

# Gearing-Up Automobile Industry with Technical Textiles

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**ABSTRACT:** Automobile is the lifeline of present society. Automotive textile is that part of textile which is used in accordance with the vehicles i. e. it is widely used in automotive industry right from light weight vehicles to a heavy truck or duty vehicles. Automotive textile is an integral aspect of technical textile. The global consumption of textiles used in automobile industry is estimated to be over 4.5 lakh tones. The percentage of textile material used in motor car amounts to 2.2% of the overall weight of the car. Apart from traditional uses as interior fabrics, carpets, headliners, etc., textiles are also being used as tyre cord, fuel filters, safety belts, air bags and as a reinforcement material for composite. This study revolves around the textile materials mainly air-bags (fibers, yarns & fabrics) used in automobile sector, their technical aspects, method of manufacturing, quality standards and testing parameters.

**KEY WORDS:** Composites, Air-Bags, seat textile etc.

## I. INTRODUCTION

Automotive textile is that part of textile which is used in accordance with the vehicles i. e. it is widely used in automotive industry right from light weight vehicles to a heavy truck or duty vehicles. Since it cannot be classified in apparel textile, it is more of a techno mechanical application of textile. Industrial textiles are widely used in transportation vehicles and systems including cars, trains, buses, airplanes and marine vehicles. Approximately 50 square yards of textile material is used in an average car for interior (Seating areas headliners, side panels, carpets and trunk, lining, tires, filters, belts hoses, airbags etc.) Automobile textiles, which are Non apparel textiles, are widely used in vehicles like cars, trains, buses, aircrafts and marine vehicles. Following are the major classified textile components used in automobile sector.

Sr.No	Breakup of Automobile Textiles	Share%
1	Carpets (Including Car Mats)	33.3
2	Upholstery (Seating Fabric)	18
3	Pre-assembled interior components	14
4	Tyres	12.8
5	Safety Belts	8.8
6	Air Bags	3.7
7	Others	9.4
	Total	100

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### Automotive Textile Components

**Visible Components:** Upholstery, Carpets, Seat belts, Roof liners, etc.

**Carpet** is an important part of the automotive interior. Carpets must withstand temperature extremes. Needle- felted carpets, tufted cut-pile carpets are generally used. Major car producers are using tufted cut-pile carpets in their cars. Carpets usually have a rubberized backing. Carpets are manufactured either by tufting or needle felting. Carpets made by tufting are based upon a supportive backing which is used as a base to accept the pile yarns which becomes the uppermost surface. Carpet backing is usually spun bonded and is made by an integrated process in which polymer chips are melted and filaments are extracted through a die. Mainly polyester is used in Making this carpet backing whereas a blend of nylon and polyester is used in some occasions. But during recent period polypropylene is assuming great importance considering the recyclability. The process of needling has got the advantages of more productivity at relatively low cost. But carpets produced by needling cannot be used to cover sharp counters especially foot areas and transmission tunnels. Superior needled material has a good filling which is determined by the amount of vertically oriented fibres at a given stitch density.

**Safety Device, Seat Belts.** Now a day's wearing of seat belt is become compulsory for drives and front seat passengers. Seat belt provides a protection regardless direction of collision but air bags provide protection against head on collision. [1]. About 1 kg of textile fibre per car is consumed in seat belts. Seat Belts need to be as soft and flexible as possible along the length direction but as rigid as possible in the width direction so they can slide easily through buckles and to retract smoothly into housing. The edges must be scuff resistant but not unpleasantly hard and the material must be resistant to UV degradation and retain its strength for the life of the car, otherwise it must be replaced some of the first seat belts were made from polyester. [2]. Now days, the seat belts are being woven on shuttle less needle looms. The twill weave is preferred because warp threads lie parallel to the face and back of the webbing and as a result, the material has a high warp ways strength and low elongation. Due to governmental pressure and legislation, safety device have become a growing market for automotive textile. Seat belts and air bags are commonly used for safety in automotive. [8] The seat belts control the forward movement of the wearers in the controlled manner during sudden stoppage of the vehicle. [9] About 1 Kg of textile fiber per car is consumed in seat belts. An airbags is an automatic safety restraint system that has gained significance within the last decade. Airbag is not an alternative to seat belt but a supplement.

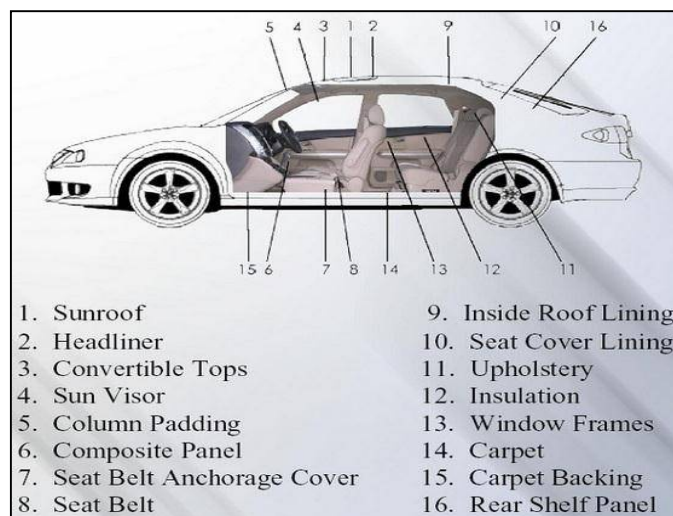


Figure - Application of Technical Textile Components in Automobiles

**Concealed Components** Airbags, Tyre cords, Composites (bumpers, side panels etc.) and rubber reinforced components (hose and filters), etc. are the concealed components of technical textiles being used in automobiles. **Air bag** is an

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automotive safety restraint system. It is an occupant restraint system consisting of a flexible fabric envelope or cushion designed to inflate rapidly during an automobile collision. Its purpose is to cushion occupants during a crash and provide protection to their bodies when they strike interior objects such as the steering wheel or a window. Thus it lowers the number of injuries by reducing the force exerted by steering wheel and the dashboard or any point on the body. This is accomplished in two ways, firstly by increasing the interval over the force being applied, and by spreading the force over a large area of the body. [3][5]

Stringent government legislation, consumer pressures are the driving forces for the massive growth and development of the air bags. In USA, the market for air bags is very huge and it is still in a growing stage in case of Japan and Western Europe. The requirement for an air bag material is high strength, resistance to ageing and abrasion, compatibility with coatings and good impact absorption. Hence nylon 6, is the mostly used material for the construction of air bags. Polyester is rarely used for this purpose and this trend seems to continue.[4][7]. Mostly used raw material for the airbag fabric is nylon 6, 6 yarns in the deniers ranging from 420 to 840. The side impact airbags used 1880 D nylon- 6. [6].

**Air filters** an average modern car contains filters in more than ten different places. The air filter in the engine is normally a wet-laid non-woven material. It is made up of a mixture of cellulose fibers derived from wood pulp and a small amount of synthetic fibers. Cabin air filters, with increasing awareness of air quality within cars, air filters are being installed as standard equipment. Non-woven with an effective surface area of about 0.3 m<sup>2</sup> are required to filter out solid particles with diameters as small as 3µm. Development is being carried out to improve performance. Up to 0.5 m<sup>2</sup> of non-woven material may be required with activated carbon and antibacterial chemicals to remove bad odours. Fredenberg of Germany produces the latest version of the highly sophisticated micron air particle filters. Micron air fibres are based on multilayer micro fibre non-wovens incorporating active carbon and particle filter components. They are said to offer an optimum combination of electrostatic and mechanical filtration, and are resistant to moisture, chemical and thermal degradation. They provide protection from all pollens and respirable particles such as diesel soot and micro-organisms. These filters also guard heating and air-conditioning systems from dirt contamination and block gaseous pollutants.

## II. FIBRES USED IN AUTOMOBILE SECTORS

Natural fibres found themselves a place in automobiles way back in 1960-1970. In the last 2 decades, due to spontaneous growth of man-made fibres, today the entire automobile encompasses synthetic/man-made fibre. The majority of used fibres as automotive fibres are polyester, nylon (6 & 6, 6) and polypropylene. The fibres produced using inorganic materials like glass and ceramics also find use in automobile.

For seat coverings the main technical requirements are resistance to sunlight (both colour fading and fabric degradation by UV), abrasion resistance and, for public transport vehicles, reduced flammability. Seats frequently get damp from contact with wet clothing and, in the case of seats in public transport, subject to abuse by vandals and other irresponsible individuals. The fabrics need to be resistant to mildew, hard wearing and strong with high tear strength. Soil resistance and easy cleanability are also necessary.

Application	Fibres used
Seat covers	Nylon, polyester, pp, wool
Seat belt	Polyester
Carpet	Nylon, PET, PP
Air bags	Nylon 66, nylon 46
Tyre cords	Viscose rayon, nylon, Kevlar
Composites	Carbon, glass, aramid

Following are the ideal features for a fibre to be selected as automotive textile.

- Resistance to sunlight, UV radiations
- Light weight
- Reduced flammability
- Higher tear strength and hard-wearing nature
- Resistance to sweat

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- Resistance to mildew
- Ease of handling and processing
- Excellent soil resistance
- Ease of cleaning

Textile product used as automotive textile component should possess the certain properties and tested for abrasion resistance, tear and tensile strength. Seam strength, stretch and recovery, dimensional stability, flame retardance, tensile strength/breaking & elongation, Color fastness and crocking, light fastness and UV degradation, Antistatic, Environmental and ageing competency.

### **Polyester**

As the fibre of the century, polyester enjoys a wide spectrum of properties like high stress property, excellent features like colorfastness, wear and abrasion, resilience, resistance to heat (during treatments), stiffness, chemical and solvent resistance, etc. Components of automobile like seat covers, headliners, door panels, package trays, tyres and safety belts are wholly made from polyester. Majority of fabrics employed in automobile interiors are made from polyester alone than any other fibre. It is also interesting to note that the polyester used in seat, door panel, etc is recyclable in nature. A report says that nearly 45% of the polyester is used as floor covering and 25% as seat cover in automotive market. Compared with nylon, polyester possess several advantages like low cost, less abrasive nature, ease and smaller package formation, etc.[8]



Figure 6 Polyesterfibre uses in seat material

**Nylon** This includes both 6 & 6,6 varieties. A satisfactory range of mechanical properties exhibited by Nylon makes it suitable as automotive textile supplement compared to Nylon 6. Nylon 6,6 has a greater contribution due to its features like wear resistance, soil shedding nature, affinity for dyestuff, good solvent resistance, fatigue and abrasion resistance, etc. Due to recent developments in varieties of polyamides like high ultra violet resistance, nylon used in fabric form provides the automobile industry a spectrum of colour choices. Nylon 6,6 is the most commercially accepted textile fiber for air bags and tyre construction.

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Figure- Nylonfibre used in Air-Bags

**Polypropylene** Features like low density, hydrophobicity, cheap availability (due to its production) have made polypropylene a popular industrial textile. The chemical properties are highly noticeable. PP is employed in the form of NWF for trunk liners or boot liners. The list includes shelves, door, seat dorsal side, etc. Compared with PET and Nylon, the following features of PP have made it more suitable as automotive textiles.

- Strength and rigidity
- Resistant to acids, alkalis, solvents (at room temperature)
- Low specific gravity (lower than water)
- Color stability
- Lower cost/weight ratio.



Figure - Polypropylene fibre use in seat material

### Key Issues, Challenges, & Opportunities in automotive Textile

- ✓ Cost Efficiency,
- ✓ Demand for Enhanced Comfort & Safety,
- ✓ New Materials,
- ✓ Sustainable and Eco-Friendly,
- ✓ Increased Demand for Customization,
- ✓ Automotive Design & the Fashion.

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## III. CONCLUSION

Textiles are no more limited for use as apparels clothing is just are but not the only purpose of textiles with the rapid changes in the social economic structure of our society. Automotive textile is an integral aspect of technical textile. Since it cannot be classified in apparel textile, it is more of a techno mechanical application of textile. Industrial textiles are widely used in transportation vehicles and systems including cars, trains, buses, airplanes and marine vehicles. The number of persons killed or injured in traffic has dropped continuously since the development of air bag system. Over the time, the development of seat belt becomes an indisputable matter of course. Today, the 3-point automatic seat belt, seat belt tensioner and airbag constitute a carefully matched passenger protection system. Implementation of these safety restraint systems with due care and regulation can further drop the fatality rate and serious injuries at the time of road accidents.

## REFERENCES

1. Vasilves Automotive industry a high potential market for non wovens sound insulation ,journal of textile and apparel Technology and management vol .3. Issue4, 2004, PP-1-5.
2. Design Driven: The Development of New Materials in Automotive Interiors. Nancy Powell, North Carolina State University 2004. Journal of Textile and Apparel, Technology and Management.
3. Validation Methodology on Airbag Deployment Process of Driver Side Airbag, Jeong, Lee Won, Jae Heun Lee, DukBeung, Chae, Jae Hueng, Kim, Paper No. 09-0363
4. The journal of Academic Emergency Medicine, "Airbag Related Burns", Celalettin Sewer, Bilge Aysal, Sinan, Yalci, October 2011
5. International Journal of Engineering Reasearch and Applications, "Airbag- A safety Restraint System of an Automobile, Tasnim N. Shaikh, SatyajeeChaudhari and Hiren Rasania, Vol.3, Issue-5, Sep.-Oct. 2013
6. Recent Developments in Inflatable Airbag Impact Attenuation Systems of Mars Exploration, AAAF-061, James Stein and Charles Sandy, ILC Dover, Inc.
7. Advance Materials Research, "Influence of Different Airbags Fabrics on Airbag Performance", Ge Chen, Jia Lu Li, Vol.332-334, September 2011
8. Powell, Nancy B. "Design Driven: The Development of New Materials in Automotive Interiors." Journal of Textile and Apparel, Technology and Management 3.4 (2004), pp. 1-19.
9. Textiles Intelligence. 2006-03-07, "Customization and Safety Provide New Potential for Automotive Textiles.", Rpt. in Technical Textile Markets, 2008, pp.01-12
10. Neale C.G. "Design in a Textile Revolution" Automotive Textiles. Chrysler Corp. (1995): p.213.
11. Moon G.E. "A Fact: The Automotive Textile is an Amazing Product" Upholstery: Marketing, Styling, & Manufacturing; George Moon Assoc. Inc. Nov. 1-2, 1989.