COMPARISION OF TRANSMISSION LOSS WITH EARPLUGS MADE USING DIFFERENT METHODS

Reg . No.M9212

AN INDEPENDENT PROJECT SUBMITTED AS PART FULFILMENT FOR THE FIRST YEAR M,Sc. (SPEECH & HEARING) TO THE UNIVERSITY OF MYSORE.

ALL INDIA INSTITUTE OF SPEECH AND HEARING MYSORE - 570 006.

MAY 1993

to

Muttachen and Achama.
***For* teaching me to differentiate**
bettween what is right & wrong.
For their never flagging faith in me
and above all for making *me*
b e l i v e i n m y s e l f .

CERTIFICATE

This is to certify that the Independent project entitled: COMPARISION OF TRANSMISSION LOSS WITH EARPLUGS MADE USING DIFFERENT METHODS is a bonaf ide work, done in part fulfilment for the first year Degree of Master of Science (Speech and Hearing), of the student with Reg.No.M9212.

Director

Mysore
May 1993

All India Institute of Speech & Hearing
Mysore - 570 006.

CERTIFICATE

This is to certify that this Independent Project entitled: COMPARISOH OF TRANSMISSION LOSS WITH EARPLUGS MADE USING DIFFERENT . METHODS has been prepared under *my* supervision and guidance. .

Mysore

May 19993

Dr. (Miss) S. Nikam

Guide

DECLARATION

I hereby declare that this Independent Project entitled: COMPARISON OF TRANSMISSION LOSS WITH EARPLUGS MADE USIHG DIFFERENT METHODS is the result of my own study under the guidance of Dr. (Miss) S.Nikam, Director, All India Institute of Speech and Hearing, Mysore, has not been submitted earlier at any University for any other Diploma or Degree.

Mysore
May 1993. Reg.No.M92l2.

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INTRODUCTION

AND

REVIEW OF LITERATURE

"Noise is a useful signal employed in the elevation of Hearing Threshold level or to decrease the intelligibility of speech".

-Audiologist

"Noise is any undesirable acoustic signal"

- Noise control Engineer.

These definitions themselves suggest how differently noise is being viewed by different personnel. It is not necessarily an *evil* always. But in an industrial set-up noise is present as a rules and to listener in a set-up such as that is harmful. Noise is almost certainly the most widespread hazard in the modern industrial environment. the problem of industrial noise seems to be as old as industry itself. Ramazzini (1713) who has been called the "Father of occupational medicine", noted that deafness was an occupational disease of millers and coppersmiths.

Our human ear which is a magnificient sense organ has its own defense mechanism against noise - the acoustic

reflex. However, this reflex has weak points in its defenses. One is that the muscle within the middle ear can become fatigued and alow if over used. In persons who work in an environment with high noise levels, these muscles will gradually lose their strength and thus more noise will reach the inner ear Secondly, these muscles can be affected by chemicals within the, working environment. Finally, the acoustic reflex is a ear-to-brain-to-ear circuit which takes at least nine-thousand ths of a second to perform.

Persons with poor acoustic reflex usually are subjected to temporary hearing loss when they come in contact with a loud noise. But usually complete recovery of hearing takes place, after several hours of being away from the noisy environment. In some cases with time, this temporary shift in threshold may become a permanent hearing loss, often referred to as noiso induced hearing loss. Noise also affects an individual's ability to hear well and discriminate. Articulation scores or intelligibility obtained in the presence of noise given at different levels gives different results. *The* results are depicted in Fig. 1.

ARTICULATION SCORE IN THE PRESENCE
OF NOISE

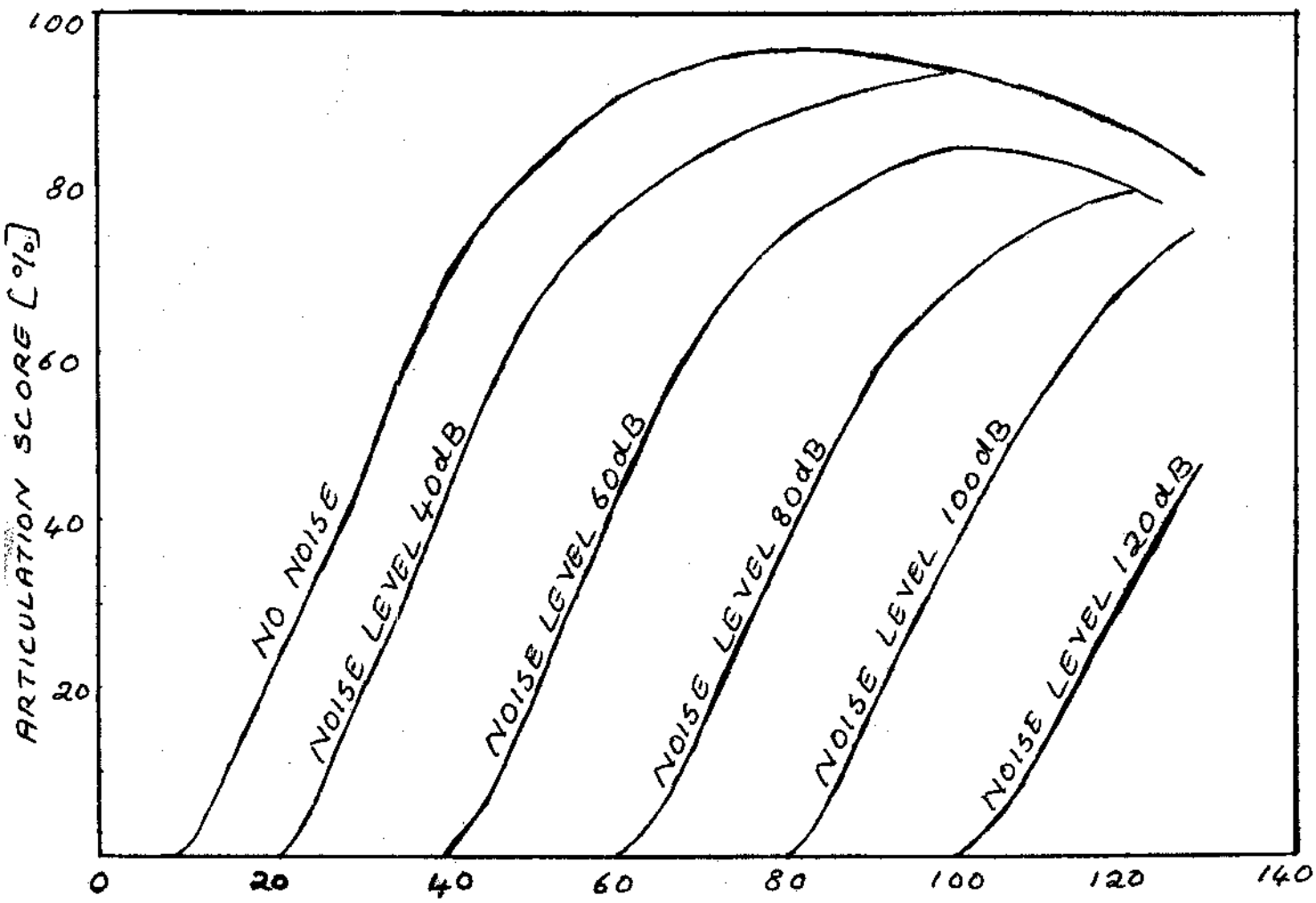

Fig (1)

All these give rise to the need for having hearing conservation program. The primary goal of an industrial hearing conservation program must be the prevention for, at least, limitation) of permanent hearing loss associated with exposure to industrial noise.

control of noise can be done at three levels- at the transmitter level, at the channel level and at the receiver level. But due to many practical problems and out of convenience, the one which is being sorted out most commonly is the third and the last option ie at the receiver level. Here the receiver is the listener, and the use of personal hearing protectors is the best means of noise control at the level of the listener/receiver.

The hearing protective devices also have some effect on auditory communication and this depends upon the frequency and initial intensity of the signal. The attenuation provided by a hearing protestor increases as the frequency increases. Since speech energy predominantly is located at or below 2 KHz, if the acoustic energy is primarily above that frequency, most hearing

protective devices *will* reduce the noise level, more than they will diminish the overall level of the speech, thus, apparently "letting the speech through and catting out the noise".

The below mentioned in the effect which hearing protective devices have on speech discrimination:

1. **Hearing protective devices have little or no effect on the ability of normal hearing listeners to understand speech in moderate background noise 75 dBA, but hearing protective devices begin to decrease speech discrimination as the background noise is decreased further HPD's *will decreases speech* discrimination for hearing-impaired listeners in low to moderate noise situations (Berger).**

2. **At high noiee levels greater er equal to 05 dBA hearing protective device actually improve speech discrimination for normal hearing listeners.**

Certain values are obtained based on the Insta-mold hearing protectors which were fitted around the first bend of the ear canal and coated twice with insta-seal koater.

TABLE 1:

Table showing mean attenuation a*nd* *Standard deviation of insta mold using manual and syringeable precedures.*

TABLE:1

INSTA MOLD D MANUAL PROCEDURE

Frequency(Hz)	125	250	500	1000	-2000	3000	4000	6OOO	8OOO
MaenAttenuation	30.50	31.4	35.3	37.5	39.3	45.5	47.48	46	45.5
S.D.	2.14	2.83	2.24	2.23	2.34	2.34	3.04	3.1	3.21

NRR-31

INSTSA MOLD D SYRINGEABLE PROCEDURE

MeanAttmuation	36.4	36.9	40.2	38.5	43. 9	48	52	45.5	48
S.D.	2	2.15	2.25	2.2	1.5	4	3.1	3.25	2.55

NRR-32

There are *many* varieties of ear protective devices which are available now in the market. The most common among these are the ear muffs, ear plugs and helmets. Among these, ear plugs, are more commonly used because of reasons as simple as of being less conspicuous, comfortable and less expensive compared to the other types. Ear plugs can be of many types namely -

- Premolded ear plugs
- Fomable ear plugs
- Custom molded ear plugs etc.

Custom molded ear plugs can otherwise be mentioned also as user specific ie they are "customised". They are most often manufactured from two part curable silicone putties, although some are available in vinyl. The silicones are either cured by the fitter using a catalyst at the time the impression is taken, or are returned to the supplier for manufacturing. The materials consistency can vary from that of thick syrup to soft putty. After mixing with the curing agent they are either hand packed into the ear canal by molding it late the shape of a cone, or placed is a large syringe and injected into the ear canal.

The present study aims at comparing the transmission lose that can be obtained using ear plugs made out of hand packed method and syringing.

METHODOLOGY

The Methodology for the present study is discussed under the following:

1. Subjects
2. Equipment used
3. Test environment
4. Test stimuli
5. Procedure.

Subjects: six subjects (3 males and 3 f males) ranging in age from 20-23 years (with a mean age of 22 years) volunteered. Their hearing was within normal limits as tested using an audiometer.

Equipment used: A calibrated Grason Stadler-16 (GSI-16) with its accessory, and loud-speakers were used for the purpose of carrying out the test. It was a dual-channel audiometer with stimuli ranging from 25O Hz to 6000 Hz.

Test Environment: The testing was carried out in a two-room situation, test-cum-control room combination in which the ambient noise levels were within permissible limits. The test environment met with the standards specified for the same. The noise levels in the test room/environment was within permissible limits (ANSI s_3-6-l969).

Test stimuli: The stimuli used were:

1. Frequency modulated tone (250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 4OOO Hz, 6OOO Hz).
2. Narrow band noise with frequencies centered at 250 Hz, 500 Hz, 1OOO Hz, 2OOO Hz, 4000 Hz, 6000 Hz .
3. White noise
4. Spondees in English (Swarnalatha)
5. P.B. word list in English (Swarnalatha).

Procedure:

*1) S*tep-I: Preparation of ear plugs.

The ears of the subjects were inspected and any case of ear discharge, ear infection, wax were ruled out. The ear plugs were then made using the material "PROVISIL" which *was* silicon based and it had been refrigerated. The base and the catalyst were thoroughly hand-mixed in recommended proportion. This was then packed into the cotton - blocked external ear. Fig. 2 depicts the procedure.

The ear plugs were made for both the ears using hand-pack method. Another pair of ear plugs were then taken using a syringe instead of a hand pack with all the other details being the same.

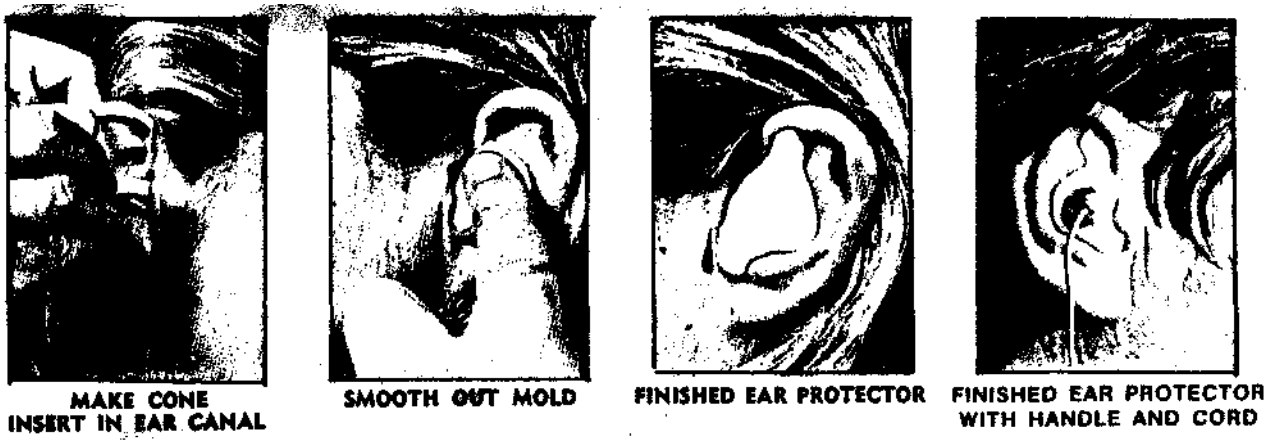
MAKE CONE
INSERT IN EAR CANAL
SMOOTH OUT MOLD
FINISHED EAR PROTECTOR
FINISHED EAR PROTECTOR
WITH HANDLE AND CORD

FIG : 2

These were then cut and trimmed to give an appropriate shape.

ii) Step-II: Testing

For the purpose of establishing, thresholds the subjects were made to sit at a distance of 1 meter from the loudspeaker with the ears at an angle of O^o from the loudspeaker. The subjects were instructed to raise their finger for even the softest sound. Modified Hughson-Westlake procedure was used.

The stimuli were presented in an ascending manner across the frequencies (ie. 25O Hz - 6000 Hz) in steps as mentioned earlier. The thresholds were noted down. The speech reception threshold was measured by presenting spondees in English. The criteria for assessing SRT was 75% correct responses at threshold level. The bracketting method was used with 1O dB ascending 15 dB descending increments. The speech discrimination score was measured using PB word list in English.

These values were later cowpared with those obtained under wearing oar plugs made using tooth means ie hand pack and syringing, measured in the seme manner.

RESULTS AND DISCUSSION

The present study eas aimed at comparing the transmission less that can be obtained using ear plugs made of hand pack sad syringe.

For this a total of six subjects wars takes and ear plugs were made using both methods ie, hand packing and syringing for both ears. The data was then obtained using these custom molded ear plugs.

The data obtained was subjected to WILCOXON MATCHED PAIRS TEST (SKIGKL). The results obtained showed that:(l) There is a significant improvement in the attenuation provided using the syringed oar plugs for all values of stimulus except for frequency modulated tone at 250 Hz and 5OO Hz at O.O5 level.

The results are summarized in Table-2.

ATTENUATION PROVIDED FOR, FREQUENCY MODULATED TONE

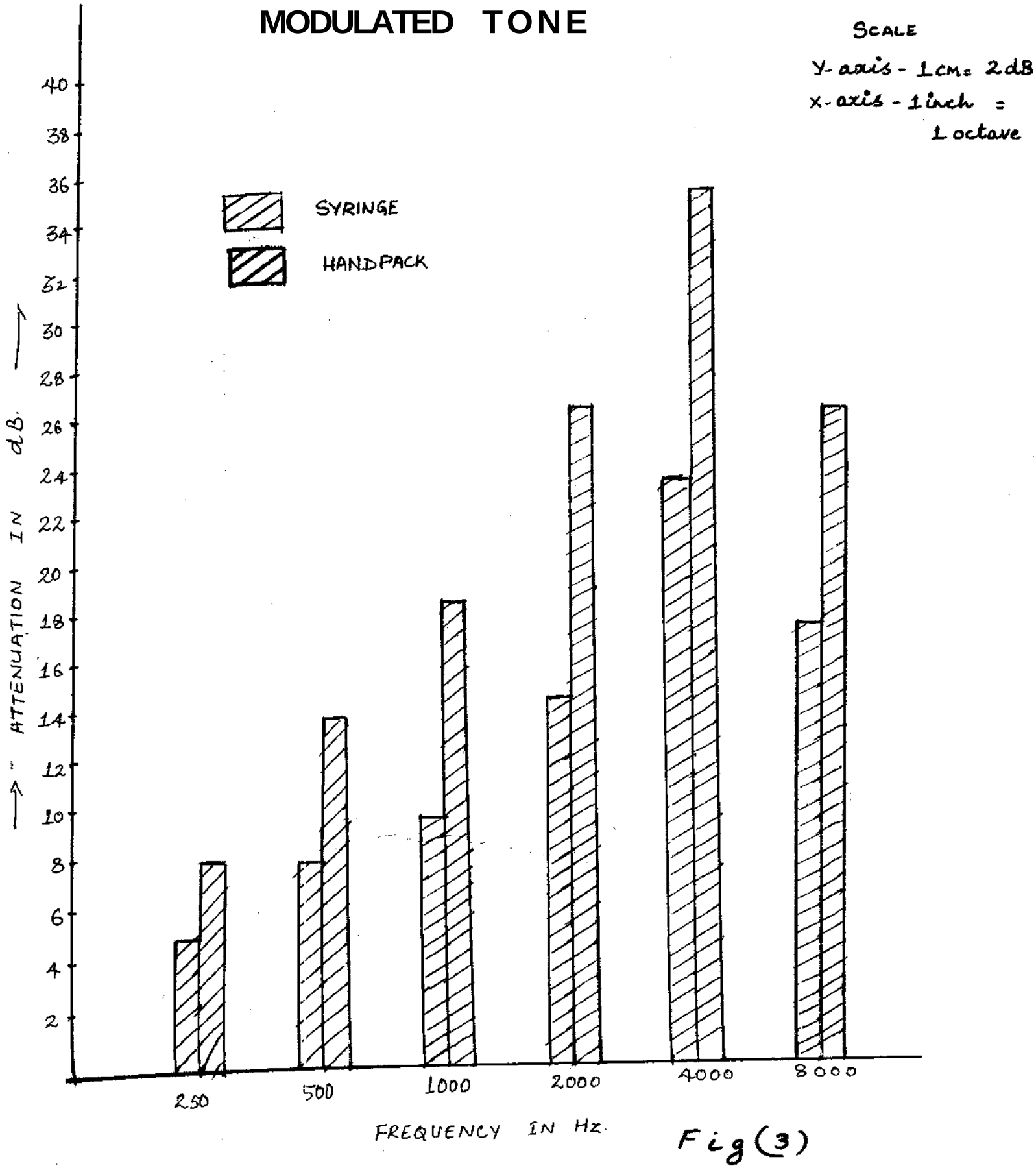

Fig (3)

ATTENUATION PROVIDED FOR NARROW BAND NOISE

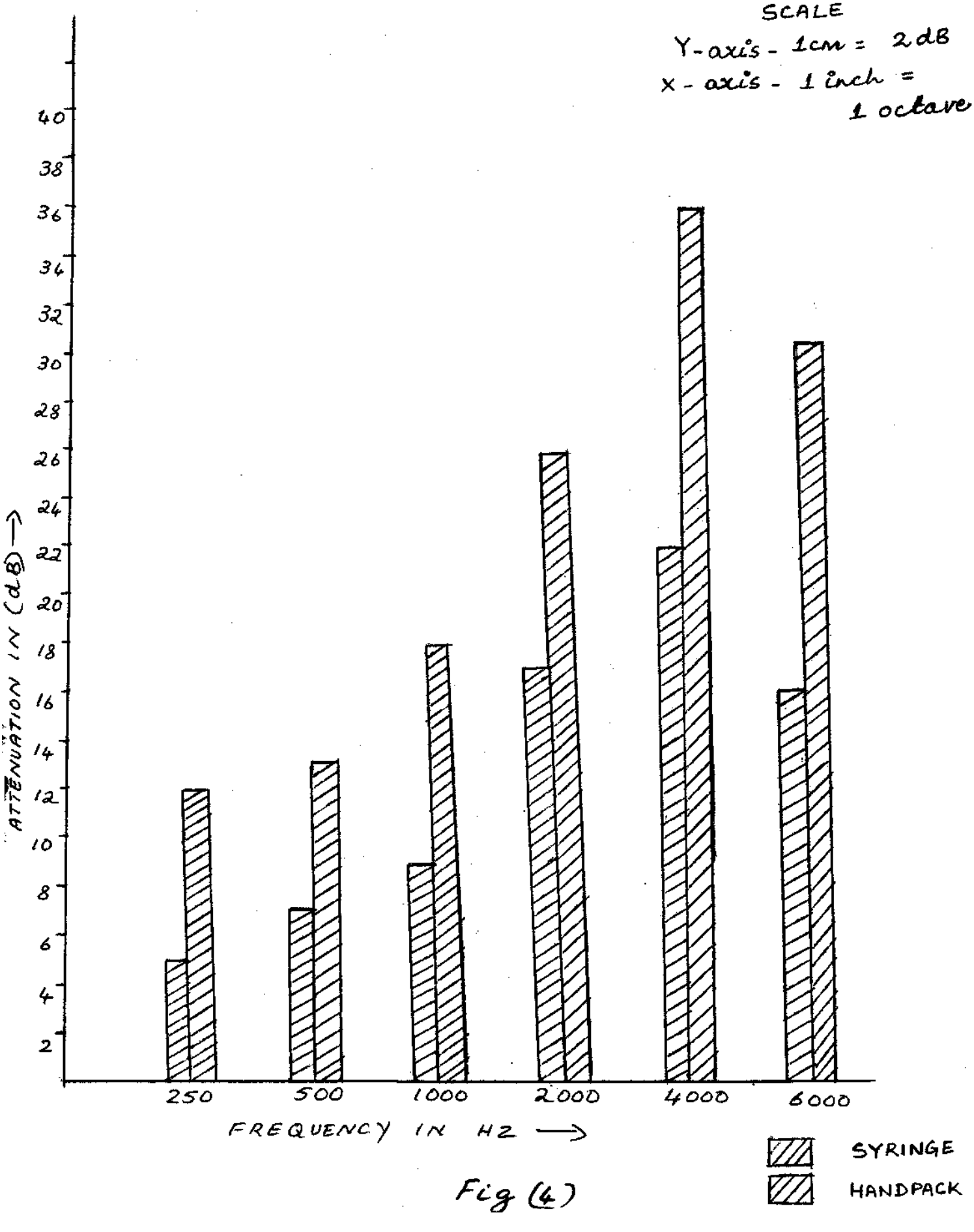

Fig (4)

ATTENUATION PROVIDED FDR WHITE NOISE

scale

Y-axis - 1cm = 2dB

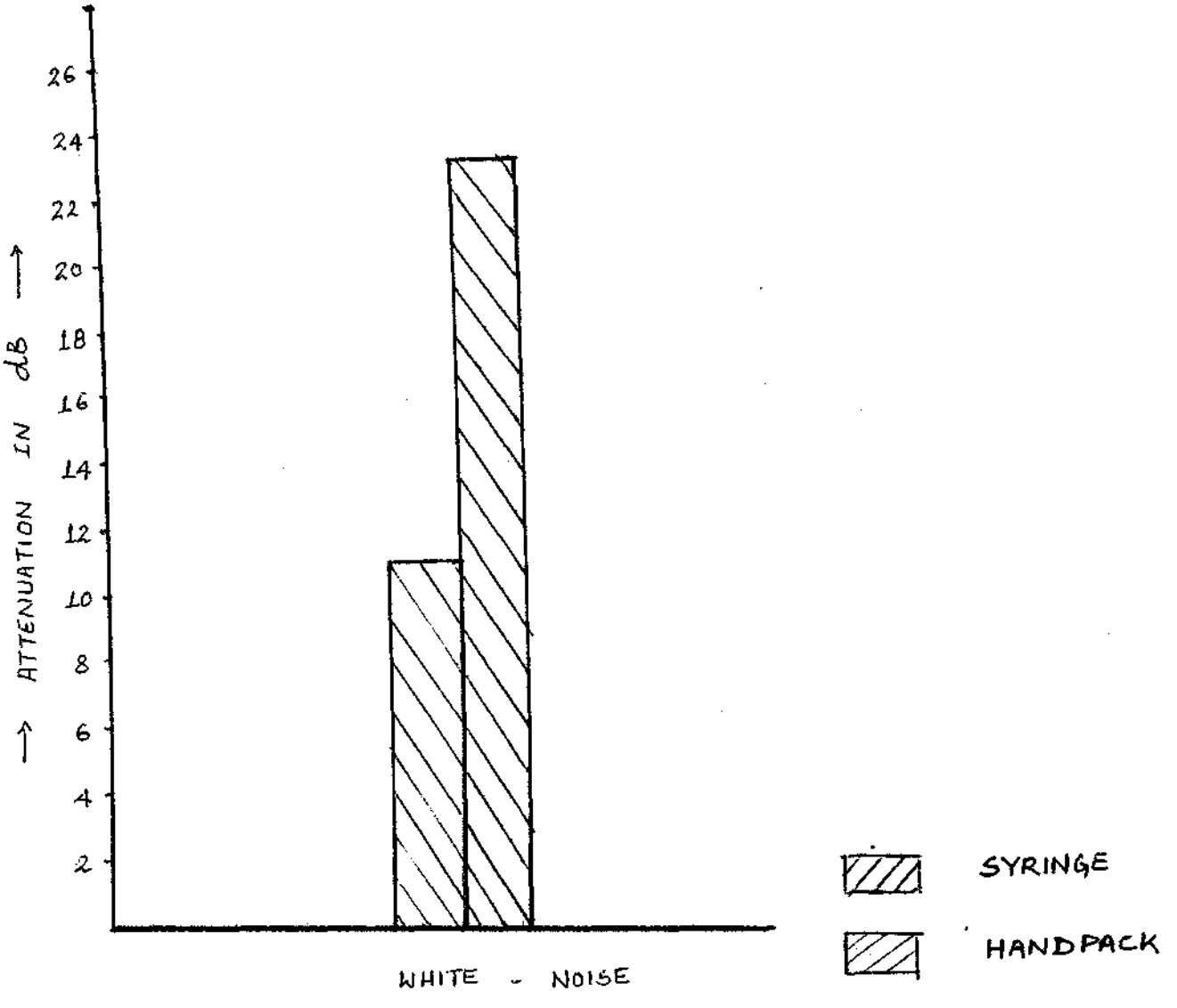

Fig (5)

Table-2: Showing significant differences using WILCOXON MATCHED PAIRS TEST and PAIRED 't' TEST.

Variables	Significant Difference using Wilcoxon Matched pairs test	Significant Difference using paired 't' test.
White noise	+ at 0.05 level	+ at 0.05 level
Narrow band noise		
250 Hz	+ "	+ "
500 Hz	+ "	+ "
1000 Hz	+ "	+ "
2000 Hz	+ "	+ "
4000 Hz	+ "	+ "
6000 Hz	+ "	+ "
F-M tone	+ "	+ "
250 Hz	+ "	+ "
500 Hz	+ "	+ "
1000 Hz	+ "	+ "
2000 Hz	+ "	+ "
4000 Hz	+ "	+ "
6000 Hz	+ "	+ "
SRT	+ "	+ "

• - Significant difference

- - No significant difference

(2) The results also showed that the amount of attenuation provided by the ear plugs made using either method was

significantly higher for the higher frequencies (2000 Hz, 4000 Hz, 6COO Hz) as compared to lower frequencies (25O Hz, 5OO Hz, 1000 Hz) at 0.05 and 0.01 levels (SEIGEL).

(3) There is a significant improvement in the speech reception threshold obtainof using syringing method at 0.05 level.

The data was also analysed using paired 't' test (GARRETT). The results obtained revealed the following:

1. There is a significant improvement in the attenuation provided using the syringed ear plugs for all types of stimuli at 0.05 level.

2. The amount of attenuation provided by the ear plugs made using the two methods was significantly higher for the higher frequencies (2000 Hz, 4000 Hz, 6COO Hz) as compared to lower frequencies (250Hz, 500 Hz, 1000 Hz) at O.O5 and 0.01 levels.

3. There is a significant improvement in the SRT obtained using syringing method at both 0.05 and 0.01 levels.

All subjects were able to get 100% discrimination scores at 40 dB above SRT.

This leads support to Berger's study which states that hearing protective devices have little or no effect. On the ability of normal hearing listeners to understand speech in moderate background noise 75 dB A.

The results revealed that attenuation varied according to the method used for the preparation of ear plugs. The ear plugs made using syringing method gave a significantly better attenuation as compared to that made using hand packing.

But among these white noise, and narrow band noise at all frequencies (25O Hz, 500 Hz, 1OOO Hz, 20O0 Hz, 4000 Hz, 6000 HZ) were attenuated better as compared to the frequency modulated tones. All the ear plugs attenuated higher frequencies better as compared to lower f requencies .Speech signal also was attenuated better by the oar plug made of syringe technique.

the superior effectiveness of the syringed ear plug in attenuating the signal can be attributed to the more precise and accurate filling of the external ear while making ear plug.

SUMMARY AND *COSCLUSION*

Noise is believed to be one of the most widespread hazards in the modern industrial environment. Our human ear which is a magnificient sense organ, has its own defense mechanism against noise, sat this is not sufficient to deal with the hazards of industrial noise. For this we have to opt other means like ear protective devices.

The present study investigated the effectiveness of syringed out ear plugs over hand packed ones.

The results can be summarized us follows:

1. Ear plugs made by syringing are better attenuators as compared to those made by hand packing.
2. The attenuation provided by ear plugs is greater for higher frequencies than for lower frequencies.

Based on these, we can come to the conclusion that syringes out ear plugs are better attenuators than hand packed ones.

BIBLIOGRAPHY

Berger, E.H., E.A.R. Log (3).

Cheromisinoff, *P.N.* , Cheromisinoff, p.p. (1978): Industrial Noise control hand book. Ann Arbor Science Publishers, Michigan.

Garrett, H.E., Woodworth, R.S. (1966): Statistics in Psychology and Education. Vakils, Feffer and Simons Ltd. , Bombay.

Lipscomb, D.M., ed. (1988): Hearing conservation in industry, schools and the military. Taylor and Francis, London.

Seigel, S:(19): Non-parametric statistics for the behavioral sciences. McGraw-Hill Kogakusha Ltd. Tokyo.

S3-6-1969 (ANSI): American National Standard Specification for Audiometers. American National Standards Institute, Inc, New York.

Swamalatha, K.C. (1972): Development and standardization of speech test material in English for Indians. An unpublishad Dissertation submited to the University of Mysore.