MERCEDES-BENZ

Mercedes-Benz
of North America, Inc.

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December 7, 1989

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Mr. Jerry R. Curry
Administrator
National Highway Traffic
Safety Administration
400 Seventh Street, SW
Washington, DC 20590

Subject: Comments to Docket 89-20, Notice 1
Concerning Standards 207, 208 and 209

Dear Mr. Curry:

Mercedes-Benz of North America, Inc. submits the attached comments to the subject docket concerning rear-impact seat back deformation and seat belt retractor locking sensitivity.

Mercedes-Benz laboratory testing and accident analyses have shown that a proper balance is necessary between seat mounting/seat back stiffness to allow both occupant energy absorption and thus mitigation of injuries, and prevention of seat back collapse which would allow a belted occupant to experience head contact. The stiffness required, however, is higher than the current Standard 207 specified 3300 lb.-in moment but far less than the Docket proposed 56000 lb.-in. To achieve the proper balance of stiffness, a dynamic rather than a static test is recommended.

As far as seat belt retractor locking is concerned, Mercedes-Benz experience has proven that an Emergency Locking Retractor (ELR) system with sensitivity to both vehicle and webbing acceleration can be designed to provide excellent comfort, convenience, and occupant protection including also rear-impact rebound conditions.

If further information is necessary, Thomas Baloga (201 573-2616) in our Safety Engineering Department should be contacted.

Sincerely,

Attachment

Mercedes-Benz Comments to Docket 89-20; Notice 1

Introduction

Results of Mercedes-Benz accident analyses have shown that rear-end impacts comprise only 4% of all serious injury (greater than AIS 3) accidents involving Mercedes-Benz vehicles. The reasons for this are the low relative speeds between same-direction traveling vehicles coupled with the protective features built into Mercedes-Benz vehicles including optimized rear-structures and seating systems with real world functional headrests.

Out of 2000 investigated accidents involving current model Mercedes-Benz passenger cars, only 2.7% (54) involved rear impacts. Relative speeds at impact were up to 44 mph (70 km/h) (Energy Equivalent Speed 19 mph [30 km/h]) with an average vehicle mass of 2425 lbm [1100 kg]; essentially no permanent deformation of the seat back could be observed. Higher speed impacts (isolated cases) produced some permanent deformation however no structural failures of seat backs have ever been found.

Minor neck injuries (AIS 1) are the most common injuries found in rear impacts.

Seat Design

The following technical safety requirements in the design of front seats are of importance;

- Protect the belted front occupant from "overloading" due to non-belted rear occupants during frontal collision.

- Protect the front occupants during rear impacts through maintaining a mostly vertical seat back position. Only then can the protective effect of seat belts, also in rear impacts, be realized (i.e. reduction of tendency for belt slippage).

- Reduce the danger to front and rear occupants during rear impacts through excessive rearward seat back deformation and the resultant interaction between occupants.

These criteria are achieved in Mercedes-Benz vehicles through a high stiffness of the seat back rails and energy absorbing seat back crossmember as well as an optimum match between belt, seat, and vehicle body structure.

Results from Standard 301 Tests

The rear impact tests of Standard 301 at 30 mph with Mercedes-Benz cars also show similar results of very low seat back deformation as seen in real world accident investigations.

During these Standard 301 tests, maximum Hybrid II dummy HIC values of 100, at an average vehicle acceleration of 10g, have been recorded. Film analyses have determined that the rebound speed (x - component) of the head and chest areas are approx. 7.5 mph and 5.6 mph respectively.

Static Tests

Mercedes-Benz uses the results of static tests, parallel to dynamic tests for product development and quality assurance of its seat designs. The results (confirmed by dynamic measurements) indicate that with a relatively stiff seat construction, bending moments are achieved that are several magnitudes higher than the 3300 lb-in required in Standard 207, however, the bending moments are also far below the Docket proposed 56000 lb-in. The proposed 56000 lb-in bending moment can only be achieved by increasing the seat back stiffness to the point where it allows almost no energy transfer from the occupant, front or rear, and will tend to increase the injury risk. We believe that the 56000 lb-in is too stiff based on our testing and experience. Furthermore, since the seat and seat back movement are highly influenced by the floor mounting into the vehicle structure, the seat's mounting must also be considered.

Mercedes-Benz Recommendation

Based on the previous comments, Mercedes-Benz recommends that the static seat test in Standard 207 be replaced by a dynamic test using belted Hybrid II dummies and performance requirements, either as a separate sled test or combined with a full-vehicle crash test like Standard 301. This dynamic test would more closely replicate the loads experienced in real world conditions.

For evaluation of injury, HIC should be used, since serious injuries occur, based on our accident investigations, only by direct contact of the head area with structural components. This contact, however, occurs only when seat back deformation is extreme. A dynamic measurement of the seat back deformation would therefore be unnecessary when a maximum HIC is specified.

Standard 208 and 209: Seat Belts with Dual Sensitivity Retractors

Mercedes-Benz cars are equipped worldwide with manual type 2 lap/shoulder belts at the front and outboard rear seating positions using Emergency Locking Retractors (ELRs) that are both vehicle and webbing acceleration sensitive. Additionally, Emergency Tensioning Retractors (ETRs) i.e. belt pre-tensioners, are combined into the front seat belt retractors, SRS driver side airbags plus knee bolster are standard in all North American cars, and passenger side airbags are standard or optional in all but one North American model.

Standard 301 tests have shown that during the rebound phase of the Hybrid II dummy movement, the belt retractor (ELR) in Mercedes-Benz cars always locks. Investigations to determine which sensitivity causes locking have not been carried out. It is perhaps theoretically possible that during the rebound phase of a rear impact, a single sensitivity ELR would not lock. This possibility does not occur in systems built to conformity with EG Guideline 77/541/EWG which requires driver seating position retractors to have dual sensitivity and thus, built in redundancy.

Locking Threshold of ELRs

Standard 209 requires locking of the ELR at an acceleration of 0.7 g and a belt spool out of less than 1 inch.

ECE Regulation 16 and EG Guidelines 77/541/EWG specify different locking thresholds for each locking sensitivity type. The belt must lock at a vehicle acceleration of less than or equal to 0.45 g. or a belt acceleration of between 0.8 and 1.5 g., with a belt spool out of less than or equal to approx. 2 inches (50 mm).

Mercedes-Benz retractors lock at a vehicle acceleration of approx. 0.4 g and a belt acceleration of between 1.0 and 1.5 g. The advantage of a reduced sensitivity for webbing withdrawal before locking (i.e. higher g) is an increase in comfort for the occupant through less "false" locking during belt donning and belted occupant movements. Mercedes-Benz has no customer complaints for premature belt locking and we believe this contributes to our better than average belt use rates in the US.

Recommendations

If requirements for retractor locking are to be proposed, we strongly recommend consideration of the following:

- the threshold of 0.7 g should apply only to vehicle acceleration sensitivity and not to webbing movement,

- the threshold for webbing movement locking should either be left optional or be identical to the ECE Regulation 16: between 0.8 g and 1.5 g with a belt spool out less than or equal to approx. 2 inches (50 mm).

Our experience has shown that these values are very well suited to occupant protection, as well as comfort and convenience.