From Passive Materials to Individualized Automotive Textiles: Thermal Comfort, Tactility and Human-Centred Design

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Abstract

Automotive textiles are moving beyond their traditional role as passive coverings and becoming key contributors to individualized comfort, perceived quality and human-centred vehicle design. This plenary presentation examines how textile materials, seat-cover constructions and multilayer assemblies influence the thermal, moisture and tactile experience of occupants, and how these functions can be aligned with differences in body characteristics, clothing, climate, journey duration and personal comfort expectations.
The microclimate at the body–seat interface is governed by heat transfer, moisture transport, compression, contact pressure and restricted air movement. Conventional tests provide valuable data on thermal resistance, thermal absorptivity, air permeability and water-vapour resistance, but they commonly evaluate flat, uncompressed specimens. Under real seating conditions, textiles operate in curved geometries and under sustained compression, while continuously receiving heat and moisture from the body. The gap between laboratory characterization and actual use therefore remains a major challenge in the reliable assessment and development of automotive textile systems.

Tactility is equally important. Surface structure, softness, friction, compressibility and recovery shape both first-contact sensation and long-term comfort. These properties are not experienced independently; they interact with thermal and physiological responses and contribute strongly to perceived quality. Human-centred design therefore requires the combined consideration of material performance, body–material contact and occupant diversity.

The presentation discusses the transition from passive seat-cover materials toward individualized automotive textile concepts based on targeted material selection, climate-specific design, zoned constructions and realistic evaluation methods. Particular attention is given to textile structure, multilayer configuration and compression-sensitive testing as means of translating laboratory results into user-relevant comfort.
Future automotive textiles should not be optimized only for an average occupant under standard conditions. They should be developed as adaptable material systems for diverse users, environments and usage scenarios. By integrating thermal comfort, tactility and human-centred design, the automotive textile sector can create seating solutions that are technically effective, inclusive and valuable to the individual occupant.

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