



## Evaluation of thermal environments in vehicles

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### Abstract

The concerns of designers in the automotive industry started to be focused on comfortable mobility only in the last decade together with the lowering of production costs and with the increasing security of vehicles. Moreover, their approach was extensively based on methods used in the research field of building systems. The thermal environment in a vehicle changes in a dynamic way as a function of the external climatic conditions and the quality and capacity of the HVAC system of the cabin.

The objective of this study was to investigate the thermal comfort inside the vehicle, analyzing the airflow around thermal manikins and evaluating thermal comfort indices. The assessment principle is based on the measurement and analysis of the conditions for heat balance in the thermo-neutral range and the associated thermal sensation. Two methods are available, in ISO 7730 and ISO 14505.

Two thermal manikins (and two human subjects) were used to evaluate thermal comfort inside a vehicle. We simulate two passengers and their interaction with the environment. The temperature of the manikins is controlled, generating a thermal plume similar of the passengers inside the cabin. Based on measurements of air temperature, mean radiant temperature, humidity and air velocity, as well as estimations of metabolic rate and clothing thermal insulation, the PMV index can be calculated. Comparison with personal thermal comfort assessment was completed.

Thermal comfort is influenced by all the factors that influence the exchange of heat between the human body and its environment. Several factors connected with the environment, like air temperature, velocity and humidity, were evaluated. The measurements were performed during a cold period, for a vehicle Renault Duster.

The results allow the evaluation of indoor thermal comfort and the discrepancy in application of standard thermal comfort indices, un-adapted to transient conditions as found in the vehicles.

**Keywords:** thermal manikin, thermal comfort in vehicle, PMV index, cabin airflow

**Thème 2 :** Machines thermiques et transferts de chaleur et de masse dans l'industrie, l'agriculture et le bâtiment