



An idea for the way forward for frontal impact

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Overview

- 1 Important issues identified by GRSP FI group
- 2 Recent accident analysis: main results
- 3 Requirements to improve protection in frontal impacts
- 4 Proposal for frontal impact Regulation No. 94
- 5 Future work required

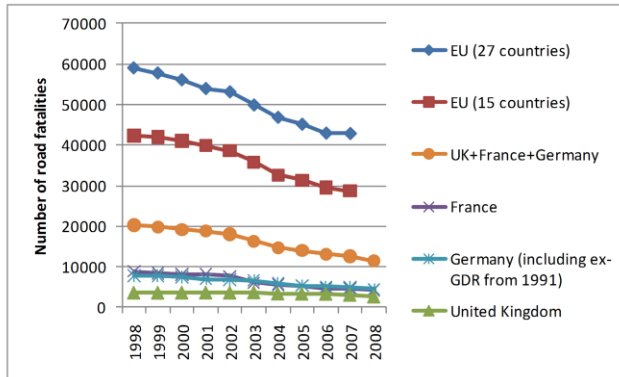
Important issues identified by GRSP FI group

- Change of test severity for Offset test
- Introduction of Full Width test
- Protection of female occupants
- Protection of older occupants
- Protection of rear occupants (abdominal injuries)
- Geometric requirements for compatibility



Current issues in frontal impact crashes EC accident analysis

Road user fatalities in EU 1998-2008



- Although road accident fatalities and car occupant fatalities in EU27 have reduced by ~30% in recent years, still a substantial problem:

- Car occupant fatalities ~ half of all road accident fatalities
- (EU27 in 2007: $42,854/2 = 21,427$)

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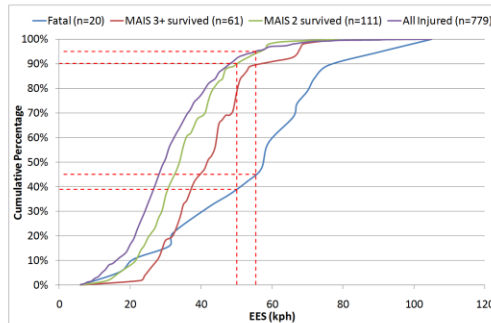


.... have reduced in recent years following the introduction of measures to improve car occupant safety such as frontal /side impact directives / regulations and EuroNCAP

Note that unbelted still a large problem, particularly in the rear.

Current issues in frontal impact crashes EC accident analysis

Cummulative percentage of EES for drivers in car-to- car/LGV impacts in GB



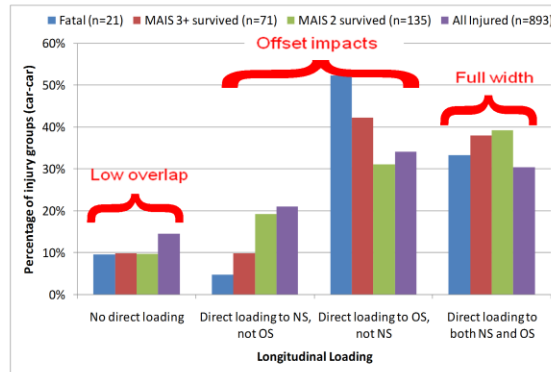
- Increase in severity of test from 50 km/h (current Reg) to 56 km/h (Euro NCAP) increases size of target population (involved in frontal impact, belted, MAIS 2+ injured) by about 3-5% for GB and 1% for Germany
- Indicates benefit of increasing severity of current Reg test to 56 km/h unlikely to be very large



Note: for GB over half fatalities in impacts with severity greater than 56 km/h

Current issues in frontal impact crashes EC accident analysis

Longitudinal loading as a percentage of injury group
for drivers in car-car/LGV impacts in GB.



- The large proportion of injured drivers in full-width type impacts indicates the need for a full-width test



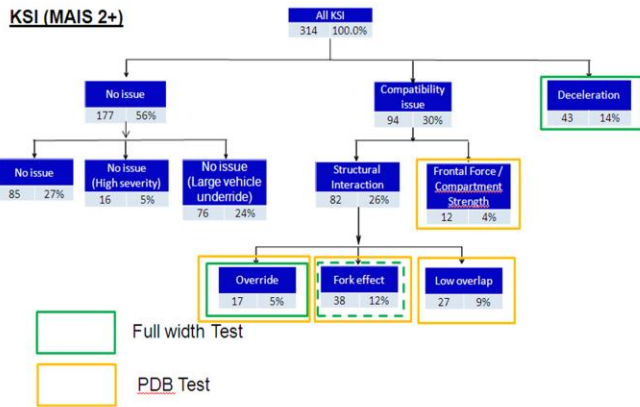
Current issues in frontal impact crashes EC accident analysis

- Other conclusions:
 - About 20% (an over-representative proportion) of the target population were elderly indicating an issue with the elderly
 - A detailed case analysis of 48 fatalities in Reg 94 compliant cars was performed to help determine why people are dying in frontal crashes despite seat-belt use, airbags and crashworthy structures of modern cars. The main reasons determined in order of importance were:
 1. High severity of the crash – much larger than severity of current Reg/Euro NCAP test.
 2. Elevated age of the occupant
 3. Underride and limited horizontal structural engagement with partner vehicle, i.e. compatibility, structural interaction.



Current issues in frontal impact crashes FIMCAR analysis

Breakdown of KSI casualties in target population using detailed case analysis for GB CCIS data



- Substantial issue with restraint related deceleration injuries as well as compatibility



Detailed case analysis was performed to determine underlying issue which led to injury for occupants in target population.

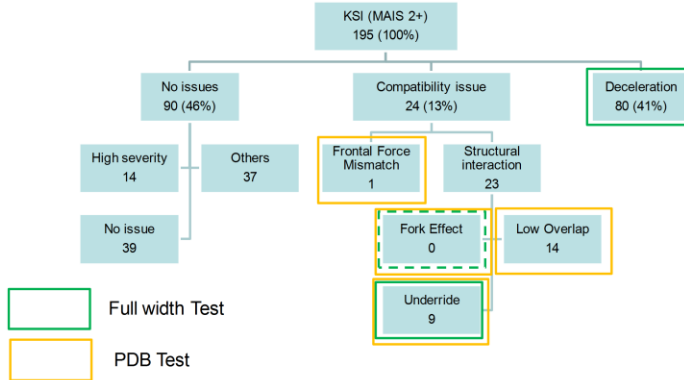
Target population selection criteria:

- Accident occurred between 2000 and 2010 (inclusive).
- The casualty was killed or seriously injured (MAIS2+)
- The casualty was a car occupant.
- A significant frontal impact occurred.
- The nature of the injury, the impact type and seatbelt use were all known.
- The casualty was in a regulatory compliant car or one which had an equivalent crash safety level.
- No rollover occurred before the first impact.
- Seatbelt was used by the casualty.
- No unbelted occupant was seated behind the casualty.
- The occupant was a front-seat occupant.

Please note that the small bias in the CCIS dataset to HGV impact partner is not taken into account in this figure, so the proportion of ‘no issue – large vehicle underride’ will likely be over-estimated.

Current issues in frontal impact crashes FIMCAR analysis

Breakdown of KSI casualties in target population
using detailed case analysis for German GIDAS data



- Larger issue with restraint related deceleration injuries



Current issues in frontal impact crashes FIMCAR analysis

Breakdown of benefit for introduction of 'full-width' test

Option		% (No.) of car occupant casualties			
		Killed		Seriously injured	
Target population	Option 2 'Full width test'	8.9% (93)		17.7% (1739)	
Benefit	Option 2 'Full width test'	Upper 6% (60)	Lower 5% (52)	Upper 10% (943)	Lower 7% (694)
	Option 2 'Full width test - structural alignment'	Upper 0.8% (8)	Lower 0.8% (8)	Upper 0.5% (46)	Lower 0.3% (25)
	Option 2 'Full width test - deceleration'	Upper 5% (52)	Lower 4% (43)	Upper 9% (916)	Lower 7% (667)

- Majority of benefit estimated to be related to reduction in restraint related deceleration injuries



Assuming that the introduction of a full-width test would:

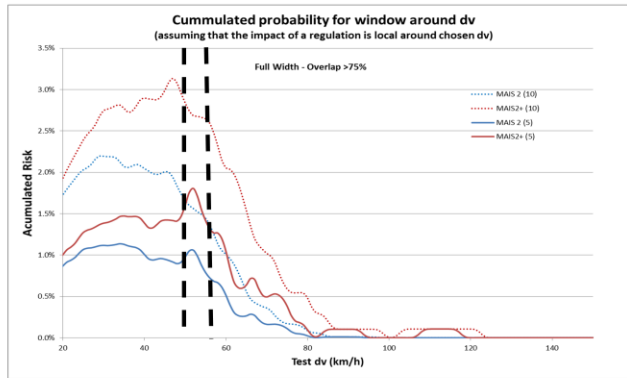
1. Improve restraint systems and reduce restraint related deceleration injuries
2. Improve structural alignment and resolve under/override caused by initial structural alignment issues.

Issues:

1. What exactly is an improved restraint system? In the analysis it was assumed that an improved restraint system would reduce restraint related injuries to the thorax, abdomen, clavicle and leg/pelvis by 1 (pessimistic) or 2 (optimistic) AIS levels. In reality a restraint that could achieve this would need to be a substantial improvement on current restraint systems and in the authors opinion would need to be adaptive to occupant size, seating position and weight as well as to accident severity.
2. How could the introduction of a full width test enforce the introduction of a restraint system of this nature? In short, the answer to this is that it couldn't because it could not assess (and hence enforce) the adaptive nature of the restraint system. A number of tests with different sized dummies at different severities would be needed to do this.

Current issues in frontal impact crashes FIMCAR analysis

GIDAS Data: Cumulated probability of an injured casualty with accident severity assuming impact of a regulation is local around chosen Delta v.



- Illustrates large proportion of casualties in accidents with lower severity than that of the current full width tests (50 & 56 km/h)



Requirements to improve protection in frontal impacts

- Improved restraint systems
 - Adaptive for accident severity and occupant size/weight
 - Provide protection in lower speed impacts (~ 40 km/h) for MAIS 2 injured occupants (and elderly) and higher speed impacts (~ 56 km/h) for MAIS 3+/Fatally injured occupants
 - Provide optimised protection (ridedown) for full range of occupant sizes/weights
- Improved compatibility
 - First step: better structural alignment to reduce under/override



Proposal for frontal impact Regulation No. 94

1. Current Offset test (or equivalent PDB test) with performance limits appropriate for mitigation of MAIS 3+/ fatal injuries
2. Full-width test at lower speed (~ 40 km/h) with performance limits appropriate for mitigation of MAIS 2 injuries
3. Full-width test at higher speed (~ 50 km/h) with performance limits appropriate for mitigation of MAIS 3+/ fatal injuries

▪ Notes:

- Dummy sizes used in tests need to be selected to ensure restraint system protects full range of occupant sizes/weights
- Deformable element preferable for full width test because makes initial part of impact more realistic which is important for triggering of restraint system
- Use LCW measures in one of full width tests to enforce alignment of structures for compatibility purposes



It has been agreed within the GRSP informal group that it is only possible to add one full width test, whereas this proposal requires two!!

Proposal for frontal impact Regulation No. 94

1. Current Offset test (or equivalent PDB test) with performance limits appropriate for mitigation of MAIS 3+/ fatal injuries
2. Full-width test at lower speed (~ 40 km/h) with performance limits appropriate for mitigation of MAIS 2 injuries (and higher injuries for elderly)
3. Full-width test at higher speed (~ 56 km/h) with performance limits appropriate for mitigation of MAIS 3+/ fatal injuries

- Notes:

- Recommend simulate higher speed test because adaptivity of restraint system is paramount and lower speed test most appropriate to check this because offset test will to some extent check its performance in higher deceleration conditions



Future work required

- Detailed impact assessment?
 - Investigation of what degree of improved protection adaptive systems could deliver and at what cost?
- Investigation of possible unintended consequences?
 - IIHS concern with large amounts of belt spool-out
- Appropriate dummies and performance limits for assessment of MAIS 2 injury prevention potential and protection of elderly (FP7 THORAX)?
- What dummies should be used in what test to best check the performance of the restraint system is suitability adaptive?
- Precise speed for lower speed test?
- How to verify CAE results?
- Performance limits for assessment of structural alignment using LCW in lower speed test?





**Do You
Have Any
Questions?**

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