

**Abstract:** Technological analysis involves continuous systematic testing of alternative permutations of production and changes of technological operations and a synthesis of future technological processes. Organization of the technological process of sewing and finishing is different for different garments. Each product is different in its own way and requires a different organization of the technological process of sewing and finishing. Well-selected technological operations shorten the time of making garment cases, reduce production costs per unit of product, allowing the flow of product through all stages without the occurrence of bottleneck production, reduce inventory, allow rational use of the machine park and prevent low labour productivity.

**Keywords:** processes, technological analysis, manufacturing operations, garment.

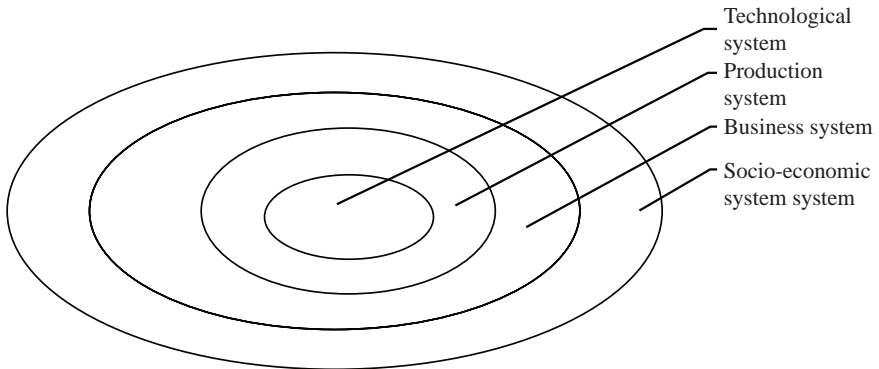
## 2.1 Technological system

Every production, every organized human labour is a complex system. Technological system is an open dynamic system closely related to the environment. Production technological system is designated as a part of a broader production system (element of the business system). Business system, in organizational terms, can act as a separate entity (company). Business system, beside production system, also contains a system of procurement, sales, distribution of resources, as well as material, energetic, informational and financial flows. Socio-economic system is broader than business system (Figure 2.1).

The basis of technological system is in the process, transforming materials from one form into another, from lower to higher use value, which directly determines the character of the production system (Figure 2.2). Other parts of the production system are

- System of design (construction) of product,
- System maintenance,
- Inventory system,

- Safety at work,
- Transport,
- Quality control.



2.1 Systems.

**Fiber**  $\Rightarrow$  **Yarn**  $\Rightarrow$  **Fabric, knitted**  $\Rightarrow$  **Clothes**

2.2 Transforming materials from one form into another.

## 2.2 Technological systems, processes and operations

Technological system usually occurs as a part of a wider system and the result of an integral activity of people in different kinds of work processes.

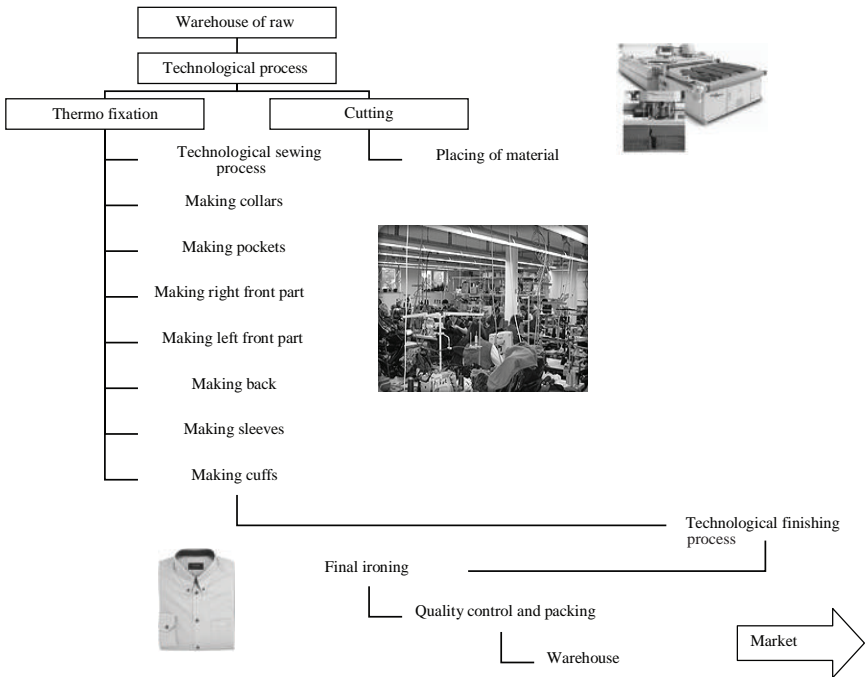
The structure of the technological system is determined by three factors:

- (1) Complexity of technology,
- (2) Complexity of products and
- (3) Management system.

Technological systems by nature are among the artificial, open, dynamic and stochastic systems. Technological systems are studied both in the sphere of production and beyond, so they are mainly divided into production and non-production technological systems.

Production technological systems can be defined as a set of objects (tools, materials, funds for the work, projected technology, human labour and finished products) with the relations that exist between input elements on one side and output elements (finished products) on the other, observed through their attributes (price, quantity and quality). Non-production technological systems occur in all out-production activities of people (education, health, culture, etc.).

The essence of the production technological system is a mutual dependence and interdependence of all elements (or objects of system) while performing the functions of transformation of material from one form into another, more useful form, where its utility output increase under the influence of organized human labour. Figure 2.3 shows the technological process of making shirts for men.



2.3 The technological process of making men’s shirts.

Production technological systems are classified according to the following:

- (1) Level of investment (of raw materials and simple compounds, drawer, basic compounds, sub-assemblies and complex materials, components and final products),
- (2) Type of labour (extractive, processing and synthetic technological processes),
- (3) Type of labour and types of activities (agricultural, mining, metallurgical, chemical, metal-processing, textile, pharmaceutical, wood and food),
- (4) Dynamics of movement of materials and stability conditions (batch wise or continuous),
- (5) Organization of production (mass, serial and unit production),
- (6) Order of processes (preparation of raw materials, chemical processing, physical processing and finishing) and

- (7) Other criteria (the character of the means of work, production volume, product type, the basic raw materials and the dynamics and type of movement of material in the technological process).

Processes in production are a horizontal division of labour whose task is to make the product. Production process includes everything that happens with the subject from the entry of raw materials in production to the release of finished products. The production process consists of elementary processes: workplaces, quality control, inter phase transport, preventive maintenance of the means of work, preventive work safety, storage and supply of water and energy.

Technological process is part of the production process which refers to the shaping of work case with defined workplaces. Technological process is the linking of technological operations in order to convert the lower use-values into the higher ones together with human activity. Technological operation is a set of direct and ancillary effects on the work piece on one machine, which enables the realization of process. Working operation is a set of all activities that form a finished product.

Operations can be divided into technological and non-technological. Technological operations directly alter the characteristics of objects to get products with new use-value on the basis of these changes. Non-technological operations do not change the characteristics of objects, but are necessary in the production process so the technological process could be done.

### **2.3 Technological analysis of manufacturing operations**

Technological analysis involves continuous systematic testing of alternative permutations of production and changes of technological operations and a synthesis of future technological processes. Optimization of technological system means the ultimate goal of the analysis of technological systems and is an element of his partial analysis.

The main objective of the analysis of technological systems is to improve performance through analysis of process. Technological analysis determines the effect of technological change in operations on the broader changes of technological system, as well as on the performance of certain operations.

Changes in the technological operations are viewed via

- fixed costs of working capital,
- expenditure of human labour,
- appropriate changes in the course and the amount of material and
- changes in all other operations of technological process.

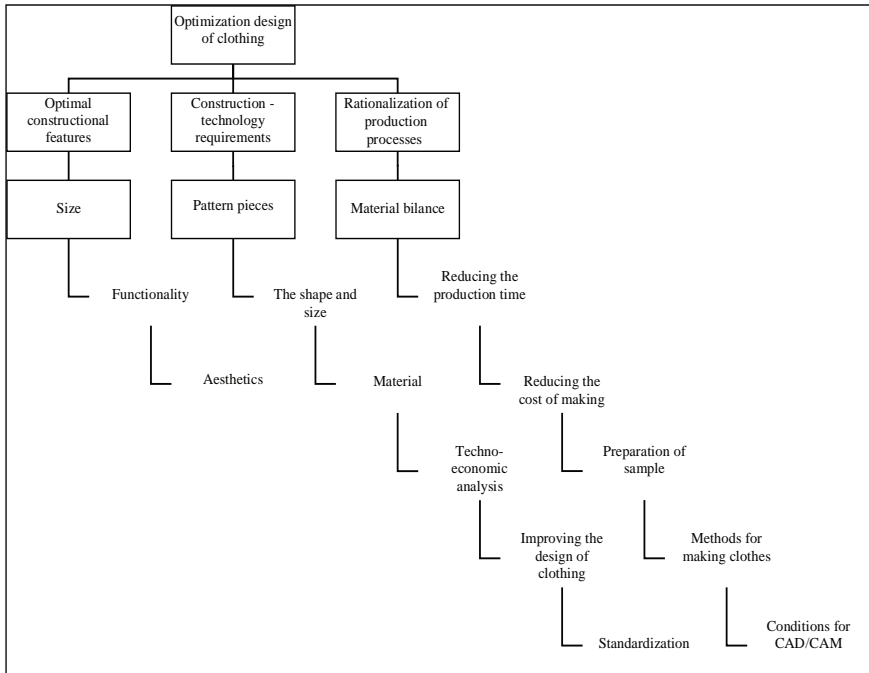
Technological analysis is a specific activity, which aims to introduce the production characteristics of products and potential problems that we are about to have in its production. The greatest number of errors in garment manufacturing, and thus the costs associated with product quality arise in defining garment, developing product and planning of technological process of making clothes. It is believed that 75% of all errors that appear on the product occur in construction preparation. The most common errors in construction preparation are

- pattern pieces do not fit the model,
- bad positioning of pattern pieces,
- unmarked indentation,
- missing of pattern piece,
- adding % due to stretch material,
- deviations in grading,
- ill-cut pattern pieces,
- non-grading of all pattern pieces,
- large consumption of materials,
- pattern pieces not fitting the layout pattern and
- inadequate size of layout pattern.

The manufacturing process is a database of functioning of organizational structures, which requires being technologic. The technologic of product is achieved through such construction of product that ensures an optimal relationship between investment of resources and the achieved quality under the given driving conditions and the absorbing power of markets.

Therefore, it is necessary for the design of technological products to undergo technological analysis, in order to determine and, if it is necessary, to improve the technologic of product, i.e. the suitability for production. It is necessary to observe the possibilities of one's own production facilities. Figure 2.4 show the functional clothing design system that provides high technologic.

While planning of production of each garment a detailed technological analysis needs to be made. The technological preparation consists of analyzing, enhancing and improving of activities related to technological processes, which can be divided into several groups of activities, such as technological analysis of production operations, the selection of machine, montage plans, selection of technological systems, the choice of inter phase transport system, the choice of mounting positions, determining the technological and technical specifications for the programming of machines, work study and workplace design.



2.4 Functional clothing construction systems that provides high technologicis.

Modern fashion design requires a small amount of clothing, many colours and patterns, so the production plants daily deal with many work orders, which caused the production of technical documentation to be one of the biggest problems in clothing industry.

Organization of the technological process of sewing and finishing is different for different garments; for each item is different in its own way and requires a different organization of the technological process of sewing. Well-selected technological operations shorten the time of making garment cases, reduce production costs per unit of product, allowing the flow of product through all stages without the occurrence of bottleneck production, reduce inventory, allowing rational use of the machine park, preventing low labour productivity and so on. Therefore, the task of technical preparations is to determine working procedure for the new product, to determine the required time of manufacture, the material normative, and to match the way of making with some details. On the basis of daily capacity, the required number of workplaces should be determined, as well as the number of ordinary and special sewing machines, automatic sewing machines and presses for trim, tables and other tools of work, the number of workers in structure with highly specified load job.

In garment industry, technological process is divided into three phases: cutting, sewing and finishing. Each phase individually requires plans of technological operations. A plan of technological operation (operation sheet) is the basic document in the development of a garment, on the basis of which other technological documentation is made.

After making an operation sheet the recapitulation of a development time is performed, according to the types of machines used for making a garment and time required for manual work ( $t_1$ ) to determine the number of necessary funds. Total production time per unit ( $t_1$ ) is obtained by adding the time of making, following the stages of production:

$$t_1 = t_c + t_s + t_f \quad [2.1]$$

Where  $t_c$  – cutting time,

$t_s$  – time for sewing phase,

$t_f$  – time for finishing phase.

Making plans and technological processes is a complex and responsible job which requires integration of knowledge in order to achieve the optimization of process parameters of production of clothing. Due to the lack of time and professional staff in the garment industry, less technological documentation is rarely made or used. Steady production lines for the production of certain garments are often used, regardless of the size of work orders.

### 2.3.1 Technological analysis of operations for making men's shirts from denim





Analysis of technological operations in the process of cutting and sewing men's shirts from denim is given as an example of technological analysis (Figure 2.5). Total production time per unit ( $t_1$ ) is 3336 s. Time of cutting shirts for men from denim (jeans) is 295 s and time for sewing and finishing phase is 3041 s (Table 2.2). Table 2.1 shows the need for three workers for cutting because total load is 300%.

Table 2.1 Technological operation plan for cutting men's shirts from denim

| Name of operation   | Means of production      | Pr quota/a piece (s) | Norma (piece) | Load (%) |
|---|--------------------------|----------------------|---------------|----------|
| Marking length of cutting layout (marker) after patterns and spreading of material (cutting layers) | Fabric Spreading machine | 21                   | 1258          | 21       |

|                                       |                                |              |      |    |
|---------------------------------------|--------------------------------|--------------|------|----|
| Putting of cutting layout on material | Hand makes                     | 4            | 6600 | 4  |
| Rough cutting                         | Straight knife Cutting machine | 31           | 851  | 32 |
| Fine cutting                          | Vertical cutter                | 59           | 447  | 60 |
| Numbering, marking of cut pieces      | Hand makes                     | 49           | 538  | 50 |
| Completing of cut pieces              | Hand makes                     | 53           | 498  | 54 |
| Control                               | Hand makes                     | 78           | 338  | 79 |
| <b>TOTAL TIME</b>                     |                                | <b>295 s</b> |      |    |

Table 2.2 Technological operation plan for making men's shirts from denim

| Name of operation   | Means of production   | Pr quota/a piece (s) | Norma (piece) | Load (%) |
|---|---|----------------------|---------------|----------|
| Open bundle and control of cutting pieces   | HR  | 33                   | 800           | 29       |
| Preparation for sewing collars  | HR  | 16                   | 1520          | 15       |
| Making collars  | OM  | 40                   | 660           | 36       |
|  Turning and shaping collar tops | RR  | 54                   | 2020          | 52       |
| Topstitch collar  | SM2   | 40                   | 650           | 36       |
|  Cut the tops of collars         | HR  | 10                   | 2500          | 9        |
| Hem stand collars   | OM  | 22                   | 1200          | 19       |
|                                  |  |                      |               |          |

(Continued)



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|                     |    |    |      |    |
|---------------------|----|----|------|----|
| Hem cuff and sewing | OM | 21 | 1230 | 19 |
| Hem two pockets     | OM | 14 | 1800 | 13 |



|   |    |    |     |    |
|---|----|----|-----|----|
| Prepare the cover for pocket for sewing | HR | 30 | 905 | 26 |
| Sewing covers for pockets               | OM | 77 | 340 | 69 |



|                                |     |     |     |     |
|--------------------------------|-----|-----|-----|-----|
| Turning the covers for pockets | HR  | 42  | 600 | 39  |
| Topstitch covers for pockets   | SM2 | 122 | 210 | 112 |



|                               |    |    |     |    |
|-------------------------------|----|----|-----|----|
| Sewing stand collar on collar | OM | 66 | 400 | 59 |
|-------------------------------|----|----|-----|----|



|                                      |    |    |      |    |
|--------------------------------------|----|----|------|----|
| Cutting and turning the stand collar | HR | 23 | 1100 | 21 |
| Topstitch the stand collar           | OM | 37 | 700  | 34 |



|                               |    |    |     |    |
|-------------------------------|----|----|-----|----|
| Sewing yoke on the front part | OM | 53 | 500 | 47 |
|-------------------------------|----|----|-----|----|

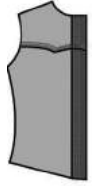


Topstitch the yoke SM 42 610 38



Pressing the front parts HR 35 750 31

Closing placket OM 89 300 78



Ironing pockets SI 20 1300 18

Mark with pattern place for sewing pockets

HR 37 713 33

Sewing pockets OM 220 120 196



Sewing covers for pockets OM 52 507 46



Sewing yoke on back OM 20 750 31



(Continued)

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Topstitch the yoke



SM2



80

300

78

Sewing labels on the yoke



OM



13

1886

12

Sewing shoulders



SMo5



37

700

34

Topstitch the shoulders



SM2



52

507

46

Facing the two sides of the sleeves fly



OM



66

400

59

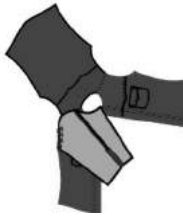
Sewing sleeves SMo5 38 694 34



Topstitch the sleeves SM2 35 754 31



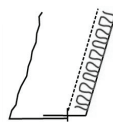
Attaching sleeves to armholes SMo5 88 300 78



Topstitch the armholes SM2 132 200 118



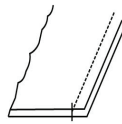
Sewing underarms seams and side SMo5 88 300 78



(Continued)

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|                                |    |    |     |    |
|--------------------------------|----|----|-----|----|
| Making cuffs                   | OM | 48 | 550 | 43 |
| Turning and shaping cuffs tops | HR | 43 | 610 | 38 |
| Attaching cuffs on the sleeves | OM | 97 | 270 | 87 |



|                                |    |    |     |    |
|--------------------------------|----|----|-----|----|
| Close the cuffs on the sleeves | OM | 66 | 400 | 59 |
|--------------------------------|----|----|-----|----|



|                     |    |    |     |    |
|---------------------|----|----|-----|----|
| Topstitch the cuffs | OM | 66 | 400 | 59 |
|---------------------|----|----|-----|----|



|                              |    |    |     |    |
|------------------------------|----|----|-----|----|
| Attaching collar to neckline | OM | 66 | 400 | 59 |
|------------------------------|----|----|-----|----|



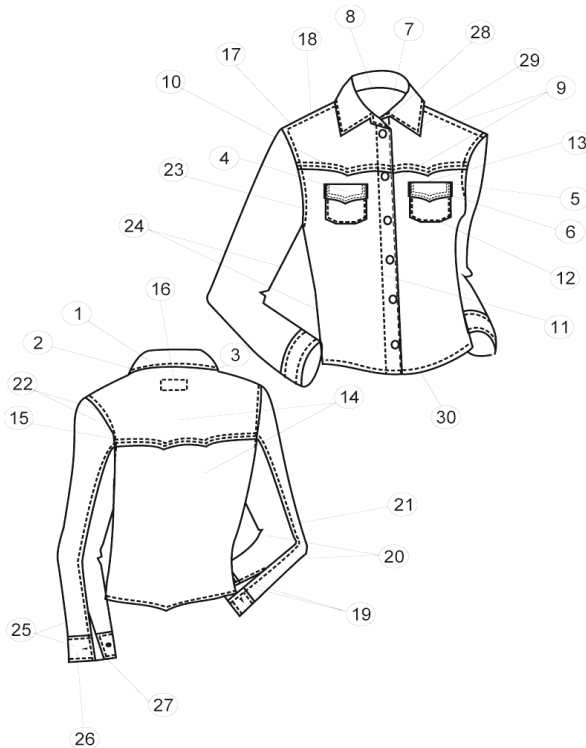
|              |    |    |     |    |
|--------------|----|----|-----|----|
| Close collar | OM | 66 | 400 | 59 |
|--------------|----|----|-----|----|

|           |    |    |     |    |
|-----------|----|----|-----|----|
| Hem shirt | OM | 52 | 500 | 47 |
|-----------|----|----|-----|----|



|                        |      |    |     |    |
|------------------------|------|----|-----|----|
| Sewing ten buttonholes | AUTh | 88 | 300 | 51 |
|------------------------|------|----|-----|----|

|  |                   |              |      |     |
|--|-------------------|--------------|------|-----|
| Close shirts at the front<br>(protection when sanding)   | OM                | 52           | 500  | 30  |
| Wearing sleeveless shirts<br>(protection of the stoning) | HR                | 52           | 500  | 30  |
| Cutting of thread  | HR                | 264          | 100  | 153 |
| Ironing on the shirt ironing<br>machines                 | Shirt<br>Finisher | 132          | 200  | 76  |
| Final ironing (cuffs, collar)                            | SI                | 32           | 810  | 19  |
| Sewing buttons   | AUTb              | 26           | 1000 | 15  |
| Putting paper labels                                     | HR                | 26           | 100  | 153 |
| Packaging shirts in the bag                              | HR                | 17           | 1553 | 10  |
| <b>TOTAL TIME</b>  |                   | <b>3037s</b> |      |     |



2.5 Men's shirts from denim.

Required number of workers in the process of cutting is provided in the following way:

$$N_w = C_d \times t_1 / T = 2.8 \approx 3 \text{ workers} \quad [2.2]$$

Where,  $C_d$  – daily capacity,  
 $t_1$  – total production time per unit,  
 $T$  – working time.

Production line with 27 workers produces (daily capacity) 247 pieces of shirts from denim per day. In the plan of technological operations (Table 2.2) the time of making this operation is given, together with the norm (number of pieces you need to do for the working time 7.5 h), the load of work operations in percentage, and the necessary means of work. Means of work are marked with the following abbreviations:

- Hand makes – HR
- Ordinary sewing machine – OM
- Special sewing machine with two needles – SM2
- Special sewing machines (overloch) with three threads – SMO3
- Special sewing machines (overloch) with five threads – SMO5
- Automatic for making buttonhole – AUTH
- Automatic for button – AUTb
- Steam iron – SI

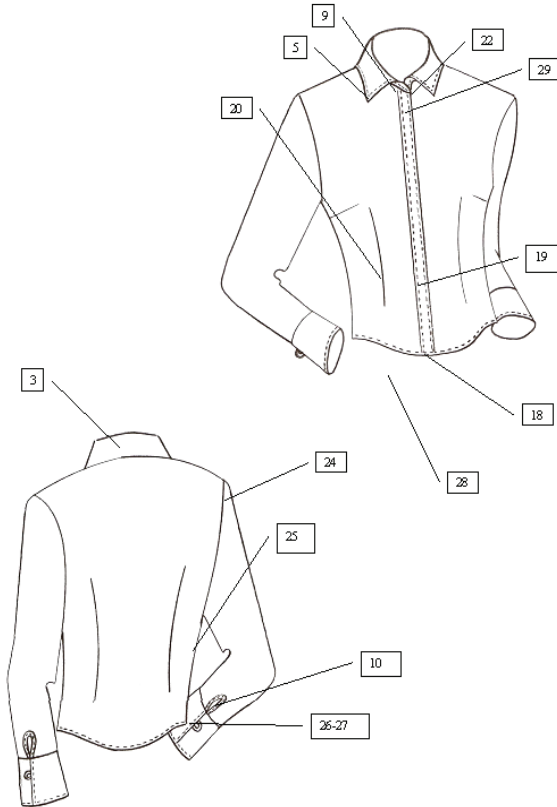
### 2.3.2 Technological analysis of operations for making women's shirts

Cutting time for women's shirts is 295 s (three workers). Technological operation plan for cutting women's shirts is shown in Table 2.3. Production lines with 29 workers produce 332 shirts per day. Model of women's shirts with positions of some of the operations are shown in Figure 2.6.

*Table 2.3* Technological operation plan for cutting women's shirts

| Name of operation                   | Means of production            | Pr quota/a piece (s) | Norma (piece) | Load (%) |
|-------------------------------------|--------------------------------|----------------------|---------------|----------|
| Spreading material                  | Hand makes                     | 36                   | 750           | 44.3     |
| Spreading nonwoven interlining      | Hand makes                     | 13                   | 2077          | 16.0     |
| Rough cutting (without front parts) | Straight knife Cutting machine | 11                   | 2455          | 13.5     |
| Fine cutting (with front parts)     | Vertical cutter                | 28                   | 964           | 34.4     |

|                                       |                |              |      |      |
|---------------------------------------|----------------|--------------|------|------|
| Numbering and marking of cut pieces   | Hand makes     | 22           | 1227 | 27.1 |
| Fusing interlining with collar        | Fusing machine | 34           | 794  | 41.8 |
| Thermal bonding interlining with cuff | Fusing machine | 45           | 600  | 55.3 |
| Completing of cut pieces              | Hand makes     | 25           | 794  | 41.8 |
| Control                               | Hand makes     | 30           | 900  | 36.9 |
| <b>TOTAL TIME</b>                     |                | <b>244 s</b> |      |      |



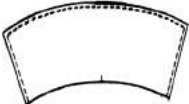
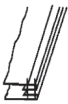





2.6 Women's shirt.

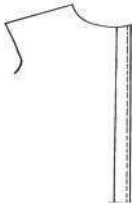


Technological operation plan for the production of women’s shirts is shown in the Table 2.4.

Table 2.4 Technological operation plan for making women’s shirts

| Name of operation   | Means of production   | Pr quota/ a piece (s) | Norma (piece) | Load (%) |
|---|---|-----------------------|---------------|----------|
| Making collars  | OM  | 54                    | 500           | 66.4     |
|    |    |                       |               |          |
| Turning and shaping collar tops   | HM  | 40                    | 675           | 49.2     |
| Ironing collar  | SI  | 62                    | 435           | 76.3     |
| Topstitch the collar (0,5cm)  | OM  | 43                    | 628           | 52.9     |
|    |    |                       |               |          |
| Hem stand collar  | OM  | 21                    | 1286          | 25.8     |
| Sewing stand collar on collar   | OM  | 54                    | 500           | 66.4     |
| Turning and shaping stand collar tops   | HM  | 40                    | 675           | 49.2     |
| Topstitch the stand collar  | OM  | 18                    | 1500          | 22.1     |
|  |  |                       |               |          |
| Placing strips on the sleeve  | SM  | 58                    | 466           | 71.2     |
|  |   |                       |               |          |
| Hem cuffs   | OM  | 39                    | 692           | 48.0     |
| Sewing cuffs with long side   | OM  | 10                    | 2700          | 12.3     |
| Ironing cuffs with long side  | SI  | 45                    | 600           | 55.3     |
| Making loop for button  | SM  | 59                    | 458           | 72.5     |
| Sewing cuffs with short side with putting loop for button                           | OM  | 53                    | 509           | 65.2     |

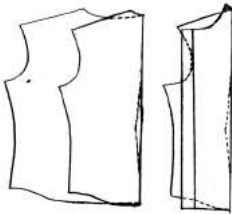
|                               |    |    |     |      |
|-------------------------------|----|----|-----|------|
| Turning cuffs                 | HM | 40 | 675 | 49.2 |
| Ironing placket               | SI | 75 | 360 | 92.2 |
| Sewing placket on front parts | OM | 40 | 675 | 49.2 |



|                                 |    |    |     |      |
|---------------------------------|----|----|-----|------|
| Topstitch the placket for 0,5cm | OM | 65 | 415 | 80.0 |
|---------------------------------|----|----|-----|------|



|  |    |    |     |      |
|--|----|----|-----|------|
| Sewing darts on front parts and back and sewing bust darts | OM | 80 | 338 | 98.2 |
|--|----|----|-----|------|



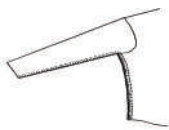



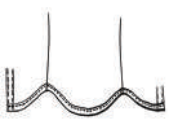



|                                    |      |     |      |       |
|------------------------------------|------|-----|------|-------|
| Sewing shoulders                   | SMo5 | 27  | 1000 | 33.2  |
| Attaching stand collar to neckline | OM   | 145 | 186  | 178.5 |



|                      |      |    |     |      |
|----------------------|------|----|-----|------|
| Closing stand collar | OM   | 61 | 443 | 74.9 |
| Attaching sleeves    | SMo5 | 54 | 500 | 66.4 |



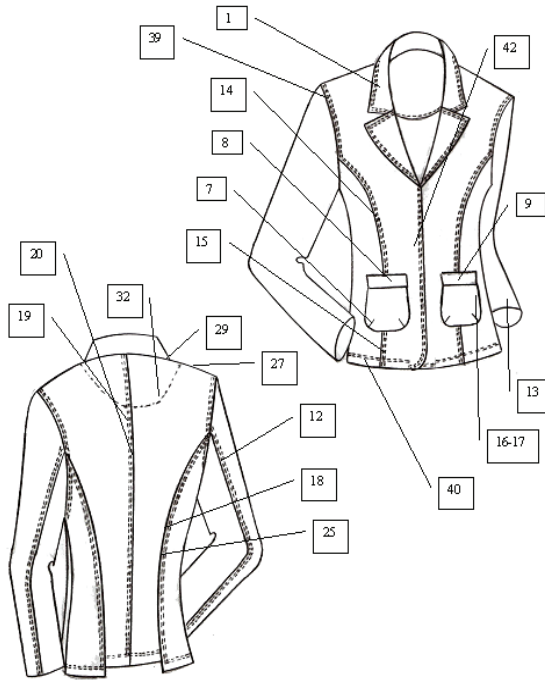
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|  |   |   |          |     |              |       |
|--|---|---|----------|-----|--------------|-------|
| Sewing side seams and sleeves with label |  |  | SMo5     | 45  | 600          | 55.3  |
| Attaching cuffs                          |   |   | OM       | 125 | 216          | 153.7 |
| Topstitch the cuffs for 0,5cm            |   |   | OM       | 133 | 203          | 163.5 |
|  |  |  |          |     |              |       |
| Hem                                      |   |   | OM       | 93  | 290          | 114.5 |
|  |  |  |          |     |              |       |
| Marking and sewing seven buttonholes     |   |   | AUTh     | 75  | 360          | 92.2  |
|  |  |  |          |     |              |       |
| Marked place for button                  |   |   | HM       | 61  | 443          | 74.9  |
| Sewing seven button                      |   |   | AUTb     | 98  | 276          | 120.3 |
| Ironing                                  |   |   | Finisher | 309 | 87           | 381.6 |
| Control                                  |   |   | HM       | 140 | 193          | 172.0 |
| Mount the hanger                         |   |   | HM       | 10  | 2700         | 12.3  |
| Buttoning                                |   |   | HM       | 62  | 435          | 76.3  |
| Putting paper labels                     |   |   | HM       | 10  | 2700         | 12.3  |
| <b>TOTAL TIME</b>                        |   |   |          |     | <b>2344s</b> |       |

The technological documentation shows that the total production time per unit ( $t_1$ ) is 2588 s.

### 2.3.3 Technological analysis of operations for making women's denim jacket

Production line with 47 workers produces 293 women's denim jackets per day (Figure 2.7). Cutting time is 369 s (four workers). Technological operation plan for the cutting women's denim jacket is shown in Table 2.5.



2.7 Women's denim jacket.

Table 2.5 Technological operation plan for cutting women's denim jacket



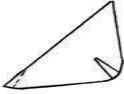





| Name of operation   | Means of production            | Pr quota/ a piece (s) | Norma (piece) | Load (%) |
|---|--------------------------------|-----------------------|---------------|----------|
| Marking length of cutting layout after patterns; spreading material | Hand makes                     | 37                    | 730           | 40.2     |
| Planing of cutting layout on material                               | Hand makes                     | 15                    | 1800          | 16.3     |
| Rough cutting   | Straight Knife Cutting Machine | 55                    | 491           | 59.7     |
| Fine cutting  | Vertical Cutter                | 31                    | 871           | 33.6     |
| Spreading elastic bar   | Hand makes                     | 15                    | 1800          | 16.3     |
| Rough cutting elastic bar   | Vertical Cutter                | 5                     | 5400          | 5.43     |












(Continued)

|                                     |            |              |     |     |
|-------------------------------------|------------|--------------|-----|-----|
| Numbering and marking of cut pieces | Hand makes | 129          | 209 | 140 |
| Completing of cut pieces            | Hand makes | 35           | 771 | 38  |
| Control                             | Hand makes | 47           | 574 | 51  |
| <b>TOTAL TIME</b>                   |            | <b>369 s</b> |     |     |

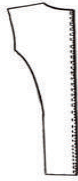
Technological operation plan for the production of women’s denim jacket is shown in Table 2.6.

Table 2.6 Technological operation plan for the production of women’s denim jacket

| Name of operation   | Means of production   | Pr quota/a piece (s) | Norma (piece) | Load (%) |
|---|---|----------------------|---------------|----------|
| Sewing collar   | OM  | 65                   | 415           | 70.6     |
|    |    |                      |               |          |
| Cutting and turning collar  | HM  | 40                   | 675           | 43.4     |
| Ironing middle collar seam  | SI  | 25                   | 1080          | 27.1     |
| Hem front fuse and double bend  | OM  | 50                   | 540           | 54.3     |
| Ironing fuse behind the neck  | SI  | 21                   | 1286          | 22.8     |
| Sewing hangers for fuse   | OM  | 8                    | 3375          | 8.68     |
| Sewing dart on pockets  | OM  | 60                   | 450           | 65.1     |
|   |  |                      |               |          |
| Sewing elastic bar on pockets   | SMo5  | 21                   | 1286          | 22.8     |
|  |  |                      |               |          |
| Topstitch the pockets   | OM  | 62                   | 435           | 67.4     |
|  |  |                      |               |          |
| Sewing sleeves  | SMo5  | 59                   | 458           | 64       |
| Topstitch the sleeves   | OM  | 145                  | 186           | 158      |
| Sewing side seam on sleeves   | SMo5  | 59                   | 458           | 64       |

|                           |   |   |     |      |      |
|---------------------------|---|---|-----|------|------|
| Hem sleeves               |    | OM  | 181 | 149  | 197  |
| Sewing front parts        |    |    | 54  | 500  | 58.6 |
| Topstitch the front parts |    |    | 62  | 435  | 67.4 |
| Drawing position          |    | HM  | 35  | 771  | 38   |
| Sewing pockets            |   | OM  | 420 | 64   | 458  |
| Overloch seam on back     |  |  | 60  | 450  | 65.1 |
| Sewing back               |  |  | 21  | 1286 | 22.8 |

(Continued)



Topstitch the back OM 39 692 42.3



Sewing back with side parts to fly OM 43 628 46.7



Closing fly on the back with formation hem OM 92 293 100

Topstitch the back hem OM 54 500 58.6

Closing fly on the side to hem OM 92 293 100

Sewing shoulders SMO5 27 1000 29.3











Topstitch the shoulders on back OM 77 351 83.5



Attaching collar OM 63 429 68.3



Seaming front fuse with back fuse OM 9 3000 9.77

|   |   |   |      |     |      |      |
|---|---|---|------|-----|------|------|
|    |    | Sewing fuse on back   | OM   | 51  | 529  | 55.4 |
|    |    | Topstitch the fuse<br>Topstitch the collar, lapel to end<br>front fuse on hem | OM   | 91  | 297  | 98.7 |
|   |   | Sewing the side seam with label   | SMo5 | 54  | 500  | 58.6 |
|   |   | Topstitch the back  | OM   | 62  | 435  | 67.4 |
|   |   | Attacking sleeves   | OM   | 185 | 146  | 201  |
|   |   | Placing strips on the armholes  | OM   | 497 | 54   | 543  |
|   |   | Sewing armholes   | OM   | 298 | 91   | 322  |
|   |   | Hem   | OM   | 195 | 138  | 212  |
|  |  | Sewing two buttonholes  | AUTh | 30  | 900  | 32.6 |
|  |  | Sewing two button   | AUTb | 16  | 1688 | 17.4 |
|   |   | Cutting of thread   | HM   | 180 | 150  | 195  |

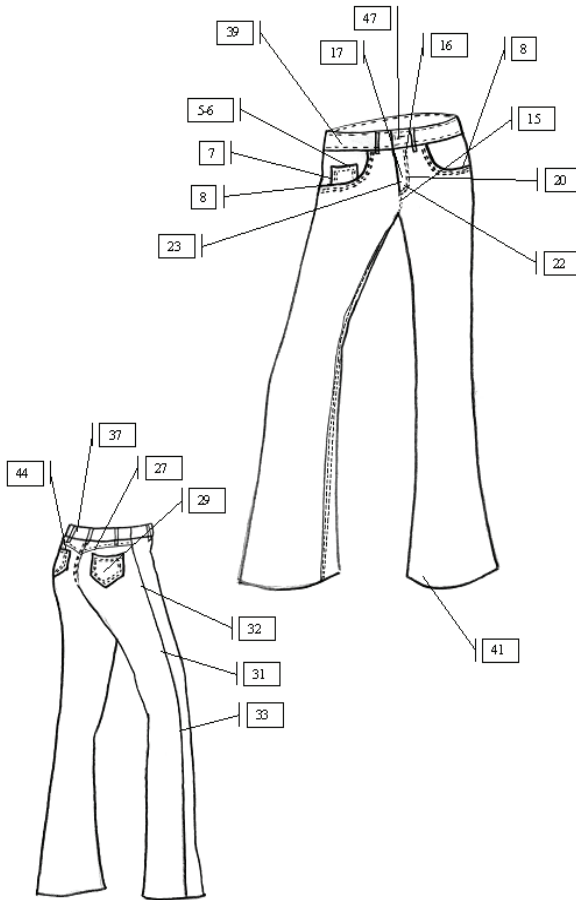
(Continued)



|                      |    |     |               |      |
|----------------------|----|-----|---------------|------|
| Ironing              | HM | 245 | 110           | 266  |
| Control              | HM | 145 | 186           | 157  |
| Mount the hanger     | HM | 6   | 4500          | 6.51 |
| Buttoning            | HM | 9   | 3000          | 9.77 |
| Putting paper labels | HM | 8   | 3375          | 8.68 |
| <b>TOTAL TIME</b>    |    |     | <b>4263 s</b> |      |

### 2.3.4 Technological analysis of operations for making women’s trousers

Production line with 28 workers produces 294 pieces of women’s trousers per day (Figure 2.8). Time needed for cutting is 347 s (three employees). Technological operation plan for the cutting women’s trousers is shown in Table 2.7.



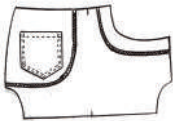

2.8 Women’s trousers.

Table 2.7 Technological operation plan for the cutting of women's trousers

| Name of operation  | Means of production            | Pr quota/a piece (s) | Norma (piece) | Load (%) |
|--|--------------------------------|----------------------|---------------|----------|
| Marking length of cutting layout after patterns; spreading material                            | Hand makes                     | 45                   | 600           | 39       |
| Planing of cutting layout on material  | Hand makes                     | 17                   | 1588          | 14.74    |
| Rough cutting front and back legs  | Straight knife Cutting machine | 47                   | 574           | 40.77    |
| Fine cutting   | Vertical cutter                | 24                   | 1125          | 20.8     |
| Marking length of cutting layout for interlining for pocket ; spreading interlining for pocket | Hand makes                     | 17                   | 1588          | 14.74    |
| Fine cutting interlining for pocket  | Vertical cutter                | 7                    | 3857          | 6.067    |
| Numbering, marking of cut pieces   | Hand makes                     | 116                  | 233           | 100.4    |
| Completing of cut pieces   | Hand makes                     | 32                   | 844           | 27.73    |
| Control  | Hand makes                     | 42                   | 643           | 36.39    |
| TOTAL TIME   |                                | 347 s                |               |          |

Technological operation plan for the production of women's trousers is shown in Table 2.8.

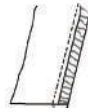
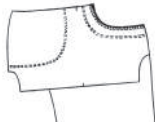
Table 2.8 Technological operation plan for the production of women's trousers from denim

| Name of operation   | Means of production | Pr quota/a piece (s) | Norma (piece) | Load (%) |
|---|---------------------|----------------------|---------------|----------|
| Hem watch pocket  | OM                  | 10                   | 2520          | 9.3      |
| Ironing watch pocket  | SI                  | 20                   | 1260          | 18.6     |
| Making position for watch pocket  | HM                  | 10                   | 2520          | 9.3      |
| Sewing watch pocket   | SM2                 | 52                   | 485           | 48.2     |
|  |                     |                      |               |          |
|  |                     |                      |               |          |
| Sewing in-pocket on pocket bag  | OM                  | 45                   | 560           | 41.8     |

(Continued)

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|                             |      |    |     |      |
|-----------------------------|------|----|-----|------|
| Sewing lacket on pocket bag | OM   | 53 | 475 | 49.3 |
| Sewing pocket bag           | SMo5 | 40 | 630 | 37.1 |



|                          |     |     |     |       |
|--------------------------|-----|-----|-----|-------|
| Topstitch hole of pocket | SM2 | 133 | 189 | 123.8 |
|--------------------------|-----|-----|-----|-------|



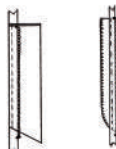
|   |      |    |      |      |
|---|------|----|------|------|
| Closing pocket bag                      | SMo5 | 44 | 573  | 40.8 |
| Turning pocket bag                      | HM   | 6  | 4200 | 56   |
| Topstitch pocket bag                    | OM   | 23 | 1096 | 21.4 |
| Sewing pocket bag with front part (leg) | OM   | 43 | 586  | 39.9 |



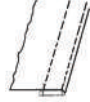
|   |      |    |      |      |
|---|------|----|------|------|
| Overloch seam on fly                          | SMo3 | 12 | 2100 | 11.1 |
| Turning on half and overloch seam on underlap | SMo3 | 10 | 2520 | 9.3  |
| Overloch seam front parts in part of underlap | SMo3 | 30 | 840  | 27.9 |



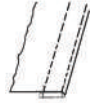
|                                      |    |    |     |      |
|--------------------------------------|----|----|-----|------|
| Sewing zipper on fly (3,5cm and 3cm) | OM | 38 | 663 | 35.3 |
|--------------------------------------|----|----|-----|------|



|                               |    |    |     |      |
|-------------------------------|----|----|-----|------|
| Sewing fly on left front part | OM | 50 | 504 | 46.4 |
|-------------------------------|----|----|-----|------|



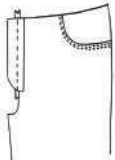
|                                      |     |    |      |      |
|--------------------------------------|-----|----|------|------|
| Topstitch on part of fly             | OM  | 60 | 420  | 55.7 |
| Making position for topstitch on fly | HM  | 10 | 2520 | 9.3  |
| Topstitch with part of fly           | SM2 | 33 | 764  | 30.6 |



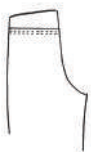
|   |    |    |     |      |
|---|----|----|-----|------|
| Sewing underlap with zipper                                   | OM | 30 | 840 | 27.9 |
| Sewing right front part on underlap and sewing part under fly | OM | 60 | 420 | 55.7 |



|                              |    |    |     |      |
|------------------------------|----|----|-----|------|
| Closing front part under fly | OM | 45 | 560 | 41.8 |
|------------------------------|----|----|-----|------|



|   |     |    |     |      |
|---|-----|----|-----|------|
| Hem on back pocket                            | OM  | 55 | 458 | 51.1 |
| Market position for embroidery on back pocket | HM  | 45 | 560 | 41.8 |
| Embroidery on back pocket                     | OM  | 95 | 265 | 88.3 |
| Ironing back pocket                           | SI  | 65 | 388 | 60.3 |
| Sewing yoke with back part                    | SMs | 60 | 420 | 55.7 |

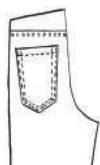


|                                 |    |    |     |      |
|---------------------------------|----|----|-----|------|
| Market position for back pocket | HM | 60 | 420 | 55.7 |
|---------------------------------|----|----|-----|------|

(Continued)

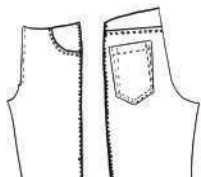
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Sewing back pocket OM 210 120 195



Seat seaming SMs 65 388 60.3

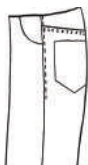
Overloch side seam SMo3 60 420 55.7



Sewing side seam OM 90 280 83.6



Topstitch side seam on back part to the end of pocket bag OM 40 630 37.1

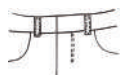


Inseam legs SMs 180 140 167.1

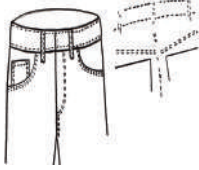
Making belt loops SMbl 15 1680 13.9

Cutting belt loops (5cm x15cm) HM 15 1680 13.9

Sewing belt loops and label OM 42 600 39



Making belt SMB 70 360 65



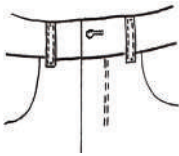
|              |    |     |     |       |
|--------------|----|-----|-----|-------|
| Closing belt | OM | 80  | 315 | 74.3  |
| Hem legs     | OM | 120 | 210 | 111.4 |



|                                       |      |    |      |      |
|---------------------------------------|------|----|------|------|
| Making bartack on fly (one)           | SMbt | 8  | 3150 | 7.4  |
| Making bartack on underlap (one)      | SMbt | 8  | 3150 | 7.4  |
| Making bartacks on back pocket (four) | SMbt | 20 | 1260 | 18.6 |



|                                     |      |    |      |      |
|-------------------------------------|------|----|------|------|
| Making bartacks on belt loops (ten) | SMbt | 75 | 336  | 69.6 |
| Making bartacks on belt             | SMbt | 15 | 1680 | 13.9 |

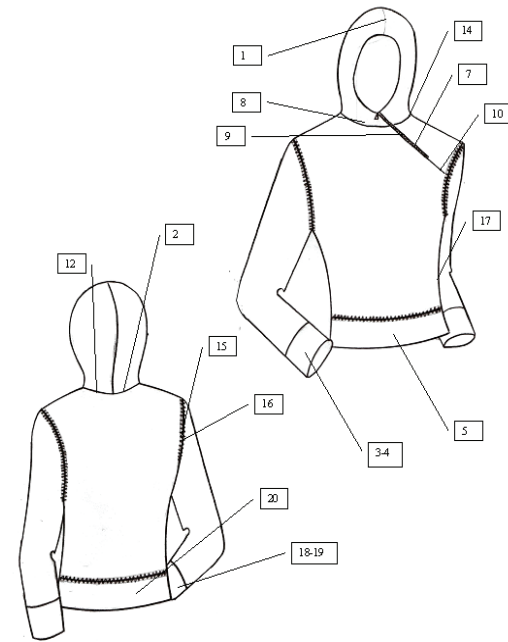


|  |          |     |               |       |
|--|----------|-----|---------------|-------|
| Making rivets on watch pocket and hole of front pocket (six) | PPr      | 83  | 304           | 77    |
| Making metallic button on belt                               | PPr      | 7   | 3600          | 6.5   |
| Cutting of thread  | HM       | 300 | 84            | 278.6 |
| Ironing  | Finisher | 305 | 83            | 281.9 |
| Control  | HM       | 140 | 180           | 130   |
| Closed pants   | HM       | 3   | 8400          | 2.8   |
| Putting paper labels   | HM       | 10  | 2520          | 9.3   |
| <b>TOTAL TIME</b>  |          |     | <b>3198 s</b> |       |

A special sewing machine for closed seams (SMs) can be used for the production of a special machine for making belt loops (SMbl), a special machine for making belt (SMB), machine for bartack (SMbt), and pneumatic presses for rivets (PPr).

### 2.3.5 Technological analysis of operations for making sweat

Production line with 10 workers produces 185 pieces of sweat per day (Figure 2.9). Cutting time for three workers is 443 s. Technological operation plan for the cutting of sweat is shown in Table 2.9.



2.9 Sweat.








Table 2.9 Technological operation plan for cutting sweat

| Name of operation  | Means of production | Pr quota/a piece (s) | Norma (piece) | Load (%) |
|--|---------------------|----------------------|---------------|----------|
| Marking length of cutting layout after patterns; spreading matherial | Hand makes          | 22                   | 1227          | 15.1     |
| Planing of cutting layout on matherial                               | Hand makes          | 4                    | 6750          | 2.7      |

|  |                                |       |     |       |
|--|--------------------------------|-------|-----|-------|
| Rough cutting: front part, back, sleeves, hood, belt, cuff | Straight knife Cutting machine | 32    | 844 | 21.9  |
| Fine cutting: front part, back, sleeves, hood, belt, cuff  | Vertical cutter                | 59    | 458 | 40.4  |
| Numbering, marking of cut pieces                           | Hand makes                     | 196   | 138 | 134.1 |
| Completing of cut pieces                                   | Hand makes                     | 53    | 509 | 36.3  |
| Control  | Hand makes                     | 77    | 351 | 52.7  |
| TOTAL TIME:  |                                | 443 s |     |       |

Technological operation plan for the sewing and finishing sweat is shown in Table 2.10.

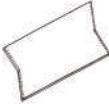













Table 2.10 Technological operation plan for the production of sweat













| Name of operation   | Means of production   | Pr quota/a piece (s) | Norma (piece) | Load (%) |
|---|---|----------------------|---------------|----------|
| Sewing middle seam internal and external hood (face and inside the hood)            | SMo3  | 31                   | 871           | 21.2     |
|   |    |                      |               |          |
| Sewing bar on external hood   | OM  | 18                   | 1500          | 12.3     |
|  |  |                      |               |          |
| Sewing cuff with the formation of openings for finger                               | OM  | 236                  | 114           | 162.3    |
|  |  |                      |               |          |
| Turning cuff  | RR  | 19                   | 1421          | 13       |
|  |   |                      |               |          |
| Sewing belt on side   | SMo3  | 5                    | 5400          | 3.4      |

(Continued)



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|   |   |     |      |       |  |
|---|---|-----|------|-------|--|
|    |    |     |      |       |  |
| Turning and bending the belt in half  | RR  | 5   | 5400 | 3.4   |  |
| Sewing shoulder to with shoulder reinforcement                                      | SMo3  | 16  | 1688 | 11    |  |
|    |    |     |      |       |  |
| Sewing external hood on neck part   | SMo3  | 26  | 1038 | 17.8  |  |
|    |    |     |      |       |  |
| Overloch seam front part for zipper and hole of internal hood                       | SMo3  | 17  | 1588 | 11.6  |  |
|    |    |     |      |       |  |
| Sewing front left part with front part from zipper                                  | OM  | 9   | 3000 | 6.2   |  |
|   |   |     |      |       |  |
| Sewing zipper   | OM  | 182 | 148  | 125   |  |
| Sewing internal and external hood and neck part from the bar                        | SMo3  | 392 | 69   | 268.1 |  |
|  |  |     |      |       |  |
| Turning hood  | RR  | 19  | 1421 | 13    |  |
| Closing neck part with bar  | OM  | 75  | 360  | 51.4  |  |
|  |  |     |      |       |  |
| Sewing sleeves  | SMo3  | 46  | 587  | 31.5  |  |

|   |   |     |        |      |  |
|---|---|-----|--------|------|--|
|    |    |     |        |      |  |
| Topstitch on sleeves  | SM2   | 80  | 338    | 54.7 |  |
|    |    |     |        |      |  |
| Side seam, sleeves seam with sewing label   | SMo3  | 49  | 551    | 33.6 |  |
|    |    |     |        |      |  |
| Sewing cuffs  | SMo3  | 31  | 871    | 21.2 |  |
|    |    |     |        |      |  |
| Sewing belt   | SMo3  | 53  | 509    | 36.3 |  |
|    |    |     |        |      |  |
| Topstitch on belt   | SM2   | 72  | 375    | 49.3 |  |
|  |  |     |        |      |  |
| Ironing   | PP  | 135 | 200    | 92.5 |  |
| Control   | RR  | 48  | 563    | 32.9 |  |
| Putting paper labels  | RR  | 8   | 3375   | 5.5  |  |
| TOTAL TIME  |   |     | 1572 s |      |  |

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