DRAFT STUDY MATERIAL

ASSISTANT FASHION DESIGNER

(Qualification Pack: Ref. Id. AMH/Q1210)
Sector: Apparel, Made-ups & Home Furnishing

(Grade XII)

PSS CENTRAL INSTITUTE OF VOCATIONAL EDUCATION
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Preface

Vocational Education is a dynamic and evolving field, and ensuring that every student has access to quality learning materials is of paramount importance. The journey of the PSS Central Institute of Vocational Education (PSSCIVE) toward producing comprehensive and inclusive study material is rigorous and time-consuming, requiring thorough research, expert consultation, and publication by the National Council of Educational Research and Training (NCERT). However, the absence of finalized study material should not impede the educational progress of our students. In response to this necessity, we present the draft study material, a provisional yet comprehensive guide, designed to bridge the gap between teaching and learning, until the official version of the study material is made available by the NCERT. The draft study material provides a structured and accessible set of materials for teachers and students to utilize in the interim period. The content is aligned with the prescribed curriculum to ensure that students remain on track with their learning objectives.

The contents of the modules are curated to provide continuity in education and maintain the momentum of teaching-learning in vocational education. It encompasses essential concepts and skills aligned with the curriculum and educational standards. We extend our gratitude to the academicians, vocational educators, subject matter experts, industry experts, academic consultants, and all other people who contributed their expertise and insights to the creation of the draft study material.

Teachers are encouraged to use the draft modules of the study material as a guide and supplement their teaching with additional resources and activities that cater to their students' unique learning styles and needs. Collaboration and feedback are vital; therefore, we welcome suggestions for improvement, especially by the teachers, in improving upon the content of the study material.

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Module 1	Preparing Garment Design Collections for a Season

Module Overview

In this unit the students will learn about different garment components, production planning and cost sheet of any garment industry, garment construction techniques which include different types of seams used in the construction of any garment. Garment components include fronts and backs of garments, sleeves, collars/neckline treatments, cuffs and sleeve treatments, plackets, pockets, and waistline treatments, among others.

The key areas that determine the basic shape, silhouette, and length of a garment are these components. Depending on the garment type, these can also be made up of one or more components, such as yokes, panels, tiers, and so on. To avoid rejections by the buyer or any faults in the end product, the most significant parts of the garment manufacturing sector is production planning and management.

On-time delivery, the most efficient use of personnel, and reassurance that the right supplies and equipment are available for each order are all benefits of meticulous planning. Everything from scheduling each activity in the process to product execution and delivery is covered by production planning. Garment makers cannot afford to waste time or materials throughout the manufacturing process. When things aren't delivered on time, lost time might lead to late fines.

Buyers quickly locate other companies to replace manufacturers that fail to deliver, and in an industry where competition is already fierce, one can't afford to take that risk. Raw material prices are steadily rising, and poor planning can result in missed opportunities and increased expenditures.

With styles changing so quickly and vendors placing smaller and smaller orders to keep up with shifting trends, each production piece's planning step must be as precise as possible. Making cost sheet is also a crucial step in production planning process.

A garment cost sheet is a sheet that is used to calculate the cost of a single piece of clothing. The material and processing costs are included on the cost sheet. When determining the cost, the quantity of production is also important.

Learning Outcomes
After completing this module, you will be able to: • To learn about different body and garment measurements • Plan and organize the design collections • To learn about various types of garments and its parts • To learn about garment construction techniques ,fabric requirement • Quality check in the garment

Module Structure	
Session 1:	Classify garments and their various components and describe garment manufacturing processes
Session 2:	Estimating the fabric and material requirements for garment construction and preparing cost sheet
Session 3:	Using garment construction techniques for garment preparation

Session 1: Classify Garments and their Various Components and Describe Garment Manufacturing Processes

Classification and Categories of Garments

A wide range of garments is available in the market catering to the ever-changing demands of the customers. With the changing habits, roles, interests, values and increased purchasing power, manufacturers are providing clothing for varied life-styles and different occasions. These garments or apparel products can be classified in several different ways based on different aspects such as:

1. Fit type
2. Utilization
3. Fabric structure
4. Function
5. Season
6. Method of manufacture
7. Gender/Age group
8. Styling
9. Price range

1. Fit type

Based on the fit of the garments, these can be categorized as slim fit, regular or straight fit and loose fit. Slim fit garments fall close to the body and follow the body curves. Regular or straight fit garments fall straight on the body and does not follow the body curves. Such garments are neither too tight nor too loose. On the other hand, loose fit garments have adequate ease and they do not reveal the body shape.

Fig.: 1.1 – Fit Type

2. Utilization

Garments can also be categorised based on its utilisation or basis of wearing. Garments which are worn next to skin are known as innerwear or under-garments or intimate apparel. These include women's lingerie items, men's briefs, vests etc. Outerwear is a category of garments which are worn over the innerwear. These include upper garments like T-shirts, shirts, kurtas, blouses, jackets; lower garments like trousers, skirts, churidar pyjamas and one-piece dresses.

3. Fabric structure

Based on the fabric structure, garments can be categorized into three types i.e., garments made from woven fabrics, knitted fabrics and non-woven materials. The raw materials used in the manufacture of these fabric structures can further be of natural origin such as cotton, wool, flax, silk etc. or produced artificially such as acrylic, nylon. Polyester etc.

The performance characteristics of the garments are significantly influenced by its fabric structure. Woven fabrics are available in variety of weave designs, possess good strength and are dimensionally stable. Knitted fabrics are soft and comfortable with lot of stretch, making it ideal for active wear. Non-woven fabrics are comparatively cheap, easy to produce and abundantly used for disposable clothing.

4. Function

Garments can also be categorized according to the function they perform to satisfy the needs of the consumer. These purpose-built garments are workwear, activewear, evening wear, nightwear, swimwear etc. Workwear includes the clothing items worn for work like profession specific uniforms, formal trousers, shirts etc. Activewear is a type of sportswear or a casual street wear clothing which is quite popular among people having an active life-style. These include leggings, crop-tops, biking shorts, jerseys, T-shirts, sweatshirts, jackets etc. Evening wear, also known as social apparel is used for attending formal parties and weddings. These include dresses, evening gowns, formal suits etc. Nightwear needs to be soft and comfortable. Swimwear should have good water resistance to keep the swimmer dry.

5. Season

Different types of clothing are required for different seasons. The most common seasonal changes that occur throughout the year are spring, summer, monsoon, autumn and winter. Based on these seasons, garments can be categorized as spring/summer wear, rain wear and autumn/winter wear. Clothing items used as spring/summer wear are crop tops, tank tops, shorts, dresses, Hawaiian shirts, polo shirts, hats/caps etc. made in light-medium weight cool fabrics. Rain wear will include clothing items made in bright colours and quick dry fabrics; raincoats, hoodies, hats, boots, etc. made from waterproof materials. On the other hand, garments such as jackets, sweatshirts, tracksuits, coats, sweaters, cardigans etc. made from heavy weight warm fabrics are used as autumn/winter wear.

6. Manufacturing method

Garments can be categorized into three types based on their manufacturing method: readymade garments and tailored garments. Readymade garments include all the clothing items that are mass produced in factory in different sizes as per the standard measurements. Whereas, tailored garments include all the clothing that is custom-made based on individual body measurements and conforms to that particular body shape.

7. Gender and age group

Garments can be also categorized based on the gender or the age group for which these are manufactured. These categories are women's wear, men's wear, unisex wear and children's wear. Women's wear includes all the clothing items produced for women like skirts, pants, tops/blouses, dresses, lingerie, gowns etc. Men's wear, on the other hand include clothing items worn by men like shirts, Polo shirt, trousers, T-shirts, formal suits etc.

However, fashion industry is also producing unisex clothing which can be worn by both men and women. These include T-shirts, shirts, hoodies, jackets, denim jeans etc. Another category of garments based on age group is children's wear. These can further be segregated as clothing for new borns (0-3 months old), infants (3-12 months), toddlers (1-3 years), children (3-6 years), little girls and boys (6-10 years), preteens (10-12 years) and teens (12-16 years) catering to different age groups.

8. Styling

Based on the variation in styling and its frequency of change, garments can be categorized as staple, semi-styled, styled and fashion garments. Staple garments basically remain unchanged from season to season with occasional minor changes in fabric, colour and silhouette. These include men's underwear and work clothes. Semi-styled garments are basic garments with minor changes from season to season. Men's classic shirts are semi-styled garments which might vary in fabric, colour, pattern, fit type, pocket type, collar/cuff shape and sleeve lengths.

Styled garments change substantially and frequently such as ladies' skirts, dresses, jackets, coats etc. On the other hand, styles which change abruptly and to a great extent in design and fabric are known as fashion garments. These styles cater to the short-term demands for fresh and exciting clothing.

9. Price range

Another basis for categorization of garments is its pricing. These categories include low-end, budget, moderate, better and designer garments. Low-end or budget garments are made from less expensive fabrics and detailing, at controlled cost of production and compromised quality. Moderately priced garments are made using better quality fabric and detailing as compared to budget garments. This price range of clothing is majorly bought by the larger segment of the population. Whereas, focus of better and designer apparel is unique styling and high-quality production. Highly expensive fabrics and trims, complex construction techniques and perfect fit speaks for the price paid for it.

STUDY OF GARMENTS AND THEIR COMPONENTS: NECKLINES, COLLARS, SLEEVES, PLACKETS, POCKETS, SKIRT ETC.

Garment components are the basic parts of garment which include garment fronts and backs, sleeves, collars/neckline treatments, cuffs and sleeve treatments, plackets, pockets, and waistline treatments etc. Fronts and backs are the major sections determining garment's basic shape, silhouette and length. These can further be of one or more pieces depending on the garment styles such as yokes, panels, tiers etc.

Neckline and collar variations emphasise the neckline area of the garment along with its finishing. Sleeves and cuffs are important part of garment silhouette and have played an interesting role as a fashion element during different time periods. Plackets and pockets further add to the functional and decorative aspect of the garment making it appealing to the target customers. Furthermore, smaller components like waistbands, facings, bindings etc. also serve important purpose in a garment by providing a well-finished look.

1. Necklines

Neckline in a garment has a functional opening for the head to slip through during wearing and taking off a garment. It frames the neck and can be of variety of shapes. Some variations fit close to natural body neckline, some can fall below, while few rises above the natural body neckline. Neckline shape can be symmetrical or asymmetrical and also front and back neckline depth and shape may or may not be same.

Broadly, necklines can be classified as basic neckline, deepened neckline. wide neckline, scooped neckline or raised neckline.

i. Basic neckline: This type of neckline follows the natural body neckline curving around the hollow between the collar bones in front and nape of neck at back. Such type of neckline is neither deepened nor widened, for example crew neck.

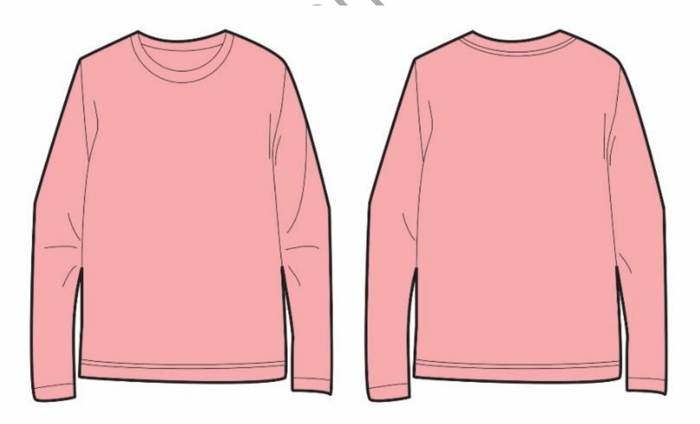


Fig.: 1.2 – Basic Neckline

ii. Deepened neckline: When a certain depth is added to neckline below the hollow of neck in front or nape of neck at back, such neckline is called deepened neckline. However, width is not added to the neckline. Depth of neckline can be same or different for front and back depending on the requirement. Examples of deepened neckline are different shapes like U-shaped, V-shaped, glass-shaped neckline which only has depth but no width is added.

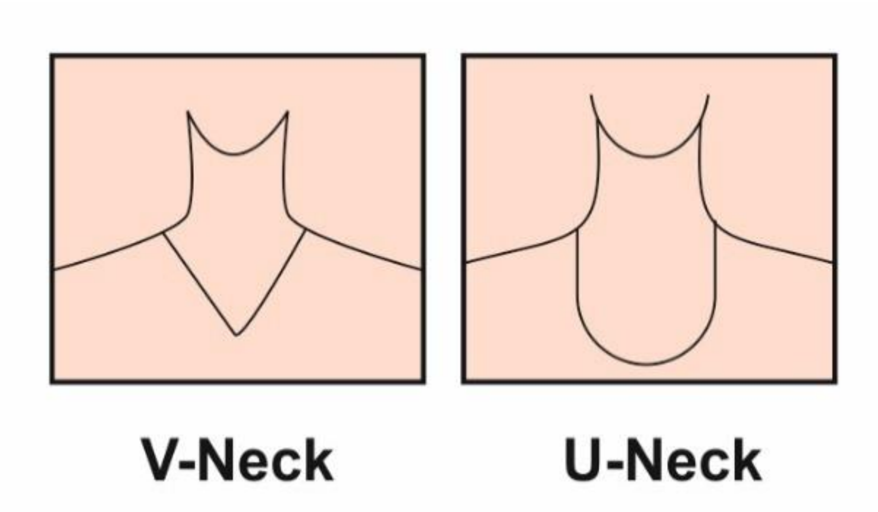


Fig.: 1.3 – Deepened neckline

iii. Wide neckline: A wide neckline, on the other hand, has only width added but the depth remains unaltered. It runs horizontally across the collar bones and ends close to the lowest shoulder point. Example of wide neckline is bateau or boat neckline.

Fig.: 1.4 – Wide neckline

iv. Scooped neckline: This type of neckline is a combination of deepened and wide neckline such that it drops below the natural body neckline and is also widened at shoulder line from the highest shoulder point. These are also referred to as wide/deep and open necklines. Neckline can be scooped both in front and back of garment and the shapes can vary as per the garment design, current fashion and personal choice. V-shaped neckline, round neckline, Square neckline, etc. are all examples which can be scooped.

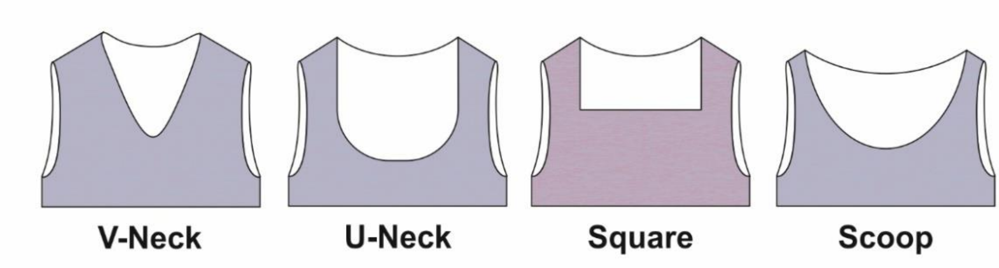


Fig.: 1.5 – Wide neckline

v. Raised neckline/built up necklines: Raised necklines are built along the bodice such that these extend above from the base of neck and encircle the neck.These should fit properly along the shoulder line and around the neck and stay in place. Example of raised or built-up neckline is stovepipe neckline.

Fig.: 1.6 – Raised neckline

Neckline Sample Development:

All the neck lines of the garments should be cut according to the shape and finished through binding, facing or piping.

Constructing a Neckline:

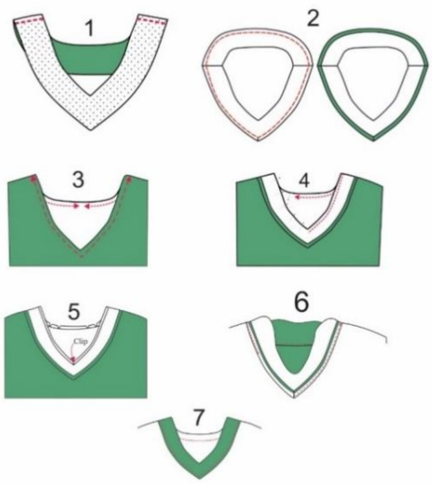


Fig.: 1.7 – Constructing a Neckline

Steps:

1. Take a piece of cotton fabric.
2. Place adult basic block (front and back) on the fabric and cut the same with seam allowances. (Students have already learnt to make basic blocks in class 11th).
3. Mark and Trace the basic neckline (front and Back) from the basic adult block for facing.
4. Cut the facing of front and back neckline of 2“widthalong the traced neckline.
5. Apply fusible interfacing to the facing pieces. Place fusible interfacing at the backside or on the shaped facing, cut and stick it using hot iron.
6. Sew the front and back facing together at the shoulder seams.
7. Finish the raw outer edges of the facing. Join the front and back bodice shoulder
8. Attach the facing to the bodice using the seam allowances marked on the neckline.
9. Add notches and turn the facing to the wrong side
10. Press seam allowances toward facing and under stitch the seam allowances, about 1/8″ away from the original stitching line.
11. Iron the facing well and hem the facing to finish the neckline.

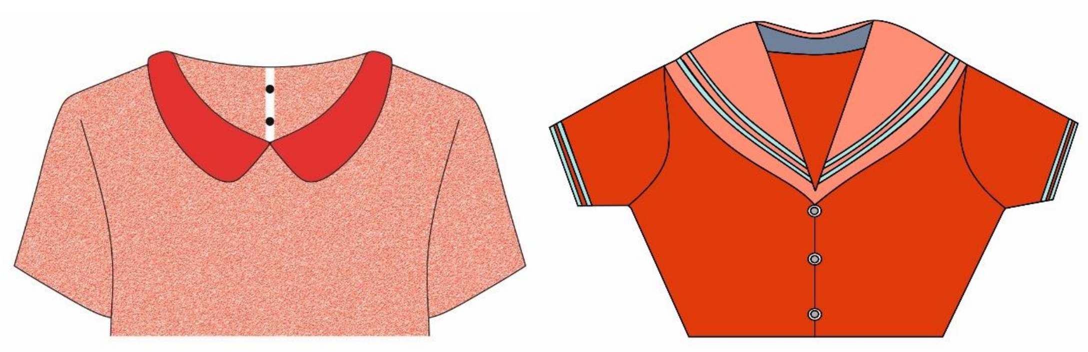
2. Collars

Collars are applied around the neckline and frame the face of the wearer. These are generally decorative but can also be functional when protecting the neck from direct sunlight or providing warmth in winters. These may be applied as a single layer (fancy lace collars) or double layered. Collar edge i.e., the outer edge of collar can be developed in variety of styles like round, curved, scalloped or pointed as per the design requirement.

Depending on the method of development of collar drafts and their method of application, collars can be classified as add-on collars and grown-on collars.

Add-on collars: These collars are developed as separate pieces based on the measurements of front and back of neckline. These can further be categorized as flat collars, stand collars and rolled collars.

- Flat collars: These collars lie flat or nearly flat around the neckline of the garment. Such collars are commonly found in women’s and children’s garments. Peter pan collar and sailor’s collar are the examples of flat collars.



(a) (b)

Fig.: 1.8 (a & b) – Peter-pan collar & Sailor's collar

- Stand collars: These are also known as band collars, extending up from the neckline edge around the neck. The front edge of the collar may be rounded, square or angled. These edges may meet in front or overlap as an extension for buttoning. In order to maintain the shape and structure of the stand collar, a layer of interlining is added in-between the two layers of collar. An example of stand collar is mandarin collar also known as Chinese neck band.

Fig.: 1.9 – Mandarin collar variations

- Rolled collars: These collars stand up next to the neck for a certain width forming a collar stand and then fall back or fold over the roll line, forming the collar fall. Rolled collars can further be categorized as partially rolled and fully rolled collars. Partially rolled collar rolls at the back but lie flat in the front, such as the bushirt collar. Whereas, a fully rolled collar rolls all the way around the neck, such as a turtle neck collar.

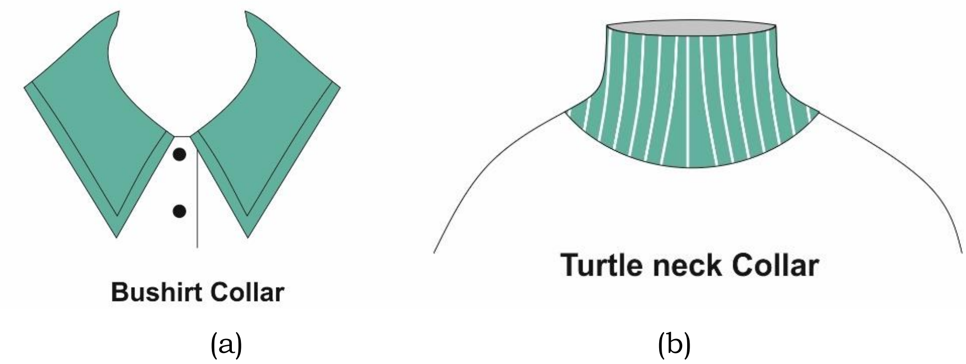


Fig.: 1.10 (a & b) – Rolled collars

Grown-on collars: These collars are not attached as separate pieces, but developed in one with the garment. The neckline curve of the bodice is modified and extended to get the desired shape of collar. A grown-on collar, such as a shawl collar, is finished with a shaped facing cut in the same size and shape as the collar extension.

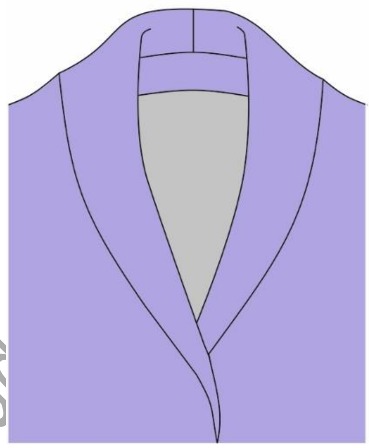


Fig.: 1.11 – Shawl collar

3. Sleeve

A sleeve is a garment component covering the arms of the wearer and it is attached at or close to the armhole in a garment. These fulfil the function of providing modesty, warmth and protection. Besides, sleeves can also be decorative as they can be made in variety of design variations. These can be of different lengths such as short, elbow length, three-quarter length, wrist length etc.

Sleeves can be classified as set-in sleeves and sleeve bodice combinations.

Set-in sleeves: Set-in sleeves are most commonly seen in garments and can come in a variety of styles i.e., closely fitted, flared, or with additional fullness. These sleeves are attached at the armhole level as a tube-like structure hanging down to cover the arms. Examples of set-in sleeve are plain sleeve, puff sleeve, leg-o-mutton sleeve, lantern sleeve, bishop, petal sleeve, shirt sleeve, etc.

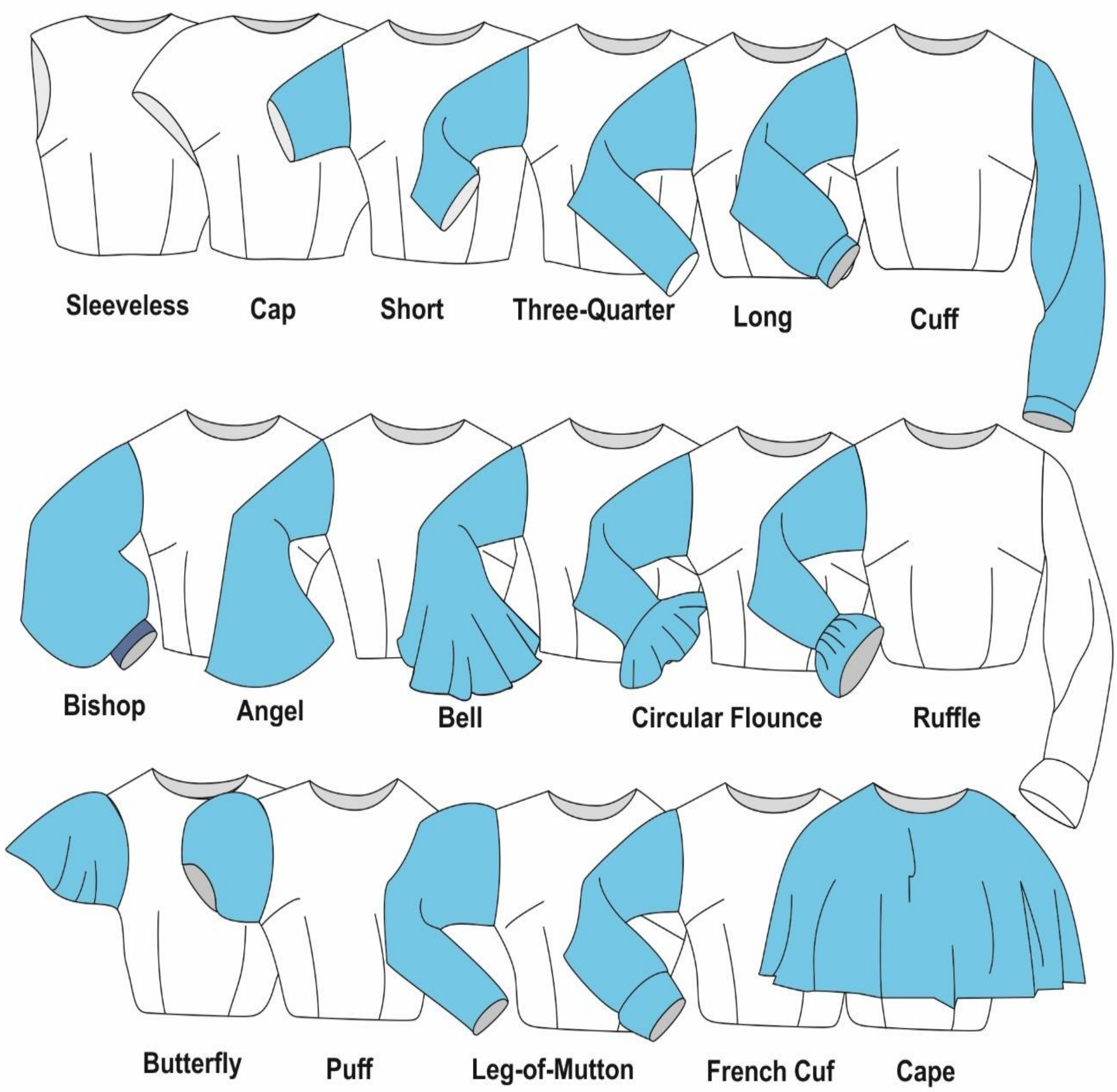


Fig.: 1.12 – Types of set-in sleeves

Sleeve bodice combinations: Sleeve bodice combinations are the types in which the bodice block is partially or fully combined with the sleeve block to develop design variations. Examples of such sleeves are kimono, raglan, saddler, dolman, etc.

- Kimono sleeve: This type of sleeve is combined fully with the bodice and cut as one. Hence, there is no armhole seam visible in the garment having kimono sleeve. In order to reinforce the underarm seam, a gusset is added where the side seam and underarm seam join. This helps to withstand the stress and makes it comfortable to wear.

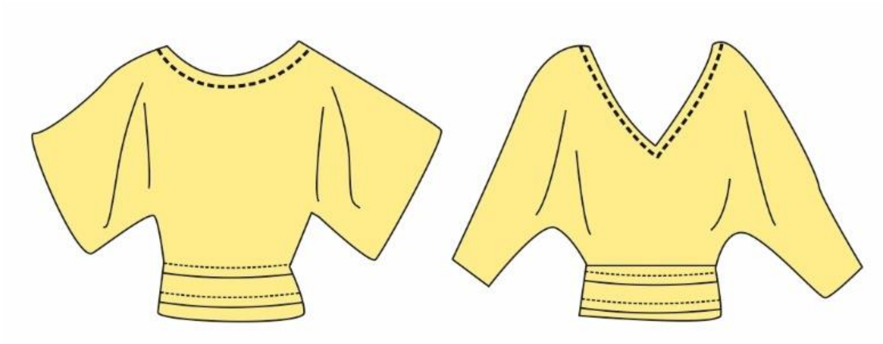


Fig.: 1.13 – Kimono Sleeve

- Raglan sleeve: It is a sleeve variation where portion of armhole and shoulder area from bodice is cut producing a characteristic diagonal line running from the underarm to the neckline of the garment. This cut portion is then combined with the sleeve block to develop a raglan sleeve. This sleeve provides roominess and comfort making it ideal for sportswear, clothing for elderly and people who are bound to wheelchair.

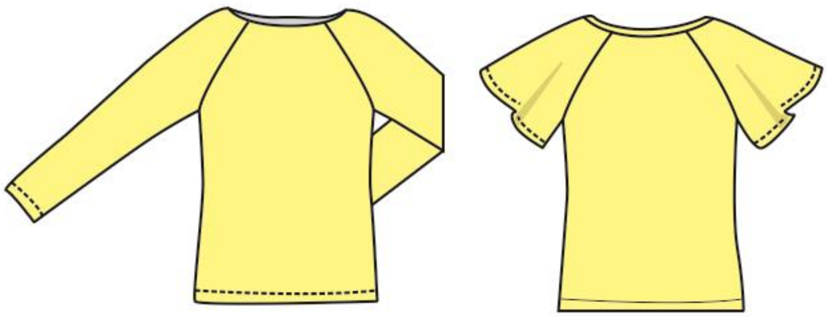


Fig.: 1.14 – Raglan Sleeve

- Saddler sleeve: In this type of sleeve, a small horizontal piece of yoke is cut from the shoulder area of the bodice and combined to the sleeve block.

Fig.: 1.15 – Saddler Sleeve

- Dolman sleeve: It is a sleeve variation where armhole is cut deeply and widely into the bodice to create an exaggerated armhole. This cut portion is combined with the sleeve top to develop a dolman sleeve. At times, armhole can be cut so low that there is no underarm seam in the garment.

Fig.: 1.16 – Dolman Sleeve

4. Cuffs

Cuff are closely fitted bands of fabric attached to the lower raw edge of the sleeve or pant leg as a finishing or to add decorative element to the garment design. These may lengthen the sleeve or pant length and can be of various widths and shapes. Cuffs are generally double-layered and its outer edge can be curved or have flat sharp corners. These also help in controlling the fullness in the sleeve or the pant which is either pleated or gathered at the lower edge before attachment of the cuff.

Based on the style of the cuff, it can be classified as extended cuff and turned back cuff. **Extended cuff** adds to the length of the sleeve. Whereas, **turned back cuff** is attached purely as a decorative feature.

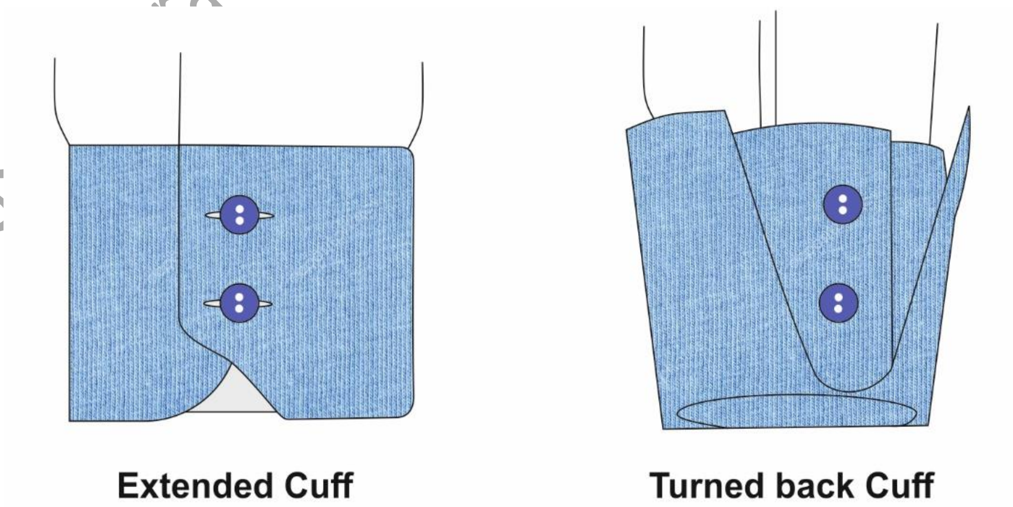


Fig.: 1.17– Cuffs

According to another classification based on method of construction, cuffs can be classified as one-piece cuff construction and two-piece cuff construction.

One-piece cuff construction: In this type of construction, one large piece of fabric is folded in half for the double-layered cuff, which is distinguished by a fold at the lower edge. These cuffs are easier to sew and are less bulky because there is no seam at the bottom border but requires a larger fabric piece.

Two-piece cuff construction: In this type of construction, two smaller pieces of fabric are stitched together showing enclosed seam at the lower edge. Such cuff requires additional labour, is slightly bulkier due to presence of seam at the lower edge but ensures better fabric utilization.

Cuffs can also be classified as open-band cuffs and closed-band cuffs based on whether it has a placket opening or not.

Open-band cuffs: These cuffs have placket opening which helps in easy wearing and taking-off of the garment over the hand or foot and when fastened, it gives a close-fit to the cuff. Different types of fasteners can be used as closures such as buttons/buttonhole, zipper, hook and eye, tie etc. Examples of open-band cuffs are barrel or shirt cuff and French cuff.

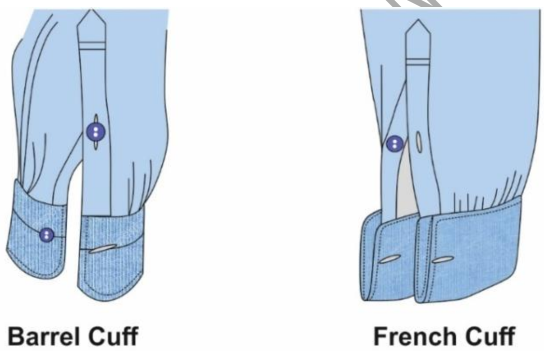


Fig.: 1.18 – Open-band Cuffs

Closed-band cuffs: These cuffs are generally constructed using stretchable material such as knits which does not require any opening for wearing. The fabric is stretchable enough for easy sliding through hand or foot while wearing. In case the cuff is made from woven material without any stretch, itshould be large enough to be pulled and does not fit very closely.

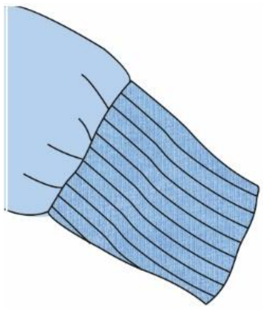


Fig.: 1.19 – Closed band Cuf

5. Pockets

Pockets are small pouches visible on the right side of the garment or hanging towards the wrong side which are partially or fully concealed from the right side. The main function of pocket is to carry small items like keys, mobile phone, wallet, handkerchief, small tools etc. and to keep the hands warm during cold weather conditions. However, pockets can also be decorative specially when applied in different design variations on top of the garment.

It is important to make sure that pockets are placed at convenient location in a garment so that the wearer can use them comfortably. If the design of the garment is symmetrical with pockets positioned on both right and left side, these should be identical and at same level. The size of the pocket should be large enough to accommodate the hands or the items it is intended to hold. The design and placement of pocket should complement the overall garment design and look good on the wearer.

Pockets can be mainly classified as applied/patch pockets, in-seam pockets and slashed pockets.

Applied/patch pockets: These pockets are made up of fabric patches that are sewn onto the right side of the garment and so visible when worn. Gathers, pleats, tucks, flaps, and other design features can be added to applied pockets in a range of shapes and sizes. These pockets are generally seen in men's shirt, back of jeans, in cargo pants and shorts, as kangaroo pocket in sweatshirts, in children's wear and women's kurtas and blouses.

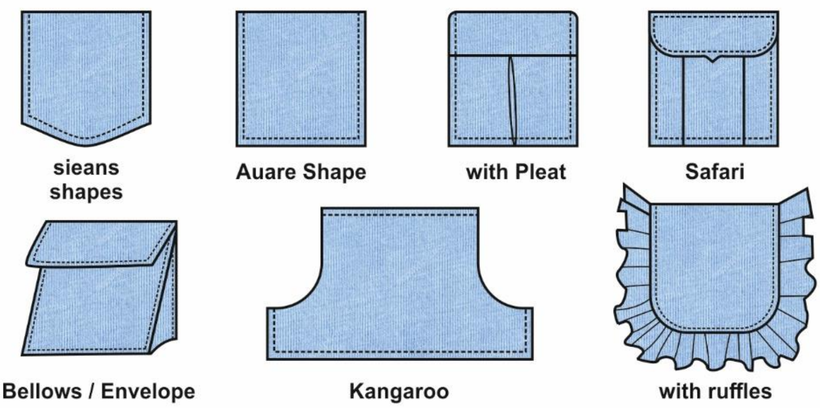


Fig.: 1.20 – Types of Pockets

In-seam pockets: As the name suggests, these pockets are stitched into a seam, mostly side seams of dresses, kurtas, pants, skirts and coats. In-seam pockets can be further categorized as concealed in-seam pockets and exposed in-seam pockets.

- Concealed in-seam pocket: These types of pockets are completely hidden inside the garment. Such pockets are commonly seen in kurtas and dresses. Only when the hand is slipped into the pocket, one can see the pocket, otherwise only a portion of the pocket bag is visible from outside.

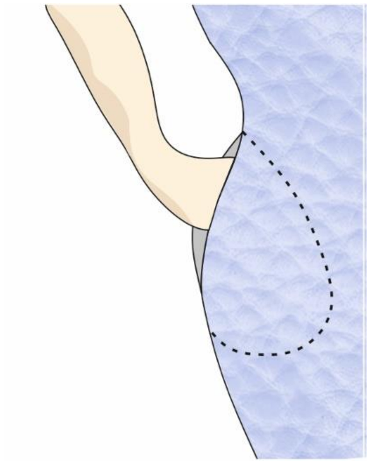


Fig.: 1.21 – Inseam Pocket

- Exposed in-seam pocket: These types of pockets are usually set into the side seam and waistline of pants and skirts and are partially visible from the right side of the garment. The opening of the pocket is cut away from the side seam in a diagonal or curved manner, exposing part of the pocket bag hanging inside the garment. Examples of exposed in-seam pockets include jeans, men's or women's pants front hip pocket and women's skirt front hip pocket.

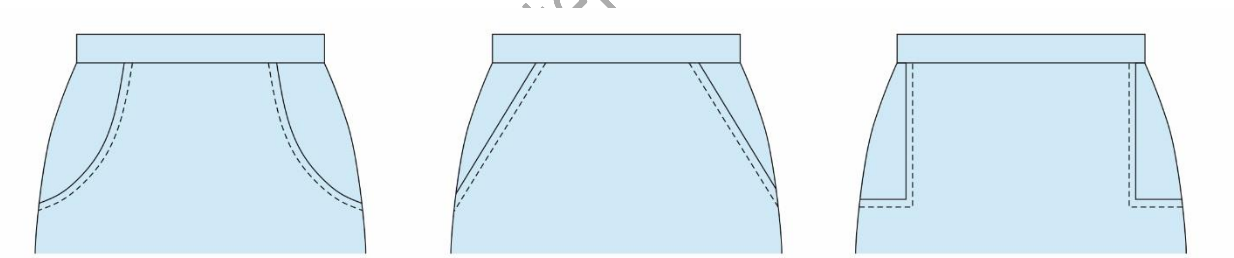


Fig.: 1.22 – Exposed in-seam front hip pockets in women's skirts

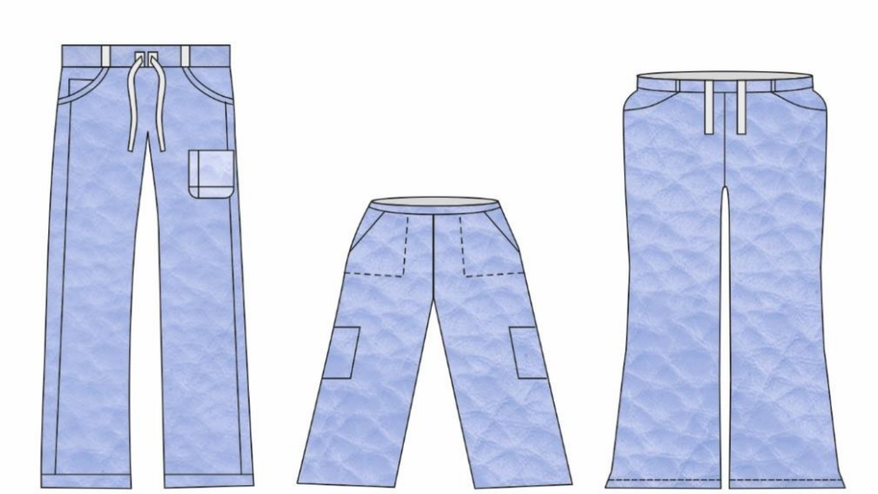


Fig.: 1.23 – Exposed in-seam front hip pockets in trousers

Slashed pockets: In the slashed pockets, only a small slit is visible in the right side of the garment with pocket pouch hanging inside. The slit can be finished as a single or double lip (also called single or double welt) i.e., narrow fabric fold created around the pocket opening while construction. These types of pockets are generally found in men's tailored jackets and coats as well as in the back side of men's formal trousers.

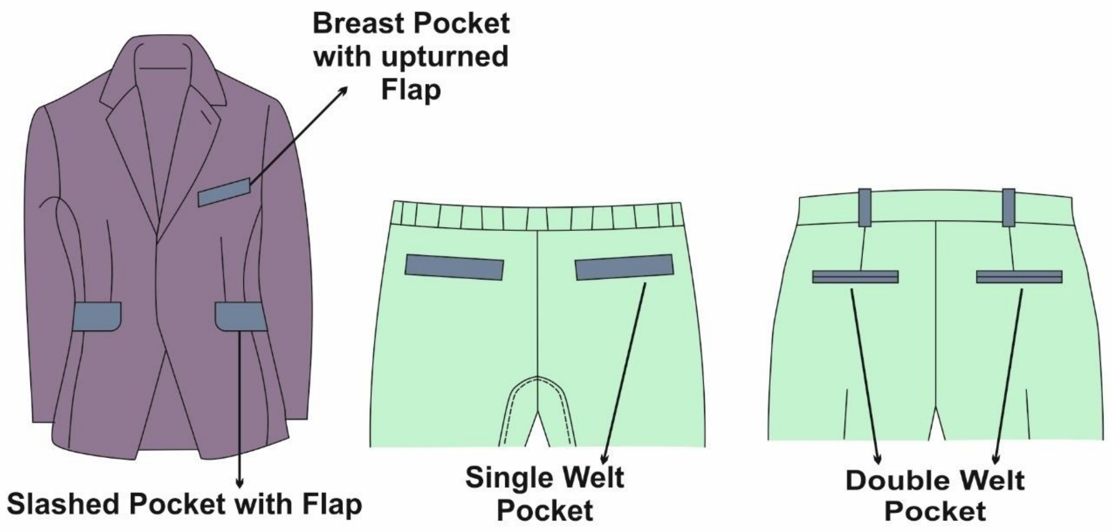


Fig.: 1.24

Flaps are added to the pockets as a decorative feature and these extend down over the pocket to cover its opening. In applied/patch pockets, flaps are stitched above the pocket and can be of different shapes. Flaps are stitched at the edge of the openings in the in-seam pockets. In the case of slashed pockets, the flap is inserted above the single lip or in-between the double lips of the pocket. Slashed pockets may also have an upturned-flap, as seen in breast pocket of tailored jackets. Such a flap extends up from the pocket opening, unlike the regular flap.

6. Plackets

Plackets are finished functional openings in clothing that make it easier to put on and take off the garments. These can be applied to the opening in the seam or can be cut as a slash in the garment. Depending upon the requirement, plackets can be located either at centre front or back, along the shoulder seam or side seam, as a sleeve opening, at crotch level in pants or at the lower end in bifurcated garments like pants, churidars etc.

Length and width of plackets can differ according to the type of garment, its size, and the location of placket in a garment. Plackets can be present along the entire length of garment, as in men's shirt, children's A-line frocks or jackets/blazers etc. However, these are smaller in length when inserted in the side seam or at the bottom of bifurcated garments. Though, plackets are generally functional in nature, they can be decorative when adding a design element to the garment.

Plackets consist of two parts, an overlap and an underlap lying to the left or right side of the garment. Both overlap and underlap are of same width. Overlap is the side which is visible on the top completely covering or overlapping the underlap. On the other hand, underlap is the side which is hidden underneath and is not visible when the placket is closed. In case of buttoned placket, buttonholes are made on the overlap and buttons are attached to the underlap.

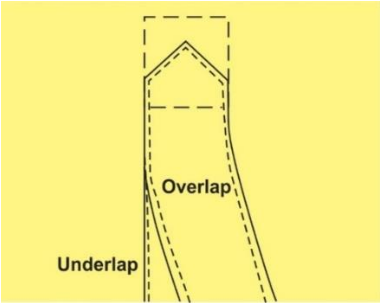


Fig.: 1.25 – Placket

The side of garment forming overlap differs for male and female garments. The overlap in men's and boys' clothes is formed by the left side of the garment. In women's and girls' apparel, however, the right side overlaps the left. Variety of fasteners can be used for closing of the placket openings such as buttons, hooks, snaps, zippers, Velcro etc.

Broadly speaking, plackets can be classified into three types: centralized plackets, asymmetrical plackets and double-breasted plackets.

Centralized plackets: As the name suggests, these plackets lie exactly in the centre of the garment i.e., centre front, centre back or in the side seam when garment is viewed from the side. Examples of centralised plackets are even hem placket, wrap over projection placket, continuous wrap placket, kurta placket, slit openings and zipper plackets.

Fig.: 1.26 – Centralized placket

Even-hem placket: In this placket, the extension for overlap and underlap are equally folded. The centre front or centre back line of the garment lies in the centre of the placket width. Hence, the buttons/buttonholes are placed in the centre of placket width. Even-hem plackets are most commonly seen in shirts, frocks etc.

Wrap over projection placket: As the name suggests, this placket has wrap side as overlap and projection side as under lap. Additional strips of fabric are attached to finish the placket opening with wrap strip completely turned to the wrong side and projection strip extending out from centre front/centre back of the garment.

Therefore, the centre front/centre back of garment lies on the edge of the placket and generally hooks and eyes are used as closures for the placket. It is quite often found in ladies' blouses.

Continuous wrap placket: This placket also has a wrap and a projection but both sides of placket are made using one continuous strip. Such kinds of plackets are generally seen in slit openings at neck or waistline, slits made in sleeves of men's shirt etc. Hooks and eyes are mostly used as fasteners and these are attached at the edge of the placket.

Kurta placket: This placket is made by insertion of a slit in the centre front of kurta or in the men's wear sleeve. Both the underlap and the overlap are made as projections using extra fabric strip. The centre front line of the garment lies in the centre of the placket width.

The length of placket can vary as per the choice of the wearer and it can be decorative when a contrasting colour fabric strip, additional design detail or fancy buttons are attached. Buttons/buttonholes or hooks/eyes are used as closures for the placket.

Slit openings: Sometimes, placket openings in a garment can be made as slit openings finished with facing. Hence, there is no overlap or underlap in this opening and mostly buttons and loops are used as closures. These are easier to make and are generally seen in sleeve cuffs and at necklines.

Zipper placket: These are the placket openings where zipper is used as a closure. Such openings are mostly seen in garments like skirts, pants and jackets.

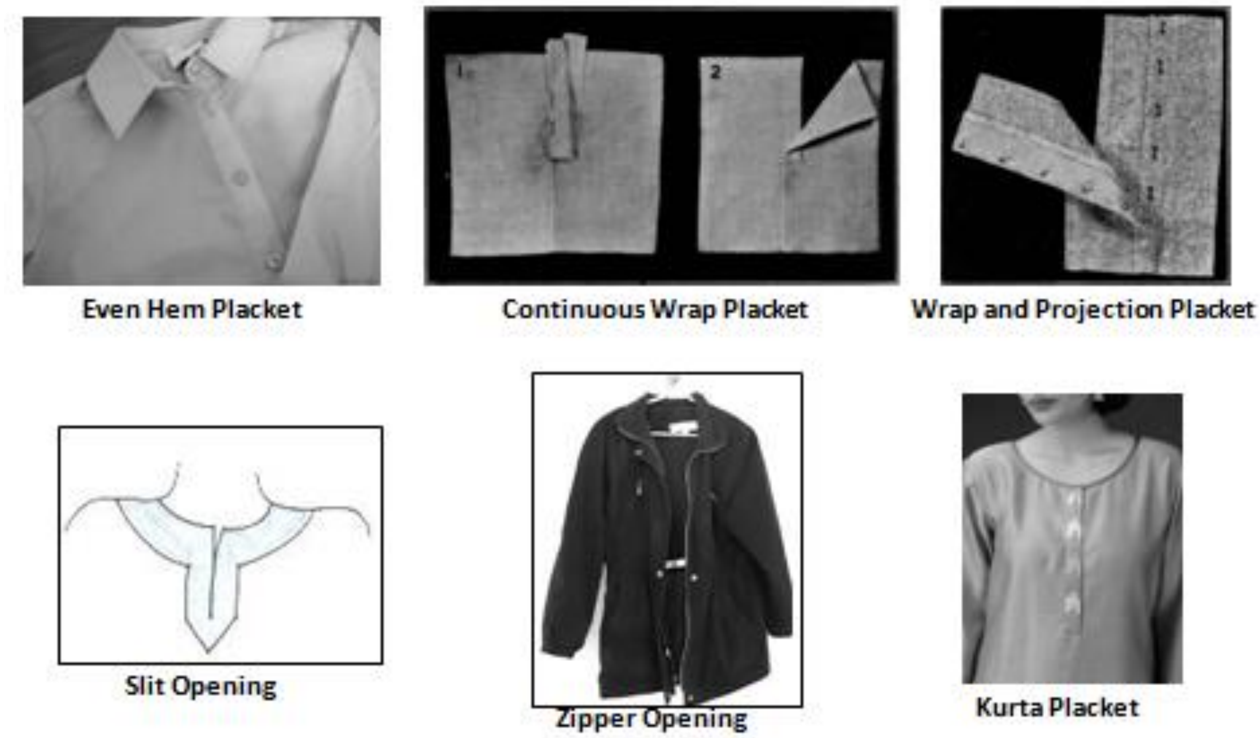


Fig.: 1.37 – Placket

Asymmetrical plackets: These are the plackets which do not lie in the centre of the garment but asymmetrically towards one side. Garments with such placket openings do not have identical right and left side. However, the methods of finishing placket openings can be the same as discussed under centralized plackets.

Fig.: 1.28 – Asymmetrical placket

Double breasted plackets: These plackets are placed symmetrically on the garment but have two rows of buttons lying on either side of the centre front. The placket overlap is wider covering both the rows of buttons.

However, either both rows of buttons are functional or only one row is functional with another row being decorative.

Fig.: 1.29 – Double breasted placket

Garment Manufacturing Processes

The garment industry has three integral phases i.e., design, production and sales. The designer presents the developed collection for the buyers and the manufacturers to view. The selected designs are then sent for production to the garment manufacturing units. Garment manufacturing involves mass-production of garments for ready-to-wear market. Garment styles in various colours and sizes are produced as per the orders placed by the buyers. These garments can range from simple staple garments to high fashion garments. However, the main focus of these production units is to provide good quality garments that meet the expectations of the target customers with respect to performance and price paid.

The mass-production of garments can take place in either in-house manufacturing units or it can be outsourced (contracted) to any other company at domestic or global level. This decision is made based on the available production capacity of the company, lead times and the cost of production.

Garment manufacturing processes include the various functions associated with the actual production of the garments.

1. **Purchase of materials and supplies**

Once the order has been placed, the manufacturing units need to buy the materials and supplies required for the production of the garments. The person responsible for this task should be well aware about the fabric properties, their availability and price. The amount of yardage of fabric required for production is calculated based on the sales history and expected future sales. Depending on the volume of purchase, orders are placed well in advance to ensure on-time delivery. At this time, additional fabric requirement for possible reorders also needs to be considered. Another important aspect is to look for fabrics which are environmentally safe like those made from organically grown fibres, dyed using vegetable colours and finished with safe substances.

Other supplies such as trims (laces, ribbons, braids, applique etc.) and notions (threads, elastic, interfacings, labels etc.) are also purchased as per the requirement. It is important that trims and notions are the best matches for the garment and should have same care properties as that of the garment fabric.

It is essential to carry out the testing of the fabrics, trims and notions with respect to the buyer's specifications before placing bulk orders. Fabrics are tested for colour matching, colour-fastness, shrinkage, tensile strength, durability and other care properties. Results of the lab tests should confirm compliance with the specified fabric performance standards. Similarly, trims and notions are also tested and approved for colour matching, care performance and overall appearance.

When the ordered fabrics and trims/notions are despatched to the manufacturing unit, these are inspected, marked for the defects and sorted out accordingly. Special equipment is used to automatically measure and inspect the yardage of fabric. Any kind of defects such as oil stains, holes or cuts, weave defects, colour variations etc. are marked so that these can be avoided in cutting. As a result, materials and supplies with acceptable quality standards are only issued for the cutting and sewing of the garment.

2. Making production pattern

The production pattern maker uses the standardized basic blocks to develop the final patterns which will be used for mass-production. The Pattern-maker applies his/her knowledge and skills to produce an efficient production pattern by eliminating any unnecessary detailing without destroying the design essence. The production engineers are consulted for optimum fabric utilization and easy garment assembling techniques. Size specifications must be strictly followed to ensure perfect fit. The final production pattern should have accurately marked seamlines, grainlines, notches etc. for the marker-maker, cutting and sewing operators to follow.

3. Grading the production pattern to different sizes

Grading is a process of systematically increasing or decreasing the dimensions of the production pattern to make up the complete size range. For example, a medium size pattern must be increased to large and extra-large sizes and decreased to make small and extra small sizes. The process is carried out based on the company's pre-determined grade specifications or rules. Grading can be done manually which requires a skilled pattern grader or it can be done using computer software. CAD/CAM systems, automatically apply the grade rules at all the points in a pattern at a click of a button. This ensures very accurate and reliable results.

4. Marker making

Marker making is a process of laying out pattern pieces for varying sizes close to each other on the paper to achieve maximum fabric utilization. The width of the paper used is same as the fabric width. While planning a layout, large pattern pieces are usually placed first. Smaller pieces are accommodated in the spacing left in-between. The pattern pieces can be moved around to achieve a tight marker avoiding excessive wastage of fabric. However, the general guidelines should be followed and the nature of fabric should be considered while planning marker. Now-a-days, marker is generally prepared using computer software which is a faster and more accurate method of ensuring maximum fabric efficiency.

5. Spreading

Spreading is a process of rolling out a number of fabric layers, one on top of another, on a long table. The numbers of layers are decided based on the orders placed, and these could range from 50-100 layers or at times even more. The spreading of fabric can be done manually by human spreaders who pull the fabric from the roll to spread it on the table aligning the edges, and smoothing any folds. While spreading, he/she also looks for marked defects in the fabric and the full width is removed if fabric has large flaws. However, nowadays, automatic spreading machines are used to carry out the process, which makes it faster and more efficient.

6. Cutting

After the spreading process, marker is laid over the top layer of spread and it is used as a guide for cutting through the layers. The manual cutters are required to carry out their job with utmost skill and accuracy ensuring that each pattern piece is cut in right dimensions. Generally, a straight knife with vertically vibrating blade is used to cut through layers of fabric having a depth of upturning inches. Round knives with rotating circular blades are used for cutting fewer layers. The cutting operator guides the cutting knife along the outline of the pattern pieces. On the other hand, the band knife used for cutting smaller pattern pieces is fixed on the cutting table and fabric is moved past it for cutting.

Computerised automated cutting is comparatively faster and more accurate, operating at a speed of up to 800 inches per minute. The movement of the cutting beam is directed by the information stored in the CAD system. Other options such as laser-beam cutting and water-jet cutting are also available, but these have restricted application.

7. Bundling

The cut pattern pieces are numbered for accurate assembly while sewing. These pieces are then separated into smaller bundles having 10-12 pieces each. Garment parts and required trims are grouped together and tied in the form of bundles. Bar-coded identification tickets are attached along with each bundle. These tickets help in keeping a track of work in progress and the efficiency of the sewing operators. The bundles are then issued to the sewing operators for assembly of the garment.

8. Garment assembly (sewing)

Garment assembly includes various sewing operations for assembling cut parts step by step until the garment is completed. Manufacturing firms can adopt different production systems for assembling garments. These include whole garment system, progressive bundle system, the unit production system, modular production system, flexible manufacturing system etc. Also, a variety of industrial sewing machines are used for assembly as per the requirements like lockstitch machines, chainstitch machines, over lock machines, blind stitch hemming machines, button sewing and buttonholing machines etc. Certain programmable automated sewing machines are also used in large manufacturing units for specific operations which require careful handling.

Apart from actual sewing, operations such as in-process pressing and inspection are also part of sewing. In-process pressing, includes all pressing operations performed during the construction of the garment. In-process inspection in sewing involves the inspection of work from each operator against the established quality standards at various inspection points during the assembling of garments. At the end of the assembly line, garments are again checked for measurements and workmanship.

9. Wet processing

Wet processing is one of the important stages in apparel manufacturing. The assembled garments are either washed or treated with certain chemicals/dyes to add final finish. This process is carried out using industrial washing machines, hydro-extractors and dryers which can accommodate a large number of garments per cycle. The most common type of wet processing is garment washing or rinsing which helps in removal of dirt and stains acquired during garment assembly, softens the garment fabric and pre-shrinks it, making it appealing to the customers.

Other wet processes include colour removal from garments either by bleaching or by other treatments like stone washing, sand washing or acid washing which slightly abrades the fabric de-starches it and removes colour in certain parts of the garment. Besides, garments can also be dyed or over dyed at this stage as per demand. Garments can also be treated with wrinkle-resistant formulas so that they maintain pressed appearance while being washed and worn. The manufacturers should ensure that the processes are carried out as per the buyer's specifications and the chemicals used do not harm the garment and its fabric.

10. Finishing

Once the garments are received after wet processing, any kind of details such as buttons, labels, snaps etc. are attached to them. Each garment is then inspected for any loose hanging threads, stains and sewing defects. Loose threads are trimmed, stains are removed and defective garments are sent for repair.

The next step in finishing is ironing/pressing the garments to remove unwanted folds and wrinkles. Pressing helps the seams to lie flat and give a neat appearance to the garment. Pressing done in-between the construction processes in the sewing section is known as under-pressing whereas, pressing done at the finishing stage is known as top-pressing. Regular pressing equipment used at the industry level includes flat steam irons and general-purpose pressing units. Other special purpose pressing equipment includes scissor type utility press, carousel machines, steam dolly, tunnel finishing etc.

11. Packing

The garments that meet the established quality specification are finally sent for packing. At this stage, any additional accessories like belts, bows, flowers etc. are added. Hang tags and size stickers are attached, garments are then folded or hung on hangers as per the buyer's specifications. These are then either packed individually in plastic bags or several garments together in one large bag called baler bags. The packed garments are finally placed in either cartons (as per size and colour assortment) or on hanging racks and sent for shipping to the buyer.

12. Final quality audit

Just before the shipment of garments, the inspection team performs the final audit to check the product quality. The garments are randomly picked up for inspection to check each and every aspect related to quality such as fabric defects or colour shading, sewing defects, uncut threads, stains, measurements etc. The team has to ensure that the garments are within the specified acceptable quality level. If any product is not found acceptable, all the garments are inspected and the required repairs are done prior to the shipment.

Activities

Activity 1: Visit a garment manufacturing industry and prepare a report/ PPT on the steps of garment manufacturing process

Materials required

1. Computer/Laptop
2. Pen/Pencil
3. Diary
4. Camera

Procedure

1. Visit a garment manufacturing unit.
2. Take a diary and pen and note functions of different departments of garment industry.
3. Using these key points make a PowerPoint presentation about different departments of a garment industry and present in your class.

Activity 2: Prepare a portfolio on different garment components and make samples of any two garment component like patch pocket and round neckline.

Materials required

1. Fabric
2. Measuring tape
3. Scissors
4. A4 sheets
5. Pen/Pencil
6. Eraser
7. Colour
8. Glue

Procedure

1. Draw different garment components given in the session and paste them in A4 sheets. Explain each one of them.
2. Make (Cutting, Stitching and Finishing) any 2 garment components of your choice.
3. Paste them in your practical file.

Check Your Progress

A. Fill in the blanks

1. ____________in a garment has a functional opening for the head to slip through during wearing and taking off a garment.
2. ______________collars are developed as separate pieces based on the measurements of front and back of neckline
3. There is no armhole seam visible in the garment having __________.

4. ____________adds to the length of the sleeve. Whereas, __________is attached purely as a decorative feature.

B. Questions

1. What are the different aspects on which garments or apparel products can be classified in several different ways? Write about each one of them.
2. What is neckline? Explain different types of neckline used in a garment.
3. Write different types of collars?
4. What is the role of pocket in any garment? What are the different types of pockets?

Session 2: Estimating the Fabric and Material Requirements for Garment Construction and Preparing Cost Sheet

Planning for production

The estimation of fabrics, materials and supplies is based on the order placed by the buyer. Based on the specifications shared by the buyer, production patterns are developed, these are graded into different sizes and marker layout is planned for economical usage of fabric. This helps in estimating the fabric requirement and accordingly orders can be placed with the textile mills.

1. Production schedule

A complete schedule for production is finalised to ensure timely delivery of the order. The production manager works backward from the date of shipment to create a reverse timetable which may vary from 2-4 months depending on the size of order. Dates are fixed for completion of stitching, cutting of pattern pieces, fabric and trims delivery etc. keeping in mind the capacity of the production unit.

2. Production capacity

Production capacity of a factory refers to the quantity of garments that can be produced in a certain period of time. This will depend on the size of the unit, type of equipment and technology employed in the factory, production processes involved, complexity of the style to be produced, skill of the operators and the initial planning.

The industrial engineers break each task into number of operations and study the time required to perform each operation using best handling techniques. This gives the 'Standard Allowed Minutes' (SAM) for each operation. SAM values for various tasks are summed up to calculate 'standard allowed hours' required making complete garment. These values help to estimate the number of garments which can be produced per hour or per day. For example, if 50 sewing operators can stitch 100 shirts in one hour, they will be able to make 800 shirts per day.

3. Specify quality standards

In order to ensure a quality end product, certain standards need to be established and followed while production. Specifications or specs are defined to meet the company's standards. These are the brief written guidelines and diagrams describing the quality check points at different stages of production as well as the finished item. Specification sheets are either sent by the buyer or developed in-house to maintain the overall quality level.

A number of specs are prepared specific to a particular garment style and include fabric and trim specifications, garment assembly specifications which include stitch and seam type, number of stitches per inch, thread size, placement of buttons, pockets and other details related to garment construction. Size and fit specification describes the key points for measuring, measuring procedure and calculation of correct dimensions for complete size range. Besides, other specifications related to wet-processing, finishing and packing are also provided.

4. Inventory control

It is essential to have complete control over the work in progress which can be tracked efficiently using computerised inventory. The cut pieces of a particular style are bundled and universal product codes are attached. These codes help in the identification of the pieces of different styles, colours, sizes and fabric sat various stages of production. This data is used by the production manager to ensure that processes are being carried out as per the planned time schedule.

5. Cutting plan

Based on the orders received for each style the cutting plan is finalised. There are two ways in which it can be planned i.e., cut to order and cut to stock. Cut to order is considered the safest method as it is based on actual order size. However, retailers generally order small quantities initially and then re-order according to the response received from the customers. Hence, production team needs to be prepared to quickly respond to cut, sew and deliver on time. It requires latest production technologies, effective communication and cooperation among different levels of production.

On the other hand, cut to stock method involves greater risk as cutting is planned according to the expected sales. These projections are based on the sales records of similar styles in the past and the prevailing economic conditions. In such cases, if the stock of garments is available, these can be quickly sent for shipment as and when required. This method is more applicable for staple styles with moderate pricing which are more in demand.

Estimating the production cost per garment

It is essential to determine the production cost of a garment based on which the wholesale price paid by the retailer for the product is decided. Costing at design development stage is known as pre-costing, which provides the best guess of estimated cost of the garment. However, at the production stage, an exact calculation of the cost per garment has to be done. The detailed cost analysis includes expenses to be incurred on fabric, trims, labour, overhead charges, sales commission and profit margin.

The costing department carefully studies the designer's worksheet or detailed sketch of the garment, actual garment sample, production pattern and the written specifications sent by the buyer to analyse the materials used and the construction methods. The designers can be consulted for additional information and recommendations on more practical and less expensive alternatives. With rapidly advancing technology, frequently changing styles and stiff competition, costing process has become quite complex. Hence, it is important that each aspect is carefully reviewed to ensure accurate prediction.

A cost sheet is prepared as a ready reference for the final cost of a garment. It includes a sketch of the garment, its brief description with respect to style and construction methods, style name, and a style number which is unique for each garment and used for tracking work in progress. Selling season, size range, colours etc. may also be mentioned on the cost sheet along with the main elements of costing as fabric, trims, labour, overhead charges and other expenses.

1. Fabric cost

Fabric is a major contributor in garment cost accounting for 60-70% of the total cost. Based on the fabric specifications and the production pattern, the costing engineer calculates the amount of fabric required for a style including the anticipated wastage. The amount of fabric required to produce one garment (in metres) multiplied by the fabric cost per metre gives the total fabric cost. Delivery charges, inspection and testing costs, and any import duty if applicable are also added to the total cost. However, for high volume production, cost is comparatively reduced due to better marker efficiency.

2. Trims and notions

Trims and notions include all the additional materials required for garment production other than fabric. The cost of these items per piece for sewing thread, buttons, zippers, labels etc. or per metre for ribbons, laces, elastic etc. multiplied by the amount of materials required for each garment. All these individual costs are then added to get total cost for trims and notions.

3. Labour cost

Labour cost includes the cost incurred on various processes of garment manufacturing which require involvement of labour. These processes involve designing, pattern making, grading, marker making, spreading, cutting, stitching, wet-processing, finishing and packing. The industrial engineers break down each task into a number of operations required for each new style of garment. These operations are then analysed with respect to the motions used by the operator as well as the time taken to perform a particular operation using time and motion study. The estimated average time required to perform the various tasks will help in calculating the overall labour cost for the garment. If any of the garment manufacturing processes are out-sourced, then the contractor adds his or her profit amount.

4. Overhead charges

Overhead charges include the daily costs of running the business besides the direct cost of producing garments. These components include investment in new equipment and technology, rent, lighting and air-conditioning, utilities, trash collection, salaries of staff at supervisory and managerial levels, insurance and pensions etc. In addition, expenses related to advertising, promotion, equipment repair, sales commission paid to sales representatives, shipping, warehousing etc. also contribute to overhead charges.

5. Other costs

There are some additional costs associated with garment production besides fabric and trim cost, labour cost and overhead cost. These include expenses incurred on chemicals used in wet processing such as bleaching agents, detergents, softeners, neutralizers etc. Materials purchased for packing like hangers, plastic bags, hang-tags, cartons etc. also add to the cost. Specialised operations such as embroidery, pleating, quilting etc. which are contracted further increase the garment cost.

Preparatory steps for garment construction

Before the patterns are laid on to the fabric for cutting, there are few essential steps that need to be taken care off to ensure perfect fit and fall in a garment. It is important that warp and weft yarns of the fabric are well aligned, edges are cut on a straight grain and the fabric is tested for shrinkage so that the garment maintains its dimensions during wash and wear. Hence, three preparatory steps i.e., preshrinking, straightening and trueing/ blocking are carried out before the fabric is cut for garment construction.

1. Preshrinking

Shrinkage is a condition where a fabric or garment becomes smaller in size after washing. This generally occurs after first washing and is known as relaxation shrinkage. Moreover, some fabrics may show additional shrinkage in subsequent washings also, and this is known as residual shrinkage. A lot of stretch and strain is applied to yarns and fabrics during processing, resulting in fiber elongation. Therefore, when fabrics or garments are washed for the first time, the elongated fibres relax back to its original dimensions leading to a certain percentage of shrinkage.

At the industry level, fabrics are tested to calculate the percentage of relaxation shrinkage as well as residual or progressive shrinkage if any during successive washings. Accordingly, fabrics are either pre-shrunk prior to cutting or pattern sizes are altered to accommodate the percentage of shrinkage. The stitched garments made using the altered patterns are then washed to remove dust and stains which also takes care of shrinkage.

If the fabric shows more than 1% shrinkage, then it should be pre-shrunk before garment construction. The fabrics labelled as 'sanforised' do not require pre-shrinking as these fabrics have undergone mechanical anti-shrinkage finishing process.

For preshrinking washable fabrics:

- Fold the fabric lengthwise with wrong side out and tack the selvedge ends together.
- Soak the fabrics in water for half an hour.
- Drain out excess water by squeezing out.
- Lay down for drying on a flat surface and straighten the warp and weft yarns.
- After drying, iron along lengthwise or crosswise grain to remove wrinkles and creases.
- Avoid moving the iron diagonally as this may cause the fabric to stretch.

For preshrinking non-washable fabrics, dry cleaning method can be adopted. For woolen fabrics, London method of pre-shrinking can be used. The fabrics are folded in wet sheet for six hours so that the possible shrinkage can occur. It is then dried flat and pressed from wrong side.

2. Straightening

The cut edge of the fabric is generally not cut on a straight grain and hence requires straightening. It is important to straighten the edges so that they match perfectly while folding the fabric for pattern layout. Three different methods of straightening of cut edges are explained below.

- **Straightening by drawing a crosswise yarn:** This method is most accurate for soft, loosely woven fabrics, though it is time consuming. Selvedge is clipped close to the cut edge and one crosswise yarn is pulled out throughout the fabric width. Pulling out of yarn creates a crosswise puckered line on which fabric can be cut to straighten the edge.

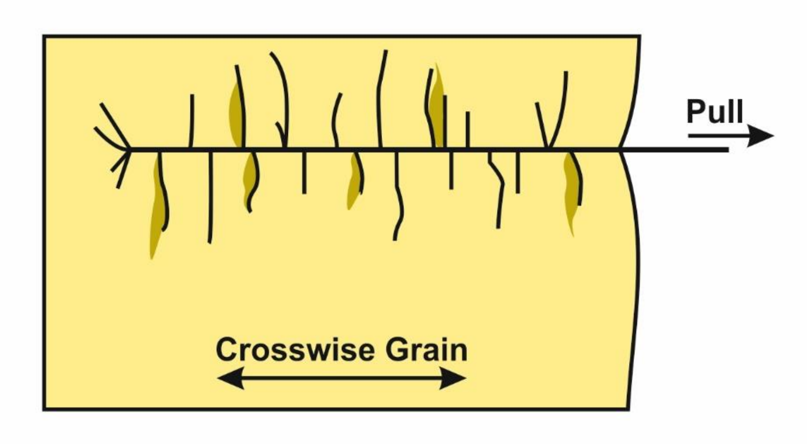


Fig.: 1.30 –Straightening the fabric by pulling the yarn and then cutting along puckered line

- **Straightening by tearing method:** Tearing is another option for straightening the cut edges of firmly woven fabrics. It is a quick method and should be done with utmost care to avoid splitting along lengthwise grain. A small clip is made in the selvedge and fabric is torn across by holding in both hands as shown in Fig. below. This method ensures that the fabric is torn along one yarn making the edge straight.

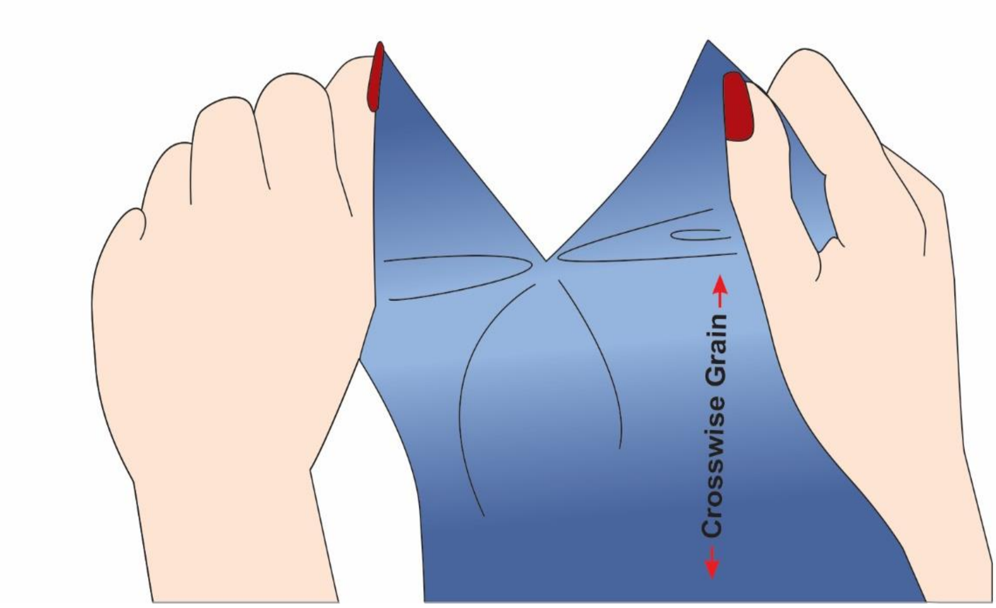


Fig.: 1.31 –Straightening of fabric by tearing method

- **Straightening by cutting on a prominent line:** This method is applied to fabrics which have a prominent pattern in crosswise direction such as stripes, checks or linear pattern created by repetition of print or characteristic crosswise yarn. It is very simple and easy to straighten cut edges in such fabrics as it may be cut on this prominent crosswise line.

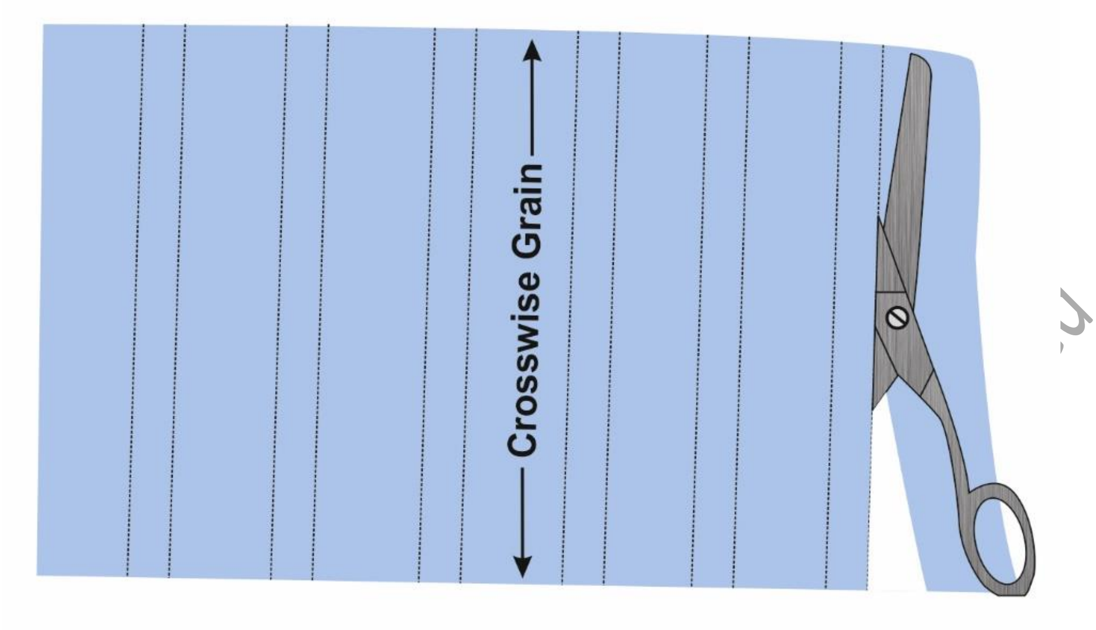


Fig.: 1.32 –Straightening by cutting along a prominent line

3. Blocking or trueing

Due to some defects while fabric manufacturing, crosswise yarns can get distorted. As a result, yarns lie at a slant (skewing) or in a curved manner (bowing) as shown in Fig. below. Such fabrics are known as off-grain fabrics. It is essential to perfect the grain prior to cutting so that the garment hangs straight without any twisting and is comfortable to wear.

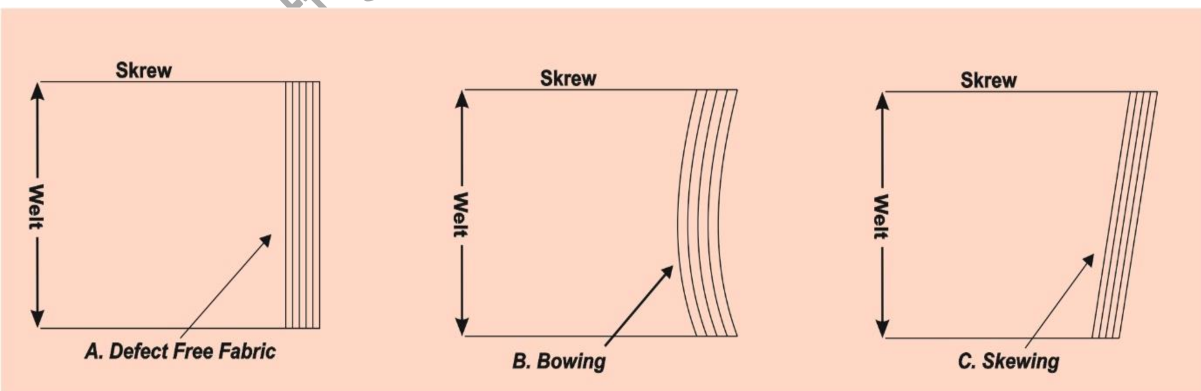
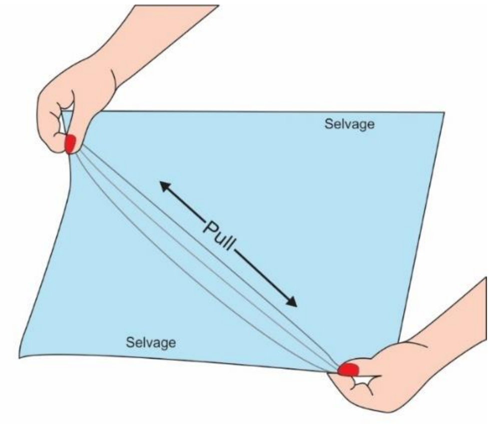
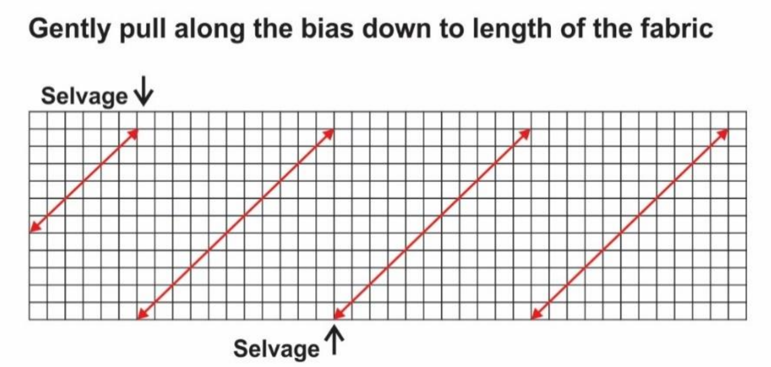


Fig.: 1.33 – Blocking or trueing

Blocking or trueing is a process of aligning the warp and weft yarns in a fabric at a right angle to each other. It can be done by pulling the fabric diagonally along true bias throughout its length. If the fabric is washable, it can be dampened first and then pulled across. Moisture in the fabric will ease the process of aligning the fabric grain.



(a)



(b)

Fig.: 1.34 – Blocking or trueing of fabric

To determine whether the fabric has been blocked accurately, it is laid open on the table with one selvedge side placed along the table edge as shown in Fig. below. If the crosswise edge of the fabric coincides with the table edge, then fabric is 'on grain' and has been blocked perfectly. However, if the edges do not match, then the fabric is 'off grain'.

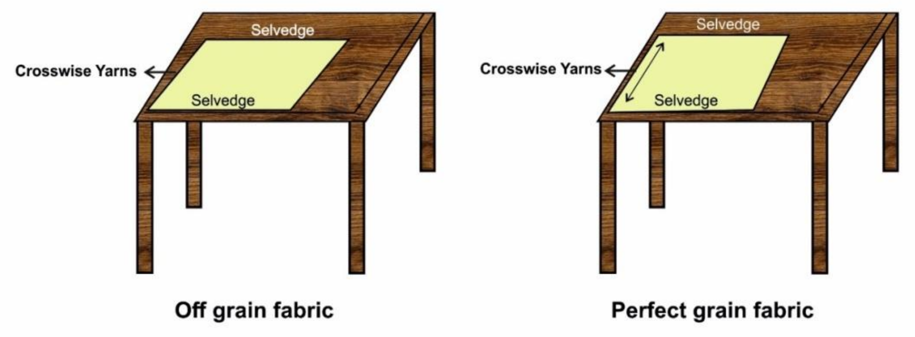


Fig.: 1.35 – Blocking or trueing of fabric

Activities

Activity 1: Visit a garment manufacturing industry and prepare a reporton how the cost is calculated per garment after the production or any industry.

Materials required

1. File sheets
2. Pen/Pencil
3. Diary

Procedure

1. Search on the internet or talk to any garment industry expert about how the cost is calculated per garment.
2. Take a diary and pen and note key points.
3. Using these key points make a report on the same and submit it in your class.

Check Your Progress

A. Multiple Choice questions

1. ____________values for various tasks are summed up to calculate ‘ standard allowed hours’ required making a complete garment.
   i. Standard Allowed Minutes
   ii. Severe Acute Malnutrition
   iii. Synchronous Access Mode
   iv. Service Access Multiplexer

2. ___________are either sent by the buyer or developed in-house to maintain the overall quality level.
   i. Fabric cost
   ii. Specification sheet
   iii. Trims and notions
   iv. Cutting plan

3. There are two ways in which the__________ can be planned i.e., cut to order and cut to stock.
   i. Production plan
   ii. Specification sheet
   iii. Inventory control
   iv. Cutting plan

B. Questions

1. Explain all the key points which should be considered while planning for production.
2. How the cost per garment is calculated. Explain in brief?
3. What are the preparatory steps for garment construction? Explain each one of them.

Session 3: Using Garment Construction Techniques for Garment Preparation

Garment construction techniques and processes

After the fabric is selected and pre-prepared as discussed in the last session, it is cut into the required shapes according to the paper pattern developed for that particular design. The next step is to convert these flat pieces of fabric into three-dimensional garment by joining them together. Various techniques and processes are involved in garment construction such as stitching of darts, pleats, gathers, seams, finishes applied to raw edges etc. to give the final shape and fit of a garment. Seam is the basic structural component and an important shaping device used in garment construction.

Seams

Seams play a very major role in the appearance, durability and comfort of a garment. Selection of different seams and seam techniques depends on type of fabric and design requirement, the location of seam, its end use, garment care and cost constraints. Seams should lie flat and smooth with no pulls and puckers. It should be stitched at a uniform distance from the edge, with matching coloured thread and using the correct stitch length.

A seam is formed when a row of stitching is done on two or more plies of fabric to join them together. This row of stitching is known as seamline. The seamline lies at a certain distance from the cut edge of the fabric. This distance between the cut edge and the seamline is known as seam allowance. The amount of seam allowance can vary according to the position and shape of the seam.

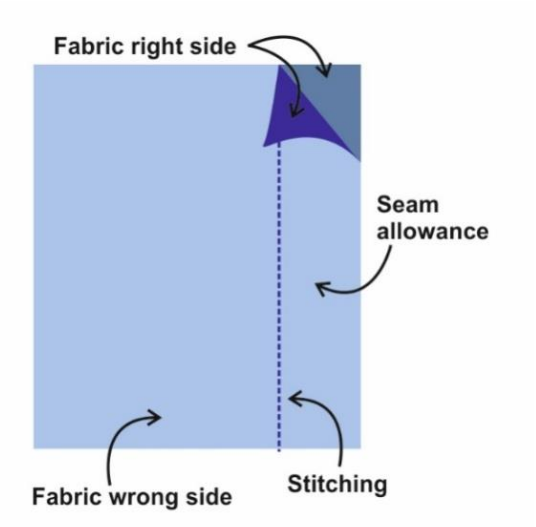


Fig.: 1.36 – Seams

Types of seams

Seams can be of different types depending on how these are stitched, pressed and finished. Broadly, seams can be categorised as plain seams, enclosed seams and decorative seams. These seam types have been discussed below:

1. Plain seam

A plain seam is the most common type of seam used for joining major garment pieces. Right sides of the fabric plies are placed face-to-face and the seam is stitched from the wrong side. The seam allowances which are visible on the wrong side may be pressed to one side or pressed open before stitching another seam which crosses it. Crossing of seams generally occurs at the waistlines, side seams/underarm seams, shoulders, facing/binding applications etc. Pressing open of seams reduces the bulk and improves the appearance and comfort of the garment. Seams stitched along the armhole while sleeve attachment or in crotch area in pants or pyjamas on the other hand, is not pressed open to avoid distorting of seam.

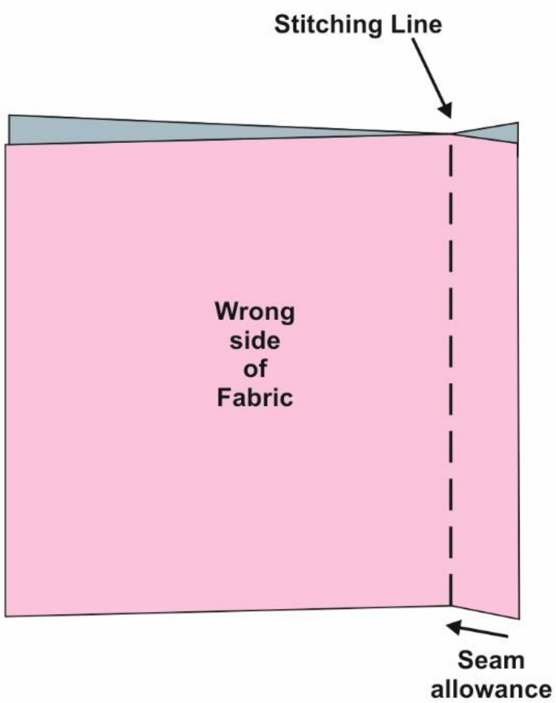


Fig.: 1.37 – Plain seam

This seam type is a best option for a variety of garments and finely woven fabrics that do not fray. Plain seam is also generally used in the garments which have an inner layer of lining attached. Plain seam has the least amount of bulk, is easy to alter and is less expensive to produce. However it is not very durable as the raw edges of seam allowances can fray. Hence, an additional finish is required to secure the cut edges and prevent ravelling.

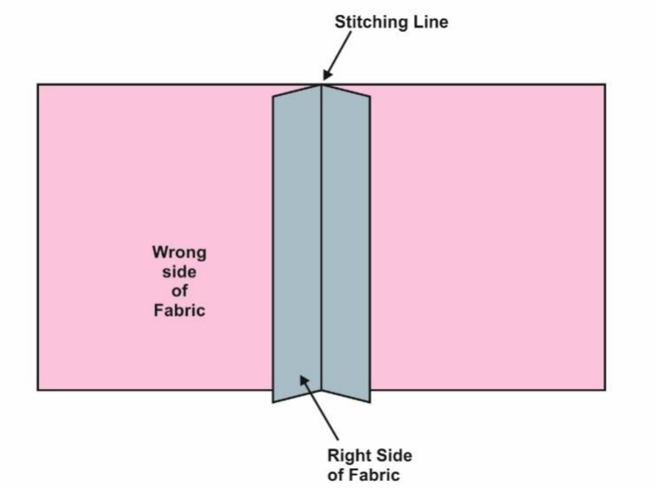


Fig.: 1.38 – Seam allowances pressed open

There are a variety of ways in which the seam allowances of plain seam can be finished. Type of seam finish to be applied will primarily depend on the type of fabric, garment style, expected garment price and durability requirements. Seam finishes give a neat finished appearance and increase the life of a garment. Seam finish can be applied separately to both sides of seam allowance in a pressed open seam or to both the layers together when allowances are pressed to one side.

Most commonly applied seam finishes have been discussed below:

- **Pinked finish:** It is a threadless finish where the edge of the seam allowances is trimmed to give saw-toothed edge either using pinking shears or a machine equipped with a special disc. It is generally used on the fabrics that do not fray easily as it only impedes the ravelling but not prevents it.

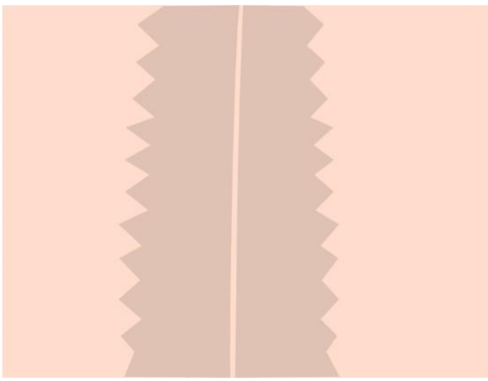


Fig.: 1.39 – Pinked finish

- **Stitched and pinked finish:** In this finish, a row of machine stitches is made close to the edge of seam allowance (at 0.5 cm) and the edges are trimmed with pinking shears beyond the stitching line. It is applied to fabrics that ravel slightly or edges that tend to curl.

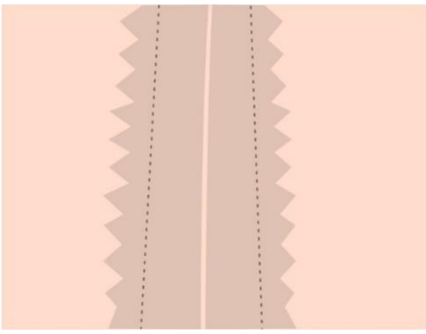


Fig.: 1.40 – Stitched and pinked finish

- **Edge stitched or double stitched finish:** In this finish, a second row of stitching is placed close to the edge and generally applied by holding both the layers of seam allowance together. Any extra threads beyond the stitching line are trimmed for a neat finish. It is quite often seen along the armhole in the sleeve attachment.

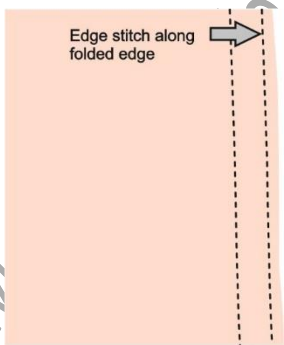


Fig.: 1.41 – Edge stitched or double stitched finish

- **Turned and stitched finish:** The edges of pressed open seam allowances are folded underside and stitched close to the folded edge. It provides a very neat finish for light to medium weight fabrics but it is not very durable as the threads may ravel out over time.

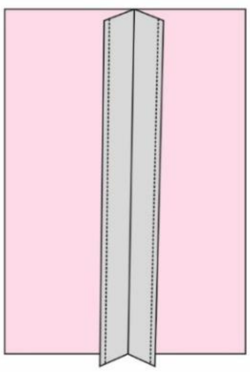


Fig.: 1.42 – Turned and stitched finish

- **Overcast or serged finish:** It is done using an overlock machine which stitches the raw edges of the seam allowances with a series of interlocking looped stitches. It is the most common type of seam finish found in ready-to-wear apparel.

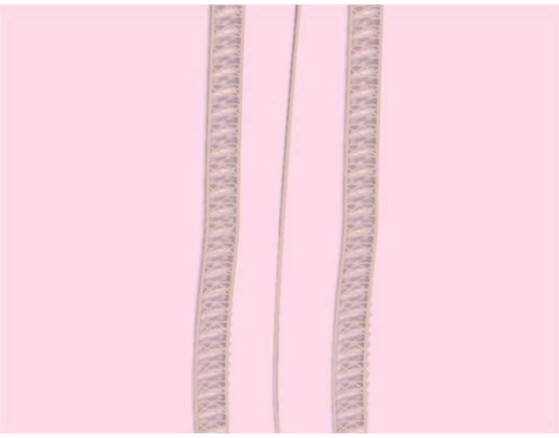


Fig.: 1.43 – Overcast or serged finish

- **Bound finish:** In this finish, edge of each ply of seam allowance is bound separately using a ribbon tape or bias binding. Such type of finish is generally applied to the unlined coats and jackets or to fabrics where the raw edges might irritate the skin of the wearer. In delicate and sheer fabrics like chiffon, lace etc., the raw edges are bound using net strips which give a very inconspicuous and less bulky look.

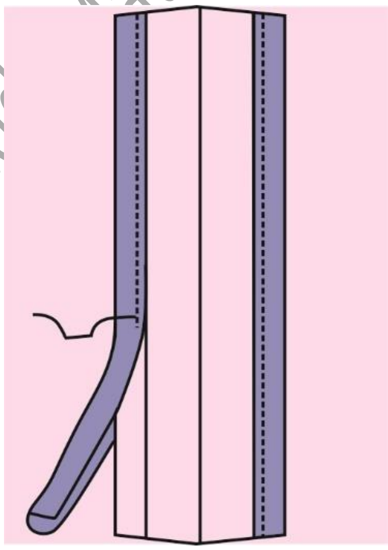


Fig.: 1.44 – Bound finish

2. **Enclosed seams**

As the name suggests, raw edges in the enclosed seams are hidden within the seam and hence do not require any additional seam finish as done for plain seam. It is the second most common seam type found in garments after plain seam. Seams used to finish the waistbands, neckline edges, collars and cuffs are examples of enclosed seam. Multiple plies of seam allowances and the garment layers are all folded in same direction in enclosed seam adding to a lot of bulk. Hence, seam allowances are required to be trimmed or graded for a non-bulky smoothly finished seam.

Other variations of the enclosed seam include French seam and mock French seam. These are briefly explained below:

- **French seam:** It is a seam with enclosed raw edges and is constructed in two separate operations. The first operation involves stitching a narrow plain seam with wrong sides of fabric facing each other. The stitched edge is then flipped so that the right sides of fabric plies face each other and a second plain seam is sewn enclosing the seam allowances of the first seam. Hence, the final seam looks similar to a plain seam from right side but appears as a tuck on the wrong side. French seam is generally used for very fine, transparent fabrics as it gives a neat interior and also for medium weight fabrics that fray easily. Since, it is costly to make this seam, it is mostly seen in high-priced womenswear, children's wear, lingerie etc. Also, this seam is more suitable for short straight or slightly curved seams and it is difficult to alter a garment with French seams.

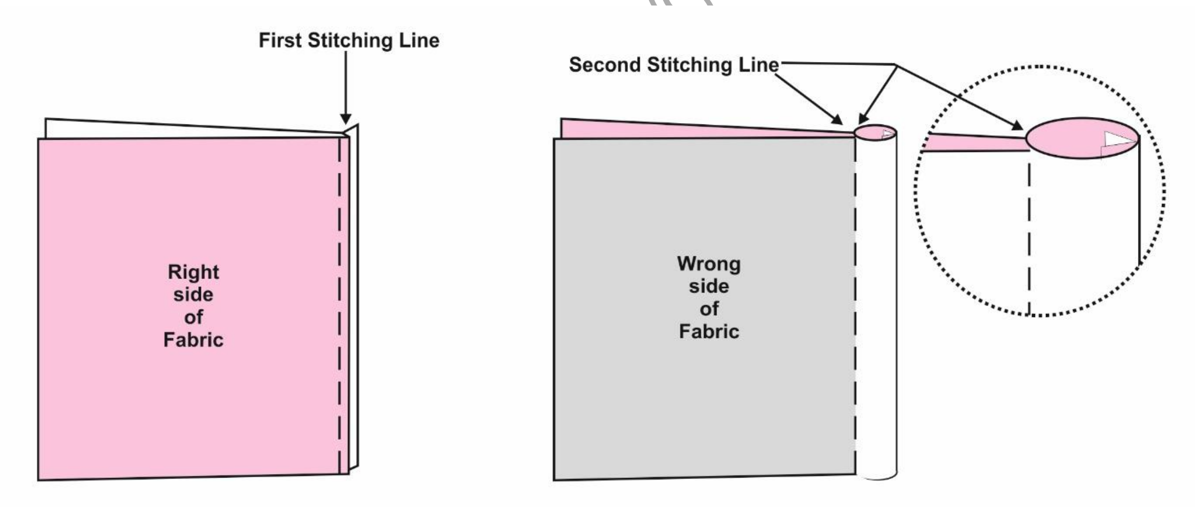


Fig.: 1.45 –French seam

- **Mock French seam:** It is a false French seam, which is an adaptation of the plain seam made at cost-effective rates. A plain seam is stitched with the right sides of the fabric facing each other and then the raw edges of the seam allowances are folded inside and stitched to resemble a true French seam. The difference between the two is that in French seam only one row of stitching is visible on the wrong side, but in the case of a mock French seam, two rows are visible. Mock French seam is strong, resists ravelling, can be used for long and curved seams and can also be altered easily.

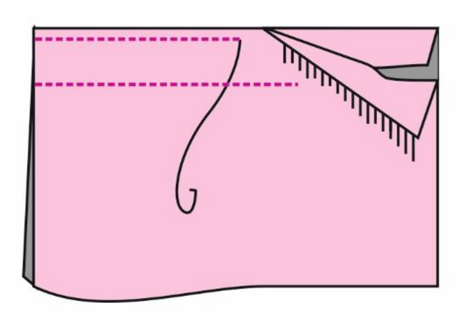


Fig.: 1.46 – Mock French Seam

3. Decorative seams

Decorative seams are stitched from the right side of the fabric adding a very prominent topstitching line and highlighting the design feature of the garment. It emphasizes the construction lines and contrasting coloured thread can be used to make it more decorative. The common examples of decorative seams are lapped seam, flat-felled seam, mock flat-felled seam, tucked seam, slot seam, corded or piped seam, bound seams. These have been briefly explained below.

- **Lapped seam:** These seams are constructed by overlapping two or more fabric plies extending in opposite direction and stitched together from the top. In the simplest lapped seam, seam allowances are lapped without any fold. Hence, raw edges are visible both on right and the wrong side of the garment. Such a kind of seam is recommended for non-ravelling materials like leather, suede, felt, vinyl etc. and it is less bulky as compared to other seam types. However, in fabric which shows some fraying, another variation of lapped seam is can be seen. While constructing this variation, the seam allowances of top fabric ply are folded under and placed over lower ply and stitched close to the fold from top. It is a fast construction technique and cost-effective where single row of stitching joins the three thicknesses of fabric giving a topstitched appearance. This variation is commonly used for attaching shaped yokes; cornered seams such as in patch/applied pockets and areas where a smooth and less bulky look is required.

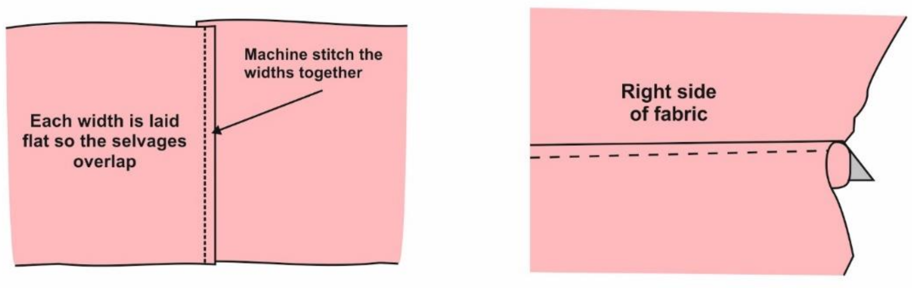


Fig.: 1.47 - Lapped seam

- **Flat-felled seam:** This seam is constructed by overlapping the folded edges of both the seam allowances in the opposite direction and joining them together using two parallel stitching rows from the right side of fabrics. Stitching penetrates through all the fabric plies and gives a very neat, flat and sturdy seam with raw edges enclosed inside. This seam is produced in a single operation at industrial level using a falling foot attachment. Flat-felled seams are frequently found on light to medium weight woven fabrics and casual garment styles such as sportswear, work clothes, jeans and men's shirts. The seam appears identical on both the right and wrong side, applies to straight and fairly straight edges and is difficult to alter.

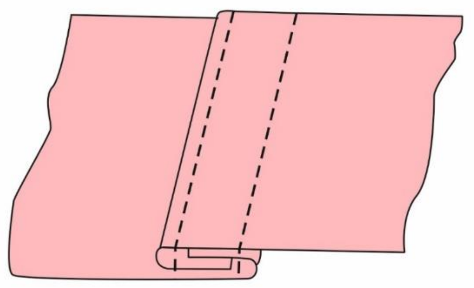


Fig.: 1.48 – Flat-felled seam

- **Mock flat-felled seam:** It appears similar to the flat-felled seam from right side but the wrong side shows the raw edges of the seam allowances. A plain seam is stitched using safety stitch, seam allowances are pressed to one side and two rows of topstitching are done from right side which holds the seam allowances in place. This seam is cost effective, requires less- skilled labour and less bulky but not as durable as the true flat-felled seam.

- **Tucked seam:** It is a variation of lapped seam where the seam allowances of top fabric ply are folded under and placed coinciding with the seamline of lower ply. It is then stitched from the top at 1/4th or ½ inch from the folded edge to create a small flap or a tucked appearance. Common examples of tucked seam are seen in yoke attachments, fake cuffs created at lower sleeve edge, front plackets opening in shirts and blouses etc.

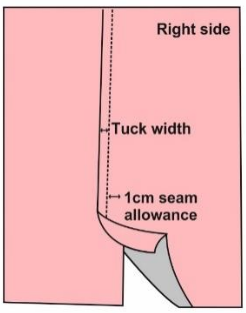


Fig.: 1.49 – Tucked seam

- **Slot seam:** This seam is created when two fabric plies with folded seam allowances are placed slightly apart on a fabric underlay (usually of a contrasting colour for added decoration) and top-stitched close to the folded edges. The contrasting colour underlay visible in-between two top-stitched fabric panels produces a slot like effect. It consumes more fabric and time in construction and hence, adds to the cost of the garment.

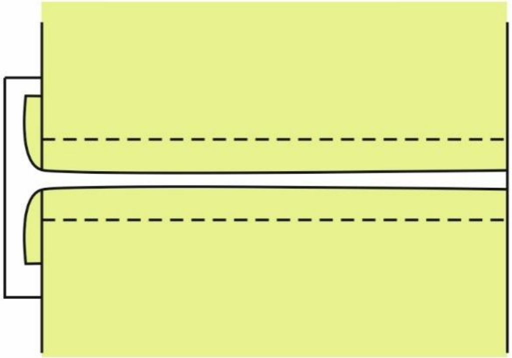


Fig.: 1.50 – Slot seam

- **Piped or corded seam:** These seams are primarily decorative where additional fabric strip (either self or contrasting fabric) is used for creating the effect. The folded fabric strip is inserted between the fabric plies with a narrow extension protruding out and stitched in place. This narrow-piped edge is visible on the right side of the garment. If a piece of thin cord is inserted into the folded fabric strip, before stitching, it is known as a corded seam. Corded seam is more commonly used as it gives three-dimensional effect and a more decorative appearance.

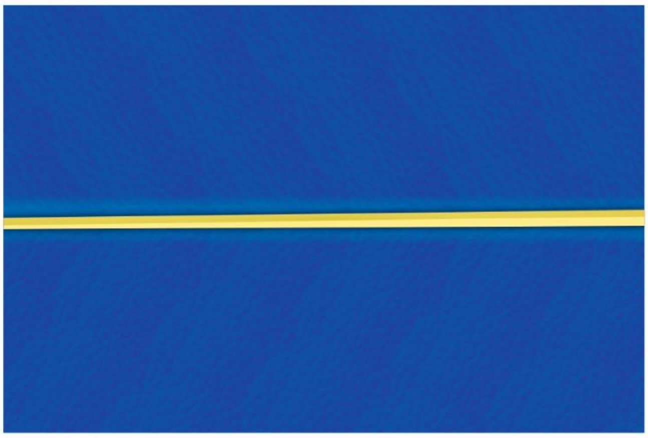


Fig.: 1.51 – Piped or corded seam

- **Welt seam:** Two fabric plies are held together with their right sides facing each other in such a manner that one edge of the seam allowances is slightly wider. A plain seam is stitched and the seam allowances are pressed to one side with the wider edge covering the narrow edge. Topstitching is done which penetrates through garment ply and holds the wider seam allowance in place. The narrow seam allowance enclosed in-between acts as a padding, giving a three-dimensional effect. Such seams are generally found in coats and jackets made from heavy-weight fabrics.

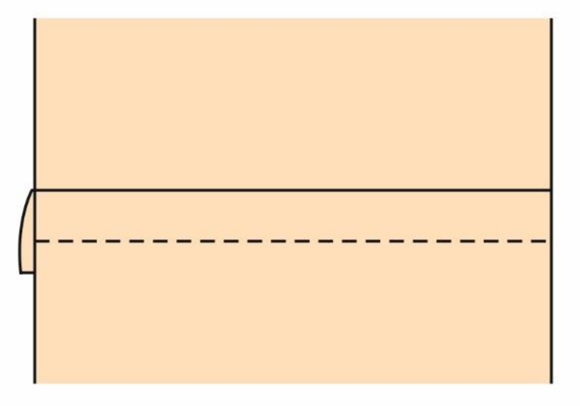


Fig.: 1.52 – Welt seam

Additional seam techniques

In order to sew smooth and professional looking seams, few additional steps need to be followed besides pressing. These are known as additional seam techniques and their application depends upon the shape and location of the seam. These processes are as follows:

1. **Trimming of seam allowances**

Trimming is a process of cutting away some of the seam allowances uniformly parallel to the edge. All the plies of seam allowances are trimmed at same width. It is generally done when wider seam allowances might interfere with further construction or garment's final look and fit. It is important to have a sharp pair of scissors for various trimming processes. Trimming removes the bulk from seam allowances and gives a neat finish. It can be applied to regular side seams, armhole seams and shoulder seams or in enclosed seams such as in collars/cuffs and French seam.

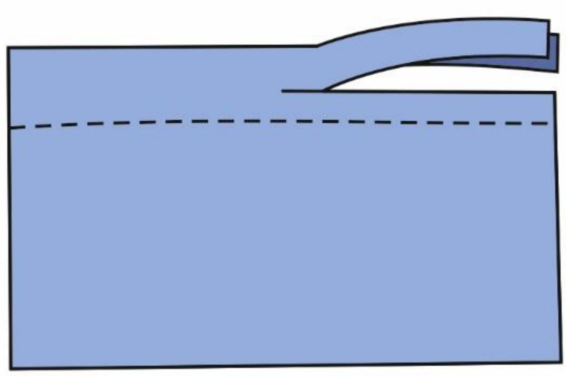


Fig.: 1.53 –Trimming

2. Grading of seam allowances

Grading is a process of trimming or cutting each ply of seam allowance to a different width. It is generally done in heavy weight fabrics and if there are more than two layers of seam allowances in a seam. This helps in gradually reducing bulk and making the seam lie flat without any ridge. Enclosed seams can be graded to narrower widths as compared to exposed seams.

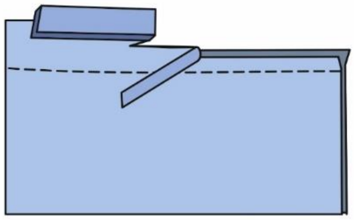


Fig.: 1.54 – Grading

3. Trimming the corners

In enclosed seams such as those in collars and cuffs that have corners, the seam allowances are trimmed away to eliminate the excessive bulk. Removal of bulk allows the two edges of the corner to lie flat close to each other when turned over. Corners can also be trimmed when one seam crosses another seam in a garment. Seams can be pressed open wherever possible and trimming the corners will further reduce bulk.

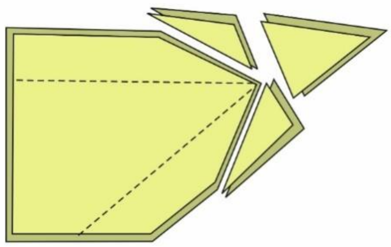
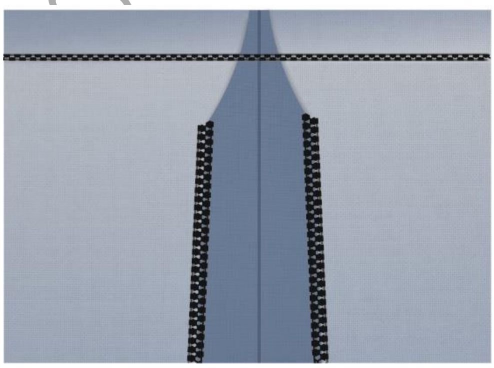


Fig.: 1.55 – Trimming corner



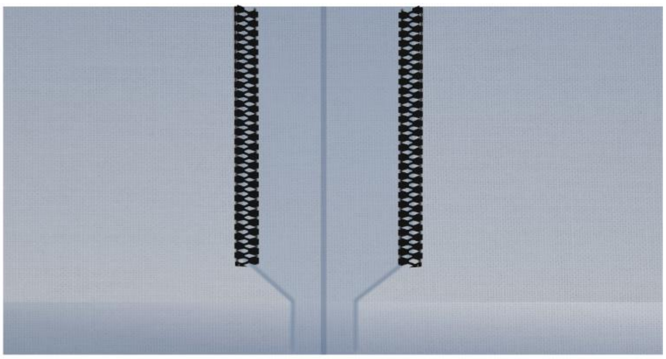


Fig.: 1.56 – Trimming of corners in seams crossing another seam

4. Clipping and Notching

Clipping and notching are the two processes which are used while sewing on curved seams. These processes help the seams to be finished in a smooth and flat manner. Depending on the sharpness of the curve, these can be made at regular intervals of ½ to 1 inch. Both these processes have been explained below.

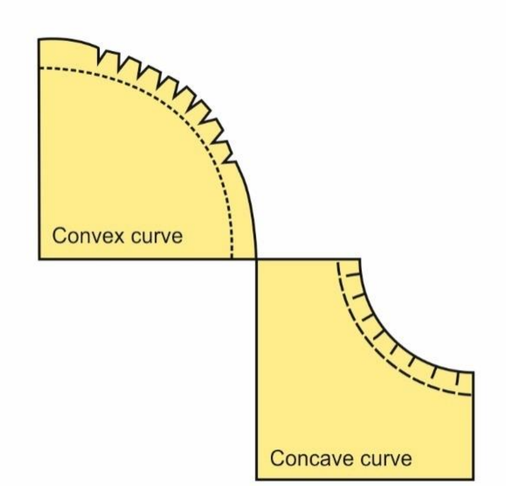


Fig.: 1.57 – Clipping and Notching

- **Clipping:** It is applied to the seam allowances of inward or concave curves. Using a sharp-tipped scissors, small slits are cut into the seam allowances and care must be taken to avoid cutting past the stitching line. Clipping is generally seen on the round neckline of a garment finished with binding or facing. It allows the edges to spread so that the shorter area can easily get folded and lie flat over the longer area giving a smooth neat finish.

Fig.: 1.58 - Clipping around neckline

- **Notching:** It is applied to the seam allowances of outward or convex curves. Using a sharp-tip scissors, small wedges are cut into the seam allowances and care must be taken to avoid cutting past the stitching line. Notching is generally seen on the outward curves of the peterpan collar. Cutting out V-shaped notches remove fullness in seam allowances allowing the edges to lie closer together. Thus, the longer area can easily be folded and lie flat over the shorter area giving a smooth flat finish.

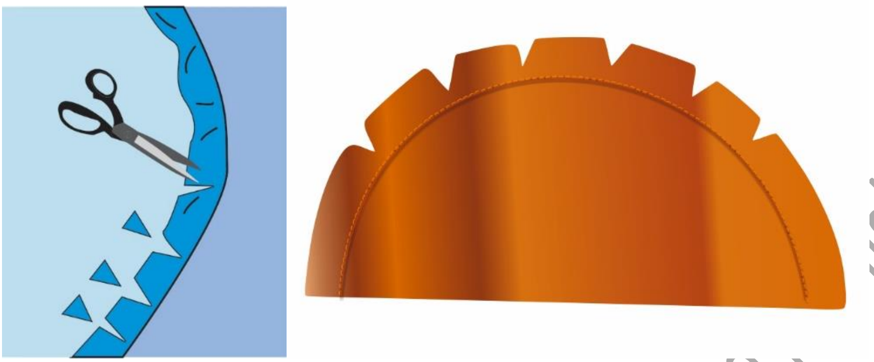


Fig.: 1.59 - Notching around Peterpan collar

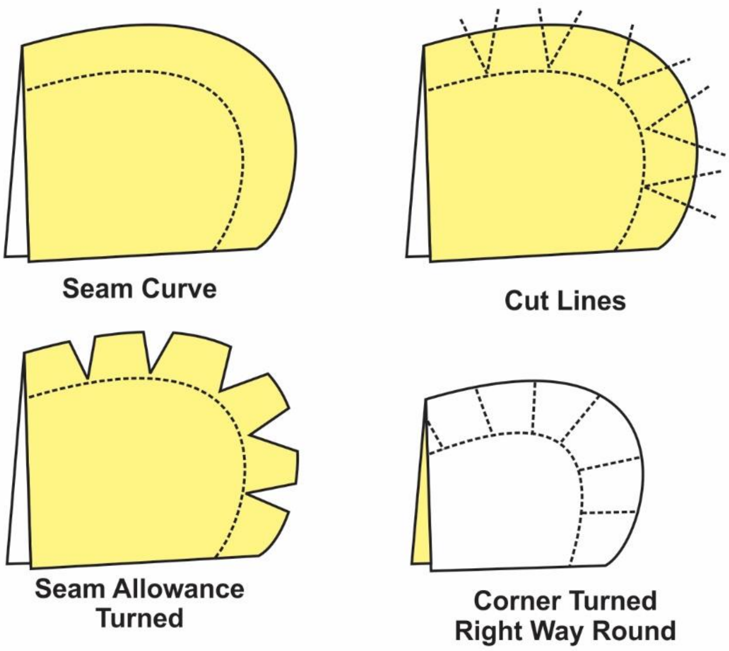


Fig.: 1.60 - Notching

5. Under-stitching

Under-stitching or control stitching is done for finishing enclosed seams such as collars, cuffs, neckline facings, waistlines, armholes etc. It is done from the right side of the garment on the underlayer (in case of collars and cuffs) or facing strip close to the seamline with seam allowances also stitched along with it. Hence, it is visible only on the wrong side of the garment. This prevents the underlayer or the facing strip from rolling on to the right side of the garment and helps to maintain a neat flat appearance. Under-stitching can be avoided if top-stitching has to be done as it also helps in keeping the seams flat.

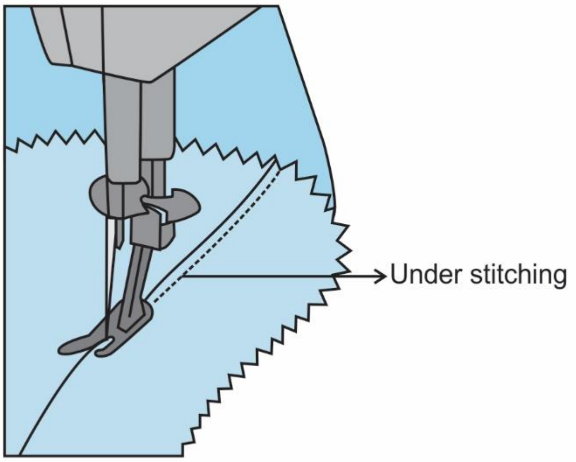


Fig.: 1.61 - Under stitching

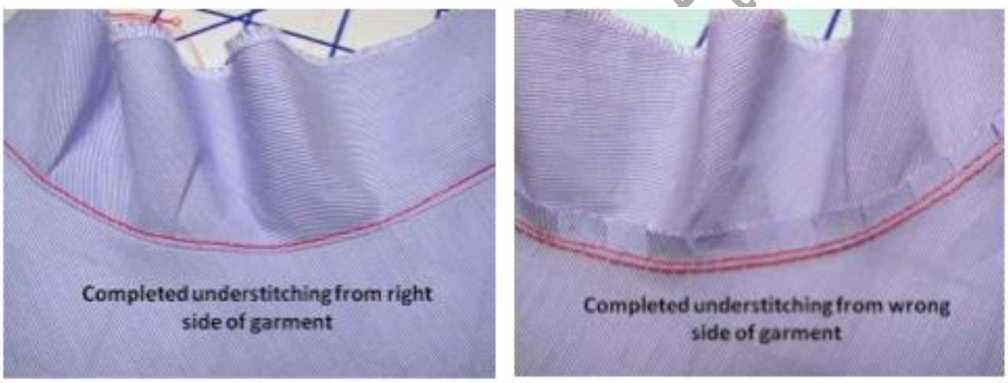
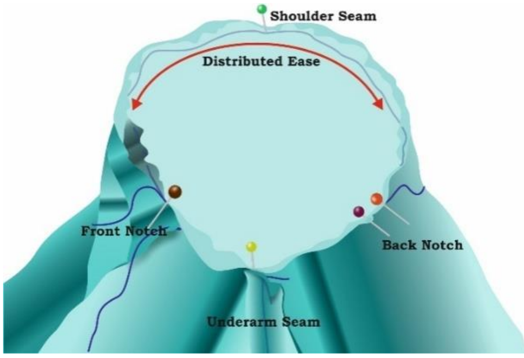


Fig.: 1.62 - Under stitching

If more than one technique is to be applied in the finishing of any garment area, then a specific sequence should be followed. Seams should first be trimmed, then graded if required, curved areas should be clipped or notched and then under-stitching should be applied. All these processes together will ensure a perfect look.

6. Easing

Easing is a technique used for joining together two fabric pieces of slightly different lengths. The longer edge is eased out into a shorter edge with no puckering along the seamline. The technique of easing is commonly applied while attaching fitted set-in-sleeve into the armhole, sewing princess seams, attaching the waistband to the skirt waistline etc. In all these cases, the two edgesto be joined together are not of same length. For easing out the longer edge, two rows of loose machining (stitch using a bigger stitch size) are done, one on the seam line and the other row slightly above in the seam allowance. These stitches are then pulled to slightly gather the longer edge so that it can match comfortably with the shorter edge. The ease should be distributed evenly so that the seam lies smooth and flat with no puckering or gathering visible along the seamline.



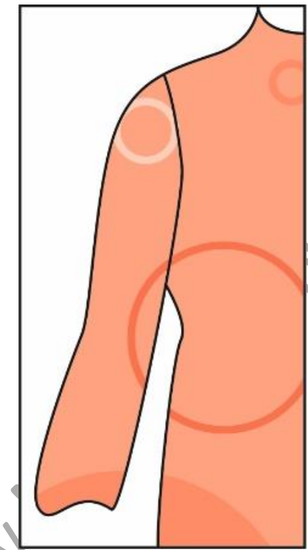


Fig.: 1.630 - Easing while sleeve attachment

7. Stay-stitching

Stay-stitching is a row of regular machine stitching done along the curved areas in a garment which require extra handling. This technique is applied to maintain the actual shape of neckline, shoulder line, armhole, waistline etc. It is done on a single layer of fabric between the cutting line and seamline prior to any basting or permanent stitching. Stay- stitching helps to hold the yarns in place and prevent any stretching. It is absolutely necessary while handling stretch fabrics.

It is important to maintain the direction of stay stitching for best results. As a general rule, it should be done in the direction which holds grain in place when stretched.

- For the neckline, it is done from shoulder to center line.
- For a V neckline, it is done from the point of V to the shoulder line.

- The shoulder line is stay-stitched from neckline to armhole.
- The skirt and top waistline are stay-stitched from side seam to the center line.
- The hipline and bias skirt seam are stay-stitched from lower edge to waistline.

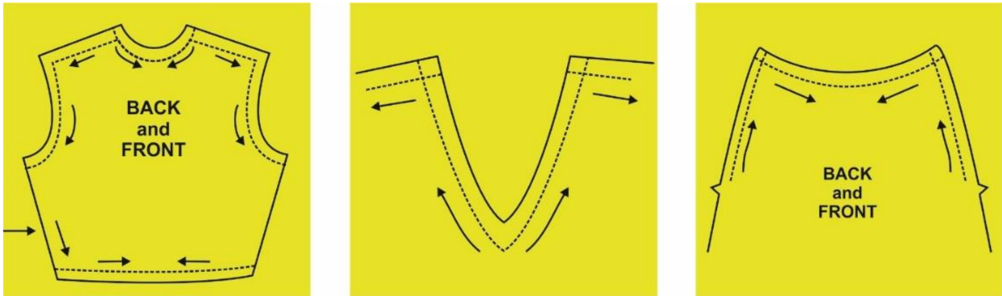


Fig.: 1.64 - Direction of Stay-stitching at different areas in a garment

Activities

Activity 1: Make a chart on types of seams explaining their special feature with pictures. Prepare sample of any 4 types of seam.

Materials required

1. Chart paper
2. Pen/Pencil
3. Colours
4. Glue
5. Scissors
6. Fabric

Procedure

1. Write about different types of seams on a chart paper.
2. Paste pictures in front of each seam or you can also draw each seam explained in the session above.
3. Prepare any 4 seams of your choice using the fabric and paste it in your file.
4. Submit the chart and seam samples to your teacher.

Check Your Progress

A. Fill in the blanks

1. ______________is a thread less finish where the edge of the seam allowances is trimmed to give saw-toothed edge either using pinking shears or a machine equipped with a special disc.
2. Raw edges in the ______________are hidden within the seam and hence do not require any additional seam finish as done for plain seam.
3. ________________are constructed by overlapping two or more fabric plies extending in opposite direction and stitched together from the top.
4. Cutting out _______________ remove fullness in seam allowances allowing the edges to lie closer together.

B. Questions

1. What is a seam? Explain about different types of seams given in the session above.
2. Explain in brief about under-stitching, notching and stay-stitching.
3. What is trimming and grading of seam allowance?

Module 2	Developing Tech Pack, Proto and Fit Samples

Module Overview

In this unit you will learn about the tech-pack, proto sample and fit sample which are very necessary to learn for a fashion designer. Garment production system is also explained in this unit. A tech pack is a document that contains all of the product's technical details. When creating new collections, it is an essential document for both designers and production teams, since it allows one to properly describe every aspect to the manufacturer. Tech pack facilitates and clarifies communication between the buyer and the manufacturer and also for a designer, reducing misunderstandings and errors. It is possible for a designer to verify that the designed garment is created to the exact specifications. The designer or cloth manufacturer will be able to exactly recreate the design using all of the technical drawings, measurements, and component data provided. As a result, the danger of a mistake during sampling and bulk production is reduced. In the garment industry, a proto sample is the initial sample in the production development stage. It is made in accordance with the buyer's requirements. The designers are in charge of creating this type of sample. In this sample, fit and fabric detailing are not considered. Fit samples, as the name implies, are manufactured in accordance with the sizing required by the brand to ensure proper fit and fall of the garments. To pass the fit evaluation, the measurements and construction must be accurate and correct. The fit sample can be constructed from the same fabric as the final design, and many alterations may be required before the correct fit is obtained. Production of garments is taken up after the sample is approved by the buyer and sealed as the finally approved sample.

Learning Outcomes

After completing this module, you will be able to:

- Developing proto and fit samples as per customer requirements
- Learn to review techpack and proto sample
- To Learn about fabric drape ,fall, surface ornamentation for garments
- Garment manufacturing
- Identify problems and critically evaluate design

Module Structure

Session 1:	Steps in development of tech packs
Session 2:	Steps in development of proto samples
Session 3:	Garment Production Systems and Sequencing of Assembly for Garment Construction

Session 1: Steps In Development of Tech Packs

Tech pack is a set of documents prepared by a designer or a design development team for providing all the necessary instructions and specifications to the product development team for making sample garments based on it. A tech pack would also be kept updated based on the evaluation of the samples produced based on it. It would be finalised after the preproduction sample is approved and sealed. It may be called by different companies by different names such as 'spec pack', 'product pack', etc. In the commercial world of readymade garments, the tech packs are developed by large scale buyers like the fashion brands or their representatives and handed over to the garment manufacturing units for producing the desired garments. Although it is considered as a technical document, it forms the basis for commercial aspects such as costing, branding, and selling.

Development of garment designs is a two step process:

- Creative design
- Technical design.

In the creative design stage, the desired styles are illustrated by fashion Fig.s whose body proportions are imaginary.

In the technical design stage, the sketches are made using actual measurements of a single person or representative of a group of people, referred to as standard sizes. A tech pack is the product of the technical design process. It would, therefore, include actual measurements to be used in the making of samples. The sketches included in the tech pack would be true to scale i.e. the measurements on the sketches included in the tech pack would be in proportion to the actual measurements.

Essential and Desirable Qualities of a Tech Pack

A properly developed tech pack would minimise the errors at the sample development stage and help the vendors to create samples correctly the very first time. As a result, a good tech pack would minimise the time required for starting bulk production. It would also save the time of the designers which would be wasted otherwise in evaluating the repeated number of corrected samples. It would also save time and costs as well as improve the productivity of the sample making teams of the vendors. The following are some of the important factors to be kept in view while developing tech packs.

1. **Unique Identification of the Style:**To associate it with the right style easily.
2. **Exact and Accurate Measurements:** All measurements in the tech pack must be specified in standard measurement units without any error whatsoever to ensure the fit of the final garment.
3. **Self-contained technical sketches:**These include all the details as well as the correct reference points.
4. **Clarity of Terms, Abbreviations and Instructions**: To ensure understanding of exact descriptions of the garment construction, finishing and packing processes to be adopted by the vendors.
5. **Proper Specification of Fabrics and Trims:**To ensure clarity in the minds of the vendors.
6. **Good Quality Artworks, Swatches, etc.:**To ensure that the sourcing process is transparent and that quality criteria are met.
7. **Completeness:** A good tech pack would also prevent the sample maker from using their own imagination to fill in the missing links in the tech pack.
8. **Evaluation and Quality Control Orientation:**To ensure objective testing and verification as per the quality standards

Steps in the Development of a Tech Pack

The following are the main steps in the development of a tech pack:

1. **Development of a Line Plan:** The starting point of tech pack development is the finalisation of the line plan for any category of clothing to be sold during a particular season.

   The line plan is developed on the basis of

   1)Analysis of Fashion trend

   2) Analysis of Market trends

   The creative designers make use of the trend forecasting to develop new styles or modify existing ones and also to decide on the fabrics and the colourways to be used in the making of the garments. The fashion merchandisers decide on the likely volumes and size scales as well as the retail and wholesale prices. A tech pack is developed for each of the styles that are part of the line plan. The line plan provides the following key inputs for the tech pack:

- The basis for the tech pack cover and header information such as season, style ID, etc.
- The basis for defining the colourways for the concerned garment style
- The basis for selecting the standard size or sizes in which sample garments would be made and evaluated
- The basis for specifying the fabrics and trims to be used keeping in view the price points necessary for their successful marketing

2. **Development of Reference Sample:** Though this is an optional step, making a reference or mock-up sample greatly helps in validating the design concept. It is called muslin sample since it is usually made of inferior cloth and without any trims. It can be made using muslin fabric by draping process in which it is wrapped around the dress form. This reference sample is usually sent to the manufacturers along with the tech pack. It should not be mistaken for the preproduction samples that the vendors retain for future reference as it may also be called as a reference sample. Reference samples may not be necessary for every garment style. Some designers might also consider it unnecessary. It provides the following advantages to tech pack development and usage particularly in the case of completely new styles.

Fig.: 2.1 - Development of Reference Sample

- Pattern makers and technical designers would find it easier to derive the actual measurements of the garment style from the mock up samples than the fashion illustrations.

- Product development teams would find it easier to understand the special features of the style from the mock up samples than from the fashion flats

- Since the mock-up sample provides the basic validation of the style, not more than one or two proto samples would be required before approving the design for production.

3. **Preparation of the Cover Page and Page Headers**: The contents of the cover page and headers may vary from company depending on the scale of readymade garment operations. The following is the list of basic information required to be included in the tech pack cover and header:

- **Company Name:** The name of the company to which the tech pack belongs

- **Season:** The name of the season, which it pertains to

- **Style Name:** The name assigned by the Company for the concerned style

- **Style ID:** The unique code assigned to the specific style

- **Name of the Designer:** The name of the person who created the design

- **Date First Sent:** The original date of handing over the tech pack to the vendor

- **Status:** The type of sample and its version number such as 'proto 2'

- **Date of revision:** This date may vary in different sections of the tech pack. For example the date of revision of POM and Grades page may be different from the data on which Bill of Materials (BOM) gets revised.

- **Name of Vendor:** The name of the manufacturer to whom the tech pack has been sent.

Fig.: 2.2 - Preparation of the Cover Page and Page Headers

Additional information which may be included in the tech pack header would include, among other thing the following:

- **Brand Name:** The name of the particular brand to which the style belongs
- **Line Plan:** The name and ID of the Company's Line Plan to which the specific tech pack belongs

- **Product Type and Description:** The main and sub product category of the company to which the tech pack belongs.
- **Fit Type:** The nature of the fit such as slim, relaxed, etc.
- **Size Range:** Indication of the sizes in which the garment would be produced as per the grading specifications
- **Sample Size:** The selected size or sizes in which the manufacturer must make the samples for review and approval.
- **Sourcing Office:** The representative office of the Company which sends the tech pack to the vendor
- **Name of the Technical Designer:** The person who created the technical sketches and prepared the measurement charts
- **Contact Person:** Name and contact details of the person with whom the vendor should correspond.

4. **Development of Overall Views:** Generally, front and back views form part of the tech pack. However, side views and inside views may be included, if there are any specific styling, finishing or labelling requirements. Overall views may be sketched by hand or made using computer software. Overall views and detailed views are also known as technical sketches or fashion flats. Development of the overall view is generally the responsibility of the technical designer. Overall views may be in black and white line drawings or colour images done using graphical software. Since the purpose of the overall views is to give the product development team a clear idea of the full garment, it would have minimal text and no callouts at all. The following are some of the expected outcomes of overall views:
    - It should give a clear idea of the intended silhouette.
    - It should clearly depict the type, shape and placement of all the style elements as well as the length of the garment. The style may also be named accordingly.
    - It should show how the patterns and other surface ornamentations are matched.
    - It should indicate all the visible stitch lines.
    - It should show the length, direction and placement of darts, tucks, gathers, etc.

5. **Development of Details Views:** These are also developed by technical designers having the requisite computerised or manual sketching skills. The number of detail views included in the tech pack would vary according to the degree of complexity of the style. Each of these views would provide complete details of the concerned style element such as the sleeve, collar, pockets, plackets, gathers, etc. Details

views may also cover trims, labels, etc. Detail views would be true to scale also. Each details view may also include multiple sketches illustrating different aspects of the style element. Sub views may not be according to scale as these are intended for visual explanations of the different aspects of the master view. The detailed views must be self-contained as they are intended to guide the complete process of cutting and stitching the garments. The following are some of the essential requirements of the detailed views.

- All the necessary explanations would need to be included either as call outs, instructions, or explanatory texts.
- These must show all the stitch lines along with the indication of measurements including tolerances wherever applicable.
- Along with the stitch lines, it must also indicate the type of stitch and the applicable distances from reference points.
- There should be a clear indication of the placement of all trims such as zippers, buttons, etc. along with the necessary reference measurements, stitch types, etc.
- These must also clearly indicate the placement and reference distances of all the fabric manipulation techniques used such as darts, pleats, tucks. Etc.
- Callout diagrams may also includea zoom in view of the stitch lines that may not be clearly visible in the master diagrams of details views.

6. **Preparation of Points of Measurement (POM) chart:** Preparing the POM Chart requires pattern development for the body size in which the proto and fit samples will be created. This size is also known as Alpha size. Large buyers would usually supply both hard and soft patterns along with the tech pack to help the sample makers use accurate measurements. The services of an expert pattern maker will be used to create the patterns based on the fashion illustrations and/or the muslin samples created by the designer. One of the main characteristics of the POMs in the tech pack is that these are absolutely flat measurements taken from the paper patterns and are not actual body measurements. The pattern maker uses own experience as well as consults standard size charts to determine the flat measurements. In this process, the pattern maker keeps in mind the design variations and fit requirements.

   The POM information is usually included in the tech pack in the form of a chart. It may also be accompanied by a technical sketch showing the exact place and direction of measurement with lines having arrows on both ends showing the exact starting and ending points. The POM chart would include body measurements relating to both the body and garment either separately or together. The number of POMs included in a tech pack would vary depending upon not only the garment style but also the brand or buyer. For example, a detailed POM for a shirt could have more than 50 measurements. Designers and brands would include a larger number of measurements for ensuring the perfect execution of the style and fit. Detailed POMs are also helpful for those reviewing the samples as they don't have to use subjective judgement to evaluate the construction and fit of the garment.

Code	Points of Measurements	Tol (+)	Tol (-)	Alpha size: 8
Body Spec Measurements				
Style Spec Measurements				

The purpose and description of the chart contents are as follows:

- **Code:** This is a numeric or alphanumeric unique id assigned to each of the points of measurement for easy cross referencing across the tech pack. These codes are also repeated in Grade/Specification sheet.
- **Points of Measurements:** This is a descriptive name given to each of the Point of Measurement
- **Tol + , Tol-**: These values represents the extent to which the actual measurements in the sample garment could exceed (+) or fall short (-)
- **Alpha Size:** The size in which samples will be made and to which the given measurements belong

7. **Preparation of Specification/Grade Sheet:** The preparation of graded pattern set is a prerequisite for preparing the grade sheet. It will be the job of an expert pattern maker to create the graded pattern set. It can be done either manually or using computer software. Manual pattern grading is done by the cutting and spreading method or the pattern shifting method. The former involves cutting a pattern into two parts and overlapping them to reduce the measurements or

spreading the two parts apart to the desired extent of increase in the measurements. In the shifting method the whole pattern is moved to the top or bottom or to the left or right at right angles to add or decrease the measurements.

Grading, however, does not involve increasing or decreasing all the points of measurements. Grading is done only at a few important places, which are known as Cardinal Points. The extent to which measurements at the cardinal points are increased or decreased for different sizes is known as the Grade Rule. It might not be also possible to use a single base pattern to create graded patterns for all sizes. When there are too many sizes, different base patterns will be required to grade them to a set of sizes. These size sets are also known as size breaks.

Generally, graded pattern sets are made available to vendors in soft copies. Large buying companies and brands would rely mostly on its own data to develop grade rules that are representative of their target consumer population. Smaller designers or brands might rely more on standard size charts available in the market for doing the grading. The Grade Sheet in the tech pack will be usually presented in the form of a chart.

Code	**Points of Measurements**	**Tol (+)**	**Tol (-)**	**S**	**M**	**L**	**XL**
Body Spec Measurements							
Style Spec Measurements							

The purpose and description of the chart contents are as follows:

- **Code:** These are numeric or alphanumeric unique ids assigned to each of the point of measurement in the POM page. However, the Grade page may not contain measurements corresponding to all the IDs in the POM page. Grade sheet may also contain measurements that are not on the POM page. These will be specific to one or more sizes

- **Points of Measurements:** This is a descriptive name given to each of the Point of Measurement
- **Tol +, Tol-**: These values represents the extent to which the actual measurements in the sample garment could exceed (+) or fall short (-)
- **Alpha Size:** The size in which samples will be made and to which the given measurements belong and this column would be highlighted using different methods
- **S, M, L, XL:** These are the sizes to which the measurements given in the row belong.

8. **Preparation of the Bill of Materials (BOM)**: The Bill of materials is an important part of the tech pack as it helps in ensuring the quality of the garment as well as its competitive pricing. It covers every input that goes into the making of the garment including labelling and packing materials. BOM is usually prepared by the merchandiser who is familiar with the sources of different categories, qualities and finishes of fabrics, yarns, buttons, zippers, etc. The specifications in the BOM would cover only the quality aspects. Quantities may be specified only in the case of trims. Generally, the BOM would also include a colourways summary. The colour-way summary will specify the colour along with the colour standard. Swatches of the fabrics to be used may also be included. The Bill of Materials will also be presented in a tabular format as shown below:

Description	**Source**	**Content**	**Quality**	**Finish**	**Placement**	**Quantity**
Fabrics						
Yarns						
Trims						

Colourways Summary						

While the nature of specifications would vary according to categories such as fabrics, yarns and trims, there will be an easily identifiable description of the item in the first column. Also, the source of each item will be mentioned along with the name of the vendor from whom the fabric or yarn is to be sourced and the product code of the item in the vendor's catalogue. These vendors are also called nominated vendors. Some buyers might leave it to the manufacturer to buy some or all of the items from their own sources. In such cases, it will be specified as 'vendor to source' or in similar language. Another common specification relevant to all the items is the information about the exact place where the fabric or trim will be used. Quality factors mentioned against each item would depend upon the category to which it belongs to.

The fabrics related specifications would include:

- **Type:** The trade or generic name and type of fabric such as woven or knitted. Specific types of weaving and knitting may also be specified.
- **Content**: The fibre composition of the fabric or yarn.
- **Quality:** The width, weight and size specifications in the case of fabric as well as other specifications such as colour fastness, shrinkage tolerance, etc.
- **Finish:** The fabric finish related specifications would cover not only the finishing processes carried out by the mills but also fabric preparation processes such as pre-shrinking, laundering, etc.
- **Colourways**: The exact colour of the fabric must be specified in the colourways summary.

Yarn related quality specifications may include the following:

- **Description:** The trade or generic name and type of yarn such as filament or spun. Specific types of weaving and knitting may also be specified.
- **Fibre Content**: The fibre composition of the yarn.

- **Other Quality Factors**: Yarn count, number of plies, colour fastness, etc.
- **Colourways**: The exact colour of the yarn must be specified in the colourways summary.

Trims related specifications may cover the following. The colour related details of trims must be included in the colourways summary.

- **Zippers:** The specifications should state whether metallic or nylon along with the length, type of puller, finish, etc.
- **Buttons:** The specifications should include type, raw material, size in standard unit like ligne, etc.
- **Interlining:** The specifications must cover the type (fusible or non fusible), fibre content, construction (woven or non woven), etc.
- **Labels:** The specifications must cover the type (printed or jacquard), raw material, size, art work, etc.

Colourways related specifications are may cover the following:

- **Standard Colour Code:** It may refer to the standard codes such as Pantone or according to other colour standards. Buyers may also use their own colour cards with assigned codes. The colour codes will be specific to the fibre composition of the fabric or yarn
- **Swatches:** These small reference samples of fabrics usually in 4"x4" or 4"x8" size have the exact shade of colour to be matched by the bulk fabric used in garment manufacturing. These are usually sourced from companies that specialise in producing sets of swatches in standard colour ranges for different types of fabrics.
- **Lab dips:** These are customised dyed samples produced by the buyer for any specific fabric. The manufacturer will be required to submit a matching lab dip of the bulk dyed fabric to be used in final manufacturing. These are usually in 6"x6" size. The lighting conditions for matching colour would also need to be matched.
- **Strike Off /Desk loom:** These are required to cross check both the design and colours in embroidered or printed or yarn dyed woven fabrics having patterns or artwork. Strike specifications will be necessary for all artwork. Desk looms are typically required in 20" or 24" inch width and one or two meters of length for matching larger patterns or print designs.

9. **Preparation of Construction and Finishing Instructions:** Clear specification of the construction requirements is essential for ensuring

good quality of workmanship. Apart from the basic function of properly joining the fabrics and trims with the required level of strength, top stitches also play a role in the style factor of the garment. Proper finishing of the seams is necessary to increase the wearer's comfort as well as the durability of the garment. Construction details would also cover stitching and finishing instructions relating to all the trims and particularly closures. Stitching instructions related to permanent labels may also be included. Sometimes, these may be specified in the labelling and packing information section. Generally, construction related information will be presented in a tabular format having the following columns:

Location	Purpose	Stitch Type	Top Stitch	Seam Finish	Supports Details	Closures Details

The type of information given under each of the above columns would be as follows:

- **Location:** Indication of the area or areas where the concerned construction specification would apply. Examples: Collar, Armhole, back shoulder yoke, side-seam, in-seam, etc.
- **Purpose:** Specifications to be done at the location: Examples: Join, Top-stitch, 1" hem, etc.
- **Stitch/Seam Type:** The details would include both the type of joining stitch and the number of needles to be used. It could also include stitch quality requirements such as stitches per inch (SPI). This specification must be tallied with type of stitching yarns specified in the BOM. Examples: Single Needle Chain Stitch used in main seams, Two Needle bottom cover stitch (2NbottomCvS) used in hemming or attaching elastic, etc. There are also global standards of ISO and ASTM. Stitch/seam specifications may include the relevant ISO or ASTOM codes
- **Top Stitch:** Top stitching is used for decorative purposes as well as for joining fabrics and attaching style elements and trims. These have stitch lines visible from the outside. Examples: Two Needle bottom cover stitch (2NbottomCvS) used in Armscye, Sleeve Hem, Shoulders, etc; Two Thread Chain Stitch used in Neck Trims, etc. This specification would also specify the distance from the nearer edge to where the stitch line should be.
- **Seam Finish:** The seam finish specifications would vary depending on the type of fabric and the possibility of fraying on the edges. The amount

of stress at the concerned seam is another factor determining the type of seam finish. Examples: Clean finish, Flat Felled Seam, Serged, Zigzag, etc.

- **Details of Supports**: There are several ways to add supports to the different parts of the garments through methods such as interfacing, lining, interlining, underlining, etc. The specifications in this regard must include the type of support and the type of material to be used. Technical sketches may also be included showing the areas of support with shades or patterns. The materials listed must be tallied with the BOM
- **Closures**: There are multiple types of closures and attachment methods. Their use depends on the type of garment and its styling. The specifications in this regard must include the type of attachment and its exact location. These must be tallied with the Details Views and the BOM.

10. **Preparation of Labelling &Packing Instructions**: The materials to be used for labelling and packing would appear in the BOM. Instructions relating to permanent labels would need to be read with the construction specifications given in the tech pack. It may also be necessary to attach technical sketches showing the placement. Labelling requirements may vary from country to country. These specifications are also usually presented in a tabular format as shown below:

Item Type	Size, Weight, etc.	Placement	Finish	Quantity per garment	Source of supply	Sketch Ref. No.

The type of information given under each of the above columns would be as given below:

- **Item Type:** The type and purpose of the label: Examples: Labels of Brand, Care, Country of Origin (COO), etc.; Hang tags for Price, Barcode, etc.; Poly bags for packing, etc.
- **Size, Weight, etc.:** Sizes of labels, Weight of poly bags, etc.
- **Placement:** The location where the label will be attached or the tags will be hung.
- **Finish:** This specification will include details of the way in which these would be attached or used.

- **Quantity:** The exact number of the concerned label/tag/bag to be used per garment.
- **Source:** It indicates the name of the supplier nominated by the buyer. It may be also left to the manufacturer to procure it from own sources.
- **Sketch:** The reference number of the technical sketch in the tech pack or the buyer's manual containing full details of the concerned item.

11. **Inclusion of Fit History Template:** This table is for recording the changes made in the POM Chart and Grade Sheet based on the review of proto/fit samples. The template would be in a tabular format. Additional columns of measurements may be added depending upon the number of samples made for making corrections in the measurements.

POM Code	Description	TOL (+)	TOL (-)	SPEC	Fit Sample 1 Date -- -- ---				Fit Sample 2 Date -- -- ---			
					Meas.	Diff.	Notes	New Spec	Meas.	Diff.	Notes	New Spec

The type of information given under each of the above columns would be as given below:

- **POM CODE:** The same as in the POM chart.
- **POM Description:** The same as in the POM Chart.
- **Tol (+):** As per Original POM.
- **Tol (-):** As per Original POM.
- **Original Spec:** As per Original POM.
- **1st Proto:** Corresponding measurements taken from 1st Proto
- **Difference:** Observed difference between the original spec and the corresponding measurements taken from 1st Proto
- **Notes:** Remarks on the observed difference
- **Revised:** Changed measurement
- **2nd Proto:** Measurements taken from 2nd Proto corresponding to the revised spec

- **Difference:** Observed difference between the revised spec and the corresponding measurements taken from 2nd Proto
- **Notes:** Remarks on the observed difference
- **New Spec:** Changed measurement
- **Date:** The respective dates of taking the measurements or changing the spec.

12. Inclusion of Review Comments Template: This template is for recording the observations of the design/technical design/merchandiser on the different samples made and submitted by the vendors. The template would have the following rows for recording the details for each review, one after another, as shown below:

Date	
Sample Type/ID	
Sample Status	
Review Details	

The type of information given under each of the above rows would be as given below

- **Date:** The Date of Review
- **Sample Type & ID:** Examples: Proto 2, Fit 1, Size Set, etc.
- **Sample Status:** Whether the sample is adopted or rejected or required to be modified
- **Review Details:** Notable reasons or factors leading to its adoption or rejection or modification

13. **Finalisation & Storage of the Tech Pack**: While the tech pack would get finalised with the approval of the preproduction sample, its finalisation and storage requires adding all the relevant materials such as the samples made, details of the processes adopted to make changes at various stages. The original tech pack would need to be returned to the buyer with all the changes. The vendor would retain a copy of the same for future reference.

Activities

Activity 1: Select any garment of your choice and prepare a mock tech pack based on it with the following components:

1. Cover page
2. Overall View
3. Points of Measurement
4. Grade Page
5. Construction page and
6. Comments

Materials Required:

1. Any used garment, which can be deconstructed as necessary
2. Paper, pen, pencil, measuring tape, French curve, ruler, flat table for creating the technical drawings, tabular data presentation and writing out the callouts and instructions
3. Imaginary names for buyer, vendor, designer, style ID, etc.

Procedure:

1. Select any used garment, take photographs, note down all the measurements required to be entered in the tech pack, prepare grade page using any standard size chart, and study all the seams.
2. Create the technical drawings for overall views and details views.
3. Prepare the construction page by mentioning the appropriate fabrics, stitches, trims used in the garment along with their correct placement.
4. Complete the tech pack with all the above sections.

Activity 2: Make a survey report on the labels and tags used on 10 different garments sold at self service retail outlet.

Materials Required:

1. Paper
2. Pen/pencil
3. Camera and Printer

Procedure:

1. Visit any one or more garment retail outlets and observe the garments on display.
2. Note down the types of all labels attached to the garment as well as the all the hang tags along with their placement in the garment.
3. Note down the method of attachment/hanging.
4. Take a photograph if permitted or draw rough sketches on paper.
5. Finally prepare a survey report of your findings by comparing the labels and tags attached to the different garment and critically evaluating whether the garments were lacking in any useful label or tags.

Check Your Progress

1. Fill in the blanks:

1. __________may be called by different companies by different names such as 'spec pack', 'product pack', etc.
2. One of the main characteristics of the _________ in the tech pack is that these are absolutely flat measurements taken from the paper patterns and are not actual body measurements.
3. ___________is usually prepared by the merchandiser who is familiar with the sources of different categories, qualities and finishes of fabrics, yarns, buttons, zippers, etc.
4. Grading is done only at a few important places, which are known as __________.

2. Short answer questions:

a. What are the two steps in the development of garment designs?
b. What is a line plan and what are its components?
c. Compare and differentiate overall views and details views
d. Compare and differentiate swatches, lab dips and strike offs
e. Describe the fabric related specifications included in the construction page
f. Describe the colourways related specifications in the tech pack
g. Define and explain the labelling related terminologies used in the tech pack

3. Long answer questions:

h. Describe the process of developing points of measurement related contents in the tech pack

i. Describe the process of developing points of construction and finishing related contents in the tech pack

j. Explain the terminologies used in the construction page and describe the process of creating the grade page in the tech pack

k. Explain the essential and desired qualities of a tech pack.

Session 2: Steps in Development of Proto Samples

Sample making is the heart of the apparel making process. The sample garment made on the basis of the specifications contained in the tech pack is the deciding factor for the buying company to confirm the order. Approval of the samples by the buyer is a precondition for the manufacturers to start bulk production of the garment concerned.

The buyers will usually confirm the order if the final proto sample meets their specifications and expectations. The manufacturers would get the green signal for bulk production only when the preproduction sample meets all the tech pack specifications. The preproduction sample is nothing but a copy of the final fit sample stitched in the bulk production section using the exact fabrics and trims mentioned in the tech pack. Its measurements and fit would be of the final approved fit sample. Developing proto and fit samples has therefore become a critical step in garment manufacturing.

Both proto and fit samples can be made using substitute fabrics and trims that may vary slightly from the exact specifications given in the tech pack. But the alternative fabrics and trims should be similar to what is specified in the tech pack, in all respects. Some buyers may indicate the extent to which the materials used in the samples can vary from the actual materials specified in the tech pack. Generally, a difference of 3 to 5% would be permitted in fabric composition, weight, etc.

Each sample would have a strict time limit within which it would need to be made and submitted for evaluation. There will be also strict limits on the number of times the client may allow rectification of mistakes. The buyers would also specify the number of copies of any single sample to be submitted for evaluation. Usually, each sample may need to be submitted in two or three copies or even more if there are more intermediaries in the buying process.

Generally, buyers prefer that the manufacturer makes the proto sample correctly in the very first attempt. They might, however, give the manufacturer a chance to submit a second proto sample, if they find the workmanship observed in the first proto to be good. In the case of fit sample also, buyers would prefer that the first sample itself is correct. Buyers may Allow up to three fit samples, if they find that there are only minor fitting problems. Fit sample specifications may also be changed by the buyer based on fit sessions and fit testing.

Buyers would provide the name and contact details of the specific person in their organisation to whom the samples must be submitted. Buyers may also require that the vendors submit additional information in a prescribed format along with the samples. Some buyers may require the information to be submitted directly into their online ERP systems.

The general process of sample making requires not only a proper understanding of the tech pack and the instructions and specifications contained in it but also redoing the sample - based on comments forwarded by the buyers. The sample making process starts with the first and second proto type samples leading to the first, second or third fit sample, which would be followed by a first preproduction sample.

The manufacturer may also be required to submit several other samples such as the photo shoot sample, salesman sample, counter sample, etc. But these samples are used mainly for commercial purposes. Only the proto and fit samples go through a process of detailed evaluation, which may lead to changes in the tech pack specifications as well.

The sample making process also includes a documentation process. The comments received from the buyers would be as per the standard format included in the tech pack. The vendors would be required to carry out the changes mentioned in the comments in the next version of the sample and also keep a documentary record of changes made in the sample at different stages. In the case of fit samples, the complete history of changes made at the different points of measurement would need to be maintained.

SAMPLE MAKING ROOM

Both the proto and fit samples are made in a separate room or section so that the sample making process does not disturb the bulk manufacturing process. This room is generally named as 'sample room'. Garment manufacturing companies may have more than one sample room or multiple teams working in the same room depending on the number of styles for which samples are being made at any given time.

The sample room will have a separate set of equipment and instruments which are suitable for producing smaller number of garments. Since every sample will be required to be made within a very period of about 5 to 10 days and the quality of samples is critical for getting orders, sample rooms need to be managed efficiently. It must have not only all the required equipment and instruments but also extremely knowledgeable and skilled personnel for doing the different tasks associated with sample making.

SAMPLE MAKING TEAM

Sample making also involves all the steps of garment making in addition to the special tasks associated with sample garments only. The sample making team, therefore, includes a large number of experts, technicians and workers. There may be several teams working on different samples at the same time. While some of these professional may be deployed full time, there may be other members who join from other departments as well as outsourced experts/technicians, on a part time basis. Since sample making involves inputs from the buyers at various stages, employees, agents or representatives of the buyers concerned should be considered as part of the sample making team. In smaller companies, a single professional may be responsible for more than one function. In larger companies, there may be more than one person performing the same function. Alternatively, each function may also be handled by a team.

The following are the functional responsibilities of the sample development team:

1. **Marketing & Merchandising Professionals:** The Garment Merchandiser/Marketing team is responsible for approaching buyers and getting orders for manufacturing any garment. They are also responsible for generating the Sample Requirement Form (SRF) and coordinating with the sample development team and submitting the samples to the clients in time.

2. **Designers & Production Merchandisers:** They are responsible for interpreting the tech packs and gathering all the relevant information provided by the client through standardised manuals or instruction sheets that are applicable to different group of garment styles. They may also have the responsibility to identify the requirement of fabrics and trims and coordinate with the Store Room personnel to make them available in time. Additionally, they may be required to prepare an estimate of the cost of the garment.

3. **Production Planners:** Person/s in charge of planning and coordinating the sample production process by creating job cards and establishing timelines.

4. **Pattern Master:** A technical professional qualified to create patterns based on the tech pack specifications and grade them for all the intended sizes. The team may include both the traditional paper pattern markers as well as those who are qualified to use computerised pattern making and grading software

5. **Production Merchandiser/Store Manager:** Person(s) in charge of procuring, inspecting, and providing the fabrics and trims required for the creation of the various samples.

6. **Fabric Cutter:** The person in charge of cutting the fabrics to the patterns developed by the pattern maker.

7. **Sewing Masters:** The person/s who receives the pieces of fabrics from the cutter and stitch them to make the sample garment.

8. **Quality Inspector/s:** The person/s responsible for checking that the samples to be submitted to the clients comply with the measurements and other specifications contained in the tech pack.

9. **Quality Testers:** The person/s responsible carrying out or coordinating the tests prescribed by the clients with respect to fabrics and trims.

10. **Client/Client Representatives:** The clients may provide their comments and approvals either electronically or during face to face meetings. They must be considered as an integral part of the sample making process.

11. **Technologists (Fabric/Garment):** At times clients may ask for fabrics, trims or finishes that need to be specifically designed for a garment style. Usually, in-house or outsourced fabric and garment technologists would be included in the sample making team in such cases.

12. **Washing /Pressing/Packing & Dispatching Personnel:** Presentation of the sample is no less important. Buyers may also indicate whether the sample requires washing and pressing before submission.

SPECIAL REQUIREMENTS FOR PROTO SAMPLES

The most important point which should be borne in mind about the proto sample is that it is not like any other regular business activity. It is a business contest. Usually, buyers would send the request for a proto sample submission to at least two or three manufacturers. The manufacturers would not get more than 7 to 10 days to prepare and submit the proto samples. The focus of evaluation at the proto sample stage would be more on the capacity and capability of the manufacturer to undertake the bulk production of the garment style in time at competitive rates. The buyer would usually place a conditional contract only on the manufacturer whose sample quality is up to the market and the price quoted is acceptable. The following are the special requirements of proto sample development:

- **Competitive Costing:** Manufacturing efficiency would be the winning formula for success in garment costing, since material costs would remain more or less the same for all competing manufacturing units. It is however, important for manufacturers to remain networked with fabric and trim suppliers offering good quality materials at competitive prices. One of the steps necessary to optimise fabric costs would be to arrive at the right width that minimises cut off waste. It would also be necessary to have readymade templates preferably in computer spreadsheets for different types of garments which can help in doing the costing quickly. Manufacturers must also have accurate knowledge of direct labour cost based on standard methodologies like Standard Allowed Minute (SAM).

  However, stitching time costs might not vary significantly between factories. Therefore, adequate attention should be paid to minimising costs relating to the time spent on material handling. Another factor that would greatly help in competitive costing is overhead costs. Steps such as energy and water consumption as well as timely maintenance of machinery and equipment can help in lowering the impact of overhead costs on garment cost. Critical requirements for cutting costs and making them competitive arethe basic agenda ofeffective production planning. It ensures optimum utilisation of both human resources and equipment and minimisation of material wastage.

- **Design Interpretation:** Success in proto sample making does not depend on just sticking to the tech pack specifications. It requires a deeper understanding of the designer's intent to give the garment the desired style. Along with the analysis of the body measurements in the PoM chart, it would be necessary to develop a clear idea of the intended silhouette and style by examining the overall and detailed views of the garment presented in the tech pack. It requires an expert pattern maker to interpret the design. The PoM would contain only point to point 2D measurements. The pattern maker would need to use her/his experience and his understanding of the designer's intent to connect these dots with shaped lines. This is the reason why the foundation patterns are called slopes. The pattern shapes are as much important as the body measurements in the evaluation of proto samples. The buyers would also require the pattern to be submitted along with the proto sample. The quality of the pattern would also be weighed in while evaluating the proto sample. It is therefore, necessary to give utmost importance to the correct interpretation of the intended design at the pattern making stage.

- **Construction Quality:** The buyers would evaluate the proto sample not only from the point of compliance to the tech pack specifications but also to assess the quality of construction. Good quality construction is a major factor that influences consumer's buying decisions and therefore, fashion brands would like to be sure that their manufacturers are capable of doing the garment construction work perfectly. However, from the manufacturer's point of view, it is an area where they would like to outscore their competitors and win the order. The following are some of the important steps necessary for facilitating good quality construction:

  - **Preparation of the fabrics and trims:** Flawless fabrics and trims provide the foundation for making a good quality sample garment. In addition to the inspection of fabrics and trims prior to use, these may also require additional treatments. Some fabrics may need to be laundered or dry cleaned to ensure preshrinking. Slippery fabrics may need to be treated with sprays that stabilise them. Pressing would be required before sewing to ensure even stitching and while stitching to get the right seam finishes. It may also be necessary to place notches while cutting to help in proper matching of fabric pieces. It is also important to ensure that there are no frayed edges. Serging may be done to prevent ravelling of edges. It is also necessary to have the lengthwise and width wise grains perpendicular to each other across the whole fabric piece. Similarly, trims like linings, interfacings, zippers must be ironed to facilitate flawless stitching.

  - **Compliance to stitch specifications and standards:** While the construction page of the tech pack provides the construction specifications, the buyer expects the manufacturers to follow the requisite standards in the construction process. A good quality construction is one which does not make the seams conspicuous unless designed to make their presence felt. A standard requirement is to make sure that the stitched areas are smooth and bulk-free. Seams need also to be linear or smoothly curved without any defects and at a consistent distance from the edges. The first step towards good quality machine stitching is to choose the right size needle and thread, followed by appropriate thread tension, stitch length and foot pedal pressure. The aim of good quality stitching is to have an equal balance between the top and bottom threads giving the seam an even look all over. The stitches must be also secured with proper locking at the beginning and end. Special attention needs to be paid to the stitching of some prominent parts of the garment such as necklines, collars, sleeves, cuffs, plackets, buttonholes, pockets, waistbands, hems, etc. as these require skilful handling of the fabrics and machines.

- **Perfect finishing:** Giving the stitched sample proper finishing is as much important as the quality of construction. Tidying up the sample garment and removing threads is the first step in finishing the construction process. The next step would be put the garment through washing process prescribed by the buyer. Next step is to give the sample garment perfect pressing. Good quality pressing should leave the texture of the fabric as natural as it can be. Seams should be pressed flat so as to make them inconspicuous. While there should be no wrinkles on the main body of the fabric, special features like pleats and tucks must be pressed perfectly to highlight their contribution to the design. Darts must be pressed to reflect the shape it is designed to create. There should be no ridges arising from the darts, facings or seams. Pressing must also be done carefully so as not to leave any steam marks or water spots.

- **Timely Submission:** The buyers are always keen to choose the manufacturer for placing the order as early as possible, keeping in view the time it would take to source the exact fabrics and trims, test the fit and approve the preproduction sample. This is the reason why they allow only a short lead time of 7 to 10 days to the garment factories to submit the proto samples. This is also the reason why they would allow the use of similar fabrics as well as substitute trims in the making of proto samples. The short lead time also helps in evaluating the capacity of the manufacturers to comply with strict production schedules.

  Therefore, effective production planning becomes a critical factor in submitting the proto sample to the buyer within the stipulated time. It is possible that the buyer gives the manufacturer a second chance to produce and submit a revised proto sample. In this case also, the very same proto sample development process would be repeated. The only additional requirement would be to implement the comments and changes received from the buyer after the evaluation of the first proto sample.

STEPS IN DEVELOPMENT FOR FIT SAMPLES

SPECIAL REQUIREMENTS OF FIT SAMPLES

While the proto sample represents an effort on the part of the manufacturer to satisfy the buyer, the focus of the fit sample would be to satisfy the future customers of the concerned garment style. Creating a fit sample would involve the combined efforts of both the buyers and manufacturers to meet the fit expectations of potential consumers. The buyers may also experiment with changes in the measurement charts and the patterns to create a fit that highlights the style and achieves larger size coverage. Usually, the buyers may choose to try out two to three fit samples. It is also possible that in some of the samples buyers discard the experimental changes and go back to the original specs.

The role of the manufacturer is however, limited to faithfully executing the changes made by the buyers in the tech pack specifications. Buyers would carry out a detailed evaluation of the fit of a garment by using multiple methods such as 1) checking the fit on dress forms, 2) conducting fit sessions involving live models and 3) virtual fit checking with the help of 3D avatars. The buyers may change the tech pack specifications from one fit sample to another till they are happy with the fit.

COMMON STEPS IN MAKING PROTO AND FIT SAMPLES

Sample making is a generic process. Both proto and fit samples are made in a similar manner in the same sample room. Only the areas of special attention changes as proto and fit samples are evaluated for different purposes. Generally, proto samples are used for assessing the capabilities of the manufacturers and their cost competitiveness for placing the order. Fit sample, on the other hand, is prepared mainly to ensure that the garment to be produced in bulk would have perfect quality. The following are the common steps in the proto and fit sample development:

1. **Sample Tag Preparation:** Every sample needs to have a tag attached to it, which provides the information necessary for its correct identification and evaluation. The tags must be in accordance with the size, format, artwork and content prescribed by the client. The specifications of the sample tags may vary from client to client and also from garment to garment. The tags would generally contain identification information specified in the tech pack headers such as the Style ID, Designer, Name of the factory submitting the sample, Date of submission, Sample Type, Sample Size, etc. In addition, there would also information about the fabric, fabric composition, fabric weight, Fabric Construction, etc. as well as details of the specific finishing or other special instructions required for evaluating the sample. It will be usually attached to the garment using a swift tack

made of plastic using a special tool. Clients may also specify how and where the tag should be attached.

2. **Paper/Electronic Pattern Development:** Pattern making is perhaps the most important step in the sample making process. It must not only follow the measurements indicated in the points of measurement (POM) chart accurately but also be according to the style depicted in the technical views. Clients may also require the paper patterns used in the making of the sample garment to be submitted along with it for evaluating the sample. Some buyers may however allow electronic submission of patterns in the case of size set samples, which must be in the prescribed software and format. Large buyers may require that the electronic patterns be uploaded to their ERP systems along with the filling out of an online form pertaining to such submission.

3. **Fabric Card Preparation:** This is a parallel process, which must be carried out alongside sample making since the fabric samples would also need to be approved by the buyers along with the samples before making the preproduction samples. The full details of the fabrics to be sourced will be included in the bill of materials (BoM) page of the tech pack. There may be buyers who may require the fabrics to be sourced from nominated vendors. In such cases, the buyers would also supply the exact fabric code and there would not be any need to include it in the fabric card. Wherever a fabric card is required to be submitted for approval, one of the first things to be done is to provide a clearly identifiable unique code for each fabric sample. The fabric card should also contain all tech pack header information to make it easy for the buyers to associate it with the correct garment style. Along with the code, a record of the date of development or procurement of the fabric must be maintained. The card would contain samples of fabrics that would be used inthe bulk production of the garment – and not of the sample garment. It is necessary to make at least three more copies of the fabric card than what is specified by the buyer. It would provide not only as a record of what was sent to the buyer but also become handy, when the production team commences the sewing process or quality inspectors need it to check the quality of the fabrics. Preparing the fabric card could also be a time consuming process, if it involves customised colours, prints or patterns. Usually, the fabric card would contain the following, which may be put together on a single card or prepared as separate cards depending on the buyers requirements:

    a. **Swatches:** These are small square pieces of fabrics of about 6”x 6” size with serrated edges cut from a larger piece of fabric to give an idea of the entire fabric, its quality and properties. It may be in a different shape and size depending on the characteristics of the fabric like a border or as specified by the buyer. It should be in the same fibre, construction, colour, weight, hand and finish indicated in the tech pack. Colour must match the Colour Standard code such as Pantone under the specific light box conditions prescribed by the buyer.

b. **Knit Downs:** The term 'knit down' refers to swatches of knitted fabrics. These are usually submitted in 12" x 12" size or as per the buyer's specification. Knit downs go through a different approval process, which is done even before the development of the proto sample. First, the yarn and its colours are approved. This is followed by the approval of the knit down. These knit downs should clearly show the knitted patterns. Proto sample development would be taken up only after the approval of the knit downs.

c. **Lab Dips:** These will be required in the case of customised colours. The normal size of the lab dip is 6"x 6". The minimum lab dip size can be as low as 2"x 2". The buyer would also want 3 to 4 or more lab dips having slightly varying shades corresponding to the same standard colour code for choosing the best. Lab dips would be evaluated under specific light box conditions including primary, secondary and tertiary light sources. Some buyers may also indicate the manner in which the fabric colour and hue need to be viewed and tested. Lab dips must be handled carefully and stored safely since even a slight dust or dirt can affect the evaluation of the colour.

d. **Strike Offs:** These refer to printed fabric samples having motifs or patterns. In this case, there may not be any size requirement, since the sample should give the buyer a complete idea of how printed patterns or motifs look. At the outset, both the fabric and the colours must be as specified by the buyer. If the print is an all over print with repeating blocks, then the repeats must be perfectly aligned and print size of the block must be exact and should not be scaled to suit the machine requirements. In the case of motifs, the sample should contain the complete artwork.

e. **Handloom/Bit Loom/desk loom:** All these are samples of yarn dyed woven fabrics having patterns. In early days, these samples were made using handlooms and that is the reason why these samples are still called handloom. The quality of the handloom is relatively poor. But these days, digital sample looms are available for making good quality of yarn dyed woven fabrics. Usually, these have a width of 24" and the length would be one or two meters. These give an idea to the buyer about the look of the fabric. Approval of desk loom samples must be obtained before ordering bulk production of such fabrics.

4. **Trims Card Preparation:** Similar to the fabric card, the trim card would be required not only for getting the approval of the buyers but also for use by the raw material sourcing team and later by the quality inspection team to check the quality of trims attached to the garment. Trims include everything that is attached to the garment such as threads, yarns, buttons, zippers, drawstrings, elastic, labels, embroidery, sequins, belts, tags, etc. As in the case of the fabric card, at least three additional copies of the trim card would be required for internal use other than the copies to be sent to the buyers. One for the record, another for the production team and one more for the quality inspection team. Each item on the card must have the code and name as per the Bill of Materials (BoM) page of the Tech Pack so as to make it easy for the buyers to identify it. The card must also carry the Tech Pack header information at the top. The trims attached to the card would be those that would go into the bulk produced garments and not into the samples. The quality, colour and construction details of the trims must completely match the specifications indicated in the BoM.

5. **Production Planning, Sourcing of Fabrics & Trims:** Once the patterns as well as the fabric and trim cards are ready, the next step is to take up the production of the sample. Since the manufacturers would only have a limited time of 7 to 10 days to submit the samples to the buyers, it is of utmost importance to do proper production planning keeping the submission as the zero date. Target date and time for the completion of the activities must be set so as to have the desired sample ready by the zero date. Simultaneously, sourcing of fabrics and trims must be undertaken. It is necessary to check first with the store room and make a list of items, which fall within the range of quality variation allowed by the buyer and make immediate arrangements for the procurement of the remaining items as quickly as possible but before the target date and time.

6. **Fabric Inspection, Marking & Cutting:** Fabrics play an important role in the look and appeal of the samples. Ensuring the quality of the fabrics starts with its proper inspection as this process would be necessary to prevent fabrics with defects getting into the samples. Since only a limited amount of fabric would be consumed in the sample making process, optimisation of markings may not have major commercial implications. However, careful marking would be necessary to adhere to the grain directions and other markings indicated on the pattern. Since sample making would involve only a few copies of the same sample, smaller cutting machines may be used

to achieve accuracy and efficiency. It may also be a good practice to verify the markings with patterns and also cross check the pattern with the points of measurement (POM) chart for being completelysure of the accuracy of the cut panels.

7. **Stitching & Finishing:** Along with the fabric quality and the accuracy of the cut panels, the quality of stitching plays a major role in creating positive impression in the minds of the buyers about the capabilities of the manufacturer. It is important therefore, to read the construction section of the tech pack thoroughly and note down the exact type of stitching and finishing specified for each and every seam. Nothing should be assumed. Finishing must also include small steps like snipping off the hanging threads. The buyer might also get the stitching tested for quality compliance in terms of the type and quality of threads, stitch per inch (SPI), seam strength, seam extension, shell deformation, puckering, etc. Adequate care must be taken to get the stitching and seam finishing absolutely correct. One of the key parameters that adversely affect the quality of stitching is inappropriate thread tension. The sewing surfaces and the tailor's hands must be perfectly clean to avoid the samples getting dirtied. The sewing machines must also be properly maintained to prevent breakage of needles which might damage the seams and the fabric. The choice of needles and sewing thread must match the fabric structure.

8. **Quality Checking:** It is better to get the quality of the sample garment in house and prevent quality problems showing up at the buyer's end. Quality aspects must be monitored during the sample making process as well as at the end of it. The quality inspectors must have copies of not only the tech pack but also the fabric and trim cards before starting the in process and post production quality checks. The following are the key aspects of the sample garment, which must be checked before it is passed for submission to the buyer:

   a. **Fabric Quality:** Fibre composition, colour/pattern, weight and hand must be cross checked with the tech pack and the entries in the store room. The surface of the fabric must also be examined carefully along with the fabric inspection report.

   b. **Colour/Print/Artwork Check:** Check and tally the fabric colour with the approved fabric swatch or lab dip in a light box with lighting conditions prescribed by the buyer. Do a crocking test by rubbing a wet or dry white cloth on the printed/coloured surfaces of the fabric to ascertain there are no colours run off or print peel off.

   c. **Pattern Shape Verification:** It is also important to tally the shape of the patterns at the cut stage and at the stitching stage to ensure that the garment fully reflects the intended style of the design. The garment must also be cross verified with the patterns or development sample, if any, sent by the buyers.

d. **Measurements:** Adherence to measurements is a very basic requirement of sample making. Even a minor error in measurements could make the buyers develop doubts about the capabilities of the manufacturers. Although PoM chart would include tolerance limits by which actual measurements of the garment could exceed or fall short of the specified measurements, sample makers must stick to the measurements stipulated in the tech pack and not rely on the permissible tolerances.

e. **Stitch Quality including Seam Finishing:** It is one of the prime concerns of the buyers and must, therefore, receive the maximum attention from the sample developers. Quality inspectors must ensure the sample garment is made strictly according to the seam specifications given in the tech pack. It would be necessary for the quality inspectors to perform the same tests that the buyers would do after receiving the sample. One of the primary parameters to be checked is stitches per inch (SPI). Count SPI randomly for each seam and confirm its compliance to the spec. Also check the seams for strength by pulling the joined fabrics apart. Identify the defects such as skipped stitches or holes along the seam as well as other stitch or seam deformations.

f. **Quality and Correct placement of Closures and other trims:** Every item on the trim card must be checked for quality compliance as per the tech pack. Placement of the trims must be checked by measuring distances specified in the tech pack. Each button and buttonhole must be checked for comfortable functionality. Zippers should be checked for smooth flow and locking as well as for their straightness and flatness. Other trims attached to the garment such as beads, sequins, shoulder pads, rivets, straps, etc. must be pulled to test the strength of the joining made to the fabric. All linings and interlinings should be checked for quality and placement compliance to tech pack specs.

g. **Labels and Tags:** Apart from the sample tag, there would be several other labels and tags. Some of the common labels and tags include brand labels, care labels, information labels. These can be made and attached to the garment in different ways such as sewing them, ironing them or sticking them. In the case of labels that are supplied by the buyers or sourced from vendors nominated by the buyers, the placement and the method of attachment must be checked for compliance with the tech pack specs. In the case of labels, which are to be made as per design provided by the buyer, checking must cover all aspects depending upon whether these are woven, printed, stamped, engraved or embroidered. Apart from labels, buyers may specify number tags to be attached. The extent of checking required would depend upon whether it is supplied by the buyers or their nominated sources or if it is to be made by the garment manufacturers themselves as in the case of labels. In addition, both the type and place of tags must be checked for compliance with the buyer's requirements.

h. **Consistency among the Sample Copies:** It is necessary not only to check each sample individually but also compare all the copies of the sample for consistency. Since copies of the samples are likely to be checked by different people located in the same or different places, any inconsistency observed among the different samples can easily damage the reputation of the garment manufacturer.

i. **Cleanliness Check:** The garment should be checked to ensure that it is free of all kinds of dirt and also that all the washing and pressing instructions given by the buyer have been followed. A metal detector test of the garment should also be done to identify and remove any broken needle attached to the garment or hidden inside the seams.

j. **Packing Check:** Most buyers will give special instructions about how the sample garments need to be packed and submitted for review. Therefore, it would be necessary to verify whether these instructions have been duly followed. If there are no specific instructions from the buyers, the packing parameters must be checked against standard industry practices.

9. **Washing, Pressing, Packing & Dispatching:** Adequate attention should be paid to packing as this would be the first thing that the buyer would get to see even before seeing the sample. Packing should be done perfectly and professionally to create the best possible first impression. The packing materials should be carefully selected so that the sample garment remains completely unaffected by the rough and tough handling, the package might face during transit. Washing and pressing is also required to create a good first impression and bring out the quality of workmanship. Fashion is all about creating a good impression. The same principle must be applied to packing for fashion garments. The buyer would usually specify the names and addresses of the persons to whom the samples need to be dispatched. The packages must contain all the information necessary for easy and quick transmission of the packages to the right people.

10. **Updating the Tech Pack and Preparing Sample Submission Documentation:** The sample making process is not complete until the

tech pack is updated with the latest information by changing the status in the tech pack header to the current version of the sample along with the date of such change. In the case of samples made in response to the comments of the buyer about the previous sample, the comments page would also need an update. The comments should clearly mention how each of the specific comments received from the buyer has been attended to and implemented. In the case of fit samples, the fit history page would also need to be updated to indicate all the changes made as per the buyer's comments. In addition, buyers may also require that the samples are submitted along with a sample submission form in their prescribed format. Some buyers may require sample submission forms directly into their ERP systems.

Activities

Activity 1: Develop and cut the mock proto sample patterns

Materials Required: Mock tech pack developed earlier, pattern making tools, and pattern cutting paper

Procedure: Analyse the measurements in the mock tech pack Prepare the patterns based on the measurements, include all the necessary markings and cut the patterns

Activity 2: Develop the mock proto sample

Materials Required: Mock proto sample patterns developed and cut earlier. sewing machine, fabrics, trims, ironing press, poly bag, empty tags with strings,

Procedure: Cut the fabrics using the pattern. Sew the mock proto sample, carry out quality inspection checks, press the sample, attach the tags and pack it neatly inside the poly bag,

Check Your Progress

Fill in the blanks:

1. ____________is responsible for approaching buyers and getting orders for manufacturing any garment.
2. SRF stands for____________.
3. The term _________ refers to swatches of knitted fabrics.

4. _________ include everything that is attached to the garment such as threads, yarns, buttons, zippers, drawstrings, elastic, labels, embroidery, sequins, belts, tags, etc.

1. Short answer questions:

a. Describe the process of making sample tags and list the information included in it

b. Describe the design interpretation process in proto sample making

c. Describe the washing, pressing and packing requirements of proto and fit samples

d. Describe the factors that contribute to the cost competitiveness of garment manufacturers.

2. Long answer questions:

a. Describe the functions of the sample room and the types of human resources required in the sample making process

b. Describe the special requirements of proto samples

c. Describe the processes of pattern making, inspection of fabric and trims and stitching and finishing in sample making.

d. Describe the process of preparing fabric and trim cards of proto and fit samples

e. Describe the quality inspection process of proto and fit samples

Session 3: Garment Production systems and Sequencing of Assembly for Garment Construction

Production of garments is taken up after the sample is approved by the buyer and sealed as the finally approved sample. It is also called the 'gold' or 'red' or the 'production' sample. Garment production is usually done inside a factory which is different from a fashion boutique which produce a few made to order garments at a time. A garment factory is designed to stitch a very large number of ready to wear garments of the same or multiple styles at the same time. A factory would have several specially trained professionals and workers to do the whole or part of the garment making work. In addition, there would be several types of industrial scale sewing machines and other specialised machinery, equipments and instruments for doing specific tasks. There would be separate rooms or floors which are dedicated to carry out each step in the garment production process.

While garment making involves common generic processes, it is up to the factory to choose the specific types of production systems depending on the type of orders, the kind of machinery it has and more importantly the skill levels and profiles of the workers. It is therefore necessary to understand the differences between the common garment production processes and the specific type of production system used by a garment factory.

- **Production Process:** A production process comprises all the steps that a factory would undertake to make a garment, according to an approved design, from start to finish. Production processes remain more or less the same in all factories. Differences would however, exist in relation to whether a particular part of the process is done by automated or manual machines. There may be also differences in the exact nature of the machinery or the skill levels of the workers engaged in doing any specific task.

- **Production Systems:** Production system refers to the manner in which different parts of all processes connected with the manufacturing of garments are linked to each other systematically. Very specifically, it describes the manner in which any garment is stitched and assembled inside the factory. Although the sequence of assembling different parts would vary from one type of garment such as shirts to another like trousers, production systems refer to the common methods used in the assembly of all types of garments, Different garment factories might use different types of garment assembly. One factory may also use more than one production system depending upon the nature of the order. Some factories may also combine more than system to create their own unique production system.

THE PRODUCTION PROCESS

The main aim of the garment production process is to make garments that meet the design, quality and delivery requirements of the client at the least possible cost with minimal rejections and wastage. This objective cannot be achieved by focusing on only one or a few aspects of the production process. Every aspect of the production process is important.

Attention to design and quality compliance would be required right from the start. If deviations and deficiencies are not addressed at the very first instance of their occurrence, these problems would only get compounded in subsequent processes. As there are large numbers of distinct processes and sub processes, it would be necessary to group these according to the stages in the production of garments and implement relevant quality control procedures separately for each.

Since bulk production commences only after the approval of the preproduction sample, it is assumed that patterns for the garments including the graded patterns, have already been developed and are available for use.

It is also assumed that the garment factory knows the exact amount of fabrics and trims required for making the garment. These are usually calculated at the time of submitting price quotations and samples for winning the contract for manufacturing the garment. The requirements for fabrics and trims are calculated either manually or with the help of CAD systems based on the measurements and specifications provided in the Tech Pack.

Production Planning

Proper planning of the entire production process is very essential for achieving the main objectives. There are two types of objectives which the production process must satisfy:

- **Buyer related objectives:**
    - **Minimising the Cost of Production:** The cost of production must be kept minimal to enable the buyer to be competitive in terms of product pricing.

- **Maximising Quality:** The quality of the garments produced by the factory must fully comply with the specifications indicated by the buyer.

- **Proper Finishing and Packing:** All the garments must be packaged in accordance with the buyer's requirements.

- **Timely Delivery:** The entire quantity of garments ordered by the buyer must be delivered to the buyers within the agreed delivery period at the place indicated by the buyer.

- **Manufacturers related objectives:**

  - **Optimal Utilisation of Production Facilities:** Production planning is necessary to minimise the idle time of machinery so that these are used to the maximum possible level.

  - **Optimal Utilisation of Human Resources:** Allocation of the right human resources for the right production process is necessary to control the overall cost of production and ensure the quality of the garments produced.

  - **Minimising the Wastage of Resources and Time:** Proper production planning is also required to ensure that there is no wastage of raw materials and there are no delays in between the various stages of production.

  - **Minimal Inventory Costs:** The garment factory needs to hold the least amount of unused stocks of raw materials and unfinished products to minimise the cost of holding unnecessary levels of inventories.

Stages of Garment Production and Related Processes

The garment manufacturing process starts only after the design, created by the in-house design team or sent by the buyer in a tech pack, is converted into a sample garment and approved. Apart from the sample garment, all the fabrics, trims and patterns as well as the cost estimates would also need to be approved before taking up the actual bulk production of the garments.

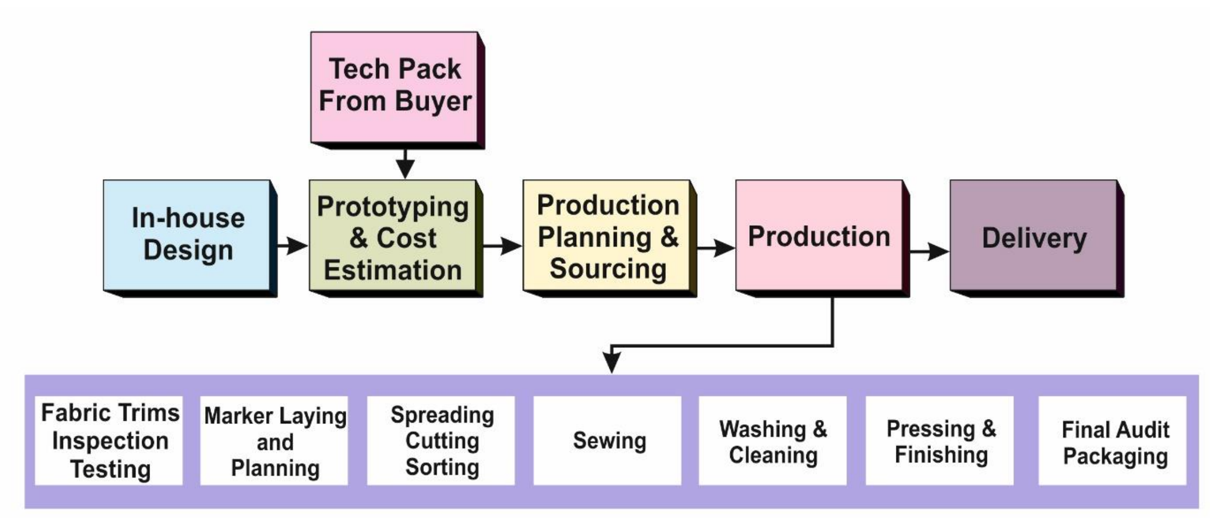


Fig.: 2.3 - Stages of Garment Production and Related Processes

There are two other important steps which must be completed before starting the bulk production process. First, the entire production process must be planned keeping in view the requirements of the client and the internal objectives of the manufacturing company. Secondly, sourcing of the bulk fabrics and trims should be completed before starting the manufacturing process.

Steps in the Manufacturing of Garments

Actual bulk production of the garments commences after the completion of the production planning and sourcing and stocking of all the necessary fabrics and trims. The following are the component steps of a garment manufacturing process. An important process that takes place during all the manufacturing steps is quality monitoring and control.

- **Inspection and testing of fabrics and trims:** Quality problems must be addressed right from the raw material stage so as to minimise the number of garments that get rejected during the final inspection as well as to eliminate the wastage of raw materials and other resources like labour and energy. Therefore, inspection and testing of fabrics and trims have become the most important initial steps in the garment manufacturing process. Fabrics are inspected either manually or with the help of machinery and the extent of deficiencies in quality is noted down. The observed quality problems are calculated using four points or 10 point or other standard systems. In the four points system for example, penalty points are assigned on a scale of 1 to 4 to each defect depending on the length or width of defect. A maximum of penalty points are allowed per 100 square yard of fabric. Under the four points system, a minimum of 10% of the total fabric must be inspected. Buyers may also stipulate 100% fabric inspection.

Apart from visual inspection, specific laboratory tests are conducted to ascertain other quality parameters such as fabric weight, hand, stretch, colour fastness, etc. depending upon the conditions imposed by the buyers. Similarly, buyers may also specify quality requirements with respect to trims. While visual inspection would be used to remove all the defective trims, laboratory tests would be done for complying with other quality requirements indicated by the buyers. Sorting and numbering of the trims will be done as part of the inspection process to ensure that right trims are used in the right place. At the same time, the fabrics would also be sorted. Fabrics produced/dyed in different batches likely have minor variations in shade. While these variations may be within the band of shades approved by the buyer, it will be necessary to ensure that there is no shade variation in the fabrics used for making any single garment based on the inspection.

- **Marker planning:** It is required to ensure that there is minimal wastage of fabrics in the cutting of the different pattern pieces. In order to achieve minimal wastage of fabrics, pattern pieces of all sizes are pooled together and arranged on a single layer in a way similar to the jigsaw puzzle game. Marker planning may be done manually or with the help of CAD software. Marker making involves the following four steps:

    - In the first step, the length and width of a layer of cloth required for cutting the panels as per the patterns of the different garment parts are determined. The length and width of the fabric are kept larger than those of the marker. Other factors which are taken into account are the width of the fabric excluding the selvedge and the size of the cutting table.
    - In the second step, the patterns are so arranged on the fabric layer or paper as to minimise the wastage of fabric. At the same time, the following are the primary requirements for marker planning:
        - **Alignment of the grain:** The patterns should be laid according to the grain direction shown on the pattern. The grain lines on the pattern should be kept parallel to the warp lines of the fabric
        - **Using the face of asymmetric fabrics:** When the front and back of the fabrics are different, then the patterns are marked paying attention to features like the direction

of nap, or pile, etc. Extra attention is required in the case of printed or fabrics having woven patterns.

- **Adhering to design requirements:** A basic requirement of marker planning is to ensure that there is space left to grain balance in accordance with the design requirements. The same applies to printed fabrics or those having woven patterns. Special attention requires to bepaid to how the cut panels would look after joining.
- **Allowance for cutting blade movement:** Adequate space is left between the pattern pieces particularly around the curved areas to allow easy movement of cutting blades.
- **Transfer of marks and notches:** The notches and marks appearing on the patterns are also transferred to the markers accurately.

- In the third step, each marked pattern piece is assigned a unique identification number based on its size and part numbers so as to ensure that there is no mixing up of the pattern later.
- In the last step, as many copies of the master marker plan are made as required using standard duplicating methods.

- **Spreading, Cutting, Sorting and Bundling:** Both spreading and cutting can be done manually or with the help of computerised as well as non computerised machines. Sorting is generally done manually.

  - **Spreading the fabric and laying the marker:** This process begins by opening the fabric bolts or rolls and laying the fabric on the cutting table according to the length and grain direction of the marker. The exact shade of the fabric should be identified and matched with the shade band and marked on the spread. Layers are formed by folding the fabric back and forth keeping the length of the folds as per the marker length. In the case of mechanised cutting, the total height of the folds is determined by the height of the cutting blade. After spreading the fabric, the marker sheet is placed on the laid fabric. Every single item included in the marker should be individually checked for its correctness. In case there are any deficiencies in the marker sheet, it must be replaced by a perfect marker sheet. The marker must be fixed firmly over the spread fabric lay to ensure that it does not move or shift its position during cutting. Some of the spreading related quality requirements are as follows:
    - **Compatibility with the cutting system:** The lay must fit the cutting table. Its height must match the height of the cutting blade to be used for the concerned marker.

- **Use of a single shade of fabric:** Since more than one roll/bolt of fabric may be needed for spreading the lay for cutting, it is necessary to ensure that there are no shade variations in the fabrics in a single lay.
- **Removal of faulty fabric areas:** Areas of fabrics having quality problems would be marked out during the fabric inspection stage. While spreading the fabrics for cutting, these marked out areas having quality issues must be eliminated.
- **Stability of the plies:** There should be no skewing or bowing of the fabric in any ply. It would also be necessary to open out all types of wrinkles to ensure that each ply is flat and smooth and would not stretch afterwards. In the case of knit fabrics, these must be cut into sections and allowed to relax overnight so that they are not stretched unnecessarily during spreading. In the case of synthetic fibres, it must be ensured that there is no static electricity between the plies so that the fabric is in fully relaxed state. It may be also necessary in some cases to cut out the selvedge to relax the fabric.
- **Quality requirements of the spread lay:** In the case of asymmetric fabrics, they must be laid either in the face-up or face-down direction only. All the plies must be aligned with each other perfectly and must have additional area to easily accommodate the markers. The lay should also be stable enough to ensure that no part of the fabric slips away or gets twisted during the process of cutting.

- **Cutting the fabric:** It is the process by which fabric pieces corresponding to the pattern pieces of the different parts of the garment are cut out from the actual fabric. Cutting may be done manually in the case of limited requirements. However, cutting of fabrics for bulk production is mostly done with the help of computerised or non computerised machines. These machines may use metallic blades or laser for cutting. The metallic blades may also come in different shapes. Adequate training in the use of these machines is a prerequisite for performing the fabric cutting job perfectly. The most important feature of cutting is that it is an irreversible process and therefore, it must be done after confirming the identity of the marker. The cutting process must also be carried out with extreme care. The following are some of the quality requirements of the fabric cutting process:
  - **Use of the correct cutting method/blade:** The choice of the cutting method should be based on the curved or

linear nature of the patterns, the type of fabric and the design requirements.

- **Importance of relaxed fabric:** It must be ensured that the fabrics in the lay are fully relaxed before cutting so that there is no stretching or shrinking afterwards.
- **No frayed edges:** Cutting must be done cleanly and smoothly particularly around the curves, leaving no frayed edges anywhere. It is important to ensure that the blades are perfectly sharpened to cut the fabric smoothly.
- **No fused edges:** Edges of synthetic fabric tend to fuse from the heat generated by the cutting process. Adequate precautions such as the use of heat absorbent paper, anti-fusion lubricants, etc to avoid fused edges.
- **Accurate cutting:** The cutting must be done perfectly on the marker lines to ensure that there is no more or less fabric at any place along the cutting line.
- **Use of block cutting where necessary:** This is required when woven or printed stripes, checks, patterns or designs need to be matched. In such cases, cutting is done not exactly on the marker lines but around them leaving a buffer for matching the designs.
- **Consistent cutting across plies:** Cutting must be exact on all plies. No ply should be allowed to slip or shrink during the process of cutting.
- **Transfer notches and marks.** All the marks and notches must be included in the cutting without fail as these marks play an important role in the sewing process.

- **Sorting and numbering:** Since the marker may include components of different garment sizes, they must be sorted accordingly. At the same time, it would be necessary to ensure that there is no mix up of panels cut from fabrics belonging to different shade bands. After sorting, each component part is also numbered based on the garment size, shade and part number.

  At the time of sorting, each of the cut panels is also inspected for possible quality problems such as weaving, dyeing, printing, cutting defects, etc.

- **Fusing if necessary and bundling:** In case any of the cut panels needs fused interlining, it is first passed through fusing machines before getting bundled. Finally, all the garment parts going into the making the whole garment or any part of it are bundled together as required by the production system of the factory. Some production systems may not need bundling. At the time of bundling also it is ensured that all panels in a bundle belong to the same shade number.

- **Sewing:** It is the process of stitching all the fabric panels together according to the construction instructions given in the tech pack and produce a whole garment. The sewing process involves the utilisation of large number of industrial scale sewing machines and operators, besides those engaged 1) in the distribution of fabric bundles and trims, 2) inline quality inspection, 3) machine repair and maintenance and 4) line and floor supervisors. The sewing process is a major factor affecting the cost competitiveness of a garment factory since all other costs such as those of raw materials, machinery, electricity, transportation, etc. would remain more or less the same for comparable factories. The efficiency of the sewing department is very important for the profitability of any garment manufacturing process. Therefore, very special attention is paid to all aspects of sewing process to minimise manufacturing costs. The following are some of the generally followed best practices of the sewing process:
    - **Garment Analysis:** Before starting the sewing operations, the garment is studied with respect to all its constructional details to identify or estimate the following:
        - **Operations:** All the types of factory operations which would be required to undertake the production of the garment.
        - **Machinery:** The exact number and type of machinery and tools that would be required to carry out the production of the particular order.
        - **Human Resources:** The exact number of factory personnel required for the successful completion of production.
        - **Days/hours of Work:** The number of days/hours needed to fulfil the order for production.
        - **Bottlenecks:** The types of problems that could arise in the production process which could delay the achievement of the production target.
    - **Line Planning and Balancing:** Line planning refers to the allocation and arrangement of the different types of machinery and operators and the organisation of the workflow to achieve a specified production target within a given period. Line balancing is the process of maximising the efficiency of a production line by identifying areas of delays or idling and taking steps to

maximise the output. The following are the main advantages of line planning and balancing:

- **Maximum Capacity Utilisation:** Properline planning helps in using the production line to its maximum possible capacity with the right amount of loading.
- **Minimal Production Time:** Correct scheduling of line plan along with the elimination of bottlenecks in the movement of materials and preventive maintenance of the machinery helps in reducing the time taken for the production of the garments to the bare minimum.
- **Reduced Cost of Production:** Efficient line planning also results in the lowest possible cost of production by reducing the idling time of the machinery and operators.
- **Reduced Requirement of Machinery:** Since line planning and balancing increase the rate of production, it would lead to a reduction in the number of machines required for achieving production targets.
- **Timely Achievement of Production Targets:** Good line planning also helps in completing the production on time by eliminating delays in the production process.
- **Optimal Utilisation of Human Resources:** Line planning achieves its objectives of producing quality garments and minimising costs and time by deploying the workforce diligently based on the level of expertise and efficiency required for each of the production processes.

- **Stitching:** Stitching is the process of attaching the fabric pieces cut as the patterns of the style to produce the whole garment in accordance with the construction instructions given in the tech pack. These instructions would normally cover: 1) the type of sewing machine to be used and the number of needles, 2) the type of stitch to be used, 3) the type of thread to be used and 4) the type of finishing to be done. Similar instructions would also be included in the tech pack about the trims to be permanently attached to the garment. Each factory may use a different type of production system for all or specific types of garments the details of which are covered in the next section. The following are the generic steps involved in the stitching process:

    - **Material Movement and Handling:** Bundled fabric pieces along with the requisite trims are distributed to the various sewing machine operators according to the production system and line plan. Efficient material handling requires that no machine operator is made to sit idle for want of materials.

- **Attachment of Additional/Customised Parts to Machinery:** Before production commences, it is also necessary to ensure each machine is fitted with the required attachments and tools for performing the jobs allocated for the operator using such machines.
- **Actual Sewing by Operators:** Operators do the operations allotted to them according to the production system. It may involve stitching a complete garment or only a part of the garments. Sewing involves not only joining the fabrics but also attaching the trims like buttons, zippers and the permanent labels in place.
- **Inline Quality Checking:** Quality inspectors keep moving around the production line to monitor the quality of sewing being done by the different operators and help correct mistakes at the source itself.
- **Inline Production Data Collection:** Data relating to the work done by the operators would be collected periodically to monitor the progress of production and take tamely action to achieve the target assigned to the production line.
- **Operator Level Production Targets and Incentives:** The factory may fix targets for each operator and award incentives for output beyond the target. Some factories might also link payments to the number of pieces produced by the operator.
- **In-house Repair/Replacement of Machinery Parts:** In order to prevent machine/tool faults affecting the output of the production process, the factory must have adequate inventory of frequently damaged parts as well as immediate repair and replacement services for machines and tools.
- **End-product Quality Checking:** Once the sewing of any garment is completed, it is checked on a table which has enough space for fully spreading the garment and examining each aspect of its construction. It is checked for both the completion of all the required construction tasks as well as the quality of the construction work. Incomplete and garments having repairable quality problems would be sent back to the operator while garments with non rectifiable quality problems would be rejected and deducted from the output of the concerned operators.

- **Washing and cleaning:** Washing is not mandatory for all garments. Washing is done when required by the buyer and in a manner prescribed by them. Washing is generally done in industry-scale washing machines. Washed garments are sent to the pressing section with bundle cards indicating the number of garments, garment size, the style number, etc. However, cleaning is done in all cases to remove the left over threads or spots and stains resulting from the construction process. Cleaning is done mostly in a sucker machine which cleans the fabrics of any remnants of threads, fabric pieces, and other waste materials. Cleaning can also be done manually by snipping off extra threads and brushing away other waste materials. The garments may also be checked with metal detectors to locate metallic parts like broken needles and remove them. This is a mandatory step in the cleaning of kid's garments.

- **Pressing and Finishing:** There are several steps in the pressing and finishing processes. The steps included in these processes are as follows:
    - **Pressing:** The method of pressing would not only depend on the fibre composition of the fabrics used in the garment, but also on whether it has been washed or not. In general, steam is applied first to relax the fabric followed by heat which sets it. The focus of pressing would be to create smooth surface at the seams and make the fabric remain fully relaxed without any creases, or folds except where folds and creases are part of the design.
    - **Quality Checks:** Pressed garments are finally checked for compliance with the tech pack specifications such as size-wise measurements and shade of the colour besides every other quality problem. Garments having defects are either rejected or sent for repair. Only garments that pass the quality checks are sent for finishing. Generally, 100% of the produced garments would be checked for measurements and appearance.
    - **Attaching Tags and Accessories:** Tags and accessories, as approved by the buyer, are then attached to all the quality checked garments. The method of attachment would also be as per the instructions of the buyers.
    - **Folding and packing:** Folding of the garments would also be done according to the instructions of the buyers. The type of folding depends on the type of packing specified by the buyer. Generally, the four types of folding is used for different types of garments:
        - **Stand-up packing:** This is the most popular folding and packing used for men's shirts. In this case, the shirt is folded with a stiff supporting material inside and around the collar in a fully buttoned up state. All parts of garments such as shoulder, sleeves, etc. are pinned up to stay firm. The folded and pinned up shirt may then be inserted into a poly bag. One of the key attractions of this

packing is that the collars are made to stand up at 90° from the floor. This kind of folding and packing is however, costly.

- **Semi stand-up packing:** This folding and packing is similar to the stand-up packing. The shirt is folded in the same way as the stand-up packing but with very little support particularly for the collar. As a result, the collar may remain at about 45° to the floor: The main supporting material may be just a foam sheet or butter paper.
- **Flat packing:** This type of folding and packing is preferred for sportswear, trousers or jeans. The garment is simply folded according to the specified dimensions.
- **Hanger Packing:** This is the preferred packing method for items like jackets. This kind of packing involves no folding. Instead, the pressed garment is hung on a hanger and covered by a poly bag.

- **Cartoning and Storage:** This is the final step in the garment manufacturing process, after which the commercial process of transportation and delivery would take place. In this process folded and packaged garments are stacked inside cartons with the size as specified by the buyers according to predefined criteria such as size, colour, etc. The cartons would be sealed by tape and full information about the contents of the carton would be written or printed or pasted over it.

- **Final Audit of the Garment:** This process is done by the buyers or their agents, who would check the contents of boxes randomly as per the terms agreed between the buyer and the factory or as per the standards prescribed by reputed international bodies.

Production Systems governing the sequence of assembling cut-pieces while stitching

The time taken to manufacture a garment and the costs involved in this process are very important factors which affect the competitiveness of garment factories. Most garment factories obtain a large part of their work from apparel brands and retailers. These buyers give manufacturing orders only to factories, which quote the lowest costs for manufacturing the garments besides having the capacity to carry out the production work in the shortest possible time without compromising quality.

It becomes therefore, necessary for garment factories to be cost conscious and minimise it by adopting technologies and best practices that help control their overall cost of production.

One of the ways in which garment factories achieve cost reduction is by organising the process of assembling the garments optimally to take advantage of increased productivity of machines and their operators.

The way in which garment manufacturers design the process of constructing garments from the cut pieces of cloth is called the production system. While smaller boutiques and custom tailoring units cater primarily to made to order clients and often stitch only one garment per order, garment factories deal with orders in which a large number of garments of the same design and style are required to be produced. Therefore, garment manufacturers adopt production systems which are very different from those of custom tailors and boutiques.

Production Systems and Economies of Scale

One of the advantages that garment factories have over boutiques and custom tailors is called the economies of scale. This is what most production systems seek to maximise. It is therefore, necessary to understand the concept of the economies of scale to understand the concept of production systems. One of the simple examples of economies of scale is the lower price that a factory would get per yard of factory as compared to a boutique. Apart from the advantage of lower price of raw materials, bulk production of garments also gives the factories several other advantages such as the following:

- **Better Utilisation of Machinery:** The productivity of a sewing machine for example, is determined by the number of garments produced by it in any given period. Because of the large number orders, factories are able to use their machines almost continuously with limited idling time. Sometimes, these factories also work in multiple shifts, which further increase the level of machine productivity.
- **Better Utilisation of Human Resources:** Bulk production garments also helps garment factories also enables them to allow operators to specialise in any specific area of garment construction. The large volume of manufacturing orders makes it possible for the factories to create full time jobs for people with specialised skills. By employing people with the right skills for specialised jobs, the factory is able to achieve higher level of overall human resources productivity.

- **Better Utilisation of Time:** Bulk production systems help in minimising the time taken to produce a single garment by employing people with the right skills for the right job as well as by introducing automation wherever possible. Automated systems for making some parts of the garments along with mechanised/computerised material handling systems help in minimising the extent of time and physical requirement of human movement. The overall production time is equal to the sum total of time consumed in sewing, transporting the materials to and from the work stations, the time consumed by the temporary storage in process of materials and the time taken for doing quality inspections.
- **Better Utilisation of Overheads:** A simple exampleof a overhead is the case of personnel required for security at the gate. Factories would generally have an entry and exit gates and the number of security personnel at the gate would not increase proportionately with the size of the factory. There are several overheads, such as accounts and administrative support, which are not required to be increased exactly proportional to the number of employees. Most of these overheads can be better utilised by utilising the factory capacity to the full. The overhead requirements would not change much when the capacity utilisation is 70, 80 or 90%. A factory would always save on overhead costs by increasing its capacity utilisation.

Types of Production Systems

A production system refers to the manner in which the various component activities of the garment production processes are grouped or combined to increase the output rate as well as reduce the cost of production. Grouping or segregation of manufacturing processes may be done on the basis of 1) the garment and its parts 2) operators and their tasks 3) types of machines used and the level of automation or 4) in response to a production order. The type of production systems adopted by the garment factories are primarily determined by their specific settings such as level of automation and technological and managerial innovations, size of the workforce and the skill profiles of the operators, time and space availability.

The scale of production is a major determinant of the choice of production system. The scale of production depends in turn on the style wise lot size of the production order. While large scale production involves the use of a variety of assembly lines, small scale production is carried out using traditional production systems.

1. Traditional Small-Scale Production Systems

The following are some common types of small-scale production systems used by garment factories:

i. **Make-through Production System:** This is the most traditional of all production systems. In this system, a single operator is assigned the task of completing the construction of the whole garment from start to finish using the bundle of cut panels and other trims are handed over at the beginning of the process. Construction of the next garment is taken up after completing the previous one. The pros and cons of this system include the following:

- **Pros**
  - The operator remains directly accountable for the quality of construction.
  - Very little time is wasted in material handling/movement.
  - This is an ideal system for couture or other made-to-order garments.
  - It makes use of limited space.
- **Cons**
  - Low productivity due to variations in the level of proficiency in all the construction tasks.
  - High wage costs because of multiple skills required to do all the production work.
  - Unsuitable for bulk production because of the lack of economies of scale.

ii. **Group System:** This system attempts to overcome the lack of full scale expertise of the operator in the make through system. The group system comprises operators who have expertise in stitching specific parts of the garment. In the case of a shirt for example, the entire garment is divided into parts such as the preparation of 1) the front, 2) back, 3) Collar, 4) Sleeve as well as assembling operations such as 1) joining the front and back to the shoulder, 2) attaching the sleeve, 3) completing the side seam and hem. The finishing tasks would include 1) making the buttonholes and attaching the buttons, and 2) blind stitching, etc. as necessary. The pros and cons of this system are as follows:

- **Pros**

- The level of operator productivity is high due to specialisation.
- Division of work by parts of the garment makes it possible to introduce specialised machines or automation.
- Since operators would be paid according to the type of job done by them, the overall human resource cost would be lower.

- **Cons**
  - The construction process would require a separate operator to perform every specialised job – leading to increased demand for human resources.
  - There would be a larger volume of work in progress inventories, which would require more efficient material handling and management.
  - There would be an increased workload for the inline quality inspectors as they would need to check the work being done by a larger number of operators.

2. Large Scale Production Systems

Large scale garment factories may also adopt variations of the traditional make-through and group production systems whenever the lot size of the order for any given order is small. In the case of larger lot sizes, the preferred mode of production would be assembly line based.

The whole garment production system may be based on the following types:

i. **Individual Operator based Whole Garment Production System:** This is an extended version of the traditional make-through system. This system is adopted only in the case of high value garments which are usually produced in very few pieces. In this case, the making of the entire garment – from cutting the cloth to sewing and finishing the garment is assigned to a single operator.

ii. **Department based Whole Garment Production System:** In this case, instead of a single operator making the entire garment, the job of completing different processes is assigned to an individual operator in the concerned department such as the departments for cutting, sewing, pressing, finishing, etc. The pros and cons of the whole garment production systems are also similar to those of the traditional make-through or group systems, which are as follows:

- **Pros**
    - The level of work in progress inventories would be minimal.
    - It would be easier to supervise and carry out quality inspections.
    - Ideally suited for orders involving the production of smaller quantities of garments for a larger number of styles.
    - As these kinds of jobs are paid on a piece rate basis, the operators can be expected to complete their work on time.

- **Cons**
    - The cost of production would be relatively higher because of the involvement of highly skilled operators.
    - This system is suitable only for smaller production requirements per style.
    - The piece rate based payment system may not be conducive to ensure the high quality requirements of such high value garments.

iii. Assembly Line based Apparel Production Systems

The industry standard for bulk production of garments is the assembly line system. There are two types of assembly line production systems namely:

1) Progressive Bundle System (PBS), and
2) Unit Production System (UPS).

Both the systems make use of detailed line planning in advance. Although both of these processes use a sequential arrangement of the various production steps, there is asignificant difference. The following are the main features of these systems:

- **Bundle/Progressive Bundle System:** In the progressive bundle system the cut panels are supplied to the operators in bundles according to a predetermined plan. These bundles are made in the cutting room and racked. In a bundle system, each bundle would contain all the cut panels of a garment. Each bundle would be accompanied by a ticket giving the identity details of the garment and a master list specifying all the jobs required to be completed along with the relevant coupon. In the progressive bundle system, each bundle would contain only those cut pieces that are required for constructing a specific part of the garment. Each of the operators is allowed to work independently. The line plan would also ensure that there would be operators who would be engaged in completing the total assembly of the garment.

- **Pros**
    - The main advantage of the progressive bundle system is higher productivity, faster throughput and reduced operational costs. The dispatch of cut pieces in smaller packs containing only the pieces required for a particular garment part makes it convenient for the individual operators to complete their work faster.
    - Since the progressive bundling system makes each operator responsible for completing a specific part or task, it enables them to become more and more proficient in their work. This in turn leads to higher productivity.
    - Since the whole process of constructing the garment is divided into independent sub processes, it also becomes easy to use specialised or automated machinery at the sub process levels.

- **Cons**
    - One of the main problems faced in the progressive bundling system is the high level work in process inventories required for maintaining undisrupted workflow.
    - Since each operator does the work independently of others, it often creates quality problems at the whole garment level. Inline quality check also becomes cumbersome because of the significant increase in the volume of work.
    - The success of this production system depends on how well the line plan is made. Any faulty planning can lead to sever disruptions in production.

- **Unit Production System:** The unit production system makes use of a mechanical or computerized material handling system for transporting the garment parts to all the operators inproduction according to a predetermined plan. In this system, every panel of the garment is arranged in an overhead conveyor system, which supplies the cut pieces of the fabric required by each and every operator. Unit production uses computerized planning to ensure that no operator is made to wait for receiving fabric pieces or finished parts of the garment. Computerised material movement also helps in reducing the time wasted in material handling and also the cost of holding higher work inprogress inventories.

- **Pros**
  - The main advantage of the UPS system flowis the computerised management of the entire process. Since both movement of materials and data collection is managed with the help computer applications, it becomes possible to produce a larger number of styles simultaneously.
  - The elimination of the bundle system significantly reduces the time wasted in dispatching and using bundles. It also eliminates the need for holding higher work inprogress inventories.
  - Computerised control also helps in providing automated line balancing.
- **Cons**
  - The main disadvantage of the UPS system is the heavy investments required for establishing the system. It also requires special expertise to operate the computerised system.
  - The success of the UPS system also depends on the quality of production planning.

3. Modern Apparel Production Systems

Although garment factories are constantly upgrading technologies and adopting new and innovative production systems, the following two production systems are noteworthy.

- **Straight line or Synchronised Production System:** In this system, the entire production process is broken down into sequential sub processes, which can be completed at the same time. As a result, the complete process of making a garment is accomplished by a series of straight line operations which get completed without any break.

- **Modular Production Systems:** This is a system based on team work and derived from the Toyota production system. The team consists of multi-skilled and fully trained operators who are able to make use of a small set of machines to produce the final garment. It is a highly responsive system since everyone in the team is capable of performing any task. It does however; require heavy investments in equipments and continuous training.

Factors Influencing the Choice of Production Systems

There are several different types of garment production systems aimed at achieving economies of scale. However, none of these systems can guarantee optimal productivity and economies of scale under all circumstances. The following are some of the important factors that are taken into account for choosing the right type of production system:

- **Order Volume per Style:** If the order from the buyer involves production of small quantities of several styles, it would be difficult to achieve economies of scale through greater degrees of automation and human resource specialization. A large volume of order per style would be ideal for automation of processes and the use of skilled personnel for different types of operations.
- **Complexity of Style:** Bulk orders for garments with standard features are most suited for automation and specialization. Production systems aimed at economies of scale would become less and less suitable as more and more complex styles are produced. The level of customization required in a garment is a factor that must be considered while choosing the production system.
- **Space Availability and Cost:** Automation as well as allocation of workload to specially trained human resources would require not only more machinery but also more space for positioning the specialized machinery. In addition, there would be an increase in the quantity of work inprogress inventories, which may need to be racked before getting passed on to the next stage of sewing. Space cost could be very high in urban locations.
- **Quality Requirements and Time Constraints:** When only limited time is available for completing the production, then the production system that saves time would be preferred. At the same time, the quality requirements can never be compromised. Therefore, the actual choice of the production system would be limited to those that save time and costs without compromising quality.

Activities

Activity 1: Visit different departments of a garment industry. Draw a diagrammatic flow chart of steps in garment manufacturing process.

Materials Required

1. Chart paper

2. Pen/pencil
3. Glue
4. Eraser
5. Colored pen/pencils
6. Scissors

Procedure

1. Take a chart paper and make a flow chart of garment manufacturing process by pasting pictures of each department.
2. Write the key responsibility of every department in front of it.
3. Submit the same in your class.

Check Your Progress

Fill in the blanks

1. A ___________is designed to stitch a very large number of ready to wear garments of the same or multiple styles at the same time.
2. In the four points system for example, penalty points are assigned on a ________ to each defect depending on the length or width of defect.
3. _____________is required to ensure that there is minimal wastage of fabrics in the cutting of the different pattern pieces.
4. __________are the problems that could arise in the production process which could delay the achievement of the production target.

Questions

1. What are the stages in garment production process?
2. What is marker planning?
3. Explain the types of production system, their pros and cons and the factors influencing the choice of production system?

Module 3 Evaluating and Improving the Proto & Fit Samples

Module Overview

After receiving the buyer's order sheets, proto samples are created. In the product development stage, this is the first sample created by a designer or according to the buyer's requirement. In this unit different criteria for evaluation of proto sample and steps involved in evaluation of proto sample are explained.

The factors influencing the fit of the garment are also discussed in this unit because the fit of the garment is always the primary objective of any designer or garment industry. Fit sessions are carried out in the garment industry or by any designer before approving any sample for bulk production. A fit session is a meeting between the design and technical teams where they assess the fit of a sample. To try on the fit sample, a dress form that fits the customer profile in terms of size and shape is used. The designer comments on the general appearance of the clothing, as well as whether the trims utilised and their placement is satisfactory, and whether the garment quality meets their expectations.

The pattern cutter will be present at these meetings to make alterations to the clothes and confirm approvals. The inspection at various level of garment production process is also explained in this unit. Inspection is the process of checking the materials of clothing, seams, buttons, thread, zippers, and other dimensions of garments using a consistent process. Inspection arrangements exist in each section of the garments industry. The major goal of inspection is to find flaws in the clothes at the earliest feasible stage of manufacture.

The earlier the flaws are discovered, the less time and money is wasted. This unit also explains advanced and innovative sample testing methods for fit, comfort, durability and environmental sustainability. From the development of the sewing machine to the rise of e-commerce, fashion has always been at the forefront of innovation. Fashion technology is evolving at a faster rate than ever before. Sewing and cutting robots, AI algorithms that predict style trends, virtual reality mirrors in changing rooms, and a slew of other technologies demonstrate how technology is automating, customising, and speeding up the fashion industry.

In this unit students will dive into the trends that are transforming the way our garments are designed, manufactured, checked for fit and inspected.

Learning Outcomes	
After completing this module, you will be able to: • Analyze the proto and fit samples with respect to the techpack developed • Identify various product testing to proceed with prototype • 1identify innovative solution to develop garment design	
Module Structure	
Session 1:	Evaluation criteria for proto samples
Session 2:	Basic and specialized garment testing methods and requirements
Session 3:	Introduction to advanced and innovative sample testing methods for fit, comfort, durability and environmental sustainability

Session 1: Evaluation Criteria for Proto Samples

The proto sample is the first in the series of samples that garment manufacturers are required to develop after receiving the tech pack from the buyers. This is an industrial process, which should not be confused with other kinds of proto sample development and evaluation done by independent fashion designers or studios. Tech pack based proto sample development serves a definite purpose in the bulk manufacturing of ready-to-wear garments.

From the garment manufacturers' point of view, the primary purpose of proto sample development is to prove their production capabilities and cost competitiveness to the potential buyers of their manufacturing services and get their order. From the buyers' point of view, proto samples are required for evaluating the technical and managerial capabilities of the potential garment factories which can be engaged to execute their bulk manufacturing orders for any specific garment at competitive rates.

The manufacturers, on their part, would have a team that is focused on timely execution of the orders as per the technical and quality specifications contained in the tech pack. The manufacturers may be also required to comply with general conditions and standard practices, which are spelt out in the form of manuals and standard instructions/guidelines. Although manufacturers would have a separate sample development team or section aside from the normal bulk production set up, there would be complete participation of marketing, sourcing, sample making, production planning, quality control, washing, finishing, packing and shipping managers to ensure that the proto sample is produced and dispatched on time and that the sample meets the buyer's expectations in the very first time.

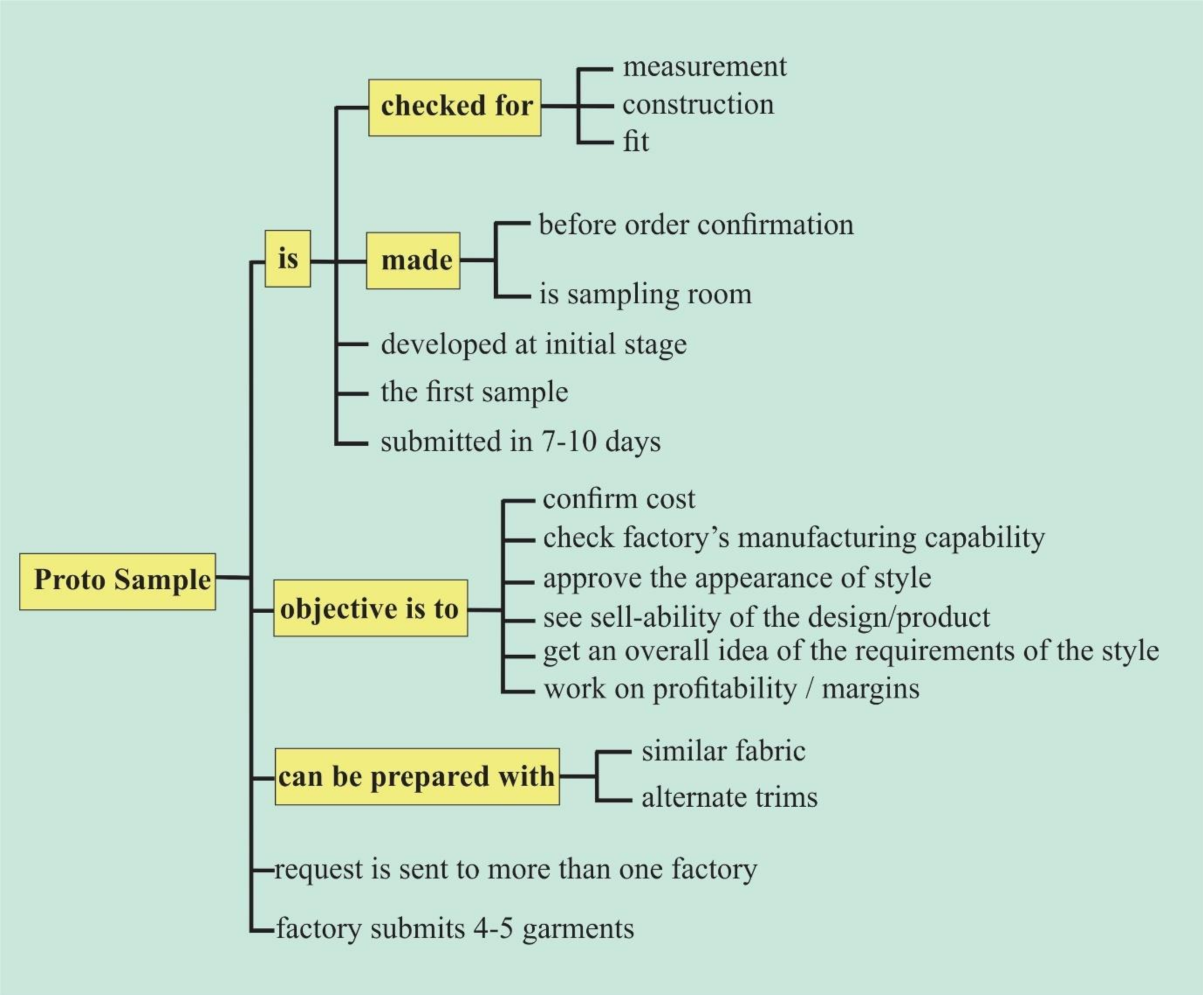


Fig.: 3.1 – Proto Sample

Focus areas of Proto sample evaluation

Evaluation of the proto sample is also the first in the series of evaluations that the samples manufactured as per any tech pack specification will go through. Every sample serves a specific purpose. Under normal circumstances, as many as 12 to 15 different types of samples may be required to be produced and submitted. Some of the samples like proto, fit and preproduction samples may need to be made and evaluated more than once to get everything right. The most important point to remember about proto samples is that they are made before the buyer places an order and the proto samples would need to pass an evaluation for the order to be placed on the manufacturer. Proto samples may also be made using fabrics and trims, which are similar to what is prescribed in the tech pack.

However, the quality variations must be within the range permitted by the buyers.

The evaluation of the proto sample would be done keeping in view the following four key considerations:

1. **Design Compliance:** The first set of criteria used in the evaluation of the proto sample would relate to the design specifications indicated in the tech pack, particularly, the views, both overall and details. Does the garment embody and bring out the style appeal of the design? How well does the proto compare with the views depicted in the tech pack? Has the garment manufacturer understood the nuances of the style statement of the garment such as silhouette, lines, balance and set? Does the proto look marketable? Does the submitted proto comply with the design intent and deserve to be accepted? Can the manufacturer be given another chance to make certain modifications which would make the proto sample eligible for approval? If the proto sample fails in design compliance, there would be every chance for it to get rejected.

2. **Cost Competitiveness:** Every new garment would most probably be a part of a line plan envisaged by the buyer/fashion brand for the forthcoming season. The pricing points at which the concerned garment is intended to be offered in the market are one of the most important parts of the line plan. The proto would be, therefore, evaluated in terms of the cost of manufacturing. The cost components of a garment fall into three main categories: 1) input costs, 2) manufacturing costs 3) labelling, finishing and shipment costs. Manufacturing costs are often calculated on the basis of the standard cost per minute estimates done by the factory concerned. Manufacturing costs will be affected by both wage costs and efficiency of the production system.

   Manufacturing efficiency would in turn depend on the quality and productivity of the technology and equipment as well as the skill sets of the workforce. Input costs could also depend on local prices as well as government taxes and levies and applicable tax refund policies and procedures.

   Evaluation of the costs would give the buyer an indication of both the manufacturing efficiency of the factory concerned as well as the competitiveness of the country where the factory is located. Costs quoted by the vendors would also need to be padded up for additional expenses such as label or shipment costs depending upon the terms to be included in the commercial agreement.

3. **Construction quality:** Buyers and fashion brands would be very sensitive to the quality of construction as it would affect their reputation in the market in a very big way. The quality of construction would be adjudged on the basis of the specifications included in the tech pack - such as the stitches to be used at different areas of the garment, along with the type of top stitch, if any. The construction quality would also be reviewed for compliance with the seam finish specifications mentioned in the tech pack. This evaluation would cover not only seams and finishes in every part of the garment but also the proper attachment of all the trims such as closures, underlying fabrics, and surface embellishments like embroidery. One of the key aspects of proto sample evaluation would be the special attention paid to the patterns. In fact, preparation of patterns is what distinguishes the proto sample from the mock-up or dummy sample. Attention to the patterns becomes a primary focus area of proto sample evaluation, since patterns, and not the sample garment, would be finally used in the bulk manufacturing process.

4. **Fit Property:** Although more elaborate fit evaluation would take place at the fit sample stage, the fit property would be tracked right from the 1st proto itself. At this stage, prime focus would be on fit issues arising out of cutting the fabric and constructing the sample garment. Fit problems are checked at key locations in the garment and also from the point of view of the design silhouette of the garment. Fit would also be checked, at this time, from the point of view of set and balance. Although there would not be a dedicated fitting session, the garment may be also checked for its fit using a suitable dress form.

Steps in the evaluation of Proto samples

The following points are the general sequence of the proto sample evaluation procedure:

- **Check the Sample Tags and Forms:** First Proto Sample evaluation is also the first time when a sample from the vendor is taken up for examination by the buyer. Its proper identification is a primary requirement. If the sample had to be submitted with predefined tags and forms, then these must be checked for compliance with the instructions given to the vendor. If not, the tags must be checked for the identification of the sample and associating it with the correct tech pack. Information such as the name of the vendor/factory, style id, designer name, etc. must be tallied with the tech pack, which would form the basis of the evaluation. The technical designer in charge of the style should also create a dossier or folder in which all the documents, notes, photographs, etc. would be stored for future reference.

- **Check the Measurements against POM:** The proto sample would be of the alpha/zero size for which all the measurements would be given in the Points of Measurement (POM) page. It would be necessary, at the outset, to take complete measurements of the sample and tally it with the POM specifications and note down the differences, if any. It should also be ensured that the measurements are taken exactly at the same landmark locations indicated on the fashion flats contained in the tech pack. Exact measurements must be recorded and the differences must be between the actual measurement taken from the sample and the POM specification ignoring the tolerances included on the POM page.

- **Check the Pattern Measurements:** Possibly, evaluation of the pattern is the most critical part of proto sample evaluation. It is important to correct flaws in the pattern at the very beginning so that all other subsequent samples are free of problems relating to the pattern. Errors in the pattern would always result in multiple problems and waste the precious time of the designers and technical designers in evaluating the quality of any sample. Evaluating the pattern also involves cross checking its measurements with the POM as well as the actual measurements of the proto sample. The focus must be on getting the pattern right, first.

- **Check the Silhouette:** While the silhouette depicted on the tech pack views is only two dimensional, it is important to assess how true the three dimensional sample reflects it. Silhouette checking, therefore, involves a 360 degree view of the sample. The best way to check and identify silhouette related problems would be to take photographs of the sample garment by putting it on a suitable dress form and taking pictures of it from as many angles as possible. Assessment of the silhouette of the sample would need to be done on the basis of the aesthetic appeal of the garment from the photographs taken from different angles.

- **Check Construction:** Checking for construction quality must cover not only specifications contained in the construction page but also the information contained in the overall and detail views. A garment is generally designed for both style and functionality. While evaluating the sample garment from the point of view of design, it must be ensured that the quality of construction does not affect the style and silhouette of the garment in any way. Simultaneously, it must also be ensured that the cuttings of the fabric and grain placement comply with the tech pack specifications and do not interfere with the functionality of the garment.

- **Check the Fit:** Checking for fit involves multiple considerations and issues. One of the elementary aspects of fit that should be checked first is to ensure that the centre front and back lines are exactly at the centre of the garment and are perpendicular to the floor. A related aspect is proportions. It must be checked whether the overall proportions of the different parts of the garment create an overall balanced look or not. The second aspect of fit evaluation would be to check for the actual amount of ease provided in the sample garment as compared to the design and fit ease included in the tech pack specs. A third element of fit that would be checked at the proto stage itself is shaping. Fabric shaping is required to let the garment develop shapes that fit the body contours without sacrificing the style and silhouette, This problem must be reviewed by looking at not only the sample garment but also the patterns.

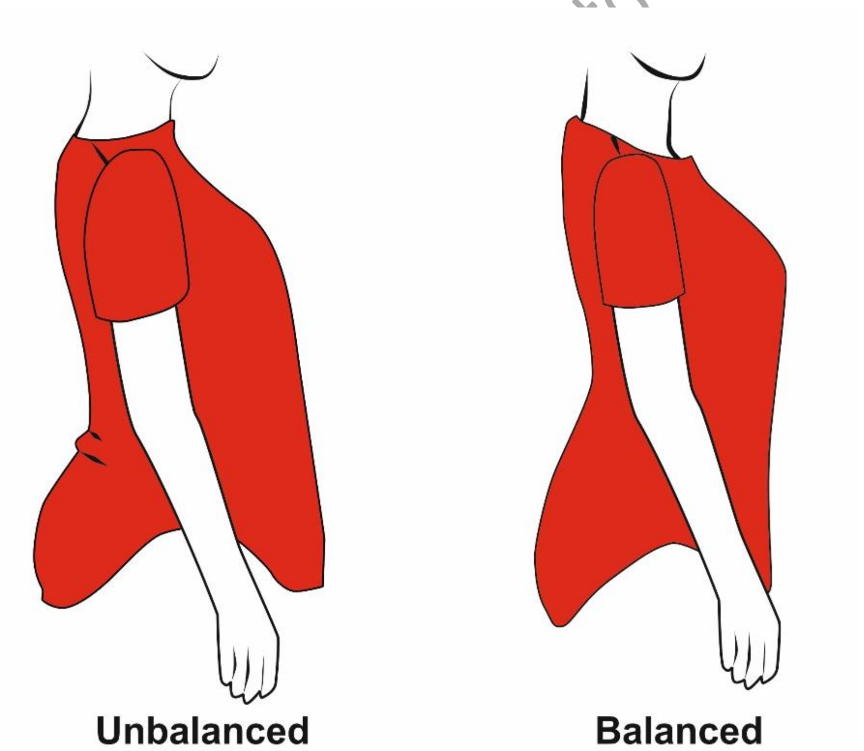


Fig.: 3.2 Check the Fit

- **Write Comments:** Proto sample evaluation would be done by a team comprising designers, technical designers, merchandisers and technologists. Each one of them would review the proto sample from their own individual perspectives. While they would record their comments independently, there would always be a need to discuss these comments and arrive at actionable recommendations, which could be communicated to the manufacturers with absolute clarity.

- **Return the Proto to the Vendor with Comments**: Proto sample evaluation may not be confined only to identifying the mistakes committed by the manufacturers, who submitted the sample. The buyer might also notice the need for making improvements and make changes in the measurements or suggest modifications in the patterns. In either case, clear cut instructions must be communicated to fabric manufacturers, indicating the changes in the measurements as well as the specific rectifications required in the sewing of the sample. The tech pack would also need to be updated with the inclusion of changes as well as comments and fit history.

Factors influencing fit

Consumers view fit from a variety of standpoints such as wearing comfort, expression of body contours, enhancement of grace and style, etc. Perceptions of fit depend on both physical and psychological factors. The physical properties of fit cover both sensorial and ergonomic aspects. The sensorial aspect covers the comfort or discomfort experienced just by wearing the garment. The ergonomic aspect covers the ease or difficulties one faces in moving or doing actions. The psychological properties of fit depend on personal perceptions and beliefs about well fitted garments. Creating a garment that satisfies these two different consumer expectations about fit is always the primary objective of every designer.

However, fit problems continue to be a major challenge since the body dimensions of people vary widely. The fashion industry has been making efforts to create size charts based on body types and shapes. However, even the standard size charts do not always prove to be perfect for all types of styles. Fit samples help in increasing the suitability of any particular style to its target consumers. It therefore becomes necessary to pay attention to both the physical and psychological fit aspects in the process of making fit samples.

Fit sample evaluation criteria

Evaluating fit samples is done while keeping in mind several factors. The following is the list of the criteria, which are used mostly for evaluating fit:

- **Set:** How well the garment wraps around body contours determines the quality of the set property of a garment fit. The fabric should drape the three dimensional body areas smoothly without creating any creases or curves. A typical set problem is the appearance of drag lines in different parts of the garment which is caused by the presence of either too much or too little fabric in any given place in the garment.

- **Line:** How well the garment reflects its silhouette, its proportions, its curves and the alignments of its style elements and trims defines the line property of the garment fit.

- **Balance:** How well the front and back as well as the right and left sides of the garment are aligned to each other reflects the balance property of the garment.

- **Grain:** How well the direction of the fabric grain is used to create the necessary strength, stability, and flexibility of the garment without disturbing the design alignments determines the grain property of fit. Generally, the length wise grain should be parallel to the body length along the centre front and back. Checking for fit must also include the checking of whether the fabric at different places of the garment follows the directions specified in the tech pack.

- **Ease:** How well the gap between the body contour and the garment facilitates body movements determines the ease factor of fit. Ease would also be assessed differently depending upon the functional requirements of the garment and the type of fabrics used in the construction of the garment. Garment designs may also include design ease that is introduced to go with the dominant fashion trends. While checking for ease both functional ease and design ease must be taken into account.

- **Comfort:** How well the garment generates a psychological feeling for comfort on the wearer determines the comfort factor of fit. Designers may also opt for a natural, relaxed, or even over sized fit depending upon how much comfort they wish to include in their design. It is important to take into account the nature of designed fit while evaluating the fit of the garment.

- **Wrinkles:** It is a negative factor, which is found in ill-fitting garments; particularly those have extra fabrics in the wrong places that lead to the formation of wrinkles. A well-fitted garment should not have any wrinkles at all.

- **Deformed Seam or Shell:** It is also a negative factor which is reflected by deficiencies and distortions in the seam lines which may create malformed shell. It may be the result of improper cutting of the fabric or incorrect stitching of the garment.

- **Tension & Stretch:** This is another negative factor. This may be a result of not providing the necessary amount of fabric required to cover the concerned body area comfortably.

Conducting Fit Sessions

Fit is one of the most important factors which influence the buying decisions of apparel consumers. Fit problems work more like the proverbial last straw that broke the camel's back. Only haute couture and custom tailored clothing are made to measure to fit the body of the concerned individual customer. The majority of fashion garments fall into the category of ready to wear. These are not meant for any particular individual. These are made for groups of people who are classified into different standardised sizes. In view of the wide variations in the body types and proportions among the people falling into any standard size, the designers always aim at creating styles that suit at least a majority of people falling into any specific size.

Fit sessions help in evaluating the extent to which any specific style of garment fits in real life or simulated fit models. The problems identified through such fit sessions help in adjusting the patterns for carrying out the necessary rectification. Fit sessions have become very important to the fashion industry since blocks, patterns and size charts are developed using past experience and old data. Fit sessions help in verifying whether the body measurements derived with the help of existing knowledge and skills meet the fit requirements and expectations of the current and future customers. Fit sessions also help in ensuring that the construction of the garments keeps the design intent such as style and silhouette intact. Another objective of fit sessions is also to make sure that the fabrics used also add to the style and silhouette of the original design and not disturb it.

The fit session is an important milestone in the garment development process as it offers the last chance to make design changes. Finally, after the fit sample is approved, it would go for production. The preproduction sample would be a perfect copy of the final fit sample made in the regular production line using the exact fabrics and trims specified in the tech pack. The findings made during the fit sessions help in making corrections not only in the concerned style but also in improving the fit of garments across different sizes and styles. Fashion brands always aim at creating consistency in the fit property of the different styles of the garments that they sell. In other words, consumers who fit into a particular style in any specific size should be able to fit into any other style of garment of the same size number. Fashion brands therefore rely on fit sessions to assess how their garments can be made to fit their target customers better.

The success of fit sessions depends upon technical knowledge as well as wisdom gained through experience. Leading fashion brands usually maintain a well organised fit room to conduct sessions.

FIT EVALUATION TEAM

Since fit plays a definitive role in the success achieved by any style, almost everyone associated with the design and construction of the garment participates in the fit sessions. The following are the key roles necessary for proper evaluation of a fit sample during a fit session:

- **Designer/Design Team:** They review the sample garment from the point of view of the style, silhouette, aesthetics, balance, placement of style elements, trims, etc. and the overall fashion statement.
- **Pattern Master:** They review the sample garment from the point of view of the rectifications that may be needed in the patterns to achieve a perfect fit
- **Technical Designers:** They review how well the style elements are fitted. They also look at every technical aspect of the construction, including stitching, seam lines, fabrics and trims used.
- **Retail Merchandiser:** Their role is to review the fit in terms of market trends, preferences of the target consumers, marketability and competitor activity.
- **Production Merchandiser/Developer/Garment Technologist:** Their role would be to assess the impact of the fabric and trims on the fit and observe fit problems arising out of deficiencies in the fabrics and trims.
- **Representatives of manufacturer:** Their role would be to provide the information needed by the evaluators.
- **Fit Model:** Their role would include providing feedback to the evaluators about their physical and psychological experiences - while wearing and simulating body movements that go with the functionality of the dress.
- **CAD/CAM Professionals:** They play an important role when fit sessions are conducted not on fit models but with the help of computer simulations.

FITTING ROOM

Fit sessions are in many respects like mini fashion shows. The purpose of fit sessions, however, is to evaluate the fit of one or a few garment samples at a time. It is usually conducted in a dedicated room with the necessary facilities.

- **Green Room:** A fully covered space for the model to change into the sample garments.
- **Legroom:** Adequate space for the evaluators to move around and take a look at the model or the dress form.
- **Table space:** A table where the sample garment can be laid out flat for taking accurate measurements.
- **Measurement Tapes & Instruments:** Technical designers and pattern makers would require these for taking measurements and comparing them with the tech pack as well as the previous samples.
- **Fit History Library:** Records of fit history of previous samples or previous styles.
- **Dress forms:** These must be of the size specifications of the sample being evaluated.
- **Sitting space:** Thesitting space has enough room for viewing the model as well as for sitting around and interacting with each other.
- **CAD/CAM systems:** These would be necessary for fit sessions involving computer simulations or software based calculations and pattern/design changes.

EVALUATION METHODS USED IN FIT SESSION

Identification of fit problems requires multiple skills. The following are the most commonly used methods used in a fit session:

- **Visual:** Since the sample garments are worn by the fit model or draped on a dress form, the evaluators have to necessarily focus on visual clues that help them in identifying the exact fit problem. Fit properties such as set, line, balance, grain, wrinkles, and seam/shell distortion can be easily identified using visual inspection.
- **Trials:** Trying the sample garments on the fit model or a dress form enables the evaluators to judge the fit of the garment with reference to the body frame and contours of the model or the dress form. Trials provide more measureable clues for identifying the fit problems more accurately. Trials are also the best way to capture the psychological aspects of fit such as comfort, looking good, feeling better, etc.

- **Calculations:** Both the technical designers and pattern makers would do several types of calculations using both standard pattern making systems and personal experience to identify the exact extent of change required in the garment measurements. One of the important fit properties where calculations are very useful is ease.
- **Simulations:** 3D simulations using software based avatars that represent the target population also help in evaluating fit. These are particularly useful in evaluating new factors like pressure that acts as a substitute for the traditional fit property of ease. Modern 3D simulation software facilitates five different fit visualisations such as pressure, stretch, warp, weft and x-ray. Sometimes the results of virtual fit trials are compared with real fit trials to arrive at a workable solution.

PREPARING FOR A FIT SESSION

Advance preparations help in improving results of fit sessions and also reducing the time required for successfully completing them. The following are the steps to be taken in advance for conducting proper and effective fit sessions.

- **Booking the Fit Model:** A fit model is not a fashion model although they can be booked through the same model agency. It may be necessary to give adequate notice to the agency to book the best suited model. The Agency must be informed about spec sheet measurements. A fit model is one who possesses more or less the same body proportions and the measurements that form part of design. After the selection, the model may need to be asked to wear a block or woven garment with proven properties for the chosen size and photographed. Some of the key points where the actual body measurements of the fit model must tally with the measurements in the spec sheet include bust, waist, back shoulder, halter, high hip, hip, thigh, and armscye and arm length. In addition, the height and weight of the fit model should also be recorded. It may also be necessary to prepare a comparative table of the spec sheet measurements and the actual measurements of the model to make it easy for the evaluators to assess the fit correctly.

- **Getting the Right Dress Form:** Custom made dress forms have become an alternative way of checking the fit for imaginary person for whom the garment is designed. Most fashion brands specify the model numbers and vendors of the dress which correspond to their size charts. Fit studios also rent out dress forms that conform to standard size charts. Modern dress forms also have movable arms and softer waists. It would be necessary to arrange for the most suitable dress form in advance. If more than one copy of the fit sample is available, one of them may be put on the dress form before the start of the fit session. The fit model may wear another copy.

Fig.: 3.3 - Right Dress Form

- **Select the Representative Avatar for 3D Fit:** Although 3D garment simulation technologies are still under various stages of development, considerable progress has been made in recent times. The avatars can be created using a 3D scanning of an individual such as a fit model or based on anthropometric data generated through surveys. Latest software applications also allow simulating body movements and getting a measurement of relative changes in the pressure factor, which in turn helps in identifying fit problems. The avatar chosen for the fit session must fulfil all the conditions and criteria used in the selection of the fit model.
- **Intimate the Participants in Time:** Since fit sessions are not the only responsibility of all those who are required to attend the fit session, it would be necessary to decide on a mutually convenient time and inform all the participants in time. Since models are to be paid by the hour, advance notification would ensure that the fit session starts and ends within the pre announced time slot. Intimations about the schedule of the fit session must be shared with those who may be required to participate in the fit session from remote locations.
- **Create a Clear Role Plan:** It is also important to give the participants advance intimation about the exact role each plays in the fit session

and what is the output expected of them at the end of the fit session. This is particularly relevant when the fit session is attended by many senior and junior professionals.

- **Prepare a Dossier of all Technical Documentation:** Evaluating fit samples would often follow the evaluation of the proto samples done at an earlier date. There can be as many as three or four fit sessions. It is therefore important to ensure that the information contained in the Sample Tag is matched with the updated Tech Pack containing all the information up to the last proto or fit sample evaluation. The dossier must include details of all comments and subsequent changes made to the design or in the measurements in the correct sequence. This is necessary to minimise the time wasted in looking for the relevant information.
- **Take complete measurements of the Fit Sample:** Actual measurements of the fit sample will help compare it with the measurements given in the updated tech pack. During the fit sessions, all the measurements indicated in the POM sheet would need to be checked. In order to save on the time spent on testing fit samples, these measurements should be recorded by the Technical Designers before the fit sessions. It must also be ensured that the points of measurements on the sample garment exactly match the points of measurements in the pattern. It may be also necessary to prepare a chart comparing the specified measurements, allowed tolerances, actual measurements, extent ease built into the design and the standard ease recommended in the popular size charts.
- **Carry out Quality Inspection in advance:** The fit sample must be subjected to all the necessary quality inspections beforehand so that fit session is devoted fully to addressing the real fit issues and is not sidetracked by any of the quality related problems.
- **Set up CAD/Systems:** Access to CAD/CAM systems would be help in checking and manipulating the electronic versions of the patterns with the help of computer software. These would also be necessary to check fit through 3D simulations.
- **Make Available All Measuring/Mending Tools:** Both the pattern maker and the technical designers would require tools that help with making measurements or making temporary adjustments to the fit.
- **Organise Photographing/Video Shooting:** Photographs and videos would be very helpful in correctly assessing the fit particularly during motions. While still photography can capture the fit of a garment along the different stages of body movements, high quality videos can also help in tracking the performance of the garments. Photographs and videos are also helpful in sharing the fit session proceedings with others and getting their feedback.
- **Arrange for Videoconferencing:** In a globalised industry, whose operations are spread over multiple locations within a single country

or across several countries video conferencing facilitates remote participation at fit sessions.

- **Stationary for Taking Notes & Template for Comments:**A fit session requires paying attention to the minute details and taking notes. The template for making comments must include the exact identity of the sample as well as the status of the sample at the fit session.

CONDUCTING A FIT SESSION

Well-planned fit sessions can make a lot of difference to the commercial success of the garment style. One of the precautions to be taken during the fit session would be to avoid compromising the design for the sake of fit. The focus should be to achieve fit without disturbing the attractiveness of the design.

Fit sessions can also prove to be a costly exercise because of the time spent by senior people from different departments. It is, therefore, necessary to keep it sharply focused on identifying fit problems and finding solutions.

The technical designer associated with the concerned style should preferably lead the fit session with the support of an Asst. Technical Designer, who would be responsible for taking note of all the discussions and making the recommended changes in the measurements. The following is the general sequence of activities and focus during a fit session.

- **Initial Briefing by the Technical Designer:** As a fit expert and as one having the role and responsibility for coordinating and monitoring all the technical aspects of any style, it is necessary for the Technical Designer to inform all the participants about the fit deficiencies observed by her or him. The brief provided by the Technical Designer must cover the following details:
    - Clear identification of the sample with the correct Style ID along with the current status of the sample such as the first, second or third fit sample.
    - Information about all the previous changes made during the evaluation of the proto samples or in the earlier versions of the fit sample.
    - Deficiencies are already noted through her/his analysis.
    - The key specs relating to specific landmark points of measurement.

- **Examination of the Fit by the Designer:** Several design criteria for fit such as set, balance and line are fit properties that are of concern to the designer.
- **Examination of the Fit by the Pattern Maker:** The pattern maker would be particularly concerned with factors like creases, wrinkles, drags as well as seam or shell deformations, which might require pattern corrections.
- **Feedback from the Merchandiser:** The primary concern of the merchandiser would be over the suitability of the observed fit properties and their appropriateness for the market conditions.
- **Feedback from the Fit Model:** The observations of the fit model about the comfort and ease as well as ease of movement. This would be relevant to every participant as the objective of the fit session is to create a garment that satisfies both the physical body measurements and psychological expectations.
- **Inputs from the CAD/CAM Professionals:** Their inputs based on computer simulations can also be helpful in identifying possible solutions to the fit problems identified through trials on the fit model and the dress forms.
- **Group Discussion:** The discussion would be focused on either on approving the fit sample or making changes. If it is not approved, then the group would need to decide on the exact details of the changes to be made. In this case, the comments of each participant would be taken into consideration. In the case of revised fit samples, the option to go back to the original specs will also be considered.
- **Recording of the Outcomes:** Based on the discussion, a formal decision would be taken either to approve the sample or to ask for changes to be made. The Technical Designer may advise the other team members to incorporate the required changes in the fit history template and forward the same to the sample developers along with specific comments. Necessary changes would be made in the technical sketches of the tech pack if there are any design changes as a result of the fit session.

Preparations for Fitting

Introduction

Fit is one of the most sought-after garment qualities. Consumers want it to look good and feel better. Designers want it to make their designs popular. Fashion brands want it to gain a larger market share. Manufacturers want it to increase their production, minimise rejections and maximise profits. At the same time, it is also one of the most difficult challenges for the ready to wear apparel industry. It is a multidimensional problem resulting from a multiplicity of factors. The task of creating a perfectly fitted ready to wear garments, therefore, requires a comprehensive understanding of the fit problems and proper planning and implementation of the appropriate solutions.

Main challenges of ready-to-wear fit

Creating a perfectly fitting ready to wear garment is the toughest challenge for both the designers and manufacturers. The following are the main challenges in making ready-to-wear garments to fit their target population perfectly:

- **Custom Fit vs. Representative Fit:** It is important, at the outset, to understand the differences between custom fit and the representative fit of ready to wear garments. While custom tailored garments are made to the actual measurements of an individual, ready to wear garments are created using imaginary measurements that are supposed to be representative of the target customers. Although there are standard size charts and standardised pattern making systems, the diversity of body types and individual preferences render them inadequate. There is always a need for updating these based on up to date anthropometric surveys. Most of these sizing systems are based on the predominant body types of the countries where these systems were initially developed. It has becomenecessary to adapt these to suit customers in different parts of the world.

- **Standard vs. Company-specific Sizing Systems:** While smaller companies rely more on standard sizing systems, larger fashion brands often use own blocks. These exclusive blocks form the basis for the designs of all the designers belonging to the company. These are also updated from time to time, though not too frequently, based on the findings of various fit sessions. The changes made to the foundational blocks of the company do not follow any of the standard norms. Instead, the changes made by the company become the unique feature of the dresses made by the company. At the same time, this also becomes a problem for the garment manufacturers. There are no universal sizing systems in the industry. Large sizes of two different brands need not have the same or similar specifications of measurements. The manufacturers would have no option but to follow the tech pack specification as revised by the technical designers based on the evaluation of the fit samples submitted by them. It would be the responsibility of the fashion brands or buyers to provide the details of the measurement changes.

- **Size Set vs. Size Shift:** A size set consists of a number of different sizes of the same garment style. These different sizes are developed by increasing or decreasing some of the key measurements of the patterns of a single reference size known as the alpha or the zero size. The changes are made according to a specified grading rule. While such rule based grading works fine within a narrow size range, it does pose fit problems in larger size sets. It is possible that the very large or very small sizes require new grading rule or a new reference pattern. This is generally known as Size Shift. In order to create perfect fitting garments, it may be necessary to limit the number of sizes developed on the basis of a single reference pattern and single grade rule. This is necessary to accommodate the significant changes in the body sizes of too heavy or too thin individuals.

- **2 Dimensional Design vs. 3 Dimensional Fit:** Except for draping-based designs, majority of the ready to wear garments are made from 2D designs. These flat designs form the basis for developing patterns used for cutting fabrics. It is up to the pattern makers to make allowance for the 3D requirements of the actual body. Pattern makers often rely on standardised or customised blocks as well as their own experience in deciding upon the extra length of fabric required in different parts of the dress to cope with the corresponding 3D requirements of the body. An associated problem is land-marking. The body requires variations in the width or length of the fabrics exactly at a given point of measurement. It becomes, therefore, necessary to ensure that the increased or decreased measurements used in the pattern exactly match body positions where such variations are required.

- **Qualitative vs. Quantitative Fit:** While the wearer as well as the designer perceives fit more in terms of qualitative parameters, technical designers have to convert everything into quantitative measurements which can be applied to the patterns to create the desired qualitative improvements. The task of translating the qualitative evaluation of the fit of a ready to wear garment is never limited to a single measurement. Any change in the measurement of any single point would need to be coordinated with a number of other measurements to ensure that fit adjustments do not affect the overall aesthetics and design features.

- **Fit Ease vs. Design Ease:** Fit ease is introduced in the foundation pattern itself. Design ease is, however, added later by the designer to create the desired silhouette. There is always a trade off between the fit ease and design ease because garments need to not only fit well but also look good. People might reject dresses which are not comfortable to wear. At the same time they would not choose a dress that does not flatter their body. The fit ease included in the basic blocks, at key landmarks of the body, would also vary depending upon the type of dress. While evaluating and correcting fit samples it would be, therefore, necessary to keep in mind the not only fit issues but also its impact on the design. This is a challenge that designers and technical designers learn to deal with only through experience and expertise.

- **Fabric vs. Foundation Patterns:** Generally, fashion brands recognise the influence of dress type on the amount of fit ease to be included in the foundation patterns. Each type of dress would have a separate basic pattern, which the designers can use to create new styles. However, the type of fabric, particularly the weight of the fabric and stretch also play a very important role in fit. While garments made out of knit or other stretch fabrics may also have different foundation patterns, it may not be possible to have a separate basic block for every single fabric type. It would be, therefore, necessary to take into account the impact of fabrics on fit. There could be significant differences in the fit ease needs between heavier and lighter fabrics at the hip and thigh.

DIFFERENT TYPES OF READY-TO-WEAR FIT

Design intent, fabric quality, garment type and its functionality, and wearer comfort are the mainfit factors, which determine how far away or how close the garment would fit the wearer's body. These serve definitive purposes and reflect clear design intents. While evaluating the fit of ready to wear garment samples, it is important to take into account the design intent. The ready to wear garment fit falls into the following two categories:

1. **Distal Fit**: It is based on how far away the garment is from the wearer's body and is composed of the following sub-categories:
    - **Slim Fit:** These are designed with the minimum possible ease to create a trimmed silhouette.
    - **Natural/Regular Fit:** These are designed with standard ease to allow easy body movements.
    - **Relaxed/Comfort Fit:** These are designed with generous amounts of ease to provide complete freedom of movement with the least stress on the body and least strain on the fabric.
    - **Vanity Fit:** These are designed with extraordinary amounts of ease at different places and positions to create high fashion silhouettes.

- **Oversized fit:** These are designed deliberately with overall excess ease to create loose garments that hide the body contours

2. **Proximal Fit**: This classification is based on how close the garment is to the body. It is composed of the following subcategories:
    - **Form Fit:** These are designed to make the garment to remain very close to the body and follow its contours with minimal stretch and no wrinkles at all. For example: Vests.
    - **Cling-Fit:** These dresses are designed to have the garment flow closely over the body contours without compressing any body part. For example: T shirts made of stretch fabrics.
    - **Action Fit:** All types of active wear fall under this category. This fit is characterised by the fabric expanding or contracting depending upon the requirements of the specific body movement while maintaining a reasonable grip on the body. However, it does not constrain the body's movement.
    - **Power Fit:** It is a fit meant to provide body support using a stiff construction like a corset or neck band. It can also be made hard withstretchable fabric and construction such as pads and guards for the knee, ankle, elbow, etc.

KEY DIMENSIONS OF READY TO WEAR FIT

Studies conducted by researchers have helped identify the key dimensions of ready to wear fit. The following are the 16 key dimensions, which must be examined while evaluating garment fit - based on multiple measurements of each:

1. Neck girth/Mid-neck/Neck base
2. Bust/Chest
3. Waist girth/Waist by natural indentation / Waist by navel
4. Hips /Seat /Hip girth
5. Sleeve Length / Length Over-arm
6. In-seam
7. Out-seam
8. Shoulder length
9. Width Across the Back

10. Across Chest Front Width
11. Waist length measured from the Back of Neck to Waist Back
12. Crotch depth/Body Rise
13. Crotch Length -Total
14. Thigh Girth/Circumference
15. Biceps Girth/Circumference
16. Wrist Girth/Circumference

The following are the key considerations that must be kept in view while reviewing the fit of some of the more important key dimensions mentioned above:

- **Neckline:** A basic requirement of the neckline is that the front neckline is positioned below the back neckline. It must also be wide enough to prevent any kind of chafing around the neck. At the same time, it should not be too wide and prevent the garment from hanging evenly at the back and the front.

- **Collar:** The collar must sit snugly around the neck. It must have just the minimal amount of ease of about a quarter inch and still feel comfortable to the wearer. The fit of the collar must also reviewed against the outer garment, if any, worn around like ties and jackets as well as accessories like scarves worn inside of the collar.

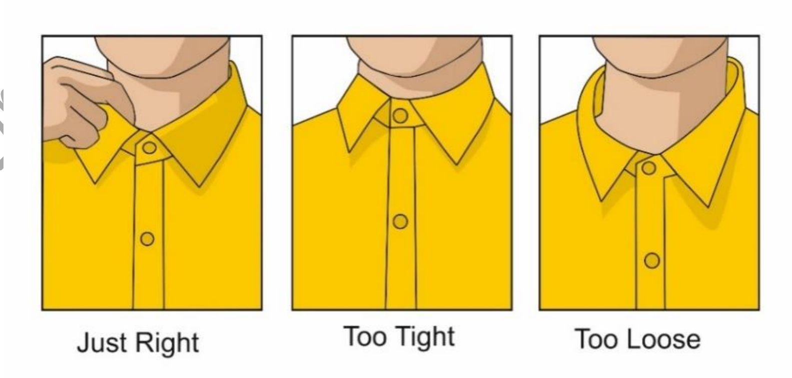


Fig.: 3.4 - Collar

- **Shoulders:** The shoulder seam must be aligned to the top of the shoulder and must give a smooth appearance. It must be wide enough to allow the sleeves to hang comfortable without causing any strain or creases at the shoulder point. It must also allow easy movement of the shoulder points.

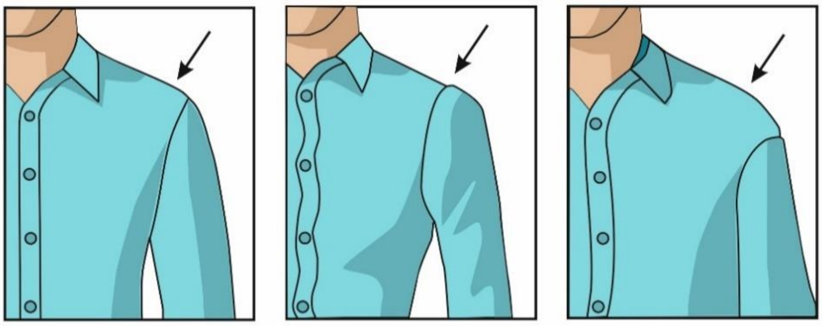


Fig.: 3.5 - Shoulders

- **Bust:** Fabric width at the bust level should be just right to prevent any gaping along the front or back closures or any strain or distortions along the side seams as well as princess seam if present. In the case of women's or girl's wear, the upper garment must flow down smoothly from the bust line. The darts must be aligned perfectly to the apex ending approximately an inch below it. Elimination of darts might create diagonal creases or wrinkles on the front.

- **Armscye:** There are five sub-dimensions of the armscye that determine its fit and these include 1) where it starts at the shoulder point, 2) where it ends at the armpit, 3) its circumference and 4) its depth. Since the arms would be required to move in the front than the back, the armhole must be cut deeper in the front than in the back. Its placement at the top should be on the shoulder point. It should end at about one inch below the arm pit to give it a close fit without constricting movement. There should not be also any drags originating from the armhole. There should not be any wrinkles along the circumference.

- **Waistline:** It is a dynamic area prone to regular bulging and contractions resulting from breathing or eating and drinking. It must, therefore, have adequate fit ease to accommodate the automatic changes in the girth of the waist. The fit at the waistline must also be reviewed keeping in mind the bottom garments that would be worn along with it. The waistline also has an important functional requirement of convenient sitting, depending upon the type of the type of the upper garment. Similar to the bust line, the waistline must also provide a perfect fit for closures if any.

- **Sleeves:** Its fit must be checked not only by itself but also in relation to the outer garment if any that would be worn over the concerned top garment. Sleeves are important from the point of view of both style and functionality. The length of the over arm is a key determinant of style. The ease of movement would be determined by its width. It is also important to check the grain direction at the bicep. The cross grain at the bicep position must run parallel to the floor. The width of the sleeves should also be coordinated with chest/bust measurement. There can also be also numerous styles of sleeves that are attached to women's, girl's or children's garments. The fit of the sleeve round or the cuffs must also be checked along with the sleeve irrespective of gender.

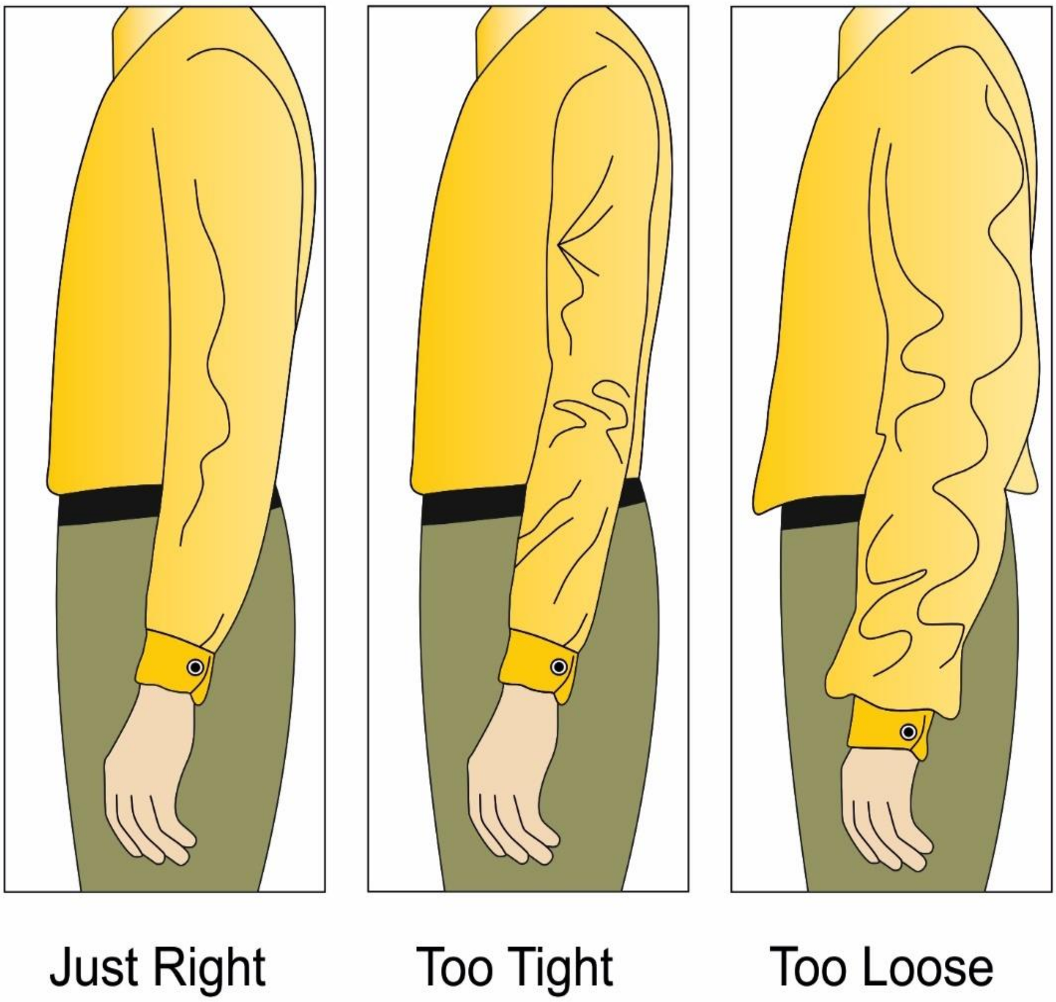


Fig.: 3.6 - Sleeves

- **Hips:** Proper fitting at the hip holds the key to the overall fit of lower garments such as trousers and skirts. A smaller waist might result in the whole lower garment getting pulled upward resulting in fit problems at the seat and crotch. The fit at the hip must be corrected first before attempting to rectify any other fit problem observed in the lower garments. The fit ease required at the hip would also depend on the fabric weight as well as the nature of the designed rise such as low, mid or high rise.

- **Crotch/Seat:** Proper fitting at the crotch is mandatory for all bifurcated garments like pants. There should be neither too much nor too little ease at the crotch position to ensure that the garment is comfortable to wear. It is normally about an inch. Unlike the shirt sleeve, which is cut deeper in the front, the crotch seam at the back would be longer and curved more deeply. The length and curvature of the back crotch would also increase more than proportionately as the size of the garment increases.

MAJOR SYMPTOMS OF FIT PROBLEMS

Fit problems fall into two broad categories: 1) Those that can be identified by visual inspection and 2) those which can be identified through fit sessions involving fit models, dress forms or computer simulations. The following are some of the fit problems, which can be noticed visually.

Symptoms of Set related Fit Problems

A garment with a proper set would hang on the body comfortably flowing along its contours without causing the fabric to develop creases anywhere. If the garment has set problems, then these would be reflected in the form of horizontal or vertical creases. These may be tight if there is less fabric than required or loose, if there is more fabric than required. Diagonal creases may appear if there is too much or too little ease in places like the crotch point. The following are some of the generally observed crease issues:

- **Tight Horizontal Creases:** These creases appear when there is less fabric as compared to the body girth at that horizontal position. A simple solution for this problem would be to relax adjacent vertical seams.

- **Loose Horizontal Creases:** These types of creases appear when there is a mismatch between the front and back lengths. Such problems can be rectified by balancing the front and back lengths.

- **Tight Vertical Creases:** These problems occur when there is a shortage of length. In order to remove these creases, it would be necessary first to track originating point of the curve and increase the length where there is a shortage of length.

- **Loose Vertical Creases:** These creases appear when there is excess fabric relative to the body girth at that position. This problem can be resolved by bringing in the adjacent vertical seems.

- **Tight Diagonal Creases:** These usually radiate from curved seams such as the neckline or the crotch. To remove it, first track down the source from which these emerge. Then relax the adjacent vertical and horizontal seams by letting them out to create enough length and width to accommodate the curved fabric.
- **Loose Diagonal Creases:** This is a reverse case of tight diagonal creases. To remove these, just contract the adjacent seam on top of the widest portion of the crease by taking it in.

Symptoms of Line related Fit Problems

A line is a multidimensional fit issue and covers not only the silhouette but also the relative proportions of the different parts of the garment. It also includes proper placement of design details as well as the smoothness of the curved lines. A proper analysis of the line related fit problems can be done only by looking at the whole of the garment, preferably through a fitting session.

The following are some of the important symptoms of line related fit issues:

- **Misalignment of Grain:** Proper placement of grain is an essential requirement for maintaining the lines of the garment. The length wise grain of the fabric must run parallel to both the centre front and centre back lines. The width wise grain must be parallel to the ground. In the case of cross grain used for shaping the fabric at different places the direction of the grain would need to be checked against the tech pack specifications.
- **Pleats:** Vertical pleats appear wherever there is width wise excess fabric. As opposed to this horizontal pleats are produced wherever there is length wise excess fabric. Bias pleats would be the result of width wise and length wise excess fabric. The solution to this problem is in removing the excess fabric by pinching.
- **Stress Lines:** These are the result of fabric shortage at the affected places in the garment. Horizontal stress lines indicate width wise shortage of fabric while vertical stress lines are the result of length wise shortage of fabrics. Bias stress lines would occur when there is both length wise and width wise shortage of fabrics. The solution to this problem requires addition of fabric. All additions of fabric may be done in small steps since even small changes can alter the line property of fit in a big way.

Symptoms of Balance related Fit Problems

Imbalance in the garment is the result of the lack of proper alignment between the right and left side or the front and back. The balance related fit problems would reveal themselves in the following ways:

- **Unbalanced Fabric Distribution:** There can be too much fabric at the back while there is a lack of it on the front and vice versa. Similarly, there can be difference in the distribution of fabric between the right and left. In a pant for example, the front may be loose and may have pleats while the back is tight. This would call for increasing the length at the back and reducing the length on the front.
- **Imbalances at the Girth levels:** Imbalance between the width at the front and back of an upper garment can distort the silhouette. It may be necessary to widen the side which is being pulled and correspondingly reduce the width on the other side.

THE NEED TO CHOOSE THE OPTIMAL METHOD

Just as there are a variety of sources of fit problems, there are also multiple ways to rectify the problem. Getting a perfect fit also requires special attention to the specific key dimensions. Some of the main methods include 1) pattern level changes, 2) seam alterations, 3) adjustments of the darts and 4) change of fabric. The choice of the best method is governed by technical, commercial and marketing considerations. It is always up to the buyers/fashion brands to choose the most appropriate method for rectifying the fit problems.

Making Sample Evaluation Comments

Introduction

Making the right comments is the crux of the sample development and evaluation process. The all important purpose of evaluating samples is to identify deficiencies as well as scope for improvement at the various stages of sample development. The comments serve as the vehicle for communicating the observed problems and intended modifications to the sample developers for getting the necessary changes made. The entire sample making and evaluation process would become pointless unless the sample evaluation comments help in improving the design, fit and quality of the garment within the planned price points.

The responsibility of providing effective comments is upon the sample evaluation team in general and the technical designer in particular. The sample developers can make the desired changes only if the instructions given to them are clear and actionable.

Key challenges in writing sample evaluation comments

The sample evaluation team would generally include designers, technical designers, merchandisers and garment technologists and each of these professionals would evaluate the sample garment from different perspectives resulting in diverse views. The following are some of the key challenges faced in framing unified and actionable comments:

- **Shifting the Focus from Compliance to Improvement:** While the basic objective of the evaluators is to assess how far the sample developers have complied with the tech pack specifications, the overarching objective of the sample development and evaluation process is to make the garment a success in the market place. Therefore, it would be necessary for the evaluators to look for opportunities for making positive improvements in the garment as opposed to just checking the spec wise compliance. It is important for the evaluators to be open-minded and not only give their suggestions for improvement but also request the sample developers to give their suggestions.

- **Achieving Optimal Trade-offs between Design, Fit, Quality and Cost:** Of course, it is the style that sells. At the same time, the buying decisions of the customers would also depend on other factors such as fit, quality and cost. All the suggestions and comments must therefore aim at the overall marketability of the garment and not just its compliance with tech pack specifications. All the comments must help improve consumer acceptance of the garment,

- **Converting the Qualitative Views into Measurable/Actionable Comments:** Initial reactions at the evaluation meetings would be generally in qualitative terms. Initial reactions may even be vague. However, to enable the sample makers to rectify the problems, all qualitative impressions must be translated into actionable comments. Evaluators should not only identify the exact location of the problem in the garment but also suggest practical changes such as alterations in the pattern or the stitch lines and indicate the exact measurement of the proposed changes. In the case of other changes desired in the fabrics or trims such as their type, quality and placements, the instructions should be clear and actionable.

- **Translating Personalised Feedbacks into Objective Comments**: During the fit sessions, the feedback provided by the models would be based on their personalised experience. It would always be necessary to study the feedback and identify the root cause of the problem experienced by the model. While making changes to the specs, it would be necessary, however, to keep in view the need to meet the needs of the target consumers. The differences in the body measurements of the model and the foundation blocks/slopers must be taken into account while making the final changes.

- **Making Clear and Coherent Comments**: Since the evaluation team usually consists of several professionals, it is important to arrive at a single unified comment with reference to any single problem. It would also be necessary that there are no internal contradictions or conflicts among the various comments and proposed changes.

FORMAT OF EVALUATION COMMENTS

A tech pack usually contains a template for making comments. There will be at least one or two proto samples, up to three fit samples and a number of pre-production samples before any garment is approved for bulk production. Each review may also contain several comments relating to different aspects of the sample garment such as overall view, patterns, measurements, grading, materials, construction, finishing, labels, etc. There would also be photographs, sketches, measurements, etc. It would, therefore, be necessary to write the comments in a standardised template and store them in an organised manner. The following table illustrates the type of content, which should form part of such a standardised template.

Date of Review	
Review/Comments ID	
Sample Type/ID	
Sample Status	
Vendor/Factory Name	
Review Details	
Aspect	**Comments with Serial Numbers**
• **Design**	1. .... 2. ....

	3. ....
• **Pattern**	4. .... 5. .... 6. ....
• **Measurements (POM)**	7. .... 8. .... 9. ....
• **Grading**	10. --- 11. .... 12. ....
• **Fabrics**	13. .... 14. .... 15. ....
• **Trims**	16. .... 17. .... 18. ....
• **Construction**	19. .... 20. .... 21. ....
• **Labels/Tags**	22. .... 23. .... 24. ....
• **Finishing/Washing**	25. .... 26. .... 27. ....
• **Packing**	28. .... 29. .... 30. ....
• **Miscellaneous**	31. .... 32. .... 33. ....

It may be necessary to give comments flowing out of any particular evaluation a unique id for cross referencing it during subsequent evaluations. The aspects against which specific comments are written should be preferably in the same order as they appear in the tech pack. Each comment may be identified by a serial number for easy cross referencing. The consecutive numbering shown in the table above is only illustrative and can be adapted according to the company's own systems. The aspects that do not have any comments may also be omitted.

Best practices in writing comments

Although, tech pack based garment production has become the industry standard, there are no universal standards applicable to the manner in which tech packs are developed and presented. There is also no standardised way of writing evaluation comments. However, the following best practices would be helpful in improving the effectiveness of evaluation comments by enabling the sample developers to do their work right the first time.

- **Leave no room for misinterpretation:** The comments should be in an unambiguous language that does not result in any misunderstanding on the part of the sample developer. Write the comments with exact measurements and instructions leaving nothing to the imagination of the sample developer.
- **Stick with the tech pack codes:** Use the same POM codes, technical drawings and other instructions appearing in the tech pack to point out problems or suggest changes. If design changes are required, then change the tech pack sketches accordingly and draw the attention of the sample maker to the changes made. If a problem needs to be rectified identify the areas of the problem in the technical drawings with appropriate colour markings.
- **Use the same tech pack language and abbreviations:** Garment related terminologies and abbreviations are yet to be standardised internationally. While it is convenient to use abbreviations, it would be necessary to provide a glossary of such abbreviations to avoid any misinterpretations.
- **Use the same units of measurements:** There is a need for using standardised units of measurements and remain consistent with the units of measurement used in the tech pack.
- **Provide supporting documentation to explain the problems:** Attach relevant photographs or sketches to explain both problem areas and proposed solutions.

- **Give details of the contact persons:** It would also be necessary to include the contact details of personnel, who could be approached for necessary clarifications relating to all or specific comments.

Maintaining fit history

Maintaining a well-organised record of fit history serves two purposes:

- First, it helps in experimenting with alternative fit ideas and finally adopting the best option. Fit history is helpful in comparing the ideas and measurements used across the entire range proto and fit samples. A tech pack is not complete till the fit history is complete.

- Second, it helps build a library of ideas relating to fitting. Since expertise in fitting is acquired mainly through experience, the knowledge gained from each fitting session becomes a rich collection of data for future reference. Maintaining a well-classified library of fit histories becomes an essential requirement for developing unique fit solutions that help achieve greater satisfaction amongst its target customers.

The futuristic value of fit histories also makes it necessary for apparel companies to have a well organised system of classification based style numbering, which make it easy for locate any particular fit history with ease.

FORMAT FOR MAINTAINING FIT HISTORY

The Fit History template is built upon the POM page of the tech pack. The first five columns of the fit history table are the same as on the POM page. The data for these columns is also copied from the POM page.

1. POM Code, which may be abbreviated to 'Code'
2. Description
3. Tolerance (+) abbreviated to TOL+
4. Tolerance (-) abbreviated to TOL-
5. Measurement Specified, which may be abbreviated to 'SPEC'

Four more columns would be added for each fit evaluation session – for entering the following data:

1. Actual measurement taken from the sample against the original spec in the POM page.
2. Observed difference between the POM Spec and the actual measurement, which may be shortened to just 'Difference' or just 'Diff.' In the case of the second or third sample, the difference would be between the New Specification, if any specified after the evaluation of the previous sample and the actual measurements in the current sample.
3. Notes, which would be often written in brief language or acronyms. It may be necessary to refer to the comments page to understand the context of the notes. The acronyms used may also vary from company to company.
4. A new or revised specification which needs to be adopted for developing the next sample.

A typical fit history page would appear as shown below:

POM Code	Description	TOL (+)	TOL (-)	SPEC	Fit Sample 1 Date -- -- ---				Fit Sample 2 Date -- -- ---			
					Meas.	Diff.	Notes	New Spec	Meas.	Diff.	Notes	New Spec

Activities

Activity 1: Using the POM and construction pages of the mock tech pack created earlier, develop the necessary patterns, sew a proto sample in muslin and evaluate it for its construction quality and cross check the measurements of the sample with the tech pack and samples and prepare your comments

Materials Required:

- Mock Tech Pack, Muslin, pattern making tools, pattern making paper, sewing machine, press,
- Paper, pen, pencil, measuring tape, French curve, ruler, flat table for creating the technical drawings, tabular data presentation and writing out the callouts and instructions
- Imaginary names for buyer, vendor, designer, style ID, etc.

Procedure:

1. Select the mock tech pack created earlier.
2. Use the measurements on the POM page to develop the patterns and sew the garment as per the specifications given in the Construction Page.
3. Evaluate the sample for measurements and construction quality covering all the aspects and prepare a report.

Activity 2: Conduct a mock fit session in a group having one or more student designers, technical designers and merchandiser as members of the evaluating team along with a fit model and prepare fit evaluation comments and the fit history form.

Materials Required:

- A sample garment with fit problems, a dress form and a fit model suitable for the size of the sample garment and camera
- Paper, pen, pencil, measuring tape, French curve, ruler, flat table for creating the technical drawings, tabular data presentation and writing out the callouts and instructions
- Imaginary names for buyer, vendor, designer, style ID, etc.

Procedure:

1. Select the sample garment to be evaluated for fit.
2. Take all the measurements that would go into the POM page of a tech pack.
3. Try the sample on the dress form, identify the fit problems, mark out the problem areas and take photographs.
4. Try the sample on the fit model, identify the fit problems, mark out the problem areas and take photographs.
5. Discuss the fit problems and arrive at practicable solutions.
6. Make necessary changes and record these in the fit history chart.
7. Prepare a report with instructions to the sample makers.

Activity 3: Select any garment of a larger size and refit it to a lower size

Materials Required:

- A sample garment, a dress form and a fit model suitable for the size of the sample garment and camera
- Paper, pen, pencil, measuring tape, French curve, ruler, marking chalk

- Sewing machine and sewing kit

Procedure:

1. Select the sample garment to be evaluated for fit.
2. Identify the fit problems.
3. Prepare a brief write up on the identified fit problems and proposed solutions.
4. Refit the garment.
5. Take photographs of the garment before and after and attach with the report.

Check Your Progress

A. Fill in the blanks:

1. _____________review how well the style elements are fitted. They also look at every technical aspect of the construction, including stitching, seam lines, fabrics and trims used
2. Fit properties such as set, line, balance, grain, wrinkles, and seam/shell distortion can be easily identified using______________.
3. The __________ is the first in the series of samples that garment manufacturers are required to develop after receiving the tech pack from the buyers.
4. Buyers and fashion brands would be very sensitive to the _______________ as it would affect their reputation in the market in a very big way.
5. How well the garment generates a psychological feeling for comfort on the wearer determines the __________ of fit.
6. Fit ease is introduced in the foundation pattern itself. ________ is, however, added later by the designer to create the desired silhouette.
7. ___________ classification is based on how close the garment is to the body.

B. Short answer questions:

1. Describe the process of evaluating cost competitiveness?
2. Describe the aspects of garment quality assessed during proto sample evaluation
3. Describe the aspects of fit assessed during proto sample evaluation.
4. What are all the measurements cross verified during proto sample evaluation and how?

5. Explain how functional requirements influence the fit requirements garments.
6. Explain how fabric properties influence the fit requirements garments.
7. Describe why pattern making is a core challenge in creating perfect fit.
8. Explain how personal preferences influence the consumer's perception of it?
9. Who all would participate in the fit evaluation process and what are their respective roles.
10. Describe the main requirements of a fitting room.
11. Describe the different methods used for evaluating fit.

C. Long answer questions:

1. Describe the different steps in proto sample evaluation.
2. Describe key factors influencing proto sample evaluation.
3. Explain the stitch and seam related aspects evaluated during proto sample evaluation.
4. List and describe the different fit evaluation criteria.
5. List and describe the different sources of fitting problems.
6. Describe in proper sequence the various activities carried out during a fit session.
7. List and explain the different preparations required for organising a fit session.

Session 2: Basic and Specialized Garment Testing Methods and Requirements

The garment industry is prone to quality problems and hence, quality control has become a vital component of it. Quality ensures that the quality problems arising at any stage are taken care of at the earliest without waiting for the final check of the garment at the end.

The checks installed in place to ensure that the least number of problems reach the last stage of production or finishing could be categorised as follows:

Quality Testing:

This refers to the inspection of the fibres, yarns and fabrics prior to the start of the production. Thus, these are also referred to as the preproduction checks to ensure no fabrics containing defects enter the production process. Not only does it ensure that the fabrics, yarns or fibres are in accordance with the preproduction or proto sample, but it also makes sure that the accessories to be used in the production of the garments are exactly the same as mentioned in the tech pack.

Quality testing can be further classified into:

- Basic Tests
- Specialised Tests

Quality Checks:

This refers to the processes carried out to ensure compliance with the standards as benchmarked by various organisation or in accordance with the specifications laid out by the buyer. These processes are carried out while the production process is going on and hence, these are referred to as quality checks during production.

These processes are carried out by the personnel referred to as “Quality inspectors” assigned at every check point. They ensure that no defect should surpass their eyes and lead to rejection or removal at a later stage. This way the wastage is also kept in check.

They can be further classified as:

- Inline quality check
- End product quality check

Quality Inspection:

This refers to the process which is carried out only after the garment has been made ready after production and finishing. This is carried out to ensure that the buyer's specifications are met with the right amount of tolerance and the buyer is never at a compromised end.

This process is never carried out by the in-house personnel as the objectivity of this process is to validate the quality in an unbiased manner. Hence, a third party organisation is invited to carry out the quality inspection prior to the approval for billing and dispatch.

There are several standards set by the various international organisations governing the quality specifications of the garments manufactured. These organisations also have several subsidiaries that provide the function of quality inspection in an unbiased manner.

Thus, with this classification of quality control, it becomes easier to reduce wastage at every stage.

Fig.: 3.7 - Quality Inspection

As we have understood the entire process with regard to quality control, we must understand the need for it. The quality of the process from cradle to grave is important due to the following factors:

- ✓ It reduces the wastage arising out of defects and discard of garments at a later stage.
- ✓ Reduces the cost of repair.
- ✓ Reduces the loss of contracts on account of non-fulfilment of quality criteria.
- ✓ Maximises the production of goods within the specified tolerances correctly the first time.

Hence, we have understood that having a quality control and assurance department in the producing organisation is a must.

Quality Testing

As we have discussed earlier, these are processes which are performed before the commencement of production, therefore it is a prerequisite for the organisation. The processes carried out can be classified on the basis of two parameters:

- Input received
- Tests carried out

On the basis of the input received, the processes are defined for each category of the raw materials received. They are classified as follows:

- Fibres, Yarns and Fabric
- Trims and accessories

On the basis of the tests carried out, they could be simply categorised as follows:

- Basic tests
- Specialised Tests

Hence, before understanding the tests in detail and their outcome, it is necessary to understand their importance in the organisation. The tests are important due to following factors:

- ➢ They reduce the risk of disruption that might occur during the production.
- ➢ They verify the preparedness of the supplier w.r.t production.
- ➢ They also ascertain the manufacturer's ability to meet the quality objectives.
- ➢ They indicate the production schedule followed by the manufacturer.

Thus, it is an important process to carry out before the commencement of production.

Let's understand in detail the various components of the quality testing:

Basic Tests: These are the processes that do not require the specialised lab equipment for the ascertainment of quality. They can also be referred to as Physical tests. The physical tests to ensure the quality of the input are classified based on the property under check of the textiles. Hence, some of the properties checked under the physical tests are as follows:

- Yarn Grade: This is employed to check the fineness or coarseness of the yarn by having a look at it. Some of the types of yarn are superfine, fine, light, medium, bulky, super bulky and many more.
- GSM: This refers to the system that is used to measure the weight per area. This stands for Gram per square meter. It is used for both woven and knitted fabrics to check the GSM and ensure its compliance with the buyer's specifications.
- Shrinkage: This is the most important property under check as the fabrics' dimension becomes less than the original and is counted as a fault. Hence, it must be done prior to production to avoid rejection at a later stage.
- Width: This also points to the dimensional stability and regularity of the same, which would ensure lower wastage in production. Hence, it is checked to confirm the dimensional stability at the garment stage.
- Lycra determination: This is an important consideration for the production of sportswear, socks, pantyhose, sweaters and many more articles. Hence, the blend of the Lycra and its percentage determines the acceptability w.r.t production of certain articles.
- Crease resistance: This is a property that is important for the people in the intensive labour industry and also for those who don't prefer creases in their apparel. Hence, the capability of the fabrics to resist creases is an important consideration.
- Shade Check: This is to ensure that the shade complies with the buyer's specification before the commencement of production. Thus, accuracy of the shade match determines the acceptability of the order.
- Rubbing fastness: This is vital for the garments which would be used extensively and might get rubbed against certain surfaces. Thus, resistance to loss of colour or print on rubbing is a crucial factor in determining the right fabric for the garment.

Specialised Tests: These are the tests that make use of the various lab equipments to ensure quality control and compliance. They could be either physical tests or chemical tests. They are also categorised based on the property under check. These properties are checked by using procedures set out by the various associations and organisations governing them. These organisations are as follows:

- American Society of Testing & Materials (ASTM)

- ❖ American Association of Textile Chemists and Colourists (AATCC)
- ❖ International Organization for Standardization (ISO)
- ❖ European Norms (EN)
- ❖ British Standards (BS)
- ❖ British Standards for European Nations (BS EN)
- ❖ DeutschesInstitut fur Normung (DIN)
- ❖ Bureau of Indian Standards (BIS)

Some of the tests are as follows:

- ➢ Fibre content:

  This is an important part of the textile inspection since it determines the moisture content, non-fibrous content, and fibre composition of the cloth quantitatively. The standard procedure employed is AATCC 20A. This further involves several mechanical, chemical, and microscopical methods.

  This test is done for both woven and knitted fabrics. The tolerance limit is as follows:

  - Woven & Knitted:
    - Single fibre: +/-0%
    - Multi fibre (up to two fibres): +/-3%

- ➢ Fabric Weight(Mass per unit area):

  This is used to measure the mass per unit area of the fabrics before their use in production. The standard procedure under concern is ASTM D3776. This further categorises the testing into various parts depending upon the conditions met. The several options are based on the type of input. The options are as follows:

  Option A: Full piece, roll, bolt or cut primarily used for commercial shipments

  Option B: Full width sample primarily for the fabrics with selvedge

  Option C: Small swatch of the fabric when sent to lab for testing

  Option D: Narrow fabrics if assigned by the trade

  This test is done for both woven and knitted fabrics. The tolerance limit is as follows:

  - Woven: +/- 3%
  - Knitted: +/- 5%

- ➢ Tensile strength:

This is used to measure the maximum stress the fabric can be subjected to before breaking. Thus, it is referred to as the test for breaking strength and elongation also known in layman language as the Grab Test. The standard procedure under concern is ASTM D5034. They primarily check the effective strength of the fabric i.e. strength of the yarns in a specific width together with the fabric assistance from the adjacent yarns. These procedures are specifically applicable to woven, nonwoven and felted fabrics. This test is not suitable for glass fabrics or knitted ones which have a stretch of more than 11%. The result is provided in SI a unit which is a technical name for system of metric units generally known as International System of Units. The results are also provided in inch-pounds units.

The tolerance limit for the same are as mentioned below:

- Jackets/Pants: 30lbs
- Tops/Skirts: 20lbs
- Linings: 15lbs
- Voile: 18lbs

- Abrasion Resistance:

This is used to measure the ability of the fabric to resist surface wear caused by flat rubbing against other materials. There are two methods commonly employed to test the abrasion resistance, which are:

Wyzenbeek: This involves rubbing along the warp and weft of the fabric. This is carried out using a Wyzenbeek machine to hold the fabric tight in position. Individual specimens of both warp and weft are cut and an approved abradant is chosen to be rubbed against them. Number of double rub cycles before the two yarn breaks occur is recorded as the abrasion rating.

Martindale: This is a Fig. 8 rub test. This is an oscillating test where fabric samples are mounted flat and rubbed in a Fig. eight like motion using a piece of worsted wool fabric chosen as abradant. Number of cycles before the objectionable change is taken as the abrasion rating.

- Piling resistance:

This measures the resistance to pile formation on fabric surface or other changes due to abrasion. It ensures better quality of the fabric. This is carried using the ICI pilling test. ICI pilling box tester is used to assess fabric surface pilling and fuzzing by tumbling randomly.

The tolerance limit is Grade 3 as shown below:

GRADE	DESCRIPTION
1	Dense surface fuzzing and/or severe pilling. Pills of various sizes covering the entire specimen
2	Distinct surface fuzzing and/or distinct pilling. Pills of various sizes covering a large portion of specimen
3	Moderate surface fuzzing and/or moderate pilling. Pills of various sizes partially covering the specimen
4	Slight surface fuzzing and /or partially formed pills
5	No change

- Skewness:

  This is used to determine the skew in the fabric after laundering. There are several tests performed to check the skewness. The tests are as follow:

  AATCC TM179: This is to check the change in the fabric after home laundering.

  ASTM D3882: This evaluates the fabric skew in the unlaundered state.

  Both the tests are independent in their approaches and the results of the two should not be compared. The percentage of skewness and the direction of the skew is determined post the test. A value close to 0 indicates a greater amount of skew.

- Dimensional Stability:

  This is used to measure the changes in the dimensions (length and breadth) of the fabrics when subjected to home laundering. The standard method is AATCC 135. The home care options includes a set of 4 washing temperatures, 3 agitation cycles and 4 drying procedures. Once the processes are complete the condition of the fabric is noted and resulting change is observed.This is suitable for both woven and knitted fabrics.

- Colourfastness to Wash:

  This is used to measure the change in the colour of the fabric and surface due to abrasion and use of detergents. The procedure under question takes into account home laundering which include five typical hand or home launderings totalling a session of 45 minutes. The standard procedure under concern is AATCC 61. This test is done for all fabrics suitable to home laundering.

- Colourfastness to Perspiration:

  This is used to measure the fastness of the coloured fabrics to acid perspiration. The procedure is carried out in a simulated environment whereby the specimen of coloured textile i.e. fabric or yarn in contact of other fibre content is wet out in a simulated acid perspiration solution. This process is carried out with fixed mechanical pressure and is allowed to dry at a slightly higher temperature.

  The result is noted after the conditioning of the specimen is completed. The colour of the specimen and the colour transfer on the other fibre content is recorded. The standard procedure under concern is AATCC 15. This is mostly carried out for active wear, swimwear, inmates and lined garments.

- Colourfastness to crocking:

  This is used to measure the amount of colour transfer that takes place by rubbing the specimen (dyed, printed or otherwise) against other surface.

  The process involves the use of both dry and wet with water white test cloth squares. As the colour transfer gets affected by the processes such as dry cleaning, ironing, shrinkage, washing, finishing, etc the impact is measured both prior and post these processes.

  The white squares against which the specimen was rubbed are compared with the Grey Scale for staining (AATCC Evaluation procedure 2) or the Chromatic Transference Scale (AATCC Evaluation procedure 8) to assign a grade. The standard procedure under concern is AATCC 8.

The lists of the tests discussed therein should not be viewed as comprehensive as it involves many other processes involved in the evaluation of the fibres and textiles. The trims and accessories also undergo certain processes which are mainly applied during the production prior to their attachment. Hence, only names should be kept in mind for the time. Some of the tests for trims and accessories are:

- Pull test
- Stretch Test
- Fatigue Test

All the tests discussed above are performed to meet the buyer specifications (physical requirements) in case of the fibres, yarns and fabrics such that if the conditions laid out by the buyer are not met, the fabric would be sent back for reprocessing. Only when the fabrics become acceptable within limits set by the buyer, they would be allowed to pass through the production process.

The name assigned to the set of tests buyer would require prior to acceptance of fabrics is Fabric Package Test (FBT). All the tests as mentioned by the buyer based on the specifications laid out would be performed by a third party organisation in a lab.

Quality Check

With the complete understanding of quality tests, only 10% of the quality control is ensured as the vital processes of quality checks form the backbone of the Quality Control and Assurance. Quality checks are referred to as processes that are carried out parallely with the production to ensure quality assurance. The third party organisations which carry out the checks on behalf of the buyers abbreviate the process as DUPRO (During Production) checks.

The quality checks are carried out in two ways which are as follows:

- In-line checks
- End Product checks

In-line Checks: These are the processes carried out by the Quality inspectors assigned to various departments to ensure no mistakes or faults take place during the production. The various departments through which the textile passes to become a garment are referred to as the quality check points. All these checkpoints are under close observation of the Quality Inspectors.

The Quality checkpoints form the backbone of the entire Quality Control and assurance as it ensures several benefits:

- ✓ It ensures on time delivery to the customers.
- ✓ It helps to monitor the production speed.
- ✓ It helps to identify the non-conformities at an early stage.
- ✓ It ensures the removal of the additional costs due to defects and rejections.
- ✓ It saves the time that would be spent in hard negotiation with the customer.

The quality checkpoints are generally four in number, but to make it more comprehensive and effective additional 3 are also kept in place to catalyse the process and ensure better quality. The quality checkpoints are as follows:

1. Fabric Store
2. Trims & Accessories Department

3. Cutting Room
4. Printing and Embroidery
5. Sewing department
6. Finishing department

The fabric store, trims and accessories department and the printing and embroidery department are the additional ones whereas others are the primary ones. Let's understand them in detail.

Fabric store:

Here, the most important process that takes place is the check of the fabric before it is being issued to the cutting department so that there are no defects in the fabric and cutting can be carried out effectively. Either the entire rolls are checked or a sample of 10% is selected randomly and checked for defects.

These rolls are laid out on the table and checked for defects by either employing a lightbox or a fabric checking machine. The defects are also found and recorded. The fabric inspection for faults is done using either of the two methods –

- 4 point method
- 10 point method

The three important processes carried out in this department before the fabric is passed to the next department are:

- Spreading: In this process, the fabric is spread out on a table and two aspects of the fabric are observed which are:
- ❖ Ply alignment: The greater the variation in the width or length of the fabric, the greater would be the wastage.
- ❖ Ply spread/slack: A tight spread would result in an undersized garment, whereas a slack spread would lead to excess length and hence oversize.
- Bowing: It shows the distortion of the weft yarns from the straight line across the width of the fabric again, resulting in the distortion of the alignment, leading to undersized components.
- Splicing: It shows the overlapping of the two ends in the case of a ply, which, depending upon the variation, could lead to wastage and improperly cut sections of the garments.

Trims & Accessories department:

The processes carried out in this department are related to colour matching and inspection of the trims and accessories w.r.t standards and the buyer's specifications. This ensures that the trims are not required to be changed at a later stage and are accepted. The various tests to ensure that the trims and accessories are in proper shape, and fit the criteria mentioned in the standards are as follows:

- Pull test: Though this is a part of the inspection process, performing it while production ensures no changes at the later stage. In this process, the accessory is pulled with a pull gauge for 10 seconds to confirm it possesses the required strength to not break apart.
- Stretch Test: As the name suggests, it is used to check the elasticity of the stretch bands and straps and check for any breakage in the fibres before stitching.

Cutting Department:

Cutting is referred to as the heart of production and if done properly as per the specifications would save a lot of trouble at later stages. But before proceeding with the cutting, it is vital to note that there are no mistakes or faults in the pattern and to ensure that, a checklist of the following is used:

- There must be clear assortments of the various parts of the garments.
- None of the parts should be mixed and all are labelled properly with marker.
- No patterns should be made on the wrong side of the fabrics.
- None of the patterns must be misaligned to the grain of the fabric.
- No pattern parts should contain lesser amount of knife clearance freedom.
- None of the patterns should be inaccurate leading to misfit garments.
- No pattern parts should be cut in a manner such that the notches, drill marks are omitted or indistinct or misplaced.

This way the defects arising from the cutting department could be omitted. The defects generally associated with the cutting department would be:

- Frayed, fuzzy, ragged or serrated edges
- Incorrect ply to ply fusion pattern
- Lack of precision
- Incorrect notches or drill marks

To ensure the success rate, several processes are carried out during spreading and cutting. These are as follows:

- Align the fabric correctly with marker length and width.
- Match the check and stripe.
- Ensure the lay contains the right amount of fabric ply.
- Check the ply direction and control fabric splicing.

- ❖ Ensure tension control.
- ❖ Match the dimensions of the pattern and cut pieces to ensure accuracy.
- ❖ Make clear drill holes and fine notches.
- ❖ Pre-check the black for any defects.
- ❖ Maintain a cutting angle to ensure no overcut or undersize garments are formed.
- ❖ Allow the fabric to relax for 12-24 hours depending upon the type of fabric under consideration.
- ❖ Ensure the height of the cutting pile is suitable and is never more than 5 inches.
- ❖ Number the parts correctly and ensure the numbering could be easily removed post sewing.
- ❖ Store the parts by making rolls rather than folding them.

This way the three main areas to be observed during the cutting process are:

- ✓ Marker checking
- ✓ Cut Part audit
- ✓ Bundle checking

Printing and Embroidery

This is an essential process only when the cut parts are used to print the design on them. In case the printing is done in the fabric form, the same would have been checked in the fabric store before issue of the same. The processes to ensure that there are no defects with respect to printing and embroidery would include:

- Checking the placement of the print
- Ensure the colour matches the sample and there is no variation in the shade
- Ensure there is no overlap of the print
- Ensure the embroidery is inspected completely for accuracy and motif placement

Sewing Department

This is the most crucial department with regard to manufacturing of the garments as the major action takes place here. The considerations to be kept in mind before starting the sewing process are as follows:

- ➢ Check the input material and trims.
- ➢ Check the proper functioning of the machine.

- ➢ Ensure the cut panels with embroidery have no defects.
- ➢ Check the appearance of the fabric for wrinkles.
- ➢ Ensure the right size of the needle is chosen for the sewing operation.

Once the above considerations are taken care of the sewing process can get started. To ensure quality control in the sewing department, the inspection process is further broken down into 5 parts. Each part has a specified process to ensure quality. They are:

- ✓ Inline Inspection: This is an essential process to identify defects and correct them right away. In this process, certain check points are established and every partially stitched piece is checked for 100% accuracy and only after the verification, is passed on to the next stage. This process is generally carried out for high value items.
- ✓ Roaming Inspection: As the name suggests, the checkers in each sub department roam around and randomly check the line items for each operations accuracy.
- ✓ Traffic Light inspection system: This is similar to a traffic light, where red indicates stop and green indicates proceed. Similarly, a department quality inspector would visit each operator and inspect random pieces for accuracy, marking red or green on the card provided to each operator depending on the rating criteria.
- ✓ End of the line or table checking: This involves the complete check of the garment completely stitched.
- ✓ Audit of the check pieces: This is a process seldom followed by the manufacturers but is an essential part of the quality assurance, as only 100% inspected pieces should be sent to the finishing department and all others must be repaired before further processes.

After the sewing is finished, several things are checked to ensure that the pieces are 100 percent perfect before moving on to the next stage. The various aspects checked would be:

- ❖ No stitching fault or seam fault is present.
- ❖ The size of the garment matched the required specifications.
- ❖ No mismatch in the trims.
- ❖ Correct labels are assigned.
- ❖ Right placement of the interlining.
- ❖ The garment matches the approved sample.
- ❖ Check the bonding of the interlining at the fusing stage.

This way the quality is confirmed before the pieces are transferred to the next section of the finishing department. Though the next section would ensure that all the garments are as per the approved sample, a washing process is carried out prior to the finishing of the garments.

Washing

For certain garments', washing is an essential process before they can be passed to the finishing department, therefore quality is checked at this stage too. The quality check carried out at this stage would include the following:

Depending upon the washing process carried out for the pieces, such as normal, stone, sand, or enzyme wash, the after effects of the washing is observed on the pieces. This would include:

- The colour tone of the blue yarn
- The whiteness of the white yarn
- The resultant colour tone
- The hand feel

Similar are the checkpoints for the pieces required to be processed through the bleaching process such as stone or garment bleach.

These checkpoints are checked on the basis of the colour chart and are graded as per the following criteria:

1. Fabric flaws and washing marks in excess of 1″ on the garment zone above the knee.
2. Fabric flaws and washing marks larger than 3″ on any part of the garment.

If any defects are identified, they are repaired and only post that the piece is transferred to the next process.

Finishing Department

This is the section which performs the job of assurance as if the pieces are checked and handled to the next one, there is a little chance of rejection at this stage. The processes for ensuring quality at this point would be divided as follows:

Initial inspection: This would ensure the check of the piece prior to the pressing of the garment at the finishing room. Hence, certain aspects which need to be checked prior to pressing are checked here. The points to be checked here include:

- Proper inspection of the garments including measurement, spot, dirt, impurities
- Water spot
- Shading variation check
- Smooth and unfold in pocket
- In secured or broken chain or button Collar closing
- Side seam

- Sleeve placket attach
- Cuff attach
- Bottom hem
- Back yoke

Final finishing inspection: Once the pressing is performed, they are again checked before being sent to folding section for tagging and packing. The points to be checked here would include:

- Proper shape in garments
- Properly dried after pressing
- Wanted wrinkle or fold in lining

Internal Audit: This entails the final check on the part of the manufacturer before a certain quantity of the garments is handed over to the buyer QC team. This is generally performed after a certain quantity of the garments is packed to ensure no defective pieces go in the shipment. This is the most comprehensive process as this is the last handling point for the manufacturer. The points to be checked would include the following:

- Button attachment and button specifications: This would ensure the right set of buttons as found in the approved sample are used and their attachment on the garment is correct. To ensure this, certain check are conducted such as
  - Is button coming off
  - Fabric not strong enough to hold the button
  - Rust on the button
  - Text on button not straight
  - Wrong position / not in line with counterpart / incorrect spacing
  - Button shank missing when required
  - Buttonhole is too big or too small
  - Buttonhole not clean / badly stitched/ losing shape / stitched with wrong thread quality
  - Spare button missing or put in the wrong position
  - Snap button too loose / too strong
  - Snap button not closing properly / broken

- Pressing: This is an important process in the finishing of the garments but without the check on the quality, it would be rejected by the buyer. Hence, several checks performed to ensure quality would include:

- Not pressed or improperly pressed pieces to be identified.
- Avoid the pigment dyed fabrics while pressing and folding, as it leaves clear visible marks on the garment. They should be hung on a hanger until washing starts.

- Full garment check: This would involve a complete check of the garment w.r.t the operations carried out on it and their effectiveness. The checks that would be performed during this stage are:
  - Workmanship defects if any
  - Measurements to assure proper fit
  - Heat seal peeling off
  - Confirmation quality check of the final garment

- Packing and carton quality check: Though this is not a major part of the garment manufacturing, it holds a vital position when looked at it from the consumer's point of view. Hence, completion of the packing would ensure better sales for the buyer and therefore would be approved. The checks performed would include:
  - Correct ticketing and placement of the tags
  - Packing accuracy of quantity, assortment, and folding of each piece
  - Correct carton selection as per buyer's specification
  - Packing, sealing, binding and barcode checking of every random sample

This entire process of quality checking would ensure the shipment is approved by the buyer after having passed the several quality checks at each check point assigned to each department. But before the buyer accepts the shipment, a quality inspection is carried out by the quality control team (3rd party) hired by the buyer to ensure no defects in the shipment. Hence, the next test of the shipments would be Quality Inspection performed by a third party.

Quality Inspection

This is referred to as the most crucial of all as it ensures on the part of the buyer that the order has been made ready as per the approved sample. This process of quality inspection involves several steps and is performed by third party organisations to eliminate the need for onsite inspection by the buyer.

The main agenda of the process is to check and confirm the order as per the desired buyer's specifications. Hence, it becomes of primal importance to understand the buyer's specification w.r.t shipment.

Buyer's specification

The buyer would approve the order if it satisfies the criteria of:

- Aesthetic Fit
- Functional Fit
- Packing& Labelling

Aesthetic Fit: This refers to the foundation of the garment which is defined by the ingredients that go into making it. This would involve the accuracy in terms of:

- **Input material used**: The fabric used for the production is same as indicated in the approved sample and bears no variation in the shade.
- **Trims & accessories attached**: This would entail that good quality trims and accessories are used during the construction and they do not fall off the garment during use.
- **Construction quality**: This is the crucial element of check which provides for accuracy in seams, application of interfacing, attachment of buttons and buttonhole accuracy. This is vital as it cannot be changed at a later stage without altering the garment

Functional Fit: This is the requirement of the buyer keeping in mind the acceptance of the consumer. Hence, its validation becomes crucial to the approval of the order. The aspects checked to ensure the garment is functional fit are:

- Comfortable to wear: This would indicate the placement of the trims and application of the good quality fabric to ensure comfort for consumer.
- Proper fit: This would indicate that the garment is within the tolerance limits set by the buyer and is constructed in the right proportions.
- Durable in nature: This would ensure that the garment is one that can be used for a longer period without facing problems like button falling off, change in shade, puckering and seams breaking apart.

Packing& Labelling: This requires the correct placement of the price tags and labels and appropriate packing to make the garment presentable to the end consumer. Incorrect placement would lead to tarnishing the image of the buyer.

Hence, the major points to be kept in mind while conducting a 3rd party quality inspection would include:

- ✓ Fit of the garments
- ✓ Functioning of the closures and application of trims and accessories
- ✓ Packing and Labelling
- ✓ Conformance to the quality standards
- ✓ Quality defects and its severity

As the buyer's specifications are clearly specified, it becomes easier for the 3rd party quality inspectors to assure the quality of the shipment. Let's understand the processes involved in quality inspection as conducted by the quality inspectors.

The processes to identify and assure would be described keeping in mind the buyer's specifications. They are as follows:

Fit of the garments:

The major aspect of any piece of clothing is its proper fit for the end consumer. An ill fit garment would lead to increase in the inventory owing to returns and non-sellable items. Not only will it create long term problems for the buyer but also make the loyal customers go for a switch.

Since, the manufacturing of the garments could only be automated to a certain extent after which it is dependent on a manual workforce, it is prone to discrepancies in the final output. This leads to the setting up of tolerance limits within which the product would be approved.

The specification of the tolerance limits is provided to the QC inspectors prior to the inspection so they can report onsite based on them. The length of the pant leg may vary, with the difference being 1/8 inch too long versus the tolerance of 1/2inch too long.

The tolerance limits need to be agreed upon in advance by the buyer and the QC inspectors. However, the tolerance limits could be adjusted for any dimension based on the importance of the same in the overall fit of the garment.

Some of the common tolerance limits set by the 3rd party QC inspectors are as follows:

ALL MEASUREMENTS IN 1/2						BASE
POINTS OF MEASUREMENTS (POM)		TOL(+/-)	12	14	16	18
1	NECK WIDTH FROM EDGE TO EDGE (Shoulder forward 1/2")	1/2	11	12	13	15
2	FRONT NECK DROP FROM HPS	1/2	11	12	13	15
3	BACK NECK DROP FROM HPS	1/2	11	12	13	15
4	SHOULDER WIDTH FROM EDGE TO EDGE EACH SIDES	1/2	10	11	12	14
5	ACROSS FRONT @ 5" FROM HPS	1/4	10	11	12	14
6	FRONT YOKE WIDTH ALONG SEAM	1/8	11	12	13	14
7	CHEST 1" BELOW ARM EXTEND	1/4	11	12	13	14

Functioning of the closures and the application of the trims and accessories:

The garment is not just an assimilation of the various components together rather it's a combination of several pieces held together in a shape with the help of stylish and functional trims like buttons, zippers, snaps, ribbons and elastic bands. Any broken trim can not only harm the body of the end consumer but it can also result in negative feedback for the buyer. It also causes trouble for the end consumer to get it repaired leading to either returns or unsellable inventory.

The garments must be thoroughly checked for the functioning of the trims and accessories to ensure durability and secure attachment to the garment. The common tests conducted are:

- Pull Test:

  This involves pulling the accessory with the pull gauge for 10 seconds to confirm its secure attachment to the garment.

- Fatigue Test:

  This involves the use of the accessory as intended for continuous 50 cycles (button and unbutton simultaneously for 50 times) to confirm its functionality and durability without damage

- Stretch Test:

  This involves stretching the elastic bands and straps to check for the elasticity and breakage if any

- Buttonhole Test:

  This involves checking the buttonholes and any stitching defects w.r.t fastening of the buttons. The defects that might be observed in the process would include:

  - Improperly sized buttonholes.
  - Buttonholes are sewn on the wrong side or in the wrong direction.
  - Buttonholes fraying around the edges.

- Visual Inspection of the accessories for non-conformance to the quality standards and appearance

QC inspectors in order to conduct the tests and determine the sample size for each style of garment. Since the manner of attachment of the trims to the garment is mostly consistent across the pieces, hence pull test and fatigue test is conducted on two pieces of every style of garment instead of the complete sample size. The quality of the elastic material used can vary across the pieces; hence the stretch test is conducted on the entire sample size.

The aspects that require special attention from QC inspectors would include:

- Threads used
- No interruption with the print and embroidery
- Proper application of Velcro
- No interruption with the care label

Packing and Labelling:

Packing forms a crucial part of the shipment as it ensures that the condition of the shipment remains the same on arrival at the buyer's place. This is ensured by the proper use of all layers of packing from primary to tertiary.

Packing would not only secure the product in its place but also make it presentable to the end consumer making it sellable. Labelling on the other hand is governed by the legal requirements set by the authorities. Labelling requirements if not adhered to as per the legal requirements would result in fines, delays or refusal of the goods at customs.

Many countries have their own set of standards governing the labelling of the garments to ensure awareness on the part of the end consumers. One such example could be that of US government which requires the entire garment sold in the country to possess the following information on their labels, namely:

- ✓ Fibre content
- ✓ Country of origin
- ✓ Manufacturer identity
- ✓ Care instructions

Several countries have strict norms pertaining to clothing line for kids and pregnant women to ensure no harm.

Packing is generally done at different levels from primary ones to ensure no dust or moisture permeates the end product to shipping cartons to facilitate proper arrival at the buyer's location. Packing in the sealed poly bags may also require adherence to several legal requirements for suffocation warnings, which if violated would result in fines and refusals.

Before the shipment is inspected by the QC inspectors, a guideline for the assortment of the products across cartons must be provided by the buyer beforehand. This would lead to elimination of the frustration at the later stage on buyer's part owing to mismatch in the number of garments received by the buyer of each style. An example of the same could be the receipt of 5 XS garments and 20 XL garments received in a carton.

The checks conducted to inspect the potential quality issues in transit and distribution are:

- Polybag size and sealing method
- Correct size of the labels, barcodes, price tags and appropriate placement
- Carton assortment

The aspects that require special attention of QC inspectors would include:

- Main label and care label
- Polybag printing
- Hangtag
- Price ticket and barcode
- Carton barcode

Conformance to the quality standards:

The quality of the fabrics and raw materials that goes into the making of the garments plays a crucial role in the saleability and acceptance of the garments by the end consumer. As the conformance to the quality is important in case of the fabrics being processed into garments, a thorough testing both on site and in laboratory becomes the backbone to assure quality.

There are several tests conducted both on site and in laboratory to assure quality of all the inputs ranging from fibre to yarn to fabrics not forgetting the trims and accessories. The tests are classified based on the object under observation such as:

- Fabric
- Trims and Accessories
- Workmanship

Fabrics: The tests conducted to assure the quality of the fabric would include the following:

- Fabric GSM Check: As the name suggests GSM (Grams per square meter) measures the density of the fabrics used for the production of the garments. This is a simple task and can be performed with little training. During this process, a circular piece is cut with the use of GSM cutter and is weighed using the electric balance to find out the discrepancy in the weights as per the buyer's specifications.

  A comfortable and light weight garment would involve the use of low GSM fabric but in case the GSM of the fabric is found lower than the specified one, a red flag is assigned signifying the use of further lower quality fabric.

- Material composition Check: This is the process carried out to assure the same ingredients go in the making of the fabric as mentioned on the label of the garment. In case of any discrepancy, it might result in legal and financial trouble spoiling the image of the brand. To perform this, a laboratory setup is required and a trained professional to identify the exact composition of the fabric under observation. A slight discrepancy can also be highlighted based on the hand feel of the garment.

Some other tests that would be carried out by the QC inspectors depending on the buyer's specifications would include:

- Physical tests: These tests are carried out on site without the need of a laboratory. They include:
  - Shrinkage test
  - Spiralled test
  - Tensile strength
  - Abrasion resistance
  - Pilling resistance
  - Button Strength Testing
  - Crease resistance
  - Dimensional stability
  - Bursting strength test

- Chemical Tests: These tests are performed in the laboratory under specified conditions to ensure the accuracy of the results. They include:
  - Colour Fastness to washing.
  - Colour Fastness to light.
  - Colour Fastness to heat.
  - Colour Fastness to Chlorinated water.

- Colour Fastness to water spotting.
- Colour Fastness to perspiration.
- Colour Fastness to Seawater.
- Fiber analysis.
- PH test.
- Repellency

The aspects that require special attention of QC inspectors would include:

- Contrast fabric
- Colour Shading
- Print/Dyeing Fault
- Bald Patches
- Holes or Cuts
- Yarn Runs
- Slubs in the fabric

Trims & Accessories: There are several tests conducted to check the durability and performance of the closures, trims and accessories. Some of the tests have been discussed earlier to assure the quality of the same.

Workmanship: As the final garment is nothing but a culmination of the various inputs like fabric, trims and accessories with the help of several operations from cutting, sewing, washing to finishing, hence it becomes primal to keep in mind the quality specification w.r.t workmanship. The tests conducted for the same are:

- Stitches per inch Check: This test is carried out by the quality inspector to check the number of stitches in per inch of the fabric. The requirements for this process include adequate lighting and a tape measure along with the garment which would be observed. This is checked to ensure the durability and quality of the garment as a garment with a higher SPI would last longer and is less likely to fall apart. Two random samples from one style would be sufficient to come up with the results.

The aspects that require special attention of QC inspectors would include:

- Miss/Skip stitch
- Misaligned/Insecure Buttons
- Seam grinning

- SPI incorrect
- Crooked stitching
- Stripes/Plaid Mismatching
- Needle damage/cut/holes
- Puckering/Twisting
- Open seam
- Broken stitch
- Fusing
- Loose/uncut thread
- Pressing

Quality defects and its severity

As the quality defects could lead to rejection and returns by the end consumer, the importance of the visual quality inspection to identify the severity of the defect in the garment cannot be undermined. Though some of the defects go unnoticed, the severity of the others may harm the end consumer and lead to returns. Hence, it is required by the QC inspectors to classify the defects based on the severity as follows:

- Minor
- Major
- Critical

The setting up of the defect classification based on the quality standards and buyer's specification would improve the clarity in the minds of the QC inspectors. The classification also depends upon the sale price and intended market for the product. Some of the common defects found in the garments would be:

- A loose needle left in the garment
- An untrimmed thread
- A variation observed in the shade of the approved sample and final garment

The defects in the garment would be classified based on the process referred to as zoning, whereby the garments are divided into two zones namely Zone A (Area of the garment where defect is clearly visible to the eyes of the end consumer) and Zone B (Area mostly ignored by the end consumer's eyes). The defects in the Zone A are of primal importance as the same would lead to rejection and need to be worked upon prior to Zone B. An example of the same would be a stain on the front of the shirt that will be more noticeable as compared to the one beneath the underarms.

Fig.: 3.8 - Quality defects and its severity

To decide the number of defects that would be acceptable in a given garment, one must adhere to several standards in place such as AQL. This is an important consideration to be kept in mind by the QC inspectors involved in the inspection process.

The aspects that require special attention of QC inspectors would include:

- Incorrect tension
- Main Label open/slanted
- Contrast thread visible Dirt mark
- Oil stain
- Garment damp
- Colour Shading
- Bald Patches
- Holes or Cuts

Print/Dyeing Fault

Thus, once the defects are identified they would be grouped into various types such as:

- Sewing defects
- Colour defects
- Sizing defects
- Garment defects

Based on the defects identified a Fault Analysis card is prepared. These are also referred to as FACERAP cards.

FACERAP is used to refer to mnemonic for Fault, Appearance, Cause, Effect, Responsibility, Action, and Prevention. This ensures the identification of the fault in place along with the cause identified by its appearance. Further, this helps to establish the accountability on the part of the operators such that no blame could be transferred and remedial actions can be taken. The best part of the process involves a record of the action to prevent a similar occurrence in future.

A specimen of the same is shown below:

Fault	Appearance	Cause	Effect	Responsibility	Action	Prevention

This way the buyer gets assured that the shipment meets the specifications and is relieved of any unexpected discrepancies in the products. Hence, quality inspection satisfies the buyer and monitors the supplier's production thereby bridging the gap between expectation and outcome.

Thus, quality inspection is vitally important for the following reasons:

- ✓ Saves the cost by solving the problems prior to shipment.
- ✓ Improves the process by implementing quick corrective action with the supplier.
- ✓ Protects the brand and reputation which would be at stake due to returns and rejection.
- ✓ Ensures end consumer satisfaction by shipping the right products.
- ✓ Optimizes the delivery and shipment with the correct packing and labelling.
- ✓ Assures adherence to standards thereby saving business losses.

While quality testing, quality check and quality inspection form the three pillars of Quality Control and Assurance, the fourth and last referring to Storage must not be ignored.

Storage of the components and garment to preserve the quality

The storage of the fabric, cut components and the finished garments is vitally important as it ensures the quality is preserved while the production takes place. The processes identified for each category are as follows:

Fabric input:

The fabric used in the production will determine the quality of the finished garment to a large extent and hence, it is important to have a good storage system in place. A good storage system would provide an ideal environment for the storage besides providing the tracking details of the fabric used in the production. The practices to ensure proper storage of the fabrics to preserve the quality are:

- ✓ Classify the fabric based on roll, width, style, batch, lot and colour.
- ✓ Store the fabric on the shelf or rack and never on the floor.
- ✓ Manage the inventory with the use of Bin card system.
- ✓ Keep the storage area clean to avoid any damage to the rolls in handling and moving.

- ✓ Ensure the same batch fabric is used from the storage to assure similar output.

Cut components:

The cut components must be stored in a place where they remain safe from the dust and any other damage. The practices to ensure safe storage of the cut components to preserve their quality are:

- ✓ Assign dedicated racks to the cut components based on the batch, lot, style, size and unique number allotted.
- ✓ Ensure that the racks are covered from the top to avoid any damage from dust or spillage of liquids.
- ✓ The cut components of the garments which require application of several processes such as washing, ironing or dyeing must be assorted and kept separately.
- ✓ Ensure the storage of the cut components in a temperature regulated environment if needed.
- ✓ The racks must be numbered and the operators must be made aware of the same to avoid any confusion during production.
- ✓ Components which need to be dried, post the dyeing or washing process should be allowed to dry in open keeping a check on any dust particles or bird activity which might spoil it.
- ✓ Post the drying of the dye, the fabric cut components should be stored separately to avoid the transfer of colours

Finished garments:

The finished garments must be stored post labelling and packing in the primary pack to assure quality and performance. The practices to adhere to while storing the finished garments are as follows:

- ✓ The finished garments must be packed in primary pack and stored
- ✓ Racks should be allocated as per the style, batch and size of the garments
- ✓ The racks or shelves should be covered to avoid any damage to the garment
- ✓ The finished garment must be folded and kept or hung depending upon the crease required in the garments
- ✓ Storage in the primary and secondary packs is done post the check of the labels on the garments
- ✓ A drop carton test is performed before the shipment is delivered to ensure the quality of the delivered garment

Thus, until the storage system is not effective in avoiding the damage to the input, the output could not be accurate and as per buyer's specification. Hence, a good quality fabric storage system is a must.

Activities

Activity 1: Visit the quality inspection laboratory of any garment industry or any textile laboratory of a college or university and make a video of all the tests they are performing on yarn, fabric or garment.

Materials Required

1. Pen/Pencil
2. Diary
3. Camera/Phone

Procedure

1. Visit any garment industry of textile lab of any college.
2. Take pictures of all the equipments used of quality testing.
3. Make a video of how the test is performed.
4. Write about all the tests which you have learnt there along with their pictures taken.
5. Submit the write-up in your class and share the video in your class whatsapp group.

Check Your Progress

A. Fill in the blanks

1. Quality checks are carried out by the personnel referred to as _________ assigned at every check point.
2. GSM stands for______________.
3. ___________ is vital for the garments which would be used extensively and might get rubbed against certain surfaces.
4. ASTM stands for____________________.
5. _______________is used to measure the maximum stress the fabric can be subjected to before breaking.
6. The name assigned to the set of tests buyer would require prior to acceptance of fabrics is _______________ (FBT).

B. Questions

1. What are the basic and specialised testes in quality testing of garments explained in the session above?
2. What are the points to keep in mind in quality check of cutting department and sewing department?
3. What is quality inspection? Explain in brief?

Session 3: Introduction to Advanced and Innovative Sample Testing Methods for Fit, Comfort, Durability And Environmental Sustainability

As the micro and macro business environment keeps changing, both apparel designers and manufacturers face the challenge of coping with the changed market conditions and customer preferences. These challenges include the need for finding not only better and better solutions to new problems but also newer and newer solutions for old problems. Fit, comfort and durability related challenges are perhaps as old as the history of garments itself. The environmental sustainability of garments is a relatively new challenge which is acquiring more and more importance because of the rapid fall in the quality of people's living environment particularly with respect to air, water, soil and climate.

While technological advancements are brought about by scientific research and development, innovations are the result of outside the box thinking. Developing and using innovative ideas requires one to discard what people usually do to solve any particular type of problem and look for unconventional methods of overcoming any challenge. Using zippers in place of buttons stands out amongst the garment technology innovations of recent times. Introduction of automated looms is among the top most innovations of all times.

The smart tailoring innovation created by the Indian designer is among the latest ideas with great potential. In this innovation, digital technology is used to produce the panels required for the construction of a garment right from the looms. This procedure eliminates the need for marking and cutting the fabrics and saves about 15% of fabrics lost during these steps.

While all the four aspects of sample garments are equally important, there is a high degree of inter-relationship between fit and comfort on the one hand and between durability and sustainability on the other. Fit would not be of value unless the wearer feels comfortable in the garment. Similarly, people would not buy any garment just because it feels comfortable to wear; they would also want the garment to fit them well and make them look good. In the same way, apparel consumers would not choose any garment made from natural fibres unless it is durable. The same applies to natural dyes. People expect organic dyes also to be as durable as their chemical alternatives. Durable garments also contribute to sustainability by saving the resources required for making replacement garments.

INNOVATIVE APPROACHES TOWARDS FIT & COMFORT

Fit is a major factor, which influences the brand and store loyalty of customers. Most customers avoid going to stores where they do not get garments that fit them well. At the same time, fit is an aspect of garments which the apparel stores are never able to satisfy customer expectations all the time. It remains as a major challenge for designers to create garments that fits everyone who belongs to a standard size group because of the wide variations in her or his body type. Apparel fashion brands and mass retailers always try to increase the coverage of their standard sizes by modifying their foundation patterns from time to time. However, in reality they still do not manage to meet the fit expectations of all their customers. Even among those who end up buying a dress, there may be customers who may not be completely satisfied with the fit.

Traditional approaches towards perfect fit involved mainly modifications in the foundation patterns to make it representative of the target customers. Fit sessions and the pattern makers' expertise provided the basis for such modifications. One of the traditional approaches to achieve larger size coverage was to have customised foundation patterns for different types/styles of dress. However, the problem of fit continues to be a major problem. It is also a major reason for the problem of returns, which the ecommerce apparel portals face. Another factor that is making fashion brands to look for innovative solutions to the fit problem is fast fashion. Fashion trends do not appear to last as long as it used to be. The current method of physical sample based fit evaluation is time consuming. The fashion industry is, therefore, very keen to use innovative fit evaluation methods, which reduce the lead time between design and bulk production.

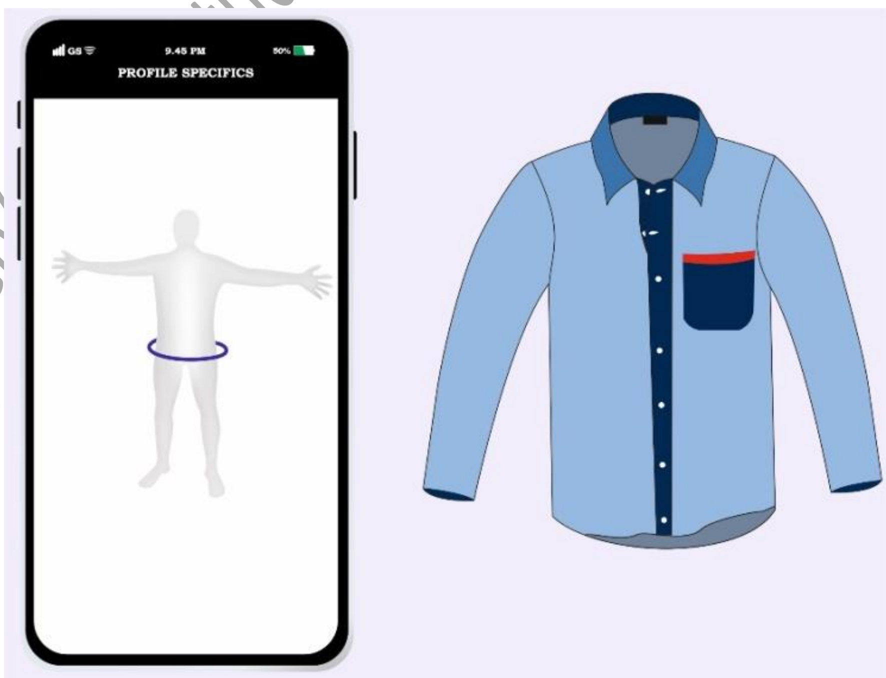


Fig.: 3.9 - Innovative Approaches

Advancements in information technology have brought about several innovations aimed at resolving the age old problem of fit in ready to wear garments. The following are some of the areas of garment design, product development and construction where innovative approaches are being adopted for improving the fit quality of garments.

- **Perfecting the Foundation Patterns using Data Analytics and Artificial Intelligence (AI):** Foundation patterns are also called 'Fit Standard' in the context of a fashion brand or retailer as these form the basis for all the styles brought to the market by the concerned company in any given type of garment. Usually, these are derived first from the body measurements of a single model, which are then adjusted over time based on the findings at the fit sessions. New data analytics techniques and AI are now helping fashion businesses to make modifications in their fit standards based on not just a few fit models but using the data collected from a larger number of customers.

  AI systems have been developed to help apparel brands and designers to use the body measurements of multiple consumers as the basis for sizing ready to wear garments. Computer algorithms are used now to extract the most representative body measurements instead of using only the measurements of the fit model. In one of the systems, the system collects data from the customers by asking them a few simple questions about their body measurements and types. AI is used then to derive all other measurements using algorithms. In another case, AI systems help analyse the complete set of data relating to their customers including the data related the measurements of the returned garments for understanding the fit problems faced by their customers. AI algorithms help in developing the fit solutions based on the data available with the company. In yet another case, AI is used to map the buying behaviour the customers with respect to the features, styles, fabrics, colours and silhouette and recommend new designs based on the data collected.

  There are several 2D virtual pattern making software applications available in the market that have made it easy to use measurements generated through data analytics as the basis for making virtual patterns. The main advantage of virtual patterns is the ease with which corrections can be carried out in the patterns. 2D virtual pattern making software applications also include very convenient methods for grading. The computerised process not only reduces the pattern making time and space but also eliminates wasteful usage of materials. Also, virtual patterns can be easily exported to computerised marker and cutting systems or shared with the sample makers electronically.

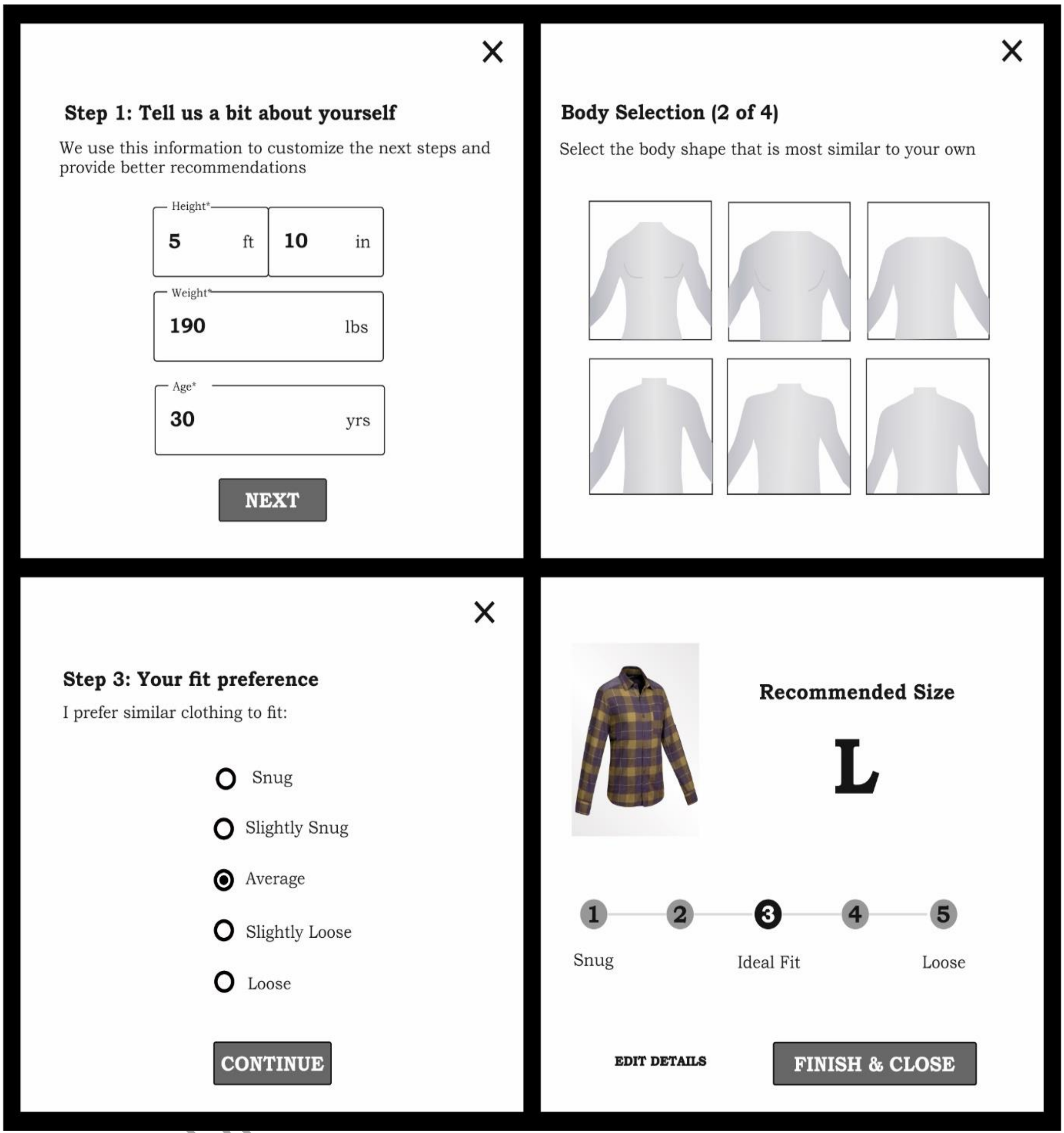


Fig.: 3.10 - Foundation Patterns

- **Fit Testing through 2D and 3D integrated Software Applications:** As against the currently popular method of creating multiple physical samples for evaluating fit, 2D&3D integrated software applications help generate virtual samples. This process helps reduce the number of physical samples required for fit testing.

  These 2D&3D integrated software applications have the facility to import the software copies of the 2D patterns and create virtual samples by combining them. These virtual samples come with a number of additional features such as following, which make the fit testing process more convenient and less time consuming:

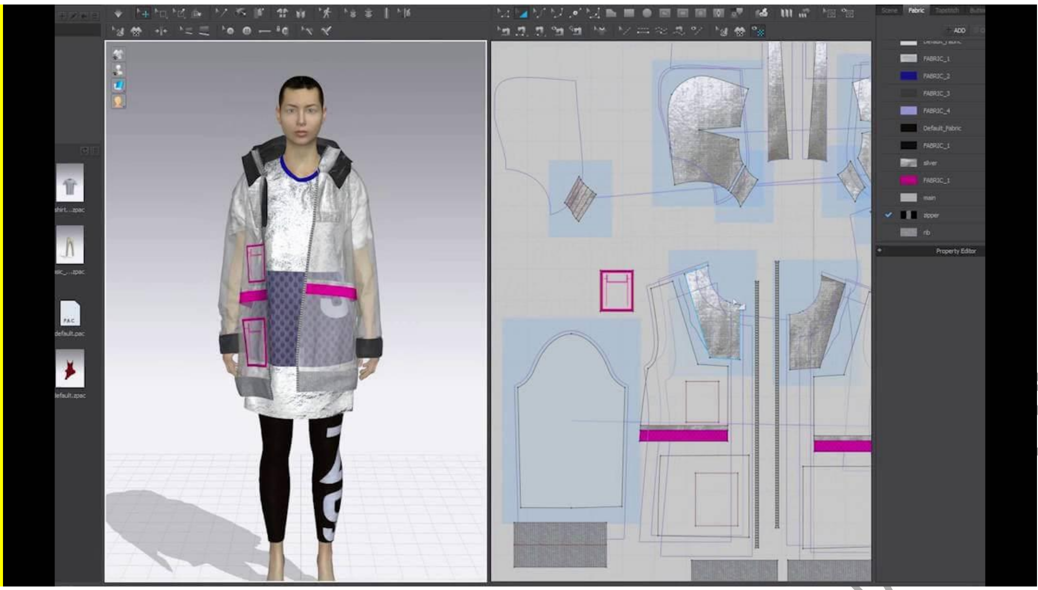


Fig.: 3.11 – Cloth Software

- **Automated Data Transfer between 2D patterns and 3D Virtual Samples:** The 2D patterns used in the creation of the virtual sample can be corrected in the 3D view itself. The changes made in the 3D view are automatically transferred to the 2D patterns.
- **360 degree Rotation:** The software gives a realistic photographic view of the virtual sample with a 360 degree rotation, which makes it easy for the designers to evaluate the fit from multiple angles.
- **Multiple Poses:** The software also provides facilities for viewing the virtual samples in different poses. The virtual avatars wearing the garments can be made to stand in predefined postures that help assess the functional fit more accurately.
- **Fabric Simulation:** Since fabrics play a definitive role in the extent of ease to be built into the garment, the 3D software includes a provision for evaluating fit of the same sample garment in different types of fabrics. Fabric related parameters are in-built into the software algorithm.
- **Evaluating the Fit of Trims & Accessories:** The 3D software applications also allow changing the size and placement of trims and accessories. This facility makes it easy for the designers to evaluate the fit of the garment along with all the trims and accessories from the very beginning.
- **Evaluating Graded Fit:** In the currently prevailing sample evaluation practices, fit is tested only in the case of the alpha size. Fit of the other is adjusted using the grade rule. On the contrary, 3D virtual samples enable the designers to evaluate the fit of all sizes at the same time.

- **Evaluating Colourways:** 3D virtual sample testing software applications also include a facility for checking alternative colourways as well as the placement of fabric ornamentations.
- **Exact Measurement of Ease:** This is one of the most significant advantages 3D fit testing software as compared to the fit session based evaluation. These applications are capable of calculating the distance between the body and the garment all over the body area. These computed values are presented in a colour coded tension / pressure map on the sample garment. Designers use this data to adjust the ease quantitatively.
- **Customised Avatars:** This is also a very important and most advantageous aspect of 3D virtual fit software applications. While it is always difficult to find a live fit model who perfectly represents the alpha size, 3D fit software includes both predefined standard size avatars as well as facility for creating a completely customised avatars based on specific measurements. Both the standardised and custom created avatars come with edit features for adjusting the different body dimensions. Customised avatars make it possible for designers to design and test virtual samples for both standard and plus size garments without having to find a suitable fit model.

- **3D Scanning and Mass Personalisation/Customisation**: Fit related problems continue to be a big challenge for both conventional and virtual stores. Inventory levels go up when customers are unsatisfied with the fit quality of garments. Unsold stocks create a huge cash burden for fashion businesses. Fit also creates problems for consumers as they find it tedious when they are required to try out many garments before finding the one with the right fit. Lack of proper fit is also the cause for the large volume of returns from online buyers of garments. Fashion brands and retailers are, therefore, very interested in finding alternative fit solutions that enable the consumers to find the garments that fit them well and at the same time, minimise the returns from customers who are dissatisfied with the fit.

  3D scanning technologies have made significant progress since their introduction in the latter half of the last century. In the new millennium, it has become even more advanced. Its usage has also been expanding in several industries. The fashion industry has become a keen user as it has the potential to improve the fit of garments significantly. 3D scanning technology helps acquire body measurement data, which are then used by a software to create a three dimensional avatar having the same body measurements of the person. The main advantage of 3D scanning is the very short time of 10 to 20 seconds taken to gather the data and its immediate use in creating the 3D avatar within a few minutes. The exact time required depends on the type of scanning method used. 3D scanning is expected to become more widely used once the mobile app based 3D scanning technology matures. Once the avatar is created, the 3D software can be used for finding a garment that fits the person perfectly or for automating the process of cutting the fabric based on the exact body measurements recorded by the 3D scanning software.

The following are the two different ways in which 3D scanning is currently being used to improve the fit related satisfaction levels of customers:

- **Automated Selection of the Best Fitting Garment at the Online/Offline Stores:** Once the e-commerce or retail outlet receives the 3D scan data from the customer, it is fed into an AI system for finding the best fitting garments for the concerned consumers. Some ecommerce portals have created virtual dressing rooms, where online customers can check the fit by virtually draping the electronic version of the selected garment on the customised avatar having their exact body measurements. Virtually trying on the the selected garments on the 3D avatars not only enable the customers to buy garments with confidence but would also significantly reduce the probability of its return because of fit problems.

  Virtual dressing rooms are becoming a necessity for ecommerce portals to attract consumers who prefer to try out the garments before buying. These consumers account for nearly a third of the apparel consumers. In addition there are a little over 20% of apparel consumers who are apprehensive about how a garment would look upon wearing. The body measurement data collected from the customers through 3D scanning can also become the basis for making changes in the fit standards of the company using data analytics and AI algorithms.

- **Mass Customisation and On Demand Production:** However much the fashion businesses might try to meet fit requirements of consumers by updating their fit standards, there would still be a majority of consumers who are dissatisfied with the fit quality of ready to wear garments. The main reason for this problem is the wide variation in the body sizes and types. The landmark points of different people do not conform to any standard rules. Similarly, the body proportions among consumers also do not fall into standard patterns. While custom stitching is a time tested solution to the fit problem, it usually costs more than the ready to wear garments. Mass customisation is now being considered as an effective way to meet the demand for well fitted low cost garments. On demand production is also being considered as a necessity for apparel businesses to minimise the financial losses resulting from the unsold stocks of garments. Both these processes take advantage of the same technology platform consisting of 3D scanning systems, 3D software applications and automated marking and cutting machinery.

In the case of mass customisation and on demand production method, customers have the option to select from the styles on offer and submit their measurement data. Then the retailer would transmit the data to micro factories equipped with automated machinery. Significant technological advancements are taking place in the area of garment construction. Already, automated marker and cutting systems that operate based on the data received from 3D CAD systems are in use. Automated knitting machinery capable of producing basic knitwear based on customer supplied data is also being used by apparel retailers. Automated sewing machines, known as 'sewbots', have also been developed. These are able to produce custom stitched items like T shirts faster than the currently used industrial sewing machines.

INNOVATIONS IN DURABILITY AND SUSTAINABILITY

There is a synergetic relationship between durability and sustainability. The clothes that last longer help save the extra materials, water and energy that would have gone into the making of replacement garments. In the case of apparel, durability has two distinct connotations. First is the physical durability of the fabrics and trims as well as of the construction. Damage ordeterioration in the quality and appearance of these materials and works may require the garments to be discarded even before the end of their full life. Second is the aspect of fashion durability.

People tend to discard clothes well before the expiry of their full life, when the style goes out of fashion. As of now there are two opposing trends in the fashion industry. Fast fashion has become a dominant trend particularly among the youth leading to premature disuse of garments. At the same time, there is also growing consumer concern about the environmental consequences of the materials and processes used in the fashion industry.

The apparel industry contributes approximately 6.7% of the total greenhouse gas emissions in the world. It is also estimated that it generates around 92 million tonnes of waste annually. It also consumes approximately 79 trillion litres of water each year.

Major Sustainability Challenges

Some of the main sustainability challenges faced by the garment industry, which require innovative solutions, include the following:

- **Increased Purchase of Clothing:** Globally, the per capita production of textiles is estimated to have more than doubled during the period 1975 to 2018 – approximately from 5.9 kg to 13 kg per year. Some companies reported that people bought 60% more clothing in 2014 as compared to the year 2000. The European Environment Agency (EEA) estimated that per capita purchase of clothes in the European Union went up to 40% during the period 1996-2012. While this increase is attributed to the relatively slower growth of apparel prices as compared to other commodities, it has resulted in increased use of water and energy and increased levels of pollution by the apparel industry.

- **Large Volume of Unsold Stocks and Factory Wastes:** It is estimated that approximately 1.5 billion garments are annually produced worldwide. Out of this about 30% are never sold. It is also estimated that around 60 billion meters of cloth is cut off as waste in the process of converting fabrics into garments. Almost half of it reaches the dumps or landfills. These, together, not only result in significant financial burden for the fashion industry but also become an environmental liability. Materials, water, and energy used in the production of these fabrics and garments turn into wasted resources of the environment.

- **High Rate of Disuse:** Apart from the unsold garments and the cut off fabrics, there is another factor that turns into a major environmental burden. According to estimates made by some apparel brands covering the period 2000 to 2014, people now keep a garment for periods that are less than 50% than before. Another study conducted in 2015 has estimated that by extending the life of just 50% of the garments by 9 months, water consumption and waste generation by the fashion industry can be reduced by 4 to 10%.

- **Micro plastic Fibres Pollution:**According to a study, garments made from synthetic fibres such as polyester, nylon, acrylic, etc. could release up to 700,000 micro plastic fibres in a single wash of 6 kilograms. Acrylic fabrics released over 728 thousand micro fibres while polyester fibres released a little over 490 thousand micro fibres. The resulting water pollution is heavy since synthetic fibres account for nearly 60% of our clothes. It is also reported that the microfibers released by clothes washing contributes up to 85% of the man made shoreline debris. The fashion industry is estimated to contribute about 35% of the micro plastic pollution in the ocean.

- **Chemical Pollution and Water Wastage in Dyeing and Printing:** About 75 gallons of water is required for dyeing a pound of clothes out of which nearly 90% is released as waste water. Some of the chemicals contained in the waste water are non biodegradable and/or carcinogenic. This process also consumes a considerable amount of energy. The process of dyeing and printing of fabrics also causes air pollution and generates solid wastes.

Major Areas of Sustainability and Durability Innovations

The growing environmental awareness among the consumers serves as a constant motivation for the fashion industry to find innovative solutions to sustainability issues. The textile industry in general and the fashion industry in particular have been quick to respond to emerging challenges. The way in which these industries have responded to corona virus pandemics is a case in point. The industry lost no time in increasing the production of masks and personal protection clothing using a variety of innovative approaches.

In the case of sustainability issues also the industry is developing and supporting a wide variety of innovations. A number of large apparel brands have also joined hands with new start-ups to make a commercial success of these innovations. The following is an illustrative list of areas where significant innovations are taking place. These innovations address one or more of the environmental challenges faced by the fashion industry.

- **Introduction of a variety of new natural fibres:** Natural fibres like cotton, silk, wool and linen have been used for long globally in a big way. Along these, a few other vegetable fibres like bamboo, coir, hemp, jute, kapok, ramie, ramina, sisal, etc. have also been popular in certain countries and regions. Apart from sheep wool, which has dominant role globally, animal fibres such as alpaca, angora, camel hair, cashmere, mohair has also been used traditionally. The search for eco friendly natural fibres has added new ones such as aloe vera, banana, lotus stem, nettle, pine apple, etc.

- **Introduction of fibres based on natural materials:** While rayon has been a popular fibre manufactured using natural raw materials, it was chemically processed. Lyocell fibres were produced without using chemicals and became a sustainable fabric. Recent advancements in biotechnology have helped expand the list of natural materials based and environment friendly fibres. Latest in the list are fibres regenerated from, milk, tea and coffee in addition to fibres processed from sea weeds, soy protein, etc. There is now a long list of fibres made from bioplasic materials, which are in turn made from renewable biomass sources.

- **Blending of natural fibres:** While blending natural fibres with synthetic fibres has been the general trend, new innovations aim at blending natural fibres to enhance the overall quality and performance of natural fibre based fabrics. One of the recent success stories is the blending of hemp with wool to make the fabric stronger. Attempts are also being made to create eco friendly fabrics by blending jute and ramie fibres.

- **Recycled fibres from used clothes**: A new process has been developed to turn a single use cotton fibre into a multi use resource. In this process, the original molecular blocks are extracted from the used fibre. These fibres are then used for creating new yarns and fabrics. This process can be continued almost endlessly. This innovation has attracted the attention of global apparel brands. This technology is expected to make a great impact in the future.

- **Dyeing with air:** Traditional methods of dyeing consume enormous amount of water. In order to tackle this environmental problem, an innovative technology has been developed and commercialised. While the traditional method of dyeing uses water as the medium for applying the dye to the fabric, in the air dyeing process air is used as the medium. Air jets are used to transfer the dye to the fabric. This method consumes 95% less water as compared to traditional dyeing. It also uses 86% less energy than the existing water borne dyeing method.

- **Digital Printing:** Unlike the traditional screen printing method in which a fixer is mixed with the colorant, digital printing involves pre treating the fabric with a fixer. The type of dye used in the printing process depends on the type of fabric. Pigment based printing done on all fabrics. Each type of dye requires a different digital printing technology. However, there are also no requirements of special finishing processes. Only steam is applied in the end to achieve proper fixing of the colorants. The main advantage of the digital printing is the facility to transfer colours and designs to the fabric directly from computer graphics. It is also environment friendly because of the lower water and energy consumption as compared to traditional screen printing.

- **3D Printing:** While 3D printing has been successfully adopted for printing shoes by leading footwear manufacturers, 3D printing of fashion garments still remains confined to fashion shows. At the same time, there is a growing interest in this innovative solution. Current applications of 3D printing are more in the area of fashion accessories. Some of the fashion designers are also experimenting with the use of 3D printing for making panels based on digital patterns, which can then be stitched together into a garment. 3D printing is also attracting serious attention from fashion brands as it is environment friendly because of the possibility of reusing the 3D printed materials.

Fig.: 3.12 - 3D Printing

- **Direct Panel Loom:** This is also one of latest innovations, which aims at eliminating the enormous amount of fabrics wasted in the cutting process. This innovation involves a digital loom which is capable of weaving the panel based on the data submitted to it. Direct Panel loom also helps in reducing the lead time in the manufacture of garments. This technology developed by an Indian designer though in early stages of development promises to be a major contributor to the sustainability objectives of the fashion industry.

We are living in an age of fast technological changes that are taking place at an unprecedented rate. These changes have far reaching implications for all types of businesses particularly manufacturing operations. At the heart of all these is the ongoing information technology revolution covering both hardware and software. Advancements in information technology are impacting industries not only on their own but also through their catalytic and synergetic role in the development of all other technologies.

Although, the textile industry witnessed rapid changes in technology over the last century, the fashion industry had remained relatively less affected by technological changes. Only the manufacturing part of the ready to wear segment came under the influence of technological changes. However, since the dawn of the new millennium, a number of new technologies have emerged which have the potential to affect every operation of the fashion industry right from designing, pattern making, spreading and stitching, and delivering to the customers.

Rapid changes in technologies necessitate continuous upgrading of garment manufacturing machinery and systems but also regular updating of the knowledge and skill sets of people working inindustry from designers to delivery agents. The technological changes that are knocking on the doors of the fashion industry have the potential to bring about what are called paradigm shifts. It means that there would be fundamental changes in the way of doing things and old practices would be replaced by newer ones.

AREAS OF MAJOR TECHNOLOGY CHANGES

While technological changes are taking place at a rapid pace in a wide variety of areas, it becomes very important to understand the broad trends while keeping in view their likely level of impact on fashion businesses and apparel manufacturers. The following are some the major technology trends:

- **Artificial Intelligence (AI) and Computer Aided Design (CAD):** The quest for artificial intelligence is not new. AI closely followed the lead given by electronic computing since the middle of the last century. The objective of AI was and is to create computing systems that emulate human intelligence as well as the human capacity to perceive realities and solve problems using knowledge, tools and skills. Unlike computer software in which the complete logic for any action is provided by the programmer, in AI, the machines are expected to become proficient in performing specific activities by continuously learning and modifying and updating knowledge on their own. The initial focus of AI was on the one hand to create expert systems which learned from the data and provided advice and on the other hand to build machines that could do the work of human beings. These machines also came to be known as robots.

Most of the work done in the area of artificial intelligence during the last century remained theoretical with a limited number of demonstrations in the form of robots that performed some of human activities. AI applications include recognition of vision, speech, hand writing.

AI has, however, gained greatly in the new millennium with the growth of the World Wide Web into an unprecedented reservoir of data and the big data technology that is helping in the process of developing AI algorithms. In the first decade of the new millennium, there was a convergence of AI, Machine Learning (ML) and Data Science providing a new foundation for AI applications in a variety of business functions. The progress in AI has also received an impetus from the development of artificial neural networks that facilitate the process of deep learning. Some of the recent applications of AI in fashion design are in training neural networks to understand aesthetic parameters from fashion forecasts. Although, the level of overall success achieved by AI is very limited in the fashion industry, the AI algorithms are already proving to be of great help in specific areas such as zeroing in on perfect fit and size coverage.

Together with AI, 3D design software has emerged as an important tool for the fashion industry. Unlike the traditional practice of using hand or computer drawn 2D sketches and testing the 360° view of the garment only during fit sessions, 3D design softwareallows designers to have an all round view the garment style right from the designing stage. An important contribution of 3D design software is in the area of fit testing. As opposed to the current practice of stitching of repetitive physical samples for evaluating fit using fit models, 3D design software enables creation of virtual avatars on which the fit of a design can be tested. An important stepping stone in this technology is the integration 3D with 2D. As a result of this integration, it has now become possible to test the fit of a style just by wrapping the 2D patterns of the garment upon an avatar created by 3D software as these have been stitched together. AI algorithms have been developed to measure the gap between the body of the avatar and the virtual garment and present the data in the form of pressure or tension maps. These maps help technical designers to alter the patterns as necessary on the 3D avatar itself. The changes made in the 3D virtual garments are also automatically carried over to the 2D Patterns.

AI and 3D design software are also helping the consumers in easily identifying the garment styles that suit them and fit their body. Virtual dressing rooms help consumers create virtual avatars based on their own body measurements and use these virtual avatars to try out the virtual versions of the garments, which they wish to buy.

Another AI/3D design software application is that of a virtual stylist, which makes recommendations of garments and accessories that would look good on them. These make use of the AI expert system algorithms to the find best fitting and best looking garments from out of the choices available.

- **Robotics and Automation:** Automation of manufacturing processes is nothing new. European countries and the US went in for massive automation of industrial processes as early as the 1980s to reduce the impact of rising labour costs and also to minimise the losses due to human errors. While automation became popular in the upstream processes such as synthetic fibre production as well as spinning and weaving, garment manufacturing was relatively less affected. No doubt, considerable research went into finding newer ways to automate garment production. However, fabric handling remained a major challenge. Added to it was the challenge of fast changes in fashion. One of the early attempts was to create a robotic arm that could replace the human hands operating the sewing machine. It however, failed to make an impact.

  While the efforts to completely automate the process of garment manufacturing, like what was successfully done in the case of automobile assembly, failed, the initiative to automate specific parts of the garment factory processes have found increasing success. In some cases, automation may be limited to a single machine or any sub process. The following are the areas where automation has been successfully implemented so far and is likely to make faster progress in future:

  - **Automated Inspection of Fabrics:** Fabric inspection is a critical step in apparel manufacturing and failure to detect defects and reject fabrics with unacceptable levels of faults can prove to be costly. An entire consignment of garments might get rejected because of fabric defects. Currently, most manufacturers use manual fabric checking using standard protocols for rejecting fabrics. Manual checking of fabric quality can also be error prone and can also cause delays when the volume of fabrics to be checked is high.

    Automated fabric inspection machines use AI for examining the fabrics by capturing images of the fabric, processing the images for detecting the defects and classifying the defects based on predefined defect classes. Just like any other AI based expert system, the fabric will be rejected if the level of defects exceeds the specified norm.

- **Automated Spreading and Cutting of Fabrics:** In the prevailing garment manufacturing process, three different processes follow fabric inspection. These processes are used for getting the fabric pieces ready for stitching the different parts of the garment together. First, the patterns according to which the fabric pieces are to be cut are placed within a predefined width and length of the fabric and arranged in a way to minimise the amount of fabric cut away as waste. This optimisation will however, be subject to the grain direction required for each pattern piece. This is referred to as the marking process. Second, the fabric is spread lengthwise in the required number of folds having length and width specified in the marker. Third, the fabric is cut following the marker either manually or with the help of automatic cutting machines. Automation is currently taking place at the machine level.

  Automated Marker Planning is done within 2D Computer aided design. Automated spreading machines come with input panels for selecting the required length, width and the number of plies, as well as the type of fabric to be spread and its properties. There are sensors that help align the grain correctly. Automated spreading machines also help save fabrics by minimising end losses. These automated machines are also capable of accepting rolled or flat folded fabrics.

  The automated cutting machines accept computer aided design software-based instructions as inputs either through network connectivity or from USB drives and carry out the cutting without any human intervention.

  There are also automated scan and cut machines that help in the accurate cutting of fabrics having custom printed patterns or images. These machines have the facility for scanning the fabric for acquiring data about the custom printed design, send the data to the back-end software and receive the optimised cutting instructions. These machines also provide an automatic compensation for misaligned patterns. The automation software also recognises features like notches and cut these as per design.

- **Automated Sewing and Knitting Machines and Processes:** Sewing is still the job of a skilled person. There is an interplay of several parameters that needs to be kept in view while stitching together fabrics to create different parts of the garment and finally assembling these. It requires finesse and dexterity to get some of the difficult seams right. At the same times, the industry never spares an opportunity to automate every possible garment manufacturing process. The following are some of initiatives that illustrate the technology developments in the area of sewing garments:

- **Part Automation of Sewing Process:** Pulling the fabric correctly during sewing is an essential requirement for perfect seam formation. In order to eliminate the possible human errors, digital pullers have been developed. These pullers are synchronised with the machine operation to ensure trouble free working. Another development is in the area of run stitching. Automated sewing machines are now available for run stitching of pockets and cuffs. The types of pockets which are automatically stitched include piped straight or slanted or rectangular as well as flap, jet andwelt pockets. Automated stitching machines are also available for making waistband, waist pleats in trousers and skirts, and also long and short seams. Modern sewing machines also come equipped with touch screen displays for selecting stitch types and related parameters.
- **Sewing Robots:** The inspiration for sewing robots is said to have come from a motorised hand-held sewing tool used by surgeons to close the wounds with spherical seams. One of the earliest of these robots is coupled with an industrial robot and has miniaturised components for performing different tasks. It can carry out double lock stitch, double chain stitch and over lock stitch. However, this robot has synchronisation problems between robot speed with needle and sewing foot movement.
- **Complete Product Stitching Automation:** US based start-up Softwear Automation has come up with a robotic set up for end to end manufacturing of select items such as T shirts, towels, tote bags, pillows, rugs, etc. without any human intervention. This automation is expected to result in significant labour and time saving. Current estimates show that their stitch line would take only 22 seconds to produce a T shirt and requires only a single operator. The output in an eight hour shift is said to be 1142 T shirts.
- **Complete Knitwear Production Automation:** A UK based start-up has launched a robotic machine for knitting complete knitwear like sweaters, skirts and shorts. It comes with software for creating designs which can be transferred to the knitting robot in a SD card. This machine has a total of six yarn feeders for creating coloured designs. It has two needle beds with 252 needles

each. Needles are controlled individually for doing knit, split, tuck or transfer functions. It has a max speed 800 mm per second, and offers 16 levels of stitch density both of which can be varied.

- **Internet of Things (IoT), 5G and Connected and Micro Factories:** Enterprise Resource Planning (ERP) systems had initially focused primarily focussed on business functions. The supply chain management module was used to integrate external suppliers of products and services. However, with the growth globalisation the manufacturing and retailing processes got internationalised. In the apparel industry for example, the garment is designed in one country and manufactured in another. Fabrics and trims may be sourced from multiple countries. The buyers may also ask the manufacturers to dispatch the ordered garments to multiple destinations. Before the Internet was established and until it became a powerful business tool, internationalised businesses relied on a globally standardised system of electronic data interchange (EDI). One of the main disadvantages the system was that there was no real time transfer of data. It was also not possible for individual enterprise to customise it. All EDI documents were required to be transmitted using only the File Transfer Protocol (FTP)

  With the increase in the intensity of global competition, companies relying on internationalised production began shifting to Cloud-based ERP System, which enabled real time data transactions irrespective of the physical location of the parties concerned. With the emergence of fast fashion and consequent volatility in fashion trends, international fashion brands are moving beyond cloud based ERP. The following are the two major directions in which technological changes are taking place:

  - **Industry 4.0, Connected Factories and Cloud Based Collaboration:** Industry 4.0 is an emerging concept, which aims at integrating the virtual with the real with the help of Internet of Things (IoT) technologies. Just as we are able to connect with and operate a video camera remotely using a mobile application, industry 4.0 aims at giving instructions to industrial machinery and equipment from remote locations or processes. It has two main facets. First, there has to be a software integration involving both the business and manufacturing related software modules. Second, there has to be machines that accept digitally transmitted instructions. Although, this is the goal of industry 4.0 which mightbe long to achieve, industry is moving ahead to collaborate on a global scale by expanding the scope of the existing cloud based ERP solutions. The apparel industry is making steady progress towards adopting cloud based collaboration. Already, there are garment making machinery, which accept digital commands either through digital input screens or from SD card based files. The integration of 2D and 3D CAD software is making it possible not only to create designs and test the fit virtually but also pass on the instructions to spreading and cutting machines but also to other machines that help automate parts of the sewing process.

- **Micro Factories:** In reality, micro factory is also an implementation of the industry 4.0 initiative. This initiative is however, a direct response to fast fashion, which requires garment styles to be produced in smaller quantities, in the shortest possible time and at the lowest possible cost. Micro factories are expected to have fully automated production lines, which can receive a tech pack digitally and carry out the production automatically. This solution is also gathering momentum because of the progress being made in 5G mobile services, which would enable fast and huge volume data transfer over wireless networks. The micro factory concept is also triggering significant developments in three related areas. First, small scale digital looms are being developed to produce fabrics on demand based on the fabric properties data supplied. One digital loom, which has been developed already, produces pattern pieces directly eliminating the need for spreading and cutting. Second, a large variety of digital printers have been developed which can print patterns and other designs, on demand, almost on all types fabrics using different types of dyes. Third, the possibility of using 3D printing for creating accessories on demand is also receiving attention. Although 3D printed garments are now limited to fashion shows, they are also successfully used for making shoes and jewellery. Another technology, which is receiving in the context of micro factories, is material handling. Even in the normal factories, the stitching time is the least and material handling accounts for the bulk of it. The robotic machines and production lines have in built conveying feeding systems. A number of alternative systems such as the overhead hanger conveyors are already in use in garment manufacturing.

NEED FOR CONTINUOUS SKILL UPGRADING

Information technology is entering every facet of garment production. Since, IT is one the areas with very high rate of change, there would be a need for upgrading the skills on a regular basis. Some of the areas, where skill development should be taken up on a priority basis include the following:

- **Use of 2D and 3CAD:** All those who work in the sample room, would need to get trained for handling 2D and 3D software
- **Use of Engineered Sewing Machines:** Sewing machines would get progressively automated and would require that the operators are well versed with use of new features and all the digital parameters required for making use of these new attachments like digital pullers as well as selecting the regular stitching parameters from touch screen based applications.
- **Use of Automated Machinery for Fabric Inspection, Spreading and Cutting:** These types of automated machinery are already used in production and the operators would need to be trained in handling these machines properly.
- **Real Time Production Tracking and Quality Inspection Software Systems:** These types of quality control systems are already in use. In future, buyers might prefer manufacturers having real time quality control systems. The entire team of the quality control department would need training in using real time systems.
- **Training in the handling of New Types of Fabrics:** A variety of new fabrics have already been developed. In all probability, there would be more and more of new fibres in future. All operators and quality inspectors should be given training required in the handling of these new fabrics.

Activities

Activity 1: Make an internet based survey of 2D and 3D integrated CAD software available for use in the Apparel Industry and prepare a brief report of their features

Materials Required:

1. Computer or smart phone with Internet access
2. Pen/Pencil
3. Practical file

Procedure:

1. Search the web with relevant keywords and identify at least two design softwares for apparel industry with 2D & 3D integration.
2. Compare the features and prepare the report

Activity 2: Make an internet-based survey of unconventional natural fibres and prepare a case study of any two natural fibres.

Materials Required:

1. Computer or smart phone with Internet access
2. A4 sheets
3. Pen/pencil

Procedure:

Search the web with relevant keywords and identify at least two different types of unconventional natural fibres.

Study their properties and their possible uses in apparel production.

Make a report on A4 sheets and submit to your teacher.

Activity 3: Prepare a case study of a garment recycling project.

Materials Required:

1. Paper
2. Pencil
3. Sketching materials.

Procedure:

1. Think of a garment which could be recycled into a new product for extending the life of the fabrics used in the old garment.
2. Illustrate step by step how you would convert the old dress into a new product which can be used in day today life.
3. Submit it in your class.

Check Your Progress

A. Fill in the Blanks

1. Automated sewing machines, known as_________.
2. Foundation patterns are also called ___________ in the context of a fashion brand or retailer
3. ______________ integrated software applications help generate virtual samples
4. ________ are used in air dyeing to transfer the dye to the fabric
5. ___________involves a digital loom which is capable of weaving the panel based on the data submitted to it.
6. Together with______________, 3D design software has emerged as an important tool for the fashion industry.

B. Short answer questions:

a. How are fit and comfort as well as durability and sustainability interrelated?

b. Describe how AI and Data Analytics are helping in redefining fit standards.

c. Describe mass customisation and on demand production.

d. Describe the features and uses of virtual dressing/try on rooms used by ecommerce stores. Describe how 3D printing is used in the fashion industry.

e. Describe and compare digital printing with conventional screen printing

f. Describe mass customisation and on demand production.

g. Describe the features and uses of virtual dressing/try on rooms used by ecommerce stores.

h. Describe the concept of connected factories and their likely role in future.

i. Describe the concept of micro factories and their likely role in future.

j. Describe the functions and advantages automated fabric inspection machines.

k. Describe the functions and advantages automated spreading and cutting machines.

l. Describe the key areas, which would regular upgrading of the skills of garment factory operators in future.

C. Long Answer Questions:

a) Describe the process of virtual fit testing giving details of the all the steps involved in the process

b) Describe the main environmental sustainability challenges faced by the fashion industry.

c) Describe the different types of initiatives being taken by the fashion industry to promote the environmental sustainability of fashion garments.

d) Discuss the role of Artificial Intelligence (AI) and three dimensional computer aided designing (3D CAD) technologies in garment design

e) Describe the details of the emerging options in the area of automated sewing and knitting.

Module 4 Maintain a Clean and Hazard Free Working Area

Module Overview

A clean workplace means more than just having a fresh surrounding area. Clean workplace encompasses various elements:

- Walking surfaces
- Light Fixtures
- Air quality

A clean and hazard free workplace ensures the safety and health of the employees and visitors. Clean walking surfaces, suitable footwear, and appropriate speed of walking are important to preventing falling accidently. Stairways and aisles that are clean and dry are also vital in reducing accidents and ensuring a safe workplace. Clean light fixtures improve lighting efficiency in the workplace. Good air quality greatly influences work environment as well as the health of the employees.

The negative effects of the unclean environment are as follows:

- A build-up of dust, lint, and grease can create breathing problems for everyone in the working area, resulting in asthma attacks, stuffy noses that may lead to serious health issues.
- A dirty work environment is breeding ground for various germs and allergens.
- Workstations, tools and equipment, machinery, materials, and the progressive bundling system of production systems are all poorly constructed, increasing the risk of musculoskeletal injury and stress-related disorders.
- Fire dangers are typically caused by overcrowding and incorrect storage of flammable goods.
- The significant health and safety risks are caused by bad sanitation and a lack of effective maintenance procedures.

Two most common ways to tackle it are:

- Use of disinfectants to prevent the spread of germs and microbes.
- Proper disposal of waste and recyclable materials keeps work areas clutter-free.

Therefore, the major health and safety concerns of the apparel industry are related to general conditions of the work environment.

Proper maintenance procedures are a must to ensure a clean and safe working environment.

Learning Outcomes
After completing this module, you will be able to: • Maintaining health, safety and security requirements at workplace • Minimize health and safety risks to self and others due to own actions • Keep work area free from potential hazards • Emergency situation and .Reporting the concerned authority

Module Structure	
Session-1:	Importance of routine maintenance and its procedures
Session-2:	Maintaining cleanliness
Session-3:	Operation of machinery, equipment and tools safely and correctly
Session-4:	Effective oral and written communication at workplace

Session 1: Importance of Routine Maintenance and Its Procedures

MAINTENANCE PROCEDURES

Maintenance is defined as the group of systematic activities carried out to keep the machines or equipment in proper running condition.

Proper working condition of machines is a must to produce good quality products in time. Therefore, there is a need to establish a maintenance department in every factory to ensure timely production. Moreover, it is required to document the process and procedures for assistance of auditor.

Good maintenance includes the regular upkeep of material, equipment, machinery and good housekeeping, e.g. trolleys are used extensively throughout the industry and play a major part in reducing manual handling. Systematic cleaning and maintenance of wheels ensure that risks of injury are minimized. Clean floors benefit by ensuring ease of movement

THE IMPORTANCE OF RUNNING MAINTENANCE

Running maintenance means routine maintenance, inspection and servicing of machines and systems to ensure smooth functioning and efficient production. Running maintenance also means routine maintenance irrespective of presence of problem in any of the machines or systems.

The major reasons for running maintenance are as follows:

1. To increase the life and productivity of machinery, equipment and tools.
2. To avoid delays in production due to malfunctioning of machines
3. To ensure better or superior quality for the product.
4. To control and reduce the wastage.

Effective maintenance program plays an important role in the manufacturing processes. The importance of running maintenance can be understood from following points:

- It effectively reduces waste and run an efficient and continuous manufacturing / service operation.
- The cost of routine maintenance is very less than the cost of repair of a major breakdown.
- Daily inspections, cleaning, lubrication and minor adjustments can be detected and corrected before they become a major problem and may result in complete shut-down of a production line.

The running maintenance is one of the three maintenance systems present in apparel industry. The maintenance systems are as follows:

Fig.: 4.1 - Types of Maintenance Systems

a. Breakdown Maintenance

Breakdown Maintenance is the repair process carried out after the equipment stops functioning.

Machine breakdown time should be recorded and tracked to see mechanic performance. It is carried out only when evident problems occur. These are unpredictable type of maintenance and difficult to schedule. The equipment is either repaired or replaced. They are important because machine breakdown time is considered as loss time in garments manufacturing. .

b. Preventive Maintenance

Preventive maintenance is periodical and timely inspection which includes daily, weekly, monthly based cleaning, inspection, equipment condition diagnosis, oiling and alignment, and servicing activities.

Maintenance team carries out preventive maintenance as per their maintenance schedule.

c. Routine Maintenance

Routine maintenance consists of periodical and timely inspection, servicing, lubrication and cleaning of the equipments. It might also involve replacing certain parts to prevent sudden failure and avoid problems to ensure un-interrupted working condition of all machines.

SAFETY PRACTICES

The maintenance systems are inadequate to ensure safe and clean working environment until they are complemented by the various safety practices. Presence of hot steamers, electrical equipment, and sharp tools and devices combined with the busy schedule make it important to work carefully and pay constant attention to safety practices. The various safety practices are as follows:

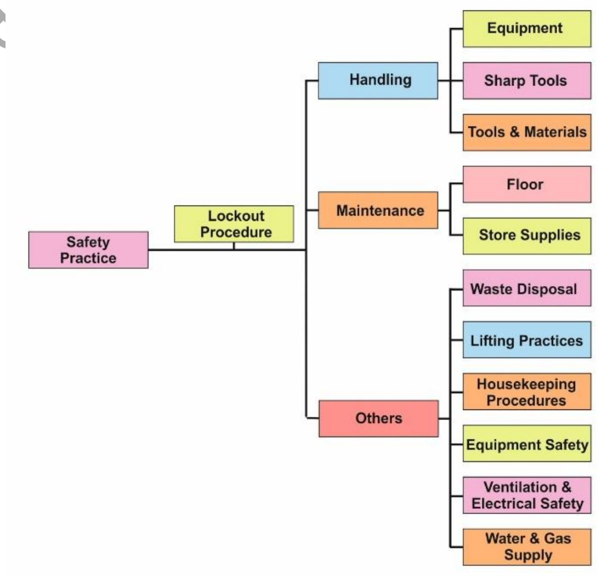


Fig.: 4.2 Safety Practices

1. Lock-out procedures

Locking out a machine means disconnection of the power feeding the machine.

The designated person carrying out the maintenance or repair is in charge of the key to the lock of power supply. Before turning the power off, this person ensures the work on the machine has been completed.

The person in charge reports early before the shift timings and removes the power lock of all the machines. This allows the power supply to make machine functional again. It is the duty of the person in charge to lock the machines during the lunch and tea breaks.

To safeguard the key, lock-out poster or signage must be posted near the equipment, so that no one can accidently restore power without the person in charge's knowledge.

The steps listed below must be followed before repairs or maintenance is carried out.

Steps of Lockout Procedure:

1. Notify all workers on duty about the lockout and the reason for it.
2. If the equipment is operating, switch it off.
3. The power cables must be unplugged. Grounding, repositioning, blocking, and bleeding down must all be used to dissipate or release stored energy in capacitors, springs, raised machine members, revolving fly wheels, hydraulic systems, and air, gas, steam, or water pressure.
4. Operate the push button or other usual working controls to guarantee that the equipment is not functional after ensuring that no workers are exposed and that the energy sources have been disconnected.
5. The equipment is now locked out.

Restoring Equipment to Service:

1. When the repair / maintenance job is completed and the equipment is ready for testing or normal service, a check of the equipment area is carried out to ensure that no one is exposed.
2. When equipment area is clear, all locks are removed. Power cables can be then reconnected.

2. Equipment handling

The points to be kept in mind while handling the equipment are as follows:

1. Do not use any machine if not trained to use.

2. Ensure the machine is switched off before cleaning or adjusting any machine.
3. Ensure fingers, hands, tools, etc., are away from moving parts. Please wait until machine fully stops.
4. Care must be taken while cleaning the cloth cutting and drilling machines. The steps followed are as follows:
   i. Pull the plug from switch board.
   ii. Do not touch the edge of the blade.
   iii. Clean the blade moving from the Centre towards the outer edge.
   iv. Clean the inside edge of the blade with a stick that has a cloth wrapped around one end.
5. Do not start a machine until the parts are locked in place and the attachments are securely fastened.
6. Use a wooden plunger (rather than hands) or other metallic tools to clean the machine.
7. Ensure awareness of the lock-out procedures that are to be followed before repairing or cleaning any machine.
8. Do not wear rings, large size wristwatch, bangles, or a tie while operating electrical power equipment.

3. Sharp tools Handling

The points to be kept in mind are as follows:

1. Use the right cutter or knife for the job.
2. Avoid close proximity to falling cutters or scissors. When a knife starts to fall, jump backward to get out of the way.
3. Always carry a cutters or scissors with the tip pointing downward, with the cutting edge turned away from the body.
4. Never talk while holding a cutters or scissors in the hand.
5. While cutting with any cutters or scissors, always cut away from the body.
6. Place cutters or scissors in drawers or in racks for proper storage.
7. Always use a sharp knife; it is much safer than a dull one.
8. Take a firm grip on a knife handle and always make sure that the handle is free of grease or any other slippery substance.

Fig.: 4.3 - Sharp tools

4. Tools & Materials handling:

The points to be kept in mind are as follows:

1. Use dry towels while handling hot openers, steamer covers/doors as wet cloth conducts heat more readily than dry cloth.
2. Avoid splashing grease on top of the range. Grease will ignite quickly, causing a fire. Do not throw water on a grease or fat fire. Use a foam based extinguisher or a wet towel.
3. Remove the lids of iron steamer or washers slowly. Lift the side of the lid that is away from operator so the steam does not rush out too quickly, causing burns to the hands or face.
4. One should Know the location of fire extinguishers; know how and when to operate them.

5. Floor Maintenance

The points to be kept in mind are as follows:

1. Wet floors are dangerous. Keep them dry.
2. Wipe out any spilled water or other similar liquids immediately.
3. Walk. Do not run or slide across the floor.
4. Never leave tools and rags on the floor.
5. Keep all path areas clear of boxes, garbage cans, portable equipment, mops and brooms, etc.
6. Using rubber mats behind the range is a good practice. Mats must be kept in good condition by daily cleaning.

6. Store supplies Safety and Maintenance

The points to be kept in mind are as follows:

1. Always store heavy materials on bottom shelves, medium-weight materials next and light-weight items on top shelves.
2. Clean all dirt, grease, and trash daily to reduce fire hazards and to eliminate breeding places for rats and cockroaches.
3. Use ladders, not boxes or chairs, to get things from high shelves.

7. Waste Disposal

The points to be kept in mind are as follows:

1. Place cloth and other scraps in proper containers.
2. Do not allow containers to overflow. Empty them before they are completely full.
3. Report broken or defective containers.
4. Wear gloves while disposing off expired washing chemicals or similar liquid trash.
5. Wash and sanitize hands properly
6. Push garbage down using a tamper or other tool. Do not push it down with hand or foot.

8. Lifting Practices

The points to be kept in mind are as follows:

1. Keep back straight, but not necessarily vertical. Have a firm grip on the object.
2. Keep the object close to the body.
3. Bend the knees before lifting.
4. Lift the object by pushing weights on legs.
5. Call for help to lift or move heavy boxes or containers.
6. Use of trolley is advisable for heavy objects.

9. Good housekeeping procedures

The points to be kept in mind are as follows:

1. Do not block exits.
2. Maintain a clean, dry, and grease-free work environment.
3. Maintain the condition of your steps and ladders.
4. Keep emergency equipment clean and unobstructed.

5. Ensure that all warning signs and labels are in good working order and are easily visible.

10. Equipment Safety

Extreme care should be taken while operating equipment. Before operating any tool or piece of equipment, one must be fully trained. Make sure that all guards are in place and function properly and that all electrical connections are properly made.

- Precautions taken while using equipment are,
    1. Understand the correct operating procedures and safety precautions before operating the equipment.
    2. Ensure that all guards are in place and functioning before any machine is started.
    3. Report defective or unsafe equipment to a responsible individual to prevent serious injury.
    4. Keep edge-cutting tools properly sharpened. Store the same in safety covers.
    5. Use tools only for their intended use and make sure the size of the tool is right for the job.
    6. Lock the machines before lubricating.
    7. Do not wear loose clothing, jewelry, or keep long hair open may around machines which increase the risk of being caught in the machinery.
    8. Approach the supervisor for any queries about a machine safety.

11. Ventilation systems

The environment in which the workers work should be free from smoke, fumes and steam. Industries should have ventilation equipment with suppression systems to release fresh air.

Many industries use emergency shutdown systems or "panic buttons." These are installed so that a single switch can be used to turn off the power to a large number of pieces of equipment.

These devices are intended to be employed in the situation in which a person is electrocuted or becomes caught in a piece of machinery. In these conditions, quick action is required. The points to be kept in mind are:

- Hit the panic button.
- Locate and learn how to use the emergency shutdown.

12. Electrical safety

The points to be kept in mind are as follows:

- As human body is sensitive to relatively small values of current, worker can receive a shock or burn from any common electrical circuit.
- Worker should be made aware of the location of the main panel or sub-panels being used, and learn how to shut them off in case of an emergency. Notify the supervisor right away.
- Obtain permission from the electrician before using a new service.
- Electrical extension cords, if they need to be used, should be orderly and not allowed to become tangled. Such cords should be taped to the floor whenever possible as this will reduce the chance of someone tripping over them

13. Water supply

If a pipe breaks or bursts, the water may damage material, tools, and equipment or work already done. In addition, water may create an electrical hazard if it comes in contact with electrical panels or outlets. Locate water shut off point of the industry, shut the water off and notify supervisor at once.

14. Gas supply

Escaping gas can cause an explosion that could injure anybody or cause severe damage. When the valve handle is running parallel with the gas line, the supply of gas is flowing and on. Locate the gas shutoff in the industry, shut the gas off and notify supervisor immediately.

CARRY OUT RUNNING MAINTENANCE WITHIN AGREED SCHEDULES

Maintenance is the action to retain, fix or restore an item in a state where it can perform its required function by the combination of all technical administrative, managerial and supervision actions.

The maintenance strategy has a significant impact on the industry's bottom line, but many maintenance managers have trouble selecting an appropriate strategy or overlook their approach altogether. Benefits of optimizing maintenance strategy include extending asset life, reducing asset failures and downtime, minimizing repair costs, and improving health and safety.

It's important to follow agreed schedules to maintain the assets properly and ensure that they remain in working order. Cutting, sewing, washing, ironing, folding, packing and finishing machines are important for the production of garments. So it is necessary to keep them in the best operating condition at economical cost.

1. Maintenance department activities in garment industry

The maintenance department is mainly responsible to look after the machines and other production equipment in proper working condition and take corrective action against any environmental pollution

a. Functions of Maintenance Department

1. Inspection of all machines and other machinery in the industry, repairing and up gradation.
2. Maintaining and ensuring continuous power supply in the factory.
3. Maintaining the water plant, compressors, air conditioning systems, Generators and boiler.
4. Planning, design and implement any kind of expansion of the industry.
5. Purchase of new machinery.
6. Issuing of different spare parts and accessories according to the production requirement.
7. Housekeeping.

2. Responsibilities of machine mechanic

a. Daily basis work of machine mechanic

1. Check machine setting correct or not
2. Check oil level and oil leaks of the machine
3. Check un-usual noise of the machine
4. Check safety equipment
5. Check machine allocation
6. Check production plan
7. Check for any loose nuts or bolts.

b. Monthly basis work of machine mechanic

1. Cleaning of whole machine by opening parts
2. Check back/ front cover
3. Check Oil lubrication, Oil level/ oil filter condition
4. Check functioning of machine
5. Check condition of Machine table
6. Cleaning and blowing
7. Check Power on/ off switch
8. Check Motor and control box condition
9. Observe abnormal sound Connections

3. Machinery maintenance schedule and procedure

a. Daily maintenance

If a machine breaks down during its operation, floor mechanics are called in to repair it. If this is not achievable in a reasonable amount of time, the machine is relocated to the maintenance room and replaced by another machine, with the appropriate steps done to repair it. The daily record of maintenance work is kept in a systematic format. Following are few of the maintenance work which are conducted daily.

Activities carried out daily:

1. Check speed and working of the machine.
2. Complete cleaning of the machine.
3. Check un-usual noise of the machine.

Activities carried out every four hours:

- Check for oil leaks.
- Clean machine parts.

b. Monthly maintenance

It is a preventive maintenance to reduce machinery problem and increase machine life, execute as per predetermined schedule fixed at the starting of the year by regular basis. This maintenance program covers total servicing of the all machine, oil change, oil filter change, or change of any defective parts. Records of monthly maintenance works must be kept in specified format.

HAZARDS LIKELY TO BE ENCOUNTERED WHEN CONDUCTING ROUTINE MAINTENANCE

Regular maintenance is essential to keep equipment, machines and the work environment safe and reliable. Maintenance workers are more likely to be exposed to various hazards.

Potential hazards could be:

A. Dangerous substances,

B. Confined spaces,

C. Working at height,

D. Awkward positions,

E. Plant under pressure,

F. Moving parts of machinery,

G. Unexpected start-ups,

H. Chemical substances or dust in the air, etc.

Insufficient maintenance can result in unsafe circumstances, accidents, and health issues. Working alongside a running operation and in close proximity to machinery makes maintenance a high-risk activity with distinct dangers and risks.

In contrast to regular operation, direct contact between the worker and the machine cannot be decreased significantly in maintenance activities, where workers must be in close proximity to the processes.

Maintenance activities are critical for the health and safety of maintenance staff. They may also be critical for others, in particular, for the equipment users or the production operators.

According to the relationships between maintenance and production, some accidents can be traced back to maintenance failures, such as insufficient, inappropriate, or late maintenance. For example, if maintenance is not performed on a regular basis, the equipment or installation can become dangerous to maintenance and production personnel. Other accidents may result from the co-activity of the two types of operators for example repair without interrupting operation.

Maintenance operations include both disassembly and reassembly, often involving complicated machinery and working at height. These can be associated with a greater risk of human error, increasing the accident risk.

Maintenance often involves unusual work, non-routine tasks and it is often performed in exceptional conditions, such as working in confined spaces. Working in confined spaces may expose workers to risks, which are:

1. Exposure to harmful gas, fumes, vapours or lack of oxygen
2. Risk of drowning in water or free-flowing solids
3. Risk of getting injured due to fire or explosion.
4. Risk of getting burned by high temperature machines

The hazards are commonly grouped as physical, chemical, biological and psychosocial. The hazards may vary significantly between planned, preventive and repair or corrective maintenance tasks.

- Type of hazards are as follows:

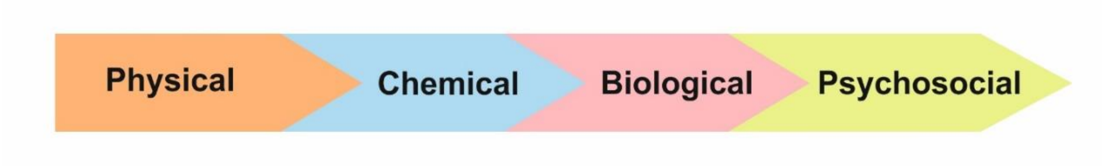


Fig.: 4.4 – Types of Hazards

1. Physical Hazard

   a. Mechanical movement - rotating elements e.g. flywheels, compressed springs, unexpected start-ups e.g. blockages cleared, trapped air in lines operating valves, restoration of power, computerized auto-start, failure of sub-standard parts and sewing machines

   b. Electrical - capacitors; high voltage; static

   c. Hydraulics - high pressure fluids

   d. Pneumatic - high pressure steam, gases, vapors

   e. Engulfment - oxygen deficient atmospheres

   f. Fire/explosion - extreme heat/cold, noise, vibration

   g. Work at Height – visibility, loading, unloading, etc.

2. Chemical Hazards

   a. Dusts and fibres e.g. heavily starched fabric materials, accumulated polluted air within production line, fibre/fabric dust and tiny fabric rags.

   b. Dangerous substances e.g. chlorine, oxygen, hydrogen

   c. Toxic, oxidizing, explosive, flammable, corrosive

   d. Hydraulic fluids, oils, acids, alkalis, organic solvents

3. Biological Hazards

   a. Pathogenic bacteria, viruses, parasites, insects, moulds and fungi.

4. Psychosocial Hazards

   a. Time pressure, long hours, shift work

   b. Poor work organisation, unsocial working hours

Activities

ACTIVITY 1

Visit a Garment manufacturing firm, discuss with maintenance team and prepare a report on various types of maintenance conducted by them.

Materials Required:

1. Writing material
2. Ruler
3. Adhesive

Procedure:

1. Make a group of 4 students each.
2. Visit a garment manufacturing firm
3. Enquire about its maintenance activities.
4. Prepare a report of your observation with pictures.
5. Submit the report to the teacher for evaluation and feedback.

Check Your Progress

1. Fill in the Blanks:

1. A clean and hazard free workplace ensures the ________________________ and health of the employees and visitors.
2. Overcrowding, together with improper storage of flammable materials, frequently creates serious ___________ hazards.
3. _________________ maintenance means routine maintenance, inspection and servicing of machines and systems to ensure smooth functioning and efficient production.
4. Locking out a machine means __________________ of the power feeding the machine.
5. The environment in which the workers work should be free from ______________________ and steam.

2. Write short answers for the following:

1. What is maintenance? Briefly explain running maintenance.
2. What are hazards? Enlist different types of hazards.

3. Write long answers for the following:

1. Briefly explain activities of maintenance department.
2. What are the types of running maintenance?

Session 2: Maintaining Cleanliness

Maintaining clean and organized premises is one of the biggest struggles of the job. Keeping the machines in the production line clean and in perfect working order and the aisles of work area free of debris with the minimum of effort is very essential. It requires a bit of effort and forward planning which can pay back several times with increased productivity.

The benefits of maintaining cleanliness

Working environment that is clean, safe, and efficient, motivates employees to take pleasure in their work. A place when clean also helps to make place look more organised and contributes to worker's efficiency.

COMPLIANCE WITH HEALTH AND SAFETY REGULATIONS /GUIDELINES

Section 11 of The Factories Act, 1948 suggests "Every factory shall be kept clean and free from effluvia arising from any drain, privy or other nuisance."

Whereas Section 12 advise that effective provisions should be established in every factory for the treatment of wastes and effluents resulting from the industrial process carried out therein, so that they can be rendered harmless and disposed of.

Section 13 specifies that effective and acceptable provisions should be provided in every factory for securing and maintaining enough ventilation via the circulation of fresh air, as well as such a temperature as will provide reasonable conditions of comfort to workers and prevent danger to health.

Section 14 suggest how dust and fumes to be handled in a factory as- Every factory where, as a result of the manufacturing process, dust, fumes, or other contaminants of such a nature and to such an amount as to be hurtful or objectionable to the employees employed within are released.

CLEANING PRACTICES

The types of work perform in the industry premises will determine how frequently it needs to be cleaned, but one should perform two kinds of cleaning schedule- deep and regular cleaning.

1. Deep cleaning

Over time, the floor of industry gets dirty; dust and grunge also gets accumulated on equipment, which can affect productivity. In this case machinery needs to be cleaned deeply. Time required in cleaning depends on what kind of work is performed, and may be different for each section of the production processes.

Deep cleaning of working area takes several hours to clean surface, tools and machines, using heavy duty cleaning equipment.

To perform the deep clean, each cleaning / housekeeping staff should be assigned an area of the premises, in order to ensure accountability. Each housekeeping staff should then be provided with the equipment and supplies they need to thoroughly clean everything in their designated area. They should be provided training to use any special cleaning equipment if they require. One should schedule the deep clean during a slow production period or a non-working day, so that there won't be any loss of productive work hours.

2. Regular cleaning

A messy work environment doesn't reflect well on the business and may have an impact on work quality and production speed.

Frequency of performing regular cleaning depends majorly on two factors, which are:

i. Type of work performed in the industry

ii. Frequency of visit of clients and suppliers in the working area.

Following are the suggestion for Regular cleaning activities:

1. Employees should be instructed to clean up any spills, debris, rubbish, etc. as they appear to prevent them from causing any sort of health / safety hazards.
2. Providing employees with a buffer time of around 5 minutes, at the end of every shift, to get their workspace clean and tidy so the next person can use it straight away.
3. Providing employees with the suitable cleaning equipment and supplies like cloth, dustpan, brush, paper towels, etc. to clean up any spills and messes on their own.
4. Management should ensure the presence of waste and recycling bins at each work station. Management should also encourage the staff to dispose of waste as soon as it appears rather than leaving it to build up. They should also set up a rotation for emptying the waste bins so they don't overflow and become a hazard themselves.
5. Equipment not used regularly, should be kept covered and cleaned once a week, to prevent dust accumulation which may potentially affect its performance.

6. Management should invest in cleaning equipment because it helps in making regular cleaning routines easier, faster and efficient as possible.
7. Make an inventory of every item that needs to be cleaned in the industry that could help the staff to clean it more efficiently.
8. A regular cleaning routine chart can also be maintained by the management to keep a track of cleaning schedules.

DIFFERENT TYPES OF CLEANING EQUIPMENT, SUBSTANCES AND THEIR USE

A variety of necessary and vital cleaning equipment and substances are designed and available in various colours, materials, mechanisms, shapes, sizes and styles to meet a cleaning need. They are used to clean easily, effectively and efficiently.

Types and uses of cleaning equipment:

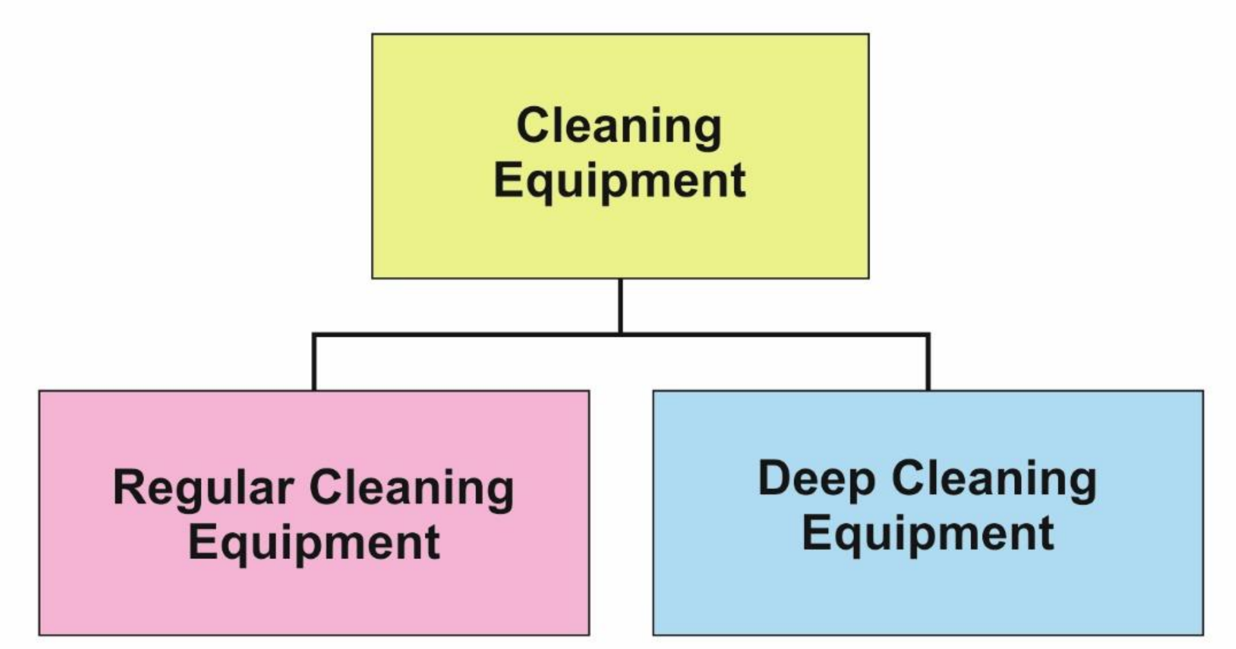


Fig.: 4.5 - Types of Cleaning Equipment

1. Regular Cleaning Equipments

1. Broom – It is cleaning equipment made of bundle of straws or twigs attached to a long handle used to sweep the floor area.
2. Dustpan- A cleaning tool used to scoop the dirt and wastes from the floor.
3. Water Hoses – It is used to supply the water in washing, toilets and other cleaning units.

4. Bucket and mug - To carry water or any other cleaning substances within the premises area and to clean the work areas.
5. Scrubber - A scrubber is a type of wide brush with a long shaft used for cleaning hard floors or surfaces. At the end of shaft attached soft bristles to sweep dirt away and hard bristles for brushing. It may be used wet, with water or cleaning fluids. There may also be a detachable mechanism to fix mop cloth, either soaked in water for cleaning or dry for wiping dry surfaces.
6. Dust cloth – Dust cloth is used to clean all fine dust build up on any surface.
7. Sponge - A sponge is a soft, porous cleaning device that is used to clean impermeable surfaces. Sponges excel in absorbing water and other water-based solutions.
8. Tissue paper- Tissue is a type of absorbent and disposable paper. They can be used for the same things as regular towels: drying hands, wiping windows and other surfaces, dusting, and cleaning up spills. They're commonly found in public restrooms, where paper towels are thought to be more hygienic than hot-air hand dryers.

2. Deep Cleaning Equipments

1. Spray cum vacuum suctioning cleaner– Cleaning is done automatically. It is used in professional cleaning to apply a pressured, diluted cleaning solution to filthy or contaminated surfaces, followed by vacuum suctioning to remove the applied liquid, as well as the suspended solids and dissolved pollutants.
3. A floor scrubber – It is a floor cleaning device that cleans bigger areas by injecting water with cleaning solution, scraping, and removing the residue off the floor as a floor mop or floor brush.
4. Auto floor scrubber – Auto floor scrubbers are used to scrub a floor, clean of light debris, dust, oil, grease or other marks on floor. These machines have an automated system for dispensing cleaning solution and then vacuuming it up.
5. Washing machine - For bulk washing, the industry uses a high- capacity washing machine. For washing a smaller number of garments and sample pieces, the domestic washing machine is used for removing dirt of soiled mop clothes and other materials.
6. Vacuum washer - A wash-head of a vacuum washer sprays water without detergent and quickly suctions it out, generating a swirl of water. The drying time is substantially reduced by instantly reabsorbing the wash water. This cleaning approach is appropriate for both intermediate and basic cleaning. The technique works on all water-resistant surfaces, such as carpet, upholstered furniture, wooden floors, stone, plastics, and so on.

1. 6. Vacuum cleaner - Both scrap and dust vacuum cleaners are used to clean all production line floors to remove the scraps and dust quickly to keep the working area clean and tidy.

Cleaning substances

Cleaning substances are hard-surface cleaners available in the form of liquids, powders, sprays, or granules and are used to remove dirt, including dust, stains, bad smells and clutter on surfaces. Purposes of cleaning agents include health, beauty, removing offensive odor and avoiding the spread of dirt and contaminants of work areas.

Disinfectants are cleaning agents that can kill bacteria or other microbes on surface of commonly used items like door handles, working tables etc. Other cleaning substance is degreaser which contain organic solvents and help to dissolve oils and fats.

a. Types of cleaning substances are:

1. Detergents

Detergents contain significant quantities of a group of chemicals known as 'Surfactants' They are similar to soap but are more soluble in hard water. It works by breaking up dirt or soil, making it easy to wash it away. Detergents are commonly available as powders or concentrated solutions. Detergents are also foaming agents of varying degrees.

2. Degreasers

Degreaser is used to remove grease from surface such as machine tops, counters and grill backsplashes. Methylated spirits or white spirit is commonly used for degreasing. It usually consists of strong alkalis, which can dissolve proteins and disperse grease or similar substances. It is generally based on caustic soda or sodium metasilicate. Sodium carbonate is also used as stain remover and for clearing blocked drains, cleaning all types of washers and other industrial equipment.

3. Abrasives

Abrasives are chemicals used to clean dirt from hard surfaces. In commercial industries abrasives are used to clean floors, pots and pans. The cleaning action of abrasives depends on the presence of fine particles which when rubbed over a soiled hard surface, dislodges the soil, remove tarnishing and surface scratches.

The various types of Abrasives are as follows:

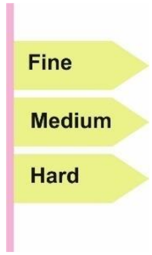


Fig.: 4.6 - Types of Abrasives

Fine abrasives are preferred over coarser ones. For example nylon pads, powdered pumice, feldspar, fine ash, filtered chalk, etc. are available in liquid, paste or powdered form.

Examples of Medium abrasives include rottenstone, salt, scouring powder and scouring paste. Scouring powders are made up of fine particles of pumice mixed with soap/ detergent, alkali and bleach.

Examples of Hard /coarse abrasives include bath bricks, sandpaper, powdered pumice, steel wool and emery paper. Abrasives are used along with other substances such as bleaches, anionic surfactants, alkaline builders and perfumes.

4. Acids

Acid cleaners are used to remove mineral deposits and for descaling or removing rust from any surfaces. Often, surfactants and corrosion inhibitors are also added to the acid. Acids dissolve metals and are thus used to remove metal stains, stains from deposits around taps, and tarnish on copper and brass, among other things.

Vinegar can also be used to clean hard surfaces and remove Calcium deposits.

a. Acidic drain cleaners use sulphuric acid to unblock clogged pipes by dissolving greases, proteins and even carbohydrate-containing substances such as toilet tissue.

b. Hydrochloric acid (HCL) is a common mineral acid. Stubborn hard-water deposits are removed by concentrated HCL. **Dilute HCL** is used for removing stubborn scales and deposits from sanitary ware.

c. To remove tarnish and stains from metals such as copper and brass, acetic acid is used.

d. Toilet cleansers use their acid content to clean and sanitise the W/C pan while also removing metal stains. They come in a variety of forms, including crystalline, powdered, and liquid.

  - Powder toilet cleaners are in the form of solid salts, such as Sodium Hydrogen Sulphate.
  - Liquid toilet cleaners contain other acids like dilute hydrochloric, phosphoric or formic acid.

These acids can convert the calcium carbonate into salts that are soluble in water and can easily be rinsed away. The toilet brush is used to scrub the toilet, remove stubborn stains and biological debris.

5. Alkalis

These are used in the form of liquid and powders. Many alkalis have bleaching properties. Alkaline cleaning chemicals include bleach and ammonia. These are dispersants that keep dissolved dirt and rust from resettling.

Caustic alkalis are very strong alkalis. Cleaning products based on caustic soda are used to unclog drains and clean industrial equipment. Fats, such as grease, oils, and protein-based compounds, can be dissolved by alkaline cleaners. Strong bases, such as sodium hydroxide or potassium hydroxide, are found in cleaning products.

6. Neutral

Non-ionic surfactants are used in neutral washing products to disperse various types of dirt. Water is the most popular cleaning agent that, even when used alone, can dissolve some type of dirt. It becomes more effective when combined with additional cleaning agents, such as a detergent.

Water is used to carry the cleaning materials to the soil, suspend the soil, remove the suspended soil from the cleaning site and rinse the detergent solution from the surface.

7. Organic Solvents

These are substances that dissolve fats, oils, grease, wax, and other similar substances. Methylated spirit, white spirit (turpentine replacement), carbon tetrachloride, and other kinds of alcohol such as isopropyl alcohol and rubbing alcohol are all examples of organic solvents. The first two are extremely flammable, whereas carbon tetrachloride is toxic if inhaled and should never be used in a confined space. Many of them are commonly used to remove stains. They are irritating to the skin and might cause fires.

8. Other Cleansing Agents

1. Polishes

They smooth out the unevenness of the article's surface by applying a thin coating of wax on it. On the surface, it also serves as a protective layer.

a. Metal polishes - They come in the form of a liquid or a paste. Plate powder, mentholated spirit, and Ammonia are examples of fine abrasives waxed with grease solvent and occasionally with an acid. When abrasive is rubbed on the metal's surface, friction is created, which removes tarnish and produces a shine.

b. Floor polishes – Spirit-based polishes, which come in paste or liquid form, may contain Silicon. It is suitable for wood, cork, linoleum, and magnesite floors. Water-based polishes are emulsions made up of fine natural and synthetic wax particles mixed in water. They can be used on thermoplastic, rubber, PVC, asphalt, and combination floors, as well as wood, cork, magnesite, and linoleum that has been sealed.

2. Floor Seals

These are placed as a semi-permanent finish to flooring surfaces to act as a protective barrier against dirt, germs, fluids, grease, stains, and bacteria. They protect the surface from scratches and make it easy to clean.

3. Bleaches

Bleaches are alkaline stabilised sodium hypochlorite solutions that are excellent for cleaning stained sinks, W/C pans, and other surfaces. They contain germicidal and whitening effects. With oxidation, bleaches can break down the tough stains. Sodium perborate is a common ingredient in detergents for washing fabrics.

4. Disinfectants and De-odorants

Disinfectants, antiseptics, and deodorants are not cleaning agents, but they are frequently used in cleaning operations. With their fragrance characteristics, these help to keep rooms free of infections and fresh.

a. Air sanitizer – It is a disinfectant/sanitizer that is used to disinfect or sanitise inanimate surfaces in the institutional and/or commercial environment by limiting or moderating the growth or development of microbiological organisms such as bacteria, fungi, or viruses. Some glycol vapours, such as tri-ethylene glycol, can operate as an air sanitizer.

b. Deodorants – It can hide unpleasant odours by interacting chemically with the particle that causes the odour or by having its own scent dominate. Restrooms, guestrooms, guest bathrooms, store rooms, and public areas such as lobbies all use them. Aerosol sprays, liquids, powders, and crystalline blocks are the most common forms.

c. Carbolic soap – It is also known as red soap, and is a mildly antiseptic soap that contains carbolic acid and/or cresylic acid, both of which are phenols and is derived from coal tar or petroleum. Carbolic acid is a skin irritant that is utilised in a wide range of industrial and consumer products.

5. Glass Cleaners

Glass cleaner comes in sprays or liquid form and is made up of water-miscible solvents. It's frequently used with isopropyl alcohol, as well as modest amounts of surfactants and alkali, to boost the cleanser's polishing effect. It can be sprayed directly onto windows, mirrors, and other glass surfaces, or it can be applied with a soft cloth and then rubbed off with a soft, lint-free glass cloth.

6. Metal cleaners

Metal cleansers contain chelating agents, abrasives, and surfactants for cleaning stainless steel sinks, faucets, metal trim, silverware, and other ferrous metals. These agents include citric and phosphoric acids, which are nonaggressive. Stainless steel, nickel and chromium cleaners contain lactic, citric or phosphoric acid.

Nonferrous metal cleaners contain ammonia, ammonium oleate, stearate and chelating agents like ammonium citrate and oxalate.

7. Absorbents

They carry out the action by absorbing the stain or grease. They are used only when the quantity of strain is too much. e.g. starch powder, fuller's earth, bran, French chalk powder, etc.

8. Anti-mildew agent

The chemical which protect the fabric material and garments from mould and mildew namely zinc chloride. It is used in textile / garments store and industries.

9. All-purpose cleaners -

All-purpose cleaners are usually concentrated solutions of surfactants and water softeners, which enhance the behaviour of surfactant when used with hard water. Common examples could be alkyl benzene sulfonates, anionic detergent and modified fatty alcohols.

SAFE WORKING PRACTICES FOR CLEANING AND THE METHOD OF CARRYING THEM OUT

Safe work practices are steps that guide a worker to perform a task with minimum risk to people, equipment, materials, environment and processes.

Safe working practices for cleaning are:

1. Understand the risks and hazards of the workplace during cleaning hours and take necessary steps to reduce risk of work-related injury.
2. Measures must be taken to ensure that cleaning operations can be carried out safely.
3. Use mechanical aids for cleaning, wherever possible.
4. Use ergonomically designed cleaning equipment, and re-arrange the work area so that everything is within easy reach.
5. Use necessary tools and personal protective equipment to carry out safe cleaning and maintenance
6. Wear protective equipment to suit the cleaning tasks. Gloves, full-face mask and apron can reduce risk of injury from concentrated cleaning substances and sharp equipment. Respirators may be used while cleaning filters.

Fig.: 4.7 – Personal Protective Equipments

7. Surrounding windows must have curtains or blinds which workers can adjust to prevent reflected glare during cleaning of production floors and machineries.
8. Humidity- It is important to maintain ventilation and humidity at a level which keeps the cleaner comfortable.

Methods for cleaning

It is the best practice to use a two or three-bucket system for mopping. This can be facilitated by using a cleaning cart or on a separate trolley, if a full cleaning cart is not available. The various methods and tools used in the cleaning process are as follows:

1. Two-bucket system – It is used for routine cleaning with one bucket containing a detergent or cleaning solution and the other with rinse water.
2. Three-bucket system- It is used to for disinfection. The detergent or cleaning solution is in one bucket, the rinse water is in another and the disinfection or disinfecting solution is in the third.
3. The rinse water bucket is used to rinse and wring out the mop before re-dipping it into the prepared solution. This extends the solution's useful life, saving both time and money.
4. The points to be kept in mind along to ensure proper cleaning are as follows:
5. Cleaning staff should be trained on appropriate use, application and removal of PPE for all environmental cleaning procedures and tasks for which they are responsible.
6. Put on all parts of PPE before entering a working area and remove it (for disposal or reprocessing, if reusable) before leaving that area.
7. Include required PPE for specific tasks in standard operating procedures and other visual job aids.
8. All PPE parts (reusable and disposable) should be available in sufficient quantity, well maintained (good quality, appropriately stored stocks) and clean before use.
9. Reprocess (i.e. clean and disinfect) all reusable PPE, at least once a day
10. Use reusable rubber gloves for cleaning.
11. To avoid interfering with gloves or affecting hand hygiene, keep sleeves at or above the elbow.
12. Wear rubber-soled closed toe shoes or boots (but not sandals), to prevent accidental injury.
13. Regularly reprocess all reusable items (i.e. thoroughly clean, disinfect, and dry).
14. Whenever a solution is changed, thoroughly clean, disinfect, and rinse equipment such as buckets and containers. To allow full drying, store them upside down.

15. Launder mop heads, floor cloths and soiled cleaning cloths at least once a day (e.g. at the end of the day) and allow them to fully dry before storage and reuse.
16. As directed by the manufacturer, reprocess all reusable materials and equipment in a separate area that is not used for other purposes.
17. Cleaning aids and products should be disinfected by thoroughly immersing them in boiling water or a disinfectant solution for the required contact time, then rinsing with clean water to eliminate any residue.
18. All reusable supplies and equipment should be kept clean and in good operating condition at all times. All reusable equipment should be evaluated on a regular basis and replaced or repaired as needed.

CARRYING OUT CLEANING ACCORDING TO SCHEDULES AND LIMITS OF RESPONSIBILITY

During the whole Garment production process, management should ensure that maintenance is coordinated, scheduled and performed correctly as per plan, and that the equipment or workplace is left in a safe condition for continued operation.

Environmental Cleaning guidelines deal with cleaning of the physical environment as it relates to the prevention and control of infections. Administrators, supervisors of housekeeping departments, infection prevention and control experts, construction/maintenance project supervisors, and public health officers are among those who fall into this category.

Cleaning according to schedule and responsibility

1. Written procedures for cleaning and disinfection of working areas and equipment should be followed.

    - Defined responsibility for specific items and areas
    - Clearly defined lines of accountability
    - Procedures for daily and terminal cleaning
    - Procedures for outbreak management
    - Cleaning and disinfection standards
    - Frequency of cleaning and disinfection.

2. Regular cleaning is necessary to maintain a standard of cleanliness.

3. Thorough and timely cleaning.

4. Monitoring of environmental cleanliness.

5. Ongoing review of cleaning procedures.

6. Cleaning schedules should be revised and developed, depending on:

   - Surfaces of high-touch or low-touch items / equipment,
   - The type of activity taking place in the area and the infection risk associated with it,
   - The vulnerability of the cleaning staff working in the area.

1. Each health care facility should have written rules and procedures for proper cleaning that clearly identify the frequency and amount of cleaning, as well as the cleaning authority.

2. Institutions should have in place systems with regard to frequency of cleaning. They should periodically conduct audits to ensure a clean environment during working hours.

3. Cleaning audit results should be evaluated and analysed, and cleaning employees should be given feedback.

4. To detect and solve cleaning issues, an action plan should be developed.

5. Knowledge of Personal Protective Equipment (PPE), hand hygiene and safe work practices is required for every cleaning staff.

6. All chemical cleaners and disinfectants should be properly labelled and kept to reduce the danger of contamination, inhalation, skin contact, or bodily damage.

7. Develop a facility-level monitoring and maintenance schedule that clearly describes the items, inspection frequency, and responsible personnel. Certain equipment, such as floor cleaners, may require regular maintenance checks by qualified personnel, as directed by the manufacturer.

8. Prepare and keep a service record, and make it available to the cleaning programme manager for examination.

Storage of cleaning substances

Cleaning agents with a longer shelf life are bought in bulk because of the reduced costs.

Points to be considered for storage of cleaning substances are:

a. Storage racks should be strong enough to carry the weight of the items. Heavier containers must be kept on the bottom shelf.

b. The store-room should always be well lit, well ventilated and clean.

c. Ensure that the lids of the containers are tightly fitted.

d. While issuing cleaning substances, use appropriate dispensers and measuring apparatus.

e) Ensure that no residual deposits of the cleaning substance is left around the rims of the containers.

f) Spillage should be avoided. And if spill occurs, it should be cleaned immediately.

g) A systematic procedure should be followed for rotating stocks.

h) Organic solvents, strong reagents and polishes should be kept away from heat sources.

i) Stock check should be conducted at regular intervals.

j) Store should be locked when not in use.

Activities

ACTIVITY 1

Prepare a geographical poster on PPE kit for safety.

Materials Required:

1. Writing material
2. Ruler
3. Adhesive

Procedure:

1. Based on your understanding, prepare a graphical and interactive poster on PPE kit for safety.
2. Display the same in your class.

Check Your Progress

A. Fill in the Blanks:

1. Working environment that is clean, safe, and efficient, ______________________ employees to take pleasure in their work.
2. __________________cleaning of working area takes several hours to clean surface, tools and machines, using heavy duty cleaning equipment.
3. _____________________are cleaning agents that can kill bacteria or other microbes on surface of commonly used items like door handles, working tables etc.
4. ______________________is used to remove grease from surface such as machine tops, counters and grill backsplashes.
5. _____________________cleaning is necessary to maintain a standard of cleanliness.

B. Write short answers for the following:

1. What are the benefits of maintaining cleanliness in apparel industry?
2. Describe various cleaning practices.

C. Write long answers for the following:

1. Briefly explain different types of cleaning substances.

Session 3: Operation of Machinery, Equipment and Tools Safely and Correctly

The most important concept to remember is that - one is responsible for one's own safety and the safety of others. Most safety practices are though very common, unfortunately can be forgotten or overlooked unless one makes safe practices a habit or an instinct.

GENERAL SAFETY

By following the right procedures, workers will commit themselves to safety on the job and with that everyone will be benefited. Accidents may occur in many ways but most often can be based on ignorance or carelessness.

Safety precautions to be followed in work area are as follows:

1. Walk instead of running - People who rush around in the work area tend to increase the likelihood of an accident.
2. Concentrate on work - Stay completely alert on the job. Lack of interest, personal problems, and distraction by others can all lead to serious accidents in the working area.
3. Understand all the rules for operating equipments. Never operate the equipment until trained
4. Never work under the influence of drugs or alcohol.
5. Pay attention to moving objects, such as equipment, cloth cutter and driller, trolleys etc.
6. Avoid back strain by lifting the materials in proper position.
7. Accidents are caused due to overlooking of situations involved with risk. They are the result of not knowing the proper way to do a task, carelessly performing an operation or job, or not being consciously aware during the performance of a task.

The most common accidents in the working area are as follows:

a. Cuts

Cuts are too common in the industry because cutter, needle and other cutting equipment and tools are constantly in use. These cuts, as well as the severity of the cuts, can be avoided by following the right safety standards and following proper cutting methods.

Accidental cuts can be prevented if the expertise of using a cutter has been mastered. If they do occur, however, they should be treated safely and promptly. If infection sets in, it can result in more serious consequences.

b. Burns

Two types of burns occur in the working area-

- Minor
- Major

Minor burns occur when an exposed body part comes into contact with a hot surface, such as a steamer, a hot air oven, or concentrated chemical compounds.

When grease and chemicals are spilled, steam is discharged too quickly, or gas is released unintentionally, major burns occur.

Burns are more painful and take longer to heal than cuts. If a blister forms as a result of the burn, it should be treated as soon as possible by skilled medical staff.

c. Falls

Falls can cause some of the most serious injuries in the commercial industry. They may disable or incapacitate a person for life.

Falls are caused by extreme carelessness, wet floors and aisles, spilled materials, rags, grease, and by torn mats or spread rags and floor boards.

d. Strains

Strains are very painful and can cost you a lot of time at work. They are caused by carrying excessively heavy loads and using inappropriate lifting techniques. The majority of strains do not require medical attention, but they do necessitate time and care in order to heal properly.

HANDLING MATERIALS, MACHINERY, EQUIPMENT AND TOOLS SAFELY AND CORRECTLY

Employers are legally required to ensure that all equipment and materials supplied and used for work purposes are safe and does not pose a long-term hazard or risk to employee's health. Employees must have sufficient knowledge and training to handle materials, machinery, equipment and tools safely.

Safe practices to handle machinery, equipment and tools are:

1. Worker should possess the required know how of machinery, equipment and tools used for the job.
2. Routine maintenance must be carried out for all machines, equipment and tools.
3. Inspection at regular intervals to avoid wear and tear that might compromise safety.

4. Proper inspection of machines before use if the equipment's safety depends on installation

5. Noise and vibration levels should be checked and should not affect the operator and others.

6. Use hand-held tools safely- Anyone who uses a hand-held tool might be at risk of injury.

7. Band knives can cause serious wounds unless effectively protected. The circular knife of portable cutting machines should also be similarly protected.

8. If power presses are used, adequate machinery guarding, preferably fixed, is necessary to keep hands out of the danger area. Guards which prevent the pressure head from coming in close contact (most importantly, the hand) comes within the area are to be used. All presses, with their steam and pneumatic supplies, must be frequently inspected.

9. The drive motors and the needle are the two most dangerous parts of a sewing machine. Long lines of machines are still driven by under bench shafting in several places. When workers bend under benches to grab goods or fix belts, many entanglement mishaps might occur, so it's vital that this shafting is effectively protected by enclosure or close railing. Several different types of needle guard, which keep fingers out of the area of risk, should be used.

10. Handling old equipment - Ensure that it is safely and properly handled, stored, transported and recovered or disposed-off. If the equipment contains hazardous components, follow additional requirements under hazardous waste legislation.

11. Personal Protective equipment -Workers in many activities may require special protective equipment at work like helmets, bump caps or hair nets for the head crash and climbing. Hearing protection should be worn if exposed to high noise levels. Safety glasses, goggles and face shields can also be used to prevent eye hazards. As a standard, everyone should wear safety spectacles, goggles and face shields while using hand or power tools. Other PPE types likes Safety boots or shoes, gloves, gauntlets, mitts, cuffs, armlets or elbow protectors, overalls, boiler suits, high visibility clothing, leggings and gaiters for different activities in production line are required. Cutting machine operators must wear a protective glove, preferably of metal mesh.

12. Amputation and Caught-in Hazards – Machine guards are mounted on machines to protect employees from moving parts. Every day, equipment should be checked carefully to confirm that all guards are in place.

13. Chemical Hazards – Chemical-processing equipment can be a source of a variety of risks. Leaks can result in slipping dangers and chemical exposure. Chemical-leaking hoses could cause respiratory problems for

workers working nearby. As a result, caution must be given when using such devices.

14. Sharp Edges – Walking very close to machinery area, may be hazardous if sharp edges are not guarded. Hence equipment mounting brackets, signages and control boxes should be checked regularly to see if sharp edges are present.
15. Ensure that all equipment are well maintained and checked regularly. All equipment should be removed from the platform, at the end of the working day, and all power supplies should also be switched off.
16. Risks caused by workplace equipment - Cutting equipment, forklift trucks, equipment using heat or bright light, can cause risks not just during the normal operation of the equipment but also during installation, maintenance, repairs, breakdowns and servicing. Hence, use of appropriate warning signs is advisable.

Tool safety

Workers should be taught how to use tools in a safe manner. When tools are misplaced or handled incorrectly by workers, they can be dangerous.

Following are some suggestions for safe handling of tools are:

a. Tools should never be tossed but should be properly passed from one employee to the next. Pointed tools should be passed with the handles facing the receiver or in their carrier.

b. Workers carrying large tools or equipment on their shoulders should pay particular attention to the workspace clearances.

c. Cutter and screwdrivers should never be carried in a worker's pocket. In a toolbox, pointed down in a tool belt / pocket tool bag, or in the hand with the tip always held away from the body are all acceptable ways to carry them.

d. Tools should always be put away, when not in use. Leaving tools on an elevated structure such as a scaffold, poses a significant risk to workers working below the elevated structure.

e. Fabric cutting tools - Cutting tool guard must be correctly set in order to give the necessary protection to the hand positioning the material, otherwise it may have a risk of accidental cuts. Supporting and maneuvering a cutting machine, while stretching across the cutting table, can present a risk of neck, upper-extremity and back disorders.

f. Handling rolls of fabric, which can weigh up to 32 kg and must be lifted above the head onto a rack for spreading, also poses muscular hazards. Proper material-handling equipment can eliminate or reduce these risks.

g. Sewing machine operators who operate in a seated position at poorly built workstations, executing the same operation throughout the workday with highly repetitive, time-pressured work are at a significant risk of acquiring musculoskeletal disorders. It is necessary to take proper precautions.

h. Adjustable seats and worktables have the ability to reduce the dangers connected with using a sewing machine.

i. Finishing workers, such as pressers, are frequently required to work standing and in static positions. Many of these occupations can benefit from the addition of chairs, stools, or sit-stand chairs. With a slanted mechanism, table tops may be adjusted to the correct height for the operator, allowing them to work in a more comfortable position. Hands, wrists, and arms can be relieved of some stress by padded table edges and appropriately made and sized equipment.

j. Burns and ergonomic dangers can occur when using presses and irons. The majority of the presses are constructed with two-handed controls, which eliminates the risk of a hand becoming stuck in the press. Working on a pressing machine also puts you at risk for shoulder, neck, and back injuries due to repeated overhead reaching and standing while using the foot pedals. By properly situating the worker at the machine make this task safer and minimise the excessive stress.

k. Ticketers who use manual ticketing guns to place tags on finished garments, are at risk of hand and wrist injury with highly repetitive operations. Automatic ticketing guns can decrease the force required to perform the operation, hence reducing stress and strain on the operator's fingers and hands.

l. Many injuries in warehouse activities, such as lifting and overhead work, are caused by manual material handling. Mechanical material handling equipment such as forklifts and hoists, can reduce injuries caused by lifting heavy lifts. This can also be reduced by designing the distribution workplace with adequate material handling, such as positioning of conveyors and worktables at appropriate heights.

m. Chemical exposure - Workers at every stage of apparel production may be exposed to the chemicals used in fabric finishing, the most common is formaldehyde. Formaldehyde releases into the air from fabric in the form of a gas. Workers may also have skin exposure to formaldehyde as they handle the fabric. Exposure to formaldehyde can be prevented by allowing the fabric to blow off-gas in a well-ventilated area before it is handled. Workers must wear gloves or apply protective cream.

Instructions for Safety at work place are as follows:

1. Keep the work area clean, tidy, well swept/washed and well lit. Floor should be level and must have a non-slippery surface.
2. Do not remove any guarding device; before operating, the operator must ensure that guarding devices are in position and good working condition.
3. Before measuring, cleaning, maintaining, or adjusting the machinery, follow the lock-out procedures.
4. Check and adjust all safety devices before operation.
5. Wear appropriate personal protective gear as prescribed, including CSA-approved safety glasses with side shields.
6. Ensure that all cutting tools and blades are clean, sharp and rust free and should be able to cut freely without extra effort.
7. Ensure there is enough space around the machine for operator, maintenance team and cleaning staff to do their job freely.
8. Ensure that all stationary equipment /machines are anchored securely to the floor.
9. Maintain distance with the cutting head and all moving parts of the machine, to avoid any accident.
10. Avoid awkward positions and postures as sudden slips could cause the hand getting harmed by the cutting tool or blade.
11. Do not leave machines unattended: turn OFF the power, when not in use.
12. Avoid distracting the operator; horseplay can lead to hazard and injuries.
13. Wearing loose-fitting clothing, gloves, neckties, rings, bracelets, or other jewellery that could get tangled in moving parts is not a good idea. Long hair should be kept out of the way, and rags should not be used near the machine's moving parts.
14. Return all portable tools to their proper storage place after use.
15. Clean all tools after use.
16. Use a vacuum cleaner or a brush to remove any rag cuttings.
17. Do not use compressed air, to blow debris from machines or from worker's clothes.
18. Keep the tools out of the aisles and out of the way of other workers. Knives and scissors must be sharp; dull equipment pose a greater risk than sharp ones. Cracked saw blades must be removed from service immediately; else, an accident may occur.

19. In the presence of combustible substances, iron or steel hand tools may produce sparks, which could lead to an ignition. Spark-resistant instruments made of nonferrous materials should be used near flammable gases, highly volatile liquids, and other explosive chemicals wherever this hazard exists.
20. Because power tools can be exceedingly dangerous if handled incorrectly, they must be equipped with guards and safety switches. Electric, pneumatic, liquid fuel based, hydraulic, and powder-actuated power tools are classified according to their power source.

USE CORRECT LIFTING AND HANDLING PROCEDURES

Musculoskeletal problems often emerge from poor work place or job design. Among the most common risky activities are as follows:

- Heavy loads
- Difficulty in gripping
- Excessive use of force
- Repetition
- Twisting and other awkward postures.

Some of these problems can be prevented in following ways:

1. **Manual handling of fabric rolls often close to machinery**, e.g. lifting to and from store room, in storage and dispatch areas, shelves, racks, trolleys and stillage, in quality control areas, reduces the risk of hazard.

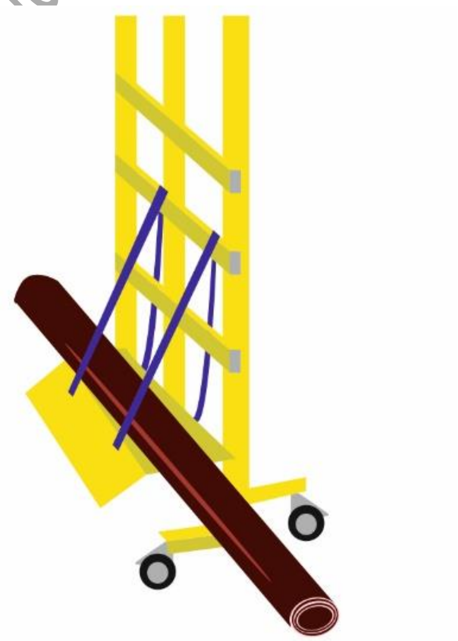


Fig.: 4.8 - Manual Handling of Fabric Rolls

a. Mechanical methods of handling the rolls, for e.g. on a conveyor and mounting on roller tracks.

b. Organize rolls according to weight, so that heavier rolls are stored at a convenient height for handling. Stackers with adjustable widths are ideal for lifting and lowering rolls in storage facilities. A roller track attached to the top of two support arms allows rolls to be passed easily to and from storage racks. The height of the trolley, which is supported by wheels, may be simply modified using a foot pump. The trolley is especially designed for transporting and moving rolls in the confined spaces of cutting section.

c. Rolls exceeding a specific weight can be routed to a truck pick-up point for loading, while lighter rolls are diverted to a manual pick-up station, where personnel can pick up the roll before bringing it to the vehicle.

Fig.: 4.9 – Mechanical handling of fabric rolls

2. **Handling loosely folded cloth at intermediate stages of the production process,** e.g. moving cloth to or from machines, inspection and quality control areas, including lifting to or from weighing scales.

   A lightweight ‘stretcher-board' can be utilised to reduce the distance through which the load is lifted as well as increase its stability and give a more uniform distribution of weight between two lifters. It also helps with grip and the ability to implement the proper force during the lift.

3. **Handling boxes** –It happens mainly in delivery and storage areas, loading and unloading from vehicles. Suspended overhead rail system allows the load to move freely within the storage area. Pneumatic grippers grasp the box securely and scales built into a roller conveyor to compensate for the weight of the load, allowing it to be moved with minimal effort. The device can be adapted to suit a range of different items and containers. Use of mechanized procedures reduces the risks.

4. **Lifting to and from bins, stillage, trolleys and machinery**- Trolley fitted with a self-leveling base can be used. As the material is removed, the suspended base rises, maintaining a constant height from which to lift an inner lining thereby preventing material from being caught in the springs.

5. **Working around machinery**- Use a mechanical handling device suspended from an overhead support or rail that grabs the package's centre and assists with lifting and manoeuvring by balancing and supporting the load.

6. Maintenance tasks can lead to some of the most hazardous handling operations. Flexible multi-purpose handling devices like tool-box trolley can be more practical during machine installation to minimize repetitive lifting of heavy loads at work place.

7. Do not attempt to lift by bending forward. Bend your hips and knees to squat down to load, keep it close to the body and straighten the legs to lift.

8. Any heavy object should never be lifted above shoulder level.

9. Avoid turning or twisting of body, while lifting or holding a heavy object.

10. **Work safely at height or in a confined space** -Plan work to be carried out at height. Plan steps to reduce the risks of all falls liable to cause personal injury or to anyone on the premises / site, e.g. employees, visitors and contractors. Make sure roofs, working platforms and walkways are safe.

MAINTENANCE OF TOOLS AND EQUIPMENT

A competent employee must regularly inspect, test and maintain the machine's guards and safety control system with reference to manufacturer's instructions. This will ensure the reliability and integrity of the safety system.

Maintenance and repair program should specify -

1. Where, how much, what type of and how often servicing is required?
2. Responsible worker for conducting the repair and maintenance program.

3. What standards to be used for performance testing and evaluation?

4. Program should be reviewed regularly to ensure their effectiveness. Develop, implement and maintain an accurate record of maintenance.

Following are the suggestions for Maintenance of machinery and tools

1. Carry out cleaning according to schedules and limits of responsibility.
2. Workers should take all practical steps to make sure all hazardous machineries are switched-off, before any cleaning or maintenance is done and whether it is safe to clean, maintain and repair. Standard procedures must be followed by trained workers for these activities to be performed safely.
3. Establish and follow a safe work system.
4. The machine should run at the slowest practical operating speed for cleaning, loading and setting up.
5. Restrict access and control of danger areas to one person only.
6. Emergency stop controls can be set within immediate reach.
7. Employers should maintain and keep machinery in sound operating condition at all times. They can manage the maintenance using:

   a. Preventive maintenance schedules.

   b .Regular inspections.

   c. Unsafe condition reports and feedback.
8. Carry out running maintenance within agreed schedules.
9. Carry out maintenance and cleaning within one's responsibility.
10. Report unsafe equipment and other dangerous occurrences.
11. Ensure that the machine guards are in proper place.
12. Use correct lifting and handling procedures for the tools and equipment.
13. Store cleaning equipment and tools safely after use.

Activities

ACTIVITY 1

Visit a Garment manufacturing firm, discuss with the safety officer / team and prepare a report on safety measures adopted by them.

Materials Required:

1. Writing material
2. Ruler

3. Adhesive
4. Camera for clicking pictures

Procedure:

1. Make a group of 4 students each.
2. Visit a garment manufacturing firm
3. Enquire about its safety measures.
4. Prepare a report of your observation with pictures.
5. Submit the report to the teacher for evaluation and feedback.

Check Your Progress

A. Write TRUE/FALSE the following:

1. People who rush around in the work area tend to decrease the likelihood of an accident.
2. Accidental cuts can be prevented if the expertise of using a cutter has been mastered.
3. Equipment mounting brackets, signages and control boxes can not be checked regularly to see if sharp edges are present.
4. Mechanical material handling equipment such as forklifts and hoists, can reduce injuries caused by lifting heavy lifts.
5. Workers should take all practical steps to make sure all hazardous machineries are switched-off, before any cleaning or maintenance is done and whether it is safe to clean, maintain and repair.

B. Write short answers for the following:

1. Enlist precautions which are taken while handling sharp objects.
2. What is safety? Why is safety important while working with machines?

Session 4: Effective Oral and Written Communication at Workplace

Effective Oral and Written Communication not only helps in communicating one's thoughts clearly and concisely, but also to create focus, energy, and passion. Clear messages help to build trust and integrity between the writer and the reader. Well-written communication helps to define goals, identify problems and arrive at solutions. Employees must clearly write and talk so that other staff understand the situation without confusion.

Effective writing allows the reader to thoroughly understand everything that one is not able to say. Listening, reading, writing and talking are collectively known as effective communication skills. Good communicators have a wide range of skills and are able to adjust their communication style in response to the many variables they face at a given time.

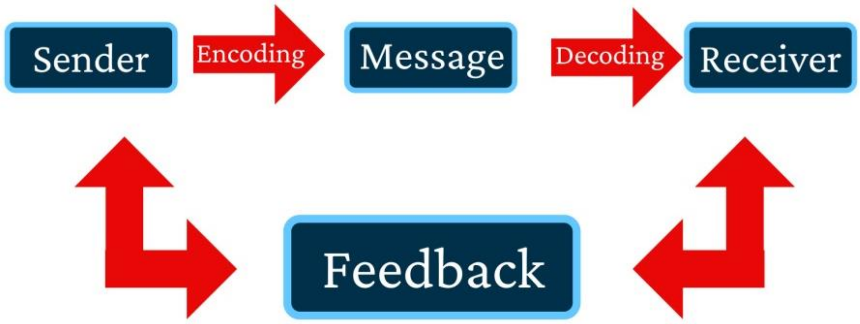


Fig: 4.10 – Communication Process

The Communication Process includes the following:

1. Sender

The sender bears the responsibility for ensuring that the message is understood and that the expectations for deliverables are clear. The sender should also consider any obstacles that may prevent the recipients from understanding the message. Languages, ethnic cultural beliefs, degree of education, and/or experience are all barriers.

2. Message

Verbal, non-verbal and written communications are affected by the sender's tone and method of communication. While sending a written message, the sender must be sure that it is professional, precise, clear and in simple language. Written communications are open to interpretation by receiver. Proof the written communication for typographical errors, grammar, punctuation and sentence structure to reduce the chances of miscommunication.

3. Method and Environment

Messages are conveyed through channels. These channels are affected by the method and environment which is chosen to communicate. All written communications are one-way communication, as there is no opportunity for people to ask questions, provide feedback, express concern or gain clarification during or immediately after communication.

4. Receiver

Messages are delivered to the concerned receivers. Receiver enters into the communication process with ideas and feelings that influence his understanding of the message and send their response.

One of the indicators of a high-performance culture is open communication in the workplace. Workplace communication is the process of exchanging information and ideas within a company. Effective communication, on the other hand, occurs when a message is sent and received correctly.

a. Effective communication at workplace is centre of all business goals. Its benefits are:-

- It avoids confusion
- It provides purpose
- It builds a positive company culture
- It creates accountability

b. Skills that employers mostly seek are:-

- Oral communication
- Listening
- Written communication
- Public speaking
- Adaptability

c. The importance of good communication at workplace:-

At all levels of an organisation, effective communication is critical to attain productivity and maintaining healthy relationships. Employers who devote time and effort to establish open lines of communication will quickly gain employee trust, resulting in increased productivity, output, and morale. Employees should be able to effectively communicate with their co-workers, managers, and customers. The message is the outcome of the encoding, which takes the form of verbal, nonverbal, or written language.

THE LINES OF COMMUNICATION, AUTHORITY AND REPORTING PROCEDURES AT WORK PLACE

Lines of communication can include a chain-of-command that requires employees to communicate only with their direct superior. Workplace communication is the process of exchanging information and ideas, both verbal and non-verbal, between one person/group and another person/group within an organisation. To establish and manage, various lines of communication within a business is essential so that all workers and managers can contact the communicator, for example a manager communicating to an employee and an employee to a customer.

Protocol is a set of guidelines regarding the chain of command for how various members of an organisation must communicate with each other.

1) Owner to Manager

The company owner provides directions to manager as well as any update or news he wants to give employees through manager.

2) Manager to Employee

Managers must delegate specific duties to workers and provide directions about work projects. A manager commonly communicates through regular meetings with the entire department. Manager may also schedule yearly employee review sessions with individual workers to discuss performance and productivity.

For example a flow chart of reporting and conducting maintenance in an industrial set-up is given as below:

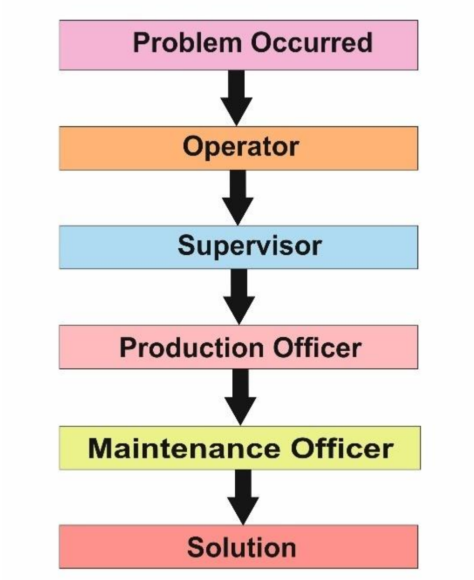


Fig.: 4.11 - Flow Chart of Maintenance

3) Employee

A line of communication is also established between employees / managers and outside business contacts. Certain employees of a manufacturing unit may have to communicate directly with representatives of companies to supply raw materials, submit orders or request information.

4) Communication with Customers

Possibly the most important line of communication at a business is between the employees of a business and its customers. In some cases, certain employees are authorized to speak to clients for business contacts.

Reporting procedures at work place

Effective communication in the workplace is imperative in a leadership role. Having effective communication skills is the key to good leadership. In turn line of communication begins in descending order, i.e. reporting procedure begin from customers to employee, employee to supervisor, supervisor to manager and from manager to industry owner.

Ways of reporting procedures for effective communication at workplace are as follows:-

1. Open Meeting

It is easier to communicate in the work place situation via open meetings. In this kind of forum, workers will hear, see and feel it. This oral communication is one of the best approaches to communicate effectively with a team.

2. Emails

In official settings, written communication via email remains potent. It will enable to pass messages to the members of the team without pulling them out of their workstations.

3. One to One

Workers understand better when we talk to them on a one-to-one basis. Ensure to maintain eye contact with them to enable the message to sink in.

4. Create a Receptive Atmosphere

To effectively communicate with the team, one must create an interesting atmosphere which is open for communication.

5. Display Confidence and Seriousness

Ensure that one must display confidence and seriousness because if team members notice any uncertainty and lack of seriousness while communicating with them, they are likely to treat the information with disregard.

6. Use Simple Words

To be effective in the communications with the team members, use words that are easily understood.

7. Use Visuals

Place visuals at strategic positions around the work place of the team. Delivering messages both through sight and sound gives room for better comprehension.

8. Listen to the Team Members

Encourage team members to open up so that the leader can be well informed while communicating with them.

9. Use Body Language

The message will be conveyed much more quickly and effectively through body language. When communicating with your team, master the skill of utilizing body language. Smiles, handshakes, and eye contact should all be used.

10. Use the Appropriate Tone of Voice

Use the appropriate tone of voice to communicate the message to the team so that the message is not misunderstood and discourage / frighten the receivers. Voice modulation in such scenarios help to be beneficial.

11. Be clear

Being clear to communicate to the team members makes it easier for them to understand the message. Make a message to the point for better comprehension. Keep the focus of point to be conveyed straight forward.

12. Encourage Feedback

Do not just talk and walk away, give room for feedback so that one can measure the effectiveness of the style of communication. It will also afford the privilege of knowing if the message was well understood.

13. Gesticulate

Use the hands to demonstrate the message. Make hand motions and signals to establish the seriousness of the subject matter while communicating with the team members.

14. Be Appreciative

Always remember to thank the listeners for their time after each communication session. Working hard on these communication strategies and establishing ground rules to keep everyone up to date will ensure a smooth project conclusion. Lines of communication make it easier to not only express the information effectively, but also to respond quickly in order to avoid missed opportunities or late work delivery.

THE IMPORTANCE OF COMPLYING WITH WRITTEN INSTRUCTIONS

A written communication is always put into writing form and used when the audience is at a distance or when record is required or where its preservation is essential and required as an evidence. It is in the form of instruction, orders, rules and regulations, policies, procedures, posters, memos, reports and information bulletins.

1. The importance of written instructions is mentioned as below:
   a. It keeps evidence of what has occurred or what was stated.
   b. It keeps permanent record for future use.
   c. It reduces the chances for misinterpretation and distortion of information.
   d. It is more reliable when transmitting lengthy information on financial, production or other important data.
   e. It provides an opportunity to put up their grievance in writing and get it supported by facts.

2. Comply with industries written instructions
   a. Carry out work functions in regulatory and accordance with legislation and organisational regulations, guidelines and procedures.
   b. Seek and obtain clarifications on policies and procedures, from the authorized person.
   c. Apply and follow the policies and procedures within work practices.
   d. Provide support to the supervisor and team members in enforcing these considerations.
   e. Comply with health and safety and security related instructions applicable at workplace.

f. Use and maintain personal protective equipment as per protocol

g. Carry out own activities in line with approved guidelines and procedures.

3. Writing Care Instructions

Care instructions should be written in the form of notices or signages to help employees remind of care or caution to be followed with regard to machinery or wet floor or any hazardous situations.

Equipment operating procedures / manufacturer's instructions

The manufacturer of machines, as well as the operator, both should take all technical and organisational measures, in order to ensure the safety of machine operators. It includes the general rules for approaching safety issues that should be taken into account by machinery designers in the design process e.g. inherently safe design, safeguarding and protective measures, information for use, mode of application, conformity assessment procedures etc. Use of machine operating manuals should be encouraged to employee designated to use particular machine.

Implementation of safety measures by the manufacturer

The manufacturer of machinery should eliminate hazards or reduce risks associated with these hazards by applying safety measures in the following order:

1. Inherently safe design

Hazard can be eliminated through the right choice of the machine design and features and minimizing personal exposure to hazards, through reduction of the number of un-necessary interventions within the danger zones. All accessible parts of the machine should have no sharp edges, sharp corners, rough surfaces, protruding parts, etc. Many hazards of the machine can be eliminated by means of choosing proper shapes and employing proper arrangement of mechanical parts.

2. Safeguarding

The hazards that cannot be eliminated using the inherently safe design approach should be reduced by means of the application of guards or protective devices. Covers, doors, fences, etc. also perform guarding functions. Guards should be difficult to remove or switch off, situated at a proper distance from the danger zone and allow performance of required operations like installation, tool changing or maintenance, guard locking, providing only limited access to the area where the operations are to be performed and without the necessity for removal.

3. Protective device

Protective devices that do not create actual physical barriers perform their protective functions by means of generating a signal that stops a dangerous motion of a given machine element. When it is impossible to apply guards, sensitive protective devices are used to reduce risk. There are several types of these devices. Optoelectronic protective devices such as light curtains, scanning devices like laser scanners and pressure-sensitive devices, mats, trip bars, trip wires etc. are often used.

4. Functional safety of machinery control system

If failure of a control function performed by a control system can result in an immediate increase in risk, then this function is named a "safety function". Generally, safety functions can be implemented for the reduction of risk associated with the improper machine operation, failure of technological processes and mechanical hazards.

The safety functions included in manufacturer's instructions are:

a. Safety-related stop function initiated by a safeguard
b. Manual reset function
c. Start/restart function
d. Local control function
e. Muting function
f. Monitoring of safety-related input values
g. Response time
h. Monitoring of safety-related parameters such as speed, temperature or pressure
i. Reaction to fluctuations, loss and restoration of power sources.
j. Common cause failure factor
k. Components and elements to achieve emergency stop function
l. Measures for escape and rescue of trapped persons
m. Measures for isolation and energy dissipation
n. Provisions for easy and safe handling of machines and parts
o. Measures for safe access to machinery.

5. Information for use

Despite the adoption of measures for inherent safe design, safeguarding and protection, the user is informed about machine design and their parts, running and maintenance of machine.

a. The information may be in the form of accompanying documents and instruction manual, on the machine itself, on the packaging and by other means, such as signals and warnings outside the machine. Information and warnings on machinery is provided in the form of readily understandable symbols or pictograms. The operator must have facilities to check the operation of the warning devices all the time.

b. Visual signals, such as flashing lights and audible signals such as sirens may be used to warn of an impending hazardous event, such as machine start-up or over-speed.

c. All the necessary markings on machine itself

- For unambiguous identification,
- In order to indicate compliance with mandatory requirements,
- For safe use.

d. The instruction handbook or other written instructions includes all information for safe commissioning, operating, adjusting and maintenance of the machine.

e. Implementation of safety measures by the user of machinery and work equipment. Work equipment should be properly adapted to the work without impairment to their safety or health.

6. Additional safeguarding

The employer should ensure that work equipment is installed, located and used in a way ensuring that the risks to the operators and other workers have been reduced. In particular, sufficient space between moving parts of work equipment and fixed or moving parts should be allowed with movable guards or protective devices.

7. Use of personal protective equipment

Technical safety measures comprise personal protective equipment. These are devices or equipment designed to protect worker against single or multiple risks that may affect health or safety at work.

Personal protective equipment also comprises,

1. A unit constituted by several devices or appliances which have been integrally combined by the manufacturer for the protection of an individual against one or more simultaneous risks, e.g. a helmet coupled with a visor and/or hearing protection.
2. A protective device or appliance combined or separately, with personal non-protective equipment worn or held by an individual for the execution of a specific activity e.g. clothing or knee protectors included in trousers used for performing work while kneeling.
3. Personal protective equipment should include the items such as:

1) Clothing - Well-fitted pants and jackets with all buttons fastened. Sleeves should be close fitting, hair nets and Aprons made of non-combustible and flame-resistant materials.

2) Footwear – Approved and sturdy footwear with non-slip sole and a closed toe and closed back.

3) Hand protection - Natural rubber latex gloves, synthetic rubber gloves, and vinyl gloves or thick plastic gloves.

4) Eye protection - Safety goggles or masks

5) Respirators - Properly fitted to provide the best protection from inhaling harmful fumes or vapours.

8. Work organisation and procedures

Proper work organisation is important in ensuring safe operation of the work equipment. All operations should be performed according to established safe working procedures. The employer should take necessary measures to ensure that the use of work equipment is restricted solely to persons given the task of using it. Written permission for conducting high risk works should be issued namely, repairs, modifications, maintenance or servicing.

SUGGESTIVE STANDARD OPERATING PROCEDURES OR INSTRUCTIONS

a. SOP for machine inventory including spares, tools and tackles.

- Receipt of material against packing list/indent.
- Machine taken for installation as per requirement.
- After installation machine is numbered. Record is to be maintained in Asset register / computer excel sheet.
- Machine is not issued to production until the numbering is complete.

b. SOP for machine installation

- Arrange the related person from agencies to install the machine.
- After installation arrange to train production from company technician.
- Hand over the bobbin/bobbin case or related material use to run machine to production department.

c. SOP for maintenance of utilities - air/water/steam related

- Making indent for materials for installation.

- After receiving of materials from vendors, installation from vender.
- Looking After the maintenance of Steam Generator and Air compressor.
- Operating of steam generator and air compressor in shift timing.

d. SOP for machine's preventive maintenance

- Preventive maintenance schedule is prepared.
- As per schedule, preventive maintenance is done and record is maintained
- All weighing scales shall be calibrated once a year and certificate is obtained.
- Maintenance department shall inform the purchase department regarding renewal of AMC (Annual Maintenance Contract) at least 1 month prior to its expiry.

e. SOP for machine breakdown maintenance

- Breakdown intimation is received from concerned department.
- Breakdown maintenance is done considering type of fault.
- Record of breakdown maintenance is maintained in the breakdown maintenance register.
- Electrician repairs all electrical faults and maintains a register for electrical repair and breakdowns.
- A machine history record shall be maintained for all machines.

f. SOP for calibration of measuring instrument &Light Illuminations record

- Any machine having measuring instrument should be calibrated yearly.
- The calibration check list shall be maintained for all such instruments.
- The maintenance in charge shall keep the certificates of calibration in a file.
- Actual date of calibration shall be maintained in the machine history sheet.
- Monthly light illumination shall be recorded in all working area on the production floor.
- At least once in 6 months, illumination checking is done and record is maintained

Activities

Activity 1:

Prepare a graphical poster on SOP instructions.

Materials Required:

1. Writing material
2. Ruler
3. Adhesive
4. Camera for clicking pictures
5.

Procedure:

1. Based on your understanding, prepare a graphical and interactive poster on SOP instructions.
2. Display the same in your class.

Check Your Progress

A. Fill in the Blanks:

1. Well-written ________________helps to define goals, identify problems and arrive at solutions.
2. Verbal, non-verbal and written communications are affected by the sender's _____________and __________________of communication.
3. Use of __________________manuals should be encouraged to employee designated to use particular machine.
4. When it is impossible to apply guards, _____________________devices are used to reduce risk.
5. Written permission for conducting high risk works should be issued namely, _________________________or servicing.

B. Write short answers for the following:

1. Which are the ways to create effective communication at workplace?
2. What are SOPs? Briefly enlist SOP for maintenance of a needle detector machine.

Module 5	Health, Safety and Security at Workplace

Module Overview

Health, safety and security are one of the most important aspects of human concern at the workplace. Therefore, we should aim at building a working environment which provides and maintains highest degree of physical, mental and social well-being for workers in all occupations.

Industries and organisations should focus on health and safety related practices at workplace and should ensure availability of all the basic facilities like safe and clean drinking water, clean rest rooms, proper ventilation and lighting facilities etc.

With the advent of technical advancements in the form of imported machineries and others services in the apparel industry, we should give more emphasis on the principles of ergonomics and occupational psychosocial factors.

Thus, the benefit of maintaining occupational health, safety and security are:

i. Reduced work related injuries

ii. Make the working conditions healthy and safe in the interest of workers, employers, as well as the public/society at large

iii. Reduce the risk of potential accidents and emergencies

iv. Preparedness with suitable responses to accidents and hazards

Hence, workers should be trained to identify and report to seniors/supervisors or any other authorized personnel in case of any malfunctions in machinery and equipment's, emergencies and take necessary corrective actions for the same.

Learning Outcomes
After completing this module, you will be able to: • Defining standard Compliance for Organization • customer specific regulations • Specific to the industry/sector, know and understand and ethical requirements and compliances • Reporting procedure in case of deviations • Identify and implement safety measures at workplace.

Module Structure	
Session-1:	Compliance to health, safety and security requirements at workplace
Session-2:	Potential safety risks and emergencies
Session-3:	Identifying and reporting malfunctions in machinery and equipment or any other hazard at workplace
Session-4:	Reporting emergency situations

Session 1: Compliance to Health, Safety and Security Requirements at Workplace

Safety and security of the workplace greatly depends on the enforcement of safety policies and rules of the industry which also ensures compliance with health and safety standards. Compliance is obtained through specific efforts made to reduce the risk of potential hazards and accidents at the workplace.

It is increasingly observed that the health, safety and security of workers are subject to a variety of risks. Inculcation of safety culture in the working environment along with strict guidelines on safe work procedures significantly reduces the risk of potential hazards/accidents.

HEALTH AND SAFETY RELATED PRACTICES APPLICABLE AT WORKPLACE

Apparel industry is a labour oriented industry. Workers are the main resources and all companies must follow certain practices applicable at workplace for maintaining health and security of their workforce.

Following points must be taken care–

- Ensuring availability of fully stocked first aid boxes at every designated location according to the floor plan/layout.
- Fire extinguishers should be placed at clearly marked areas at regular intervals

Fig.: 5.1 (a & b) - HEALTH AND SAFETY RELATED PRACTICES

- It is advisable to maintain an accident register. This helps in record keeping of various accidents, their causes and the damages. The information in accident registers can be useful in prevention of accidents in future.
- Factories should ensure proper positioning of emergency lights on work floor leading the pathway to exit.
- It is essential to ensure that all fire-fighting equipment such as extinguishers are regularly inspected and kept in good working order.
- Exit signs should be clearly marked and displayed.

Fig.: 5.2 – Exit Sign

- Yellow lines should be marked on the factory floor to demarcate the pedestrian pathway from the space allocated for machines.

Fig.: 5.3 – Yellow Demarcation for Pedestrian Pathway

- Aisles should be designed wide enough and should not have any obstruction in between to prevent any accidents during movement of men and material.
- Cables /Wires should never be left loose or visible hanging at the floor.
- Proper lighting with well-distributed artificial light to ensure effective use of available daylight should be arranged.
- Good general ventilation plus local exhaust ventilation to remove air contaminants at the source should be ensured.
- A clean lunch room commonly called as canteen area for employees to have their meals should be allocated.
- Oily floors are a common cause of accidents and fire hazard. Splash guards and drip pans should be installed wherever oil spills or drips may occur. Prevent accidents by keeping oil and grease off the floor.
- Adequate supply of clean and pure drinking water must be ensured for all workers.
- Workers should be encouraged to use mask and gloves wherever required.
- Provision must be made for clean washrooms/restrooms for workers and staff members
- Mock drills must be performed with the workers at regular intervals for them to be prepared in case of any spills, fire, and explosion.
- It is advisable to carry out the regular maintenance of the factory if something gets broken or damaged. It must be ensured that same be replaced or immediately corrected/fixed, for example - defective ladders, broken handrails, steps, etc.

- Factories should have a provision of regular maintenance programmes like inspection, lubrication, upkeep and repair of tools, equipment, machines and processes.

Compliance to health, safety and security requirements at workplace will help in eliminating risk related to potential accidents and hazards caused by unfavourable conditions and thus, will lead to efficient, smooth and uninterrupted production cycle and safe and secure work environment.

ACCESS TO CLEANDRINKING WATER AND SANITARY FACILITIES

Welfare facilities like access to clean drinking water, hygienic and well ventilated wash rooms or rest rooms are a vital part of good working conditions in an industry.

Clean Drinking Water

Provision of safe and clean drinking water, beverages or an adequate meal is mandatory for a healthy workforce.

Availability of clean drinking water is indispensable for all workers. Mostly in hot weather conditions a lot of water is lost from the body in the form of sweat or evaporation. If appropriate arrangements are not provided then the workers might have to make the arrangements by themselves or leave the workplace often in search of clean and safe drinking water.

In case of impure or contaminated water being made available for the workers, it can be a cause of frequent transmission of diseases among them. If the workers get dehydrated, they can be tired, exhausted or fatigued and will be less productive in their outcome. Thus, provision of clean and pure drinking water should be made near the workstations. Preferably, cool drinking water must be provided specially in hot weather conditions. For example - Arrangements of water coolers or water dispenser with clean and cold drinking water can be done at regular intervals near the workstations.

Sanitary Facility

All industries must ensure appropriate sanitary facilities for workers within the working premises. Hygienic and disinfected toilets/restrooms are very important. It is also requisite to equip adequate number of washrooms as per the number of workers/staff working in an industry and ensure their maintenance and cleanliness.

To ensure mental and physical well-being of workers and to prevent spread of any diseases within the working premises, it is vital to have proper sanitary facilities. These facilities also helps in improving rate of production as healthy workers are more efficient in their working and it simultaneously leads to lower rates of absenteeism within the workforce.

Therefore, developments in sanitary facilities should be undertaken and materials incorporated should be durable, easy to clean and quick drying likes tiles. Frequent cleaning and maintenance of toilets is also recommended.

The following points must be considered

i. Sanitary facility must be within easy access from the work site.

ii. These facilities must be well enclosed, well lit and adequately ventillated.

iii. Proper supply of toilet paper and other hygiene supplies must be ensured.

iv. It must be equipped with a covered garbage bin.

v. Hand claning facility like a wash basin along with soap and a sanitary way to dry hands must be installed in every single toilet facility.

Activities

ACTIVITY 1

Prepare a report on various types of health and safety related practices applicable at a work place. Place it a file and submit the same.

Materials Required:

1. Writing material
2. Adhesive
3. Ruler

Procedure:

1. Visit an apparel industry, learn and understand about the health and safety related practices being followed.
2. Make a report on the same.
3. Submit the report in your class.

Activities

A. Fill in the Blanks –

1. _______________________, safety and __________________are one of the most important aspects of human concern at the workplace.
2. ________________________ should be placed at clearly marked areas at regular intervals.

3. Factories should ensure proper positioning of ____________________lights on work floor leading the pathway to exit.
4. _______________________ floors are a common cause of accidents and fire hazard.
5. ______________________ leads to lower rates of absenteeism within the workforce.

B. Write short answers for the following –

1. Mention points that must be taken care for maintaining health and safety related practices at workplace. (Any Five)
2. Write about the importance of having access to clean drinking water and sanitary facilities at the workplace.

Session: 2 Potential Safety Risks And Emergencies

Safety risks are chances of any detrimental or unfavourable result/outcome or anticipated losses (For example – Deaths or injuries caused due to malfunction of a machine in a factory) caused due to natural or human induced causes.

Emergency is an unforeseen and unexpected incident demanding instant/immediate response. It may be caused due to natural, technological or human causes/forces.

Preparedness against any potential safety risk or emergency is essential to protect the workers against any damage of life and property. The impact of any emergency crisis can be substantially reduced by active participation of employees and employers in safety related practices at workplace.

RESPONSE TO POTENTIAL ACCIDENTS AND EMERGENCIES

Ergonomically designed work areas have several benefits like:

- Increased human comfort
- Reduced stress and fatigue
- Increased workers rate of production
- Reduced risks of potential accidents/hazards.

Some of the factors that must be considered to be prepared are as follows –

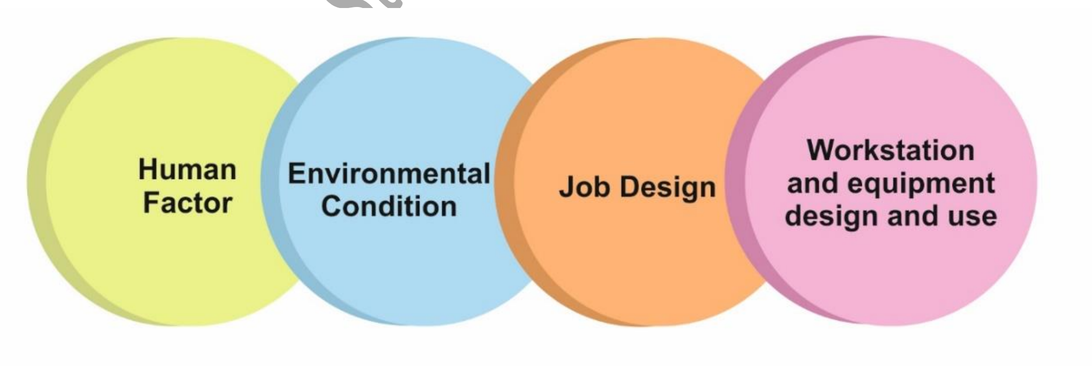


Fig.: 5.4 – Factors Responsible for Potential Accidents

- **Human factors**

  Major human factors that affect are:

  - Physiological
  - Psychological

- Physical
- Cognitive

Human factors mostly include all physiological and psychological factors. Workers dimensions like reach, posture and strength must be considered while considering the human factors. Physical injury can cause a negative impact on employee's work performance and lead to increase cases of absenteeism. Cognitive factors equally affect the job performance. For Example – Lack of proper guidance and feedback from supervisors or lack of autonomy can often cause stress and result in lack of motivation among workers to perform well.

- **Environmental conditions**

Environmental Conditions in particular like proper lighting facilities, sound & vibrations, extreme temperature, humidity and poor air quality may affect the workers performance. Undesirable and unpleasant levels of a fore mentioned condition can be detrimental to workers health and safety.

- **Job Design**

A job must be designed keeping in mind the anthropometric characteristics such as age, gender, height, weight and ethnic differences. Proper use of ergonomics is advised as tasks can be either static or dynamic. Static tasks need a sustained position which can cause stress and pain in the lower back, neck and shoulder areas. Whereas, dynamic tasks require continuous body movements, very fast movements can cause fatigue, pain, weakness and sometimes lead to injury if performed with excessive force. Poor job designs and lack of proper training to workers can often be cited as an underlying cause of injuries among workers.

- **Workstation & Equipment Design and Use**

A workstation should be designed keeping in mind factors such as workable heights, placement, reach, requirements and postures. Adjustable equipments make it possible to adapt it in accordance to individual requirements. Tools and equipments must also have flexibility of usage and it should not force the workers to use an unnatural body posture or motion while using it. All equipments and workstation should work together in a well-coordinated system to ensure a smooth flow of production and safety of workers.

The following points are mostly the main sources of accidents at the workplace -

- Spills
- Slippery surfaces

- Obstructions (Unclear Pathways)
- Broken equipments/tools.
- Machineries which are not regularly checked/maintained and kept unrepaired.
- Areas lacking safety signages (Fire and Emergency Exits)

Therefore, workers and employers must take collective active measures to adhere to an accident prevention plan. The following points must be considered to strengthen the safety practices at work and be prepared with response to any emergency situation –

1. Regular programmes and training sessions must be conducted on safety related practices at workplace for workers. It can be held in the form of mock drills for evacuation during fire hazards or any chemical spills, quick response training during accidents/emergencies etc.

2. Ensuring installation of proper lighting system, to have a well-lit and clear visible job site/ workstation, to avoid any potential risk associated with darkness around the workplace.

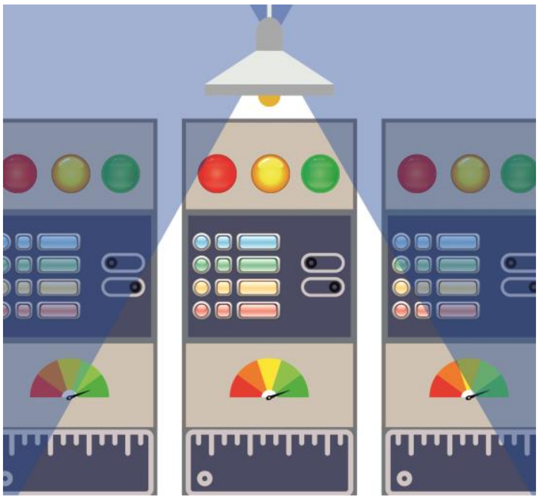


Fig.: 5.5 – Proper Lighting System

3. Clearly visible and demarcated safety signs must be placed/ installed wherever necessary, which will help in clear identification of hazardous areas and associated risk like obstacles in pathway, toxic chemicals being stored, slippery floor, emergency exit doors etc.

4. In case of a chemical or any hazardous spill, ensure to always suppress and hold the spill and always keep the cleaning equipment at an easily accessible location.

5. Ensure to conduct routine audits and checks for all potential safety hazards and emergencies to prevent any actual loss.

6. In case of an emergency/ accident, evacuate the premises and helps fellow workers in need.

7. Proper ventilation facilities must be ensured throughout the working place to avoid inhalation of any toxic chemical or foreign particles by the employees at the time of any chemical leak.

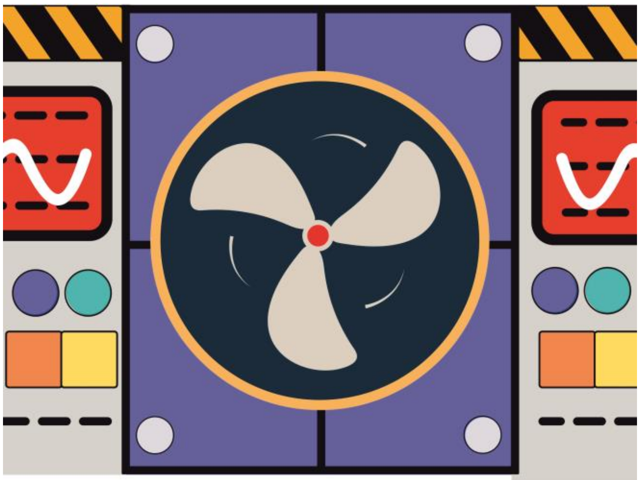


Fig.: 5.6 – Proper Ventilation System

8. Workers must be instructed to follow all the rules with regards to the attire/uniform permitted for their job role. For example- Workers working in the dyeing unit must wear slippage resistant shoes to prevent any fall or trips which can lead to injury.

9. Employees in an apparel or home furnishing industry need to spend long hours in the sitting posture which can cause soreness in back and reduced circulation in legs. Therefore, to avoid any pain or injury, adjustable chairs must be provided to ensure easily adjustable heights, seat tilt and backrest positions.

10. Chairs with a cushioned/contoured seat, which distributes the worker's weight ensuring no body part feels all the pressure must be preferred.

11. To minimise awkward body postures, chair should also be placed at an appropriate distance from the workstation, so that the workers can perform their tasks without stretching their elbows away from the body.

12. Workstation design must ensure that all the tools and materials are positioned to reduce risk of tilting too far or leading to an awkward body position. It can increase the level of stress/strain in arms, shoulders and the neck. This greatly increases the risk of injury which can be avoided by proper preventive actions and adhering to ergonomically designed principles of work.

13. Workers who need to stand for prolonged hours must be provided with anti-fatigue mats. These mats help in better circulation and reduce fatigue in lower body parts.

14. Emphasis should be given on frequent short breaks to stretch and change body positions. It allows legs, beck, neck and eyes to rest in between long working hours. Shorter breaks often reduce the risk of discomfort, fatigue and injury among the workforce.

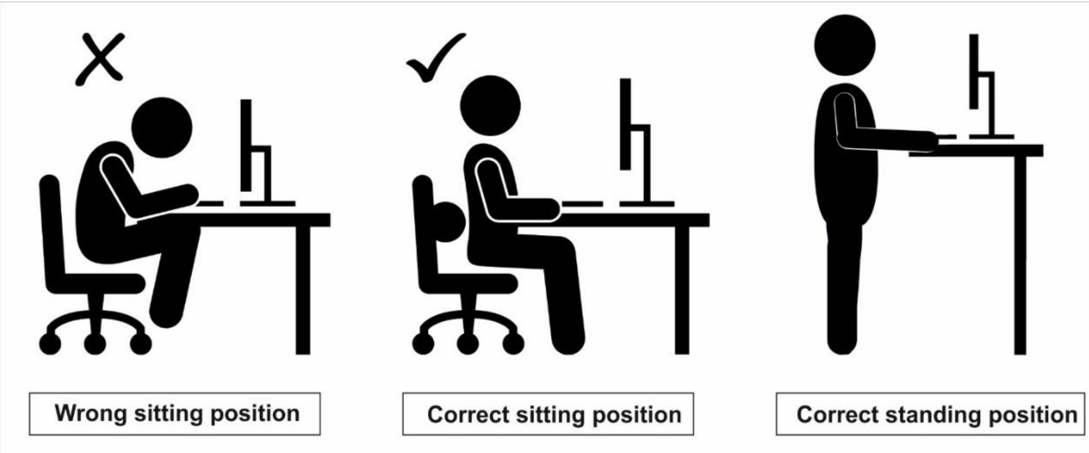


Fig.: 5.7 – Correct Body Positions

MAINTENANCE AND STORAGE OF PROTECTIVE EQUIPMENTS

An effective system of maintenance and storage of protective equipments and tools is crucial to provide the level of protection they are intended or designed for. Therefore, one must always maintain an inspection schedule for all the protective equipments and tools including its shelf life. Inspection must include thorough check against any breaks, tears or any other visible sign of damage.

Maintenance also includes cleaning, examining, repairing, testing and replacing (in case it cannot be repaired) tools and equipment on a scheduled basis. Some Examples of Protective equipment are – Gloves, masks, protective helmet, safety shoes/boots, protective eye wear, ear plugs etc.

Adequate and proper storage facilities for storing of all protective equipments and tools when not in use is must. Employers must provide for a clean and safe place for the same. For example – Pegs for hanging clothing or safety helmets, case for safety glasses, a zip lock bags, shelves or racks for storing of ear muffs, gloves, masks etc.

The facility of storage must be appropriate and sufficient to protect the protective equipments from any kind of contamination, loss or damage due to coming in contact of water or sunlight. The place should be dry, clean and well sanitized and should also not be subjected to extreme temperatures.

It should protect the equipments against ageing and damaging. For hygiene purposes, one must consider separate storage from ordinary clothing storage in cases where protective equipments may become contaminated during use.

Duties of the workers in respect to protective equipments –

- All the protective equipments must be worn by the workers in accordance to the work requirements and instructions provided.
- Workers must ensure that all the protective equipments must be stored back carefully to their designated/ allocated storage areas after use.
- All the protective equipments must be inspected before use and any defect observed must be reported to the supervisor.
- It is the responsibility of the worker/employee to take due care of the protective equipments provided to them and do not make any modifications to the same them unless and until they are authorized and trained for its maintenance activities.

Fig.: 5.8 – Proper Storage Facility for PPEs

Activities

Activity 1

Prepare a chart with details of potential hazards and their possible solutions applicable at a workplace.

Materials Required:

1. Writing material
2. Coloured pencils/pens
3. Eraser
4. Ruler

Procedure:

- Collect information about the potential hazards and their possible solutions applicable at a workplace.
- Take a chart paper and prepare the chart by placing the collected information on it.
- Display the chart in your classroom.

Check Your Progress

A. Fill in the following blanks –

1. ____________________ is an unforeseen and unexpected incident demanding instant/immediate response.
2. _______________________ to a worker can cause a negative impact on his/her work performance and lead to increase cases of absenteeism.
3. A ________________________should be designed keeping in mind factors such as workable heights, placement, reach, requirements and postures.
4. To minimise awkward body postures __________________should also be placed at an appropriate distance from the workstation.

5. Shorter ____________________often reduce the risk of discomfort, fatigue and injury among the workforce.

C. State weather the following statements are True/False.

1. Tools and equipments should not have flexibility of usage and it should force the workers to use an unnatural body posture or motion.
2. Workers and employers must take collective active measures to adhere to an accident prevention plan.
3. Safety signs must not be displayed clearly.
4. Routine audits and checks for all potential safety hazards and emergencies are not necessary.
5. Workers must be instructed to follow all the rules in regard to the attire/uniform permitted for their job role.
6. Emphasis should be given on frequent short breaks to stretch and change body positions.
7. The facility of storage for protective equipments must be appropriate and sufficient to protect the protective equipments from any kind of contamination, loss or damage.
8. Workers must not ensure that all the protective equipments must be stored back carefully to their designated/ allocated storage areas after use.

Session: 3 Identifying and Reporting Malfunctions in Machinery and Equipment or any other Hazard at Workplace

Identification of malfunction in machinery/equipment or any other hazard at a workplace is an indispensable component of the health and safety management system. It is the first step in development of the safety procedures for prevention and controlling of any hazard.

A hazard is a source of any potential damage.

Identification of hazards includes the following:

- Identifying both existing and prospective workplace hazard
- Assessing or calculating the risks involved
- Determining and implementing the control measures
- Reviewing the situation

Workers must be trained to identify all the possible hazards associated with their job role and also know the control measures during an emergency situation to prevent any injury to people, property or environment from the same.

Workers must follow all the safety practices which comply with the standard operating procedures. They must regularly check/inspect the workplace, equipments, machines, tools for any abnormal changes, conditions or unanticipated emissions/leaks for identification of any perilous conditions. In case of an unsafe condition they must report them to their supervisor or authorized personnel and collectively work towards resolving the same.

Workers are exposed to various potential hazards while working near or on a machine. There is a risk of injury caused due to entanglement, friction or abrasion, cutting, stabbing or getting trapped in the moving parts of the machines. Therefore, it is suggested that workers must follow guidelines related to dress code/uniform/using protective equipments and safe working practices applicable while working near or on a machine.

Risk is also associated with noise, vibrations and radiations generated by the machines. Levels of the aforementioned must be monitored to prevent any health issues among workers. Workers must be also able to identify and report any sparks or loose fitting which can cause fire accidents or electric shocks, over speeding or under speeding of parts of machines etc.

The following points must be checked for identification of possible hazards linked with machines, equipments, tools and services –

1. Identify use of the machine by considering the following points-
   - Cycle time & rate of production.
   - Intended use of the machine.
   - Different types of materials being used on it.
   - Amount of force being generated.
   - Range of motion or moving parts of the machine.

2. Identification of space required by the machine for safe operation of **all** tasks including access for maintenance and repairs.

3. Identifying the environmental limits of the machine such as the operating temperatures, humidity levels, and noise generation level.

4. Consideration of all the tasks performed by and on the machine such as – trial runs including
   - Regular operations
   - Change of tools
   - Scheduled maintenance of machine
   - Recovery from crashes/timeouts.

5. Identification of operation/ motions of machine such as –
   - Parts of the machine which are movable.
   - Range of motion of moving parts.
   - Type of motion (e.g., rotation, shearing, bending, cutting, punching)

6. Identify the entanglement hazards of the machine that can be caused due to coming in contact with rotating or moving parts of the machine.

7. Identify hazards due to cutting, where a worker can come in contact with cutting tools, saws, routers, knives, or any other sharp material.

8. Identify any potential hazard due to slips or fall in and around the machine due to the spills on the floor surface such as lubricating oils, grease, water etc.

9. Identifying any ergonomic issues caused while operating the machine. Ensure the following -

- Workers do not have to reach exclusively.
- Workers do not have to use excessive force.
- Workers do not have to perform movements at a very high speed.
- Machine cycle must be planned in accordance with the workers capacity
- Workers can perform work in multiple positions that promote a neutral body position.
- Work surface is adjustable according to the workers requirements.
- Worker has enough room space to move without striking anything.

10. Identify all the work that a worker must perform while operating the machine such as -

- Feeding stock into the machine
- Removal of final products from the machine
- Removal of scrap
- Scheduled and regular cleaning parts of the machine.
- Pre and Post shift safety checks.

Therefore, it is advisable to identify, report and correct any prospective risk which can lead to a hazard at a workplace, thereby ensuring prevention and control of any injury or loss.

SAFETY SIGNS AT WORK PLACE AND THEIR MEANING

- **First aid:**

It is an emergency treatment given to a sick or injured person. The main aim of first aid is to preserve life, prevent from further harm or injury and to start the recovery process. A first aid kit is used in giving the first aid. The sign of first aid which is mostly used is as follows –

Fig.: 5.9 – First Aid Sign

- **Fire exit:**

This sign marks the way to nearest exit point during a fire accident.

Fig.: 5.10 – Fire Exit Sign

- **Assembly points:**

This signage marks the area where the workers need to assemble in case of any hazard or emergency.

Fig.: 5.11 – Emergency Assembly Sign

- **Fire equipment:**

This sign marks the location of storage area of firefighting equipments such as fire extinguisher, fire blankets etc.

Fig.: 5.12 – Fire Equipment Sign

- **Smoking ban signs:**

This signs mark areas/location where smoking is not allowed/prohibited.

Fig.: 5.13 – Smoking Prohibited Sign

- **Machinery Hazards:**

These signs mark the areas near the machinery where one needs to be cautious of his/her movements and actions for safety purposes.

Fig.: 5.14 – Machinery Hazards Sign

- **Hazardous substance:**

This sign marks the areas where any hazardous or toxic substance is stored.

Fig.: 5.15 - Hazardous Substance Sign

- **Pedestrian access and no access:**

These signs indicate where pedestrians can and cannot access respectively.

Fig.: 5.16 – No Pedestrians access Sign

- **Flammable substance:**

This signs denotes the location of any extremely flammable substance being stored there.

Fig.: 5.17 - Flammable substance Sign

- **Wet floor :**

This sign marks the areas with wet/ slippery floor to be cautious while crossing it.

Fig.: 5.18 - Wet Floor Sign

Activities

ACTIVITY 1

Prepare a report with pictures and details of all the safety signs applicable at workplace.

Materials Required:

- Writing material
- Pictures of safety signs
- Coloured pencils/pens
- Ruler
- Adhesive

Procedure:

1. Collect pictures and information about all the safety signs applicable at workplace.
2. Prepare a report with all the details.
3. Submit the same in your class.

Check Your Progress

A. Fill in the Blanks :

1. A ______________________is a source of any potential damage.
2. ______________________ of hazard is the first step in development of the safety procedures for prevention and controlling of any hazard.
3. _______________________ hazards of the machine can arise due to coming in contact with rotating or moving parts of the machine.

4. ________________________ is an emergency treatment given to a sick or injured person.

5. _______________________ signage marks the area where the workers need to assemble in case of any hazard or emergency.

B. **Write short answers for the following** –

1. Mention points to be considered for identification of possible hazards in a workplace. (Any Five)

2. Identify and name the following safety signs –

-  ....
-  ....
-  ....
-  ....

Session : 4 Reporting Emergency Situations

Identifying and reporting all hazards/emergency situations is of vital importance for the safety and security of the workplace. All such unsafe incidents must be immediately and directly reported to a supervisor or any other concerned authority. All the workers must be trained so that in case of any hazard or potential emergency situation, the standard procedure could be followed like reporting it to the supervisors expeditiously.

Employers must develop and set up a hazard reporting system for the workers. Implementation of such a system will make the workplace a safer and secure place to perform and work well.

All the workers must be trained in hazard identification and its control measures. They must be trained on the following points

- Identification of an unsafe condition – This involves recognising any incident that might cause harm or damage to the people, machinery, tools or property. For example -Containers that are not labelled properly, insufficient stairway lighting, broken machine guards **etc.**

- Identification of an unsafe act that must be reported – This involves any inappropriate behaviour that could lead to an accident/cause an injury or any other damage. For Example – Workerusing equipments in a careless manner or not using PPE while running a machine.

- Procedure followed if any unsafe condition is witnessed - Any such unsafe situation should be immediately reported to the supervisor. It can be in a form of a verbal complain, a hard copy of a form to be filled or an online complain system on the website of the company.

- Follow up action post reporting the incident – Workers must expect that the corrective and preventive measures will be taken within the expected time frame. In case of any delay, they must report it again till any necessary action is taken for the same.

Taking necessary preventive actions can save from potential injuries or any significant losses caused due to sheer negligence. Reporting of hazards ensures that employees are involved in the safety management system of the company and are aware of the safety guidelines followed in the company.

For making the reporting by the workers smooth and easy, the following points can be considered –

1. Making reporting procedures easy and possible.
2. Ensure that there is no negative impact or punishment linked with the process of reporting an emergency.
3. Workers who report the hazards or any unsafe incident should be rewarded or recognised for the same.
4. Posters or signs to encourage reporting of any unsafe practices at work can be placed within the work premises.

REPORTING PROTOCOL AND REQUIRED DOCUMENTATION

In case of any hazardous condition, all workers are responsible for reporting it to their supervisors. Supervisor is responsible to take corrective steps and in case of serious conditions, must fill the hazard reporting form along with the assistance of the worker. The following steps must be followed –

- Workers who identifies an emergency condition/concern must report to his supervisor immediately.
- The supervisor must respond promptly, take necessary actions to resolve the matter within the reasonable time limits.
- If the supervisor is not able to solve the situation, then he/she must report the matter to the manager or to concerned senior authority.
- The employee is responsible to draft a document/fill the form (Depending on the rules of the company) outlining the concerns and fact.
- The senior committee members will investigate the matter and ensure correction of the unsafe conditions.

The process of reporting the hazard immediately allows the workers to report the unsafe conditions immediately. This process allows a fast response and prevent further damage. Hazards can be reported verbally or by filling a form, generally called as a hazard reporting form.

Hazard reporting form is a document which is used to report an unsafe incident/ accident at the workplace and ensures that it has been reported formally and necessary corrective steps have been taken. It is used by the first line workers – such as factory workers.

Hazards Reporting Form

Use this form to report safety concerns

Employee Name	Employee Number
Department / Area	Supervisor Name
Describe Fully the safety concern or hazard:	
What can be done to make this situation Safe?	
YES	

YES	NO	Has the supervisor in that area been notified of the safety concern or hazards?
YES	NO	Has the maintenance team been notified of the safety concern or hazards?
Employee Signature		Report Date:

Fig.: 5.19 – Hazard Reporting Form

EMERGENCY RESPONSES DURING A HAZARD/EMEGENCY

Any kind of hazard or emergency can occur anywhere and at anytime. To prevent the amount of loss and damage caused due to such unwanted incidents, employers need to provide relevant training to their employees to be adequately prepared to deal with any undesirable circumstances.

Emergency response training can be very advantageous for the employees to acquire knowledge on how to respond to an emergency situation. Employees must learn life-saving skills and acquire knowledge to save themselves and co-workers during the course of any emergency.

It is advisable to designate roles and responsibilities to every employee in the form of tasks they must perform during an emergency and train them to be specialised to fulfil the requirements of specific roles, For example – specific employee may be trained to perform first aid in the event of any injury or specific group of employees must be trained to handle fire-fighting equipments in case of fire.

Details about the following equipments, people and locations must be displayed clearly at every workstation for reference for use during any emergency situations –

Location of emergency equipments -

- Fire alarm
- Fire extinguisher
- Fire hose
- First Aid
- Panic alarm
- Personal Protective Equipments

Emergency contact numbers -

- Fire station and employee trained in fix hazard handling
- Ambulance and first aid attendant
- Police
- Hospital

EMERGENCY RESPONSE PLAN

An emergency action plan involves allocating designated actions that all the employees need to take for their safety during an emergency situation. Some of the suggested actions to be taken in case of an emergency like a fire or chemical hazard, injury etc. are as follows –

- In case of a fire accident or a chemical spill, one must try to move quickly towards the nearest accessible exit door.
- Walk, do not run during an emergency and do not use elevators.
- Help other co-workers to evacuate along the way to exit.
- In case of fire, if the fire alarm does not ring automatically, try activating the alarm manually for notification of all other employees.
- Exit the building/factory premises and assemble in the allocated area of assembling during an emergency.
- If any person gets caught in fire then try to extinguish their burning clothes by using the drop and roll technique, dousing with some cold water and using an emergency shower or using a fire blanket.
- If caught in the area filled with smoke, then try and stay in lower positions as smoke will rise to ceiling level first. Drop down to your hands and knees and crawl toward the nearest accessible exit point.

Fig.: 5.20 – Emergency Response plan

- In case of any toxic spill or leak, alert all workers in the immediate area of spill.
- Wear your required personal protective equipments (PPE) like gloves, protective eye wear etc.
- In case of a minor spill try to contain the spill with spill absorbent material and clean the area where the spill occurred.
- Try to seek immediate medical help in case of any exposure to the spill contents.
- In case of a chemical exposure to the skin or eyes, try to immediately clean it with cool water for at least 15 minutes.
- Do not attempt to move or reposition a victim in case of a muscle, joint or bone injury, sprain or fracture as it can further deteriorate/worsen the condition.
- If there is any open wound injury or bleeding wound, then try to cover the wound with dressing/first aid at the earliest.

Activities

ACTIVITY 1

Prepare a sample report of an emergency situation at the workplace.

Materials Required:

- Writing material

- Ruler

Procedure:

1. Study an emergency situation at a workplace.
2. Prepare a sample report of the emergency situation.
3. Submit the same in your class.

Check Your Progress

A. Fill in the Blanks:

1. All unsafe incidents must be immediately and directly reported to a ______________________________.
2. ______________________________training can be very advantageous for the employees to acquire knowledge on how to respond to an emergency situation.
3. An ________________________action plan involves allocating designated actions that all the employees need to take for their safety during an emergency situation.
4. In case of a fire accident or a chemical spill, one must try to move quickly towards the nearest accessible________________________________.

B. Write short answers for the following –

1. Describe briefly about how the workers must be trained in hazard identification and its control.
2. Mention suggested actions to be taken in case of an emergency. (Any Five)

Module 6	Industry and Organisational Requirements

Module Overview

The Indian garment industry is well established and recognized worldwide and also enjoys a considerable demand from both domestic as well as global market. The growth of manufacturers and suppliers from developing countries like India, China, Pakistan, Bangladesh and others, and zeal to compete and offer products at competitive prices, the manufacturers have compromised with working conditions, safety and rights of workers. The recognition to Labour Standards and worker's rights, most of the international apparel buyers started focusing and pressurizing manufacturers to comply with the Labour Standards and Worker's rights. This resulted in increased awareness and compliance to code of conduct policies among Indian garment factories.

Indian apparel manufacturers and suppliers are not only bound to follow government guidelines but they also must comply with Social Compliance Standards and Code of Ethics. Such compliance is mandatory not only for the manufacturers but also for their vendors, distributors and other collaborators involved in the supply chain.

Learning Outcomes

After completing this module, you will be able to:

- Describe Standard Organisational Compliance and Related Documents
- Demonstrate Customer specific regulations and requirements
- Explain Ethical Compliance and Related Documents
- Identify and report Compliance Deviation

Module Structure

Session-1: Standard organisational compliance and related documents
Session-2: Customer specific regulations and requirements
Session-3: Ethical compliance and related documents
Session-4: Documentation and reporting of compliance deviation

Session: 1 Standard Organisational Compliance and Related Documents

WHAT IS ORGANISATIONAL COMPLIANCE?

Compliance means conforming to a rule. Compliance helps in better organisational control as it is a set of processes to ensure that the organisation as a whole abide by these set of regulations.

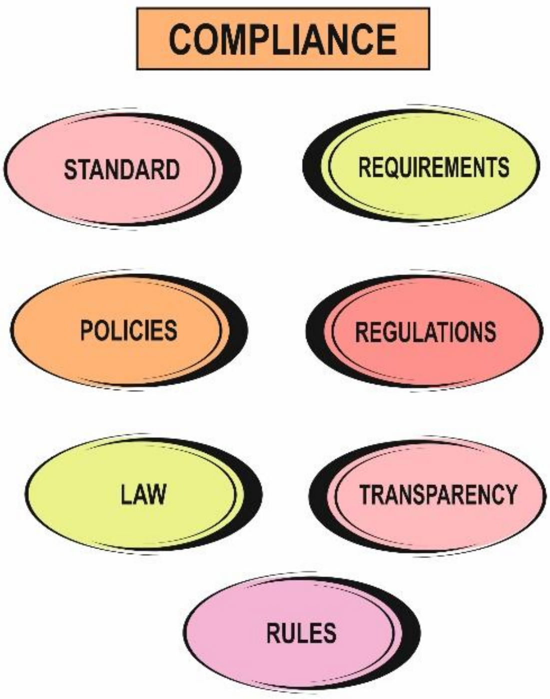


Fig.: 6.1 – Organizational Compliance

SIGNIFICANCE OF COMPLIANCE IN INDIAN GARMENT INDUSTRY

Compliance with respect to the garment industry must meet the audit requirements and refers to the following:

1. Quality of products
2. Safe and comfortable working environment

Apart from quality of products, International buyers are also demanding ethical manufacturing of products, which leads to the compliance of standards by garment manufacturers. The rise in export of garment products increases the demand for social compliance has also increased in the Indian Garment Industry.

Social Compliance

Social compliance refers to compliance in respect to social responsibility, ethical treatment of employees and the working environment. A code of conduct is followed regarding employee wages, working hours and work conditions. In order to keep a check on compliance by manufacturing unit, regarding various environmental standards, a compliance audit is conducted regularly. Some of the common requirements of social compliance are as follows-

i. **Child Labour-**Organisations must ensure no child under the age of 15 is employed.

ii. **Forced Labour-** No person should be employed under any threat and if they have not offered their services voluntarily.

iii. **Discrimination-** An organisation must not discriminate among its employees on factors like remuneration, promotion, training facilities etc.

iv. **Working hours-** An organisation must comply with government rules and industry standards on working hours, break timings, public holidays etc.

v. **Disciplinary Practices-** An organisation must not use any mental or physical abuse against the employees in the name of punishment.

Fig.: 6.2 – Social Compliance

Introduction to audit

Audit means to officially inspect, check or examine. Thus audit in organisational terms means check or inspection of various departments, resources and finances of an organisation. Audit is conducted regularly to ensure that no fraud or scam is caused by the organisation.

Audits and assessments ensure safety management, Security Management, and Risk Management. Aim of Auditing is to adhere to the prescribed policies and procedures and to verify compliance with regulatory requirements and industry standards. It helps to ensure that all programs are properly designed and implemented. Further, audits also helps in identifying programme deficiencies so that recommendations can be developed for corrective action.

Audit in Garment Industry:

Audit can be done by:

1. Internal Auditor - Employees or heads of a particular department
2. External Auditor - An outside firm or an independent auditor.

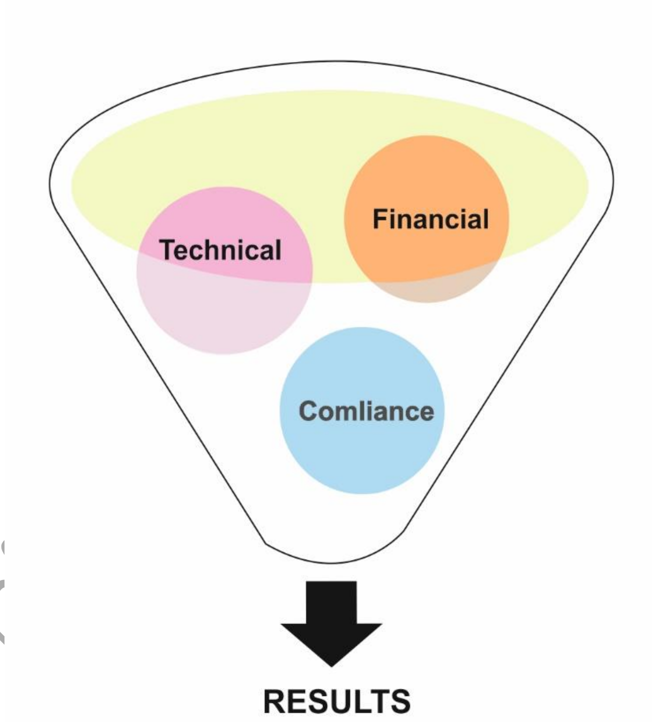


Fig.: 6.3 – Types of Audit

Compliance Audit

A basic Compliance audit may require the auditor toexamine the rules, regulations, orders and instructions for their legality, adequacy, transparency and prudence. Auditors gather information through visual observation at the site, review of document and interviewing staff. This collected data is then compared with the applicable permits and regulations to evaluate the compliance to the applicable legal requirements.

Following information may be collected and reviewed by an auditor during compliance audit-

1. Licenses, permits and facility information
2. Child labour
3. Forced labour and discrimination
4. Freedom of association and collective bargaining
5. Right of worker
6. Disciplinary practice
7. Working hours
8. Wages, benefits & compensation
9. Workplace safety
10. Occupational health & welfare
11. Environment management
12. Management practice & sub-contractor /supplier control
13. Training records
14. Company policies

Technical Audit

Technical Audit (TA) is a very crucial task for garment manufacturing unit. Every buyer conducts a technical audit before confirming an order to any garment factory. Many garment buyers have their own technical audit checklist, which may vary from buyer to buyer. Audit must be conducted in a routine manner at different stages of garment manufacturing. Through Technical Audit, auditors check the ability of a manufacturing unit to make export quality garments as per order and specifications. The initial step of a Technical Audit is to check the plant outline and its suitability to complete the order. The objective is to pick the right manufacturing unit for the order.

Following information is collected by an Auditor during Technical Audit-

- General Information about the Plant like number of staff members, production facility, location etc.
- Production capacity
- Versatility in product manufacturing
- Quality control of raw Materials
- In-house quality system
- Production planning &executions

- Process control
- Availability of in-house testing facility
- Availability of in-house design team
- Housekeeping and maintenance of instruments
- Quality assurance process
- Lighting, fire safety etc.

Financial Audit

Financial audit is an examination or inspection of accounts books by an auditor. It is then compared with physical checking of inventory to make sure that proper documentation is being followed. The objective is toconfirm the accuracy of financial statements prepared by the organisation.All the public listed firms are required to get their financial accounts audited by an independent auditor, before the results for any quarter is declared.

The idea behind financial audit is to check and verify the accounts by an independent authority to ensure that all books of accounts are maintained in a fair manner and there is no misrepresentation or fraud being conducted.

In India, independent financial audit for any organisation is conducted by chartered accountants licensed by The Institute of Chartered Accountants of India (ICAI).

Steps in auditing process:

Following are the four main steps in the auditing process:

1. **Defining the auditor's role and the terms of engagement**. It could be in the form of a work / authorization letter which is duly signed by the buyer.
2. **Planning the audit**. It includes detailed planning of deadlines and the departments the auditor would cover. Duration of audit may vary depending upon nature and area of work.
3. **Compilation of the information collected from the audit.** When an auditor audits the department, findings are usually put out in a report or compiled in a systematic manner.
4. **Reporting the result**. The results are documented in the auditor's report.

Phases of Audit:

There are three main phases of compliance audit in India:

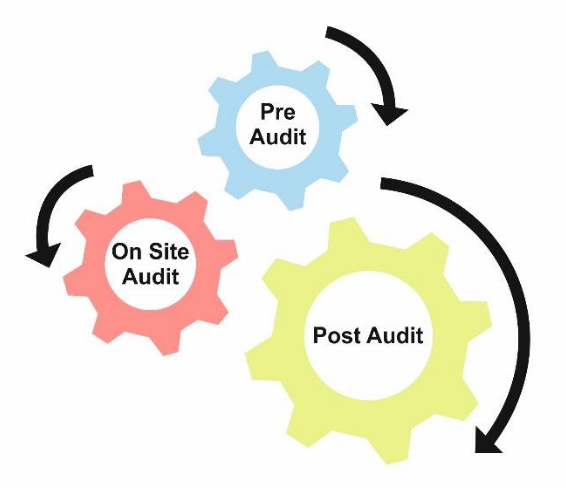


Fig.: 6.4 – Phases of Audit

i. **Pre-Audit Phase**

- Planning and organising the audit
- Establishing the audit objectives
- Scope and etiquette
- Reviewing the design of the programme by inspecting documentation.

ii. **On-site Audit Phase**

- Conducting personal interviews
- Reviewing records
- Making observations to assess programme implementation.

iii. **Post-audit Phase**

- Briefing the management about audit findings
- Preparation of Final report.

CORE LABOUR STANDARDS

International labour organisation has set rules for core labour standards, to protect the rights of workers and to ensure that worker get good working conditions.

Rules are set of four fundamental and universal Human Rights, as conceived by International Labour Organisation:

i. Freedom from forced labour

ii. Freedom from child labour

iii. Freedom from discrimination at work

iv. Freedom of association and right to bargain collectively.

In most countries, all the export-import trade agreements require both the seller and buyer to meet the International labour Standards specially on the issues linked with Child labour and rights of workers.

These are the minimum 'enabling rights' which workers need to defend in order to improve their working conditions, to work in freedom and dignity.

The aim behind this concept is to make sure that the apparel industries have labour contractors which don't engage forced or child labourand get the supply chain of the suppliers audited.

Apparel Export Promotion Council (AEPC), which is an apex body of Indian apparel exporters, has designed a garment factory compliance program called 'Disha' (Driving Industry towards Sustainable Human Capital Advancement), with an aim to make India a global benchmark for social compliance in apparel manufacturing and export business. This Common Compliance Code project will prepare the Indian apparel manufacturers and exporters on a common platform towards a more social and environmentally compliant industrial environment.

Common Compliance Code

The common compliance code gives opportunity for the industry to negate international claims against child labour promotion in the garment industry. It also helps to improve the image of the industry and win more international businesses.

Some of the common compliance code guidelines for Indian Garment industry are:

- Employers must not be involved in unfair labour practices including child labour and forced labour.
- There should be no discrimination among workers' remuneration for work of equal value on the basis of gender, race, religion, age, disability, sexual orientation, nationality, political opinion, or social or ethnic origin.
- Employers should not threaten female workers with dismissal or any other employment decision that may affects their employment status negatively, in order to prevent them from getting married or becoming pregnant.
- Employers should ensure that proper air ventilation systems are installed within their factory premises to prevent airborne diseases among workers.
- If workers wish to form organisations or participate in union activities, including strikes, employer shall not restrict the workers in doing so by use any form of physical or psychological violence, threats, harassment, or abuse.

- Workers should be entitled to at a day rest in a week. If workers are required to work on a rest day, an alternative rest day must be provided in next week.
- Workers should be provided with paid annual leaves as per local laws, regulations and procedures. Employer shall not impose any undue restrictions on workers' use of annual leave or sick leave or maternity leave.
- Workers should be paid at least the legal minimum wage or the prevailing industry wage, whichever is higher.
- Employers should compensate workers for the hours they have worked. Workers engaged on a per piece rate payment scheme or any other incentive scheme, must be paid accordingly.
- There should not be any sort of unreasonable restrain in the freedom of movement of workers, including movement in canteen during breaks, using toilets, accessing water, or to access necessary medical attention.
- Garment exporters or manufacturer must ensure that none of their workers is less than 14 years of age, as per the guidelines for non-hazardous employment. Child labour is the most important concern in Indian Industries nowadays. Further, each worker shall have the right to enter into and to terminate their employment freely.

  Indian apparel manufacturers must follow all the compliance related guidelines to comply with global standards. Compliance to such codes or guidelines also helps the industries to boost their image or to project a positive image and protect their goodwill in the market. The Indian garment industry must stress on strong compliance rather than competition of manufacturing cheaper garments.

INTERNATIONAL LABOUR STANDARDS

International labour standard is a set of legal standards and guidelines which set up basic principles and worker's rights at workplace. These standards aim at improving working conditions on a global scale.

Functions of International Labour Standards:

i. To prevent disruptive competition through the defence of particular workers group and setting minimum wage and working conditions.

ii. To promote constructive competition through definite rights, for e.g. workers involvement in decision-making, improvements in productivity and motivation of workers, increasing aggregate demand and promoting the creation of jobs, active labour market policies and ways of adjusting socially desirable measures.

Corporate Social Responsibility

What is Social Responsibility?

Social responsibility is "an organisation's obligation to increase its positive impact and reduce its negative impact on the society". It can also be known as "the concept that business entities should also be concerned with the welfare of the society at large".

The social responsibility of an organisation is referred to as 'Corporate Social Responsibility'.

Corporate social responsibility (CSR)essentially means that the organisation should work in an ethical manner and it should also be in the best interest of the various stakeholders. Nowadays, this concept of Corporate Social Responsibility in Indian garment industry is gaining great popularity. More and more organisations are trying to work in a way to protect the interests of the society at large along with the interest of its stakeholders including employees, customers and the suppliers.

Social Responsibility can be divided into two types:

a. Human responsibility refers to the responsibilities of the organisation towards the various 'stakeholders' in business parlance, including employees, shareholders, the government, customers, investors, suppliers, competitors and the society at large.

b. Environmental responsibility refers to the responsibilities of the organisation towards environment protection.

The scope of social responsibility extends beyond the legal responsibilities of an organisation. It has to be voluntarily fulfilled by the organisation; however there also are legal obligations.

Social Responsibility in the Garment Industry

The garment and textile industry is one of the largest industries in the world. It is also the biggest employer in India after agriculture. Globalization has made clothing affordable for all and competitive low prices. However, it has major negative impact on environment and society throughout the product life cycle. Production of textiles and garments requires consumption of vast energy. A considerable amount of wastes including sewage and discarded clothing is also generated which leads to the burden on the environment. Moreover, poor labour standards and poor working cum living conditions are additional outcomes of the ready-made Garment industry. Poor labour standards may include low wages, long working hours, hazardous work environment, workplace abuse and being excluded from unions.

Buyer companies in developed countries prefer outsourcing the production from overseas suppliers especially from countries where labour cost is considerably low, in order to keep the costing at the lower side as much as possible and also to avoid the ill effects of production and industrialization. Working conditions of labour and their human rights are a matter of great concern in developing countries such as in India, China, Bangladesh, Pakistan and other Asian countries. This poor condition leads to many tragedies like factory fire and labour abuse that again results in poor life for workers and even death.

Textiles and garment firms are realising their responsibilities towards its stakeholders, environment and society. The ways in which a textile firm can fulfil its responsibility towards various stakeholders are similar to those of firms in other industries, as is evident from the suggestive points mentioned below:

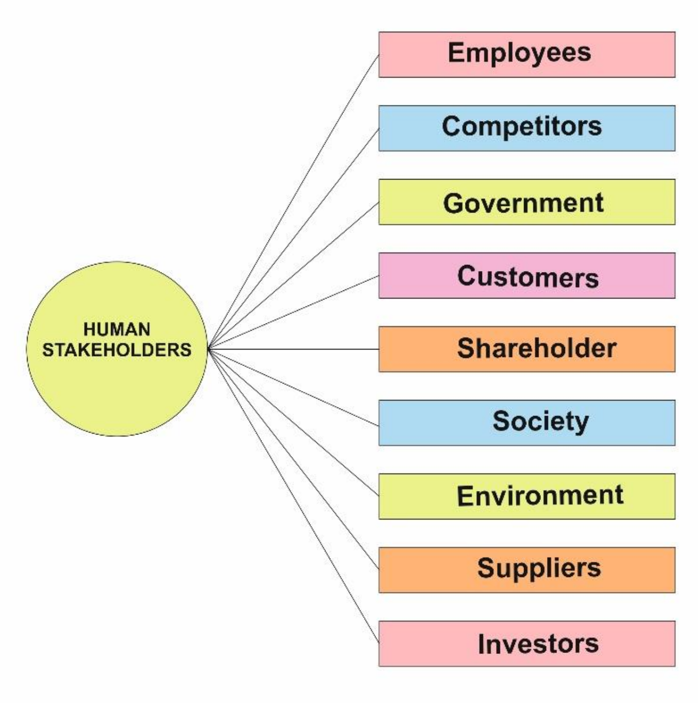


Fig.: 6.5 – Stakeholders in Garment Industry

1. Towards employees:

- By having ethical recruitment, remuneration, promotion and other policies.
- By providing opportunities to the employees to voice their opinion and complaints and have an effective policy for the solution of these complaints.
- Ensuring a safe working environment for the employees.
- Having fair policies for the solution of employee disputes.

2. Towards shareholders:

- By representing a fair picture of the company's financial position and profit/loss to the shareholders.

- By rewarding them with a fair rate of dividend.

3.Towards the government:

- By providing the necessary information to the government as and when required.
- By paying taxes and dues timely.
- By abiding by the laws and regulations of the area in which the firm operates.
- Contributing to the economy through exports.

4.Towards customers:

- By providing quality products to the customers at reasonable prices.
- By undertaking constant research and development and coming up with innovative and more useful products from time.

5. Towards investors:

- By giving the investors a true and fair picture of the financial condition of the business.
- By ensuring a fair ROI (Return on Investment)

6. Towards suppliers:

- By ensuring timely and fair payment to the suppliers.
- By maintaining a good relationship with the suppliers.

7. Towards competitors:

- By indulging in fair and ethical practices, thereby raising the spirit of fair competition

8. Towards society:

- By involvement in activities that ensure development of area and society at large.
- By having a philanthropy arm to take care of the needs of the under-privileged.
- By creating job opportunities.

9. **Towards environment:**

- By ensuring the purchase of environment-friendly supplies. By ensuring a pollution-free process of production. By establishing a system of efficient disposal.

- By adopting practices which make the production and product eco-friendly.
- By adopting eco-friendly packaging.

Activities

Activity 1

Make a PowerPoint presentation on CSR activities of a Firm.

Materials Required:

1. Writing material
2. Computer / laptop for PPT

Procedure:

1. Make a group of 4 students each.
2. Select a garment manufacturing firm
3. Enquire about its CSR activities through published literature or internet. (Volunteer in CSR activities if opportunity available)
4. Prepare a presentation document (preferably a PPT)
5. Present the presentation to the class.

Check Your Progress

A. Fill in the Blanks:

1. ________________is conducted regularly to ensure that no fraud or scam is caused by the organisation
2. *A ____________ audit may require the auditor to* examine the rules, regulations, orders and instructions for their legality, adequacy, transparency and prudence.
3. Compliance audit, Technical audit and __________ audit are three types of audits.
4. Pre-Audit, _______ audit and Post-audit are three phases of audit.

B. Write short answers for the following:

1. What are the three phases of audit? Explain.
2. What do you mean by audit? Explain its importance.

3. What is the significance of compliance in Garment Industry?

C. Write long answers for the following:

1. Explain types of audit.
2. Explain Corporate Social Responsibility.
3. Explain Core Labour Standards.

Session: 2 Customer Specific Regulations and Requirements

Customer specific regulations and requirements are the requirements developed by the customer with the expectations that the supplier will identify, implement and audit these requirements.

These requirements fall into following categories:

i. Material specific requirement

ii. Delivery requirements

iii. General requirements

iv. Process requirements (ex: calendaring)

Customers specific requirement cannot be ignored and seek to expand the standard or define how a customer wants a portion of the standard to be met.

Country specific regulations for sector and their importance:

There are several country based regulations and requirements which a manufacturer / supplier needs to comply with. Some of these regulations could be mandatory while the rest could be voluntary / suggestive which the companies are expected to follow. Compliance to all the regulations might give a company some competitive edge over others. There could be certain requirements specific for a market or specific to a product category.

1. MANDATORY REGULATIONS

There are several mandatory requirements that manufacturers and exporters need to comply with. This includes legal requirements concerning product safety, use of chemicals, product quality and labelling. Additionally, many buyers have created their own non-negotiable terms and conditions which all their suppliers are bound to follow. These requirements could be non-legal, but still mandatory. Following are the few textiles and apparel related mandatory regulations / guidelines followed worldwide:

i. REACH

REACH stands for Registration, Evaluation, Authorization and Restriction of Chemicals and applies to all products including textile and apparels to be exported to European Union.

Hundreds of chemicals are used at different stages of textile and apparel manufacturing. Some of these chemicals could be harmful to the user.

Hence, it is essential to follow REACH regulations to avoid the possible harm to the user of the product. This restriction is imposed over a wide range of chemicals used in textile and leather and such restrictions could limit the use of these chemicals completely or partially as measured by weight.

A list of some of the important chemicals banned for textile and apparel sector is as follows:

a. **Azo dyes and its aromatic amines**–

   Currently, around 60%-70% of dyes used for industrial purposes belong to the family of azo dyes due to its economic efficiency and usability. They are widely used in the textile industry to give vibrant colors to almost all materials including cotton, silk, wool, leather and other fibers. Overexposure to azo dyes can cause diseases like bladder cancers, liver cancers, and hematuria.

   India has published legislation prohibiting the handling of a total of 112 azo and benzidine based dyes. In 1993, the Government of India prohibited the handling of 42 benzidine-based dyes. The Ministry of Environment and Forests further prohibited the handling of an additional 70 azo dyes in 1997.

   According to the Indian import policy, import of textiles and textile articles is permitted subject to the condition that they do not contain any of the hazardous dyes (azo dyes) whose handling, production, carriage or use is prohibited in India under the provisions of the Environment (Protection) Act, 1986.

b. **Tris (2,3-dibromopropyl) phosphate, tris (aziridinyl) phosphinoxide, and polybrominated biphenyls (PBB)** – Used as waterproofing and stain-repelling chemicals.

c. **Perfluoro octane sulfonic acid and its derivatives (PFOS)** – Used as biocide and preservatives

d. **Dioctyl tin (DOT) compounds, tributyltin (TBT) compounds, and pentachlorophenol (PCP)** – Used in metal trims and accessories (zippers, buttons, jewellery)

e. **Polycyclic-aromatic hydrocarbons (PAHs), and phthalates** – Used in leather products

f. **Persistent Organic Pollutants (POPs)** - used to make waterproof Textile material or flame-retardant fabric, and for leather finishing.

ORR Chem stands for Chemical Risk Reduction Ordinance and is a regulation from Switzerland regarding use of chemicals. ORR Chem totally bans certain chemicals while allow them only for certain applications when no other substitute is available. The idea is to minimize the risk and possible harm from chemicals by limiting their use.

Similarly, Austria, Denmark, Finland, Norway, Germany and the Netherlands also have specific regulations for the use of some chemicals like Formaldehyde and PCP.

Stockholm Convention is a global regulation to protect human health and the environment from chemicals that remain intact in the environment for longer periods, become widely distributed geographically, accumulate in the fatty tissue of humans and animals, and have harmful impacts on human health and the environment.

Product Safety Regulations It is buyer's responsibility to provide design of the product which is legally safe for consumers to use. However if a manufacturer / exporter is not sure about the safety of the product, he must discuss this with the buyer or check with the safety guidelines of the importer country. Before manufacturing a product for export, an exporter may always ask its suppliers for fabric, trims and accessories if they have exported their material before or are familiar with the legal safety requirements of apparel export.

a. Children's clothing regulations

Generally such regulations are formulated for children below 14 years of age. The idea is to avoid fatal incidents, strangulation and choking hazards. A few regulations have been developed by various countries as listed below:

- The European Union has a Specific Standard for the Safety of Children's Wear including bathrobes, pyjamas, nightshirts, etc. It does not apply to baby's nightwear. This standard does not require additional labelling on the product. General product safety directive of European Union restricts the presence of certain heavy material in packaging of children's clothing, including lead, mercury, chromium, and others.

  EN 14682 – Cords and drawstrings on children's clothing, **EN 14878 Textiles** – Burning behaviour of children's nightwear – Specification and **ASTM F1816-97** – Standard Safety Specification for Drawstrings.

- Similarly, UK has The Nightwear (Safety) Regulations 1985, for children's clothing. The United Kingdom's **BS 4578 Standard** devises test methods for hardness and air permeability for infants' pillows.

- The Washington Children's Safe Products Act (CSPA) requires manufacturers or importers of children's products to report to the Department of Ecology of Washington, before placing in the market products that contain chemicals that are included on the "List of Chemicals of High Concern to Children".

- Similarly, State of Vermont Act 188 also stipulates that manufacturers or importers of children's products should report to the Health Department when these products contain chemical.
- Substances recorded in the "**List of Chemicals of High Concern to Children".**

b. Flammability or Fire Safety Standards

Countries like UK, Ireland, Netherland and Switzerland have specific legal requirements regarding apparel flammability. Flame retarding chemicals are used to avoid fabric flammability but this again is restricted under REACH, Hence a manufacturer / exporter has to check both REACH and Flammability guidelines for textile and apparel products.

There are national standards concerning the flammability of textile and apparel products in several countries. For ex: Standard for protective clothing, standard for protective gloves for firefighters, fire safety standard for bedding, standard for protective clothing with limited flame spread properties etc.

c. Standard for Personal Protective Equipment

CE stands for "European Conformity" and is an administrative marking which indicates conformity with health, safety and environmental protection. While exporting Personal Protective Equipment (PPE) to European Union, exporter is required to comply with the specific safety standards for the design, manufacturing, material use, testing and user instructions concerning PPE. The exporter is required to affix CE marking to indicate that the product is in line with the PPE safety requirements. CE marking is required only if one or more of the 25 CE marking directives cover the products being exported.

d. Biocide related regulations

If biocides are added to textiles to protect it from pests or bacteria, it must comply with the Biocidal Product Regulation (BPR) as well as REACH.

- **Labelling Requirements**

With an aim to inform the consumer about the kind of apparel they are buying, it is required to affix a label to the product. It also educates the consumer about the material content, country of origin / 'Made in', product care, washing instructions, etc.

According to EU Textile and clothing regulation, products have to be labelled or marked before they are made available in the market for sale.

As per a Notification issued by the Ministry of Commerce on November 24, 2000, all pre-packaged products (intended for direct retail sale only) imported into India must carry the following declarations on the label: • name and address of the importer • generic or common name of the commodity packed • net quantity in terms of standard unit of weights and measurement (in metric) / size if garment • month and year of packing in which the commodity is manufactured, packed or imported, and the maximum retail sales price (MRP) • fibre content Footwear: Similar guidelines are applicable to footwear, which includes sizing and listing which standards are used. India follows the British size system for footwear. India has a voluntary Eco-Labelling scheme known as ‘Eco-mark', which provides for easy identification of environment-friendly products. Criteria for the Eco-mark have been set for 16 product categories, including textiles and leather.

Following are some key points of labelling requirements:

a. Full fibre composition must be mentioned on the label of textile products. For example, Silk, wool, Nylon, Polyester, Cotton, Spandex etc. There is no mandatory standard for mentioning the fibre composition in most countries. However it is suggested as best practice to show the percentage of each fibre on the label. As per the mandatory labelling guidelines for textile and apparel products under the **Textile Labelling Act (TLA) of Canada**, it is mandatory to disclose fibre content information expressed in percentages by mass and the dealer identity information on the label.

Fig.: 6.6 – Fibre Content and Country of Origin label

b. Non-textile parts of animal origin must be clearly mentioned in the label (such as fur or leather)

c. The label should not contain abbreviations with the exception of mechanized processing codes.

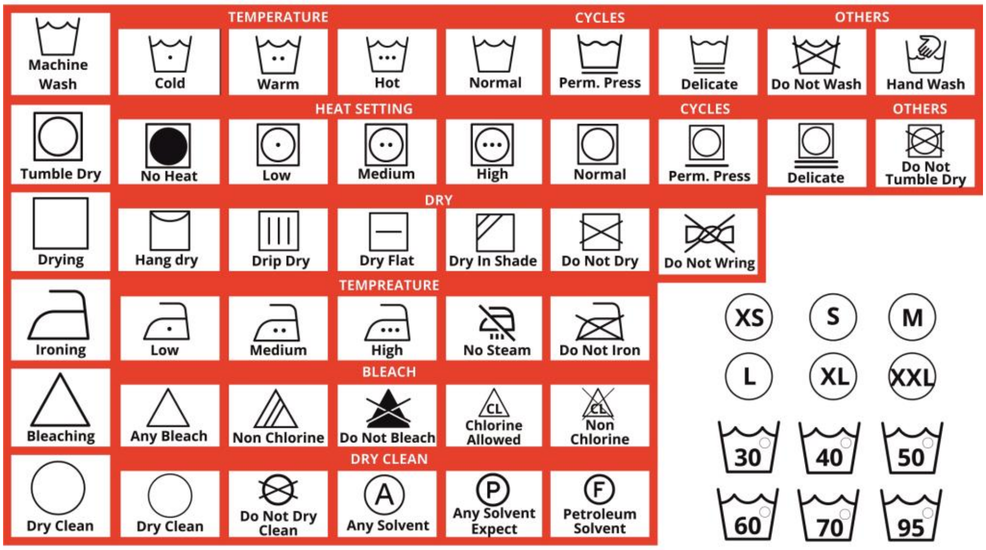


Fig.: 6.7 – Care Labels Symbols

d. Care instruction label is not mandatory under EU textiles regulation. However, if an exporter wishes to include them, care must be taken to use symbols as acceptable in the importer country.

Fig.: 6.8 – Care Labels

An ideal care instruction label must include information on:

- General care and warnings
- Washing
- Drying
- Ironing
- Dry-cleaning

e. Country of Origin is not a mandatory standard for exporting to most countries, however if an exporter wishes to include, it should be clearly labelled and should not be deceptive. For example, a product imported from China, must not be labelled as 'Made in India'.

Fig.: 6.9 – Brand, Size and Fibre Content Labels

f. Apparel products must carry a durable, legible, easily visible and accessible label, either on the product or on its packaging. Language of the label is preferably the language of the country of importer. For example, while exporting to Germany, the preferred language should be German. For apparels to be sold in Canadian markets, the care label should be in both English and French.

g. Size mentioning is not obligatory but expected on labels. Australia has defined size standards apparels too, which are:

- **AS 1344-1997**: Size coding scheme for women's clothing- Underwear, outerwear and foundation garments
- **AS 1954:1976**: Size coding scheme for men's clothing(including multiple fitting outerwear and industrial wear)
- **AS 1182:1997**: Size coding scheme for infants' and children's clothing- Underwear and outerwear

Intellectual Property Rights (IPR)

Intellectual property (IP) is a legal concept which refers to creations of the mind for which exclusive rights are recognized. Under intellectual property law, owners are granted certain exclusive rights to a variety of intangible assets, such as musical, literary, and artistic works; discoveries and inventions; and words, phrases, symbols, and designs. Common types of intellectual property rights include copyright, trademarks, patents, industrial design rights, trade dress, and in some jurisdictions trade secrets. Illegal copy of registered apparel trademarks or design is considered as infringement to IPR. While selling own designs or apparels under a trademark, an exporter must make sure that no Intellectual Property Rights are being violated. Similarly if designs are provided by the buyer, they will also be liable in case it is found to violate any IPR.

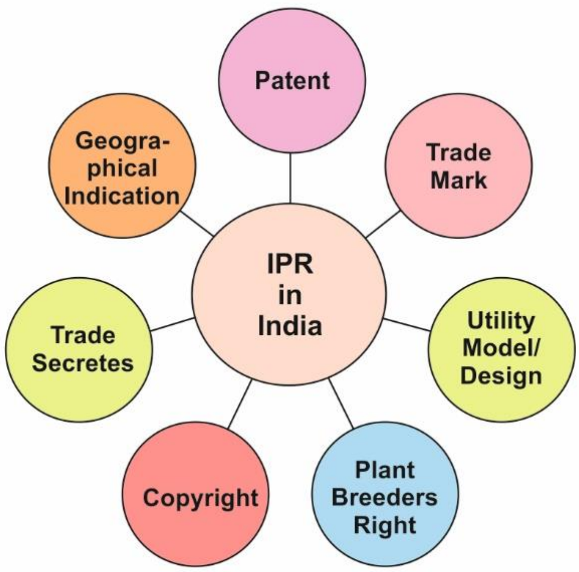


Fig.: 6.10 – IPR in India

2. VOLUNTARY STANDARDS

In addition to mandatory standards (including legal and non-legal), there are many services that buyers implicitly expect or at least highly appreciate if an exporter intends to do business with them.

A voluntary consensus safety standard (also known as a "non-government consensus standard") is a safety standard for consumer products that establishes consumer product safety practices recommended to be followed by product manufacturers, distributors and sellers.

Buyers set their own standards for products. The exported products must comply to such standards along with the mandatory standard requirements.

These standards can be based on the end use of the product or may be based on the product processing etc.. Such standards are implemented by the buyer to meet their business goals of desirable quality product and desirable manufacturing for the product. These standards are different for different buyers.

For example:- The EU has a voluntary standard for Textiles known as **The Burning Behaviour of Children's Nightwear**, which helps in complying with the GPSD.

CUSTOMER SPECIFIC REQUIREMENTS MANDATED AS A PART OF WORK PROCESS

As we have country specific regulations in this sector for export of textiles and apparel related products, similarly, there could be few customer / company specific requirements / regulations, which exporter / manufacturer needs to fulfil in order to do business with that customer.

Following are few basic types of customer specific requirements

1. Restricted Substances Lists (RSLs)

Apart from REACH guidelines, many fashion brands and retailers have created their own list of restricted substances, which they impress upon their suppliers to follow. Such company specific Restricted Substances Lists may be stricter than REACH. Suppliers intending to work with these firms are required to comply with these customer specific RSL along with other Country specific regulations.

Customer Specific Standards are often based on **Zero Discharge of Hazardous Chemicals (ZDHC)** guidelines on safe chemicals use.

2. Product design and development

Generally buyers have their own design team and provide new designs to suppliers. However, suppliers or manufacturers can also maintain their design team and suggest the buyers about new designs ideas. Buyers will always appreciate new designs, materials or production methods to make them stand out in the market and have a competitive edge over other brands.

3. Garment Care Preferences

Most customers prefer an easy handling fabric which can be hand washed or machine washed and easy to care.

4. Smaller Lead Time

Some apparel brands/buyers work on fast fashion concept and prefer a supplier / manufacturer who can work on deadlines and smaller lead time.

5. Complexities

Factories usually try to get easier work order based on available fabric, simple designs and large lead time. However, brands in order to stand out in the market might ask for complex designs and innovative fabrics. To work with such buyers / brands and to supply those with their specific requirements could be difficult. Also manufacturers / exporters are required to be flexible with workmanship, Minimum Order Quantity (MOQ) and price.

6. Location of Factory in GSP

As per EU's Generalised System of Preferences (GSP) there are around 71 countries worldwide which are preferred over on listed countries to manufacture and export to EU buyers. EU Buyers are also benefited with removal of import duties. Thus, buyers might have specific requirements for manufacturer from a country listed in GSP.

Activities

Activity 1

Visit a Garment export unit and make a report on Country specific regulations which they follow.

Materials Required:

1. Writing Material
2. Ruler
3. Adhesive

Procedure:

1. Make a visit to any nearby garment export unit.
2. Enquire about the countries where they export their product.
3. Enquire and prepare a report about the country specific regulations being followed for any export order.

Check Your Progress

A. Fill in the Blanks –

1. __________ stands for Registration, Evaluation, Authorization and Restriction of Chemicals.
2. ________ is an administrative marking which indicates conformity with health, safety and environmental protection.
3. With an aim to inform the consumer about the kind of apparel they are buying, it is required to affix a ____________________to the product.
4. ZDHC stands for _________________________.
5. GSP stands for ______________________.

B. Write short answers for the following:

1. Explain 'Restricted Substances List'.
2. Give few examples of Children's clothing standards.

C. Write long answers for the following:

1. What are customer specific requirements?
2. Explain any 3 country specific mandatory regulations.

Session: 3 Ethical Compliance and Related Documents

Indian Garment industry is getting attention from consumers, social workers, welfare organisations and branded international buyers. Many international buyers are demanding their manufacturers / suppliers to comply with their 'Code of Conduct' and 'Code of Ethics' while placing an order.

Adherence to quality standards and employee satisfaction has become important parameters for measuring the organisation's performance. Manufacturers and organisations comply with regulations and codes, not only out of a need to act generously, but also for survival in a globally competitive environment.

In the light of growing competition among exporting countries and increasing demand for products that meet internationally recognised standards, it is essential for the manufacturers / suppliers to improve their safety and health compliance code and provide proper working environment in their factories.

Several countries have also developed various international compliance standards on health and safety compliance. Exporters should follow these compliance codes to survive in the global market. Moreover, regular practice of compliance with code of conduct would ensure higher price of products, less employee turnover rate, smooth industrial relation as well as global image & reputation.

In a consumer market, brand name and reputation are most critical assets. Companies should adopt Ethical compliance code to protect their goodwill in the market. The Indian garment industry needs to be tough on compliance rather than competing with other developing countries manufacturing cheaper garments.

Why code of ethics is required?

Code of Ethics represents an organisation's self-made constitution / regulation which aim to provide general behavioural guidelines. Such guidelines are generally towards safe working conditions, prohibition of child labour, environment protections, work hours and wage rate control, equality and discrimination issues, labour safety standards, bribery and corruption, unfair practices etc.

Codes of Ethics are generally not as detailed as Code of Conduct. Code of Ethics represents an organisation's culture and values. Large organisations usually have a dedicated department of Corporate Social Responsibility to take care of ethical practices of the organisation. Also it is a great tool for the organisation or the Brand to portray and improve brand image to the customers.

By following such ethical practices, it is conveyed that the brand is dedicated towards high quality products, comply with legal requirements and undertakes to protect the environment. Such message boost customers' confidence in the brand and products quality. Brands speak loud about their ethics and value on their websites and promotion campaigns to educate the customers and stand out in the market.

Attention to working conditions and labour related issues is also required as most of the buyers outsource their requirements from countries with lower wage rates in order to cut down on costs. But such manufacturer might not be following ethical and fair practices related with labour and environment. Hence, buyers link their code of ethics to work orders for manufacturers and compel them to respect all the labour and environment related guidelines which the buyer company believes in.

These ethics are required for:

- Increasing national competitiveness in terms of social compliance
- Increasing competitiveness of small scale manufacturers
- Reducing burden on manufacturers

In India, the **Apparel Export Promotion Council (AEPC)** is committed towards legal compliance and ethical business practices and encourages members / exporters to comply with all applicable laws and regulations of the country, to meet all the **International Compliance Standards**.

Further, the council has designed a garment factory compliance program 'DISHA' (Driving Industry towards Sustainable Human Capital Advancement) that aims to spread awareness regarding the importance of compliance among Indian garment exporters.

Some of the important compliance codes in Indian garment industry are listed below.

Fig.: 6.11 – Code of Ethics

1. Working Hour and Wage Rate Compliance

- Garment factory must ensure that employees should get at least minimum wages according to the domestic law and as per the time spent by them in the industry.
- Employer should pay equal wages to both men and women employees, for performing the same work or work of a similar nature.
- Worker employed for more than nine hours on any day or for more than 48 hours in any week, should be entitled to wages at premium legal rates for such overtime work.
- Every worker should be given one holiday (for a period of 24 consecutive hours) in a week. Whenever a worker is required to work on a weekly holiday, he is to be allowed a compensatory holiday for each holiday so lost.
- Every worker is to be allowed at least half an hour rest interval after a maximum working of 5 hours at a stretch.
- Overtime work should be voluntary for employees and should be supported by legally required rate of compensation for such overtime period.
- No worker should be employed below the age of 14 as per guidelines of International Labour Organisation.
- There should not be any sort of forced labour whether in the form of prison labour, indentured labour, bonded labour or otherwise.

2. Workplace and Work Environment Compliance

- Organizations should ensure proper ventilation, sufficient light and air to provide the employees with standard working environment.
- Indian garment industries should provide the workers with comfortable sitting chair with back support and proper leg space.
- All employees should be treated with dignity and respect. No employee should be subject to any physical, sexual, psychological or verbal harassment or abuse.
- Right of employees to form association and collective bargaining should be respected and recognized. No employee should be subject to any sort of harassment, intimidation or retaliation for engaging in association or collective bargaining.

3. Non-discrimination compliance

- Organizations should not discriminate employees on the basis of physical characteristics, beliefs and cultural characteristics. All the terms and conditions of employment should be based on an individual's ability to do the job. They should provide equal employment opportunities for all employees and associates irrespective of the employees' race, colour, religion, age, sex, creed, national origin, marital status, etc.

- Women workers should receive equal remuneration, including benefits, equal treatment, equal evaluation of the quality of their work, and equal opportunity to fill all positions as male workers.
- Women workers who avail maternity leave, should not face dismissal or threat of dismissal or loss of seniority or deduction of wages, and should be allowed to return to their former employment at the same rate of pay and benefits.

4. Health and Safety Compliance in Indian Garment Industry

- Employees should not be exposed to hazards, including glues and solvents, which may endanger their safety, including their reproductive health.
- No employee should work on machines without adequate training, knowledge and supervision.
- Industries should comply with international standard code, such as ISO(Indian Standards Organisation) or importing countries standard code to become competitive in international markets.
- Wiring should be in good condition with no broken junctions or wires sticking out at the end.
- Eye-wear and face shields should be provided in areas with danger of sparks, glare, hazardous liquids and excessive dust.
- Ear plugs or muffs should be given in places with excessive noise such as generator rooms and rooms with embroidery machine.
- Headgear and protective shoes are necessary for workers involved in loading and unloading operations.
- Factories should have effective fire extinguisher with proper usage instructions.

Activities

ACTIVITY 1

Visit a Garment export unit and make a report on Code of Ethics which they follow.

Materials Required:

1. Writing material
2. Ruler

3. Adhesive

Procedure:

1. Make a visit to any nearby garment manufacturing unit.
2. Enquire about the countries where they export their product.
3. Enquire and prepare a report about the Code of Ethics being followed.

Check Your Progress

A. Fill in the Blanks:

1. Adherence to ____________________and employee satisfaction has become important parameters for measuring the organisation's performance.
2. ____________________represents an organisation's self-made constitution / regulation which aim to provide general behavioural guidelines.
3. Large organisations usually have a dedicated department of _____________________________________to take care of ethical practices of the organisation.
4. _________________________is committed towards legal compliance and ethical business practices.
5. Organizations should not _____________________employees on the basis of physical characteristics, beliefs and cultural characteristics.

B. Write short answers for the following –

1. Explain 'Code of Ethics'.
2. Explain in brief about workplace and work environment compliance in garment unit.
3. Discuss about wage rates and working hour's compliance for workers in a garment unit.

C. Write long answers for the following-

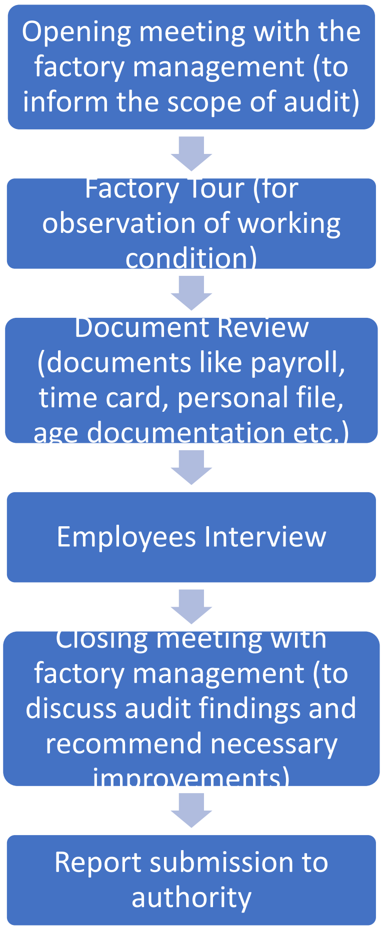
1. Write short note on compliance code guidelines for Indian Garment Industry.
2. Explain Health and Safety compliance in Indian Garment Industry.

Session: 4 Documentation and Reporting of Compliance Deviation

Social compliance deals with employee's health and safety, their legal rights and working environment from social perspective. To make a factory compliant to such national or International standards, it needs to follow local labour law and international social compliance requirements. Social compliance audit is generally related to child labour, forced labour, health and safety, abuse and discrimination, disciplinary practices, working hours, remuneration, freedom of association, management systems, etc.. Social compliance is a vital part of the apparel industry because it has an impact on a company's reputation and business.

Identification and reporting of any possible deviation

Social compliance audits conducted as per the Code of Ethics of different buyers are based on the following steps:



CORE LABOUR STANDARDS

COMPLIANCE CLUSTERS	COMPLIANCE POINTS
1. Child Labour	• Child Labourers • Documentation and Protection of young workers • Hazardous works and other worst forms
2. Discrimination	• Gender • Other grounds • Race and Origin • Religion and Political opinion
3. Forced Labour	• Bounded Labour • Coercion • Forced Labour and overtime • Prison Labour
4. Freedom of Association and collective Bargaining	• Collective bargaining • Freedom to Associate • Interference and discrimination • Strikes • Union Operations
5. Compensation	• Minimum wages • Overtime wages • Method of payment • Wage information, use and deduction • Paid leave • Social security and other benefits
6. Contrasts and Human Resources	• Employment contracts • Contracting procedures • Termination • Dialogue, Discipline and Disputes
7. Occupational safety and health	• OSH Management systems • Chemicals and hazardous substances • Workers Protection

	• Working Environment • Health services and First Aid • Welfare facilities • Workers Accommodation • Emergency preparedness
8. Working Time	• Regular Hours • Overtime • Leave

These are 8 major compliance cluster which are divided into compliance points. These points are required to be checked during audit. The audit checklist may vary from organisation to organisation but a suggestive checklist is shown below:

a. Checklist for Child labour and young workers:

1. Employer having a reliable system to check age of worker before hiring.
2. Employer complying to guidelines regarding fitness of worker
3. Maintenance of a register of workers below 18 years of age
4. Workers below 18 years of age performing work which is hazardous by nature.
5. Workers engaged for more than permissible working hours.
6. Engagement of employer in child labour.

b. Checklist regarding wages and working hours:

1. Workers are paid their wages on time
2. Worker's wages are paid correctly as per norms and minimum standards.
3. Women workers are paid for maternity leaves.
4. Workers are paid correctly for annual leaves
5. Workers are paid correctly for festival holidays.
6. Workers are paid correctly for sick leaves.
7. Workers are paid correctly for casual Leaves.
8. Workers are paid correctly for duration of work stoppages.

9. An accurate pay-roll record is maintained by the employer.

c. Checklist for social security and other benefits:

1. Employer has provided compulsory group insurance for workers?
2. Employer pays correct compensation in case of worker's death.
3. Workers are paid correct compensation for work related accidents and diseases.
4. Employer has established a Provident Fund and deposit employer's share for workers as per norms.
5. Festival bonuses are paid to workers as per norms.
6. Workers are provided with wage slips.
7. Any unauthorized deduction is not made by employer from worker's wages / salary.

d. Checklist for worker working with chemical and hazardous substances:

1. Workers engaged for working with chemical or hazardous substances are effectively trained.
2. Employer has taken action and precaution to prevent exposure to chemicals or hazardous substances.
3. All chemicals or hazardous substances are properly labelled.
4. Employer maintains an inventory of chemicals and hazardous substances at workplace.
5. All chemicals and hazardous substances are properly stored.
6. Availability of adequate washing and cleaning facility in case of exposure to hazardous substances.
7. Employer possesses license for storage and use of chemicals.

e. Checklist for emergency preparedness:

1. Workers are trained for firefighting and rescue.
2. Availability of emergency exit window and doors.
3. Availability of alternative stairs.
4. Availability of firefighting equipment.
5. Availability and functioning of fire detection and alarm system.
6. Emergency exists and escape routes are clearly marked.
7. All flammable materials are safely stored.
8. Possible sources of ignition are appropriately safeguarded.

9. Periodic emergency drills are conducted.

f. Checklist for Health services and first aid:

1. Availability of required health facility and staff.
2. Employer complying with medical check-ups of workers.
3. Workers are trained for first-aid and first-aid team is formed.
4. Availability of readily assessable first-aid boxes.

g. Checklist for welfare activities:

1. Availability of adequate day care facility
2. Availability of adequate lunch room / canteen.
3. Availability of adequate rest rooms
4. Availability of adequate washing facility
5. Availability of clean and safe drinking water
6. Accessible toilets and washrooms.

h. Checklist for working environment:

1. Noise levels are acceptable.
2. Temperature and ventilations are acceptable.
3. Workplace is clean and tidy.
4. Workplace is adequately lit.

PROCEDURE TO FOLLOW IN CASE OF DEVIATION

After the compliance audit, in case of any deviations are recorded, the auditor prepares a **Corrective Action Plan (CAP)**. Such plans are reviewed periodically and worked upon to avoid deviations before next audit.

Following are the aims of CAP:

1. To identify the most important shortcomings
2. To understand the root cause of the shortcomings
3. To assign a responsible person
4. To propose corrective action
5. To reach goals within time

In order to ensure that suggestions of CAP are implemented, follow-up audits are done as soon as a number of improvements are achieved. Third party audits can also help the manufacturer / exporter to get better suggestions and audit reports.

Exit meeting with management

The exit meeting with management takes place at the end of the factory visit. The aims of the exit meeting are:

- To get management on board to implement the process- to improve labour practices.
- To present the main audit findings to management, check whether management agrees with the findings and ask a response from their end with respect to findings thereby unveiling the possible causes of the problems which are identified.
- To propose corrective action plans for improvements, discuss with management whether improvements are feasible and within timeframe.
- To present main audit findings to factory level trade union representatives or elected worker representatives.

Activities

ACTIVITY 1

Visit a garment manufacturing unit and make a report on Corrective Action Plan which they follow in case of compliance deviation.

Materials Required:

1. Writing material
2. Ruler
3. Adhesive

Procedure:

1. Make a visit to any nearby garment export unit.
2. Enquire about the countries where they export their product.
3. Enquire and prepare a report about the Corrective Action Plan followed in case of compliance deviation.

Check Your Progress

A. Fill in the Blanks:

1. _________________compliance deals with employee's health and safety, their legal rights and working environment from social perspective.
2. Social compliance audits are conducted as per the _______________ of different buyers.
3. These are _______________ major compliance cluster which are divided into compliance points.
4. After the compliance audit, in case of any deviations are recorded, the auditor prepares a ________________.

B. Write short answers for the following –

1. Explain in brief the process of auditing compliance standards in a garment unit.
2. What precautions are to be taken by a Garment unit where chemicals or hazardous substances are used?
3. What are the guidelines regarding employment of child labour and young workers?

C. Write long answers for the following-

1. What procedure to be followed in case of any deviation in compliance with standards?
2. How should a garment unit be prepared for emergency?

ANSWER KEY

MODULE 1

SESSION 1

Fill in the blanks

1. Neckline
2. Add-on Collars
3. Kimono sleeve
4. Extended cuff, turned back cuff

SESSION 2

Multiple Choice questions

1. Ans. Standard Allowed Minutes
2. Ans. Specification sheet
3. Ans. Cutting plan

SESSION 3

Fill in the blanks

1. Pinked finish
2. enclosed seams
3. Lapped seam
4. V-shaped notches

MODULE 2

SESSION 1

Fill in the blanks

1. Tech-pack
2. POMs (Point of measurements)
3. BOM (Bill of Material)
4. Cardinal Points

SESSION 2

Fill in the blanks

1. The Garment Merchandiser/Marketing team
2. Sample Requirement Form
3. 'Knit down'
4. Trims

SESSION 3

Fill in the blanks

1. Garment factory
2. Scale of 1 to 4
3. Marker planning
4. Bottlenecks

MODULE 3

SESSION 1

Fill in the blanks

1. Technical Designers
2. Visual inspection.
3. Proto sample

4. Quality of construction
5. Comfort factor
6. Design ease
7. Proximal Fit

SESSION 2

Fill in the blanks

1. Quality inspectors
2. Gram per Square Meter.
3. Rubbing fastness
4. American Society of Testing & Materials.
5. Tensile strength
6. Fabric Package Test (FBT).

SESSION 3

Fill in the blanks

1. Sewbots
2. Fit Standard
3. 2D&3D
4. Air jets
5. Direct panel loom
6. Artificial Intelligence (AI)

MODULE-4

SESSION-1

Fill in the blanks

1. Safety
2. Fire
3. Running
4. Disconnection
5. Smoke, fumes

SESSION-2

Fill in the blanks

1. Motivates
2. Deep
3. Disinfectants
4. Degreaser
5. Regular

SESSION-3

True/false

1. False
2. True
3. False
4. True
5. True

SESSION-4

Fill in the blanks

1. Communication
2. Tone , method
3. Machine operating
4. Sensitive protective
5. Repairs, modifications, maintenance

MODULE-5

SESSION-1

Fill in the blanks

1. Health, security
2. Fire extinguishers
3. Emergency
4. Oily
5. Proper sanitary facilities

SESSION-2

Fill in the blanks

1. Emergency
2. Physical injury
3. Workstation
4. Chair
5. Breaks

True/false

1. False
2. True
3. False
4. False
5. True
6. True
7. True
8. False

SESSION-3

Fill in the blanks

1. Hazard
2. Identification
3. Entanglement
4. First aid
5. Assembly points

Identify and name the safety signs

1. Wet floor
2. Smoking ban sign
3. Hazardous substance
4. Flammable substance

SESSION-4

Fill in the blanks

1. Supervisor
2. Emergency response
3. Emergency
4. Exit door

MODULE-6

SESSION-1

Fill in the blanks

1. Audit
2. Compliance audit
3. Financial
4. On-site

SESSION-2

Fill in the blanks

1. REACH
2. CE
3. Label

4. Zero discharge of hazardous chemicals
5. Generalised system of preferences

SESSION-3

Fill in the blanks

1. Quality standards
2. Code of ethics
3. Corporate social responsibility
4. Apparel export promotion council (AEPC)
5. Discriminate

SESSION-4

Fill in the blanks

1. Social
2. Code of Ethics
3. 8
4. Corrective action plan (CAP)

GLOSSARY

Approved sample or prototype sample- It is the first sample which is used as a guide for all of the production for a particular garment style.

Bar tacking: When a series of stitches are used to strengthen any particular area of a garment that may be subject to stress or additional wear.

Buttonhole: A slit made in a garment to insert a button for fastening.

Cost Sheet- A garment cost sheet is a sheet that is used to calculate the cost of a single piece of clothing. The material and processing costs are included on the cost sheet.

Crimp: It is the natural wavy structure of wool fiber.

Custom-made: Any order which is built according to buyer's specifications.

Drafting- Drafting is the process of preparing a pattern by taking measurements from a person, form, or model, in order to create a foundation, which is used as the basis for design.

Environmental sustainability- The responsibility to maintain natural resources and protect global ecosystems in order to support health and wellbeing is known as environmental sustainability.

Exporter: An individual, country, or company that export goods or services to another country for sale.

Fabric- A fabric is two dimensional structure which is produced by weaving, knitting or other techniques of bonding the yarns.

Fit samples- Fit samples are garments made by a manufacturer so that the company buying the product may inspect them to ensure they fit properly on the human body or dress form of a standard measurement.

Fit- The fit of a garment is determined by how closely its measurements match to those of the body.

Forecasting: Forecasting is prediction of colors, textures, silhouettes, fabrics, prints, footwear and accessories which will be in the upcoming trends on the runway and in retail stores.

Grading- Grading in a pattern is the process of creating a range of sizes for a single apparel style. The purpose of grading is to properly fit a pattern to a range of sizes.

Interlining-An extra layer of fabric which is used under the main fabric of a garment to provide warmth and strength to the garment for ex: men's coat. It is sandwiched between the main fabric and the lining.

Job card: A job card is a document of production unit which describes schedules and planning of each process of a product as per customer requirements.

Lustre: Lustre is the shine of any fabric or garment.

Marker Making- A marker is a kind of stencil that shows how pattern pieces should be cut of one or more garments from several layers of fabric.

Marker-It is a full scale pattern used for cutting parts and components of garment. It indicates the fabric arrangement of all the components of a garment.

Merchandising- Promoting the sale of goods, especially by their presentation in retail outlets.

Ornamentation: Decorative elements which are added to garments to enhance its appearance.

Over-locking: Sewing (a seam, hem, or edge) with a particular stitch that prevents fraying.

Pattern- A pattern is used as a guide to cut parts and components of a garment from fabric for sewing.

Pattern blocks- The pattern block is the sewing pattern created for the clothing style that has been perfected for a good fit. The pattern block is generally used to build a new clothing style with minimal need for pattern revisions and corrections.

Pattern Making- A pattern is the template from which the parts of a garment are traced on the fabric before being cut out and assembled. Patterns are usually made of paper and sometimes of paperboard or cardboard if they need to be more robust to withstand repeated use.

Sampling- Sampling is the process of making proto-type sample of a product prior to starting bulk production.

SOP- Standard Operating Procedures refer to a step by step instruction set by an organization for a particular work.

Wrinkle: These are the unintentional and unwanted creases in fabric.

Yoke: A yoke is a shaped pattern piece which is attached to form a part of garment.

List of Credits

Graphics

Verma Prachi – Fig. 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.10, 1.11, 1.12, 1.13, 1.14, 1.15, 1.16, 1.17, 1.18, 1.19, 1.20, 1.21, 1.22, 1.23, 1.24, 1.25, 1.26, 1.28, 1.29, 1.33, 1.40, 1.49, 1.50, 1.51, 1.52, 1.53, 1.54, 1.55, 1.56, 1.57, 1.58, 1.59, 1.60, 1.61, 1.62, 1.63, 1.64, 2.2, 2.3, 3.1, 3.2, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10, 3.11, 3.12, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 4.10, 4.11, 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9, 5.10, 5.11, 5.12, 5.13, 5.14, 5.15, 5.16, 5.17, 5.18, 5.19, 5.20, 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 6.10, 6.11

Photographs

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