

Aziza B. Kasimova,
senior teacher,

Fatima U. Nigmatova,
ScD, professor,
Tashkent institute of textile and light industry

Method of Through Designing of Sportswear from Cotton-Nitron Fabrics

Key words: *clothes, cotton –nitron, project, sport wear, construction, method, structure, cloth.*

Annotation: *Application as a part of cotton -nitron knitted cloths of elastic threads allows receiving the clothes of sports direction possessing a high extensibility, form stability and comfort in operation. It is an actual problem, while designing of sportswear taking into account the technology factors, bearing the differentiated estimation of efficiency of use of cotton -nitron jersey.*

The requirements given to sportswear for separate kinds of winter sports (a mountain bicycle, skis, jumps from a springboard, etc.) form a specific circle of the problems which decision can remove the serious problem of equipment of the sportsmen, influencing to certain degree even on the results of competition. Special requirements to winter sportswear are expressed in its heat-shielding properties for which maintenance has the great value of correct choice of properties of materials, air permeability, and also structure of a package of materials taking into account functional responsibility of each of them.

Problem of the present researches is working out of designing functional sportswear for the cold period, a having zone of various extensibility, from the mixed cotton-nitron knitted cloth taking into account their deformational properties.

The design of the sportswear intended for protection against low temperatures in a combination to wind influence should be as much as possible "closed" to interfere penetrating cold air in under-clothes space and thereby to create high heat-isolation effect. For this purpose, for example, there are used cuffs of the sleeves, the closed collar, a hood, a belt etc. At the same time, it should be convenient in exploitation and not constrain movements, promote keeping of a normal thermal condition of a body, to maintenance of skin breath and blood circulation of the person.

The fabric and design of elements of a suit should consider various situations in which there can be a sportsman on road: changing of temperature, rain and snow, possibility of falling, thirst, driving against and in a wind direction. Therefore, one of the major requirements is - the clothes should be impenetrable for atmospheric moisture convenient at putting on and taking off operations and not to constrain movements.

It is very important, that at long-term driving on a bicycle the clothes design should be as much as possible correspond to movement of the sportsman and a bicycle design, the material for bike- costume should be highly elastic, strong and steady to wear.

The package of materials of clothes should be moist conductive for timely removal of moisture from under clothes zones.

Feature of designs of sportswear for the specified kinds of sports consists of densely fitting form (fig. 1) which can be created from the knitted cloth possessing a sufficient extensibility and mobility of loopy structure. For the purpose of increasing wear resistance, form stability, degrees of extensibility and mobility of a cotton knitted fabric is put a fiber nitron and lycra-elastic thread into structure. Thus, it is formed the mixed elastic knitted cloth demanding qualitatively new approach to the decision of problems of designing sportswear (1,2).

It is offered the method of through designing and the sportswear manufacturing, consists of reception entirely knitted products from new structure of an elastic knitted cloth. The essence of the method consists in association of processes of cloth designing from the mixed cotton-nitron yarn and clothes designing in one indissoluble process of getting of a product (3).

The method is synthesis small operational technologies (promoting of material, laborious decrease and to increase adaptability to manufacture of knitted products), including structure of design stages of a cloth, manufacture of jersey, design and technological preparation taking into account requirements to a product.

For a sports suit it is recommended to use the following fibrous structure of the mixed cloth: 75-55 % cotton, 17-35 % poly-acryl-nitrile fibers and an elastic thread - lycra of 8-10 %.

Results of previous made researches (2) have shown that new knitted cloths differ from traditional qualitatively by new structure, dimensions, durability, equal loopy structure, a wooliness, have a "warm" woolly stamp. Applying of elastic threads in structure, gives to a knitted cloth the best form-shape and form-fixing, high wear resistance and elasticity (1), and fibers nitron has - high heat-shielding properties.

Working out of a design of sportswear included outline worked of model, search of the form of a product in whole and separate parts, definition of the most dynamical (mobile) zones on a surface for designing of free movement of the sportsman, level choice of fitting products to a body of the person in each zone, an location of ornaments, their color combination. Depending on imagination of the designer and functional purpose of a sports suit the location of zones can be varied (fig. 1).

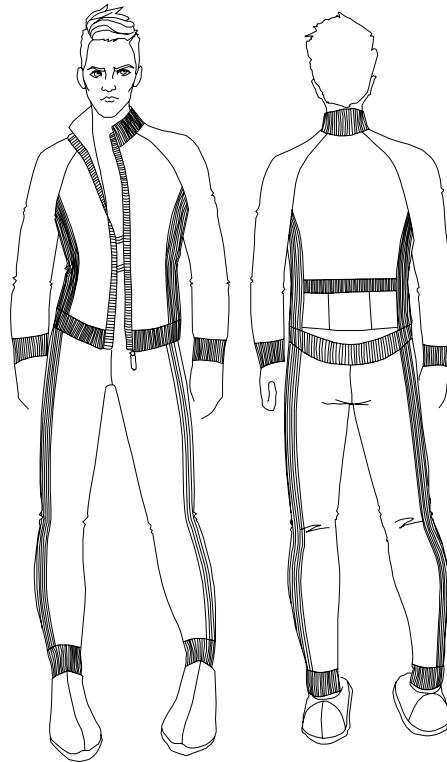


Fig. 1. Appearance of a sports suit of the bicyclist

Specificity of a knitted cloth to form-shape and preserve the form in process of wearing a product does not allow the approached methods of design and demands more perfect approaches which are based on the account of whole complex of requirements to the fabric and a product.

It is the method of zone designing of the sports suit, considering requirements to bike costume and elastic properties of a cloth. On clothes design is projected the sites with various values of increases on free zones, middle and strong fitting. Thus, the suit form consists of the alternating zones having different extensibility. In places of the steadiest fitting products to body are provided negative increases of the big size taking into account properties of a cloth. In particular, in designing of a heat-shielding suit of the bicyclist in the areas of a breast, neck, waist, hips, a shin at calculation of width of corresponding constructive sites, is necessary to put the size of cloth compressed, characterizing a negative increase. Thus, at designing of zone is necessary form of densely fitting sports suit from an elastic knitted cloth is reached not at the expense of traditional methods of designing (a tuck, reliefs, partitioning etc.), and by alternation of zones of various extensibility.

Let us consider realization of a method of zone designing for getting construction of completed knitted products. The base of design of a sports suit of the bicyclist (I), a modeling design taking into account negative increases (II) are shown on fig. 2. Parameters of a back design, a front part and a sleeve are given in two variants of design. In an initial base design of a sports suit, the increase size on free fitting in the area of a breast is 5 sm. At zone designing a base design modify with account the size of a negative increase, which value is defined depending on the size of coefficient cross-section stretching of a cloth or get

narrowed coefficient (4). The width of overall dimensions of details of products after modification can differ from the sizes BC (basic construction) in limits from 2 to 10 sm.

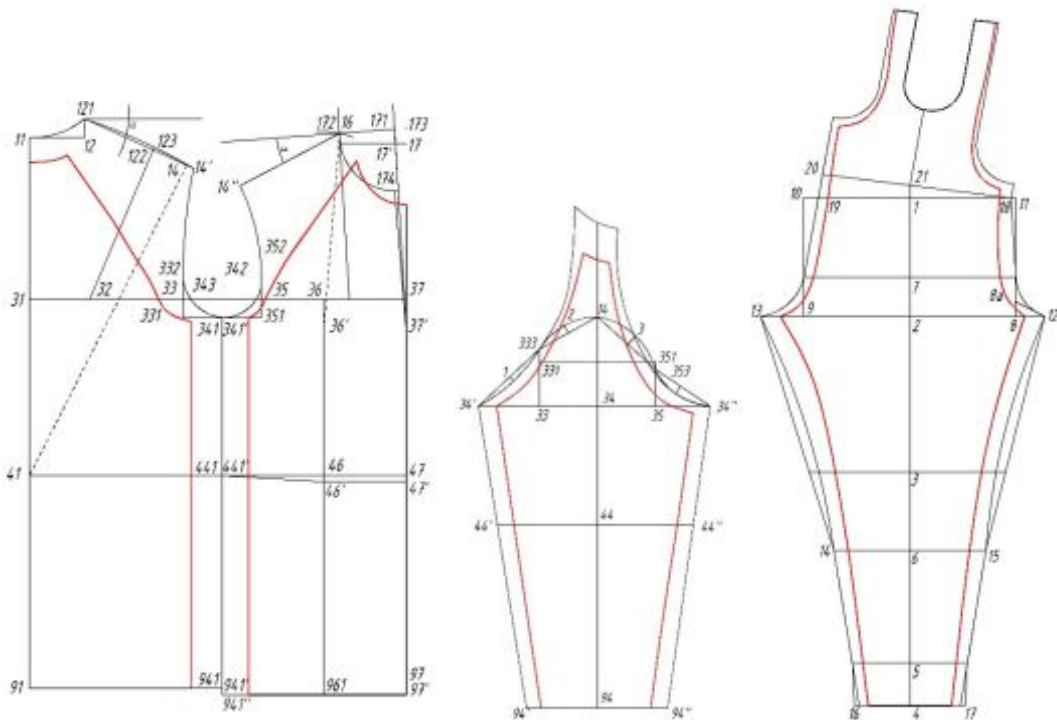


Fig. 2. A design of a sports suit for the bicyclist: I - base, II - modeling taking into account negative increases.

Width of a product - is key parameter for definition of an extensibility of knitted cloths. The extensibility completed knitted products is reached by two ways. Due to the first was the interlacing type is changed at the same system of threads, for example, satin stitch on lastic (type of interlacing) The second provides to enter elastic lycra threads - in structure of a cloth and increase in its concentration (5). It is established, that an extensibility of a cloth with an interlacing lastic above on 3-5 % in comparison with a satin stitch and weft jersey [3,6], and addition of lycra thread in structure of a new cloth has allowed to increase degree of its extensibility from I group (10 %) to III group (31 %) (1). These are the properties of a cloth have been used at designing of structure new completed knitted jersey.

In designing of a cloth in the zones of a breast, necks hands, ankles of feet are projected sites with various size of an extensibility, completed knitted with a figure (for example, densely fitting cuffs of an interlacing lastic). Sites with the greatest and moderate extensibility can alternate depending on zones fitting products to a body (fig. 3). In our case to parameter of a waist width corresponds a zone of raised fitting, and parameter of sleeve width - a zone moderated fitting.

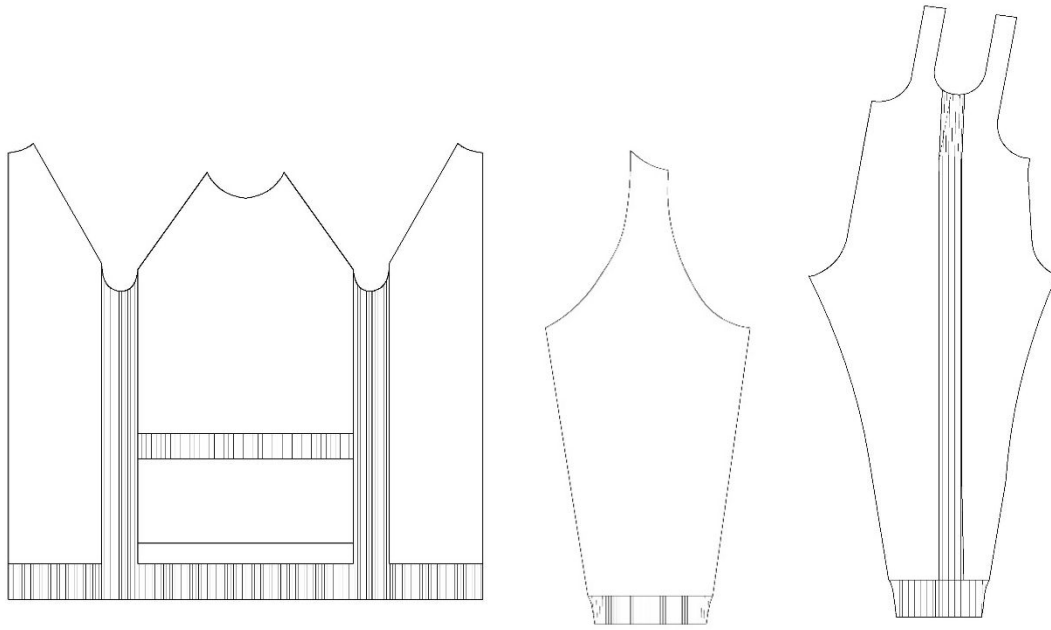


Fig. 3. A template design completed knitted products of a sports suit of the bicyclist

It is offered the generalized factor of through designing K_{sp} considering a number of technological factors, bearing the differentiated estimation of efficiency of using knitted cloths with nitron fibers. Thus, it is taken dependence on the factor of through designing:

$$K_{cн} = (1 - R_y)(1 - R_c)(1 - R_m)(1 - R_{пл})(1 + R_{ш}) \quad (1)$$

Where R_y - getting narrow design's factor, considering deformational properties of a cloth and dynamic changes of the sizes of a figure; R_c - factor of compression of the cloth, considering width of a cloth after removing from the knitting machine and depending on relaxation degree; R_r - the factor considering compression of a cloth after, wet processing; $R_{пл}$ - the factor expressing relative plastic deformation; $R_{ш}$ - the factor providing a positive increase for performance of connecting seams, depending on modeling features of a product and seam parameters.

For factor definition getting narrow first of all to count a base narrow limit $K_{\epsilon\delta}$ (%) [7], then it is corrected taking into account dynamic increase dimensional signs at the maximum operational loadings of the sportsman:

$$K_{\epsilon\delta} = \frac{\epsilon}{\epsilon+100} * 100 \quad (2)$$

$$K_y = T_i K_{\epsilon\delta} + \Delta T_i (K_{\epsilon} - 1) \quad (3)$$

$$R_y = \frac{K_y}{L_{\delta}} \quad (4)$$

Where ε - an extensibility of a cloth, %; T_i - size of I th dimensional sign, sm; ΔT_i a-dynamic increase of I th dimensional sign; K_y - the corrected size of a narrow limit, sm; L_6 the-size of a corresponding site due to drawing of base design of a product, sm.

It is executed the model study of constructive decisions in which as the result are prepared the drawings of details for cutting out a semi-finished product which are developed by regular way.

For calculation of the sizes of the semi-finished product, which has been removed directly from the knitting machine, define technological parameters of a cloth (8).

Key parameter is the factor of compression of cloth R_c which for each kind of a cloth is an experimentally-calculated method. Owing to presence elastic threads and its relaxations the sizes of a cloth undergo changes and in most cases decrease. Therefore in a design are put the sizes of a semi-finished product according to a factor of compression of cloth R_c which depends on relaxation degree:

$$R_c = \frac{(L_2 - L_1)}{L_2} \quad (5)$$

Where L_1 - a cloth width after removal from the knitting machine; L_2 - cloth width which have been removed directly from the knitting machine, corresponding to nominal length of the knitting machine with corresponding number of needles; R_c - the factor of compression of the cloth, which size depends on cloth structure.

Then size L_2 corresponding to a design of semi-finished product, it is possible to define under the formula:

$$L_2 = \frac{L_1}{(1 - R_c)} \quad (6)$$

For the account putting a material after wet processing it is recommended to enter factor R_m considering these putting into calculation of a product parameters:

$$R_m = \frac{(L_1 - L_0)}{L_1}, \% \quad (7)$$

Where L_0 - the size of a cloth after damp-thermal processing.

Thus, factors R_c and R_r characterize a technological part of factor of through designing K_{cn} , i.e. numerically reflect a knitted cloth on a stage of development and preparation for a following stage - to cut and to manufacture of a product.

In the presence of seams in product designs (relief, side) it is necessary to enter factor R_{III} considering parameters of connecting seams and making a positive increase ΔL_n .

R_{III} is calculated under the formula:

$$R_{III} = \frac{(L_6 + \Delta L_n)}{L_6} \quad (8)$$

Where L_6 is the-size under the drawing of a base design of a product, sm; ΔL_n - the allowance size on a seam, sm

Factor $R_{\text{пл}}$ characterises plastic deformation $\varepsilon_{\text{пл}}$ and is defined under the formula:

$$R_{\text{пл}} = \frac{\varepsilon_{\text{пл}}}{\varepsilon_{\text{п}}} \quad (9)$$

Definitive design stage of a sports product from cotton nitron knitted cloth is getting of a flat template - the curves that sizes correspond to the sizes of knitted basic details: backs, a front part, sleeves, trousers.

Width of a cloth and length of knitting machine L corresponding to it define under the formula:

$$L = \frac{B}{K_{\text{сп}}} \quad (10)$$

Where B - the flat template size of a detail clothes, sm

Let us analyze an example of calculation of values $K_{\text{сп}}$ for experimental samples cotton-nitron cloth of various structure with reference to sportswear of the bicyclist.

As a result of studying of movements are carried out by the sportsman and the analysis of structure and a principle of training exercises of the sportsmen specializing on cycling the most typical movements are revealed and defined dynamic increases of dimensional signs. So the dynamic increase of width of a back of the bicyclist, measured during cycling, makes from 20 to 30 %, the length of back to waist – approximately of 25 %, a grasp of hips - from 10 to 18 %. These data are used at calculation of narrowing limits of design of a jacket and overall of the bicyclist.

Table 1

Values of coefficient of through designing and its components for manufacturing cycle-costume from cotton -nitron jersey

Type of factors	Factor of compression of a cloth	Factor of shrinking cloths after wet processing:		Factor of narrowing design		The factor of design considering and parameters of a seam:		Factor of plastic deformation		Factor of through design :	
		Along the length	Along the width	a Jacket	An overall	A jacket	An overall	Along the length	Along the width	Jacket	An overall
Designation	R_c	R_t		R_u		R_{sh}		R_{pl}		K_{sd}	
Type of the sample interlacing (lastic 2+1)	0,6	0,14	0,05	0,32	0,36	0,34	0,26	0,038	0,045	0,25	0,22

It is experimentally established, that at a stage of model sketch study it is necessary to define accurately sequence and methods of technological processing of a product, it is necessary the exact calculation of increases and technological allowances taking into account a kind of raw materials, parameters of structure of the future cloth, deformational properties of jersey and connecting seams.

Due to the offered method it is worked out cloths and prepared samples of cycle costume models in the conditions of private enterprises «YUTEX» (Tashkent city), intended for trainings in the open air in the cold season of the year. All samples have received positive estimation of experts from school of winter technical kinds of sports and the Federation of cycling of Uzbekistan.

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