Annals of Warsaw University of Life Sciences – SGGW
Forestry and Wood Technology № 114, 2021: 110-115
(Ann. WULS - SGGW, Forestry and Wood Technology. 114, 2021: 110-115)

Influence of technological parameters on the upholstery seams in furniture

EWA SKORUPIŃSKA[1], KRZYSZTOF WIADEREK[2], MACIEJ SYDOR[1]

[1]Departament of Woodworking and Fundamentals of Machine Design, Faculty of Forestry and Wood Technology, Poznań University of Life Sciences
[2]Departament of Furniture Design, Faculty of Forestry and Wood Technology, Poznań University of Life Sciences

Abstract: *Influence of technological parameters of the upholstery seams in furniture.* Based on the real problem of weak seams in covers of wooden furniture, a multifaceted analysis of the issue was performed. As a result, it was decided to carry out comparative laboratory strength tests of seams made with the use of various technological parameters. For the production of test samples, we used different yarn threads to find the best and sufficiently strong seams for used fabrics. The test results show that not only the thread and fabric used, but also the sewing technology parameters have a significant influence on the seam strength. Overall, these results indicate that to increase the seam strength, it is necessary to choose thread type B with very high strength and low elongation at break. This solution will minimize the risk of broken threads in case of deviation of material features and technological parameters, which can be variable in the long duration of large-scale production.

Keywords: thread, seam, fabric, elongation, upholstered furniture

INTRODUCTION

To achieve the highest possible quality of use for upholstered furniture, it is necessary to design a wooden support structure as well as to properly select the materials of the spring layer and the decorative layer. The correctness of construction and functionality of upholstered furniture is determined both by the frame design ensuring correct linear and angular furniture relations, as well as by the design of upholstered parts assuring comfort and aesthetic requirements (Eckelman 1978, Smardzewski 2015, Joščák and Langová 2018). The seats of upholstered furniture deform elastically during their use (Wiaderek 2012). Consequently, the seams of the upholstery fabrics covering them are prone to tearing. Typical locations of broken seams are shown in Figure 1

Figure 1. Examples of broken seam in upholstery furniture seats

There are studies available in the literature on techniques decreasing the seam slippage (Galuszynski 1985, Pasayev *et al.* 2012), the influence of cyclic loads on the strength of seams (Shimazaki and Lloyd 1990), influence of thread properties (Gunaydin 2019) and the influence of various parameters on the visual quality of the seams (Pavlinić *et al.* 2006). However, there is little comparative research on the quality of seams (Sukran 2020), for obvious reasons, they do not cover all possible seam variants in the furniture industry.

To improve the quality of upholstery seams, it is necessary to perform laboratory tests the selected seam variants. This study aimed to determine the influence of thread type on the tearing strength of seams. An additional aim was to indicate the influence of technological parameters on the quality of seams in upholstered furniture.

MATERIALS

Four variants of samples were tested. The test samples were made of two types of sofa fabric: woven and velvet, each of these fabrics in two variants (for the European Union and for Great Britain market). The fabrics intended for the EU market did not have any additional coatings, while the fabrics for the UK market were coated with flame retardant chemicals; as a result of the coating, both “UK” fabrics were harder than “EU” fabrics. The following fabrics were investigated: woven EU (“Gunnared dark grey EU” and (“Gunnared light grey EU”), woven GB (“Gunnared dark grey GB”), velvet EU (“Sunningdale dark grey EU” and (“Sunningdale yellow EU”), velvet GB (“Sunningdale yellow GB”). Tufting tapes of 11 cm length were used for all samples. Three types of sewing threads were used. Table 1 shows the technical data of the threads used in laboratory tests.

Table 1. Technical data of threads

Thread	Tex №	Linear density (dtex)*	Linear density (Nm)*	Breaking force (cN)**	Elongation at break (%)**	Needle size Nm	Needle size №	Material
A	70	244 × 3	41 / 3	4534	17	90-120	14-19	Polyester
B	90	302 × 3	33 / 3	5605	18	100-130	16-21	Polyester
C	70	263 × 3	38 / 3	5030	29	110-130	18-21	PA11
Notes: * According to ISO 2060:1994; ** according to ISO 2062:2009								

A typical industrial sewing machine for heavy sewing was used to prepare the test samples (Djurkop 867, Djurkop, DE). Thread balance and number of threads in the 10 cm seam were verified on 6 fabric variants (3 samples from each variant). The seams were made in accordance with the current documentation (3 stitches per 1 cm) and technology (machine calibration, thread tension, etc.). A #301 stitch type was used (ISO 4915:1991), shown in figure 2.

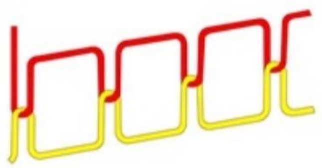

Figure 2. The #301 stitch type used in experiments (ISO 4915:1991)

Seam strength and seam elongation were verified using the following technological parameters:

- thread A, 3 stitches per 1 cm (lowest price),
- thread B, 3 stitches per 1 cm (middle price),
- thread C, 3 stitches per 1 cm (the highest price).

Therefore, 4 sample variants were made for the tests. Seam strength and seam elongation were measured according to ISO 13935-2:2014 and ISO 13934-1:2013 standards. A laboratory universal testing machine was used as the measuring device (figs. 3 and 4).

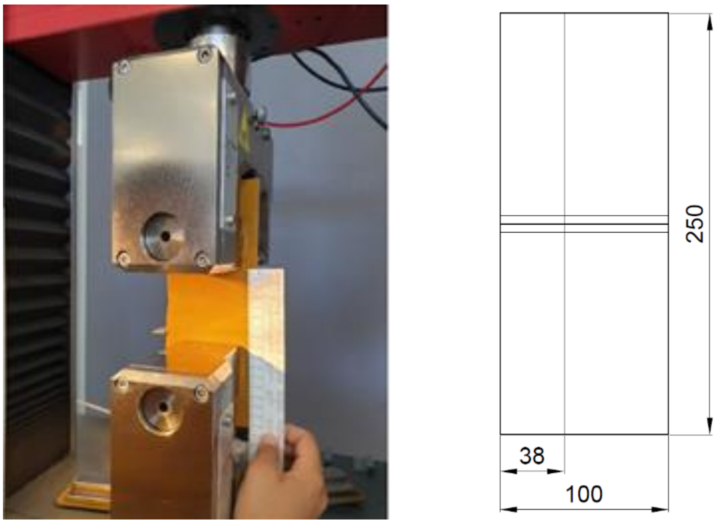

Figure 3. Seam strength test ISO 13935-2:2014

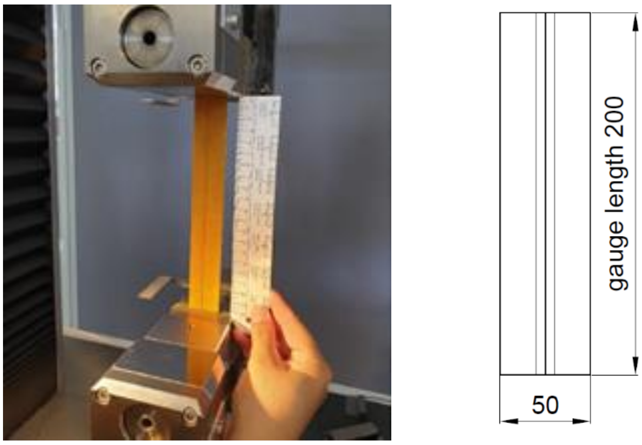

Figure 4. Seam elongation test ISO 13934-1:2013

RESULTS AND DISCUSSION

Figure 5 shows the measured strength differences between the used seams.

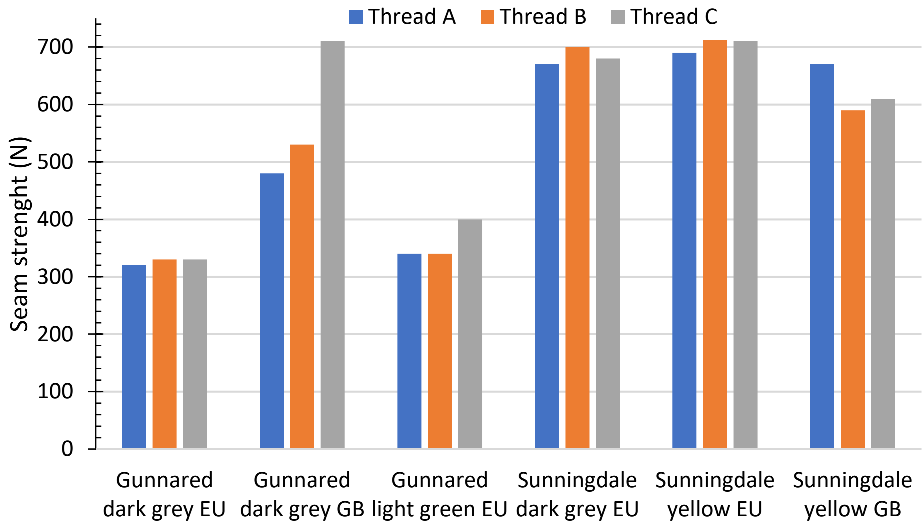

Figure 5. Seam strength test results

Thread B is the most resistant to breaking (table 1), but by analyzing Figure 5, it can be seen that it can form the most durable seam in only one out of six cases. Figure 6 shows the significant influence of thread type and fabric type on seam elongation.

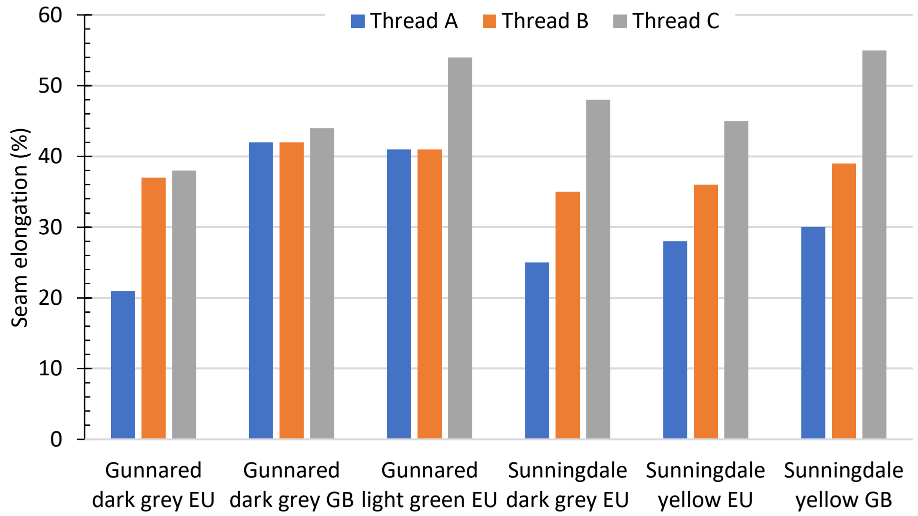

Figure 6. Seam elongation test results

Figure 6 shows that the greatest elongation was observed for the C thread, and the smallest for the A thread. The B thread had medium and more uniform elongations. Analyzing the seam elongation results and taking into account the thread parameters in Table 1, it can be concluded that the most elastic thread (C) allows to make the most elastic seam for velvet. However, this is not a fixed rule. In two out of three woven, the much less elastic thread (B) allowed for very flexible seams. The seam strength increases with the fabric's malleability. It is important at the furniture design stage to choose the right fabrics for a given construction. If the cover is composed of small elements, which in effect will be subjected to constant stress – it is better to choose the fabrics with higher malleability. The results suggest that critical for the sewing process are:

- machine calibration, proper tension of threads in the machine,
- the thread itself, seam elongation between threads A and B has a great effect on improving seam elongation. Seam elongation in tufted seat construction of upholstery is quite important to maintain the seam order.

CONCLUSIONS

During the production of a very long series of products, with the supply of materials whose technological properties may slightly change in the long duration of large-scale production. It is very important to detect the problem at the technology delivery stage. Nevertheless, the production process is also crucial for the end result and low claim rate. The production process should be as little sensitive to disturbance as possible. The critical parameters in this process are machine calibration and thread tension. The results of this study show:

1. Fireproofing of fabrics changes the seam strength, this may be due to fabric stiffening, resulting in less fabric flexibility. Under tension, the fabric will have little stretch.
2. Machine calibration and thread tension are critical for the sewing process analyzed.

Based on the analysis of research results, two technological decisions were made: (1) We decided to change threads to B. (2) Recommendations were made for maintenance and machine operators to perform the required actions in order to avoid future problems. This will minimize the risk of broken threads in case of deviation of material features and technological parameters, which can be variable in the long duration of large-scale production.

Author's participation: Ewa Skorupińska – identification of the research problem, participation in the planning of the experiment, participation in the research, preparation of research results, participation in the analysis of the results, participation in the drawing conclusions, writing the article. Krzysztof Wiaderek – participation in the analysis of the results. Maciej Sydor – participation in the analysis of the results, participation in the drawing conclusions.

REFERENCES

1. ECKELMAN C.A., 1978: Strength design of furniture. Casper: Tim Tech Inc., [Online]. Available: http://www.agriculture.purdue.edu/fnr/faculty/Eckelman/pdf/pdm0scan.pdf
2. GAŁUSZYŃSKI S., 1985: 31 - Some aspects of the mechanism of seam slippage in woven fabrics. The Journal of The Textile Institute, 76 (6), 425-433, doi: 10.1080/00405008508658957.
3. GUNAYDIN G.K., 2019: Effect of coating ratio and weft density on some physical properties of upholstery fabrics, Ind. Tex., 70 (4), 379-385, doi: 10.35530/IT.070.04.1695.
4. ISO 13934-1: 2013 Textiles - Tensile properties of fabrics - Part 1: Determination of maximum force and elongation at maximum force using the strip method
5. ISO 13935-2: 2014 Textiles - Seam tensile properties of fabrics and made-up textile articles - Part 2: Determination of maximum force to seam rupture using the grab method
6. ISO 2060: 1994 Textiles - Yarn from packages - Determination of linear density (mass per unit length) by the skein method

7. ISO 2062: 2009 Textiles - Yarns from packages - determination of single-end breaking force and elongation at break using constant rate and elongation at break using constant rate of extension (CFR) tension
8. ISO 4915: 1991 Textiles - Stitch types - Classification and terminology
9. JOŠČÁK P., LANGOVÁ N., 2018: Pevnostné navrhovanie nábytku / Strength design of furniture. Zvolen: Technická Univerzita vo Zvolene
10. PASAYEV N., KORKMAZ M., BASPINAR D., 2012: Investigation of the techniques decreasing the seam slippage in chenille fabrics (Part I), Textile Research Journal, 82 (9), 855-863, doi: 10.1177/0040517511413320.
11. PAVLINIĆ D. Z., GERŠAK J., DEMŠAR J., BRATKO I., 2006: Predicting Seam Appearance Quality, Textile Research Journal, 76 (3), 235-242, doi: 10.1177/0040517506061533.
12. SHIMAZAKI K., LLOYD D. W., 1990: Opening Behavior of Lockstitch Seams in Woven Fabrics Under Cyclic Loading Conditions, Textile Research Journal, 60 (11), 654-662, doi: 10.1177/004051759006001105.
13. SMARDZEWSKI J., 2015: Furniture design. Basel, Switzerland: Springer International Publishing A.G., [Online]. Available: https://doi.org/10.1007/978-3-319-19533-9
14. SUKRAN K., 2020: Comparison of sewn fabric bending rigidities obtained by heart loop method: effects of different stitch types and seam directions, Industria Textila, 71 (2), 105-111, doi: 10.35530/IT.071.02.1647.
15. WIADEREK K., 2012: Antropotechniczne modelowanie sztywności siedzisk mebli do wypoczynku / Anthropotechnical modeling of the seat stiffness in furniture for rest, Dysertacja doktorska / PhD thesis, Uniwersytet Przyrodniczy w Poznaniu, Poznań

Streszczenie: *Wpływ parametrów technologicznych na szwy tapicerskie w meblach*. W oparciu o rzeczywisty problem słabych pokryć szwów drewnianych mebli tapicerowanych, przeprowadzono wieloaspektową analizę tego zagadnienia. W rezultacie postanowiono przeprowadzić laboratoryjne badania porównawcze wytrzymałości szwów wykonanych z zastosowaniem różnych parametrów technologicznych. Do produkcji próbek testowych użyliśmy różnych nici, aby znaleźć najlepsze i wystarczająco mocne szwy dla używanych tkanin obiciowych. Wyniki badań pokazują, że nie tylko zastosowana nić i tkanina, ale również parametry zastosowanej technologii szycia mają istotny wpływ na wytrzymałość szwu. Uzyskane wyniki wskazują, że w celu zwiększenia wytrzymałości szwu konieczne jest wybranie nici typu B o bardzo dużej wytrzymałości i niewielkim wydłużeniu przy zerwaniu. Takie rozwiązanie zminimalizuje ryzyko zerwania nici w przypadku ewentualnych zmian cech materiałowych i parametrów technologicznych, co może nastąpić w długim okresie produkcji na dużą skalę.

Corresponding author:

Ewa Skorupińska
ul. Wojska Polskiego 28, 60-637 Poznań, Poland
email: ewa.skorupinska@up.poznan.pl
phone: +48 61 8466144