

THE EFFECTIVENESS OF ADJUSTABLE PEDALS USAGE

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Introduction - Although airbags have been shown to reduce the number of severe/fatal injuries for both drivers and passengers, 56 incidents have been reported in the US (NHTSA, January 1999) where a driver was severely or fatally injured due to an airbag deployment. Most of these incidences occurred at low to moderate crash severity. About one third of the drivers were short-statured females who may have been sitting close to the airbag module.

Parenteau *et al.* (1999) investigated NASS-CDS accident cases involving an airbag-equipped vehicle. Though 7% of the cases involving an airbag deployment occurred at the seat forward position, the drivers had the highest risk of being severely injured. Based on a survey, De Leonardis *et al.* (1998) estimated that about 5% of females in the US sit less than 25 cm away from the airbag module. Short-statured drivers may sit in the seat forward location to reach the accelerator and brake pedals. Dobson *et al.* (1996) reported a linear relation between the length of the legs and seat location.

Adjustable pedals could be used to reduce the serious or fatal injuries to short statured driver by increasing the distance between their chest and the airbag module. The adjustable pedals may also increase ergonomical comfort during normal driving by optimizing the driver's seating position.

Objective – The objective of this study was to determine the driver-airbag module distance with and without adjustable pedals.

Materials and Methods - For this study, 20 volunteers were tested in a small and large vehicle equipped with adjustable pedals. The pedals could be adjusted through extension towards the driver. The volunteers were divided into 3 height groups: short (5th percentile), medium (50th percentile), and tall (95th Percentile).

The volunteers sat in each vehicle and adjusted the pedals in 3 different positions:

- 1) Normal - which corresponds to actual production pedal location,
- 2) Comfortable - which corresponds to the driver desired pedal extension, and
- 3) Maximum Tolerable - which corresponds to maximum drivable pedal extension. This position was used to obtain subjective feedback from the volunteers.

For each position, the volunteer drove along a prescribed road course. The subject's comfort was evaluated through a questionnaire. After the drive, three-dimensional measurements were recorded by digitizing 11 anthropometric points on the driver's body and 5 points in the vehicle interior.

Results

Small Car: In the small car, the pedal extension between the normal and comfortable position was larger in the short-statured group than in the medium group. The corresponding mean change in chest-to-steering wheel distance was about 40 mm in the short and group 50 mm in the medium. The seatback angle decreased by 3° in the short group and increased by 2° in the medium group, which could explain the higher change in chest-to-steering wheel distance in the medium group than the short group. For the short-statured group, the comfort rating was slightly higher in the most comfortable pedal position than in the normal position.

Large Car: In the large car, the difference in pedal extension between the comfortable and the normal position was more than two times higher in the short-statured group than in the medium group. The corresponding change in distance between the steering wheel and driver's chest was about 40 mm for the short-statured group and about 30 mm for the medium group. The tall group did not extend the pedals since their seat track was in its rearward limit in the normal position.

Conclusions - The results obtained in this study showed the effectiveness of adjustable pedals, in particular for short-statured drivers in particular in the large vehicle. For short statured drivers in the comfortable position, the pedal extension was higher in the large car than in the small car. However, the increase in chest-to-steering wheel distance was similar in both vehicles. This suggests that a short statured can comfortably increase his/her chest distance by 40 mm with pedal extension. During static airbag deployment tests, a 40 mm increase in chest-to steering distance could potentially reduce the loads applied the occupant in a crash situation.

The results obtained in this study provide quantitative information that can be used as guidelines for future pedal designs. However, further evaluation of the pedals for integration in the overall occupant safety system is still necessary.

References

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