

ISSN 2181-8622

Manufacturing technology problems



Scientific and Technical Journal Namangan Institute of Engineering and Technology

INDEX  COPERNICUS
I N T E R N A T I O N A L

**Volume 10
Issue 2
2025**



SLIB.UZ
Scientific library of Uzbekistan

EVALUATION OF DEFORMATION PROPERTIES OF HIGHLY ELASTIC KNITTED FABRICS IN SPORTSWEAR DESIGN

MONNOPOV JOKHONGIR

PhD student, Namangan State Technical University, Namangan, Uzbekistan

Phone.: (0891) 281-3443, E-mail.: mannopovjahongir@gmail.com

**Corresponding author*

KAYUMOV JURABEK

Doctor of Technical Sciences, Samarkand State University of Architecture and Civil Engineering, Samarkand, Uzbekistan

Phone.: (0899) 051-0855, E-mail.: juramirza@gmail.com

MAKSUDOV NABIJON

Docent, Namangan State Technical University, Namangan, Uzbekistan

Phone.: (0894) 307-3947, E-mail.: maksudovnabijon@mail.ru

Abstract: The article analyzes the modern range of compression materials, highlighting key factors such as the elasticity, deformation, and abrasion resistance properties of the materials. In the process of designing compression sportswear, selecting fabric samples and conducting tests to determine their mechanical properties is of significant scientific and practical importance. As a result of experimental studies, the elongation of materials was studied, and special testing equipment of the YG026A-III and YG026T models was used to assess the deformation properties. The deformation properties were evaluated, and elongation diagrams were provided, which will help improve the methods used to determine the operational characteristics of materials.

Keywords: elastic fabrics, compression sportswear, tensile strength, compression pressure, deformation.

Introduction. Currently, there is an increasing demand for compression clothing with improved ergonomic and operational characteristics for athletes, healthcare professionals, and individuals leading an active lifestyle. Compression garments offer functions such as enhancing blood circulation, reducing muscle fatigue, and preventing injuries by applying pressure to the human muscle system. In addition, the comfort and long-term wearability of these garments are also crucial factors. Today, most compression clothing has certain shortcomings in terms of breathability, elasticity, and hygienic requirements, which makes their further improvement a pressing issue. Therefore, creating a technology for producing compression sportswear with high operational characteristics is an important scientific and practical task [1].

To achieve and maintain optimal athletic form, athletes frequently use various strategies to aid in recovery and enhance performance. In recent years, compression sportswear that covers the entire body has become popular during training and competitions in various sports. Compression garments are used to: 1) increase the physiological parameters of muscle tissue during exercise and physical training: strength, power, endurance; improve circulation; reduce resistance from the environment (air, water) during high-speed sports; correct body shape; thermoregulation; protect joints and tendons from injuries and strains; 2) accelerate recovery and reduce muscle pain during training and rest periods.

The primary function of compression sportswear for general training is to provide a comfortable environment for athletes during training [2]. Literature analysis shows that compression sportswear helps supply oxygen to muscles during tension and slows down the accumulation of lactic acid. Athletes highly value compression garments for strengthening muscles, reducing vibrations, and decreasing the risk of micro-injuries. Compression garments support the calf muscles, reduce pressure in the calf, and provide protection against excess load in cold conditions, giving athletes a sense of safe movement. During challenging workouts or after long-distance events, compression serves as a preventive measure. The most popular compression sportswear includes t-shirts, leggings, shorts, tops, sleeves, knee and elbow braces, calf supports, and more. The continuous growth of the compression sportswear market leads to rapid advancements in materials, designs, and manufacturing methods [7].

In the design of such sportswear, it is crucial to select elastic materials suited to the specific sport. Several key properties of elastic materials must be considered in this process.

In recent years, the most common reasons for the rejection of some sportswear include:

- Inability to withstand high physical activity and extreme climatic conditions
- Loss of elasticity after multiple uses
- Fading of colors
- Tearing or thinning of the fabric due to excessive friction in areas such as the knees and elbows.

From a design perspective, sportswear must be well-constructed, with sturdy seams, and resistant to wear in high-friction areas. The materials used for the garments should be selected based on their elastic and viscous properties, and deformation characteristics are essential to understand when evaluating the material's performance in a given situation. It is important for compression clothing to retain its shape and characteristics throughout the duration of its use. Therefore, in addition to testing materials according to established standards, scientific research should focus on the stability of elastic and viscous properties to ensure that the garments maintain their form over time [8].

Methods.

Among the elastic-viscoelastic characteristics of elongation in textile materials, the most important for garment design are as follows:

1. Extension – defined as the relative change in the length of the sample under the applied load.
2. Elasticity – the ratio of the total deformation to the initial deformation expressed as a percentage. During active physical training with rapid, high-amplitude movements, the material must return to its original dimensions at the same rate in order to maintain contact with the body's surface.
3. Residual Deformation – the relative increase in the material's dimensions after the removal of the applied load, which defines the residual deformation of the material.

When designing body-compressing garments, it is essential to select, order, and use materials based on their deformation characteristics.


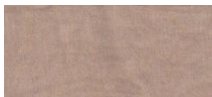

The "Textile Industry Engineering" faculty at Namangan State Technical University has sufficient laboratory equipment for studying the physical-mechanical properties of high-elasticity knitted materials in its educational-scientific laboratory.

Results. Thus, to study the fiber composition, surface density, and structural characteristics of knitted fabrics, commonly used samples for compression sportswear production were selected. Experimental studies were conducted on 15 different types of material samples to determine the deformation properties of elastic materials. The physical-mechanical properties of the fabrics obtained from the research are presented in Table 1. The evaluation of the deformation characteristics of the fabrics was carried out using the specialized testing equipment of type YG026A-III (Figure 1).



Figure 1. YG026A-III equipment

Table 1.

No	Samples	Appearance of the fabric	Fiber content of fabrics (%)	Surface density	Fabric thickness	A group of items
1	Sample 1		Cotton-95, PU-5	195,5	0,45	T-shirt and tank top
2	Sample 2		Cotton-92, PU-8	200,1	0,6	T-shirt and tank top
3	Sample 3		Cotton-95, PU-5	212,2	0,5	T-shirt and tank top

4	Sample 4		Cotton-97, PU-3	169,9	0,6	T-shirt and tank top
5	Sample 5		Cotton-90, PU-10	175,7	0,75	T-shirt and tank top
6	Sample 6		Cotton-95, PU-5	165,4	0,5	Sports underwear
7	Sample 7		Viscose-90, PU-10	196,5	0,8	T-shirt and tank top
8	Sample 8		Cotton-95, PU-5	415,4	1,0	Sports suit
9	Sample 9		Cotton-92, PU-8	182,4	0,6	Sports underwear
10	Sample 10		Cotton-95, PU-5	171,1	0,5	Sports underwear
11	Sample 11		Cotton-95, PU-5	231,4	0,6	T-shirt and tank top
12	Sample 12		PE- 92 PU-8	185,2	0,5	Sports suit
13	Sample 13		PE-94 PU-6	180,4	0,5	T-shirt and tank top
14	Sample 14		PE-94 PU-4	311,3	0,8	Sports suit
15	Sample 15		PE-96 PU-4	430,4	0,8	Sports suit

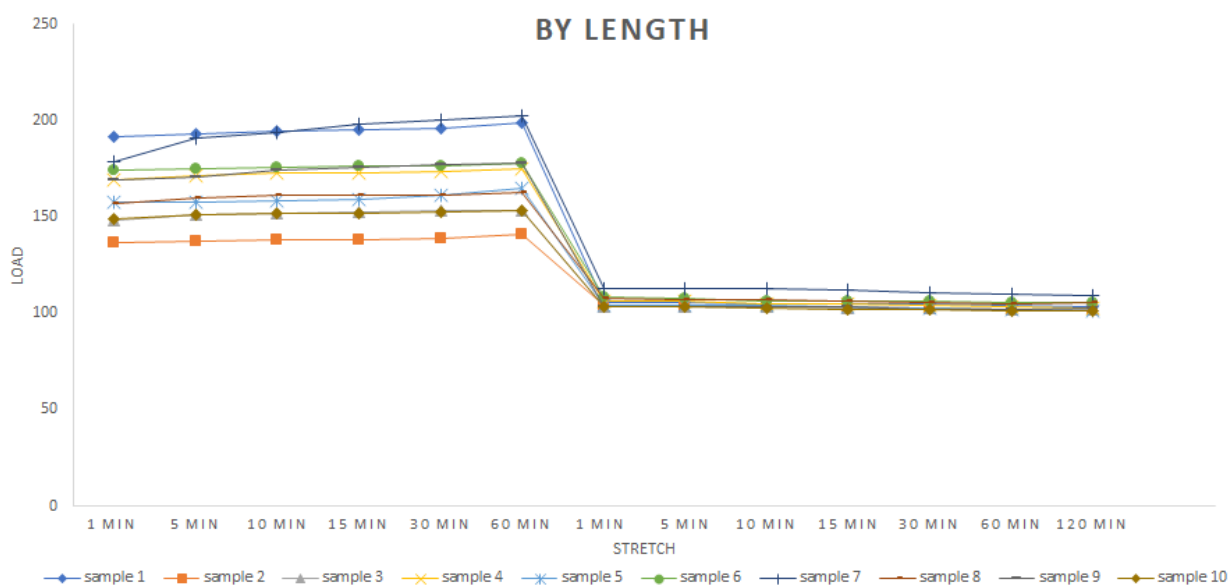
Note: Abbreviations used in the table: PL-polyester fiber, PU-polyurethane fiber.

Discussions. In the framework of experimental research, the tensile strength, deformation stability, and abrasion resistance properties of elastic knitted materials were evaluated. The tensile strength of the samples in both the width and length directions was determined using the YG026T universal testing machine, and this process was conducted in accordance with standard methods [12].

The results presented in Table 2 show that the tensile strength, engagement degree, and abrasion resistance were assessed through the number of cycles of resistance. To determine the deformation characteristics of the knitted fabrics, tests were carried out under a load equal to 5% of the breaking strength, in both the width and length directions. This method is an important criterion for assessing the material's stability under operating conditions [7].

Table 2. Mechanical Properties of Elastic Knitted Fabrics

№	Tensile strength		Elongation at break		Engagement		Number of cycles resistant to abrasion
	By length (N)	By width (N)	By length	By width	By length	By width	
Sample 1	332,2	315,2	216,8	265,1	4	3	23000
Sample 2	176,8	75,8	67,66	261,74	3	4	16000
Sample 3	331,8	174,8	116,8	326,44	3	2	24500
Sample 4	247,8	253,8	133,44	225,4	4	4	19000
Sample 5	200	275,4	242,12	144,54	3	5	16500
Sample 6	432,2	224,2	143,66	323,04	5	3	28500
Sample 7	125,2	114	152,12	195,14	2	3	15000
Sample 8	206,4	661,2	125,96	84,7	4	5	17500
Sample 9	238	215	149,36	276,32	2	3	20500
Sample 10	365,8	207	117,78	312,2	3	4	19500
Sample 11	180,6	82,4	79,2	210,5	2	2	14500
Sample 12	206,7	70,8	135,4	196,2	2	3	16500
Sample 13	135,1	101,2	102,4	148,3	2	2	15500
Sample 14	306,9	86,5	157,4	198,7	3	2	17500
Sample 15	116,3	68,7	96,5	202,4	2	2	16500


Figure 2. Chart of elongation by length of various woven knitted fabrics

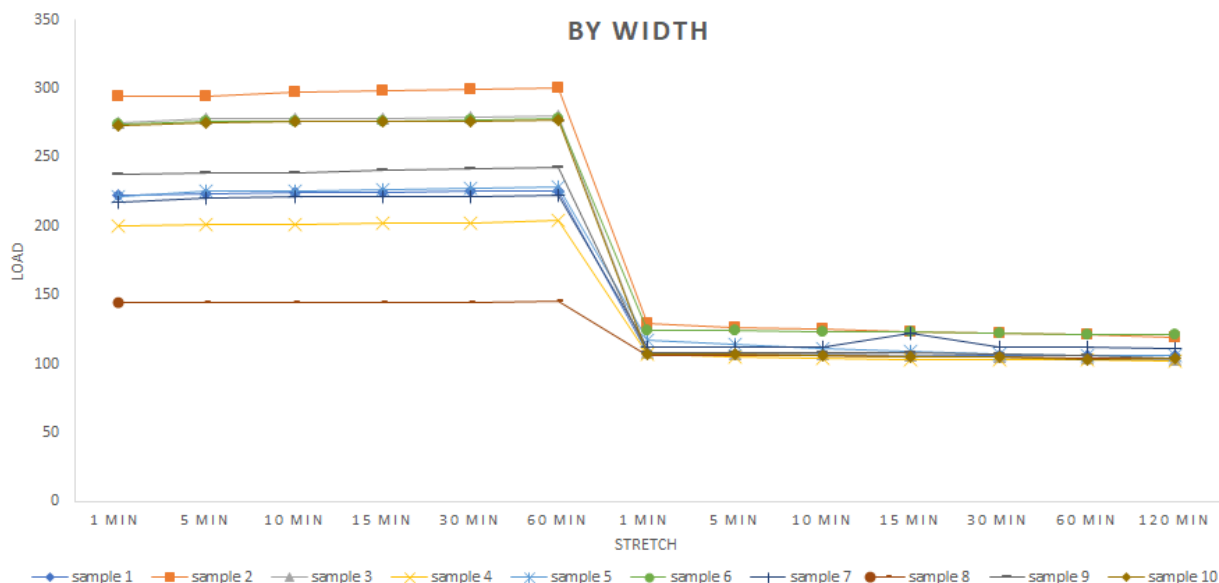


Figure 3. A diagram of the widthwise elongation of various woven knitted fabrics

Conclusions. The results show that, using the available knitting equipment, the fabric with a composition of 95% cotton and 5% polyurethane, and a surface density of 171.1 g/m², meets the required deformation properties. This material can be used to produce compression sportswear with high functional parameters. To increase consumer demand, it is necessary to conduct a broader user survey and make greater use of raw materials with higher linear density. The current technology is universal, primarily enabling the production of a variety of compression items. Furthermore, this product range has high demand and, with seamless longitudinal knitting, can compete with imported analogs. [9][10]

References

1. Filatov, V. N. *Elastic Textile Shells* / V. N. Filatov - Moscow: Legprombytdizdat, 1987. - 248 p.
2. Duffield, R., Kalkhoven, J. T. *Effects of Compression Garments in Strength, Power and Speed-Based Exercise*, University of Technology, Sydney, 01 Jan 2016, (Springer International Publishing), pp. 63-78.
3. Tishlenko, I. V. *Development of a Method for Designing Compression Knitwear*; Specialty 05.19.04 – Technology of Garment Production; for the degree of Candidate of Technical Sciences, Ivanovo, 2017; 204 p.
4. Saidova, Sh. A. *Development of a Method for Designing Ergonomic Clothing Using 3D Scanning*; Abstract of PhD thesis in technical sciences: 27.10.2017 / Sh. A. Saidova - Moscow, 2017. - 19 p.
5. Liu, Y. J. *Survey on CAD Methods in 3D Garment Design* / Y. J. Liu, et al. // Computers in Industry, 2010, 61, pp. 576-593.
6. Fan, J. *Clothing Appearance and Fit*, Science and Technology / J. Fan, W. Yu, L. Hunter // Woodhead Publishing Limited and The Textile Institute, 2004.

7. Zhang, X. *Numerical Simulation of 3D Dynamic Garment Pressure* / X. Zhang, K. W. Yeung, Y. Li // Textile Research Journal, 2002, 72 (3), pp. 245-252.
8. Maksudov, N. B. *Creation of Technology for Developing Compression Sportswear with Improved Hygienic and Deforming Properties*. Dissertation, Tashkent, 2020.
9. Ivanov, A. P., Petrov, S. V. (2005). *Technology of Textile Materials' Deformation Properties*. Moscow: Tekhnika, 2005.
10. GOST 30426-96. *Compression Materials – Physical and Mechanical Properties and Test Methods*. Moscow: Standart, 1996.
11. Apeagyei, P. *Usability of Pattern Customising Technology in the Achievement and Testing of Fit for Mass Customization* / P. Apeagyei, R. Otieno // Journal of Fashion Marketing and Management, 2007, 11(3), pp. 349-365.
12. *Sports Medicine* // Textbook for Physical Education Institutes - Moscow: Physical Culture and Sport, 1987, 326 p.
13. Taya, Y. *Evaluation Method of Clothing Fitness with Body – Part 4: Evaluation by Waveform Spacing between Body and Clothing* / Y. Taya, A. Shibuya, T. Nakajima // Journal Textile Machinery Society of Japan, 1995, 48(11), pp. 261-269.
14. Broun, P. J. *Consumer Choices Clothing Ideas for People with Special Needs* / P. J. Broun // Iowa State University Extension, 2003, 196 p.
15. Connel, L. J. *Body Scan Analysis for Fit Models Based on Body Shape and Posture Analysis* / L. J. Connel, P. Ulrich, A. Knox, et al. // National Textile Center Research Briefs-Management Systems Competency, 2004, 84 p.
16. Liu, R., Lao, T. T., Xiao Wang, S. (2013). *Technical Knitting and Ergonomical Design of 3D Seamless Compression Hosiery and Pressure Performances In Vivo and In Vitro*. Fibers and Polymers, 14(8), 1391-1399.
17. Bhatia, D., Malhotra, U. (2016). *Thermophysiological Wear Comfort of Clothing: An Overview*. Journal of Textile Science and Engineering, 6(2), 250.
18. Junyan, H. U. (2006). *Characterization of Sensory Comfort of Apparel Product*. Hong Kong Polytechnic University.
19. Chunyan, Q., Yue, H. U. (2015). *Design of Outdoor Sports Monitoring Function Cycling Jerseys*. European Journal of Business and Social Sciences, 4(2), 180-189.
20. De Raeve, A., Vasile, S. (2016). *Adapted Performance Sportswear*. In: Proceedings of the 7th International Conference on 3D Body Scanning Technology. Lugano, Switzerland, 30 Nov.-1 Dec. 2016, pp. 9-15.

CONTENTS

TECHNICAL SCIENCES: COTTON, TEXTILE AND LIGHT INDUSTRY

Kadirov K., Xoldorov B., To'xtashev A.	3
Analysis of power quality indicators in light industry enterprises	
Monnopov J., Kayumov J., Maksudov N.	15
Evaluation of deformation properties of highly elastic knitted fabrics in sportswear design	
Nazarova M., Musayeva G., Mirzaraximova S.	22
Study of clothing quality control and analysis	
Abdullayev R.	28
Theoretical basis of technological parameters of the new pneumo-mechanical gin machine	
Bakhritdinov B.	33
Increase production volume by regeneration of cotton	
Otamirzayev A.	38
Measures to dangermine during the initial processing of cotton	
Kamolova M., Abdukarimova M., Mahsudov Sh.	42
Measures to dangermine during the initial processing of cotton	
Shogofurov Sh., Jurabayev N., Xolikov K.	55
Analysis of the technology of obtaining knitted fabrics with patterns and their physical and mechanical properties	
Jurabayev N., Shogofurov Sh., Yusupov S.	64
Study of the physical and mechanical properties of hosiery products made from bamboo yarn	

TECHNICAL SCIENCES: AGRICULTURE AND FOOD TECHNOLOGIES

Nasriddinov B., Serkaev Q., Yo'ldiev A.	70
Effect of solvent compositions on oil indicators in cotton oil extraction	
Yulchiev A., Yuldashev Sh.	79
Economic efficiency in the production of cream-perfumed soap	
Ikromova Y., Ikromov F., Khamdamov A., Xudayberdiyev A.	85
Modeling of primary distillation process of vegetable oil miccella	
Ismailov M., Adashev B.	92
Prevention of external flood formation on the surface of heat exchanger pipes	

CHEMICAL SCIENCES

Tajibayeva N., Ergashev O.	99
Nanofibers based on chitosan and synthetic polymers: a review of properties and applications	

Kuchkarova D., Soliyev M., Ergashev O.	
Quantitative determination of adsorption activity of adsorbents obtained on the basis of cotton stalk and cotton boll	104
Abdullaxanova G., Ergashev O.	
Differential heat and entropy of adsorption of methanethiol in sodalite	112
Paygamova M., Khamzakhojayev A., Ochilov A., Paygamov R.	
Physicochemical properties of carbon adsorbents derived from renewable biomass	121
Kochkarova R.	
Use of electron spectra in determining the coordination number of central atoms of complex compounds based on Ni(II) and Co(II) ions	131
Yusupova M., Mamadjonova M., Egamberdiev S., Abduvohidov I.	
Study of the conditions for the aminolysis of secondary polycarbonate	136
Ikramova G., Askarova O., Siddikov D., Karimov A., Botirov E.	
Chemical components of perovskia kudrjashevii	142
Kaxarova M., Soliyev M.	
Types of plant growth regulators and their application in agriculture	147
Juraboev F.	
Investigation of the synthesis of acetylene amino alcohols and the study of their biological activity	151
Salikhanova D., Usmonova Z.	
Thermal activation of plums	155
Kadirxanov J., Urinov A.	
Development of composite materials for corrosion protection of main gas and oil pipelines with increased chemical adhesion	160
Sotiboldiev B.	
Synthesis of hybrid composites of polysaccharides based on methyltrimethoxysilane	167
Jumayeva D., Nomonova Z.	
Chemical characterization of raw materials used for adsorbent production	174
Muratova M.	
Method for producing a fire retardant agent with nitric acid solutions of various concentrations	183
Shamuratova M., Abdikamalova A., Eshmetov I.	
Physicochemical properties and results of sem analysis of soils in the regions of Karakalpakstan	192
Dadakhanova G., Soliev M., Nurmonov S.	
Composition of oil products and methods of separation of individual substances	199

Hoshimov F., Bektemirov A., Ergashev O.	206
Effectiveness of the drug "Akaragold 72%" against cotton spider mites	
Abdirashidov D., Turaev Kh., Tajiyeu P.	213
Analysis of the physicochemical properties of polyvinyl chloride and the importance of mineral fillers in increasing its fire resistance	

TECHNICAL SCIENCES: MECHANICS AND MECHANICAL ENGINEERING

Makhmudjonov M., Muminov Kh., Tilavkhanova L.	219
Classification and analysis of level measurement methods	
Mukhammadjanov M.	226
Digital modeling of the heat transfer process in oil power transformers in operation	
Mukhtorov D.	230
Investigation of drying efficiency in a solar installation with composite polyethylene film depending on the product thickness	
Tursunov A., Shodmanov J.	239
Advancing sustainable environmental strategies in the cotton industry through dust emission reduction	
Saidov O.	247
Event-driven process orchestration in e-governance: modeling asynchronous integration patterns	
Obidov A., Mamajanov Sh.	252
Organization of scientific and research processes based on information and digital technologies in higher education	
Turdaliyev V., Akbarov A., Toychieva M.	259
Theoretical study of the vibration of chain networks	
Abdusattarov B., Xamidov S.	265
Modeling the process of separating cotton particles from air in the working chamber of a cotton gin	
Toirov O., Amirov S., Khalikov S.	272
Diagnostics of the condition of elements of electric power supply substation	

ADVANCED PEDAGOGICAL TECHNOLOGIES IN EDUCATION

Mukhtorov D., Jamoldinov K.	281
Development and improvement of drying technologies in a solar dryer	
Uzokov F.	291
Graphical solution of systems of equations in two-and three-dimensional spaces using MS excel	

ECONOMICAL SCIENCES

Yuldashev K., Kodirov X.

Financing of pre-school educational institutions based on public-private partnerships and their results **299**

Boltaboev D.

Specific aspects of labor resource management in different countries **304**
