

SMEDA–JICA INDUSTRY SUPPORT PROGRAM

BEST PRACTICES MANUAL GARMENTS SECTOR



Compiled by: Industry Support Cell



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BACKGROUND

This manual prepared under the SMEDA–JICA Industry Support Program. With the courtesy of Government of Japan and JICA (Japan International Co-operation Agency), Senior Volunteers Program started in Pakistan in 2004 for the support of Textile Industry. The objective of this program was to provide expertise, knowledge transfer and skill up-gradation for the enhancement of productivity, efficiency and to give know how to local industry for better management practices.

Senior Japanese Garment Expert **Mr. Kotaro OTAKA** offered his services as Senior Volunteer for Garments Sector of Pakistan for a period of two years. During this period **Mr. Kotaro OTAKA** provided guidance / consultancy to various industrial units.

This manual highlights the main areas where the guidance was provided in different industrial units. This includes key findings, process details, important recommendations / suggestions and recommended formats. It has been prepared by Mr. Haider Sagheer & Mr. Wasif Shafi and reviewed and checked by Mr. Kotaro OTAKA.

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PATTERN MAKING & CUTTING

The objective of cutting room is cutting of garment parts accurately and economically and in sufficient volume to keep the sewing room supplied with work.

The four processes involved are:

- A. The planning, and if appropriate the drawing and reproduction of the marker
- B. The spreading of the fabric to form a lay
- C. The cutting of the fabric.
- D. Preparation for sewing

Potential for Cost Saving in Cutting Department

As a unit, the cutting room has a greater effect on excessive manufacturing costs than any other department concerned with the actual production of garments.

These costs can be divided into two groups.

Internal costs: The cost incurred in the cutting room itself.

External costs: Those incurred by other department as a result of malfunctions of the cutting room.

Internal cost:

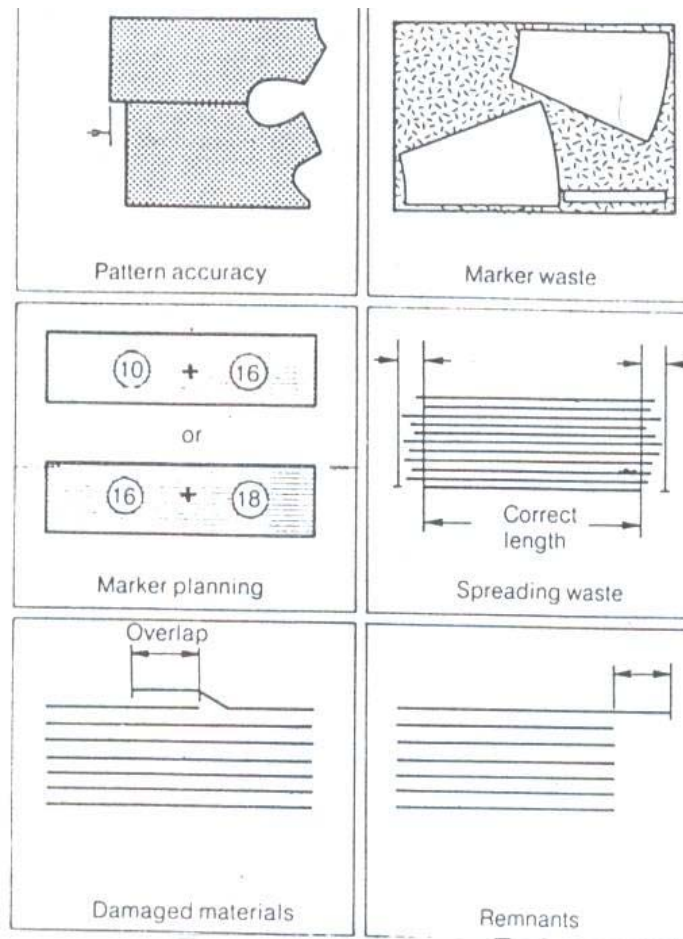
Labor:

To make optimum use of manpower, there must be a continually balanced and controlled work flow through the cutting room. Waiting around for work or doing fill in work is a very expensive proposition in the cutting room. The key to reducing or eliminating labor cost in the cutting room is planning and control.

Material:

Materials represent some 40-50 % of the cost price of most mass produced clothing and are the largest cost component of a garment. Excessive use of fabric caused by lack of detailed planning together with inferior spreading and cutting techniques can cause serious losses to company.

The figure below shows the factors affecting the use of material and while each one has relatively small effects, together these factors if left uncontrolled can create very serious losses.



External cost:

Defects:

Readily visible cloth defects must be eliminated during spreading or before issuing the work to sewing room. There is no point in sewing a garment that will either require extensive alterations during productions, or will be rejected at final inspection because of damaged components.

Accuracy:

Accuracy of cutting is of supreme importance because of its influence on the correct assembly of the garment, and more importantly on the sizing. Apart from quality problems, inaccurate cutting not only cause hold ups in production but also mean the costly re-cutting of the components.

Sewing:

Guides for sewing such as nips, notches, etc. must be accurate and complete. A missing guide mark might result in distorted seaming or could mean the return of components to the cutting room, which apart from the cost would also interfere with the production flow.

Some of the major quality factors under the control of the cutting room are:

- Elimination or concealment of defected fabric.
- All components cut on the correct grain lines
- Dimensionally accurate garment that do not exceed the specified tolerance
- All material spread at correct tension to prevent over or under sized components and /or garments.
- Consistent and accurate pattern marking.

GUIDE LINES FOR PATTERN PLANNING & CUTTING DEPARTMENT:

A. The Planning, Drawing and Reproduction of the marker

Marker planning must be given great attention , because when the cutting room cuts cloth it spends around half of the company's turnover. Any reduction in the amount of cloth used per garment leads to increased profits.

The following factors are taken into account when planning the marker:

- ☒ The width of the fabric from which the garments are to be cut.
- ☒ In knitted, whether it is tubular, flat open width or folded on one side.
- ☒ The normal length of the lay, which is connected to the type and length of cutting table.
- ☒ The need to minimize the amount of waste between the marked out garment portions.
- ☒ The need to ease the path of the cutter blade
- ☒ The need at all times to maintain the grain and directionality of the fabric.
- ☒ The alignment of the patterns and checks.

DO'S & DON'TS

- ☒ In order to plan efficiently the marker should be viewed as a whole to see it at a glance . The planner should proceed by first positioning the larger pattern pieces in a relationship which looks promising and then fitting the smaller pieces into the gaps .
- ☒ Since most the pieces are irregular and often tend to be carrot-shaped , those edges should be discovered which fit together most neatly .
- ☒ Several pattern placement combination should be tried and the pattern placements with shortest marker should be selected.
- ☒ When pattern pieces are laid down the piece of cloth , the grain line should be parallel to the line of warp in a woven fabric or the wales in knitted fabric. When pattern pieces are laid across the width ,the grain line should lie parallel to the weft or course direction .

- ☑ The placement of pattern pieces in the marker must give freedom of knife movement and not restrict the path of the knife so that it leads to accurate cutting.
- ☑
- ☑ Space must be provided whenever the blade is to be turned. Similarly a curved part of the pattern such as sleeve head , when placed abutting a straight edge , leads to a shallow curve in the straight edge or the crown of the sleeve head being straightened.
- ☑
- ☑ A pattern count must always be made at the completion of the planning of a marker to check that the complete menu of the patterns has been included.
- ☑
- ☑ Correct labeling of the garment part is essential so that in the later stages , operators are to correctly identify the parts which make up the whole garment sizes. It is the responsibility of the marker planner to code every pattern piece with its size as the marker is planned.
- ☑
- ☑ For a given quantity of the garments, a high lay rather than a low lay gives a lower cutting labour cost . The higher lay will also be more shorter giving a lower over all cutting cost.
- ☑

Pattern Marking

- ☑ Weights and round headed pins should be used to properly fix the pattern paper on the fabric so as to avoid fraying .
- ☑ The edges of the card pattern should not be worn out (a scotch tape can be used to avoid it) .
- ☑ The pattern must be held firmly while drawing takes place.
- ☑ The chalk used needs to be easily held and readily sharpened to achieve a sharp line.
- ☑ For paper marker *spot and cross paper* should be used to ensure adherence to grain line.

B. The Spreading of the Fabric to Form a Lay

- ☑ Spreading is a sophisticated method of material handling, adding nothing to the manufacture of garments, yet in conventional cutting rooms it is the technological bottleneck. The operators who build the operation lay are also responsible for the quality control of the operation, whether they are spreading by hand or machine. Faults must be located and decisions made about them as regards eliminating them from the lay. Pipes can be used in lay setting to avoid stretching of the knitted fabric.

DO'S & DON'TS

Shade Sorting:

Where rolls of cloth of the same color but different shades do have to be spread adjacent to each other in a lay , they should be separated by layer of interleaving paper (a roughened tissue in bright) or fabric strip. This assists in separation of the plies for bundling.

Controlling Slippage of Fabric Layers:

Where fabric surfaces may slip against each other, the use of interleaving paper can also assist in holding the spread firm.

Alignment of Plies:

Every ply should have the minimum possible extra outside the marker length and width. However the width of the fabric varies and the marker plan is made to fit the narrowest. The surplus is usually distributed outside the edge of the marker plan. Accuracy in this alignment must be ensured as inaccuracy mean that the plies do not cover the whole area of the marker plan and part of some pieces would be missing when cut. The alignment can be checked using a needle with a thread inserted from the top through the layers on the straightened edge of the lay.

Correct Ply Tension:

If the plies are spread with too slack a tension they will lie in ridges with irregular fullness . if plies are spread in a stretched state they will maintain their tension while held in the lay , but will contract after cutting or during sewing , thus shrinking the garment part to a smaller size than the pattern pieces . The panel from the top and bottom layers should be matched with the pattern after cutting to check the correctness of size.

Elimination of Fabric Fault:

The spreading operator is responsible that fabric faults do not occur in cut garment parts. The simplest way to achieve this is by creating a splice. The spreader cuts across the ply at position of the fault and pulls back the cut e end to overlap the as far back as the next splice mark.

Avoidance of Distortions in the Spread:

A layer of glazed paper, laid glazed side town, should be placed at the bottom of the lay. This helps to avoid disturbing the lowest plies of material in the spread when the base plate of straight knife passes underneath and also facilitates movement of the cut parts. In addition it prevents snagging of the fabric on the table surface which often becomes roughened with use.

Spreading Knitted Fabric:

Spreading a lay of knitted fabric involves similar technology to that of woven fabric with one large exception. Knitted fabric is extensible and is readily distorted in width and length. Great care must be exercised in handling the fabric at all stages, whether

spreading is carried out manually or by machine. The fabric must finish on the table as relaxed state as possible.

- ☒ Relaxing of the fabric for 8-12 hours should be done before setting the range.
- ☒ Assess degree of distortion prior to spreading
- ☒ Hand spreading requires at least 2 people standing on the opposite sides of the table. Any localized pulling will distort the fabric which will be prevented from recovery by friction with the adjacent layers. Inevitably with the with knitted fabric the edges of the fabric with in the lay are less well aligned than with lays of woven fabric and there is greater edge cutting loss. The overall width and length of the lay must be constantly checked, as distortions of dimensions tend to be cumulative and once induced may affect every layer and be very difficult to eliminate once the lay is built up.
- ☒ Knitted fabric can be patterned either in color or structurally. Stripes, prints and knitted color designs patterns present alignment problems both in terms of the layers of the fabric with in the lay and in terms of marker in relation to the lay. Inevitably extra care must be taken and a high degree of handling skills are required to spread such a lay.

C. The Cutting of the Fabric.

The use of cutting is to separate fabric parts as replicas of the pattern pieces in the marker plan. When cutting by hand with straight knives it is very easy to deform knitted fabric, particularly within the depths of the lay. While the cutter is apparently following the surface marker, the lower layers are not necessarily being cut accurately.

Operator Skill:

There is also a strong element of cutter skill. Other faults of bad cutting are the failure to accurately follow lines of the marker, and the cutting off of the corners.

Precision of cut

The ease with which accuracy is achieved depends on the method of cutting employed and in some cases on the maker planning and , marker making. Accuracy of cut depends upon:

- ☒ Good line definition (sharp lines , complete edges marking , and no dual marking)
- ☒ Appropriate , well maintained cutting knives
- ☒ Skill and motivation of the cutter.

Clean edges:

The raw edge of the fabric should not show fraying or snagging. Such defects come from an imperfectly sharpened knife.

Support of the lay:

The cutting system must provide the means not only to support the fabric (through clips or spikes) but also to allow the blade to penetrate the lowest ply of spread and sever all fibres (by means of glazed paper and appropriate lay height ~ 6- 8 inches)

Cutting wider width fabric

With some wide widths of knitted fabric, the ability to get into the centre of the lay may present problems. Two cutters should work together on either side of the table.

The edge sections should be cut first, then the centre can be repositioned near the edge.

Pattern Control

For proper control of the pattern number of parts per pattern and number of pieces per sheet should also be identified on the pattern.

Cutting White fabric

Special care must be taken for cleanliness and material handling for white fabric. Cutting tables must be cleaned before doing any cutting to avoid dust and other stains accumulation as was observed

Problems of powered knives and their rectification

Device	Defect	Cure
All powered knives (straight knives , band knives , circular knives)	Most Fused edges , frayed edges and scorching	Training in manual skills Slower cutting speed, sharp blades , special blades (notched or wavy and /or striated) , anti fusion paper
Straight knives	Failure to follow marker	Marker positioned correctly and secure ; lighter , slower machines ; better clamping Table width should be greater than that of the lay marker by at least twice the length of the base of the knife
	Cut out of vertical	Proper table width , heavier machine base ; replacement of worn blades.

D. Preparation for Sewing

Position Marking

Marking the components with guides for sewing and other operations. The emphasis given to Total Quality Control is proportional to the effect on quality which can be achieved in most clothing companies by attention to this department. A little extra work in cutting can save a far greater amount of time in making up and can slash quality costs. A good general rule is to make all notches in V shape since they are easier to see.

Shade Marking

To ensure that the components cut from different shades of the same color do not get mixed up during assembly process/ every component for one garment is marked with a unique number, usually printed on a small sticker.

Bundle preparation:

Bundles of cut work are prepared according to size. Color and quantities, their actual composition determined by the requirements of the sewing room. For example all the components for one bundle of garments can be packed into one box, or each of the major components packed into one box, or each of the major components packed in its own container ready to be issued to different preparations and subassembly section in the factory. Alternatively if unit production system is used, the components for single garment can be loaded directly into the system from the cutting table.

Bundle Tickets

The tickets identify each bundle and in themselves play an important role in production planning and control for the sewing and finishing sections.

An Example of Bundle Ticket

Bundle No.		Cutting date:		Quantity:	
Lot no:		Color:		Size:	
Operation name	Operator name / machine no.	Operation name	Operator name / machine no.	Operation name	Operator name / machine no.
<i>Pocket press</i>		<i>Pocket fold</i>		<i>Pocket stitch</i>	
<i>Over lock shoulder</i>		<i>Over lock neck</i>		<i>Over lock cuff</i>	
<i>Over lock sleeve</i>		<i>Over lock side</i>		<i>Flat lock shoulder</i>	
<i>Flat lock neck</i>		<i>Flat lock cuff</i>		<i>Flat lock arm hole</i>	
<i>Top stitch label</i>		<i>Top stitch placket</i>		<i>Top stitch placket</i>	
<i>Top stitch neck</i>		<i>Top stitch yoke</i>		<i>Button marking</i>	
<i>Button hole</i>		<i>Other</i>		<i>Cropping</i>	
<i>Checking</i>		<i>Pressing</i>			

SAMPLE DEVELOPMENT

The performance of sample room is of paramount importance in the out put of the stitching floor. The information flow from the sample room ensures a consistent quality of the product from the stitching floor. This co-ordination should not be limited to the pre-production meetings but should be a continuous phenomenon. The sample master should occasionally visit the department to monitor whether the production conforms to the sample produced by the sample department both in quality and operators' techniques. Moreover, the people at the sample room must work with a view to simplify the operation and to make it easier for the operators on the stitching floor.

DO'S & DON'TS

- ☑ Develop and document a standard operating procedure for the article clearly describing each step and the accepted quality level.
- ☑ The production manger / supervisor must involve in the sample development and be instructed to practically show the standard method to each stitching operator. Repeated instructions and close follow up is utmost importance in producing the desired results.
- ☑ Any problem that arise during the initial sample bulk production must be tracked back to find out the root cause and must be sorted out before going bulk.
- ☑ Once the operations procedures are set, time and motion study must be carried out. Economy of motion must be emphasized and daily production targets must be set on its basis.
- ☑ Balancing of line should be based on time study(see guidelines in the chapter on Method Study). Sampling must be carried out with the objective to smoothen and enhance the production. Proper planning and improvements based on the findings of pre -production samples ensure less hurdles in productivity and consistent improved quality.

Use of Dummy

Apart from conformance to the buyers' specs. , it is very useful to check the overall fitting of the garment using dummy.

Machine Setting

To avoid such problem owing to higher tension of the boot, the operators should always check for suitable machine settings for different types of fabric. Each operator should be provided a piece of fabric of which is to be run in production and machine performance should be checked on it before sewing the production pieces. It is the responsibility of Sample Room to initially communicate the machine parameters to the production people.

Improvement in Effectiveness of Pre-Production Meeting

The effectiveness of the Pre-production meetings needs to be improved to have less co-ordination failure as observed during the visit. Some suggestions are:

- ☑ Pre-production meeting must be held for each new style.
- ☑ Sample master, production manger, floor in charge and respective supervisor along with line QC in charge should be involved.
- ☑ The Sample master must also discuss with the cutting in charge and production representatives the cutting panels - shapes and contours, notches and critical areas to be taken care while cutting and sewing.
- ☑ The approved sample after discussion and solving discrepancies must be signed by production manager, QC in charge and sample master before issuing to production floor.

STITCHING

Sewing Problems

The problem which arise when materials are sewn vary in their seriousness with some causing only minor appearance problems , negligible in low price garments , while other cause damage to the material which it would not be economic to repair even if it were possible.

The problems are most commonly divided into:

1. Problems of stitch formation which give rise to poor seam appearance and performance.
2. Problems of fabric distortion known as “Pucker” which also give rise to poor seam appearance.
3. Problems of damage to fabric along the stitch line

1. Problems of stitch formation:

The main problems which arise from the actual stitch formation are:

- Slipped stitches
- Staggered stitches
- Unbalanced stitches
- Variable stitch density
- Needle , bobbin or looper thread breakage

Slipped Stitches: Causes and remedies

Slipped stitch arise from the hook or looper in machine not picking up the loop in the needle thread. Thread elongation and recovery properties are very important in determining the thread loop forming properties. Thread which forms large , consistent loops are much more safely picked up by the looper, if the timing is imperfect or the needle is badly deflected in passing through heavy material. Other causes of slipped stitch are:

- Bent needles
- Incorrect needle size or the for thread size or type
- Incorrect thread tension
- Poor material control arising from a large throat plate hole or poor presser foot control. If presser foot and needle hole clearance are too great , the fabric may move up and down with the needle.

Staggered Stitching: Causes and Remedies

Staggered stitching can be caused by yarns in the fabric deflecting needle away from a straight line of stitching, giving a poor appearance.

In some hard woven fabric, really straight stitching will only be achieved at a slight angle of bias.

Unbalanced stitches:

Unbalanced stitches in lock stitching can reduce potential for stretch in a seam in knitted fabric and lead to seam cracking. Bobbin tension should be adjusted until a full bobbin in its case will just slide down the thread when held by the end of the thread. Needle thread tension should be adjusted so that the threads interlock in the middle of the fabric, unless different color threads are used, for example in top stitching, when a slight tension towards under side may be needed to prevent the color of the underneath thread showing on the top.

Variable stitch density:

Variable stitch density arises from insufficient foot pressure in a Drop Feed System, causing uneven feeding of the fabric through the machine. It can occur particularly with materials with sticky or slippery surfaces. Pressure must be adequate to enable even feeding.

Needle, looper or bobbin thread breakage:

Needle, looper or bobbin thread breakage arises largely as a result of normally smooth metal surfaces in the machine becoming shipped or otherwise damaged and causing damage to the thread. The guard over the hook in a lockstitch machine can become chipped, as can the needle hole in throat plate, as a result of needle deflection. Thread breakage during production is time consuming for the operator, especially if a join in the stitching is not acceptable and the operator must unpick it and start again. Both the cause of the damaged machine parts and if appropriate the cause of needle deflection must be investigated.

2. Problem of Pucker

The main problem which arises which is solely one of appearance is that of pucker. There are several factors which contribute to pucker including fabric structure, seam construction, needle size and feeding problem as well as incorrect thread tension and unsuitable thread.

Pucker may show itself when the garment is first sewn or it may not appear until later when the garment is pressed, wetted or washed. It may show itself in all plies of the material which have been sewn together or only on some. It can also arise from more than one cause which can make elimination extremely difficult.

However there are five main causes which cover almost 90 percent of the puckering problem. These are:

a: Seam pucker due to different fabric stretch

One of the prime causes of seam pucker is differential fabric feeding caused by feeding mechanism. When two fabric plies are being sewn, regardless of whether they are separate fabrics or folded sections of the same fabric, the problem arises that the friction between the feed dog and bottom ply is greater than that between intervening plies. The tendency is for lower ply to be taken satisfactorily through the machine by the feed dog and the top ply to be retarded by the presser foot.

This can be minimized by:

- ☒ Modified feed system (differential bottom feed system , adjustable top feed system , needle feed system , puller feed system)
- ☒ Operator handling

b. Seam pucker caused by differential fabric dimensional stability

It occurs if one of the fabric is dimensionally unstable while the other is not. In such cases, the seam may be perfectly flat and un-puckered as it leaves the machine but on subsequent washing one of the fabric may shrink more than the other so that a differential pucker appears

Differential pucker due to dimensional stability may be suspected when the two fabrics being joined are markedly different or when one shows noticeably more pucker than other. To avoid it, fabrics should be tested for dimensional stability by marking up sections of fabrics and subjecting them to washing process that the garment will undergo. Several washings may be needed as some fabrics shrink progressively. If the two fabrics show a difference in dimensional change of 2 percent or more then pucker due to differential dimensional change may be expected.

c. Seam pucker due to extension in the sewing thread

All sewing threads have some extensibility and are thus extended by the tension forces applied during stitching and pass into seam in an extended state. When removed from the machine they will tend to contract. Provided the fabric contracts by the same amount this will have no visible effect but if the sewing threads are particularly extensible and continue to contract after fabric has reached its original unstretched length , pucker will result.

It is possible to test whether pucker is due to extension of sewing threads. A seam is sewn joining two pieces of fabric using the thread in question at tension previously stretched. If this seam shows pucker it is re-sewn with a sheet of paper on top of it, sewing through the paper as well as fabric. After sewing the paper is torn away along the needle holes.

The paper ensures that extra thread is fed into each stitch and when paper is removed the extra length is released into the seam. If the pucker previously was due to thread problem, this sea should show now be free of pucker.

Where thread extension is proved to be a cause of puckered seams, consideration must given to the type of thread being used and to the tension settings on individual machines .

d. Seam pucker due to sewing thread shrinkage

This type of puckering does not appear until the garment has been pressed or washed. Cotton sewing threads increase in diameter and shrink in lengthy when wet and these distortions may cause pucker in sensitive fabric. Synthetic sewing threads have negligible wet shrinkage and should always be used for such fabrics.

e. Seam pucker due to structural jamming:

This type of pucker occur due to weave structure of the fabric i.e. in high density fabric. In such cases there is no room in the fabric structure for the insertion of sewing thread. This type of puckering is entirely independent of the mechanism of sewing machine and entirely inherent in fabric structure.

Prevention of this type of pucker is a matter for the fabric designer rather than garment manufacturer. And where there is a choice of fabric , it may be possible to prevent the problem.

When a garment maker has no choice in matter of fabric , measures have to betaken in the design of the garment and sewing of it to minimize the problem. The only step which can be taken which will always produce perfectly sewn seam is to sew the seam on the bias that is, at some definite angle (15 -20 °) to the warp or weft.

f. Seam pucker due to mismatched pattern

Occasionally situation may occur where there is pucker on some seams but not on others. If the patterns are carefully checked it will be found that there is a discrepancy between the lengths of the stitching lines on the pattern pieces that go together in that seam and consequently in a difference in the length of the cut parts which the machinist is sewing together . An experienced operator will ease in the longer ply and if successful in doing so the garments parts will level but the seams will have a puckered appearance on one ply.

Apart from faulty pattern , the same puckering problem can occur as a result of inaccurate cutting of garment parts which are then eased together.

3. Problems of damage to the fabric along the stitch line

The sewing damage or needle damage is a serious problem in garment production leading to poor seam appearance and performance.

It is inevitable that damaged needle will damage the material that they sew and the main problem is to establish the reasons for the damage occurring and preventing its continues occurrence. The real problem is that a new and apparently perfect needle can cause damage because it is itself inappropriate in point type for the material being sewn or because the speed of the machine is such that damage occurs. The problem is especially serious in knitted fabric because they will ladder.

The problem of damage which occur in sewing can be divided into the following :

- Mechanical damage
- Needle heating damage

Possible remedies for Mechanical damage :

Proper selection of needle:

- Set point needle type for woven fabric
- Ball point needle type for knitted fabric

Machine speed:

Reducing machine speed is often effective in reducing the incidence of mechanical damage but it is not a popular solution since it affects production level. However, since sewing normally takes place for about 20 percent of an operator's working time, a reduction in machine speed will not have much effect.

Finishing of fabric:

Improve finish (more lubricity) applied to the fabric during processing stage.

Possible remedies for needle heating damage:

This occurs as a result of friction between the needle and the fabric being sewn. In high speed sewing of dense materials having synthetic fibres are more prone to this problem.

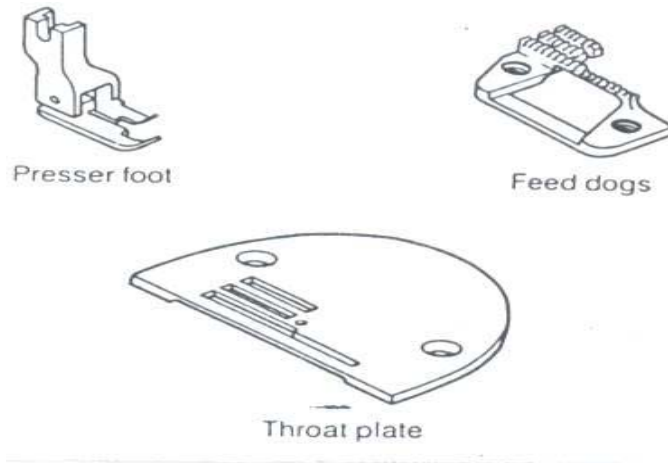
Possible solutions are:

- Reduce the sewing speed.
- Changing shape or surface of the needle

Consideration for Sewing Machine Feeding System

Machine feed system in its simplest form (drop feed system) comprises of

- Throat plate
- Feed dog
- Presser foot / boot



Throat Plate

The needle hole in throat plate should be only about 30 percent larger than the size of the needle, since if this hole is too large , fabric can be pushed into the hole with each penetration of the needle , a problem known as “flagging”.

The surface of the throat plate should be free of cuts or abrasion. to enable the material to freely pass over it without damaging the fabric.

Feed dog selection

The purpose of the feed dog is to move the fabric along by a predetermined amount between successive stitches. Important considerations for selection of feed dog are :

- ☑ The motion of the needle in up and down direction must be accurately synchronized with the elliptical motion of the feed dog so that the movement of the fabric only takes place when the needle is out of the fabric.
- ☑ For sewing light to medium weight fabrics, a tooth pitch (distance from peak to peak) of 1.3 to 1.6 mm is normal
- ☑ The peaks can be slightly rounded off if damage occurs on fine fabric.

- ☑ On very light weight fabric, sagging can appear between the teeth and pucker can occur after sewing as a result. Fine toothed feed dog with a pitch of only 1.0 to 1.25 mm can be used to prevent this.
- ☑ On heavyweight fabric a certain amount of sagging is required for satisfactory feeding in order to keep both plies together. In this case, coarser feed dogs of 2.5 mm tooth pitch may be used.
- ☑ On very delicate fabrics, damage or marking of the fabric may arise against the feed dog, despite rounding off the teeth. In this case a rubber coated feed dog with no sharp teeth at all may be used.
- ☑ Of more importance in preventing damage during feeding is a deliberate mismatch between stitch size and feed dog size. If for example a seam is sewn at 6 stitches per cm using a feed dog with 6 teeth per cm , then a tooth will repeatedly hit the same section of the fabric as it moves past and marking of the fabric or even damage could occur.

Needle Selection

Selection of a needle and thread sizes or a particular seaming situation is a question of achieving a balance between minimum damage and pucker , which is usually a matter of small needle size and fine thread, and seam strength which may require a more substantial needle and thread.

For use in a particular machine, needles must conform to the machine manufacturer's specification as regards shank diameter, length from butt to eye and total length. In addition, different needle manufacturers add their own design features as a result of development work to overcome the problems caused by higher machine speed and the demand for finer needle size to reduce pucker , fabric damage and needle heating effects.

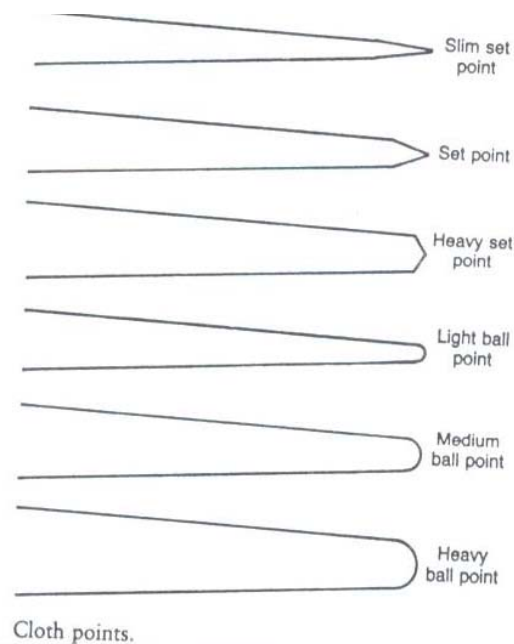
The following points should be deliberated over for selection of needle:

- ☑ As fabric becomes finer and more densely constructed, the demand is for needles and threads which can be used satisfactorily in smaller sizes.
- ☑ If the needle is too small for the tread, the thread will neither pass freely through the eyes nor fit properly into the long groove and will suffer from excessive abrasion. This can lead to costly thread breakages in production because the operator must stop to rethread the needle and possibly also to unpick some of the stitches so that a join does not show in important parts of the garment. Even worse a break in a situation of multi needle sewing with fabric running through folders could be impossible to repair. The use of too fine a needle when sewing heavy plies of material can lead to the needle being

deflected which can affect the stitch loop pickup and cause slip stitches or it can even lead to needle breakage.

- ☑ If the needle is too large for the thread, there will be poor control of the loop formation which may cause slipped stitches. There will also be holes in the fabric and which are too big for the stitches and give an unattractive seam appearance. An unnecessary large needle also tends to give rise damaged fabric along the stitch line, and in closely woven fabrics, pucker along the seam line due to fabric distortion.
- ☑ Cloth point needles are used for sewing textile material which has a round cross section and the tip at the end of the point can vary in shape to suit the particular material being sewn. Cloth points needle can further be classified as:

- ☑ Set point needle
- ☑ Ball point needle



Selection of needle for knitted fabric:

Knitted fabric consists of yarn with spaces between them and if a yarn in a knitted fabric is broken the knitted structure may become to unravel. This yarn breakage can happen in two way, either by the needle directly striking the yarn and damaging it or by the needle entering a knitted loop which is not large enough to accommodate it, and where for reasons of machine speed or lack of flexibility of fabric, the loop is not able sufficiently to draw in extra yarn and become large enough to take the needle. This situation is

generally referred to as needle damage but it is not the result of the needle itself being damaged but of the point type and fabric combination being unsuitable.

Thus the requirement in sewing knitted fabrics is for a needle which will slightly deflect the yarns and enters the spaces, but which is not itself so deflected that it fails to form the stitch properly, a needle of as small a size as possible consistent with needle strength and sewing thread size, and finally a fabric which is sufficiently lubricated that it has flexibility in relation to the movement of the needle. The shape of the tip of the needle point which best achieves this deflection is a ball shape and the needle is referred to as a ball point needle.

Ball point needles are available with light, medium or heavy ball and each of these is available on different sizes of needle. As the needle size decreases, the radius of each ball point decreases proportionally.

To maintain the proper tip bluntness, the heavier ball points may be needed for the smaller needle sizes.

Open-mesh knitted fabrics can usually be sewn without difficulty as the yarn tends to be so thick that they can even be pierced by the needle without being damaged. In these cases medium set point needles are usually sufficient.

Material with very small loops made of thin yarn are more susceptible to damage and thin needles with light ball points are more suitable.

For sewing knitted fabric containing elastic yarns where the thread is wrapped around the elastic, a ball point needle is suitable.

With an uncovered elastic thread in knitted fabric, a very acute set point needle should be used so that the needle can perforate the threads. The needle must also be fine so that the elastic thread is not totally cut by it.

Selection of needle for woven fabric:

The woven fabric may have quite sizeable spaces with in the structure if loosely woven from low twist yarns or they may be extremely dense if high twist yarns have been packed closely together. In both the cases the needle should go between the fibres and does not break them. The shape of the tip of the needle point which best achieves this penetration between the fibres has the appearance of being slightly coned shaped. It is usually referred to as a set point needle type. A tip has been set, or ground, and polished at a broader angle than the main section of the point and reduces the possibility of damage at the tip.

Medium set point needle can be considered as a general purpose needle for sewing variety of woven fabrics and in some cases can be used for knits as well.

In sewing dense combinations of material such as shirting fabric and interlining in collars and cuffs, where for the sake of appearance a very straight line of stitching is needed, needles with very acute points must be used in order to avoid an uneven, wandering seam due to the needle being deflected by the hard yarns in the fabric.

The increased danger of damaging the fabric can be minimized by using smallest possible needle size.

A heavy set point or stub point can be used for button sewing so that the button can be safely deflected slightly in to the correct position so that the needle passes through the hole. However, the use of stub point needles when button sewing on some fabrics may lead to fabric damage and it is preferable that operators using button-sew machines are encouraged to insert the button straight rather than crooked in the clamp so that the needle will not strike the button and break either itself or the button.

For woven fabrics containing fine elastic yarn, ball points needles may have to be used.

Different Feeding Systems and Their Usage

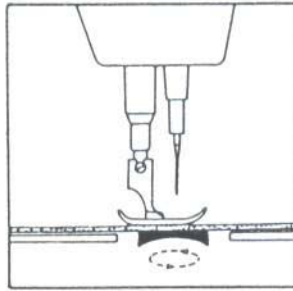


Fig. 15.15 DROP FEED This feed system is used on all regular sewing machines for flat seams on materials where inter-ply shifting is unlikely to occur.

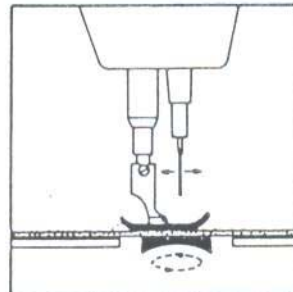


Fig. 15.16 COMPOUND FEED The combined needle and feed dog movement ensures that plies do not shift out of alignment while being sewn. A feed of this type is used for sewing a slippery material such as velvet, or for top-stitching edges.

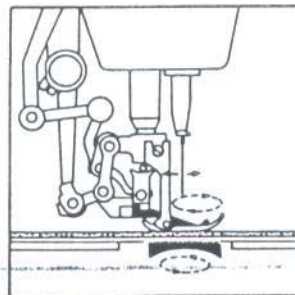
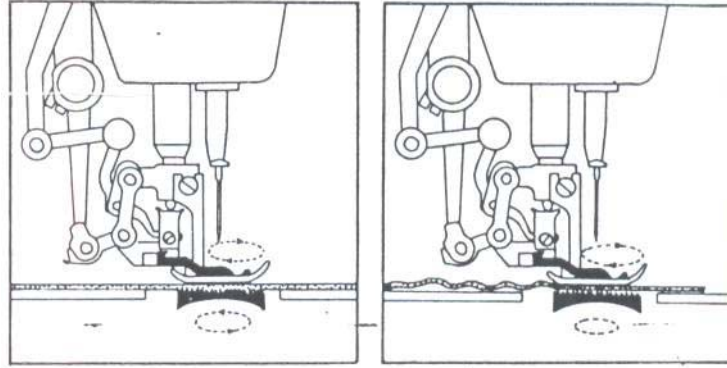
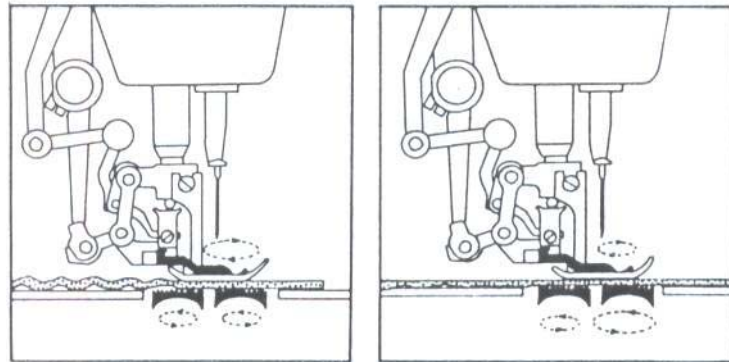


Fig. 15.17 UNISON FEED This features the synchronised movement of the needle, feed dogs and top feed with the foot. This feed system is especially suitable for operations where several plies of material have to be joined, for example when sandwiching a finished collar between the body and the neck line facing.



■ **DROP AND VARIABLE TOP FEED** The top and bottom feeds are adjusted to create fullness on the top ply by means of a stretching action on the bottom ply. A typical operation using this feed is the closing of shoulder seams.



■ **DIFFERENTIAL BOTTOM AND VARIABLE TOP FEED** The action of the bottom feed is capable of very fine adjustments between the top and bottom feeds. This is used on slippery fabrics where fullness has to be created on the bottom ply. One example would be the slight easing of a satin lining on the inside of a velvet garment.

Instructions for Stitching Operators (SOP)

- ☑ Clean the machine before starting the work. The machine as well as table top should be properly cleaned .
- ☑ Check the level of the oil in the machine.
- ☑ Check needle condition whether it is sharp or not. Check for bluntness or bending of the needle. To check whether the needle is straight or not, roll the needle on a smooth surface (e.g. table top). If it rolls smoothly, it is an indication that the needle is straight.
- ☑ Check thread and its passage way.
- ☑ Check whether needle is in the centre of throat plate hole using pressure foot.
- ☑ Turn on the motor but do not press the paddle until motor starts running in full swing.
- ☑ For moving the machine in the forward direction, push the machine paddle in the forward direction and for stopping the machine press the paddle in the backward direction and cut the thread.
- ☑ Before starting stitching, the machine performance must be checked by stitching on a waste fabric (same type of fabric for which production is being done). Any stitching problem thus found must be rectified before sewing the actual product. The quality of stitching should also be approved from the supervisor or quality officer.
- ☑ Seam allowance should be taken in accordance with the supervisor instructions.
- ☑ Turn off the machine while breaks or leaving the machine.
- ☑ At day end, turn off the machine, take out the bobbin from bobbin case, put a waste fabric under the foot / presser foot and cover the machine.

Instructions for Edge cutter , Kaj Machine , , Over lock , Safety Feedo machine

- ☑ Check blade sharpness on hourly basis and clean dust and fibres from the looper area.
- ☑ For single needle, double needle and flat lock machine, periodically check bobbin case especially after a bobbin is changed.

QUALITY CONTROL

Quality control is seen as the agent of the quality assurance to attain requisite quality. The function of quality control is "To ensure, at minimum practicable cost, that the requisite quality of product is being achieved at every stage of manufacture from raw materials to boxed stock."

This means six things:

- a. *Checking the suitability of raw materials*
- b. *Checking the manufacturing capability of the production undertaking*
- c. *Monitoring production; feeding back information; responding to that information; and so getting defects removed at source*
- d. *Reduction of the fault rate*
- e. *Saving costs*
- f. *Maintenance of product consistency*

All of these factors increase the possibility of developing further business and the competitiveness of the company, and is therefore to the benefit of the company; Quality control thus becomes a positive -benefit.

A further point stems from one aspect of Q.C: continually monitoring production and deciding whether, in any part of the manufacturing chain, materials, machines or workmanship need attention to effect a reduction in the fault rate. It is very easy to "pass the buck" that is for production personnel to blame materials or to say that it is the responsibility of QC, and so relax any endeavour on their part to avoid faults. In fact, quality cannot be inspected into goods; it is to direct attention and effort towards the most effective areas for avoiding faults and to maintain product consistency.

Components of an Effective QC System

To maximize the production of goods within the specified tolerances correctly the first time, an effective QC system is required. The requirements of which are:

- i. Specification - i.e. that parts of the total specification which is required by the making-up supervisor.
- ii. Tolerance
- iii. Monitoring of
 - a. the product to ensure conformity with the specification
 - b. the operators to determine where non-compliance with the specification arises.
- iv. Collection of data - from supervisor's sample checks.
- v. Analysis of data.
- vi. Corrective action
 - a. short term- fault correction
 - b. long term - fault prevention

Guide Line for Designing an Effective QC System

- ☒ Itemize the variables that occur in fabric and garment production in order to provide a complete specification.
- ☒ Develop a specification in a number of parts or sections to ensure that all design and production staff have a clear idea as to what is needed
- ☒ Establish acceptable working tolerances in relation to all values on the specification.
- ☒ Establish fault rate recording systems
- ☒ Improve technical understanding of the product including the fabric geometry and the interrelationship of yarn count, loop length, pick count, relaxation and fabric properties, sewing problems, causes and prevention of seam breakdown , the effects of various factors on the apparent shade of goods affecting shade matching
- ☒ Check consistency of incoming raw materials
- ☒ Select suitable instrumentation for determining specified manufacturing values

- ☒ Choose recording systems to provide a history of control
- ☒ Select a method to assess operator effectiveness
- ☒ Commence testing of fabric and garments and record results
- ☒ Analyse results
- ☒ Check colour vision of personnel
- ☒ Examine fabric on receipt
- ☒ Consider fabric storage facilities
- ☒ Examine fabric cutting quality
- ☒ Develop through recording systems in the sampling department
- ☒ Prepare working standards and samples for shade matching

Final Inspection

Efficiency of Examination

No examination process can be considered 100 % effective, and observable or measurable faults creep through. Below 80 % of the examination process could be regarded as inefficient. There is a time factor involved, in that efficiencies rise with time spent on examination. Indeed efficiency can be estimated by withdrawing samples of garments examined and subjecting them to a much more thorough examination i.e. spending more time on the job.

It is also wise to have group discussion with the examiners when changes of style, production process, raw material and customer specification take place, to establish peculiarities in the standard asked for.

Dimensional Considerations

Measuring the dimension of the knitted garment poses particular problems. Handling and placing a knitted garment on flat surface can induce stretch up to 5%.

For upper body garment, it is usual to measure the body width under arm, total length, length of each sleeve and width of each shoulder. The skills of the examiner in placing the garment on the table and in using the measurement tape is vital. Examiners can be said to sense (trained eyes) rather than measure the garment that is out of specs.

QC In Sewing

The manner in which the sewing operation is organized has a direct effect on quality problems. There is little doubt that division of labors accompanied by piece-rate produces quality control headaches of a high order. In particular, knitted garment that are put together by over-locking pose problems.

The over-locking machinery cuts off the edge of the fabric to ensure a fixed dimension of the bight. What is not fixed is the amount of cut off. Pattern for over-lock contain an allowance for cutting by the over-lock knives, which varies from 3mm - 6 mm. A sloppy over-locker can readily cut 20 mm of a particular edge, altering the dimensions of the garment considerably as observed during the visit. The workers training in this respect is necessary.

Other problems arise from the difficulties of **controlling alignment of two components during stitching**. Because of knitted fabric stretch, it is easy for one of the components to stretch during stitching. Subsequent attempts at correction with in the length of the seam make matters worse and the garments show obvious distortions as observed during the visit.

The above factors that affect quality, and need to be close control , relate to the operator and his / her skills. Such factors are best dealt with through training, environmental and management action rather than thorough checking , measurement and punitive action. The best quality control process are built into the production system . “ ***Make well and there is little need to check***”.

Role and Skill Level of Supervisors

The supervisor has a major role in ensuring that the required quality of the product is being achieved. He will be unable to play that role if firstly, he is not aware of precisely what is required and the means of monitoring it, and secondly, is not convinced of the necessity for it.

Even if the above conditions are satisfied, his efforts will be inhibited if he is required to devote the greater part of his time to ordinary roles such as that of a service man, although a highly paid one. In short, a supervisor must be encouraged and permitted to supervise.

As a result of systematic development the supervisor should, amongst other facets of supervision, be:

1. Thoroughly familiar with the specification
2. Thoroughly familiar with and skilled in techniques of monitoring the consistency of the product
3. convinced of the necessity for the required quality

Given then, the ability to communicate, he can pass that conviction and knowledge on to his operatives and, by so doing lay the foundation for an overall improvement in workroom standards.

A realistic approach to making the supervisor aware of the necessity for quality is to outline the cost of poor or inadequate quality. Such an approach may be based on:

- ❖ Basic Cost of re-work
 - Cost of returning work
 - Cost of operative time
 - Cost of supervisors' time
 - Cost of re-inspection
- ❖ Loss of production because of operatives repairing defective work.
- ❖ Loss of production by a likely quality purge all round.
- ❖ Late delivery because of rectification time.
- ❖ Customer dissatisfaction with quality.
- ❖ Cancellation of orders
- ❖ Reduction of profit possibly even a loss due to excessive rejects.

It is advantageous if the supervisor spends a short period of training actually working in the Q.C. Department.

During this period the supervisor should become fully conversant with the specification, how it was derived and the significance of each item contained therein.

He or she should be taught sampling procedures and checks and should practice those checks.

Faults should be taught in a systematic manner - a manner, which the supervisor can, in turn, employ when teaching trainees and retraining experienced operatives.

Such knowledge is vital, as knowledge is one of the many facets through which a supervisor gains respect, - and without respect a supervisor cannot function efficiently.

Skill Level of Operators

The skill level of operators should be improved by proper training. Due to this reason defective percentage and rework is high. A systematic and extensive training program is needed to be developed for catering this critical problem, the guidelines to which are given in the *WORK FORCE MANAGEMENT* section.

Instruction Sheet

The quality of garment can not be attained if the information is not transferred to the operator level i.e. What to produce and how to produce? For this the instruction sheet for the operators and QC staff should be developed with the help of customer's specs and sample. The idea is that customer specs should not be kept in lock or at QA table rather this information should be provided at each level by converting them in easy to understand manner.

The instruction sheet should incorporate all the customer specification , style-wise along with the sketch of the garment. The critical areas of the garment need to be highlighted on the same sketch so that the operator and quality control staff could focus on the desired quality level.

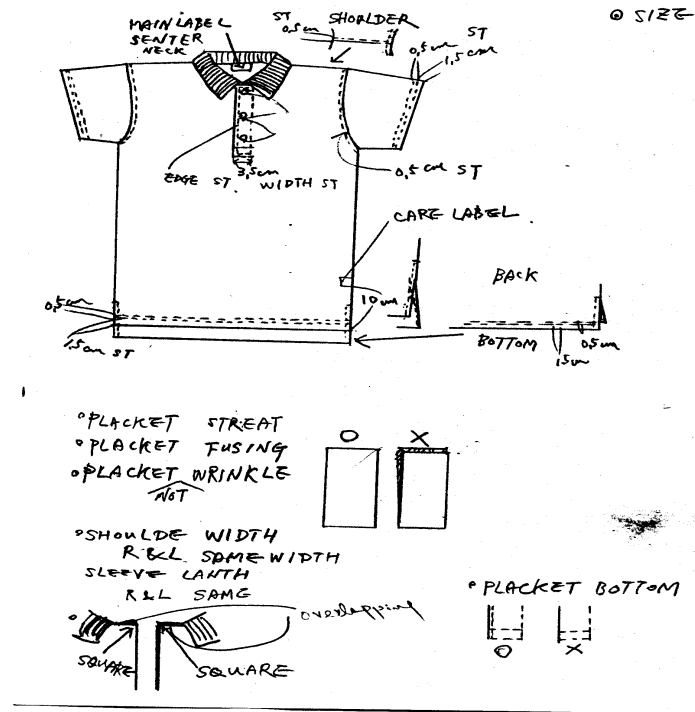


Illustration of the sketch for instruction sheet(Polo shirt)

Standard Operating Procedures(SOPs)

Standard operating procedures for each article/ style must be developed at sample stage and stitching supervisor must be taught the same. The supervisor must communicate this information to operators and ensure that they follow the same procedure to have better and consistent quality.

Line Checking

The line checkers should inspect the stitching method and quality along with checking measurement/ specs. and give immediate feedback to the respective operators. The role of supervisors and QC staff is very critical especially at the start of a new style and lays the foundation of consistent quality product.

In essence it is the job of the inline QC staff to make the operators realize that the ***quality has to be built in*** by their efforts ***not by only quality checks***. Focus should be on finding out and eliminating the cause of a fault rather than only pointing it out or rejecting the article. The skill level of line checker in this regard is very important. He should be trained to become fully conversant with the specification, how it was derived and the significance of each item contained therein. Such knowledge is vital so that he can employ it to train the new operators and retrain the experienced ones.

The number of line checkers on the stitching floor is dependant on the skill level of operators and garment to be produced.

Re-Work Control

To decrease the re-work percentage, fault must be categorized and data must be collected according to each category. After collecting, analyze this data and give feedback to respective department. To control the rework and rejection, an inspection chart has been handed over to record the defects at an interval of two hours. Based on the findings of the report (after every 02 hours) , the supervisor should find the cause of recurrent fault and rectify it by discussing with the respective operator.

The in-line QC staff must also constantly give immediate feedback to the concerned operator so as to reduce the amount of re-work. Through an effective work culture, re-work can be substantially reduced if each department sets its own quality standard and constantly strive to achieve that standard. The department heads should designs means to motivate the workers for pursuing that standard.

Inspection by Operators

In order to build a quality – driven work culture, the operators must be instructed to inspect their own operation before forwarding it to the next operator. This practice, if properly adopted, will reduce the amount of re-work.

Provision of Waste Fabric to the Operator

Operators must be provided with the cutting of waste fabric which is to be run in production so as to check stitching quality and do necessary machine setting accordingly.

CROPPING

Cropping By Stitching Operators

The operators should be provided with small scissors to cut thread after stitching to improve the efficiency and effectiveness of final cropping.

Standard Procedure

A standard method / procedure must be developed for cropping and properly communicated to the workers for efficient cropping.

Time study can also be done to determine the average time of cropping for each style and hence setting targets for cropping on the basis of it.

Cropping Position

The workers should be instructed to do cropping in standing position to have a better view of the whole garment

PRODUCTION MANAGEMENT

Production Planning and Control

An effective lay out for planning and monitoring the production must be formulated to avoid time loss due to break in material flow (operators sitting idle) and re-work cost the factory for overheads , labor and time without productivity.

The key related issues are:

- Determining the optimum production capacity for each operation.
- Setting factual production targets.
- Optimum production lay out for various styles.

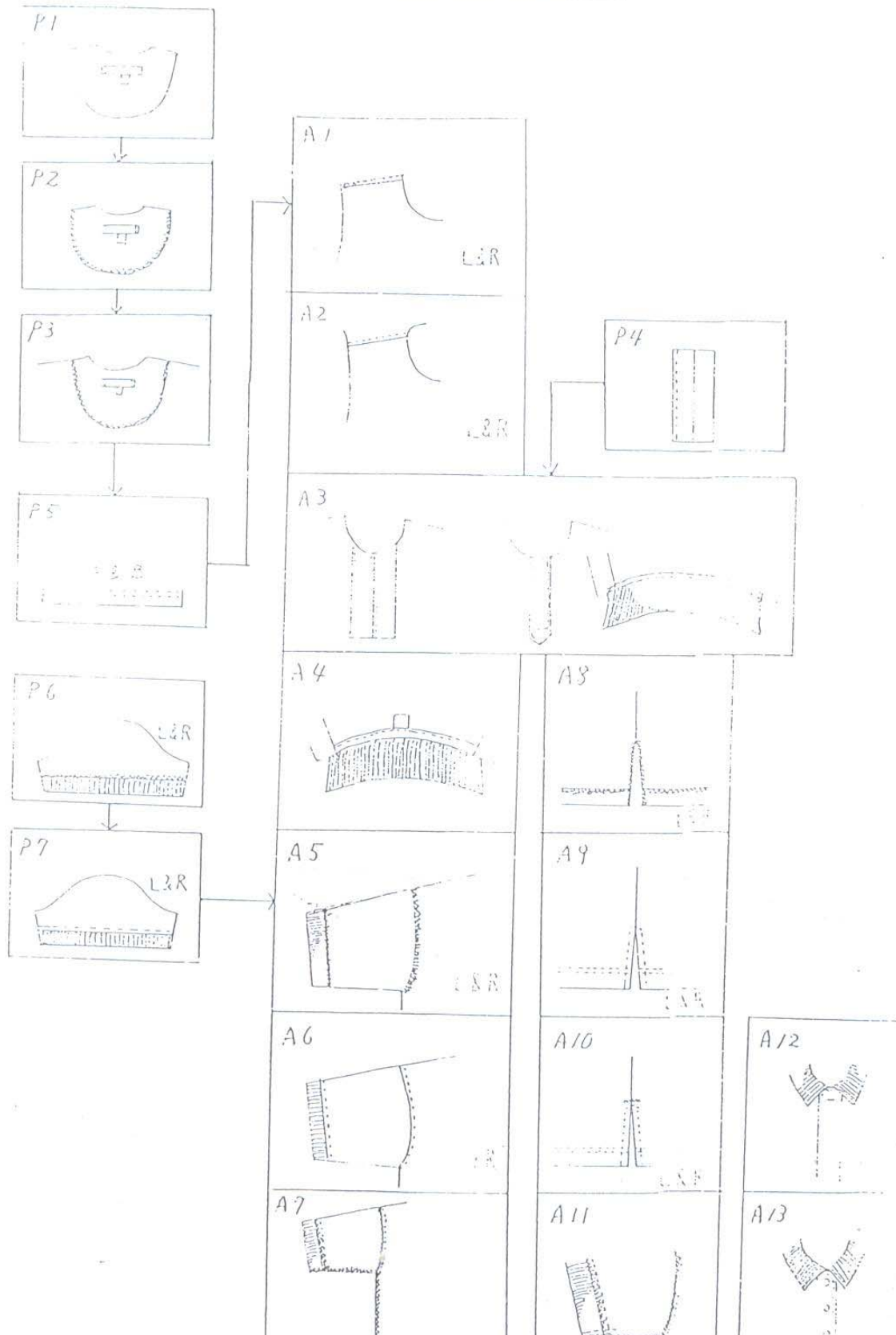
Use of Process Chart

The JICA expert suggested to break down each style into a series of sewing processes (pictorial representation given in annexure). The time required for each process should be calculated keeping in view the motion economy. This data must be used for setting targets for each operator and line balancing.

The process planning for line balancing being done at the moment does not seem to be effective as at many positions bottle- necks were observed while at some other workers were sitting idle.

See below the process analysis of a POLO Shirt.

P6LG SEWING PROCESS



Line Balancing

To reduce bottle neck and have uniform material flow the management should properly carry out time and motion study and set individual and line wise target on its basis. The following are the guide lines regarding work measurement and line balancing implementation:

Step 1: Process Analysis

- Define the sequence in working out each operation using process chart as described above .
- Define specification and quality requirements.

Step 2: Estimate Standard Time for Each Operation

- Calculate SAM¹ (standard allowed Time) using stop watch method

Step 3: Organize Operation Line

- Upon the completion of process analysis and estimation of standard allowed minutes for each operation , the nest step is balancing the production line.
- The line should be balanced through the synchronization of the output rate from each workstation or operator.
- Plan the lay out for smooth material flow.

Step4: Issuance of Operation Sheet and Quality Specifications

- Operations sheets (mentioning the production target)should be issued to ensure that each operator clearly understands the material flow .
- Manufacturing and quality specification must be communicated to the operator.

Step 5: Line Loading and Line Balancing

- Once the production starts , it is necessary to time study the actual operation time for each operation. If deviation is found adjustment should be made to re-balance line.
- Short interval scheduling should be applied. Production data at each operator should be collected every two hours. If the output is not balanced , line re-balancing or workload reassigning is necessary.

¹ SAM is defined as the normal time required by a normal operator working under normal conditions with normal skill and pace using a specific method to complete a unit of work at desired quality level.

- One tendency of the fast operators is to subconsciously pace themselves to the previous operations causing serious problems in line balancing . This tendency must be checked and all the operators must be taught the necessity of working at their full capacity. Then the faster operators will have time to help out on other operations.
- Management must anticipate problem operations and give an adequate amount of upfront training. Ideally, there should be at least two members who are fairly proficient at each job.

Daily Production Report (Line-Wise)

To record daily production of each line a report monitoring output at an interval of 2 hours as is being done in unit 01. This should be used to track variation in the production so as to immediately rectify the cause of below target production.

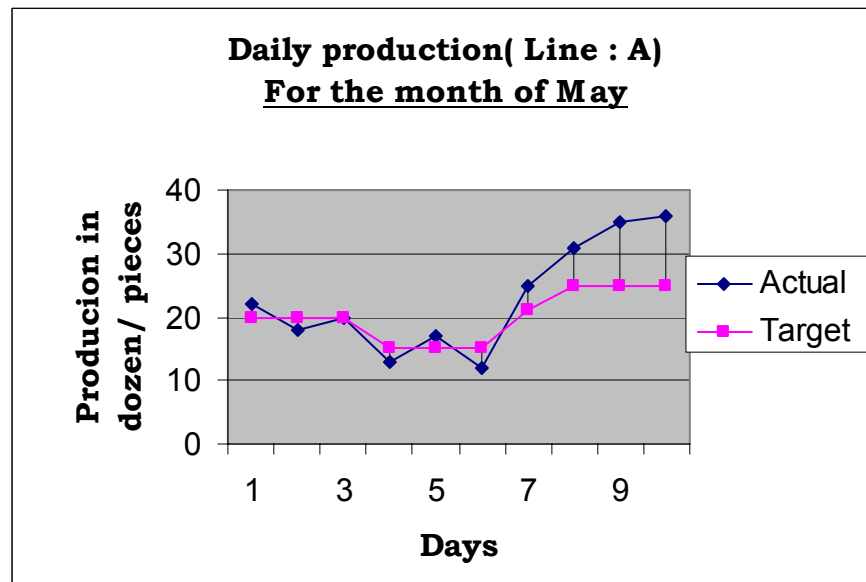
To motivate operators , competition among lines may be introduced which should be linked to some incentive for the line meeting or exceeding targets or minimum amount of re-work.

SAMPLE TARGET BOARD

Line no.:		No. of operators:		
Date:		Style No.:		Shift:
Time	Target	Actual	Re-work	Remarks
8-10				
10-12				
12-01				
01-02	Lunch			
02-04				
04-05				
TOTAL				

Graphical Presentation

The daily production should not only be recorded but displayed graphically as well in the production hall and the targets being set for each day must also be shown on the same graph so as to easily monitor the variation in planned and actual production.



Operator Working Chart

A record of daily production of each operator for one month should be maintained . This data will be helpful in judging the efficiency of each worker.

Capacity Utilization

The management should plan capacity utilization on the basis of the time taken for stitching a complete garment . The time required can be estimated by process breakdown of each garment and then determining the time required for each operation. However care must be taken to also incorporate the time required for the necessary movements of the operator like picking the part , matching it and disposing the garment after stitching. The management must also focus on a smooth work flow and the presentation of the part to each operator so as to minimize the motion of the operator.

GARMENT ENGINEERING

Production engineering is concerned with the design, improvement and installation of integrated systems of manpower, materials and equipment. It draws on specialized diagnostic and measurement techniques to develop and specify systems and evaluate their results.

Apart from the design of planning and control system, the production engineering function is also responsible for the following activities:

- Setting time standards
- The design and administration of incentive schemes
- Planning the layout for production areas, offices, stores etc.
- Designing special purpose fixtures and fittings
- Providing consultancy services for all departments in the company.

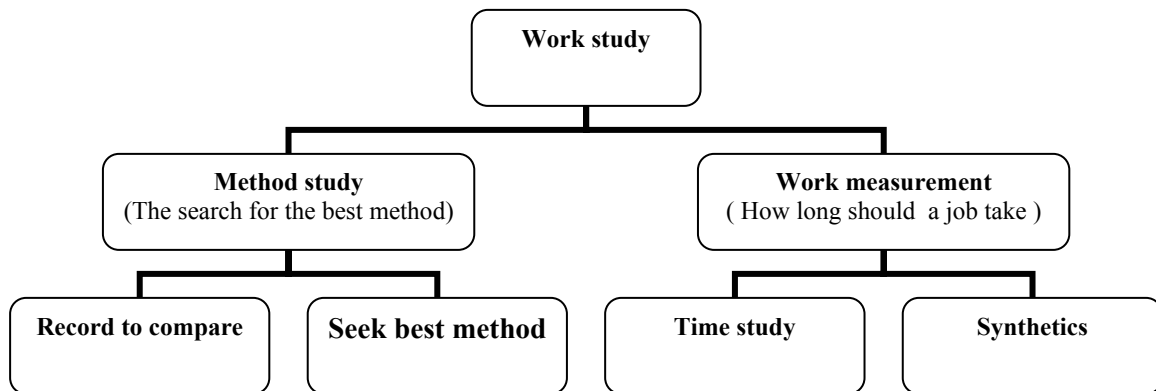
A technique central to production engineering is work study and it is probably the most effective tool available to management for measuring and diagnosing working situation. While work study is widely accepted at the production level, it can also be profitably applied to other departments in the factory including:

- Service departments
- Warehouses and stores
- General administration
- Planning and control function of all types

Work Study

The fundamental concept of work study is to establish and handle facts in a systematic and disciplined manner . There are two specialized techniques use for the purpose:

Method study: An investigative technique used to determine the best way of doing a job
Work Measurement : to establish how long a job should take



Used together these techniques can influence the following factors:

- The lowering of cost
- Productivity ratios
- Manufacturing profitability
- The partial or entire elimination of unnecessary work
- The setting of equitable work loads
- The determination of performance standards and methods for checking achievements.

Method Study

Why to use method study;

- Different operators will develop different ways of doing a job. Not all can be right
- Some ways of working may have been developed because they were easier to learn or the operator had a special skill.

- The systematic recording of method is essential for work measurement and helps when we wish to compare different approaches.

Improving Work Room Method

The selection of the best method must be done in a systematic way . A suggested sequence is set out below :

Examination:

This typifies the work study approach by getting down to basics. There is no need to improve the method for sewing a seam which can be eliminated or done more cheaply on a different type of machine. The questions that must be asked at this stage are:

- Is the operation necessary ?
- Are parts best done else where?
- Are the machines and needles right for the job?
- Is the material likely to change ?

Analysis : (record what you see and not what you expect)

If we are familiar with a skill , we have a model with which we can compare other methods. Record the method first in general terms . If there is time constraint , select for detailed examination parts which seem to be likely to offer the greatest savings.

Record one part at a time and wait for it to come round again.

Wherever possible look at several people doing the same job. It often happens that the best method is a combination of elements from different people, with improvements from the person doing the yarn.

Typical questions for this part are:

- How is the operation best performed ?
- What aids can assist?
- What changes in layout will help?
- What effect will these changes have on the previous and subsequent operation?

Discussion and Test:

The involvement of the people concerned will not only bring out any weakness in the proposed scheme but it is an effective way of ensuring their cooperation in making the new method work.

Approach for Method study

The basic pattern for method study is:

- Select work to be studied
- Record from observations of all relevant facts.
- Examine critically
- Develop the best method and workplace.
- Define a new method which gives best economic returns.
- Install as a standard practice.
- Maintain by regular routine checks

Motion Economy :

Principles of motion economy directly affects the operator's handling methods and sewing techniques. Principles of motion economy are defined as LAWS . When applied, these laws result in an operation being performed in the most efficient way and least fatiguing manner possible. Therefore ,this allows attainment of the highest production.

This deals with:

- A. The use of human body
- B. Arrangements and the conditions of the work place
- C. Design of Machinery and Fixtures/ Work aids

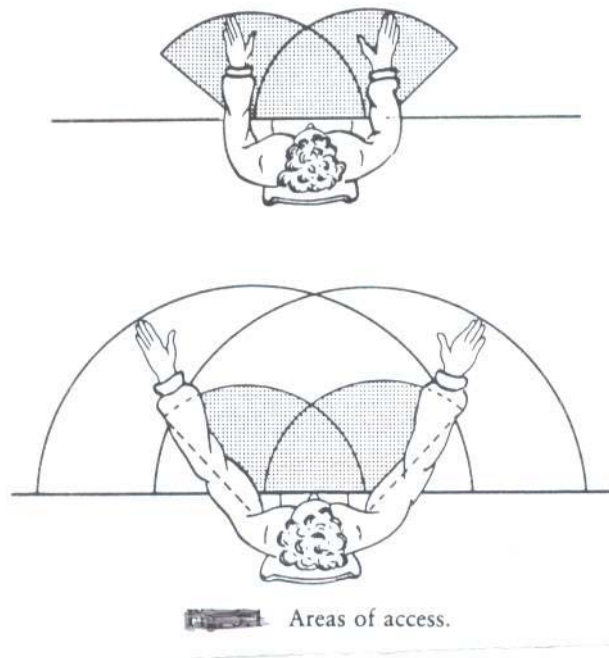
A. Use of Human Body

- The extent of movement should be kept to the minimum class of motion.

Class I : Finger	Best
Class II : Fingers	↓
Class III : Hand	
Class IV : Forearm	
Class V : Arm body	
Class VI : Walking about	Worst

- People come in different shapes and sizes. As far as possible the work place should be adjusted to the individual
- The body naturally adjusts to counterbalance any movement of its parts. Ideally one useful movement should be matched by another, so that they are symmetrical.
- Where possible, movements of the arms and of the other parts of the body should occur together . That is they should be simultaneous.
- Jerky movements is tiring and unproductive. Fir the best results movements should be continuous.

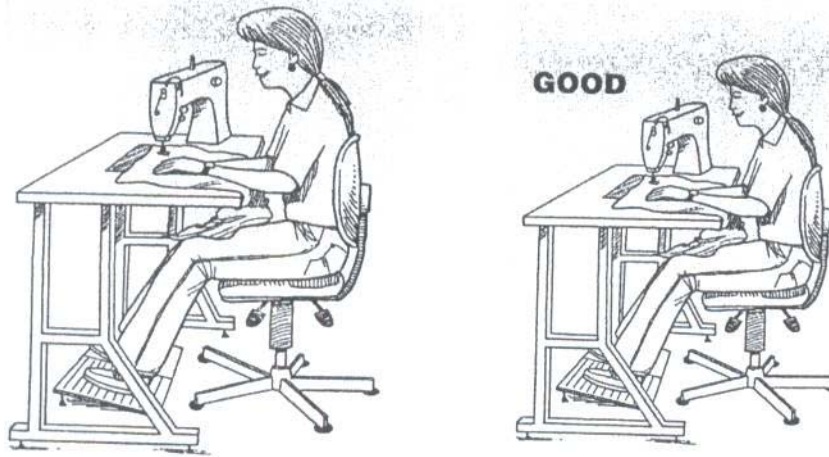
- When we carry out a new job we must think about the order in which we do things , look ahead to see where parts are and concentrate , in order to work within the limits. With practice , we can do the same job with the minimum of thought and effort. If the tools and parts are always in the same place the method becomes habitual.
- Restricted movements are more tiring than unrestricted ones. Work aids can often reduce the control that the operator must exert and so make the work less tiring. Edge guides are an example.
- Rhythmic movement is natural movement. Nevertheless , some operation build into their jobs unnecessary movement which , however rhythmic , are wasteful.
- The easiest way is the natural way. Sometimes , to the untrained persons the easiest way to does not seem to be natural but , as training builds up co-ordination , the best way becomes the natural way.
- The figure below shows how a work surface should be laid out for maximum motion economy . Articles in frequent use should be within the shaded area and all other articles within the un shaded area if possible.



Guidelines for better use of human body

Awkward body postures are a major ergonomic concern in the garment industry. Awkward postures take the body away from a comfortable position, which reduces efficiency and increases the use of energy. Another major concern are static postures. Static means to hold in place, so these are postures where the body is held in one position for a long period of time. An example is when you work with your arms above shoulder

height for long periods of time. These types of postures require constant muscle use for the time the body is held in the position. This reduces rest and recovery time, which leads to muscle tiredness. The following are recommendations which will help to reduce the risk of injury due to the above concerns.



For seated and standing work, the height of the workstation should allow workers to function with elbows at 90 degrees. If the workstation is too low, the worker is forced to bend at the waist to reach the work being done. This puts stress on the lower back. If the station is too high, the worker is forced to lift their shoulders or move their elbows away from the body to reach their work. This puts increased stress on the shoulders which may lead to injury.

During seated work, if a good back support is not present or used, static postures occur which results in constant use of the back muscles.

It is important to adjust the workstation in order to allow the worker to use the backrest.

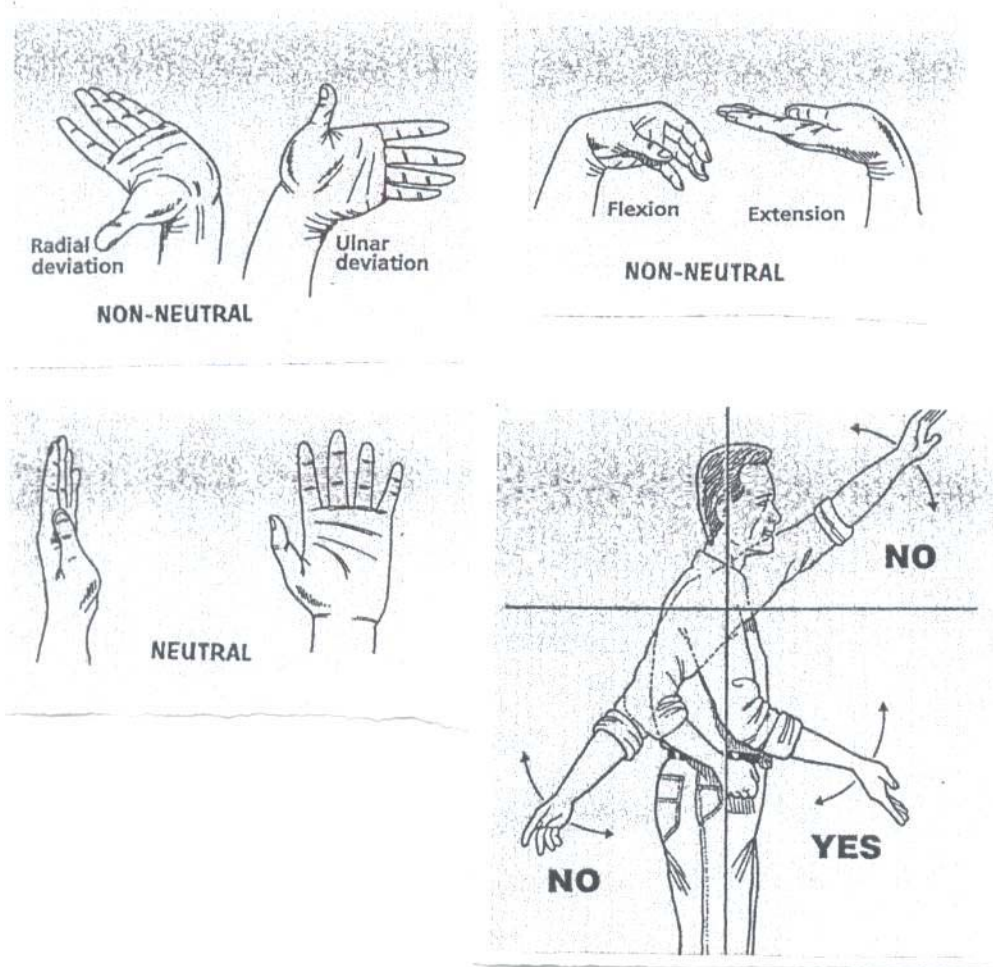
It is also important to adjust the worker's chair to allow duties to be performed with their bodies in comfortable positions. The workstation and chair should be positioned so that the worker's knees, hips, and elbows are at 90 degrees, which will reduce stress on the body.

There should also be enough room to allow the worker to change their sitting position throughout the day.

Static postures can also occur during standing work. If the worker stands in one position for long periods of time, muscles of the back and legs will be constantly activated. This can lead to increased fatigue, and decreased blood circulation to the legs. During the day, workers should try to walk around to allow their blood to flow. As well, workers should try and sit for short periods of time while working to give their leg and back muscles a rest.

Awkward wrist postures are one of the major causes of physical disorders and muscle strains. Awkward wrist postures are those which take the wrist away from the neutral position. Neutral position is when the hand is in line with the forearm. The workstation should be adjusted and the worker educated on awkward wrist postures, their harmful effects, and the signs and symptoms of muscular strains.

Workers should not constantly work with their arms above shoulder level. Work above the shoulders increases the use of the shoulder muscles. With this constant use, the muscles do not have time to rest and thus tire more rapidly. The majority of work should be done between knuckle height and shoulder level.



Workers should try not to twist their upper body when placing objects besides them. By keeping their feet in place and only moving their upper body, workers are putting large stresses on their backs, which may lead to injuries.

Workers should move their feet, instead of twisting at the waist, in order to face the area where the object is going to be placed. If the worker is sitting, they should try to swivel in their chair, instead of twisting their upper body.

Design of Machinery and Fixtures

- A. Machinery and attachments (such as folders) can be used to do in one operation something which would ordinarily require two or more operations? For example, use of lap seam folder can achieve the effect of a join and top stitch (or flat stitch) seam in one operation. Without the use of such a folder , two or more sewing operations would be required to produce the same result.
- B. Guide or stops can be used to help in locating materials , scissors etc.
- C. When the actual sewing (or pressing or trimming) operation involves working on one corner or along one short edge of a large piece material , the bundle can be pinned (or clipped or clamped) along the end opposite to the one being worked on. By doing this the operator can , the operator can place the entire bundle on the table near the needle , pick up one piece , do the operation on it , break the thread , flip the piece forward , then repeat for the next piece. When the operation has been done on the entire bundle , the operator picks up the bundle by holding it near the pin (or clip or clamp) , shakes the bundle to straighten out all the pieces , remove the pin or clamp if desired , and is then ready to dispose the bundle. Although this technique does not eliminate the cutting apart and stacking of each piece , it does reduce both the cutting apart time and stacking of each piece ,
- D. Use of foot pedals to relieve hands for other work. Foot pedals, bundles clamps , handles etc. should be accessible and designed to give the greatest mechanical advantage . Consider the possibility of using fixture . check the height and position of the fixture .
- E. Investigate the possibility of employing the gravity feed or drop delivery. The use of tilt tables to bring the work from the front of one machine to the back of a second machine , is one application of this principle.
- F. A gravity drop system should be used to reduce the search and move times.

Method (Motion) Study

Involving Workers in Methods Improvement:

Piece rate establishment involves setting time values , via time study or synthetic pre-determined data on a specific method. Since you can set correct piece rates on wrong ways to do a job , it makes sense to first find the most preferred , efficient way. Proper method determination requires answering all of the questions asked previously. These are questions we must ask ourselves about the jobs we are observing. But since most of us do not have all the useful information , it suggests that other might have some answers on how best to do or improve their jobs.

Therefore we should ask the very workers ,who do the job , ways to improve their jobs. When workers think of the changes that effect their jobs , they don't resist nd resent changes as much as workers who do not get involved.

The garment engineer should rather act as an *engineer* who listens to the operator's suggestion and together they come up with a mutually acceptable better way to do a job. People will change with less resistance and resentment if they can be helped by the *engineer* to help themselves. This is called selling of change. There are five "R's "of selling that can be employed to help sell change. They are :

- Easier
- Faster
- Better
- Newer
- Cheaper

Recording Methods / Carrying out Method Analysis

Elements:

First see if the job can be broken down into elements . each of which consists of a series of actions which are linked , with a recognizable beginning and end.

Give each element a title and write them down in a sequence .Where possible , separate machining from non-machining elements since they have different allowances.

Breakpoints

Identify break points. A breakpoints marks the end of the one element anf beginning of the other . It is important to have clearly defined breakpoints between elements to make it easier to time them.

Systematic analysis

Initially it is best to concentrate on one element at a time, recording , checking and amending until the record is complete. Study – relax – study . It sometimes happen that an unskilled operator will change the method between one cycle and another.

Then when the study is complete , examine it for discrepancies , and if necessary do a check study. Draw a line between each element , ending with the break point.

Check

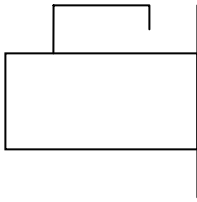
When the study is complete , check it against the initial record of the work cycle. Finally take another look at the break down into elements , in order to see that they are about the right length an that different types of work are separated as far as possible.

It does no real harm if a very small piece of non-machining work is included with what is mainly a sewing cycle if it makes sense on other counts.

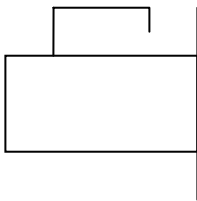
Record

Some possible formats are :

Format 1

<u>Operation</u> Sew centre row collar	Layout
Operator name: XYZ Time and date: 09:30 ; 02-08-05	Tumble box  Operator
<u>Elements</u>	<u>Key points</u>
Position collar at needle & sew on	Sew on at step 2 mm from edge No visible tolerance
Sew centre row , sew off in chain	Pull plies taut near points
Clip collars and stack	Left hand hold collars Right hand clips and stacks.

Format 2

<u>Operation</u> Sew centre row collar		Layout	
Operator name: XYZ Time and date: 09:30 ; 02-08-05		Tumble box  Operator	
<u>Equipments & work aids:</u> Brother VX 1200 (2 mm compensating foot) Quality specs. Seam allowance: 2 mm $\pm$ 0 Basic Time :			
Left hand	Attention points	Right hand	
Position at needle	Press seam flat & hold lining away from ply	Pick up one collar Position at needle	
Guide collar forward	Stitch seam 2 mm to right of of edge from front edge of collar band	Guide collar forward.	
Ditto	Stitch past leaf ,stop needle up , pull down ply from front and holding it taut , stitch on	Ditto	
Ditto	Stitch to within 7 cm of step , stop , needle up , & pull ply back from point.	Guide collars forward & then pull ply taut.	

Performing Work Measurement

Standard time and production standards can be developed through a variety of methods that include Methods Time Measurement (MTM), Basic Motion (BMT), and Modular Arrangement of Predetermined Time Standards (MODAPTS), etc.

Stopwatch time studies, which identify time elements of a work task, are the oldest and most frequently used method for setting production standards and piece rates. Stopwatch time studies are based upon the performance of the task, with a given method, and job conditions. A qualified examiner using a competent worker who operates at a competitive pace should perform the time study. Allowances must be made for employee fatigue and needs.

The results of this approach are two-fold: 1) the determination of a base time that includes the productive, repetitive, and basic parts the operation should take; 2) the conversion of this **base time** into **standard time** through use of a predetermined allowance for those tasks required of a worker other than interruptions such as clean up, personal time, etc.

Using a Time Study Process

The development of any work standard requires careful attention to the work method employed, and assumes that the most appropriate method (based on the guide lines provided in Method Study) has been developed. Accurate description of method addresses two basic criteria of work measurement:

1) what are the methods employed and what are the work motions involved with equipment used, work environment, etc.? (As discussed in the previous section of method study)

Determining the Work Elements

Once the basic method of operation has been determined, it is possible to break the operation into various parts, or elements, that can be timed independently. An element breakdown is the least subject to error, gives an exact description of the operating procedure, and permits development of information that may be used as a reference for future jobs of similar nature.

Four types of elements can occur:

- 1) Regular elements—those that occur in each cycle of an operation
- 2) Irregular elements—those that do not occur in each cycle, but which are repeated consistently. For example, the packaging of every 20 units completed.
- 3) Constant elements—those for which the time remains unchanged throughout the study. For example, machine speeds.
- 4) Foreign elements—those elements introduced by the worker, which are not part of the normal cycle. For example, dropping a pair of pliers.

Regardless of type, there are five basic criteria for an element:

- 1) Motions are in a coherent or unified series of related activities.
- 2) There is a definite end point for each element, and it is described precisely.
- 3) Descriptions are precise and have the same meaning when applied in various studies, for example: reach, grasp, move, fold and turn.
- 4) Machine time and external or manual times are separated.
- 5) Elements include only one activity that contributes to the progress of the task, and is short enough so that foreign elements will more likely occur between regular within one of them.

The length of an element should be consistent with the accuracy of the timing instrument and with good judgment. For our purposes, an element should be no longer than .50 minutes in duration, nor should it be less than .02 minutes, which is the shortest that an element can be timed.

Application to the Work Method

Each item of the work prepared earlier should be reviewed to establish the elements of the job. If an item of the rough breakdown does not meet the requirements for an element it may be combined with the next item in the sequence and checked to determine if the combination meets the requirements. In practice, some elements do not meet all the requirements.

Determining the Number of Cycles to Time

It is impossible in any realistic manual operation to achieve consistent performance over a period of several cycles. The time required for completion of the regular elements will vary according to complexity of the work method and qualifications of the worker. Changes in worker rhythm or pattern, the positioning of parts and tools, and observer recording errors will all have an impact. An effort must be made, therefore, to obtain a reasonably representative number of observations for the time study.

A “more is better” approach is generally not feasible, from either an economic or parts availability standpoint. It is possible, however, to determine an appropriate sample size for a valid and reliable time study using statistical and researched data accepted by the field.

There is a chart derived from an industrial engineering standard that gives a reasonable accurate estimate of the number of cycles to be timed. The chart is based on the completion of *10 preliminary readings for cycles of less than two minutes* duration; *five readings for operations two minutes or longer*.

Selecting a Worker for the Study

The selection of a worker as a time study subject is important. Such a selection proves difficult even for competitive industry, which has developed procedures for the rating of operator performance. For our purposes, it is important to realize that Federal Wage and Hour regulations require that time studies be made with a regular worker or a worker who is non-disabled for the type of work being tested. In addition, the worker's production level must be comparable to that of a non-disabled person of average ability.

Our intent should be the identification of an individual who comes as close as possible to the basic requirements for performance of the job as defined. The worker who is selected should be cooperative and as close to competitive skill and effort as possible. Even through the person may be representative of a qualified, competent worker employed in private enterprise, you should not expect the time study subject to function exactly at 100 percent. A minimum expectation of 80 percent of normal performance should be established. However, this requirement should be maintained whether the individual is a workshop employee or a staff member.

The time study subject, who is not disabled for the job, should be given sufficient opportunity to practice the work method to be studied. While time for practice in the work method will vary according to complexity of the task, familiarity with the operation can be judged by the presence of smooth, rhythmic motions.

To create as comfortable and normal a work situation as possible, all those involved with the time study should be informed of the procedures to be followed and the reasons for conducting the study. The worker should understand the purpose of the study and should feel at ease. If the worker appears nervous or inconsistent in performance, the time study should be postponed or another subject selected.

Rating the Operator

For a valid rating of operator performance, four key areas are reviewed. The four performance factors measured are broken down and assigned numerical values in order for each to be more accurately scored.

Of those factors to be rated, working conditions and consistency will be the easiest to evaluate. Working conditions are influences such as proper temperature and humidity, ventilation, lighting, layout of work area, and orderliness and housekeeping. We are rating constancy of the environment, not its relative degree of comfort.

Worker consistency is a factor that can be determined with a slight degree of objectivity. If a worker purposely slows up while being time studied in an attempt to gain a more favorable production standard, an analysis of the time data will reveal a great deal of variability. This variation in elemental times results from the worker not being able to fake his performance with consistency. In addition, there is high correlation between a worker's consistency and his skill. The more skilful worker when putting forth good effort will have less variation among the elemental times.

Skill and effort are more difficult to evaluate. There is a tendency to refer to a worker as being good, average or poor, with no degrees in between. Other degrees of skill and effort are certainly present and can be categorized and quantified. There is a list that provides a description of the characteristics present within each *skill* and *effort* category, and its corresponding numerical value.

Operating Rating Chart

<i>Operator Rating</i>	<i>Comment</i>
0	No movement
50	Very slow , little motivation
75	Steady, purposeful movement – No obvious shirking
100	Brisk pace , well motivated
125	Very fast , not attainable for a working day by most people

Determining Allowances

Various factors other than the actual work will occur during the course of a day, week, etc. for any job: getting material, putting materials away, preparing the work area, cleaning up, adjustment inspection, and personal time are unavoidable. The time study is usually so short in duration that few, if any, of these occurrences are likely to be included. If the standard time is to indicate work output in the work day, rather than just performance of the regular work, the base time must be adjusted in consideration of personal fatigue and other delay factors.

An exact allowance factor can be determined through direct observation and study. "Delay studies" can be made for different work areas and types of work. It is entirely possible for legitimate allowances to range from as low as 1.10 to as high as 1.40, depending on the nature and amount of occurrences that are unavoidable.

The procedure for conducting a delayed study is:

- 1) Make observations over an extended period of all activities, of all operators, in a single work center, either by continuous timing or by sampling.

- 2) Find the total time spent by all operators on each classification of activity, and convert this total to a percentage of the total time studied for all operators.
- 3) Select those percentages for legitimate (unavoidable) delays and add to get the total "allowable" delay percentage.
- 4) Divide this "total allowable delay percentage" by 100 minus the total delay percentage to determine the delay factor.
- 5) Add 1.00 to any delay factor to obtain the "allowance factor."

Generally, not less than 15 percent allowance (9-10 minutes per hour) shall be used in conducting time studies."

Observing and Recording Actual Times

Equipment

- For general time study work, a decimal minute stopwatch (100 units per minute) is preferred as calculations to two decimal places are made easier.
- A time study clipboard that holds a stopwatch and a time study record sheet is also desirable.

Observation

The observer should be as close as possible to the operation, so that it can be clearly viewed, but not so close that the worker feels uncomfortable. All aspects of the operation, the workstation and the stopwatch should be in the same line of sight, by assuming a position to the side and slightly behind the worker.

Primary attention should be on the finger, hand and arm movements to detect the break point for each element. Sounds can often be employed to make this task much easier. Explanations should be given to supervisors and co-workers in the area prior to starting the study, so that interruptions can be avoided.

At the moment of the elemental break point, three settings will be simultaneously accomplished:

- Detection of the break point.
- Reading of the stopwatch noted.
- Recording on the observation sheet.

Readings

Using continuous reading of the stopwatch, the observer quickly looks at the watch to determine the time at the element end point. The watch reading (R) is posted for that element to the nearest 0.01 minute.

Without stopping the watch, readings for all elements previously listed are posted as the operator repeats each cycle. The watch is stopped at the end of the final reading. For verification, the times of the day should be recorded for both the beginning and the end of the study.

Since the smallest realistic unit is 0.01 minutes, all readings include two decimal positions. For speed and convenience, however, the decimal point is often omitted. In addition several two-digit readings may be posted within one minute. The next posting would then show the whole minute reading as well as the hundredths-minute reading using a three-digit number.

If no reading is recorded, for whatever reason, indicate a missed reading as -M- in the area provided on the form.

To summarize the Time Study, compute elapsed times, discard abnormal times, determine validity of foreign elements, and calculate base time (average time x operator efficiency rating).

Elapsed Time

Once the basic time study data has been posted, it is necessary to compute elapsed times by determining the time interval (T) for each element. The time interval is the difference between the reading (R) for the end point of that element, and the reading for the end point of the previous element. By subtracting each reading from the next throughout the study, the time interval (T) for successive elements is developed. Remember that in short elements, the whole-minute division was not posted, but rather the hundredths of a minute.

The use of a different color pen for recording elapsed times will make analysis of the time study much easier.

Abnormal Times

Once time intervals (T) have been determined, they must be examined for consistency within each element. Wide variations may indicate errors in subtraction, which should be examined and corrected. Abnormally small values probably indicate a watch reading error, and can be discovered by reviewing several prior and subsequent readings. Such time intervals should be discarded, however, since they could indicate the element was not completely performed. Hesitation or fumbles that would not occur with normal performances may have caused an unusually large time interval, and these should also be discarded.

Abnormal times are discarded to eliminate the effects of activities that occur during the study, but would not necessarily occur with normal performance and working conditions. (The factoring of allowances will account for irregular occurrences). This will also give a sampling, which is a “statistically normal” distribution.

The Validity of Foreign Elements

During the course of time study observation, the worker can introduce various foreign elements. Such elements, which are not necessary to complete the process, are recorded even though they are not part of the prescribed task. As they occur, a notation should be made at the point of posting the reading and footnoted on the time study sheet. This is done by identification of foreign elements “A”, “B”, “C”, etc. A worker dropping a piece

or being interrupted by a supervisor are examples of foreign elements. With completion of the time study, it is necessary to determine the validity of these foreign elements. Most are individual occurrences, which would not be expected to repeat themselves during the normal course of operation. These are not valid and are discarded. There are, however, some foreign elements that are likely to occur on a random basis throughout the day, and are legitimate parts of the job. This category should be considered as valid, and should be averaged with other time data in the summary.

Base Times

Once all abnormal times and invalid foreign elements have been discarded, the base time for each element, as well as the operation as a whole, is calculated:

- 1) Total the times for the remaining, valid elements and post this total in the appropriate columns.
- 2) Determine the number of occurrences, or valid elapsed times, for each element.
- 3) Determine an average time per element by dividing the total time by the number of occurrences.

NOTE: An element may occur only once during a series of cycles, for example, packaging. Nonetheless, 15 cycles were completed. The number of occurrences, 15, should be posted in the appropriate column.

Determine an average time per element by dividing the total time by the number of occurrences.

- 1) Post the operator performance rating for the entire operation.
- 2) Multiply the average time by the operator's performance rating to obtain the base time.

Once posted, the base times for each element can be totaled to determine a total base time for the operation.

Compute Standards

From the total base time, standards are computed by factoring the total base time by the predetermined allowances(see table below) for that particular task (base time x allowances), establishing a standard time per unit. This standard time can then be used to establish a production standard, usually pieces per hour (or minutes per piece, or piece rate, which is the prevailing rate divided by pieces per hour), utilized for wage determination and production scheduling. Other forms of production standard include:

- 1) Hours per unit.
- 2) Hours per 100 units.
- 3) Hours per 1000 units.

Filing for Future Reference

It is important that the original time study be filed for future reference. This time study not only provides the basis and justification for wage payments to clients, but it is also a key factor in determining an appropriate bid. Without an adequate record of the methods,

procedures and results of the time study, it will be difficult to determine when adjustments in wage rates or production standards need to be made due to changes in the work method, materials or working environment. These standards should also be posted for the individuals to enhance productivity.

A well-maintained workshop records system is essential to the safeguarding of wage payments and effective management of the operation.

Machine Delay Allowances

<i>Typical machine delay allowances (including bobbin and cop replacement)</i>	
Single needle lockstitch	9%
Twin needle lock stitch	14%
Three thread over lock	7%
Four thread over lock	9%
Five thread over lock	11%

Personal and Fatigue Allowance:

These together with similar allowances, are added to the total of the machine basic times with machine delay allowances added plus the total of the basic times for other elements. A typical P & F allowance would be 14 %.

WORKFORCE MANAGEMENT

Organizations must make full use of its employees- its most valuable resource. Employee actually performing the operations often have the best idea for improving them. Human resource are as essential an aspect of processes as technology. The abilities of managers and workers, and how they are organized, trained and motivated can give a firm a competitive edge. Firms can capitalize on the insights and experience of their employees in various ways, ranging from departmental problem-solving teams to cross-functional, self-directed teams. However, to utilize fully the talents of their work force, firms must establish the proper environment, which includes restructuring the organization and its incentives, appropriately designing jobs, and using the proper tools to measure performance.

Workers Training

Organization must rely on their employees to anticipate possible problems, develop new product, increase productivity and quality to remain competitive. In order to make it possible On-job training is one of the useful tool. Teaching new work methods to experienced workers or training new employees in current practices helps to achieve our goal.

Mangers too need to develop new skills not only those directly relating to their own duties but also those needed to teach their sub ordinates.

Systematic training involves the training of a person in: -

- a. Basic knowledge
- b. Correct methods
- c. Quality standards (It means the establishment of the threshold at which level of severity a defect becomes unacceptable, i.e. a fault. It is the equivalent of tolerances applicable to measurable factors.)

Without these last item defective production cannot be prevented. It is vital that all faults and defects that are likely to arise in any job should be taught to all trainees during their

instruction. An operative must be able to recognize these faults and take action on them, that is, to report, correct or prevent them and where possible, to prevent their recurrence.

Training of Quality standards is greatly assisted by a library of faults, each fault being illustrated in the various degrees of severity, - from certainly acceptable to definitely no.

Much duplication of effort is avoided if the faults likely to be encountered are categorized under one or other of two headings: -

1. General faults
2. Job faults

General faults are, for example, those resulting from machine or operative defects, which may be common to any garment in the workroom. They may include such as:

1. Skip stitches
2. Unbalanced seams
3. Careless handling faults
4. Seam breakaway
5. Incorrect tensions

Job faults are those which are specific to a given garment e.g.

1. Bad pattern match
2. Wrong measurement

Fault Analysis

'Fault Analysis' is the name of a well tried technique in which all facets of each fault are recorded under appropriate headings. Together with an example or examples of each fault the analysis provides an invaluable teaching aid. The headings are indicated below with an explanation of each

- a. Fault. - Enter here the name of the fault. The correct, or agreed name. This must be taught in order to ensure that everyone concerned refers to the fault by a common name.
- b. Appearance. - Write a clear description of the fault, and/or attach an example of the fault. No one can take remedial action with a defect unless they can recognize the appearance or feel of the defect.
- c. Cause(s). - List under this heading the main cause(s) of the faults. For example, "Incorrect machine setting", "Faulty cutting", "Contamination", "Faulty measurements". Operatives will be better armed to identify faults if they are aware of what can cause them.
- d. Effect(s). - The fault being analyzed if not rectified will have certain effects. Describe what these effects or results will be. For example, "Fabric will be scrap", "Garment will be a reject or second", "Loss of earnings". Operatives need to be taught the effect of faulty work.
- e. Responsibility. - Record under this heading who is directly responsible for the fault. Operatives need to be aware of which defects are their own fault and which are the faults of others. This discourages the passing on of blame, and at the same time avoids blaming unfairly. Basically it is not a question of apportioning blame but we do need to know where the responsibility for a fault lies in order that corrective action may be taken
- f. Action. - List the action or actions to be taken when the fault is found. For example, "Reject", "Unpick and re-sew", "Report to the Supervisor", "Call the mechanic", or whatever. Each and every operator must know what action they personally are to take, and the right action is vital.
- g. Prevention. - At times faults will occur over which no one has control, in other words there is no prevention. However if there is, record any action, which can, or should be taken to avoid a recurrence of the fault. For example, "Inspect needles frequently", "Check tension and stitching every fifth garment", "Ensure edges match before sewing". Prevention where it is possible is invariably better than cure.

It can be seen from such a chart or card that if all this information is properly recorded there is nothing else anyone will need to know about a fault or defect. You have equipped yourself with a comprehensive record of everything that needs to be known and the information can now be suitably applied in your teaching of operatives, the chart forming the basis of any notes you need.

Collecting Examples of Faults

Collect an example or examples of all faults which an operative must know in order to be classed as competent, analyze them and record the information which is then used for teaching purposes. In almost all cases the faults which are of most importance are the borderline examples. Even new workers will recognize obvious faults. The critical faults are those where it is difficult to decide what will just pass and what will just not pass. In essence the sort of faults which cause people to resort to opinion instead of facts.

It is prudent to keep several well-labeled examples of the faults for both comparison and for teaching purposes. Examples which the Instructor and management have reached an agreement on. In this way operatives can usually check when in doubt and by comparison make the right decision regarding acceptability. At the same time such examples may also be employed for teaching purposes.

Mounting examples

Generally, examples will be handled by many trainees and will, unless suitably mounted and protected, deteriorate very rapidly. Fabric samples could be mounted flat on a background of stiff card. The whole of this would then be sealed in a cellophane or clear envelope, thus enabling them to be handled almost indefinitely without detriment.

Storage of Examples

Fabric faults in envelopes may be conveniently stored in filing cabinets, drawers, or boxes of suitable depth, with the related FACERAP card being clipped. Careful storage will cut down the tedious non-productive effort of constantly replacing examples.

Suggested Teaching Method

This should be carried out by means of knowledge lessons and some suggestions regarding time and how to organize the Development, or main part of the lesson, are given below.

- a. Limit the session to 30 minutes. This will involve a limitation of the number of faults dependent on their complexity.
- b. Have a card for each fault, showing a complete analysis.
- c. Show the example of each fault and discuss the cause, how to recognize it, and explain whatever action by the operative is appropriate.
- d. Place examples of faults around the room, shuffle the analysis cards, and then get the trainees to place the cards against the appropriate examples.
- e. Alternatively, show the fault, and then ask the trainee to complete the information regarding it.

Then compare the trainees' completed cards with the master card and discuss as at c) above.