# QUALITY PARAMETERS OF COMPRESSION PRODUCTS

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*Updating the assortment of knitting products and increasing quality parameters is one of the most important and actual tasks of the knitting industry.*

*The following quality parameters of knitting product are taken as factors describing its mechanical properties: stiffness, elongation at break, elongation at tension less than breaking strength, resistance to single and repeated forces, resistance to wrinkling and friction, penetration in wet-heat treatment and etc. [9].*

*Air permeability, water absorption, hygroscopicity, heat retention, electrification, etc. of knitting products. defining parameters are used as factors describing physical properties. The number and number of defects per unit* of length or surface is a descriptive parameter of the appearance of the knitting product.

The decrease or increase of the indicated parameter values directly depends on the kind and nature of the raw materials used in the products, and the method of obtaining knitting products. Most of the properties mentioned above are not accepted as factors characterizing the quality of all kinds of knitting products.

The quality parameters of knitting products are selected and determined depending on the purpose for which the knitting product is used, operating conditions, product structure, parameters describing physical-mechanical properties, as well as the kind and function of the knitting machine used in the production of knitting product.

The main parameters of the physical-mechanical properties of the knitting product determine the environment of its use. The offered knitting product samples are designed for compression fleecy knitting products. Therefore, the main characteristics of these knitting products are air permeability, stretchability and the ability to quickly return to the initial state, that is, elastic deformation.

Researchers at the Tashkent Institute of Textile and Light Industry (TITLI) are actively engaged in the development and investigation of functional knits, with a specific focus on medical compression garments [10-12]. Building upon this foundational work, the present study aims to create compression hosiery with enhanced characteristics. To this end, seven distinct variants of fleecy knitted structures were developed.

Fleecy knitwear is characterized by the incorporation of supplementary filament systems. In these structures, certain loops within a single course are extended not only through loops of adjacent courses but also through the tucks formed by the fleecy yarns. A fundamental fleecy construction typically comprises a base yarn and a fleecy yarn. During production on successive feeders, standard holding-down sinkers guide these yarns. The fleecy yarn is specifically tucked onto the needles, drawn over the existing (old) loops, and subsequently cast off in conjunction with them to form new loops [13-16].

A single course within a fleecy knit fabric can incorporate multiple fleecy yarns. The classification of these fabrics is directly based on the quantity of these yarns, leading to distinctions such as simple, doubled, or tripled fleecy knitwear.

Furthermore, the formation of fleecy structures is versatile and can be built upon any fundamental knitting structures. Consequently, fleecy fabrics are categorized as single-weft, double-weft, or warp-knitted, a designation that depends on the specific base knit structure into which the fleecy yarn is integrated.

A single fleecy fabric naturally tends to curl at its edges due to its basic knitted structure. However, the extent of curling is less noticeable in the directions—courses or wales—where the fleecy yarn is incorporated. The resulting fabric shows lower tensile properties when the fleecy yarn is aligned with the tension direction, as in inlaid knitting. Compared with inlaid structures, fleecy knitted fabrics exhibit greater elongation, since the tucks and floats of the fleecy yarn, particularly when arranged along the course, are more curved than those in inlaid fabrics.

Fleecy knitting structures are formed using at least two yarn systems on either weft- or warp-knitting machines. Production methods can be categorized as single-cycle or multi-cycle (commonly two- and three-cycle). In the single-cycle method, base and fleecy yarns are simultaneously laid on the needle within one loop-formation system. In the double-cycle method, ground and fleecy yarns are placed separately in distinct loop-forming systems. The three-cycle method introduces an additional step, where fleecy, ground, and plating yarns are each laid in separate interlooping cycles. In this study, several variations of fleecy knitting structures and their notations were designed and defined as: 1/1, c = 0; 2/1, c = 0; 3/1, c = 0; 1/1, c = 1; 2/1, c = 1; 3/1, c = 1; and 3/2, c = 1 (where the first value represents the number of wales in the fleecy yarn float, the second indicates the number of wales where the fleecy yarn forms tucks with ground loops, and s denotes the shifting steps).

Air permeability is of great importance for knitting products when evaluating clothes from a hygienic point of view, because the air permeability ensures air exchange from the bottom of the garment, and the heat retention property of the product also depends on it.

Air permeability refers to how well the product allows air to pass through. The coefficient of air permeability shows how much air can pass through 1 $cm^2$ of product in 1 minute under a specified pressure. The air permeability coefficient of the knitting product intended for outer products depends on the thickness of the knitting product, texture and density and is measured in $cm^3$ /($cm^2$ •sec).

The porosity of the knitting product, the number and value of the holes, as well as the thickness of the knitting product are of great importance for the air permeability of the textile product.

The greater the porosity of the product, the lighter its weight and the higher the air permeability. High air permeability depends not only on the number of pores, but also on their shape and size. The smaller the pores, the greater the friction resistance and the lower the air permeability.

The air permeability of knitting product samples was determined experimentally on the "AR-360 SM" machine in the unit $cm^3$ /$cm^2$ s at 20°C 1 atm. A diagram of the relationship between air permeability and the thickness of the knitting product is presented in figure 1.

The air permeability of the obtained compression fleecy knitting product samples varied from 28.12 to 48.26 $cm^3$/($cm^2$ •sec) and the change was 41.7% (Table 1, Figure 1). Compared to the base fabric, variant II has a minimum air permeability of 28.12 $cm^3$/ ($cm^2$ •sec), which is 5% less than the base fabric (variant I). The highest air permeability of 48.26 $cm^3$/ ($cm^2$ •sec) was observed in variant V, which is 38.8% more than the base fabric (variant I).

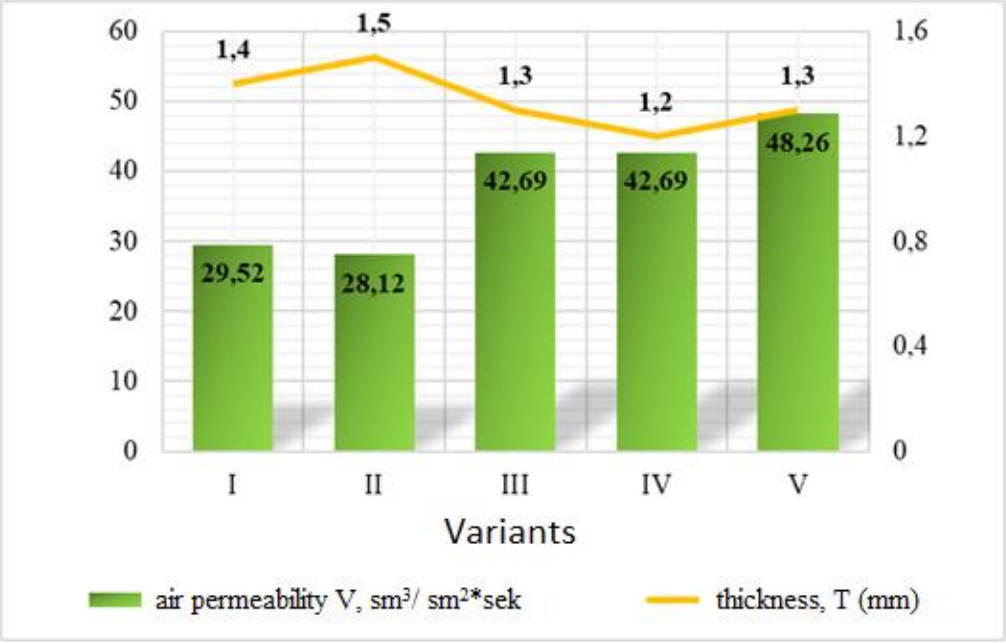



Fig.1. Histogram of the relationship between the air permeability and the thickness of the compression fleecy knitting product.

The parameter of abrasion resistance of knitting products varies in a significantly large range from 20 to 500 thousand at the limits of the tool circle that determines the abrasion resistance. In terms of quality evaluation, the abrasion resistance of the knitting product is measured by the number of rotations on the loom until the product of the sample is worn. The results of the analysis show that the abrasion resistance of compression fleecy knitting product is 26.5 thousand/cycle from 30 thousand/cycle changed from to a higher parameter. This, in turn, means that the compression fleecy knitting product has a high level of resistance to friction.

Among the compression fleecy knitting products, the highest values of breaking strength in both length and width were observed in variant I (base) and the lowest values in both length and width were observed in variant III. As a result of the analysis, it can be concluded that as the amount of spandex yarns in the product increases, the tensile strength of the compression fleecy knitting product also increases. At the same time, in the composition of the compression fleecy knitting product, the displacement of the fleecy yarns from the next loop row to one and two loop widths leads to a decrease in the width of the fleecy knitting product breaking strength.

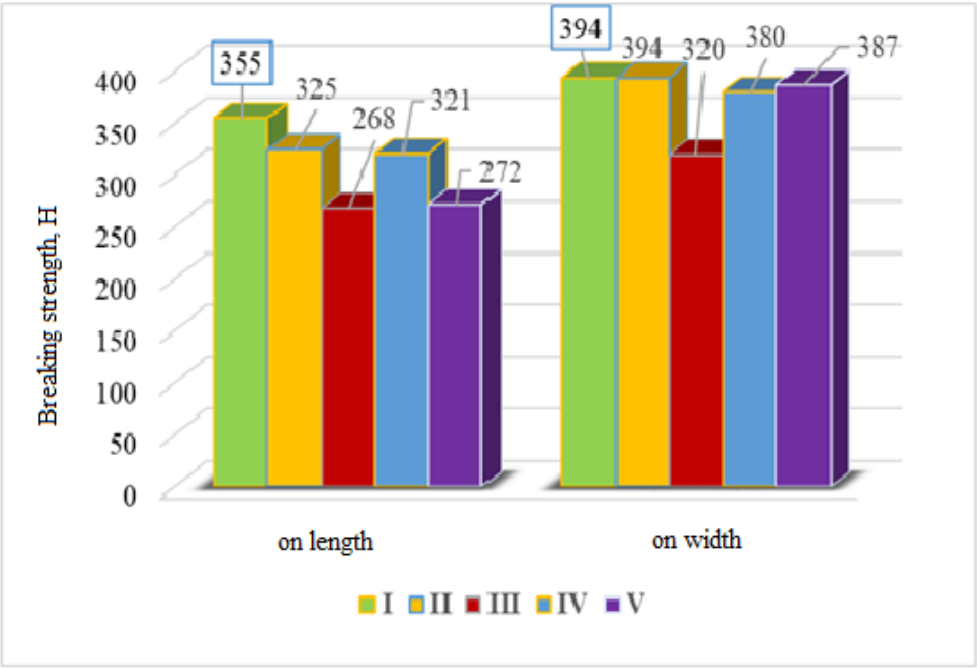



Fig.2. Histogram of changes in breaking strength of compression fleecy knitting product.

Determining the quality of the product during the period of use varies depending on the level of demand. Therefore, the quality value for one or another kind of product, especially for multi-purpose products, is not constant. For example, light coveloops and special clothes are made from linen woven fabric, but their quality parameters are different.

Value of the quality of textile materials and other kinds of products is based on the results of determination and measurement of its quality parameters, as well as the value of comparison with standards and regulatory documents. Because the methods of determining product properties are mainly detailed in standards and other regulatory documents.

Based on the methods of obtaining compression fleecy knitting products, it was determined that the raw materials used are of great importance, and the kind and characteristics of raw materials used in the production of compression fleecy knitting products were selected. In order to improve the operational properties of compression fleecy knitting product, spun cotton yarn with a linear density of 30 tex, latex yarn, and spandex yarn with a linear density of 75d 40F were used. Technological parameters and physical-mechanical properties of compression fleecy knitting products were determined and analyzed. From the results of the study of technological parameters, it was found that the change of the thickness and surface density of the knitting product obeys a certain law, that is, as the thickness of the fleecy knitting product increases, its surface density also increases (variants I and II), and vice versa, as the thickness decreases, the surface density also decreases (II, III, IV, V variants), in which the surface density was observed to vary in the range of 405 - 525.4 g/m$^2$.

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