

中低频噪声下护耳器防护效果的测试与评价

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提 要 用本作者研究的人体客观测试法对国际上几种典型护耳器在佩戴情况下进行的实验室和现场测试表明,耳塞、耳罩在低频段(125Hz, 250Hz)的声衰减均不超过23dB。证实了传统主观测试法在低频段存在4~5dB的生理噪声误差。耳塞在低频段的降噪能力高于耳罩。大容积耳罩的声衰减高于小容积耳罩。耳塞和耳罩同时佩戴所收到的降噪效果比单独使用高6~18dB。该结果表明,低频噪声比高频噪声更难以防护。该结果为进一步防治耳聋和改进护耳器提供依据。

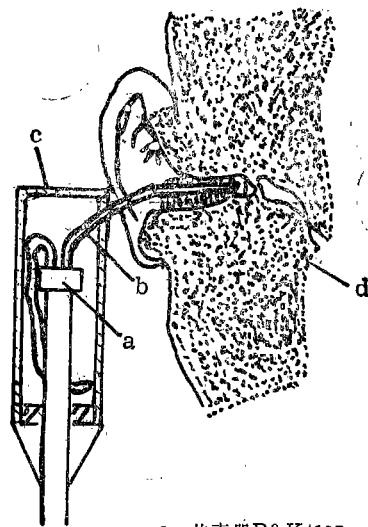
关键词 护耳器 声衰减 听力损失

生产性噪声对人体危害日趋严重。实践证明,最经济有效的个体防护措施是佩戴护耳器^[1]。以往很多情况下,护耳器的防护效果(声衰减dB)是计算各频段的声衰减算术平均值所得。护耳器防护高频噪声的能力大大高于防护低频噪声,这对能量主要分布在低频段的噪声环境来讲,佩戴护耳器并不能将噪声降到预期强度^[2]。因此,对低频噪声环境,应客观测试护耳器佩戴时产生的各频段的声衰减,以利于实施综合降噪措施,促进护耳器改进以及对声源进行噪声控制。该研究是用护耳器声衰减人体客观测试法对国际上典型的护耳器低频段声衰减进行测试和评价,从而搞清护耳器低频段降噪效果,为低频强噪声下的耳聋防治提供依据和实施有效的防护措施。

材料与方法

一、实验室实验

人体客观测试法是用一个 probe 传声器(B&K 4135/WA0378)测鼓膜附近的声压级。probe传声器带有一外径1.5mm,内径为0.8mm的有机树脂软管(以下简称软管)。测试时将该软管穿过E·A·R型耳塞的中心到达鼓膜附近,或将软管置于面颊和耳罩软垫之间到达鼓膜附近(见图1),用另一传声器B&K4136测耳廓附近的噪声强度。耳廓附近声压级减去鼓膜附近声压级的差,再加上耳道对噪声的放大作用,便是耳塞的声衰减^[4]。



a. 传声器B&K4135

b. 有机树脂软管 c. 金属罩 d. 耳塞

图1 插入式传声器的屏蔽和测试安装图

选择听力正常,年龄在25~45岁之间的10名职员作为受试者,实验在芬兰国家职业卫生研究院半消声室内进行。测试时受试者面对声源,声源是由B&K 1405噪声发生器产生的,B&K2706功率放大器放大过的20Hz~20kHz的 100 ± 0.3 dB的白噪声。用B&K2131 1/3倍频程分析仪进行测量分析。

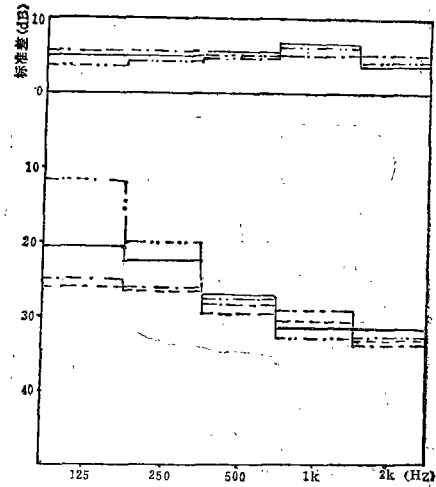
为进行比较,用上述10名受试者对E·A·R耳塞作了主观法测试。实验信号和操作程序按ISO 4869进行^[5]。

二、现场测试

现场测试是在芬兰武装部队105mm加农炮射击情况下进行,测试时受试者离炮位10米左右。传声器的安装和实验室实验相同。

结 果

实验室主观测试法和人体客观测试法所测 E·A·R 型耳塞的声衰减结果列于图 2 中, 图 2 同时列出了 Berger 用主观法对 E·A·R 耳塞和 MK-IR 耳罩声衰减的测量结果^[6]。结果表明, 本作者用主观法所测 E·A·R 的声衰减和 Berger 的声衰减曲线完全一致(差异 < 1.5 dB)。而该实验用人体客观测试法所测 E·A·R 耳塞的声衰减在低频段(125Hz, 250Hz)比主观法所测值低 4~5 dB, 500Hz 以上各频段人体客观测试法和主观测试法的测试结果完全一致。人体客观测试法所测 125Hz 频段的声衰减为 20 dB, 250Hz 时为 23 dB, 500Hz 时为 27 dB, 1kHz 时为 32 dB, 2kHz 时为 32 dB。MK-IR 耳罩的声衰减在 125Hz 时为 13 dB, 250Hz 时为 20 dB, 500Hz~2kHz 时与 E·A·R 耳塞声衰减趋于一致。



— 人体客观测试法; ——— 主观法(ISO4869);
—— Berger 所测结果; - · - · - 为 Berger 所
测耳罩 (MK-IR) 的声衰减结果

图 2 实验室 E·A·R 耳塞声衰减测试结果 (N=10)

现场测试结果见表 1。105mm 加农炮脉冲噪声的 A 持续时间为 3.6 毫秒, 对应的频率

表 1 当 105mm 加农炮射击时护听器内侧和外侧的峰值声压级和标准差及护听器声衰减

护听器	采样次数	声压级 (dB) (护听器以外)	声压级 (dB) (护听器以内)	听力保护 (dB) (噪声衰减)
耳罩 (大容积)	5	154.3 ± 1.8	136.9 ± 2.4	17.4 ± 1.8
耳罩 (小容积)	5	153.0 ± 1.2	145.3 ± 0.7	7.7 ± 1.1
耳塞 (E·A·R)	5	152.2 ± 2.4	134.7 ± 3.0	17.5 ± 1.1
耳塞 + 耳罩 (大容积)	5	154.5 ± 0.4	131.1 ± 2.7	23.4 ± 2.5
耳塞 + 耳罩 (小容积)	5	154.6 ± 0.6	128.8 ± 1.1	25.8 ± 0.9

约为 140Hz。因此现场为低频脉冲噪声。E·A·R 耳塞的声衰减 (17.5 dB) 与大容积耳罩 (Silenda Super) 的声衰减 (17.4 dB) 相近, 大大高于小容积耳罩 (Silenda Mil) 的声衰减 (7.7 dB)。当 E·A·R 耳塞与大容积耳罩同时佩戴时, 其声衰减升为 23.4 dB, 当耳塞与小容积耳罩同时佩戴时其声衰减升为 25.8 dB。

讨 论

从图 2 可以看出, 无论耳罩还是耳塞, 其声衰减都随着频率的增加而增加。这与以往的研究结果是一致的。这说明护听器在低频段所产生的降噪效果远远不如中高频段 (有时可差 20 dB)。因此对低频段应加强防护, 并采取相应的附加措施。该结果也证实了国际上即

使具有强降噪能力的 E·A·R 耳塞和 Silenda Super 耳罩的声衰减, 低频段一般不会超过 23 dB, 现场测试结果 (表 1) 也证实了上述观点。因此当一个低频脉冲噪声峰值声压级超过 165 dB 时, 或低频稳态噪声的 A 声级超过 110 dB 时, 护听器很难将其降到安全限值以下。从图 2 中也看出在低频段主观法所测耳塞声衰减值比人体客观法高 4~5 dB 左右, 这是由于主观法的生理噪声在低频段对护听器的声衰减有 4~5 dB 的过高估价^[3]。再加上实验室主观测试时的佩戴方式 (耳塞的深浅和耳罩的尺寸等) 比实际应用现场优越的多, 过高估价常达十几分贝。这种过高评价干扰了人们对噪声对人体危害程度的判断, 大大增加了产生耳聋的机率。无论实验室和现场结果都表明 E·A·R 耳塞 (泡沫) 在

低频段的降噪能力优于耳罩,或者在强大脉冲噪声下耳塞和优质的大容积耳罩的降噪能力等同。因此能量分布在低频段的噪声推荐用耳塞。现场测试表明,大容积耳罩在低频段比小容积耳罩的降噪能力高10dB左右。

表1表明无论大容积耳罩还是小容积耳罩,只要和耳塞同时佩戴,均收到明显的降噪效果。同时使用产生的声衰减比单独使用耳塞或大容积耳罩高6~8dB,比单独使用小容积耳罩高18dB左右。这种同时佩戴耳塞、耳罩的措施对提高个体防噪声效果有重大意义。因此在强大低频脉冲噪声下同时佩戴耳塞、耳罩将收到事半功倍的效果。

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喷漆作业晕厥1例报告

沈阳变压器厂工业卫生科 曹洪伟

患者,男,24岁,喷漆工龄4年。1990年3月1日13时40分,患者在直径1.5m、长2.4m的油箱内喷漆,5分钟后,自觉头昏,停止工作。14时被他人发现,倒在油箱内,被送厂医院急诊室。

主诉:头痛,头昏,恶心,气短二十余分钟。查体:神志清晰,两侧鼻孔可见残留油漆。血压14.5/9kPa,两肺呼吸音正常,心音纯律整,肝脾未触及,生理反射存在,病理反射未引出,未见特殊阳性体征。经半月住院观察,对症治疗,症状稍缓解出院。

现场调查:溶剂为工业用甲苯,油箱内喷漆时(模拟)甲苯浓度为400~580mg/m³,超过国家卫生标准3~4.8倍。

患者发病前健康状况良好。

讨论

甲苯急性中毒突出表现为对中枢神经和植物神经系统的作用和皮肤粘膜的刺激作用。据资料记载:71.4g/m³短时接触可危及人的生命,3.76g/m³浓度吸入1小时和3g/m³7~8小时引起中毒,200~380mg

/m³吸入8小时有产生头晕、疲倦和嗜睡等不良影响也有病例报告,当接触浓度大于200ppm(约822.7mg/m³)时有急性中毒作用。其机理认为下丘脑、脑垂体、肾上腺皮质系统在较高浓度甲苯的短时间作用下,可呈现一时性应激反应,即一时性晕厥和四肢无力,伴有非特异性症状,如头痛、恶心、共济失调等。

现场模拟测定甲苯浓度均未达到资料记载的发生急性中毒的条件,这样的浓度该现场以及其它喷漆作业现场也偶然存在,从未发生过急性中毒。

据现场调查,患者接触甲苯时间为5~15分钟,现场又没有达到可发生急性中毒作用的浓度,人体不致于中毒。

各种毒物对机体的作用,存在着个体差异。在人群中极少数人对某种化学物质有高度敏感性,但该患者于发病前已有职业史四年之久,其耐受能力已基本适宜这种作业环境。

综上所述,此例发病原因值得进一步探讨。

(本文承沈阳变压器厂李春耀主任医师指导,在此致谢!)

of some EDA late type asthma might be an immunologic response mediated by IgG.

Key words: Ethylenediamine late type asthma specific antibody Bronchial provocation test pathogenic mechanism

Neurological and Electroneuromyographic Assessment in 130 workers Exposed to Carbon Disulfide

Zhang Shoulin, et al

130 workers (94 men and 36 women) exposed to carbon disulfide (CS_2) from a rayon factory were examined in 1989, they had exposed to CS_2 4 to 26 (mean 17) years. The concentrations of CS_2 in the air of workplace were more than 10mg/m^3 mostly and reaching 100mg/m^3 occasionally. Physical and neurological examinations were done. The ENMG was carried out with a Dantec 2000c EMG system recording muscle potentials motor conduction velocities (MCV) and sensory conduction velocities (SCV).

Results showed that the initial symptoms of workers were headache, fatigue, dizziness and deterioration of memory. 57 cases showed symmetrical distal sensory Tendon reflexes diminished in 19.2% of the subjects. ENMG abnormalities manifested as increased polyphasic motor unit potentials, decrease of interference recruitment pattern and prolongation of distal latency of motor and sensory nerves. Totally 110 subjects in this group showed impairments of functions of peripheral nerves.

Key words: CS_2 ENMG polyneuropathy

Study on Chronic Hazard of Nitromethane to Human Body

Bai Ruyi, et al

90 workers who have exposed to nitromethane for 1~10 years were investigated in the study. The results showed that the workers with long-term exposure to nitromethane of low concentration ($1.3\sim 27.4\text{mg/m}^3$) had mild neurasthenic and mucosal stimulation. The levels of RBC and Hb and the activities of AKP and ChE were increased. The serum level of T_3 was significantly decreased.

It seemed that these changes might be used as biomonitoring indices for the workers of nitromethane.

Key words: nitromethane cross investigation

Measurement and Evaluation of Hearing Protectors Against Impulse Noise

Liu Changchun

The attenuation rate of earplugs and earmuffs measured at the low frequencies (125 Hz, 250Hz) did not exceed 23dB. The ability of earplug (E.A.R.) in reducing noise is higher than earmuffs at low frequencies. The attenuation of joined use of earplug (E.A.R.) and earmuff was 6~18dB higher than that of independent use of earplug or earmuff. The results showed that the protection of hearing at low frequencies is much more difficult than that at higher frequencies, then would offer an essential data for further improving the protection of hearing.

Key words: protector attenuation of noise hearing loss

X-Ray Analysis of White Areas and Patch-streak Shadows and its Diagnostic Significance for Pneumoconiosis

Liu Peicheng, et al

The authors reported 207 cases of pneumoconiosis with white areas and patch-streak shadows (1.53%, 207/13 540 cases) in lungs, who did not complicated with pulmonary tuberculosis or other lung diseases, and discussed their diagnostic significance. The relation between the small shadows and the white areas and patch-streak shadows, their pathological basis and differential diagnosis were also discussed.

Key words: pneumoconiosis white area patch-streak density