Development of stitching jigs for sleeve button placket and sleeve buttonhole placket in men’s formal shirt

Dr. D. Vijay Kirubakar Raj1, Dr. M. Renuka Devi2
1,2 Assistant Professor, Department of Textile Technology, Anna University, Chennai-25, India.

Abstract - The operations in assembling garment from their components, requires lot of energy and skill for the sewing operators. One of such operation is sleeve placket attachment in the construction of men’s formal shirt. Currently, the apparel technologists are working in inventing new jigs for the operations involved such construction both to lower the level of operator skill required and to increase the level of automation possible. However the development of jigs for operations like sleeve placket attachment are difficult to achieve. This work is an attempt to develop two stitching jigs for use in stitching together the components of the sleeve.

I. INTRODUCTION

Automation is the process or technique of doing certain tasks by the use of automatic equipment in the place of human operators during product manufacture. Automation seeks to reduce human intervention to a minimum resulting in saving of labour and energy, improves precision, accuracy, quality of products, and productivity. It has the huge scope in industries where the wages for labour keeps increasing. Thus sewing units in developed countries are shifting to increasing levels of automation of labour-intensive clothing production.

Stitching jigs are work aids which are used where accurate stitching lines are required. It holds fabric layers during sewing which enables easier seam formation and allows semi-automated stitching for the specific garment constructing operations. The fabric is loaded first into the jig and then the jig loaded into the sewing machine. This reduces the complexity of the stitching operations, (Carr and Latham 1999).

However, stitching jigs are not available for many of the garment sub assembly operations. One among these is sleeve placket attaching. Developing a stitching jig(s) for attaching sleeve button plackets and sleeve buttonhole plackets will improve quality and reduces the difficulties of the sewing operation thus will help to increase the level of automation for the sewing operation, (RajkishoreNayak and Rajiv Padhye 2017).

II. OBJECTIVES

- To develop stitching jigs for the sleeve button and buttonhole placket creation operations.
- To make possible a retrofit of such jigs into existing sewing machines.
- To eliminate the need for ironing of the sleeve button and buttonhole placket components.
- To discuss the advantages of replacing analog jigs with digital control in the future.

Work aids are devices that are built into machines, added to them afterwards, attached alongside or made use to improve productivity, improve or maintain quality standards, reduce training time and minimize fatigue to the operator, (Carr and Latham 1999).

The collars where stitching jigs are successful have two identical points. The front and reverse edges of formal jackets and raincoats much match. Likewise patch pockets, cuffs and other small items such as epaulettes and tabs must be in perfect pairs. The only way to ensure this where die cutting is not possible is to control the sewing line in relation to the pattern shape of the garment rather than the edge of the cut material and this is what stitching jigs are meant to achieve (Carr and Latham 1999).
A stitching jig (Figure 1) is a type of work aid to be used where accurate stitching lines are required. It uses an edge guide to achieve accurate sewing assuming accurate cutting. Hence run-stitch or profile-stitch operations can be done using a jig or template, (Carr and Latham 1999).

Jigs consisting of two layers of a rigid material such as aluminum or plastic which are joined together by a hinge. A slot is cut out of both layers of material which conforms to the exact sewing line in the garment part and the bottom layer carries a shaped guide close to the hinge to which the edges of the garment parts are aligned, (Carr and Latham 1999).

![Fig. 1 Stitching jig used for cuff](image)

The inside surface of the jig is covered with a strip of non-slip material like emery sheet to have a firm grip on the fabric. The fabric plies are sandwiched in the jig and the jig is sewn in a specially adapted sewing machine where the throat plate has a protrusion to glide through the slot; the double roller presser feet and rubber-covered feed dog guides the jig along the slot. Sewing stackers and bundle clamps are additional devices attached to or outside the sewing table to organize the garment components before sewing, during sewing or after sewing. (Solinger 1988).

The two pieces of the garment part are laid into the jig, along with the interlining if a sew-in interlining is being used, and the jig is closed to hold them firm. If fullness is needed on the top ply to give a piped effect on a part such as a pocket flap, a fulling bar would be included in the jig between the two plies (Figure 2). This ensures the inclusion of extra length in the top ply so that the lining cannot show on the right side of the finished part. The operator then sews round the slot on a machine with a specially adapted presser foot and feed dog. (RajkishoreNayak and Rajiv Padhye 2015).

![Fig. 2 Stitching jig for pair pocket flaps](image)

List of Components that can be Sewn Using Jig (Figure 3)
1. Attach collar band
2. Collar
3. Cuff
4. Epaulette
5. Jacket forepart (SB)
6. Jacket forepart (DB)
7. Jacket collar
8. Pocket flap
9. Pointed collar
10. Raincoat forepart
11. Van Dyke flap
12. Vest Front
13. Yoke or gun patch

Fig. 3 List of components that can be sewn using jigs

Advantages of Stitching Jigs

- Ensure correct shape and size of the components.
- Outer edge of the component needs not be accurately cut.
- Quality is improved.
- If automated, productivity is more.
- Higher possibility of employing unskilled operators.
- Reduces labour cost.
- Reduces rejection rate.

Disadvantages of Stitching Jig

- A larger seam allowance around the outside of the garment part is needed so that the fabric edge does not become pushed down into the stitching slot.
- The extra fabric for seam allowance is costly and it must be trimmed off, often by hand, afterwards.
- Separate jigs are needed for every style and size and consequently they are only used for long production runs. A minor change of pattern shape can require a new set of jigs.
- Careful training and control are required if stitches are longer than 5 mm.
- Suitable only of sewing identical pieces. Example: Sewing two layers of collar.
- Conventional feeding system has to be replaced by a specially designed presser foot and feed dog.
- Maintaining constant Stiches per Inch (SPI) is difficult. (Harold Carr et al 2007).
Construction of Sleeve Placket

The construction of the sleeve placket involves following major operation.

a. Ironing of sleeve button placket and sleeve button hole placket fabric components.
b. Sewing of sleeve button placket.
c. Sewing of sleeve buttonhole placket.

The sleeve button placket attaching is always performed first and then followed by sleeve buttonhole placket.

![Components of men's sleeve placket](image)

**Fig. 4** Components of men’s sleeve placket (a) men’s sleeve pattern (b) sleeve button placket (c) men’s sleeve (d) sleeve buttonhole placket

### III. MATERIALS AND METHODS

**Materials**

The stitching jigs for sleeve buttonhole and sleeve button placket is made from acrylic. To create the groove along the edge of the slot, thin aluminum sheet of thickness 0.01mm is used along the edges of the slot.

A sliding plate is used for inserting and folding the seam allowance of sleeve buttonhole placket and sleeve button placket. The sliding plate is also made up of aluminum sheet of thickness 0.01mm.

To move to the acrylic jig during sewing, a rubber coated feed dog is used.
Jig

The jig is cut out in the acrylic sheet of thickness 1.5cm. The acrylic sheet is first cut to the exact dimensions of each component of the jig. For precision in cutting, laser cutting machine is employed.

Sleeve button placket jig

The sleeve button placket jig (Figure 5) is used for sewing sleeve button placket with sleeve.

Components of sleeve button placket jig

1) Bottom plate (Figure 6)
2) Top plate (Figure 6)
3) Middle fixed plate (Figure 7)
4) Middle movable plate (Figure 7)

![Isometric view of sleeve button placket jig](image1)

Fig. 5 Isometric view of sleeve button placket jig

![Bottom and top plates of sleeve button placket jig](image2)

Fig. 6 Bottom and top plates of sleeve button placket jig (a) Isometric view (b) Sketch of bottom / top plate.

The bottom plate (Figure 6) is the base plate of the jig that supports all the component such as middle plates and top plate. The middle-bottom plate is fixed to the bottom plate of the jig. The
middle-bottom plate and middle-top plate are fixed through a hinge. The middle plate consists of grooves which are created by thin metal sheet (Figure 7).

Fig. 7 (a) Middle plates of sleeve button placket jig (b) Sleeve buttonhole placket jig

The sleeve buttonhole placket jig (Figure 8) is used to attach sleeve buttonhole placket with sleeve.
Components of sleeve buttonhole placket jig

1) Bottom plate (Figure 9)
2) Top plate (Figure 9)
3) Middle fixed plate (Figure 10)
4) Middle movable plate (Figure 11)

![Isometric view of sleeve buttonhole placket jig](image)

**Fig. 8** Isometric view of sleeve buttonhole placket jig

![Bottom and top plate of sleeve buttonhole placket jig](image)

**Fig. 9** Bottom and top plate of sleeve buttonhole placket jig
(a) isometric view (b) sketch of top / bottom plate

All dimensions are in mm
The bottom plate (Figure 9) is the base plate of the jig that supports all the component such as middle plates and top plate. The middle-bottom plate is fixed to the bottom plate of the jig. The middle-bottom plate and middle-top plate are fixed through a hinge. The middle plate consists of grooves which is created by thin metal sheet (Figure 10).

![Thin metal sheet](image1)

All dimensions are in mm

![Thin metal sheet](image2)

All dimensions are in mm

Fig. 10 Sketch of middle plates of sleeve buttonhole placket jig
(a) movable middle plate (b) fixed middle plate

**Profiled flexible slider**

A profiled aluminum sheet called slider of 0.01mm thickness is used to fold the seam allowances. The slider of sleeve button placket (Figure 11) and sleeve buttonhole placket (Figure 12) is guided by the groove present in the jig.
Fig. 11 Slider of sleeve button placket

Adhesive tape (Figure 13) is used to allow hinging action for middle movable plate.
Specifications

- Material – polyester adhesive film.
- Width – 1 mm.
- Thickness – 0.2 mm.

Hinge

The hinge (Figure 14) is attached between the top and bottom plates of the jigs which allows hinging action causes opening and closing of the jig.

Specifications of hinge

- Material – stainless steel.
- Thickness 3 mm.
- Length 2 cm.

Modified Feed Dog

- The modified feed dog (Figure 15-a) for a moving stitching jigs comprises a zinc die cast body portion having a toothed surface region covered by a layer of elastomeric material.
- The elastomeric material is urethane coated over the surface of the feed dog (Figure 15-b).
- The teeth are covered and hence results in flat toothless surface.
Modified Pressure Foot

The presser foot is attached with a projection called stopper. The projection is cylindrical in shape, less than or equal to the thickness of the top plate of the jigs. In the sleeve button placket jig and sleeve buttonhole placket jig, the top plate is 1.5mm and hence the projection length is 1.5 mm. The outer diameter of the hollow cylindrical projection is 3.9 mm.
Role of the modified presser foot:

- The projection in the presser foot gets engaged with the slot of the top plate and guides the jig during sewing.
- The presser foot exerts pressure that is necessary to keep the jig in the closed position during sewing.

The cylindrical shaped projection can only have a maximum diameter of 4mm since the space between the two rows of feed dogs on either side of the needle hole is 4mm.

**Methods**

The sewing using jig is similar to the manual method yet more comfortable and also involves the stitching of sleeve button placket at first using sleeve button placket jig and followed by the stitching of sleeve buttonhole placket using sleeve button hole placket jig.

**Jig Driving Mechanism**

The jig is moved over the rubber coated feed dog and guided through the track of the slot by the projected stopper attached to the presser foot (Figure 19).
Procedure for Sewing Sleeve Button Placket Using Sleeve Button Placket Jig

Loading of material into the jig

- Open the top plate of the jig and then open the middle top plate of the jig. Position the sleeve button placket fabric component to the location marks in the jig (Figure 20).

- Place the profiled flexible metal sheet for sleeve button placket over the fabric component and position it to the location marks (Figure 21).

- The top edge of the slider is pushed along with the flexible sheet to lock into the grooves (Figure 22).

- The sleeve component is placed in such a way that the slit is positioned properly and ensuring that the stitching is to be done on back of the sleeve.

- The middle plate is closed over the edge of the slit (Figure 23).

- Then the top plate is closed (Figure 24).

Fig. 19 Side view of the jig after loaded to the machine

Fig. 20 Positioning of the sleeve placket component.
Fig. 21 Placement of slider

Fig. 22 Loading of the fabric

Fig. 23 Positioning of the sleeve into the jig and closing of the middle plate
Fig. 24 Closing the top plate of the buttonhole placket jig

Loading jig to the machine

- Slide the loaded jig with the right hand on the top plate, towards the needle, lining up the start position.
- Once the jig is positioned properly, the presser foot is lowered and the projection in the presser foot will be locked into the slot of the jig.
- Start the sewing and stop when it reaches the right-angled corner of the slot.
- Rotate the jig to 90 degrees towards the side and sew until it reaches the end of the slot.

Unloading of material from the machine

- Lift the presser foot.
- Open the top plate and then open the middle top plate.
- Slide the sewn components up and pull the sleeve out of the jig.

Sewing Sleeve Buttonhole Placket Using Sleeve Buttonhole Placket Jig

Loading of material into the jig

- Open the top plate of the jig and then open the middle top plate of the jig. Position the sleeve buttonhole placket fabric component to the location marks in the jig (Figure 25).
- Place the profiled flexible metal sheet for sleeve button placket over the fabric component and position it to the location marks (Figure 26).
- The allowance at the top edge is folded as shown in the figure and pushed along with the flexible sheet to lock into the grooves (Figure 27).
- The sleeve component is placed in such a way that the slit is positioned properly and ensuring that the stitching is to be done on back of the sleeve.
- Then the sleeve is folded at the slit line (Figure 28 (a)).
- The sleeve is then folded at the top (Figure 28 (b)).
- The middle plate is closed over the edge of the slit (Figure 28 (c)).
- The sleeve is unfolded (Figure 28 (d)).
• Then the top plate is closed (Figure 29)

Fig. 25 Step 1 Positioning of the sleeve buttonhole placket component over the jig.

Fig. 26 Step 2 Pushing the slider to lock the folded edges into the jig

Fig. 27 Step 3 Removal of slider
Fig. 28 Step 4 Sleeve positioning  
(a) Folded at the slit line  
(b) Folded at the top  
(c) Closing of the middle plate  
(d) Unfolding the sleeve
Fig. 29 Step 5 Closing the top plate

Loading jig to the machine

- Slide the loaded jig with the right hand on the top plate, towards the needle, lining up the start position.
- Once the jig is positioned properly, the presser foot is lowered and the projection in the presser foot will be locked into the slot of the jig.
- Start the sewing and stop when it reaches the right-angled corner of the slot.
- Rotate the jig to 90 degrees toward your side and sew until it reaches the end of the slot.

Unloading of material from the machine

- Lift the presser foot.
- Open the top plate and then open the middle top plate.
- Slide the sewn components downwards and pull the sleeve out of the jig

III. RESULTS AND DISCUSSIONS

Samples Comparison

Fig. 30 Sample produced using jig
The samples prove that the sleeve placket can be constructed using the stitching jig.

From the comparison of samples, it is observed that the accuracy of the stitch line is good and the defect in the sample is negligible.

Time Study

A time study is conducted for the sewing of sleeve placket using jig and without jig. The results are given below.

Table 4.1 Comparison of time study for sleeve placket attaching

| Operation cycles | Time taken for sewing (s) |  |  |
|------------------|---------------------------|---|---|
|                  | Sewing without using jig  | Sewing using developed jig |  |
|                  | Unskilled operator | Semi-skilled operator | Unskilled operator | Semi-skilled operator |
| 1.               | 278                      | 241                      | 217                | 213                |
| 2.               | 283                      | 244                      | 200                | 216                |
| 3.               | 287                      | 231                      | 221                | 213                |
| 4.               | 289                      | 236                      | 215                | 216                |
| 5.               | 290                      | 236                      | 206                | 218                |
| Average time taken | 285.4                  | 238.67                  | 212.33             | 215.2             |

The time study data was statistically analysed and it is observed that the time taken by the operator for sewing the sleeve placket using the jig is independent of the skill level of the sewing operator. Clearly the time taken by the operator for sewing the sleeve placket using jig is lower than that of operations carried out without using jig.
IV. CONCLUSION

In this work, the stitch jigs are developed for one of the critical sewing operations i.e. sleeve placket attaching. The developed stitching jigs include (i) stitching jig for sleeve button placket attaching and (ii) stitching jig for sleeve buttonhole placket attaching. The samples from the stitching jigs are taken out and compared. The time study for sleeve placket attaching operation using jig and without jig is done and compared. It is found that the average cycle time for the completion of sleeve placket is lower and independent of the skill level of the sewing operator using the developed jig. The stitching jig contributes greatly to perineal levels of quality.

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