inter·noise 96
25th Anniversary Congress – Liverpool

INCE: 49.1

HAND-ARM VIBRATION PROTECTION - TESTING AND EVALUATING GLOVES OFFERED AS ANTIVIBRATION GLOVES ON THE POLISH MARKET

J Koton, P Kowalski & J Szopa

Central Institute for Labour Protection, Warsaw, Poland

1. INTRODUCTION

It is generally known that excessive exposure to hand-transmitted vibration from various hand tools and processes causes vibration injuries in the human organism. In several countries vibration injuries are considered an occupational disease. In Poland about 600 new cases of occupational hand-arm vibration syndrome (HAVS) appear every year. It is supposed that some reduction of the risk of vibration damage could be achieved by using gloves providing adequate attenuation of vibration. Until quite recently there was no suitable method for the measurement and evaluation of the vibration transmissibility of gloves intended for protection against vibration. Recently such a method — in the form of draft standard (pr EN 30819) — has been elaborated by WG3 of CEN/TC 231. In the Central Institute for Labour Protection in Warsaw investigations of various gloves sold as antivibration gloves on the Polish market were carried out according to this standard and with the use of the newly-built measurement stand fulfilling the requirements of this standard. The main focus of the investigations was to establish whether the gloves offered as hand vibration protectors fulfil the minimum criteria established in pr EN 30819 for antivibration gloves. In this paper the results of investigations are presented and discussed.

2. MEASUREMENT METHOD

According to the method described in the EN draft standard [1], the measurement of gloves is carried out in a laboratory, under conditions as typical of the actual workplace as possible.

The method uses a vibration excitation system (shaker) equipped with a special handle to measure the gripping force. A device for measuring the feed force is also necessary. Throughout the test period the values of the gripping force and the feed force have to be monitored continuously so as to keep them at the required levels (the gripping force must be constant at 30N ± 5N, the feed force — at 50N ± 8N).

The measurement handle is excited by two specially-shaped vibration test signals M and H which are representative of the vibration of some tools.

The vibration (in terms of weighted accelerations) is simultaneously measured at two points: on the surface of the handle and — by means of a special adaptor — at the palm of the hand, without a glove and with a glove (inside the glove). The measurements are made separately for each of the test signals M and H for three persons. Three gloves of one type are used (one for each test person) and the measurements are carried out twice.

From the weighted accelerations obtained at the handle and in the palm of the hand, weighted transmissibility is calculated (for a "bare hand" and for a "gloved hand"). The ratio of those two weighted transmissibilities is called the corrected vibration transmissibility of a glove. The mean corrected vibration transmissibilities for each of the test signals M and H ($\overline{TR}_M$ and $\overline{TR}_H$) calculated as the arithmetic mean values from the six results (two measurements × three persons) are the finally evaluated quantities. They are compared with the minimum criteria established for antivibration gloves in the EN standard [1].

Additionally, vibration transmissibility may be determined as a function of frequency.

3. MEASUREMENT STAND

In order to measure and evaluate gloves intended for protection against vibration, an appropriate measuring system is needed. Such a system has been built in the Central Institute for Labour Protection (CIOP) in Warsaw. This system fulfils the requirements of the method described above.

For the excitation of vibration, an LDS shaker type V721 with a power amplifier type PA2000 are used. The required test signals M and H are shaped using a specially-designed digital filters. During the measurements, the gripping force and the feed force are monitored continuously. The gripping force and the feed force systems were built using eddy current transducers. One of them is placed inside the measurement handle and the other — inside the measuring platform on which the operator has to stand during the testing of the gloves. For measuring weighted accelerations, a B&K sound level meter type 2231

with a human-vibration unit type 2522 are applied. The transmissibility as a function of frequency is determined by means of a narrow-band twin-channel analyzer (B&K, type 2034).

A schematic diagram of the measuring system used in CIOP for determining the vibration transmissibility of gloves is shown in Figure 1.

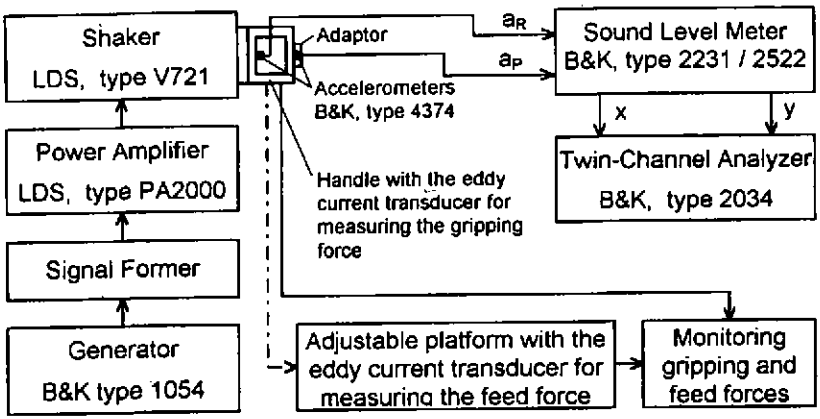

Fig. 1. Schematic diagram of the measuring system used in CIOP for determining the vibration transmissibility of gloves.

4. INVESTIGATIONS AND RESULTS

Using the method and the measurement system described above, investigations of gloves were carried out. They had a preliminary character because our measurement stand had been built quite recently. The main focus of the investigations was to check whether the gloves sold as antivibration gloves on the Polish market fulfil the minimum criteria for antivibration gloves according to prEN 30819. In accordance with prEN 30819, gloves can be considered antivibration gloves if they fulfil both of the following criteria:

$$\overline{TR}_M < 1 \text{ and } \overline{TR}_H < 0.6,$$

where: $\overline{TR}_s$ - mean corrected vibration transmissibility of a glove for vibration test signals s (s = M or H).

For the above-mentioned purpose, ten types of "antivibration" gloves produced in various countries (Finland, Poland, Czech Republic, Canada, Germany, USA) were bought and tested. The results obtained from the investigations are shown in Table 1.

Table 1.

Type of glove	$\overline{TR_M}$ (STD)	$\overline{TR_H}$ (STD)
1	0.887 (0.015)	0.791 (0.052)
2	**0.838 (0.035)**	**0.563 (0.035)**
3	0.943 (0.016)	0.898 (0.034)
4	0.972 (0.048)	1.002 (0.022)
5	0.961 (0.015)	0.975 (0.029)
6	0.953 (0.017)	0.985 (0.056)
7	0.886 (0.034)	0.797 (0.027)
8	0.907 (0.031)	0.828 (0.019)
9	0.895 (0.037)	0.848 (0.018)
10	0.871 (0.043)	0.759 (0.070)

5. CONCLUSIONS

1. The obtained results point to the fact that very often gloves offered as antivibration gloves do not fulfil the requirements established in the appropriate EN standard. Among the ten types of the "antivibration" gloves tested, only one type (No. 2 in Table 1.) could be classified as useful for protection against vibration in view of the requirements of prEN [1]. However, it has been established that it is possible to construct gloves which provide protection from vibration and that they should be used by workers exposed to hand-transmitted vibration at work.
2. It is necessary to measure, evaluate and approve gloves distributed among workers. Approval should be granted by authorized units.

6. ACKNOWLEDGEMENTS

The authors would like to thank the State Committee for Scientific Research in Poland for sponsoring Project 7S10102007 as well as Dr. Jolanta Liwkowicz for her assistance in providing gloves for investigations.

7. REFERENCES

[1] prEN 30819: Mechanical vibration and shock - Hand-arm vibration - Method for the measurement and evaluation of the vibration transmissibility of gloves at the palm of the hand.

[2] A.W. Bednall, Antivibration gloves; H.S.E., Report No. 13, 1988.

[3] Griffin, Vibration injuries of the hand and arm: their occurrence and the evolution of standards and limits; H.S.E., Report No. 9, 1980.

[4] B.W. Hohmann, R. Thali, Measurement of the vibration attenuation provided by gloves; Proceedings of the 6th International Conference on Hand-Arm Vibration, Bonn, Federal Republic of Germany, pp. 765-773, 1992.