# Construction Features of Single-Seamed Sleeves for Women's Outerwear

Hristo Petrov

*Abstract*—**The form and elements of internal development of women's outerwear are directly dependent on the style in fashion, the purpose and the season. Basic constructions are dimensioned with proportions between component lines and allowances for freedom relating to the straight, fitted or semi-fitted silhouette. By applying modeling principles, corresponding model variants are obtained from these constructions. In women's outerwear, sleeves can be both single-stitched and multi-stitched. Multi-stitched sleeves can be constructed in an assembly pattern similar to a women's jacket sleeve, or by splitting the unfolded single-stitched sleeve. Their constructive shaping may be accompanied by a preliminary deepening of the sleeve curve, or by transforming the shoulder folds of the two main details. The second option is considered here, when the shoulder flexion on the back is completely closed, and that on the front - partially. The research and suggestions made do not concern the constructions of the back and the front part, but affect the geometric construction of the sleeve, some of its model variants and the placement of technological matching centers.**

***Keywords*— Women's outerwear, single-stitched sleeve, size, basic construction, sleeve oval.**

## I. INTRODUCTION

Research into the development of garment design methods is of interest, both theoretically and applied. This is dictated by finding unity of meaning in some calculation formulas for sizing the basic constructions relating to the different types of clothing.

The subject of research is the methodology, which is based on discrete measurements from a type figure, allowances for freedom of fit, as well as guidelines for sizing and geometric unfolding of the single-seam sleeve for women's outerwear. By effectively applying some of these studies, it is possible to relatively accurately determine both the dimensions of the designed part and the location of important structural points of its contour and the contours of its corresponding main parts.

The construction of the latter comes down to finding a suitable algorithm for determining their reasonable behavior. In a purely theoretical aspect, the mathematical formulation for effective management of their character for the needs of the respective methodology is of interest.

The rich statistical material, numerous experimental studies and relevant analyses, create prerequisites for searching and finding functional relationships in the dimensioning, creation and geometric modeling of the main and derivative details. All this requires an appropriate approach, both in the organization and conduct of relevant research, and in the processing and analysis of the obtained results.

## II. PRELIMINARY NOTES

One of the most responsible and complex details in clothing is the sleeve, and the appearance and comfort of wearing the product largely depends on its structural design and technological performance. The type and shape of the sleeves is directly dependent on the type, purpose and overall compositional solution in the clothing. Outerwear is a multi-layered product, and for face fabrics, pure woolen fabrics and a mixture of wool with chemical fibers in various proportions and a mass that is within (300 ÷ 500) g per linear meter are mainly used. Among the chemical fibers used in the mixtures are polyamide, viscose, polyester and polyacrylonitrile.

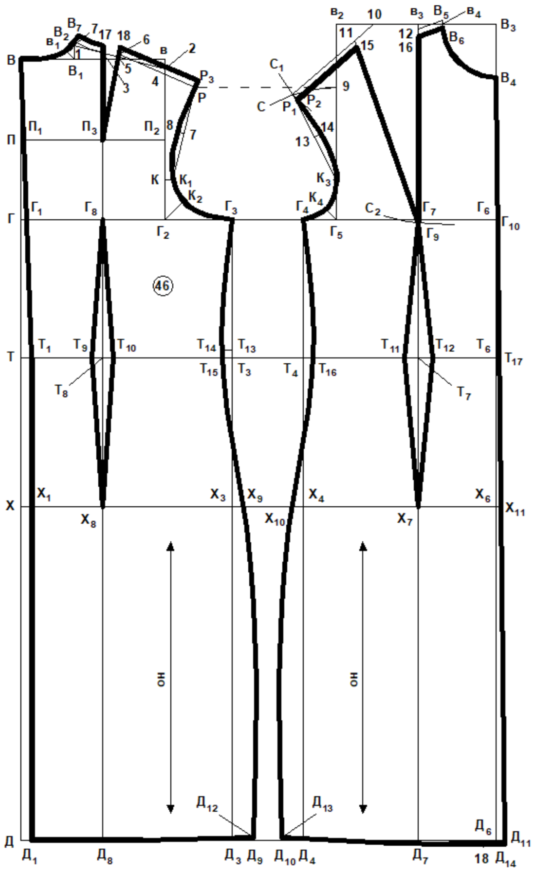

Fig. 1. Basic construction of a women's coat

In Fig. 1 shows the basic construction of a women's coat, sized for a standard size 164/92/100, of the normal fullness group. The construction is in a semi-fitted silhouette, with no seam allowances and with pre-set allowances for

**Received:** 19.09.2024
**Published:** 30.09.2024
https://doi.org/10.47978/TUS.2024.74.03.013

**Hristo Petrov** is with the Technical University of Sofia, College - Sliven, Sliven, Burgasko Shose Blvd. No. 59, Bulgaria (petrov@tu-sofia.bg)

freedom along the main component lines relating to half of the garment: PS (LG) = 10.0 cm, PS (LT) = 8.5 cm and PS (LH) = 8.5 cm. It should be noted that in the shoulder area of the two main pieces, a 1.0 cm part of the shoulder of the front piece has been transferred to the back.

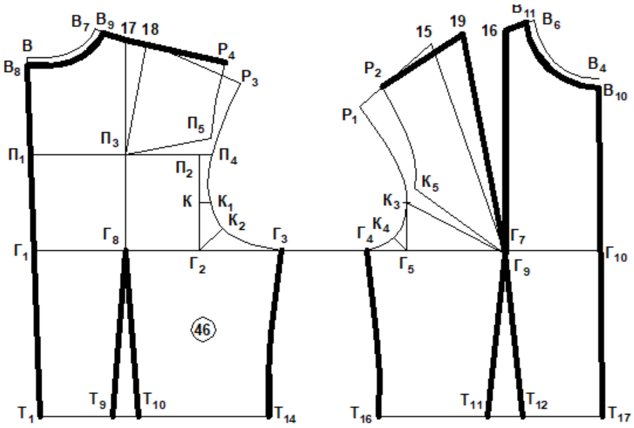


Fig. 2. Correction of neck curve and shoulder

The additional thing that has been done is the transformation of the shoulder folds from the two main details as follows: for the back, it has been moved to point $П_4$ of the sleeve fold - and for the front part, a part of the fold has been closed while being open at point $K_3$, with a solution of $K_3K_5 = П_4П_5$ (Fig. 2).

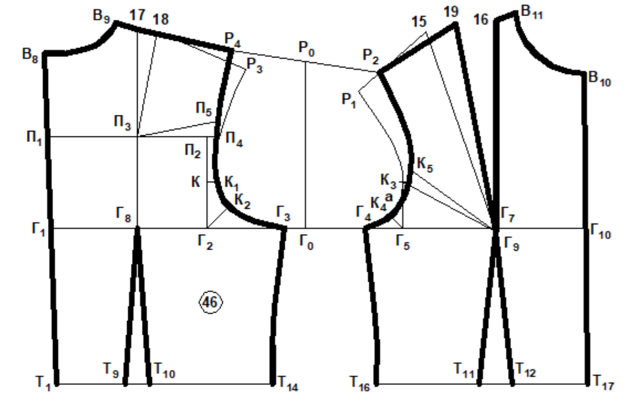


Fig. 3. Forming the sleeve curve

Next is shaping of the new sleeve curve as smooth lines connecting the points $P_4П_5K_2Г_3$ and $P_2K_5aK_4Г_4$ (Fig. 3). The size of the segment $Г_5a$ = 0,25 $SH_{PMU\ (LG)}$ will be used in the construction of the sleeve oval, part of which will belong to the section of the sleeve curve of the front part.

TABLE 1
PRELIMINARY CALCULATIONS BY SIZE

| Height | 164 | | | | | | | Δ |
|---|---|---|---|---|---|---|---|---|
| **Size** | **44** | **46** | **48** | **50** | **52** | **54** | **56** | 2.0 |
| $D_{GR\ (LG)}$ | 22.2 | 22.6 | 23.0 | 23.4 | 23.8 | 24.2 | 24.6 | 0.4 |
| $D_{GR\ (LT)}$ | 41.8 | 42.0 | 42.2 | 42.4 | 42.6 | 42.8 | 43.0 | 0.2 |
| $D_{GR\ (LH)}$ | 62.7 | 63.0 | 63.3 | 63.6 | 63.9 | 64.2 | 64.5 | 0.3 |
| $D_{IZD}$ | 114.7 | 115.0 | 115.3 | 115.6 | 115.9 | 116.2 | 116.5 | 0.3 |
| $D_{PR\ CH(LT)}$ | 46.6 | 47.0 | 47.4 | 47.8 | 48.2 | 48.6 | 49.0 | 0.4 |
| δ | 4.8 | 5.0 | 5.2 | 5.4 | 5.6 | 5.8 | 6.0 | 0.2 |
| $SH_{GR\ (LG)}$ | 18.6 | 19.4 | 20.2 | 21.0 | 21.8 | 22.6 | 23.4 | 0.8 |
| $SH_{PMU(LG)}$ | 13.8 | 14.2 | 14.6 | 15.0 | 15.4 | 15.8 | 16.2 | 0.4 |
| $SH_{PRCH(LG)}$ | 21.6 | 22.4 | 23.2 | 24.0 | 24.8 | 25.6 | 26.4 | 0.8 |
| $SH_{VR\ IZV}$ | 7.34 | 7.48 | 7.62 | 7.76 | 7.90 | 8.04 | 8.18 | 0.14 |
| $V_{VR\ IZV}$ | 2.44 | 2.49 | 2.54 | 2.59 | 2.64 | 2.69 | 2.74 | 0.05 |
| $SH_{R\ (GR)}$ | 16.0 | 16.0 | 16.0 | 16.0 | 16.0 | 16.0 | 16.0 | 0.0 |
| $SH_{R\ (PR\ CH)}$ | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 15.0 | 0.0 |

Table 1 shows the calculations made for the main construction sections from the base drawings for seven standard sizes, at a height of 164, in a semi-fitted silhouette and the same allowances for freedom of fit. Their geometric construction is analogous to the considered basic size.

## III. MAIN RESULTS AND DISCUSSIONS

### *1. Construction of the basic structure of the single-stitched sleeve*

In most construction methods, the usual approach is to construct the sleeve for a given size, then compare it to the sleeve curve from the master drawing and make appropriate adjustments if necessary. In most cases, these corrections do not affect the algorithm for constructing the sleeve, but rather serve to directly control such characteristics of the oval as curvature, slope and change of the tangent to it, etc. Here, the approach is proposed to economize the sleeve construction algorithm and satisfactorily match curvilinear contours of the technologically joined parts. Table 2 gives the calculated and measured values necessary for the sizing and construction of the sleeve:

1. Sleeve depth: $D_{B\ RAK}$ = (0.8 ÷ 0.9) $P_0Г_0$ = 0.85.20.6 ≈ **17.5 cm**.

2. Sleeve width: $SH_{RAK}$ = 0.5 $O_{MISH}$ + $П_S$ = 0.5.29.4 + (4.0 ÷ 5.0) = **19.0 cm**.

3. Sleeve width along the length line: $SH_{RAK\ (LD)}$ = 0.5 $O_{KIT}$ + $П_S$ = 0.5. 16.4 + (6.0 ÷ 8.0) = **15.0 cm**.

TABLE 2
VALUES OF CONSTRUCTIVE SECTIONS OF THE SLEEVE BY STANDARD SIZES

| Height | 164 | | | | | | | Δ |
|---|---|---|---|---|---|---|---|---|
| **Size** | **44** | **46** | **48** | **50** | **52** | **54** | **56** | 2.0 |
| $D_{B\ RAK}$ | 16.95 | 17.5 | 18.05 | 18.6 | 19.25 | 19.80 | 20.35 | 0.55 |
| $SH_{RAK}$ | 18.35 | 19.00 | 19.65 | 20.30 | 20.95 | 21.60 | 22.25 | 0.65 |
| $SH_{RAK(LD)}$ | 14.8 | 15.0 | 15.2 | 15.4 | 15.6 | 15.8 | 16.0 | 0.2 |
| $P_0Г_0$ | 19.95 | 20.60 | 21.25 | 21.90 | 21.55 | 22.20 | 23.85 | 0.65 |
| $O_{RAK\ IZV}$ | 48.6 | 50.1 | 51.6 | 53.1 | 54.6 | 56.1 | 57.6 | 1.5 |
| $O_{RAKOVAL}$ | 53.1 | 54.9 | 56.7 | 58.5 | 60.3 | 62.1 | 63.9 | 1.8 |
| δ | 4.5 | 4.8 | 5.1 | 5.4 | 5.7 | 6.0 | 6.3 | 0.3 |

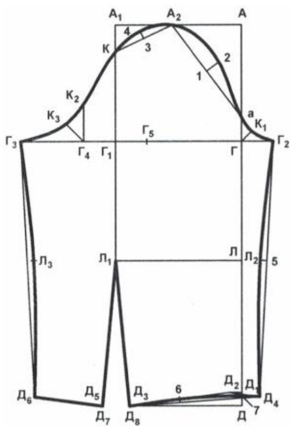


Fig. 4. Basic construction on a single-stitched sleeve

The sleeve (Fig. 4) is built in the following sequence [2]. **А – Г** = $D_{B\,RAK}$ = 17.5 cm; **А – Д** = $D_{RAK}$ + 2.0 = 55.6 + 2.0 = 57.6 cm; **Д – Д$_1$** = 2.0 cm; **Г – Л** = 0.5 $ДД_1$ – 1.0 = 17.85 cm; **А – А$_1$** = $SH_{RAK}$ = 19.0 cm; **А$_1$ – А$_2$** = 0.5 $SH_{RAK}$ – 1.0 = 8.5 cm; **Г – а** = 0.25 $SH_{PMU\,(LG)}$ = 3.6 cm; **А$_2$ – 1** = 0.5 $А_2а$; **1 – 2** ≈ 2.3 cm; **А$_1$ – К** = Га + 0.5 = 4.1 cm; **А$_2$ – 3** = 0.5 $А_2К$; **3 – 4** ≈ 1.2 cm; **Г – Г$_2$** = $Г_5Г_4$ (from the front) = 4.7 cm; **Г – К$_1$** = $Г_2К_4$ (from the front) = 2.13 cm; **Г$_2$– Г$_3$** = 2 $SH_{RAK}$ = 2. 19.0 = 38.0 cm; **Г$_3$ – Г$_4$** = $Г_2Г_3$ (from the back) = 9.5 cm; **Г$_4$ – К$_2$** = $Г_2К$ (from the back) = 5.6 cm; **Г$_2$ – К$_2$** = $Г_2К_3$ (from the back) = 3.76 cm; a smooth line connects the points **Г$_3$К$_3$К$_2$К4А$_2$2аК$_1$Г$_2$**; **Г$_2$ – Г$_5$** = 0.5 $Г_2Г_3$ = 19.0 cm.

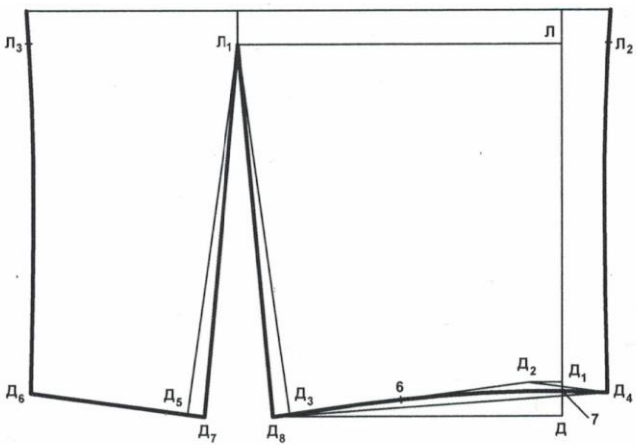


Fig. 5. Shaping the sleeve lengthwise

For greater clarity, the drawing is enlarged (Fig. 5). **Д$_1$ – Д$_2$** = 2.0 cm; **Д$_2$ – Д$_3$** = $SH_{RAK\,(LD)}$ = 15.0 cm; **Л$_1$ – Д$_5$** mirror image of $Л_1Д_3$ relative to an imaginary vertical line passed through point $Л_1$; **Д$_2$ – Д$_4$** = $Г_5Г_4$ (from the front part) = 4.7 cm and $Д_2Д_4$ is the mirror image of $Д_2Д_3$ relative to an imaginary vertical line passed through point $Д_2$; **Г$_3$ – Д$_6$** parallel to $Д_2Д_3$ relative to an imaginary vertical line passed through point $Г_5$; straight lines **Д$_3$ – Д$_4$** and **Д$_5$ – Д$_6$**.

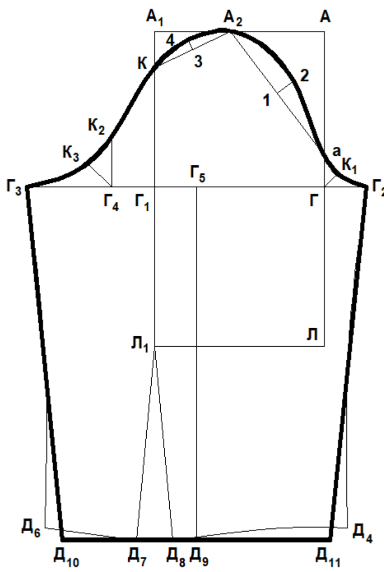


Fig. 6. Sleeve without a fold along the length line

Calculate the difference between the width of the unfolded sleeve and the measured widths from the drawing: 2 $SH_{RAK\,(LD)}$ – ($Д_3Д_4$ + $Д_5Д_6$) = 2. 15.0 – (19.68 + 10.22) = 0.1 cm; for the considered case it is too small and can be neglected. Otherwise, it can be reflected as follows: along the continuation of the lines $Д_6Д_5$ and $Д_4Д_3$, apply **Д$_5$ – Д$_7$** = **Д$_3$ – Д$_8$** = 0.5 [2 $SH_{RAK\,(LD)}$ – ($Д_3Д_4$ + $Д_5Д_6$)] = 0.05 cm; **Д$_3$ – 6** = 0.5 $Д_3Д_4$; **Д$_1$ – 7** ≈ 0.5 cm; smooth line **Д$_8$,6,7Д$_4$**. **Г$_2$ – 5** = 0.5 $Г_2Д_4$; **5 – Л$_2$** ≈ 0.5 cm; smooth line **Г$_2$Л$_2$Д$_4$**; a smooth line **Г$_3$Л$_3$Д$_6$** mirroring $Г_2Л_2Д_4$ is constructed relative to an imaginary vertical line passed through point $Г_5$.

In Fig. 6 shows a sleeve without a fold [5] along the length line with the following geometric construction: a vertical line descends from point $Г_5$ ⇒ point **Д$_9$**; **Д$_9$ – Д$_{10}$** = **Д$_9$ – Д$_{11}$** = $SH_{RAK\,(LD)}$ = 15.0 cm; straight lines **Г$_3$ – Д$_{10}$** and **Г$_2$ – Д$_{11}$**.

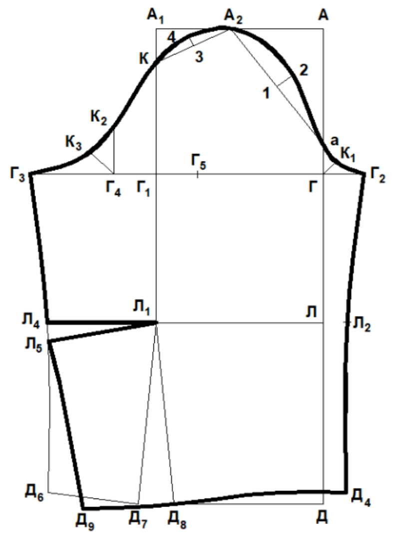


Fig. 7. Sleeve with a fold in in the longitudinal seam

In Fig. 7 is an illustrated sleeve with a transformed fold in the elbow area [4]: the fold is closed from the length line and opens in item $Л_4$ ⇒ item **Л$_5$** and **Д$_9$**.

*2. Equating the circumferences of the sleeve ring and the sleeve oval*

For classic outerwear of this type, one of the essential requirements is that the length of the oval should be greater than the length of the sleeve bend, i.e. **Δ** = $O_{RAK\,OVAL}$ – $O_{RAK\,IZV}$ > 0.

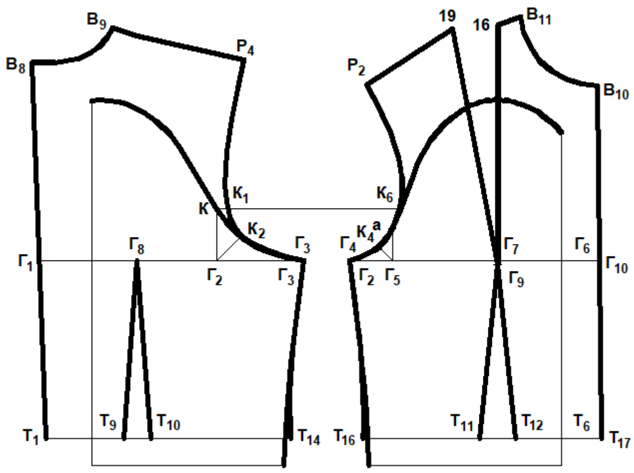


Fig. 8. Combining the main details with the sleeve

The numerical value of this size will mostly depend on the model and physico-mechanical parameters of the face fabric [1]. The recommended difference is for the sleeve oval to exceed the sleeve curve by (7 ÷ 10) % [4] , and for the model size it is 9.6 %.

The measured values (Fig. 8) are as follows: $O_{RAK\ IZV\ (GR)} = \mathbf{P_4Г_3} = 27.4$ cm; $O_{RAK\ IZV\ (PR\ CH)} = \mathbf{P_2Г_4} = 22.7$ cm; $O_{RAK\ IZV} = O_{RAK\ IZV\ (GR)} + O_{RAK\ IZV\ (PR\ CH)} = 50.1$ cm; $O_{RAK\ OVAL} = \mathbf{Г_3A_2Г_2} \approx 54.9$ cm (see Fig. 6). Therefore, the support will be: $\Delta = O_{RAK\ OVAL} - O_{RAK\ IZV} = 54.9 - 50.1 =$ **4.8 cm**.

From point $K_1$ of the sleeve bend on the back (Fig. 8) a horizontal line is passed until the intersection of the sleeve bend on the front part ⇒ point $\mathbf{K_6}$.

Along the sleeve oval line, measure $\mathbf{Г_3K_7} = Г_3K_1 = 10.8$ cm (from the back) and $\mathbf{Г_2K_8} = \mathbf{Г_4K_6} = 8.3$ cm (from the front) (Fig. 9, Fig. 10 and Fig. 11).

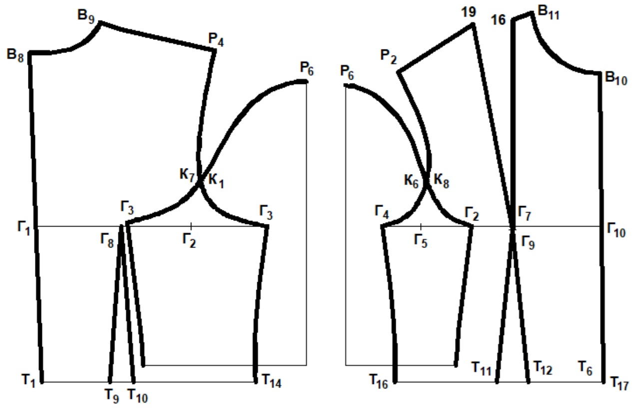

Fig. 9. Combining parts belonging to the details

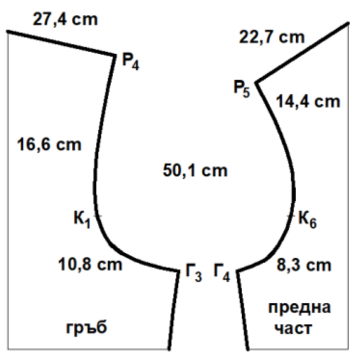


Fig. 10. Place centers on sleeve curve

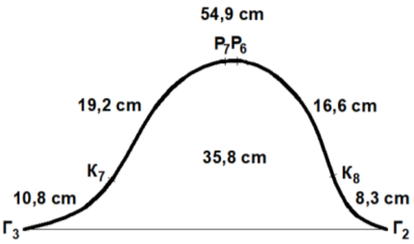


Fig. 11. Placing centers on the hollow oval

The sleeve center point $P_6$ is determined the last way: $K_1P_4 + K_6P_5 = 31.0$ cm; $K_7K_8 = 35.8$ cm; therefore, 1.0 cm of the sleeve curve will correspond to 1.155 cm of the sleeve oval; then $K_7P_6 = 1{,}155$. $K_1P_4 = 19.2$ cm and $K_8P_6 = 1.155$. $14.4 = 16.6$ cm (Fig. 11). With a very small difference in lengths between $K_1P_4$ and $K_6P_5$ for some models and standard sizes, it is possible to apply an even fit for the sleeve center, i.e. $K_7P_7 = 0{,}5\ K_7K_8 = 17.9$ cm (see Fig. 11).

The sleeve construction algorithm allows to modify the line of the sleeve oval by changing the shape and correcting its due without significantly affecting its basic parameters.

In Fig. 12 two variants [5] typical only for reducing the length of the sleeve oval are illustrated. One case (Fig. 12 a) results in a sleeve with a shorter oval length at the expense of reducing the sleeve depth. With the following sample distances: : $\mathbf{4 - 4'} = 0.2$ cm, $\mathbf{A_2 - A_2'} = 0.6$ cm and $\mathbf{2 - 2'} = 0.3$ cm and construction of a smooth line $\mathbf{Г_3K_3K_2K4'A_2'2'aK'Г_2}$, gets $O_{RAK\ OVAL} = 54.1$ cm (length reduced by 0.8 cm) and $DB_{RAK} = 16.9$ cm.

The other modification (Fig. 12 b) is obtained by successive rotation of the sectors $Д_9Д_8Л_1Д_7Д_6Г_3K_3K_2K4A_2Д_9$ and $Д_9A_22aK_1Г_2Д_4Д_9$, respectively clockwise and counterclockwise at an angle α.

The rotation is relative to point $Д_9$, which lies on the line of the length of the sleeve after descending a vertical line from point $A_2$. The reduction of the length of the oval is at the expense of a narrowing of the sleeve in width, with the curve drawn between points $\mathbf{Г_3'K_3'K_2'K'4'A_22'a'K_1'Г_2'}$. For the specific example with $\alpha = 1^0$, or $\mathbf{A_2 - A_2' = A_2 - A_2''} \approx 1.0$ cm, $O_{RAK\ OVAL} = 53.2$ cm (reduced length by 3.1 cm), and $SH_{RAK} = Г_3'Г_2' = 36.6$ cm (reduced width by 1.4 cm).

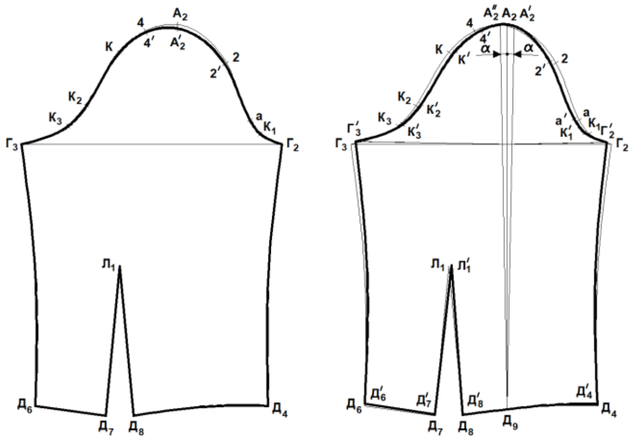

Fig. 12. Correction of the sleeve oval

Similar studies can be made for different values in the intervals of the factor for the depth of the sleeve curve and the allowance for freedom to the width of the sleeve. Dependencies can be derived that lead to obtaining a satisfactory ratio between the lengths of the considered curves with a satisfactory character of the line of the oval.

## IV. CONCLUSIONS

In summary, it can be said that another approach has been proposed for the geometric construction of one of the main details of women's outerwear – the single-seam unfolded sleeve, which economizes the drawing activity and the accuracy of curve matching in the lower curvilinear contour is significantly increased.

An effective way of marking the connectivity areas is presented in determining the relationship between the circumferential dimensions of the sleeve curve and the sleeve oval, while ensuring that a relative additional length is included for support within applicable limits of technological performance.

The other thing that has been done is that there are two options for adjusting the length of the sleeve oval, by changing the control points of the curve. This approach can be successfully applied to both decrease and increase the oval to obtain satisfactory values for the sleeve curve.

## REFERENCES

[1] Kanchev, Ts. G., Shulekova, Z., Clothing Technology Part II, Technica, Sofia, 2005. Kanchev, Ts. G., Shulekova, Z., Clothing Technology Part II, Technica, Sofia, 2005..
[2] Petrov, Hr., Clothing Design, TU - Sofia, Sofia, 2010
[3] Müller, M., Schnittkonstruktionen für Kleider und Blusen, Rundschau- Verlag Otto G.Königer GmbH & Co, München, 1992.
[4] Müller, M., Schnittkonstruktionen für Kleider und Blusen, Rundschau- Verlag Otto G.Königer GmbH & Co, München, 1992.
[5] https://www.theshapesoffabric.com/2022/11/15/how-to-sew-different-types-of-sleeves/