



UNION OF ENGINEERS AND TEXTILE
TECHNICIANS OF SERBIA

EDITOR:
SNEŽANA UROŠEVIĆ

VI INTERNATIONAL SCIENTIFIC CONFERENCE
CONTEMPORARY TRENDS AND INNOVATIONS
IN THE TEXTILE INDUSTRY

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**CONTEMPORARY TRENDS
AND INNOVATIONS IN THE
TEXTILE INDUSTRY**

VI MEĐUNARODNA NAUČNA KONFERENCIJA
**SAVREMENI TRENDOVI I
INOVACIJE U TEKSTILNOJ
INDUSTRIJI**

PROCEEDINGS

EDITOR:
Prof. dr SNEŽANA UROŠEVIĆ

PROCEEDINGS

Belgrade, 14-15th September, 2023
Union of Engineers and Technicians of Serbia
Dom inženjera „Nikola Tesla“



UNION OF ENGINEERS AND TEXTILE TECHNICIANS OF SERBIA

AND

UNION OF ENGINEERS AND TECHNICIANS OF SERBIA
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PREFACE

The 6 th International conference "Contemporary Trends and Innovations in the Textile Industry" CT&ITI 2023, is co-organized by the Union of Engineers and Textile Technicians of Serbia, the Union of Engineers and Technicians of Serbia, the Faculty of Technology and Metallurgy in Belgrade, the University of Faculty of Technology, Shtip, North of Macedonia, Society for Robotics of Bosnia i Hercegovina and Balkan Society Of Textile Engineering-BASTE of Greece.

The Ministry of Science, Technological Development and Innovation of the Republic of Serbia of the Republic of Serbia recognized the importance of this Conference, and thus, supported it.

The aim of this Conference is to consider current technical, technological, economic, ecological, R&D, legal and other issues related to the textile industry, then the application of contemporary achievements and the introduction of technical and technological innovations in the production process of fiber, textile, clothing and technical textile by applying scientific solutions in order to improve the business and increase the competitive advantages of the textile industry on the domestic and global market.

Leading scientists and experts from the Balkans and other countries, working at faculties, textile colleges and institutes, but also individuals who professionally deal with the issues at hand are taking part in this Conference.

The Conference program involves papers dedicated to the scientific and practical aspects of the following topics: Textile and Textile Technology, Textile Design, Management and Marketing in the Textile Industry and Ecology and Sustainable Development in the Textile Industry. The Conference program includes 54 papers, and a total of 132 participants from 16 countries: Albania, Bosnia and Hercegovina, Bulgaria, Croatia, Germany, Greece, India, Latvia, North of Macedonia, Portugal, Russia, Serbia, Spain, Slovenia, Turkey and Ukraina.

Therefore, this Conference is an opportunity for establishing scientific, educational and economic cooperation of our country with other countries. Certain number of papers by domestic authors present the project results dealing with fundamental research and technological development, financed by the Ministry of Education, Science and Technological Development of the Republic of Serbia.

I would like to thank all those who have made it possible to organize the conference Contemporary Trends and Innovations in the Textile Industry and make it a success. First, I would like to thank the Scientific and Organizing Committee for working hard, spending countless hours and finding the best solutions for numerous organizational aspects of our Conference. Also, I would like to express my gratitude to all sponsors who believed in the importance of this Conference and co-financed it. I also thank all the other institutions that supported the Conference in various ways, because without their support, the Conference could not have been organized. Last but not least, I would like to thank plenary lecturers, all authors and co-authors and guests for their participation in the Conference.

On behalf of the Organizing Committee

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FINAL CONTROL OF MEN'S SHIRTS

Silvana Zhezhova^{1*}, Sonja Jordeva¹, Saska Golomeova Longurova¹, Sanja Risteski¹ and Vangja Dimitrijeva Kuzmanoska¹

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ABSTRACT: *Quality control is one of the most important factors in the textile industry and it is often closely related to the accepted quality level and final control. The final control is done by the quality controller to ensure that the quality of the garment accomplish the requirements of the client. Quality control is a requirement in the production of men's shirts because it maintains the quality of the brand and the cooperation between the garment company and the customer. Every step in the manufacturing process of men's shirts is vital to the overall quality of the final product. Namely, errors identified during the production process are immediately reported to the manufacturer, so direct intervention is possible for their removal, and not after transport to the client's country. In this way it is possible to save time, reduce production costs and at the same time reduce organizational problems.*

Keywords: *men's shirt, textile materials, quality control, final control.*

ZAVRŠNA KONTROLA MUŠKIH KOŠULJA

APSTRAKT: *Kontrola kvaliteta je jedan od najvažnijih faktora u tekstilnoj industriji i često je usko povezana sa prihvaćenim nivoom kvaliteta i završnom kontrolom. Završnu kontrolu vrši kontrolor kvaliteta kako bi se osiguralo da kvalitet odeće ispunjava zahteve klijenta. Kontrola kvaliteta je uslov u proizvodnji muških košulja jer se njome održava kvalitet brenda i saradnja između konfekcije i kupca. Svaki korak u procesu proizvodnje muških košulja je od vitalnog značaja za ukupan kvalitet finalnog proizvoda. Naime, greške uočene u procesu proizvodnje odmah se prijavljuju proizvođaču, pa je moguća direktna intervencija na njihovom otklanjanju, a ne nakon transporta u zemlju naručioca. Na ovaj način je moguće uštedeti vreme, smanjiti troškove proizvodnje i istovremeno smanjiti organizacione probleme.*

Ključne reči: *muška košulja, tekstilni materijali, kontrola kvaliteta, završna kontrola.*

1. INTRODUCTION

Men's shirts were previously considered as underwear but over time the perception regarding men's shirts changed. Shirts can either be tailored to an individual's physique



or they can be chosen from a variety of fits (Fig. 1). Depending on the purpose, men's shirts are generally divided into casual, sports and formal [1, 2].

The casual shirts have a few cutting parts. Primarily they have a functional meaning - fronts, back, back panel, sleeves, cuffs, long sleeve slit, collar, and sometimes one or two pockets on the front part. Depending on the season, casual shirts are usually divided into winter and summer shirts. It is also determined by the type of material from which they are made, the type of sleeves - long for winter shirts and short for summer shirts.

In sport shirts, the front and back parts can be made up of several parts and with panels in different shapes. Different decorative elements can be used for different models. Sports shirts often use decorative stitching made of thread in a different color, contrasting with the color of the base material.

Formal shirts are meant for various formal occasions. Along with the basic elements of casual shirts, several elements of shirts from the 17th and 18th centuries are also used - zircon decorations, corners, and sometimes lace.

The men's shirt belongs to the group of clothes, for which the most semi-automatic machines have been produced and used to perform various operations. The reason is that the quantities of the same model are large, and the difference between different models is small because the men's shirt is constant to the changes of fashion [3].

The sleeves of the shirts are long or short depending on the season. Formal shirts are long-sleeved. The lower end of the sleeves ends with cuffs and a notch formed by a slit. In high-quality shirts, the slit is always classic.

Collars come in a wide variety of styles, shapes, sizes, and widths but should always work to enhance the design of the garment they are attached to. Shirt collars are usually two-piece and one-piece. In high-quality shirts, the collar is usually two-pieced. One-pieced collars are used in summer shirts. To shape the neckline, some models use other types of collars, for example a russian collar.

Most of the shirts have hard collars and cuffs. Sports shirts are an exception. The desired strength is achieved by fixing the parts with special adhesive interlayers, and in some models, elastic bands are sewn into the corners of the collar to protect them from folding. Doubled lapped seam (Flat and Felled seam) is considered one of the strongest seam and is usually used in men's shirts' side seam operation [4, 5].

2. TYPES OF TEXTILE MATERIALS USED FOR MEN'S SHIRTS

A shirt is a garment that is worn often and usually has close contact with the human body. These characteristics also give the properties of the textile materials from which it is made, namely; high washing fastness, low wrinkling, color fastness, good hygienic properties, i.e. air permeability, hygroscopicity, easy maintenance. Textile materials should also have a soft touch and be comfortable to wear. With the materials used for making summer shirts, special attention should be paid to the influence of the sun, so that they do not change their strength and do not fade easily [6].

Both woven and knitted materials are used to make the shirts. Cotton, linen, wool and silk woven fabrics are most commonly used.



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Cotton fabrics are used to make all kinds of shirts. They can be 100% cotton or a mixture with other chemical fibers: viscose and polyester. Depending on the aesthetic form, they can be with a smooth or embossed surface, single-colored, multi-colored, etc.

Linen fabrics have good hygienic properties. To avoid wrinkling during washing, it is necessary to treat them against wrinkling. They are linen fabrics or various blends of linen and viscose, polyester and cotton. These materials are used to make summer, casual and sports shirts in different colors and patterns.

Silk fabrics can be natural silk, a blend of viscose and polyester, or a blend of viscose with polyester and cotton. As a result of using blended yarns, the materials have good durability, little wrinkling and maintain their appearance when worn. Artificial silk is mostly used for formal shirts, but also for casual summer shirts.

Woolen fabrics are used primarily for casual winter shirts. They are produced from different types of wool with chemical fibers: viscose, polyester. Thanks to the chemical fibers, woolen fabrics have good durability, little wrinkling even during washing, and the shirts retain their good appearance when worn.

Knitted materials. They are circular knitted from cotton or various blends of cotton, polyester and viscose. Due to their elasticity and easy maintenance, they are comfortable to wear and very suitable for summer shirts [6, 7].

3. FINAL CONTROL OF MEN'S SHIRT

The quality of the product is the most important point from the customer's point of view and should be given a lot of attention to the selection of appropriate machines, devices and equipment that will ensure the required quality [7].

Due to the application of various types of textile materials in the process of manufacturing clothes, special attention should be paid to the process of ironing. Ironing plays a major role in the final appearance of the garment and therefore in its attractiveness at the time of purchase. The process of ironing serves to emphasize the diversity and extremes that exist in the clothing industry for different types of clothing, the level of change in styles, and the number of styles produced. To achieve the best ironing results, manufacturers of ironing equipment and machines are constantly working on the development of new possible solutions and ironing techniques. Their efforts are aimed at fully automating the machines with the possibility of precise programming of the ironing parameters.

Smaller apparel companies and fashion studios mostly use simple steam presses and tables for ironing all parts of the garment which prolongs the finishing time of the garment. The bigger apparel companies use specialized finishing ironing machines. Today it is very important, among other things, to carefully choose machines that will reduce the total time to produce a unit of product at a minimum and which will increase the quality of the product.

Quality control is one of the most important factors in a company. Quality is totality of all the properties and characteristics of the products or services that relate to their ability to meet established or expressed needs [8, 9]. The final control of the product is performed after sorting the clothes. The controllers who perform the final control are



usually employees of the company that manufactures the product, but they can be employees of the client. This second variant is becoming more common among clothing companies that produce clothing intended for foreign markets. Namely, identified errors in production are immediately reported to the manufacturer, so direct intervention is possible in order to eliminate them, and not after transport to the client's country. In this way it is possible to save time, reduce costs and at the same time reduce organizational problems. During the final control of the product, it is still possible to correct some errors by re-entering the production process, and damaged products or those with irreparable defects can be classified in a lower class with a reduced price [9].

4. RESULT AND DISCUSSION

The research was done in the apparel company ANGELO in Shtip from August 2022 to October 2022. This company has been operating since 26.12.2003. and is specialized in the production of men's and women's shirts. The company works on the principles of the LON (CMT) system and exports their products mostly to Belgium, Netherlands and Italy. However, part of the production is also intended for the domestic market.

In the finishing department of this company there are no specialized machines and devices for final ironing of shirts, such as (machine for final ironing of collars and cuffs, machine for final ironing of a shirt with blowing, etc.) There are only 3 presses for final ironing and three tables for inspection, control and packing (adjustment) of the shirts (Fig. 2, 3 and 4). The acquisition and inclusion of specialized machines and equipment for shirt ironing would increase the capacity in the finishing department as well as the quality of the product.

A final control of three models of men's shirts, ie a total of 1417 shirts, was performed. The data from the final control of the shirts is entered into a document called the final control protocol (Tables 1, 2 and 3).

The first model is a Martin Maple Classic fit men's long sleeve shirt from order W009 (Table 1). A total of 545 shirts were controlled. Of them, 513 pieces are without errors, that is, 6 % of the shirts have errors. The most common errors in this model of men shirt occurred during the assembling the front and back parts with doubled lapped seam, when sewing the sleeves with a 1cm seam (american seams), when sewing and closing the cuffs on the sleeves and during the adjustment.

In the men's shirt - Ledub Mod fit with long sleeves (Table 2) from order 52877, out of a total of 292 controlled pieces, 260 are without error, while 32 irregularities were found, i.e. errors. This means that errors occur in 11 % of the shirts. The most common errors in the shirt are when sewing the sleeves with a 1cm seam and bad button position, that is, a broken buttons (6 errors).

Table 3 shows the data from the final control of the men's shirt with long sleeves from the LCF-Mod fit model. A total of 580 pieces were controlled. Of them, 527 are without errors, while errors were observed in 53 pieces, which means that 9 % of the shirts have an error. Although the percentage of shirts with an error is not very high, the most common error in this model is a specific error in the shade of the material, and for this

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reason 22 shirts will be disassembled and re-tailored. This means that a very large percentage of the errors that occur will not be able to be simply corrected.

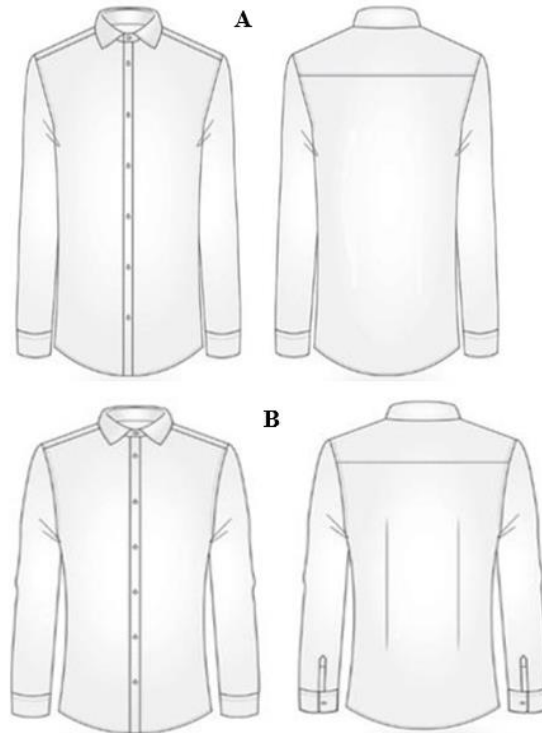


Figure 1: Classic (A), flat and waisted (B) model of men's shirt

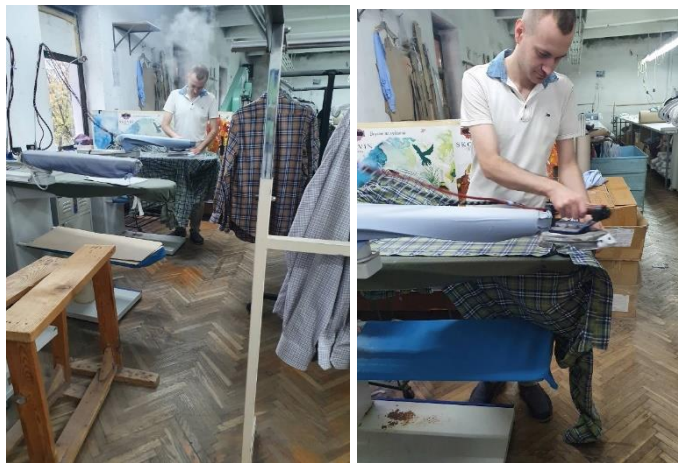


Figure 2: Presses for final ironing in MK Angelo



Figure 3: Packing the shirts at MK Angelo



Figure 4: Tables for review, control, and packaging of shirts in MK Angelo



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Table 1: Protocol of final control of the men's shirt, Martin Maple Classic fit

Company: Angelo Order: W009 Model: Men's shirt - Martin Maple Classic fit Pieces: 545					
Data	08.08. 2022	09.08.2022	10.08.2022	11.08.2022	Total
Total pieces controlled	140	130	140	135	545
Good pieces	129	121	131	132	513
Close collar	2	1	1	/	4
Sewing the sleeves with a 1cm seam	2	2	1	1	6
Assembling the front and back with doubled lapped seam	1	/	2	1	4
Label: Bad position or damaged	/	/	1	/	1
Sewing and closing the cuffs	2	3	1	/	6
Button position or broken button	1	1	1	/	3
Hem bottom	1	1	/	/	2
Final ironing	/	/	/	/	
Adjustment	2	1	2	1	6
Other common mistakes	/	/	/	/	/

Table 2: Protocol of final control of the men's shirt, Ledub Mod fit

Company: Angelo Order: 52877 Model: Men's shirt - Ledub Mod fit Pieces: 292					
Data	12.09. 2022	13.09.2020	14.09.2020	13.05.2020	Total
Total pieces controlled	70	74	72	76	292
Good pieces	60	68	64	68	260
Close collar	1	/	/	1	2
Sewing the sleeves with a 1cm seam	2	2	1	1	6
Assembling the front and back with doubled lapped seam	1	1	1	/	3
Label: Bad position	1	/	1	/	2



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or damaged					
Sewing and closing the cuffs	1	1	/	1	3
Button position or broken button	1	1	2	2	6
Hem bottom	1	1	1	/	3
Final ironing	/	/	1	1	2
Adjustment	2	/	1	2	5
Other common mistakes	/	/	/	/	

Table 3: Protocol of final control of the men's shirt, LCF-Mod fit

Company: Angelo Order: S4545 Model: Men's shirt - LCF-Mod fit Pieces: 580					
Data	19.09. 2022	20.09. 2022	21.09. 2022	22.09. 2022	Total
Total pieces controlled	145	145	150	140	580
Good pieces	130	133	134	130	527
Close collar	1	/	1	/	2
Sewing the sleeves with a 1cm seam	1	1	/	/	2
Assembling the front and back with doubled lapped seam	/	1	2	/	3
Label: Bad position or damaged	/	/	2	/	2
Sewing and closing the cuffs	1	2	1	1	5
Button position or broken button	1	1	1	/	3
Hem bottom	/	/	2	/	2
Final ironing	/	1	/	2	3
Adjustment	1	/	2	/	3
Other common mistakes	2	1	/	3	6
Shade in the material	8	5	5	4	22



5. CONCLUSION

The quality of the product is the most important point from the customer's point of view and should be given a lot of attention to the selection of appropriate machines, devices and equipment that will ensure the required quality.

From the results of the final control of 1417 men's shirts from three work orders in one apparel company, it can be noted that the most common errors in men's shirts are: closing the american seam and bad position of the button or damaged button, errors from the sewing the cuffs on the sleeves. In the third analyzed model, in 22 shirts, a specific error in the shade of the material was detected and they will not be able to be repaired. These shirts will need to be re-tailored, which means an increase in total production costs.

The control shows the most common errors in the production of the men shirts and it will be possible to find a way to prevent them in the future. Most of them can be eliminated by re-entering the shirts in the production process, and damaged products or those with irreparable defects can be classified in a lower class with a reduced price.

REFERENCES

- [1] Rogale, D., Ujević, D., Firšt, R.S.& Hrastinski, M. (2011). *Procesi proizvodnje odjeće*. Zagreb: Sveučilište u Zagrebu, Tekstilno tehnološki fakultet.
- [2] С. Јордева, С. Голомеова Лонгурова, (2020). *Технологија на изработка на облека I*, УГД, Штип.
- [3] Maras, A. (2017). *Tehnološki proces dorade muške košulje*. Zagreb: Sveučilište u Zagrebu, Tekstilno-tehnološki fakultet.
- [4] Carr, H. & Latham, B. (2008). *Technology of clothing manufacture*. Oxford: Blackwell Publishing Ltd. United Kingdom, editor: David J.Tyler.
- [5] Дејановски, С. (1989). *Технологија на конфекционирање со машини: I дел*. Скопје: Просветно дело.
- [6] Дејановски, С. (1989). *Технологија на конфекционирање со машини II дел*. Скопје: Просветно дело.
- [7] Кънчев, Ц., Шулекова, З. (2010). *Технологија на облеклото. Част 2*. Изд."Техника", София.
- [8] Trautman J.E. (1979). *Material utilization in the apparel industry*. Arlington: Apparel Research Fondation Inc.
- [9] Чепујноска, В. (2009). *Менаџмент на квалитетот*. Скопје: Технолошко-металуршки факултет.