Transmitted by the expert from Australia

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Establishment of an Informal Group to examine a proposal for a Pole Side Impact Global Technical Regulation

This paper supplements Australia's proposal for a Pole Side Impact Global Technical Regulation (GTR), providing a potential task list for an Informal Group and summarising some existing areas of knowledge and potential issues.

Background

At the 150th session of the World Forum for Harmonization of Vehicle Regulations (WP.29) in March 2010, Australia put forward an informal paper proposing a Pole Side Impact GTR (WP.29-150-11).

As the report of the meeting indicates, "AC.3 requested the secretariat to distribute WP.29-150-11 with an official symbol for consideration and vote at the June 2010 session. It was agreed to transmit WP.29-150-11 to GRSP for consideration at its May 2010 session and to assess the need for an informal group".

The formal proposal is at http://www.unece.org/trans/doc/2010/wp29/ECE-TRANS-WP29-2010-81e.pdf.

The thrust of the Australian proposal is that recent progress in development of the world side impact dummy (WorldSID) provides a unique opportunity to develop and agree a universal regulatory standard on pole side impact crashworthiness. Such a standard could drive significant reductions in the large number of fatalities and serious injuries occurring in pole side impacts, other side impacts and rollovers. Fatalities are particularly likely in pole side impacts.

Potential standards that could be considered are the perpendicular pole test currently used, for example, in EuroNCAP, an offset perpendicular test as contemplated by APROSYS, the oblique angle test being introduced in the US FMVSS 214 and variants of these.

The latest developments on WorldSID are summarised in http://www.unece.org/trans/doc/2010/wp29/ECE-TRANS-WP29-2010-82e.pdf.

Potential Task List for an Informal Group

The major tasks that could be performed by an Informal Group include:

1. Review of existing research, including crash tests, and literature;
2. Assessment of safety need, including analysis of current fatalities and injuries from pole side impact, other side impacts and rollovers, taking account of positive safety developments already occurring or likely such as ESC;

3. Examination of possible test procedures;
4. Consideration of variations to candidate test procedures;
5. Establishment of likely countermeasures driven by shortlisted test procedures;
6. Calculation of likely injury mitigation coverage of the crash and injury population from these countermeasures (pole side impacts, vehicle-to-vehicle side impacts, other side impacts, ejection prevention and head protection in rollover);
7. Assessment of benefits and costs for shortlisted test procedures (including data from a significant range of countries, as there may be wide variations in benefits);
8. Assessment of likely incremental benefits and costs from testing for smaller (5^{th} percentile female) and non-struck side occupants;
9. Selection of a preferred test procedure; and
10. Production of a draft regulation for consideration by GRSP and subsequently WP29.

Australia would be happy to chair or co-chair an Informal Group and provide secretariat support.

Recent Research and Developments

A significant volume of research on side impact crashworthiness was conducted and shared under the International Harmonised Research Activities (IHRA) Side Impact Working Group (SIWG). The SIWG recommended a number of test procedures to mitigate injuries in side impacts. The proposed suite of four broad test types included a mobile deformable barrier to vehicle crash test, interior headform tests, out-of-position airbag deployment tests and a vehicle to pole side impact crash test. At the time IHRA was operating, the benefits of a regulation for pole side impact were supported by most participating jurisdictions.

Following the cessation of IHRA, side impact research and standards development work has continued in a number of countries and forums. At the same time, there has been continued development and evaluation of the WorldSID dummy, in both 50^{th} percentile adult male and 5^{th} percentile female forms.

IHRA SIWG Status Report – ESV 2005

Key points included:

- "The real world crash data clearly indicated that vehicle impacts into narrow objects was an area that needed to be addressed."
- Support for Pole Side Impact test procedure, in conjunction with barrier test, interior headform and out of position airbag testing.
- Oblique and perpendicular pole impact test methods were examined.
- The US made a case for the oblique impact configuration for vehicle to pole testing, particularly as this would drive a curtain airbag type technology, considered to be less sensitive to seat position and seat back angle. Comment also cited higher head injury values in the oblique configuration.
- The proposed vehicle to pole test configuration was:

- Oblique impact at 75 degrees to the longitudinal plane of the test vehicle.
- Speed of 32 km/h.
- Pole impact to evaluate at least head and thorax protection.
- Mid-sized adult male test device.
- Rigid pole diameter of 254 mm.
- Pole to span at least below sill height to above roof height.

US (FMVSS 214 Update)

Key points included:

- Regulation introduced progressively:
  - Oblique pole test introduced from September 2010.
  - Can be tested between 26 and 32 km/h.
  - 254mm pole, 75°.
  - 50^{th} percentile male and 5^{th} percentile female dummies.

APROSYS (2006, 2009)

Key points include:

- Examined IHRA proposal for a car-to-pole test (oblique 75°, 254mm pole, 32km/h impact).
- Suggested that an offset (100 mm forward of head centre of gravity) perpendicular test was simpler to perform and could achieve similar injury outcomes to the oblique test.
- Suggested that an oblique test would be possible for harmonisation.
- ESC would likely have a significant effect on the number of crashes and therefore fatality and injury risk.

Crash Statistics

Available data are strongly indicative of a major problem that a pole side impact standard would address. For example:

Australia

- In Australia between 1999 and 2008 the rate of fatality from road crashes decreased from 9.3 to 6.9 per 100,000 people. The rate of fatality in single vehicle crashes decreased in this period from 3.4 to 3.3 per 100,000 people – a much smaller decrease. Gains achieved in protection in vehicle-to-vehicle and other crash types were not replicated in single vehicle crashes. (Penetration of ESC in the vehicle population would have been small for the years studied – greater reductions in single vehicle crashes would be expected as the proportion of vehicles equipped with ESC increases).

Victorian state data

- In 10 years to end 2008, 39% of fatal side impact crashes involved a collision with a pole or tree (for passenger car, station wagon, taxi, panel van, and utility vehicle types).
- In 10 years to end 2008, 11% of total fatal crashes involved a side impact with a pole or tree (for passenger car, station wagon, taxi, panel van, and utility vehicle types).
- In 10 years to end 2008, 2.5% of serious injury crashes involved a side impact with a pole or tree (for passenger car, station wagon, taxi, panel van, and utility vehicle types).

Australian National Crash In-depth Study

- Fildes et al showed AIS 3+ head injuries to have occurred in 24% of cases involving occupants seated on the struck side of the vehicle. Side impact regulations should be addressing this important body region in order to maximise benefit as head injuries are likely to result in fatalities or serious injuries with high societal cost.
- Fildes et al showed AIS 3+ chest injuries to have occurred in 50% of struck side impacts. Further gains need to be made in this area.

US

- 9,270 fatalities from side impacts in 2004, 22% of total road fatalities that year (NHTSA, 2007).
- The Fatality Analysis Reporting System (FARS) provides comprehensive statistics. In 2008, about 20% of road fatalities were from side impacts.

EU

APROSYS (2009)

- Approximately 10,000 car occupant fatalities in side impact crashes in Europe annually.

Otte et al (ESV 2009, from Germany and UK data)

- Pole side impacts are infrequent (<2% of accidents, excluding vulnerable road users), but severity is high (25-35% are MAIS 3+).
- ESC appears to be highly effective in reducing pole side impact crashes (40-54% reduction).

EEVC WG21

- In the UK, single vehicle car to pole impacts account for 24.9% (mass data) / 32.4% (in-depth data) of all front row occupant side impact fatalities for passenger vehicles manufactured after 1998.
- In the UK, side impact fatalities were 37.5% of total fatalities (2005).
- In France, single vehicle car to pole impacts account for 30.2% of all front row occupant side impact fatalities for passenger vehicles manufactured after 1998.
- In France, side impact fatalities were 29.1% of total fatalities (2005).
- In Sweden, side impact fatalities were 31% of total fatalities (2005).

Further Analysis Needs

Further analysis of key datasets is required in order to quantify the crash population, particularly in order to sufficiently quantify the likely benefits of any proposed regulation for pole side impacts.

This analysis should include assessment of head and thorax injuries in vehicle to vehicle crashes that would be mitigated by countermeasures for pole impacts (curtain airbags and vehicle structural changes).

The analysis should also examine other side impacts and rollover crashes where injury mitigation would be achieved through prevention of ejection achievable with curtain airbags in conjunction with reduction of hard contact with vehicle interiors.

Costs and Benefits

In the regulatory analysis published in 2007 to introduce an oblique pole test, NHTSA estimated the total costs of countermeasures as ranging from US$126 a vehicle (wide head/torso combination airbag with 2 sensors) to US$280 (wide window curtain and torso airbag with 4 sensors). More pertinently, taking account of compliance levels in 2005 and manufacturers' plans, NHTSA estimated an incremental cost range of US$25 to US$66 a vehicle.

NHTSA estimated net benefits ranging from negative US$225 million to positive US$567 million in the first new model compliant year, depending on the method used by manufacturers to comply with this standard. NHTSA's assumptions included:

- A US$3.7 million value of life.
- 100% take-up of ESC.
- 266 to 311 fatalities and 352 to 371 AIS 3-5 injuries from pole and other types of side impact averted in the first new model compliant year.
- Potential benefits from rollovers were not included.

EEVC Working Group 13 has recently produced benefit and cost estimates for the adoption of a range of regulatory options, including a EuroNCAP style pole test in the UK. For the pole test option, fleet weighted estimates of the total cost of countermeasures range from €121 to €387, however incremental figures were not provided.

EEVC estimated a gross benefit of £328 million. Assumptions included:

- A £1.65 million value of life.
- An annual reduction of 75 fatalities, 230 serious injuries and 305 minor injuries.
- No consideration of the potential effects of ESC or rollover benefits associated with head curtain airbags.

Gross costs were estimated at £705 million, however the report made it clear that benefits "represent a conservative (or even 'worst case') estimate" while costs are full costs. The

report recommended “that a comparison of the absolute values of the benefits and costs should not be made because it could well be misleading”. The main function of benefits and costs cited was to allow comparison with other options considered in the report. The pole test option was estimated to produce the greatest benefit of those investigated.

Dummy Considerations

- Pole tests currently in regulation (FMVSS 214) and NCAP programmes use versions of the ES-2 dummy (ES-2 and ES-2re)
- The ISO biofidelity rating of the ES-2 dummy is 4.7 (4.2 for ES-2re).
- The WorldSID 50th percentile male dummy is now nearly ready for consideration for use in regulation and has a much higher ISO biofidelity rating (7.6).
- Furthermore, the shoulder of the ES-2 dummy has a substantially lower biofidelity rating than the WorldSID 50th percentile male. Shoulder design substantially affects dummy response during pole and side airbag interactions.
- Biofidelity is extremely important in narrow object crashes as the margins between minor and serious or fatal injury are relatively small.
- The WorldSID dummy was not available in final form when current regulatory and NCAP crash test standards were developed.
- Availability of the WorldSID dummy offers an opportunity for significant enhancement of the real-world benefit achieved by a pole side impact standard.

Small female occupant

- Statistical work to date has shown that the greatest exposure in pole side impact crashes is for young male occupants, fairly closely aligned to the 50th percentile male dummy.
- The pole test part of FMVSS 214 includes a test with a small female dummy (currently SID-IIs).
- Unlike the 50th percentile adult male, the 5th percentile adult female WorldSID requires significant work before it is finalised.
- While it is possible that the WorldSID 5th percentile female will be finalised within the timeframe of an Informal Group, it may be preferable to consider phased implementation if a test with a small female occupant is proposed.

Non struck side occupants

- Studies show as many as 40% of injuries/fatalities are for occupants seated on the non-struck side of the vehicle.
- Benefits of countermeasures for non-struck side occupants may need to be considered.
- Consideration is required as to whether a separate test procedure for occupants seated on the non-struck side is needed, or whether an assessment of protection for these occupants could be incorporated in the proposed pole side impact test.

Other Coverage Considerations

Head injuries in Vehicle-to-vehicle crashes

- Pole test procedures are generally not proposed to mitigate pole (or narrow object) collisions in isolation.
- In particular the pole test is promoted to drive countermeasures for head and thorax protection in general, including vehicle-to-vehicle crashes.
- Head injuries are key injuries in a significant proportion of side impact fatalities (70% reported in Gopal et al ESV 2009).
- Yet barrier-to-car test procedures rarely show any significant head injury, and therefore do not accurately indicate the necessity for head protection countermeasures.

Rollover

- Side curtain airbags (if deployed) are generally considered to reduce the risk of ejection (and injury/fatality) in rollover crashes.
- We have not located any studies in the literature documenting assessment of this.
- However, benefits from pole impact countermeasures in rollover crashes should also be examined by the working group.

Assessment of effectiveness

- Predictions of the effectiveness of likely countermeasures must be evaluated in order to support any regulatory proposal.
- This may include assessment of existing (but not mandatory) countermeasures currently in the fleet.

Australian Testing Program

- A series of at least six pole tests will be conducted in Australia in coming months, commencing with three in June 2010, using the three candidate pole test procedures, with WorldSID 50th percentile male dummies.
- Australia would be happy to contribute data from these tests to a GRSP Informal Group.

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