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# Qualitative Research on Pant Fit: To Improve Plus-size Fit in the Plus-Size Market

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QUALITATIVE RESEARCH ON PANT FIT: TO IMPROVE PLUS-SIZE FIT IN THE PLUS-SIZE MARKET.

by

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Submitted in Partial Fulfillment of the Requirements
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at
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# QUALITATIVE RESEARCH ON PANT FIT: TO IMPROVE PLUS-SIZE FIT IN THE PLUS-SIZE MARKET.

A Thesis Submitted to the Faculty of the School of Arts, Media, and Communications
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By

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## Abstract

Title of Thesis: QUALITATIVE RESEARCH ON PANT FIT: TO IMPROVE PLUS-SIZE FIT IN THE PLUS-SIZE MARKET.

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This study explored the plus–size apparel fit and the satisfaction of the plus–size women in the United States. According to researchers, there is a well-known gap for apparel grading when it comes to plus–size apparel. This study took a qualitative approach and used structured interviews and surveys with twenty plus–size women size 16 through 22 and ages ranging from 22 through 50 in the Midwest area. The results of the interviews and the survey indicate the plus–size woman is unsatisfied with the fit of their clothing, more specifically the fit of their pants. The results indicate there are many variants that can cause the fit of a garment not to fit as intended. In this industry, advancement of apparel mass production to include mass customization is imperative. The research questions this researcher intended to answer were:

*What is the current plus–size apparel dissatisfaction for the top three body shapes?*

*What pattern shape changes should be made on plus–size pants?*

*Can we achieve a good fit with the traditional grading?*

*In theory, does it make sense to create a grade rule for various body shapes? For mass customization, should plus–size apparel align with menswear techniques?*



*Keywords*: *Mass customization, plus–size, garment manufacturing, pattern construction, garment fit, fit value, dissatisfaction, plus-size market*

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## Introduction/ Background Information

*Fashion is architecture: it is a matter of proportions. – CoCo Chanel*

In 1958, the Department of Commerce conducted a study to establish a Voluntary Product Standard (National Bureau of Standards, 1971) for *ready-to-wear* – clothes made in standard sizes to fit most people (Totora & Marketti, 2015). The fashion industry commonly identifies the 'hourglass' shape or ideal figure as one of equal proportions, where the bust and hips are the same or equivalent to their specifications, and a waist is approximately .70 – .75% of the hip circumference. When the study was conducted, women were still wearing waist-defining body modifications on a consistent basis to help permanently mold their bodies. Since 1958, there has been an increase in obesity, fast food consumption, and immigrants migrating to the United States (Barnes, 2014). These points indicate the *sizing standards,* methods used to create clothing for a variety of people in the target market or demographic (National Bureau of Standards, 1971), that were analyzed in 1958 and have been upheld are no longer the reflection of the United States apparel consumer. In addition, American consumers have become more liberal with their bodies and embraced freedom from confining undergarments. Yet, consumers are frustrated with the ill fit of their garments.

The purpose of the Voluntary Product Standard study was "to establish requirements which are in accordance with the principal demands of the industry and, at the same time, are not contrary to the public interest" (National Bureau of Standards, 1971). The results of the study yielded the standard body shape of consumers to be the 'hourglass' shape (Barnes, 2014). The implementation of this undergarment and any permanent mold created by the corset could have skewed the results of this study. When patterns are produced for the base size, they tend to be

generated based on the muse of the brand, which is intended to reflect their target customer; the hourglass shape tends to reflect this base pattern.

In the United States, immigration has increased, fast food consumption has increased, and obesity has increased since 1958 (Barnes, 2014). As a result, the sizing standards analyzed in 1958 do not reflect the needs of the apparel consumers in the United States today. These findings suggest that despite the increase of obesity, BMI, and cultural implications, the apparel companies are still creating garments based on the hourglass shape. "According to most industry veterans, the measurements that comprised a women's size 8 in the early 1970s are essentially the same measurements that comprise a size 2 or 4 today. What did not change over those years, however, was the basic shape - the hourglass shape - that was the starting point for most clothing patterns" (Gribbin, 2014). As the BMI and weight of the consumer increases, there can be a disproportion in the fat, which can make garment accuracy difficult (Barnes, 2014). It is this researcher's belief that reimplementing the standard of wearing waist-defining body modifications can reduce customer dissatisfaction.

Several brands have a narrow view of who their customer is. There is a belief that plus–size customers do not spend as much as their straight-sized counterparts. However, the reason this consumer seems to purchase less is because there are far fewer options for them. However, according to Statista, 67% of adult American women wear a size 14 or larger. Plus–size shoppers represent over $20 billion worth of purchasing power (Shahbandeh, 2020). The plus–size market is growing at a faster rate than other segments of the apparel industry. Annual sales of women's clothing sized 14 and higher rose significantly in 2018 (Shahbandeh, 2020).

## Statement of the Problem

With the plus-size consumer being known as the predominantly overlooked consumer group in the fashion industry, plus-size females have noted the need for improvements in large size clothing. Some improvements have been seen by the plus-size consumer but nevertheless, during the process of improving the offerings, the industry seems to have failed to make adequate improvements for fit. Referring to researchers Ashdown and O'Connell, (2006) noting the fit issues relating to one's body shape, they informed the readers that several retailers provide clothing for specific body shapes. This is causing fit issues for women with other body shapes. Several apparel companies have conventionally been ill-equipped to outline or resolve apparel fit issues due to a lack of sizing information for the current woman in the United States.

The contemporary ready-to-wear apparel system is not providing well-fitting clothing for all plus–size consumers. This setback is correlated to the ready-to-wear system being established with the hourglass body shape and a standard straight size grade between sizes. This process is very efficient for mass production; however, this system has been shown to provide fit issues with the varieties of sizes and shapes in the population. Bodies that have the same measurements may have different distributions and shapes on the body, resulting in the need for different shapes to achieve good fit (Petrova & Ashdown, 2008). There is a well-documented source of fit dissatisfaction for female consumers with pants; this garment is a primary target for apparel customization.

The process in the apparel mass customization system has been identified as (a) body dimension collection; (b) style and fabric selection; (c) clothing pattern generation; (d) fabric cutting; and (e) sewing, fitting, and final adjustment (Myers-McDevitt, 2011). The goal of mass apparel production is to be reliable, accurate, and fast to market for consumers. Companies need

to provide apparel for the consumer quickly; this is a necessity to compete in the ready-to-wear apparel industry. The turnaround time and speed to market requires accuracy and consistency. The products should meet the consumers' expectations without multiple alterations. The apparel mass production systems should produce products that meet the expectations of consumers with a wide range of body sizes and shapes.

Current apparel mass customization methods require a step when the individual custom garment pattern is test fit on the body and corrected before the final garment can be produced (Ashdown & O'Connell, 2006; Myers-McDevitt, 2011). An additional purpose of fit testing is to examine the interaction of the fabric with the design (Myers-McDevitt, 2011). This step is essential for new garment designs prior to the designs being available as an option within the apparel mass customization system (Myers-McDevitt, 2011).

In order to advance apparel mass customization, it is essential to understand how and why the current pattern-drafting systems result in the need for drafted patterns to be corrected to fit individuals (Ashdown & O'Connell, 2006). The researcher sought to evaluate the current practices to advise methods used for automated systems. The researcher sought to expand the apparel mass customization theoretical framework to consider the theoretical principles of naturally incorporating the pattern-drafting system used to achieve the patterns.

To evaluate the implementation of apparel mass customization, it is essential to first understand the body shape of the consumer and the pattern development process. The purposes of this research were to understand the body-to-pattern relationships and test if the relationships are consistent for various consumer body shapes.

## Rationale

Sizing standards used in the United States that categorize the body measurements used in the design and product development process of clothing were established from identified best practices of the apparel industry. However, the industry as a whole has not adopted a single system of clothing sizing. It has been noted in previous research that manufacturers and retailers use their own sizing systems as a marketing tool, convinced that this is a differential advantage of their product for their market. Regardless of the sizing systems used, however, almost all are based on the myth that humans have mathematically proportional bodies and that they grow in proportional ways. In addition, the shapes and proportions of today's American population differ greatly from the shapes of the generations before. So, a variety of issues impact our inability to 'fit' the American customer of today. These fit issues continue to be a growing concern.

Mass customization methodology gives the impression towards a resolution by permitting customized fit of apparel. A substantial fundamental issue exists, nevertheless, when attempting to alter a garment for fit based on one standard shaped garment product. Major alterations hardly ever provide the desired fit in the final garment. This detection has led the researcher to understand that optimum customization can only occur if customization starts from the most correctly shaped garment for each customer's body shape type.

Using body shape analysis will enable the identification of personal body shapes, allowing the use of the most correctly shaped garment for the customization procedure which will better ensure satisfactory fit of the final garment.

## Literary Reviews

Clothing is important for each wearer; one's aesthetic is a form of identity and nonverbal communication. The comfort of someone's clothing is dependent on social and physical

variables. Garment fit affects one's comfort and their aesthetic, and a well-fitting garment increases one's aesthetic appearance and their confidence with how they perceive themselves as well as how they are perceived by others. There are several tools and resources needed to deliver well-fitting garments.

Clothing is multifaceted – it covers wearers, protects their bodies, and is used as a personal identifier for one's aesthetic (Eicher, 2008). Clothes communicate personality, standpoint, group belonging, etc. (Eicher, 2008). According to Ashdown and O'Connell (2006), garments that fit well enhance appearance and increase confidence. However, it is best to state that even though apparel is a strong communication tool for the wearer, not all garments give clear and complete signals about the wearer's self-identity, being that one's interpretation is subjective.

**Defining Plus–size**

Plus–size is the term assigned to women that wear apparel in women's sizes 14W through 40W as well as the apparel itself, generally available in women's sizes 14W through 32W (ASTM Standard D6960/D6960M-16, 2016). The term plus–size in the United States is applied to women's apparel and women's sizes 14W through 20W. Plus–size also referred to as "larger-size" in other apparel studies (Czerniawski, 2015). Sizes can be broken down by other categories including misses', women's, and plus–sizes; during the production phase, body proportions are to be taken into consideration for sizing (Ashdown, 2006).

The definition of plus-size is not consistent, nor are the women's apparel sizing standards. Further, several brands have their own definition of plus-size. The modeling industry even sometimes considers a model wearing above a size 6 to be a plus-size model (Czerniawski, 2015). According to the World Health Organization, the average woman in the United States is

roughly five foot four with a waist circumference of 37.5 inches and a weight of 166.2 pounds. Based on the measurements given, it suggests the average woman in the United Stated is most likely plus–size (World Health Organization, 2020). According to NPD (2012), the average woman is a size 16.

Sizing still varies across apparel brands and retailers, as each apparel firm has their own apparel fit guides. In addition, clothing and fit guides for individual retailers typically rely on the measurements of one to two fit models and make assumptions about proportion to estimate other body measurements (Ashdown, 2006).

**Influence of Obesity**

Obesity is a dominant issue that is facing the United States today. The elevated weight measurements are common amongst adults, more specifically women (World Health Organization, 2020). Overweight and obese people are typically classified as such based on the BMI (Body Mass Indicator). The BMI is a measure of body fat and health based on a man or woman's height and weight ratio. The BMI formula provided by the World Health Organization (2020) identifies four categories of BMI: underweight, normal, overweight, and obese. A normal BMI is 18.5-24.9 while an overweight BMI is 25-29.9. A person is considered obese if their BMI is 30 or greater (World Health Organization, 2020). Obesity is classified as having excess body fat. Currently, 32.5% of men and women are overweight and 37.7% are obese, including the 7.7% that are extremely obese (World Health Organization, 2020). This percentage has more than doubled from 13.4% since the 1960s and is projected to continue to rise.

Although someone does not have to classify as overweight or obese to be considered plus–size, the increasing number of people with higher weights indicate that the plus–size apparel market will only grow as the size of people in the United States specifically continues to

rise (Shahbandeh, 2020). The concrete link between one's BMI, obesity, and being plus – size is still a mystery.

During a 6-month study with the CDC from January 2017 to June of 2017, 29.2% of females in the United States were determined to be obese. Non-Hispanic Black people ranked among the highest in terms of ethnicity with approximately 47.4% of women who were obese. Hispanic people ranked at 35.9% and Non-Hispanic White people at 29.4%. The ratings were among women aged 20 and over (CDC, 2017).

**Apparel Fit**

Garment fit is essential for the wearer. A well composed cohesive design has no use if the final garment is ill fit. A well fit garment is better visually and is physically more comfortable than a garment with ill fit; most times, ill fit garments are pulled and not sold or not used. Pulling those garments from the shelves can cause a significant profit loss for the retailer.

Ashdown mentions the importance of proportions and posture when discussing wearing comfort (Ashdown, 2014). Ideally, garments should be fitted in such a way that they are in balance with the body. The garment should follow the silhouette of the body (Ashdown, 2014). The researcher Gribbin (2014) spoke in support of Ashdown's (2014) positions, noting the garment's fit has to deal with the body's shape. Good apparel fit becomes more likely when the garment reflects the three-dimensional shape of the body. The inadequate product development process is the root cause of the good fit issues. A poorly-planned product development process may cause an ill-fitting garment; however, most fitting issues arise due to body shape variations since everyone has a different shape.

Fit has been used recurrently throughout data analyses in most studies. Fit in this study is specifically associated to "numerical fit" or the ability of the participants' body measurements to

fit between a range of body measurements that have been provided by numerous sizing standards. Nevertheless, it has been documented by other researchers that consumers have a few different definitions of fit. This research will consider numerical values and participants' opinions as well.

**Plus–size Apparel Market**

The United States apparel market is one of the largest markets in the world, accounting for over 25% of the global market (Shahbandeh, 2020). The women's plus–size apparel market is valued at 9.8 billion United States dollars as of 2019, up from 9.7 billion United States dollars the year before (Shahbandeh, 2020). With over a third of the United States population being obese, they potentially represent a significant amount of the market. The plus–size apparel consumers are likely to shop more and buy more.

In the United States, the estimated percentage of women wearing plus–size apparel between sizes 14 and 34 is over 60 % of the entire apparel market. The plus–size apparel market is growing and is expected to continue to grow. In the United States alone, there are over 100 million plus–size women who spent 17.5 billion dollars on plus–size clothing during a one-year period (Shahbandeh, 2020). Statista has predicted an increase in sales of the United States plus–size apparel market by 3% for the upcoming year (Shahbandeh, 2020).

**Plus–size Consumer Dissatisfaction**

According to NPD (2012), 63% of plus–size women report shopping for plus–size clothing is more stressful than shopping for regular size apparel. The dissatisfaction of this market is extremely high in multiple segments. However, it seems the plus-size consumers' dissatisfaction is either not being heard, considered, or it is slowly being approached.

Apparel fit is one of the key components required when making apparel purchases. Consumers' opinions of a well-fitting garment imply comfort physically and psychologically; aesthetic appearance goes hand in hand. Individuals who are dissatisfied with their bodies have been found to be more likely to have negative attitudes towards their body shape and to be less confident about their apparel choices. Consumers who find themselves dissatisfied with their bodies may be less secure that the garments will fit their bodies and feel a higher degree of apprehension with fit in the size of garments.

**American Society of Testing and Materials (ASTM)**

The ASTM standards operate globally; they are defined and set to improve the lives of millions daily. Their goal is to enhance performance and help consumers have confidence in the things they buy and use (ASTM, 2021). Their standard tables for Body Measurements for Plus Women's Figure type, Size Range 14W through 40W were developed from data published by the U.S. Department of Commerce: The Caesar Study; the SizeUSA Study; current United States industry; and studies, scans, and documentation from Alvanon Inc. (ASTM, 2021).

Additionally, to serve the industry better, incremental movement between sizes was reviewed, ensuring a smooth transition between sizes. To verify the proposed body measurements, a three-dimensional avatar was created in the plus women's size range 14W through 40W (curvy and straight) by Alvanon, Inc. for visual reference (ASTM, 2021).

**Body Shape Assessment Scale**

The purpose of this research was to develop a set of scales to assess female body shape as visualized in body scans, resulting in an instrument that could be applied through software to the analysis of body scan data (Connell et al., 2006). Various shapes were described by Connell et al. (2006) in their research which involved the development of the Body Shape Assessment Scale

(BSAS). This scale was created to be used in partnership with body scan data to analyze scans. This scale can be used manually or electronically for larger studies. Nine scales for body shape assessment were included in the BSAS (body build, body shape, shoulder slope, front torso shape, hip shape, bust shape, buttocks shape, back shape, and posture). This study is a logical and theoretical approach for the development of apparel sizing that will fit well (Connell et al., 2006). There are several nuances of the female body shapes, and they need to be understood to reflect the knowledge of skilled pattern and fit specialists as well as be applicable to pattern development for a diverse female population.

The SizeUSA data was used to evaluate the variations in hip shape in five size categories. This study identified SizeUSA subjects' bust, waist, and hip measurements that fit into the ASTM standards by using frequency analyses. According to Stanton (2019), when reviewing the Body Shape Distribution of the SizeUSA plus–size sample with *BMI*, it is essential to bear in mind that the results show the majority of this plus–size sample was obese or overweight with shapes typically being that of Rectangle, Spoon, Oval, and Bottom Hourglass (Stanton, 2019).

Stanton (2019) also took into consideration the *ethnicity* of the consumers with the following body shapes: Rectangle, Spoon, Oval, and Bottom Hourglass. These ranked the highest amongst the Black, White, and Hispanic ethnic backgrounds. However, where Bottom Hourglass ranked lowest out of the four shapes for Hispanics and Whites, it was the second lowest for Blacks with Oval as the lowest (Stanton, 2019).

In addition to ethnicity in Stanton's 2019 research, a*ge* had a clear pattern in terms of body shape. The Bottom Hourglass, Oval, and Rectangle shapes were prominent throughout the age ranges of 18 through 45 (Stanton, 2019). According to Stanton's (2019) research, the Bottom Hourglass shape was identified less after the age of 45, which is a clear indication that shape

changes with age. Atrophy (muscle loss) is consistent with these results. There are several physiological changes associated with aging, including osteoporosis (bone loss), atrophy, decreased water retention, increased body fat, and a reduction in height. In most people, body fat increases near the internal organs around the midsection (Dugdale, 2021).

After analyzing the data collected, the researchers determined there were a few variations in the shape of the hip in each size of the plus–size (14W through 32W) sample. The researchers determined that fit issues have a greater possibility of becoming prevalent since weight gain does not always indicate an increase in a specific part of the body such as the hips. Weight gain may be distributed to another area of the body, thus creating different shapes. The hip shape was viewed from the front to distinguish the differences between the level of greatest width and the curve degree from the waist to the crotch line. The researchers noted there were some shapes that were straight or nearly straight below the waist. Curved shapes had three levels that could be identified by splitting the distance between the crotch and the waistline. The researchers noted there were varying hip shapes and identified four: the straight hip, high hip, mid-level hips, and low hip.

After analyzing the data collected, the researchers determined there were three variations in the shape of the front torso. Based on the side view of the front torso, the "b" shape is flat between the base of the bust and waist and then becomes rounded below the waist. Then, there is the "B" shape, rounded above and below the waist placement. Lastly, the shape the researchers identified as "D" is the shape with continuous rounding from the base of the bust through the abdominal area. This shape has a minimal amount of waist definition.

The researchers examined the buttocks at its side view to assess the shape and prominence of the buttocks. There were two shape variations that were observed. The

researchers identified one variation as the "Low Hook" since the buttocks silhouette is formed by a flat line angling out from the waist until it is curved under near the crotch line. The second identification the researchers made was noted as the "Even Arch" because it had more roundness immediately below the waist and maintained this symmetrical curve line to the crotch line. The shape ranged from nearly flat to very prominent relative to the back waistline.

The next shape to note of is the back shape. The shape starts at the neck and continues just above the waist back curvature. The widest point of the curve was used as a landmark, and there were three levels the researchers noted: the upper back, just below the neck to the top of the arm; the middle back, where the prominent curvature is approximately at the mid-arm; and the lower back, which is mostly the fullness below the underarm.

The American Society for Testing and Materials (ASTM) standard D6960 (2016) provides measurements that support one body shape: the hourglass. The body shape assessment scale (BSAS) highlights a variety of body shapes within the population. The body shape assessment scale is comprised of:

**Rectangle/Banana/Straight.** This body shape describes a person who typically has waist measurements that are less than 9 inches smaller than the hip or bust measurements (Connell et al., 2006; Staton, 2019).

**Oval/Round.** This body shapes describes a person who has a bust that is larger than the rest of their body, with a narrower hip and fuller midsection (Staton, 2019).

**Hourglass/X-shape.** This body shape (typically presented as the "ideal") describes a person with hip and bust measurements nearly equal in size, with a narrower waist measurement (Connell et al., 2006; Staton, 2019).

**Inverted triangle/Apple.** This body shape describes a person who has broader shoulders and bust than they do hips (Connell et al., 2006; Staton, 2019).

**Spoon/Pear/Bell/Triangle.** This body shape describes a person who has hip measurements greater than their bust measurements (Connell et al., 2006; Staton, 2019).

These shapes are determined by measuring the bust, waist, high hip, and hip. These precise points of measure (POMS) are the bust: the circumference measured around the chest over the fullest part of the breasts while wearing a properly fitted bra; waist: the smallest circumference measured around the natural waist, just above the belly button; high hip: the circumference of the upper swell of the hip over the pelvic region approximately 8" below the natural waist; and hip: the largest circumference measured around the rear (Stanton, 2019).

There are some key factors to contemplate when consumers express dissatisfaction with difficulties finding apparel choices that fit their shape when making online or in-store purchases. One of the key aspects that needs evaluating is the base size body shape; brands tend to start with the body shape that represents a small percentage of female consumers: the hourglass body. This shape is used as their basic shape, as it is considered the ideal female body figure (Gribbin, 2014).

The second key factor is the grade rules that are applied to the base size. Some fit issues stem from the linear grade rules assuming body measurements increase and decrease the same amount (Gribbin, 2014). The purpose of this process is to guarantee the pattern is proportioned as it increases and decreases. However, consumers who need larger or smaller sizes are most likely to complain about their apparel fit. This is mainly due to the shape of the patterns for the clothing not fitting well with the shape of the consumer's body (Gribbin, 2014).

**Female Figure Identification Technique for Apparel**

The shapes and proportions of today's American population vary greatly from the shapes of the generations in the past. The clothing sizing has been based on a sizing system established in the 1940s. There are many fit problems that occur with customers. The FFIT's objective is the development of better fitting clothing (Devarajan et al., 2004). This researcher's study showed the five basic body shapes were not adequate. The mass customization method for body shape assessment seemed to be the best solution.

**Hourglass Shape.** This body shape describes a person with hip and bust measurements nearly equal in size, with a narrower waist measurement (Devarajan et al., 2004).

**Bottom Hourglass Shape.** This body shape describes a person with the general hourglass body shape, but the hip measurements are slightly larger than the bust (Devarajan et al., 2004).

**Top Hourglass Shape.** This body shape describes a person with the general hourglass shape, but the bust measurement is slightly larger than the hips (Devarajan et al., 2004).

**Spoon.** This body shape describes a person with a body shape where their hips are larger than their bust (Devarajan et al., 2004).

**Rectangle.** This body shape describes a person with a waist the same measurements as your hip and bust (Devarajan et al., 2004).

**Diamond.** This body shapes describes a person with hips wider than their shoulders, a narrow bust and fuller waist (Devarajan et al., 2004).

**Oval.** This body shape describes a person with their bust larger than the rest of their body, their hips narrow, and their midsection is fuller (Devarajan et al., 2004).

**Triangle.** This body shapes describes a person with their shoulders and bust being narrower than their hips (Devarajan et al., 2004).

**Inverted Triangle.** This body shapes describes a person with their shoulders and bust being larger than their relatively narrow hips (Devarajan et al., 2004).

## The Relationship Between the Garment and the Body

To accomplish appropriate fit, the garment must have a suitable relationship with the body. The elements that should be considered in this relationship are points of measure (POMs), ease, proportions, and shape. Points of measure (POM) codes are used to specify the measuring points of a garment or product. The *ease* is the difference between the garment measurement and the body measurement. This is important to keep in mind when creating garments as it allows the wearer room for comfort, mobility, and access to a range of motion. The *proportions* are the relationships between different body component lengths. The *shape* is the proportion of measurements to one another and the relationship of the body shape to garment shape. These relationships are vitally important to building blocks for garment patterning systems. The patternmaker must understand the locations of key body components to influence the accurate placement of pattern features and assist in determining grading rules.

## Pattern Development

The garment measurements are determined mostly by the pattern measurements. There are some measurements the pattern cannot 100% determine such as the elastic reduction on a legline opening for swim trunks. Styles are usually created in a sample size and then a grade is applied to it to create the style in smaller and larger sizes. The initial pattern is usually created based on the company's basic pattern blocks/slopers, created based on samples referenced from other companies, or drafted and created from scratch. Current pattern drafting methods do not

take the shape of the body into consideration. The measurements of the body are taken into consideration when creating the patterns for the style. The shape of the patterns also has the chance of changing because of the added ease amounts. The body-to-pattern relationships, the ease and shape for the plus–size consumer, and their various body shapes have undergone limited study.

Ease is achieved during the pattern development process by adding additional amounts to the body measurements. Patternmaking methods use some additional ease amounts to body measurements such as adding 0.5" in the waist for mobility. Pattern drafting for mass production does not directly apply body shape to the pattern shapes. Nevertheless, it is possible that these relationships may be changed by the added ease amounts.

**Body-to-Pattern Relationship**

The pattern development system's goal is to accomplish a good fit; however, it is dependent on the capability to produce a predictable body-to-pattern measurement relationship as well as ease. Research on the body-to-pattern measurement relationships during pattern drafting has been limited. Ease amounts vary per methods used; this causes the pattern with the same measurements to have varying fit. Some patternmaking methods for knit fabrications such as swimwear may have negative seam allowance and negative ease.

Garments are required to have adequate ease to provide the allowance for range of motion. Ease is the allowance added to the body shape and body measurements for the pattern construction. Having ease in a garment is different from the body measurement and the garment's specifications. There are two kinds of ease that are to be considered when producing a garment: wearing ease and design ease. The body measurement plus wearing ease plus design ease equals fashion style or silhouette.

As previously stated, wearing ease is required for all apparel garments for body movement. Without enough wearing ease, the wearer has a chance of feeling uncomfortable in the garment. Garments may also appear tight or wrinkled. This can also cause the garment's wear and tear to accelerate from the strain of seams peeling. There are a few factors that should be kept in mind when considering the ease of a garment: body movements, fabrication, garment style, and customer preferences. Design ease is extra style fullness added to the wearing ease; this ease is meant explicitly for the appearance of the garment. The amount of this ease depends on trends and desired design aesthetic of the garment.

The shape and proportion of the pattern are two key factors in pattern development. Current patternmaking development methods do not necessarily take varying body shapes into consideration. Understanding the body-to-pattern shape relationships that result from following patternmaking methods may inform improvements in apparel mass customization (Boorady, 2014). With the pattern being one of the main influences of how the garments fit on the body, body shape should be evaluated. The pattern shapes between straight-sizing and plus-sizing are significantly different. The distribution of soft tissue is unique and difficult to generalize across a large demographic (Boorady, 2014). Plus-sizing is different than sizing for misses, and the shapes vary significantly. Extended sizing companies must pay key attention to this detail when extending to plus–sizes. Sizing up from a straight-size missy 8 does not address the specific needs for the plus–size consumer.

**Body-to-Pattern Relationship for Pants**

Pants are one of the most difficult garments to fit any consumer, especially with the plus–size consumer. As one's weight increases, there is a greater chance of their body weight distributing disproportionately. Plus–size consumers are usually categorized in the medical

profession as overweight or obese. The fat distribution on females is usually stored in the lower abdomen, buttocks, thighs, and hips (Boorady, 2014). Some consumers gain more weight in their stomach and hips. Because women's body shapes are so varied, finding pants that fit their bodies is challenging. There are just too many fit points. The hip-to-waist ratio and getting pants to fit is the greatest need (Boorady, 2014). As the female consumer ages, the distribution of fat also shifts to the midriff, which will also have an effect on apparel fit. Research has shown larger sizes need their bottoms snugger in order for the garment to feel right and stay in place. The plus–size consumer feels more secure if the garment is more secure (Boorady, 2014). Adding an elastic waistband helps accommodate a variety of body shapes.

The relationship of the body to the pattern around the center front and center back of the lower torso, between the legs, is unique to split garments. On the pattern, generally there is a U-shaped line that joins at the inseam. This shape is called the crotch curve, and the measurement along this curve is called the crotch length (Boorady, 2014). The crotch extension is the part of the pants that rests between the legs, and the ease amount in the crotch extension is crucial for a proper fit in the split garment (Hamilton, 2015). The particular shape of the crotch curvature on the pattern and the ease included in the crotch extension are direct results of subsequent steps in patterning (Hamilton, 2015). Supplementary crucial circumference measurement locations for women's pants fit are the waist, thigh, knee, and ankle.

## Pattern Apparel Grading

### *Terminology*

Pattern-grading is the process of systematically increasing and decreasing the dimensions of a master -size pattern into a range of sizes for production (Mullet, 2016). The understanding of patterns and pattern-grading terminology is vital while grasping the concepts of pattern apparel

grading. Knowing the exact terms helps the reader understand the applications in this process. Not understanding the terminology can leave the reader confused about the process.

There are four types of patterns used in apparel production: basic slopers, basic blocks, master patterns, and production patterns. The *basic sloper* contains the minimum number of pattern pieces required for a fitted garment; it has minimal ease and no seam allowances (Figure 1). The sloper's darts extend to their respective pivot points and the slopers lack dart take up. Slopers are used as the basis for flat pattern design. *Basic blocks* are a set of pattern pieces for a style category such as a full circle skirt, six-panel skirt, etc. Most blocks consist of the major pattern pieces without finishing details. The *master pattern* has the design details added to them such as design lines and dart take ups, and the pattern is trued and balanced (Mullet, 2016).

Grade has three definitions in the context of pattern grading. The term grade is used as a verb and a noun. The verb of *grade* means to systematically decrease and increase dimensions of the master pattern or basic block to create a range of sizes for production. The dimensions change at the pattern's cardinal points. The *cardinal points* include the intersections of seams and in some cases, curved areas of the pattern (Figure 1). The sizes graded from the master pattern are stacked in a grade nest (Figure 2), so the differences are easily observed. The second definition of *grade*, the noun, describes the total change of the body girth. The amount between the sizes is determined from the size specifications. The third definition of *grade* is a noun: the amount of the incremental size changes at each cardinal point on the pattern piece. The body's girth is divided according to the location of the cardinal point to determine that grade. For instance, the bust girth is divided by 2 to determine the front and back grades. A *grade rule* specifies the amount of increase or decrease at each cardinal point for each size in the size range relative to the base size. Grade rules are written and applied to each cardinal point. A *grading*

*system* is an aggregate of grade rules that specify how the increase and decrease are distributed throughout the pattern piece (Mullet, 2016).

***Pattern Grading Methods.***

There are four methods to grading a pattern: the cut – and – spread method, pattern shifting, the block method or the measurement method, and computer grading. Regardless of the method used for grading, the pattern movements are within the Cartesian graph (Figure 3). The graph is divided into quadrants by the intersecting axes. The most simplistic method is the cut – and – spread method, which is the basis of the other two methods, to cut the pattern and spread the pieces by increments to grade up and down (Figure 4) (Mullet, 2016). Pattern shifting or the block method is the process of increasing the dimensions by moving it a specific distance up, down, left, and right, and redrawing the outline to produce the same results as the cut – and – spread method (Figure 5) (Mullet, 2016). The measurement method falls under the same category as pattern shifting; the pattern is graded at each cardinal point instead of manually moving the pattern (Figure 6) (Mullet, 2016). Computer grading is faster, more accurate, and efficient. Computerizing the mathematical differences between the garment sizes and plotting those from the reference points can be completed with various software programs (Mullet, 2016).

***Establishing the Grade***

When establishing the grade, one needs to have the body measurements needed to develop the pattern. For instance, the POMs – waist, hip, thigh circumference, inseam length, etc. – will be key points of measure when creating a pant pattern. Once the measurements from the body are noted, then one can address the grading predicament – how much is needed to grade the pattern up to the next size and how much is needed to grade the pattern down to the smaller size (Mullet, 2016). In order to establish the overall grade, or the total amount needed to make

the pattern larger or smaller, the difference between the base size pattern and the body measurements have to be calculated to try and achieve the ideal graded fit (Mullet, 2016).

The development of a set grade rules must be completed for each pattern piece in the garment style and for all sizes in the size range before grading the master block. A grade rule table is used to record the relative grade rules for each cardinal point for all pattern sizes in the size range (Mullet, 2016). Grade rules are developed for half-pattern pieces, which represent only one-fourth of the total increase in circumference. When a grade rule is written to increase or decrease a horizontal circumference grade, the total of increments is divided by four (Mullet, 2016). Width measurements on a pattern are divided by two because they represent the left to right sides of the body. Length measurements are used without division because the pattern piece represents the total body length for a specific area (Mullet, 2016).

There are two types of overall grades: a *uniform grade* and a *mixed grade* (Mullet, 2016). A *uniform grade* means that the bust, waist, and hip measurements change the same amount from one size to another (Mullet, 2016). For example, if a pattern measures 35" – 27" – 37" and the body measures 37" – 29" – 39", then the difference between each measurement is 2 inches, and the overall grade is an even two inches. Sizes of commercial patterns and apparel tend to follow a uniform grade. A *mixed grade* does not change the same amount between sizes (Mullet, 2016). This changes the shape of a garment, as well as its size. Some call mixed grading a pattern alteration rather than grading since the pattern proportions are changing.

***Understanding Menswear Apparel and Their Requirements***

This segment takes a look at the menswear apparel industry to gain a better understanding of impact of body shape, size, and other associations to fit. In menswear, there are four basic body types: H type, which represents a slimmer body shape; V or Y type, which

represents a proportionally smaller backside and thighs, with a bigger chest and wider shoulder point to point; X type, which represents a shape with a more prominent backside, shoulder point to point, and muscular arms and thighs with a slimmer waist; and O type, which represents a more complex shape, a full mid-section, wider than the hips, similar to the apple shape in womenswear (Bellemare, 2014). These shapes are taken into consideration the same as womenswear when creating pattern grades for apparel. In North America, four body heights have been identified as: short, regular, tall, and extra tall (Bellemare, 2014). These four heights are also identified with four types of figures: slim, regular, large, and big. Focusing on pants specifically, menswear pants are developed in a mass customization method, providing an array of sizes to the customer based on the figure type, waist circumference, and inseam length (Bellemare, 2014); for example, the retailer Joseph A. Bank will display their *Regular* fit pants with a 32-inch waist circumference 32 inch inseam as *Regular 32 x 32.*

## Research Purpose

The population of plus–size consumers is growing and is expected to continue increasing. This consumer represents a significant portion of the market for retail companies (Shahbandeh, 2020). Though, there are relatively few research studies that have investigated plus–size consumers' body shapes and mass apparel production development. This study investigated these topics with an exploratory nature. Many companies are making efforts to investigate the demographics of plus–size consumers, their attitudes about plus–size clothing, and the fit of the clothing options, as well as the relationships among those. This study collected direct information about plus–size consumers' experiences with their pant fits by using both a preliminary qualitative study and a follow up quantitative study to find a solution to their concerns.

Apparel mass customization has been a favorable resolution to women's fit problems with split garments for quite some time now. Patternmaking is a key component to apparel mass production and customization. The body-to-pattern relationships for plus–size consumers have not been predictable nor clearly identified. The researcher aimed to identify the body-to-pattern relationships with the top body shapes of the plus–size consumer.

This research was broken down into three parts. First, the researcher was to identify the consumers' fit dissatisfaction and their projected body types. While reviewing this, the researcher was to review the ASTM grade increases and decreases and compare them to consumer majority body shapes on the BSAS. The second portion of this study will be designated to identify how the relationships of the current grade and body shapes collate. For part three, the researcher is going to theoretically apply the methods used in menswear to the plus-size apparel pant. The content was voice recorded, scribed by hand, and kept in a notebook. Focus group one lasted approximately two hours and focus group two lasted approximately one hour.

After receiving consent to proceed from the Institutional Review Board chair, the focus group was conducted. As an incentive to participate, the participants' names were put into a drawing for a gift card at the conclusion of the study. This ensured the participants' attendance throughout the entire course of the project. Additional spectators were chosen that worked in the fashion industry, and general American consumers were consulted via email using the images of the participants to analyze their feedback.

## Research Methodologies

The data for this research was gathered using qualitative, quantitative, and deconstructive methods. Focus groups of plus–size women gathered virtually via online platforms such as

Zoom, Google Meet, and FaceTime calls. These groups gathered to collect more information about the fit of plus–size pants. There were a few variables involved in the focus group: the body, waist-defining body modifications such as Spanx, the fabrications of the pant, and the retailers. In the following section, the researcher will analyze the experiences the participants had while wearing their pants and what they wish was different or accommodated in their pants. The women chosen to participate in the focus groups were selected from a network of alumnae and sorority members in the St. Louis Metropolitan area.

In order to explore the research question(s) properly, this study consists of three data collection methods: (1) a qualitative method using survey interviews, (2) a follow up quantitative method using the ASTM measurements and the BSAS identifier for body shapes, and (3) deconstructing the current system to find a new apparel production theory. Bearing in mind the limited amount of research on plus–size consumers, it was deemed necessary to use an exploratory qualitative study to provide the foundation and guidance needed for comprehensive theoretical development of the research question. The quantitative study was used to test research questions, allowing for generalization of the findings. The deconstruction was used to break down the current standards and introduce a new theory to provide a better fit for plus–size pants.

**Preliminary Research Methods.**

The first step of data collection for this research was a preliminary qualitative study. The researcher previously gathered the focus group for interviews and fit sessions. During this period, they were used as a primary data collection tool to get a better understanding of plus–size consumers' feelings about the way their pants fit and their experiences with their pants. The researcher took this as an opportunity to gather any concerns they had about their pant fit as well.

Research has been done with the fit of pants for straight size consumers and their fit discrepancies. However, minimal research has been conducted regarding the fit of pants for the plus–size consumer with the varying body shapes and the body-to-pattern relationships that affect the fit. For this study's purpose, an online survey was distributed to plus–size consumers. The participants read and consented to participate in the online survey created by the researcher. The survey was split into two sections: the first section focused on the participants' body shapes and the second focused on apparel fit.

During the survey, participants were asked to answer questions that assisted the researcher in honing in on specific locations of fit discrepancies. The research group for the survey consisted of approximately 20 participants; their ages ranged from 20 through 47 years old and their garments sizes ranged from 12 through 22. The following research questions were presented in the initial survey regarding pant fit.

*Based on the graph shown, what body shape do you think you have?*

*How do your garments typically fit?*

*How do you prefer your garments to fit?*

*Do you prefer knit or woven fabric garments?*

*What fit issues do you have with bottoms?*

*How often do you have difficulty finding clothes that fit?*

Each participant completed the survey and identified their body shape based on measurements from BSAS.

Based on the outcome of the survey, a small group of participants were selected to continue forward with the focus group fit sessions. Due to the COVID-19 pandemic, only two participants were included in this study. However, the focus group discussions were held via

video conference calls and images were gathered. The consumers' dissatisfaction was also noted from the fit sessions conducted and inquiring of their range of motion or lack thereof. There was a mixed-method approach used to elicit the consumers' opinions and some professionals' talents.

**Current Study and Research Questions**

In response to the gaps in the literature, this study sought to explore various body shapes of the plus–size consumer, the current ASTM grade, and standard pattern shapes. The overarching purpose of the research was to identify the consumer dissatisfaction and the effectiveness of current patternmaking and grading methods for use in apparel mass customization for women's pants. The following research questions were proposed.

*What is the current plus–size apparel dissatisfaction for the top three body shapes?*

*What pattern shape changes should be made on plus–size pants?*

*Can we achieve a good fit with the traditional grading?*

*In theory, does it make sense to create a grade rule for various body shapes? For mass customization, should plus–size apparel aligns with menswear techniques?*

## Results

### *Preliminary Research Results*

During this preliminary research study, only two participants were included because of the COVID-19 pandemic. Based on the qualitative data from the survey, the plus–size consumers noted their dissatisfaction with their pants in a few key areas: the waist, hip, abdomen, circumference of leg, rises, and inseam lengths. While fitting the participants, the researcher noticed some fit issues: the waist placements, bunching at the crotch, fit at the waist placement and abdomen, the fit around the hips and circumference, and the leg fitting too tight.

The objective of this research was to identify fit issues of pants for plus–size women of varying body shapes. The data collection process of this research was based on comparing the body shape of the consumer, their body measurements, and the specs of the woven garment to evaluate the pattern shapes for fit. Based on the first section of results from the survey, the consumers shop at extended retailers more frequently than plus–size exclusive retailers. However, with the consumers' choice of making purchases from extended sizing, they run into some fit dissatisfaction.

Based on the two participants and their body shapes, some of the woven pant specifications were out of tolerance. For this study, the tolerance has been identified per fabrication type: for knits .25" and for woven .5". The four points of measure to identify their body shapes were:

**Bust Circumference.** Place the tape measure around the fullest part of the bust.

**Waist Circumference at natural waist.** Measure the waist, where the tape/elastic is located. Be sure not to pull too tight, leave room to breathe, and place a finger inside the tape comfortably.

**High Hip Circumference.** Start this measurement at the hip bones.

**Hip Circumference.** Place the tape measure around the widest part of the hip and backside.

Based on the measurements received from participant one (Bust – 46.50" Waist – 38.50" High Hip – 53.00" Hip – 55.00") this participant's body shape was a spoon/pear/triangle shape. Evaluating the measurements from the second participant (Bust – 49.50" Waist – 36.50" High Hip – 51.00" Hip – 53.00") this participant's body shape is an hourglass.

The first participant's fit session resulted in extreme dissatisfaction as the participant was just about unable to pull the pant up around her hips. After measuring the sample to approximate the pattern relation to the body, the researcher noted the pant pattern measurements did not add up to the participants' body measurements to start. The pants were very tight on the participants' high hip, hips, and thighs. The pant did not meet the preferred waist placement at mid waist (1.5" below natural waist placement). This indicated the rises and crotch depth were not long/deep enough to compensate for the participant's girth. The pant on the participant had extreme pulling at the front rise and back rise; this indicated that the garment was tight and was under spec for the participants' body measurements and body shape.

The second participant's fit session resulted in extreme dissatisfaction with the overall sample. In an effort to approximate the pattern connection with the body, the researcher measured the sample and found that the pant pattern measurements did not add up to the participant's body measurements. The pants were extremely tight at the high hips, hips, and thighs of the participants. The pants did not meet the desired waist placement at mid-waist (1.5" below natural waist placement). According to the participant, the rises and crotch depth were too shallow or too short to accommodate the participant's circumference. This participant's pants were excessively pulling at the front rise and back rise. These signs suggest that the garment was under spec for the participant's body measurements and shape.

When asked to demonstrate range of motion, the participant was unable to bend over to touch her feet. The participant was also unable to simply sit down in the pant, as the seam for the back rise pulled significantly and the threads at the seam were seen. This indicates that the circumference of the pant in the waist and in the hip was too small for the participant's waist and hip. Both participants yielded results of dissatisfaction in the same areas.

Based upon the basic pattern shape of a basic pant for a plus–size consumer, there were a few things the researcher took into consideration when theoretically recreating the pattern shapes. For the pitch: waist angle changes, and this affects the balance of the pant. The front-waist placement drops, and the back-waist placement increases. The posture can change for the distribution of weight, and this can counterbalance the balance of the garment. The two participants had similar body shapes, *pear shaped* and *hourglass*, but both participants wear the same size in pants. The measurements for their waist, high hip, and hip were within 2 inches of each other. The pants fit differently between the two participants. The body grows and changes in the pattern shape distribution and proportion in bottoms. As the body becomes bigger, the depth of the rise increases, and the length of the inseam should then decrease. The U-crotch curve increases to compensate for the shape of the abdomen and buttocks. As previously noted, the waist placements change as the body grows; this causes the front rise to reduce and the back rise to increase.

The current development of pants for the plus–size consumer has the inseam increasing with the ASTM grade. The pattern engineering for plus–size bodies has to be re-evaluated. The more curves and shape the body has, the greater need is for more curvatures to be added to the pattern. Sometimes the proportions may need to be changed due to the various body shapes. As the pitch changes for the waist placement on the pant and the rises decrease and increase, the inseam of the pant decreases to accommodate for the depth added in the crotch. With the depth being added to the crotch, as the depth increases, the pattern also has to account for the circumference of the waist and hips.

***Current Study Results***

The objective of the focus groups and fit sessions was to examine the plus–size consumer's dissatisfaction with their fit of their pants. In addition to the influences of various body shapes, the patterns for apparel product development, and grading process, the researcher aimed to and theorize a solution for this consumers' dissatisfaction. The data collection process of this research was based on qualitative and quantitative data. The quantitative data consisted of reviewing the measurements for the ASTM, plus-size apparel retail company specifications, the patternmaking, and grading processes. The qualitative data consisted of conducting focus group interviews and fit sessions via Zoom to determine the consumers' dissatisfaction and fit issues.

In response to the gaps in the literature, this study sought to explore various body shapes of the plus–size consumer, the current ASTM grade, and standard pattern shapes. The overarching purpose of the researcher was to identify consumer dissatisfaction, as well as the effectiveness of current patternmaking and grading methods for use in apparel mass customization for women's pants. The following research questions were proposed.

*What is the current plus–size apparel dissatisfaction for the top three body shapes?*

*What pattern shape changes should be made on plus–size pants?*

*Can we achieve good fit with the traditional grading?*

*In theory, does it make sense to create a grade rule for various body shapes? For mass customization, should plus–size apparel align with menswear techniques?*

**Research Question 1:** *What is the current plus–size apparel dissatisfaction for the top three body shapes?*

Based on the survey that was distributed in the preliminary research, it has been concluded that the plus–size consumers have several fit concerns when it comes to their apparel

choices. Most of the plus–size consumer dissatisfaction came from pants not fitting to their liking. Some of the dissatisfaction was due to the waist either being too big or too tight, the pants fitting too tight or loose across the hips and thighs, and having a reduced range of motion. There were also visual technical discrepancies with the sample group. The pants had visual pulling at the center back rise of the pants, the waist placement did not match as advertised at the natural waist, and the overall circumference of the pants was below standards. Overall, the dissatisfaction with the pant fit was consistent. Some of these issues can be linked to the pattern shapes needing to be adjusted for the plus–size figure. There needs to be more curves and shapes for the plus–size figure.

During the focus group interviews, many of the participants expressed their dissatisfaction with plus–size pant fit. Many of the participants echoed similar dissatisfactions. Some things one participant would say would personally identify with other participants, and this would spark another conversation. The first focus group had more petite consumers. Specifically, the petite consumers had many of the same concerns – the inseam lengths are just too long. Participant one's body shape is more of an oval shape. Participant two is more of a pear; however, they both expressed a few of the same concerns.

> **Participant 1.** As a short plus-sized woman, finding the perfect pants fit can be a bit challenging. If pants options do not come in petite, they usually are too long for me. Also, because I carry most of my weight in the midsection, when I find pants that fit my waist, they are usually too big in the thigh area. My thighs may be slimmer than what the universal standard sizing is to match my waist size, so even pants that should be a slim fit do not fit slim for me. My hips are also a little narrower than the universal sizing standards, so that causes fit issues as well. Sometimes when pants come in petite, they are too short when I put them on because my midsection likely takes up more room than expected. So, I typically end up getting regular length pants and get them hemmed if they are too long. Chaffing on the thighs is also a big problem with certain fabrics.

Both participants shared the concerns about inseam length in addition to the circumference fit issues. Participant two had issues with the rises not being long enough to hit at the desired waist placement; this also causes her issues with the pants not covering her backside.

> **Participant 2:** As long as I can remember, I have had issues with pants fitting. As a woman with curves and a larger derriere, often times it's hard to find pants that are not tight in the hips or thighs. Low rise pants also are not the best fit when you have a larger derriere. A lot of pants have a straight up and down fit not accounting for curves, which creates a bagging, unflattering fit. My biggest concern is finding petite plus size pants. Some companies that cater to plus sizes only make average fits. This is frustrating, especially for jeans as sometimes buying trendy jeans with embellishments or special hems are not possible or too costly to have hemmed.

Participant three has more of an hourglass body shape and has issues with finding pants that fit at her waist placement. The participant also finds it uncomfortable to have to wear a belt with her pants to avoid the paper bag effect of her pants around her waist. To avoid this, she has to pay extra money to get her pants tailored and altered to her desired waist fit.

> **Participant 3:** Shopping as a plus size woman is often a very challenging task in more ways than one. One of the biggest issues that I have is finding pants that fit me well. The reason that it's so challenging for me is because I have very thick thighs and a large butt, but my waist is smaller than what is expected of someone who needs the pants size. That makes it very difficult to find flattering jeans as well as work bottoms that have little to no stretch in them, and I often find myself wearing leggings, sweatpants, or dresses and skirts because I am able to better avoid dealing with the hunt as I call it. When I do wear jeans or pants without much stretch, I often have to wear a belt or have my pants tailored so that I am not perpetually an unwilling supporter of the paper bag pants trend. I wish that the plus size fashion industry would take things like that into consideration when they are making pants for us.

Participant four is a taller consumer and has a hard time finding pants that fit her body shape and her inseam length.

> **Participant 4:** Finding pants for me is such a chore. I am a plus size woman that is also tall in comparison to most women so it's like when I go shopping for bottoms, I have to do double work because I need to find pants that fit my thunder thighs and wide butt as well as my long legs. I remember that I was often teased in high school about my flooding pants because I could never find pants that were long enough, so I was always walking around like MJ with long socks and short pants. I think men's pants are better because they account for the waist and the length of the legs, so sometimes I buy my pants from the men's section, but the issue with that is the crotch area always being too baggy since it accounts for a body part that I do not have. Hopefully manufacturers realize that tall women exist, and we like to wear pants that fit well too.

One thing there is to be said about the interviews is all of the consumers have concerns with how their pants fit. It is affecting their overall experiences with clothes. All of the consumers expressed the wish and the hopes for the plus–size apparel industry to key into their concerns and make a change for the better.

When asking the participants during the virtual fit sessions what they would change about their pants, some of them noted several changes they would like to see such as slimmer thighs, smaller waist circumferences, shorter or longer inseams, etc. Based on the discussion, the researcher noted several customizations needed for the varying participants.

**Research Questions 2:** *What pattern shape changes should be made on plus–size pants?*

A well-fitting pair of pants should have enough room to go around the hips and between the legs. When the proportions are off, fit issues can occur. A normal relationship of a pant pattern to the body should be similar to the reference (Figure 9). One of the issues that was noticed was what some in the industry may call "smile lines" on the front crotch. The drag lines are pulling up at the crotch placement on each side of the body, creasing at the bikini line. This pulling is caused by not having enough depth in the crotch and front thigh. One of the solutions for this problem is to extend the front rise and thigh circumference at the front crotch, blending

to zero at mid-thigh. Another problem seen during the fit sessions was wrinkles pulling across the upper thigh on the front pant; the wearer felt the thigh was tight. One of the solutions for this problem is to scoop out the hook in the front crotch, blending to zero at the waist seam and crotch point. Other fit issues that were on the back pant consisted of having a wedgie or draglines toward the outer hip and inner knee. When the pant is tight around the fullest part of the rear end, one of the solutions here can be to extend the back rise and thigh circumference at the back crotch, blending to zero at mid-thigh. Eliminating a wedgie can be solved by scooping the back rise at the hook in the back crotch, blending to zero at the waist seam and crotch point.

The researcher conducted another exercise after examining the photos taken in the fit sessions from the preliminary study. The researcher found images of Alvanon plus–size forms, compared the forms, and reviewed their measurements presented. The ASTM grade and the Alvanon forms are matching specs for the POMs chosen, bust, waist, and hip. This is due to Alvanon's research being heavily influential in the apparel industry for creating apparel standards. The POMs have been compared to the bodies of a few of the plus–size consumers interviewed. Alvanon is a global innovations company that helps apparel brands improve their fit to reflect modern-day consumers (Alvanon, 2021). Since 2001, Alvanon has used the latest technology and body shape data to advise the world's leading apparel brands and retailers on fit and sizing strategies (Alvanon, 2021). Many companies conduct their fit process based on these forms, and with the researcher's review of these forms and the photos of the participants, there are some visual differences that cause fit issues for that consumer. The researcher focused on the size 20 participants and the size 20 Alvanon dress forms.

Alvanon has straight and curvy dress forms for the plus–size markets. The researcher reviewed both forms' body shapes in a size 20 and the consumer size 20. The visual differences

seen seemed to be posture, shape of the front torso, and hip, thigh, and buttocks shapes. Reviewing the overview of the ASTM grade, the researcher took into account for the majority of body shapes. The research conducted by this researcher included majority women of ethnic backgrounds. There were similarities with the body shapes of the participants in this study. Most of the participants had extra weight being carried at the front torso, seeing all of the variations noted in the Literature Review section of this study. The next variation from the Alvanon forms was the shape of the buttocks. The form's buttocks were more of a low hook, and most of the participants had an even arch buttock. Also, after seeing a few women who were a size 20, their bodies were a little fuller than the dress forms from Alvanon. By checking the POMs from the ASTM chart, the consumers' bodies did not match up exactly, which was expected.

Participant fives's body shape was as hourglass shape. She was fuller than the Alvanon dress form; however, her pant size is a size 20. Participant 5's bust was bigger than the size 20 dress form, landing around the size 22 dress form at 49 ½ inches. This participant's waist was smaller than the size 20 dress form, landing around the size 16 dress form at 39 ¾ inches. The participant's hip measurements were in between a size 20 and 22 dress form, landing at 50 ¾ inches. This is something the researcher saw frequently in the participants and consumers. Some consumers are between sizes, while others wear one size in their tops and another in their bottoms.

As noted early in the text, as the body mass increases, the distortion of portions become greater; this leads to a variance in the shape. This section addresses the pattern changes that should be taken into consideration when creating the pant for a plus–size consumer. When the body mass increase occurs, the angle in the pitch of the pant changes, and this also affects the balance of the overall pant. The front rise should lower as the body mass increases to try and

maintain the same visual waist placement across size ranges, and the back rise should increase to cover the rear end and land at the same visual waist placement. With the front of the body carrying more weight as the body increases, the patterns balance also varies.

Considering the fit sessions held in the preliminary research, the researcher noted where the shape could increase to fit their bodies better. For participant one, increasing the total pant circumference through the hips approximately six inches would be beneficial for a better overall pant fit. Increase the front rise approximately 2" and increase the back rises 2.5 – 3". By increasing the pant rises, the pant will now lay at the same visual natural waist placement. Once the waist placement is met, the waist placement of the pant waist can increase 1" for ease. Reviewing the participants in the pants side by side, their body shapes were very similar and they had some of the same issues that could have been solved with an overall pattern increase and reshaping of the rise hooks. The misconception of plus–size consumers is they are all big and tall. This may leave the inseams too long and dragging on the floor. The crotch depth and girth increases and deepens the rise, which in turn shortens the inseams.

**Research Question 3:** *Can we achieve good fit with the traditional grading?*

In the attempt to answer this question, the researcher decided to review a series of plus-size apparel companies' size charts. The companies the researcher reviewed were Ashley Stewart, Eloquii, Universal Standard, Fashion to Figure, Lane Bryant, Torrid, and Dia and Co. With reviewing these companies' size charts, there are some companies that provide a few customizations such as group grading in lengths for height. The researcher notes some similarities in the specifications as well.

***ASTM sizing rules versus retail sizing rules***

Ashley Stewart's specifications for sizes 16 – 22 in pants are as follows: (Figure 10)

- Size 16: Waist – 34", Hip – 46"
- Size 18: Waist – 37", Hip – 48"
- Size 20: Waist – 39", Hip – 50"
- Size 22: Waist – 41", Hip – 52"
- The group grading for heights were the same across all sizes: Extra Short 24" – 27", Short 26" – 30", Regular 29" – 33", Tall 32" – 36".

Eloquii's specifications for sizes 16 – 22 in pants are as follows: (Figure 11)

- Size 16: Waist – 39" – 41", Hip – 48" – 50", Thigh circumference 24 ¼" – 29 ½"
- Size 18: Waist – 41" – 43", Hip – 50" – 52", Thigh circumference 29 ½" – 30 ¾"
- Size 20: Waist – 43" – 45", Hip – 52" – 54", Thigh circumference 30 ¾" – 32"
- Size 22: Waist – 43" – 45", Hip – 52" – 54", Thigh circumference 30 ¾" – 32"

Universal Standard's size chart specifications are noted in split sizes. The specifications are for sizes 16 – 22 in pants are as follows: (Figure 12)

- Size 14/16: Waist – 35" – 37.5", Hip – 45" – 47.5"
- Size 18/20: Waist – 40" – 42", Hip – 50" – 52"
- Size 22/24: Waist – 44" – 46", Hip – 54" – 56"

Fashion to Figure's size chart specifications are noted in split sizes. The specifications are for sizes 16 – 22 in pants are as follows: (Figure 13)

- Size 14/16: Waist – 36" – 38", Hip – 46" – 48"
- Size 18/20: Waist – 39" – 41", Hip – 49" – 51"
- Size 22/24: Waist – 42 ½" – 44 ½", Hip – 52 ½" – 54 ½"

Lane Bryant's specifications for sizes 16 – 22 in pants are as follows: (Figure 14)

- Size 16: Waist – 38", Low Hip – 46 ½"
- Size 18: Waist – 40", Low Hip – 48 ½"
- Size 20: Waist – 42", Low Hip – 50 ½"
- Size 22: Waist – 44", Low Hip – 52 ½"
- Lane Bryant also advises pant lengths based on the consumers' height. Petite is recommended for women 5'3" and under. Short is recommended for women 5'4" and

under. Regular is recommended for women 5'4" to 5'8". Long is recommended for women 5'8" and over.

Torrid's specifications for sizes 16 – 22 in pants are as follows: (Figure 15)

- Size 16: Waist – 38" – 40", Low Hip – 48" – 50"
- Size 18: Waist – 40" – 42", Low Hip – 50" – 52"
- Size 20: Waist – 42" – 44", Low Hip – 52" – 54"
- Size 22: Waist – 44" – 46", Low Hip – 54" – 56"

Dia and Co's specifications for sizes 16 – 22 in pants are as follows: (Figure 16)

- Size 16: Waist – 38", Hip – 47 ½"
- Size 18: Waist – 39 ½", Hip – 49"
- Size 20: Waist – 41 ½", Hip – 51"
- Size 22: Waist – 44", Hip – 53 ½"

ASTM specifications for sizes straight and curvy body shapes in size 16 – 22 pants are as follows: (Figure 17 & Figure 18)

- Size 16 Straight: Waist – 39", High Hip – 44", Low Hip – 45"
- Size 16 Curvy: Waist – 37 ½", High Hip – 45 ½", Low Hip – 47"
- Size 18 Straight: Waist – 41", High Hip – 46", Low Hip – 47"
- Size 18 Curvy: Waist – 39 ½", High Hip – 47 ½", Low Hip – 49"
- Size 20 Straight: Waist – 43 ¼", High Hip – 48 1/8", Low Hip – 49"
- Size 20 Curvy: Waist – 41 ¾", High Hip – 49 ½", Low Hip – 51"
- Size 22 Straight: Waist – 45 ½", High Hip – 50 ¼", Low Hip – 51"
- Size 22 Curvy: Waist – 44", High Hip – 51 5/8", Low Hip – 53"

There are some circumference similarities within 1" for some brands such as Dia and Co's., Torrid, and Lane Bryant.

When reviewing the current ASTM grade for the plus-size consumer sizes 16 – 22, if retailers and manufacturers follow the grade and grade from the body shapes described

previously, customers will have a more accurate identification of what size garment they wear, instead of it changing per retailer and manufacturer.

**Research Question 4:** *In theory, does it make sense to create a grade rule for various body shapes? For mass customization, should plus–size apparel align with menswear techniques?*

Throughout the entirety of the research, this study has focused on the various body shapes and how they affect apparel fit, specifically in pants. Some companies are already implementing some mass customization techniques such as offering petite and tall sizes, and also offering sizes for straight and curvy body shapes. However. even with these customizations, plus-size consumers are still experiencing fit issues with their pants. The consistent fit issues seen can be compared to the years old statement of trying to fit a square peg in a round hole. This analogy expresses that something is not fitting in with societal standards. The plus-size consumer has not been prioritized when it comes to addressing apparel fit issues. Something has to change; a new standard has to be implemented.

During the study, the researcher gathered plus-size women of various backgrounds on an online platform for a fit discussion. This was an open platform for women to gather and express their frustrations with their pant fit. These research questions were posed to the members of the study to gain insight on the consumers' thoughts. When the researcher posed the part of the question referring to a grade for various body shapes, some participants mentioned Lane Bryant. These participants remembered when Lane Bryant implemented their Right Fit Jeans (Figure 19). Lane Bryant's Right Fit Jeans divided the plus-size consumer up into three separate categories based on individual body shape and size – not just the size that fits their largest body part (*Lane Bryant's Right Fit Jeans Start Sizing Revolution*, 2007). A Yellow/square body type is straight from the waist through the hips (*Lane Bryant's Right Fit Jeans Start Sizing Revolution*,

2007). Women with a Red/triangle fit are slightly curved from the waist to the hips (*Lane Bryant's Right Fit Jeans Start Sizing Revolution*, 2007). A woman with a Blue/circle body type has a small waist and is fullest at the hips (*Lane Bryant's Right Fit Jeans Start Sizing Revolution*, 2007). However, quite a few participants remembered having some fit issues with those pants as well. So, it seems the participants may be hesitant with implementing something like this again. However, they all do agree there is a difference with how pants fit per the body shape.

The researcher then posed a follow up question wanting to know how they would feel if things were created by body shape and had measurements attached, similar to menswear. This was a theory the participants seemed to enjoy. The thought of being able to pick a pants based on your body shape and the specific measurements such as waist circumference, hip circumference, thigh circumference, and inseam length seemed like the most ideal option for solving or coming close to solving the fit issues for plus-size consumers and their pants. However, there was some hesitancy with this theory. Some participants were concerned about how some plus-size consumers would feel psychologically when picking up a pair of pants with their measurements displayed. The researcher could understand how the consumer could be frustrated with picking up pants that displays their waist and hip measurements. However, the researcher did ask a follow up question. Would the consumer prefer a garment that doesn't display their measurements but still has fit issues or a garment that displays their measurements but comes closer to alleviating those fit concerns? When it was put that way, the participants came to a concession that they would prefer pants that fit between the two.

## Conclusion

This researcher has taken some time to review the ASTM apparel grades for plus–size consumers size 16W – 20W, reviewed the body shape analysis scale, plus-size apparel

companies' size charts, and qualitative data from a case study, while using the preliminary research results as a basis of the fit concerns and fit issues with pants for the plus–size consumer. After collecting all of the feedback and data from the fit sessions, the researcher has come to a solution that works in theory. Instead of trying to fit a square peg in a round hole, fit the square peg in a square hole. Creating the pant pattern based on the body shape can be a mass customization method that can improve fit for the plus–size consumer.

Focusing on sizes 16W as the base size grading up to a size 20W, previous research conducted presented in the text "Body shape and its influence on apparel size and consumer choices" by E. A. Gribbon at Alvanon, Inc. noted that the majority of female consumers do not have an hourglass body shape. At 46.12%, the majority of the female consumers' body shapes are rectangle, coming in second is the spoon/pear body shape at 20.92%, third is the inverted triangle at 13.83%, and last is the hourglass at 8.40%. If the apparel industry is reinforcing the ideal body shape, the hourglass, instead of adapting for the majority, these fit issues will continue.

There are two critical reasons that plus–size pants' fit is severely off; the first is the industry assumes their consumer has one body shape when creating pattern blocks, and the second is the grading applications assume individuals' bodies vary by the same amount on the front and the back of the body. So, the first step into improving the fit for the plus–size consumer in their pants is to create a base size fit for their body shape. A proper fit is not about the size and measurements, it is about the shape (Gribbin, 2014). After creating the patterns that will work for that body shape, the grade needs to be applied and vetted for its accuracy. In the United States, the grade intervals for the plus–size consumer have seemed to follow a uniform grade where the bust, waist, and hips consistently increased and decreased by the same amount, increasing and

decreasing two inches. With the current feedback from plus–size consumers, the current intervals are not working for the majority of plus–size consumers, especially as their body mass increases.

Treating the plus–size apparel market similar to menswear may be the answer. For menswear, their garments are sold by body type and the most important specs for a satisfying fit. For their pants, their specs that are of importance are the waist circumference and the inseam lengths. Women naturally have more curves than men, and for plus–size apparel specifically, this consumer has more curves and variances in shape that need to be considered. For plus–size apparel, the specs of importance may be the waist circumference, hip circumference or thigh circumference, and the inseam length.

Portions of this theory are already being implemented at well-known brands such as Lane Bryant and designer brands such as Buckle. The long standing plus–size apparel company Lane Bryant has a *Pant Shop* that has catered to different body shapes for their pant fits. *The Pant Shop* offers three options that work with consumers' unique curves: *Curvy*, *Straight,* and *Very Curvy*. *Curvy* is for the smaller waist, fuller through the hip and thigh. The pant is intended to sit below the natural waist, hitting approximately at mid waist. *Straight* is for the fuller waist and hip and slimmer through the thigh. This pant is intended to sit slightly below the natural waist. *Very Curvy* is for the hourglass body shape, very full through the hip and thigh. This pant is intended to sit at the natural waist.

According to Lane Bryant's online reviews from their customers, they seem to feel very happy with the pants from their Pant Shop. These pants fit a lot better than many of the other options available. However, there are still some consumers that are not pleased. There are issues with the inseams being too long or too short for some consumers. One customer, who is just under 6 feet tall, expressed her experience with the pant from Lane Bryant; she noted a few

problems she had with their clothes, saying they have a tendency to run too big. Another consumer, being more of an hourglass figure, had a very small a fuller buttocks. The pants were too big for her waistline. This consumer recommends this line to other consumers even though the pants do not work for her.

Designer brand jeans for straight women sizes such as Buckle have implemented the standards to follow menswear by providing the sizes by waist and inseam lengths (Figure 20). Straight size consumers have noted the difference in fit between other brands and these designer label brands. Reading some of their customer reviews, their customers enjoy this designer label's product. Many customers love their jeans and enjoy the fit of the jeans. Many consumers find them a bit pricey, but as a designer label, it is expected. Some customers have found it frustrating purchasing jeans from them, and the fit or quality may be lower than expected with the price they are paying.

Seeing that at least two companies are currently implementing two methods that seem to be making a big difference for their customer, it seems that combining these methods may be the next best thing to achieving an ideal pant fit for the plus–size consumer. Seeing the fit discrepancies between the two participants are similar with the Hourglass and Pear body shapes, it is better to categorize them together in the same category: curvy. The next body shape the researcher thinks should be considered is rectangle and the inverted triangle. For example, participant one's pants would be Curvy: 40" –56" – 32".

## Limitations and Future Research

This study yielded useful results; however, there were several limitations to the research. One of the main factors was the size of the focus group being limited to such a small number. This was also due to the influence of the COVID-19 pandemic; with the push for social

distancing, the virtual fit sessions did not seem to be the best way to conduct research as it was quite difficult to gather accurate research data. This also hindered the results of study as the researcher was not physically able to create and manipulate the patterns for the wearer. This one-on-one interaction is needed to make decisions on the overall fit revisions. Without the fit sessions being conducted, the researcher was not able to test the theory introduced.

The interviews with the consumer took place over the phone and on video chat platforms. Internet and data connection may have been spotty, causing portions to be inaudible. To mitigate this limitation, participants were asked to reiterate. This may have caused the participant to adlib a little bit and veer off from their original statement. In the future, when the COVID-19 pandemic has subsided, it will be much better to conduct these sessions in person.

Other limitations included pleasing every consumer's personal aesthetic as one's perspective, and preference is subjective. The consumer's individual dress aesthetics is about how they choose to appear and how they want to be viewed by themselves and others within a specific context (DeLong, 2015). How the consumer views themselves and how they think they are being perceived by others has a lot to do with their satisfaction or dissatisfaction with a product. The participants expressed dissatisfaction with products that fit them too tightly and/or too loosely in the waist, had pulling across the back rise, bunching at the front crotch, tight circumferences, and wide circumferences around the leg opening.

Future research includes previous research conducted on the waist-defining body modifications and compression garments. According to data gathered from previous research titled To Corset or Not to Corset, the waist-defining body modifier can have approximately 1" or more effect on apparel fit in the waist. This extra inch can leave the pants fitting well or too loosely in the waist. Some consumers wear waist-defining body modifications such as girdles,

waist trainers, Spanx, etc. to smooth their midsection in their attire; some consumers feel confined in this modification. This is also tied into the wearer's dress aesthetic, but this will have a great influence on the wear's apparel fit.

An additional factor in understanding the difficulty of extended sizes is that the age of the target markets' bodies grows and shapes differently. The body changes as the consumer ages and loses the defined waist, the curvature of the spine, tissue in the buttocks, and the buttocks starts to drop and lower, and the breast shape drops and becomes less firm (Boorady, 2014).

Reviewing this research, the next element that should be considered for the future for this research is the implementation of 3-D technology. 3-D fit technology is being implemented into the industry every day, and this can serve as a great tool for fit sessions. Fitting on a 3-D avatar and being able to see the fit issues immediately before sending a physical sample helps save time and helps elevate potential issues before meeting with a live fit model. 3-D technology is something many companies are investing in implementing and assisting their brand's fit. This technology can be useful for the plus–size consumer as well with providing various body shapes for each consumer and for testing the patterns and grades.

Another aspect that should be considered is that apparel brands have the right to adjust their patterns and standards from the ASTM apparel grades. This industry grade is viewed as a guide; however, this guide also causes fit issues because there is a more significant opportunity for discrepancies and fit issues for this consumer. This is also causing serious dissatisfaction for this customer. In 2019, a young woman posted on Twitter (the social media site) about the fit discrepancies for a size 12 pair of jeans. She photographed seven pairs of jeans, and each pair of jeans in the image was a size 12 from different brands (Figure 21). The visual difference of each

pant laying on top on one another was significant. The young woman expressed that none of the pants fit the same and that women have grown frustrated with their clothing sizes.

Another thing to consider for pant fit is the fabrication choices. Woven fabrics have less room for error. Knit fabrics give more grace than woven fabrics and may be more suited for plus–size apparel production. More apparel brands have adopted fabrics with spandex and elastane contents to allow for more comfortability and mobility. Along with the different fabrications to consider, pant construction should also be considered. Some pants have a forgiving construction, such as a flat front facing with an elastic reduction waistband in the back. The elastic waistband will provide more ease and pull the back of the pant closer to the body.

In addition to the fabric variations, this study focused on the plus–size women in the United States from sizes 16W through 20W. Future research could examine the plus–size women in other countries and include sizes 14W through 32W—the participants of the study all self-reported their apparel size and body measurements.

Being in the United States, where it is culturally and racially diverse, certain body shapes and fit issues may be related to specific ethnic backgrounds. This is something to consider in future research. Since the number of participants was limited in this study, the diversity was not met.

## Discussion

Although this research study is experimental with a small focus group, it encompasses the understanding of the plus–size figure and body shape and the apparel fit issues that the women of this market experience. As sewing patterns are created using the same proportions and measurements as ready-to-wear clothing, the information regarding fit dissatisfaction and sewing alterations imparts valuable awareness of how plus–size garment design needs to improve. The

findings suggest that the main apparel fit issues that need to be evaluated for pants are the waist circumference, hip circumference, thigh circumference, crotch length (front rise and back rise), and inseam lengths. In addition to the variation in waist and hip measurements experienced by participants, as well as the percentage of women indicating a pear-shaped body, the study shows that more understanding is needed on how best to design apparel for the lower half of a plus-size person.

Based on the premise of mass customization efforts, it will only be successful if customization starts from the most correctly shaped garment patterns, determining elemental basic body shapes as vital. Mass customization seems to provide a potential solution allowing customized fit in apparel. If plus – size apparel companies implement the use of mass customization options for the consumers, they may see a return on this investment within ten to thirteen years. This kind of change will require patience to implement and gain support from the plus – size community. Based on some of the participants' concerns, specifically the psychological impact it may have on consumers seeing a 42-inch waist, a 58-inch hip spec, and a 30-inch inseam on their garments, this could cause the consumer to become self-conscious about purchasing this item.

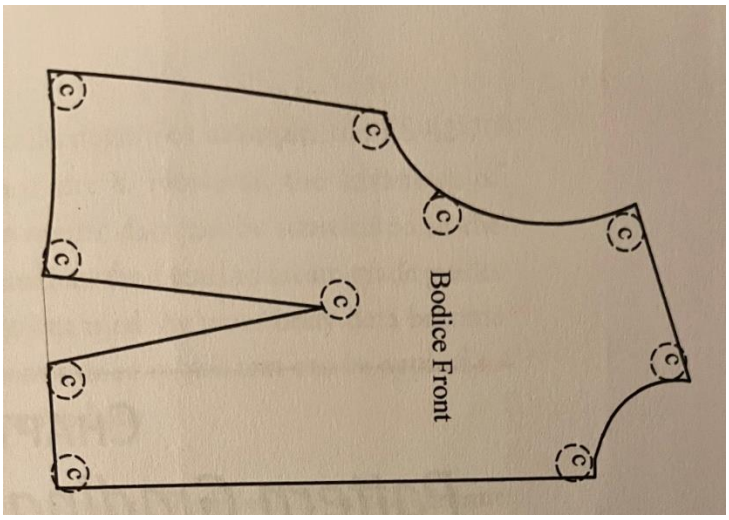
Other options to consider while improving the plus-size market includes custom pants made from scratch by one's measurements. This method will not be as immediate as going to the store and picking up a pair of pants, but the customer will know they were made for their body and should fit very nicely. Another option to improve the market to alleviate the waist gap concern customers have is implementing an elastic waistband on the inside. Something similar to childrenswear pants with elastic and buttons to tighten the waist. If companies do not see the

benefit in investing on the product development side to improve the plus-size market, it would be beneficial to invest in having onsite tailors or seamstresses for alterations to be made in-house.

## Reference Images

**Figure 1**

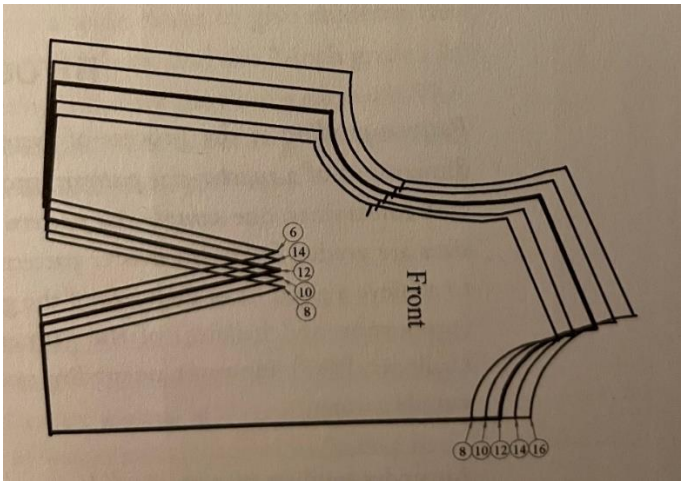
Sloper




Note. Mullet, K. (2016). *Cardinal Points.* From Concepts of pattern grading (3rd Edition).

**Figure 2**

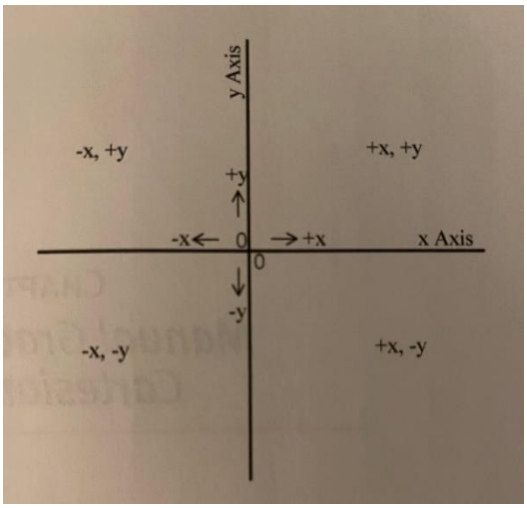
Nested Graded Pattern Block




Note. Mullet, K. (2016). *Nested Graded Pattern Block*. From Concepts of pattern grading (3rd Edition).

**Figure 3**

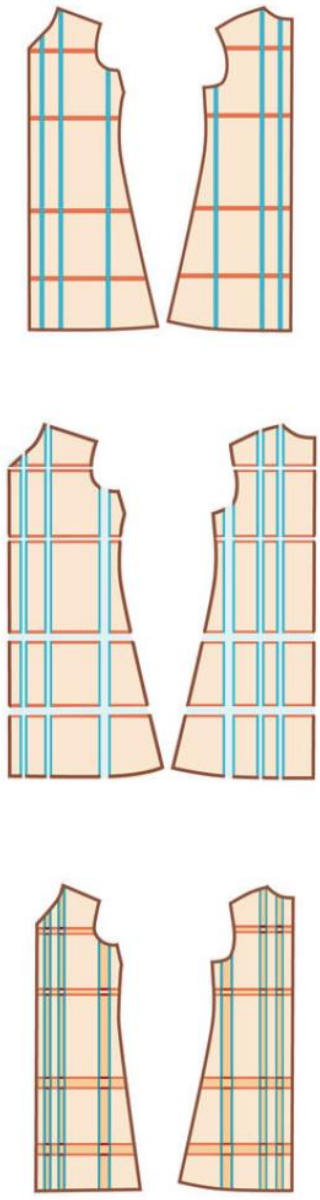
Cartesian Graph




Note. Mullet, K. (2016). *Cartesian Graph*. From Concepts of pattern grading (3rd Edition).

**Figure 4**

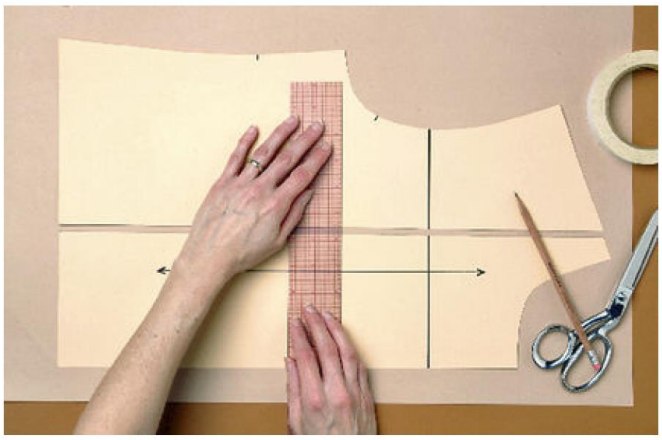
Pattern Grading



Note. Horlamus, T. (2002). *Grading up*. From Making sense of pattern grading.

**Figure 5**

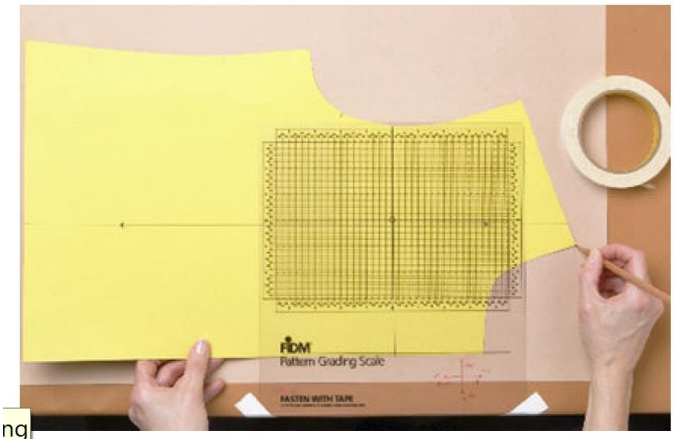
Cut and Spread Method



Note. Note. Horlamus, T. (2002). *Cut and spread method*. From Making sense of pattern grading.

**Figure 6**

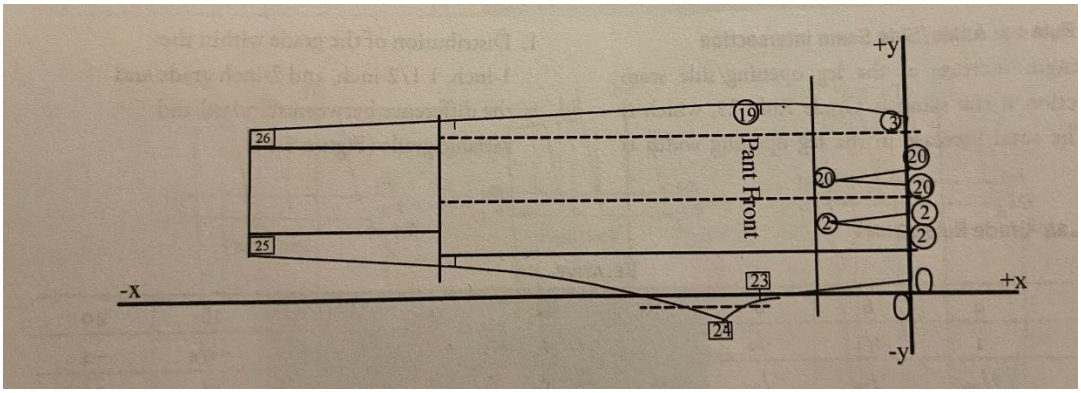
Pattern Shifting




Note. Note. Horlamus, T. (2002). *Pattern shifting*. From Making sense of pattern grading.

**Figure 7**

Cartesian Points on pants




Note. Mullet, K. (2016). *Cartesian Points on Pants.* From Concepts of pattern grading (3rd Edition).

**Figure 8**

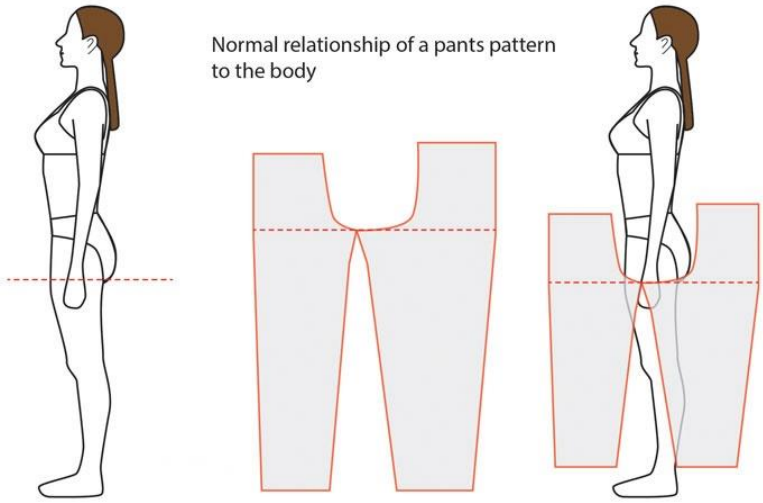
Grade Rules Table example

| CIRCUMFERENCE GRADE | | CROSS BUST/WAIST GRADES (CIRC. DIVIDED BY 4) |
|---|---|---|
| **Size 12 to 4** | $(1^1/_2 + 1 + 1+1) = -4^1/_2$ | $-1\ ^1/_8''$ |
| **Size 12 to 6** | $(1^1/_2 + 1 + 1) = -3^1/_2$ | $-^7/_8''$ |
| **Size 12 to 8** | $(1^1/_2 + 1) = -2^1/_2''$ | $-^5/_8''$ |
| **Size 12 to 10** | $-1^1/_2''$ | $-^3/_8''$ |
| SIZE 12 | **MASTER OR BASE PATTERN** | |
| **Size 12 to 14** | $1^1/_2''$ | $^3/_8''$ |
| **Size 12 to 16** | $(1^1/_2 + 1^1/_2) = 3''$ | $^3/_4''$ |
| **Size 12 to 18** | $(1^1/_2 + 1^1/_2 + 2) = 5''$ | $1^1/_4''$ |
| **Size 12 to 20** | $(1^1/_2 + 1^1/_2 + 2 + 2) = 7''$ | $1^3/_4''$ |
| **Size 12 to 22** | $(1^1/_2 + 1^1/_2 + 2 + 2 = 2) = 9''$ | $2^1/_4''$ |

Note. Mullet, K. (2016). *Grade Rules Table example*. From Concepts of pattern grading (3rd Edition).

**Figure 9**

Pant pattern relationships to the body




Note.

**Figure 10**

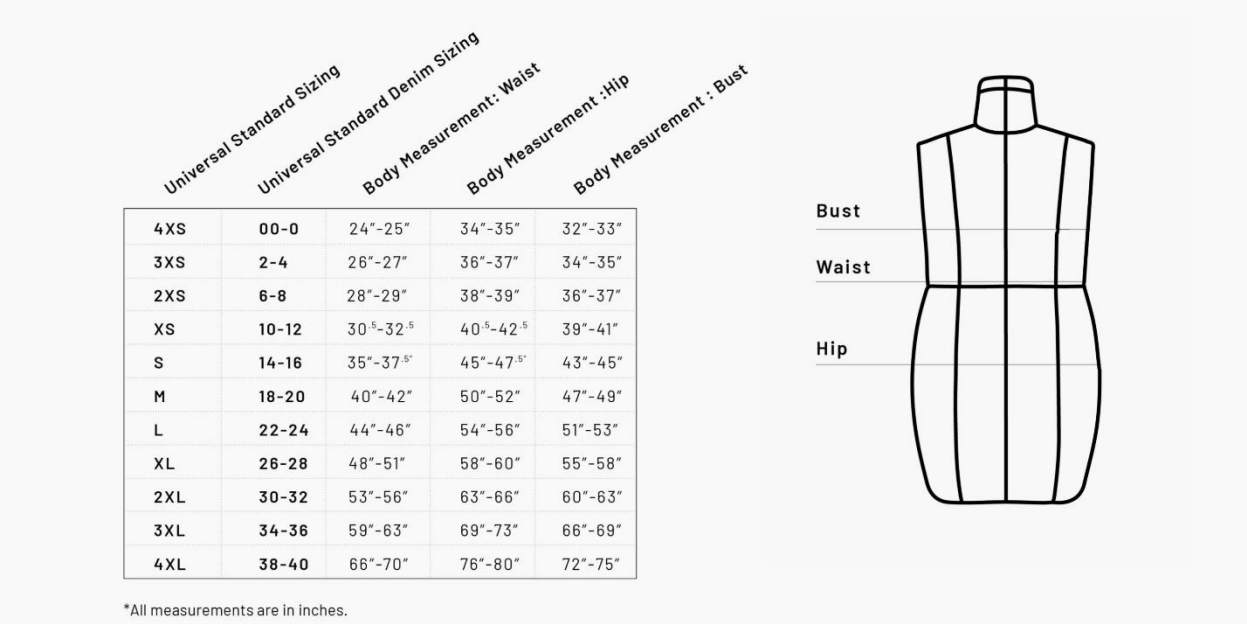
Ashley Stewart Size Chart

| BOTTOMS | | | | | | | |
|---|---|---|---|---|---|---|---|
| SIZE | | WAIST | HIPS | XSHORT | SHORT | REGULAR | TALL |
| 10 | L | 30 | 40 | 24 - 27 | 26 - 30 | 29 - 33 | 32 - 36 |
| 12 | XL | 31.5 | 41.5 | 24 - 27 | 26 - 30 | 29 - 33 | 32 - 36 |
| 14 | 1X | 33 | 44 | 24 - 27 | 26 - 30 | 29 - 33 | 32 - 36 |
| 16 | 1X | 35 | 46 | 24 - 27 | 26 - 30 | 29 - 33 | 32 - 36 |
| 18 | 2X | 37 | 48 | 24 - 27 | 26 - 30 | 29 - 33 | 32 - 36 |
| 20 | 2X | 39 | 50 | 24 - 27 | 26 - 30 | 29 - 33 | 32 - 36 |
| 22 | 3X | 41 | 52 | 24 - 27 | 26 - 30 | 29 - 33 | 32 - 36 |
| 24 | 3X | 43 | 54 | 24 - 27 | 26 - 30 | 29 - 33 | 32 - 36 |
| 26 | 4X | 45 | 56 | 24 - 27 | 26 - 30 | 29 - 33 | 32 - 36 |
| 28 | 4X | 47 | 58 | 24 - 27 | 26 - 30 | 29 - 33 | 32 - 36 |
| 30 | 5X | 49 | 60 | 24 - 27 | 26 - 30 | 29 - 33 | 32 - 36 |
| 32 | 5X | 51 | 62 | 24 - 27 | 26 - 30 | 29 - 33 | 32 - 36 |
| 34 | 6X | 53 | 64 | 24 - 27 | 26 - 30 | 29 - 33 | 32 - 36 |
| 36 | 6X | 55 | 66 | 24 - 27 | 26 - 30 | 29 - 33 | 32 - 36 |
| | | | | INSEAMS | | | |

Note: Ashley Stewart. (n.d). *Size chart.* From Ashley Stewarts' website.

**Figure 11**

Eloquii Size Chart



| Universal Standard Sizing | Universal Standard Denim Sizing | Body Measurement: Waist | Body Measurement :Hip | Body Measurement : Bust |
|---|---|---|---|---|
| 4XS | 00-0 | 24″-25″ | 34″-35″ | 32″-33″ |
| 3XS | 2-4 | 26″-27″ | 36″-37″ | 34″-35″ |
| 2XS | 6-8 | 28″-29″ | 38″-39″ | 36″-37″ |
| XS | 10-12 | 30.5-32.5 | 40.5-42.5 | 39″-41″ |
| S | 14-16 | 35″-37.5″ | 45″-47.5″ | 43″-45″ |
| M | 18-20 | 40″-42″ | 50″-52″ | 47″-49″ |
| L | 22-24 | 44″-46″ | 54″-56″ | 51″-53″ |
| XL | 26-28 | 48″-51″ | 58″-60″ | 55″-58″ |
| 2XL | 30-32 | 53″-56″ | 63″-66″ | 60″-63″ |
| 3XL | 34-36 | 59″-63″ | 69″-73″ | 66″-69″ |
| 4XL | 38-40 | 66″-70″ | 76″-80″ | 72″-75″ |

*All measurements are in inches.



Note: Eloquii. (n.d). *Size chart.* From Eloquii's website.

**Figure 12**

Universal Standard Size Chart

Pants, Jeans, and Shorts

| US Size | Dia | Waist | Hip |
|---|---|---|---|
| 12 | 0X | 35" | 44.5" |
| 14 | 1X | 36.5" | 46" |
| 16 | 1X | 38" | 47.5" |
| 18 | 2X | 39.5" | 49" |
| 20 | 2X | 41.5" | 51" |
| 22 | 3X | 44" | 53.5" |
| 24 | 3X | 46.5" | 56" |
| 26 | 4X | 49" | 58.5" |
| 28 | 4X | 51.5" | 61" |
| 30 | 5X | 54" | 63.5" |
| 32 | 5X | 56.5" | 66" |

Note: Universal Standard. (n.d). *Size chart.* From Universal Standard's website.

**Figure 13**

Fashion to Figure Size Chart

## FTF size chart

**FTF styles are thoughtfully designed and fit specifically for curvy bodies size 12-24.**

**BOTTOMS / JEANS**

**Please note, FTF sizing is not the same as New York & Company. Reference the below measurement before the purchase.*

| | | | | | |
|---|---|---|---|---|---|
| FTF | 0 | 1 | 2 | 3 | 4 |
| US | XL | 1X | 2X | 3X | 4X |
| SIZES | 12 | 14-16 | 18-20 | 22-24 | 26-28 |
| WAIST | 34" | 36-38" | 39-41" | 42.5-44.5" | 47-49.5" |
| HIP | 44" | 46-48" | 49-51" | 52.5-54.5" | 57-59.5" |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| FTF | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 |
| US | XL | | 1X | | 2X | | 3X | | 4X |
| WAIST | 34" | 36" | 38" | 40" | 42" | 44" | 47" | 50" | 53" |
| HIP | 44" | 46" | 48" | 50" | 52" | 54" | 57" | 60" | 63" |

**how to measure**

- For the best fit, measure over the undergarments you'll be wearing. Stand with your feet approximately 12" apart.
- Bust: Measure around the chest at the fullest part of the bust. The tape should be held securely around the body but not tight.
- Natural Waist: Measure around your waist at the narrowest part. The tape should be held securely around the body but not tight.
- Hips: Measure around your hips at widest part. Usually about eight inches below waist. The tape should be held securely around the body but not tight.

Note: Fashion to Figure. (n.d). *Size chart.* From Fashion to Figure's website.

**Figure 14**

Lane Bryant Size Chart

**STEP 2:** FIND YOUR SIZE

Use the chart below to determine your size. If you're on the borderline between two sizes, order the smaller size for a tighter fit or the larger size for a looser fit.

| SIZE | WAIST | LOW HIP |
|---|---|---|
| 10 | 32 | 40.5 |
| 12 | 34 | 42.5 |
| 14 | 36 | 44.5 |
| 16 | 38 | 46.5 |
| 18 | 40 | 48.5 |
| 20 | 42 | 50.5 |
| 22 | 44 | 52.5 |
| 24 | 46 | 54.5 |
| 26 | 48 | 56.5 |
| 28 | 50 | 58.5 |
| 30 | 52 | 60.5 |
| 32 | 54 | 62.5 |
| 34 | 56 | 64.5 |
| 36 | 58 | 66.5 |
| 38 | 60 | 68.5 |
| 40 | 62 | 70.5 |

Note: Lane Bryant. (n.d). *Size chart.* From Lane Bryant's website.

**Figure 15**

Torrid Size Chart

TORRID MEASUREMENTS

| TORRID SIZES | BUST | WAIST | LOW HIP |
|---|---|---|---|
| 10 | 38-40" | 32-34" | 42-44" |
| 12 | 40-42" | 34-36" | 44-46" |
| 14 | 42-44" | 36-38" | 46-48" |
| 16 | 44-46" | 38-40" | 48-50" |
| 18 | 46-48" | 40-42" | 50-52" |
| 20 | 48-50" | 42-44" | 52-54" |
| 22 | 50-52" | 44-46" | 54-56" |
| 24 | 52-54" | 46-48" | 56-58" |
| 26 | 56-58" | 50-52" | 60-64" |
| 28 | 60-64" | 54-58" | 66-70" |
| 30 | 66-70" | 60-64" | 72-76" |

Note: Torrid. (n.d). *Size chart.* From Torrid's website.

**Figure 16**

Dia and Co Size Chart

| Split Sizes | US | Natural Waist | Hips | Thigh |
|---|---|---|---|---|
| 14/16 | 14 | 37-39 | 46-48 | 27-28 1/4 |
| | 16 | 39-41 | 48-50 | 28 1/4-29 1/2 |
| 18/20 | 18 | 41-43 | 50-52 | 29 1/2-30 3/4 |
| | 20 | 43-45 | 52-54 | 30 3/4-32 |
| 22/24 | 22 | 45-47 | 54-56 | 32-33 1/4 |
| | 24 | 47-49 | 56-58 | 33 1/4-34 1/2 |
| 26/28 | 26 | 50-52 | 59-61 | 34 1/2-36 1/4 |
| | 28 | 53-55 | 62-64 | 36 1/4-38 |

Note: Dia and Co. (n.d). *Size chart.* From Dia and Co's website.

**Figure 17**

ASTM Size Chart | Straight

| Size Category | Plus Straight | | Plus Straight | | Plus Straight | | Plus Straight | | Plus Straight | |
|---|---|---|---|---|---|---|---|---|---|---|
| Size Range | 16 | | 18 | | 20 | | 22 | | 24 | |
| Neck Base | 15 3/4 | 40 | 16 | 40.75 | 16 1/4 | 41.5 | 16 5/8 | 42.25 | 17 | 43.25 |
| Across Shoulder | 15 3/4 | 40.25 | 16 | 40.75 | 16 1/8 | 41 | 16 3/8 | 41.75 | 16 5/8 | 42.25 |
| Chest | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Bust | 43 | 109.25 | 45 | 114.25 | 47 | 119.5 | 49 | 124.5 | 51 | 129.5 |
| HPS to Apex | 11 3/8 | 28.75 | 11 3/4 | 29.75 | 12 | 30.5 | 12 3/8 | 31.5 | 12 3/4 | 32.5 |
| Waist | 39 | 99 | 41 | 104.25 | 43 1/4 | 109.75 | 45 1/2 | 115.5 | 47 3/4 | 121.25 |
| CF Neck to Waist | 14 7/8 | 38 | 15 1/8 | 38.25 | 15 1/4 | 38.5 | 15 3/8 | 39 | 15 1/2 | 39.25 |
| CB Neck to Waist | 16 1/2 | 42 | 16 5/8 | 42 | 16 5/8 | 42.25 | 16 3/4 | 42.5 | 16 3/4 | 42.5 |
| High Hip | 44 | 111.75 | 46 | 116.75 | 48 1/8 | 122.25 | 50 1/4 | 127.5 | 52 3/8 | 133 |
| Low Hip | 45 | 114.25 | 47 | 119.25 | 49 | 124.5 | 51 | 129.5 | 53 | 134.75 |
| Inseam | 30 1/2 | 77.5 | 30 1/2 | 77.5 | 30 1/4 | 76.75 | 30 | 76.25 | 29 3/4 | 75.75 |
| Total Rise | 27 3/8 | 69.5 | 28 1/4 | 71.75 | 29 1/4 | 74.5 | 30 1/4 | 77 | 31 3/8 | 79.75 |
| Thigh | 27 | 68.75 | 28 1/8 | 71.5 | 29 1/4 | 74.25 | 30 3/8 | 77.25 | 31 1/2 | 80 |
| CB Neck to Wrist | 31 | 78.5 | 31 1/8 | 79 | 31 3/8 | 79.75 | 31 5/8 | 80.5 | 31 7/8 | 81 |
| Bicep | 15 1/8 | 38.5 | 15 1/2 | 39.5 | 15 7/8 | 40.25 | 16 1/4 | 41.25 | 16 5/8 | 42.25 |
| Total Height | 65 1/2 | 166.25 | 65 1/2 | 166.25 | 65 1/2 | 166.25 | 65 1/2 | 166.25 | 65 1/2 | 166.25 |
| Head | 22 1/4 | 56.5 | 22 1/2 | 57.25 | 22 1/2 | 57.25 | 22 3/4 | 57.75 | 22 3/4 | 57.75 |

Note: Alvanon. (2018). *ASTM – Alvanon plus straight size chart.* From http://alvanon.com/wp-content/uploads/2018/06/AF-SPECS_US-ASTM-Plus_v1.0.pdf

**Figure 18**

ASTM Size Chart | Curvy

| Size Category | Plus Curvy | | Plus Curvy | | Plus Curvy | | Plus Curvy | | Plus Curvy | |
|---|---|---|---|---|---|---|---|---|---|---|
| Size Range | 16 | | 18 | | 20 | | 22 | | 24 | |
| Neck Base | 15 3/4 | 40 | 16 | 40.75 | 16 1/4 | 41.5 | 16 5/8 | 42.25 | 17 | 43.25 |
| Across Shoulder | 15 3/4 | 40.25 | 16 | 40.75 | 16 1/8 | 41 | 16 3/8 | 41.75 | 16 5/8 | 42.25 |
| Chest | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Bust | 43 | 109.25 | 45 | 114.25 | 47 | 119.5 | 49 | 124.5 | 51 | 129.5 |
| HPS to Apex | 11 3/8 | 28.75 | 11 3/4 | 29.75 | 12 | 30.5 | 12 3/8 | 31.5 | 12 3/4 | 32.5 |
| Waist | 37 1/2 | 95.25 | 39 1/2 | 100.5 | 41 3/4 | 106.25 | 44 | 112 | 46 1/4 | 117.5 |
| CF Neck to Waist | 14 7/8 | 37.75 | 15 | 38.25 | 15 1/8 | 38.5 | 15 1/4 | 38.75 | 15 1/2 | 39.25 |
| CB Neck to Waist | 16 1/2 | 42 | 16 5/8 | 42.25 | 16 5/8 | 42.25 | 16 3/4 | 42.5 | 16 3/4 | 42.5 |
| High Hip | 45 1/2 | 115.5 | 47 1/2 | 120.5 | 49 1/2 | 125.75 | 51 5/8 | 131.25 | 53 3/4 | 136.5 |
| Low Hip | 47 | 119.5 | 49 | 124.5 | 51 | 129.5 | 53 | 134.75 | 55 | 139.75 |
| Inseam | 30 1/2 | 77.5 | 30 1/2 | 77.5 | 30 1/4 | 76.75 | 30 | 76.25 | 29 3/4 | 75.75 |
| Total Rise | 28 | 71 | 28 3/4 | 73.25 | 29 7/8 | 76 | 31 | 78.75 | 32 1/8 | 81.75 |
| Thigh | 28 1/2 | 72.25 | 29 5/8 | 75.25 | 30 3/4 | 78 | 31 7/8 | 81 | 33 | 83.75 |
| CB Neck to Wrist | 31 | 78.5 | 31 1/8 | 79 | 31 3/8 | 79.75 | 31 5/8 | 80.5 | 31 7/8 | 81 |
| Bicep | 15 1/8 | 38.5 | 15 1/2 | 39.5 | 15 7/8 | 40.25 | 16 1/4 | 41.25 | 16 5/8 | 42.25 |
| Total Height | 65 1/2 | 166.25 | 65 1/2 | 166.25 | 65 1/2 | 166.25 | 65 1/2 | 166.25 | 65 1/2 | 166.25 |
| Head | 22 1/4 | 56.5 | 22 1/2 | 57.25 | 22 1/2 | 57.25 | 22 3/4 | 57.75 | 22 3/4 | 57.75 |

Note: Alvanon. (2018). *ASTM – Alvanon plus straight size chart.* From http://alvanon.com/wp-content/uploads/2018/06/AF-SPECS_US-ASTM-Plus_v1.0.pdf

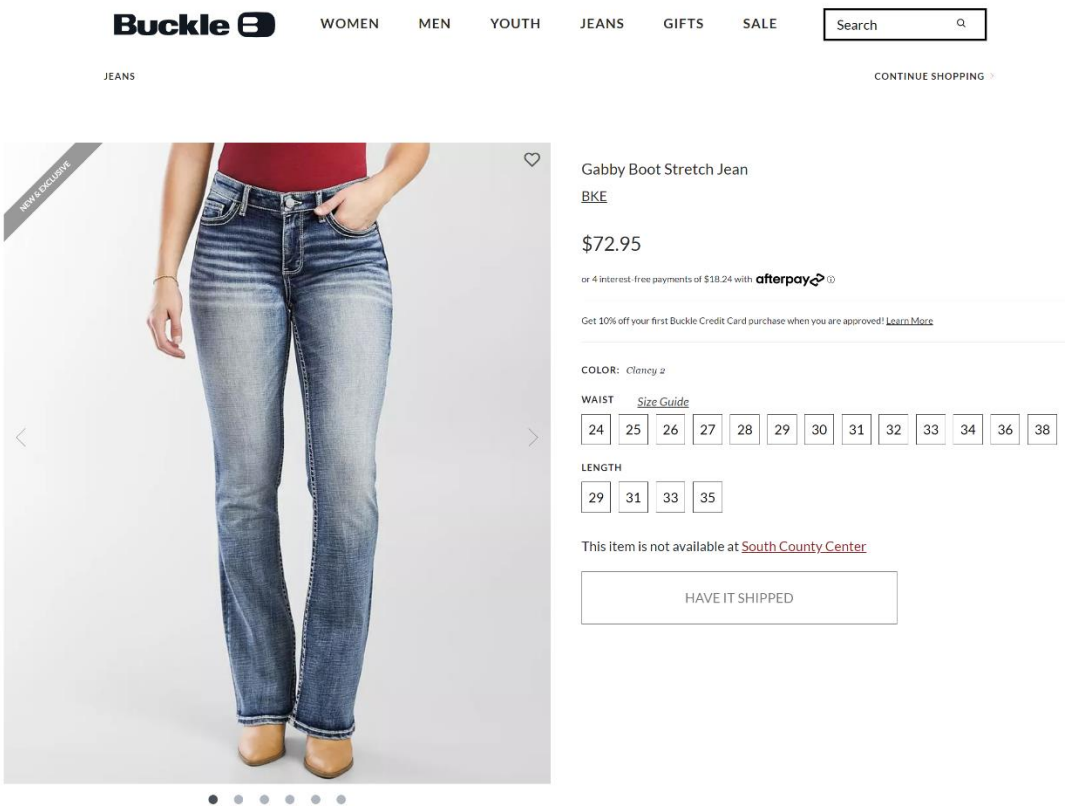
**Figure 19**

Right Fit | Lane Bryant


Note:

**Figure 20**

Buckle Jeans




Note.

**Figure 21**

Variation in Size 12 pants

Note.

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