

Comparative measurements of reclined seats with SAE J826 and SAE J4002 H-point measurement devices

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I. INTRODUCTION

Actual vehicle seat characteristics like H-point and torso angle are determined with H-point measurement devices (HPMs) when seats are adjusted to its torso design angle of *c.* 25°. To date, there have been no studies examining the suitability of the different HPMs for seat adjustments with seat-back positions exceeding the current range of torso angles of driving postures. This could occur in automated vehicles, when seats are adjusted to more reclined positions. This research compares the suitability and the results of the SAE J826 and SAE J4002 HPM when adjusting seats to different reclined seat-back positions with torso angles above 25°.

II. METHODS

Three different serial front seats were adjusted to the lowermost and uppermost cushion tilt adjustment. The seat-back angles were varied in order to obtain torso angles ranging from 25° to 45° in steps of 5°. H-point and torso angles were determined with two existing H-point measurements devices called HPM I, as defined in SAE J826, and HPM II, as described by SAE J4002. The measurement procedures were according to ECE R17 (HPM I) respectively SAE J4003 (HPM II) and maintained even for the large back angles. In addition to HPM measurement possibilities, seat adjustments such as cushion tilt, seat-back angle and position of the recliner axis were documented. In every of the 50 different measurement configurations (seat/HPM/cushion tilt/torso angle) at least five valid measurements have been conducted. The measurement setup and first impressions of the behaviour of the two different HPMs are shown in Fig. 1 and Fig. 2.

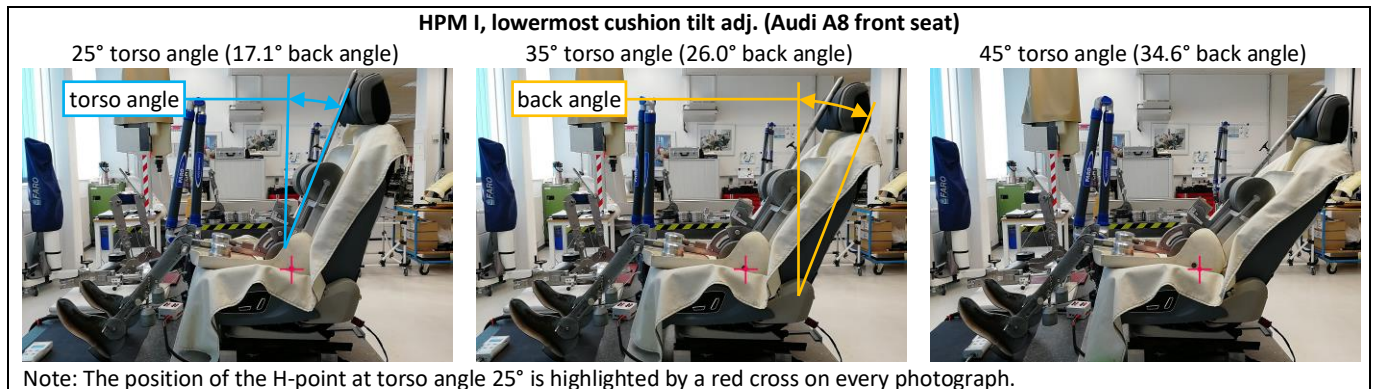


Fig. 1. Movement of HPM I during measurements between 25° and 45° torso angle.

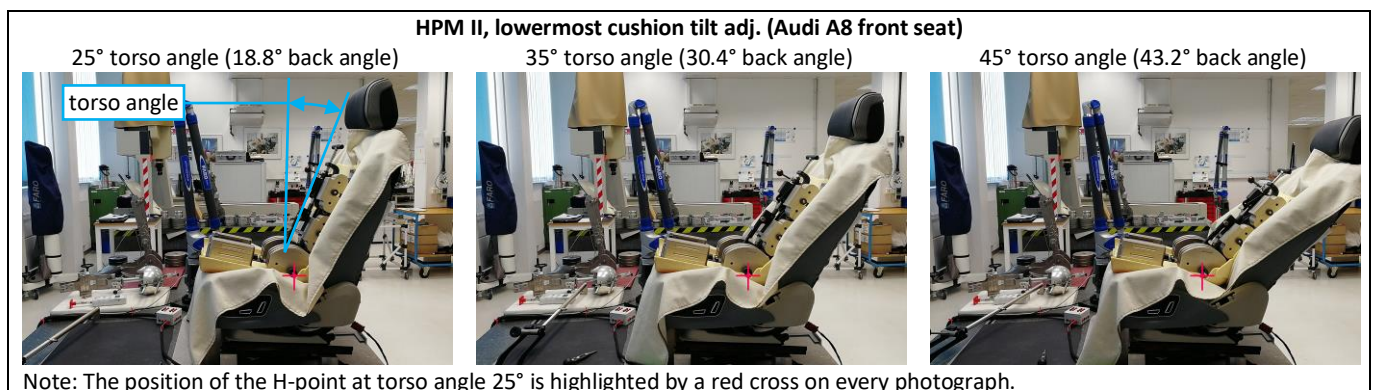


Fig. 2. Movement of HPM II during measurements between 25° and 45° torso angle.

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Additional pressure distributions of the seat cushion and back were also determined to locate and track the contact areas between the HPM and the seat foam. The variation of the position of the H-point with increasing torso angle was compared for both devices to a previous study [1] on the effects of reclined seats on the posture of seated occupants.

III. INITIAL FINDINGS

The maximum seat torso angle that could be measured with the HPM I was limited to c. 50° and with the HPM II to c. 58° (depending on the seat geometry). Seat-back angles of seats are not identical for the same torso angles between HPM I and HPM II. This difference increases with increased torso angles allowing to measure more reclined seat backs with the HPM II (see Fig. 1 and Fig. 2). The H-point measured in average of the three seats by the HPM I moves by about 10 mm forward in the travel direction (-x direction of the car’s coordinate system) when adjusting the torso angle from 25° to 45° (see Fig. 3 – blue line). Under the same measurement conditions, the HPM II shows the opposite behaviour: the H-point moves towards the seat back by about 10 mm (Fig. 3 – red line). The seat cushion tilt adjustment in its uppermost position reduces the forward movement of the H-point of the HPM I under increased seat-back angles (see Fig. 4). The H-point of the HPM II with the cushion tilt adjustment in its uppermost position moves further rearward than in its lowermost position. The standard deviation of the measured H-point x coordinates was at 25° torso angle against the expectations 27% higher and of the z coordinates 48% higher than at 45°.

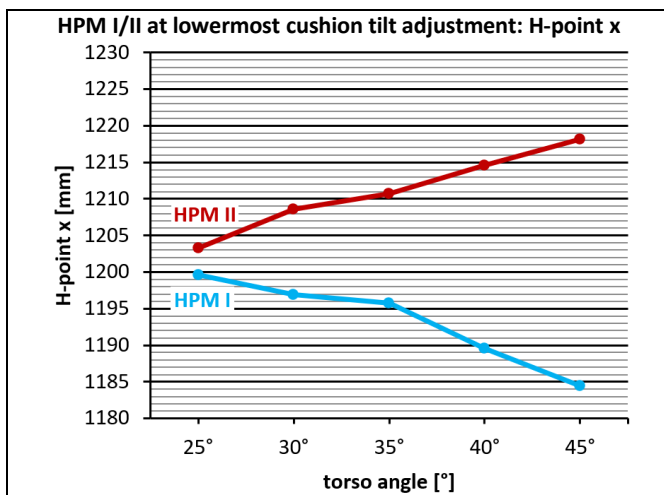


Fig. 3. Influence of torso angle at lowermost cushion tilt adjustment to H-point x position (Audi A8 front seat).

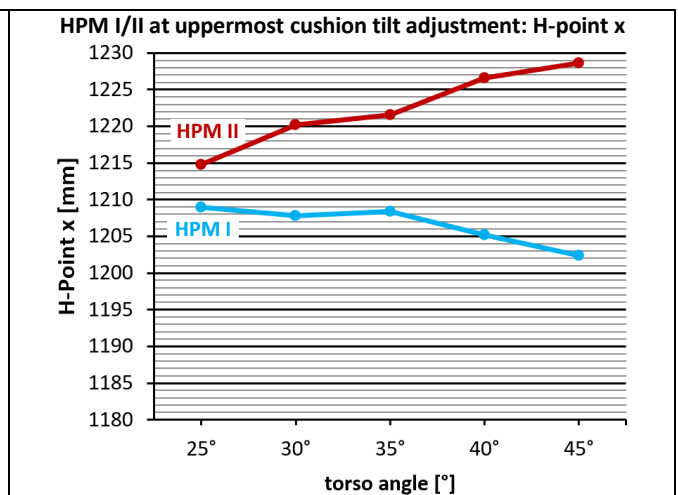


Fig. 4. Influence of torso angle at uppermost cushion tilt adjustment to H-point x position (Audi A8 front seat).

IV. DISCUSSION

When comparing the evolution of the H-point measurement under increased seat-back angles with the study [1], only the behaviour of the HPM II follows the same tendency observed in occupants of classic vehicle seats during increased seat-back angles. The HPM I exhibited less human-like behaviour at torso angles exceeding 25°. In addition, the HPM II allows us to measure more reclined seat backs. The HPM II appears, therefore, more suitable for H-point and torso angle measurements at large seat-back angles when used in reclined seating positions.

New seating positions in automated vehicles may require the use of crash test dummies in more reclined seat adjustments to investigate further before identifying the “right” H-point measurement device to use.

V. REFERENCES

[1] Reed, M. P., *et al.*, Effects of Recline on Passenger Posture and Belt Fit, UMTRI-2018-2, 2018.