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## SENSATION OF LOW FREQUENCY NOISE OF DEAF PERSONS

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### INTRODUCTION

It is said that low frequency noise (LFN) is felt by the ear and by the body also. LFN of high sound pressure level causes a person to feel nausea like seasickness. In this study the subjects are all deaf persons and their hearing losses are over 90dB. The deaf persons' thresholds of sensation of LFN are measured and compared to the thresholds of hearing of ordinary persons, and the sensory organs of LFN in ordinary person with normal hearing are studied.

### MEASURING APPARATUS

As shown in Fig.1, a low frequency chamber is made of concrete blocks 15cm wide and a loudspeaker of 76cm $\phi$  is attached to the top of the chamber. A door is made of a veneer of 24mm wide. The total weight of the chamber is about 3 tons. The harmonics of LFN in the chamber were measured by a FFT analyzer and there was no problem that the harmonics can be heard by the subjects.

### EXPERIMENTAL METHOD

LFN is emitted from a loudspeaker with a sine oscillator and a DC amplifier. The deaf subject sits in the low frequency chamber and the sound pressure level of LFN is increased gradually. When the deaf subject has some

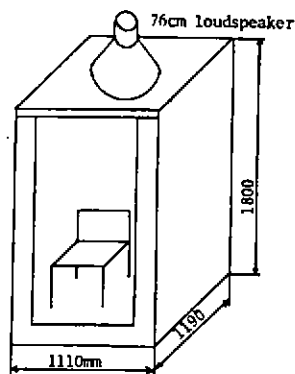


Fig.1 Low frequency chamber

feeling on any place of the body (for example on the ear or breast etc.), the subject presses a button and that is the threshold of sensation. Many of the subjects were born deaf or became deaf in infancy as a result of high fevers. Balance tests, in which subjects stand on one leg and with closed eyes, were done and they could stand. It is concluded that Many have normal semi-circular canals. All the 13 subjects were 20-40 years old.

#### VIBRATION IN LOW FREQUENCY CHAMBER

Vertical acceleration level (re  $10^{-5} \text{m/s}^2$  rms) on the floor and chair in the low frequency chamber was measured. Acceleration level on the floor is very small and there is no possibility that not the LFN but the vibration is detected by the subject. But there is the possibility that the vibration is detected with LFN of 8Hz 130dB. For investigating the influence of vibration, the thresholds of LFN of two deaf subjects were measured standing on the floor and sitting on the chair in the chamber. As shown in Fig.2 and 3, the threshold differences of the two conditions are very small and later all the thresholds are measured sitting on the chair to avoid fatigue.

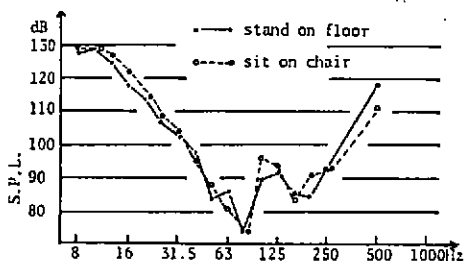


Fig.2 Threshold of sensation of LFN of a deaf person (male, 33 years old)

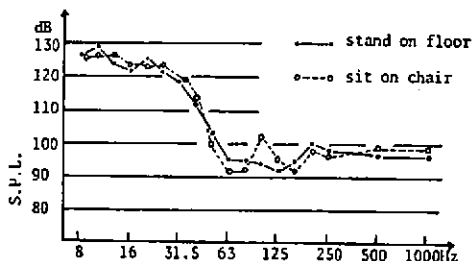


Fig.3 Threshold of sensation of LFN of a deaf person (female, 29 years old)

#### SENSORY ORGANS AND THRESHOLDS OF SENSATION OF LFN

The thresholds of sensation of 13 deaf persons and the thresholds of hearing of ordinary persons with normal hearing are shown in Fig.4. The two threshold curves resemble each other at the low frequency region below 100Hz but the difference of the two values are 30-40dB. There are minimal values at 63Hz and 160Hz in the thresholds of deaf

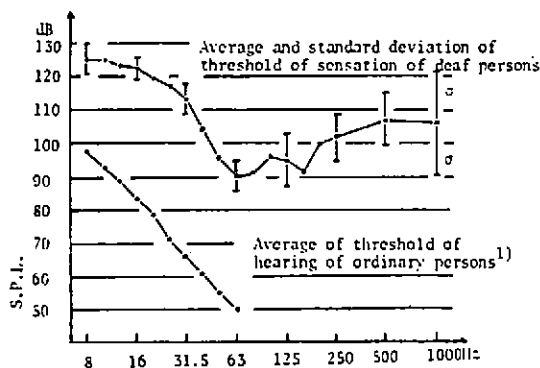


Fig.4 Average and standard deviation of threshold of sensation, 13 deaf persons and average of threshold of hearing of ordinary persons<sup>1)</sup>.

persons. The minimal value at 63Hz may show the resonance of the breast, but that of 160Hz is unknown.

Tab.1 shows the main parts of sensation of deaf persons. The sound over 250Hz are detected by the ear like the ordinary sound but sounds below 160Hz are detected by a feeling of vibration in the breast.

Hz	Main sensed part	Hz	Main sensed part
8	ear, breast, buttock	63	breast
10	abdomen, breast	80	breast
12.5	breast	100	breast
16	breast	125	breast
20	breast	160	breast
25	breast	200	leg
31.5	breast	250	ear
40	breast	500	ear
50	breast	1000	ear

Tab.1 Main sensed parts of LFN of deaf persons.

## CONCLUSION

(1) The difference between deaf subjects and ordinary persons with normal hearing is only in the cochleas and auditory pathways. As the difference causes the threshold difference of 30~40dB at the threshold values, the ordinary person hears, and feels the LFN with the cochlea at the level of LFN pollution. The sensory organ of the ordinary person is mainly the cochleas.

(2) Deaf subjects have regular semicircular canals but the thresholds are not small. So semicircular canals are not sensory organs of LFN at the levels of LFN pollution. Sometimes LFN causes a person to feel nausea. But the nausea may occur not from the vibration of semicircular canals but from the passage through the auditory path, brain, autonomic nervous systems and stomach.

(3) Deaf persons detect LFN by the vibration feelings of vibration and ordinary persons can detect LFN at high levels in parts of the bodies other than the ears.

#### Literature

1) S.YAMADA et al., Hearing of low frequency sound and influence on human body, Conference on low frequency noise and hearing, 7-9 May 1980 at Aalborg, Denmark.

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