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An extensive analysis and testing of wedding dress fabric

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An Extensive Analysis and Testing of Wedding Dress Fabric

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Abstract

This material analysis explores polyester satin, polyester chiffon, nylon tulle, silk organza, and silk taffeta that are utilized in the wedding gown industry today. Each of the five fabrics are extensively tested in the laboratory to determine cover factor, drape, abrasion, crocking (wet & dry), stiffness, tensile strength, and seam strength. These fabric properties are usually considered to have significant effects on the garment performance. The results from these tests are analyzed, giving a better understanding of each fabric's individual characteristics to help dressmaking designers further their knowledge and better construct their wedding dress garments.

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Introduction

Problem Statement and Background

With an exorbitant selection of wedding dress fabric on the market, it is problematic for a designer to blindly choose which material to use without further investigation. Different styles of dresses depend upon the characteristics of the fabric used, which include cover factor, drape, abrasion, colorfastness, stiffness, flexibility, and seam strength, to name a few. Understanding the different outcomes from textile tests will aid the designer in choosing the appropriate fabric based on the conditions under which it will be worn.

There are a large number of dress styles and fabric combinations to choose from when designing a wedding dress. It is significant to note that a wedding gown is usually worn only one day and possibly passed down to future generations. Therefore, critical fabric characteristics such as abrasion, seam strength, and colorfastness need to be examined further. How a dress holds up through the minor abrasions and general wear during the wedding day will be crucial if longevity is an issue. The resistance of the fabric's color to fading is also important for how it will be cleaned after it is worn and placed into storage. Other critical factors in choosing a wedding gown fabric are season, temperature, and location. Cover factor, drape, stiffness, and flexibility are all crucial characteristics that need to be explored. The temperature of the wedding day may impact which fabric is chosen based on its cover factor and drape. Indoor versus outdoor ceremonies may cause a designer to look into the flexibility and stiffness of the fabric. Each of these characteristics has an important purpose that a designer can utilize when constructing the perfect gown for a particular bride.

Wedding gown fabrics are described based on the fiber content and fabric weave. Fiber content consists of:

- Silk: This is the most sought after fiber for wedding gown fabric. It is soft, lustrous, and beautiful. The most popular country to produce silk is France, which is why so many French names are used when describing the fabric weave: dupioni, peau de soie, and so on. Most brides enjoy the silk fiber; however, it is the most expensive with prices usually costing more than $1000 a dress. For those budget conscious brides, more affordable silk fabrics and silk blended fabrics have become available with a lower price over the past years.
- Cotton: Cotton is very popular in everyday clothing, which is why it is very rare to see a cotton wedding gown. It is, however, still an option that designers utilize in sheer or embroidered selections.
- Linen: Generally, linen wrinkles very easily; therefore, it is usually combined with other fibers such as cotton. Due to this, it is most used for bridal suits and other informal dresses.
- Rayon: Rayon is an affordable fiber and is usually found in blends.
- Nylon, acetate, and polyester: These three options became popular in the 1970s and are generally woven in with other fibers to make the overall fabric more affordable with a different appearance.

Fabric weaves comprise two different sets of threads: the warp or vertical threads and the weft or horizontal threads. Different weaves create different types of fabric that most noticeably stand out based on their thickness and texture.

The following are different types of fabric weaves that are common in bridal fashion:

- Brocade: This weave yields a heavy weight fabric, which is created on a special loom. It has a textured, distinct pattern that can sometimes be highlighted with metallic thread. Commonly, brocade fabric has a floral pattern.
- Charmeuse: A lighter weight variation of satin, charmeuse has a softer clingier appearance. Generally, charmeuse is cut on the bias and used in sheath or column dresses.
- Chiffon: Similar to charmeuse, chiffon is also a lightweight, sheer woven fabric. It can be made from any fiber. It is delicate and is commonly used in outdoor weddings.
- Crepe: This is a thin, soft, light fabric with a crinkled surface. There are newer, more affordable options of polyester crepes, which offer a similar feel and drape to silk crepes. Crepe de chine, or crepe from China, has tiny irregularities in the surface texture making it feel like pebbles. Usually it is made from silk; however, it can be made of wool.
- Damask: Similar to brocade, damask has raised designs but is much lighter in weight. The patterns are subtler giving it an ethereal look.
- Double-faced satin: This fabric is heavyweight, with a sheen seen on both sides. Generally it is used for structured styles and tends to be higher end couture fabric.
- Duchess Satin: This weave can also be known as silk-faced satin. High-end designers generally use duchess satin quite often even though it is quite affordable. It has a discreet luster and weighs less than traditional silk finishes. Generally it is a

blend of silk and polyester woven into a satin finish. It can, however, be seen as a hybrid of silk and rayon which is becoming very popular.

- Dupioni: Fibers with various thicknesses are usually used in this fabric, which give it a crisp texture with many visible natural waves. It also has a slight sheen. Generally, dupioni is on the less expensive side of silk variations with many options of colors. Therefore, it is not only a good choice for brides but also for bridesmaids.
- Faille: This is a finely ribbed blend of silk, rayon, cotton, or polyester that is seen in couture and structured styles. It has a light sheen and can also be used in bridesmaid styles.
- Gabardine: This slightly shiny fabric is ribbed and obtainable in an assortment of fibers.
- Gazar: Light, crisp and sheer is the best way to describe this fabric, which is a variation of organza with a more stiff or starch feel.
- Georgette: Georgette is a form of crepe that has a dull texture. It is usually made of polyester or silk.
- Grosgrain: This fabric is strong, and closely woven which gives it a corded appearance.
- Illusion: Illusion is a sheer fabric with a stretch. It is often seen in veil nets and used as part of the back of a dress or its sleeves.
- Italian Satin: This satin is heavier with lots of body. It has an antique finish that has a sophisticated look.

- Jersey: This machine knitted fabric can be made from a variety of fibers. It has lengthwise ribs on the surface and crosswise ribs on the underside. Jersey's best quality for a wedding gown is that it drapes softly.
- Mikado: This fabric is stiffer with a slight sheen.
- Moire: Moire is a heavy silk taffeta that has a wavy appearance.
- Organdy: This fabric is transparent, crisp, and stiff. It is generally made from cotton.
- Organza: Organza is similar to chiffon in that it is sheer; however, organza is heavier with more body. It holds a lot of shape; therefore, it is seen in structured styles like full skirts or overlays without adding bulk. It can also be used as an interfacing if sheerness is a factor in the design of the gown. Organza is made of silk, rayon, nylon, or polyester.
- Peau de soie: Meaning "skin of silk," peau de soie is a heavy, smooth satin that has very fine ribbing. This fabric has a duller finish compared to conventional satin. Generally it is seen on shoes, handbags and high-end gowns.
- Satin: This fabric is tightly woven, which gives it a beautiful sheen on one side and a matte finish on the other. It is great for skirts of all lengths because of its weight and drape.
- Slipper satin: Slipper satin is an especially soft satin that is extremely shiny. It looks nice in a low-lit atmosphere since light catches so well on its shiny surface.
- Shantung: This fabric is similar to dupioni; however, shantung is more lightweight. It has a light-catching glimmer with a nubby irregular texture. It usually is used in structural designs.

- Taffeta: This crisp, smooth fabric has a slight rib and moderate sheen. It makes a rustling sound when worn. Usually it is made from silk or polyester and can be draped or structured as it wrinkles easily.
- Tulle: Generally, this fabric is used for veils and ball-gown skirts as it is described as fine netting. The silk variety is usually softer than the polyester option; however, both are rough on the skin. Tulle can come in different grades or weights and can be layered to create heavy volume or remain single-ply to be sheer.
- Twill: These fabrics are made from woven fibers that create a diagonal pattern.
- Velvet: Dense and luxurious, this fabric can be found in three different forms: velvet, burnout or panne. Velvet is the stiffest of the three. Burnout is created by burning out the pile with chemicals, which creates a brocade effect with more drape. Finally, panne is a glossier version with the pile flattened in one direction. Generally, velvet is used mostly for winter weddings.

Along with fibers and fabric weaves, lace is another option that brides can choose to add to their gown. The following are options that are available:

- Alencon: This is most likely the most popular of wedding lace. The background has flowers and swags. The edges have cording which makes it stand out among other designs. It can be pre-beaded or beaded after it is sewn on the dress.
- Battenburg: A strip of linen fabric is stitched into a pattern of loops that are then connected with thread. This lace is found on wedding gowns along with table and bed linens.
- Chantilly: This lace has a plain net background with flowers or ribbons as the embellishment while the edges have a fine cording.

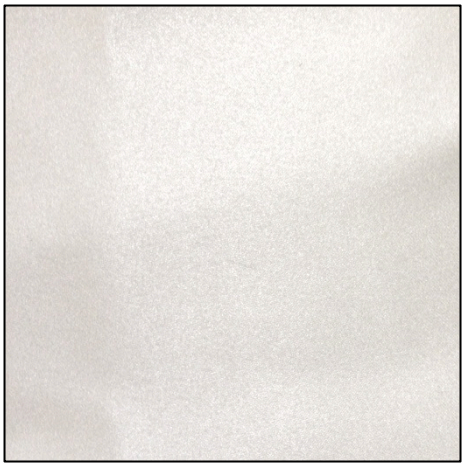
- Cluny: Cluny is made up of loosely twisted yarn that gives a thick, three-dimensional appearance. It is best known as "old-fashioned."
- Coin-dot: Circles or dots are woven into the background netting of this lace.
- Dotted Swiss: This lace is sheer, lightweight, and is embellished with small raised dots. Suitable for summer ceremonies, casual weddings, and flower girl dresses and often seen on necklines and layered over skirts.
- Eyelet: Cotton is generally the fiber that this lace is made from. It has perforated holes with embroidery around the edges.
- Guipure: This lace has a series of motifs such as roses, daisies, or geometric designs which include ovals that are connected by a few threads.
- Honiton: This is an English lace that features floral and leaf patterns that are held together with small braids.
- Schiffli: An all over embroidery design is seen on this lightweight lace, which is placed on a net background.
- Soutache: This lace is an alternative to Alencon. The cording used is thicker which makes it stand out more.
- Venise: Venise lace has a needlepoint design. Generally it has heavy raised floral, foliage, or geometric shapes that give it a chunky appearance. The connecting threads are referred to as "brides."

When it comes to the design and fabric choice of the dress itself, each gown will look different if trying to achieve the same shape. For example, when creating a ballgown for a winter wedding, a heavier, more structured fabric such as silk taffeta may be an ideal choice as compared to silk chiffon. A silk chiffon ballgown will look less full

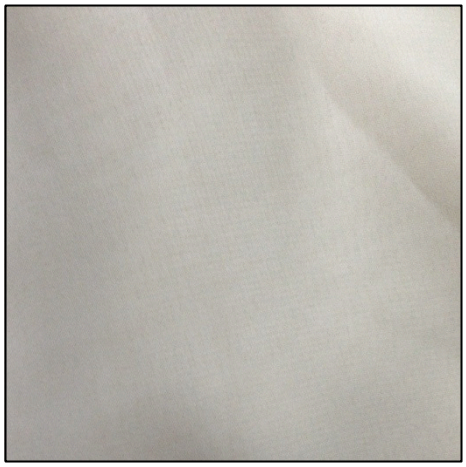
as it is a very lightweight, delicate fabric that is usually used in more free flowing styles during the summer months. Upon doing this research and analysis, the specific fabrics chosen will be characterized based on their individual strengths and weaknesses.

If a dressmaker understands the best uses for specific bridal gown fabric he or she will have an easier time deciding on a finished look. The resource limitations and time must also be taken into consideration, as a select number of the fabrics will be studied and a select number of tests will be performed in this investigation. These fabrics include: polyester satin, polyester chiffon, nylon tulle, silk organza, and silk taffeta. These tests include: picks per inch, ends per inch, cover factor, drape meter test, crocking (wet & dry) test, stiffness test, tensile strength test, and seam strength test.

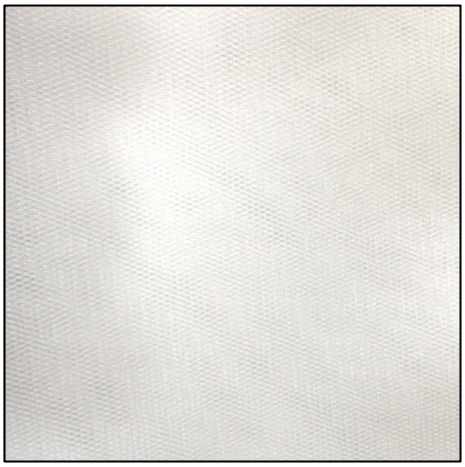
At the end of the day, the dressmaker's choice in fabric will weigh over any other factor. Some dressmakers like how satin feels or the sound that taffeta makes without understanding their positives and negatives. This is why dressmakers need to learn in more detail about the fabric they are using. Having a detailed model of different wedding fabric characteristics for reference will generate the knowledge and wherewithal for the designer to properly construct a gown based on their brides individual wedding demands.



Polyester Satin



Polyester Chiffon



Nylon Tulle

Silk Organza

Silk Taffeta

Figure 1. Fabric Samples

Purpose of the Study

The purpose of this study is to investigate and understand the properties of wedding dress fabrics and learn how these laboratory test results allow dressmakers to select appropriate fabrics for wedding gowns. These fabrics include polyester satin, polyester chiffon, nylon tulle, silk organza, and silk taffeta.

Objectives

The following objectives were emerged to address the purpose of the study:

1. Collect various fabrics that are usually used in making wedding gowns
2. Conduct specific tests such as: picks per inch, ends per inch, cover factor, drape meter test, abrasion test, crocking (wet & dry) test, stiffness test, tensile strength test, and seam strength test.
3. Analyze the test data to develop a model for choosing wedding gown fabric.

Hypothesis

Understanding properties of various wedding gowns so that a model can be created that will allow the dressmaker to select appropriate fabric for this product.

Justification and Significance

Fabric properties are closely related to the material they are made from and are crucial when formulating construction and design. The complete analysis of wedding fabric will allow dressmakers to appropriately select the fabric for making wedding gowns using the knowledge developed in this study.

Methodology

The fabric was gathered from a local fabric store: Haberman Fabrics in Royal Oak, Michigan. The following tests were conducted on the fabric: picks per inch, ends per inch, cover factor, drape meter test, abrasion test, crocking (wet & dry) test, stiffness test, tensile strength test, and seam strength test.

Picks Per Inch and Ends Per Inch

The construction of woven fabric has various aspects, which include PPI and EPI. PPI stands for picks per inch and EPI stands for ends per inch. When determining the PPI of a fabric, the weft yarns are counted. When determining the EPI of a fabric, the warp yarns are counted.

Cover Factor

Cover factor of a fabric is a percentage that is calculated by comparing the open spaces of the fabric to the space occupied by the threads in the fabric. This relates to the number of warp and number of weft threads based on fabric count and yarn linear density. Cover factor combines the significance of the fabric count and yarn size in heat and air transfer to indicate the fabric's structural properties and thermal comfort.

Drape Meter Test

The drape meter test, which was described by Chu, Cummings, Teixeira (Text. Res. J. 20, 539, 1950) was utilized for this study to determine the drape coefficient for each fabric. To calculate the drape coefficient the following equation was used:

$$D = \frac{AP - AD}{A - AD}$$

A: Area of the specimen

AD: Area of supporting disk

AP: Actual projected area of specimen

Two samples were cut and draped over a supporting disk. Each sample measured 10 inches in diameter (A). The supporting disk was 5 inches in diameter (AD). A light shined on the draped fabric and the outline of the shadow was sketched (AP). From there the outline was digitized on the computer in the Gerber program to measure the area of each sample. Each sample was digitized into the Gerber program using a cursor that traced the outline of the shadow. The outline was scanned digitally in the x, y coordinates and was placed into CAD. It was then opened in the Gerber software and further measured. The Gerber software gives a precise area of each sample that is digitized to yield the areas under the curves. There were 10 samples in total, 2 from each fabric.

Abrasion Test

The abrasion test measures the weight loss of fabric as well as pilling. Pilling is created after the fabric is continuously rubbed against another fabric in an abrasion machine. This test measures 4 circular 1-3/8" diameter test samples from each fabric. First the samples are weighed and then placed in the Abrasion Test machine. Each of the 20 samples went through 2000 cycles of abrasion. After the cycles were complete, the samples were observed for pilling and weighed again.

Crocking (Wet & Dry) Test

Crocking measures the transfer of color from a colored textile to another fabric surface during a rubbing test. The crocking test may be influenced by moisture as most textiles transfer color when wet; therefore, a wet test is also included to determine the

difference. The color that is transferred may differ in hue from the color of the test specimen. When this occurs, it is usually due to the fact that the test specimen was dyed with a combination of dyes that have different levels of colorfastness to crocking. Two samples for both wet and dry testing were used for each fabric. A 7" x 3" test fabric sample is attached to the base of the machine and a standard white fabric crock square is rubbed against it for 10 cycles. The test fabric is then evaluated against a grey sale of 1 – 5 with 5 showing no hue change.

Stiffness Test

The stiffness test utilizes a manually operated instrument that requires the user to physically record stiffness data, average the readings, and multiply the results by a scaling factor. Each fabric was tested with 4 different test material samples of 1-1/2" x 1-1/2" and was attached through clamps onto the machine. After all the angles are zeroed out, the material is deflected 15 degrees to the left and then zeroed out and deflected 15 degrees to the right. The measurements are taken from each side and an average reading is found. Finally, this number is multiplied by an assigned number on the Set Up Chart and the final stiffness value is determined in Taber Stiffness Units.

Tensile Strength Test

The tensile strength test is performed to measure the strength of the fabric's warp and weft threads. The peak load, strain at break, and modulus of the woven fabric are determined after the test has been performed. The peak load measures the maximum load recorded during the extension of the fabric. The strain at break measures the percentage of elongation at the moment the test specimen ruptures. And the modulus measures the initial resistance of the material to the tensile force. During this test, all of the warp or

weft yarns in the specimen are gripped. Since the full width of the specimen is clamped in the test machine, the strength is related to the width and the number of yarns in the sample.

Seam Strength Test

The seam strength test is performed to test the strength of a regular seam between the many warp and weft threads in the specimen. The peak load, strain at break, and modulus of the woven fabric are determined after the test has been performed. The peak load measures the maximum load recorded during the extension of the fabric. The strain at break measures the percentage of elongation at the moment the test specimen ruptures. The modulus measures the initial resistance of the material to the tensile force. During this test all warp or weft yarns are gripped. Since the full width of the specimen is clamped in the test machine, the strength is related to the width of the sewn seam between the fabric pieces.

Results and Discussion

Table 1

Results of Fabric PPI, EPI, Cover Factor, Drape Coefficient, and Weight Loss Due to Abrasion %

Material	PPI	EPI	Cover Factor	Drape Coefficient	Weight Loss Due to Abrasion%
Polyester Satin	84	124	0.121	1.17	0.09%
Polyester Chiffon	84	116	0.074	0.61	0.41%
Nylon Tulle	-	-	-	1.08	0.10%
Silk Organza	104	140	0.098	1.49	0.63%
Silk Taffeta	80	196	0.165	1.71	0.72%

Table 2

Results of Fabric Abrasion Pilling, Crocking Wet & Dry, and Stiffness

Material	Abrasion Pilling	Crocking Wet	Crocking Dry	Stiffness
Polyester Satin	5	5	5	0.21
Polyester Chiffon	5	5	5	0.04
Nylon Tulle	5	5	5	0.04
Silk Organza	5	5	5	0.28
Silk Taffeta	5	5	5	0.50

Table 3

Results of Fabric Tensile Strength

	Tensile Strength					
	Peak Load		Strain at Break		Modulus	
Material	Warp	Weft	Warp	Weft	Warp	Weft
Polyester Satin	107.892	77.862	95.362	73.291	1.238	2.054
Polyester Chiffon	35.092	22.478	116.046	89.803	0.323	0.287
Nylon Tulle	-	-	-	-	-	-
Silk Organza	71.415	13.759	41.146	21.392	3.833	0.838
Silk Taffeta	82.959	59.041	50.897	61.105	5.488	1.477

Table 4

Results of Fabric Seam Strength

	Seam Strength					
	Peak Load		Strain at Break		Modulus	
Material	Warp	Weft	Warp	Weft	Warp	Weft
Polyester Satin	14.675	16.079	11.869	10.293	1.067	2.536
Polyester Chiffon	10.759	7.761	45.925	38.082	0.257	0.213
Nylon Tulle	7.136	-	91.809	-	0.065	-
Silk Organza	17.825	9.696	9.270	28.292	1.657	0.516
Silk Taffeta	16.711	11.137	11.743	7.966	1.207	3.194

The results of the experiments are seen in the calculated averages in Tables 1, 2, 3, and 4. The outcomes of the PPI and EPI test determine the number of yarns present in the fabric's warp and weft direction, which ultimately attributes to the texture. A

dressmaker can utilize this test to understand the weaving process of the fabric. It also determines whether it will be stronger in the warp yarns or weft yarns depending on which direction has more yarns present. Finally, it can give a clue to the dressmaker of the fabric's texture as this characteristic relates to the number of yarns in either direction. Table 1 shows that silk organza had the highest PPI while silk taffeta had the lowest PPI. Silk taffeta had the largest EPI while polyester chiffon had the lowest EPI.

Cover factor determines the space occupied by thread in the fabric compared to the open spaces of the fabric. This test is important for dressmakers as it relates to how heat and air transfers through the fabric determining its thermal comfort. This test will be very beneficial when determining what appropriate temperature the wedding gown should be worn. Silk taffeta has the highest cover factor and would be better used during colder temperatures. Polyester chiffon has the lowest cover factor and would be better used during warmer temperatures.

The drape meter test is performed to determine how the fabric will fold when bent under its own weight. The test also demonstrates a fabric's ability to hug and fit a silhouette of the human body. This test is very beneficial for the dressmaker when determining what kind of shape the final wedding dress will acquire. A lower resistance to bending means the fabric will more easily fold and bend around the body, while a higher resistance means the opposite. Polyester chiffon had the lowest result in the drape meter test while silk taffeta had the highest result in the drape meter test.

The abrasion test is an important test for wedding dress material. Abrasion happens between fabrics, fabric and an object, fibers, yarns, and if dirt within the fabric rubs against the fibers. During the day of the wedding, the hem as well as all parts of the

dress will be subject to abrasion. The abrasion test measures the weight loss percentage as well as the pilling that occurs with each fabric. Table 2 shows that polyester satin had the lowest percentage of weight lost while silk taffeta had the highest percentage of weight lost. All fabrics scored a 5 on the pilling scale, which denotes no pilling.

The wet and dry crocking test is important in understanding how a fabric's color resists fading, which for a wedding gown is crucial for how it will be cleaned and stored for future generations. All materials scored a 5 on the grey scale, which denotes that there was no hue color change.

The stiffness test is performed to understand the stiffness of a material, which corresponds to the force required to bend the fabric. This is an important test for dressmakers as it relates to the fabric drape and softness. Polyester chiffon and nylon tulle both had equally the lowest stiffness score, while silk taffeta had the highest stiffness score. Low stiffness and high resiliency attributes to nylon fabric's high resistance to abrasion as seen in Table 2. Silk is a very stiff fiber that is strong but has very little elongation. This means it does not absorb the energy from abrasion; therefore, it breaks easily as it is not able to yield to the applied forces on it. High tenacity polyester and also the chiffon weave structure may cause more breakage to the fiber.

The tensile test, which relates to durability, is important because it measures the fiber, yarn, and fabric strength properties. Dressmakers can utilize this data when determining where the dress may be tighter. These areas included are around zippers and buttons. By understanding how the fabric breaks in either the warp or weft direction, a dressmaker can design the final product according to the results from the fabric's peak load, strain at break, and modulus. Polyester satin had the largest average peak load in

the warp direction, while silk organza had the smallest average peak load in the weft direction. Polyester chiffon had the largest average percentage of strain at break in the warp direction, while silk organza had the smallest average percentage of strain at break in the weft direction. Silk taffeta had the largest average modulus in the warp direction, while polyester chiffon had the smallest average modulus in the weft direction. Polyester chiffon is constructed with much finer yarn than satin even though PPI and EPI were not much different. Due to this, absolute load at break for polyester chiffon would be expected lower than that of satin. Polyester chiffon also has a lower modulus because it is a finer fiber with less stiffness.

The final test measured the seam strength of the fabric. This test is very similar to the tensile test; however, it measures the strength of the seam and how much pull and force the seam can take before it breaks. The seam strength test depends on three factors: type of stitch, number of stitches per inch, and strength of the sewing thread with respect to the strength of the fabric. All of the tests used the same type of thread, stitch and number of stitches per inch. All test specimens used 15 stitches per inch. This is a crucial test for wedding dress fabric, as the seams are what hold the entire piece together. The results establish the peak load, strain at break, and modulus of the fabric. Silk organza had the largest average peak load in the warp direction, while nylon tulle had the smallest average peak load. Nylon tulle had the largest average strain at break while silk taffeta had the smallest average strain at break in the warp direction. And finally, silk taffeta had the largest average modulus in the warp direction, while nylon tulle had the smallest average modulus. Since nylon has extra fine filaments and chiffon has fine filaments their seam strengths are generally on the lower end as far as this testing is concerned.

Conclusion

All of the objectives have been met and a detailed model has been presented in Tables 1, 2, 3, and 4. The final results from these tables can help dressmakers utilize the specific characteristics of each of the five fabrics selected in the study. Since resources and time were limited in this study, further tests can be performed for an even more thorough investigation on other wedding dress fabrics. As described in the introduction, there are many other fiber weaves with different fiber content that can be additionally analyzed.

Other tests that can be looked into for further examinations include durability, reliability, dimensional stability, stretch properties, and fabric aesthetics. Each of these tests can also give dressmakers more detail about each fabric. Durability will help the designer understand a fabric's lifetime span, which will be crucial if a bride hopes to pass her dress down to future generations. Reliability of the fabric will give insight into whether the fabric is consistent in the properties that it is know to have. Dimensional stability testing will let the designer know whether a fabric will retain its original shape or remain stable over the course of the wedding day. This test will also be beneficial to future generations. The stretch properties of a wedding gown fabric will be crucial when determining the fit of the gown, as the bride will want to feel comfortable with the ability to move freely during the wedding day. Finally, testing the aesthetics of the fabric will give the dressmaker understanding into the fabric's hand as finishes performed on the material may modify the texture, luster, or drape.

The model created in this analysis is just the beginning for wedding gown fabrics. Dressmakers need an extensive resource for the material they use so that they can efficiently create the best gown possible for their clients.

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