Epona Sport: Investigating Inclusive Sizing and Comfort in Footwear and Apparel for Professional Female Equestrians

Mary-Gwynedd Taylor

M.S. Sports Product Design, University of Oregon

Vanessa Preisler, Carly Mick and Rachael Volker

June 13, 2023

Table of Contents

Designer Introduction

Mary-Gwynedd Taylor is a designer who was born in England and raised across several countries and several states across the U.S. Through all these international moves, one thing has remained a constant… Being a multi-sport athlete (skiing, CrossFit, rowing, soccer, and horse riding). Playing and competing in sports in so many places has solidified her thinking that everyone is capable and driven to achieve and they just need to be supported in attaining their goals.

At the Savannah College of Art and Design, she merged her interests in sports, history, and design, majoring in Equestrian Studies, Industrial Design, and minoring in Art History. While at SCAD, she was also a member of the national championship-winning Equestrian Team where she saw firsthand how equestrian female athletes struggle to find affordable and well-fitting apparel and footwear for all sizes. Working as a professional show groom, she witnessed Olympians who would forgo the safety of proper riding attire and footwear, instead choosing to wear sneakers or rainboots for daily work and training… Years of observation of equestrian professionals and her lived experience sparked the idea for this project.

Personal Strengths

What makes any design project special, is the unique stance that the designer takes. The Clifton strengths assessment identifies the unique and innate talents that each person holds (Rath, 2022). Per the test, my top five strengths are relator, futuristic, learner, strategic, and focus. I believe that these personal traits will be a guiding force in creating a successful thesis project. My

Figure 1 Clifton Strengths Results (Rath,2022).

"futuristic" and "strategic" strengths are the driving force of my work, the ability to parse through the clutter to identify a way forward to the future that I believe is possible. Being a "learner" means that I am driven by the process of learning and find the journey from ignorance into knowing energizing. This will be especially helpful when I am several months into this research. My "focus" strength will keep my work on track as more information and data constantly filters in. This will serve as a beneficial tunnel vision, locking onto a goal and not ceasing until the goal is met. Finally, the "relator" strength will allow me to tap into close relationships that I have been nurturing for years. The "relator" strength pulls me towards people I already know to co-create. The research phase will allow me to use these close relationships to create a personal and thoughtful outcome, informed by the expertise of people I already hold in high esteem.

Professional Interest

I am a human-focused designer driven by the idea that every athlete can achieve their goals so long as they have the necessary apparel, equipment, and footwear. The only limiting factor to the level of one's success should be decided by the athlete, not by poorly fitted apparel, or painful footwear. I believe that through hard work and determination, athletes can achieve any dream they set their mind to… To me, the poem *If* by Rudyard Kipling says it best. "If you can fill the unforgiving minute/ With sixty seconds' worth of distance run, / Yours is the Earth and everything that's in it" (Kipling & Brock, 2016).

I also believe that the past informs the future, and all design can be improved by taking design queues from athletes who trod the path before. Merging historical context and state-of-the-art testing, materials, and manufacturing will bring designs into the future. This project aims to bring innovative, functional, and beautiful design solutions to the equine industry, which can

sometimes be reticent to change. Placing the athlete at the center of the design, rather than fashion or tradition will frame the equestrian female professional as the powerful athlete that she has always been.

I hope that this project will attract future employers from the luxury sports industry, which is too often left out of sports product innovation. I will have valuable experience designing a cohesive apparel line and footwear, but also understand how to update function without disrupting classic aesthetics and form that are held dear in luxury markets.

Golden Circle

I believe products shouldn't get in the way of people attaining their goals. Pain caused by poor training equipment, apparel, and footwear can shorten an athlete's "playable years." Non-inclusive sizing and poor product offerings discourage athletes from pursuing their goals. Designing products that honor heritage styling while implementing innovation will bring athletes in luxury sports into the future.

Project Background

To keep horses is to care for them. The sport of horse riding is much more than sitting on the back of a horse and letting them do the work. It's a partnership that includes mucking stalls, turning out horses to pasture, grooming, feeding, and many other activities more specific to the focus of the business and individual horse's needs. An average day in the life of a working equestrian starts early, is spent mostly outside, and can involve all manner of terrain and ground quality. The day will also involve the training of many horses, with hours spent on horseback. To expedite the process of changing shoes all day for each activity, many equestrians keep their boots on all day… Imagine doing all of that in dress shoes.

Riding boots are expensive, ranging from the low end of $350 to $2,000 for a standard, mass-manufactured boot (*English Riding Boots | Dover Saddlery*, n.d.). Due to anatomical differences including lower leg length, calf circumference, and general foot needs, many riders and equestrian professionals opt for custom boots. Custom boots can go from $1,500 and well into the thousands. This boot-buying process requires fittings with a handful of boot makers and can take 8-12 weeks to make by hand (La Mundial, 2022).

Once the boot-buying process is finished, the breaking-in process begins. Breaking in these boots can cause blisters, sometimes bleeding and even scarring, most behind the knee and around the ankle (Redrup, 2021). If the rider is lucky, the boots will fit well and be a perfect fit for a few years before the leather begins to break down. On top of this, many riders keep multiple boots in rotation, so one pair is always in good condition for shows, which usually means competing in a painful boot.

Riding boots have a heel which more than an aesthetic choice is a safety precaution, keeping the foot from sliding into the stirrup in case of a fall (*Footwear | Equine Programs*, n.d.). At all levels of equine sport, riders will forgo personal safety for comfort, many choosing to ride in sneakers or wellington rain boots.

When it comes to apparel, the standard outfit is a pair of riding breeches, a long-sleeved top or polo shirt, and a water-resistant coat for cooler temperatures and inclement weather. The clothing available faces many of the same issues as boots. The foundation of equestrian apparel comes from tailored suiting… as a result, the clothes are not built for dirty jobs, or with high mobility in mind. On the purchasing front, many companies do not even provide inclusive sizing, with many brands stopping at a US women's size 14 (Wild, 2021) …. This leaves many equestrian professionals wearing clothes that are not purpose-built, fit poorly, and deteriorate quickly. When speaking about her brand, FullerFillies, founder Suzanne Wild said "As a 39-year-old, I returned to horse riding after a 25-year lapse. I was a slight size 8 back in the day, but now I couldn't even fit that on one leg – I was a UK size 18/20. Still, I thought I could waltz into a tack shop and purchase what I needed. After all, I was pretty representative of over half the ladies I saw at yards, events, markets – in fact, EVERYWHERE there were horses, I saw carbon copies of me!" (Wild, 2021).

This thesis aims to identify ways of improving everyday equestrian apparel and footwear for the female equestrian professional. Improving the fit of footwear, clothing and choosing materials that improve the accessibility of purpose-built products.

Equestrian Sport History

Equestrian sport has been around since the beginnings of civilization, indeed, the training of horses contributed to mankind being able to traverse the globe. Empires have been built and fallen on the backs of horses. Used as modes of transportation, beasts of burden and even for sport, horses have been walking alongside humans for almost every step of history (Williams, 2015).

*Figure 2 Modern rider displaying correct equitation position as described by Xenophon (*Rulebook*, n.d.)*

In about 355 BC, military leader and Greek philosopher Xenophon wrote the first edition of *The Art of Horsemanship* (Xenophon, 2017). This text covered everything from horse purchase, horse care, mounting, rider position and training. This text is still used today as a guidebook for many equestrian professionals and athletes. The rider's position as described in *The Art of Horsemanship* illustrates the position that modern riders strive for today when in the saddle. It also describes points of contact for the rider…Xenophon (Part VII)

> "When mounted, the rider should sit on the horse not as if he were sitting in a chair, but as if he were standing with his legs apart. This will allow him to hold on with his thighs, and the upright position will allow him to throw a javelin with greater power. The lower legs should hang loosely from the knee, as a stiff leg is more likely to break should it collide with an obstacle. The rider's

Figure 3 Vase Depicting Two Riders in ancient Greek horse racing (Tufts, 2012)

body above his hips should be supple, as he will be able to move more easily when fighting and will be less likely to be unseated if he is shoved" (p.54).

Later, in 600 BC, the Hippodrome of Olympia played host to equestrian disciplines of horse and chariot racing. While the Ancient Olympiads were primarily played in the nude, riders can be seen wearing leg coverings in artistic renderings or sandals in some cases (Tufts, 2012).

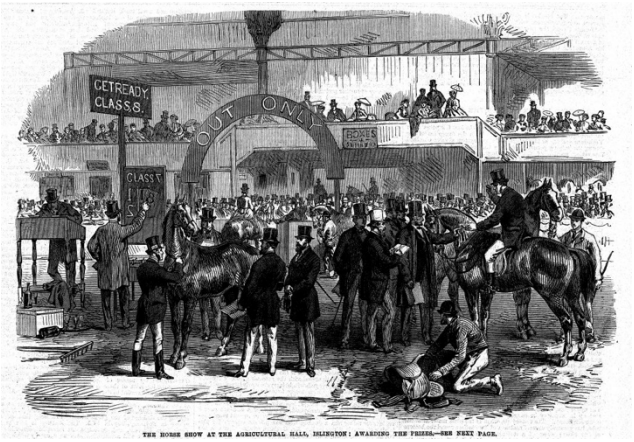


*Figure 4 The Illustrated London News depicting judging Class 7 at the 1st Dublin International Horse Show (*The Essential History of Show Jumping*, 2020)*

While there were many unofficial horse shows were held in modern times, the Dublin International Horse Show holds the reputation of being the first international horse show in 1865 (*The Essential History of Show Jumping*, 2020). Thus began a snowball in the popularity of spectating Show Jumping, with "big" shows popping up in Washington D.C., New York City, London, and Paris. Show Jumping made its debut at the modern Olympic games in 1900, where military officers, Hobbyists, and professionals competed in the High Jump, Broad Jump, and Prize jumping (*A Brief History in Interrupted Olympic Games*, 2020).

The military contingent held the largest portion of equestrian competitors until World War I when horses and soldiers sustained huge casualties in the line of battle (Brown, 2020). This, coupled with the advent of motorized military vehicles, caused a growth in equestrianism as a sport and hobby for the masses. Since 1950 showjumping has remained an important part of the Olympic games. Only growing in popularity with modern transportation, horse care, equipment, and skill (*A Brief History in Interrupted Olympic Games*, 2020).

History of the Riding Boot

The history of riding boots is almost as old as the history of horse riding. The earliest depictions of riding footwear can be seen in ancient Greek and Roman artworks. More concretely, the earliest evidence of riding boots show that tall footwear and trousers were worn by the Achaemenids, a group that ruled Persia from 550 to 330 B.C. These boots were used to protect the legs on long rides and from severe weather conditions across the European and Asian continents (Druesedow et al., 1984).

Figure 5 Bayeux Tapestry (Artist Unknown. 1092. Bayeux Tapestry, Bayeux Museum*).*

The Bayeux tapestry, woven in 1092, depicts a rider wearing one of the earliest representations of a riding boot. The soldier can be seen wearing short leather boots with knee-high fabric reinforcements affixed with leather straps (Musset, 2002). These were likely used for leg protection in battle, and to combat the wear caused by long hours spent on horseback. By the 1200s, the precursor to the riding boot we know today was invented and became more popular due to its durability and usefulness to the rider. This was a tall leather boot with a large heel (Rydale, 2018).

Figure 6 Henri II of France, wearing Military style 'jackboots' (Francois Clouet, 1536, Henri II, Metropolitan Museum of Art).

The biggest jump in popularity for tall riding boots came in the 15-1600s due to growing military demand. This was a tall polished black leather boot with a slightly

smaller heel. The fashion of these boots carried over to portraits of royalty, nobility, and hunting parties (Druesedow et al., 1984).

Due to increased popularity, the style of the riding boot evolved quite quickly until the 1800s. The heel once again became smaller, maintaining the practical feature of keeping the foot from slipping through the stirrup, and laces were added. Sir George Hoby, the finest bootmaker in Regency London and inventor of the wellington boot was most well known for making boots for the Duke of Wellington. In the equestrian community, he is also well known for a time when a customer came back to his shop asking for his boots to be repaired. When asked by Hoby what had been done to damage his fine boots, the customer replied 'Why, in walking to my stable'… This angered Hoby and he sneered 'I make boots for riding, not walking." This tells the beginning of the story of how riding boots are not practical for the modern equestrian (McCormack, 2017).

Figure 7 George Beau Brummel (1800) wearing tall riding boots (Druesedow et al., 1984).

Figure 8 Napoleon, displaying two toned leather boots (Jaques- Louis David, 1801, Napoleon Crossing the Alps, Chateau de Malmaison).

The 18th and 19th centuries saw riding boots surpass shoes in popularity for men's fashion. The boot styles were trimmer and more stylish with two-toned leathers, light brown lining, turned-down tops, and a black outer body. Protecting feet from the elements created a

push for the development of new materials, including the more water-resistant patent leather (Foot Talk, 2021).

Since then, the style of these boots has remained generally unchanged. Through manufacturing and material developments, boots now have a lower profile fit on the leg due to supple leathers, have more flexibility due to elastic and some even have zippers for easy donning and doffing. Some companies have tried to push the envelope with iconoclastic footwear designs, none more than the Nike 'Ippeas'. Even after listening to athlete insights and ideas from top equestrian athletes, several rounds of prototypes, this new take on the riding boot was met with backlash from the equestrian community. The boot featured synthetic leathers that provided protection, support, traction, horse control, and reduced weight all while aiming to maintain the traditional aesthetics of riding boots (Greene, 2008). The asymmetrical zipper was too much…

Figure 9 Nike Ippeas with spur detail (Greene, 2008).

History of Equestrian Apparel

Much like the history of riding footwear, the story of equestrian apparel is long. Since mankind has been working with horses, there has been an effort to create clothing that protects and provides comfort to the rider. It is quite fair to say that equestrian apparel is the first and oldest form of sports product and apparel design, as they were designed to serve the performance needs of the rider with thoughtful design, innovative materials, meaningful decoration, and high-quality workmanship (Druesedow et al., 1984).

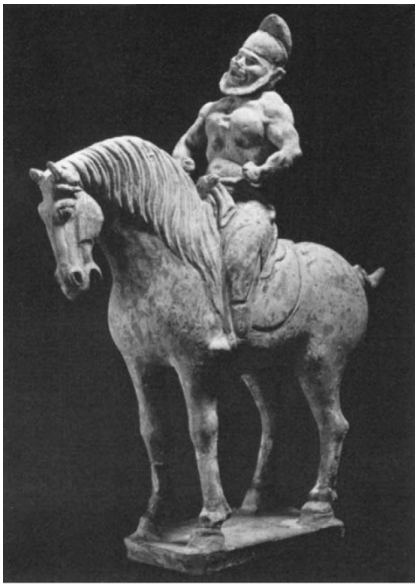


Figure 10 T'ang dynasty figurine showing riding pants 4th century (Druesedow et al., 1984).

Early equestrians wore their everyday clothes to ride, but as tack and riding styles advanced, so did riding apparel (Druesedow et al., 1984). The earliest riding pants seem to have been worn by the Achaemenids in Persia from 550 to 330 B.C., but this was likely a product of tailoring clothing to fit under armor and over the tack. It is unlikely that specialized riding apparel came to be used until the renaissance in Europe. In the 16th century, the Spanish Riding School, in Vienna Austria was introduced. Prompted by the rediscovery of classical dressage training in Greece, the Haute Ecole boomed in popularity in Europe (Britannica, 2013). The Spanish riding school, founded in 1565, focused on training Lipizzaner stallions… The rider's apparel aimed to emulate the nobility of the horse while being "sober and understated, sitting quietly and functionally behind the skill of the rider" (The Editors of Encyclopaedia Britannica, 1998).

Figure 11 19th century Spanish Riding school attire in comparison with modern Spanish Riding School training session (Julius Von Blaas, 1845, Morning Exercise in the Hofreitschule, Kunsthistorisches Museum) (Littauer, 2002).

To do this, the trainers and riders and the Spanish Riding School wore brown tailcoats, white buckskin breeches, and black top riding boots. This uniform was a pared-down version of the uniforms worn by the Austrian military in the 16th century and has remained the prevailing standard for equestrian training and competition worldwide (Littauer, 2002).

Jodhpurs were invented in the late 1800s by Sir Pratep Singh, Maharaj of Idar, India. As an avid polo player, Singh wanted a riding pant that was more comfortable than the standard "tight pant" made popular by the riders from the Spanish Riding School. Starting with the inspiration of the traditional Indian pant 'churidar', he increased the baggy fit of the pant on the upper leg area and hips. He maintained the tight fit around the calf area to fit comfortably fit under boots but added suede reinforcement around the inner knee.

Figure 12 1908 Idar Polo Club (Laffaye, 2009).

These fit adjustments, coupled with cotton and twill cut on the bias, afforded polo players easy movement in the saddle (Laffaye, 2009).

This style was adopted in polo clubs across India and quickly spread through the British Empire after the Idar Polo Club played a match for Queen Victoria, becoming the preferred pant style for riding across Europe. The jodhpur was co-opted by Cavalry units across Europe and eventually trickled down to civilian riders (Nanjappa, 2022).

Figure 13 Princess Elizabeth wearing Jodhpurs (Vance, 2022).

In late 1800s England, the creation of riding clothes transitioned from dressmakers to tailors. This ushered in a new age of civilian riding attire, moving away from the rich ornamentation of the 1700s into a more toned-down riding costume (Druesedow et al., 1984). Because of the long history of British riding, the English have long been at the forefront of riding apparel. British aristocracy spent much of their time at country estates, hosting hunting parties and working in practical wool apparel (Hansen, 2015). Tailors began to create riding attire inspired by military suiting wool and began to adjust pattern pieces to the needs of the rider, for example, the single vent recognized in most suiting was added to tailored jackets to guide rainwater off one's tack (Evans, 2018).

Figure 14 1930's hunt apparel depicted in Downton Abbey (Potter, 2016).

Following women's transition from riding side saddle to astride the horse, innovation around women's apparel mostly stagnated. From 1920 onward, riding habits have remained largely unchanged in the way of

show apparel… Men and women still wear a fitted blazer, a slimmed-down version of Jodhpurs, a button-down white shirt with a stock tie or collar, gloves, and breeches. In modern history, the biggest changes have been in materiality, not silhouette. In the late 1980s, stretch materials began to be integrated into riding pants, and in the 2010s, stretch tops and show coats followed. Currently, natural fabrics are still favored to provide longevity; tweeds, waxed canvas, wools, and leathers (Potter, 2016).

Figure 16 1990s fox hunting apparel (Potter, 2016).

Figure 17 Current casual riding attire

Figure 15 Current hunt seat competition apparel

Equestrian clothing has first and foremost been designed for the needs of the sport. As a predominantly outdoor endeavor, it always has been and always will be crucial that the apparel stand up to strenuous activity, allow for a large range of movement, and protect against the elements.

Equestrian Market

From the outside view, Equestrian sport may seem like a niche market, but looks can be deceiving…Across the world, the contributions to global markets from equestrian industries are significant, adding 300 billion dollars per year and 1.6 million full-time jobs to global economies (Equine Business Association, 2021). These numbers only break the surface… When speaking about equestrian professionals in the sphere of sport, the number of people directly employed through the care and management of sport horses is larger than other "mainstream" industries such as TV& Radio and the Railroad industry (HorsesOnly, 2022).

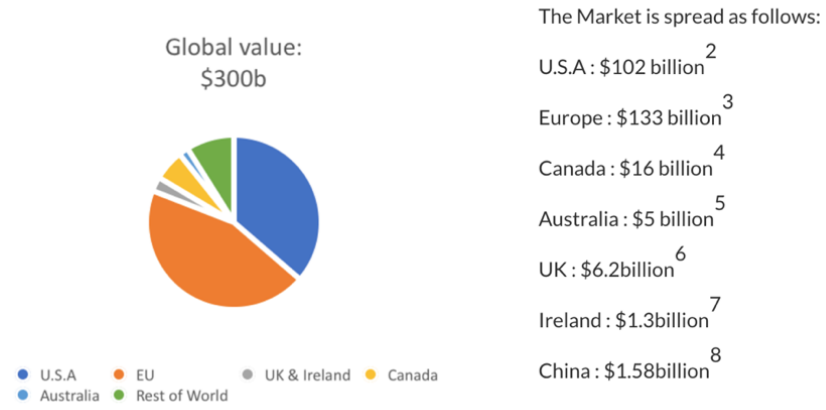


Figure 18 Equestrian Industry Global Value (Equine Business Association,2021).

It is hard to know the exact number of horses in the United States due to the number of unregistered animals and wild horses. That said, the American Horse Council (AHC) has compiled records from the United States Equestrian Federation, National Agriculture Statistic Service, and the American Veterinary Medical Association. Their records show that out of the 7,246,835 horses in the U.S, approximately 5,593,917 are kept as Show horses, Racehorses, Recreational Horses or are involved in breeding for any of the aforementioned purposes (American Horse Council, 2017). The equine sport industry is large, but it is heavily weighted toward female participants, with 77.4% women and 22.6% men. Of the women participants, the average age of equestrian professionals is 35-54 years old (Equine Business Association, 2021).

The User

This project will aim to serve female equestrian professionals aged 18-60 years old. This user shows and cares for horses full-time as her primary job. A day in the life of this user will involve riding, mucking stalls, grooming, feeding, and turning out horses. Due to the large age range, the necessity of inclusively sized clothing is imperative, as morphology changes throughout the course of one's life.

Even the women on the US Olympic team have different body types, which aren't always served by the current clothes offering. Katie Duerrhammer, 34, is a gold medal-winning, farm-owning, size 12 rider (*Katie Duerrhammer*, n.d.). Figure 21 shows a tight fit around her waist and belt line and crotch seam that is digging into her body. Beezie Madden 59, is a multiple Olympic medal-winning, farm-owning show jumper, instructor, and clinician (*Beezie Madden*, n.d.). On the podium at the Lima 2019 World Equestrian Games, her pants are bunched around the knee, outer leg seams are pulling, and the waist sits low and tight on her hips (fig.23) … All indicating poor fit. Adrienne Sternlicht aged 29, is a show jumping World Cup medalist ranked 77th in the world, riding instructor, and barn manager. She is seen here with her competition partner Benny's Legacy wearing riding leggings and sneakers around the stable yard (fig. 22) (*Adrienne Sternlicht*, n.d.). She has forgone wearing boots, presumably for comfort, but her leggings are bunched around her legs due to length and the side seams are rippling. If the women at the highest level of this sport aren't being provided for, it can be assumed that none are.

*Figure 19 Katie Duhammer (*Katie Duerrhammer*, n.d.).*

*Figure 20 Beezie Madden (*Beezie Madden*, n.d.).*

*Figure 21 Adrienne Sternlicht (*Adrienne Sternlicht*, n.d.).*

Environment

Every stable yard is different, but some environmental factors remain the same across almost every equestrian center and farm across America. The user of this product line will encounter grass, dirt, sand, mud, gravel, and asphalt daily. The average temperature range across the United States has a high of 70.7 degrees Fahrenheit and a low of 26.2 degrees (NOAA, n.d). This spectrum can swing higher or lower depending on the state; therefore, this product line should be appropriate in temperatures from the 20s up to the high 90s (fig.22). The limits of temperature are dependent on the safety of the horse and rider, rather than the locale (Vitalize, 2019).

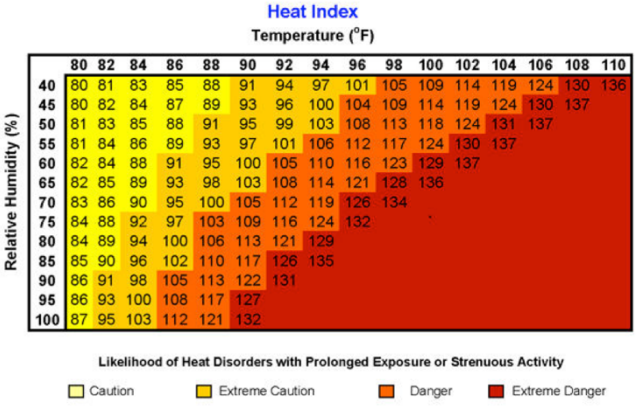


Figure 22 Heat stress in horses (Vitalize, 2019).

Positions and skills for Success

The ideal user for this product is a female equestrian professional that does everything in her power to provide high-quality care and training for every horse in her stable. The average day of work would include waking early to feed, turning out each horse to pasture, grooming and bathing, exercising horses (riding, lunging) then turning around and doing the same steps in reverse. The ideal user would have multiple hours in the saddle per day with equal or more groundwork around the stable yard.

How Might We?

The intent of this project and product line is to answer questions surrounding the often-neglected needs of the apparel and footwear offered to professional female equestrians. Riding boot design has not been updated at the same rate as other sports footwear and was only ever designed for a man's foot anatomy. Coupled with the variance in body types for female riders, and inadequate sizing options, this thesis aims to answer this:

How might we provide size-inclusive, and comfortable riding footwear and apparel to help female equestrian professionals reach their full potential?

Line Plan

Figure 23 Line Plan

As this collection is geared towards the working female equestrian professional, the line will consist of a pair of riding breeches, a jacket, and tall boots (fig. 24). This line will focus on supporting the user through all steps of her working day, including, but not limited to mucking

stalls, feeding, grooming, turning out horses, and riding. All these tasks require different areas of mobility, support, and protection and therefore will explore different innovations to achieve the best result. Given the wide age range, this line will also focus on inclusive sizing and needs specific to female anatomy.

Product Line Naming Rationale

This product line needed a name that accurately referenced the historic background of the sport while celebrating the nature of this work and the user. Epona, was the goddess protector of horses, foals, riders, and horse care. Her place in history is significant. She was originally a Celtic goddess seen in depictions across Scotland, England, and France, but her influence went much farther afield, becoming the only Celtic goddess to be worshiped by the Romans and the Greeks (Bober and Magnen, 1958). In all artistic depictions across history, Epona is seen astride a mare with her foal in tow, seated or standing amongst horses with a cornucopia or bread. The food not only represents care of horses, but also fertility. In coins and sculpture, she can be seen in all stages of life. Epona's history and variety of representations make her the perfect figure head for a product line focused on inclusivity and the care of horses. Below is the exploration process and final logo for the product line.

Figure 24 Epona Representations (Musee de Luxembourg, 2007)

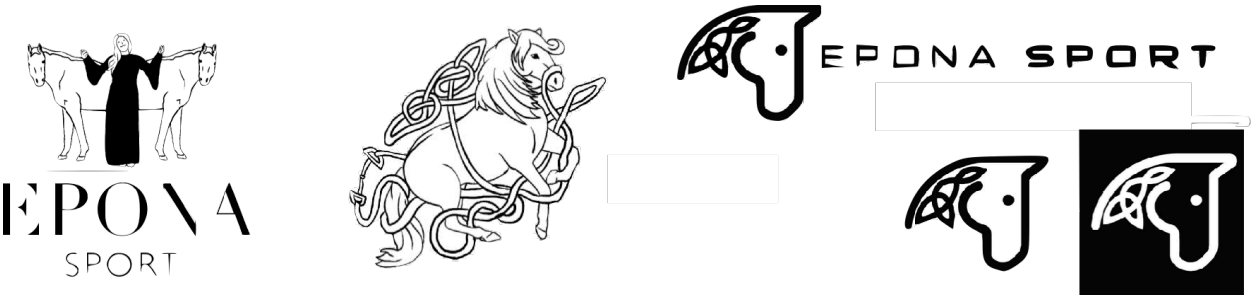


Figure 25 Epona Logo Process

Figure 26 Final Epona Logo

Product Rules

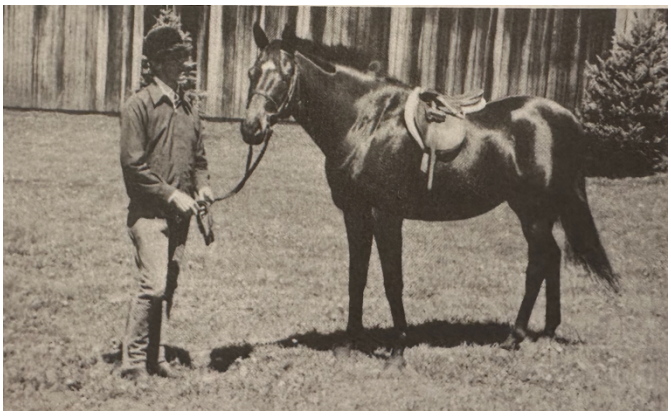


Figure 27 Correct causal riding attire, per George Morris (Morris,1981)

At a private equestrian center, there are almost no rules when it comes to attire or footwear, but some clothing and footwear have become standard across the industry. For bottoms, tight-fitting, comfortable pants made of smooth material is basic. Professionals opt for breeches, or jodhpurs, as they are purpose-built for riding, interfacing easily with boots and the saddle. Former US Equestrian Team Chef D'Equippe and 'Father' of Hunt Seat Equitation, George Morris (1981), said "While I do not prefer casual attire, it is realistic for out times. At the very least, I expect well-fitting boots, pants, and a tidy shirt" (p.7). On the top, shirts and jackets with a slim profile are preferred for safety and comfort while working in the stable yard and while riding (fig. 26) (Morris, 1981).

For footwear, closed-toed shoes around horses are a must. Beyond that, paddock boots and chaps, or tall boots are the norm. The boot must not have too much traction or outsole "bulk" so as not to get caught on the stirrup or rub the horse. The Horse's sensitive belly skin is in constant contact are in contact with the boot and the skin can easily be broken (fig.27). Boots must also have a small heel to prevent the foot from slipping through the stirrup.

Figure 28 Scarring on horses' side from boot and heel contact (Garber, 2020).

At the competitive level, there are several sets of apparel and boot rules but the three major governing bodies for equine sport provide these guides:

Federation Equestre International (*Rulebook*, n.d.):

- Black or brown boots.
- Boots must have a heel.

United States Equestrian Federation (*Rulebook*, n.d.):

- Boots and half chaps are allowed.
- Fourth level or below, riders may wear tall boots or paddock boots with half chaps or gaiters (only applicable for children).
- Tall English- style riding boots, including dress or field boots or variations thereof, are required above the fourth level.

- Boots/ shoes worn while riding or anywhere in the competition grounds or barn must have a distinguishable heel.

United States Equestrian Team (*Rulebook*, n.d.):

- Boots/ shoes worn while riding or anywhere in the competition grounds or barn must have a distinguishable heel.

Jobs to be Done

The boots, pants, and coat created for this thesis will stand up to long days working as an equestrian professional and answer the how might we question of this project; How might we provide durable, size-inclusive, and comfortable riding footwear and apparel that meets the daily working needs of the female equestrian professional? The tasks included in an average working day include, but are not limited to, walking long distances, mucking out stalls, turning horses out to pasture (which requires traversing various terrain for distances up to 1 mile), riding and training horses, and grooming.

The footwear and apparel must be easy to clean and low maintenance…. Currently it is recommended that boots be cleaned with saddle soap and polished each day. Many articles of riding apparel are stain prone and require complex laundering methods or dry-cleaning. Given the nature of being an outdoor sport, the product line must be robust enough to be used in all seasons and weather. This means the boot will keep the wearers foot dry while allowing a moisture exchange that keeps the users foot and leg free of excessive sweat. The apparel will help the user maintain a comfortable temperature during hot and cold days. All materials chosen for this line must be water resistant, tear proof and abrasion resistant, ensuring longevity of the product's life.

The boot must be well-fitting and comfortable throughout the myriad of tasks the wearer encounters over the course of a working day. This means a design that doesn't cause blisters, allows for joint mobility at the knee and ankle and allows for the anatomical needs specific to female anatomy. In all sport sectors, women's shoes have traditionally been manufactured using a smaller version of a men's last, with dimensions scaled according to foot length. Currently, when buying boots, there is rarely if ever any separation between footwear options for men and women, meaning females are left to buy men's boots by default (*English Riding Boots | Dover Saddlery*, n.d.). The study *Gender Differences in Adult Foot Shape: Implications for Shoe Design* by Roshna Wunderlich and Peter Cavanagh found that at comparable foot lengths, women have larger calf and ankle circumferences, a higher maximum calf circumference and lower ankle heights. Additionally, they found "the remaining five measurements indicate that at the same foot length a woman's foot has a higher arch, a shallower first toe, a shorter ankle length, a shorter length of the outside ball of foot, and a smaller instep circumference than a man's foot" (Wunderlich & Cavanagh, 2001). All of this shows that footwear designed for female users must be designed with their anatomical differences in mind so that the footwear can be comfortable and better fitting.

With apparel, the specific anthropometric needs are less glaring, as riding current riding apparel is already separated by sex. That said, clothing options offer a narrow size range and are based off of measurements used in the general fashion industry. Female riders have body compositions that differ from 'standard' builds, with larger hip and thighs and smaller upper body (Ayvazyan, 2022) (Douglas et al, 2015). This product line will have garments designed to fit the body types of female riders resulting in greater comfort and mobility for the wearer.

This line must maintain classical equestrian boot aesthetics. The boot must be a tall, black, and have slim profile. Any and all technology or design adjustments must be subtly and camouflaged in the final design, otherwise the design would run a risk of being rejected by the industry (Greene, 2008). For apparel, all articles of clothing must be well tailored to highlight the lines of the rider and have minimal trims or decoration. Not only as an aesthetic requirement, but as a matter of safety (Morris, 1981).

State of the Art Products

Given the classical nature of this industry, not many recent innovations have been made in this product space. The innovations focus primarily on work in the saddle, with comfortable soles on boots, four-way stretch in breeches, and reduction of chaffing points.

*Figure 29 State of the art products features and benefits (*Sergio Grasso Riding Boots Energy Walk & Ride, *n.d.)(FreeJumpSystem, 2021) (*THE TAILORED SPORTSMAN Vintage *n.d.)*

Other innovations in the equestrian apparel and footwear space are difficult to rate because they are attempting to push the envelope of what is worn, used, or widely accepted. Many of these new products are not allowed in competition or they have received poor reviews. The FreeJump stirrup employs magnets to keep the foot more secure in the stirrup, but this is outlawed in competition (FreeJumpSystem, 2021). The Animo breeches aim to be more durable as they are made of denim but have reviews citing poor mobility and chafing (Animo, 2022). Lastly, the Dada Sport breeches have silicone grip patches that are too sticky in the saddle and attract dust and dirt to the rider while working (Dada Sport, n.d).

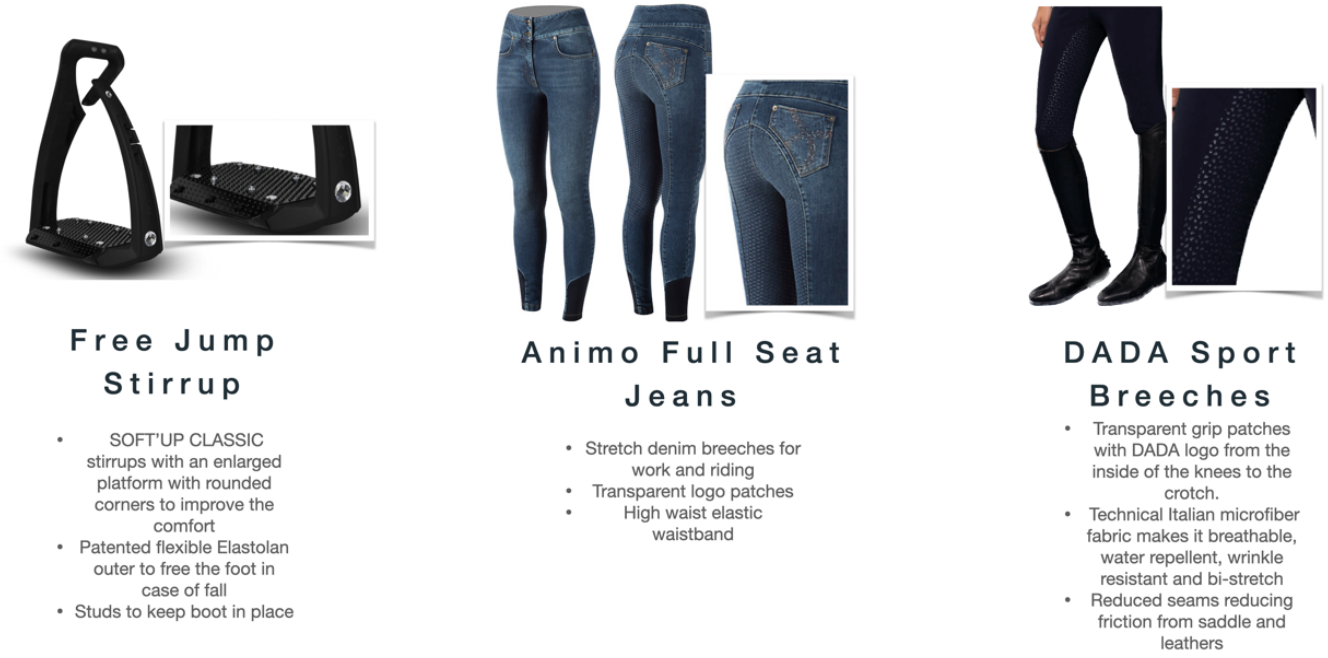


*Figure 30 innovative products, features, and their benefits (FreeJumpSystem, 2021) (*NIUZ 22X*, n.d.) (Kit Full Seat, n.d.).*

Intellectual Property Landscape

The generalized equestrian patent space, like many other areas relating to modernity in equine sport is small. This portion covers intellectual property relevant to this research covers leg protection, heel protection and stain resistance. These patents will serve as guides to how this footwear and apparel can propel the sport beyond the status quo.

Lower Leg Protection

WO2009041838A1 outlines the invention of a leg covering, or riding half chap. The chap is made to be suitable for use while riding, offering protection against the abrasive nature of prolonged contact with the saddle or horse. Though classic half-chaps offer adequate protection, they often cause overheating of the rider's lower leg because they are worn over breeches and socks. Due to their tight fit, they also become difficult and uncomfortable to walk in for extended periods. This patent presents a solution to rigidity and heat retention by offering substantial inner leg protection while leaving the outer leg uncovered mostly. Additionally, WO2009041838A1 proposes the use of stretchable meshes, neoprene coupled with industry standard leathers or suede (Walmsley, 2009).

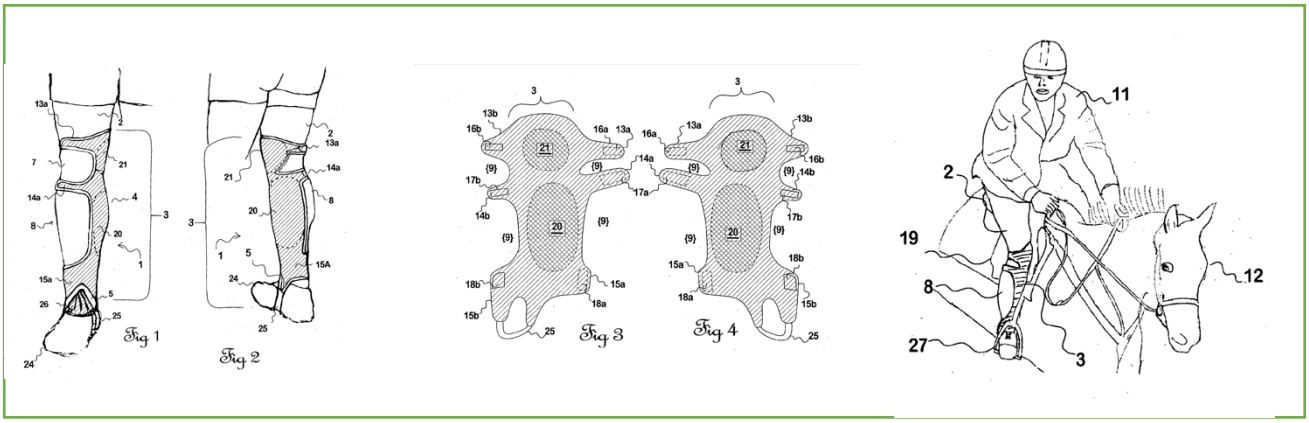


Figure 31 Lower leg protection patent (Walmsely, 2009).

Heel Protection

The need for robust and durable boot imperative in a stable yard. Between protection from the horse's heavy hoof, and the long periods on ones feet, the chance for injury is high. US patent US20050138846A1 presents the invention of an integrated guard that wraps around the heel of a work boot (fig. 31). This invention protects against damage to the boot itself and provides heel support with semi-rigid and rigid systems integrated into the boot, rather than as an external component (O'Connor, 2003).

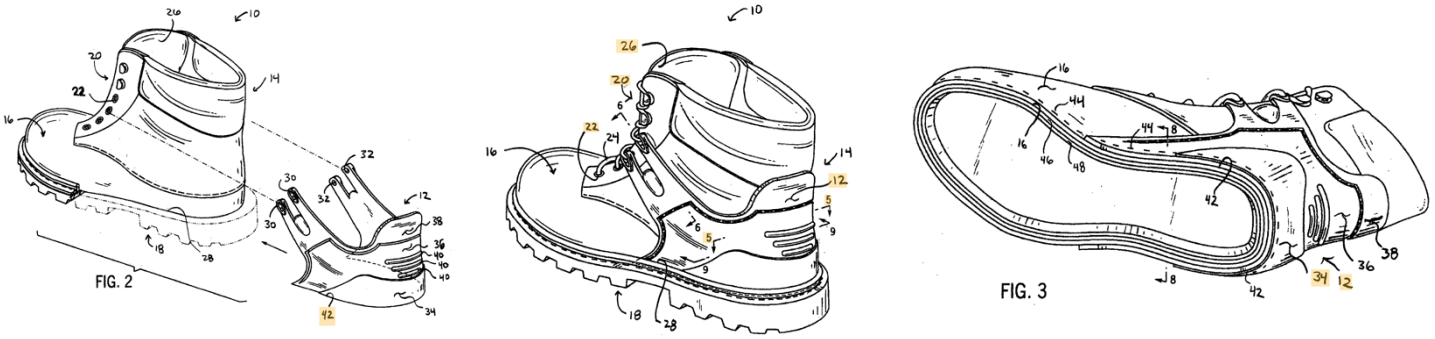


Figure 32 US20050138846A1 Heel protection (O'Connor, 2003).

Stain Resistant Materials

Lastly, equestrians come into myriad staining substances throughout the course of their working day; Vetrolin, hoof oil, iodine, saddle soap, soil, grass, and boot polish to name a few. US patent US007407899B2 discusses the invention of a textile substrate that improves the liquid repellency, stain release and antimicrobial properties in stretch fabrics. By accident, inventors Yunzhang Wang, Daike Wang, and Simon Zhang discovered that the order in which the stain release agent, particulate component and water repellant agent are applied can improve the stain, water, and oil repelling qualities of a fabric (Wang, Y et Al., 2005).

Product Anatomy

Boot Anatomy and Materials

1. Pull strap- Top Grain Calf's Leather
2. Shaft- Top Grain Calf's Leather
3. Laces- Waxed cotton
4. Instep- Top Grain Calf's Leather
5. Vamp- Top Grain Calf's Leather
6. Toe Box- Top Grain Calf's Leather
7. Zipper Keeper- Elastic+ Top Grain leather
8. Zipper- YKK zipper
9. Spur rest- TPU Rubber
10. Heel Counter- Top Grain leather
11. Heel- TPU Rubber
12. Outsole- TPU Rubber

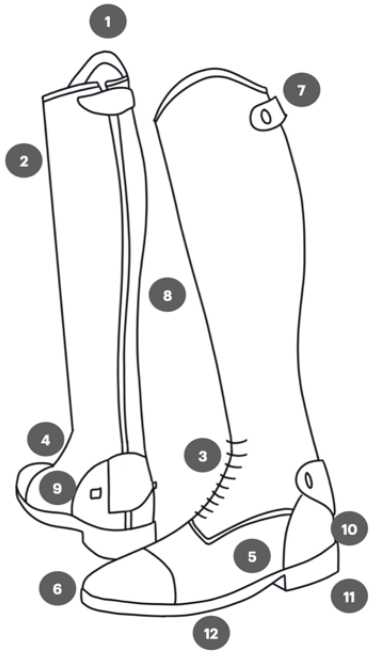


Figure 33 Boot anatomy key.

Pant Anatomy and Materials

1. Waistband- 4-way stretch polyester
2. Belt loop- 4-way stretch polyester
3. Zipper- YKK zipper
4. Pocket- 4-way stretch polyester
5. Knee Patch- Clarino faux suede
6. Boot- Sock- polyester mesh

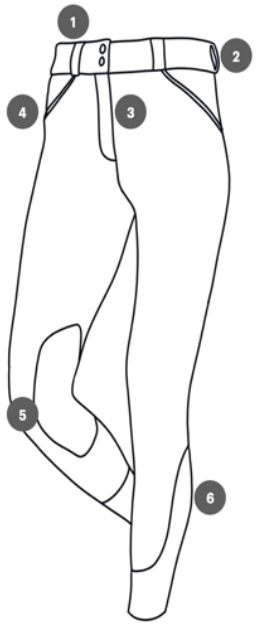


Figure 34 Pant anatomy key.

Jacket Anatomy and Materials

1. Collar- Ribbed Knit Cotton + Elastane
2. Zipper- YKK Zipper
3. Pocket- Polyester Mesh
4. Top- 92% Polyester, 8% Spandex
5. Sleeves- 92% Polyester, 8% Spandex
6. Cuffs- 92% Polyester, 8% Spandex

Figure 35 Jacket Anatomy Key

State of the Art Manufacturing

On the apparel side, manufacturing is low-tech. Garments like the jacket, and breeches are made in a standard "cut, sew, and ship" format. Large equestrian brands tend to work directly with overseas manufacturers who are accustomed to creating equestrian apparel. Pikeur, PF of Sweden, and Tailored Sportsman all come from the same facility (Li, n.d.).

For footwear, large brands work with overseas boot manufacturers. This process includes an in-depth leather inspection, where the bootmaker checks for material inconsistencies. After they cut the leather, mark components and notches, glue and stitch the upper, mount the boot on last to shape the heel and toe, steam to shape contours, mount the outsole and to the upper with glue, and finally complete a quality inspection. A smaller boot maker or custom manufacturer will carry out the same process but will not use injection molded outsoles or use a die cutter for leather. All steps will be completed by hand and sewn for reinforcement (breeches.com, 2017).

Figure 36 How TuffRider Boots Are made (breeches.com, 2017).

Competitor SWOT Analysis

This analysis compares two of the most popular products in each line item's category (boots, jackets, and riding breeches) from some of the most popular riding outfitters in the United States. Each section compares major parts of the product and identifies its strengths, weaknesses, opportunities, and threats. Points related to reviews can be found under each item's purchase page.

Boot SWOT

Dover Saddlery: Ladies Madison Field Boot, $310 (*Field Boots | Dover Saddlery*, n.d.).

	S	W	O	T
Outsole+ Insole	• Zoned Traction • Stirrup grip zone • Heel traction	• Shallow traction • Aesthetic traction may not serve purpose well • No obvious mid foot support • Stirrup grip zone borders rip off • Minimal size range (regular/ wide, Short/ tall, 6-10)	• More purposeful traction • Add mid-foot support shank • Reinforce stirrup zoning • Add insole to provide cushioning	• Poor reviews on longevity • No mid foot shank • No cushioning • Minimal size range
Upper+ Heel Counter	• Elastic Laces • Protected Zipper • Reinforced Spur rests • Double stitched seams • Low quarter panel for mobility	• Quarter panel places seams around vulnerable ankle, causing blisters • Toe-box attachment seam is behind the toe bend= blisters • Narrow toe box	• Cover seams around ankle to reduce blisters • Widen toe box to allow for foot spread in walking/ riding	• Narrow toe box • Reviews of toe bend cracking
Shaft	• Elastic gusset at inside knee • Contoured Snap Zipper keeper • Single leather panel over calf • Spanish style top elongates leg	• Reports of blisters around knee bend • Runs tall- In reviews • Boot buckles around ankle when boot drops	• Lower boot around knee bend • Reduce height overall • Reinforce posterior of boot to reduce chances of buckling as boot breaks in	• Reviews of blisters around knee bend • Boot shaft drops too far too quickly
Zipper	• Elastic panel along zipper	• Reports of zipper splitting • Reports of zipper pull tab breaking in half or falling off • Reports of zipper buckling as boot drops around ankle	• Choose a zipper better built for purpose • Redesign zipper pull tab • Reinforce zipper around ankle to reduce chances of buckling	• Weak trims- zipper pull breaking, zipper buckling

Ariat: Heritage Contour Field Zip Tall Riding Boot, $370 (*Heritage Contour Riding Boot*, n.d.).

	S	W	O	T
Outsole+ Insole	• Zoned traction for stirrup • Mid foot stabilizing shank • Dura tread sole resistant to barnyard acids, oils, and slips	• No heel traction • Deep grooves promote cracking when flexed • Minimal size range (regular/ wide, Short/ tall, 6-10)	• Add heel traction • Reduce groove depth • Redesign traction to better support foot in flexion • Add insole to provide cushioning	• No heel traction • Cracking around toe • Poor reviews • Minimal size range
Upper+ Heel Counter	• Classic square toe • No harsh seams around ankle • Low profile heel counter • Wide toe box	• No heel zipper cover • No quarter panel= decreased mobility • Seams not double stitched= prone to tearing • Seam directly over toe flex point • Reports of cracking+ breaking over toe flex point	• Add low quarter panel to allow for ankle flexion • Double stitch seams for durability • Adjust toe seam placement over flex point • Rework leather finish or thickness over toe flex point to reduce chances of cracking	• No zipper keeper on heel • "Cheap" manufacturing (single stitching) • Poor reviews on durability
Shaft	• Elastic gusset at inside knee • Snap zipper keeper • Single leather panel over calf/ leg	• No contouring of zipper keeper • Reports of zipper keeper causing blisters • Lower cut top shortens rider's look • Reports of knee gusset buckling, causing blisters and pinching • Reports of inner leg wearing out quickly	• Contour zipper keeper to reduce instances of blisters • Redesign knee gusset to reduce instances of buckling and pinching • Elongate boot top • Line inner leg to reduce chances of holes/ hotspots	• "Cheap" manufacturing (contouring on zipper keeper • Cheap materials that wear out quickly (shaft leather)
Zipper	• Elastic panel along zipper	• Reports of zipper buckling on lower leg causing blisters • Reports of zipper pull tab breaking • Reports of zipper detaching along seams	• Reinforce zipper to reduce chances of bucking • Reinforce zipper seams • Create sturdier pull tab	• Poor manufacturing around zipper seams • Cheap materials (zipper pull)

Jacket SWOT

Ariat: Salient Jacket, $140 (*Salient Jacket*, n.d.).Noble Outfitters Women's Full Flex Canvas

	S	W	O	T
Front	• Textured paneling for "flattering" fit • Scalloped hem • Wind and water resistant with breathability • 94% Polyester, 6% Spandex allows some mobility • Zippered pockets • Military inspired cut with epaulets and belt detail • Two way Zipper	• Reports of zipper breaking and loosing silver finish • Small size range and reports of running small • Serged inner seams cause chafing	• Flat fell seams • Increase/ improve size range and grading • Change zipper finish	• Cheap manufacturing choices (serged seams) • Small size range excludes buyers • Cheap Trims
Back	• Textured paneling for "flattering" fit • Scalloped hem • Wind and water resistant with breathability • 94% Polyester, 6% Spandex allows some mobility • Military inspired cut with epaulets and belt detail	• Serged inner seams cause chafing • Reports of tight fit over back	• Flat fell seams • Improve fit over back	• Cheap manufacturing choices (serged seams) • Reviews citing fit problems can deter buyers
Collar	• Rolled Seam moves stitching away from edge • Wind and water resistant with breathability • 94% Polyester, 6% Spandex allows some mobility • Two way zipper	• No Zipper cover causes rubbing/ chafing	• Flat fell seams • Line collar in fleece • Add zipper cover	• Lack of zipper cover/ thoughtful finishing can deter buyers
Sleeves	• Scalloped hem on cuff • Wind and water resistant with breathability • 94% Polyester, 6% Spandex allows some mobility	• Reports of extra tight fit around shoulder/ arm holes • Can't roll sleeves • Reports of elbows wearing out quickly	• Open arm hole to allow for greater mobility • Reinforce elbows • Allow sleeves to be rolled up	• Cheap manufacturing choices (serged seams) • Reviews citing fit problems can deter buyers

Jacket, $140 (*Women's FullFlexx*^{TM}, n.d.)

	S	W	O	T
Front	• Button placket cover • Full front two way zipper • Water resistant canvas • Polyester batting • Adjustable cinch waist with interior toggles • Faux fur lined pockets • Concealed interior seams	• DWR finish isn't environmentally friendly and wears off • Poor breathability • Upright pockets are difficult to use • No pocket closure • Faux fur lined pockets get dirty quickly • Large concealed carry interior pocket adds unnecessary bulk	• Change cotton waterproofing finish • Add ventilation • Remove faux fur lined pockets • Add pocket zipper • Rotate pocket opening to ergonomic position	• DWR finish can deter environmentally minded customers • Faux fur can be polarizing • Concealed carry pocket could deter some users
Back	• Water resistant canvas • Polyester batting • Adjustable cinch waist • Bi-Swing back panel • Concealed interior seams	• DWR finish isn't environmentally friendly and wears off • Poor breathability • No snaps to close bi- swing panel	• Change cotton waterproofing finish • Add ventilation • Add snaps to bi-swing panel	• Lack of thoughtful (and inexpensive) finishes like a button over bi-swing panel • DWR finish can deter environmentally minded customers
Collar	• Water resistant canvas • Polyester batting • Faux fur lined collar • Zipper cover • Detachable faux fur lined hood • Concealed interior seams	• DWR finish isn't environmentally friendly and wears off • Reports of poor hood fit • Hood zipper is hard to use	• Change cotton waterproofing finish • Add ventilation • Improve hood attachment • Improve hood fit	• DWR finish can deter environmentally minded customers • Poor reviews on hood fit can deter customers • Faux fur lining can be polarizing
Sleeves	• Articulated elbow • Zip up arm pocket • Knit storm cuff • Concealed interior seams	• DWR finish isn't environmentally friendly and wears off • Poor breathability • Bulky cuff	• Change cotton waterproofing finish • Add ventilation • De-bulk cuff	• DWR finish can deter environmentally minded customers • Bulky cuff is poor for purpose

Pant SWOT

PS of Sweden: Kim Breeches, $170 (*Kim Breeches*, n.d.).

	S	W	O	T
Waistband	• Mid rise waistband • Two inch tall waistband • Reinforced belt loops • Faux denim look • Zipper with button and hole top closure	• Single belt loop on rear promotes gapping • Reports of zipper breaking • Limited size range 30-40 • Dry clean only • Faux denim look implies durability	• Change material to a machine washable fabric • Add secondary back belt loop • Improve zipper • Choose a durable material	• Not easy to clean/ care for garment • Denim look can be polarizing • Cheap trims • Limited size range is exclusive
Front	• Three front pockets • No inner leg seams • Flat felled outer seams • Mesh boot sock • Faux denim look • Reinforced upper thigh	• Casual look • Small Pocket is unnecessary • Limited size range 30-40 • Dry clean only • Faux denim look implies durability	• Change material to a machine washable fabric • Choose a durable material • Remove tiny pocket • Increase size range	• Denim look can be polarizing • Not easy to clean/ care for garment • Limited size range is exclusive
Back	• No inner leg seams • Flat felled outer seams • Mesh boot sock • Reinforced upper thigh • Large back pockets • Yoke provides closer fit • Faux denim look	• Casual look • Back pockets are mostly aesthetic • Limited size range 30-40 • Dry clean only • Faux denim look implies durability	• Add back pocket closure to make functional • Increase size range • Change material to a machine washable fabric • Choose a durable material	• Non functional back pocket • Not easy to clean/ care for garment • Denim look can be polarizing
Traction	• Rubber graphic knee traction area	• Reports of rubber graphic being "too sticky" • No knee patch to protect pant for longevity • Dry clean only	• Reduce rubber graphic traction and reinforce knee roll area	• Material finish can be stylistically polarizing and has mixed reviews

Tailored Sportsman: Vintage Midrise Breeches, $225 (Tack, n.d.).

	S	W	O	T
Waistband	• Two inch reinforced waistband prevents rolling • Reinforced belt loops • Double belt loop on center back to prevent gapping • Zipper front closure with hook and eye faux buttons	• Dry clean only • Reinforced waistband can cause increased sweating around midsection • Very small and weak zipper prone to breakage • Hook and eye buttons are difficult to close/ bend easily	• Change material to a machine washable fabric • Use single layer waistband to reduce temperature around midsection • Replace zipper • Replace hook and eye with button and hole closure	• Not easy to clean/ care for garment • Cheap trims (zipper + hook and eye)
Front	• Front pockets • Flat felled seams on outer leg	• Dry clean only • Front pocket bag of itchy wool blend • Reports of tearing on inner and outer seams on upper thigh • Serged Seams on inner leg • Velcro cuff closure causes blisters inside boot	• Change material to a machine washable fabric • Change pocket material and affix it to pant • Flat fell or reduce inner thigh seams • Boot sock lower leg or remove cuff closure	• Not easy to clean/ care for garment • Velcro cuff is an out of date and cheap choice for the price of the pant • Serged seams are poor for purpose
Back	• Euroseat cut • Flat felled seams on outer leg	• Dry clean only • Serged Seams on inner leg • Euroseat can dig into buttocks	• Change material to a machine washable fabric • Flat fell or reduce seams on inner thigh • Rework euroseat cut to allow for stretch	• Not easy to clean/ care for garment • Poor patterning on euroseat seam can deter buyers, because it even digs into buttocks on product photos • Serged seams are poor for purpose
Traction	• Large suede knee patches	• Dry clean only • Simple zigzag stitch can split easily • No ventilation around knee bend • Patch goes unnecessarily deep into boot • Patch wears out quickly	• Reduce knee patch length • Reinforce attachment stitch with adhesive • Change patch shape or thickness to reduce chances of wearing out	• Antiquated patch design and attachment

Trends

The generalized trends that will guide this project aim to create cohesion across the apparel and footwear line as well as carve out a place in the current market. The branding, color, and graphics chosen draw inspiration from future fashion and sports trends, while paying homage to heritage brands that are loved across the industry.

Color

Current Color Trends

Since the 1800s, equestrian apparel has been primarily earth tones and neutrals. This comes from the sport's boom in popularity from foxhunting. The garments needed to hide dirt and debris while also acting as camouflage during the hunt (Potter, 2016). This resulted in dark browns, tans, and tweeds becoming popular in the equestrian sport space. Today, this trend holds true, with only a few brands integrating brighter colors into their apparel.

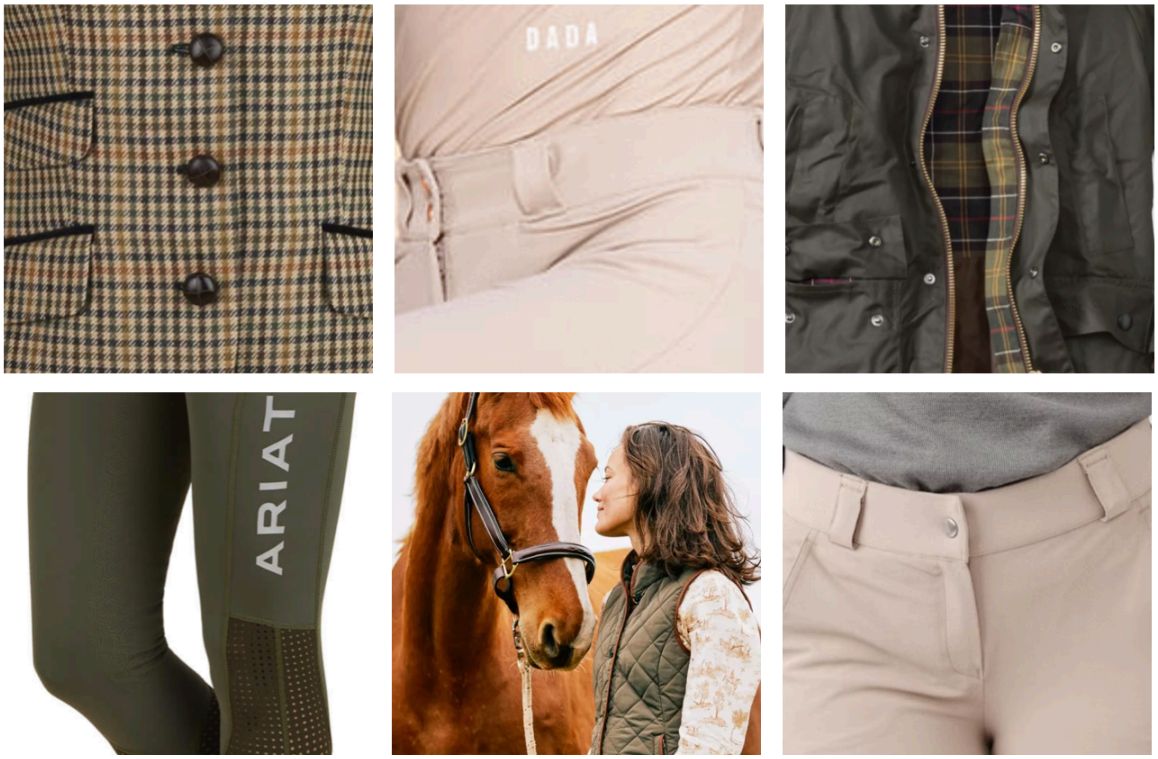


*Figure 37 Current Color Trends (Cordings, n.d.) (kit full, n.d.) (Barbour, n.d.) (*Eos Knee Patch Tight*, n.d.) (silk, n.d.) (Ariat, n.d.).*

Future Color Trends:

This project will be based in classic navy blue and neutrals that will be a foundation for any working wardrobe. This will be achieved through "circular color," a method of deriving material color through industry detritus, including food scraps, deadstock fabrics, and other textile waste. Using accents of "complementary clashing" colors will provide bright colors and personality to the line, without using traditional sports colors of pink and teal. Lastly, "protective metals" encourage a focus on the protection and hygiene of the user, which is achieved through materials such as copper, zinc, and silver. This can be highlighted as an accent on the garments and footwear.

*Figure 38 Future color trends ((*WGSN | Advanced Colour Forecast 2025 - WGSN*, n.d.)*

Graphics

Current Graphic Trends:

Currently, graphics on equestrian apparel are fairly minimal, with logos being the largest graphic on most clothes. Additionally, heritage toile patterns and equine imagery are used as artworks on shirts and linings. Companies like Voltaire Designs use a crossed ribbon motif on horse accessories and apparel, creating consistency between the horse and rider. Finally, many brands use classic plaid patterns on outerwear and accessories, tying back to hunting traditions.

Figure 39 Current graphic trends (Ariat,n.d.) (Animo,n.d.) (Voltaire design, n.d.).

Future Graphic Trends:

Graphics trends across sports and fashion spheres are leaning towards inspiration from heritage textiles and printmaking processes. Color-blocked graphics from the Bauhaus era are universally appealing and can serve in easily understood branding and graphics in garments (Hartov, 2021). Lastly, there is a surge of equestrian/ luxury sport participation in China and Japan, so taking graphic queues from vintage Japanese collage advertisements will ground the collection in world history, rather than a solely western lens (Xu, 2020).

*Figure 40 Future Graphic trends (*WGSN | Advanced Colour Forecast 2025 - WGSN Beauty*, n.d.)*

Branding

Current Branding trends:

Unsurprisingly the branding, like every other equestrian trend is based on history. Many of the trusted equestrian brands have been around for 100+ years, Devocoux; est.1885, Hermes; est. 1837, Tailored Sportsman; est.1920, and their branding shows it (Hansen, 2015). They feature simple and classic typography with Devocoux and Hermes including illustrations that reference their history of creating carriage tack. The newer brands like Ariat, PS of Sweden, and Voltaire all have easily read typography, and minimal color with Ariat and Voltaire alluding to a connection with the horse industry through graphic logos.

Figure 41 Current Branding Trends

Future branding trends:

Within the equestrian community, branding is very important. Logos from brands like Veredus Hermes and Devocoux are all similar (horse illustration with the brand name underneath) but easily recognized across the world. This collection will aim to use iconic equestrian imagery that honors past branding styles while moving forward with playful and bold fonts.

*Figure 42 Future Graphic Trends (Milton Menasco, n.d.) (DADA Sport,n.d.) (*hermes.com*, n.d.).*

Research Studies

Albeit the large financial contributions and investment within equestrian sports, the industry itself faces a dearth of rider-focused research. Many of the existing studies focus solely on the biomechanics, physiology, and psychology of the horse and the rider is considered noise within the data. The research studies below place focus on the rider rather than the horse.

Physiological Research Related to Product Space

In a study completed at Hartpury University, an equestrian-focused program in the United Kingdom, Dr. Jenni Louise Douglas aimed to synthesize research surrounding the physiology of an equestrian. Her article, entitled *A Systematic Review of Physical Fitness, Physiological Demands and Biomechanical Performance in Equestrian Athletes*, investigates existing literature surrounding the physiology of equestrian athletes (Douglas et al, 2015). Through analyzing 15 peer-reviewed papers and many other articles, Dr. Douglas provides a comprehensive overview of the average body fat, BMI, and height of different rider groups. The paper also covers the VO2 max, heart rate, and lactate accumulation across disciplines and changes in heart rate and oxygen consumption through the gaits. The study gives concrete evidence to prove that female equestrians engage their lower body muscles at a significantly higher rate than upper. This results in larger leg and hip muscles and creating a morphology unlike standard ratios used in the fashion and design industry (Ayvazyan, 2022).

While this is a more focused overview of rider physiology than has been previously compiled, it is still lacking in depth around equestrian athlete physiology. For a study of this kind, the athlete sample group is relatively small and has a broad spectrum of rider disciplines. The data surrounding equestrian body types and sizing will help to guide the apparel

side of this project to create an accurate and inclusive size range for equestrian work apparel (Douglas et al, 2015).

Biomechanical Research Related to Product Space

Dr. Céleste A. Wilkins, another researcher from Hartpury University, conducted the study *Dynamic Technique Analysis of the Female Equestrian Rider* wherein she researched and ranked different assessment techniques to track the kinematics of a rider over the horse's movement cycle. As previously mentioned, the focus of these studies is usually the horse's movement, not the rider's. In the case of this paper, the focus was solely on the rider. This data was collected with a group of 52 volunteer professional female riders who took part in tests that employed motion capture technology. These were done in a closed arena on horseback and a rider simulator. The data measured rider kinematics and compared how the rider's movement and movements differed on and off the simulator as compared to a horse (Wilkins, 2021).

Most important to the needs of this thesis research, chapter 4 of Dr. Wilkins' study concluded that special considerations surrounding the riders clothing must be made when conducting motion capture studies. Extraneous clothing worn during testing can exacerbate kinematic data stemming directly from the horse. While the soft tissue of the riders lower body can increase error in the measurement of pelvic orientation while riding, it was concluded that markers must be placed on the rider's breeches for safety while riding.

For the purposes of this paper, the in-depth explanations of how to affix motion markers onto the body (on clothing versus direct skin contact) and how rider motion capture can be improved will inform the research of this paper, apparel design, and footwear design.

Psychological Research Related to Product Space

Physically Active Adult Women's Experiences with Plus-Size Athletic Apparel, written by Deborah Christel explores the experiences of adult women, existing beyond the boundaries of straight sizing, buying athletic apparel. The stigma around weight is prevalent in all areas of sport. "Inaccessible exercise equipment's, clothing and facilities negatively influence fat people's motivation to exercise and has an especially strong impact on women" (Christel, 2012). She goes on to explain that women should be welcomed to pursue movement and exercise for reasons of joy rather than to fit within societal norms. The objectives of this study were to ascertain the plus size adult women's experience when wearing and buying athletic clothing and to determine whether athletic clothing availability was a deterrent to engage in physical activity and effects on self-esteem when related to athletic clothing fit.

To get a baseline of information for this study, Christel reviewed literature exploring comfort as well as psychological research related to appearance and physical activity. The conclusion to this portion was that the perception of fit was tied to the pervasion of societal norms surrounding bodily aesthetics. When 'actual' fit and perception don't align, the research showed that women employed one of 4 coping mechanisms (Christel, 2012).

(1) Individual accepts societal standards and work to attain (sometimes unrealistic) standards
(2) Individual accepts societal standards and ceases in pursuing athletics
(3) Individual modifies their personal standard of devotion to the 'ideal'
(4) Raise self-esteem and self-identity by changing societal norms by 'taking up space'

Of the 14 participants in the interview phase of study, one was an equestrian, riding at least 5 days a week at her barn and partaking in at least 10 additional hours of barn chores and grooming. When asked about athletic apparel during her 1:1 interview, she said "For one the clothes are by nature tight fitting (breeches are like tights with leather or suede reinforced seat and legs). There is no way to camouflage cellulite in riding breeches. But I am passionate about riding so it's not a choice. Additionally, because I ride a horse I know some of the people at the barn wonder if I am too large to be riding and I'm a size 12" (Christel, 2012).

It can't even be said that equestrian industry is fat-phobic, because women who fall within straight sizes are shamed, encouraged to become smaller and not provided with fitting, purpose-built apparel. The article *Riders, Body Image and "The Look"* from the Plaid Horse Magazine highlights amateur equestrian Rennie Dyball's experience when shopping for a riding jacket (Dyball, 2019). The 38-year-old, size 8 riding pant, b-cup woman was trying on a coat she had been eyeing in the tack shop. Loving her look and excited to purchase her new jacket, she was approached by a saleswoman who looked her up and down, while remarking "you should try a different store, you're too curvy for everything we have here." This negative shopping experience derailed the self-confidence a rider who had previously released herself from devotion to the "ideal body" (Christel, 2012). Dyball goes on to discuss the prevalence of body image issues within the sport, citing judges at the Maclay Finals praising the skinniest athletes for having "the look." She also

Figure 43 Photo taken of 'too curvy' Rennie Dyball a day before the "shop incident" (Dyball, 2019).

recounts her fear of returning to equestrian sport after the birth of her daughter because she knew she would feel self-conscious wearing skintight, beige colored breeches that were already at the largest size available, size 10.

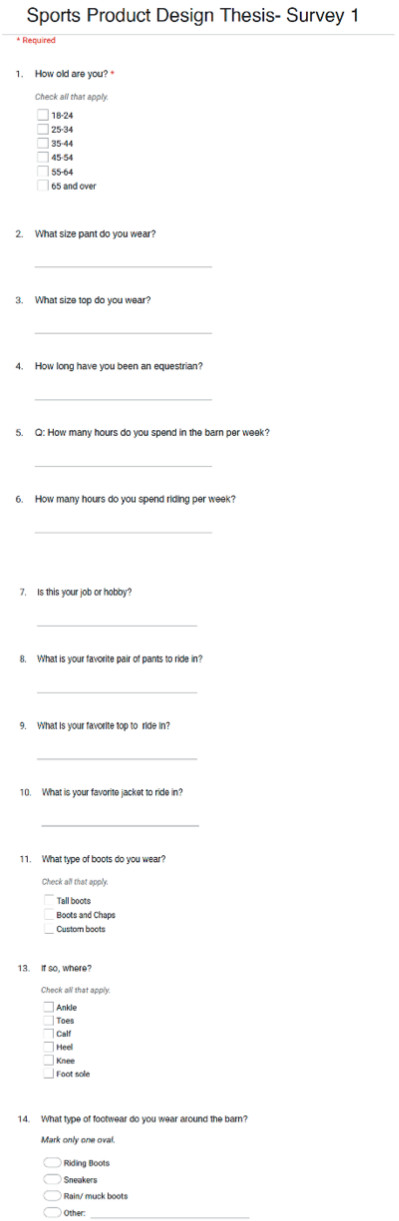
Research Plan

To gain valuable insight into what equestrians need and how they move, in-person research will begin with "looking", as outlined in "Research Methods for Design" (Milton, et al. 2013). To begin to understand what a working equestrian goes through in a day, this project will observe a rider via a photo and video diary through a day in the life of a working female equestrian. Once this has been compiled, the rider and researcher will analyze and discuss cherished belongings and equipment to identify areas of wear and features of the products. Lastly, product autopsies will be completed for each of the proposed products in the line plan (jacket, pant, and boot). This will provide insight into how each product was manufactured and potential areas for improvement.

Following the looking phase is "asking." This phase will begin with questionnaires and surveys posted to equestrian Facebook groups, discussion boards, and collegiate equestrian team rosters. This will provide large response groups with data focused on boots, apparel choices, and product needs. Afterward, the asking phase will narrow down to focus groups of professional equestrian females in the target user age range. The discussion will center around apparel needs, pain points, daily workload, sizing issues, and fatigue or injury caused by riding boots. Lastly, willing participants will be invited for 1:1 interviews where female equestrian professionals can delve more deeply into their specific needs regarding apparel and footwear.

Baseline User Research

For baseline research into equestrians, products they use, pain points, and new product interest, a survey was disseminated on these Facebook groups; Oregon Horse Forum, Savannah Area Eventers, SCAD Equestrian Team Alumni and shared with individuals working in the professional equestrian sphere on the 6th of November 2022.



Sports Product Design Thesis- Survey 1

* Required

1. How old are you? *

Check all that apply.

- 18-24
- 25-34
- 35-44
- 45-54
- 55-64
- 65 and over

2. What size pant do you wear?

3. What size top do you wear?

4. How long have you been an equestrian?

5. Q: How many hours do you spend in the barn per week?

6. How many hours do you spend riding per week?

7. Is this your job or hobby?

8. What is your favorite pair of pants to ride in?

9. What is your favorite top to ride in?

10. What is your favorite jacket to ride in?

11. What type of boots do you wear?

Check all that apply.

- Tall boots
- Boots and Chaps
- Custom boots

13. If so, where?

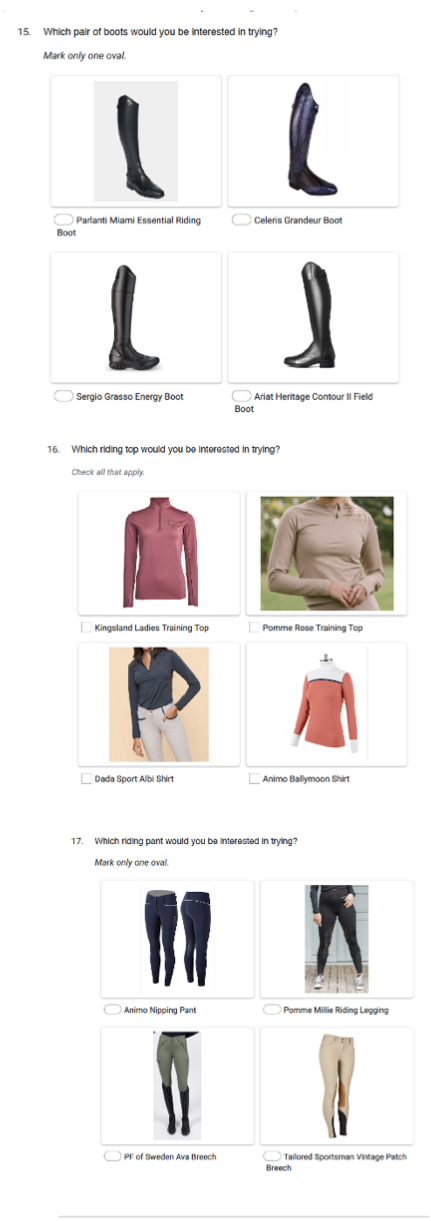
Check all that apply.

- Ankle
- Toes
- Calf
- Heel
- Knee
- Foot sole

14. What type of footwear do you wear around the barn?

Mark only one oval.

- Riding Boots
- Sneakers
- Rain/ muck boots
- Other:



15. Which pair of boots would you be interested in trying?

Mark only one oval.

Parlanti Miami Essential Riding Boot

Celeris Grandeur Boot

Sergio Grasso Energy Boot

Ariat Heritage Contour II Field Boot

16. Which riding top would you be interested in trying?

Check all that apply.

Kingsland Ladies Training Top

Pomme Rose Training Top

Dada Sport Albi Shirt

Animo Ballymoon Shirt

17. Which riding pant would you be interested in trying?

Mark only one oval.

Animo Nipping Pant

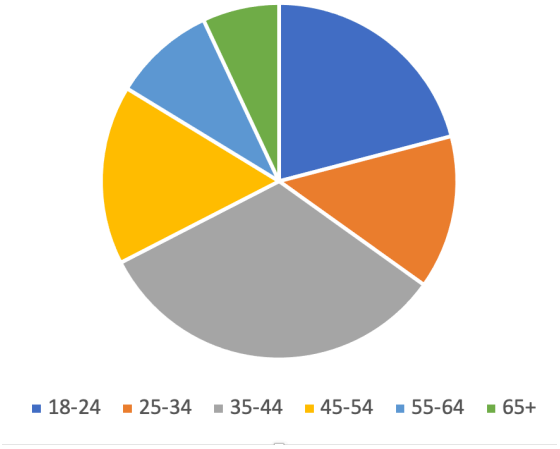
Pomme Millie Riding Legging

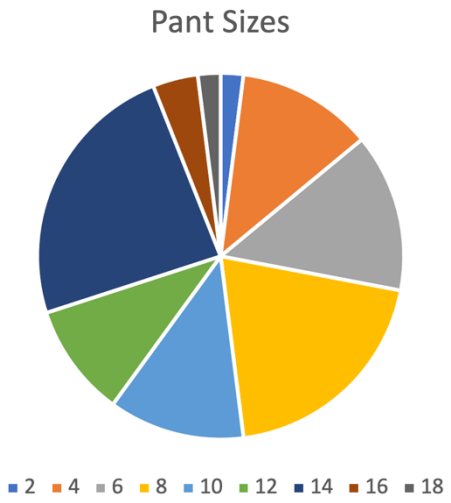
PF of Sweden Ava Breech

Tailored Sportsman Vintage Patch Breech

General Questions

The survey was completed by 43 participants with a majority in the group falling within the 35-44 range. For clothing sizes, most participants fell within the middle of the US pant and top size range of 8-12. The top sizing shows a lean towards size 6 on tops, indicating a lower upper body mass in comparison to the lower body, which is in line with the findings of Dr. Jenni Louise Douglas; higher muscle activity on the lower body of equestrians (Douglas et al, 2015).





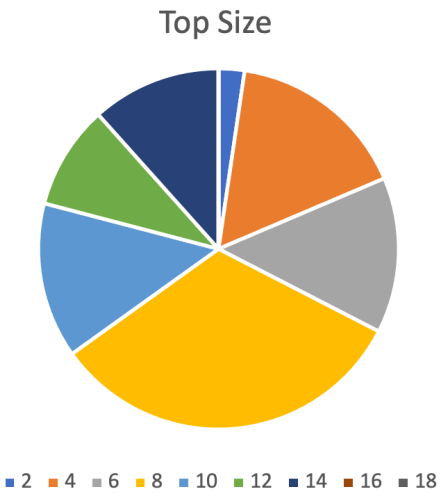


Figure 44 Survey "general" question responses

Boot Questions

Participants were asked what types of footwear they preferred to ride in and wear around the barn. Results showed the majority wear custom tall boots, 27. All participants responded yes when asked whether their riding boots cause discomfort. The areas of discomfort were concentrated around the ankle and heel, followed by the toes, sole, and knee. In this line of questioning, pain around the calf was minimal. Even with the unanimous response of boots causing pain, the respondents still prefer to keep on their riding boots rather than sneakers or rain/ muck boots.

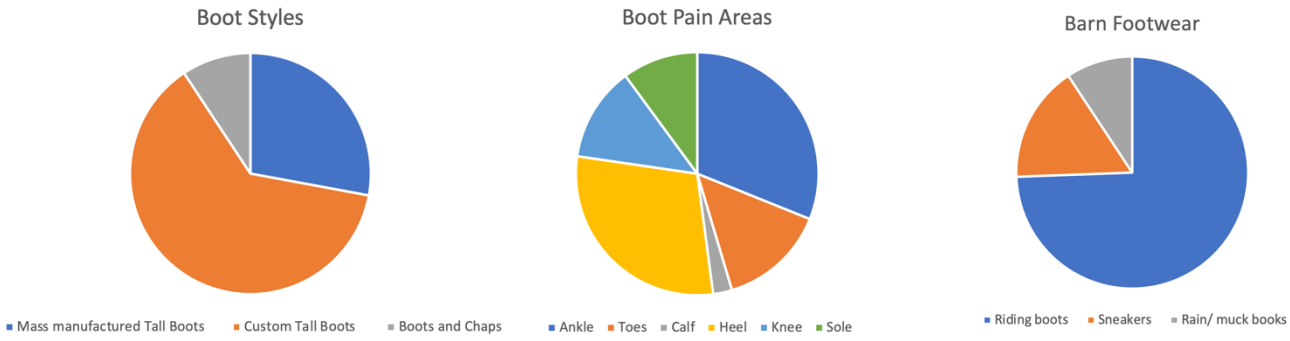


Figure 45 Boot related survey responses

Style Questions

Finally, when asked to indicate their preference for riding boot, top, and pants styles, participants were asked to choose from the most popular style, something avant-garde, a middle-ground product, and a product at the forefront of innovation. Respondents were not provided with any information other than a photo of each product. With boots styles, the overwhelming preference was for the Parlanti boot, which is a plain black boot. The least favorite was the Celeris boot, which used blue alligator leather detailing (fig. 45).

*Figure 46 Survey responses: Boot style (Parlanti International, n.d.) (*Grandeur*, 2018).*

With Tops and pants, the reactions indicated an openness to try less common cuts and styles. The Pomme Rose Training Top (Innovative) has an off-centered ¾ zip and Henley style neckline (fig. 46). It received the highest ranking. The Animo Ballymoon Shirt (Avant-garde) received the lowest ranking, with only 1 out of 43 wanting to try it.

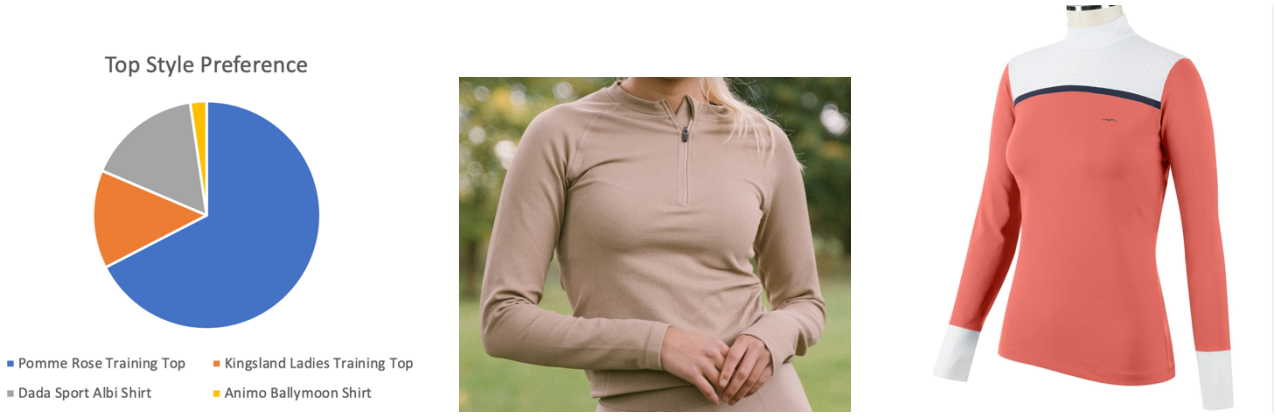


*Figure 47 Survey Responses: Top Style Preference (*Pomme | Equestrian Wear for the Modern Rider*, 2022) (Animo, n.d.).*

For pants, (classic) Tailored Sportsman's came out on top… The classic vintage high-rise features a clean design with minimal embellishments. A close second place went to the innovative cargo style PF of Sweden Ava breech. The least favored was the Pomme Millie

Riding Legging (Avant-garde) which is a softer material legging style with a contrasting grip pattern (fig.47).

*Figure 48 Survey Responses: Top Style Preference (*Pomme | Equestrian Wear for the Modern Rider*, 2022) (Tailored, n.d.) (*Pomme | Equestrian Wear for the Modern Rider*, 2022)*

Product Performance Testing Plan

All product, material, product, and user testing must relate to the aforementioned project question: how might we provide durable, size-inclusive, and comfortable riding footwear and apparel that meets the daily working needs of the female equestrian professional? The testing must bring clarity around mobility and comfort needs, durability, and size inclusion with existing products. The user research will define clear areas of opportunity related to 'real' female equestrian anatomy and movements required over the course of a working day.

Testing Product Selection

- Boot: To identify a baseline for boot quality, preliminary testing will be conducted on the Riding Sport™ Ladies' Black Field Boot. At $113 it is an affordable and size inclusive range (*Riding Sport™ Ladies' Black Field Boots | Dover Saddlery*, n.d.). This testing will analyze function, comfort, fit, cushioning and durability.

*Figure 49 Boot for testing (*Riding Sport™ Ladies' Black Field Boots | Dover Saddlery*, n.d.)*

- Pant: To identify a baseline for riding pant quality, preliminary testing will be conducted on the Trophy Hunter Low-Rise Breech from Tailored Sportsman (*THE TAILORED SPORTSMAN Vintage Patch*, n.d.). While on the pricey end of riding pant at $195, the pair of pants comes highly rated and is industry standard. This testing will focus on function, comfort, fit, mobility, durability, ease of care.

Figure 50 Pant for Testing (Tailored, n.d.).

- Jacket: To identify a baseline for riding jacket quality, preliminary testing will be conducted on the Noble Equestrian™ Ladies' Sydney Soft Shell Jacket. At $59, this coat is highly rated, and made for all weather use (Dover, n.d.). This testing will focus on function, comfort, fit, mobility, durability, ease of care.

Figure 51 Jacket for Testing (Dover Saddelry, n.d.).

Fit Testing

Products to be Used: Boot, Pant, Jacket

Study Size: Minimum 5 participants

Phase	Procedure	Data collected	Duration
Recruitment/ Sign-Up	Subjects are contacted and asked to participate based on being size 8 athlete	N/A	N/A
Subject preparation	1. Subject signs human subject release form 2. Subject is given leggings and sports bra 3. Subject is measured 4. Subject is given riding apparel and footwear to use during testing	Body measurements to inform future pattern making - Height - Weight - Neck circumference - Torso length - Hip circumference - Arm Length - Calf circumference	~10 minutes
Data Collection Phase #1	Subject stands for photographs standing, knelt down and in 2-point riding position	- Front back and side photographs will be taken of subject in each position. Baseline fit will be compared visually with prototypes - Video	~10 minutes
Data Collection Phase #2	Subject stands for TrueToForm 3D Body Scan	- 5, 3d models of size 12 women to inform future pattern making	~3 minutes
Data Analysis/ Use	**Phase #1:** Analyze photographs and videos for signs of bunching, tightness, and wrinkling **Phase #2:** Compare morphological differences between size 8 athletes	**Phase #1:** Create fit metrics around bunching, stretch, tightness and wrinkling using video and photos to be compared with prototype **Phase #2:** Use 3D body scans to test fit on multiple body types when creating digital prototypes in Clo or Browzwear	N/A

Mobility Testing

Products to be Used: Boot, Pant, Jacket

Study Size: Minimum 1 participants

Location: University of Oregon

Equipment/ Props Needed: Riding Tack, Grooming Equipment, leggings, and shirt.

Phase	**Procedure**	**Data collected**	**Duration**
Recruitment/ Sign-Up	Subjects are contacted and asked to participate based on expertise	N/A	N/A
Subject preparation	1. Subject signs human subject release form 2. Subjects are given riding apparel and footwear to use during testing	N/A	-10 minutes
Data Collection Phase #1	- Subject is asked to complete common (and repeatable) barn tasks for 4 minutes at a time in preferred barn clothes and provided apparel/ footwear 1. Sweeping barn aisle 2. Brushing horse 3. Mucking Stall 4. Posting trot	Video	- Set up time 30 minutes - 4 minutes per movement
Data Collection Phase #2	Subjects complete survey	Questions: 1. Likert scale: mobility and comfort while wearing garment through barn tasks. 2. For each test, user will indicate where movement was inhibited or where garment caused discomfort on anatomical diagram	5 minutes

Data Collection Phase #3	Interview subjects as a group. Discuss likes and dislikes of each product	- Audio Recording	Open ended discussion
Data Analysis	**Phase #1:** Analyze video for signs of bunching, tightness, and wrinkling **Phase #2:** Analyze survey response data with visualization software (Excel) **Phase #3:** Identify similarities and preferences between test subjects	**Phase #1:** Create footwear and garment impact metric based on video comparison between preferred apparel/ footwear and testing apparel/ footwear **Phase #2:** Compare Baseline data to prototype **Phase #3:** Implement preferences into prototype	N/A

Durability Testing

Products to be Used: Boot, Pant, Jacket

Study Size: N/A

Location: Portland Oregon

Equipment/ Props Needed: Swatches of each product, Durometer, Wyzenbeek testing apparatus,

Seam strength/ slippage testing apparatus, Staining chemicals

Phase	Procedure	Data collected	Duration
Data Collection Phase #1	**Wyzenbeek Test** - Take photo of swatch before test -Place material each swatch in abrasive testing apparatus and run for 1 minute each - Take photo of swatch after test	- Before and after swatch pictures	1 minute per swatch
Data Collection Phase #2	**Seam slippage and strength test** - Place each seam type found in each product in vice -Start timer Stretch until seams open, tear or slip, -Stop timer	-Time to failure baseline metrics of seam types used in equestrian apparel and footwear	TBD

Data Collection Phase #3	Material stain resistance test
	- mark grid on each fabric panel
	- Pour equal amounts of common barn chemicals onto gridded swatch
	  - Hoof oil
	  - Iodine
	  - Vetrolin
	- let sit for 24 hours, then wash on 'normal' laundry cycle
	- Photograph results of stain resistance
		- Photos	25 hrs

Data Analysis	**Phase #1:** Analyze after photos ranking durability on sliding scale **Phase #2:** Analyze time to failure data, ranking in excel **Phase #3:** Rank staining visually	**Phase #1:** test new materials choices against best ranking materials from data collected **Phase #2:** Time to failure baseline metrics that can inform and be compared prototype for better construction **Phase #3:** Visually compare to prototyping materials to ensure final proto is better than baseline	N/A

SWOT Synthesis

To begin the design process, the SWOT was re-analyzed to determine areas of focus for the forthcoming product line. The four main areas of issue from the existing products were waterproofing, mobility, traction, and cushion. This focus served as guides for the product line's design process. Following this synthesis, performance goals for the product line were determined.

Figure 52 SWOT Synthesis

Waterproofing

- Create waterproof riding boots suitable in all weather
- Create waterproof jacket for use in+ out of the saddle

Waterproofing is successful if:

- Boots and apparel repel more water than current product

Traction

- Create zoned traction on boot soles that support daily movements in and out of the saddle
- Create zoned traction on pants that allows for appropriate movement in the saddle

Traction is successful if:

- Force required to move boot is higher than 10n
- Rider reports on improved traction in the saddle

Mobility

- Greater joint mobility in apparel and footwear
  - Ankle, knee, elbow

Mobility is successful if:

- Flexion measured in ankle is greater than 27°
- Movement measured in knees and elbows is higher than with current product

Cushion

- Create insole/ outsole with cushion for periods of long use
- Improve cushion between user and saddle

Cushion is successful if:

- Pressure mapping shows less pressure points than current product
- User reports increased comfort

Figure 53 Performance Goals

Mood Boards

An aesthetic and functional mood board were created to guide the creation process of this product line.

Functional Mood Board

The functional mood served to direct the functional aspects of the Epona line such as trims, materials, and physical attributes to improve the function of the product offering. These attributes are more clearly apparent in the workalike prototypes from this term.

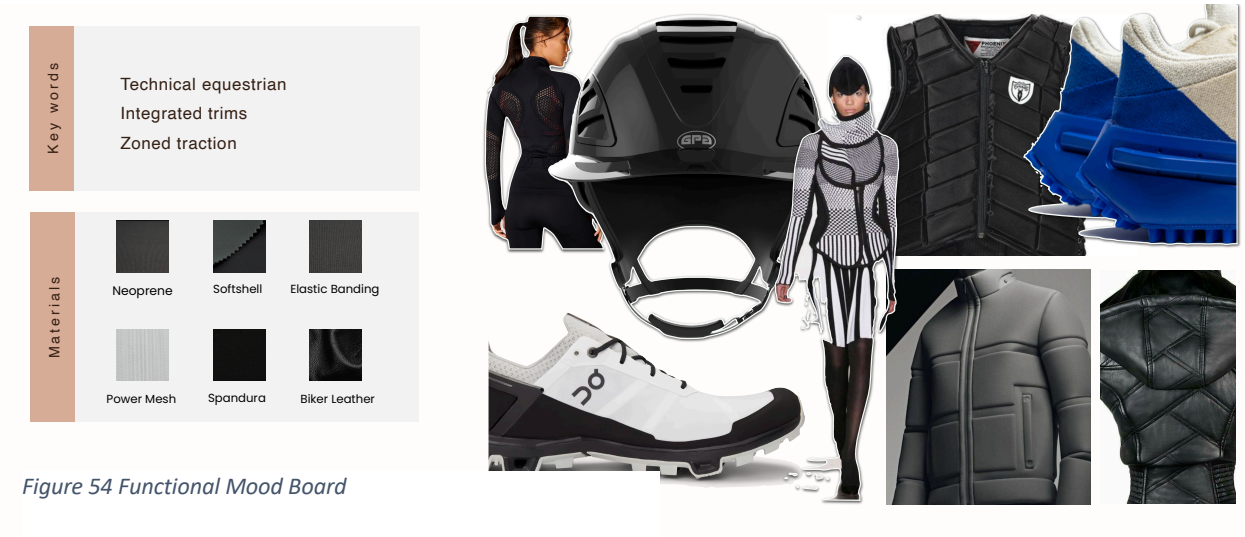


Figure 54 Functional Mood Board

Aesthetic Mood Board

The aesthetic mood focuses on styling choices that will link the work more closely with the classic styling common in the industry and create a cohesive color and pattern story that will be used in the final prototypes. The color scheme below is based on the primary colors used in horse show ribbons and styling seen in luxury equestrian brands like Hermes and Loro Piana (Hermes, n.d) (Loro Piana, n.d).

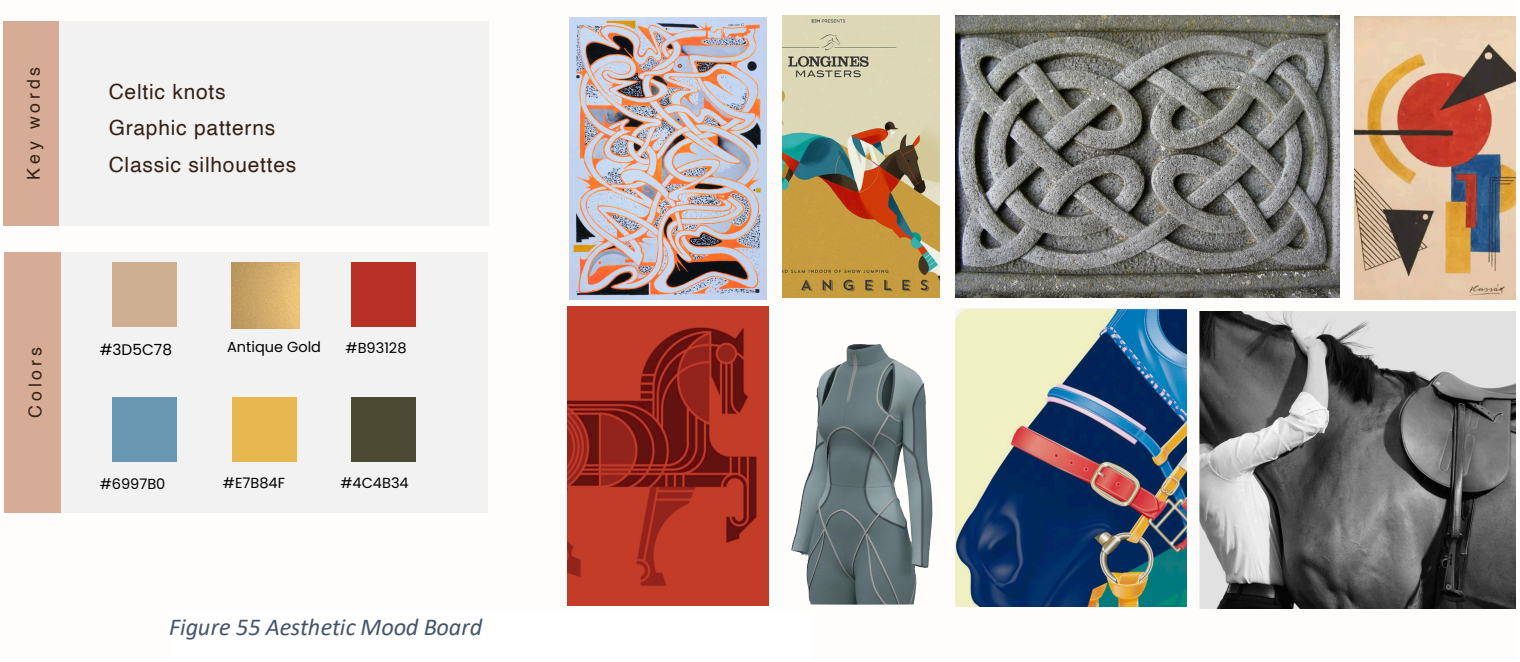


Figure 55 Aesthetic Mood Board

New Technologies

These four new technologies, serve to answer the problems posed by the SWOT synthesis. Equi-Vent provides greater mobility and ventilation, Equi-Span provides target stretch that accommodates the natural morphology changes experienced by women, while Equi-Seat and Equi-Tread provide traction in and out of the saddle.

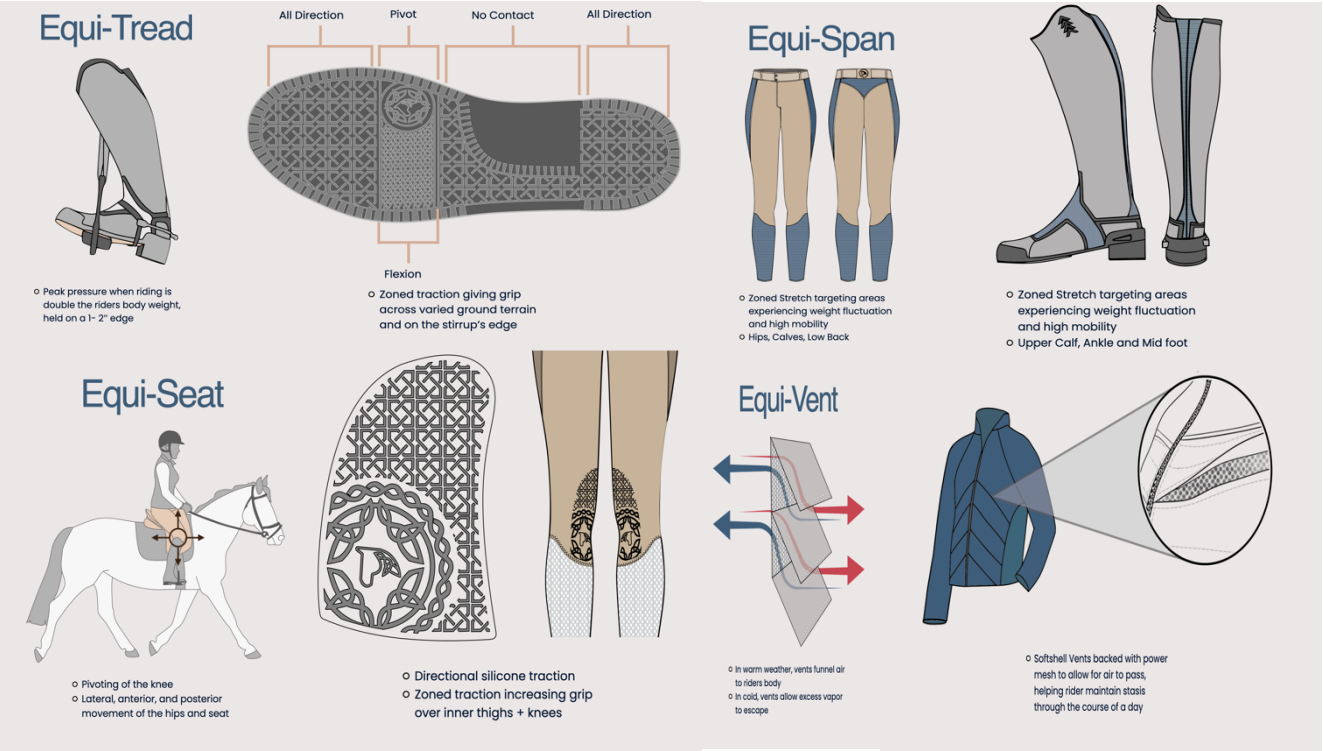


Figure 56 New Technologies

Ideation and Prototyping

After devising the new technologies, the sketching and prototyping phase began for the jacket, pants, and boots. The aim of this process was to choose silhouettes that addressed fit and mobility while maintaining a classic equestrian silhouette. For apparel, four pairs of riding pants were created. The goal was to arrive at a final pattern that addressed issues of fit, mobility,

durability, and traction. The jacket is constructed with the Equi-Vent technology, and the pants have Equi-seat traction at the knees and inner thighs.

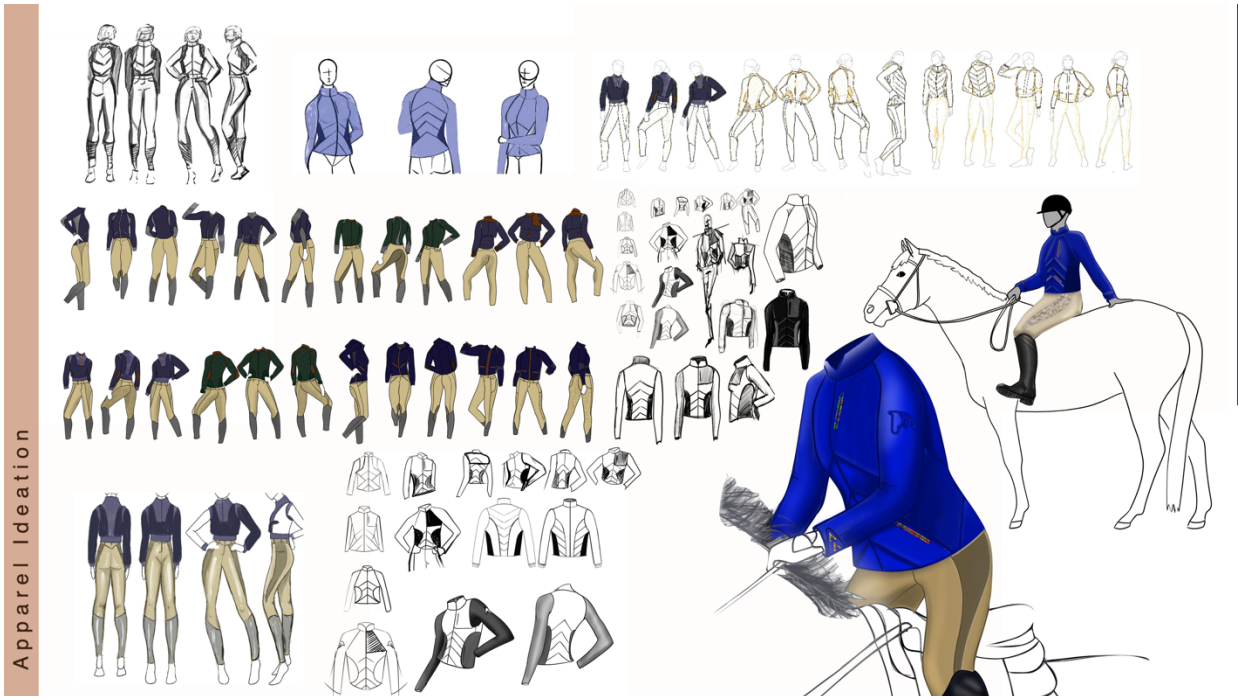


Figure 58 Apparel Ideation

Figure 57 Footwear Ideation

Prototyping the boots started with basic silhouette ideation that focused on areas of stretch and flexibility that could be inserted at the ankle and behind the leg. A custom last was created that better fits real female foot anatomy… A wider toe box, higher midfoot and bigger heel. Prototypes were first created in EVA foam to create correct pattern pieces and then in leather for testing. The midsole, which is not present on current competitor riding boots provides extra toe and heel protection, midsole support, and cushion. The heel block, midsole, and outsole were 3D printed in TPU filament to mimic the durometer of rubber.

Figure 59 Prototyping Process

Testing

To confirm function of the prototypes and new technologies, testing was completed. Areas of testing included seam friction, flexion, traction, mobility, and ventilation. All testing showed improvement from available product and proved intended function of Epona products.

Figure 60 Seam Friction testing

Testing

Ventilation

Products Tested

- Lami-Cell softshell
- Epona Prototype

Method

- Place jacket on mannequin
- Place Steamer under jacket
- Visually verify increased ventilation through escape of steam

Results

- Epona prototype Jacket provided increased ventilation compared to the Lami-Cell softshell
- Steam escaped through the gill vents

Traction

Products Tested

- TPU
- Screen Printed Silicone
- Spandura

Method

- Manually drag swatches over leather surface to verify traction

Results

- Silicone provided the best traction

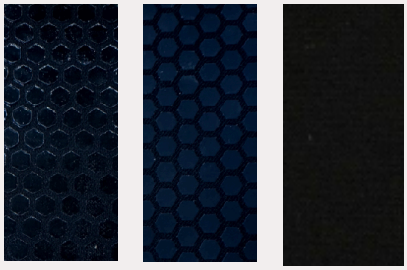


Figure 61 Ventilation and traction testing

Testing

Mobility

Products Tested

- Nike 3/4 Sleeve
- Lululemon leggings
- Epona prototype pants

Method

- Instruct tester to move through various positions common to barn work
- This includes brushing, kneeling, squatting
- User reports back levels of comfort and visually confirm same levels of mobility in prototypes

Results

- User was able to attain same levels of mobility in prototype pants as with leggings
- In some cases, user reported unproved mobility in prototype

Baseline

Prototype

Figure 62 Mobility Testing

Testing

Flexion

Products Tested

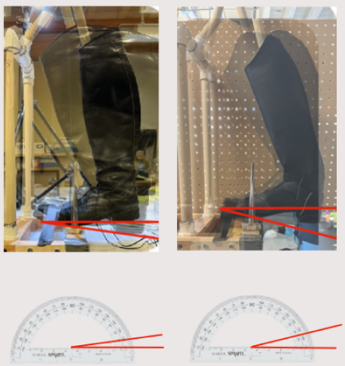
- LaMundial Dress Boot
- Dover Ladies Field Boot
- Salomon Outline Boot
- Epona Proto Boot

Method

- Place boots in flexion jig
- Photograph natural flexion
- Place 10lb weight on jig
- Photograph angle under load
- Overlay photos and measure angle of flexion

Results

- Epona Prototype boot allowed for 7° more flexion than baseline products



Results

	Boot 1	Boot 2	Boot 3	Proto Boot
Test 1	19°	20°	27°	25
Test 2	21°	20°	26°	26
Test 3	17°	21°	27°	24
Test 4	18°	20°	28°	26
Test 5	19°	18°	27°	26
Test 6	19°	21°	27°	25
Test 7	20°	21°	27°	25
Test 8	18°	20°	25°	26
Test 9	19°	20°	26°	26
Test 10	18°	19°	27°	27
AVG Flex	20.6°	20°	26.7°	25.6°

Figure 63 Boot Flexion testing

Testing

Traction

Products Tested

- LaMundial Dress Boot
- Dover Ladies Field Boot
- Epona Proto Boot

Method

- Place boot on surface
- Wrap cord around ankle
- Pull force gauge until boot slides
- Measure force just before movement

Results

- Epona Prototype boot required an avg 4n more traction force on grass and asphalt

	Grass	Grass	Grass	Asphalt	Asphalt	Asphalt
Test 1	10n	7.2n	**12n**	6n	3n	**8.9n**
Test 2	10n	7n	**12.7n**	6.5n	3.3n	**8.5n**
Test 3	10.9n	8n	**13.1n**	6.7n	3.1n	**8n**
Test 4	11.2n	7.7n	**12.8n**	7n	3.2n	**9.2n**
Test 5	11n	N/a	**12.4n**	6.6n	3.3n	**9.1n**
Test 6	10.7n	7.4n	**13.4n**	6.3n	3.4n	**9n**
Test 7	10n	N/a	**13n**	6.4n	N/a	**8.7n**
Test 8	10.2n	N/a	**12.9n**	8n	N/a	**8.8n**
Test 9	10.4n	6.8n	**13n**	6.2n	3n	**9.2n**
Test 10	10.3n	7n	**13.3n**	6.8n	4n	**9.1n**
AVG N	10.47n	7.3n	**12.86n**	6.65n	3.28n	**8.85n**

Figure 64 Boot Traction Testing

Final Design

Following ideation, prototyping and many rounds of fit testing, I created the final Epona Sport line. This line consists of a jacket, pants and riding boot that stays true to classic and well-loved equestrian aesthetics, while injecting new life through new technologies and modern sport materials.

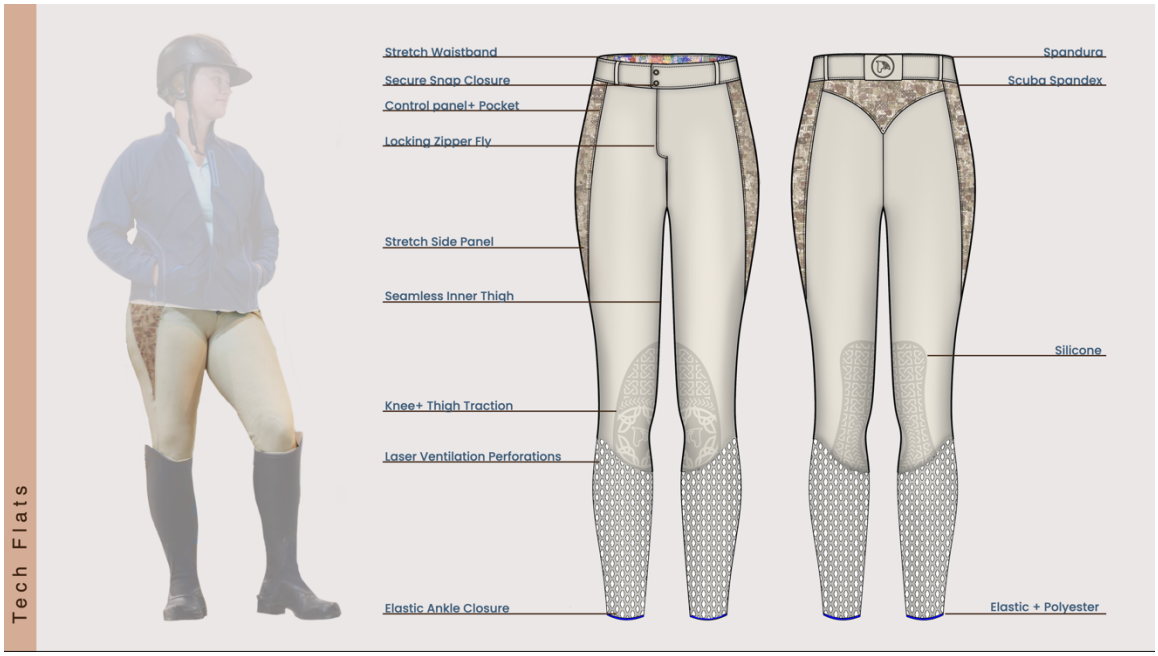


Figure 66 Final Epona Sport Pant Tech Flat

Figure 65 Final Epona Sport Pant Detail Photos

Figure 67 Final Epona Sport Boot Tech Flat

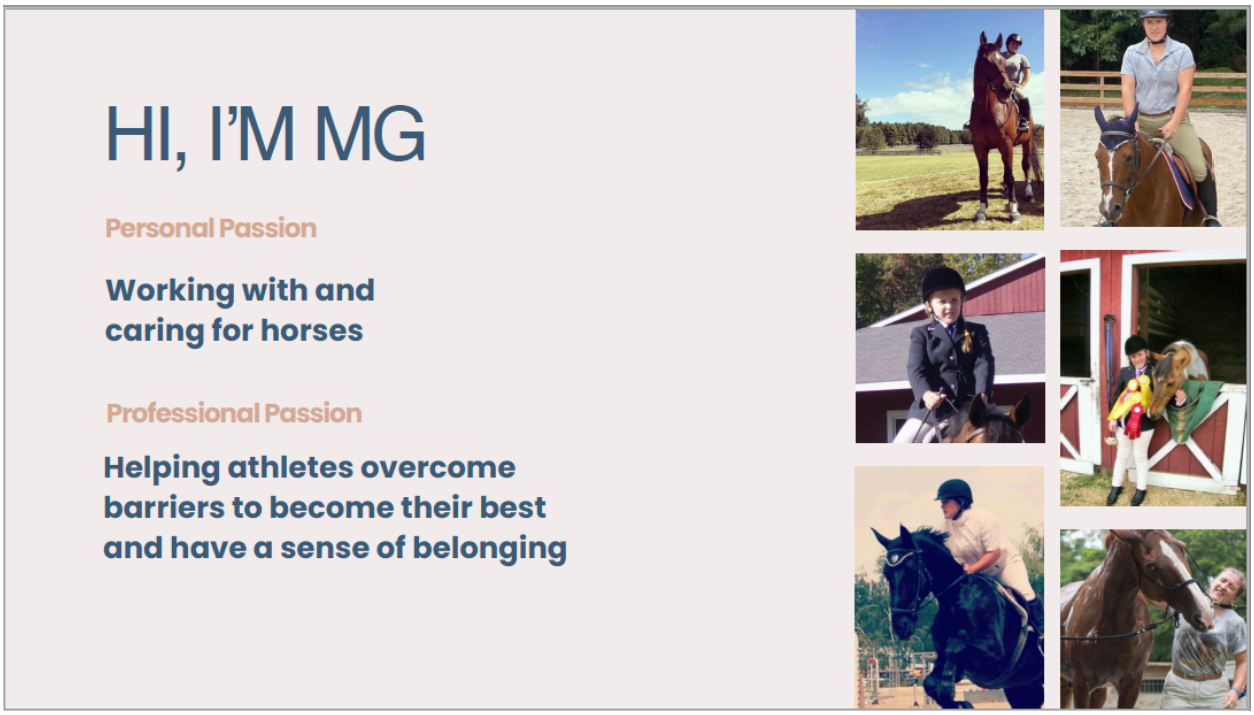
Figure 68 Final Epona Sport Boot Detail Photos

Figure 70 Final Epona Sport Jacket Detail Tech Flat

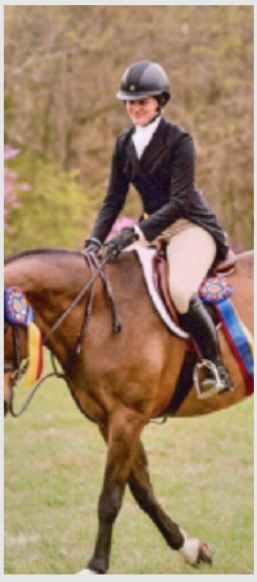
Figure 69 Final Epona Sport Jacket Detail Photos

Appendix


EPONA SPORT
Investigating Inclusive Sizing and Comfort in Footwear and Apparel for Professional Female Equestrians


HI, I'M MG
Personal Passion
Working with and caring for horses
Professional Passion
Helping athletes overcome barriers to become their best and have a sense of belonging

The Obvious Problem



The Deeper Issue

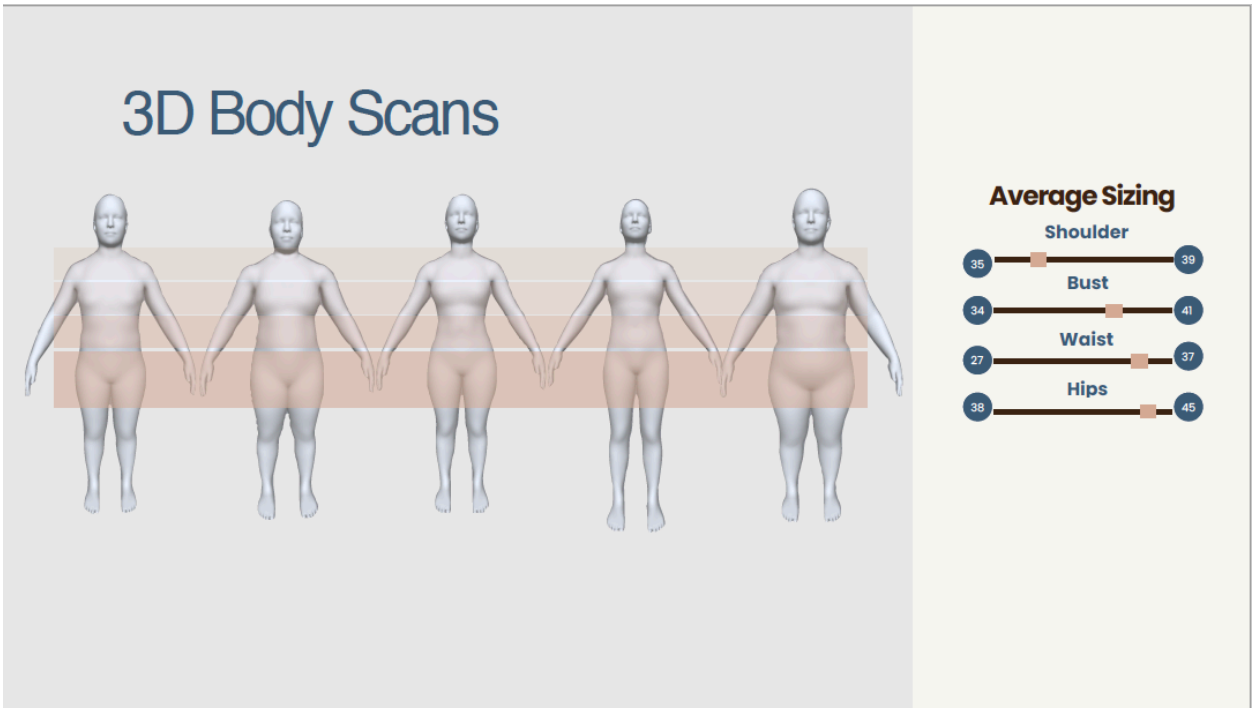
"Our bodies, especially women's take a beating... **Injuries, babies, genetics**, so many reasons we have a hard time fitting into breeches... **Fitness and riding talent prevail at a large variety of sizes**"

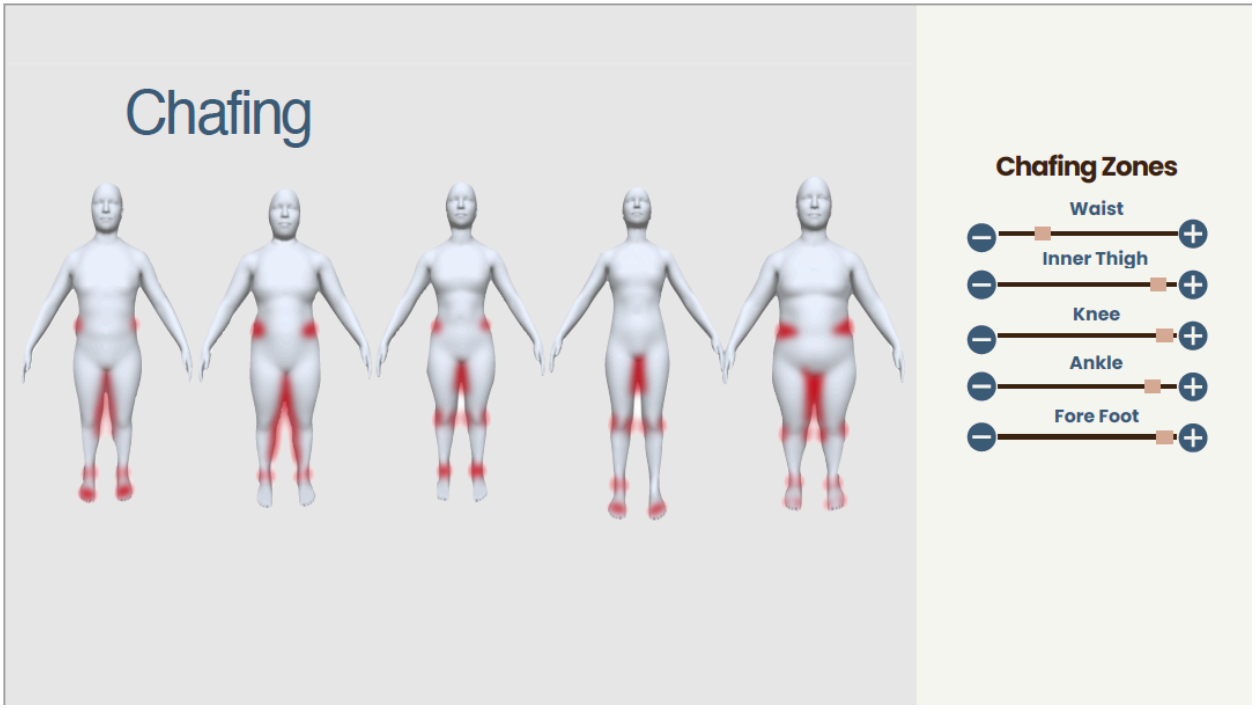
Chandra Thurman

@Fat_Black_Equestrain

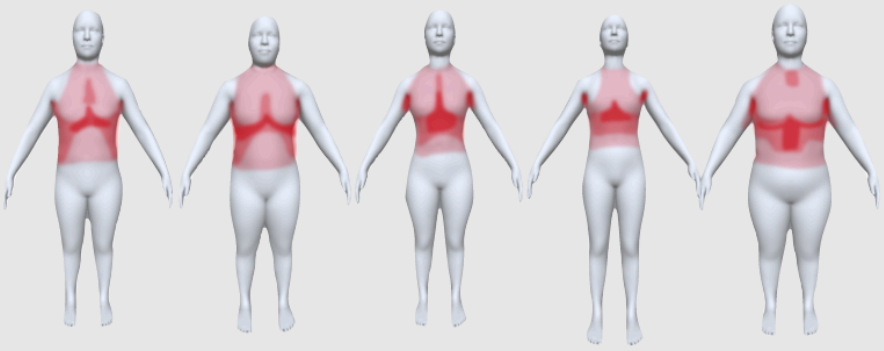
How might we provide **size inclusive, and comfortable** riding apparel and footwear to help female equestrian professionals reach their full potential?

Preliminary Research


3D Body Scans
Average Sizing
Shoulder
35
39
Bust
34
41
Waist
27
37
Hips
38
45


Chafing
Chafing Zones
Waist
Inner Thigh
Knee
Ankle
Fore Foot

Thermoregulation



Ventilation Needs

Shoulder

Bust

Under Bust

Under Arm

Core

Modernized Riding Boot Last

Classic

New

Updated Zones

Toe Box

Rear Knee

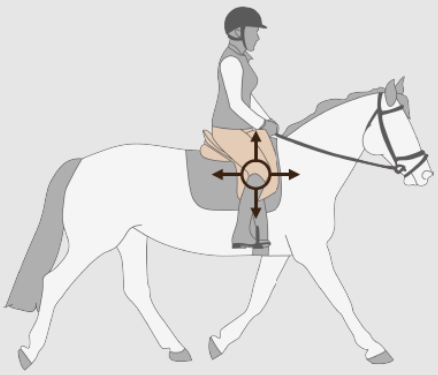
Ankle

Calf

Fore Foot

Technologies

Equi-Seat

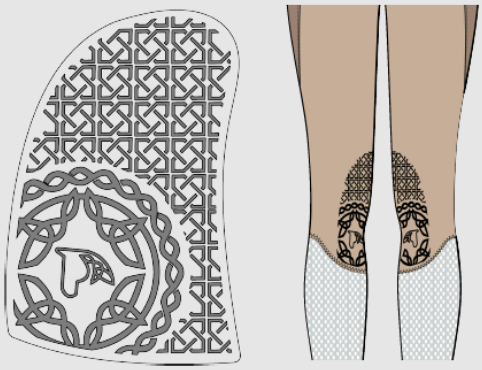


- Pivoting of the knee
- Lateral, anterior, and posterior movement of the hips and seat

Traction

Traction

Equi-Seat



- Directional silicone traction
- Zoned traction increasing grip over inner thighs + knees

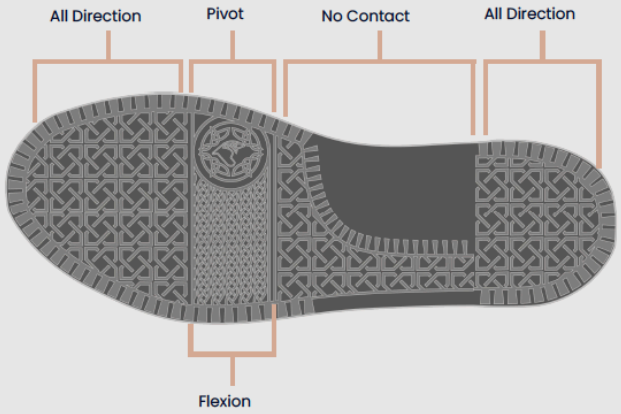
Traction

Equi-Tread

- Peak pressure when riding is double the riders body weight, held on a 1- 2" edge

Traction

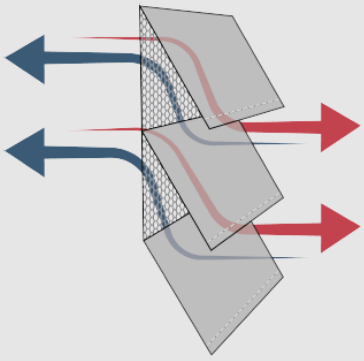
Equi-Tread



- Zoned traction giving grip across varied ground terrain and on the stirrup's edge

Ventilation

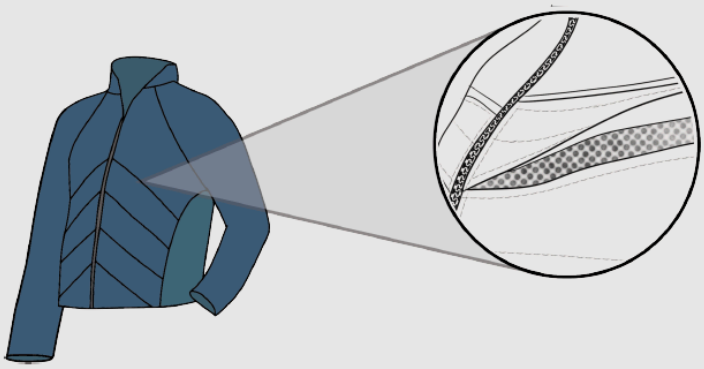
Equi-Vent



- In warm weather, vents funnel air to riders body
- In cold, vents allow excess vapor to escape

Ventilation

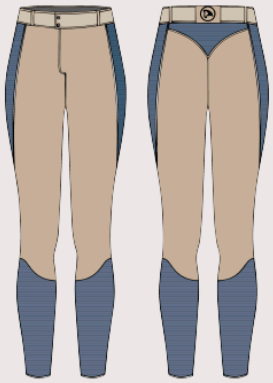
Equi-Vent



- Softshell Vents backed with power mesh to allow for air to pass, helping rider maintain stasis through the course of a day

Stretch

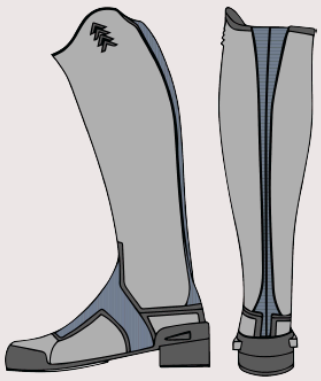
Equi-Span



- Zoned Stretch targeting areas experiencing weight fluctuation and high mobility
- Hips, Calves, Low Back

Stretch

Equi-Span

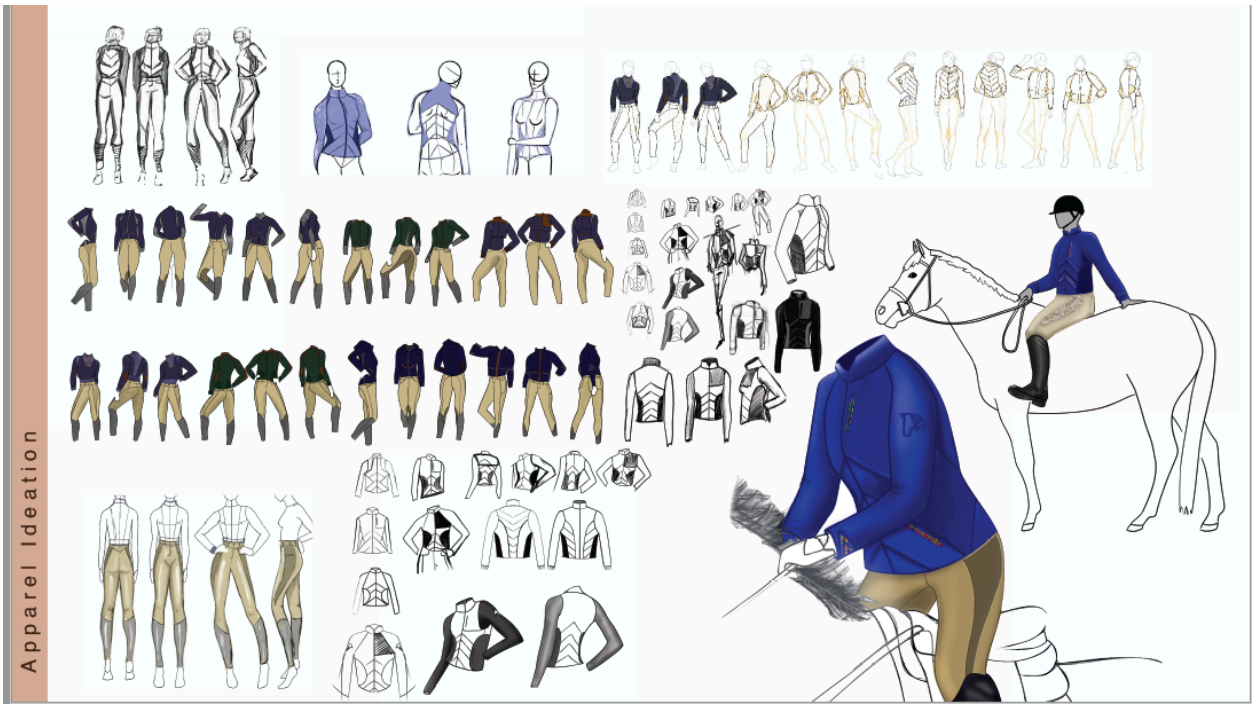


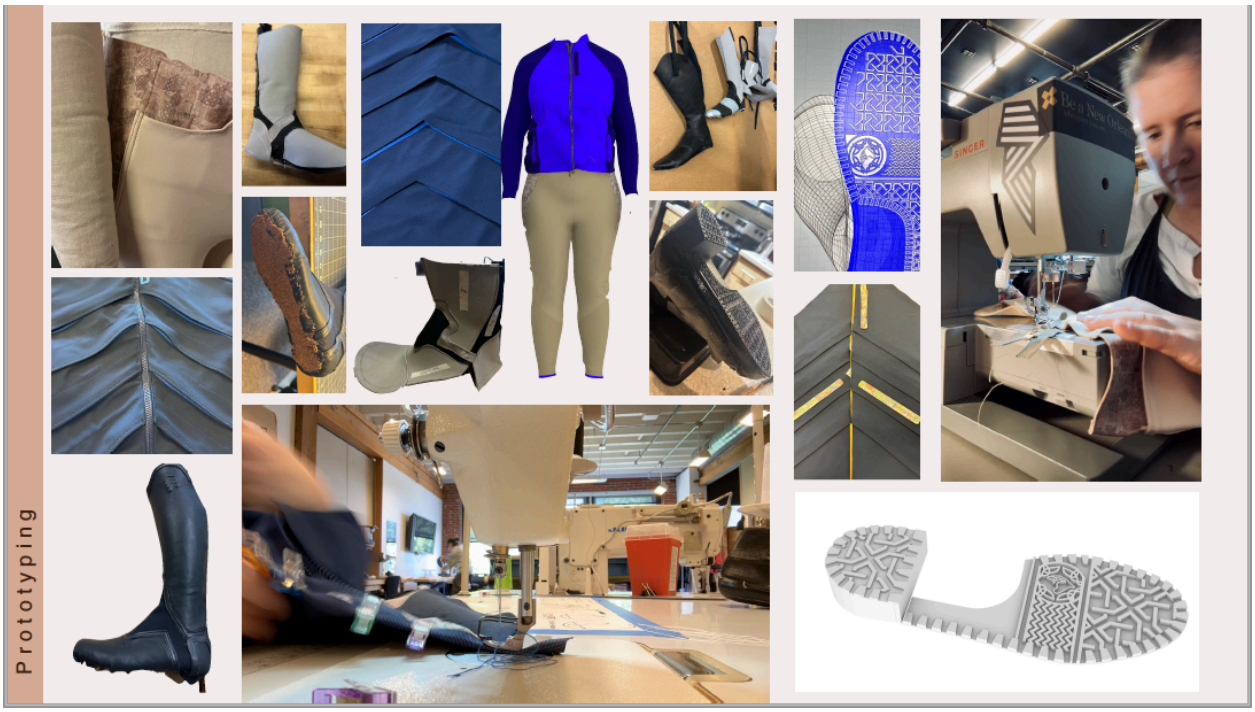
- Zoned Stretch targeting areas experiencing weight fluctuation and high mobility
- Upper Calf, Ankle and Mid foot

Design Process

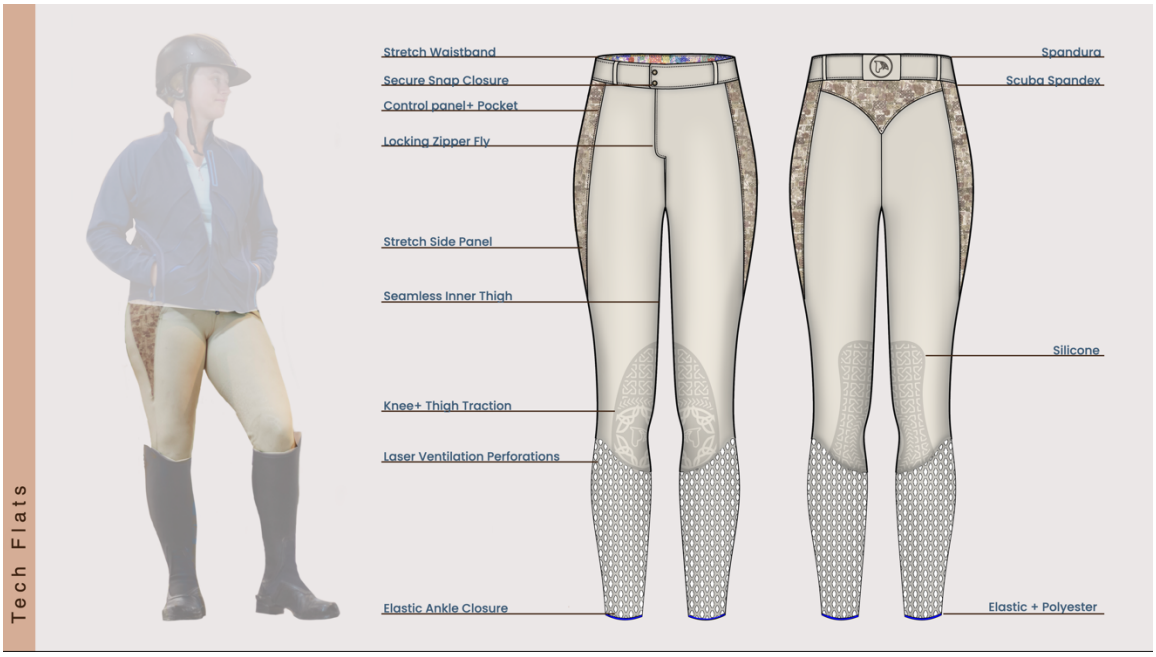

Inspiration


Boot Ideation


Apparel Ideation


Prototyping

Final Design


Tech Flats
Stretch Waistband
Secure Snap Closure
Control panel+ Pocket
Locking Zipper Fly
Stretch Side Panel
Seamless Inner Thigh
Knee+ Thigh Traction
Laser Ventilation Perforations
Elastic Ankle Closure
Spandura
Scuba Spandex
Silicone
Elastic + Polyester

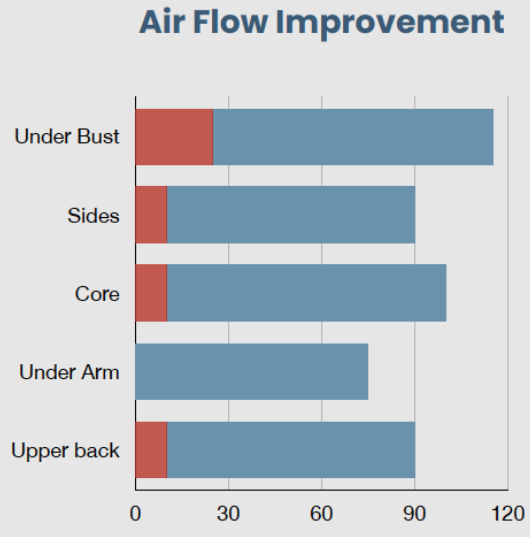

Tech Flats
Low Profile Collar
Two Way Zip
Chest Pocket
Raglan Sleeve
Stretch Vents
Side Pockets
YKK Zipper+ Suede Placket
Soft Shell Bodice
Spandex
Waterproofed Spandura
Power Mesh Vents
Laser Ventilation Perforations
Stretch Side Panels
Dropped Back Hem


Tech Flats
Spanish Style Boot
Dropped Zip
Upper Calf Stretch
Smooth Boot Shaft
Waterproof+ Flexible Neoprene
Foam Insole
Integrated Spur Rest
Toe Cap
Equi-Tread Outsole
YKK Locking Zipper
Elastic
Calf Leather
Neoprene
Rubber Midsole+ Outsole

Validation

Validation

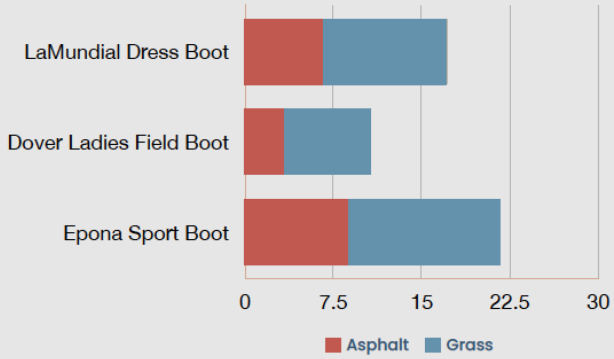
Ventilation



Traction

Validation

Traction Testing

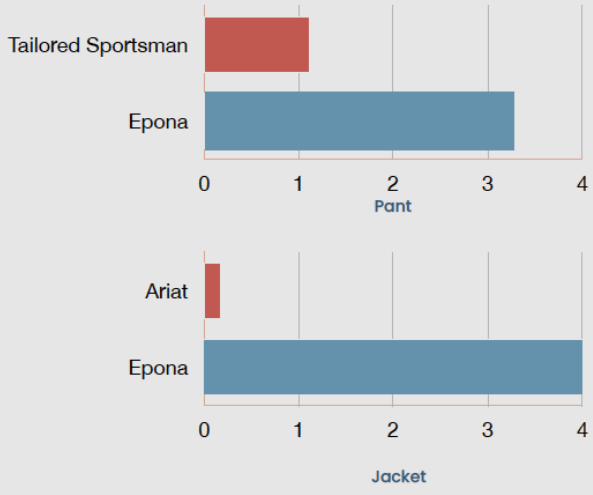


"I usually slip in the wash stall, but I feel secure"

Stretch

Validation

Stretch Distance



Ventilation

Validation

Temperature Range

"It's 98 ° but I feel cooler when Im wearing the jacket. It feels like cool air is pumping in"

"Even though it's cold, Im going through menopause and I don't remember the last time I didn't end the ride drenched in sweat"

Thank You!

Bibliography

A Brief History in Interrupted Olympic Games. (2020, April 27). Horse Network. https://horsenetwork.com/2020/03/a-brief-history-in-unusual-olympic-games/

Adrienne Sternlicht. (n.d.). US Equestrian. https://www.usef.org/team-usa/athletes/adrienne_sternlicht

Ayvazyan, S. (2020, August 9). *Human Body Proportions*. Drawingforall.net. https://www.drawingforall.net/human-body-proportions/

Beezie Madden. (n.d.). US Equestrian. https://www.usef.org/team-usa/athletes/beezie_madden

Bober, P. P., & Magnen, R. (1958). Epona, Deesse Gauloise des Chevaux, Protectrice des Cavaliers. *American Journal of Archaeology*. https://doi.org/10.2307/501975

Breeches.com. (2017, December 6). *How TuffRider Horse Riding Boots are manufactured? Simple 9 Steps Video* [Video]. YouTube. https://www.youtube.com/watch?v=hNedHgzyDYo

Cecile Long Sleeve Base Layer. (n.d.). PF Of Sweden. https://www.psofsweden.com/us/cecile-base-layer-navy?gclid=CjwKCAiAjs2bBhACEiwALTBWZTpRRYhaMsXaQCMvcajnvU6bWGFxiBml72l7_GMVPr2TIVS4pXGvPRoCuC0QAvD_BwE

CNN Newsource. (2022, September 18). *How horse racing was Queen Elizabeth II's enduring passion*. KESQ. https://kesq.com/sports/national-sports/cnn-sports/2022/09/18/how-horse-racing-was-queen-elizabeth-iis-enduring-passion-2/

Cordings. (n.d.). *Wincanton Tweed Jacket*. https://www.cordings.co.uk/us/wincanton-tweed-

jacket.html?gclid=Cj0KCQiAyracBhDoARIsACGFcS5bxqDhrjCBJA4fjPyaCo4Ot7fatbuDxe_DqU_hZWGBco-A0qWIgz8aAmEkEALw_wcB

Deborah A. Christel. (2012). Physically active adult women's experiences with plus-size athletic apparel. *SAGE*.

Douglas, J. L., Price, M., & Peters, D. (2012). A systematic review of physical fitness, physiological demands and biomechanical performance in equestrian athletes. *Comparative Exercise Physiology*, *8*(1), 53–62. https://doi.org/10.3920/cep12003

Downey, G. (2022, May 3). *Dressed for the Ride: The history of rider wear*. Horses and People. https://horsesandpeople.com.au/dressed-for-the-ride-the-history-of-rider-wear/

Dyball, L. (2019, October 4). *Riders, Body Image and "The Look."* The Plaid Horse Magazine. https://www.theplaidhorse.com/2018/05/22/riders-body-image-and-the-look/

ECONOMICS. (n.d.). https://horsecouncil.org/resources/economics/

English Riding Boots | Dover Saddlery. (n.d.). http://www.doversaddlery.com/riding-boots-chaps/c/2000/

Eos Knee Patch Tight. (n.d.). Ariat International. https://www.ariat.com/P16382_W_APP.html?dwvar_P16382__W__APP_length=Regula

Equine Business Association. (2022, May 17). *Equine Industry Statistics Overview l*. https://equinebusinessassociation.com/equine-industry-statistics/

Evans, S. (2021, September 2). *How Equestrian Style Became Timeless a Tradition*. Horse Sport.

https://horsesport.com/magazine/fashion/equestrian-style-became-timeless/

FEI Jumping Rules (27th ed.). (2022). [Ebook]. FEI.

Footalk. (2021). *Regency Period Boots (1811 to 1820)*. http://historyofboots.blogspot.com/2009/06/regency-period-boots.html

Footwear | Equine Programs. (n.d.). https://equine.ca.uky.edu/saddle-up-safely/footwear

Freejumpsystem. (2022, December 6). *Soft'Up Classic*. FreejumpSystem. https://www.freejumpsystem.com/en/produit/softup-classic/

Garber, K. (2020, March 4). Common Causes of Spur Marks and How to Address Them. *Dressage Today*. https://dressagetoday.com/instruction/common-causes-spur-marks-and-how-to-address-them/

Grandeur. (2018, November 7). Celeris Riding Boots. https://celerisridingboots.com/product/grandeur/

Hansen, A. B. (2015, December 17). *Horses, fashion & history*. Equilife World. https://www.equilifeworld.com/equestrian-lifestyle/horses-fashion-history/

Hartov, O. (2020, June 30). *The Bauhaus Is One of the Most Influential Design Movements in History*. Gear Patrol. https://www.gearpatrol.com/briefings/a609440/influence-of-the-bauhaus-movement/

Heritage Contour II Field Zip Tall Riding Boot. (n.d.). Ariat International. https://www.ariat.com/HRTG_CTR_II_FLD_ZP_W_FOO.html?dwvar_HRTG__CTR__

II__FLD__ZP__W__FOO_color=BLACK

hermes.com. (n.d.). https://www.hermes.com/

Katie Duerrhammer. (n.d.). US Equestrian. https://www.usef.org/team-usa/athletes/katie_duerrhammer

Kim Breeches. (n.d.). PS Of Sweden. https://www.psofsweden.com/us/kim-breechesnavy?gclid=CjwKCAiAjs2bBhACEiwALTBWZVxuDxA4jr9rrCwpGYSWzyxtCe6tOTgZO-EnFAtwJ005VJU64W0OlhoCxw0QAvD_BwE

Kipling, R., & Brock, E. C. (2016). *Rewards and fairies (1910). By: Rudyard Kipling,illustrated By: Charles E. Brock: historical fantasy*. CreateSpace Independent Publishing Platform.

Kit Full Seat - Pantalon d'équitation galbant taille haute à grip Couleur Bleu marine Tailles bas 36. (n.d.). Dada Sport. https://www.dadasport.com/en/pants-short/789-4146-kit-full-seat-riding pants-full-grip

LM Boots | Custom riding boots. (n.d.). https://www.lmboots.com/

Long-Sleeved Everyday Silk Shirt. (n.d.). Orvis. https://www.orvis.com/long-sleeved-everyday-silk-shirt/3AGG.html

Loro Piana. (n.d.). Loro Piana. https://us.loropiana.com/en/c/woman

Milton Menasco | Horses | Style | Badass Stuff. (n.d.). MILTON MENASCO. https://www.shopmiltonmenasco.com/

Murphy, S. (2020, June 18). *Victorian Horse Shows: Spectacle, Leisure, Commodity – Journal of*

Victorian Culture Online. https://jvc.oup.com/2020/06/18/victorian-horse-shows/

Musset, L. (2002). *La tapisserie de Bayeux: oeuvre d'art et document historique (DDB.BX.LIVRES)*. ZODIAQUE.

Nanjappa, V. (2022, January 13). *Jodhpurs Guide - History & Style Of The Infamous Indian Pants Explained*. Gentleman's Gazette. https://www.gentlemansgazette.com/jodhpurs-guide-pants-history-style-where-to-buy/

NIUZ 22X. (n.d.). Animo Srl. https://www.animoitalia.com/product-page/niuz-22x

Noble Equestrian<sup>TM Ladies' Sydney Soft Shell Jacket | Dover Saddlery. (n.d.). https://www.doversaddlery.com/noble-sydney-softshell-jacket/p/X1-400771/

Official Barbour Website. (n.d.). http://www.barbour.com/barbour-classic-beadnellr-wax-jacket-olive-lwx0668ol71

Parlanti International. (2022, November 29). *Parlanti Aspen Pro<sup>TM* Riding Boots | BRAND NEW | Official Parlanti Shop. <span>https://parlantiinternational.com/shop/parlanti-aspen-pro-riding-boots/

Pomme | Equestrian wear for the modern rider. (2022, December 4). Pomme. https://www.wearepomme.com/?gclid=Cj0KCQiA7bucBhCeARIsAIOwr-9yrXzqukX-_IUfjGg_7Nqvw_Wtcryalo5upVucnSBJyvd8j09sRh0aAoJHEALw_wcB

Potter, L. (2016, February 17). *40 Years of Equestrian Fashion*. Horse Illustrated Magazine. https://www.horseillustrated.com:443/horse-magazines-horse-illustrated-40-years-of-

equestrian-fashion

Rath. (2022). *Clifton Strengths Finder 2.0*. Gallup Press.

Redrup, G. (2021, June 9). How to break in new riding boots: 11 top tips to make the process as painless as possible. *Horse & Hound*. https://www.horseandhound.co.uk/features/how-to-break-in-new-riding-boots-735833

Riding Sport<sup>TM Ladies' Black Field Boots | Dover Saddlery. (n.d.). <span>https://www.doversaddlery.com/rs-field-boot-black/p/X1-381453/

Rulebook. (n.d.). US Equestrian. https://www.usef.org/compete/resources-forms/rules-regulations/rulebook

Rydale, R. (2018, August 13). The History of Riding Boot Fashion: Inspiration for our NEW boots. *Rydale Clothing*. https://www.rydale.com/blogs/news/the-history-of-the-riding-boot

Salient Jacket. (n.d.). Ariat International. https://www.ariat.com/P22959_W_APP.html?dwvar_P22959__W__APP_color=NAVY_ECLIPSE

Sergio Grasso Riding Boots Energy Walk & Ride. (n.d.-a). FUNDIS Equestrian. https://www.fundis-equestrian.com/us/rider/riding-footwear/riding-boots/sergio-grasso/6628/sergio-grasso-riding-boots-energy-walk-ride

SmartPak Equine. (2022, December 1). *Piper SmartCore<sup>TM* Long Sleeve ¼ Zip Sun

Shirt. <span>https://www.smartpakequine.com/pt/piper-smartcore-long-sleeve--zip-sun-shirt-19332

Tack, F. H. (n.d.). *Tailored Sportsman Vintage Mid Rise Front Zip Breeches*. Farm House Tack. http://www.farmhousetack.com/products/tailored-sportsman-vintage-mid-rise-front-zip-breeches

Temperature - US Monthly Average. (n.d.). NOAA Climate.gov. https://www.climate.gov/maps-data/data-snapshots/data-source/temperature-us-monthly-average

The Editors of Encyclopedia Britannica. (1998, July 20). *Spanish Riding School of Vienna | school, Vienna, Austria*. Encyclopedia Britannica. https://www.britannica.com:443/topic/Spanish-Riding-School-of-Vienna

The Essential History of Show Jumping. (2020, December 18). Horse Network. https://horsenetwork.com/2020/12/the-essential-history-of-show-jumping/

THE TAILORED SPORTSMAN Vintage Patch Mid-Rise Breech | Dover Saddlery. (n.d.). https://www.doversaddlery.com/ts-vntg-patch-mid-rise-frnt-zp/p/X1-350120/

United States Eventing Association, Inc. (2021, March 9). *Rule Refresher: Dress, Attire Edition*. USEA : United States Eventing Association Inc. https://useventing.com/news-media/news/rule-refresher-dress-attire-edition-1

Vitalize, S. (2019, July 2). *Understanding Heat Stress in Horses*. Vitalize.

https://vitalizeeq.com/2017/05/10/understanding-heat-stress-in-horses/

WGSN | Advanced Colour Forecast 2025 - WGSN Beauty. (n.d.). https://www.wgsn.com/beauty/p/article/88678

Wild. (2021, May 29). *Fuller Fillies: Plus-Sized Apparel Our Globetrotters Love!* Globetrotting. https://www.globetrotting.com.au/fuller-fillies-plus-sized-apparel-our-globetrotters-love/

Women's FullFlexx<sup>TM Canvas Jacket. (n.d.). Noble Outfitters. <span>http://www.nobleoutfitters.com/products/womens-fullflexx-canvas-jacket

Xenophon, X. (2017). *The Art of Horsemanship (Classic Reprint)*. Forgotten Books.

Xu, Q. (2020, November 30). *A Study of the Marketing Strategies of High-End Luxury Brands: The Case of Hermes*. Atlantis Press. https://www.atlantis-press.com/proceedings/icemci-20/125947124

Greene, J. (2008, August 7). *Nike's radical new Olympic riding boot*. Bloomberg.com. www.bloomberg.com/news/articles/2008-08-06/nikes-radical-new-olympic-riding-boot?

Laffaye, H. A. (2009). *The evolution of polo*. McFarland & Co.

Li, V. (n.d.). *Wholesale silicon horse riding pants leggings women sports breeches*. Made-In-China. www.opeequestrian.en.made-in-china.com/product/IygQPqTJqVha/China-Wholesale-Silicon-Horse-Riding-Pants-Leggings-Women-Sports-Breeches.html

Littauer, M. A. (2002). After Seeing the Spanish Riding School, a Classical Heritage? In *Selected Writings on Chariots and other Early Vehicles, Riding and Harness* (pp. 460-475). Brill.

McCormack, M (2017) *Boots, Material Culture and Georgian Masculinities*, DOI: 10.1080/030871022.2017.136823

Milton, A., & Rodgers, P. (2013). *Research methods for product design*. Laurence King Publishing.

Horses: Style: Badass stuff. Milton Menasco. (n.d.). www.shopmiltonmenasco.com/

Morris, G. H. (1981). *George H. Morris teaches beginners how to ride: A clinic for instructors, parents, and students*. Doubleday.

O'Connor, M. (2003). *Shoe Heel Protector* (United States US20050138846A1). United States Patent and Trademark Office. https://patents.google.com/patent/US20050138846A1/en?q=womens+work+boots&oq=womens+work+boots

Understanding heat stress in horses. Vitalize. (2019) www.vitalizeeq.com/2017/05/10/understanding-heat-stress-in-horses/

Walmsley, K. B. (2009, April 2). Apparel for Riders. (WO2009041838A1). World intellectual Property Organization. https://patents.google.com/patent/WO2009041838A1/en?oq=WO2009041838A1

Wang, Y et Al. (2005). *Textile Substrates Having Layered Finish Structure for Improving Liquid Repellency and Stain Release* (US007407899B2). United States Patent and Trademark Office. https://patents.google.com/patent/US7485588B2/en?q=Textile+Substrates+Having+Layered+Finish+Structure+for+Improving+Liquid+Repellency+and+Stain+Release&oq=Textile+Substrates+Having+Layered+Finish+Structure+for+Improving+Liquid+Repellency+and+Stain+Release+

Wilkins, C. (2021). *Dynamic technique analysis of the female equestrian rider* (Doctoral dissertation, University of the West of England).

Wunderlich, R. E., & Cavanagh, P. R. (2001). Gender differences in adult foot shape: implications for shoe design. *Medicine and Science in Sports and Exercise*, 605–611. https://doi.org/10.1097/00005768-200104000-00015