EEVC WG20 and WG12
Rear Impact Test Procedure Development Programme

Presented by David Hynd
Chairman, EEVC WG20
Introduction

- EEVC WG20 formed in 2003 to develop test procedures for rear impacts
  - Prime focus on neck injury reduction

- EEVC WG12 to recommend dummies, injury criteria and injury risk functions for WG20 test procedures
  - Based on biomechanical evidence
EEVC WG20 - Test Procedures

Three WG20 test procedures under development

- **Static test of head restraint geometry**
  - A robust test procedure with geometric requirement can ensure head restraint provision is adequate for those occupants taller than the 50th percentile male

- **Dynamic test of head restraint geometry**
  - As an alternative to the static test of geometry

- **Dynamic, injury risk assessment test procedure**
  - To encourage more advanced and effective solutions than just good geometry
EEVC WG12 - Dummy Issues

WG12 will make recommendations on

- **Selection of a dummy**
  - With appropriate biofidelity in low-speed rear impact test conditions

- **Injury criteria**
  - With a biomechanical basis

- **Injury risk functions**
  - With a biomechanical basis
WG20 Progress
WG20 Progress

State-of-the-art review

- Update of earlier WG12 review, focusing on
  - Accident data and insurance statistics
  - Biomechanics
  - Dummy development
  - Car and seat design
  - Test procedures
  - Finalised and on-going research programmes

WG20 Progress

State-of-the-art review

- Key conclusions
  - Whiplash Associated Disorder (WAD) symptoms are well documented, but the actual injury remains to be established
    - Several injury locations and injury mechanisms have been suggested
    - Further work is needed before a WAD risk assessment parameter (LNL, Nkm, T1-rebound velocity, NIC, NDC, IV-NIC, etc.) can be finally established
    - The dynamic motion of the human head-neck system during a low-speed rear impact is known from volunteer test data
  - Both mean and peak acceleration appear to be important crash severity parameters together with delta-v
  - Women have about twice the injury risk compared to men
  - Energy absorbing seats, active head restraints and good head restraint geometry all seem to be beneficial, based on claims evidence
  - The BioRID II and the RID2/RID3D are the best suited dummies for rear impact whiplash prevention testing
WG20 Progress

Static test of head restraint geometry

- Developed draft test procedure based on RCAR procedure with 3-D H machine and HRMD
  - Test procedure evaluated
  - Repeatability
  - Reproducibility…

WG20 Progress

Geometric test procedure evaluation programme

- **Three seats**
  - Volvo S40, Ford Focus Mk1, Citroen C3
- **Three test tools**
  - AA1, AA2, SAE
- **Four test teams**
  - BASt, IDIADA, Thatcham, TRL
WG20 Progress

Ford Focus Mk1 Results

RGAR Backset (mm)

RCAR Height (mm)

WG20 Backset (mm)

WG20 Height (mm)
WG20 Progress

Geometric test procedure evaluation - conclusions

- Experienced testers slightly better repeatability than inexperienced
- Reduce torso angle requirement
  - From $25^\circ \pm 1^\circ$ to $25^\circ \pm 0.5^\circ$
- Improve certification of 3-D H machine
  - To improve reproducibility of machine itself
- Seat most important source of test variability
  - Possible to have good repeatability and wide range of comfort adjustments
- With reduction of torso angle requirement and improved certification of 3-D H machine
  - Repeatability and reproducibility improved
  - Need to demonstrate sufficient for regulatory use
WG20 Progress

Geometric test procedure evaluation - issues outstanding

- WG20 working on some outstanding issues, e.g.
  - Temperature and humidity requirements
  - Pre-conditioning of seat
  - Selection of torso angle
  - Accommodation of tilting front seats
  - Testing of height and tilt locking devices
WG20 Progress

Geometric test procedure evaluation

- Selection of height and backset limits
  - Not available yet
  - Will come from cost-benefit study
- Due June 2007
WG20 Progress

Geometric test procedure evaluation - other options

- WG is evaluating proposals at GRSP Informal Group on Head Restraints
  - UTAC simplified tool for backset measurement
WG20 Progress

Geometric test procedure evaluation - other options
WG20 Progress

Geometric test procedure evaluation - other options

- WG20 is evaluating proposals at GRSP Informal Group on Head Restraints
  - UTAC simplified tool for backset measurement
  - OICA and JASIC methods using modified Reg17 equipment
WG20 Progress

Geometric test procedure evaluation - other options
WG20 Progress

Dynamic test of head restraint geometry

- Adopted as a new work item October 2006
  - Develop a test procedure that can be used to measure head restraint backset dynamically
  - Particularly beneficial for reactive head restraints
  - Less design restrictive

- Scope
  - Biofidelic dummy to ensure correct head-neck movement and seat back interaction
  - Dynamic equivalent of static test procedure
    - No additional cost-benefit
    - No assessment of injury risk
  - Use info from dynamic injury assessment test procedure programme
    - Pulse, adjustment of head restraint, selection of dummy
WG20 Progress

Dynamic test of head restraint geometry

- Progress
  - Gathering data from upcoming dynamic rear impact tests for re-analysis
    - To allow initial investigation of the issue
    - To evaluate proposed methods for calculating backset (including from image analysis)
  - Analysis Q1, 2007
WG20 Progress

Dynamic, injury risk assessment test procedure

- Key tasks
  - Selection of pulse or pulses
  - Selection of scope, e.g.
    - Seat test
    - Seat and restraint system
    - Full vehicle buck
  - Define adjustment of head restraint

- Draft test procedure due end June 2007
  - Evaluate with WG12-recommended dummy and injury criteria
WG12 Progress
WG12 Progress

Dummy selection

- Several dummies used in or proposed for low-speed rear impact test procedures
  - BioRID-2, RID\textsuperscript{3D}, Hybrid III
  - Most have been evaluated in certain test conditions, but…
  - … No consistent evaluation of the latest versions across a range of test conditions

- WG12 have selected a range of biofidelity, repeatability and reproducibility test conditions
  - Evaluate the BioRID-2, RID\textsuperscript{3D} and Hybrid III dummies
    - BioRID-2 and RID\textsuperscript{3D} included as purpose-designed rear impact dummies
    - Hybrid III included as proposed in rear impact GTR
Dummy selection

- **Rear impact biofidelity requirements chosen, based on**
  - The availability of the full data set
  - Quality of the test set-up and instrumentation
  - Reproducibility
  - Relevance of the test conditions, loading condition and velocity change
  - Distribution of subject anthropometry, gender and age
  - The number of tests and test subjects

- **Biofidelity requirements**
  - 4 based on volunteer data
  - 1 based on PMHS data
  - See 19th ESV 2005 paper for details
WG12 Progress
WG12 Progress

Dummy selection

- New target corridors developed using a standardised method
  - EEVC WG9 method

- Dummy evaluation programme underway
  - BioRID-2, RID³D and Hybrid III
  - Biofidelity, repeatability and reproducibility
  - Most tests completed, analysis due February 2007
WG12 Progress

Injury criteria
- Published criteria are being evaluated
  - Including proposed injury mechanism
  - Certain biomechanical basis not established for any criteria
  - Injury criteria being calculated from dummy evaluation tests to assess capability of dummies and as first check on criteria
  - No new criteria being developed by WG12

Injury risk functions
- Available injury risk functions have been documented
  - No further evaluation until biomechanical basis for criteria established
WG12 Progress

Dummy biofidelity
- Analysis due February 2007

Injury criteria
- Published criteria are being evaluated

Injury risk functions
- To be developed once biomechanical basis for criteria is established
Contacts

EEVC Web Site

www.eevc.org

ESV Web Site

www-esv.nhtsa.dot.gov
End of Presentation

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