EEVC WG12-20 Hybrid III Biofidelity Review

Presented by David Hynd, TRL Limited
Chairman, EEVC WG20
GTR Meeting : 8th November, 2007
Hybrid III Biofidelity Review

- **Review of**
  - EEVC research
  - EC project results
  - Published literature

- **Biofidelity of**
  - Head-neck kinematics
  - Seat back interaction
Hybrid III Biofidelity Review

Literature Review

- 1 paper found that Hybrid III head motion *relative to T1* simulated volunteer results (Viano and Davidsson, 2002)
- 1 paper found that Hybrid III *head rotation* biofidelic relative to original Mertz and Patrick design target for the neck (Prasad *et al.*, 1997)
  - Dynamic tests with 1 volunteer and 2 PMHS, plus quasi-static volunteer tests
Hybrid III Biofidelity Review

Literature Review

- All other references (approx 20) concluded that the Hybrid III was *not* biofidelic in low-speed rear impact
  - Some head-neck motion and force parameters OK for some seat designs - but dependent on interaction with seat back
    - Affected by thoracic spine and shoulders
  - All studies that examined seat back interaction found that Hybrid III not at all biofidelic due to rigid thoracic spine

- More flexible spine recommended to ensure good seat interaction
Hybrid III Biofidelity Review

EC Project Review

- Comparison with volunteer and PMHS data
  - Interaction with seat back not satisfactory

- Tests in real car seats
  - Better - but no T1 rotation, retraction (S-shaped neck response) or ramping-up
Hybrid III Biofidelity Review

EEVC Biofidelity Testing

- Not yet published, but biofidelity review is complete
- Results clearly support literature review

- [Link to biofidelity presentation]
Hybrid III Biofidelity Review

Conclusion

- Hybrid III not biofidelic in low-speed rear impact seat testing
  - Thoracic spine too stiff
  - Seat back interaction poor (dependent on seat)
  - No T1 rotation
  - No retraction
Hybrid III Biofidelity Review

- Why is good biofidelity important in low-speed rear impact seat testing?

- Primary benefit of dynamic test option is to allow reactive head restraints
  - Head restraint movement actuated by interaction between occupant spine/thorax and seat back
  - If seat interaction not biofidelic, actuation with dummy not likely to be same as actuation with human occupant
  - Hybrid III (stiff spine box) expected to actuate some reactive head restraints much more effectively than human occupant

- I.e. some seats will pass test, but not work in the real-world
- Expected benefit will not be delivered
Hybrid III Biofidelity Review

Also, report collates other info presented at previous GTR and GRSP meetings

- HR-5-12
  - Volvo WHIPS seat fails Hybrid III test (head angle 19.6°)
  - BUT
  - ‘Good’ SRA rating (by a large margin)
  - ‘Good’ IIWPG rating (by a large margin)
  - [NB: Volvo WHIPS also has good insurance claims performance]

- Questions using claims rates for 2 seats to construct risk function
- Mean delta-v for claims 10 km.hr⁻¹

- Conclusion: proposed GTR Hybrid III test design restrictive
Hybrid III Biofidelity Review

Also, report collates other info presented at previous GTR and GRSP meetings

- HR-7-13
  - WHIPS seats have 49% claims reduction compared to previous generation Volvo seat (IIHS)
  - Volvo study showed 36% reduction in long-term injury
  - S80 seat fails proposed GTR (average head-torso angle 16.3°)
  - Proposed requirement design restrictive
Hybrid III Biofidelity Review

Also, report collates other info presented at previous GTR and GRSP meetings

- HR-5-11
  - Hybrid III seat back interaction poor - affects results for some seats
  - Hybrid III results not well correlated to IIWPG rating
Hybrid III Biofidelity Review

Also, report collates other info presented at previous GTR and GRSP meetings

- HR-6-7
  - Shows one seat where
  - Hybrid III deploys head restraint by 90 mm
  - BioRID II deploys head restraint by 35 mm

- For two other seats, actuation similar
End of Presentation

Presented by David Hynd, TRL Limited
Chairman, EEVC WG20
Tel: +44 1344 770310   Email: wg20chair@eevc.org