Development and test of new kinds of anti-vibration knitted hand protection

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EXTENDED ABSTRACT

Key Words: personal protective gloves, vibration isolation, textile testing, cut resistance, safety workwear

1. INTRODUCTION

Anti-vibration gloves are an important sort of personal protective equipment (PPE), aimed at ensuring improved comfort in work with percussion drills, road-breakers and similar vibrating tools, and avoiding health impairment such as neurological changes, numbness and in a later phase reduced blood circulation, aka white finger disease. As any other protective workwear, apart from good vibration isolation paired with reasonable tractability, in particular cases anti-vibration gloves should also have appropriate resistance to cutting (sharp objects, knives) and fire too.
The degree of vibration reduction provided by gloves generally depends on the thickness and softness of the lining (resilient gel, foam or rubber-like material, or an array of air bladders), but also from the person in work [1]. On average, anti-vibration gloves must provide considerable protection against relatively high vibration frequencies (200 Hz and above), and might not, on average, increase vibration levels at lower frequencies. To protect against lower vibration frequencies the contact areas of the glove need to contain thicker resilient material. This may seriously limit dexterity and comfort and the gloves may therefore be unsafe to use, and unacceptable to employees.

2. EXPERIMENTAL

Research was carried out the develop suitable testing equipment, and to select and further develop appropriate materials and the applicable technologies to manufacture novel cut resistant anti-vibration gloves as prototypes for protection, safety. Theoretical works dealing with adoption of techniques and solutions of already existing materials and fibres were made, extended by a wide-range of experimental and validation activities [2].
Two special apparatuses were designed and built: to perform cutting tests under well controlled conditions according to the international standard ISO 13997, and a test setup for the measurement of vibration isolation materials according to the standard ISO 9052-1 as well as for the determination of the overall vibration isolation of gloves following ISO 10819.

2.1 Materials

Samples in three-layer sandwich form were fabricated by using various technologies, where the upper layer consisted of 100% Kevlar or 100% Dynetex knitted fabric, as inner layers different space fabrics or silicon were selected, and 100% cotton fabric as underlining. Thickness, space fabrics, surface structures were variables.

Figure 1. Knitted samples with special surface

2.2 Measurements

10 knitted fabric and 23 three-layers samples were investigated. Protection of these samples against mechanical hazards (cutting) and fire were tested, and also ergonomical characteristics was evaluated. A number of tests were performed to achieve optimum performance in terms of vibration isolation, safety and tractability. The selected knitted materials were tested in the first phase of the development to determine their elasticity parameters such as stiffness and internal damping as a function of vibration amplitude of various frequencies and static load [2].

2.3 Test of cut and heat resistance

"Coup Test" according to the EN 388 standard and the "TDM-100 Test" according to MSZ EN ISO 13997:2000 was performed to evaluate mechanical risks for hand protection. The "TDM-100" test was carried out on the testing device (Fig.2) developed by Hungarian partners for INNOVATEXT in the framework of the research. Test of heat resistance was performed according to MSZ EN 407:2004 .

Figure 2. Cut resistance testing device in the laboratory of INNOVATEXT

2.4 Test of vibration isolation

The evaluation of the three-layers samples were performed according the requirements of the standard [3]. The load was a 8 kg pressing plate, size 200×200×25,6 mm (Fig.3). The level of vibration damping was calculated from the frequency response function (FRF) obtained from accelerometers fixed on the base plate and the pressing plate. (Note that FRF values lower than 1 mean damping, while higher values than 1 represent amplification.)

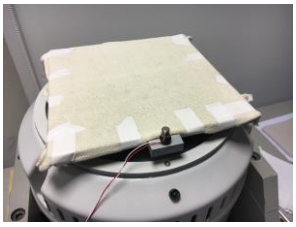

Figure 3. Measuring device for testing vibration isolation in the laboratory of BME

3. RESULTS AND CONCLUSION

Cut resistance of the knitted samples was 5 and 4 (from rate 1-5), according to the TDM-100: B, while all other physical performance factors or abrasion, tear and puncture resistance gave level 1. Samples including silicon and space fabric show significant anti-vibration characteristics in frequencies 10-200 Hz (Fig.4). The transmissibility value (y) decreases rapidly at frequency range of 50 – 130 Hz, the vibration was reduced by one to two orders of magnitude (corresponding to 20 to 40 dB damping). Further research and tests according to ISO 10819 shoud be continued to evaluate the prototype of gloves made from the selected fabrics with optimal performances.

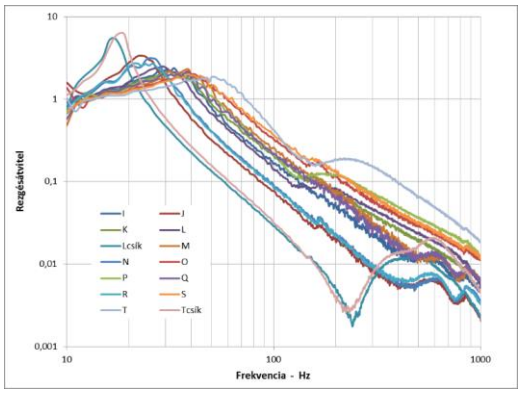

Figure 4. Vibration isolation of the measured samples

5. ACKNOWLEDGEMENT

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6. REFERENCES

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