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Influence of Woven Fabric Construction on Seam Thread Slippage

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Abstract

The aim of this paper is to investigate the effect of woven construction and tension of warp and weft in the woven fabric on the seam slippage using a new approach with video analysis. The method includes measuring the surface of the resulting hole after subjecting the samples to seam slippage test, described in standard HRN EN ISO 13936-1:2008. The new method provides a more detailed and broader description of seam damage caused by tensile stress. Testing was also conducted using the standard method by measuring the distance two adjacent threads. The results show that surface of resulting "hole" depends on the density of warp and weft and the weave of the fabric. The new approach enables a detailed overview of the seam damage after tensile stress.

Keywords: Woven Fabric Structure; Warp and Weft Interlacement; Weave Factor; Seam Slippage; Seam Fault

1 Introduction

Due to different static and dynamic loads in places of a sewn seam adjacent warp or weft threads can be misplaced, i.e. fabric density can be changed along the seam. This occurrence is described as thread slippage in a seam which is measured in the area of the greatest distance between two adjacent fabric threads expressed in millimetres. Excessive slippage disturbs aesthetic appearance of the product, but it also reduces its utility value, functionality and quality. The amount of permissible slippage depends on the agreement between the manufacturer and the customer. Slippage value depends on many factors related to external factors (intensity and duration of loading), fabric and yarn parameters and parameters of a sewn seam. Fabric weave, number of weft and warp interlacements in a weave unit, warp and weft density, surface properties of warp and weft that are exclusively related to friction parameters of yarn, yarn fineness, yarn manufacturing technology, fiber fineness, raw material composition and fiber length of the yarn and fabric finishing treatments have the biggest influence. One of the most important parameters is the contact area between warp and weft threads in the places of crossing points (greater area-higher friction force) [1-6]. Different types of sewing stitches are used in the technological sewing

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process. Due to the formation of sewing stitches various forces come into effect that can be considered in two parts: action of forces when tightening sewing stitches and action of forces when the needle with the sewing thread passes through the material to be sewn. Fabric slippage in clothing belongs to one of the most significant quality parameters from an aesthetic point of view. Except in cases of a combination of fabric properties which have an undesirable effect on slippage described in the introduction, seams in garments exposed to higher stresses are subjected to seam thread slippage. There are several critical places, such as shoulders, back and side seams of the jacket, pocket seams and buttock seams of the trousers [7, 8]. Narrow clothing is more prone to greater slippage, regardless of whether it was so designed or whether it is worn by a fuller-figured person. Normal clothing care (clothes laundering or dry cleaning) can also facilitate slippage which can occur because of removing anti-slippage agents.

The most common requirement on fabrics for manufacturing clothes in practice is that seam slippage is not greater than 2 mm, and for linings smaller or equal to 1 mm which should be retained during the whole garment lifecycle.

In case of a sewn seam the sewing thread joins two fabric pieces [9]. The seam is under certain tension which depends on thread tension during the sewing process, fabric tension and seam density. Seam tension is transferred to the surrounding parts of the fabric and affects the fabric transversally to the seam axis. This results in a deformation of the seam geometry and the misplacement of threads along the seam. Depending on the seam direction, warp and weft threads are misplaced (density disruption), and the distance between two adjacent threads depends on the ratio of the friction force between the warp and weft threads in relation to the value of loading force (tensile force) in the seam. Thread slippage in the fabric seam can be described as a deformation reflected as the misplacement of warp or weft threads, so-called "seam opening", and they are not broken, but there is a density disruption of fabric threads in the seam area. The greatest distance in millimetres among threads is observed.

Higher density of warp or weft threads in the fabric results in lower slippage. This is the consequence of a greater contact surface between two thread systems and a larger number of interlacements on a fabric length unit which directly affects the value of friction force among fabric threads. Fabric construction is more stable when a larger number of interlacements of two thread systems of the fabric is applied. The contact surface between the threads directly affects the value of friction force; it is higher if the number of interlacements is larger. In places where there is no interlacing between the warp and weft threads, where the threads are more mobile making the fabric structure less stable, the contact surface between two thread systems is smaller. If there is higher tension of warp threads in processing and weaving, weaving-in compared to weft threads is smaller. Size pick-up increases their rigidity so that weft threads with lower tension are suppler, they wrap around the warp threads in crossing points, leading to higher weft contraction. The results show that weft thread consumption is higher. The reason for this is that the weft is tighter in the weaving process and adjusts more or wraps more around the warp. An exception is warp rib weave with a thread density of 24/20. The reason could be bending stiffness or the weft has not adjusted to the warp (it interlaces with the warp in 1/1, and the weft interlaces with the weft in 2/2). In this pattern warp density is higher than weft density which supports the theory that the reason might be high bending stiffness of the yarn [10]. It was found that two adjacent weft threads, which interlace in the same way, were calculated as the square root of the number of the adjacent identical binding weft threads due to Hamilton's theory according to which the threads have the possibility of drawing closer to each other, whereby they change the shape of the cross-section [11]. The previous studies confirmed this theory where it was established that