DEFORMATION OF ELASTIC KNITTED FABRICS UNDER CYCLIC LOADING

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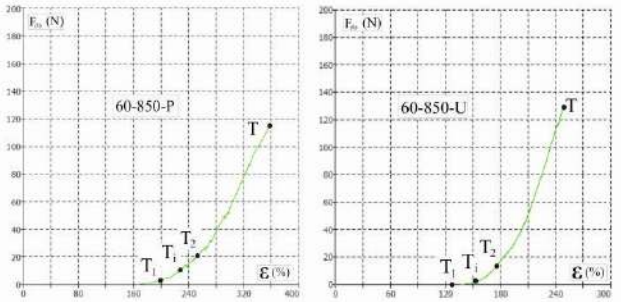
In the modern world, there is an increasing demand for elastic knitted fabrics which comfortably lie on the body and often press on it with a certain force. Such knitted fabrics are usually made with two yarns. The first one is ground, usually of natural fibres, and the other is elastane. In the production of recreational clothes, polyamide (PA) or polyester (PES) multifilament yarns are used instead of cotton. Single cotton yarns have the elongation at break 3 to 8 %, PA or PES 20 to 40 %, and elastane 400 to 900 %. Adequate elongation amounts are obtained by different yarn combinations, structures and density. These are coordinated with the garment construction, which results in the desired pressure on the body.

Different forms of compression preventive products: women's preventive pantyhose, maternity preventive pantyhose, compression knee-highs, long compression underwear, sports long underwear, compression recreational set

Uniaxial tensile elongation of knitted fabric

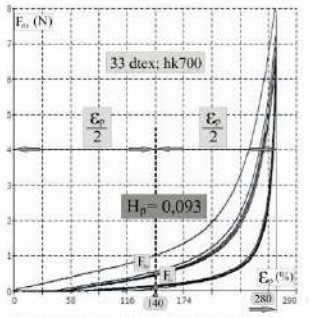
The force/elongation diagram can basically be divided into three parts. The first part of the diagram spanning from 0 to T_1 is considered linear and is assumed to represent the elastic area. The second part of the diagram is from point T_1 to point T_2 and represents the elastic-plastic knitted fabric area, where point T_i is also located. Some knitted fabric structures are elastic up to this part as well. The third area starts at the beginning of the second linear part of the diagram (T_2), which is assumed to be the beginning of knitted fabric plastic deformation or permanent deformation. These three points are often used as a basis during repeated knitted fabric loading in research of its elongation properties during use or on a dynamometer in cyclic measurements. In certain knitted fabric structures, these three points represent different knitted fabric deformations.



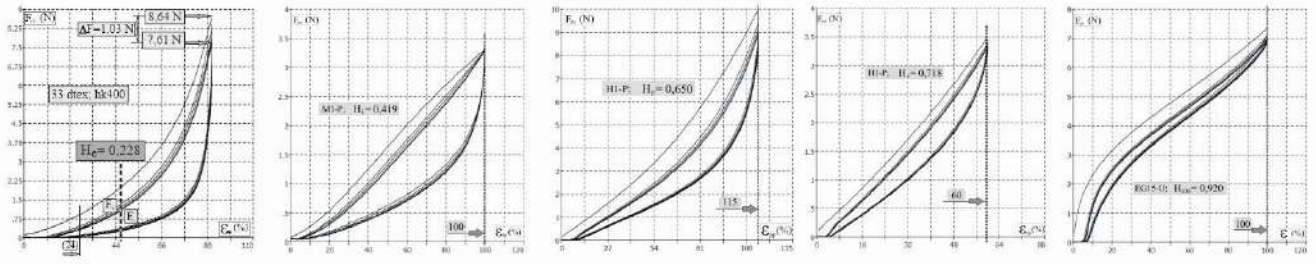
Force/elongation diagrams for traverse (P) and longitudinal (U) elongation of the elastic knitted fabrics

Cyclic loadings

In order to observe knitted fabric behaviour during use it is purposeful to load it cyclically. The standards recommend conducting five continual measurements per elongation area and then identifying the difference between one time static and cyclic results. It is not necessary to conduct more than five cyclic measurements or five loops, because in most materials, the results after only the third elongation or third loop differ less than 5 %, and in the fifth loop less than 1 %. The three previously mentioned points obtained in the diagram of knitted fabric force/elongation at break are of interest for different textile materials, especially elastic knitted fabrics. If a knitted fabric is five times cyclically loaded for elongation, e.g., to point T_1 or the assumed end of plastic deformation, what can be noticed is a drop in force and residual deformation of knitted fabric. Similar changes can be observed if these measurements are repeated for the curve vertex point (point T_i). Point T_2 represents the beginning of permanent deformation so the cyclic measurements can also be conducted and compared to the previous ones at this point. Further elongations to T_2 are unnecessary for knitted fabrics used to make classic garments. However, knitted fabrics which are used for special clothes or have technical purposes, are tested for cyclic loadings all until break. After five cyclic loadings, certain knitted fabric structures are expected to exhibit different force drops and residual deformation of knitted fabric.



Deformations of knitted fabric of fine women's stockings after cyclic loading



a. b. c. d. e.

Diagrams of cyclic elongations of: a) fine women's stockings, b) shirts, c i d) elastic pants, e) a 15 mm wide elastic ribbon; The hysteresis index (Hx) from 0.093 to 0.920.

Conclusion

The subject of research are tensile properties of elastic knitted fabrics with a special focus on the hysteresis curve index.The first knitted fabric structure is the simplest and comes from finished unused fine women's stockings. Four different knitted fabric structures with different density and stretchability which lie along the female leg from ankle to crotch are analysed. The curve hysteresis index in these knitted fabrics is between 0.000 to 0.400. The hysteresis index of unused knitted fabric intended for recreational clothes is much higher than in fine women's stockings and ranges from 0.3 to 0.8. The hysteresis index of the swimsuit knitted fabric is analysed after a few months of use, washing and drying. The obtained index is in the area between 0.3 and 0.5. The hysteresis index of elastic ribbons used in clothes production is the largest and ranges from 0.8 to 0.95.

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