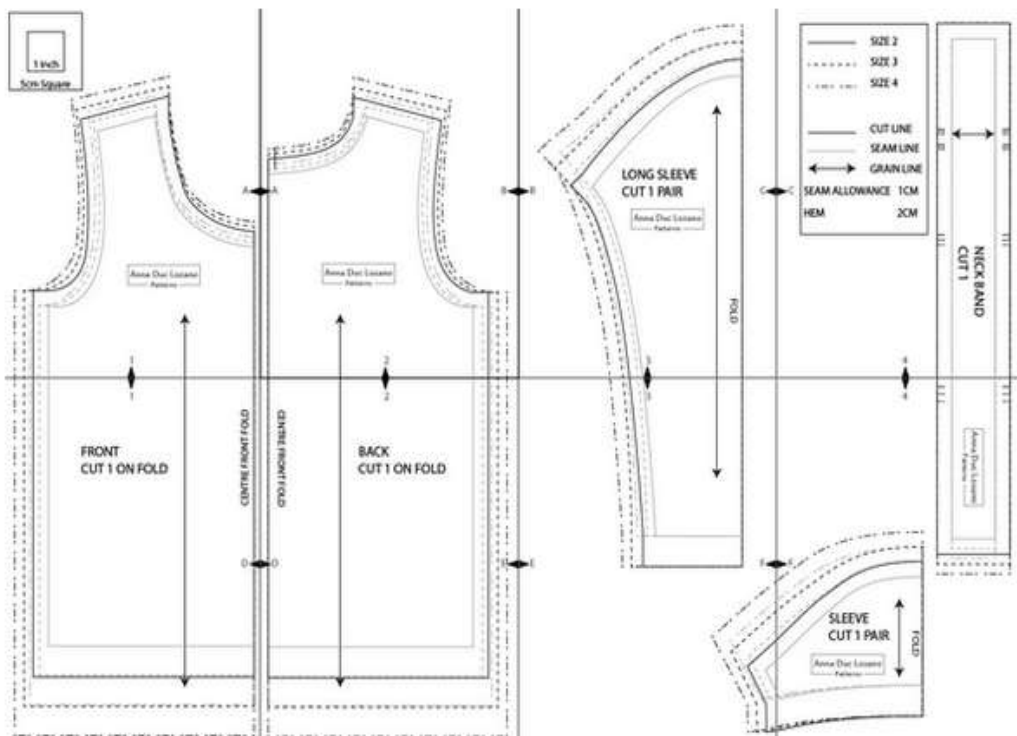


# Garment Production

## Level-II

Based on March 2022. Curriculum Version 1



**Module Title: Developing Pattern and Conduct Grading**

**Module code: IND GAP2 M03 0322**

**Nominal duration: 130Hour**

**Prepared by: Ministry of Labour and Skill**

**August 2022**

**Addis Ababa, Ethiopia**

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## Acknowledgment

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## Acronym

LAP Test =Learning Activity Performance Test

Teck Pack=Technical Package

Spec Sheet=Specification Sheet

OHS=Occupational Health and Safety

BOM=Bill of Material

2D=Two Dimensional

3D=Three Dimensional

HPS=High Point Shoulder

QC=Quality Control

CB=Center Back

CF=Center Front

CAD=Computer Aided Design

## Introduction to the Module

This module covers the knowledge, skills and attitudes required to develop patterns from a fashion illustration by using basic patternmaking and grading principles. The module includes the development of tech packs skills for the entire selected outfit of the range. This module is designed to meet the industry requirement under the garment production occupational standard, particularly for the unit of competency: **Develop Pattern and Conduct Grading.**

**This module covers the units:**

- Patternmaking tools and equipment
- Garment Tech Pack/ Specification,
- Design Blocks ,
- Patternmaking and Grading Principles and
- Pattern Tests

## Learning Objective of the Module

- Prepare drawing tools, equipment and workstation
- Develop a tech pack/ specification
- Select blocks to be used
- Apply basic patternmaking principles to develop patterns
- Test patterns
- Grading task and
- Complete patternmaking

## Module Instruction

For effective use this modules trainees are expected to follow the following module instruction:

1. Read the information written in each unit
2. Accomplish the Self-checks at the end of each unit
3. Perform Operation Sheets which were provided at the end of units
4. Do the “LAP test” giver at the end of each unit and
5. Read the identified reference book for Examples and exercise

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## Unit one: Patternmaking tools and equipments

This unit is developed to provide you the necessary information regarding the following content coverage and topics:

- Setting up workstation
- Set up Patternmaking tools and equipment
- Apply OHS practice

This unit will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- ✓ Set up patternmaking workstation according to ohs practices and specifications for work.
- ✓ Ready Patternmaking tools and equipments for use.
- ✓ Identify OHS practices and workplace practices for dealing with hazards.

## 1.1 Patternmaking tools and equipment

To work efficiently, the patternmaker must have the proper tools and supplies. To communicate effectively in the workroom and to minimize errors due to misunderstanding, the patternmaker should know and understand terminology. This unit introduces tools, supplies, and definitions of terms used in industry.

The professional patternmaker arrives on the job with all tools required for patternmaking. Each tool should be marked with an identity symbol and transported in a carrying case. For making better communication with the workroom and to minimize errors due to misunderstanding, the pattern maker should know and understand some terminology related to pattern-making tools. **Some tools and equipments are:**

- Pattern blocks, scissors for paper and fabric, ruler, square ruler, pencils, marker pens, hole punch, pins, fashion triangle, French curve, hip curve, pattern notcher, weights, tape measure, eraser, sharpener, tape, chalk
- Pattern making / grading: Formula collection for pattern making
- Pattern making paper, card board
- Selected fabric, facing material and accessories for cutting, Piece of fabric (Abujedid, bobline)



Fig: Pattern making tools

Fig 1.1 pattern making tools

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### 1.1.1 Functions of Patternmaking Tools

Tools provide the symbols used in marking fabric and patterns in the production of garments. Symbols are like a silent language that is understood among the designer, seamstress, grader, marker maker, and production personnel. Without these symbols, garments would not be cut or stitched with accuracy. Missing or misplaced symbols disrupt the flow of production. The entire above pattern making tools have explained the below with their function:

1. **Dress Forms:** A standardized duplication of a human form, cotton padded and canvas covered, set on a movable, light adjustable stand and compressible shoulders and sloper. It is used to take measurements, develop patterns, fit garment samples, to alter garments, to establish style lines for the garment.



**Fig.3.2.2. - Dress Forms**

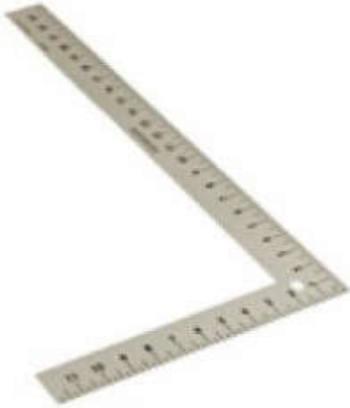


**Fig.3.2.3. - Measuring Tape**

2. **Measuring Tape:** Measuring tapes are very essential for acute drafting and perfection. It is used to measure a figure or a model form as well as drafting patterns. It is 60" long and ½" wide with metal strip on one side. Metal tips on either side help the tape to flat and keep the ends from fraying.

3. **Rulers:** It is a 12"/24" ruler used for drawing straight lines as per measurements. Wooden, metal and plastic rulers are available. The marking and divisions on the ruler should be clear and accurate.





4. Tailors square/ 'L' Square: A 24"X14" metal ruler with two arms that form a 90 degree angle. To find a 45 degree angle mark outside and inside corners extend line through corner. Tailors square are also available in plastic.

5. French curve: A curved ruler to draw curved lines of armholes and necklines in women's wear.

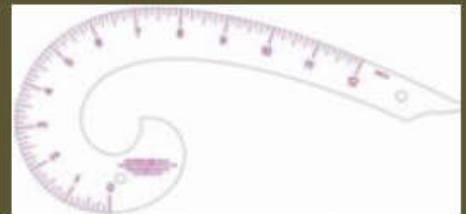


Fig.3.2.6. - French Curve



6. **Hip Curve:** A curved ruler to draw curved lines for women's wear. Hip curves are available in different sizes. Smaller ones are used for drafting in books in reduced scale.



**Fig.3.2.7. - Hip Curve**



7. **Scissors:** A cutting instrument, ranging in size from 8" to 12", with two sharply pointed straight blades. Used to cut paper patterns and fabric. Paper cutting scissors and cloth cutting scissors are different.

8. **Notcher:** It is a punching tool for producing U-shaped notch  $\frac{1}{4}$  inch deep by  $\frac{1}{6}$  inch wide. It is used to make notch marks which indicates seam allowance, central lines etc. It looks like a single punch machine.



**Fig.3.2.9. - Notcher**



**Fig.3.2.10. - Tailor's Chalk**

9. **Tailors' Chalk:** It is available in various colors with fine edges and used for accurate marking. These types of chalks rub off easily and can be used on right side of the fabric.





10. **Tracing Wheel:** it is used to transfer lines or symbols from one pattern to another or from final pattern to muslin or other fabric.



**Fig.3.2.11. - Tracing Wheel**



**Fig.3.2.12. - Pins & Holder**

11. **Pins & Pin holder:** A small firmly stuffed pillow made in a variety of shapes and sizes. It is used to hold pins, needles for easy accessibility and storage.



**Fig.3.2.13. - Stiletto**

12. **Stiletto:** A metal rod that tapers to a needle point, approximately 1/8 inch (3.2mm) in diameter by 3 to 8 inches (8 to 20 cm) in length, with a wooden or plastic handle. Typical uses are punching dart ends on blocks or patterns, marking placement of pockets, trimmings, or bands on patterns, marking punch-hole placement in fabric.



**Fig.3.2.14. - Brown Paper**

13. **Thick brown paper:** Brown paper is used for drafting. Use strong brown papers for finished pattern. Used for preliminary patterns drafting and development of the final pattern.

## 1.2 OHS practice

May include but not limited to:

- Manual handling techniques
- Standard operating procedures
- Personal protective equipment
- Safe materials handling
- Implement in work flow rest breaks
- Ergonomic arrangement of workplaces
- Following marked walkways
- Safe storage of equipment
- Cleaning of work space

The apparel industry is a labour-intensive industry. In an existing garment factory or in a new set-up workers' health and safety must be considered in the first place. Workers are the main resources that keep the machine running in a factory, and making the desired products. In an unhealthy workplace, workers could not work for a long time. All companies must follow health and safety policies.

In a garment unit, you need to take care of the following points at the factory level.

- First aid box
- Maintain accident resister
- Fire extinguishers with marked area
- Emergency lights on the floor and in the path to the exit
- Fire alarm
- Exit signs
- Exit doors should be kept open while the factory is working
- Yellow lines on the shop floor to demarcate a pedestrian pathway and space for machines
- Factory layout and evacuation plans
- No obstruction in the aisles on the shop floor
- No cables left loose or visibly hanging
- Enough light to the shop floor
- Broken needle record policy
- Canteen for workers
- Enough toilets for workers and members of staff
- Safety measures followed at every workstation
- Adequate pure drinking water supply
- Encourage workers to use safety masks where needed
- Voluntary overtime work

### 1.2.1 Safety measures:

Following are few examples of work safety that must be followed in the shop floor.

#### Fabric Store

- a) Don't keep fabric roll on the floor. Store fabrics on the racks or on pallets
- b) Keep enough space for walking and fabric and other item movement
- c) Musk
- d) have air ventilation and enough light.

#### Cutting Section

- Wear metal hand gloves while operating cutting machine
- Don't use loose wire. All power supply must be covered
- Wear mask

#### Stitching floor

- a) Use Needle guard while operating on a sewing machine
- b) Keep walking space free of obstacle
- c) Wear mask in the sewing floor
- d) Keep enough space at each sewing workstation for operator movement
- e) Provide height-adjustable chair to workers
- f) Enough light

#### Finishing section

- Wear a mask while working on a chemical process
- Keep steam pipelines insulated

## Self check-1

### Test-I Matching

Instruction: select the correct answer for the give choice. You have given 1 Minute for each question.  
Each question carries 5 Point.

A	B
-----1. OHS practice	A. Used for drafting
-----2. Thick brown paper	B. Persona protective equipment
-----3. French curve	C. Used to transfer lines or symbols from on pattern to another
-----4. Tracing wheel	D. Used to make notch marks
-----5. Notcher	E. Used to draw curve lines of armhole.

### Test II: short Answer

**Instruction:** write short answer for the given question. You are provided 3 minute for each question and each point has 5Points.

1. What are the required take cares someone who working in garment industry?
2. Why you use patternmaking tools and equipments in pattern workstation?
3. Write the function of patternmaking tools and equipments?

Note: Satisfactory rating – above 60%      Unsatisfactory - below 60%

You can ask you teacher for the copy of the correct answers

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## Unit Two: Garment Tech Pack/ Specification

This unit is developed to provide you the necessary information regarding the following content coverage and topics:

- Identifying entire outfit
- Interpreting and understand garment tech pack
- Preparing garment tech pack for entire outfit

This unit will also assist you to attain the learning outcomes stated in the cover page.

Specifically, upon completion of this learning guide, you will be able to:

- ✓ Identify the entire outfit
- ✓ Prepare a techpack for the entire outfit
- ✓ Complete pattern specification sheets and attached to patterns for storage.





## 2.2.2 Tech Pack

Tech pack or Technical Package is a detailed blueprint describing a product's design so it can be manufactured accurately to achieve the look desired by the designer. A Tech pack is typically a document created by designers, technical designers, and product developers. It includes design sketches, measurements and specs, color ways, bill of materials, material images, packing instructions, care instructions, construction details, and much more.

Techpack is a dynamic document that needs to be updated after every product change. Designers and product developers need to continuously work on the tech pack to provide accurate details of a product to the manufacturer.

OCS Online Clothing Study		Apparel Tech Pack				www.onlineclothingstudy.com	
Style No.	Description	Collection	Category	Created by	Date		
FMFRNM001	H/S Crew Neck Tee	SS-15	Men	Abc	11/6/2014		

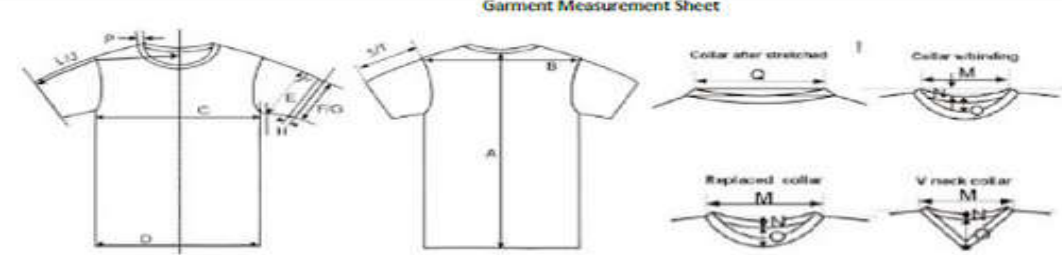
Garment Measurement Sheet								
								
Measurement set: 01 UOM: CM (Note: Measurements are not approved. Ensure to use approved measurement for bulk)								
Code	NAME	XXS	XS	S	M	L	XL	Allowance (+/-)
A	LENGTH OF BACK ON CENTER	48.00	51.00	54.00	58.00	62.00	66.00	
B	LENGTH OF SHOULDERS ON BACK	31.00	32.50	34.00	36.00	38.00	40.00	
C	1/2 WIDTH OF CHEST	37.00	39.00	41.00	44.00	47.00	50.00	
D	1/2 WIDTH OF BOTTOM	37.00	39.00	41.00	44.00	47.00	50.00	
E	1/2 WIDTH OF SLEEVE 2 CM UNDER ARM HOLE	13.50	14.50	15.50	17.00	18.50	20.00	
F	1/2 WIDTH OF BOTTOM SLEEVE	12.50	13.00	13.50	14.20	14.90	15.60	
J	LENGTH OF SLEEVE FROM 1/2 NECK HOLE	28.00	30.00	32.00	34.00	36.00	38.00	
M	WIDTH OF NECK HOLE	15.90	16.20	16.50	17.00	17.50	18.00	
N	DEPTH OF BACK NECK HOLE	2.50	2.50	2.50	2.50	2.50	2.50	
O	DEPTH OF FRONT NECK HOLE	6.10	6.30	6.50	6.80	7.10	7.40	
P	HEIGHT OF COLLAR / RIB WIDTH	2.00	2.00	2.00	2.00	2.00	2.00	
Q	1/2 MINIMUM NECK HOLE WIDTH, AFTER STRETCHED	26.50	27.00	27.50	28.20	28.90	29.60	
S	LENGTH OF SLEEVE FROM SHOULDERS	12.50	13.75	15.00	16.00	17.00	18.00	

Fig 2.2 Apparel Tech pack

### A typical tech pack include

**Product Summary** – This includes a design cover image (typically a flat sketch). Also, a product code, name, description, color, date of creation, last modification date, season, material description, supplier, selling price, country of origin, and product life cycle stage.

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**Technical Drawing**– Technical drawings specify product details from different angles – front, back, side and inside.

**Measurements/spec sheet** – This includes measurements (point of measures) across all sizes of the product along with any tolerances.

**Colors Pitching** – This lists the different product color ways (or options) and describes which color body part goes with which product color way.

**Care Instructions** – Details all the care instructions, care symbols, and material composition included in the product’s care label.

**Bill of Material** – Bill of Material (BOM) is the list of all components required to create the final product along with their quantity, size, price, and supplier. Items included are fabrics, care labels, buttons, zippers, hangers and packaging materials etc.

**Material Images** – This includes pictures of all the materials and components used in the product.

**3D Images and Assets** – These include the 3D product images created using 3D design software.

**Comments and Feedback** -This section is used once the first sample of the product is received. Product development team can review the sample and add comments and feedback for any changes they expect from the manufacturer.

## 2.2.3 Important of Teck Pack

**Reduces errors** – A good tech pack contains all the information about a product. In other words, a tech pack is a comprehensive explanation of the expectations a designer has from the manufacturer. It clearly communicates all the product details, which decreases the chance of mistakes.

**Avoids Delays** – When details are clear in a tech pack, it enables the factory to plan manpower, resources and block production capacity. This avoids delays in launching new products to market.

**Controls Quality** – Whenever product samples are ready, a tech pack can be used as a reference to check quality.

**Saves Time** – With tech packs, the manufacturer can make your product accurately the first time around. This saves time involved in re-work, re-approvals and production.

**Improves Collaboration** – Techpack enhances collaboration and removes information gaps.

**Decreases Cost** – Firstly, brands can send a tech pack to multiple manufacturers and receive product quotes to compare and negotiate prices, quantities, and terms. Secondly, a detailed tech pack reduces revisions, therefore reducing the overall product development cost and time.

**Accurate Quotations** – A tech pack with a detailed breakdown of the product enables the manufacturer to quote product costs accurately. If required, the manufacturer can also provide a detailed cost breakdown by component (materials, trims, packaging, labor etc).

## 2.2.4 Difference Tech pack and Spec sheet

### A Spec Sheet includes:

- |   |                        |
|---|------------------------|
| a) Product Code (Style Number For Fabric And Fabrication) | e) Placement details.  |
| b) Product Description                                    | f) Materials and Trims |
| c) Technical Sketch                                       | g) Reference Materials |
| d) Detailed Measurements                                  | h) Graded Spec         |

### A Techpack includes:

- |   |  |
|---|--|
| • A Pattern   | • Bill Of Material (BOM)   |
| • Testing Details (FPT and GPT requirement)                                 | • Updated with comments on garment samples submitted to buyers. Mainly size set sample and PP sample comments. |
| • Costing Details   | • Some buyers also include mini marker and fabric consumptions in the apparel techpack                         |
| • Quality requirement   | • Test requirements  |
| • Technical sketch  | • Quality Control  |
| • Workmanship and stitching instructions                                    |  |
| • Sample of Fabric, colour combination for trims for different base colours |  |
| • Packaging Information   |  |

## 2.3 Steps to build a specification sheet and a tech pack

### 2.3.1 Steps to Build a Specification Sheet

The following steps are involved in making a **garment** spec sheet.

1. Develop a spec sheet template
2. Fill up the basic information regarding the design
3. Make a technical sketch of the garment
4. Specify all the measurements of the finished garments
5. Technical information to be provided on the spec sheet

#### Step-1: Develop spec sheet template

To prepare a spec sheet for the new design, you first need to develop a spec sheet template.

#### Step-2: Fill up the basic information regarding the design

At the top of the sheet these all information's are mentioned:

- Company logo
- Product description
- Product style and code
- Season of the style
- Buyer Name
- Fabric Design

#### Step-3: Make a technical sketch of the garment

The front page of a Specification Sheet usually contains pictures of front and backline sketches of the product. The drawings/sketches are usually produced using Adobe Illustrator or could be made with hand as well.

#### Step-4: Specify all the measurements of the finished garments

The measurements play a very crucial role in deciding the fit of the garment. Pattern makers use measurements as a guide for the general size and fit of a particular finished garment. So some of the POM's are as follows:

1. Body Length: length of the garment from HPS (high point shoulder) to the bottom sweep.
2. Across Chest: Measured 1" below armhole horizontally from edge to edge.
3. Waist: Measured horizontally from edge to edge to a specific distance below HPS.
4. Bottom Hem: Measured side seam to seam
5. Shoulder seam: Measured from HPS along the seam or along the natural fold line to the outer shoulder edge.

6. Across Front: From specified point below HPS, measure straight across edge to edge of armhole.
7. Across Back: From specified point below HPS, measure straight across edge to edge of armhole.
8. Bicep: Measured 1” below armhole, measured straight across edge to edge parallel to the sleeve opening.
9. Cuff/Sleeve Opening: Measure along cuff/sleeve opening, edge to edge.
10. Front Neck Drop: From back neck seam to top edge of the front neck.
11. Back Neck Drop: From imaginary line to the top edge of back neck seam.

### 2.3.2 Steps to Build a Tech Pack

1. Produce a tech pack for every item you design.
2. Don’t forget to include your pattern (physical or digital file).
3. Every sample received and revision notes documenting the development should be included.
4. Ideally, attach the Techpack to a sealed sample.
5. Don’t forget to include packing and QC checklists.





### 2.3.4 Sample garment tack pack for entire outfit

Here is a sample image of cover page of techpack.

DRESS SAMPLE SPECIFICATION WORKSHEET					
SEASON	Spring 2013		DATE	Monday, January 23, 2012	
GROUP NAME	Wine and Roses		STYLE #	1242012	
SIZE CLASSIFICATION / RANGE:	Missy / 0 - 12		TECHNICAL DESIGNER:	Kara Pelletier	
FABRIC NAME:	Poplin		PRODUCT CATEGORY:	Dresses	
FIBER CONTENT:	100% Cotton		BRAND / LABEL	J. Crew	
STYLE DESCRIPTION:	Sleeveless dress with fitted bodice and box pleated A-line skirt				
POINT OF MEASUREMENT				SKETCHES	
MEASUREMENTS ARE:		Circumference		SIZE:	8
POI #	Description	Body Measurement	Functional Ease	Design Ease	Requested Measurement
1	Front Length from HPS				34
10	Chest Width (1" below armholes)	35 1/2	1		36 1/2
13	Across Shoulder	15 3/4			15 3/4
20	Waist Width (14" from HPS)	27 1/2	1		28 1/2
31	Hip Width (24" from HPS)	38	2		40
95	Sweep				50
43	Armhole width - Curved	16	1/4		16 1/4
60	Front Neck Drop (HPS to seam)				3
61	Back Neck Drop (HPS to seam)				2
63	Neck Width (HPS to HPS)				11 3/4
156	Shoulder Slope				2
<a href="https://textilelearner.net">https://textilelearner.net</a>					

Figure-1: Cover page of Tech pack

Here is a sample image of the technical sketch.

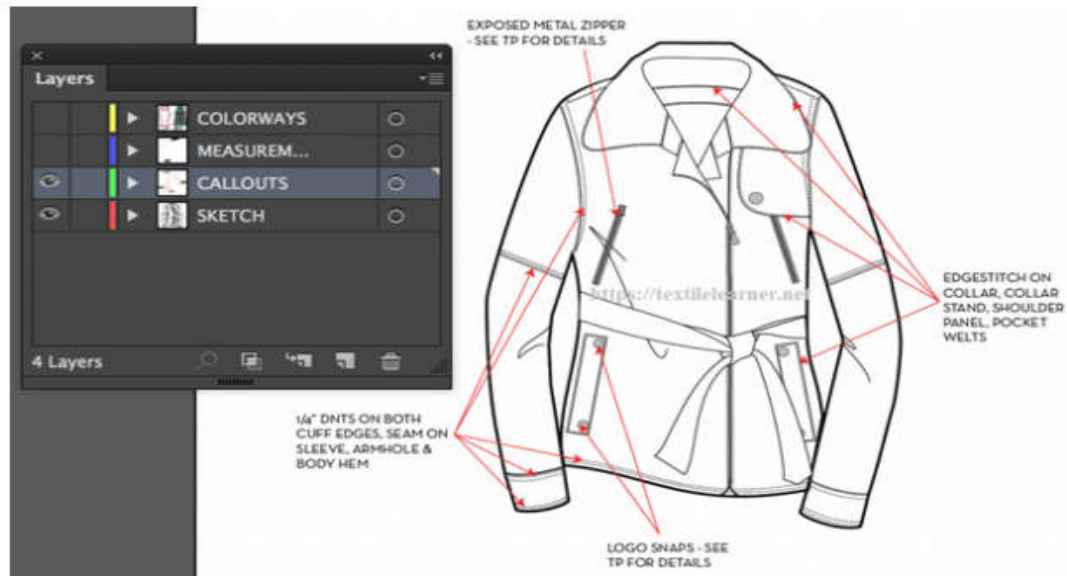


Figure-2: Drawing technical sketch in Adobe Illustrator





**Fig 2.3 girls 7-16 skirts tech pack**

## Self check 2.1

### Test-I Matching

Instruction: match the correct answer from column “A” with column “B”. You have given 30 Minute for each question. Each question carries 3 Point.

A	B
-----1. Technical Package	F. Company logo
-----2. Garment entire outfit	G. Product Summary
-----3. Spec sheet	H. Describes your product in technical detail
----4. Content of teck pack	I. Detailed blueprint describing a product’s design
----5. Basic information at the top of spec sheet	J. Harmonious garments and accessories worn together

### Test II: short Answer

**Instruction:** write short answer for the given question. You are provided 3 minute for each question and each point has 5Points.

1. What are the important of teck pack?
2. Write down at least three contents of teck pack?
3. What is the difference between teck pack and spec sheet?
4. Explain garment entire outfits.

Note: Satisfactory rating – above 60%      Unsatisfactory - below 60%

You can ask you teacher for the copy of the correct answers

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## Operation sheet 2.1

- **Operation title:** Girls 7-15 skirts teck pack
- **Purpose:** To understand skirts garment design technical package preparation.
- **Instruction:** Using the figure below and given required information of teck pack with detailed sketch. You have given 3hours for the task and you are expected to write the answer on the given line.

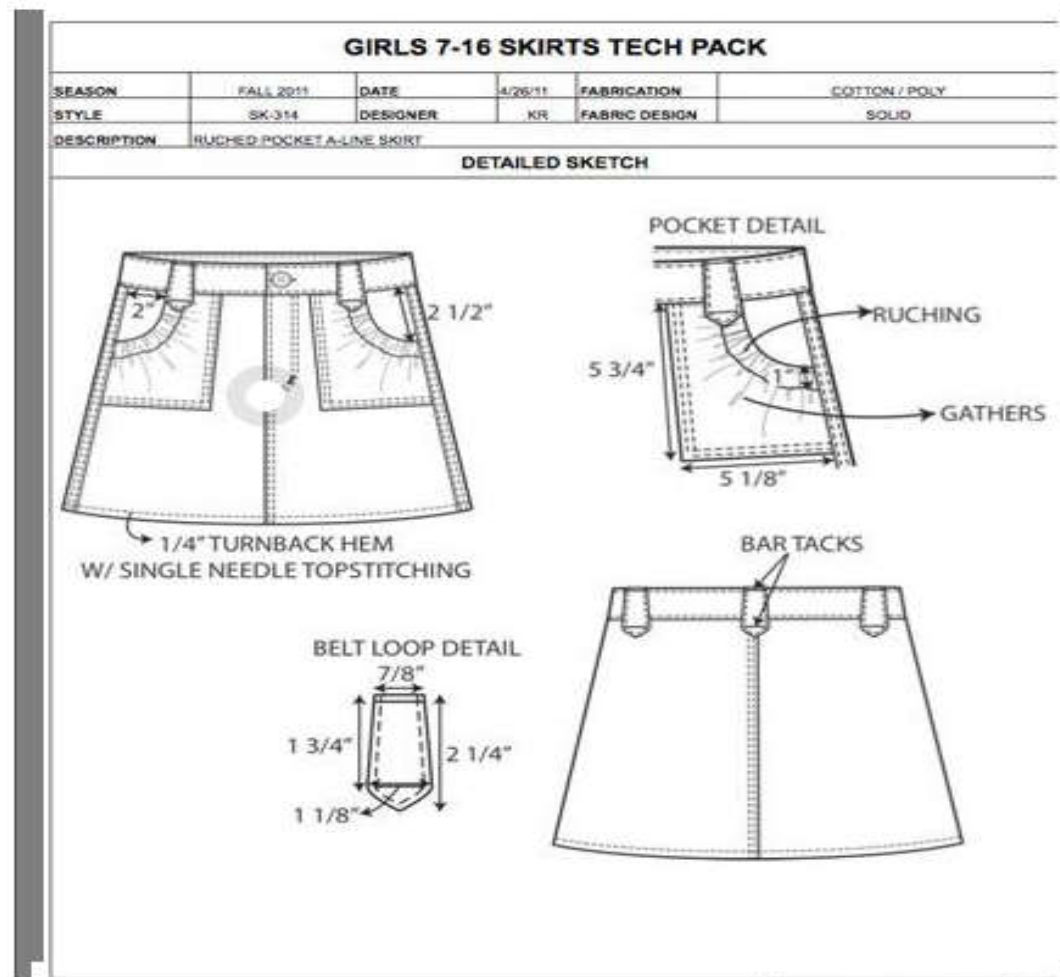


Figure given for operation sheet 2.1

- **Tools and requirement:** ruler, paper, hip curve rulers, pencil and eraser,

- **Steps in doing the task**

1. Produce a tech pack for every item you design.
2. Put your pattern (physical or digital file).
3. Include every sample received and revision notes.
4. Attach the Techpack to a sealed sample.
5. Include packing and QC checklists.

- **Quality Criteria:** the given information and detailed sketches are set clearly at accurate place.

- **Precautions:** use the right tools for the right purpose.

## Lap Test 2.1

**Instructions:** Given necessary templates, tools and materials you are required to perform the following tasks within 4 hour.

- Task-1: Perform liner measurement using ruler
- Task-2: perform detail sketches every items of the design.
- Task-3: mark the required information's and symbols from the design
- Task-4: Test everything through QC checklists.

## Unit Three: Design Blocks

This unit is developed to provide you the necessary information regarding the following content coverage and topics:

- Analyzing block design
- Identify fabric performance characteristic to affect pattern piece
- Preparing plan to develop pattern
- Determining ease allowance
- Selecting appropriate block

This unit will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- ✓ Analyze Design to identify appropriate modifications.
- ✓ Identify Fabric performance characteristics that may affect garment pattern.
- ✓ Plan pattern development according to design, material, measurements, quality standards and workplace practices.
- ✓ Determine Ease allowances
- ✓ Select appropriate block.

### 3.1 Block Design

Block patterns are the basic shapes which are later transformed into new garment designs.

You might find them not only in the apparel field but in bag, shoes and many other fields, which I know nothing about. So let's get back to clothing.

The block pattern section might be divided into two categories: the basic block and the fashion block.

#### 3.1.1 Basic block

The basic block pattern is a parent pattern, a foundation from which all other styles evolve. It is a well-fitting pattern that is pretty simple and doesn't have any styling details. Usually, it has seam allowances, but some articles and books tell the opposite.

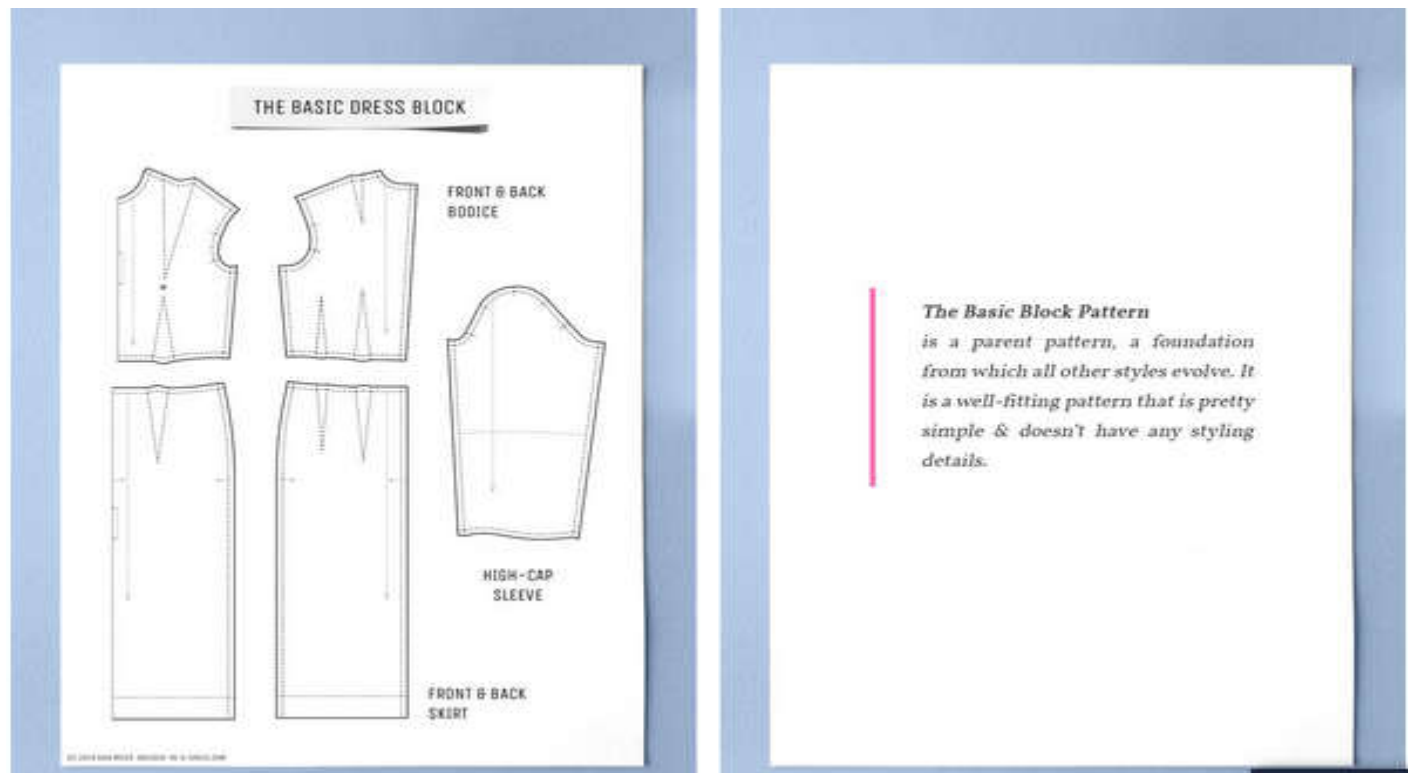


Fig 3.1 Basic Dress Block

#### 3.1.1.1 Types of Basic Blocks

Most of the time, the basic block has the minimal sufficient wearing ease. The most common ones are:

**Loose**—for designs with a relaxed fit;

**Semi-fitted**—like in a sheath dress;

**Fitted**—for sleeveless designs or fabrics that stretch.

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The basic blocks don't only differ in silhouettes—there are separate ones for **different types of clothing**:

- **Dresses, blouses and skirts**
- **Pants**
- **Jackets**
- **Coats, etc**

### 3.1.2 FASHION BLOCK

Fashion or intermediate block is a basic shape that is in use continually; it's a pattern piece that keeps popping up in many designs of a company or a wardrobe.

Every brand or every sewist will have a unique collection of fashion blocks.

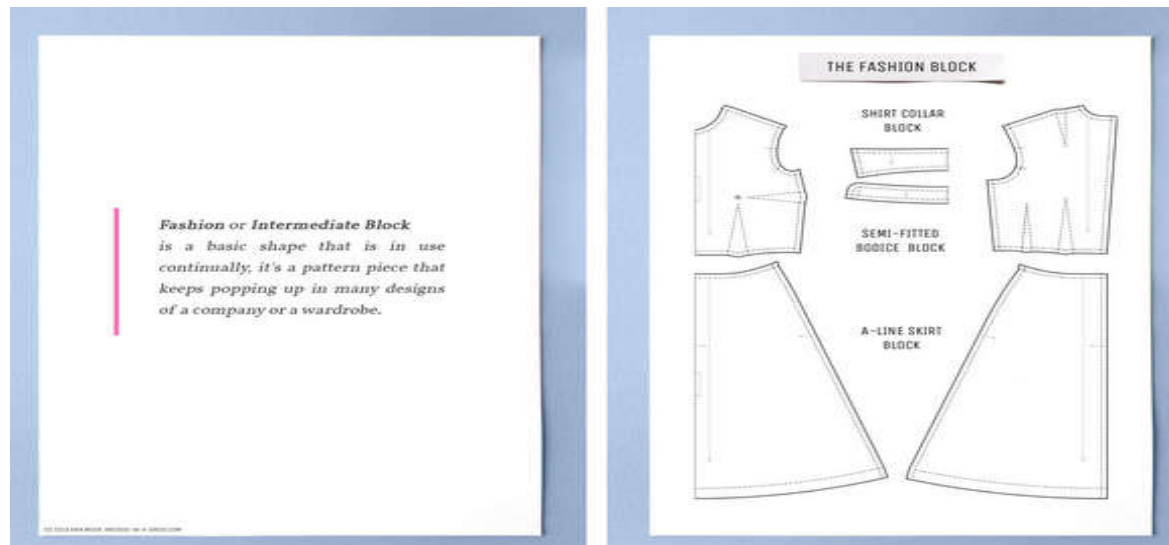


Fig 3.2 Fashion Block

### 3.1.3 Types of Block Pattern

Basically there are four different type of block, the standard block, the simplified block, the trade block and the tailoring block.

#### 1. Standard block

The standard block is most widely used basic foundation which follows the natural lines of the figure and is little influenced by other considerations. The main objective of standard block is to provide a reliable basis of correct proportions and fit. More specific blocks can be prepared with the help of standard block and every type of pattern can be checked.

The standard block is simple in construction and may be neutral as it need not emphasize fashions exaggerations. The Standard block is drafted without any turnings (seam allowance).

## **2. Simplified block**

Simplified block is produced by a simple method of drafting. It is very simple in construction so more suitable for schools and technical classes, where the primary object of drafting is to have a reliable pattern for practical dressmaking.

Simplified block is made to individual measurements.

## **3. Trade block**

The Trade block is an adaptation of the Standard block made to suit various requirements of the wholesale manufacturing trade. The proportions a trade block may follow one of the numerous ‘Size Charts’ used in the ‘wholesale’, or be adapted to fit a special dress stand. The block may emphasize or underline some current fashion trends.

Trade block includes all seam allowances and notches for high speed production of industry.

Trade blocks undergo constant modifications according to change of fashion, developments in factory technique and ideas in retailing (e.g. the sizing system in shops).

## **4. Tailoring block**

The Tailoring block is an adaptation of the Standard block. Tailoring block includes a few special features and proportions of mostly jacket patterns drafted by tailors. These special manipulations are related to the technique of high-class tailoring, to give a garment its correct final shape.

### **3.2 Fabric performance characteristic**

In garment manufacturing the main raw material used is fabric which is either woven or knitted or nonwoven. In addition to textile fabrics, sometimes leather and fur are also used in apparel manufacturing. The fabric should have appropriate texture and color according to end use. Cover factor, tensile extensibility, bending and shear rigidity, frictional hysteresis, thickness, and lateral compressibility are the important fabric properties. Fabric characteristics distinguish one fabric from another.





### 3.2.1 Physical Properties / Characteristics of Fabric:

Physical properties are generally the static physical dimensions of a fabric. The physical properties used for describing a fabric are given below.

1. Fiber or filament: type, size and length
2. Yarn: linear density, diameter, twist and number of ply
3. Weight: grams per meter or yards per pound
4. Thickness
5. Fabric structure: for woven fabrics: type of weave, count of war and weft, ends per inch (EPI), picks per inch (PPI). For knitted fabrics: type of knit, wales per inch (WPI), course per inch (CPI) and loop length
6. Non-fibrous matter: residual chemicals left over the fabric
7. Finishes: chemicals and mechanical finishes applied to the woven fabric to improve the durability, and/or utility values
8. Fabric width: the length of the filling or course
9. Color, hue, value and intensity: hue in color refers to the type of spectrum such as red, green, blue, yellow, etc. Value refers to the shade of spectrum such as light blue or dark blue. Intensity refers to the degree of brilliance such as bright light blue or dull light blue

10. Fabric density: weight per unit of volume

11. Surface contour: the geometric dimension of the surface plane

Six major categories of fabric characteristics that are of significance for the garment manufacturer are:

- |                            |   |
|----------------------------|---|
| A. Style characteristics   | E. Durability characteristics                 |
| B. Hand characteristics    | F. Garment production working characteristics |
| C. Visual characteristics  |   |
| D. Utility characteristics |   |

#### **A. Style Characteristics:**

Style characteristics generally change, which has an effect on the emotional appeal the fabric imparts to the consumer. This is validated when a customer handles a fabric and rates the fabric with adjectives like stiff, soft, hard, etc.

#### **B. Hand Characteristics:**

Hand characteristics are the transforms in the fabric surface with hand maneuvering which apply tensile, compression and molding forces on the fabric. The hand characteristics involve few utility characteristics. The characteristics that influence the fabric hand are:

- |                              |  |
|------------------------------|--|
| 1. Thickness compressibility | 7. Flexibility self flex, resistance flex, maintenance flex and reflex |
| 2. Plane compressibility     | 8. Resilience  |
| 3. Elongation                | 9. Gravity drape, gravity sag and gravity elongation                   |
| 4. Elasticity                |  |
| 5. Torsion                   |  |
| 6. Malleability              |  |

#### **C. Visual Characteristics:**

Visual characteristics are the changes in color values when either the fabric or light is moved. Visual characteristics can be measured in all its aspects with instruments such as the Cary or Farrand spectrophotometers used for measuring static visual values. This includes measuring color change due to either fabric or light movement.

#### **D. Utility Characteristics:**

Utility characteristics refer to the comfort, fit and wearing characteristics of a garment while the fabric experiences mechanical, thermal or chemical conditions during the usage of the garment. The

transmission and transformation are the two main types in this category. A transmission characteristic transmits mass or energy through the fabric. It alters physical properties of the fabric without obliterating the fabric.

**a) Transmission characteristics:**

- ◆ Weight
- ◆ Thickness
- ◆ Elongation
- ◆ Moisture transmission
- ◆ Radioactivity transmission
- ◆ Air permeability
- ◆ Water permeability

**b) Transformation characteristics:**

1. Color fastness
2. Crease resistance
3. Crease retention
4. Crack resistance
5. Dimensional stability
6. Felting (matting)
7. Fusing
8. Mildew resistance
9. Moisture absorption
10. Moisture retention (drying)
11. Pilling
12. Scorching
13. Soiling
14. Shrinkage
15. Static electricity
16. Yarn slippage

**E. Durability Characteristics:**

Durability characteristics are the ability of a fabric to retain the utility and style characteristics during wear. It is an indirect measure of stress, which destroys the fabric or its capability to retain the required style or utility characteristics.

The durability characteristics are:

1. Tearing strength
2. Tensile strength
3. Abrasive strength
4. Bursting strength
5. Corrosive strength
10. Radiation absorption strength
6. Dry cleaning durability
7. Fire resistance
8. Launder ability
9. Moth resistance
11. Yarn severance

## **F. Garment Manufacturing Working Characteristics:**

Garment production working characteristics affect the quality of product as well as cost of production. Some working characteristics, such as seam strength, are measured by durability limits. The working characteristics of a fabric are:

- Coefficient of friction (cutting, sewing, pressing and packaging)
- Sewed seam strength
- Sewed seam slippage (yarn slippage)
- Sewing distortions
- Yarn severage
- Bondability strength (fused, cemented and heat-sealed seams)
- Die mouldability
- Pressing mouldability

### **A. Characteristics of Woven Fabric:**

Two or more sets of yarns interlaced to form the fabric structure. Yarns interlace at right angles.

- Can be ravelled from any cut edge.
- May be bowed or skewed.
- Usually lighter in weight because less yarn is used.
- Possess limited stretch and adaptability to body movement.
- Bulkiness and recovery from wrinkle depend on weave structure.
- Stable to stress, less air permeable, especially with dense fabric.
- Provide maximum hiding power and cover.
- More stable in use and care.
- May shrink less than 2%.

### **B. Characteristics of Knitted Fabric:**

Series of interconnected loops made with one or more sets of yarns.

- Can be ravelled from top to bottom. Warp knits cannot ravel.
- Fabric can snag and run, bowed or skewed.
- Usually heavier because more yarn is used.
- Possess stretch and elasticity, adapts to body movement.
- Good recovery from wrinkles; air permeable.
- Possess open spaces between yarns and bulky.
- Porous and less opaque.
- Less stable in use and care.
- Higher shrinkage unless heat-set.

### 3.3 Pattern development

#### 3.3.1 Pattern

Patterns are the outline of each components of a garment. Pattern making is the technique to make patterns for all components of a garment. It is an art of manipulating and shaping a flat piece of 2D fabric into 3D garment form. Pattern making is a bridge between design and production. A sketch can be turned into a garment through a pattern which interprets the design in the form of the garment components. The job of a pattern maker is to interpret the designs into sample pattern pieces then drafting them. Pattern for a garment is the blue print on the

basis of which the fabric is cut.

Patterns are achieved by two methods namely, Flat method and Draping method.



**Fig 3.3 patterns**

##### 3.3.1.1 Importance of Pattern Making

- Basic pattern can be used for making dresses with same measurements.
- New patterns can be made by making changes in the basic pattern.
- Used for changing shapes & sizes.
- It is useful for both beginners and well-experienced persons.
- It helps to save time and cloth while cutting cloth using patterns.

##### 3.3.1.2 Types of Patterns

**1. Basic Pattern / Block Pattern:** The pattern we make for garment manufacturing is called a basic pattern. Different patterns suitable for different styles can be developed from this basic pattern. It is also called Sloper or Block pattern. e.g. Basic Bodice, Basic Skirt, Basic Sleeve etc

**2. Working Pattern:** For developing styles from a pattern, for slashing & manipulating, we use pattern, and these patterns are called working patterns. Different experiments and changes can be made in this pattern. e.g., Collar band, Pocket etc.

**3. Production Pattern:** The patterns we build up after completing it with necessary seam allowance

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and marking required is called production pattern. The information such as symbol, cut number, allowances etc. are marked. We cut clothes using this pattern.

**4. Industrial Patterns:** The patterns which we use for mass production in readymade garment industry are known as industrial pattern. e.g., Shirt patterns

**5. Commercial Patterns:** It is readymade patterns available in the market. It is constructed according to the standard measurements. It contains all instructions to cut and stitch the garments.

**6. Personal Patterns:** The Pattern which is used for customized tailoring is coming under this category which is being prepared for a specific measurement exclusively for a person.

**7. Graded Pattern:** In industry the patterns are graded according to the size requirement based on the order. Usually, the medium size patterns are graded to other sizes by applying grade rules.

**8. Computer Aided patterns:** Nowadays patterns are made through software with the given measurements and it is being graded to other sizes also.

### 3.3.2 Pattern- Making: Terminology

**1. Block/Sloper:** Sloper is a term given to a very basic set of pattern piece used to make patterns of any style. This is a term for a paper cutting of basic bodice, skirt, sleeve or any such basic pattern from which all the other designs are developed. Block normally represents the dimensions of a specific form or figure. It has darts to fit to the contours of the body but no other design features. It is a foundation that is used to make the pattern for a design and has no seam allowances. It is important that the correct block is chosen for the design; this not only saves time during adaptation but can affect the final shape. The basic blocks can be drafted to fit individual figures by using personal measurements instead of the standard measurements listed in the size chart.

**2. Muslin:** Muslin is used for making test fits. This is basically an unbleached plain woven cotton fabric. It is available in light, medium and heavy weight. Medium quality is used for test fitting and draping.

**3. Pattern:** Pattern is developed from the block that includes all the information needed for cutting And production of the garment including seam allowance.

**4. Seam Allowances:** The amount of seam allowance required for each seam line may vary depending on the location and end purpose. Generally the seam allowances as followed in the industry are -

- 1/4" – for sharp curves

- $\frac{1}{2}$ " – for smoother curves like neckline, armhole, waistline, style line, etc.
- 1" – for straight seam line like side seam, centre line, shoulder, plackets, etc.
- 2" – for straight edge hem line in dresses, skirts, etc.

**5. Ease:** Ease is the amount of a garment allows the wearer beyond the measurements of their body. Ease is not generally included in sizing measurements. Ease is comprised of two separate measurements, wearing ease and design ease. Wearing ease is the amount added to a person's body measurements so one can move in a garment. Design ease is the amount of fullness added at the key body points that creates the overall look or style of a garment. Wearing ease for different body parts are:

- Bust area – Add 2 to 4 inches to the bust measurement. The larger the bust and body size the more ease to factor in.
- Waist area – Add  $\frac{1}{2}$  to 1  $\frac{1}{2}$  inches to allow for turning around, bending and raising arms.
- Hip area – Add 2 to 4 inches, again, the larger the body size or give of the fabric, the more ease to consider.

**6. Grain Line:** Grain line is a line drawn from end to end on each pattern piece to indicate how the Pattern should align with the lengthwise grain of the fabric.

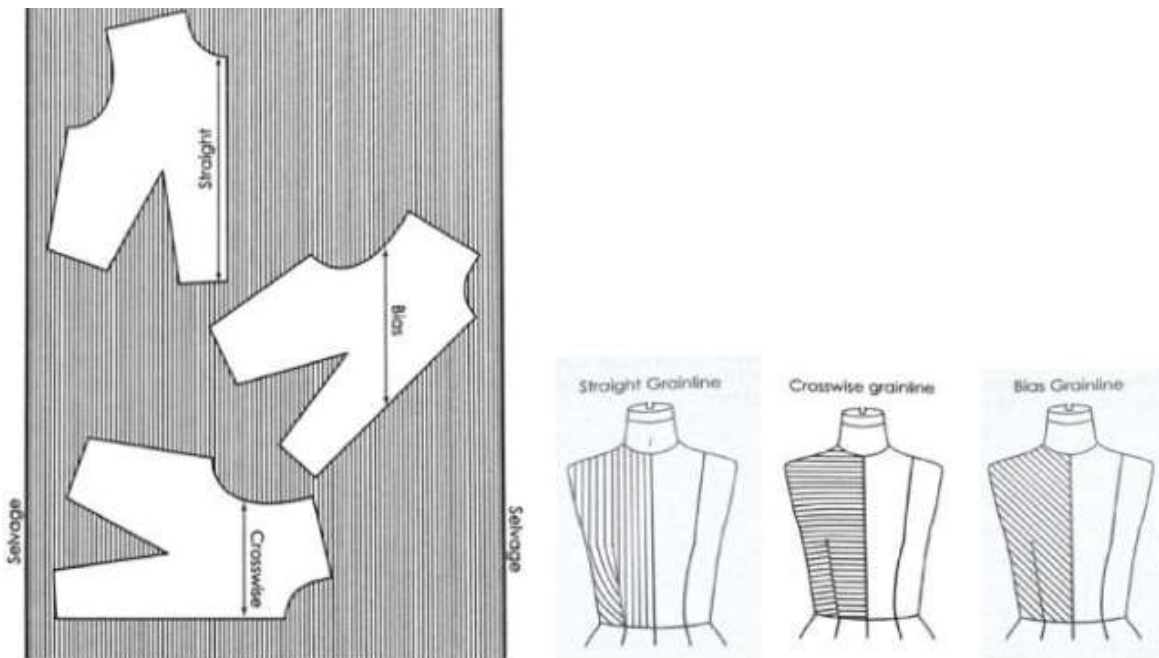
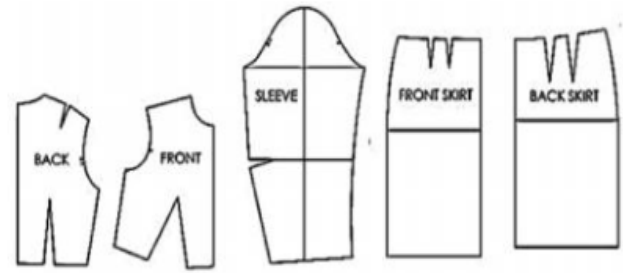


Fig 3.4 Grain Line

**7. Basic Pattern Set:** It is a 5- piece pattern set consisting of a front/back bodice front/back skirt and a long sleeve, which represents the dimensions of a specific form or figure. It is developed without design features and is always traced for pattern development.



**Fig 3.5 Basic pattern set**

**8. Balance:** Refers to hang and proportion of the garment.

**9. Balance Marks:** Marks made on edges of complimentary pattern pieces that indicate corresponding seam line and area. They are a useful construction guide on all seams.

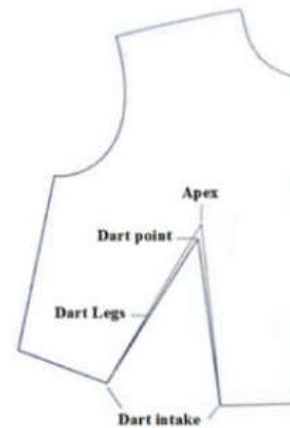
**10. Dart:** Wedge shape or triangular shape marked on the pattern that controls the fit of the garment.

**Dart legs:** The two sides of the triangular shape & should be of the same length.

**Dart point:** The point at which the dart ends.

**Dart intake:** The amount of suppression taken between the dart legs.

**Apex :** The highest point on the bust



**Fig 3.6 Dart**

### 3.3.3 Pattern Development

Pattern development is the process of transforming a design into its required flat pattern pieces and then drafting them out, the job of a pattern maker is to interpret the designer's into sample pattern pieces and then drafting them. Pattern making can be divided in two stages namely measuring correctly & knowledge of technique devised to include necessary seam allowances. Measuring the human body is the precursor to developing garments to fit the body. Pattern for a garment is the blue print on the basis of which the fabric is cut and the same is achieved by the following methods:

a. Draping Method

b. Flat Drafting Method

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### 3.3.3.1 Draping

Draping method is the oldest pattern making method and is generally regarded as a creative approach. In this method a piece of two-dimensional fabric is draped directly on a dress form or figure and made to fit on the dress form to achieve the desired look or shape. The fabric may conform to the basic shape of the form or arranged artistically in folds for a specific design. This muslin pattern is then transferred on the paper, corrections are made, if any, and then the same are converted into a final pattern.



**Fig 3.7 Draping**

#### a) Three Stages of Draping

- A muslin cloth is spread on a dress form & attached it to using a pin. Mark darts using tailor's chalk for getting correct size & shape. After fitting the dress correctly in the dress form, it is removed from the dress form.
- Then, using tracing wheel & carbon paper, the parts we marked in the muslin cloth and darts are copied on a brown paper. Thus, we can develop suitable patterns.
- Using temporary stitches we can make a dress and wear it on a dress form and after rectifying the defects it can be stitched.

#### b) Principles of Draping

- ✓ Always use grain lines.
- ✓ Straight grain should always run perpendicular to the floor and cross grain parallel to the floor.
- ✓ The body lines such as bust line, waistline, hipline etc should be parallel to the floor
- ✓ Use good quality pins that do not loose shape easily.
- ✓ Establish seam lines on the form

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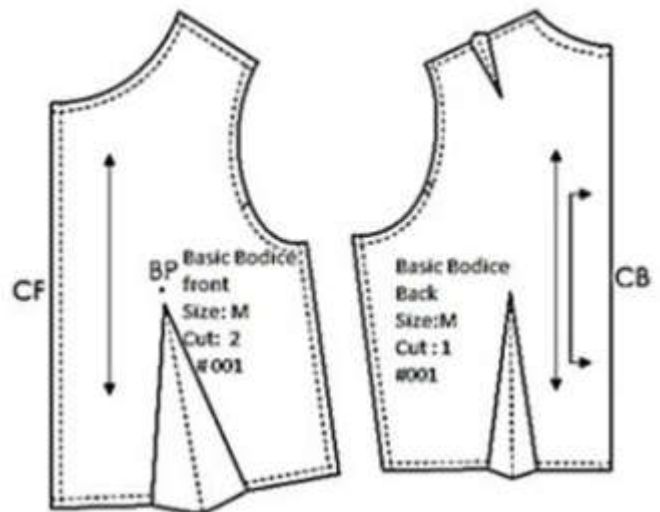
- ✓ Tear the muslin piece instead of cutting
- ✓ Check the balance of the warp and weft
- ✓ Mark grain line on muslin; mark cross grain at the fullest part of the dress form
- ✓ Place the muslin on the form as per the marked lines, place it in position with pins

### 3.3.3.2 Drafting

Flat Pattern Drafting is a method where body or dress form measurements are taken for developing a pattern. With step by step procedure, the measurements are then converted into a pattern. This system depends on accurate measurements to complete the paper pattern. There are limitless designs, which can be achieved for workable garments.

Flat drafting may be done in conjunction with a dress form so that as the design evolves, proportion and balance in the garment can be checked side by side. It is important to transfer the pattern on to muslin to test the fit, on a dress form or a human figure. Flat pattern cutting is now widely used because of its accuracy of sizing and the speed with which complicated designs are made. By manipulating basic blocks we can create new designs. Pattern drafting is a system of pattern cutting that uses a combination of ease allowance and body measurement taken from body measurement of the customer or dress form measurement to create patterns for the chosen design.

Drafting is easy to understand and is considered as the fastest and most efficient pattern design method.



**Fig3.8 Drafting**

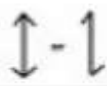





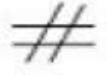
### 3.3.4 FINISHING OF PATTERNS

- Finishing of patterns means writing the name, size, number etc. on pattern pieces.
- Symbols are also used for easy cutting and use of patterns.




### 3.3.4.1. Pattern Information on Industrial Blocks

- The name of the each piece
- The size of the each piece
- Number of pieces to be cut
- Landmarks
- Symbols (Folding symbol etc.)
- Balance line marks
- Seam allowance
- Construction lines
- Grain lines
- Style number
- Notches - Marks that are needed to help assemble garment sections correctly.
- Directional Fabrics - For fabrics which have designs in one direction such as floral print, stripes, plaid, velvet, fur etc. A symbol "cut one way" or (?) is indicated on the pattern.
- Seam Allowances.

### 3.3.4.2 Symbol keys used in Pattern making

	Double headed arrow grain line or Direction of Warp yarn
	One headed arrow grain line or one way direction of Warp yarn
	Seam line
  	Punch/Circles or Perforation mark  Dart Symbol  Pleat Symbol
	Style Number



	<p>Cut no further or Cut up to the cross mark</p> <p>On fold symbol</p> <p>Vertical Button hole symbol</p>
	<p>Horizontal Button hole symbol</p> <p>Diagonal Button hole symbol</p> <p>Gathers symbol</p>
	<p>Slit mark</p> <p>Final line or Cutting line</p>

### 3.3.3.5 Difference between Block Pattern and Production Pattern:

There are some differences between them. This is discussed below:

Block Pattern	Production Pattern
Block pattern or basic block refers to the original pattern that fits a specific and ideal body structure, but without any special beauty enhancement structure, design or style.	The production pattern is created after the sample garment and its price are approved by the appropriate authority.
The block pattern is made for an ideal size.	Production patterns are made in different sizes for a larger number of productions.
The block pattern is based on the average size which is the ideal size.	Production patterns are created based on the working pattern of the sample garment.
Final production is not done by block pattern.	Final production is done by production pattern which is used for higher production.

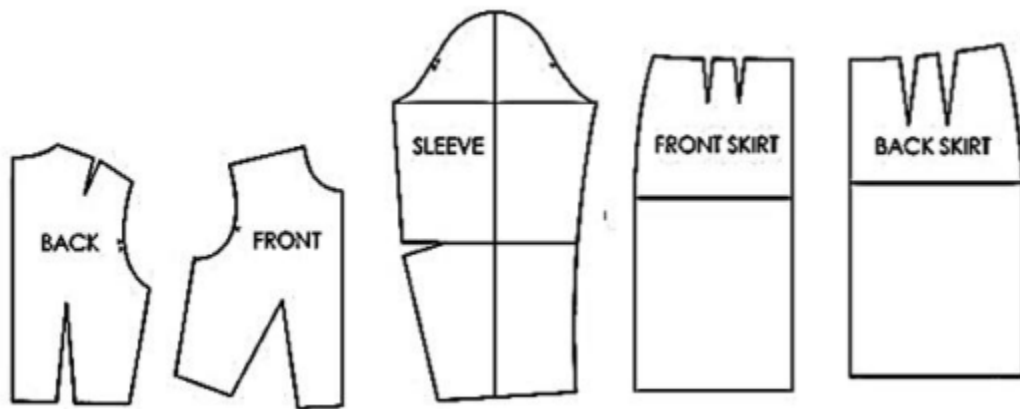
### 3.3.3.6 Pattern Defects

- Some parts of pattern are missing, -- probably because the marker did not include the correct number of parts.
- Mixed parts-- probably because the marker is not correctly labeled, resulting in a marriage of wrong sized parts.
- Patterns not facing in correct direction on napped fabrics. Not all patterns facing in same direction (either way) on a one-way fabric.
- Patterns not aligned with respect to the fabric grain.
- Poor line definition -- (e.g. too thick chalk; indistinctly printed line, perforated lay not powdered) leading to inaccurate cutting.
- Skimpy marking, --- caused by either the marker did not use the outside edge of the pattern; or the pattern was moved or swung after partial marking

### 3.4 Selecting appropriate block

#### 3.4.1 Drafting - Basic Pattern Set

The basic pattern is the foundation upon which pattern making, fit, and designs are based. The basic dresses made up of five distinct parts - Front bodice, Back Bodice, Front Skirt, Back Skirt and Sleeve.



**Fig 3.9 Basic Pattern set**

##### 3.4.1.1 Basic Bodice

Basic Bodice is one of the basic patterns that come under basic pattern set which covers the upper body part. It has darts to fit to the contours of the body but no other design features.

##### Measurements Required:

Center Back length (Full length) : 40 cm  
Chest/Bust : 88 cm

Across Shoulder : 36 cm

Waist Round : 76 cm

Shoulder to Bust Point : 24 cm

Bust Point to Bust Point : 18 cm

##### Drafting Procedure:

Square across and square down from zero.

0 - 1 = chest/2 + 6cm

0 - 2 = Waist length

Square down to mark 3

2 - 3 = 0 - 1

1 - 3 = 0 - 2

0 - 4 = Chest/4 + 3cm (for drafting back bodice)

Square down to mark 5

0 - 6 = chest / 4

Square across to mark 7

6 - 7 is the chest line.

0 - 8 = 1/12th chest for marking back neck width.

1 - 9 = 0 - 8

0 - 10 = 2 cm for back neck drop. Draw back neck curve 8 - 10

1 - 11 = 1/12th chest + 0.5 cm for front neck drop. Draw front neck curve by joining 9 - 11

0 - 12 = 1/2 shoulder

Square down up to chest line to mark 13

12-16 = 1.5 cm (1/2") for marking shoulder slope.

1 - 14 = 0 - 12

Square down till 15

14 - 17 = 12 - 16

Join 8 - 16 & 9 - 17

Mark point 18 where the chest line 6 - 7 intersect the centre line 4 to 5

Take the mid of 15 & 17 and mark 'a'.

a - a1 = 1.5 cm

Complete the curve by joining 17,'a1' and 18.

Take the mid of 13 & 16 and mark 'b'.

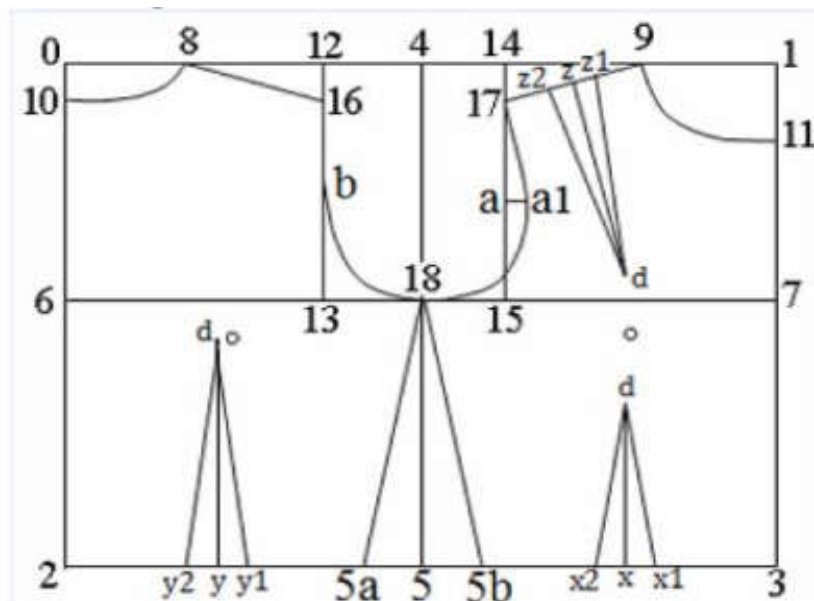
Complete the curve by joining 16,'b' and 18.

Measure 1.5 cm from point 5 on both side and mark 5a and 5 b.

Join 18 to 5a & 15 to 5b for side seam.

Shoulder to bust point = 24 cm

Bust point to Bust point = 18 cm.



**Fig3.10 Basic bodice**

## Dart

Dart width/ intake calculations

Front dart(x) = Bust round - Waist round + side

deduction/3

= 88 - 76 + 4 / 3

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$$= 88 - 70/3 = 8/3 = 2.66$$

Back dart(y) = Half of the front dart(x)

$$= 2.66/2$$

$$= 1.33$$

$$\text{Shoulder dart (z)} = \text{Bust} / 36 = 88/36$$

$$= 2.4$$

### Front Dart

Measure 3cm down for front waist dart from bust point and label dart point as 'd'. From 'd' draw a line down till the waistline, mark 'x'.

x - x1	=	½ waist dart width towards left
x - x2	=	½ waist dart width towards right.

Join x1 - d - x2.

### Back Dart

Measure 1 cm right from bust point and label dart point 'd'. From 'd' draw a line down till the waistline, mark 'y'.

y - y1	=	½ waist dart width towards left
y - y2	=	½ waist dart width towards right.

Join y1 - d - y2.

### Shoulder Dart

Find the mid-point on shoulder line mark z.

Draw a line from Z directing to Bust point, away by 3.5 cm and mark dart point 'd'.

z - z1	=	½ waist dart width towards left.
z - z2	=	½ waist dart width towards right.

Join z1 - d - z2.

Apply dart allowance for all the darts (Front Waist, Front Shoulder and Back Waist).

(Dart allowance should be approx. half dart width extended in the direction of center line (outside the block) of the dart and joined at the ends)

Complete the pattern with required pattern information

Mark grain lines and require land marks.

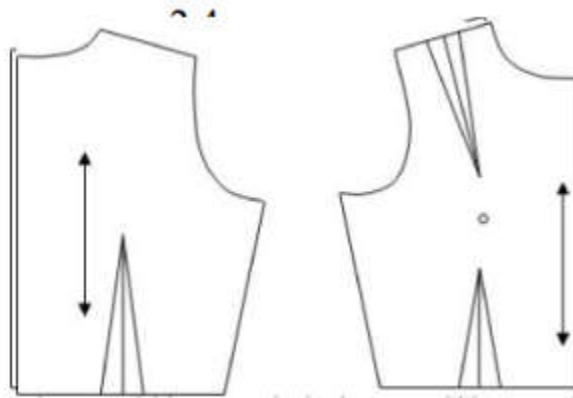


Fig3.11 Basic bodice Dart

### 3.4.1.2 Basic Skirt

Measurements Required		
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Skirt Length	:	29"
Waist Round	:	28"

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Hip Round	:	34"
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### Drafting Procedure

Square across and square down from zero.

0 - 1 = Skirt length

0 - 2 =  $\frac{1}{2}$  hip +  $\frac{1}{2}$ "

Square across from 1

and square down from 2 to mark the point 3.

0 - 4 =  $\frac{1}{4}$ th hip +  $\frac{1}{2}$ "

Square down to 5

Mark CB & CF.

0 - 6 =  $\frac{1}{4}$ th hip as waist to hip length.

Square across to 7 and mark line as hipline.

8 is the mid of 0 - 6

Square across from 8 to 9. Mark the line as top hipline.

4 - 4a =  $\frac{1}{2}$ "

Join 0 - 4a

0 - 10 =  $\frac{1}{4}$ th waist +  $\frac{1}{4}$ th ease allowance + 1.5" for two back darts.

Draw the curve line from point 10 to the hip line

Join 2 & 4a.

2 - 11 =  $\frac{1}{4}$ th waist +  $\frac{1}{4}$ th ease allowance +  $\frac{3}{4}$ " for the front darts.

Draw the curve line from 11 to the hipline.

12 is the mid of 2 & 4a.

Square down just before the top hip line.

12a = 12b

=  $\frac{3}{8}$ "

Join the dart legs

Divide 0 - 10 line into three equal parts and mark point 13 & 14

13 - 15 =  $\frac{1}{4}$ " before the top hip line.

13a = 13b

=  $\frac{3}{8}$ "

Complete the dart by joining dart legs.

Square down from 14 to 16 up to top hip line

14a = 14b =  $\frac{3}{8}$ "

Complete the dart by joining dart legs.

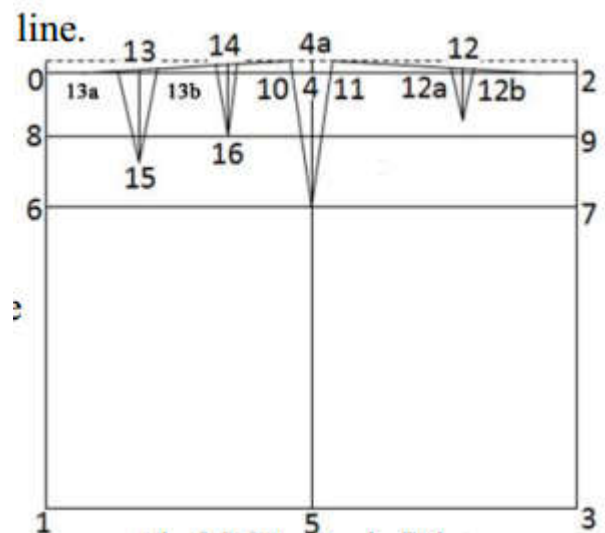


Fig3.12 Basic Skirt

### 3.4.1.3 Sleeve Measurements

Sleeve length : 22.5"

Chest/Bust : 34"

Sleeve Bottom : 7"

### Drafting Procedure

Square across and square down from zero.

0 - 1 = Sleeve Length,

0 - 2 = Chest/2 - 1½",

now square down from 2 - 3 and complete the block with dotted line.

4 is the mid of 0 - 2 and square down the line to

5. Now the block has been

separated for applying front and back sleeve armhole curves.

0 - 6 = 1/8 chest

Square across to 7

6 - 7 is the bicep line

Join 4 - 6 & 4 - 7

5 - 8 = 5 - 9

= 1/2 bottom

8 - 8a = 9 - 9a

= 5/8"

Join the wrist curve 8a, 5, 9a

Join 6 - 8a & 7 to 9a

Divide 4-6 into three equal part and mark as 'a'

and 'b'

a - a1 = 3/4" upward,

b - b1 = 5/8" upward

Take the mid of 4 - 7 and mark 'c'.

Find the mid of 4 - c & 7 - c and mark point d &

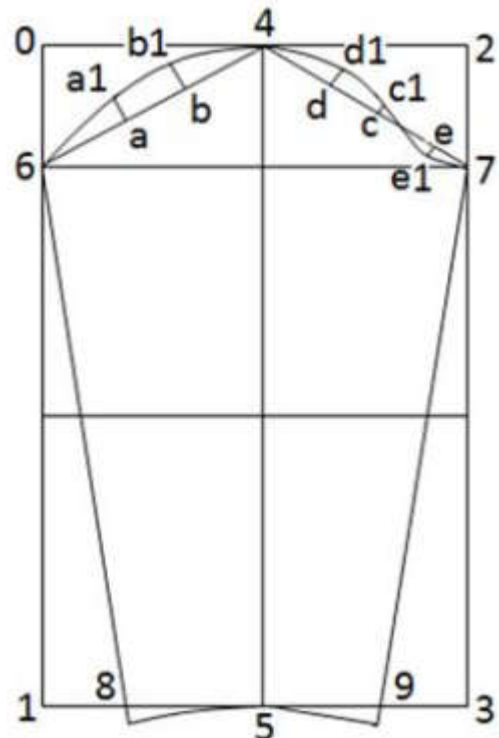
e.

d - d1 = 5/8" upward,

c - c1 = 1/8" upward

e - e1 = 1/4" down ward

join the curve line 6 - a1 - b1 - 4 - d1 - c1 - e1 - 7



**Fig3.13 sleeve**

## Self check-3.1

### Test-I Matching

Instruction: select the correct answer for the give choice. You have given 30 Minute for each question.  
Each question carries 3 Point.

A

- 1. Bloch pattern
- 2. Fabric characteristics
- 3. Production pattern
- 4. Standard block
- 5. Industrial pattern
- 6. Muslin

B

- A. Pattern with necessary seam allowance
- B. provide correct proportions and fit
- C. Durability
- D. Patterns use for mass production
- E. used for making test fits
- F. Basic shapes transformed into new garment designs.

### Test II: short Answer writing

**Instruction:** write short answer for the given question. You are provided 3 minute for each question and each point has 5Points.

- Mention types of block patterns and their functions?
- Explain significance of fabric characteristics for garment manufacturing?
- What are the methods of pattern making?
- List at least 5 pattern making terminology.

### Test III: Multiple choices

**Instruction:** select the correct answer from the given choices. You are provided 3 minute for each question and each point has 5Points.

1. ----- are the outline of each components of a garment.  
A. pattern      B. Dart      C. ease      D. draping
2. ----- are fabric characteristics changes in color values when either the fabric or light is moved.  
A. Utility      B. Visual      C. Transmition      D. Durability

Note: Satisfactory rating – above 60%      Unsatisfactory - below 60%

You can ask you teacher for the copy of the correct answers

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## Operation sheet 3.1

- **Operation title: Drafting knee-length basic skirt pattern**
- **Purpose:** To draft basic skirt pattern with a given measurement.
- **Instruction:** Using the figure below and given required measurement of knee-length skirt, drafting basic skirt pattern. You have given 3hours for the task and you are expected to write the answer on the given line.

- **Measurements required:**

- ✓ Waist:  $72\text{cm}/2 = 36\text{cm}$  or  $28.34\text{in}/2 = 14.17\text{in}$
- ✓ Hip:  $96\text{cm}/2 = 48\text{cm} + 1\text{cm of ease} = 49\text{cm}$
- ✓ Or  $37.8\text{in}/2 = 18.9\text{in} + 0.39\text{in} = 19.29\text{in}$
- ✓ Waist to hip:  $20\text{cm}$  or  $7.87\text{in}$
- ✓ Total length of the skirt:  $58\text{cm}$  or  $22.8\text{in}$

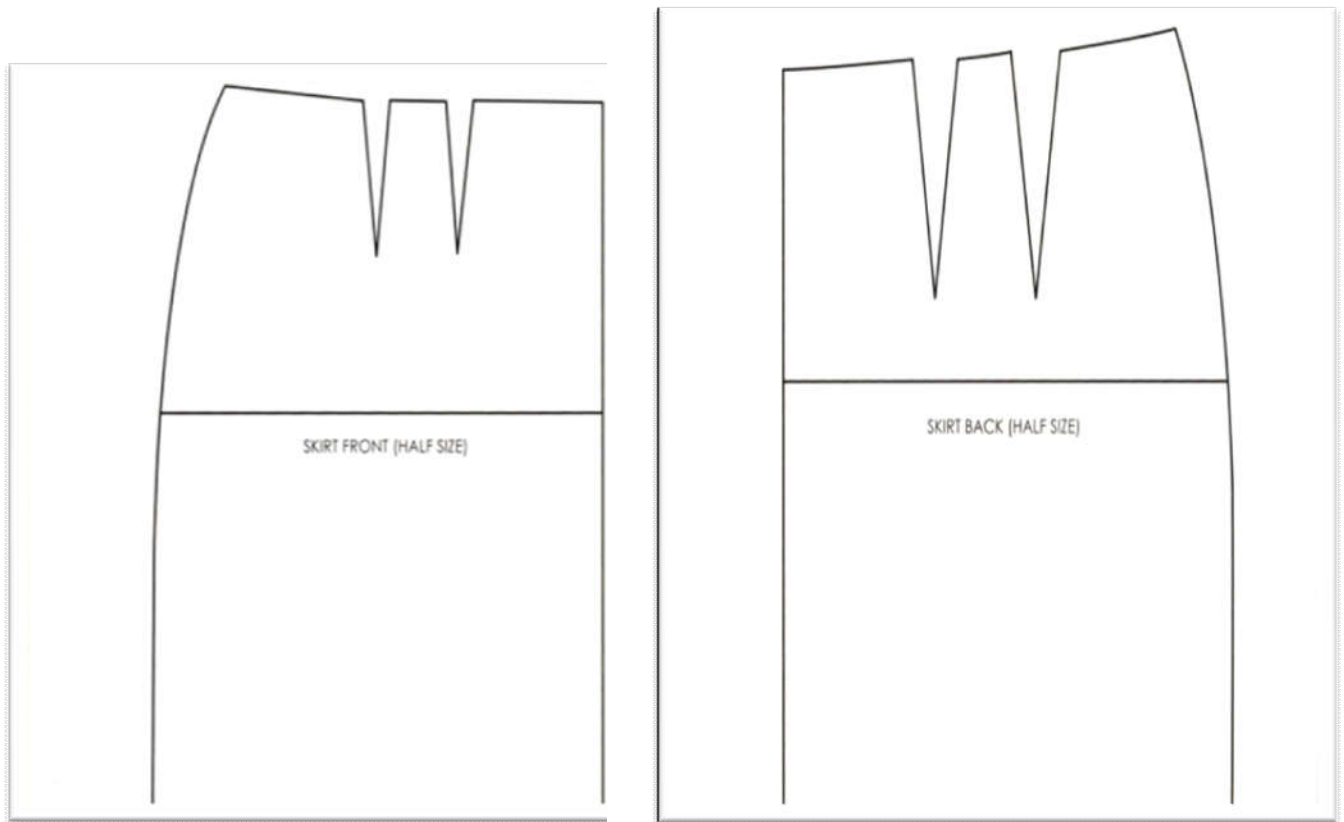


Figure 3.14: Figure given for operation sheet 3.1

- **Tools and requirement:** ruler, paper, hip curve rulers, pencil and eraser,

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- **Steps in doing the task**

### **Front of skirt**

1. Prepare your paper
2. Plot the length
3. Plot the hip
4. Front dart
5. Plot waist

### **Back of skirt**

1. Plot the back length
2. Back darts
3. Plot waist
6. Label your pattern pieces

- **Quality Criteria:** the given information and detailed sketches are set clearly at accurate place.
- **Precautions:** use the right tools for the right purpose.

### **Lap Test 3.2**

**Instructions:** Given necessary templates, tools and materials you are required to perform the following tasks within 4 hour.

- Task-1: Perform liner measurement using ruler
- Task-2: perform detail sketches every items of the design.
- Task-3: mark the required information's and symbols from the design
- Task-4: Test everything through QC checklists.

## Operation sheet 3.2

- **Operation title:** Drafting knee-length basic skirt pattern
- **Purpose:** To draft women's skirt pattern with a given measurement.
- **Instruction:** Using the figure below and given required measurement of women's skirt, drafting women's skirt pattern. You have given 5 hours for the task and you are expected to write the answer on the given line.
- **Measurements required:**

Full length 28", Shoulder width 17", N. W. length 16 ½", Mid Bust 36", Waist 30", Hip 38", Neck 14, short Sleeve length 10", Long sleeve length 23", Cuff 2 ½ x 11", Pocket Size 4 ¾" x 5 ¼".

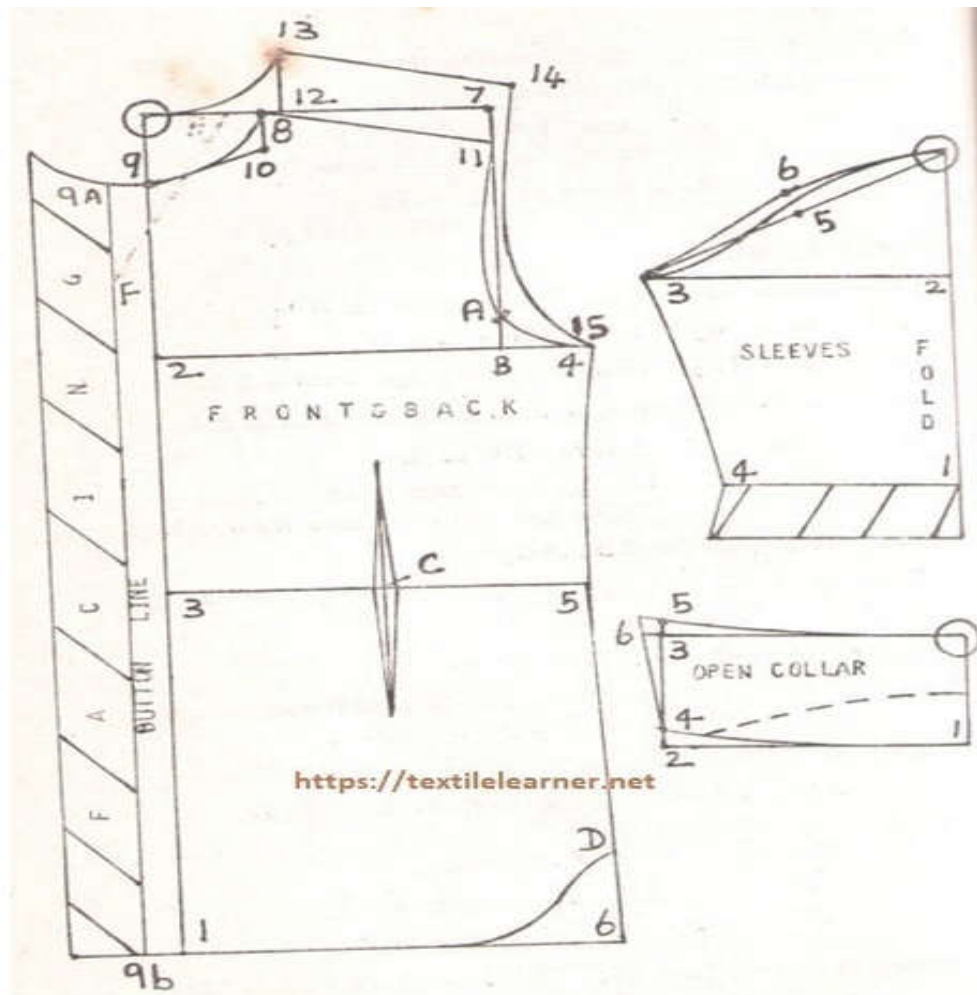


Figure 3.15: Figure given for operation sheet 3.2

- **Tools and requirement:** ruler, paper, hip curve rulers, pencil and eraser, fixser 0.7

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- **Women's Shirt Drafting Procedure:**

**Front part**

1 – 0 = Full length + 1 ¼“ for bottom hem + Seam.

2 – 0 = Armhole depth is Bust ¼ (-) 1 ¼”.

3 – 0 = N. W. length + ½”.

4 – 2 = Bust 1/4 + 1 ½”.

5 – 3 = Same as 4 to 2 (-) ¾”.

6 – 1 = Same as 4 to 2 + ¾”.

7 – 0 = ½ shoulder width + ½” for seam.

8 – 0 = 1/5th Neck + ¼”.

9 – 0 = 1/5th Neck shape neck part 9 to 8 as per draft.

10 – 8 = 1/5th Neck.

11 – 7 = shoulder's slope 1 ½”.

A to B ¾” upward at lower arm hole curve portion. C = is the centre of 3 to 5 measure. Dart length 8”. Dart in take is ½” as per draft making this waist dart in front and back portion of the shirt will give the proper fitness in the waist portion of the shirt. 9 to 9A are the button standing line is ¾”. 9B to 9A is the parallel line to the drawn.

**Back part:**

1 – 0 = Back part starting line.

12 – 0 = 1/5th Neck + ¼”.

12 – 13 = upward 2 ¼”.

14 – 11 is down ward 2 ¼ ”.

14 to 15 is the back armhole curve.

**Short Sleeves:**

1 – 0 = Short sleeve length + ½”.

2 – 0 = 1/8th Bust ( - ) ½”.

3 – 2 = 1/4th Bust + ½”.

3 – 5 – 0 is the front sleeve shape.

4 – 1 = 3 to 2 measure ( - ) 1”.

3 – 6 – 0 = Back Sleeve Shape.

**Collar (Open collar type):**

1 – 0 = 3 ¼” as standard.

1 -2 = ½ Neck girth + ¼”.

3 – 2 = Same as 1 to 0 measure.

4 -2 = ¾ for shape.

3 -5 = ½ upward.

6 – 3 is ½” outer point as per the draft

- **Quality Criteria:** the given information and detailed sketches are set clearly at accurate place.
- **Precautions:** use the right tools for the right purpose.

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## Lap Test 3.2

**Instructions:** Given necessary templates, tools and materials you are required to perform the following tasks within 5 hour.

- Task-1: Identify pattern parts
- Task-2: perform patterns of each garment parts.
- Task-3: mark the pattern information's and symbols from each parts
- Task-4: Test the finishing pattern through QC checklists.

## Unit Four: Patternmaking Principles

This unit is developed to provide you the necessary information regarding the following content coverage and topics:

- ◆ Applying basic patternmaking and grading principles to develop pattern
- ◆ Grading rule, requirement and methods
- ◆ Checking a pattern piece accurately
- ◆ Labeling All pattern pieces

This unit will also assist you to attain the learning outcomes stated in the cover page.

Specifically, upon completion of this learning guide, you will be able to:

- Develop Pattern in applying basic patternmaking and grading principles in accordance with specifications
- Use methods and formulas
- Check Pattern pieces for accuracy, including seam allowances, ease allowances, seam match, hems, specific material requirements and functional openings.
- Label all pattern pieces, including grain lines, notches, pattern information and cutting instructions.

## 4.1 Basic patternmaking and grading principles

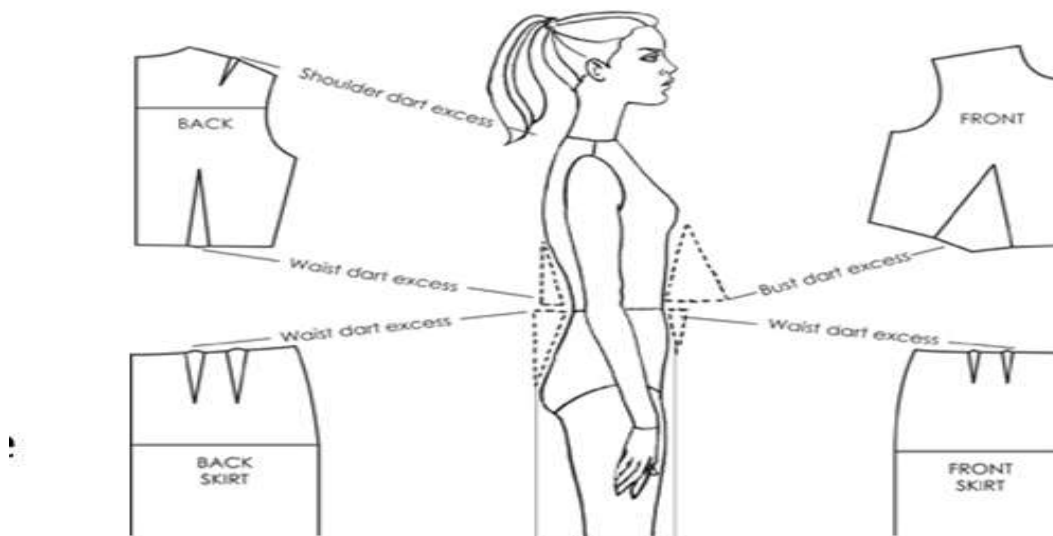
### 4.1.1 Patternmaking principles

For making flat pattern and for making alterations according to different design it is very important to know the pattern making principles. Any pattern can be created and modified if we know the basic three principles, which are:

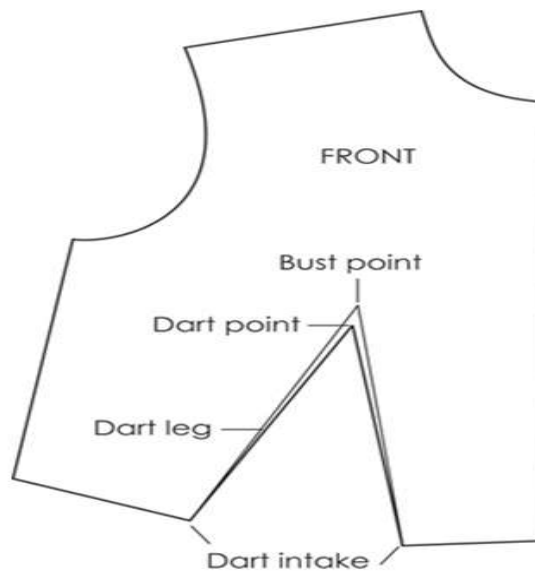
- 1. Principle of dart Manipulation:** there are many rules for creating, combining and dividing the darts and transferring dart at different places on a pattern piece. Dart can be shifted to a new place by slash and spread method and by pivot method.
- 2. Principle of added Fullness:** there are rules for adding fullness in a garment. Fullness can be provided in a garment with the help of gathers, pleats, tucks etc. (adding more fabric in the design)
- 3. Principle of contouring:** there are rules for making contoured patterns to make it fit the curves of the human figure. (Fitting to the hollows of a model's figure)

#### 4.1.1.1 Dart Manipulation

- Changing the location of a dart within the pattern frame.
- ✓ The dart is responsible for fit
- ✓ The dart will ALWAYS be part of the design in one form or another



- To Manipulate Darts: Two methods (same result) are used. such as-
  1. Pivot
  2. Slash & spread
- Allows dart to be moved without changing the pattern's size or fit.
- ✓ Dart point
- ✓ Dart leg
- ✓ Dart intake
- 1. Pivot point:**
  - Designated point on the pattern (e.g. **bust point** **point**).
  - Pattern is slashed to, or pivoted from, this point.



### ➤ **Dart Equivalent:**

- A dart can be converted into:
  - ✓ Pleats
  - ✓ Tuck-darts
  - ✓ Gathers
- functions as a dart
- fit is not adversely affected



## To Demonstration of principale Dart Manipulation: Bodices

### Front Bodices:

1. Single-dart manipulation
  - (slash and spread)
  - Mid-Shoulder Dart
2. Single-dart manipulation
  - (pivot)
  - Side Dart
3. Double-dart manipulation
  - (slash and spread)
- Mid-Shoulder and Waist Dart
4. Double-dart manipulation
  - (pivot)
  - Shoulder-Tip and Waist Dart .

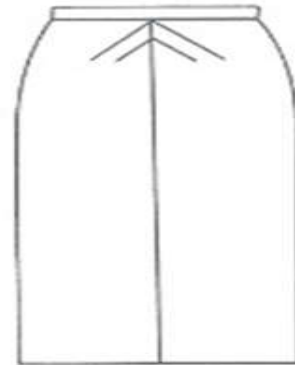
### Back Bodices:

5. Shoulder Dart Multi-dispersion.
6. Back Neck Dart.
7. Dart Excess Transferred to Armhole.

### Flexible Dart Manipulation—skirts

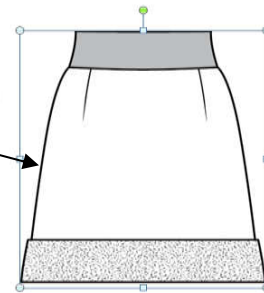
Darts may be

- Pivoted
- Combined
- Converted into dart equivalents
  - ✓ Pleats
  - ✓ Tuck darts
  - ✓ Gathers



### Transferring dart excess to hemline

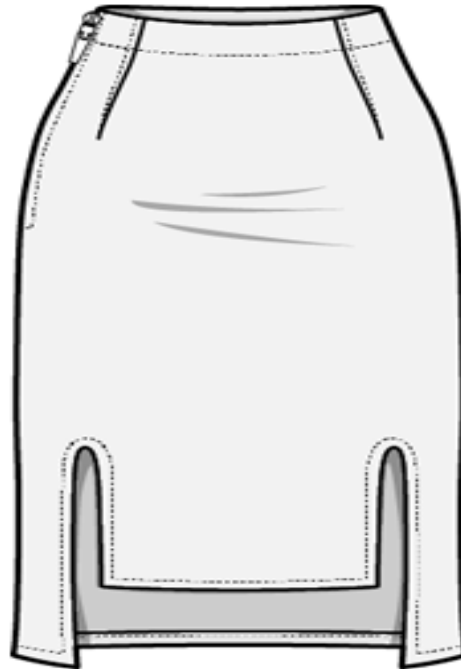
- A-line skirt
  - One dart converted to flare
- Flared skirt
  - Two darts converted to flare



### ➤ Demonstration of Dart Manipulation: Skirts

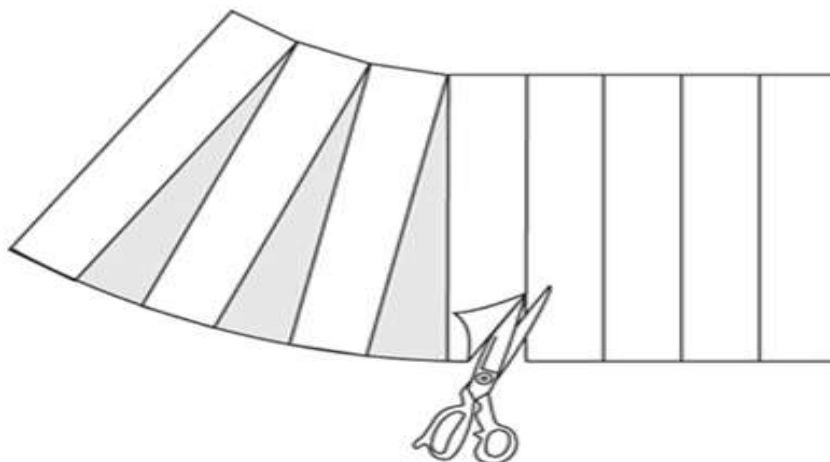
1. Curved Darts
2. One Dart
3. A-line Flared (slash and spread)

#### 4. Flared (pivot)



##### 4.1.1.2 Added Fullness principle

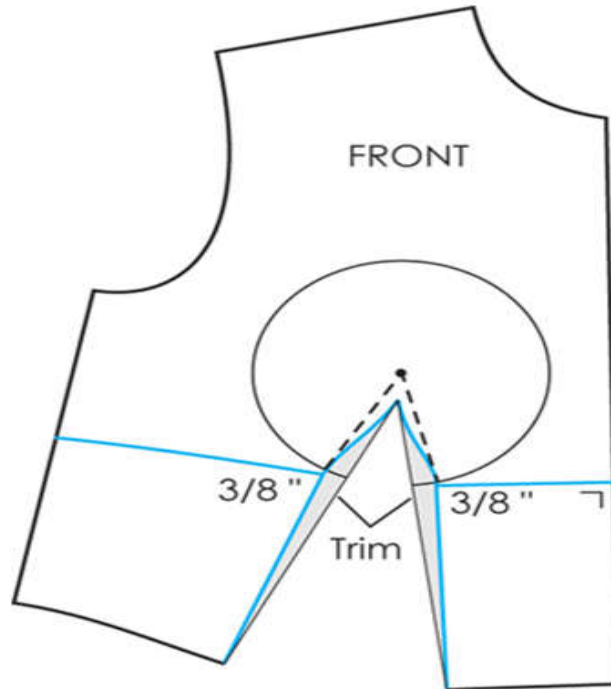
- Applies when design fullness is greater than the dart excess can provide.
- Added fullness is not directed to the pivotal point (bust).
- Adding to the pattern's outline also indicates that added material is needed for the design.





#### 4.1.1.3 Contouring Principle

- Fitting to the contour above, below, and between the bust, leaving the dart excess to be absorbed into style lines or gathers.
- Gapping ease caused by cutout neck lines and armholes is transferred to be absorbed.



#### 4.1.2 Grading principles

##### 4.1.2.1 Pattern Grading Definition:

Pattern grading is a technique used to increase or decrease the size of a garment pattern according to the measurements in a given size chart. Pattern grading is the drafting process of enlarging or diminishing a style pattern into patterns for other sizes. The function of grading is to see that this is accomplished with proper fit for the other size without changing the style sense of the original model.



Size Chart (Unisex)					
Size	Chest	Sleeve	Waist	Inseam	Height
XS	30" - 32"	32"	28" - 30"	28"	5' 2" - 5' 6"
S	34" - 36"	33"	30" - 32"	30"	5' 5" - 5' 9"
M	36" - 38"	34"	32" - 34"	32"	5' 8" - 6'
L	40" - 42"	36"	34" - 36"	34"	5' 10" - 6' 2"
XL	44" - 46"	37"	36" - 38"	36"	6' - 6' 6"

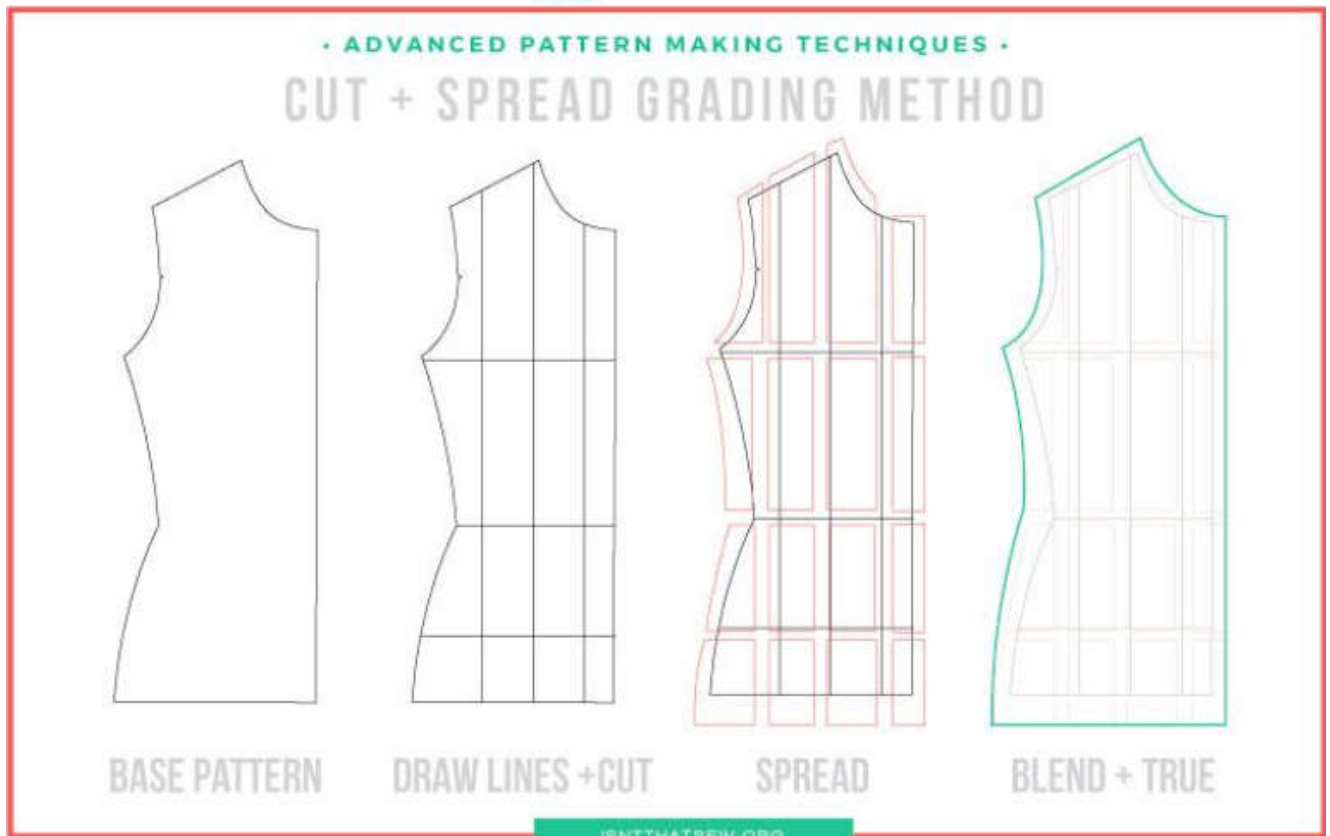
Fit Guide	
<b>A. Chest</b>	Underneath arms, around torso at largest point
<b>B. Sleeve</b>	From center of neck to wrist
<b>C. Waist</b>	Around waist at belt line
<b>D. Inseam</b>	From crotch to ankle
<b>E. Height</b>	Stand upright against wall and measure

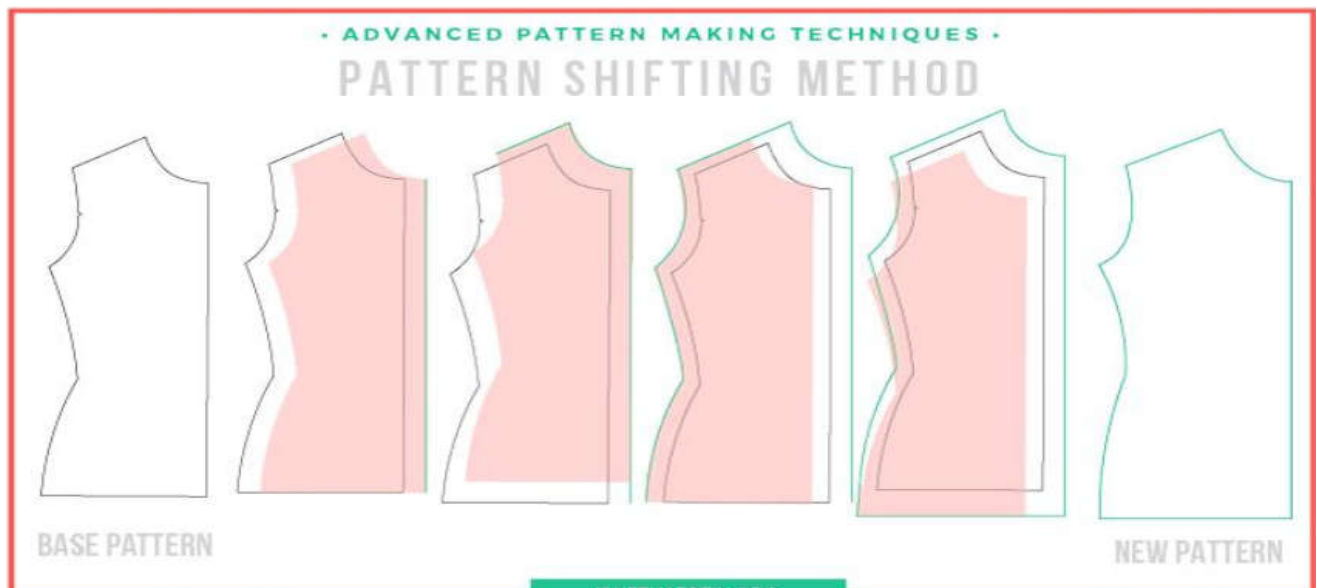
#### 4.1.1.2 Methods of grading

There are three basic methods of grading:

**1. Cut-and-spread method:** The easiest method, which is the basis of the other two methods, is to cut the pattern and spread the pieces by a specific amount to grade up, or overlap them to grade down. No special training or tools are required-just scissors, a pencil, tape, and a ruler that breaks 1 in. down to 1/64



**2. Pattern shifting:** Pattern shifting is the process of increasing the overall dimensions of a pattern by moving it to a measured distance up and down and left and right, (using a specially designed ruler) and redrawing the outline, to produce the same results as the cut-and-spread method.



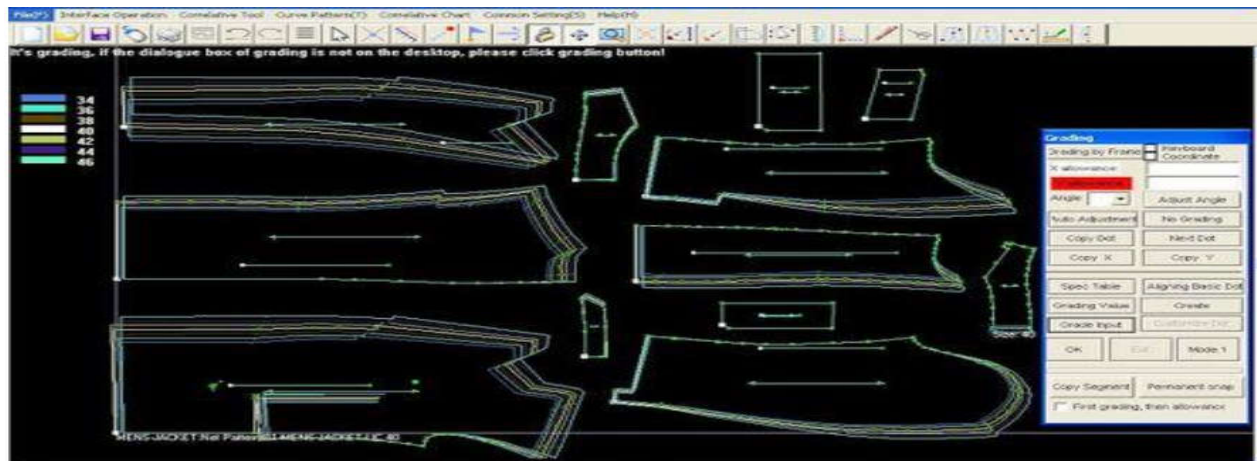
### Advantages:

- Cost effective process

### Disadvantages:

- Time consuming process
- Expected accuracy may not be obtained.

**3. Computer Grading**, is the fastest method, but tends to be an investment intensive and only larger manufacturers can afford. However, sophisticated home computer software is becoming affordable.



### Advantages:

- Quick process i.e. less time consumption;
- High accuracy may be obtained

### Disadvantages:

- High initial cost is involved
- Skilled operator is require

## 4.1.2 Grading principles

### 1. Pattern and grade development

The dynamics of fashion necessitates the continual development of new styles, with each of these styles requiring a different pattern.

### 2. The Grading system

This principle provides the necessary accuracy and versatility required for grading patterns according to the considerable variations in customers' requirements.

### 3. Size ranges

This term refers to the differences in the major girth measurements between the smallest and largest size in the size chart.

Size chart No. 1

<i>Women's sizes</i>										
	<i>Regular size</i>						<i>Outsize range</i>			
Sizes	A	B	C	D	E	F	G	H	I	J
Bust	80	85	90	95	100	105	110	115	120	125
Waist	60	65	70	75	80	85	90	95	100	105
Hips	85	90	95	100	105	110	115	120	125	130

#### 4. Size intervals

A sizing system is nothing more than the artificial division of the population into sizes groups according to a pre-determined size interval i.e., the major girth differences between each size.

#### 5. Size charts

There are two types of size charts in general use:

##### Type 1: Body measurements

This type of chart provides the body measurements for each size and the pattern maker uses these measurements as a basis for constructing a pattern with the requisite amounts of ease.

##### Type 2: Garment measurements

This chart details the finished measurements specification for each size and is used for pattern grading and quality control purposes.

Size chart	Garment type: Skirt			Style No. 1234	
Size / Size symbol	A	B	C	D	E
Waist	62	66	70	74	78
Hips	86	90	94	98	102
Length	59	59.5	60	60.5	61

## 6. Measurements

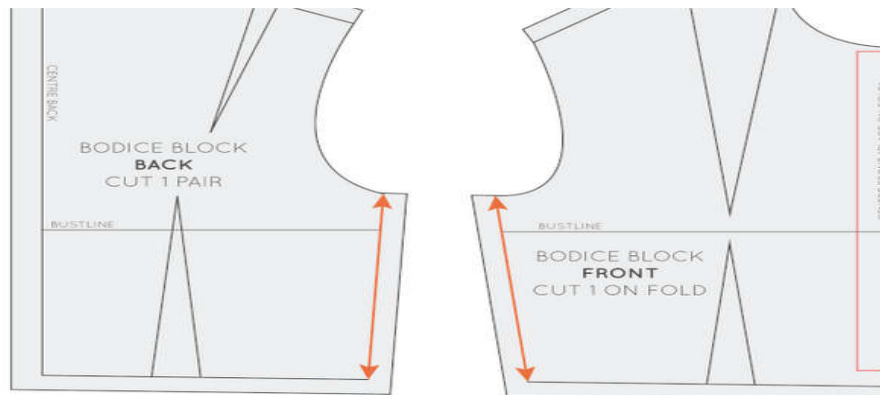
The measurements given for a size represent the average measurements of a woman having a particular bust or hip girth, and this combination is denoted by size symbol.

## 7. Nomenclature

A size is a combination of measurements and each combination is designated by a symbol which is a common 'code' between the manufacturer and the consumer.

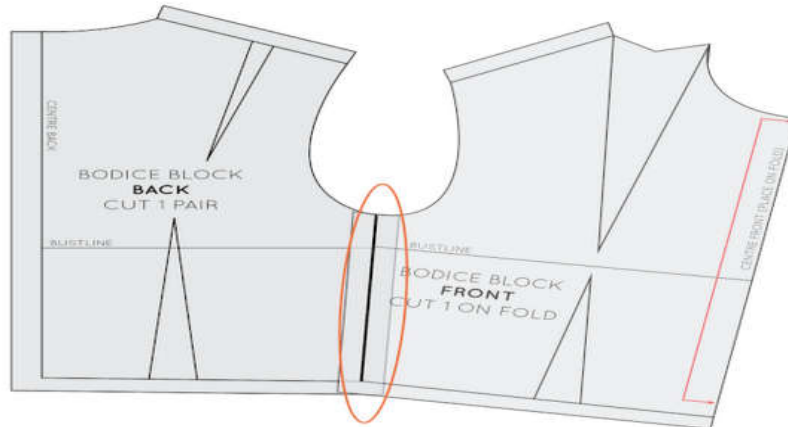
## Checking pattern pieces

### a) Measure Each Seam



To check that your patterns fit together correctly, you need to check that each seam is the same length as the seam it will be sewn to. For example, in the case of the bodice block, we need to check that the side seams and shoulder seams are the same length. To do this, you can simply take a ruler or tape measure and measure each seam.

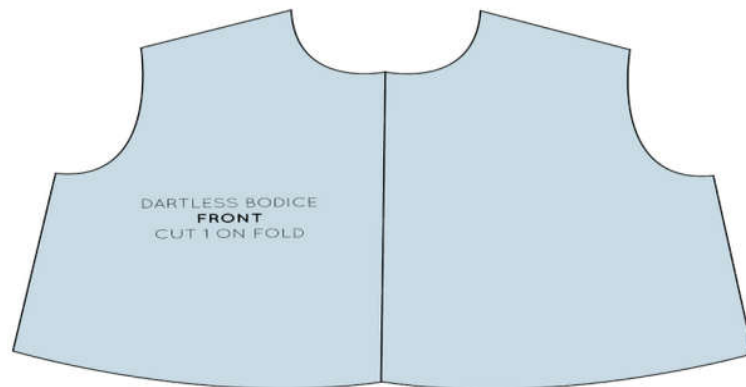
### b) Match Pattern Pieces and Check Seam Length



Match up the seams as if you were sewing them and check that they are the same length.

### C) Check That Patterns Are Square

When a pattern is symmetrical always check both ends of the centre line (or "PLACE ON FOLD" line) meet the other seam at a right angle.



In the example shown, the neckline and hemline were not square to the centre front and when the pattern was cut on the fold, a peak was created in the neckline and a point in the hemline.



## Self check 4.1

### Test II: short Answer writing

**Instruction:** write short answer for the given question. You are provided 3 minute for each question and each point has 5Points.

1. Mention the major methods of patter grading?
2. Explain pattern making principles and their function?
3. What are the principles of pattern grading?
4. How to check pattern pieces?.

### Test III: Multiple choices

**Instruction:** select the correct answer from the given choices. You are provided 3 minute for each question and each point has 5Points.

1. ----- is a technique used to increase or decrease the size of a garment pattern according to the measurements in a given size chart..  
A. pattern      B. patternmaking      C. pattern grading      D. draping
2. ----- is pattern making principles that apply by adding more fabric in the design.  
A. Dart manipulation      B. add fullness      C. contour      D. patternmaking
3. One is not advantage of computer aided pattern grading?  
A. Quick process i.e. less time consumption;      B, High accuracy may be obtained  
C. High initial cost is involved      D. All except A
4. ----- is the process of increasing the overall dimensions of a pattern by moving it to a measured distance up and down and left and right.  
A. pattern shifting      B. computer grading      C. cut and spread method      D. contouring

Note: Satisfactory rating – above 60%      Unsatisfactory - below 60%

You can ask you teacher for the copy of the correct answers

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## Operation sheet 4.1

**Operation title:** Manipulating center front neck dart

**Purpose:** To Manipulate center front neck dart.

- **Instruction:** Using the figure below and given required pattern tools, manipulate center front neck dart. You have given ½ hours for the task and you are expected to write the answer on the given line.

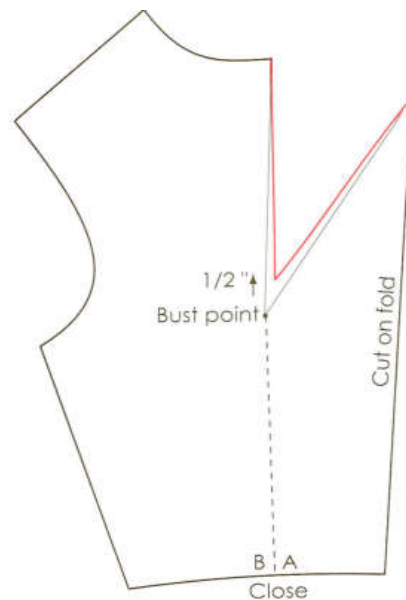


Figure 4.3: Figure given for operation sheet 4.1

- **Tools and requirement:** ruler, paper, hip curve rulers, pencil and eraser,
- **Steps in doing the task**
  1. Draw slashes line from C.F. neck dart to bust point.
  2. Close dart legs A and B. Tape.
  3. Retrace and complete dart legs
- **Quality Criteria:** the given information and detailed sketches are set clearly at accurate place.
- **Precautions:** use the right tools for the right purpose.

## Lap Test 4.1

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within 4 hour.

- Task-1: draw slash lines using ruler
- Task-2: close dart legs using tape.
- Task-3: retrace and finish new dart legs

## Unit Five: Pattern Tests

This unit is developed to provide you the necessary information regarding the following content coverage and topics:

- Check fitting with toile (chip piece of fabric )
- Alternating a pattern piece to improve fitting
- Documenting alternated pattern piece
- Developing Facing, closure

This unit will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, you will be able to:

- ✓ Make a toile (chip piece of fabric) to test the fit and accuracy of pattern.
- ✓ Altered pattern to reflect test fitting outcomes, quality standards and workplace practices.
- ✓ Document alterations to patterns
- ✓ Develop facing, closure options

## 5.1 Pattern alteration

Fitting is an important part that makes a garment perfect. The art of garment fitting requires skill and patience. When standard fit is done, garments will look better and feel more comfortable. Making apparel which really fits is one of garment making's greatest challenges and crucial successes. Perfect measurements are the key of good fit.

Good fit are influenced by many things such as:

- The current fashion look,
- The hang and stretch of the fabric,
- The amount of ease preferred and
- Figure size and type.

### Pattern Alteration:

Pattern alteration means customize patterns to fit according to body shape. For example, shortening arms or lengthening a top. Patterns are prepared according to standard measurement chart which are based on average sizes. After measuring the human body and adding needed ease, compare this measurement to the pattern's measurement.



Fig5.1 pattern adjustment or alteration

Pattern adjustment or alteration is often necessary to achieve good fit in a garment. Once the fabric is cut, however, fitting adjustments are limited to existing darts and seam allowances. Before cutting the garment, check the pattern fit and alterations according to the correct body measurement that will eliminate many problems form fabric. Therefore, fitting problems should be solved before the garment is cut by making needed changes in the pattern.

### 5.1.1 Ways of pattern alteration

A pattern can be altered and adjusted three ways:

1. By folding out excess fullness to make an area smaller.
2. By slashing and spreading to increase dimensions, or slashing and overlapping to decrease dimensions.
3. By redrawing darts or seamlines.

### 5.1.2 Importance of Pattern Alterations:

1. To get a perfect fit on your figure, garment is cut after the pattern is altered.
2. If the pattern is altered before the fabric is cut, there will be no adjusting in the final fitting.
3. There is no danger of wasting expensive fabric and spoiling the garment.
4. Each adjustment necessary in the flat pattern for saving time and avoid ripping later.
5. Sometimes alterations are essential to get perfect pattern.

### 5.1.3 Patterns Alteration Standards:

1. Original grain-lines are saved.
2. Patterns are kept in balance and proportion.
3. Change is created only where needed and is not obvious.
4. Designer's lines are protected.

### 5.1.4 Basic Rules or Techniques of Pattern Alteration:

Traditionally, alteration of garment patterns is an essential step in producing attractive and accurately fitting clothing from patterns which already exist. There have been numerous publications by tailoring experts on how to alter garment patterns for different figure forms. Alterations can be done by using measurements, taken by a tape measure and incorporating them onto a paper pattern using the slash, seam or pivot methods.

**Basic pattern alteration techniques are given below:**

1. All similar pieces must be altered to correspond with the alterations on the major piece.
2. Additions or extensions must be made by taping an extension strip to the edge involved.
3. Altered patterns must have the same character as the original pattern piece.
4. Correct movement on altered pattern to give the altered line the same character as the original line.
5. The altered pattern must be properly flat, as like the original pattern piece.

There are also some methods for pattern alteration:

- Pattern alteration for flattering the figure
- Pattern alteration for non-standard figures
- Pattern alteration with experimental methods
- Pattern alteration using computer-aided design (CAD) programs

### 5.1.5 Principles of Pattern Alteration:

1. As far as possible make changes within the pattern by slashing and spreading or slashing and lapping.
2. To preserve the original grain line, make all slashes and folds parallel or perpendicular to the grain line (to center front line, center back line etc.).
3. Where there are darts, make changes between the tip of the dart and the outside edge.
4. If an alteration in length is made along one edge of the pattern, take care to make an identical alteration in the adjoining edge.
5. When tucks or darts are used for making a pattern smaller, remember that the width of these should be just half the amount to be removed.
6. When decreasing or increasing the width of pattern pieces, if only half the pattern (half back or half front) is used, subtract or add only one fourth of the total adjustment to be made.
7. When the pattern alteration involves slashing and spreading, it is necessary to keep a sheet of paper beneath and to pin or stick to it the spread-out parts so that they will thereafter remain in position.

Use the following checklist that helps you, if further alterations or minor fitting is needed for a good fit.

1. Adequate wearing ease is available for sitting, moving and bending.
2. Armhole seams curve smoothly over the end of shoulder.
3. Crosswise grain lines are parallel to floor.
4. Crotch depth is right, neither too low and baggy nor too tight and binding.
5. Darts point to the fullest part of the curve.
6. Hemline is even.
7. Hipline fits smoothly.



8. Lengthwise grain lines, side seams, center front and center back seams hang straight or at right angles to the floor.
9. Pant legs hang smoothly and do not restrict any part of the legs.
10. Pants hang smoothly from the waist. The waistband fits the body comfortably and stays in place when bending and sitting.
11. Pants have no pulls or excess fabric across the front or back crotch level.
12. Shoulder seam length comes to end of shoulders.
13. Sleeves are comfortable with no wrinkles.
14. The length of the garment is becoming.

## 5.2 Developing Facing, closure

### 5.2.1 Facing

In sewing and tailoring, **facing** is a small piece of fabric, separate or a part of the fabric itself, used to finish the fabric edges. Facing makes a garment look professionally finished with the seams well hidden inside the folds of the facing. Facing is mostly used to finish the edges in necklines, armholes, hems and openings. They are also used widely in all other sewing like quilts and home decor items like curtain hems. A facing is a piece of fabric used to finish raw edges of a garment at open areas, such as the neckline, armholes, and front and back plackets or openings. A facing may be a separate pattern piece to be added to the garment or an extension of the pattern piece itself. The facing is cut on the same grain as the garment section it will “face” so it will wear and hang in the same manner.

There are basically three types of facing. **1. Shaped facing 2. Extended facing 3. Bias facing**

Shaped facings are cut to match the outside shape of the piece to provide a neat finish, and are often cut from the same pattern pieces. Shaped facings are typically made of the same fabric as the garment, but may also be made of lighter-weight fabric or in a contrasting color as a design element. Extended facings are extensions of the garment fabric, folded back and usually stabilized. Bias facings are strips of lightweight fabric cut on the true bias (US) or cross-grain (UK), and shaped rather than cut to match the edge to which they are applied.

### 5.2.2 Closure

Closures are functional trims used to open or close a garment. Usually closures are not visible when the garment is worn. Fasteners are used to hold garment sections closed (shirt opening), in place (Waistband of shirt or trouser) or together (wrap of wrap around top or skirt). Fasteners usually serve decorative as well as functional purposes. Closures and Fasteners can be categorized as:

- Buttons
- Zips
- Hooks n eyes/bars
- Buckles and Rings
- Stoppers
- Snaps, Shanks and Grommets(Eyelets)

## Self check 5.1

### Test II: short Answer writing

**Instruction:** write short answer for the given question. You are provided 3 minute for each question and each point has 5Points.

1. Mention the principles of pattern alteration?
2. Explain garment facing and closure?
3. What are the ways and important of pattern alteration?
4. Describe Basic pattern alteration techniques.
5. Mention and discuss types of garment facing.
6. What are the influence of good fit pattern pieces?

Note: Satisfactory rating – above 60%                      Unsatisfactory - below 60%

You can ask you teacher for the copy of the correct answers

## References books:

1. Armstrong, H.J Pattern Making for Fashion designers Prentice Hall, New Jercey
2. Seaman, A.A & Julian, B.T, Fashion Drawing The Basic Principles, Batsford Ltd. London.
3. Apparel Manufacturing Technology By T. Karthik, P. Ganesan and D. Gopalakrishnan
4. Clothing: Fashion, Fabrics and Construction, Fifth Edition by Jeanette Weber
5. Fundamentals and Advances in Knitting Technology by Sadhan C. Ray
6. Garment Manufacturing Technology Edited by Rajkishore Nayak and Rajiv Padhye
7. Materials and Technology for Sportswear and Performance Apparel Edited by Steven George Hayes, Praburaj Venkatraman
8. Clothing Appearance and Fit: Science and Technology by J. Fan, W. Yu and L. Hunter
9. How to Use, Adapt, and Design Sewing Patterns by Lee Hollahan
10. Dressmaking: The Complete Step by Step Guide to Making Your Own Clothes by Alison Smith

### Participants of this Module (training material) preparation

<b>No</b>	<b>Name</b>	<b>Qualification (Level)</b>	<b>Field of Study</b>	<b>Organization/ Institution</b>	<b>Mobile number</b>	<b>E-mail</b>
<b>1</b>	Amlaku Tewellign	A(MSC)	Garment Technology	BPTC	0918026571	amlaktewe@gmail.com
<b>2</b>	Melkie Erkihun	A(MSC)	Garment Technology	BMC	0925755581	merkyhun@gmail.com
<b>3</b>	Dejene Bifa	A	Garment Technology	AKPTC	0913647972	Dejene.bifa@yahoo.com
<b>4</b>	Mohammed Yimer	A	Garment Technology	CPTC	0913833994	Yimermohamed2010@gmail.com