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# EVALUATING AVAILABILITY CHARACTERISTICS OF KNITTED USED FOR INTERIOR DESIGN

**LUTIC Liliana**

"Gh. Asachi" University, Faculty of Textile Leather and Industrial Management, Knitting and Ready – Made Clothing Department, 29 Dimitrie Mangeron Street, 700050, Iasi, România

Corresponding author: Lutic Liliana, E-mail: llutic@tex.tuiasi.ro

***Abstract:*** *Technical knitted are successfully used in manufacturing mattresses, upholstery and interior decoration. This is due to the extremely varied design of the knitted, the structural diversity, the raw materials of a remarkable variety (including the ecological and biodegradable ones), durability, particular versatility and improved performances during use. These aspects lead to beneficiaries' satisfaction during both the visual and tactile analysis of the products as well as their use. Establishing a correlation between the requirements of the beneficiaries, the functions and representative quality characteristics, in relation to the usage of the product, is the basis of the creation and design activity, finalized with the elaboration of the product and process documentation. Evaluating the product's quality level has as a starting point, the use of standardized methods for measuring / estimating the representative quality characteristics, in order to determine the degree of influence these characteristics have on the product behavior during use. This leads to the possibility of choosing the optimal variants, which best reflects the wishes of the beneficiaries. In the case of knitted intended for mattresses, upholstery and interior decoration, availability characteristics (durability, maintaing shape, appearance, color and size) can be considered a priority.*
*In this sense, the paper presents the evaluation methods for resistance and deformation of technical knitwear, under the action of uniaxial and multiaxial mechanical stresses (tearing resistance and elongation, piercing resistance and deformation arrow). These characteristics highlight the durability of the products and their ability to maintain their original shape, appearance and dimensions over time.*

***Key words:*** *quality, availability, mattress, decorations, evaluation, characteristics.*

## 1. GENERAL CONSIDERATIONS

Knitted fabrics ensure the manufacture of a great diversity of products used in all compartments of human activity. This is due to the many advantages offered:

- diversity of presentation forms;
- reduced specific mass compared to other textile materials;
- creating knitted structures that combine the characteristics of woven fabrics (resistance to mechanical stress, reduced extensibility), with those specific for knitted (spatial modelling capacity, voluminousness, possibilities for extended diversification, pleasant touch, etc);
- use of a large range of yarns with superior features;
- performance of knitting technologies;
- possibility of directing the knitting process in order to insure the quality characteristics demanded by the beneficiaries;

- high economic efficiency.

Speciality literature classifies knitted products in 12 branches: Agrotech, Buildtech, Clothtech, Hometech, Geotech, Medtech, Protech, Sporttech, Mobiltech, Indutech, Packtech, Oekotech [1, 2].

## 2. TECHINCAL KNITTED USED FOR INTERIOR DECORATIONS

### 2.1 Beneficiary requirements for the products used in interior design (Hometech)

The technical knitted used in mattress manufacturing, upholstery articles and interior decorations (Hometech branch) is characterized by an extermly varied design, structural diversivity, raw materials with remarkable variety, including the ecological and biodegradable ones, durability and versatility. These aspects lead to gaining user satisfaction during both the visual and tactile analysis of the products as well as improved performance during their use.

Beneficiary requirements for products used in interior design can be [3]:

- Constructive - ergonomic requirements regarding insurance of dimensional correspondence, fibrous composition, structure, mass;
- Aesthetic requirements for surface appearance, type of material, colour or chromatic combination, novelty degree, seams appearance, etc;
- Requirements for insurance of thermal and psychosensorial comfort, flexibility, extensibility and elasticity;
- Ecological requirements for health protection, harmful substances content, flammability, biodegradation capacity in the environment;
- Availability requirements: durability, preservation of shape, dimensions, appearance, colours and elasticity;
- Maintanence requirements regarding for efficient cleaning ability, resistance to dirt, remedy and reconditioning, decontamination ability, etc.

Technical solutions that made possible satisfying these requirements were aimed at:

- ✓ producing integrated knitted with “quilted” finish, whose thickness is obtained by inserting filling yarn between the two layers of stratified knitted fabrics;
- ✓ creating stratified Jacquard structure with voluminous filling yarns, fixed between the two layers of the knitted by connection points; the effect consists of increasing the elastic rebound capacity after compression forces exerted during use are stopped;
- ✓ using natural fibres with an ability to absorb and wick away moisture, good air circulation and temperature regulating capacity (offers warm or cool sensation according to the outside temperature);
- ✓ using synthetic fibres obtained through performant technologies that offer the possibility to create voluminous structures with a touch specific to natural fibers;
- ✓ processing yarns with a high mechanical stress endurance;
- ✓ using filament yarns and structures resistant to pilling;
- ✓ producing knitted structures with high resistance against homogenous and heterogeneous friction;
- ✓ using yarns and knitted structures with high endurance for cyclical stress (pull – return, repeated bending and compression);
- ✓ using yarns and a finishing technologies that ensure a fast and efficient cleaning;
- ✓ sing advanced technologies to produce materials resistant to dirt and moisture;
- ✓ using yarns and a finishing technologies that ensure a fast and efficient cleaning.

**2.2. Knitted used for interior designs.**

**Integrated knitted fabrics** are complex multilayer type structures. The yarns processed in manufacturing the two layers of integrated knitted must have characteristics specific for esthetics, comfort, protection and durability, while the filling yarns serve the purpose of thermal isolation and elastic rebound after compression.

In this paper, the study of knitted behaviour aimed for mattresses, covers and interior decorations was performed for five variants of integrated knitted fabrics, with jacquard structure, manufactured from different types of yarns. The knitted was subjected to:

- unidirectional traction loads until tearing, measuring resistance and tear elongation;
- multiaxial deformation loads, measuring the piercing resistance and the deformation arrow [4].

The characteristics of the five variants of integrated knitwear under study are presented in Table 1.

***Table 1:*** *Characteristics of integrated knitted variants*

| Knitted variant | Structure | Prime material | | | Filling yarns sequence | Thickness [mm] | Weight [g/m$^2$] | Special characteristics |
|---|---|---|---|---|---|---|---|---|
| | | Front yarns | Back yarns | Filling yarns | | | | |
| **V 1** | **Irregular jacquard** | PES Nm 18/1 | PES 150 den | PES 600 den | 1/4 | 1,59 | 245 | Special esthetic look by using yarns of different sheen High termal comfort |
| **V2** | **Double relief rib jacquard** | PES Nm 18/1 | PES 150 den | PA 1250 dtex | 1/3 | 2,48 | 350 | |
| **V 3** | **Double relief rib jacquard** | Bamboo viscose Nm 20/1 | PES 150 den | PES 1200 den | 1/4 | 2,49 | 250 | High termal comfort achieved through ecologicall fibers |
| **V 4** | **Double relief rib jacquard** | Bamboo viscose Nm 20/1 | PES 150 den | PES 600 den | 1/4 | 3,15 | 264 | |
| **V 5** | **Irregular jacquard** | PES 52% PES+ Viscose 48% Nm 20/1 | PES 150 den | PES 1200 den | 1/2 | 2,68 | 342 | Superior comfort and ecological charcateristics |

## 2. EVALUATING AVAILABILITY CHARACTERISTICS

**3.1. Evaluating availability of the knitted**

The integrated knitted fabrics can be used as outer layer for producing mattresses, furniture upholstery and interior decorations (covers, coverlets), etc. As such, it is necessary that the knitted be characterised by:

- ❖ high spatial shaping ability;
- ❖ increased resistance to different types of loads;
- ❖ good rebound ability by returning to initial shape and size when usage mechanical loads are ceased;
- ❖ proper adhesion strength to contact layers.

Evaluating product quality implies the establishment of representative characteristics in relation to their destination and the application of standardized testing methods, in order to choose

the optimal variants. Static mechanical loads (tearing elongation and resistance, piercing resistance, ripping) and dynamic loads (shock resistance), non destructive or distructive, are commonly encountered during use. To assess the availability of integrated knitted used in mattresses, upholstery and interior decoration (covers, coverlets, etc.) these characteristics were considered as representative: durability for unidirectional loards for stretching to tearing and multidirectiona loadsl to piercing. Tear elongation and piercing resistance influence the product's behavior during use and largely determine its availability function. Testing the behavior of the five intergrated knitted variants under tear-elongation mechanical loads was performed in three directions of strain: longitudinal direction (stitch columns), transverse (stitch rows) and a diagonal direction, forming a 45-degree angle with the vertical axis [4, 5].

The average values obtained are summarized in Table 2.

***Table 2:*** *Resistance values for the analysed knitted variants*

| Knitted variant | Tearing resistance $R_T$ [daN] | | | Tearing elongation ε [%] | | | Piercing resistance $R_P$ [daN] | Deformation arrow [mm] |
|---|---|---|---|---|---|---|---|---|
| | Şir Col | Rând Row | Diagonal | Şir Col | Rând Row | Diagonal | | |
| **V 4** | 57,8 | 60,0 | 57,0 | 84 | 40,0 | 41,0 | 84,5 | 1,7 |
| **V 5** | 59,4 | 61,9 | 58,1 | 82 | 42,0 | 43,0 | 86,0 | 1,8 |
| **V 1** | 54,6 | 67,0 | 54,0 | 105 | 55,0 | 70,0 | 80,5 | 1,8 |
| **V 3** | 41,2 | 46,4 | 34,8 | 92 | 55,0 | 95,0 | 74,8 | 2,7 |
| **V 6** | 56,7 | 68,0 | 56,4 | 79,0 | 39,0 | 42,0 | 87,5 | 1,5 |

Comparative analysis of tearing resistance for the six variants of knitted are suggestively illustrated in figures 1 – 4.

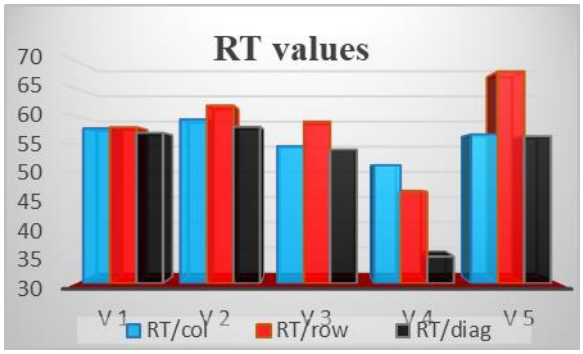


***Fig. 1*** *Comparative analysis of tearing resistance variation on the three stress directions for the knitted variants tested*

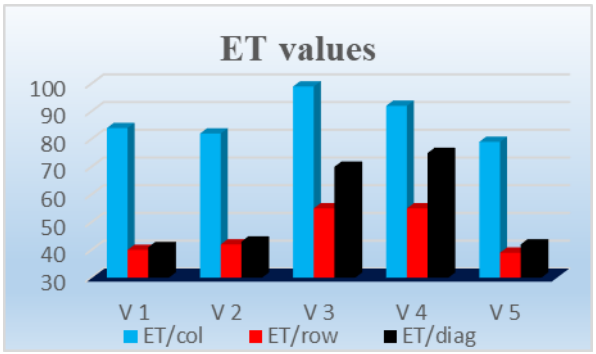


***Fig. 2*** *Comparative analysis of tearing elongation variation on the three stress directions, for the knitted variants tested*

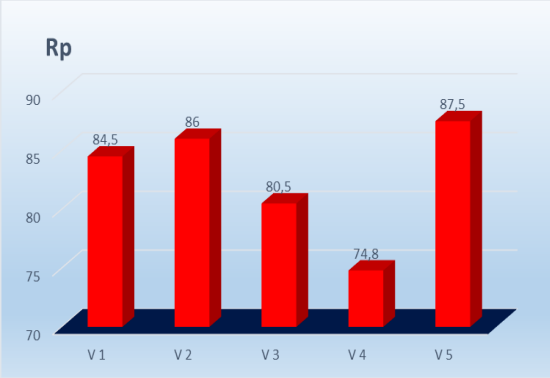


***Fig. 3:*** *Comparative analysis for piercing resistance for all three knitted fabrics models*


***Fig. 4:*** *Comparative analysis for arrow deformation for all three knitted fabrics models*

### 3.2. Conclusions regarding knitted behavious for elongation and piercing demands

- Tearing resistance values, on the three strain directions, are not significantly influenced by the thickness, or the mass of the knitted, but only by the raw material processed, the linear density of the filling yarns processed, and the number of connection points between the two layers of integrated knitted;
- Knitted variants made of PES yarns, on both front and back (V1, V2, V5) have the highest values of tear-elongation and piercing resistance;
- The highest tear-elongation resistance values (over 58 daN), on the transverse direction (stitch rows), were recorded in five of the knitted variants analysed. This is explained by the distribution of forces both on the stitch elements (needle loops and jack loops) and on the filling yarns, inserted between the two layers of the knitted;
- The lowest tear resistance values for the three stress directions, were recorded in the V4 variant that contains bamboo viscose yarns on the front and the lowest filling yarns count. Even if the V1 variant has the same filling yarns count, the fact that it is made on the front with PES yarns compensates for this;
- The lowest resistance values were registered in variant V4; this is explained by the lowest count of filling yarns (600 den) and their lowest insertion ratio (1/4);
- The lowest numbers for tear-elongation were recorded on the transverse direction (of the stitch columns), and the highest values of elongation were recorded in the longitudinal direction (of the stitch rows);
- The lowest numbers in tear-elongation and the deformation arrow were recorded in the V5, V2 knitted variants, for which the insert ratio of filling threads is higher (1/2, 1/3 respectively);
- In regard to the availability characteristics, **the tearing and piercing resistances can be associated with the ability of the product to maintain its integrity**, to the destructive loads exerted during use. **Elongations (deformations) can be associated with shape stability.** As such, it can be considered that:
  - The best variants, with superior behaviours in use (minimal risks of losing their initial characteristics over time) are the variants V1, V2, V5;
  - The most unfavorable variants (with the highest risk of deformation) are the V3, V4 variants.

## 4. CONCLUSIONS

Technical knitted fabrics used to manufacture mattresses, upholstery and interior decoration are characterized by: varied design, structural diversity, a wide spectrum of raw materials, durability, versatility and high performance during use. For the evaluation of the availability of integrated technical knitted, there were considered as representative, in regards to their destination, measurements of resistances for tear elongation and piercing (using the textile dynamometer). Resistance to tearing and piercing can be associated with the ability of the product to maintain its integrity against destructive loads that may occur during use. Elongation and deformation arrow may be associated with the stability of the shape, appearance and dimensions of the product. The evaluation resulted in the following conclusions:

- ❖ In what concerns the availability characteristics, the best variants of integrated knitted with superior behaviours during use (minimal risks of losing their initial characteristics over time) are:
  - Knit fabrics made of PES yarn (on the front, back and as filling yarns) (variants V1, V2);
  - Knitted made of yarn blends with 52% PES, 8% viscose (variant V5).
- ❖ The least favourable variants of the five analyzed (with the highest risk of deformation) are knitted manufactured with bamboo-viscose yarns on the front and PES yarns on the back and filling (variants V3, V4).

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