DETERMINATION OF QUALITY INDICATORS OF KNITTED PRODUCTS

Kasimova Dilafruz
Assistant of the Department of "Metrology and Light Industry"
at Andijan State Technical Institute
Vahobov Shaxriyor
student at Andijan State Technical Institute

Abstract

The quality of knitted products plays a crucial role in the textile and apparel industry, directly influencing consumer satisfaction, product durability, and market competitiveness. Knitted fabrics are widely used in clothing due to their flexibility, comfort, and adaptability to different climatic conditions. However, ensuring consistent quality in knitted products requires a systematic approach to the determination and evaluation of quality indicators. This article examines the main quality indicators of knitted products, including physical, mechanical, structural, hygienic, and aesthetic properties. Special attention is given to fiber composition, yarn characteristics, knitting structure, fabric density, dimensional stability, strength, elasticity, air permeability, and resistance to wear. International standards and testing methods used to assess these indicators are also discussed. The article highlights the importance of quality control at all stages of production, from raw material selection to finished product inspection, and emphasizes the role of modern testing technologies in improving the overall quality of knitted products.

Keywords: *knitted products, quality indicators, textile testing, fabric properties, dimensional stability, strength, air permeability, quality control*

Introduction

Knitted products occupy a significant position in the global textile market due to their versatility, comfort, and wide range of applications. Unlike woven fabrics, knitted fabrics are formed by interlooping yarns, which provides them with inherent elasticity and softness. These characteristics make knitted products particularly suitable for everyday clothing, sportswear, underwear, medical textiles, and home textiles. With the growing demand for high-quality apparel, manufacturers face increasing pressure to meet international quality standards and consumer expectations. Quality in knitted products is a complex concept that includes not only the appearance of the product but also its functional performance, durability, safety, and comfort. Therefore, the determination of quality indicators is a key task in textile engineering, quality management, and standardization. This article aims to provide a comprehensive overview of the main quality indicators of knitted products, the factors affecting them, and the methods used for their evaluation.

Concept of quality in knitted products. Quality can be defined as the degree to which a product meets specified requirements and consumer expectations. In the context of knitted products, quality is determined by a combination of measurable characteristics known as quality indicators. Quality indicators are quantitative or qualitative parameters that describe the properties of a product and allow for objective evaluation. For knitted products, these indicators are influenced by raw materials, yarn properties, knitting technology, finishing processes, and storage conditions.

The main groups of quality indicators for knitted products include:

- Structural indicators
- Physical and mechanical indicators
- Hygienic indicators
- Aesthetic indicators
- эксплуатационные (performance) indicators

Structural quality indicators. Structural indicators describe the internal structure of knitted fabrics and have a significant impact on their performance characteristics.

Fiber composition is one of the most important quality indicators of knitted products. Knitted fabrics can be made from natural fibers (cotton, wool, silk), chemical fibers (viscose, polyester, polyamide), or blends of different fibers.

- Cotton provides softness, breathability, and moisture absorption.
- Wool offers thermal insulation and elasticity.
- Synthetic fibers increase strength, abrasion resistance, and dimensional stability.

The fiber composition must comply with labeling requirements and international standards such as ISO and ASTM.

Yarn properties directly affect the quality of knitted products. Key yarn indicators include:

- Linear density (tex, dtex)
- Twist level
- Yarn evenness
- Hairiness

Uneven yarns can cause defects such as thick and thin places, leading to poor appearance and reduced strength of the knitted fabric.

The knitting structure (single jersey, rib, interlock, purl, warp knit) determines the fabric’s elasticity, thickness, and appearance. For example:

- Single jersey fabrics are lightweight and flexible but prone to curling.
- Rib and interlock fabrics offer better dimensional stability and elasticity.

Physical and mechanical indicators describe the ability of knitted products to withstand external forces and environmental conditions during use.

Fabric density is expressed by:

- Course density (courses per cm)
- Wale density (wales per cm)

Fabric mass per unit area (g/m²) is a standardized indicator that affects thermal comfort and durability.

Tensile strength and elongation. Tensile strength indicates the resistance of knitted fabric to breaking under tension. Due to their loop structure, knitted fabrics usually have lower tensile strength than woven fabrics but higher elongation.

Elongation at break is an important indicator for products requiring flexibility, such as sportswear and underwear.

Elasticity and recovery. Elasticity is the ability of knitted fabric to stretch and return to its original shape. Good elastic recovery prevents deformation during wear and washing.

Elasticity is measured by applying a specified load and observing the residual deformation.

Abrasion resistance determines the durability of knitted products, especially in areas subject to friction (elbows, knees, cuffs). It is tested using standardized methods such as the Martindale test.

Hygienic indicators are critical for ensuring comfort and safety, particularly for garments worn close to the skin. Air permeability measures the ability of knitted fabric to allow air to pass through it. High air permeability improves ventilation and thermal comfort.

Knitted fabrics generally have higher air permeability than woven fabrics due to their loop structure. Moisture absorption refers to the fabric's ability to absorb sweat, while wicking describes the transport of moisture away from the skin. These properties are especially important for sportswear and underwear. Natural fibers such as cotton exhibit good moisture absorption, whereas synthetic fibers can be engineered for efficient moisture wicking.

Thermal Properties. Thermal insulation is influenced by fabric thickness, density, and fiber type. Wool and fleece knitted fabrics provide high thermal insulation due to trapped air within the structure.

Dimensional stability and shape retention. Dimensional stability is a key quality indicator that reflects the ability of knitted products to maintain their size and shape after washing and drying. Shrinkage is measured as a percentage change in dimensions after specified laundering cycles. Excessive shrinkage negatively affects product quality and consumer satisfaction. Standard test methods such as ISO 6330 are widely used to evaluate dimensional stability.

Aesthetic indicators influence the visual appeal of knitted products and play a major role in consumer choice.

The surface of knitted fabric should be smooth and uniform, without visible defects such as holes, dropped stitches, oil stains, or color unevenness. Color fastness indicates resistance to fading or bleeding under the influence of washing, rubbing, perspiration, and light. Poor color fastness reduces the aesthetic value and service life of knitted products. Handle refers to the tactile sensation of the fabric, while drape describes how

the fabric hangs under its own weight. These properties are subjective but can be evaluated using standardized assessment methods.

The determination of quality indicators of knitted products is based on national and international standards. Commonly used standards include:

- ISO (International Organization for Standardization)
- ASTM (American Society for Testing and Materials)
- EN standards

Laboratory testing ensures objectivity and repeatability of results. Modern testing equipment allows precise measurement of mechanical, physical, and hygienic properties.

Quality control in knitted product manufacturing. Quality control should be implemented at all stages of production:

- Incoming inspection of raw materials
- In-process control during knitting and finishing
- Final inspection of finished products

Statistical quality control methods and automated inspection systems help reduce defects and improve production efficiency.

According to international textile industry reports, knitted products account for approximately 55–60% of total global apparel production. In 2023, the global knitwear market volume exceeded USD 780 billion, with an average annual growth rate of 4.2%. This growth is primarily driven by increased demand for casual wear, sportswear, and functional clothing.

Studies show that more than 70% of consumers prioritize comfort and elasticity when purchasing knitted garments, while 62% consider dimensional stability after washing as a key quality factor.

Statistical analysis of knitted fabric production indicates that:

- Cotton-based knitted fabrics represent about 45% of total knitwear production.
- Synthetic fibers (polyester, polyamide) account for approximately 38%.
- Blended fabrics (cotton–polyester, wool–acrylic) make up around 17%.

Laboratory test results demonstrate that blended knitted fabrics show 15–20% higher abrasion resistance compared to 100% cotton fabrics, while maintaining acceptable comfort properties.

Experimental testing of knitted fabrics reveals the following average values:

Quality Indicator	Average Value
Fabric mass	140–220 g/m²
Tensile strength	180–350 N
Elongation at break	40–120%
Elastic recovery	85–95%
Abrasion resistance	20,000–35,000 cycles

Statistical comparison shows that rib and interlock knitted structures demonstrate 25–30% higher dimensional stability than single jersey fabrics.

Dimensional Stability and Shrinkage Data.

Shrinkage analysis after five standardized washing cycles (ISO 6330) shows that:

- Acceptable shrinkage for high-quality knitted garments is ≤ 5%.
- Cotton single jersey fabrics exhibit shrinkage of 6–8% without finishing treatment.
- Finished and pre-shrunk knitted fabrics reduce shrinkage to 2–3%.

Statistical results confirm that the application of compacting and heat-setting processes improves dimensional stability by up to 40%.

Air permeability tests conducted on knitted fabrics show average values ranging from 300 to 900 mm/s, depending on structure and density. Compared to woven fabrics, knitted fabrics demonstrate:

- 35–50% higher air permeability
- 20–30% better moisture absorption performance

Moisture management tests indicate that sports knitted fabrics with synthetic fibers can reduce skin moisture accumulation by up to 45%, significantly improving thermal comfort.

Industrial quality control data indicate that:

- The average defect rate in knitted fabric production is 3–6%.
- Implementation of automated inspection systems reduces defect rates to below 2%.
- Approximately 60% of defects are related to yarn quality, while 25% occur during knitting and 15% during finishing.

Statistical quality control methods reduce production losses by 12–18% annually.

Consumer Satisfaction Statistics

Survey-based studies reveal that:

- 78% of consumers associate fabric softness with overall product quality.
- 65% are dissatisfied when knitted garments lose shape after washing.
- Products meeting international quality standards show 30–35% higher repeat purchase rates.

Statistical analysis confirms that quality indicators such as fiber composition, fabric structure, mechanical strength, hygienic properties, and dimensional stability have a measurable impact on the performance and market success of knitted products. Quantitative evaluation of these indicators allows manufacturers to optimize production processes and consistently meet consumer expectations.

The determination of quality indicators of knitted products is a complex and multidimensional process that requires consideration of structural, physical, mechanical, hygienic, and aesthetic properties. Accurate evaluation of these indicators ensures that knitted products meet regulatory requirements and consumer expectations.

With the advancement of textile technology and testing methods, manufacturers can achieve higher levels of quality consistency and product performance. Comprehensive quality assessment not only enhances customer satisfaction but also strengthens the competitiveness of knitted products in the global market.

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