

# Tekstilna industrija



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SAVEZ INŽENJERA I TEHNIČARA TEKSTILNE INDUSTRIJE  
UNION OF TEXTILE ENGINEERS AND TECHNICIANS OF SERBIA



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SADRŽAJ

Reč urednika	3
Tim Borgstätt, Boris Mahltig	
LASER TREATMENT OF HIGH-PERFORMANCE KYNOL FIBERS – AN EXAMPLE AS ALTERNATIVE TOOL FOR COLORATION AND IMAGING ON SURFACES OF HIGH-PERFORMANCE FIBERS	4
Miodrag Đorđević, Viktorija Stanković, Ana Ilić	
ODREĐIVANJE DUŽINE PREDJE U PETLJI NA BAZI TEHNOLOŠKIH PARAMETARA MAŠINE	10
Maja Jankoska	
DIGITAL PRINTING OF MEN'S T-SHIRT	15
Ivanka Ristić, Aleksandar Zdravković, Aleksandra Mikić, Nebojša Ristić	
DORADA MEŠAVINE PAMUK/PES KOMBINACIJOM REAKTIVNE SMOLE I HITOZANA	22
Milena Trajkova, Sanja Risteski, Vinita Srebrnkoska	
DETERMINATION OF THE LOAD IN DIFFERENT OPERATION IN SEWING MODEL OF WOMAN SHIRT	29
Nikola Maksimović	
METHODS TO DIGITIZING PHYSICAL PROPERTIES OF FABRIC FOR VIRTUAL SIMULATION	36
Silvana Zazova, Sonja Jordeva, Sashka Golomeova Longurova, Aco Janevski	
TEXTILE INDUSTRY IN NORTH MACEDONIA	44
Vesti i Informacije	52
Tržište tekstila	58
Uputstva autorima	73

U FINANSIRANJU ČASOPISA UČESTVOVALO  
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## REČ UREDNIKA

Zbog novonastale situacije izazvane pademljom virusa COVID 19, a u skladu sa merama koje su preduzete u cilju suzbijanja istog, III Medunarodna konferencija "Savremeni trendovi i inovacije u tekstilnoj industriji" nije održana u predviđenom terminu od 21. do 22. maja 2020. godine. Poštujući sve preporuke za bezbedno održavanje javnih skupova konferencija se održala od 17. do 18. septembra 2020. godine u Beogradu u svečanoj sali Doma inženjera "Nikola Tesla".

Konferencija se po prvi put održala u kombinovanom obliku, tako što su Plenarna sekcija i Sekcija 1 održane uživo sa dozvoljenih trideset prisustvni u sali. Zatim, u Online sekciji, autori iz inostranstva, ali i autori iz naše zemlje koji nisu bili u mogućnosti da prisustvuju konferenciji, uključili su se putem video linka i time je omogućeno praćenje njihovih prezentacija. U Poster elektronskoj sekciji radovi autora su postavljeni na sajt Saveza inženjera i tehničara Srbije, na stranici Saveza inženjera i tehničara tekstilaca Srbije na srpskom i engleskom jeziku, te je na taj način poster sekcija bila dostupna svim učesnicima konferencije, ali i široj javnosti.

I u ovim vanrednim okolnostima ostvaren je cilj konferencije, a organizovanje ovog naučnog skupa je opravdalo dato poverenje. Nadamo se da ćemo se sledeće godine, 2021. godine na IV Medunarodnoj konferenciji "Savremeni trendovi i inovacije u tekstilnoj industriji" okupiti u većem broju i u drugim, boljim okolnostima.

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	Editorial Council	3
	Tim Borgstädt, Boris Mahtlig	
	LASER TREATMENT OF HIGH-PERFORMANCE KYNOL FIBERS – AN EXAMPLE AS ALTERNATIVE TOOL FOR COLORATION AND IMAGING ON SURFACES OF HIGH-PERFORMANCE FIBERS	4
	Miodrag Đorđević, Viktorija Stanković, Ana Ilić	
	DETERMINATION OF YARN LENGTH IN A LOOP BASED ON THE TECHNOLOGICAL PARAMETERS OF THE MACHINE	10
	Maja Jankoska	
	DIGITAL PRINTING OF MEN'S T-SHIRT	15
	Ivanka Ristić, Aleksandar Zdravković, Aleksandra Mikić, Nebojša Ristić	
	FINISHING BLEND COTTON/PES BY COMBINATION OF REACTIVE RESIN AND CHITOSAN	22
	Milena Trajkova, Sanja Risteski, Vineta Srebreňkoska	
	DETERMINATION OF THE LOAD IN DIFFERENT OPERATION IN SEWING MODEL OF WOMAN SHIRT	29
	Nikola Maksimović	
	METHODS TO DIGITIZING PHYSICAL PROPERTIES OF FABRIC FOR VIRTUAL SIMULATION	36
	Silvana Zazova, Sonja Jordeva, Sashka Golomoova Longurova, Aco Janevski	
	TEXTILE INDUSTRY IN NORTH MACEDONIA	44
	News and Information	52
	Textile market	58
	Instruction to authors	73
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# DETERMINATION OF THE LOAD IN DIFFERENT OPERATION IN SEWING MODEL OF WOMAN SHIRT

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**Abstract:** Quality control is a set of steps or guidelines designed to guarantee that a product or service meets certain performance standards. Quality control in textiles is concerned with being certain a product meets performance standards and customer expectations. In this paper one model of woman shirt is observed. For this model a working plan was made and the time that is required to perform the operations of sewing the model was also defined. The total time for each operation, the daily production capacity, the daily capacity per worker and the tact of the group were also calculated. The percentage of load per operation was also defined. The observation in the term of choosing the right operation for the operators was also done.

**Key words:** quality, control, losses, observation.

## ODREĐIVANJE OPTEREĆENJA U RAZLIČITIM OPERACIJAMA PRILIKOM ŠIVENJA MODELA ŽENSKE KOŠULJE

**Apstrakt:** Kontrola kvaliteta je skup koraka ili smernica dizajnerskih tako da garantuju da proizvod ili usluga ispunjavaju određene standarde performansi. Kontrola kvaliteta tekstila bavi se sigurnošću da proizvod ispunjava standarde performansi i očekivanja kupaca. U ovom radu je razmatran jedan model ženske košulje. Za ovaj model napravljen je radni plan i određeno je vreme koje je potrebno za obavljanje operacija šivenja modela. Takođe se izračunava ukupno vreme za svaku operaciju, dnevni kapacitet proizvodnje, dnevni kapacitet po radniku i takt grupe. Takođe je definisan procenat opterećenja po operaciji. Obavljeno je i posmatranje u smislu izbora prave operacije za operatore.

**Ključne reči:** kvalitet, kontrola, troškovi, posmatranje.

### 1. INTRODUCTION

Quality means customer needs is to be satisfied. Failure to maintain an adequate quality standard can therefore be unsuccessful, but maintaining an adequate standard of quality also costs effort. There are a number of factors on which quality fitness of garment industry is based such as - performance, reliability, durability, visual and perceived quality of the garment. In the garment industry quality control is practiced right from the initial stage of sourcing raw materials to the stage of final finished garment. Quality control is generally understood as assessing for quality after products have already been manufactured and sorted

into acceptable and unacceptable categories. Apparel garments, accessories, and other textile products are assessed for quality in the preproduction phase, during production, and with a final inspection after the product has been completed.

Textile industries are increasingly faced with the demand for small orders and various items. This conditions a flexible system of operation, good knowledge of the technological process of making clothing items and proper deployment of operations in the production line. Technology sheet is applied for workload time adjustment, and process plan is developed for a known spatial connection.

To survive in this comparative world the textile industry should work more efficient to improve production and the quality of the garments to sustain in the enormous competitive market. The sustainability and profitability of garment industry is governed by the productivity of that industry. Garment manufacturing involves number of operations carried out at different spots by the operators. All these activities need to be performed in synchronized, planned and timely to achieve desired productivity. There are various practices and methods applied in industries to improve productivity of the industries [1, 2].

The deployment of workers and the preparation of a plan for the technological process is prepared by the head of the brigade/production line. He strives for efficient preparation of the plan, which means to pass a ready-made product through the sewing process quickly as possible and without defects. The head of the production line prepares a special plan for each individual product, but taking care of:

- ✓ Existing Machine Park.
- ✓ Work ability of each worker.
- ✓ Connection of operations.
- ✓ Training of workers to perform certain operations.

Also, is necessary to know which worker, depending on his/her work ability, at which operation to be placed. The goal is to provide a proper load on the working place, which can lead to more organized work for better production of a suitable garment for shaping, and avoid any set-back in the production process [3, 4, 5].

One of the possible installation systems of working places in a production line is with the transport trolleys. In the production line, machines are usually arranged on two sides, the transport system works with the help of moving trolleys that move freely, starting from the first operation to the last one.

When sewing a woman's shirt, usually the first operation is interphase ironing. The worker irons the garment pieces that will be further sewn. The worker arranges them on a trolley and moves it to the next working place. The next worker performs the appropriate operation, arranges the sewn pieces on the trolley and pushes it to the next worker. Thus, the stroller is moved to the last worker, respectively to the last sewing operation. This is a known as a very effective system because workers do not waste time getting up, taking and returning garment pieces to perform their operation. This allows them to pay more

attention to the task at hand and contribute to greater performance.

At the same time, two or even three spare trolleys can be found in one working place, which means that operator is supplied with work for a certain period of time.

By applying this system of trolleys, workers are dependent on each other, depending on how the trolley moves through the production line [6].

The head of the brigade needs to know the workers well so, that he can assign easier and faster operations to workers who perform slower and have less experience, and give more complex operations to those who are more capable of perform it. In order to avoid set-backs in the production line, due to insufficient execution of workers in some of the operations, the head of the production line prepares a plan for each work order according to the retention time of the garment pieces in one working place in minutes. According to the calculated flow, it determines the operations of the workers depending on their ability, taking into account that they can achieve the norm, and at the same time they are not overloaded [7,8].

### 2. EXPERIMENTAL

The model of women shirt that is subject of this paper is shown below (Figure 1). The shirt is produced in production line with a system of trolleys. The shirt is made of 100% PES.

The model has open collar, 2 darts on the front and 2 darts on the back. On the right front part there is a batten on which buttons and brackets are placed, and on the left front part there is an outer pocket with epaulet, button and button hole. On the back there is a plate. The sleeves are short with upward folded cuff and epaulet buttoned.

Table 1 shows a working plan for the design of a female model of shirt (size from 38 to 50).

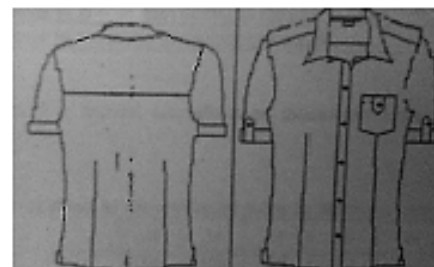


Figure 1: Technical sketch of the women shirt (front and rear part)

**Table 1:** Working plan for the model of female shirt

Ser.Number	Fabric color	Model	Size/ number of apparel products							
			38	40	42	44	46	48	50	Σ
1	White	K1895	38	40	42	44	46	48	50	Σ
			48	60	75	75	75	75	50	468

The machine arrangement for sewing this model of women's shirt in the production line is shown below (Figure 2).

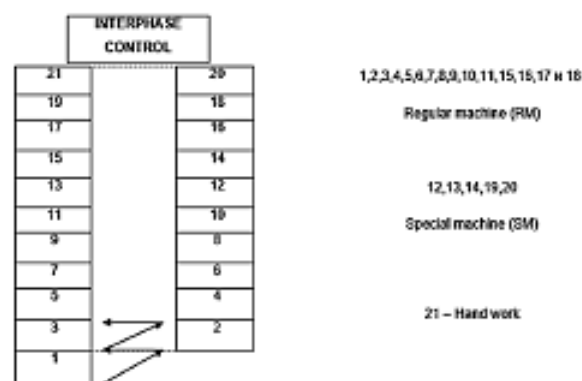
The basic requirements that are need to be fulfilled for the quality level of a model are:

- ✓ The side seams should be faced to the back of the shirt.

- ✓ The pocket should be in the middle and the left side dart.

- ✓ The sleeve epaulettes should be positioned in the middle of the sleeve parallel to the middle of the shoulder.

- ✓ The epaulette of the pocket should be positioned in the middle of the pocket.

**Figure 2:** The machine arrangement for sewing the model of women's shirt in the production line**Figure 3:** Appearance of cutting layout of the presented model**Table 2:** Plan of technological operations, norm, time of production and working equipment for the given model of women shirt

Ser. Number	Name of operation	Time (min) /piece	Norm/ Piece	Working equipment
1	Collar assembling and insert thread	1,05	400	RM
2	Flip and cut collar	0,54	777	HW
3	Collar upper stitch + closure around	1,09	385	RM
4	Measure and cut collar	0,15	2800	HW
5	Collar stitch	0,49	857	RM
6	Gouge, mark collar, assembling collars	1,4	300	RM +HW
7	Flip and cut collar base	0,42	1000	HW
8	Ironing finished collar with collar base	0,21	913	Press cloth
9	Cutting collar along her length	0,58	2000	HW
10	Fastens two-sided label	0,84	724	RM
11	Ironing batten with gauge	2,1	500	Iron
12	Sewing, closing batten on the front part	1,05	200	RM
13	Upper stitch on stitched batten	1,05	400	RM
14	Measure, stitch darts along front part	1,14	400	RM +HW
15	Measure, stitch darts along rear part	0,30	400	RM +HW
16	Overlock pocket	0,26	3000	SM
17	Sewing batten on pocket and insert epaulette	0,38	1400	RM
18	Stitch pocket (not ironed) from above	1,29	1615	RM
19	Ironing and forming the pocket	0,59	1105	Iron
20	Marking and sewing pocket	1,29	325	RM +HW
21	Stitch and mark pocket epaulette	0,59	711	RM +HW
22	Cutting and flip pocket epaulette	0,33	1272	HW
23	Upper stitch pock et epaulette backwards	0,54	777	RM
24	Measure and cut pocket epaulette	0,14	3000	HW
25	Sewing plate on the rear part with overlock	0,42	1000	SM
26	Upper stitch plate (rear part)	0,58	724	RM
27	Sewing the plate on the rear part with overlock	0,55	763	SM
28	Upper stitch plates (front part)	0,62	677	RM
29	Cuff ironing along middle	0,35	1200	Press cloth
30	Stitch epaulets to the sleeve	1,18	355	RM
31	Cut and flip sleeve epaulette	0,65	646	HW
32	Upper stitch sleeve epaulette backwards	1,08	388	RM
33	Measure and cut front sewn epaulette	0,21	2000	HW
34	Assembling shoulders with overlock	0,55	763	SM
35	Sewing sleeve with overlock	0,96	437	SM
36	Sewing cuff on sleeve and inserting epaulets	1,05	400	RM
37	Overlock sewn cuffs	0,42	1000	SM
38	Fastens sleeves before assembling	0,56	750	RM
39	Side assembling	0,87	482	SM
40	Fastens sleeve	0,56	750	RM
41	Overlock fringe, measure and cut	0,78	477	SM
42	Overlock side slits	0,42	1000	SM
43	Hem shirt	1,4	300	RM

44	Fastens slits	0,62	677	RM
45	Hem slits	1,2	350	RM
46	Collar stitch + cut neck slit	1,56	269	RM
47	Collar closure + upper stitch	1,83	229	RM
48	Sewing 5 + 1 button	0,72	583	SM
49	Making 6 button holes	0,68	617	SM
50	Marking button position on pocket	0,14	3000	HW
51	Sewing pocket button	0,12	3500	SM
52	Making pocket button hole	0,14	3000	SM
53	Marking button position on sleeves	0,28	1500	HW
54	Sewing buttons on sleeves	0,24	1750	SM
55	Making button holes on sleeves	0,28	1500	SM
56	Fastening paddings	0,52	807	SM
57	Cleaning extra thread	1,20	250	HW
Total time		39,1139min		

RM - Regular machine, HW - Hand work, SM- Special machine

### 3. RESULTS AND DISCUSSION

The obtained results for the given model are shown below.

- ✓ Time for manual operation:  $\sum_i HW = 4,27min$
- ✓ Time for regular machine:  $\sum_i RM = 24,06min$
- ✓ Time for special machine:  $\sum_i SM = 7,81min$
- ✓ Time for Inter phase ironing:  $\sum_i IPI = 2,03min$ .

Taking into account this calculation the total time is 39,0 min

- ✓ The daily production capacity (Cd) of a female shirt for 7 working hours shift (Tr) for 21 workers (R) is:  $C_d = 226,15min$
- ✓ The daily capacity per worker  $C_{dr} = 10,76$
- ✓ The tact of the group  $R_g = 1,85$ .

The percentage of load per operation is calculated and for operation 1 (table 2) is:  $S_o = 56\%$ . On the same way percentage of load is calculated for all remaining operations.

$$S_o = \frac{S_o}{R_g} \cdot 100 = \frac{1,05}{1,85} \cdot 100 = 56,0\%$$

This model of women's shirt is complicated for sewing, because it has a large number of construction parts (figure 3). Also the model was from the newest collection and for the first time was sewn in this operation line. The working places in this brigade were set according to the transport trolley system for simpler

models, in this case it would be necessary to relocate jobs 16, 25 and 27 so that the trolleys would always move only forward. However, this was not done, because it was considered that it is simpler for the trolley from the overlock machine jobs 12, 13 and 14 to go back to the working places to perform operations 16, 15 and 27. It is noted that performing operations 12 and 13 required less time, and that operation 12 combines two operations. It is also noted that due to the complexity of the model and a large number of operations, certain jobs are significantly burdened (working place 16) as well as that the manual work - thread cleaning is increased.

From the the obtained results it is noted that, working places such as: Hem shirt, fastens slits and hem slits are very loaded with percent of load ( $S = 174\%$ ). Also the operation such as: Marking and sewing pocket, upper stitch plate (rear part) and upper stitch plates (front part) shown high percent of load ( $S = 134\%$ ).

The percent of load over 100% was also obtained in the following operations: Sewing cuff on sleeve and inserting epaulets, fastens sleeves before assembling and fastens sleeve with the load of 117%. 116% of load was obtained in the operations such as: Collar upper stitch + closure around and measure, stitch darts along front part. In the operations: Flip and cut collar base, Fastens two-sided label and Measure, stitch darts along rear part, the load was 111%. In the operations: Measure and cut collar, collar stitch, gouge and mark collar, assembling collars, Ironing finished collar with collar base, Ironing batten with gauge, Ironing

and forming the pocket and measure and cut pocket epaulette the load was 110 %, and 109 % of load was noticed in the operations such as: Sewing 5 + 1 button, marking button position on pocket, sewing pocket button, marking button position on sleeves, sewing buttons on sleeves and fastening paddings.

Lower than 100% load was obtained in the following operations (serial number according to the Table 3): 97% of load for the operations 9, 46, 47. The load for the operations: 6, 25, 27, 34, 35, 37, 39, 41 and 42 was 92%. For the operations: 30, 31, 32 and 33 the load was 84%, and for the operations: 13, 18, 22, 23, 17 and 14 the load was 70%. In the operation cleaning thread the obtained load was 65%, and the lowest percent of load (59%) was noticed in the operations such as: Making 6 button holes, making pocket button hole and making button holes on sleeves.

Also, has been observed that workers have a lower percentage of performance at the beginning of the working day, and over time they achieve full work efficiency. Reduced performance is observed if workers do not feel well, perform a certain operation for the first time, change the working operation, but sometimes deliberately slow down the work to reduce the set norm.

### 4. CONCLUSION

In the production line with a system of trolleys, a new model of woman shirt was produced.

Time for manual operation ( $\sum_i HW = 4,27min$ ), time for regular machine ( $\sum_i RM = 24,06min$ ) time for special machine ( $\sum_i SM = 7,81min$ ), time for Inter phase ironing ( $\sum_i IPI = 2,03min$ ) and the total time ( $\sum_i T = 39,0min$ ) were obtained.

The daily production capacity ( $C_d = 226,15min$ ), the daily capacity per worker ( $C_{dr} = 10,76$ ), the tact of the group ( $R_g = 1,85$ ) and the percentage of load per operation ( $S_o = 56\%$ ) were also calculated. From the obtained results can be concluded that some of the working places shown high percent of load compared with others working places.

The operations such as: Hem on the shirt, fastens slits and hem slits are very loaded with percent of load ( $S = 174\%$ ).

The operation such as: Marking and sewing pocket, upper stitch plate (rear part) and upper stitch plates (front part) also had shown high percent of load ( $S = 134\%$ ).

The operations sewing cuff on sleeve and inserting epaulets, fastens sleeves before assembling and fastens sleeve shown load of 117 %.

116% of load was obtained in the operations such as: Collar upper stitch + closure around and measure, stitch darts along front part.

In the operations: Flip and cut collar base, Fastens two-sided label and Measure, stitch darts along rear part, the obtained load was 111 %.

In the operations: Measure and cut collar, collar stitch, gouge and mark collar, assembling collars, Ironing finished collar with collar base, Ironing batten with gauge, Ironing and forming the pocket and measure and cut pocket epaulette the load was 110 %, and 109 % of load was noticed in the operations such as: Sewing 5 + 1 button, marking button position on pocket, sewing pocket button, marking button position on sleeves, sewing buttons on sleeves and fastening paddings.

Lower than 100 % load was obtained in the following operations (serial number according to the Table 3): 97% of load for the operations 9, 46, 47. The load for the operations: 6, 25, 27, 34, 35, 37, 39, 41 and 42 was 92%. For the operations: 30, 31, 32 and 33 the load was 84 %, and for the operations: 13, 18, 22, 23, 17 and 14 the load was 70%. In the operation cleaning thread the obtained load was 65%, and the lowest percent of load (59%) was noticed in the operations such as: Making 6 button holes, making pocket button hole and making button holes on sleeves.

With the observation of the results was also noted that workers have a lower percentage of performance at the beginning of the working day, and over time they achieve full work efficiency. Reduced performance is observed if workers do not feel well, perform a certain operation for the first time, change the working operation, but sometimes deliberately slow down the work to reduce the set norm. For successful staffing of the production line it is necessary to know the skills of the workers and their capabilities to perform various operations. Operators who are low skilled should be deployed to operations with longer manufacturing time, and skilled and fast operations workers with shorter manufacturing time.

For successful garment production, for the realization of the products plans and accuracy of given delivery deadlines, especially in conditions when is working with small work orders, the good organization of work it is necessary, and that can be achieved with right arrangement of operators in the production line. The obtained results of the percent of the load in all operations of sewing the model of woman shirt can help in distribution the work to operators through a prior assessment of their working skills.

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