

Design and Development of Air Conditioning and Ventilated Car Driver Seat”- A Review

M. R. Bodkhe¹, Prof. A. A. Kanaskar², Prof. S. S. Jawre³

¹ M. Tech. student, Mechanical Engg. Department, S.S.P.A.C.E Wardha, Maharashtra, India

² Assistant Professor, Mechanical Engg. Department, S.S.P.A.C.E Wardha, Maharashtra, India

³ Assistant Professor, Mechanical Engg. Department, S.S.P.A.C.E Wardha, Maharashtra, India

bodkhemegha@gmail.com, abhijitkanaskar007@gmail.com, jawre.sandip@gmail.com

Abstract- The importance of having a comfortable driver’s seat is increasing as customer’s expectations rise. That is why the development of more comfortable seats is a current issue in the automotive industry. Thermal comfort is vital aspect to be measured in the ergonomics assessment of the driver seats, which are significant interfaces between man and machine in autos. Determining thermal comfort in autos is a complex task, because thermal comfort involves the interaction of many variables and automobiles are susceptible to temporal fluctuations in their thermal environments. In this research article the review is carried out on the thermal comfort of the air ventilated car driver seat. Overall in these study different parameters related with design comfort of the driver seat is also studied.

1. INTRODUCTION

Ever since it started running on roads, seats have been an integral part of the automobile. From the very early times when there existed simple benches, to the latest state-of-the-art massaging chairs, automobile seats have changed immensely over time. They have transformed from a flat horizontal plank, to contoured individual chairs capable of catering to individual needs. Heating and cooling features have turned car seats into ambient zones on-the-go. With the addition of softer and more comfortable foams, leather, massage function, they have become much more luxurious. The implementation of modern three-point seatbelt along with airbags has made seats safer. Conclusively, the plethora of features and functions on modern-day car seats turned them into an extremely complex system. A feature to cool down seats for improved thermal comfort has been around for almost two decades. It was first introduced in a production vehicle, for the front seats, by a Swedish OEM in 1997. Since then; it has been adopted by many manufacturers, and fitted in a wide variety of vehicles in almost all market segments. This feature has been most commonly offered for the front seats. In recent times, it has been made available for the rear seats as well. Although, that remains confined mostly to high luxury brands, and their flagship model variants.

2. THERMAL COMFORT

The main goal of the seat ventilation is to improve thermal comfort. It is incredibly difficult to quantify, and many factors like air temperature, humidity,

clothing insulation, and metabolic rate influence the overall comfort. Considering the interior of a car, the window size and the physiological differences are significant to the feeling of thermal comfort [4]. When air is circulated to cool down a person, it can be perceived as pleasant in the beginning. But, after the person is cooled down, it can be perceived as an unwanted draft. The most sensitive area is the lower back, where a strong cooling can cause cramps [5]. Another critical aspect is that spot cooling can cause thermal discomfort [6]. The following are the components of the ventilated car seat.

2.1. Spacer Layouts

To ensure air flow through the foam, a spacer material is used which consists of polyester fibres and knitted textile. The idea is to have a stiff material that does not compress when force is applied. Yet, it ensures low resistance to airflow. In the cushion foam, these materials are used on both sides.

2.2. Passive Cooled System

Until now, the only way to move air in a commercial product was by using a fan, where the difference lay between radial and axial fans. The opinions of OEMs are split; either axial or radial fans are employed to push or pull air. According to the supplier, the trend is to use a radial fan for a pull system. The main advantage is that radial fans have better efficiency while axial fans are used in greater numbers to compensate for this disadvantage.

2.3. Active Cooled System

Thermoelectric devices or Thermo electric coolers utilize the Peltier effect between two materials to create a temperature gradient. One side of the TED is heated, while the other is cooled. The effect can be easily switched if the current changes direction. This is especially interesting for car seats because the heating and cooling can be implemented using just one. As an important aspect of today's product development, simulations are significant tools for analysing and optimizing a system did simulations of parts of a human body.

2.4. Duct Design

To optimize the airflow through the system, a significant factor is to understand the design of the ductwork. Even though the B-side is not strictly pipes, it can be assumed to be so, for engineering purposes. Crucial parts are the outlets, inlets and areas where the flow separates. Most literature focuses on fans with a pushing system. Throughout the system, it is not relevant if the fluid is pushed or pulled through the pipe. [8]

3. COMFORT CONSIDERATIONS

"Comfort" is the first word in the title of this thesis and so it is very important to provide a definition and interpretation of what comfort means.

The meaning of the word comfort is described in many dictionaries as "being relaxed and free from pain- well being". The word comfort has been defined in Webster's Dictionary as a state or feeling of having relief, encouragement and enjoyment. Slater defines luxury as a pleasant state of physiological, psychological and physical harmony between a human being and its environment. To provide better comfort, the little car seat research that is available is mainly focused on the decrease of its comfort. The highest that can be achieved is that people will not notice the discomfort anymore. Another possibility following the definition of Slater is to implement physiological knowledge in the seat research process, to increase the comfort in such a way that people will notice it.

3.1 Comfort & Health

A part from comfort health issues are considered as well in this thesis partly because there is a clear link between discomfort and musculoskeletal complaints [10]. A lot of physiological measurements are based on health research. Seat comfort is a complex phenomenon [11].

4. LITERATURE REVIEW

Jason A. Lustbader [1] studied the increasing local heat loss and better targeting of body segments with large contributions to thermal comfort can offset the

effects of higher cabin temperature. The thermal comfort improvement can be used to reduce the A/C heat capacity by 4%, resulting in a predicted A/C fuel use reduction of 2.8% on an EPA highway cycle and 4.5% in an EPA city cycle.

E B Ratts et al. [2] this paper focuses on the particular thermal interaction between the seat and passenger. To test the method, a test apparatus was constructed that generates heat and water vapour. The apparatus was placed on a seat cushion for a fixed time period. At the end of the period, heat and water transported were measured. These integrated values were used to quantify the seat's capability to move heat and moisture and ultimately to compare seats.

Tulin Gunduz Cengiz et al. [3] in this paper the study was conducted by using ramie blended seat cover and the comparison with other seat covers was done to taste the efficiency of the ramie blended seat cover over the other types of seat cover. Ramie is mostly blended (commonly 55% ramie and 45% cotton) with other fibres for its unique strength and absorbency, lustre and dye-affinity. When it mixed with ramie and wool adds lightness and minimizes shrinkage. When polyester is included in the blend, ramie improves wrinkle resistance and helps provide easy care and shrinkage control.

Diane E. Gyi et al. [4] a study of static, laboratory-based experiment allowed a more controlled environment and therefore highly adjustable driving rig was constructed. The technique of interface pressure measurement has generated considerable interest in the automotive industry as a method, which could be used to predict driver discomfort during the development of prototype seat designs. Future studies using this technique should provide information regarding such factors as gender, body mass, anthropometric data, and posture and foam hardness due to the confounding nature of these variables.

Gyouhyung Kyunga et al. [5] the experiment was conducted which involved a number of driving sessions, in which a variety of subjective comfort and discomfort responses were obtained. In addition, efforts were made to obtain a group of individuals with a wide range of statures, and participants were divided into three stature groups.

T.C Fai et al. [6] studies the parameter to be considered in seat design of an automobile taking various parameters under consideration. Mainly in the seat design of an automobile the vibrations are to be considered they mainly affect in the comfort of driver and passengers. Different approaches such as pressure and ergonomic are to be considered in seat design.

This paper carried out a large number of studies and up-to-date techniques developed for vehicle seats used by different types of transportation systems.

Volkmar T. Bartels [7] the Hohenstein Institutes carried out a research project in order to improve this situation. The aim of the project was to enhance the physiological seat comfort for the passenger by using textile alternatives. A three-dimensional knitted spacer fabric turns out to be the better cushion alternative in comparison to a moulded foam pad. The results obtained from the physiological laboratory test methods nicely match with correspond to the seat trials with human test subjects.

Tulin Gunduz Cengiz et al. [8] there are standards for procedures and equipment for evaluating thermal environments in automobiles. ISO 7730 and ASHRAE/55 are widely used as a method for evaluation of conditions for thermal comfort. This paper presents an particular estimation of thermal comfort in road trial study. In the experiments used, the 100% polyester seat cover had three different cover materials, which were velvet, jacquard and micro fibre. All experiments were carried out on a sunny day with ten participants over 1 h.

A. Melikov et al [9] carried out the research work on the comfort analysis of vehicle driver's seat through simulation of the sitting process. In this research work the method for ergonomic analysis of the seating comfort in the driver's seat for passenger vehicles is presented in two phases. In the first phase, the comfort seating postures of the driver are analyzed considering the comfort angles for the placement of human body and the necessary space for foot controls in vehicles, as well as the ranges of adjustments of the driver's seat and steering wheel.

Kiran Kumar Dama et.al. [10] Presented the research work on the, review on the automotive seat comfort design. In this research work the different researches were study. The main objective of this presented paper is to assign the measurement methods that are used to improve the physiological comfort of an automotive driver's seating.

5. CONCLUSION

It has been clear from the presented research study, that the physiological seat comfort of automobile seats can be considerably improved by using textile covering layers and cushions. In this study the subjective evaluations is carried out on the different types of automobiles seat for thermal and physical comfort. This presented research can be useful for developing the thermal comfort seat for automobiles.

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