REAL EAR ATTENUATION MEASUREMENT OF EAR PROTECTORS USING EAR PHONES-II AT SUPRA THRESHOLDS, USING SIMULTANEOUS BINAURAL LOUDNESS BALANCE METHOD:

P.J. KUMAR C.S. VENKATESH* M. RAGINI

Kumar, Venkatesh and Ragini (1982) had measured the real ear atttenuation of Ear Insert type of Protectors by presenting pure tones through the ear phones. There was a mean attenuation of 27.75 dB at 250 Hz; 32.25 dB at 500 Hz; 33.5 dB at 1000 Hz; 37.63 dB at 2000 Hz; 41.38 dB at 4000 Hz; 45.25 dB at 6000 Hz; and 46 dB at 8000 Hz.

Usually the insert type of ear protectors are used by the people who work in noisy environment to avoid noise induced hearing loss (NIHL). It is a fact that noise present in most situations are at much more higher level than the level that is used to measure the efficiency of an ear protector at threshold. This is true" in case of both free field and closed field measures. In such situations, a question raises as to "Whether the attenuation characteristics, measured through the thresholds obtained with and without the ear protectors can really reflect upon the efficiency of such a protector?"

The purpose of the present study was;

i) to measure the attenuation characteristics of ear insert type of hearing protectors at threshold and at supra-threshold levels;

ii) to see if thereis any difference in terms of attenuation obtained through these methods; and

iii) to answer the question "whether the attenuation characteristics measured through the thresholds obtained with and without the ear protectors in the ear, is sufficient to make out the efficiency of an ear protector?"

A.I.I.S.H. MYSORE - 570 006.

Method:

Twenty students, in an age range of 17 to 24 years, served as the subjects. They provided fourty ears in total, with no otological and audiological abnormalities. Only right ear of these subjects was used to measure the attenuation. Left ear of these subjects served as the reference ear in the Simultaneous Binural Loudness Balance (SBLB) task.

E.A.R. ear protectors were used, as the study aimed at measuring the attenuation characteristics of these protectors at frequencies 250Hz, 500 Hz, 1 KHz, 2 KHz, A KHz, 6 KHz and 8 KHz at threshold and supra threshold levels.

A well calibrated Beltone 200-C Diagnostic Audiometer with TDH-49 earphones, kept in a sound treated two room situation (in the Department of Audiology, All India Institute of Speech and Hearing) was used to;

(i) measure thresholds

(ii) measure thresholds with ear protectors in the right ear.

(iii) to administer SBLB with ear protectors in the right ear.

Procedure-I:

Pure tone thresholds at frequencies 250 Hz, 1000 Hz, 2000 Hz, A000 Hz, 6000 Hz and 8000 Hz were measured with and without the ear protectors in the external auditory meatus, using hughson west lake procedure. The difference between the thresholds taken with and without ear protectors was considered as the amount of attenuation provided by the ear protector at that: frequency at threshold level.

Amount of Attenuation in dBHL at threshold level	=	Threshold with the ear protector in the ear	-	Threshold without the ear protector in the ear

Procedure-H:

This was to measure the attenuation provided by the ear protector at supra-threshold levels using SBLB test, the mentioned frequencies. Left ear served as the reference ear with a tone of 70 dBSL at all the frequencies and right ear served as the test ear. SBLB threshold were obtained by varying the intensity of the tone in the right ear in ascending manner.

Amount of Attenuation at supra-threshold in dBHL	_	Intensity level in the right ear at which the balancing was obtained
		The sensation at which the reference tone was presented in left ear (i.e. -70dBSL)
		Threshold of the right ear

Balancing thresholds were obtained thrice to confirm the level of balancing.

The difference between the intensity level in the right ear at which the balancing was obtained and that the reference tone presented in the left ear at that frequency was considered as the amount of attenuation provided by the ear protector, at that frequency at that supra-threshold. Schematically it can be presented as below:

Results & Discussions:

The results of procedures I and II are presented in table 1 and II respectively.

Table 'A' depicts the range of thresholds for seven frequencies, average threshold of seven frequencies, range of attenuation at threshold for seven frequencies, range of attenuation at suprathreshold for seven frequencies, and average attenuation at supra-threshold for seven frequencies for each subject.

Table 'B' depicts range of thresholds, average of thresholds, range of attenuation at threshold level, mean of attenuation at threshold level, standard deviation of attenuation at threshold level, range of attenuation at supra threshold level, mean of attenuation at supra threshold level, standard deviation of attenuation at supra threshold level, the mean difference between the two measures, the standard error of difference, and the level of significance of difference at each frequency.

It was analyzed to see if there existed a significant difference between the attenuated and preattenuated measures at each frequency. Also analysis of mean differences between these two measures showed that the attenuation measured at threshold level was significantly higher than the attenuation measured at supra-threshold level for all frequencies.

The analysis indicates a gradual increase in the attenuation with increasing frequency, at threshold level which is similar to the previous study (Kumar et.al., 1982). However, such an increase in attenuation with increasing frequency was not observed in supra-threshold measurements. The attenuation was minimum at 250 Hz and was maximum at 6 KHz.

The attenuation at threshold level was found to be always higher than that of supra-threshold level for all frequencies. These differences are statistically significant at 0.01 level. This indicates that the attenuation measurements at threshold level provide an overestimation of the attenuation characteristics of an ear protector. Hence, it cannot be taken as a measure of efficiency of an ear protector. The attenuation measures at supra-threshold level can be taken as effective indicators of attenuation characteristics of

an ear protector than those of threshold level. One should note that it is at higher intensity levels that the ear-protectors are usually used.

The measures made at threshold may be indicating the capacity upto which the ear protectors are able in tolerate the intensity input. Beyond an intensity level, ear protectors may no longer tolerate the impinging intansity and thus allow the energy to reach the ear. Hence, attenuation measured at supra-threshold will always be smaller than t'nat of thresh-old level and a real one.

TABLE - A

Subject	Range of threshold at 7 Freqs.	Average threshold	Range of at 7 Freqs.	Average attenua-tion at threshold	Range of Attenua-tion at supra-tbreshold at 7 freqs.	Average Attenuation at supra-threshold
1.	0-10	2.86	50-60	44.29	10-35	22.86
2.	0-15	5.71	10-35	23.57	0-20	9.29
3.	0-15	5.71	15-55	30.71	0-20	10.71
4.	5-25	14.29	25-40	32.14	0-10	2.86
5.	0-15	7.86	50-50	38.57	0-20	10.71
6.	0-20	11.43	25-45	35.71	0-25	16.43
7.	0-10	05.00	30-65	46.43	10-25	17.86
8.	10-25	16.43	20-65	40.71	0-20	10.00
9.	10-10	2.86	30-50	39.29	5-30	13.57
10.	0-10	5.00	20-70	45.00	10-40	26.43
11.	0-20	11.43	25-50	36.43	0-25	7.86
12.	0-25	8.57	30-50	41.43	5-30	18.57
13.	0-10	5.00	20-45	29.87	5-25	17.86
14.	0-05	4.29	15-55	34.29	5-30	15.71
15.	0-10	2.14	20-50	40.71	0-30	16.43
16.	0-20	8.57	70-55	36.43	5-30	14.29
17.	0-10	5.71	35-50	41.25	10-35	23.57
18.	10-20	17.14	15-50	30.71	0-20	6.43
19.	0-15	10.00	25-55	41.43	0-35	18.57
20.	5-10	3.57	40-65	50.00	15-30	22.14
TOTAL		153.57		759.15	-	302.32
MEAN		7.68		37.96		15.12
STANDARD DEVIATION				6.46572		6.27363
MEAN DIFFERENCE:		22.84	Significant at 0.01 level with CR = 11.338812 and SEB 2.014496 at 38 degrees of freedom			

T A B L E - B

	250Hz	500Hz	1000Hz	2000Hz	4000Hz	6000Hz	8000Hz
Range of Thresholds	0-20	0-20	-5 to 20	-10 to 15	-0 to 20	-5 to 20	0-20
Average of Thresholds	8-5	8-75	5-75	4-00	9-5	8-85	8-75
Range of Attenuation at Threshold	10-45	15-50	15-50	20-50	25-55	30-70	30-65
Mean Attenuation at Threshold	27-00	29-5	35-25	38-25	41-5	46-5	47-5
Standard Deviation of Attenuation at Threshold	9.92	10.12	9.39	7.99	8.44	11.48	9.93
Range of Attenuation at supra-threshold	0-15	0-35	0-35	0-30	5-40	0-35	0-20
Mean Attenuation at supra-threshold	6.25	15.25	18.25	16.75	19.00	20.5	9.5
Standard Deviation of Attenuation at supra-threshold	5.82	11.64	10.14	9.40	9.26	9.45	7.42
Mean difference in attenuation	20.75	14.25	16.75	21.5	22.5	26.00	38.00
Standard error of difference	2.57	3.43	3.09	7.79	8.03	7.82	13.71
Level of significance	0.01	0.01	0.01	0.01	0.01	0.01	0.01