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Measurement of the Temperature and Pressure Characteristic of Car Seats-Relationship Between Humans

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Abstract: Research of the interaction of the biomechanical properties of a sitting person and car seat is based on measurements of several basic parameters, such as the surface contact pressure, contact temperature, contact humidity, etc. So obtained surface maps each parameter can be compared at a same time and so can be identify correlations between these parameters and biomechanical properties of human, e.g. human anatomy, sex and age, the body forms, physique etc. Based on these analyzes is possible to optimize the levels of each parameter for obtaining the maximum seating comfort. The correlation between fatigue for the driver and sitting comfort is described in many publications dealing with this theme. However, repeatability real experiments in a car is questionable. It is therefore preferable to perform these measurements in the laboratory and simulate the same conditions as in moving car at a constant ambient temperature and humidity, with the same test persons. The most suitable is the use in the measurement of different types of car seats and various human.

Keywords: Car Seat; Temperature; Pressure; Comfort; Parameters.

1 Introduction

Research of the biomechanical properties of the human body in correlation with car seats and acting external factors is difficult. For testing with humans, there are a lot of restrictions to protect their health during and after the experiment, e.g. mechanical vibrations can damage human health. Therefore, it is preferable to perform laboratory experiments with humans, where is possible to define precisely test. The content of this article is to detect the correlation between temperature and pressure values for different types of car seats and various types of measured persons. Important parameters seating comfort include interaction seating pressure and interaction setting temperature in combination or separately. It is advisable to determine the existence of a correlation between these parameters. Affect these parameters or not? Can we determine the optimal value and keep it constant level?

2 Preparation of Measurement

- For created a group of people Fig. 1 and group of seats Fig. 2 can defined:
- quantity of people and their physique, women / men,
- position of the test, sitting,
- type of test, static or dynamic,
- schedule a test, its duration,
- measured parameters, temperature and pressure,
- ensuring the necessary presence of a doctor, medical supervision is not required, etc.

Comfortable mechanical properties of interaction parameters for automobile seats and biomechanical properties of the human body cannot be are defined only on the basis of physical properties. The feeling of true comfort sitting person may be entirely subjective only upon of his individuality [2]. Still, there are exist some completely independent physical parameters that support this feeling [3]. Sensation of comfort may encourage correct settings bio comfort as e.g. contact temperature, contact pressure, contact humidity, etc. These values can we get and by the study of the human body and measuring the real experiment. Experiments on humans but can be carried out only under strictly defined conditions and based on the Code of Ethics.

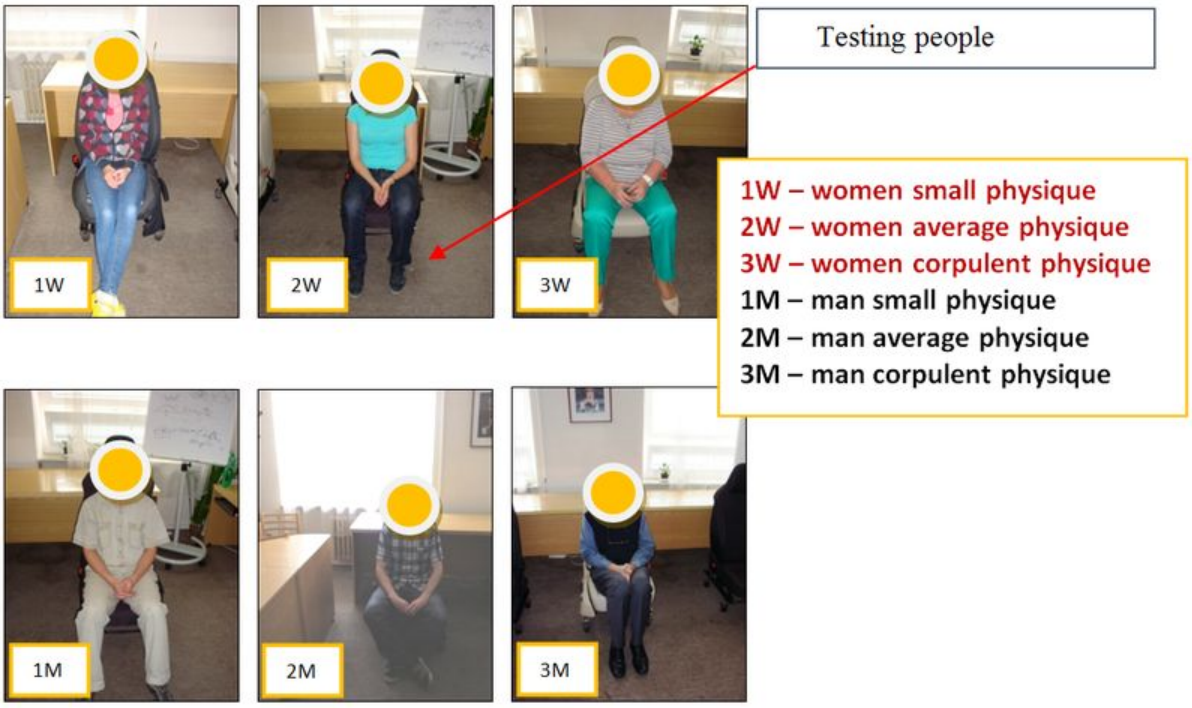

Fig. 1: Group of the tested people tested.

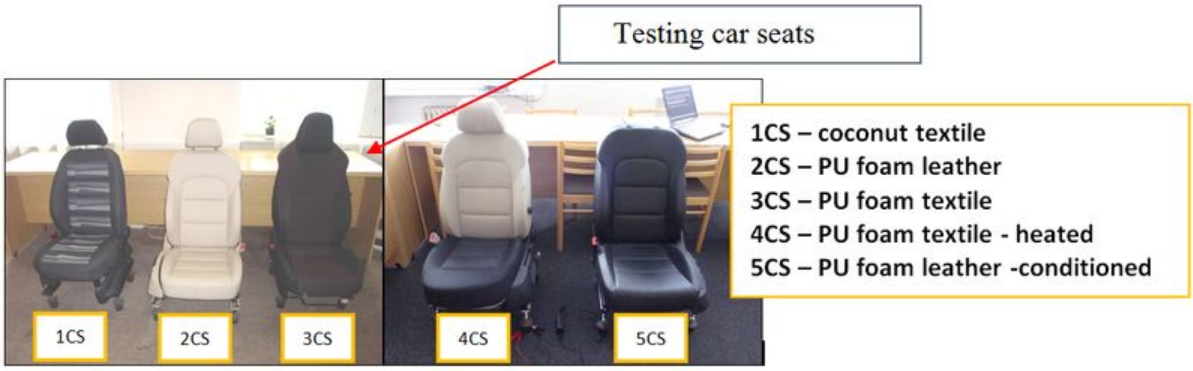

Fig. 2: Group of the tested car seats.

3 Calibration of Sensors

To get good results it is necessary to have good attention to calibrate the sensors and the all measurement chain [1]. Calibration is performed before each experiment. As the measuring devices are used thermal camera model AE for temperature fields measurement and X-Sensor for pressure fields measurement Fig. 3. Calibrations are always saved to the measured data. Calibration of thermal camera Fig. 3 is a relatively complex process dependent on many parameters and must be made according to specific conditions that must remain constant. This can be achieved only under laboratory conditions. Calibration X-Sensor is done by using calibration files that are loaded before each measurement and remain constant throughout the measurement. Calibration allows to obtain during the measurement of absolute measured values but only in the interval of precision measuring equipment. For proportional measurements should be used relative measured values. It is therefore important to determine whether the change in the measured value is not comparable with the accuracy (sensitivity) measurements. In our case, it is the accuracy of both measuring equipment sufficient for static measurements.

4 Measurement Methods

For the measurements we have chosen this strategy. Were chosen the following basic types of car seats, seat with polyurethane padding and textile cover (3CS), with polyurethane padding and leather cover (2CS), seat

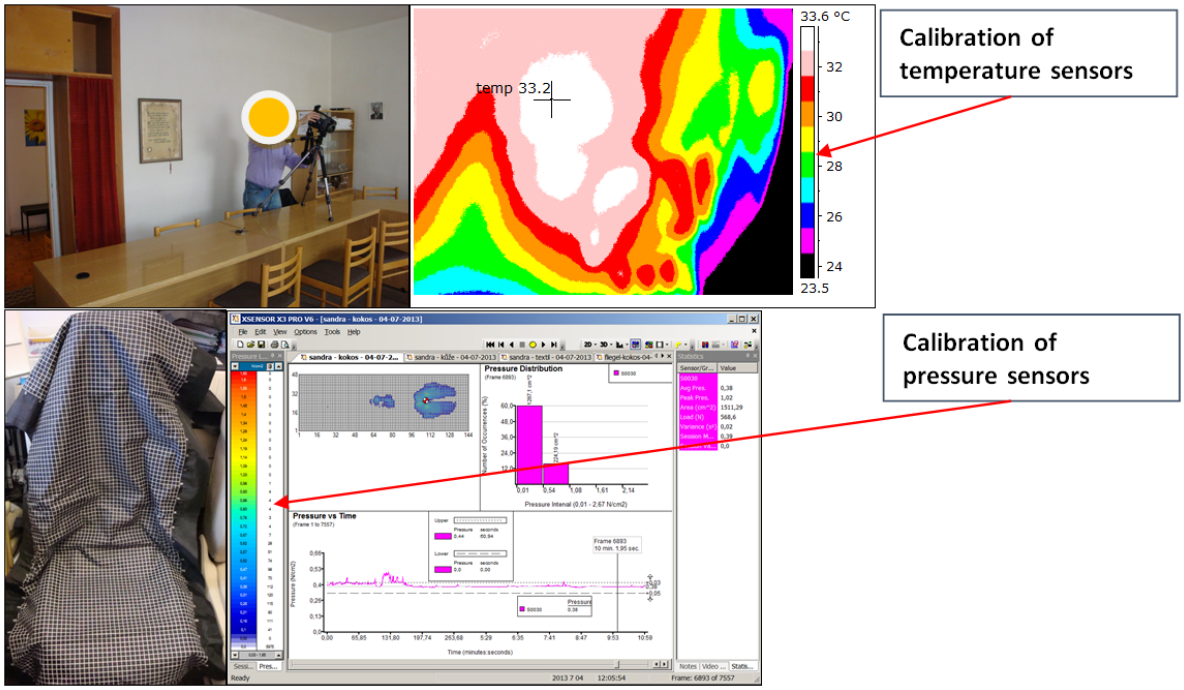

Fig. 3: Calibration of sensors.

filled with coconut fiber and textile cover (1CS), seat with polyurethane padding and textile cover with heater equipment (4CS), air-conditioned seat with polyurethane padding and leather cover (5CS). Test persons were 3 women (1W, 2W, 3W) and 3 men (1M, 2M, 3M) aged 25 to 55 years, weight categories from 45 to 85 kg and a height of 155-185 cm, in the group of small physique, average physique, corpulent physique. Measurement of the pressure fields at intervals of 5-300 seconds, temperature measurement time of 300 seconds and 305 seconds. Substitution of people conducted in the cycle with a delay of 600 seconds sufficient to relax each seats. The sample of measurement results are shown in Fig. 4 and 5.

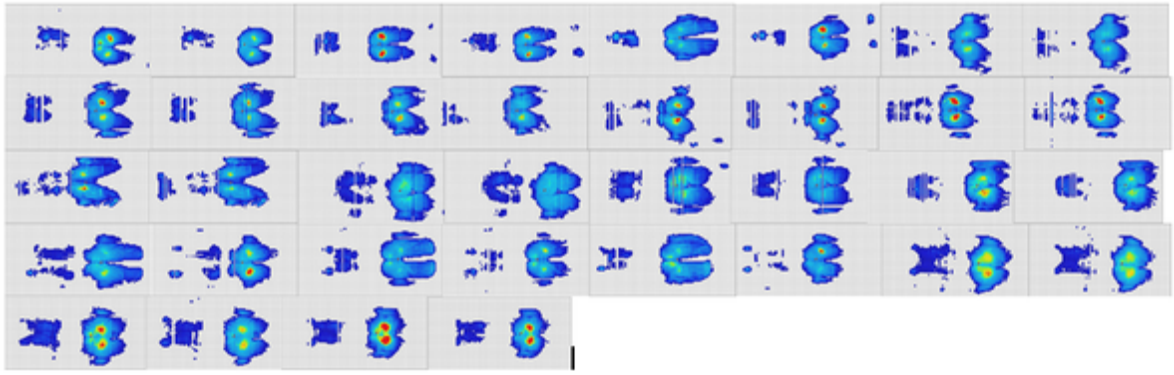

Fig. 4: Measurement in laboratory – pressure surface.

5 Results and Discussion

Examples of the evaluation test are shown in Fig. 6 and 7. Surfaces of seat and back are divided into several areas such as areas for maximum pressure and temperature, for medium pressures and temperatures for minimum pressures and temperatures. In each area we have always compared the local pressures and temperatures for measured each persons at same time.

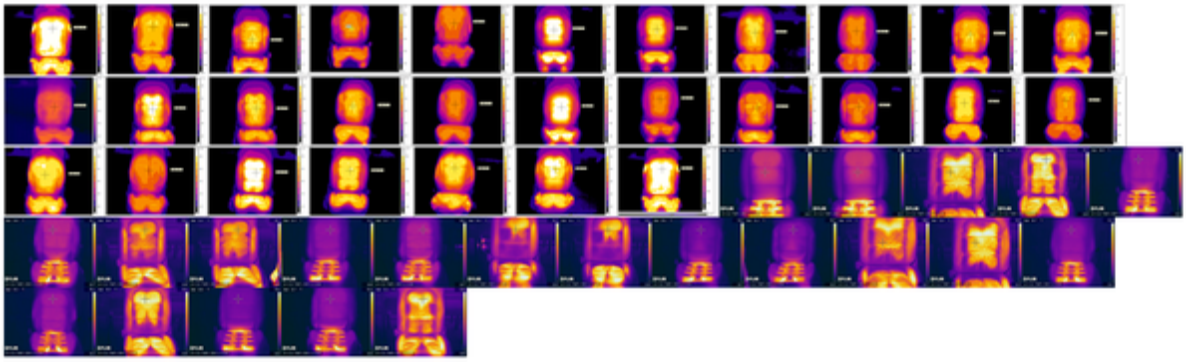

Fig. 5: Measurement in laboratory – temperature surface.

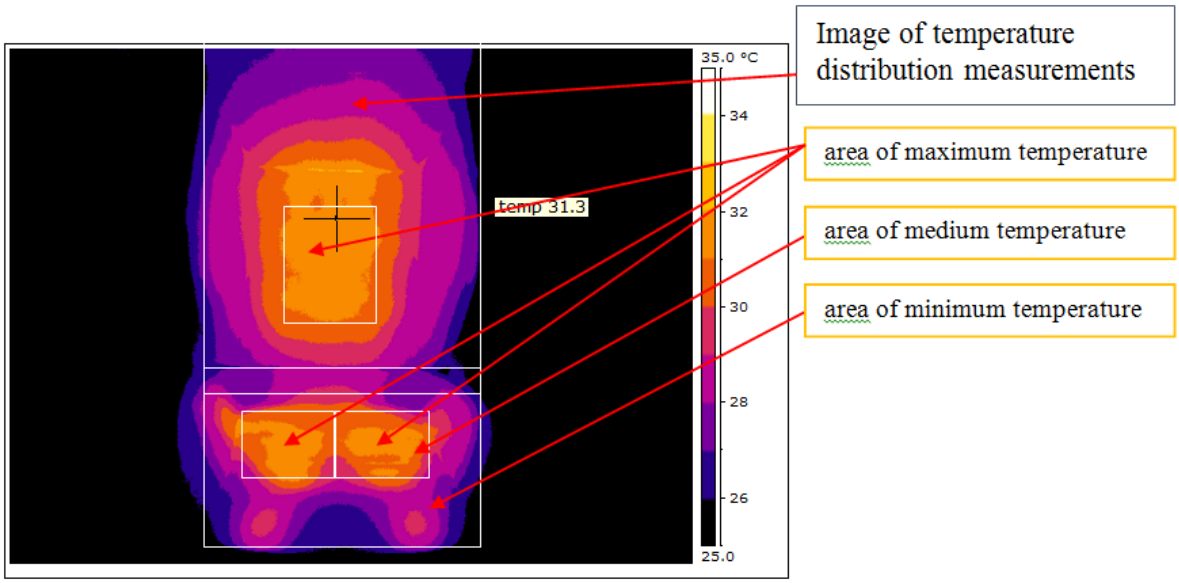

Fig. 6: Measurement in laboratory – area of contact temperature.

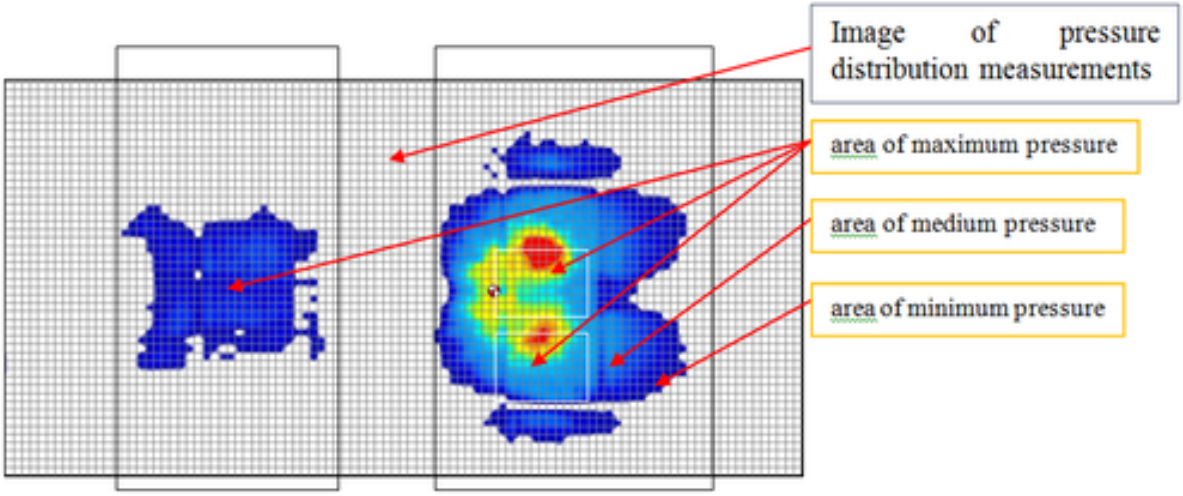

Fig. 7: Measurement in laboratory – area of contact pressure.

6 Relationship Between Pressure and Temperature

We are looking for whether exists a relationship between the contact pressure and contact temperature. From the test results we are able to compare different settings of a car seat without heating with heating and air conditioning with different test persons. As an example we give overview of a combination of measurements on the seat 2CS (polyurethane foam and leather cover) and 5CS (polyurethane foam and leather cover) Fig. 8 and 9.

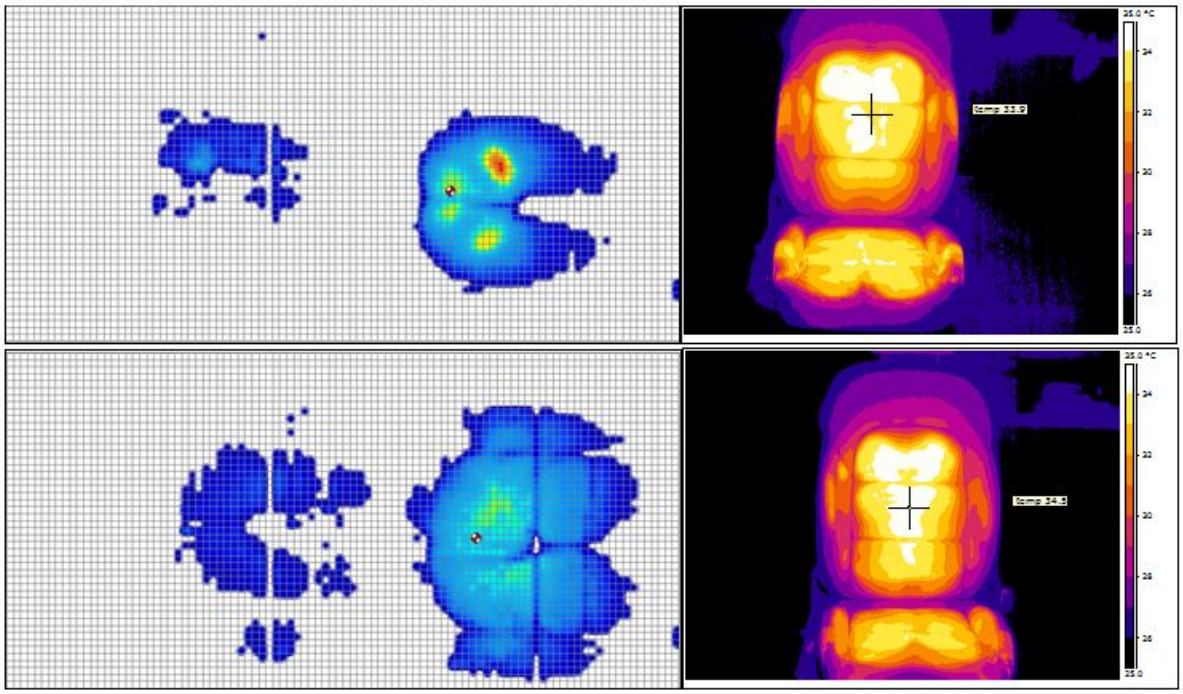

Fig. 8: Measurement in laboratory – comparison of 2CS-1W-3W.

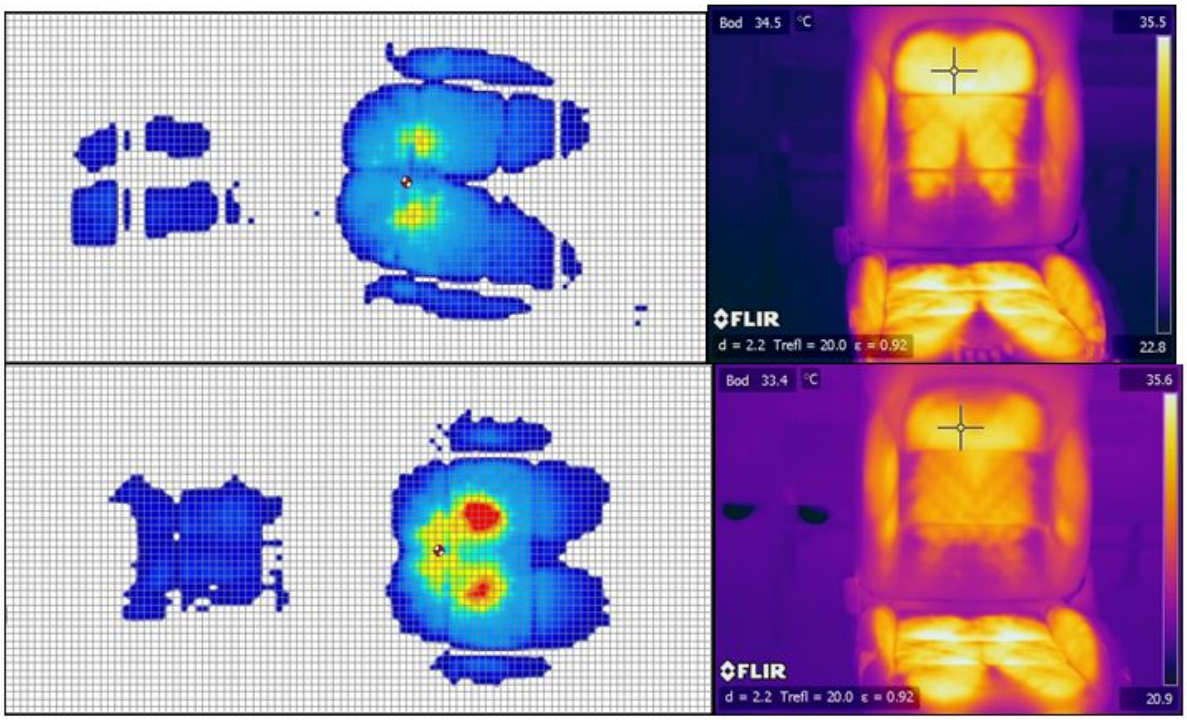

Fig. 9: Measurement in laboratory comparison of 5CS-1M-3M.

As an example we give overview of a combination of measurements on the seat 3CS (polyurethane foam and textile cover) and 3CS (polyurethane foam and textile cover) in Fig. 10 and 11.

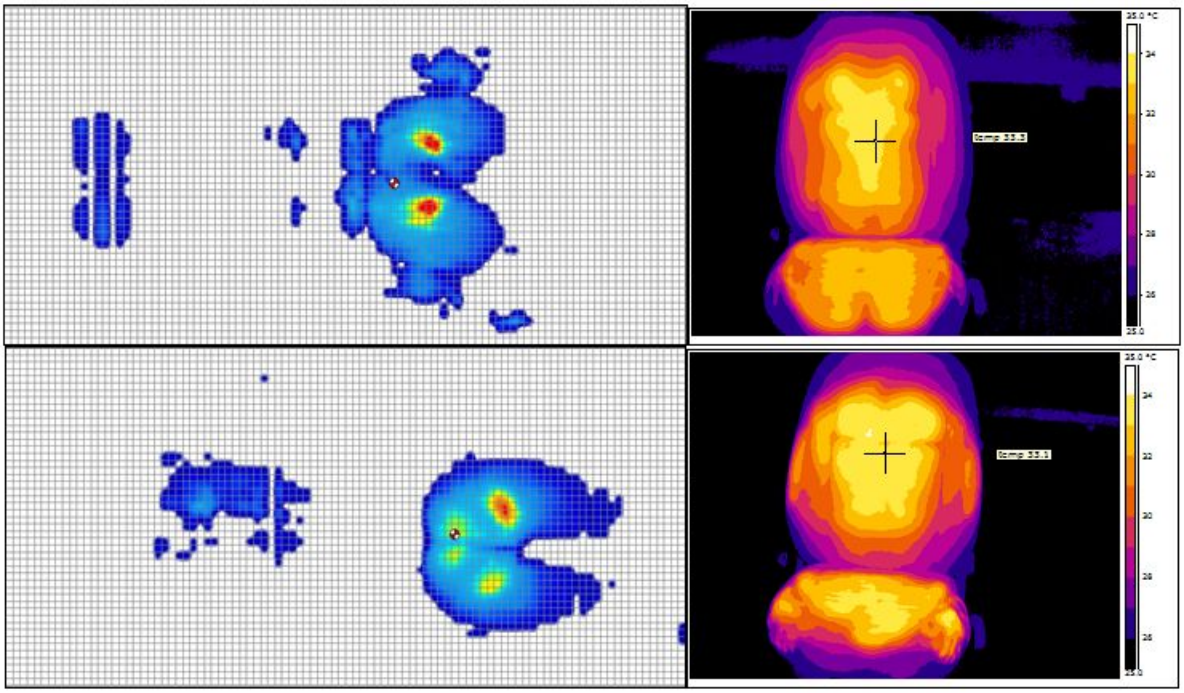

Fig. 10: Measurement in laboratory – comparison of 3CS-1W-2W.

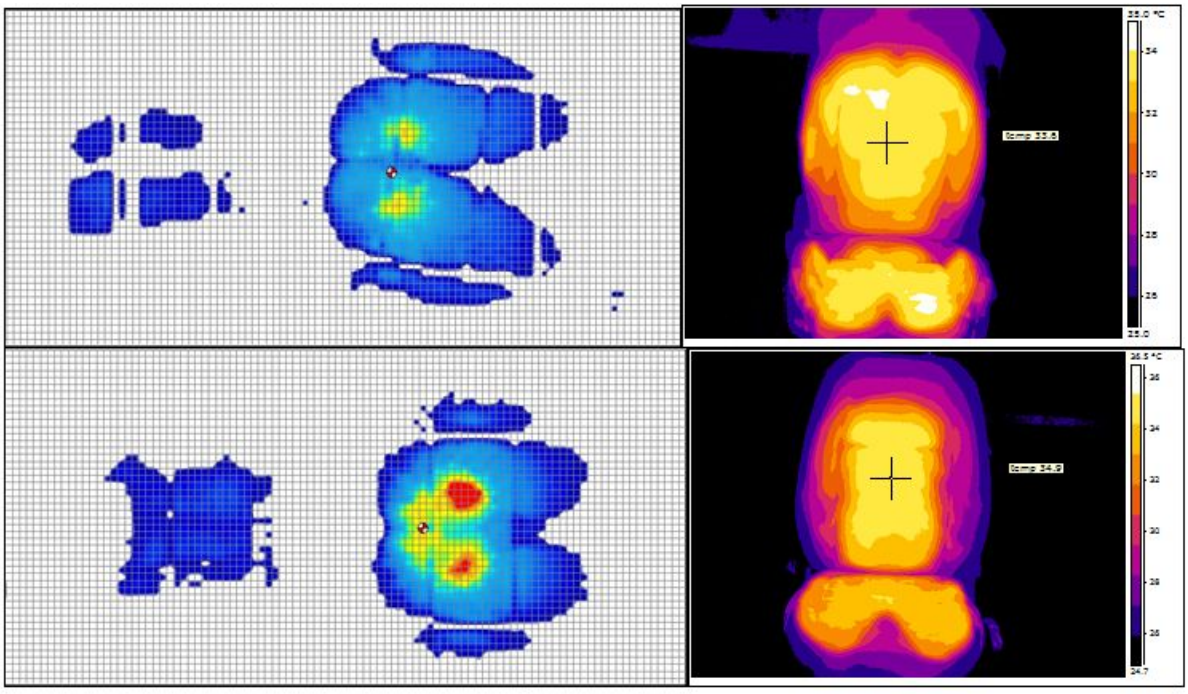

Fig. 11: Measurement in laboratory – comparison of 3CS-1M-3M.

As an example we give overview of a combination of measurements on the seat 4CS (polyurethane foam and textile and heating) in Fig. 12 and 13.

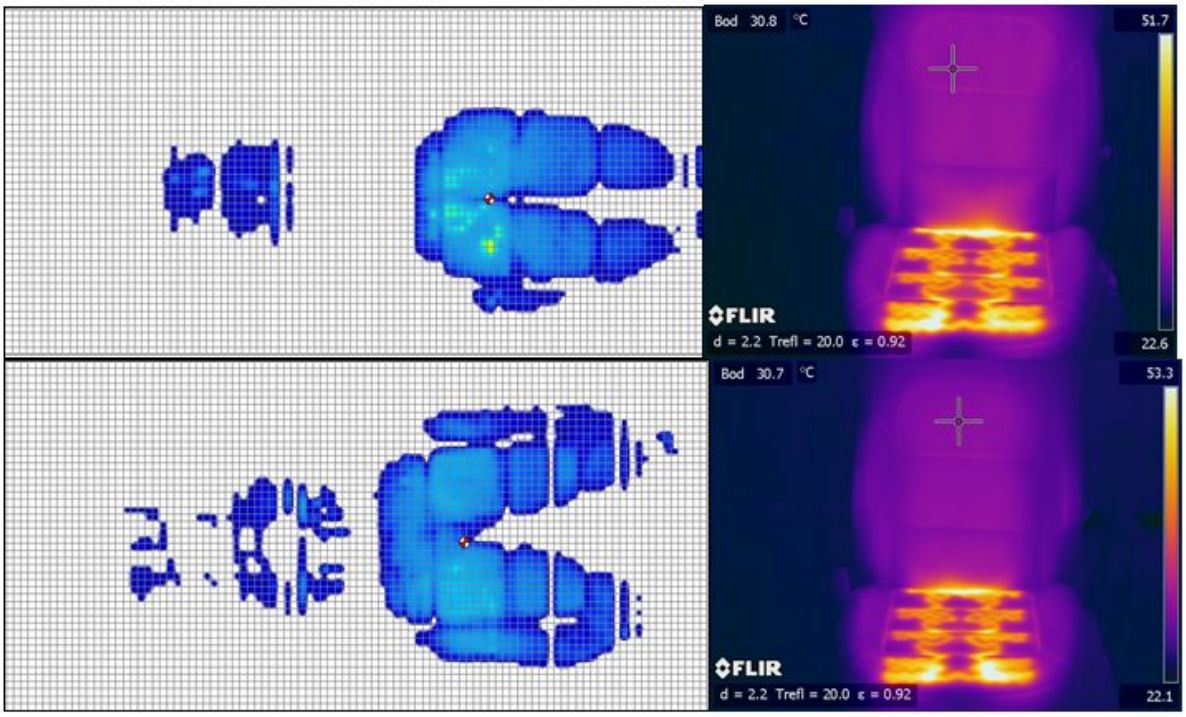

Fig. 12: Measurement in laboratory – comparison of 4CS-1M-2M.

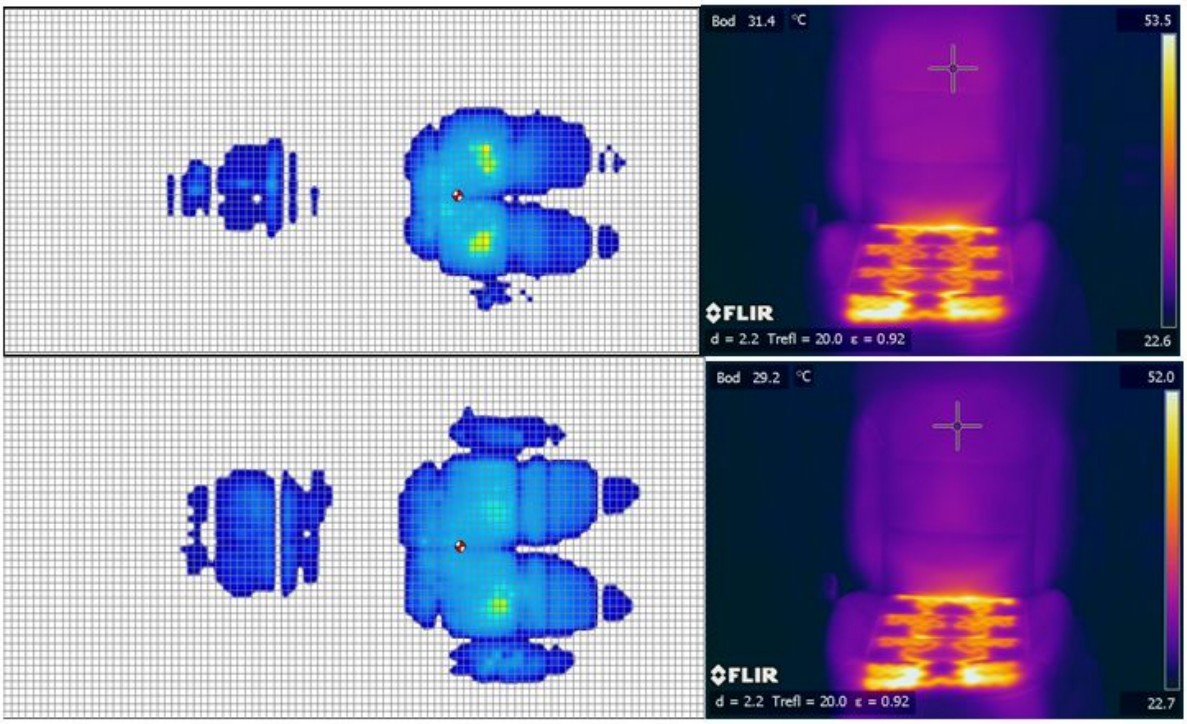

Fig. 13: Measurement in laboratory – comparison of 4CS-1W-3W.

By the analysis of contact pressures and temperatures, we also found another property of car seats, and the seat which was made from coconut fibers in contrast to classic seat with polyurethane foams, for all measured people, for example. Fig. 14 and 15 are showed different inverse dependency of the contact pressure and time. In the interval from 5 to 300 seconds, the contact pressure is not increased, as by the polyurethane foam, but instead decreased. This is very good terms for long seat comfort.

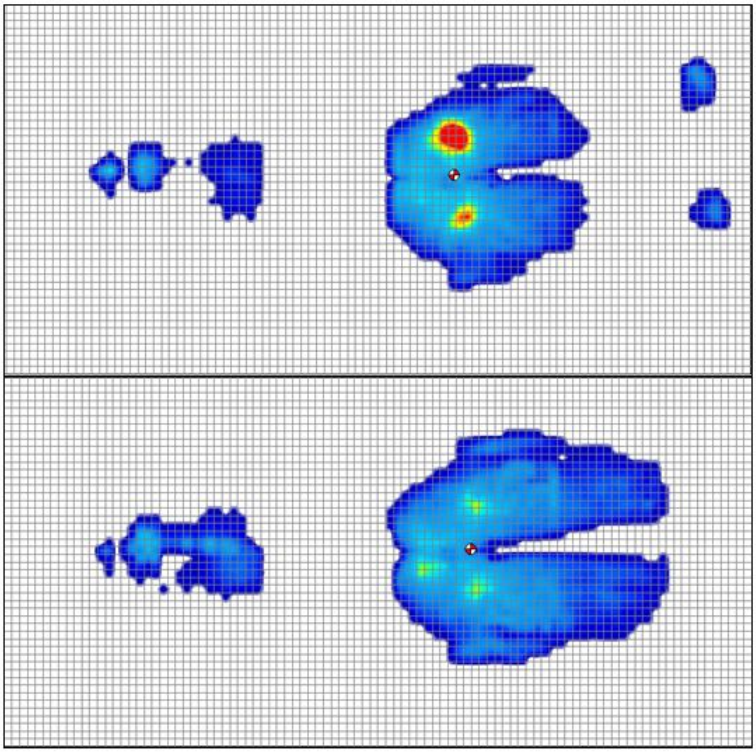

Fig. 14: Measurement in laboratory – comparison of 1CS-1W.

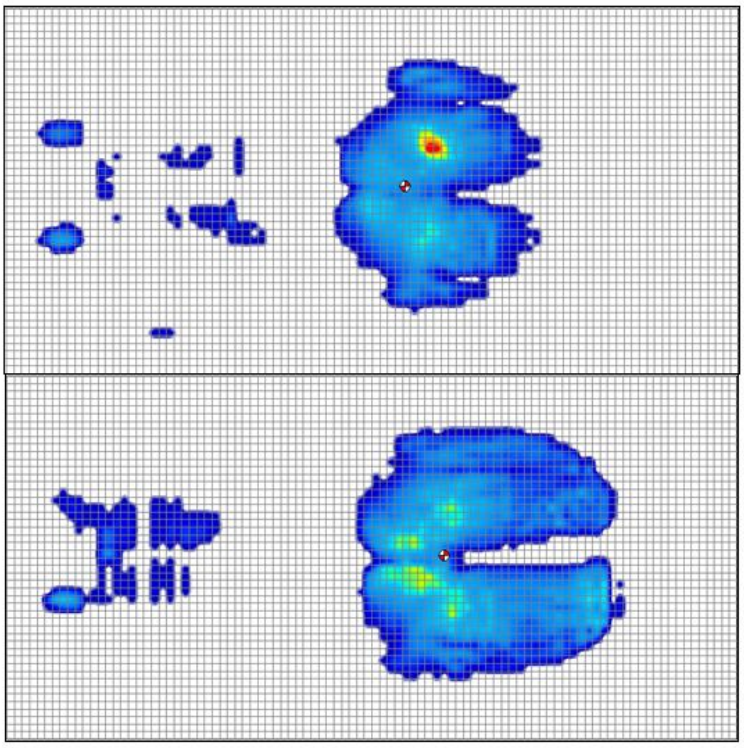

Fig. 15: Measurement in laboratory – comparison of 1CS-2W.

7 Conclusion

The results indicate that there wasn't correlation between contact pressure and temperature at the human sitting on a car seat. The thermal conductivity of polyurethane foams substantially does not depend on the size of its compression. Parameters such as contact temperature and the contact pressure can be adjusted / managed completely independently, the optimum values depending only on physiological aspects people for maximum seating comfort. Research of thermal control of the human body is suitable for automated setting parameter conditioned seats at optimal intervals without external intervention. Further testing will focus on research of the influence of two types of air-conditioning car seat Type-1-S (suction) and Type-2-F (blowing) with tempered air.

References

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