The Fashion Manufacturing Process
A Product Development Approach

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Chapter 10:

Pre-Assembly Processes – The Cutting Room

Marking, Spreading, Cutting and Bundling

The development of an incredible style is the first step in the manufacturing process. Once the specifications for the product are established, the fabrication process begins. Depending on the profile of the Manufacturing or Private Label Retailing firm, the Pre-Assembly processes may be completely in-house, partially in-house, or entirely outside the manufacturing firm itself. Marker making, spreading, cutting, and bundle preparation are the major Pre-Assembly processes.

Marker making is a critical step in the manufacturing process. Traditional manufacturers manage the process of marker making in-house. By retaining strict control over this critical step, they keep the fabric consumption as low as possible. Controlling this step also permits them to ensure that the issues that affect quality will be given proper attention. These include placing patterns on-grain, keeping patterns paired, and attending to details such as drill holes and notches. Depending on the relative efficiency of each marker produced, the company may save or waste thousands of dollars a year.

Spreading and cutting process fabric as it is received from the textile mill into cut parts ready for sewing. The methods chosen for these steps has a direct effect on the quality and cost of the finished garment.

It is essential that the designer, product developer, and marketing decision maker understand that choices made on the nature of the fabric, and the fashion design will directly affect the cost of the spreading, and cutting process needed for that style. Fabric and garment decisions will affect the quality achieved in the spreading process as well. The axiom “Quality Costs Money” is clearly found in the marking, spreading and cutting processes. There is a direct relationship between the methods chosen and the time needed to achieve varying degrees of quality.

As one would suspect, simplicity is the key to reducing cost. You will learn in this chapter how symmetric fabric and garment designs yield the lowest price per unit in the spreading and cutting process.

In spreading and cutting, volume is also a key to reduced costs. The greater the volume produced (within the limits of the process), the lower will be the per-unit cost. Therefore, the focus of technology is to increase the number of plies that can be spread and cut in one cycle, or to increase the speed with which the spreading and/or cutting takes place.

Goods: A truncated form of the phrase *Piece Goods* which are textile fabrics, either woven or knitted.
Lay: Multiple superimposed layers of fabric on a cutting table.
Spreading: The process of rolling out layer after layer of cloth, smoothly without wrinkles, in such a manner that the selvedge on one side of the cloth is straight, and parallel to that edge of the cutting table.
Selvedge: The natural edge of milled fabric. Sometimes referred to as "self-edge".
Put up: The preparation of fabric for the spreading process.
Cutting Table: Work table that is at least six inches wider than the widest fabric to be processed, and two to three feet longer than the longest spread length.
Marker: The tracing of pattern pieces used to guide the cutting process. The marker is usually created on paper and placed over the top layer of a spread (lay). Kept on-grain, the patterns are fitted next to each other in the most efficient manner possible for the marker mode required.
Flat open and rolled: Fabric is rolled on a tube with the fabric layer spread out and selvedges at each end of the tube.
Folded and rolled: Fabric is folded in the length, and rolled on a tube. The selvedges are oriented one on the other.
Tubular folded: Fabric that is created on a circular knitting machine is flattened and rolled on a tube. Both edges of the fabric are virtually, folded.
Book Fold: Fabric is folded into a carton accordion style, under no tension or compression. The fabric is released flat and open.
Velvet Frame: A Steel or Plastic frame with concentric hooks to hang flat open fabric to prevent compression of the fabric face.

1. **FABRIC AND GARMENT SYMMETRY**

Understanding the modes of marker making and spreading are important concepts. The relationship to fabric and garment symmetry identify how correct choices must be made to obtain good quality and to control cost. There is a direct relationship between quality and cost. Methods that lead to better quality take more time, thus more cost. ("Time is Money!")

a. For the purpose of defining marker making and spreading modes, we use specific definitions of fabric and garment symmetry.
b. A Symmetric Garment is one in which, except for the difference of buttonhole and button-sew, dividing the garment along the vertical centerline of the body, the right half parts are identical but mirror image of the left hand parts.
c. A Symmetric Fabric is one which has no change in appearance when the fabric is turned 180^{o} in the same plane.

2. **PUT-UP.**

Fabrics are prepared at the mill in a variety of ways for production. The way in which it is rolled or folded when dyeing and finishing is completed is referred to as "**put-up**". Some methods of put-up are used to protect the fabric, others are strictly for the convenience of spreading and handling.

a. **Flat, open and rolled** is the most common preparation. It is utilized for most woven fabrics prepared for factory production. The fabric is rolled on a hard cardboard tube (or plastic tube) where the selvedges are at opposite ends of the tube. The fabric is usually rolled with the technical face to the inside of the roll. Roll lengths on each tube can reach 1,200 yards on a single roll, but are more often in the 150 yard range, depending on the weight of the roll.
b. **Folded and Rolled** is a put-up that allows the utilization of a single center fold in the length of the goods. In this preparation, the fabric selvedges are superimposed one over the other. This preparation is utilized with very wide fabrics that cannot be processed by a manufacturer who does not have wide enough cutting tables. Folded and rolled fabric orients the technical face of the fabric inside the folded surfaces, so they are not visible on the surface of the spread.
c. **Tubular Folded** goods are prepared by rolling fabrics manufacturers on weft knitting machines. These machines knit in a circular motion, creating a tube of fabric. This put-up results in fabric on a roll with two folds, one at each end of the tube. This preparation results in the technical face of the fabric oriented together. For every other layer, the face is not visible from the surface of the spread.
d. **Book Fold** is the most relaxed put up. Fabric is laid back and forth in a carton. Book Fold is used for delicate fabrics to minimize the stress on the fabric.
e. A **Velvet Frame** is used for pile fabrics. A tube connects two square frames that contain concentric circles of sharp hooks. The fabric is hung from the hooks where the selvedges are fastened to pairs of hooks (at each edge of the fabric) starting closest to the center and rotating around the

Reality Check (a Real World example)
A well known lingerie manufacturer chose to take advantage of a new milling process that would produce fabrics 120" wide.
However, the tables owned by the manufacturer were only 96" wide. Rather than investing between appr. $6,000 to widen the spreading tables and $35,000 to purchase a wider spreading machine, the manufacturer chose to pay a 10% premium to have the mill fold and roll the fabric. They reasoned that most lingerie fabrics are sheer, and therefore the spreader can see through the fabric from the back and identify any flaws to maintain quality. This solution worked well for many years. Later, wider tables and equipment were invested in, however, to recoup the 10% premium and achieve a 2% improvement in fabric utilization from making markers with more pattern pieces in mixed markers than closed markers.

Fabric Pre-Inspection: Inspecting fabric for flaws on a lighted inspecting machine before it is spread and cut.
Dotted paper: Thin paper with marks at 1" by 1" intersection points in a grid parallel to the long edge of the paper, and perpendicular across the width of the paper. The paper is available in widths of 54" to 140" in 6" increments, and in lengths of 100 to 1,000 yards on a roll.
Legend: The marker "key" containing the style number, size /quantity breakdown, marker mode and spreading mode, written at each end of the marker.
Spreading mode: The mode of spreading indicates the way in which the nap and face of the fabric is spread from one ply to the next.
Marker efficiency: The percentage of fabric used in patterns vs. the fabric wasted between the parts.
Bundle preparation: Sorting, separating and marking the cut parts, and tying them into bundles for the sewing process

center to the outer edge of the frames. This creates an air space between the concentric layers of fabric.

f. **Carded Bolt** is a put-up most often seen in men's suiting and fabric retail. The fabric is folded in half lengthwise, and rolled on a flat board (cardboard).

3. **FABRIC PRE-INSPECTION** (See chapter XX on Quality)

a. **Fabric is pre-inspected** as it arrives in the manufacturing warehouse for two distinct reasons. First, since fabric is purchased from the mill with a quoted level of damages (which is agreed to as acceptable) based on the price negotiated between the manufacturer and the mill, it is necessary to confirm that the percentage of damages promised by the mill is not exceeded. Second, pre-marking the damages in the fabric expedites the spreading process, better insuring that the spreader will recognize and remove all the damages in the fabric before they reach the sewing room.

b. **Fabric Inspection Machines** provide an easy to use visual workplace that simultaneously measure the actual yardage in the roll of fabric. New Computerized systems can automatically recognize certain types of flaws and automatically mark the selvedge with a reflective tape.

c. Acceptance or Rejection A lot of fabric is accepted or rejected based on the statistical sampling and inspection of rolls of fabric in the lot. Exceeding the permissible number of damages will fail the lot. (See Chapter 14 on Quality Assurance for details.)

4.MARKER MAKING

General Description of a marker: A marker is the layout of patterns on the top layer of fabric (which guides the cutter). In order to make a marker, the usuable width of the fabric to be spread and cut must be known, and a full set of pattern pieces for all the sizes must be on hand. The marker is usually traced on **dotted paper** (if made by hand), or printed on plain white paper that is marginally wider than the width of the fabric. For men's suiting and certain other applications, the marker is traced on the top layer of fabric which is turned face down whenever possible. The marker is consumed (destroyed) in the cutting process.

Under typical conditions, the marker is created for a single style, single fabric, and single fabric width. Separate markers will be created for linings and/or interfacings if they are required for the style. The **legend** at the beginning end of the marker contains this information, as well as the size/quantity breakdown, the intended fabric **spreading mode**, and the **marker efficiency**.

In the preparation of a marker, the patterns are oriented ***on-grain***, and are interlocked as closely together as possible without overlapping. The Marker Maker will lock the patterns together where the scoop of one pattern will fit the projection of another in order to ultimately get the patterns as close as possible, using up all possible open spaces between the patterns. The closer the patterns can be placed, the more ***efficient*** the marker is.

In the cutting process, the paper marker pattern is left on top of each cut bundle of parts. In the creation of the marker, on every pattern piece, the marker maker will write the style number, and size of that particular part to act as a bundle identifier, telling the bundle preparation personnel what each part is.

Traditional vs. Modern Methods

The process of marker making has not changed since the industrial revolution (the advent of multi-ply cutting). The basic concept of achieving the most efficient utilization of fabric by orienting the patterns as closely together as possible is the foundation of the process whether the marker is created with a full set of hard paper patterns, or on a computer screen. The use of computerized marker making facilitates visualizing the entire marker better, enables the saving of ideal pattern layouts, and saves time in the generation process (printing the marker vs. tracing every pattern by hand). More recently developed programs for marker making on the computer are available to pre-lay patterns into the marker following placement rules. It is still up to a trained and experienced marker maker to complete the process by making minor corrections to the computerized layout.

Mixed Marker: A marker in which all the pattern pieces of a style are utilized. There is no restriction on where they can be placed, as long as they are placed on-grain.
Open Marker: A marker in which all the pattern pieces of a style are utilized as pairs (all the left and right pattern pieces). The Open marker patterns are placed in pairs (left and right of the same size) to ensure that if there are shade differences in the length of the goods, parts of the garment that are seen side by side will appear with the same shade.
Closed Marker: A marker in which half the pattern pieces of a style are utilized. Either the left half, or the right half of a pattern pair is laid into the marker. When created for closed goods (folded in the length), one selvedge is marked as the folded edge.
Closed-on-open: A marker with half of a set of patterns for each garment, placed on open fabric. Every part of the garment must have corresponding left and right patterns, or blocking and re-laying is required.
This mode is intended for fabric spread face to face.
Utilization (See Marker efficiency): Fabric Utilization is the percentage of fabric that is utilized by patterns in the marker. The more closely the patterns fit together, the higher the fabric utilization. Typical apparel fabric utilization ranges from 65% to 90% depending on the shape/ sizes of the patterns, and on the marker mode.

a. **Markers** are defined by two parameters, which are noted in the ***legend*** at the beginning of the marker. The first parameter relates to how the patterns are used in relation to the relative garment symmetry.
   i. A **mixed marker** is the most popular type of marker. When the garment is asymmetric, or for the purpose of obtaining good efficiency, the mixed marker is used on fabric that is spread open and face up on the table. For most woven fabrics, and flat open knits, mixed markers offer the best **utilization** of fabric because the patterns are placed wherever they fit best in the length of the marker.
   ii. An **open marker** is the second most popular type of marker. When the garment is asymmetric, or for the purpose of obtaining the best quality from the spreading process, the open marker keeps pairs of parts (left and right) close together in the length of the marker. The open marker is used on fabric that is spread open and face up on the table. For most woven fabrics, and flat open knits, open markers offer the second best utilization of fabric.
   iii. The **closed marker** is used under special circumstances. As only one half of the pattern set is used, the fabric spread on the table is folded in it's length and is oriented face to face. After cutting, any one pattern piece would yield the left and right piece of the garment when choosing a pair of consecutive plies. Styles that have certain pattern pieces that cover the full width (a one piece back versus a left and right back pattern piece) can be oriented on the control fold of the marker (see *Spreading Closed Goods*). Cutting through at the fold, yields a one-piece part.
   iv. The **closed-on-open** marker is similar to the closed marker. However, since there is no fold at the selvedge, the pattern pieces

Blocking and re-laying: The process of spreading a part for two sizes with the intention of splitting the block, and re-cutting the smaller size out of half of the block.
Single section marker: A marker with all the patterns of all the sizes needed, placed wherever they will yield the most economical use of fabric.
Section Marker: A marker created with one or several sizes mixed together, separated from the other sizes by a section line (across the full width of the marker).
Step Spreading: Is a spreading method for varying the number of units spread by size, where each section will have a different number of fabric layers under it. Each section usually has only one or two sets of each size patterns, and the variance in ply count appears as gradual steps when the fabric is spread on the table. Only the plies needed are spread under each section.

Grain: The natural warp direction of fabric. The grain is always parallel to the selvedge of the fabric. In a garment, the grain is most often aligned with the vertical center line of the body.

Down nap direction: As the garment is worn, the down direction is when the nap points toward the floor. When a nap naturally hangs down, it reflects more light than when it is turned 180^0

must be either left or right. Styles with one-piece parts like a one-piece back panel can **not** be made using a closed-on-open marker without blocking and re-laying. For any one part in the marker, a pair of consecutive plies of fabric (spread face to face) produce the left and right pieces of the garment. Fabric dyeing must be consistent to use this method, as garments will be constructed of two consecutive plies of fabric.

v. **Blocking and re-laying** in the spreading process may be used in conjunction with a closed-on-open marker. To take advantage of a symmetric garment, and placing a half set of patterns in the marker, when one pattern in the garment is full body width (rather than left and right patterns), for two consecutive sizes in the marker, only the larger pattern of the two is placed in the marker. After the part is cut, the cut block for the pattern is divided in half, and the smaller size pattern of that part is placed on the second half. This is then recut to the smaller size.

vi. Single Section Marker. When the patterns of all the different sizes are scattered throughout the full length of the marker (placed wherever they fit the best), the marker is known as non-sectional or **single section marker.** This marker type has the highest utilization of fabric (highest efficiency) as the highest quantity of patterns (of all marker types) are fitted together. The marker often has multiple sets of the most commonly ordered sizes depending on the ratio of sizes ordered.

vii. Section Marker. Markers with more than one section, known as **section markers** are utilized when the order ratios are unknown in advance. The section marker facilitates producing different order ratios using the same marker through **step spreading**. Although at the lowest efficiency, single-section markers permit total flexibility in matching varied order ratios.

viii. Grain. Patterns are placed in the marker with the **grain** line on the pattern, oriented parallel to the fabric grain (defined by the selvedge line). This convention is only deviated from slightly (only on solid fabrics), when absolutely necessary, to interlock patterns reducing waste. The grain directly affects garment quality so is very important.

b. Mode. The second parameter for defining marker type is the **mode**. Markers are prepared in one of several modes. The direction of the **nap** is used to define the mode of spreading. Fabric is naturally rolled, under most circumstances, with the "**down**" direction of the nap toward the open end of the roll of fabric.

i. The Nap/ One/ Way marker (abbreviated N/O/W) is made with every pattern placed with the "down" direction of the pattern in the same direction. This mode is necessary for fabrics that are asymmetric. All patterns are placed on-grain, and in the "down" direction, which is usually toward the left edge (starting point where

the legend is written). The Nap/One/ Way marker is the highest quality but least efficient of the three nap directions for a marker.

ii. The Nap/ Either/ Way marker (abbreviated N/E/W) is made where there is no restriction of which way the pattern are oriented. The patterns may be oriented either "down" or "up", placed wherever they fit best, only making sure that the patterns are on-grain. The Nap/ Either/ Way marker is usually the most efficient mode yielding the highest ***fabric utilization***. This Mode assumes consistent (dye) color in the length and width of the goods. Nap/ Either/ Way also requires the fabric be symmetric.

iii. The Nap/ Up/& Down marker (abbreviated N/U/D) is more efficient than the Nap/ One/ Way marker, but not as efficient as the Nap/ Either/ Way marker. In order to get a better fit between the patterns, alternating sizes of patterns are oriented in opposite directions. Should the fabric have slight variations in shade, the patterns are placed where the left and right pairs of parts are located close together in the length of the marker. This method is yields moderately good fabric utilization, and good quality.

Mode: The mode refers to the orientation of each layer in relation to the previous layer.
Nap: The surface of the technical face of the fabric has a nap, if, when the fabric is turned 180degrees in the same plane, the fabric looks different. This nap is the result of the fabric construction (such as velveteen, velvet, terry, etc.), the result of fabric finishing techniques (surface treatment on some microfiber textiles, or combing on wools), or a print on the fabric.

Reality Check (a Real World example)
There are many knit fabrics that look symmetric from a distance. They seem to have no patterns at all.
Since circular knits are really asymmetric (their loops face in one direction only), when spreading, it is risky to handle them as if they are symmetric.
A maker of women's undergarments attempted to spread a new knit fabric for panties in the same manner as it's traditional fabric. The new fabric had a pattern knit into the fabric so there were contrasting, concentric circles of color. (alternating bands of color).
The effect was something similar to prison stripes. Spreading the tubular fabric up and down the table as was always done, the factory manager did not notice that there was a minor discernable difference in the fabric direction. The difference became apparent when the garment parts were sewn together.

c. **Defining Markers** (See the Fabric/Garment – Marker & Spreading Matrix)

i. Markers are defined by identifying the mode and preparation. For example: a marker with all patterns facing in one direction for asymmetric fabric, for an asymmetric garment with all the parts (left and right pattern pieces) is Nap/One/Way – Mixed (N/O/W Mixed) marker. A marker with the patterns oriented randomly in both directions made for a symmetric garment with half the set of patterns for symmetric fabric with a fold on one or both selvedges, is Nap/ Either/ Way – Closed (N/E/W/ Closed)

d. Constructing a Marker

i. A Marker is made by placing pattern after pattern into the marker space. This space defines the fabric that will be utilized in the lay. The space is defined by the following components which are common to all markers.

1. The two Selvedge Lines are drawn parallel to the edge of the cutting table. The distance between the selvedges denotes the minimum usable width of the fabric. If the fabric were 60 inches wide, the width between the selvedge lines would (usually) be no wider that 59 inches.
2. The Beginning Line is at the left end of the marker as seen by the marker maker/spreader. This line is perpendicular to the selvedge and denotes the beginning point of the marker. Usually 18 to 24 inches of paper are left at the left end before the marker to accommodate the legend.
3. The End Line is placed at the end of the marker (opposite the Beginning Line). This line is drawn across the width of the marker and is located after the extent of the last pattern.

Additional length may be added to the end to accommodate the fabric allowance for ***end cutting*** or the use of ***catchers***.

4. Splice Marks . **Splice marks** are placed along the control selvedge (closest to the spreader). These facilitate the overlapping of fabric needed when a roll of fabric runs out, or when a damage in the fabric must be eliminated
    a. Damage Control Splice Marks are placed along the entire length of the marker. Wherever the patterns in the marker meet in what appears to be a natural break across the width of the marker, the damage control splice mark is placed along the selvedge. The damage control splice mark is most effective at saving wasted fabric when it is as small as possible, and given the layout of the patterns are placed at frequent intervals in the marker length.
    b. Controlling Damages using Splice Marks: In use, when the spreader comes across a damage in the fabric, they would cut off the fabric, just past the damage in the direction of spreading. Then, locating the last splice mark passed in the direction of spread, the spreader would cut off the last ply of fabric at the splice mark (perpendicular line) closest to the (just) cut off end. The spreader then pulls back the fabric to the splice mark closest to the starting point of the ply (the 'first' perpendicular line passed). The spreader would then continue spreading at that point. The overlap is only counted as one pass (ply). The fabric removed in this process is called "damages". Usually the yardage lost due to damages is recorded, and ultimately may be considered to increase the cost of fabric. This is fabric that was purchased, but not utilized for garments, thus increasing the cost of the process.
    c. Section (Splice) Marks are places in any section marker. Section marks may be used for damage control in the same manner as splice marks for damage control. The section mark is usually small in size, covering only one inch before the section line, and one inch after the section line.
5. Legend. The ***legend*** is used to provide the critical information about the marker. Usually placed at the beginning (and often the end) of the marker, the legend contains the reference information about the marker. Prior to spreading, it is critical for the spreader to check the legend against the cutting order to ensure that the correct

Splice Mark: Indicator on the control side selvedge, visible as a pair of lines perpendicular to the selvedge, drawn outside the selvedge, with an X between them. The splice mark denotes the 'left' and 'right' ends of a complete intersection where patterns in the length of the marker begin and end. In one pass of spreading, overlapping at the splice mark ensures that all the pattern pieces cut in that layer of fabric will be complete parts.

Reality Check (a Real World example)

The saying goes,"You cannot have enough splice marks". Since the number of splice marks is directly a result of how often the patterns in the marker create a natural intersection in a small linear length of the marker. Bridal gown markers suffer from not having these intersections. A damage found in the middle of a bridal pattern in the marker can cause the loss of an entire yard of fabric or more. No wonder why bridal gowns are so expensive.

style number, fabric type, width, and ratio for the order is about to be spread.

6. Placement Rules. When the patterns are placed, the marker maker will follow several rules. First, the patterns are oriented so the grain line on the pattern is parallel to the selvedge line. The patterns will be oriented with the nap direction as specified by the marker mode. The patterns will be interlocked as efficiently as possible in order to waste the least amount of fabric. The patterns will be placed from largest to smallest, as this is the most efficient way to create a marker, causing the least amount of pattern manipulation as necessary. Small patterns are placed whenever possible in the spaces between the larger patterns. The cutting method is considered when interlocking patterns to prevent "impossible" cutting situations.

Reality Check (a Real World example)

"WHO made the mistake FIRST?" As the quality control director, the last phone call I want to receive is the one that starts," The customer (retailer) has a complaint". As it turns out, a major retail catalog company had received a style we shipped and were upset because they received the wrong coat. Was it a shipping mistake? No, the hangtag had the correct style number. Was it a receiving mistake? No, the paperwork from the factory was all in order. Did the factory make a mistake? "NO" said the factory owner, who said they had proof that the parts they received were the ones correctly marked for that style. Well then, WHERE was the mistake made? The next call was to the cutting room. Of course, the owner of the cutting room could not believe he was responsible for the mistake. When asked to look up his records, he found the correct style number was cut. However, mysteriously, he still had a marker with the style number on the legend, that he was supposed to have cut and shipped to the factory. After much aguing, we concluded that the spreader had pulled the marker for a round collar coat, and cut it in place of the hooded coat required! (In reality, the spreader was responsible for making the initial error, but EVERYONE else along the way had a part in not checking what they were working on, against the published description and sketch for the style)

e. **Use of the Marker after Cutting**.

Once the spread is cut, the marker paper serves as a critical source of information for every cut bundle of parts. With the style number, and size, the bundle is easily identified and matched up correctly with the other parts to make correct garments. The cut paper of the marker is also used for quality control. Comparing the paper (which should be saved in the sort term) with the original patterns, it is possible to check the accuracy of cutting.

f. **Marker Duplication**.

Manually made markers must be duplicated if they are to be utilized more than once. Since the marker is the cutting guide, it is, in effect, destroyed when it is cut on the lay. Several duplication methods exist to create copies of the original marker.

i. Carbon paper is sometimes used to create duplicates as a marker is being traced manually. The carbon is placed between layers of marker paper (top being dotted for pattern orientation, and subsequent layers blank). The marker maker presses hard in tracing to transfer the carbon to the subsequent layers of paper. This method is limited to making 2 or three copies of the original marker.

ii. Multipack marker systems utilize **NCR** paper are available for making up to 5 duplicates at a time in the same manner.

iii. Ammonia based duplication methods require a carbon reverse be made (carbon on the underside of the original marker). This system uses a special duplicating machine to create a limited supply of duplicate markers (RR50,) (Up to 20 copies can be made)

iv. Wide bed photocopies are also available to duplicate markers in a similar manner as a standard copy machine on continuous marker paper.

g. **Computerized Marker Making** has been around for over thirty years. The method requires an experienced marker maker to place the patterns correctly in the marker. The marker maker works at a computer monitor rather than with full sets of hard paper patterns, and all of the pattern

manipulation is done on the computer screen rather than by tracing the patterns onto the full size marker paper on the cutting table. There are many advantages in computerized marker making

i. The marker maker has a view of the entire marker at one time.
ii. Infinite repositioning of the patterns is possible easily.
iii. Tracing around the patterns is eliminated
iv. Efficiency is calculated 'on-the-fly' as patterns are placed.
v. The marker is saved in computer memory eliminating the need for a large "marker library"
vi. Full sets of graded pattern on hard paper are unnecessary. Once the sample size pattern is digitized, grading is performed automatically according to pre-installed grade rules
vii. Markers can be created in one location, and electronically transmitted anywhere in the world.
viii. Variances in fabric width can be quickly accommodated with markers made specific to the fabric width.
ix. New systems can automatically do a "rough marker" which would only require the marker maker to adjust manually.

Repeat: When the pattern on a fabric is repetitive, one complete set of colors/ stripes, or plaid stripes/ lines, is known as a 'repeat'. A pattern may be repeated multiple times across the width of the fabric.

h. **Stripes and Plaids** require special marking, spreading and cutting and bundling. In fashion, vertical stripes are often expected to match at several points depending on the price point. Across the center front, from the pocket to the body, at the shoulder, at the yoke, and, sometimes from the collar to the body. Horizontal stripes will match at the sideseam, across the center front, from the sleeve to the body, across a pocket, and across a center back seam.
   i. Plaids require matching in the horizontal as well as the vertical direction.
   ii. How the stripe/plaid marker is made. As it is impossible to place a pocket literally 'on top of' a front panel in the marker, the pattern is placed further down the length of the marker in a location that matches the stripe or plaid **repeat.** Markers for stripes and plaids start with patterns that are marked with a stripe registration line which indicated a control point in the stripe, with information on the width of the repeat. The marker is scored in the length (and width for plaids) with a line at the beginning of every repeat. When patterns are placed in the marker, they must be oriented by the marker maker to match up with the repeat on the marker.

Block: For off-table cutting, a block is a continuous area of the marker in which all the parts that need to be cut by die or band knife cutting will fit (including extra waste allowance between the parts and around the perimeter of the block).
Off-table cutting: Cutting methods that requires a section of fabric from the lay to be moved **to** the cutting machine. The cutting takes place *OFF* the cutting table.

i. **Off- Table Cutting**. The marker requirements for Die Cutting or Band Knife cutting are that additional allowance must be made for fabric waste. Patterns will be placed loosely in the marker in an area known as a **block**. The block is devoted exclusively to the patterns that will be taken **off the cutting table** to either method of cutting**.** When it is time to trace the marker, this block is left a as a blank area with a list of the parts (and quantities) to be cut. The block is removed from the cutting table to either the band knife, or die-cutting machines.

j. **Marker Making Guidelines**. There are some General Rules of Thumb that apply to the marker making process.

1. Maximize the fabric width. The wider the fabric is, the more efficient the marker will be, increasing the fabric utilization.
2. Maximize the overall quantity of parts in the marker. The greater the number of parts in the marker, the greater the efficiency as parts will 'lock' better if there are more of them.
3. Maximize the overall quantity and variety of sizes in the marker; Widely different sizes of patterns fit together better. More sizes in the marker, offers more opportunities for the patterns to match and interlock better.
4. Maximize the overall quantity of pattern sets in the marker, like the overall quantity of parts offers more chances for the patterns to lock together better.

Spreading: The process of repetitively unrolling one layer of cloth on top of another. Each layer is oriented so that one of the selvedges is superimposed one on top of the next. Care is given to ensure that the fabric is wrinkle free, and that there is a minimum of tension (stretch) in the fabric while spreading.

Ply: refers to each layer of fabric in the spreading process. Even if fabric is folded in half, and placed on the table, it would be considered as two plies (made from one technical layer). This is clearer to understand if you consider that when cutting straight through the entire spread of cloth from top to bottom, each ply is counted separately.

Spreading mode: The orientation of the face of the fabric, and the nap direction as fabric is being spread on the cutting table.

5. SPREADING

Spreading fabric for cutting may be done in a variety of ways. These **spreading modes** describe the way in which the face of the fabric will be oriented, and what the nap direction is from **ply** to ply. The choice of spreading mode will affect the cost of spreading and the quality of the of the finished product (the result of the cutting). **Spreading quality** is achieved when any flaws in the face of the fabric can be identified by the spreader (even if the fabric was pre-inspected), and removed (either during the process of spreading, or marked for removal after spreading). The highest levels of spreading quality are, therefore, achieved with spreading modes that permit the face of the fabric to be "up" and visible to the spreader at all times. Understanding how fabric is spread facilitates understanding why the choice of certain types of fabrics will increase or decrease the overall cost of the product. When quality problems are encountered in fabric shade, they often are traced back to the choice of spreading mode.

a. **Choosing Spreading Modes**. The choice of spreading mode often dictates certain methods of fabric handling and the choice of machinery used for spreading. The availability of the proper spreading equipment may restrict the choices of spreading (and marker types) available for a particular facility (All spreading machines can Not spread all modes of spreading).

ii. The highest quality of spreading is achieved by the Face/ One/ Way, Nap/ One/ Way mode of spreading (F/O/W, N/O/W). Each layer of fabric is spread with the face up (usually) permitting the spreader to see all of the face of the cloth to identify any flaws in the fabric. The fabric is spread in one direction only, from the end of the table to the beginning (Right to Left from the machine operator's point of view). This will ensure that there will be no problems with nap direction in the finished product. For this mode of spreading, the patterns in an *open* marker are placed N/O/W. This is a slow method of spreading,

Reality Check (a Real World example) "When is the spreading mode is important?". A sportswear manufacturer who traditionally made woven garments decided to market a line of supersuede garments in solid colors. Understanding that the fabric is a napped woven fabric, the marker maker chose to make a N/O/W marker. The fabric and marker went to the cutting room with little fanfare. The spreader who was accustomed to spreading solid colors F/O/W N/U/D for best quality and productivity, did the same with the solid supersuede fabric. No one explained to the spreader that supersuede is a NAPPED fabric.
The result was that half of the garments in the first lay were cut *Upside Down*! When the cut work was processed in the sewing room, the problem was finally discovered. Even worse, without individual ply marking, more than half of the garments were made with left and right panels not matching in direction on the same garment!

Face: The side of the fabric that is intended to be the 'outside' (side visible to the consumer) of the fabric. Although some fabrics look the same from the face to the back, there is always a technical "face". Under most circumstances, when fabric is rolled at the mill, the face is closest to the tube, putting the back of the cloth to the outside of the roll. This minimizes the potential for getting dirt or dust on the face of the outermost part of the fabric.

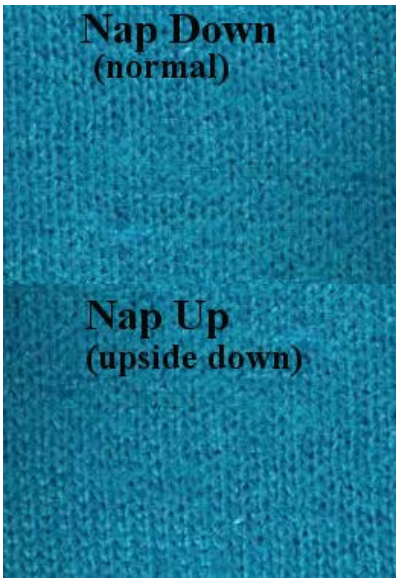
however, because after each layer is spread, the fabric is cut at the end (across the width of the table just past the beginning of the marker), and the machine and operator transverse back to the opposite end of the table to begin spreading the next layer of fabric (known as "deadheading", a term borrowed from the trucking industry to mean 'traveling without a load'). This process is repeated until all the plies needed are spread.

iii. The second highest level of spreading quality is possible with the Face/ One/ Way, Nap/ Up/ and Down method of spreading(F/O/W-N/U/D). In this mode, the fabric is spread from the end of the table to the beginning. At the beginning of the table, the spreader cuts the fabric across the width, then must rotate the roll of fabric 180^0 (in the same plane). The spreader then continues spreading the fabric from the beginning back to the end of the table where the fabric will be cut and rotated again. This process is repeated until all the plies needed are spread. This mode requires that the fabric be symmetric, as alternating plies are placed in opposite directions. Markers for this method are most often *open*, Nap/ Up/ Down to take advantage of asymmetric fabric, and are more efficient (than Nap/One/Way). The marker may be Nap/ One/ Way although there will be no gain in quality (the only gain would be more efficient spreading time)

iv. The most efficient (fastest) method of spreading is the second lowest quality method. Face to Face, Nap/ Up/ Down (F/F- N/U/D). For Symmetric fabrics, and moderate overall quality, this method of spreading is widely popular. Starting at the end of the table, the spreader spreads the fabric to the beginning of the table. Without cutting the end, the spreader folds over and weights the fabric end down, and begins spreading back toward the end again. For ***open***, Nap/Either/ Way markers, this mode produces the lowest cost of spreading and most efficient (least costly) fabric consumption. The quality is low, as the face of every other ply is not visible to the spreader to see and remove damages. This mode of spreading also facilitates the use of *closed* markers on open fabric, Nap/ Either/ Way, Nap/ Up/ Down or Nap/ One/ Way (most, moderate, and least efficient respectively). This mode requires the identification of damages parts during the sewing process by the sewing operators, or quality control inspectors.

v. When fabric is asymmetric, the Face to Face, Nap/ One/ Way mode allows the use of an ***open*** or ***closed*** marker on open fabric that is napped or one-directional. The result of this mode is fabric that is face to face, where consecutive plies will yield pairs of parts (left and right). This method is relatively slow, and produces the lowest quality, as the face of every other ply is not visible to the spreader. This mode also requires the identification of damages parts during the sewing process by the sewing operators, or quality control inspectors.

Reality Check (a Real World example) Does it matter when fabric is "Upside down"?. Looking at several of your Jersey Knit T-shirts in your closet under a magnifying glass, take look at the loops in the knit. You might be able to notice that some of your T-shirts are made with the knit loops upside down.
In fact, half of all T-shirts sold in the United States are manufactured with the fabric Upside Down. Unless you examine them under a magnifying glass, you will not even notice. This maximizes the spreading productivity thus reducing the cost.



Jersey Knit
Can you see the difference?

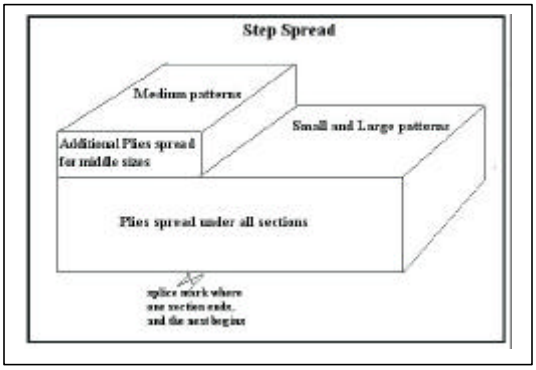
vi. Closed – Face to Face, Nap/ One/ Way Closed fabric is fabric that is folded in it's length either due to the textile milling process (as with tubular knits), or deliberately by the mill to facilitate the manufacturing process. (Very wide fabrics might be purchased folded to enable the use of narrower tables for spreading that are already in place in the facility). Closed – Face to Face, Nap/ One/ Way spreading is the process where the spreader starts at the end of the table spreading the fabric (tubular or folded and rolled) back to the beginning of the table. The spreader cuts across the fabric width past the marker end, and then transverses back to the end of the table to start the process again. Two layers of fabric are laid on the table in one pass, where both layers are Face/ Face. Folded fabrics facilitate the use of ***closed markers*** where the fold is utilized for parts that are single, in conjunction with paired parts. (a single back panel pattern is folded in half, and laid on the edge of the fold. Other, paired parts are placed in the open areas of the marker, and when cut, yield left and right pairs). Use of the *closed* marker (half a set of patterns) speeds the cutting process, as it takes roughly half the time to cut half a set of patterns. Quality, as other Face/ Face modes is moderate at best, as half the fabric spread is not viewable by the spreader.

vii. The Closed – Face / Face, Nap/ Up/ and Down mode is similar to the Closed – Face to Face, Nap/ One/ Way mode except that after the first pass, the spreader does not cut the fabric off at the beginning of the table. Instead, the fabric (two plies Face to Face) is folded over and the spreader begins spreading back to the end of the table. This results in a Face to Face mode where ***pairs of plies*** alternate up and down the table. As this method reverses the direction of the nap, the quality is lower. Unless the nature of the nap or construction is such that in the end use of the product, the nap direction is not noticeable by the consumer, this method would not be used. (See **Does it matter when fabric is "Upside down"?**)

b. Order Management:

In order to manage cut quantities to match order quantities, there are several strategies used. The most economical approach is to use a single section maker which contains patterns in the ratio that the style is ordered in. Fabric is spread in multiples of the ratio of the marker.
Step spreading for a section marker is done when the order ratio and quantity is controlled by the number of plies under one set of patterns in each section.

i. Single Section Marker: A typical example is for the size range of extra small, small, medium, large and extra large, there would be one set of size extra small patterns, two sets of small patterns, three sets of medium patterns, two sets of large patterns and one set of extra large patterns. Thus,

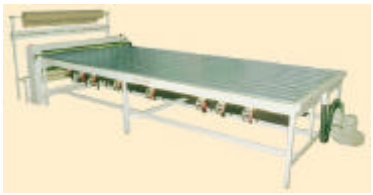


there would be nine complete pattern sets in the marker. Orders received in multiples of this ration XS/1, S/2, M/3, L/2, XL/1 would be satisfied by spreading the required number of plies. If the orders are received in multiples of a different ratio, it is necessary to create a different marker.

ii. Section Spreading (Step Spread) is used for section markers where the quantity and ratio of garments cut is determined by varying the number of plies spread over each section. In most situations, the marker section with the need for the greatest number of plies is situated closest to the left (beginning point) of the spread. Then each section by decreasing numbers of plies needed are located after the first going down the table. For the first color, the plies needed for every section would be spread down the length of the table. Then, for the first (and second if needed, etc) sections, the additional plies needed for the section's quantity are spread over just that section. Finally the additional plies needed just for the first ply are spread on the first section.

Nails and Pins: Spreading fabrics that have stripes or plaid lines that must be superimposed from one ply to the next must be spread using Nails or Pins. Placed in waste areas of the marker, nails or pins penetrate the fabric at the beginning of an "index" stripe or cross line at the same line on every ply. The spreader counts to the stripe with each ply ensuring alignment from one ply to the next. Nails are double ended and are driven into a wooden cutting table. Pins are pushed up from below the table surface in a specially made table.

Pin Table



c. Spreading Stripes and Plaids

i. Stripes and Plaids require the management and orientation of each layer of fabric exactly over the next. This is done by using **Nails** or **Spreading Pins** to align every ply. The Nails will be driven into the spreading table, and located in the waste areas of the marker, at a given repeat line, between where the patterns will fall. The modern approach is to use a programmed ***pin table*** that raises sets of pins up through the table surface to accomplish the same result as using nails. The spreader will count the number of stripes on the fabric to a given repeat where the nail is located, then the spreader will push the fabric onto the nail at the very edge of the stripe, ensuring that the fabric lays flat. This is repeated all the way down the table. By lining up one stripe, the fabric will be cut uniformly, so that the parts will align. Stripes are usually spread face up for the best quality.

ii. Plaids are handled in much the same manner. For plaids, nails will ***also*** be used across the width of the fabric, at every other repeat in the fabric pattern.

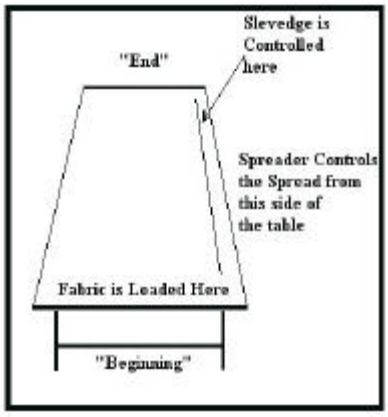
d. Velvet and Velveteen fabric are spread using special frames on which the fabric is put up. These frames are designed to be mounted on manually operated spreading machines. Velvet and Velveteen is spread F/O/W, N/O/W. The marker is *open*, N/O/W. Two spreaders are required. The process is slow, as the spreaders must unhook the selvedge at each corner

(both sides of the roll), at all four corners of the velvet rack during spreading.

Cutting order: A document which identifies the garment style, fabric, width, colors and quantities by size which need to be spread. The marker to be used will be identified as well.
Cutting ticket: A document used as a report of what was cut against the Cutting order. In addition to the ACTUAL number of garments cut by size and color, the Cutting ticket identifies yardages of each piece of ends and damaged fabric as a result of the spread. Roll identification tickets consumed will be attached to the cutting ticket.
Often in the industry, the Cutting order and Cutting ticket are combined on one document.

Tension free: To prevent fabric from shrinking after spreading, it is necessary to relax the fabric once it is on the cutting table. Minimizing the stretch as the fabric is being spread reduces the need to relax the fabric once it is on the table.

Control side of the table: When viewed from the beginning end of the table (where the fabric is loaded onto the spreading machine), the *control side* of the table is to the operator's *right*.



e. Recordkeeping.

i. During the Spreading process, the spreader records each ply spread on a **cutting ticket** to report the fabric usage and actual number of plies and colors (shades) spread. Following the **cutting order**, the spreader will record how many plies of fabric are spread per roll of fabric. The yardage not spread in 'ends' and 'damages' will also be recorded. The spreader will collect the **roll tickets** and staple them to the cutting ticket as a confirmation of having spread each roll.

f. Spreading Machines by Mode

A variety of machinery may be used for spreading fabrics. Although investment is often a concern in choosing equipment, the deciding factor on what type of spreading machine is required is made by three factors. First, what modes of spreading are required of the machine, and second, how critical is the need to spread **tension free**, and third, how heavy (and what diameter) will the rolls of fabric be (and what diameter) as they arrive from the mill. This information must be researched in advance in order to determine compatible spreading equipment. Although automatic machines may spread faster, the limitation to spreading speed is normal walking speed unless there is no concern for the spreader to locate damages in the fabric. Then the machines may be operated faster.

i. Solid Bar (the Broom Stick approach). Although seemingly absurd, this method of spreading by two workers is still used. The limitation in roll weight is whatever the spreaders can carry and manage. There is no tension control, and this method can, theoretically, be used to spread any mode of spreading.

ii. Stationary Rack. This machine is essentially two uprights mounted at the end of the table. A steel bar is passed through the roll of fabric, and two spreaders will pull the goods from the beginning of the table, all the way to the end of the spread length. Once the fabric is aligned on the table and weighted at the end, the spreaders work their way back to the roll, smoothing out ripples in the fabric and aligning the selvedge on the **control side**. This machine is ideally used for used for F/O/W, N/O/W, but with difficulty (flipping the roll over) F/F, N/O/W. It is not suited for N/U/D modes of spreading. The stationary rack has no tension control, so it is up to the operators to relax the fabric with each ply.

iii. Drop-in Un-winder. This little used machine is a cradle with rollers that surround the fabric roll. It is most often used when the fabric tube in the roll of fabric is crushed, or

Rolling Rack

Turntable Spreader

Automatic Rolling Rack

Automatic Turntable Spreader

too small for the steel bar in a stationary rack or other machine. The modes and challenges of this method are similar to the stationary rack.

iv. Rolling Rack. The rolling rack, like all rolling machines, as implied, rolls down the length of the table with the roll of fabric mounted on it. Like all rolling machines, the wheels on the control side of the machine are grooved steel wheels and sit on a rail mounted on the edge of the table, facilitating the controlled path of the machine in a straight line down the table. Like most rolling machines, the wheels on the far side of the machine ride on the top of the opposite edge of the table. The rolling rack is ideally used for F/O/W, N/O/W, and F/F, N/U/D spreading. The other two modes of spreading on open goods would require the operator to remove the roll and flip it end for end after every other ply (not recommended) The Rolling rack has no tension control, so in addition to smoothing out wrinkles and aligning the control selvedge during spreading, the spreader must carefully unroll the fabric slightly ahead of the speed that the machine is advanced. Uneven spread tension is often the result.

v. Turntable (nicknamed "Woolen Turntable"). The Turntable spreader is another manually operated machine. Like the Rolling rack, the Turntable is manually pushed down the table, and has the same tension challenges as the rolling rack. However, as the roll of fabric is mounted on a rack that can easily be rotated, in addition to the two methods of spread that the Rolling rack is designed for, the Turntable is ideal for F/F, N/O/W and F/O/W, N/U/D spreading. For these methods, the spreader would cut the fabric off at the end, then release the lock and spin the turntable 180^0 to reverse the face of the fabric.

vi. Semi Automatic Rolling Rack with Electric Eye and Catchers. Semi-automatic machines are designed with electric eye edge sensors that use a servo motor to shift the rack side to side to align the selvedge on the control side of the table. This saves the spreader time. Additionally, for F/O/W, N/O/W spreading at one end, and for F/F, N/O/W spreading at both ends, a mechanical catcher device is used (a 'mechanized' cloth weight that automatically lifts and tucks the fabric under it) which is also a time saving device.

vii. Automatic Rolling Rack. The fully automatic rolling rack has a drive motor and end switches that permit the machine to automatically drive itself from beginning to the end of the table and back. Other features are similar to the semi-automatic rolling rack. The machine can be mounted with an end cutter that would also automatically cut off the end

for F/O/W, N/O/W spreading. The spreader then is required to look for damages during spreading and manage the rolls of fabric mounting them and changing them. These machines may have a ride-on platform for the operator to travel with the machine saving them from walking all day.

viii. Automatic Turntable. There are two forms of automatic turntable. The most common has all the features of the automatic rolling rack, may use either catchers or a cut-off knife mechanism, and is self powered. This machine still requires the spreader to manually rotate the fabric turntable rack when spreading F/F, N/O/W and F/O/W, N/U/D modes of spreading. The FULLY automatic turntable spreader is also capable of rotating the fabric as well.

Tubular Knit Spreader

ix. Tubular Knit Fabric Spreader. Tubular knit fabrics pose a special challenge. As two layers of fabric are being placed on the table from the roll simultaneously, a frame is inserted inside the tube of fabric to control both layers as they pass through the machine. The frame prevents twisting or folding as the fabric is placed on the table. Positive feed rollers reduce the tension in the fabric during spreading.

Air flotation table

g. Advanced Technology

i. Damage control mark sensors

1. One of the newest advances in spreading systems is the use of automatic sensors and marks on the piece goods to identify damages in the fabric. Reflective tape is applied to the fabric selvedge during the pre-inspection process. Automatic spreading machines are mounted with a sensor that detects the tape as it passes through the electric edge control eye. The sensor stops the spreading machine permitting the spreader to locate the damage and remove it during the spreading process. This technology is particularly useful for Face/ Face modes of spreading where the spreader cannot see the face of the fabric on every other ply. This system can essentially assure the same spreading quality from F/F as F/O/W spreading. Also, this system permits higher spreading speeds as the spreader is not limited to how fast they can spread and see damages at the same time.

ii. Air Flotation Tables are cutting tables that have a system of air jets mounted down the center of the table. Air is forced out under the lay permitting it to float on a cushion of air much like a hovercraft. This facilitates moving either a block, or the entire spread down the table. When used in conjunction with automatic cutting systems, this

Vacuum Table

technology facilitates spreading down the length of a long table, then easily moving the entire spread to the automatic cutting system.

iii. The Vacuum Table is a revolutionary technology used in conjunction with servo cutting machines. Replacing the use of cloth weights to keep the fabric in place during cutting, clear mylar plastic is spread over the entire lay after the marker is in place. Through small holes in the cutting table surface, air is sucked out of the lay. This compresses the lay and stabilizes it.

iv. Heavy Roll Loaders are used when roll weights exceed 200 lbs per roll. Able to manage rolls weighing over 1,200 lbs, these are used to lift the fabric rolls from the floor to the spreading machine.

Sphul-Anderson Panel Cutter

v. Fully Automated Panel Cutting Systems are used for home fashions items like table cloths, sheets, mattress pads, napkins, bedding and curtains. The Spuhl-Anderson Panel Cutter is one of these systems which automatically pulls the fabric off the roll an exact measured distance, then cuts it off squarely and accurately.

6. **TECHNIQUES FOR SPREADING QUALITY**

a. **Removing Tension in the lay**. An essential element of spreading is to relax tension in the fabric during the spreading process. Should there be any significant 'stretch' in the fabric after spreading, when the fabric is cut into parts, each part will shrink. Even 5% shrinkage is enough to change a whole garment size.

i. Relaxing overnight.

For most knit fabrics, the common practice is to let the entire lay "relax" on the cutting table overnight. If the lay is significantly long, it may be cut into long blocks in the length of the goods, allowing the shrinkage to occur more evenly.

ii. Beating the Lay.

To further ensure that the fabric is spread without tension, the practice of "beating the lay" is performed for most hand-spread modes. The spreader takes a wooden yardstick and hits the top layer of fabric repeatedly down the length of the table. This will cause the fabric to "jump" or purposefully shrink back prior to laying down the next ply.

Short knife: Hand held knife with a blade that passes through the handle. A short amount of the blade is kept razor sharp for cutting fabrics without snagging.

iii. Tight Selvedges.

Depending on the milling method, some fabrics are finished where the selvedge is shorter (tighter) than the body of the goods. To relax the selvedge, the spreader will take a **short knife** and slit the selvedge every six or twelve inches. The slits are cut into the goods only the depth of the of the selvedge, thus not damaging the fabric for the garments.

iv. Positive fabric feed

Positive fabric feed in spreading machines is used on all automatic and semi-automatic spreading machines. The positive feed roller is tacky enough to grip the cloth and pull the cloth off the fabric roll. The positive feed roller feeds the fabric down toward the table at the same rate that the spreading machine moves down the table. This results in minimal or no tension in the fabric on the table.

Wand mounted round knife

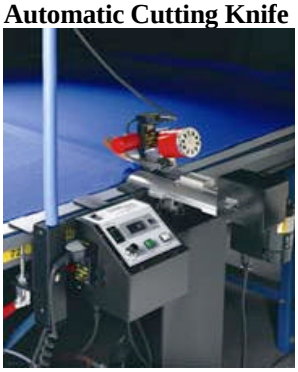
b. **Cutting at the Ends**. When spreading F/O/W, N/O/W, F/F, N/O/W, and F/O/W, N/U/D, it is necessary to cut the fabric at the end of each spread length. This can be accomplished by one of several methods.

i. Hand Shears may be used to cut across the width of the table. For fabrics over 45" wide, the spreader will utilize an assistant working on the other side of the table in, cutting from the opposite edge.

ii. Wand mounted round knife. A wand mounted round knife is an electric shears connected to a wand approximately 36 inches long. This device permits one spreader to cut across the entire width of the fabric. This eliminates the need for another spreader to work the other side of the cutting table (effectively cutting the spreading labor cost in half). If a semi-automatic or automatic spreading machine is in use, the electric shears is connected to, and stored on the spreading machine.

iii. Automatic Cutting Knife. Another method of cutting the fabric at the end is the Automatic Cutting Knife. Mounted on the table or mounted on the spreading machine. The automatic cutting knife when activated, will automatically cut across the width of the fabric in a straight line.

Automatic Cutting Knife



Shade Separation: Each roll of fabric may potentially be a slightly different shade of the same color. Each shade is bundled separately so garments will be assembled of the same shade. Shades are separated after cutting, to prevent mixing the shades when the bundles go to the sewing room.

c. **Reducing fabric waste at the ends**. The aforementioned methods of end cutting have a varied effect on fabric consumption. Hand guided cutting with shears will regularly cause the loss of approximately 3" of fabric in every ply. This is because cutting 'by eye' is inaccurate. The spreader does not take the time to rule a line on the fabric exactly perpendicular to the selvedge to cut the end. Using the electric shears only reduces this loss marginally, as it too, is hand guided.

The automatic cutting knife reduces the loss of fabric at the ends, by reducing the variance to less than 1" per ply. The automatic cutting knife, mounted on the spreading machine will

consistently cut perpendicular to the selvedge. The only loss my come due to natural skewing of the fabric which is marginal.

d. **Controlling Shades**. In order to be assured that garments will not be sewn together from fabric of differing shades, it is necessary to separate shades and colors from roll to roll. When multiple colors of fabric (noticeable difference) are to be spread, the spreader will alternate colors by roll. This permits easy **shade separation** after cutting. This will result in a 'rainbow effect' when looking at the cut edge of a bundle before sorting. In sorting, all the plies of one shade become a single bundle which is marked, tied and sent to the sewing room. When only one color is being spread, it is necessary to separate the fabric shades by roll using tissue paper or wax paper.

Tissue paper: is a very lightweight paper spread across the width of the fabric and down the length of the spread to separate shades of fabric.
Wax paper: Like household wax paper, in the spreading process, wax paper the width of the fabric and the length of the spread is used for shade separation, or just to lubricate the cutting machine blade during cutting. Depending on how much lubrication is needed will determine how many layers of fabric are separated by a layer of wax paper.

i. Tissue Paper. In order to create a noticeable separation between varying shades of the same color in the spread, **Tissue Paper** is used. The tissue separating paper on a roll that is the width of the fabric, is spread out over the last ply of one roll, before the first ply of the next roll of similar color (but different shade) is spread. After cutting, this tissue paper (often a pale pink in color) is visible in the cut bundle.

ii. Wax paper**. Wax Paper** would be utilized as a shade separator in the case where the lay is high, and friction from the cutting blade might burn or fuse the edges of the fabric near the bottom of the lay. The wax paper would be applied the same as the tissue paper described previously. As the cutting machine cuts through the lay, small amounts of the wax from the wax paper acts as a lubricant on the blade edge, reducing friction, therefore cooling the blade.

e. **Fabric Control During Spreading**.

Controlling the fabric during spreading is necessary for the cut parts to be of the highest quality. Ideally, each ply should be spread with the selvedge (or fold) superimposed one atop another on the control edge, the fabric should be square, flat and without tension.

I. Smoothing fabric. Some fabric when delivered on the roll, may have pleats folded in the goods on the roll. The spreader must straighten out those pleats before cutting, or the cut parts will be misshapen. During spreading it is also necessary for the spreader to open out any unnecessary folds, or creases, and to eliminate 'bubbles' caused by uneven tension in softer fabrics.

II. Skewing is when the fabric comes off the roll angled across the weft (width). This condition known as skewing is when the weft at one selvedge is further down the table than the other. This will cause the fabric to be off-grain in the (across) cross body direction. A spreader can pull the goods slightly to minimize this problem, but most often, management may decide not to spread skewed goods.

III. Bowing occurs when the cross-grain weft bends further down the table in the center of the goods only. This condition is difficult to minimize, so in extreme cases, the fabric will be rejected.

f. Damage Removal

The Spreader is the last quality control inspector to see the fabric before it is cut up into garments. The mill would most often, "wash their hands" of responsibility for damages and flaws once the fabric on the roll is cut. Therefore the spreader is expected to identify flaws in the fabric and either eliminate them during the spreading process, or mark them for removal later.

Seconds: Garments which contain a flaw, but are completely manufactured, are known as "Seconds". This denotes that the fabric or construction is not top ("first") quality which commands the full wholesale price. "Seconds" have a reduced value as completed garments, capable of being sold at flea markets, discounters, etc.

I. Damage Control Marks

Often, in the process of their own inspection procedure, the ***mill*** may mark damages in the fabric. These markings are usually noted by either a short yarn tied at the selvedge, or a plastic tag inserted in the selvedge. The spreader will use these selvedge marks in addition to inspecting all areas of the fabric to find damages in the cloth. Larger manufacturers (or those with a history of problem goods) may ***pre-inspect*** 100% of the fabric they will use. In addition to marking the damages for the spreader, adjustments on fabric price may be negotiated with the mill should the fabric be shown to have more damages than the mill quoted (for the price paid).

A modern approach to locating and removing damages in the fabric are Automatic Selvedge Mark Detection Systems; **See Advanced Technology Damage Control Marking Sensors** These systems improve the level of spreading quality achieved, and in less time.

II. Damages in Closed Fabric.

Closed fabric preparations pose a particular problem in detecting damages. At any given point in the spreading process, the spreader cannot see the face of every other ply of fabric. For this fabric preparation, the loss to damages is always greater. For lower cost products, the decision is made that the spreader will not attempt to eliminate the damages unless they are profound. In this case, as in the manufacture of T-Shirts, the garments are all handles the same, and are completely manufactured. In final inspection, the garments with damages in them are separated out and sold off as "**seconds**". In some product categories, seconds are a big business. Since underwear is manufactured from tubular jersey knit fabrics (closed preparation – Folded at both edged) the spreader is never able to catch all the damages.

Reality Check (a Real World example)
BLOOPERS® In order to promote the sale of it's discounted, second quality underwear, Fruit of the Loom created a new brand called BLOOPERS®. This was a clever approach to an age old problem in making underwear from tubular knit fabric. Since it was impossible to catch all the damages during spreading, FOTL produces a large volume of "seconds". In order to sell these without confusing the public into thinking they were buying first quality merchandise with flaws, the BLOOPERS® brand was born. Now at selected retailers, FOTL could sell their "seconds" in the same store as their first quality merchandise.

Cutting room Humor:
The cutting room foreman was explaining to the company intern that a slang term for spreading fabric was "stretching goods". The intern, trying to show that she knew something about spreading quality said," I know that it is a problem to stretch the goods. What do you do to prevent that?". The foreman said, "We relax the goods". When the intern asked how they did that, the foreman without hesitation answered," we talk to it very softly"

Spreading Labor Cost
= Labor Cost/hour * Spreading time
garments /marker

Cost of Damages and Ends
yards lost to
= Dmgs & Ends * Fabric Cost/yard
garments / marker

III. Re-Cutting

Marking damages without removing them is a practice followed when the cost of fabric is high. Rather than removing the damages using splice marks, when the spreader identifies a damage in the fabric, they may first roll out the marker to see if the damage falls in the waste area between parts in the marker. If the damage falls over a garment part, the spreader will lay tissue over the garment parts affected by the damage. After cutting, bundle workers will see the tissue paper showing in the cut edge of the bundle. They will pull the affected ply, and the cutter will select a piece of Ends fabric in the same shade, and tracing the damaged part, then re-cut a good part from the ends fabric. This good part will be replaced in the cut bundle.

g. Ends and Damaged Goods

I. Ends are the remnants left at the end of a roll of fabric. Ends are un-usable in the main lay when they are too short to extend over an entire section. However, since ends are good fabric, they may be utilized in splicing short distances such as the small parts section of a marker. Ends may be used for re-cuts as well.

II. Damaged goods are all the yardage of fabric that must be removed when splicing to remove damaged fabric. Seldom completely good fabric, parts of damaged goods may be usable for Splicing.

III. Ends and Damages must be recorded on the cutting ticket. The exact yardage of each is recorded as well. The cost of the Ends and Damages must be added into the cost of manufacturing. These fabrics were paid for, but unusable for garments, thus increasing the cost of each garment produced.

h. **Evaluating Spreading Cost** There is a direct relationship between spreading methods and time.

The two cost calculations for spreading are the labor cost for the time to spread, and the cost of fabric absorbed in the spreading of good garments as well as the fabric cost of ends and damages. These costs may be calculated for each lay, or may be applied to averages for spreading time and # garments per marker.

i. Spreading Labor Cost: Labor cost is calculated as the Cost per hour (loaded with an overhead and profit factor), multiplied by the Average spreading time. This cost is divided by the number of garments produced in the spread.

ii. Spreading vs. walking. Generalities can be surmised related to the mode of spreading. When the spreader is deadheading as in the F/O/W- N/O/W and F/O/W- N/O/W method, the cost of spreading will be almost double of the cost of F/F methods.

Since labor time is directly related to spreading cost ***and***

quality, the use of labor saving devices is important to spreading.

iii. The Cost of Ends and Damages is calculated by taking the total yardage recorded for a lay due to these two factors. This yardage is multiplied by the $cost/ yard for purchasing these goods divided by the number of garments spread in the lay. Even though ends are actually first quality fabric, they are un-usable in the spread. The only way to recoup the cost of ends is to attempt to sell them off (salvage value).

7. PREPARATION FOR CUTTING

Once the last ply of fabric is spread, the spreader will re-count the numbers of plies reported on the cutting ticket. Then the following additional steps are performed to complete the preparation for cutting.

a. **Moving the spreading machine aside**. The spreader will park the Spreading Machine and remove catchers if they were used. The spreading machine must be parked back far enough from the lay to permit the cutter to work. When space is a premium, the spreader may simply drive the machine further down the table, later to move it back as the beginning of the marker is cut and removed from the table.

b. **Facilitate shrinkage of the lay**. If the lay is knit, the lay would then be cut into blocks and left on the table overnight to relax (shrink back). These blocks are cut at natural splice sections in the lay. The cutter would cut between the parts across the width of the goods. This releases the tension in the plies closest to the table.

c. **Recheck the marker**. The marker is then placed on the spread. The control selvedge is aligned with the selvedge on the control side. The beginning line is aligned at the beginning of the spread. The spreader will then recheck to see that the fabric reaches the end of the marker, and that every ply of fabric is wide enough for the marker.

d. **Fastening the Marker to the Spread**

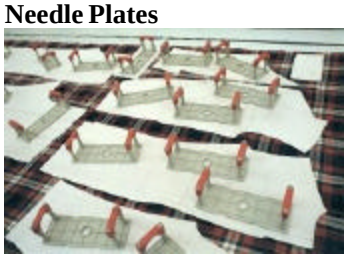
i. There are several popular methods of fastening the marker to the lay of fabric. It is necessary to keep the marker from shifting during the cutting process.

1. Cloth weights are two to ten pound metal weights that hold the marker down on the lay. Cloth weights are used whenever other methods of fastening the marker are not possible due to the nature of the fabric. Cloth weights are often used with low lays (slippery or expensive fabrics).
2. Lay tacks (sharp staples) are the most common method of fastening the marker to the lay. Using a ***lay tacker*** a device similar to an open paper stapler, the spreader will press lay tacks into the marker and upper layers of the fabric. This will stabilize the lay and keep the marker in place. For best results (to prevent damaging the finished fabric parts) the spreader should apply the lay tacks to the waste areas between the parts. Use of the lay tacks on the parts is only permissible if the fabric will not show pin holes as a result.

Reality Check (A Real-World example)
A salesman at a successful blouse manufacturer received a call from his favorite buyer. The buyer was going to be sending back an entire lot of woven blouses. The store had received several returns from consumers who purchased the blouses in the pre-season sale, and had returned them claiming that they were damaged. After trying to calm the buyer, the salesman was able to request that the returned blouses be returned quickly from the store. When the quality control manager looked at the blouses, sure enough, there were pairs of holes in the fabric spaced ½" apart. The salesman was baffled. There were four or five pairs of holes per garment. The quality control manager quickly called the factory. "How are the markers fastened to the lay? He asked the factory manager. The answer was that they use lay tacks. "Check to see if they put the lay tacks in the garment parts or in the waste between the parts"..Sure enough, the spreaders were placing the lay tacks in the body of the garments. But the factory manager was quick to point out that they say no ill effect in the fabric. To be on the safe side, the quality control manager asked that they refrain from putting lay tacks in the patterns. Continued…

Continued:
On further investigation, it was determined that all the returned garments had been washed before being returned. Realizing he had discovered the mystery, the quality manager determined that although yarns in the fabric were severed by the lay tacks, they remained invisible. On washing, the ends of the broken yarns softened and frayed, thus becoming visible. Had the spreaders followed the general rule to only place lay tacks in the seam allowance of the patterns, or in the waste area between the parts, the problem would never had come up.

Needle Plates



3. Straight T-pins are used on softer woven fabrics such as wools and wool blends, and terry cloth. These 1 ½" to 3" long pins have a "T" shaped head, and are driven down through the marker into the lay. T-pins more securely hold the marker and lay together. Whereas if the lay tacks are placed in the waste area, and discarded during the cutting process, T-pins must be carefully removed after cutting to ensure that they do not travel with the bundles to the cutting room.
4. Light spray adhesive is some times used in conjunction with cloth weights. In this method, the underside of the marker is sprayed with a rubber based adhesive. This adhesive is tacky enough to hold the marker paper to the top layer of fabric in the lay, but is easily separated after cutting. To protect the face of the top layer of fabric, the top layer must be face down, so it is most often used with closed marker preparations.
5. Needle Plate. The needle place is a quick set device to stabilize the marker and upper layers of fabric. The cutter positions the place and presses the needles into the fabric. Care must be taken to ensure that the pins do not penetrate the body area of the patterns.
6. Cloth clamps are manually set spring clips that hold the edge of a cut bundle square and prevents shifting of the plies. Cloth clamps are particularly useful when cutting small parts. Holding the clamp, the cutter can keep their fingers safely away from the cutting blade. After cutting a part away from the lay, the cloth clamp will permit the cutter to keep the cut bundle intact to facilitate notching the inside edge of the bundle.
7. Mylar plastic and Vacuum. Servo cutting and computerized cutting require a more secure way of holding fabric to the table. By using vacuum technology and mylar plastic to trap the air in the lay, the entire lay can be secured to the table. Removing the air from between the plies can also increase cutting productivity permitting taller spreading heights (more plies) under the cutting machine. Vacuum does, however increase the density of the lay, so increased friction and heat buildup must be considered.

8. **Fabric/Garment – Marker & Spreading Matrix**

This matrix is a quick reference guide to marking and spreading modes. In general, the lesser quality modes are faster, and therefore less costly than the higher quality modes.

Fabric/Garment Marker-Spreading Quality Matrix				
Fabric	Symmetric	Symmetric	Assymetric	Assymetric
Garment	Symmetric	Assymetric	Symmetric	Assymetric
Type of **Marker** for High Quality	Open or Mixed N/E/W	Open N/E/W	Open or Mixed N/O/W	Open N/O/W
Type of **Marker** for Lesser Quality	Closed N/E/W		Mixed or Closed N/U/D	Open N/U/D
Type of **Spreading** for High Quality	F/O/W N/U/D	F/O/W N/U/D	F/F N/O/W	F/O/W N/O/W
Type of **Spreading** for Lesser Quality	F/F N/U/D or Closed Goods F/F N/U/D		Closed Goods F/F N/O/W	F/F N/O/W

To choose the optimal marker type and spreading mode, first identify the symmetry characteristics of the fabric and garment. Then Select the marker type and Spreading mode for either High Quality, or for Lesser Quality.

9. **CUTTING. Cutting** is the process of separating the garment parts from the body of the fabric lay. Accurate production cutting is essential to producing garments that fit the same as the approved sample garment. When cutting multiple layers of fabric, several issues of accuracy and quality must be addressed. During the cutting process, the accuracy of the cut parts in relation to the original pattern is subject to the stability of the fabric, the movement of the fabric during cutting, the vertical accuracy of the cutting edge as it cuts through the cloth, the quality of the cut edge (clean cut without fraying, flagging or singing), and the accurate inclusion of sewing marks such as notches in the cut edge, and drill holes.
    a. **Hand Shears** are used when cutting samples and limited quantities of garments. The **cutter** must control the shears keeping the cut edge layer adds to the difficulty of accurate cutting, the patterns are often traced in tailor's chalk on the top layer of fabric. Hand shears are limited to the cutters physical strength, but usually no more than two layers of fabric due to the loss of accuracy as the shears lifts the fabric off the cutting table. This method is slow and unproductive.
    b. The **Short Knife** is an alternate method to hand shears. The short knife is still in use in sloping and cutting leather apparel. The short knife slices through the fabric, scoring the table in the process much the same way as slicing vegetables on a cutting board in the kitchen. Fabrics cut this way

Sloping: To make custom fit shirts from standard sizes, individual plies (up to 6 at a time) are placed on a hard cutting surface. The parts are remarked with the fit for an individual consumer. The cutter then "slopes" the parts, re-cutting to the new measurements. The newly shaped parts become a custom fitted garment.

must be heavily weighted, as the short knife ***pushes*** as it cuts through the fabric, distorting multiple layers of fabric. Ten to twelve layers of fabric may be accurately cut this way. Since leather must be cut singly (one layer at a time to facilitate cutting around the natural flaws in each skin), the short knife is used. Either the patterns are traced on each skin before cutting, or a hard template (metal edged- wooden form) is used for each pattern and the cutter will place the template down on the leather between the flaws, and slice through the leather with the short knife. The short knife is one way that round knife cutters can accurately cut notches in the edge of a taller lay of fabric.

The short knife is also used for **sloping** on dress shirts and other 'customized' apparel where only a few layers of fabric are being cut at one time.

c. **<u>Electric Powered Cutting Machines</u>** are used most often in mass production of fashion apparel. Capable of cutting through many plies of fabric, these machines are used throughout the world. Cutting machines all have inherent advantages and disadvantages, and the correct choice of machine for the application (use) will yield the best cutting quality. All electric powered cutting machines have some common components. The electric motor is located above the cutting blade. The cutting blade is mounted in a 'standard' which supports the blade and the weight of the motor. The base plate holds up the standard, and usually has ball bearing rollers that make it easier for the cutter to move the machine about on the cutting table. The large base plate passes below the lay as the cutting machine is operated. To minimize distortion of the lay during cutting, the base plate is made as thin as possible.

i. The <u>Straight Knife</u> or "Up and Down" (Vertical Knife) is a machine with a straight vertical blade. Straight knives are available from 3" to 14" tall, capable of cutting lays from 2 ½" to 13 ½" in height. Depending on the density of the fabric, this may represent a wide range of plies. When encountering notches, the straight knife may be used to cut notches by pushing the blade into the notch mark on the patterns above each bundle.

ii. The <u>Round Knife</u> utilizes a circular blade that cuts cleanly through fabric much the same way that a circular wood saw cuts through wood. The blade at the cutting edge rotates down toward the table continuously providing a cleaner cut close to the table surface. The straight knife chops the fabric down close to the table surface. Additional advantage of the round knife are that it can cut without pushing the lay as it cuts, facilitating cutting on slippery fabrics. Continuously slicing downward, it also makes cutting very dense fabrics easier. The disadvantage of the round knife is that at the cutting edge, the blade is not vertical. Therefore, cutting accuracy is sacrificed as the lay get higher.

Both round knife and up and down knives are ***on-table*** cutting methods. Ultimately, cutting accuracy is dependent upon the control that the cutter exerts on the machine to cut vertically, and to split the

line of the marker while cutting. To achieve greater accuracy, more advanced technology is required "on the cutting table", or the fabric may be spread with blocks for all or certain parts designated to be cut 'off the cutting table'.

Off-Table cutting: cutting methods requiring that the fabric block be moved from the cutting table to the cutting system.

d. **Die Cutting** is an ***off-table*** cutting method that provides cutting quality close to perfection. Steel rule dies used most often in fashion manufacturing, are made with a wooden form wrapped by a sharpened steel cutting edge. These are less expensive than cast-steel dies. A die is required for every part in every size that must be cut. This represents a large investment at over $100.00 per die. In this process, Fabric blocks are included in the marker for the parts to be cut by die. The blocks are shifted off the cutting table. At the cutting machine (known as a 'clicker'), the dies are placed (by size, etc as needed.) down on the cloth, and the machine head presses the dies down through the fabric lay. Every part comes out the same exact shape and size when die cut correctly. A limitation, is the height of the cutting die. The tallest cutting die can only cut appr. 2 inches in height. Taller blocks of fabric need to be separated and cut several times.

Die cutting

Beam Clicker

Cloth Dies

e. **Band Knife Cutting** is another off-table cutting method. The block of fabric is moved to the band knife cutting machine. The Band knife is similar to the butcher or wood working band saw. A continuous blade passes down through a table top cutting surface. The operator guides the block of fabric to the blade. Cutting accuracy is achieved by using thin wooden forms the shape of each pattern to be cut. The band knife is particularly useful for high pile fabrics like terry, or velvet, as well as soft knits.

Placing a cloth die

f. Auxiliary Devices

i. Notchers are either manual or electric machines used to make notches in the edge of a cut bundle. Unless cutting notches while cutting with the up and down knife, notchers are necessary for creating notches.

1. Cold Notcher. The **Cold notcher** is a manually operated, spring-loaded device with a short blade mounted on a plunger. Placed at the edge of the bundle, the cutter lines the blade up with the notch. In a single stroke downward, the notch is cut into the edge of all of the fabric plies.
2. Hot Notcher. When the fabric is a soft weave or knit, the cut notch will be lost in the edge fraying during handling each part. To create a more lasting notch, a **hot notcher** is used. The hot notches utilizes a vertical heated edge which burns a notch into the edge of the bundle. The temperature is controlled, so as to leave a brown burn mark without melting or doing excessive damage to the fibers.
3. Ink Notcher. The ink notcher is similar to the hot notcher. Instead of burning a notch into the edge of the fabric, this device leaves a trace of UV marking ink on the edge of the

Band Knife Cutting

fabric. This ink is visible under UV lights at the sewing station.

ii. Cloth Drills are used when a mark is needed inside the body of a part to indicate the point of a dart, location of a pocket slash, or position of an interior component such as a patch pocket, or appliqué. Drill holes are a more productive alternative to chalk marking parts individually.
    1. The Cold drill works in a similar manner to a punch cutting a small circle of material as it bores down through the layers of fabric. The shaft rotates like a wood drill, cutting the hole as it moved vertically downward.
    2. The Hot drill uses a solid shaft that is electrically heated. The drill leaves a burn mark to leave a lasting mark on loose weaves and knits.
    3. The String marking is a device that uses a needle that penetrates all the plies of the lay. The needle carries a thin cord which is left in the fabric marking a drill hole location. This is used on very loosely knit or woven fabrics where a not notch would damage the fabric. The sewing operator pinches each ply at the string, holding the point as a reference for sewing.

iii. Inside Slasher. The Inside Slasher is a device used to cut the inside slash for interior 'slash' pockets. The cut is entirely internal on the part, so cutting from the edge is not possible. The Inside Slasher has a double edge blade that reciprocates, and is inserted from above the part bundle, where the part bundle is moved under the knife.

10. **ADVANCED CUTTING SYSTEMS**. Advanced Cutting systems are labor saving, time saving systems that either increase the cutters efficiency, or can eliminate the cutter entirely. Most control the process mechanically, improving quality by improving the consistency of the process over what (human) hand guided cutting can produce.
    a. The **Servo Cutting System** utilizes a spreading table with vacuum, and a swing-arm mounted cutting machine. As the cutting machine is mounted from above, the standard and base plate can be significantly smaller. This results in less disturbance of the lay during cutting. With the swing arm servo motor activated, the cutter can cut through more dense fabrics than the same cutter can do in one sitting.
    b. **Computerized Spreading/ Cutting Systems**
    Keeping pace with computer system development, computerized grading, marking, spreading and cutting systems are continuously evolving through technology. Three technologies exist for the cutting process, automatic knife cutting, laser cutting and waterjet cutting. The two latter technologies, laser and waterjet cutting are

Cloth Drill: Electric device that bores a small hole through all the layers of fabric. The cloth drill has a bubble level to indicate that the shaft is perfectly vertical.

Servo Cutter

Computerized Cutting

Computerized knife cutting systems: Utilizing a bare, double-edged knife that penetrates all the fabric into a bristle block table surface. These systems are directed by the computerized marker. The cutting surface supports the fabric, but permits the blade to penetrate the surface, allows vacuum to be used to hold the fabric to the table. Clear thin mylar holds the vacuum in, creating large amounts of holding force. The cutting head is mounted on an automatic servo arm that spans across the table. The fabric is either advanced automatically, or the cutter moves down the table.

limited to one or two layers of fabric, or one layer of leather. Computerized knife cutting is now capable of 2 ¾" (compressed by vacuum) in cutting height. For lower density fabrics such as knits, this translates to almost 5" of fabric uncompressed. These systems utilize the computer made marker to directly drive the cutting head. Therefore, no paper marker is needed. In place of the marker, either an unlined overlay paper will be placed over the lay to identify the cut parts, or self stick labels would be applied to the top layer of fabric over each cut part. Computer cutters have a cloth drill mounted on the cutting head, to facilitate inserting drill holes whenever needed. The newest systems are tailored to the average cutting height.

Laser Cutting Systems: Computer guided Laser that is used to cut one ply at a time. Usually coupled with a continuous feed system, this is an accurate method of cutting. The laser vaporizes the fabric in it's path. The laser never requires sharpening as the knife cutting system does.

c. **Leather Cutting** Traditionally cut by short knife, Leather is today cut by **laser cutting systems**. These systems contain scanners that are so sensitive that they scan each skin, and identify every flaw in the skin. The system then plots the optimal placement of patterns on the skin, then drive the laser cutter to cut the patterns out automatically.

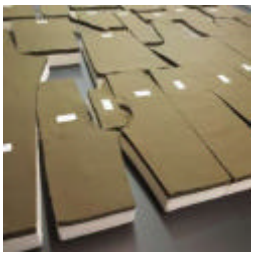
Safety Gloves

11. SAFETY DEVICES

a. **Steel mesh gloves** are used to protect the cutters free hand. Made of chain-mail, these gloves are flexible, yet protect the three fingers, or entire free hand of the cutter. The glove provides enough warning that the cutter will pull his hand away from the blade before cutting the skin.

b. **Blade Guards** are incorporated into every cutting machine. The standard of all hand guided machines cover the back of the blade. There is a 'floating' guard that is adjusted to ride above the lay in front of the blade to prevent the cutter from accidentally hitting the cutting edge.

c. **Die cutting machine guards** With their tremendous crushing force, die cutting machines are designed to only be activated by the cutter placing ***both hands*** on the controls. In addition, modern machines have a ring sensor around the cutting head that retracts the head when it touches the cutters hand or arm.



Cut Bundles

Re-cutting: The process of marking a fabric part that is damaged, and then re-cutting it after the lay is cut. The part is pulled from the bundle, and is traced on fabric of the same color and dye lot, and then replaced in the bundle.

12. BUNDLE PROCESSING.

As the cut bundles are separated from the lay, they are moved to a separate table or section of table for sorting and preparation for the sewing room. Several factors will determine exactly what steps will be taken here.

a. The simplest method of **sorting bundles** is to separate the various shades of color in the spread. Each group of plies would be marked for their position in the lay. These groups would then be marked and tied together with a lanyard or strip of selvedge scavenged from the lay.

b. **Ply marking** is performed when there is the slightest chance that the fabric shade might be different from one ply to the next. In each bundle, starting with the layer of fabric closest to the table, the plies are marked with a small sticker (on the back of the cloth) that contains the style#, size and consecutive ply number starting with #1 (nearest the table). This

numbering is duplicated on every cut bundle. Therefore, in the sewing room, sewing operators match plies together numerically ensuring all parts of a garment come from one layer (shade) of fabric. This process was referred to as ***sobar*** ticketing for many years from the brand of machine used.

i. Ply tickets may be self adhesive stickers, applied with a hand held machine similar to a grocery marking machine. These devices can be set to number once per digit, or twice per digit (for face to face pairs) before advancing to the next control number.

ii. Special Ply tickets. For knits, loose weaves, or pile fabrics where the self adhesive stickers will not hold, sobar marking is done with a paper ticket that is stapled to the fabric. This staple is an open staple that is removed later by pinching the ticket and pulling the staple out with the ticket. Unlike the self adhesive sticker which might be missed and left in the garment, these MUST be removed later by the sewing operator, or the staple poses a safety hazard in the finished product.

c. **Bundle Sorting**. After the cut bundles are separated, (marked) and tied, the bundles are sorted and grouped together however is necessary for the sewing process. Parts that will be sewn together in the early stages of production will be tied together.

Spreading quality is achieved by spreading fabric with the control selvedge aligned, the warp and weft on grain, and every ply flat and smooth. Spreading quality is further achieved by spreading the fabric with a minimum of tension, and by removing all damages from the cut parts before they reach the sewing process. Fabric width is maintained to be wider than the spreadable width of the marker.

d. **Re-Cutting**. During the process of bundling, if the method of damage control that is used is **re-cutting,** the bundle processors will look for tissue paper interspersed in each cut bundle prior to tying the bundle. (See Re-Cutting below)

13. SPREADING AND CUTTING QUALITY

a. **Quality Spreading** produces fabric parts that are on-grain, and free from pleats, creases, folds or damages The higher the fabric is spread on the cutting table, the greater the productivity and lower the per-unit cost. For good quality cutting, the spread must be limited to the practical cutting height for the cutting machine in use. The following methods are used to achieve good quality spreading.

i. Straight Selvedge. The control selvedge of the fabric must be maintained in a straight line(parallel to the length of the cutting table), with the selvedge laid one ply superimposed on the previous ply. As fabric width varies, the variance is seen on the far side of the table from the control selvedge.

ii. Checking Fabric Width. The width of the fabric must be maintained to be at least as wide as the usable width of the marker. This may require the fabric be measured and sorted by width before spreading. During the spreading process, the spreader will either periodically measure width with a ruler, or the spreading machine may be mounted with a 'width alarm' that would either sound an alert, or stop the spreading machine if the width becomes too narrow. The newest automatic spreaders have a width alarm that sounds when the fabric becomes narrower than a pre-set width.

iii. Reducing tension by Beating the Lay. Depending on the technology available, the minimization of tension in the fabric is achieved by machine and/or manual methods. Manually, the spreader may 'beat the lay' with a lightweight yardstick to cause each ply to shrink back after spreading. If tension (stretch) is inevitable in the fabric (as is the case with knit fabric), the lay may be left on the table overnight to permit natural shrinkage prior to cutting. Powered spreading machines may further minimize stretching with a positive feed roller.

iv. Removal of Damaged Fabric. Spreading quality is also achieved by consistently identifying and removing damaged fabric before sewing. The exact method used is determined by the cost of fabric/ garment (price point), and by the method of spreading used.

v. Splice marks are utilized to remove damages during the spreading process. This method requires the spreader stop when a damage is visually identified, locate a splice mark on the table prior to the damage, and cut the fabric at the nearest splice mark, then the fabric is cut just past the damage. Good fabric from the roll is then pulled back to the first part of the splice mark in the direction of spread, and spreading continues. This method is the most popular method used for low to moderate priced fabrics.

vi. Re-Cutting. When the fabric price is very high, the system of "marking damages for **re-cutting**" is used. In this method, the spreader will often, before marking a damage, check to see if the damage will fall on a part, or between parts in the waste area of the marker. If on a part, the spreader will lay some tissue paper over the immediate area of the part that will contain the damage, and continue spreading. In bundling, the ply with the damage will be located below the tissue paper, and will be pulled for re-cutting from fabric of the same color and dye lot.

vii. Marking damages for Seconds. When the fabric cost is very low or when spreading F/F, it is impossible to see all the damages. When damages are found, they are simply marked with a neon colored label. In this case, the fabric will be cut, and the garments will be sewn. In the garment inspection process, the marked garments, and any others found to be containing damages, will be marked as "***seconds***", or "second quality garments". These are separated from the lot and sold off as imperfect garments.

b. **Cutting Quality** is achieved by cutting every part to be exactly as the pattern for that part with no adverse effects on the fabric. The higher the fabric is spread, the greater the challenge to cut every part with the best quality. Cutting quality is measured by several factors related to how the cutter controls the cutting process.

i. Cutting accuracy is a measure of how closely the cutter splits the pattern line in the marker.

ii. Cutting perpendicular to the Table. A second measure of cutting quality is that the cutting blade cuts the fabric perpendicular to the table, so every part is the same shape and size as the pattern from the marker. The challenge of a round knife is that the cut edge is a concave shape, only straight when the cutting machine is moving in a straight line. When cutting curves, the round knife is only effective on low lays (few plies)

iii. Fabric Edge in the bundle. Another measure of cutting quality is the quality of the edge of the fabric. If the fabric is cut cleanly without fraying, this is considered good quality.

iv. Heat during Cutting. Heat may be a factor during cutting if the lay is dense or particularly high. Burning, singing or melting the cut edge is poor quality. Fabrics of thermoplastic fibers are particularly sensitive to heat. The cut surface may actually be melted into a solid block of plastic if heat is not controlled. Controlling lay height, or using methods of cooling the blade such as the use of wax paper spread periodically during spreading can keep the blade temperature in a safe range. Air blowers and in the case of industrial fabrics, the use of Oil sprays may also be used to cool the cutting blade.

v. Accuracy of Markings. Additional factors of cutting quality are the accuracy of auxiliary markings on the pattern. Drill holes must be perpendicular to the table to appear in the correct place on every ply. Notches must be made perpendicular to the table, and must be deep enough to be visible, but not so deep as to cut past the seam allowance.

14. CHAPTER REVIEW.

In this chapter we learned how fabric symmetry and garment symmetry determine the type of marker, and spreading method. The choices made will determine the overall quality of the garment and how it will appear as a finished product. Productivity is achieved by cutting more plies at one time with a single marker. Order planning determines the ratio of sizes in an individual marker. Markers can be made specifically for each ratio, or by using a section marker, varying order ratios can be satisfied by varying the number of plies spread.

Open markers containing all the pattern pieces can be more efficient, and most flexible for the garment symmetry. Closed markers specifically serve symmetric garments, with the advantage of faster spreading methods, and half the cutting time since closed markers have half a set of patterns.

Whenever the spreader can see the face of the fabric, good quality is possible. Damages in the face of the fabric will be missed when fabric is spread face to face.

Automation in spreading and cutting speeds up the process, while at the same time improves the consistency and therefore, the quality.

Computerized markers can be used to drive computerized cutting systems. These systems are more efficient for the marker making process, as well as much faster and more accurate than hand guided cutting. With a limit to the

spreading height, however, they cannot spread the overall volume of hand guided cutting in one lay.

Post Chapter Content to be added later:

1. Review Points

2. Chapter Questions
(answers on the CD)

3. Video references on the CD

4. General References and Web references