Improved Procedure for Determining Percentage Loss of Hearing

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IMPROVED PROCEDURE FOR DETERMINING PERCENTAGE LOSS OF HEARING

JOHN MACRAE

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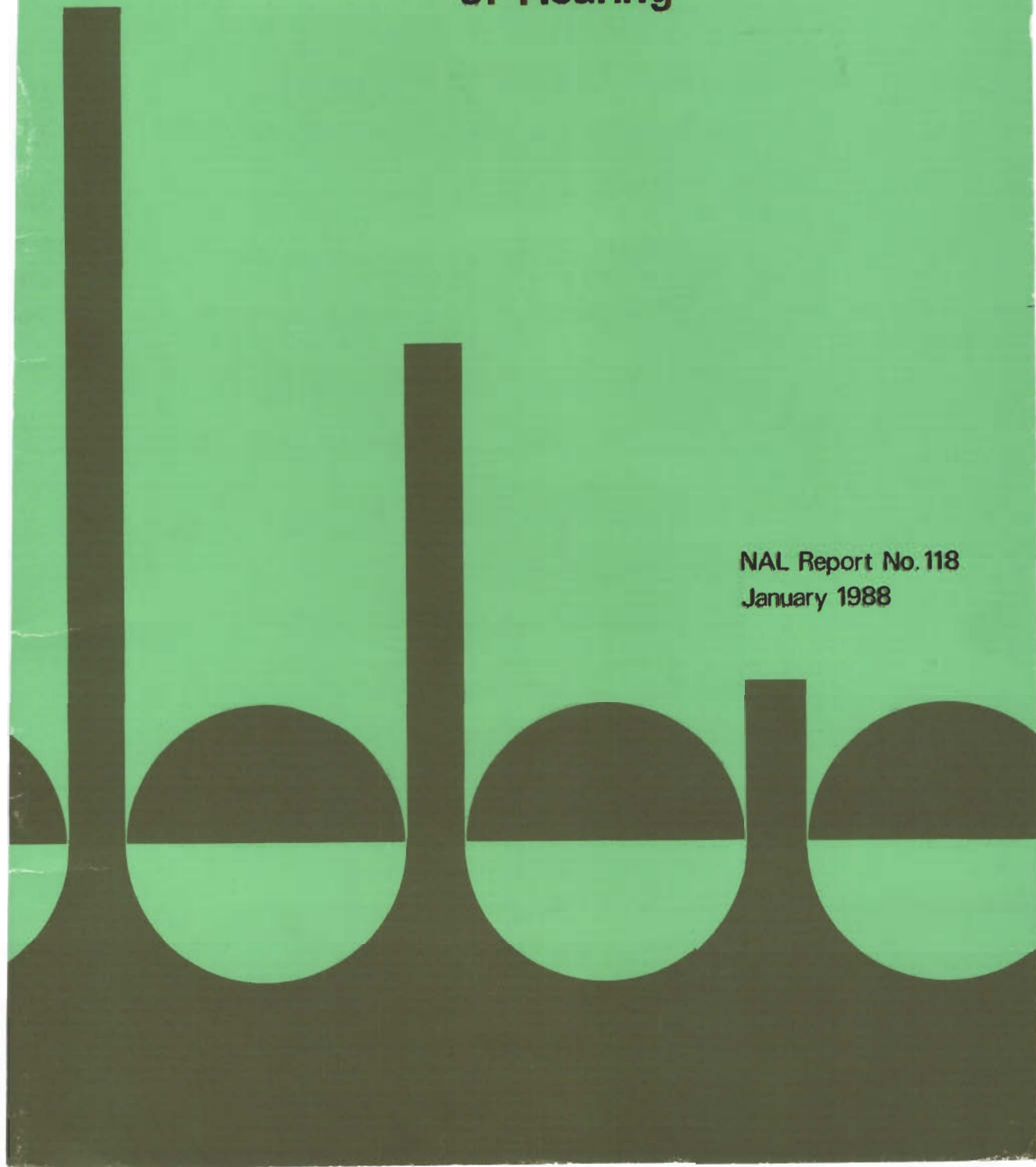
SYDNEY HEARING CENTRE
175 CASTLEREAGH ST.
SYDNEY. N.S.W. 2000
TELEPHONE: 267 8055

ABSTRACT

This report presents empirical formulas and computer programs which can
be used to calculate binaural and monaural percentage loss of hearing
(PLH) accurately in hearing threshold level (HTL) steps as small as 0.5
dB or less. Binaural and monaural PLH tables are also presented which
differ slightly from the currently used tables but which give the same
results as the computer programs. PLH determined by means of these new
tables is at least as good a predictor of hearing difficulties in
everyday life as PLH determined by means of the currently used tables.
The slight change in the PLH tables and publication of the International
Standard ISO 7029 concerning the effects of ageing on HTL have made it
necessary to prepare a revised presbyacusis correction table. Separate
values of age-related PLH are required for males and females since
hearing deteriorates faster as a result of ageing in men than in women.
The frequency range of the new binaural and monaural PLH tables is 500
to 4000 Hz, the same as that of the currently used tables, and it is
recommended that this range be used for general purposes. However, there
are special circumstances where a set of tables which cover the
frequency range 500 to 8000 Hz are required. Tables which extend the
frequency range of the PLH procedure to 8000 Hz have been prepared and
are also presented in this report. It is recommended that the new
procedure for determining PLH replace the currently used tables.

INTRODUCTION

The use of computers to carry out routine audiological calculations is becoming widespread. It is therefore desirable to be able to calculate percentage loss of hearing (PLH) accurately by means of computer. In the case of the binaural tables, this has only been possible previously by the cumbersome and error-prone means of storing the percentage loss tables in computer memory and using a computer program to look up the tables (Macrae, 1979), with the associated disadvantage that the calculations are restricted to hearing threshold levels (HTLs) in steps of 5 dB. This report presents empirical formulas and two computer programs based on the formulas which can be used to calculate PLH accurately. One of the programs is used to calculate binaural PLH and the other to calculate monaural PLH. An advantage of both programs is that they can be used to calculate PLH from HTLs in steps as small as 0.5 dB or less. Because of the adoption of the new formulas, revised binaural and monaural PLH tables have been prepared which differ slightly from those currently in use (Tables for Determining Percentage Loss of Hearing, National Acoustic Laboratories, 1982) but which give the same results as the computer programs. It is recommended that this new procedure for determining PLH replace the currently used tables.

EMPIRICAL FORMULAS

The empirical formulas use to calculate the binaural and monaural tables are based on an equation relating binaural PLH to the HTLs of the better and worse ears (HTL_B and HTL_W) suggested by A.J.Miller of the CSIRO Division of Mathematics and Statistics. At each frequency,

$$PLH = K / (1 + e^F) \tag{1}$$

where $F = aDS^3 + bDS^2 + cD + dS^3 + eS^2 + fS + g$

$$S = .01 (HTL_B + HTL_W) - 1$$

$$D = .01 (HTL_W - HTL_B)$$

Inversion of equation (1) yields the following equation

$$\ln (K/PLH - 1) = aDS^3 + bDS^2 + cD + dS^3 + eS^2 + fS + g \tag{2}$$

and the values of the parameters a to g in this equation were obtained by fitting it to the data given in the current PLH tables by means of the statistical procedure of multiple regression. The values of the parameters obtained by this technique are given for various audiometric frequencies in Table 1.

Monaural PLH can also be calculated by means of equation (1). Monaural PLH is the same as binaural PLH when the HTLs of both ears are the same. Equation (1) therefore gives monaural PLH when the value of D is set to zero. In this case

$$F = dS^3 + eS^2 + fS + g$$

$$\text{and} \quad S = .01 (HTL \times 2) - 1$$

Computer programs in BASIC for calculating binaural and monaural PLH are given in Appendixes 1 and 2, respectively.

	K	a	b	c	d	e	f	g
500	20.09	10.576	-1.817	2.255	-4.884	1.509	-3.008	0.067
1000	25.14	10.576	-1.817	2.255	-4.884	1.509	-3.008	0.067
1500	20.09	10.576	-1.817	2.255	-4.884	1.509	-3.008	0.067
2000	15.06	10.576	-1.817	2.255	-4.884	1.509	-3.008	0.067
3000	10.02	10.576	-1.817	2.255	-4.884	1.509	-3.008	0.067
4000	10.03	11.578	-3.573	2.541	-5.746	2.807	-3.519	0.258

Table 1   Values of parameters of equation (1) at audiometric frequencies in the range 500 to 4000 Hz.

	K	a	b	c	d	e	f	g
4000	6.00	11.578	-3.573	2.541	-5.746	2.807	-3.519	0.258
6000	2.98	10.335	-2.866	2.534	-5.212	2.711	-3.689	0.267
8000	0.98	4.162	-0.418	2.544	-4.423	2.439	-3.794	0.281

Table 2   Values of parameters of equation (1) at audiometric frequencies in the range 4000 to 8000 Hz.

REVISION OF BINAURAL AND MONAURAL TABLES

As a result of adopting these formulas, it has been necessary to make slight changes to the PLH tables so that PLH obtained by means of tables is the same as PLH obtained by means of the computer programs. It is presumed that there will be a continuing need in some cases to use tables rather than the computer programs to determine PLH so revised binaural and monaural tables for determining PLH are given in Appendix 3 and Appendix 4, respectively. The overall values of PLH obtained with these revised tables differ slightly from the overall values of PLH obtained with the tables currently in use but the differences which occur are well within the order of error inherent in the procedure used to arrive at PLH.

In order to determine the extent of the differences, PLH was calculated using the current tables and the revised tables on a sample of 227 individuals with hearing losses ranging from slight to profound. The differences, obtained by subtracting the current PLH from the new PLH, ranged from 2.3% to -1.1%, with a mean of 0.1%. A histogram of the distribution of differences is given in Figure 1. Correlations were carried out between both current and new PLH and the degree of difficulty hearing in everyday life reported by the 227 individuals, as represented by their score on a hearing questionnaire. The correlation coefficients for current and new PLH were 0.877 and 0.878, respectively, so the new PLH predicts everyday hearing difficulties at least as well as the current PLH.
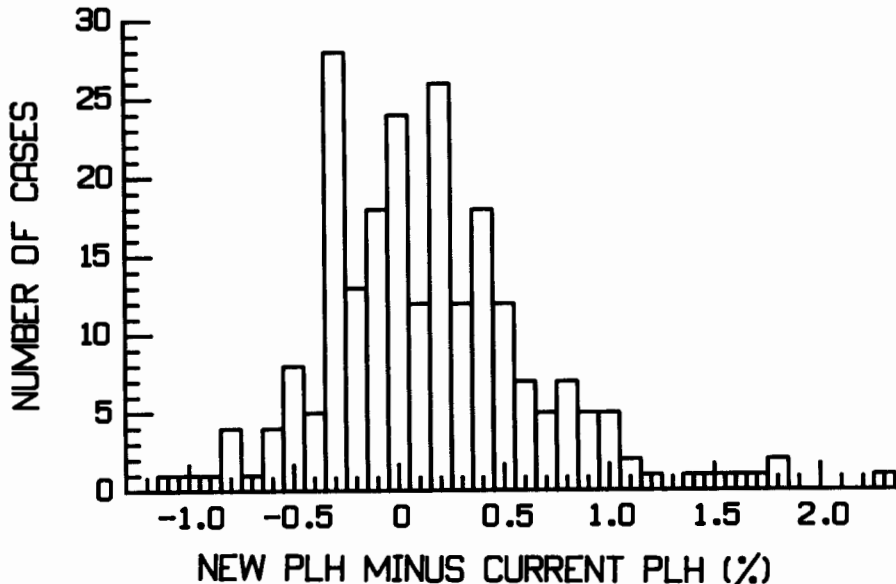

Fig.1: Histogram of differences between new PLH and current PLH, obtained by subtracting current PLH from new PLH.

REVISION OF PRESBYACUSIS CORRECTION TABLE

As a result of the slight change in the PLH tables and the
publication of International Standard ISO 7029 concerning the threshold
of hearing by air conduction as a function of age and sex, the
presbyacusis correction table given previously (Tables for Determining
Percentage Loss of Hearing, National Acoustic Laboratories, 1982) has
been revised. It is clear from ISO 7029 that it is necessary to have
separate values of age-related PLH (PLH_A) for males and females since
hearing deteriorates faster as a result of ageing in men than in women.
The revised values were obtained by using equations given in ISO 7029 to
calculate the median HTL to be expected at various ages at the
audiometric frequencies 500 to 4000 Hz for men and women separately,
then calculating the associated PLH using the revised procedure and,
finally, smoothing the results by means of polynomial regression. The
values in the revised presbyacusis correction table, which is given in
Appendix 5, can also be calculated by means of empirical formulas, which
facilitate computerisation. The relevant formulas are given in the
table. A computer program for calculating age-related PLH is given in
Appendix 6.

When it is required that a correction for presbyacusis be carried
out, it is recommended that values obtained from the table given in
Appendix 5 or obtained by means of the computer program given in
Appendix 6 be used. These values represent the binaural or monaural PLH
that the individual could be expected to have on the basis of ageing
alone. Normally, both ears are equally affected by ageing so the
age-related binaural PLH is the same as the age-related monaural PLH.
The value from the table or computer program appropriate to the age and
sex of the individual should be subtracted from their binaural PLH or
from the PLH of each ear separately if monaural PLH has been determined
for each ear.

Even when it is not required that a correction for presbyacusis be
carried out, there are sometimes circumstances in which it would be
appropriate to carry out an adjustment for the effects of ageing. For
example, consider the case of a man who retired from employment at the
age of 60 years and who claimed at the age of 70 years that he had a
hearing loss due to his employment but that he was ignorant of his right
to claim compensation at the time of retirement. The hearing loss of
this man would most probably have deteriorated as a result of ageing in
the 10 years from retirement to the time of making the claim. According
to the presbyacusis table given in Appendix 5, his age-related PLH at
age 60 years would be expected to be 0.8% whereas at age 70 years it
would be 4.9%, an increase of 4.1%. In these circumstances, it would
seem reasonable to attribute 4.1% of his binaural PLH to ageing.

EXTENSION OF BINAURAL AND MONAURAL TABLES

The frequency range of the current tables for determining PLH is 500 to 4000 Hz. In an earlier draft of the tables, the frequency range adopted was 250 to 8000 Hz but serious practical difficulties were found to be associated with the inclusion of the frequencies 250, 6000 and 8000 Hz in the procedure. In the case of 250 Hz, ambient noise at the time of the test often produces spurious "losses of hearing" and invalid bone conduction thresholds are not uncommon. At 6000 and 8000 Hz, measurement of bone conduction HTLs is not possible with most clinical audiometers and is affected by instability of calibration. These frequencies were therefore eliminated from the final version of the tables: the weighting of 250 Hz was transferred to 500 Hz and the weightings of 6000 and 8000 Hz were transferred to 4000 Hz. These objections to the inclusion of 250, 6000 and 8000 Hz are still valid so the frequency range of the revised tables presented in this report continues to be restricted to the range 500 to 4000 Hz and it is recommended that this range be used for general purposes.

There is, however, a need for a set of tables which cover the frequency range from 500 to 8000 Hz, which arises in the following circumstances. It may happen that a claimant for compensation for hearing loss has a special requirement to be able to hear at frequencies above 4000 Hz. A hypothetical example would be that of an electronics technician or a sonar operator whose ability to carry out his duties is adversely affected by a hearing loss at 6000 or 8000 Hz. While the claimant may not have any percentage loss of hearing in the 500 to 4000 Hz range, the statutory authority responsible for administration of the relevant workers compensation legislation may accept that he has a right to compensation for his hearing loss at 6000 and 8000 Hz and will then need to know his overall percentage loss taking the frequencies 6000 and 8000 Hz into account.

The following set of tables has been prepared for use in these circumstances. In these extension tables, the binaural and monaural tables at 500, 1000, 1500, 2000 and 3000 Hz remain the same as in the revised tables but the binaural and monaural tables at 4000 Hz are different because the weighting at this frequency is reduced from 10% to 6% to allow for the weightings of 3% at 6000 Hz and 1% at 8000 Hz. The values of the parameters used in calculating the extension tables are given in Table 2. The binaural extension tables at 4000, 6000 and 8000 Hz are given in Appendix 7 and the monaural extension tables are given in Appendix 8. The associated tables at 500 to 3000 Hz are not given since they are the same as those given in the revised tables. The presbyacusis table given in Appendix 5 can be used in connection with the extended tables since changes in the values of the presbyacusis table associated with the extended frequency range are small and can be neglected.

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BIBLIOGRAPHY

International Organization for Standardization, International Standard
ISO 7029 "Acoustics - Threshold of hearing by air conduction as a
function of age and sex for otologically normal persons".

Macrae J.H. (1979), "Computer programs for calculating percentage loss
of hearing", National Acoustic Laboratories Informal Report No.65,
October, 1979.

National Acoustic Laboratories (1982), "Tables for determining
percentage loss of hearing", Australian Government Publishing Service,
Canberra.

APPENDIX 1

COMPUTER PROGRAM FOR CALCULATING BINAURAL PERCENTAGE LOSS OF HEARING

```
100   DIM R(6),L(6),K(6),Z(6),A(6),B(6),C(6),D(6),E(6),F(6),G(6)
110   FOR N = 1 TO 6
120   READ K(N),A(N),B(N),C(N),D(N),E(N),F(N),G(N)
130   NEXT N
140   DATA   20.09,10.576,-1.817,2.255,-4.884,1.509,-3.008,.067
150   DATA   25.14,10.576,-1.817,2.255,-4.844,1.509,-3.008,.067
160   DATA   20.09,10.576,-1.817,2.255,-4.884,1.509,-3.008,.067
170   DATA   15.06,10.576,-1.817,2.255,-4.884,1.509,-3.008,.067
180   DATA   10.02,10.576,-1.817,2.255,-4.884,1.509,-3.008,.067
190   DATA   10.03,11.578,-3.573,2.541,-5.746,2.807,-3.519,.258
200   PRINT "INPUT HEARING THRESHOLD LEVELS": PRINT
210   INPUT "L500  ";L(1): INPUT "L1000 ";L(2): INPUT "L1500 ";L(3)
220   INPUT "L2000 ";L(4): INPUT "L3000 ";L(5): INPUT "L4000 ";L(6)
230   PRINT
240   INPUT "R500  ";R(1): INPUT "R1000 ";R(2): INPUT "R1500 ";R(3)
250   INPUT "R2000 ";R(4): INPUT "R3000 ";R(5): INPUT "R4000 ";R(6)
260   FOR N = 1 TO 6
270   IF N = 6 THEN 340: IF N = 5 THEN 310
280   IF L(N) < = 18 THEN L(N) = 15
290   IF R(N) < = 18 THEN R(N) = 15
300   GOTO 360
310   IF L(N) < = 19.5 THEN L(N) = 15
320   IF R(N) < = 19.5 THEN R(N) = 15
330   GOTO 360
340   IF L(N) < = 22.5 THEN L(N) = 20
350   IF R(N) < = 22.5 THEN R(N) = 20
360   IF L(N) > 95 THEN L(N) = 95
370   IF R(N) > 95 THEN R(N) = 95
380 T1 = R(N) + L(N):D1 =  ABS (R(N) - L(N))
390   IF T1 > 155 THEN 430
400   IF T1 < 140 THEN 430
410   IF (T1 + D1) < > 190 THEN 430
420 T1 = T1 - 5:D1 =  ABS (D1) - 5
430   IF N = 6 THEN 470
440   IF T1 > 30 THEN 500
450 Z(N) = 0
460   GOTO 560
470   IF T1 > 40 THEN 500
480 Z(N) = 0
490   GOTO 560
500 S1 = .01 * T1 - 1:D2 = .01 *  ABS (D1)
510 S2 = S1 * S1:S3 = S2 * S1
520 F0 = A(N) * D2 * S3 + B(N) * D2 * S2 + C(N) * D2
530 F1 = F0 + D(N) * S3 + E(N) * S2 + F(N) * S1 + G(N)
540 P1 = K(N) / (1 +  EXP (F1))
550 Z(N) =  INT (P1 * 10 + .5) / 10
560   NEXT N
570 Z1 = 0: FOR N = 1 TO 6:Z1 = Z1 + Z(N): NEXT N
580   PRINT : PRINT : PRINT "BINAURAL PLH = ";Z1;"%"
590   END
```

COMPUTER PROGRAM FOR CALCULATING MONAURAL PERCENTAGE LOSS OF HEARING

```
100    DIM T(6),K(6),Z(6),D(6),E(6),F(6),G(6)
110    FOR N = 1 TO 6
120    READ K(N),D(N),E(N),F(N),G(N)
130    NEXT N
140    DATA  20.09,-4.884,1.509,-3.008,.067
150    DATA  25.14,-4.884,1.509,-3.008,.067
160    DATA  20.09,-4.884,1.509,-3.008,.067
170    DATA  15.06,-4.884,1.509,-3.008,.067
180    DATA  10.02,-4.884,1.509,-3.008,.067
190    DATA  10.03,-5.746,2.807,-3.519,.258
200    PRINT "INPUT HEARING THRESHOLD LEVELS"
210    PRINT
220    INPUT "500     ";T(1)
230    INPUT "1000    ";T(2)
240    INPUT "1500    ";T(3)
250    INPUT "2000    ";T(4)
260    INPUT "3000    ";T(5)
270    INPUT "4000    ";T(6)
280    FOR N = 1 TO 6
290    IF N = 6 THEN 350
300    IF N = 5 THEN 330
310    IF T(N) > 18 THEN 370
315    Z(N) = 0
320    GOTO 440
330    IF T(N) > 19.5 THEN 370
335    Z(N) = 0
340    GOTO 440
350    IF T(N) > 22.5 THEN 370
360    Z(N) = 0
365    GOTO 440
370    IF T(N) > 95 THEN T(N) = 95
380    S1 = .01 * (T(N) * 2) - 1
390    S2 = S1 * S1
400    S3 = S2 * S1
410    F1 = D(N) * S3 + E(N) * S2 + F(N) * S1 + G(N)
420    P1 = K(N) / (1 +  EXP (F1))
430    Z(N) =  INT (P1 * 10 + .5) / 10
440    NEXT N
450    Z1 = 0
460    FOR N = 1 TO 6
470    Z1 = Z1 + Z(N)
480    NEXT N
490    PRINT : PRINT
500    PRINT "MONAURAL PLH=";Z1
510    END
```

APPENDIX 3

BINAURAL TABLES FOR DETERMINING PECENTAGE LOSS OF HEARING

January, 1988

It is recommended that the following procedure be used to assess binaural percentage loss of hearing.

1. Measure the hearing threshold levels (HTLs) of the person at the audiometric frequencies 500, 1000, 1500, 2000, 3000 and 4000 Hz.

2. Determine the better and worse ears at each of these frequencies. At a particular frequency, the better ear is the ear with the smaller HTL. The better ear at one frequency may be the worse at another.

3. Using the HTLs of the better and worse ears, read the percentage loss of hearing (PLH) at each frequency from the appropriate table (Table RB-500, RB-1000, RB-1500, RB-2000, RB-3000 or RB-4000) and add these six values together to obtain the overall binaural PLH.

Example

HEARING THRESHOLD LEVELS

FREQUENCY	RIGHT EAR	LEFT EAR	BETTER EAR	WORSE EAR	PLH
500	40	10	10	40	1.7
1000	45	25	25	45	4.2
1500	50	40	40	50	7.1
2000	55	55	55	55	8.4
3000	60	70	60	70	6.5
4000	65	85	65	85	7.1

OVERALL BINAURAL PLH = 35.0%

TABLE RB - 500

VALUES OF PERCENTAGE LOSS OF HEARING CORRESPONDING TO GIVEN HEARING THRESHOLD LEVELS IN THE BETTER AND WORSE EARS AT 500 HZ

HTL - BETTER EAR

HTL - WORSE EAR	≤15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	≥95
≤15	0																
20	0.4	0.6															
25	0.6	1.0	1.4														
30	1.0	1.4	2.0	2.8													
35	1.3	1.8	2.5	3.4	4.5												
40	1.7	2.2	3.0	3.9	5.1	6.4											
45	2.0	2.6	3.4	4.3	5.5	6.8	8.1										
50	2.3	2.9	3.7	4.7	5.8	7.1	8.4	9.7									
55	2.5	3.2	4.0	5.0	6.1	7.3	8.6	9.9	11.2								
60	2.7	3.4	4.2	5.2	6.3	7.5	8.8	10.0	11.3	12.6							
65	2.8	3.5	4.4	5.4	6.5	7.7	8.9	10.2	11.5	12.7	14.0						
70	2.9	3.7	4.5	5.5	6.6	7.8	9.1	10.3	11.6	12.9	14.2	15.5					
75	3.0	3.8	4.7	5.7	6.8	8.0	9.2	10.5	11.8	13.1	14.5	15.7	16.9				
80	3.1	3.9	4.8	5.8	6.9	8.1	9.3	10.6	12.0	13.3	14.7	16.0	17.2	18.2			
85	3.2	4.0	4.9	5.9	7.0	8.2	9.4	10.7	12.1	13.5	14.9	16.2	17.4	18.4	19.1		
90	3.4	4.1	5.0	6.0	7.1	8.3	9.5	10.8	12.2	13.6	15.0	16.3	17.6	18.5	19.2	19.7	
≥95	3.4	4.2	5.1	6.1	7.1	8.3	9.5	10.8	12.2	13.6	15.0	16.4	17.6	18.6	19.3	19.7	20.0

TABLE RB - 1000

VALUES OF PERCENTAGE LOSS OF HEARING CORRESPONDING TO GIVEN

HEARING THRESHOLD LEVELS IN THE BETTER AND WORSE EARS AT 1000 HZ

HTL - BETTER EAR

HTL - WORSE EAR	≤15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	≥95
≤15	0																
20	0.5	0.8															
25	0.8	1.2	1.8														
30	1.2	1.7	2.5	3.5													
35	1.7	2.3	3.1	4.3	5.7												
40	2.1	2.8	3.7	4.9	6.3	8.0											
45	2.5	3.3	4.2	5.4	6.9	8.5	10.2										
50	2.8	3.6	4.7	5.9	7.3	8.8	10.5	12.1									
55	3.1	3.9	5.0	6.2	7.6	9.1	10.7	12.4	14.0								
60	3.3	4.2	5.3	6.5	7.9	9.4	11.0	12.6	14.2	15.7							
65	3.5	4.4	5.5	6.7	8.1	9.6	11.2	12.8	14.4	15.9	17.5						
70	3.7	4.6	5.7	6.9	8.3	9.8	11.3	12.9	14.6	16.2	17.8	19.4					
75	3.8	4.7	5.8	7.1	8.5	10.0	11.5	13.1	14.8	16.4	18.1	19.7	21.1				
80	3.9	4.9	6.0	7.3	8.6	10.1	11.7	13.3	15.0	16.7	18.4	20.0	21.5	22.7			
85	4.1	5.0	6.2	7.4	8.8	10.3	11.8	13.4	15.1	16.9	18.6	20.3	21.7	23.0	23.9		
90	4.2	5.2	6.3	7.5	8.9	10.3	11.9	13.5	15.2	17.0	18.7	20.4	21.9	23.2	24.1	24.6	
≥95	4.3	5.3	6.4	7.6	8.9	10.3	11.9	13.5	15.2	17.0	18.7	20.5	22.0	23.3	24.2	24.7	25.0

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TABLE RB - 1500

VALUES OF PERCENTAGE LOSS OF HEARING CORRESPONDING TO GIVEN HEARING THRESHOLD LEVELS IN THE BETTER AND WORSE EARS AT 1500 HZ

HTL – WORSE EAR	HTL – BETTER EAR																
	≤15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	≥95
≤15	0																
20	0.4	0.6															
25	0.6	1.0	1.4														
30	1.0	1.4	2.0	2.8													
35	1.3	1.8	2.5	3.4	4.5												
40	1.7	2.2	3.0	3.9	5.1	6.4											
45	2.0	2.6	3.4	4.3	5.5	6.8	8.1										
50	2.3	2.9	3.7	4.7	5.8	7.1	8.4	9.7									
55	2.5	3.2	4.0	5.0	6.1	7.3	8.6	9.9	11.2								
60	2.7	3.4	4.2	5.2	6.3	7.5	8.8	10.0	11.3	12.6							
65	2.8	3.5	4.4	5.4	6.5	7.7	8.9	10.2	11.5	12.7	14.0						
70	2.9	3.7	4.5	5.5	6.6	7.8	9.1	10.3	11.6	12.9	14.2	15.5					
75	3.0	3.8	4.7	5.7	6.8	8.0	9.2	10.5	11.8	13.1	14.5	15.7	16.9				
80	3.1	3.9	4.8	5.8	6.9	8.1	9.3	10.6	12.0	13.3	14.7	16.0	17.2	18.2			
85	3.2	4.0	4.9	5.9	7.0	8.2	9.4	10.7	12.1	13.5	14.9	16.2	17.4	18.4	19.1		
90	3.4	4.1	5.0	6.0	7.1	8.3	9.5	10.8	12.2	13.6	15.0	16.3	17.6	18.5	19.2	19.7	
≥95	3.4	4.2	5.1	6.1	7.1	8.3	9.5	10.8	12.2	13.6	15.0	16.4	17.6	18.6	19.3	19.7	20.0

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TABLE RB - 2000

VALUES OF PERCENTAGE LOSS OF HEARING CORRESPONDING TO GIVEN

HEARING THRESHOLD LEVELS IN THE BETTER AND WORSE EARS AT 2000 HZ

HTL - BETTER EAR

HTL - WORSE EAR	≤15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	≥95
≤15	0																
20	0.3	0.5															
25	0.5	0.7	1.1														
30	0.7	1.0	1.5	2.1													
35	1.0	1.4	1.9	2.5	3.4												
40	1.3	1.7	2.2	2.9	3.8	4.8											
45	1.5	1.9	2.5	3.3	4.1	5.1	6.1										
50	1.7	2.2	2.8	3.5	4.4	5.3	6.3	7.3									
55	1.9	2.4	3.0	3.7	4.6	5.5	6.4	7.4	8.4								
60	2.0	2.5	3.1	3.9	4.7	5.6	6.6	7.5	8.5	9.4							
65	2.1	2.6	3.3	4.0	4.9	5.7	6.7	7.6	8.6	9.6	10.5						
70	2.2	2.7	3.4	4.1	5.0	5.9	6.8	7.8	8.7	9.7	10.7	11.6					
75	2.3	2.8	3.5	4.3	5.1	6.0	6.9	7.9	8.9	9.9	10.8	11.8	12.7				
80	2.4	2.9	3.6	4.4	5.2	6.1	7.0	8.0	9.0	10.0	11.0	12.0	12.9	13.6			
85	2.4	3.0	3.7	4.4	5.3	6.1	7.1	8.1	9.1	10.1	11.1	12.1	13.0	13.8	14.3		
90	2.5	3.1	3.8	4.5	5.3	6.2	7.1	8.1	9.1	10.2	11.2	12.2	13.2	13.9	14.4	14.8	
≥95	2.6	3.2	3.8	4.6	5.4	6.2	7.1	8.1	9.1	10.2	11.3	12.3	13.2	14.0	14.5	14.8	15.0

TABLE RB - 3000

VALUES OF PERCENTAGE LOSS OF HEARING CORRESPONDING TO GIVEN
HEARING THRESHOLD LEVELS IN THE BETTER AND WORSE EARS AT 3000 HZ

HTL - BETTER EAR

HTL - WORSE EAR	≤15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	≥95
≤15	0																
20	0.2	0.3															
25	0.3	0.5	0.7														
30	0.5	0.7	1.0	1.4													
35	0.7	0.9	1.2	1.7	2.3												
40	0.8	1.1	1.5	2.0	2.5	3.2											
45	1.0	1.3	1.7	2.2	2.7	3.4	4.1										
50	1.1	1.4	1.9	2.3	2.9	3.5	4.2	4.8									
55	1.2	1.6	2.0	2.5	3.0	3.6	4.3	4.9	5.6								
60	1.3	1.7	2.1	2.6	3.1	3.7	4.4	5.0	5.6	6.3							
65	1.4	1.8	2.2	2.7	3.2	3.8	4.4	5.1	5.7	6.4	7.0						
70	1.5	1.8	2.3	2.8	3.3	3.9	4.5	5.2	5.8	6.5	7.1	7.7					
75	1.5	1.9	2.3	2.8	3.4	4.0	4.6	5.2	5.9	6.6	7.2	7.8	8.4				
80	1.6	2.0	2.4	2.9	3.4	4.0	4.7	5.3	6.0	6.6	7.3	8.0	8.6	9.1			
85	1.6	2.0	2.5	3.0	3.5	4.1	4.7	5.4	6.0	6.7	7.4	8.1	8.7	9.2	9.5		
90	1.7	2.1	2.5	3.0	3.5	4.1	4.7	5.4	6.1	6.8	7.5	8.2	8.8	9.2	9.6	9.8	
≥95	1.7	2.1	2.6	3.0	3.6	4.1	4.7	5.4	6.1	6.8	7.5	8.2	8.8	9.3	9.6	9.8	10.0

TABLE RB - 4000

VALUES OF PERCENTAGE LOSS OF HEARING CORRESPONDING TO GIVEN
HEARING THRESHOLD LEVELS IN THE BETTER AND WORSE EARS AT 4000 HZ

HTL - BETTER EAR

HTL - WORSE EAR	≤20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	≥95
≤20	0															
25	0.2	0.3														
30	0.3	0.5	0.8													
35	0.5	0.7	1.0	1.5												
40	0.6	0.9	1.3	1.8	2.5											
45	0.8	1.1	1.5	2.1	2.7	3.5										
50	0.9	1.3	1.7	2.3	2.9	3.6	4.4									
55	1.0	1.4	1.9	2.4	3.1	3.8	4.5	5.2								
60	1.2	1.5	2.0	2.6	3.2	3.9	4.6	5.3	6.0							
65	1.2	1.6	2.1	2.7	3.3	3.9	4.6	5.3	6.0	6.7						
70	1.3	1.7	2.2	2.7	3.4	4.0	4.7	5.4	6.1	6.8	7.5					
75	1.4	1.8	2.3	2.8	3.4	4.1	4.8	5.5	6.2	6.9	7.6	8.2				
80	1.4	1.9	2.3	2.9	3.5	4.2	4.9	5.6	6.3	7.0	7.7	8.4	8.9			
85	1.5	1.9	2.4	3.0	3.6	4.2	4.9	5.7	6.4	7.1	7.8	8.5	9.0	9.5		
90	1.6	2.0	2.5	3.0	3.6	4.3	5.0	5.7	6.5	7.2	7.9	8.6	9.1	9.5	9.8	
≥95	1.6	2.0	2.5	3.1	3.7	4.3	5.0	5.7	6.5	7.2	8.0	8.7	9.2	9.6	9.8	10.0

APPENDIX 4

MONAURAL TABLES FOR DETERMINING PERCENTAGE LOSS OF HEARING

January 1988

The following set of tables enable overall monaural percentage loss of hearing (PLH) to be determined for each ear separately when hearing threshold levels (HTLs) have been obtained in steps smaller than 5 dB. If an estimate of overall binaural PLH is required when the monaural PLHs of the two ears have been determined, it can be obtained by multiplying the PLH of the better ear by four, adding the PLH of the worse ear, and dividing the sum by five. This estimate is less accurate than the overall binaural PLH determined by means of the binaural tables given in Appendix 3 or by means of the computer program given in Appendix 1. Since the computer program will calculate binaural PLH from HTLs in steps as small as 0.5 dB or less, it should be used if binaural PLH is required from HTLs in steps less than 5 dB.

Example

	LEFT EAR		RIGHT EAR	
FREQUENCY	HTL	PLH	HTL	PLH
500	24	1.2	29	2.5
1000	34	5.2	39	7.5
1500	44	7.8	39	6.0
2000	54	8.2	44	5.8
3000	64	6.8	54	5.4
4000	69	7.3	59	5.8
OVERALL MONAURAL PLH		36.5%		33.0%

ESTIMATED BINAURAL PLH = ((4 x 33.0) + 36.5) / 5

= 33.7%

VALUES OF MONAURAL PERCENTAGE LOSS OF HEARING CORRESPONDING TO GIVEN

HEARING THRESHOLD LEVELS AT 500 HZ IN ONE EAR ONLY

HTL	PLH	HTL	PLH	HTL	PLH	HTL	PLH	HTL	PLH
≦18.0	0	33.5	4.0	49.0	9.4	64.5	13.9	80.0	18.2
18.5	0.4	34.0	4.2	49.5	9.6	65.0	14.0	80.5	18.3
19.0	0.5	34.5	4.3	50.0	9.7	65.5	14.1	81.0	18.4
19.5	0.5	35.0	4.5	50.5	9.9	66.0	14.3	81.5	18.5
20.0	0.6	35.5	4.7	51.0	10.0	66.5	14.4	82.0	18.6
20.5	0.7	36.0	4.9	51.5	10.2	67.0	14.6	82.5	18.7
21.0	0.7	36.5	5.1	52.0	10.3	67.5	14.7	83.0	18.8
21.5	0.8	37.0	5.3	52.5	10.4	68.0	14.9	83.5	18.9
22.0	0.9	37.5	5.4	53.0	10.6	68.5	15.0	84.0	19.0
22.5	1.0	38.0	5.6	53.5	10.7	69.0	15.2	84.5	19.0
23.0	1.0	38.5	5.8	54.0	10.9	69.5	15.3	85.0	19.1
23.5	1.1	39.0	6.0	54.5	11.0	70.0	15.5	85.5	19.2
24.0	1.2	39.5	6.2	55.0	11.2	70.5	15.6	86.0	19.3
24.5	1.3	40.0	6.4	55.5	11.3	71.0	15.8	86.5	19.3
25.0	1.4	40.5	6.5	56.0	11.4	71.5	15.9	87.0	19.4
25.5	1.6	41.0	6.7	56.5	11.6	72.0	16.1	87.5	19.4
26.0	1.7	41.5	6.9	57.0	11.7	72.5	16.2	88.0	19.5
26.5	1.8	42.0	7.1	57.5	11.9	73.0	16.3	88.5	19.5
27.0	1.9	42.5	7.3	58.0	12.0	73.5	16.5	89.0	19.6
27.5	2.1	43.0	7.4	58.5	12.1	74.0	16.6	89.5	19.6
28.0	2.2	43.5	7.6	59.0	12.3	74.5	16.8	90.0	19.7
28.5	2.3	44.0	7.8	59.5	12.4	75.0	16.9	90.5	19.7
29.0	2.5	44.5	8.0	60.0	12.6	75.5	17.0	91.0	19.8
29.5	2.6	45.0	8.1	60.5	12.7	76.0	17.2	91.5	19.8
30.0	2.8	45.5	8.3	61.0	12.8	76.5	17.3	92.0	19.8
30.5	2.9	46.0	8.5	61.5	13.0	77.0	17.4	92.5	19.8
31.0	3.1	46.5	8.6	62.0	13.1	77.5	17.6	93.0	19.9
31.5	3.3	47.0	8.8	62.5	13.3	78.0	17.7	93.5	19.9
32.0	3.4	47.5	8.9	63.0	13.4	78.5	17.8	94.0	19.9
32.5	3.6	48.0	9.1	63.5	13.6	79.0	17.9	94.5	19.9
33.0	3.8	48.5	9.2	64.0	13.7	79.5	18.1	≧95.0	20.0

TABLE RM - 1000

VALUES OF MONAURAL PERCENTAGE LOSS OF HEARING CORRESPONDING TO GIVEN

HEARING THRESHOLD LEVELS AT 1000 HZ IN ONE EAR ONLY

HTL	PLH	HTL	PLH	HTL	PLH	HTL	PLH	HTL	PLH
≤18.0	0	33.5	5.0	49.0	11.8	64.5	17.3	80.0	22.7
18.5	0.6	34.0	5.2	49.5	12.0	65.0	17.5	80.5	22.9
19.0	0.6	34.5	5.4	50.0	12.1	65.5	17.7	81.0	23.0
19.5	0.7	35.0	5.7	50.5	12.3	66.0	17.9	81.5	23.1
20.0	0.8	35.5	5.9	51.0	12.5	66.5	18.1	82.0	23.3
20.5	0.8	36.0	6.1	51.5	12.7	67.0	18.2	82.5	23.4
21.0	0.9	36.5	6.3	52.0	12.9	67.5	18.4	83.0	23.5
21.5	1.0	37.0	6.6	52.5	13.1	68.0	18.6	83.5	23.6
22.0	1.1	37.5	6.8	53.0	13.3	68.5	18.8	84.0	23.7
22.5	1.2	38.0	7.0	53.5	13.4	69.0	19.0	84.5	23.8
23.0	1.3	38.5	7.3	54.0	13.6	69.5	19.2	85.0	23.9
23.5	1.4	39.0	7.5	54.5	13.8	70.0	19.4	85.5	24.0
24.0	1.5	39.5	7.7	55.0	14.0	70.5	19.5	86.0	24.1
24.5	1.7	40.0	8.0	55.5	14.1	71.0	19.7	86.5	24.2
25.0	1.8	40.5	8.2	56.0	14.3	71.5	19.9	87.0	24.3
25.5	1.9	41.0	8.4	56.5	14.5	72.0	20.1	87.5	24.3
26.0	2.1	41.5	8.6	57.0	14.7	72.5	20.3	88.0	24.4
26.5	2.2	42.0	8.9	57.5	14.8	73.0	20.5	88.5	24.5
27.0	2.4	42.5	9.1	58.0	15.0	73.5	20.6	89.0	24.5
27.5	2.6	43.0	9.3	58.5	15.2	74.0	20.8	89.5	24.6
28.0	2.7	43.5	9.5	59.0	15.4	74.5	21.0	90.0	24.6
28.5	2.9	44.0	9.7	59.5	15.6	75.0	21.2	90.5	24.7
29.0	3.1	44.5	10.0	60.0	15.7	75.5	21.3	91.0	24.7
29.5	3.3	45.0	10.2	60.5	15.9	76.0	21.5	91.5	24.8
30.0	3.5	45.5	10.4	61.0	16.1	76.5	21.7	92.0	24.8
30.5	3.7	46.0	10.6	61.5	16.3	77.0	21.8	92.5	24.8
31.0	3.9	46.5	10.8	62.0	16.4	77.5	22.0	93.0	24.9
31.5	4.1	47.0	11.0	62.5	16.6	78.0	22.1	93.5	24.9
32.0	4.3	47.5	11.2	63.0	16.8	78.5	22.3	94.0	24.9
32.5	4.5	48.0	11.4	63.5	17.0	79.0	22.5	94.5	24.9
33.0	4.8	48.5	11.6	64.0	17.2	79.5	22.6	≥95.0	25.0

TABLE RM - 1500

VALUES OF MONAURAL PERCENTAGE LOSS OF HEARING CORRESPONDING TO GIVEN

HEARING THRESHOLD LEVELS AT 1500 HZ IN ONE EAR ONLY

HTL	PLH	HTL	PLH	HTL	PLH	HTL	PLH	HTL	PLH
≦18.0	0	33.5	4.0	49.0	9.4	64.5	13.9	80.0	18.2
18.5	0.4	34.0	4.2	49.5	9.6	65.0	14.0	80.5	18.3
19.0	0.5	34.5	4.3	50.0	9.7	65.5	14.1	81.0	18.4
19.5	0.5	35.0	4.5	50.5	9.9	66.0	14.3	81.5	18.5
20.0	0.6	35.5	4.7	51.0	10.0	66.5	14.4	82.0	18.6
20.5	0.7	36.0	4.9	51.5	10.2	67.0	14.6	82.5	18.7
21.0	0.7	36.5	5.1	52.0	10.3	67.5	14.7	83.0	18.8
21.5	0.8	37.0	5.3	52.5	10.4	68.0	14.9	83.5	18.9
22.0	0.9	37.5	5.4	53.0	10.6	68.5	15.0	84.0	19.0
22.5	1.0	38.0	5.6	53.5	10.7	69.0	15.2	84.5	19.0
23.0	1.0	38.5	5.8	54.0	10.9	69.5	15.3	85.0	19.1
23.5	1.1	39.0	6.0	54.5	11.0	70.0	15.5	85.5	19.2
24.0	1.2	39.5	6.2	55.0	11.2	70.5	15.6	86.0	19.3
24.5	1.3	40.0	6.4	55.5	11.3	71.0	15.8	86.5	19.3
25.0	1.4	40.5	6.5	56.0	11.4	71.5	15.9	87.0	19.4
25.5	1.6	41.0	6.7	56.5	11.6	72.0	16.1	87.5	19.4
26.0	1.7	41.5	6.9	57.0	11.7	72.5	16.2	88.0	19.5
26.5	1.8	42.0	7.1	57.5	11.9	73.0	16.3	88.5	19.5
27.0	1.9	42.5	7.3	58.0	12.0	73.5	16.5	89.0	19.6
27.5	2.1	43.0	7.4	58.5	12.1	74.0	16.6	89.5	19.6
28.0	2.2	43.5	7.6	59.0	12.3	74.5	16.8	90.0	19.7
28.5	2.3	44.0	7.8	59.5	12.4	75.0	16.9	90.5	19.7
29.0	2.5	44.5	8.0	60.0	12.6	75.5	17.0	91.0	19.8
29.5	2.6	45.0	8.1	60.5	12.7	76.0	17.2	91.5	19.8
30.0	2.8	45.5	8.3	61.0	12.8	76.5	17.3	92.0	19.8
30.5	2.9	46.0	8.5	61.5	13.0	77.0	17.4	92.5	19.8
31.0	3.1	46.5	8.6	62.0	13.1	77.5	17.6	93.0	19.9
31.5	3.3	47.0	8.8	62.5	13.3	78.0	17.7	93.5	19.9
32.0	3.4	47.5	8.9	63.0	13.4	78.5	17.8	94.0	19.9
32.5	3.6	48.0	9.1	63.5	13.6	79.0	17.9	94.5	19.9
33.0	3.8	48.5	9.2	64.0	13.7	79.5	18.1	≧95.0	20.0

VALUES OF MONAURAL PERCENTAGE LOSS OF HEARING CORRESPONDING TO GIVEN

HEARING THRESHOLD LEVELS AT 2000 HZ IN ONE EAR ONLY

HTL	PLH	HTL	PLH	HTL	PLH	HTL	PLH	HTL	PLH
≤18.0	0	33.5	3.0	49.0	7.0	64.5	10.4	80.0	13.6
18.5	0.3	34.0	3.1	49.5	7.2	65.0	10.5	80.5	13.7
19.0	0.4	34.5	3.2	50.0	7.3	65.5	10.6	81.0	13.8
19.5	0.4	35.0	3.4	50.5	7.4	66.0	10.7	81.5	13.9
20.0	0.5	35.5	3.5	51.0	7.5	66.5	10.8	82.0	13.9
20.5	0.5	36.0	3.7	51.5	7.6	67.0	10.9	82.5	14.0
21.0	0.5	36.5	3.8	52.0	7.7	67.5	11.0	83.0	14.1
21.5	0.6	37.0	3.9	52.5	7.8	68.0	11.2	83.5	14.1
22.0	0.7	37.5	4.1	53.0	7.9	68.5	11.3	84.0	14.2
22.5	0.7	38.0	4.2	53.5	8.0	69.0	11.4	84.5	14.3
23.0	0.8	38.5	4.4	54.0	8.2	69.5	11.5	85.0	14.3
23.5	0.9	39.0	4.5	54.5	8.3	70.0	11.6	85.5	14.4
24.0	0.9	39.5	4.6	55.0	8.4	70.5	11.7	86.0	14.4
24.5	1.0	40.0	4.8	55.5	8.5	71.0	11.8	86.5	14.5
25.0	1.1	40.5	4.9	56.0	8.6	71.5	11.9	87.0	14.5
25.5	1.2	41.0	5.0	56.5	8.7	72.0	12.0	87.5	14.6
26.0	1.3	41.5	5.2	57.0	8.8	72.5	12.1	88.0	14.6
26.5	1.3	42.0	5.3	57.5	8.9	73.0	12.3	88.5	14.7
27.0	1.4	42.5	5.4	58.0	9.0	73.5	12.4	89.0	14.7
27.5	1.5	43.0	5.6	58.5	9.1	74.0	12.5	89.5	14.7
28.0	1.6	43.5	5.7	59.0	9.2	74.5	12.6	90.0	14.8
28.5	1.8	44.0	5.8	59.5	9.3	75.0	12.7	90.5	14.8
29.0	1.9	44.5	6.0	60.0	9.4	75.5	12.8	91.0	14.8
29.5	2.0	45.0	6.1	60.5	9.5	76.0	12.9	91.5	14.8
30.0	2.1	45.5	6.2	61.0	9.6	76.5	13.0	92.0	14.9
30.5	2.2	46.0	6.3	61.5	9.7	77.0	13.1	92.5	14.9
31.0	2.3	46.5	6.5	62.0	9.8	77.5	13.2	93.0	14.9
31.5	2.5	47.0	6.6	62.5	10.0	78.0	13.3	93.5	14.9
32.0	2.6	47.5	6.7	63.0	10.1	78.5	13.4	94.0	14.9
32.5	2.7	48.0	6.8	63.5	10.2	79.0	13.5	94.5	14.9
33.0	2.8	48.5	6.9	64.0	10.3	79.5	13.5	≥95.0	15.0

TABLE RM - 3000

VALUES OF MONAURAL PERCENTAGE LOSS OF HEARING CORRESPONDING TO GIVEN

HEARING THRESHOLD LEVELS AT 3000 HZ IN ONE EAR ONLY

HTL	PLH	HTL	PLH	HTL	PLH	HTL	PLH	HTL	PLH
≤18.0	0	33.5	2.0	49.0	4.7	64.5	6.9	80.0	9.1
18.5	0	34.0	2.1	49.5	4.8	65.0	7.0	80.5	9.1
19.0	0	34.5	2.2	50.0	4.8	65.5	7.1	81.0	9.2
19.5	0	35.0	2.3	50.5	4.9	66.0	7.1	81.5	9.2
20.0	0.3	35.5	2.3	51.0	5.0	66.5	7.2	82.0	9.3
20.5	0.3	36.0	2.4	51.5	5.1	67.0	7.3	82.5	9.3
21.0	0.4	36.5	2.5	52.0	5.1	67.5	7.3	83.0	9.4
21.5	0.4	37.0	2.6	52.5	5.2	68.0	7.4	83.5	9.4
22.0	0.4	37.5	2.7	53.0	5.3	68.5	7.5	84.0	9.5
22.5	0.5	38.0	2.8	53.5	5.4	69.0	7.6	84.5	9.5
23.0	0.5	38.5	2.9	54.0	5.4	69.5	7.6	85.0	9.5
23.5	0.6	39.0	3.0	54.5	5.5	70.0	7.7	85.5	9.6
24.0	0.6	39.5	3.1	55.0	5.6	70.5	7.8	86.0	9.6
24.5	0.7	40.0	3.2	55.5	5.6	71.0	7.9	86.5	9.6
25.0	0.7	40.5	3.3	56.0	5.7	71.5	7.9	87.0	9.7
25.5	0.8	41.0	3.4	56.5	5.8	72.0	8.0	87.5	9.7
26.0	0.8	41.5	3.4	57.0	5.8	72.5	8.1	88.0	9.7
26.5	0.9	42.0	3.5	57.5	5.9	73.0	8.2	88.5	9.7
27.0	1.0	42.5	3.6	58.0	6.0	73.5	8.2	89.0	9.8
27.5	1.0	43.0	3.7	58.5	6.1	74.0	8.3	89.5	9.8
28.0	1.1	43.5	3.8	59.0	6.1	74.5	8.4	90.0	9.8
28.5	1.2	44.0	3.9	59.5	6.2	75.0	8.4	90.5	9.8
29.0	1.2	44.5	4.0	60.0	6.3	75.5	8.5	91.0	9.9
29.5	1.3	45.0	4.1	60.5	6.3	76.0	8.6	91.5	9.9
30.0	1.4	45.5	4.1	61.0	6.4	76.5	8.6	92.0	9.9
30.5	1.5	46.0	4.2	61.5	6.5	77.0	8.7	92.5	9.9
31.0	1.6	46.5	4.3	62.0	6.6	77.5	8.8	93.0	9.9
31.5	1.6	47.0	4.4	62.5	6.6	78.0	8.8	93.5	9.9
32.0	1.7	47.5	4.5	63.0	6.7	78.5	8.9	94.0	9.9
32.5	1.8	48.0	4.5	63.5	6.8	79.0	8.9	94.5	9.9
33.0	1.9	48.5	4.6	64.0	6.8	79.5	9.0	≥95.0	10.0

VALUES OF MONAURAL PERCENTAGE LOSS OF HEARING CORRESPONDING TO GIVEN

HEARING THRESHOLD LEVELS AT 4000 HZ IN ONE EAR ONLY

HTL	PLH	HTL	PLH	HTL	PLH	HTL	PLH	HTL	PLH
≤18.0	0	33.5	1.3	49.0	4.2	64.5	6.6	80.0	8.9
18.5	0	34.0	1.4	49.5	4.3	65.0	6.7	80.5	9.0
19.0	0	34.5	1.4	50.0	4.4	65.5	6.8	81.0	9.0
19.5	0	35.0	1.5	50.5	4.5	66.0	6.9	81.5	9.1
20.0	0	35.5	1.6	51.0	4.5	66.5	6.9	82.0	9.2
20.5	0	36.0	1.7	51.5	4.6	67.0	7.0	82.5	9.2
21.0	0	36.5	1.8	52.0	4.7	67.5	7.1	83.0	9.3
21.5	0	37.0	1.9	52.5	4.8	68.0	7.2	83.5	9.3
22.0	0	37.5	2.0	53.0	4.9	68.5	7.2	84.0	9.4
22.5	0	38.0	2.1	53.5	5.0	69.0	7.3	84.5	9.4
23.0	0.2	38.5	2.2	54.0	5.0	69.5	7.4	85.0	9.5
23.5	0.2	39.0	2.3	54.5	5.1	70.0	7.5	85.5	9.5
24.0	0.3	39.5	2.4	55.0	5.2	70.5	7.5	86.0	9.5
24.5	0.3	40.0	2.5	55.5	5.3	71.0	7.6	86.5	9.6
25.0	0.3	40.5	2.6	56.0	5.3	71.5	7.7	87.0	9.6
25.5	0.3	41.0	2.7	56.5	5.4	72.0	7.8	87.5	9.6
26.0	0.4	41.5	2.8	57.0	5.5	72.5	7.8	88.0	9.7
26.5	0.4	42.0	2.9	57.5	5.6	73.0	7.9	88.5	9.7
27.0	0.5	42.5	3.0	58.0	5.7	73.5	8.0	89.0	9.7
27.5	0.5	43.0	3.1	58.5	5.7	74.0	8.1	89.5	9.8
28.0	0.6	43.5	3.2	59.0	5.8	74.5	8.2	90.0	9.8
28.5	0.6	44.0	3.3	59.5	5.9	75.0	8.2	90.5	9.8
29.0	0.7	44.5	3.4	60.0	6.0	75.5	8.3	91.0	9.8
29.5	0.7	45.0	3.5	60.5	6.0	76.0	8.4	91.5	9.9
30.0	0.8	45.5	3.5	61.0	6.1	76.5	8.4	92.0	9.9
30.5	0.8	46.0	3.6	61.5	6.2	77.0	8.5	92.5	9.9
31.0	0.9	46.5	3.7	62.0	6.3	77.5	8.6	93.0	9.9
31.5	1.0	47.0	3.8	62.5	6.3	78.0	8.7	93.5	9.9
32.0	1.0	47.5	3.9	63.0	6.4	78.5	8.7	94.0	9.9
32.5	1.1	48.0	4.0	63.5	6.5	79.0	8.8	94.5	9.9
33.0	1.2	48.5	4.1	64.0	6.6	79.5	8.9	≥95.0	10.0

APPENDIX 5

PRESBYACUSIS CORRECTION TABLE

January 1988

When correction for presbyacusis is required, it is recommended that values obtained from Table P (or calculated by means of the computer program given in Appendix 6) be used. The value from Table P appropriate to the age and sex of the person should be subtracted from their binaural PLH or from the monaural PLH of each ear.

Examples

(1) A man aged 62 years has a binaural PLH of 10.8% and his loss is to be corrected for presbyacusis.

AGE-CORRECTED BINAURAL PLH = 10.8 - 1.3

= 9.7%

(2) A woman aged 70 years has monaural PLHs of 5.6% in the right ear and 7.8% in the left ear and her losses are to be corrected for presbyacusis.

AGE-CORRECTED MONAURAL PLH (RIGHT EAR) = 5.6 - 0.4

= 5.2%

AGE-CORRECTED MONAURAL PLH (LEFT EAR) = 7.8 - 0.4

= 7.4%

Table P: Values of age-related percentage loss of hearing (PLH_A) for males and females at various ages

MALE		FEMALE	
AGE (Years)	PLH_A (Percent)	AGE (Years)	PLH_A (Percent)
≦55	0	≦68	0
56	0.1	69	0.2
57	0.2	70	0.4
58	0.4	71	0.6
59	0.6	72	0.8
60	0.8	73	1.1
61	1.0	74	1.4
62	1.3	75	1.7
63	1.7	76	2.1
64	2.0	77	2.5
65	2.4	78	2.9
66	2.9	79	3.4
67	3.3	80	3.9
68	3.8		
69	4.4		
70	4.9		
71	5.5		
72	6.2		
73	6.8		
74	7.5		
75	8.3		
76	9.0		
77	9.8		
78	10.7		
79	11.5		
80	12.5		

$$PLH_A = a + b(AGE) + c(AGE^2)$$

	a	b	c
MALE	47.15857	−1.79509	.01696
FEMALE	56.81628	−1.81723	.01444

APPENDIX 6

COMPUTER PROGRAM FOR CALCULATING AGE-RELATED PERCENTAGE LOSS OF HEARING

```
100   INPUT "AGE ";A
105   PRINT
110   INPUT "SEX Ø=MALE 1=FEMALE ";S
120   IF S > Ø THEN 180
130   IF A > 55 THEN 160
140 Z = Ø
150   GOTO 220
160 Z = 47.15857 - 1.79059 * A + .01696 * A * A
170   GOTO 220
180   IF A > 68 THEN 210
190 Z = Ø
200   GOTO 220
210 Z = 56.81628 - 1.81723 * A + .01444 * A * A
220 P =   INT (Z * 1Ø + .5) / 1Ø
230   PRINT : PRINT
240   PRINT "AGE-RELATED PLH = ";P
```

APPENDIX 7

BINAURAL EXTENSION TABLES

January 1988

These tables replace Table RB-4000 in the binaural tables given in Appendix 3 when it is necessary to determine binaural PLH over the range 500 to 8000 Hz. The weighting of 10% given to 4000 Hz in Appendix 3 has been split between 4000, 6000 and 8000 Hz, with 4000 Hz receiving 6%, 6000 Hz 3% and 8000 Hz 1%. When determining binaural PLH over the range 500 to 8000 Hz, the appropriate tables from Appendix 3 are used for the frequencies 500, 1000, 1500, 2000 and 3000 Hz and the relevant tables given in this Appendix are used for the frequencies 4000, 6000 and 8000 Hz.

Example

HEARING THRESHOLD LEVELS

FREQUENCY	RIGHT EAR	LEFT EAR	BETTER EAR	WORSE EAR	PLH
500	40	10	10	40	1.7
1000	45	25	25	45	4.2
1500	50	40	40	50	7.1
2000	55	55	55	55	8.4
3000	60	70	60	70	6.5
4000	65	85	65	85	4.3
6000	55	75	55	75	1.7
8000	45	65	45	65	0.4

OVERALL BINAURAL PLH = 34.3%

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TABLE EB – 4000

VALUES OF PERCENTAGE LOSS OF HEARING CORRESPONDING TO GIVEN HEARING THRESHOLD LEVELS IN THE BETTER AND WORSE EARS AT 4000 HZ.

HTL – BETTER EAR

HTL – WORSE EAR	≤20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	≥95
≤20	0															
25	0.1	0.2														
30	0.2	0.3	0.5													
35	0.3	0.4	0.6	0.9												
40	0.4	0.5	0.8	1.0	1.5											
45	0.5	0.7	0.9	1.2	1.6	2.1										
50	0.6	0.8	1.0	1.4	1.7	2.2	2.6									
55	0.6	0.8	1.1	1.5	1.8	2.2	2.7	3.1								
60	0.7	0.9	1.2	1.5	1.9	2.3	2.7	3.2	3.6							
65	0.7	1.0	1.3	1.6	2.0	2.4	2.8	3.2	3.6	4.0						
70	0.8	1.0	1.3	1.6	2.0	2.4	2.8	3.2	3.7	4.1	4.5					
75	0.8	1.1	1.4	1.7	2.1	2.5	2.9	3.3	3.7	4.1	4.5	4.9				
80	0.9	1.1	1.4	1.7	2.1	2.5	2.9	3.3	3.8	4.2	4.6	5.0	5.3			
85	0.9	1.2	1.4	1.8	2.1	2.5	2.9	3.4	3.8	4.3	4.7	5.1	5.4	5.7		
90	0.9	1.2	1.5	1.8	2.2	2.6	3.0	3.4	3.8	4.3	4.7	5.1	5.5	5.7	5.9	
≥95	1.0	1.2	1.5	1.8	2.2	2.6	3.0	3.4	3.9	4.3	4.8	5.2	5.5	5.7	5.9	6.0

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TABLE EB - 6000

VALUES OF PERCENTAGE LOSS OF HEARING CORRESPONDING TO GIVEN HEARING THRESHOLD LEVELS IN THE BETTER AND WORSE EARS AT 6000 HZ.

HTL - BETTER EAR

HTL - WORSE EAR	≤25	30	35	40	45	50	55	60	65	70	75	80	85	90	≥95
≤25	0														
30	0.1	0.2													
35	0.2	0.3	0.4												
40	0.3	0.4	0.5	0.7											
45	0.3	0.4	0.6	0.8	1.0										
50	0.4	0.5	0.7	0.9	1.1	1.3									
55	0.4	0.5	0.7	0.9	1.1	1.3	1.5								
60	0.4	0.6	0.7	0.9	1.1	1.4	1.6	1.8							
65	0.5	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0						
70	0.5	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2					
75	0.5	0.7	0.8	1.0	1.2	1.4	1.7	1.9	2.1	2.3	2.5				
80	0.6	0.7	0.9	1.1	1.3	1.5	1.7	1.9	2.1	2.3	2.5	2.7			
85	0.6	0.7	0.9	1.1	1.3	1.5	1.7	1.9	2.1	2.3	2.5	2.7	2.8		
90	0.6	0.7	0.9	1.1	1.3	1.5	1.7	1.9	2.2	2.4	2.6	2.7	2.8	2.9	
≥95	0.6	0.8	0.9	1.1	1.3	1.5	1.7	1.9	2.2	2.4	2.6	2.7	2.8	2.9	3.0

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TABLE EB - 8000

VALUES OF PERCENTAGE LOSS OF HEARING CORRESPONDING TO GIVEN HEARING THRESHOLD LEVELS IN THE BETTER AND WORSE EARS AT 8000 HZ.

HTL - BETTER EAR

HTL - WORSE EAR	≤30	35	40	45	50	55	60	65	70	75	80	85	≥90
≤30	0												
35	0.1	0.1											
40	0.1	0.2	0.2										
45	0.1	0.2	0.3	0.3									
50	0.2	0.2	0.3	0.3	0.4								
55	0.2	0.2	0.3	0.4	0.4	0.5							
60	0.2	0.2	0.3	0.4	0.4	0.5	0.6						
65	0.2	0.3	0.3	0.4	0.5	0.5	0.6	0.7					
70	0.2	0.3	0.3	0.4	0.5	0.5	0.6	0.7	0.7				
75	0.2	0.3	0.3	0.4	0.5	0.5	0.6	0.7	0.8	0.8			
80	0.2	0.3	0.3	0.4	0.5	0.6	0.6	0.7	0.8	0.8	0.9		
85	0.2	0.3	0.4	0.4	0.5	0.6	0.6	0.7	0.8	0.8	0.9	0.9	
≥90	0.2	0.3	0.4	0.4	0.5	0.6	0.6	0.7	0.8	0.8	0.9	0.9	1.0

APPENDIX 8

MONAURAL EXTENSION TABLES

January 1988

These tables replace Table RM-4000 in the monaural tables given in Appendix 4 when it is necessary to determine monaural PLH over the range 500 to 8000 Hz. The weighting of 10% given to 4000 Hz in Appendix 4 has been split between 4000, 6000 and 8000 Hz, with 4000 Hz receiving 6%, 6000 Hz 3% and 8000 Hz 1%. When determining monaural PLH over the range 500 to 8000 Hz, the appropriate tables from Appendix 4 are used for the frequencies 500, 1000, 1500, 2000 and 3000 Hz and the relevant tables given in this Appendix are used for the frequencies 4000, 6000 and 8000 Hz.

Example

FREQUENCY	LEFT EAR		RIGHT EAR	
	HTL	PLH	HTL	PLH
500	24	1.2	29	2.5
1000	34	5.2	39	7.5
1500	44	7.8	39	6.0
2000	54	8.2	44	5.8
3000	64	6.8	54	5.4
4000	69	4.4	59	3.5
6000	61	1.8	53	1.4
8000	54	0.5	44	0.3
OVERALL MONAURAL PLH		35.9%		32.4%

TABLE EM - 4000

VALUES OF MONAURAL PERCENTAGE LOSS OF HEARING CORRESPONDING TO GIVEN

HEARING THRESHOLD LEVELS AT 4000 HZ IN ONE EAR ONLY

HTL	PLH	HTL	PLH	HTL	PLH	HTL	PLH	HTL	PLH
≦ 22.5	0	37.5	1.2	52.5	2.9	67.5	4.2	82.5	5.5
23.0	0.1	38.0	1.2	53.0	2.9	68.0	4.3	83.0	5.5
23.5	0.1	38.5	1.3	53.5	3.0	68.5	4.3	83.5	5.6
24.0	0.2	39.0	1.4	54.0	3.0	69.0	4.4	84.0	5.6
24.5	0.2	39.5	1.4	54.5	3.1	69.5	4.4	84.5	5.6
25.0	0.2	40.0	1.5	55.0	3.1	70.0	4.5	85.0	5.7
25.5	0.2	40.5	1.5	55.5	3.2	70.5	4.5	85.5	5.7
26.0	0.2	41.0	1.6	56.0	3.2	71.0	4.6	86.0	5.7
26.5	0.3	41.5	1.7	56.5	3.2	71.5	4.6	86.5	5.7
27.0	0.3	42.0	1.7	57.0	3.3	72.0	4.6	87.0	5.8
27.5	0.3	42.5	1.8	57.5	3.3	72.5	4.7	87.5	5.8
28.0	0.3	43.0	1.8	58.0	3.4	73.0	4.7	88.0	5.8
28.5	0.4	43.5	1.9	58.5	3.4	73.5	4.8	88.5	5.8
29.0	0.4	44.0	1.9	59.0	3.5	74.0	4.8	89.0	5.8
29.5	0.4	44.5	2.0	59.5	3.5	74.5	4.9	89.5	5.8
30.0	0.5	45.0	2.1	60.0	3.6	75.0	4.9	90.0	5.9
30.5	0.5	45.5	2.1	60.5	3.6	75.5	5.0	90.5	5.9
31.0	0.5	46.0	2.2	61.0	3.7	76.0	5.0	91.0	5.9
31.5	0.6	46.5	2.2	61.5	3.7	76.5	5.1	91.5	5.9
32.0	0.6	47.0	2.3	62.0	3.7	77.0	5.1	92.0	5.9
32.5	0.7	47.5	2.3	62.5	3.8	77.5	5.1	92.5	5.9
33.0	0.7	48.0	2.4	63.0	3.8	78.0	5.2	93.0	5.9
33.5	0.8	48.5	2.5	63.5	3.9	78.5	5.2	93.5	5.9
34.0	0.8	49.0	2.5	64.0	3.9	79.0	5.3	94.0	5.9
34.5	0.9	49.5	2.6	64.5	4.0	79.5	5.3	94.5	5.9
35.0	0.9	50.0	2.6	65.0	4.0	80.0	5.3	≧ 95.0	6.0
35.5	1.0	50.5	2.7	65.5	4.1	80.5	5.4		
36.0	1.0	51.0	2.7	66.0	4.1	81.0	5.4		
36.5	1.1	51.5	2.8	66.5	4.1	81.5	5.4		
37.0	1.1	52.0	2.8	67.0	4.2	82.0	5.5		

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TABLE EM - 6000

VALUES OF MONAURAL PERCENTAGE LOSS OF HEARING CORRESPONDING TO GIVEN

HEARING THRESHOLD LEVELS AT 6000 HZ IN ONE EAR ONLY

HTL	PLH	HTL	PLH	HTL	PLH	HTL	PLH	HTL	PLH
≦27.0	0	42.0	0.8	57.0	1.6	72.0	2.3	87.0	2.9
27.5	0.1	42.5	0.9	57.5	1.7	72.5	2.4	87.5	2.9
28.0	0.2	43.0	0.9	58.0	1.7	73.0	2.4	88.0	2.9
28.5	0.2	43.5	0.9	58.5	1.7	73.5	2.4	88.5	2.9
29.0	0.2	44.0	1.0	59.0	1.7	74.0	2.4	89.0	2.9
29.5	0.2	44.5	1.0	59.5	1.8	74.5	2.4	89.5	2.9
30.0	0.2	45.0	1.0	60.0	1.8	75.0	2.5	90.0	2.9
30.5	0.2	45.5	1.0	60.5	1.8	75.5	2.5	90.5	2.9
31.0	0.3	46.0	1.1	61.0	1.8	76.0	2.5	91.0	2.9
31.5	0.3	46.5	1.1	61.5	1.9	76.5	2.5	91.5	2.9
32.0	0.3	47.0	1.1	62.0	1.9	77.0	2.5	92.0	2.9
32.5	0.3	47.5	1.2	62.5	1.9	77.5	2.6	92.5	2.9
33.0	0.3	48.0	1.2	63.0	1.9	78.0	2.6	93.0	2.9
33.5	0.4	48.5	1.2	63.5	1.9	78.5	2.6	93.5	2.9
34.0	0.4	49.0	1.2	64.0	2.0	79.0	2.6	94.0	2.9
34.5	0.4	49.5	1.3	64.5	2.0	79.5	2.6	94.5	2.9
35.0	0.4	50.0	1.3	65.0	2.0	80.0	2.7	≧95.0	3.0
35.5	0.5	50.5	1.3	65.5	2.0	80.5	2.7		
36.0	0.5	51.0	1.3	66.0	2.1	81.0	2.7		
36.5	0.5	51.5	1.4	66.5	2.1	81.5	2.7		
37.0	0.5	52.0	1.4	67.0	2.1	82.0	2.7		
37.5	0.6	52.5	1.4	67.5	2.1	82.5	2.7		
38.0	0.6	53.0	1.4	68.0	2.2	83.0	2.8		
38.5	0.6	53.5	1.5	68.5	2.2	83.5	2.8		
39.0	0.7	54.0	1.5	69.0	2.2	84.0	2.8		
39.5	0.7	54.5	1.5	69.5	2.2	84.5	2.8		
40.0	0.7	55.0	1.5	70.0	2.2	85.0	2.8		
40.5	0.7	55.5	1.6	70.5	2.3	85.5	2.8		
41.0	0.8	56.0	1.6	71.0	2.3	86.0	2.8		
41.5	0.8	56.5	1.6	71.5	2.3	86.5	2.8		

TABLE EM - 8000

VALUES OF MONAURAL PERCENTAGE LOSS OF HEARING CORRESPONDING TO GIVEN

HEARING THRESHOLD LEVELS AT 8000 HZ IN ONE EAR ONLY

HTL	PLH	HTL	PLH	HTL	PLH	HTL	PLH
≦31.5	0	46.5	0.4	61.5	0.6	76.5	0.8
32.0	0.1	47.0	0.4	62.0	0.6	77.0	0.8
32.5	0.1	47.5	0.4	62.5	0.6	77.5	0.8
33.0	0.1	48.0	0.4	63.0	0.6	78.0	0.8
33.5	0.1	48.5	0.4	63.5	0.6	78.5	0.9
34.0	0.1	49.0	0.4	64.0	0.7	79.0	0.9
34.5	0.1	49.5	0.4	64.5	0.7	79.5	0.9
35.0	0.1	50.0	0.4	65.0	0.7	80.0	0.9
35.5	0.2	50.5	0.4	65.5	0.7	80.5	0.9
36.0	0.2	51.0	0.4	66.0	0.7	81.0	0.9
36.5	0.2	51.5	0.4	66.5	0.7	81.5	0.9
37.0	0.2	52.0	0.5	67.0	0.7	82.0	0.9
37.5	0.2	52.5	0.5	67.5	0.7	82.5	0.9
38.0	0.2	53.0	0.5	68.0	0.7	83.0	0.9
38.5	0.2	53.5	0.5	68.5	0.7	83.5	0.9
39.0	0.2	54.0	0.5	69.0	0.7	84.0	0.9
39.5	0.2	54.5	0.5	69.5	0.7	84.5	0.9
40.0	0.2	55.0	0.5	70.0	0.7	85.0	0.9
40.5	0.2	55.5	0.5	70.5	0.7	85.5	0.9
41.0	0.3	56.0	0.5	71.0	0.8	86.0	0.9
41.5	0.3	56.5	0.5	71.5	0.8	86.5	0.9
42.0	0.3	57.0	0.5	72.0	0.8	87.0	0.9
42.5	0.3	57.5	0.6	72.5	0.8	87.5	0.9
43.0	0.3	58.0	0.6	73.0	0.8	88.0	0.9
43.5	0.3	58.5	0.6	73.5	0.8	88.5	0.9
44.0	0.3	59.0	0.6	74.0	0.8	89.0	0.9
44.5	0.3	59.5	0.6	74.5	0.8	89.5	0.9
45.0	0.3	60.0	0.6	75.0	0.8	≧90.0	1.0
45.5	0.3	60.5	0.6	75.5	0.8		
46.0	0.3	61.0	0.6	76.0	0.8		