



International Journal of Innovative Research in Science Engineering and Technology (IJIRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.699

Volume 14, Issue 3, March 2025

Compression Sportswear for Sprinters

Sabaritha S, Nanthakumar C, Mohanraj R, Dr Bhaarathi Dhurai, Mr Sathish Kumar

U.G. Student, Department of Fashion Technology, Kumaraguru College of Technology, Coimbatore, Tamil Nadu, India

U.G. Student, Department of Fashion Technology, Kumaraguru College of Technology, Coimbatore, Tamil Nadu, India

U.G. Student, Department of Fashion Technology, Kumaraguru College of Technology, Coimbatore, Tamil Nadu, India

Professor, Department of Textile Technology, Kumaraguru College of Technology, Coimbatore, Tamil Nadu, India

Managing Director, Innorex Private Materials, Tirupur, Tamil Nadu, India

ABSTRACT: The pursuit of excellence in sportswear design has led to significant innovations, particularly in the development of garments for sprinters. This project focuses on designing and constructing compression-based athletic wear. The fabric chosen for this specific purpose boasts exceptional stretch and recovery properties, which are essential for maintaining an athlete's movement without restriction. The design aims to address key elements such as breathability, aerodynamics, blood circulation, and compression. This initiative includes the creation of a one-piece compression garment for competition, along with compression t-shirts and shorts for training sessions. The one-piece garment is engineered for high stretch and recovery, ensuring optimal flexibility during events. The compression t-shirt is designed to manage sweat and moisture, keeping the athlete dry, while the compression shorts are tailored to minimize skin chafing. The garments are crafted to provide targeted compression, with the t-shirt and compression shorts offering compression during training to enhance sweat and moisture management, as well as offering some compression benefits. The one-piece garment, however, delivers full compression to boost performance and reduce recovery time during the event. This compression not only aids in performance but also helps alleviate muscle soreness. The pressure exerted by the fabric is a result of its tension and stretch around the body, ensuring optimal fit and comfort for the athlete.

KEYWORDS: Compression garment, high stretch and recovery, movements without restriction, breathability, performance enhancing, optimal fit

I. INTRODUCTION

Compression garments have become a crucial part of a sprinter's gear, helping athletes push their limits while addressing the physical demands of intense training and competition. These specialized athletic outfits are designed to optimize performance and recovery by providing muscle and joint support. Compression garments are carefully crafted to enhance comfort, reduce drag, and support muscles during high-speed running. With the use of advanced materials and technologies, these garments give athletes a competitive advantage on the track. The compression promotes improved blood circulation and reduces muscle fatigue, while lightweight fabrics are favoured for maximum comfort and performance. In addition to being lightweight, sprinter garments are designed with ample ventilation to regulate body temperature effectively. Their design plays a significant role in enhancing sprinter performance, boosting confidence, and ensuring comfort. Moisture-wicking properties are integrated into the garment to keep athletes dry, and the garment's stretchable, high-recovery fabrics are non-irritating and soft to the touch. To enhance compression, the garment is constructed with fewer cut panels, offering a more streamlined fit. The design also prioritizes minimizing friction and chafing, which can occur during physical activity, while ensuring flexibility and freedom of movement in key areas. Compression garments have become an essential tool for sprinters, contributing to improved training results and peak performance in competition.

II. LITERATURE

Compression garments apply pressure through fabric tension as they mold to the body's contours. The level of compression is determined by the body's shape and the distribution of soft and hard tissues, which may shift with movement. Light compression, generally between 15-20 mmHg, provides mild support, whereas moderate compression, ranging from 20-30 mmHg, is widely used in sports and medical settings to improve circulation and

support muscle recovery. Firm compression, at 30-40 mmHg, offers additional support for conditions like varicose veins, while extra firm compression, ranging from 40-50 mmHg, is used for severe medical needs such as post-surgical recovery and chronic venous insufficiency [1].

Sprinting engages multiple muscle groups that enhance propulsion, stability, and strength. The hip flexors and extensors play a key role in leg movement, with flexors lifting the knees and driving the leg forward, while extensors generate push-off force and extend the hip. The quadriceps and calves support knee and ankle motion, as the quadriceps straighten the leg for propulsion and the calves flex the ankle to produce force. Core muscles, including the abdominals and obliques, provide stability and assist in controlling rotational movement. The back and shoulder muscles contribute to arm swing and posture, with the back pulling the arm backward and stabilizing the spine, while the shoulders push the arm forward and support joint stability. These muscle groups work together to maximize speed, coordination, and efficiency. Proper muscle activation and synchronization are essential for maintaining balance, reducing energy loss, and improving overall sprinting performance. [5]. The abdominal muscles support spinal alignment and core engagement, while the obliques assist in twisting the torso and coordinating upper and lower body movements. The back and shoulder muscles aid in arm swing and posture, with the back muscles pulling the arm back and stabilizing the spine, while the shoulders push the arm forward and support joint stability. These muscles work together to enhance speed, balance, and overall sprinting performance [2]. Efficient sprinting requires propelling the body forward while maintaining an optimal forward-leaning posture. The torso and shins should be parallel, forming an acute angle of around 45 degrees with the ground. Leaning too far forward can reduce vertical force effectiveness, increasing instability and the likelihood of stumbling. Maintaining proper body alignment is key to achieving optimal force distribution, balance, and sprinting efficiency [3].

Sweat distribution across the body varies by region. On the front, the chest experiences a slight increase in perspiration, while the shoulders, particularly over the deltoid muscles, sweat significantly more. The sides of the torso also have higher sweat levels, especially in the mid-torso and abdominal regions. On the back, perspiration is most prominent over the shoulders, shoulder blades, and mid-back, particularly in the lateral areas away from the spine. The lower thoracic and lumbar spine regions also show considerable sweat production. Additionally, the lower lateral areas above the hips have similar sweat levels to those observed in females, whereas the waistline produces notably higher amounts of perspiration [4].

III. METHODOLOGY

RESEARCH AND ANALYSIS

- Understanding the sport of sprinting
- Analysing the requirement for the sprinters
- Research about the existing sprinter garments

DESIGN DEVELOPMENT AND MATERIAL SOURCING

- Developing design according to the requirements
- According to the design materials are chosen
- According to the design and materials trims are chosen

PATTERN MAKING

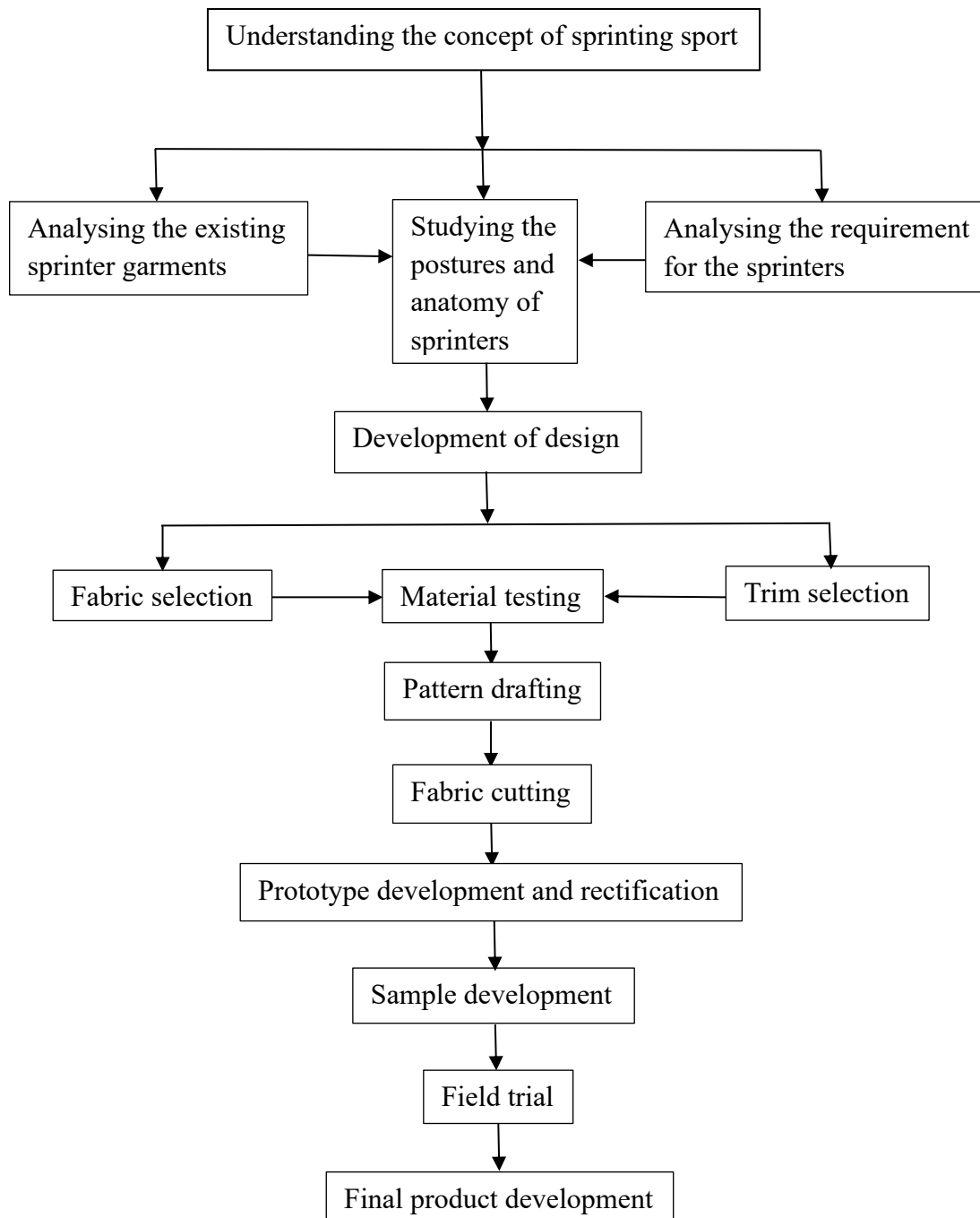
- Construction method is derived
- Pattern for the design is drafted

PROTOTYPE DEVELOPMENT

- Fabric is cut according to pattern drafted
- These cut panels along with the trims are sewn
- Prototype development and assessing the prototype

TESTING

- Conduction of test and evaluation
- Test on air permeability, tensile strength, stretch and recovery, moisture management
- Fit check, compression, breathability, chafing test
- Final product development



IV. ONE-PIECE COMPRESSION GARMENT

A one-piece compression garment for sprinters is designed to optimize performance by providing a streamlined fit that enhances muscle support, reduces drag, and ensures comfort during high-intensity movements. The single-piece design is selected to maintain consistent compression by removing elements that could weaken its effectiveness, ensuring uniform support across the body, allowing for unrestricted movement and reducing the risk of chafing, which is crucial for athletes who require maximum flexibility and speed. A semi-auto lock zip is incorporated to ensure secure fastening without the risk of accidental opening during a race, providing ease of use while maintaining a snug fit. The garment also features precisely cut panels that are strategically placed to contour the body, improving aerodynamics and

optimizing muscle compression, which aids in reducing muscle oscillation and improving overall sprinting efficiency. Additionally, the design includes targeted compression zones to enhance blood circulation and reduce muscle vibrations, preventing energy loss and lowering the risk of injury. The fabric is often lightweight, stretchable, and moisture-wicking, ensuring that sweat is efficiently managed to keep the sprinter dry and comfortable. Many designs incorporate reinforced areas around the quadriceps, hamstrings, and calves to provide extra support where it is most needed, helping to maintain proper muscle alignment and posture. The use of textile technology in these garments not only improves compression benefits but also ensures durability and resistance to wear and tear from intense training sessions. A sleeveless design is used in one-piece compression garments for sprinters to maximize freedom of movement and reduce resistance during high-speed performance. By eliminating sleeves, the garment allows unrestricted motion of the shoulders and arms, which is essential for efficient sprinting mechanics. The absence of sleeves also improves ventilation, helping to regulate body temperature and prevent overheating during intense exertion. Additionally, it reduces fabric weight and eliminates any potential discomfort or chafing around the arms, ensuring a snug yet comfortable fit. The sleeveless structure further enhances aerodynamics by minimizing excess material that could create drag, allowing sprinters to maintain optimal speed and efficiency. With a sleek and ergonomic structure, a one-piece compression garment for sprinters enhances performance by maximizing support, comfort, and efficiency, making it an essential piece of athletic wear for competitive runners.

Tricot Raschel fabric is used in one-piece compression garments for sprinters due to its exceptional elasticity, breathability, and durability. This fabric provides a balanced combination of flexibility and support, allowing athletes to move freely while maintaining muscle compression to enhance performance. Its lightweight and moisture-wicking properties help in keeping the sprinter dry by efficiently managing sweat. This fabric promotes air circulation, reducing heat buildup and ensuring comfort during intense physical activity. Additionally, the high-strength fibres used in Tricot Raschel fabric contribute to its durability, making it resistant to wear and tear from rigorous training sessions. Its ability to maintain shape and compression even after multiple washes makes it a preferred choice for high-performance athletic wear. The use of Hydra Mesh fabric in strategic areas improves breathability by allowing heat and moisture to escape while maintaining compression to support key muscle groups, reducing fatigue and enhancing endurance. A flat seam is a stitching technique where two fabric edges are joined together with minimal bulk, creating a smooth and even surface. This method is commonly used in one-piece compression garments for sprinters to reduce friction and prevent skin irritation during high-intensity movements. By eliminating raised seams, flat seams enhance comfort and minimize chafing, which is crucial for athletes who engage in rapid and repetitive motion. Additionally, this stitching technique maintains the garment's stretchability and durability, ensuring that the compression remains effective while allowing unrestricted movement. The seamless feel also contributes to better aerodynamics by reducing surface resistance, ultimately supporting the sprinter's performance.



Fig 1-(a) Final front sketch of one-piece compression garment (b) Final back sketch of one-piece compression garment

A forward shoulder design is used in one-piece compression garments for sprinters to enhance mobility, improve fit, and reduce strain on the shoulder joints during high-intensity movements. By shifting the shoulder seams slightly forward, this design allows for a more natural range of motion, especially during arm swings, which are crucial for sprinting efficiency. It also helps in reducing friction and pressure points, preventing discomfort or irritation during prolonged use. Additionally, a forward shoulder construction contributes to better posture alignment, ensuring that the

upper body remains in an optimal position for generating speed and maintaining balance. This design choice enhances overall comfort and performance, making it a valuable feature in compression garments for sprinters.

V. TRAINING GARMENT

A training compression T-shirt designed for performance features advanced fabric technology and a strategic design to enhance comfort, mobility, and breathability during intense workouts. The incorporation of Hydra Mesh panels in key areas, such as the underarms and back, allows for superior ventilation by promoting airflow and moisture-wicking, keeping the wearer cool and dry. This feature is essential for maintaining comfort during prolonged training sessions, reducing heat buildup, and preventing excessive sweating. The raglan sleeve construction is specifically chosen to provide an extended range of motion, eliminating shoulder seams that could cause discomfort or restrict movement. This design is particularly beneficial for athletes engaging in dynamic activities, as it ensures flexibility and unrestricted arm motion. The combination of a Chinese collar with a round collar creates a modern and functional aesthetic, offering a snug fit around the neck without feeling too tight or restrictive. This hybrid collar design also prevents excessive shifting of the T-shirt during movement, ensuring a secure and distraction-free fit. Additionally, the use of flat seam construction throughout the garment enhances comfort by reducing friction against the skin, minimizing the risk of chafing or irritation. Flat seams also contribute to the durability of the T-shirt, ensuring that it maintains its structural integrity even after repeated use and washes. The compression fit of the T-shirt provides muscle support by improving circulation and reducing muscle oscillation, helping athletes maintain endurance and recover efficiently. With a combination of Hydra Mesh panels, raglan sleeves, a unique collar design, and flat seam construction, this training compression T-shirt is engineered for optimal performance, making it an essential piece for athletes seeking both functionality and comfort in their training apparel.

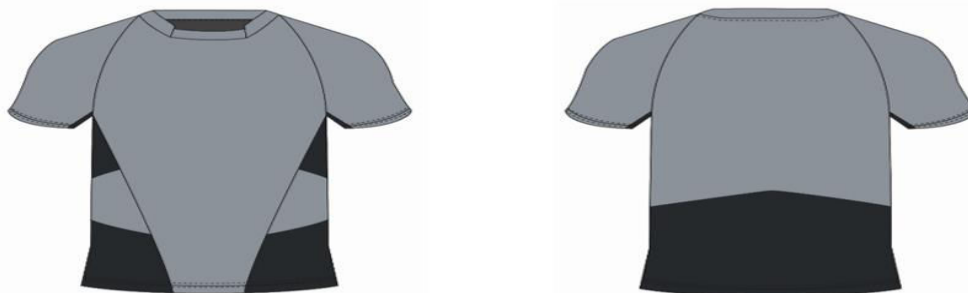


Fig 2 – (a) Final front sketch of compression t-shirt (b) Final back sketch of compression t-shirt

Training compression shorts are designed to provide athletes with enhanced support, flexibility, and breathability during intense workouts. The elastic waist ensures a secure and comfortable fit, allowing the shorts to stay in place without restricting movement, while the elastic bottom band provides additional grip around the thighs to prevent the fabric from riding up during dynamic activities. Strategically placed Hydra Mesh panels enhance ventilation by promoting airflow and moisture-wicking, keeping the body cool and dry even during prolonged training sessions.

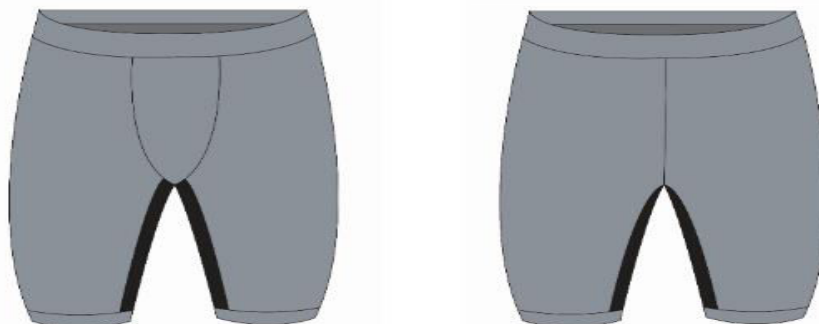


Fig 3 – (a) Final front sketch of compression shorts (b) Final back sketch of compression shorts

The inclusion of extra cut panels allows for better contouring to the body, ensuring targeted compression in key muscle areas to reduce fatigue and improve circulation. These design elements work together to support muscle efficiency, minimize strain, and enhance overall performance. The lightweight and stretchable fabric of the shorts allows for unrestricted mobility, making them ideal for high-intensity training. Additionally, flatlock stitching helps to minimize friction, preventing chafing and discomfort.

VI. TEST RESULTS

TEST	RESULT
Air permeability	11.56 cm ³ /sec/cm ²
Maximum load	183.45
Elongation	115%
Recovery	95%
Moisture management	OMMC: 4

Tricot raschel fabric is used for all three garments. The fabric composition is 75% polyester and 25% elastane. The fabric is 220. The fabric is 4 way stretch. Hydra mesh is used for ventilation. The fabric has better air permeability, tensile strength, moisture management, elongation and recovery percentage.

VII. CONCLUSION

The development of the Sprinters Garment project has successfully demonstrated significant performance enhancement through innovative fabric selection and ergonomic design. By integrating advanced materials and optimizing structural elements, the garment has improved aerodynamic efficiency, comfort, and durability, ultimately benefiting athletes by reducing drag and enhancing mobility. The experimental analysis and testing results validate the effectiveness of the design in optimizing sprinting performance. This project highlights the potential of technical apparel in sports and sets a foundation for future improvements in wearable sports technology.

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