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김규상 · 김형렬¹⁾ · 노재훈^{1)‡}

1)

Ambient Noise Levels in Industrial Audiometric Testing Areas: Compliance with Industry Standards

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The ambient noise levels in the test rooms affect the workers's hearing threshold. The present study was designed to assess the ambient noise levels in the industrial audiometric testing areas to determine if valid hearing tests could be performed in these environments.

The ambient noise levels were measured in 141 audiometric testing areas across 47 industries located in Incheon. These results compared with the ANSI S3.1-1999 and OSHA criteria for maximum permissible ambient noise levels.

The ambient noise SPLs were highest in the lower frequencies, and this decreased as the frequency increased.

For the supraaural earphone, none of the rooms met the ANSI standard. Comparing the room data with the OSHA standard, compliance levels were achieved as follows: 0(0%) at 500 Hz, 4 (2.8%) at 1000 Hz, 27 (19.1%) at 2000 Hz, 134 (95.0%) at 4000 Hz, and 141 (100%) at 8000 Hz.

The results of this study strongly indicate that clinical audiometry is being conducted in test rooms having unacceptable or excessive ambient noise levels.

Key Words: Ambient noise, Industrial audiometry, Standards . Hearing

I. 서 론

가 가 . 2 1
가 가 . 1

가

가 가

: 2004 11 22 , : 2004 12 27

‡ : (134

Tel : 02-361-5354, E-mail : jhroh@yumc.yonsei.ac.kr

(Lankford
Hopkins, 2000) 1
(Wong, 2003)
(, 2004)
0 dB HL 가
1000 Hz
1
가
()

(Occupational
Safety and Health Administration)
(OSHA, 1996)
1960 (American 가
National Standards Institute, ANSI)
(Maximum Permissible
Ambient Noise Levels, MPANLs)

10
dB HL
0 dB HL 가

ANSI (ANSI
S3.1-1999)(ANSI, 1999)

0 dB HL 가

ANSI S3.1-1999 47

(Frank 3
Williams, 1994)

(Lankford
Hopkins, 2000) 1
(Wong, 2003)
(, 2004)
0 dB HL 가
1000 Hz

가

1 ((Occupational Safety and Health Stand-
ards)
(Appendix 2)(OSHA,
1996)

II. 연구 방법

1. 연구 대상

1
()
(1000, 4000 Hz
)
가 . 1 2002
102
(5 dB)
(dB(A)) . 2
2003 11 2004 9

47

가 .

(Frank 3

2. 연구 방법

가

. Bruel & Kjaer
(sound level meter, type 2260)
1.2 m
dB(A)
1/3 125, 250, 500, 800,
1000, 1600, 2000, 3150, 4000, 6300
8000 Hz dB SPL
125, 250, 500,
1000, 2000, 4000 8000 Hz
0 dB HL 가 ANSI
S3.1-1999(ANSI, 1999) 1/3
(Appendix 1)
가 가

(Occupational Safety and Health Stand-
ards)
(Appendix 2)(OSHA,
1996)

III. 연구 결과

1. 청력검사를 시행하는 산업장에서 지시소음계로 간이 측정된 배경소음 수준

94
59.04 dB(A), 6.15
dB(A) . 60 dB(A)
29 (30.9%), 55 dB(A) 26 (27.7%), 65
dB(A) 21 (22.3%), 50 dB(A) 9 (9.6%),
70 dB(A) 4 (4.3%), 45 dB(A) 3 (3.2%),
75 dB(A) 2 (2.1%) 45 dB(A)
75 dB(A) (1, 1).

2. 청력검사를 시행하는 산업장에서 정밀소음계로 측정된 배경소음 수준

Table 1. Ambient noise levels for industrial audiometric testing areas in first investigation

unit : dB(A)

No.	Mean	S.D.	Range
94	59.04	6.15	45 ~ 75

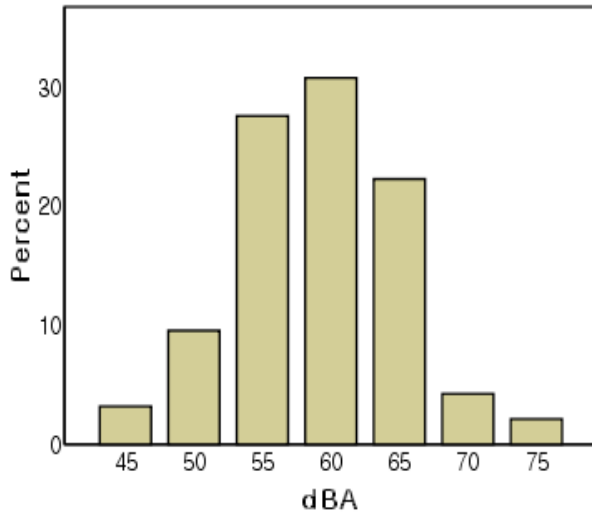


Fig 1. Ambient noise levels for industrial audiometric testing areas in first investigation.

8000 Hz
 , 125 Hz 127
 (90.1%), 250 Hz 1000 Hz
 141 (100%), 2000 Hz 140 (99.3%),
 4000 Hz 134 (95.0%), 8000 Hz
 124 (87.9%)가

, 500 Hz 141 (100%), 1000Hz
 137 (97.2%), 2000 Hz 114
 (80.9%), 4000 Hz 7
 (5.0%)가 , 8000 Hz

, 2000 Hz

4000 Hz
 (2, 2).

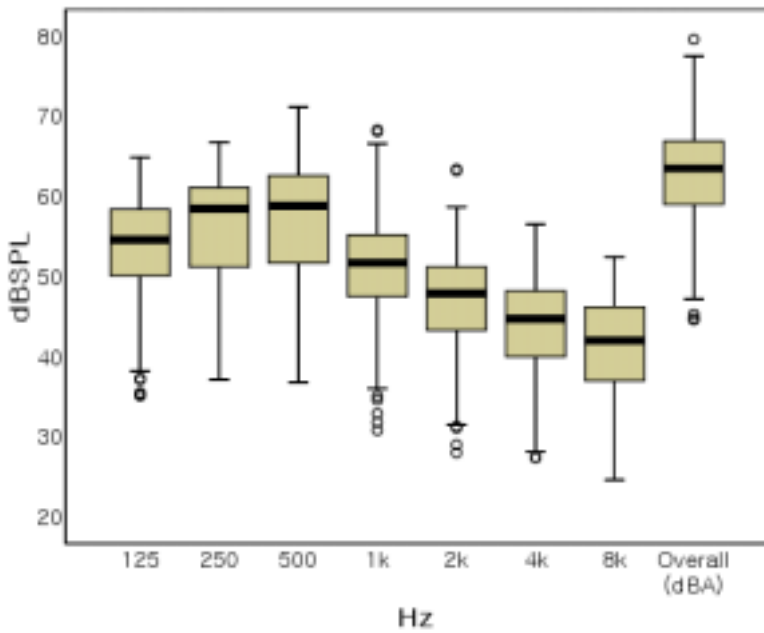
A 62.4 dB(A) (supra-aural earphone)
 79.6 dB(A) (ears covered) 0 dB
 125 Hz HL 가
 8000 Hz (ANSI S3.1-1999, Appendix 1)
 53.8, 56.1, 56.6, 51.0, 46.9, 43.5, 1) 가 500 Hz

3. 산업장의 검사 장소별 배경소음 수준

Table 2. Summary of ambient noise levels for industrial audiometric testing areas in second investigation

Frequency, Hz	Mean	SD	Range	MPANLs, freq.(%)	
				ANSI S3.1-1999	OSHA App. D-1
125	53.8	6.8	35.1~64.9	127(90.1)	
250	56.1	7.1	37.1~66.7	141(100.0)	
500	56.6	8.0	36.8~71.2	141(100.0)	141(100.0)
1000	51.0	7.1	30.8~68.3	141(100.0)	137(97.2)
2000	46.9	6.5	28.0~63.4	140(99.3)	114(80.9)
4000	43.5	6.3	27.4~56.5	134(95.0)	7(5.0)
8000	41.0	6.7	24.6~52.4	124(87.9)	0(0.0)
Overall Octaves*	62.4	7.0	44.6 ~ 79.6	141(100.0)	141(100.0)

MPANL: maximum permissible ambient noise levels
 Unit: sound pressure levels (SPLs), measured on one-third octave band
 * greater than MPANLs at any frequency



5. 총소음량의 크기에 따른 주파수별 배경소음 수준

S3.1-1999
 50 dB(A)
 4000 Hz
 500 Hz
 60 ~ 65 dB(A)
 2000 Hz

(5).

Fig 2. Box plots of ambient noise levels for industrial audiometric testing areas

IV. 고 찰

66.5 dB(A), 60.0 dB(A), 66.5 dB(A)
 4. 각 산업장별 총소음량 음압의 차이에 따른 주파수별 배경소음의 차이

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125 ~ 250 Hz, 500 ~ 4000 Hz, 250 H, 500 Hz, 1000 Hz
 가 (3). (4). 가

Table 3. Ambient noise levels by type of industrial audiometric testing areas

	Type of testing areas*			F	p-value	
	A (69)	B (63)	C (9)			
Frequency, Hz	125	52.2(7.9)	55.7(5.0)	52.9(5.8)	4.75	.010
	250	54.1(7.8)	58.1(5.9)	57.9(6.0)	5.91	.003
	500	54.8(8.2)	58.4(7.5)	58.5(6.5)	3.78	.025
	1000	49.0(7.9)	52.8(5.6)	53.4(6.6)	5.61	.005
	2000	44.4(7.3)	49.2(4.6)	50.2(3.9)	11.70	.000
	4000	41.4(7.0)	45.4(5.0)	45.5(4.0)	7.78	.001
	8000	39.1(7.7)	42.8(5.4)	42.5(3.5)	5.74	.004
	Overall dose(dB(A))	60.0(7.4)	64.5(5.5)	66.5(6.7)	9.44	.000

Unit: sound pressure levels (SPLs), measured on one-third octave band
 * A: Office/conference room, B: Common area room(dining room, auditorium), C: Lounge

Table 4. Ambient noise levels for industrial audiometric testing areas by magnitude of difference between maximum and minimum A-weighted overall doses in the same industries

Frequency, Hz	Difference*			F	p-value
	< 4 dB (15)	4-8 dB (15)	≥ 8 dB (17)		
125	2.3(3.5)	1.1(4.5)	4.8(6.2)	2.33	.109
250	1.4(2.3)	4.7(2.7)	9.4(6.0)	15.28	.000
500	3.6(4.7)	6.5(2.1)	10.8(5.0)	11.83	.000
1000	4.1(4.4)	4.9(2.4)	10.3(5.0)	10.95	.000
2000	3.6(4.2)	3.9(2.1)	6.1(5.8)	1.47	.241
4000	3.1(5.5)	2.5(3.2)	5.7(6.3)	1.75	.185
8000	4.0(6.5)	2.1(4.8)	5.1(7.3)	.93	.402

Unit: sound pressure levels (SPLs), measured on one-third octave band
 * difference between maximum and minimum A-weighted overall dose in the same industry

Table 5. Ambient noise levels for industrial audiometric testing areas by level of A-weighted overall dose

Overall dose, dB(A)	No.	Frequency, Hz						
		125	250	500	1000	2000	4000	8000
≤ 50	9	39.3	40.4	42.2	35.0	31.5	30.9	28.7
50 ~ 55	11	44.5	46.2	45.0	42.3	39.0	35.1	33.1
55 ~ 60	24	52.0	51.1	50.3	46.8	44.8	40.1	39.1
60 ~ 65	44	54.7	57.6	57.8	51.7	47.5	44.6	41.7
65 ~ 70	36	57.3	60.8	61.9	55.0	49.9	47.2	44.4
> 70	17	60.3	64.2	66.4	60.6	55.3	49.2	46.2
OSHA Standards				40	40	47	57	62
ANSI S3.1-1999		44	30	16	21	29	32	32

unit : sound pressure levels (SPLs), measured on one-third octave band

1999 (supra-aural headphone) (ears covered testing) (ears not covered testing) 125 Hz 8000 Hz 250 Hz 8000 Hz 500 Hz (Frank, 2000). (ANSI, 1999). 가 250 8000 500 8000 Hz 125 8000 Hz ANSI ANSI 가

가 125-250 Hz 가 , 가 500 Hz 8000 Hz 125 Hz 10 (8.1%), 250 Hz 29 (23.4%), 500 Hz 45 (36.3%), 1000 Hz 15 (12.1%) 5 dB , 1/1 1/3 (Frank, 2004). 55 (44.4%) (,) 1

ANSI 80 % 4000 Hz
 , 1000-2000 Hz ANSI 5.0%
 500 Hz 8000 Hz ANSI 가
 , 4000 Hz
 2000 Hz 1
 4000 Hz
 1000 Hz 가 1000 Hz 가 가
 1000 Hz 가 , 가 가 1
 2
 , 50 dB(A)
 . ANSI
 가 가 가 S3.1 50 dB(A)
 가 55 dB(A) 1000 Hz 4000 Hz
 가 1000 Hz 가
 가 10 dB 가 , 4000 Hz
 4000 Hz (, 2000). , 4000 Hz
 , 2000 Hz
 가 , 60 ~ 65 dB(A)
 , 1000 Hz 1/3
 가
 1 1/1
 가
 ANSI 1
 . Frank Williams
 (1994) 490
 2
 1000 Hz 30 dB HL,
 , 4000 Hz 40 dB HL 1000 가
 Hz 가 가
 , 20 dB HL 가
 3
 가
 가 ,
 250 Hz, 500 Hz 1000
 (Wong , 2003)
 . 1
 500 Hz 1 59.04 Hz
 44.8 dB, 1000 Hz 41.4 dB, 2000 Hz 38.1 dB(A), 2 62.4 dB(A)
 dB, 4000 Hz 32.7 dB, 8000 Hz 28.1 dB , 2000 Hz

dBHL) 1 ()

, 가 , 2000 Hz 4000 Hz

1 ()

가

1

5 ~ 10 dB

, 4000 Hz

250 H, 500 Hz 1000 Hz

, 1000 Hz

1 () 1000 Hz

V. 결 론

1 ()

(supra-aural earphone)

가

1 94 (5 dB)

2000;4(2):

Audiocup

Audio-Mate

109-16.

(noise reduction

(dB(A))

, 2 47

earphone enclosure)

(Frank , 1997).

가

500 ~ 8000 Hz

3

0 dB HL

가

125 Hz 8000 Hz

ANSI S3.1

가 가

78, 64, 50, 47, 49, 50, 56 dB SPL

1

1

1000 Hz 4000 Hz

2000 Hz

A

62.4 dB(A)

0 dB HL

가

가 가

(1000 Hz 30 dBHL, 4000 Hz 40

REFERENCES

American National Standards Institute. Maximum permissible ambient noise levels for audiometric test rooms. ANSI S3.1-1999, New York: American National Standards Institute, 1999.

Frank T. ANSI update: maximum permissible ambient noise levels for audiometric test rooms. *Am J Audiol* 2000; 9:3-8.

Frank T, Greer AC, Magistro DM. Hearing thresholds, threshold repeatability, and attenuation values for passive noise-reducing earphone enclosures. *Am Ind Hyg Assoc J* 1997;58:772-8.

Frank T, Williams DL. Ambient noise levels

- in industrial audiometric test rooms. *Am Ind Hyg Assoc J* 1994;55:433-7.
- Lankford JE, Hopkins CM. Ambient noise levels in nursing homes: implications for audiometric assessment. *Am J Audiol* 2000;9:30-5.
- Occupational Safety and Health Administration. OSHA regulations (Standards - 29 CFR): Occupational noise exposure. - 1910.95. Appendix D - Audiometric test rooms. OSHA, 1996.
- Wong TW, Yu TS, Chen WQ, Chiu YL, Wong CN, Wong AHS. Agreement between hearing thresholds measured in non-soundproof work environments and a soundproof booth. *Occup Environ Med* 2003;60:667-71.