Design and research of a new type of anti-vibration gloves with the use of distance knitted fabrics

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The poster presents tests of vibration damping in anti-vibration gloves with knitted spacers. The research was carried out at the Lodz University of Technology, Faculty of Materials Technology and Textile Design. Measurements of the anti-vibration properties of the gloves were made on two types of vibration generating devices - a hammer drill and an orbital sander.
Two gloves with spacer knitted inserts with different physico-mechanical parameters and one standard available on the market were tested. The conducted research shows that all gloves have vibro-insulating properties to a different degree.
An alternative to the typical upholstery materials used for seats can be 3D distance knitted fabrics, as vibro-isolating inserts. A spacer knitted fabric made in accordance with the guidelines was used. The knitted fabric structure is shown in Figure 1.

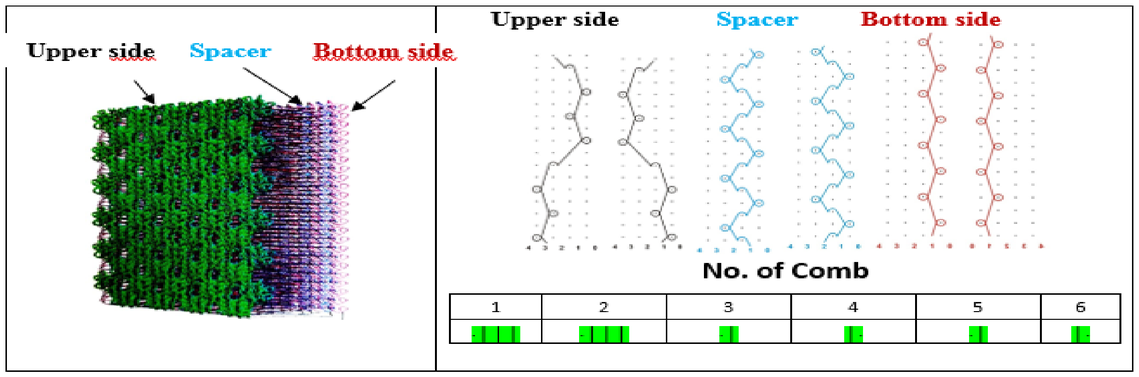

Fig. 1. Scheme of the structure of 3D knitted fabric; upper outer layer of spacer knit; fasteners; bottom layer of spacer knit

Gloves prototypes were made. The diagram of the arrangement of individual layers is shown in Fig. 2.

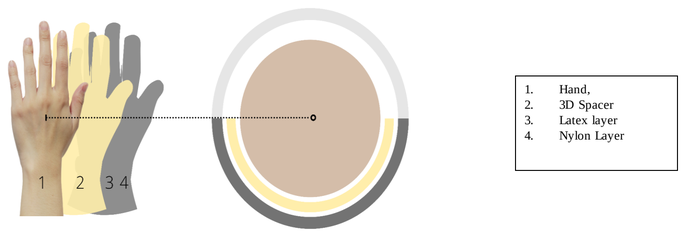

Fig. 2. The leayout diagram in the prototype of an anti-vibration glove with a spacer knitted fabric insert

Methodology and conducted research

For the tests, a test stand was constructed (Fig. 3) by simulating the work of an operator of a manual mechanical tool, with the use of a Metabo KHE 2444 hammer drill, a Metabo FSR 200 Intec orbital sander and a VM-54 Rion meter with a PV 62 Rion vibration sensor, which enables the measurement of vibration acceleration in three axes.

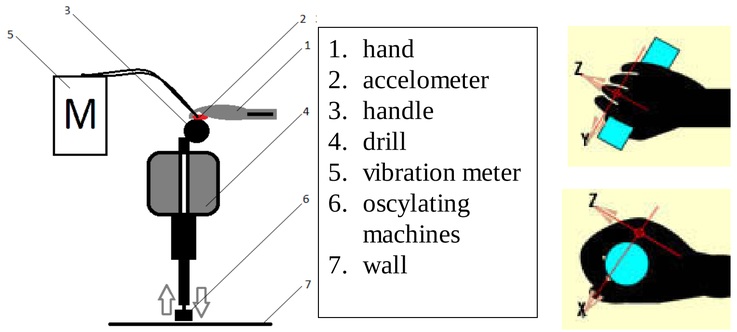

Fig.3. Scheme of the measuring stand; Coordinate systems used to measure hand vibration (ISO 5348)

The tests were carried out for prototype gloves with a knitted vibro-insulating insert and commercial antivibration gloves in accordance with the standard, where the RMS values of vibration acceleration of the sensor on the handle of the tool were measured in three different axes. Four people participated in the tests, taking 3 measurements for each variant within 1 minute. Measurements were also made on a standard anti-vibration glove available on the market. For comparison, vibration measurements were performed without the use of damping materials. All variants are shown below:

- Measurement without the use of an anti-vibration glove
- Measured using a standard commercially available anti-vibration glove
- Measurement using a prototype anti-vibration glove with spacer knit materials

Results and discussion

The results of acceleration measurement in three directions x,y,z, (Table 1).

Table 1. Measurement acceleration in three directions x,y,z.

	X RMS , m/s²	Y RMS , m/s²	Z RMS , m/s²
without anti-vibration gloves	0.263	0.111	0.324
comercial anti-vibration gloves	0.258	0.084	0.336
Prototype anti-vibration gloves	0.291	0.086	0.308

Table 2. Calculated Seat coefficient in three directions x,y,z.

	SEAT, x	SEAT, y	SEAT, z
Commercial anti-vibration gloves	1.020	1.317	0.962
Prototype anti-vibration gloves	0.905	1.293	1.049

To assess the damping quality, a dimensionless SEAT index (Seat Effective Amplitude Transmissibility) was proposed and defined as the ratio of the weighted vibration acceleration determined at the station (without damping inserts) to the weighted vibration acceleration determined at the station with the use of knitted damping inserts (Table 2).

$$SEAT = ARMS/\ ARMS, D \qquad [1]$$

where: SEAT - effectiveness of protection indicator, ARMS - the effective value of weighted vibration acceleration without the suppression (damping inserts), ARMS, D - the effective value of weighted vibration acceleration with the suppressing (damping inserts) characteristic.

Conclusion

The paper presents the research and construction of Prototype anti-vibration gloves with3D knitted materials. The selected material for the construction of the sensory system is a 3D type material.
A very important factor, from the structure of the ant vibration gloves point of view, is the choice of a knitted material with the best possible damping properties. The selected 3D knitted material had a very good SEAT vibration damping coefficient of 2.3. The connectors acted as spacers and as flat springs role with linear characteristics (dependence of the elastic force on the spring deflection from the equilibrium position). The authors analyzed the the SEAT vibroinsulation coefficient coefficient in three axes x,y,z for prototype antivibation gloves and commercial one. The test was done according to the ISO standard. Analyzing the measurement results between the prototype and the commercial glove, we can find a great similarity. Damping vibration properties in all x, y and z directions is similar, which confirms the possibility of using 3D inserts in the construction of anti-vibration gloves.