DIGITAL PRINTING OF MEN’S T-SHIRT

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Abstract: The T-shirt as we know it today is an apparel staple. This is the simple garment that is deeply ingrained in world culture. T-shirts are worn in one color, and there are more and more t-shirts that have printed applications on the front or back. When using the digital printing method "Direct to Garment" the quality of the garment is paramount to the quality of the final product, and makes of shirts will give different results. If the material is tightly woven and 100% cotton such as the tested samples, it is obtained guaranteed the best possible finish. The aim of this paper is computer construction, modeling and grading of parts of men’s T-shirts, making a marker as well as sewing. The focus of this article is digital T-shirt printing.

Key words: men’s T-shirt, construction, sewing, digital printing.

1. INTRODUCTION

The T-shirt is a style of fabric shirt named after the T-shape and body shape. It traditionally has short sleeves and a round neckline, known as a crew neck that does not have a collar. T-shirts are usually made of stretchy, light and cheap fabric and are easy to clean. Usually made of cotton textiles in a stockinet or jersey knit, it has an extremely flexible texture compared to woven linen shirts. Some modern versions have a body made of a continuously knitted tube, produced on a circular knit so that the torso has no side seams. T-shirt making has become highly automated and may involve cutting fabrics with a laser or a jet of water. The T-shirt evolved from the underwear used in the 19th century and in the mid-20th century it changed from underwear to casual clothing of general use [1]. The V-neck T-shirt has a V-neck, as opposed to the round neckline of the more common neck T-shirt (also called a U-neck). The V-neck is introduced so that the neckline of the shirt does not look when worn under the outer shirt, as is the case with the crew neck shirt [2-4].

T-shirts were originally worn as undershirts, but are now worn frequently as the only piece of clothing on the top half of the body, other than possibly a brassiere or, rarely, a waistcoat (vest). T-shirts have also become a medium for self-expression and advertising, with any imaginable combination of words, art and photographs on display [5]. A T-shirt typically extends to the waist. Variants of the T-shirt, such as the V-neck, have been developed. Hip hop fashion calls for tall-T shirts which may extend down to the knees. A similar item is the T-shirt dress or T-dress, a dress-length T-shirt that can be worn without pants [6]. The rise of online shopping in the early 2000s caused a proliferation of new T-shirt ideas and trends. While sev-
eral brick-and-mortar chains included these items in their inventories, many of these shirts were pioneered by online start-ups. Innovations included the flip-up T-shirt, which the wearer can lift and stretch over their head to display an interior print, and all-over print clothing [7]. With the rise of social media and video sharing sites also came numerous tutorials on DIY T-shirt projects [8].

Direct-to-garment printing (DTG) is a process of printing on textiles using specialized aqueous inkjet technology [9]. Since this is a digital process the print is sharper and has a higher resolution, or DPI, than traditional printing methods such as screen printing. However, unlike screen printing, there is no long setup or clean-up process, and DTG has the ability to print just one single shirt for minimal cost [10]. Das et al. [11] investigated printing by using sodium hydrosulphite, stannous chloride and zinc sulphoxylate formaldehyde as discharging agents on reactive dyed cotton fabric. The obtained results showed that sodium hydrosulphite as a discharging agent, excellent colorfastness to rubbing and whiteness index of reactive dyed cotton fabric discharged with sodium hydrosulphite shows superior value in comparison to stannous chloride and zinc sulphoxylate formaldehyde at the white discharged areas.

The aim of this paper is computer construction, modeling and grading of cutting parts of men's T-shirts, as well as sewing and digital printing with a particular design on special machines for digital printing. The focus is on the digital printing of T-shirts.

2. EXPERIMENTAL PART

2.1. Materials and Methods

Computer construction, modeling and grading of the men's T-shirt with the computer program AccuMark from the Gerber Company was made. After that, a marker of size 52 was made, and with the help of that marker, the tailoring and sewing of two T-shirts with a different neckline were made. When this process was completed, digital printing with a certain design on both T-shirts was made on a digital machine using DTG.

T-shirt digital printing is a type of printing by which the printer directly prints a motif on the fabric. The paint enters the pores of the fabric directly and there is no feeling of a “glued piece of plastic”.

The future of printed T-shirts is great; it is a great fashion detail, a basic piece of clothing but also a walking advertisement. New innovative printing technologies make it possible to turn a T-shirt into a completely new product. Figure 1 shows a digital printing T-shirt machine A3 WER E2000T.

![Figure 1: Digital printing T-shirt machine A3 WER E2000T](image1)

Two T-shirts were made that differ in the neck opening, model 1 with a round neckline and model 2 is with V-neck. Printing for both models does not take place identically, as many conditions depend on the material itself. Although the two materials are the same, i.e. they are 100 % cotton in composition, the black material in its production has undergone an additional phase of dyeing, and it is normal that it has undergone chemical changes in its composition due to the absorption of the dye (and the touch can be noted that black the material is a softer than white), while white has no additional colors, and it follows that the materials themselves would receive different colors when printing the designs. Therefore, the way of printing these two T-shirts from the same material is still different. Figure 2 shows a technical sketch of a men's T-shirt.

![Figure 2: Technical sketch of men's T-shirt](image2)
3. RESULTS AND DISCUSSION

3.1. Computer construction on the basic pattern of the men’s T-shirt

The construction of a basic pattern of the T-shirt is made on base main measures and pre-calculated necessary measures with additions for comfort for size 52, [12]. The main and construction measures are shown in Table 1.

Figure 3 shows the computer construction of the basic pattern of the men’s T-shirt and sleeve with around neckline. The construction of the T-shirt with a V-neck is performed in the same way as with a round neckline. The necessary functions were used to construct an appropriate computer program AccuMark-Gerber Technology.

Table 1: Main measures for size 52 of men’s T-shirt

| Main measures          |          |
|------------------------|----------|
| Body height            | 172 cm   |
| Chest                  | 104 cm   |

| Construction measures  |          |
|------------------------|----------|
| Center length          | 42 cm    |
| Full length            | 66.5 cm  |
| Across chest           | 32 cm    |
| Armhole depth          | 24.5 cm  |

After construction, modeling was done so that the T-shirt was narrowed at the waist by 1 cm, (Figure 3). Then the cutting parts, the front and back part and the sleeve are opened and the seams are added.

Figure 3: Construction on the basic pattern of the men’s T-shirt and modeling

Figure 4: Completion on cut parts with a seam allowance of men’s T-shirt
Trace the cut pieces and added allowance seams to each of them. The seam allowances on all sides are 0.7 cm and for the hem is 2 cm, shown in Figure 4.

For the production of men's T-shirt following cut parts are required:
- 1x front part
- 1x back part
- 2x sleeve parts.

3.2. Grading sizes and create a Marker of men's T-shirt

Computer grading is made on four sizes 48, 50, 52 and 54. Grading of all sizes is shown in Figure 5.

According to the obtained accurate marker from the Gerber program, have utilization of 82.5%, which is considered a solid utilization of the material. Marker for men's T-shirt size 52 is shown in Figure 6.

3.3. Fabrication of men's T-shirt

Table 2 shows the operations of sewing t-shirts as well as the applied types of stitch and their graphic representation. When the material is cut, it is approached with sewing a T-shirt with certain sewing machines.

Figure 5: Grading sizes 48-54 of basic materials of men's T-shirt

Figure 6: Marker for men's T-shirt size 52
Table 2: Sewing operation and type of stitch of T-shirt

| Sewing operation                                           | Type of stitch |
|------------------------------------------------------------|----------------|
| 1. The back and front parts joined by assembling the seams on both shoulders. | 504            |
| 2. The sleeve is assembling with the front and back pieces. |                |
| 3. Assembling the side seam, i.e. joining the back and front parts through the side seam and internal seam of the sleeve. | 301            |
| 4. Sewing the tape on the neckline.                        |                |
| 5. Making a hem along the length of the shirt and on the sleeves. | 406            |

3.4. Digital printing of T-shirt with DTG (direct to garment)

After sewing the T-shirts, digital printing was done for a particular design by a specific procedure on the printing machine with the DTG technique and finally the desired models of T-shirts were obtained, which are shown in Figure 7 and Figure 8.

For model 1 with a round neckline (Figure 7), a digital print based on watercolors was used. The T-shirt is printed directly on a printer with a pre-set command from a computer. It is then fixed to a press at a temperature of 180 degrees for a period of 60 seconds.

For model 2 with V-neck (Figure 8), a digital print based on siser foil with a transfer is used. The print is transferred to a press, also at a temperature of 180 degrees, but with duration of 15 seconds.

The DTG direct printing technique on garments is intended for the production of high-quality textile printing, in smaller quantities, thus obtaining a unique pattern. Print images of unlimited colors directly on a wide range of materials using inkjet technology. With the advent of the DTG (Direct to Garment) printer, T-shirt printing is taking on a new dimension. The color print is transferred directly to the T-shirt.

Figure 7: The final product of model 1 of men's T-shirt with digit print
4. CONCLUSIONS

Fashion has always been an ever-changing phenomenon, and this affects many different industries across the world. The speed at which one particular style fluctuates in and out of fashion has been further enhanced by online social media and the popularity of celebrity culture, fashion blogs, and websites. Influences spread immediately, transcending national boundaries and affecting every demographic. This means that designers and garment printers must adapt to become more flexible. In this paper, the following conclusions are obtained:

- The development and evolution of T-shirts over the years - with each step of the world and trends, T-shirts have constantly undergone different changes.
- AccuMark program - is used to computer construction, modeling, grading cutting parts and forming a Marker for size 52 as the base size.
- Tailoring - the phase in which the material from which the T-shirts will be made is tailored, i.e. cut according to the passed cut image on it, whereby all the cut parts of the piece of clothing are obtained, ready for assembly.
- Sewing - the stage where, step by step, the components of the material are attached or sewn to each other by forming the necessary seams when using the appropriate machines, type of stitch and threads.
- Processing - is the final stage in which care is taken to make the product look best.
- Printing procedure - is the last stage, in which the printed design is applied to the T-shirt and a finished product is obtained.

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