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# METHOD DEVELOPMENT OF APPLYING SHRINKAGE VALUES INTO BASE PATTERN OF MEN'S GARMENT DYED SHIRT

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**Abstract:** One of the major challenges faced when designing garments in garment dyeing is the significant shrinkage of cotton fabric in both length and width during the dyeing process. In previous researches, shrinkage values of various cotton fabrics were determined, drawing a base pattern for designing a men's shirt produced by garment dyeing, and a method of calculating the shrinkage values of the selected cotton fabric was researched, and in this article, the scheme defining main feature points on Cartesian coordinate system and drawing of the shirt new pattern based on shrinking values was developed.

**Keywords:** Pattern, method, shirt, garment dyeing, shrinkage, coordinate system, constructive points, pattern blocks, sleeve.

**Introduction.** In the modern garment industry, three traditional methods of pattern constructing are generally used for shirt making: 1) the proportional method, which uses several body measurements (BM) to calculate all pattern indexes through linear regression equations; 2) short measuring or metric method that uses a direct BM set for pattern drawing, 3) combined method of the above proportional and direct measure methods [1]. Based on these three methods, some new parametric models are also proposed to automatically construct patterns.

Based on a large-scale population census, the proportional method allows to build an integrated base pattern with regression calculation equations that calculate the necessary pattern indexes of other segments based on only a few body measurements (for example, chest girth CG, back length BL). This style is widely used for ready-to-wear clothing in the world. [2-4]. The advantages and disadvantages of these methods are obvious. On the one hand, it requires very few body measurements, which saves a lot of time and effort. On the other hand, correlations between CG and other dimensions cannot be explained by the current results; and the method requires some experience from the patternmaker. These drawbacks lead to the incomplete fit of the final product.

The direct measure method uses construction parameters directly based on standard or individual body measurements without equations. It can be applied to both ready-to-wear and made to measure clothing. These parameters are usually calculated by adding adjustable constants to the BM value. This method also has advantages and disadvantages. It involves a time-consuming and complicated body measurement process and requires high precision of BM. However, once the BM is well measured, the pattern achieves a good fit. These patterns can fit the figure better than a proportional pattern. However, the fit problems have not been completely eliminated.

The combined method, as its name notifies, involves the use of both methods - proportional and short measure by using both regression equations and several complementary body measurements

together. The base pattern of a shirt can be drawn using any of the above methods, depending on whether the garment is produced for mass or individual consumers.

**Methods.** This research was carried out on men's garment dyeing shirts intended for mass production and the base pattern of shirt was constructed by M.Müller & Sohn's method [6]. This method offers convenience in constructing the base pattern, as it allows for the use of a few basic body measurements to build the basic pattern of various garments. In this approach, auxiliary measurements are derived using specific ratios of the main measurements, along with certain fixed values [7]. By utilizing this technique, pattern construction becomes faster, requiring fewer body measurements and formulas. As a result, the design processes become more efficient, enhancing overall productivity. In order to design the drawing of the base pattern of the men's shirt, the necessary body measurements were determined according to the typical figure size 176-100-40 and the ease allowances were selected. According to abovementioned method, the base pattern of the shirt was made and shrinkage values calculated by new developed formula. The shrinkage percentage of chosen fabric is 9,4 % in warp and 8,5 % in weft direction [8].

**Results and Discussions.** The main designing problem that needs to be solved in the method of garment dyeing is that the dimensions of the clothes after dyeing are reduced due to the shrinking and the final measurements do not correspond to the state of the initial base pattern [9-10]. There has been no previous researches on the design of men's shirts produced by garment dyeing. Applying shrinking ratios directly to garment design requires a lot of practice and calculation, and is also prone to fault. In some books [11-13], it is shown that changes to the pattern due to the change in dimensions due to the deformation or shrinkage during ironing of knitted fabrics are introduced at the last stage, when the basic drawing is ready.

First, shirt base pattern was drawn by Gemini CAD software based on the standard size, and the main constructive points of the final drawing were determined. According to each detailed coordinate system, the coordinate values of the points remaining from the 0.0 point were determined, and the new coordinates were calculated with the shrinkage value added according to the formula determined in the previous study, here in warp direction located y-axis, the x-axis corresponds to weft. Figure 1 below shows the location of the shirt pattern blocks on the coordinate system and the scheme of marking the main feature points.

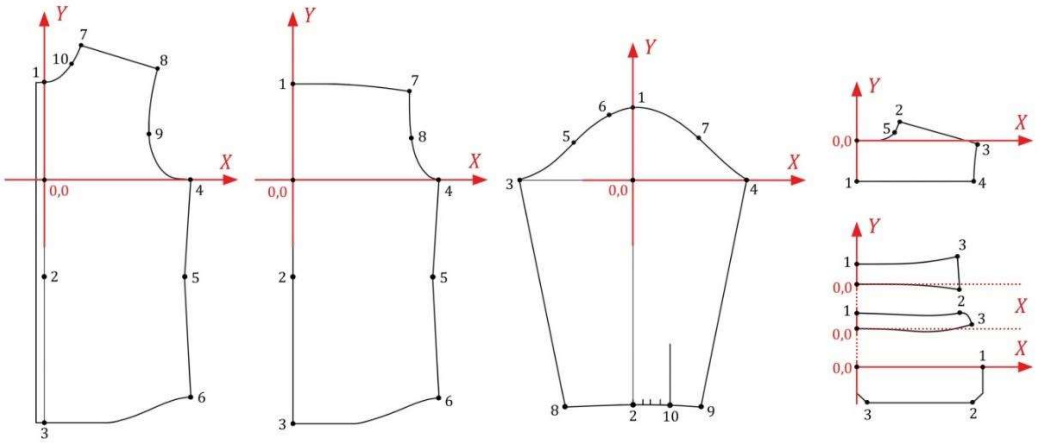



**Figure 1. Model of re-design the shirt base pattern on Cartesian coordinate system by adding the shrinkage values**

Like all CAD systems, Gemini system defines pattern points using a Cartesian coordinate system, with grid origin 0,0 as the base point doing set origin function. It is expressed with a positive or negative sign, depending on whether the points are located on the right or left, above or below the origin point. The values of each point on the x and y coordinate axes are organized based on table 1, and the shirt pattern construction with new shrinking ratios was created.

**Table 1**

**Coordinates of normal base and shrinkage values added patterns**

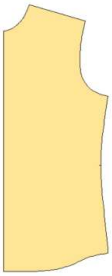
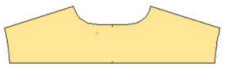
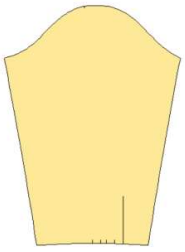
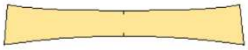
| № | Pattern block | | Basic constructive points | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | | 2 | | 3 | | … | 9 | | 10 | |
| | | | *x* | *y* | *x* | *y* | *x* | *y* | … | *x* | *y* | *x* | *y* |
| 1 | Front | B | 0,0 | 17,8 | 0,0 | -19,0 | 0,0 | -48,0 | … | 20,5 | 7,0 | 5,23 | 21,25 |
| | | G | 0,0 | 19,63 | 0,0 | -20,95 | 0,0 | -52,94 | … | 22,39 | 7,72 | 5,71 | 23,43 |
| 2 | Back | B | 0,0 | 18,0 | 0,0 | -19,0 | 0,0 | -48,0 | … | - | - | - | - |
| | | G | 0,0 | 19,85 | 0,0 | -20,95 | 0,0 | -52,94 | … | - | - | - | - |
| 3 | Yoke | B | 0,0 | -8,0 | 8,4 | 3,9 | 23,4 | -0,63 | … | - | - | - | - |
| | | G | 0,0 | -8,82 | 9,18 | 4,3 | 25,56 | -0,69 | … | - | - | - | - |
| 4 | Sleeve | B | 0,0 | 13,2 | 0,0 | -46,3 | -21,9 | 0,0 | … | 13,8 | -46,8 | 7,3 | -46,4 |
| | | G | 0,0 | 14,56 | 0,0 | -51,06 | -23,92 | 0,0 | … | -15,07 | -51,61 | 7,97 | -51,17 |
| 5 | Collar stand | B | 0,0 | 3,0 | 20,1 | 2,8 | 22,8 | 0,7 | … | - | - | - | - |
| | | G | 0,0 | 3,31 | 21,95 | 3,09 | 24,9 | 0,77 | … | - | - | - | - |
| 6 | Collar | B | 0,0 | 4,0 | 20,1 | 1,3 | 19,6 | 5,2 | … | - | - | - | - |
| | | G | 0,0 | 4,41 | 21,95 | 1,43 | 21,41 | 5,73 | … | - | - | - | - |
| 7 | Cuff | B | 25,0 | 0,0 | 23,0 | -7,0 | 2,0 | -7,0 | … | - | - | - | - |
| | | G | 27,3 | 0,0 | 25,1 | -7,7 | 2,2 | -7,7 | … | - | - | - | - |

here B – coordinates of base pattern, G – coordinates of shrinkage values added pattern (garment dyeing)

Differences in perimeter and surface between the initial base pattern and the shrinkage values added pattern are directly related to fabric shrinking percent and its direction. For example, since in this situation, shrinking in warp is greater than in the weft direction, the perimeter variation in the front, back and sleeve blocks is longer as from 9,80 to 9,86 percent, in the pieces such as collar, stand and cuff on the contrary, it was observed that it was 9,26-9,36 percent, but the surface change is almost the same in all the details, which means that the design process can be considered correctly and qualitatively performed.

**Table 2**

**Dimensional changes between base and shrinkage values added pattern blocks**

| № | Pattern block | | Perimeter, cm | | Surface, $cm^2$ | | Change difference, percent (%) | |
|---|---|---|---|---|---|---|---|---|
| | | | Base pattern | Garment dyeing | Base | Garment dyeing | Peri-meter | Surface |
| 1 | Front bodice |  | 192,31 | 211,34 | 1832,1 | 2200,8 | 9,89 | 20,12 |
| 2 | Back bodice |  | 227,44 | 249,72 | 3327,7 | 4008,4 | 9,80 | 20,45 |
| 3 | Yoke |  | 111,26 | 121,82 | 425,5 | 511,9 | 9,49 | 20,31 |
| 4 | Sleeve |  | 175,33 | 192,62 | 1967,8 | 2368,3 | 9,86 | 20,35 |
| 5 | Collar stand |  | 93,92 | 102,62 | 135,4 | 162,8 | 9,26 | 20,24 |
| 6 | Collar |  | 92,76 | 101,44 | 184,4 | 221,6 | 9,36 | 20,17 |
| 7 | Cuff |  | 61,66 | 67,42 | 171 | 205,4 | 9,34 | 20,12 |

After the dyeing process, the sizes of the shirts are reduced due to the shrinkage. Therefore, their final size and measurements should correspond to the standard initial sizes without exceeding the permitted deviations. To determine this, the measuring method also has been developed in accordance with GOST 4103-82. By comparing these measurements with the initial basic pattern, it is possible to improve the construction drawing with shrinkage values.

**Conclusion.** As before emphasized, main designing problem that primary to be

solved in garment dyeing is that the dimensions of the clothes after dyeing are reduced due to the shrinking and the final measurements do not correspond to desired sizes.

This can be caused by several errors, for example, incorrect determination of shrinkage values of the fabric, error in applying shrinkage parameters to the pattern construction, incorrect location of various details in the warp and weft direction of the sewn garment, or different shrinking of pieces due to their difference. In order to solve that problem above research was implemented.

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