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Factors Affecting Curtain Airbag Performance

Lokesh Walki[1*], Anjanbabu V.A[2*], Harishanand K. S[3*], Jayasheel I Harit[4*]

[1*] PG Scholar, Department of Mechanical Engineering, East Point College of Engineering and Technology, Bangalore-560049, Karnataka, India

[2*] Professor, Department of Mechanical Engineering, East Point College of Engineering and Technology, Bangalore-560049, Karnataka, India

[3*] Professor, Department of Mechanical Engineering, East Point College of Engineering and Technology, Bangalore-560049, Karnataka, India

[4*] Professor, Department of Mechanical Engineering, East Point College of Engineering and Technology, Bangalore-560049, Karnataka, India

ABSTRACT

Rollover crashes are next only to frontal crashes in the annual number of vehicle occupant dying in light vehicles having gross weight rating 4536Kg (GVW 4536Kg). Rollover crashes are complicated, unpredictable and especially deadly safety problem. As per National Automotive Sampling System (NASS) records an vehicle occupant is 14 times more likely to meet with death in a rollover crash than in a frontal crash

Vehicle occupant protection in a rollover crash poses a very challenge. Ejection mitigation is one of the most important problem in rollover safety. Occupant ejection is the main reason for cause of injury (like brain injury, amputation, paralysis, internal injuries, spinal cord injury, broken bones, severe abrasions and lacerations) and fatality in rollover crashes. The death rate for an ejected passenger is 3 times more as compared to occupants who are confined inside the vehicle. According to 1998–2008 Fatal Analysis Reporting System (FARS) record, on an average, frontal crash deaths is about 12,000 per year, while for rollover fatalities it is 10,000 per year. In 2007, 34 percent of all casualty were in rollover crashes. The rise in demand of sport utility vehicles (SUVs) has brought very serious occupant safety issues. With their relatively narrow track width and high center of gravity, these vehicles rollover much more easily than sedans.

Key words: FMVSS-226,NASS,NPRM,OPW

INTRODUCTION

Airbags save lives. The Curtain Airbag (CAB) or

Inflatable curtain airbag is a key restraint component and currently used to provide head and neck protection (to increase ejection mitigation performance) for the vehicle occupants during side-impact collisions and vehicle rollovers developed by TRW. The curtain airbag is fixed to the vehicle A and B pillar at its end points along the roof rail as shown in the Fig.1.5 (a). The system is made of a low permeable material so that it allows the airbag to remain inflated for more than 6 seconds. Fig.1.5 (b). shows the Inflatable curtain airbag system in Deployed Position.

Compared to side impact only airbags, curtain airbags are designed to cover more of the window opening. Rollover activation uses more advanced crash sensors and are designed to stay inflated longer as long as rollover events can last. They made not only to cushion but also made adequately strong to keep a vehicle occupant from being partially or completely ejected through a side windows.

OBJECTIVE

Rollovers crash are second only to frontal crashes in the annual number of vehicle occupant dying in light vehicles. Rollover crashes can be complex, unpredictable and particularly deadly safety problem. As per National Automotive Sampling System (NASS) data an occupant is 14 times more likely to be killed in a rollover than in a frontal crash. Occupant protection in rollover crashes poses a challenge. One of the most important problems in rollover safety is ejection mitigation. Ejection is a major cause of death and injury. For this reason, reducing occupantejections through the side windows offers the potential benefits for safety. National Highway Traffic Safety Administration recognized this seriousness of rollover accident and released FMVSS226 NPRM regulation as “Ejection Mitigation”. This FMVSS226 standard establishes requirement for ejection mitigation systems to minimize the chances of partial and complete ejections of vehicle occupants through side windows during side impact or rollovers events.

The main aim of this project is to analysis the parameters affecting for curtain airbag design for to increase the ejection mitigation performance. The major contributing parameters chosen are,

Curtain Airbag Pressure

Curtain Airbag Design

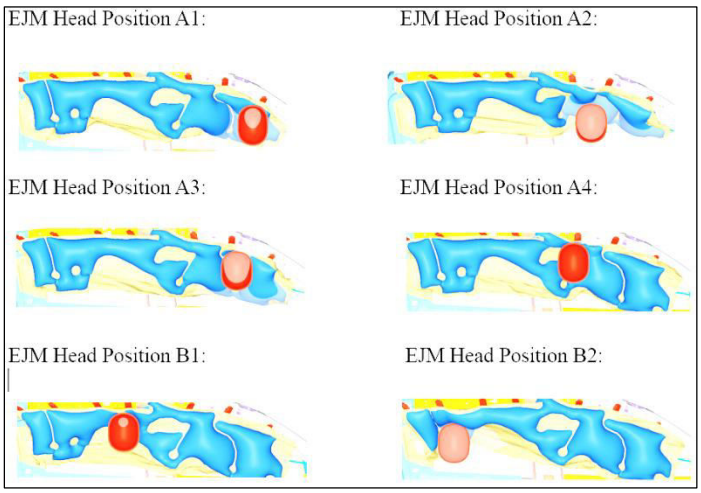
Amount of Fabric Coating Material

Cushion Thickness

Location of Strap (Tether)

Strength of Cushion Mounting Tab and Tether

Contact Friction



CURTAIN AIRBAG DESIGN

In IC module, cushion is the main part and is designed to receive and maintain inflator gas so-that the pressure inside the bag can raise and reach a required level. For an occupant impact energy absorption airbag inflation with a minimum pressure and thickness are the key factors. Cushions have several designs according to the number of seating rows, manufacturing technologies and the inflator module location.

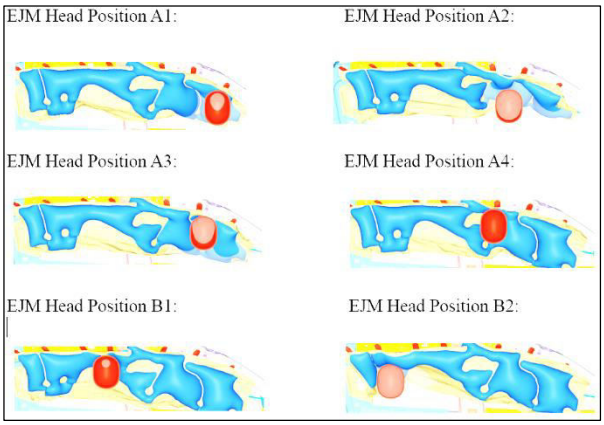
❖ According to number of rows in vehicle segments.

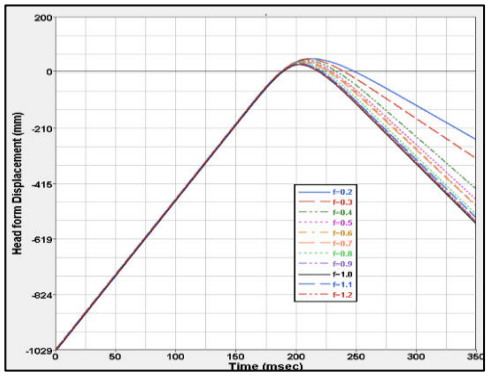
- A-B pillar cushion covering 1 row.
- A-C pillar cushion covering 2 rows – most of the curtains are A-C type.
- A-D pillar cushion covering 3 rows.

❖ According to manufacturing technologies,

- Cut and sewn
- One piece woven (OPW).

The cushion receives the inflator gas and must maintain it sufficiently to reach a certain pressure, depending on required level of occupant protection. Pressure inside the cushion reduces with time but must fulfil customer requirement (a typical example may be: pressure at 30msec must be above 60 kPa and at 7 sec must still be over 35 kPa). Cushion pressure retention is primarily controlled through amount of coating, but cushion developing technology has also an effect (cut and sewn or OPW bags behave differently). OPW seams as compared to cut and sewn seam are tighter and less permeable. Another advantage of OPW seams are yarns which are used in the construction are made of same material as of the fabric itself , unlike cut and sewn which uses separate threads which is more thicker, and as a consequence careful attention is needed for stressed areas in a cushion. Cut and sewn seam are restricted for first impact only because of natural leakage in the fabric.





CONCLUSION

The curtain airbags are of greater importance in today's vehicle because occupant is 14 times more likely to be killed in a rollover crashes, since safety of human life is very important. In the Present work, CAE Analysis of Curtain Airbag parameters to increase the occupant ejection mitigation (EjM) Performance was carried out. Parameters affecting for curtain airbag to increase the vehicle occupant ejection mitigation Performance have been carried out using LS DYNA tool. This simulation has been carried out according to National Highway Traffic Safety Administration regulations of Federal Motor Vehicle Safety Standard 226. Major seven parameters which have critical effect on the performance of curtain airbag in mitigating the ejection through side windows are curtain airbag pressure, curtain airbag design, amount of fabric coating material, cushion thickness, location of Strap, strength of cushion mounting tab and Strap and Contact friction have been studied and their corresponding effect has been discussed in each section.

Curtain airbag design specifications were established through analysis of parameters in order to satisfy the FMVSS226 regulations and demand by the ejection mitigation countermeasure. A series of LS DYNA FEM results obtained in this study helped in designing CAB to be in good agreement as per FMVSS226 NPRM regulations with the requirement that the impactor headform is to be kept within 100mm from inside window surface. The parameter affecting for curtain airbag for satisfaction of ejection mitigation (FMVSS226) regulations and performance at every head form impact position is achieved within the excursion of 80 mm with the test speed of 24kph and 16kph at 1.5 seconds and 6 seconds respectively as specified by NPRM.

Overall, considering the current designs used by IC cushion designers, the current approach can be a powerful method to understand the major factors affecting the behavior of curtain airbag deployments and head excursions.

SCOPE FOR FUTURE WORK

The proposed work can be extended to

i. Experimental validation.
ii. Newly defined Curtain airbag design parameters which includes fabric leakage, inflator consideration, Door overlap, elevation at which test is conducted.

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