A Study of the Impulse Noise for the Protecting Earplug Performance

SungHak Chung and HyoSeok Yun

Agency for Defense Development
35-5 YuSeong Post-Office
YuSeong, DaeJeon, 305-301, KOREA

ABSTRACT

The objective of this study is the frequency of the noise source 170 dB level of impulse noise attenuation performance by earplugs to identify, to analyze the frequency characteristics of a shape and pattern. The impulse noise of the frequency earplug in order to analyze the impulsive noise attenuation performance for the analysis of the noise source equipment was built. In order to check the noise attenuation performance and noise attenuation performance Ear simulator production was verified. Previous studies have most transportation and public noise, even in the noise source for sound levels were 140 dB, but this study is higher than that of the impulsive noise source features. The result of the impulsive noise attenuation effect is frequency-dependent mean 28.58 dB.

Keywords: Impulsive Noise, Frequency, Earplug, Noise Reduction

INTRODUCTION

Noise is caused by physical phenomena among the people offended by the sound means. Shock pulse for the feel unlike normal wave, impulsive noise is high energy, short duration of the features. Impulsive noise such as a strong impact wave is accompanied by Missiles launched, rockets injected or fired, which leads to the operator may be exposed to a dangerous situation. Thus, the operator is exposed to impulsive noise for the first hearing protection must be worn earplugs. In this study, the public earplugs readily available in the market to select the maximum peak sound pressure of 170 dB or more rocket motor insulation against impulsive noise performance experiment sought to prove.

In the introduction, the purpose of this paper is to background and objective. In the Chapter 2, the impulse noise protected insulation performance of the earplugs. And literature review and case studies were described. Chapter 3 describes the experimental method for impulsive noise measurement proposed, And, B & K HATS (Bruel & Kjaer Head and Torso Simulator) tested on the noise insulation performance of impulsive noise. This study is the indoor-impulsive noise and noise insulation performance characteristics of the reflecting the impulsive noise attenuation for the indoor by suggesting contribute to the selection of earplugs.

IMPULSIVE NOISE PERFORMANCE OF THE EARPLUGS

Impulsive noise research on the performance of the earplugs can’t be found in Korea, but EU and America international researches about this issue have been actively studied. Patterson as the some of the case studies used in a wide variety of military protective equipment, hearing the sound insulation performance of every targets were analyzed by Matti et al. Defined with respect to a wide range of canvas with protective equipment for each source of noise attenuation have studied. Buck K. researched the ANR (Active Noise Reduction) for electrical protective equipment, and used to offset the noise attenuation analysis for the case studies. Impulsive noise generated in the confined space about the dangers of human bodies and ergonomics studies are performed by Richard Price.

EXPERIMENTAL DESIGN

This study used in measured by 3M Foam Earplug 1110 Corded (Product Code: 0-51138-29009-7, NSN: 50051138-2900907) and Ultra-fit Earplug (Product Code: 370-1000, NSN: 6515-01-466-2710). In case of the operator has to wear the hearing protection devices to find out the noise insulation performance, the experiments were carried out by the B&K HATS. Result of the B&K HATS are expected in the noise insulation performance did not come out did not get it closed. And it was confirmed that the condition is not perfect. B&K HATS used for the performance test for continuous noise and impulse noise, in order for the impulsive noise experiments is required for head and torso simulator. Thus, the noise insulation performance of earplugs to ensure an accurate decided to use the simulator was followed by a commercially available simulator followed by less than the limit of 170 dB sound pressure produced by the simulator, but then followed by a direct experiment was conducted. Following the simulator used in sound pressure sensor is the B & K 4944A.

This sensor of the Maximum Sound Pressure is used up to 182 dB sound pressure level can be measured. When measured by the data collection rate was 100,000 Hz. The position of the all sound pressure sensor 120 height from the floor and the sound pressure sensor is installed and windshield-like noise due to the effects of wind minimized.

RESULT

Figure 1 is followed by the noise insulation performance of the B&K HATS.

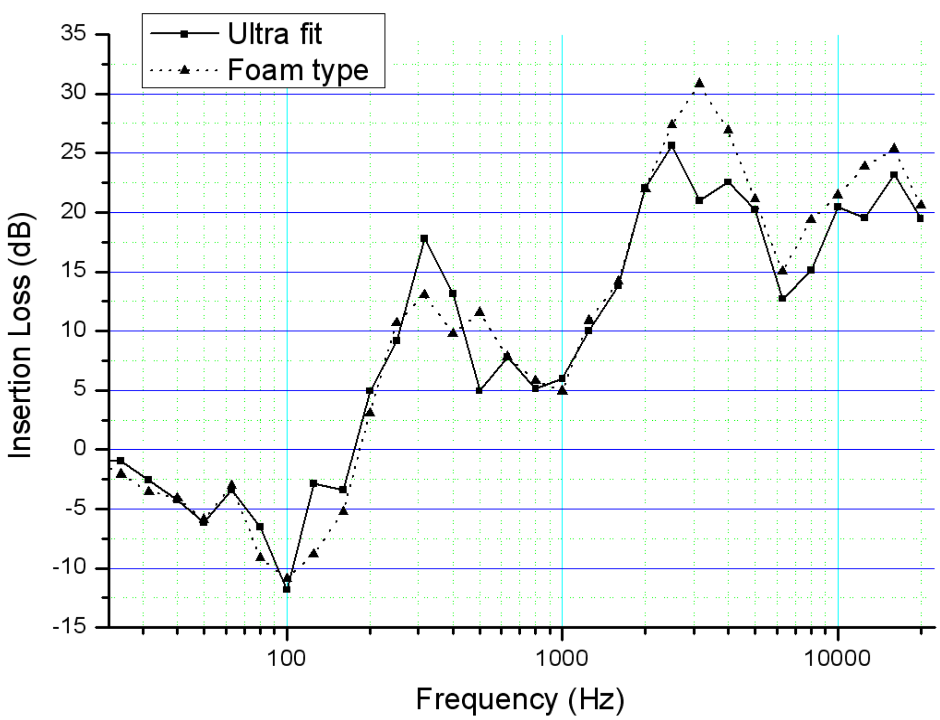

Figure 1 Attenuation effects of Bruel & Kjaer Head and Torso Simulator

Figure 2 shows a measurement with and have the proper pattern when the B & K HATS shows the results measured by using the measurement is very similar to the good fit vs. poor fit. Beyond 500 Hz sound pressure on Figure 2 is increased in the same area of the data pattern.

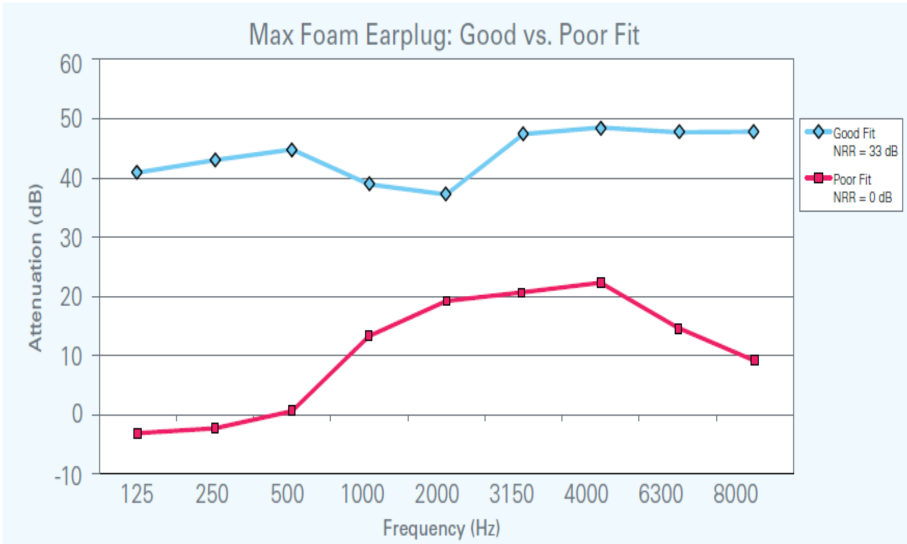

Figure 2 Attenuation of the Earplug : Good vs. Poor Fit

Looking to analyze the cause for this result, the currently used commercially available inner diameter of the head model of the ear canal is 1/4" and the inside of the 1/4" is a microphone. The inner diameter of the ear canal due to the small ear canal earplugs if you are installing the break occurs is not yet fully in contact with the path of the sound is transmitted considered. However, even if the sound pressure level is low, such as anechoic conditions, the gap is not large, because the sound can be reduced accordingly, but as the impulsive noise pressure level of the noise and large gaps in these strong impulsive noise is more easily transmitted due to the spreading effect is analyzed in. Therefore reduce the gap similar to the actual internal structure of the ear to modify the size of the ear canal and the B&K HATS for the evaluation saw production. Following the noise insulation performance results using the Ear Simulator is shown in Figure 3.

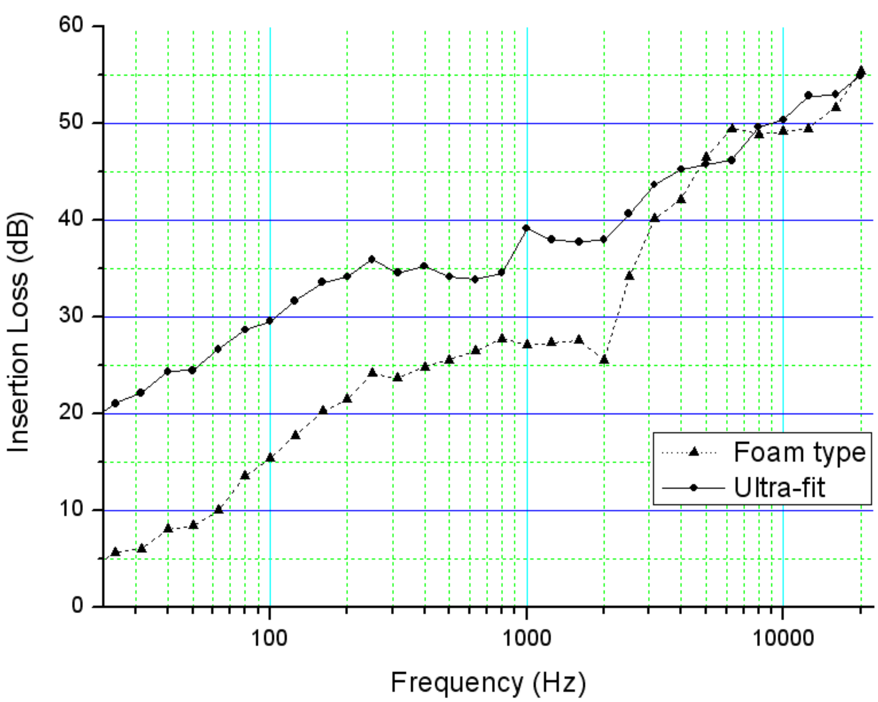

Figure 3 Attenuation effects of the Ear Simulator

Measurement protocol were made under completely sealed, and the result of the impulsive noise insulation performance of the 3M Foam 1110 corded ear plug is the average 26.7247 dB (± 14.3935) and, Ultra-fit of the average 28.5809 dB (± 13.3139) was shown. These results also shown that, statistical analysis of the two types of the noise insulation performance is significant difference (P<0.01). Ear Simulator analyzed the noise insulation performance. Pair T-Test result was shown in Table 1.

Table 1 : Attenuation Result of Pair T-test for Ear Simulator

Earplug Type	Original Sound - 3MFoam1110	Original Sound - Ultrafit	3MFoam1110 - Ultrafit
Average	26.7247	28.5809	1.8561
SD	14.3935	13.3139	5.8778
Ave. of SE	0.4249	0.3931	0.1735
T value	62.882	72.703	10.695
DF	1146	1146	1146
P value	0.000	0.000	0.000

CONCLUSIONS

This study checked for the impulse noise insulation performance. First test was not for the completely sealed, but implementation of human-like shape using the B&K HATS data patterned did not. The result of the initial test is not achieved. Followed after the implementation of fully enclosed making the simulator was to determine the noise insulation performance of the ear plugs was appropriate. Results of the impulsive noise insulation performance of earplugs were made under completely sealed and could know how much.

Earplug and a negative pressure generated in the sealed space between the sensor 200 Hz or less to avoid the frequency a more accurate test environment to improve the frequency characteristic would be able to identify. High-frequency bands above 1 kHz for all protective gear to make sure that good performance can be seen, increasing the low-frequency band can be seen Degraded. 200 of 1,000 Hz hearing protection equipment in the low frequency region from 5 to 18 dB of noise insulation effect showed. 200 Hz sound pressure level rather than by the frequency increased. The analysis of the cause, attributed to the earplug and Bruel & Kjaer Head and Torso Simulator confined space between the sound pressures sensors are formed in this space continues to impulse low-frequency wave, the reverberation of sound pressure level is likely to be because increased. For a full hearing protective equipment attenuates the sound pressure level is presented in Figure 3. This result is to be used as one indicator is determined to not crowd. The results of this study, peak sound pressure level of the entire sound pressure level are verified for the case of severe side, but the advantage that seems to be consistent. The maximum sound pressure level is increased in order to determine the cause that the measured time potted pressure FFT data to the 1/3 octave band sound pressure represented by the area statistical analysis, the sound pressure is increased in the frequency domain, all showed a 100 Hz or less in particular increases sharply at low frequency difference was confirmed.

In this study when compared with previous studies impulsive noise source level of 140 dB, even the most high-impulsive source of noise is the noise source, but rather that the impulse of a higher level features. The frequency of the noise insulation effects of impulsive noise by an average of 28.58 dB. These findings have future indoor-impulsive noise for insulation performance indicators that reflect the on-site management will likely be utilized.

REFERENCES

Buck K. (2000), "Performance of Hearing Protectors in Impulse Noise", RTO HFM Lecture Series

Hard Leight Lab (2008), "Assessing Fit Effectiveness of Earplugs", Hard Leight Acoustical Laboratory, pp.1-7.

Matti E Ylikoski, Jussi O Pekkarinen, (1995), "Physical Characteristics of Gunfire Impulse Noise and Its Attenuation by Hearing Protectors", Scand Adiol, No. 24, pp.3-11.

Patterson J. H., and Johnson D. L. (1994), "Temporary Threshold Shifts Produced by High Intensity Freefield Impulse Niose in Humans Wearing Hearing Protection", USAARL Report No. 94-46.

Price G. Richard (1991), "Firing Recoilless Weapons from Enclosures", Technical Memorandum 20-91, U.S. Army Human Engineering Laboratory, Aberdeen Proving Ground, MD, pp.39-48.

Price G. Richard (1978), "Firing from Enclosures with 90mm Recoilless Rifle : Assessment of Acoustic Hazard", Technical Memorandum 11-78, U.S. Army Human Engineering Laboratory, Aberdeen Proving Ground, MD, pp.1-14.