74.1	78.2	80.9	70.1	59.9	54.2	83.8	76
42	79.7	79.9	82.6	82.7	73.4	65.4	63.4	87.7	80
43	80.2	82.0	84.3	85.4	73.6	70.7	67.6	89.6	82
44	78.4	78.2	82.2	83.4	67.2	65.2	67.0	87.3	79
45	68.2	71.0	78.6	81.7	76.7	74.2	60.1	85.0	77
46	70.0	70.[illegible]	77.7	80.9	74.4	72.2	66.2	84.0	76
47	70.8	70.6	78.8	78.6	76.6	75.3	61.0	84.0	76
48	75.1	75.6	77.8	77.2	69.3	64.6	62.5	82.9	75
49	79.7	75.6	77.6	80.5	69.1	66.2	60.6	85.0	77
50	70.3	70.8	71.5	71.3	61.9	58.8	52.1	77.2	((69))
51	69.7	70.1	70.4	70.5	61.2	55.9	49.1	76.4	((68))
52	81.3	83.6	86.7	89.9	78.0	76.1	75.5	92.9	85
53	64.3	65.2	66.9	69.4	62.8	59.5	56.0	73.6	((66))
54	62.4	66.0	68.0	69.7	64.6	58.4	48.4	74.0	((66))
55	70.6	67.4	80.6	81.8	76.8	76.2	46.2	85.7	78
56	66.3	66.4	74.1	70.0	65.0	57.9	52.0	76.8	((69))
57	81.0	80.7	83.7	87.7	81.0	79.2	64.7	91.1	83
58	75.8	71.6	77.6	84.0	67.8	69.2	58.0	85.8	78
59	58.5	58.3	58.9	68.1	68.5	63.4	45.6	72.5	((65))
60	64.2	66.0	88.8	77.4	71.7	70.2	46.9	89.3	81
61	65.6	66.6	61.5	71.6	63.2	63.7	57.9	74.6	((67))
62	73.8	77.3	80.9	83.2	76.2	58.4	53.3	86.6	79
63	62.8	62.3	61.1	67.6	64.9	55.5	50.2	71.5	((64))
64	68.3	62.5	57.3	61.2	60.5	55.9	47.4	70.8	((63))
65	73.4	70.2	74.4	83.6	65.9	55.8	43.8	84.7	77
66	75.5	75.1	76.1	78.4	72.0	59.4	51.2	82.9	75
67	60.0	56.1	52.8	60.4	68.5	56.6	43.1	70.1	((62))
68	75.5	75.1	76.1	78.4	72.0	59.4	51.2	82.9	75
69	60.0	56.1	52.8	60.4	68.5	56.6	43.1	70.1	((62))
70	60.1	64.0	67.3	71.6	67.8	55.3	49.3	74.7	((67))
71	81.7	79.8	78.6	79.9	72.9	62.1	54.2	86.4	78
72	82.8	82.6	85.8	90.3	79.6	74.9	64.2	92.9	85
73	75.4	76.2	80.1	83.0	74.8	67.9	60.9	86.2	78
74	71.7	72.8	76.7	80.1	73.9	63.6	58.1	83.2	75
75	62.4	63.8	64.7	70.5	69.3	60.6	50.0	74.5	((66))
76	62.4	63.8	64.7	70.5	69.3	60.6	50.0	74.5	((66))
77	71.6	66.1	77.2	81.8	62.7	55.8	59.5	83.5	76
78	74.8	72.9	75.5	80.2	65.7	58.3	56.1	82.9	75
79	78.2	76.6	73.8	75.0	65.4	65.4	51.0	82.4	74
80	71.6	70.2	71.2	74.6	64.2	59.1	53.8	78.5	70
81	59.7	60.4	66.3	67.4	61.0	52.7	49.7	71.2	((63))
82	68.2	66.0	74.8	76.4	65.4	67.8	65.4	79.9	72
83	78.4	78.2	82.2	83.4	67.2	65.2	67.0	87.3	79

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-3.20
HPD selection for underground bus drivers

	Neq calculated on basis of mean LpA values and exposure period of 8 h.								
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	71.0	77.0	79.0	83.0	84.0	81.0	69.0	88.6	88.6
with HPD									
1	68.1	72.1	64.0	59.8	55.9	49.9	44.0	74.3	74
2	66.3	64.1	60.2	60.6	64.3	58.0	51.4	71.0	71
3	64.5	64.8	59.4	64.7	64.6	62.2	48.6	71.5	72
4	68.1	67.8	58.0	64.3	65.5	61.4	49.3	73.2	73
5	66.7	67.6	63.1	64.8	56.3	48.4	39.6	72.0	72
6	63.6	67.4	60.5	60.2	55.7	49.6	36.7	70.2	70
7	65.9	66.2	57.9	56.6	57.5	47.9	34.8	69.9	70
8	65.6	67.6	60.4	60.0	57.5	48.6	37.9	70.8	71
9	60.9	61.5	57.8	54.8	54.6	48.6	42.4	65.9	((66))
10	60.8	64.2	60.9	55.4	55.7	49.7	42.4	67.7	((68))
11	67.3	66.1	61.8	56.9	56.3	48.4	43.1	70.8	71
12	65.5	61.5	57.9	56.3	52.8	46.9	40.9	67.9	((68))
13	60.1	59.2	56.2	50.6	52.6	43.5	34.6	64.1	((64))
14	65.2	67.6	65.1	59.2	58.3	48.6	43.3	71.4	71
15	71.0	69.2	64.9	61.5	60.2	56.3	50.7	74.3	74
16	67.3	66.9	63.0	58.9	58.5	48.9	38.5	71.4	71
17	70.3	71.2	63.3	59.6	59.0	50.0	39.7	74.4	74
18	66.3	67.5	63.1	62.0	55.6	49.1	44.3	71.5	71
19	63.2	63.1	55.4	54.2	56.8	45.0	32.7	67.2	((67))
20	66.3	63.9	57.8	55.8	63.3	50.2	37.5	70.0	70
21	65.3	64.3	55.5	54.5	56.9	45.7	38.4	68.6	((69))
22	68.4	68.8	64.3	59.5	57.0	55.0	40.6	72.8	73
23	69.0	69.6	62.1	59.8	57.3	47.7	37.3	73.1	73
24	66.9	68.8	64.1	60.8	58.8	51.0	44.3	72.3	72
25	66.8	71.3	64.4	59.8	59.5	57.6	42.0	73.7	74
26	68.6	70.8	66.2	62.2	59.0	49.9	40.4	74.1	74
27	65.1	67.4	61.5	56.4	57.3	50.4	43.0	70.5	70
28	69.0	72.9	62.5	58.4	55.6	51.0	39.7	74.8	75
29	68.8	71.4	63.2	56.8	58.1	50.0	39.2	73.9	74
30	60.4	66.5	55.3	45.2	45.0	37.1	42.0	67.8	((68))
31	58.8	61.6	58.0	53.6	51.0	49.2	37.9	65.2	((65))
32	53.0	56.6	49.2	46.0	48.2	47.4	35.8	59.6	((60))
33	61.3	59.7	54.9	44.1	54.1	50.7	38.5	64.8	((65))
34	53.4	51.8	46.7	50.9	54.0	41.9	30.8	59.1	((59))
35	61.8	60.5	50.1	53.0	48.5	36.2	30.3	64.8	((65))
36	56.3	51.4	40.6	41.0	54.3	38.1	35.1	59.4	((59))
37	58.6	62.2	67.5	68.3	66.5	58.0	45.9	73.0	73
38	56.0	61.3	62.6	64.2	59.2	44.3	35.8	68.5	((68))
39	58.6	62.2	67.1	68.3	66.5	58.0	45.9	72.9	73
40	58.1	64.3	64.9	68.5	57.2	47.8	37.2	71.5	71
41	57.1	64.1	66.2	66.9	59.1	47.9	38.2	71.1	71
42	64.7	69.9	70.6	68.7	62.4	53.4	47.4	75.3	75
43	65.2	72.0	72.3	71.4	62.6	58.7	51.6	77.2	77
44	63.4	68.2	70.2	69.4	56.2	53.2	51.0	74.6	75
45	53.2	61.0	66.6	67.7	65.7	62.2	44.1	72.4	72
46	55.0	60.1	65.7	66.9	63.4	60.2	50.2	71.2	71
47	55.8	60.6	66.8	64.6	65.6	63.3	45.0	71.8	72
48	60.1	65.6	65.8	63.2	58.3	52.6	46.5	70.6	71
49	64.7	65.6	65.6	66.5	58.1	54.2	44.6	71.9	72
50	55.3	60.8	59.5	57.3	50.9	46.8	36.1	65.0	((65))
51	54.7	60.1	58.4	56.5	50.2	43.9	33.1	64.1	((64))
52	66.3	73.6	74.7	75.9	67.0	64.1	59.5	80.2	80
53	49.3	55.2	54.9	55.4	51.8	47.5	40.0	61.1	((61))
54	47.4	56.0	56.0	55.7	53.6	46.4	32.4	61.8	((62))
55	55.6	57.4	68.6	67.8	65.8	64.2	30.2	73.1	73
56	51.3	56.4	62.1	56.0	54.0	45.9	36.0	64.6	((65))
57	66.0	70.7	71.7	73.7	70.0	67.2	48.7	78.4	78
58	60.8	61.6	65.6	70.0	56.8	57.2	42.0	72.4	72
59	43.5	48.3	46.9	54.1	57.5	51.4	29.6	60.4	((60))
60	49.2	56.0	76.8	63.4	60.7	58.2	30.9	77.2	77
61	50.6	56.6	49.5	57.6	52.2	51.7	41.9	61.9	((62))
62	58.8	67.3	68.9	69.2	65.2	46.4	37.3	74.1	74
63	47.8	52.3	49.1	53.6	53.9	43.5	34.2	59.1	((59))
64	53.3	52.5	45.3	47.2	49.5	43.9	31.4	57.7	((58))
65	58.4	60.2	62.4	69.6	54.9	43.8	27.8	71.1	71
66	60.5	65.1	64.1	64.4	61.0	47.4	35.2	70.4	70
67	45.0	46.1	40.8	46.4	57.5	44.6	27.1	58.6	((59))
68	60.5	65.1	64.1	64.4	61.0	47.4	35.2	70.4	70
69	45.0	46.1	40.8	46.4	57.5	44.6	27.1	58.6	((59))
70	45.1	54.0	55.3	57.6	56.8	43.3	33.3	62.3	((62))
71	66.7	69.3	66.6	65.9	61.9	50.1	38.2	73.9	74
72	67.8	72.6	73.8	76.3	68.6	62.9	48.2	80.0	80
73	60.4	66.2	68.1	69.0	63.8	55.9	44.9	73.5	74
74	56.7	62.3	64.7	66.1	62.9	51.6	42.1	70.6	71
75	47.4	53.3	52.7	56.5	58.3	48.6	34.0	62.2	((62))
76	47.4	53.3	52.7	56.5	58.3	48.6	34.0	62.2	((62))
77	56.6	56.1	65.2	67.8	51.7	43.8	43.5	70.2	70
78	59.8	62.9	63.5	66.2	54.7	46.3	40.1	69.8	70
79	63.2	66.6	61.8	61.0	54.4	53.4	35.0	70.0	70
80	56.6	60.2	59.2	60.6	53.2	47.1	37.8	65.7	((66))
81	44.7	50.4	54.3	53.4	50.0	40.7	33.7	58.7	((59))
82	53.2	56.0	62.8	62.4	54.4	55.8	49.4	67.0	((67))
83	63.4	68.2	70.2	69.4	56.2	53.2	51.0	74.6	75

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-3.21
HPD selection for landcruiser occupants

	Neq calculated on basis of mean LpA values and exposure period of 8 h.								
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	77.0	81.0	92.0	94.0	96.0	91.0	83.0	99.9	99.9
with HPD									
1	74.1	76.1	77.0	70.8	67.9	59.9	58.0	81.3	81
2	72.3	68.1	73.2	71.6	76.3	68.0	65.4	80.5	80
3	70.5	68.3	72.4	75.7	76.6	72.2	62.6	81.4	81
4	74.1	71.3	71.0	75.3	77.5	71.4	63.3	82.0	82
5	72.7	71.5	76.1	75.8	68.3	58.4	53.6	80.8	81
6	69.6	71.4	73.5	71.2	67.7	59.6	50.7	78.2	78
7	71.9	70.2	70.9	67.6	69.5	57.9	48.8	77.3	77
8	71.6	71.6	73.4	71.0	69.5	58.6	51.9	78.6	79
9	66.9	65.3	70.8	65.8	66.6	58.6	56.4	74.7	75
10	66.8	68.2	73.9	66.4	67.7	59.7	56.4	76.8	77
11	73.3	70.1	74.8	67.9	68.3	58.4	57.1	78.8	79
12	71.5	65.3	70.9	67.3	64.8	56.9	54.9	75.9	76
13	66.1	63.2	69.2	61.6	64.6	53.5	48.6	72.8	73
14	71.2	71.6	78.1	70.2	70.3	58.6	57.3	80.6	81
15	77.0	73.2	77.9	72.5	72.2	66.3	64.7	82.4	82
16	73.3	70.9	76.0	69.9	70.5	58.9	52.5	79.8	80
17	76.3	75.2	76.3	70.6	71.0	60.0	53.7	81.6	82
18	72.3	71.5	76.1	73.0	67.6	59.1	58.3	80.0	80
19	69.2	67.1	68.4	65.2	68.8	55.0	46.7	75.0	75
20	72.3	67.9	70.8	66.8	75.3	60.2	51.5	78.8	79
21	71.3	68.3	68.5	65.5	68.9	55.7	52.4	75.9	76
22	74.4	72.8	77.3	70.5	69.0	65.0	54.6	80.9	81
23	75.0	73.6	75.1	70.8	69.3	57.7	51.3	80.3	80
24	72.9	72.8	77.1	71.8	70.8	61.0	58.3	80.8	81
25	72.8	75.3	77.4	70.8	71.5	67.6	56.0	81.5	81
26	74.6	74.8	79.2	73.2	71.0	59.9	54.4	82.5	83
27	71.1	71.4	74.5	67.4	69.3	60.4	57.0	78.5	79
28	75.0	76.9	75.5	69.4	67.6	61.0	53.7	81.2	81
29	74.8	75.4	76.2	67.8	70.1	60.0	53.2	80.9	81
30	66.4	70.5	68.3	56.2	57.0	47.1	56.0	73.7	74
31	64.8	65.6	71.0	64.6	63.0	59.2	51.9	74.0	74
32	59.0	60.6	62.2	57.0	60.2	57.4	49.8	67.6	((68))
33	67.3	63.7	67.9	55.1	66.1	60.7	52.5	72.9	73
34	59.4	55.8	59.7	61.9	66.0	51.9	44.8	69.0	((69))
35	67.8	64.5	63.1	64.0	60.5	46.2	44.3	71.6	72
36	62.3	55.4	53.6	52.0	66.3	48.1	49.1	68.4	((68))
37	64.6	66.2	80.5	79.3	78.5	68.0	59.9	84.5	85
38	62.0	65.3	75.6	75.2	71.2	54.3	49.8	79.4	79
39	64.6	66.2	80.1	79.3	78.5	68.0	59.9	84.4	84
40	64.1	68.3	77.9	79.5	69.2	57.8	51.2	82.3	82
41	63.1	68.1	79.2	77.9	71.1	57.9	52.2	82.2	82
42	70.7	73.9	83.6	79.7	74.4	63.4	61.4	85.9	>86<
43	71.2	76.0	85.3	82.4	74.6	68.7	65.6	87.8	>88<
44	69.4	72.2	83.2	80.4	68.2	63.2	65.0	85.5	>86<
45	59.2	65.0	79.6	78.7	77.7	72.2	58.1	83.9	84
46	61.0	64.1	78.7	77.9	75.4	70.2	64.2	82.7	83
47	61.8	64.6	79.8	75.6	77.6	73.3	59.0	83.3	83
48	66.1	69.6	78.8	74.2	70.3	62.6	60.5	81.1	81
49	70.7	69.6	78.6	77.5	70.1	64.2	58.6	82.1	82
50	61.3	64.8	72.5	68.3	62.9	56.8	50.1	75.0	75
51	60.7	64.1	71.4	67.5	62.2	53.9	47.1	74.0	74
52	72.3	77.6	87.7	86.9	79.0	74.1	73.5	91.1	>91<
53	55.3	59.2	67.9	66.4	63.8	57.5	54.0	71.7	72
54	53.4	60.0	69.0	66.7	65.6	56.4	46.4	72.5	73
55	61.6	61.4	81.6	78.8	77.8	74.2	44.2	84.9	85
56	57.3	60.4	75.1	67.0	66.0	55.9	50.0	76.4	76
57	72.0	74.7	84.7	84.7	82.0	77.2	62.7	89.3	>89<
58	66.8	65.6	78.6	81.0	68.8	67.2	56.0	83.4	83
59	49.5	52.3	59.9	65.1	69.5	61.4	43.6	71.7	72
60	55.2	60.0	89.8	74.4	72.7	68.2	44.9	90.0	>90<
61	56.6	60.6	62.5	68.6	64.2	61.7	55.9	71.8	72
62	64.8	71.3	81.9	80.2	77.2	56.4	51.3	85.2	85
63	53.8	56.3	62.1	64.6	65.9	53.5	48.2	69.7	70
64	59.3	56.5	58.3	58.2	61.5	53.9	45.4	66.4	((66))
65	64.4	64.2	75.4	80.6	66.9	53.8	41.8	82.0	82
66	66.5	69.1	77.1	75.4	73.0	57.4	49.2	80.8	81
67	51.0	50.1	53.8	57.4	69.5	54.6	41.1	70.1	70
68	66.5	69.1	77.1	75.4	73.0	57.4	49.2	80.8	81
69	51.0	50.1	53.8	57.4	69.5	54.6	41.1	70.1	70
70	51.1	58.0	68.3	68.6	68.8	53.3	47.3	73.5	74
71	72.7	73.8	79.6	76.9	73.9	60.1	52.2	83.2	83
72	73.8	76.6	86.8	87.3	80.6	72.9	62.2	90.9	>91<
73	66.4	70.2	81.1	80.0	75.8	65.9	58.9	84.6	85
74	62.7	66.8	77.7	77.1	74.9	61.6	56.1	81.7	82
75	53.4	57.8	65.7	67.5	70.3	58.6	48.0	73.4	73
76	53.4	57.8	65.7	67.5	70.3	58.6	48.0	73.4	73
77	62.6	60.1	78.2	78.8	63.7	53.8	57.5	81.7	82
78	65.8	66.9	76.5	77.2	66.7	56.3	54.1	80.5	80
79	69.2	70.6	74.8	72.0	66.4	63.4	49.0	78.6	79
80	62.6	64.2	72.2	71.6	65.2	57.1	51.8	76.0	76
81	50.7	54.4	67.3	64.4	62.0	50.7	47.7	70.1	70
82	59.2	60.0	75.8	73.4	66.4	65.8	63.4	78.6	79
83	69.4	72.2	83.2	80.4	68.2	63.2	65.0	85.5	>86<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-3.22
HPD selection for dragline machine room attendants

	dB-Neq	Mean:	86.5	Max:	89	Min:	79	Obs (n):	8
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	82.0	90.0	91.0	93.0	88.0	86.0	76.0	97.4	86.5
with HPD									
1	79.1	85.1	76.0	69.8	59.9	54.9	51.0	86.6	76
2	77.3	77.1	72.2	70.6	68.3	63.0	58.4	81.5	71
3	75.5	77.8	71.4	74.7	68.6	67.2	55.6	81.8	71
4	79.1	80.8	70.0	74.3	69.5	66.4	56.3	84.0	73
5	77.7	80.6	75.1	74.8	60.3	53.4	46.6	83.8	73
6	74.6	80.4	72.5	70.2	59.7	54.6	43.7	82.3	71
7	76.9	79.2	69.9	66.6	61.5	52.9	41.8	81.7	71
8	76.6	80.6	72.4	70.0	61.5	53.6	44.9	82.8	72
9	71.9	74.3	69.8	64.8	58.6	53.6	49.4	77.5	((67))
10	71.8	77.2	72.9	65.4	59.7	54.7	49.4	79.6	((69))
11	78.3	79.1	73.8	66.9	60.3	53.4	50.1	82.5	72
12	76.5	74.3	69.9	66.3	56.8	51.9	47.9	79.4	((68))
13	71.1	72.2	68.2	60.6	56.6	48.5	41.6	75.8	((65))
14	76.2	80.6	77.1	69.2	62.3	53.6	50.3	83.4	72
15	82.0	82.2	76.9	71.5	64.2	61.3	57.7	85.9	75
16	78.3	79.9	75.0	68.9	62.5	53.9	45.5	83.2	72
17	81.3	84.2	75.3	69.6	63.0	55.0	46.7	86.5	76
18	77.3	80.5	75.1	72.0	59.6	54.1	51.3	83.3	72
19	74.2	76.1	67.4	64.2	60.8	50.0	39.7	78.8	((68))
20	77.3	76.9	69.8	65.8	67.3	55.2	44.5	80.9	70
21	76.3	77.3	67.5	64.5	60.9	50.7	45.4	80.3	((69))
22	79.4	81.8	76.3	69.5	61.0	60.0	47.6	84.7	74
23	80.0	82.6	74.1	69.8	61.3	52.7	44.3	85.0	74
24	77.9	81.8	76.1	70.8	62.8	56.0	51.3	84.3	73
25	77.8	84.3	76.4	69.8	63.5	62.6	49.0	85.9	75
26	79.6	83.8	78.2	72.2	63.0	54.9	47.4	86.2	75
27	76.1	80.4	73.5	66.4	61.3	55.4	50.0	82.5	72
28	80.0	85.9	74.5	68.4	59.6	56.0	46.7	87.2	76
29	79.8	84.4	75.2	66.8	62.1	55.0	46.2	86.1	75
30	71.4	79.5	67.3	55.2	49.0	42.1	49.0	80.4	69
31	69.8	74.6	70.0	63.6	55.0	54.2	44.9	77.1	((66))
32	64.0	69.6	61.2	56.0	52.2	52.4	42.8	71.4	((60))
33	72.3	72.7	66.9	54.1	58.1	55.7	45.5	76.2	((65))
34	64.4	64.8	58.7	60.9	58.0	46.9	37.8	69.3	((58))
35	72.8	73.5	62.1	63.0	52.5	41.2	37.3	76.6	((66))
36	67.3	64.4	52.6	51.0	58.3	43.1	42.1	69.6	((59))
37	69.6	75.2	79.5	78.3	70.5	63.0	52.9	83.3	72
38	67.0	74.3	74.6	74.2	63.2	49.3	42.8	79.5	((69))
39	69.6	75.2	79.1	78.3	70.5	63.0	52.9	83.1	72
40	69.1	77.3	76.9	78.5	61.2	52.8	44.2	82.6	72
41	68.1	77.1	78.2	76.9	63.1	52.9	45.2	82.4	72
42	75.7	82.9	82.6	78.7	66.4	58.4	54.4	86.9	76
43	76.2	85.0	84.3	81.4	66.6	63.7	58.6	88.9	78
44	74.4	81.2	82.2	79.4	60.2	58.2	58.0	86.2	75
45	64.2	74.0	78.6	77.7	69.7	67.2	51.1	82.4	72
46	66.0	73.1	77.7	76.9	67.4	65.2	57.2	81.5	71
47	66.8	73.6	78.8	74.6	69.6	68.3	52.0	81.7	71
48	71.1	78.6	77.8	73.2	62.3	57.6	53.5	82.3	71
49	75.7	78.6	77.6	76.5	62.1	59.2	51.6	83.3	72
50	66.3	73.8	71.5	67.3	54.9	51.8	43.1	76.8	((66))
51	65.7	73.1	70.4	66.5	54.2	48.9	40.1	76.0	((65))
52	77.3	86.6	86.7	85.9	71.0	69.1	66.5	91.4	81
53	60.3	68.2	66.9	65.4	55.8	52.5	47.0	72.2	((61))
54	58.4	69.0	68.0	65.7	57.6	51.4	39.4	72.9	((62))
55	66.6	70.4	80.6	77.8	69.8	69.2	37.2	83.2	72
56	62.3	69.4	74.1	66.0	58.0	50.9	43.0	76.1	((65))
57	77.0	83.7	83.7	83.7	74.0	72.2	55.7	89.0	78
58	71.8	74.6	77.6	80.0	60.8	62.2	49.0	83.1	72
59	54.5	61.3	58.9	64.1	61.5	56.4	36.6	68.3	((57))
60	60.2	69.0	88.8	73.4	64.7	63.2	37.9	89.0	78
61	61.6	69.6	61.5	67.6	56.2	56.7	48.9	72.7	((62))
62	69.8	80.3	80.9	79.2	69.2	51.4	44.3	85.2	74
63	58.8	65.3	61.1	63.6	57.9	48.5	41.2	69.3	((58))
64	64.3	65.5	57.3	57.2	53.5	48.9	38.4	68.8	((58))
65	69.4	73.2	74.4	79.6	58.9	48.8	34.8	81.7	71
66	71.5	78.1	76.1	74.4	65.0	52.4	42.2	81.8	71
67	56.0	59.1	52.8	56.4	61.5	49.6	34.1	65.2	((54))
68	71.5	78.	76.1	74.4	65.0	52.4	42.2	81.8	71
69	56.0	59.	52.8	56.4	61.5	49.6	34.1	65.2	((54))
70	56.1	67.0	67.3	67.6	60.8	48.3	40.3	72.5	((62))
71	77.7	82.8	78.6	75.9	65.9	55.1	45.2	85.6	75
72	78.8	85.6	85.8	86.3	72.6	67.9	55.2	91.0	80
73	71.4	79.2	80.1	79.0	67.8	60.9	51.9	84.6	74
74	67.7	75.8	76.7	76.1	66.9	56.6	49.1	81.4	70
75	58.4	66.8	64.7	66.5	62.3	53.6	41.0	71.7	((61))
76	58.4	66.8	64.7	66.5	62.3	53.6	41.0	71.7	((61))
77	67.6	69.1	77.2	77.8	55.7	48.8	50.5	81.0	70
78	70.8	75.9	75.5	76.2	58.7	51.3	47.1	81.1	70
79	74.2	79.6	73.8	71.0	58.4	58.4	42.0	81.9	71
80	67.6	73.2	71.2	70.6	57.2	52.1	44.8	77.2	((66))
81	55.7	63.4	66.3	63.4	54.0	45.7	40.7	69.7	((59))
82	64.2	69.3	74.8	72.4	58.4	60.8	56.4	77.8	((67))
83	74.4	81.2	82.2	79.4	60.2	58.2	58.0	86.2	75

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-3.23

HPD selection for overburden drill operators

	dB-Neq	Mean:	88.0	Max:	91	Min:	81	Obs (n):	8
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	70.0	87.0	88.0	89.0	85.0	79.0	70.0	93.7	91
with HPD									
1	67.1	82.1	73.0	65.8	56.9	47.9	45.0	82.8	80
2	65.3	74.1	69.2	66.6	65.3	56.0	52.4	76.6	74
3	63.5	74.8	68.4	70.7	65.6	60.2	49.6	77.5	75
4	67.1	77.8	67.0	70.3	66.5	59.4	50.3	79.4	77
5	65.7	77.6	72.1	70.8	57.3	46.4	40.6	79.5	77
6	62.6	77.4	69.5	66.2	56.7	47.6	37.7	78.5	76
7	64.9	76.2	66.9	62.6	58.5	45.9	35.8	77.2	74
8	64.6	77.6	69.4	66.0	58.5	46.6	38.9	78.7	76
9	59.9	71.3	66.8	60.8	55.6	46.6	43.4	73.2	71
10	59.8	74.2	69.9	61.4	56.7	47.7	43.4	75.9	73
11	66.3	76.1	70.8	62.9	57.3	46.4	44.1	77.8	75
12	64.5	71.3	66.9	62.3	53.8	44.9	41.9	73.7	71
13	59.1	69.2	65.2	56.6	53.6	41.5	35.6	71.2	((68))
14	64.2	77.6	74.1	65.2	59.3	46.6	44.3	79.5	77
15	70.0	79.2	73.9	67.5	61.2	54.3	51.7	81.0	78
16	66.3	76.9	72.0	64.9	59.5	46.9	39.5	78.6	76
17	69.3	81.2	72.3	65.6	60.0	48.0	40.7	82.1	79
18	65.3	77.5	72.1	68.0	56.6	47.1	45.3	79.2	76
19	62.2	73.1	64.4	60.2	57.8	43.0	33.7	74.2	72
20	65.3	73.9	66.8	61.8	64.3	48.2	38.5	75.7	73
21	64.3	74.3	64.5	60.5	57.9	43.7	39.4	75.3	73
22	67.4	78.8	73.3	65.5	58.0	53.0	41.6	80.3	78
23	68.0	79.6	71.1	65.8	58.3	45.7	38.3	80.6	78
24	65.9	78.8	73.1	66.8	59.8	49.0	45.3	80.3	78
25	65.8	81.3	73.4	65.8	60.5	55.6	43.0	82.2	80
26	67.6	80.8	75.2	68.2	60.0	47.9	41.4	82.2	80
27	64.1	77.4	70.5	62.4	58.3	48.4	44.0	78.5	76
28	68.0	82.5	71.5	64.4	56.6	49.0	40.7	83.4	81
29	67.8	81.4	72.2	62.8	59.1	48.0	40.2	82.1	79
30	59.4	76.5	64.3	51.2	46.0	35.1	43.0	76.9	74
31	57.8	71.6	67.0	59.6	52.0	47.2	38.9	73.3	71
32	52.0	66.6	58.2	52.0	49.2	45.4	36.8	67.5	((65))
33	60.3	69.7	63.9	50.1	55.1	48.7	39.5	71.3	((69))
34	52.4	61.8	55.7	56.9	55.0	39.9	31.8	64.6	((62))
35	60.8	70.5	59.1	59.0	49.5	34.2	31.3	71.5	((69))
36	55.3	61.4	49.6	47.0	55.3	36.1	36.1	63.4	((61))
37	57.6	72.2	76.5	74.3	67.5	56.0	46.9	79.8	77
38	55.0	71.3	71.6	70.2	60.2	42.3	36.8	76.0	73
39	57.6	72.2	76.1	74.3	67.5	56.0	46.9	79.6	77
40	57.1	74.3	73.9	74.5	58.2	45.8	38.2	79.1	76
41	56.1	74.1	75.2	72.9	60.1	45.9	39.2	79.0	76
42	63.7	79.9	79.6	74.7	63.4	51.4	48.4	83.5	81
43	64.2	82.0	81.3	77.4	63.6	56.7	52.6	85.5	83
44	62.4	78.2	79.2	75.4	57.2	51.2	52.0	82.7	80
45	52.2	71.0	75.6	73.7	66.7	60.2	45.1	78.9	76
46	54.0	70.1	74.7	72.9	64.4	58.2	51.2	78.0	75
47	54.8	70.6	75.8	70.6	66.6	61.3	46.0	78.3	76
48	59.1	75.6	74.8	69.2	59.3	50.6	47.5	78.8	76
49	63.7	75.6	74.6	72.5	59.1	52.2	45.6	79.4	77
50	54.3	70.8	68.5	63.3	51.9	44.8	37.1	73.4	71
51	53.7	70.1	67.4	62.5	51.2	41.9	34.1	72.5	70
52	65.3	83.6	83.7	81.9	68.0	62.1	60.5	88.0	85
53	48.3	65.2	63.9	61.4	52.8	45.5	41.0	68.7	((66))
54	46.4	66.0	65.0	61.7	54.6	44.4	33.4	69.5	((67))
55	54.6	67.4	77.6	73.8	66.8	62.2	31.2	79.7	77
56	50.3	66.4	71.1	62.0	55.0	43.9	37.0	72.9	70
57	65.0	80.7	80.7	79.7	71.0	65.2	49.7	85.4	83
58	59.8	71.5	74.6	76.0	57.8	55.2	43.0	79.3	77
59	42.5	58.3	55.9	60.1	58.5	49.4	30.6	64.6	((62))
60	48.2	66.3	85.8	69.4	61.7	56.2	31.9	86.0	83
61	49.6	66.5	58.5	63.6	53.2	49.7	42.9	69.0	((66))
62	57.8	77.3	77.9	75.2	66.2	44.4	38.3	81.9	79
63	46.8	62.3	58.1	59.6	54.9	41.5	35.2	65.6	((63))
64	52.3	62.5	54.3	53.2	50.5	41.9	32.4	64.1	((61))
65	57.4	70.2	71.4	75.6	55.9	41.8	28.8	77.9	75
66	59.5	75.1	73.1	70.4	62.0	45.4	36.2	78.2	76
67	44.0	56.1	49.8	52.4	58.5	42.6	28.1	61.5	((59))
68	59.5	75.1	73.1	70.4	62.0	45.4	36.2	78.2	76
69	44.0	56.1	49.8	52.4	58.5	42.6	28.1	61.5	((59))
70	44.1	64.0	64.3	63.6	57.8	41.3	34.3	69.1	((66))
71	65.7	79.8	75.6	71.9	62.9	48.1	39.2	81.8	79
72	66.8	82.6	82.8	82.3	69.6	60.9	49.2	87.5	85
73	59.4	76.2	77.1	75.0	64.8	53.9	45.9	81.1	78
74	55.7	72.8	73.7	72.1	63.9	49.6	43.1	77.9	75
75	46.4	63.8	61.7	62.5	59.3	46.6	35.0	68.2	((65))
76	46.4	63.8	61.7	62.5	59.3	46.6	35.0	68.2	((65))
77	55.6	66.1	74.2	73.8	52.7	41.8	44.5	77.4	75
78	58.8	72.9	72.5	72.2	55.7	44.3	41.1	77.4	75
79	62.2	76.6	70.8	67.0	55.4	51.4	36.0	78.1	75
80	55.6	70.2	68.2	66.6	54.2	45.1	38.8	73.5	71
81	43.7	60.4	63.3	59.4	51.0	38.7	34.7	66.3	((64))
82	52.2	66.0	71.8	68.4	55.4	53.8	50.4	74.3	72
83	62.4	78.2	79.2	75.4	57.2	51.2	52.0	82.7	80

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-3.24

HPD selection for production backactor operators

	dB-Neq	Mean:	87.3	Max:	89	Min:	81	Obs (n):	17
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	81.0	83.0	89.0	87.0	85.0	81.0	75.0	93.2	87.3
with HPD									
1	78.1	78.1	74.0	63.8	56.9	49.9	50.0	82.0	76
2	76.3	70.1	70.2	64.6	65.3	58.0	57.4	78.5	73
3	74.5	70.8	69.4	68.7	65.6	62.2	54.6	77.9	72
4	78.1	73.8	68.0	68.3	66.5	61.4	55.3	80.3	74
5	76.7	73.6	73.1	68.8	57.3	48.4	45.6	79.9	74
6	73.6	73.4	70.5	64.2	56.7	49.6	42.7	77.7	72
7	75.9	72.2	67.9	60.6	58.5	47.9	40.8	78.0	72
8	75.6	73.6	70.4	64.0	58.5	48.6	43.9	78.7	73
9	70.9	67.3	67.8	58.8	55.6	48.6	48.4	74.0	((68))
10	70.8	70.2	70.9	59.4	56.7	49.7	48.4	75.6	70
11	77.3	72.1	71.8	60.9	57.3	48.4	49.1	79.4	73
12	75.5	67.3	67.9	60.3	53.8	46.9	46.9	76.9	71
13	70.1	65.2	66.2	54.6	53.6	43.5	40.6	72.6	((67))
14	75.2	73.6	75.1	63.2	59.3	48.6	49.3	79.6	74
15	81.0	75.2	74.9	65.5	61.2	56.3	56.7	82.9	77
16	77.3	72.9	73.0	62.9	59.5	48.9	44.5	79.8	74
17	80.3	77.2	73.3	63.6	60.0	50.0	45.7	82.7	77
18	76.3	73.5	73.1	66.0	56.6	49.1	50.3	79.5	74
19	73.2	69.1	65.4	58.2	57.8	45.0	38.7	75.3	((69))
20	76.3	69.9	67.8	59.8	64.3	50.2	43.5	77.9	72
21	75.3	70.3	65.5	58.5	57.9	45.7	44.4	76.9	71
22	78.4	74.8	74.3	63.5	58.0	55.0	46.6	81.1	75
23	79.0	75.6	72.1	63.8	58.3	47.7	43.3	81.3	75
24	76.9	74.8	74.1	64.8	59.8	51.0	50.3	80.4	74
25	76.8	77.3	74.4	63.8	60.5	57.6	48.0	81.2	75
26	78.6	76.8	76.2	66.2	60.0	49.9	46.4	82.2	76
27	75.1	73.4	71.5	60.4	58.3	50.4	49.0	78.5	73
28	79.0	78.9	72.5	62.4	56.6	51.0	45.7	82.5	77
29	78.8	77.4	73.2	60.8	59.1	50.0	45.2	81.9	76
30	70.4	72.5	65.3	49.2	46.0	37.1	48.0	75.1	((69))
31	68.8	67.6	68.0	57.6	52.0	49.2	43.9	73.1	((67))
32	63.0	62.6	59.2	50.0	49.2	47.4	41.8	66.9	((61))
33	71.3	65.7	64.9	48.1	55.1	50.7	44.5	73.2	((67))
34	63.4	57.8	56.7	54.9	55.0	41.9	36.8	65.9	((60))
35	71.8	66.5	60.1	57.0	49.5	36.2	36.3	73.3	((67))
36	66.3	57.4	50.6	45.0	55.3	38.1	41.1	67.3	((61))
37	68.6	68.2	77.5	72.3	67.5	58.0	51.9	79.7	74
38	66.0	67.3	72.6	68.2	60.2	44.3	41.8	75.5	70
39	68.6	68.2	77.1	72.3	67.5	58.0	51.9	79.5	74
40	68.1	70.3	74.9	72.5	58.2	47.8	43.2	78.2	72
41	67.1	70.	76.2	70.9	60.1	47.9	44.2	78.5	73
42	74.7	75.9	80.6	72.7	63.4	53.4	53.4	83.1	77
43	75.2	78.0	82.3	75.4	63.6	58.7	57.6	84.8	79
44	73.4	74.2	80.2	73.4	57.2	53.2	57.0	82.5	77
45	63.2	67.0	76.6	71.7	66.7	62.2	50.1	78.7	73
46	65.0	66.1	75.7	70.9	64.4	60.2	56.2	77.8	72
47	65.8	66.6	76.8	68.6	66.6	63.3	51.0	78.5	73
48	70.1	71.6	75.8	67.2	59.3	52.6	52.5	78.4	72
49	74.7	71.6	75.6	70.5	59.1	54.2	50.6	79.7	74
50	65.3	66.8	69.5	61.3	51.9	46.8	42.1	72.7	((67))
51	64.7	66.1	68.4	60.5	51.2	43.9	39.1	71.8	((66))
52	76.3	79.6	84.7	79.9	68.0	64.1	65.5	87.3	81
53	59.3	61.2	64.9	59.4	52.8	47.5	46.0	68.1	((62))
54	57.4	62.3	66.0	59.7	54.6	46.4	38.4	68.7	((63))
55	65.6	63.4	78.6	71.8	66.8	64.2	36.2	80.0	74
56	61.3	62.4	72.1	60.0	55.0	45.9	42.0	73.2	((67))
57	76.0	76.7	81.7	77.7	71.0	67.2	54.7	84.9	79
58	70.8	67.6	75.6	74.0	57.8	57.2	48.0	79.1	73
59	53.5	54.3	56.9	58.1	58.5	51.4	35.6	63.9	((58))
60	59.2	62.0	86.8	67.4	61.7	58.2	36.9	86.9	81
61	60.6	62.6	59.5	61.6	53.2	51.7	47.9	67.6	((62))
62	68.8	73.3	78.9	73.2	66.2	46.4	43.3	81.2	75
63	57.8	58.3	59.1	57.6	54.9	43.5	40.2	64.8	((59))
64	63.3	58.5	55.3	51.2	50.5	43.9	37.4	65.4	((59))
65	68.4	66.2	72.4	73.6	55.9	43.8	33.8	77.1	71
66	70.5	71.1	74.1	68.4	62.0	47.4	41.2	77.7	72
67	55.0	52.1	50.8	50.4	58.5	44.6	33.1	61.6	((56))
68	70.5	71.1	74.1	68.4	62.0	47.4	41.2	77.7	72
69	55.0	52.1	50.8	50.4	58.5	44.6	33.1	61.6	((56))
70	55.1	60.0	65.3	61.6	57.8	43.3	39.3	68.3	((62))
71	76.7	75.8	76.6	69.9	62.9	50.1	44.2	81.5	76
72	77.8	78.6	83.8	80.3	69.6	62.9	54.2	86.9	81
73	70.4	72.2	78.1	73.0	64.8	55.9	50.9	80.6	75
74	66.7	68.8	74.7	70.1	63.9	51.6	48.1	77.4	71
75	57.4	59.8	62.7	60.5	59.3	48.6	40.0	67.3	((61))
76	57.4	59.8	62.7	60.5	59.3	48.6	40.0	67.3	((61))
77	66.6	62.1	75.2	71.8	52.7	43.8	49.5	77.4	71
78	69.8	68.9	73.5	70.2	55.7	46.3	46.1	77.0	71
79	73.2	72.6	71.8	65.0	55.4	53.4	41.0	77.6	72
80	66.6	66.2	69.2	64.6	54.2	47.1	43.8	73.1	((67))
81	54.7	56.4	64.3	57.4	51.0	40.7	39.7	66.1	((60))
82	63.2	62.0	72.8	66.4	55.4	55.8	55.4	74.5	((69))
83	73.4	74.2	80.2	73.4	57.2	53.2	57.0	82.5	77

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-3.25
HPD selection for coal truck drivers

	dB-Neq	Mean:	95.7	Max:	99	Min:	89	Obs (n):	26
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	82.0	85.0	87.0	92.0	91.0	87.0	82.0	96.5	95.7
with HPD									
1	79.1	80.1	72.0	68.8	62.9	55.9	57.0	83.2	82
2	77.3	72.1	68.2	69.6	71.3	64.0	64.4	80.2	79
3	75.5	72.8	67.4	73.7	71.6	68.2	61.6	80.3	79
4	79.1	75.8	66.0	73.3	72.5	67.4	62.3	82.3	81
5	77.7	75.6	71.1	73.8	63.3	54.4	52.6	81.3	80
6	74.6	75.4	68.5	69.2	62.7	55.6	49.7	79.1	78
7	76.9	74.2	65.9	65.6	64.5	53.9	47.8	79.3	79
8	76.6	75.6	68.4	69.0	64.5	54.6	50.9	80.0	79
9	71.9	69.3	65.8	63.8	61.6	54.6	55.4	75.1	74
10	71.8	72.2	68.9	64.4	62.7	55.7	55.4	76.5	76
11	78.3	74.1	69.8	65.9	63.3	54.4	56.1	80.4	80
12	76.5	69.3	65.9	65.3	59.8	52.9	53.9	77.9	77
13	71.1	67.2	64.2	59.6	59.6	49.5	47.6	73.6	73
14	76.2	75.6	73.1	68.2	65.3	54.6	56.3	80.4	80
15	82.0	77.2	72.9	70.5	67.2	62.3	63.7	84.0	83
16	78.3	74.9	71.0	67.9	65.5	54.9	51.5	80.8	80
17	81.3	79.2	71.3	68.6	66.0	56.0	52.7	83.9	83
18	77.3	75.5	71.1	71.0	62.6	55.1	57.3	80.7	80
19	74.2	71.1	63.4	63.2	63.8	51.0	45.7	76.6	76
20	77.3	71.9	65.8	64.8	70.3	56.2	50.5	79.4	79
21	76.3	72.3	63.5	63.5	63.9	51.7	51.4	78.3	77
22	79.4	76.8	72.3	68.5	64.0	61.0	53.6	82.1	81
23	80.0	77.6	70.1	68.8	64.3	53.7	50.3	82.5	82
24	77.9	76.8	72.1	69.8	65.8	57.0	57.3	81.5	81
25	77.8	79.3	72.4	68.8	66.5	63.6	55.0	82.5	82
26	79.6	78.8	74.2	71.2	66.0	55.9	53.4	83.2	82
27	76.1	75.4	69.5	65.4	64.3	56.4	56.0	79.6	79
28	80.0	80.9	70.5	67.4	62.6	57.0	52.7	83.8	83
29	79.8	79.4	71.2	65.8	65.1	56.0	52.2	83.1	82
30	71.4	74.5	63.3	54.2	52.0	43.1	55.0	76.5	76
31	69.8	69.6	66.0	62.6	58.0	55.2	50.9	74.1	73
32	64.0	64.6	57.2	55.0	55.2	53.4	48.8	68.4	((68))
33	72.3	67.7	62.9	53.1	61.1	56.7	51.5	74.3	73
34	64.4	59.8	54.7	59.9	61.0	47.9	43.8	68.0	((67))
35	72.8	68.5	58.1	62.0	55.5	42.2	43.3	74.6	74
36	67.3	59.4	48.6	50.0	61.3	44.1	48.1	69.0	((68))
37	69.6	70.2	75.5	77.3	73.5	64.0	58.9	81.3	80
38	67.0	69.2	70.6	73.2	66.2	50.3	48.8	77.0	76
39	69.6	70.2	75.1	77.3	73.5	64.0	58.9	81.2	80
40	69.1	72.3	72.9	77.5	64.2	53.8	50.2	80.2	79
41	68.1	72.1	74.2	75.9	66.1	53.9	51.2	79.7	79
42	75.7	77.9	78.6	77.7	69.4	59.4	60.4	83.8	83
43	76.2	80.0	80.3	80.4	69.6	64.7	64.6	85.7	85
44	74.4	76.2	78.2	78.4	63.2	59.2	64.0	83.2	82
45	64.2	69.0	74.6	76.7	72.7	68.2	57.1	80.5	80
46	66.0	68.1	73.7	75.9	70.4	66.2	63.2	79.5	79
47	66.8	68.6	74.8	73.6	72.6	69.3	58.0	79.7	79
48	71.1	73.6	73.8	72.2	65.3	58.6	59.5	79.1	78
49	75.7	73.6	73.6	75.5	65.1	60.2	57.6	80.9	80
50	66.3	68.8	67.5	66.3	57.9	52.8	49.1	73.5	73
51	65.7	68.1	66.4	65.5	57.2	49.9	46.1	72.7	72
52	77.3	81.6	82.7	84.9	74.0	70.1	72.5	88.7	>88<
53	60.3	63.2	62.9	64.4	58.8	53.5	53.0	69.6	((69))
54	58.4	64.0	64.0	64.7	60.6	52.4	45.4	70.0	((69))
55	66.6	65.4	76.6	76.8	72.8	70.2	43.2	81.2	80
56	62.3	64.4	70.1	65.0	61.0	51.9	49.0	72.9	72
57	77.0	78.7	79.7	82.7	77.0	73.2	61.7	86.8	>86<
58	71.8	69.6	73.6	79.0	63.8	63.2	55.0	81.2	80
59	54.5	56.3	54.9	63.1	64.5	57.4	42.6	68.1	((67))
60	60.2	64.0	84.8	72.4	67.7	64.2	43.9	85.2	84
61	61.6	64.6	57.5	66.6	59.2	57.7	54.9	70.5	70
62	69.8	75.3	76.9	78.2	72.2	52.4	50.3	82.4	82
63	58.8	60.3	57.1	62.6	60.9	49.5	47.2	67.4	((67))
64	64.3	60.5	53.3	56.2	56.5	49.9	44.4	67.0	((66))
65	69.4	68.2	70.4	78.6	61.9	49.8	40.8	80.0	79
66	71.5	73.1	72.1	73.4	68.0	53.4	48.2	79.0	78
67	56.0	54.1	48.8	55.4	64.5	50.6	40.1	66.0	((65))
68	71.5	73.1	72.1	73.4	68.0	53.4	48.2	79.0	78
69	56.0	54.1	48.8	55.4	64.5	50.6	40.1	66.0	((65))
70	56.1	62.0	63.3	66.6	63.8	49.3	46.3	70.5	70
71	77.7	77.8	74.6	74.9	68.9	56.1	51.2	82.7	82
72	78.8	80.6	81.8	85.3	75.6	68.9	61.2	88.6	>88<
73	71.4	74.2	76.1	78.0	70.8	61.9	57.9	82.0	81
74	67.7	70.8	72.7	75.1	69.9	57.6	55.1	79.0	78
75	58.4	61.8	60.7	65.5	65.3	54.6	47.0	70.3	69
76	58.4	61.8	60.7	65.5	65.3	54.6	47.0	70.3	69
77	67.6	64.1	73.2	76.8	58.7	49.8	56.5	78.9	78
78	70.8	70.9	71.5	75.2	61.7	52.3	53.1	78.7	78
79	74.2	74.6	69.8	70.0	61.4	59.4	48.0	78.9	78
80	67.6	68.2	67.2	69.6	60.2	53.1	50.8	74.5	74
81	55.7	58.4	62.3	62.4	57.0	46.7	46.7	67.1	((66))
82	64.2	64.0	70.8	71.4	61.4	61.8	62.4	75.5	75
83	74.4	76.2	78.2	78.4	63.2	59.2	64.0	83.2	82

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-3.26
HPD selection for front-end loader operators

	dB-Neq	Mean:	87.9	Max:	92	Min:	84	Obs (n):	14
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	126	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	78.0	83.0	85.0	88.0	87.0	82.0	78.0	92.9	87.9
with HPD									
1	75.1	78.1	70.0	64.8	58.9	50.9	53.0	80.5	75
2	73.3	70.1	66.2	65.6	67.3	59.0	60.4	76.7	72
"3"	71.5	70.8	65.4	69.7	67.6	63.2	57.6	76.8	72
"4"	75.1	73.8	64.0	69.3	68.5	62.4	58.3	78.9	74
5	73.7	73.6	69.1	69.8	59.3	49.4	48.6	78.1	73
6	70.6	73.4	66.5	65.2	58.7	50.6	45.7	76.2	71
"7"	72.9	72.2	63.9	61.6	60.5	48.9	43.8	76.2	71
8	72.6	73.6	66.4	65.0	60.5	49.6	46.9	77.0	72
"9"	67.9	67.3	63.8	59.8	57.6	49.6	51.4	72.0	((67))
10	67.8	70.2	66.9	60.4	58.7	50.7	51.4	73.7	((69))
11	74.3	72.1	67.8	61.9	59.3	49.4	52.1	77.1	72
12	72.5	67.3	63.9	61.3	55.8	47.9	49.9	74.4	((69))
13	67.1	65.2	62.2	55.6	55.6	44.5	43.6	70.4	((65))
14	72.2	73.6	71.1	64.2	61.3	49.6	52.3	77.5	73
15	78.0	75.2	70.9	66.5	63.2	57.3	59.7	80.7	76
16	74.3	72.9	69.0	63.9	61.5	49.9	47.5	77.7	73
17	77.3	77.2	69.3	64.6	62.0	51.0	48.7	80.8	76
18	73.3	73.5	69.1	67.0	58.6	50.1	53.3	77.6	73
19	70.2	69.1	61.4	59.2	59.8	46.0	41.7	73.4	((68))
20	73.3	69.9	63.8	60.8	66.3	51.2	46.5	75.9	71
21	72.3	70.3	61.5	59.5	59.9	46.7	47.4	74.9	70
22	75.4	74.8	70.3	64.5	60.0	56.0	49.6	79.0	74
23	76.0	75.6	68.1	64.8	60.3	48.7	46.3	79.4	74
24	73.9	74.8	70.1	65.8	61.8	52.0	53.3	78.5	74
25	73.8	77.3	70.4	64.8	62.5	58.6	51.0	79.7	75
26	75.6	76.8	72.2	67.2	62.0	50.9	49.4	80.3	75
27	72.1	73.4	67.5	61.4	60.3	51.4	52.0	76.7	72
28	76.0	78.9	68.5	63.4	58.6	52.0	48.7	81.1	76
29	75.8	77.4	69.2	61.8	61.1	51.0	48.2	80.2	75
"30"	67.4	72.5	61.3	50.2	48.0	38.1	51.0	74.0	((69))
"31"	65.8	67.6	64.0	58.6	54.0	50.2	46.9	71.2	((66))
"32"	60.0	62.6	55.2	51.0	51.2	48.4	44.8	65.5	((60))
33	68.3	65.7	60.9	49.1	57.1	51.7	47.5	71.0	((66))
34	60.4	57.8	52.7	55.9	57.0	42.9	39.8	64.5	((60))
35	68.8	66.5	56.1	58.0	51.5	37.2	39.3	71.2	((66))
36	63.3	57.4	46.6	46.0	57.3	39.1	44.1	65.2	((60))
37	65.6	68.2	73.5	73.3	69.5	59.0	54.9	78.1	73
"38"	63.0	67.3	68.6	69.2	62.2	45.3	44.8	73.9	((69))
39	65.6	68.2	73.1	73.3	69.5	59.0	54.9	77.9	73
40	65.1	70.3	70.9	73.5	60.2	48.8	46.2	77.0	72
"41"	64.1	70.1	72.2	71.9	62.1	48.9	47.2	76.7	72
42	71.7	75.9	76.6	73.7	65.4	54.4	56.4	81.0	76
43	72.2	78.0	78.3	76.4	65.6	59.7	60.6	82.9	78
44	70.4	74.2	76.2	74.4	59.2	54.2	60.0	80.4	75
45	60.2	67.0	72.6	72.7	68.7	63.2	53.1	77.2	72
46	62.0	66.1	71.7	71.9	66.4	61.2	59.2	76.3	71
47	62.8	66.6	72.8	69.6	68.6	64.3	54.0	76.5	72
"48"	67.1	71.6	71.8	68.2	61.3	53.6	55.5	76.4	71
"49"	71.7	71.6	71.6	71.5	61.1	55.2	53.6	77.8	73
"50"	62.3	66.8	65.5	62.3	53.9	47.8	45.1	70.8	((66))
"51"	61.7	66.1	64.4	61.5	53.2	44.9	42.1	70.0	((65))
52	73.3	79.6	80.7	80.9	70.0	65.1	68.5	85.7	81
"53"	56.3	61.2	60.9	60.4	54.8	48.5	49.0	66.6	((62))
"54"	54.4	62.0	62.0	60.7	56.6	47.4	41.4	67.1	((62))
"55"	62.6	63.4	74.6	72.8	68.8	65.2	39.2	78.0	73
"56"	58.3	62.4	68.1	61.0	57.0	46.9	45.0	70.3	((65))
57	73.0	76.7	77.7	78.7	73.0	68.2	57.7	83.6	79
58	67.8	67.6	71.6	75.0	59.8	58.2	51.0	77.8	73
"59"	50.5	54.3	52.9	59.1	60.5	52.4	38.6	64.3	((59))
"60"	56.2	62.0	82.8	68.4	63.7	59.2	39.9	83.1	78
"61"	57.6	62.5	55.5	62.6	55.2	52.7	50.9	67.2	((62))
62	65.8	73.3	74.9	74.2	68.2	47.4	46.3	79.5	75
"63"	54.8	58.3	55.1	58.6	56.9	44.5	43.2	64.1	((59))
"64"	60.3	58.5	51.3	52.2	52.5	44.9	40.4	63.6	((59))
65	65.4	66.2	68.4	74.6	57.9	44.8	36.8	76.4	71
66	67.5	71.1	70.1	69.4	64.0	48.4	44.2	76.0	71
"67"	52.0	52.1	46.8	51.4	60.5	45.6	36.1	62.2	((57))
68	67.5	71.1	70.1	69.4	64.0	48.4	44.2	76.0	71
"69"	52.0	52.1	46.8	51.4	60.5	45.6	36.1	62.2	((57))
70	52.1	60.0	61.3	62.6	59.8	44.3	42.3	67.3	((62))
71	73.7	75.8	72.6	70.9	64.9	51.1	47.2	79.8	75
72	74.8	78.6	79.8	81.3	71.6	63.9	57.2	85.4	80
73	67.4	72.2	74.1	74.0	66.8	56.9	53.9	78.9	74
74	63.7	68.8	70.7	71.1	65.9	52.6	51.1	75.9	71
"75"	54.4	59.8	58.7	61.5	61.3	49.6	43.0	66.9	((62))
"76"	54.4	59.8	58.7	61.5	61.3	49.6	43.0	66.9	((62))
"77"	63.6	62.1	71.2	72.8	54.7	44.8	52.5	75.6	71
"78"	66.8	68.9	69.5	71.2	57.7	47.3	49.1	75.5	71
79	70.2	72.6	67.8	66.0	57.4	54.4	44.0	76.0	71
80	63.6	66.2	65.2	65.6	56.2	48.1	46.8	71.4	((66))
81	51.7	56.4	60.3	58.4	53.0	41.7	42.7	64.1	((59))
82	60.2	62.0	68.8	67.4	57.4	56.8	58.4	72.4	((67))
83	70.4	74.2	76.2	74.4	59.2	54.2	60.0	80.4	75

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-3.27
HPD selection for production tyre dozer operators

	dB-Neq	Mean:	88.9	Max:	96	Min:	86	Obs (n):	16
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
v/o HPD	78.0	84.0	84.0	86.0	84.0	82.0	76.0	91.5	96
vith HPD									
1	75.1	79.1	69.0	62.8	55.9	50.9	51.0	80.9	85
2	73.3	71.1	65.2	63.6	64.3	59.0	58.4	76.4	81
3	71.5	71.8	64.4	67.7	64.6	63.2	55.6	76.4	81
4	75.1	74.8	63.0	67.3	65.5	62.4	56.3	78.8	83
5	73.7	74.6	68.1	67.8	56.3	49.4	46.6	78.2	83
6	70.6	74.4	65.5	63.2	55.7	50.6	43.7	76.5	81
7	72.9	73.2	62.9	59.6	57.5	48.9	41.8	76.4	81
8	72.6	74.6	65.4	63.0	57.5	49.6	44.9	77.3	82
9	67.9	68.3	62.8	57.8	54.6	49.6	49.4	72.0	77
10	67.8	71.2	65.9	58.4	55.7	50.7	49.4	73.9	78
11	74.3	73.1	66.8	59.9	56.3	49.4	50.1	77.3	82
12	72.5	68.3	62.9	59.3	52.8	47.9	47.9	74.4	79
13	67.1	66.2	61.2	53.6	52.6	44.5	41.6	70.4	75
14	72.2	74.6	70.1	62.2	58.3	49.6	50.3	77.6	82
15	78.0	76.2	69.9	64.5	60.2	57.3	57.7	80.8	85
16	74.3	73.9	68.0	61.9	58.5	49.9	45.5	77.8	82
17	77.3	78.2	68.3	62.6	59.0	51.0	46.7	81.1	>86<
18	73.3	74.5	68.1	65.0	55.6	50.1	51.3	77.8	82
19	70.2	70.1	60.4	57.2	56.8	46.0	39.7	73.6	78
20	73.3	70.9	62.8	58.8	63.3	51.2	44.5	75.9	80
21	72.3	71.3	60.5	57.5	56.9	46.7	45.4	75.1	80
22	75.4	75.8	69.3	62.5	57.0	56.0	47.6	79.2	84
23	76.0	76.6	67.1	62.8	57.3	48.7	44.3	79.7	84
24	73.9	75.8	69.1	63.8	58.8	52.0	51.3	78.7	83
25	73.8	78.3	69.4	62.8	59.5	58.6	49.0	80.2	85
26	75.6	77.8	71.2	65.2	59.0	50.9	47.4	80.6	85
27	72.1	74.4	66.5	59.4	57.3	51.4	50.0	77.0	81
28	76.0	79.9	67.5	61.4	55.6	52.0	46.7	81.6	>86<
29	75.8	78.4	68.2	59.8	58.1	51.0	46.2	80.6	85
30	67.4	73.5	60.3	48.2	45.0	38.1	49.0	74.6	79
31	65.8	68.6	63.0	56.6	51.0	50.2	44.9	71.4	76
32	60.0	63.6	54.2	49.0	48.2	48.4	42.8	65.8	70
33	68.3	66.7	59.9	47.1	54.1	51.7	45.5	71.1	76
34	60.4	58.8	51.7	53.9	54.0	42.9	37.8	64.0	((69))
35	68.8	67.5	55.1	56.0	48.5	37.2	37.3	71.5	76
36	63.3	58.4	45.6	44.0	54.3	39.1	42.1	65.0	70
37	65.6	69.2	72.5	71.3	66.5	59.0	52.9	76.9	81
38	63.0	68.3	67.6	67.2	59.2	45.3	42.8	73.1	78
39	65.6	69.2	72.1	71.3	66.5	59.0	52.9	76.7	81
40	65.1	71.3	69.9	71.5	57.2	48.8	44.2	76.2	81
41	64.1	71.1	71.2	69.9	59.1	48.9	45.2	75.9	80
42	71.7	76.9	75.6	71.7	62.4	54.4	54.4	80.7	85
43	72.2	79.0	77.3	74.4	62.6	59.7	58.6	82.6	>87<
44	70.4	75.2	75.2	72.4	56.2	54.2	58.0	79.8	84
45	60.2	68.0	71.6	70.7	65.7	63.2	51.1	76.0	80
46	62.0	67.1	70.7	69.9	63.4	61.2	57.2	75.1	80
47	62.8	67.6	71.8	67.6	65.6	64.3	52.0	75.4	80
48	67.1	72.6	70.8	66.2	58.3	53.6	53.5	76.1	81
49	71.7	72.6	70.6	69.5	58.1	55.2	51.6	77.4	82
50	62.3	67.8	64.5	60.3	50.9	47.8	43.1	70.7	75
51	61.7	67.1	63.4	59.5	50.2	44.9	40.1	69.9	74
52	73.3	80.6	79.7	78.9	67.0	65.1	66.5	85.0	>90<
53	56.3	62.2	59.9	58.4	51.8	48.5	47.0	66.1	71
54	54.4	63.0	61.0	58.7	53.6	47.4	39.4	66.6	71
55	62.6	64.4	73.6	70.8	65.8	65.2	37.2	76.7	81
56	58.3	63.4	67.1	59.0	54.0	46.9	43.0	69.6	74
57	73.0	77.7	76.7	76.7	70.0	68.2	55.7	82.8	>87<
58	67.8	68.6	70.6	73.0	56.8	58.2	49.0	76.6	81
59	50.5	55.3	51.9	57.1	57.5	52.4	36.6	62.7	((67))
60	56.2	63.0	81.8	66.4	60.7	59.2	37.9	82.0	>87<
61	57.6	63.6	54.5	60.6	52.2	52.7	48.9	66.7	71
62	65.8	74.3	73.9	72.2	65.2	47.4	44.3	78.8	83
63	54.8	59.3	54.1	56.6	53.9	44.5	41.2	63.3	((68))
64	60.3	59.5	50.3	50.2	49.5	44.9	38.4	63.6	((68))
65	65.4	67.2	67.4	72.6	54.9	44.8	34.8	75.2	80
66	67.5	72.1	69.1	67.4	61.0	48.4	42.2	75.7	80
67	52.0	53.1	45.8	49.4	57.5	45.6	34.1	60.4	((65))
68	67.5	72.1	69.1	67.4	61.0	48.4	42.2	75.7	80
69	52.0	53.1	45.8	49.4	57.5	45.6	34.1	60.4	((65))
70	52.1	61.0	60.3	60.6	56.8	44.3	40.3	66.2	71
71	73.7	76.8	71.6	68.9	61.9	51.1	45.2	79.8	84
72	74.8	79.6	78.8	79.3	68.6	63.9	55.2	84.7	>89<
73	67.4	73.2	73.1	72.0	63.8	56.9	51.9	78.2	83
74	63.7	69.8	69.7	69.1	62.9	52.6	49.1	75.0	79
75	54.4	60.8	57.7	59.5	58.3	49.6	41.0	65.7	70
76	54.4	60.8	57.7	59.5	58.3	49.6	41.0	65.7	70
77	63.6	63.1	70.2	70.8	51.7	44.8	50.5	74.3	79
78	66.8	69.9	68.5	69.2	54.7	47.3	47.1	74.8	79
79	70.2	73.6	66.8	64.0	54.4	54.4	42.0	76.2	81
80	63.6	67.2	64.2	63.6	53.2	48.1	44.8	71.1	76
81	51.7	57.4	59.3	56.4	50.0	41.7	40.7	63.2	((68))
82	60.2	63.0	67.8	65.4	54.4	56.8	56.4	71.4	76
83	70.4	75.2	75.2	72.4	56.2	54.2	58.0	79.8	84

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-3.28
HPD selection for rehabilitation bulldozer operators

	dB-Neq	Mean:	95.5	Max:	102	Min:	76	Obs (n):	21
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
v/o HPD	73.9	85.0	90.0	92.0	94.0	91.0	90.0	98.9	95.5
with HPD									
1	71.0	80.1	75.0	68.8	65.9	59.9	65.0	82.1	79
2	69.2	72.1	71.2	69.6	74.3	68.0	72.4	79.9	77
3	67.4	72.8	70.4	73.7	74.6	72.2	69.6	80.5	77
4	71.0	75.8	69.0	73.3	75.5	71.4	70.3	81.5	78
5	69.6	75.6	74.1	73.8	66.3	58.4	60.6	80.1	77
6	66.5	75.4	71.5	69.2	65.7	59.6	57.7	78.2	75
7	68.8	74.2	68.9	65.6	67.5	57.9	55.8	77.2	74
8	68.5	75.6	71.4	69.0	67.5	58.6	58.9	78.6	75
9	63.8	69.3	68.8	63.8	64.6	58.6	63.4	74.3	71
10	63.7	72.2	71.9	64.4	65.7	59.7	63.4	76.4	73
11	70.2	74.1	72.8	65.9	66.3	58.4	64.1	78.2	75
12	68.4	69.3	68.9	65.3	62.8	56.9	61.9	74.8	71
13	63.0	67.2	67.2	59.6	62.6	53.5	55.6	72.0	((69))
14	68.1	75.6	76.1	68.2	68.3	58.6	64.3	80.0	77
15	73.9	77.2	75.9	70.5	70.2	66.3	71.7	82.0	79
16	70.2	74.9	74.0	67.9	68.5	58.9	59.5	79.1	76
17	73.2	79.2	74.3	68.6	69.0	60.0	60.7	81.7	78
18	69.2	75.5	74.1	71.0	65.6	59.1	65.3	79.5	76
19	66.1	71.1	66.4	63.2	66.8	55.0	53.7	74.6	71
20	69.2	71.9	68.8	64.8	73.3	60.2	58.5	77.6	74
21	68.2	72.3	66.5	63.5	66.9	55.7	59.4	75.6	72
22	71.3	76.8	75.3	68.5	67.0	65.0	61.6	80.5	77
23	71.9	77.6	73.1	68.8	67.3	57.7	58.3	80.3	77
24	69.8	76.8	75.1	69.8	68.8	61.0	65.3	80.5	77
25	69.7	79.3	75.4	68.8	69.5	67.6	63.0	81.9	78
26	71.5	78.8	77.2	71.2	69.0	59.9	61.4	82.2	79
27	68.0	75.4	72.5	65.4	67.3	60.4	64.0	78.5	75
28	71.9	80.9	73.5	67.4	65.6	61.0	60.7	82.4	79
29	71.7	79.4	74.2	65.8	68.1	60.0	60.2	81.5	78
30	63.3	74.5	66.3	54.2	55.0	47.1	63.0	75.7	72
31	61.7	69.6	69.0	62.6	61.0	59.2	58.9	73.7	70
32	55.9	64.6	60.2	55.0	58.2	57.4	56.8	68.0	((65))
33	64.2	67.7	65.9	53.1	64.1	60.7	59.5	72.4	((69))
34	56.3	59.8	57.7	59.9	64.0	51.9	51.8	67.6	((64))
35	64.7	68.5	61.1	62.0	58.5	46.2	51.3	71.4	((68))
36	59.2	59.4	51.6	50.0	64.3	48.1	56.1	67.1	((64))
37	61.5	70.2	78.5	77.3	76.5	68.0	66.9	82.8	79
38	58.9	69.3	73.6	73.2	69.2	54.3	56.8	77.9	75
39	61.5	70.2	78.1	77.3	76.5	68.0	66.9	82.7	79
40	61.0	72.3	75.9	77.5	67.2	57.8	58.2	80.8	77
41	60.0	72.1	77.2	75.9	69.1	57.9	59.2	80.7	77
42	67.6	77.9	81.6	77.7	72.4	63.4	68.4	84.7	81
43	68.1	80.0	83.3	80.4	72.6	68.7	72.6	86.8	83
44	66.3	76.2	81.2	78.4	66.2	63.2	72.0	84.3	81
45	56.1	69.0	77.6	76.7	75.7	72.2	65.1	82.3	79
46	57.9	68.1	76.7	75.9	73.4	70.2	71.2	81.4	78
47	58.7	68.6	77.8	73.6	75.6	73.3	66.0	81.8	78
48	63.0	73.6	76.8	72.2	68.3	62.6	67.5	80.2	77
49	67.6	73.6	76.6	75.5	68.1	64.2	65.6	80.9	78
50	58.2	68.8	70.5	66.3	60.9	56.8	57.1	74.1	71
51	57.6	68.1	69.4	65.5	60.2	53.9	54.1	73.2	70
52	69.2	81.6	85.7	84.9	77.0	74.1	80.5	90.1	>87<
53	52.2	63.2	65.9	64.4	61.8	57.5	61.0	70.9	((68))
54	50.3	64.2	67.0	64.7	63.6	56.4	53.4	71.3	((68))
55	58.5	65.4	79.6	76.8	75.8	74.2	51.2	83.2	80
56	54.2	64.4	73.1	65.0	64.0	55.9	57.0	74.8	71
57	68.9	78.7	82.7	82.7	80.0	77.2	69.7	87.9	85
58	63.7	69.6	76.6	79.0	66.8	67.2	63.0	81.7	78
59	46.4	56.3	57.9	63.1	67.5	61.4	50.6	70.1	((67))
60	52.1	64.0	87.8	72.4	70.7	68.2	51.9	88.1	85
61	53.5	64.6	60.5	66.6	62.2	61.7	62.9	71.4	((68))
62	61.7	75.3	79.9	78.2	75.2	56.4	58.3	83.7	80
63	50.7	60.3	60.1	62.6	63.9	53.5	55.2	68.5	((65))
64	56.2	60.5	56.3	56.2	59.5	53.9	52.4	65.7	((62))
65	61.3	68.2	73.4	78.6	64.9	53.8	48.8	80.2	77
66	63.4	73.1	75.1	73.4	71.0	57.4	56.2	79.6	76
67	47.9	54.1	51.8	55.4	67.5	54.6	48.1	68.3	((65))
68	63.4	73.1	75.1	73.4	71.0	57.4	56.2	79.6	76
69	47.9	54.1	51.8	55.4	67.5	54.6	48.1	68.3	((65))
70	48.0	62.0	66.3	66.6	66.8	53.3	54.3	72.0	((69))
71	69.6	77.8	77.6	74.9	71.9	60.1	59.2	82.4	79
72	70.7	80.6	84.8	85.3	78.6	72.9	69.2	89.4	>86<
73	63.3	74.2	79.1	78.0	73.8	65.9	65.9	83.1	80
74	59.6	70.8	75.7	75.1	72.9	61.6	63.1	80.2	77
75	50.3	61.8	63.7	65.5	68.3	58.6	55.0	71.9	((68))
76	50.3	61.8	63.7	65.5	68.3	58.6	55.0	71.9	((68))
77	59.5	64.1	76.2	76.8	61.7	53.8	64.5	79.9	77
78	62.7	70.9	74.5	75.2	64.7	56.3	61.1	79.0	76
79	66.1	74.6	72.8	70.0	64.4	63.4	56.0	78.3	75
80	59.5	68.2	70.2	69.6	63.2	57.1	58.8	74.8	71
81	47.6	58.4	65.3	62.4	60.0	50.7	54.7	68.6	((65))
82	56.1	64.0	73.8	71.4	64.4	65.8	70.4	77.7	74
83	66.3	76.2	81.2	78.4	66.2	63.2	72.0	84.3	81

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-3.29
HPD selection for rehabilitation backactor operators

	dB-Neq	Mean:	82.0	Max:	86	Min:	79	Obs (n):	17
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	69.0	71.0	73.0	73.0	79.0	77.0	67.0	82.9	82.0
with HPD									
1	66.1	66.1	58.0	49.8	50.9	45.9	42.0	69.6	((69))
2	64.3	58.1	54.2	50.6	59.3	54.0	49.4	66.9	((66))
3	62.5	58.8	53.4	54.7	59.6	58.2	46.6	66.7	((66))
4	66.1	61.8	52.0	54.3	60.5	57.4	47.3	68.9	((68))
5	64.7	61.6	57.1	54.8	51.3	44.4	37.6	67.3	((66))
6	61.6	61.4	54.5	50.2	50.7	45.6	34.7	65.3	((64))
7	63.9	60.2	51.9	46.6	52.5	43.9	32.8	65.9	((65))
8	63.6	61.6	54.4	50.0	52.5	44.6	35.9	66.4	((65))
9	58.9	55.3	51.8	44.8	49.6	44.6	40.4	61.5	((61))
10	58.8	58.2	54.9	45.4	50.7	45.7	40.4	62.9	((62))
11	65.3	60.1	55.8	46.9	51.3	44.4	41.1	67.0	((66))
12	63.5	55.3	51.9	46.3	47.8	42.9	38.9	64.6	((64))
13	58.1	53.2	50.2	40.6	47.6	39.5	32.6	60.2	((59))
14	63.2	61.6	59.1	49.2	53.3	44.6	41.3	66.7	((66))
15	69.0	63.2	58.9	51.5	55.2	52.3	48.7	70.6	70
16	65.3	60.9	57.0	48.9	53.5	44.9	36.5	67.4	((66))
17	68.3	65.2	57.3	49.6	54.0	46.0	37.7	70.4	70
18	64.3	61.5	57.1	52.0	50.6	45.1	42.3	66.9	((66))
19	61.2	57.1	49.4	44.2	51.8	41.0	30.7	63.2	((62))
20	64.3	57.9	51.8	45.8	58.3	46.2	35.5	66.3	((65))
21	63.3	58.3	49.5	44.5	51.9	41.7	36.4	64.9	((64))
22	66.4	62.8	58.3	49.5	52.0	51.0	38.6	68.6	((68))
23	67.0	63.6	56.1	49.8	52.3	43.7	35.3	69.0	((68))
24	64.9	62.8	58.1	50.8	53.8	47.0	42.3	67.8	((67))
25	64.8	65.3	58.4	49.8	54.5	53.6	40.0	68.9	((68))
26	66.6	64.8	60.2	52.2	54.0	45.9	38.4	69.6	((69))
27	63.1	61.4	55.5	46.4	52.3	46.4	41.0	66.1	((65))
28	67.0	66.9	56.5	48.4	50.6	47.0	37.7	70.3	((69))
29	66.8	65.4	57.2	46.8	53.1	46.0	37.2	69.6	((69))
30	58.4	60.5	49.3	35.2	40.0	33.1	40.0	62.8	((62))
31	56.8	55.6	52.0	43.6	46.0	45.2	35.9	60.4	((60))
32	51.0	50.6	43.2	36.0	43.2	43.4	33.8	54.9	((54))
33	59.3	53.7	48.9	34.1	49.1	46.7	36.5	61.1	((60))
34	51.4	45.8	40.7	40.9	49.0	37.9	28.8	54.6	((54))
35	59.8	54.5	44.1	43.0	43.5	32.2	28.3	61.2	((60))
36	54.3	45.4	34.6	31.0	49.3	34.1	33.1	56.0	((55))
37	56.6	56.2	61.5	58.3	61.5	54.0	43.9	66.7	((66))
38	54.0	55.3	56.6	54.2	54.2	40.3	33.8	62.0	((61))
39	56.6	56.2	61.1	58.3	61.5	54.0	43.9	66.6	((66))
40	56.1	58.3	58.9	58.5	52.2	43.8	35.2	64.4	((64))
41	55.1	58.1	60.2	56.9	54.1	43.9	36.2	64.5	((64))
42	62.7	63.9	64.6	58.7	57.4	49.4	45.4	69.4	((68))
43	63.2	66.0	66.3	61.4	57.6	54.7	49.6	71.0	70
44	61.4	62.2	64.2	59.4	51.2	49.2	49.0	68.3	((67))
45	51.2	55.0	60.6	57.7	60.7	58.2	42.1	66.1	((65))
46	53.0	54.1	59.7	56.9	58.4	56.2	48.2	64.8	((64))
47	53.8	54.6	60.8	54.6	60.6	59.3	43.0	66.1	((65))
48	58.1	59.6	59.8	53.2	53.3	48.6	44.5	64.8	((64))
49	62.7	59.6	59.6	56.5	53.1	50.2	42.6	66.5	((66))
50	53.3	54.8	53.5	47.3	45.9	42.8	34.1	59.3	((58))
51	52.7	54.1	52.4	46.5	45.2	39.9	31.1	58.5	((58))
52	64.3	67.6	68.7	65.9	62.0	60.1	57.5	73.6	73
53	47.3	49.2	48.9	45.4	46.8	43.5	38.0	55.1	((54))
54	45.4	50.0	50.0	45.7	48.6	42.4	30.4	55.6	((55))
55	53.6	51.4	62.6	57.8	60.8	60.2	28.2	67.0	((66))
56	49.3	50.4	56.1	46.0	49.0	41.9	34.0	58.7	((58))
57	64.0	64.7	65.7	63.7	65.0	63.2	46.7	72.3	71
58	58.8	55.6	59.6	60.0	51.8	53.2	40.0	65.3	((64))
59	41.5	42.3	40.9	44.1	52.5	47.4	27.6	54.8	((54))
60	47.2	50.0	70.8	53.4	55.7	54.2	28.9	71.1	70
61	48.6	50.6	43.5	47.6	47.2	47.7	39.9	55.9	((55))
62	56.8	61.3	62.9	59.2	60.2	42.4	35.3	67.5	((67))
63	45.8	46.3	43.1	43.6	48.9	39.5	32.2	53.3	((52))
64	51.3	46.5	39.3	37.2	44.5	39.9	29.4	53.7	((53))
65	56.4	54.2	56.4	59.6	49.9	39.8	25.8	63.3	((62))
66	58.5	59.1	58.1	54.4	56.0	43.4	33.2	64.6	((64))
67	43.0	40.1	34.8	36.4	52.5	40.6	25.1	53.6	((53))
68	58.5	59.1	58.1	54.4	56.0	43.4	33.2	64.6	((64))
69	43.0	40.1	34.8	36.4	52.5	40.6	25.1	53.6	((53))
70	43.1	48.0	49.3	47.6	51.8	39.3	31.3	55.9	((55))
71	64.7	63.8	60.6	55.9	56.9	46.1	36.2	68.7	((68))
72	65.8	66.6	67.8	66.3	63.6	58.9	46.2	73.4	72
73	58.4	60.2	62.1	59.0	58.8	51.9	42.9	67.1	((66))
74	54.7	56.8	58.7	56.1	57.9	47.6	40.1	64.2	((63))
75	45.4	47.8	46.7	46.5	53.3	44.6	32.0	56.3	((55))
76	45.4	47.8	46.7	46.5	53.3	44.6	32.0	56.3	((55))
77	54.6	50.1	59.2	57.8	46.7	39.8	41.5	62.8	((62))
78	57.8	56.9	57.5	56.2	49.7	42.3	38.1	63.4	((63))
79	61.2	60.6	55.8	51.0	49.4	49.4	33.0	65.0	((64))
80	54.6	54.2	53.2	50.6	48.2	43.1	35.8	59.8	((59))
81	42.7	44.4	48.3	43.4	45.0	36.7	31.7	52.4	((51))
82	51.2	50.0	56.8	52.4	49.4	51.8	47.4	60.7	((60))
83	61.4	62.2	64.2	59.4	51.2	49.2	49.0	68.3	((67))

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-3.30
HPD selection for rehabilitation rear dumper operators

	dB-Neq	Mean:	89.0	Max:	94	Min:	85	Obs (n):	15
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	76.0	78.0	80.0	83.0	83.0	81.0	78.0	89.0	89.0
with HPD									
1	73.1	73.1	65.0	59.8	54.9	49.9	53.0	76.6	77
2	71.3	65.1	61.2	60.6	63.3	58.0	60.4	73.6	74
3	69.5	65.8	60.4	64.7	63.6	62.2	57.6	73.3	73
4	73.1	68.8	59.0	64.3	64.5	61.4	58.3	75.6	76
5	71.7	68.6	64.1	64.8	55.3	48.4	48.6	74.5	75
6	68.6	68.4	61.5	60.2	54.7	49.6	45.7	72.3	72
7	70.9	67.2	58.9	56.6	56.5	47.9	43.8	72.9	73
8	70.6	68.6	61.4	60.0	56.5	48.6	46.9	73.4	73
9	65.9	62.3	58.8	54.8	53.6	48.6	51.4	68.5	((69))
10	65.8	65.2	61.9	55.4	54.7	49.7	51.4	69.8	70
11	72.3	67.1	62.8	56.9	55.3	48.4	52.1	74.0	74
12	70.5	62.3	58.9	56.3	51.8	46.9	49.9	71.6	72
13	65.1	60.2	57.2	50.6	51.6	43.5	43.6	67.1	((67))
14	70.2	68.6	66.1	59.2	57.3	48.6	52.3	73.7	74
15	76.0	70.2	65.9	61.5	59.2	56.3	59.7	77.6	78
16	72.3	67.9	64.0	58.9	57.5	48.9	47.5	74.3	74
17	75.3	72.2	64.3	59.6	58.0	50.0	48.7	77.4	77
18	71.3	68.5	64.1	62.0	54.6	49.1	53.3	74.0	74
19	68.2	64.1	56.4	54.2	55.8	45.0	41.7	70.1	70
20	71.3	64.9	58.8	55.8	62.3	50.2	46.5	72.9	73
21	70.3	65.3	56.5	54.5	55.9	45.7	47.4	71.9	72
22	73.4	69.8	65.3	59.5	56.0	55.0	49.6	75.6	76
23	74.0	70.6	63.1	59.8	56.3	47.7	46.3	76.0	76
24	71.9	69.8	65.1	60.8	57.8	51.0	53.3	74.8	75
25	71.8	72.3	65.4	59.8	58.5	57.6	51.0	75.8	76
26	73.6	71.8	67.2	62.2	58.0	49.9	49.4	76.6	77
27	70.1	68.4	62.5	56.4	56.3	50.4	52.0	73.0	73
28	74.0	73.9	63.5	58.4	54.6	51.0	48.7	77.2	77
29	73.8	72.4	64.2	56.8	57.1	50.0	48.2	76.5	77
30	65.4	67.5	56.3	45.2	44.0	37.1	51.0	69.9	70
31	63.8	62.6	59.0	53.6	50.0	49.2	46.9	67.4	((67))
32	58.0	57.6	50.2	46.0	47.2	47.4	44.8	61.7	((62))
33	66.3	60.7	55.9	44.1	53.1	50.7	47.5	67.9	((68))
34	58.4	52.8	47.7	50.9	53.0	41.9	39.8	61.1	((61))
35	66.8	61.5	51.1	53.0	47.5	36.2	39.3	68.2	((68))
36	61.3	52.4	41.6	41.0	53.3	38.1	44.1	62.5	((63))
37	63.6	63.2	68.5	68.3	65.5	58.0	54.9	73.6	74
38	61.0	62.3	63.6	64.2	58.2	44.3	44.8	69.3	((69))
39	63.6	63.2	68.1	68.3	65.5	58.0	54.9	73.4	73
40	63.1	65.3	65.9	68.5	56.2	47.8	46.2	72.3	72
41	62.1	65.1	67.2	66.9	58.1	47.9	47.2	72.0	72
42	69.7	70.9	71.6	68.7	61.4	53.4	56.4	76.6	77
43	70.2	73.0	73.3	71.4	61.6	58.7	60.6	78.4	78
44	68.4	69.2	71.2	69.4	55.2	53.2	60.0	75.9	76
45	58.2	62.0	67.6	67.7	64.7	62.2	53.1	72.7	73
46	60.0	61.1	66.7	66.9	62.4	60.2	59.2	71.9	72
47	60.8	61.6	67.8	64.6	64.6	63.3	54.0	72.3	72
48	65.1	66.6	66.8	63.2	57.3	52.6	55.5	72.0	72
49	69.7	66.6	66.6	66.5	57.1	54.2	53.6	73.8	74
50	60.3	61.8	60.5	57.3	49.9	46.8	45.1	66.5	((66))
51	59.7	61.1	59.4	56.5	49.2	43.9	42.1	65.6	((66))
52	71.3	74.6	75.7	75.9	66.0	64.1	68.5	81.2	81
53	54.3	56.2	55.9	55.4	50.8	47.5	49.0	62.2	((62))
54	52.4	57.0	57.0	55.7	52.6	46.4	41.4	62.5	((63))
55	60.6	58.4	69.6	67.8	64.8	64.2	39.2	73.5	74
56	56.3	57.4	63.1	56.0	53.0	45.9	45.0	65.7	((66))
57	71.0	71.7	72.7	73.7	69.0	67.2	57.7	79.2	79
58	65.8	62.6	66.6	70.0	55.8	57.2	51.0	73.3	73
59	48.5	49.3	47.9	54.1	56.5	51.4	38.6	60.3	((60))
60	54.2	57.0	77.8	63.4	59.7	58.2	39.9	78.1	78
61	55.6	57.6	50.5	57.6	51.2	51.7	50.9	63.1	((63))
62	63.8	68.3	69.9	69.2	64.2	46.4	46.3	74.8	75
63	52.8	53.3	50.1	53.6	52.9	43.5	43.2	59.9	((60))
64	58.3	53.5	46.3	47.2	48.5	43.9	40.4	60.4	((60))
65	63.4	61.2	63.4	69.6	53.9	43.8	36.8	71.8	72
66	65.5	66.1	65.1	64.4	60.0	47.4	44.2	71.7	72
67	50.0	47.1	41.8	46.4	56.5	44.6	36.1	58.4	((58))
68	65.5	66.1	65.1	64.4	60.0	47.4	44.2	71.7	72
69	50.0	47.1	41.8	46.4	56.5	44.6	36.1	58.4	((58))
70	50.1	55.0	56.3	57.6	55.8	43.3	42.3	62.6	((63))
71	71.7	70.8	67.6	65.9	60.9	50.1	47.2	75.8	76
72	72.8	73.6	74.8	76.3	67.6	62.9	57.2	80.9	81
73	65.4	67.2	69.1	69.0	62.8	55.9	53.9	74.4	74
74	61.7	63.8	65.7	66.1	61.9	51.6	51.1	71.3	71
75	52.4	54.8	53.7	56.5	57.3	48.6	43.0	62.5	((63))
76	52.4	54.8	53.7	56.5	57.3	48.6	43.0	62.5	((63))
77	61.6	57.1	66.2	67.8	50.7	43.8	52.5	71.0	71
78	64.8	63.9	64.5	66.2	53.7	46.3	49.1	71.1	71
79	68.2	67.6	62.8	61.0	53.4	53.4	44.0	72.0	72
80	61.6	61.2	60.2	60.6	52.2	47.1	46.8	67.2	((67))
81	49.7	51.4	55.3	53.4	49.0	40.7	42.7	59.5	((60))
82	58.2	57.0	63.8	62.4	53.4	55.8	58.4	68.2	((68))
83	68.4	69.2	71.2	69.4	55.2	53.2	60.0	75.9	76

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-3.31
HPD selection for primary breaker attendants

	dB-Neq	Mean:	92.3	Max:	98	Min:	79	Obs (n):	8
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	62.9	75.4	85.8	92.0	95.2	94.0	86.9	99.2	92.3
with HPD									
1	60.0	70.5	70.8	68.8	67.1	62.9	61.9	76.1	((69))
2	58.2	62.5	67.0	69.6	75.5	71.0	69.3	78.6	72
3	56.4	63.2	66.2	73.7	75.8	75.2	66.5	80.2	73
4	60.0	66.2	64.8	73.3	76.7	74.4	67.2	80.4	73
5	58.6	66.0	69.9	73.8	67.5	61.4	57.5	76.6	70
6	55.5	65.8	67.3	69.2	66.9	62.6	54.6	74.0	((67))
7	57.8	64.6	64.7	65.6	68.7	60.9	52.7	72.8	((66))
8	57.5	66.0	67.2	69.0	68.7	61.6	55.8	74.3	((67))
9	52.8	59.7	64.6	63.8	65.8	61.6	60.3	71.0	((64))
10	52.7	62.6	67.7	64.4	66.9	62.7	60.3	72.7	((66))
11	59.2	64.5	68.6	65.9	67.5	61.4	61.0	73.6	((67))
12	57.4	59.7	64.7	65.3	64.0	59.9	58.8	70.8	((64))
13	52.0	57.6	63.0	59.6	63.8	56.5	52.5	68.2	((61))
14	57.1	66.0	71.9	68.2	69.5	61.6	61.2	75.8	((69))
15	62.9	67.6	71.7	70.5	71.4	69.3	68.6	78.0	71
16	59.2	65.3	69.8	67.9	69.7	61.9	56.4	74.9	((68))
17	62.2	69.6	70.1	68.6	70.2	63.0	57.6	76.2	((69))
18	58.2	65.9	69.9	71.0	66.8	62.1	62.2	75.4	((69))
19	55.1	61.5	62.2	63.2	68.0	58.0	50.6	71.0	((64))
20	58.2	62.3	64.6	64.8	74.5	63.2	55.4	75.9	((69))
21	57.2	62.7	62.3	63.5	68.1	58.7	56.3	71.4	((65))
22	60.3	67.2	71.1	68.5	68.2	68.0	58.5	76.0	((69))
23	60.9	68.0	68.9	68.8	68.5	60.7	55.2	75.0	((68))
24	58.8	67.2	70.9	69.8	70.0	64.0	62.2	76.2	((69))
25	58.7	69.7	71.2	68.8	70.7	70.6	59.9	77.4	71
26	60.5	69.2	73.0	71.2	70.2	62.9	58.3	77.5	71
27	57.0	65.8	68.3	65.4	68.5	63.4	60.9	74.0	((67))
28	60.9	71.3	69.3	67.4	66.8	64.0	57.6	75.6	((69))
29	60.7	69.8	70.0	65.8	69.3	63.0	57.1	75.5	((69))
30	52.3	64.9	62.1	54.2	56.2	50.1	59.9	68.2	((61))
31	50.7	60.0	64.8	62.6	62.2	62.2	55.8	69.8	((63))
32	44.9	55.0	56.0	55.0	59.4	60.4	53.7	65.1	((58))
33	53.2	58.1	61.7	53.1	65.3	63.7	56.4	69.4	((63))
34	45.3	50.2	53.5	59.9	65.2	54.9	48.7	67.0	((60))
35	53.7	58.9	56.9	62.0	59.7	49.2	48.2	66.2	((59))
36	48.2	49.8	47.4	50.0	65.5	51.1	53.0	66.2	((59))
37	50.5	60.6	74.3	77.3	77.7	71.0	63.8	81.9	75
38	47.9	59.7	69.4	73.2	70.4	57.3	53.7	76.3	((69))
39	50.5	60.6	73.9	77.3	77.7	71.0	63.8	81.9	75
40	50.0	62.7	71.7	77.5	68.4	60.8	55.1	79.1	72
41	49.0	62.5	73.0	75.9	70.3	60.9	56.1	78.6	72
42	56.6	68.3	77.4	77.7	73.6	66.4	65.3	81.8	75
43	57.1	70.4	79.1	80.4	73.8	71.7	69.5	84.0	77
44	55.3	66.6	77.0	78.4	67.4	66.2	68.9	81.5	75
45	45.1	59.4	73.4	76.7	76.9	75.2	62.0	81.9	75
46	46.9	58.5	72.5	75.9	74.6	73.2	68.1	80.6	74
47	47.7	59.0	73.6	73.6	76.8	76.3	62.9	81.4	75
48	52.0	64.0	72.6	72.2	69.5	65.6	64.4	77.2	70
49	56.6	64.0	72.4	75.5	69.3	67.2	62.5	78.5	72
50	47.2	59.2	66.3	66.3	62.1	59.8	54.0	70.9	((64))
51	46.6	58.5	65.2	65.5	61.4	56.9	51.0	69.8	((63))
52	58.2	72.0	81.5	84.9	78.2	77.1	77.4	88.1	81
53	41.2	53.6	61.7	64.4	63.0	60.5	57.9	69.1	((62))
54	39.3	54.4	62.8	64.7	64.8	59.4	50.3	69.6	((63))
55	47.5	55.8	75.4	76.8	77.0	77.2	48.1	82.7	76
56	43.2	54.8	68.9	65.0	65.2	58.9	53.9	71.9	((65))
57	57.9	69.1	78.5	82.7	81.2	80.2	66.6	87.0	80
58	52.7	60.0	72.4	79.0	68.0	70.2	59.9	80.6	74
59	35.4	46.7	53.7	63.1	68.7	64.4	47.5	71.0	((64))
60	41.1	54.4	83.6	72.4	71.9	71.2	48.8	84.4	78
61	42.5	55.0	56.3	66.6	63.4	64.7	59.8	70.6	((64))
62	50.7	65.7	75.7	78.2	76.4	59.4	55.2	81.8	75
63	39.7	50.7	55.9	62.6	65.1	56.5	52.1	67.9	((61))
64	45.2	50.9	52.1	56.2	60.7	56.9	49.3	64.0	((57))
65	50.3	58.6	69.2	78.6	66.1	56.8	45.7	79.4	72
66	52.4	63.5	70.9	73.4	72.2	60.4	53.1	77.4	70
67	36.9	44.5	47.6	55.4	68.7	57.6	45.0	69.3	((62))
68	52.4	63.5	70.9	73.4	72.2	60.4	53.1	77.4	70
69	36.9	44.5	47.6	55.4	68.7	57.6	45.0	69.3	((62))
70	37.0	52.4	62.1	66.6	68.0	56.3	51.2	71.2	((64))
71	58.6	68.2	73.4	74.9	73.1	63.1	56.1	79.2	72
72	59.7	71.0	80.6	85.3	79.8	75.9	66.1	87.8	81
73	52.3	64.6	74.9	78.0	75.0	68.9	62.8	81.4	75
74	48.6	61.2	71.5	75.1	74.1	64.6	60.0	78.9	72
75	39.3	52.2	59.5	65.5	69.5	61.6	51.9	71.8	((65))
76	39.3	52.2	59.5	65.5	69.5	61.6	51.9	71.8	((65))
77	48.5	54.5	72.0	76.8	62.9	56.8	61.4	78.3	71
78	51.7	61.3	70.3	75.2	65.9	59.3	58.0	77.0	70
79	55.1	65.0	68.6	70.0	65.6	66.4	52.9	74.6	((68))
80	48.5	58.6	66.0	69.6	64.4	60.1	55.7	72.6	((66))
81	36.6	48.8	61.1	62.4	61.2	53.7	51.6	66.8	((60))
82	45.1	54.4	69.6	71.4	65.6	68.8	67.3	76.0	((69))
83	55.3	66.6	77.0	78.4	67.4	66.2	68.9	81.5	75

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-3.32

HPD selection for raw coal screening house attendants

	dB-Neq	Mean:	86.0	Max:	100	Min:	83	Obs (n):	15
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	66.9	78.4	85.8	92.0	94.2	92.0	80.9	98.0	86.0
with HPD									
1	64.0	73.5	70.8	68.8	66.1	60.9	55.9	77.0	((65))
2	62.2	65.5	67.0	69.6	74.5	69.0	63.3	77.6	((66))
"3"	60.4	66.2	66.2	73.7	74.8	73.2	60.5	79.3	((67))
"4"	64.0	69.2	64.8	73.3	75.7	72.4	61.2	79.6	((68))
5	62.6	69.0	69.9	73.8	66.5	59.4	51.5	76.9	((65))
6	59.5	68.8	67.3	69.2	65.9	60.6	48.6	74.4	((62))
"7"	61.8	67.6	64.7	65.6	67.7	58.9	46.7	73.1	((61))
8	61.5	69.0	67.2	69.0	67.7	59.6	49.8	74.7	((63))
"9"	56.8	62.7	64.6	63.8	64.8	59.6	54.3	70.7	((59))
10	56.7	65.6	67.7	64.4	65.9	60.7	54.3	72.6	((61))
11	63.2	67.5	68.6	65.9	66.5	59.4	55.0	73.9	((62))
12	61.4	62.7	64.7	65.3	63.0	57.9	52.8	70.9	((59))
13	56.0	60.6	63.0	59.6	62.8	54.5	46.5	68.3	((56))
14	61.1	69.0	71.9	68.2	68.5	59.6	55.2	76.0	((64))
15	66.9	70.6	71.7	70.5	70.4	67.3	62.6	77.8	((66))
16	63.2	68.3	69.8	67.9	68.7	59.9	50.4	75.2	((63))
17	66.2	72.6	70.1	68.6	69.2	61.0	51.6	77.0	((65))
18	62.2	68.9	69.9	71.0	65.8	60.1	56.2	75.7	((64))
19	59.1	64.5	62.2	63.2	67.0	56.0	44.6	71.1	((59))
20	62.2	65.3	64.6	64.8	73.5	61.2	49.4	75.4	((63))
21	61.2	65.7	62.3	63.5	67.1	56.7	50.3	71.7	((60))
22	64.3	70.2	71.1	68.5	67.2	66.0	52.5	76.3	((64))
23	64.9	71.0	68.9	68.8	67.5	58.7	49.2	75.7	((64))
24	62.8	70.2	70.9	69.8	69.0	62.0	56.2	76.5	((64))
25	62.7	72.7	71.2	68.8	69.7	68.6	53.9	77.6	((66))
26	64.5	72.2	73.0	71.2	69.2	60.9	52.3	77.9	((66))
27	61.0	68.8	68.3	65.4	67.5	61.4	54.9	74.2	((62))
28	64.9	74.3	69.3	67.4	65.8	62.0	51.6	76.9	((65))
29	64.7	72.8	70.0	65.8	68.3	61.0	51.1	76.4	((64))
"30"	56.3	67.9	62.1	54.2	55.2	48.1	53.9	69.6	((58))
"31"	54.7	63.0	64.8	62.6	61.2	60.2	49.8	69.8	((58))
"32"	48.9	58.0	56.0	55.0	58.4	58.4	47.7	64.6	((53))
33	57.2	61.1	61.7	53.1	64.3	61.7	50.4	68.9	((57))
34	49.3	53.2	53.5	59.9	64.2	52.9	42.7	66.4	((54))
35	57.7	61.9	56.9	62.0	58.7	47.2	42.2	67.0	((55))
36	52.2	52.8	47.4	50.0	64.5	49.1	47.0	65.4	((53))
37	54.5	63.6	74.3	77.3	76.7	69.0	57.8	81.4	((69))
"38"	51.9	62.7	69.4	73.2	69.4	55.3	47.7	76.1	((64))
39	54.5	63.6	73.9	77.3	76.7	69.0	57.8	81.3	((69))
40	54.0	65.7	71.7	77.5	67.4	58.8	49.1	79.1	((67))
"41"	53.0	65.5	73.0	75.9	69.3	58.9	50.1	78.6	((67))
42	60.6	71.3	77.4	77.7	72.6	64.4	59.3	81.8	70
43	61.1	73.4	79.1	80.4	72.8	69.7	63.5	83.9	72
44	59.3	69.6	77.0	78.4	66.4	64.2	62.9	81.4	((69))
45	49.1	62.4	73.4	76.7	75.9	73.2	56.0	81.2	((69))
46	50.9	61.5	72.5	75.9	73.6	71.2	62.1	79.8	((68))
47	51.7	62.0	73.6	73.6	75.8	74.3	56.9	80.5	((68))
"48"	56.0	67.0	72.6	72.2	68.5	63.6	58.4	77.0	((65))
"49"	60.6	67.0	72.4	75.5	68.3	65.2	56.5	78.4	((66))
"50"	51.2	62.2	66.3	66.3	61.1	57.8	48.0	70.9	((59))
"51"	50.6	61.5	65.2	65.5	60.4	54.9	45.0	69.9	((58))
52	62.2	75.0	81.5	84.9	77.2	75.1	71.4	87.7	76
"53"	45.2	56.6	61.7	64.4	62.0	58.5	51.9	68.6	((57))
"54"	43.3	57.4	62.8	64.7	63.8	57.4	44.3	69.2	((57))
"55"	51.5	58.8	75.4	76.8	76.0	75.2	42.1	81.9	70
"56"	47.2	57.8	68.9	65.0	64.2	56.9	47.9	71.7	((60))
57	61.9	72.1	78.5	82.7	80.2	78.2	60.6	86.5	74
58	56.7	63.0	72.4	79.0	67.0	68.2	53.9	80.5	((68))
"59"	39.4	49.7	53.7	63.1	67.7	62.4	41.5	70.0	((58))
"60"	45.1	57.4	83.6	72.4	70.9	69.2	42.8	84.3	72
"61"	46.5	58.0	56.3	66.6	62.4	62.7	53.8	69.8	((58))
62	54.7	68.7	75.7	78.2	75.4	57.4	49.2	81.7	70
"63"	43.7	53.7	55.9	62.6	64.1	54.5	46.1	67.3	((55))
"64"	49.2	53.9	52.1	56.2	59.7	54.9	43.3	63.4	((51))
65	54.3	61.6	69.2	78.6	65.1	54.8	39.7	79.3	((67))
66	56.4	66.5	70.9	73.4	71.2	58.4	47.1	77.2	((65))
"67"	40.9	47.5	47.6	55.4	67.7	55.6	39.0	68.3	((56))
68	56.4	66.5	70.9	73.4	71.2	58.4	47.1	77.2	((65))
"69"	40.9	47.5	47.6	55.4	67.7	55.6	39.0	68.3	((56))
70	41.0	55.4	62.1	66.6	67.0	54.3	45.2	70.7	((59))
71	62.6	71.2	73.4	74.9	72.1	61.1	50.1	79.3	((67))
72	63.7	74.0	80.6	85.3	78.8	73.9	60.1	87.7	76
73	56.3	67.6	74.9	78.0	74.0	66.9	56.8	81.2	((69))
74	52.6	64.2	71.5	75.1	73.1	62.6	54.0	78.6	((67))
"75"	43.3	55.2	59.5	65.5	68.5	59.6	45.9	71.1	((59))
"76"	43.3	55.2	59.5	65.5	68.5	59.6	45.9	71.1	((59))
"77"	52.5	57.5	72.0	76.8	61.9	54.8	55.4	78.2	((66))
"78"	55.7	64.3	70.3	75.2	64.9	57.3	52.0	77.0	((65))
79	59.1	68.0	68.6	70.0	64.6	64.4	46.9	74.8	((63))
80	52.5	61.6	66.0	69.6	63.4	58.1	49.7	72.5	((60))
81	40.6	51.8	61.1	62.4	60.2	51.7	45.6	66.5	((54))
82	49.1	57.4	69.6	71.4	64.6	66.8	61.3	75.1	((63))
83	59.3	69.6	77.0	78.4	66.4	64.2	62.9	81.4	((69))

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
"n" These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-3.33

HPD selection for crushing and screening house attendants

	dB-Neq	Mean:	89.0	Max:	91	Min:	86	Obs (n):	9
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	80.0	84.0	87.0	89.0	89.0	86.0	77.0	94.6	89.0
with HPD									
1	77.1	79.1	72.0	65.8	60.9	54.9	52.0	81.9	76
2	75.3	71.1	68.2	66.6	69.3	63.0	59.4	78.4	73
3	73.5	71.8	67.4	70.7	69.6	67.2	56.6	78.4	73
4	77.1	74.8	66.0	70.3	70.5	66.4	57.3	80.5	75
5	75.7	74.6	71.1	70.8	61.3	53.4	47.6	79.7	74
6	72.6	74.4	68.5	66.2	60.7	54.6	44.7	77.7	72
7	74.9	73.2	65.9	62.6	62.5	52.9	42.8	77.7	72
8	74.6	74.6	68.4	66.0	62.5	53.6	45.9	78.5	73
9	69.9	68.3	65.8	60.8	59.6	53.6	50.4	73.6	((68))
10	69.8	71.2	68.9	61.4	60.7	54.7	50.4	75.2	70
11	76.3	73.1	69.8	62.9	61.3	53.4	51.1	78.8	73
12	74.5	68.3	65.9	62.3	57.8	51.9	48.9	76.2	71
13	69.1	66.2	64.2	56.6	57.6	48.5	42.6	72.1	((66))
14	74.2	74.6	73.1	65.2	63.3	53.6	51.3	79.1	73
15	80.0	76.2	72.9	67.5	65.2	61.3	58.7	82.4	77
16	76.3	73.9	71.0	64.9	63.5	53.9	46.5	79.3	74
17	79.3	78.2	71.3	65.6	64.0	55.0	47.7	82.3	77
18	75.3	74.5	71.1	68.0	60.6	54.1	52.3	79.2	74
19	72.2	70.1	63.4	60.2	61.8	50.0	40.7	75.0	((69))
20	75.3	70.9	65.8	61.8	68.3	55.2	45.5	77.7	72
21	74.3	71.3	63.5	60.5	61.9	50.7	46.4	76.6	71
22	77.4	75.8	72.3	65.5	62.0	60.0	48.6	80.7	75
23	78.0	76.6	70.1	65.8	62.3	52.7	45.3	81.0	75
24	75.9	75.8	72.1	66.8	63.8	56.0	52.3	80.0	74
25	75.8	78.3	72.4	65.8	64.5	62.6	50.0	81.2	76
26	77.6	77.8	74.2	68.2	64.0	54.9	48.4	81.9	76
27	74.1	74.4	69.5	62.4	62.3	55.4	51.0	78.2	73
28	78.0	79.9	70.5	64.4	60.6	56.0	47.7	82.5	77
29	77.8	78.4	71.2	62.8	63.1	55.0	47.2	81.7	76
30	69.4	73.5	63.3	51.2	50.0	42.1	50.0	75.3	70
31	67.8	68.6	66.0	59.6	56.0	54.2	45.9	72.8	((67))
32	62.0	63.6	57.2	52.0	53.2	52.4	43.8	67.0	((61))
33	70.3	66.7	62.9	50.1	59.1	55.7	46.5	72.7	((67))
34	62.4	58.8	54.7	56.9	59.0	46.9	38.8	66.2	((61))
35	70.8	67.5	58.1	59.0	53.5	41.2	38.3	72.9	((67))
36	65.3	58.4	48.6	47.0	59.3	43.1	43.1	67.1	((61))
37	67.6	69.2	75.5	74.3	71.5	63.0	53.9	79.7	74
38	65.0	68.3	70.6	70.2	64.2	49.3	43.8	75.4	70
39	67.6	69.2	75.1	74.3	71.5	63.0	53.9	79.5	74
40	67.1	71.3	72.9	74.5	62.2	52.8	45.2	78.3	73
41	66.1	71.1	74.2	72.9	64.1	52.9	46.2	78.2	73
42	73.7	76.9	78.6	74.7	67.4	58.4	55.4	82.6	77
43	74.2	79.0	80.3	77.4	67.6	63.7	59.6	84.4	79
44	72.4	75.2	78.2	75.4	61.2	58.2	59.0	81.9	76
45	62.2	68.0	74.6	73.7	70.7	67.2	52.1	78.9	73
46	64.0	67.1	73.7	72.9	68.4	65.2	58.2	77.9	72
47	64.8	67.6	74.8	70.6	70.6	68.3	53.0	78.4	73
48	69.1	72.6	73.8	69.2	63.3	57.6	54.5	77.9	72
49	73.7	72.6	73.6	72.5	63.1	59.2	52.6	79.3	74
50	64.3	67.8	67.5	63.3	55.9	51.8	44.1	72.3	((67))
51	63.7	67.1	66.4	62.5	55.2	48.9	41.1	71.5	((66))
52	75.3	80.6	82.7	81.9	72.0	69.1	67.5	87.2	82
53	58.3	62.2	62.9	61.4	56.8	52.5	48.0	68.1	((62))
54	56.4	63.0	64.0	61.7	58.6	51.4	40.4	68.6	((63))
55	64.6	64.4	76.6	73.8	70.8	69.2	38.2	79.8	74
56	60.3	63.4	70.1	62.0	59.0	50.9	44.0	72.0	((66))
57	75.0	77.7	79.7	79.7	75.0	72.2	56.7	85.1	80
58	69.8	68.6	73.6	76.0	61.8	62.2	50.0	79.2	74
59	52.5	55.3	54.9	60.1	62.5	56.4	37.6	66.1	((60))
60	58.2	63.0	84.8	69.4	65.7	63.2	38.9	85.0	79
61	59.6	63.6	57.5	63.6	57.2	56.7	49.9	68.5	((63))
62	67.8	74.3	76.9	75.2	70.2	51.4	45.3	81.0	75
63	56.8	59.3	57.1	59.6	58.9	48.5	42.2	65.6	((60))
64	62.3	59.5	53.3	53.2	54.5	48.9	39.4	65.3	((60))
65	67.4	67.2	70.4	75.6	59.9	48.8	35.8	77.7	72
66	69.5	72.1	72.1	70.4	66.0	52.4	43.2	77.5	72
67	54.0	53.1	48.8	52.4	62.5	49.6	35.1	64.1	((59))
68	69.5	72.1	72.1	70.4	66.0	52.4	43.2	77.5	72
69	54.0	53.1	48.8	52.4	62.5	49.6	35.1	64.1	((59))
70	54.1	61.0	63.3	63.6	61.8	48.3	41.3	68.8	((63))
71	75.7	76.8	74.6	71.9	66.9	55.1	46.2	81.3	76
72	76.8	79.6	81.8	82.3	73.6	67.9	56.2	86.9	81
73	69.4	73.2	76.1	75.0	68.8	60.9	52.9	80.5	75
74	65.7	69.8	72.7	72.1	67.9	56.6	50.1	77.4	72
75	56.4	60.8	60.7	62.5	63.3	53.6	42.0	68.4	((63))
76	56.4	60.8	60.7	62.5	63.3	53.6	42.0	68.4	((63))
77	65.6	63.1	73.2	73.8	56.7	48.8	51.5	77.1	71
78	68.8	69.9	71.5	72.2	59.7	51.3	48.1	76.9	71
79	72.2	73.6	69.8	67.0	59.4	58.4	43.0	77.5	72
80	65.6	67.2	67.2	66.6	58.2	52.1	45.8	72.9	((67))
81	53.7	57.4	62.3	59.4	55.0	45.7	41.7	65.7	((60))
82	62.2	63.0	70.8	68.4	59.4	60.8	57.4	74.0	((68))
83	72.4	75.2	78.2	75.4	61.2	58.2	59.0	81.9	76

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-3.34

HPD selection for coal preparation plant attendants

	dB-Neq	Mean:	92.0	Max:	95	Min:	90	Obs (n):	11
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	77.0	82.0	85.0	88.0	88.0	87.0	85.0	94.2	92.0
with HPD									
1	74.1	77.1	70.0	64.8	59.9	55.9	60.0	79.7	77
2	72.3	69.1	66.2	65.6	68.3	64.0	67.4	76.8	75
3	70.5	69.8	65.4	69.7	68.6	68.2	64.6	77.0	75
4	74.1	72.8	64.0	69.3	69.5	67.4	65.3	78.7	77
5	72.7	72.6	69.1	69.8	60.3	54.4	55.6	77.5	75
6	69.6	72.4	66.5	65.2	59.7	55.6	52.7	75.5	73
7	71.9	71.2	63.9	61.6	61.5	53.9	50.8	75.4	73
8	71.6	72.6	66.4	65.0	61.5	54.6	53.9	76.2	74
9	66.9	66.3	63.8	59.8	58.6	54.6	58.4	71.5	((69))
10	66.8	69.2	66.9	60.4	59.7	55.7	58.4	73.2	71
11	73.3	71.1	67.8	61.9	60.3	54.4	59.1	76.4	74
12	71.5	66.3	63.9	61.3	56.8	52.9	56.9	73.7	72
13	66.1	64.2	62.2	55.6	56.6	49.5	50.6	69.7	((68))
14	71.2	72.6	71.1	64.2	62.3	54.6	59.3	77.0	75
15	77.0	74.2	70.9	66.5	64.2	62.3	66.7	80.1	78
16	73.3	71.9	69.0	63.9	62.5	54.9	54.5	77.0	75
17	76.3	76.2	69.3	64.6	63.0	56.0	55.7	79.9	78
18	72.3	72.5	69.1	67.0	59.6	55.1	60.3	77.0	75
19	69.2	68.1	61.4	59.2	60.8	51.0	48.7	72.6	70
20	72.3	68.9	63.8	60.8	67.3	56.2	53.5	75.4	73
21	71.3	69.3	61.5	59.5	60.9	51.7	54.4	74.1	72
22	74.4	73.8	70.3	64.5	61.0	61.0	56.6	78.3	76
23	75.0	74.6	68.1	64.8	61.3	53.7	53.3	78.6	76
24	72.9	73.8	70.1	65.8	62.8	57.0	60.3	77.9	76
25	72.8	76.3	70.4	64.8	63.5	63.6	58.0	79.1	77
26	74.6	75.8	72.2	67.2	63.0	55.9	56.4	79.6	77
27	71.1	72.4	67.5	61.4	61.3	56.4	59.0	76.0	74
28	75.0	77.9	68.5	63.4	59.6	57.0	55.7	80.2	78
29	74.8	76.4	69.2	61.8	62.1	56.0	55.2	79.3	77
30	66.4	71.5	61.3	50.2	49.0	43.1	58.0	73.2	71
31	64.8	66.6	64.0	58.6	55.0	55.2	53.9	70.7	((69))
32	59.0	61.6	55.2	51.0	52.2	53.4	51.8	65.1	((63))
33	67.3	64.7	60.9	49.1	58.1	56.7	54.5	70.4	((68))
34	59.4	56.8	52.7	55.9	58.0	47.9	46.8	64.3	((62))
35	67.8	65.5	56.1	58.0	52.5	42.2	46.3	70.4	((68))
36	62.3	56.4	46.6	46.0	58.3	44.1	51.1	64.8	((63))
37	64.6	67.2	73.5	73.3	70.5	64.0	61.9	78.3	76
38	62.0	66.3	68.6	69.2	63.2	50.3	51.8	73.8	72
39	64.6	67.2	73.1	73.3	70.5	64.0	61.9	78.1	76
40	64.1	69.3	70.9	73.5	61.2	53.8	53.2	76.8	75
41	63.1	69.1	72.2	71.9	63.1	53.9	54.2	76.5	74
42	70.7	74.9	76.6	73.7	66.4	59.4	63.4	80.8	79
43	71.2	77.0	78.3	76.4	66.6	64.7	67.6	82.7	81
44	69.4	73.2	76.2	74.4	60.2	59.2	67.0	80.2	78
45	59.2	66.0	72.6	72.7	69.7	68.2	60.1	77.7	76
46	61.0	65.1	71.7	71.9	67.4	66.2	66.2	76.9	75
47	61.8	65.6	72.8	69.6	69.6	69.3	61.0	77.2	75
48	66.1	70.6	71.8	68.2	62.3	58.6	62.5	76.2	74
49	70.7	70.6	71.6	71.5	62.1	60.2	60.6	77.5	75
50	61.3	65.8	65.5	62.3	54.9	52.8	52.1	70.4	((68))
51	60.7	65.1	64.4	61.5	54.2	49.9	49.1	69.6	((67))
52	72.3	78.6	80.7	80.9	71.0	70.1	75.5	85.9	84
53	55.3	60.2	60.9	60.4	55.8	53.5	56.0	66.7	((65))
54	53.4	61.0	62.0	60.7	57.6	52.4	48.4	67.0	((65))
55	61.6	62.4	74.6	72.8	69.8	70.2	46.2	78.5	76
56	57.3	61.4	68.1	61.0	58.0	51.9	52.0	70.2	((68))
57	72.0	75.7	77.7	78.7	74.0	73.2	64.7	83.7	82
58	66.8	66.6	71.6	75.0	60.8	63.2	58.0	77.7	76
59	49.5	53.3	52.9	59.1	61.5	57.4	45.6	65.2	((63))
60	55.2	61.0	82.8	68.4	64.7	64.2	46.9	83.1	81
61	56.6	61.6	55.5	62.6	56.2	57.7	57.9	67.6	((65))
62	64.8	72.3	74.9	74.2	69.2	52.4	53.3	79.3	77
63	53.8	57.3	55.1	58.6	57.9	49.5	50.2	64.2	((62))
64	59.3	57.5	51.3	52.2	53.5	49.9	47.4	63.2	((61))
65	64.4	65.2	68.4	74.6	58.9	49.8	43.8	76.3	74
66	66.5	70.1	70.1	69.4	65.0	53.4	51.2	75.7	74
67	51.0	51.1	46.8	51.4	61.5	50.6	43.1	63.0	((61))
68	66.5	70.1	70.1	69.4	65.0	53.4	51.2	75.7	74
69	51.0	51.1	46.8	51.4	61.5	50.6	43.1	63.0	((61))
70	51.1	59.0	61.3	62.6	60.8	49.3	49.3	67.4	((65))
71	72.7	74.8	72.6	70.9	65.9	56.1	54.2	79.2	77
72	73.8	77.6	79.8	81.3	72.6	68.9	64.2	85.3	83
73	66.4	71.2	74.1	74.0	67.8	61.9	60.9	78.9	77
74	62.7	67.8	70.7	71.1	66.9	57.6	58.1	75.9	74
75	53.4	58.8	58.7	61.5	62.3	54.6	50.0	67.2	((65))
76	53.4	58.8	58.7	61.5	62.3	54.6	50.0	67.2	((65))
77	62.6	61.1	71.2	72.8	55.7	49.8	59.5	75.6	73
78	65.8	67.9	69.5	71.2	58.7	52.3	56.1	75.2	73
79	69.2	71.6	67.8	66.0	58.4	59.4	51.0	75.4	73
80	62.6	65.2	65.2	65.6	57.2	53.1	53.8	71.2	((69))
81	50.7	55.4	60.3	58.4	54.0	46.7	49.7	64.2	((62))
82	59.2	61.0	68.8	67.4	58.4	61.8	65.4	73.2	71
83	69.4	73.2	76.2	74.4	60.2	59.2	67.0	80.2	78

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Appendix 4

HPD selection for gold/platinum surface plants and works

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Table A-4.1
HPD selection for cyanide plant conveyor attendants

dB-Neq	Mean:	87.3	Max:	93	Min:	84	Obs (n):	19
	Effective LpA (dB) At Centre Frequency (Hz)						LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	78.6	81.7	83.6	84.2	80.7	68.7	61.3	89.2	87.3
with HPD									
1	75.7	76.8	68.6	61.0	52.6	37.6	36.3	79.7	78
2	73.9	68.8	64.8	61.8	61.0	45.7	43.7	75.8	74
3	72.1	69.5	64.0	65.9	61.3	49.9	40.9	75.2	73
4	75.7	72.5	62.6	65.5	62.2	49.1	41.6	77.9	76
5	74.3	72.3	67.7	66.0	53.0	36.1	31.9	77.3	75
6	71.2	72.1	65.1	61.4	52.4	37.3	29.0	75.3	73
7	73.5	70.9	62.5	57.8	54.2	35.6	27.1	75.7	74
8	73.2	72.3	65.0	61.2	54.2	36.3	30.2	76.3	74
9	68.5	66.0	62.4	56.0	51.3	36.3	34.7	71.3	((69))
10	68.4	68.9	65.5	56.6	52.4	37.4	34.7	72.8	71
11	74.9	70.8	66.4	58.1	53.0	36.1	35.4	76.8	75
12	73.1	66.0	62.5	57.5	49.5	34.6	33.2	74.3	72
13	67.7	63.9	60.8	51.8	49.3	31.2	26.9	69.9	((68))
14	72.8	72.3	69.7	60.4	55.0	36.3	35.6	76.7	75
15	78.6	73.9	69.5	62.7	56.9	44.0	43.0	80.3	78
16	74.9	71.6	67.6	60.1	55.2	36.6	30.8	77.2	75
17	77.9	75.9	67.9	60.8	55.7	37.7	32.0	80.3	78
18	73.9	72.2	67.7	63.2	52.3	36.8	36.6	76.9	75
19	70.8	67.8	60.0	55.4	53.5	32.7	25.0	72.9	71
20	73.9	68.6	62.4	57.0	60.0	37.9	29.8	75.4	74
21	72.9	69.0	60.1	55.7	53.6	33.4	30.7	74.6	73
22	76.0	73.5	68.9	60.7	53.7	42.7	32.9	78.5	77
23	76.6	74.3	66.7	61.0	54.0	35.4	29.6	79.0	77
24	74.5	73.5	68.7	62.0	55.5	38.7	36.6	77.8	76
25	74.4	76.0	69.0	61.0	56.2	45.3	34.3	78.9	77
26	76.2	75.5	70.8	63.4	55.7	37.6	32.7	79.6	78
27	72.7	72.1	66.1	57.6	54.0	38.1	35.3	76.0	74
28	76.6	77.6	67.1	59.6	52.3	38.7	32.0	80.4	78
29	76.4	76.1	67.8	58.0	54.8	37.7	31.5	79.6	78
30	68.0	71.2	59.9	46.4	41.7	24.8	34.3	73.1	71
31	66.4	66.3	62.6	54.8	47.7	36.9	30.2	70.3	((68))
32	60.6	61.3	53.8	47.2	44.9	35.1	28.1	64.5	((63))
33	68.9	64.4	59.5	45.3	50.8	38.4	30.8	70.6	((69))
34	61.0	56.5	51.3	52.1	50.7	29.6	23.1	63.3	((61))
35	69.4	65.2	54.7	54.2	45.2	23.9	22.6	71.0	((69))
36	63.9	56.1	45.2	42.2	51.0	25.8	27.4	64.8	((63))
37	66.2	66.9	72.1	69.5	63.2	45.7	38.2	75.6	74
38	63.6	66.0	67.2	65.4	55.9	32.0	28.1	71.9	70
39	66.2	66.9	71.7	69.5	63.2	45.7	38.2	75.4	73
40	65.7	69.0	69.5	69.7	53.9	35.5	29.5	74.8	73
41	64.7	68.8	70.8	68.1	55.8	35.6	30.5	74.7	73
42	72.3	74.6	75.2	69.9	59.1	41.1	39.7	79.5	78
43	72.8	76.7	76.9	72.6	59.3	46.4	43.9	81.3	79
44	71.0	72.9	74.8	70.6	52.9	40.9	43.3	78.7	77
45	60.8	65.7	71.2	68.9	62.4	49.9	36.4	74.4	72
46	62.6	64.8	70.3	68.1	60.1	47.9	42.5	73.6	72
47	63.4	65.3	71.4	65.8	62.3	51.0	37.3	74.0	72
48	67.7	70.3	70.4	64.4	55.0	40.3	38.8	74.9	73
49	72.3	70.3	70.2	67.7	54.8	41.9	36.9	76.5	75
50	62.9	65.5	64.1	58.5	47.6	34.5	28.4	69.5	((68))
51	62.3	64.8	63.0	57.7	46.9	31.6	25.4	68.7	((67))
52	73.9	78.3	79.3	77.1	63.7	51.8	51.8	83.6	82
53	56.9	59.9	59.5	56.6	48.5	35.2	32.3	64.6	((63))
54	55.0	60.7	60.6	56.9	50.3	34.1	24.7	65.1	((63))
55	63.2	62.1	73.2	69.0	62.5	51.9	22.5	75.4	73
56	58.9	61.1	66.7	57.2	50.7	33.6	28.3	68.7	((67))
57	73.6	75.4	76.3	74.9	66.7	54.9	41.0	81.3	79
58	68.4	66.3	70.2	71.2	53.5	44.9	34.3	75.5	74
59	51.1	53.0	51.5	55.3	54.2	39.1	21.9	60.3	((58))
60	56.8	60.7	81.4	64.6	57.4	45.9	23.2	81.6	80
61	58.2	61.3	54.1	58.8	48.9	39.4	34.2	64.9	((63))
62	66.4	72.0	73.5	70.4	61.9	34.1	29.6	77.4	75
63	55.4	57.0	53.7	54.8	50.6	31.2	26.5	61.8	((60))
64	60.9	57.2	49.9	48.4	46.2	31.6	23.7	62.9	((61))
65	66.0	64.9	67.0	70.8	51.6	31.5	20.1	73.8	72
66	68.1	69.8	68.7	65.6	57.7	35.1	27.5	74.4	72
67	52.6	50.8	45.4	47.6	54.2	32.3	19.4	58.2	((56))
68	68.1	69.8	68.7	65.6	57.7	35.1	27.5	74.4	72
69	52.6	50.8	45.4	47.6	54.2	32.3	19.4	58.2	((56))
70	52.7	58.7	59.9	58.8	53.5	31.0	25.6	64.6	((63))
71	74.3	74.5	71.2	67.1	58.6	37.8	30.5	78.7	77
72	75.4	77.3	78.4	77.5	65.3	50.6	40.5	83.4	81
73	68.0	70.9	72.7	70.2	60.5	43.6	37.2	76.9	75
74	64.3	67.5	69.3	67.3	59.6	39.3	34.4	73.6	72
75	55.0	58.5	57.3	57.7	55.0	36.3	26.3	63.9	((62))
76	55.0	58.5	57.3	57.7	55.0	36.3	26.3	63.9	((62))
77	64.2	60.8	69.8	69.0	48.4	31.5	35.8	73.3	71
78	67.4	67.6	68.1	67.4	51.4	34.0	32.4	73.7	72
79	70.8	71.3	66.4	62.2	51.1	41.1	27.3	75.0	73
80	64.2	64.9	63.8	61.8	49.9	34.8	30.1	69.9	((68))
81	52.3	55.1	58.9	54.6	46.7	28.4	26.0	62.1	((60))
82	60.8	60.7	67.4	63.6	51.1	43.5	41.7	70.1	((68))
83	71.0	72.9	74.8	70.6	52.9	40.9	43.3	78.7	77

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-4.2
HPD selection for crusher attendants

	dB-Neq	Mean:	92.0	Max:	106	Min:	83	Obs (n):	46
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	79.1	82.8	86.3	88.6	88.9	85.1	71.9	94.1	92.0
with HPD									
1	76.2	77.9	71.3	65.4	60.8	54.0	46.9	80.9	79
2	74.4	69.9	67.5	66.2	69.2	62.1	54.3	77.6	75
3	72.6	70.6	66.7	70.3	69.5	66.3	51.5	77.7	76
4	76.2	73.6	65.3	69.9	70.4	65.5	52.2	79.7	78
5	74.8	73.4	70.4	70.4	61.2	52.5	42.5	78.8	77
6	71.7	73.2	67.8	65.8	60.6	53.7	39.6	76.7	75
7	74.0	72.0	65.2	62.2	62.4	52.0	37.7	76.8	75
8	73.7	73.4	67.7	65.6	62.4	52.7	40.8	77.5	75
9	69.0	67.1	65.1	60.4	59.5	52.7	45.3	72.7	71
10	68.9	70.0	68.2	61.0	60.6	53.8	45.3	74.3	72
11	75.4	71.9	69.1	62.5	61.2	52.5	46.0	77.9	76
12	73.6	67.1	65.2	61.9	57.7	51.0	43.8	75.3	73
13	68.2	65.0	63.5	56.2	57.5	47.6	37.5	71.2	((69))
14	73.3	73.4	72.4	64.8	63.2	52.7	46.2	78.2	76
15	79.1	75.0	72.2	67.1	65.1	60.4	53.6	81.4	79
16	75.4	72.7	70.3	64.5	63.4	53.0	41.4	78.4	76
17	78.4	77.0	70.6	65.2	63.9	54.1	42.6	81.4	79
18	74.4	73.3	70.4	67.6	60.5	53.2	47.2	78.3	76
19	71.3	68.9	62.7	59.8	61.7	49.1	35.6	74.1	72
20	74.4	69.7	65.1	61.4	68.2	54.3	40.4	76.8	75
21	73.4	70.1	62.8	60.1	61.8	49.8	41.3	75.6	74
22	76.5	74.6	71.6	65.1	61.9	59.1	43.5	79.7	78
23	77.1	75.4	69.4	65.4	62.2	51.8	40.2	80.0	78
24	75.0	74.6	71.4	66.4	63.7	55.1	47.2	79.1	77
25	74.9	77.1	71.7	65.4	64.4	61.7	44.9	80.2	78
26	76.7	76.6	73.5	67.8	63.9	54.0	43.3	80.9	79
27	73.2	73.2	68.8	62.0	62.2	54.5	45.9	77.2	75
28	77.1	78.7	69.8	64.0	60.5	55.1	42.6	81.4	79
29	76.9	77.2	70.5	62.4	63.0	54.1	42.1	80.7	79
30	68.5	72.3	62.6	50.8	49.9	41.2	44.9	74.2	72
31	66.9	67.4	65.3	59.2	55.9	53.3	40.8	71.8	70
32	61.1	62.4	56.5	51.6	53.1	51.5	38.7	66.0	((64))
33	69.4	65.5	62.2	49.7	59.0	54.8	41.4	71.8	70
34	61.5	57.6	54.0	56.5	58.9	46.0	33.7	65.4	((63))
35	69.9	66.3	57.4	58.6	53.4	40.3	33.2	71.9	70
36	64.4	57.2	47.9	46.6	59.2	42.2	38.0	66.3	((64))
37	66.7	68.0	74.8	73.9	71.4	62.1	48.8	79.1	77
38	64.1	67.1	69.9	69.8	64.1	48.4	38.7	74.7	73
39	66.7	68.0	74.4	73.9	71.4	62.1	48.8	79.0	77
40	66.2	70.1	72.2	74.1	62.1	51.9	40.1	77.7	76
41	65.2	69.9	73.5	72.5	64.0	52.0	41.1	77.5	75
42	72.8	75.7	77.9	74.3	67.3	57.5	50.3	81.8	80
43	73.3	77.8	79.6	77.0	67.5	62.8	54.5	83.6	82
44	71.5	74.0	77.5	75.0	61.1	57.3	53.9	81.1	79
45	61.3	66.8	73.9	73.3	70.6	66.3	47.0	78.3	76
46	63.1	65.9	73.0	72.5	68.3	64.3	53.1	77.3	75
47	63.9	66.4	74.1	70.2	70.5	67.4	47.9	77.8	76
48	68.2	71.4	73.1	68.8	63.2	56.7	49.4	77.1	75
49	72.8	71.4	72.9	72.1	63.0	58.3	47.5	78.5	76
50	63.4	66.6	66.8	62.9	55.8	50.9	39.0	71.5	((69))
51	62.8	65.9	65.7	62.1	55.1	48.0	36.0	70.6	((69))
52	74.4	79.4	82.0	81.5	71.9	68.2	62.4	86.4	84
53	57.4	61.0	62.2	61.0	56.7	51.6	42.9	67.3	((65))
54	55.5	61.8	63.3	61.3	58.5	50.5	35.3	67.9	((66))
55	63.7	63.2	75.9	73.4	70.7	68.3	33.1	79.2	77
56	59.4	62.2	69.4	61.6	58.9	50.0	38.9	71.3	((69))
57	74.1	76.5	79.0	79.3	74.9	71.3	51.6	84.5	82
58	68.9	67.4	72.9	75.6	61.7	61.3	44.9	78.6	76
59	51.6	54.1	54.2	59.7	62.4	55.5	32.5	65.7	((64))
60	57.3	61.8	84.1	69.0	65.6	62.3	33.8	84.4	82
61	58.7	62.4	56.8	63.2	57.1	55.8	44.8	67.8	((66))
62	66.9	73.1	76.2	74.8	70.1	50.5	40.2	80.3	78
63	55.9	58.1	56.4	59.2	58.8	47.6	37.1	64.9	((63))
64	61.4	58.3	52.6	52.8	54.4	48.0	34.3	64.4	((62))
65	66.5	66.0	69.7	75.2	59.8	47.9	30.7	77.2	75
66	68.6	70.9	71.4	70.0	65.9	51.5	38.1	76.8	75
67	53.1	51.9	48.1	52.0	62.4	48.7	30.0	63.8	((62))
68	68.6	70.9	71.4	70.0	65.9	51.5	38.1	76.8	75
69	53.1	51.9	48.1	52.0	62.4	48.7	30.0	63.8	((62))
70	53.2	59.8	62.6	63.2	61.7	47.4	36.2	68.2	((66))
71	74.8	75.6	73.9	71.5	66.8	54.2	41.1	80.4	78
72	75.9	78.4	81.1	81.9	73.5	67.0	51.1	86.2	84
73	68.5	72.0	75.4	74.6	68.7	60.0	47.8	79.8	78
74	64.8	68.6	72.0	71.7	67.8	55.7	45.0	76.8	75
75	55.5	59.6	60.0	62.1	63.2	52.7	36.9	67.9	((66))
76	55.5	59.6	60.0	62.1	63.2	52.7	36.9	67.9	((66))
77	64.7	61.9	72.5	73.4	56.6	47.9	46.4	76.5	74
78	67.9	68.7	70.8	71.8	59.6	50.4	43.0	76.2	74
79	71.3	72.4	69.1	66.6	59.3	57.5	37.9	76.5	74
80	64.7	66.0	66.5	66.2	58.1	51.2	40.7	72.1	70
81	52.8	56.2	61.6	59.0	54.9	44.8	36.6	65.0	((63))
82	61.3	61.8	70.1	68.0	59.3	59.9	52.3	73.3	71
83	71.5	74.0	77.5	75.0	61.1	57.3	53.9	81.1	79

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-4.3

HPD selection for cyanide plant milling attendants

	dB-Neq	Mean:	91.0	Max:	100	Min:	85	Obs (n):	45
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	79.3	83.8	87.5	87.3	84.6	78.0	62.4	92.5	91.0
with HPD									
1	76.4	78.9	72.5	64.1	56.5	46.9	37.4	81.5	80
2	74.6	70.9	68.7	64.9	64.9	55.0	44.8	77.4	76
"3"	72.8	71.6	67.9	69.0	65.2	59.2	42.0	77.1	76
"4"	76.4	74.6	66.5	68.6	66.1	58.4	42.7	79.5	78
5	75.0	74.4	71.6	69.1	56.9	45.4	33.0	79.2	78
6	71.9	74.2	69.0	64.5	56.3	46.6	30.1	77.2	76
"7"	74.2	73.0	66.4	60.9	58.1	44.9	28.2	77.2	76
8	73.9	74.4	68.9	64.3	58.1	45.6	31.3	78.0	77
"9"	69.2	68.1	66.3	59.1	55.2	45.6	35.8	73.1	72
10	69.1	71.0	69.4	59.7	56.3	46.7	35.8	74.9	73
11	75.6	72.9	70.3	61.2	56.9	45.4	36.5	78.3	77
12	73.8	68.1	66.4	60.6	53.4	43.9	34.3	75.6	74
13	68.4	66.0	64.7	54.9	53.2	40.5	28.0	71.6	70
14	73.5	74.4	73.6	63.5	58.9	45.6	36.7	78.8	77
15	79.3	76.0	73.4	65.8	60.8	53.3	44.1	81.8	80
16	75.6	73.7	71.5	63.2	59.1	45.9	31.9	78.9	77
17	78.6	78.0	71.8	63.9	59.6	47.0	33.1	81.9	80
18	74.6	74.3	71.6	66.3	56.2	46.1	37.7	78.7	77
19	71.5	69.9	63.9	58.5	57.4	42.0	26.1	74.4	73
20	74.6	70.7	66.3	60.1	63.9	47.2	30.9	76.8	75
21	73.6	71.1	64.0	58.8	57.5	42.7	31.8	76.0	74
22	76.7	75.6	72.8	63.8	57.6	52.0	34.0	80.2	79
23	77.3	76.4	70.6	64.1	57.9	44.7	30.7	80.5	79
24	75.2	75.6	72.6	65.1	59.4	48.0	37.7	79.6	78
25	75.1	78.1	72.9	64.1	60.1	54.6	35.4	80.8	79
26	76.9	77.6	74.7	66.5	59.6	46.9	33.8	81.5	80
27	73.4	74.2	70.0	60.7	57.9	47.4	36.4	77.8	76
28	77.3	79.7	71.0	62.7	56.2	48.0	33.1	82.1	81
29	77.1	78.2	71.7	61.1	58.7	47.0	32.6	81.3	80
"30"	68.7	73.3	63.8	49.5	45.6	34.1	35.4	75.0	73
"31"	67.1	68.4	66.5	57.9	51.6	46.2	31.3	72.4	71
"32"	61.3	63.4	57.7	50.3	48.8	44.4	29.2	66.4	((65))
33	69.6	66.5	63.4	48.4	54.7	47.7	31.9	72.1	71
34	61.7	58.6	55.2	55.2	54.6	38.9	24.2	65.0	((64))
35	70.1	67.3	58.6	57.3	49.1	33.2	23.7	72.3	71
36	64.6	58.2	49.1	45.3	54.9	35.1	28.5	66.0	((64))
37	66.9	69.0	76.0	72.6	67.1	55.0	39.3	78.8	77
"38"	64.3	68.1	71.1	68.5	59.8	41.3	29.2	74.8	73
39	66.9	69.0	75.6	72.6	67.1	55.0	39.3	78.6	77
40	66.4	71.1	73.4	72.8	57.8	44.8	30.6	77.7	76
"41"	65.4	70.9	74.7	71.2	59.7	44.9	31.6	77.7	76
42	73.0	76.7	79.1	73.0	63.0	50.4	40.8	82.3	81
43	73.5	78.8	80.8	75.7	63.2	55.7	45.0	84.1	83
44	71.7	75.0	78.7	73.7	56.8	50.2	44.4	81.6	80
45	61.5	67.8	75.1	72.0	66.3	59.2	37.5	77.8	76
46	63.3	66.9	74.2	71.2	64.0	57.2	43.6	77.0	75
47	64.1	67.4	75.3	68.9	66.2	60.3	38.4	77.4	76
"48"	68.4	72.4	74.3	67.5	58.9	49.6	39.9	77.6	76
"49"	73.0	72.4	74.1	70.8	58.7	51.2	38.0	78.8	77
"50"	63.6	67.6	68.0	61.6	51.5	43.8	29.5	72.0	71
"51"	63.0	66.9	66.9	60.8	50.8	40.9	26.5	71.2	70
52	74.6	80.4	83.2	80.2	67.6	61.1	52.9	86.6	85
"53"	57.6	62.0	63.4	59.7	52.4	44.5	33.4	67.4	((66))
"54"	55.7	62.8	64.5	60.0	54.2	43.4	25.8	68.0	((67))
"55"	63.9	64.2	77.1	72.1	66.4	61.2	23.6	78.9	77
"56"	59.6	63.2	70.6	60.3	54.6	42.9	29.4	72.0	71
57	74.3	77.5	80.2	78.0	70.6	64.2	42.1	84.2	83
58	69.1	68.4	74.1	74.3	57.4	54.2	35.4	78.4	77
"59"	51.8	55.1	55.4	58.4	58.1	48.4	23.0	63.5	((62))
"60"	57.5	62.8	85.3	67.7	61.3	55.2	24.3	85.4	84
"61"	58.9	63.4	58.0	61.9	52.8	48.7	35.3	67.3	((66))
62	67.1	74.1	77.4	73.5	65.8	43.4	30.7	80.5	79
"63"	56.1	59.1	57.6	57.9	54.5	40.5	27.6	64.3	((63))
"64"	61.6	59.3	53.8	51.5	50.1	40.9	24.8	64.5	((63))
65	66.7	67.0	70.9	73.9	55.5	40.8	21.2	76.7	75
66	68.8	71.9	72.6	68.7	61.6	44.4	28.6	77.0	76
"67"	53.3	52.9	49.3	50.7	58.1	41.6	20.5	61.0	((60))
68	68.8	71.9	72.6	68.7	61.6	44.4	28.6	77.0	76
"69"	53.3	52.9	49.3	50.7	58.1	41.6	20.5	61.0	((60))
70	53.4	60.8	63.8	61.9	57.4	40.3	26.7	67.7	((66))
71	75.0	76.6	75.1	70.2	62.5	47.1	31.6	80.9	79
72	76.1	79.4	82.3	80.6	69.2	59.9	41.6	86.3	85
73	68.7	73.0	76.6	73.3	64.4	52.9	38.3	79.9	78
74	65.0	69.6	73.2	70.4	63.5	48.6	35.5	76.7	75
"75"	55.7	60.6	61.2	60.8	58.9	45.6	27.4	66.9	((65))
"76"	55.7	60.6	61.2	60.8	58.9	45.6	27.4	66.9	((65))
"77"	64.9	62.9	73.7	72.1	52.3	40.8	36.9	76.5	75
"78"	68.1	69.7	72.0	70.5	55.3	43.3	33.5	76.4	75
79	71.5	73.4	70.3	65.3	55.0	50.4	28.4	77.0	76
80	64.9	67.0	67.7	64.9	53.8	44.1	31.2	72.4	71
81	53.0	57.2	62.8	57.7	50.6	37.7	27.1	65.2	((64))
82	61.5	62.8	71.3	66.7	55.0	52.8	42.8	73.4	72
83	71.7	75.0	78.7	73.7	56.8	50.2	44.4	81.6	80

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
"n" These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-4.4
HPD selection for filter attendants

	dB-Neq	Mean:	87.8	Max:	103	Min:	78	Obs (n):	35
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
v/o HPD	77.9	82.3	84.9	84.3	81.4	74.6	63.1	89.9	87.8
with HPD									
1	75.0	77.4	69.9	61.1	53.3	43.5	38.1	79.9	78
2	73.2	69.4	66.1	61.9	61.7	51.6	45.5	75.7	74
3	71.4	70.1	65.3	66.0	62.0	55.8	42.7	75.2	73
4	75.0	73.1	63.9	65.6	62.9	55.0	43.4	77.8	76
5	73.6	72.9	69.0	66.1	53.7	42.0	33.7	77.4	75
6	70.5	72.7	66.4	61.5	53.1	43.2	30.8	75.5	73
7	72.8	71.5	63.8	57.9	54.9	41.5	28.9	75.6	74
8	72.5	72.9	66.3	61.3	54.9	42.2	32.0	76.4	74
9	67.8	66.6	63.7	56.1	52.0	42.2	36.5	71.3	((69))
10	67.7	69.5	66.8	56.7	53.1	43.3	36.5	73.1	71
11	74.2	71.4	67.7	58.2	53.7	42.0	37.2	76.7	75
12	72.4	66.6	63.8	57.6	50.2	40.5	35.0	74.0	72
13	67.0	64.5	62.1	51.9	50.0	37.1	28.7	69.9	((68))
14	72.1	72.9	71.0	60.5	55.7	42.2	37.4	77.0	75
15	77.9	74.5	70.8	62.8	57.6	49.9	44.8	80.2	78
16	74.2	72.2	68.9	60.2	55.9	42.5	32.6	77.2	75
17	77.2	76.5	69.2	60.9	56.4	43.6	33.8	80.3	78
18	73.2	72.8	69.0	63.3	53.0	42.7	38.4	77.0	75
19	70.1	68.4	61.3	55.5	54.2	38.6	26.8	72.8	71
20	73.2	69.2	63.7	57.1	60.7	43.8	31.6	75.2	73
21	72.2	69.6	61.4	55.8	54.3	39.3	32.5	74.4	72
22	75.3	74.1	70.2	60.8	54.4	48.6	34.7	78.5	76
23	75.9	74.9	68.0	61.1	54.7	41.3	31.4	78.9	77
24	73.8	74.1	70.0	62.1	56.2	44.6	38.4	77.9	76
25	73.7	76.6	70.3	61.1	56.9	51.2	36.1	79.1	77
26	75.5	76.1	72.1	63.5	56.4	43.5	34.5	79.8	78
27	72.0	72.7	67.4	57.7	54.7	44.0	37.1	76.1	74
28	75.9	78.2	68.4	59.7	53.0	44.6	33.8	80.5	78
29	75.7	76.7	69.1	58.1	55.5	43.6	33.3	79.7	78
30	67.3	71.8	61.2	46.5	42.4	30.7	36.1	73.4	71
31	65.7	66.9	63.9	54.9	48.4	42.8	32.0	70.6	((68))
32	59.9	61.9	55.1	47.3	45.6	41.0	29.9	64.7	((63))
33	68.2	65.0	60.8	45.4	51.5	44.3	32.6	70.5	((68))
34	60.3	57.1	52.6	52.2	51.4	35.5	24.9	63.2	((61))
35	68.7	65.8	56.0	54.3	45.9	29.8	24.4	70.8	((69))
36	63.2	56.7	46.5	42.3	51.7	31.7	29.2	64.4	((62))
37	65.5	67.5	73.4	69.6	63.9	51.6	40.0	76.3	74
38	62.9	66.6	68.5	65.5	56.6	37.9	29.9	72.5	70
39	65.5	67.5	73.0	69.6	63.9	51.6	40.0	76.1	74
40	65.0	69.6	70.8	69.8	54.6	41.4	31.3	75.3	73
41	64.0	69.4	72.1	68.2	56.5	41.5	32.3	75.4	73
42	71.6	75.2	76.5	70.0	59.8	47.0	41.5	80.1	78
43	72.1	77.3	78.2	72.7	60.0	52.3	45.7	81.9	80
44	70.3	73.5	76.1	70.7	53.6	46.8	45.1	79.3	77
45	60.1	66.3	72.5	69.0	63.1	55.8	38.2	75.2	73
46	61.9	65.4	71.6	68.2	60.8	53.8	44.3	74.4	72
47	62.7	65.9	72.7	65.9	63.0	56.9	39.1	74.9	73
48	67.0	70.9	71.7	64.5	55.7	46.2	40.6	75.5	73
49	71.6	70.9	71.5	67.8	55.5	47.8	38.7	76.8	75
50	62.2	66.1	65.4	58.6	48.3	40.4	30.2	70.0	((68))
51	61.6	65.4	64.3	57.8	47.6	37.5	27.2	69.2	((67))
52	73.2	78.9	80.6	77.2	64.4	57.7	53.6	84.3	82
53	56.2	60.5	60.8	56.7	49.2	41.1	34.1	65.2	((63))
54	54.3	61.3	61.9	57.0	51.0	40.0	26.5	65.8	((64))
55	62.5	62.7	74.5	69.1	63.2	57.8	24.3	76.3	74
56	58.2	61.7	68.0	57.3	51.4	39.5	30.1	69.6	((68))
57	72.9	76.0	77.6	75.0	67.4	60.8	42.8	81.9	80
58	67.7	66.9	71.5	71.3	54.2	50.8	36.1	75.9	74
59	50.4	53.6	52.8	55.4	54.9	45.0	23.7	60.9	((59))
60	56.1	61.3	82.7	64.7	58.1	51.8	25.0	82.8	81
61	57.5	61.9	55.4	58.9	49.6	45.3	36.0	65.3	((63))
62	65.7	72.6	74.8	70.5	62.6	40.0	31.4	78.1	76
63	54.7	57.6	55.0	54.9	51.3	37.1	28.3	62.1	((60))
64	60.2	57.8	51.2	48.5	46.9	37.5	25.5	62.8	((61))
65	65.3	65.5	68.3	70.9	52.3	37.4	21.9	74.2	72
66	67.4	70.4	70.0	65.7	58.4	41.0	29.3	74.9	73
67	51.9	51.4	46.7	47.7	54.9	38.2	21.2	58.5	((56))
68	67.4	70.4	70.0	65.7	58.4	41.0	29.3	74.9	73
69	51.9	51.4	46.7	47.7	54.9	38.2	21.2	58.5	((56))
70	52.0	59.3	61.2	58.9	54.2	36.9	27.4	65.3	((63))
71	73.6	75.1	72.5	67.2	59.3	43.7	32.3	79.0	77
72	74.7	77.9	79.7	77.6	66.0	56.5	42.3	83.9	82
73	67.3	71.5	74.0	70.3	61.2	49.5	39.0	77.5	75
74	63.6	68.1	70.6	67.4	60.3	45.2	36.2	74.3	72
75	54.3	59.1	58.6	57.8	55.7	42.2	28.1	64.5	((62))
76	54.3	59.1	58.6	57.8	55.7	42.2	28.1	64.5	((62))
77	63.5	61.4	71.1	69.1	49.1	37.4	37.6	73.9	72
78	66.7	68.2	69.4	67.5	52.1	39.9	34.2	74.1	72
79	70.1	71.9	67.7	62.3	51.8	47.0	29.1	75.3	73
80	63.5	65.5	65.1	61.9	50.6	40.7	31.9	70.3	((68))
81	51.6	55.7	60.2	54.7	47.4	34.3	27.8	62.8	((61))
82	60.1	61.3	68.7	63.7	51.8	49.4	43.5	70.9	((69))
83	70.3	73.5	76.1	70.7	53.6	46.8	45.1	79.3	77

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-4.5

HPD selection for carbon-in-pulp plant conveyor attendants

	dB-Neq	Mean:	84.1	Max:	89	Min:	80	Obs (n):	5
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	70.6	76.2	78.4	81.2	79.8	75.6	67.1	85.9	84.1
with HPD									
1	67.7	71.3	63.4	58.0	51.7	44.5	42.1	73.5	72
2	65.9	63.3	59.6	58.8	60.1	52.6	49.5	69.5	((68))
3	64.1	64.0	58.8	62.9	60.4	56.8	46.7	69.7	((68))
4	67.7	67.0	57.4	62.5	61.3	56.0	47.4	71.8	70
5	66.3	66.8	62.5	63.0	52.1	43.0	37.7	71.1	((69))
6	63.2	66.6	59.9	58.4	51.5	44.2	34.8	69.3	((67))
7	65.5	65.4	57.3	54.8	53.3	42.5	32.9	69.1	((67))
8	65.2	66.8	59.8	58.2	53.3	43.2	36.0	70.0	((68))
9	60.5	60.5	57.2	53.0	50.4	43.2	40.5	64.9	((63))
10	60.4	63.4	60.3	53.6	51.5	44.3	40.5	66.8	((65))
11	66.9	65.3	61.2	55.1	52.1	43.0	41.2	70.1	((68))
12	65.1	60.5	57.3	54.5	48.6	41.5	39.0	67.2	((65))
13	59.7	58.4	55.6	48.8	48.4	38.1	32.7	63.3	((61))
14	64.8	66.8	64.5	57.4	54.1	43.2	41.4	70.6	((69))
15	70.6	68.4	64.3	59.7	56.0	50.9	48.8	73.5	72
16	66.9	66.1	62.4	57.1	54.3	43.5	36.6	70.6	((69))
17	69.9	70.4	62.7	57.8	54.8	44.6	37.8	73.7	72
18	65.9	66.7	62.5	60.2	51.4	43.7	42.4	70.6	((69))
19	62.8	62.3	54.8	52.4	52.6	39.6	30.8	66.3	((64))
20	65.9	63.1	57.2	54.0	59.1	44.8	35.6	68.8	((67))
21	64.9	63.5	54.9	52.7	52.7	40.3	36.5	67.8	((66))
22	68.0	68.0	63.7	57.7	52.8	49.6	38.7	72.0	70
23	68.6	68.8	61.5	58.0	53.1	42.3	35.4	72.3	71
24	66.5	68.0	63.5	59.0	54.6	45.6	42.4	71.5	70
25	66.4	70.5	63.8	58.0	55.3	52.2	40.1	72.8	71
26	68.2	70.0	65.6	60.4	54.8	44.5	38.5	73.4	72
27	64.7	66.6	60.9	54.6	53.1	45.0	41.1	69.7	((68))
28	68.6	72.1	61.9	56.6	51.4	45.6	37.8	74.1	72
29	68.4	70.6	62.6	55.0	53.9	44.6	37.3	73.2	71
30	60.0	65.7	54.7	43.4	40.8	31.7	40.1	67.0	((65))
31	58.4	60.8	57.4	51.8	46.8	43.8	36.0	64.3	((62))
32	52.6	55.8	48.6	44.2	44.0	42.0	33.9	58.5	((57))
33	60.9	58.9	54.3	42.3	49.9	45.3	36.6	63.9	((62))
34	53.0	51.0	46.1	49.1	49.8	36.5	28.9	57.4	((56))
35	61.4	59.7	49.5	51.2	44.3	30.8	28.4	64.1	((62))
36	55.9	50.6	40.0	39.2	50.1	32.7	33.2	58.0	((56))
37	58.2	61.4	66.9	66.5	62.3	52.6	44.0	71.2	((69))
38	55.6	60.5	62.0	62.4	55.0	38.9	33.9	67.1	((65))
39	58.2	61.4	66.5	66.5	62.3	52.6	44.0	71.1	((69))
40	57.7	63.5	64.3	66.7	53.0	42.4	35.3	70.2	((68))
41	56.7	63.3	65.6	65.1	54.9	42.5	36.3	69.9	((68))
42	64.3	69.1	70.0	66.9	58.2	48.0	45.5	74.2	72
43	64.8	71.2	71.7	69.6	58.4	53.3	49.7	76.1	74
44	63.0	67.4	69.6	67.6	52.0	47.8	49.1	73.6	72
45	52.8	60.2	66.0	65.9	61.5	56.8	42.2	70.4	((69))
46	54.6	59.3	65.1	65.1	59.2	54.8	48.3	69.5	((68))
47	55.4	59.8	66.2	62.8	61.4	57.9	43.1	69.7	((68))
48	59.7	64.8	65.2	61.4	54.1	47.2	44.6	69.5	((68))
49	64.3	64.8	65.0	64.7	53.9	48.8	42.7	70.9	((69))
50	54.9	60.0	58.9	55.5	46.7	41.4	34.2	64.0	((62))
51	54.3	59.3	57.8	54.7	46.0	38.5	31.2	63.2	((61))
52	65.9	72.8	74.1	74.1	62.8	58.7	57.6	78.9	77
53	48.9	54.4	54.3	53.6	47.6	42.1	38.1	59.7	((58))
54	47.0	55.2	55.4	53.9	49.4	41.0	30.5	60.3	((58))
55	55.2	56.6	68.0	66.0	61.6	58.8	28.3	71.2	((69))
56	50.9	55.6	61.5	54.2	49.8	40.5	34.1	63.6	((62))
57	65.6	69.9	71.1	71.9	65.8	61.8	46.8	76.7	75
58	60.4	60.8	65.0	68.2	52.6	51.8	40.1	70.9	((69))
59	43.1	47.5	46.3	52.3	53.3	46.0	27.7	57.4	((56))
60	48.8	55.2	76.2	61.6	56.5	52.8	29.0	76.5	75
61	50.2	55.8	48.9	55.8	48.0	46.3	40.0	60.2	((58))
62	58.4	66.5	68.3	67.4	61.0	41.0	35.4	72.7	71
63	47.4	51.5	48.5	51.8	49.7	38.1	32.3	57.2	((55))
64	52.9	51.7	44.7	45.4	45.3	38.5	29.5	56.5	((55))
65	58.0	59.4	61.8	67.8	50.7	38.4	25.9	69.6	((68))
66	60.1	64.3	63.5	62.6	56.8	42.0	33.3	69.2	((67))
67	44.6	45.3	40.2	44.6	53.3	39.2	25.2	55.1	((53))
68	60.1	64.3	63.5	62.6	56.8	42.0	33.3	69.2	((67))
69	44.6	45.3	40.2	44.6	53.3	39.2	25.2	55.1	((53))
70	44.7	53.2	54.7	55.8	52.6	37.9	31.4	60.4	((59))
71	66.3	69.0	66.0	64.1	57.7	44.7	36.3	72.9	71
72	67.4	71.8	73.2	74.5	64.4	57.5	46.3	78.6	77
73	60.0	65.4	67.5	67.2	59.6	50.5	43.0	72.1	70
74	56.3	62.0	64.1	64.3	58.7	46.2	40.2	69.1	((67))
75	47.0	53.0	52.1	54.7	54.1	43.2	32.1	59.9	((58))
76	47.0	53.0	52.1	54.7	54.1	43.2	32.1	59.9	((58))
77	56.2	55.3	64.6	66.0	47.5	38.4	41.6	68.9	((67))
78	59.4	62.1	62.9	64.4	50.5	40.9	38.2	68.6	((67))
79	62.8	65.8	61.2	59.2	50.2	48.0	33.1	69.0	((67))
80	56.2	59.4	58.6	58.8	49.0	41.7	35.9	64.6	((63))
81	44.3	49.6	53.7	51.6	45.8	35.3	31.8	57.3	((56))
82	52.8	55.2	62.2	60.6	50.2	50.4	47.5	65.6	((64))
83	63.0	67.4	69.6	67.6	52.0	47.8	49.1	73.6	72

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-4.6

HPD selection for carbon-in-pulp plant milling attendants

	dB-Neq	Mean:	91.5	Max:	95	Min:	86	Obs (n):	7
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	78.9	85.7	88.3	88.0	84.9	78.9	66.8	93.3	91.5
with HPD									
1	76.0	80.8	73.3	64.8	56.8	47.8	41.8	82.7	81
2	74.2	72.8	69.5	65.6	65.2	55.9	49.2	77.9	76
3	72.4	73.5	68.7	69.7	65.5	60.1	46.4	77.9	76
4	76.0	76.5	67.3	69.3	66.4	59.3	47.1	80.2	78
5	74.6	76.3	72.4	69.8	57.2	46.3	37.4	80.0	78
6	71.5	76.1	69.8	65.2	56.6	47.5	34.5	78.3	77
7	73.8	74.9	67.2	61.6	58.4	45.8	32.6	77.9	76
8	73.5	76.3	69.7	65.0	58.4	46.5	35.7	78.9	77
9	68.8	70.0	67.1	59.8	55.5	46.5	40.2	73.8	72
10	68.7	72.9	70.2	60.4	56.6	47.6	40.2	75.9	74
11	75.2	74.8	71.1	61.9	57.2	46.3	40.9	78.9	77
12	73.4	70.0	67.2	61.3	53.7	44.8	38.7	75.9	74
13	68.0	67.9	65.5	55.6	53.5	41.4	32.4	72.2	70
14	73.1	76.3	74.4	64.2	59.2	46.5	41.1	79.7	78
15	78.9	77.9	74.2	66.5	61.1	54.2	48.5	82.3	81
16	75.2	75.6	72.3	63.9	59.4	46.8	36.3	79.5	78
17	78.2	79.9	72.6	64.6	59.9	47.9	37.5	82.7	81
18	74.2	76.2	72.4	67.0	56.5	47.0	42.1	79.6	78
19	71.1	71.8	64.7	59.2	57.7	42.9	30.5	75.1	73
20	74.2	72.6	67.1	60.8	64.2	48.1	35.3	77.3	75
21	73.2	73.0	64.8	59.5	57.8	43.6	36.2	76.6	75
22	76.3	77.5	73.6	64.5	57.9	52.9	38.4	81.0	79
23	76.9	78.3	71.4	64.8	58.2	45.6	35.1	81.3	79
24	74.8	77.5	73.4	65.8	59.7	48.9	42.1	80.5	79
25	74.7	80.0	73.7	64.8	60.4	55.5	39.8	82.0	80
26	76.5	79.5	75.5	67.2	59.9	47.8	38.2	82.4	81
27	73.0	76.1	70.8	61.4	58.2	48.3	40.8	78.7	77
28	76.9	81.6	71.8	63.4	56.5	48.9	37.5	83.3	81
29	76.7	80.1	72.5	61.8	59.0	47.9	37.0	82.3	80
30	68.3	75.2	64.6	50.2	45.9	35.0	39.8	76.3	75
31	66.7	70.3	67.3	58.6	51.9	47.1	35.7	73.4	72
32	60.9	65.3	58.5	51.0	49.1	45.3	33.6	67.5	((66))
33	69.2	68.4	64.2	49.1	55.0	48.6	36.3	72.6	71
34	61.3	60.5	56.0	55.9	54.9	39.8	28.6	65.5	((64))
35	69.7	69.2	59.4	58.0	49.4	34.1	28.1	72.8	71
36	64.2	60.1	49.9	46.0	55.2	36.0	32.9	66.2	((64))
37	66.5	70.9	76.8	73.3	67.4	55.9	43.7	79.6	78
38	63.9	70.0	71.9	69.2	60.1	42.2	33.6	75.7	74
39	66.5	70.9	76.4	73.3	67.4	55.9	43.7	79.4	78
40	66.0	73.0	74.2	73.5	58.1	45.7	35.0	78.7	77
41	65.0	72.8	75.5	71.9	60.0	45.8	36.0	78.7	77
42	72.6	78.6	79.9	73.7	63.3	51.3	45.2	83.3	81
43	73.1	80.7	81.6	76.4	63.5	56.6	49.4	85.2	83
44	71.3	76.9	79.5	74.4	57.1	51.1	48.8	82.5	81
45	61.1	69.7	75.9	72.7	66.6	60.1	41.9	78.7	77
46	62.9	68.8	75.0	71.9	64.3	58.1	48.0	77.8	76
47	63.7	69.3	76.1	69.6	66.5	61.2	42.8	78.2	76
48	68.0	74.3	75.1	68.2	59.2	50.5	44.3	78.6	77
49	72.6	74.3	74.9	71.5	59.0	52.1	42.4	79.6	78
50	63.2	69.5	68.8	62.3	51.8	44.7	33.9	73.1	71
51	62.6	68.8	67.7	61.5	51.1	41.8	30.9	72.3	70
52	74.2	82.3	84.0	80.9	67.9	62.0	57.3	87.6	>86<
53	57.2	63.9	64.2	60.4	52.7	45.4	37.8	68.4	((67))
54	55.3	64.7	65.3	60.7	54.5	44.3	30.2	69.1	((67))
55	63.5	66.1	77.9	72.8	66.7	62.1	28.0	79.7	78
56	59.2	65.1	71.4	61.0	54.9	43.8	33.8	72.9	71
57	73.9	79.4	81.0	78.7	70.9	65.1	46.5	85.1	83
58	68.7	70.3	74.9	75.0	57.7	55.1	39.8	79.1	77
59	51.4	57.0	56.2	59.1	58.4	49.3	27.4	64.2	((62))
60	57.1	64.7	86.1	68.4	61.6	56.1	28.7	86.2	84
61	58.5	65.3	58.8	62.6	53.1	49.6	39.7	68.4	((67))
62	66.7	76.0	78.2	74.2	66.1	44.3	35.1	81.5	80
63	55.7	61.0	58.4	58.6	54.8	41.4	32.0	65.3	((63))
64	61.2	61.2	54.6	52.2	50.4	41.8	29.2	65.1	((63))
65	66.3	68.9	71.7	74.6	55.8	41.7	25.6	77.5	76
66	68.4	73.8	73.4	69.4	61.9	45.3	33.0	78.0	76
67	52.9	54.8	50.1	51.4	58.4	42.5	24.9	61.6	((60))
68	68.4	73.8	73.4	69.4	61.9	45.3	33.0	78.0	76
69	52.9	54.8	50.1	51.4	58.4	42.5	24.9	61.6	((60))
70	53.0	62.7	64.6	62.6	57.7	41.2	31.1	68.7	((67))
71	74.6	78.5	75.9	70.9	62.8	48.0	36.0	81.8	80
72	75.7	81.3	83.1	81.3	69.5	60.8	46.0	87.2	85
73	68.3	74.9	77.4	74.0	64.7	53.8	42.7	80.8	79
74	64.6	71.5	74.0	71.1	63.8	49.5	39.9	77.6	76
75	55.3	62.5	62.0	61.5	59.2	46.5	31.8	67.8	((66))
76	55.3	62.5	62.0	61.5	59.2	46.5	31.8	67.8	((66))
77	64.5	64.8	74.5	72.8	52.6	41.7	41.3	77.3	75
78	67.7	71.6	72.8	71.2	55.6	44.2	37.9	77.2	75
79	71.1	75.3	71.1	66.0	55.3	51.3	32.8	78.1	76
80	64.5	68.9	68.5	65.6	54.1	45.0	35.6	73.3	72
81	52.6	59.1	63.6	58.4	50.9	38.6	31.5	66.1	((64))
82	61.1	64.7	72.1	67.4	55.3	53.7	47.2	74.2	72
83	71.3	76.9	79.5	74.4	57.1	51.1	48.8	82.5	81

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-4.7
HPD selection for assay personnel

	dB-Neq	Mean:	87.3	Max:	97	Min:	72	Obs (n):	40
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	63.0	71.6	82.1	85.2	81.3	79.0	67.9	88.6	87.3
with HPD									
1	60.1	66.7	67.1	62.0	53.2	47.9	42.9	71.0	70
2	58.3	58.7	63.3	62.8	61.6	56.0	50.3	68.7	((67))
3	56.5	59.4	62.5	66.9	61.9	60.2	47.5	70.3	((69))
4	60.1	62.4	61.1	66.5	62.8	59.4	48.2	70.6	((69))
5	58.7	62.2	66.2	67.0	53.6	46.4	38.5	70.7	((69))
6	55.6	62.0	63.6	62.4	53.0	47.6	35.6	67.9	((67))
7	57.9	60.8	61.0	58.8	54.8	45.9	33.7	66.2	((65))
8	57.6	62.2	63.5	62.2	54.8	46.6	36.8	68.1	((67))
9	52.9	55.9	60.9	57.0	51.9	46.6	41.3	64.0	((63))
10	52.8	58.8	64.0	57.6	53.0	47.7	41.3	66.3	((65))
11	59.3	60.7	64.9	59.1	53.6	46.4	42.0	67.9	((67))
12	57.5	55.9	61.0	58.5	50.1	44.9	39.8	64.9	((64))
13	52.1	53.8	59.3	52.8	49.9	41.5	33.5	61.9	((61))
14	57.2	62.2	68.2	61.4	55.6	46.6	42.2	70.3	((69))
15	63.0	63.8	68.0	63.7	57.5	54.3	49.6	71.5	70
16	59.3	61.5	66.1	61.1	55.8	46.9	37.4	69.1	((68))
17	62.3	65.8	66.4	61.8	56.3	48.0	38.6	70.7	((69))
18	58.3	62.1	66.2	64.2	52.9	47.1	43.2	69.7	((68))
19	55.2	57.7	58.5	56.4	54.1	43.0	31.6	63.7	((62))
20	58.3	58.5	60.9	58.0	60.6	48.2	36.4	66.5	((65))
21	57.3	58.9	58.6	56.7	54.2	43.7	37.3	64.5	((63))
22	60.4	63.4	67.4	61.7	54.3	53.0	39.5	70.3	((69))
23	61.0	64.2	65.2	62.0	54.6	45.7	36.2	69.6	((68))
24	58.9	63.4	67.2	63.0	56.1	49.0	43.2	70.3	((69))
25	58.8	65.9	67.5	62.0	56.8	55.6	40.9	71.0	70
26	60.6	65.4	69.3	64.4	56.3	47.9	39.3	72.1	71
27	57.1	62.0	64.6	58.6	54.6	48.4	41.9	67.8	((67))
28	61.0	67.5	65.6	60.6	52.9	49.0	38.6	70.8	((69))
29	60.8	66.0	66.3	59.0	55.4	48.0	38.1	70.3	((69))
30	52.4	61.1	58.4	47.4	42.3	35.1	40.9	63.5	((62))
31	50.8	56.2	61.1	55.8	48.3	47.2	36.8	63.7	((62))
32	45.0	51.2	52.3	48.2	45.5	45.4	34.7	56.7	((55))
33	53.3	54.3	58.0	46.3	51.4	48.7	37.4	61.4	((60))
34	45.4	46.4	49.8	53.1	51.3	39.9	29.7	57.2	((56))
35	53.8	55.1	53.2	55.2	45.8	34.2	29.2	60.6	((59))
36	48.3	46.0	43.7	43.2	51.6	36.1	34.0	54.8	((53))
37	50.6	56.8	70.6	70.5	63.8	56.0	44.8	74.2	73
38	48.0	55.9	65.7	66.4	56.5	42.3	34.7	69.5	((68))
39	50.6	56.8	70.2	70.5	63.8	56.0	44.8	74.0	73
40	50.1	58.9	68.0	70.7	54.5	45.8	36.1	72.8	72
41	49.1	58.7	69.3	69.1	56.4	45.9	37.1	72.5	71
42	56.7	64.5	73.7	70.9	59.7	51.4	46.3	76.0	75
43	57.2	66.6	75.4	73.6	59.9	56.7	50.5	78.1	77
44	55.4	62.8	73.3	71.6	53.5	51.2	49.9	75.9	75
45	45.2	55.6	69.7	69.9	63.0	60.2	43.0	73.5	72
46	47.0	54.7	68.8	69.1	60.7	58.2	49.1	72.5	71
47	47.8	55.2	69.9	66.8	62.9	61.3	43.9	72.6	71
48	52.1	60.2	68.9	65.4	55.6	50.6	45.4	71.1	70
49	56.7	60.2	68.7	68.7	55.4	52.2	43.5	72.3	71
50	47.3	55.4	62.6	59.5	48.2	44.8	35.0	65.1	((64))
51	46.7	54.7	61.5	58.7	47.5	41.9	32.0	64.1	((63))
52	58.3	68.2	77.8	78.1	64.3	62.1	58.4	81.4	80
53	41.3	49.8	58.0	57.6	49.1	45.5	38.9	61.6	((60))
54	39.4	50.6	59.1	57.9	50.9	44.4	31.3	62.3	((61))
55	47.6	52.0	71.7	70.0	63.1	62.2	29.1	74.6	73
56	43.3	51.0	65.2	58.2	51.3	43.9	34.9	66.3	((65))
57	58.0	65.3	74.8	75.9	67.3	65.2	47.6	79.1	78
58	52.8	56.2	68.7	72.2	54.1	55.2	40.9	74.0	73
59	35.5	42.9	50.0	56.3	54.8	49.4	28.5	59.7	((58))
60	41.2	50.6	79.9	65.6	58.0	56.2	29.8	80.1	79
61	42.6	51.2	52.6	59.8	49.5	49.7	40.8	61.7	((60))
62	50.8	61.9	72.0	71.4	62.5	44.4	36.2	75.2	74
63	39.8	46.9	52.2	55.8	51.2	41.5	33.1	58.8	((57))
64	45.3	47.1	48.4	49.4	46.8	41.9	30.3	54.9	((54))
65	50.4	54.8	65.5	71.8	52.2	41.8	26.7	72.9	72
66	52.5	59.7	67.2	66.6	58.3	45.4	34.1	70.7	((69))
67	37.0	40.7	43.9	48.6	54.8	42.6	26.0	56.4	((55))
68	52.5	59.7	67.2	66.6	58.3	45.4	34.1	70.7	((69))
69	37.0	40.7	43.9	48.6	54.8	42.6	26.0	56.4	((55))
70	37.1	48.6	58.4	59.8	54.1	41.3	32.2	63.0	((62))
71	58.7	64.4	69.7	68.1	59.2	48.1	37.1	73.1	72
72	59.8	67.2	76.9	78.5	65.9	60.9	47.1	81.2	80
73	52.4	60.8	71.2	71.2	61.1	53.9	43.8	74.7	73
74	48.7	57.4	67.8	68.3	60.2	49.6	41.0	71.6	70
75	39.4	48.4	55.8	58.7	55.6	46.6	32.9	62.1	((61))
76	39.4	48.4	55.8	58.7	55.6	46.6	32.9	62.1	((61))
77	48.6	50.7	68.3	70.0	49.0	41.8	42.4	72.3	71
78	51.8	57.5	66.6	68.4	52.0	44.3	39.0	70.9	70
79	55.2	61.2	64.9	63.2	51.7	51.4	33.9	68.5	((67))
80	48.6	54.8	62.3	62.8	50.5	45.1	36.7	66.2	((65))
81	36.7	45.0	57.4	55.6	47.3	38.7	32.6	60.1	((59))
82	45.2	50.6	65.9	64.6	51.7	53.8	48.3	68.7	((67))
83	55.4	62.8	73.3	71.6	53.5	51.2	49.9	75.9	75

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-4.8
HPD selection for compressor attendants

	dB-Neq	Mean:	96.6	Max:	113	Min:	82	Obs (n):	21
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	72.5	77.9	82.8	93.5	95.1	86.4	73.3	97.9	96.6
with HPD									
1	69.6	73.0	67.8	70.3	67.0	55.3	48.3	77.1	76
2	67.8	65.0	64.0	71.1	75.4	63.4	55.7	77.9	77
3	66.0	65.7	63.2	75.2	75.7	67.6	52.9	79.3	78
4	69.6	68.7	61.8	74.8	76.6	66.8	53.6	80.0	79
5	68.2	68.5	66.9	75.3	67.4	53.8	43.9	77.7	76
6	65.1	68.3	64.3	70.7	66.8	55.0	41.0	74.7	73
7	67.4	67.1	61.7	67.1	68.6	53.3	39.1	73.9	73
8	67.1	68.5	64.2	70.5	68.6	54.0	42.2	75.3	74
9	62.4	62.2	61.6	65.3	65.7	54.0	46.7	70.9	70
10	62.3	65.1	64.7	65.9	66.8	55.1	46.7	72.3	71
11	68.8	67.0	65.6	67.4	67.4	53.8	47.4	74.4	73
12	67.0	62.2	61.7	66.8	63.9	52.3	45.2	71.9	71
13	61.6	60.1	60.0	61.1	63.7	48.9	38.9	68.6	((67))
14	66.7	68.5	68.9	69.7	69.4	54.0	47.6	75.8	74
15	72.5	70.1	68.7	72.0	71.3	61.7	55.0	78.2	77
16	68.8	67.8	66.8	69.4	69.6	54.3	42.8	75.6	74
17	71.8	72.1	67.1	70.1	70.1	55.4	44.0	77.6	76
18	67.8	68.4	66.9	72.5	66.7	54.5	48.6	76.1	75
19	64.7	64.0	59.2	64.7	67.9	50.4	37.0	71.9	71
20	67.8	64.8	61.6	66.3	74.4	55.6	41.8	76.3	75
21	66.8	65.2	59.3	65.0	68.0	51.1	42.7	72.7	71
22	69.9	69.7	68.1	70.0	68.1	60.4	44.9	76.3	75
23	70.5	70.5	65.9	70.3	68.4	53.1	41.6	76.5	75
24	68.4	69.7	67.9	71.3	69.9	56.4	48.6	76.6	75
25	68.3	72.2	68.2	70.3	70.6	63.0	46.3	77.3	76
26	70.1	71.7	70.0	72.7	70.1	55.3	44.7	78.1	77
27	66.6	68.3	65.3	66.9	68.4	55.8	47.3	74.3	73
28	70.5	73.8	66.3	68.9	66.7	56.4	44.0	77.2	76
29	70.3	72.3	67.0	67.3	69.2	55.4	43.5	76.7	75
30	61.9	67.4	59.1	55.7	56.1	42.5	46.3	69.4	((68))
31	60.3	62.5	61.8	64.1	62.1	54.6	42.2	69.5	((68))
32	54.5	57.5	53.0	56.5	59.3	52.8	40.1	64.1	((63))
33	62.8	60.6	58.7	54.6	65.2	56.1	42.8	68.9	((68))
34	54.9	52.7	50.5	61.4	65.1	47.3	35.1	67.2	((66))
35	63.3	61.4	53.9	63.5	59.6	41.6	34.6	68.4	((67))
36	57.8	52.3	44.4	51.5	65.4	43.5	39.4	66.5	((65))
37	60.1	63.1	71.3	78.8	77.6	63.4	50.2	81.8	80
38	57.5	62.2	66.4	74.7	70.3	49.7	40.1	76.7	75
39	60.1	63.1	70.9	78.8	77.6	63.4	50.2	81.8	80
40	59.6	65.2	68.7	79.0	68.3	53.2	41.5	79.9	79
41	58.6	65.0	70.0	77.4	70.2	53.3	42.5	79.0	78
42	66.2	70.8	74.4	79.2	73.5	58.8	51.7	81.8	80
43	66.7	72.9	76.1	81.9	73.7	64.1	55.9	83.9	83
44	64.9	69.1	74.0	79.9	67.3	58.6	55.3	81.5	80
45	54.7	61.9	70.4	78.2	76.8	67.6	48.4	81.2	80
46	56.5	61.0	69.5	77.4	74.5	65.6	54.5	79.9	79
47	57.3	61.5	70.6	75.1	76.7	68.7	49.3	80.0	79
48	61.6	66.5	69.6	73.7	69.4	58.0	50.8	76.8	75
49	66.2	66.5	69.4	77.0	69.2	59.6	48.9	78.9	78
50	56.8	61.7	63.3	67.8	62.0	52.2	40.4	70.7	((69))
51	56.2	61.0	62.2	67.0	61.3	49.3	37.4	69.9	((69))
52	67.8	74.5	78.5	86.4	78.1	69.5	63.8	87.9	>87<
53	50.8	56.1	58.7	65.9	62.9	52.9	44.3	68.7	((67))
54	48.9	56.9	59.8	66.2	64.7	51.8	36.7	69.4	((68))
55	57.1	58.3	72.4	78.3	76.9	69.6	34.5	81.6	80
56	52.8	57.3	65.9	66.5	65.1	51.3	40.3	71.0	70
57	67.5	71.6	75.5	84.2	81.1	72.6	53.0	86.7	85
58	62.3	62.5	69.4	80.5	67.9	62.6	46.3	81.2	80
59	45.0	49.2	50.7	64.6	68.6	56.8	33.9	70.4	((69))
60	50.7	56.9	80.6	73.9	71.8	63.6	35.2	82.0	81
61	52.1	57.5	53.3	68.1	63.3	57.1	46.2	70.0	((69))
62	60.3	68.2	72.7	79.7	76.3	51.8	41.6	82.1	81
63	49.3	53.2	52.9	64.1	65.0	48.9	38.5	68.0	((67))
64	54.8	53.4	49.1	57.7	60.6	49.3	35.7	63.9	((63))
65	59.9	61.1	66.2	80.1	66.0	49.2	32.1	80.5	79
66	62.0	66.0	67.9	74.9	72.1	52.8	39.5	77.7	76
67	46.5	47.0	44.6	56.9	68.6	50.0	31.4	69.0	((68))
68	62.0	66.0	67.9	74.9	72.1	52.8	39.5	77.7	76
69	46.5	47.0	44.6	56.9	68.6	50.0	31.4	69.0	((68))
70	46.6	54.9	59.1	68.1	67.9	48.7	37.6	71.4	70
71	68.2	70.7	70.4	76.4	73.0	55.5	42.5	79.7	78
72	69.3	73.5	77.6	86.8	79.7	68.3	52.5	88.2	>87<
73	61.9	67.1	71.9	79.5	74.9	61.3	49.2	81.6	80
74	58.2	63.7	68.5	76.6	74.0	57.0	46.4	79.1	78
75	48.9	54.7	56.5	67.0	69.4	54.0	38.3	71.7	70
76	48.9	54.7	56.5	67.0	69.4	54.0	38.3	71.7	70
77	58.1	57.0	69.0	78.3	62.8	49.2	47.8	79.0	78
78	61.3	63.8	67.3	76.7	65.8	51.7	44.4	77.8	76
79	64.7	67.5	65.6	71.5	65.5	58.8	39.3	74.9	74
80	58.1	61.1	63.0	71.1	64.3	52.5	42.1	72.9	72
81	46.2	51.3	58.1	63.9	61.1	46.1	38.0	66.6	((65))
82	54.7	56.9	66.6	72.9	65.5	61.2	53.7	74.8	73
83	64.9	69.1	74.0	79.9	67.3	58.6	55.3	81.5	80

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-4.9
HPD selection for smelt house personnel

	dB-Neq	Mean:	85.7	Max:	89	Min:	82	Obs (n):	15
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	74.0	75.2	76.5	83.5	79.3	68.0	61.4	86.2	85.7
with HPD									
1	71.1	70.3	61.5	60.3	51.2	36.9	36.4	74.2	74
2	69.3	62.3	57.7	61.1	59.6	45.0	43.8	71.2	71
3	67.5	63.0	56.9	65.2	59.9	49.2	41.0	71.0	70
4	71.1	66.0	55.5	64.8	60.8	48.4	41.7	73.3	73
5	69.7	65.8	60.6	65.3	51.6	35.4	32.0	72.5	72
6	66.6	65.6	58.0	60.7	51.0	36.6	29.1	70.1	70
7	68.9	64.4	55.4	57.1	52.8	34.9	27.2	70.6	70
8	68.6	65.8	57.9	60.5	52.8	35.6	30.3	71.1	71
9	63.9	59.5	55.3	55.3	49.9	35.6	34.8	66.2	((66))
10	63.8	62.4	58.4	55.9	51.0	36.7	34.8	67.3	((67))
11	70.3	64.3	59.3	57.4	51.6	35.4	35.5	71.7	71
12	68.5	59.5	55.4	56.8	48.1	33.9	33.3	69.5	((69))
13	63.1	57.4	53.7	51.1	47.9	30.5	27.0	64.8	((64))
14	68.2	65.8	62.6	59.7	53.6	35.6	35.7	71.3	71
15	74.0	67.4	62.4	62.0	55.5	43.3	43.1	75.4	75
16	70.3	65.1	60.5	59.4	53.8	35.9	30.9	72.1	72
17	73.3	69.4	60.8	60.1	54.3	37.0	32.1	75.1	75
18	69.3	65.7	60.6	62.5	50.9	36.1	36.7	71.8	71
19	66.2	61.3	52.9	54.7	52.1	32.0	25.1	67.9	((67))
20	69.3	62.1	55.3	56.3	58.6	37.2	29.9	70.7	70
21	68.3	62.5	53.0	55.0	52.2	32.7	30.8	69.6	((69))
22	71.4	67.0	61.8	60.0	52.3	42.0	33.0	73.3	73
23	72.0	67.8	59.6	60.3	52.6	34.7	29.7	73.8	73
24	69.9	67.0	61.6	61.3	54.1	38.0	36.7	72.5	72
25	69.8	69.5	61.9	60.3	54.8	44.6	34.4	73.3	73
26	71.6	69.0	63.7	62.7	54.3	36.9	32.8	74.3	74
27	68.1	65.6	59.0	56.9	52.6	37.4	35.4	70.6	70
28	72.0	71.1	60.0	58.9	50.9	38.0	32.1	74.9	74
29	71.8	69.6	60.7	57.3	53.4	37.0	31.6	74.2	74
30	63.4	64.7	52.8	45.7	40.3	24.1	34.4	67.3	((67))
31	61.8	59.8	55.5	54.1	46.3	36.2	30.3	65.0	((64))
32	56.0	54.8	46.7	46.5	43.5	34.4	28.2	59.1	((59))
33	64.3	57.9	52.4	44.6	49.4	37.7	30.9	65.6	((65))
34	56.4	50.0	44.2	51.4	49.3	28.9	23.2	59.0	((58))
35	64.8	58.7	47.6	53.5	43.8	23.2	22.7	66.1	((66))
36	59.3	49.6	38.1	41.5	49.6	25.1	27.5	60.2	((60))
37	61.6	60.4	65.0	68.8	61.8	45.0	38.3	71.7	71
38	59.0	59.5	60.1	64.7	54.5	31.3	28.2	67.7	((67))
39	61.6	60.4	64.6	68.8	61.8	45.0	38.3	71.6	71
40	61.1	62.5	62.4	69.0	52.5	34.8	29.6	71.1	71
41	60.1	62.3	63.7	67.4	54.4	34.9	30.6	70.4	70
42	67.7	68.1	68.1	69.2	57.7	40.4	39.8	74.4	74
43	68.2	70.2	69.8	71.9	57.9	45.7	44.0	76.3	76
44	66.4	66.4	67.7	69.9	51.5	40.2	43.4	73.9	73
45	56.2	59.2	64.1	68.2	61.0	49.2	36.5	70.7	70
46	58.0	58.3	63.2	67.4	58.7	47.2	42.6	69.9	((69))
47	58.8	58.8	64.3	65.1	60.9	50.3	37.4	69.4	((69))
48	63.1	63.8	63.3	63.7	53.6	39.6	38.9	69.6	((69))
49	67.7	63.8	63.1	67.0	53.4	41.2	37.0	71.9	71
50	58.3	59.0	57.0	57.8	46.2	33.8	28.5	64.2	((64))
51	57.7	58.3	55.9	57.0	45.5	30.9	25.5	63.4	((63))
52	69.3	71.8	72.2	76.4	62.3	51.1	51.9	79.3	79
53	52.3	53.4	52.4	55.9	47.1	34.5	32.4	60.0	((60))
54	50.4	54.2	53.5	56.2	48.9	33.4	24.8	60.4	((60))
55	58.6	55.6	66.1	68.3	61.1	51.2	22.6	71.3	71
56	54.3	54.6	59.6	56.5	49.3	32.9	28.4	63.0	((62))
57	69.0	68.9	69.2	74.2	65.3	54.2	41.1	77.3	77
58	63.8	59.8	63.1	70.5	52.1	44.2	34.4	72.3	72
59	46.5	46.5	44.4	54.6	52.8	38.4	22.0	57.8	((57))
60	52.2	54.2	74.3	63.9	56.0	45.2	23.3	74.8	74
61	53.6	54.8	47.0	58.1	47.5	38.7	34.3	61.1	((61))
62	61.8	65.5	66.4	69.7	60.5	33.4	29.7	73.0	72
63	50.8	50.5	46.6	54.1	49.2	30.5	26.6	57.9	((57))
64	56.3	50.7	42.8	47.7	44.8	30.9	23.8	58.2	((58))
65	61.4	58.4	59.9	70.1	50.2	30.8	20.2	71.3	71
66	63.5	63.3	61.6	64.9	56.3	34.4	27.6	69.7	((69))
67	48.0	44.3	38.3	46.9	52.8	31.6	19.5	55.3	((55))
68	63.5	63.3	61.6	64.9	56.3	34.4	27.6	69.7	((69))
69	48.0	44.3	38.3	46.9	52.8	31.6	19.5	55.3	((55))
70	48.1	52.2	52.8	58.1	52.1	30.3	25.7	60.9	((60))
71	69.7	68.0	64.1	66.4	57.2	37.1	30.6	73.6	73
72	70.8	70.8	71.3	76.8	63.9	49.9	40.6	79.4	79
73	63.4	64.4	65.6	69.5	59.1	42.9	37.3	72.6	72
74	59.7	61.0	62.2	66.6	58.2	38.6	34.5	69.6	((69))
75	50.4	52.0	50.2	57.0	53.6	35.6	26.4	60.4	((60))
76	50.4	52.0	50.2	57.0	53.6	35.6	26.4	60.4	((60))
77	59.6	54.3	62.7	68.3	47.0	30.8	35.9	69.9	((69))
78	62.8	61.1	61.0	66.7	50.0	33.3	32.5	69.7	((69))
79	66.2	64.8	59.3	61.5	49.7	40.4	27.4	69.8	((69))
80	59.6	58.4	56.7	61.1	48.5	34.1	30.2	65.4	((65))
81	47.7	48.6	51.8	53.9	45.3	27.7	26.1	57.5	((57))
82	56.2	54.2	60.3	62.9	49.7	42.8	41.8	65.8	((65))
83	66.4	66.4	67.7	69.9	51.5	40.2	43.4	73.9	73

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Appendix 5

HPD selection for conventional gold and platinum mining

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Table A-5.1

HPD selection for development teams

	dB-Neq	Mean:	102.8	Max:	112	Min:	85	Obs (n):	65
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	89.8	99.3	100.6	103.9	105.3	103.8	101.9	110.8	102.8
with HPD									
1	86.9	94.4	85.6	80.7	77.2	72.7	76.9	95.8	>88<
2	85.1	86.4	81.8	81.5	85.6	80.8	84.3	92.6	85
3	83.3	87.1	81.0	85.6	85.9	85.0	81.5	93.1	85
4	86.9	90.1	79.6	85.2	86.8	84.2	82.2	94.5	>87<
5	85.5	89.9	84.7	85.7	77.6	71.2	72.5	93.2	85
6	82.4	89.7	82.1	81.1	77.0	72.4	69.6	91.7	84
7	84.7	88.5	79.5	77.5	78.8	70.7	67.7	90.9	83
8	84.4	89.9	82.0	80.9	78.8	71.4	70.8	92.1	84
9	79.7	83.6	79.4	75.7	75.9	71.4	75.3	87.3	79
10	79.6	86.5	82.5	76.3	77.0	72.5	75.3	89.3	81
11	86.1	88.4	83.4	77.8	77.6	71.2	76.0	91.7	84
12	84.3	83.6	79.5	77.2	74.1	69.7	73.8	88.4	80
13	78.9	81.5	77.8	71.5	73.9	66.3	67.5	85.2	77
14	84.0	89.9	86.7	80.1	79.6	71.4	76.2	92.9	85
15	89.8	91.5	86.5	82.4	81.5	79.1	83.6	95.4	>87<
16	86.1	89.2	84.6	79.8	79.8	71.7	71.4	92.4	84
17	89.1	93.5	84.9	80.5	80.3	72.8	72.6	95.6	>88<
18	85.1	89.8	84.7	82.9	76.9	71.9	77.2	92.8	85
19	82.0	85.4	77.0	75.1	78.1	67.8	65.6	88.2	80
20	85.1	86.2	79.4	76.7	84.6	73.0	70.4	90.8	83
21	84.1	86.6	77.1	75.4	78.2	68.5	71.3	89.5	82
22	87.2	91.1	85.9	80.4	78.3	77.8	73.5	93.9	>86<
23	87.8	91.9	83.7	80.7	78.6	70.5	70.2	94.1	>86<
24	85.7	91.1	85.7	81.7	80.1	73.8	77.2	93.7	>86<
25	85.6	93.6	86.0	80.7	80.8	80.4	74.9	95.4	>87<
26	87.4	93.1	87.8	83.1	80.3	72.7	73.3	95.5	>88<
27	83.9	89.7	83.1	77.3	78.6	73.2	75.9	92.0	84
28	87.8	95.2	84.1	79.3	76.9	73.8	72.6	96.4	>88<
29	87.6	93.7	84.8	77.7	79.4	72.8	72.1	95.3	>87<
30	79.2	88.8	76.9	66.1	66.3	59.9	74.9	89.7	82
31	77.6	83.9	79.6	74.5	72.3	72.0	70.8	86.7	79
32	71.8	78.9	70.8	66.9	69.5	70.2	68.7	81.4	73
33	80.1	82.0	76.5	65.0	75.4	73.5	71.4	85.8	78
34	72.2	74.1	68.3	71.8	75.3	64.7	63.7	80.1	72
35	80.6	82.8	71.7	73.9	69.8	59.0	63.2	85.5	78
36	75.1	73.7	62.2	61.9	75.6	60.9	68.0	80.1	72
37	77.4	84.5	89.1	89.2	87.8	80.8	78.8	94.4	>86<
38	74.8	83.6	84.2	85.1	80.5	67.1	68.7	89.9	82
39	77.4	84.5	88.7	89.2	87.8	80.8	78.8	94.3	>86<
40	76.9	86.6	86.5	89.4	78.5	70.6	70.1	92.8	85
41	75.9	86.4	87.8	87.8	80.4	70.7	71.1	92.6	85
42	83.5	92.2	92.2	89.6	83.7	76.2	80.3	96.8	>89<
43	84.0	94.3	93.9	92.3	83.9	81.5	84.5	98.9	>91<
44	82.2	90.5	91.8	90.3	77.5	76.0	83.9	96.2	>88<
45	72.0	83.3	88.2	88.6	87.0	85.0	77.0	93.9	>86<
46	73.8	82.4	87.3	87.8	84.7	83.0	83.1	93.1	85
47	74.6	82.9	88.4	85.5	86.9	86.1	77.9	93.5	>86<
48	78.9	87.9	87.4	84.1	79.6	75.4	79.4	92.3	84
49	83.5	87.9	87.2	87.4	79.4	77.0	77.5	93.2	85
50	74.1	83.1	81.1	78.2	72.2	69.6	69.0	86.6	79
51	73.5	82.4	80.0	77.4	71.5	66.7	66.0	85.7	78
52	85.1	95.9	96.3	96.8	88.3	86.9	92.4	102.1	>94<
53	68.1	77.5	76.5	76.3	73.1	70.3	72.9	83.0	75
54	66.2	78.3	77.6	76.6	74.9	69.2	65.3	83.4	75
55	74.4	79.7	90.2	88.7	87.1	87.0	63.1	94.7	>87<
56	70.1	78.7	83.7	76.9	75.3	68.7	68.9	86.2	78
57	84.8	93.0	93.3	94.6	91.3	90.0	81.6	99.9	>92<
58	79.6	83.9	87.2	90.9	78.1	80.0	74.9	93.6	>86<
59	62.3	70.6	68.5	75.0	78.8	74.2	62.5	81.9	74
60	68.0	78.3	98.4	84.3	82.0	81.0	63.8	98.8	>91<
61	69.4	78.9	71.1	78.5	73.5	74.5	74.8	84.0	76
62	77.6	89.6	90.5	90.1	86.5	69.2	70.2	95.5	>88<
63	66.6	74.6	70.7	74.5	75.2	66.3	67.1	80.6	73
64	72.1	74.8	66.9	68.1	70.8	66.7	64.3	78.9	71
65	77.2	82.5	84.0	90.5	76.2	66.6	60.7	92.2	84
66	79.3	87.4	85.7	85.3	82.3	70.2	68.1	91.9	84
67	63.8	68.4	62.4	67.3	78.8	67.4	60.0	79.9	72
68	79.3	87.4	85.7	85.3	82.3	70.2	68.1	91.9	84
69	63.8	68.4	62.4	67.3	78.8	67.4	60.0	79.9	72
70	63.9	76.3	76.9	78.5	78.1	66.1	66.2	83.8	76
71	85.5	92.1	88.2	86.8	83.2	72.9	71.1	95.3	>87<
72	86.6	94.9	95.4	97.2	89.9	85.7	81.1	101.4	>93<
73	79.2	88.5	89.7	89.9	85.1	78.7	77.8	95.0	>87<
74	75.5	85.1	86.3	87.0	84.2	74.4	75.0	92.1	84
75	66.2	76.1	74.3	77.4	79.6	71.4	66.9	83.7	76
76	66.2	76.1	74.3	77.4	79.6	71.4	66.9	83.7	76
77	75.4	78.4	86.8	88.7	73.0	66.6	76.4	91.4	83
78	78.6	85.2	85.1	87.1	76.0	69.1	73.0	91.2	83
79	82.0	88.9	83.4	81.9	75.7	76.2	67.9	91.4	83
80	75.4	82.5	80.8	81.5	74.5	69.9	70.7	87.2	79
81	63.5	72.7	75.9	74.3	71.3	63.5	66.6	80.3	72
82	72.0	78.3	84.4	83.3	75.7	78.6	82.3	89.3	81
83	82.2	90.5	91.8	90.3	77.5	76.0	83.9	96.2	>88<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-5.2

HPD selection for pneumatic loader operators

	dB-Neq	Mean:	105.6	Max:	112	Min:	87	Obs (n):	28
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	87.0	93.9	96.1	97.8	99.7	101.4	99.8	106.6	105.6
with HPD									
1	84.1	89.0	81.1	74.6	71.6	70.3	74.8	91.0	>90<
2	82.3	81.0	77.3	75.4	80.0	78.4	82.2	88.6	>88<
3	80.5	81.7	76.5	79.5	80.3	82.6	79.4	88.9	>88<
4	84.1	84.7	75.1	79.1	81.2	81.8	80.1	90.2	>89<
5	82.7	84.5	80.2	79.6	72.0	68.8	70.4	88.4	>87<
6	79.6	84.3	77.6	75.0	71.4	70.0	67.5	86.8	>86<
7	81.9	83.1	75.0	71.4	73.2	68.3	65.6	86.4	85
8	81.6	84.5	77.5	74.8	73.2	69.0	68.7	87.4	>86<
9	76.9	78.2	74.9	69.6	70.3	69.0	73.2	82.9	82
10	76.8	81.1	78.0	70.2	71.4	70.1	73.2	84.7	84
11	83.3	83.0	78.9	71.7	72.0	68.8	73.9	87.4	>86<
12	81.5	78.2	75.0	71.1	68.5	67.3	71.7	84.5	83
13	76.1	76.1	73.3	65.4	68.3	63.9	65.4	80.8	80
14	81.2	84.5	82.2	74.0	74.0	69.0	74.1	88.2	>87<
15	87.0	86.1	82.0	76.3	75.9	76.7	81.5	91.3	>90<
16	83.3	83.8	80.1	73.7	74.2	69.3	69.3	87.9	>87<
17	86.3	88.1	80.4	74.4	74.7	70.4	70.5	91.0	>90<
18	82.3	84.4	80.2	76.8	71.3	69.5	75.1	88.1	>87<
19	79.2	80.0	72.5	69.0	72.5	65.4	63.5	83.7	83
20	82.3	80.8	74.9	70.6	79.0	70.6	68.3	86.3	85
21	81.3	81.2	72.6	69.3	72.6	66.1	69.2	85.1	84
22	84.4	85.7	81.4	74.3	72.7	75.4	71.4	89.4	>88<
23	85.0	86.5	79.2	74.6	73.0	68.1	68.1	89.6	>89<
24	82.9	85.7	81.2	75.6	74.5	71.4	75.1	89.1	>88<
25	82.8	88.2	81.5	74.6	75.2	78.0	72.8	90.6	>90<
26	84.6	87.7	83.3	77.0	74.7	70.3	71.2	90.8	>90<
27	81.1	84.3	78.6	71.2	73.0	70.8	73.8	87.3	>86<
28	85.0	89.8	79.6	73.2	71.3	71.4	70.5	91.5	>91<
29	84.8	88.3	80.3	71.6	73.8	70.4	70.0	90.6	>90<
30	76.4	83.4	72.4	60.0	60.7	57.5	72.8	84.8	84
31	74.8	78.5	75.1	68.4	66.7	69.6	68.7	82.1	81
32	69.0	73.5	66.3	60.8	63.9	67.8	66.6	76.9	76
33	77.3	76.6	72.0	58.9	69.8	71.1	69.3	81.7	81
34	69.4	68.7	63.8	65.7	69.7	62.3	61.6	75.4	74
35	77.8	77.4	67.2	67.8	64.2	56.6	61.1	81.2	80
36	72.3	68.3	57.7	55.8	70.0	58.5	65.9	75.9	75
37	74.6	79.1	84.6	83.1	82.2	78.4	76.7	89.5	>88<
38	72.0	78.2	79.7	79.0	74.9	64.7	66.6	84.7	84
39	74.6	79.1	84.2	83.1	82.2	78.4	76.7	89.3	>88<
40	74.1	81.2	82.0	83.3	72.9	68.2	68.0	87.5	>86<
41	73.1	81.0	83.3	81.7	74.8	68.3	69.0	87.4	>86<
42	80.7	86.8	87.7	83.5	78.1	73.8	78.2	91.9	>91<
43	81.2	88.9	89.4	86.2	78.3	79.1	82.4	94.0	>93<
44	79.4	85.1	87.3	84.2	71.9	73.6	81.8	91.5	>90<
45	69.2	77.9	83.7	82.5	81.4	82.6	74.9	89.2	>88<
46	71.0	77.0	82.8	81.7	79.1	80.6	81.0	88.6	>88<
47	71.8	77.5	83.9	79.4	81.3	83.7	75.8	89.1	>88<
48	76.1	82.5	82.9	78.0	74.0	73.0	77.3	87.6	>87<
49	80.7	82.5	82.7	81.3	73.8	74.6	75.4	88.5	>87<
50	71.3	77.7	76.6	72.1	66.6	67.2	66.9	81.7	81
51	70.7	77.0	75.5	71.3	65.9	64.3	63.9	80.8	80
52	82.3	90.5	91.8	90.7	82.7	84.5	90.3	97.4	>96<
53	65.3	72.1	72.0	70.2	67.5	67.9	70.8	78.4	77
54	63.4	72.9	73.1	70.5	69.3	66.8	63.2	78.4	77
55	71.6	74.3	85.7	82.6	81.5	84.6	61.0	90.1	>89<
56	67.3	73.3	79.2	70.8	69.7	66.3	66.8	81.5	80
57	82.0	87.6	88.8	88.5	85.7	87.6	79.5	95.1	>94<
58	76.8	78.5	82.7	84.8	72.5	77.6	72.8	88.5	>87<
59	59.5	65.2	64.0	68.9	73.2	71.8	60.4	77.1	76
60	65.2	72.9	93.9	78.2	76.4	78.6	61.7	94.3	>93<
61	66.6	73.5	66.6	72.4	67.9	72.1	72.7	79.5	79
62	74.8	84.2	86.0	84.0	80.9	66.8	68.1	90.3	>89<
63	63.8	69.2	66.2	68.4	69.6	63.9	65.0	75.6	75
64	69.3	69.4	62.4	62.0	65.2	64.3	62.2	74.5	74
65	74.4	77.1	79.5	84.4	70.6	64.2	58.6	86.6	>86<
66	76.5	82.0	81.2	79.2	76.7	67.8	66.0	86.8	>86<
67	61.0	63.0	57.9	61.2	73.2	65.0	57.9	74.8	74
68	76.5	82.0	81.2	79.2	76.7	67.8	66.0	86.8	>86<
69	61.0	63.0	57.9	61.2	73.2	65.0	57.9	74.8	74
70	61.1	70.9	72.4	72.4	72.5	63.7	64.1	78.5	78
71	82.7	86.7	83.7	80.7	77.6	70.5	69.0	90.3	>89<
72	83.8	89.5	90.9	91.1	84.3	83.3	79.0	96.2	>95<
73	76.4	83.1	85.2	83.8	79.5	76.3	75.7	89.9	>89<
74	72.7	79.7	81.8	80.9	78.6	72.0	72.9	86.9	>86<
75	63.4	70.7	69.8	71.3	74.0	69.0	64.8	78.6	78
76	63.4	70.7	69.8	71.3	74.0	69.0	64.8	78.6	78
77	72.6	73.0	82.3	82.6	67.4	64.2	74.3	86.3	85
78	75.8	79.8	80.6	81.0	70.4	66.7	70.9	86.0	85
79	79.2	83.5	78.9	75.8	70.1	73.8	65.8	86.6	>86<
80	72.6	77.1	76.3	75.4	68.9	67.5	68.6	82.2	81
81	60.7	67.3	71.4	68.2	65.7	61.1	64.5	75.4	74
82	60.2	72.9	79.9	77.2	70.1	76.2	80.2	85.2	84
83	79.4	85.1	87.3	84.2	71.9	73.6	81.8	91.5	>90<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-5.3
HPD selection for PTV personnel

	dB-Neq	Mean:	99.3	Max:	107	Min:	83	Obs (n):	32
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	85.5	91.9	95.2	96.8	98.3	93.5	99.9	104.6	99.3
with HPD									
1	82.6	87.0	80.2	73.6	70.2	62.4	74.9	89.3	84
2	80.8	79.0	76.4	74.4	78.6	70.5	82.3	87.2	82
3	79.0	79.7	75.6	78.5	78.9	74.7	79.5	86.8	81
4	82.6	82.7	74.2	78.1	79.8	73.9	80.2	88.3	83
5	81.2	82.5	79.3	78.6	70.6	60.9	70.5	86.9	82
6	78.1	82.3	76.7	74.0	70.0	62.1	67.6	85.1	80
7	80.4	81.1	74.1	70.4	71.8	60.4	65.7	84.7	79
8	80.1	82.5	76.6	73.8	71.8	61.1	68.8	85.7	80
9	75.4	76.2	74.0	68.6	68.9	61.1	73.3	81.4	76
10	75.3	79.1	77.1	69.2	70.0	62.2	73.3	83.2	78
11	81.8	81.0	78.0	70.7	70.6	60.9	74.0	85.9	81
12	80.0	76.2	74.1	70.1	67.1	59.4	71.8	83.0	78
13	74.6	74.1	72.4	64.4	66.9	56.0	65.5	79.2	74
14	79.7	82.5	81.3	73.0	72.6	61.1	74.2	86.7	81
15	85.5	84.1	81.1	75.3	74.5	68.8	81.6	89.8	85
16	81.8	81.8	79.2	72.7	72.8	61.4	69.4	86.4	81
17	84.8	86.1	79.5	73.4	73.3	62.5	70.6	89.3	84
18	80.8	82.4	79.3	75.8	69.9	61.6	75.2	86.6	81
19	77.7	78.0	71.6	68.0	71.1	57.5	63.6	82.0	77
20	80.8	78.8	74.0	69.6	77.6	62.7	68.4	84.7	79
21	79.8	79.2	71.7	68.3	71.2	58.2	69.3	83.5	78
22	82.9	83.7	80.5	73.3	71.3	67.5	71.5	87.8	82
23	83.5	84.5	78.3	73.6	71.6	60.2	68.2	87.9	83
24	81.4	83.7	80.3	74.6	73.1	63.5	75.2	87.5	82
25	81.3	86.2	80.6	73.6	73.8	70.1	72.9	88.7	83
26	83.1	85.7	82.4	76.0	73.3	62.4	71.3	89.2	84
27	79.6	82.3	77.7	70.2	71.6	62.9	73.9	85.7	80
28	83.5	87.8	78.7	72.2	69.9	63.5	70.6	89.7	84
29	83.3	86.3	79.4	70.6	72.4	62.5	70.1	88.9	84
30	74.9	81.4	71.5	59.0	59.3	49.6	72.9	83.1	78
31	73.3	76.5	74.2	67.4	65.3	61.7	68.8	80.4	75
32	67.5	71.5	65.4	59.8	62.5	59.9	66.7	75.0	70
33	75.8	74.6	71.1	57.9	68.4	63.2	69.4	79.9	75
34	67.9	66.7	62.9	64.7	68.3	54.4	61.7	73.8	((69))
35	76.3	75.4	66.3	66.8	62.8	48.7	61.2	79.5	74
36	70.8	66.3	56.8	54.8	68.6	50.6	66.0	74.5	((69))
37	73.1	77.1	83.7	82.1	80.8	70.5	76.8	88.1	83
38	70.5	76.2	78.8	78.0	73.5	56.8	66.7	83.4	78
39	73.1	77.1	83.3	82.1	80.8	70.5	76.8	88.0	83
40	72.6	79.2	81.1	82.3	71.5	60.3	68.1	86.2	81
41	71.6	79.0	82.4	80.7	73.4	60.4	69.1	86.2	81
42	79.2	84.8	86.8	82.5	76.7	65.9	78.3	90.6	85
43	79.7	86.9	88.5	85.2	76.9	71.2	82.5	92.7	>87<
44	77.9	83.1	86.4	83.2	70.5	65.7	81.9	90.3	85
45	67.7	75.9	82.8	81.5	80.0	74.7	75.0	87.3	82
46	69.5	75.0	81.9	80.7	77.7	72.7	81.1	87.2	82
47	70.3	75.5	83.0	78.4	79.9	75.8	75.9	86.9	82
48	74.6	80.5	82.0	77.0	72.6	65.1	77.4	86.3	81
49	79.2	80.5	81.8	80.3	72.4	66.7	75.5	87.1	82
50	69.8	75.7	75.7	71.1	65.2	59.3	67.0	80.2	75
51	69.2	75.0	74.6	70.3	64.5	56.4	64.0	79.3	74
52	80.8	88.5	90.9	89.7	81.3	76.6	90.4	96.3	>91<
53	63.8	70.1	71.1	69.2	66.1	60.0	70.9	77.1	72
54	61.9	70.9	72.2	69.5	67.9	58.9	63.3	76.9	72
55	70.1	72.3	84.8	81.6	80.1	76.7	61.1	88.0	83
56	65.8	71.3	78.3	69.8	68.3	58.4	66.9	80.3	75
57	80.5	85.6	87.9	87.5	84.3	79.7	79.6	93.2	>88<
58	75.3	76.5	81.8	83.8	71.1	69.7	72.9	87.1	82
59	58.0	63.2	63.1	67.9	71.8	63.9	60.5	74.7	((69))
60	63.7	70.9	93.0	77.2	75.0	70.7	61.8	93.2	>88<
61	65.1	71.5	65.7	71.4	66.5	64.2	72.8	77.9	73
62	73.3	82.2	85.1	83.0	79.5	58.9	68.2	89.1	84
63	62.3	67.2	65.3	67.4	68.2	56.0	65.1	74.2	((69))
64	67.8	67.4	61.5	61.0	63.8	56.4	62.3	72.7	((67))
65	72.9	75.1	78.6	83.4	69.2	56.3	58.7	85.5	80
66	75.0	80.0	80.3	78.2	75.3	59.9	66.1	85.4	80
67	59.5	61.0	57.0	60.2	71.8	57.1	58.0	73.0	((68))
68	75.0	80.0	80.3	78.2	75.3	59.9	66.1	85.4	80
69	59.5	61.0	57.0	60.2	71.8	57.1	58.0	73.0	((68))
70	59.6	68.9	71.5	71.4	71.1	55.8	64.2	77.2	72
71	81.2	84.7	82.8	79.7	76.2	62.6	69.1	88.8	84
72	82.3	87.5	90.0	90.1	82.9	75.4	79.1	94.9	>90<
73	74.9	81.1	84.3	82.8	78.1	68.4	75.8	88.6	83
74	71.2	77.7	80.9	79.9	77.2	64.1	73.0	85.7	80
75	61.9	68.7	68.9	70.3	72.6	61.1	64.9	77.0	72
76	61.9	68.7	68.9	70.3	72.6	61.1	64.9	77.0	72
77	71.1	71.0	81.4	81.6	66.0	56.3	74.4	85.3	80
78	74.3	77.8	79.7	80.0	69.0	58.8	71.0	84.8	80
79	77.7	81.5	78.0	74.8	68.7	65.9	65.9	84.9	80
80	71.1	75.1	75.4	74.4	67.5	59.6	68.7	80.8	76
81	59.2	65.3	70.5	67.2	64.3	53.2	64.6	74.2	((69))
82	67.7	70.9	79.0	76.2	68.7	68.3	80.3	84.2	79
83	77.9	83.1	86.4	83.2	70.5	65.7	81.9	90.3	85

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-5.4
HPD selection for stope teams

	dB-Neq	Mean:	102.3	Max:	115	Min:	80	Obs (n):	74
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	91.9	102.0	105.5	107.7	109.1	106.9	103.9	114.3	102.3
with HPD									
1	89.0	97.1	90.5	84.5	81.0	75.8	78.9	98.8	>87<
2	87.2	89.1	86.7	85.3	89.4	83.9	86.3	95.7	84
"3"	85.4	89.8	85.9	89.4	89.7	88.1	83.5	96.4	84
"4"	89.0	92.8	84.5	89.0	90.6	87.3	84.2	97.6	>86<
5	87.6	92.6	89.6	89.5	81.4	74.3	74.5	96.4	84
6	84.5	92.4	87.0	84.9	80.8	75.5	71.6	94.8	83
"7"	86.8	91.2	84.4	81.3	82.6	73.8	69.7	93.8	82
8	86.5	92.6	86.9	84.7	82.6	74.5	72.8	95.2	83
"9"	81.8	86.3	84.3	79.5	79.7	74.5	77.3	90.5	79
10	81.7	89.2	87.4	80.1	80.8	75.6	77.3	92.7	81
11	88.2	91.1	88.3	81.6	81.4	74.3	78.0	94.8	83
12	86.4	86.3	84.4	81.0	77.9	72.8	75.8	91.4	79
13	81.0	84.2	82.7	75.3	77.7	69.4	69.5	88.4	76
14	86.1	92.6	91.6	83.9	83.4	74.5	78.2	96.3	84
15	91.9	94.2	91.4	86.2	85.3	82.2	85.6	98.4	>86<
16	88.2	91.9	89.5	83.6	83.6	74.8	73.4	95.6	84
17	91.2	96.2	89.8	84.3	84.1	75.9	74.6	98.5	>87<
18	87.2	92.5	89.6	86.7	80.7	75.0	79.2	95.9	84
19	84.1	88.1	81.9	78.9	81.9	70.9	67.6	91.2	79
20	87.2	88.9	84.3	80.5	88.4	76.1	72.4	93.9	82
21	86.2	89.3	82.0	79.2	82.0	71.6	73.3	92.3	80
22	89.3	93.8	90.8	84.2	82.1	80.9	75.5	97.0	85
23	89.9	94.6	88.6	84.5	82.4	73.6	72.2	97.1	85
24	87.8	93.8	90.6	85.5	83.9	76.9	79.2	96.9	85
25	87.7	96.3	90.9	84.5	84.6	83.5	76.9	98.4	>86<
26	89.5	95.8	92.7	86.9	84.1	75.8	75.3	98.7	>87<
27	86.0	92.4	88.0	81.1	82.4	76.3	77.9	95.0	83
28	89.9	97.9	89.0	83.1	80.7	76.9	74.6	99.2	>87<
29	89.7	96.4	89.7	81.5	83.2	75.9	74.1	98.2	>86<
"30"	81.3	91.5	81.8	69.9	70.1	63.0	76.9	92.5	81
"31"	79.7	86.6	84.5	78.3	76.1	75.1	72.8	90.0	78
"32"	73.9	81.6	75.7	70.7	73.3	73.3	70.7	84.4	72
33	82.2	84.7	81.4	68.8	79.2	76.6	73.4	88.8	77
34	74.3	76.8	73.2	75.6	79.1	67.8	65.7	83.5	72
35	82.7	85.5	76.6	77.7	73.6	62.1	65.2	88.3	76
36	77.2	76.4	67.1	65.7	79.4	64.0	70.0	83.1	71
37	79.5	87.2	94.0	93.0	91.6	83.9	80.8	98.4	>86<
"38"	76.9	86.3	89.1	88.9	84.3	70.2	70.7	93.7	82
39	79.5	87.2	93.6	93.0	91.6	83.9	80.8	98.3	>86<
40	79.0	89.3	91.4	93.2	82.3	73.7	72.1	96.6	85
"41"	78.0	89.1	92.7	91.6	84.2	73.8	73.1	96.5	85
42	85.6	94.9	97.1	93.4	87.5	79.3	82.3	100.6	>89<
43	86.1	97.0	98.8	96.1	87.7	84.6	86.5	102.6	>91<
44	84.3	93.2	96.7	94.1	81.3	79.1	85.9	100.1	>88<
45	74.1	86.0	93.1	92.4	90.8	88.1	79.0	97.9	>86<
46	75.9	85.1	92.2	91.6	88.5	86.1	85.1	96.9	85
47	76.7	85.6	93.3	89.3	90.7	89.2	79.9	97.4	85
"48"	81.0	90.6	92.3	87.9	83.4	78.5	81.4	96.0	84
"49"	85.6	90.6	92.1	91.2	83.2	80.1	79.5	96.9	85
"50"	76.2	85.8	86.0	82.0	76.0	72.7	71.0	90.2	78
"51"	75.6	85.1	84.9	81.2	75.3	69.8	68.0	89.3	77
52	87.2	98.6	101.2	100.6	92.1	90.0	94.4	105.8	>94<
"53"	70.2	80.2	81.4	80.1	76.9	73.4	74.9	86.6	75
"54"	68.3	81.0	82.5	80.4	78.7	72.3	67.3	87.1	75
"55"	76.5	82.4	95.1	92.5	90.9	90.1	65.1	98.7	>87<
"56"	72.2	81.4	88.6	80.7	79.1	71.8	70.9	90.4	78
57	86.9	95.7	98.2	98.4	95.1	93.1	83.6	103.7	>92<
58	81.7	86.6	92.1	94.7	81.9	83.1	76.9	97.5	>86<
"59"	64.4	73.3	73.4	78.8	82.6	77.3	64.5	85.6	74
"60"	70.1	81.0	103.3	88.1	85.8	84.1	65.8	103.6	>92<
"61"	71.5	81.6	76.0	82.3	77.3	77.6	76.8	87.2	75
62	79.7	92.3	95.4	93.9	90.3	72.3	72.2	99.5	>87<
"63"	68.7	77.3	75.6	78.3	79.0	69.4	69.1	84.2	72
"64"	74.2	77.5	71.8	71.9	74.6	69.8	66.3	81.9	70
65	79.3	85.2	88.9	94.3	80.0	69.7	62.7	96.0	84
66	81.4	90.1	90.6	89.1	86.1	73.3	70.1	95.5	84
"67"	65.9	71.1	67.3	71.1	82.6	70.5	62.0	83.6	72
68	81.4	90.1	90.6	89.1	86.1	73.3	70.1	95.5	84
"69"	65.9	71.1	67.3	71.1	82.6	70.5	62.0	83.6	72
70	66.0	79.0	81.8	82.3	81.9	69.2	68.2	87.6	76
71	87.6	94.8	93.1	90.6	87.0	76.0	73.1	98.7	>87<
72	88.7	97.6	100.3	101.0	93.7	88.8	83.1	105.2	>93<
73	81.3	91.2	94.6	93.7	88.9	81.8	79.8	98.9	>87<
74	77.6	87.8	91.2	90.8	88.0	77.5	77.0	95.9	84
"75"	68.3	78.8	79.2	81.2	83.4	74.5	68.9	87.4	75
"76"	68.3	78.8	79.2	81.2	83.4	74.5	68.9	87.4	75
"77"	77.5	81.1	91.7	92.5	76.8	69.7	78.4	95.5	84
"78"	80.7	87.9	90.0	90.9	79.8	72.2	75.0	94.9	83
79	84.1	91.6	88.3	85.7	79.5	79.3	69.9	94.7	83
80	77.5	85.2	85.7	85.3	78.3	73.0	72.7	90.8	79
81	65.6	75.4	80.8	78.1	75.1	66.6	68.6	84.3	72
82	74.1	81.0	89.3	87.1	79.5	81.7	84.3	93.1	81
83	84.3	93.2	96.7	94.1	81.3	79.1	85.9	100.1	>88<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
"n" These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-5.5
HPD selection for hydrojet operators

	dB-Neq	Mean:	95.4	Max:	101	Min:	91	Obs (n):	11
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	78.2	84.0	91.0	94.3	96.8	98.9	95.5	103.0	95.4
with HPD									
1	75.3	79.1	76.0	71.1	68.7	67.8	70.5	82.8	75
2	73.5	71.1	72.2	71.9	77.1	75.9	77.9	83.4	76
3	71.7	71.8	71.4	76.0	77.4	80.1	75.1	84.4	77
4	75.3	74.8	70.0	75.6	78.3	79.3	75.8	84.8	77
5	73.9	74.6	75.1	76.1	69.1	66.3	66.1	81.6	74
6	70.8	74.4	72.5	71.5	68.5	67.5	63.2	79.4	72
7	73.1	73.2	69.9	67.9	70.3	65.8	61.3	78.6	71
8	72.8	74.6	72.4	71.3	70.3	66.5	64.4	79.9	72
9	68.1	68.3	69.8	66.1	67.4	66.5	68.9	76.5	((69))
10	68.0	71.2	72.9	66.7	68.5	67.6	68.9	78.1	70
11	74.5	73.1	73.8	68.2	69.1	66.3	69.6	80.0	72
12	72.7	68.3	69.9	67.6	65.6	64.8	67.4	77.2	70
13	67.3	66.2	68.2	61.9	65.4	61.4	61.1	73.8	((66))
14	72.4	74.6	77.1	70.5	71.1	66.5	69.8	81.3	74
15	78.2	76.2	76.9	72.8	73.0	74.2	77.2	84.4	77
16	74.5	73.9	75.0	70.2	71.3	66.8	65.0	80.7	73
17	77.5	78.2	75.3	70.9	71.8	67.9	66.2	82.9	75
18	73.5	74.5	75.1	73.3	68.4	67.0	70.8	81.1	73
19	70.4	70.1	67.4	65.5	69.6	62.9	59.2	76.2	((69))
20	73.5	70.9	69.8	67.1	76.1	68.1	64.0	80.0	72
21	72.5	71.3	67.5	65.8	69.7	63.6	64.9	77.4	70
22	75.6	75.8	76.3	70.8	69.8	72.9	67.1	82.1	75
23	76.2	76.6	74.1	71.1	70.1	65.6	63.8	81.5	74
24	74.1	75.8	76.1	72.1	71.6	68.9	70.8	81.9	74
25	74.0	78.3	76.4	71.1	72.3	75.5	68.5	83.2	76
26	75.8	77.8	78.2	73.5	71.8	67.8	66.9	83.3	76
27	72.3	74.4	73.5	67.7	70.1	68.3	69.5	79.9	72
28	76.2	79.9	74.5	69.7	68.4	68.9	66.2	82.9	75
29	76.0	78.4	75.2	68.1	70.9	67.9	65.7	82.3	75
30	67.6	73.5	67.3	56.5	57.8	55.0	68.5	76.2	((69))
31	66.0	68.6	70.0	64.9	63.8	67.1	64.4	75.4	((68))
32	60.2	63.6	61.2	57.3	61.0	65.3	62.3	70.6	((63))
33	68.5	66.7	66.9	55.4	66.9	68.6	65.0	75.1	((67))
34	60.6	58.8	58.7	62.2	66.8	59.8	57.3	70.2	((63))
35	69.0	67.5	62.1	64.3	61.3	54.1	56.8	73.0	((65))
36	63.5	58.4	52.6	52.3	67.1	56.0	61.6	70.1	((63))
37	65.8	69.2	79.5	79.6	79.3	75.9	72.4	85.2	78
38	63.2	68.3	74.6	75.5	72.0	62.2	62.3	79.7	72
39	65.8	69.2	79.1	79.6	79.3	75.9	72.4	85.1	78
40	65.3	71.3	76.9	79.8	70.0	65.7	63.7	82.5	75
41	64.3	71.1	78.2	78.2	71.9	65.8	64.7	82.3	75
42	71.9	76.9	82.6	80.0	75.2	71.3	73.9	86.2	79
43	72.4	79.0	84.3	82.7	75.4	76.6	78.1	88.4	81
44	70.6	75.2	82.2	80.7	69.0	71.1	77.5	86.1	78
45	60.4	68.0	78.6	79.0	78.5	80.1	70.6	85.4	78
46	62.2	67.1	77.7	78.2	76.2	78.1	76.7	84.5	77
47	63.0	67.6	78.8	75.9	78.4	81.2	71.5	85.3	78
48	67.3	72.6	77.8	74.5	71.1	70.5	73.0	81.9	74
49	71.9	72.6	77.6	77.8	70.9	72.1	71.1	82.9	75
50	62.5	67.8	71.5	68.6	63.7	64.7	62.6	75.6	((68))
51	61.9	67.1	70.4	67.8	63.0	61.8	59.6	74.5	((67))
52	73.5	80.6	86.7	87.2	79.8	82.0	86.0	92.5	85
53	56.5	62.2	66.9	66.7	64.6	65.4	66.5	73.5	((66))
54	54.6	63.0	68.0	67.0	66.4	64.3	58.9	73.3	((66))
55	62.8	64.4	80.6	79.1	78.6	82.1	56.7	86.4	79
56	58.5	63.4	74.1	67.3	66.8	63.8	62.5	76.3	((69))
57	73.2	77.7	83.7	85.0	82.8	85.1	75.2	90.7	83
58	68.0	68.6	77.6	81.3	69.6	75.1	68.5	84.1	76
59	50.7	55.3	58.9	65.4	70.3	69.3	56.1	73.9	((66))
60	56.4	63.0	88.8	74.7	73.5	76.1	57.4	89.3	82
61	57.8	63.6	61.5	68.9	65.0	69.6	68.4	75.0	((67))
62	66.0	74.3	80.9	80.5	78.0	64.3	63.8	85.2	78
63	55.0	59.3	61.1	64.9	66.7	61.4	60.7	71.1	((63))
64	60.5	59.5	57.3	58.5	62.3	61.8	57.9	68.5	((61))
65	65.6	67.2	74.4	80.9	67.7	61.7	54.3	82.2	75
66	67.7	72.1	76.1	75.7	73.8	65.3	61.7	81.1	74
67	52.2	53.1	52.8	57.7	70.3	62.5	53.6	71.4	((64))
68	67.7	72.1	76.1	75.7	73.8	65.3	61.7	81.1	74
69	52.2	53.1	52.8	57.7	70.3	62.5	53.6	71.4	((64))
70	52.3	61.0	67.3	68.9	69.6	61.2	59.8	74.1	((67))
71	73.9	76.8	78.6	77.2	74.7	68.0	64.7	83.7	76
72	75.0	79.6	85.8	87.6	81.4	80.8	74.7	91.4	84
73	67.6	73.2	80.1	80.3	76.6	73.8	71.4	85.0	77
74	63.9	69.8	76.7	77.4	75.7	69.5	68.6	82.2	75
75	54.6	60.8	64.7	67.8	71.1	66.5	60.5	74.6	((67))
76	54.6	60.8	64.7	67.8	71.1	66.5	60.5	74.6	((67))
77	63.8	63.1	77.2	79.1	64.5	61.7	70.0	81.8	74
78	67.0	69.9	75.5	77.5	67.5	64.2	66.6	80.8	73
79	70.4	73.6	73.8	72.3	67.2	71.3	61.5	79.8	72
80	63.8	67.2	71.2	71.9	66.0	65.0	64.3	76.6	((69))
81	51.9	57.4	66.3	64.7	62.8	58.6	60.2	70.6	((63))
82	60.4	63.0	74.8	73.7	67.2	73.7	75.9	80.9	73
83	70.6	75.2	82.2	80.7	69.0	71.1	77.5	86.1	78

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-5.6
HPD selection for winch operators

	dB-Neq	Mean:	98.3	Max:	109	Min:	84	Obs (n):	50
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	77.5	83.8	82.9	91.8	87.8	89.1	76.5	95.4	98.3
with HPD									
1	74.6	78.9	67.9	68.6	59.7	58.0	51.5	80.8	84
2	72.8	70.9	64.1	69.4	68.1	66.1	58.9	77.3	80
"3"	71.0	71.6	63.3	73.5	68.4	70.3	56.1	78.4	81
"4"	74.6	74.6	61.9	73.1	69.3	69.5	56.8	79.9	83
5	73.2	74.4	67.0	73.6	60.1	56.5	47.1	78.9	82
6	70.1	74.2	64.4	69.0	59.5	57.7	44.2	76.9	80
"7"	72.4	73.0	61.8	65.4	61.3	56.0	42.3	76.4	79
8	72.1	74.4	64.3	68.8	61.3	56.7	45.4	77.5	80
"9"	67.4	68.1	61.7	63.6	58.4	56.7	49.9	72.3	75
10	67.3	71.0	64.8	64.2	59.5	57.8	49.9	74.0	77
11	73.8	72.9	65.7	65.7	60.1	56.5	50.6	77.2	80
12	72.0	68.1	61.8	65.1	56.6	55.0	48.4	74.5	77
13	66.6	66.0	60.1	59.4	56.4	51.6	42.1	70.4	73
14	71.7	74.4	69.0	68.0	62.1	56.7	50.8	77.7	81
15	77.5	76.0	68.8	70.3	64.0	64.4	58.2	80.8	84
16	73.8	73.7	66.9	67.7	62.3	57.0	46.0	77.8	81
17	76.8	78.0	67.2	68.4	62.8	58.1	47.2	81.0	84
18	72.8	74.3	67.0	70.8	59.4	57.2	51.8	78.1	81
19	69.7	69.9	59.3	63.0	60.6	53.1	40.2	73.7	77
20	72.8	70.7	61.7	64.6	67.1	58.3	45.0	76.1	79
21	71.8	71.1	59.4	63.3	60.7	53.8	45.9	75.1	78
22	74.9	75.6	68.2	68.3	60.8	63.1	48.1	79.2	82
23	75.5	76.4	66.0	68.6	61.1	55.8	44.8	79.6	83
24	73.4	75.6	68.0	69.6	62.6	59.1	51.8	78.8	82
25	73.3	78.1	68.3	68.6	63.3	65.7	49.5	80.2	83
26	75.1	77.6	70.1	71.0	62.8	58.0	47.9	80.6	84
27	71.6	74.2	65.4	65.2	61.1	58.5	50.5	77.0	80
28	75.5	79.7	66.4	67.2	59.4	59.1	47.2	81.5	84
29	75.3	78.2	67.1	65.6	61.9	58.1	46.7	80.5	83
"30"	66.9	73.3	59.2	54.0	48.8	45.2	49.5	74.4	77
"31"	65.3	68.4	61.9	62.4	54.8	57.3	45.4	71.6	75
"32"	59.5	63.4	53.1	54.8	52.0	55.5	43.3	66.1	((69))
33	67.8	66.5	58.8	52.9	57.9	58.8	46.0	71.1	74
34	59.9	58.6	50.6	59.7	57.8	50.0	38.3	65.4	((68))
35	68.3	67.3	54.0	61.8	52.3	44.3	37.8	71.5	74
36	62.8	58.2	44.5	49.8	58.1	46.2	42.6	65.3	((68))
37	65.1	69.0	71.4	77.1	70.3	66.1	53.4	79.6	83
"38"	62.5	68.1	66.5	73.0	63.0	52.4	43.3	75.4	78
39	65.1	69.0	71.0	77.1	70.3	66.1	53.4	79.5	82
40	64.6	71.1	68.8	77.3	61.0	55.9	44.7	79.0	82
"41"	63.6	70.9	70.1	75.7	62.9	56.0	45.7	78.1	81
42	71.2	76.7	74.5	77.5	66.2	61.5	54.9	81.8	85
43	71.7	78.8	76.2	80.2	66.4	66.8	59.1	83.9	>87<
44	69.9	75.0	74.1	78.2	60.0	61.3	58.5	81.3	84
45	59.7	67.8	70.5	76.5	69.5	70.3	51.6	79.2	82
46	61.5	66.9	69.6	75.7	67.2	68.3	57.7	78.1	81
47	62.3	67.4	70.7	73.4	69.4	71.4	52.5	78.0	81
"48"	66.6	72.4	69.7	72.0	62.1	60.7	54.0	77.0	80
"49"	71.2	72.4	69.5	75.3	61.9	62.3	52.1	78.9	82
"50"	61.8	67.6	63.4	66.1	54.7	54.9	43.6	71.5	74
"51"	61.2	66.9	62.3	65.3	54.0	52.0	40.6	70.7	74
52	72.8	80.4	78.6	84.7	70.8	72.2	67.0	87.2	>90<
"53"	55.8	62.0	58.8	64.2	55.6	55.6	47.5	67.9	71
"54"	53.9	62.8	59.9	64.5	57.4	54.5	39.9	68.3	71
"55"	62.1	64.2	72.5	76.6	69.6	72.3	37.7	79.7	83
"56"	57.8	63.2	66.0	64.8	57.8	54.0	43.5	70.2	73
57	72.5	77.5	75.6	82.5	73.8	75.3	56.2	85.4	>88<
58	67.3	68.4	69.5	78.8	60.6	65.3	49.5	80.1	83
"59"	50.0	55.1	50.8	62.9	61.3	59.5	37.1	66.8	70
"60"	55.7	62.8	80.7	72.2	64.5	66.3	38.4	81.6	84
"61"	57.1	63.4	53.4	66.4	56.0	59.8	49.4	69.4	72
62	65.3	74.1	72.8	78.0	69.0	54.5	44.8	80.8	84
"63"	54.3	59.1	53.0	62.4	57.7	51.6	41.7	65.8	((69))
"64"	59.8	59.3	49.2	56.0	53.3	52.0	38.9	64.3	((67))
65	64.9	67.0	66.3	78.4	58.7	51.9	35.3	79.2	82
66	67.0	71.9	68.0	73.2	64.8	55.5	42.7	77.1	80
"67"	51.5	52.9	44.7	55.2	61.3	52.7	34.6	63.5	((66))
68	67.0	71.9	68.0	73.2	64.8	55.5	42.7	77.1	80
"69"	51.5	52.9	44.7	55.2	61.3	52.7	34.6	63.5	((66))
70	51.6	60.8	59.2	66.4	60.6	51.4	40.8	68.9	72
71	73.2	76.6	70.5	74.7	65.7	58.2	45.7	80.5	83
72	74.3	79.4	77.7	85.1	72.4	71.0	55.7	87.2	>90<
73	66.9	73.0	72.0	77.8	67.6	64.0	52.4	80.4	83
74	63.2	69.6	68.6	74.9	66.7	59.7	49.6	77.4	80
"75"	53.9	60.6	56.6	65.3	62.1	56.7	41.5	68.7	72
"76"	53.9	60.6	56.6	65.3	62.1	56.7	41.5	68.7	72
"77"	63.1	62.9	69.1	76.6	55.5	51.9	51.0	77.7	81
"78"	66.3	69.7	67.4	75.0	58.5	54.4	47.6	77.1	80
79	69.7	73.4	65.7	69.8	58.2	61.5	42.5	76.7	80
80	63.1	67.0	63.1	69.4	57.0	55.2	45.3	72.7	76
81	51.2	57.2	58.2	62.2	53.8	48.8	41.2	65.2	((68))
82	59.7	62.8	66.7	71.2	58.2	63.9	56.9	73.9	77
83	69.9	75.0	74.1	78.2	60.0	61.3	58.5	81.3	84

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< *Neq values greater than 85 dB indicate underprotection*
"n" These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-5.7
HPD selection for winch bell operators

	dB-Neq	Mean:	96.5	Max:	106	Min:	83	Obs (n):	22
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	84.5	86.9	89.0	92.5	89.8	86.1	87.3	97.2	96.5
with HPD									
1	81.6	82.0	74.0	69.3	61.7	55.0	62.3	85.3	85
2	79.8	74.0	70.2	70.1	70.1	63.1	69.7	82.1	81
3	78.0	74.7	69.4	74.2	70.4	67.3	66.9	81.7	81
4	81.6	77.7	68.0	73.8	71.3	66.5	67.6	84.1	83
5	80.2	77.5	73.1	74.3	62.1	53.5	57.9	83.2	83
6	77.1	77.3	70.5	69.7	61.5	54.7	55.0	81.1	80
7	79.4	76.1	67.9	66.1	63.3	53.0	53.1	81.5	81
8	79.1	77.5	70.4	69.5	63.3	53.7	56.2	82.0	81
9	74.4	71.2	67.8	64.3	60.4	53.7	60.7	77.2	76
10	74.3	74.1	70.9	64.9	61.5	54.8	60.7	78.5	78
11	80.8	76.0	71.8	66.4	62.1	53.5	61.4	82.6	82
12	79.0	71.2	67.9	65.8	58.6	52.0	59.2	80.2	79
13	73.6	69.1	66.2	60.1	58.4	48.6	52.9	75.7	75
14	78.7	77.5	75.1	68.7	64.1	53.7	61.6	82.4	82
15	84.5	79.1	74.9	71.0	66.0	61.4	69.0	86.2	>86<
16	80.8	76.8	73.0	68.4	64.3	54.0	56.8	83.0	82
17	83.8	81.1	73.3	69.1	64.8	55.1	58.0	86.0	85
18	79.8	77.4	73.1	71.5	61.4	54.2	62.6	82.8	82
19	76.7	73.0	65.4	63.7	62.6	50.1	51.0	78.7	78
20	79.8	73.8	67.8	65.3	69.1	55.3	55.8	81.4	81
21	78.8	74.2	65.5	64.0	62.7	50.8	56.7	80.4	80
22	81.9	78.7	74.3	69.0	62.8	60.1	58.9	84.3	84
23	82.5	79.5	72.1	69.3	63.1	52.8	55.6	84.7	84
24	80.4	78.7	74.1	70.3	64.6	56.1	62.6	83.5	83
25	80.3	81.2	74.4	69.3	65.3	62.7	60.3	84.5	84
26	82.1	80.7	76.2	71.7	64.8	55.0	58.7	85.3	85
27	78.6	77.3	71.5	65.9	63.1	55.5	61.3	81.7	81
28	82.5	82.8	72.5	67.9	61.4	56.1	58.0	86.0	85
29	82.3	81.3	73.2	66.3	63.9	55.1	57.5	85.2	85
30	73.9	76.4	65.3	54.7	50.8	42.2	60.3	78.6	78
31	72.3	71.5	68.0	63.1	56.8	54.3	56.2	76.1	75
32	66.5	66.5	59.2	55.5	54.0	52.5	54.1	70.3	70
33	74.8	69.6	64.9	53.6	59.9	55.8	56.8	76.5	76
34	66.9	61.7	56.7	60.4	59.8	47.0	49.1	69.6	((69))
35	75.3	70.4	60.1	62.5	54.3	41.3	48.6	76.8	76
36	69.8	61.3	50.6	50.5	60.1	43.2	53.4	70.9	70
37	72.1	72.1	77.5	77.8	72.3	63.1	64.2	82.3	82
38	69.5	71.2	72.6	73.7	65.0	49.4	54.1	78.3	78
39	72.1	72.1	77.1	77.8	72.3	63.1	64.2	82.2	81
40	71.6	74.2	74.9	78.0	63.0	52.9	55.5	81.4	81
41	70.6	74.0	76.2	76.4	64.9	53.0	56.5	81.0	80
42	78.2	79.8	80.6	78.2	68.2	58.5	65.7	85.5	85
43	78.7	81.9	82.3	80.9	68.4	63.8	69.9	87.3	>87<
44	76.9	78.1	80.2	78.9	62.0	58.3	69.3	84.9	84
45	66.7	70.9	76.6	77.2	71.5	67.3	62.4	81.3	81
46	68.5	70.0	75.7	76.4	69.2	65.3	68.5	80.7	80
47	69.3	70.5	76.8	74.1	71.4	68.4	63.3	80.7	80
48	73.6	75.5	75.8	72.7	64.1	57.7	64.8	80.8	80
49	78.2	75.5	75.6	76.0	63.9	59.3	62.9	82.6	82
50	68.8	70.7	69.5	66.8	56.7	51.9	54.4	75.3	75
51	68.2	70.0	68.4	66.0	56.0	49.0	51.4	74.5	74
52	79.8	83.5	84.7	85.4	72.8	69.2	77.8	90.2	>90<
53	62.8	65.1	64.9	64.9	57.6	52.6	58.3	71.1	70
54	60.9	65.9	66.0	65.2	59.4	51.5	50.7	71.3	71
55	69.1	67.3	78.6	77.3	71.6	69.3	48.5	82.1	81
56	64.8	66.3	72.1	65.5	59.8	51.0	54.3	74.5	74
57	79.5	80.6	81.7	83.2	75.8	72.3	67.0	87.9	>87<
58	74.3	71.5	75.6	79.5	62.6	62.3	60.3	82.3	82
59	57.0	58.2	56.9	63.6	63.3	56.5	47.9	68.2	((67))
60	62.7	65.9	86.8	72.9	66.5	63.3	49.2	87.1	>86<
61	64.1	66.5	59.5	67.1	58.0	56.8	60.2	71.8	71
62	72.3	77.2	78.9	78.7	71.0	51.5	55.6	83.7	83
63	61.3	62.2	59.1	63.1	59.7	48.6	52.5	68.5	((68))
64	66.8	62.4	55.3	56.7	55.3	49.0	49.7	68.9	((68))
65	71.9	70.1	72.4	79.1	60.7	48.9	46.1	81.0	80
66	74.0	75.0	74.1	73.9	66.8	52.5	53.5	80.5	80
67	58.5	56.0	50.8	55.9	63.3	49.7	45.4	65.9	((65))
68	74.0	75.0	74.1	73.9	66.8	52.5	53.5	80.5	80
69	58.5	56.0	50.8	55.9	63.3	49.7	45.4	65.9	((65))
70	58.6	63.9	65.3	67.1	62.6	48.4	51.6	71.4	71
71	80.2	79.7	76.6	75.4	67.7	55.2	56.5	84.5	84
72	81.3	82.5	83.8	85.8	74.4	68.0	66.5	89.9	>89<
73	73.9	76.1	78.1	78.5	69.6	61.0	63.2	83.3	83
74	70.2	72.7	74.7	75.6	68.7	56.7	60.4	80.2	79
75	60.9	63.7	62.7	66.0	64.1	53.7	52.3	70.9	70
76	60.9	63.7	62.7	66.0	64.1	53.7	52.3	70.9	70
77	70.1	66.0	75.2	77.3	57.5	48.9	61.8	80.1	79
78	73.3	72.8	73.5	75.7	60.5	51.4	58.4	80.1	79
79	76.7	76.5	71.8	70.5	60.2	58.5	53.3	80.8	80
80	70.1	70.1	69.2	70.1	59.0	52.2	56.1	76.1	75
81	58.2	60.3	64.3	62.9	55.8	45.8	52.0	68.4	((68))
82	66.7	65.9	72.8	71.9	60.2	60.9	67.7	77.1	76
83	76.9	78.1	80.2	78.9	62.0	58.3	69.3	84.9	84

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-5.8

HPD selection for survey/sample/ventilation personnel

	dB-Neq	Mean:	98.0	Max:	105	Min:	79	Obs (n):	71
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	91.2	100.1	101.6	104.5	108.7	105.4	103.1	112.6	98.0
with HPD									
1	88.3	95.2	86.6	81.3	80.6	74.3	78.1	96.8	82
2	86.5	87.2	82.8	82.1	89.0	82.4	85.5	94.2	80
3	84.7	87.9	82.0	86.2	89.3	86.6	82.7	94.7	80
4	88.3	90.9	80.6	85.8	90.2	85.8	83.4	96.1	81
5	86.9	90.7	85.7	86.3	81.0	72.8	73.7	94.2	80
6	83.8	90.5	83.1	81.7	80.4	74.0	70.8	92.7	78
7	86.1	89.3	80.5	78.1	82.2	72.3	68.9	92.1	77
8	85.8	90.7	83.0	81.5	82.2	73.0	72.0	93.2	79
9	81.1	84.4	80.4	76.3	79.3	73.0	76.5	88.5	74
10	81.0	87.3	83.5	76.9	80.4	74.1	76.5	90.5	76
11	87.5	89.2	84.4	78.4	81.0	72.8	77.2	92.9	78
12	85.7	84.4	80.5	77.8	77.5	71.3	75.0	89.6	75
13	80.3	82.3	78.8	72.1	77.3	67.9	68.7	86.4	72
14	85.4	90.7	87.7	80.7	83.0	73.0	77.4	94.0	79
15	91.2	92.3	87.5	83.0	84.9	80.7	84.8	96.5	82
16	87.5	90.0	85.6	80.4	83.2	73.3	72.6	93.6	79
17	90.5	94.3	85.9	81.1	83.7	74.4	73.8	96.6	82
18	86.5	90.6	85.7	83.5	80.3	73.5	78.4	93.8	79
19	83.4	86.2	78.0	75.7	81.5	69.4	66.8	89.5	75
20	86.5	87.0	80.4	77.3	88.0	74.6	71.6	92.5	78
21	85.5	87.4	78.1	76.0	81.6	70.1	72.5	90.7	76
22	88.6	91.9	86.9	81.0	81.7	79.4	74.7	95.0	80
23	89.2	92.7	84.7	81.3	82.0	72.1	71.4	95.2	81
24	87.1	91.9	86.7	82.3	83.5	75.4	78.4	94.8	80
25	87.0	94.4	87.0	81.3	84.2	82.0	76.1	96.4	82
26	88.8	93.9	88.8	83.7	83.7	74.3	74.5	96.5	82
27	85.3	90.5	84.1	77.9	82.0	74.8	77.1	93.1	78
28	89.2	96.0	85.1	79.9	80.3	75.4	73.8	97.3	83
29	89.0	94.5	85.8	78.3	82.8	74.4	73.3	96.3	82
30	80.6	89.6	77.9	66.7	69.7	61.5	76.1	90.6	76
31	79.0	84.7	80.6	75.1	75.7	73.6	72.0	87.8	73
32	73.2	79.7	71.8	67.5	72.9	71.8	69.9	82.5	((68))
33	81.5	82.8	77.5	65.6	78.8	75.1	72.6	87.1	73
34	73.6	74.9	69.3	72.4	78.7	66.3	64.9	82.1	((67))
35	82.0	83.6	72.7	74.5	73.2	60.6	64.4	86.6	72
36	76.5	74.5	63.2	62.5	79.0	62.5	69.2	82.2	((68))
37	78.8	85.3	90.1	89.8	91.2	82.4	80.0	96.0	81
38	76.2	84.4	85.2	85.7	83.9	68.7	69.9	91.1	76
39	78.8	85.3	89.7	89.8	91.2	82.4	80.0	95.9	81
40	78.3	87.4	87.5	90.0	81.9	72.2	71.3	93.7	79
41	77.3	87.2	88.8	88.4	83.8	72.3	72.3	93.6	79
42	84.9	93.0	93.2	90.2	87.1	77.8	81.5	97.9	83
43	85.4	95.1	94.9	92.9	87.3	83.1	85.7	99.9	85
44	83.6	91.3	92.8	90.9	80.9	77.6	85.1	97.2	83
45	73.4	84.1	89.2	89.2	90.4	86.6	78.2	95.5	81
46	75.2	83.2	88.3	88.4	88.1	84.6	84.3	94.5	80
47	76.0	83.7	89.4	86.1	90.3	87.7	79.1	95.2	81
48	80.3	88.7	88.4	84.7	83.0	77.0	80.6	93.4	79
49	84.9	88.7	88.2	88.0	82.8	78.6	78.7	94.3	80
50	75.5	83.9	82.1	78.8	75.6	71.2	70.2	87.6	73
51	74.9	83.2	81.0	78.0	74.9	68.3	67.2	86.7	72
52	86.5	96.7	97.3	97.4	91.7	88.5	93.6	103.1	>88<
53	69.5	78.3	77.5	76.9	76.5	71.9	74.1	84.3	70
54	67.6	79.1	78.6	77.2	78.3	70.8	66.5	84.7	70
55	75.8	80.5	91.2	89.3	90.5	88.6	64.3	96.2	82
56	71.5	79.5	84.7	77.5	78.7	70.3	70.1	87.4	73
57	86.2	93.8	94.3	95.2	94.7	91.6	82.8	101.3	>87<
58	81.0	84.7	88.2	91.5	81.5	81.6	76.1	94.5	80
59	63.7	71.4	69.5	75.6	82.2	75.8	63.7	84.3	70
60	69.4	79.1	99.4	84.9	85.4	82.6	65.0	99.8	85
61	70.8	79.7	72.1	79.1	76.9	76.1	76.0	85.2	71
62	79.0	90.4	91.5	90.7	89.9	70.8	71.4	96.8	82
63	68.0	75.4	71.7	75.1	78.6	67.9	68.3	82.4	((68))
64	73.5	75.6	67.9	68.7	74.2	68.3	65.5	80.4	((66))
65	78.6	83.3	85.0	91.1	79.6	68.2	61.9	93.0	78
66	80.7	88.2	86.7	85.9	85.7	71.8	69.3	93.1	78
67	65.2	69.2	63.4	67.9	82.2	69.0	61.2	82.9	((68))
68	80.7	88.2	86.7	85.9	85.7	71.8	69.3	93.1	78
69	65.2	69.2	63.4	67.9	82.2	69.0	61.2	82.9	((68))
70	65.3	77.1	77.9	79.1	81.5	67.7	67.4	85.4	71
71	86.9	92.9	89.2	87.4	86.6	74.5	72.3	96.4	82
72	88.0	95.7	96.4	97.8	93.3	87.3	82.3	102.5	>88<
73	80.6	89.3	90.7	90.5	88.5	80.3	79.0	96.2	82
74	76.9	85.9	87.3	87.6	87.6	76.0	76.2	93.4	79
75	67.6	76.9	75.3	78.0	83.0	73.0	68.1	85.8	71
76	67.6	76.9	75.3	78.0	83.0	73.0	68.1	85.8	71
77	76.8	79.2	87.8	89.3	76.4	68.2	77.6	92.3	78
78	80.0	86.0	86.1	87.7	79.4	70.7	74.2	92.1	77
79	83.4	89.7	84.4	82.5	79.1	77.8	69.1	92.4	78
80	76.8	83.3	81.8	82.1	77.9	71.5	71.9	88.2	74
81	64.9	73.5	76.9	74.9	74.7	65.1	67.8	81.6	((67))
82	73.4	79.1	85.4	83.9	79.1	80.2	83.5	90.4	76
83	83.6	91.3	92.8	90.9	80.9	77.6	85.1	97.2	83

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-5.9
HPD selection for timber crews

	dB-Neq	Mean:	97.8	Max:	104	Min:	80	Obs (n):	26
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	92.5	99.2	103.2	105.9	109.3	105.8	103.0	113.3	97.8
with HPD									
1	89.6	94.3	88.2	82.7	81.2	74.7	78.0	96.7	81
2	87.8	86.3	84.4	83.5	89.6	82.8	85.4	94.7	79
3	86.0	87.0	83.6	87.6	89.9	87.0	82.6	95.3	80
4	89.6	90.0	82.2	87.2	90.8	86.2	83.3	96.5	81
5	88.2	89.8	87.3	87.7	81.6	73.2	73.6	94.7	79
6	85.1	89.6	84.7	83.1	81.0	74.4	70.7	92.8	77
7	87.4	88.4	82.1	79.5	82.8	72.7	68.8	92.3	77
8	87.1	89.8	84.6	82.9	82.8	73.4	71.9	93.4	78
9	82.4	83.5	82.0	77.7	79.9	73.4	76.4	88.9	73
10	82.3	86.4	85.1	78.3	81.0	74.5	76.4	90.8	75
11	88.8	88.3	86.0	79.8	81.6	73.2	77.1	93.3	78
12	87.0	83.5	82.1	79.2	78.1	71.7	74.9	90.3	75
13	81.6	81.4	80.4	73.5	77.9	68.3	68.6	86.9	71
14	86.7	89.8	89.3	82.1	83.6	73.4	77.3	94.4	79
15	92.5	91.4	89.1	84.4	85.5	81.1	84.7	97.0	82
16	88.8	89.1	87.2	81.8	83.8	73.7	72.5	94.0	79
17	91.8	93.4	87.5	82.5	84.3	74.8	73.7	96.8	81
18	87.8	89.7	87.3	84.9	80.9	73.9	78.3	94.1	79
19	84.7	85.3	79.6	77.1	82.1	69.8	66.7	89.8	74
20	87.8	86.1	82.0	78.7	88.6	75.0	71.5	93.0	78
21	86.8	86.5	79.7	77.4	82.2	70.5	72.4	91.0	76
22	89.9	91.0	88.5	82.4	82.3	79.8	74.6	95.3	80
23	90.5	91.8	86.3	82.7	82.6	72.5	71.3	95.4	80
24	88.4	91.0	88.3	83.7	84.1	75.8	78.3	95.1	80
25	88.3	93.5	88.6	82.7	84.8	82.4	76.0	96.4	81
26	90.1	93.0	90.4	85.1	84.3	74.7	74.4	96.8	81
27	86.6	89.6	85.7	79.3	82.6	75.2	77.0	93.2	78
28	90.5	95.1	86.7	81.3	80.9	75.8	73.7	97.1	82
29	90.3	93.6	87.4	79.7	83.4	74.8	73.2	96.3	81
30	81.9	88.7	79.5	68.1	70.3	61.9	76.0	90.2	75
31	80.3	83.8	82.2	76.5	76.3	74.0	71.9	88.1	73
32	74.5	78.8	73.4	68.9	73.5	72.2	69.8	82.6	((67))
33	82.8	81.9	79.1	67.0	79.4	75.5	72.5	87.6	72
34	74.9	74.0	70.9	73.8	79.3	66.7	64.8	82.7	((67))
35	83.3	82.7	74.3	75.9	73.8	61.0	64.3	86.9	71
36	77.8	73.6	64.8	63.9	79.6	62.9	69.1	82.8	((67))
37	80.1	84.4	91.7	91.2	91.8	82.8	79.9	97.0	81
38	77.5	83.5	86.8	87.1	84.5	69.1	69.8	92.0	76
39	80.1	84.4	91.3	91.2	91.8	82.8	79.9	96.9	81
40	79.6	86.5	89.1	91.4	82.5	72.6	71.2	94.7	79
41	78.6	86.3	90.4	89.8	84.4	72.7	72.2	94.6	79
42	86.2	92.1	94.8	91.6	87.7	78.2	81.4	98.6	83
43	86.7	94.2	96.5	94.3	87.9	83.5	85.6	100.6	85
44	84.9	90.4	94.4	92.3	81.5	78.0	85.0	98.0	83
45	74.7	83.2	90.8	90.6	91.0	87.0	78.1	96.4	81
46	76.5	82.3	89.9	89.8	88.7	85.0	84.2	95.4	80
47	77.3	82.8	91.0	87.5	90.9	88.1	79.0	96.0	81
48	81.6	87.8	90.0	86.1	83.6	77.4	80.5	94.1	79
49	86.2	87.8	89.8	89.4	83.4	79.0	78.6	95.1	80
50	76.8	83.0	83.7	80.2	76.2	71.6	70.1	88.1	73
51	76.2	82.3	82.6	79.4	75.5	68.7	67.1	87.2	72
52	87.8	95.8	98.9	98.8	92.3	88.9	93.5	103.9	>88<
53	70.8	77.4	79.1	78.3	77.1	72.3	74.0	84.9	((69))
54	68.9	78.2	80.2	78.6	78.9	71.2	66.4	85.4	70
55	77.1	79.6	92.8	90.7	91.1	89.0	64.2	97.2	82
56	72.8	78.6	86.3	78.9	79.3	70.7	70.0	88.5	73
57	87.5	92.9	95.9	96.6	95.3	92.0	82.7	102.1	>87<
58	82.3	83.8	89.8	92.9	82.1	82.0	76.0	95.7	80
59	65.0	70.5	71.1	77.0	82.8	76.2	63.6	84.9	69
60	70.7	78.2	101.0	86.3	86.0	83.0	64.9	101.4	>86<
61	72.1	78.8	73.7	80.5	77.5	76.5	75.9	85.7	70
62	80.3	89.5	93.1	92.1	90.5	71.2	71.3	97.6	82
63	69.3	74.5	73.3	76.5	79.2	68.3	68.2	83.0	((68))
64	74.8	74.7	69.5	70.1	74.8	68.7	65.4	80.8	((65))
65	79.9	82.4	86.6	92.5	80.2	68.6	61.8	94.2	79
66	82.0	87.3	88.3	87.3	86.3	72.2	69.2	93.7	78
67	66.5	68.3	65.0	69.3	82.8	69.4	61.1	83.5	((68))
68	82.0	87.3	88.3	87.3	86.3	72.2	69.2	93.7	78
69	66.5	68.3	65.0	69.3	82.8	69.4	61.1	83.5	((68))
70	66.6	76.2	79.5	80.5	82.1	68.1	67.3	86.2	71
71	88.2	92.0	90.8	88.8	87.2	74.9	72.2	96.8	81
72	89.3	94.8	98.0	99.2	93.9	87.7	82.2	103.4	>88<
73	81.9	88.4	92.3	91.9	89.1	80.7	78.9	97.1	82
74	78.2	85.0	88.9	89.0	88.2	76.4	76.1	94.3	79
75	68.9	76.0	76.9	79.4	83.6	73.4	68.0	86.4	71
76	68.9	76.0	76.9	79.4	83.6	73.4	68.0	86.4	71
77	78.1	78.3	89.4	90.7	77.0	68.6	77.5	93.6	78
78	81.3	85.1	87.7	89.1	80.0	71.1	74.1	93.0	78
79	84.7	88.8	86.0	83.9	79.7	78.2	69.0	92.7	77
80	78.1	82.4	83.4	83.5	78.5	71.9	71.8	88.9	73
81	66.2	72.6	78.5	76.3	75.3	65.5	67.7	82.5	((67))
82	74.7	78.2	87.0	85.3	79.7	80.6	83.4	91.3	76
83	84.9	90.4	94.4	92.3	81.5	78.0	85.0	98.0	83

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-5.10
HPD selection for night-shift stope teams

	dB-Neq	Mean:	91.4	Max:	102	Min:	75	Obs (n):	39
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	85.8	88.4	93.1	95.6	92.3	88.2	80.1	99.6	91.4
with HPD									
1	82.9	83.5	78.1	72.4	64.2	57.1	55.1	87.0	79
2	81.1	75.5	74.3	73.2	72.6	65.2	62.5	83.7	75
3	79.3	76.2	73.5	77.3	72.9	69.4	59.7	83.7	75
4	82.9	79.2	72.1	76.9	73.8	68.6	60.4	85.7	78
5	81.5	79.0	77.2	77.4	64.6	55.6	50.7	85.2	77
6	78.4	78.8	74.6	72.8	64.0	56.8	47.8	82.9	75
7	80.7	77.6	72.0	69.2	65.8	55.1	45.9	83.1	75
8	80.4	79.0	74.5	72.6	65.8	55.8	49.0	83.8	76
9	75.7	72.7	71.9	67.4	62.9	55.8	53.5	79.0	71
10	75.6	75.6	75.0	68.0	64.0	56.9	53.5	80.6	72
11	82.1	77.5	75.9	69.5	64.6	55.6	54.2	84.3	76
12	80.3	72.7	72.0	68.9	61.1	54.1	52.0	81.8	74
13	74.9	70.6	70.3	63.2	60.9	50.7	45.7	77.5	((69))
14	80.0	79.0	79.2	71.8	66.6	55.8	54.4	84.5	76
15	85.8	80.6	79.0	74.1	68.5	63.5	61.8	87.9	80
16	82.1	78.3	77.1	71.5	66.8	56.1	49.6	84.8	77
17	85.1	82.6	77.4	72.2	67.3	57.2	50.8	87.7	79
18	81.1	78.9	77.2	74.6	63.9	56.3	55.4	84.6	76
19	78.0	74.5	69.5	66.8	65.1	52.2	43.8	80.4	72
20	81.1	75.3	71.9	68.4	71.6	57.4	48.6	83.0	75
21	80.1	75.7	69.6	67.1	65.2	52.9	49.5	82.0	74
22	83.2	80.2	78.4	72.1	65.3	62.2	51.7	86.1	78
23	83.8	81.0	76.2	72.4	65.6	54.9	48.4	86.3	78
24	81.7	80.2	78.2	73.4	67.1	58.2	55.4	85.4	77
25	81.6	82.7	78.5	72.4	67.8	64.8	53.1	86.3	78
26	83.4	82.2	80.3	74.8	67.3	57.1	51.5	87.2	79
27	79.9	78.8	75.6	69.0	65.6	57.6	54.1	83.5	75
28	83.8	84.3	76.6	71.0	63.9	58.2	50.8	87.6	79
29	83.6	82.8	77.3	69.4	66.4	57.2	50.3	86.9	79
30	75.2	77.9	69.4	57.8	53.3	44.3	53.1	80.2	72
31	73.6	73.0	72.1	66.2	59.3	56.4	49.0	78.1	70
32	67.8	68.0	63.3	58.6	56.5	54.6	46.9	72.0	((64))
33	76.1	71.1	69.0	56.7	62.4	57.9	49.6	78.1	70
34	68.2	63.2	60.8	63.5	62.3	49.1	41.9	71.4	((63))
35	76.6	71.9	64.2	65.6	56.8	43.4	41.4	78.3	70
36	71.1	62.8	54.7	53.6	62.6	45.3	46.2	72.4	((64))
37	73.4	73.6	81.6	80.9	74.8	65.2	57.0	85.4	77
38	70.8	72.7	76.7	76.8	67.5	51.5	46.9	81.2	73
39	73.4	73.6	81.2	80.9	74.8	65.2	57.0	85.2	77
40	72.9	75.7	79.0	81.1	65.5	55.0	48.3	84.3	76
41	71.9	75.5	80.3	79.5	67.4	55.1	49.3	84.0	76
42	79.5	81.3	84.7	81.3	70.7	60.6	58.5	88.2	80
43	80.0	83.4	86.4	84.0	70.9	65.9	62.7	90.1	82
44	78.2	79.6	84.3	82.0	64.5	60.4	62.1	87.7	79
45	68.0	72.4	80.7	80.3	74.0	69.4	55.2	84.5	76
46	69.8	71.5	79.8	79.5	71.7	67.4	61.3	83.6	75
47	70.6	72.0	80.9	77.2	73.9	70.5	56.1	83.8	76
48	74.9	77.0	79.9	75.8	66.6	59.8	57.6	83.5	75
49	79.5	77.0	79.7	79.1	66.4	61.4	55.7	85.1	77
50	70.1	72.2	73.6	69.9	59.2	54.0	47.2	77.8	70
51	69.5	71.5	72.5	69.1	58.5	51.1	44.2	77.0	((69))
52	81.1	85.0	88.8	88.5	75.3	71.3	70.6	92.9	85
53	64.1	66.6	69.0	68.0	60.1	54.7	51.1	73.6	((65))
54	62.2	67.4	70.1	68.3	61.9	53.6	43.5	74.1	((66))
55	70.4	68.8	82.7	80.4	74.1	71.4	41.3	85.5	77
56	66.1	67.8	76.2	68.6	62.3	53.1	47.1	77.9	70
57	80.8	82.1	85.8	86.3	78.3	74.4	59.8	90.7	82
58	75.6	73.0	79.7	82.6	65.1	64.4	53.1	85.3	77
59	58.3	59.7	61.0	66.7	65.8	58.6	40.7	70.8	((63))
60	64.0	67.4	90.9	76.0	69.0	65.4	42.0	91.1	83
61	65.4	68.0	63.6	70.2	60.5	58.9	53.0	73.9	((66))
62	73.6	78.7	83.0	81.8	73.5	53.6	48.4	86.7	78
63	62.6	63.7	63.2	66.2	62.2	50.7	45.3	70.9	((63))
64	68.1	63.9	59.4	59.8	57.8	51.1	42.5	70.6	((62))
65	73.2	71.6	76.5	82.2	63.2	51.0	38.9	83.9	76
66	75.3	76.5	78.2	77.0	69.3	54.6	46.3	83.1	75
67	59.8	57.5	54.9	59.0	65.8	51.8	38.2	68.2	((60))
68	75.3	76.5	78.2	77.0	69.3	54.6	46.3	83.1	75
69	59.8	57.5	54.9	59.0	65.8	51.8	38.2	68.2	((60))
70	59.9	65.4	69.4	70.2	65.1	50.5	44.4	74.3	((66))
71	81.5	81.2	80.7	78.5	70.2	57.3	49.3	86.7	79
72	82.6	84.0	87.9	88.9	76.9	70.1	59.3	92.8	85
73	75.2	77.6	82.2	81.6	72.1	63.1	56.0	86.2	78
74	71.5	74.2	78.8	78.7	71.2	58.8	53.2	83.1	75
75	62.2	65.2	66.8	69.1	66.6	55.8	45.1	73.6	((65))
76	62.2	65.2	66.8	69.1	66.6	55.8	45.1	73.6	((65))
77	71.4	67.5	79.3	80.4	60.0	51.0	54.6	83.3	75
78	74.6	74.3	77.6	78.8	63.0	53.5	51.2	82.8	75
79	78.0	78.0	75.9	73.6	62.7	60.6	46.1	82.8	75
80	71.4	71.6	73.3	73.2	61.5	54.3	48.9	78.6	70
81	59.5	61.8	68.4	66.0	58.3	47.9	44.8	71.5	((63))
82	68.0	67.4	76.9	75.0	62.7	63.0	60.5	79.9	72
83	78.2	79.6	84.3	82.0	64.5	60.4	62.1	87.7	79

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-5.11
HPD selection for mine overseers

	dB-Neq	Mean:	96.2	Max:	106	Min:	89	Obs (n):	57
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	90.1	96.9	101.6	104.4	106.5	102.6	100.8	110.9	96.2
with HPD									
1	87.2	92.0	86.6	81.2	78.4	71.5	75.8	94.5	80
2	85.4	84.0	82.8	82.0	86.8	79.6	83.2	92.4	78
3	83.6	84.7	82.0	86.1	87.1	83.8	80.4	92.9	78
4	87.2	87.7	80.6	85.7	88.0	83.0	81.1	94.1	79
5	85.8	87.5	85.7	86.2	78.8	70.0	71.4	92.6	78
6	82.7	87.3	83.1	81.6	78.2	71.2	68.5	90.6	76
7	85.0	86.1	80.5	78.0	80.0	69.5	66.6	90.1	75
8	84.7	87.5	83.0	81.4	80.0	70.2	69.7	91.2	76
9	80.0	81.2	80.4	76.2	77.1	70.2	74.2	86.7	72
10	79.9	84.1	83.5	76.8	78.2	71.3	74.2	88.6	74
11	86.4	86.0	84.4	78.3	78.8	70.0	74.9	91.1	76
12	84.6	81.2	80.5	77.7	75.3	68.5	72.7	88.1	73
13	79.2	79.1	78.8	72.0	75.1	65.1	66.4	84.7	70
14	84.3	87.5	87.7	80.6	80.8	70.2	75.1	92.3	78
15	90.1	89.1	87.5	82.9	82.7	77.9	82.5	94.8	80
16	86.4	86.8	85.6	80.3	81.0	70.5	70.3	91.9	77
17	89.4	91.1	85.9	81.0	81.5	71.6	71.5	94.5	80
18	85.4	87.4	85.7	83.4	78.1	70.7	76.1	92.1	77
19	82.3	83.0	78.0	75.6	79.3	66.6	64.5	87.5	73
20	85.4	83.8	80.4	77.2	85.8	71.8	69.3	90.6	76
21	84.4	84.2	78.1	75.9	79.4	67.3	70.2	88.7	74
22	87.5	88.7	86.9	80.9	79.5	76.6	72.4	93.2	78
23	88.1	89.5	84.7	81.2	79.8	69.3	69.1	93.2	78
24	86.0	88.7	86.7	82.2	81.3	72.6	76.1	92.9	78
25	85.9	91.2	87.0	81.2	82.0	79.2	73.8	94.2	79
26	87.7	90.7	88.8	83.6	81.5	71.5	72.2	94.7	80
27	84.2	87.3	84.1	77.8	79.8	72.0	74.8	91.0	76
28	88.1	92.8	85.1	79.8	78.1	72.6	71.5	94.9	80
29	87.9	91.3	85.8	78.2	80.6	71.6	71.0	94.1	79
30	79.5	86.4	77.9	66.6	67.5	58.7	73.8	87.9	73
31	77.9	81.5	80.6	75.0	73.5	70.8	69.7	85.9	71
32	72.1	76.5	71.8	67.4	70.7	69.0	67.6	80.3	((66))
33	80.4	79.6	77.5	65.5	76.6	72.3	70.3	85.2	71
34	72.5	71.7	69.3	72.3	76.5	63.5	62.6	80.3	((66))
35	80.9	80.4	72.7	74.4	71.0	57.8	62.1	84.7	70
36	75.4	71.3	63.2	62.4	76.8	59.7	66.9	80.2	((66))
37	77.7	82.1	90.1	89.7	89.0	79.6	77.7	94.9	80
38	75.1	81.2	85.2	85.6	81.7	65.9	67.6	90.1	75
39	77.7	82.1	89.7	89.7	89.0	79.6	77.7	94.8	80
40	77.2	84.2	87.5	89.9	79.7	69.4	69.0	92.9	78
41	76.2	84.0	88.8	88.3	81.6	69.5	70.0	92.8	78
42	83.8	89.8	93.2	90.1	84.9	75.0	79.2	96.7	82
43	84.3	91.9	94.9	92.8	85.1	80.3	83.4	98.7	84
44	82.5	88.1	92.8	90.8	78.7	74.8	82.8	96.3	82
45	72.3	80.9	89.2	89.1	88.2	83.8	75.9	94.4	80
46	74.1	80.0	88.3	88.3	85.9	81.8	82.0	93.4	79
47	74.9	80.5	89.4	86.0	88.1	84.9	76.8	93.8	79
48	79.2	85.5	88.4	84.6	80.8	74.2	78.3	92.1	77
49	83.8	85.5	88.2	87.9	80.6	75.8	76.4	93.2	78
50	74.4	80.7	82.1	78.7	73.4	68.4	67.9	86.2	72
51	73.8	80.0	81.0	77.9	72.7	65.5	64.9	85.3	71
52	85.4	93.5	97.3	97.3	89.5	85.7	91.3	102.0	>87<
53	68.4	75.1	77.5	76.8	74.3	69.1	71.8	82.9	((68))
54	66.5	75.9	78.6	77.1	76.1	68.0	64.2	83.4	((69))
55	74.7	77.3	91.2	89.2	88.3	85.8	62.0	95.2	80
56	70.4	76.3	84.7	77.4	76.5	67.5	67.8	86.6	72
57	85.1	90.6	94.3	95.1	92.5	88.8	80.5	100.0	85
58	79.9	81.5	88.2	91.4	79.3	78.8	73.8	93.9	79
59	62.6	68.2	69.5	75.5	80.0	73.0	61.4	82.4	((68))
60	68.3	75.9	99.4	84.8	83.2	79.8	62.7	99.7	85
61	69.7	76.5	72.1	79.0	74.7	73.3	73.7	83.5	((69))
62	77.9	87.2	91.5	90.6	87.7	68.0	69.1	95.7	81
63	66.9	72.2	71.7	75.0	76.4	65.1	66.0	80.7	((66))
64	72.4	72.4	67.9	68.6	72.0	65.5	63.2	78.4	((64))
65	77.5	80.1	85.0	91.0	77.4	65.4	59.6	92.5	78
66	79.6	85.0	86.7	85.8	83.5	69.0	67.0	91.7	77
67	64.1	66.0	63.4	67.8	80.0	66.2	58.9	80.8	((66))
68	79.6	85.0	86.7	85.8	83.5	69.0	67.0	91.7	77
69	64.1	66.0	63.4	67.8	80.0	66.2	58.9	80.8	((66))
70	64.2	73.9	77.9	79.0	79.3	64.9	65.1	84.1	69
71	85.8	89.7	89.2	87.3	84.4	71.7	70.0	94.7	80
72	86.9	92.5	96.4	97.7	91.1	84.5	80.0	101.5	>87<
73	79.5	86.1	90.7	90.4	86.3	77.5	76.7	95.2	80
74	75.8	82.7	87.3	87.5	85.4	73.2	73.9	92.3	78
75	66.5	73.7	75.3	77.9	80.8	70.2	65.8	84.1	((69))
76	66.5	73.7	75.3	77.9	80.8	70.2	65.8	84.1	((69))
77	75.7	76.0	87.8	89.2	74.2	65.4	75.3	92.0	77
78	78.9	82.8	86.1	87.6	77.2	67.9	71.9	91.2	77
79	82.3	86.5	84.4	82.4	76.9	75.0	66.8	90.6	76
80	75.7	80.1	81.8	82.0	75.7	68.7	69.6	87.0	72
81	63.8	70.3	76.9	74.8	72.5	62.3	65.5	80.6	((66))
82	72.3	75.9	85.4	83.8	76.9	77.4	81.2	89.4	75
83	82.5	88.1	92.8	90.8	78.7	74.8	82.8	96.3	82

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-5.12
HPD selection for day-shift shift supervisors

	dB-Neq	Mean:	100.3	Max:	110	Min:	87	Obs (n):	66
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	90.3	95.7	101.7	104.5	107.1	103.0	101.0	111.4	100.3
with HPD									
1	87.4	90.8	86.7	81.3	79.0	71.9	76.0	94.0	83
2	85.6	82.8	82.9	82.1	87.4	80.0	83.4	92.5	81
"3"	83.8	83.5	82.1	86.2	87.7	84.2	80.6	93.0	82
"4"	87.4	86.5	80.7	85.8	88.6	83.4	81.3	94.1	83
5	86.0	86.3	85.8	86.3	79.4	70.4	71.6	92.4	81
6	82.9	86.1	83.2	81.7	78.8	71.6	68.7	90.2	79
"7"	85.2	84.9	80.6	78.1	80.6	69.9	66.8	89.8	79
8	84.9	86.3	83.1	81.5	80.6	70.6	69.9	90.9	80
"9"	80.2	80.0	80.5	76.3	77.7	70.6	74.4	86.6	76
10	80.1	82.9	83.6	76.9	78.8	71.7	74.4	88.4	77
11	86.6	84.8	84.5	78.4	79.4	70.4	75.1	90.9	80
12	84.8	80.0	80.6	77.8	75.9	68.9	72.9	88.1	77
13	79.4	77.9	78.9	72.1	75.7	65.5	66.6	84.6	73
14	84.5	86.3	87.8	80.7	81.4	70.6	75.3	92.1	81
15	90.3	87.9	87.6	83.0	83.3	78.3	82.7	94.7	84
16	86.6	85.6	85.7	80.4	81.6	70.9	70.5	91.7	81
17	89.6	89.9	86.0	81.1	82.1	72.0	71.7	94.2	83
18	85.6	86.2	85.8	83.5	78.7	71.1	76.3	91.8	81
19	82.5	81.8	78.1	75.7	79.9	67.0	64.7	87.3	76
20	85.6	82.6	80.5	77.3	86.4	72.2	69.5	90.7	80
21	84.6	83.0	78.2	76.0	80.0	67.7	70.4	88.5	77
22	87.7	87.5	87.0	81.0	80.1	77.0	72.6	92.9	82
23	88.3	88.3	84.8	81.3	80.4	69.7	69.3	92.8	82
24	86.2	87.5	86.8	82.3	81.9	73.0	76.3	92.7	82
25	86.1	90.0	87.1	81.3	82.6	79.6	74.0	93.7	83
26	87.9	89.5	88.9	83.7	82.1	71.9	72.4	94.3	83
27	84.4	86.1	84.2	77.9	80.4	72.4	75.0	90.7	80
28	88.3	91.6	85.2	79.9	78.7	73.0	71.7	94.2	83
29	88.1	90.1	85.9	78.3	81.2	72.0	71.2	93.6	82
"30"	79.7	85.2	78.0	66.7	68.1	59.1	74.0	87.2	76
"31"	78.1	80.3	80.7	75.1	74.1	71.2	69.9	85.7	75
"32"	72.3	75.3	71.9	67.5	71.3	69.4	67.8	80.0	((69))
33	80.6	78.4	77.6	65.6	77.2	72.7	70.5	85.2	74
34	72.7	70.5	69.4	72.4	77.1	63.9	62.8	80.5	((69))
35	81.1	79.2	72.8	74.5	71.6	58.2	62.3	84.4	73
36	75.6	70.1	63.3	62.5	77.4	60.1	67.1	80.5	((69))
37	77.9	80.9	90.2	89.8	89.6	80.0	77.9	95.1	84
"38"	75.3	80.0	85.3	85.7	82.3	66.3	67.8	90.1	79
39	77.9	80.9	89.8	89.8	89.6	80.0	77.9	95.0	84
40	77.4	83.0	87.6	90.0	80.3	69.8	69.2	92.9	82
"41"	76.4	82.8	88.9	88.4	82.2	69.9	70.2	92.8	82
42	84.0	88.6	93.3	90.2	85.5	75.4	79.4	96.7	>86<
43	84.5	90.7	95.0	92.9	85.7	80.7	83.6	98.6	>88<
44	82.7	86.9	92.9	90.9	79.3	75.2	83.0	96.2	85
45	72.5	79.7	89.3	89.2	88.8	84.2	76.1	94.6	83
46	74.3	78.8	88.4	88.4	86.5	82.2	82.2	93.6	82
47	75.1	79.3	89.5	86.1	88.7	85.3	77.0	94.1	83
"48"	79.4	84.3	88.5	84.7	81.4	74.6	78.5	92.0	81
"49"	84.0	84.3	88.3	88.0	81.2	76.2	76.6	93.1	82
"50"	74.6	79.5	82.2	78.8	74.0	68.8	68.1	86.0	75
"51"	74.0	78.8	81.1	78.0	73.3	65.9	65.1	85.1	74
52	85.6	92.3	97.4	97.4	90.1	86.1	91.5	102.0	>91<
"53"	68.6	73.9	77.6	76.9	74.9	69.5	72.0	82.9	72
"54"	66.7	74.7	78.7	77.2	76.7	68.4	64.4	83.4	72
"55"	74.9	76.1	91.3	89.3	88.9	86.2	62.2	95.4	84
"56"	70.6	75.1	84.8	77.5	77.1	67.9	68.0	86.7	76
57	85.3	89.4	94.4	95.2	93.1	89.2	80.7	100.1	>89<
58	80.1	80.3	88.3	91.5	79.9	79.2	74.0	94.0	83
"59"	62.8	67.0	69.6	75.6	80.6	73.4	61.6	82.8	72
"60"	68.5	74.7	99.5	84.9	83.8	80.2	62.9	99.8	>89<
"61"	69.9	75.3	72.2	79.1	75.3	73.7	73.9	83.5	72
62	78.1	86.0	91.6	90.7	88.3	68.4	69.3	95.8	85
"63"	67.1	71.0	71.8	75.1	77.0	65.5	66.2	80.9	70
"64"	72.6	71.2	68.0	68.7	72.6	65.9	63.4	78.4	((67))
65	77.7	78.9	85.1	91.1	78.0	65.8	59.8	92.6	81
66	79.8	83.8	86.8	85.9	84.1	69.4	67.2	91.7	81
"67"	64.3	64.8	63.5	67.9	80.6	66.6	59.1	81.3	70
68	79.8	83.8	86.8	85.9	84.1	69.4	67.2	91.7	81
"69"	64.3	64.8	63.5	67.9	80.6	66.6	59.1	81.3	70
70	64.4	72.7	78.0	79.1	79.9	65.3	65.3	84.3	73
71	86.0	88.5	89.3	87.4	85.0	72.1	70.2	94.5	83
72	87.1	91.3	96.5	97.8	91.7	84.9	80.2	101.5	>90<
73	79.7	84.9	90.8	90.5	86.9	77.9	76.9	95.2	84
74	76.0	81.5	87.4	87.6	86.0	73.6	74.1	92.4	81
"75"	66.7	72.5	75.4	78.0	81.4	70.6	66.0	84.4	73
"76"	66.7	72.5	75.4	78.0	81.4	70.6	66.0	84.4	73
"77"	75.9	74.8	87.9	89.3	74.8	65.8	75.5	92.1	81
"78"	79.1	81.6	86.2	87.7	77.8	68.3	72.1	91.2	80
79	82.5	85.3	84.5	82.5	77.5	75.4	67.0	90.3	79
80	75.9	78.9	81.9	82.1	76.3	69.1	69.8	86.9	76
81	64.0	69.1	77.0	74.9	73.1	62.7	65.7	80.7	70
82	72.5	74.7	85.5	83.9	77.5	77.8	81.4	89.6	78
83	82.7	86.9	92.9	90.9	79.3	75.2	83.0	96.2	85

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
"n" These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-5.13
HPD selection for night-shift shift supervisors

	dB-Neq	Mean:	89.5	Max:	92	Min:	81	Obs (n):	7
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	85.5	87.5	91.9	93.9	91.4	87.2	80.0	98.4	89.5
with HPD									
1	82.6	82.6	76.9	70.7	63.3	56.1	55.0	86.3	77
2	80.8	74.6	73.1	71.5	71.7	64.2	62.4	83.1	74
3	79.0	75.3	72.3	75.6	72.0	68.4	59.6	82.8	74
4	82.6	78.3	70.9	75.2	72.9	67.6	60.3	85.1	76
5	81.2	78.1	76.0	75.7	63.7	54.6	50.6	84.4	76
6	78.1	77.9	73.4	71.1	63.1	55.8	47.7	82.1	73
7	80.4	76.7	70.8	67.5	64.9	54.1	45.8	82.5	74
8	80.1	78.1	73.3	70.9	64.9	54.8	48.9	83.1	74
9	75.4	71.8	70.7	65.7	62.0	54.8	53.4	78.3	((69))
10	75.3	74.7	73.8	66.3	63.1	55.9	53.4	79.7	71
11	81.8	76.6	74.7	67.8	63.7	54.6	54.1	83.7	75
12	80.0	71.8	70.8	67.2	60.2	53.1	51.9	81.3	72
13	74.6	69.7	69.1	61.5	60.0	49.7	45.6	76.9	((68))
14	79.7	78.1	78.0	70.1	65.7	54.8	54.3	83.7	75
15	85.5	79.7	77.8	72.4	67.6	62.5	61.7	87.3	78
16	81.8	77.4	75.9	69.8	65.9	55.1	49.5	84.1	75
17	84.8	81.7	76.2	70.5	66.4	56.2	50.7	87.1	78
18	80.8	78.0	76.0	72.9	63.0	55.3	55.3	83.9	75
19	77.7	73.6	68.3	65.1	64.2	51.2	43.7	79.8	71
20	80.8	74.4	70.7	66.7	70.7	56.4	48.5	82.5	74
21	79.8	74.8	68.4	65.4	64.3	51.9	49.4	81.4	73
22	82.9	79.3	77.2	70.4	64.4	61.2	51.6	85.4	77
23	83.5	80.1	75.0	70.7	64.7	53.9	48.3	85.7	77
24	81.4	79.3	77.0	71.7	66.2	57.2	55.3	84.7	76
25	81.3	81.8	77.3	70.7	66.9	63.8	53.0	85.6	77
26	83.1	81.3	79.1	73.1	66.4	56.1	51.4	86.5	78
27	79.6	77.9	74.4	67.3	64.7	56.6	54.0	82.8	74
28	83.5	83.4	75.4	69.3	63.0	57.2	50.7	86.9	78
29	83.3	81.9	76.1	67.7	65.5	56.2	50.2	86.2	77
30	74.9	77.0	68.2	56.1	52.4	43.3	53.0	79.5	71
31	73.3	72.1	70.9	64.5	58.4	55.4	48.9	77.3	((68))
32	67.5	67.1	62.1	56.9	55.6	53.6	46.8	71.3	((62))
33	75.8	70.2	67.8	55.0	61.5	56.9	49.5	77.5	((69))
34	67.9	62.3	59.6	61.8	61.4	48.1	41.8	70.7	((62))
35	76.3	71.0	63.0	63.9	55.9	42.4	41.3	77.8	((69))
36	70.8	61.9	53.5	51.9	61.7	44.3	46.1	71.9	((63))
37	73.1	72.7	80.4	79.2	73.9	64.2	56.9	84.1	75
38	70.5	71.8	75.5	75.1	66.6	50.5	46.8	80.0	71
39	73.1	72.7	80.0	79.2	73.9	64.2	56.9	84.0	75
40	72.6	74.8	77.8	79.4	64.6	54.0	48.2	83.0	74
41	71.6	74.6	79.1	77.8	66.5	54.1	49.2	82.8	74
42	79.2	80.4	83.5	79.6	69.8	59.6	58.4	87.2	78
43	79.7	82.5	85.2	82.3	70.0	64.9	62.6	89.0	80
44	77.9	78.7	83.1	80.3	63.6	59.4	62.0	86.6	78
45	67.7	71.5	79.5	78.6	73.1	68.4	55.1	83.2	74
46	69.5	70.6	78.6	77.8	70.8	66.4	61.2	82.3	73
47	70.3	71.1	79.7	75.5	73.0	69.5	56.0	82.6	74
48	74.6	76.1	78.7	74.1	65.7	58.8	57.5	82.4	74
49	79.2	76.1	78.5	77.4	65.5	60.4	55.6	84.1	75
50	69.8	71.3	72.4	68.2	58.3	53.0	47.1	76.8	((68))
51	69.2	70.6	71.3	67.4	57.6	50.1	44.1	76.0	((67))
52	80.8	84.1	87.6	86.8	74.4	70.3	70.5	91.7	83
53	63.8	65.7	67.8	66.3	59.2	53.7	51.0	72.5	((64))
54	61.9	66.5	68.9	66.6	61.0	52.6	43.4	73.0	((64))
55	70.1	67.9	81.5	78.7	73.2	70.4	41.2	84.2	75
56	65.8	66.9	75.0	66.9	61.4	52.1	47.0	76.7	((68))
57	80.5	81.2	84.6	84.6	77.4	73.4	59.7	89.5	81
58	75.3	72.1	78.5	80.9	64.2	63.4	53.0	84.0	75
59	58.0	58.8	59.8	65.0	64.9	57.6	40.6	69.6	((61))
60	63.7	66.5	89.7	74.3	68.1	64.4	41.9	89.9	81
61	65.1	67.1	62.4	68.5	59.6	57.9	52.9	72.8	((64))
62	73.3	77.8	81.8	80.1	72.6	52.6	48.3	85.5	77
63	62.3	62.8	62.0	64.5	61.3	49.7	45.2	69.8	((61))
64	67.8	63.0	58.2	58.1	56.9	50.1	42.4	70.0	((61))
65	72.9	70.7	75.3	80.5	62.3	50.0	38.8	82.5	74
66	75.0	75.6	77.0	75.3	68.4	53.6	46.2	82.0	73
67	59.5	56.6	53.7	57.3	64.9	50.8	38.1	67.3	((58))
68	75.0	75.6	77.0	75.3	68.4	53.6	46.2	82.0	73
69	59.5	56.6	53.7	57.3	64.9	50.8	38.1	67.3	((58))
70	59.6	64.5	68.2	68.5	64.2	49.5	44.3	73.0	((64))
71	81.2	80.3	79.5	76.8	69.3	56.3	49.2	85.9	77
72	82.3	83.1	86.7	87.2	76.0	69.1	59.2	91.5	83
73	74.9	76.7	81.0	79.9	71.2	62.1	55.9	85.0	76
74	71.2	73.3	77.6	77.0	70.3	57.8	53.1	81.9	73
75	61.9	64.3	65.6	67.4	65.7	54.8	45.0	72.4	((64))
76	61.9	64.3	65.6	67.4	65.7	54.8	45.0	72.4	((64))
77	71.1	66.6	78.1	78.7	59.1	50.0	54.5	82.0	73
78	74.3	73.4	76.4	77.1	62.1	52.5	51.1	81.6	73
79	77.7	77.1	74.7	71.9	61.8	59.6	46.0	82.0	73
80	71.1	70.7	72.1	71.5	60.6	53.3	48.8	77.5	((69))
81	59.2	60.9	67.2	64.3	57.4	46.9	44.7	70.3	((61))
82	67.7	66.5	75.7	73.3	61.8	62.0	60.4	78.6	70
83	77.9	78.7	83.1	80.3	63.6	59.4	62.0	86.6	78

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-5.14
HPD selection for miners

	dB-Neq	Mean:	103.2	Max:	113	Min:	85	Obs (n):	49
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	90.9	99.8	102.0	104.7	107.9	103.6	101.2	111.9	103.2
with HPD									
1	88.0	94.9	87.0	81.5	79.8	72.5	76.2	96.6	>88<
2	86.2	86.9	83.2	82.3	88.2	80.6	83.6	93.6	85
3	84.4	87.6	82.4	86.4	88.5	84.8	80.8	94.1	85
4	88.0	90.6	81.0	86.0	89.4	84.0	81.5	95.5	>87<
5	86.6	90.4	86.1	86.5	80.2	71.0	71.8	94.0	85
6	83.5	90.2	83.5	81.9	79.6	72.2	68.9	92.5	84
7	85.8	89.0	80.9	78.3	81.4	70.5	67.0	91.8	83
8	85.5	90.4	83.4	81.7	81.4	71.2	70.1	93.0	84
9	80.8	84.1	80.8	76.5	78.5	71.2	74.6	88.2	79
10	80.7	87.0	83.9	77.1	79.6	72.3	74.6	90.2	82
11	87.2	88.9	84.8	78.6	80.2	71.0	75.3	92.6	84
12	85.4	84.1	80.9	78.0	76.7	69.5	73.1	89.4	81
13	80.0	82.0	79.2	72.3	76.5	66.1	66.8	86.2	77
14	85.1	90.4	88.1	80.9	82.2	71.2	75.5	93.8	85
15	90.9	92.0	87.9	83.2	84.1	78.9	82.9	96.2	>88<
16	87.2	89.7	86.0	80.6	82.4	71.5	70.7	93.4	85
17	90.2	94.0	86.3	81.3	82.9	72.6	71.9	96.4	>88<
18	86.2	90.3	86.1	83.7	79.5	71.7	76.5	93.6	85
19	83.1	85.9	78.4	75.9	80.7	67.6	64.9	89.2	81
20	86.2	86.7	80.8	77.5	87.2	72.8	69.7	92.1	83
21	85.2	87.1	78.5	76.2	80.8	68.3	70.6	90.4	82
22	88.3	91.6	87.3	81.2	80.9	77.6	72.8	94.8	>86<
23	88.9	92.4	85.1	81.5	81.2	70.3	69.5	95.0	>86<
24	86.8	91.6	87.1	82.5	82.7	73.6	76.5	94.6	>86<
25	86.7	94.1	87.4	81.5	83.4	80.2	74.2	96.1	>87<
26	88.5	93.6	89.2	83.9	82.9	72.5	72.6	96.3	>88<
27	85.0	90.2	84.5	78.1	81.2	73.0	75.2	92.8	84
28	88.9	95.7	85.5	80.1	79.5	73.6	71.9	97.1	>88<
29	88.7	94.2	86.2	78.5	82.0	72.6	71.4	96.1	>87<
30	80.3	89.3	78.3	66.9	68.9	59.7	74.2	90.3	82
31	78.7	84.4	81.0	75.3	74.9	71.8	70.1	87.5	79
32	72.9	79.4	72.2	67.7	72.1	70.0	68.0	82.1	73
33	81.2	82.5	77.9	65.8	78.0	73.3	70.7	86.7	78
34	73.3	74.6	69.7	72.6	77.9	64.5	63.0	81.6	73
35	81.7	83.3	73.1	74.7	72.4	58.8	62.5	86.4	78
36	76.2	74.2	63.6	62.7	78.2	60.7	67.3	81.6	73
37	78.5	85.0	90.5	90.0	90.4	80.6	78.1	95.8	>87<
38	75.9	84.1	85.6	85.9	83.1	66.9	68.0	91.0	82
39	78.5	85.0	90.1	90.0	90.4	80.6	78.1	95.7	>87<
40	78.0	87.1	87.9	90.2	81.1	70.4	69.4	93.8	85
41	77.0	86.9	89.2	88.6	83.0	70.5	70.4	93.7	85
42	84.6	92.7	93.6	90.4	86.3	76.0	79.6	97.9	>89<
43	85.1	94.8	95.3	93.1	86.5	81.3	83.8	99.8	>91<
44	83.3	91.0	93.2	91.1	80.1	75.8	83.2	97.2	>88<
45	73.1	83.8	89.6	89.4	89.6	84.8	76.3	95.2	>87<
46	74.9	82.9	88.7	88.6	87.3	82.8	82.4	94.1	85
47	75.7	83.4	89.8	86.3	89.5	85.9	77.2	94.7	>86<
48	80.0	88.4	88.8	84.9	82.2	75.2	78.7	93.3	85
49	84.6	88.4	88.6	88.2	82.0	76.8	76.8	94.2	>86<
50	75.2	83.6	82.5	79.0	74.8	69.4	68.3	87.5	79
51	74.6	82.9	81.4	78.2	74.1	66.5	65.3	86.6	78
52	86.2	96.4	97.7	97.6	90.9	86.7	91.7	102.9	>94<
53	69.2	78.0	77.9	77.1	75.7	70.1	72.2	84.0	75
54	67.3	78.8	79.0	77.4	77.5	69.0	64.6	84.5	76
55	75.5	80.2	91.6	89.5	89.7	86.8	62.4	95.9	>87<
56	71.2	79.2	85.1	77.7	77.9	68.5	68.2	87.4	79
57	85.9	93.5	94.7	95.4	93.9	89.8	80.9	101.0	>92<
58	80.7	84.4	88.6	91.7	80.7	79.8	74.2	94.5	>86<
59	63.4	71.1	69.9	75.8	81.4	74.0	61.8	83.6	75
60	69.1	78.8	99.8	85.1	84.6	80.8	63.1	100.2	>91<
61	70.5	79.4	72.5	79.3	76.1	74.3	74.1	84.7	76
62	78.7	90.1	91.9	90.9	89.1	69.0	69.5	96.7	>88<
63	67.7	75.1	72.1	75.3	77.8	66.1	66.4	82.0	73
64	73.2	75.3	68.3	68.9	73.4	66.5	63.6	79.9	71
65	78.3	83.0	85.4	91.3	78.8	66.4	60.0	93.1	84
66	80.4	87.9	87.1	86.1	84.9	70.0	67.4	92.9	84
67	64.9	68.9	63.8	68.1	81.4	67.2	59.3	82.1	73
68	80.4	87.9	87.1	86.1	84.9	70.0	67.4	92.9	84
69	64.9	68.9	63.8	68.1	81.4	67.2	59.3	82.1	73
70	65.0	76.8	78.3	79.3	80.7	65.9	65.5	85.2	76
71	86.6	92.6	89.6	87.6	85.8	72.7	70.4	96.2	>88<
72	87.7	95.4	96.8	98.0	92.5	85.5	80.4	102.4	>94<
73	80.3	89.0	91.1	90.7	87.7	78.5	77.1	96.1	>87<
74	76.6	85.6	87.7	87.8	86.8	74.2	74.3	93.3	85
75	67.3	76.6	75.7	78.2	82.2	71.2	66.2	85.3	77
76	67.3	76.6	75.7	78.2	82.2	71.2	66.2	85.3	77
77	76.5	78.9	88.2	89.5	75.6	66.4	75.7	92.4	84
78	79.7	85.7	86.5	87.9	78.6	68.9	72.3	92.1	83
79	83.1	89.4	84.8	82.7	78.3	76.0	67.2	92.2	84
80	76.5	83.0	82.2	82.3	77.1	69.7	70.0	88.1	79
81	64.6	73.2	77.3	75.1	73.9	63.3	65.9	81.5	73
82	73.1	78.8	85.8	84.1	78.3	78.4	81.6	90.1	81
83	83.3	91.0	93.2	91.1	80.1	75.8	83.2	97.2	>88<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-5.15
HPD selection for team leaders

	dB-Neq	Mean:	104.9	Max:	116	Min:	86	Obs (n):	36
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	91.1	100.5	102.9	105.3	108.9	105.8	103.0	113.0	104.9
with HPD									
1	88.2	95.6	87.9	82.1	80.8	74.7	78.0	97.2	>89<
2	86.4	87.6	84.1	82.9	89.2	82.8	85.4	94.5	>86<
3	84.6	88.3	83.3	87.0	89.5	87.0	82.6	95.1	>87<
4	88.2	91.3	81.9	86.6	90.4	86.2	83.3	96.4	>88<
5	86.8	91.1	87.0	87.1	81.2	73.2	73.6	94.7	>87<
6	83.7	90.9	84.4	82.5	80.6	74.4	70.7	93.2	85
7	86.0	89.7	81.8	78.9	82.4	72.7	68.8	92.5	84
8	85.7	91.1	84.3	82.3	82.4	73.4	71.9	93.6	>85<
9	81.0	84.8	81.7	77.1	79.5	73.4	76.4	88.9	81
10	80.9	87.7	84.8	77.7	80.6	74.5	76.4	91.0	83
11	87.4	89.6	85.7	79.2	81.2	73.2	77.1	93.3	85
12	85.6	84.8	81.8	78.6	77.7	71.7	74.9	90.0	82
13	80.2	82.7	80.1	72.9	77.5	68.3	68.6	86.8	79
14	85.3	91.1	89.0	81.5	83.2	73.4	77.3	94.5	>86<
15	91.1	92.7	88.8	83.8	85.1	81.1	84.7	96.9	>89<
16	87.4	90.4	86.9	81.2	83.4	73.7	72.5	94.0	>86<
17	90.4	94.7	87.2	81.9	83.9	74.8	73.7	97.0	>89<
18	86.4	91.0	87.0	84.3	80.5	73.9	78.3	94.3	>86<
19	83.3	86.6	79.3	76.5	81.7	69.8	66.7	89.8	82
20	86.4	87.4	81.7	78.1	88.2	75.0	71.5	92.8	85
21	85.4	87.8	79.4	76.8	81.8	70.5	72.4	91.0	83
22	88.5	92.3	88.2	81.8	81.9	79.8	74.6	95.4	>87<
23	89.1	93.1	86.0	82.1	82.2	72.5	71.3	95.6	>87<
24	87.0	92.3	88.0	83.1	83.7	75.8	78.3	95.3	>87<
25	86.9	94.8	88.3	82.1	84.4	82.4	76.0	96.8	>89<
26	88.7	94.3	90.1	84.5	83.9	74.7	74.4	97.0	>89<
27	85.2	90.9	85.4	78.7	82.2	75.2	77.0	93.5	85
28	89.1	96.4	86.4	80.7	80.5	75.8	73.7	97.7	>90<
29	88.9	94.9	87.1	79.1	83.0	74.8	73.2	96.7	>89<
30	80.5	90.0	79.2	67.5	69.9	61.9	76.0	91.0	83
31	78.9	85.1	81.9	75.9	75.9	74.0	71.9	88.3	80
32	73.1	80.1	73.1	68.3	73.1	72.2	69.8	82.9	75
33	81.4	83.2	78.8	66.4	79.0	75.5	72.5	87.5	79
34	73.5	75.3	70.6	73.2	78.9	66.7	64.8	82.4	74
35	81.9	84.0	74.0	75.3	73.4	61.0	64.3	86.9	79
36	76.4	74.9	64.5	63.3	79.2	62.9	69.1	82.4	74
37	78.7	85.7	91.4	90.6	91.4	82.8	79.9	96.7	>89<
38	76.1	84.8	86.5	86.5	84.1	69.1	69.8	91.8	84
39	78.7	85.7	91.0	90.6	91.4	82.8	79.9	96.6	>88<
40	78.2	87.8	88.8	90.8	82.1	72.6	71.2	94.5	>86<
41	77.2	87.6	90.1	89.2	84.0	72.7	72.2	94.4	>86<
42	84.8	93.4	94.5	91.0	87.3	78.2	81.4	98.6	>90<
43	85.3	95.5	96.2	93.7	87.5	83.5	85.6	100.6	>92<
44	83.5	91.7	94.1	91.7	81.1	78.0	85.0	98.0	>90<
45	73.3	84.5	90.5	90.0	90.6	87.0	78.1	96.2	>88<
46	75.1	83.6	89.6	89.2	88.3	85.0	84.2	95.1	>87<
47	75.9	84.1	90.7	86.9	90.5	88.1	79.0	95.8	>88<
48	80.2	89.1	89.7	85.5	83.2	77.4	80.5	94.1	>86<
49	84.8	89.1	89.5	88.8	83.0	79.0	78.6	94.9	>87<
50	75.4	84.3	83.4	79.6	75.8	71.6	70.1	88.3	80
51	74.8	83.6	82.3	78.8	75.1	68.7	67.1	87.4	79
52	86.4	97.1	98.6	98.2	91.9	88.9	93.5	103.8	>96<
53	69.4	78.7	78.8	77.7	76.7	72.3	74.0	84.9	77
54	67.5	79.5	79.9	78.0	78.5	71.2	66.4	85.4	77
55	75.7	80.9	92.5	90.1	90.7	89.0	64.2	96.9	>89<
56	71.4	79.9	86.0	78.3	78.9	70.7	70.0	88.3	80
57	86.1	94.2	95.6	96.0	94.9	92.0	82.7	101.9	>94<
58	80.9	85.1	89.5	92.3	81.7	82.0	76.0	95.3	>87<
59	63.6	71.8	70.8	76.4	82.4	76.2	63.6	84.6	76
60	69.3	79.5	100.7	85.7	85.6	83.0	64.9	101.1	>93<
61	70.7	80.1	73.4	79.9	77.1	76.5	75.9	85.7	78
62	78.9	90.8	92.8	91.5	90.1	71.2	71.3	97.5	>89<
63	67.9	75.8	73.0	75.9	78.8	68.3	68.2	82.8	75
64	73.4	76.0	69.2	69.5	74.4	68.7	65.4	80.7	73
65	78.5	83.7	86.3	91.9	79.8	68.6	61.8	93.8	>86<
66	80.6	88.6	88.0	86.7	85.9	72.2	69.2	93.7	>86<
67	65.1	69.6	64.7	68.7	82.4	69.4	61.1	83.1	75
68	80.6	88.6	88.0	86.7	85.9	72.2	69.2	93.7	>86<
69	65.1	69.6	64.7	68.7	82.4	69.4	61.1	83.1	75
70	65.2	77.5	79.2	79.9	81.7	68.1	67.3	86.0	78
71	86.8	93.3	90.5	88.2	86.8	74.9	72.2	96.9	>89<
72	87.9	96.1	97.7	98.6	93.5	87.7	82.2	103.2	>95<
73	80.5	89.7	92.0	91.3	88.7	80.7	78.9	96.9	>89<
74	76.8	86.3	88.6	88.4	87.8	76.4	76.1	94.1	>86<
75	67.5	77.3	76.6	78.8	83.2	73.4	68.0	86.2	78
76	67.5	77.3	76.6	78.8	83.2	73.4	68.0	86.2	78
77	76.7	79.6	89.1	90.1	76.6	68.6	77.5	93.2	85
78	79.9	86.4	87.4	88.5	79.6	71.1	74.1	92.8	85
79	83.3	90.1	85.7	83.3	79.3	78.2	69.0	93.0	85
80	76.7	83.7	83.1	82.9	78.1	71.9	71.8	88.9	81
81	64.8	73.9	78.2	75.7	74.9	65.5	67.7	82.3	74
82	73.3	79.5	86.7	84.7	79.3	80.6	83.4	91.1	83
83	83.5	91.7	94.1	91.7	81.1	78.0	85.0	98.0	>90<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-5.16
HPD selection for banksmen

	dB-Neq	Mean:	88.3	Max:	98	Min:	75	Obs (n):	47
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	78.4	80.0	81.6	85.9	84.3	80.8	75.6	90.5	88.3
with HPD									
1	75.5	75.1	66.6	62.7	56.2	49.7	50.6	78.7	77
2	73.7	67.1	62.8	63.5	64.6	57.8	58.0	75.7	73
"3"	71.9	67.8	62.0	67.6	64.9	62.0	55.2	75.3	73
"4"	75.5	70.8	60.6	67.2	65.8	61.2	55.9	77.7	76
5	74.1	70.6	65.7	67.7	56.6	48.2	46.2	76.8	75
6	71.0	70.4	63.1	63.1	56.0	49.4	43.3	74.5	72
"7"	73.3	69.2	60.5	59.5	57.8	47.7	41.4	75.1	73
8	73.0	70.6	63.0	62.9	57.8	48.4	44.5	75.6	73
"9"	68.3	64.3	60.4	57.7	54.9	48.4	49.0	70.6	((68))
10	68.2	67.2	63.5	58.3	56.0	49.5	49.0	71.9	70
11	74.7	69.1	64.4	59.8	56.6	48.2	49.7	76.2	74
12	72.9	64.3	60.5	59.2	53.1	46.7	47.5	73.9	72
13	67.5	62.2	58.8	53.5	52.9	43.3	41.2	69.3	((67))
14	72.6	70.6	67.7	62.1	58.6	48.4	49.9	75.8	74
15	78.4	72.2	67.5	64.4	60.5	56.1	57.3	79.8	78
16	74.7	69.9	65.6	61.8	58.8	48.7	45.1	76.6	74
17	77.7	74.2	65.9	62.5	59.3	49.8	46.3	79.6	77
18	73.7	70.5	65.7	64.9	55.9	48.9	50.9	76.2	74
19	70.6	66.1	58.0	57.1	57.1	44.8	39.3	72.4	70
20	73.7	66.9	60.4	58.7	63.6	50.0	44.1	75.1	73
21	72.7	67.3	58.1	57.4	57.2	45.5	45.0	74.1	72
22	75.8	71.8	66.9	62.4	57.3	54.8	47.2	77.8	76
23	76.4	72.6	64.7	62.7	57.6	47.5	43.9	78.3	76
24	74.3	71.8	66.7	63.7	59.1	50.8	50.9	77.0	75
25	74.2	74.3	67.0	62.7	59.8	57.4	48.6	77.9	76
26	76.0	73.8	68.8	65.1	59.3	49.7	47.0	78.8	77
27	72.5	70.4	64.1	59.3	57.6	50.2	49.6	75.2	73
28	76.4	75.9	65.1	61.3	55.9	50.8	46.3	79.4	77
29	76.2	74.4	65.8	59.7	58.4	49.8	45.8	78.7	77
"30"	67.8	69.5	57.9	48.1	45.3	36.9	48.6	72.0	70
"31"	66.2	64.6	60.6	56.5	51.3	49.0	44.5	69.5	((67))
"32"	60.4	59.6	51.8	48.9	48.5	47.2	42.4	63.8	((62))
33	68.7	62.7	57.5	47.0	54.4	50.5	45.1	70.1	((68))
34	60.8	54.8	49.3	53.8	54.3	41.7	37.4	63.3	((61))
35	69.2	63.5	52.7	55.9	48.8	36.0	36.9	70.5	((68))
36	63.7	54.4	43.2	43.9	54.6	37.9	41.7	64.7	((63))
37	66.0	65.2	70.1	71.2	66.8	57.8	52.5	75.6	73
"38"	63.4	64.3	65.2	67.1	59.5	44.1	42.4	71.5	((69))
39	66.0	65.2	69.7	71.2	66.8	57.8	52.5	75.5	73
40	65.5	67.3	67.5	71.4	57.5	47.6	43.8	74.6	72
"41"	64.5	67.1	68.8	69.8	59.4	47.7	44.8	74.2	72
42	72.1	72.9	73.2	71.6	62.7	53.2	54.0	78.7	76
43	72.6	75.0	74.9	74.3	62.9	58.5	58.2	80.5	78
44	70.8	71.2	72.8	72.3	56.5	53.0	57.6	78.0	76
45	60.6	64.0	69.2	70.6	66.0	62.0	50.7	74.6	72
46	62.4	63.1	68.3	69.8	63.7	60.0	56.8	73.8	72
47	63.2	63.6	69.4	67.5	65.9	63.1	51.6	73.9	72
"48"	67.5	68.6	68.4	66.1	58.6	52.4	53.1	74.0	72
"49"	72.1	68.6	68.2	69.4	58.4	54.0	51.2	76.0	74
"50"	62.7	63.8	62.1	60.2	51.2	46.6	42.7	68.5	((66))
"51"	62.1	63.1	61.0	59.4	50.5	43.7	39.7	67.7	((66))
52	73.7	76.6	77.3	78.8	67.3	63.9	66.1	83.2	81
"53"	56.7	58.2	57.5	58.3	52.1	47.3	46.6	64.2	((62))
"54"	54.8	59.0	58.6	58.6	53.9	46.2	39.0	64.5	((62))
"55"	63.0	60.4	71.2	70.7	66.1	64.0	36.8	75.4	73
"56"	58.7	59.4	64.7	58.9	54.3	45.7	42.6	67.5	((65))
57	73.4	73.7	74.3	76.6	70.3	67.0	55.3	81.3	79
58	68.2	64.6	68.2	72.9	57.1	57.0	48.6	75.6	73
"59"	50.9	51.3	49.5	57.0	57.8	51.2	36.2	62.0	((60))
"60"	56.6	59.0	79.4	66.3	61.0	58.0	37.5	79.8	78
"61"	58.0	59.6	52.1	60.5	52.5	51.5	48.5	65.1	((63))
62	66.2	70.3	71.5	72.1	65.5	46.2	43.9	76.9	75
"63"	55.2	55.3	51.7	56.5	54.2	43.3	40.8	61.9	((60))
"64"	60.7	55.5	47.9	50.1	49.8	43.7	38.0	62.6	((60))
65	65.8	63.2	65.0	72.5	55.2	43.6	34.4	74.3	72
66	67.9	68.1	66.7	67.3	61.3	47.2	41.8	73.8	72
"67"	52.4	49.1	43.4	49.3	57.8	44.4	33.7	60.0	((58))
68	67.9	68.1	66.7	67.3	61.3	47.2	41.8	73.8	72
"69"	52.4	49.1	43.4	49.3	57.8	44.4	33.7	60.0	((58))
70	52.5	57.0	57.9	60.5	57.1	43.1	39.9	64.7	((62))
71	74.1	72.8	69.2	68.8	62.2	49.9	44.8	78.0	76
72	75.2	75.6	76.4	79.2	68.9	62.7	54.8	83.1	81
73	67.8	69.2	70.7	71.9	64.1	55.7	51.5	76.5	74
74	64.1	65.8	67.3	69.0	63.2	51.4	48.7	73.4	71
"75"	54.8	56.8	55.3	59.4	58.6	48.4	40.6	64.5	((62))
"76"	54.8	56.8	55.3	59.4	58.6	48.4	40.6	64.5	((62))
"77"	64.0	59.1	67.8	70.7	52.0	43.6	50.1	73.3	71
"78"	67.2	65.9	66.1	69.1	55.0	46.1	46.7	73.4	71
79	70.6	69.6	64.4	63.9	54.7	53.2	41.6	74.2	72
80	64.0	63.2	61.8	63.5	53.5	46.9	44.4	69.4	((67))
81	52.1	53.4	56.9	56.3	50.3	40.5	40.3	61.5	((59))
82	60.6	59.0	65.4	65.3	54.7	55.6	56.0	69.9	((68))
83	70.8	71.2	72.8	72.3	56.5	53.0	57.6	78.0	76

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n *These HPD evaluations are based on standards which may overestimate effectiveness*
HPD details are tabulated in Table A-1.1

Table A-5.17
HPD selection for diesel loco operators

	dB-Neq	Mean:	94.1	Max:	106	Min:	82	Obs (n):	31
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	78.4	81.9	85.7	91.6	89.6	88.8	79.5	95.8	94.1
with HPD									
1	75.5	77.0	70.7	68.4	61.5	57.7	54.5	80.3	79
2	73.7	69.0	66.9	69.2	69.9	65.8	61.9	77.8	76
3	71.9	69.7	66.1	73.3	70.2	70.0	59.1	78.5	77
4	75.5	72.7	64.7	72.9	71.1	69.2	59.8	79.9	78
5	74.1	72.5	69.8	73.4	61.9	56.2	50.1	78.9	77
6	71.0	72.3	67.2	68.8	61.3	57.4	47.2	76.5	75
7	73.3	71.1	64.6	65.2	63.1	55.7	45.3	76.3	75
8	73.0	72.5	67.1	68.6	63.1	56.4	48.4	77.2	76
9	68.3	66.2	64.5	63.4	60.2	56.4	52.9	72.5	71
10	68.2	69.1	67.6	64.0	61.3	57.5	52.9	74.0	72
11	74.7	71.0	68.5	65.5	61.9	56.2	53.6	77.4	76
12	72.9	66.2	64.6	64.9	58.4	54.7	51.4	74.9	73
13	67.5	64.1	62.9	59.2	58.2	51.3	45.1	70.7	((69))
14	72.6	72.5	71.8	67.8	63.9	56.4	53.8	77.8	76
15	78.4	74.1	71.6	70.1	65.8	64.1	61.2	81.0	79
16	74.7	71.8	69.7	67.5	64.1	56.7	49.0	78.0	76
17	77.7	76.1	70.0	68.2	64.6	57.8	50.2	80.8	79
18	73.7	72.4	69.8	70.6	61.2	56.9	54.8	78.1	76
19	70.6	68.0	62.1	62.8	62.4	52.8	43.2	73.7	72
20	73.7	68.8	64.5	64.4	68.9	58.0	48.0	76.5	75
21	72.7	69.2	62.2	63.1	62.5	53.5	48.9	75.1	73
22	75.8	73.7	71.0	68.1	62.6	62.8	51.1	79.3	78
23	76.4	74.5	68.8	68.4	62.9	55.5	47.8	79.5	78
24	74.3	73.7	70.8	69.4	64.4	58.8	54.8	78.7	77
25	74.2	76.2	71.1	68.4	65.1	65.4	52.5	79.8	78
26	76.0	75.7	72.9	70.8	64.6	57.7	50.9	80.5	79
27	72.5	72.3	68.2	65.0	62.9	58.2	53.5	76.8	75
28	76.4	77.8	69.2	67.0	61.2	58.8	50.2	80.8	79
29	76.2	76.3	69.9	65.4	63.7	57.8	49.7	80.0	78
30	67.8	71.4	62.0	53.8	50.6	44.9	52.5	73.4	72
31	66.2	66.5	64.7	62.2	56.6	57.0	48.4	71.5	70
32	60.4	61.5	55.9	54.6	53.8	55.2	46.3	65.8	((64))
33	68.7	64.6	61.6	52.7	59.7	58.5	49.0	71.4	70
34	60.8	56.7	53.4	59.5	59.6	49.7	41.3	65.8	((64))
35	69.2	65.4	56.8	61.6	54.1	44.0	40.8	71.5	70
36	63.7	56.3	47.3	49.6	59.9	45.9	45.6	66.0	((64))
37	66.0	67.1	74.2	76.9	72.1	65.8	56.4	80.2	79
38	63.4	66.2	69.3	72.8	64.8	52.1	46.3	75.7	74
39	66.0	67.1	73.8	76.9	72.1	65.8	56.4	80.1	78
40	65.5	69.2	71.6	77.1	62.8	55.6	47.7	79.0	77
41	64.5	69.0	72.9	75.5	64.7	55.7	48.7	78.4	77
42	72.1	74.8	77.3	77.3	68.0	61.2	57.9	82.1	80
43	72.6	76.9	79.0	80.0	68.2	66.5	62.1	84.1	82
44	70.8	73.1	76.9	78.0	61.8	61.0	61.5	81.7	80
45	60.6	65.9	73.3	76.3	71.3	70.0	54.6	79.7	78
46	62.4	65.0	72.4	75.5	69.0	68.0	60.7	78.6	77
47	63.2	65.5	73.5	73.2	71.2	71.1	55.5	78.8	77
48	67.5	70.5	72.5	71.8	63.9	60.4	57.0	77.3	76
49	72.1	70.5	72.3	75.1	63.7	62.0	55.1	79.1	77
50	62.7	65.7	66.2	65.9	56.5	54.6	46.6	71.6	70
51	62.1	65.0	65.1	65.1	55.8	51.7	43.6	70.7	((69))
52	73.7	78.5	81.4	84.5	72.6	71.9	70.0	87.5	>86<
53	56.7	60.1	61.6	64.0	57.4	55.3	50.5	68.1	((66))
54	54.8	60.9	62.7	64.3	59.2	54.2	42.9	68.6	((67))
55	63.0	62.3	75.3	76.4	71.4	72.0	40.7	80.4	79
56	58.7	61.3	68.8	64.6	59.6	53.7	46.5	71.4	70
57	73.4	75.6	78.4	82.3	75.6	75.0	59.2	85.6	84
58	68.2	66.5	72.3	78.6	62.4	65.0	52.5	80.2	79
59	50.9	53.2	53.6	62.7	63.1	59.2	40.1	67.2	((66))
60	56.6	60.9	83.5	72.0	66.3	66.0	41.4	84.0	82
61	58.0	61.5	56.2	66.2	57.8	59.5	52.4	69.2	((67))
62	66.2	72.2	75.6	77.8	70.8	54.2	47.8	81.1	79
63	55.2	57.2	55.8	62.2	59.5	51.3	44.7	66.0	((64))
64	60.7	57.4	52.0	55.8	55.1	51.7	41.9	64.4	((63))
65	65.8	65.1	69.1	78.2	60.5	51.6	38.3	79.2	77
66	67.9	70.0	70.8	73.0	66.6	55.2	45.7	77.2	76
67	52.4	51.0	47.5	55.0	63.1	52.4	37.6	64.6	((63))
68	67.9	70.0	70.8	73.0	66.6	55.2	45.7	77.2	76
69	52.4	51.0	47.5	55.0	63.1	52.4	37.6	64.6	((63))
70	52.5	58.9	62.0	66.2	62.4	51.1	43.8	69.3	((68))
71	74.1	74.7	73.3	74.5	67.5	57.9	48.7	80.5	79
72	75.2	77.5	80.5	84.9	74.2	70.7	58.7	87.4	>86<
73	67.8	71.1	74.8	77.6	69.4	63.7	55.4	80.7	79
74	64.1	67.7	71.4	74.7	68.5	59.4	52.6	77.8	76
75	54.8	58.7	59.4	65.1	63.9	56.4	44.5	69.1	((67))
76	54.8	58.7	59.4	65.1	63.9	56.4	44.5	69.1	((67))
77	64.0	61.0	71.9	76.4	57.3	51.6	54.0	78.1	76
78	67.2	67.8	70.2	74.8	60.3	54.1	50.6	77.3	76
79	70.6	71.5	68.5	69.6	60.0	61.2	45.5	76.5	75
80	64.0	65.1	65.9	69.2	58.8	54.9	48.3	72.8	71
81	52.1	55.3	61.0	62.0	55.6	48.5	44.2	65.8	((64))
82	60.6	60.9	69.5	71.0	60.0	63.6	59.9	74.5	73
83	70.8	73.1	76.9	78.0	61.8	61.0	61.5	81.7	80

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n *These HPD evaluations are based on standards which may overestimate effectiveness*
HPD details are tabulated in Table A-1.1

Table A-5.18
HPD selection for electric loco operators

	dB-Neq	Mean:	92.7	Max:	104	Min:	80	Obs (n):	22
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	81.9	84.5	86.0	85.8	85.6	81.7	73.0	92.4	92.7
with HPD									
1	79.0	79.6	71.0	62.6	57.5	50.6	48.0	82.7	83
2	77.2	71.6	67.2	63.4	65.9	58.7	55.4	79.0	79
3	75.4	72.3	66.4	67.5	66.2	62.9	52.6	78.3	79
4	79.0	75.3	65.0	67.1	67.1	62.1	53.3	81.1	81
5	77.6	75.1	70.1	67.6	57.9	49.1	43.6	80.3	81
6	74.5	74.9	67.5	63.0	57.3	50.3	40.7	78.3	79
7	76.8	73.7	64.9	59.4	59.1	48.6	38.8	78.8	79
8	76.5	75.1	67.4	62.8	59.1	49.3	41.9	79.3	80
9	71.8	68.8	64.8	57.6	56.2	49.3	46.4	74.3	75
10	71.7	71.7	67.9	58.2	57.3	50.4	46.4	75.7	76
11	78.2	73.6	68.8	59.7	57.9	49.1	47.1	79.9	80
12	76.4	68.8	64.9	59.1	54.4	47.6	44.9	77.4	78
13	71.0	66.7	63.2	53.4	54.2	44.2	38.6	73.0	73
14	76.1	75.1	72.1	62.0	59.9	49.3	47.3	79.6	80
15	81.9	76.7	71.9	64.3	61.8	57.0	54.7	83.5	84
16	78.2	74.4	70.0	61.7	60.1	49.6	42.5	80.3	81
17	81.2	78.7	70.3	62.4	60.6	50.7	43.7	83.4	84
18	77.2	75.0	70.1	64.8	57.2	49.8	48.3	79.9	80
19	74.1	70.6	62.4	57.0	58.4	45.7	36.7	76.0	76
20	77.2	71.4	64.8	58.6	64.9	50.9	41.5	78.6	79
21	76.2	71.8	62.5	57.3	58.5	46.4	42.4	77.8	78
22	79.3	76.3	71.3	62.3	58.6	55.7	44.6	81.6	82
23	79.9	77.1	69.1	62.6	58.9	48.4	41.3	82.0	82
24	77.8	76.3	71.1	63.6	60.4	51.7	48.3	80.8	81
25	77.7	78.8	71.4	62.6	61.1	58.3	46.0	81.8	82
26	79.5	78.3	73.2	65.0	60.6	50.6	44.4	82.6	83
27	76.0	74.9	68.5	59.2	58.9	51.1	47.0	79.0	79
28	79.9	80.4	69.5	61.2	57.2	51.7	43.7	83.4	84
29	79.7	78.9	70.2	59.6	59.7	50.7	43.2	82.6	83
30	71.3	74.0	62.3	48.0	46.6	37.8	46.0	76.1	76
31	69.7	69.1	65.0	56.4	52.6	49.9	41.9	73.3	74
32	63.9	64.1	56.2	48.8	49.8	48.1	39.8	67.5	((68))
33	72.2	67.2	61.9	46.9	55.7	51.4	42.5	73.8	74
34	64.3	59.3	53.7	53.7	55.6	42.6	34.8	66.4	((67))
35	72.7	68.0	57.1	55.8	50.1	36.9	34.3	74.1	74
36	67.2	58.9	47.6	43.8	55.9	38.8	39.1	68.1	((68))
37	69.5	69.7	74.5	71.1	68.1	58.7	49.9	78.2	79
38	66.9	68.8	69.6	67.0	60.8	45.0	39.8	74.4	75
39	69.5	69.7	74.1	71.1	68.1	58.7	49.9	78.1	78
40	69.0	71.8	71.9	71.3	58.8	48.5	41.2	77.2	78
41	68.0	71.6	73.2	69.7	60.7	48.6	42.2	77.2	77
42	75.6	77.4	77.6	71.5	64.0	54.1	51.4	82.2	82
43	76.1	79.5	79.3	74.2	64.2	59.4	55.6	83.9	84
44	74.3	75.7	77.2	72.2	57.8	53.9	55.0	81.3	82
45	64.1	68.5	73.6	70.5	67.3	62.9	48.1	77.1	77
46	65.9	67.6	72.7	69.7	65.0	60.9	54.2	76.3	77
47	66.7	68.1	73.8	67.4	67.2	64.0	49.0	76.9	77
48	71.0	73.1	72.8	66.0	59.9	53.3	50.5	77.6	78
49	75.6	73.1	72.6	69.3	59.7	54.9	48 6	79.3	80
50	66.2	68.3	66.5	60.1	52.5	47.5	40.1	72.2	72
51	65.6	67.6	65.4	59.3	51.8	44.6	37.1	71.4	72
52	77.2	81.1	81.7	78.7	68 6	64.8	63.5	86.2	>86<
53	60.2	62.7	61.9	58.2	53.4	48.2	44.0	67.3	((68))
54	58.3	63.5	63.0	58.5	55 2	47.1	36.4	67.8	((68))
55	66.5	64.9	75.6	70.6	67.4	64.9	34.2	78.1	78
56	62.2	63.9	69.1	58.8	55.6	46.6	40.0	71.3	72
57	76.9	78.2	78.7	76.5	71.6	67.9	52.7	84.1	84
58	71.7	69.1	72.6	72.8	58.4	57.9	46.0	77.9	78
59	54.4	55.8	53.9	56.9	59.1	52.1	33.6	63.7	((64))
60	60.1	63.5	83.8	66.2	62.3	58.9	34.9	84.0	84
61	61.5	64.1	56.5	60.4	53 8	52.4	45 9	67.8	((68))
62	69.7	74 8	75 9	72.0	66.8	47.1	41.3	80.0	80
63	58.7	59.8	56.1	56.4	55.5	44 2	38.2	64.7	((65))
64	64.2	60.0	52.3	50.0	51.1	44.6	35.4	66.1	((66))
65	69.3	67.7	69.4	72.4	56.5	44.5	31.8	76.1	76
66	71.4	72.6	71.1	67.2	62.6	48.1	39.2	77.2	77
67	55.9	53.6	47.8	49.2	59.1	45.3	31.1	62.1	((62))
68	71.4	72.6	71.1	67.2	62.6	48.1	39.2	77.2	77
69	55.9	53.6	47.8	49.2	59.1	45.3	31.1	62.1	((62))
70	56.0	61.5	62.3	60.4	58 4	44.0	37.3	67.3	((68))
71	77.6	77.3	73 6	68.7	63.5	50.8	42.2	81.6	82
72	78.7	80.1	80.8	79.1	70.2	63.6	52.2	85.9	>86<
73	71.3	73.7	75.1	71.8	65.4	56.6	48.9	79.5	80
74	67.6	70.3	71.7	68.9	64.5	52.3	46.1	76.2	77
75	58 3	61.3	59.7	59.3	59.9	49.3	38.0	66.9	((67))
76	58.3	61.3	59.7	59.3	59.9	49.3	38.0	66.9	((67))
77	67.5	63.6	72.2	70.6	53.3	44.5	47.5	75.6	76
78	70 7	70.4	70 5	69.0	56.3	47.0	44.1	76.3	77
79	74.1	74.1	68.8	63.8	56 0	54.1	39 0	77.9	78
80	67.5	67.7	66.2	63.4	54.8	47.8	41.8	72.6	73
81	55.6	57.9	61.3	56.2	51.6	41.4	37.7	64.6	((65))
82	64.1	63.5	69.8	65.2	56.0	56.5	53.4	72.7	73
83	74.3	75.7	77.2	72.2	57.8	53.9	55.0	81 3	82

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-5.19
HPD selection for tramming personnel

	dB-Neq	Mean:	96.6	Max:	103	Min:	92	Obs (n):	23
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	78.4	83.2	88.9	91.3	95.1	88.8	73.7	98.1	96.6
with HPD									
1	75.5	78.3	73.9	68.1	67.0	57.7	48.7	81.5	80
2	73.7	70.3	70.1	68.9	75.4	65.8	56.1	79.6	78
"3"	71.9	71.0	69.3	73.0	75.7	70.0	53.3	80.2	79
"4"	75.5	74.0	67.9	72.6	76.6	69.2	54.0	81.4	80
5	74.1	73.8	73.0	73.1	67.4	56.2	44.3	79.8	78
6	71.0	73.6	70.4	68.5	66.8	57.4	41.4	77.7	76
"7"	73.3	72.4	67.8	64.9	68.6	55.7	39.5	77.4	76
8	73.0	73.8	70.3	68.3	68.6	56.4	42.6	78.4	77
"9"	68.3	67.5	67.7	63.1	65.7	56.4	47.1	73.9	72
10	68.2	70.4	70.8	63.7	66.8	57.5	47.1	75.7	74
11	74.7	72.3	71.7	65.2	67.4	56.2	47.8	78.5	77
12	72.9	67.5	67.8	64.6	63.9	54.7	45.6	75.7	74
13	67.5	65.4	66.1	58.9	63.7	51.3	39.3	72.2	71
14	72.6	73.8	75.0	67.5	69.4	56.4	48.0	79.5	78
15	78.4	75.4	74.8	69.8	71.3	64.1	55.4	82.0	81
16	74.7	73.1	72.9	67.2	69.6	56.7	43.2	79.3	78
17	77.7	77.4	73.2	67.9	70.1	57.8	44.4	81.8	80
18	73.7	73.7	73.0	70.3	66.7	56.9	49.0	79.2	78
19	70.6	69.3	65.3	62.5	67.9	52.8	37.4	75.0	74
20	73.7	70.1	67.7	64.1	74.4	58.0	42.2	78.5	77
21	72.7	70.5	65.4	62.8	68.0	53.5	43.1	76.2	75
22	75.8	75.0	74.2	67.8	68.1	62.8	45.3	80.4	79
23	76.4	75.8	72.0	68.1	68.4	55.5	42.0	80.5	79
24	74.3	75.0	74.0	69.1	69.9	58.8	49.0	80.1	79
25	74.2	77.5	74.3	68.1	70.6	65.4	46.7	81.2	80
26	76.0	77.0	76.1	70.5	70.1	57.7	45.1	81.8	80
27	72.5	73.6	71.4	64.7	68.4	58.2	47.7	78.1	77
28	76.4	79.1	72.4	66.7	66.7	58.8	44.4	81.8	80
29	76.2	77.6	73.1	65.1	69.2	57.8	43.9	81.2	80
"30"	67.8	72.7	65.2	53.5	56.1	44.9	46.7	74.6	73
"31"	66.2	67.8	67.9	61.9	62.1	57.0	42.6	73.0	72
"32"	60.4	62.8	59.1	54.3	59.3	55.2	40.5	67.2	((66))
33	68.7	65.9	64.8	52.4	65.2	58.5	43.2	72.7	71
34	60.8	58.0	56.6	59.2	65.1	49.7	35.5	68.1	((67))
35	69.2	66.7	60.0	61.3	59.6	44.0	35.0	72.1	71
36	63.7	57.6	50.5	49.3	65.4	45.9	39.8	68.2	((67))
37	66.0	68.4	77.4	76.6	77.6	65.8	50.6	82.4	81
"38"	63.4	67.5	72.5	72.5	70.3	52.1	40.5	77.3	76
39	66.0	68.4	77.0	76.6	77.6	65.8	50.6	82.3	81
40	65.5	70.5	74.8	76.8	68.3	55.6	41.9	80.0	79
"41"	64.5	70.3	76.1	75.2	70.2	55.7	42.9	79.9	78
42	72.1	76.1	80.5	77.0	73.5	61.2	52.1	83.9	82
43	72.6	78.2	82.2	79.7	73.7	66.5	56.3	85.7	84
44	70.8	74.4	80.1	77.7	67.3	61.0	55.7	83.2	82
45	60.6	67.2	76.5	76.0	76.8	70.0	48.8	81.7	80
46	62.4	66.3	75.6	75.2	74.5	68.0	54.9	80.4	79
47	63.2	66.8	76.7	72.9	76.7	71.1	49.7	81.2	80
"48"	67.5	71.8	75.7	71.5	69.4	60.4	51.2	79.1	78
"49"	72.1	71.8	75.5	74.8	69.2	62.0	49.3	80.3	79
"50"	62.7	67.0	69.4	65.6	62.0	54.6	40.8	73.2	72
"51"	62.1	66.3	68.3	64.8	61.3	51.7	37.8	72.3	71
52	73.7	79.8	84.6	84.2	78.1	71.9	64.2	88.8	>87<
"53"	56.7	61.4	64.8	63.7	62.9	55.3	44.7	69.8	((68))
"54"	54.8	62.2	65.9	64.0	64.7	54.2	37.1	70.6	((69))
"55"	63.0	63.6	78.5	76.1	76.9	72.0	34.9	82.6	81
"56"	58.7	62.6	72.0	64.3	65.1	53.7	40.7	73.9	72
57	73.4	76.9	81.6	82.0	81.1	75.0	53.4	87.3	>86<
58	68.2	67.8	75.5	78.3	67.9	65.0	46.7	81.0	79
"59"	50.9	54.5	56.8	62.4	68.6	59.2	34.3	70.3	((69))
"60"	56.6	62.2	86.7	71.7	71.8	66.0	35.6	87.0	>86<
"61"	58.0	62.8	59.4	65.9	63.3	59.5	46.6	70.2	((69))
62	66.2	73.5	78.8	77.5	76.3	54.2	42.0	83.0	82
"63"	55.2	58.5	59.0	61.9	65.0	51.3	38.9	68.3	((67))
"64"	60.7	58.7	55.2	55.5	60.6	51.7	36.1	65.9	((64))
65	65.8	66.4	72.3	77.9	66.0	51.6	32.5	79.6	78
66	67.9	71.3	74.0	72.7	72.1	55.2	39.9	79.0	78
"67"	52.4	52.3	50.7	54.7	68.6	52.4	31.8	69.1	((68))
68	67.9	71.3	74.0	72.7	72.1	55.2	39.9	79.0	78
"69"	52.4	52.3	50.7	54.7	68.6	52.4	31.8	69.1	((68))
70	52.5	60.2	65.2	65.9	67.9	51.1	38.0	71.7	70
71	74.1	76.0	76.5	74.2	73.0	57.9	42.9	82.0	80
72	75.2	78.8	83.7	84.6	79.7	70.7	52.9	88.7	>87<
73	67.8	72.4	78.0	77.3	74.9	63.7	49.6	82.4	81
74	64.1	69.0	74.6	74.4	74.0	59.4	46.8	79.7	78
"75"	54.8	60.0	62.6	64.8	69.4	56.4	38.7	71.8	70
"76"	54.8	60.0	62.6	64.8	69.4	56.4	38.7	71.8	70
"77"	64.0	62.3	75.1	76.1	62.8	51.6	48.2	79.0	78
"78"	67.2	69.1	73.4	74.5	65.8	54.1	44.8	78.3	77
79	70.6	72.8	71.7	69.3	65.5	61.2	39.7	77.7	76
80	64.0	66.4	69.1	68.9	64.3	54.9	42.5	74.1	73
81	52.1	56.6	64.2	61.7	61.1	48.5	38.4	67.8	((66))
82	60.6	62.2	72.7	70.7	65.5	63.6	54.1	75.9	74
83	70.8	74.4	80.1	77.7	67.3	61.0	55.7	83.2	82

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
"n" These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-5.20
HPD selection for tips personnel

	dB-Neq	Mean:	94.7	Max:	103	Min:	80	Obs (n):	16
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	80.0	85.2	89.7	92.8	92.3	88.1	81.2	97.6	94.7
with HPD									
1	77.1	80.3	74.7	69.6	64.2	57.0	56.2	83.0	80
2	75.3	72.3	70.9	70.4	72.6	65.1	63.6	79.9	77
"3"	73.5	73.0	70.1	74.5	72.9	69.3	60.8	80.4	78
"4"	77.1	76.0	68.7	74.1	73.8	68.5	61.5	82.0	79
5	75.7	75.8	73.8	74.6	64.6	55.5	51.8	81.2	78
6	72.6	75.6	71.2	70.0	64.0	56.7	48.9	79.1	76
"7"	74.9	74.4	68.6	66.4	65.8	55.0	47.0	78.7	76
8	74.6	75.8	71.1	69.8	65.8	55.7	50.1	79.7	77
"9"	69.9	69.5	68.5	64.6	62.9	55.7	54.6	74.9	72
10	69.8	72.4	71.6	65.2	64.0	56.8	54.6	76.8	74
11	76.3	74.3	72.5	66.7	64.6	55.5	55.3	79.8	77
12	74.5	69.5	68.6	66.1	61.1	54.0	53.1	77.0	74
13	69.1	67.4	66.9	60.4	60.9	50.6	46.8	73.2	70
14	74.2	75.8	75.8	69.0	66.6	55.7	55.5	80.6	78
15	80.0	77.4	75.6	71.3	68.5	63.4	62.9	83.3	80
16	76.3	75.1	73.7	68.7	66.8	56.0	50.7	80.5	78
17	79.3	79.4	74.0	69.4	67.3	57.1	51.9	83.3	80
18	75.3	75.7	73.8	71.8	63.9	56.2	56.5	80.5	78
19	72.2	71.3	66.1	64.0	65.1	52.1	44.9	76.0	73
20	75.3	72.1	68.5	65.6	71.6	57.3	49.7	78.8	76
21	74.3	72.5	66.2	64.3	65.2	52.8	50.6	77.4	75
22	77.4	77.0	75.0	69.3	65.3	62.1	52.8	81.8	79
23	78.0	77.8	72.8	69.6	65.6	54.8	49.5	81.9	79
24	75.9	77.0	74.8	70.6	67.1	58.1	56.5	81.4	78
25	75.8	79.5	75.1	69.6	67.8	64.7	54.2	82.5	80
26	77.6	79.0	76.9	72.0	67.3	57.0	52.6	83.2	80
27	74.1	75.6	72.2	66.2	65.6	57.5	55.2	79.4	77
28	78.0	81.1	73.2	68.2	63.9	58.1	51.9	83.5	81
29	77.8	79.6	73.9	66.6	66.4	57.1	51.4	82.7	80
"30"	69.4	74.7	66.0	55.0	53.3	44.2	54.2	76.3	73
"31"	67.8	69.8	68.7	63.4	59.3	56.3	50.1	74.2	71
"32"	62.0	64.8	59.9	55.8	56.5	54.5	48.0	68.3	((65))
33	70.3	67.9	65.6	53.9	62.4	57.8	50.7	73.7	71
34	62.4	60.0	57.4	60.7	62.3	49.0	43.0	68.0	((65))
35	70.8	68.7	60.8	62.8	56.8	43.3	42.5	73.6	71
36	65.3	59.6	51.3	50.8	62.6	45.2	47.3	68.1	((65))
37	67.6	70.4	78.2	78.1	74.8	65.1	58.1	82.6	80
"38"	65.0	69.5	73.3	74.0	67.5	51.4	48.0	78.1	75
39	67.6	70.4	77.8	78.1	74.8	65.1	58.1	82.4	80
40	67.1	72.5	75.6	78.3	65.5	54.9	49.4	81.2	78
"41"	66.1	72.3	76.9	76.7	67.4	55.0	50.4	80.9	78
42	73.7	78.1	81.3	78.5	70.7	60.5	59.6	84.9	82
43	74.2	80.2	83.0	81.2	70.9	65.8	63.8	86.8	84
44	72.4	76.4	80.9	79.2	64.5	60.3	63.2	84.4	81
45	62.2	69.2	77.3	77.5	74.0	69.3	56.3	81.9	79
46	64.0	68.3	76.4	76.7	71.7	67.3	62.4	80.8	78
47	64.8	68.8	77.5	74.4	73.9	70.4	57.2	81.2	78
"48"	69.1	73.8	76.5	73.0	66.6	59.7	58.7	80.1	77
"49"	73.7	73.8	76.3	76.3	66.4	61.3	56.8	81.4	79
"50"	64.3	69.0	70.2	67.1	59.2	53.9	48.3	74.4	71
"51"	63.7	68.3	69.1	66.3	58.5	51.0	45.3	73.5	71
52	75.3	81.8	85.4	85.7	75.3	71.2	71.7	89.8	>87<
"53"	58.3	63.4	65.6	65.2	60.1	54.6	52.2	70.5	((68))
"54"	56.4	64.2	66.7	65.5	61.9	53.5	44.6	71.2	((68))
"55"	64.6	65.6	79.3	77.6	74.1	71.3	42.4	82.8	80
"56"	60.3	64.6	72.8	65.8	62.3	53.0	48.2	74.6	72
57	75.0	78.9	82.4	83.5	78.3	74.3	60.9	87.8	85
58	69.8	69.8	76.3	79.8	65.1	64.3	54.2	82.1	79
"59"	52.5	56.5	57.6	63.9	65.8	58.5	41.8	69.1	((66))
"60"	58.2	64.2	87.5	73.2	69.0	65.3	43.1	87.8	85
"61"	59.6	64.8	60.2	67.4	60.5	58.8	54.1	71.0	((68))
62	67.8	75.5	79.6	79.0	73.5	53.5	49.5	83.7	81
"63"	56.8	60.5	59.8	63.4	62.2	50.6	46.4	68.2	((65))
"64"	62.3	60.7	56.0	57.0	57.8	51.0	43.6	66.6	((64))
65	67.4	68.4	73.1	79.4	63.2	50.9	40.0	80.9	78
66	69.5	73.3	74.8	74.2	69.3	54.5	47.4	79.8	77
"67"	54.0	54.3	51.5	56.2	65.8	51.7	39.3	67.0	((64))
68	69.5	73.3	74.8	74.2	69.3	54.5	47.4	79.8	77
"69"	54.0	54.3	51.5	56.2	65.8	51.7	39.3	67.0	((64))
70	54.1	62.2	66.0	67.4	65.1	50.4	45.5	71.7	((69))
71	75.7	78.0	77.3	75.7	70.2	57.2	50.4	83.1	80
72	76.8	80.8	84.5	86.1	76.9	70.0	60.4	89.6	>87<
73	69.4	74.4	78.8	78.8	72.1	63.0	57.1	83.2	80
74	65.7	71.0	75.4	75.9	71.2	58.7	54.3	80.2	77
"75"	56.4	62.0	63.4	66.3	66.6	55.7	46.2	71.3	((68))
"76"	56.4	62.0	63.4	66.3	66.6	55.7	46.2	71.3	((68))
"77"	65.6	64.3	75.9	77.6	60.0	50.9	55.7	80.2	77
"78"	68.8	71.1	74.2	76.0	63.0	53.4	52.3	79.5	77
79	72.2	74.8	72.5	70.8	62.7	60.5	47.2	79.0	76
80	65.6	68.4	69.9	70.4	61.5	54.2	50.0	75.2	72
81	53.7	58.6	65.0	63.2	58.3	47.8	45.9	68.4	((66))
82	62.2	64.2	73.5	72.2	62.7	62.9	61.6	76.9	74
83	72.4	76.4	80.9	79.2	64.5	60.3	63.2	84.4	81

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
"n" These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-5.21
HPD selection for onsetters' teams

	dB-Neq	Mean:	92.1	Max:	102	Min:	81	Obs (n):	21
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	82.6	86.4	89.9	93.6	95.3	93.3	88.4	100.0	92.1
with HPD									
1	79.7	81.5	74.9	70.4	67.2	62.2	63.4	84.6	77
2	77.9	73.5	71.1	71.2	75.6	70.3	70.8	82.3	74
3	76.1	74.2	70.3	75.3	75.9	74.5	68.0	82.7	75
4	79.7	77.2	68.9	74.9	76.8	73.7	68.7	84.2	76
5	78.3	77.0	74.0	75.4	67.6	60.7	59.0	82.7	75
6	75.2	76.8	71.4	70.8	67.0	61.9	56.1	80.6	73
7	77.5	75.6	68.8	67.2	68.8	60.2	54.2	80.6	73
8	77.2	77.0	71.3	70.6	68.8	60.9	57.3	81.4	73
9	72.5	70.7	68.7	65.4	65.9	60.9	61.8	76.7	((69))
10	72.4	73.6	71.8	66.0	67.0	62.0	61.8	78.3	70
11	78.9	75.5	72.7	67.5	67.6	60.7	62.5	81.6	74
12	77.1	70.7	68.8	66.9	64.1	59.2	60.3	79.0	71
13	71.7	68.6	67.1	61.2	63.9	55.8	54.0	75.0	((67))
14	76.8	77.0	76.0	69.8	69.6	60.9	62.7	82.0	74
15	82.6	78.6	75.8	72.1	71.5	68.6	70.1	85.3	77
16	78.9	76.3	73.9	69.5	69.8	61.2	57.9	82.2	74
17	81.9	80.6	74.2	70.2	70.3	62.3	59.1	85.0	77
18	77.9	76.9	74.0	72.6	66.9	61.4	63.7	82.1	74
19	74.8	72.5	66.3	64.8	68.1	57.3	52.1	78.0	70
20	77.9	73.3	68.7	66.4	74.6	62.5	56.9	81.0	73
21	76.9	73.7	66.4	65.1	68.2	58.0	57.8	79.4	71
22	80.0	78.2	75.2	70.1	68.3	67.3	60.0	83.5	76
23	80.6	79.0	73.0	70.4	68.6	60.0	56.7	83.7	76
24	78.5	78.2	75.0	71.4	70.1	63.3	63.7	82.9	75
25	78.4	80.7	75.3	70.4	70.8	69.9	61.4	84.1	76
26	80.2	80.2	77.1	72.8	70.3	62.2	59.8	84.7	77
27	76.7	76.8	72.4	67.0	68.6	62.7	62.4	81.1	73
28	80.6	82.3	73.4	69.0	66.9	63.3	59.1	85.1	77
29	80.4	80.8	74.1	67.4	69.4	62.3	58.6	84.3	76
30	72.0	75.9	66.2	55.8	56.3	49.4	61.4	77.9	70
31	70.4	71.0	68.9	64.2	62.3	61.5	57.3	75.8	((68))
32	64.6	66.0	60.1	56.6	59.5	59.7	55.2	70.2	((62))
33	72.9	69.1	65.8	54.7	65.4	63.0	57.9	75.8	((68))
34	65.0	61.2	57.6	61.5	65.3	54.2	50.2	70.1	((62))
35	73.4	69.9	61.0	63.6	59.8	48.5	49.7	75.6	((68))
36	67.9	60.8	51.5	51.6	65.6	50.4	54.5	70.7	((63))
37	70.2	71.6	78.4	78.9	77.8	70.3	65.3	83.9	76
38	67.6	70.7	73.5	74.8	70.5	56.6	55.2	79.1	71
39	70.2	71.6	78.0	78.9	77.8	70.3	65.3	83.8	76
40	69.7	73.7	75.8	79.1	68.5	60.1	56.6	82.1	74
41	68.7	73.5	77.1	77.5	70.4	60.2	57.6	81.8	74
42	76.3	79.3	81.5	79.3	73.7	65.7	66.8	85.9	78
43	76.8	81.4	83.2	82.0	73.9	71.0	71.0	87.8	80
44	75.0	77.6	81.1	80.0	67.5	65.5	70.4	85.3	77
45	64.8	70.4	77.5	78.3	77.0	74.5	63.5	83.4	75
46	66.6	69.5	76.6	77.5	74.7	72.5	69.6	82.4	74
47	67.4	70.0	77.7	75.2	76.9	75.6	64.4	82.9	75
48	71.7	75.0	76.7	73.8	69.6	64.9	65.9	81.2	73
49	76.3	75.0	76.5	77.1	69.4	66.5	64.0	82.7	75
50	66.9	70.2	70.4	67.9	62.2	59.1	55.5	75.5	((68))
51	66.3	69.5	69.3	67.1	61.5	56.2	52.5	74.6	((67))
52	77.9	83.0	85.6	86.5	78.3	76.4	78.9	91.0	83
53	60.9	64.6	65.8	66.0	63.1	59.8	59.4	72.0	((64))
54	59.0	65.4	66.9	66.3	64.9	58.7	51.8	72.4	((64))
55	67.2	66.8	79.5	78.4	77.1	76.5	49.6	84.2	76
56	62.9	65.8	73.0	66.6	65.3	58.2	55.4	75.4	((67))
57	77.6	80.1	82.6	84.3	81.3	79.5	68.1	89.3	81
58	72.4	71.0	76.5	80.6	68.1	69.5	61.4	83.1	75
59	55.1	57.7	57.8	64.7	68.8	63.7	49.0	71.6	((64))
60	60.8	65.4	87.7	74.0	72.0	70.5	50.3	88.1	80
61	62.2	66.0	60.4	68.2	63.5	64.0	61.3	72.9	((65))
62	70.4	76.7	79.8	79.8	76.5	58.7	56.7	84.7	77
63	59.4	61.7	60.0	64.2	65.2	55.8	53.6	70.0	((62))
64	64.9	61.9	56.2	57.8	60.8	56.2	50.8	68.7	((61))
65	70.0	69.6	73.3	80.2	66.2	56.1	47.2	81.8	74
66	72.1	74.5	75.0	75.0	72.3	59.7	54.6	81.0	73
67	56.6	55.5	51.7	57.0	68.8	56.9	46.5	69.8	((62))
68	72.1	74.5	75.0	75.0	72.3	59.7	54.6	81.0	73
69	56.6	55.5	51.7	57.0	68.8	56.9	46.5	69.8	((62))
70	56.7	63.4	66.2	68.2	68.1	55.6	52.7	73.1	((65))
71	78.3	79.2	77.5	76.5	73.2	62.4	57.6	84.4	76
72	79.4	82.0	84.7	86.9	79.9	75.2	67.6	90.7	83
73	72.0	75.6	79.0	79.6	75.1	68.2	64.3	84.2	76
74	68.3	72.2	75.6	76.7	74.2	63.9	61.5	81.4	73
75	59.0	63.2	63.6	67.1	69.6	60.9	53.4	73.2	((65))
76	59.0	63.2	63.6	67.1	69.6	60.9	53.4	73.2	((65))
77	68.2	65.5	76.1	78.4	63.0	56.1	62.9	80.9	73
78	71.4	72.3	74.4	76.8	66.0	58.6	59.5	80.5	73
79	74.8	76.0	72.7	71.6	65.7	65.7	54.4	80.4	72
80	68.2	69.6	70.1	71.2	64.5	59.4	57.2	76.4	((68))
81	56.3	59.8	65.2	64.0	61.3	53.0	53.1	69.5	((62))
82	64.8	65.4	73.7	73.0	65.7	68.1	68.8	78.3	70
83	75.0	77.6	81.1	80.0	67.5	65.5	70.4	85.3	77

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-5.22
HPD selection for underground artisans

	dB-Neq	Mean:	93.7	Max:	101	Min:	82	Obs (n):	41
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	79.9	86.9	93.2	102.3	103.7	99.8	94.0	107.4	101
with HPD									
1	77.0	82.0	78.2	79.1	75.6	68.7	69.0	86.1	80
2	75.2	74.0	74.4	79.9	84.0	76.8	76.4	87.2	81
"3"	73.4	74.7	73.6	84.0	84.3	81.0	73.6	88.7	82
"4"	77.0	77.7	72.2	83.6	85.2	80.2	74.3	89.1	83
5	75.6	77.5	77.3	84.1	76.0	67.2	64.6	86.5	80
6	72.5	77.3	74.7	79.5	75.4	68.4	61.7	83.7	77
"7"	74.8	76.1	72.1	75.9	77.2	66.7	59.8	82.7	76
8	74.5	77.5	74.6	79.3	77.2	67.4	62.9	84.1	78
"9"	69.8	71.2	72.0	74.1	74.3	67.4	67.4	80.1	74
10	69.7	74.1	75.1	74.7	75.4	68.5	67.4	81.6	75
11	76.2	76.0	76.0	76.2	76.0	67.2	68.1	83.3	77
12	74.4	71.2	72.1	75.6	72.5	65.7	65.9	80.7	74
13	69.0	69.1	70.4	69.9	72.3	62.3	59.6	77.5	71
14	74.1	77.5	79.3	78.5	78.0	67.4	68.3	85.0	79
15	79.9	79.1	79.1	80.8	79.9	75.1	75.7	87.4	81
16	76.2	76.8	77.2	78.2	78.2	67.7	63.5	84.5	78
17	79.2	81.1	77.5	78.9	78.7	68.8	64.7	86.3	80
18	75.2	77.4	77.3	81.3	75.3	67.9	69.3	85.1	79
19	72.1	73.0	69.6	73.5	76.5	63.8	57.7	80.6	74
20	75.2	73.8	72.0	75.1	83.0	69.0	62.5	85.0	79
21	74.2	74.2	69.7	73.8	76.6	64.5	63.4	81.4	75
22	77.3	78.7	78.5	78.8	76.7	73.8	65.6	85.4	79
23	77.9	79.5	76.3	79.1	77.0	66.5	62.3	85.2	79
24	75.8	78.7	78.3	80.1	78.5	69.8	69.3	85.7	79
25	75.7	81.2	78.6	79.1	79.2	76.4	67.0	86.6	80
26	77.5	80.7	80.4	81.5	78.7	68.7	65.4	87.1	81
27	74.0	77.3	75.7	75.7	77.0	69.2	68.0	83.4	77
28	77.9	82.8	76.7	77.7	75.3	69.8	64.7	86.1	80
29	77.7	81.3	77.4	76.1	77.8	68.8	64.2	85.6	79
"30"	69.3	76.4	69.5	64.5	64.7	55.9	67.0	78.6	72
"31"	67.7	71.5	72.2	72.9	70.7	68.0	62.9	78.8	72
"32"	61.9	66.5	63.4	65.3	67.9	66.2	60.8	73.6	((67))
33	70.2	69.6	69.1	63.4	73.8	69.5	63.5	78.1	72
34	62.3	61.7	60.9	70.2	73.7	60.7	55.8	76.0	70
35	70.7	70.4	64.3	72.3	68.2	55.0	55.3	77.0	71
36	65.2	61.3	54.8	60.3	74.0	56.9	60.1	75.1	((69))
37	67.5	72.1	81.7	87.6	86.2	76.8	70.9	90.9	84
"38"	64.9	71.2	76.8	83.5	78.9	63.1	60.8	85.7	79
39	67.5	72.1	81.3	87.6	86.2	76.8	70.9	90.8	84
40	67.0	74.2	79.1	87.8	76.9	66.6	62.2	88.9	82
"41"	66.0	74.0	80.4	86.2	78.8	66.7	63.2	88.0	82
42	73.6	79.8	84.8	88.0	82.1	72.2	72.4	91.0	85
43	74.1	81.9	86.5	90.7	82.3	77.5	76.6	93.2	>87<
44	72.3	78.1	84.4	88.7	75.9	72.0	76.0	90.8	84
45	62.1	70.9	80.8	87.0	85.4	81.0	69.1	90.5	84
46	63.9	70.0	79.9	86.2	83.1	79.0	75.2	89.3	83
47	64.7	70.5	81.0	83.9	85.3	82.1	70.0	89.5	83
"48"	69.0	75.5	80.0	82.5	78.0	71.4	71.5	86.2	80
"49"	73.6	75.5	79.8	85.8	77.8	73.0	69.6	87.9	82
"50"	64.2	70.7	73.7	76.6	70.6	65.6	61.1	80.0	74
"51"	63.6	70.0	72.6	75.8	69.9	62.7	58.1	79.1	73
52	75.2	83.5	88.9	95.2	86.7	82.9	84.5	97.2	>91<
"53"	58.2	65.1	69.1	74.7	71.5	66.3	65.0	78.0	72
"54"	56.3	65.9	70.2	75.0	73.3	65.2	57.4	78.6	72
"55"	64.5	67.3	82.8	87.1	85.5	83.0	55.2	91.0	85
"56"	60.2	66.3	76.3	75.3	73.7	64.7	61.0	80.4	74
57	74.9	80.6	85.9	93.0	89.7	86.0	73.7	95.9	>89<
58	69.7	71.5	79.8	89.3	76.5	76.0	67.0	90.3	84
"59"	52.4	58.2	61.1	73.4	77.2	70.2	54.6	79.4	73
"60"	58.1	65.9	91.0	82.7	80.4	77.0	55.9	92.1	>86<
"61"	59.5	66.5	63.7	76.9	71.9	70.5	66.9	79.5	73
62	67.7	77.2	83.1	88.5	84.9	65.2	62.3	91.1	85
"63"	56.7	62.2	63.3	72.9	73.6	62.3	59.2	76.9	71
"64"	62.2	62.4	59.5	66.5	69.2	62.7	56.4	72.9	((66))
65	67.3	70.1	76.6	88.9	74.6	62.6	52.8	89.4	83
66	69.4	75.0	78.3	83.7	80.7	66.2	60.2	86.7	80
"67"	53.9	56.0	55.0	65.7	77.2	63.4	52.1	77.7	71
68	69.4	75.0	78.3	83.7	80.7	66.2	60.2	86.7	80
"69"	53.9	56.0	55.0	65.7	77.2	63.4	52.1	77.7	71
70	54.0	63.9	69.5	76.9	76.5	62.1	58.3	80.3	74
71	75.6	79.7	80.8	85.2	81.6	68.9	63.2	88.7	82
72	76.7	82.5	88.0	95.6	88.3	81.7	73.2	97.3	>91<
73	69.3	76.1	82.3	88.3	83.5	74.7	69.9	90.6	84
74	65.6	72.7	78.9	85.4	82.6	70.4	67.1	88.1	82
"75"	56.3	63.7	66.9	75.8	78.0	67.4	59.0	80.6	74
"76"	56.3	63.7	66.9	75.8	78.0	67.4	59.0	80.6	74
"77"	65.5	66.0	79.4	87.1	71.4	62.6	68.5	88.0	82
"78"	68.7	72.8	77.7	85.5	74.4	65.1	65.1	86.8	80
79	72.1	76.5	76.0	80.3	74.1	72.2	60.0	84.0	78
80	65.5	70.1	73.4	79.9	72.9	65.9	62.8	82.0	76
81	53.6	60.3	68.5	72.7	69.7	59.5	58.7	75.8	((69))
82	62.1	65.9	77.0	81.7	74.1	74.6	74.4	84.6	78
83	72.3	78.1	84.4	88.7	75.9	72.0	76.0	90.8	84

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
"n" These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-5.23

HPD selection for main fan attendants

	dB-Neq	Mean:	109.0	Max:	112	Min:	86	Obs (n):	6
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	92.8	105.1	105.7	105.0	102.2	102.9	97.7	111.6	109.0
with HPD									
1	89.9	100.2	90.7	81.8	74.1	71.8	72.7	101.1	>98<
2	88.1	92.2	86.9	82.6	82.5	79.9	80.1	95.3	>93<
3	86.3	92.9	86.1	86.7	82.8	84.1	77.3	95.7	>93<
4	89.9	95.9	84.7	86.3	83.7	83.3	78.0	97.9	>95<
5	88.5	95.7	89.8	86.8	74.5	70.3	68.3	97.7	>95<
6	85.4	95.5	87.2	82.2	73.9	71.5	65.4	96.7	>94<
7	87.7	94.3	84.6	78.6	75.7	69.8	63.5	95.7	>93<
8	87.4	95.7	87.1	82.0	75.7	70.5	66.6	97.0	>94<
9	82.7	89.4	84.5	76.8	72.8	70.5	71.1	91.6	>89<
10	82.6	92.3	87.6	77.4	73.9	71.6	71.1	94.1	>91<
11	89.1	94.2	88.5	78.9	74.5	70.3	71.8	96.3	>94<
12	87.3	89.4	84.6	78.3	71.0	68.8	69.6	92.5	>90<
13	81.9	87.3	82.9	72.6	70.8	65.4	63.3	89.7	>87<
14	87.0	95.7	91.8	81.2	76.5	70.5	72.0	97.7	>95<
15	92.8	97.3	91.6	83.5	78.4	78.2	79.4	99.6	>97<
16	89.1	95.0	89.7	80.9	76.7	70.8	67.2	97.1	>94<
17	92.1	99.3	90.0	81.6	77.2	71.9	68.4	100.6	>98<
18	88.1	95.6	89.8	84.0	73.8	71.0	73.0	97.4	>95<
19	85.0	91.2	82.1	76.2	75.0	66.9	61.4	92.7	>90<
20	88.1	92.0	84.5	77.8	81.5	72.1	66.2	94.4	>92<
21	87.1	92.4	82.2	76.5	75.1	67.6	67.1	94.0	>91<
22	90.2	96.9	91.0	81.5	75.2	76.9	69.3	98.7	>96<
23	90.8	97.7	88.8	81.8	75.5	69.6	66.0	99.1	>96<
24	88.7	96.9	90.8	82.8	77.0	72.9	73.0	98.5	>96<
25	88.6	99.4	91.1	81.8	77.7	79.5	70.7	100.4	>98<
26	90.4	98.9	92.9	84.2	77.2	71.8	69.1	100.5	>98<
27	86.9	95.5	88.2	78.4	75.5	72.3	71.7	96.8	>94<
28	90.8	101.0	89.2	80.4	73.8	72.9	68.4	101.7	>99<
29	90.6	99.5	89.9	78.8	76.3	71.9	67.9	100.5	>98<
30	82.2	94.6	82.0	67.2	63.2	59.0	70.7	95.1	>92<
31	80.6	89.7	84.7	75.6	69.2	71.1	66.6	91.5	>89<
32	74.8	84.7	75.9	68.0	66.4	69.3	64.5	85.9	83
33	83.1	87.8	81.6	66.1	72.3	72.6	67.2	90.0	>87<
34	75.2	79.9	73.4	72.9	72.2	63.8	59.5	82.8	80
35	83.6	88.6	76.8	75.0	66.7	58.1	59.0	90.2	>88<
36	78.1	79.5	67.3	63.0	72.5	60.0	63.8	82.6	80
37	80.4	90.3	94.2	90.3	84.7	79.9	74.6	97.2	>95<
38	77.8	89.4	89.3	86.2	77.4	66.2	64.5	93.5	>91<
39	80.4	90.3	93.8	90.3	84.7	79.9	74.6	97.1	>94<
40	79.9	92.4	91.6	90.5	75.4	69.7	65.9	96.5	>94<
41	78.9	92.2	92.9	88.9	77.3	69.8	66.9	96.6	>94<
42	86.5	98.0	97.3	90.7	80.6	75.3	76.1	101.3	>99<
43	87.0	100.1	99.0	93.4	80.8	80.6	80.3	103.3	>101<
44	85.2	96.3	96.9	91.4	74.4	75.1	79.7	100.4	>98<
45	75.0	89.1	93.3	89.7	83.9	84.1	72.8	96.5	>94<
46	76.8	88.2	92.4	88.9	81.6	82.1	78.9	95.6	>93<
47	77.6	88.7	93.5	86.6	83.8	85.2	73.7	96.1	>94<
48	81.9	93.7	92.5	85.2	76.5	74.5	75.2	96.7	>94<
49	86.5	93.7	92.3	88.5	76.3	76.1	73.3	97.2	>95<
50	77.1	88.9	86.2	79.3	69.1	68.7	64.8	91.3	>89<
51	76.5	88.2	85.1	78.5	68.4	65.8	61.8	90.5	>88<
52	88.1	101.7	101.4	97.9	85.2	86.0	88.2	105.7	>103<
53	71.1	83.3	81.6	77.4	70.0	69.4	68.7	86.6	84
54	69.2	84.1	82.7	77.7	71.8	68.3	61.1	87.3	85
55	77.4	85.5	95.3	89.8	84.0	86.1	58.9	97.3	>95<
56	73.1	84.5	88.8	78.0	72.2	67.8	64.7	90.6	>88<
57	87.8	98.8	98.4	95.7	88.2	89.1	77.4	103.1	>100<
58	82.6	89.7	92.3	92.0	75.0	79.1	70.7	96.6	>94<
59	65.3	76.4	73.6	76.1	75.7	73.3	58.3	82.3	80
60	71.0	84.1	103.5	85.4	78.9	80.1	59.6	103.7	>101<
61	72.4	84.7	76.2	79.6	70.4	73.6	70.6	86.9	84
62	80.6	95.4	95.6	91.2	83.4	68.3	66.0	99.4	>97<
63	69.6	80.4	75.8	75.6	72.1	65.4	62.9	83.3	81
64	75.1	80.6	72.0	69.2	67.7	65.8	60.1	82.6	80
65	80.2	88.3	89.1	91.6	73.1	65.7	56.5	94.9	>92<
66	82.3	93.2	90.8	86.4	79.2	69.3	63.9	96.0	>93<
67	66.8	74.2	67.5	68.4	75.7	66.5	55.8	79.3	77
68	82.3	93.2	90.8	86.4	79.2	69.3	63.9	96.0	>93<
69	66.8	74.2	67.5	68.4	75.7	66.5	55.8	79.3	77
70	66.9	82.1	82.0	79.6	75.0	65.2	62.0	86.6	84
71	88.5	97.9	93.3	87.9	80.1	72.0	66.9	99.9	>97<
72	89.6	100.7	100.5	98.3	86.8	84.8	76.9	105.0	>102<
73	82.2	94.3	94.8	91.0	82.0	77.8	73.6	98.7	>96<
74	78.5	90.9	91.4	88.1	81.1	73.5	70.8	95.4	>93<
75	69.2	81.9	79.4	78.5	76.5	70.5	62.7	85.8	83
76	69.2	81.9	79.4	78.5	76.5	70.5	62.7	85.8	83
77	78.4	84.2	91.9	89.8	69.9	65.7	72.2	94.6	>92<
78	81.6	91.0	90.2	88.2	72.9	68.2	68.8	95.0	>92<
79	85.0	94.7	88.5	83.0	72.6	75.3	63.7	96.3	>94<
80	78.4	88.3	85.9	82.6	71.4	69.0	66.5	91.3	>89<
81	66.5	78.5	81.0	75.4	68.2	62.6	62.4	83.9	81
82	75.0	84.1	89.5	84.4	72.6	77.7	78.1	92.0	>89<
83	85.2	96.3	96.9	91.4	74.4	75.1	79.7	100.4	>98<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-5.24
HPD selection for pump attendants

	dB-Neq	Mean:	94.9	Max:	114	Min:	82	Obs (n):	17
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	78.3	85.7	88.3	89.5	91.1	82.5	77.9	95.5	94.9
with HPD									
1	75.4	80.8	73.3	66.3	63.0	51.4	52.9	82.6	82
2	73.6	72.8	69.5	67.1	71.4	59.5	60.3	78.6	78
"3"	71.8	73.5	68.7	71.2	71.7	63.7	57.5	78.8	78
"4"	75.4	76.5	67.3	70.8	72.6	62.9	58.2	80.7	80
5	74.0	76.3	72.4	71.3	63.4	49.9	48.5	80.0	79
6	70.9	76.1	69.8	66.7	62.8	51.1	45.6	78.4	78
"7"	73.2	74.9	67.2	63.1	64.6	49.4	43.7	77.9	77
8	72.9	76.3	69.7	66.5	64.6	50.1	46.8	79.0	78
"9"	68.2	70.0	67.1	61.3	61.7	50.1	51.3	73.9	73
10	68.1	72.9	70.2	61.9	62.8	51.2	51.3	76.0	75
11	74.6	74.8	71.1	63.4	63.4	49.9	52.0	78.8	78
12	72.8	70.0	67.2	62.8	59.9	48.4	49.8	75.7	75
13	67.4	67.9	65.5	57.1	59.7	45.0	43.5	72.2	72
14	72.5	76.3	74.4	65.7	65.4	50.1	52.2	79.8	79
15	78.3	77.9	74.2	68.0	67.3	57.8	59.6	82.3	82
16	74.6	75.6	72.3	65.4	65.6	50.4	47.4	79.5	79
17	77.6	79.9	72.6	66.1	66.1	51.5	48.6	82.6	82
18	73.6	76.2	72.4	68.5	62.7	50.6	53.2	79.6	79
19	70.5	71.8	64.7	60.7	63.9	46.5	41.6	75.2	75
20	73.6	72.6	67.1	62.3	70.4	51.7	46.4	77.7	77
21	72.6	73.0	64.8	61.0	64.0	47.2	47.3	76.5	76
22	75.7	77.5	73.6	66.0	64.1	56.5	49.5	80.9	80
23	76.3	78.3	71.4	66.3	64.4	49.2	46.2	81.2	81
24	74.2	77.5	73.4	67.3	65.9	52.5	53.2	80.6	80
25	74.1	80.0	73.7	66.3	66.6	59.1	50.9	82.0	81
26	75.9	79.5	75.5	68.7	66.1	51.4	49.3	82.4	82
27	72.4	76.1	70.8	62.9	64.4	51.9	51.9	78.8	78
28	76.3	81.6	71.8	64.9	62.7	52.5	48.6	83.2	83
29	76.1	80.1	72.5	63.3	65.2	51.5	48.1	82.2	82
"30"	67.7	75.2	64.6	51.7	52.1	38.6	50.9	76.3	76
"31"	66.1	70.3	67.3	60.1	58.1	50.7	46.8	73.4	73
"32"	60.3	65.3	58.5	52.5	55.3	48.9	44.7	67.6	((67))
33	68.6	68.4	64.2	50.6	61.2	52.2	47.4	72.7	72
34	60.7	60.5	56.0	57.4	61.1	43.4	39.7	66.6	((66))
35	69.1	69.2	59.4	59.5	55.6	37.7	39.2	72.7	72
36	63.6	60.1	49.9	47.5	61.4	39.6	44.0	66.9	((66))
37	65.9	70.9	76.8	74.8	73.6	59.5	54.8	80.7	80
"38"	63.3	70.0	71.9	70.7	66.3	45.8	44.7	76.4	76
39	65.9	70.9	76.4	74.8	73.6	59.5	54.8	80.6	80
40	65.4	73.0	74.2	75.0	64.3	49.3	46.1	79.3	79
"41"	64.4	72.8	75.5	73.4	66.2	49.4	47.1	79.2	79
42	72.0	78.6	79.9	75.2	69.5	54.9	56.3	83.6	83
43	72.5	80.7	81.6	77.9	69.7	60.2	60.5	85.5	85
44	70.7	76.9	79.5	75.9	63.3	54.7	59.9	82.8	82
45	60.5	69.7	75.9	74.2	72.8	63.7	53.0	79.9	79
46	62.3	68.8	75.0	73.4	70.5	61.7	59.1	78.8	78
47	63.1	69.3	76.1	71.1	72.7	64.8	53.9	79.3	79
"48"	67.4	74.3	75.1	69.7	65.4	54.1	55.4	78.9	78
"49"	72.0	74.3	74.9	73.0	65.2	55.7	53.5	79.9	79
"50"	62.6	69.5	68.8	63.8	58.0	48.3	45.0	73.3	73
"51"	62.0	68.8	67.7	63.0	57.3	45.4	42.0	72.5	72
52	73.6	82.3	84.0	82.4	74.1	65.6	68.4	88.2	>88<
"53"	56.6	63.9	64.2	61.9	58.9	49.0	48.9	69.0	((68))
"54"	54.7	64.7	65.3	62.2	60.7	47.9	41.3	69.8	((69))
"55"	62.9	66.1	77.9	74.3	72.9	65.7	39.1	80.7	80
"56"	58.6	65.1	71.4	62.5	61.1	47.4	44.9	73.2	73
57	73.3	79.4	81.0	80.2	77.1	68.7	57.6	86.0	85
58	68.1	70.3	74.9	76.5	63.9	58.7	50.9	79.8	79
"59"	50.8	57.0	56.2	60.6	64.6	52.9	38.5	67.2	((67))
"60"	56.5	64.7	86.1	69.9	67.8	59.7	39.8	86.3	>86<
"61"	57.9	65.3	58.8	64.1	59.3	53.2	50.8	69.3	((69))
62	66.1	76.0	78.2	75.7	72.3	47.9	46.2	82.2	82
"63"	55.1	61.0	58.4	60.1	61.0	45.0	43.1	66.6	((66))
"64"	60.6	61.2	54.6	53.7	56.6	45.4	40.3	65.4	((65))
65	65.7	68.9	71.7	76.1	62.0	45.3	36.7	78.4	78
66	67.8	73.8	73.4	70.9	68.1	48.9	44.1	78.5	78
"67"	52.3	54.8	50.1	52.9	64.6	46.1	36.0	65.7	((65))
68	67.8	73.8	73.4	70.9	68.1	48.9	44.1	78.5	78
"69"	52.3	54.8	50.1	52.9	64.6	46.1	36.0	65.7	((65))
70	52.4	62.7	64.6	64.1	63.9	44.8	42.2	70.0	((69))
71	74.0	78.5	75.9	72.4	69.0	51.6	47.1	82.1	81
72	75.1	81.3	83.1	82.8	75.7	64.4	57.1	87.8	>87<
73	67.7	74.9	77.4	75.5	70.9	57.4	53.8	81.5	81
74	64.0	71.5	74.0	72.6	70.0	53.1	51.0	78.5	78
"75"	54.7	62.5	62.0	63.0	65.4	50.1	42.9	69.7	((69))
"76"	54.7	62.5	62.0	63.0	65.4	50.1	42.9	69.7	((69))
"77"	63.9	64.8	74.5	74.3	58.8	45.3	52.4	77.9	77
"78"	67.1	71.6	72.8	72.7	61.8	47.8	49.0	77.7	77
79	70.5	75.3	71.1	67.5	61.5	54.9	43.9	78.2	78
80	63.9	68.9	68.5	67.1	60.3	48.6	46.7	73.7	73
81	52.0	59.1	63.6	59.9	57.1	42.2	42.6	66.8	((66))
82	60.5	64.7	72.1	68.9	61.5	57.3	58.3	74.9	74
83	70.7	76.9	79.5	75.9	63.3	54.7	59.9	82.8	82

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
"n" These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-5.25
HPD selection for refrigeration plant attendants

	dB-Neq	Mean:	101.2	Max:	111	Min:	91	Obs (n):	8
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	83.3	88.9	93.6	97.4	99.3	94.2	84.5	103.1	101.2
with HPD									
1	80.4	84.0	78.6	74.2	71.2	63.1	59.5	86.8	85
2	78.6	76.0	74.8	75.0	79.6	71.2	66.9	84.5	83
3	76.8	76.7	74.0	79.1	79.9	75.4	64.1	85.3	83
4	80.4	79.7	72.6	78.7	80.8	74.6	64.8	86.5	85
5	79.0	79.5	77.7	79.2	71.6	61.6	55.1	85.1	83
6	75.9	79.3	75.1	74.6	71.0	62.8	52.2	83.0	81
7	78.2	78.1	72.5	71.0	72.8	61.1	50.3	82.6	81
8	77.9	79.5	75.0	74.4	72.8	61.8	53.4	83.6	82
9	73.2	73.2	72.4	69.2	69.9	61.8	57.9	79.0	77
10	73.1	76.1	75.5	69.8	71.0	62.9	57.9	80.8	79
11	79.6	78.0	76.4	71.3	71.6	61.6	58.6	83.6	82
12	77.8	73.2	72.5	70.7	68.1	60.1	56.4	80.7	79
13	72.4	71.1	70.8	65.0	67.9	56.7	50.1	77.2	75
14	77.5	79.5	79.7	73.6	73.6	61.8	58.8	84.6	83
15	83.3	81.1	79.5	75.9	75.5	69.5	66.2	87.2	85
16	79.6	78.8	77.6	73.3	73.8	62.1	54.0	84.3	82
17	82.6	83.1	77.9	74.0	74.3	63.2	55.2	87.0	85
18	78.6	79.4	77.7	76.4	70.9	62.3	59.8	84.4	83
19	75.5	75.0	70.0	68.6	72.1	58.2	48.2	80.1	78
20	78.6	75.8	72.4	70.2	78.6	63.4	53.0	83.3	81
21	77.6	76.2	70.1	68.9	72.2	58.9	53.9	81.3	79
22	80.7	80.7	78.9	73.9	72.3	68.2	56.1	85.6	84
23	81.3	81.5	76.7	74.2	72.6	60.9	52.8	85.7	84
24	79.2	80.7	78.7	75.2	74.1	64.2	59.8	85.3	83
25	79.1	83.2	79.0	74.2	74.8	70.8	57.5	86.4	85
26	80.9	82.7	80.8	76.6	74.3	63.1	55.9	87.0	85
27	77.4	79.3	76.1	70.8	72.6	63.6	58.5	83.3	81
28	81.3	84.8	77.1	72.8	70.9	64.2	55.2	87.2	85
29	81.1	83.3	77.8	71.2	73.4	63.2	54.7	86.4	85
30	72.7	78.4	69.9	59.6	60.3	50.3	57.5	80.0	78
31	71.1	73.5	72.6	68.0	66.3	62.4	53.4	78.2	76
32	65.3	68.5	63.8	60.4	63.5	60.6	51.3	72.4	71
33	73.6	71.6	69.5	58.5	69.4	63.9	54.0	77.7	76
34	65.7	63.7	61.3	65.3	69.3	55.1	46.3	72.9	71
35	74.1	72.4	64.7	67.4	63.8	49.4	45.8	77.3	75
36	68.6	63.3	55.2	55.4	69.6	51.3	50.6	72.9	71
37	70.9	74.1	82.1	82.7	81.8	71.2	61.4	87.4	>86<
38	68.3	73.2	77.2	78.6	74.5	57.5	51.3	82.6	81
39	70.9	74.1	81.7	82.7	81.8	71.2	61.4	87.3	85
40	70.4	76.2	79.5	82.9	72.5	61.0	52.7	85.5	84
41	69.4	76.0	80.8	81.3	74.4	61.1	53.7	85.2	83
42	77.0	81.8	85.2	83.1	77.7	66.6	62.9	89.0	>87<
43	77.5	83.9	86.9	85.8	77.9	71.9	67.1	91.0	>89<
44	75.7	80.1	84.8	83.8	71.5	66.4	66.5	88.5	>87<
45	65.5	72.9	81.2	82.1	81.0	75.4	59.6	86.8	85
46	67.3	72.0	80.3	81.3	78.7	73.4	65.7	85.6	84
47	68.1	72.5	81.4	79.0	80.9	76.5	60.5	86.1	84
48	72.4	77.5	80.4	77.6	73.6	65.8	62.0	84.3	82
49	77.0	77.5	80.2	80.9	73.4	67.4	60.1	85.6	84
50	67.6	72.7	74.1	71.7	66.2	60.0	51.6	78.5	77
51	67.0	72.0	73.0	70.9	65.5	57.1	48.6	77.6	76
52	78.6	85.5	89.3	90.3	82.3	77.3	75.0	94.2	>92<
53	61.6	67.1	69.5	69.8	67.1	60.7	55.5	75.0	73
54	59.7	67.9	70.6	70.1	68.9	59.6	47.9	75.7	74
55	67.9	69.3	83.2	82.2	81.1	77.4	45.7	87.6	>86<
56	63.6	68.3	76.7	70.4	69.3	59.1	51.5	78.8	77
57	78.3	82.6	86.3	88.1	85.3	80.4	64.2	92.5	>91<
58	73.1	73.5	80.2	84.4	72.1	70.4	57.5	86.5	85
59	55.8	60.2	61.5	68.5	72.8	64.6	45.1	75.0	73
60	61.5	67.9	91.4	77.8	76.0	71.4	46.4	91.8	>90<
61	62.9	68.5	64.1	72.0	67.5	64.9	57.4	75.6	74
62	71.1	79.2	83.5	83.6	80.5	59.6	52.8	88.2	>86<
63	60.1	64.2	63.7	68.0	69.2	56.7	49.7	73.3	71
64	65.6	64.4	59.9	61.6	64.8	57.1	46.9	70.9	((69))
65	70.7	72.1	77.0	84.0	70.2	57.0	43.3	85.3	83
66	72.8	77.0	78.7	78.8	76.3	60.6	50.7	84.2	82
67	57.3	58.0	55.4	60.8	72.8	57.8	42.6	73.5	72
68	72.8	77.0	78.7	78.8	76.3	60.6	50.7	84.2	82
69	57.3	58.0	55.4	60.8	72.8	57.8	42.6	73.5	72
70	57.4	65.9	69.9	72.0	72.1	56.5	48.8	76.7	75
71	79.0	81.7	81.2	80.3	77.2	63.3	53.7	87.2	85
72	80.1	84.5	88.4	90.7	83.9	76.1	63.7	94.0	>92<
73	72.7	78.1	82.7	83.4	79.1	69.1	60.4	87.6	>86<
74	69.0	74.7	79.3	80.5	78.2	64.8	57.6	84.8	83
75	59.7	65.7	67.3	70.9	73.6	61.8	49.5	76.7	75
76	59.7	65.7	67.3	70.9	73.6	61.8	49.5	76.7	75
77	68.9	68.0	79.8	82.2	67.0	57.0	59.0	84.5	83
78	72.1	74.8	78.1	80.6	70.0	59.5	55.6	83.7	82
79	75.5	78.5	76.4	75.4	69.7	66.6	50.5	83.0	81
80	68.9	72.1	73.8	75.0	68.5	60.3	53.3	79.4	78
81	57.0	62.3	68.9	67.8	65.3	53.9	49.2	72.9	71
82	65.5	67.9	77.4	76.8	69.7	69.0	64.9	81.2	79
83	75.7	80.1	84.8	83.8	71.5	66.4	66.5	88.5	>87<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-5.26
HPD selection for use in refuge bays

	Neq calculated on basis of mean LpA values and exposure period of 8 h.								
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	75.5	75.6	72.2	87.7	94.3	95.3	89.3	98.8	98.8
with HPD									
1	72.6	70.7	57.2	64.5	66.2	64.2	64.3	76.3	76
2	70.8	62.7	53.4	65.3	74.6	72.3	71.7	78.9	79
3	69.0	63.4	52.6	69.4	74.9	76.5	68.9	80.1	80
4	72.6	66.4	51.2	69.0	75.8	75.7	69.6	80.6	81
5	71.2	66.2	56.3	69.5	66.6	62.7	59.9	75.3	75
6	68.1	66.0	53.7	64.9	66.0	63.9	57.0	73.2	73
7	70.4	64.8	51.1	61.3	67.8	62.2	55.1	73.7	74
8	70.1	66.2	53.6	64.7	67.8	62.9	58.2	74.2	74
9	65.4	59.9	51.0	59.5	64.9	62.9	62.7	70.9	71
10	65.3	62.8	54.1	60.1	66.0	64.0	62.7	71.7	72
11	71.8	64.7	55.0	61.6	66.6	62.7	63.4	74.5	75
12	70.0	59.9	51.1	61.0	63.1	61.2	61.2	72.3	72
13	64.6	57.8	49.4	55.3	62.9	57.8	54.9	68.3	((68))
14	69.7	66.2	58.3	63.9	68.6	62.9	63.6	74.5	74
15	75.5	67.8	58.1	66.2	70.5	70.6	71.0	79.1	79
16	71.8	65.5	56.2	63.6	68.8	63.2	58.8	75.0	75
17	74.8	69.8	56.5	64.3	69.3	64.3	60.0	77.4	77
18	70.8	66.1	56.3	66.7	65.9	63.4	64.6	74.8	75
19	67.7	61.7	48.6	58.9	67.1	59.3	53.0	71.6	72
20	70.8	62.5	51.0	60.5	73.6	64.5	57.8	76.2	76
21	69.8	62.9	48.7	59.2	67.2	60.0	58.7	72.9	73
22	72.9	67.4	57.5	64.2	67.3	69.3	60.9	76.4	76
23	73.5	68.2	55.3	64.5	67.6	62.0	57.6	76.0	76
24	71.4	67.4	57.3	65.5	69.1	65.3	64.6	75.8	76
25	71.3	69.9	57.6	64.5	69.8	71.9	62.3	77.3	77
26	73.1	69.4	59.4	66.9	69.3	64.2	60.7	76.7	77
27	69.6	66.0	54.7	61.1	67.6	64.7	63.3	74.1	74
28	73.5	71.5	55.7	63.1	65.9	65.3	60.0	76.7	77
29	73.3	70.0	56.4	61.5	68.4	64.3	59.5	76.4	76
30	64.9	65.1	48.5	49.9	55.3	51.4	62.3	69.4	((69))
31	63.3	60.2	51.2	58.3	61.3	63.5	58.2	69.2	((69))
32	57.5	55.2	42.4	50.7	58.5	61.7	56.1	65.6	((66))
33	65.8	58.3	48.1	48.8	64.4	65.0	58.8	70.5	71
34	57.9	50.4	39.9	55.6	64.3	56.2	51.1	66.4	((66))
35	66.3	59.1	43.3	57.7	58.8	50.5	50.6	68.2	((68))
36	60.8	50.0	33.8	45.7	64.6	52.4	55.4	66.8	((67))
37	63.1	60.8	60.7	73.0	76.8	72.3	66.2	79.7	80
38	60.5	59.9	55.8	68.9	69.5	58.6	56.1	73.1	73
39	63.1	60.8	60.3	73.0	76.8	72.3	66.2	79.7	80
40	62.6	62.9	58.1	73.2	67.5	62.1	57.5	75.2	75
41	61.6	62.7	59.4	71.6	69.4	62.2	58.5	74.7	75
42	69.2	68.5	63.8	73.4	72.7	67.7	67.7	78.5	78
43	69.7	70.6	65.5	76.1	72.9	73.0	71.9	80.8	81
44	67.9	66.8	63.4	74.1	66.5	67.5	71.3	78.0	78
45	57.7	59.6	59.8	72.4	76.0	76.5	64.4	80.3	80
46	59.5	58.7	58.9	71.6	73.7	74.5	70.5	79.0	79
47	60.3	59.2	60.0	69.3	75.9	77.6	65.3	80.5	80
48	64.6	64.2	59.0	67.9	68.6	66.9	66.8	74.7	75
49	69.2	64.2	58.8	71.2	68.4	68.5	64.9	76.2	76
50	59.8	59.4	52.7	62.0	61.2	61.1	56.4	68.2	((68))
51	59.2	58.7	51.6	61.2	60.5	58.2	53.4	67.0	((67))
52	70.8	72.2	67.9	80.6	77.3	78.4	79.8	85.7	>86<
53	53.8	53.8	48.1	60.1	62.1	61.8	60.3	67.6	((68))
54	51.9	54.6	49.2	60.4	63.9	60.7	52.7	67.4	((67))
55	60.1	56.0	61.8	72.5	76.1	78.5	50.5	81.2	81
56	55.8	55.0	55.3	60.7	64.3	60.2	56.3	68.0	((68))
57	70.5	69.3	64.9	78.4	80.3	81.5	69.0	85.4	85
58	65.3	60.2	58.8	74.7	67.1	71.5	62.3	77.5	77
59	48.0	46.9	40.1	58.8	67.8	65.7	49.9	70.3	70
60	53.7	54.6	70.0	68.1	71.0	72.5	51.2	76.8	77
61	55.1	55.2	42.7	62.3	62.5	66.0	62.2	69.9	70
62	63.3	65.9	62.1	73.9	75.5	60.7	57.6	78.4	78
63	52.3	50.9	42.3	58.3	64.2	57.8	54.5	66.5	((67))
64	57.8	51.1	38.5	51.9	59.8	58.2	51.7	64.2	((64))
65	62.9	58.8	55.6	74.3	65.2	58.1	48.1	75.3	75
66	65.0	63.7	57.3	69.1	71.3	61.7	55.5	74.7	75
67	49.5	44.7	34.0	51.1	67.8	58.9	47.4	68.5	((69))
68	65.0	63.7	57.3	69.1	71.3	61.7	55.5	74.7	75
69	49.5	44.7	34.0	51.1	67.8	58.9	47.4	68.5	((69))
70	49.6	52.6	48.5	62.3	67.1	57.6	53.6	69.0	((69))
71	71.2	68.4	59.8	70.6	72.2	64.4	58.5	77.2	77
72	72.3	71.2	67.0	81.0	78.9	77.2	68.5	84.7	85
73	64.9	64.8	61.3	73.7	74.1	70.2	65.2	78.5	78
74	61.2	61.4	57.9	70.8	73.2	65.9	62.4	76.2	76
75	51.9	52.4	45.9	61.2	68.6	62.9	54.3	70.5	70
76	51.9	52.4	45.9	61.2	68.6	62.9	54.3	70.5	70
77	61.1	54.7	58.4	72.5	62.0	58.1	63.8	73.9	74
78	64.3	61.5	56.7	70.9	65.0	60.6	60.4	73.5	73
79	67.7	65.2	55.0	65.7	64.7	67.7	55.3	73.5	73
80	61.1	58.8	52.4	65.3	63.5	61.4	58.1	69.9	70
81	49.2	49.0	47.5	58.1	60.3	55.0	54.0	64.0	((64))
82	57.7	54.6	56.0	67.1	64.7	70.1	69.7	74.6	75
83	67.9	66.8	63.4	74.1	66.5	67.5	71.3	78.0	78

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Appendix 6

HPD selection for mechanized gold and platinum mining

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Table A-6.1
HPD selection for bulldozer operators

	dB-Neq	Mean:	100.4	Max:	104	Min:	86	Obs (n):	12
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	81.6	85.2	89.2	97.2	95.4	90.1	78.4	100.5	100.4
with HPD									
1	78.7	80.3	74.2	74.0	67.3	59.0	53.4	83.8	84
2	76.9	72.3	70.4	74.8	75.7	67.1	60.8	81.8	82
3	75.1	73.0	69.6	78.9	76.0	71.3	58.0	82.9	83
4	78.7	76.0	68.2	78.5	76.9	70.5	58.7	84.0	84
5	77.3	75.8	73.3	79.0	67.7	57.5	49.0	83.0	83
6	74.2	75.6	70.7	74.4	67.1	58.7	46.1	80.3	80
7	76.5	74.4	68.1	70.8	68.9	57.0	44.2	80.0	80
8	76.2	75.8	70.6	74.2	68.9	57.7	47.3	81.0	81
9	71.5	69.5	68.0	69.0	66.0	57.7	51.8	76.2	76
10	71.4	72.4	71.1	69.6	67.1	58.8	51.8	77.7	78
11	77.9	74.3	72.0	71.1	67.7	57.5	52.5	80.9	81
12	76.1	69.5	68.1	70.5	64.2	56.0	50.3	78.5	78
13	70.7	67.4	66.4	64.8	64.0	52.6	44.0	74.4	74
14	75.8	75.8	75.3	73.4	69.7	57.7	52.7	81.5	81
15	81.6	77.4	75.1	75.7	71.6	65.4	60.1	84.6	85
16	77.9	75.1	73.2	73.1	69.9	58.0	47.9	81.6	82
17	80.9	79.4	73.5	73.8	70.4	59.1	49.1	84.3	84
18	76.9	75.7	73.3	76.2	67.0	58.2	53.7	81.9	82
19	73.8	71.3	65.6	68.4	68.2	54.1	42.1	77.4	77
20	76.9	72.1	68.0	70.0	74.7	59.3	46.9	80.5	80
21	75.9	72.5	65.7	68.7	68.3	54.8	47.8	78.7	79
22	79.0	77.0	74.5	73.7	68.4	64.1	50.0	82.8	83
23	79.6	77.8	72.3	74.0	68.7	56.8	46.7	83.0	83
24	77.5	77.0	74.3	75.0	70.2	60.1	53.7	82.5	82
25	77.4	79.5	74.6	74.0	70.9	66.7	51.4	83.3	83
26	79.2	79.0	76.4	76.4	70.4	59.0	49.8	84.2	84
27	75.7	75.6	71.7	70.6	68.7	59.5	52.4	80.3	80
28	79.6	81.1	72.7	72.6	67.0	60.1	49.1	84.2	84
29	79.4	79.6	73.4	71.0	69.5	59.1	48.6	83.5	83
30	71.0	74.7	65.5	59.4	56.4	46.2	51.4	76.7	77
31	69.4	69.8	68.2	67.8	62.4	58.3	47.3	75.2	75
32	63.6	64.8	59.4	60.2	59.6	56.5	45.2	69.4	((69))
33	71.9	67.9	65.1	58.3	65.5	59.8	47.9	74.8	75
34	64.0	60.0	56.9	65.1	65.4	51.0	40.2	70.4	70
35	72.4	68.7	60.3	67.2	59.9	45.3	39.7	75.1	75
36	66.9	59.6	50.8	55.2	65.7	47.2	44.5	70.0	70
37	69.2	70.4	77.7	82.5	77.9	67.1	55.3	85.1	85
38	66.6	69.5	72.8	78.4	70.6	53.4	45.2	80.5	80
39	69.2	70.4	77.3	82.5	77.9	67.1	55.3	85.0	85
40	68.7	72.5	75.1	82.7	68.6	56.9	46.6	84.0	84
41	67.7	72.3	76.4	81.1	70.5	57.0	47.6	83.2	83
42	75.3	78.1	80.8	82.9	73.8	62.5	56.8	86.4	>86<
43	75.8	80.2	82.5	85.6	74.0	67.8	61.0	88.5	>88<
44	74.0	76.4	80.4	83.6	67.6	62.3	60.4	86.2	>86<
45	63.8	69.2	76.8	81.9	77.1	71.3	53.5	84.4	84
46	65.6	68.3	75.9	81.1	74.8	69.3	59.6	83.4	83
47	66.4	68.8	77.0	78.8	77.0	72.4	54.4	83.1	83
48	70.7	73.8	76.0	77.4	69.7	61.7	55.9	81.5	81
49	75.3	73.8	75.8	80.7	69.5	63.3	54.0	83.5	83
50	65.9	69.0	69.7	71.5	62.3	55.9	45.5	75.7	76
51	65.3	68.3	68.6	70.7	61.6	53.0	42.5	74.9	75
52	76.9	81.8	84.9	90.1	78.4	73.2	68.9	92.1	>92<
53	59.9	63.4	65.1	69.6	63.2	56.6	49.4	72.6	73
54	58.0	64.2	66.2	69.9	65.0	55.5	41.8	73.2	73
55	66.2	65.6	78.8	82.0	77.2	73.3	39.6	85.0	85
56	61.9	64.6	72.3	70.2	65.4	55.0	45.4	75.5	75
57	76.6	78.9	81.9	87.9	81.4	76.3	58.1	90.3	>90<
58	71.4	69.8	75.8	84.2	68.2	66.3	51.4	85.3	85
59	54.1	56.5	57.1	68.3	68.9	60.5	39.0	72.3	72
60	59.8	64.2	87.0	77.6	72.1	67.3	40.3	87.7	>88<
61	61.2	64.8	59.7	71.8	63.6	60.8	51.3	73.8	74
62	69.4	75.5	79.1	83.4	76.6	55.5	46.7	85.9	>86<
63	58.4	60.5	59.3	67.8	65.3	52.6	43.6	70.9	71
64	63.9	60.7	55.5	61.4	60.9	53.0	40.8	68.3	((68))
65	69.0	68.4	72.6	83.8	66.3	52.9	37.2	84.4	84
66	71.1	73.3	74.3	78.6	72.4	56.5	44.6	81.8	82
67	55.6	54.3	51.0	60.6	68.9	53.7	36.5	70.0	70
68	71.1	73.3	74.3	78.6	72.4	56.5	44.6	81.8	82
69	55.6	54.3	51.0	60.6	68.9	53.7	36.5	70.0	70
70	55.7	62.2	65.5	71.8	68.2	52.4	42.7	74.4	74
71	77.3	78.0	76.8	80.1	73.3	59.2	47.6	84.6	85
72	78.4	80.8	84.0	90.5	80.0	72.0	57.6	92.3	>92<
73	71.0	74.4	78.3	83.2	75.2	65.0	54.3	85.5	85
74	67.3	71.0	74.9	80.3	74.3	60.7	51.5	82.7	83
75	58.0	62.0	62.9	70.7	69.7	57.7	43.4	74.1	74
76	58.0	62.0	62.9	70.7	69.7	57.7	43.4	74.1	74
77	67.2	64.3	75.4	82.0	63.1	52.9	52.9	83.1	83
78	70.4	71.1	73.7	80.4	66.1	55.4	49.5	82.1	82
79	73.8	74.8	72.0	75.2	65.8	62.5	44.4	80.4	80
80	67.2	68.4	69.4	74.8	64.6	56.2	47.2	77.4	77
81	55.3	58.6	64.5	67.6	61.4	49.8	43.1	70.5	70
82	63.8	64.2	73.0	76.6	65.8	64.9	58.8	78.9	79
83	74.0	76.4	80.4	83.6	67.6	62.3	60.4	86.2	>86<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-6.2
HPD selection for diamond drill operators

	dB-Neq	Mean:	106.3	Max:	110	Min:	102	Obs (n):	18
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	86.1	92.4	95.6	98.2	104.0	102.6	102.8	108.7	106.3
with HPD									
1	83.2	87.5	80.6	75.0	75.9	71.5	77.8	90.1	>88<
2	81.4	79.5	76.8	75.8	84.3	79.6	85.2	90.0	>88<
3	79.6	80.2	76.0	79.9	84.6	83.8	82.4	90.2	>88<
4	83.2	83.2	74.6	79.5	85.5	83.0	83.1	91.1	>89<
5	81.8	83.0	79.7	80.0	76.3	70.0	73.4	87.9	85
6	78.7	82.8	77.1	75.4	75.7	71.2	70.5	86.2	84
7	81.0	81.6	74.5	71.8	77.5	69.5	68.6	85.9	83
8	80.7	83.0	77.0	75.2	77.5	70.2	71.7	86.8	84
9	76.0	76.7	74.4	70.0	74.6	70.2	76.2	83.1	81
10	75.9	79.6	77.5	70.6	75.7	71.3	76.2	84.6	82
11	82.4	81.5	78.4	72.1	76.3	70.0	76.9	87.0	85
12	80.6	76.7	74.5	71.5	72.8	68.5	74.7	84.1	82
13	75.2	74.6	72.8	65.8	72.6	65.1	68.4	80.5	78
14	80.3	83.0	81.7	74.4	78.3	70.2	77.1	87.9	85
15	86.1	84.6	81.5	76.7	80.2	77.9	84.5	91.2	>89<
16	82.4	82.3	79.6	74.1	78.5	70.5	72.3	87.5	85
17	85.4	86.6	79.9	74.8	79.0	71.6	73.5	90.2	>88<
18	81.4	82.9	79.7	77.2	75.6	70.7	78.1	87.7	85
19	78.3	78.5	72.0	69.4	76.8	66.6	66.5	83.4	81
20	81.4	79.3	74.4	71.0	83.3	71.8	71.3	87.0	85
21	80.4	79.7	72.1	69.7	76.9	67.3	72.2	84.8	82
22	83.5	84.2	80.9	74.7	77.0	76.6	74.4	88.8	>86<
23	84.1	85.0	78.7	75.0	77.3	69.3	71.1	88.8	>86<
24	82.0	84.2	80.7	76.0	78.8	72.6	78.1	88.7	>86<
25	81.9	86.7	81.0	75.0	79.5	79.2	75.8	90.0	>88<
26	83.7	86.2	82.8	77.4	79.0	71.5	74.2	90.1	>88<
27	80.2	82.8	78.1	71.6	77.3	72.0	76.8	86.9	84
28	84.1	88.3	79.1	73.6	75.6	72.6	73.5	90.5	>88<
29	83.9	86.8	79.8	72.0	78.1	71.6	73.0	89.7	>87<
30	75.5	81.9	71.9	60.4	65.0	58.7	75.8	84.0	82
31	73.9	77.0	74.6	68.8	71.0	70.8	71.7	81.8	79
32	68.1	72.0	65.8	61.2	68.2	69.0	69.6	77.1	75
33	76.4	75.1	71.5	59.3	74.1	72.3	72.3	81.8	79
34	68.5	67.2	63.3	66.1	74.0	63.5	64.6	76.9	74
35	76.9	75.9	66.7	68.2	68.5	57.8	64.1	80.4	78
36	71.4	66.8	57.2	56.2	74.3	59.7	68.9	77.4	75
37	73.7	77.6	84.1	83.5	86.5	79.6	79.7	90.8	>88<
38	71.1	76.7	79.2	79.4	79.2	65.9	69.6	85.1	83
39	73.7	77.6	83.7	83.5	86.5	79.6	79.7	90.7	>88<
40	73.2	79.7	81.5	83.7	77.2	69.4	71.0	87.5	85
41	72.2	79.5	82.8	82.1	79.1	69.5	72.0	87.5	85
42	79.8	85.3	87.2	83.9	82.4	75.0	81.2	91.9	>89<
43	80.3	87.4	88.9	86.6	82.6	80.3	85.4	94.0	>92<
44	78.5	83.6	86.8	84.6	76.2	74.8	84.8	91.6	>89<
45	68.3	76.4	83.2	82.9	85.7	83.8	77.9	90.5	>88<
46	70.1	75.5	82.3	82.1	83.4	81.8	84.0	90.0	>88<
47	70.9	76.0	83.4	79.8	85.6	84.9	78.8	90.5	>88<
48	75.2	81.0	82.4	78.4	78.3	74.2	80.3	87.8	85
49	79.8	81.0	82.2	81.7	78.1	75.8	78.4	88.5	>86<
50	70.4	76.2	76.1	72.5	70.9	68.4	69.9	81.5	79
51	69.8	75.5	75.0	71.7	70.2	65.5	66.9	80.4	78
52	81.4	89.0	91.3	91.1	87.0	85.7	93.3	98.2	>96<
53	64.4	70.6	71.5	70.6	71.8	69.1	73.8	79.4	77
54	62.5	71.4	72.6	70.9	73.6	68.0	66.2	79.0	77
55	70.7	72.8	85.2	83.0	85.8	85.8	64.0	91.2	>89<
56	66.4	71.8	78.7	71.2	74.0	67.5	69.8	81.7	79
57	81.1	86.1	88.3	88.9	90.0	88.8	82.5	95.9	>94<
58	75.9	77.0	82.2	85.2	76.8	78.8	75.8	88.7	>86<
59	58.6	63.7	63.5	69.3	77.5	73.0	63.4	79.6	77
60	64.3	71.4	93.4	78.6	80.7	79.8	64.7	94.0	>92<
61	65.7	72.0	66.1	72.8	72.2	73.3	75.7	80.7	78
62	73.9	82.7	85.5	84.4	85.2	68.0	71.1	90.8	>88<
63	62.9	67.7	65.7	68.8	73.9	65.1	68.0	77.3	75
64	68.4	67.9	61.9	62.4	69.5	65.5	65.2	75.1	73
65	73.5	75.6	79.0	84.8	74.9	65.4	61.6	86.8	84
66	75.6	80.5	80.7	79.6	81.0	69.0	69.0	87.0	85
67	60.1	61.5	57.4	61.6	77.5	66.2	60.9	78.2	76
68	75.6	80.5	80.7	79.6	81.0	69.0	69.0	87.0	85
69	60.1	61.5	57.4	61.6	77.5	66.2	60.9	78.2	76
70	60.2	69.4	71.9	72.8	76.8	64.9	67.1	80.0	78
71	81.8	85.2	83.2	81.1	81.9	71.7	72.0	90.0	>88<
72	82.9	88.0	90.4	91.5	88.6	84.5	82.0	96.5	>94<
73	75.5	81.6	84.7	84.2	83.8	77.5	78.7	90.4	>88<
74	71.8	78.2	81.3	81.3	82.9	73.2	75.9	87.8	85
75	62.5	69.2	69.3	71.7	78.3	70.2	67.8	80.7	78
76	62.5	69.2	69.3	71.7	78.3	70.2	67.8	80.7	78
77	71.7	71.5	81.8	83.0	71.7	65.4	77.3	86.5	84
78	74.9	78.3	80.1	81.4	74.7	67.9	73.9	86.0	84
79	78.3	82.0	78.4	76.2	74.4	75.0	68.8	86.1	84
80	71.7	75.6	75.8	75.8	73.2	68.7	71.6	82.3	80
81	59.8	65.8	70.9	68.6	70.0	62.3	67.5	76.2	74
82	68.3	71.4	79.4	77.6	74.4	77.4	83.2	86.6	84
83	78.5	83.6	86.8	84.6	76.2	74.8	84.8	91.6	>89<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-6.3

HPD selection for dump truck operators

	dB-Neq	Mean:	99.9	Max:	102	Min:	95	Obs (n):	14
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	87.3	100.7	92.7	97.4	93.2	90.1	81.7	103.6	99.9
with HPD									
1	84.4	95.8	77.7	74.2	65.1	59.0	56.7	96.2	>92<
2	82.6	87.8	73.9	75.0	73.5	67.1	64.1	89.4	>86<
3	80.8	88.5	73.1	79.1	73.8	71.3	61.3	89.9	>86<
4	84.4	91.5	71.7	78.7	74.7	70.5	62.0	92.6	>89<
5	83.0	91.3	76.8	79.2	65.5	57.5	52.3	92.3	>89<
6	79.9	91.1	74.2	74.6	64.9	58.7	49.4	91.6	>88<
7	82.2	89.9	71.6	71.0	66.7	57.0	47.5	90.7	>87<
8	81.9	91.3	74.1	74.4	66.7	57.7	50.6	91.9	>88<
9	77.2	85.0	71.5	69.2	63.8	57.7	55.1	86.0	82
10	77.1	87.9	74.6	69.8	64.9	58.8	55.1	88.5	85
11	83.6	89.8	75.5	71.3	65.5	57.5	55.8	90.9	>87<
12	81.8	85.0	71.6	70.7	62.0	56.0	53.6	87.0	83
13	76.4	82.9	69.9	65.0	61.8	52.6	47.3	84.0	80
14	81.5	91.3	78.8	73.6	67.5	57.7	56.0	92.0	>88<
15	87.3	92.9	78.6	75.9	69.4	65.4	63.4	94.2	>90<
16	83.6	90.6	76.7	73.3	67.7	58.0	51.2	91.6	>88<
17	86.6	94.9	77.0	74.0	68.2	59.1	52.4	95.6	>92<
18	82.6	91.2	76.8	76.4	64.8	58.2	57.0	92.0	>88<
19	79.5	86.8	69.1	68.6	66.0	54.1	45.4	87.7	84
20	82.6	87.6	71.5	70.2	72.5	59.3	50.2	89.0	85
21	81.6	88.0	69.2	68.9	66.1	54.8	51.1	89.0	85
22	84.7	92.5	78.0	73.9	66.2	64.1	53.3	93.4	>90<
23	85.3	93.3	75.8	74.2	66.5	56.8	50.0	94.1	>90<
24	83.2	92.5	77.8	75.2	68.0	60.1	57.0	93.2	>89<
25	83.1	95.0	78.1	74.2	68.7	66.7	54.7	95.4	>92<
26	84.9	94.5	79.9	76.6	68.2	59.0	53.1	95.2	>91<
27	81.4	91.1	75.2	70.8	66.5	59.5	55.7	91.7	>88<
28	85 3	96.6	76.2	72.8	64.8	60.1	52.4	97.0	>93<
29	85.1	95.1	76.9	71.2	67.3	59.1	51.9	95.6	>92<
30	76.7	90.2	69.0	59.6	54.2	46.2	54.7	90.4	>87<
31	75.1	85.3	71.7	68.0	60.2	58.3	50.6	86.0	82
32	69.3	80.3	62.9	60.4	57.4	56.5	48.5	80.8	77
33	77.6	83.4	68.6	58.5	63.3	59.8	51.2	84.6	81
34	69.7	75.5	60.4	65.3	63.2	51.0	43.5	77.1	73
35	78.1	84.2	63.8	67.4	57.7	45.3	43.0	85.3	82
36	72.6	75.1	54.3	55.4	63.5	47.2	47.8	77.3	74
37	74.9	85 9	81.2	82.7	75.7	67.1	58.6	88.9	85
38	72.3	85.0	76.3	78.6	68.4	53.4	48.5	86.6	83
39	74.9	85.9	80.8	82.7	75.7	67.1	58.6	88.9	85
40	74.4	88.0	78.6	82.9	66.4	56 9	49.9	89.7	>86<
41	73.4	87.8	79.9	81.3	68.3	57.0	50.9	89.4	>86<
42	81.0	93.6	84.3	83.1	71.6	62.5	60.1	94.6	>91<
43	81.5	95.7	86.0	85.8	71.8	67.8	64.3	96.7	>93<
44	79.7	91.9	83.9	83 8	65.4	62.3	63.7	93.3	>90<
45	69.5	84.7	80.3	82.1	74.9	71.3	56.8	87.9	84
46	71 3	83.8	79.4	81.3	72.6	69.3	62.9	87.0	83
47	72.1	84.3	80.5	79.0	74.8	72.4	57.7	87.2	84
48	76.4	89.3	79.5	77.6	67.5	61.7	59.2	90.2	>87<
49	81.0	89.3	79.3	80.9	67.3	63.3	57.3	90 8	>87<
50	71.6	84.5	73.2	71.7	60.1	55 9	48 8	85.2	82
51	71.0	83.8	72.1	70.9	59.4	53.0	45 8	84.5	81
52	82.6	97.3	88.4	90.3	76.2	73.2	72.2	98.7	>95<
53	65.6	78.9	68.6	69.8	61.0	56.6	52.7	80.0	76
54	63.7	79.7	69.7	70.1	62.8	55.5	45.1	80.7	77
55	71.9	81.1	82.3	82.2	75.0	73.3	42.9	87.3	84
56	67.6	80.1	75.8	70.4	63.2	55.0	48.7	82.0	78
57	82.3	94.4	85.4	88.1	79.2	76.3	61.4	96.1	>92<
58	77.1	85.3	79.3	84.4	66.0	66.3	54.7	88.8	85
59	59.8	72.0	60.6	68.5	66.7	60.5	42.3	74.9	71
60	65.5	79.7	90.5	77.8	69.9	67.3	43.6	91.1	>87<
61	66.9	80.3	63.2	72.0	61.4	60.8	54.6	81.2	78
62	75.1	91.0	82.6	83.6	74.4	55.5	50.0	92.4	>89<
63	64.1	76.0	62.8	68.0	63.1	52.6	46.9	77.2	74
64	69.6	76.2	59.0	61.6	58.7	53.0	44.1	77.3	74
65	74.7	83.9	76.1	84.0	64.1	52.9	40.5	87.6	84
66	76.8	88.8	77.8	78.8	70.2	56.5	47.9	89.8	>86<
67	61.3	69.8	54.5	60.8	66.7	53.7	39.8	72.4	((69))
68	76.8	88.8	77.8	78.8	70.2	56.5	47.9	89.8	>86<
69	61.3	69.8	54.5	60.8	66.7	53.7	39.8	72.4	((69))
70	61.4	77.7	69.0	72.0	66.0	52.4	46.0	79.5	76
71	83.0	93.5	80.3	80.3	71.1	59.2	50.9	94.3	>91<
72	84.1	96.3	87.5	90.7	77.8	72.0	60.9	98 0	>94<
73	76.7	89.9	81.8	83.4	73.0	65.0	57.6	91.5	>88<
74	73.0	86.5	78.4	80.5	72.1	60.7	54 8	88.2	85
75	63.7	77.5	66.4	70.9	67.5	57.7	46.7	79.1	75
76	63.7	77.5	66.4	70.9	67.5	57.7	46.7	79.1	75
77	72.9	79.8	78.9	82.2	60.9	52.9	56.2	85.6	82
78	76.1	86.6	77.2	80.6	63.9	55.4	52.8	88.2	85
79	79.5	90.3	75.5	75.4	63.6	62.5	47.7	90.9	>87<
80	72.9	83.9	72.9	75.0	62.4	56.2	50.5	85.0	81
81	61.0	74.1	68.0	67.8	59.2	49.8	46.4	76.0	72
82	69.5	79.7	76.5	76 8	63.6	64.9	62.1	83.0	79
83	79.7	91.9	83.9	83.8	65.4	62.3	63.7	93.3	>90<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-6.4
HPD selection for front-end loader operators

	dB-Neq	Mean:	97.8	Max:	101	Min:	93	Obs (n):	11
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	93.8	94.8	98.1	97.2	92.3	82.1	81.1	102.8	97.8
with HPD									
1	90.9	89.9	83.1	74.0	64.2	51.0	56.1	93.9	>89<
2	89.1	81.9	79.3	74.8	72.6	59.1	63.5	90.4	85
3	87.3	82.6	78.5	78.9	72.9	63.3	60.7	89.5	84
4	90.9	85.6	77.1	78.5	73.8	62.5	61.4	92.4	>87<
5	89.5	85.4	82.2	79.0	64.6	49.5	51.7	91.7	>87<
6	86.4	85.2	79.6	74.4	64.0	50.7	48.8	89.5	84
7	88.7	84.0	77.0	70.8	65.8	49.0	46.9	90.2	85
8	88.4	85.4	79.5	74.2	65.8	49.7	50.0	90.6	>86<
9	83.7	79.1	76.9	69.0	62.9	49.7	54.5	85.7	81
10	83.6	82.0	80.0	69.6	64.0	50.8	54.5	87.0	82
11	90.1	83.9	80.9	71.1	64.6	49.5	55.2	91.5	>86<
12	88.3	79.1	77.0	70.5	61.1	48.0	53.0	89.1	84
13	82.9	77.0	75.3	64.8	60.9	44.6	46.7	84.5	80
14	88.0	85.4	84.2	73.4	66.6	49.7	55.4	91.0	>86<
15	93.8	87.0	84.0	75.7	68.5	57.4	62.8	95.0	>90<
16	90.1	84.7	82.1	73.1	66.8	50.0	50.6	91.8	>87<
17	93.1	89.0	82.4	73.8	67.3	51.1	51.8	94.8	>90<
18	89.1	85.3	82.2	76.2	63.9	50.2	56.4	91.3	>86<
19	86.0	80.9	74.5	68.4	65.1	46.1	44.8	87.5	82
20	89.1	81.7	76.9	70.0	71.6	51.3	49.6	90.1	85
21	88.1	82.1	74.6	68.7	65.2	46.8	50.5	89.3	84
22	91.2	86.6	83.4	73.7	65.3	56.1	52.7	93.1	>88<
23	91.8	87.4	81.2	74.0	65.6	48.8	49.4	93.5	>88<
24	89.7	86.6	83.2	75.0	67.1	52.1	56.4	92.1	>87<
25	89.6	89.1	83.5	74.0	67.8	58.7	54.1	93.0	>88<
26	91.4	88.6	85.3	76.4	67.3	51.0	52.5	94.0	>89<
27	87.9	85.2	80.6	70.6	65.6	51.5	55.1	90.3	85
28	91.8	90.7	81.6	72.6	63.9	52.1	51.8	94.6	>90<
29	91.6	89.2	82.3	71.0	66.4	51.1	51.3	93.9	>89<
30	83.2	84.3	74.4	59.4	53.3	38.2	54.1	87.0	82
31	81.6	79.4	77.1	67.8	59.3	50.3	50.0	84.6	80
32	75.8	74.4	68.3	60.2	56.5	48.5	47.9	78.7	74
33	84.1	77.5	74.0	58.3	62.4	51.8	50.6	85.3	80
34	76.2	69.6	65.8	65.1	62.3	43.0	42.9	77.8	73
35	84.6	78.3	69.2	67.2	56.8	37.3	42.4	85.7	81
36	79.1	69.2	59.7	55.2	62.6	39.2	47.2	79.7	75
37	81.4	80.0	86.6	82.5	74.8	59.1	58.0	89.6	85
38	78.8	79.1	81.7	78.4	67.5	45.4	47.9	85.8	81
39	81.4	80.0	86.2	82.5	74.8	59.1	58.0	89.4	84
40	80.9	82.1	84.0	82.7	65.5	48.9	49.3	88.6	84
41	79.9	81.9	85.3	81.1	67.4	49.0	50.3	88.6	84
42	87.5	87.7	89.7	82.9	70.7	54.5	59.5	93.6	>89<
43	88.0	89.8	91.4	85.6	70.9	59.8	63.7	95.2	>90<
44	86.2	86.0	89.3	83.6	64.5	54.3	63.1	92.8	>88<
45	76.0	78.8	85.7	81.9	74.0	63.3	56.2	88.3	83
46	77.8	77.9	84.8	81.1	71.7	61.3	62.3	87.6	83
47	78.6	78.4	85.9	78.8	73.9	64.4	57.1	88.0	83
48	82.9	83.4	84.9	77.4	66.6	53.7	58.6	88.9	84
49	87.5	83.4	84.7	80.7	66.4	55.3	56.7	90.8	>86<
50	78.1	78.6	78.6	71.5	59.2	47.9	48.2	83.5	78
51	77.5	77.9	77.5	70.7	58.5	45.0	45.2	82.7	78
52	89.1	91.4	93.8	90.1	75.3	65.2	71.6	97.5	>93<
53	72.1	73.0	74.0	69.6	60.1	48.6	52.1	78.6	74
54	70.2	73.8	75.1	69.9	61.9	47.5	44.5	78.9	74
55	78.4	75.2	87.7	82.0	74.1	65.3	42.3	89.4	84
56	74.1	74.2	81.2	70.2	62.3	47.0	48.1	82.9	78
57	88.8	88.5	90.8	87.9	78.3	68.3	60.8	95.3	>90<
58	83.6	79.4	84.7	84.2	65.1	58.3	54.1	89.4	84
59	66.3	66.1	66.0	68.3	65.8	52.5	41.7	73.6	((69))
60	72.0	73.8	95.9	77.6	69.0	59.3	43.0	96.0	>91<
61	73.4	74.4	68.6	71.8	60.5	52.8	54.0	78.7	74
62	81.6	85.1	88.0	83.4	73.5	47.5	49.4	91.3	>86<
63	70.6	70.1	68.2	67.8	62.2	44.6	46.3	75.6	71
64	76.1	70.3	64.4	61.4	57.8	45.0	43.5	77.5	72
65	81.2	78.0	81.5	83.8	63.2	44.9	39.9	87.6	83
66	83.3	82.9	83.2	78.6	69.3	48.5	47.3	88.4	83
67	67.8	63.9	59.9	60.6	65.8	45.7	39.2	71.6	((67))
68	83.3	82.9	83.2	78.6	69.3	48.5	47.3	88.4	83
69	67.8	63.9	59.9	60.6	65.8	45.7	39.2	71.6	((67))
70	67.9	71.8	74.4	71.8	65.1	44.4	45.4	78.3	73
71	89.5	87.6	85.7	80.1	70.2	51.2	50.3	92.9	>88<
72	90.6	90.4	92.9	90.5	76.9	64.0	60.3	97.3	>92<
73	83.2	84.0	87.2	83.2	72.1	57.0	57.0	90.8	>86<
74	79.5	80.6	83.8	80.3	71.2	52.7	54.2	87.5	83
75	70.2	71.6	71.8	70.7	66.6	49.7	46.1	77.5	73
76	70.2	71.6	71.8	70.7	66.6	49.7	46.1	77.5	73
77	79.4	73.9	84.3	82.0	60.0	44.9	55.6	87.3	82
78	82.6	80.7	82.6	80.4	63.0	47.4	52.2	87.7	83
79	86.0	84.4	80.9	75.2	62.7	54.5	47.1	89.2	84
80	79.4	78.0	78.3	74.8	61.5	48.2	49.9	84.0	79
81	67.5	68.2	73.4	67.6	58.3	41.8	45.8	76.1	71
82	76.0	73.8	81.9	76.6	62.7	56.9	61.5	84.3	79
83	86.2	86.0	89.3	83.6	64.5	54.3	63.1	92.8	>88<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-6.5
HPD selection for jeep/4x4 occupants

	Neq calculated on basis of mean LpA values and exposure period of 8 h.								
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	81.8	80.9	80.1	83.9	85.3	78.8	62.4	90.2	90.2
with HPD									
1	78.9	76.0	65.1	60.7	57.2	47.7	37.4	80.9	81
2	77.1	68.0	61.3	61.5	65.6	55.8	44.8	78.1	78
3	75.3	68.7	60.5	65.6	65.9	60.0	42.0	77.1	77
4	78.9	71.7	59.1	65.2	66.8	59.2	42.7	80.1	80
5	77.5	71.5	64.2	65.7	57.6	46.2	33.0	78.9	79
6	74.4	71.3	61.6	61.1	57.0	47.4	30.1	76.5	77
7	76.7	70.1	59.0	57.5	58.8	45.7	28.2	77.7	78
8	76.4	71.5	61.5	60.9	58.8	46.4	31.3	77.9	78
9	71.7	65.2	58.9	55.7	55.9	46.4	35.8	72.9	73
10	71.6	68.1	62.0	56.3	57.0	47.5	35.8	73.7	74
11	78.1	70.0	62.9	57.8	57.6	46.2	36.5	78.9	79
12	76.3	65.2	59.0	57.2	54.1	44.7	34.3	76.8	77
13	70.9	63.1	57.3	51.5	53.9	41.3	28.0	71.8	72
14	76.0	71.5	66.2	60.1	59.6	46.4	36.7	77.8	78
15	81.8	73.1	66.0	62.4	61.5	54.1	44.1	82.5	83
16	78.1	70.8	64.1	59.8	59.8	46.7	31.9	79.1	79
17	81.1	75.1	64.4	60.5	60.3	47.8	33.1	82.2	82
18	77.1	71.4	64.2	62.9	56.9	46.9	37.7	78.5	78
19	74.0	67.0	56.5	55.1	58.1	42.8	26.1	75.0	75
20	77.1	67.8	58.9	56.7	64.6	48.0	30.9	77.9	78
21	76.1	68.2	56.6	55.4	58.2	43.5	31.8	76.9	77
22	79.2	72.7	65.4	60.4	58.3	52.8	34.0	80.3	80
23	79.8	73.5	63.2	60.7	58.6	45.5	30.7	80.9	81
24	77.7	72.7	65.2	61.7	60.1	48.8	37.7	79.2	79
25	77.6	75.2	65.5	60.7	60.8	55.4	35.4	79.9	80
26	79.4	74.7	67.3	63.1	60.3	47.7	33.8	81.0	81
27	75.9	71.3	62.6	57.3	58.6	48.2	36.4	77.4	77
28	79.8	76.8	63.6	59.3	56.9	48.8	33.1	81.7	82
29	79.6	75.3	64.3	57.7	59.4	47.8	32.6	81.1	81
30	71.2	70.4	56.4	46.1	46.3	34.9	35.4	73.9	74
31	69.6	65.5	59.1	54.5	52.3	47.0	31.3	71.5	71
32	63.8	60.5	50.3	46.9	49.5	45.2	29.2	65.8	((66))
33	72.1	63.6	56.0	45.0	55.4	48.5	31.9	72.9	73
34	64.2	55.7	47.8	51.8	55.3	39.7	24.2	65.5	((66))
35	72.6	64.4	51.2	53.9	49.8	34.0	23.7	73.3	73
36	67.1	55.3	41.7	41.9	55.6	35.9	28.5	67.7	((68))
37	69.4	66.1	68.6	69.2	67.8	55.8	39.3	75.4	75
38	66.8	65.2	63.7	65.1	60.5	42.1	29.2	71.7	72
39	69.4	66.1	68.2	69.2	67.8	55.8	39.3	75.3	75
40	68.9	68.2	66.0	69.4	58.5	45.6	30.6	74.4	74
41	67.9	68.0	67.3	67.8	60.4	45.7	31.6	74.0	74
42	75.5	73.8	71.7	69.6	63.7	51.2	40.8	79.3	79
43	76.0	75.9	73.4	72.3	63.9	56.5	45.0	80.8	81
44	74.2	72.1	71.3	70.3	57.5	51.0	44.4	78.3	78
45	64.0	64.9	67.7	68.6	67.0	60.0	37.5	73.9	74
46	65.8	64.0	66.8	67.8	64.7	58.0	43.6	73.2	73
47	66.6	64.5	67.9	65.5	66.9	61.1	38.4	73.7	74
48	70.9	69.5	66.9	64.1	59.6	50.4	39.9	74.7	75
49	75.5	69.5	66.7	67.4	59.4	52.0	38.0	77.5	77
50	66.1	64.7	60.6	58.2	52.2	44.6	29.5	69.6	70
51	65.5	64.0	59.5	57.4	51.5	41.7	26.5	68.8	((69))
52	77.1	77.5	75.8	76.8	68.3	61.9	52.9	83.1	83
53	60.1	59.1	56.0	56.3	53.1	45.3	33.4	64.6	((65))
54	58.2	59.9	57.1	56.6	54.9	44.2	25.8	64.7	((65))
55	66.4	61.3	69.7	68.7	67.1	62.0	23.6	74.6	75
56	62.1	60.3	63.2	56.9	55.3	43.7	29.4	67.5	((68))
57	76.8	74.6	72.8	74.6	71.3	65.0	42.1	81.5	82
58	71.6	65.5	66.7	70.9	58.1	55.0	35.4	75.6	76
59	54.3	52.2	48.0	55.0	58.8	49.2	23.0	62.2	((62))
60	60.0	59.9	77.9	64.3	62.0	56.0	24.3	78.3	78
61	61.4	60.5	50.6	58.5	53.5	49.5	35.3	65.6	((66))
62	69.6	71.2	70.0	70.1	66.5	44.2	30.7	76.7	77
63	58.6	56.2	50.2	54.5	55.2	41.3	27.6	62.7	((63))
64	64.1	56.4	46.4	48.1	50.8	41.7	24.8	65.1	((65))
65	69.2	64.1	63.5	70.5	56.2	41.6	21.2	73.9	74
66	71.3	69.0	65.2	65.3	62.3	45.2	28.6	74.8	75
67	55.8	50.0	41.9	47.3	58.8	42.4	20.5	61.2	((61))
68	71.3	69.0	65.2	65.3	62.3	45.2	28.6	74.8	75
69	55.8	50.0	41.9	47.3	58.8	42.4	20.5	61.2	((61))
70	55.9	57.9	56.4	58.5	58.1	41.1	26.7	64.5	((65))
71	77.5	73.7	67.7	66.8	63.2	47.9	31.6	79.7	80
72	78.6	76.5	74.9	77.2	69.9	60.7	41.6	83.3	83
73	71.2	70.1	69.2	69.9	65.1	53.7	38.3	76.5	77
74	67.5	66.7	65.8	67.0	64.2	49.4	35.5	73.4	73
75	58.2	57.7	53.8	57.4	59.6	46.4	27.4	64.8	((65))
76	58.2	57.7	53.8	57.4	59.6	46.4	27.4	64.8	((65))
77	67.4	60.0	66.3	68.7	53.0	41.6	36.9	72.6	73
78	70.6	66.8	64.6	67.1	56.0	44.1	33.5	73.9	74
79	74.0	70.5	62.9	61.9	55.7	51.2	28.4	76.1	76
80	67.4	64.1	60.3	61.5	54.5	44.9	31.2	70.4	70
81	55.5	54.3	55.4	54.3	51.3	38.5	27.1	61.4	((61))
82	64.0	59.9	63.9	63.3	55.7	53.6	42.8	69.4	((69))
83	74.2	72.1	71.3	70.3	57.5	51.0	44.4	78.3	78

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-6.6
HPD selection for jumbo drill rig operators

	dB-Neq	Mean:	100.7	Max:	108	Min:	88	Obs (n):	16
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	79.4	85.9	91.7	96.0	98.3	98.4	96.8	103.9	100.7
with HPD									
1	76.5	81.0	76.7	72.8	70.2	67.3	71.8	84.3	81
2	74.7	73.0	72.9	73.6	78.6	75.4	79.2	84.5	81
3	72.9	73.7	72.1	77.7	78.9	79.6	76.4	85.2	82
4	76.5	76.7	70.7	77.3	79.8	78.8	77.1	85.8	83
5	75.1	76.5	75.8	77.8	70.6	65.8	67.4	82.9	80
6	72.0	76.3	73.2	73.2	70.0	67.0	64.5	80.7	78
7	74.3	75.1	70.6	69.6	71.8	65.3	62.6	80.0	77
8	74.0	76.5	73.1	73.0	71.8	66.0	65.7	81.2	78
9	69.3	70.2	70.5	67.8	68.9	66.0	70.2	77.7	74
10	69.2	73.1	73.6	68.4	70.0	67.1	70.2	79.3	76
11	75.7	75.0	74.5	69.9	70.6	65.8	70.9	81.3	78
12	73.9	70.2	70.6	69.3	67.1	64.3	68.7	78.5	75
13	68.5	68.1	68.9	63.6	66.9	60.9	62.4	75.0	72
14	73.6	76.5	77.8	72.2	72.6	66.0	71.1	82.5	79
15	79.4	78.1	77.6	74.5	74.5	73.7	78.5	85.6	82
16	75.7	75.8	75.7	71.9	72.8	66.3	66.3	81.9	79
17	78.7	80.1	76.0	72.6	73.3	67.4	67.5	84.3	81
18	74.7	76.4	75.8	75.0	69.9	66.5	72.1	82.4	79
19	71.6	72.0	68.1	67.2	71.1	62.4	60.5	77.6	74
20	74.7	72.8	70.5	68.8	77.6	67.6	65.3	81.3	78
21	73.7	73.2	68.2	67.5	71.2	63.1	66.2	78.8	76
22	76.8	77.7	77.0	72.5	71.3	72.4	68.4	83.3	80
23	77.4	78.5	74.8	72.8	71.6	65.1	65.1	82.9	80
24	75.3	77.7	76.8	73.8	73.1	68.4	72.1	83.2	80
25	75.2	80.2	77.1	72.8	73.8	75.0	69.8	84.4	81
26	77.0	79.7	78.9	75.2	73 3	67.3	68.2	84.6	81
27	73.5	76.3	74.2	69.4	71.6	67.8	70.8	81.2	78
28	77.4	81.8	75.2	71.4	69.9	68.4	67.5	84.4	81
29	77.2	80.3	75.9	69.8	72.4	67.4	67.0	83.7	81
30	68.8	75.4	68.0	58.2	59.3	54.5	69.8	77.8	75
31	67.2	70.5	70.7	66.6	65.3	66.6	65.7	76.5	73
32	61.4	65.5	61.9	59.0	62.5	64.8	63.6	71.6	((68))
33	69.7	68.6	67.6	57.1	68.4	68.1	66.3	76.1	73
34	61.8	60.7	59.4	63.9	68.3	59.3	58.6	71.6	((68))
35	70.2	69.4	62.8	66.0	62.8	53.6	58.1	74.4	71
36	64.7	60.3	53.3	54.0	68.6	55.5	62.9	71.5	((68))
37	67.0	71.1	80.2	81.3	80.8	75.4	73.7	86.4	83
38	64.4	70.2	75.3	77.2	73.5	61.7	63.6	81.0	78
39	67.0	71.1	79.8	81.3	80.8	75.4	73.7	86.3	83
40	66.5	73.2	77.6	81.5	71.5	65.2	65.0	83.9	81
41	65.5	73.0	78.9	79.9	73.4	65.3	66.0	83 6	80
42	73.1	78.8	83.3	81.7	76.7	70.8	75.2	87.4	84
43	73.6	80.9	85.0	84.4	76.9	76.1	79.4	89.6	>86<
44	71.8	77.1	82.9	82.4	70.5	70.6	78 8	87.3	84
45	61.6	69.9	79.3	80.7	80.0	79.6	71 9	86 2	83
46	63.4	69.0	78.4	79.9	77.7	77.6	78.0	85.5	82
47	64 2	69.5	79.5	77.6	79.9	80.7	72.8	85.9	83
48	68.5	74.5	78.5	76.2	72.6	70.0	74 3	83.1	80
49	73.1	74.5	78.3	79.5	72.4	71.6	72 4	84.1	81
50	63.7	69.7	72 2	70.3	65.2	64.2	63.9	76.8	74
51	63.1	69.0	71.1	69.5	64.5	61.3	60.9	75.7	73
52	74.7	82.5	87.4	88.9	81.3	81.5	87.3	93.7	>91<
53	57.7	64.1	67.6	68.4	66.1	64 9	67.8	74.6	71
54	55.8	64.9	68.7	68.7	67.9	63.8	60.2	74.5	71
55	64.0	66.3	81.3	80.8	80.1	81.6	58.0	87.1	84
56	59.7	65.3	74.8	69.0	68.3	63.3	63.8	77.3	74
57	74.4	79.6	84.4	86.7	84.3	84 6	76.5	91.7	>88<
58	69.2	70.5	78.3	83.0	71.1	74.6	69.8	85.3	82
59	51.9	57.2	59.6	67.1	71.8	68.8	57.4	74.8	72
60	57.6	64.9	89.5	76.4	75.0	75.6	58.7	90.0	>87<
61	59.0	65.5	62.2	70.6	66.5	69.1	69.7	76.0	73
62	67.2	76.2	81.6	82.2	79.5	63.8	65.1	86.6	83
63	56.2	61.2	61.8	66.6	68.2	60.9	62.0	72.4	((69))
64	61.7	61.4	58.0	60.2	63.8	61.3	59.2	69.6	((66))
65	66.8	69.1	75.1	82.6	69.2	61.2	55 6	83.8	81
66	68.9	74.0	76.8	77.4	75.3	64.8	63.0	82.4	79
67	53.4	55.0	53.5	59.4	71.8	62.0	54.9	72.7	70
68	68.9	74.0	76 8	77.4	75.3	64.8	63.0	82.4	79
69	53.4	55.0	53.5	59.4	71.8	62.0	54.9	72.7	70
70	53.5	62.9	68.0	70.6	71.1	60.7	61.1	75.5	72
71	75.1	78.7	79.3	78.9	76.2	67.5	66.0	85.1	82
72	76 2	81.5	86.5	89.3	82 9	80.3	76.0	92.6	>89<
73	68.8	75.1	80.8	82.0	78.1	73.3	72.7	86.3	83
74	65.1	71.7	77.4	79.1	77.2	69.0	69.9	83.5	80
75	55.8	62.7	65.4	69.5	72.6	66.0	61.8	75.8	73
76	55.8	62.7	65.4	69.5	72.6	66 0	61.8	75.8	73
77	65.0	65.0	77.9	80.8	66.0	61.2	71.3	83.2	80
78	68.2	71.8	76.2	79.2	69.0	63 7	67.9	82.1	79
79	71.6	75.5	74.5	74.0	68.7	70.8	62.8	81.0	78
80	65.0	69.1	71.9	73.6	67.5	64.5	65.6	77.9	75
81	53.1	59.3	67.0	66.4	64.3	58.1	61.5	71.8	((69))
82	61.6	64.9	75.5	75.4	68.7	73.2	77.2	81.9	79
83	71.8	77.1	82.9	82.4	70.5	70.6	78 8	87.3	84

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-6.7
HPD selection for LHD operators

	dB-Neq	Mean:	99.3	Max:	104	Min:	89	Obs (n):	21
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	90.0	91.4	95.0	100.2	98.1	92.4	82.8	103.9	99.3
with HPD									
1	87.1	86.5	80.0	77.0	70.0	61.3	57.8	90.5	>86<
2	85.3	78.5	76.2	77.8	78.4	69.4	65.2	87.7	83
3	83.5	79.2	75.4	81.9	78.7	73.6	62.4	87.7	83
4	87.1	82.2	74.0	81.5	79.6	72.8	63.1	89.8	85
5	85.7	82.0	79.1	82.0	70.4	59.8	53.4	88.9	84
6	82.6	81.8	76.5	77.4	69.8	61.0	50.5	86.5	82
7	84.9	80.6	73.9	73.8	71.6	59.3	48.6	86.9	82
8	84.6	82.0	76.4	77.2	71.6	60.0	51.7	87.5	83
9	79.9	75.7	73.8	72.0	68.7	60.0	56.2	82.6	78
10	79.8	78.6	76.9	72.6	69.8	61.1	56.2	83.9	79
11	86.3	80.5	77.8	74.1	70.4	59.8	56.9	88.0	83
12	84.5	75.7	73.9	73.5	66.9	58.3	54.7	85.7	81
13	79.1	73.6	72.2	67.8	66.7	54.9	48.4	81.2	77
14	84.2	82.0	81.1	76.4	72.4	60.0	57.1	87.9	83
15	90.0	83.6	80.9	78.7	74.3	67.7	64.5	91.6	>87<
16	86.3	81.3	79.0	76.1	72.6	60.3	52.3	88.5	84
17	89.3	85.6	79.3	76.8	73.1	61.4	53.5	91.4	>87<
18	85.3	81.9	79.1	79.2	69.7	60.5	58.1	88.3	84
19	82.2	77.5	71.4	71.4	70.9	56.4	46.5	84.2	80
20	85.3	78.3	73.8	73.0	77.4	61.6	51.3	87.0	82
21	84.3	78.7	71.5	71.7	71.0	57.1	52.2	85.9	81
22	87.4	83.2	80.3	76.7	71.1	66.4	54.4	89.7	85
23	88.0	84.0	78.1	77.0	71.4	59.1	51.1	90.0	85
24	85.9	83.2	80.1	78.0	72.9	62.4	58.1	89.0	84
25	85.8	85.7	80.4	77.0	73.6	69.0	55.8	89.7	85
26	87.6	85.2	82.2	79.4	73.1	61.3	54.2	90.7	>86<
27	84.1	81.8	77.5	73.6	71.4	61.8	56.8	87.0	82
28	88.0	87.3	78.5	75.6	69.7	62.4	53.5	91.1	>87<
29	87.8	85.8	79.2	74.0	72.2	61.4	53.0	90.5	>86<
30	79.4	80.9	71.3	62.4	59.1	48.5	55.8	83.6	79
31	77.8	76.0	74.0	70.8	65.1	60.6	51.7	81.5	77
32	72.0	71.0	65.2	63.2	62.3	58.8	49.6	75.6	71
33	80.3	74.1	70.9	61.3	68.2	62.1	52.3	81.9	77
34	72.4	66.2	62.7	68.1	68.1	53.3	44.6	75.6	71
35	80.8	74.9	66.1	70.2	62.6	47.6	44.1	82.2	78
36	75.3	65.8	56.6	58.2	68.4	49.5	48.9	76.6	72
37	77.6	76.6	83.5	85.5	80.6	69.4	59.7	89.1	84
38	75.0	75.7	78.6	81.4	73.3	55.7	49.6	84.8	80
39	77.6	76.6	83.1	85.5	80.6	69.4	59.7	89.0	84
40	77.1	78.7	80.9	85.7	71.3	59.2	51.0	88.0	83
41	76.1	78.5	82.2	84.1	73.2	59.3	52.0	87.5	83
42	83.7	84.3	86.6	85.9	76.5	64.8	61.2	91.5	>87<
43	84.2	86.4	88.3	88.6	76.7	70.1	65.4	93.3	>89<
44	82.4	82.6	86.2	86.6	70.3	64.6	64.8	91.0	>86<
45	72.2	75.4	82.6	84.9	79.8	73.6	57.9	88.2	84
46	74.0	74.5	81.7	84.1	77.5	71.6	64.0	87.3	83
47	74.8	75.0	82.8	81.8	79.7	74.7	58.8	87.2	83
48	79.1	80.0	81.8	80.4	72.4	64.0	60.3	86.7	82
49	83.7	80.0	81.6	83.7	72.2	65.6	58.4	88.7	84
50	74.3	75.2	75.5	74.5	65.0	58.2	49.9	81.1	76
51	73.7	74.5	74.4	73.7	64.3	55.3	46.9	80.2	76
52	85.3	88.0	90.7	93.1	81.1	75.5	73.3	96.4	>92<
53	68.3	69.6	70.9	72.6	65.9	58.9	53.8	77.1	73
54	66.4	70.4	72.0	72.9	67.7	57.8	46.2	77.6	73
55	74.6	71.8	84.6	85.0	79.9	75.6	44.0	88.9	84
56	70.3	70.8	78.1	73.2	68.1	57.3	49.8	80.6	76
57	85.0	85.1	87.7	90.9	84.1	78.6	62.5	94.5	>90<
58	79.8	76.0	81.6	87.2	70.9	68.6	55.8	89.2	85
59	62.5	62.7	62.9	71.3	71.6	62.8	43.4	75.5	71
60	68.2	70.4	92.8	80.6	74.8	69.6	44.7	93.2	>89<
61	69.6	71.0	65.5	74.8	66.3	63.1	55.7	77.9	73
62	77.8	81.7	84.9	86.4	79.3	57.8	51.1	90.2	>86<
63	66.8	66.7	65.1	70.8	68.0	54.9	48.0	75.0	70
64	72.3	66.9	61.3	64.4	63.6	55.3	45.2	74.6	70
65	77.4	74.6	78.4	86.8	69.0	55.2	41.6	88.1	83
66	79.5	79.5	80.1	81.6	75.1	58.8	49.0	86.6	82
67	64.0	60.5	56.8	63.6	71.6	56.0	40.9	73.3	((69))
68	79.5	79.5	80.1	81.6	75.1	58.8	49.0	86.6	82
69	64.0	60.5	56.8	63.6	71.6	56.0	40.9	73.3	((69))
70	64.1	68.4	71.3	74.8	70.9	54.7	47.1	78.2	74
71	85.7	84.2	82.6	83.1	76.0	61.5	52.0	90.3	>86<
72	86.8	87.0	89.8	93.5	82.7	74.3	62.0	96.4	>92<
73	79.4	80.6	84.1	86.2	77.9	67.3	58.7	89.7	85
74	75.7	77.2	80.7	83.3	77.0	63.0	55.9	86.8	82
75	66.4	68.2	68.7	73.7	72.4	60.0	47.8	77.8	73
76	66.4	68.2	68.7	73.7	72.4	60.0	47.8	77.8	73
77	75.6	70.5	81.2	85.0	65.8	55.2	57.3	87.0	82
78	78.8	77.3	79.5	83.4	68.8	57.7	53.9	86.5	82
79	82.2	81.0	77.8	78.2	68.5	64.8	48.8	86.3	82
80	75.6	74.6	75.2	77.8	67.3	58.5	51.6	82.2	78
81	63.7	64.8	70.3	70.6	64.1	52.1	47.5	74.8	70
82	72.2	70.4	78.8	79.6	68.5	67.2	63.2	83.2	79
83	82.4	82.6	86.2	86.6	70.3	64.6	64.8	91.0	>86<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-6.8
HPD selection for mobile scaler operators

	dB-Neq	Mean:	98.2	Max:	101	Min:	95	Obs (n):	13
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	86.7	91.8	82.5	89.4	91.8	106.5	86.9	107.0	98.2
with HPD									
1	83.8	86.9	67.5	66.2	63.7	75.4	61.9	88.9	80
2	82.0	78.9	63.7	67.0	72.1	83.5	69.3	86.9	78
3	80.2	79.6	62.9	71.1	72.4	87.7	66.5	89.1	80
4	83.8	82.6	61.5	70.7	73.3	86.9	67.2	89.8	81
5	82.4	82.4	66.6	71.2	64.1	73.9	57.5	85.9	77
6	79.3	82.2	64.0	66.6	63.5	75.1	54.6	84.7	76
7	81.6	81.0	61.4	63.0	65.3	73.4	52.7	84.8	76
8	81.3	82.4	63.9	66.4	65.3	74.1	55.8	85.4	77
9	76.6	76.1	61.3	61.2	62.4	74.1	60.3	80.7	72
10	76.5	79.0	64.4	61.8	63.5	75.2	60.3	82.2	73
11	83.0	80.9	65.3	63.3	64.1	73.9	61.0	85.5	77
12	81.2	76.1	61.4	62.7	60.6	72.4	58.8	82.9	74
13	75.8	74.0	59.7	57.0	60.4	69.0	52.5	78.7	70
14	80.9	82.4	68.6	65.6	66.1	74.1	61.2	85.3	77
15	86.7	84.0	68.4	67.9	68.0	81.8	68.6	89.5	81
16	83.0	81.7	66.5	65.3	66.3	74.4	56.4	85.9	77
17	86.0	86.0	66.8	66.0	66.8	75.5	57.6	89.3	81
18	82.0	82.3	66.6	68.4	63.4	74.6	62.2	85.7	77
19	78.9	77.9	58.9	60.6	64.6	70.5	50.6	81.9	73
20	82.0	78.7	61.3	62.2	71.1	75.7	55.4	84.6	76
21	81.0	79.1	59.0	60.9	64.7	71.2	56.3	83.5	75
22	84.1	83.6	67.8	65.9	64.8	80.5	58.5	87.9	79
23	84.7	84.4	65.6	66.2	65.1	73.2	55.2	87.8	79
24	82.6	83.6	67.6	67.2	66.6	76.5	62.2	86.7	78
25	82.5	86.1	67.9	66.2	67.3	83.1	59.9	89.1	80
26	84.3	85.6	69.7	68.6	66.8	75.4	58.3	88.4	80
27	80.8	82.2	65.0	62.8	65.1	75.9	60.9	85.2	76
28	84.7	87.7	66.0	64.8	63.4	76.5	57.6	89.7	81
29	84.5	86.2	66.7	63.2	65.9	75.5	57.1	88.7	80
30	76.1	81.3	58.8	51.6	52.8	62.6	59.9	82.5	74
31	74.5	76.4	61.5	60.0	58.8	74.7	55.8	80.2	71
32	68.7	71.4	52.7	52.4	56.0	72.9	53.7	76.2	((67))
33	77.0	74.5	58.4	50.5	61.9	76.2	56.4	80.9	72
34	69.1	66.6	50.2	57.3	61.8	67.4	48.7	73.1	((64))
35	77.5	75.3	53.6	59.4	56.3	61.7	48.2	79.7	71
36	72.0	66.2	44.1	47.4	62.1	63.6	53.0	73.8	((65))
37	74.3	77.0	71.0	74.7	74.3	83.5	63.8	85.7	77
38	71.7	76.1	66.1	70.6	67.0	69.8	53.7	79.3	71
39	74.3	77.0	70.6	74.7	74.3	83.5	63.8	85.7	77
40	73.8	79.1	68.4	74.9	65.0	73.3	55.1	82.3	73
41	72.8	78.9	69.7	73.3	66.9	73.4	56.1	81.9	73
42	80.4	84.7	74.1	75.1	70.2	78.9	65.3	87.4	79
43	80.9	86.8	75.8	77.8	70.4	84.2	69.5	89.9	81
44	79.1	83.0	73.7	75.8	64.0	78.7	68.9	86.3	78
45	68.9	75.8	70.1	74.1	73.5	87.7	62.0	88.4	80
46	70.7	74.9	69.2	73.3	71.2	85.7	68.1	86.7	78
47	71.5	75.4	70.3	71.0	73.4	88.8	62.9	89.3	81
48	75.8	80.4	69.3	69.6	66.1	78.1	64.4	83.7	75
49	80.4	80.4	69.1	72.9	65.9	79.7	62.5	85.4	77
50	71.0	75.6	63.0	63.7	58.7	72.3	54.0	78.5	70
51	70.4	74.9	61.9	62.9	58.0	69.4	51.0	77.4	((69))
52	82.0	88.4	78.2	82.3	74.8	89.6	77.4	93.2	84
53	65.0	70.0	58.4	61.8	59.6	73.0	57.9	75.7	((67))
54	63.1	70.8	59.5	62.1	61.4	71.9	50.3	75.3	((66))
55	71.3	72.2	72.1	74.2	73.6	89.7	48.1	90.1	81
56	67.0	71.2	65.6	62.4	61.8	71.4	53.9	75.9	((67))
57	81.7	85.5	75.2	80.1	77.8	92.7	66.6	94.1	85
58	76.5	76.4	69.1	76.4	64.6	82.7	59.9	85.2	76
59	59.2	63.1	50.4	60.5	65.3	76.9	47.5	77.5	((69))
60	64.9	70.8	80.3	69.8	68.5	83.7	48.8	85.7	77
61	66.3	71.4	53.0	64.0	60.0	77.2	59.8	78.8	70
62	74.5	82.1	72.4	75.6	73.0	71.9	55.2	84.5	76
63	63.5	67.1	52.6	60.0	61.7	69.0	52.1	72.6	((64))
64	69.0	67.3	48.8	53.6	57.3	69.4	49.3	73.6	((65))
65	74.1	75.0	65.9	76.0	62.7	69.3	45.7	80.5	72
66	76.2	79.9	67.6	70.8	68.8	72.9	53.1	82.7	74
67	60.7	60.9	44.3	52.8	65.3	70.1	45.0	72.1	((63))
68	76.2	79.9	67.6	70.8	68.8	72.9	53.1	82.7	74
69	60.7	60.9	44.3	52.8	65.3	70.1	45.0	72.1	((63))
70	60.8	68.8	58.8	64.0	64.6	68.8	51.2	73.6	((65))
71	82.4	84.6	70.1	72.3	69.7	75.6	56.1	87.3	79
72	83.5	87.4	77.3	82.7	76.4	88.4	66.1	92.4	84
73	76.1	81.0	71.6	75.4	71.6	81.4	62.8	85.7	77
74	72.4	77.6	68.2	72.5	70.7	77.1	60.0	82.1	73
75	63.1	68.6	56.2	62.9	66.1	74.1	51.9	76.2	((67))
76	63.1	68.6	56.2	62.9	66.1	74.1	51.9	76.2	((67))
77	72.3	70.9	68.7	74.2	59.5	69.3	61.4	78.7	70
78	75.5	77.7	67.0	72.6	62.5	71.8	58.0	81.3	73
79	78.9	81.4	65.3	67.4	62.2	78.9	52.9	84.8	76
80	72.3	75.0	62.7	67.0	61.0	72.6	55.7	78.8	70
81	60.4	65.2	57.8	59.8	57.8	66.2	51.6	70.4	((62))
82	68.9	70.8	66.3	68.8	62.2	81.3	67.3	82.4	74
83	79.1	83.0	73.7	75.8	64.0	78.7	68.9	86.3	78

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-6.9
HPD selection for roadway grader operators

	dB-Neq	Mean:	95.0	Max:	98	Min:	87	Obs (n):	9
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	85.2	86.8	89.3	92.8	90.5	84.7	72.5	97.0	95.0
with HPD									
1	82.3	81.9	74.3	69.6	62.4	53.6	47.5	85.6	84
2	80.5	73.9	70.5	70.4	70.8	61.7	54.9	82.4	80
3	78.7	74.6	69.7	74.5	71.1	65.9	52.1	82.0	80
4	82.3	77.6	68.3	74.1	72.0	65.1	52.8	84.5	82
5	80.9	77.4	73.4	74.6	62.8	52.1	43.1	83.6	82
6	77.8	77.2	70.8	70.0	62.2	53.3	40.2	81.4	79
7	80.1	76.0	68.2	66.4	64.0	51.6	38.3	81.9	80
8	79.8	77.4	70.7	69.8	64.0	52.3	41.4	82.4	80
9	75.1	71.1	68.1	64.6	61.1	52.3	45.9	77.5	75
10	75.0	74.0	71.2	65.2	62.2	53.4	45.9	78.8	77
11	81.5	75.9	72.1	66.7	62.8	52.1	46.6	83.1	81
12	79.7	71.1	68.2	66.1	59.3	50.6	44.4	80.7	79
13	74.3	69.0	66.5	60.4	59.1	47.2	38.1	76.2	74
14	79.4	77.4	75.4	69.0	64.8	52.3	46.8	82.7	81
15	85.2	79.0	75.2	71.3	66.7	60.0	54.2	86.7	85
16	81.5	76.7	73.3	68.7	65.0	52.6	42.0	83.4	81
17	84.5	81.0	73.6	69.4	65.5	53.7	43.2	86.5	84
18	80.5	77.3	73.4	71.8	62.1	52.8	47.8	83.1	81
19	77.4	72.9	65.7	64.0	63.3	48.7	36.2	79.2	77
20	80.5	73.7	68.1	65.6	69.8	53.9	41.0	81.9	80
21	79.5	74.1	65.8	64.3	63.4	49.4	41.9	80.9	79
22	82.6	78.6	74.6	69.3	63.5	58.7	44.1	84.7	83
23	83.2	79.4	72.4	69.6	63.8	51.4	40.8	85.1	83
24	81.1	78.6	74.4	70.6	65.3	54.7	47.8	83.9	82
25	81.0	81.1	74.7	69.6	66.0	61.3	45.5	84.8	83
26	82.8	80.6	76.5	72.0	65.5	53.6	43.9	85.7	84
27	79.3	77.2	71.8	66.2	63.8	54.1	46.5	82.0	80
28	83.2	82.7	72.8	68.2	62.1	54.7	43.2	86.3	84
29	83.0	81.2	73.5	66.6	64.6	53.7	42.7	85.6	84
30	74.6	76.3	65.6	55.0	51.5	40.8	45.5	78.8	77
31	73.0	71.4	68.3	63.4	57.5	52.9	41.4	76.4	74
32	67.2	66.4	59.5	55.8	54.7	51.1	39.3	70.5	((69))
33	75.5	69.5	65.2	53.9	60.6	54.4	42.0	76.9	75
34	67.6	61.6	57.0	60.7	60.5	45.6	34.3	70.0	((68))
35	76.0	70.3	60.4	62.8	55.0	39.9	33.8	77.3	75
36	70.5	61.2	50.9	50.8	60.8	41.8	38.6	71.5	69
37	72.8	72.0	77.8	78.1	73.0	61.7	49.4	82.6	81
38	70.2	71.1	72.9	74.0	65.7	48.0	39.3	78.6	77
39	72.8	72.0	77.4	78.1	73.0	61.7	49.4	82.5	80
40	72.3	74.1	75.2	78.3	63.7	51.5	40.7	81.6	80
41	71.3	73.9	76.5	76.7	65.6	51.6	41.7	81.2	79
42	78.9	79.7	80.9	78.5	68.9	57.1	50.9	85.7	84
43	79.4	81.8	82.6	81.2	69.1	62.4	55.1	87.5	>86<
44	77.6	78.0	80.5	79.2	62.7	56.9	54.5	85.0	83
45	67.4	70.8	76.9	77.5	72.2	65.9	47.6	81.6	80
46	69.2	69.9	76.0	76.7	69.9	63.9	53.7	80.7	79
47	70.0	70.4	77.1	74.4	72.1	67.0	48.5	80.8	79
48	74.3	75.4	76.1	73.0	64.8	56.3	50.0	81.0	79
49	78.9	75.4	75.9	76.3	64.6	57.9	48.1	83.0	81
50	69.5	70.6	69.8	67.1	57.4	50.5	39.6	75.5	74
51	68.9	69.9	68.7	66.3	56.7	47.6	36.6	74.7	73
52	80.5	83.4	85.0	85.7	73.5	67.8	63.0	90.2	>88<
53	63.5	65.0	65.2	65.2	58.3	51.2	43.5	71.1	((69))
54	61.6	65.8	66.3	65.5	60.1	50.1	35.9	71.5	70
55	69.8	67.2	78.9	77.6	72.3	67.9	33.7	82.4	80
56	65.5	66.2	72.4	65.8	60.5	49.6	39.5	74.8	73
57	80.2	80.5	82.0	83.5	76.5	70.9	52.2	88.2	>86<
58	75.0	71.4	75.9	79.8	63.3	60.9	45.5	82.6	81
59	57.7	58.1	57.2	63.9	64.0	55.1	33.1	68.5	((66))
60	63.4	65.8	87.1	73.2	67.2	61.9	34.4	87.4	85
61	64.8	66.4	59.8	67.4	58.7	55.4	45.4	71.7	70
62	73.0	77.1	79.2	79.0	71.7	50.1	40.8	84.0	82
63	62.0	62.1	59.4	63.4	60.4	47.2	37.7	68.7	((67))
64	67.5	62.3	55.6	57.0	56.0	47.6	34.9	69.4	((67))
65	72.6	70.0	72.7	79.4	61.4	47.5	31.3	81.3	79
66	74.7	74.9	74.4	74.2	67.5	51.1	38.7	80.8	79
67	59.2	55.9	51.1	56.2	64.0	48.3	30.6	66.4	((64))
68	74.7	74.9	74.4	74.2	67.5	51.1	38.7	80.8	79
69	59.2	55.9	51.1	56.2	64.0	48.3	30.6	66.4	((64))
70	59.3	63.8	65.6	67.4	63.3	47.0	36.8	71.6	70
71	80.9	79.6	76.9	75.7	68.4	53.8	41.7	84.9	83
72	82.0	82.4	84.1	86.1	75.1	66.6	51.7	90.1	>88<
73	74.6	76.0	78.4	78.8	70.3	59.6	48.4	83.5	82
74	70.9	72.6	75.0	75.9	69.4	55.3	45.6	80.4	78
75	61.6	63.6	63.0	66.3	64.8	52.3	37.5	71.2	((69))
76	61.6	63.6	63.0	66.3	64.8	52.3	37.5	71.2	((69))
77	70.8	65.9	75.5	77.6	58.2	47.5	47.0	80.4	78
78	74.0	72.7	73.8	76.0	61.2	50.0	43.6	80.4	78
79	77.4	76.4	72.1	70.8	60.9	57.1	38.5	81.1	79
80	70.8	70.0	69.5	70.4	59.7	50.8	41.3	76.3	74
81	58.9	60.2	64.6	63.2	56.5	44.4	37.2	68.6	((67))
82	67.4	65.8	73.1	72.2	60.9	59.5	52.9	76.9	75
83	77.6	78.0	80.5	79.2	62.7	56.9	54.5	85.0	83

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-6.10
HPD selection for roofbolter operators

	dB-Neq	Mean:	94.3	Max:	98	Min:	89	Obs (n):	13
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	84.5	90.2	92.1	93.7	90.6	88.0	80.1	98.6	94.3
with HPD									
1	81.6	85.3	77.1	70.5	62.5	56.9	55.1	87.4	83
2	79.8	77.3	73.3	71.3	70.9	65.0	62.5	83.0	79
3	78.0	78.0	72.5	75.4	71.2	69.2	59.7	83.0	79
4	81.6	81.0	71.1	75.0	72.1	68.4	60.4	85.3	81
5	80.2	80.8	76.2	75.5	62.9	55.4	50.7	84.8	81
6	77.1	80.6	73.6	70.9	62.3	56.6	47.8	83.1	79
7	79.4	79.4	71.0	67.3	64.1	54.9	45.9	82.9	79
8	79.1	80.8	73.5	70.7	64.1	55.6	49.0	83.8	80
9	74.4	74.5	70.9	65.5	61.2	55.6	53.5	78.7	74
10	74.3	77.4	74.0	66.1	62.3	56.7	53.5	80.5	76
11	80.8	79.3	74.9	67.6	62.9	55.4	54.2	83.9	80
12	79.0	74.5	71.0	67.0	59.4	53.9	52.0	81.0	77
13	73.6	72.4	69.3	61.3	59.2	50.5	45.7	77.1	73
14	78.7	80.8	78.2	69.9	64.9	55.6	54.4	84.4	80
15	84.5	82.4	78.0	72.2	66.8	63.3	61.8	87.4	83
16	80.8	80.1	76.1	69.6	65.1	55.9	49.6	84.4	80
17	83.8	84.4	76.4	70.3	65.6	57.0	50.8	87.6	83
18	79.8	80.7	76.2	72.7	62.2	56.1	55.4	84.4	80
19	76.7	76.3	68.5	64.9	63.4	52.0	43.8	80.1	76
20	79.8	77.1	70.9	66.5	69.9	57.2	48.6	82.4	78
21	78.8	77.5	68.6	65.2	63.5	52.7	49.5	81.6	77
22	81.9	82.0	77.4	70.2	63.6	62.0	51.7	85.8	82
23	82.5	82.8	75.2	70.5	63.9	54.7	48.4	86.2	82
24	80.4	82.0	77.2	71.5	65.4	58.0	55.4	85.3	81
25	80.3	84.5	77.5	70.5	66.1	64.6	53.1	86.7	82
26	82.1	84.0	79.3	72.9	65.6	56.9	51.5	87.2	83
27	78.6	80.6	74.6	67.1	63.9	57.4	54.1	83.5	79
28	82.5	86.1	75.6	69.1	62.2	58.0	50.8	88.0	84
29	82.3	84.6	76.3	67.5	64.7	57.0	50.3	87.1	83
30	73.9	79.7	68.4	55.9	51.6	44.1	53.1	81.0	77
31	72.3	74.8	71.1	64.3	57.6	56.2	49.0	78.1	74
32	66.5	69.8	62.3	56.7	54.8	54.4	46.9	72.3	((68))
33	74.8	72.9	68.0	54.8	60.7	57.7	49.6	77.6	73
34	66.9	65.0	59.8	61.6	60.6	48.9	41.9	70.7	((66))
35	75.3	73.7	63.2	63.7	55.1	43.2	41.4	77.9	74
36	69.8	64.6	53.7	51.7	60.9	45.1	46.2	71.5	((67))
37	72.1	75.4	80.6	79.0	73.1	65.0	57.0	84.3	80
38	69.5	74.5	75.7	74.9	65.8	51.3	46.9	80.4	76
39	72.1	75.4	80.2	79.0	73.1	65.0	57.0	84.1	80
40	71.6	77.5	78.0	79.2	63.8	54.8	48.3	83.4	79
41	70.6	77.3	79.3	77.6	65.7	54.9	49.3	83.3	79
42	78.2	83.1	83.7	79.4	69.0	60.4	58.5	87.8	84
43	78.7	85.2	85.4	82.1	69.2	65.7	62.7	89.7	85
44	76.9	81.4	83.3	80.1	62.8	60.2	62.1	87.1	83
45	66.7	74.2	79.7	78.4	72.3	69.2	55.2	83.4	79
46	68.5	73.3	78.8	77.6	70.0	67.2	61.3	82.5	78
47	69.3	73.8	79.9	75.3	72.2	70.3	56.1	82.8	79
48	73.6	78.8	78.9	73.9	64.9	59.6	57.6	83.1	79
49	78.2	78.8	78.7	77.2	64.7	61.2	55.7	84.4	80
50	68.8	74.0	72.6	68.0	57.5	53.8	47.2	77.6	73
51	68.2	73.3	71.5	67.2	56.8	50.9	44.2	76.8	73
52	79.8	86.8	87.8	86.6	73.6	71.1	70.6	92.3	>88<
53	62.8	68.4	68.0	66.1	58.4	54.5	51.1	73.1	((69))
54	60.9	69.2	69.1	66.4	60.2	53.4	43.5	73.7	((69))
55	69.1	70.6	81.7	78.5	72.4	71.2	41.3	84.3	80
56	64.8	69.6	75.2	66.7	60.6	52.9	47.1	77.1	73
57	79.5	83.9	84.8	84.4	76.6	74.2	59.8	89.9	>86<
58	74.3	74.8	78.7	80.7	63.4	64.2	53.1	84.0	80
59	57.0	61.5	60.0	64.8	64.1	58.4	40.7	69.6	((65))
60	62.7	69.2	89.9	74.1	67.3	65.2	42.0	90.1	>86<
61	64.1	69.8	62.6	68.3	58.8	58.7	53.0	73.5	((69))
62	72.3	80.5	82.0	79.9	71.8	53.4	48.4	86.0	82
63	61.3	65.5	62.2	64.3	60.5	50.5	45.3	70.2	((66))
64	66.8	65.7	58.4	57.9	56.1	50.9	42.5	70.2	((66))
65	71.9	73.4	75.5	80.3	61.5	50.8	38.9	82.6	78
66	74.0	78.3	77.2	75.1	67.6	54.4	46.3	82.6	78
67	58.5	59.3	53.9	57.1	64.1	51.6	38.2	67.0	((63))
68	74.0	78.3	77.2	75.1	67.6	54.4	46.3	82.6	78
69	58.5	59.3	53.9	57.1	64.1	51.6	38.2	67.0	((63))
70	58.6	67.2	68.4	68.3	63.4	50.3	44.4	73.4	((69))
71	80.2	83.0	79.7	76.6	68.5	57.1	49.3	86.5	82
72	81.3	85.8	86.9	87.0	75.2	69.9	59.3	91.9	>88<
73	73.9	79.4	81.2	79.7	70.4	62.9	56.0	85.4	81
74	70.2	76.0	77.8	76.8	69.5	58.6	53.2	82.3	78
75	60.9	67.0	65.8	67.2	64.9	55.6	45.1	72.7	((68))
76	60.9	67.0	65.8	67.2	64.9	55.6	45.1	72.7	((68))
77	70.1	69.3	78.3	78.5	58.3	50.8	54.6	82.0	78
78	73.3	76.1	76.6	76.9	61.3	53.3	51.2	82.0	78
79	76.7	79.8	74.9	71.7	61.0	60.4	46.1	82.8	79
80	70.1	73.4	72.3	71.3	59.8	54.1	48.9	78.1	74
81	58.2	63.6	67.4	64.1	56.6	47.7	44.8	70.6	((66))
82	66.7	69.2	75.9	73.1	61.0	62.8	60.5	78.8	75
83	76.9	81.4	83.3	80.1	62.8	60.2	62.1	87.1	83

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-6.11
HPD selection for tip impact breaker operators

	dB-Neq	Mean:	89.0	Max:	95	Min:	87	Obs (n):	10
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	78.8	84.4	96.8	98.2	99.7	94.1	85.3	103.8	95
with HPD									
1	75.9	79.5	81.8	75.0	71.6	63.0	60.3	85.2	76
2	74.1	71.5	78.0	75.8	80.0	71.1	67.7	84.1	75
3	72.3	72.2	77.2	79.9	80.3	75.3	64.9	85.2	76
4	75.9	75.2	75.8	79.5	81.2	74.5	65.6	85.6	77
5	74.5	75.0	80.9	80.0	72.0	61.5	55.9	84.8	76
6	71.4	74.8	78.3	75.4	71.4	62.7	53.0	82.1	73
7	73.7	73.6	75.7	71.8	73.2	61.0	51.1	80.8	72
8	73.4	75.0	78.2	75.2	73.2	61.7	54.2	82.4	74
9	68.7	68.7	75.6	70.0	70.3	61.7	58.7	78.7	70
10	68.6	71.6	78.7	70.6	71.4	62.8	58.7	80.9	72
11	75.1	73.5	79.6	72.1	72.0	61.5	59.4	82.6	74
12	73.3	68.7	75.7	71.5	68.5	60.0	57.2	79.5	71
13	67.9	66.6	74.0	65.8	68.3	56.6	50.9	76.7	((68))
14	73.0	75.0	82.9	74.4	74.0	61.7	59.6	84.8	76
15	78.8	76.6	82.7	76.7	75.9	69.4	67.0	86.1	77
16	75.1	74.3	80.8	74.1	74.2	62.0	54.8	83.7	75
17	78.1	78.6	81 1	74.8	74.7	63.1	56.0	85.2	76
18	74.1	74.9	80.9	77.2	71.3	62.2	60.6	84.0	75
19	71.0	70.5	73.2	69.4	72.5	58.1	49.0	78.6	70
20	74.1	71.3	75.6	71.0	79.0	63.3	53.8	82.3	74
21	73.1	71.7	73.3	69.7	72.6	58.8	54.7	79.3	71
22	76.2	76.2	82.1	74.7	72.7	68.1	56.9	84.8	76
23	76.8	77.0	79.9	75.0	73.0	60.8	53.6	84.0	75
24	74.7	76.2	81.9	76.0	74.5	64.1	60.6	84.7	76
25	74.6	78.7	82.2	75.0	75.2	70.7	58.3	85.4	77
26	76.4	78.2	84.0	77.4	74.7	63.0	56.7	86.5	78
27	72.9	74.8	79.3	71.6	73.0	63.5	59.3	82.4	74
28	76.8	80.3	80.3	73.6	71.3	64.1	56.0	84.8	76
29	76.6	78.8	81.0	72.0	73.8	63.1	55.5	84.6	76
30	68.2	73.9	73.1	60.4	60.7	50.2	58.3	77.4	((69))
31	66.6	69.0	75.8	68.8	66.7	62.3	54.2	78.1	((69))
32	60.8	64.0	67.0	61.2	63.9	60.5	52.1	71.4	((63))
33	69.1	67.1	72.7	59.3	69.8	63.8	54.8	76.5	((68))
34	61.2	59.2	64.5	66.1	69.7	55.0	47.1	72.7	((64))
35	69.6	67.9	67.9	68.2	64.2	49.3	46.6	74.9	((66))
36	64.1	58.8	58.4	56.2	70.0	51.2	51 4	71.7	((63))
37	66.4	69.6	85.3	83.5	82.2	71.1	62.2	88.8	80
38	63.8	68.7	80.4	79.4	74.9	57.4	52.1	83.8	75
39	66.4	69.6	84.9	83.5	82 2	71.1	62.2	88.6	80
40	65.9	71.7	82.7	83.7	72.9	60.9	53.5	86.6	78
41	64.9	71.5	84.0	82.1	74.8	61.0	54.5	86.6	78
42	72.5	77.3	88.4	83.9	78.1	66.5	63.7	90.3	82
43	73 0	79.4	90.1	86 6	78.3	71.8	67.9	92.2	83
44	71.2	75.6	88.0	84.6	71.9	66 3	67 3	90.0	81
45	61.0	68.4	84.4	82.9	81.4	75.3	60.4	88.1	79
46	62.8	67.5	83.5	82.1	79.1	73.3	66.5	87.0	78
47	63.6	68.0	84.6	79.8	81.3	76.4	61.3	87.6	79
48	67.9	73.0	83.6	78.4	74.0	65.7	62.8	85.5	77
49	72.5	73.0	83.4	81.7	73 8	67.3	60.9	86.4	78
50	63.1	68.2	77.3	72.5	66.6	59.9	52.4	79.3	71
51	62.5	67.5	76.2	71.7	65.9	57.0	49.4	78.3	70
52	74.1	81.0	92.5	91.1	82.7	77.2	75.8	95.4	>87<
53	57.1	62.6	72.7	70.6	67.5	60.6	56.3	76.0	((67))
54	55.2	63.4	73.8	70.9	69.3	59.5	48.7	76.8	((68))
55	63.4	64.8	86.4	83.0	81.5	77.3	46.5	89.2	80
56	59.1	63.8	79.9	71.2	69.7	59.0	52.3	80.9	72
57	73.8	78.1	89.5	88.9	85.7	80.3	65.0	93.5	85
58	68.6	69.0	83.4	85.2	72.5	70.3	58.3	87.7	79
59	51.3	55.7	64.7	69.3	73.2	64.5	45.9	75.5	((67))
60	57.0	63.4	94.6	78.6	76.4	71.3	47.2	94.8	>86<
61	58.4	64.0	67 3	72.8	67.9	64.8	58.2	75.7	((67))
62	66.6	74.7	86.7	84.4	80.9	59.5	53 6	89.5	81
63	55.6	59.7	66.9	68.8	69.6	56.6	50.5	73.7	((65))
64	61.1	59.9	63.1	62.4	65.2	57.0	47.7	70.0	((61))
65	66.2	67.6	80.2	84.8	70.6	56.9	44.1	86.3	78
66	68.3	72.5	81.9	79.6	76.7	60.5	51.5	85.0	76
67	52.8	53.5	58.6	61.6	73.2	57.7	43.4	73.8	((65))
68	68.3	72.5	81.9	79.6	76.7	60.5	51.5	85.0	76
69	52.8	53.5	58.6	61.6	73.2	57.7	43.4	73.8	((65))
70	52.9	61.4	73.1	72.8	72.5	56.4	49.6	77.7	((69))
71	74.5	77.2	84.4	81.1	77.6	63.2	54.5	87.4	79
72	75.6	80.0	91.6	91.5	84 3	76.0	64.5	95.2	>86<
73	68.2	73.6	85.9	84.2	79.5	69.0	61.2	88.9	80
74	64.5	70.2	82 5	81.3	78 6	64.7	58.4	86.0	77
75	55.2	61.2	70.5	71.7	74.0	61.7	50.3	77.4	((69))
76	55.2	61.2	70.5	71.7	74.0	61.7	50.3	77.4	((69))
77	64.4	63.5	83.0	83.0	67.4	56.9	59.8	86.1	77
78	67.6	70.3	81.3	81.4	70.4	59.4	56.4	84.8	76
79	71.0	74.0	79.6	76.2	70.1	66 5	51.3	82.7	74
80	64.4	67.6	77.0	75.8	68.9	60 2	54.1	80.2	71
81	52.5	57.8	72.1	68.6	65.7	53.8	50.0	74.5	((66))
82	61.0	63.4	80.6	77.6	70.1	68.9	65.7	83.0	74
83	71.2	75.6	88.0	84.6	71.9	66.3	67.3	90.0	81

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-6.12
HPD selection for utility vehicle drivers

	dB-Neq	Mean:	95.4	Max:	99	Min:	86	Obs (n):	13
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	89.6	92.5	94.9	98.8	98.0	95.6	91.0	103.9	95.4
with HPD									
1	86.7	87.6	79.9	75.6	69.9	64.5	66.0	90.8	82
2	84.9	79.6	76.1	76.4	78.3	72.6	73.4	87.7	79
3	83.1	80.3	75.3	80.5	78.6	76.8	70.6	87.7	79
4	86.7	83.3	73.9	80.1	79.5	76.0	71.3	89.8	81
5	85.3	83.1	79.0	80.6	70.3	63.0	61.6	88.8	80
6	82.2	82.9	76.4	76.0	69.7	64.2	58.7	86.6	78
7	84.5	81.7	73.8	72.4	71.5	62.5	56.8	86.9	78
8	84.2	83.1	76.3	75.8	71.5	63.2	59.9	87.5	79
9	79.5	76.8	73.7	70.6	68.6	63.2	64.4	82.6	74
10	79.4	79.7	76.8	71.2	69.7	64.3	64.4	84.1	76
11	85.9	81.6	77.7	72.7	70.3	63.0	65.1	88.0	79
12	84.1	76.8	73.8	72.1	66.8	61.5	62.9	85.5	77
13	78.7	74.7	72.1	66.4	66.6	58.1	56.6	81.1	73
14	83.8	83.1	81.0	75.0	72.3	63.2	65.3	88.0	79
15	89.6	84.7	80.8	77.3	74.2	70.9	72.7	91.6	83
16	85.9	82.4	78.9	74.7	72.5	63.5	60.5	88.4	80
17	88.9	86.7	79.2	75.4	73.0	64.6	61.7	91.4	83
18	84.9	83.0	79.0	77.8	69.6	63.7	66.3	88.2	80
19	81.8	78.6	71.3	70.0	70.8	59.6	54.7	84.2	76
20	84.9	79.4	73.7	71.6	77.3	64.8	59.5	86.9	78
21	83.9	79.8	71.4	70.3	70.9	60.3	60.4	85.8	77
22	87.0	84.3	80.2	75.3	71.0	69.6	62.6	89.7	81
23	87.6	85.1	78.0	75.6	71.3	62.3	59.3	90.1	82
24	85.5	84.3	80.0	76.6	72.8	65.6	66.3	89.0	81
25	85.4	86.8	80.3	75.6	73.5	72.2	64.0	90.0	82
26	87.2	86.3	82.1	78.0	73.0	64.5	62.4	90.8	82
27	83.7	82.9	77.4	72.2	71.3	65.0	65.0	87.2	79
28	87.6	88.4	78.4	74.2	69.6	65.6	61.7	91.4	83
29	87.4	86.9	79.1	72.6	72.1	64.6	61.2	90.6	82
30	79.0	82.0	71.2	61.0	59.0	51.7	64.0	84.1	76
31	77.4	77.1	73.9	69.4	65.0	63.8	59.9	81.6	73
32	71.6	72.1	65.1	61.8	62.2	62.0	57.8	75.9	((67))
33	79.9	75.2	70.8	59.9	68.1	65.3	60.5	81.9	73
34	72.0	67.3	62.6	66.7	68.0	56.5	52.8	75.4	((67))
35	80.4	76.0	66.0	68.8	62.5	50.8	52.3	82.1	74
36	74.9	66.9	56.5	56.8	68.3	52.7	57.1	76.5	((68))
37	77.2	77.7	83.4	84.1	80.5	72.6	67.9	88.6	80
38	74.6	76.8	78.5	80.0	73.2	58.9	57.8	84.3	76
39	77.2	77.7	83.0	84.1	80.5	72.6	67.9	88.5	80
40	76.7	79.8	80.8	84.3	71.2	62.4	59.2	87.4	79
41	75.7	79.6	82.1	82.7	73.1	62.5	60.2	87.0	78
42	83.3	85.4	86.5	84.5	76.4	68.0	69.4	91.3	83
43	83.8	87.5	88.2	87.2	76.6	73.3	73.6	93.2	85
44	82.0	83.7	86.1	85.2	70.2	67.8	73.0	90.7	82
45	71.8	76.5	82.5	83.5	79.7	76.8	66.1	87.8	79
46	73.6	75.6	81.6	82.7	77.4	74.8	72.2	86.9	78
47	74.4	76.1	82.7	80.4	79.6	77.9	67.0	87.2	79
48	78.7	81.1	81.7	79.0	72.3	67.2	68.5	86.6	78
49	83.3	81.1	81.5	82.3	72.1	68.8	66.6	88.3	80
50	73.9	76.3	75.4	73.1	64.9	61.4	58.1	81.1	73
51	73.3	75.6	74.3	72.3	64.2	58.5	55.1	80.2	72
52	84.9	89.1	90.6	91.7	81.0	78.7	81.5	96.1	>88<
53	67.9	70.7	70.8	71.2	65.8	62.1	62.0	77.0	((68))
54	66.0	71.5	71.9	71.5	67.6	61.0	54.4	77.4	((69))
55	74.2	72.9	84.5	83.6	79.8	78.8	52.2	88.6	80
56	69.9	71.9	78.0	71.8	68.0	60.5	58.0	80.5	72
57	84.6	86.2	87.6	89.5	84.0	81.8	70.7	94.1	>86<
58	79.4	77.1	81.5	85.8	70.8	71.8	64.0	88.4	80
59	62.1	63.8	62.8	69.9	71.5	66.0	51.6	75.3	((67))
60	67.8	71.5	92.7	79.2	74.7	72.8	52.9	93.0	85
61	69.2	72.1	65.4	73.4	66.2	66.3	63.9	77.8	((69))
62	77.4	82.8	84.8	85.0	79.2	61.0	59.3	89.8	81
63	66.4	67.8	65.0	69.4	67.9	58.1	56.2	74.7	((66))
64	71.9	68.0	61.2	63.0	63.5	58.5	53.4	74.5	((66))
65	77.0	75.7	78.3	85.4	68.9	58.4	49.8	87.1	79
66	79.1	80.6	80.0	80.2	75.0	62.0	57.2	86.4	78
67	63.6	61.6	56.7	62.2	71.5	59.2	49.1	73.2	((65))
68	79.1	80.6	80.0	80.2	75.0	62.0	57.2	86.4	78
69	63.6	61.6	56.7	62.2	71.5	59.2	49.1	73.2	((65))
70	63.7	69.5	71.2	73.4	70.8	57.9	55.3	77.7	((69))
71	85.3	85.3	82.5	81.7	75.9	64.7	60.2	90.2	82
72	86.4	88.1	89.7	92.1	82.6	77.5	70.2	95.9	>87<
73	79.0	81.7	84.0	84.8	77.8	70.5	66.9	89.3	81
74	75.3	78.3	80.6	81.9	76.9	66.2	64.1	86.3	78
75	66.0	69.3	68.6	72.3	72.3	63.2	56.0	77.5	((69))
76	66.0	69.3	68.6	72.3	72.3	63.2	56.0	77.5	((69))
77	75.2	71.6	81.1	83.6	65.7	58.4	65.5	86.2	78
78	78.4	78.4	79.4	82.0	68.7	60.9	62.1	86.0	77
79	81.8	82.1	77.7	76.8	68.4	68.0	57.0	86.4	78
80	75.2	75.7	75.1	76.4	67.2	61.7	59.8	81.9	73
81	63.3	65.9	70.2	69.2	64.0	55.3	55.7	74.5	((66))
82	71.8	71.5	78.7	78.2	68.4	70.4	71.4	83.0	75
83	82.0	83.7	86.1	85.2	70.2	67.8	73.0	90.7	82

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-6.13

HPD selection for vibromax compactor roller operators

	dB-Neq	Mean:	92.3	Max:	96	Min:	86	Obs (n):	7
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	83.1	82.2	86.2	90.7	88.3	82.2	68.3	94.5	92.3
with HPD									
1	80.2	77.3	71.2	67.5	60.2	51.1	43.3	82.5	80
2	78.4	69.3	67.4	68.3	68.6	59.2	50.7	79.9	78
3	76.6	70.0	66.6	72.4	68.9	63.4	47.9	79.4	77
4	80.2	73.0	65.2	72.0	69.8	62.6	48.6	81.9	80
5	78.8	72.8	70.3	72.5	60.6	49.6	38.9	81.0	79
6	75.7	72.6	67.7	67.9	60.0	50.8	36.0	78.4	76
7	78.0	71.4	65.1	64.3	61.8	49.1	34.1	79.3	77
8	77.7	72.8	67.6	67.7	61.8	49.8	37.2	79.6	77
9	73.0	66.5	65.0	62.5	58.9	49.8	41.7	74.8	73
10	72.9	69.4	68.1	63.1	60.0	50.9	41.7	75.8	74
11	79.4	71.3	69.0	64.6	60.6	49.6	42.4	80.5	78
12	77.6	66.5	65.1	64.0	57.1	48.1	40.2	78.3	76
13	72.2	64.4	63.4	58.3	56.9	44.7	33.9	73.6	71
14	77.3	72.8	72.3	66.9	62.6	49.8	42.6	79.8	78
15	83.1	74.4	72.1	69.2	64.5	57.5	50.0	84.1	82
16	79.4	72.1	70.2	66.6	62.8	50.1	37.8	80.8	79
17	82.4	76.4	70.5	67.3	63.3	51.2	39.0	83.7	82
18	78.4	72.7	70.3	69.7	59.9	50.3	43.6	80.4	78
19	75.3	68.3	62.6	61.9	61.1	46.2	32.0	76.6	74
20	78.4	69.1	65.0	63.5	67.6	51.4	36.8	79.5	77
21	77.4	69.5	62.7	62.2	61.2	46.9	37.7	78.4	76
22	80.5	74.0	71.5	67.2	61.3	56.2	39.9	82.0	80
23	81.1	74.8	69.3	67.5	61.6	48.9	36.6	82.4	80
24	79.0	74.0	71.3	68.5	63.1	52.2	43.6	81.1	79
25	78.9	76.5	71.6	67.5	63.8	58.8	41.3	81.6	79
26	80.7	76.0	73.4	69.9	63.3	51.1	39.7	82.8	81
27	77.2	72.6	68.7	64.1	61.6	51.6	42.3	79.2	77
28	81.1	78.1	69.7	66.1	59.9	52.2	39.0	83.2	81
29	80.9	76.6	70.4	64.5	62.4	51.2	38.5	82.7	80
30	72.5	71.7	62.5	52.9	49.3	38.3	41.3	75.4	73
31	70.9	66.8	65.2	61.3	55.3	50.4	37.2	73.5	71
32	65.1	61.8	56.4	53.7	52.5	48.6	35.1	67.5	((65))
33	73.4	64.9	62.1	51.8	58.4	51.9	37.8	74.4	72
34	65.5	57.0	53.9	58.6	58.3	43.1	30.1	67.6	((65))
35	73.9	65.7	57.3	60.7	52.8	37.4	29.6	74.8	73
36	68.4	56.6	47.8	48.7	58.6	39.3	34.4	69.2	((67))
37	70.7	67.4	74.7	76.0	70.8	59.2	45.2	80.0	78
38	68.1	66.5	69.8	71.9	63.5	45.5	35.1	75.8	74
39	70.7	67.4	74.3	76.0	70.8	59.2	45.2	79.9	78
40	70.2	69.5	72.1	76.2	61.5	49.0	36.5	79.0	77
41	69.2	69.3	73.4	74.6	63.4	49.1	37.5	78.4	76
42	76.8	75.1	77.8	76.4	66.7	54.6	46.7	82.8	81
43	77.3	77.2	79.5	79.1	66.9	59.9	50.9	84.5	82
44	75.5	73.4	77.4	77.1	60.5	54.4	50.3	82.2	80
45	65.3	66.2	73.8	75.4	70.0	63.4	43.4	78.9	77
46	67.1	65.3	72.9	74.6	67.7	61.4	49.5	78.1	76
47	67.9	65.8	74.0	72.3	69.9	64.5	44.3	78.1	76
48	72.2	70.8	73.0	70.9	62.6	53.8	45.8	78.0	76
49	76.8	70.8	72.8	74.2	62.4	55.4	43.9	80.3	78
50	67.4	66.0	66.7	65.0	55.2	48.0	35.4	72.5	70
51	66.8	65.3	65.6	64.2	54.5	45.1	32.4	71.7	70
52	78.4	78.8	81.9	83.6	71.3	65.3	58.8	87.4	85
53	61.4	60.4	62.1	63.1	56.1	48.7	39.3	68.2	((66))
54	59.5	61.2	63.2	63.4	57.9	47.6	31.7	68.6	((66))
55	67.7	62.6	75.8	75.5	70.1	65.4	29.5	79.8	78
56	63.4	61.6	69.3	63.7	58.3	47.1	35.3	71.8	70
57	78.1	75.9	78.9	81.4	74.3	68.4	48.0	85.5	83
58	72.9	66.8	72.8	77.7	61.1	58.4	41.3	80.2	78
59	55.6	53.5	54.1	61.8	61.8	52.6	28.9	66.1	((64))
60	61.3	61.2	84.0	71.1	65.0	59.4	30.2	84.3	82
61	62.7	61.8	56.7	65.3	56.5	52.9	41.2	69.0	((67))
62	70.9	72.5	76.1	76.9	69.5	47.6	36.6	81.1	79
63	59.9	57.5	56.3	61.3	58.2	44.7	33.5	66.0	((64))
64	65.4	57.7	52.5	54.9	53.8	45.1	30.7	66.8	((65))
65	70.5	65.4	69.6	77.3	59.2	45.0	27.1	78.9	77
66	72.6	70.3	71.3	72.1	65.3	48.6	34.5	77.9	76
67	57.1	51.3	48.0	54.1	61.8	45.8	26.4	64.0	((62))
68	72.6	70.3	71.3	72.1	65.3	48.6	34.5	77.9	76
69	57.1	51.3	48.0	54.1	61.8	45.8	26.4	64.0	((62))
70	57.2	59.2	62.5	65.3	61.1	44.5	32.6	68.9	((67))
71	78.8	75.0	73.8	73.6	66.2	51.3	37.5	82.0	80
72	79.9	77.8	81.0	84.0	72.9	64.1	47.5	87.5	85
73	72.5	71.4	75.3	76.7	68.1	57.1	44.2	80.8	79
74	68.8	68.0	71.9	73.8	67.2	52.8	41.4	77.7	76
75	59.5	59.0	59.9	64.2	62.6	49.8	33.3	68.6	((66))
76	59.5	59.0	59.9	64.2	62.6	49.8	33.3	68.6	((66))
77	68.7	61.3	72.4	75.5	56.0	45.0	42.8	77.9	76
78	71.9	68.1	70.7	73.9	59.0	47.5	39.4	77.7	76
79	75.3	71.8	69.0	68.7	58.7	54.6	34.3	78.2	76
80	68.7	65.4	66.4	68.3	57.5	48.3	37.1	73.5	71
81	56.8	55.6	61.5	61.1	54.3	41.9	33.0	65.8	((64))
82	65.3	61.2	70.0	70.1	58.7	57.0	48.7	74.2	72
83	75.5	73.4	77.4	77.1	60.5	54.4	50.3	82.2	80

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-6.14
HPD selection for mine overseers

	dB-Neq	Mean:	89.9	Max:	92	Min:	87	Obs (n):	11
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	85.3	88.1	89.8	93.6	94.8	90.2	81.2	99.3	89.9
with HPD									
1	82.4	83.2	74.8	70.4	66.7	59.1	56.2	86.3	77
2	80.6	75.2	71.0	71.2	75.1	67.2	63.6	83.3	74
3	78.8	75.9	70.2	75.3	75.4	71.4	60.8	83.2	74
4	82.4	78.9	68.8	74.9	76.3	70.6	61.5	85.4	76
5	81.0	78.7	73.9	75.4	67.1	57.6	51.8	84.2	75
6	77.9	78.5	71.3	70.8	66.5	58.8	48.9	82.1	73
7	80.2	77.3	68.7	67.2	68.3	57.1	47.0	82.5	73
8	79.9	78.7	71.2	70.6	68.3	57.8	50.1	83.1	74
9	75.2	72.4	68.6	65.4	65.4	57.8	54.6	78.2	((69))
10	75.1	75.3	71.7	66.0	66.5	58.9	54.6	79.6	70
11	81.6	77.2	72.6	67.5	67.1	57.6	55.3	83.6	74
12	79.8	72.4	68.7	66.9	63.6	56.1	53.1	81.1	72
13	74.4	70.3	67.0	61.2	63.4	52.7	46.8	76.7	((67))
14	79.5	78.7	75.9	69.8	69.1	57.8	55.5	83.4	74
15	85.3	80.3	75.7	72.1	71.0	65.5	62.9	87.1	78
16	81.6	78.0	73.8	69.5	69.3	58.1	50.7	84.0	75
17	84.6	82.3	74.1	70.2	69.8	59.2	51.9	87.0	78
18	80.6	78.6	73.9	72.6	66.4	58.3	56.5	83.7	74
19	77.5	74.2	66.2	64.8	67.6	54.2	44.9	79.8	70
20	80.6	75.0	68.6	66.4	74.1	59.4	49.7	82.7	73
21	79.6	75.4	66.3	65.1	67.7	54.9	50.6	81.5	72
22	82.7	79.9	75.1	70.1	67.8	64.2	52.8	85.3	76
23	83.3	80.7	72.9	70.4	68.1	56.9	49.5	85.7	76
24	81.2	79.9	74.9	71.4	69.6	60.2	56.5	84.5	75
25	81.1	82.4	75.2	70.4	70.3	66.8	54.2	85.6	76
26	82.9	81.9	77.0	72.8	69.8	59.1	52.6	86.3	77
27	79.4	78.5	72.3	67.0	68.1	59.6	55.2	82.7	73
28	83.3	84.0	73.3	69.0	66.4	60.2	51.9	87.0	78
29	83.1	82.5	74.0	67.4	68.9	59.2	51.4	86.2	77
30	74.7	77.6	66.1	55.8	55.8	46.3	54.2	79.6	70
31	73.1	72.7	68.8	64.2	61.8	58.4	50.1	77.1	((68))
32	67.3	67.7	60.0	56.6	59.0	56.6	48.0	71.5	((62))
33	75.6	70.8	65.7	54.7	64.9	59.9	50.7	77.5	((68))
34	67.7	62.9	57.5	61.5	64.8	51.1	43.0	71.1	((62))
35	76.1	71.6	60.9	63.6	59.3	45.4	42.5	77.8	((68))
36	70.6	62.5	51.4	51.6	65.1	47.3	47.3	72.3	((63))
37	72.9	73.3	78.3	78.9	77.3	67.2	58.1	83.9	75
38	70.3	72.4	73.4	74.8	70.0	53.5	48.0	79.6	70
39	72.9	73.3	77.9	78.9	77.3	67.2	58.1	83.8	74
40	72.4	75.4	75.7	79.1	68.0	57.0	49.4	82.5	73
41	71.4	75.2	77.0	77.5	69.9	57.1	50.4	82.1	73
42	79.0	81.0	81.4	79.3	73.2	62.6	59.6	86.6	77
43	79.5	83.1	83.1	82.0	73.4	67.9	63.8	88.4	79
44	77.7	79.3	81.0	80.0	67.0	62.4	63.2	85.8	76
45	67.5	72.1	77.4	78.3	76.5	71.4	56.3	83.1	74
46	69.3	71.2	76.5	77.5	74.2	69.4	62.4	82.0	73
47	70.1	71.7	77.6	75.2	76.4	72.5	57.2	82.5	73
48	74.4	76.7	76.6	73.8	69.1	61.8	58.7	81.9	73
49	79.0	76.7	76.4	77.1	68.9	63.4	56.8	83.6	74
50	69.6	71.9	70.3	67.9	61.7	56.0	48.3	76.4	((67))
51	69.0	71.2	69.2	67.1	61.0	53.1	45.3	75.6	((66))
52	80.6	84.7	85.5	86.5	77.8	73.3	71.7	91.2	82
53	63.6	66.3	65.7	66.0	62.6	56.7	52.2	72.2	((63))
54	61.7	67.1	66.8	66.3	64.4	55.6	44.6	72.7	((63))
55	69.9	68.5	79.4	78.4	76.6	73.4	42.4	83.8	74
56	65.6	67.5	72.9	66.6	64.8	55.1	48.2	75.7	((66))
57	80.3	81.8	82.5	84.3	80.8	76.4	60.9	89.4	80
58	75.1	72.7	76.4	80.6	67.6	66.4	54.2	83.4	74
59	57.8	59.4	57.7	64.7	68.3	60.6	41.8	71.1	((62))
60	63.5	67.1	87.6	74.0	71.5	67.4	43.1	88.0	79
61	64.9	67.7	60.3	68.2	63.0	60.9	54.1	73.0	((64))
62	73.1	78.4	79.7	79.8	76.0	55.6	49.5	85.0	76
63	62.1	63.4	59.9	64.2	64.7	52.7	46.4	70.3	((61))
64	67.6	63.6	56.1	57.8	60.3	53.1	43.6	70.2	((61))
65	72.7	71.3	73.2	80.2	65.7	53.0	40.0	82.1	73
66	74.8	76.2	74.9	75.0	71.8	56.6	47.4	81.8	72
67	59.3	57.2	51.6	57.0	68.3	53.8	39.3	69.6	((60))
68	74.8	76.2	74.9	75.0	71.8	56.6	47.4	81.8	72
69	59.3	57.2	51.6	57.0	68.3	53.8	39.3	69.6	((60))
70	59.4	65.1	66.1	68.2	67.6	52.5	45.5	73.2	((64))
71	81.0	80.9	77.4	76.5	72.7	59.3	50.4	85.7	76
72	82.1	83.7	84.6	86.9	79.4	72.1	60.4	91.1	82
73	74.7	77.3	78.9	79.6	74.6	65.1	57.1	84.5	75
74	71.0	73.9	75.5	76.7	73.7	60.8	54.3	81.6	72
75	61.7	64.9	63.5	67.1	69.1	57.8	46.2	73.2	((64))
76	61.7	64.9	63.5	67.1	69.1	57.8	46.2	73.2	((64))
77	70.9	67.2	76.0	78.4	62.5	53.0	55.7	81.1	72
78	74.1	74.0	74.3	76.8	65.5	55.5	52.3	81.1	72
79	77.5	77.7	72.6	71.6	65.2	62.6	47.2	81.8	72
80	70.9	71.3	70.0	71.2	64.0	56.3	50.0	77.2	((68))
81	59.0	61.5	65.1	64.0	60.8	49.9	45.9	69.7	((60))
82	67.5	67.1	73.6	73.0	65.2	65.0	61.6	77.9	((69))
83	77.7	79.3	81.0	80.0	67.0	62.4	63.2	85.8	76

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectveness
HPD details are tabulated in Table A-1.1

Table A-6.15
HPD selection for miners

	dB-Neq	Mean:	96.6	Max:	104	Min:	85	Obs (n):	16
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	88.9	90.2	94.7	96.4	97.5	95.6	92.3	103.0	96.6
with HPD									
1	86.0	85.3	79.7	73.2	69.4	64.5	67.3	89.4	83
2	84.2	77.3	75.9	74.0	77.8	72.6	74.7	86.9	80
3	82.4	78.0	75.1	78.1	78.1	76.8	71.9	86.6	80
4	86.0	81.0	73.7	77.7	79.0	76.0	72.6	88.7	82
5	84.6	80.8	78.8	78.2	69.8	63.0	62.9	87.5	81
6	81.5	80.6	76.2	73.6	69.2	64.2	60.0	85.2	79
7	83.8	79.4	73.6	70.0	71.0	62.5	58.1	85.7	79
8	83.5	80.8	76.1	73.4	71.0	63.2	61.2	86.3	80
9	78.8	74.5	73.5	68.2	68.1	63.2	65.7	81.6	75
10	78.7	77.4	76.6	68.8	69.2	64.3	65.7	82.9	77
11	85.2	79.3	77.5	70.3	69.8	63.0	66.4	87.0	81
12	83.4	74.5	73.6	69.7	66.3	61.5	64.2	84.6	78
13	78.0	72.4	71.9	64.0	66.1	58.1	57.9	80.2	74
14	83.1	80.8	80.8	72.6	71.8	63.2	66.6	86.9	80
15	88.9	82.4	80.6	74.9	73.7	70.9	74.0	90.6	84
16	85.2	80.1	78.7	72.3	72.0	63.5	61.8	87.4	81
17	88.2	84.4	79.0	73.0	72.5	64.6	63.0	90.2	84
18	84.2	80.7	78.8	75.4	69.1	63.7	67.6	87.1	81
19	81.1	76.3	71.1	67.6	70.3	59.6	56.0	83.1	77
20	84.2	77.1	73.5	69.2	76.8	64.8	60.8	86.0	80
21	83.2	77.5	71.2	67.9	70.4	60.3	61.7	84.7	78
22	86.3	82.0	80.0	72.9	70.5	69.6	63.9	88.6	82
23	86.9	82.8	77.8	73.2	70.8	62.3	60.6	88.9	82
24	84.8	82.0	79.8	74.2	72.3	65.6	67.6	87.8	81
25	84.7	84.5	80.1	73.2	73.0	72.2	65.3	88.7	82
26	86.5	84.0	81.9	75.6	72.5	64.5	63.7	89.6	83
27	83.0	80.6	77.2	69.8	70.8	65.0	66.3	86.0	80
28	86.9	86.1	78.2	71.8	69.1	65.6	63.0	90.0	84
29	86.7	84.6	78.9	70.2	71.6	64.6	62.5	89.4	83
30	78.3	79.7	71.0	58.6	58.5	51.7	65.3	82.5	76
31	76.7	74.8	73.7	67.0	64.5	63.8	61.2	80.5	74
32	70.9	69.8	64.9	59.4	61.7	62.0	59.1	74.7	((68))
33	79.2	72.9	70.6	57.5	67.6	65.3	61.8	81.0	75
34	71.3	65.0	62.4	64.3	67.5	56.5	54.1	74.4	((68))
35	79.7	73.7	65.8	66.4	62.0	50.8	53.6	81.0	75
36	74.2	64.6	56.3	54.4	67.8	52.7	58.4	75.7	((69))
37	76.5	75.4	83.2	81.7	80.0	72.6	69.2	87.5	81
38	73.9	74.5	78.3	77.6	72.7	58.9	59.1	83.0	77
39	76.5	75.4	82.8	81.7	80.0	72.6	69.2	87.4	81
40	76.0	77.5	80.6	81.9	70.7	62.4	60.5	85.8	79
41	75.0	77.3	81.9	80.3	72.6	62.5	61.5	85.7	79
42	82.6	83.1	86.3	82.1	75.9	68.0	70.7	90.1	84
43	83.1	85.2	88.0	84.8	76.1	73.3	74.9	91.9	>86<
44	81.3	81.4	85.9	82.8	69.7	67.8	74.3	89.5	83
45	71.1	74.2	82.3	81.1	79.2	76.8	67.4	86.8	80
46	72.9	73.3	81.4	80.3	76.9	74.8	73.5	85.9	79
47	73.7	73.8	82.5	78.0	79.1	77.9	68.3	86.4	80
48	78.0	78.8	81.5	76.6	71.8	67.2	69.8	85.5	79
49	82.6	78.8	81.3	79.9	71.6	68.8	67.9	87.1	81
50	73.2	74.0	75.2	70.7	64.4	61.4	59.4	79.8	73
51	72.6	73.3	74.1	69.9	63.7	58.5	56.4	79.0	73
52	84.2	86.8	90.4	89.3	80.5	78.7	82.8	94.9	>88<
53	67.2	68.4	70.6	68.8	65.3	62.1	63.3	75.8	((69))
54	65.3	69.2	71.7	69.1	67.1	61.0	55.7	76.2	70
55	73.5	70.6	84.3	81.2	79.3	78.8	53.5	87.8	81
56	69.2	69.6	77.8	69.4	67.5	60.5	59.3	79.7	73
57	83.9	83.9	87.4	87.1	83.5	81.8	72.0	92.9	>86<
58	78.7	74.8	81.3	83.4	70.3	71.8	65.3	86.9	80
59	61.4	61.5	62.6	67.5	71.0	66.0	52.9	74.3	((68))
60	67.1	69.2	92.5	76.8	74.2	72.8	54.2	92.8	>86<
61	68.5	69.8	65.2	71.0	65.7	66.3	65.2	76.4	70
62	76.7	80.5	84.6	82.6	78.7	61.0	60.6	88.5	82
63	65.7	65.5	64.8	67.0	67.4	58.1	57.5	73.4	((67))
64	71.2	65.7	61.0	60.6	63.0	58.5	54.7	73.5	((67))
65	76.3	73.4	78.1	83.0	68.4	58.4	51.1	85.3	79
66	78.4	78.3	79.8	77.8	74.5	62.0	58.5	85.1	79
67	62.9	59.3	56.5	59.8	71.0	59.2	50.4	72.5	((66))
68	78.4	78.3	79.8	77.8	74.5	62.0	58.5	85.1	79
69	62.9	59.3	56.5	59.8	71.0	59.2	50.4	72.5	((66))
70	63.0	67.2	71.0	71.0	70.3	57.9	56.6	76.5	70
71	84.6	83.0	82.3	79.3	75.4	64.7	61.5	88.9	83
72	85.7	85.8	89.5	89.7	82.1	77.5	71.5	94.5	>88<
73	78.3	79.4	83.8	82.4	77.3	70.5	68.2	88.1	82
74	74.6	76.0	80.4	79.5	76.4	66.2	65.4	85.0	79
75	65.3	67.0	68.4	69.9	71.8	63.2	57.3	76.3	70
76	65.3	67.0	68.4	69.9	71.8	63.2	57.3	76.3	70
77	74.5	69.3	80.9	81.2	65.2	58.4	66.8	84.8	78
78	77.7	76.1	79.2	79.6	68.2	60.9	63.4	84.5	78
79	81.1	79.8	77.5	74.4	67.9	68.0	58.3	85.1	79
80	74.5	73.4	74.9	74.0	66.7	61.7	61.1	80.6	74
81	62.6	63.6	70.0	66.8	63.5	55.3	57.0	73.4	((67))
82	71.1	69.2	78.5	75.8	67.9	70.4	72.7	82.2	76
83	81.3	81.4	85.9	82.8	69.7	67.8	74.3	89.5	83

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-6.16

HPD selection for miners' assistants

	dB-Neq	Mean:	98.3	Max:	103	Min:	84	Obs (n):	14
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	89.7	91.3	95.6	97.6	98.3	96.7	94.1	104.1	98.3
with HPD									
1	86.8	86.4	80.6	74.4	70.2	65.6	69.1	90.3	85
2	85.0	78.4	76.8	75.2	78.6	73.7	76.5	87.8	82
3	83.2	79.1	76.0	79.3	78.9	77.9	73.7	87.6	82
4	86.8	82.1	74.6	78.9	79.8	77.1	74.4	89.6	84
5	85.4	81.9	79.7	79.4	70.6	64.1	64.7	88.4	83
6	82.3	81.7	77.1	74.8	70.0	65.3	61.8	86.2	80
7	84.6	80.5	74.5	71.2	71.8	63.6	59.9	86.6	81
8	84.3	81.9	77.0	74.6	71.8	64.3	63.0	87.2	81
9	79.6	75.6	74.4	69.4	68.9	64.3	67.5	82.5	77
10	79.5	78.5	77.5	70.0	70.0	65.4	67.5	83.9	78
11	86.0	80.4	78.4	71.5	70.6	64.1	68.2	87.9	82
12	84.2	75.6	74.5	70.9	67.1	62.6	66.0	85.4	80
13	78.8	73.5	72.8	65.2	66.9	59.2	59.7	81.0	75
14	83.9	81.9	81.7	73.8	72.6	64.3	68.4	87.8	82
15	89.7	83.5	81.5	76.1	74.5	72.0	75.8	91.5	>86<
16	86.0	81.2	79.6	73.5	72.8	64.6	63.6	88.2	82
17	89.0	85.5	79.9	74.2	73.3	65.7	64.8	91.1	85
18	85.0	81.8	79.7	76.6	69.9	64.8	69.4	88.0	82
19	81.9	77.4	72.0	68.8	71.1	60.7	57.8	83.9	78
20	85.0	78.2	74.4	70.4	77.6	65.9	62.6	86.8	81
21	84.0	78.6	72.1	69.1	71.2	61.4	63.5	85.6	80
22	87.1	83.1	80.9	74.1	71.3	70.7	65.7	89.5	84
23	87.7	83.9	78.7	74.4	71.6	63.4	62.4	89.8	84
24	85.6	83.1	80.7	75.4	73.1	66.7	69.4	88.8	83
25	85.5	85.6	81.0	74.4	73.8	73.3	67.1	89.6	84
26	87.3	85.1	82.8	76.8	73.3	65.6	65.5	90.5	85
27	83.8	81.7	78.1	71.0	71.6	66.1	68.1	86.9	81
28	87.7	87.2	79.1	73.0	69.9	66.7	64.8	90.9	85
29	87.5	85.7	79.8	71.4	72.4	65.7	64.3	90.3	84
30	79.1	80.8	71.9	59.8	59.3	52.8	67.1	83.5	78
31	77.5	75.9	74.6	68.2	65.3	64.9	63.0	81.4	76
32	71.7	70.9	65.8	60.6	62.5	63.1	60.9	75.7	70
33	80.0	74.0	71.5	58.7	68.4	66.4	63.6	81.9	76
34	72.1	66.1	63.3	65.5	68.3	57.6	55.9	75.3	((69))
35	80.5	74.8	66.7	67.6	62.8	51.9	55.4	81.9	76
36	75.0	65.7	57.2	55.6	68.6	53.8	60.2	76.5	71
37	77.3	76.5	84.1	82.9	80.8	73.7	71.0	88.5	83
38	74.7	75.6	79.2	78.8	73.5	60.0	60.9	84.0	78
39	77.3	76.5	83.7	82.9	80.8	73.7	71.0	88.4	83
40	76.8	78.6	81.5	83.1	71.5	63.5	62.3	86.8	81
41	75.8	78.4	82.8	81.5	73.4	63.6	63.3	86.7	81
42	83.4	84.2	87.2	83.3	76.7	69.1	72.5	91.1	85
43	83.9	86.3	88.9	86.0	76.9	74.4	76.7	92.9	>87<
44	82.1	82.5	86.8	84.0	70.5	68.9	76.1	90.5	85
45	71.9	75.3	83.2	82.3	80.0	77.9	69.2	87.8	82
46	73.7	74.4	82.3	81.5	77.7	75.9	75.3	86.9	81
47	74.5	74.9	83.4	79.2	79.9	79.0	70.1	87.4	82
48	78.8	79.9	82.4	77.8	72.6	68.3	71.6	86.5	81
49	83.4	79.9	82.2	81.1	72.4	69.9	69.7	88.1	82
50	74.0	75.1	76.1	71.9	65.2	62.5	61.2	80.8	75
51	73.4	74.4	75.0	71.1	64.5	59.6	58.2	79.9	74
52	85.0	87.9	91.3	90.5	81.3	79.8	84.6	95.9	>90<
53	68.0	69.5	71.5	70.0	66.1	63.2	65.1	76.9	71
54	66.1	70.3	72.6	70.3	67.9	62.1	57.5	77.2	71
55	74.3	71.7	85.2	82.4	80.1	79.9	55.3	88.7	83
56	70.0	70.7	78.7	70.6	68.3	61.6	61.1	80.7	75
57	84.7	85.0	88.3	88.3	84.3	82.9	73.8	93.9	>88<
58	79.5	75.9	82.2	84.6	71.1	72.9	67.1	87.9	82
59	62.2	62.6	63.5	68.7	71.8	67.1	54.7	75.3	69
60	67.9	70.3	93.4	78.0	75.0	73.9	56.0	93.7	>88<
61	69.3	70.9	66.1	72.2	66.5	67.4	67.0	77.5	72
62	77.5	81.6	85.5	83.8	79.5	62.1	62.4	89.5	84
63	66.5	66.6	65.7	68.2	68.2	59.2	59.3	74.4	((69))
64	72.0	66.8	61.9	61.8	63.8	59.6	56.5	74.4	((69))
65	77.1	74.5	79.0	84.2	69.2	59.5	52.9	86.3	81
66	79.2	79.4	80.7	79.0	75.3	63.1	60.3	86.1	80
67	63.7	60.4	57.4	61.0	71.8	60.3	52.2	73.3	((68))
68	79.2	79.4	80.7	79.0	75.3	63.1	60.3	86.1	80
69	63.7	60.4	57.4	61.0	71.8	60.3	52.2	73.3	((68))
70	63.8	68.3	71.9	72.2	71.1	59.0	58.4	77.5	72
71	85.4	84.1	83.2	80.5	76.2	65.8	63.3	89.9	84
72	86.5	86.9	90.4	90.9	82.9	78.6	73.3	95.5	>90<
73	79.1	80.5	84.7	83.6	78.1	71.6	70.0	89.1	83
74	75.4	77.1	81.3	80.7	77.2	67.3	67.2	86.0	80
75	66.1	68.1	69.3	71.1	72.6	64.3	59.1	77.3	71
76	66.1	68.1	69.3	71.1	72.6	64.3	59.1	77.3	71
77	75.3	70.4	81.8	82.4	66.0	59.5	68.6	85.8	80
78	78.5	77.2	80.1	80.8	69.0	62.0	65.2	85.5	80
79	81.9	80.9	78.4	75.6	68.7	69.1	60.1	86.0	80
80	75.3	74.5	75.8	75.2	67.5	62.8	62.9	81.5	76
81	63.4	64.7	70.9	68.0	64.3	56.4	58.8	74.4	((69))
82	71.9	70.3	79.4	77.0	68.7	71.5	74.5	83.3	77
83	82.1	82.5	86.8	84.0	70.5	68.9	76.1	90.5	85

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-6.17
HPD selection for shift supervisors

	dB-Neq	Mean:	91.9	Max:	94	Min:	85	Obs (n):	12
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	87.1	89.1	92.2	95.0	96.2	92.9	86.7	101.1	91.9
with HPD									
1	84.2	84.2	77.2	71.8	68.1	61.8	61.7	87.8	79
2	82.4	76.2	73.4	72.6	76.5	69.9	69.1	85.0	76
3	80.6	76.9	72.6	76.7	76.8	74.1	66.3	84.9	76
4	84.2	79.9	71.2	76.3	77.7	73.3	67.0	87.0	78
5	82.8	79.7	76.3	76.8	68.5	60.3	57.3	85.8	77
6	79.7	79.5	73.7	72.2	67.9	61.5	54.4	83.6	74
7	82.0	78.3	71.1	68.6	69.7	59.8	52.5	84.1	75
8	81.7	79.7	73.6	72.0	69.7	60.5	55.6	84.6	75
9	77.0	73.4	71.0	66.8	66.8	60.5	60.1	79.8	71
10	76.9	76.3	74.1	67.4	67.9	61.6	60.1	81.2	72
11	83.4	78.2	75.0	68.9	68.5	60.3	60.8	85.2	76
12	81.6	73.4	71.1	68.3	65.0	58.8	58.6	82.8	74
13	76.2	71.3	69.4	62.6	64.8	55.4	52.3	78.4	((69))
14	81.3	79.7	78.3	71.2	70.5	60.5	61.0	85.1	76
15	87.1	81.3	78.1	73.5	72.4	68.2	68.4	88.8	80
16	83.4	79.0	76.2	70.9	70.7	60.8	56.2	85.6	76
17	86.4	83.3	76.5	71.6	71.2	61.9	57.4	88.6	79
18	82.4	79.6	76.3	74.0	67.8	61.0	62.0	85.3	76
19	79.3	75.2	68.6	66.2	69.0	56.9	50.4	81.4	72
20	82.4	76.0	71.0	67.8	75.5	62.1	55.2	84.3	75
21	81.4	76.4	68.7	66.5	69.1	57.6	56.1	83.1	74
22	84.5	80.9	77.5	71.5	69.2	66.9	58.3	86.9	78
23	85.1	81.7	75.3	71.8	69.5	59.6	55.0	87.2	78
24	83.0	80.9	77.3	72.8	71.0	62.9	62.0	86.1	77
25	82.9	83.4	77.6	71.8	71.7	69.5	59.7	87.1	78
26	84.7	82.9	79.4	74.2	71.2	61.8	58.1	87.9	79
27	81.2	79.5	74.7	68.4	69.5	62.3	60.7	84.3	75
28	85.1	85.0	75.7	70.4	67.8	62.9	57.4	88.4	79
29	84.9	83.5	76.4	68.8	70.3	61.9	56.9	87.8	79
30	76.5	78.6	68.5	57.2	57.2	49.0	59.7	81.0	72
31	74.9	73.7	71.2	65.6	63.2	61.1	55.6	78.7	70
32	69.1	68.7	62.4	58.0	60.4	59.3	53.5	73.0	((64))
33	77.4	71.8	68.1	56.1	66.3	62.6	56.2	79.2	70
34	69.5	63.9	59.9	62.9	66.2	53.8	48.5	72.7	((64))
35	77.9	72.6	63.3	65.0	60.7	48.1	48.0	79.4	70
36	72.4	63.5	53.8	53.0	66.5	50.0	52.8	73.9	((65))
37	74.7	74.3	80.7	80.3	78.7	69.9	63.6	85.6	76
38	72.1	73.4	75.8	76.2	71.4	56.2	53.5	81.2	72
39	74.7	74.3	80.3	80.3	78.7	69.9	63.6	85.5	76
40	74.2	76.4	78.1	80.5	69.4	59.7	54.9	84.1	75
41	73.2	76.2	79.4	78.9	71.3	59.8	55.9	83.8	75
42	80.8	82.0	83.8	80.7	74.6	65.3	65.1	88.3	79
43	81.3	84.1	85.5	83.4	74.8	70.6	69.3	90.1	81
44	79.5	80.3	83.4	81.4	68.4	65.1	68.7	87.6	78
45	69.3	73.1	79.8	79.7	77.9	74.1	61.8	84.9	76
46	71.1	72.2	78.9	78.9	75.6	72.1	67.9	83.9	75
47	71.9	72.7	80.0	76.6	77.8	75.2	62.7	84.4	75
48	76.2	77.7	79.0	75.2	70.5	64.5	64.2	83.6	74
49	80.8	77.7	78.8	78.5	70.3	66.1	62.3	85.3	76
50	71.4	72.9	72.7	69.3	63.1	58.7	53.8	78.0	((69))
51	70.8	72.2	71.6	68.5	62.4	55.8	50.8	77.2	((68))
52	82.4	85.7	87.9	87.9	79.2	76.0	77.2	92.9	84
53	65.4	67.3	68.1	67.4	64.0	59.4	57.7	73.9	((65))
54	63.5	68.1	69.2	67.7	65.8	58.3	50.1	74.4	((65))
55	71.7	69.5	81.8	79.8	78.0	76.1	47.9	85.7	77
56	67.4	68.5	75.3	68.0	66.2	57.8	53.7	77.6	((68))
57	82.1	82.8	84.9	85.7	82.2	79.1	66.4	91.1	82
58	76.9	73.7	78.8	82.0	69.0	69.1	59.7	85.1	76
59	59.6	60.4	60.1	66.1	69.7	63.3	47.3	72.7	((64))
60	65.3	68.1	90.0	75.4	72.9	70.1	48.6	90.3	81
61	66.7	68.7	62.7	69.6	64.4	63.6	59.6	74.6	((65))
62	74.9	79.4	82.1	81.2	77.4	58.3	55.0	86.7	78
63	63.9	64.4	62.3	65.6	66.1	55.4	51.9	71.8	((63))
64	69.4	64.6	58.5	59.2	61.7	55.8	49.1	71.8	((63))
65	74.5	72.3	75.6	81.6	67.1	55.7	45.5	83.6	74
66	76.6	77.2	77.3	76.4	73.2	59.3	52.9	83.4	74
67	61.1	58.2	54.0	58.4	69.7	56.5	44.8	71.0	((62))
68	76.6	77.2	77.3	76.4	73.2	59.3	52.9	83.4	74
69	61.1	58.2	54.0	58.4	69.7	56.5	44.8	71.0	((62))
70	61.2	66.1	68.5	69.6	69.0	55.2	51.0	74.8	((66))
71	82.8	81.9	79.8	77.9	74.1	62.0	55.9	87.2	78
72	83.9	84.7	87.0	88.3	80.8	74.8	65.9	92.7	84
73	76.5	78.3	81.3	81.0	76.0	67.8	62.6	86.2	77
74	72.8	74.9	77.9	78.1	75.1	63.5	59.8	83.3	74
75	63.5	65.9	65.9	68.5	70.5	60.5	51.7	74.7	((66))
76	63.5	65.9	65.9	68.5	70.5	60.5	51.7	74.7	((66))
77	72.7	68.2	78.4	79.8	63.9	55.7	61.2	82.9	74
78	75.9	75.0	76.7	78.2	66.9	58.2	57.8	82.8	74
79	79.3	78.7	75.0	73.0	66.6	65.3	52.7	83.4	74
80	72.7	72.3	72.4	72.6	65.4	59.0	55.5	78.8	70
81	60.8	62.5	67.5	65.4	62.2	52.6	51.4	71.5	((62))
82	69.3	68.1	76.0	74.4	66.6	67.7	67.1	79.9	71
83	79.5	80.3	83.4	81.4	68.4	65.1	68.7	87.6	78

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-6.18
HPD selection for surveyors and samplers

	dB-Neq	Mean:	93.4	Max:	99	Min:	81	Obs (n):	21
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	86.1	90.6	91.2	95.7	94.6	90.8	81.4	100.3	93.4
with HPD									
1	83.2	85.7	76.2	72.5	66.5	59.7	56.4	88.1	81
2	81.4	77.7	72.4	73.3	74.9	67.8	63.8	84.4	77
3	79.6	78.4	71.6	77.4	75.2	72.0	61.0	84.5	78
4	83.2	81.4	70.2	77.0	76.1	71.2	61.7	86.7	80
5	81.8	81.2	75.3	77.5	66.9	58.2	52.0	85.8	79
6	78.7	81.0	72.7	72.9	66.3	59.4	49.1	83.9	77
7	81.0	79.8	70.1	69.3	68.1	57.7	47.2	83.9	77
8	80.7	81.2	72.6	72.7	68.1	58.4	50.3	84.7	78
9	76.0	74.9	70.0	67.5	65.2	58.4	54.8	79.6	73
10	75.9	77.8	73.1	68.1	66.3	59.5	54.8	81.2	74
11	82.4	79.7	74.0	69.6	66.9	58.2	55.5	84.9	78
12	80.6	74.9	70.1	69.0	63.4	56.7	53.3	82.2	75
13	75.2	72.8	68.4	63.3	63.2	53.3	47.0	78.0	71
14	80.3	81.2	77.3	71.9	68.9	58.4	55.7	85.0	78
15	86.1	82.8	77.1	74.2	70.8	66.1	63.1	88.4	81
16	82.4	80.5	75.2	71.6	69.1	58.7	50.9	85.3	78
17	85.4	84.8	75.5	72.3	69.6	59.8	52.1	88.5	82
18	81.4	81.1	75.3	74.7	66.2	58.9	56.7	85.3	78
19	78.3	76.7	67.6	66.9	67.4	54.8	45.1	81.2	74
20	81.4	77.5	70.0	68.5	73.9	60.0	49.9	83.7	77
21	80.4	77.9	67.7	67.2	67.5	55.5	50.8	82.8	76
22	83.5	82.4	76.5	72.2	67.6	64.8	53.0	86.7	80
23	84.1	83.2	74.3	72.5	67.9	57.5	49.7	87.1	80
24	82.0	82.4	76.3	73.5	69.4	60.8	56.7	86.1	79
25	81.9	84.9	76.6	72.5	70.1	67.4	54.4	87.4	80
26	83.7	84.4	78.4	74.9	69.6	59.7	52.8	87.9	81
27	80.2	81.0	73.7	69.1	67.9	60.2	55.4	84.3	77
28	84.1	86.5	74.7	71.1	66.2	60.8	52.1	88.8	82
29	83.9	85.0	75.4	69.5	68.7	59.8	51.6	87.9	81
30	75.5	80.1	67.5	57.9	55.6	46.9	54.4	81.6	75
31	73.9	75.2	70.2	66.3	61.6	59.0	50.3	78.7	72
32	68.1	70.2	61.4	58.7	58.8	57.2	48.2	73.1	((66))
33	76.4	73.3	67.1	56.8	64.7	60.5	50.9	78.7	72
34	68.5	65.4	58.9	63.6	64.6	51.7	43.2	72.2	((65))
35	76.9	74.1	62.3	65.7	59.1	46.0	42.7	79.1	72
36	71.4	65.0	52.8	53.7	64.9	47.9	47.5	73.1	((66))
37	73.7	75.8	79.7	81.0	77.1	67.8	58.3	85.3	78
38	71.1	74.9	74.8	76.9	69.8	54.1	48.2	81.2	74
39	73.7	75.8	79.3	81.0	77.1	67.8	58.3	85.2	78
40	73.2	77.9	77.1	81.2	67.8	57.6	49.6	84.4	77
41	72.2	77.7	78.4	79.6	69.7	57.7	50.6	83.9	77
42	79.8	83.5	82.8	81.4	73.0	63.2	59.8	88.3	81
43	80.3	85.6	84.5	84.1	73.2	68.5	64.0	90.2	83
44	78.5	81.8	82.4	82.1	66.8	63.0	63.4	87.5	81
45	68.3	74.6	78.8	80.4	76.3	72.0	56.5	84.5	78
46	70.1	73.7	77.9	79.6	74.0	70.0	62.6	83.5	77
47	70.9	74.2	79.0	77.3	76.2	73.1	57.4	83.7	77
48	75.2	79.2	78.0	75.9	68.9	62.4	58.9	83.6	77
49	79.8	79.2	77.8	79.2	68.7	64.0	57.0	85.2	78
50	70.4	74.4	71.7	70.0	61.5	56.6	48.5	78.1	71
51	69.8	73.7	70.6	69.2	60.8	53.7	45.5	77.3	70
52	81.4	87.2	86.9	88.6	77.6	73.9	71.9	93.0	>86<
53	64.4	68.8	67.1	68.1	62.4	57.3	52.4	73.9	((67))
54	62.5	69.6	68.2	68.4	64.2	56.2	44.8	74.4	((67))
55	70.7	71.0	80.8	80.5	76.4	74.0	42.6	85.1	78
56	66.4	70.0	74.3	68.7	64.6	55.7	48.4	77.2	70
57	81.1	84.3	83.9	86.4	80.6	77.0	61.1	91.0	84
58	75.9	75.2	77.8	82.7	67.4	67.0	54.4	85.2	78
59	58.6	61.9	59.1	66.8	68.1	61.2	42.0	71.9	((65))
60	64.3	69.6	89.0	76.1	71.3	68.0	43.3	89.4	82
61	65.7	70.2	61.7	70.3	62.8	61.5	54.3	74.8	((68))
62	73.9	80.9	81.1	81.9	75.8	56.2	49.7	86.7	80
63	62.9	65.9	61.3	66.3	64.5	53.3	46.6	71.6	((65))
64	68.4	66.1	57.5	59.9	60.1	53.7	43.8	71.4	((64))
65	73.5	73.8	74.6	82.3	65.5	53.6	40.2	84.0	77
66	75.6	78.7	76.3	77.1	71.6	57.2	47.6	83.4	76
67	60.1	59.7	53.0	59.1	68.1	54.4	39.5	69.9	((63))
68	75.6	78.7	76.3	77.1	71.6	57.2	47.6	83.4	76
69	60.1	59.7	53.0	59.1	68.1	54.4	39.5	69.9	((63))
70	60.2	67.6	67.5	70.3	67.4	53.1	45.7	74.6	((68))
71	81.8	83.4	78.8	78.6	72.5	59.9	50.6	87.3	80
72	82.9	86.2	86.0	89.0	79.2	72.7	60.6	92.8	>86<
73	75.5	79.8	80.3	81.7	74.4	65.7	57.3	86.2	79
74	71.8	76.4	76.9	78.8	73.5	61.4	54.5	83.2	76
75	62.5	67.4	64.9	69.2	68.9	58.4	46.4	74.3	((67))
76	62.5	67.4	64.9	69.2	68.9	58.4	46.4	74.3	((67))
77	71.7	69.7	77.4	80.5	62.3	53.6	55.9	82.9	76
78	74.9	76.5	75.7	78.9	65.3	56.1	52.5	82.9	76
79	78.3	80.2	74.0	73.7	65.0	63.2	47.4	83.5	77
80	71.7	73.8	71.4	73.3	63.8	56.9	50.2	78.9	72
81	59.8	64.0	66.5	66.1	60.6	50.5	46.1	71.2	((64))
82	68.3	69.6	75.0	75.1	65.0	65.6	61.8	79.5	73
83	78.5	81.8	82.4	82.1	66.8	63.0	63.4	87.5	81

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-6.19
HPD selection for team leaders

	dB-Neq	Mean:	102.5	Max:	116	Min:	87	Obs (n):	19
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	90.4	95.7	98.9	102.5	104.8	100.3	97.5	108.8	102.5
with HPD									
1	87.5	90.8	83.9	79.3	76.7	69.2	72.5	93.4	>87<
2	85.7	82.8	80.1	80.1	85.1	77.3	79.9	90.9	85
3	83.9	83.5	79.3	84.2	85.4	81.5	77.1	91.3	85
4	87.5	86.5	77.9	83.8	86.3	80.7	77.8	92.8	>87<
5	86.1	86.3	83.0	84.3	77.1	67.7	68.1	91.4	85
6	83.0	86.1	80.4	79.7	76.5	68.9	65.2	89.4	83
7	85.3	84.9	77.8	76.1	78.3	67.2	63.3	89.2	83
8	85.0	86.3	80.3	79.5	78.3	67.9	66.4	90.1	84
9	80.3	80.0	77.7	74.3	75.4	67.9	70.9	85.4	79
10	80.2	82.9	80.8	74.9	76.5	69.0	70.9	87.1	81
11	86.7	84.8	81.7	76.4	77.1	67.7	71.6	90.1	84
12	84.9	80.0	77.8	75.8	73.6	66.2	69.4	87.3	81
13	79.5	77.9	76.1	70.1	73.4	62.8	63.1	83.6	77
14	84.6	86.3	85.0	78.7	79.1	67.9	71.8	90.8	85
15	90.4	87.9	84.8	81.0	81.0	75.6	79.2	93.8	>87<
16	86.7	85.6	82.9	78.4	79.3	68.2	67.0	90.8	84
17	89.7	89.9	83.2	79.1	79.8	69.3	68.2	93.6	>87<
18	85.7	86.2	83.0	81.5	76.4	68.4	72.8	90.8	84
19	82.6	81.8	75.3	73.7	77.6	64.3	61.2	86.6	80
20	85.7	82.6	77.7	75.3	84.1	69.5	66.0	89.6	83
21	84.7	83.0	75.4	74.0	77.7	65.0	66.9	87.9	82
22	87.8	87.5	84.2	79.0	77.8	74.3	69.1	92.0	>86<
23	88.4	88.3	82.0	79.3	78.1	67.0	65.8	92.3	>86<
24	86.3	87.5	84.0	80.3	79.6	70.3	72.8	91.7	85
25	86.2	90.0	84.3	79.3	80.3	76.9	70.5	92.9	>87<
26	88.0	89.5	86.1	81.7	79.8	69.2	68.9	93.4	>87<
27	84.5	86.1	81.4	75.9	78.1	69.7	71.5	89.8	83
28	88.4	91.6	82.4	77.9	76.4	70.3	68.2	93.9	>88<
29	88.2	90.1	83.1	76.3	78.9	69.3	67.7	93.1	>87<
30	79.8	85.2	75.2	64.7	65.8	56.4	70.5	86.8	80
31	78.2	80.3	77.9	73.1	71.8	68.5	66.4	84.5	78
32	72.4	75.3	69.1	65.5	69.0	66.7	64.3	78.9	73
33	80.7	78.4	74.8	63.6	74.9	70.0	67.0	84.2	78
34	72.8	70.5	66.6	70.4	74.8	61.2	59.3	78.9	73
35	81.2	79.2	70.0	72.5	69.3	55.5	58.8	84.0	78
36	75.7	70.1	60.5	60.5	75.1	57.4	63.6	79.3	73
37	78.0	80.9	87.4	87.8	87.3	77.3	74.4	92.9	>87<
38	75.4	80.0	82.5	83.7	80.0	63.6	64.3	88.1	82
39	78.0	80.9	87.0	87.8	87.3	77.3	74.4	92.8	>87<
40	77.5	83.0	84.8	88.0	78.0	67.1	65.7	91.0	85
41	76.5	82.8	86.1	86.4	79.9	67.2	66.7	90.7	84
42	84.1	88.6	90.5	88.2	83.2	72.7	75.9	94.8	>89<
43	84.6	90.7	92.2	90.9	83.4	78.0	80.1	96.8	>90<
44	82.8	86.9	90.1	88.9	77.0	72.5	79.5	94.2	>88<
45	72.6	79.7	86.5	87.2	86.5	81.5	72.6	92.3	>86<
46	74.4	78.8	85.6	86.4	84.2	79.5	78.7	91.2	85
47	75.2	79.3	86.7	84.1	86.4	82.6	73.5	91.7	85
48	79.5	84.3	85.7	82.7	79.1	71.9	75.0	90.2	84
49	84.1	84.3	85.5	86.0	78.9	73.5	73.1	91.5	85
50	74.7	79.5	79.4	76.8	71.7	66.1	64.6	84.4	78
51	74.1	78.8	78.3	76.0	71.0	63.2	61.6	83.5	77
52	85.7	92.3	94.6	95.4	87.8	83.4	88.0	99.9	>94<
53	68.7	73.9	74.8	74.9	72.6	66.8	68.5	80.9	75
54	66.8	74.7	75.9	75.2	74.4	65.7	60.9	81.4	75
55	75.0	76.1	88.5	87.3	86.6	83.5	58.7	93.0	>87<
56	70.7	75.1	82.0	75.5	74.8	65.2	64.5	84.4	78
57	85.4	89.4	91.6	93.2	90.8	86.5	77.2	98.1	>92<
58	80.2	80.3	85.5	89.5	77.6	76.5	70.5	92.0	>86<
59	62.9	67.0	66.8	73.6	78.3	70.7	58.1	80.6	74
60	68.6	74.7	96.7	82.9	81.5	77.5	59.4	97.1	>91<
61	70.0	75.3	69.4	77.1	73.0	71.0	70.4	81.7	75
62	78.2	86.0	88.8	88.7	86.0	65.7	65.8	93.7	>87<
63	67.2	71.0	69.0	73.1	74.7	62.8	62.7	79.0	73
64	72.7	71.2	65.2	66.7	70.3	63.2	59.9	77.3	71
65	77.8	78.9	82.3	89.1	75.7	63.1	56.3	90.6	84
66	79.9	83.8	84.0	83.9	81.8	66.7	63.7	90.0	84
67	64.4	64.8	60.7	65.9	78.3	63.9	55.6	79.1	73
68	79.9	83.8	84.0	83.9	81.8	66.7	63.7	90.0	84
69	64.4	64.8	60.7	65.9	78.3	63.9	55.6	79.1	73
70	64.5	72.7	75.2	77.1	77.6	62.6	61.8	82.2	76
71	86.1	88.5	86.5	85.4	82.7	69.4	66.7	93.2	>87<
72	87.2	91.3	93.7	95.8	89.4	82.2	76.7	99.6	>93<
73	79.8	84.9	88.0	88.5	84.6	75.2	73.4	93.2	>87<
74	76.1	81.5	84.6	85.6	83.7	70.9	70.6	90.4	84
75	66.8	72.5	72.6	76.0	79.1	67.9	62.5	82.3	76
76	66.8	72.5	72.6	76.0	79.1	67.9	62.5	82.3	76
77	76.0	74.8	85.1	87.3	72.5	63.1	72.0	89.9	84
78	79.2	81.6	83.4	85.7	75.5	65.6	68.6	89.4	83
79	82.6	85.3	81.7	80.5	75.2	72.7	63.5	89.2	83
80	76.0	78.9	79.1	80.1	74.0	66.4	66.3	85.2	79
81	64.1	69.1	74.2	72.9	70.8	60.0	62.2	78.5	72
82	72.6	74.7	82.7	81.9	75.2	75.1	77.9	87.1	81
83	82.8	86.9	90.1	88.9	77.0	72.5	79.5	94.2	>88<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-6.20
HPD selection for tips labour

	dB-Neq	Mean:	93.7	Max:	97	Min:	86	Obs (n):	17
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	82.1	87.3	88.1	92.9	94.4	100.1	85.6	102.2	93.7
with HPD									
1	79.2	82.4	73.1	69.7	66.3	69.0	60.6	84.8	76
2	77.4	74.4	69.3	70.5	74.7	77.1	68.0	82.8	74
3	75.6	75.1	68.5	74.6	75.0	81.3	65.2	84.4	76
4	79.2	78.1	67.1	74.2	75.9	80.5	65.9	85.2	77
5	77.8	77.9	72.2	74.7	66.7	67.5	56.2	82.5	74
6	74.7	77.7	69.6	70.1	66.1	68.7	53.3	80.8	72
7	77.0	76.5	67.0	66.5	67.9	67.0	51.4	80.6	72
8	76.7	77.9	69.5	69.9	67.9	67.7	54.5	81.4	73
9	72.0	71.6	66.9	64.7	65.0	67.7	59.0	76.8	((68))
10	71.9	74.5	70.0	65.3	66.1	68.8	59.0	78.4	70
11	78.4	76.4	70.9	66.8	66.7	67.5	59.7	81.5	73
12	76.6	71.6	67.0	66.2	63.2	66.0	57.5	78.8	70
13	71.2	69.5	65.3	60.5	63.0	62.6	51.2	74.9	((66))
14	76.3	77.9	74.2	69.1	68.7	67.7	59.9	81.8	73
15	82.1	79.5	74.0	71.4	70.6	75.4	67.3	85.3	77
16	78.4	77.2	72.1	68.8	68.9	68.0	55.1	82.0	74
17	81.4	81.5	72.4	69.5	69.4	69.1	56.3	85.1	77
18	77.4	77.8	72.2	71.9	66.0	68.2	60.9	82.0	74
19	74.3	73.4	64.5	64.1	67.2	64.1	49.3	77.9	((69))
20	77.4	74.2	66.9	65.7	73.7	69.3	54.1	80.9	72
21	76.4	74.6	64.6	64.4	67.3	64.8	55.0	79.4	71
22	79.5	79.1	73.4	69.4	67.4	74.1	57.2	83.7	75
23	80.1	79.9	71.2	69.7	67.7	66.8	53.9	83.7	75
24	78.0	79.1	73.2	70.7	69.2	70.1	60.9	82.9	74
25	77.9	81.6	73.5	69.7	69.9	76.7	58.6	84.7	76
26	79.7	81.1	75.3	72.1	69.4	69.0	57.0	84.6	76
27	76.2	77.7	70.6	66.3	67.7	69.5	59.6	81.2	73
28	80.1	83.2	71.6	68.3	66.0	70.1	56.3	85.4	77
29	79.9	81.7	72.3	66.7	68.5	69.1	55.8	84.5	76
30	71.5	76.8	64.4	55.1	55.4	56.2	58.6	78.2	70
31	69.9	71.9	67.1	63.5	61.4	68.3	54.5	76.1	((68))
32	64.1	66.9	58.3	55.9	58.6	66.5	52.4	71.4	((63))
33	72.4	70.0	64.0	54.0	64.5	69.8	55.1	76.3	((68))
34	64.5	62.1	55.8	60.8	64.4	61.0	47.4	70.0	((62))
35	72.9	70.8	59.2	62.9	58.9	55.3	46.9	75.5	((67))
36	67.4	61.7	49.7	50.9	64.7	57.2	51.7	70.3	((62))
37	69.7	72.5	76.6	78.2	76.9	77.1	62.5	83.8	75
38	67.1	71.6	71.7	74.1	69.6	63.4	52.4	78.5	70
39	69.7	72.5	76.2	78.2	76.9	77.1	62.5	83.7	75
40	69.2	74.6	74.0	78.4	67.6	66.9	53.8	81.5	73
41	68.2	74.4	75.3	76.8	69.5	67.0	54.8	81.1	73
42	75.8	80.2	79.7	78.6	72.8	72.5	64.0	85.4	77
43	76.3	82.3	81.4	81.3	73.0	77.8	68.2	87.6	79
44	74.5	78.5	79.3	79.3	66.6	72.3	67.6	84.7	76
45	64.3	71.3	75.7	77.6	76.1	81.3	60.7	84.6	76
46	66.1	70.4	74.8	76.8	73.8	79.3	66.8	83.2	75
47	66.9	70.9	75.9	74.5	76.0	82.4	61.6	84.8	76
48	71.2	75.9	74.9	73.1	68.7	71.7	63.1	81.1	73
49	75.8	75.9	74.7	76.4	68.5	73.3	61.2	82.5	74
50	66.4	71.1	68.6	67.2	61.3	65.9	52.7	75.5	((67))
51	65.8	70.4	67.5	66.4	60.6	63.0	49.7	74.5	((66))
52	77.4	83.9	83.8	85.8	77.4	83.2	76.1	90.9	82
53	60.4	65.5	64.0	65.3	62.2	66.6	56.6	72.4	((64))
54	58.5	66.3	65.1	65.6	64.0	65.5	49.0	72.5	((64))
55	66.7	67.7	77.7	77.7	76.2	83.3	46.8	85.8	77
56	62.4	66.7	71.2	65.9	64.4	65.0	52.6	74.7	((66))
57	77.1	81.0	80.8	83.6	80.4	86.3	65.3	90.3	82
58	71.9	71.9	74.7	79.9	67.2	76.3	58.6	83.2	75
59	54.6	58.6	56.0	64.0	67.9	70.5	46.2	73.3	((65))
60	60.3	66.3	85.9	73.3	71.1	77.3	47.5	86.8	78
61	61.7	66.9	58.6	67.5	62.6	70.8	58.5	74.4	((66))
62	69.9	77.6	78.0	79.1	75.6	65.5	53.9	84.0	75
63	58.9	62.6	58.2	63.5	64.3	62.6	50.8	70.1	((62))
64	64.4	62.8	54.4	57.1	59.9	63.0	48.0	69.3	((61))
65	69.5	70.5	71.5	79.5	65.3	62.9	44.4	81.1	73
66	71.6	75.4	73.2	74.3	71.4	66.5	51.8	80.6	72
67	56.1	56.4	49.9	56.3	67.9	63.7	43.7	70.0	((61))
68	71.6	75.4	73.2	74.3	71.4	66.5	51.8	80.6	72
69	56.1	56.4	49.9	56.3	67.9	63.7	43.7	70.0	((61))
70	56.2	64.3	64.4	67.5	67.2	62.4	49.9	72.7	((64))
71	77.8	80.1	75.7	75.8	72.3	69.2	54.8	84.2	76
72	78.9	82.9	82.9	86.2	79.0	82.0	64.8	90.5	82
73	71.5	76.5	77.2	78.9	74.2	75.0	61.5	83.9	75
74	67.8	73.1	73.8	76.0	73.3	70.7	58.7	80.9	72
75	58.5	64.1	61.8	66.4	68.7	67.7	50.6	73.5	((65))
76	58.5	64.1	61.8	66.4	68.7	67.7	50.6	73.5	((65))
77	67.7	66.4	74.3	77.7	62.1	62.9	60.1	80.0	72
78	70.9	73.2	72.6	76.1	65.1	65.4	56.7	80.0	71
79	74.3	76.9	70.9	70.9	64.8	72.5	51.6	80.8	72
80	67.7	70.5	68.3	70.5	63.6	66.2	54.4	76.2	((68))
81	55.8	60.7	63.4	63.3	60.4	59.8	50.3	69.1	((61))
82	64.3	66.3	71.9	72.3	64.8	74.9	66.0	78.9	70
83	74.5	78.5	79.3	79.3	66.6	72.3	67.6	84.7	76

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-6.21
HPD selection for backfill labour

	dB-Neq	Mean:	90.2	Max:	94	Min:	83	Obs (n):	19
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	80.1	82.6	85.9	88.1	87.8	82.0	80.7	93.4	90.2
with HPD									
1	77.2	77.7	70.9	64.9	59.7	50.9	55.7	81.1	78
2	75.4	69.7	67.1	65.7	68.1	59.0	63.1	77.9	75
3	73.6	70.4	66.3	69.8	68.4	63.2	60.3	77.6	74
4	77.2	73.4	64.9	69.4	69.3	62.4	61.0	79.9	77
5	75.8	73.2	70.0	69.9	60.1	49.4	51.3	79.0	76
6	72.7	73.0	67.4	65.3	59.5	50.6	48.4	76.9	74
7	75.0	71.8	64.8	61.7	61.3	48.9	46.5	77.2	74
8	74.7	73.2	67.3	65.1	61.3	49.6	49.6	77.8	75
9	70.0	66.9	64.7	59.9	58.4	49.6	54.1	73.0	70
10	69.9	69.8	67.8	60.5	59.5	50.7	54.1	74.4	71
11	76.4	71.7	68.7	62.0	60.1	49.4	54.8	78.4	75
12	74.6	66.9	64.8	61.4	56.6	47.9	52.6	75.9	73
13	69.2	64.8	63.1	55.7	56.4	44.5	46.3	71.5	((68))
14	74.3	73.2	72.0	64.3	62.1	49.6	55.0	78.3	75
15	80.1	74.8	71.8	66.6	64.0	57.3	62.4	82.0	79
16	76.4	72.5	69.9	64.0	62.3	49.9	50.2	78.8	76
17	79.4	76.8	70.2	64.7	62.8	51.0	51.4	81.8	79
18	75.4	73.1	70.0	67.1	59.4	50.1	56.0	78.5	75
19	72.3	68.7	62.3	59.3	60.6	46.0	44.4	74.5	71
20	75.4	69.5	64.7	60.9	67.1	51.2	49.2	77.3	74
21	74.4	69.9	62.4	59.6	60.7	46.7	50.1	76.2	73
22	77.5	74.4	71.2	64.6	60.8	56.0	52.3	80.1	77
23	78.1	75.2	69.0	64.9	61.1	48.7	49.0	80.4	77
24	76.0	74.4	71.0	65.9	62.6	52.0	56.0	79.4	76
25	75.9	76.9	71.3	64.9	63.3	58.6	53.7	80.3	77
26	77.7	76.4	73.1	67.3	62.8	50.9	52.1	81.2	78
27	74.2	73.0	68.4	61.5	61.1	51.4	54.7	77.5	74
28	78.1	78.5	69.4	63.5	59.4	52.0	51.4	81.7	78
29	77.9	77.0	70.1	61.9	61.9	51.0	50.9	81.0	78
30	69.5	72.1	62.2	50.3	48.8	38.1	53.7	74.3	71
31	67.9	67.2	64.9	58.7	54.8	50.2	49.6	72.0	((69))
32	62.1	62.2	56.1	51.1	52.0	48.4	47.5	66.1	((63))
33	70.4	65.3	61.8	49.2	57.9	51.7	50.2	72.3	((69))
34	62.5	57.4	53.6	56.0	57.8	42.9	42.5	65.6	((62))
35	70.9	66.1	57.0	58.1	52.3	37.2	42.0	72.5	((69))
36	65.4	57.0	47.5	46.1	58.1	39.1	46.8	66.8	((64))
37	67.7	67.8	74.4	73.4	70.3	59.0	57.6	78.7	75
38	65.1	66.9	69.5	69.3	63.0	45.3	47.5	74.4	71
39	67.7	67.8	74.0	73.4	70.3	59.0	57.6	78.5	75
40	67.2	69.9	71.8	73.6	61.0	48.8	48.9	77.4	74
41	66.2	69.7	73.1	72.0	62.9	48.9	49.9	77.2	74
42	73.8	75.5	77.5	73.8	66.2	54.4	59.1	81.6	78
43	74.3	77.6	79.2	76.5	66.4	59.7	63.3	83.4	80
44	72.5	73.8	77.1	74.5	60.0	54.2	62.7	80.9	78
45	62.3	66.6	73.5	72.8	69.5	63.2	55.8	77.7	74
46	64.1	65.7	72.6	72.0	67.2	61.2	61.9	76.9	74
47	64.9	66.2	73.7	69.7	69.4	64.3	56.7	77.2	74
48	69.2	71.2	72.7	68.3	62.1	53.6	58.2	76.9	74
49	73.8	71.2	72.5	71.6	61.9	55.2	56.3	78.6	75
50	64.4	66.4	66.4	62.4	54.7	47.8	47.8	71.3	((68))
51	63.8	65.7	65.3	61.6	54.0	44.9	44.8	70.5	((67))
52	75.4	79.2	81.6	81.0	70.8	65.1	71.2	86.2	83
53	58.4	60.8	61.8	60.5	55.6	48.5	51.7	67.1	((64))
54	56.5	61.6	62.9	60.8	57.4	47.4	44.1	67.5	((64))
55	64.7	63.0	75.5	72.9	69.6	65.2	41.9	78.6	75
56	60.4	62.0	69.0	61.1	57.8	46.9	47.7	71.0	((68))
57	75.1	76.3	78.6	78.8	73.8	68.2	60.4	84.1	81
58	69.9	67.2	72.5	75.1	60.6	58.2	53.7	78.3	75
59	52.6	53.9	53.8	59.2	61.3	52.4	41.3	64.8	((62))
60	58.3	61.6	83.7	68.5	64.5	59.2	42.6	83.9	81
61	59.7	62.2	56.4	62.7	56.0	52.7	53.6	67.6	((64))
62	67.9	72.9	75.8	74.3	69.0	47.4	49.0	79.9	77
63	56.9	57.9	56.0	58.7	57.7	44.5	45.9	64.6	((61))
64	62.4	58.1	52.2	52.3	53.3	44.9	43.1	64.7	((62))
65	67.5	65.8	69.3	74.7	58.7	44.8	39.5	76.8	74
66	69.6	70.7	71.0	69.5	64.8	48.4	46.9	76.6	73
67	54.1	51.7	47.7	51.5	61.3	45.6	38.8	63.0	((60))
68	69.6	70.7	71.0	69.5	64.8	48.4	46.9	76.6	73
69	54.1	51.7	47.7	51.5	61.3	45.6	38.8	63.0	((60))
70	54.2	59.6	62.2	62.7	60.6	44.3	45.0	67.7	((64))
71	75.8	75.4	73.5	71.0	65.7	51.1	49.9	80.5	77
72	76.9	78.2	80.7	81.4	72.4	63.9	59.9	85.9	83
73	69.5	71.8	75.0	74.1	67.6	56.9	56.6	79.4	76
74	65.8	68.4	71.6	71.2	66.7	52.6	53.8	76.4	73
75	56.5	59.4	59.6	61.6	62.1	49.6	45.7	67.3	((64))
76	56.5	59.4	59.6	61.6	62.1	49.6	45.7	67.3	((64))
77	65.7	61.7	72.1	72.9	55.5	44.8	55.2	76.2	73
78	68.9	68.5	70.4	71.3	58.5	47.3	51.8	76.0	73
79	72.3	72.2	68.7	66.1	58.2	54.4	46.7	76.6	73
80	65.7	65.8	66.1	65.7	57.0	48.1	49.5	72.0	((69))
81	53.8	56.0	61.2	58.5	53.8	41.7	45.4	64.7	((61))
82	62.3	61.6	69.7	67.5	58.2	56.8	61.1	73.1	70
83	72.5	73.8	77.1	74.5	60.0	54.2	62.7	80.9	78

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-6.22
HPD selection for underground boilermakers

	dB-Neq	Mean:	90.6	Max:	96	Min:	81	Obs (n):	16
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	84.1	87.9	99.7	106.2	115.5	117.5	105.4	120.0	96
with HPD									
1	81.2	83.0	84.7	83.0	87.4	86.4	80.4	92.8	((69))
2	79.4	75.0	80.9	83.8	95.8	94.5	87.8	98.9	75
3	77.6	75.7	80.1	87.9	96.1	98.7	85.0	101.0	77
4	81.2	78.7	78.7	87.5	97.0	97.9	85.7	100.9	77
5	79.8	78.5	83.8	88.0	87.8	84.9	76.0	93.0	((69))
6	76.7	78.3	81.2	83.4	87.2	86.1	73.1	91.5	((67))
7	79.0	77.1	78.6	79.8	89.0	84.4	71.2	91.4	((67))
8	78.7	78.5	81.1	83.2	89.0	85.1	74.3	92.1	((68))
9	74.0	72.2	78.5	78.0	86.1	85.1	78.8	89.9	((66))
10	73.9	75.1	81.6	78.6	87.2	86.2	78.8	91.1	((67))
11	80.4	77.0	82.5	80.1	87.8	84.9	79.5	91.6	((68))
12	78.6	72.2	78.6	79.5	84.3	83.4	77.3	89.0	((65))
13	73.2	70.1	76.9	73.8	84.1	80.0	71.0	86.8	((63))
14	78.3	78.5	85.8	82.4	89.8	85.1	79.7	93.1	((69))
15	84.1	80.1	85.6	84.7	91.7	92.8	87.1	96.9	73
16	80.4	77.8	83.7	82.1	90.0	85.4	74.9	92.9	((69))
17	83.4	82.1	84.0	82.8	90.5	86.5	76.1	93.9	70
18	79.4	78.4	83.8	85.2	87.1	85.6	80.7	92.4	((68))
19	76.3	74.0	76.1	77.4	88.3	81.5	69.1	90.0	((66))
20	79.4	74.8	78.5	79.0	94.8	86.7	73.9	95.8	72
21	78.4	75.2	76.2	77.7	88.4	82.2	74.8	90.4	((66))
22	81.5	79.7	85.0	82.7	88.5	91.5	77.0	94.6	71
23	82.1	80.5	82.8	83.0	88.8	84.2	73.7	92.3	((68))
24	80.0	79.7	84.8	84.0	90.3	87.5	80.7	94.0	70
25	79.9	82.2	85.1	83.0	91.0	94.1	78.4	96.7	73
26	81.7	81.7	86.9	85.4	90.5	86.4	76.8	94.4	70
27	78.2	78.3	82.2	79.6	88.8	86.9	79.4	92.4	((68))
28	82.1	83.8	83.2	81.6	87.1	87.5	76.1	92.7	((69))
29	81.9	82.3	83.9	80.0	89.6	86.5	75.6	93.1	((69))
30	73.5	77.4	76.0	68.4	76.5	73.6	78.4	84.2	((60))
31	71.9	72.5	78.7	76.8	82.5	85.7	74.3	88.6	((65))
32	66.1	67.5	69.9	69.2	79.7	83.9	72.2	85.8	((62))
33	74.4	70.6	75.6	67.3	85.6	87.2	74.9	90.0	((66))
34	66.5	62.7	67.4	74.1	85.5	78.4	67.2	86.7	((63))
35	74.9	71.4	70.8	76.2	80.0	72.7	66.7	83.5	((59))
36	69.4	62.3	61.3	64.2	85.8	74.6	71.5	86.4	((62))
37	71.7	73.1	88.2	91.5	98.0	94.5	82.3	100.6	77
38	69.1	72.2	83.3	87.4	90.7	80.8	72.2	93.2	((69))
39	71.7	73.1	87.8	91.5	98.0	94.5	82.3	100.5	77
40	71.2	75.2	85.6	91.7	88.7	84.3	73.6	94.7	71
41	70.2	75.0	86.9	90.1	90.6	84.4	74.6	94.8	71
42	77.8	80.8	91.3	91.9	93.9	89.9	83.8	98.3	74
43	78.3	82.9	93.0	94.6	94.1	95.2	88.0	100.7	77
44	76.5	79.1	90.9	92.6	87.7	89.7	87.4	97.2	73
45	66.3	71.9	87.3	90.9	97.2	98.7	80.5	101.6	78
46	68.1	71.0	86.4	90.1	94.9	96.7	86.6	99.9	76
47	68.9	71.5	87.5	87.8	97.1	99.8	81.4	102.0	78
48	73.2	76.5	86.5	86.4	89.8	89.1	82.9	94.6	71
49	77.8	76.5	86.3	89.7	89.6	90.7	81.0	95.7	72
50	68.4	71.7	80.2	80.5	82.4	83.3	72.5	88.1	((64))
51	67.8	71.0	79.1	79.7	81.7	80.4	69.5	86.6	((63))
52	79.4	84.5	95.4	99.1	98.5	100.6	95.9	105.4	81
53	62.4	66.1	75.6	78.6	83.3	84.0	76.4	87.9	((64))
54	60.5	66.9	76.7	78.9	85.1	82.9	68.8	88.2	((64))
55	68.7	68.3	89.3	91.0	97.3	100.7	66.6	102.8	79
56	64.4	67.3	82.8	79.2	85.5	82.4	72.4	89.2	((65))
57	79.1	81.6	92.4	96.9	101.5	103.7	85.1	106.5	82
58	73.9	72.5	86.3	93.2	88.3	93.7	78.4	97.5	74
59	56.6	59.2	67.6	77.3	89.0	87.9	66.0	91.7	((68))
60	62.3	66.9	97.5	86.6	92.2	94.7	67.3	100.3	76
61	63.7	67.5	70.2	80.8	83.7	88.2	78.3	90.4	((66))
62	71.9	78.2	89.6	92.4	96.7	82.9	73.7	98.8	75
63	60.9	63.2	69.8	76.8	85.4	80.0	70.6	87.2	((63))
64	66.4	63.4	66.0	70.4	81.0	80.4	67.8	84.2	((60))
65	71.5	71.1	83.1	92.8	86.4	80.3	64.2	94.3	70
66	73.6	76.0	84.8	87.6	92.5	83.9	71.6	94.7	71
67	58.1	57.0	61.5	69.6	89.0	81.1	63.5	89.7	((66))
68	73.6	76.0	84.8	87.6	92.5	83.9	71.6	94.7	71
69	58.1	57.0	61.5	69.6	89.0	81.1	63.5	89.7	((66))
70	58.2	64.9	76.0	80.8	88.3	79.8	69.7	89.8	((66))
71	79.8	80.7	87.3	89.1	93.4	86.6	74.6	96.3	72
72	80.9	83.5	94.5	99.5	100.1	99.4	84.6	105.0	81
73	73.5	77.1	88.8	92.2	95.3	92.4	81.3	98.9	75
74	69.8	73.7	85.4	89.3	94.4	88.1	78.5	96.7	73
75	60.5	64.7	73.4	79.7	89.8	85.1	70.4	91.5	((67))
76	60.5	64.7	73.4	79.7	89.8	85.1	70.4	91.5	((67))
77	69.7	67.0	85.9	91.0	83.2	80.3	79.9	93.2	((69))
78	72.9	73.8	84.2	89.4	86.2	82.8	76.5	92.6	((69))
79	76.3	77.5	82.5	84.2	85.9	89.9	71.4	92.8	((69))
80	69.7	71.1	79.9	83.8	84.7	83.6	74.2	89.6	((66))
81	57.8	61.3	75.0	76.6	81.5	77.2	70.1	84.5	((61))
82	66.3	66.9	83.5	85.6	85.9	92.3	85.8	94.9	71
83	76.5	79.1	90.9	92.6	87.7	89.7	87.4	97.2	73

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-6.23
HPD selection for diesel fitter/mechanics

	dB-Neq	Mean:	91.8	Max:	94	Min:	87	Obs (n):	17
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	93.2	92.0	95.4	103.2	102.7	97.2	89.7	107.2	94
with HPD									
1	90.3	87.1	80.4	80.0	74.6	66.1	64.7	92.6	79
2	88.5	79.1	76.6	80.8	83.0	74.2	72.1	90.8	78
3	86.7	79.8	75.8	84.9	83.3	78.4	69.3	90.8	78
4	90.3	82.8	74.4	84.5	84.2	77.6	70.0	92.8	80
5	88.9	82.6	79.5	85.0	75.0	64.6	60.3	91.5	78
6	85.8	82.4	76.9	80.4	74.4	65.8	57.4	88.7	75
7	88.1	81.2	74.3	76.8	76.2	64.1	55.5	89.5	76
8	87.8	82.6	76.8	80.2	76.2	64.8	58.6	89.9	77
9	83.1	76.3	74.2	75.0	73.3	64.8	63.1	85.2	72
10	83.0	79.2	77.3	75.6	74.4	65.9	63.1	86.1	73
11	89.5	81.1	78.2	77.1	75.0	64.6	63.8	90.7	77
12	87.7	76.3	74.3	76.5	71.5	63.1	61.6	88.6	75
13	82.3	74.2	72.6	70.8	71.3	59.7	55.3	83.8	71
14	87.4	82.6	81.5	79.4	77.0	64.8	64.0	90.1	77
15	93.2	84.2	81.3	81.7	78.9	72.5	71.4	94.4	81
16	89.5	81.9	79.4	79.1	77.2	65.1	59.2	91.0	78
17	92.5	86.2	79.7	79.8	77.7	66.2	60.4	93.9	81
18	88.5	82.5	79.5	82.2	74.3	65.3	65.0	90.7	77
19	85.4	78.1	71.8	74.4	75.5	61.2	53.4	86.9	74
20	88.5	78.9	74.2	76.0	82.0	66.4	58.2	90.1	77
21	87.5	79.3	71.9	74.7	75.6	61.9	59.1	88.6	75
22	90.6	83.8	80.7	79.7	75.7	71.2	61.3	92.2	79
23	91.2	84.6	78.5	80.0	76.0	63.9	58.0	92.6	79
24	89.1	83.8	80.5	81.0	77.5	67.2	65.0	91.3	78
25	89.0	86.3	80.8	80.0	78.2	73.8	62.7	91.9	79
26	90.8	85.8	82.6	82.4	77.7	66.1	61.1	93.0	80
27	87.3	82.4	77.9	76.6	76.0	66.6	63.7	89.4	76
28	91.2	87.9	78.9	78.6	74.3	67.2	60.4	93.3	80
29	91.0	86.4	79.6	77.0	76.8	66.2	59.9	92.8	80
30	82.6	81.5	71.7	65.4	63.7	53.3	62.7	85.4	72
31	81.0	76.6	74.4	73.8	69.7	65.4	58.6	83.7	71
32	75.2	71.6	65.6	66.2	66.9	63.6	56.5	78.0	((65))
33	83.5	74.7	71.3	64.3	72.8	66.9	59.2	84.7	71
34	75.6	66.8	63.1	71.1	72.7	58.1	51.5	78.8	((66))
35	84.0	75.5	66.5	73.2	67.2	52.4	51.0	85.0	72
36	78.5	66.4	57.0	61.2	73.0	54.3	55.8	79.9	((67))
37	80.8	77.2	83.9	88.5	85.2	74.2	66.6	91.7	78
38	78.2	76.3	79.0	84.4	77.9	60.5	56.5	87.2	74
39	80.8	77.2	83.5	88.5	85.2	74.2	66.6	91.7	78
40	80.3	79.3	81.3	88.7	75.9	64.0	57.9	90.5	77
41	79.3	79.1	82.6	87.1	77.8	64.1	58.9	89.7	76
42	86.9	84.9	87.0	88.9	81.1	69.6	68.1	93.5	80
43	87.4	87.0	88.7	91.6	81.3	74.9	72.3	95.3	82
44	85.6	83.2	86.6	89.6	74.9	69.4	71.7	93.0	80
45	75.4	76.0	83.0	87.9	84.4	78.4	64.8	90.9	78
46	77.2	75.1	82.1	87.1	82.1	76.4	70.9	89.9	77
47	78.0	75.6	83.2	84.8	84.3	79.5	65.7	89.9	77
48	82.3	80.6	82.2	83.4	77.0	68.8	67.2	88.6	75
49	86.9	80.6	82.0	86.7	76.8	70.4	65.3	91.1	78
50	77.5	75.8	75.9	77.5	69.6	63.0	56.8	83.0	70
51	76.9	75.1	74.8	76.7	68.9	60.1	53.8	82.2	((69))
52	88.5	88.6	91.1	96.1	85.7	80.3	80.2	98.7	85
53	71.5	70.2	71.3	75.6	70.5	63.7	60.7	79.5	((66))
54	69.6	71.0	72.4	75.9	72.3	62.6	53.1	79.9	((67))
55	77.8	72.4	85.0	88.0	84.5	80.4	50.9	91.5	78
56	73.5	71.4	78.5	76.2	72.7	62.1	56.7	82.3	((69))
57	88.2	85.7	88.1	93.9	88.7	83.4	69.4	97.1	84
58	83.0	76.6	82.0	90.2	75.5	73.4	62.7	91.8	79
59	65.7	63.3	63.3	74.3	76.2	67.6	50.3	79.2	((66))
60	71.4	71.0	93.2	83.6	79.4	74.4	51.6	93.9	81
61	72.8	71.6	65.9	77.8	70.9	67.9	62.6	80.7	((67))
62	81.0	82.3	85.3	89.4	83.9	62.6	58.0	92.4	79
63	70.0	67.3	65.5	73.8	72.6	59.7	54.9	77.9	((65))
64	75.5	67.5	61.7	67.4	68.2	60.1	52.1	77.5	((64))
65	80.6	75.2	78.8	89.8	73.6	60.0	48.5	90.8	78
66	82.7	80.1	80.5	84.6	79.7	63.6	55.9	88.9	76
67	67.2	61.1	57.2	66.6	76.2	60.8	47.8	77.4	((64))
68	82.7	80.1	80.5	84.6	79.7	63.6	55.9	88.9	76
69	67.2	61.1	57.2	66.6	76.2	60.8	47.8	77.4	((64))
70	67.3	69.0	71.7	77.8	75.5	59.5	54.0	81.0	((68))
71	88.9	84.8	83.0	86.1	80.6	66.3	58.9	92.6	79
72	90.0	87.6	90.2	96.5	87.3	79.1	68.9	98.9	>86<
73	82.6	81.2	84.5	89.2	82.5	72.1	65.6	92.1	79
74	78.9	77.8	81.1	86.3	81.6	67.8	62.8	89.3	76
75	69.6	68.8	69.1	76.7	77.0	64.8	54.7	81.0	((68))
76	69.6	68.8	69.1	76.7	77.0	64.8	54.7	81.0	((68))
77	78.8	71.1	81.6	88.0	70.4	60.0	64.2	89.4	76
78	82.0	77.9	79.9	86.4	73.4	62.5	60.8	88.9	76
79	85.4	81.6	78.2	81.2	73.1	69.6	55.7	88.6	75
80	78.8	75.2	75.6	80.8	71.9	63.3	58.5	84.5	71
81	66.9	65.4	70.7	73.6	68.7	56.9	54.4	77.1	((64))
82	75.4	71.0	79.2	82.6	73.1	72.0	70.1	85.5	72
83	85.6	83.2	86.6	89.6	74.9	69.4	71.7	93.0	80

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-6.24
HPD selection for diesel fuel bay attendants

	dB-Neq	Mean:	90.5	Max:	92	Min:	89	Obs (n):	6
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	93.2	92.0	95.4	103.2	102.7	97.2	89.7	107.2	92
with HPD									
1	90.3	87.1	80.4	80.0	74.6	66.1	64.7	92.6	77
2	88.5	79.1	76.6	80.8	83.0	74.2	72.1	90.8	76
3	86.7	79.8	75.8	84.9	83.3	78.4	69.3	90.8	76
4	90.3	82.8	74.4	84.5	84.2	77.6	70.0	92.8	78
5	88.9	82.6	79.5	85.0	75.0	64.6	60.3	91.5	76
6	85.8	82.4	76.9	80.4	74.4	65.8	57.4	88.7	73
7	88.1	81.2	74.3	76.8	76.2	64.1	55.5	89.5	74
8	87.8	82.6	76.8	80.2	76.2	64.8	58.6	89.9	75
9	83.1	76.3	74.2	75.0	73.3	64.8	63.1	85.2	70
10	83.0	79.2	77.3	75.6	74.4	65.9	63.1	86.1	71
11	89.5	81.1	78.2	77.1	75.0	64.6	63.8	90.7	75
12	87.7	76.3	74.3	76.5	71.5	63.1	61.6	88.6	73
13	82.3	74.2	72.6	70.8	71.3	59.7	55.3	83.8	((69))
14	87.4	82.6	81.5	79.4	77.0	64.8	64.0	90.1	75
15	93.2	84.2	81.3	81.7	78.9	72.5	71.4	94.4	79
16	89.5	81.9	79.4	79.1	77.2	65.1	59.2	91.0	76
17	92.5	86.2	79.7	79.8	77.7	66.2	60.4	93.9	79
18	88.5	82.5	79.5	82.2	74.3	65.3	65 0	90.7	75
19	85.4	78.1	71.8	74.4	75.5	61.2	53.4	86.9	72
20	88.5	78.9	74.2	76.0	82.0	66.4	58.2	90.1	75
21	87.5	79.3	71.9	74.7	75.6	61.9	59.1	88.6	73
22	90.6	83.8	80.7	79.7	75.7	71.2	61.3	92.2	77
23	91.2	84.6	78.5	80.0	76.0	63.9	58.0	92.6	77
24	89.1	83.8	80.5	81.0	77.5	67.2	65.0	91.3	76
25	89.0	86.3	80.8	80.0	78.2	73.8	62.7	91.9	77
26	90.8	85.8	82.6	82.4	77.7	66.1	61.1	93.0	78
27	87.3	82.4	77.9	76.6	76.0	66.6	63.7	89.4	74
28	91.2	87.9	78.9	78.6	74.3	67.2	60.4	93.3	78
29	91.0	86.4	79.6	77.0	76.8	66.2	59.9	92.8	78
30	82.6	81.5	71.7	65.4	63.7	53.3	62.7	85.4	70
31	81.0	76.6	74.4	73.8	69.7	65.4	58.6	83.7	((69))
32	75.2	71.6	65.6	66.2	66.9	63.6	56.5	78.0	((63))
33	83.5	74.7	71.3	64.3	72.8	66.9	59.2	84.7	69
34	75.6	66.8	63.1	71.1	72.7	58.1	51.5	78.8	((64))
35	84.0	75.5	66.5	73.2	67.2	52.4	51.0	85.0	70
36	78.5	66.4	57.0	61.2	73.0	54.3	55 8	79.9	((65))
37	80 8	77.2	83.9	88.5	85.2	74.2	66.6	91.7	76
38	78.2	76.3	79.0	84.4	77.9	60.5	56.5	87.2	72
39	80.8	77.2	83.5	88.5	85.2	74.2	66.6	91.7	76
40	80 3	79.3	81.3	88.7	75.9	64.0	57.9	90.5	75
41	79.3	79.1	82.6	87.1	77.8	64.1	58.9	89.7	74
42	86.9	84.9	87.0	88.9	81.1	69.6	68.1	93.5	78
43	87.4	87.0	88.7	91 6	81.3	74.9	72.3	95.3	80
44	85 6	83.2	86.6	89.6	74.9	69.4	71.7	93.0	78
45	75 4	76.0	83.0	87.9	84.4	78.4	64.8	90.9	76
46	77.2	75.1	82.1	87.1	82.1	76.4	70.9	89.9	75
47	78.0	75.6	83.2	84.8	84.3	79.5	65.7	89.9	75
48	82.3	80.6	82.2	83.4	77.0	68 8	67.2	88.6	73
49	86.9	80.6	82.0	86.7	76.8	70.4	65.3	91.1	76
50	77.5	75.8	75.9	77.5	69.6	63.0	56.8	83.0	((68))
51	76.9	75.1	74.8	76.7	68.9	60.1	53.8	82.2	((67))
52	88.5	88.6	91.1	96.1	85.7	80.3	80.2	98.7	83
53	71.5	70.2	71.3	75.6	70.5	63.7	60.7	79.5	((64))
54	69.6	71.0	72.4	75.9	72.3	62.6	53.1	79.9	((65))
55	77.8	72.4	85.0	88.0	84.5	80.4	50.9	91.5	76
56	73.5	71.4	78.5	76.2	72.7	62.1	56.7	82.3	((67))
57	88.2	85.7	88.1	93.9	88.7	83.4	69.4	97.1	82
58	83.0	76.6	82.0	90.2	75.5	73.4	62.7	91.8	77
59	65.7	63.3	63.3	74.3	76.2	67.6	50.3	79.2	((64))
60	71.4	71.0	93.2	83.6	79.4	74.4	51.6	93.9	79
61	72.8	71.6	65 9	77.8	70.9	67.9	62.6	80.7	((65))
62	81.0	82.3	85.3	89.4	83.9	62.6	58.0	92.4	77
63	70.0	67.3	65.5	73.8	72.6	59.7	54.9	77.9	((63))
64	75.5	67.5	61.7	67.4	68.2	60.1	52.1	77.5	((62))
65	80.6	75.2	78.8	89.8	73.6	60.0	48.5	90.8	76
66	82.7	80.1	80.5	84.6	79.7	63.6	55.9	88.9	74
67	67.2	61.1	57.2	66.6	76.2	60.8	47.8	77.4	((62))
68	82.7	80.1	80.5	84.6	79.7	63.6	55.9	88.9	74
69	67.2	61.1	57.2	66.6	76.2	60.8	47.8	77.4	((62))
70	67.3	69.0	71.7	77.8	75.5	59.5	54.0	81.0	((66))
71	88 9	84.8	83.0	86.1	80.6	66.3	58.9	92.6	77
72	90.0	87.6	90.2	96.5	87.3	79.1	68.9	98.9	84
73	82.6	81.2	84.5	89.2	82.5	72.1	65.6	92.1	77
74	78.9	77.8	81.1	86.3	81.6	67.8	62.8	89.3	74
75	69.6	68.8	69.1	76.7	77.0	64.8	54.7	81.0	((66))
76	69.6	68.8	69.1	76.7	77.0	64.8	54.7	81.0	((66))
77	78.8	71.1	81.6	88.0	70.4	60.0	64.2	89.4	74
78	82.0	77.9	79.9	86.4	73.4	62.5	60.8	88.9	74
79	85.4	81.6	78.2	81.2	73.1	69.6	55.7	88.6	73
80	78.8	75 2	75 6	80 8	71.9	63.3	58.5	84.5	((69))
81	66.9	65.4	70.7	73.6	68.7	56.9	54.4	77.1	((62))
82	75.4	71.0	79.2	82.6	73.1	72.0	70.1	85.5	70
83	85.6	83.2	86 6	89.6	74 9	69 4	71.7	93.0	78

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-6.25
HPD selection for underground electricians

	dB-Neq	Mean:	92.5	Max:	96	Min:	83	Obs (n):	16
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	74.5	74.1	75.9	81.3	81.9	81.5	76.6	87.6	96
with HPD									
1	71.6	69.2	60.9	58.1	53.8	50.4	51.6	74.0	82
2	69.8	61.2	57.1	58.9	62.2	58.5	59.0	71.9	80
"3"	68.0	61.9	56.3	63.0	62.5	62.7	56.2	71.6	80
"4"	71.6	64.9	54.9	62.6	63.4	61.9	56.9	73.8	82
5	70.2	64.7	60.0	63.1	54.2	48.9	47.2	72.3	81
6	67.1	64.5	57.4	58.5	53.6	50.1	44.3	69.8	78
"7"	69.4	63.3	54.8	54.9	55.4	48.4	42.4	70.8	79
8	69.1	64.7	57.3	58.3	55.4	49.1	45.5	71.1	80
"9"	64.4	58.4	54.7	53.1	52.5	49.1	50.0	66.3	75
10	64.3	61.3	57.8	53.7	53.6	50.2	50.0	67.3	76
11	70.8	63.2	58.7	55.2	54.2	48.9	50.7	71.9	80
12	69.0	58.4	54.8	54.6	50.7	47.4	48.5	69.8	78
13	63.6	56.3	53.1	48.9	50.5	44.0	42.2	65.0	73
14	68.7	64.7	62.0	57.5	56.2	49.1	50.9	71.2	80
15	74.5	66.3	61.8	59.8	58.1	56.8	58.3	75.6	84
16	70.8	64.0	59.9	57.2	56.4	49.4	46.1	72.2	81
17	73.8	68.3	60.2	57.9	56.9	50.5	47.3	75.2	84
18	69.8	64.6	60.0	60.3	53.5	49.6	51.9	71.8	80
19	66.7	60.2	52.3	52.5	54.7	45.5	40.3	68.1	77
20	69.8	61.0	54.7	54.1	61.2	50.7	45.1	71.1	80
21	68.8	61.4	52.4	52.8	54.8	46.2	46.0	69.9	78
22	71.9	65.9	61.2	57.8	54.9	55.5	48.2	73.4	82
23	72.5	66.7	59.0	58.1	55.2	48.2	44.9	73.9	82
24	70.4	65.9	61.0	59.1	56.7	51.5	51.9	72.5	81
25	70.3	68.4	61.3	58.1	57.4	58.1	49.6	73.2	82
26	72.1	67.9	63.1	60.5	56.9	50.4	48.0	74.2	83
27	68.6	64.5	58.4	54.7	55.2	50.9	50.6	70.7	79
28	72.5	70.0	59.4	56.7	53.5	51.5	47.3	74.7	83
29	72.3	68.5	60.1	55.1	56.0	50.5	46.8	74.1	83
"30"	63.9	63.6	52.2	43.5	42.9	37.6	49.6	67.0	75
"31"	62.3	58.7	54.9	51.9	48.9	49.7	45.5	64.9	73
"32"	56.5	53.7	46.1	44.3	46.1	47.9	43.4	59.4	((68))
33	64.8	56.8	51.8	42.4	52.0	51.2	46.1	66.0	74
34	56.9	48.9	43.6	49.2	51.9	42.4	38.4	59.3	((68))
35	65.3	57.6	47.0	51.3	46.4	36.7	37.9	66.2	75
36	59.8	48.5	37.5	39.3	52.2	38.6	42.7	60.9	((69))
37	62.1	59.3	64.4	66.6	64.4	58.5	53.5	71.3	80
"38"	59.5	58.4	59.5	62.5	57.1	44.8	43.4	66.8	75
39	62.1	59.3	64.0	66.6	64.4	58.5	53.5	71.2	80
40	61.6	61.4	61.8	66.8	55.1	48.3	44.8	69.8	78
"41"	60.6	61.2	63.1	65.2	57.0	48.4	45.8	69.3	78
42	68.2	67.0	67.5	67.0	60.3	53.9	55.0	73.8	82
43	68.7	69.1	69.2	69.7	60.5	59.2	59.2	75.6	84
44	66.9	65.3	67.1	67.7	54.1	53.7	58.6	73.1	82
45	56.7	58.1	63.5	66.0	63.6	62.7	51.7	70.7	79
46	58.5	57.2	62.6	65.2	61.3	60.7	57.8	69.8	78
47	59.3	57.7	63.7	62.9	63.5	63.8	52.6	70.2	79
"48"	63.6	62.7	62.7	61.5	56.2	53.1	54.1	69.2	78
"49"	68.2	62.7	62.5	64.8	56.0	54.7	52.2	71.5	80
"50"	58.8	57.9	56.4	55.6	48.8	47.3	43.7	63.7	72
"51"	58.2	57.2	55.3	54.8	48.1	44.4	40.7	62.9	71
52	69.8	70.7	71.6	74.2	64.9	64.6	67.1	78.6	>87<
"53"	52.8	52.3	51.8	53.7	49.7	48.0	47.6	59.8	((68))
"54"	50.9	53.1	52.9	54.0	51.5	46.9	40.0	59.9	((68))
"55"	59.1	54.5	65.5	66.1	63.7	64.7	37.8	71.5	80
"56"	54.8	53.5	59.0	54.3	51.9	46.4	43.6	62.6	71
57	69.5	67.8	68.6	72.0	67.9	67.7	56.3	77.0	85
58	64.3	58.7	62.5	68.3	54.7	57.7	49.6	71.1	80
"59"	47.0	45.4	43.8	52.4	55.4	51.9	37.2	59.0	((67))
"60"	52.7	53.1	73.7	61.7	58.6	58.7	38.5	74.3	83
"61"	54.1	53.7	46.4	55.9	50.1	52.2	49.5	61.1	70
62	62.3	64.4	65.8	67.5	63.1	46.9	44.9	72.0	80
"63"	51.3	49.4	46.0	51.9	51.8	44.0	41.8	57.8	((66))
"64"	56.8	49.6	42.2	45.5	47.4	44.4	39.0	58.5	((67))
65	61.9	57.3	59.3	67.9	52.8	44.3	35.4	69.7	78
66	64.0	62.2	61.0	62.7	58.9	47.9	42.8	69.1	78
"67"	48.5	43.2	37.7	44.7	55.4	45.1	34.7	57.1	((66))
68	64.0	62.2	61.0	62.7	58.9	47.9	42.8	69.1	78
"69"	48.5	43.2	37.7	44.7	55.4	45.1	34.7	57.1	((66))
70	48.6	51.1	52.2	55.9	54.7	43.8	40.9	60.4	((69))
71	70.2	66.9	63.5	64.2	59.8	50.6	45.8	73.3	82
72	71.3	69.7	70.7	74.6	66.5	63.4	55.8	78.5	>87<
73	63.9	63.3	65.0	67.3	61.7	56.4	52.5	71.8	80
74	60.2	59.9	61.6	64.4	60.8	52.1	49.7	68.9	77
"75"	50.9	50.9	49.6	54.8	56.2	49.1	41.6	60.6	((69))
"76"	50.9	50.9	49.6	54.8	56.2	49.1	41.6	60.6	((69))
"77"	60.1	53.2	62.1	66.1	49.6	44.3	51.1	68.6	77
"78"	63.3	60.0	60.4	64.5	52.6	46.8	47.7	68.7	77
79	66.7	63.7	58.7	59.3	52.3	53.9	42.6	69.6	78
80	60.1	57.3	56.1	58.9	51.1	47.6	45.4	64.7	73
81	48.2	47.5	51.2	51.7	47.9	41.2	41.3	56.9	((65))
82	56.7	53.1	59.7	60.7	52.3	56.3	57.0	65.9	74
83	66.9	65.3	67.1	67.7	54.1	53.7	58.6	73.1	82

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
"n" These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-6.26

HPD selection for reclaiming and salvage personnel

	dB-Neq	Mean:	92.7	Max:	106	Min:	87	Obs (n):	13
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	80.8	87.4	90.3	90.2	100.4	97.4	91.8	103.2	106
with HPD									
1	77.9	82.5	75.3	67.0	72.3	66.3	66.8	84.8	>88<
2	76.1	74.5	71.5	67.8	80.7	74.4	74.2	84.2	>87<
3	74.3	75.2	70.7	71.9	81.0	78.6	71.4	84.8	>88<
4	77.9	78.2	69.3	71.5	81.9	77.8	72.1	85.8	>89<
5	76.5	78.0	74.4	72.0	72.7	64.8	62.4	82.4	85
6	73.4	77.8	71.8	67.4	72.1	66.0	59.5	80.9	84
7	75.7	76.6	69.2	63.8	73.9	64.3	57.6	80.8	84
8	75.4	78.0	71.7	67.2	73.9	65.0	60.7	81.7	84
9	70.7	71.7	69.1	62.0	71.0	65.0	65.2	77.4	80
10	70.6	74.6	72.2	62.6	72.1	66.1	65.2	79.2	82
11	77.1	76.5	73.1	64.1	72.7	64.8	65.9	81.6	84
12	75.3	71.7	69.2	63.5	69.2	63.3	63.7	78.6	81
13	69.9	69.6	67.5	57.8	69.0	59.9	57.4	75.4	78
14	75.0	78.0	76.4	66.4	74.7	65.0	66.1	82.5	85
15	80.8	79.6	76.2	68.7	76.6	72.7	73.5	85.4	>88<
16	77.1	77.3	74.3	66.1	74.9	65.3	61.3	82.3	85
17	80.1	81.6	74.6	66.8	75.4	66.4	62.5	85.1	>88<
18	76.1	77.9	74.4	69.2	72.0	65.5	67.1	82.1	85
19	73.0	73.5	66.7	61.4	73.2	61.4	55.5	78.5	81
20	76.1	74.3	69.1	63.0	79.7	66.6	60.3	82.5	85
21	75.1	74.7	66.8	61.7	73.3	62.1	61.2	79.7	82
22	78.2	79.2	75.6	66.7	73.4	71.4	63.4	83.6	>86<
23	78.8	80.0	73.4	67.0	73.7	64.1	60.1	83.6	>86<
24	76.7	79.2	75.4	68.0	75.2	67.4	67.1	83.3	>86<
25	76.6	81.7	75.7	67.0	75.9	74.0	64.8	84.8	>88<
26	78.4	81.2	77.5	69.4	75.4	66.3	63.2	84.9	>88<
27	74.9	77.8	72.8	63.6	73.7	66.8	65.8	81.6	84
28	78.8	83.3	73.8	65.6	72.0	67.4	62.5	85.3	>88<
29	78.6	81.8	74.5	64.0	74.5	66.4	62.0	84.6	>87<
30	70.2	76.9	66.6	52.4	61.4	53.5	64.8	78.4	81
31	68.6	72.0	69.3	60.8	67.4	65.6	60.7	76.3	79
32	62.8	67.0	60.5	53.2	64.6	63.8	58.6	71.5	74
33	71.1	70.1	66.2	51.3	70.5	67.1	61.3	76.5	79
34	63.2	62.2	58.0	58.1	70.4	58.3	53.6	72.3	75
35	71.6	70.9	61.4	60.2	64.9	52.6	53.1	75.1	78
36	66.1	61.8	51 9	48.2	70.7	54.5	57.9	72.7	75
37	68.4	72.6	78.8	75.5	82.9	74.4	68.7	85.6	>88<
38	65.8	71.7	73.9	71.4	75.6	60.7	58.6	79.8	83
39	68.4	72.6	78.4	75.5	82.9	74.4	68.7	85.6	>88<
40	67.9	74.7	76.2	75.7	73 6	64.2	60.0	81.5	84
41	66.9	74.5	77.5	74.1	75.5	64.3	61.0	81.9	85
42	74.5	80.3	81.9	75.9	78.8	69.8	70.2	86.3	>89<
43	75.0	82.4	83.6	78.6	79.0	75.1	74.4	88.1	>91<
44	73.2	78.6	81.5	76.6	72.6	69.6	73 8	85.2	>88<
45	63.0	71.4	77.9	74.9	82.1	78.6	66 9	85.4	>88<
46	64.8	70.5	77.0	74.1	79.8	76.6	73.0	84.0	>87<
47	65.6	71.0	78.1	71.8	82.0	79.7	67.8	85.5	>88<
48	69.9	76.0	77.1	70.4	74.7	69.0	69.3	82.0	85
49	74.5	76.0	76 9	73.7	74.5	70.6	67.4	82.7	>86<
50	65.1	71.2	70.8	64.5	67.3	63.2	58.9	76.0	79
51	64.5	70.5	69.7	63.7	66.6	60.3	55.9	75.0	78
52	76.1	84.0	86.0	83.1	83.4	80.5	82.3	91.4	>94<
53	59.1	65.6	66 2	62.6	68.2	63.9	62.8	73.3	76
54	57.2	66.4	67 3	62.9	70.0	62.8	55.2	73.9	77
55	65.4	67.8	79.9	75.0	82.2	80.6	53.0	86.2	>89<
56	61.1	66.8	73.4	63.2	70.4	62.3	58.8	76.4	79
57	75.8	81.1	83.0	80.9	86.4	83.6	71.5	90.7	>94<
58	70.6	72.0	76.9	77.2	73.2	73.6	64.8	82.4	85
59	53.3	58.7	58.2	61.3	73.9	67.8	52.4	75.3	78
60	59.0	66.4	88.1	70.6	77.1	74.6	53.7	88.7	>92<
61	60.4	67.0	60.8	64.8	68.6	68.1	64.7	74.3	77
62	68.6	77.7	80.2	76.4	81.6	62.8	60.1	85.6	>88<
63	57.6	62.7	60.4	60.8	70.3	59.9	57.0	72.3	75
64	63.1	62.9	56 6	54.4	65.9	60.3	54.2	70.0	73
65	68.2	70.6	73.7	76.8	71.3	60.2	50.6	80.2	83
66	70.3	75.5	75.4	71.6	77.4	63.8	58.0	81.9	85
67	54.8	56.5	52.1	53.6	73.9	61.0	49.9	74.3	77
68	70.3	75.5	75 4	71.6	77.4	63.8	58.0	81.9	85
69	54.8	56.5	52.1	53.6	73.9	61.0	49.9	74.3	77
70	54.9	64.4	66.6	64.8	73.2	59.7	56.1	75.2	78
71	76.5	80.2	77.9	73.1	78 3	66.5	61.0	84.8	>88<
72	77.6	83.0	85.1	83.5	85 0	79.3	71.0	90.9	>94<
73	70.2	76.6	79.4	76.2	80.2	72.3	67.7	84.9	>88<
74	66.5	73.2	76 0	73.3	79.3	68.0	64.9	82.6	85
75	57.2	64.2	64 0	63.7	74.7	65.0	56.8	76.1	79
76	57.2	64.2	64.0	63.7	74.7	65.0	56.8	76.1	79
77	66.4	66.5	76.5	75.0	68.1	60.2	66.3	79.9	83
78	69.6	73.3	74.8	73.4	71.1	62.7	62.9	80.0	83
79	73.0	77 0	73.1	68.2	70.8	69.8	57.8	80.8	84
80	66.4	70.6	70.5	67.8	69.6	63.5	60.6	76.6	79
81	54.5	60.8	65.6	60.6	66.4	57.1	56.5	70.6	73
82	63.0	66 4	74.1	69.6	70.8	72.2	72.2	79.4	82
83	73.2	78 6	81 5	76.6	72.6	69.6	73 8	85.2	>88<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-6.27

HPD selection for wire mesh/lacing/barricades personnel

	dB-Neq	Mean:	102.7	Max:	106	Min:	92	Obs (n):	23
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	86.4	93.0	96.1	97.9	99.4	94.4	90.9	104.0	102.7
with HPD									
1	83.5	88.1	81.1	74.7	71.3	63.3	65.9	90.2	>89<
2	81.7	80.1	77.3	75.5	79.7	71.4	73.3	86.7	85
3	79.9	80.8	76.5	79.6	80.0	75.6	70.5	87.0	>86<
4	83.5	83.8	75.1	79.2	80.9	74.8	71.2	88.7	>87<
5	82.1	83.6	80.2	79.7	71.7	61.8	61.5	87.8	>86<
6	79.0	83.4	77.6	75.1	71.1	63.0	58.6	86.1	85
7	81.3	82.2	75.0	71.5	72.9	61.3	56.7	85.7	84
8	81.0	83.6	77.5	74.9	72.9	62.0	59.8	86.7	85
9	76.3	77.3	74.9	69.7	70.0	62.0	64.3	81.8	80
10	76.2	80.2	78.0	70.3	71.1	63.1	64.3	83.8	82
11	82.7	82.1	78.9	71.8	71.7	61.8	65.0	86.6	85
12	80.9	77.3	75.0	71.2	68.2	60.3	62.8	83.6	82
13	75.5	75.2	73.3	65.5	68.0	56.9	56.5	80.0	79
14	80.6	83.6	82.2	74.1	73.7	62.0	65.2	87.5	>86<
15	86.4	85.2	82.0	76.4	75.6	69.7	72.6	90.1	>89<
16	82.7	82.9	80.1	73.8	73.9	62.3	60.4	87.3	>86<
17	85.7	87.2	80.4	74.5	74.4	63.4	61.6	90.3	>89<
18	81.7	83.5	80.2	76.9	71.0	62.5	66.2	87.4	>86<
19	78.6	79.1	72.5	69.1	72.2	58.4	54.6	82.9	82
20	81.7	79.9	74.9	70.7	78.7	63.6	59.4	85.6	84
21	80.7	80.3	72.6	69.4	72.3	59.1	60.3	84.3	83
22	83.8	84.8	81.4	74.4	72.4	68.4	62.5	88.7	>87<
23	84.4	85.6	79.2	74.7	72.7	61.1	59.2	88.9	>88<
24	82.3	84.8	81.2	75.7	74.2	64.4	66.2	88.3	>87<
25	82.2	87.3	81.5	74.7	74.9	71.0	63.9	89.6	>88<
26	84.0	86.8	83.3	77.1	74.4	63.3	62.3	90.1	>89<
27	80.5	83.4	78.6	71.3	72.7	63.8	64.9	86.4	85
28	84.4	88.9	79.6	73.3	71.0	64.4	61.6	90.7	>89<
29	84.2	87.4	80.3	71.7	73.5	63.4	61.1	89.8	>88<
30	75.8	82.5	72.4	60.1	60.4	50.5	63.9	83.8	82
31	74.2	77.6	75.1	68.5	66.4	62.6	59.8	81.2	80
32	68.4	72.6	66.3	60.9	63.6	60.8	57.7	75.4	74
33	76.7	75.7	72.0	59.0	69.5	64.1	60.4	80.5	79
34	68.8	67.8	63.8	65.8	69.4	55.3	52.7	74.6	73
35	77.2	76.5	67.2	67.9	63.9	49.6	52.2	80.5	79
36	71.7	67.4	57.7	55.9	69.7	51.5	57.0	74.9	74
37	74.0	78.2	84.6	83.2	81.9	71.4	67.8	88.8	>87<
38	71.4	77.3	79.7	79.1	74.6	57.7	57.7	84.3	83
39	74.0	78.2	84.2	83.2	81.9	71.4	67.8	88.7	>87<
40	73.5	80.3	82.0	83.4	72.6	61.2	59.1	87.2	>86<
41	72.5	80.1	83.3	81.8	74.5	61.3	60.1	87.1	>86<
42	80.1	85.9	87.7	83.6	77.8	66.8	69.3	91.4	>90<
43	80.6	88.0	89.4	86.3	78.0	72.1	73.5	93.3	>92<
44	78.8	84.2	87.3	84.3	71.6	66.6	72.9	90.7	>89<
45	68.6	77.0	83.7	82.6	81.1	75.6	66.0	88.1	>87<
46	70.4	76.1	82.8	81.8	78.8	73.6	72.1	87.1	>86<
47	71.2	76.6	83.9	79.5	81.0	76.7	66.9	87.6	>86<
48	75.5	81.6	82.9	78.1	73.7	66.0	68.4	86.8	85
49	80.1	81.6	82.7	81.4	73.5	67.6	66.5	87.8	>86<
50	70.7	76.8	76.6	72.2	66.3	60.2	58.0	81.1	80
51	70.1	76.1	75.5	71.4	65.6	57.3	55.0	80.2	79
52	81.7	89.6	91.8	90.8	82.4	77.5	81.4	96.2	>95<
53	64.7	71.2	72.0	70.3	67.2	60.9	61.9	77.1	76
54	62.8	72.0	73.1	70.6	69.0	59.8	54.3	77.7	76
55	71.0	73.4	85.7	82.7	81.2	77.6	52.1	88.9	>88<
56	66.7	72.4	79.2	70.9	69.4	59.3	57.9	81.1	80
57	81.4	86.7	88.8	88.6	85.4	80.6	70.6	94.1	>93<
58	76.2	77.6	82.7	84.9	72.2	70.6	63.9	88.0	>87<
59	58.9	64.3	64.0	69.0	72.9	64.8	51.5	75.6	74
60	64.6	72.0	93.9	78.3	76.1	71.6	52.8	94.1	>93<
61	66.0	72.6	66.6	72.5	67.6	65.1	63.8	77.5	76
62	74.2	83.3	86.0	84.1	80.6	59.8	59.2	90.1	>89<
63	63.2	68.3	66.2	68.5	69.3	56.9	56.1	74.7	73
64	68.7	68.5	62.4	62.1	64.9	57.3	53.3	73.4	72
65	73.8	76.2	79.5	84.5	70.3	57.2	49.7	86.5	85
66	75.9	81.1	81.2	79.3	76.4	60.8	57.1	86.3	85
67	60.4	62.1	57.9	61.3	72.9	58.0	49.0	74.0	73
68	75.9	81.1	81.2	79.3	76.4	60.8	57.1	86.3	85
69	60.4	62.1	57.9	61.3	72.9	58.0	49.0	74.0	73
70	60.5	70.0	72.4	72.5	72.2	56.7	55.2	78.0	77
71	82.1	85.8	83.7	80.8	77.3	63.5	60.1	89.8	>88<
72	83.2	88.6	90.9	91.2	84.0	76.3	70.1	95.8	>94<
73	75.8	82.2	85.2	83.9	79.2	69.3	66.8	89.4	>88<
74	72.1	78.8	81.8	81.0	78.3	65.0	64.0	86.5	85
75	62.8	69.8	69.8	71.4	73.7	62.0	55.9	77.8	76
76	62.8	69.8	69.8	71.4	73.7	62.0	55.9	77.8	76
77	72.0	72.1	82.3	82.7	67.1	57.2	65.4	86.0	85
78	75.2	78.9	80.6	81.1	70.1	59.7	62.0	85.6	84
79	78.6	82.6	78.9	75.9	69.8	66.8	56.9	85.9	85
80	72.0	76.2	76.3	75.5	68.6	60.5	59.7	81.6	80
81	60.1	66.4	71.4	68.3	65.4	54.1	55.6	74.8	73
82	68.6	72.0	79.9	77.3	69.8	69.2	71.3	83.1	82
83	78.8	84.2	87.3	84.3	71.6	66.6	72.9	90.7	>89<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Appendix 7

Hand-held rockdrills

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Mean L_{pA} at the given centre frequency and mean (L_{Aeq}) for various hand-held rockdrills : development

Drill (TABLE 3.4)	Operating Pressure	L_{pA} (dB) at the Given Centre Frequency (Hertz)								L_{Aeq} (dB)
		63	125	250	500	1000	2000	4000	8000	
P-1/Ds	400 kPa	78,6	88,0	92,4	95,0	98,6	101,5	102,4	98,6	107,1
	600 kPa	82,3	89,2	95,1	97,3	100,6	104,2	105,3	102,1	109,9
P-1/Ds-1	400 kPa	80,6	91,1	96,5	97,3	99,4	102,6	104,3	100,3	108,8
	600 kPa	81,3	92,8	98,4	101,4	101,7	103,5	105,1	100,9	110,2
P-2/Ds	400 kPa	79,0	84,2	86,3	90,6	97,6	102,0	102,4	98,8	106,9
	600 kPa	79,1	84,8	87,8	92,8	99,0	102,9	103,5	99,2	107,9
P-2/Du	400 kPa	79,8	94,3	102,0	107,3	109,0	112,0	107,9	105,8	116,1
	600 kPa	83,2	95,9	103,9	110,2	108,5	112,8	109,8	108,3	117,5
P-3/Ds	400 kPa*	-	-	-	-	-	-	-	-	-
	600 kPa	84,6	87,9	92,8	97,9	103,1	101,6	101,3	97,1	108,0
P-3/Du	400 kPa	79,2	93,4	100,1	106,0	107,5	107,6	106,7	103,4	113,7
	600 kPa	87,2	90,9	101,9	109,5	110,8	110,1	109,0	105,2	116,4
WH-1/D	17 MPa	77,3	78,4	82,0	87,0	95,5	100,3	103,0	101,0	106,8
WH-2/D	17 MPa	77,2	75,4	76,3	84,2	96,5	100,5	101,0	95,6	105,1
WH-3/D	17 MPa	77,3	75,3	75,2	81,4	94,7	99,2	101,4	95,6	104,6
1 Avg-P/Ds	400 kPa	79,5	88,6	93,4	95,1	98,6	102,1	103,1	99,3	107,7
	600 kPa	82,3	89,6	95,0	98,3	101,4	103,2	104,1	100,2	109,1
2 Avg-P/Du	400 kPa	79,5	93,9	101,2	106,7	108,3	110,3	107,3	104,8	115,1
	600 kPa	85,6	94,1	103,0	109,9	109,8	111,7	109,4	107,0	117,0
3 Avg-WH/D	17 MPa	77,3	76,6	78,9	84,8	95,6	100,0	101,9	98,2	105,6

* No data : See text, Section 3.4.1.1
1 Avg-P/Ds : Average for Silenced Pneumatic Drills
2 Avg-P/Du : Average for Unsilenced Pneumatic Drills
3 Avg-WH/D : Average for Water-hydraulic Drills

Table A-7.2

N_{eq} *as a function of drilling time for unprotected operators of various hand-held rockdrills: development*

Drill (TABLE 3.4)	Operating Pressure	L_{Aeq} (dB)	N_{eq} (dB) for Stated Drilling Time Per Shift (minutes)									
			30	60	90	120	150	180	210	240	270	300
P-1/Ds	400 kPa	107,1	95	98	100	101	102	103	104	104	105	105
	600 kPa	109,9	98	101	103	104	105	106	107	107	108	108
P-1/Ds-1	400 kPa	108,8	97	100	102	103	104	105	105	106	107	107
	600 kPa	110,2	98	101	103	104	105	106	107	107	108	108
P-2/Ds	400 kPa	106,9	95	98	100	101	102	103	103	104	105	105
	600 kPa	107,9	96	99	101	102	103	104	105	105	106	106
P-2/Du	400 kPa	116,1	104	107	109	110	111	112	113	113	114	114
	600 kPa	117,5	106	109	110	112	113	113	114	115	115	116
P-3/Ds	400 kPa+	-	-	-	-	-	-	-	-	-	-	-
	600 kPa	108,0	96	99	101	102	103	104	105	105	106	106
P-3/Du	400 kPa	113,7	102	105	107	108	109	110	110	111	111	112
	600 kPa	116,4	105	108	109	111	112	112	113	114	114	115
WH-1/D	17 MPa	106,8	95	98	100	101	102	103	104	104	105	105
WH-2/D	17 MPa	105,1	93	96	98	99	100	101	102	102	103	103
WH-3/D	17 MPa	104,6	93	96	97	99	100	100	101	102	102	103
1 Avg-P/Ds	400 kPa	107,7	95,8	98,8	100,6	101,8	102,8	103,6	104,3	104,8	105,4	105,8
	600 kPa	109,1	97,3	100,3	102,0	103,3	104,3	105,0	105,7	106,3	106,8	107,3
2 Avg-P/Du	400 kPa	115,1	103,2	106,2	108,0	109,2	110,2	111,0	111,7	112,3	112,8	113,2
	600 kPa	117,0	105,1	108,1	109,9	111,2	112,1	112,9	113,6	114,2	114,7	115,1
3 Avg-WH/D	17 MPa	105,6	93,8	96,8	98,5	99,8	100,7	101,5	102,2	102,8	103,3	103,8

+ No data : See text, Section 3.4.1.1
1 Avg-P/Ds : Average for Silenced Pneumatic Drills
2 Avg-P/Du : Average for Unsilenced Pneumatic Drills
3 Avg-WH/D : Average for Water-hydraulic Drills

Table A-7.3

Attenuation performance of seven representative hearing protection devices

HPD Designation	Name and Description	Mean Attenuation and Standard Deviation (dB) at the Given Centre Frequency (Hertz)										Standard Applied during Evaluation
		63	125	250	500	1000	2000	3150	4000	6300	8000	
HPD 1	EAR 1000 Conventional muff	18,4 4,3	14,8 3,7	15,2 2,8	24,3 2,9	34,4 5,8	34,7 3,2	37,2 2,6	36,2 2,7	36,7 2,7	39,9 3,3	BS-5108: 1983
HPD 2	EAR 1000 Helmet-mounted muff	- -	8,4 1,5	11,8 1,2	23,4 2,4	28,4 2,7	29,9 1,7	35,9 2,3	37,5 2,0	37,4 2,9	37,5 3,5	BS-5108: 1983
HPD 3	EAR Model 200 Semi-aural Caps Band-mounted, semi-aural caps, band positioned under chin	23,0 4,9	22,3 4,7	20,7 4,0	19,3 2,6	21,3 3,4	32,6 2,9	38,5 2,5	37,9 2,5	41,1 3,4	36,5 3,6	BS-5108: 1983
HPD 4	EAR 1000 Conventional muff with EAR FOAM Disposable plugs	30,0 6,5	31,6 7,0	37,2 6,0	46,3 7,0	42,7 5,3	39,0 4,5	45,7 4,1	49,8 4,6	46,5 4,7	49,3 5,0	BS-5108: 1983
HPD 5	RACAL DBA 2638 "Semi-disposable" plugs (reusable)	- -	22,0 4,9	21,3 5,8	20,3 5,1	23,0 4,6	29,8 5,5	40,5 3,9	44,9 4,2	42,7 6,1	43,3 5,2	BS-5108: 1983
HPD 6	EAR FOAM Disposable plugs	24,8 7,3	26,1 7,8	26,7 7,4	28,9 7,0	30,4 5,9	32,8 4,9	42,8 4,6	43,6 5,0	44,6 5,2	44,4 5,5	BS-5108: 1974
HPD 7	Varifoon Custom-moulded, variable attenuation plugs set for maximum attenuation	- -	30,5 2,1	28,8 1,1	30,7 3,0	34,8 2,6	39,0 2,5	- -	42,5 1,1	- -	44,6 4,6	SABS 1451 Pt 2:1988/ ISO-4869: 1990

Table A-7.4

Attenuation provided by representative HPDs for operators of various hand-held rockdrills : development

Drill (TABLE 3.4)	Operating Pressure	Attenuation (dB)* Provided by Representative Hearing Protection Devices						
		HPD 1	HPD 2	HPD 3	HPD 4	HPD 5	HPD 6	HPD 7
P-1/Ds	400 kPa	20,8	20,1	19,7	31,1	17,0	20,6	33,2
	600 kPa	21,3	20,7	20,3	31,6	17,4	21,0	33,5
P-1/Ds-1	400 kPa	19,3	18,5	19,3	30,5	16,5	19,7	33,4
	600 kPa	18,6	17,9	18,1	30,2	15,2	18,7	32,5
P-2/Ds	400 kPa	24,3	23,4	21,6	32,2	18,8	22,7	33,8
	600 kPa	24,1	23,3	21,2	32,2	18,5	22,4	33,6
P-2/Du	400 kPa	19,9	19,5	18,1	30,8	14,8	18,8	31,7
	600 kPa	20,5	20,0	17,4	31,0	15,2	19,2	31,6
P-3/Ds	400 kPa+	-	-	-	-	-	-	-
	600 kPa	20,4	19,9	18,1	30,7	15,1	19,2	31,6
P-3/Du	400 kPa	19,7	19,2	17,3	30,8	14,5	18,6	31,4
	600 kPa	20,4	20,1	16,9	31,5	14,2	18,5	31,0
WH-1/D	17 MPa	28,1	27,4	25,4	33,7	21,7	25,7	34,9
WH-2/D	17 MPa	24,4	23,5	22,6	32,1	19,4	23,1	33,9
WH-3/D	17 MPa	22,2	21,5	19,2	31,9	16,9	20,9	34,7
1 Avg-P/Ds	400 kPa	20,7	19,9	20,0	31,1	17,2	20,6	33,5
	600 kPa	20,4	19,8	19,0	31,1	16,3	20,0	32,8
2 Avg-P/Du	400 kPa	20,2	19,7	17,8	30,8	14,9	19,0	31,5
	600 kPa	20,1	19,8	17,6	31,1	14,5	18,7	31,3
3 Avg-WH/D	17 MPa	27,1	26,5	23,0	33,4	20,3	24,5	34,5

* Attenuation calculated on the basis of the frequency spectrum for each drill/condition (Table A-7.1) and the frequency-specific attenuation performance of each HPD (Table A-7.3).

\+ No data : See text, Section 3.4.1.1

1 Avg-P/Ds : Average for Silenced Pneumatic Drills
2 Avg-P/Du : Average for Unsilenced Pneumatic Drills
3 Avg-WH/D : Average for Water-hydraulic Drills

Table A-7.5

Drilling time per hole and drill performance for various hand-held rockdrills : development

Drill (TABLE 3.4)	Average Time Required to Drill One Hole 2,3 m x 38 mm (min)		Drill Performance (m/hr)	
	Pneumatic Drills Operating at Stated Pressure			
	400 kPa	600 kPa	400 kPa	600 kPa
P-1/Ds	6,19	3,07	22,29	44,95
P-1/Ds-I	5,82	4,35	23,71	31,72
P-2/Ds	6,13	5,04	22,51	27,38
P-2/Du	7,89	2,95	17,49	46,78
P-3/Ds	7,86	4,25	17,56	32,47
P-3/Du	5,71	4,78	24,17	28,87
1 Avg-P/Ds				
Observed	6,50	4,18	21,52	34,13
Estimated Typical	-	6,97	-	20,47
2 Avg-P/Du				
Observed	6,60	3,87	20,83	37,83
Estimated Typical*	-	6,45	-	22,91
Water-hydraulic Drills Operating at 17 MPa				
WH-1/D	6,25		22,08	
WH-2/D	6,43		21,46	
WH-3/D	4,61		29,93	
3 Avg-WH/D				
Observed	5,76		24,49	
Estimated Typical*	5,07		26,50	

* Observed drilling times per hole and drill performance values are not representative of deep level mining, for reasons explained in the text (Section 3.4.1.3). In addition, no reliable information was available for direct observations of drill performance in development ends. Accordingly, estimated typical values are included in the table, determined by assuming the same percentage differences in performance (in comparison to development drill observations from the present study) as occurred between stope drilling in the present study and drilling operations in deep level production stopes.

1 Avg-P/Ds : Average for Silenced Pneumatic Drills
2 Avg-P/Du : Average for Unsilenced Pneumatic Drills
3 Avg-WH/D : Average for Water-hydraulic Drills

Table A-7.6

Mean L_{pA} at the given centre frequency and mean (L_{Aeq}) for various hand-held rockdrills : stoping

Drill (TABLE 3.4)	Operating Pressure	L_{pA} (dB) at the Given Centre Frequency (Hertz)								L_{Aeq} (dB)
		63	125	250	500	1000	2000	4000	8000	
P-1/Ss	400 kPa	79,0	88,3	84,9	91,4	96,8	101,3	102,6	101,4	107,2
	600 kPa	84,0	90,6	93,0	96,9	99,8	105,3	106,5	104,7	111,0
P-2/Ss	400 kPa	77,0	76,7	76,9	83,1	93,8	102,4	104,1	99,5	107,4
	600 kPa	77,9	79,2	80,2	87,6	95,3	103,4	105,3	101,6	108,7
P-2/Su	400 kPa	81,2	90,8	98,4	107,0	108,3	110,3	109,2	107,1	115,7
	600 kPa	90,5	101,7	104,3	109,6	110,6	112,9	111,8	110,8	118,5
P-3/DSs	400 kPa	79,9	85,1	87,3	89,8	97,0	103,3	103,0	100,1	107,7
	600 kPa	83,7	92,4	95,9	100,9	106,7	106,8	108,6	104,6	113,3
P-3/DSu	400 kPa	79,2	89,8	100,4	108,1	110,9	109,3	108,6	105,9	116,0
	500 kPa	81,8	95,3	101,5	109,2	112,1	111,1	111,3	110,1	118,0
	600 kPa	85,7	94,2	101,9	110,3	113,5	112,4	112,6	111,3	119,2
P-3/Ss	400 kPa	79,5	88,2	89,5	96,2	100,0	101,3	102,7	99,0	107,5
	600 kPa	82,4	87,4	92,4	93,6	99,3	105,7	108,1	107,1	112,2
P-3/Su	400 kPa	78,0	91,8	98,5	104,2	106,0	111,4	109,5	108,8	115,8
	600 kPa	86,1	94,0	102,3	109,0	109,4	113,9	112,6	111,3	118,7
WH-1/S	17 MPa	77,1	75,1	77,4	87,8	98,7	104,6	107,3	105,4	111,0
WH-2/S	17 MPa	76,8	74,4	77,6	85,4	98,8	105,0	107,0	102,7	110,4
WH-3/S	17 MPa	76,6	75,7	75,3	86,7	96,9	104,4	107,2	99,4	109,7
1 Avg-P/Ss	400 kPa	79,0	86,3	86,5	92,2	97,4	102,2	103,1	100,1	107,4
	600 kPa	82,6	89,4	92,9	97,0	102,3	105,5	107,3	105,0	111,6
2 Avg-P/Su	400 kPa	79,7	90,9	99,2	106,7	108,9	110,4	109,1	107,4	115,8
	600 kPa	88,0	98,2	103,0	109,7	111,5	113,1	112,3	111,1	118,8
3 Avg-WH/S	17 MPa	76,8	75,1	76,9	86,7	98,2	104,7	107,2	103,2	110,4

1 Avg-P/Ss : Average for Silenced Pneumatic Drills
2 Avg-P/Su : Average for Unsilenced Pneumatic Drills
3 Avg-WH/S : Average for Water-hydraulic Drills

Table A-7.7

N_{eq} *as a function of drilling time for unprotected operators of various hand-held rockdrills : stoping*

Drill (TABLE 3.4)	Operating Pressure	L_{Aeq} (dB)	N_{eq} (dB) for Stated Drilling Time Per Shift (minutes)									
			30	60	90	120	150	180	210	240	270	300
P-1/Ss	400 kPa	107,2	95	98	100	101	102	103	104	104	105	105
	600 kPa	111,0	99	102	104	105	106	107	107	108	109	109
P-2/Ss	400 kPa	107,4	95	98	100	101	102	103	104	104	105	105
	600 kPa	108,7	97	100	101	103	104	104	105	106	106	107
P-2/Su	400 kPa	115,7	104	107	108	110	111	111	112	113	113	114
	600 kPa	118,5	107	110	111	113	113	114	115	116	116	117
P-3/DSs	400 kPa	107,7	96	99	101,0	102	103	103	104	105	105	106
	600 kPa	113,3	101	104	106	107	108	109	110	110	111	111
P-3/DSu	400 kPa	116,0	104	107	109	110	111	112	112	113	113	114
	500 kPa	118,0	106	109	111	112	113	114	114	115	115	116
	600 kPa	119,2	107	110	112	113	114	115	116	116	117	117
P-3/Ss	400 kPa	107,5	95	98	100	101	102	103	104	104	105	105
	600 kPa	112,2	100	103	105	106	107	108	109	109	110	110
P-3/Su	400 kPa	115,8	104	107	109	110	111	112	112	113	113	114
	600 kPa	118,7	107	110	111	113	114	114	115	116	116	117
WH-1/S	17 MPa	111,0	99	102	104	105	106	107	107	108	108	109
WH-2/S	17 MPa	110,4	98	101	103	104	105	106	107	107	108	108
WH-3/S	17 MPa	109,7	98	101	102	104	105	105	106	107	107	108
1 Avg-P/Ss	400 kPa	107,4	95,4	98,4	100,2	101,4	102,4	103,2	103,8	104,4	104,9	105,4
	600 kPa	111,6	99,6	102,6	104,4	105,6	106,6	107,4	108,0	108,6	109,1	109,6
2 Avg-P/Su	400 kPa	115,8	103,8	106,8	108,5	100,8	110,7	111,5	112,2	112,8	113,3	113,8
	600 kPa	118,8	106,8	109,8	111,6	112,8	113,8	114,6	115,2	115,8	116,3	116,8
3 Avg-WH/S	17 MPa	110,4	98,4	101,4	103,1	104,4	105,4	106,2	106,8	107,4	107,9	108,4

1 Avg-P/Ss : Average for Silenced Pneumatic Drills
2 Avg-P/Su : Average for Unsilenced Pneumatic Drills
3 Avg-WH/S : Average for Water-hydraulic Drills

Table A-7.8

Attenuation provided by representative HPDs for operators of various hand-held rockdrills : stoping

Drill (TABLE 3.4)	Operating Pressure	Attenuation (dB)* Provided by Representative Hearing Protection Devices						
		HPD 1	HPD 2	HPD 3	HPD 4	HPD 5	HPD 6	HPD 7
P-1/Ss	400 kPa	21,8	21,0	19,4	31,5	16,9	20,8	34,2
	600 kPa	19,5	18,6	18,4	30,1	15,5	19,2	34,1
P-2/Ss	400 kPa	21,0	20,8	17,1	31,8	14,6	18,9	35,2
	600 kPa	22,2	21,8	19,8	31,9	16,5	20,6	35,1
P-2/Su	400 kPa	27,1	26,4	23,8	33,9	21,0	25,0	31,9
	600 kPa	25,2	24,5	24,0	33,5	20,9	24,5	32,2
P-3/DSs	400 kPa	22,1	21,7	18,6	31,9	15,6	20,0	34,1
	600 kPa	22,0	21,7	17,9	32,2	15,4	19,8	32,8
P-3/DSu	400 kPa	22,9	22,3	20,6	31,8	17,3	21,4	31,1
	600 kPa	26,9	26,3	22,0	32,8	19,4	23,6	31,7
P-3/Ss	400 kPa	27,5	26,9	23,1	33,4	20,5	24,6	32,9
	600 kPa	23,4	22,1	22,2	31,9	19,4	22,9	35,0
P-3/Su	400 kPa	22,9	22,0	21,9	32,0	18,8	22,4	33,0
	600 kPa	28,4	27,6	25,5	33,5	21,7	25,6	32,6
WH-1/S	17 MPa	28,9	28,3	25,0	34,3	22,0	26,1	35,1
WH-2/S	17 MPa	28,6	28,0	24,4	33,7	21,3	25,4	35,0
WH-3/S	17 MPa	28,7	28,1	25,2	33,8	21,7	25,7	35,4
1 Avg-P/Ss	400 kPa	23,9	22,9	21,9	32,2	19,0	22,8	34,1
	600 kPa	23,6	22,8	21,3	32,5	18,7	22,5	34,3
2 Avg-P/Su	400 kPa	21,9	21,5	18,5	31,8	15,7	20,0	32,0
	600 kPa	21,1	20,5	18,6	31,3	15,8	19,8	32,2
3 Avg-WH/S	17 MPa	28,7	28,2	24,8	33,9	21,6	25,7	35,2

* Attenuation calculated on the basis of the frequency spectrum for each drill/condition (Table A-7.6) and the frequency-specific attenuation performance of each HPD (Table A-7.3).

1 Avg-P/Ss : Average for Silenced Pneumatic Drills
2 Avg-P/Su : Average for Unsilenced Pneumatic Drills
3 Avg-WH/S : Average for Water-hydraulic Drills

Table A-7.9

Drilling time per hole and drill performance for various hand-held rockdrills : stoping

Drill (TABLE 3.4)	Average Time Required to Drill One Hole 1,2 m x 36 mm (min)		Drill Performance (m/hr)	
	Pneumatic Drills Operating at Stated Pressure			
	400 kPa	600 kPa	400 kPa	600 kPa
P-1/Ss	8,15	3,39	8,83	21,24
P-2/Ss	7,22	4,88	9,97	14,75
P-2/Su	4,46	2,91	16,14	24,74
P-3/DSs	4,89	3,74	14,72	19,25
P-3/DSu	3,72	3,37	19,35	21,36
P-3/Ss	4,69	3,85	15,35	18,70
P-3/Su	5,03	3,19	14,42	22,57
1 Avg-P/Ss				
Observed	6,24	3,97	12,22	18,49
Estimated Typical	-	6,62	-	11,09
2 Avg-P/Su				
Observed	4,40	3,16	16,64	22,89
Estimated Typical*	-	5,27	-	13,86
Water-hydraulic Drills Operating at 17 MPa				
WH-1/S	3,63		19,83	
WH-2/S	3,37		21,37	
WH-3/S	3,50		20,57	
3 Avg-WH/S				
Observed	3,50		20,59	
Estimated Typical*	3,08		22,28	

* Observed drilling times per hole and drill performance values are not representative of deep level mining, for reasons explained in the text (Section 3.4.2.3). Accordingly, estimated typical values for unsilenced pneumatic and water-hydraulic machines are included in the table, determined on the basis of direct observations of these machines in deep level production stopes. No silenced pneumatics were observed during deep level studies, and estimated typical values for these machines at 600 kPa were determined by assuming the same percentage losses in performance in relation to unsilenced machines in deep level stopes, as that observed between silenced and unsilenced drills during the present study.

1 Avg-P/Ss : Average for Silenced Pneumatic Drills
2 Avg-P/Su : Average for Unsilenced Pneumatic Drills
3 Avg-WH/S : Average for Water-hydraulic Drills

Table A-7.10

Comparison of frequency spectra determined in an underground stope and on surface for drill P-3/DSs and drill P-3/DSu

Frequency (Hz)	A-Weighted Sound Pressure Level (dB)							
	Drill P-3/DSs (silenced)				Drill P-3/DSu (unsilenced)			
	400 kPa		600 kPa		400 kPa		600 kPa	
	Stope	Surface*	Stope	Surface*	Stope	Surface*	Stope	Surface*
63	79,9	75,9	83,7	77,8	79,2	76,9	85,7	79,8
125	85,1	83,9	92,4	86,1	89,8	87,9	94,2	89,9
250	87,3	92,5	95,9	95,4	100,4	102,4	101,9	103,5
500	89,8	96,2	100,9	98,4	108,1	106,8	110,3	108,8
1000	97,0	100,5	106,7	103,5	110,9	109,0	113,5	110,0
2000	108,3	102,8	106,8	106,3	109,3	108,3	112,4	111,2
4000	103,0	106,0	108,6	108,5	108,6	110,0	112,6	112,1
8000	100,1	102,9	104,6	106,4	105,9	107,9	111,3	110,8
L_{Aeq}	110,3	109,8	113,3	112,8	116,0	115,7	119,2	117,9

* Surface results determined in accordance with CAGI Pneurop Test Code and supplied by manufacturer.

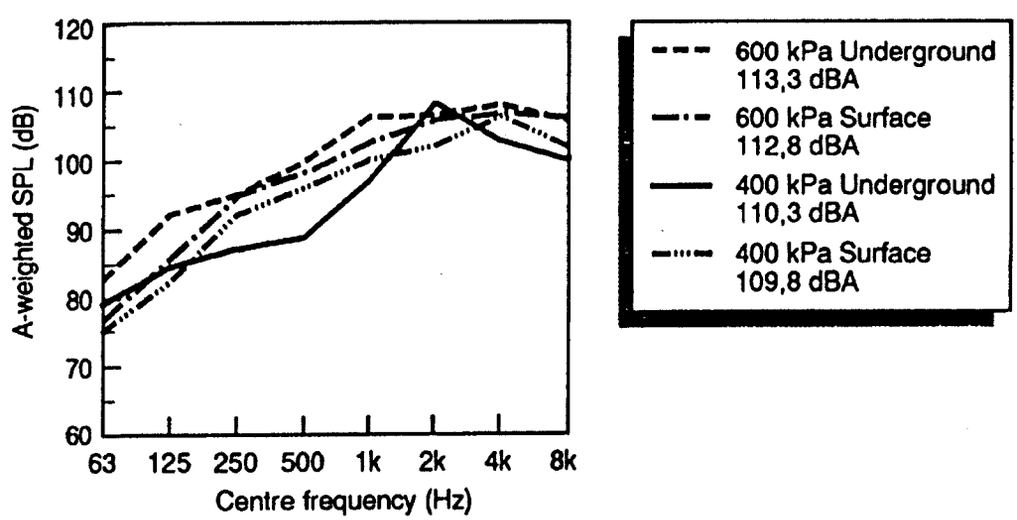

Figure A-7.1 ***Comparison of frequency spectra determined in an underground stope and on surface for drill P-3/DSs (silenced, dual-purpose pneumatic)***

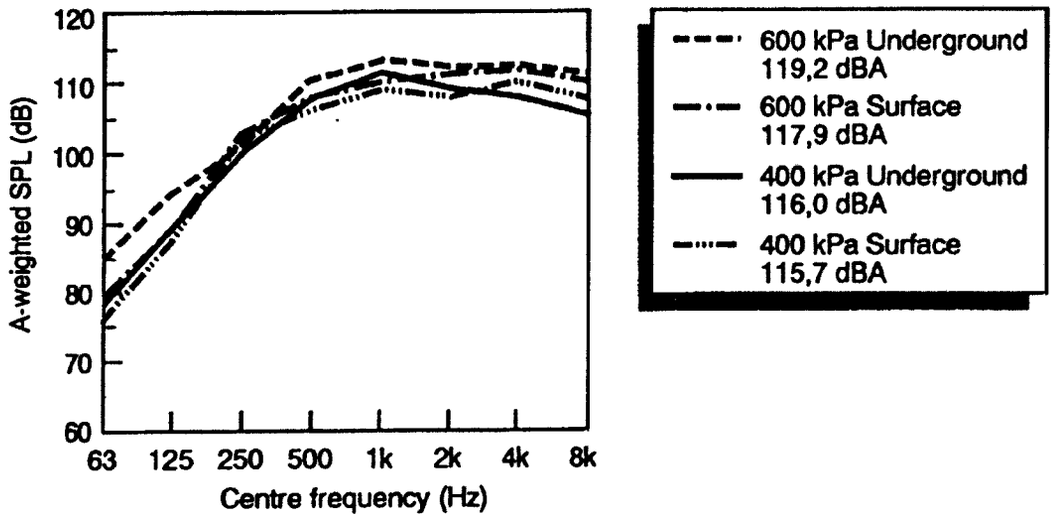

Figure A-7.2 Comparison of frequency spectra determined in an underground stope and on surface for drill P-3/DSu (unsilenced, dual-purpose pneumatic)

Table A-7.11

Comparison of frequency spectra determined in an underground stope and on surface for drill P-3/Ss and drill P-3/Su

Frequency (Hz)	A-Weighted Sound Pressure Level (dB)							
	Drill P-3/Ss (silenced)				Drill P-3/Su (unsilenced)			
	400 kPa		600 kPa		400 kPa		600 kPa	
	Stope	Surface*	Stope	Surface*	Stope	Surface*	Stope	Surface*
63	79,5	72,6	82,4	74,9	78,0	74,8	86,1	77,8
125	88,2	77,9	87,4	78,7	91,8	83,9	94,0	86,1
250	89,5	89,4	92,4	92,4	98,5	96,5	102,3	95,4
500	96,2	90,8	93,6	92,8	104,2	102,8	109,0	98,4
1000	100,0	98,0	99,3	99,0	106,0	102,1	109,4	106,9
2000	101,3	102,7	105,7	105,2	111,4	110,2	113,9	109,8
4000	102,7	106,5	108,1	109,0	109,5	110,0	112,6	111,0
8000	99,0	103,0	107,1	105,5	108,8	109,9	111,3	112,9
L_{Aeq}	107,5	109,6	112,2	112,0	115,8	115,3	118,7	116,8

* Surface results determined in accordance with CAGI Pneurop Test Code and supplied by manufacturer.

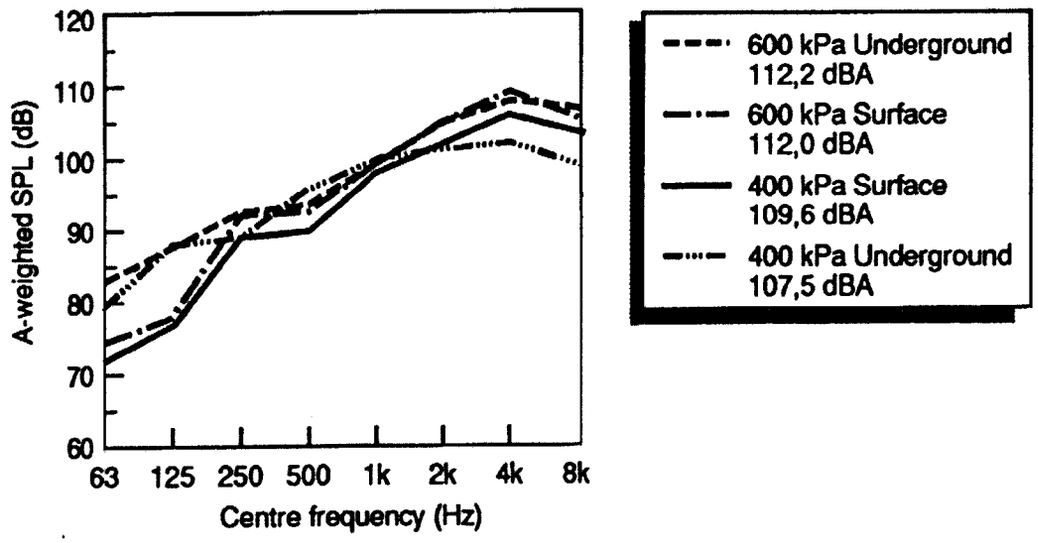

Figure A-7.3 Comparison of frequency spectra determined in an underground stope and on surface for drill P-3/Ss (silenced pneumatic stoper)

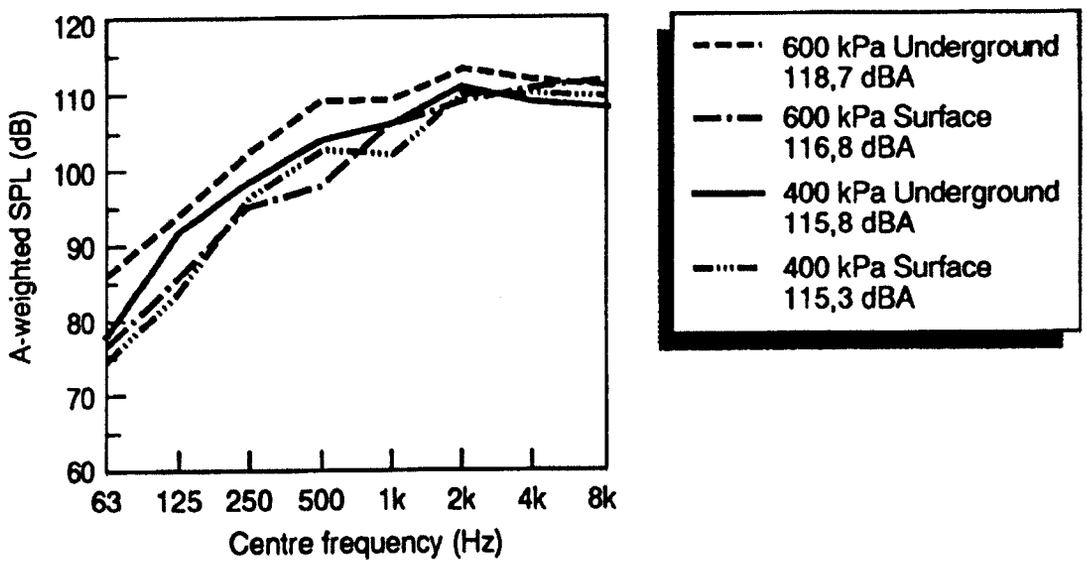

Figure A-7.4 Comparison of frequency spectra determined in an underground stope and on surface for drill P-3/Su (unsilenced pneumatic stoper)

Table A-7.12

HPD selection for RDOs: silenced pneumatic, development, 400 kPa

	dB-Neq	Mean:	102.8	Max:	104	Min:	102	Obs (n):	15
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	88.6	93.4	95.1	98.6	102.1	103.1	99.3	107.7	102.8
with HPD									
1	85.7	88.5	80.1	75.4	74.0	72.0	74.3	91.1	>86<
2	83.9	80.5	76.3	76.2	82.4	80.1	81.7	89.4	85
3	82.1	81.2	75.5	80.3	82.7	84.3	78.9	89.9	85
4	85.7	84.2	74.1	79.9	83.6	83.5	79.6	91.1	>86<
5	84.3	84.0	79.2	80.4	74.4	70.5	69.9	88.8	84
6	81.2	83.8	76.6	75.8	73.8	71.7	67.0	87.0	82
7	83.5	82.6	74.0	72.2	75.6	70.0	65.1	87.0	82
8	83.2	84.0	76.5	75.6	75.6	70.7	68.2	87.8	83
9	78.5	77.7	73.9	70.4	72.7	70.7	72.7	83.3	78
10	78.4	80.6	77.0	71.0	73.8	71.8	72.7	84.8	80
11	84.9	82.5	77.9	72.5	74.4	70.5	73.4	88.0	83
12	83.1	77.7	74.0	71.9	70.9	69.0	71.2	85.3	80
13	77.7	75.6	72.3	66.2	70.7	65.6	64.9	81.3	76
14	82.8	84.0	81.2	74.8	76.4	70.7	73.6	88.3	83
15	88.6	85.6	81.0	77.1	78.3	78.4	81.0	91.8	>87<
16	84.9	83.3	79.1	74.5	76.6	71.0	68.8	88.4	84
17	87.9	87.6	79.4	75.2	77.1	72.1	70.0	91.4	>87<
18	83.9	83.9	79.2	77.6	73.7	71.2	74.6	88.4	84
19	80.8	79.5	71.5	69.8	74.9	67.1	63.0	84.3	79
20	83.9	80.3	73.9	71.4	81.4	72.3	67.8	87.4	83
21	82.9	80.7	71.6	70.1	75.0	67.8	68.7	85.8	81
22	86.0	85.2	80.4	75.1	75.1	77.1	70.9	89.9	85
23	86.6	86.0	78.2	75.4	75.4	69.8	67.6	90.0	85
24	84.5	85.2	80.2	76.4	76.9	73.1	74.6	89.3	84
25	84.4	87.7	80.5	75.4	77.6	79.7	72.3	90.7	>86<
26	86.2	87.2	82.3	77.8	77.1	72.0	70.7	91.0	>86<
27	82.7	83.8	77.6	72.0	75.4	72.5	73.3	87.6	83
28	86.6	89.3	78.6	74.0	73.7	73.1	70.0	91.6	>87<
29	86.4	87.8	79.3	72.4	76 2	72.1	69.5	90.8	>86<
30	78.0	82.9	71.4	60.8	63.1	59.2	72.3	84.7	80
31	76.4	78.0	74.1	69.2	69.1	71.3	68.2	82.3	77
32	70.6	73.0	65.3	61.6	66.3	69.5	66.1	77.3	72
33	78.9	76.1	71.0	59.7	72.2	72.8	68.8	82.4	78
34	71.0	68.2	62.8	66.5	72.1	64.0	61.1	76.6	72
35	79.4	76.9	66.2	68.6	66.6	58.3	60.6	81.9	77
36	73.9	67.8	56.7	56.6	72.4	60.2	65.4	77.3	72
37	76.2	78.6	83.6	83.9	84.6	80.1	76.2	90.1	85
38	73.6	77.7	78.7	79.8	77.3	66.4	66.1	85.0	80
39	76.2	78.6	83.2	83.9	84.6	80.1	76.2	90.0	85
40	75.7	80.7	81.0	84.1	75.3	69.9	67.5	87.7	83
41	74.7	80.5	82.3	82.5	77.2	70.0	68.5	87.5	83
42	82.3	86.3	86.7	84.3	80.5	75.5	77.7	91.9	>87<
43	82.8	88.4	88.4	87.0	80.7	80.8	81.9	93.9	>89<
44	81.0	84.6	86.3	85.0	74.3	75.3	81.3	91.3	>86<
45	70.8	77.4	82.7	83.3	83.8	84.3	74.4	90.0	85
46	72.6	76.5	81.8	82.5	81.5	82.3	80.5	89.1	84
47	73.4	77.0	82.9	80.2	83.7	85.4	75.3	89.9	85
48	77.7	82.0	81.9	78.8	76.4	74.7	76.8	87.6	83
49	82.3	82.0	81.7	82.1	76.2	76.3	74.9	88.8	84
50	72.9	77.2	75.6	72.9	69.0	68.9	66.4	81.7	77
51	72.3	76.5	74 5	72.1	68.3	66.0	63.4	80.8	76
52	83.9	90.0	90 8	91.5	85.1	86 2	89.8	97.4	>93<
53	66.9	71.6	71.0	71.0	69.9	69.6	70.3	78.7	74
54	65.0	72.4	72.1	71.3	71.7	68.5	62.7	78.7	74
55	73.2	73.8	84.7	83.4	83.9	86.3	60.5	90.9	>86<
56	68.9	72.8	78.2	71 6	72.1	68.0	66.3	81.3	76
57	83.6	87.1	87.8	89.3	88.1	89.3	79.0	95.8	>91<
58	78.4	78.0	81.7	85 6	74.9	79.3	72.3	88.9	84
59	61.1	64.7	63.0	69.7	75.6	73.5	59.9	78.8	74
60	66.8	72.4	92.9	79.0	78.8	80.3	61.2	93.5	>89<
61	68.2	73.0	65.6	73.2	70.3	73.8	72.2	80.1	75
62	76.4	83.7	85.0	84.8	83.3	68.5	67.6	90.5	>86<
63	65.4	68.7	65.2	69.2	72.0	65.6	64.5	76.5	72
64	70.9	68.9	61.4	62.8	67.6	66.0	61.7	75 4	71
65	76.0	76.6	78.5	85.2	73.0	65.9	58.1	87.1	82
66	78.1	81.5	80.2	80.0	79.1	69.5	65.5	87.0	82
67	62.6	62.5	56.9	62.0	75.6	66.7	57.4	76.7	72
68	78.1	81.5	80.2	80.0	79.1	69.5	65.5	87.0	82
69	62.6	62.5	56.9	62.0	75.6	66.7	57.4	76.7	72
70	62.7	70.4	71.4	73.2	74.9	65.4	63.6	79.3	74
71	84.3	86.2	82.7	81.5	80.0	72.2	68.5	90.6	>86<
72	85.4	89.0	89.9	91.9	86.7	85.0	78.5	96.6	>92<
73	78.0	82.6	84.2	84.6	81.9	78.0	75.2	90.2	85
74	74.3	79.2	80.8	81.7	81.0	73.7	72.4	87.4	82
75	65.0	70.2	68.8	72.1	76.4	70.7	64.3	79.8	75
76	65.0	70.2	68.8	72.1	76.4	70.7	64.3	79.8	75
77	74.2	72.5	81.3	83.4	69.8	65.9	73.8	86.4	82
78	77.4	79.3	79.6	81.8	72 8	68.4	70.4	86.2	81
79	80.8	83.0	77.9	76.6	72.5	75.5	65.3	86.8	82
80	74.2	76.6	75.3	76.2	71.3	69.2	68.1	82.5	78
81	62.3	66.8	70.4	69.0	68.1	62.8	64.0	75.6	71
82	70.8	72.4	78.9	78.0	72.5	77.9	79.7	85 4	80
83	81.0	84.6	86.3	85.0	74.3	75.3	81 3	91.3	>86<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-7.13

HPD selection for RDOs: silenced pneumatic, development, 600 kPa

	dB-Neq	Mean:	104.3	Max:	105	Min:	103	Obs (n):	20
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	89.6	95.0	98.3	101.4	103.2	104.1	100.2	109.1	104.3
with HPD									
1	86.7	90.1	83.3	78.2	75.1	73.0	75.2	92.7	>88<
2	84.9	82.1	79.5	79.0	83.5	81.1	82.6	90.7	>86<
3	83.1	82.8	78.7	83.1	83.8	85.3	79.8	91.3	>86<
4	86.7	85.8	77.3	82.7	84.7	84.5	80.5	92.5	>88<
5	85.3	85.6	82.4	83.2	75.5	71.5	70.8	90.6	>86<
6	82.2	85.4	79.8	78.6	74.9	72.7	67.9	88.7	84
7	84.5	84.2	77.2	75.0	76.7	71.0	66.0	88.4	84
8	84.2	85.6	79.7	78.4	76.7	71.7	69.1	89.3	85
9	79.5	79.3	77.1	73.2	73.8	71.7	73.6	84.9	80
10	79.4	82.2	80.2	73.8	74.9	72.8	73.6	86.6	82
11	85.9	84.1	81.1	75.3	75.5	71.5	74.3	89.5	85
12	84.1	79.3	77.2	74.7	72.0	70.0	72.1	86.7	82
13	78.7	77.2	75.5	69.0	71.8	66.6	65.8	82.9	78
14	83.8	85.6	84.4	77.6	77.5	71.7	74.5	90.1	85
15	89.6	87.2	84.2	79.9	79.4	79.4	81.9	93.3	>88<
16	85.9	84.9	82.3	77.3	77.7	72.0	69.7	90.0	85
17	88.9	89.2	82.6	78.0	78.2	73.1	70.9	92.9	>88<
18	84.9	85.5	82.4	80.4	74.8	72.2	75.5	90.1	85
19	81.8	81.1	74.7	72.6	76.0	68.1	63.9	85.8	81
20	84.9	81.9	77.1	74.2	82.5	73.3	68.7	88.7	84
21	83.9	82.3	74.8	72.9	76.1	68.8	69.6	87.2	82
22	87.0	86.8	83.6	77.9	76.2	78.1	71.8	91.4	>87<
23	87.6	87.6	81.4	78.2	76.5	70.8	68.5	91.5	>87<
24	85.5	86.8	83.4	79.2	78.0	74.1	75.5	91.0	>86<
25	85.4	89.3	83.7	78.2	78.7	80.7	73.2	92.3	>88<
26	87.2	88.8	85.5	80.6	78.2	73.0	71.6	92.7	>88<
27	83.7	85.4	80.8	74.8	76.5	73.5	74.2	89.2	84
28	87.6	90.9	81.8	76.8	74.8	74.1	70.9	93.2	>88<
29	87.4	89.4	82.5	75.2	77.3	73.1	70.4	92.3	>88<
30	79.0	84.5	74.6	63.6	64.2	60.2	73.2	86.2	81
31	77.4	79.6	77.3	72.0	70.2	72.3	69.1	84.0	79
32	71.6	74.6	68.5	64.4	67.4	70.5	67.0	78.7	74
33	79.9	77.7	74.2	62.5	73.3	73.8	69.7	83.8	79
34	72.0	69.8	66.0	69.3	73.2	65.0	62.0	78.0	73
35	80.4	78.5	69.4	71.4	67.7	59.3	61.5	83.2	78
36	74.9	69.4	59.9	59.4	73.5	61.2	66.3	78.4	74
37	77.2	80.2	86.8	86.7	85.7	81.1	77.1	92.2	>87<
38	74.6	79.3	81.9	82.6	78.4	67.4	67.0	87.2	82
39	77.2	80.2	86.4	86.7	85.7	81.1	77.1	92.1	>87<
40	76.7	82.3	84.2	86.9	76.4	70.9	68.4	90.1	85
41	75.7	82.1	85.5	85.3	78.3	71.0	69.4	89.9	85
42	83.3	87.9	89.9	87.1	81.6	76.5	78.6	94.1	>89<
43	83.8	90.0	91.6	89.8	81.8	81.8	82.8	96.2	>91<
44	82.0	86.2	89.5	87.8	75.4	76.3	82.2	93.6	>89<
45	71.8	79.0	85.9	86.1	84.9	85.3	75.3	92.0	>87<
46	73.6	78.1	85.0	85.3	82.6	83.3	81.4	91.1	>86<
47	74.4	78.6	86.1	83.0	84.8	86.4	76.2	91.7	>87<
48	78.7	83.6	85.1	81.6	77.5	75.7	77.7	89.7	85
49	83.3	83.6	84.9	84.9	77.3	77.3	75.8	90.8	>86<
50	73.9	78.8	78.8	75.7	70.1	69.9	67.3	83.8	79
51	73.3	78.1	77.7	74.9	69.4	67.0	64.3	82.8	78
52	84.9	91.6	94.0	94.3	86.2	87.2	90.7	99.6	>95<
53	67.9	73.2	74.2	73.8	71.0	70.6	71.2	80.6	76
54	66.0	74.0	75.3	74.1	72.8	69.5	63.6	80.8	76
55	74.2	75.4	87.9	86.2	85.0	87.3	61.4	92.9	>88<
56	69.9	74.4	81.4	74.4	73.2	69.0	67.2	83.7	79
57	84.6	88.7	91.0	92.1	89.2	90.3	79.9	97.7	>93<
58	79.4	79.6	84.9	88.4	76.0	80.3	73.2	91.3	>86<
59	62.1	66.3	66.2	72.5	76.7	74.5	60.8	80.2	75
60	67.8	74.0	96.1	81.8	79.9	81.3	62.1	96.5	>92<
61	69.2	74.6	68.8	76.0	71.4	74.8	73.1	81.7	77
62	77.4	85.3	88.2	87.6	84.4	69.5	68.5	92.8	>88<
63	66.4	70.3	68.4	72.0	73.1	66.6	65.4	78.2	73
64	71.9	70.5	64.6	65.6	68.7	67.0	62.6	76.8	72
65	77.0	78.2	81.7	88.0	74.1	66.9	59.0	89.7	85
66	79.1	83.1	83.4	82.8	80.2	70.5	66.4	89.1	84
67	63.6	64.1	60.1	64.8	76.7	67.7	58.3	77.9	73
68	79.1	83.1	83.4	82.8	80.2	70.5	66.4	89.1	84
69	63.6	64.1	60.1	64.8	76.7	67.7	58.3	77.9	73
70	63.7	72.0	74.6	76.0	76.0	66.4	64.5	81.3	76
71	85.3	87.8	85.9	84.3	81.1	73.2	69.4	92.5	>88<
72	86.4	90.6	93.1	94.7	87.8	86.0	79.4	98.8	>94<
73	79.0	84.2	87.4	87.4	83.0	79.0	76.1	92.5	>88<
74	75.3	80.8	84.0	84.5	82.1	74.7	73.3	89.5	85
75	66.0	71.8	72.0	74.9	77.5	71.7	65.2	81.5	77
76	66.0	71.8	72.0	74.9	77.5	71.7	65.2	81.5	77
77	75.2	74.1	84.5	86.2	70.9	66.9	74.7	89.1	84
78	78.4	80.9	82.8	84.6	73.9	69.4	71.3	88.6	84
79	81.8	84.6	81.1	79.4	73.6	76.5	66.2	88.6	84
80	75.2	78.2	78.5	79.0	72.4	70.2	69.0	84.6	80
81	63.3	68.4	73.6	71.8	69.2	63.8	64.9	77.8	73
82	71.8	74.0	82.1	80.8	73.6	78.9	80.6	87.3	82
83	82.0	86.2	89.5	87.8	75.4	76.3	82.2	93.6	>89<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-7.14

HPD selection for RDOs: unsilenced pneumatic, development, 400 kPa

	dB-Neq	Mean:	110.2	Max:	111	Min:	109	Obs (n):	10
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	93.9	101.2	106.7	108.3	110.3	107.3	104.8	115.1	110.2
with HPD									
1	91.0	96.3	91.7	85.1	82.2	76.2	79.8	98.8	>94<
2	89.2	88.3	87.9	85.9	90.6	84.3	87.2	96.5	>92<
3	87.4	89.0	87.1	90.0	90.9	88.5	84.4	97.0	>92<
4	91.0	92.0	85.7	89.6	91.8	87.7	85.1	98.2	>93<
5	89.6	91.8	90.8	90.1	82.6	74.7	75.4	96.9	>92<
6	86.5	91.6	88.2	85.5	82.0	75.9	72.5	94.9	>90<
7	88.8	90.4	85.6	81.9	83.8	74.2	70.6	94.2	>89<
8	88.5	91.8	88.1	85.3	83.8	74.9	73.7	95.4	>91<
9	83.8	85.5	85.5	80.1	80.9	74.9	78.2	91.0	>86<
10	83.7	88.4	88.6	80.7	82.0	76.0	78.2	93.1	>88<
11	90.2	90.3	89.5	82.2	82.6	74.7	78.9	95.4	>91<
12	88.4	85.5	85.6	81.6	79.1	73.2	76.7	92.3	>87<
13	83.0	83.4	83.9	75.9	78.9	69.8	70.4	89.0	84
14	88.1	91.8	92.8	84.5	84.6	74.9	79.1	96.8	>92<
15	93.9	93.4	92.6	86.8	86.5	82.6	86.5	99.0	>94<
16	90.2	91.1	90.7	84.2	84.8	75.2	74.3	96.2	>91<
17	93.2	95.4	91.0	84.9	85.3	76.3	75.5	98.8	>94<
18	89.2	91.7	90.8	87.3	81.9	75.4	80.1	96.4	>92<
19	86.1	87.3	83.1	79.5	83.1	71.3	68.5	91.7	>87<
20	89.2	88.1	85.5	81.1	89.6	76.5	73.3	94.7	>90<
21	88.2	88.5	83.2	79.8	83.2	72.0	74.2	92.8	>88<
22	91.3	93.0	92.0	84.8	83.3	81.3	76.4	97.5	>93<
23	91.9	93.8	89.8	85.1	83.6	74.0	73.1	97.4	>93<
24	89.8	93.0	91.8	86.1	85.1	77.3	80.1	97.3	>92<
25	89.7	95.5	92.1	85.1	85.8	83.9	77.8	98.5	>94<
26	91.5	95.0	93.9	87.5	85.3	76.2	76.2	99.0	>94<
27	88.0	91.6	89.2	81.7	83.6	76.7	78.8	95.3	>90<
28	91.9	97.1	90.2	83.7	81.9	77.3	75.5	99.1	>94<
29	91.7	95.6	90.9	82.1	84.4	76.3	75.0	98.4	>93<
30	83.3	90.7	83.0	70.5	71.3	63.4	77.8	92.2	>87<
31	81.7	85.8	85.7	78.9	77.3	75.5	73.7	90.4	>86<
32	75.9	80.8	76.9	71.3	74.5	73.7	71.6	84.6	80
33	84.2	83.9	82.6	69.4	80.4	77.0	74.3	89.5	85
34	76.3	76.0	74.4	76.2	80.3	68.2	66.6	84.3	79
35	84.7	84.7	77.8	78.3	74.8	62.5	66.1	88.8	84
36	79.2	75.6	68.3	66.3	80.6	64.4	70.9	84.2	79
37	81.5	86.4	95.2	93.6	92.8	84.3	81.7	99.3	>94<
38	78.9	85.5	90.3	89.5	85.5	70.6	71.6	94.4	>90<
39	81.5	86.4	94.8	93.6	92.8	84.3	81.7	99.1	>94<
40	81.0	88.5	92.6	93.8	83.5	74.1	73.0	97.3	>92<
41	80.0	88.3	93.9	92.2	85.4	74.2	74.0	97.2	>92<
42	87.6	94.1	98.3	94.0	88.7	79.7	83.2	101.3	>96<
43	88.1	96.2	100.0	96.7	88.9	85.0	87.4	103.2	>98<
44	86.3	92.4	97.9	94.7	82.5	79.5	86.8	100.8	>96<
45	76.1	85.2	94.3	93.0	92.0	88.5	79.9	98.7	>94<
46	77.9	84.3	93.4	92.2	89.7	86.5	86.0	97.7	>93<
47	78.7	84.8	94.5	89.9	91.9	89.6	80.8	98.3	>93<
48	83.0	89.8	93.5	88.5	84.6	78.9	82.3	96.7	>92<
49	87.6	89.8	93.3	91.8	84.4	80.5	80.4	97.5	>93<
50	78.2	85.0	87.2	82.6	77.2	73.1	71.9	90.7	>86<
51	77.6	84.3	86.1	81.8	76.5	70.2	68.9	89.8	85
52	89.2	97.8	102.4	101.2	93.3	90.4	95.3	106.4	>102<
53	72.2	79.4	82.6	80.7	78.1	73.8	75.8	87.2	82
54	70.3	80.2	83.7	81.0	79.9	72.7	68.2	87.8	83
55	78.5	81.6	96.3	93.1	92.1	90.5	66.0	99.7	>95<
56	74.2	80.6	89.8	81.3	80.3	72.2	71.8	91.4	>87<
57	88.9	94.9	99.4	99.0	96.3	93.5	84.5	104.4	>99<
58	83.7	85.8	93.3	95.3	83.1	83.5	77.8	98.2	>93<
59	66.4	72.5	74.6	79.4	83.8	77.7	65.4	86.4	82
60	72.1	80.2	104.5	88.7	87.0	84.5	66.7	104.7	>100<
61	73.5	80.8	77.2	82.9	78.5	78.0	77.7	87.7	83
62	81.7	91.5	96.6	94.5	91.5	72.7	73.1	100.2	>95<
63	70.7	76.5	76.8	78.9	80.2	69.8	70.0	84.9	80
64	76.2	76.7	73.0	72.5	75.8	70.2	67.2	82.6	78
65	81.3	84.4	90.1	94.9	81.2	70.1	63.6	96.7	>92<
66	83.4	89.3	91.8	89.7	87.3	73.7	71.0	96.1	>91<
67	67.9	70.3	68.5	71.7	83.8	70.9	62.9	84.7	80
68	83.4	89.3	91.8	89.7	87.3	73.7	71.0	96.1	>91<
69	67.9	70.3	68.5	71.7	83.8	70.9	62.9	84.7	80
70	68.0	78.2	83.0	82.9	83.1	69.6	69.1	88.4	84
71	89.6	94.0	94.3	91.2	88.2	76.4	74.0	99.1	>94<
72	90.7	96.8	101.5	101.6	94.9	89.2	84.0	105.9	>101<
73	83.3	90.4	95.8	94.3	90.1	82.2	80.7	99.6	>95<
74	79.6	87.0	92.4	91.4	89.2	77.9	77.9	96.7	>92<
75	70.3	78.0	80.4	81.8	84.6	74.9	69.8	88.2	83
76	70.3	78.0	80.4	81.8	84.6	74.9	69.8	88.2	83
77	79.5	80.3	92.9	93.1	78.0	70.1	79.3	96.4	>92<
78	82.7	87.1	91.2	91.5	81.0	72.6	75.9	95.6	>91<
79	86.1	90.8	89.5	86.3	80.7	79.7	70.8	95.0	>90<
80	79.5	84.4	86.9	85.9	79.5	73.4	73.6	91.4	>87<
81	67.6	74.6	82.0	78.7	76.3	67.0	69.5	85.1	80
82	76.1	80.2	90.5	87.7	80.7	82.1	85.2	93.9	>89<
83	86.3	92.4	97.9	94.7	82.5	79.5	86.8	100.8	>96<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-7.15

HPD selection for RDOs: unsilenced pneumatic, development, 600 kPa

	dB-Neq	Mean:	112.1	Max:	113	Min:	112	Obs (n):	10
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	94.1	103.0	109.9	109.8	111.7	109.4	107.0	117.0	112.1
with HPD									
1	91.2	98.1	94.9	86.6	83.6	78.3	82.0	100.7	>96<
2	89.4	90.1	91.1	87.4	92.0	86.4	89.4	98.2	>93<
3	87.6	90.8	90.3	91.5	92.3	90.6	86.6	98.8	>94<
4	91.2	93.8	88.9	91.1	93.2	89.8	87.3	99.7	>95<
5	89.8	93.6	94.0	91.6	84.0	76.8	77.6	98.8	>94<
6	86.7	93.4	91.4	87.0	83.4	78.0	74.7	96.9	>92<
7	89.0	92.2	88.8	83.4	85.2	76.3	72.8	95.8	>91<
8	88.7	93.6	91.3	86.8	85.2	77.0	75.9	97.2	>92<
9	84.0	87.3	88.7	81.6	82.3	77.0	80.4	93.0	>88<
10	83.9	90.2	91.8	82.2	83.4	78.1	80.4	95.3	>90<
11	90.4	92.1	92.7	83.7	84.0	76.8	81.1	97.2	>92<
12	88.6	87.3	88.8	83.1	80.5	75.3	78.9	93.9	>89<
13	83.2	85.2	87.1	77.4	80.3	71.9	72.6	91.0	>86<
14	88.3	93.6	96.0	86.0	86.0	77.0	81.3	99.0	>94<
15	94.1	95.2	95.8	88.3	87.9	84.7	88.7	100.8	>96<
16	90.4	92.9	93.9	85.7	86.2	77.3	76.5	98.1	>93<
17	93.4	97.2	94.2	86.4	86.7	78.4	77.7	100.5	>96<
18	89.4	93.5	94.0	88.8	83.3	77.5	82.3	98.3	>93<
19	86.3	89.1	86.3	81.0	84.5	73.4	70.7	93.2	>88<
20	89.4	89.9	88.7	82.6	91.0	78.6	75.5	96.2	>91<
21	88.4	90.3	86.4	81.3	84.6	74.1	76.4	94.3	>89<
22	91.5	94.8	95.2	86.3	84.7	83.4	78.6	99.4	>95<
23	92.1	95.6	93.0	86.6	85.0	76.1	75.3	99.1	>94<
24	90.0	94.8	95.0	87.6	86.5	79.4	82.3	99.3	>94<
25	89.9	97.3	95.3	86.6	87.2	86.0	80.0	100.5	>96<
26	91.7	96.8	97.1	89.0	86.7	78.3	78.4	101.1	>96<
27	88.2	93.4	92.4	83.2	85.0	78.8	81.0	97.3	>92<
28	92.1	98.9	93.4	85.2	83.3	79.4	77.7	100.9	>96<
29	91.9	97.4	94.1	83.6	85.8	78.4	77.2	100.1	>95<
30	83.5	92.5	86.2	72.0	72.7	65.5	80.0	94.1	>89<
31	81.9	87.6	88.9	80.4	78.7	77.6	75.9	92.5	>88<
32	76.1	82.6	80.1	72.8	75.9	75.8	73.8	86.5	82
33	84.4	85.7	85.8	70.9	81.8	79.1	76.5	91.2	>86<
34	76.5	77.8	77.6	77.7	81.7	70.3	68.8	85.9	81
35	84.9	86.5	81.0	79.8	76.2	64.6	68.3	90.1	85
36	79.4	77.4	71.5	67.8	82.0	66.5	73.1	85.4	80
37	81.7	88.2	98.4	95.1	94.2	86.4	83.9	101.5	>97<
38	79.1	87.3	93.5	91.0	86.9	72.7	73.8	96.7	>92<
39	81.7	88.2	98.0	95.1	94.2	86.4	83.9	101.4	>96<
40	81.2	90.3	95.8	95.3	84.9	76.2	75.2	99.4	>95<
41	80.2	90.1	97.1	93.7	86.8	76.3	76.2	99.6	>95<
42	87.8	95.9	101.5	95.5	90.1	81.8	85.4	103.7	>99<
43	88.3	98.0	103.2	98.2	90.3	87.1	89.6	105.7	>101<
44	86.5	94.2	101.1	96.2	83.9	81.6	89.0	103.3	>98<
45	76.3	87.0	97.5	94.5	93.4	90.6	82.1	101.0	>96<
46	78.1	86.1	96.6	93.7	91.1	88.6	88.2	100.0	>95<
47	78.9	86.6	97.7	91.4	93.3	91.7	83.0	100.7	>96<
48	83.2	91.6	96.7	90.0	86.0	81.0	84.5	99.1	>94<
49	87.8	91.6	96.5	93.3	85.8	82.6	82.6	99.7	>95<
50	78.4	86.8	90.4	84.1	78.6	75.2	74.1	93.1	>88<
51	77.8	86.1	89.3	83.3	77.9	72.3	71.1	92.1	>87<
52	89.4	99.6	105.6	102.7	94.7	92.5	97.5	108.8	>104<
53	72.4	81.2	85.8	82.2	79.5	75.9	78.0	89.5	85
54	70.5	82.0	86.9	82.5	81.3	74.8	70.4	90.1	85
55	78.7	83.4	99.5	94.6	93.5	92.6	68.2	102.1	>97<
56	74.4	82.4	93.0	82.8	81.7	74.3	74.0	94.1	>89<
57	89.1	96.7	102.6	100.5	97.7	95.6	86.7	106.5	>102<
58	83.9	87.6	96.5	96.8	84.5	85.6	80.0	100.3	>95<
59	66.6	74.3	77.8	80.9	85.2	79.8	67.6	88.1	83
60	72.3	82.0	107.7	90.2	88.4	86.6	68.9	107.9	>103<
61	73.7	82.6	80.4	84.4	79.9	80.1	79.9	89.5	85
62	81.9	93.3	99.8	96.0	92.9	74.8	75.3	102.5	>98<
63	70.9	78.3	80.0	80.4	81.6	71.9	72.2	86.7	82
64	76.4	78.5	76.2	74.0	77.2	72.3	69.4	84.1	79
65	81.5	86.2	93.3	96.4	82.6	72.2	65.8	98.6	>94<
66	83.6	91.1	95.0	91.2	88.7	75.8	73.2	98.3	>93<
67	68.1	72.1	71.7	73.2	85.2	73.0	65.1	86.2	81
68	83.6	91.1	95.0	91.2	88.7	75.8	73.2	98.3	>93<
69	68.1	72.1	71.7	73.2	85.2	73.0	65.1	86.2	81
70	68.2	80.0	86.2	84.4	84.5	71.7	71.3	90.4	>86<
71	89.8	95.8	97.5	92.7	89.6	78.5	76.2	101.2	>96<
72	90.9	98.6	104.7	103.1	96.3	91.3	86.2	108.1	>103<
73	83.5	92.2	99.0	95.8	91.5	84.3	82.9	101.9	>97<
74	79.8	88.8	95.6	92.9	90.6	80.0	80.1	98.9	>94<
75	70.5	79.8	83.6	83.3	86.0	77.0	72.0	90.1	85
76	70.5	79.8	83.6	83.3	86.0	77.0	72.0	90.1	85
77	79.7	82.1	96.1	94.6	79.4	72.2	81.5	98.7	>94<
78	82.9	88.9	94.4	93.0	82.4	74.7	78.1	97.8	>93<
79	86.3	92.6	92.7	87.8	82.1	81.8	73.0	97.0	>92<
80	79.7	86.2	90.1	87.4	80.9	75.5	75.8	93.6	>89<
81	67.8	76.4	85.2	80.2	77.7	69.1	71.7	87.5	83
82	76.3	82.0	93.7	89.2	82.1	84.2	87.4	96.4	>91<
83	86.5	94.2	101.1	96.2	83.9	81.6	89.0	103.3	>98<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-7.16

HPD selection for RDOs: water-hydraulic, development, 17 MPa

	dB-Neq	Mean:	100.7	Max:	102	Min:	100	Obs (n):	15
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	76.6	78.9	84.8	95.6	100.0	101.9	98.2	105.6	100.7
with HPD									
1	73.7	74.0	69.8	72.4	71.9	70.8	73.2	80.9	76
2	71.9	66.0	66.0	73.2	80.3	78.9	80.6	85.4	80
3	70.1	66.7	65.2	77.3	80.6	83.1	77.8	86.5	82
4	73.7	69.7	63.8	76.9	81.5	82.3	78.5	86.7	82
5	72.3	69.5	68.9	77.4	72.3	69.3	68.8	80.9	76
6	69.2	69.3	66.3	72.8	71.7	70.5	65.9	78.5	74
7	71.5	68.1	63.7	69.2	73.5	68.8	64.0	78.0	73
8	71.2	69.5	66.2	72.6	73.5	69.5	67.1	79.1	74
9	66.5	63.2	63.6	67.4	70.6	69.5	71.6	76.9	72
10	66.4	66.1	66.7	68.0	71.7	70.6	71.6	77.8	73
11	72.9	68.0	67.6	69.5	72.3	69.3	72.3	79.2	74
12	71.1	63.2	63.7	68.9	68.8	67.8	70.1	76.9	72
13	65.7	61.1	62.0	63.2	68.6	64.4	63.8	73.2	((68))
14	70.8	69.5	70.9	71.8	74.3	69.5	72.5	80.1	75
15	76.6	71.1	70.7	74.1	76.2	77.2	79.9	84.6	80
16	72.9	68.8	68.8	71.5	74.5	69.8	67.7	79.7	75
17	75.9	73.1	69.1	72.2	75.0	70.9	68.9	81.3	76
18	71.9	69.4	68.9	74.6	71.6	70.0	73.5	80.3	75
19	68.8	65.0	61.2	66.8	72.8	65.9	61.9	76.2	71
20	71.9	65.8	63.6	68.4	79.3	71.1	66.7	81.2	76
21	70.9	66.2	61.3	67.1	72.9	66.6	67.6	77.2	72
22	74.0	70.7	70.1	72.1	73.0	75.9	69.8	81.2	76
23	74.6	71.5	67.9	72.4	73.3	68.6	66.5	80.0	75
24	72.5	70.7	69.9	73.4	74.8	71.9	73.5	81.1	76
25	72.4	73.2	70.2	72.4	75.5	78.5	71.2	82.7	78
26	74.2	72.7	72.0	74.8	75.0	70.8	69.6	81.6	77
27	70.7	69.3	67.3	69.0	73.3	71.3	72.2	79.3	74
28	74.6	74.8	68.3	71.0	71.6	71.9	68.9	80.6	76
29	74.4	73.3	69.0	69.4	74.1	70.9	68.4	80.4	76
30	66.0	68.4	61.1	57.8	61.0	58.0	71.2	74.5	70
31	64.4	63.5	63.8	66.2	67.0	70.1	67.1	75.0	70
32	58.6	58.5	55.0	58.6	64.2	68.3	65.0	71.8	((67))
33	66.9	61.6	60.7	56.7	70.1	71.6	67.7	75.9	71
34	59.0	53.7	52.5	63.5	70.0	62.8	60.0	72.1	((67))
35	67.4	62.4	55.9	65.6	64.5	57.1	59.5	71.9	((67))
36	61.9	53.3	46.4	53.6	70.3	59.0	64.3	72.1	((67))
37	64.2	64.1	73.3	80.9	82.5	78.9	75.1	86.4	82
38	61.6	63.2	68.4	76.8	75.2	65.2	65.0	79.9	75
39	64.2	64.1	72.9	80.9	82.5	78.9	75.1	86.4	82
40	63.7	66.2	70.7	81.1	73.2	68.7	66.4	82.5	78
41	62.7	66.0	72.0	79.5	75.1	68.8	67.4	81.9	77
42	70.3	71.8	76.4	81.3	78.4	74.3	76.6	85.4	81
43	70.8	73.9	78.1	84.0	78.6	79.6	80.8	88.0	83
44	69.0	70.1	76.0	82.0	72.2	74.1	80.2	85.6	81
45	58.8	62.9	72.4	80.3	81.7	83.1	73.3	87.0	82
46	60.6	62.0	71.5	79.5	79.4	81.1	79.4	86.1	81
47	61.4	62.5	72.6	77.2	81.6	84.2	74.2	87.1	82
48	65.7	67.5	71.6	75.8	74.3	73.5	75.7	81.7	77
49	70.3	67.5	71.4	79.1	74.1	75.1	73.8	82.9	78
50	60.9	62.7	65.3	69.9	66.9	67.7	65.3	74.8	70
51	60.3	62.0	64.2	69.1	66.2	64.8	62.3	73.5	((69))
52	71.9	75.5	80.5	88.5	83.0	85.0	88.7	93.3	>88<
53	54.9	57.1	60.7	68.0	67.8	68.4	69.2	74.7	70
54	53.0	57.9	61.8	68.3	69.6	67.3	61.6	74.0	((69))
55	61.2	59.3	74.4	80.4	81.8	85.1	59.4	87.9	83
56	56.9	58.3	67.9	68.6	70.0	66.8	65.2	75.1	70
57	71.6	72.6	77.5	86.3	86.0	88.1	77.9	92.1	>87<
58	66.4	63.5	71.4	82.6	72.8	78.1	71.2	84.8	80
59	49.1	50.2	52.7	66.7	73.5	72.3	58.8	76.5	72
60	54.8	57.9	82.6	76.0	76.7	79.1	60.1	85.5	81
61	56.2	58.5	55.3	70.2	68.2	72.6	71.1	77.0	72
62	64.4	69.2	74.7	81.8	81.2	67.3	66.5	85.2	80
63	53.4	54.2	54.9	66.2	69.9	64.4	63.4	72.9	((68))
64	58.9	54.4	51.1	59.8	65.5	64.8	60.6	69.9	((65))
65	64.0	62.1	68.2	82.2	70.9	64.7	57.0	82.8	78
66	66.1	67.0	69.9	77.0	77.0	68.3	64.4	81.1	76
67	50.6	48.0	46.6	59.0	73.5	65.5	56.3	74.4	69
68	66.1	67.0	69.9	77.0	77.0	68.3	64.4	81.1	76
69	50.6	48.0	46.6	59.0	73.5	65.5	56.3	74.4	69
70	50.7	55.9	61.1	70.2	72.8	64.2	62.5	75.5	71
71	72.3	71.7	72.4	78.5	77.9	71.0	67.4	83.0	78
72	73.4	74.5	79.6	88.9	84.6	83.8	77.4	91.8	>87<
73	66.0	68.1	73.9	81.6	79.8	76.8	74.1	85.4	81
74	62.3	64.7	70.5	78.7	78.9	72.5	71.3	83.0	78
75	53.0	55.7	58.5	69.1	74.3	69.5	63.2	76.8	72
76	53.0	55.7	58.5	69.1	74.3	69.5	63.2	76.8	72
77	62.2	58.0	71.0	80.4	67.7	64.7	72.7	81.8	77
78	65.4	64.8	69.3	78.8	70.7	67.2	69.3	80.7	76
79	68.8	68.5	67.6	73.6	70.4	74.3	64.2	79.2	74
80	62.2	62.1	65.0	73.2	69.2	68.0	67.0	76.7	72
81	50.3	52.3	60.1	66.0	66.0	61.6	62.9	71.0	((66))
82	58.8	57.9	68.6	75.0	70.4	76.7	78.6	82.3	77
83	69.0	70.1	76.0	82.0	72.2	74.1	80.2	85.6	81

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-7.17

HPD selection for RDOs: silenced pneumatic, stoping, 400 kPa

	dB-Neq	Mean:	102.4	Max:	104	Min:	102	Obs (n):	20
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	86.3	86.5	92.2	97.4	102.2	103.1	100.1	107.4	102.4
with HPD									
1	83.4	81.6	77.2	74.2	74.1	72.0	75.1	87.1	82
2	81.6	73.6	73.4	75.0	82.5	80.1	82.5	88.3	83
3	79.8	74.3	72.6	79.1	82.8	84.3	79.7	88.9	84
4	83.4	77.3	71.2	78.7	83.7	83.5	80.4	89.7	85
5	82.0	77.1	76.3	79.2	74.5	70.5	70.7	85.9	81
6	78.9	76.9	73.7	74.6	73.9	71.7	67.8	83.5	78
7	81.2	75.7	71.1	71.0	75.7	70.0	65.9	83.9	79
8	80.9	77.1	73.6	74.4	75.7	70.7	69.0	84.5	79
9	76.2	70.8	71.0	69.2	72.8	70.7	73.5	81.1	76
10	76.1	73.7	74.1	69.8	73.9	71.8	73.5	82.1	77
11	82.6	75.6	75.0	71.3	74.5	70.5	74.2	85.2	80
12	80.8	70.8	71.1	70.7	71.0	69.0	72.0	82.9	78
13	75.4	68.7	69.4	65.0	70.8	65.6	65.7	78.7	74
14	80.5	77.1	78.3	73.6	76.5	70.7	74.4	85.3	80
15	86.3	78.7	78.1	75.9	78.4	78.4	81.8	89.5	84
16	82.6	76.4	76.2	73.3	76.7	71.0	69.6	85.5	81
17	85.6	80.7	76.5	74.0	77.2	72.1	70.8	88.0	83
18	81.6	77.0	76.3	76.4	73.8	71.2	75.4	85.5	80
19	78.5	72.6	68.6	68.6	75.0	67.1	63.8	81.5	77
20	81.6	73.4	71.0	70.2	81.5	72.3	68.6	85.5	80
21	80.6	73.8	68.7	68.9	75.1	67.8	69.5	83.0	78
22	83.7	78.3	77.5	73.9	75.2	77.1	71.7	86.8	82
23	84.3	79.1	75.3	74.2	75.5	69.8	68.4	86.7	82
24	82.2	78.3	77.3	75.2	77.0	73.1	75.4	86.3	81
25	82.1	80.8	77.6	74.2	77.7	79.7	73.1	87.3	82
26	83.9	80.3	79.4	76.6	77.2	72.0	71.5	87.5	83
27	80.4	76.9	74.7	70.8	75.5	72.5	74.1	84.5	79
28	84.3	82.4	75.7	72.8	73.8	73.1	70.8	87.4	82
29	84.1	80.9	76.4	71.2	76.3	72.1	70.3	87.0	82
30	75.7	76.0	68.5	59.6	63.2	59.2	73.1	80.3	75
31	74.1	71.1	71.2	68.0	69.2	71.3	69.0	79.4	74
32	68.3	66.1	62.4	60.4	66.4	69.5	66.9	75.0	70
33	76.6	69.2	68.1	58.5	72.3	72.8	69.6	80.3	75
34	68.7	61.3	59.9	65.3	72.2	64.0	61.9	75.3	70
35	77.1	70.0	63.3	67.4	66.7	58.3	61.4	78.8	74
36	71.6	60.9	53.8	55.4	72.5	60.2	66.2	75.9	71
37	73.9	71.7	80.7	82.7	84.7	80.1	77.0	89.0	84
38	71.3	70.8	75.8	78.6	77.4	66.4	66.9	83.0	78
39	73.9	71.7	80.3	82.7	84.7	80.1	77.0	88.9	84
40	73.4	73.8	78.1	82.9	75.4	69.9	68.3	85.5	80
41	72.4	73.6	79.4	81.3	77.3	70.0	69.3	85.2	80
42	80.0	79.4	83.8	83.1	80.6	75.5	78.5	89.3	84
43	80.5	81.5	85.5	85.8	80.8	80.8	82.7	91.5	>86<
44	78.7	77.7	83.4	83.8	74.4	75.3	82.1	89.1	84
45	68.5	70.5	79.8	82.1	83.9	84.3	75.2	89.2	84
46	70.3	69.6	78.9	81.3	81.6	82.3	81.3	88.3	83
47	71.1	70.1	80.0	79.0	83.8	85.4	76.1	89.2	84
48	75.4	75.1	79.0	77.6	76.5	74.7	77.6	85.3	80
49	80.0	75.1	78.8	80.9	76.3	76.3	75.7	86.6	82
50	70.6	70.3	72.7	71.7	69.1	68.9	67.2	78.9	74
51	70.0	69.6	71.6	70.9	68.4	66.0	64.2	77.7	73
52	81.6	83.1	87.9	90.3	85.2	86.2	90.6	95.9	>91<
53	64.6	64.7	68.1	69.8	70.0	69.6	71.1	77.3	72
54	62.7	65.5	69.2	70.1	71.8	68.5	63.5	76.8	72
55	70.9	66.9	81.8	82.2	84.0	86.3	61.3	90.1	85
56	66.6	65.9	75.3	70.4	72.2	68.0	67.1	79.1	74
57	81.3	80.2	84.9	88.1	88.2	89.3	79.8	94.5	>89<
58	76.1	71.1	78.8	84.4	75.0	79.3	73.1	87.3	82
59	58.8	57.8	60.1	68.5	75.7	73.5	60.7	78.5	73
60	64.5	65.5	90.0	77.8	78.9	80.3	62.0	91.0	>86<
61	65.9	66.1	62.7	72.0	70.4	73.8	73.0	79.1	74
62	74.1	76.8	82.1	83.6	83.4	68.5	68.4	88.4	83
63	63.1	61.8	62.3	68.0	72.1	65.6	65.3	75.4	70
64	68.6	62.0	58.5	61.6	67.7	66.0	62.5	73.5	((69))
65	73.7	69.7	75.6	84.0	73.1	65.9	58.9	85.4	80
66	75.8	74.6	77.3	78.8	79.2	69.5	66.3	84.7	80
67	60.3	55.6	54.0	60.8	75.7	66.7	58.2	76.6	72
68	75.8	74.6	77.3	78.8	79.2	69.5	66.3	84.7	80
69	60.3	55.6	54.0	60.8	75.7	66.7	58.2	76.6	72
70	60.4	63.5	68.5	72.0	75.0	65.4	64.4	78.1	73
71	82.0	79.3	79.8	80.3	80.1	72.2	69.3	87.6	83
72	83.1	82.1	87.0	90.7	86.8	85.0	79.3	94.7	>90<
73	75.7	75.7	81.3	83.4	82.0	78.0	76.0	88.4	83
74	72.0	72.3	77.9	80.5	81.1	73.7	73.2	85.8	81
75	62.7	63.3	65.9	70.9	76.5	70.7	65.1	79.0	74
76	62.7	63.3	65.9	70.9	76.5	70.7	65.1	79.0	74
77	71.9	65.6	78.4	82.2	69.9	65.9	74.6	84.7	80
78	75.1	72.4	76.7	80.6	72.9	68.4	71.2	84.0	79
79	78.5	76.1	75.0	75.4	72.6	75.5	66.1	83.7	79
80	71.9	69.7	72.4	75.0	71.4	69.2	68.9	80.2	75
81	60.0	59.9	67.5	67.8	68.2	62.8	64.8	74.0	((69))
82	68.5	65.5	76.0	76.8	72.6	77.9	80.5	84.6	80
83	78.7	77.7	83.4	83.8	74.4	75.3	82.1	89.1	84

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-7.18

HPD selection for RDOs: silenced pneumatic, stoping, 600 kPa

	dB-Neq	Mean:	106.8	Max:	108	Min:	104	Obs (n):	20
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	89.4	92.9	97.0	102.3	105.5	107.3	105.0	111.6	106.8
with HPD									
1	86.5	88.0	82.0	79.1	77.4	76.2	80.0	91.8	>87<
2	84.7	80.0	78.2	79.9	85.8	84.3	87.4	92.4	>88<
3	82.9	80.7	77.4	84.0	86.1	88.5	84.6	93.1	>88<
4	86.5	83.7	76.0	83.6	87.0	87.7	85.3	93.8	>89<
5	85.1	83.5	81.1	84.1	77.8	74.7	75.6	90.3	85
6	82.0	83.3	78.5	79.5	77.2	75.9	72.7	88.1	83
7	84.3	82.1	75.9	75.9	79.0	74.2	70.8	88.0	83
8	84.0	83.5	78.4	79.3	79.0	74.9	73.9	88.8	84
9	79.3	77.2	75.8	74.1	76.1	74.9	78.4	85.3	81
10	79.2	80.1	78.9	74.7	77.2	76.0	78.4	86.6	82
11	85.7	82.0	79.8	76.2	77.8	74.7	79.1	89.2	84
12	83.9	77.2	75.9	75.6	74.3	73.2	76.9	86.7	82
13	78.5	75.1	74.2	69.9	74.1	69.8	70.6	82.7	78
14	83.6	83.5	83.1	78.5	79.8	74.9	79.3	89.7	85
15	89.4	85.1	82.9	80.8	81.7	82.6	86.7	93.6	>89<
16	85.7	82.8	81.0	78.2	80.0	75.2	74.5	89.6	85
17	88.7	87.1	81.3	78.9	80.5	76.3	75.7	92.2	>87<
18	84.7	83.4	81.1	81.3	77.1	75.4	80.3	89.9	85
19	81.6	79.0	73.4	73.5	78.3	71.3	68.7	85.5	81
20	84.7	79.8	75.8	75.1	84.8	76.5	73.5	89.2	84
21	83.7	80.2	73.5	73.8	78.4	72.0	74.4	87.0	82
22	86.8	84.7	82.3	78.8	78.5	81.3	76.6	91.0	>86<
23	87.4	85.5	80.1	79.1	78.8	74.0	73.3	90.8	>86<
24	85.3	84.7	82.1	80.1	80.3	77.3	80.3	90.7	>86<
25	85.2	87.2	82.4	79.1	81.0	83.9	78.0	91.9	>87<
26	87.0	86.7	84.2	81.5	80.5	76.2	76.4	92.0	>87<
27	83.5	83.3	79.5	75.7	78 8	76.7	79.0	88.8	84
28	87.4	88.8	80.5	77.7	77.1	77.3	75.7	92.1	>87<
29	87.2	87.3	81.2	76.1	79.6	76.3	75.2	91.5	>87<
30	78.8	82.4	73.3	64.5	66.5	63.4	78.0	85.4	81
31	77.2	77.5	76.0	72.9	72.5	75.5	73.9	83.9	79
32	71.4	72.5	67.2	65.3	69.7	73.7	71.8	79.5	75
33	79.7	75.6	72.9	63.4	75.6	77.0	74.5	84.2	79
34	71.8	67.7	64.7	70.2	75.5	68.2	66.8	79.1	74
35	80.2	76.4	68.1	72.3	70.0	62.5	66.3	82.7	78
36	74.7	67.3	58.6	60.3	75.8	64.4	71.1	79.6	75
37	77.0	78.1	85.5	87.6	88.0	84.3	81.9	93.2	>88<
38	74.4	77.2	80.6	83.5	80.7	70.6	71.8	87.5	83
39	77.0	78.1	85.1	87.6	88.0	84.3	81.9	93.2	>88<
40	76.5	80.2	82.9	87.8	78.7	74.1	73.2	90.3	85
41	75.5	80.0	84.2	86.2	80.6	74.2	74.2	89.9	85
42	83.1	85.8	88.6	88.0	83.9	79.7	83.4	94.0	>89<
43	83.6	87.9	90.3	90.7	84.1	85.0	87.6	96.3	>91<
44	81.8	84.1	88.2	88.7	77.7	79.5	87.0	93.9	>89<
45	71.6	76.9	84.6	87.0	87.2	88.5	80.1	93.4	>89<
46	73.4	76.0	83.7	86.2	84.9	86.5	86.2	92.8	>88<
47	74.2	76.5	84.8	83.9	87.1	89.6	81.0	93.4	>89<
48	78.5	81.5	83.8	82.5	79.8	78.9	82.5	89.9	85
49	83.1	81.5	83.6	85.8	79.6	80.5	80.6	91.0	>86<
50	73.7	76.7	77.5	76.6	72.4	73.1	72.1	83.5	79
51	73.1	76.0	76.4	75.8	71.7	70.2	69.1	82.4	78
52	84.7	89.5	92.7	95.2	88.5	90.4	95.5	100.7	>96<
53	67.7	71.1	72.9	74.7	73.3	73.8	76.0	81.8	77
54	65.8	71.9	74.0	75.0	75.1	72.7	68.4	81.3	76
55	74.0	73.3	86.6	87.1	87.3	90.5	66.2	94.3	>89<
56	69.7	72.3	80.1	75.3	75.5	72.2	72.0	83.6	79
57	84.4	86.6	89.7	93.0	91.5	93.5	84.7	98.8	>94<
58	79.2	77.5	83.6	89.3	78.3	83.5	78.0	92.0	>87<
59	61.9	64.2	64.9	73.4	79.0	77.7	65.6	82.3	78
60	67.6	71.9	94.8	82.7	82.2	84.5	66.9	95.7	>91<
61	69.0	72.5	67.5	76.9	73.7	78.0	77.9	83.6	79
62	77.2	83.2	86.9	88.5	86.7	72.7	73.3	92.9	>88<
63	66.2	68.2	67.1	72.9	75.4	69.8	70.2	79.5	75
64	71.7	68.4	63.3	66.5	71.0	70.2	67.4	77.5	73
65	76.8	76.1	80.4	88.9	76.4	70.1	63.8	90.1	85
66	78.9	81.0	82.1	83.7	82.5	73.7	71.2	89.1	84
67	63.4	62.0	58.8	65.7	79.0	70.9	63.1	80.1	75
68	78.9	81.0	82.1	83.7	82.5	73.7	71.2	89.1	84
69	63.4	62.0	58.8	65.7	79.0	70.9	63.1	80.1	75
70	63.5	69.9	73.3	76.9	78.3	69.6	69.3	82.2	77
71	85.1	85.7	84.6	85.2	83.4	76.4	74.2	92.1	>87<
72	86.2	88.5	91.8	95.6	90.1	89.2	84.2	99.2	>94<
73	78.8	82.1	86.1	88.3	85.3	82.2	80.9	92.9	>88<
74	75.1	78.7	82.7	85.4	84.4	77.9	78.1	90.2	85
75	65.8	69.7	70.7	75.8	79.8	74.9	70.0	83.0	78
76	65.8	69.7	70.7	75.8	79.8	74.9	70.0	83.0	78
77	75.0	72.0	83.2	87.1	73.2	70.1	79.5	89.5	85
78	78.2	78.8	81.5	85.5	76.2	72.6	76.1	88.7	84
79	81.6	82.5	79.8	80.3	75.9	79.7	71.0	88.3	83
80	75.0	76.1	77.2	79.9	74.7	73.4	73.8	84.7	80
81	63.1	66.3	72.3	72.7	71.5	67.0	69.7	78.5	74
82	71.6	71.9	80.8	81.7	75.9	82.1	85.4	89.3	84
83	81.8	84.1	88 2	88.7	77.7	79.5	87.0	93.9	>89<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-7.19

HPD selection for RDOs: unsilenced pneumatic, stoping, 400 kPa

	dB-Neq	Mean:	110.7	Max:	111	Min:	110	Obs (n):	15
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	90.9	99.2	106.7	108.9	110.4	109.1	107.4	115.8	110.7
with HPD									
1	88.0	94.3	91.7	85.7	82.3	78.0	82.4	97.5	>92<
2	86.2	86.3	87.9	86.5	90.7	86.1	89.8	96.5	>91<
3	84.4	87.0	87.1	90.6	91.0	90.3	87.0	97.2	>92<
4	88.0	90.0	85.7	90.2	91.9	89.5	87.7	97.8	>93<
5	86.6	89.8	90.8	90.7	82.7	76.5	78.0	96.1	>91<
6	83.5	89.6	88.2	86.1	82.1	77.7	75.1	93.9	>89<
7	85.8	88.4	85.6	82.5	83.9	76.0	73.2	92.8	>88<
8	85.5	89.8	88.1	85.9	83.9	76.7	76.3	94.3	>89<
9	80.8	83.5	85.5	80.7	81.0	76.7	80.8	90.5	85
10	80.7	86.4	88.6	81.3	82.1	77.8	80.8	92.4	>87<
11	87.2	88.3	89.5	82.8	82.7	76.5	81.5	94.2	>89<
12	85.4	83.5	85.6	82.2	79.2	75.0	79.3	91.1	>86<
13	80.0	81.4	83.9	76.5	79.0	71.6	73.0	88.1	83
14	85.1	89.8	92.8	85.1	84.7	76.7	81.7	96.0	>91<
15	90.9	91.4	92.6	87.4	86.6	84.4	89.1	98.1	>93<
16	87.2	89.1	90.7	84.8	84.9	77.0	76.9	95.1	>90<
17	90.2	93.4	91.0	85.5	85.4	78.1	78.1	97.3	>92<
18	86.2	89.7	90.8	87.9	82.0	77.2	82.7	95.5	>90<
19	83.1	85.3	83.1	80.1	83.2	73.1	71.1	90.4	85
20	86.2	86.1	85.5	81.7	89.7	78.3	75.9	93.7	>89<
21	85.2	86.5	83.2	80.4	83.3	73.8	76.8	91.4	>86<
22	88.3	91.0	92.0	85.4	83.4	83.1	79.0	96.4	>91<
23	88.9	91.8	89.8	85.7	83.7	75.8	75.7	95.9	>91<
24	86.8	91.0	91.8	86.7	85.2	79.1	82.7	96.4	>91<
25	86.7	93.5	92.1	85.7	85.9	85.7	80.4	97.5	>92<
26	88.5	93.0	93.9	88.1	85.4	78.0	78.8	98.0	>93<
27	85.0	89.6	89.2	82.3	83.7	78.5	81.4	94.3	>89<
28	88.9	95.1	90.2	84.3	82.0	79.1	78.1	97.5	>92<
29	88.7	93.6	90.9	82.7	84.5	78.1	77.6	96.9	>92<
30	80.3	88.7	83.0	71.1	71.4	65.2	80.4	90.7	>86<
31	78.7	83.8	85.7	79.5	77.4	77.3	76.3	89.7	85
32	72.9	78.8	76.9	71.9	74.6	75.5	74.2	84.0	79
33	81.2	81.9	82.6	70.0	80.5	78.8	76.9	88.5	83
34	73.3	74.0	74.4	76.8	80.4	70.0	69.2	84.0	79
35	81.7	82.7	77.8	78.9	74.9	64.3	68.7	87.1	82
36	76.2	73.6	68.3	66.9	80.7	66.2	73.5	83.4	78
37	78.5	84.4	95.2	94.2	92.9	86.1	84.3	99.5	>94<
38	75.9	83.5	90.3	90.1	85.6	72.4	74.2	94.4	>89<
39	78.5	84.4	94.8	94.2	92.9	86.1	84.3	99.4	>94<
40	78.0	86.5	92.6	94.4	83.6	75.9	75.6	97.3	>92<
41	77.0	86.3	93.9	92.8	85.5	76.0	76.6	97.2	>92<
42	84.6	92.1	98.3	94.6	88.8	81.5	85.8	101.1	>96<
43	85.1	94.2	100.0	97.3	89.0	86.8	90.0	103.1	>98<
44	83.3	90.4	97.9	95.3	82.6	81.3	89.4	100.8	>96<
45	73.1	83.2	94.3	93.6	92.1	90.3	82.5	99.1	>94<
46	74.9	82.3	93.4	92.8	89.8	88.3	88.6	98.2	>93<
47	75.7	82.8	94.5	90.5	92.0	91.4	83.4	98.7	>94<
48	80.0	87.8	93.5	89.1	84.7	80.7	84.9	96.5	>91<
49	84.6	87.8	93.3	92.4	84.5	82.3	83.0	97.3	>92<
50	75.2	83.0	87.2	83.2	77.3	74.9	74.5	90.3	85
51	74.6	82.3	86.1	82.4	76.6	72.0	71.5	89.3	84
52	86.2	95.8	102.4	101.8	93.4	92.2	97.9	106.7	>102<
53	69.2	77.4	82.6	81.3	78.2	75.6	78.4	87.4	82
54	67.3	78.2	83.7	81.6	80.0	74.5	70.8	87.7	83
55	75.5	79.6	96.3	93.7	92.2	92.3	68.6	100.0	>95<
56	71.2	78.6	89.8	81.9	80.4	74.0	74.4	91.3	>86<
57	85.9	92.9	99.4	99.6	96.4	95.3	87.1	104.5	>99<
58	80.7	83.8	93.3	95.9	83.2	85.3	80.4	98.5	>93<
59	63.4	70.5	74.6	80.0	83.9	79.5	68.0	86.8	82
60	69.1	78.2	104.5	89.3	87.1	86.3	69.3	104.8	>100<
61	70.5	78.8	77.2	83.5	78.6	79.8	80.3	88.1	83
62	78.7	89.5	96.6	95.1	91.6	74.5	75.7	100.1	>95<
63	67.7	74.5	76.8	79.5	80.3	71.6	72.6	84.9	80
64	73.2	74.7	73.0	73.1	75.9	72.0	69.8	81.9	77
65	78.3	82.4	90.1	95.5	81.3	71.9	66.2	97.0	>92<
66	80.4	87.3	91.8	90.3	87.4	75.5	73.6	95.8	>91<
67	64.9	68.3	68.5	72.3	83.9	72.7	65.5	84.8	80
68	80.4	87.3	91.8	90.3	87.4	75.5	73.6	95.8	>91<
69	64.9	68.3	68.5	72.3	83.9	72.7	65.5	84.8	80
70	65.0	76.2	83.0	83.5	83.2	71.4	71.7	88.5	83
71	86.6	92.0	94.3	91.8	88.3	78.2	76.6	98.5	>93<
72	87.7	94.8	101.5	102.2	95.0	91.0	86.6	105.9	>101<
73	80.3	88.4	95.8	94.9	90.2	84.0	83.3	99.6	>95<
74	76.6	85.0	92.4	92.0	89.3	79.7	80.5	96.8	>92<
75	67.3	76.0	80.4	82.4	84.7	76.7	72.4	88.4	83
76	67.3	76.0	80.4	82.4	84.7	76.7	72.4	88.4	83
77	76.5	78.3	92.9	93.7	78.1	71.9	81.9	96.7	>92<
78	79.7	85.1	91.2	92.1	81.1	74.4	78.5	95.5	>90<
79	83.1	88.8	89.5	86.9	80.8	81.5	73.4	94.2	>89<
80	76.5	82.4	86.9	86.5	79.6	75.2	76.2	91.2	>86<
81	64.6	72.6	82.0	79.3	76.4	68.8	72.1	85.2	80
82	73.1	78.2	90.5	88.3	80.8	83.9	87.8	94.6	>89<
83	83.3	90.4	97.9	95.3	82.6	81.3	89.4	100.8	>96<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-7.20

HPD selection for RDOs: unsilenced pneumatic, stoping, 600 kPa

	dB-Neq	Mean:	113.8	Max:	114	Min:	113	Obs (n):	15
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1K	2K	4K	8K	(dB)	(dB)
w/o HPD	98.2	103.0	109.7	111.5	113.1	112.3	111.1	118.8	113.8
with HPD									
1	95.3	98.1	94.7	88.3	85.0	81.2	86.1	101.6	>97<
2	93.5	90.1	90.9	89.1	93.4	89.3	93.5	100.2	>95<
3	91.7	90.8	90.1	93.2	93.7	93.5	90.7	100.6	>96<
4	95.3	93.8	88.7	92.8	94.6	92.7	91.4	101.6	>97<
5	93.9	93.6	93.8	93.3	85.4	79.7	81.7	99.9	>95<
6	90.8	93.4	91.2	88.7	84.8	80.9	78.8	97.7	>93<
7	93.1	92.2	88.6	85.1	86.6	79.2	76.9	97.3	>92<
8	92.8	93.6	91.1	88.5	86.6	79.9	80.0	98.4	>93<
9	88.1	87.3	88.5	83.3	83.7	79.9	84.5	94.3	>89<
10	88.0	90.2	91.6	83.9	84.8	81.0	84.5	96.1	>91<
11	94.5	92.1	92.5	85.4	85.4	79.7	85.2	98.7	>94<
12	92.7	87.3	88.6	84.8	81.9	78.2	83.0	95.9	>91<
13	87.3	85.2	86.9	79.1	81.7	74.8	76.7	92.2	>87<
14	92.4	93.6	95.8	87.7	87.4	79.9	85.4	99.7	>95<
15	98.2	95.2	95.6	90.0	89.3	87.6	92.8	102.5	>97<
16	94.5	92.9	93.7	87.4	87.6	80.2	80.6	99.3	>94<
17	97.5	97.2	94.0	88.1	88.1	81.3	81.8	101.7	>97<
18	93.5	93.5	93.8	90.5	84.7	80.4	86.4	99.5	>94<
19	90.4	89.1	86.1	82.7	85.9	76.3	74.8	94.7	>90<
20	93.5	89.9	88.5	84.3	92.4	81.5	79.6	97.9	>93<
21	92.5	90.3	86.2	83.0	86.0	77.0	80.5	96.0	>91<
22	95.6	94.8	95.0	88.0	86.1	86.3	82.7	100.6	>96<
23	96.2	95.6	92.8	88.3	86.4	79.0	79.4	100.4	>95<
24	94.1	94.8	94.8	89.3	87.9	82.3	86.4	100.3	>95<
25	94.0	97.3	95.1	88.3	88.6	88.9	84.1	101.3	>96<
26	95.8	96.8	96.9	90.7	88.1	81.2	82.5	101.9	>97<
27	92.3	93.4	92.2	84.9	86.4	81.7	85.1	98.3	>93<
28	96.2	98.9	93.2	86.9	84.7	82.3	81.8	101.8	>97<
29	96.0	97.4	93.9	85.3	87.2	81.3	81.3	101.2	>96<
30	87.6	92.5	86.0	73.7	74.1	68.4	84.1	94.9	>90<
31	86.0	87.6	88.7	82.1	80.1	80.5	80.0	93.4	>88<
32	80.2	82.6	79.9	74.5	77.3	78.7	77.9	87.8	83
33	88.5	85.7	85.6	72.6	83.2	82.0	80.6	92.9	>88<
34	80.6	77.8	77.4	79.4	83.1	73.2	72.9	87.5	82
35	89.0	86.5	80.8	81.5	77.6	67.5	72.4	92.0	>87<
36	83.5	77.4	71.3	69.5	83.4	69.4	77.2	87.6	83
37	85.8	88.2	98.2	96.8	95.6	89.3	88.0	102.4	>97<
38	83.2	87.3	93.3	92.7	88.3	75.6	77.9	97.4	>92<
39	85.8	88.2	97.8	96.8	95.6	89.3	88.0	102.3	>97<
40	85.3	90.3	95.6	97.0	86.3	79.1	79.3	100.3	>95<
41	84.3	90.1	96.9	95.4	88.2	79.2	80.3	100.2	>95<
42	91.9	95.9	101.3	97.2	91.5	84.7	89.5	104.3	>99<
43	92.4	98.0	103.0	99.9	91.7	90.0	93.7	106.3	>101<
44	90.6	94.2	100.9	97.9	85.3	84.5	93.1	104.0	>99<
45	80.4	87.0	97.3	96.2	94.8	93.5	86.2	102.0	>97<
46	82.2	86.1	96.4	95.4	92.5	91.5	92.3	101.2	>96<
47	83.0	86.6	97.5	93.1	94.7	94.6	87.1	101.7	>97<
48	87.3	91.6	96.5	91.7	87.4	83.9	88.6	99.8	>95<
49	91.9	91.6	96.3	95.0	87.2	85.5	86.7	100.7	>96<
50	82.5	86.8	90.2	85.8	80.0	78.1	78.2	93.6	>89<
51	81.9	86.1	89.1	85.0	79.3	75.2	75.2	92.7	>88<
52	93.5	99.6	105.4	104.4	96.1	95.4	101.6	109.8	>105<
53	76.5	81.2	85.6	83.9	80.9	78.8	82.1	90.6	>86<
54	74.6	82.0	86.7	84.2	82.7	77.7	74.5	90.8	>86<
55	82.8	83.4	99.3	96.3	94.9	95.5	72.3	103.0	>98<
56	78.5	82.4	92.8	84.5	83.1	77.2	78.1	94.4	>89<
57	93.2	96.7	102.4	102.2	99.1	98.5	90.8	107.6	>103<
58	88.0	87.6	96.3	98.5	85.9	88.5	84.1	101.4	>96<
59	70.7	74.3	77.6	82.6	86.6	82.7	71.7	89.7	85
60	76.4	82.0	107.5	91.9	89.8	89.5	73.0	107.8	>103<
61	77.8	82.6	80.2	86.1	81.3	83.0	84.0	91.3	>86<
62	86.0	93.3	99.6	97.7	94.3	77.7	79.4	103.1	>98<
63	75.0	78.3	79.8	82.1	83.0	74.8	76.3	88.0	83
64	80.5	78.5	76.0	75.7	78.6	75.2	73.5	85.9	81
65	85.6	86.2	93.1	98.1	84.0	75.1	69.9	99.8	>95<
66	87.7	91.1	94.8	92.9	90.1	78.7	77.3	99.0	>94<
67	72.2	72.1	71.5	74.9	86.6	75.9	69.2	87.7	83
68	87.7	91.1	94.8	92.9	90.1	78.7	77.3	99.0	>94<
69	72.2	72.1	71.5	74.9	86.6	75.9	69.2	87.7	83
70	72.3	80.0	86.0	86.1	85.9	74.6	75.4	91.4	>86<
71	93.9	95.8	97.3	94.4	91.0	81.4	80.3	102.0	>97<
72	95.0	98.6	104.5	104.8	97.7	94.2	90.3	108.9	>104<
73	87.6	92.2	98.8	97.5	92.9	87.2	87.0	102.7	>98<
74	83.9	88.8	95.4	94.6	92.0	82.9	84.2	99.7	>95<
75	74.6	79.8	83.4	85.0	87.4	79.9	76.1	91.3	>86<
76	74.6	79.8	83.4	85.0	87.4	79.9	76.1	91.3	>86<
77	83.8	82.1	95.9	96.3	80.8	75.1	85.6	99.6	>95<
78	87.0	88.9	94.2	94.7	83.8	77.6	82.2	98.6	>94<
79	90.4	92.6	92.5	89.5	83.5	84.7	77.1	97.9	>93<
80	83.8	86.2	89.9	89.1	82.3	78.4	79.9	94.4	>89<
81	71.9	76.4	85.0	81.9	79.1	72.0	75.8	88.2	83
82	80.4	82.0	93.5	90.9	83.5	87.1	91.5	97.7	>93<
83	90.6	94.2	100.9	97.9	85.3	84.5	93.1	104.0	>99<

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Table A-7.21

HPD selection for RDOs: water-hydraulic, stoping, 17 MPa

	dB-Neq	Mean:	105.4	Max:	106	Min:	105	Obs (n):	15
	Effective LpA (dB) At Centre Frequency (Hz)							LAeq	Neq
	125	250	500	1k	2k	4k	8k	(dB)	(dB)
w/o HPD	75.1	76.9	86.7	98.2	104.7	107.2	103.2	110.4	105.4
with HPD									
1	72.2	72.0	71.7	75.0	76.6	76.1	78.2	83.6	79
2	70.4	64.0	67.9	75.8	85.0	84.2	85.6	90.0	85
3	68.6	64.7	67.1	79.9	85.3	88.4	82.8	91.3	>86<
4	72.2	67.7	65.7	79.5	86.2	87.6	83.5	91.2	>86<
5	70.8	67.5	70.8	80.0	77.0	74.6	73.8	83.7	79
6	67.7	67.3	68.2	75.4	76.4	75.8	70.9	81.7	77
7	70.0	66.1	65.6	71.8	78.2	74.1	69.0	81.2	76
8	69.7	67.5	68.1	75.2	78.2	74.8	72.1	82.2	77
9	65.0	61.2	65.5	70.0	75.3	74.8	76.6	81.1	76
10	64.9	64.1	68.6	70.6	76.4	75.9	76.6	81.8	77
11	71.4	66.0	69.5	72.1	77.0	74.6	77.3	82.4	77
12	69.6	61.2	65.6	71.5	73.5	73.1	75.1	80.1	75
13	64.2	59.1	63.9	65.8	73.3	69.7	68.8	76.8	72
14	69.3	67.5	72.8	74.4	79.0	74.8	77.5	83.6	79
15	75.1	69.1	72.6	76.7	80.9	82.5	84.9	88.5	84
16	71.4	66.8	70.7	74.1	79.2	75.1	72.7	82.8	78
17	74.4	71.1	71.0	74.8	79.7	76.2	73.9	83.9	79
18	70.4	67.4	70.8	77.2	76.3	75.3	78.5	83.6	79
19	67.3	63.0	63.1	69.4	77.5	71.2	66.9	79.7	75
20	70.4	63.8	65.5	71.0	84.0	76.4	71.7	85.3	80
21	69.4	64.2	63.2	69.7	77.6	71.9	72.6	80.6	76
22	72.5	68.7	72.0	74.7	77.7	81.2	74.8	84.6	80
23	73.1	69.5	69.8	75.0	78.0	73.9	71.5	82.4	77
24	71.0	68.7	71.8	76.0	79.5	77.2	78.5	84.6	80
25	70.9	71.2	72.1	75.0	80.2	83.8	76.2	86.6	82
26	72.7	70.7	73.9	77.4	79.7	76.1	74.6	84.4	79
27	69.2	67.3	69.2	71.6	78.0	76.6	77.2	83.0	78
28	73.1	72.8	70.2	73.6	76.3	77.2	73.9	82.8	78
29	72.9	71.3	70.9	72.0	78.8	76.2	73.4	83.0	78
30	64.5	66.4	63.0	60.4	65.7	63.3	76.2	77.6	73
31	62.9	61.5	65.7	68.8	71.7	75.4	72.1	79.0	74
32	57.1	56.5	56.9	61.2	68.9	73.6	70.0	76.4	71
33	65.4	59.6	62.6	59.3	74.8	76.9	72.7	80.2	75
34	57.5	51.7	54.4	66.1	74.7	68.1	65.0	76.5	71
35	65.9	60.4	57.8	68.2	69.2	62.4	64.5	74.0	((69))
36	60.4	51.3	48.3	56.2	75.0	64.3	69.3	76.5	71
37	62.7	62.1	75.2	83.5	87.2	84.2	80.1	90.6	>86<
38	60.1	61.2	70.3	79.4	79.9	70.5	70.0	83.4	78
39	62.7	62.1	74.8	83.5	87.2	84.2	80.1	90.6	>86<
40	62.2	64.2	72.6	83.7	77.9	74.0	71.4	85.5	81
41	61.2	64.0	73.9	82.1	79.8	74.1	72.4	85.2	80
42	68.8	69.8	78.3	83.9	83.1	79.6	81.6	88.9	84
43	69.3	71.9	80.0	86.6	83.3	84.9	85.8	91.7	>87<
44	67.5	68.1	77.9	84.6	76.9	79.4	85.2	89.2	84
45	57.3	60.9	74.3	82.9	86.4	88.4	78.3	91.5	>87<
46	59.1	60.0	73.4	82.1	84.1	86.4	84.4	90.6	>86<
47	59.9	60.5	74.5	79.8	86.3	89.5	79.2	91.8	>87<
48	64.2	65.5	73.5	78.4	79.0	78.8	80.7	85.7	81
49	68.8	65.5	73.3	81.7	78.8	80.4	78.8	86.5	81
50	59.4	60.7	67.2	72.5	71.6	73.0	70.3	78.5	73
51	58.8	60.0	66.1	71.7	70.9	70.1	67.3	76.9	72
52	70.4	73.5	82.4	91.1	87.7	90.3	93.7	97.4	>92<
53	53.4	55.1	62.6	70.6	72.5	73.7	74.2	79.1	74
54	51.5	55.9	63.7	70.9	74.3	72.6	66.6	78.1	73
55	59.7	57.3	76.3	83.0	86.5	90.4	64.4	92.5	>88<
56	55.4	56.3	69.8	71.2	74.7	72.1	70.2	79.0	74
57	70.1	70.6	79.4	88.9	90.7	93.4	82.9	96.5	>91<
58	64.9	61.5	73.3	85.2	77.5	83.4	76.2	88.3	83
59	47.6	48.2	54.6	69.3	78.2	77.6	63.8	81.3	76
60	53.3	55.9	84.5	78.6	81.4	84.4	65.1	88.9	84
61	54.7	56.5	57.2	72.8	72.9	77.9	76.1	81.5	77
62	62.9	67.2	76.6	84.4	85.9	72.6	71.5	88.7	84
63	51.9	52.2	56.8	68.8	74.6	69.7	68.4	77.3	72
64	57.4	52.4	53.0	62.4	70.2	70.1	65.6	74.3	((69))
65	62.5	60.1	70.1	84.8	75.6	70.0	62.0	85.6	81
66	64.6	65.0	71.8	79.6	81.7	73.6	69.4	84.7	80
67	49.1	46.0	48.5	61.6	78.2	70.8	61.3	79.1	74
68	64.6	65.0	71.8	79.6	81.7	73.6	69.4	84.7	80
69	49.1	46.0	48.5	61.6	78.2	70.8	61.3	79.1	74
70	49.2	53.9	63.0	72.8	77.5	69.5	67.5	79.6	75
71	70.8	69.7	74.3	81.1	82.6	76.3	72.4	86.2	81
72	71.9	72.5	81.5	91.5	89.3	89.1	82.4	95.3	>90<
73	64.5	66.1	75.8	84.2	84.5	82.1	79.1	89.2	84
74	60.8	62.7	72.4	81.3	83.6	77.8	76.3	86.9	82
75	51.5	53.7	60.4	71.7	79.0	74.8	68.2	81.2	76
76	51.5	53.7	60.4	71.7	79.0	74.8	68.2	81.2	76
77	60.7	56.0	72.9	83.0	72.4	70.0	77.7	84.9	80
78	63.9	62.8	71.2	81.4	75.4	72.5	74.3	83.7	79
79	67.3	66.5	69.5	76.2	75.1	79.6	69.2	82.8	78
80	60.7	60.1	66.9	75.8	73.9	73.3	72.0	80.3	75
81	48.8	50.3	62.0	68.6	70.7	66.9	67.9	75.0	70
82	57.3	55.9	70.5	77.6	75.1	82.0	83.6	86.9	82
83	67.5	68.1	77.9	84.6	76.9	79.4	85.2	89.2	84

((xx)) Neq values less than 70 dB may indicate overprotection
>xx< Neq values greater than 85 dB indicate underprotection
n These HPD evaluations are based on standards which may overestimate effectiveness
HPD details are tabulated in Table A-1.1

Appendix 8

Educational and motivational materials for use in mines' HCPs

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A-8.2 Handouts for trainees . . . . . .

A-8.2.1 English booklet "Make safe your ears" . . . . . .

A-8.2.2 Zulu booklet "Vikela izindlebe zakho" . . . . . .

A-8.1 Guidelines for trainers

A-8.1.1 Guidelines for trainers Part 1: Hearing protection devices: induction talk for employees in noisy occupations

GEN 011 HEARING CONSERVATION

GUIDELINES FOR TRAINERS : PART 1

HEARING PROTECTION DEVICES:
INDUCTION TALK FOR EMPLOYEES IN NOISY OCCUPATIONS

To be presented before* or immediately after Audiometric Testing

***SEE NOTE BOTTOM OF PAGE 1**

PREFACE

These guidelines for Trainers (Part 1), entitled "Hearing Protection Devices : Induction Talk for Employees In Noisy Occupations", are designed to assist trainers in increasing workers' awareness of noise as a hazard that can have negative impact on employment and quality of life. Although it is recognized that a personal protection strategy using hearing protection devices is only an interim measure to be used until such time as engineering solutions have reduced noise at the source, such a strategy can limit the occurrence of noise-induced hearing loss and should therefore be implemented or optimized as a matter of urgency. Accordingly, education, motivation and training should receive priority in any hearing conservation programme. It is against this background that the present guidelines to trainers were produced by the CSIR: Division of Mining Technology, on behalf of the Safety in Mines Research Advisory Committee and the Department of Minerals and Energy, as part of Project GEN 011.

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OBJECTIVES AND NOTES FOR TRAINERS/PRESENTERS

One of the most effective strategies to conserve hearing in a noisy environment is to make people working in these areas aware of the noise hazard and its consequences. Then they will want to protect themselves from suffering the consequences of hearing loss.

The objectives of this induction talk are:

(i) to promote a comprehensive understanding of the nature, the cause and the consequences of noise-induced deafness, as well as to motivate workers to take steps towards preventing loss of their own hearing;

(ii) to demonstrate the advantages of using Hearing Protection Devices (HPDs) in noisy places and encourage a positive attitude towards HPDs;

(iii) to demonstrate the proper use and care of HPDs; and

(vi) where the induction talk is to be immediately followed by audiometry, to ensure the correct responses or behaviour expected from employees during audiometric testing.

Note: **This is only a suggested induction talk. It is subject to change and modification to suit particular situations and audiences in the mining industry. The trainer or presenter should encourage participation by the audience and allow ample time for questions and discussion.**

***If the induction talk is to be presented before audiometric testing, it will not be permissible to demonstrate the effectiveness of HPDs in improving speech and signal intelligibility in loud noise (Section 5). This is to avoid causing possible temporary hearing loss during the demonstration and recording inaccurate test results during audiometry. If it is desired that this demonstration be included as part of induction, the men should participate only after they have finished their audiometric test. Alternatively, the induction talk could be presented before**

audiometry, omitting the HPD demonstration, and the demonstration only could then be presented after audiometry. Ensure that the noise source used during the demonstration does not interfere with the audiometric testing of other groups.

1. INTRODUCTION

Reference is made to four overhead transparencies which are included with these guidelines (also illustrated in the Appendix). In order to make use of these visual aids, the trainer should ensure that an overhead projector and screen are available.

Friendly greetings to all and introductions

- "We are going to look at the issue of hearing protection : Protecting your ears against the damage that they can suffer in loud noise. Where there are men and machines working, there is loud noise which can damage your ears. Once your ears are damaged you will never be able to hear properly again. **Imagine if you could never hear properly again.** You would never understand what other members of your team or your friends and loved ones say to you. You would never understand the radio or television properly, enjoy music or be able to speak on a telephone. You would never hear the soft sounds of nature, such as the birds singing or the crickets at night. **You would have difficulty understanding what your supervisor or other members of your team are saying or hearing warning signals, which could have a bad effect on your job and on your safety."**

Presenter to display overhead slide of "thermometer scale" (Figure A-1) to illustrate how different sounds compare with each other in terms of loudness

- "This picture shows us how loud different sounds are. Where the lines are red, it shows that the noise is loud enough to be dangerous, and that in these situations we need to protect our ears."

- "Whenever you go near noise, such as when you are near a drill or loader or any powerful machine, the noise is slowly destroying your hearing. The damage is just a

little every day, but after many shifts the damage is great. There is no pain when your ears are damaged and as you lose more and more hearing you **think** that you are getting used to the noise. What is really happening is that **your ears are being slowly deafened.** It does not matter if you are big and strong or small or young or old: **loud noise can damager your ears."**

- "At the end of the shift, if you hear a ringing sound coming from inside your ears or you feel half-deaf, it means that the loud noise damaged your ears slightly during the shift. The next day your ears will feel good again but they may have lost a little hearing without you even knowing. I am sure that you have met somebody who has worked for a long time on the mine who does not hear very well. When you speak to somebody who does not hear well, you always have to say everything two or three times before he understands you. You also have to shout before he hears you. Very soon you stop speaking to him. **How would <u>you</u> feel if your friends and family stopped speaking to you because you could hardly hear them and they found it too much trouble to shout and repeat everything to you?"**

2. HOW TO RECOGNISE DANGEROUS NOISE

- "How do you know when the noise is loud enough to damage your ears?"
  "Whenever you are in a place where you must shout before a person standing close to you can understand you, there is enough noise to damage your ears."

  Presenter to explain that 'standing close' would mean within one metre or approximately arm's length

- "Also, whenever you see this sign,"

  Presenter to display the overhead slide of the mandatory symbolic sign for ear protection (Figure A-2) on the overhead projector

  "you are about to enter an area where the noise is dangerous. This sign tells us that the noise is so loud that it can damage our ears. Before we are allowed to go into this are we need to protect our ears from the loud noise."

- "If at the end of your shift you hear a ringing or a hissing sound coming from inside your ears, that means the noise during your shift was too loud and caused a bit of

damage to your ears. This picture shows what our ears look like on the inside and this inner part of the ear is where the noise causes the damage."

Presenter to display the overhead slide that shows the general anatomy or structure of the ear (Figure A-3), pointing to the inner ear

- "This next picture shows the inside parts of two different people's inner ears."

  Presenter to display the overhead slide that shows a magnified view of two inner ears (Figure A-4)

- "See how the inner ear in the top picture still has all the little nerve endings or 'wires' that allow us to hear, while the one on the bottom has lost all the nerves or 'wires' in these places where the arrows are ponting to."

  Presenter to point out the difference between the normal inner ear and the damaged one

- "The inner ear in the top picture is still healthy and that person can hear very well. The inner ear in the bottom picture has been damaged by loud noise and that person has very bad hearing. He will never be able to hear properly because the little nerves or 'wires' cannot grow back again. If this person had protected his hearing his ear would look more like the top one and he would still be able to hear properly."

- "To make sure that your ears do not get damaged like this one, before you go back to work you should **make sure you have HPDs.**"

- "YOU SHOULD USE HPDs WHENEVER THE NOISE IS LOUD AND MAKE CERTAIN THAT THEY ARE FITTED PROPERLY."

3. HOW TO PROTECT OURSELVES AGAINST DANGEROUS NOISE

- "YES! We must **protect our ears** from the noise just as we protect our bodies with hardhats, strong boots, knee guards and gloves. We must **protect our ears** just the same as we protect our eyes with safety goggles. How do we **protect our ears** against loud noise? We can **protect our ears with earmuffs or earplugs**. These are known as **Hearing Protection Devices or HPDs.**"

  Presenter displays of HPDs including earmuffs, earplugs, band-mounted plugs

- "Because earmuffs are too big and very hot to wear underground, most underground workers prefer earplugs. If you work where the noise often stops for a few minutes at a time or if you are going into and out of the noisy area, you might prefer band-mounted earplugs like these,"

  Presenter to show audience band-mounted plugs

  "or if it's not too hot, earmuffs like these."

  Presenter to show earmuffs

- "Whichever type of hearing protection devices or HPDs you use, they should be replaced if you lose them or if they become damaged or worn out."

- "You can get new ones at the Medical/Dressing Station, at the change house or crush or from your Safety Representative or your Team Leader during the shift."

  Presenter to explain where HPDs are available

4. HOW TO FIT EARPLUGS PROPERLY

- "These earplugs will protect your ears from loud noise only if you fit them properly. We are now going to learn the correct way of fitting earplugs."

  - **AT THIS STAGE THE GROUP SHOULD BE ISSUED WITH EARPLUGS**

    Although some individuals such as surface workers might ultimately be using muffs, for the purpose of this demonstration it will be better to use earplugs. If disposable earplugs made of compressible foam are used at your mine, it will be necessary to point out the importance of rolling the plugs into a thin "sausage shape" before inserting them. If some men will be using band-mounted plugs, they should be shown the correct method of wearing these, including how to get a good, tight fit by first pulling the ear outwards and upwards to straighten the ear canal while pressing the plug into the ear.

- "Would you please insert one of the earplugs into your LEFT ear."

  - **PAUSE TO ALLOW TIME FOR FITTING EARPLUGS -**

- "Please look up here. Some of you did fit your earplugs correctly, by first reaching over your head with one hand and pulling the top of your ear outwards and upwards."

  (Presenter demonstrates as he explains correct fitting)

- "This straightens out the ear canal and allows you to get a good, tight fit while you insert the earplug with the other hand. You should continue to press the earplug in after you let go of your ear. This will lock the earplug in place until you decide to remove it. This is true for any type of earplug: the ones with cords, the ones without cords and even the type with the plastic band."

- "When you have fitted an earplug properly you can hear the difference. Please insert you right earplug properly and, if you can hear or feel a difference between the two ears, you might need to refit your left earplug."

  PAUSE TO ALLOW TIME FOR FITTING THE SECOND EARPLUG AND POSSIBLY REFITTING THE FIRST ONE -

5. DEMONSTRATION OF HOW HPDs MAKE IT EASIER TO HEAR SPEECH AND SIGNALS IN LOUD NOISE.

This demonstration can be done with earplugs of any type or with earmuffs.

Presenter will need to speak more loudly now. Ensure that the noise from this demonstration does not interfere with audiometric testing for other groups of employees.

- "How many of you are thinking that you will not be able to hear what others say when they speak to you?"

  PAUSE

  Presenter switches on a noise source : either a machine, (e.g. angle grinder (to be safe, it would be best to have the cutting disk removed), vacuum cleaner, petrol mower or a tape recording of a machine, but NOT a radio or television. The presenter should face the group, holding or positioning the noise source directly in front of him as he speaks. REMEMBER TO SPEAK UP.

PRESENTER BLOWS A PEA-WHISTLE TO GET PEOPLE'S ATTENTION AND DEMONSTRATE SIGNAL AUDIBILITY IN NOISE WITH HPDs.

- "How many of you can hear what I am saying to you? Can you understand what I'm saying?"

  Presenter should now make a brief statement of fact or an announcement pausing for workers' response BUT LEAVING THE NOISE SOURCE RUNNING

- "Now remove your HPDs (-both of them)."

  PAUSE FOR NOISE TO MAKE IMPRESSION

PRESENTER BLOWS PEA-WHISTLE TO REGAIN PEOPLE'S ATTENTION AND DEMONSTRATE POOR SIGNAL AUDIBILITY IN NOISE WITHOUT HPDs.

- "How many of you can hear what I am saying to you now? Can you still understand what I'm saying?"

  Presenter should now make a second brief statement of fact or announcement.

PAUSE FOR RESPONSE AND THEN SWITCH OFF NOISE SOURCE AND WAIT FOR THE ABSENCE OF NOISE TO MAKE AN IMPRESSION

- Presenter asks men what it was that he said while they were wearing their earplugs and what it was he said to them after they had removed their earplugs. He asks them to **indicate when they were better able to hear** the whistle and the speech sounds: **when they were wearing HPDs** or **when they were not wearing HPDs.**

- If there is anyone who insists that he could hear speech and signals better without HPDs, ask whether he is certain his HPDs were fitted correctly. If he is certain that they were fitted correctly and he still insists that he could hear better without the earplugs, it may be that the man has already suffered considerable hearing loss. People with bad hearing need earplugs that are specially selected for their type of hearing loss and workplace.

- Hopefully the group's consensus will be that it was **easier to hear speech and signals in loud noise while wearing HPDs.**

- "Some people may think that while wearing HPDs they will not be able to hear warning signals or what someone is saying to them. This is not true. As we just learned, it is easier to hear the whistle in the noise when we are wearing our HPDs. The same is true for other signals and for speech: **Where there is loud machine noise it is easier to hear speech and signals when we are wearing our HPDs.** This is because the HPDs block out most of the machine noise, but only a little bit of the speech and signals. Because the HPDs make the machine noise much less and the sound from the speech and signals only a little bit less, it becomes easier to hear the things that we need to hear, allowing us to work more safely."

- **"As for roof talk, you cannot hear it when the machines are running** even if you are not wearing HPDs. What you should do is **remove your HPDs when there is no dangerous noise or when the machines have stopped.** Then you will be <u>better</u> able to hear any roof talk because your ears will not be tired from the noise. Be sure to **refit your HPDs before the machines start up again."**

PAUSE

6. <u>GETTING USED TO WEARING HPDs</u>

- "How many of you men found that wearing your HPDs was uncomfortable?"

PAUSE FOR RESPONSE

- "If you wear your HPDs for short periods at first, you will get used to them. You do not have to wear them where there is no dangerous noise. If you find that you cannot get used to them or if they cause pain, you can come and see us and you can try other types of HPDs. But give yourself a fair chance to get used to your HPDs - it is a bit like getting used to wearing a hardhat or a new pair of shoes: it takes time."

- **PAUSE AND ENCOURAGE DISCUSSION : TRY TO GET AGREEMENT THAT HPDs ARE HELPFUL AND THAT ONE CAN GET USED TO THEM. ENCOURAGE MEN WHO HAVE ALREADY HAD GOOD EXPERIENCES WITH HPDs TO TELL THE GROUP ABOUT THEM.**

7. CARING FOR EARPLUGS

- **"Earplugs need to be cared for and kept clean.** They must be cleaned in warm soapy water and dried after every shift. This is to avoid the problems that can be caused by dirty earplugs."

  Presenter to demonstrate correct way of cleaning earplugs. It should be pointed out that compressible foam earplugs are meant to be used once and then discarded, never washed.

- **"Earplugs should be protected** inside their carrying case when not in use. They must be replaced when they get old, damaged or lost. To avoid losing them, tie the carrying case to your overall or inside your hardhat. If you think that there is something wrong with your ears you must come to the Medical/Dressing Station."

- "To avoid discomfort and possible damage to your ears, NEVER TRAVEL UP OR DOWN IN THE CAGE WHILE WEARING EARPLUGS. Remove your earplugs before you enter the cage."

- **ENCOURAGE QUESTIONS AND DISCUSSION**

8. EARMUFFS

For groups that will be using earmuffs in their workplace or if members of the group express interest in muffs and it is likely that some members will be using them, muffs should be discussed. The presenter/trainer should explain that muffs and plugs both given similar protection against loud noise.

If time allows, the demonstration of how HPDs make it easier to hear speech and signals in loud noise (Section 5) could be included in this section on earmuffs. If the group has already had the demonstration with earplugs, it should not be necessary to repeat it with earmuffs.

- "People who work where it is not too hot or work on surface and go into and out of noise frequently may find earmuffs to be better for them than earplugs."

  Presenter to display muffs

- Earmuffs have a plastic shell with a soft cushion,"

  Presenter to show soft cushion

  "to cover each ear and a strong headband to press the cushions tightly over the ears."

  Presenter to demonstrate the flexible headband by spreading the cups apart from each other as he puts the muffs on.

- "If you have long hair you should move it out of the way so the muffs can seal tightly round your ears. For this reason, if you wear glasses or safety goggles muffs will not work properly because the glasses will stop the cushions from sealing properly and the noise will get into your ears."

  Presenter removes muffs

- "Men with beards may also find that earmuffs do not seal properly around their ears."
- "If you are going to wear muffs and a hardhat together, you will need muffs that have a thin head strap that you put over your head before putting on your hardhat."

  Presenter to show muffs with thin plastic head strap and draw attention to it

- "When fitting these muffs you should first put the thin strap over your head and place the cushions around your ears. Then swing the strong headband behind your head before putting on your hardhat."

  Presenter to demonstrate correct fitting

- "Another way to wear muffs and a hardhat together is with a hardhat that already has the earmuffs attached to it."

  Presenter to show group a hardhat with muffs attached

- "With this type of hardhat you put it on your head and then swing the muffs down over your ears."

  Presenter to demonstrate

- "Make certain that the hardhat and the muffs are both adjusted to fit you properly."

- "Like earplugs, muffs also need to be cleaned, especially the cushions that seal around the ears. A clean, damp cloth or tissue should be used to wipe the cushions at the end of each shift. The headband that presses the muffs tightly around your ears should be checked to see that it is still strong. The head strap that goes over your head before you put on your hardhat should be checked and adjusted so the muffs don't slip down off your ears."

- **"If your earmuffs become damaged or lost, you should replace them before going back into the loud noise.** If the cushions no longer seal properly, get new cushions

or, if replacement cushions are not available, get new earmuffs."

9. INTRODUCTION TO AUDIOMETRY

(This section is intended to introduce the men to audiometric testing and ensure appropriate responses during the testing procedure.)

- "We will be testing your ears today and again at regular intervals to see if they are being damaged. If we find that your ears are being damaged by loud noise or that you do not use your HPDs in noisy areas, we will have to warn you about the damage your ears are suffering. If you become so deaf that you cannot work safely, you might need to change your job to a place which is quiet or less dangerous. This ear test will help us to find out if your ears are being damaged **before** the damage becomes too great."

- "When we test your ears you have nothing to be afraid of. You will be asked to sit in a metal box (like a telephone booth) and a pair of earphones will be placed over your ears. Soon you will hear a sound coming out of the earphones. This sound will be like the sound of a soft whistle or a humming sound."

  Presenter can demonstrate the type of sound workers should expect to hear

- "When you hear the sound you must press a button like this one that you hold in your hand."

  Presenter to demonstrate

- "That's all you need to do. Even if the sound is very soft, just press the button once and then let it go. Do not press the button if you did not hear the sound. When you press the button do not hold the button down for too long. Just quickly press the button and let it go."

  Presenter to give a practical demonstration of how to respond

- "Please wait quietly until it is your turn to be tested. Do not talk while you are waiting, as this can disturb the people who are being tested."

- "DOES ANYONE HAVE ANY QUESTIONS?"

Figure A-1 Illustration of relative loudness for various situations

Figure A-2 International symbolic safety sign for mandatory hearing protection

Figure A-3 General anatomy of the human ear

APPENDIX

VISUAL AIDS FOR TRAINERS

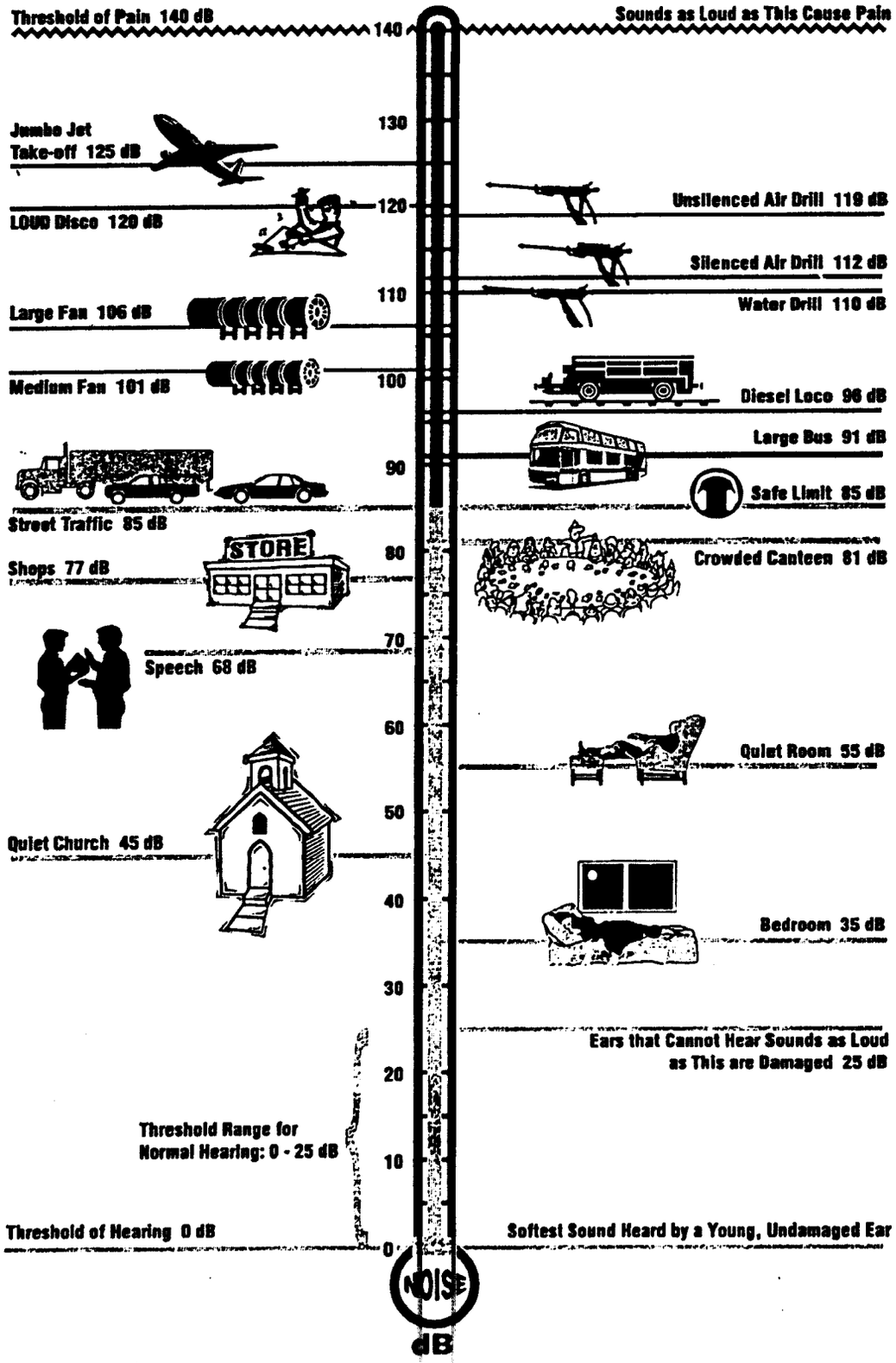

Figure A-1 Illustration of relative loudness for various situations

Figure A-2 International symbolic safety sign for mandatory hearing protection

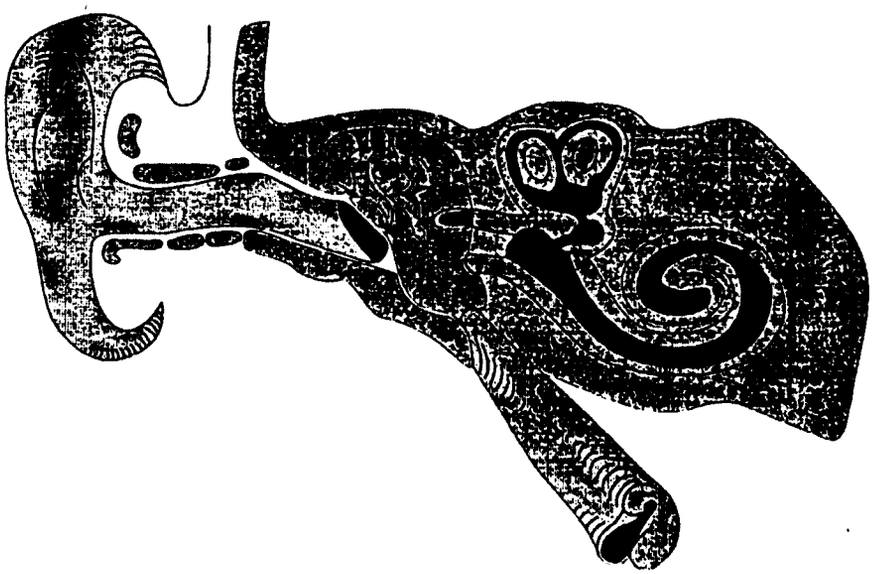

Figure A-3 General anatomy of the human ear

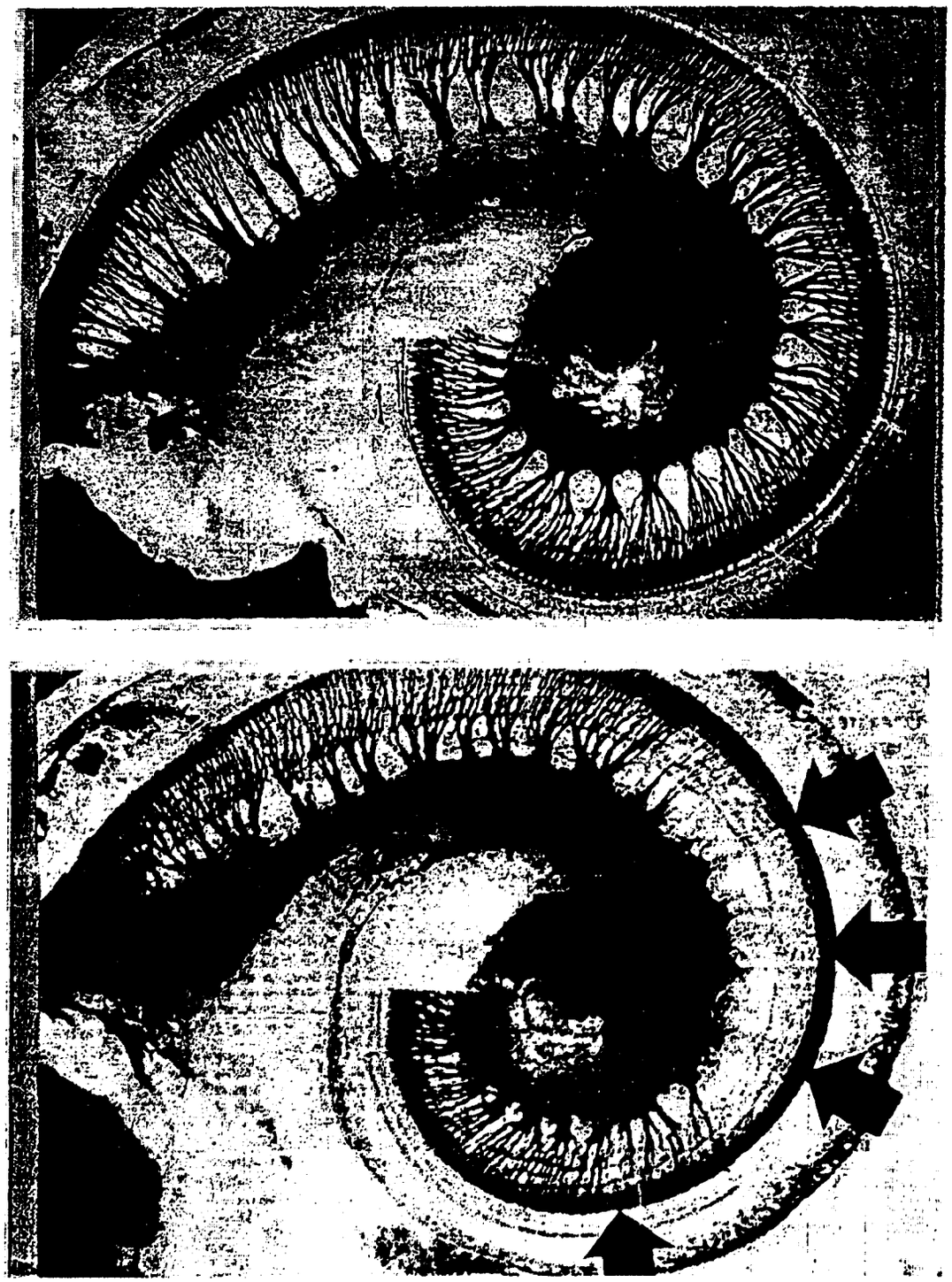

Figure A-4 Comparison of normal and noise-damaged inner ears

A-8.1.2 Guidelines for trainers Part 2: Use of the training video "To hear or not to hear: the choice is yours": Educational/motivational module and HPD training module

GEN 011 HEARING CONSERVATION

GUIDELINES FOR TRAINERS : PART 2

USE OF TRAINING VIDEO
"TO HEAR OR NOT TO HEAR : THE CHOICE IS YOURS":
EDUCATIONAL/MOTIVATIONAL MODULE AND
HPD TRAINING MODULE

PREFACE

These guidelines for Trainers (Part 2), entitled "Use of the Training Video, `To Hear Or Not To Hear : The Choice Is Yours'", are designed to assist the trainer in using the video to maximum benefit. In order for the trainer to familiarise himself with the content of the programme, it is suggested that he not only preview the video, but also refer to the detailed scripts (English and Zulu) that are appended.

Until such time as engineering solutions have been implemented to reduce noise at the source, education, motivation and training of noise-exposed workers will continue to play a crucial role in hearing conservation programmes. It is against this background that the present guidelines for trainers were produced by the CSIR: Division of Mining Technology, on behalf of the Safety in Mines Research Advisory Committee and the Department of Minerals and Energy, as part of Project GEN 011.

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1. INTRODUCTION AND GENERAL INFORMATION TO ASSIST THE TRAINER

The use of a suitable video programme can greatly assist the trainer in fulfilling his primary responsibility of ensuring that employees are equipped with the knowledge and skills necessary to perform their duties safely and productively. As with any video programme, getting the most out of it requires that the trainer first familiarise himself with the content of the film and that he is fully aware of the training objectives or the intended learning outcomes of the programme. This will enable him to prepare the group for what they are about to see and hear, as well as to pre-direct attention to key points and where appropriate, pre-empt any potential negative reaction from members of the group. To this end, the video programme (each module on its own VHS cassette for the trainer's convenience) is supplied with these guidelines for trainers and copies of the script in English and in Zulu (appended).

2. OBJECTIVES AND INTENDED LEARNING OUTCOMES

After participating in a preparatory discussion, viewing the video and then discussing the issues raised in the film, employees should come away with:

- an increased awareness of noise as a hazard;
- a basic understanding of how loud noise damages hearing and the realisation that noise-induced hearing loss is irreversible;
- an appreciation of the personal consequences of noise-induced hearing loss and a desire to avoid those consequences;
- the ability to recognise dangerous noise;
- knowledge of the various types of hearing protection devices, their correct use and how to care for them;
- an understanding of the benefits that hearing protection devices offer, viz. protection against hearing loss, improved communication in loud noise (contributing to safety and productivity), as well as reduced fatigue; and
- an acceptance of the mine's personal protection strategy.

3. USE OF THE VIDEO

The video is in two modules, the first of which is educational and motivational (approximately 15 minutes), while the second module is instructional (approximately 9 minutes). Although both modules could be shown in succession, greater benefit would be gained through the use of an intervening group discussion. There is little point in moving on to the instructional part of the programme before members of the group have accepted the importance of protecting themselves against loud noise. If the trainer is of the opinion that trainees are already sufficiently aware of noise as a hazard and motivated to avoid its consequences, he might choose to show only the instructional or HPD training module.

The video has been produced in two language versions, English and Zulu. One possible method of catering for other language groups would be for the trainer to prepare a translation of the voice track in the appropriate language, and either record the translated narration for simultaneous playback via an audio cassette player, or read the translation to the group while screening the video with the television volume turned down. In either case, reference to the appended scripts would assist the trainer

in providing an accurate translation.

3.1 Preparatory Discussion for Educational/Motivational Module

There is no need to embark on a lengthy discussion which could pre-empt the message of the video. However, the group should be informed that the film deals with a hazard that most of them will be faced with in their jobs, and that it is an unseen hazard that affects more people than any other. Members of the group should be asked to consider what is said in the film and compare the information contained therein with what they already know about this hazard. They should be told that they will then be given an opportunity to discuss the film and their reactions to it.

If there is any statement or scene that might be at variance with the situation at your mine and thus pose a possible distraction, the group should be warned and, if appropriate, given the correct information and asked to disregard the possible distraction.

3.2 Group Discussion Following Educational/Motivational Module

This discussion should be led by the trainer and be structured to the extent that it reinforces the message of this module. In order to accomplish this, it would be essential that any doubts or concerns from the group be identified, discussed and resolved. The best way to ensure this is by encouraging group members to participate and state their views, even their objections. If these are not aired and discussed, they will remain in people's minds as before, group members will not accept the message of the film and they may continue to work as they always have.

The trainer should be confident that the message from the video is a reasonable one with the interests of the workers as its cornerstone. He should consider assuming the less authoritative role of a facilitator and, in doing so, encourage the expression of opposing views: they will always exist to a greater or lesser extent and, as stated above, failure to deal with them adequately will result in a less favourable outcome. The trainer should anticipate likely opposing views and positions, and prepare himself for dealing with them. Reference to Guidelines for Trainers Part 3, "Frequently asked Questions ..." will assist in this regard.

Depending on the group, the trainer should, as much as possible, rely on members to answer any objections/resistance to the use of hearing protection devices (HPDs). Particularly where a more senior or respected employee describes his own experiences with noise and supports the use of HPDs, it will encourage other members of the group to recognise noise as a hazard and to accept, even demand personal protection. Although the discussion approach may be more time-consuming than a traditional lecture ("I talk you listen"), its effectiveness in dealing with negative attitudes and beliefs is much greater and it encourages all participants to consider the issues and make their own decisions. If the decision is their own, they are more likely to adhere to it, regardless of whether a supervisor or safety officer is present.

Hopefully, within approximately ten minutes the group will reach the consensus that loud noise is a danger, and that they wish to protect themselves against it in order to avoid the detrimental effects it can have on their jobs and on their personal lives.

3.3 Preparatory Discussion for HPD Training Module

Members of the group should be reminded that the Educational/Motivational module of the video programme showed how noise is a hazard that can damage people's hearing with serious consequences, explained how to recognise dangerous noise and discussed the benefits of using HPDs. The group should also be reminded of the consensus that they hopefully reached during the discussion that followed: that people should protect themselves against loud noise by using their hearing protection. They should know that the next module of the video will show them **how** to protect themselves.

Explain that the HPD Training module of the video will start out by reminding them how to recognise dangerous noise and will then look at the different types of HPDs that are available. If all the types presented in the film are not available at your mine, this should be pointed out **before** the tape is shown, in order to avoid raising viewers' expectations. (There should be some selection from which employees can make a choice, not only to accommodate different ears in different workplaces, but to capitalise on the fact that an individual is more likely to be satisfied with his own choice than with someone else's.)

Inform the group that after considering the advantages and disadvantages of the different HPDs, the film will show how to fit the various types and how to care for them. (In some instances, depending on the mine or possibly the particular group viewing the video, it could be advantageous to dispense with certain sections. For example, if the group consists exclusively of stope workers and earmuffs would not normally be issued for use in stopes, the portion of the film that provides a detailed explanation of how to fit earmuffs could be skipped. In order to fast forward without raising objections ("Why aren't you showing us the part about the earmuffs?") the trainer could stop the tape, issue earplugs to the group and, while they are practising the correct fitting of earplugs, switch off the monitor and fast-forward the tape to the next appropriate section. This would require the trainer to pre-familiarise himself with the tape counter reading for the next appropriate section and stop the tape at the correct point.)

3.4 Group Discussion After Viewing HPD Training Module

When the tape has ended, the trainer should provide ample opportunity for members of the group to raise queries and concerns. If successful, he should retain the approach used after the Educational/Motivational module. Although the HPD Training module is primarily instructional and most questions would relate to specific concerns around the use and care of particular HPDs, notable exceptions would likely be the issues of getting used to HPDs, and improved speech and warning signal intelligibility while wearing HPDs in loud noise. If the group does not raise these issues, the trainer should.

In explaining and supporting the fact that HPDs make it easier to hear speech (and signals) in loud noise, members of the group should be reminded of the miner's old tactic of blocking his ear in order to hear what someone is saying to him. Explain that HPDs do exactly the same thing as the finger in the ear: block out most of the high-pitched machine noise, making it easier to hear what is being said. And, of course, it should be pointed out that HPDs provide this advantage all the time they are worn, while also allowing the man to keep both hands free for doing the job.

3.5 Hands-on Training in the Correct Use of HPDs

Time should be allowed for traineess to practise fitting HPDs if this has not already been done, particularly those who will ultimately be issued with earplugs. The trainer should distribute the devices to members of the group, preferably offering a choice from the available range. Workers should practise the correct method of fitting their HPDs with the trainer assisting those who require it, demonstrating commonly made faults and means to overcome fitting problems.

If time permits, a demonstration could be given on the improved intelligibility of speech and warning signals that HPDs provide in loud noise (as detailed in Section 5 of Guidelines for Trainers Part 1, "Induction Talk for Workers in Noisy Occupations").

APPENDIX 1

ENGLISH SCRIPT FOR VIDEO

A-1.1

HCP TRAINING VIDEO : EDUCATIONAL/MOTIVATIONAL MODULE

"To Hear or Not to Hear : The Choice is Yours"

Audio	Visual
PRESENTER V/O AND MUSIC	
1. The men who work on the mines are not ordinary men doing ordinary jobs. They are strong men, skilled men, men who work together, and the work they do is tough.	Various shots of mine workers
2. Every day these men labour with powerful machinery in difficult conditions to wrench nature's wealth from the rock and then to process and refine it in the plant.	Scenes highlighting men at the rockface and in the surface plants
3. It takes strength and stamina to work like this. These men are fully aware of the difficult conditions they work under and they make sure they wear protective clothing to reduce the risks. Safety boots to protect their feet, guards for their knees, gloves for their hands, goggles for their eyes, hard hats for their heads and earplugs or muffs to protect their ears, or to be more precise, their hearing.	Scenes highlighting protective clothing worn by mine workers, featuring waterproof garments, hard hats, goggles, gloves and ear muffs
PRESENTER TO CAMERA	
4. They work hard, but they work smart, and working smart means working safe. And yet there is one type of injury that many do not take as seriously as they should.	Studio Presenter dressed as Team Leader
PRESENTER V/O	
5. It is not an obvious injury, like an injured hand or a broken leg. This is a different kind of damage and it happens to every single man who does not take precautions against it. It is a terrible kind of injury because he does not know that he is being hurt and he does not feel any pain.	Injured man being attended to at Medical Station Mine worker sitting in audiometric test booth; Audiometrist closes door of booth
PRESENTER TO CAMERA	
6. He may only realise that he is badly damaged when it is too late and he can do nothing about it.	Presenter

HCP TRAINING VIDEO : EDUCATIONAL/MOTIVATIONAL MODULE

Audio	Visual
PRESENTER V/O He can never be healed. He is permanently disabled. He is deaf.	Mine worker undergroing an audiometric examination. Freeze frame on man's face as narrator says the word "deaf"
"To Hear or Not to Hear : The Choice is Yours"	
Introductory Music	Title with warning symbol for hearing protection
Clip from Interview with Subject 2 "It is difficult for me, simply because if I cannot hear at work I cannot perform as expected. Because of this I am struggling to work. I no longer earn underground pay. I was transferred from underground. Now I am transferred to the surface."	Subject 2
Question from Interviewer "Now you, if I ask you, do you see money being better, or would you ask God to bring back your hearing: what would you choose to take?"	Interviewer
Subject 2's Response "I would prefer to hear again. I feel the loneliness. I don't know what it is the others are laughing about and I feel the loneliness within me."	Subject 2
PRESENTER TO CAMERA 8. Imagine a world in which you cannot hear and you are not able to communicate with others the way you are used to - by talking.	Presenter
PRESENTER V/O 9. You would have to learn to communicate in other ways - by writing, lip reading or using sign language. And what's more, to remain close to you, your family and friends would have to learn new ways of communicating with you.	Various scenes of men gesturing, writing and using hand signals. Scene of a family at an outdoor social gathering.

HCP TRAINING VIDEO : EDUCATIONAL/MOTIVATIONAL MODULE

Audio	Visual
PRESENTER TO CAMERA	
10. Deafness, more than most afflictions, severely affects not only the deaf person himself, but all his loved ones too, as experienced by this woman, Octavia, and her two children.	Presenter
Clip from Interview with Octavia, wife of a Mine worker	
(In apparent response to Interviewer's question). "It is not like before - he was a soft man full of jokes and playing ball games. It was not as if there was a mother and a father. He was like one of the children and we were a united family."	Close-up of Octavia Octavia and children in room with Interviewer
Clip from Interview with Sibusisu, the younger son	
"I feel he is troubling us. When we laugh he thinks we are gossiping about him and making jokes about him. When we talk he thinks we are talking about him. He doesn't allow us to watch T.V. He doesn't even want us to play cassettes or listen to stories. When we try to play cassettes he shouts at us and hits us."	Close-up of Sibusisu
Clip from Interview with Octavia	
"When you want him to hear you, you must shout into his ears. Not that you shout just once. You have to shout for a long time, so therefore, I can no longer discuss private matters or family affairs with him. Then I become frustrated."	Close-up of Octavia
Question from Interviewer	
"Does his deafness cause him to become agressive?"	Octavia and children in room with Interviewer
Octavia's Response	
"Yes, he fights because he thinks we are making a fool of him. Even at work he says people are making him a laughingstock and that hurts me. There is no longer any friendship with his co-workers. They think that he is too proud to talk to them. They do not understand that he is not doing this purposely. It is because he is deaf.	Same as above, then slowly zooming to close-up of Octavia

HCP TRAINING VIDEO : EDUCATIONAL/MOTIVATIONAL MODULE

Audio	Visual
PRESENTER TO CAMERA	
11. There are other men in mining who, like Octavia's husband, suffer from noise-induced hearing loss.	Presenter
PRESENTER V/O	
which has nothing to do with how strong or weak they are, or how young or old. Some men have severe hearing loss when they are only 30 years old.	Mine workers in canteen: old, young, fat and thin
PRESENTER V/O	
12. They became deaf from working with very loud machinery and not wearing hearing protection devices or HPDs - such as earplugs or earmuffs. Some did not wear their HPDs because they wanted others to see them as "Madotas" and not as "New Ones".	Scenes of workers in workshops and in plant
PRESENTER TO CAMERA	
13. But this is crooked thinking. Would you admire someone who tried to take an iron rod out of a fire using his bare hands? No, you would think he was either stupid or very foolish for not protecting his hands from injury. In the same way, it is not a sign of strength to work in loud noise without protecting your hearing.	Presenter
Clip from Interview with Subject 2	
"I would tell a person, if I see him without his protectors, as a person who has lost his hearing working underground, I would tell him that those things are there to protect his ears."	Subject 2
PRESENTER V/O	
14. Signs in the workplace warn us to wear boots, gloves, hard hats, goggles and HPDs when they are necessary.	Succession of warning signs for protective gear
15. If men believe they should wear a hard hat to protect their heads, why do they not also believe they should wear earplugs or muffs to protect their hearing?	Mine worker wearing hard hat but not his HPDs

HCP TRAINING VIDEO : EDUCATIONAL/MOTIVATIONAL MODULE

Audio	Visual
PRESENTER TO CAMERA	
16. It makes no difference that they cannot see or feel their ears being damaged, as they can see and feel other types of injuries. The damage to their hearing is being done.	Presenter
PRESENTER V/O	
17. The difference is that other injuries occur suddenly; the damage is immediate and easy to see.	Injured mine worker being attended to
PRESENTER TO CAMERA	
18. Loss of hearing happens slowly, but surely. Most men don't notice it. They don't see it happening and they don't feel it happening. But it is happening.	Presenter
PRESENTER V/O	
19. Unfortunately, many only realise that their hearing is damaged at their annual hearing test, or when they can no longer communicate with friends and family the way they used to.	Audiometric test centre
PRESENTER TO CAMERA	
20. Some people may think that if their hearing is already damaged, then there is no point in wearing earplugs or muffs. What they don't understand is that the damage does not stop at a certain point. It gets worse and worse.	Presenter
PRESENTER V/O	
21. Every time they go into an area where there is very loud noise and they are not wearing HPDs, their hearing is damaged a little bit more. The first few times their hearing suffers, their ears may feel a bit numb or deaf and they may hear a ringing or hissing sound in their ears after leaving the noisy area. (Sound effect : high-pitched ringing sound.)	Scene of worker entering compressor house (HPD warning sign over door) not wearing HPDs Scene inside compressor house. Scene outside compressor house: worker exits and rubs his ear

HCP TRAINING VIDEO : EDUCATIONAL/MOTIVATIONAL MODULE

Audio	Visual
PRESENTER TO CAMERA	
22. This is a warning bell to let them know that the noise was too loud and was hurting their ears. If they continue going back into a noisy environment without hearing protection, their hearing will be permanently damaged and get worse very fast. They will hear less and less clearly until eventually, they may not be able to hear anything at all.	Presenter
Clip from Interview with Subject 2	
"Here at work there are some dangers. It is necessary that at times I should hear. When people speak to me I cannot hear and I have to wait for them to pull me out of the danger, or I have to follow them to run away from the danger."	Subject 2
PRESENTER TO CAMERA	
23. Some people may think they are getting used to the noise,	Presenter
PRESENTER V/O	
but what has actually happened is that they have already lost some of their hearing and that is why the noise does not seem as loud as before.	Mine worker operating noisy machinery without wearing HPDs
PRESENTER TO CAMERA	
24. Another mistake people may make is to think that if they lose their hearing they can simply get a hearing aid and be able to hear again just as well as before. But that is not true.	Presenter
PRESENTER V/O	
25. Old people, who cannot hear as well as they used to, can be helped with a hearing aid, in the same way they can be helped by wearing glasses because they cannot see as well, or using a walking stick because they cannot get about as well as they could when they were younger.	Old man with hearing loss takes hearing aid out of his pocket and fits it

HCP TRAINING VIDEO : EDUCATIONAL/MOTIVATIONAL MODULE

Audio	Visual
PRESENTER TO CAMERA	
26. The kind of hearing loss that comes with old age is the result of ears becoming weaker as the person gets older. The ears are not as good as they used to be, but they can be helped by a hearing aid.	Presenter
PRESENTER V/O	
27. Unfortunately, the kind of hearing loss that is caused by loud noise cannot be helped by a hearing aid. The ears are not just weak; some of the nerve cells inside the ears are actually destroyed by the loud noise.	Animated graphic depicting destruction of nerve cells inside inner ear. One by one, nerve cells break off and fall away.
PRESENTER TO CAMERA	
28. For the person with noise-induced hearing loss, sounds will not only become softer and softer, but they will also become unclear and strange-sounding. Wearing a hearing aid will not make him able to hear more clearly,	Presenter
PRESENTER V/O	
it will simply be like turning up the volume of a radio which is not properly tuned in on a station. What he will hear will probably sound like this: (Add sound effect : badly-tuned radio being turned up louder. Sound is louder but unclear.)	Radio with hand turning up volume zooming to close-up of radio's speaker
PRESENTER TO CAMERA	
29. If this is how he hears everything, how will he be able to understand what his supervisor and other members of his team are saying?	Presenter
PRESENTER V/O	
30. How will he be able to hear the warning signals of approaching machinery?	Loco in haulage with warning signal/shuttle car with warning signal
PRESENTER TO CAMERA	
31. If his hearing is so bad he will not only be less productive, but more importantly, he will be a safety risk to himself and the other members of the team. If this is the case, he will not be able to carry on doing the same kind of work.	Presenter

HCP TRAINING VIDEO : EDUCATIONAL/MOTIVATIONAL MODULE

Audio	Visual
PRESENTER V/O	Man pushing a broom
32. He could be transferred to a less important job, for which he might also be paid less.	
PRESENTER TO CAMERA	
33. Or even worse, his hearing might be so bad that he could have great difficulty finding any job at all,	Presenter
PRESENTER V/O	
either on the mines or any place else, and then how would he support himself and his family?	Man holding placard appealing for a job
PRESENTER TO CAMERA	
34. A far easier solution is to make sure he does not suffer any loss of hearing in the first place and he can do that by always wearing HPDs whenever he is working in loud noise.	Presenter
PRESENTER V/O	
35. Everyone working in hazardous noise needs to protect his hearing from being damaged by that noise. So whenever and wherever you see this sign,	Mine worker in plant wearing ear-muffs. Cut to International warning sign for hearing protection
PRESENTER TO CAMERA	
or the noise is so loud that you must shout to be heard from one metre away, you must make sure you are wearing earplugs or earmuffs.	Presenter
36. You may think that it is okay to wear your HPDs for most of the time and to take them off every now and again, but it only takes a few seconds for very loud noise to weaken your hearing, so you should not take off your HPDs even to talk to someone.	

HCP TRAINING VIDEO : EDUCATIONAL/MOTIVATIONAL MODULE

Audio	Visual
PRESENTER V/O	
37. Doing that is a mistake in two ways. Not only are you risking your hearing by doing so, but in a very noisy environment, it is easier to hear someone talking to you when you are wearing your HPDs. This is because the HPDs are designed to filter out the higher pitched noises that come from the machinery, while letting through most of the low pitched sounds, such as people's voices.	Scene in workshop with two men wearing HPDs and one man not wearing HPDs and unable to hear what one of the others is saying. Man wearing HPDs indicates to worker to put on his HPDs which are hanging around his neck. Worker dons his HPDs and it is immediately apparent that he is now able to hear what the other man is saying to him, as he responds by putting on his safety gloves.
PRESENTER V/O	
38. The same is true for warning signals: in loud noise you will hear signals better when you are wearing your HPDs, and so you will be able to work more safely.	Shuttlecar operator reacting to warning signal
PRESENTER TO CAMERA	
39. And as far as "roof talk" is concerned, you know that you can only hear "roof talk" when your machine is switched off. If you have been working without HPDs, your ears will be so tired when you switch off the machine that you won't be able to hear the "roof talk". But, if you have been wearing your HPDs and then remove them after switching off the machine, your ears will be in good condition and you will be able to hear the "roof talk" if it happens.	Presenter

HCP TRAINING VIDEO : EDUCATIONAL/MOTIVATIONAL MODULE

Audio	Visual
40. Your ability to hear is a precious gift, don't throw it away. Be smart, be safe, and wear your HPDs whenever you are in loud noise. By doing so you will be protecting not only your hearing, but also your job and your family's future.	Presenter
Take care - talk to you later!	Presenter closes
Closing music	Dissolve to title Fade to black
	CSIR Mining Technology Logo, fade to black.
	Copyright statement & Production House Logo

A-1.2

HCP TRAINING VIDEO : HPD TRAINING MODULE

"To Hear or Not to Hear : The Choice is Yours"

Audio	Visual
Opening Music	Title: "To Hear or Not to Hear : The Choice is Yours" with warning sign
PRESENTER TO CAMERA 1. Hello and welcome to this presentation on hearing protection. In this video are going to learn how to recognise dangerous noise and how to protect ourselves against it.	Studio Presenter dressed as a Team Leader and seated behind table
PRESENTER V/O 2. We'll also be looking at what types of hearing protection devices, or HPDs are available, how to fit them correctly and how to care for them.	Pan across display of different types of HPDs on table in front of presenter. Then pull back to presenter. NB: **In all scenes where a selecton of HPDs is shown, the display has been reduced to a single representative for each type.**
PRESENTER TO CAMERA 3. You know that loud noise can damage your ears and destroy your hearing, but how do you know when noise is loud enough to be dangerous?	Presenter
Noise is measured with a sound measuring machine such as this, which measures noise in decibels. The louder the noise, the more decibels there are.	Presenter picks up a sound level meter (SLM) from table and displays to camera.
PRESENTER V/O 4. In most people's everyday lives, the noise around them, whether in an office, in the street or at home	Close-up of SLM measuring decibels as he speaks, zooming in to close-up of SLM display
PRESENTER TO CAMERA is normally not a problem, because it is usually at safe levels.	Presenter

HCP TRAINING VIDEO : HPD TRAINING MODULE

Audio	Visual
PRESENTER TO CAMERA	
6. But in the workplace, machinery produces noise which is often louder than safe levels.	Presenter
Where the noise is potentially dangerous, a sign like this should warn people entering or working in that area to wear HPDs.	Presenter picks up International hearing protection sign from table and presents to camera, zoom to close-up of sign
PRESENTER TO CAMERA	
7. But even without the signs, you can still tell whether the noise is too loud. If you are standing within one metre or an arm's length from someone and you have to shout to hear each other, then the noise is loud enough to damage your hearing.	Presenter Presenter extends a tape measure to indicate one metre
So, whenever you find yourself in that situation or wherever you see the warning sign, make sure you are wearing your HPDs.	
8. The next question to answer is which type of HPD should you wear? There are basically three types available:	Presenter
PRESENTER V/O	
disposable earplugs, re-usable earplugs and earmuffs.	Cut to disposable earplugs, re-usable earplugs, earplugs on plastic band and earmuffs
PRESENTER TO CAMERA	
9. Some disposable earplugs are made of compressible foam	Presenter
PRESENTER V/O	
which you shape in your fingers before putting into your ears.	Close-up on earplugs as presenter's fingers shape them
But these can get dirty easily and have to be replaced often.	Close-up of dirty plugs
10. Re-usable earplugs are already shaped to fit your ears and some have a little handle which makes it easy to put into your ears without getting the plugs dirty.	Close-up of re-usable earplugs on table Close-up of re-usable with handle held in fingers Close-up of corded re-usable plugs

HCP TRAINING VIDEO : HPD TRAINING MODULE

Audio	Visual
PRESENTER TO CAMERA Re-usable earplugs are easy to wash and they also last longer than the disposable earplugs.	Presenter
PRESENTER TO V/O 11. Other re-usable earplugs are mounted on a plastic band	Close-up of band-mounted plugs
PRESENTER V/O 12. Then there are the earmuffs, which are worn over the ears rather than in them.	Close-up of earmuffs. Camera pulls back as presenter picks up earmuffs and presents them to camera
PRESENTER TO CAMERA 13. These different types of HPDs all give the same sort of protection against loud noise. The type you choose depends on where you are working and which type you find most comfortable to wear.	Presenter, still holding earmuffs, with other types of HPDs
If you work underground or in any other hot environment, then earmuffs are not the best choice. Although they might feel comfortable at first, you may feel too hot after you've been wearing them for a few minutes. And after a few days, they could even begin to irritate your skin or cause a skin rash.	Presenter
Also, if you wear safety glasses while you are working, they might prevent the earmuffs from sealing tightly against your ears.	Presenter
14. Earplugs are the best choice if you have to work in	Presenter
PRESENTER V/O loud noise for long periods, especially in hot areas.	Cut to close-up of Presenter's fingers pointing to various earplugs

HCP TRAINING VIDEO : HPD TRAINING MODULE

Audio	Visual
PRESENTER TO CAMERA	
15. If you use earplugs, they might feel uncomfortable at first but you should get used to them after a while. If after two or three days you still find them uncomfortable,	Presenter
PRESENTER V/O	
you can try other types of HPDs and see if they feel better.	Camera pans over selection of HPDs
PRESENTER TO CAMERA	
16. Once you have found the type you are comfortable with and you have worn them for a while, you won't even notice that you are wearing them. You may even find that in loud noise you feel uncomfortable without them.	Presenter
You will also feel much better at the end of your shift if you have been wearing your HPDs while working. You won't feel so tired and your ears will feel good. There won't be a ringing or a hissing sound in them.	Presenter
17. When you fit your HPDs, it is very important that you fit them properly, because if you do not, then the loud noise can still get into your ears and damage your hearing.	Presenter
So, let's look at how to fit HPDs correctly.	Presenter
PRESENTER V/O	
18. If you are using disposable earplugs, first roll them into a thin sausage shape, then reach over your head and gently pull the top of your ear outwards.	Close-up as Presenter rolls a disposable plug into a sausage shape. Cut to show presenter reaching over his head with one hand and grasping top of ear
19. Pulling the ear outwards straightens the ear canal which makes it easier to insert the plug and to get a good tight fit.	Animated graphic showing hand pulling ear outwards and ear canal straightening

HCP TRAINING VIDEO : HPD TRAINING MODULE

Audio	Visual
PRESENTER V/O	
20. Now, while still pulling your ear outwards with one hand, put in the earplug with the other hand. Then let go of your ear while still holding the earplug in place.	Close-up of presenter inserting foam plug in one ear and releasing ear while holding earplug in place
21. This allows the earplug to mould nicely into your ear and will ensure a good, tight fit to keep out the noise.	Animated graphic showing ear being released and ear canal reverting to original shape around foam plug. Graphic shows diminished sound arrows on inside of plug
PRESENTER TO CAMERA	
22. Remember that the tiniest little gap between the	Presenter
PRESENTER V/O	
earplug and your ear will allow the noise to get in and damage your hearing.	Animated Graphic shows small gap opening between ear canal and plug and strong sound waves getting past plug and into ear.
PRESENTER TO CAMERA	
23. You can check if your HPDs are fitted correctly by pressing against them.	Presenter
PRESENTER V/O	
If doing this makes the noise sound softer, then they are not fitted correctly.	Close-up of presenter pressing against plug in ear to indicate how to check if fitted correctly
PRESENTER TO CAMERA	
24. If you use re-usable earplugs, you obviously won't have to shape them with your fingers, but you will still fit them in the same way to make sure that your ears are properly protected.	Presenter

HCP TRAINING VIDEO : HPD TRAINING MODULE

Audio	Visual
PRESENTER V/O	
25. Whatever kind of earplugs you are wearing, once you are away from the noise and want to remove them, do so slowly and carefully, first pulling the top of your ear outwards as you did when you fitted them, to avoid discomfort.	Close-up of various earplugs Presenter demonstrates slow, careful removal of earplug
PRESENTER TO CAMERA	
26. If you are using muffs, first remove anything that might get between the muffs and your ears, such as hair or earrings. The muffs only work properly when they seal tightly around your ears so that loud noise cannot get in.	Presenter
PRESENTER V/O	
27. It is this band on the muffs that makes them press tightly around your ears. If you wear a hardhat, make sure this band swings down behind your head and position the thin strap over your head to keep the muffs in place before you put on your hardhat.	Close-up of muffs with presenter's hands indicating headband Presenter dons muffs and swings band down behind his head, then positions headstrap, picks up hardhat and puts it on
PRESENTER TO CAMERA	
Remember to make sure that the muffs seal properly.	Presenter
PRESENTER V/O	
28. If you use a hardhat with its own earmuffs, simply put on your hardhat and swing the muffs down over your ears. Again, make certain that the muffs seal properly.	Presenter dons combo hardhat/muffs and swings muffs over ears
29. If you use earplugs that are mounted on their own plastic band, you can let the band hang down either under your chin or behind your head. It does not matter, as long as the plugs press firmly into your ears.	Close-up of earplugs on plastic band; cut to presenter wearing plugs with band under chin, then removing and refitting plugs with band behind head

HCP TRAINING VIDEO : HPD TRAINING MODULE

Audio	Visual
PRESENTER V/O	
30. Whichever type of HPD you use, whether earplugs or earmuffs, they must be cared for and kept clean.	Pan across selection of HPDs
PRESENTER TO CAMERA	
31. Everything needs to be kept in good condition in order to work properly and the same applies to HPDs. If you allow your HPD to become dirty they could cause skin irritation or an ear infection. If you do develop an ear infection, have it checked at the medical station.	Presenter
32. To avoid problems like these, make sure that at the end of every working shift	Presenter
PRESENTER V/O	
you wash your earplugs with soap and warm water, dry them and then put them back into their carrying case until the next time you use them.	Cut to close-up hands washing earplugs in basin, using hand soap, then rinsing and drying. Cut to close-up of earplugs being placed back into carrying case
PRESENTER TO CAMERA	
33. If you drop your earplugs, clean them before putting them back into your ears. If there is no water nearby, you can clean them by wetting your finger in your mouth and rubbing the dirt off in that way. But only if your fingers are not dirty.	Presenter
*34. If you use earplugs, **remember**: To avoid discomfort and possible damage to your ears, **NEVER** travel up or down in the cage while wearing earplugs. Always remove your earplugs before you enter the cage.	Presenter: *** This scene to be used only in the gold/platinum version.**
PRESENTER V/O	
35. You can keep your earplugs ready for use and avoid losing them by tying the cord of the carrying case to your overall or hardhat.	Close-up of earplugs being replaced into carrying case secured to inside of hardhat

HCP TRAINING VIDEO : HPD TRAINING MODULE

Audio	Visual
PRESENTER TO CAMERA	
36. If you do lose them, or if they get old or damaged, you should immediately get new ones from your supervisor or safety representative. The same applies to earmuffs. Replace them immediately if they get lost or damaged and keep them clean by wiping them with a damp sponge or cloth, after every shift.	Presenter
37. When you first start wearing HPDs you will notice that noises not only sound softer, but also different.	Presenter; cut to close-up of corded re-usable plug in ear
PRESENTER TO CAMERA	
38. The HPDs block out more of the high pitched sounds like machine noise, which makes it easier for you to hear the low pitched sounds, like people's voices. They will still have to speak just as loudly, but the sound of their voices will be much clearer and easier to understand if you are wearing your HPDs.	Presenter

HCP TRAINING VIDEO : HPD TRAINING MODULE

Audio	Visual
PRESENTER TO CAMERA The same is true for warning signals. Because HPDs block out the machine noise more, it becomes easier to hear warning signals, which allows you to work more safely.	Presenter
As you know, there can be many dangers in the workplace, but by working smart and using your safety equipment you will be doing everything you can to make sure that you are not injured. And this includes wearing your HPDs whenever you are in loud noise. Protect your hearing, because if it is damaged you can never get it right again. Work smart and work safe. Wear your HPDs and look after them. They will look after your hearing.	Presenter closes
Closing music	Dissolve to Title, fade to black CSIR Mining Technology Logo Fade to black Production house logo

APPENDIX 2

ZULU SCRIPT FOR VIDEO

A-2.1

HCP TRAINING VIDEO : EDUCATIONAL MOTIVATIONAL MODULE

"To Hear or Not to Hear : The Choice is Yours"

Audio	Visual
PRESENTER V/O AND MUSIC	
1. Amadoda asebenza ezimayini akuwona amadoda ajwayelkile, nenza umsebenzi owejwayelekile. Ngamadoda anamandla, amadoda aqeqeshiwe, amadoda asebenza ngokubambisana, kanti nomsebenzi awenzayo awulula.	Various shots of mine workers
2. Zonke izinsuku lamadoda asebenza ngemishini esindayo ezimweni ezilukhuni ukuvumbulula ingcebo yemvelo emadwaleni bese iyalungiswa icolisiswe embonini.	Scenes highlighting men at the rockface and in the surface plants
3. Kudingeka ukuthi ubenamandla nogqozi ukuze usebenze kanjena. Lamadoda ayazi ukuthi asebenza ngaphansi kwezimo ezinezingozi ngakho-ke ayaqiniseka ukuthi agqoke izingubo eziwavikelayo ukuze ehlise ithuba lokulimala. Ngamabhuzi okuvikela izinyawo zawo, okokuvikela amadolo, amagilavu okuvikela izandla, izibuko zokuvikela amehlo, izigqoko eziqinile zokuvikela amakhanda kanye nama-earplug ezindlebe noma okokuvikela izindlebe noma singathi nje ukuvikela ukuzwa.	Scenes highlighting protective clothing worn by mine workers, featuring waterproof garments, hard hats, goggles, gloves and ear muffs
PRESENTER TO CAMERA	
4. Basebe nza kanzima kodwa okuhle ukuthi basebenza ngobuhlakani, kanti ukusebenza ngobuhlakani kusho ukusebenza ngokucophelela. Kodwa kukhona ukulimala abaningi abangakuqapheli ngendlela efanele.	Studio Presenter dressed as Team Leader
PRESENTER V/O	
5. Akukhona ukulimala okusobala njengokulimalla isandla noma ukuphuka umlenze. Lokhu ukulimala okwehluke kakhulu kanti ke kwenzeka kunoma iyiphi indoda engaqikeleli ekubeni ivikeleke.	Injured man being attended to at Medical Station
Lokhu ukullimala okuyisimanga ngoba umuntu usuke engezwa ukuthi uyalimala futhi akunabuhlungu abuzwayo.	Mine worker sitting in audiometric test booth; Audiometrist closes door of booth

HCP TRAINING VIDEO : EDUCATIONAL MOTIVATIONAL MODULE

Audio	Visual
PRESENTER V/O	
6. Umuntu angabona ukuthi ulimele sekudlule isikhathi eside ingasekho into engenziwa. Ngeke aselapheka. Usekhubazekile unomphelo. Useyisithulu.	Mine worker having an audiometric examination. Freeze frame on man's face as narrator says the word "deaf"

"To Hear or Not to Hear : The Choice is Yours"

Introductory Music	**Title with warning symbol for hearing protection**
PRESENTER TO CAMERA	
7. Ukulahlekelwa ukuzwa okudalwa ngumsindo omkhulu ikhona okujwayelekekunakho konke ukulimala okwenzekayo ezindaweni zokusebenzela. Kdwenzeka kuzozonke izinhlobo zemisebenzi: Emafemini, kuma-workshops, ezimayini kanye nakwezinye izindawo ezingezona ezokusebenzela.	Presenter
Clip from Interview with Subject 1	
"Engikutholile ukuthi uma ungasezwa, isimo sakho siyehliswa. Abantu abasakuthathi njengomuntu."	Subject 1
Clip from Interview with Subject 2	
"Kuyinkinga kimina, ngoba uma ngingasezwa, emsebenzini angeke ngisebenze njengoba kulindelekike. Ngenxa yalokhu sengisebenza Kglukhuni."	Subject 2
"Angisaholelwa iholo lokusebenza phansi komhlaba. Ngigudluliwe phansi komhlaba. Manje ngigudlulelwe kwindawo yangaphezulu komhlaba."	
Question from Interviewer	
"Manje wena, uma ngikubuza, ubona ubungcono bemali noma wena ungacela ku Nkulunkulu ukuthi akubuyisele ukuzwa: yikuphi wena ongakukhetha?"	Interviewer
Subject 2's Response	
"Ngingathanda ngiphinde ngizwe futhi. Ungiphethe umzwangedwa. Angazi ukuthi yini lena abanye ebahlekisayo. Futhi mina ngiwuza ngaphakathi kimina umzwangedwa."	Subject 2

HCP TRAINING VIDEO : EDUCATIONAL MOTIVATIONAL MODULE

Audio	Visual
PRESENTER TO CAMERA	
8. Ake ubheke kade uphila ugcine ungasakwazi ukuzwa futhi ungasakwazi ukuxhumana nabanye ngendlela owadwenza ngayo phambilini-ngokukhuluma.	Presenter
PRESENTER V/O	
9. Ngenxa yalokho sekufanele ufunde ukuxhumana ngezinye izindlela..ngokubhala, ukufunda izindebe noma ukusebenzisa ulimi lwezimpawu. Okukhulu kakhulu ukuthi ukuze ukwazi ukuxhumana nomndeni wakho nabangani bakho, nabo sekufanele bafunde izindlela ezintsha zokuxhumana nawe.	Scene without sound of men in workshop at end of their shi
PRESENTER TO CAMERA	
10. Ubuthulu ngaphezu kwazozonke izinkathazo, abuthinti umuntu oyisithulu yedwa, kodwa bonke labo asondelene nabo, njengoba kwenzeka ku Octavia kanye nezingane zakhe ezimbili.	Presenter
Clip from Interview with Octavia wife of a Mineworker (in response to interviewer's question): "Yebo bayathokoza abantwana uma ubaba ebuya emsebenzini njengasemhleni. Umyeni wami ungumuntu olungile onamancoko. Udlala nathi layindlini. Udlala nathi ibhola layindlini, kanye neminye imidlalo. Uma ungena lapha endlini angeke ubone umehluko phakathi komzali nengane. Siwumndeni ozwanayo obumbene."	Octavia and children in room with Interviewer and close-up of Octavia
Clip from Interview with Sibusisu, the younger son "Mangabe sihleka uthi sihleka yena, sihleba ngaye. Uma sithi siyakhuluma uthi sikhuluma ngaye. Engafuni ukuthi sibukele umabonakude, silalele nomsakazo. Engafuni sidlale ama cassette, silalele nomdlalo. Mangabe siwuvula umsakazo uyasithethisa asishaye."	Close-up of Sibusisu

HCP TRAINING VIDEO : EDUCATIONAL MOTIVATIONAL MODULE

Audio	Visual
Clip from Interview with Octavia	
"Uma ufuna ukuthi ezwe kumele ukhulumele phezulu. Noma okanye ukhulumele ezindlebeni. Hayi ukuthi uzukhuluma kanye. Kumele uphindaphinde lokho okushoyo aze ezwe. Angisakwazi ukuxoxa izimfihlo zomndeni wami naye."	Close-up of Octavia
Question from Interviewer	
"Ngabe ukungezwa kwakhe kumenza abe nolaka na?"	Octavia and children in room with Interviewer
Octavia's Response	
"Yebo uthatha ukuthi simenza isilima. Sihlekisa ngaye. Ngoba nasemsebenzini ubona sengathi bamenza isiphukuphuku. Yilokho okusangenza ukuthi ngilusukumele phezulu loludaba. Futhi nasemsebenzini ubengasazwani nabantu. Bethi useyaqhosha."	Same visual as above, then slowly zooming to close-up of Octavia
PRESENTER TO CAMERA	
11. Kukhona namanye amadoda afana nomyeni ka Octavia emayini agula ngesifo sokungezwa esibangelwa ngumsindo	Presenter
PRESENTER V/O	
akungaphathelene nokuthi umuntu unamandla kangakanani noma ubuthakathaka kanjani, ukuthi mudala kangakanani noma musha kangakanani. Amanye amadoda baye balahlekelwe ukuzwa kwabo beseneminyaka njeengamashumi amathathu ubudala.	Mine workers in canteen, old young, fat, thi
12. Babayizithulu ngokusebenza ngemishini enomsindo kakhulu besebenza bengagqokanga izinto zokuvikela izindlebe noma ama HPD okungama-earplugs noma ama-earmuffs. Abanye babengawafaki ama-HPD ngoba befuna ukubonwa ukuthi bona bangamadoda hayi onyuwani.	Scenes of workers in workshop and underground

HCP TRAINING VIDEO : EDUCATIONAL MOTIVATIONAL MODULE

Audio	Visual
PRESENTER TO CAMERA	
13. Kodwa leyo imicabango nje ebheke eceleni. Ungamcoma yini umuntu ozama ukukhipha insimbi eshisayo emlilweni esebenzisa izandla nje? Cha ungacabanga ukuthi uyisiwula noma isithutha ngokungavikeli izandla zakhe ekulimalenli. Ngokunjalo futhi aakubona ubuhlakani noma ubunsizwa ukusebenza endaweni enomsindo omkhulu ngaphandle kokuvikela izindlebe.	Presenter
Clip from Interview with Subject 2	
"Ngingamtshela umuntu, uma ngimbona ngaphandle kokokuvikela, njengomuntu owalahlekelwa ukuzwa, ngisebenza ngaphansi komhlabathi, mina ngingamtshela ukuthi lezizinto zilapha ukumvikela izindlebe".	Subject 2
PRESENTER V/O	
14. Izimpawu endaweni esisebenzla kuyo ziyasexhwayisa ukuba sifake amabhuthi, amagilavu nezigqoko eziqinile kanye nama HPD uma kudingekile.	Succession of warning signs for protective gear
15. Uma amadoda ebona kukuthi kufanele agqoke izigqoko eziqinile ukuze avikele amakhanda awo, kungani engakholelwa ekutheni agqoke ama earplugs noma ama muffs ukuvikela ukuzwa kwabo?	Mine worker wearing hard hat but not his HPDs
PRESENTER TO CAMERA	
16. Akwenzi mehluko ukuthi ababoni noma abezwa uma izindlebe zabo zilimala njengoba baye bezwe noma babone ezinye izinhlobo zokulimala. Noma kunjalo okubhlungu ukuthi umonakalo wokuzwa uyenzeka.	Presenter
PRESENTER V/O	
17. Umehluko ukuthi ezlinye izindlela zokulimala zenzeka masinyane; umonakalo owenzekayo uyashesha futhi ubonakala kalula.	Injured mine worker being attended to

HCP TRAINING VIDEO : EDUCATIONAL MOTIVATIONAL MODULE

Audio	Visual
PRESENTER TO CAMERA	
18. Ukulahlekelwa ukuzwa kwenzeka kancane kancane. Iningi lamadoda alizwa ngisho ukuzwa ukuthi liyalimala. Abakuboni uma kwenzeka futhi abakuzwa uma kwenzeka. Okukhulu ukuthi kuyenzeka.	Presenter
PRESENTER V/O	
19. Ngephutha abaningi bayebathole ukuthi ukuzwa kwabo sekonakele ngenkathi sebeyohlolwa ukuthi angabe basezwa kahle yini okuyinto eyenziwa njalo ngonyaka, nanoma uma bengasakwazi ukuxhumana ngokuyikho nabangani kanye nemindeni yabo ngendlela ababenza ngayo phambilini.	Audiometric test centre
PRESENTER TO CAMERA	
20. Abanye abantu bangacabanga ukuthi njengoba ukuzwa kwabo sekonakele, asisekho isidingo sokufaka ama-earplugs noma ama-earmuffs. Abangakwazi kukuthi umonakalo awumi endaweni eyodwa kodwa uyaqhubeka uze ube mubi kakhulu.	Presenter
PRESENTER V/O	
21. Ngasosonke isikhathi uma beya endaweni enomsindo omkhulu ukuzwa kwabo kuya ngokuya konakala kancane kancane uma bengawagqokile ama HPDs. Uma ukuzwa kwabo kusaqala konakala bangezwa izindlebe zaabo ziba ndiki ndiki bezwe umsindo okhala sansimbi noma ohishizayo uma sebephumile endaweni enomsindo.	Scene of worker entering compressor house (HPD warning sign over door) not wearing his HPDs Scene inside compressor house. Scene outside compressor house : worker and rubs his ear
PRESENTER TO CAMERA	
22. Lesi isexhwayiso ukuze bazi ukuthi umsindo ubumkhulu kakhulu futhi ubulimaza izindlebe zabo. Uma beqhubeka nokuya endaweni enomsindo ngaphandle kwezivikela-zindlebe ukuzwa kwabo kuyokhubazeka unomphelo futhi kungami. Bayoqala bezwe kancane ekugcineni bangabe besezwa sanhlobo.	Presenter

HCP TRAINING VIDEO : EDUCATIONAL MOTIVATIONAL MODULE

Audio	Visual
PRESENTER TO CAMERA	
23. Abanye abantu bangathatha kukuthi bona sebewejwayele umsindo,	Presenter
PRESENTER V/O	
kodwa iqiniso ukuthi sekukhona ukuzwa kwabo osekubalahlekele ngakhoke yingakho sekuzwakala sengathi umsindo awusenganga kuqala.	Mine worker operating noisy machinery without wearing HPDs
PRESENTER TO CAMERA	
24. Ellinye iphutha abantu abalenzayo ukucabanga kuthi uma sebelahlekelwe ukuzwa kwabo bayovele basebenzise izinsizwa-kuzwa bese bayezwa futhi njengakuqala. Kanti akunjalo neze.	Presenter
PRESENTER V/O	
25. Abantu ikakhulukazi abadala abangasakwazi ukuzwa njengoba babezwa kuqala, bayaluthola usizo kuzinsizwa-kuzwa njendlela efanayo uma befake izibuko zamehlo ngoba bengasaboni kahle, noma besebenzisa induku yokudondolozela ngoba bengasakwazi ukuzihambela kahle njengesikhathi babenza besebancane.	Oldman with hearing loss takes hearing aid out of his pocket and fits it
PRESENTER TO CAMERA	
26. Ukungezwa okwenzeka kubantu asebebadala kubangelwa ukuthi izindlebe seziya ngokuba ntekenteke njengoba umuntu eya ngokuya ekhula, Izindlebe azisaqinile njengoba zaziqinile njengakuqala, kodwa zona zisengasikala ngezinsizwa-kuzwa.	Presenter
PRESENTER V/O	
27. Okubuhlungu ukuthi uhlobo lokulahlekelwa ukuzwa oludalwa umsindo omkhulu lungeke lwasizwa izinsizwa-kuzwa. Phela akusho ukuthi amadlebe antekenteke nje kodwa ama nerve cells asezindlebeni ayafa ngenxa yomsindo omkhulu.	Animated graphic depicting damage to nerve cells in inner ear

HCP TRAINING VIDEO : EDUCATIONAL MOTIVATIONAL MODULE

Audio	Visual
PRESENTER TO CAMERA	
29. Uma lena kuyindlela ezwa ngayo yonke into, uyozwa kanjani ukuthi umholi wakhe kanye nabanye asebenza nabo bathini?	Presenter
PRESENTER V/O	
30. Uyozizwa kanjani izimpawu ezimexwayisa ngemishini esuke iqhamuka?	Loco in haulage with warning signal
PRESENTER TO CAMERA	
31. Umaÿa ukuzwa kwakhe kukubi kanjena angeke nje ahluleke ukukhiqiza kuphela, nokuphepha kwakhe kuyobekeka engozini kanye nalabo aseqenjini nabo. Uma kunjalo ngeke akwazi ukuqhubeka nomsebenzi ofanayo.	Presenter
PRESENTER V/O	
32. Uyoshintshelwa emsebenzini ongabalulekile futhi okungenzeka neholo lakhona libe phansi.	Man pushing a broom
33. Okubi ukuthi ukuzwa kwakhe kungaba kubi kakhulu kumdalele ukuthi angasakwazi nokuthola omunye umsebenzi okungaba sezimayini noma yikuphi njena. Ngaleyondlela adziphilise kanjani-ke yena klanye nomndeni wakhe?	Man holding placard appealing for a job
PRESENTER TO CAMERA	
34. Into elelula kakhulu ukuba wenze isiqiniseko sokuba ungahlangabezani nenkinga yokulahlekelwa ukuzwa kwakho ngokusebenzisa ama-HPDs uma usebenza endaweni enomsindo omkhulu.	Presenter

HCP TRAINING VIDEO : EDUCATIONAL MOTIVATIONAL MODULE

Audio	Visual
35. Noma ngubani osebenza endaweni enomsindo omubi kumele avikele izindlebe zakhe ukuze zingacekelwa phansi ngumsindo. Ngakhoke noma nini noma kuphi uma ubona loluphawu.... noma umsindo uphakeme ngendlela yokuthi kumele umemeze uma uqhele ngemithi elilodwa ukuze uzwakale qiniseka ukuthi ufake okokuvikela izindlebe ama-earplugs noma ama-earmuffs.	Presenter
36. Ungacabanga kuthi kulungile ukuthi kugqoke ama-HPDs isikhathi esiningi bese uyawakhipha njalo nje emuva kwesikhashana, khumbula ukuthi kuthatha imizuzwana embalwa uma umsindo umkhulu ukuze ukhinyabeze izindlebe zakho, ngakhoke akufanele neze ukhikphe ama HPDs akho ngisho ukhuluma nomuntu komunye.	Presenter Cut-away to International warning sign for hearing protection
PRESENTER V/O 37. Ukwenza lokho kuliphutha ngezindlela ezimbili. Awubeke nje kuphela ukuzwa kwakho ebucayini ngokwenza njalo, kodwa endaweni enomsindo omkhulu umuntu okhuluma naye ungamuzwa kangcono uma uwafakile kunokuba ungawafakanga. Imbangela ukuthi ama-HPDs enzelwe ukuba ehlise umsindo omkhulu ophakeme ovela noma kophuma emshinini, kanti umsindo ophansi noma amazwi abantu angene kalula.	Scene in workshop with two men wearing HPDs and one man not wearing HPDs and unable to hear what one of the men is saying. Man wearing HPDs indicates to worker to put on his HPDs which are hanging around his neck. Worker dons his HPDs and it is immediately apparent that he is now able to hear what the other man is saying to him, as he responds.
PRESENTER V/O 38. Kufana nemsindo eyisexhwayiso nje; ezindaweni ezinomsindo omkhulu imisindo eyizexhwayiso uyizwa kangcono uma ufake ama-HPDs ngaleyondlela usebenze ngokuphepha okukhul.	Shuttlecar operator reacting to warning sig

HCP TRAINING VIDEO : EDUCATIONAL MOTIVATIONAL MODULE

Audio	Visual
PRESENTER TO CAMERA	
39. Kanti-ke i-roof talk uyazi ukuthi ungayizwa kuphela uma umshini kwakho kuvaliwe. Uma kade usebenza ungawafakile ama-HPDs kuyothi lapho uvala umshini izindlebe zakho zikhathale ngendlela yokuthi ungeke ukwazi ukuzwa i-roof talk. Kodwa uma kade ufake ama-HPDs wawakhipha emuva kokuvala umshini izindlebe zakho ziyoba sesimweni esihle futhi uzwe i-roof talk uma yenzekala.	Presenter
40. Ukuzwa kwakho kuyisipho esikhulu, ungasilahli neze. Phaphama, uhlakaniphe, ugqoke ama-HPDs akho uma usebenza endaweni enomsindo omkhulu. Ngokwenza njalo uyobe ungavikeli nje izindlebe zakho, kodwa uyobe uvikela nomsebenzi wakho nekusasa lomndeni wakho. Uqaphele, sizophinde sibonane!	Presenter Presenter closes
Closing music	Dissolve to Title, fade to black CSIR Mining Technology Logo, fade to black Copyright Statement Production House logo

A-2.2

HCP TRAINING VIDEO : HPD TRAINING MODULE

"To Hear or Not to Hear : The Choice is Yours"

Audio	Visual
Opening Music	**Title: "To Hear or Not to Hear : The Choice is Yours"** with Hearing Protection with warning sign
PRESENTER TO CAMERA	
1. Sanibonani ngiyanemukela kuloluhlelo oluphathelene nokuvikela ukuzwa. Kulevidea sizofunda ukuthi singawuzwa kanjani umsindo oyingozi nokuthi besesizivikela kanjani kuwona.	Studio Presenter dressed as a Team Leader and seated behind table
PRESENTER V/O	
2. Sizobheka futhi izinhlobo ezahlukehlukene zezinto zokuzivikela noma ama HPD atholakalayo, nokuthi singawafaka kanjani ngendlela efanele nokuthi singawagcina kanjani.	Pan across display of different types of HPDs on table in front of presenter. Then pull back to presenter. NB: **In all scenes where a selecton of HPDs is shown, the display has been reduced to a single representative of each type.**
PRESENTER TO CAMERA	
3. Uyazi ukuthi umsindo omkhulu ungalimaza izindlebe zakho futhi ullahlekelwe ukuzwa, kodwa ungazi kanjani ukuthi umsindo mkhulu ngokwenele ukuba ube yingozi?	Presenter
Umsindo ukalwa ngomshini wokukala umsindo, njengalona, okala umsindo ngamadesibheli. Umsindo ubamkhulu kakhulu uma amadesibheli ephezulu.	Presenter picks up sound level meter (SLM) from table.
PRESENTER V/O	
4. Ekuphileni kwabantu kwansukuzonke, okungaba semahhovisi, emigwaqweni noma emakhaya,	Close-up of SLM measuring decibels as he speaks, zooming in to close-up of SLM display.
PRESENTER TO CAMERA	
umsindo ovamise ukuba khona, awuyona inkinga, ngoba kawumkhulu ngokwendlulele.	Presenter

HCP TRAINING VIDEO : HPD TRAINING MODULE

	Audio	Visual
	PRESENTER V/O	
5.	Lokho kungenzeka kuphela uma umsindo usufinyelela kumadesibheli angu 80 kuya ku 85 nangaphezulu ukuze ube yingozi.	Close-up of SLM display
	PRESENTER TO CAMERA	
6.	Kodwa ezindaweni zokusebenza, imishini yenza umsindo ovamise ukuba ngaphezulu kwamaleveli aphephile.	Presenter
	Uma umsindo kusobala ukuthi uyingozi, uphawu olufana nalolu kumele luxwayise abantu abangenayo noma abasebenzayo kuleyondawo ukuba bangqoke ama HPD.	Presenter picks up international hearing protection sign from table and presents to camera, zoom to close-up of sign.
	PRESENTER TO CAMERA	
7.	Kodwa nangaphandle kwezimpawu, ungakwazi ukusho ukuthi umsindo mkhulu kakhulu noma cha. Uma umi endaweni engaba ymitha noma ubude bengalo ukusuka komunye umuntu kodwa kufanele nixhumane ngokumemeza, kusho ukuthi lowomsindo mukhulu ngokwenele ukukhinyabeza ukuzwa kwakho.	Presenter extends a tape measure to indicate one metre.
	Nÿgakho-ke uma uzithola ukuleso simo noma ubona izimpawu zokwexwayisa, qiniseka ukuthi ufake ama HPD akho.	Presenter
	PRESENTER V/O	
8.	Omunye umbuzo odinga ubuzwe ukuthi yiziphi izinhlobo zama HPD odinga uzigqoke? Kunezinhlobo ezintathu ezitholokalayo: ama-earplugs asebenza bese elahlwa, ilawo aphinda asetshenziswe futhi kanye nama-earmuffs.	Pan across HPDs on table. Presenter in turn picks up and puts down disposable earplugs, re-usable earplugs, earplugs on plastic band and earmuffs.
	PRESENTER TO CAMERA	
9.	Amanye ama-earplugs alahlwayo enziwe ngegwebu elisarabha eliminyene	Presenter
	PRESENTER V/O	
	olilungisa ngeminwe ngaphambi kokuba ufake ezindlebeni zakho.	Close-up on earplugs as presenter's fingers shape them

HCP TRAINING VIDEO : HPD TRAINING MODULE

Audio	Visual
PRESENTER V/O	
Kodwa loluhlobo lungcola masinyane bese ludinga lushintshwe njalo nje.	Close-up of dirty plugs
10. Ama-earplugs asetshenziswa abuye aphinde asetshenziswe futhi wona avele alungele ukuba uthathe uwafake endlebeni futhi amanye anesibambo esenza ukuthi kube lula ukuwafaka ngaphandle kokuthi angcole. Ama-earplugs aphinde asetshenziswe awasheka kalula futhi athatha isikhathi eside kunalawo abuye alahlwe.	Close-up of re-usable with handle held in fingers Close-up of corded re-usable plugs
PRESENTER TO CAMERA	
11. Amanye ama earplugs lawo abuye akwazi ukusetshenziswa futhi, axhunywe ngebhande leplastiki lokho okwenza kubelula ukuwafaka nokuwakhipha lokho okwenza kubelula kulabobantu abaphuma bengena ezindaweni ezinomsindo.	Presenter picks up band-mounted plugs, zoom in on band-mounted plugs.
PRESENTER V/O	
12. Bese kubakhona aloluhlobo lwa-ma-earmuffs afakwa ngaphezu kwendlebe hhayi phakathi.	Close-up of earmuffs. Camera pulls back as presenter picks up earmuffs and presents them to camera.
PRESENTER TO CAMERA	
13. Zonke lezinhlobo ezehlukene zama HPD zinika ukuvikeleka okufanayo kumleveli omsindo omkhulu. Uhlobo olukhethayo luya ngokuthi usebenza kuphi nokuthi yiluphi uhlobo oluvumelana kahle nawe.	Presenter
Uma usebenza ngaphansi komhlaba noma yikuyiphi indawo eshisayo, ama-earmuffs awalungile. Noma-ke ekuqaleni kungaba sengathi akahle angkulethela ukushisa emva kwesikhashanyana. Khanti emuva kwezinsuku ezimbalwa angenza isikhumba sakho sinsonsothe sibe namashashaza. Futhi uma ugqoka izibuko zokuphepha ngenkathi usebenza, zingavimbela ukuthi ama-earmuffs anganamatheli kahle ezindlebeni zakho.	Presenter

HCP TRAINING VIDEO : HPD TRAINING MODULE

Audio	Visual
PRESENTER V/O	
14. Ama-earplugs yiwona angcono kakhulu uma ungumuntu osebenza ezindaweni ezinomsindo isikhathi eside, ikakhulukazi ezindaweni ezishisayo.	Close-up of Presenter's fingers pointing to selection of earplugs
PRESENTER TO CAMERA	
15. Uma ukhetha ukusebenzisa ama-earplugs, kungenzeka angakuphathi kahle uma usaqala kodwa ayejwayeleka emva kwesikhashana. Uma kudlula izinsuku ezimbili noma ezintathu engakuphathi kahle,	Presenter
PRESENTER V/O	
kufanele uzame ezinye izinhlobo zama HPD ubone ukuthi ngeke yini uzwe ubungcono.	Camera pans over selection of HPDs
PRESENTER TO CAMERA	
16. Uma usuthole uhlobo oluzwana nawe futhi ususlusebenzise isikhashana, ungeke usezwa nokuthi uwagqokile. Ungathola nokuthi uma usendaweni enomsido omkhulu awusaphatheki kahle uma ungawafakile. Uyozizwa ungcono kakhulu futhi ekupheleni kwe shift yakho uma kade ufake ama HPD ngenkathi usebenza. Ungeke uzizwe ukhathele nezindlebe zakho uyozizwa zikahle. Ngeke kubekhona ukuduma nokuhishiza ezindlebeni zakho.	Presenter
17. Uma ufaka ama HPD akho, kubalulekile ukuba uqiniseke ukuthi angena kahle ngoba uma kungenjalo lomsindo omkhulu ungathola ukuthi usangena ezindlebeni udale umonakalo ezindlebeni.	Presenter
Ngakho-ke akesibheke ukuthi afakwa kanjani ama HPD ngendlela efanele.	Presenter
18. Uma usebenzisa ama-earplugs lawo abuye alahlwe, qala ngokuthi uwagoqe njengesosishi, bese welulela isandla sakho ekhanda udonsele ichopho lendlebe yakho ngaphandle.	Close-up as he rolls a disposable plug into a sausage shape. Pull back to show presenter reaching over his head with one hand and grasping top of ear.

HCP TRAINING VIDEO : HPD TRAINING MODULE

Audio	Visual
PRESENTER V/O	
19. Ukudonsela indlebe ykÿho kuqondisa umgudu wendlebe yakho okwenza kubelula ukufaka iplug futhi ibambelele ithi ne.	Animated graphic showing hand pulling ear outwards and ear canal straightening
PRESENTER TO CAMERA	
20. Ngenkathi usadonsa indlebe yakho ngesinye isandla, faka i-earplug ngesinye isandla. Manje yeka indlebe yakho ngenkathi usabambe i-earplug.	Cut back to close-up of presenter inserting foam plug in one ear. Pull back to show presenter releasing ear while holding earplug in place.
PRESENTER V/O	
21. Lokhu kwenza ukuthi i-earplug ibambe kahle endlebeni futhi lokhu kuzokwenza ukuthi kuqine kunamathele ukuze umsindo ungangeni ezindlebeni.	Animated graphic showing ear being released and ear canal reverting to original shape around foam plug. Graphic shows diminished sound arrows on inside of plug.
PRESENTER V/O	
22. Khumbula ukuthi ngisho esincane isikhala phakathi kwe-earplug nendlebe yakho siyokwenza ukuthi umsindo ungene wenze umonakalo endlebeni yakho.	Animated Graphic shows small gap opening between ear canal and plug and strong sound waves getting past plug and into ear.
23. Ungahlola ukuthi ama HPD akho angene kahle ngokuwacindezela. Uma uzwa ukuthi umsindo ushona phansi uma wenze njalo, wazi ukuthi akafakekanga kahle.	Close-up of presenter pressing against plug in ear to indicate how to check if fitted correctly.
PRESENTER TO CAMERA	
24. Uma ukhetha ama-earplugs aphinde asetshenziswe, ngeke kudingeke ukuthi uwabumbe ngeminwe yakho,	Presenter
PRESENTER V/O	
kodwa uyowafaka ngendlela efanayo ukuqiniseka ukuthi izindlebe zakho zivikelekile.	Cut to close-up as he inserts plug into ear.

HCP TRAINING VIDEO : HPD TRAINING MODULE

Audio	Visual
PRESENTER V/O	
25. Noma ngabe usebenzisa nhloboni yama earplugs, uma ungasekho endaweni enomsindo futhi usufuna ukuwakhipha, qikelela ukuwakhipha ngobunono ukuze angakudaleli imihuzuko, ngokudonsela ngaphandle ichopho lendlebe yakho okufanayo nendlela owafake ngayo.	Presenter demonstrates slow, careful removal of first one earplug and then the other.
PRESENTER TO CAMERA	
26. Uma usebenzisa ama-earmuffs, qala ususe noma yini engase ibe phakathi kwawo nezindlebe zakho, njengezinwele, namacici. Loluhlobo lusebenza kahle uma lubambe lwaqina endlebeni yakho ukuze umsindo omkhulu ungangeni.	Presenter
PRESENTER V/O	
27. Yilelibhande elibambe ama-earmuffs eliwenza abambe aqine ezindlebeni.	Close-up of presenter's hands, ndicating headband
Uma ugqoke isigqoko esiqinile, qiniseka ukuthi lentambo iyehla ijikele ngemuva kwekhanda lakho kusale ibhande phezu kwekhanda ukuze le-earmuff ihlale endaweni yayo ngaphambi kokuba ufake isigqoko sakho.	Presenter dons muffs and swings band down behind his head, then positions head strap, picks up hard-hat and puts it on.
Khumbula ukwenza isiqiniseko sokuthi i-earmuff ivale ngendlela efanele.	
28. Uma usebenzisa umakalapa onama-earmuff enzelwe kuwo okuvikela izindlebe, vele ufake isogqoko sakho ekhanda bese ujikisa ama-earmuffs akho ehlele ezindlebeni. Yenza isiqiseko futhi ukuthi ama-earmuffs avale kahle kungabikho lutho olungenayo.	Presenter dons combination hard-hat/muffs and swings muffs over ears.
29. Uma usebenzisa ama-earplug ahlanganiswe ngentambo yawo yephlastiki, ungenza ukuthi intambo ilengele ngaphansi kwesilevu sakho noma ngemuva kwekhanda. Akukhathalekile inqobo nje uma ama-earplug ebambille aqina ezindlebeni zakho.	Presenter picks up earplugs on plastic band, swings band to behind head and then under chin to show different ways in which to wear it.

HCP TRAINING VIDEO : HPD TRAINING MODULE

Audio	Visual
PRESENTER TO CAMERA	
31. Yonke into idinga igcinwe esimweni esihle ukuze isebenze kahle, kunjalo nakuma HPD. Uma uvumela ama HPD akho ukuba angcole angadala ukunukubezeka kwesikhumba noma isifo sezindlebe. Uma uthola isifo sezindlebe, hamba uyohlolwa e-Medical Station.	Presenter
32. Ukuze ugweme izinkinga ezifana nalezi,	Presenter
PRESENTER V/O	
qiniseka ukuthi zonke izinsuku emva komsebenzi uhlanza ama ear plugs akho ngamanzi afudumele nensipho. Uwaneke ome bese uwabuyisela ethinini lawo ephephile kuze kube yisikhathi somsebenzi.	Cut to - close-up hands washing earplugs in basin, using hand soap, then rinsing and drying them. Pull back to MC/U to show person replacing earplugs in carrying case.
33. Uma kungenzeka uwise ama ear plug akho phansi, wawashe ngaphambi kokuba uwafake futhi. Uma engekho amanzi eduze, ungamanzisa umunwe wakho ngamathe bese usula ukungcola. Lokho ungakwenza uma iminwe yakho inganzolile.	
PRESENTER TO CAMERA	
*34. Uma usebenzisa ama-earplugs, **khumbula**: ukuvikela ukungaphatheki kahle nokulimala okungenzeka ezindlebeni zakho; Ungalingi wehle wenyuka ngekheshi ube usagqoke ama-earplugs. Akhiphe ngasosonke isikhathi ama-earplugs akho ngaphambi kokuba ungene ekheshini.	Presenter *** This scene to be used only in the gold/ platinum version.**
PRESENTER V/O	
35. Ungagcina ama-earplug akho elungele ukusebenza futhi angalahleki ngokuwalengisa ngentambo ku-overall yakho noma esigqokweni.	Close-up of putting plugs into carrying case inside hardhat

HCP TRAINING VIDEO : HPD TRAINING MODULE

Audio	Visual
PRESENTER TO CAMERA	
36. Uma uwalahla noma uma esegugile noma emoseka, kumele uthole ngokushesha amasha kumholi wakho emsebenzini noma kulowo obhekene nokuphepha. Kusafana nakuma earmuffs. Thola amanye ngokushesha uma elahleka noma emosakala bese uwagcina ehlanzekile ngasosonke isikhathi ngokuwawasha ngesiponji esimanzi noma indwangu emva kwe shift ne shift.	Presenter
PRESENTER V/O	
37. Uma usaqala ukugqoka ama HPD uyoqaphela ukuthi imisindo iyancipha futhi ibe nomehluko.	Close-up of corded re-usable plug in ear
38. Ama HPD ehlisa umsindo ophakeme kakhulu njengomsindo wemishini, owenza ukuthi kube lula ukuthi uzwe imisindo ephansi, njengemisindo yamazwi abantu. Nokho kuyadingeka ukuthi bakhulume kakhulu kodwa umsindo wamaphimbo abo ayocaca futhi azwakale kahle uma ugqoke ama HPD. Kuyafana nje nezimpawu zokuxwayisa. Ngenxa yokuthi ama HPD avimba imisindo yemishini, kakhulu, kuba lula ukuzwa izimpawu zokuxwayisa, ezikwenza ukuthi usebenze ngendlela ephephile. Njÿengoba wazi kungabakhona izingozi eziningi emsebenzini, kodwa uma usebenza kahle nangobuhlakani usebenzisa izinto eziphephile, uyobe wenza umsebenzi omkhulu ukuqinisekisa ukuthi awulimali. Lokho ungakuqinisekisa ngokugqoka ama HPD akho uma usendaweni enomsindo.	Presenter

HCP TRAINING VIDEO : HPD TRAINING MODULE

Audio	Visual
PRESENTER TO CAMERA	
Vikela ukuzwa kwakho ngoba uma kuke nje kwalimala ngeke kuphinde kwelapheke futhi. Sebenza ngobuhlakani nangokuphepha ngoku gqoka ama HPD akho, uwanakekele, ngoba yiwona ayogcina ukuzwa kwakho kuphephile.	Presenter Presenter closes Dissolve to Title, fade to black.
Closing music	CSIR/Mining Technology Logo fade to black. Copyright Statement.

A-8.1.3 Guidelines for trainers Part 3: Typical concerns raised by individuals resistant to using hearing protection devices

GEN 011 HEARING CONSERVATION

GUIDELINES FOR TRAINERS : PART 3

TYPICAL CONCERNS RAISED BY INDIVIDUALS RESISTANT TO USING HEARING PROTECTION DEVICES

PREFACE

It is universally accepted that personal protection strategies should be implemented as a last resort and only temporarily until engineering solutions are in place that reduce or eliminate hazards at their source. Where personal protection strategies are implemented as an interim measure, effective education, motivation and training of exposed workers are essential. In the case of the noise hazard, experience has shown that workers' attitudes and beliefs regarding hearing protection devices are often more negative than for personal protection against other hazards.

The present guidelines are designed to assist trainers in addressing negative attitudes and beliefs of workers, in order to gain wider acceptance of and compliance with personal protection strategies. These guidelines were compiled by the CSIR: Division of Mining Technology, on behalf of the Safety in Mines Research Advisory Committee and the Department of Minerals and Energy, as part of Project GEN 011.

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1. INTRODUCTION AND GENERAL INFORMATION TO ASSIST THE TRAINER

Reference is made to two overhead transparencies which are included with these guidelines (refer to the Appendix in Part 1 of the guidelines). In order to make use of these visual aids, the trainer should ensure that an overhead projector and screen are available.

Below are a number of typical and frequently expressed `excuses', objections, questions and comments that men raise when asked to use hearing protection devices (HPDs). They are often indicative of negative attitudes towards hearing protection and should be dealt with in an unhurried, non-threatening and informative manner. Take the time to allow the man to ask his question or state his opinion. Do not express scepticism or disregard what he says and discourage other members of the group from doing so. Try to address the man's concerns positively, providing reasons and explanation, encouraging other group members to contribute. Try to ensure that the man is satisfied with the explanation.

2. QUESTIONS/CONCERNS/COMMENTS/OBJECTIONS FREQUENTLY RAISED BY WORKERS

Q-1 "My ears must get used to the noise" or "My ears are already used to the noise/noise doesn't worry me."

A If someone's ears are used to the noise or loud noise doesn't worry him, that means that his ears have already lost some of their hearing. It may not seem so to him, because he may still understand what people say to him, but he will be unable to hear the very soft sounds. He would also have difficulty understanding what is being said if there is interference from noise. His hearing loss would also show up on his ear test at the hospital or medical station.

If he continues to work in loud noise without protection he will suffer a bit

more damage every day. After a number of years he will begin to notice that he is not able to understand everything that people say to him. Others will hear what is said but he will need to ask the speaker to repeat himself. Or else he will just try to act as though he understood in order to avoid embarassment, but he will have missed out on what was said and begin to feel awkward and unsure of himself.

He will find it difficult to use the telephone and the radio will always sound `muffled' to him. He will want to make the radio louder, but the others will tell him that it is already loud enough. He might still be young and strong but he will have the ears of an old man. All this could happen to anyone not using hearing protection while working in loud noise.

Q-2 "If I go deaf the mine can give me a hearing aid."

A A hearing aid can help a person whose ears are weak, possibly as a result of being old. The hearing aid makes the sound louder so the weak ear is able to hear better. But loud noise actually destroys many of the tiny nerve fibres that are supposed to send messages to the brain. Once some of these never fibres are destroyed, some of the messages are no longer sent to the brain, no matter how loud the sound is.

For someone whose ears have been damaged by loud noise, a hearing aid will make certain parts of the sound seem louder, but not any clearer because part of the message does not reach the brain. It is like turning up the volume of a radio that is not properly tuned onto the station. The sound is louder but still difficult to understand because it is not clear.

Q-3 "If I am deaf it means that I am an Ndota and have an important job on the mine working with big noisy machines."

A It is unfortunate that some people have this misunderstanding. They think that if their ears are bad it shows them to be important. They think that if people have to speak loudly to them and repeat things to them, it shows that

they are an Ndota and not a "New One".

What really happens is that other people start to make jokes about them that they are unable to hear. At first people make good-natured and friendly jokes and laugh at them in a nice way. The deaf person can't really hear the joke properly so he can't join in with the laughter. This makes some deaf people angry and the other men sometimes find this even funnier and make more jokes and laugh more. The jokes soon become less friendly.

Eventually other people get tired of trying to talk to the deaf one because it is too much trouble to say things two or three times. It is a bit like trying to talk to a Mompara - it's too much trouble to explain things to him so people just stop including him in their conversations. This means that he gets left out of what is being said and so he doesn't know what is going on with the people around him. He becomes isolated and ALONE. When he replies to someone or answers a question that someone has asked him, because he didn't hear the question properly, he may give the answer to some different question. Because his responses to what was said to him seem funny or strange, people begin to lose respect for him. Even his own children could lose their respect for him when he always answers in the wrong way. The saddest part of all this is that it is totally, **100 per cent avoidable. The damage caused by noise can be prevented by using hearing protection devices.**

Q-4 "Miners are tough and don't need earplugs or earmuffs. Only 'moffies' wear them."

A Miners do hard work that only strong men can do. Miners do need to work harder but modern miners also need to work smarter. And this includes working safer. No one is stupid enough to go underground without his hard hat and safety boots. People who are grinding or chipping would not be willing to work without safety goggles to protect their eyes and gloves to protect their hands. The same is true of welders - they would refuse to work if they didn't have gloves and welding goggles or a welding helmet. These people all know what would happen to them if they worked without their safety equipment.

But too many people fail to realize how important it is to also protect their hearing. Do you know why people often don't see the importance of hearing protection? It is because they can't **see** the damage that noise causes. It's also because it takes a long time for the damage to become great enough to cause problems. These things make people think that there is no damage occurring. But there **is** damage happening every day and it **all adds up** until the person finally realises that noise is dangerous. But by then it's too late. The damage that noise does to people's ears is **PERMANENT** - it can never get better or be cured by a doctor or Songoma. **IT IS FOREVER.**

If someone says that you are weak because you wear earplugs or earmuffs, he is probably not educated enough to know that noise is dangerous. But you shouldn't fight with him about it. You should try and explain to him about noise and tell him that you are trying to work smarter by working safer. (You can even joke back with him by moving your lips and mouth as if you are speaking without making any sounds. He might at first think that he is having trouble with his ears, but then he will realise it is only a joke, **but** a joke with a message : **If you don't wear your HPDs you might go deaf.)**

- **Display overhead transparency of the ear's general anatomy** (Figure A-3 from Part 1 of the "Guidelines for Trainers")

Point out and explain the function or job of each of the ear's three sections; outer ear, which gathers the sound; middle ear, which relays the sound to the inner ear; and inner ear, which relays the sound to the brain. Explain that damage to the outer or middle ear can be cured, but **damage to the inner can never be cured.** Inform the group of the fact that **loud noise damages the inner ear** and therefore the **damage from noise is permanent.**

- **Display slide showing inner ear damage on overhead projector** (Figure A-4 from Part 1 of the "Guidelines for Trainers")

Compare the normal ear at the bottom of the slide with the damaged ear at the top of the slide, pointing out the area where nerve fibres or "wires" have

been destroyed by loud noise (the damaged area where the nerve fibres have been destroyed is indicated with arrows). Explain that the destruction of nerve fibres as illustrated in the upper picture will make it impossible for the person to hear certain sounds, causing him to misunderstand or miss out on some of what is being said. **Emphasise that this damage is permanent because the nerve fibres cannot grow back or be repaired.**

Q-5 "How can I tell if the noise is loud enough to damage my ears?"

A If your ears feel a little bit numb or deaf after your shift, or if you hear a ringing or hissing sound coming from inside your ears, that means that the noise during your shift caused some damage inside your ears. If the damage was slight, and if this sort of thing is not repeated again and again, your ears will recover. But if you continue to work in loud noise without HPDs, the damage will become **permanent**. And **the damage will become greater** every time you go into a noisy place without protection.

If you are having difficulty understanding what some people say to you on the telephone or in a crowded room where others are talking, then you have already lost some of your hearing. This might have been pointed out to you when you last had your ears tested at the hospital or medical station. If this is the case, it is vital that you use hearing protection to save your remaining hearing. Often it takes a long time for the first damage to become noticeable but then the ears begin to lose more hearing very quickly. **This is permanent and it cannot be cured, BUT IT CAN BE AVOIDED BY WEARING HEARING PROTECTION.**

If your ears have not yet been damaged very much or perhaps not at all, you should do your best to protect your good hearing by wearing your HPDs when working in loud noise.

If you don't want to wait until you have damaged your ears to find out that the noise is dangerous, you can look for the warning signs in your workplace.

- **Presenter to display international symbolic safety sign for hearing protection or the overhead transparency** (Figure A-2 from Part 1 of the "Guidelines for Trainers") -

Whenever you see this sign, it means that the noise in that workplace has been measured and found to be dangerous. If you are working in such a place you should be wearing your hearing protection.

BUT even without the signs, you can tell that the noise is dangerous if you need to shout for someone close by to be able to hear you. If this is what happens in your workplace, you and everyone else working there should be using HPDs.

Q-6 **"If I wear earplugs or earmuffs I won't be able to properly hear signals or what people are saying to me."**

A This is something that many people believe to be true, but it is **not** true. In loud noise, earplugs or earmuffs actually make it easier for most people to hear signals and understand what others are saying to them. This is because HPDs block out most of the high-pitched noise from the machines and only a little bit of the deeper sound from signals and people's voices. In this way, HPDs make it easier to hear the voices and signals by making the machine noise much quieter.

It's a little bit like turning down the volume of a very loud radio in a room full of people. By turning the radio down, the people are able to speak more softly and more easily understand each other. The earplugs turn down the machine noise very much and turn down the signals and voices just a little bit, making it easier to hear the signals and voices.

You may have seen some men removing their HPDs when they are trying to listen to someone or perhaps done this yourself. This is a mistake because it lets in all of the machine noise, which not only makes it more difficult to hear what is being said, but it can also damage the person's hearing.

Only men whose hearing has been badly damaged will find it more difficult to hear signals and voices while wearing HPDs. These men should still wear protection to save their remaining hearing, but they should be given HPDs that don't block out quite as much of the noise as do the HPDs that the other people are given.

We all know that communication is important for good teamwork and for safety. If we can better understand each other in the workplace, then we can do the job better and more safely. **Using the correct HPDs can make it easier to understand each other, by blocking out most of the machine noise and letting in most of the sounds from signals and voices.**

Q-7 "If I wear earplugs or earmuffs I won't be able to hear `roof talk'."

A If you are working in a place with noisy machines, the noise is already too loud to hear `roof talk'. If you have been working without HPDs, when the machines stop your ears will be numb or a little bit deafened from the loud noise and you won't be able to hear the `roof talk'. What you should do is wear your HPDs when the machines are running and take them out when the machines stop. Then your ears will be fresh and strong and able to hear any `roof talk' if it happens. But remember to refit your HPDs before the machines start up again.

Q-8 "These earplugs will make my ears sick or cause an infection."

A The only way earplugs can cause a sickness in your ears is if you allow them to become dirty. You should never put dirty earplugs into your ears. If you use the kind of earplugs that can be used many times, you should wash them after each shift or whenever they get dirty. You should wash your earplugs every day using ordinary soapy water and a towel or tissue to dry them. If you drop your earplugs on the floor and they get dirty, clean them before you put them into your ears. If there is no water close by, you can even clean them with your finger by first wetting your finger in your mouth. Of course, you can only do this if your fingers are not dirty.

Earmuffs also need to be cleaned in order to avoid the risk of skin irritation. Use a clean, damp cloth or tissue to wipe the cushions every day or whenever they become dirty.

Q-9 "Earplugs are uncomfortable. They hurt my ears."

A It is true that safety equipment can be a little bit uncomfortable. It would be much more comfortable to work without a hardhat and without heavy safety boots and without a self-rescuer. But we wear these things because we **might** need them to protect ourselves against injury or death, in the case of an accident. Earplugs protect us against a hazard that is **always** present when the machines are working : **that hazard is noise and there is no question that noise WILL cause damage to anyone not wearing his HPDs.**

Just as you have got used to wearing a hardhat, you can get used to wearing HPDs. By wearing them only for short periods and taking them out when the noise is not so great, your ears will gradually adjust to them. If after three or four days you are still having trouble, you should try a different kind of earplug to see if it fits your ears better. Earplugs are a bit like shoes - some feet are only comfortable in certain types of shoes and similarly, some types of earplugs might be more comfortable for you than others. The only way to find out if a certain type of plug fits your ears is to try it out for a few days. If they do fit well, eventually you won't notice that they are in your ears. You'll even find that without your earplugs you feel uncomfortable in noisy places.

When you wear your earplugs in the noise, at the end of the shift you'll find that your ears don't feel half-deaf and you won't have that ringing or hissing noise inside your ears. (This noise inside your ears is caused by damage to the little nerves inside the inner ear and for some people, the hissing or ringing is so loud that it keeps them awake at night.) Another thing you'll find if you wear your HPDs is that you won't feel so tired at the end of your shift. Noise actually causes stress and tiredness, the same as heat and the same as worries. In addition to protecting your hearing, HPDs can reduce the stress of working in a noisy job. (Lighter side : If you feel uncomfortable or stressed

when someone shouts at you, perhaps earplugs will help!)

Q-10 "Earmuffs make me feel too hot."

A If you work underground or in a hot place on surface, earmuffs might make you feel too hot and uncomfortable. This might also be true if you do a lot of hard work or operate a hot machine. If earmuffs make you feel too hot, then you should probably try earplugs. **EARPLUGS AND EARMUFFS BOTH GIVE SIMILAR PROTECTION AGAINST LOUD NOISE**. Earplugs are better for people who work very hard in hot places; earmuffs are better for people who are constantly going into and out of the noise, because earmuffs are easier to put on and take off. Some people use band-mounted earplugs because, like earplugs, they are not too hot to wear, and, like earmuffs, they are easy to put on and take off.

Q-11 "I know my job and I don't need to hear anything to do it properly."

A All of us working on the mine are part of a team and team members must work together. We need to be able to communicate with each other in order to work efficiently and safely.

Q-12 (NB This is not often expressed but indications are that a number of men are thinking along these lines, especially as they approach retirement. It is a comment/question that the presenter could raise by saying `Many men think that ...)

"I don't want to wear earplugs because I'm already a little bit deaf and I'm planning to get more deaf so I can get paid compensation by the mine."

A This is an indication that the man who thinks this way, firstly, doesn't appreciate how valuable his hearing is and how much he depends on it. Secondly, it shows that he doesn't know how deaf he would need to be before he got any money. If you can hear what I'm saying to you now, then it will take many more years of very loud noise before you are deaf enough to get any money. Finally, even if you did become so deaf that you couldn't hear

properly and you qualified for some compensation, you would probably only get a single, one-off, lump-sum payout equal to half of your monthly salary. If you were very deaf you might get more than half of one month's salary, but it would still be a single one-time-only payment in most cases. Even if you were deaf enough to get a pension, it would only be a small part of your present earnings and you would need to give up your job in order to collect it. And remember, the money won't do anything to help your deafness. There are many men who have difficulty understanding others but who are not deaf enough to get **any** money. All they have to show for their years in the noise is bad hearing.

DON'T LET IT HAPPEN TO YOU. YOU CAN PREVENT IT BY WEARING YOUR HPDs WHENEVER YOU ARE IN LOUD NOISE.

A-8.1.4 Part 4: Use of the handout for trainees, "Make Safe Your Ears" (English) and Vikela izindlebe zakho (Zulu)

GEN 011 HEARING CONSERVATION

GUIDELINES FOR TRAINERS : PART 4

USE OF THE HANDOUT FOR TRAINEES, "MAKE SAFE YOUR EARS"

PREFACE

The present guidelines for trainers are intended to assist in realising maximum benefit from the use of the booklet "Make Safe Your Ears." The booklet was designed as a handout for trainees participating in hearing conservation training and induction programmes, and has been produced in English and Zulu language versions.

Although some concern may exist around the differing levels of literacy prevailing within the target audience, it would be the trainer's responsibility to assist trainees in the use of the booklet, as required. Furthermore, in dealing with a topic that should be of interest to noise-exposed workers, training aids that challenge the audience's reading skills can actually contribute to the further development of those skills.

Education, motivation and training comprise an essential element of any personal protection strategy, and this is especially true where hearing protection devices are required as part of a hearing conservation programme. In response to this need the CSIR: Division of Mining Technology produced the present guidelines for trainers, on behalf of the Safety in Mining Research Advisory Committee and the Department of Minerals and Energy as part of Project GEN 011.

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1. INTRODUCTION AND GENERAL INFORMATION TO ASSIST THE TRAINER

These guidelines for trainers are intended to assist in realising maximum benefit from the A-5 booklet designed as a handout for trainees. **The booklet should reinforce information on hearing conservation and hearing protection devices (HPD) already presented during the training and induction programme.** In order to provide for different audiences, the booklet has been produced in English (Appendix 1) and in Zulu (Appendix 2), but the guidelines that follow are in English.

Topics dealt with in the booklet include:

- **Consequences of exposure to loud noise**
- **How to recognise dangerous noise**
- **Advantages of using HPDs**
- **Various types of HPDs**
- **Correct use and care of HPDs.**

Although the booklet may be self-explanatory for some individuals, the trainer should not make this assumption, especially for an entire group. **As with any training materials or learning activity, optimal effectiveness will only be achieved if appropriate preparation has been made.** Depending on time constraints and the extent to which hearing conservation and personal protection have already been dealt with during training and induction, the trainer may choose:

i) **to briefly outline the format and message of the booklet** at the time of distribution, relying on trainees to read the handouts on their own (this approach would only be beneficial where members of the group have already participated in a comprehensive training and induction programme on hearing conservation and have the necessary reading skills);

ii) **to work through the booklet on a page-by-page basis,** emphasising important points and providing an explanation of those that cause difficulty/disagreement, or appear to have eluded members of the group; or

iii) **to adopt an approach that includes elements of both i) and ii).**

These guidelines provide sufficient information for the trainer to follow the second approach, if time allows. Each page of the booklet has a heading which either summarises or characterises the topic dealt with on that particular page. Our "Narrator" or "Trainer" in the booklet is a Team Leader, modelled after the presenter in the video "To Hear Or Not to Hear: The Choice Is Yours". He serves as a credible source of information, answering questions posed by characters in the booklet and providing explanation of various points.

2. NOTES FOR TRAINERS

FRONT COVER: "MAKE SAFE YOUR EARS"

The trainer should initiate a discussion introducing the issue of hearing protection, pointing out, or encouraging members of the group to point out, the various types of HPDs illustrated on the cover of the booklet. Also draw attention to the blue-and-white warning sign for hearing protection in the upper-right corner of the cover. If members of the group are not aware of the meaning of this sign, they should be informed, preferably by other members of the group.

PAGE 1: "WORK SMART AND WORK SAFE - PROTECT YOUR HEARING"

On the opening page our narrator makes **a strong connection between working smart and working safe.** He reminds the reader of the **importance of safety equipment** and points out the fact that **some men fail to protect themselves against loud noise,** and that **such men will certainly suffer damage.** The narrator acknowledges that some men may have reservations or questions about using hearing protection, but he undertakes to address these concerns in the booklet.

PAGE 2: "BAD HEARING CAUSES PROBLEMS..."

Here we see a mineworker who believes that his ears are accustomed to the noise. The narrator explains that the reason why **this mineworker doesn't find the noise to be too loud is because his ears have already lost some of their hearing.** The reader then sees how the **mineworker's hearing loss is causing problems:**

i) **at work:** he cannot hear what his supervisor is saying to him;
ii) **in social situations:** he cannot hear what his friends are talking about, and
iii) **even when he is alone:** he cannot hear the music from his new radio, although it is clear to the reader that there is definitely music coming out of the radio.

PAGE 3: "...THESE PROBLEMS CAN HURT YOUR JOB"

The reader now sees the same mineworker from Page 2 about to undergo his annual medical examination to renew his Red Ticket. After his ears are tested, the Medical Station Superintendent informs him that **his hearing is so bad he has become a safety risk.** The man then realises that **he should have used his HPDs** while working in loud noise, but of course **it is too late now:** HIS EARS ARE PERMANENTLY DAMAGED.

PAGE 4: "HOW TO RECOGNISE DANGEROUS NOISE"

Another man now asks a very important question that the reader himself should also be asking: **"How can I tell if the noise is loud enough to damage my ears?"** The narrator answers him, saying that there are **three different ways to recognise dangerous noise:**

1) **the blue-and-white warning sign** for hearing protection tells us when the noise is dangerous;
2) if it is necessary for people standing close by to **shout in order to hear each other** then the noise is dangerous;
3) if someone hears a **ringing or buzzing or hissing sound inside his ears** at the

end of the shift then the noise was dangerous.

The reader is reminded that **wherever the noise is dangerous he should be wearing HPDs.**

PAGE 5: "WHAT ABOUT ROOFTALK?"

A mineworker expresses the belief that HPDs will prevent him from hearing rooftalk. The narrator explains that **while the machines are working there is too much noise to hear rooftalk** and that **someone who has been working without HPDs will not be able to hear the rooftalk even after the machines stop, because his ears will be tired from all the noise.**

In the next scene on Page 5 the reader sees **a man who has been wearing HPDs** (his band-mounted earplugs are around his neck; he has removed them from his ears because the machines have stopped). He is **shouting to a machine operator who has not been wearing HPDs, "Rooftalk!! Get out!!".** It is then explained to the reader that **it is better to wear HPDs while the machines are working, and to remove them only when the machines stop, remembering to refit the HPDs before the machines restart.** In this way it is possible to keep one's ears fresh and able to hear rooftalk should it occur.

PAGE 6: "CAN A HEARING AID FIX-UP THE DAMAGE IN MY EARS - NO!

A mineworker expresses the opinion that a hearing aid can solve the problem of hearing loss caused by loud noise. The narrator states that **a hearing aid CANNOT fix the problems caused by loud noise.** He acknowledges that **a hearing aid can help someone with weak ears such as an old person,** but explains that **loud noise destroys some of the tiny nerves inside the ear** and that **making the sound louder will not help the dead nerves to hear it.** For the person with noise-induced hearing loss who wears a hearing aid, some of the sound will be louder, but **other parts of the sound will not be heard at all,** no matter how loud the volume control of a hearing aid is turned up.

This will result in the person hearing things incorrectly. On the right side of Page 6 are two examples illustrating this effect:

- At the upper right the reader sees a radio playing music and the sound is being made louder by a hearing aid which is fitted in a person's ear. The hearing aid delivers all of the sound into the ear, but because **some of the tiny nerves inside the ear have been destroyed, only certain parts of the sound are received by the brain.** This causes confusion for the person.

- At the lower right **a mineworker is speaking to another man who is wearing a hearing aid.** Look closely at the man on the right and the hearing aid will be visible in his ear. IT WILL PROBABLY BE NECESSARY TO POINT OUT THE HEARING AID TO TRAINEES. When the first man tells the one with the hearing aid that it is time to knock-off and go home ("Chiela. Hamba khaya."), **the man with the hearing aid only hears some of the sounds** (the high-pitched consonant sounds are lost) **and he completely misinterprets the message as "MAMBA."**

These two examples illustrate the fact that **a hearing aid can make the sound louder, but once noise has destroyed some of the tiny nerves inside the ear, the person will never be able to hear properly again, even with a hearing aid, because some of the sounds are lost.**

PAGE 7: "DIFFERENT TYPES OF HPDs"

The narrator explains that, because of the different jobs, workplaces and men on the mine, there are different types of HPDs, which he presents to the reader. In addition to the six types of HPDs, a storage case for earplugs is illustrated.

PAGE 8: "EARMUFFS"

The narrator explains that earmuffs are suitable for people who go in and out of noisy areas, but IT SHOULD BE POINTED OUT BY THE TRAINER THAT EARMUFFS ARE

UNCOMFORTABLE TO WEAR IN HOT PLACES. The narrator draws attention to the strong band that presses the earmuffs tightly around the ears, and the reader is shown **how to wear earmuffs without and with a hardhat.**

The narrator shows the reader helmet-mounted muffs and how to use them, pointing out that **muffs do not work very well for people with large earrings, long hair or glasses.**

THE TRAINER SHOULD EXPLAIN THAT THESE THINGS PREVENT THE MUFFS FROM SEALING PROPERLY AND EMPHASISE THAT THE SAME PROBLEM WOULD OCCUR WITH SOME TYPES OF SAFETY GOGGLES.

PAGE 9: "BAND-MOUNTED PLUGS"

The narrator shows the reader a pair of **band-mounted plugs** and explains that, like earmuffs, they are **easy to put on and take off, making them a good choice for people going in and out of noisy areas.** He also mentions that **band-mounted plugs are more comfortable to wear in hot areas than muffs.**

The illustrations on the right side of Page 9 illustrate the **two methods of wearing band-mounted plugs: with the band behind the neck and with the band under the chin.**

THE TRAINER SHOULD POINT OUT TO TRAINEES THAT SOME BAND-MOUNTED PLUGS WILL ONLY GIVE GOOD PROTECTION WHEN WORN UNDER THE CHIN, BUT, WHERE THIS IS THE CASE, IT IS CLEARLY STATED ON THE INSTRUCTION SHEET THAT COMES WITH THE BAND-MOUNTED PLUGS.

PAGE 10: "FITTING AND CARING FOR PRE-MOULDED EARPLUGS"

On the left side of this page, the narrator shows the reader **"pre-moulded earplugs", which are often referred to as "re-usable plugs".** He demonstrates the **use of the little handle** and reminds the reader to **make certain that the plug is clean.**

The three illustrations down the centre of the page demonstrate the **correct method of fitting this type of plug.**

At the right side of the page the narrator tells the reader about the **importance of keeping earplugs clean in order to avoid ear problems,** and **the correct method of washing, drying and storing** re-usable plugs is illustrated.

PAGE 11: "FITTING UNMOULDED EARPLUGS"

On the left side of the page the narrator tells the reader that **"unmoulded earplugs", which are often referred to as "disposable plugs", must first be shaped in the fingers in order for them to fit into the ears.**

The five illustrations on the remainder of Page 11 demonstrate the **importance of having clean hands before shaping the plug in the fingers,** and the **correct method of fitting unmoulded or disposable plugs.**

THE TRAINER SHOULD MAKE A POINT OF TELLING TRAINEES THAT DISPOSABLE PLUGS SHOULD NOT BE WASHED WHEN THEY BECOME DIRTY, BUT DISCARDED AND REPLACED WITH A NEW PAIR. **(This is because most disposable plugs are made of compressible foam, which absorbs and retains soap and water. The soap can irritate the sensitive skin inside the ear, and the water fills up the air spaces in the plug that are meant to absorb loud noise, rendering the plugs ineffective.)**

PAGE 12: "YOUR CHOICE OF HPDs DEPENDS ON WHERE YOU WORK"

At the top of the page the narrator points out that **the man on the left operating the grinder uses earmuffs, because it is not so hot in the workshop,** while **the machine operator on the right works underground where it is hot, so he prefers earplugs.**

The four illustrations on the lower part of the page demonstrate the **correct method of fitting a "pre-moulded" or "re-usable plug" that does not have a little handle.**

The method is identical to that for plugs with handles, except for the way of holding the plug while inserting it.

At the lower-right corner Page 12, **the reader is reminded, once again, that earplugs must be kept clean.**

PAGE 13: "FOR EARPLUGS TO PROTECT YOU, THEY MUST FIT PROPERLY"

The narrator tells the reader **how to check that earplugs are fitted correctly: by lightly pressing against each plug with one finger.** He explains that **if doing this makes the noise seem much softer, the plugs are not fitted correctly and should be refitted.**

On the right side of the page are **two picture comparing a badly-fitted plug with a correctly-fitted plug:**

- **The upper drawing is marked with a large X to show that the plug is not correctly fitted,** and the bold arrows inside the plug show the reader that **this plug is not blocking out the loud noise.**

- **The lower drawing is marked with a large TICK (✓) to show that this plug is correctly fitted,** and the grey arrows inside the plug show the reader that **this plug is blocking out the loud noise while still allowing most of the sounds from speech and signals to pass through.**

At the bottom of the page is a drawing of the ear with **bold arrows showing how loud noise enters and travels through the ear.** At the right is a **magnifying glass that allows the reader to see the tiny hair-like nerves inside the ear. It is these nerves that send information about the sound to the brain, allowing the person to hear. Loud noise destroys some of these nerves, which causes some of the information to be lost, MAKING IT IMPOSSIBLE FOR THE PERSON TO HEAR CERTAIN SOUNDS.**

THE TRAINER SHOULD POINT OUT THAT, ONCE THESE TINY NERVES ARE

DESTROYED BY LOUD NOISE, THE HEARING LOSS THAT RESULTS IS PERMANENT. THE NERVES DO NOT GROW BACK.

TRAINEES SHOULD BE TOLD THAT EACH AND EVERY ONE OF THEM WHO HAS WORKED IN LOUD NOISE WITHOUT USING HPDs HAS CERTAINLY HAD SOME OF THESE NERVES DESTROYED ALREADY, AND SHOULD PREVENT FURTHER DAMAGE BY ALWAYS USING HPDs WHILE WORKING IN LOUD NOISE.

LOOK AFTER THE GOOD HEARING YOU STILL HAVE BY USING HPDs WHERE THE NOISE IS DANGEROUS.

PAGE 14: "SAFETY RULES FOR EARPLUGS"

The narrator tells the reader that **whatever type of earplugs are used, they should only be removed after leaving the noisy area or after the noise stops.** THE TRAINER SHOULD EMPHASISE TO TRAINEES THAT THIS IS TRUE FOR ANY TYPE OF HPD.

The narrator advises the reader to **remove his earplugs slowly and carefully to avoid hurting his ears.** THE TRAINER SHOULD TELL TRAINEES THAT THE SAFEST WAY TO REMOVE EARPLUGS IS IN THE SAME WAY THEY ARE INSERTED: BY FIRST PULLING THE TOP OF THE EAR OUTWARDS, TO OPEN THE EAR CANAL AND "BREAK THE SEAL" BETWEEN THE EAR AND THE EARPLUG.

On the right side of Page 14 are two drawings:

- The upper drawing shows a headgear marked with a large X, and there is a warning to the reader that he should NEVER TRAVEL UP OR DOWN IN THE CAGE WHILE WEARING EARPLUGS: HE SHOULD REMOVE HIS EARPLUGS BEFORE ENTERING THE CAGE. THE TRAINER SHOULD EXPLAIN THAT THIS IS TO AVOID DISCOMFORT, PAIN AND POSSIBLE DAMAGE TO THE EARDRUMS CAUSED BY CHANGES IN AIR PRESSURE WHILE THE CAGE IS TRAVELLING. This would not normally be a problem at collieries or other shallow mines.

- The lower drawing is of a WHITE CROSS with a large TICK (✓). The reader is told NOT TO WEAR EARPLUGS IF HE DEVELOPS A SORE OR AN EAR INFECTION: He should HAVE IT SEEN TO AT THE MEDICAL STATION. Once again the reader is reminded to KEEP HIS EARPLUGS CLEAN.

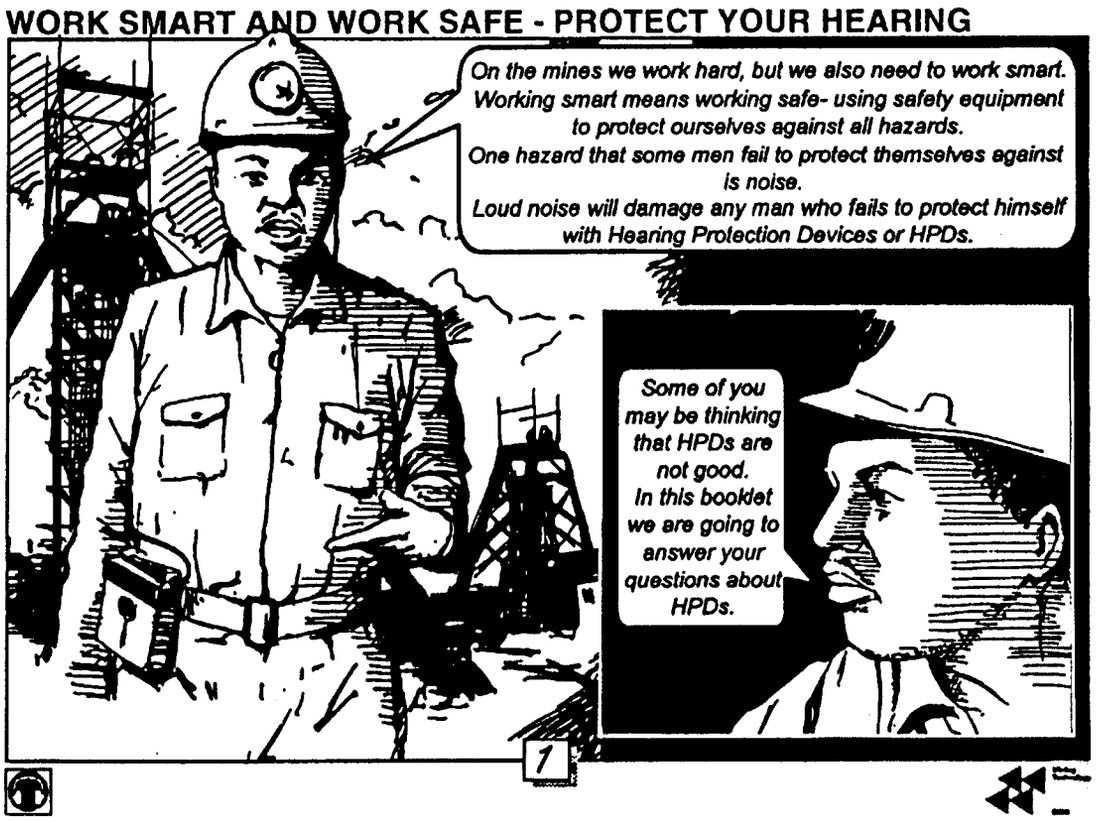
BACK COVER: TO HEAR OR NOT TO HEAR, THE CHOICE IS YOURS!
THE TRAINER SHOULD EMPHASISE THE IMPORTANCE OF THIS CHOICE: BY USING HPDs THE MEN WILL BE PROTECTING THEMSELVES FROM HEARING LOSS AND ALL OF ITS CONSEQUENCES, WHICH CAN IMPACT TREMENDOUSLY ON THEIR JOBS, THEIR FRIENDSHIPS AND THEIR FAMILY LIFE.

APPENDIX 1

HANDOUT FOR TRAINEES : "MAKE SAFE YOUR EARS"

The English version of the handout for trainees, "Make Safe Your Ears" has been reproduced in this Appendix. The booklet itself is in A-5 landscape format and, accordingly, two pages from the booklet (including front and back covers) have been reproduced on each of the following eight pages.

WORK SMART AND WORK SAFE - PROTECT YOUR HEARING



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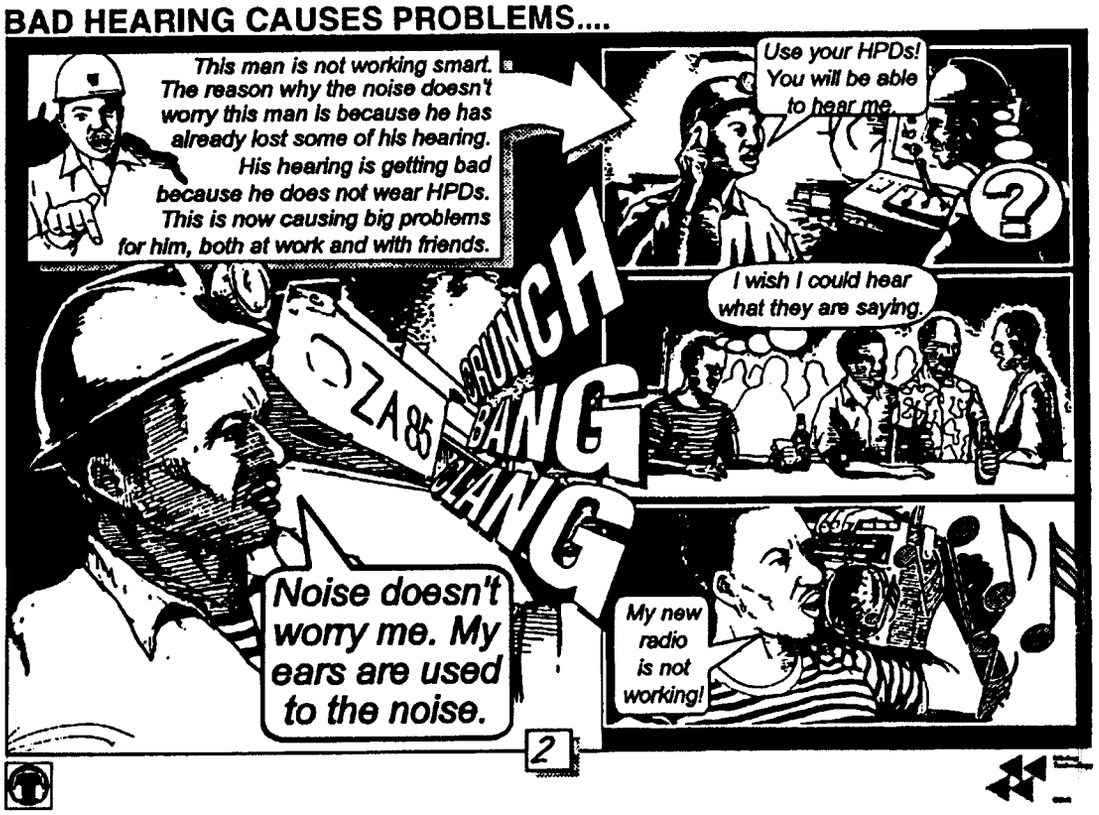
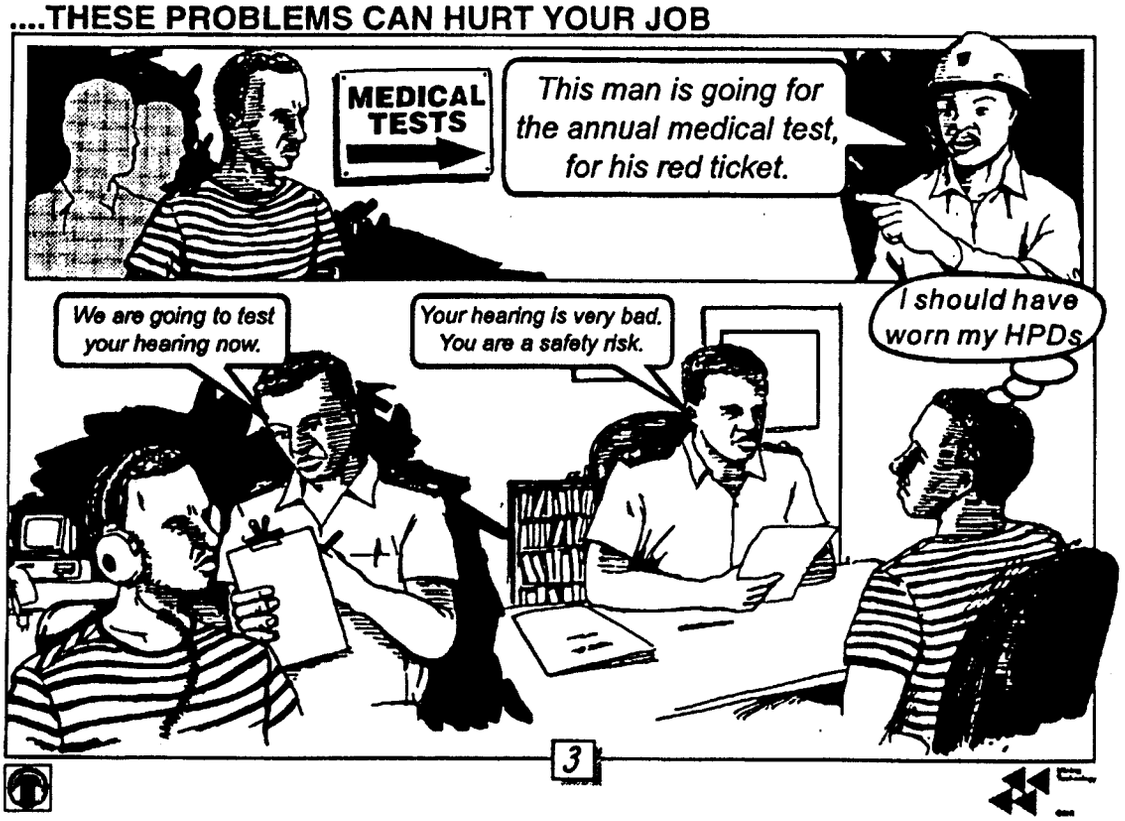
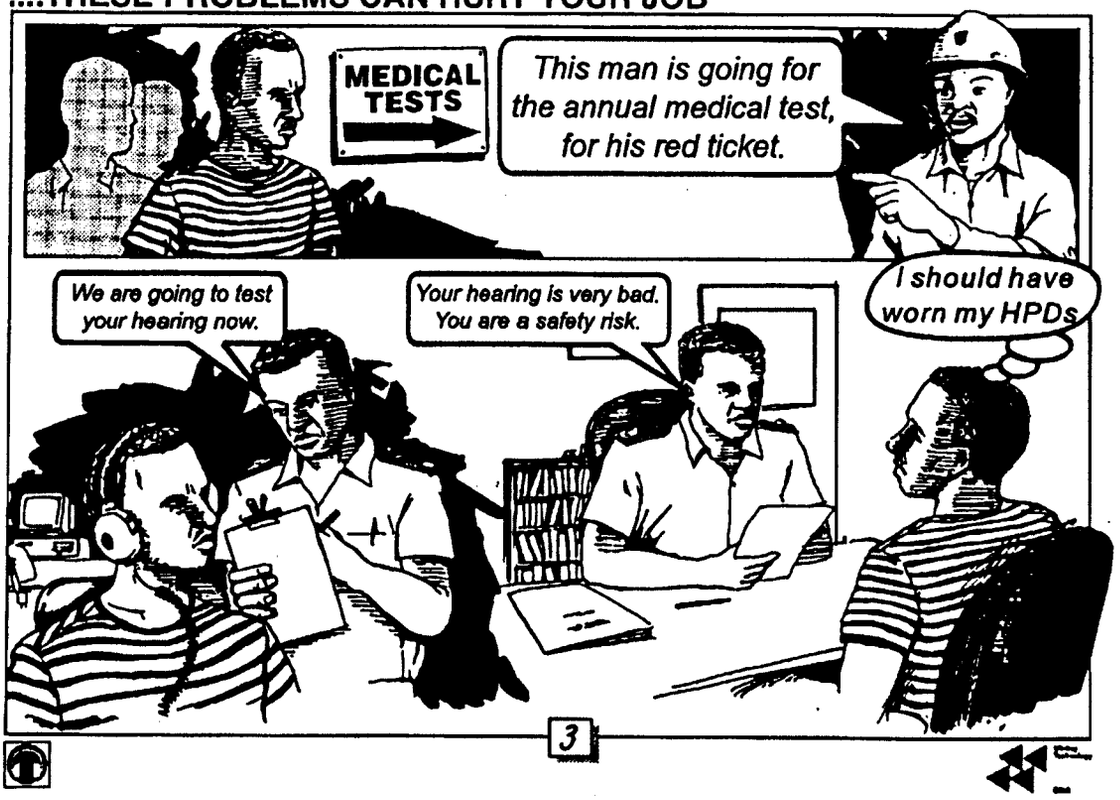


....THESE PROBLEMS CAN HURT YOUR JOB

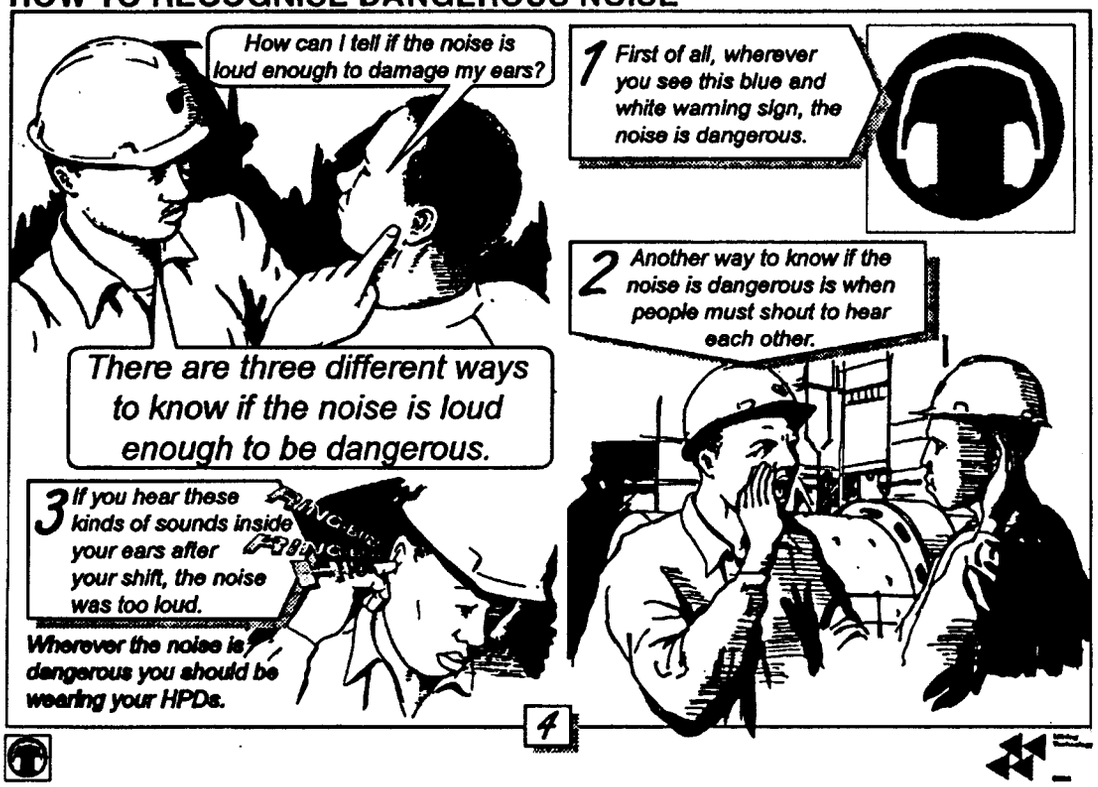


BAD HEARING CAUSES PROBLEMS....

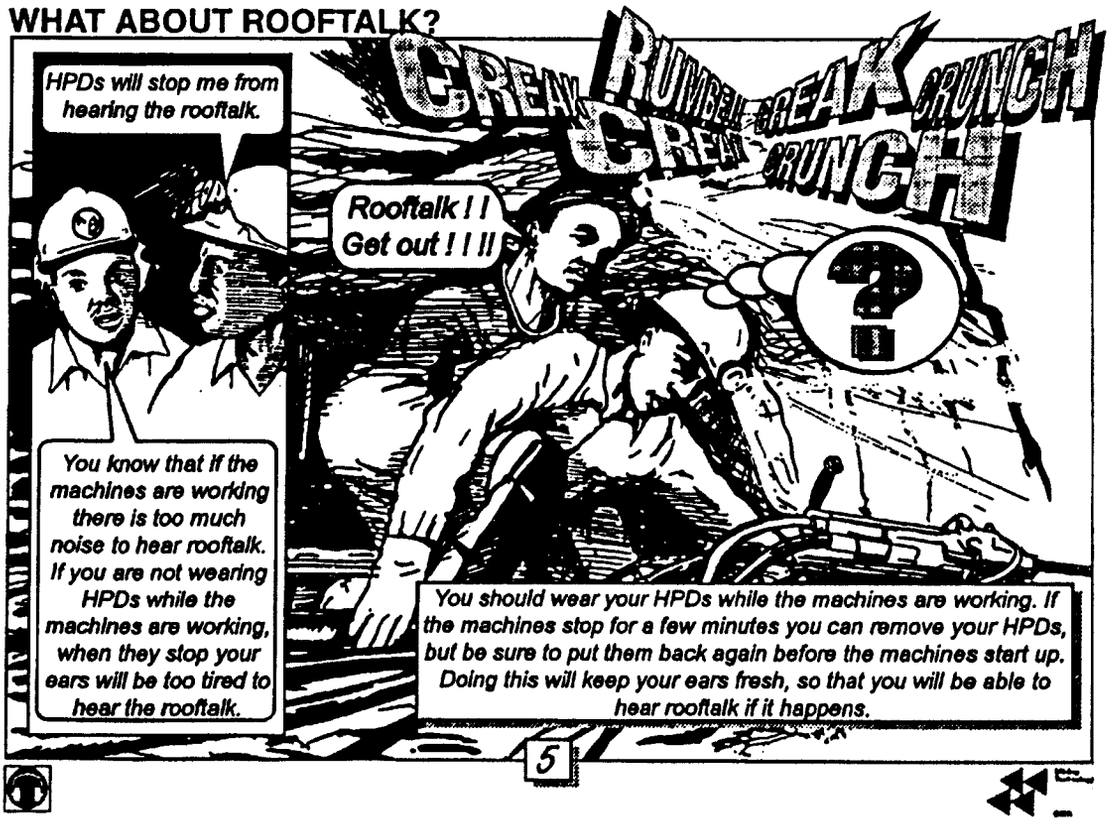
....THESE PROBLEMS CAN HURT YOUR JOB



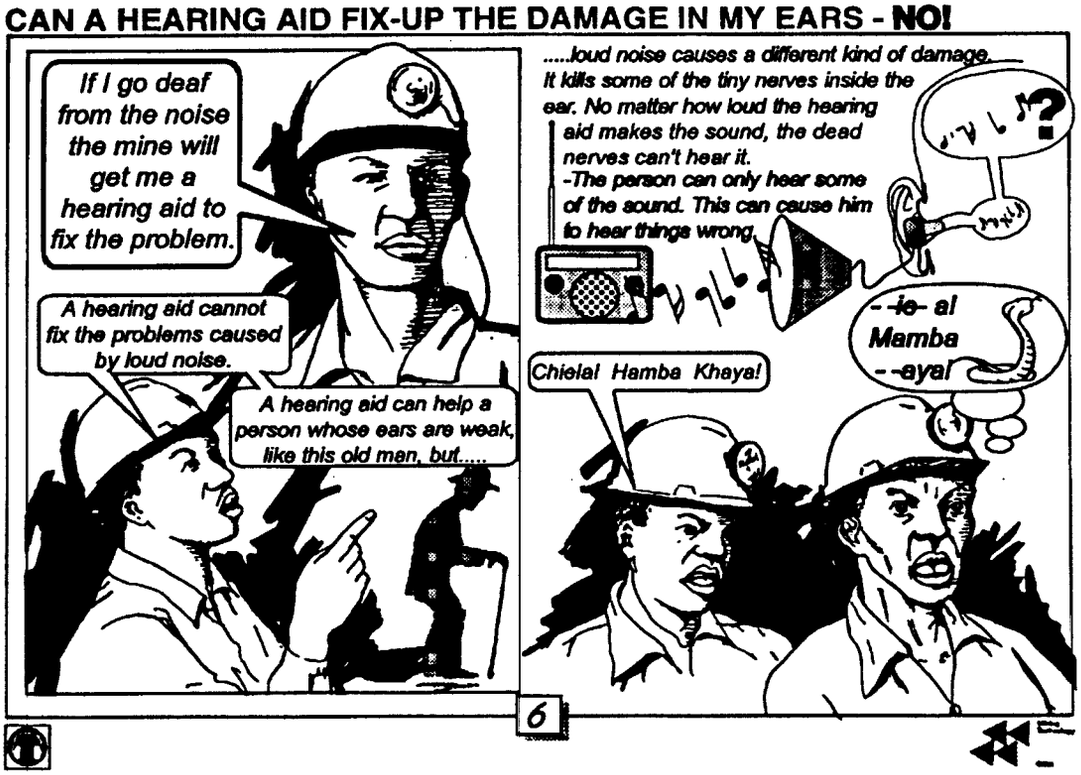
HOW TO RECOGNISE DANGEROUS NOISE



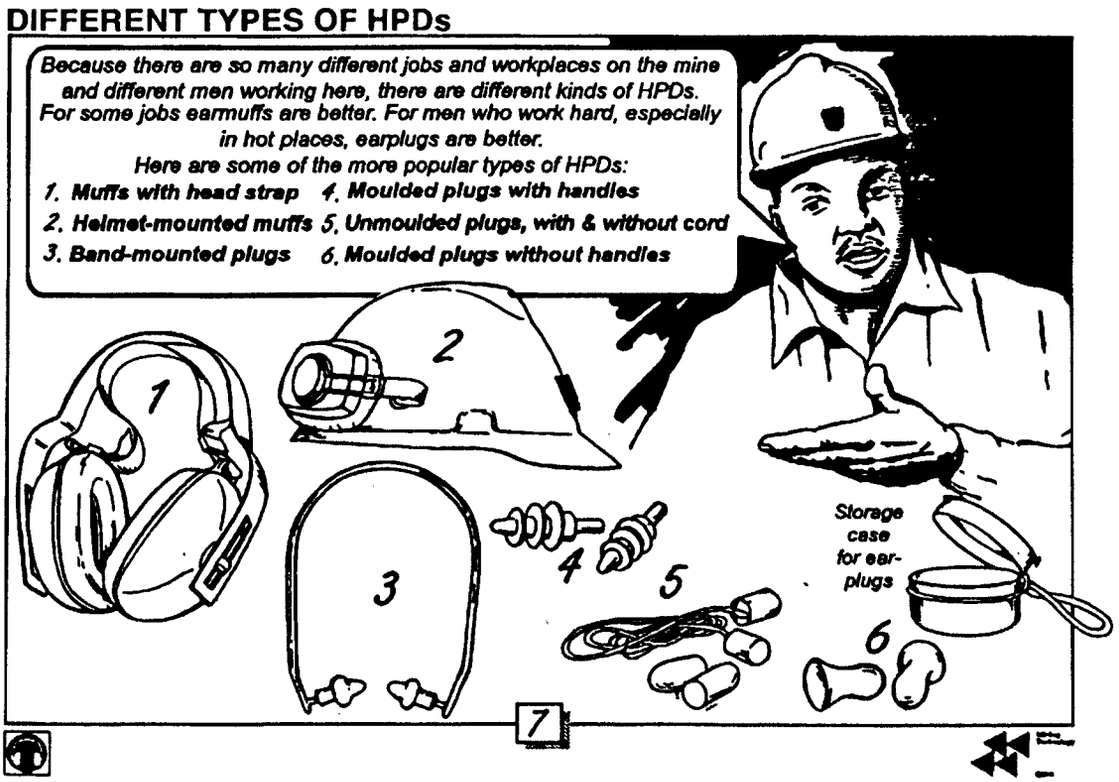
WHAT ABOUT ROOFTALK?



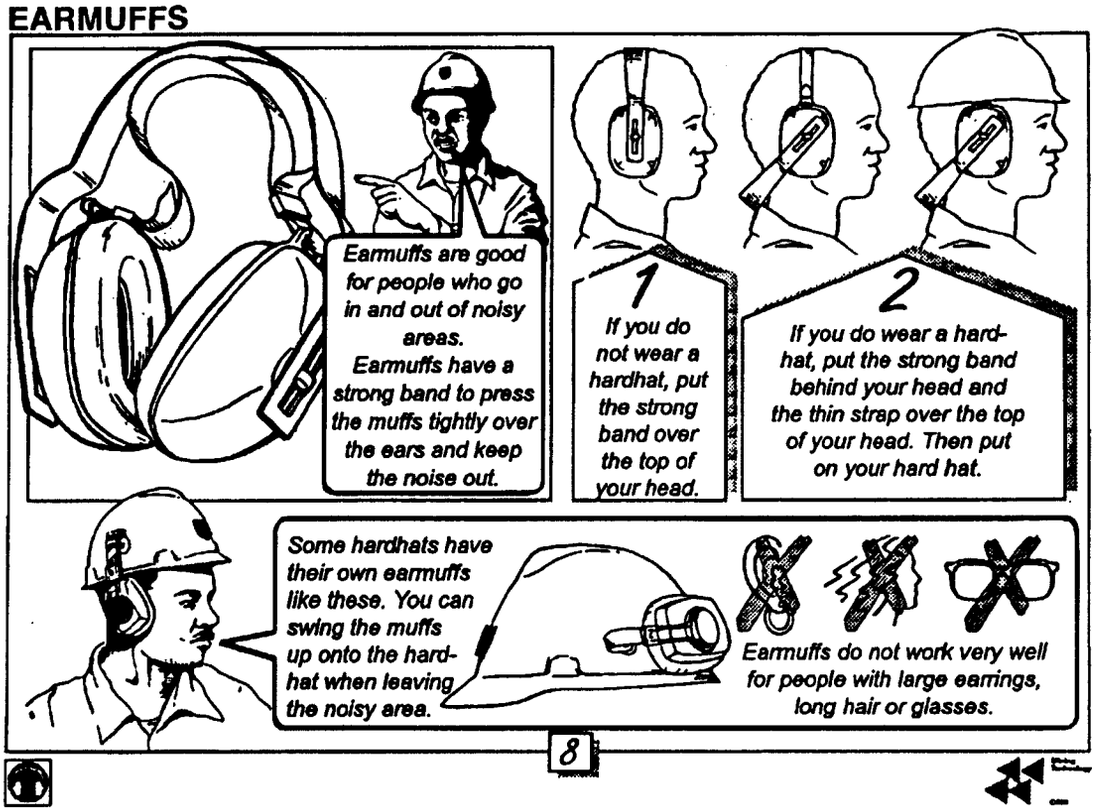
CAN A HEARING AID FIX-UP THE DAMAGE IN MY EARS - NO!



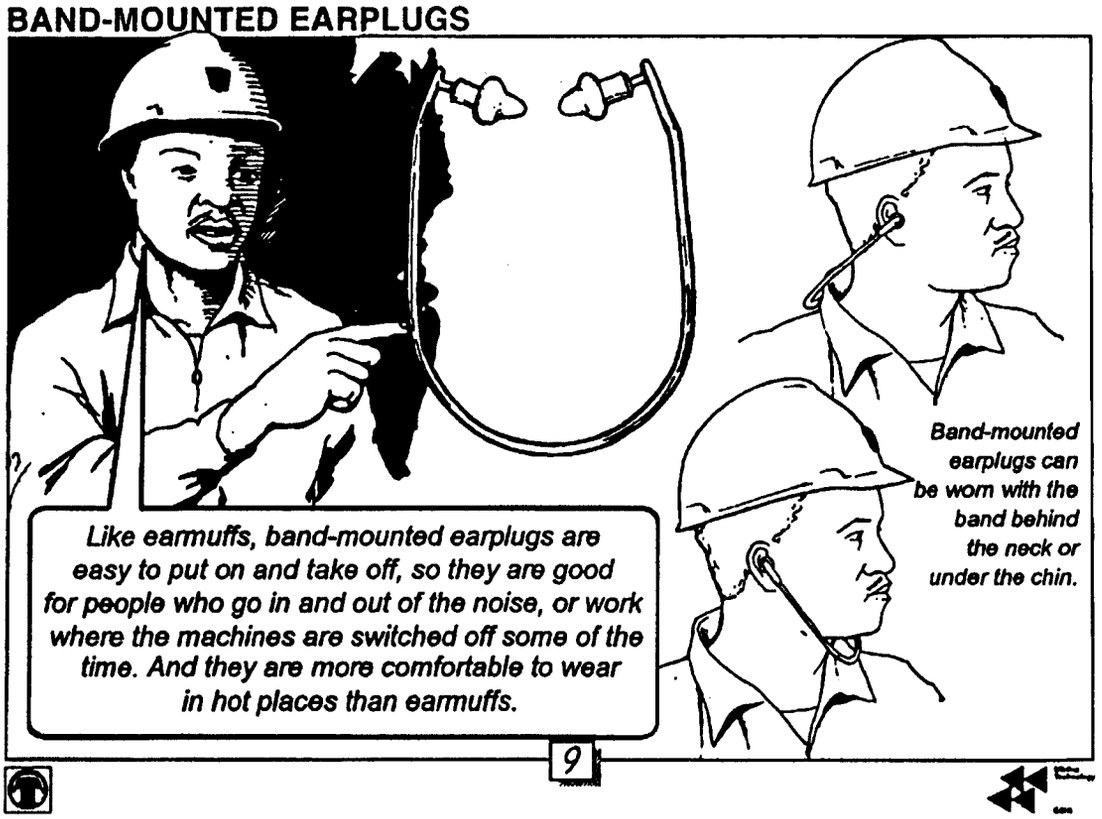
DIFFERENT TYPES OF HPDs



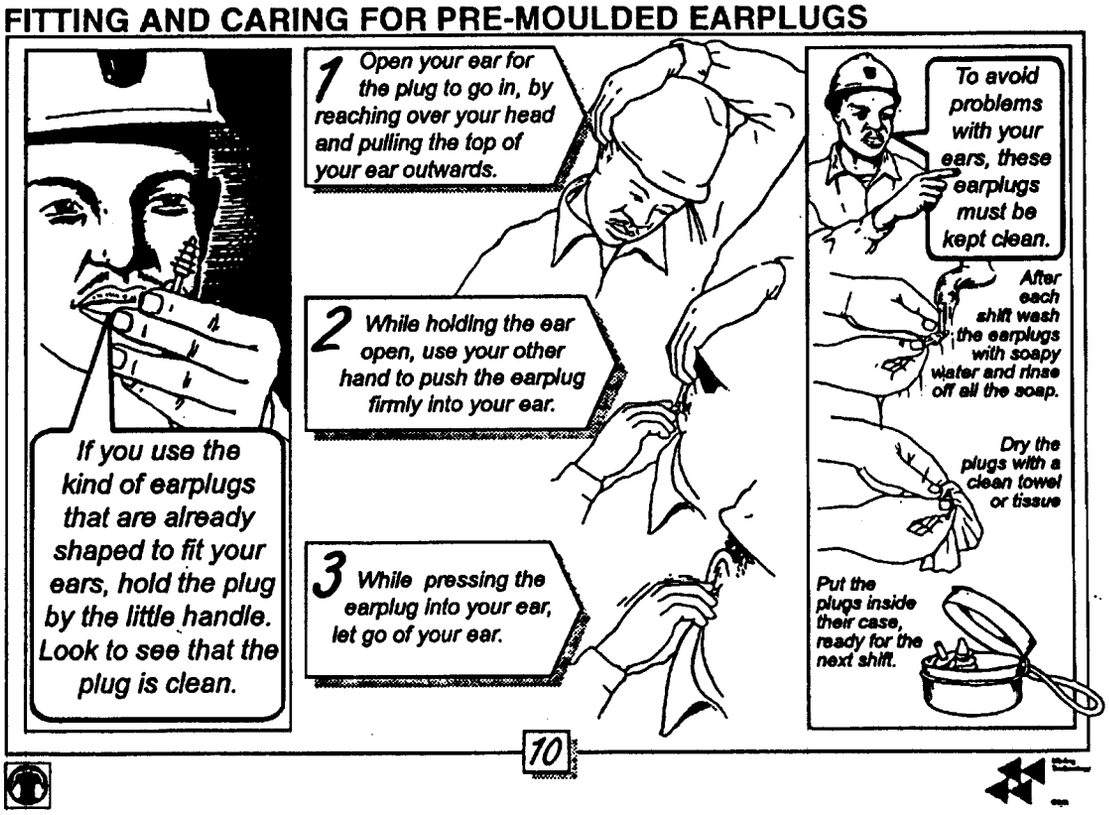
EARMUFFS



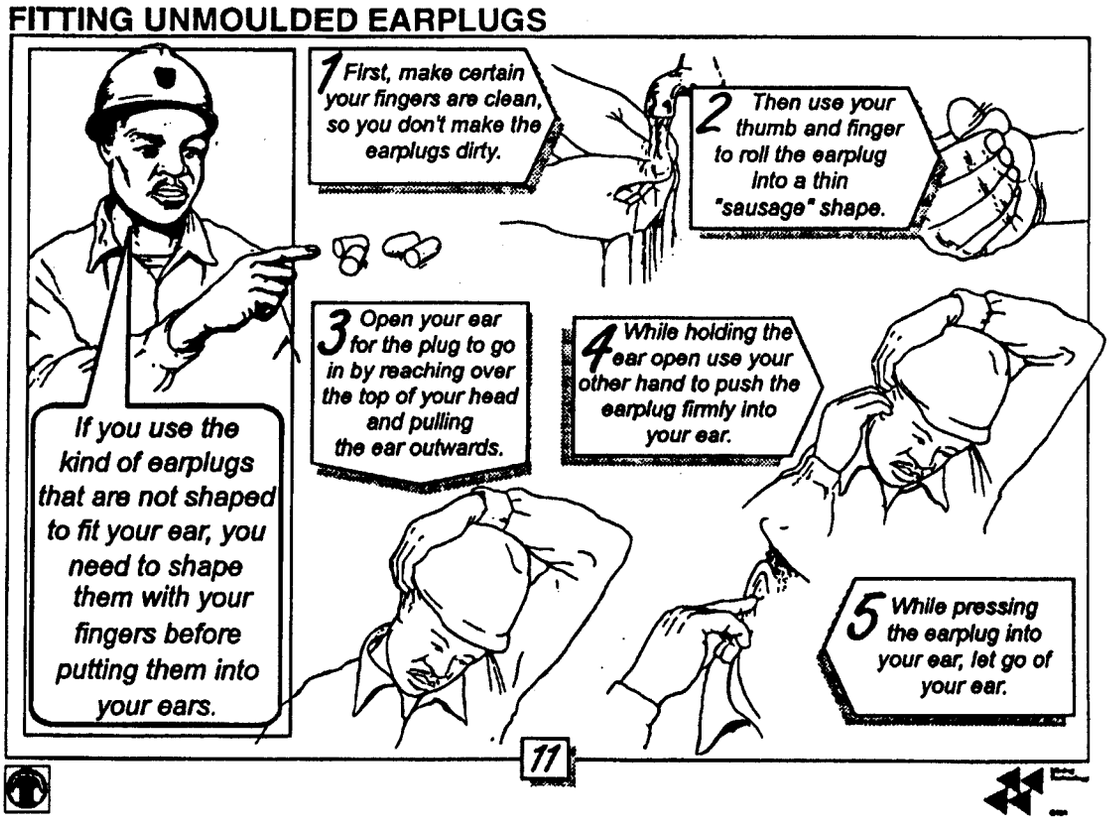
BAND-MOUNTED EARPLUGS



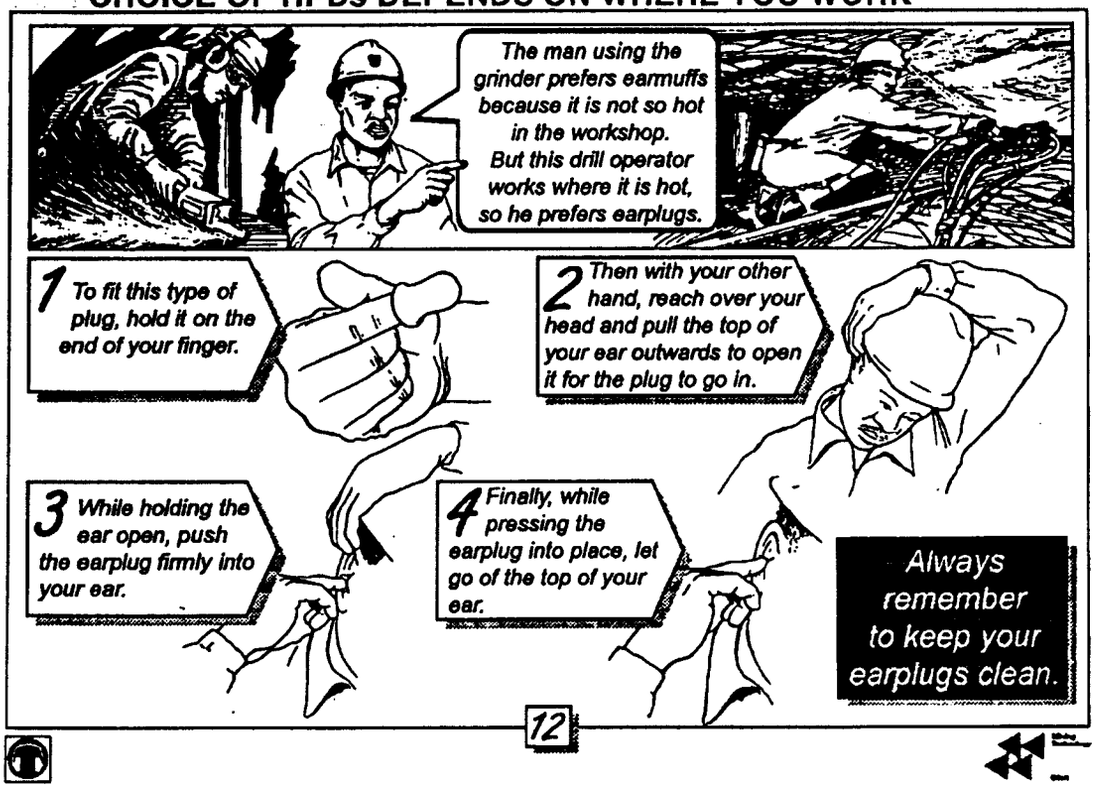
FITTING AND CARING FOR PRE-MOULDED EARPLUGS



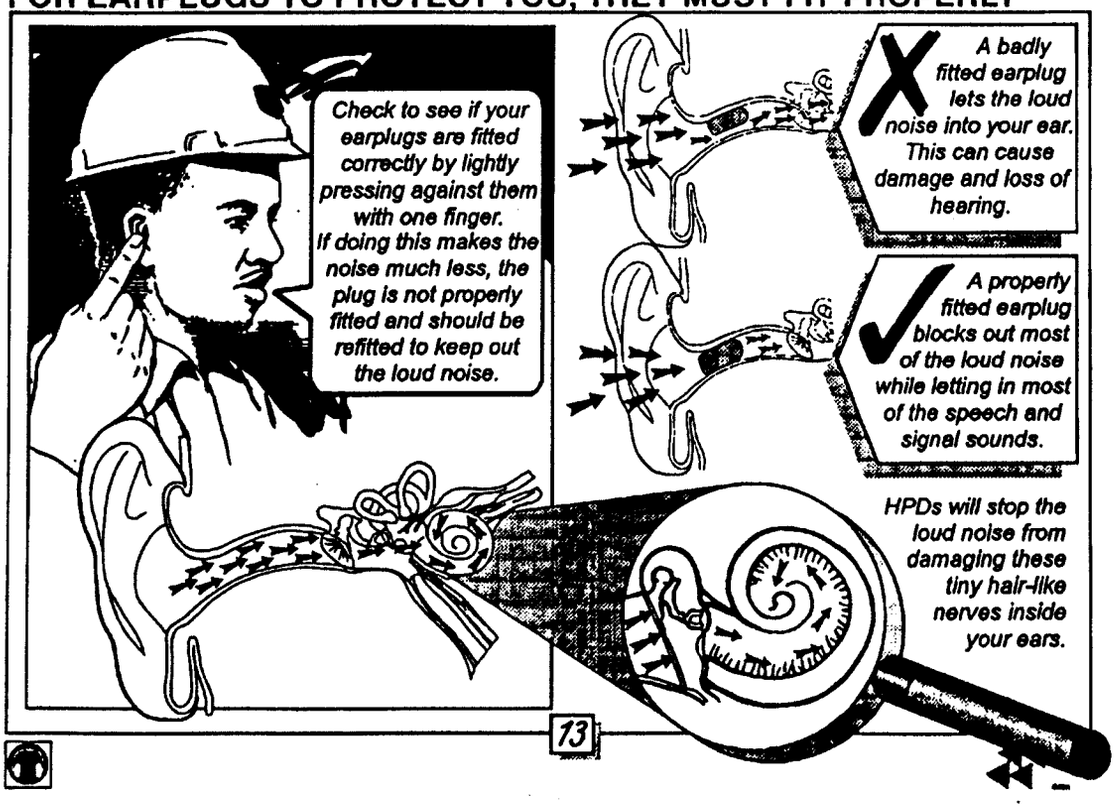
FITTING UNMOULDED EARPLUGS



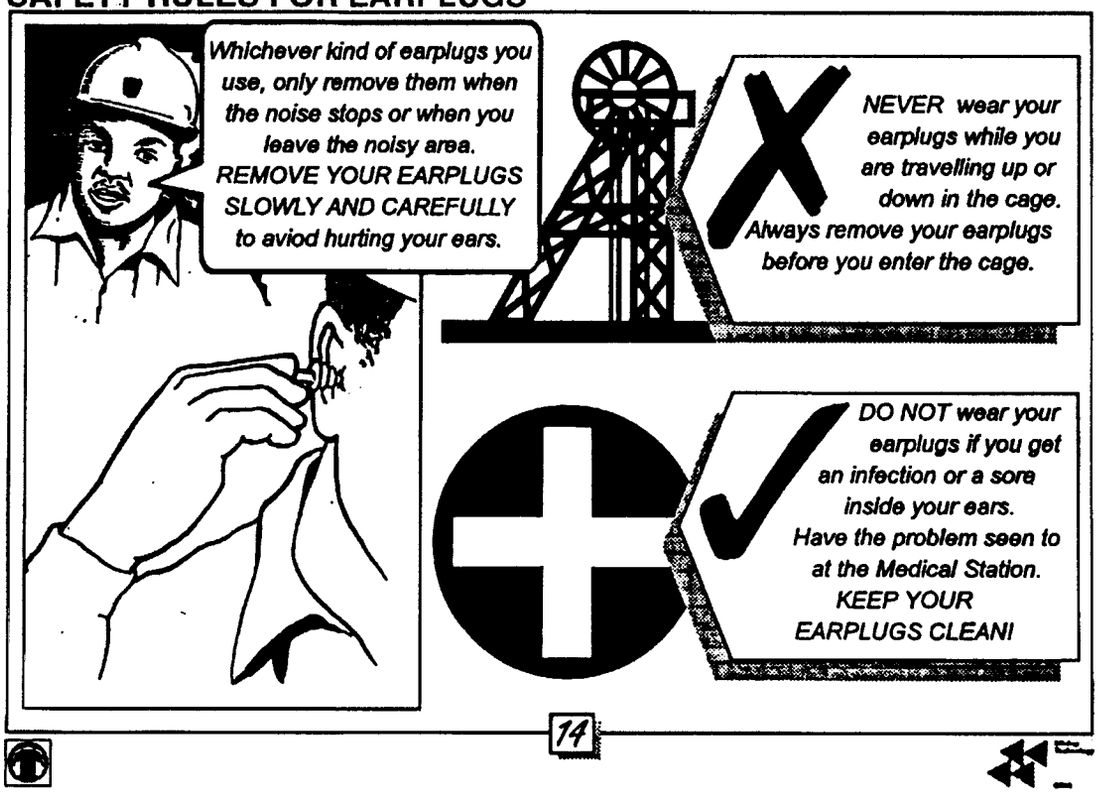
CHOICE OF HPDs DEPENDS ON WHERE YOU WORK



FOR EARPLUGS TO PROTECT YOU, THEY MUST FIT PROPERLY



SAFETY RULES FOR EARPLUGS



To Hear Or Not To Hear

The Choice Is Yours!

FOR MORE INFORMATION: THE MANAGER, OCCUPATIONAL HYGIENE
CSIR DIVISION OF MINING TECHNOLOGY
P.O. BOX 91230, AUCKLAND PARK 2006
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Mining Technology
CSIR

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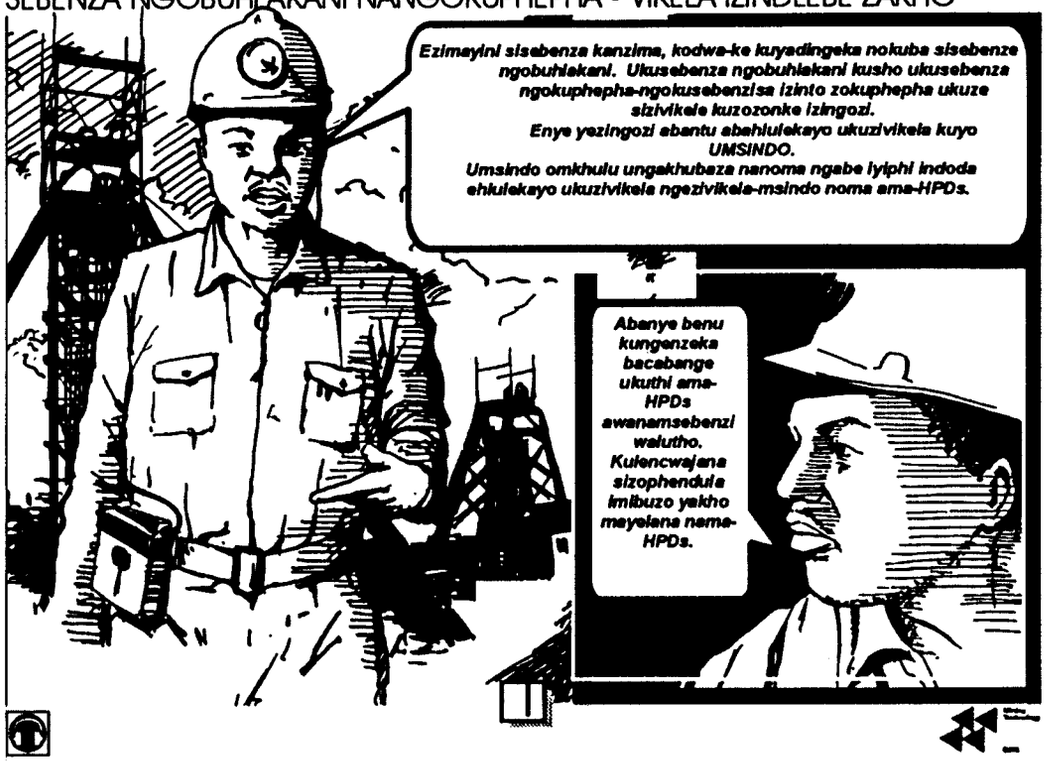
APPENDIX 2

HANDOUT FOR TRAINEES : "Vikela izindlebe zakho"

The Zulu version of the handout for trainees, "Vikela izindlebe zakho" has been reproduced in this Appendix. The booklet itself is in A-5 landscape format and, accordingly, two pages from the booklet (including front and back covers) have been reproduced on each of the following eight pages.

SEBENZA NGOBUHLAKANI NANGOKUPHEPHA - VIKELA IZINDLEBE ZAKHO

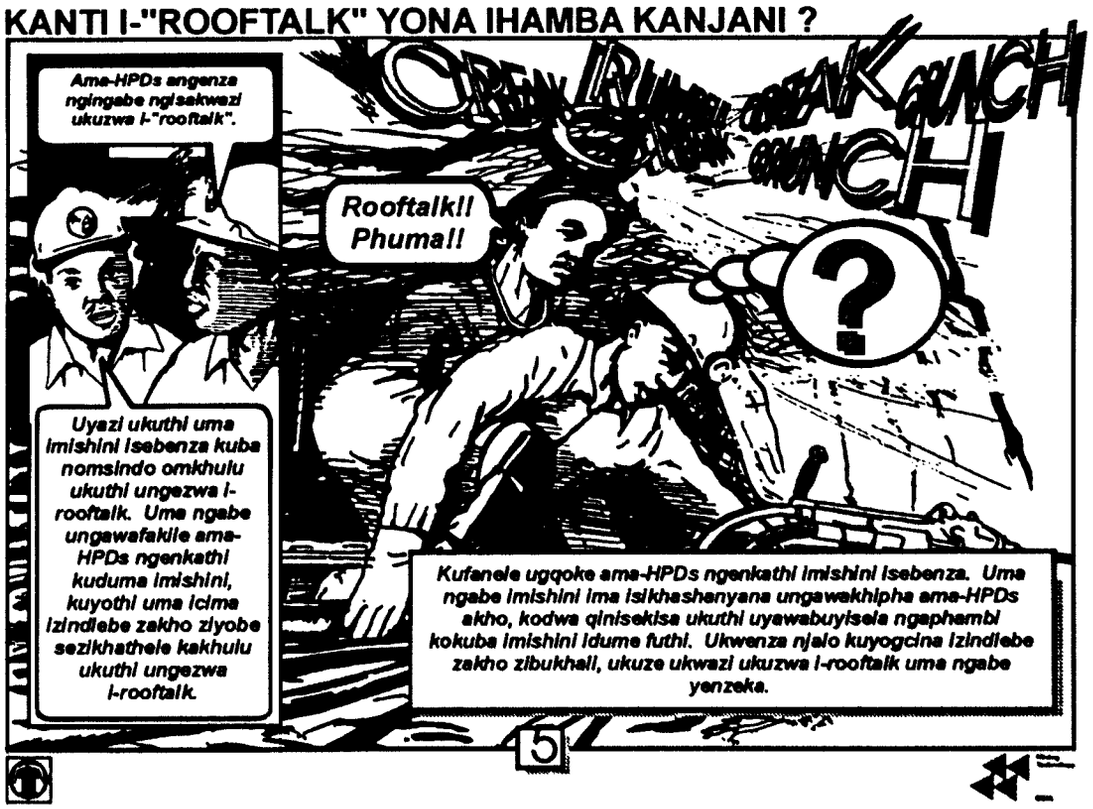


UKUNGEZWA KAHLE KUDALA IZINKINGA

....IZINKINGA EZINJENA ZINGAKONELA UMSEBENZI WAKHO

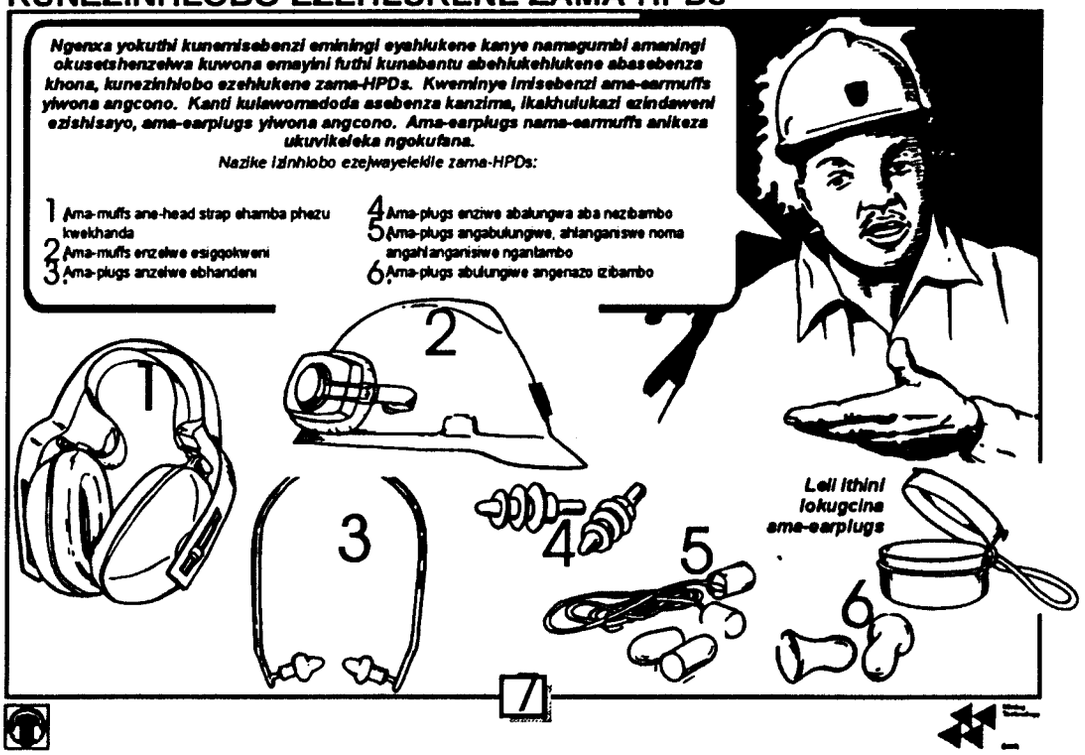
UNGAWUZWA KANJANI UMSINDO OYINGOZI

KANTI I-"ROOFTALK" YONA IHAMBA KANJANI ?

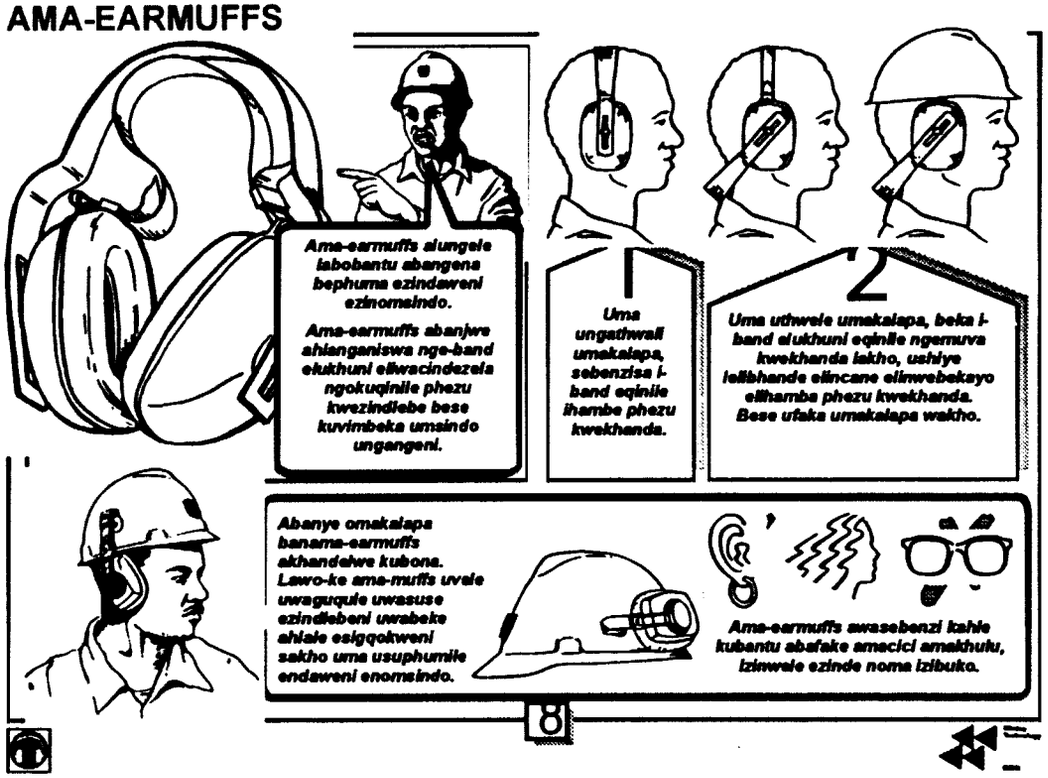


ANGABE IZINSIZA-KUZWA ZIYAKWAZI YINI UKULUNGISA UMONAKALO OSUDALEKILE EZINDLEBENI ZAMI - CHA I

KUNEZINHLOBO EZEHLUKENE ZAMA-HPDs

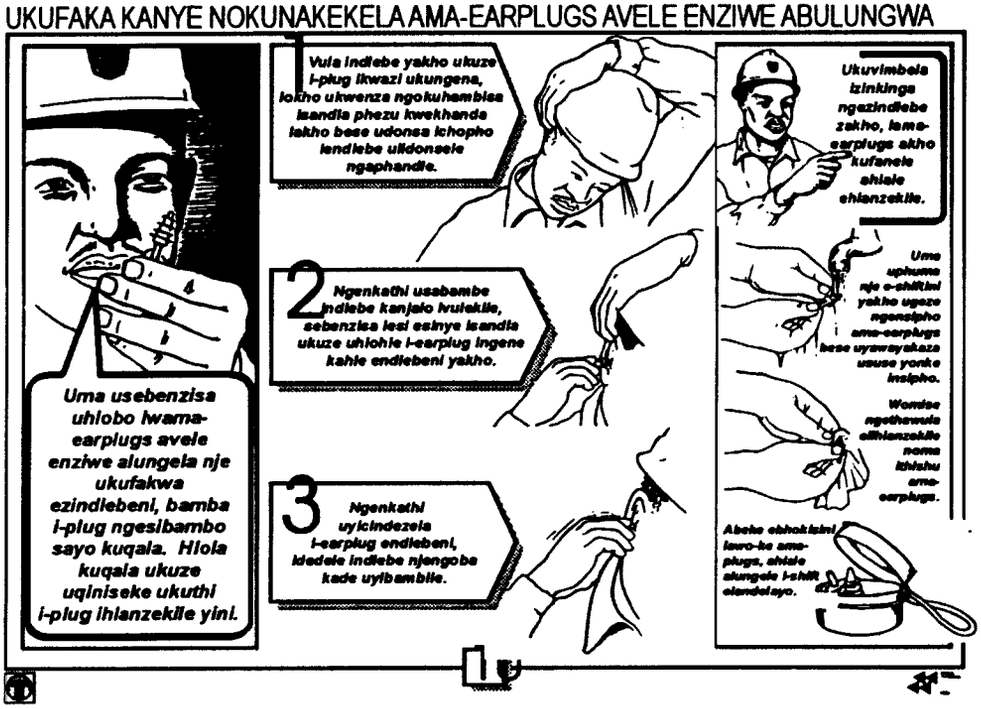


AMA-EARMUFFS

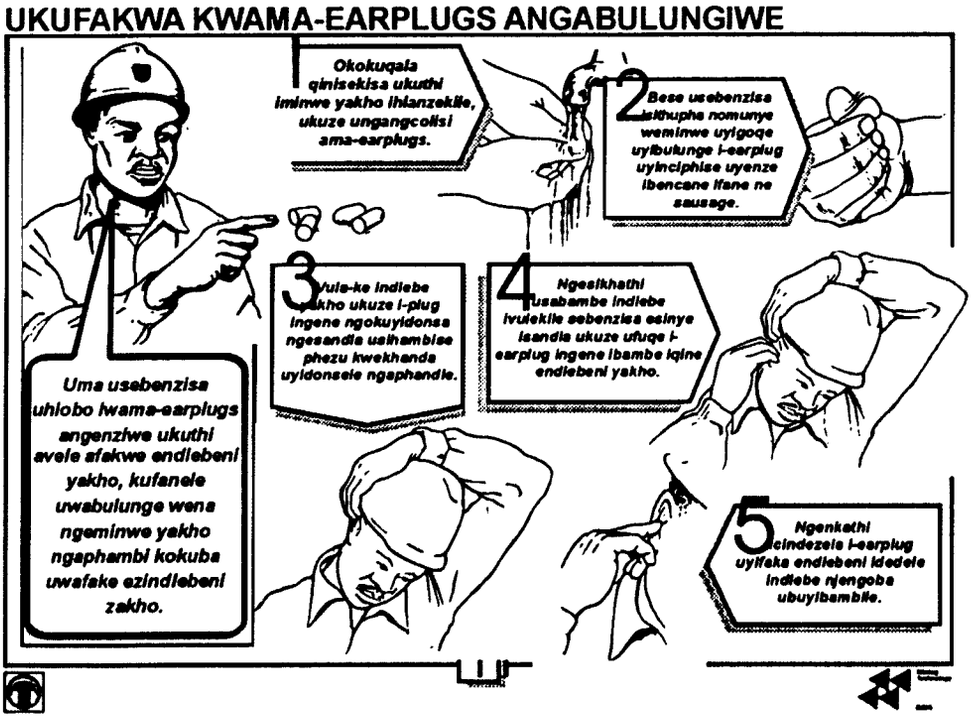


AMA-EARPLUGS AXHUNYWE KWI-BAND

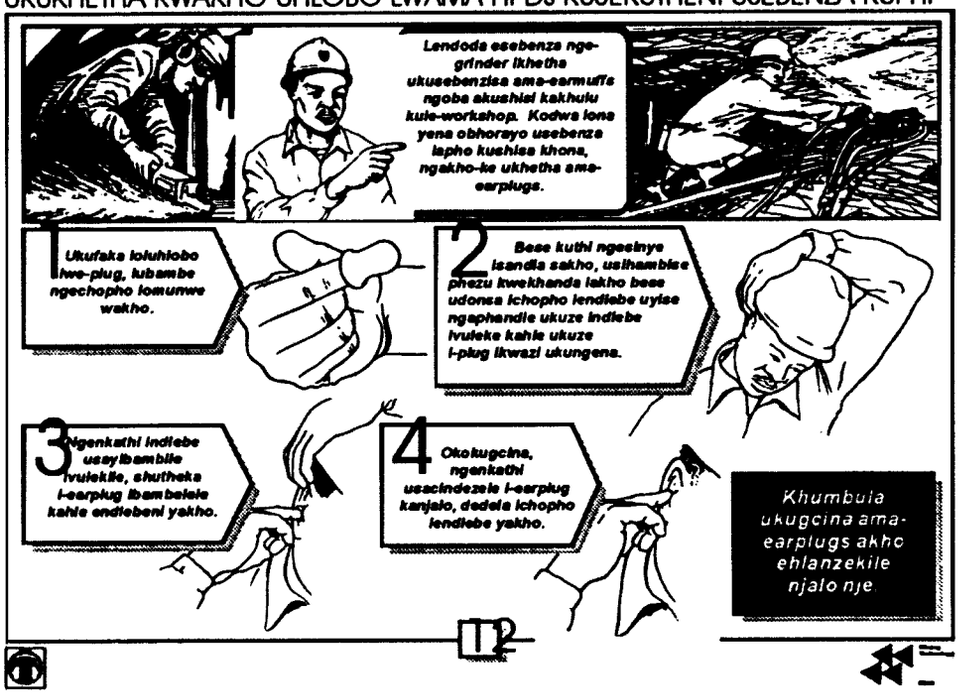
UKUFAKA KANYE NOKUNAKEKELA AMA-EARPLUGS AVELE ENZIWE ABULUNGWA



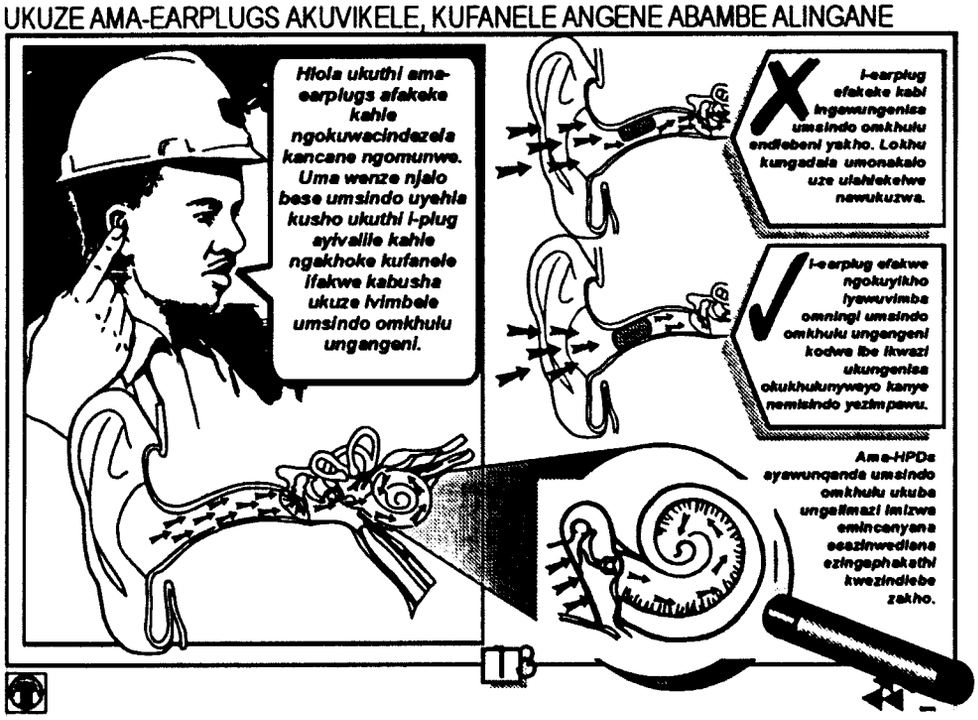
UKUFAKWA KWAMA-EARPLUGS ANGABULUNGIWE



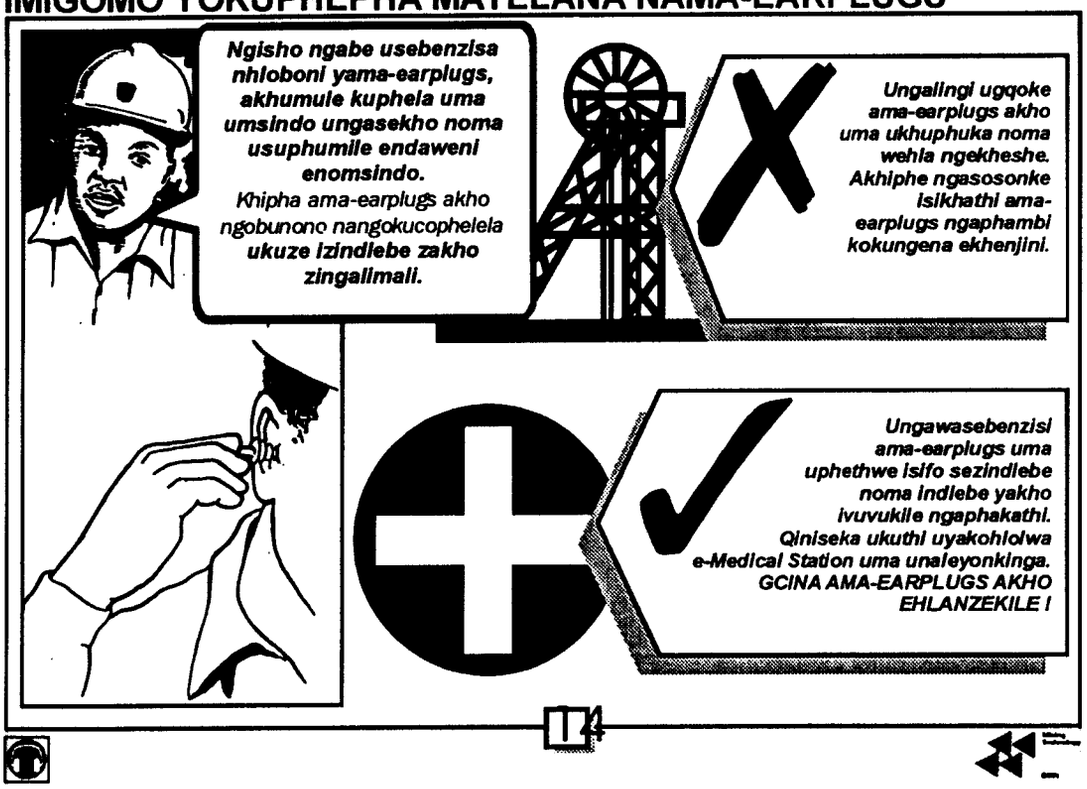
UKUKHETHA KWAKHO UHLOBO LWAMA-HPDs KUSEKUTHENI USEBENZA KUPHI



UKUZE AMA-EARPLUGS AKUVIKELE, KUFANELE ANGENE ABAMBE ALINGANE



IMIGOMO YOKUPHEPHA MAYELANA NAMA-EARPLUGS



Ukuzwa noma ukuba yisithulu

Inselelo ngeyakho!

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Appendix 9

Computer software for monitoring and evaluating HCPs

Page

A-9.1 Functional design of the Hearbase HCP software 418

A-9.2 Hearbase user's guide 446

A-9.1 A Functional Design of the Hearbase HCP Software

A FUNCTIONAL DESIGN OF THE HEARBASE HCP SOFTWARE

by

M Dell
Decision Support Services Programme
Division for Information Services
CSIR

Contract Report DIS-C123

January 1995

1. INTRODUCTION

In 1988, a special sub-committee of the Research Advisory Committee of the Chamber of Mines produced a document aimed at the protection of hearing at South African mines. This document, entitled "Guidelines for the Implementation and Control of a Hearing Conservation Programme in the South African Mining Industry" (which we shall refer to as "the Guide"), provides a system of forms (in Appendix II) to be used in the review and evaluation of Hearing Conservation Programmes (HCP).

The computer software to be developed in this project, and which shall henceforth be referred to as HearBase, is based on this set of forms. Amendments and additions to the forms have since been made by Miningtek personnel in order to expand the capabilities of the software, and these will also be included. However, the diagram used in form A-3 will be excluded. A functional design of HearBase is outlined in the sections that follow. The following issues are dealt with :

- User interface
- Database structure
- System requirements
- Documentation

2. USER INTERFACE

The user interface can be broken down into four components, viz the menu structures, the data entry screens, the report structures (output) and security.

2.1 Menu structures

The menu structure is designed to encompass all the functions reflected in the block diagram Figure AII-1 (pg 64) of the Guide, and is shown in the table below. Included are options to backup input data, restore it, and export/import input data to/from text files. The setting of passwords and the selection of printers are also done in the 'Utilities' sub-menu.

Table 1. The menu structure.

Level 1	Level 2	Level 3	Level 4
Input data	Noise surveys	Worker noise exposure (A-1,2)	Survey site
			Noise levels recorded
		Machinery noise (A-3)	Survey site
			Noise levels recorded
		Survey personnel (A-0)	Personnel details
			Qualifications
		Survey equipment (A-0)	Equipment details
			Equipment calibration
	HPD's	Types (A-5)	
		Issued (A-5)	
		Surveys (A-4.1&2)	Survey results
			Survey sites
		Non-compliance reasons (A-4.1&2)	
	Audiometry	Results (A-6)	
		Audiometry booths (A-7)	Booth details
			Booth tests
		Audiometers (A-7)	Audiometer details
			Audiometer calibration
		Audiometry operators (A-7)	Operator details and status
			Operator assessments
	Training and reinforcement	Audiometry and induction/training (A-8)	
		Posters for reinforcement (A-9)	Status
			Sites
			Irregularity types
		Warning signs (A-9)	Status
			Sites
			Irregularity types

Table 1 (continued)

Level 1	Level 2	Level 3	Level 4
Input data	Name of mine		
	Occupational codes		
	Review periods		
	Report destination		
Reports	Input forms	Noise surveys	Personnel & equipment (A-0)
			Worker noise exposure (A-1)
			Categorised survey data (A-2)
			Machinery noise levels (A-3)
		HPD's	HPD compliance (A-4.1)
			HPD compliance (A-4.2)
			Issuing and distribution (A-5)
		Audiometry	Results (A-6)
			Status of test centre (A-7)
		Training and reinforcement	Audiometry and induction/training (A-8)
			Posters/warning signs (A-9)
	Processing	Noise surveys	Personnel & equipment (P-0)
			Worker noise exposure (P-1)
			Machinery noise (P-2)
		HPD's	Results (P-3)
		Audiometry	Results (P-4)
			Status of test centre (P-5)
		Training and reinforcement	Results (P-6)
	Review	Synopsis (R-1)	
		Programme status (R-2)	
		Criteria (R-3)	

Table 1 (continued)

Level 1	Level 2	Level 3	Level 4
Forms	Noise surveys	Personnel & equipment (A-0)	
		Noise exposure summary (A-1)	
		Noise exposure data (A-2)	
		Equipment sound levels (A-3)	
	HPD's	Non-compliance summary (A-4.1)	
		Non-compliance data (A-4.2)	
		Distribution (A-5)	
	Audiometry	Results (A-6)	
		Status of test centre (A-7)	
	Training	Audiometry coverage (A-8)	
		Posters/warning signs (A-9)	
Utilities	Backup data		
	Restore data		
	Delete old data		
	Export	All input data	
		Noise surveys	
		HPD's	
		Audiometry	
		Occupational codes	
	Import	All input data	
		Noise surveys	
		HPD's	
		Audiometry	
		Occupational codes	
	Passwords		
	Printer		
	Screen		
Quit			

2.2 Data entry screens

All the data entry will be done in Clarion format, viz browsing a table of records followed by prompts to enter data in fields of records to be edited or inserted. Where variables can only assume values within a certain range, this will be checked upon entry fields being completed. Similarly, lookup tables will be used where appropriate to ensure referential integrity of data entered.

The specific contents of the data entry screens are as follows :

- Input data.Noise surveys.Worker noise exposure.Survey site :
  The user enters details concerning the site at which the noise levels were recorded. These are stored in WORKSITE.DAT. The details can be inserted or edited, but can only be deleted once all the sound levels recorded at that site are also deleted;

- Input data.Noise surveys.Worker noise exposure.Noise levels recorded :
  This item involves entering the details of a particular noise survey. This includes the date, site, noise surveyor and his instrument. This information is stored in WORKSURV.DAT. A button on the screen allows one to enter the noise levels recorded during the survey. These noise levels are stored in WORKNOIS.DAT;

- Input data.Noise surveys.Machinery noise.Survey site :
  Once again, the description of the site at which the machinery noise was recorded, is entered and is stored in MACHSITE.DAT. The sites can be entered and edited, but can only be deleted once all measurements at that site have been deleted;

- Input data.Noise surveys.Machinery noise.Noise levels recorded :
  The details of a particular noise survey are entered and stored in the file MACHSURV.DAT. These include the date, site, noise surveyor and his instrument. Pressing a button on the screen allows one to enter the associated noise measurements which are then stored in MACHNOIS.DAT;

- Input data.Noise surveys.Survey personnel.Personnel details :
  The noise survey personnel and their qualifications are entered in this screen. These details are stored in SURVEYOR.DAT and can be inserted or edited at will. However, a surveyor cannot be deleted from the system until all noise surveys conducted by him are removed from the system;

- Input data.Noise surveys.Survey personnel.Qualifications ;
  Allows the user to update the list of qualifications of noise surveyors. This is stored in QUALIFIC.DAT and is used as a lookup table when editing the noise surveyor personnel details. Once again, the only restriction is that a qualification cannot be deleted while it is referred to elsewhere in the system;

- Input data.Noise surveys.Survey equipment.Equipment details :
  The noise survey instrumentation details are entered in this screen. These details are stored in SURVEQP.DAT and can be inserted or edited at will. However, an item cannot be deleted from the system until all other references to it are removed from the system;

- Input data.Noise surveys.Survey equipment.Equipment calibration :
  Allows the user to update the calibration history of noise survey equipment, which is selected from a lookup table based on SURVEQP.DAT. The data is stored in the file CALIBRAT.DAT, which can be edited at will by authorised personnel;

- Input data.HPD's.Types :
  The file HPDTYPES.DAT edited here is used as a lookup table in the recording of HPD compliance and issue levels. HPD types can be entered into the system at any stage, and their descriptions can be edited freely. However, an HPD type can only be deleted once it no longer appears elsewhere in the system;

- Input data.HPD's.Issued :
  The distribution of HPD's is recorded by entering this menu option, which allows editing of HPDISSUE.DAT. Records in the file can be inserted, edited and deleted without restriction, provided the user has the necessary authorisation;

- Input data.HPD's.Surveys.Survey results :
  The compliance at each site is entered in this module, and the data is stored in the file HPDCOMPL.DAT. The data can be inserted, modified and deleted without restriction by authorised personnel;

- Input data.HPD's.Surveys.Survey sites :
  The sites at which the HPD compliance was recorded are entered here, and are stored in HPDSITES.DAT. Sites can be entered and edited, but can only be deleted once all compliance measurements at the site have been deleted;

- Input data.HPD's.Non-compliance reasons :
  This list of reasons for non-compliance is used as a lookup table during the entering of compliance data. This list is stored in the file HPDREAS.DAT, in which new reasons can be added at any time, and any changes are reflected in the rest of the system. However, a reason may only be deleted once it is no longer used in HPDCOMPL.DAT;

- Input data.Audiometry.Results :
  Entered here are the summarised results of audiometry tests. The data is stored in AUDIORES.DAT and records can be inserted, deleted or changed at will;

- Input data.Audiometry.Audiometry booths.Booth details :
  Displays the list of audiometry booths and their details, as stored in BOOTHS.DAT. This file is used as a lookup table and records cannot be deleted so long as the information is used elsewhere in the system;

- Input data.Audiometry.Audiometry booths.Booth tests :
  The status of each booth can be entered in this module of the program. The file in which the information is stored is BOOTHTST.DAT, which can be edited without restriction;

- Input data.Audiometry.Audiometers.Audiometer details :
  Displays the list of audiometers and their details, as stored in AUDEQ.DAT. Once again, this file is used as a lookup table and records cannot be deleted so long as the information is used elsewhere in the system;

- Input data.Audiometry.Audiometers.Audiometer calibration :
  For each audiometer, the calibration of the equipment can be entered in this module of the program. The file in which the information is stored is CALIBRAT.DAT, which can be edited without restriction;

- Input data.Audiometry.Audiometry operators.Operator details and status :
  The personal particulars of each audiometry operator are entered in this module, and are stored in the file AUDOP.DAT. This is used as a lookup table so records can only be deleted once they are no longer referred to in the system;

- Input data.Audiometry.Audiometry operators.Operator assessments :
  The results of proficiency tests on audiometry operators are entered here. The relevant file is AUDOPTST.DAT, whose records can be inserted, changed and deleted without restriction;

- Input data.Training and reinforcement.Audiometry and induction/training :
  This module concerns the success in exposing all relevant staff to training courses and audiometry tests. The records entered are stored in TRAINING.DAT, and can be inserted, changed and deleted without restriction;

- Input data.Training and reinforcement.Posters for reinforcement.Status :
  Information on the display of posters in relevant areas is entered in this module, and is stored in file POSTERS.DAT, which can be edited without restriction by authorised personnel. Poster sites and reasons for missing posters are selected from lookup tables;

- Input data.Training and reinforcement.Posters for reinforcement.Sites :
  Here one edits the names of poster sites, which are used in lookup tables and are stored in POSTSITE.DAT. The only restriction is that one may not delete a poster site name while it is still in use in POSTERS.DAT;

- InputData.Training and reinforcement.Posters for reinforcement.Irregularity types :
  This module allows one to compile a lookup table which is used when entering data on the proliferance of posters. Entries can only be deleted once they no longer appear elsewhere in the database. The reasons are stored in POSTREAS.DAT.

- Input data.Training and reinforcement.Warning signs.Status :
  Information on the display of warning signs in relevant areas is entered in this module, and is stored in file SIGNS.DAT, which can be edited without restriction by authorised personnel. Warning sign sites and reasons for missing warning signs are selected from lookup tables;

- Input data.Training and reinforcement.Warning signs.Sites :
  Here one edits the names of warning sign sites, which are used in lookup tables and are stored in SIGNSITE.DAT. The only restriction is that one may not delete the name of a warning sign site while it is still in use in SIGNS.DAT;

- InputData.Training and reinforcement.Warning signs.Irregularity types :
  This module allows one to compile a lookup table which is used when entering data on the proliferance of warning signs. Entries can only be deleted once they no longer appear elsewhere in the database. The reasons are stored in SIGNREAS.DAT;

- Input data.Name of mine :
  The name of the mine should be entered here. This name will appear on all reports and will be used for password purposes, as in RadBase. Only those users with administrator clearance will have access to this option. The name of the mine will be stored as a single record in the file SETUP.DAT;

- Input data.Occupational codes :
  This will allow users with administrator clearance to update the list of categories of occupational code categories. When selecting an occupational code category elsewhere in Hearbase, the user will first have to choose between surface, underground (conventional), underground (mechanised) and open cast. These are stored in file WHERE.DAT. Each of these will have a set of occupational code categories associated with it (stored in OCCODES.DAT), and the names of these categories will be editable under this menu heading. Categories can be edited, added and deleted too if there are no references to this category elsewhere in the data. Only users with administrator clearance will be given access to this facility. The surface, underground and open cast classification types will be fixed;

- Input data.Review periods :
  Most of the reports are based on review periods. The input form reports summarise information over a current review period, while the processing and review reports involve comparisons with previous review periods. This menu item allows the current and previous review periods to be specified;

- Input data.Report destination :

  The default report destination can be specified here. The user can choose between the screen, a file and any of the printer ports. A report that has been directed to the screen can also be redirected to a printer after viewing.

2.3 Reports

Reports are generated by HearBase on three levels. Input form reports merely display a subset of the input data in a format similar to that in which it is entered (forms A-0 to A-9). Processing reports, intended for heads of departments, will be similar to the forms P-0 to P-6. Review reports are intended for top management, and will be replicas of the forms R-1 to R-3. For the latter reports, the user will be given the opportunity to investigate any indicators of problems to determine the causes. This may involve the displaying on the screen of the input data which led to that situation.

The expected format of the reports is shown in greater detail in the following diagrams. In each of the diagrams, a row or two of information has been included as an example.

- Reports.Input forms.Noise surveys.Personnel and equipment (A-0) :

  This report will consist of two parts, one indicating the noise survey personnel, and the other the instruments they are using. For each noise surveyor, the noise survey files will be scanned to determine whether the surveyor was involved in any noise surveys during the period of interest. The particulars of that surveyor will be displayed only if he has. Similarly, the particulars of only the noise survey equipment used during the period of interest will be displayed in the report. This is done by checking the file of noise survey results. The file of certificates issued for the noise survey equipment is checked to determine whether valid certificates were available for the duration of the review period :-

Report A-0

STATUS OF NOISE SURVEY PERSONNEL AND EQUIPMENT

Review period : 01/01/92 to 31/12/92

Personnel :

First name	Surname	Qualification	Date qualified
David	Mtsweni	Tech Coll	24/3/90

Equipment :

Serial no	Description	ISO	Calibrated
RM1253	Quiet DM-20	1	True

- Reports.Input forms.Noise surveys.Workers noise exposure (A-1) :

  This report displays very similar information to that in (A-2), but in a different format. The user will select a site from a lookup table, and will then be presented with a table of the following type :-

Report A-1

NOISE EXPOSURE RESULTS

Review period : 01/01/93 to 01/01/94

Site : Shaft 2

Noise Zone	dB Range	Mean Daily Popul (P)	Mean N_{eq}	$N_{eq}P$	Max $N_{eq}.P$	Problem Rating
A	>120	0	0.0	0	0	0.00
B	110-120	5	112.8	564	425	1.32
C	100-109	4	105.0	420	340	1.23
D	90-99	4	93.2	373	340	1.09
E	85-89	4	87.2	349	340	1.02
Total		17	100.3	1706	1445	1.18

- Reports.Input forms.Noise surveys.Categorised survey data (A-2) :

  This report will display the raw noise survey data recorded at a particular site during the current review period. The user will be offered a lookup table of survey sites from which to choose. Upon selection, a table will appear showing all the decibel readings recorded at the selected place as follows :-

Report A-2

NOISE MEASUREMENTS - BASIC DATA

Review period : 01/01/93 to 01/01/94

Survey site : 13/26 Boxhole development

	Decibel range					
	< 85	85-89	90-99	100-109	110-120	> 120
	76	85	91	103	110	
	80		92	103	112	
	82		95	106	113	
			95	108	114	
					115	
Total	238	85	373	420	564	0
Mean	79	85	93	105	113	0
Std dev	2	0	2	2	2	0

- Reports.Input forms.Noise surveys.Machinery noise levels (A-3) :

  In this report, the noise levels recorded at any particular site during the current review period are displayed. The user is first offered a lookup table of machinery sites. Once a selection is made here, all the measurements recorded at the selected site during the review period are displayed in the following form :-

Report A-3

MACHINERY SOUND POWER LEVELS

Review period : 01/01/93 to 01/01/94

Survey site : Power generator SS120

Noise levels (dB)
95
97
98

- Reports.Input forms.HPD's.HPD compliance (A4.1) :

  This report serves as a summary of HPD surveys conducted during the current review period :-

Report A-4.1

HPD COMPLIANCE

Review period : 23/02/91 to 23/02/92

Site Description	Total No	Sample Size	Non-compl No	Non-compl %
13-26 Box	130	40	19	48
10-22 Develop	35	6	3	50
Total	165	46	22	48

- Reports.Input forms.HPD's.HPD compliance (A-4.2) :

  In this module, results are displayed of all HPD compliance surveys at a particular site during the current review period. The report is expected to look as follows :-

Report A-4.2

HPD COMPLIANCE

Review period : 01/01/93 to 01/01/94

Survey site : 13-26 Box 10-22

Full employee complement : 139

Non-compliance rating : 47%

Reason for non-compliance	Departments to be notified	No	%
HPD's not issued	Trn, Med, SLC	8	42
Lost and unable to obtain a replacement	Trn, SLC	0	0
Does not perceive noise as health hazard	Trn	6	32
Does not consider the area noisy	Trn, ECV	5	26
Believes HPD's do not provide protection	Trn	0	0

Trn : Training SLC : Safety / Loss control

Med : Medical ECV : Environmental control / Ventilation

- Reports.Input forms.HPD's.Issuing and distribution (A-5) :

  This simply displays the issue of HPD's to employees during the current review period :-

Report A-5

HPD DISTRIBUTION, PREFERENCE AND TURNOVER

Review period : 23/02/87 to 23/02/88

HPD Type	Initial issue	Re-issue	Total
Conventional Muff	0	0	0
Helmet Muff	0	0	0
Premoulded Plugs	650	498	1148
Disposable Plugs	0	0	0
Band-mount Plugs	0	0	0
Custom Plugs	0	0	0
Total	650	498	1148

- Reports.Input forms.Audiometry.Results (A-6) :

This report displays the combined audiometry results for one particular occupational code category during a selected period of interest. The user will be asked to select the occupational code category, and the combined results per result category will then be displayed in tabular form. This is expected to look as follows :-

Report A-6

AUDIOMETRY

Occupational code category: Engineers

Review period : 01/01/92 to 30/0692

Total audiograms : 108

Code	Audiogram category	Total	%
	Warnings :		
2L	Low frequency	14	13
2H	High frequency	33	30
	Total	47	43
	Referrals :		
	Abnormal hearing loss		
3AL	Low frequency	0	0
3AH	High frequency	33	31
3B	Unilateral hearing loss		
	Abnormal deterioration in hearing		
3CL	Low frequency	0	0
3CH	High frequency	0	0
	Total	33	31
Total		80	74

- Reports.Input forms.Audiometry.Status of test centre (A-7) :

This module displays a report consisting of three tables. This is because the status of the audiometric test centre depends on the status of each of the audiometry staff, their equipment and the test booths. Only those operators, equipment and test booths involved in audiometry during this period are taken into consideration. The first table displays the relevant audiometry operators, their qualification, and an indication of whether they fared acceptably in the proficiency tests conducted during the review period. Similarly, the valid certification of the audiometers and test booths during the review period are also checked in the compilation of this report. The report would then appear as follows :-

Report A-7

STATUS OF AUDIOMETRIC TEST CENTRE

Review period : 23/02/88 to 23/06/88

Operators :

Operator name	Qualified	Qual date	Proficiency
P van Zyl	True	12/01/78	Acceptable

Audiometers :

Serial no	Model	Purchase	Rating
RM125	Quiet DM-20	25/07/91	Acceptable

Booths :

Booth	Rating
Booth #2	Acceptable

- Reports.Input forms.Training and reinforcement.Audiometry and induction/training (A-8) :

This report displays a summary of the audiometry coverage during the review period, in the following manner

Report A-8

STATUS OF AUDIOMETRY COVERAGE

Review period : 12/03/91 to 12/09/91

New returnees ex-leave :

No of People	Ex-leave / Returnees	New Engagements	Total	%
Total	50	30	80	100
No requiring audiograms	40	25	65	81
No actually tested	20	20	40	62
No trained	10	30	40	50

High-risk individuals (N_{eq}> 105dB) :

No of People	Total	%
Total	80	100
No actually tested	23	29

- Reports.Input forms.Training and reinforcement.Posters and warning signs (A-9) :

  This report displays the summarised statistics for posters and warning signs over the review period. For each of these, the results will be given by location, including the most common irregularity :-

Report A-9

STATUS OF POSTERS AND WARNING SIGNS

Review period : 01/01/91 to 30/06/91

Posters :

Location	Inspections Total	Irreg	%	Main reason
Rec areas	12	3	25	Damaged
Hostels	14	2	14	Missing
Total	26	5	19	

Warning signs :

Location	Inspections Total	Irreg	%	Main reason
Crush	20	3	15	Damaged
Workshops	10	7	70	Missing
Total	30	10	33	

- Reports.Processing.Noise surveys.Personnel & equipment (P-0) :

  This report summarises the capabilities of the staff conducting the noise surveys, and the state of their instruments, during both the current and the previous review periods. The following report is envisaged:-

Report P-0

STATUS OF NOISE SURVEY PERSONNEL AND INSTRUMENTS

Previous review period : 01/01/91 to 30/06/91

Current review period : 01/07/91 to 31/12/91

Criterion	% Unacceptability Previous	Current	% change
Course Attendance	10	12	+20
Equipment Rating	25	23	- 8
Total	35	35	0

- Reports.Processing.Noise surveys.Worker noise exposure (P-1) :

  This report summarises the extent to which workers are exposed to noise during each of the current and previous review periods. The noise exposure for each of these periods, and the percentage change from the previous review period to the current review period, are calculated for each of the sites tested during the current review period. The report will resemble the following :-

Report P-1

NOISE LEVELS RELATED TO POPULATION SIZE

Previous review period : 01/01/91 to 30/06/91
Current review period : 01/07/91 to 31/12/91

Site	N.P	Max N.P	Problem size rating Previous	Current	% change
13-26	1933	1700	1.08	1.14	+ 6
Box-hole	180	170	1.00	1.06	+ 6
Development	702	510	1.47	1.38	- 6
Total	2815	2380	1.15	1.18	+ 3

- Reports.Processing.Noise surveys.Machinery noise (P-2) :

  All machinery sites at which the noise levels were sampled during the current review period, are considered in this report. The comparison between the noise levels and the percentage change between the two periods are given in the report, which will look as follows :-

Report P-2

SOUND POWER LEVELS GENERATED BY EQUIPMENT/PROCESSES

Previous review period : 01/01/91 to 01/07/91
Current review period : 01/07/91 to 31/12/91

Site	Average (dB) Previous	Current	% change
Compressor 1	118	120	+ 2
Generator 3	95	95	0
Total	213	215	+ 1

- Reports.Processing.HPD compliance.Results (P-3) :

  This report is also based on a comparison between results obtained during two review periods. All reasons for non-compliance will be displayed in the report :-

Report P-3

HPD COMPLIANCE

Previous review period : 01/01/91 to 30/06/91
Current review period : 01/07/91 to 31/12/91

Labour Force	Previous	Current	% change
Total complement	156	139	-11
Compliance rating	51%	47%	- 8
Non-compliance incidents	32	25	-22
Nature thereof			
1. HPD's not issued	25%	32%	+28
2. Does not consider the area noisy	12%	24%	+100
3. Believes HPD's impair communication	0%	20%	-

- Reports.Processing.Audiometry.Results (P-4) :

  Here the results are given by occupational code category, and compared between the two review periods. The report will appear as follows:-

Report P-4

AUDIOMETRY

Previous review period : 01/01/91 to 30/06/91
Current review period : 01/07/91 to 31/12/91

Occupation	% Referrals & Warnings		
	Previous	Current	% Change
Engineers	69	53	- 23
Drivers	67	33	- 51
Plant	45	50	+ 11
Management	14	37	+164
Hoist/Bank	68	60	- 12
Total	263	233	- 11

Percentage of eligible employees tested : 68%
Percentage of high-risk employees tested : 45%

- Reports.Processing.Audiometry.Status of test centre (P-5) :

  This is a summary of A-7 forms based on the two review periods. The following report is envisaged:-

Report P-5

STATUS OF AUDIOMETRIC TEST CENTRE

Previous review period : 01/01/91 to 30/06/91
Current review period : 01/07/91 to 31/12/91

Criterion	% Unacceptability Previous	Current	% change
Operator proficiency	0	40	-
Equipment rating	50	20	-60
Test booth rating	0	0	-
Total	25	30	+20

- Reports.Processing.Training and reinforcement.Results (P-6) :

  This report represents a summary of the data contained in forms of the type A-9. The data is presented for each of two review periods in three tables:-

Report P-6

EDUCATION AND REINFORCEMENT

Previous review period : 01/01/91 to 30/06/91
Current review period : 01/07/91 to 31/12/91

Posters for reinforcement

Location	% irregularities Prev	Curr	Most prevalent irregularity
Change rooms	12	8	Illegible
Hostels	16	9	Damaged

Warning signs

Location	% irregularities Prev	Curr	Most prevalent irregularity
Workshops	10	12	Missing
Plant	20	20	Missing

Training and induction

	Prev	Curr
Total requiring audiograms	40	48
Number trained	32	36
% trained	80	75

- Reports.Review.Criteria (R-3) :

This report summarises all the preliminary reports into one table, and this table is further summarised in the other two review reports. The report R-3 is expected to look as follows :-

Report R-3

CRITERIA

Previous review period : 01/01/91 to 30/06/91
Current review period : 01/07/91 to 31/12/91

Criterion	Previous	Current	% change
Noise survey (% unacceptability)	0	25	-
Problem size rating (N.P/max N.P)	1.18	1.10	- 7
Noise sources (% sites > 85dB)	25	25	0
HPD non-compliance (%)	47	69	+ 47
Audiometry warnings & referrals (%)	47	27	- 43
Test centre status (% unacceptability)	25	30	+ 20
Audiometry non-coverage (%)	20	20	0
Posters/warning signs (% irregularity)	25	30	+ 20

- Reports.Review.Programme status and trend (R-2) :

This form summarises report R-3 further to indicate the trend in an increase/decrease flag rather than percentage change. These flags are then summarised in report R-1 to give an indication to management of whether the HCP is improving or not. The report R-2 is expected to look as follows :-

Report R-2

Progress Review : Programme Status and Trend

Previous review period : 01/01/91 to 30/06/91
Current review period : 01/07/91 to 31/12/91

Criterion	Status	Previous	Current	Trend
Noise survey	1	0	25	1
Problem size rating	1	1.18	1.10	0
Noise sources	1	25	25	0
HPD non-compliance	1	47	69	1
Audiometry warnings & referrals	1	47	27	0
Test centre status	1	25	30	1
Audiometry non-coverage	1	20	20	0
Posters/warning signs	1	25	30	1
Total	8			4

- Reports.Review.Synopsis (R-1) :

This report is intended to convey the progress of the HCP in one table. The report is once again based on two review periods, and the following table is displayed :-

Report R-1

SYNOPSIS

Previous review period : 01/01/91 to 30/06/91
Current review period : 01/07/91 to 31/12/91

Score	Previous	Current
Status	6	8
Trend	1	4

2.4 Security

Provision will be made for three levels of passwords.

a) Administration :

A person designated as the administrator of the system will have access to all levels of the program, from data entry in any module to generation of reports. The administrator will also be responsible for the allocation of passwords to other users at any of the three levels. No other type of user will be allowed to alter the mine details, or to delete old data;

b) Review :

Users in this category will be able to generate reports of any type, and to browse the raw data. However, they will not be allowed to enter data or to edit data which has already been entered. It is envisaged that management would fall into this category;

c) Data entry :

This type of user will be responsible for the entering of data to the system. Each such user can be restricted to the entering of one or more of the following input data categories : Noise surveys, HPD's or audiometry.

3. DATABASE STRUCTURE

3.1 File descriptions

Outlined below are the names, fields and descriptions of the database files to be used in HearBase. The primary key fields are shown in bold.

AudEq - Audiometry equipment details

SerialNo(STRING 10)-Serial no of audiometer
Model(STRING 30)-Model description
Purchase(LONG)-Purchase date of audiometer
ActiveFrom(LONG)-Commissioning date of audiometer
ActiveTo(LONG)-Final date of use of audiometer
PrevTested(BYTE)-Flag indicating if audiometer adequately calibrated during previous review period
CurrTested(BYTE)-Flag indicating if audiometer adequately calibrated during current review period

AudEqTst - Results of audiometer tests

TestDate(LONG)-Date of audiometer test
SerialNo(STRING 10)-Serial no of audiometer
Result(STRING 12)-Test result : "Acceptable" or "Unacceptable"

AudioCat - Audiometry result categories

OutcomeCode(STRING 5)-Code indicating outcome type
Description(STRING 30)-Description of outcome category

AudioRes - Audiometry results

Date(LONG)-Date of test
OCodeCat(SHORT)-Occupational code category number of staff tested
OutcomeCode(STRING 5)-Outcome type
Number(SHORT)-Number in this result category

AudOp - Audiometry operators

Operator(SHORT)-Operator no
FirstName(STRING 20)-First name of audiometry operator
Surname(STRING 20)-Surname of audiometry operator
Qualified(STRING 5)-Indicates if qualified : "True" or "False"
Date(LONG)-Date of qualification
ActiveFrom(LONG)-Date from which operator was active
ActiveTo(LONG)-Date until which operator was active
PrevTested(BYTE)-Flag indicating if operator was adequately tested during the previous review period
CurrTested(BYTE)-Flag indicating if operator was adequately tested during the current review period

AudOpTst - Audiometry staff test results

Operator(SHORT)-Operator no
TestDate(LONG)-Date of test of audiometry operator
Proficiency(STRING 12)-Test result - "Acceptable" or "Unacceptable"

Booths - Audiometry booths

BoothNo(SHORT)-Booth number
BoothName(STRING 10)-Name of booth as entered by user
ActiveFrom(LONG)-Commissioning date of test booth
ActiveTo(LONG)-Final date of use of booth
PrevTested(BYTE)-Flag indicating if booth status was acceptable during previous review period
CurrTested(BYTE)-Flag indicating if booth status was acceptable during current review period

BoothTst - Results of tests on booths

BoothNo(SHORT)-Booth number
TestDate(LONG)-Date of test of booth
Outcome(STRING 12)-String indicating outcome : "Acceptable" or "Unacceptable"

Calibrat - Noise survey equip calibrations

SerialNo(STRING 10)-Serial no of noise survey instrument

Certificate(STRING 30)-Calibration certificate name

FromDate(LONG)-Calibration date

ToDate(LONG)-Expiry date of certificate

dBRange - Used to categorise noise measurements

RecordNo(BYTE)-Record no - used to order records

dBUpTo85(STRING 3)-Noise measurements less than or equal to 85 dB

dB86To95(STRING 3)-Noise measurements 86 to 95 dB

dB96To105(STRING 3)-Noise measurements 96 to 105 dB

dB106To115(STRING 3)-Noise measurements 106 to 115 dB

dBExceeding115(STRING 3)-Noise measurements exceeding 115 dB

HPDCompl - Results of HPD compliance surveys

SurveyNo(LONG)-HPD survey no

ReasonNo(BYTE)-Indicates reason for non-compliance

Number(SHORT)-Number of non-compliance incidents of this type

HPDIssue - Issue of HPDs to staff

Date(LONG)-Date of issue/reissue

HPDType(BYTE)-Type no of HPD being issued

Initial(SHORT)-Quantity of HPDs being issued for the first time

Reissue(SHORT)-Number reissued

Display(BYTE)-Temporary flag indicating whether record is to be displayed or not

HPDReas - Reasons for HPD non-compliance

ReasonNo(BYTE)-Reason no

Reason(STRING 30)-Reason for non-compliance

Department(STRING 30)-Department(s) to be notified

Complied(BYTE)-Flag indicating if complied

PrevIncidents(SHORT)-No of non-compliance incidents of this type during the previous review period

CurrIncidents(SHORT)-No of non-compliance incidents of this type during the current review period

HPDSite - Sites at which HPD surveys are conducted

SiteNo(BYTE)-No of site

Description(STRING 30)-Description of site

TotalComplement(SHORT)-Mean no of employees in the vicinity

HPDSurv - Dates and sites of surveys conducted

SurveyNo(LONG)-Survey number

Date(LONG)-Date of survey

SiteNo(BYTE)-Number of site at which survey was conducted

HPDTypes - Contains the list of HPD types

TypeNo(BYTE)-Type no of HPD

Description(STRING 30)-Description of HPD

ISOTypes - ISO ratings

ISONo(BYTE)-ISO number

Description(STRING 20)-Description of ISO

MachNois - Machinery noise levels recorded

SurveyNo(LONG)-Date survey was conducted

dB(SHORT)-Noise level recorded

MachSite - Machinery sites at which noise levels were recorded

SiteNo(LONG)-Site number

Description(STRING 30)-Description of machinery survey site

MachSurv - Machinery noise surveys conducted

SurveyNo(LONG)-Survey number

SurvDate(LONG)-Date of survey

SiteNo(LONG)-No of site at which survey was conducted

SerialNo(STRING 10)-Serial no of survey instrument

EmployeeNo(STRING 8)-Employee no of noise surveyor

OcCodes - Occupational code categories

CatNo(LONG)-Number indicating occ code category

LocNo(BYTE)-Indicates surface, underground (conventional), underground (mechanised) or open cast

Category(STRING 30)-Occupational code category name

Password - Passwords assigned by administrator of system

UserName(STRING 6)-Name of user

Password(STRING 6)-User's password

UserTypeNo(BYTE)-Indicator of rights of user

Periods - Lists periods to be checked. Used in determining if equipment/surveyor was certified during a review period

FromDate(LONG)-Start of period

ToDate(LONG)-End date of period

Posters - Poster survey results

Date(LONG)-Date of survey

SiteNo(SHORT)-Poster site number

ReasonNo(BYTE)-Poster reason number

Number(BYTE)-Number of posters in this irregularity category

PostReas - Reasons for irregularity

ReasonNo(BYTE)-Poster reason number

Reason(STRING 30)-Type of irregularity

OK(BYTE)-Indicates if acceptable or not

NoOfIrregularity(SHORT)-Temporary field : no of occurrences of this irregularity type

PostSite - Poster sites

SiteNo(SHORT)-Poster site number

Description(STRING 30)-Actual site description

Qualific - Noise surveyor qualifications

QualNo(BYTE)-Qualification number

Qual(STRING 30)-Name of qualification

RepDest - Contains default destination of report

FileSpec(STRING 64)-Destination of reports

Review - Contains dates defining review periods

ThisFrom(LONG)-Start date of current review period

ThisTo(LONG)-End date of current review period

LastFrom(LONG)-Start date of previous review period

LastTo(LONG)-End date of previous review period

Setup - Setup file

Description(STRING 30)-Description of the miscellaneous data type

Data(STRING 30)-Data value

SignReas - Reasons for warning sign irregularities

ReasonNo(BYTE)-Reason number

Reason(STRING 30)-Description of irregularity

OK(BYTE)-Indicates if this reason means OK

NoOfIrregularity(SHORT)-Temporary field : no of irregularities of this type during review period

Signs - Results of warning sign surveys

Date(LONG)-Date of warning sign survey

SiteNo(SHORT)-Warning sign site number

ReasonNo(BYTE)-Irregularity reason number

Number(BYTE)-Number of incidents

SignSite - Warning sign sites

SiteNo(SHORT)-Warning sign site number

Description(STRING 30)-Actual site description

SurvEqp - Details of noise survey equipment

SerialNo(STRING 10)-Serial no of noise survey instrument
Model(STRING 30)-Model description of survey instrument
ISOType(BYTE)-ISO type of survey equipment
CurrActive(BYTE)-Flag indicating if used in current review period
PrevActive(BYTE)-Flag indicating if used in previous review period
CurrCalibrated(BYTE)-Flag indicating if calibrated for entire current review period
PrevCalibrated(BYTE)-Flag indicating if calibrated for entire previous review period

Surveyor - Noise surveyor details

EmployeeNo(STRING 8)-Employee no of noise surveyor
FirstName(STRING 20)-First name of noise surveyor
Surname(STRING 20)-Surname of noise surveyor
Qualified(STRING 5)-Indicates if surveyor is qualified : "True" or "False"
QualNo(BYTE)-Qualification no of noise surveyor
QualDate(LONG)-Date noise surveyor qualified
CurrActive(BYTE)-Flag indicating if active during current review period
PrevActive(BYTE)-Flag indicating if active during previous review period

Training - Status of audiometry coverage

StarDate(LONG)-Start date of period
EndDate(LONG)-End date of period
Leave(SHORT)-No of employees returning from leave during period
New(SHORT)-New engagements during period
LeaveAud(SHORT)-No of leave returnees requiring audiometry
NewAud(SHORT)-No of new employees requiring audiometry
RiskyAud(SHORT)-No of high-risk staff requiring audiometry
LeaveTst(SHORT)-No of leave returners actually tested
NewTst(SHORT)-No of new staff tested
RiskyTst(SHORT)-No of high-risk staff tested
LeaveTrn(SHORT)-No of leave returners trained during period
NewTrn(SHORT)-No of new staff trained

UserType - Types of users, categorised according to their rights

UserTypeNo(BYTE)-User type number
Description(STRING 10)-Description of editing rights of user type

Where - Location categories

LocNo(BYTE)-Location number : assigned initially
Location(STRING 20)-Location categories

WorkNois - Results of surveys on worker noise exposure

SurveyNo(LONG)-Noise exposure survey number
OCodeCat(LONG)-Occupational code category of workers
dB(SHORT)-Noise level recorded

WorkSite - Work sites at which noise levels were recorded

SiteNo(LONG)-Site number
Description(STRING 30)-Description of work site

WorkSurv - Site where worker noise exposure is recorded

SurveyNo(LONG)-Noise exposure survey number
SurvDate(LONG)-Date of survey
SiteNo(LONG)-No of site at which survey was conducted
SerialNo(STRING 10)-Serial no of survey instrument
EmployeeNo(STRING 8)-Employee no of noise surveyor
DisplayFlag(BYTE)-Temporary field : a flag to display or not

3.2 File relations

The table below shows the set of one-to-many relations amongst the database files.

Parent file	Fields	Child file	Fields
AudEq	SerialNo	AudEqTst	SerialNo
AudioCat	OutcomeCode	AudioRes	OutcomeCode
AudOp	Operator	AudOpTst	Operator
Booths	BoothNo	BoothTst	BoothNo
HPDReas	ReasonNo	HPDCompl	ReasonNo
HPDSite	SiteNo	HPDSurv	SiteNo
HPDSurv	SurveyNo	HPDCompl	SurveyNo
HPDTypes	TypeNo	HPDIssue	HPDType
MachSite	SiteNo	MachSurv	SiteNo
MachSurv	SurveyNo	MachNois	SurveyNo
OcCodes	CatNo	AudioRes	OCodeCat
OcCodes	CatNo	WorkNois	OCodeCat
PostReas	ReasonNo	Posters	ReasonNo
PostSite	SiteNo	Posters	SiteNo
Qualific	QualNo	Surveyor	QualNo
SignReas	ReasonNo	Signs	ReasonNo
SignSite	SiteNo	Signs	SiteNo
SurvEqp	SerialNo	Calibrat	SerialNo
SurvEqp	SerialNo	MachSurv	SerialNo
SurvEqp	SerialNo	WorkSurv	SerialNo
Surveyor	EmployeeNo	MachSurv	EmployeeNo
Surveyor	EmployeeNo	WorkSurv	EmployeeNo
UserType	UserTypeNo	Password	UserTypeNo
WorkSite	SiteNo	WorkSurv	SiteNo
WorkSurv	SurveyNo	WorkNois	SurveyNo

4. SYSTEM REQUIREMENTS

The HearBase software will be written in Clarion 3 for a standalone 80386 PC or compatible with 4Mb RAM running under DOS 3.3 or higher. HP and Epson printers will be catered for in the software ; the correct printing of reports cannot be guaranteed on other printer types.

5. DOCUMENTATION

A detailed user's guide will be provided to assist in the use of HearBase.

A-9.2 Hearbase User's Guide

HEARBASE USER'S GUIDE

Hearing conservation programme software for South African mines

by
M Dell
Decision Support Services Programme
Division for Information Services
CSIR

Contract Report DIS-C34

August 1995

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Introduction

The report ***"Guidelines for the implementation and control of a hearing conservation programme in the South African mining industry"*** was released by the Chamber of Mines Research Organisation in 1988. HEARBASE is a software tool based on the procedures outlined in this report. The system allows for the entry of data related to hearing conservation. A variety of reports based on this data can be produced, thereby allowing management to review the progress of the mine in hearing conservation.

The use of the HEARBASE software is described in this manual. Although the manual is aimed primarily at first-time users, it is hoped that it will also be a useful reference for the more experienced user.

Getting Started

SYSTEM REQUIREMENTS

The software is designed for a standalone PC running under DOS, although some provision is made for the interchange of data from one system to another. The minimum system requirements to use HEARBASE are

- An IBM compatible microcomputer with 80386 series CPU (or higher)
- DOS 5.0 (or later) operating system
- 4MB RAM with 540KB free
- A colour monitor
- A Microsoft-compatible mouse (optional)
- A printer (optional)

HEARBASE MATERIALS

The HEARBASE package includes the following items :

- A 1.4Mb diskette
- A HEARBASE user's guide

MAKING BACKUP DISKETTES

It is recommended that a backup diskette is made prior to the installation of HEARBASE. The DOS command DISKCOPY is suitable for this purpose. The backup diskette should then be used for installation. Ensure that the write protection tab of the diskette has been set to prevent overwriting of the software.

INSTALLING THE SOFTWARE

When HEARBASE is installed on the hard disk of the computer, a directory HEARBASE is created and the HEARBASE files are all placed in this directory. The steps which should be followed to install HEARBASE are

- Place the installation diskette into the appropriate drive.
- Change the current drive to this drive, say drive B, by typing **B:** at the DOS prompt.
- Type **INSTALL C:** and press **<Enter>** if HEARBASE is to be installed on the C drive (replace C with the appropriate drive label if HEARBASE is to be installed on another drive).

Once the cursor has returned to the DOS prompt, a message will appear on the screen indicating whether the installation has been successful or not. The installation diskette should then be removed from the drive and stored in a safe place.

ACCESS RIGHTS

Upon delivery, HEARBASE will have been initialised for the sole use of the person taking ownership of the software. This person will henceforth be referred to as the administrator and will be able to access all components of the software. The administrator's user id will be supplied with the software, and so will his password (usually 'XXXXXX'). The administrator will be responsible for the issuing of user names, passwords and access rights to other staff who are to use the system.

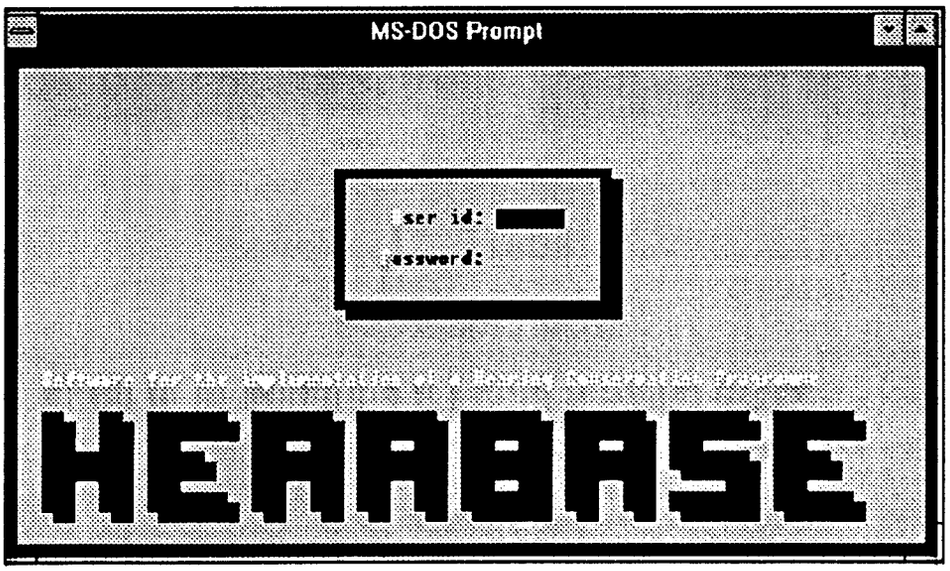
The access rights given to each user can be one of six types:

- Noise surveys
- HPDs
- Audiometry
- Training/reinforcement
- Reports
- Administrator

The first four of these allow the user to access input data of a specific type only. This has the advantage that the entering of each type of data can be done by staff responsible for the collection of that data without the possibility of interference with other data in the system. Similarly, staff entitled to examine reports only are denied access to the input data. Certain utilities are accessible by all user types, but only users having administrator status will be able to access all components of the program.

ENTERING THE SYSTEM

The software is activated by typing **HEARBASE** at the DOS prompt in the directory C:\HEARBASE. An entry screen will appear prompting the user for a **User id** and **Password**. Both of these should be entered exactly as issued, without any leading spaces. If an error is made entering these identifying codes, the backspace key (←) can be used to correct it. Failure to do so will cause a screen to be displayed denying the user access to the system, followed by a return to the DOS prompt. Included on the screen should be the name and telephone number of the administrator, who can be contacted for a change in access rights, or the resetting of a password.



ONLINE HELP

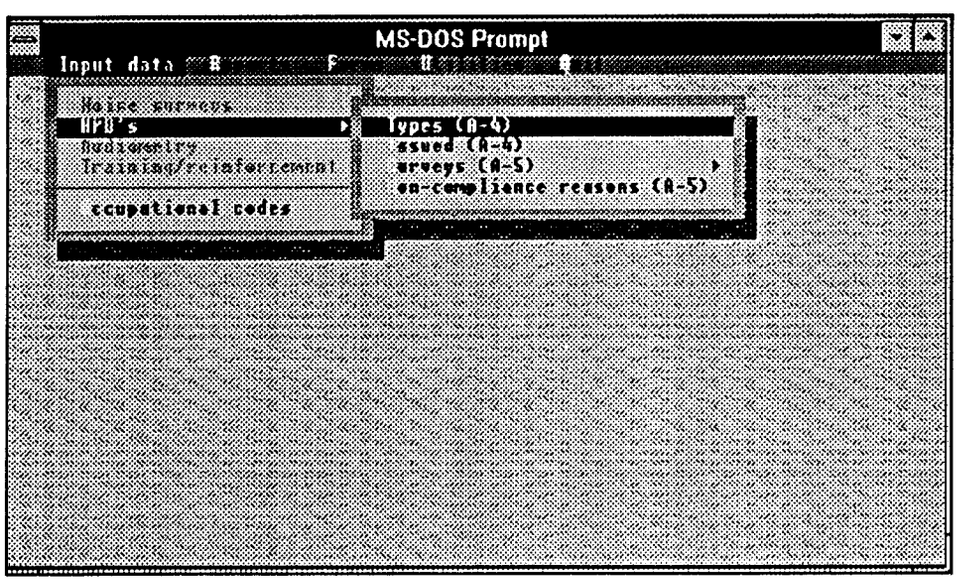
Help to the user is provided mainly in the form of the user's guide. A limited online help facility is also provided, and this can be activated at most points within the program (excluding the menu system) by pressing the **<F1>** key.

Basic Editing Skills

HEARBASE is a menu driven data management system. You will thus only be required to use a limited number of commands. The main menu lists the options available in HEARBASE.

SELECTING FROM MENUS

Upon the successful entering of a user name and associated password, the user arrives at the main menu bar. The menu bar contains five options: **Input data**, **Reports**, **Forms**, **Utilities** and **Quit**. The first four of these display pulldown menus (ie a further list of choices to be made) when selected, and the fifth exits the user from the program. The activation of certain items on the pulldown menus will cause further pulldown menus to appear. The menu bar and the nested set of pulldown menus constitute the HEARBASE menu system. Depending on the access rights of the user, certain items on the pulldown menus may be unavailable. This is indicated by a "greying out" of the relevant menu item.



An option on the menu system can be selected by highlighting the option using the cursor keys (→, ←, ↑ and ↓) and then pressing **<Enter>**. Alternatively, the highlighted character displayed on each menu item can also be used. Pressing the highlighted character whilst holding down the **<Alt>** key will select the menu item, providing that the menu item is

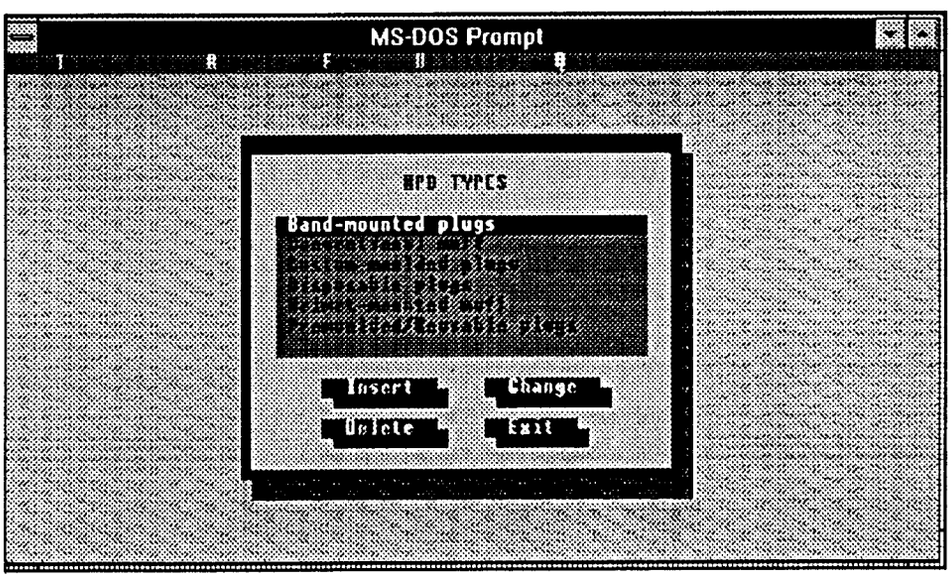
currently visible on the screen. If two menu options make use of the same highlighted character, the first option will be selected.

Pressing **<Esc>** from a sub-menu will return the user to the main menu bar, and selecting the **Quit** option will return the user to the DOS prompt

Thus the system is composed of a hierarchy of menus and input screens. These are displayed in *windows*, or areas on the screen which contain information related to a specific task. The top window is always the active screen.

BROWSING DATA TABLES

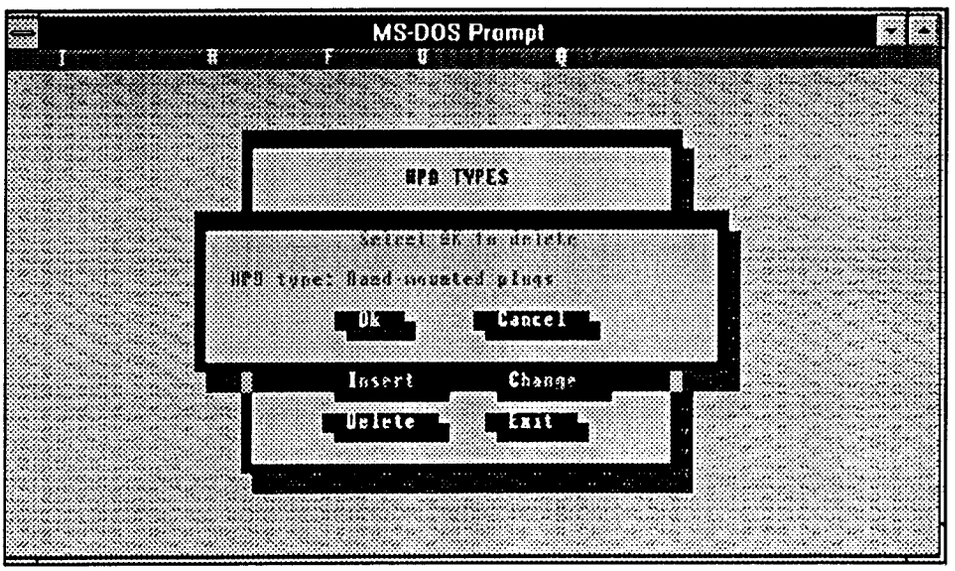
Where numerous data items of a particular type are stored in the system, the data is displayed in data tables. The data items are listed beneath one another in the table as shown below.



These tables of records can be scrolled using the cursor control keys (↑ and ↓). Once the bar is positioned on a particular record, actions can be performed on this record by appropriately activating the "buttons" placed beneath the table. These actions may include any of **Select**, **Change**, **Delete** or **Insert**. These buttons are activated by pressing the relevant highlighted character whilst holding down the **<Alt>** key. For example, the **Exit** button can be activated by pressing **<Alt> X** to return the user to the main menu bar.

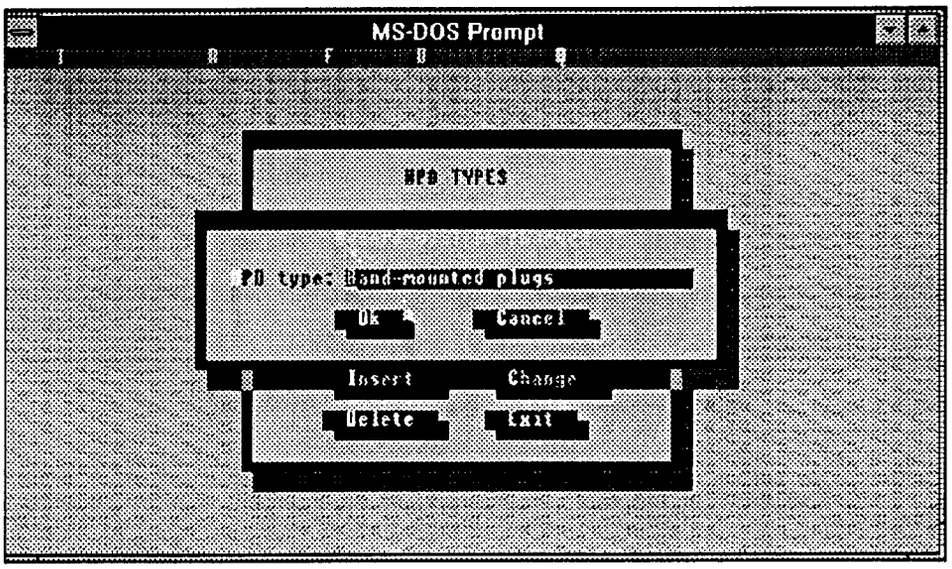
DELETING A DATA RECORD

The data record displayed at the scroll bar in a table can be deleted by activating the **Delete** button beneath the table. This is done by pressing **<Alt> D**. A data form will then appear showing the current values of all fields in the data record, and seeking confirmation of the deletion. Pressing **<Alt> O** will cause the record to be deleted, whilst **<Alt> C** will cancel the operation. If the deletion of the record removes an essential link to other information in the database, a screen will appear informing the user of the key fields involved. The user then has to delete the related information before he may delete this record.



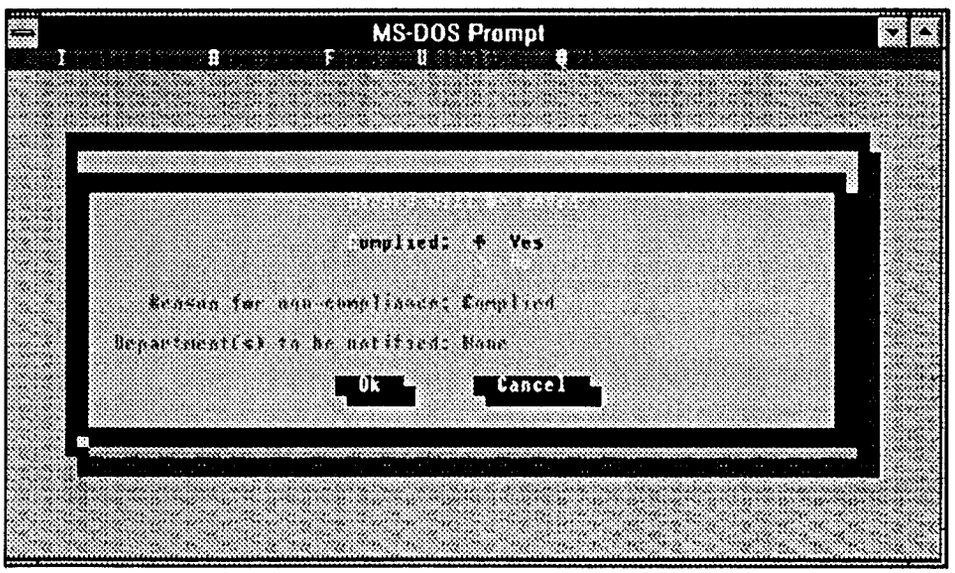
INSERTING OR CHANGING A DATA RECORD

When the highlighted item in a data table is to be altered, the **Change** button beneath the data table should be activated by pressing **<Alt> C**. A data form displaying the current values of all fields in the record will then appear. Had the **Insert** button been activated instead, a data form with blank fields would have appeared. In both cases, the values of the fields can be updated. This is done by moving the cursor to the selected field (**<Tab>** and **<Shift> <Tab>**) and entering the correct value. Once all changes have been made, they can be confirmed by activating the **OK** button (**<Alt> O**) or cancelled by entering **<Alt> C**.



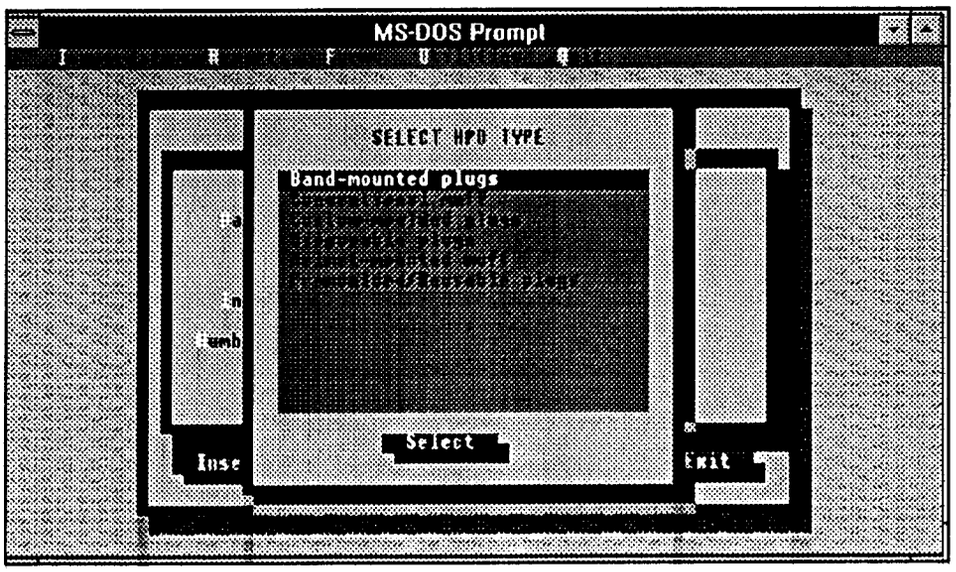
LOOKUP TABLES AND RADIO BUTTONS

On many data entry screens, there are fields where the user has a limited number of choices he can make. Where those possible choices are fixed, eg where a noise surveyor is either qualified or he isn't, the user is restricted by placing "radio buttons" indicating his choices. This simplifies the entry of data and it ensures that valid data is entered.



To make a selection on a radio button, move the cursor to the field using **<Tab>** and **<Shift> <Tab>**. The cursor control keys can then be used to highlight the desired option, and **<Space>** confirms the choice.

lookup tables are provided. An example of this is where a user is entering the results of an HPD survey and, when prompted for the site of the survey, has to choose from the list of sites already entered. One consequence of this is that one has to ensure that the files used as lookup tables are fully populated before attempting to enter other data which makes use of these lookup tables. A lookup table is also displayed when a user attempts to proceed from a field whose contents are invalid in the above sense. Therefore, if one is on a field with limited choices but would like to see the other choices, the entry of a ? and subsequently attempting to leave the field will bring up a lookup table from which a selection can be made.



Input Data

As its name implies, the input data sub-system allows the user to enter the HCP data upon which all subsequent reports are based. Place the cursor on **Input data** in the main menu and activate the menu option. A list of five choices will appear.

OCCUPATIONAL CODE CATEGORIES

(User types: Noise surveys, HPDs, Audiometry, Training/reinforcement, Administrator)

Before entering any input data, the user should check that all occupational code categories required are entered into the system. This is because the entered occupational code categories are used in lookup tables used during the entering of input data. Occupational code categories can be edited by placing the cursor on the **Occupational codes** menu option and activating it. The user will then be presented with a list of four options : surface, conventional underground, mechanised underground or opencast. Occupational code categories are classified into these four groups according to the location of such staff. Place the scroll bar on the relevant choice and activate the **Select** button, or activate the **Cancel** button to return to the calling menu.

The user will then be presented with a table of current entries, unless there are no entries of that type, in which case the user will immediately be placed in insert mode. From the table of entries, the user will be able to insert, change or delete entries by moving the scroll bar to the appropriate entry and then activating the **Insert**, **Change** or **Delete** button respectively. These operations are typical of all HEARBASE data editing : in a vertical list of records, move the scroll bar to the appropriate record using the vertical arrow keys (↑ and ↓). This record can be altered by pressing **<Alt> C** (the hotkey for **Change**) or deleted using the key combination **<Alt> D**. Pressing **<Alt> I**, the hotkey for **Insert**, allows one to add more records, while **<Alt> X** returns the user to the calling menu without making further changes to the database. Each of these actions could have been performed by moving the highlighted (red) cursor to the appropriate button (using **<Tab>** and **<Shift> <Tab>**), and then pressing **<Enter>**.

Note that the names of the occupational code categories must be unique even if they are classified in different locations. A duplicate will not be accepted - instead an error message will be displayed. A category may be deleted only once there are no references to it elsewhere in the database. Here too, an error message will warn the user of an illegal deletion. The user then has to search the input data for the other references, delete them, then return and delete the relevant item in the Occupational codes. This precaution is used to maintain the internal consistency of the database.

NOISE SURVEY EQUIPMENT

(User types: Noise surveys, Administrator)

The details of all noise survey instrumentation used must be entered prior to the entering of survey results. This is because each survey result recorded in HEARBASE must include the serial number of the instrument with which the survey was conducted, and these are offered in a lookup table. The entering of equipment details is selected by proceeding from the Noise surveys option in the Input data menu, and then selecting Survey equipment and Equipment details in succession. Each instrument is identified by a unique **Serial no**, and its **ISO type**, and indication of its level of precision, is also entered. Once again, the buttons can be accessed using the **<Tab>** and **<Shift> <Tab>** keys, or by pressing the relevant hotkey simultaneously with the **<Alt>** key. The information here can only be deleted once all other references to it are removed from the system.

NOISE SURVEY EQUIPMENT CALIBRATION

(User types: Noise surveys, Administrator)

Once the particulars of each instrument have been recorded, the calibration history of the machine can be entered. Each calibration record includes the instrument **Serial no**, a **Certificate name**, the **Date of calibration** and an **Expiry date**. The user is warned if an illegal date is entered.

NOISE SURVEYOR QUALIFICATIONS

(User types: Noise surveys, Administrator)

The list of qualifications of noise surveyors is also a very basic, and hence infrequently entered, type of data. This also means that all relevant qualifications must be entered prior to the entering of noise surveyors in order that they can be used in lookup tables. Once again, the only restriction is that a qualification cannot be deleted while it is referred to elsewhere in the system.

NOISE SURVEYORS

(User types: Noise surveys, Administrator)

Once the surveyor qualifications have been entered, this information can be built upon with the entering of the particulars of noise survey personnel. The noise surveyor information will in turn be built upon during the recording of noise survey results. For each noise surveyor, the **Employee no** entered must be unique, but can consist of both characters and numbers. The two last fields on the input screen (**Qualification** and **Qualification date**) can only be accessed if the **Qualified** field is set to **True**. This can be done by moving the cursor to the field using **<Tab>** and **<Shift> <Tab>**, using the vertical arrow keys ↑ and ↓ to move the cursor between the options within the field, and then to depress the **<Space>** bar. This confirms the current cursor position of the "radio button" as the selected option. The qualification, if entered, is selected from a lookup table by moving the scroll bar vertically to the selected option, and the activating the **Select** button. Once again, a surveyor cannot be deleted from this table while higher level data still makes use of this information.

MACHINERY NOISE SURVEY SITES

(User types: Noise surveys, Administrator)

The descriptions of the sites at which machinery noise has been recorded, must be entered here prior to the entering of the survey results. Each site description can be entered in arbitrary format (ie characters and digits), but must be unique. It effectively serves as an address for the site in question. The sites can be entered and edited, but can only be deleted once all measurements at that site have been deleted from HEARBASE.

MACHINERY NOISE SURVEY RESULTS

(User types: Noise surveys, Administrator)

The details of a particular machinery noise survey are entered here. The table of existing data contains the basic details of the survey, but not the results thereof. These details can be edited in the usual way, ie by the activation of the **Insert**, **Change** or **Delete** button. The **Date of survey** can then be entered, and the **Site**, **Surveyor employee no** and **Instrument serial no** selected from lookup tables. The actual results of the survey are

entered by activating the **Results** button beneath the table of records on the screen MACHINERY NOISE LEVELS. The results corresponding to the survey whose particulars appear at the scroll bar will then be displayed. These too can be activated using the **Insert**, **Change** and **Delete** buttons.

WORKER NOISE EXPOSURE SURVEY SITES

(User types: Noise surveys, Administrator)

Sites at which the exposure of miners to noise was recorded, are entered here. This list acts as a lookup table elsewhere in HEARBASE so the sites must be entered before the recorded noise levels can be entered. Each site sampled must be entered here as a character string. All worker sites must be unique. The sites can be inserted or edited, but can only be deleted once all the information concerning noise surveys conducted at that site has been deleted. Once again, an error message will be displayed if the user does not abide by this rule.

WORKER NOISE EXPOSURE SURVEY RESULTS

(User types: Noise surveys, Administrator)

The details of a particular noise exposure survey can be entered here. The table of existing data contains the basic details of the survey, but not the results thereof. These details can be edited in the usual way, ie by the activation of the **Insert**, **Change** or **Delete** button. In this manner, the **Date of survey**, **Site**, **Surveyor employee no** and **Instrument serial no** can be entered. The actual results of the survey are entered by activating the **Results** button beneath the table of records on the screen WORKER NOISE EXPOSURE. The results corresponding to the survey whose particulars appear at the scroll bar will then be displayed.

REASONS FOR NON-COMPLIANCE WITH HPD REGULATIONS

(User types: HPDs, Administrator)

The first of the HPD input data to be entered are all the reasons for non-compliance with HPD usage. This data is entered first because it is at a low level : it does not make use of any other information, but is used in some of the other HPD data. Upon selection of this option, the user is presented with a table of all reasons which have been offered thus far. One of these reasons should always be **Complied** - compliance is regarded as one possible outcome of an HPD compliance test, with all other possible outcomes being identified by the reason for non-compliance. The table of entries can be browsed in the usual manner, ie by making use of the vertical cursor keys (↑ and ↓). Editing the record at the scroll bar can be initiated by activating the relevant button (**Insert**, **Change** or **Delete**), although the user will automatically enter **Insert** mode if the table is empty. Activating a button is done by moving the cursor to the relevant button using the **<Tab>** and **<Shift> <Tab>** keys, and then pressing **<Enter>**. Alternatively, the **<Alt>** key can be depressed in conjunction with the highlighted character on the relevant button.

If the selected action was **Delete**, then the fields of the current record are displayed on a form prompting the user to continue with the deletion (**OK**), or to ignore it (**Cancel**). Note that the deletion will only be allowed if the current record isn't referred to elsewhere in the system. On the other hand, if a record is being **Inserted** or **Changed**, a form will appear allowing the user to access each field of the record. The first of these is a "radio button" labelled **Complied**, where the user should indicate if the test outcome implied compliance with HPD regulations, or not. The default setting for this option is **No**, because all but one of the possible outcomes should refer to non-compliance. If the option **Yes** is selected, the other two fields are set to default values. All test outcomes indicating compliance will then be dealt with by this entry. For each incident of non-compliance, the user should ensure that the relevant reason proffered is entered here. The **Compliance** option **No** should be selected, following which the reason and relevant departments should be entered. Activating the **OK** or **Cancel** buttons confirms or ignores (respectively) any changes which have been made.

HPD SURVEY SITES

(User types: HPDs, Administrator)

The sites at which HPD surveys were conducted are entered here. Once again, this list of sites is used as a lookup table so survey sites have to entered here before the survey results can be entered. Also, the survey site may not be deleted until all surveys at the site have been removed. The actual site **Description** entered here must uniquely identify the

site. The **Mean employee complement** is the typical number of employees active at this site, and is used to determine HPD compliance statistics at the relevant site.

HPD SURVEY RESULTS

(User types: HPD's, Administrator)

The compliance of staff with HPD regulations is entered in this module. The table should display the results of all compliance surveys entered, and these can be scrolled using the vertical arrow keys (↑ and ↓). The survey at the scroll bar can be edited by activating the relevant button (**Insert**, **Change** or **Delete**), although the survey may not be deleted whilst findings of the survey remain in the system. For example, the **Insert** button brings up a form with the **Date of survey** and the **Survey site**. The validity of the date entered will be checked, and sites can only be selected from the lookup tables provided. Once the new survey has been entered, the user is returned to the table of surveys. With the cursor placed on the survey of interest, the activation of the **Results** button (press **R** whilst holding down **<Alt>**) reveals the findings of the survey. If no results of this survey have yet been entered, the user will immediately be placed in **Insert** mode, whereupon the first compliance category can be selected from the lookup table. For each compliance category, the number in this category should be entered.

HPD TYPES

(User types: HPD's, Administrator)

The issuing of HPDs is stored in the database according to the type of HPD. Hence, the available types must first be entered here so that they can be used in a lookup table when the Issued data is entered. An HPD type can only be deleted once it no longer appears elsewhere in the system.

HPD'S ISSUED

(User types: HPD's, Administrator)

Upon selecting this option, the user is presented with a table of records displaying the issues of HPDs thus far. If no records have yet been entered, the user is immediately placed in **Insert** mode. Otherwise, the **Insert** button has to be activated to enter new

Issued data. The information required about each issue is the **Date of issue**, the **HPD type** (selected from a lookup table), the **Initial issue** (the number of first time recipients of HPDs) and the **Number reissued** (the number of replacement HPDs).

AUDIOMETRY OPERATORS

(User rights: Audiometry, Administrator)

The personal particulars of each audiometry operator are entered in this module. Upon selection of this menu item, the user will be presented with a table of records, each referring to a different audiometry operator. These can be scrolled using the vertical arrow keys (↑ and ↓) and can be edited by activating the relevant button : **Insert**, **Change** or **Delete**. Each of these is activated by moving the cursor to the relevant button (using **<Tab>** or **<Shift> <Tab>**) and then pressing **<Enter>**. The record of a particular audiometer operator may not be deleted if the results of a survey conducted by the operator still reside in the database.

If the table of records was empty when the user entered the Operator details module, the user will immediately be placed **Insert** mode, which displays the record fields. The **First name** and **Surname** must uniquely identify the operator - duplicates are not allowed. The "radio button" of the **Qualified** field is set by default to **True**. It can be altered by moving the cursor to the **Qualified** field, using the vertical arrow keys (↑ and ↓) to highlight the selected choice, and then confirming the choice by depressing the **<Space>** bar. The **Date of qualification** field only becomes accessible if the **Qualified** field is set to **True**. Moving between fields and buttons is accomplished using the **<Tab>** and **<Shift> <Tab>** key combinations. The fields **Active from** and **To** are used to define the period of activity of the operator. A date must be entered for **Active from**, but the value of **To** may be left blank if the operator is still active. All dates must be entered in the format dd/mm/yy, and an error message will be displayed if an unacceptable date is entered. The form is completed by activating **OK** (to confirm the changes) or **Cancel** (to ignore all changes).

AUDIOMETRY OPERATOR PROFICIENCY TESTS

(User rights: Audiometry, Administrator)

The results of proficiency tests on audiometry operators are entered here. These are used in the Reports section to estimate the acceptability of the operator assessments. The **Test data**, **Operator name** and **Proficiency** is stored for each test. The **Proficiency** is classified as *Acceptable* or *Unacceptable*, and entered using a "radio button."

AUDIOMETERS

(User rights: Audiometry, Administrator)

Upon selecting this option, a table of records is displayed where each record corresponds to a different audiometer. The information in each record is a **Serial no**, which must uniquely identify the audiometer, a **Description** of the instrument, its **Purchase date**, and the period during which it was in use. The date at which the audiometer was first used must be entered in **In use from**, but the **Until** field may be left blank if the audiometer is still in use.

AUDIOMETER CALIBRATION

(User rights: Audiometry, Administrator)

The calibration details of the audiometers are entered in this module. Each calibration record contains the **Date of test**, the audiometer **Serial no**, and the outcome of the test (*Acceptable* or *Unacceptable*). The audiometer **Serial no** must be selected from the lookup table, while the **Test result** is entered on the radio button.

AUDIOMETRY BOOTHS

(User rights: Audiometry, Administrator)

This option allows the user to browse and edit the audiometry test booths in use. Each booth record is characterised by the **Booth name** (which must be unique), and the period during which the booth was in use. A date must be entered in the field **In use since**, but the field **Use discontinued on** can be left blank if the booth is still in use. Both dates must be entered in the format dd/mm/yy. The list of test booths entered here is used in lookup tables elsewhere so no record can be deleted until all references to that test booth have been removed from the system.

AUDIOMETRY BOOTH TESTS

(User rights: Audiometry, Administrator)

The status of each booth can be entered in this module of the program. Each record in the table consists of a **Test date**, a **Booth name** (selected from a lookup table), and a test **Outcome** (*Acceptable* or *Unacceptable*) which is entered on a radio button. The booth test results are used in the compilation of reports on the status of the audiometric test centre.

AUDIOMETRY RESULTS

(User rights: Audiometry, Administrator)

Entered here are the summarised results of audiometry tests on staff. For each **Test date**, the results are entered by **Occupational code category** and **Test outcome**. The **Occupational code category** is selected from a lookup table, and allows management to identify any occupational tendencies in hearing loss. The **Test outcome** must be selected from a lookup table of standard audiometry result types which consider the frequency ranges of hearing, a change in hearing capability since the last test, and differences in hearing from one ear to the other.

AUDIOMETRY APPLICATION

(User types: Training, Administrator)

This module concerns the success in exposing all relevant staff to training courses and audiometry tests. Each record entered consists of the aggregation of data over a certain period. Staff due for audiometry and training are classified into three groups : new staff, returnees/ex-leave and high risk staff (those regularly exposed to noise levels exceeding 105dB). For any given period and for each staff category, the following figures are entered : the **Total no**, the **No requiring audiometry**, the **No actually tested** and the **No trained**.

When the Audiometry application menu option is selected, a table of records is displayed. Each of these is a summary of data over a particular period. These records can be browsed using the vertical arrow keys (↑ and ↓). Activating the buttons **Change** or **Delete** allows

the user to perform the relevant function on the record at the scroll bar. These buttons are activated by moving the cursor to the relevant button (using **<Tab>** and **<Shift> <Tab>**) and then pressing **<Enter>**. Alternatively, the highlighted character on the relevant button can be depressed while holding down the **<Alt>** key. The **Insert** button allows the user to insert new records. This mode is entered automatically if the table currently contains no records.

When a new record is being inserted, or when an existing record is being edited, a form appears with all fields listed. The **From** and **To** fields define the period over which data was aggregated. A date must be entered in each field in the format dd/mm/yy. The dates entered are checked for the correct format and for the required precedence. Similarly, for each of the staff categories displayed, certain checks are made on the consistency of the data entered. For example, the **No requiring audiometry** amongst new engagements cannot exceed the **Total No**. Once the required information has been entered, it can be confirmed by activating the **OK** button, or ignored by activating **Cancel**.

When the table of records is complete, the **Exit** button can be activated by depressing the simultaneous **<Alt> X** key combination.

WARNING SIGN IRREGULARITY TYPES

(User types: Training, Administrator)

This module allows one to compile a lookup table which is used when entering data on the proliferance of warning signs. Each such survey result will be classified as *Acceptable*, or it will be deemed *Unacceptable* for one of any number of reasons. The reasons for unacceptability should all be entered here. Since *Acceptable* is also a possible outcome, the table of records should also contain this possibility. When the **Insert** or **Change** button is activated, a form appears displaying all the relevant data fields. A radio button allows the user to indicate the acceptability of the outcome. The default option here is *No* since all but one entry will be considered unacceptable. Altering the status of the radio button requires the moving of the cursor to the button by means of the **<Tab>** and **<Shift> <Tab>** keystrokes. Once there, the cursor can be positioned using the vertical arrow keys. The choice at the cursor can then be confirmed by depressing the **<Space>** bar. If the option *Yes* is selected, the field **Warning sign irregularity** is automatically filled and becomes unaccessible. Otherwise, a unique character string describing the reason for unacceptability must be entered. Once the form is complete, it can be confirmed or ignored by activating the **OK** or **Cancel** button respectively.

Activating the **Delete** button removes the record at the scroll bar from the database. This is only permitted if no warning sign survey elsewhere in the database makes use of this irregularity type.

WARNING SIGN SITES

(User types: Training, Administrator)

This option allows the user to enter the sites at which warning sign surveys were conducted. For each site, a unique character string should be entered. These site names will be used in a lookup table when the results of such surveys are entered into the system. No site may be deleted while surveys conducted at that site still exist within HEARBASE.

WARNING SIGN STATUS

(User types: Training, Administrator)

The table entered here displays the results of warning sign surveys. These survey results can be scrolled using the vertical arrow keys (↑ and ↓) and edited by activating the relevant button beneath the table. If the table contains no records, the user will automatically enter **Insert** mode. A form will display the data fields which have to be completed. The **Date of survey** should be entered in the usual format dd/mm/yy. Both the **Warning sign site** and the **Type of irregularity** are selected from lookup tables. The **Number of irregularities** is the number of instances of this finding during the specified survey. These results are used in the compilation of reports on the status of training and reinforcement at the mine.

POSTER IRREGULARITY TYPES

(User types: Training, Administrator)

This module allows one to compile a lookup table which is used when entering data on the proliferance of posters. Each such survey result will be classified as *Acceptable*, or it will be deemed *Unacceptable* for one of any number of reasons. The reasons for unacceptability should all be entered here. Since *Acceptable* is also a possible outcome, the table of records should also contain this possibility. When the **Insert** or **Change** button is activated, a form appears displaying all the relevant data fields. A radio button allows the user to indicate the acceptability of the outcome. The default option here is *No* since all but one entry will be considered unacceptable. Altering the status of the radio button requires the moving of the cursor to the button by means of the **<Tab>** and **<Shift> <Tab>** keystrokes. Once there, the cursor can be positioned using the vertical

arrow keys. The choice at the cursor can then be confirmed by depressing the **<Space>** bar. If the option *Yes* is selected, the field **Poster irregularity** is automatically filled and becomes unaccessible. Otherwise, a unique character string describing the reason for unacceptability must be entered. Once the form is complete, it can be confirmed or ignored by activating the **OK** or **Cancel** button respectively.

Activating the **Delete** button removes the record at the scroll bar from the database. This is only permitted if no poster survey elsewhere in the database makes use of this irregularity type.

POSTER SITES

(User types: Training, Administrator)

This option allows the user to enter the sites at which poster surveys were conducted. For each site, a unique character string should be entered. These site names will be used in a lookup table when the results of such surveys are entered into the system. No site may be deleted while surveys conducted at that site still exist within HEARBASE.

POSTER STATUS

(User types: Training, Administrator)

The table entered here displays the results of poster surveys. These survey results can be scrolled using the vertical arrow keys (↑ and ↓) and edited by activating the relevant button beneath the table. If the table contains no records, the user will automatically enter **Insert** mode. A form will display the data fields which have to be completed. The **Date of survey** should be entered in the usual format dd/mm/yy. Both the **Poster site** and the **Type of irregularity** are selected from lookup tables. The **Number of irregularities** is the number of instances of this finding during the specified survey. These results are used in the compilation of reports on the status of training and reinforcement at the mine.

Reports

The Reports sub-system allows the appropriate users to generate reports indicating the status of the hearing conservation programme or a component thereof. All reports are based on the data entered in the Input data section. Reports are generated by HearBase on three levels and are labelled A-0 to A-9, P-0 to P-6 and R-1 to R-3, largely in accordance with the COMRO report upon which the HEARBASE software is based. The input form reports (A-0 to A-9) merely display a subset of the input data in a format similar to that in which it is entered. Processing reports (P-0 to P-6) are intended for heads of departments, and are summaries of the input data over the current review period. Review reports (R-1 to R-3) are intended for top management, and compare HCP indicators over the current review period with those from the previous review period. Reports containing no data will not be generated - a message will be given to this effect. All reports include the name of the mine and the date and time at which the report was generated.

Each report generated is displayed on the screen, but may then be redirected to a printer. All the reports make use of line drawing symbols, and some printers may need to be set up to print these characters correctly. Contact your PC support staff if this turns out to be necessary.

To enter the Reports module, position the cursor on Reports in the main menu and press the **<Enter>** key. A list of four choices should appear. These should be dealt with in the order specified below.

REVIEW PERIODS

(User types: Reports, Administrator)

Most of the reports are based on review periods. The input form reports summarise information over a current review period, while the processing and review reports involve comparisons between the current and previous review periods. This menu item allows the current and previous review periods to be specified.

The Review periods menu option can be selected by **<Alt> R** (**R** whilst holding down the **<Alt>** key). A form then appears allowing the input of the dates defining the two review periods. One can move from one field to another by making use of the **<Tab>** and **<Shift> <Tab>** key combinations. All dates must be entered in the format dd/mm/yy, and each **To** date may not precede the corresponding **From** date. Once the dates have been

entered, the current values can be confirmed by activating the **OK** button (**<Alt> O**) or the original values can be retained by activating the **Cancel** button (**<Alt> C**).

NOISE SURVEY PERSONNEL AND INSTRUMENTS (A-0)

(User rights: Reports, Administrator)

This, the first of the reports, consists of two parts, one based on the noise survey personnel, and the other on the instruments they are using. Only those noise surveyors active during the current review period, and those instruments used during this period, are displayed here. The file of certificates issued for the noise survey equipment is checked to determine whether valid certificates were issued for the entire duration of the review period. The outcome of this check is listed under **Calibration**. The report can be scrolled on the screen using the vertical arrow keys (↑ and ↓), or the **<PgUp>** and **<PgDn>** keys. The number of lines displayed on the screen can be alternated between 25 and 40 by activating the **25/40 Mode** button. This is done by pressing the key combination **<Alt> M**. Pressing **<Alt> P** activates the **Print** button. A menu then appears allowing the user to select the port to which the text file should be sent. The default choice, *LPT1*, is likely to be the one to which the printer is connected. Alternatively, the cursor can be moved using the horizontal arrow keys (← and →) and the choice confirmed by depressing the **<Space>** bar. Finally, pressing **<Enter>** will initiate the printing. **<Alt> X** exits the report.

WORKER NOISE EXPOSURE (A-1)

(User rights: Reports, Administrator)

Upon requesting this report, the user is offered a table of sites at which the noise exposure of workers has been measured. After selecting a site, a report is produced showing a summary of all noise levels recorded at this site during the current review period. A problem size rating is obtained by dividing by 85dB the mean of all measurements exceeding 85dB, which is the maximum level still considered safe.

When the table of sites is displayed, the scroll bar should be positioned upon the appropriate site using the vertical arrow keys (↑ and ↓). Activating the **Select** button (**<Alt> S**) confirms the choice of site, whilst **<Alt> C** cancels the report generation. When a report is generated, it can be scrolled as before (using ↑, ↓, **<PgUp>** and **<PgDn>**) and printed by activating the **Print** button. The **Exit** button returns the user to the calling menu.

CATEGORISED NOISE SURVEY DATA (A-2)

(User rights: Reports, Administrator)

This report is similar to A-1 and also requires the selection of a site at which worker noise exposure was measured. The measurements recorded at this site during the current review period are then displayed in decibel ranges. The mean values, total value and standard deviation of measurements in each decibel range are displayed in the report.

CATEGORISED NOISE SURVEY DATA (A-3)

(User rights: Reports, Administrator)

The selection of this menu item activates a table of all sites at which machinery noise levels have potentially been sampled. Selecting a site here results in all noise levels recorded at this site during the current review period being listed in increasing order. This report can be scrolled and printed as mentioned before.

HPD COMPLIANCE (A-4.1)

(User rights: Reports, Administrator)

This, the first of the HPD reports, serves as a summary of all HPD compliance surveys conducted during the current review period. The results are displayed by survey site to allow for problem sites to be identified. For each survey site, the typical number of employees stationed there is listed under **Total no**. The total number of employees sampled at this site during the current review period is listed in the column **Sample size**, and the total number amongst these who were not complying with HPD regulations is listed both as an absolute value and as a percentage of the sample.

HPD COMPLIANCE (A-4.2)

(User rights: Reports, Administrator)

In this module, the user has to select a particular site of interest. The results of HPD surveys conducted at this site during the current review period are then analysed according to the reasons given for non-compliance. The **Non-compliance rating** indicates the percentage of staff at this site not complying with HPD regulations while the percentages displayed in the last column indicate the breakdown according to reason given for non-compliance.

HPD DISTRIBUTION (A-5)

(User rights: Reports, Administrator)

This report summarises the issue of HPD's to employees during the current review period. For each type of HPD, the number issued to staff for the first time (**Initial issue**) and the number or replacements (**Re-issued**) are listed separately.

AUDIOMETRY RESULTS (A-6)

(User rights: Reports, Administrator)

This report displays the combined audiometry results for one particular occupational code category during the selected period of interest. The user is presented with a table of occupational code categories, from which one must be selected. The combined results per result category are then given in tabular form. Note that this table includes only those incidents of hearing loss of one form or another. The breakdown by occupational code category and hearing loss type will allow management to identify any trends in hearing loss.

STATUS OF AUDIOMETRIC TEST CENTRE (A-7)

(User rights: Reports, Administrator)

The purpose of this report is to indicate the status of the audiometric test centre during the current review period. This depends on the audiometer operators, the audiometers themselves and the audiometry booths. Only those operators, audiometers and test booths that were involved in audiometry during the review period are displayed. An audiometer operator is given a rating of *Acceptable* if he qualified before the start of the review period, or before becoming involved in audiometry if this is after the start of the review period. Furthermore, he must have passed proficiency tests at most two years apart over the review period. An audiometer or test booth receives a rating of *Acceptable* if it is tested (and found to be working) at least once a year over the review period.

AUDIOMETRY COVERAGE (A-8)

(User rights: Reports, Administrator)

This report summarises the success of the audiometric test centre in testing all those employees eligible for testing, and of the training department in training employees in hearing conservation. The mine staff involved are new employees, those returning from leave and those exposed to high noise levels (exceeding 105dB). For each of these categories, the number requiring audiograms, the number actually tested and the number trained are expressed as percentages of the total number of staff in the category. The standard report options are available by activating the buttons.

POSTERS/WARNING SIGNS (A-9)

(User rights: Reports, Administrator)

The success of the HCP in terms of training and reinforcement of hearing conservation is captured in this report. Summarised statistics are presented indicating the prevalence of irregularities in the display of posters and warning signs, given by site type and the main reason for the irregularities. The percentages shown are based on all survey results during the current review period.

NOISE SURVEY PERSONNEL AND INSTRUMENTS (P-0)

(User rights: Reports, Administrator)

This report is based on the tables in report A-0 for two review periods. For each of these periods, the percentage of the active noise surveyors who were suitably qualified at the start of the review period is displayed under **Course attendance**. Similarly, the **Equipment rating** score is the percentage of audiometers used that were calibrated at least every year during the review period in question. The **Total** for each column is the weighted average of the **Course attendance** and **Equipment rating** percentages, where the weights are calculated according to the number of active noise survey operators and instruments. For example, if only one noise survey operator was active, but two instruments were used, then the **Total** will be one third of the **Course attendance** score plus two thirds of the **Equipment rating** score. The report can be diverted to the printer in the usual way.

WORKER NOISE EXPOSURE (P-1)

(User rights: Reports, Administrator)

This report summarises the extent to which workers are exposed to noise during each of the current and previous review periods. The noise exposure for each of these periods, and the percentage change from the previous review period to the current review period, are calculated for each of the sites tested during the current review period. The column **N.P** contains the sum of all noise readings recorded at the relevant site during the current review period, while **Max N.P** is the number of readings at that site times 85dB. The ratio **N.P/Max N.P** is referred to as the **Problem size rating**, which is also shown.

MACHINERY NOISE SURVEYS (P-2)

(User rights: Reports, Administrator)

This report compares the average noise level recorded at each machinery site during the previous and current review periods, and the percentage change during the two review periods.

HPD COMPLIANCE (P-3)

(User rights: Reports, Administrator)

The results of HPD compliance surveys during the current and previous review periods are compared here. These figures include findings at all sites. The **Non-compliance rating** is the percentage of sampled workers who were not complying with HPD regulations, and the actual number is displayed in **Non-compliance incidents**. The non-compliance incidents are broken down by reason.

AUDIOMETRY RESULTS (P-4)

(User rights: Reports, Administrator)

This report shows the percentage change in audiometry warnings and referrals during the two review periods. Results are given per occupational code category to allow the user to determine the degree to which hearing problems are occupation related.

STATUS OF AUDIOMETRIC TEST CENTRE (P-5)

(User rights: Reports, Administrator)

For each of the two review periods, the **Operator proficiency** indicates the percentage of audiometer operators who were qualified during the review period (or the portion during which they were active) and passed proficiency tests at least once every two years during this period. The **Equipment calibration** and **Test booth rating** are the percentages of audiometers and test booths (respectively) adequately calibrated at least once a year during the review period, or the portion thereof during which they were used in audiometry. The **Total** percentage is a weighted average of the three percentages in the column above it. The weighting of each of the three is in proportion to the number of active operators/audiometers/booths (whichever is relevant).

TRAINING/REINFORCEMENT (P-6)

(User rights: Reports, Administrator)

This report represents a summary of the data contained in reports A-8 and A-9 for the two review periods. For both educational posters and warning signs, the percentage of irregularities at each survey site is displayed, as well as the predominant type of irregularity. The **Total** is the number of irregularities at all sites expressed as a percentage of the all findings at all the sites. The third table indicates the number of staff trained during each review period, expressed as a percentage of the total number eligible for audiometry during the relevant review period.

CRITERIA (R-3)

(User rights: Reports, Administrator)

This report summarises all the preliminary reports into one table, and gives an indication of which aspects of the HCP have improved from the previous review period to the current one. The report is further summarised in the other two review reports.

PROGRAMME STATUS (R-2)

(User rights: Reports, Administrator)

This report summarises report R-3 by analysing the status and trend of each element of the HCP. Each status is assigned a value zero if any irregularity was recorded during the current review period, and unity otherwise. A trend of unity indicates an increase in irregularities from the previous review period to the current one. Hence a status of one is desirable and a trend of one undesirable. These flags are then summarised in report R-1 to give an indication to management of whether the HCP is improving or not.

SYNOPSIS (R-1)

(User rights: Reports, Administrator)

This report is intended to convey the entire status and progress of the HCP in one table. It is a summary of report R-2. A high **Status** value is desirable, but not a high **Trend** value.

Forms

This menu sub-system allows the user to print out blank forms to be used for data capture by mine staff. The types of forms available are labelled A-0 to A-9, in accordance with the COMRO report upon which HEARBASE is based. The type of form printed out is determined by the menu option selected. All the reports make use of line drawing symbols, and some printers may need to be set up to print these characters correctly. Contact your PC support staff if this turns out to be necessary.

Using the horizontal arrow keys (→ and ←) move the cursor on the main pulldown menu to Forms and press **<Enter>**. Five items should appear on the menu, and these should be selected (where appropriate) in the order laid out below. To select a menu option, position the cursor using the vertical arrow keys (↑ and ↓) and press **<Enter>**.

FORM DESTINATION

(User rights: Noise surveys, HPDs, Audiometry, Training, Administrator)

This menu option allows the user to set the default form destination. A radio button allows the user to set the destination type, and the field **Filename** allows the user to enter the destination file name only when the radio button is set to *File*. The radio button options *LPT1* to *LPT4* and *COM1* to *COM4* refer to the various ports on the computer; *LPT1* is usually the port to which the printer is connected. ***Note that a form sent to a file will cause the current file contents to be overwritten without any warning to the user.***

To select a radio button option, move the cursor to the desired position using the arrow keys (→, ←, ↑ and ↓). The option at the current cursor position is selected by pressing the **<Space>** bar. If the option *File* was selected, the **Filename** field becomes accessible to the user. Use the **<Tab>** (and **<Shift>** **<Tab>** to reverse) to move to the next field/button. Any valid DOS file name can be entered here. A DOS manual can be consulted for the rules governing the naming of files. If the **OK** button is activated at any point (by pressing **O** whilst holding down the **<Alt>** key), then the current field values will be stored. Alternatively, activating the **Cancel** button (**<Alt>** **C**) will ignore any changes made and restore the original values.

NOISE SURVEY FORMS (A-0) TO (A-3)

(User rights: Noise surveys, Administrator)

Once the relevant menu item has been reached, select it by pressing **<Enter>**. This form will then be sent to the selected destination. If this destination is the screen, the form will appear on the screen and can be scrolled using the vertical arrow keys (↑ and ↓) or mouse. It can then be redirected to the printer by activating the **Print** button at the bottom of the screen (hold down the **<Alt>** key and press the highlighted key **P**). A radio button indicating the form destination is then displayed. A specific port (typically *LPT1*) is selected by moving the cursor using the horizontal arrow keys (← and →) and pressing **<Space>**. The printing process can be initiated by pressing **<Enter>**.

The **25/40 Mode** button allows the user to alternate between 25 and 40 lines being displayed on the screen. Pressing **M** whilst holding down the **<Alt>** key will activate the button, and it should be reactivated when one wishes to return to the original choice. Activating the **Exit** button (**<Alt>** **X**) returns the user to the calling menu.

HPD FORMS (A-4.1) TO (A-5)

(User rights: HPDs, Administrator)

Once the relevant menu item has been reached, select it by pressing **<Enter>**. This form will then be sent to the selected destination. If this destination is the screen, the form will appear on the screen and can be scrolled using the vertical arrow keys (↑ and ↓) or mouse. It can then be redirected to the printer by activating the **Print** button at the bottom of the screen (hold down the **<Alt>** key and press the highlighted key **P**). A radio button indicating the form destination is then displayed. A specific port (typically *LPT1*) is selected by moving the cursor using the horizontal arrow keys (← and →) and pressing **<Space>**. The printing process can be initiated by pressing **<Enter>**.

The **25/40 Mode** button allows the user to alternate between 25 and 40 lines being displayed on the screen. Pressing **M** whilst holding down the **<Alt>** key will activate the button, and it should be reactivated when one wishes to return to the original choice. Activating the **Exit** button (**<Alt>** **X**) returns the user to the calling menu.

AUDIOMETRY FORMS (A-6) TO (A-7)

(User rights: Audiometry, Administrator)

Once the relevant menu item has been reached, select it by pressing **<Enter>**. This form will then be sent to the selected destination. If this destination is the screen, the form will appear on the screen and can be scrolled using the vertical arrow keys (↑ and ↓) or mouse. It can then be redirected to the printer by activating the **Print** button at the bottom of the screen (hold down the **<Alt>** key and press the highlighted key **P**). A radio button indicating the form destination is then displayed. A specific port (typically *LPT1*) is selected by moving the cursor using the horizontal arrow keys (→ and ←) and pressing **<Space>**. The printing process can be initiated by pressing **<Enter>**.

The **25/40 Mode** button allows the user to alternate between 25 and 40 lines being displayed on the screen. Pressing **M** whilst holding down the **<Alt>** key will activate the button, and it should be reactivated when one wishes to return to the original choice. Activating the **Exit** button (**<Alt>** **X**) returns the user to the calling menu.

TRAINING/REINFORCEMENT FORMS (A-8) TO (A-9)

(User rights: Training, Administrator)

Once the relevant menu item has been reached, select it by pressing **<Enter>**. This form will then be sent to the selected destination. If this destination is the screen, the form will appear on the screen and can be scrolled using the vertical arrow keys (↑ and ↓) or mouse. It can then be redirected to the printer by activating the **Print** button at the bottom of the screen (hold down the **<Alt>** key and press the highlighted key **P**). A radio button indicating the form destination is then displayed. A specific port (typically *LPT1*) is selected by moving the cursor using the horizontal arrow keys (→ and ←) and pressing **<Space>**. The printing process can be initiated by pressing **<Enter>**.

The **25/40 Mode** button allows the user to alternate between 25 and 40 lines being displayed on the screen. Pressing **M** whilst holding down the **<Alt>** key will activate the button, and it should be reactivated when one wishes to return to the original choice. Activating the **Exit** button (**<Alt>** **X**) returns the user to the calling menu.

Maintenance (Utilities)

Provision is made in HEARBASE for various maintenance functions. The types of maintenance required of the average user are the backing up (and restoring) of input data and the changing of passwords. The administrator of the system has further responsibilities which include the exporting and importing of input data, the deleting of old data, the maintenance of user ids and the resetting of passwords.

When the **Utilities** option is selected on the bar menu, a sub-menu containing the maintenance functions will appear. Those greyed out are not the responsibility of the current user. The remainder should be dealt with in the order in which they are presented below.

BACKUP DATA

(User rights: Noise surveys, HPD's, Audiometry, Training, Administrator)

This option allows the user to backup all input data to diskettes. ***This should be done on a daily basis***, or after each new set of input data is entered. At least three sets of backup diskettes should be kept, and these should be rotated so that the last three sets of backup data are on the diskettes at any given time. Data suspected of being corrupted should never be backed up onto a diskette containing earlier backup data.

When the **Backup** option is selected, a form will appear asking for the **Backup drive**. The name of the drive in which the backup diskette will be placed should be entered. Activating the **OK** button by pressing the key combination **<Alt> O** will then result in the display of a message requesting the user to enter a diskette and warning that ***all files currently on the drive will be overwritten***. Use is made of the standard DOS command BACKUP, so the restrictions on its use are those listed in any DOS manual.

RESTORE DATA

(User rights: Noise surveys, HPD's, Audiometry, Training, Administrator)

This option allows the user to restore an input data set from a backup diskette, and makes use of the standard DOS command RESTORE. The restrictions on its use are thus described in any DOS manual. ***Note that the use of this command will lead to the input***

data files in the current directory being overwritten. This option should only be used when the current data set in use has been corrupted and the entire data set needs to be replaced with an earlier version on a backup diskette.

PASSWORDS

(User rights: Noise surveys, HPD's, Audiometry, Training, Administrator)

Selecting this option activates a menu allowing the user to **Edit password** or **Edit users**. Pressing **<Enter>** selects the first option. The user is first prompted for his existing password and, if it is correctly entered, then allowed to enter a new password. Any alphanumerical characters may be used in the password entered. Activating the **OK** button will accept the **New password**, while the **Cancel** button will cause the **Current password** to be maintained.

Each user should change his password on a regular basis, and this password should not be lent to anybody else.

The second option is for administrators to allocate new users to the system, remove users from the system or reset passwords of current users. A password becomes 'XXXXXX' after being reset, and all new users are assigned this password. Selecting this option displays the **ID** of current users and their **Access rights** in a table. These can be edited by activating the relevant button. When a user's details are being **Changed** or **Inserted**, a form is displayed showing the current details of the user. Both the **Access rights** and the **Reset password** options are set using radio buttons. If the **Access rights** are set to *Administrator*, the fields **Administrator name** and **Tel no** become accessible so that the appropriate details of the administrator can be displayed where necessary during use of HEARBASE on the current PC.

NAME OF MINE

(User rights: Administrator)

The name of the mine should be entered here as a character string and will be printed on the bottom of all reports. The name entered can be confirmed by activating the **OK** button (**<Alt> O**) or cancelled using the **Cancel** button.

EXPORT DATA

(User rights: Administrator)

The current version of HEARBASE was designed for use at a single PC at any given mine. However, limited provision has been made for the entering of data at various points and the subsequent aggregation of such data. The aggregation process contains risks of both data loss and of data duplication. Therefore, this function has been assigned to users of administrator status only.

If input data at a mine is being entered on more than one PC, the aggregation of such data involves the exporting of data from each data entry point onto a diskette. This data is then imported onto the master PC where the reports are generated. The **Export Data** option copies all or part of the input data files to the target diskette. Once this has been done, the success thereof should be verified by listing all files on the target diskette. The **Delete Old Data** option should then be run using the same data type and the current date. This will ensure that no duplication of data will take place at a later date.

To export input data, select the **Export** option on the menu. Six input data categories are then displayed. Once again, the menu cursor should be moved to the selected data type and **<Enter>** pressed. The **Destination directory**, whether on the current drive or not, should be entered as a pathname. Activating the **OK** button by pressing **<Alt> O** will copy all selected types of data files to the **Destination directory**. Alternatively, the operation can be **Cancel**led by pressing **<Alt> C**.

IMPORT DATA

(User rights: Administrator)

This option allows datasets on other disks or in other directories to be integrated with the datafiles in the current directory. Relations between datafiles are maintained but care should be taken to prevent ***data being corrupted during this process***. An example of this corruption is where a dataset is exported and then immediately imported again. In general, this will not leave the dataset unchanged. For in combining the imported dataset with the current one, the software has no way of knowing whether the audiometry coverage (for example) in each dataset for a given period refers to the same data (and should be left unchanged) or whether it should be combined. In general, such ambiguous cases are dealt with by combining data. This ambiguity can be avoided by using the **Delete Old Data** option each time input data is exported. This is explained under **Export Old Data**.

DELETE OLD DATA

(User rights: Administrator)

The purpose of this facility is to allow the administrator to limit the size of a data set by eliminating all "old" input data. A **Date of oldest data** is entered in the format dd/mm/yy and files are scanned for database records with date fields. Where the contents of the date field are older than the **Date of oldest data**, and the data has no relation to new data, the record is deleted. A typical example is a noise survey conducted prior to the **Date of oldest data**. However, a noise survey operator whose qualification date was prior to the **Date of oldest data**, for example, will not be deleted from the system because he may still be active.

Appendix

HEARBASE FILES

The files provided with and created by HEARBASE consist of the program file HEARBASE.EXE, the online help file HEARBASE.HLP, the data files and their associated key files. Each data file has a file extension 'DAT' while the key files, which are used to order the accessing of the data files, have extensions 'K0*' (where * represents any number from 1 to 9).

Most problems encountered in HEARBASE are likely to be associated with the data or key files. Should the key files be corrupted, they can be deleted without losing information. In that case, the program will prompt the user to approve the regeneration of a key file each time one is found to be missing. Should a problem arise with the data files themselves, backups should be restored from disk. An attempt can be made to restore only those files with which problems are being experienced, but the relations between files must be observed. In other words, if only a portion of a dataset is restored, all files related to the set of restored files must be restored too. A list of all data files is shown below, and includes a description of the file, its contents and primary key fields (shown in bold). A table indicating the relations between files is presented at the end of the Appendix.

AudEq - Audiometry equipment details
- **SerialNo**(STRING 10)-Serial no of audiometer
- Model(STRING 30)-Model description
- Purchase(LONG)-Purchase date of audiometer
- ActiveFrom(LONG)-Commissioning date of audiometer
- ActiveTo(LONG)-Final date of use of audiometer
- PrevTested(BYTE)-Temporary flag indicating if audiometer adequately calibrated during previous review period
- CurrTested(BYTE)-Temporary flag indicating if audiometer adequately calibrated during current review period

AudEqTst - Results of audiometer tests
- **TestDate**(LONG)-Date of audiometer test
- **SerialNo**(STRING 10)-Serial no of audiometer
- Result(STRING 12)-Test result : "Acceptable" or "Unacceptable"

AudioCat - Audiometry result categories : not editable in program
- **OutcomeCode**(STRING 5)-Code indicating outcome type
- Description(STRING 30)-Description of outcome category

AudioRes - Audiometry results
- **Date**(LONG)-Date of test
- **OCodeCat**(SHORT)-Occupational code category number of staff tested
- **OutcomeCode**(STRING 5)-Outcome type
- Number(SHORT)-Number in this result category

AudOp - Audiometry operators
- **Operator**(SHORT)-Operator no
- FirstName(STRING 20)-First name of audiometry operator
- Surname(STRING 20)-Surname of audiometry operator
- Qualified(STRING 5)-Indicates if qualified : "True" or "False"
- Date(LONG)-Date of qualification
- ActiveFrom(LONG)-Date from which operator was active
- ActiveTo(LONG)-Date until which operator was active
- PrevTested(BYTE)-Temporary flag indicating if operator was adequately tested during the previous review period
- CurrTested(BYTE)-Temporary flag indicating if operator was adequately tested during the current review period

AudOpTst - Audiometry staff test results
- **Operator**(SHORT)-Operator no
- **TestDate**(LONG)-Date of test of audiometry operator
- Proficiency(STRING 12)-Test result - "Acceptable" or "Unacceptable"

Booths - Audiometry booths
- **BoothNo**(SHORT)-Booth number
- BoothName(STRING 10)-Name of booth as entered by user
- ActiveFrom(LONG)-Commissioning date of test booth
- ActiveTo(LONG)-Final date of use of booth
- PrevTested(BYTE)-Temporary flag indicating if booth status was acceptable during previous review period
- CurrTested(BYTE)-Temporary flag indicating if booth status was acceptable during current review period

BoothTst - Results of tests on booths
BoothNo(SHORT)-Booth number
TestDate(LONG)-Date of test of booth
Outcome(STRING 12)-String indicating outcome : "Acceptable" or "Unacceptable"

Calibrat - Noise survey equip calibrations
SerialNo(STRING 10)-Serial no of noise survey instrument
Certificate(STRING 30)-Calibration certificate name
FromDate(LONG)-Calibration date
ToDate(LONG)-Expiry date of certificate

dBRange - Temporary file used to categorise noise measurements
RecordNo(BYTE)-Record no - used to order records
dBUpTo85(STRING 3)-Noise measurements less than or equal to 85 dB
dB86To95(STRING 3)-Noise measurements 86 to 95 dB
dB96To105(STRING 3)-Noise measurements 96 to 105 dB
dB106To115(STRING 3)-Noise measurements 106 to 115 dB
dBExceeding115(STRING 3)-Noise measurements exceeding 115 dB

HPDCompl - Results of HPD compliance surveys
SurveyNo(LONG)-HPD survey no
ReasonNo(BYTE)-Indicates reason for non-compliance
Number(SHORT)-Number of non-compliance incidents of this type

HPDIssue - Issue of HPDs to staff
Date(LONG)-Date of issue/reissue
HPDType(BYTE)-Type no of HPD being issued
Initial(SHORT)-Quantity of HPDs being issued for the first time
Reissue(SHORT)-Number reissued
Display(BYTE)-Temporary flag indicating whether record is to be displayed or not

HPDReas - Reasons for HPD non-compliance
ReasonNo(BYTE)-Reason no
Reason(STRING 30)-Reason for non-compliance
Department(STRING 30)-Department(s) to be notified
Complied(BYTE)-Flag indicating if complied
PrevIncidents(SHORT)-Temp flag: No of non-compliance incidents of this type during the previous review period
CurrIncidents(SHORT)-Temp flag: No of non-compliance incidents of this type during the current review period

HPDSite - Sites at which HPD surveys are conducted
SiteNo(BYTE)-No of site
Description(STRING 30)-Description of site
TotalComplement(SHORT)-Mean no of employees in the vicinity

HPDSurv - Dates and sites of surveys conducted
SurveyNo(LONG)-Survey number
Date(LONG)-Date of survey
SiteNo(BYTE)-Number of site at which survey was conducted

HPDTypes - Contains the list of HPD types
TypeNo(BYTE)-Type no of HPD
Description(STRING 30)-Description of HPD

ISOTypes - ISO ratings : not editable in program
ISONo(BYTE)-ISO number
Description(STRING 20)-Description of ISO category

MachNois - Machinery noise levels recorded
SurveyNo(LONG)-Machinery survey no
dB(SHORT)-Noise level recorded

MachSite - Machinery sites at which noise levels were recorded
SiteNo(LONG)-Site number
Description(STRING 30)-Description of machinery survey site

MachSurv - Machinery noise surveys conducted
SurveyNo(LONG)-Survey number
SurvDate(LONG)-Date of survey
SiteNo(LONG)-No of site at which survey was conducted
SerialNo(STRING 10)-Serial no of survey instrument
EmployeeNo(STRING 8)-Employee no of noise surveyor

OcCodes - Occupational code categories
CatNo(LONG)-Number indicating occ code category
LocNo(BYTE)-Indicates surface, underground (conventional), underground (mechanised) or open cast
Category(STRING 30)-Occupational code category name

Password - Passwords assigned by administrator of system
UserName(STRING 6)-Name of user
Password(STRING 6)-User's password
UserTypeNo(BYTE)-Indicator of rights of user

Periods - Lists periods to be checked. Used in determining if equipment/surveyor was certified during a review period
FromDate(LONG)-Start of period
ToDate(LONG)-End date of period

Posters - Poster survey results
Date(LONG)-Date of survey
SiteNo(SHORT)-Poster site number
ReasonNo(BYTE)-Poster reason number
Number(BYTE)-Number of posters in this irregularity category

PostReas - Reasons for irregularity
ReasonNo(BYTE)-Poster reason number
Reason(STRING 30)-Type of irregularity
OK(BYTE)-Indicates if acceptable or not
NoOfIrregularity(SHORT)-Temporary field : no of occurrences of this irregularity type

PostSite - Poster sites
- **SiteNo**(SHORT)-Poster site number
- Description(STRING 30)-Actual site description

Qualific - Noise surveyor qualifications
- **QualNo**(BYTE)-Qualification number
- Qual(STRING 30)-Name of qualification

Review - Contains dates defining review periods
- **ThisFrom**(LONG)-Start date of current review period
- ThisTo(LONG)-End date of current review period
- LastFrom(LONG)-Start date of previous review period
- LastTo(LONG)-End date of previous review period

Setup - Setup file
- **Description**(STRING 30)-Description of the miscellaneous data type
- Data(STRING 30)-Data value

SignReas - Reasons for warning sign irregularities
- **ReasonNo**(BYTE)-Reason number
- Reason(STRING 30)-Description of irregularity
- OK(BYTE)-Indicates if this reason means OK
- NoOfIrregularity(SHORT)-Temporary field : no of irregularities of this type during review period

Signs - Results of warning sign surveys
- **Date**(LONG)-Date of warning sign survey
- **SiteNo**(SHORT)-Warning sign site number
- **ReasonNo**(BYTE)-Irregularity reason number
- Number(BYTE)-Number of incidents

SignSite - Warning sign sites
- **SiteNo**(SHORT)-Warning sign site number
- Description(STRING 30)-Actual site description

SurvEqp - Details of noise survey equipment
- **SerialNo**(STRING 10)-Serial no of noise survey instrument
- Model(STRING 30)-Model description of survey instrument
- ISOType(BYTE)-ISO type of survey equipment
- CurrActive(BYTE)-Temporary flag indicating if used in current review period
- PrevActive(BYTE)-Temporary flag indicating if used in previous review period
- CurrCalibrated(BYTE)-Temporary flag indicating if calibrated for entire current review period
- PrevCalibrated(BYTE)-Temporary flag indicating if calibrated for entire previous review period

Surveyor - Noise surveyor details
- **EmployeeNo**(STRING 8)-Employee no of noise surveyor
- FirstName(STRING 20)-First name of noise surveyor
- Surname(STRING 20)-Surname of noise surveyor
- Qualified(STRING 5)-Indicates if surveyor is qualified : "True" or "False"
- QualNo(BYTE)-Qualification no of noise surveyor
- QualDate(LONG)-Date noise surveyor qualified
- CurrActive(BYTE)-Temporary flag indicating if active during current review period
- PrevActive(BYTE)-Temporary flag indicating if active during previous review period

Training - Status of audiometry coverage
- **StarDate**(LONG)-Start date of period
- EndDate(LONG)-End date of period
- Leave(SHORT)-No of employees returning from leave during period
- New(SHORT)-New engagements during period
- LeaveAud(SHORT)-No of leave returnees requiring audiometry
- NewAud(SHORT)-No of new employees requiring audiometry
- RiskyAud(SHORT)-No of high-risk staff requiring audiometry
- LeaveTst(SHORT)-No of leave returners actually tested
- NewTst(SHORT)-No of new staff tested
- RiskyTst(SHORT)-No of high-risk staff tested
- LeaveTrn(SHORT)-No of leave returners trained during period
- NewTrn(SHORT)-No of new staff trained

UserType - Types of users, categorised according to their access rights : not editable in program
- **UserTypeNo**(BYTE)-User type number
- Description(STRING 10)-Description of editing rights of user type

Where - Location categories : not editable in program
- **LocNo**(BYTE)-Location number : assigned initially
- Location(STRING 20)-Location categories

WorkNois - Results of surveys on worker noise exposure
- **SurveyNo**(LONG)-Noise exposure survey number
- **OCodeCat**(LONG)-Occupational code category of workers
- **dB**(SHORT)-Noise level recorded

WorkSite - Work sites at which noise levels were recorded
- **SiteNo**(LONG)-Site number
- Description(STRING 30)-Description of work site

WorkSurv - Site where worker noise exposure is recorded
- **SurveyNo**(LONG)-Noise exposure survey number
- SurvDate(LONG)-Date of survey
- SiteNo(LONG)-No of site at which survey was conducted
- SerialNo(STRING 10)-Serial no of survey instrument
- EmployeeNo(STRING 8)-Employee no of noise surveyor
- DisplayFlag(BYTE)-Temporary field : a flag to display or not

The table below shows the set of one-to-many relations between the database files.

Parent file	Fields	Child file	Fields
AudEq	SerialNo	AudEqTst	SerialNo
AudioCat	OutcomeCode	AudioRes	OutcomeCode
AudOp	Operator	AudOpTst	Operator
Booths	BoothNo	BoothTst	BoothNo
HPDReas	ReasonNo	HPDCompl	ReasonNo
HPDSite	SiteNo	HPDSurv	SiteNo
HPDSurv	SurveyNo	HPDCompl	SurveyNo
HPDTypes	TypeNo	HPDIssue	HPDType
MachSite	SiteNo	MachSurv	SiteNo
MachSurv	SurveyNo	MachNois	SurveyNo
OcCodes	CatNo	AudioRes	OCodeCat
OcCodes	CatNo	WorkNois	OCodeCat
PostReas	ReasonNo	Posters	ReasonNo
PostSite	SiteNo	Posters	SiteNo
Qualific	QualNo	Surveyor	QualNo
SignReas	ReasonNo	Signs	ReasonNo
SignSite	SiteNo	Signs	SiteNo
SurvEqp	SerialNo	Calibrat	SerialNo
SurvEqp	SerialNo	MachSurv	SerialNo
SurvEqp	SerialNo	WorkSurv	SerialNo
Surveyor	EmployeeNo	MachSurv	EmployeeNo
Surveyor	EmployeeNo	WorkSurv	EmployeeNo
UserType	UserTypeNo	Password	UserTypeNo
WorkSite	SiteNo	WorkSurv	SiteNo
WorkSurv	SurveyNo	WorkNois	SurveyNo