

# Spacer fabrics: Its types and Applications

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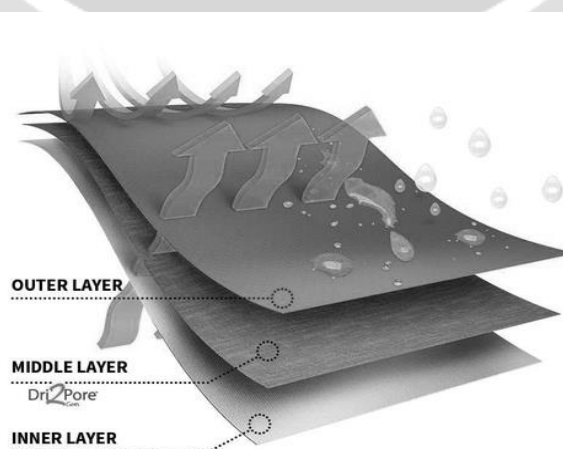
## ABSTRACT

Spacer fabrics are an innovative class of textiles that have gained attention for their different applications in various fields. These fabrics are made to provide unique functional properties such as breathability, cushioning, moisture management, and thermal insulation. Spacer fabrics are commonly used in medicals, automotive, sports, aerospace, and fashion. This article discusses highlight the techniques of producing spacer fabrics, its properties, applications and end uses. Further, it discusses the recent trends and developments in materials used and technologies needed to enhance the attributes and functional properties.

**Key words :** Spacer, knitting, warp, weft, layer

## 1.INTRODUCTION

Spacer fabrics are multi-layered fabrics made up of woven or knitted and the layers are connected by yarns. These yarns create distance or space between the 2 layers. This yarn is called pile yarns or spacer yarns which differ in density, material, elasticity which determines the thickness and compressibility of the fabric [1]. The fabric layers have different functions, one side can be moisture-wicking and other can be strength and aesthetic. The spacer fabrics are lightweight and stronger. Three - layer spacer fabric is shown in Figure 1. In this structure, the outer layer can be knitted, woven, or non-woven., depending on the required characteristics. This layer provides aesthetic properties like texture, softness and abrasion resistance. Spacer layer is the core layer which connects two outer layers and also responsible for providing cushioning effect [2]. This gives required thickness to the fabric, air-flow, and moisture flow. The third layer serves as the base of the 3D structure and is responsible for moisture wicking and breathability.



## 2. TYPES OF SPACER FABRICS

### 2.1 Warp knitted spacer fabrics

Warp-knitted spacer fabrics were produced in warp-knitting machines. They give excellent cushioning and elastic properties. They are used in automotive seats, mattresses, and footwear. Warp-knitted spacer fabric consists of two ground surfaces. Which are bound through pile yarns with stitches. two needle bars are possible and have great similarities to flat knitting [3]. It has great flexibility and also air, water-permeability. The warp-knitted spacer fabrics are shown in Figure 2.

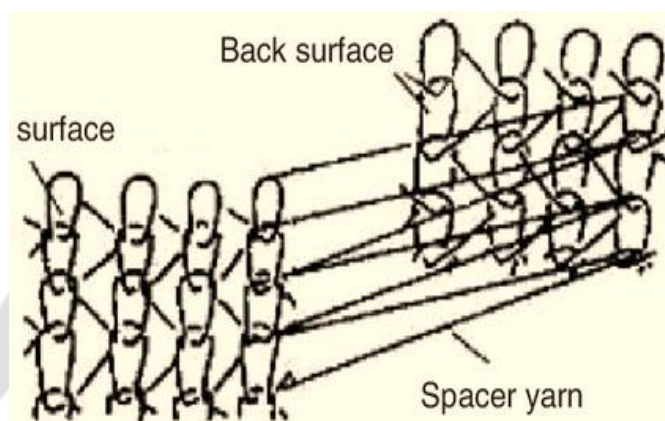


Figure 2. Warp-knitted spacer fabric

### 2.2 Weft knitted spacer fabrics

The weft-knitted spacer fabrics are made with complex and customizable designs in weft-knitting machines. They are softer and flexible than warp-knitted spacer fabrics, perfect for sportswear, medical, and apparel textiles. Circular knitting machine with two sets of needles are used to create two individual layers of fabric that are held together by tucks [4]. This fabric is known as double-faced fabric also called as spacer fabric. It is produced by flat, V bed, and purl machines. The weft knitted spacer fabric are given in Figure 3.

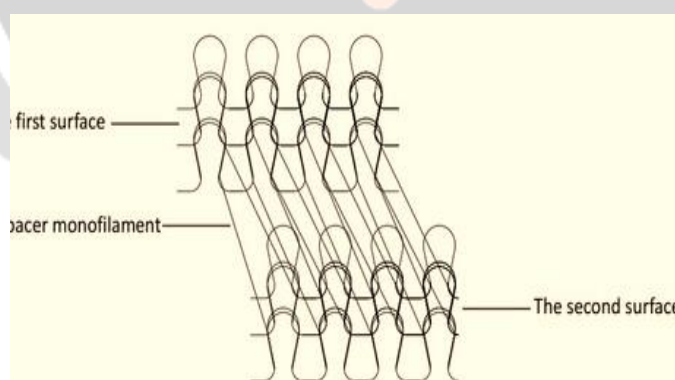


Figure 3. Weft knitted spacer fabric

### 2.3 Spacer fabric from Non-woven

Non-layer spacer fabrics have two layers connected by methods like needle punching and chemical bonding. The fabrics are lightweight and cost-effective. They are used in filtration and medical application [5]s. The structure of spacer fabric made from non-woven is depicted in Figure 4.

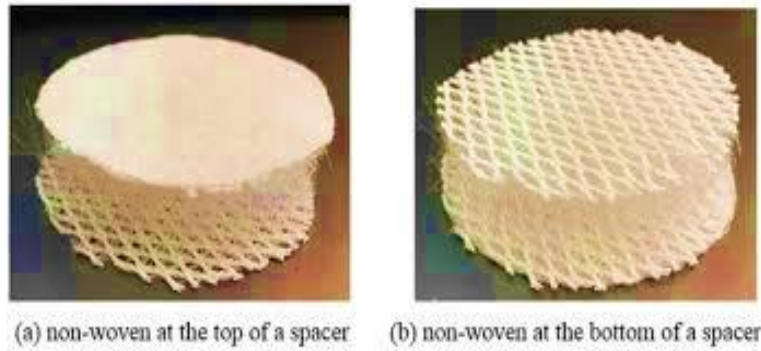


Figure 4. Non woven spacer fabrics

2.4 3D spacer mesh

They are an open structure for airflow, mostly made of synthetic fibers like polyester and nylon. 3D knitting machines are used to develop the structure. 3D spacer mesh are used in back packs, cushions and mattresses. Figure 5 depicts the structure of 3D spacer mesh.

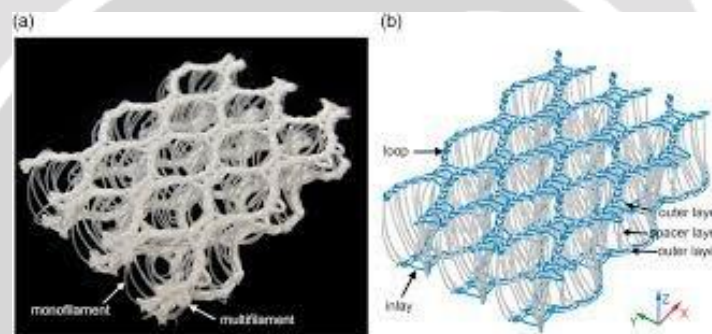


Figure 5. 3D spacer mesh

Figure 5. 3D Spacer mesh

3. Application of spacer fabrics

3.1 Space fabrics in medical textiles

Due to their breathability, moisture management, and cushioning, spacer fabrics are increasingly used in medical textiles. Spacer fabrics provide pressure relief and comfort, decreasing the risk of bedsores in patients who are bedridden for a certain extended period. Spacer fabrics are used in orthopedic supports and braces due to cushioning and moisture wicking properties. Spacer fabrics are used in wound care products due to air circulation and moisture management which is shown in Figure 6.



Figure 6. Spacer fabrics in wound care

### 3.2 Spacer fabrics in sports and footwear

Spacer fabrics are used in sportswear like sports bra and activewear. Spacer fabrics provide support, ventilation, and moisture - wicking properties. Spacer fabrics are used in the uppers of running shoes to provide breathability, flexibility, and comfort [5].



Figure 7. Spacer fabrics in sports

### 3.3 Spacer fabrics in Automotives

In automotives spacer fabrics are used in seat belts, headliners, and door panels increasing the driver's experience. Spacer fabrics are used in automobile's interiors to provide sound insulation, thermal regulation, and impact resistance. Figure 8 depicts the spacer fabrics in automobile seats.



Figure 8. Spacer fabrics in automobile seat

### 3.4 Spacer fabrics in Aero-space and military

High-performance materials like spacer fabrics are used in aerospace and military. These fabrics provide thermal insulation, flame resistance and impact protection. Spacer fabrics are used as protective textiles like flight suits and military gear due to lightweight and thermal and fame resistance. aircraft interiors like seats, cushions, thermal insulation, and sound-proofing. Figure 9 shows the spacer fabrics in aero-space applications [6].



Figure 9. Spacer fabrics in aero-space

### 3.5 Spacer fabrics in furniture and upholstery

Spacer fabrics provide cushioning and ventilation, making them suitable for chairs, mattresses, and sofas. They provide comfort and long-term seating and depicted in Figure 10.



**Figure 10. Spacer fabrics in furnitures**

### 6.6 Spacer fabrics in architecture and construction:

Spacer fabrics are used in sound-absorbing panels due to their noise dampening ability. The structure helps to trap air, making it perfect for thermal insulation in buildings. The structures used in construction are shown in Figure 11.



**Figure 11. Spacer fabrics in construction**

## 4. CONCLUSION

Spacer fabric is a structure having remarkable comfort, breathability, moisture management, cushioning, utility, and adaptability. The possibility of making the structure in various forms with wide range of properties makes it suitable to utilize in industries such as sportswear, architecture, healthcare, and automotive. The inherent qualities (strong, flexible, and lightweight) allow for an endless range of possible uses, making them an essential component of high-performance technical solutions as well as daily goods.

## 5. REFERENCE

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