Hand-Arm Vibration (HAV) produced by pneumatics screwdrivers used in a wind power company

Abstract

In this paper we present a wind power company´s study to check how portable tools can cause hand-arm vibration.
The most used pneumatic screwdrivers have been specifically analyzed by this companies.
These results may help to determine how vibration can affect workers. In this way are determined not only the normalized values of exposure for a day of eight hours and a comparison with the reference values of legislation, mainly *Directive 2002/44/EC of June 25*, *2002* and *RD 1311/2005, of November 4*. In the same way, daily working time should not be exceed by workers in order not to reach those benchmarks nor the baseline levels.

Keywords: vibrations; hand-arm; screwdrivers.

1. INTRODUCTION

The importance of different physical agents in the workplace has been increasing in recent times. The European Union has developed in recent years successive Directives different agents. This included the *Directive 2002/44/EC of 25 June 2002* on the minimum health and safety requirements regarding the exposure of workers to the risks arising from vibration, or, later, *Directive 2003/10/CE, on February 6, 2003*, about the risks from noise for workers.
Finally, it must include the publication in Spain of *RD 1311/2005, of 4 November*, on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (vibration).
That publication of *Directive 2002/44/EC* and Spanish level of *RD 1311/2005*, can be said that if anything could be described as existing legislation relating to vibration at work, was diffuse and poorly concrete quantitatively speaking.
No doubt that this has had a significant impact when it comes to check the working conditions in the workplace.
Thus, it is safe to say that, unlike other physical agents present in the workplace, such as noise or radiation, mechanical vibrations in the workplace have received little attention from the Administration and Companies required to hold a suitable conditions for their workers.
The above statement holds easily when it is found that, unlike what happens with the vibrations, there are, for example, numerous examples of studies of noise in the work environment related to jobs and machinery.
Similarly, in our country the obligation to undertake periodic hygienic assessment for noise in industries is generally accomplished by companies, at least the medium and large companies.
Just the opposite happens with the mechanical vibrations are very few reviews submitted by companies and prevention services, despite the legal obligation to which they are subjected by the aforementioned legislation.
Applied Acoustics Laboratory of the University of León, has responded to the request by the wind power company to make a study of vibrations in different equipment and machinery, both hand-arm as whole body.
In this paper we present the first results on hand-arm vibration exist in the use of equipment widely used in industry (pneumatic screwdriver), hoping thereby to contribute to a better understanding of the employment situation due to mechanical vibration, indicating the daily maximum use of such equipment.

2. MATERIALS AND METHOD

2.1. Test identification

The present study is based on the evaluation of human exposure to hand-arm vibration produced by pneumatics screwdrivers used in a wind power company.
In total 7 teams have been analyzed, making measurements during routine tasks screwed.

Table 1 – Equipment Characteristics.

Equipment	Trademark	Maximun Torque (Nm)	Exposure time/day (min)
1	A	1030	90
2	A	1030	30
3	B	1015	30
4	B	1015	90
5	A	1030	15
6	C	180	60
7	B	1015	30

Runtime screwing each process: 10 seconds.
Data on runtime and daily exposure were provided by the company and the workers themselves.

2.2. Execution of measurements

Adjusted to the provisions of *R.D.1311/05*, on the protection of the health and safety of workers from risks arising or likely to arise from exposure to vibration and specifically reflected in the *UNE-EN ISO 5349-2:2002*. "Mechanical Vibrations. Measurement and evaluation of human exposure to hand-transmitted vibration." Part 1 – General requirements and Part 2 – Practical guidance for measurements at the workplace.
2 measurements were performed of and operation of screw in and unscrew, with a duration of 10 seconds each. The duration of the measure covers in any case working time for full operation.
Triaxial accelerometer was installed by hand adapter guaranteed full vibration from transmission.
Calibration was performed before and after the test.

2.3. Instrumentation

The instrumentation used in performing the measurements is:

- Vibration meters/analysers SVANTEK, Mod. Svan948.
- Triaxial accelerometer for hand-arm vibration (HAV) DYTRAN, mod. 3023M2.
- Vibration calibrator RION VE-10.
- Hand adapter for hand-arm vibration SVANTEK.
- Thermohigrometer SIKA MH3330.

3. EVALUATION OF VIBRATIONS

The evaluation of the level of exposure to vibration transmitted to the hand-arm system is based on the calculation of daily exposure value normalized to a reference period of eight hours, A (8), calculated as the square root of the sum of the squares of the rms values of the frequency-weighted acceleration, determined on the orthogonal axes ahwx, ahwy, ahwz defined according to the *UNE-EN ISO 5349-1:2002.*
In the three axes applies equally weighting filter Wh, reviewed in the *UNE-EN ISO 5349-2:2002.*
According *R.D. 1311/05*, the daily exposure limit value standardized to a reference period of eight hours is set to 5 m/s².
Similarly, the daily exposure value normalized to a reference period of eight hours leading to an action is set at 2,5 m/s^2.

According to the above:

$$A_{eq} = \sqrt{a_{hwx}^2 + a_{hwy}^2 + a_{hwz}^2}$$

Overall acceleration Aeq for the period of work with exposure time T. To determine the A (8) normalized for the period of 8 hours:

$$A(8) = A_{eq}\sqrt{\frac{T}{8}}$$

If there are several sources of vibration to which the worker was exposed, would proceed to obtain the overall value that corresponds to the employee, as provided in Norm cited above. There is no requirement in our case, as it only considers a source of vibration, pneumatic screwdriver.

4. RESULTS AND DISCUSSION

The results are presented below:

Table 2 - Results

Equipment	Trademark	Aeq m/s^2	Exposure time/day (min)	A(8) m/s^2	Maximum time exceedance of the limit value	Maximum time exceedance action value
1	A	11,7	90	5,1	1 h 27 min	21 min
2	A	9,9	30	2,5	2 h 2 min	30 min
3	B	12,2	30	3,1	1 h 30 min	20 min
4	B	8,7	90	3,8	2 h 38 min	39 min
5	A	16,0	15	2,8	2 h 31 min	11 min
6	C	6,1	60	2,2	5 h 22 min	80 min
7	B	8,9	30	2,2	2 h 31 min	38 min

According to initial data, indicated by the company and its employees, it is observed:

- In one case, the pneumatic screwdriver No. 5, it exceeds the limit value A (8), for standard working day of eight hours.
- In three other cases the action values are exceded for the standard 8 hours day.
- In some pneumatic screwdrivers, values obtained during the execution of the work are very high, which could motivate the exceeding reference values in the case of very short working time, other than those indicated by the workers themselves. It can be seen for pneumatic screwdrivers 5, 3 and 1, with shorter maximum daily use of teams of 11, 20 and 21 minutes respectively.

It should be noted that if it were to study exposure to hand-arm vibration of workers in particular, would be necessary to know if during working hours using other equipment vibration levels to consider.

5. CONCLUSIONS

The results from the study by our Applied Acoustics Laboratory represents levels of hand-arm vibration corresponding to the use of pneumatic screwdrivers, equipment often used in the industry.

The values obtained indicate that in some cases exceeding the acceleration limit value for the 8-hour day of 5 m/s^2 indicating the legislation, and several of them 2,5 m/s^2, by reference to the action values.

The data are relevant, as, for example, in any team reach 16,0 m/s^2 or 12,2 m/s^2 for acceleration equivalent, means that we are facing a situation that can be described clearly susceptible of improvement.

Times daily maximum for use with such devices do not exceed the above values, have been calculated purported to help improve the situation of workers in their safety and health at work in terms of mechanical vibrations.

6. REFERENCES

Directive 2002/44/EC of the European Parliament and of the Council of 25 June 2002 on the minimum health and safety requirements regarding the exposure of workers to the risks arising from physical agents (vibration) (sixteenth individual Directive within the meaning of Article 16 of Directive 89/391/EEC.

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UNE ISO 2631-1:2008. Mechanical vibration and shock. Evaluation of human exposure to whole-body vibration. Part 1: General Requirements.