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Résumé

En pliant et rivetant les différents parties de la structure des voitures, les marteaux pneumatiquies utilisés engendrent bruit et vibration. Le bruit produit par les six marteaux étudiés dans une usine de fobrication de voiture est de type impulsive avec plus de vignt impulses par second. Le niveaux moyen de la pressoin crête est 131.9dB avec la deviation standard de 2.1dB. Le niveau equivalent pendant une journée de travail est 114 dB. La vibration des mains a été aussi evaluée dans les 3 directions (x,y,z). La direction z est la direction principale par laquelle la vibration entre les mains. La valeur efficace moyenne d'acceleration est 23.5 m/s2 avec la deviation standard de 15.2 m/s2. Le temps d'exposition total pendant la Journée de travail est environ 6-30 minutes.Les résultats montrent que les valeurs mesurées excèdent bien des valeurs limites proposés et le temps d'exposition permissible.

Abstract

When bending sharp and Jagged edges of materials and riveting different components of the cars structures, pneumatic hammers generate noise and vibration. The severity of the noise as a potential operator hazard should be considered in light of the following data. The noise produced by the six studied hammers is impact noise with more than 20 impulses per second. The average peak pressure level is 131.9 dB with the standard deviation of 2.1 dB. The equivalent level during a shift work, 8 hours per day, is 114 dB . Hand-arm vibration has also been measured in each applicable direction (x,y,z). The Z direction is the principal direction that vibration enters the hand. The average effective acceleration is 23.5 m/s2 and the standard deviation is 15.2 m/s2. The total exposure time during a shift is about 6-30 minutes which intermittently included 30-60 seconds. The measured levels correlate with operator exposures exceeding the allowable exposure time and the permissible values . This paper presents the assessment of sound pressure level and vibration acceleration magnitude produced by the pneumatic hammers and tests a noise silencer that provided as much as 9 dB of noise reduction to the tool .

Introduction

High level noise in the work place have resulted in a number of medical problems for workers, especially noise induced hearing loss (1). Vibration is also another hazardous physical agent which is usually with noise in industry. Vibration is a concern because of the adverse effects of hand-arm vibration syndrome that are adressed by various exposure guidelines and standards for segmental vibration (2).

The purpose of this paper is (1) to identify characteristic of pneumatic hammer used in automobile assembley (2) to present some practical aspects of impulsive noise and hand-arm vibration exposure assessment (3) to suggest a control design if the measured levels is higher than the permissible ones.

Materials and Methods

This study was conducted in an automobile assembly which is engaged in the manufacture of cars, buses, and minibuses. Pneumatic hammers are used in automobile industry to bend sharp and Jagged edges of materials and to rivet different components of the cars structures.

Six pneumatic hammers commanly used in three shops were studied and for simplicity they are marked by numbers. The hammer no.2 operates with two heads used to shape the metal pieces of buses. Description of pneumatic hammers are summarized in table I.

TABLE I - Description of pneumatic Hammer operating with 6.5-7 atm. of pressure

Diameter of connecting Hose, In	Weight Kg	Frequency HZ	No. of Hammers
1/2	4.3	45	3,4,5,6
1/2	6.4	27	2
3/8	2.2	62	1

Noise Measurements

The noise measurement were made by Brüel and Kjaer precision integrating sound level meter type 2230 and the narrow band, octave and one-third octave filter set type 1625. Measurements were taken according to recommended guidelines (3,4). The noise produced by these hammers was impact noise with more than 20 impulses per second and all noise measurements were taken at the position of worker's ear. There was always some background noise during the survey but the difference between sound levels was about 16 dB, so the contribution of lower level was insignificant. Sound pressure level at peak and RMS value was measured and narrow band analyziz of data was performed. Then equivalent continuous noise level, Leq, and immision level, EA, were estimated (3).

Vibration Measurements

Hand-arm vibration has also been measured in each applicable direction (x,y,x). the Z direction is the principal one that vibration enters the hand. The vibration measurement were made using Brüel and Kjaer type 2513 and triaxial accelerometer type 4392 having a charge sensitivity 0.1 pc/m2 . Accelerometer was attached to the hand of workers handling the pneumatic hammer and the measurments were made in 3 orthogonal coordinate axes in accordance with the ISO 5349 (5).

Results

Pneumatic hammers generate noise from two sources : exhaust air and the internal piston. The impact of the head of the hammers to the metal pieces also generate higher levels. Table II summarizes peak pressur. equivalent and immission levels and exposure time during hammering.

TABLE II - Summary of pressure levels and total time exposure for pneumatic Hammers Tested

No	SPL. peak dB	Exposure Time (min)	No of impulses per day	leq (T) dB	E_A dB
1	131.0	30.00	111600	119.0	133.8
2 (II)	135.0	9.60	16135	114.1	128.9
2 (III)	134.2	9.60	16135	115.2	130.0
3	130.0	6.00	16200	111.2	126.0
4	131.2	7.80	21060	113.5	128.3
5	132.6	7.80	21060	114.9	129.7
6	129.4	6	16200	110.3	125.1

Among the hammers, No.2 which has no muffler on it generated the highest level of noise. The mean value of crest factor was 17 dB and the standard deviation was 2 dB, indicating a potential hazard of damaging hearing.

Table III summarizes the acceleration magnitudes in three coordinate axes for each of the hammer tested.

TABLE III - Summary of Dominant Frequency and corresponding individual Axis Acceleration magnitude

No	Frequency Hz	A peak (m/s2)			A rms m/s2		
		X	Y	Z	X	Y	Z
1	62	100	80	255	2.7	14.5	18
2 (II)	27	500	450	630	25	25	50
2 (III)	27	190	180	136	25	25	36
3	45	9	80	180	2.3	8	12.5
4	45	100	100	200	12.5	10	28
5	45	57	80	160	6.3	7.1	10
6	45	80	100	190	5	14.5	10

As it is recommended by guideline discipline, the Z axis is the principal direction of entering vibration to the hand. The mean value of RMS acceleration value was 23.5 m/s2 and the standard deviation was 15.2 m/s2 .

Discussion

The peak pressure level of the pneumatic hammer under study were less than the threshold of pain, 140 dB. The mean value of immission level is 128.8 dB which exceeds the permissible value, 105 dB. The total exposure time during the shift work is about 6-30 minutes which intermittently included 30-60 seconds . Also, the comparison of the total equivalent level with permissible values shows that the exposure time is much more than the allowable exposure time at the same level.

The comparison of the effective acceleration of vibration of hammers with permissible values regarding to the exposure time, showes that the exposure time of four hammers are higher than the allowable exposure time. (2) , Table IV

TABLE IV - Summary of Z axis Acceleration magnitude and Exposure time

No	A peak - Z m/s2	A rms - Z m/s2	Exposure time min	Aeq (4) m/s2
1	225	18	30.0	79.5
2 (II)	630	50	3.6	80.9
2 (III)	316	36	6.0	49.9
3	180	12.5	6.0	28.5
4	200	28.0	7.8	36.5
5	160	10	7.8	29.2
6	190	10	6	30.0

In order to control harmful effet of noise and vibration two designs have been studied. A kind of muffler made of PVC installed on the hammer. We had about 9 dB reduction of peak pressure level of noise.

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