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QUALITY EVALUATION OF JEANS AT THREE PRICE CATEGORIES

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QUALITY EVALUATION OF JEANS AT THREE PRICE CATEGORIES

THESIS

A thesis proposal submitted in partial fulfilment of the
requirements for the degree of Master of Science in the
Department of Retailing and Tourism Management
at the University of Kentucky

By

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ABSTRACT OF THESIS

QUALITY EVALUATION OF JEANS AT THREE PRICE CATEGORIES

The purpose of this study was to evaluate the specifications, appearance and performance characteristics of jeans at three price categories and to evaluate the relationship between price and product quality. Three brands; Lucky, Gap, and Faded Glory represented men's jeans in the price categories of better, moderate, and mass merchant (budget). Jeans were inspected and the design, material, and construction specifications were identified and compared. The appearance and performance characteristics of jeans were evaluated initially and compared to the initial characteristics after one and five launderings. ASTM and AATCC test methods were used to evaluate color difference, colorfastness to dry and wet crocking, smoothness retention, fabric breaking strength, seam strength, and dimensional change. The results of the study found that Lucky jeans had more design, material, and construction details, which would be preferable for style focused consumers with less interest on durability characteristics. Gap jeans had the highest fabric breaking strength and would be suitable for price-conscious consumers interested in durability as well as style and design. Home laundering had less impact on the appearance and performance characteristics of Faded Glory jeans and the price-conscious consumers that are primarily interested in durability would prefer Faded Glory jeans.

KEYWORDS: Jeans, Quality, Price, Denim, Specifications

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TABLE OF CONTENTS

List of Tables

List of Figures

Chapter One

Consumers use apparel throughout their lives not only to protect their bodies from outside harm but also to express their cultural attitude, social class, affluence, and religion (Marshall, 2000, p. 47). The apparel industry is one of the most globalized industries in the world. Today, the apparel and textile industry is witnessing a remarkable growth in production by manufacturers and in sales by retailers of apparel around the world. The textile and apparel industry is a broad international system of production, merchandising, marketing, and distribution (Glock & Kunz, 2005, p. 4). Consumers take into account the physical characteristics of apparel while categorizing them as low or high quality products (Davis, 1985). They also use high quality apparel to feel better about themselves and enhance the way others perceive them. This indicates that consumers judge the quality of apparel based on its psychological and social effects (Jean D. Hines & O'Neal, 1995).

Denim jeans are considered one of the most popular apparel items among consumers in all retail channels including mass-merchants, specialty stores, and department stores (Allen & Huffman, 2005). Traditional denim fabric consists of 100% cotton fibers, but there are other fibers used to produce denim fabric, including polyester and spandex. Denim fabric is cut into specific components according to the determined design. Each pair of denim jeans consists of different components such as pockets, seat, leg panels, waistband and belt loops. These components are assembled using an industrial sewing machine. Suspender buttons, branding patch, rivets, and other sewing procedures, including bartacks and trims are also added to jeans during the production process ("Jean Anatomy: Defining Details of the Blue Jean ", 2012). Then, jeans are prewashed, stone-washed, or sprayed with sands or chemical substances to create a desired appearance (Robbins, 2006, pp. 51-55). To most consumers, higher-priced jeans are often associated with higher quality and are expected to provide superior fit and styling (Davies, 2005).

Problem

Quality perception can be defined as the consumer's judgment about the superiority of a product (Zeithaml, 1988). Studies suggest that consumer's perception of a product's quality is multidimensional, and there is a significant positive relationship between the extrinsic attributes including price (Darke & Chung, 2005; Heisey, 1990;

Swinker & Hines, 2006), brand (Grewal, Monroe, & Krishnan, 1998; Jean D. Hines & Swinker, 2001; Homer, 2008; Romeo, 2009), store image (Vahie & Paswan, 2006), sales promotion (Darke & Chung, 2005), and perceived quality. Consumers often believe that higher-priced brands of apparel have better quality level (Calvo-Porral, Martinez-Fernandez, Juanatey-Boga, & Levy-Mangin, 2015; Chang, Burns, & Noel, 1996; Swinker & Hines, 2006).

Consumers also refer to the intrinsic cues such as aesthetics (Jean D. Hines & Swinker, 2001; Romeo, 2009; Swinker & Hines, and attributes 2006) and fabric (Jean D. Hines & O'Neal, 1995) for evaluating the quality of products. While consumers recognize prominent brands of jeans as being more attractive, stylish and of higher quality (Pandya, 2013), such dimensions of the apparel's quality as performance, durability, and serviceability can only be determined through standard quality evaluation procedures (Bubonia, 2014, pp. 6-7).

In the apparel industry, manufacturers and retailers strive to fulfill their customers' needs by providing them with their desired product, at determined price points, and the targeted quality level. In order to determine the apparel product's quality, it is important to measure the garment's appearance and performance characteristics in addition to other external influences such as country of origin, brand, retail price, and advertising (Bubonia, 2014, pp. 6-7). However, the appearance and performance characteristics of apparel, including shrinkage, colorfastness, fabric breaking strength and seam strength are more challenging for the customers to measure. Moreover, due to the nature of these characteristics, they can be evaluated by consumers only after use and care (Rayman & Nelson, 1993).

Purpose

The quality of a product is often linked to the brand name across all categories of apparel products. Well-known and higher-priced brands are assumed and expected to have higher quality than non-branded products (Baugh & Davis, 1989; Vigneron & Johnson, 1999). Wade (2011) examined the relationship between the brand and the perception of quality of denim and according to her study, the higher-priced brands of jeans are related to superior perceived quality. The purpose of this study was to evaluate

the specifications, appearance and performance characteristics of jeans at three price categories and to identify the relationship between price and product quality.

Objectives

The initial product specifications, appearance features, and performance characteristics of jeans were measured and compared to determine the differences between product quality of jeans at three price categories. Production specifications were compared by identifying the design, material, and construction specifications of jeans. The appearance and performance characteristics were measured initially and after one and five wash cycles. The evaluations include color difference, colorfastness to dry and wet crocking, smoothness retention, fabric breaking strength, seam strength, and dimensional change. The test methods complied with ASTM and AATCC procedures. The research objectives for this study were as follows:

1. To identify and compare the product specifications of jeans at three price categories.
2. To measure and compare the appearance and performance characteristics of jeans at three price categories before home laundering.
3. To measure and compare the appearance and performance characteristics of jeans at three price categories after home laundering.
4. To compare the appearance and performance characteristics of jeans at three price categories with ASTM Standard Specifications for 100% Cotton Denim Fabric.

Research Questions

1. Is there a difference between product specifications for jeans at three price categories?
    a. Is there a difference between the design specifications of jeans at three price categories?
    b. Is there a difference between the material specifications of jeans at three price categories?
    c. Is there a difference between the construction specifications of jeans at three price categories?
2. Is there a difference between design specifications, appearance and performance characteristics of jeans at three price categories before home laundering?

a. Is there a difference between the appearance characteristics of jeans at three price categories?
b. Is there a difference between the durability characteristics of jeans at three price categories?
c. Is there a difference between design specifications that determine fit of jeans at three price categories?

3. Is there a difference between the design specifications, appearance and performance characteristics of jeans at three price categories after home laundering?
    a. Is there a difference between the appearance characteristics of jeans at three price categories?
    b. Is there a difference between the durability characteristics of jeans at three price categories?
    c. Is there a difference between design specifications that determine fit of jeans at three price categories?
4. Do the appearance and performance characteristics of jeans at three price categories comply with the requirements of ASTM D6554 / D6554M - 14 Standard Specification for 100 % Cotton Denim Fabrics?

Justification

Psychological, demographical, and socio-cultural factors often influence consumers' purchasing decisions. More specifically, such determinants as age, gender, income, and ethnicity carry a weight in shaping consumers' expectations (Gagliano & Hathcote, 1994). In making the purchase decision, consumers also evaluate the various features of products based on their preferences (Dickson, Lennon, Montalto, Shen, & Zhang, 2004). The apparel products are classified under the three attributes of price, quality and value (Zeithaml, 1988). Consumers frequently use brand name or price when judging a product's quality. Brand name is among consumers' primary concerns influencing significantly the quality perception of products. Brands at higher price categories are presumed to have a superior quality compared to medium and lower-priced brands (Brucks, Zeithaml, & Naylor, 2000). According to the Cotton Incorporated Lifestyle Monitor™ Survey (2013), on average, men and women in the U.S. own about 6

and 7 pairs of denim jeans, respectively. Premium denim represents around 26% of the overall jeans market, and it is expected to become the fastest growing segment of the market (Technavio, 2015). Quality is one of the primary attributes referred to by consumers when purchasing higher-priced jeans (Bell, 2008). Therefore, it is necessary to evaluate the quality of jeans and determine whether the most expensive denim jean perform better with regard to specific standard physical quality attributes.

Quality is a popular topic in consumer research, marketing, retail management, and the press. How consumers perceive quality of a product and how their perceptions affect their purchasing behavior are critical issues to those involved in the design, production, and sale of garments (Jean Durliat Hines, Jakes, & O'Neal, 1990). Performance characteristics are the primary features of a garment including both aesthetics and functional attributes. Aesthetic characteristics are important for consumers because in addition to the general attractiveness of the design, style, and fit, jeans should also sustain their appearance and shape after laundering. The results of this research evaluated the relationship between product quality of jeans and price that were identified by evaluating the specifications, appearance, and performance characteristics of jeans. The results contributed to consumers' knowledge of the influence of brands on perceived quality, and it may affect their purchase decisions.

Limitations

Retailers and apparel manufacturers are concerned with producing products at the desired quality level and targeted price point. The quality of physical products can be described according to three different approaches: the product-based, manufacturer-based, and user-based approach. This study was only focused on evaluating the product-based quality which amounts to assessing the measurable characteristics of jeans. This research excluded the non-physical characteristics or the secondary quality indicators of jeans, including the elements of country of origin, price, reputation of the brand and retailer, and advertising (Bubonia, 2014, pp. 4-6). The second limitation of this study was the number of samples. The number of jeans used for the evaluation tests was restricted. Therefore, the results cannot be extended to all brands in this price category of jeans, and a greater sample size would better represent the relationship between the sample and population. Apparel products can be found in different price categories. Johnson and

More (2001, p. 70) classified apparel into the following groups: couture, designer, bridge, better and contemporary, moderate, and mass merchant. This study only used jeans from three price categories of better, moderate, and mass merchant (budget). The samples of this research were not collected randomly and they were selected by the nonprobability sampling selection approach. Nonprobability samples are less likely to be representative of the target population as the researcher purchased jeans from the official website of each brand.

Assumptions

In this study, it was assumed that the jeans in the sample were representative of all jeans at each price category. The appearance and performance characteristics of the jeans were measured after one and five wash cycles. For the purpose of this research, wash cycles represented the "use" amount of each pair of jeans.

Chapter Two

Review of Literature

The purpose of this study was to evaluate the specifications, appearance and performance characteristics of jeans at three price categories and to evaluate the relationship between price and product quality. This chapter provides an in-depth description of the concept of quality, evolution of quality, and methods of quality assurance. This chapter also reviews the textile and apparel industry as well as the dimensions of apparel quality. The history of denim fabric, denim jeans and the design of a pair of jeans were also addressed. Finally, the different textile analysis and the standard measurement of quality for apparel and textiles used in this study are discussed.

The Apparel Industry Overview

The apparel industry is relatively new because most of its development occurred in the 19th and 20th centuries. In the 1700s, spinning and weaving processes were mechanized in England. These developments exclusively belonged to England until 1789, when a British mechanic transported the new technology to the United States and created the first spinning mill (Burns & Bryant, 2002, p. 5). Before 1850, almost all apparel was custom and hand-made for specific individuals. The textile industry experienced growth in the late 18th century, after the exponential increase in demand for cheaper, ready-to-wear apparel (Burns & Bryant, 2002, pp. 2-5).

Ready-to-wear apparel is a term that is used to describe a wide range of merchandise that is mass produced (Brown & Rice, 2001, p. 1). The leading factors that contributed to the growth of ready-to-wear apparel were, firstly, the increase in middle-class demands. The second cause was the advent of sewing machines that could keep up with this demand while lowering production cost. The other factor was the establishment of size standards, patterns, and relatively easier production methods (Brown & Rice, 2001, p. 3; Glenn, 2006). The improvements in cutting, pressing, and sewing machines, the advances in textile technology caused by the Industrial Revolution, the arrival of immigrants with good sewing skills, and the rapid increase of department stores and specialty retailers fueled the expansion of mass-produced apparel. In the late 1800s, the ready-to-wear apparel industry was able to produce a wide range of apparel items, from work attire to formal wear (Brown & Rice, 2001, p. 3).

Move from Domestic to Global

The apparel industry's success was based on a low cost and mass-production strategy. The efficiency of the mass production system is based on the large amount of orders and requires longer production time. The inflexibility of this system forces retailers to select and order styles long before the start of each season (Doeringer & Crean, 2006). Moreover, in this system styles change slowly and factories cannot shift to another type of apparel without altering the design and layout of the factory (Bailey, 1993). This means that the availability of apparel items for customers is determined by designers and department stores.

It was in the late 1920s when consumers started to become the major controlling force in the apparel industry. So, designers and retailers began to listen to consumers by adding their desired features to the garments. These actual features are called intrinsic attributes and they include the texture and color of the fabric, care methods, width of a hem, and other characteristics which affect garments quality and aesthetic appeal (Shields, 2010). Eventually, changes in the apparel market forced retailers to adopt a more flexible production system. Consumers became more fashion oriented and desired more personalized styles, fit, and colors (S.-E. Lee & Chen, 1999).

In response to this demand, retailers needed new merchandise in a shorter amount of time. Companies began to move most of their domestic manufacturing sites to Asian countries where the production costs were cheaper (Bonacich, Cheng, & Chinchilla, 1994). Lower labor costs were a key economic factor that pushed western countries to move their facilities to China, Indonesia, Thailand, and other Asian countries (Wang, 2013). By the mid-1980s, the American system of mass production started to change to a more specialized product design system with a global supply chain and marketing structure. This enabled them to produce a greater variety of products with shorter life cycle (Doeringer & Crean, 2006). The new system which is described as "quick response", empowers firms to respond to the market's demand more quickly and it increases revenues by managing the supplier's inventory and creating a balance between supply and demand (Gereffi & Frederick, 2010).

Industry Today

Today, the textile and apparel industry is considered one of the most successful businesses around the globe. The American Apparel & Footwear Association (AAFA) reports show the latest business and trade information related to the United States' consumption, production, employment, imports, and retail prices. Based on their latest reports, "apparel and footwear contributed $354 billion to the U.S. economy in 2012 which was a bigger contribution than new cars, fast food, or practically any other industry" (American Apparel & Footwear Association, 2014). According to the AAFA (2014) , in 2012, the total value of apparel and footwear were $282.2 billion at retail, and 97.5 % of the products were made in other countries (AAFA, 2014). Recent statistics show that the average consumer's annual expenditure for apparel and related services in 2014 in the U.S. was $1,786 (United States Department of Labor, 2014). The apparel industry offers two major types of products; functional and innovative. The functional or core apparel products are consumed frequently and purchased regularly by people. They are not influenced by trends and are easier to forecast. The innovative apparel products are very fashionable and they have a shorter life cycle. Apparel companies have more problems with the innovative products because they are harder to forecast. A number of different strategies were employed by apparel companies in order to build the most efficient supply chain and tackle problem areas. An effective functional supply chain allows companies to maintain a competitive edge through supplying exceptional service to their customers and by reducing inventory loss (Church, 2007).

Quality

Quality is a multidimensional complex concept, and no single definition can reflect its various influences, concerns, and dimensions. Quality consists of all characteristics that describe an object or a service (Kadolph, 2007, p. 13). Quality is a tool for manufacturers, retailers, and marketers to differentiate their products from other competitors (Armstrong & Kotler, 2012, p. 7). According to the Cambridge Online Dictionary, quality can be defined as "the degree of excellence" that comports with consumers' values, needs, and perceptions (Stamper, Sharp, & Donnell, 1991, p. 312). Based on the International Organization for Standardization (ISO) 4802, quality is the "ensemble of properties and characteristics of a product or a service which confer on its

capacity to satisfy expressed or implicit requirements." Quality can also be defined as a set of product attributes or properties that make a product useable. Hence, "fitness for use" is another term that is widely used to describe the quality of a product regarding its success in fulfilling the user's purposes (J. M. Juran & Gryna, 1988, p. 29; Mehta, 1992, p. 4).

Quality is the main factor in a product that satisfies customers' expectations by either meeting or exceeding them. Quality is defined within a particular cost framework determined by manufacturers, buyers, and consumers. The meaning of quality varies among consumers and firms, and it may change from one period of time to another (Stamper et al., 1991, pp. 312-313). It is important to draw a distinction between the two categories of quality: theoretical and technical. Theoretical quality is the degree to which the products' designed characteristics or specifications satisfy the consumer's needs. Technical quality is the extent to which the values measured from the finished product align with the values that were determined during the design phase (Bona, 1994, pp. 13-14).

When creating quality products, a series of steps need to be followed. A product with a desirable level of quality is an outcome of combining inputs with a conversion process. The inputs in creating products are knowledge, expertise, experience, information, technology, tools, materials, supplies, and energy. For creating a quality product from inputs, two main strategies are employed. These strategies are classified as process-focused and product-focused. The process-focused includes issues concerning *how* the product is designed and manufactured, and the product-focused approach deals with *what* is designed and manufactured (Kolarik, 1995, p. 202).

Approaches used to define quality. According to Garvin (1984), five major approaches to define quality are the transcendent approach, the product-based approach, the user-based approach, the manufacturing-based approach, and the value-based approach. In the transcendent approach, quality is the degree of excellence that infers fine quality and makes a distinction from poor quality. The transcendent approach defines quality vaguely, and it is primarily focused on the aesthetic experiences. The multisensory foundation of the aesthetic experience consists of visuals in addition to kinesthetic, tactile, olfactory, and audible sensations (Fiore, Kimle, & Moreno, 1996).

According to the product-based approach, quality consists of a set of specific and measurable features or components of a finished product (Kadolph, 2007, p. 14). In this view, differences in the quality of products stem from the differences in the quantity of product attributes that can be evaluated objectively. Because quality reflects the quantity of attributes, higher quality can be achieved at higher costs (Garvin, 1984). Another definition of the product-based quality is the amount of unpriced features within each unit of priced features (Leffler, 1982).

The user-based approach defines quality from the consumers' perspective. As stated in this definition, users determine whether a product or a service has their anticipated level of expectations and quality (Kadolph, 2007, p. 14). The top quality goods or services are the ones that can satisfy consumers' needs and preferences more. According to Miller (1992), the user-based approach rests on customers' delineation of quality. This means that a technically and functionally perfect product will fail in the marketplace if it does not fulfill consumers' expectations. From marketers' perspectives, a quality product is the result of an ideal combination of the product features that offers maximal satisfaction to a particular segment of the market.

In the apparel and textiles industry, perceived quality and serviceability (care) are the dimensions that emerged from the user-based approach of quality (Eckman, Damhorst, & Kadolph, 1990). The relationship between the product and its features is determined either by its design or in the case of a non-manufactured product, by its nature (Lancaster, 1979). The critical problem with the user-based approach is the difficulty in identifying the varying preferences of users. Dissimilarities in reaction to the attributes of a product are the result of diverse preferences related to that product's features and not the different perceptions of the product attributes. The other issue is the equation of quality with the maximum satisfaction. This means that a consumer would prefer a specific brand because of its unique feature while considering other brands as being of higher quality (Garvin, 1984; Lancaster, 1979). From the manufacturers' perspective, quality is the degree of conformance to the predetermined characteristics and standards. In this definition, quality is achieved when the overall product attributes are consistently in an acceptable range. The manufacturers' based quality is an indicator of company's ability to produce goods with an even quality level that can be sold in the market at full

price (Kadolph, 2007, pp. 14-15). Manufacturing-based quality is attainable by implementing a set of engineering and production control techniques as well as using statistical methods for assuring that the product attributes are within the acceptable range. It is reasonable to remember that all of these activities are focused on cost reduction since preventing defects from happening have lower costs than repairing them. The critical issue in creating a quality product is to develop a consistent quality definition in the different stages of design and manufacturing. The inconsistency in defining quality may arise from confusing the concept of quality and grade (Garvin, 1984). Quality refers to satisfying needs, including those that relate to price while grade indicates the exclusion or inclusion of attributes to achieve a lower or higher cost (Freund, 1985). Finally, the value-based definition describes quality in terms of price and cost. Based on this approach, quality products perform at an acceptable price, and the quality level is discussed in relationship to price (Garvin, 1984). Therefore, consumers are willing to purchase a product that has the best quality for a given price (Mehta, 1992, p. 3; Takeuchi, 1983)

Traditional methods of quality assurance. The quality movement traces could be found in medieval Europe, where craftsmen were organized into unions called guilds. The workers that acquired abilities by performing a sequence of tasks were called craftsmen or artisans. The craftsmen had the skill to produce high quality products due to a number of reasons. First, they were trained at a young age and in return for the knowledge and skills learned during the training period, they served their masters for years. The craftsmen gained experience by observing and performing a group of tasks in numerous production cycles. Their strategy for identifying the quality problems was through examining self-made products, finding the root cause, and correcting the problems (Juran, 1995, p. 608). Until the start of the Industrial Revolution, guilds were the dominant craft and trade organization. The guilds were responsible for creating specific rules for product and service quality. They developed full specifications for raw materials, manufacturing processes, finished products, and inspection methods. In order to ensure that the craftsmen followed these regulations, they established audit procedures in which a special mark or seal was used to provide quality a guarantee for the finished products (Juran, 1995, p. 610; Quality).

Quality in the industrial era. With the expansion of regional trade, a host of suppliers, processors, and marketers emerged between producers and customers (Maguad, 2006). The Industrial Revolution began around the mid-1700s in Europe when the factory system was made possible by discovering a new source of mechanical power and the invention of power-driven machinery. It was a new era for the mass production and distribution which diminished the craft system gradually. With the emergence of the factory system, craftsmen became factory workers and their work transformed into specialized tasks (Fisher & Nair, 2009; Maguad, 2006).

Mass production with a drastic decrease in manufacturing costs was possible with the aid of the rapid advancement of technology. The cost advantage of mass production made products available and affordable for consumption by everyone. As a result, the demand increased radically, and in response, firms and inventors collaborated to re-engineer the production processes by providing a wide range of newly designed supporting tools and equipment to simplify each task down to a shorter cycle time. In the factory system, workers were obligated to make a product like its sample. Hence, they hardly had an opportunity to receive feedback from the users of the products to improve their performance. In early 19th century, quality was not considered as a primary issue because first, people were satisfied by having affordable commodities that were scarce a century earlier, and second, workers were preoccupied with the unbearable working condition (Reilly, 1994, p. 3).

The factories during this period mainly relied on the inspection system, so they established a setting for the major changes in defining and accepting quality. The end-of-line inspection method was chiefly used to certify that the products shipped to customers had a reasonable level of quality (Fisher & Nair, 2009). Factories relied on the skill of workers followed by supervisory audits or by departmental inspectors for quality assurance. There were also full-time inspectors who reported the records to the particular production supervisor (Juran, 1995, pp. 622-625).

According to Juran (1995, p. 630), the major motives that led to a quality revolution were: the development of products with more complexity and precision, the establishment of quality regulations by government, the threats to the environment, the

emergence of the consumerism movement, and the intense competition in producing quality products. This intense global competition in quality was a result of a rapid growth in science and technology as well as the consolidation of quality concepts supported by various quality specialists (Maguad, 2006).

The statistical quality control era effectively began with Shewhart's pioneering work on variation, sampling, and his emphasis on the need for documentation (Lewis & Smith, 1994, p. 45). In 1924, Shewhart developed the control charts to better understand the issue of variation. The primary focus in this method is on the prevention of problems and process improvements instead of the costly defect corrections. His other valuable invention was the plan-do-check-act (PDCA) cycle, which is a repetitive process of study that is functional in experiments or system improvements (Rinehart, 1993 p43). Statistical Quality Control (SQC) is a method of using specific samples for inspection instead of examining all or a large amount of products. This method is based on the probability that the proportion of defects found in the sample is representing the proportion of defects in the total production lot. If the number of defects is more than the predetermined quality standards, then the origin of defects should be identified and corrected (Glock & Kunz, 2005, p. 2015).

Modern quality movement. The modern quality movement started after World War Ⅱ with the establishment of the International Organization for Standardization (ISO) in 1947 and the American Society for Quality Control (ASQC) in 1946 (Merrill, 2015). Today, quality is not limited to inspection, and it encompasses a wider range of factors. It took the work of experts including Juran, Deming, and Feigenbaum to transform the concept of quality from a simple technical system to a more complex concept known as total quality (Maguad, 2006).

Over the last decades, the United States' industrial sectors shifted towards "Total Quality Management (TQM)" systems in which instead of concentrating on inspection, quality is achieved by improving all processes and embracing the entire organization. TQM involves both cultural aspects and a set of guiding principles that represent the foundation of a continuously improving organization. Once implemented correctly, TQM can lead to doing the right task, on time and all the time (Mehta, 1992, p. 250).

After World War Ⅱ, a number of individuals went to Japan to assist Japanese leaders in reforming their industries. Japan rose to industrial supremacy primarily due to its dedication to quality and customer satisfaction. Initially developed by the Toyota Motor Company, the lean production concept is one of the outcomes of Japanese efforts in quality. The lean manufacturing system is focused on eliminating all waste in manufacturing processes. This production method is characterized by autonomation, just-in-time supplier delivery disciplines, rapid changeover times, high quality level, and continuous improvement (Rooney & Rooney, 2005). The other methodology developed by Motorola is Six Sigma. This business strategy is a statistical measure of production performance which reduces process variations that originate defects (Maguad, 2006; Rooney & Rooney, 2005).

Textile and Apparel Quality

The apparel products consist of physical attributes which are perceived differently by various consumers (North, De Vos, & Kotze, 2003). Manufacturers design the quality of products to meet or exceed the consumer's expectations. Quality is considered to be a significant factor in influencing consumers' purchase intentions, so companies are concerned whether the quality of apparel have the predetermined standards for fabrics, raw materials, and performance for the desired use (Chowdhary, 2002). Apparel companies are responsible for making decisions about manufacturing and product development and as a result, quality is regulated by them (Glock & Kunz, 2005).

In the product-based approach, quality is a measurable quantity of a variable or a characteristic of a product (Garvin, 1984). According to this definition, the quality level is dependent on the number of desired features the product possesses. In the manufacturing definition, quality is the result of a series of engineering and manufacturing processes and it is represented by the conformance to the predetermined requirements (Kadolph, 2007, p. 447). This definition is a suitable tool for measuring and controlling the production operations because it is an indication of how well the manufacturing process is conforming to its design specifications.

Quality is more than just a list of required physical specifications for consumers. The nonphysical quality aspects of garments such as color, stylishness, and aesthetics are

significantly important for consumers as well. Consequently, for meeting consumers' expectations of quality, retailers and manufacturers of apparel products are challenged to consider the abstract attributes of apparel in addition to its physical properties (Kincade, 2007, pp. 6-7).

Apparel companies have realized that along with the quality control department efforts, having high quality products depends on strong management and commitment of members in the system. The importance of quality in firms can be measured by the sacrifices that an organization will make to achieve quality. The maximum level of commitment to quality can be accomplished through constant training programs in the organization as well as having accurate evaluation and control systems (Gilbert, 1987).

The quality of apparel and textiles has been studied using experimental techniques (Heisey, 1990) and self-reports (Morganosky, 1990). Sometimes subjects are required to evaluate apparel quality based on a provided list of features (Wall & Heslop, 1989), and sometimes the experts in the textile industry judge garment quality (Morganosky, 1990). However, the most common method is asking subjects to rate the quality of apparel (Davis, 1985; Jean D. Hines & Swinker, 2001). To summarize, textile and apparel quality can be measured with three approaches: actual quality, attitude toward quality, and perceived quality (Lennon & Fairhurst, 1994). The actual quality of an apparel product cannot be determined by measuring one property because it is a combination of the results from different assessments in a variety of units (McCullough & Morris, 1980).

Dimensions of textile and apparel quality. Quality is a multidimensional concept consisting of eight major elements that can be divided into the following categories: performance, features, reliability, conformance, durability, serviceability, aesthetics, and perceived quality (Garvin, 1984). Bubonia (2014, p. 4) has narrowed these dimensions down to five elements of performance, durability, serviceability, conformance, and aesthetics. In another study (Rayman, Burns, & Nelson, 2011), apparel quality has also been categorized into the seven factors of performance, compliance, garment care, appearance, construction /workmanship, and style/fashion.

***Performance*.** Performance is a combination of product and user-based approaches of quality and emphasizes the measurable product characteristics (Kadolph,

2007, p. 19). Garment features are directly related to product performance, and they consist of the physical characteristics that support the performance of a garment including fibers, fabric finishes, yarns' structure, seam construction (Bubonia, 2014, pp. 4-5). From the product developer's perspective, and performance is one of the most important factors that determines the quality of a product, and it is often estimated by consumers after the purchase and based on their experience. In order to assess the quality of apparel and textiles, manufacturers use the ASTM International (American Society for Testing and Materials) methods for testing product performance (Keiser & Garner, 2012, p. 414).

Performance has two different qualitative components: expressive and instrumental performance. Expressive performance is associated with the psychological level of performance which is the consumers' response to a characteristic of an apparel item such as its style and design. Instrumental performance is related to the performance of the physical attributes of a product including its durability (Myers & Alpert, 1968).

Durability. Durability has both technical and economic dimensions. In the economic dimension, durability is the amount of use before a product breaks down and replacement is preferable due to the cost of repair (Garvin, 1984). Technically, for apparel products, durability is described as the length of use before it becomes physically deteriorated. In the user-based approach of quality, durability can be defined as the length of use of an apparel item before it becomes inappropriate for its original end use (Bubonia, 2014, p. 5; Kadolph, 2007, p. 21).

Serviceability. Serviceability is the capability, speed, and courtesy of repair (Garvin, 1984). Serviceability in textile products refers to their clean-ability and ease of care. Dimensional change, wrinkling, and soil-release can also be considered serviceability of garments (Kadolph, 2007, p. 21).

Conformance. The degree to which the performance and design of a product meets its predetermined standards is defined as conformance. In order to achieve the desired quality level, garments should conform to the product specifications which include garment and material components as well as design and assembly (Bubonia, 2014, p. 5). Conformance is also related to consumer-based approach of quality because

customers consider a product in conformance if it meets their expectations, requirements, and wants (Aloudat, 2006).

Aesthetics. Aesthetics, the user-based element of quality, is highly subjective and depends on personal preferences. Aesthetic relies on individuals' judgments about the garments' comfort, appearance, smell, and sound (Bubonia, 2014, p. 5). According to O'Neal (1998), aesthetics is the study of human response to the non-instrumental qualities of an item or incidence. This dimension of quality refers to the aesthetic experience that an apparel can generate, whether on a sensory (e.g. fabric's color is pleasant to the wearer), emotional (reminding consumer of a specific memory), or cognitive level (a certain symbolic meaning for the wearer) (Geršak, 2002). Aesthetic provides sensual harmony through visual consistency and tangible comfort elements. The combination of structural integrity and aesthetic presence increases that value of a garment. This value signifies the garment's distinction, usefulness, and equivalent worth in the marketplace (Scheller & Kunz, 1998).

A relationship has been identified between aesthetics and the way that consumers dress to be respected by themselves and also by others. This backs up the assumption that aesthetics may play a significant part during the decision-making process in a way that it could surpass the other factors that also have a role in evaluation of apparel quality (DeLong, 1998, p. 3).

To summarize, quality, which has been described in a variety of ways in the literature, can be classified into two perspectives: the marketer's approach, which is the product-based or manufacturing based definition of quality, and the consumer's approach which is typically the user-based or value-based description of quality (Garvin, 1984; Holbrook & Corfman, 1985).

Perceived Quality

Consumer's appraisal of a product's superiority or excellence is described as perceived quality (Zeithaml, 1988). Due to the lack of information, consumer's assessment is often based on indirect attributes of products, including image, brand name, and advertising (Garvin, 1984). Consumers' perception of product quality is influenced by both intrinsic and extrinsic cues. Intrinsic cues are the physical characteristics of a

product including fabric, color, and finish. These attributes cannot be manipulated without physically changing the product. Extrinsic cues are the non-physical attributes of products including brand name, country of origin, and store image (Olson & Jacoby, 1972). Another study on female shoppers suggests that consumers' evaluations of quality involve aesthetical behavioral qualities as well as functional behavioral qualities. Two sensory dimensions of sight and touch influence a consumer's assessment of quality in a way that a consumer will disregard other attributes of apparel if she is dissatisfied with the color and texture (De Klerk & Lubbe, 2008). Compared to other apparel categories, the quality of denim jeans is mainly evaluated based on extrinsic attributes (Romeo, 2009).

Perceived quality and brand. Consumers often have a specific attitude towards brands that depends on their level of satisfaction and the brands perceived quality (Keller, 2003, p. 117). Researchers have categorized brand-related associations to cognitive and affective (Dubé, Cervellon, & Jingyuan, 2003) or attribute and non-attribute (Srinivasan, Park, & Chang, 2005). The functional traits including quality and performance are the cognitive brand-related beliefs whereas the affective associations such as the brands image reflect the subjective and emotional aspects of the brand (Homer, 2006). A consumer's appraisal of a brand usually initiates with trustworthiness and quality perception that can result in brand consideration as well as recognition of brand superiority (Keller, 2003, p. 127). The level of consumer's familiarity with a brand has a positive effect on perceived quality (Mieres, Martín, & Gutiérrez, 2006). According to Romeo (2009), compared to other apparel categories, the quality of denim jeans is often evaluated based on its brand. Consumers, moreover, tend to associate brand names and designer logos with higher quality denim jeans (Wade, 2011).

Perceived quality and price. Apparel products are offered at different price points in the market. These price points are classified as mass merchant, moderate, better, bridge, and designer (Bubonia, 2014, p. 7). Although several studies on consumer behavior show that the extrinsic cue of price is frequently used as a determinant of quality (Darke & Chung, 2005; Swinker & Hines, 2006; Zeithaml, 1988), respondents strongly disagreed with this statement: "higher-priced garments are higher in quality than lower-priced garments" (Swinker & Hines, 2006). This indicates that price influences

consumers' perceptions of the quality, and users believe that price does not affect the physical quality of garments(Swinker & Hines, 2006). The consumers' perception of quality is also influenced by pricing and promotions. According to Darke and Chung (2005), discounts and sales promotions have negative quality implications and undermine the perception of product value for consumers.

Manufacturers Quality

Quality is a major concern of apparel companies, as they aspire to remain competitive by providing higher quality products based on the needs of the consumer. Apparel quality can be measured from an industry perspective which is more focused on measurable physical characteristics (Abraham, 1992). In apparel manufacturing, quality is associated with the physical attributes of design, material, construction, and finishing. Apparel quality is also related to functionality, utility, and durability. Utility is the products' usefulness and can be measured by comfort, fit and, care requirements. Throughout the production process, garment standards are used as a tool to measure the quality of a product. Many organizations around the world develop standards worldwide such as ISO (International Organization of Standardization), ASTM (American Society of Testing and Materials), and AATCC (American Association of Textile Chemists and Colorists) (Keiser & Garner, 2012, pp. 412-415).

Measurements of Quality

Measurements of quality are used in the global market are categorized into five groups of standards, specifications, regulations, test methods, and certifications (Roberts, 1998). Standards are the documents created within the agreement of national and international organizations and used for measuring quality. Standards are developed to "describe characteristics of a product in a precise and consistent fashion and they also help describe a minimum level of safety" (Kadolph, 2007, p. 48). Specifications are defined as "the criteria that make up a standard"(Roberts, 1998, p. 70). The garment and fabric attributes that should comply with standards are designated by specification requirements (Bubonia, 2014, p. 286). The mandatory standards developed by governments are regulations (Roberts, 1998). The safety regulations for garments are often classified into flammability, drawstrings, small parts, and lead content (Keiser & Garner, 2012, p. 421). Test methods are in depth procedures used for measuring and

evaluating textile materials, and garment characteristics. Test methods for assessing quality are categorized into evaluating materials, durability evaluation, comfort, safety, and appearance.

Overview of the Quality of Garments

In order to certify that the established standards and specifications are being met, the quality of garments is measured during the development and manufacturing steps. Consumer satisfaction and perceived quality are influenced by garment appearance and performance. The elements of quality that participate in the evaluation of apparel are performance, durability, serviceability, aesthetics, and conformance (Bubonia, 2014, pp. 273-274). The appearance quality of garments is related to the mechanical and physical properties of fabric being used as well as the quality and method of sewing during the manufacturing process (Geršak, 2002). Although the buyers and sellers are responsible for determining the performance characteristics of apparel before the production, various standards and recommendations for performance specification of fabrics and garments have been developed by the ASTM (Mehta, 1992, p. 71). Each standardized text method is used for measuring a performance attribute of apparel, and the results will help to identify the cause of a problem. Laboratory tests are also performed on garments after cleaning to evaluate the aesthetic appearance and determine if any modifications needs to be made during product development process(Bubonia, 2014, p. 274).

Dimensional stability. Any variation in width or length of a garment that is subjected to specific conditions is known as dimensional change. The length and width of a garment are measured before and after laundering using benchmarks drawn on selected areas to determine if apparel is able to retain its shape (AATCC, 2012).

Smoothness appearance. The appearance of garments, which is important to consumers, might change during use or after laundering. A prevalent issue that affects the appearance of textile materials is wrinkling. Therefore, it is necessary to assess the smoothness appearance of fabrics and seams to determine how the aesthetic look of a garment will change after laundering (AATCC, 2014; Bubonia, 2014, p. 276).

Color performance. Measuring the attributes that are important to consumers, including how permanent the color of a garment is, enables companies to ensure user

satisfaction (Kadolph, 2007, p. 234). The AATCC technical manual (2013a) defines colorfastness as "the resistance of a material to change in any of its color characteristics, to transfer of its colorant(s) to adjacent materials, or both, as a result of the exposure of the material to any environment that might be encountered during the processing, testing, storage or use of the material" (ASTM, 2013a, p. 21). The color of a fabric may be transferred to the surface of another adjacent material by rubbing or contact, and this change is measured through crocking tests. The colorfastness to home laundering test evaluates the changes in the color of a garment after specific laundering cycles. Color or stain of a garment may transfer to another garment during laundering and this is measured by utilizing multi-fiber fabrics in color transfer tests (Kadolph, 2007, p. 266).

Jeans

The global presence of denim jeans is a claim that can be simply proven by counting the people wearing jeans around you in any country. Jeans were considered a clothing phenomenon since they were expanding with the same pace that the world was expanding (Miller & Woodward, 2011). Representing an estimated $60 billion global market for retailers, denim jeans are considered a staple in consumers' wardrobes. According to the Cotton Inc. Lifestyle Monitor™ survey (Salfino, 2013) , denim sales for men and women were nearly $14.3 billion in 2012. Americas' myth pants are believed to be strong, informal, comfortable, classic, hardworking, and reliable (Little, 2007).

History of denim jeans. It all started when Levi Strauss made the initial pairs of "waist overalls" in California in 1873. He established a company named J. Strauss Brother & Co, which he later renamed to Levi Strauss & Co, and he traveled to California at the time of the gold rush, not to search for gold, but to sell supplies such as apparel, fabric, needles, underwear, etc. (Paul & Pardeshi, 2003, p. 12). During that time, he came up with an idea of making a pair of pants that could tolerate the rigors of gold mining. These sturdy, functional pants that were made out of a 100% cotton fabric, named denim, had pockets that could hold the mining tools perfectly (Little, 2007, p. 11). Denim has been produced from cotton in America since the 1700s, but the word "denim" came from a French woven fabric. This fabric was initially made in Nimes, France and it was called *serge de Nimes*. After exporting the fabric to England, *serge de Nimes* was shortened to *deNimes* or as we call it today, denim. The origin of the word "jean" goes back to a

garment that was worn by sailors. This garment was made in Genoa, Italy, and is pronounced "Genes" in the Italian language (Kyi, 2005, pp. 22-23). The classic denim fabric that is used today was originally manufactured in England in the 1600s and brought to the United States due to the established trade relations with England. Denim is a twill fabric, made exclusively from cotton fiber, woven with one colored thread and one white thread. Because of its durable structure, it was typically used as a work-wear apparel (Robbins, 2006, p. 30).

In 1872, after receiving a letter from Jacob Davis, who was a tailor that had a great idea about improving the strength of the jeans, Levi Strauss decided to cooperate with Davis to patent the new idea and expand his business (Paul & Pardeshi, 2003, p. 14). The new patent was for increasing the strength of the pockets by applying copper rivets to the stress points of work pants. The initial "waist overalls" that were made out of heavy blue denim fabric had only one back pocket with two rivets, a watch pocket, suspender buttons, and a rivet in the crotch part (Robbins, 2006, p. 40). Strauss also sewed the "Two Horse Brand" leather patch, which is considered America's first apparel trademark, into the back hip pocket (Keller, 2003, p. 140). By the 1920s, Levi's jeans and overalls were so popular that they started to become a part of American and western culture. The jeans craze continued and surpassed from work-wear apparel to a popular piece of clothing among young people and university students in the 1950s and 1960s. Jeans started to be made in different styles and in countries with low labor costs, making them cheaper and more accessible around the world. With this huge popularity, designers started to offer high-end jeans with their own labels and today, jeans are offered in different styles and colors (Paul & Pardeshi, 2003, p. 16).

Denim fabric. Denim fabric is used to manufacture different types of apparel for people of all genders, classes, and ages. Denim is a durable warp faced twill fabric, woven with indigo-dyed warp and white filling yarns. Denim is usually manufactured from cotton or a blend of cotton with Lycra, polyester, lyocell, wool, flax, hem, etc. Indigo is widely used in denim dying and gives the blue color to the fabric, and its low colorfastness characteristics are considered an advantage for achieving the desired look and design. Currently, natural indigo is replaced by synthetic indigo, a more sustainable type of dye. Other types of dye used in denim manufacturing are non-indigo dyes such as

Sulphur dyes. The non-indigo dyes are more efficient and are a better ecological alternative to indigo dyes (Paul, 2015, pp. 1-3).

Design and style. The initial pair of jeans, known as waist overalls, had only one back pocket and was a little baggy. There was a buckle at the back of the waistline and they had suspender buttons instead of belt loops. Levi Strauss jeans had a curved, wing-shaped, orange stitching on the back pocket named Arcuate Design. In 1873, after Levi Strauss agreed to help Jacob Davis with his patent, copper rivets were used for strengthening the waist overall pants. Later, due to the increase of the popularity of jeans, the company gave certain numbers to their different designs and the initial number that was assigned to the original style was 501. As a way of advertising their brand, they stitched a leather label, with a picture of a pair of jeans between two draft horses, to the back of the waistband (Kyi, 2005, pp. 22-23). It was around 1901 when they inserted the second back pocket, and belt loops were added late in 1922 in addition to the suspender buttons (Robbins, 2006, pp. 41-42).

Jeans have transferred from work wear apparel to a ready-to-wear apparel item. Currently, a classic pair of jeans has five pockets, belt loops, zip fly, back yoke, and rivets. The suspender buttons have been removed from today's jeans. Jeans are offered in a variety of designs and fits. Jeans can have straight, boot cut, or skinny fit. Depending on each year's trends, jeans are offered with a low or high rise and different types of back yoke. Today, due to the technological developments, designers have more freedom to produce creative compositions (Paul, 2015, p. 308).

Summary

Function and aesthetics are two important attributes that influence a consumer's selection of a product (Rahman, Jiang, & Liu, 2010). These two attributes are influenced by internal or intrinsic features of a garment as well as the external or extrinsic attributes including the country of origin, brand, retail price, and advertising (Bubonia, 2014, pp. 6-7). The physical or internal features of apparel products that are related to apparel quality are design, construction, material, and finishing. These physical attributes are associated with the products' performance and appearance characteristics (Keiser & Garner, 2012, p. 414).

Fabric, stitch type, seam type, color, and style are the four primary attributes often used to evaluate the quality of jeans. The price of jeans is an indicator of their quality which is associated with durability and stability of these attributes (Rahman, 2012). Although price has an influence on the perceived quality of a product, it does not essentially reflect quality. Related literature supports the idea that the two dimensions of the quality, performance and appearance (aesthetics), should be measured through standard laboratory testing. This background of literature justifies the need for research for determining the relationship between price and the quality of denim jeans.

Chapter Three

Methodology

The research was designed as a quasi-experimental laboratory study. The purpose of this study was to evaluate the specifications, appearance and performance characteristics of jeans at three price categories and to evaluate the relationship between price and product quality. In this research, the product specifications of jeans were identified. Next, the appearance and performance characteristics of jeans were examined initially and after one and five repeated laundering cycles. The data was analyzed within and between each price category. The research design and statistical analyses are presented in this chapter.

Research Design

The data obtained in this research was quantitative through the use of a quasi-experimental research design. The independent variables in this research were jeans at each price category. The dependent variables were color difference, colorfastness to dry and wet crocking, smoothness retention, fabric breaking strength, seam strength, and dimensional change. Other dependent variables were the material specifications of jeans including fabric count, fabric weight, and yarn number.

Samples

The sample for this study included nine pairs of men's jeans; which consist of three new pairs of jeans from the three price categories of better, moderate, and mass merchant (budget). Jeans at better price category are priced under contemporary designer and bridge price categories. The Lucky 363 New Vintage Straight style jeans were evaluated as a better price category. Moderate products appeals to price conscious consumers are priced below the better category. For the moderate price category, the Original 1969 standard fit jeans were obtained from Gap's official website. Mass merchant apparel is offered at low and affordable price. The lowest pricing level in this category is labelled as budget. Faded Glory men's original fit jeans, Walmart's own brand of apparel, were tested as jeans in the mass merchant (budget) price category. Since all jeans were obtained online from each brand's official website, jeans in this study were considered a convenience sample that was not selected randomly. The characteristics of the fabric are influenced by the fiber content and finishes applied to the garment so this

study evaluated 100% cotton jeans with nearly similar fits, aesthetic features, and color (Bubonia, 2014, p. 50). The samples were conditioned for a minimum of 24 hours at 70° ± 2° Fahrenheit and at a relative humidity (RH) of 65% ± 2% according to the ASTM D1776 Standard Practice for Conditioning and Testing Textiles (ASTM, 2008).

Procedures

In the initial phase of this study, the design, material, and construction specification of all jeans were visually evaluated and recorded. The design, style, and fit of jeans were identified and compared. The physical properties of fabric are influenced by its weight, yarn twist and yarn number, and its construction (Kadolph, 2007). Moreover, the quality of seams in garments is affected by fabric physical traits such as weight, strength, finish, and fiber type and blend (Choudhary & Goel, 2013). Currently, the most common raw denim used in the market for producing denim jean and apparel is the mid-weight denim (Connor, 2013). The material specifications of jeans were analyzed through evaluating the fabric weight, fabric count, yarn twist, and yarn number and inspecting the overall denim fabric quality. The construction specifications of jeans such as seam type and stich type were inspected for further comparison. In the next phase, this research employed laboratory testing according to ASTM and AATCC test methods. Initially, the appearance and performance characteristics of jeans were measured. Then, all three samples from each price category were washed under the same conditions. The characteristics of jeans that were likely to be changed after washing including color difference, colorfastness to dry and wet crocking, smoothness retention, fabric breaking strength, seam strength, and dimensional change, were evaluated after one and five laundering cycles. The pre-wash and post-wash results were compared within and between jeans at each price category to determine the relationship between the performance quality and the price. Moreover, the results were compared to the requirements in the ASTM Standard Specification for 100% Cotton Denim Fabric. Color difference, colorfastness to crocking, smoothness retention, fabric breaking strength, and seam strength tests were performed in order to determine and compare the appearance and performance elements of quality.

Fabric weight. ASTM D3776/D3776M-09a (2013), *Standard Test Methods for Mass per Unit Area (Weight) of Fabric* was used for measuring the weight of denim fabric. Three 5.94 in^2 swatches of fabric were randomly cut from various locations of each sample, using the Universal Sample Cutter, available in the Textile Testing Laboratory. Then, the specimens were weighed on the Analytical Balance and the mass per unit areas were calculated and reported in ounces per square yard. Fabric weight testing was completed initially and after one and five wash cycles.

Fabric count. According to the ASTM D3775-12, *Standard Test Method for Warp (End) and Filling (Pick) Count of Woven Fabrics*, the number of warp and filling yarns per unit distance in three randomly selected parts of the sample were measured using a linen tester and a pointer. The fabric counts were calculated by averaging all of the individual counts for both warp and filling direction. The results were recorded by stating the warp count first followed by the fill count (ASTM, 2012). Fabric count was performed before wash and then after one and five repeated laundering cycles.

Fabric weave. Denim is a woven twill fabric, made from all cotton or cotton and synthetic fiber blends and in a variety of yarn numbers (ASTM, 2013b). Prior to washing, the basic characteristics of twill weave of each sample including the direction of the diagonal lines and pattern of warp and filling threads were visually identified and recorded.

Yarn number. Six yarns parallel to the warp and filling direction in specimen length of 7 in. were cut from each sample and the yarn number was determined in accordance with ASTM D1059-01, *Standard Test Method for Yarn Number Based on Short-Length Specimens.* All calculations were based on the indirect yarn numbering system, a system that states yarn number as the equal linear density, and were reported in yards per pound (ASTM, 2014a).

Color difference. The color difference of garments before and after one and five wash cycles were visually measured according to the AATCC Evaluation Procedure 9-2011, *Visual assessment of Color Difference of Textiles.* From each price category, three washed samples were placed adjacent to the unwashed specimen in the same direction. Samples were evaluated using a Spectra Light QC apparatus and under D_{65} illuminant.

The pre-wash and post-wash color difference magnitudes were determined and recorded according to the AATCC Gray Scale for Color Change with the rating scale of one through five with grade one indicating severe color change. Final results were reported by averaging the grades given to each specimen.

Colorfastness to crocking. The wet and dry crocking tests were performed based on the AATCC Test Method 8-2013, *Colorfastness to Crocking: Crockmeter Method*. Three random places on each sample were evaluated for each wet and dry crocking. In the dry crocking test, the specimens and 5 cm × 5 cm white crock cloth squares were placed on a SDL Atlas electronic crock meter apparatus. Then, the automatic crock meter was set to run for 10 complete cycles. The crock cloth squares were removed, conditioned, and evaluated using the AATCC Gray Scale for Staining. In the wet crocking process, distilled water was applied to each crock square cloth. The automatic crock meter ran for 10 cycles and the crock square cloth was removed, air dried, conditioned, and evaluated based on the AATCC Gray Scale for Staining. Wet and dry colorfastness to crocking tests were performed initially and then after one and five wash cycles.

Smoothness retention. The smoothness appearance of jeans was evaluated following the AATCC Test Method 143-2011, *Appearance of Apparel and Other Textile End Products after Repeated Home Laundering*. Three jeans of each brand of Lucky, Gap, and Faded Glory were washed and dried according to the specific instructions on their care labels. Samples were conditioned after one and five wash cycles for 24 hours and then they were mounted on an AATCC verified viewing board. For measuring the smoothness appearance, the fabric length was set up in a vertical direction. Jeans were assessed by one observer standing in front of the specimens within 1.2 ± 0.3 m distance, under the fluorescent light. The samples were evaluated using the AATCC Three-Dimensional Smoothness Appearance Replicas. The numerical grades between one and five were assigned to each garment with five representing the smoothest appearance. The results were reported by averaging the grades given to each specimen by the observer.

Fabric breaking strength. A total of six specimens from each sample of each price category were assessed for breaking strength both before and after one and five

home laundering cycles following the ASTM D 5034-11, *Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test).* The standard suggests cutting five specimens in the warp direction and eight specimens in the filling direction, but due to lack of space, only three specimens in the warp and three specimens in the filling direction were taken from each sample. The size of specimens was 7 in. × 4 in. with their long dimensions parallel either to the warp or filling direction. Specimens were cut from various locations of the sample and were tested using a 400 lb load cell on an Instron® 33R4465A tensile testing machine located in the University of Kentucky Textile Testing Lab. For each pair of jeans, the data of both directions was recorded and the results were stated as the average of warp, fill, and the overall average in pounds of force (lbf) (ASTM, 2008). The fabric breaking strength test was completed initially and after one and five wash cycles.

Seam strength. The strength of inseams and sideseams of jeans were measured using the ASTM D 1683-11a, *Standard Test Method for Failure in Sewn Seams of Woven Apparel Fabrics*. Although it was recommended to remove five specimens from each sample's seam, due to lack of space, only two specimens were cut from the inseam and side seam of each pair of jean. The size of specimens were 7 in. × 4 in. and the seam was centered and perpendicular to the long side of the specimens (7 in.). An Instron® 33R4465A tensile testing machine located in the University of Kentucky Textile Testing Lab with a 400 lb load cell was used for measuring the seam breaking strength. The specimens were clamped into the Instron ® and the process was terminated when the seam broke. The seam strength results were recorded in lbf (pounds of force) and the type of rupture was documented. The seam rupture could be caused by fabric failure, sewing thread failure, sewn seam yarn slippage, or a combination of these factors. The seam breaking strength was measured initially and after one and five home laundering cycles. For each sample, the results were averaged based on seam type and compared to the ASTM D6554 / D6554M – 14, *Standard Specification for 100 % Cotton Denim Fabrics* as well as the performance of specimens in other price categories.

Dimensional change. Dimensional changes of jeans were evaluated after one and five wash and dry cycles according to the AATCC Test Method 150-2012, *Dimensional Changes of Garments after Home Laundering*. Using the guide table for benchmark

locations in this test method, the front rise, back rise, in seam, out seam, hip, thigh, and waistband and leg opening circumferences were evaluated and marked as measuring point locations. Then, the distance between marked areas was measured and recorded initially and after one and five wash cycles. Samples were washed and dried following the specific information on their care and maintenance label and were conditioned for 24 hours prior to measuring. The dimensional change was calculated using the following formula:

$$\%DC = 100\ (B-A)/A$$

Where:

DC = Percentage of dimensional change

A = Original dimension

B = Dimension after laundering

Laundering conditions. All the samples in this research were laundered according to information provided on their attached care label. The apparatus used for washing the samples was a General Electric high efficiency top-loading washing machine. The washer was set on a cold regular cycle, with hot water temperature of 130 °F and cold water temperature of 60°F and cold rinse. Each set of jeans was washed separately with 69.20 g of a widely used brand of commercial laundry detergent. The amount of detergent was determined using the recommended dose based on specific load weight. Samples were dried with a General Electric tumble dryer set on normal low cycle.

Data Analysis

Data from the fabric count, fabric weight, yarn number, color difference, colorfastness to crocking, smoothness retention, fabric breaking strength, and seam strength were analyzed using the Statistical Package for Social Science (SPSS). Descriptive statistics including means, standard deviation, and percentages were calculated and presented. Analysis of Variance (ANOVA) and independent sample t-test were used for identifying any significant differences in color difference, colorfastness to crocking, smoothness retention, breaking strength, seam strength, and dimensional change among jeans at each price category.

Chapter Four

Results

The purpose of this study was to evaluate the specifications, appearance and performance characteristics of jeans at three price categories and to evaluate the relationship between price and product quality. In this research, three pairs of men's jeans from each price category of better, moderate, and mass merchant (budget) were evaluated. First, the jeans were inspected to evaluate the design, material, and construction specifications. Next, the initial the performance and appearance characteristics of the jeans were evaluated and after one and five home laundering cycles. The performance and appearance characteristics were breaking strength, seam strength, dimensional change, color fading, smoothness retention, and colorfastness to wet and dry crocking. All testing was performed in accordance with standard AATCC and ASTM standard test methods and was conducted under controlled laboratory settings. The collected data was examined and presented using descriptive statistics and one-way ANOVA with the Statistical Package for Social Science (SPSS) program.

Design Specifications

Technical design specifications enable the designers to clearly communicate with the factory about the design and constructional details of a garment (J. Lee & Steen, 2015, p. 35). Design features, style details, color pallets, fabric, and fit are also specified based on line concept, cost, and production limitation (Bubonia, 2014, pp. 24-25). In this section, the design specifications of jeans including the style summary, preliminary product profile, silhouette, style of the component part, and color were discussed to provide a general knowledge of the technical design specifications of the jeans.

Style summary. Drawings or pictures of the front and back of the style along with the general description of the garment, size range, color, and basic fabric information were provided in the style summary. The style summary of Lucky, Gap, and Faded Glory garments are presented in Table 4.1, Table 4.2, and Table 4.3, respectively.

Table 4.1

*Style Summary, Lucky Jeans**

Description: Five Pocket Jeans Item Category: Jeans Brand: Lucky Fabric Category: Woven- Italian Denim Fiber Content: 100% Cotton Color: IOLITE Finish: None	Style: 363 New Vintage Straight Size: 36W, 34L Fit: Straight Country of Origin: Imported-Haiti Season: All seasons Item #: 7M12083

Figure 4.1. Front and Back Photo of 363 New Vintage Lucky Jeans

Description: An easy fit designed for all builds, with a 17.25 inch refined straight leg opening. Mid-rise (9 inch front rise and 13.5 inch back rise).

Care Instruction:

Machine wash cold; Wash separately; Non-Chlorine bleach; Tumble dry low; Cool iron; Do not dry clean.

*Http://www.luckybrand.com/363-new-vintage-straight/7M12083.html?dwvar_7M12083_color=410&cgid=m-jeans-shop-by-fit-relaxed-fit, Copyright 2016 by Lucky Brand LLC.

Table 4.2

*Style Summary, Gap Jeans**

Description: Standard fit jeans, five pocket styling Item Category: Jeans Brand: Gap Fabric Category: Woven- Premium denim without stretch Fiber Content: 100% Cotton Color: Resin Rinse Finish: Resin Rinse	Style: Original 1969 Standard Fit Jeans Size: 36W, 34L Style Component: Button closure, zip fly Fit: Standard, Straight through the leg and thigh Country of Origin: Imported- Bangladesh Season: All Seasons Item #: 737512

Figure 4.2. Front and Back Photo of the Original 1969 Standard Fit Gap Jeans

Description: Straight, with a bit of room to move.
Cut: Sits just below the waist.
Care Instruction: Machine Wash

*Http://www.gap.com/browse/product/product.do?pid=7375
&vid= 1&locale =1&sem =false&sdkw=original-1969-standard-fit-jeans P737512&sd
https%3A%2F%2Fwww.google.com%2F, Copyright 1997-2016 by Gap Inc.

Table 4.3

*Style Summary, Faded Glory Jeans**

Description: Original fit jeans Item Category: Jeans Brand: Faded Glory Fabric Category: Woven-Denim Fiber Content: 100% Cotton Color: DKTINIT Finish: None	Style: Men's Original Fit Jeans Size: 36W, 34L Style Component: Belt Loops, Button, zip fly Fit: Original fit Country of Origin: Imported- Mexico Season: All Seasons Item #: 315FG

Figure 4.3. Front Photo of the Men's Original Fit Faded Glory Jeans

Description: "Update your wardrobe with style and comfort when you wear Faded Glory Men's Jeans. These are stylish pants made from cotton fabric. They ensure complete comfort. They feature five pockets to provide enough room to hold all your essentials. These original fit jeans have belt loops. They are durable. They have a single-button closure with zipper fly for comfort and easy on and off. These are the cotton jeans men love to wear for casual nights out with the guys. They are easy to clean and are also available in men's big sizes. Wear them around the house when you are just lounging and watching television or reading a book. Alternately, you can head out with friends to a sporting event or the golf course for a relaxing afternoon." (http://www.walmart.com/)

Care Instruction: Machine Wash Cold

*Http://www.walmart.com/ip/Faded-Glory-Men-s-Original-Fit-Jeans/11037730,

Based on the online presentation, the 363 New Vintage Straight Lucky jeans were described as “An easy fit designed for all builds, with a 17.25 inch refined straight leg opening” (LuckyBrand, 2016). Another detail that was mentioned on Lucky’s website was the rise of jeans which was stated as “Mid-rise (9 inch front rise and 13.5 inch back rise)” (LuckyBrand, 2016). The color of this imported apparel was labeled as IOLITE, and it is manufactured from 100% cotton Italian denim. Although different wet and dry processes are usually applied to the garment for achieving the desired appearance, the name or type of specific finish was not found in the online presentation of the 363 New Vintage Straight Lucky jeans.

Gap jeans were merchandised as the Original 1969 standard fit jeans and is depicted as “Straight, with a bit of room to move.” (Gap, 2016). These jeans were fabricated with 100% cotton, premium denim and are without stretch. The online presentation labelled the color and finish of the Gap Original 1969 standard fit as resin rinse. This five pocket style garment is “straight through the leg and thigh” , “sits just below the waist”, and features button closure with a zip fly (Gap, 2016). These jeans are imported and the fabric and care information on Gap’s website is summarized as machine wash.

Faded Glory is Walmart’s primary apparel brand, and the online presentation described this item as “Men's Original Fit Jeans” (Walmart, 2016). Faded Glory jeans were imported and have belt loops, five pockets, and a single-button closure with zipper fly. The color of these 100% cotton jeans were labeled as DKTINT, and the fabric and care instruction were summarized as “Machine wash cold” (Walmart, 2016).

Preliminary product profile. The preliminary product profile has a brief description of the product along with the garment material information and also provided the original retail price of the garment as well as the paid price. Finally, the garment’s care and maintenance instructions were addressed based on the attached care label. The preliminary product profiles of Lucky, Gap, and Faded Glory jeans are listed in Table 4.4, Table 4.5, and Table 4.6, respectively.

Table 4.4

Preliminary Product Profile, Lucky Jeans

Product Information
Brand Name/Manufacturer: Lucky
Source: Lucky Brand Website, http://www.luckybrand.com/
Price:
Paid: $90.3
Original: $129
Size Purchased:
Waist: 36
Length: 34
Country of Origin: Haiti
Material Information
Fashion Fabric
Fiber Content: 100% Cotton
Fabric Name: Denim
Construction Type: Woven
Finish: None
Secondary Materials
Trims: Two rivets attached to the edge of both right and left hand pockets. Two rivets attached to the edge of the coin pocket. Patch label sewn to the waistline. A four-leaf clover sign is sewn to the yoke.
Closure: Copper color jean-tack button on the waistband. Zipper is used on the fly closure.
Thread: Corespun thread.
Care and Maintenance
Location of Care Instruction: Inside label attached to the edge of the waistband
Specific Label Information: Machine wash cold; Wash separately; Non-Chlorine bleach; Tumble dry low; Cool iron; Do not dry clean.

Figure 4.4. Care Label, Lucky Jeans

Table 4.5

Preliminary Product Profile, Gap Jeans

Product Information Brand Name/Manufacturer: Gap Source: Gap Website, http://www.gap.com/ Price: Paid: $42 Original: $ 69.95 Size Purchased: Waist: 36 Length: 34 Country of Origin: Bangladesh **Material Information** Fashion Fabric Fiber Content: 100% Cotton Fabric Name: Denim Construction Type: Woven Finish: Resin rinse Secondary Materials Trims: Two rivets attached to the edge of both right and left hand pockets. Two rivets attached to the edge of the coin pocket. Patch label sewn to the waistline. Closure: Silver color jean-tack button on the waistband. Zipper is used on the fly closure. Thread: Corespun thread **Care and Maintenance** Location of Care Instruction: Inside label attached to the edge of the side seam Specific Label Information: Machine Wash Cold; Wash and dry with like colors; Only non-chlorine bleach when needed; Tumble dry low; Warm iron; Do not iron print; Do not dry clean.

Figure 4.5. Care Label, Gap Brand Jeans

Table 4.6

Preliminary Product Profile, Faded Glory Jeans

Product Information Brand Name/Manufacturer: Faded Glory Source: Walmart Website, http://www.Walmart.com/ Price: $9.96 Size Purchased: Waist: 36 Length: 34 Country of Origin: Mexico **Material Information** Fashion Fabric Fiber Content: 100% Cotton Fabric Name: Denim Construction Type: Woven Finish: None Secondary Materials Trims: Two rivets attached to the edge of both right and left hand pockets. Two rivets attached to the edge of the coin pocket. Closure: Copper color jean-tack button on the waistband. Zipper is used on the fly closure. Thread: Corespun thread. **Care and Maintenance** Location of Care Instruction: Inside label attached to the edge of the waistband. Specific Label Information: Machine wash cold; With like colors; Do not bleach; Tumble dry low; Warm iron when needed.

Figure 4.6. Care Label, Faded Glory Jeans

Men's pants are sized by waist and inseam measurements. For this study, 36 inch waist and 34 inch inseam denim jeans were tested. The 363 New Vintage Lucky jeans were originally priced at $129 but they were purchased with a 30% discount at the price of $90.3. The woven fabric is 100% cotton Italian denim, but the product was manufactured in Haiti. A branding patch label and a four-leaf clover sign were sewn to the waistband and yoke of jeans, respectively. A Jean-tack was used as a fastening and two rivets were installed to each edge of the hand pockets and coin pocket. The inside care label was attached to the waistband and the information specifies that the garment should be machine washed separately with cold water, without any chlorine bleach, and should be dried with a tumble dryer at low temperature. These jeans should not be dry-cleaned and the care symbols instructed consumers to "cool iron" the item.

Gap jeans were manufactured in Bangladesh and were priced at $69.95 but were obtained with a 40% discount at the price of $42. In addition to the branding patch label sewn to the waistband of the jeans, two rivets were attached to each edge of the hand pockets and coin pocket. The Original 1969 Gap jeans should not be dry cleaned as well, and the care label recommended users to machine wash the garment with similar color items in cold water and use a non-chlorine bleach when needed. Additional information instructed consumers to use a tumble dryer at low temperature and iron jeans with medium heat. Faded Glory men's original fit jeans were imported from Mexico and were priced at $9.96. The number and position of the rivets were similar to Lucky and Gap jeans but unlike the other two brands, Faded Glory jeans did not have a branding patch label. Care labels specified to machine wash the jeans in cold water, with like color items, and without bleach. It is also recommended to dry the jeans with a tumble dryer at a low temperature and warm iron when needed.

Silhouette. Silhouette is defined as the outline or shape of a garment which excludes its design details (Keiser & Garner, 2012, p. 123; J. Lee & Steen, 2015, p. 93). All three pairs of jeans from Lucky, Gap, and Faded Glory were similar in style and silhouette. Figure 4.7 illustrates the front and back silhouette of jeans.

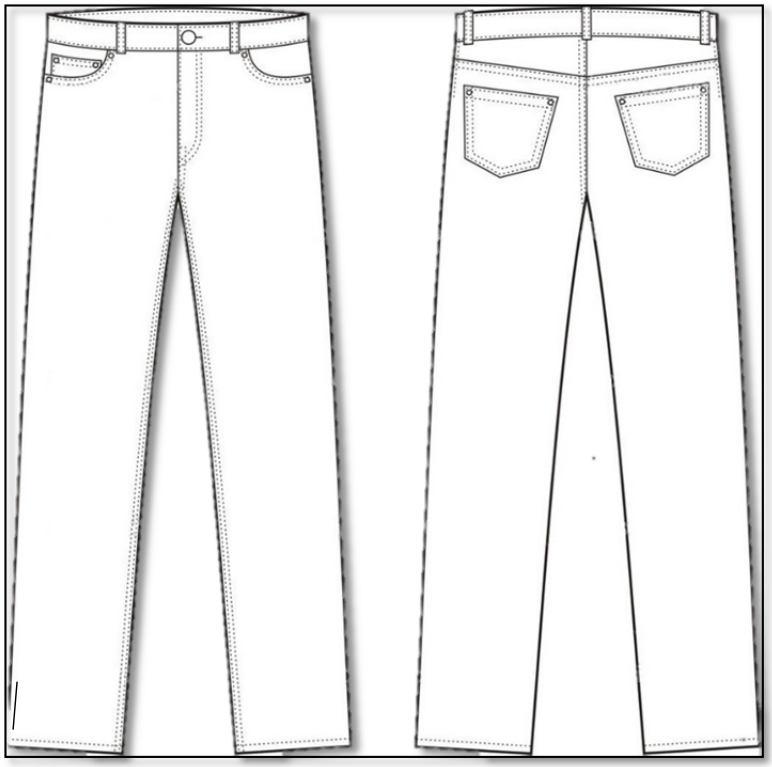


Figure 4.7. Front and Back Silhouette of Jeans

Style. The overall style of jeans and their component parts were described in this section. All samples in each brand category had straight fit through leg and thigh with jean-tack button closure on the waistband and a zip fly. The style name of Lucky jeans was 363 New Vintage Straight. On the official website of Lucky, these jeans were described as "An easy fit designed for all builds, with a 17.25 inch refined straight leg opening" (LuckyBrand, 2016). They had five pockets and five belt loops were attached to the waistband. The style name of Gap jeans was Original 1969 Standard Fit Jean. The seat sat below the waist and was straight through the leg, thigh, and leg opening, and had five pockets (Gap, 2016). On the Walmart website Faded Glory jeans were described as Men's Original Fit Jeans and they featured five pockets (Walmart, 2016). Below, the style of each component part is separately described.

Pockets. All jeans had three types of pockets including two hand pockets, two back pockets, and one coin pocket. The hand pockets were the seam-to-seam style. This style is durable and strong because the pocket begins in one seam (waistband) and ends in

another seam (side seam) (J. Lee & Steen, 2015, pp. 246-247). The edge of the pockets faced the pocket bags which were separately sewn to the inside edge. Hand pockets were secured with two metal rivets on each edge. The coin pocket and back pockets in all samples were simple patch pockets with a one ply of fabric similar to the main fabric of the jeans. The coin pocket was sewn above the right hand pocket and its opening was reinforced with two metal rivets.

Belt loops. Belt loops in the inspected jeans were made in long strap pieces using 2-needle bottom coverstitch and then cut to a specific length before being attached (J. Lee & Steen, 2015, p. 222). The Lucky jeans had two belt loops in the front and three in the back. The Gap jeans had two belt loops in the front and four in the back. Finally, a total of seven belt loops, two in the front and five in the back, had been sewn to the waistband of Faded Glory jeans.

Fly. Jeans usually have either a button fly or a zipper fly but the jeans evaluated for this research had a zipper fly.

Back yoke. Jeans had a V-shaped back yoke, the most widely used yoke style in denim jeans (Wilson, 2013).

Garment length and leg width. Lucky, Gap, and Faded Glory jeans were ankle length with straight legs. Straight cut pants are described as pants that have similar widths from the knee to leg opening (Calasibetta, Tortora, & Abling, 2003, p. 360).

Edge treatment. Functional topstitching was used around the pockets, waistband, hem of the leg opening, belt loops, and inseam. This type of topstitching helps to keep the edge treatments flat and holds different layers of jeans together.

Color. The Lucky website categorized the color of the 363 New Vintage Straight Lucky jeans as IOLITE. The color of Gap jeans was described by their finish which was resin rinse and the Walmart official website categorized the color of the Faded Glory jeans as DKTINT which could be the abbreviation of dark tint.

Size and fit specifications. Apparel manufacture ring companies are responsible for designing and producing products that fit the target customer. In this research, jeans with 36 in. waistband and 34 in. inseam measurements were tested. Table 4.7 shows the

standard body measurements for men with a waist size of 36 in. The standard garment measurements for men with a waist size of 36 in. are listed in Table 4.8. Table 4.9 summarizes ease allowances for men's loose fitting garments.

Table 4.7

*Standard Body Measurements**

Standard Body Measurement	Men Size W36 (in.)
Waist Width	36
Thigh Width	22.5
Knee Girth	15.62
Ankle Girth	11
Waist Height	45.39
Hip Height	38.25
Crotch Height	34.5
Crotch Length	31
Knee Height	21.5
Ankle Height	2.87

*The Apparel Design and Production Hand Book: A Technical Reference, Page 17, Copyright 2001 by The Fashiondex, Inc.

Table 4.8

*Standard Garment Measurements**

Standard Garment Measurement	Size W36 (in.)
Front Rise	10.75
Back Rise	14
Waist Circumference	36
Thigh	24
Hip	45
Leg Opening Circumference	17

* The Apparel Design and Production Hand Book: A Technical Reference, Page 137, Copyright 2001 by The Fashiondex, Inc.

Table 4.9

*Ease Allowance for Men's Sizing, Loose fitting garments**

Ease Allowance Points	Ease Allowance(in.)
Hip/Seat	4-6
Waistband	1-2
Thigh	4-5
Leg Opening	4-5

***** Complete Guide to Size Specification and Technical Design Myers McDevitt, Page 36, Copyright 2009 by Bloomsbury Academic.

***Garment Measurements of Lucky, Gap, and Faded Glory jeans*.** In each length and width directions, four measuring points were evaluated for assessing the jeans' measurements. Tables 4.10, 4.11, and 4.12 demonstrate the garment measurements for Lucky, Gap, and Faded Glory jeans.

Table 4.10

Garment Measurements, Lucky Jeans

Location	Garment Measurements				
	Sample 1	Sample 2	Sample 3	Overall Average (in.)	Standard Deviation
	Average (in.)	Average (in.)	Average (in.)		
Length					
Front Rise	10.81	10.41	10.57	10.60	0.18
Back Rise	15.16	14.88	14.51	14.85	0.29
Inseam	34.55	34.02	34.09	34.22	0.26
Sideseam	44.37	43.90	44.23	44.17	0.22
Width					
Waist Circumference	38.15	37.87	36.30	37.44	0.90
Thigh Circumference	28.12	28.08	28.12	28.10	0.06
Hip Circumference	47.40	48.22	48.34	48	0.24
Leg Opening Circumference	18.15	18.03	18.01	18.06	0.08

Table 4.11

Garment Measurements, Gap Jeans

Location	Garment Measurements				
	Sample 1	Sample 2	Sample 3	Overall Average	Standard Deviation
	Average (in.)	Average (in.)	Average (in.)		
Length					
Front Rise	10.38	10.51	10.39	10.43	0.08
Back Rise	15.29	15.25	15.09	15.21	0.10
Inseam	34.51	34.64	34.64	34.60	0.08
Sideseam	43.78	44.37	44.15	44.10	0.29
Width					
Waist Circumference	38.59	40.01	39.22	39.27	0.64
Thigh Circumference	27.94	27.74	27.98	27.88	0.08
Hip Circumference	47.64	47.04	48.10	47.60	0.29
Leg Opening Circumference	19.89	19.02	19.71	19.54	0.41

Table 4.12

Garment Measurements, Faded Glory Jeans

Location	Garment Measurements				
	Sample 1	Sample 2	Sample 3	Overall Average	Standard Deviation
	Average (in.)	Average (in.)	Average (in.)		
Length					
Front Rise	10.49	10.57	10.39	10.49	0.10
Back Rise	14.70	14.72	14.89	14.77	0.12
Inseam	34.39	33.82	33.88	34.03	0.28
Sideseam	43.76	43.43	43.88	43.69	0.21
Width					
Waist Circumference	38.55	37.49	37.49	37.85	0.55
Thigh Circumference	27.32	26.80	27.28	27.14	0.13
Hip Circumference	45.74	45.82	45	45.52	0.21
Leg Opening Circumference	18.24	18.39	18.39	18.34	0.11

In Lucky jeans, the overall front rise was 10.60 in. and the average back rise was 14.85 in., which were comparable to the 10.75 in. front rise and 14 in. back rise discussed in the standard garment measurement table. Inseam and sideseam measurements vary depending on the specific size that consumers purchase. For this study, jeans with 34 in. inseams were evaluated. Lucky jeans had a 34.22 in. inseam and a 44.17 in. sideseam. In comparison to Gap and Faded Glory samples, Lucky jeans had a higher variation in waist circumference measurements. The average waist circumference measurement was 37.44 in. and was within the 34-36 in. standard range. The average hip measurement was 48 in. and was inside the standard hip measurement range from 39 in. to 51 in. The average thigh measurement was 28.01 in. and was within the standard range based on the 24 in. standard thigh measurement and the 4-5 in. ease allowance. The leg opening circumference measurement was 18.06 in. and fell within the 12-22 in. standard measurement range.

Gap jeans front rise was 10.43 in. and back rise measurements was 15.21 in. Gap jeans had 34.60 in. inseam and 44.10 in. sideseam. In contrast to Lucky and Faded Glory jeans, Gap samples had a larger waist circumference. The standard range for waist circumference measurement is from 34 in. to 38 in. On average, Gap jeans waist circumferences were 39.27 in. and did not fall within the standard range. The standard hip measurement is 45 in. and the allocated easer allowance is between 4 in. to 6 in. The average hip measurements for Gap jeans were 47.6 in. and fell into the standard range. The average thigh measurement was 27.88 in. and the leg opening circumference measurements was 19.54 in. and both of them were within the standard measurement range.

On average, Faded Glory jeans had a 10.49 in. front rise and a 14.77 in. back rise, and the measurements were comparable to the front and back rise sizes provided in the standard garment measurement table. The average inseam measurement was 34.03 in. and the sideseam measurement was 43.69 in. Faded Glory jeans had the lowest variation in waist size. The average waist circumference measurement was 37.85, and Faded Glory jeans were within the 34-38 in. standard waist size range. The average hip measurement was 45.52 in. and was inside the standard hip measurement range from 39 in. to 51 in.

Faded Glory jeans had a 48 in. thigh and 18.06 in. leg opening circumference. Thigh and leg opening circumference measurements were within the 19-29 in. and 12-22 in. range.

Five elements of fit. The fit of a garments helps to reveal and cover the desired parts of our body. A perfect fit depends on many factors including the target market and trend. The fit of a garment is evaluated using five elements of grain, line, ease, balance, and set (J. Lee & Steen, 2015, p. 331).

Grain. All three samples were "on grain" and the lengthwise and crosswise threads had a 90 degree interaction.

*Line***.** In Lucky, Gap, and Faded Glory jeans, sideseams and inseams were straight and perpendicular to the floor.

*Ease***.** Fit and design ease are the two categories of ease used for ordinary movements and to emphasize to a certain silhouette (J. Lee & Steen, 2015, p. 331). All three jeans at each price category were straight fit jeans and had similar width from knee down to the leg opening.

*Balance***.** Jeans used in this study were not symmetrically balanced because the coin pocket was only sewn above the right hand pocket. Moreover, in the Lucky and Gap samples, a branding patch label was only attached above the right back pocket.

*Set***.** Lucky, Gap, and Faded Glory samples had a smooth appearance, and nonessential draglines or wrinkles were not observed on the surface of the fabric.

Material Specifications

Garments have additional components that are classified as support materials, including interlinings, trims, lining, closures, and other support devices. The Material specifications determine that all the required components for the construction of a specific garment are available in the agreed quantity and color. The details of these components were discussed in the material specifications and the support findings and trim specifications tables. The characteristics of the fabric were also stated in the fashion fabric specifications table. Table 4.13 showed the material specifications for the Lucky, Gap, and Faded Glory jeans.

Table 4.13

Material Specifications, Lucky, Gap, and Faded Glory Jean

Brand: Lucky Style: Five pocket jean Size Category: Men Size Range: Waist: 28-36, 38, 40, 42 Length: 30, 32, 34, 36, 38 Sample Size: Waist: 36, Length: 34	Season: All Season Price: $129.00 Description: Five pocket straight fit jean Brand: Lucky Fabric Category: Woven Cotton Color: IOLITE

Description	Use	Material
Cotton Woven Fabric	Shell	100% Cotton
Interfacing	Interfacing	None
Buttons	Fastener	Copper
Zipper	Fastener	Brass
Rivets	Reinforcement	Copper
Thread	Stitching	Corespun
Branding Patch Label		Leather
Care Label	Care and maintenance instruction	Polyester

Brand: Gap Style: Five pocket jean Size Category: Men Size Range: Waist: 28, 29, 30, 31, 32, 33, 34, 35, 36, 38, 40, 42, 44 Length: 28, 30, 32, 34 Sample Size: Waist: 36, Length: 34	Season: All Season Price: $69.95 Description: Five pocket straight fit jean Brand: Gap Fabric Category: Woven Cotton Color: Resin rinse

Description	Use	Material
Cotton Woven Fabric	Shell	100% Cotton
Interfacing	Interfacing	100% Polyester
Buttons	Fastener	Brass
Zipper	Fastener	Brass
Rivets	Reinforcement	Brass
Thread	Stitching	Corespun
Branding Patch Label		Synthetic Leather
Care Label	Care and maintenance instruction	100% Polyester

Table 4.13 (continued)

Material Specifications, Lucky, Gap, and Faded Glory Jeans

Brand: Faded Glory Style: Five pocket jean Size Category: Men Size Range: Waist: 30, 32, 33, 34, 36, 38, 40, 42 Length: 29, 30, 32, 34 Sample Size: Waist: 36, Length: 34	Season: All Season Price: $9.96 Description: Five pocket straight fit jean Brand: Faded glory Fabric Category: Woven Cotton Color: DKTINT

Description	Use	Material
Cotton Woven Fabric	Shell	100% Cotton
Interfacing	Interfacing	None
Buttons	Fastener	Brass
Zipper	Fastener	Brass
Rivets	Reinforcement	Brass
Thread	Stitching	100% Polyester Corespun
Branding Patch Label		
Care Label	Care and maintenance instruction	100% Polyester

Six copper rivets and one copper jean-tack were used in Lucky jeans, and the branding patch label was made out of leather. Gap jeans branding patch label was manufactured from synthetic leather. Rivets and jean tacks on Gap and Faded Glory jeans were produced from brass. The material of inside care labels for all jeans was 100% polyester.

Fashion fabric specifications. Apparel is manufactured with different fabrics based on the intended end-use, apparel categories, consumer expectations, fashion trends, price, and the climate in which they are being used (Keiser & Garner, 2012, p. 166). The fashion fabric specifications provide details about the fabric of the jeans. The fashion fabric specifications for Lucky, Gap, and Faded Glory jeans are summarized in Table 4.14.

Table 4.14

Fashion Fabric Specifications, Lucky, Gap, and Faded Glory Jeans

Lucky
Fabric Name: Denim Fiber Content: 100% Cotton Fabric Count: 132 Fabric Weight : 10.45 (oz/ yd^2) Yarn Type: Spun yarn Yarn Twist: Z direction twist for warp and filling yarns Fabric Structure: 2/1 warp-faced left-hand twill weave fabric. Color Application: Warp yarns were dyed blue and filling yarns were white. Finishes: None
Gap
Fabric Name: Denim Fiber Content: 100% Cotton Fabric Count: 119 Fabric Weight : 11.94 (oz/ yd^2) Yarn Type: Spun yarn Yarn Twist: Z direction twist for warp and filling yarns Fabric Structure: 3/1 warp-faced right-hand twill weave fabric. Color Application: Warp yarns were dyed blue and filling yarns were white. Finishes: Resin rinse
Faded Glory
Fabric Name: Denim Fiber Content: 100% Cotton Fabric Count: 107 Fabric Weight : 12.91 (oz/ yd^2) Yarn Type: Spun yarn Yarn Twist: Z direction twist for warp and filling yarns Fabric Structure: 3/1 warp-faced right-hand twill weave fabric. Color Application: Warp yarns were dyed blue and filling yarns were white. Finishes: None

Lucky jeans were manufactured from 100% cotton Candiani denim, an Italian company with the world's finest denim mill, recognized for producing premium denim fabrics. Lucky jeans were fabricated from a 2/1 warp-faced left-hand twill that correlates with the description of denim which is a fabric woven as right or left-hand 2/1 twill, 3/1 twill, 2/1 broken twill, or 3/1 broken twill (Paul, 2015, p. 170). This fabric was woven with single spun yarns twisted in Z direction and similar to other brand categories, warp yarns were dyed blue and were followed by white filling yarns. Evaluations showed the average fabric weight of 10.45 oz/yd² and fabric count of 82×50 yarns/in for all three Lucky samples.

Gap jeans were manufactured from 100% cotton premium denim with resin rinse finish. The visual inspection showed that the fabric was a 3/1 warp-faced right-hand twill and the average weight of the fabric was 11.94 oz/yd². Gap jeans' fabrics were woven with single spun yarns twisted in Z direction and the average fabric count was 69×50 yarns/in. Similar to Gap samples, Faded Glory jeans were also fabricated from 100% cotton denim and were woven as 3/1 warp-faced right-hand twill using spun yarns that were twisted in Z direction. For all three Faded Glory samples, the average fabric weight of 12.91 oz/yd² and fabric count of 64×42 yarns/in were recorded.

Fabric count. Three 1 in. × 1 in. square shaped specimens were cut from each sample, and the number of warp and filling yarns per inch were counted using a linen tester and a pick. The number of warp and filling yarns were determined initially and after one and five wash cycles. The fabric count is reported by stating warp yarn count first followed by the filling yarn count. The results of fabric count of Lucky, Gap, and Faded glory jeans are shown in Table 4.15.

Table 4.15

Fabric Count, Lucky, Gap, and Faded Glory Jeans

ASTM D3775-12, Standard Test Method for Warp (End) and Filling (Pick) Count of Woven Fabrics									
Sample Number	Initial			Wash 1			Wash 5		
	Fabric Count (yarns/in)	Avg (yarns /in)	SD*	Fabric Count (yarns/in)	Avg (yarns/ in)	SD*	Fabric Count (yarns/in)	Avg (yarns/ in)	SD*
Lucky Jeans									
1	82×50	82×50	0.00×0 .58	80×51	79×51	1.53×0 .00	80×51	80×50	0.00×0 .58
2	82×50			79×51			80×50		
3	82×51			77×51			80×50		
Gap Jeans									
1	69×51	69×50	0.58×1 .15	69×50	70×50	0.58×0 .58	69×51	69×51	0.58×0 .00
2	69×49			70×50			70×51		
3	70×49			70×49			69×51		
Faded Glory Jeans									
1	63×42	64×42	1×0.58	66×43	67×43	0.58×1	66×43	66×43	0.00×0 .00
2	64×43			67×42			66×43		
3	65×42			67×44			66×43		

*SD: Standard deviation.

Initially, the average fabric count for Lucky jeans was 82×50 while for Gap jeans fabric count was 69×50 and for Faded Glory jeans it was 64×42. After one wash cycle, in Lucky jeans, the number of warp and filling yarns was 79×51 and after five wash cycles it was 80×50. The average fabric count for Gap jeans was 70×50 after one wash and it was 69×51 after five wash cycles. In Faded Glory jeans, after one laundering, the average fabric count was 67×43 and after five laundering cycles it was 66×43. In Lucky, Gap, and Faded Glory jeans the changes in fabric count after laundering was minimal. The insignificant variations in fabric count after laundering have a relationship with the finishing of denim fabric. The prewashed denim jeans are more dimensionally stable in subsequent washing resulting in less warp and filling yarns movements (Paul, 2015, pp. 436-437).

Fabric weight. Three 5.94 in^2 specimens were cut from each pair of jeans using a Universal Sample Cutter. The conditioned specimens were weighed and the initial fabric weight was calculated. The fabric weight was also measured after one and five

laundering cycles. Fabric weight was reported based on ounce per square yard. The results of fabric weight for Lucky, Gap, and Faded Glory jeans are presented in Table 4.16.

Table 4.16

Fabric Weight, Lucky, Gap, and Faded Glory Jeans

ASTM D3776/D3776M-09a, Standard Test Methods for Mass Per Unit Area (Weight) of Fabric									
Sample Number	Initial			Wash 1			Wash 5		
	Fabric Weight (oz/yd²)	Avg (oz/yd²)	SD*	Fabric Weight (oz/yd²)	Avg (oz/yd²)	SD*	Fabric Weight (oz/yd²)	Avg (oz/yd²)	SD*
Lucky Jeans									
1	10.63	10.45	0.03	10.72	10.64	0.02	10.62	10.63	0.01
2	10.47			10.55			10.62		
3	10.26			10.63			10.66		
Gap Jeans									
1	11.91	11.94	0.03	12.23	12.18	0.03	12.27	12.18	0.02
2	12.15			12.35			12.22		
3	11.75			11.98			12.05		
Faded Glory Jeans									
1	12.77	12.91	0.03	12.81	12.91	0.03	12.86	12.86	0.02
2	13.23			12.83			12.94		
3	12.73			13.10			12.78		

*SD: Standard deviation.

The initial fabric weight for Lucky jeans was 10.45 oz/yd². After one wash, the average fabric weight was 10.64 oz/yd² and a fabric weight of 10.63 was reported after five wash cycles. Gap jeans were constructed from fabrics weighing 11.94 oz/yd². After one laundering cycle, the average fabric weight was 12.18 oz/yd² and the number did not change after five wash cycles. Prior to washing and after one laundering cycle, the average fabric weight for Faded Glory jeans was 12.91 oz/yd². After five wash cycles, the average mass per unit area of fabric was 12.86 oz/yd. The results showed that the impact of laundering on fabric weight of Lucky, Gap, and Faded Glory jeans was insignificant. ASTM categorizes denim fabrics ranged from 8.01 oz/yd² to 13.74 oz/yd² as medium

weight denims (ASTM, 2014b). Lucky, Gap, and Faded Glory jeans are manufactured from medium-weight denim fabrics.

Yarn number. Six yarns in each warp and filling directions were removed from each pair of jeans. Yarn number was calculated based on the indirect yarn numbering system and was reported in yards per pound. Table 4.17 reports the results of yarn number for Lucky, Gap, and Faded Glory jeans.

Table 4.17

Yarn Number, Lucky, Gap, and Faded Glory Jeans

ASTM D1059-01 Standard Test Method for Yarn Number Based on Short-Length Specimens *						
Sample Number	Warp	Filling	Avg Warp (yd/lb)	Avg Filling (yd/lb)	SD** Warp	SD** Filling
Lucky Jeans						
1	8.41	9.14	8.76	8.97	0.18	0.15
2	8.52	8.88				
3	8.76	8.88				
Gap						
1	6.24	7.98	6.06	7.88	0.09	0.10
2	6.18	7.78				
3	6.06	7.88				
Faded Glory						
1	5.63	6.64	5.48	6.71	0.07	0.12
2	5.53	6.85				
3	5.48	6.64				

*Calculations are based on indirect yarn numbering system.

**SD: Standard deviation.

The average yarn number for Lucky jeans was 8.76 yd/lb for warp yarns and 8.97 yd/lb for filling yarns. In Gap jeans, the average yarn number was 6.06 yd/lb for yarns in warp direction and it was 7.88 yd/lb for yarns in filling direction. On average, Faded Glory jeans' fashion fabrics were woven with 5.48 yd/lb warp yarns and 6.71 yd/lb filling yarns. The result indicated that compared to Gap and Faded Glory, Lucky jean's fabric was woven with finer yarns.

Finish. Information provided by the Gap website specified that the Original 1969 standard fit jeans were resin rinsed. Three dimensional whiskers were observed on the front panel (around hips and thigh area) of Lucky jeans. Whisker is one of the design elements used on jeans, creating worn out lines and patterns that are usually generated by natural wearing on hips and the front thigh area (Paul, 2015, p. 327).

Support findings and trims. Decorative and functional additions are used to complete the garment or enhance its design. The additional features that include interlinings, linings, support devices, closures, thread, and labels are categorized as findings (Keiser & Garner, 2012, p. 213). The studied jeans had similarities in the location and the number of some support findings such as buttons, zippers, and rivets. Decorative trims were not observed on the surface of all jeans. The support findings and trim specifications of Lucky, Gap, and Faded Glory jeans are listed in Table 4.18.

Table 4.18

Support Findings and Trim Specifications, Lucky, Gap, and Faded Glory Jeans

Lucky
Interfacing: None Thread: Gold color cotton/polyester corespun thread Buttons: One copper jean tack button with the diameter of 0.67 inch is located on the waistband of the garment. Rivets: Six copper rivets. Two rivets positioned on the opening edges of coin pocket and hand pockets. Zipper: A closed-end zipper is used for closure.
Gap
Interfacing: 100% Polyester fusible interfacing, Thread: Gold color cotton/polyester corespun thread Buttons: One brass jean tack button with the diameter of 0.63 inch is located on the waistband of the garment. Rivets: Six brass rivets. Two rivets positioned on the opening edges of coin pocket and hand pockets. Zipper: A closed-end zipper is used for closure.
Faded Glory
Interfacing: None Thread: White and gold color 100% polyester corespun thread Buttons: One brass jean tack button with the diameter of 0.63 inch is located on the waistband of the garment. Rivets: Six brass rivets. Two rivets positioned on the opening edges of coin pocket and hand pockets. Zipper: A closed-end zipper is used for closure.

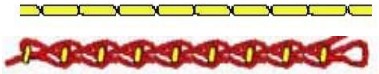
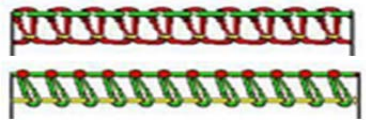
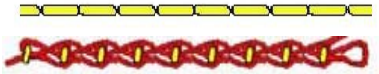
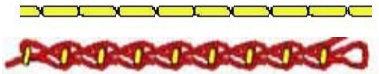
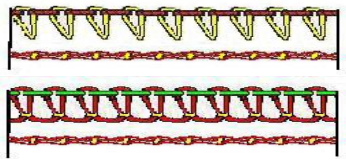
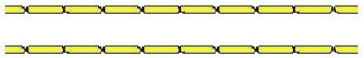
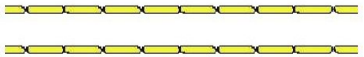
Lucky jeans were sewn with a gold color cotton/polyester corespun thread. Other support findings included one 0.67 inch diameter copper jean-tack and a total of six copper rivets. Similar to Gap and Faded Glory samples, rivets were positioned on the opening edges of the hand pockets and coin pocket. A 100% polyester fusible interfacing was ironed to the back side of Gap jeans' fashion fabric to reinforce the waistband and yoke areas. Gap and Lucky jeans were joined with two differently colored cotton/polyester corespun sewing threads: gold and light gold. Faded Glory jeans were also sewn with white and gold color 100% polyester core spun sewing threads. White thread was only used for sideseam edge treatment and inseams looper thread. Both Gap and Faded Glory jeans had one brass jean tack and six brass rivets. Finally, all jeans used a closed-end zipper for closure.

Construction Specifications

Construction details have the specific instructions needed for manufacturing the apparel to meet the quality standards. Construction specifications include the details of stitches, seams, and hems as well as the specific number of stitches per inch (SPI) (J. Lee & Steen, 2015, p. 50). Depending on the apparel end use, different stitches and seam types are used in the construction of the garment. Stitches hold the garment together and the number of stitches per inch (SPI) is a key quality indicator of sewn apparel products (J. Lee & Steen, 2015, p. 189). The stitch types and specifications for Lucky, Gap, and Faded Glory jeans are listed in Tables 4.19, 4.20, and 4.21. Tables 4.22, 4.23, and 4.24 demonstrate the details of different types of seams used in the Lucky, Gap, and Faded Glory jeans.

Table 4.19

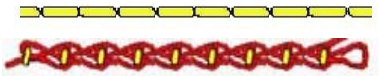
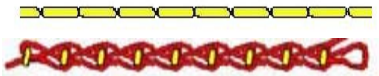
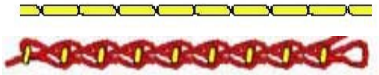
Stitch Type, Lucky Jeans

Stitch Type							
Stitch Location	Sewing Machine	Stitch Classification	Stitch Name	Stitches per Inch			Illustration*
				Sample 1	Sample 2	Sample 3	
Inseam	Chainstitch	401	Chainstitch	10	10	10	
Inseam (Edge treatment)	Chainstitch	504	3-Thread overedge	10	9	10	
Inseam topstitching	Chainstitch	401	Chainstitch	10	10	10	
Sideseam	Chainstitch	401	Chainstitch	10	9	9	
Sideseam (Edge treatment)	Chainstitch	515 (401+503)	4-Thread Safetystitch	12	11	12	
Fly	2-Needle lockstitch	301	Lockstitch	8	9	9	
Fly shield edge	Lockstitch	301	Lockstitch	9	9	9	

*American & Efird Inc. website. http://www.amefird.com/wp-content/uploads/2009/10/Stitch-Type-Matrix.pdf, Copyright 2009 by American & Efird Inc.

Table 4.19 (continued)

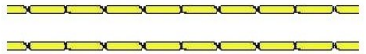
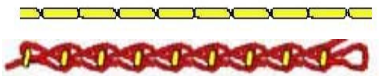
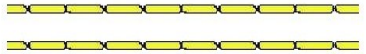
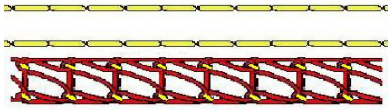
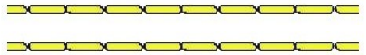
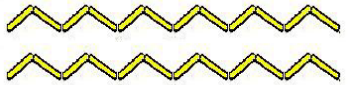
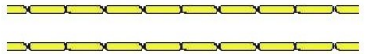
Stitch Type, Lucky Jeans

Stitch Type							
Stitch Location	Sewing Machine	Stitch Classification	Stitch Name	Stitches per Inch			Illustration*
				Sample 1	Sample 2	Sample 3	
Fly facing (Edge treatment)	Chainstitch	504	3-Thread overedge	10	9	9	
Zipper attachment	Lockstitch	301	Lockstitch	8	7	8	
Waistband attachment	Chainstitch	401	Chainstitch	10	9	9	
Waistband (Edge treatment)	Chainstitch	401	Chainstitch	10	9	9	
Yoke attachment	2-Needle Chainstitch	401	Chainstitch	9.5	9.5	9	
Back pocket	Lockstitch	301	Lockstitch	8	8	8	
Back pocket, hand pocket, and coin pocket edge treatment	Lockstitch	301	Lockstitch	8	9	9	

*American & Efird Inc. website. http://www.amefird.com/wp-content/uploads/2009/10/Stitch-Type-Matrix.pdf, Copyright 2009 by American & Efird Inc.

Table 4.19 (continued)

Stitch Type, Lucky Jeans

Stitch Type							
Stitch Location	Sewing Machine	Stitch Classification	Stitch Name	Stitches per Inch			Illustration*
				Sample 1	Sample 2	Sample 3	
Coin pocket	Lockstitch	301	Lockstitch	9	9	9	
Back rise	Chain stitch	401	Chainstitch	9	9	9	
Front rise	Lockstitch	301	Lockstitch	8	8	8	
Belt loops	Chainstitch	406	2-Needle bottom coverstitch	8	8	9	
Hand pocket bag Seam	Lockstitch	301	Lockstitch	11	11	11	
Leg opening hem	Lockstitch	301	Lockstitch	9	9	9	
Buttonhole and bartacks	Lockstitch	304	Zigzag lockstitch	50	48	48	
Leather branding patch	Lockstitch	301	Lockstitch	7	9	9	

*American & Efird Inc. website. http://www.amefird.com/wp-content/uploads/2009/10/Stitch-Type-Matrix.pdf, Copyright 2009 by American & Efird Inc.

Table 4.20

Stitch Type, Gap Jeans

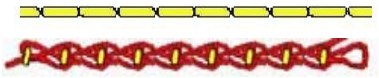
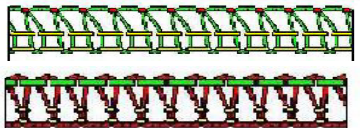
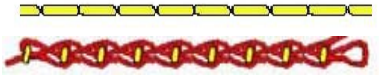
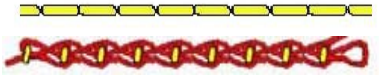
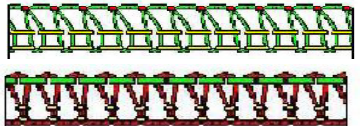
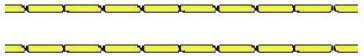
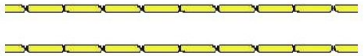
Stitch Type							
Stitch Location	Sewing Machine	Stitch Classification	Stitch Name	Stitches per Inch			Illustration*
				Sample 1	Sample 2	Sample 3	
Inseam	Chainstitch	401	Chainstitch	8	9	9	
Inseam (Edge treatment)	Chainstitch	514	4-Threade overedge	10	9	10	
Inseam topstitching	Chainstitch	401	Chainstitch	10	10	10	
Sideseam	Chainstitch	401	Chainstitch	10	9	9	
Sideseam (Edge treatment)	Chainstitch	514	4-Threade overedge	10	10	10	
Fly	2-Needle lockstitch	301	Lockstitch	8	8	8	
Fly shield edge	Lockstitch	301	Lockstitch	8	8	8	

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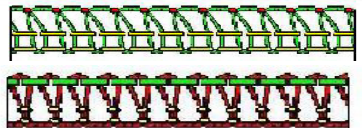
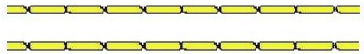
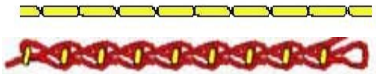
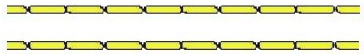
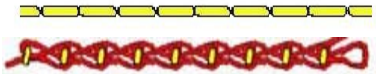
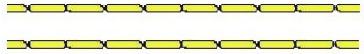
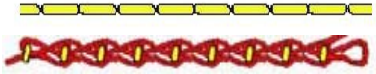
Table 4.20 (continued)

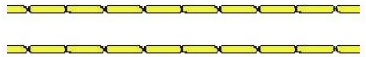
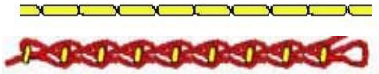
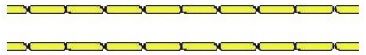
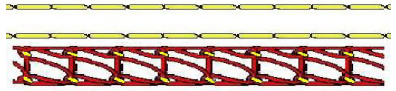
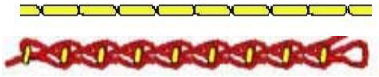
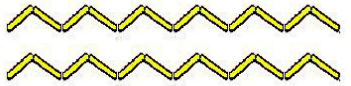
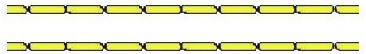
Stitch Type, Gap Jeans

Stitch Type							
Stitch Location	Sewing Machine	Stitch Classification	Stitch Name	Stitches per Inch			Illustration*
				Sample 1	Sample 2	Sample 3	
Fly facing (Edge treatment)	Chainstitch	514	4-Threade overedge	11	10	10	
Zipper attachment	Lockstitch	301	Lockstitch	9	9	9	
Waistband attachment	Chainstitch	401	Chainstitch	10	8	8	
Waistband (Edge treatment)	Lockstitch	301	Lockstitch	9	9	8	
Yoke attachment	2-Needle Chainstitch	401	Chainstitch	8	8	8	
Back pocket	Lockstitch	301	Lockstitch	8	8	8	
Back pocket (Edge treatment)	2-Needle Chainstitch	401	Chainstitch	8	8	8	
Coin pocket	Lockstitch	301	Lockstitch	7	8	8	

*American & Efird Inc. website. http://www.amefird.com/wp-content/uploads/2009/10/Stitch-Type-Matrix.pdf, Copyright 2009 by American & Efird Inc.

Table 4.20 (continued)

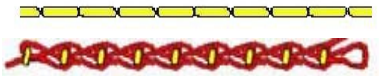
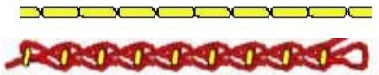
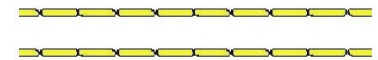
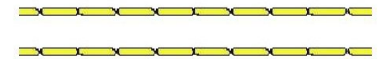
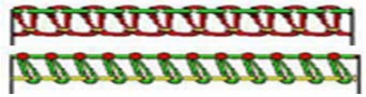
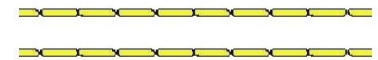
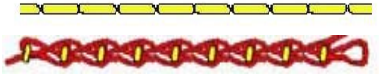
Stitch Type, Gap Jeans

Stitch Type							
Stitch Location	Sewing Machine	Stitch Classification	Stitch Name	Stitches per Inch			Illustration*
				Sample 1	Sample 2	Sample 3	
Hand pocket and coin pocket (Edge treatment)	2-Needle lockstitch	301	Lockstitch	7	8	8	
Back rise	Chain stitch	401	Chainstitch	8	8	8	
Front rise	Lockstitch	301	Lockstitch	8	8	8	
Belt loops	Chainstitch	406	2-Needle bottom coverstitch	8	9	9	
Hand pocket bag Seam	Lockstitch	301	Lockstitch	10	10	10	
Leg opening hem	Chain stitch	401	Chainstitch	9	8	8	
Buttonhole and bartacks	Lockstitch	304	Zigzag lockstitch	52	50	50	
Branding patch label	Lockstitch	301	Lockstitch	9	9	8	

*American & Efird Inc. website. http://www.amefird.com/wp-content/uploads/2009/10/Stitch-Type-Matrix.pdf, Copyright 2009 by American & Efird Inc.

Table 4.21

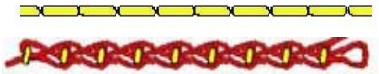
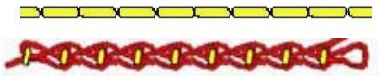
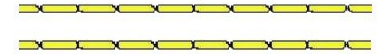
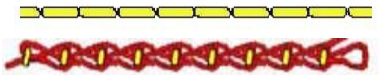
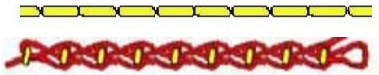
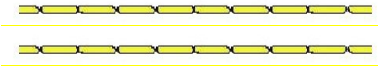
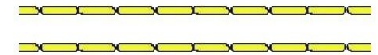
Stitch Type, Faded Glory Jeans

Stitch Type							
Stitch Location	Sewing Machine	Stitch Classification	Stitch Name	Stitches per Inch			Illustration*
				Sample 1	Sample 2	Sample 3	
Inseam	2-Needle Chainstitch	401	Chainstitch	9	9	9	
Sideseam	Chainstitch	401	Chainstitch	9	9	9	
Sideseam (Edge treatment)	Chainstitch	504	3-Thread overedge	9	8	9	
Fly	2-Needle lockstitch	301	Lockstitch	9	8	9	
Fly shield edge	Lockstitch	301	Lockstitch	8	8	8	
Fly facing (Edge treatment)	Chainstitch	504	3-Thread overedge	8	9	8	
Zipper attachment	Lockstitch	301	Lockstitch	9	8	9	
Waistband attachment	Chainstitch	401	Chainstitch	8	8	8	

*American & Efird Inc. website. http://www.amefird.com/wp-content/uploads/2009/10/Stitch-Type-Matrix.pdf, Copyright 2009 by American & Efird Inc

Table 4.21 (continued)

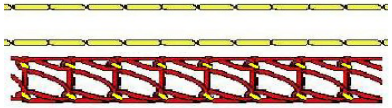
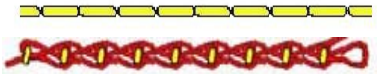
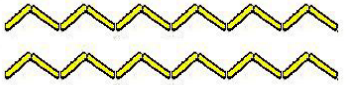
Stitch Type, Faded Glory Jeans

Stitch Type							
Stitch Location	Sewing Machine	Stitch Classification	Stitch Name	Stitches per Inch			Illustration*
				Sample 1	Sample 2	Sample 3	
Waistband (Edge treatment)	Chainstitch	401	Chainstitch	8	8	8	
Yoke attachment	2-Needle Chainstitch	401	Chainstitch	8	8	8	
Back pocket	Lockstitch	301	Lockstitch	8	8	9	
Back pocket (Edge treatment)	2-Needle Chainstitch	401	Chainstitch	8	8	8	
Coin pocket	Chainstitch	401	Chainstitch	8	8	8	
Hand pocket and coin pocket (Edge treatment)	2-Needle lockstitch	301	Lockstitch	7	8	8	
Back rise	Chain stitch	401	Chainstitch	8	8	8	
Front rise	Lockstitch	301	Lockstitch	9	9	9	

*American & Efird Inc. website. http://www.amefird.com/wp-content/uploads/2009/10/Stitch-Type-Matrix.pdf, Copyright 2009 by American & Efird Inc.

Table 4.21 (continued)

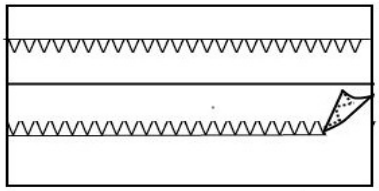
Stitch Type, Faded Glory Jeans

Stitch Type							
Stitch Location	Sewing Machine	Stitch Classification	Stitch Name	Stitches per Inch			Illustration*
				Sample 1	Sample 2	Sample 3	
Belt loops	Chainstitch	406	2-Needle bottom coverstitch	8	9	9	
Hand pocket bag Seam	Lockstitch	301	Lockstitch	10	10	10	
Leg opening hem	Chain stitch	401	Chainstitch	9	8	8	
Buttonhole and bartacks	Lockstitch	304	Zigzag lockstitch	52	50	50	

*American & Efird Inc. website. http://www.amefird.com/wp-content/uploads/2009/10/Stitch-Type-Matrix.pdf, Copyright 2009 by American & Efird Inc

Table 4.22

Seam Type, Lucky Jeans

Seam Type			
Seam Location	Seam Class	Seam Notation	Illustration*
Side Seam	Plain seam, (busted)	SSa	
Inseam	Lapped seam	LSq	
Front and back rise	Lapped seam	LSas	
Zipper tape seam	Superimposed seam, Attaching tape to edge	SSaa	
Fly and fly facing seam	Enclosed seam, Superimposed seam class	SSe	
Waistband seam	Bound seam	BSc	
Belt loops	Edge finishes hem	EFh	
Belt loops and waistband seam	Lapped seam	LSd	
Coin and back pockets seam	Lapped seam	LSd	

*American & Efird Inc. website.http://www.amefird.com/wp-content/uploads/2009/10/Seam Type.pdf. Copyright 2006 by American & Efird Inc.

Table 4.22 (continued)

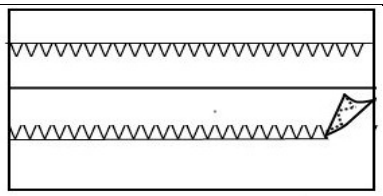
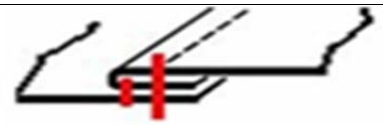
Seam Type, Lucky Jeans

Seam Type			
Seam Location	Seam Class	Seam Notation	Illustration*
Hand pockets and facing seam	Enclosed seam, Superimposed seam class	SSe	
Yoke seam	Lapped seam	LSc	
Leg opening hem	Edge Finishes	EFb	

* American & Efird Inc. website. http://www.amefird.com/wp-content/uploads/2009/10/SeamType.pdf.Copyright 2006 by American & Efird Inc.

Table 4.23

Seam Type, Gap Jeans

Seam Type			
Seam Location	Seam Class	Seam Notation	Illustration*
Side Seam	Plain seam, (busted)	SSa	
Inseam	Lapped seam, Seam and cord seam	LSq	
Front and back rise	Lapped seam	LSas	
Zipper tape seam	Superimposed seam, Attaching tape to edge	SSaa	
Fly and fly facing seam	Enclosed seam, Superimposed seam class	SSe	
Waistband seam	Bound seam	BSc	
Belt loops	Edge finishes hem	EFh	
Belt loops and waistband seam	Lapped seam	LSd	

* American & Efird Inc. website. http://www.amefird.com/wp-content/uploads/2009/10/Seam Type.pdf. Copyright 2006 by American & Efird Inc.

Table 4.23 (continued)

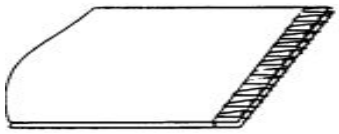
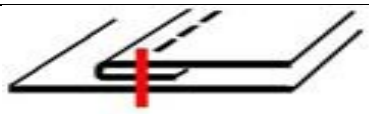
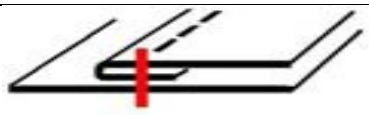
Seam Type, Gap Jeans

Seam Type			
Seam Location	Seam Class	Seam Notation	Illustration*
Coin and back pockets seam	Lapped seam	LSd	
Hand pockets and facing seam	Enclosed seam, Superimposed seam class	SSe	
Yoke seam	Lapped seam	LSc	
Leg opening hem	Edge Finishes	EFb	

* American & Efird Inc. website. http://www.amefird.com/wp-content/uploads/2009/10/Seam Type.pdf. Copyright 2006 by American & Efird Inc.

Table 4.24

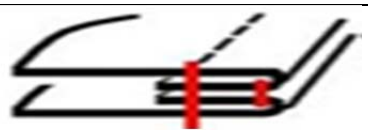
*Seam Type, Faded Glory Jeans**

Seam Type			
Seam Location	Seam Class	Seam Notation	Illustration*
Side Seam	Plain superimposed seam	SSa	
Inseam	Felled seam, lapped seam category	LSc	
Front and back rise	Lapped seam	LSas	
Zipper tape seam	Superimposed seam	SSaa	
Fly and fly facing seam	Enclosed seam, Superimposed seam class	SSe	
Waistband seam	Bound seam	BSc	
Belt loops	Edge finishes hem	EFh	
Belt loops and waistband seam	Lapped seam	LSd	
Coin and back pockets seam	Lapped seam	LSd	

* American & Efird Inc. website. http://www.amefird.com/wp-content/uploads/2009/10/Seam Type.pdf. Copyright 2006 by American & Efird Inc.

Table 4.24 (continued)

Seam Type, Faded Glory Jeans

Seam Type			
Seam Location	Seam Class	Seam Notation	Illustration*
Hand pockets and facing seam	Superimposed seam	SSe	
Yoke seam	Lapped seam	LSc	
Leg opening hem	Edge Finishes	EFb	

*American & Efird Inc. website. http://www.amefird.com/wp-content/uploads/2009/10/Seam Type.pdf. Copyright 2006 by American & Efird Inc.

Lucky, Gap, and Faded Glory jeans varied in some construction specifications but the major differences were in inseam and sideseam stitch and seam type. Lucky jeans sideseams were plain busted seams joined by 401 class stitches. The raw edges where finished a combination stitch that creates decorative 401 chainstitch and 503 serged edges. Inseams were lapped seams constructed and topstitched with 401 class stitches using a chainstitch sewing machine. In Gap samples, sideseams were plain busted seam sewn with 401 chainstitch. Inseams were lapped seams joined and topstitched with 401 class stitches. Faded Glory jeans had felled seam type inseams constructed with 401 2-needle chainstitch. A plain superimposed seam with 401 class stitches was also used for sideseams.

In all three brand categories, both front rise and back rise were flat felled seams. The yoke was joined by a lapped seam sewn with 2-needle chainstitch machine. Bound seam was used for waistbands and the waistbands were attached to jeans with 401 class stitch. Fly and fly facing were also joined by an enclosed seam and were topstitched with 301 lockstitches. Belt loops were sewn with a 406 class 2-needle coverstitch and were reinforced with bartacks. Coin and back pockets were attached by patch pockets setting with topstitching. Lucky and Gap jeans' back and coin pockets were sewn to the garment with 301 lockstitches whereas a 401 chainstitch was used in the attachment of Faded Glory pockets. Lucky jeans hand, coin, and back pockets edge treatments were topstitched with 301 class stitch. However, in Gap and Faded Glory jeans, hand and coin pockets edge treatments were topstitched with 301 lockstitch and back pockets edge treatments had 401 class stitches. Leg openings had a clean finished hem with topstitching. Lucky jeans leg opening hems were topstitched with 301 lockstitch whereas the Gap and Faded Glory samples had leg opening hems with 401 class topstitching.

Appearance Characteristics

The characteristics that affected the appearance of jeans including color difference, colorfastness to wet and dry crocking, and smoothness retention were evaluated for Lucky, Gap, and Faded Glory jeans. These characteristics were assessed initially and after one and five laundering cycles.

Color difference. After one and five wash cycles, samples were conditioned and evaluated using the AATCC Gray Scale for Color Change with rating a scale of one through five. The results of color difference for Lucky, Gap, and Faded Glory jeans are summarized in Table 4.25.

Table 4.25

Color Difference, Lucky, Gap, and Faded Glory Jeans

AATCC Evaluation Procedure 9-2011, Visual Assessment of Color Difference of Textiles*						
Sample	Wash 1			Wash 5		
	Rating	Avg	SD**	Rating	Avg	SD**
Lucky Jeans						
1	4.50	4.33	0.14	3.50	3.50	0.00
2	4.25			3.50		
3	4.25			3.50		
Gap Jeans						
1	3.75	3.83	0.14	2.25	2.25	0.00
2	3.75			2.25		
3	4.00			2.25		
Faded Glory Jeans						
1	3.75	3.67	0.14	3.25	3.25	0.00
2	3.50			3.25		
3	3.75			3.25		

*Specimens are rated according to the AATCC Gray Scale for Color Change with rating scale of 1-5. Grade 1 indicates severe color change and grade 5 indicates no color change.
**SD: Standard deviation.

After one wash, the color difference of Lucky jeans was 4.33. The color faded more after five wash cycles, and the average grade for Lucky jeans was 3.5. After one laundering cycle, Gap jeans were graded as 3.83. The color of Gap jeans faded more and grade of 2.25 was assigned after five wash cycles. Faded Glory jeans were rated as 3.67 after one laundering cycle, and the color difference after five wash cycle was 3.25. In Faded Glory jeans, the changes in color difference after five laundering cycle were minimal.

Colorfastness to dry and wet crocking. Three random locations on each pair of jeans were evaluated for wet and dry crocking using 5 cm × 5 cm white crock cloth squares and a SDL Atlas electronic crockmeter apparatus. The specimens were evaluated according to the AATCC Gray Scale for Staining with a rating scale of one through five. The results of colorfastness to dry and wet crocking for Lucky, Gap, and Faded Glory jeans are shown in Tables 4.25 and 4.26.

Table 4.25

Colorfastness to Dry Crocking, Lucky, Gap, and Faded Glory Jeans

AATCC Test Method 8-2013, Colorfastness to Crocking: Crockmeter Method*									
Sample Number	Initial			Wash 1			Wash 5		
	Rating	Avg	SD**	Rating	Avg	SD**	Rating	Avg	SD**
Lucky Jeans									
1	4.25	4.14	0.13	4.67	4.69	0.17	4.58	4.53	0.08
2	4.08			4.67			4.50		
3	4.08			4.75			4.50		
Gap Jeans									
1	4.33	4.22	0.15	4.58	4.47	0.15	4.67	4.64	0.13
2	4.25			4.42			4.58		
3	4.08			4.42			4.67		
Faded Glory Jeans									
1	4.83	4.78	0.08	4.75	4.75	0.00	4.75	4.75	0.00
2	4.75			4.75			4.75		
3	4.75			4.75			4.75		

*Specimens are rated according to the AATCC Gray Scale for Staining with rating scale of 1-5. Grade1 indicates poor colorfastness and grade 5 indicates no staining.
**SD: Standard deviation.

Initially, a grade of 4.14 was assigned to Lucky jeans while for Gap jean, the colorfastness to dry crocking was 4.22 and for Faded Glory jeans it was 4.78. After laundering, less color was transferred to Lucky jeans crock cloth samples. After one laundering cycle, they were graded as 4.69 and a grade of 4.53 was appointed to them after five wash cycles. Laundering decreased the level of stinging of Gap jeans and they were graded as 4.74 after one wash and 4.64 after five wash cycles. In Faded Glory jeans, the level of staining remained unchanged after home laundering.

Table 4.26

Colorfastness to Wet Crocking, Lucky, Gap, and Faded Glory Jeans

AATCC Test Method 8-2013, Colorfastness to Crocking: Crockmeter Method*									
Sample Number	Initial			Wash 1			Wash 5		
	Rating	Avg	SD**	Rating	Avg	SD**	Rating	Avg	SD**
Lucky Jeans									
1	1.83	1.94	0.21	1.92	2.28	0.55	2.67	2.31	0.35
2	2.17			2.58			2.33		
3	1.83			2.33			1.92		
Gap Jeans									
1	2.5	2.11	0.33	2.17	2.11	0.13	3.08	3.03	0.08
2	1.75			2.00			3.00		
3	2.08			2.17			3.00		
Faded Glory Jeans									
1	3.08	2.83	0.28	3.33	3.03	0.26	3.75	3.58	0.18
2	2.75			2.83			3.58		
3	2.67			2.92			3.42		

*Specimens are rated according to the AATCC Gray Scale for Staining with rating scale of 1-5. Grade 1 indicates poor colorfastness and grade 5 indicates no staining.

**SD: Standard deviation.

The initial Lucky jeans crock cloths were graded as 1.94 and after laundering, the changes in colorfastness to wet crocking were insignificant. After one wash cycle, a rating of 2.28 was assigned to Lucky jeans and they were graded as 2.31 after five wash cycles. Prior to washing, the colorfastness to wet crocking of Gap jeans was 2.11 and after five wash cycles, and the level of staining decreased to 3.03. Initially, Faded Glory jeans were graded as 2.83. After one laundering cycle, Faded Glory jeans were graded as 3.03, and the level of staining decreased to rating of 3.58 after five laundering cycles.

Smoothness retention. Lucky, Gap, and Faded Glory jeans were washed, dried, and conditioned after one and five laundering cycles and were mounted on an AATCC verified viewing board. The samples were evaluated using the AATCC Three-Dimensional Smoothness Appearance Replicas and the numerical grades between one and five were assigned to each pair of jeans with five corresponding to the smoothest appearance. Table 4.27 provides the results of the smoothness retention evaluation of Lucky, Gap, and Faded Glory jeans.

Table 4.27

Smoothness Retention, Lucky, Gap, and Faded Glory Jeans

AATCC Test Method 143-2011, Appearance of Apparel and Other Textile End Products after Repeated Home Laundering*						
Sample	Wash 1			Wash 5		
	Rating	Avg	SD**	Rating	Avg	SD**
Lucky Jeans						
1	4.00	4.33	0.29	4.00	4.00	0.00
2	4.50			4.00		
3	4.50			4.00		
Gap Jeans						
1	4.00	3.83	0.14	3.75	3.75	0.00
2	3.75			3.75		
3	3.75			3.75		
Faded Glory Jeans						
1	4.00	4.17	0.29	4.00	4.00	0.00
2	4.00			4.00		
3	4.50			4.00		

*Specimens are rated according to the AATCC Smoothness Appearance Replicas with rating scale of 1-5. Grade 1 indicates severely wrinkled appearance and Grade 5 indicates very smooth appearance.

**SD: Standard deviation.

After on wash cycle, the smoothness appearance of Lucky jeans was graded as 4.33 while for Gap jeans, the smoothness retention grade was 3.83 and for Faded Glory jeans it was 4.17. After five laundering cycles, a grade of 4.00 was assigned to Lucky jeans. Smoothness retentions of Gap jeans slightly decreased to 3.75 after five laundering cycles. Faded Glory jeans smoothness retention grade was 4.00 after five laundering cycles. The overall changes in smoothness appearance of Lucky, Gap, and Faded Glory jeans after home laundering were negligible.

Durability Characteristics

Durability is the ability of garments to withstand deterioration or wearing out in use (Kadolph, 2007, p. 21). The durability characteristics of Lucky, Gap, and Faded Glory jeans were evaluated by measuring the fabric breaking strength and seam strength.

Fabric breaking strength. Three 7 in. × 4 in. specimens were cut in each warp and filling direction from Lucky, Gap, and Faded Glory jeans. Specimens were tested using a 400 lb load cell on an Instron® 33R4465A tensile testing machine. The results are reported in Table 4.28 and are stated as the average of warp, fill, and the overall average in pounds of force (lbf).

Table 4.28

Fabric Breaking Strength, Lucky, Gap, and Faded Glory Jeans

ASTM D5034-(09)2013 Standard Test Method for Breaking Strength and Elongation (Grab Test)												
Sample Number	Initial				Wash 1				Wash 5			
	Warp (lbf)	Filling (lbf)	Overall Avg (lbf)	SD*	Warp (lbf)	Filling (lbf)	Overall Avg (lbf)	SD*	Warp (lbf)	Filling (lbf)	Overall Avg (lbf)	SD*
Lucky Jeans												
1	101.83	79.81	93.53	8.25	108.09	71.38	90.47	5.27	113.20	79.18	95.42	4.80
2	123.93	73.87			117.83	66.14			119.27	74.96		
3	104.80	70.00			113.00	66.36			110.00	75.88		
Gap Jeans												
1	211.61	137.60	173.09	5.55	228.17	125.30	178.43	5.52	231.73	127.57	182.07	5.14
2	214.04	134.17			230.40	128.87			235.87	128.20		
3	213.83	127.29			231.77	126.07			239.57	129.47		
Faded Glory Jeans												
1	187.07	108.03	150.20	9.71	185.80	104.37	148.95	3.93	192.50	107.63	152.18	5.5
2	185.43	131.87			193.77	106.27			202.47	104.93		
3	174.67	114.13			192.80	108.79			195.23	110.33		

*SD: Standard deviation.

Specimens cut from Lucky jeans demonstrated a breaking strength equal to 93.53 lbf initially. After one wash, the fabric breaking strength was 90.47 which increased to 95.42 lbf after five wash cycles. Prior to washing, Gap jeans average specimens broke at 173.09 lbf. After one laundering cycle, the average breaking strength slightly increased to 178.43 lbf and five laundering cycles, Gap jeans specimens broke at 182.07 lbf. Initially, average breaking strength of 150.20 lbf was reported for Faded Glory jeans. After one wash cycle, Faded Glory specimens broke at 148.95 lbf. After five laundering cycles, the fabric breaking strength of Faded Glory jeans slightly increased to 152.18 lbf.

Seam Strength. Two specimens were cut from the inseam and sideseam of each pair of jeans. The size of specimens was 7 in. × 4 in. and the seam was centered and perpendicular to the long side of the specimens. Seam strength was measured using an Instron® 33R4465A tensile testing machine with a 400 lb load cell. The average of seam strength for inseam and sideseam of each sample was calculated and reported in pounds of force (lbf). In this study, the seam rupture was caused by fabric failure, yarn slippage, and sewing thread failure. The type of seam failure was recorded by the researcher in every instance of testing and denoted by a "*" on Table C8 in Appendix C. Table 4.29 presents the seam strength results for Lucky, Gap, and Faded Glory jeans.

Table 4.29

Seam Strength, Lucky, Gap, and Faded Glory Jeans

ASTM D 1683-11, Standard Test Method for Failure in Sewn Seams of Woven Apparel Fabrics						
Sample Number	Initial		Wash 1		Wash 5	
	Side Seam (lbf)	Inseam (lbf)	Side Seam (lbf)	Inseam (lbf)	Side Seam (lbf)	Inseam (lbf)
Lucky Jeans						
1	56.87	72.33	58.18	74.68	60.45	67.20
2	68.67	76.55	63.78	72.76	55.01	59.61
3	67.44	69.83	69.44	73.16	57.70	63.49
Avg	64.33	72.90	63.80	73.53	57.72	63.43
SD*	6.16	3.82	5.66	1.82	2.97	4.12
Gap Jeans						
1	106.15	110.10	106.25	125.95	117.25	133.15
2	104.25	116.40	101.17	125.20	108.40	120.20
3	106.96	113.86	103.10	116.85	103.43	115.30
Avg	105.78	113.45	103.51	122.67	109.69	122.88
SD*	2.99	4.02	4.01	4.95	6.67	8.71
Faded Glory Jeans						
1	95.59	124.25	102.50	121.20	91.46	119.25
2	102.31	129.30	96.35	127.70	103.35	132.85
3	94.38	124.55	94.89	120.45	99.20	121.00
Avg	97.43	126.03	97.91	123.12	98.00	124.37
SD*	4.37	5.08	4.97	6.04	5.75	7.18

*SD: Standard deviation.

Initially, the average Lucky jeans seam strength for side seam was 64.33 lbf. After on wash, the sideseam strength decreased to 63.80 lbf and after five washes, the average sideseam broke at 57.70 lbf. In contrast to sideseams, inseams had a higher overall seam strength. Prior to washing, the average inseam specimens broke at 72.90 lbf. The sideseam strength after one wash was 73.53 lbf and 63.43 lbf after five laundering cycles. The average seam strength for Gap jeans' sideseams was 105.78 lbf. The average seam breaking strength remained almost unchanged after wash. The average seam strength for inseams was higher than sideseams in Gap jeans. Initially, the average inseam specimens broke at 113.45 lbf. After one laundering cycle, the inseam strength slightly increased to 122.67 lbf and inseams broke at 122.88 lbf after five laundering cycles.

Prior to washing, the average pounds of force needed for breaking the Faded Glory jeans sideseam was 97.43 lbf and the changes in seam breaking strength after laundering were minimal. Compared to sideseams, inseams of Faded Glory jeans had a higher level of seam strength. Initially, the average seam strength for inseams was 126.03 lbf which slightly decreased to 123.12 lbf after one wash and 124.37 lbf after five wash cycles.

Dimensional Change

The dimensions of apparel change when they are exposed to various external influences from the environment. This can lead to variations in the size and fit of a garment. The dimensional change of Lucky, Gap, and Faded Glory jeans was assessed after one and five wash and dry cycles. The locations used for measuring the dimensional change were front rise, back rise, inseam, sideseam, waistband circumferences, hip, thigh, and leg opening circumferences. Table 4.30 summarizes the results of dimensional change for Lucky, Gap, and Faded Glory jeans.

Table 4.30

Dimensional Change, Lucky, Gap, and Faded Glory Jeans

AATCC TM150-2012, Dimensional Changes of Garments after Home Laundering *												
Location	Sample 1				Sample 2				Sample 3			
	Wash 1	Wash 5	Avg	SD**	Wash 1	Wash 5	Avg	SD**	Wash 1	Wash 5	Avg	SD**
Lucky Jeans												
Length												
Front Rise	1.4%	1.7%	1.30%	0.01	0.7%	1.3%	0.88%	0.02	0.4%	0.4%	0.92%	0.01
Back Rise	0.0%	0.4%			-1.4%	-1.4%			-1.5%	-0.2%		
Inseam	1.7%	2.0%			1.2%	2.3%			1.0%	2.4%		
Side seam	1.1%	1.0%			0.6%	1.3%			0.2%	1.1%		
Width												
Waist Circumference	0%	1%	1.13%	0.02	-1%	1%	1.27%	0.01	0%	1%	0.87%	0.01
Thigh	0%	0%			0%	1%			0%	0%		
Hip	2%	4%			2%	3%			1%	2%		
Leg Opening Circumference	0%	0%			1%	1%			0%	1%		
Length Dimensional Change		1.09%			Width Dimensional Change		1.03%		Overall Dimensional Change		1.06%	

*Negative sign indicates increase in the dimensions. Positive numbers indicate shrinkage.

** SD: Standard deviation.

Table 4.30 (continued)

Dimensional Change, Lucky, Gap, and Faded Glory Jeans

AATCC TM150-2012, Dimensional Changes of Garments after Home Laundering *												
Location	Sample 1				Sample 2				Sample 3			
	Wash 1	Wash 5	Avg	SD**	Wash 1	Wash 5	Avg	SD**	Wash 1	Wash 5	Avg	SD**
Gap Jeans												
Length												
Front Rise	0.9%	2.1%	1.87%	0.01	-0.2%	0.1%	0.97%	0.01	-0.1%	0.8%	0.98%	0.01
Back Rise	0.5%	0.5%			0.6%	0.4%			-0.6%	-0.8%		
Inseam	2.4%	3.6%			1.6%	2.0%			1.9%	2.8%		
Sideseam	0.9%	1.3%			1.0%	1.3%			1.2%	1.2%		
Width												
Waist Circumference	1%	1%	1.71%	0.01	3%	2%	1.73%	0.01	1%	2%	1.83%	0.01
Thigh	1%	1%			1%	1%			1%	1%		
Hip	3%	3%			2%	2%			3%	3%		
Leg Opening Circumference	0%	1%			-1%	1%			0%	2%		
Length Dimensional Change		1.27%			Width Dimensional Change		1.76%		Overall Dimensional Change		1.51%	

*Negative sign indicates increase in the dimensions. Positive numbers indicate shrinkage.

** SD: Standard deviation.

Table 4.30 (continued)

Dimensional Change, Lucky, Gap, and Faded Glory Jeans

AATCC TM150-2012, Dimensional Changes of Garments after Home Laundering *												
Location	Sample 1				Sample 2				Sample 3			
	Wash 1	Wash 5	Avg	SD**	Wash 1	Wash 5	Avg	SD**	Wash 1	Wash 5	Avg	SD**
Faded Glory Jeans												
Length												
Front Rise	0.5%	2.0%	1.56%	0.02	0.1%	1.3%	1.53%	0.01	-0.1%	0.5%	1.61%	0.01
Back Rise	-0.1%	-0.8%			0.8%	0.6%			-0.1%	1.0%		
Inseam	1.5%	3.7%			1.5%	2.8%			1.6%	2.4%		
Side seam	-0.3%	1.3%			0.8%	1.4%			1.4%	2.6%		
Width												
Waist Circumference	2%	3%	1.25%	0.01	1%	1%	0.85%	0.01	1%	1%	0.73%	0.00
Thigh	1%	2%			0%	1%			0%	0%		
Hip	3%	1%			1%	0%			1%	1%		
Leg Opening Circumference	0%	0%			0%	1%			1%	1%		
Length Dimensional Change		1.57%			Width Dimensional Change		0.94%		Overall Dimensional Change		1.25%	

*Negative sign indicates increase in the dimensions. Positive numbers indicate shrinkage.

** SD: Standard deviation.

Lucky jeans had similar changes in dimension in length and width directions. The average dimensional change was 1.09% in length and 1.03% in width direction. The overall change was 1.06%. On average, Shrinkage in the length direction of Gap jeans was 1.27% and the shrinkage in the width direction was 1.76%. The overall dimensional change was 1.51%. For the Faded Glory jeans, the dimensional change in length direction was more than the width direction. The average shrinkage in length direction was 1.57% and the width shrinkage was 0.94%, and the overall shrinkage was 1.25%. The results from the dimensional change of Lucky, Gap, and Faded Glory jeans complied with the results of fabric count. All jeans are woven with twill fabrics that restrict the warp and filling yarns movements and shrinkage in each direction (Topalbekiroğlu & Kaynak, 2008).

Research Questions

Research question #1. *Is there a difference between the product specifications for jeans at three price categories?*

Research question #1a. *Is there a difference between the design specifications of jeans at three price categories?*

Lucky, Gap, and Faded Glory jeans online presentations varied in the quantity and type of information. Compared to Lucky, Gap and Walmart websites offered more information about their products. The Walmart website provided a detailed description of Faded Glory men's original fit jeans, but unlike Lucky and Gap, it only featured one front photo of the jeans. The care and maintenance instructions for these jeans were also different. While Lucky samples could not be ironed, Gap and Faded Glory jeans could be ironed with medium (warm) heat. Lucky, Gap, and Faded Glory jeans had similar styles and fits. All samples had straight with jean-tack button closure on the waistband and a zip fly. There were variations in the number of belt loops sewn to the waistband of jeans at each price category. Lucky jeans had five belt loops and Gap and Faded Glory jeans had six and seven belt loops attached to their waistbands, respectively. Another difference in design specifications of samples was the bartacks on back pockets. Unlike Gap jeans, the edges of back pockets in the Lucky and Faded Glory jeans were secured with bartacks.

Research question #1b. *Is there a difference between the material specifications of jeans at three price categories?*

Different types of support findings were used in jeans from each price category. Lucky jeans jean-tack and rivets were manufactured from copper whereas jean-tacks and rivets of Gap and Faded Glory samples were fabricated from brass, a low-priced material in comparison to copper. Gap jeans were the only samples that had their fly and waistband reinforced with 100% polyester fusible interfacing.

Several variations in fashion fabric specifications of jeans at three price categories were recorded. Lucky jeans were fabricated from a 2/1 warp-faced left-hand twill, whereas, Gap and Faded Glory jeans were woven as 3/1 warp-faced right-hand twill. Compared to Gap and Faded Glory samples, Lucky jeans had the lowest fabric weight and the highest fabric count. This statement was verified after evaluating the yarn number of each sample. Lucky jeans had the highest yarn number, which in the indirect measuring system indicates finer yarns. The evaluation showed that the average fabric count and fabric weight for each sample remained almost unchanged after one and five wash cycles. Another important difference in material specifications of Lucky and Gap samples was the type of treatments applied to jeans at each price category. Lucky jeans had three dimensional whiskers and Gap jeans were resin rinsed. Visual inspection showed various types of fabric defects in Lucky, Gap, and Faded Glory jeans. Gap jeans had a smoother fabric with less pills and snags compared to Lucky and Faded Glory jeans which could be a result of resin rinse finish on Gap jeans. Several abrasion marks were also observed on the surface of Lucky, Gap, and Faded Glory jeans. Other fabric defects that were identified on the surface of jeans were slubs and barres. In comparison to Lucky and Gap, these irregularities were observed more frequently in Faded Glory jeans.

Research question #1c. *Is there a difference between the construction specifications of jeans at three price categories?*

The most important difference in the construction specification of jeans was the type of seams and stitches used in inseam and sideseam. Lucky jeans' sideseam was sewn by a plain busted seam which has higher production costs than the plain superimposed seam used in Gap and Faded Glory jeans' side seam. Lucky and Gap jeans' inseams were

joined with a lapped seam with topstitching, but in Faded Glory jeans, a felled seam with 2-needle topstitching was used for sewing the inseam.

Visual inspection revealed different types of defects in seams and stitches of jeans at each price category. In Lucky, Gap, and Faded Glory jeans edges of seams in several areas were ragged. Slightly puckered seams were observed in the waistband, back rise, crotch, and fly seam of Lucky and Gap jeans. This type of defect was more severe in Faded Glory jeans in which puckered seam were observed in the sideseam and front rise in addition to the waistband, back rise, crotch, and fly. Lucky, Gap, and Faded Glory jeans had a twisted leg opening hem and waistband that prevented the hem from lying flat and gave it skewed appearance. Stitch defects identified in Lucky, Gap, and Faded Glory included broken, skipped, loose, crowded, and uneven stitches. Lucky jeans had lower stitch defects (both location and quantity) followed by Gap, and Faded Glory. The important stitch defect that impacted the appearance of jeans was unevenness in yoke topstitching. This defect was observed in one of Lucky and Gap samples and all three Faded Glory jeans. Figure 4.8 illustrates an uneven yoke in Faded Glory jeans.

Figure 4.8. Uneven back yoke in Faded Glory jeans

Research question #2. *Is there a difference between design specifications, appearance and performance characteristics of jeans at three price categories before home laundering?*

Research question #2a. *Is there a difference between the appearance characteristics of jeans at three price categories?*

The results from colorfastness to wet and dry crocking of Lucky, Gap, and Faded Glory jeans were examined through an independent sample t-test. The p-values obtained from the t-test indicated that there was a significant difference in the average colorfastness to wet and dry crocking between Lucky and Faded Glory jeans and Gap and Faded Glory jeans. Regarding the significance, it can be stated that in comparison to Lucky and Gap jeans, Faded Glory jeans had a lower propensity to dry and wet crocking. The independent sample t-test also found that there was no significant difference between the colorfastness to wet and dry crocking of Lucky and Gap jeans. Table 4.31 provides the p-values obtained from the independent sample t-test.

Table 4.31

Independent sample t-test for Color Fastness to Dry and Wet Crocking, Lucky, Gap, and Faded Glory Jeans

Independent sample t-test for Color Fastness to Dry and Wet Crocking		
Brand	P-Value for Dry Crocking	P-Value for Wet Crocking
Lucky-Gap	0.421	0.533
Lucky-Faded Glory	0.001*	0.006*
Gap-Faded Glory	0.002*	0.045*

***** Indicates statistically significant difference ($p<0.05$)

Research question #2b. *Is there a difference between the durability characteristics of jeans at three price categories?*

Results from the fabric breaking strength evaluation indicated that Gap jeans had a higher breaking strength followed by Faded Glory and Lucky jeans. Lucky jeans had the lowest seam strength for both sideseam and inseam. In Lucky jeans, 50% of seam failure was caused by sewing thread rupture, whereas in Gap and Faded Glory jeans only 12.5% and 25% of ruptures were characterized by thread break, respectively. Seam break due to fabric rupture and yarn slippage is considered less desirable because such failure is not repairable (Mehta, 1992, p. 79).

Research question #3c. *Is there a difference between design specifications that determine fit of jeans at three price categories?*

Measurements of jeans were compared to the standard garment measurements and ease allowances. For this study, jeans with waist size of 36 in. and inseam of 34 in. were evaluated. The results showed a high variation in waist circumference measurements of Lucky jeans. The waist circumference measurements of Lucky jeans ranged from 36.30 in. to 38.15 in., which would impact the fit of jeans for the consumers. Gap jeans had an average waist circumference measurement of 39.27 in. which was 1.27 in. higher than the standard range and did not comply with the recommended size chart available in Gap website. Based on the results, Gap jeans would not fit the population whose waist size fell within predetermined standard dimensions.

Research question #3.*Is there a difference between the appearance and performance characteristics of jeans at three price categories after home laundering?*

Research question #3a. *Is there a difference between the appearance characteristics of jeans at three price categories?*

A one-way ANOVA was used to determine whether there was a difference between the appearance characteristics of jeans at each price category before and after one and five wash cycles. The one-way ANOVA showed that the color of Lucky (p=0.000), Gap (p=0.000), and Faded Glory (p=0.007) jeans changed after home laundering. The results from color difference evaluations of each brand were compared two by two with an independent sample t-test and are summarized in Table 4.32.

Table 4.32

Independent Sample t-test for Color Difference, Lucky, Gap, and Faded Glory Jeans

Independent sample t-test for Color difference		
Brand	P-Value for Wash 1	P-Value for Wash 5
Lucky-Gap	0.013*	T-test cannot be conducted because the standard deviations of both groups are 0.
Lucky-Faded Glory	0.005*	
Gap-Faded Glory	0.230	

***** Indicates statistically significant difference ($p<0.05$)

The results indicated that there is a significant variation between the color difference of Lucky and Gap jeans and Lucky and Faded Glory jeans. The outputs of the

color difference test showed that Lucky jeans had a lower level of color change than Gap and Faded Glory jeans.

Another evaluated appearance characteristic was colorfastness to dry and wet crocking. One-way ANOVA found that the colorfastness to dry crocking of Lucky ($p=0.000$) and Gap ($p=0.005$) jeans changed. Ratings showed that both jeans had a lower level of staining after one and five wash cycles. For Gap ($p=0.004$) and Faded Glory ($p=0.014$) jeans, changes between the initial measurements and after home laundering colorfastness to wet crocking were significant. This means that the propensity for wet crocking for Gap and Faded Glory jeans decreased after five wash cycles. An independent sample t-test showed that there was a significant difference between the colorfastness to wet crocking of Lucky, Gap, and Faded Glory jeans after five laundering cycles. This indicated that Lucky jeans had the highest level of staining followed by Gap and Faded Glory jeans. However, the conducted independent sample t-test revealed that after five wash cycles, the results obtained from the colorfastness to dry crocking of Lucky and Gap jeans and Lucky and Faded Glory jeans were statistically significant. Based on obtained data, Lucky jeans had a higher level of staining than Gap and Faded Glory jeans. Table 4.33 provides the p-values of independent sample t-test for colorfastness to dry and wet crocking.

Table 4.33

Independent Sample t-test for Colorfastness to Dry and Wet Crocking, Lucky, Gap, and Faded Glory Jeans

Independent Sample t-test for Colorfastness to Crocking				
	Dry Crocking		Wet Crocking	
Brand	P-Value for Wash 1	P-Value for Wash 5	P-Value for Wash 1	P-Value for Wash 5
Lucky-Gap	0.020*	0.048*	0.461	0.030*
Lucky-Faded Glory	0.184	0.014*	0.038*	0.006*
Gap-Faded Glory	0.035*	0.067	0.005*	0.005*

***** Indicates statistically significant difference ($p<0.05$)

According to the results from one-way ANOVA, the smoothness retention of Lucky, Gap, and Faded Glory jeans did not change after one and five wash cycles. Moreover, the independent sample t-test found that there was no significant difference

between the average smoothness retention of Lucky, Gap, and Faded Glory jeans after home laundering.

Research question #3b. *Is there a difference between the durability characteristics of jeans at three price categories?*

The one-way ANOVA found that the fabric breaking strength of Gap jeans ($p=0.005$) changed after laundering. Based on this p-value, it can be concluded that there was a 5.2% increase in the fabric breaking strength of Gap jeans after five laundering cycles. The changes in fabric breaking strength of Lucky and Faded Glory jeans were not statistically significant. The results from one-way ANOVA also indicated that the 13% decrease in seam strength of sideseams in Lucky jeans ($p=0.011$) after laundering were statistically significant. The one-way ANOVA showed that there was no significant difference in seam strength of Gap and Faded Glory jeans after laundering.

Research question #3c. *Is there a difference between design specifications that determine fit of jeans at three price categories?*

After laundering, a higher level of dimensional change occurred in inseam and hip measurements of jeans. In Lucky jeans, there were 2.23% (0.76 in.) and 3% (0.72in.) decrease in inseam and hip measurements. The average amount of shrinkage in inseam and hip of Gap jeans were 2.8% (0.97 in.) and 2.67% (0.64 in.). Faded Glory jeans had the highest amount of inseam shrinkage, but the dimensional change in hip measurements was insignificant (less than 0.67%). After home laundering, the inseam measurements decreased 2.97% (1 in.). The decrease in the dimensions would impact the fit of Faded Glory jeans for the intended user.

Research question #4. *Do the appearance and performance characteristics of jeans at three price categories comply with the requirements of the ASTM D6554 / D6554M - 14 Standard Specification for 100 % Cotton Denim Fabrics?*

The ASTM D6554 / D6554M - 14 Standard Specification for 100 % Cotton Denim Fabrics provides the performance requirements for 100% cotton woven denim fabric prior to the manufacture of jeans (ASTM, 2014b). The results from colorfastness to laundering, colorfastness to dry and wet crocking, fabric breaking strength, and dimensional change of Lucky, Gap, and Faded Glory jeans were compared with ASTM D6554/D6554M-14 requirements for prewashed and medium-weight denim fabrics.

Results from this study suggested that the appearance and performance characteristics of Lucky, Gap, and Faded Glory jeans complied with standard specifications in ASTM D6554/D6554M-14. Table 4.34 summarizes the ASTM Standard Specification for 100 % Cotton Denim Fabrics.

Table 4.34

ASTM D6554 / D6554M - 14 Standard Specifications for 100 % Cotton Denim Fabrics

Characteristics	ASTM Requirements
Color Difference	Grade 2
Colorfastness to Dry Crocking	Grade 3
Colorfastness to Wet Crocking	Grade 1.5
Breaking Strength, Warp	130 lbf
Breaking Strength, Filling	55 lbf
Dimensional Change	4%

Chapter Five

Conclusions

This study evaluated the specifications, appearance and performance characteristics of jeans at three price categories prior to washing and after one and five laundering cycles. Three pairs of men's jeans from each brand of Lucky, Gap, and Faded Glory were evaluated in this research. The brands used in this study were representative of better, moderate, and mass merchant (budget) price categories.

All jeans were subjected to an inspection to identifying the design, material and construction specifications. The appearance and performance characteristics were assessed according to the test procedures from the AATCC, 2015 Edition and ASTM, 2015 Edition. Prior to washing, jeans testing included colorfastness to dry and wet crocking, fabric breaking strength, and seam strength. Then, jeans were laundered under similar washing conditions that included detergent brand and dose, washer and dryer type and cycle, and water temperature. In addition to all the tests mentioned above, the color difference, smoothness retention, and dimensional change of jeans were also evaluated after one and five laundering cycles. This study enabled the researcher to identify and compare the overall product specifications, appearance and performance characteristics of jeans based on their price category and to gain in-depth knowledge regarding the product quality of jeans. The research objectives for this study were as follows:

1. *To identify and compare the product specifications of jeans at three price categories.*

Lucky, Gap, and Faded Glory jeans had a similar style and a straight fit. Jeans used for this research were designed and manufactured for men with an inseam of 34 in. and a waist circumference of 36 in. However, the initial measurements of samples showed that the inseam and waist circumference of Gap jeans had higher variation from the expected inseam and waist circumference size. Moreover, the out of standard range waist circumference of Gap jeans made it affect the fit of jeans for the anticipated consumers.

In spite of some structural, design, and style similarities, the three jeans at each price category performed differently with regards to the material specifications. Lucky jeans were manufactured from a higher quality fabric (Italian premium denim) and

supporting devices including rivets and branding patch label. Compared to Gap, and Faded Glory jeans, the premium denim fabrics used in Lucky jeans had a lighter weight and were woven with finer yarns. Lucky and Gap jeans were sewn with polyester/cotton corespun threads which have superior quality in comparison with 100% polyester spun threads used in Faded Glory jeans. Using corespun threads in Lucky and Gap jeans minimized seam puckering and resulted in fewer stitch defects after laundering. Results from the visual inspection also revealed that Lucky jeans had less fabric defects. The fabric count and fabric weight of jeans were also evaluated after laundering. It was observed that machine washing and drying did not change the fabric count and fabric weight of Lucky, Gap, and Faded Glory jeans significantly. The minimal effect of laundering on these specifications was caused by the high number of yarn interfacing in twill weave fabrics which created more restriction on movement of yarns in warp and filling directions.

2. *To measure and compare the appearance and performance characteristics of jeans at three price categories before home laundering.*

The colorfastness to dry and wet crocking, fabric breaking strength, and seam strength of jeans were tested before home laundering and according to the appropriate AATCC procedures and ASTM standards. In terms of appearance evaluation, an independent sample t-test showed that Faded Glory jeans had significantly superior colorfastness to crocking characteristics, and Lucky jeans, which were the higher price item, performed poorly in colorfastness to dry and wet crocking test.

Evaluations of durability characteristics indicated that although all three categories of jeans had more than the acceptable level of fabric breaking strength, it was the lowest for Lucky jeans, followed by Faded Glory and Gap. Breaking strength of fabrics is influenced by factors including fabric weight and fabric finish (Fan & Hunter, 2009, pp. 180,352). Lucky jeans' fabrics were woven with finer yarns, resulting in lower fabric mass per unit area (fabric weight), which influenced the fabric breaking strength. Gap jeans high fabric breaking strength could also be caused by its type of finish (resin rinse) since resin treated fabrics have a higher tensile strength (Fan & Hunter, 2009, p. 352). The inseam and side seam of jeans were tested for seam strength evaluation. Both inseam and sideseam strength of Lucky jeans were comparably lower than Gap and

Faded Glory jeans. Three types of seam failure were observed in this study: fabric rupture, seam slippage, and sewing thread rupture. Lucky jeans had an advantage over jeans in other price categories in terms of seam failure type. In Lucky jeans 50% of failures were caused by sewing thread rupture, a repairable type of seam failure.

3. *To measure and compare the appearance and performance characteristics of jeans at three price categories after home laundering.*

The color difference, colorfastness to dry and wet crocking, smoothness retention, fabric breaking strength, seam strength, and dimensional change of Lucky, Gap, and Faded Glory jeans were assessed after one and five laundering cycles, following the AATCC procedures and ASTM standards. The assessments of appearance of jeans after home laundering showed that Lucky jeans had the lowest level of color fading followed by Faded Glory and Gap. Recently, workplace casualization is turning into an advantage for the denim industry. The high level of changes in color of Gap jeans after laundering is considered a major drawback since consumers have become more interested in dark denim jeans that can be worn to work and are less prone to fade after laundering (D'Adamo, 2015). In Lucky jeans the changes in color transferred to wet crock cloth after home laundering were not statistically significant. However, Lucky, the most expensive of the three jeans evaluated for this research had the poorest performance in both dry and wet crocking tests. Results from smoothness retention evaluation indicated that there was no significant difference between the smoothness retention of Lucky, Gap, and Faded Glory jeans, and all jeans had an acceptable level of smoothness after home laundering.

One-way ANOVA assessments of durability characteristics of jeans after home laundering found that among all three price categories, only the 5.2% decrease in Gap jeans fabric breaking strength was significant after five wash cycles. Another durability characteristic that was measured was the seam strength of sideseams and inseams. The results from one-way ANOVA indicated that apart from the decline in Lucky jeans inseam strength, the differences in seam strength of jeans were not statistically significant after home laundering. The decrease in fabric breaking strength of Gap jeans and inseam strength of Lucky jeans after laundering negatively influenced the durability of jeans, one of the five dimensions of apparel and textile quality which was defined as the length of

use of an apparel item before it becomes inappropriate for its original end use (Bubonia, 2014, p. 5; Kadolph, 2007, p. 21)

The dimensional change of jeans was evaluated as an indicator of fit after one and five wash cycles. On average, Lucky jeans had a relatively lower dimensional change compared to Gap and Faded Glory jeans. This could be caused by the higher fabric count and tighter fabric construction of Lucky jeans that led to better dimensional stability after laundering (Fan & Hunter, 2009, p. 348). Due to the twill weave fabric structure of denim jeans, the fabric shrinkage was restricted, and the overall average of dimensional change in all jeans was negligible (Topalbekiroğlu & Kaynak, 2008). However, the level of shrinkage in inseams of Gap and Faded Glory jeans were more than 2.8%. This level of shrinkage would affect the serviceability and conformance of jeans which are considered dimensions of textile and apparel quality. The 2.8% shrinkage of Gap and Faded Glory jeans did not conform to consumers' needs because it no longer meets their expectations regarding the fit of jeans (Aloudat, 2006). Moreover, this level of shrinkage indicated that Gap and Faded Glory jeans would not be serviceable, or relatively easy to maintain after home laundering.

4. *To compare the appearance and performance characteristics of jeans at three price categories with the ASTM Standard Specifications for 100% Cotton Denim Fabric.*

The characteristics compared to the ASTM Standard Specifications for 100% Cotton Denim Fabric were colorfastness to laundering (color difference), colorfastness to dry and wet crocking, fabric breaking strength, and dimensional change. All jeans in Lucky, Gap, and Faded Glory price categories successfully met the ASTM requirements.

This study found major differences in material specifications and measurements and similarities in design and constructional specification of Lucky, Gap, and Faded Glory jeans. Lucky, as the highest priced brand of jeans used in this study was manufactured with higher quality fabric and supporting material. In contrast, the measurement of Faded Glory jeans, the low-priced brand, matched more closely to both standard garment measurements for the selected size. Lucky and Gap jeans had a superior quality and appearance of seams and stitches.

According to data from Cotton Inc. Lifestyle Monitor (2014), consumers are willing to spend more money to get sturdier jeans. Important factors for men's jeans

purchases are comfort, fit, and durability while women are more likely to choose jeans based on style and brand name (CottonInc., 2015). Lucky jeans, which were the highest priced jeans in the study, were not as colorfast and had a lower fabric and seam breaking strength which would impact durability. However, after one and five wash cycles the dimensional changes not significant. Gap jeans, which were in the moderate price category, had the poorest color difference performance and the highest overall shrinkage. Gap jeans had the highest fabric breaking strength and the level of increase in fabric breaking strength was statistically significant. Although the color of Faded Glory jeans faded after laundering, the durability characteristics of jeans remained unchanged. Compared to Lucky and Gap, home laundering had less impact on appearance and performance characteristics of Faded Glory jeans, the lowest priced jeans of the three price categories.

The conclusion of this study is that Lucky, Gap, and Faded Glory jeans would meet the needs of their specific target market. Lucky jeans were made of premium denim fabric and included some construction details used in premium brand jeans but at a lower price. Consumers that are focused on style and design with less interest on durability characteristics would be able to justify the cost of Lucky jeans. Gap jeans were moderately priced and were targeted for the middle or upper class working professionals. The conclusion of this study showed that price-conscious consumers that are interested in durability as well as style and design would prefer Gap jeans. Finally, price-conscious consumers that are primarily interested in durability would prefer Faded Glory jeans. Faded Glory jeans would be desirable for the consumer conducting manual labor as well as the value-driven consumers who prefer basic jeans that are durable.

Limitations

The small sample size of jeans was one of the limitations of this study. Three pairs of jeans from each price category were used for evaluations and a lager sample size would provide a stronger representation of the appearance and performance quality characteristic of jeans. Although statistical analysis can be conducted with a small sample size, a larger sample size would increase the statistical power and reliability of the study. This study was only focused on men's jeans. The specification, appearance and performance characteristics of women's jeans may produce different results than men's

jeans. The inadequate information about the manufacturing methods and dying, washing, and finishing techniques of jeans used in this study was another limitation of this research. This information is vital since it can impact the appearance and performance quality characteristics of jeans. Lucky, Gap, and Faded Glory jeans in this study were obtained from only one channel of distribution, the official website of each brand. Jeans offered from other channels of distribution, including retailers, discounter stores, and outlets, might have different quality characteristics.

Recommendations for Future Research

Further research can be conducted on assessing the quality of jeans in different price categories after wear and care. A comparison between characteristics of used and unused jeans would provide a greater insight into the appearance of performance of jeans in different price categories. Based upon the results of this study, it is recommended to evaluate other characteristics of garments that affect the quality of jeans. Other evaluations that are quality indicators include abrasion, pilling, snagging resistance, and tear strength of jeans. Further studies can also evaluate the appearance and performance characteristics of jeans for women and children. A final recommendation is to extend these assessments to other types of garments to identify the product specifications and evaluate the appearance and performance characteristics based on the intended and targeted end-use of the apparel.

Appendix A
Definition of Terms

Autonomation - Automation with a human touch. The ability of production lines to be stopped in the event of problem (Saito, Kozo, & Cho, 2012).

Balance - Balance is related to the structural and grainline of the garment. For example, the length grain should be parallel to the length of the body at center front. The balance of the details of garments can be evaluated by trying on the apparel on a mannequin (J. Lee & Steen, 2015, p. 339).

Bridge -Refers to a price-point between designer and better (Keiser & Garner, 2012)

Color -"The visual sensation, varying according to spectral energy distribution of the light, which a person with normal color vision obtains when light from an object enters the human eye" (Tortora & Merkel, 1996, pp. 125-126).

Denim - "A well-known basic cotton or blended fabric usually woven in a 2/1 or 3/1 warp-faced right-hand twill" (Tortora & Merkel, 1996, p. 168).

Denim Jeans - "Ankle length pants traditionally made in faded blue or indigo denim" (Calasibetta et al., 2003, p. 355).

Ease - The difference between the measurements of the garment and the actual body measurements of the wearer at a specific point (J. Lee & Steen, 2015, p. 331).

Fly - Fly or fly front is a common method for applying different types of closures (Keiser & Garner, 2012, p. 220).

Grain - The direction of the fabric's threads used in the garment is grain (Keiser & Garner, 2012, p. 378).

Jeans Finishing - Different wet and dry process that can provide both functional and aesthetics properties. These processes can result in color fading, better handle and unique looks (Paul, 2015).

Indigo- Indigo is a name of a color derived from tentoria plant. Indigo dye one of the oldest dyes in history is made from leaves of specific plant species. Today, synthetic indigo is widely used for dying denim fabrics (Paul, 2015).

Just-In-Time- Just-In-Time refers to the method of manufacturing and delivering what is needed, in the amount needed, in specific time (Saito et al., 2012).

Line -The way that the structural lines of the garment follow to the lines of the body. (Keiser & Garner, 2012, p. 380).

Mass Merchant - A price category in which apparel are offered in different segments and at low affordable prices (Keiser & Garner, 2012, p. 47).

Mass Production – "Mass production is a way of manufacturing things en masse (and for the masses) that takes the initiative for choosing products out of the hands of the consumer and puts it into the hands of the manufacturer" (Smith, 2009).

Moderate - A price category in which apparel is priced below the better price-point, appealing more to mature consumers (Keiser & Garner, 2012, pp. 44,48).

Premium Jeans - Jeans that have superior fit and styling and are usually priced above 130$ (Paul, 2015, p. 206).

Quality- "The degree of excellence" that comports with consumers' values, needs, and perceptions (Stamper et al., 1991, p. 312).

Set - A garment that have smooth fit on the wearer without any unwanted wrinkles (Lee & Steen, 2015, p. 339).

Six Sigma - A quality concept commonly used when the manufacturing process is under statistical control (Maguad, 2006; Rooney & Rooney, 2005).

Sizing - Allocating a particular body type to categories that reflect the body measurements of people in that size group (Keiser & Garner, 2012, pp. 357-358).

Style - "A characteristic mode of design, construction, or texture in either a household or apparel fabric" (Tortora & Merkel, 1996, p. 550).

Trims - The surface treatments or decorative materials that give uniqueness to a style (Keiser & Garner, 2012, p. 231).

Twill Weave - A type of weave with diagonal ribs in either Z or S directions (Paul, 2015, p. 169).

Whisker - One of the design elements used on denim jeans, which is creating worn out lines and patterns that is usually generated by natural wearing on hips and the front thigh area (Paul, 2015, p. 327).

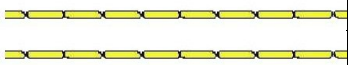
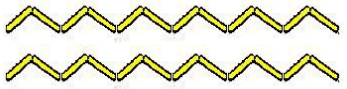
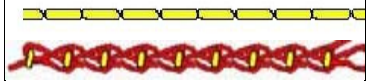
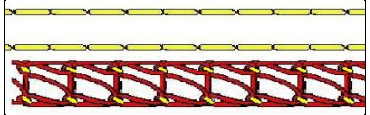
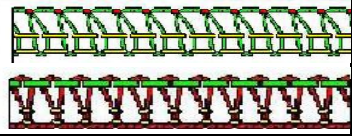
Yoke - A sewn-in panel used in different garments and especially pants and jeans, to create a fitted shape and style without the use of darts (J. Lee & Steen, 2015, p. 123).

Appendix B

Construction Specifications and Garment Measurements

Table B1

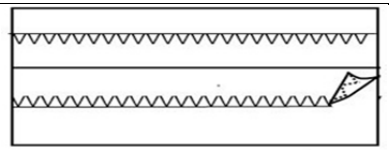
*Stitch Terminology**

Stitch Type				
Stitch Classification	Stitch Name	Sewing Machine	Stitch Description	Illustration
301	Lockstitch	Lockstitch	Formed by a needle thread passing through the material and interlocking with a bobbin thread with the threads meeting in the center of the seam. Stitch looks the same top & bottom	
304	Zig Zag Lockstitch	Lockstitch	Formed with a needle and a bobbin that are set in the center of the seam and form a symmetrical zig-zag pattern.	
401	Chainstitch	Chainstitch	Formed by 1-needle thread passing through the material and interloped with 1-looper thread and pulled up to the underside of the seam	
406	2-Needle bottom coverstitch	Chainstitch	Formed by 2-needle threads passing through the material and interloping with 1-looper thread with the stitch set on the underside of the seam.	
504	3-Thread overedge	Chainstitch	Formed with 1-needle thread and 2-looper threads with the looper threads forming a purl on the edge of the seam. For overedge seaming and serging.	
514	4-Threade overedge	Chainstitch	Formed with 2-needle threads and 2 looper threads with the looper threads forming a purl on the edge of the seam. 514 – both needles enter the upper looper loop.	

*American & Efird Inc. website. http://www.amefird.com/wp-content/uploads/2009/10/Stitch-Type-Matrix.pdf, Copyrigth 2009

Table B2

*Seam Terminology**

Seam Type			
Seam Class	Seam Notation	Common Application	Illustration
Plain seam, (busted)	SSa	A superimposed seam that is busted open, ironed and serged.	
Superimposed seam, Attaching tape to edge	SSaa	Attaching a Zipper tape to Fly Facing; Attaching Stay Tape to Armhole	
Enclosed seam, Superimposed seam class	SSe	For making collars & Cuffs on Shirts; attaching front pockets, bagging front pockets, setting fly on Chinos, etc.	
Lapped seam	LSq	Sideseam on jeans; Chinos; Jackets, etc.	
Lapped seam	LSas	Crotch Seaming on Jeans & Chinos	
Lapped seam	LSd	For setting patch pockets, flaps, pocket facings, etc. generally with a 301 Lockstitch	

*American & Efird Inc. website. http://www.amefird.com/wp-content/uploads/2009/10/Seam Type.pdf. Copyright 2006 American & Efird Inc

Table B2 (continued)

*Seam Terminology**

Seam Type			
Seam Class	Seam Notation	Common Application	Illustration
Edge Finishes	EFb	Hemming Shirts, Jeans, Shorts, etc.	
Bound seam	BSc	For setting sleeve facings to shirts, piping edges of outerwear, etc. Can be sewn with a 301 lockstitch or 401 Chainstitch	
Edge finishes hem	EFh	Making Belt Loops for Jeans and Casual Pants, Shorts, Etc. Usually sewn with 406 stitch.	

*American & Efird Inc. website. http://www.amefird.com/wp-content/uploads/2009/10/Seam Type.pdf. Copyright 2006 by American & Efird Inc

Table B3

Garment Measurements, Lucky Jeans

Garment Measurement, Lucky, Initial											
Location	Sample 1			Sample 2			Sample 3			Overall Avg (in.)	SD*
	Rate 1 (in.)	Rate 2 (in.)	Avg (in.)	Rate 1 (in.)	Rate 2 (in.)	Avg (in.)	Rate 1 (in.)	Rate 2 (in.)	Avg (in.)		
Length											
Front Rise	10.83	10.79	10.81	10.43	10.39	10.41	10.51	10.63	10.57	10.60	0.18
Back Rise	15.16	15.16	15.16	14.88	14.88	14.88	14.45	14.57	14.51	14.85	0.29
Inseam	34.49	34.61	34.55	34.06	33.98	34.02	34.13	34.06	34.09	34.22	0.26
Side seam	44.45	44.29	44.37	43.90	43.90	43.90	44.21	44.25	44.23	44.17	0.22
Width											
Waist Circumference	38.11	38.19	38.15	37.80	37.95	37.87	36.38	36.22	36.30	37.44	0.90
Thigh	13.98	14.13	14.06	14.02	14.06	14.04	14.02	14.09	14.06	14.05	0.06
Hip	23.78	23.62	23.70	24.17	24.06	24.11	24.17	24.17	24.17	24.00	0.24
Leg Opening Circumference	18.19	18.11	18.15	18.03	18.03	18.03	17.95	18.07	18.01	18.06	0.08

*SD: Standard Deviation

Table B3 (continued)

Garment Measurements, Lucky Jeans

Garment Measurement, Lucky, Wash 1											
Location	Sample 1			Sample 2			Sample 3			Overall Avg (in.)	SD*
	Rate 1 (in.)	Rate 2 (in.)	Avg (in.)	Rate 1 (in.)	Rate 2 (in.)	Avg (in.)	Rate 1 (in.)	Rate 2 (in.)	Avg (in.)		
Length											
Front Rise	10.63	10.69	10.66	10.38	10.31	10.34	10.56	10.50	10.53	10.51	0.14
Back Rise	15.13	15.19	15.16	15.13	15.06	15.09	14.75	14.69	14.72	14.99	0.21
Inseam	34.00	33.94	33.97	33.63	33.56	33.59	33.75	33.75	33.75	33.77	0.17
Side seam	43.75	44.00	43.88	43.63	43.63	43.63	44.13	44.12	44.12	43.87	0.24
Width											
Waist Circumference	38.00	38.13	38.07	38.25	38.13	38.19	36.25	36.25	36.25	37.50	0.97
Thigh	14.00	14.06	14.03	14.06	14.06	14.06	14.00	14.00	14.00	14.03	0.03
Hip	23.13	23.25	23.19	23.75	23.75	23.75	23.88	23.88	23.88	23.61	0.33
Leg Opening Circumference	18.13	18.00	18.07	17.75	18.00	17.88	18.00	18.00	18.00	17.98	0.12

*SD: Standard Deviation

Table B3 (continued)

Garment Measurements, Lucky Jeans

Garment Measurement, Lucky, Wash 5											
Location	Sample 1			Sample 2			Sample 3			Overall Avg (in.)	SD*
	Rate 1 (in.)	Rate 2 (in.)	Avg (in.)	Rate 1 (in.)	Rate 2 (in.)	Avg (in.)	Rate 1 (in.)	Rate 2 (in.)	Avg (in.)		
Length											
Front Rise	10.63	10.63	10.63	10.25	10.31	10.28	10.56	10.50	10.53	10.48	0.16
Back Rise	15.06	15.13	15.09	15.13	15.06	15.09	14.50	14.56	14.53	14.91	0.29
Inseam	33.88	33.81	33.84	33.19	33.25	33.22	33.25	33.31	33.28	33.45	0.31
Side seam	43.94	43.88	43.91	43.31	43.31	43.31	43.75	43.75	43.75	43.66	0.28
Width											
Waist Circumference	37.88	37.75	37.82	37.63	37.63	37.63	35.88	36.00	35.94	37.13	0.93
Thigh	14.19	14.06	14.13	13.94	13.94	13.94	14.13	14.13	14.13	14.06	0.10
Hip	22.75	22.75	22.75	23.25	23.75	23.50	23.63	23.63	23.63	23.29	0.45
Leg Opening Circumference	18.13	18.13	18.13	17.75	17.88	17.82	17.88	12.82	15.35	17.10	2.10

*SD: Standard Deviation

Table B4

Garment Measurements, Gap Jeans

Garment Measurement, Gap, Initial											
Location	Sample 1			Sample 2			Sample 3			Overall Avg (in.)	SD*
	Rate 1 (in.)	Rate 2 (in.)	Avg (in.)	Rate 1 (in.)	Rate 2 (in.)	Avg (in.)	Rate 1 (in.)	Rate 2 (in.)	Avg (in.)		
Length											
Front Rise	10.38	10.38	10.38	10.53	10.49	10.51	10.34	10.45	10.39	10.43	0.08
Back Rise	15.25	15.33	15.29	15.25	15.25	15.25	15.09	15.09	15.09	15.21	0.10
Inseam	34.47	34.54	34.51	34.62	34.66	34.64	34.70	34.58	34.64	34.60	0.08
Side seam	43.62	43.94	43.78	44.33	44.41	44.37	44.06	44.25	44.15	44.10	0.29
Width											
Waist Circumference	38.67	38.51	38.59	40.09	39.93	40.01	39.14	39.30	39.22	39.27	0.64
Thigh	13.91	14.03	13.97	13.79	13.95	13.87	13.99	13.99	13.99	13.94	0.08
Hip	23.54	24.09	23.82	23.50	23.54	23.52	24.05	24.05	24.05	23.80	0.29
Leg Opening Circumference	19.85	19.93	19.89	19.02	19.02	19.02	19.69	19.73	19.71	19.54	0.41

*SD: Standard Deviation

Table B4 (continued)

Garment Measurements, Gap Jeans

Garment Measurement, Gap, Wash 1											
Location	Sample 1			Sample 2			Sample 3			Overall Avg (in.)	SD*
	Rate 1 (in.)	Rate 2 (in.)	Avg (in.)	Rate 1 (in.)	Rate 2 (in.)	Avg (in.)	Rate 1 (in.)	Rate 2 (in.)	Avg (in.)		
Length											
Front Rise	10.31	10.25	10.28	10.50	10.56	10.53	10.44	10.38	10.41	10.41	0.12
Back Rise	15.19	15.25	15.22	15.13	15.19	15.16	15.25	15.13	15.19	15.19	0.06
Inseam	33.69	33.69	33.69	34.13	34.07	34.10	34.00	34.00	34.00	33.93	0.19
Side seam	43.44	43.38	43.41	43.88	43.94	43.91	43.81	43.41	43.61	43.64	0.26
Width											
Waist Circumference	38.25	38.50	38.38	39.00	39.00	39.00	38.75	38.75	38.75	38.71	0.29
Thigh	13.88	13.88	13.88	13.75	13.75	13.75	13.93	13.88	13.90	13.84	0.08
Hip	23.13	23.13	23.13	23.00	23.00	23.00	23.25	23.50	23.38	23.17	0.19
Leg Opening Circumference	19.75	19.88	19.82	19.13	19.13	19.13	19.75	19.75	19.75	19.57	0.34

*SD: Standard Deviation

Table B4 (continued)

Garment Measurements, Gap Jeans

Garment Measurement, Gap, Wash 5											
Location	Sample 1			Sample 2			Sample 3			Overall Avg (in.)	SD*
	Rate 1 (in.)	Rate 2 (in.)	Avg (in.)	Rate 1 (in.)	Rate 2 (in.)	Avg (in.)	Rate 1 (in.)	Rate 2 (in.)	Avg (in.)		
Length											
Front Rise	10.19	10.13	10.16	10.50	10.50	10.50	10.31	10.31	10.31	10.32	0.16
Back Rise	15.25	15.19	15.22	15.19	15.19	15.19	15.25	15.19	15.22	15.21	0.03
Inseam	33.13	33.38	33.25	34.00	33.88	33.94	33.63	33.75	33.69	33.63	0.33
Side seam	43.19	43.25	43.22	43.75	43.81	43.78	43.63	43.63	43.63	43.54	0.26
Width											
Waist Circumference	38.13	38.25	38.19	39.00	39.13	39.07	38.63	38.63	38.63	38.63	0.40
Thigh	13.75	13.81	13.78	13.69	13.69	13.69	13.88	13.81	13.84	13.77	0.08
Hip	23.13	23.00	23.07	22.88	23.00	22.94	23.38	23.25	23.32	23.11	0.18
Leg Opening Circumference	19.63	19.63	19.63	18.88	18.88	18.88	19.50	19.25	19.38	19.30	0.35

*SD: Standard Deviation

Table B5

Garment Measurements, Faded Glory Jeans

Garment Measurement, Faded Glory, Initial											
Location	Sample 1			Sample 2			Sample 3			Overall Avg (in.)	SD*
	Rate 1 (in.)	Rate 2 (in.)	Avg (in.)	Rate 1 (in.)	Rate 2 (in.)	Avg (in.)	Rate 1 (in.)	Rate 2 (in.)	Avg (in.)		
Length											
Front Rise	10.41	10.57	10.49	10.53	10.61	10.57	10.38	10.41	10.39	10.49	0.10
Back Rise	14.78	14.62	14.70	14.66	14.78	14.72	14.86	14.93	14.89	14.77	0.12
Inseam	34.43	34.35	34.39	33.80	33.84	33.82	33.92	33.84	33.88	34.03	0.28
Side seam	43.74	43.78	43.76	43.47	43.39	43.43	43.94	43.82	43.88	43.69	0.21
Width											
Waist Circumference	38.59	38.51	38.55	37.41	37.57	37.49	37.57	37.41	37.49	37.85	0.55
Thigh	13.64	13.68	13.66	13.36	13.44	13.40	13.68	13.60	13.64	13.57	0.13
Hip	22.83	22.91	22.87	22.87	22.95	22.91	22.52	22.48	22.50	22.76	0.21
Leg Opening Circumference	18.16	18.31	18.24	18.47	18.31	18.39	18.39	18.39	18.39	18.34	0.11

*SD: Standard Deviation

Table B5 (continued)

Garment Measurements, Faded Glory Jeans

Garment Measurement, Faded Glory, Wash 1											
Location	Sample 1			Sample 2			Sample 3			Overall Avg (in.)	SD*
	Rate 1 (in.)	Rate 2 (in.)	Avg (in.)	Rate 1 (in.)	Rate 2 (in.)	Avg (in.)	Rate 1 (in.)	Rate 2 (in.)	Avg (in.)		
Length											
Front Rise	10.31	10.25	10.28	10.50	10.56	10.53	10.44	10.38	10.41	10.41	0.12
Back Rise	15.19	15.25	15.22	15.13	15.19	15.16	15.25	15.13	15.19	15.19	0.06
Inseam	33.69	33.69	33.69	34.13	34.07	34.10	34.00	34.00	34.00	33.93	0.19
Side seam	43.44	43.38	43.41	43.88	43.94	43.91	43.81	43.41	43.61	43.64	0.26
Width											
Waist Circumference	38.25	38.50	38.38	39.00	39.00	39.00	38.75	38.75	38.75	38.71	0.29
Thigh	13.88	13.88	13.88	13.75	13.75	13.75	13.93	13.88	13.90	13.84	0.08
Hip	23.13	23.13	23.13	23.00	23.00	23.00	23.25	23.50	23.38	23.17	0.19
Leg Opening Circumference	19.75	19.88	19.82	19.13	19.13	19.13	19.75	19.75	19.75	19.57	0.34

*SD: Standard Deviation

Table B5 (continued)

Garment Measurements, Faded Glory Jeans

Garment Measurement, Faded Glory, Wash 5											
Location	Sample 1			Sample 2			Sample 3			Overall Avg (in.)	SD*
	Rate 1 (in.)	Rate 2 (in.)	Avg (in.)	Rate 1 (in.)	Rate 2 (in.)	Avg (in.)	Rate 1 (in.)	Rate 2 (in.)	Avg (in.)		
Length											
Front Rise	10.25	10.31	10.28	10.38	10.50	10.44	10.38	10.31	10.34	10.35	0.09
Back Rise	15.00	14.63	14.81	14.63	14.63	14.63	14.75	14.75	14.75	14.73	0.15
Inseam	33.38	32.88	33.13	32.88	32.88	32.88	33.06	33.06	33.06	33.02	0.20
Side seam	43.13	43.25	43.19	42.75	42.88	42.81	42.81	42.69	42.75	42.92	0.22
Width											
Waist Circumference	37.63	37.35	37.49	37.13	37.13	37.13	37.00	37.00	37.00	37.21	0.24
Thigh	13.44	13.44	13.44	13.25	13.25	13.25	13.63	13.56	13.59	13.43	0.16
Hip	22.63	22.63	22.63	22.88	23.00	22.94	22.38	22.38	22.38	22.65	0.25
Leg Opening Circumference	18.38	18.25	18.32	18.13	18.13	18.13	18.25	18.25	18.25	18.23	0.09

*SD: Standard Deviation

Table B6

Yarn Number, Lucky, Gap, and Faded Glory Jeans

ASTM D1059-01 Standard Test Method for Yarn Number Based on Short-Length Specimens*

Yarn Number, Lucky							
Sample	Number of Yarn Specimens	Length (in.)	Length (yd)	Yarn Weight (g)	Yarn Number (yd/lb)	Average Warp (yd/lb)	Average Filling (yd/lb)
Sample 1							
Warp	6	7	0.194	0.075	8.41		
Fill	6	7	0.194	0.069	9.14		
Sample 2							
Warp	6	7	0.194	0.074	8.52	8.76	8.97
Fill	6	7	0.194	0.071	8.88		
Sample 3							
Warp	6	7	0.194	0.072	8.76		
Fill	6	7	0.194	0.071	8.88		
Yarn Number, Gap							
Sample 1							
Warp	6	7	0.194	0.101	6.24		
Fill	6	7	0.194	0.079	7.98		
Sample 2							
Warp	6	7	0.194	0.102	6.18	6.06	7.88
Fill	6	7	0.194	0.081	7.78		
Sample 3							
Warp	6	7	0.194	0.104	6.06		
Fill	6	7	0.194	0.08	7.88		

* Calculations are based on indirect yarn numbering system.

Table B6 (continued)

Yarn Number, Lucky, Gap, and Faded Glory Jeans

ASTM D1059-01 Standard Test Method for Yarn Number Based on Short-Length Specimens*

Yarn Number, Faded Glory							
Sample	Number of Yarn Specimens	Length (in.)	Length (yd)	Yarn Weight (g)	Yarn Number (yd/lb)	Average Warp (yd/lb)	Average Filling (yd/lb)
Sample 1							
Warp	6	7	0.194	0.112	5.63		
Fill	6	7	0.194	0.095	6.64		
Sample 2							
Warp	6	7	0.194	0.114	5.53	5.48	6.71
Fill	6	7	0.194	0.092	6.85		
Sample 3							
Warp	6	7	0.194	0.115	5.48		
Fill	6	7	0.194	0.095	6.64		

* Calculations are based on indirect yarn numbering system.

Table B7

Fabric Weight, Lucky Jeans

ASTM D3776/D3776M-09a, Standard Test Methods for Mass Per Unit Area (Weight) of Fabric

Fabric Weight, Lucky, Initial														
Sample 1					Sample 2					Sample 3				
Specimen	Weight (g)	Weight (oz/yd²)	Avg (oz/yd²)	SD*	Specimen	Weight (g)	Weight (oz/yd²)	Avg (oz/yd²)	SD*	Specimen	Weight (g)	Weight (oz/yd²)	Avg (oz/yd²)	SD*
1	1.39	10.68	10.63	0.18	1	1.38	10.62	10.47	0.13	1	1.35	10.40	10.26	0.25
2	1.36	10.43			2	1.35	10.40			2	1.30	9.97		
3	1.40	10.78			3	1.35	10.40			3	1.35	10.41		
Fabric Weight, Lucky, Wash 1														
Sample 1					Sample 2					Sample 3				
Specimen	Weight (g)	Weight (oz/yd²)	Avg (oz/yd²)	SD*	Specimen	Weight (g)	Weight (oz/yd²)	Avg (oz/yd²)	SD*	Specimen	Weight (g)	Weight (oz/yd²)	Avg (oz/yd²)	SD*
1	1.39	10.68	10.72	0.11	1	1.36	10.47	10.55	0.08	1	1.40	10.78	10.63	0.12
2	1.41	10.85			2	1.38	10.64			2	1.37	10.56		
3	1.38	10.64			3	1.37	10.55			3	1.37	10.57		
Fabric Weight, Lucky, Wash 5														
Sample 1					Sample 2					Sample 3				
Specimen	Weight (g)	Weight (oz/yd²)	Avg (oz/yd²)	SD*	Specimen	Weight (g)	Weight (oz/yd²)	Avg (oz/yd²)	SD*	Specimen	Weight (g)	Weight (oz/yd²)	Avg (oz/yd²)	SD*
1	1.37	10.56	10.62	0.06	1	1.38	10.60	10.62	0.02	1	1.41	10.86	10.66	0.18
2	1.39	10.68			2	1.38	10.64			2	1.37	10.56		
3	1.38	10.63			3	1.38	10.63			3	1.37	10.55		

*SD: Standard Deviation

Table B8

Fabric Weight, Gap Jeans

ASTM D3776/D3776M-09a, Standard Test Methods for Mass Per Unit Area (Weight) of Fabric

Fabric Weight, Gap, Initial														
Sample 1					Sample 2					Sample 3				
Specimen	Weight (g)	Weight (oz/yd²)	Avg (oz/yd²)	SD*	Specimen	Weight (g)	Weight (oz/yd²)	Avg (oz/yd²)	SD*	Specimen	Weight (g)	Weight (oz/yd²)	Avg (oz/yd²)	SD*
1	1.53	11.80	11.91	0.10	1	1.56	11.97	12.15	0.21	1	1.53	11.79	11.75	0.11
2	1.56	11.97			2	1.61	12.38			2	1.54	11.82		
3	1.56	11.98			3	1.57	12.11			3	1.51	11.62		
Fabric Weight, Gap, Wash 1														
Sample 1					Sample 2					Sample 3				
Specimen	Weight (g)	Weight (oz/yd²)	Avg (oz/yd²)	SD*	Specimen	Weight (g)	Weight (oz/yd²)	Avg (oz/yd²)	SD*	Specimen	Weight (g)	Weight (oz/yd²)	Avg (oz/yd²)	SD*
1	1.61	12.40	12.23	0.15	1	1.59	12.25	12.35	0.16	1	1.57	12.05	11.98	0.09
2	1.58	12.18			2	1.59	12.26			2	1.56	11.99		
3	1.57	12.10			3	1.63	12.54			3	1.54	11.88		
Fabric Weight, Gap, Wash 5														
Sample 1					Sample 2					Sample 3				
Specimen	Weight (g)	Weight (oz/yd²)	Avg (oz/yd²)	SD*	Specimen	Weight (g)	Weight (oz/yd²)	Avg (oz/yd²)	SD*	Specimen	Weight (g)	Weight (oz/yd²)	Avg (oz/yd²)	SD*
1	1.58	12.17	12.27	0.09	1	1.56	11.98	12.22	0.21	1	1.56	12.01	12.05	0.03
2	1.60	12.29			2	1.60	12.32			2	1.57	12.08		
3	1.60	12.35			3	1.61	12.37			3	1.57	12.05		

*SD: Standard Deviation

Table B9

Fabric Weight, Faded Glory Jeans

ASTM D3776/D3776M-09a, Standard Test Methods for Mass Per Unit Area (Weight) of Fabric

Fabric Weight, Faded Glory, Initial														
Sample 1					Sample 2					Sample 3				
Specimen	Weight (g)	Weight (oz/yd²)	Avg (oz/yd²)	SD*	Specimen	Weight (g)	Weight (oz/yd²)	Avg (oz/yd²)	SD*	Specimen	Weight (g)	Weight (oz/yd²)	Avg (oz/yd²)	SD*
1	1.65	12.70	12.77	0.11	1	1.73	13.29	13.23	0.06	1	1.67	12.85	12.73	0.12
2	1.65	12.72			2	1.72	13.22			2	1.64	12.62		
3	1.68	12.89			3	1.71	13.17			3	1.65	12.72		
Fabric Weight, Faded Glory, Wash 1														
Sample 1					Sample 2					Sample 3				
Specimen	Weight (g)	Weight (oz/yd²)	Avg (oz/yd²)	SD*	Specimen	Weight (g)	Weight (oz/yd²)	Avg (oz/yd²)	SD*	Specimen	Weight (g)	Weight (oz/yd²)	Avg (oz/yd²)	SD*
1	1.65	12.68	12.81	0.16	1	1.67	12.83	12.83	0.05	1	1.66	12.75	13.10	0.31
2	1.66	12.75			2	1.66	12.78			2	1.73	13.35		
3	1.69	12.99			3	1.67	12.88			3	1.72	13.21		
Fabric Weight, Faded Glory, Wash 5														
Sample 1					Sample 2					Sample 3				
Specimen	Weight (g)	Weight (oz/yd²)	Avg (oz/yd²)	SD*	Specimen	Weight (g)	Weight (oz/yd²)	Avg (oz/yd²)	SD*	Specimen	Weight (g)	Weight (oz/yd²)	Avg (oz/yd²)	SD*
1	1.69	13.02	12.86	0.15	1	1.68	12.95	12.94	0.09	1	1.67	12.82	12.78	0.16
2	1.67	12.82			2	1.69	13.02			2	1.64	12.61		
3	1.66	12.74			3	1.67	12.84			3	1.68	12.92		

*SD: Standard Deviation

Table B9

Fabric Count, Lucky Jeans

ASTM D3775-12, Standard Test Method for Warp (End) and Filling (Pick) Count of Woven Fabrics**

Specimen	Initial, Sample 1					Wash 1, Sample 1					Wash 5, Sample 1				
	Warp	Filling	Fabric Count	Avg	SD*	Warp	Filling	Fabric Count	Avg	SD*	Warp	Filling	Fabric Count	Avg	SD*
1	82	49	82×49	82×50	0.58×0.58	81	50	81×50	80×51	1.15×1	79	49	79×49	80×51	1×1
2	83	50	83×50			79	52	79×52			80	50	80×50		
3	82	50	82×50			79	51	79×51			81	51	81×51		
Specimen	Initial, Sample 2					Wash 1, Sample 2					Wash 5, Sample 2				
	Warp	Filling	Fabric Count	Avg	SD*	Warp	Filling	Fabric Count	Avg	SD*	Warp	Filling	Fabric Count	Avg	SD*
1	83	50	83×50	82×50	1.15×1	80	51	80×51	79×51	0.58×1	80	50	80×50	80×50	0.58×0.58
2	81	51	81×51			79	50	79×50			79	51	79×51		
3	83	49	83×49			79	52	79×52			80	50	80×50		
Specimen	Initial, Sample 3					Wash1, Sample 3					Wash 5, Sample 3				
	Warp	Filling	Fabric Count	Avg	SD*	Warp	Filling	Fabric Count	Avg	SD*	Warp	Filling	Fabric Count	Avg	SD*
1	82	50	82×50	82×51	1.15×0.58	77	51	77×51	77×51	0.58×0.58	80	49	80×49	80×50	0.58×0.58
2	80	51	80×51			77	50	77×50			79	50	79×50		
3	82	51	82×51			76	51	76×51			80	50	80×50		
	Overall Average			82×50		Overall Average			79×51		Overall Average			80×50	

*SD: Standard Deviation

**Calculations are based on yarns per inch.

Table B10

Fabric Count, Gap Jeans

ASTM D3775-12, Standard Test Method for Warp (End) and Filling (Pick) Count of Woven Fabrics**

Specimen	Initial, Sample 1					Wash 1, Sample 1					Wash 5, Sample 1				
	Warp	Filling	Fabric Count	Avg	SD*	Warp	Filling	Fabric Count	Avg	SD*	Warp	Filling	Fabric Count	Avg	SD*
1	68	52	68×52	69×51	1.15×1	69	50	69×50	69×50	1.53×0.58	68	50	68×50	69×51	1×0.58
2	68	51	68×51			71	50	71×50			69	51	69×51		
3	70	50	70×50			68	51	68×51			70	51	70×51		
Specimen	Initial, Sample 2					Wash 1, Sample 2					Wash 5, Sample 2				
	Warp	Filling	Fabric Count	Avg	SD*	Warp	Filling	Fabric Count	Avg	SD*	Warp	Filling	Fabric Count	Avg	SD*
1	69	50	69×50	69×49	0.58×0.58	70	51	70×51	70×50	0.58×0.58	70	50	70×50	70×51	0.58×1
2	69	49	69×49			70	50	70×50			69	51	69×51		
3	70	49	70×49			71	50	71×50			70	52	70×52		
Specimen	Initial, Sample 3					Wash1, Sample 3					Wash 5, Sample 3				
	Warp	Filling	Fabric Count	Avg	SD*	Warp	Filling	Fabric Count	Avg	SD*	Warp	Filling	Fabric Count	Avg	SD*
1	69	50	69×50	70×49	0.58×0.58	69	49	69×49	70×49	1×0.58	69	51	69×51	69×51	0.58×0.58
2	70	49	70×49			70	50	70×50			69	50	69×50		
3	70	49	70×49			71	49	71×49			70	51	70×51		
	Overall Average			69×50		Overall Average			70×50		Overall Average			69×51	

*SD: Standard Deviation

**Calculations are based on yarns per inch.

Table B11

Fabric Count, Faded Glory Jeans

ASTM D3775-12, Standard Test Method for Warp (End) and Filling (Pick) Count of Woven Fabrics*

Specimen	Initial, Sample 1					Wash 1, Sample 1					Wash 5, Sample 1				
	Warp	Filling	Fabric Count	Avg	SD* Warp	Warp	Filling	Fabric Count	Avg	SD	Warp	Filling	Fabric Count	Avg	SD*
1	63	43	63×43	63×42	0.58× 0.58	65	44	65×44	66×43	1×0.58	67	43	67×43	66×43	0.58× 0.58
2	63	42	63×42			67	43	67×43			66	42	66×42		
3	64	42	64×42			66	43	66×43			66	43	66×43		
Specimen	Initial, Sample 2					Wash 1, Sample 2					Wash 5, Sample 2				
	Warp	Filling	Fabric Count	Avg	SD*	Warp	Filling	Fabric Count	Avg	SD	Warp	Filling	Fabric Count	Avg	SD*
1	64	43	64×43	64×43	1×0.58	66	43	66×43	67×42	1.15×1	65	44	65×44	66×43	0.58× 0.58
2	63	44	63×44			68	41	68×41			66	43	66×43		
3	65	43	65×43			66	42	66×42			66	43	66×43		
Specimen	Initial, Sample 3					Wash1, Sample 3					Wash 5, Sample 3				
	Warp	Filling	Fabric Count	Avg	SD*	Warp	Filling	Fabric Count	Avg	SD	Warp	Filling	Fabric Count	Avg	SD*
1	64	43	64×43	65×42	0.58× 0.58	68	43	68×43	67×44	1×1.15	66	43	66×43	66×43	1×0.58
2	65	42	65×42			66	45	66×45			67	43	67×43		
3	65	42	65×42			67	43	67×43			65	44	65×44		
	Overall Average			64×42		Overall Average			67×43		Overall Average			66×43	

*SD: Standard Deviation

**Calculations are based on yarns per inch.

Appendix C

Appearance and Performance Evaluations

Table C1

Color Fading, Lucky, Gap, and Faded Glory Jeans

AATCC Evaluation Procedure 9-2011, Visual assessment of Color Difference of Textiles**

Color Fading, Lucky, Wash 1						Color Fading, Lucky, Wash 5					
Sample	Rate 1	Rate 2	Average	SD*	Overall Average	Sample	Rate 1	Rate 2	Average	SD*	Overall Average
1	4.50	4.50	4.50	0.14	4.33	1	3.50	3.50	3.50	0.00	3.50
2	4.50	4.00	4.25			2	3.50	3.50	3.50		
3	4.00	4.50	4.25			3	3.50	3.50	3.50		
Color Fading, Gap, Wash 1						Color Fading, Gap, Wash 5					
Sample	Rate 1	Rate 2	Average	SD*	Overall Average	Sample	Rate 1	Rate 2	Average	SD*	Overall Average
1	4.00	3.50	3.75	0.14	3.83	1	2.50	2.00	2.25	0.00	2.25
2	3.50	4.00	3.75			2	2.50	2.00	2.25		
3	4.00	4.00	4.00			3	2.50	2.00	2.25		
Color Fading, Faded Glory, Wash 1						Color Fading, Faded Glory, Wash 5					
Sample	Rate 1	Rate 2	Average	SD*	Overall Average	Sample	Rate 1	Rate 2	Average	SD*	Overall Average
1	3.50	4.00	3.75	0.14	3.67	1	3.00	3.50	3.25	0.00	3.25
2	3.50	3.50	3.50			2	3.50	3.00	3.25		
3	3.50	4.00	3.75			3	3.00	3.50	3.25		

*SD: Standard Deviation

** Specimens are rated according to the AATCC Gray Scale for Color Change with rating scale of 1-5. Grade 1 indicates severe color change and grade 5 indicates no color change

Table C2

Color Fastness to Dry Crocking, Lucky Jeans

AATCC Test Method 8-2013, Colorfastness to Crocking: Crockmeter Method**

Specimen	Dry Crocking, Lucky, Initial											
	Sample 1		Avg	SD*	Sample 2		Avg	SD*	Sample 3		Avg	SD*	Overall Avg
	Rate 1	Rate 2			Rate 1	Rate 2			Rate 1	Rate 2			
1	4.00	4.50	4.25	0.00	4.50	4.00	4.25	0.14	4.50	4.00	4.25	0.14	4.14
2	4.00	4.50	4.25		4.00	4.00	4.00		4.00	4.00	4.00		
3	4.00	4.50	4.25		4.00	4.00	4.00		4.00	4.00	4.00		
Specimen	Dry Crocking, Lucky, Wash 1											
	Sample 1		Avg	SD*	Sample 2		Avg	SD*	Sample 3		Avg	SD*	Overall Avg
	Rate 1	Rate 2			Rate 1	Rate 2			Rate 1	Rate 2			
1	4.50	4.50	4.50	0.14	4.50	4.50	4.50	0.14	4.50	5.00	4.75	0.25	4.69
2	4.50	5.00	4.75		4.50	5.00	4.75		5.00	5.00	5.00		
3	4.50	5.00	4.75		4.50	5.00	4.75		4.50	4.50	4.50		
Specimen	Dry Crocking, Lucky, Wash 5											
	Sample 1		Avg	SD*	Sample 2		Avg	SD*	Sample 3		Avg	SD*	Overall Avg
	Rate 1	Rate 2			Rate 1	Rate 2			Rate 1	Rate 2			
1	4.50	4.50	4.50	0.14	4.50	4.50	4.50	0.00	4.50	4.50	4.50	0.00	4.53
2	4.50	4.50	4.50		4.50	4.50	4.50		4.50	4.50	4.50		
3	4.50	5.00	4.75		4.50	4.50	4.50		4.50	4.50	4.50		

*SD: Standard Deviation

**Specimens are rated according to the AATCC Gray Scale for Staining with rating scale of 1-5. Grade1 indicates “extreme color change" and grade 5 indicates to "no color change".

Table C3

Color Fastness to Dry Crocking, Gap Jeans

AATCC Test Method 8-2013, Colorfastness to Crocking: Crockmeter Method**

Specimen	Dry Crocking, Gap, Initial											
	Sample 1		Avg	SD*	Sample 2		Avg	SD*	Sample 3		Avg	SD*	Overall Avg
	Rate 1	Rate 2			Rate 1	Rate 2			Rate 1	Rate 2			
1	4.50	4.50	4.50	0.14	4.00	4.50	4.25	0.00	4.00	4.50	4.25	0.14	4.22
2	4.50	4.00	4.25		4.50	4.00	4.25		4.00	4.00	4.00		
3	4.50	4.00	4.25		4.50	4.00	4.25		4.00	4.00	4.00		
Specimen	Dry Crocking, Gap, wash 1											
	Sample 1		Avg	SD*	Sample 2		Avg	SD*	Sample 3		Avg	SD*	Overall Avg
	Rate 1	Rate 2			Rate 1	Rate 2			Rate 1	Rate 2			
1	4.50	4.50	4.50	0.14	4.00	4.50	4.25	0.14	4.00	4.50	4.25	0.14	4.47
2	4.50	5.00	4.75		4.50	4.50	4.50		4.50	4.50	4.50		
3	4.50	4.50	4.50		4.50	4.50	4.50		4.50	4.50	4.50		
Specimen	Dry Crocking, Gap, Wash 5											
	Sample 1		Avg	SD*	Sample 2		Avg	SD*	Sample 3		Avg	SD*	Overall Avg
	Rate 1	Rate 2			Rate 1	Rate 2			Rate 1	Rate 2			
1	4.50	5.00	4.75	0.14	4.50	4.50	4.50	0.14	4.50	5.00	4.75	0.14	4.64
2	4.50	4.50	4.50		4.50	5.00	4.75		4.50	4.50	4.50		
3	4.50	5.00	4.75		4.50	4.50	4.50		4.50	5.00	4.75		

*SD: Standard Deviation

**Specimens are rated according to the AATCC Gray Scale for Staining with rating scale of 1-5. Grade1 indicates "extreme color change" and grade 5 indicates to "no color change".

Table C4

Color Fastness to Dry Crocking, Faded Glory Jeans

AATCC Test Method 8-2013, Colorfastness to Crocking: Crockmeter Method**

Specimen	Dry Crocking, Faded Glory, Initial											
	Sample 1		Avg	SD*	Sample 2		Avg	SD*	Sample 3		Avg	SD*	Overall Avg
	Rate 1	Rate 2			Rate 1	Rate 2			Rate 1	Rate 2			
1	5.00	5.00	5.00	0.14	4.50	5.00	4.75	0.00	4.50	5.00	4.75	0.00	4.78
2	4.50	5.00	4.75		4.50	5.00	4.75		4.50	5.00	4.75		
3	4.50	5.00	4.75		4.50	5.00	4.75		4.50	5.00	4.75		
Specimen	Dry Crocking, Faded Glory, Wash 1											
	Sample 1		Avg	SD*	Sample 2		Avg	SD	Sample 3		Avg	SD	Overall Avg
	Rate 1	Rate 2			Rate 1	Rate 2			Rate 1	Rate 2			
1	4.50	5.00	4.75	0.00	4.50	5.00	4.75	0.00	4.50	5.00	4.75	0.00	4.75
2	4.50	5.00	4.75		4.50	5.00	4.75		4.50	5.00	4.75		
3	4.50	5.00	4.75		4.50	5.00	4.75		4.50	5.00	4.75		
Specimen	Dry Crocking, Faded Glory, Wash 5											
	Sample 1		Avg	SD*	Sample 2		Avg	SD*	Sample 3		Avg	SD8	Overall Avg
	Rate 1	Rate 2			Rate 1	Rate 2			Rate 1	Rate 2			
1	4.50	5.00	4.75	0.00	4.50	5.00	4.75	0.00	4.50	5.00	4.75	0.00	4.75
2	4.50	5.00	4.75		4.50	5.00	4.75		4.50	5.00	4.75		
3	4.50	5.00	4.75		4.50	5.00	4.75		4.50	5.00	4.75		

*SD: Standard Deviation

**Specimens are rated according to the AATCC Gray Scale for Staining with rating scale of 1-5. Grade1 indicates "extreme color change" and grade 5 indicates to "no color change".

Table C5

Colorfastness to Wet Crocking, Lucky Jeans

AATCC Test Method 8-2013, Colorfastness to Crocking: Crockmeter Method**

Specimen	Wet Crocking, Lucky, Initial											
	Sample 1		Avg	SD*	Sample 2		Avg	SD*	Sample 3		Avg	SD*	Overall Avg
	Rate 1	Rate 2			Rate 1	Rate 2			Rate 1	Rate 2			
1	2.00	2.00	2.00	0.14	2.00	2.50	2.25	0.14	2.00	2.00	2.00	0.14	1.94
2	2.00	1.50	1.75		2.00	2.50	2.25		2.00	1.50	1.75		
3	2.00	1.50	1.75		2.00	2.00	2.00		1.50	2.00	1.75		
Specimen	Wet Crocking, Lucky, Wash 1											
	Sample 1		Avg	SD*	Sample 2		Avg	SD*	Sample 3		Avg	SD*	Overall Avg
	Rate 1	Rate 2			Rate 1	Rate 2			Rate 1	Rate 2			
1	1.50	2.00	1.75	0.14	3.00	3.00	3.00	0.72	3.00	3.00	3.00	0.58	2.28
2	2.00	2.00	2.00		3.00	3.00	3.00		2.00	2.00	2.00		
3	2.00	2.00	2.00		2.00	1.50	1.75		2.00	2.00	2.00		
Specimen	Wet Crocking, Lucky, Wash 5											
	Sample 1		Avg	SD*	Sample 2		Avg	SD*	Sample 3		Avg	SD*	Overall Avg
	Rate 1	Rate 2			Rate 1	Rate 2			Rate 1	Rate 2			
1	2.50	3.00	2.75	0.14	2.00	2.50	2.25	0.14	2.00	2.00	2.00	0.14	2.31
2	2.50	3.00	2.75		2.00	2.50	2.25		1.50	2.00	1.75		
3	2.50	2.50	2.50		2.50	2.50	2.50		2.00	2.00	2.00		

*SD: Standard Deviation

**Specimens are rated according to the AATCC Gray Scale for Staining with rating scale of 1-5. Grade1 indicates "extreme color change" and grade 5 indicates to "no color change".

Table C6

Colorfastness to Wet Crocking, Gap Jeans

AATCC Test Method 8-2013, Colorfastness to Crocking: Crockmeter Method**

Specimen	Wet Crocking, Gap, Initial											
	Sample 1		Avg	SD*	Sample 2		Avg	SD*	Sample 3		Avg	SD*	Overall Avg
	Rate 1	Rate 2			Rate 1	Rate 2			Rate 1	Rate 2			
1	2.50	2.50	2.50	0.00	2.00	1.50	1.75	0.00	2.00	2.00	2.00	0.14	2.11
2	2.50	2.50	2.50		2.00	1.50	1.75		2.00	2.00	2.00		
3	2.50	2.50	2.50		2.00	1.50	1.75		2.00	2.50	2.25		
Specimen	Wet Crocking, Gap, Wash 1											
	Sample 1		Avg	SD*	Sample 2		Avg	SD*	Sample 3		Avg	SD*	Overall Avg
	Rate 1	Rate 2			Rate 1	Rate 2			Rate 1	Rate 2			
1	2.00	2.00	2.00	0.14	2.00	2.00	2.00	0.00	2.00	2.00	2.00	0.14	2.11
2	2.00	2.50	2.25		2.00	2.00	2.00		2.00	2.50	2.25		
3	2.00	2.50	2.25		2.00	2.00	2.00		2.50	2.00	2.25		
Specimen	Wet Crocking, Gap, Wash 5											
	Sample 1		Avg	SD*	Sample 2		Avg	SD*	Sample 3		Avg	SD*	Overall Avg
	Rate 1	Rate 2			Rate 1	Rate 2			Rate 1	Rate 2			
1	3.00	3.00	3.00	0.14	3.00	3.00	3.00	0.00	3.00	3.00	3.00	0.00	3.03
2	3.00	3.00	3.00		3.00	3.00	3.00		3.00	3.00	3.00		
3	3.00	3.50	3.25		3.00	3.00	3.00		3.00	3.00	3.00		

*SD: Standard Deviation

**Specimens are rated according to the AATCC Gray Scale for Staining with rating scale of 1-5. Grade1 indicates "extreme color change" and grade 5 indicates to "no color change".

Table C7

Colorfastness to Wet Crocking, Faded Glory Jeans

AATCC Test Method 8-2013, Colorfastness to Crocking: Crockmeter Method**

Specimen	Wet Crocking, Faded Glory, Initial											
	Sample 1		Avg	SD*	Sample 2		Avg	SD*	Sample 3		Avg	SD*	Overall Avg
	Rate 1	Rate 2			Rate 1	Rate 2			Rate 1	Rate 2			
1	3.00	3.50	3.25	0.29	3.00	3.00	3.00	0.25	2.50	2.50	2.50	0.14	2.83
2	3.00	3.50	3.25		3.00	2.50	2.75		2.50	3.00	2.75		
3	3.00	2.50	2.75		2.50	2.50	2.50		2.50	3.00	2.75		
Specimen	Wet Crocking, Faded Glory, Wash 1											
	Sample 1		Avg	SD*	Sample 2		Avg	SD*	Sample 3		Avg	SD*	Overall Avg
	Rate 1	Rate 2			Rate 1	Rate 2			Rate 1	Rate 2			
1	3.50	3.50	3.50	0.14	3.00	3.00	3.00	0.14	2.50	3.00	2.75	0.14	3.03
2	3.00	3.50	3.25		2.50	3.00	2.75		3.00	3.00	3.00		
3	3.00	3.50	3.25		2.50	3.00	2.75		3.00	3.00	3.00		
Specimen	Wet Crocking, Faded Glory, Wash 5											
	Sample 1		Avg	SD*	Sample 2		Avg	SD*	Sample 3		Avg	SD*	Overall Avg
	Rate 1	Rate 2			Rate 1	Rate 2			Rate 1	Rate 2			
1	3.50	4.00	3.75	0.00	3.50	3.50	3.50	0.14	3.50	3.50	3.50	0.14	3.58
2	3.50	4.00	3.75		3.50	4.00	3.75		3.00	3.50	3.25		
3	3.50	4.00	3.75		3.50	3.50	3.50		3.50	3.50	3.50		

*SD: Standard Deviation

**Specimens are rated according to the AATCC Gray Scale for Staining with rating scale of 1-5. Grade1 indicates "extreme color change" and grade 5 indicates to "no color change".

Table C8

Smoothness Retention, Lucky, Gap, and Faded Glory Jeans

AATCC Test Method 143-2011, Appearance of Apparel and Other Textile End Products after Repeated Home Laundering**

Smoothness Retention, Lucky, Wash 1						Smoothness Retention, Lucky, Wash 5					
Sample	Rate 1	Rate 2	Average	SD*	Overall Average	Sample	Rate 1	Rate 2	Average	SD*	Overall Average
1	4.00	4.00	4.00	0.29	4.33	1	4.00	4.00	4.00	0.00	4.00
2	4.00	5.00	4.50			2	4.00	4.00	4.00		
3	4.00	5.00	4.50			3	4.00	4.00	4.00		
Smoothness Retention, Gap, Wash 1						Smoothness Retention, Gap, Wash 5					
Sample	Rate 1	Rate 2	Average	SD*	Overall Average	Sample	Rate 1	Rate 2	Average	SD*	Overall Average
1	4.00	4.00	4.00	0.14	3.83	1	4.00	3.50	3.75	0.00	3.75
2	3.50	4.00	3.75			2	4.00	3.50	3.75		
3	3.50	4.00	3.75			3	4.00	3.50	3.75		
Smoothness Retention, Faded Glory, Wash 1						Smoothness Retention, Faded Glory, Wash 5					
Sample	Rate 1	Rate 2	Average	SD*	Overall Average	Sample	Rate 1	Rate 2	Average	SD*	Overall Average
1	4.00	4.00	4.00	0.29	4.17	1	4.00	4.00	4.00	0.00	4.00
2	4.00	4.00	4.00			2	4.00	4.00	4.00		
3	4.00	5.00	4.50			3	4.00	4.00	4.00		

*SD: Standard Deviation

** Specimens are rated according to the AATCC Smoothness Appearance Replicas with rating scale of 1-5.
Grade 1 indicates severely wrinkled appearance and grade 5 indicates to very smooth appearance.

Table C9

Breaking Strength, Lucky Jeans

ASTM D5034-(09)2013 Standard Test Method for Breaking Strength and Elongation (Grab Test)

Specimen	Breaking Strength, Lucky, Initial											
	Sample 1		Avg (lbf)	Sample 2		Avg (lbf	Sample 3		Avg (lbf	Overall Avg (lbf)	Overall SD Warp	Overall SD Filling
	Warp (lbf)	Filling (lbf)		Warp (lbf)	Filling (lbf)		Warp (lbf)	Filling (lbf)				
1	104.30	76.12		119.50	69.77		102.05	75.17.				
2	100.60	78.86		128.80	72.75		105.08	69.13				
3	100.60	84.45	90.82	123.50	79.09	98.90	107.26	70.87	90.88	93.53	10.33	5.42
Avg	101.83	79.81		123.93	73.87		104.80	70.00				
SD*	2.14	4.25		4.67	4.76		2.62	1.23				
Specimen	Breaking Strength, Lucky, Wash 1											
1	110.90	72.77		122.60	71.12		109.20	69.37				
2	113.90	69.77		119.70	65.12		113.00	67.22				
3	99.46	71.61	89.74	111.20	62.17	91.99	116.80	62.50	89.68	90.47	6.34	3.93
Avg	108.09	71.38		117.83	66.14		113.00	66.36				
SD*	7.62	1.51		5.92	4.56		3.80	3.51				
Specimen	Breaking Strength, Lucky, Wash 5											
1	111.40	81.50		117.40	84.11		106.40	72.64				
2	112.40	80.75		119.70	71.25		113.90	75.35				
3	115.80	75.30	96.19	120.70	69.53	97.12	109.70	79.65	92.94	95.42	4.53	5.06
Avg	113.20	79.18		119.27	74.96		110.00	75.88				
SD*	2.31	3.38		1.69	7.97		3.76	3.53				

*SD: Standard Deviation

Table C10

Breaking Strength, Gap Jeans

ASTM D5034-(09)2013 Standard Test Method for Breaking Strength and Elongation (Grab Test)

Specimen	Breaking Strength, Gap, Initial											
	Sample 1		Avg (lbf)	Sample 2		Avg (lbf	Sample 3		Avg (lbf	Overall Avg (lbf)	Overall SD Warp	Overall SD Filling
	Warp (lbf)	Filling (lbf)		Warp (lbf)	Filling (lbf)		Warp (lbf)	Filling (lbf)				
1	211.04	134.60		212.00	131.90		208.08	133.10				
2	206.10	146.70		214.90	135.12		215.70	121.70				
3	217.70	131.50	174.61	215.22	135.50	174.11	217.70	127.08	170.56	173.09	3.95	6.77
Avg	211.61	137.60		214.04	134.17		213.83	127.29				
SD*	5.82	8.03		1.77	1.98		5.08	5.70				
Specimen	Breaking Strength, Gap, Wash 1											
1	226.10	123.70		227.80	122.20		235.10	133.00				
2	233.10	135.20		229.50	136.60		232.50	120.00				
3	225.30	117.00	176.73	233.90	127.80	179.63	227.70	125.20	178.92	178.43	3.64	6.91
Avg	228.17	125.30		230.40	128.87		231.77	126.07				
SD*	4.29	9.20		3.15	7.26		3.75	6.54				
Specimen	Breaking Strength, Gap, Wash 5											
1	227.10	122.70		236.20	122.10		239.90	137.40				
2	232.90	133.50		232.40	133.40		241.20	125.40				
3	235.20	126.50	179.65	239.00	129.10	182.03	237.60	125.60	184.52	182.07	4.97	5.30
Avg	231.73	127.57		235.87	128.20		239.57	129.47				
SD*	4.17	5.48		3.31	5.70		1.82	6.87				

*SD: Standard Deviation

Table C11

Breaking Strength, Faded Glory Jeans

ASTM D5034-(09)2013 Standard Test Method for Breaking Strength and Elongation (Grab Test)

Specimen	Breaking Strength, Faded Glory, Initial											
	Sample 1		Avg (lbf)	Sample 2		Avg (lbf	Sample 3		Avg (lbf	Overall Avg (lbf)	Overall SD* Warp	Overall SD* Filling
	Warp (lbf)	Filling (lbf)		Warp (lbf)	Filling (lbf)		Warp (lbf)	Filling (lbf)				
1	193.40	110.20		184.30	130.90		173.90	115.00				
2	185.61	102.50		187.30	136.00		170.61	119.87				
3	182.20	111.40	147.55	184.70	128.70	158.65	179.50	107.53	144.40	150.20	7.40	11.57
Avg	187.07	108.03		185.43	131.87		174.67	114.13				
SD*	5.74	4.83		1.63	3.74		4.49	6.22				
Specimen	Breaking Strength, Faded Glory, Wash 1											
1	194.60	103.10		192.60	109.60		193.30	109.88				
2	187.80	105.30		194.70	102.70		195.70	105.00				
3	180.80	104.70	146.05	194.00	106.50	150.02	189.40	111.50	150.80	148.95	4.59	3.14
Avg	185.80	104.37		193.77	106.27		192.80	108.79				
SD*	6.90	1.14		1.07	3.46		3.18	3.38				
Specimen	Breaking Strength, Faded Glory, Wash 5											
1.00	186.30	109.40		198.70	109.50		189.60	107.40				
2.00	197.40	111.10		202.90	102.10		197.30	110.80				
3.00	193.80	102.40	150.07	205.80	103.20	153.70	198.80	112.80	152.78	152.18	6.63	4.08
Avg	192.50	107.63		202.47	104.93		195.23	110.33				
SD*	5.66	4.61		3.57	3.99		4.94	2.73				

*SD: Standard Deviation

Table C12

Seam Strength, Lucky Jeans

ASTM D 1683-11, Standard Test Method for Failure in Sewn Seams of Woven Apparel Fabrics

Specimen	Seam Strength, Lucky, Initial										
	Sample 1		Avg (lbf)	Sample 2		Avg (lbf)	Sample 3		Avg (lbf)	Overall Avg Side seam (lbf)	Overall SD* Side seam
	Side seam (lbf)	Inseam (lbf)		Side seam (lbf)	Inseam (lbf)		Side seam (lbf)	Inseam (lbf)			
1.00	53.63**	75.84	64.60	68.81**	77.32	72.61	68.00**	70.50*	68.63	64.33	6.16
2.00	60.11**	68.82		68.52	75.78		66.88	69.15		Overall Avg Inseam (lbf)	Overall * Inseam
Avg	56.87	72.33		68.67	76.55		67.44	69.83			
SD*	4.58	4.96		0.21	1.09		0.79	0.95		72.90	3.82
Specimen	Seam Strength, Lucky, Wash 1										
	Sample 1		Avg (lbf)	Sample 2		Avg (lbf)	Sample 3		Avg (lbf)	Overall Avg Side seam (lbf)	Overall SD* Side seam
	Side seam (lbf)	Inseam (lbf)		Side seam (lbf)	Inseam (lbf)		Side seam (lbf)	Inseam (lbf)			
1	55.99**	74.75**	66.43	64.65**	75.25	68.27	66.12**	73.09	71.30	63.80	5.66
2	60.36**	74.61		62.91**	70.26		72.76**	73.22		Overall Average Inseam (lbf)	Overall SD* Inseam
Avg (lbf)	58.18	74.68		63.78	72.76		69.44	73.16			
SD*	3.09	0.10		1.23	3.53		4.70	0.09		73.53	1.82

*SD: Standard Deviation

**Indicates sewing thread failure.

Table C12 (continued)

Seam Strength, Lucky Jeans

ASTM D 1683-11, Standard Test Method for Failure in Sewn Seams of Woven Apparel Fabrics

Specimen	Seam Strength, Lucky, Wash 5										
	Sample 1		Avg (lbf)	Sample 2		Avg (lbf)	Sample 3		Avg (lbf)	Overall Avg Side seam (lbf)	Overall SD Side seam
	Side seam (lbf)	Inseam (lbf)		Side seam (lbf)	Inseam (lbf)		Side seam (lbf)	Inseam (lbf)			
1	61.22	66.70	63.82	54.30	58.92	57.31	60.18**	67.08	60.60	57.72	2.97
2	59.67**	67.69		55.71	60.30		55.22**	59.90		Overall Avg Inseam (lbf)	Overall SD Inseam
Avg	60.45	67.20		55.01	59.61		57.70	63.49			
SD*	1.10	0.70		1.00	0.98		3.51	5.08		63.43	4.12

*SD: Standard Deviation
**Indicates sewing thread failure.

Table C13

Seam Strength, Gap Jeans

ASTM D 1683-11, Standard Test Method for Failure in Sewn Seams of Woven Apparel Fabrics

Specimen	Seam Strength, Gap, Initial									
	Sample 1		Avg (lbf)	Sample 2		Avg (lbf)	Sample 3		Avg (lbf)	Overall Avg Side seam (lbf)	Overall SD Side seam
	Side seam (lbf)	Inseam (lbf)		Side seam (lbf)	Inseam (lbf)		Side seam (lbf)	Inseam (lbf)			
1	109.30	106.60	108.13	107.09	117.80	110.32	106.30	111.40	110.41	105.78	2.99
2	103.00	113.60		101.40	115.00		107.61	116.31		Overall Avg Inseam (lbf)	Overall SD* Inseam
Avg (lbf)	106.15	110.10		104.25	116.40		106.96	113.86			
SD*	4.45	4.95		4.02	1.98		0.93	3.47		113.45	4.02
Specimen	Seam Strength, Gap, Wash 1										
	Sample 1		Avg (lbf)	Sample 2		Avg (lbf)	Sample 3		Avg (lbf)	Overall Avg Side seam (lbf)	Overall SD* Side seam
	Side seam (lbf)	Inseam (lbf)		Side seam (lbf)	Inseam (lbf)		Side seam (lbf)	Inseam (lbf)			
1	110.50	126.40	116.10	99.69	126.30	113.19	100.50	119.80	109.98	103.51	4.01
2	102.00	125.50		102.65	124.10		105.70	113.90		Overall Average Inseam (lbf)	Overall SD* Inseam
Avg (lbf)	106.25	125.95		101.17	125.20		103.10	116.85			
SD*	6.01	0.64		2.09	1.56		3.68	4.17		122.67	4.95

*SD: Standard Deviation

Table C13 (continued)

Seam Strength, Gap Jeans

ASTM D 1683-11, Standard Test Method for Failure in Sewn Seams of Woven Apparel Fabrics

Specimen	Seam Strength, Gap, Wash 5										
	Sample 1		Avg (lbf)	Sample 2		Avg (lbf)	Sample 3		Avg (lbf)	Overall Avg Side seam (lbf)	Overall SD* Side seam
	Side seam (lbf)	Inseam (lbf)		Side seam (lbf)	Inseam (lbf)		Side seam (lbf)	Inseam (lbf)			
1	117.80	135.00	125.20	109.90	116.20	114.30	106.70**	115.40	109.36	109.69	6.67
2	116.70	131.30		106.90	124.20		100.15	115.20		Overall Avg Inseam (lbf)	Overall SD* Inseam
Avg	117.25	133.15		108.40	120.20		103.43	115.30			
SD*	0.78	2.62		2.12	5.66		4.63	0.14		122.88	8.71

*SD: Standard Deviation

**Indicates sewing thread failure.

Table C14

Seam Strength, Faded Glory Jeans

ASTM D 1683-11, Standard Test Method for Failure in Sewn Seams of Woven Apparel Fabrics

Specimen	Seam Strength, Faded Glory, Initial										
	Sample 1		Avg (lbf)	Sample 2		Avg (lbf)	Sample 3		Avg (lbf)	Overall Avg Side seam (lbf)	Overall SD* Side seam
	Side seam (lbf)	Inseam (lbf)		Side seam (lbf)	Inseam (lbf)		Side seam (lbf)	Inseam (lbf)			
1	94.41*8	119.20	109.92	99.21	125.60	115.80	94.89	121.50	109.47	97.43	4.37
2	96.77	129.30		105.40	133.00		93.87	127.60		Overall Avg Inseam (lbf)	Overall SD* Inseam
Avg (lbf)	95.59	124.25		102.31	129.30		94.38**	124.55			
SD*	1.67	7.14		4.38	5.23		0.72	4.31		126.03	5.08
Specimen	Seam Strength, Faded Glory, Wash 1										
	Sample 1		Avg (lbf)	Sample 2		Avg (lbf)	Sample 3		Avg (lbf)	Overall Avg Side seam (lbf)	Overall SD* Side seam
	Side seam (lbf)	Inseam (lbf)		Side seam (lbf)	Inseam (lbf)		Side seam (lbf)	Inseam (lbf)			
1	99.30	125.00	111.85	99.57	134.30	112.03	97.79	119.30	107.67	97.91	4.97
2	105.70	117.40		93.13*	121.10		91.99	121.60		Overall Average Inseam (lbf)	Overall SD* Inseam
Avg (lbf)	102.50	121.20		96.35	127.70		94.89	120.45			
SD*	4.53	5.37		4.55	9.33		4.10	1.63		123.12	6.04

*SD: Standard Deviation

**Indicates sewing thread failure.

Table C14 (continued)

Seam Strength, Faded Glory Jeans

ASTM D 1683-11, Standard Test Method for Failure in Sewn Seams of Woven Apparel Fabrics

Specimen	Seam Strength, Faded Glory, Wash 5										
	Sample 1		Avg (lbf)	Sample 2		Avg (lbf)	Sample 3		Avg (lbf)	Overall Avg Side seam (lbf)	Overall SD* Side seam
	Side seam (lbf)	Inseam (lbf)		Side seam (lbf)	Inseam (lbf)		Side seam (lbf)	Inseam (lbf)			
1	89.92	123.10	105.36	100.80**	131.90	118.10	100.10	122.90	110.10	98.00	5.75
2	93.00	115.40		105.90**	133.80		98.30	119.10		Overall Avg Inseam (lbf)	Overall SD* Inseam
Avg	91.46	119.25		103.35	132.85		99.20	121.00			
SD*	2.18	5.44		3.61	1.34		1.27	2.69		124.37	7.18

*SD: Standard Deviation

**Indicates sewing thread failure.

Table C15

Dimensional Change, *Lucky Jeans*

AATCC TM150-2012, Dimensional Changes of Garments after Home Laundering**

Location	Dimensional Change, Lucky, Sample 1									
	Initial (in.)	Wash 1 (in.)	Shrinkage Wash 1		SD*	Overall Avg	Wash 5 (in.)	Shrinkage Wash 5		SD*	Overall Avg
			Individual	Avg				Individual	Avg		
Length											
Front Rise	10.81	10.66	1.4%				10.63	1.7%			
Back Rise	15.16	15.16	0.0%	1.05%	0.01		15.09	0.4%	1.30%	0.01	
Inseam	34.55	33.97	1.7%				33.84	2.0%			
Side seam	44.37	43.88	1.1%				43.91	1.0%			
Width						0.90%					1.21%
Waist Circumference	38.15	38.07	0%				37.82	1%			
Thigh	14.06	14.03	0%	0.75%	0.01		14.13	0%	1.13%	0.02	
Hip	23.70	23.19	2%				22.75	4%			
Leg Opening Circumference	18.15	18.07	0%				18.13	0%			

*SD: Standard Deviation

**Negative sign indicates increase in the dimensions.

Table C15 (continued)

Dimensional Change, Lucky Jeans

AATCC TM150-2012, Dimensional Changes of Garments after Home Laundering**

Location	Dimensional Change, Lucky, Sample 2									
	Initial (in.)	Wash 1(in.)	Shrinkage Wash 1		SD*	Overall Avg	Wash 5 (in.)	Shrinkage Wash 5		SD*	Overall Avg
			Individual	Avg				Individual	Average		
Length											
Front Rise	10.41	10.34	0.7%				10.28	1.3%			
Back Rise	14.88	15.09	-1.4%	0.28%	0.01		15.09	-1.4%	0.88%	0.02	
Inseam	34.02	33.59	1.2%				33.22	2.3%			
Side Seam	43.90	43.63	0.6%				43.31	1.3%			
Width						0.31%					1.08%
Waist Circumference	37.87	38.19	-1%				37.63	1%			
Thigh	14.04	14.06	0%	0.34%	0.01		13.94	1%	1.27%	0.01	
Hip	24.11	23.75	2%				23.50	3%			
Leg Opening Circumference	18.03	17.88	1%				17.82	1%			

*SD: Standard Deviation

**Negative sign indicates increase in the dimensions.

Table C15 (continued)

Dimensional Change, *Lucky Jeans*

AATCC TM150-2012, Dimensional Changes of Garments after Home Laundering**

Location	Dimensional Change, Lucky, Sample 3									
	Initial (in.)	Wash 1(in.)	Shrinkage Wash 1		SD*	Overall Avg	Wash 5 (in.)	Shrinkage Wash 5		SD*	Overall Avg
			Individual	Avg				Individual	Avg		
Length											
Front Rise	10.57	10.53	0.4%				10.53	0.4%			
Back Rise	14.51	14.72	-1.5%	0.05%	0.01		14.53	-0.2%	0.92%	0.01	
Inseam	34.09	33.75	1.0%				33.28	2.4%			
Side Seam	44.23	44.12	0.2%				43.75	1.1%			
Width						0.25%					2.65%
Waist Circumference	36.30	36.25	0%				35.94	1%			
Thigh	14.06	14.00	0%	0.45%	0.01		14.13	0%	4.38%	0.07	
Hip	24.17	23.88	1%				23.63	2%			
Leg Opening Circumference	18.01	18.00	0%				15.35	15%			

*SD: Standard Deviation

**Negative sign indicates increase in the dimensions.

Table C16

Dimensional Change, Gap Jeans

AATCC TM150-2012, Dimensional Changes of Garments after Home Laundering**

Location	Dimensional Change, Gap, Sample 1									
	Initial (in.)	Wash 1(in.)	Shrinkage Wash 1		SD*	Overall Avg	Wash 5 (in.)	Shrinkage Wash 5		SD*	Overall Avg
			Individual	Avg				Individual	Avg		
Length						1.13%					1.79%
Front Rise	10.38	10.28	0.9%	1.15%	0.01		10.16	2.1%	1.87%	0.01	
Back Rise	15.29	15.22	0.5%				15.22	0.5%			
Inseam	34.51	33.69	2.4%				33.25	3.6%			
Side Seam	43.78	43.41	0.9%				43.22	1.3%			
Width											
Waist Circumference	38.59	38.38	1%	1.12%	0.01		38.19	1%	1.71%	0.01	
Thigh	13.97	13.88	1%				13.78	1%			
Hip	23.82	23.13	3%				23.07	3%			
Leg Opening Circumference	19.89	19.82	0%				19.63	1%			

*SD: Standard Deviation

**Negative sign indicates increase in the dimensions.

Table C16 (continued)

Dimensional Change, Gap Jeans

AATCC TM150-2012, Dimensional Changes of Garments after Home Laundering**

Location	Dimensional Change, Gap, Sample 2										
	Initial (in.)	Wash 1(in.)	Shrinkage Wash 1		SD*	Overall Avg	Wash 5 (in.)	Shrinkage Wash 5		SD*	Overall Avg
			Individual	Avg				Individual	Avg		
Length						1.01%					1.35%
Front Rise	10.51	10.53	-0.2%	0.77%	0.01		10.50	0.1%	0.97%	0.01	
Back Rise	15.25	15.16	0.6%				15.19	0.4%			
Inseam	34.64	34.10	1.6%				33.94	2.0%			
Side Seam	44.37	43.91	1.0%				43.78	1.3%			
Width											
Waist Circumference	40.01	39.00	3%	1.26%	0.01		39.07	2%	1.73%	0.01	
Thigh	13.87	13.75	1%				13.69	1%			
Hip	23.52	23.00	2%				22.94	2%			
Leg Opening Circumference	19.02	19.13	-1%				18.88	1%			

*SD: Standard Deviation

**Negative sign indicates increase in the dimensions.

Table C16 (continued)

Dimensional Change, Gap Jeans

AATCC TM150-2012, Dimensional Changes of Garments after Home Laundering**

Location	Dimensional Change, Gap, Sample 3									
	Initial (in.)	Wash 1(in.)	Shrinkage Wash 1		SD*	Overall Avg	Wash 5 (in.)	Shrinkage Wash 5		SD*	Overall Avg
			Individual	Avg				Individual	Avg		
Length						0.85%					1.40%
Front Rise	10.39	10.41	-0.1%	0.58%	0.01		10.31	0.8%	0.98%	0.01	
Back Rise	15.09	15.19	-0.6%				15.22	-0.8%			
Inseam	34.64	34.00	1.9%				33.69	2.8%			
Side Seam	44.15	43.61	1.2%				43.63	1.2%			
Width											
Waist Circumference	39.22	38.75	1%	1.11%	0.01		38.63	2%	1.83%	0.01	
Thigh	13.99	13.90	1%				13.84	1%			
Hip	24.05	23.38	3%				23.32	3%			
Leg Opening Circumference	19.71	19.75	0%				19.38	2%			

*SD: Standard Deviation

**Negative sign indicates increase in the dimensions.

Table C17

Dimensional Change, Faded Glory Jeans

AATCC TM150-2012, Dimensional Changes of Garments after Home Laundering**

Location	Dimensional Change, Faded Glory, Sample 1									
	Initial (in.)	Wash 1(in.)	Shrinkage Wash 1		SD*	Overall Avg	Wash 5 (in.)	Shrinkage Wash 5		SD*	Overall Avg
			Individual	Avg				Individual	Avg		
Length											
Front Rise	10.49	10.44	0.5%				10.28	2.0%			
Back Rise	14.70	14.72	-0.1%	0.38%	0.01		14.81	-0.8%	1.56%	0.02	
Inseam	34.39	33.88	1.5%				33.13	3.7%			
Side Seam	43.76	43.91	-0.3%				43.19	1.3%			
Width						0.97%					1.40%
Waist Circumference	38.55	37.82	2%				37.49	3%			
Thigh	13.66	13.47	1%	1.57%	0.01		13.44	2%	1.25%	0.01	
Hip	22.87	22.25	3%				22.63	1%			
Leg Opening Circumference	18.24	18.19	0%				18.32	0%			

*SD: Standard Deviation

**Negative sign indicates increase in the dimensions.

Table C17 (continued)

Dimensional Change, *Faded Glory Jeans*

AATCC TM150-2012, Dimensional Changes of Garments after Home Laundering**

Location	Dimensional Change, Faded Glory, Sample 2										
	Initial (in.)	Wash 1(in.)	Shrinkage Wash 1		SD*	Overall Avg	Wash 5 (in.)	Shrinkage Wash 5		SD*	Overall Avg
			Individual	Avg				Individual	Avg		
Length											
Front Rise	10.57	10.56	0.1%				10.44	1.3%			
Back Rise	14.72	14.61	0.8%	0.79%	0.01		14.63	0.6%	1.53%	0.01	
Inseam	33.82	33.31	1.5%				32.88	2.8%			
Side Seam	43.43	43.06	0.8%				42.81	1.4%			
Width						0.66%					1.19%
Waist Circumference	37.49	37.07	1%				37.13	1%			
Thigh	13.40	13.38	0%	0.53%	0.00		13.25	1%	0.85%	0.01	
Hip	22.91	22.75	1%				22.94	0%			
Leg Opening Circumference	18.39	18.38	0%				18.13	1%			

*SD: Standard Deviation

**Negative sign indicates increase in the dimensions.

Table C17 (continued)

Dimensional Change, *Faded Glory Jeans*

AATCC TM150-2012, Dimensional Changes of Garments after Home Laundering**

Location	Dimensional Change, Faded Glory, Sample 3										
	Initial (in.)	Wash 1(in.)	Shrinkage Wash 1		SD*	Overall Avg	Wash 5 (in.)	Shrinkage Wash 5		SD*	Overall Avg
			Individual	Avg				Individual	Avg		
Length											
Front Rise	10.39	10.41	-0.1%				10.34	0.5%			
Back Rise	14.89	14.91	-0.1%	0.70%	0.01		14.75	1.0%	1.61%	0.01	
Inseam	33.88	33.34	1.6%				33.06	2.4%			
Side Seam	43.88	43.25	1.4%				42.75	2.6%			
Width						0.87%					1.17%
Waist Circumference	37.49	37.00	1%				37.00	1%			
Thigh	13.64	13.59	0%	1.03%	0.00		13.59	0%	0.73%	0.00	
Hip	22.50	22.19	1%				22.38	1%			
Leg Opening Circumference	18.39	18.19	1%				18.25	1%			

*SD: Standard Deviation

**Negative sign indicates increase in the dimensions.

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