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**

- **EEVC WG20 (2005). *Updated State-of-the-Art Review on Whiplash Injury Prevention.* WD80. European Enhanced Vehicle-safety Committee. March 2005. Available from www.eevc.org**

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…**

- **Hynd D, Carroll J and Walter L (2006).** *Geometric test procedure evaluation.* **EEVC WG20 Report WD-123. European Enhanced Vehicle-safety Committee. June 2006. www.eevc.org**
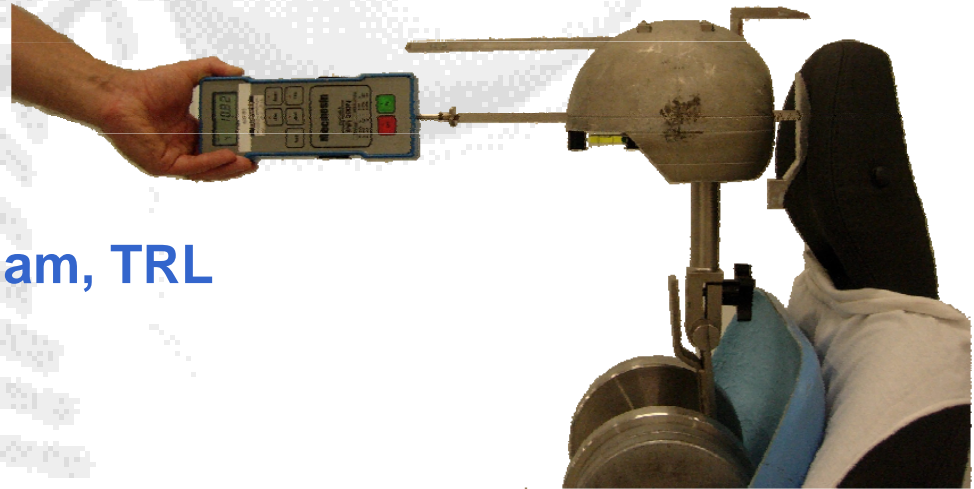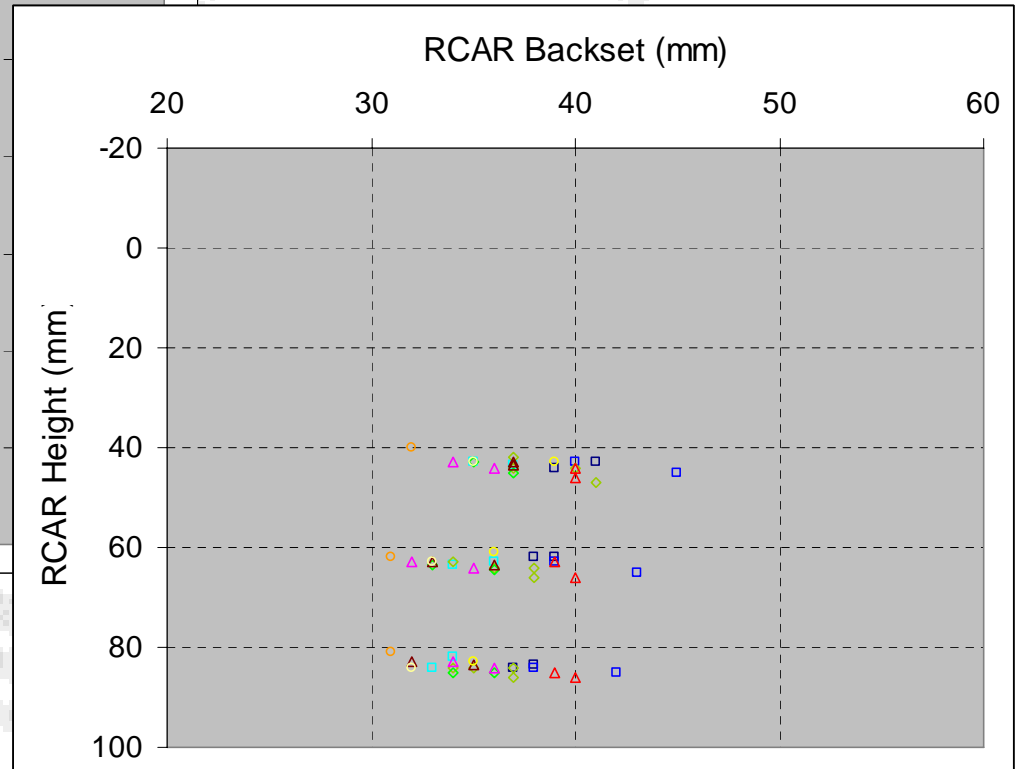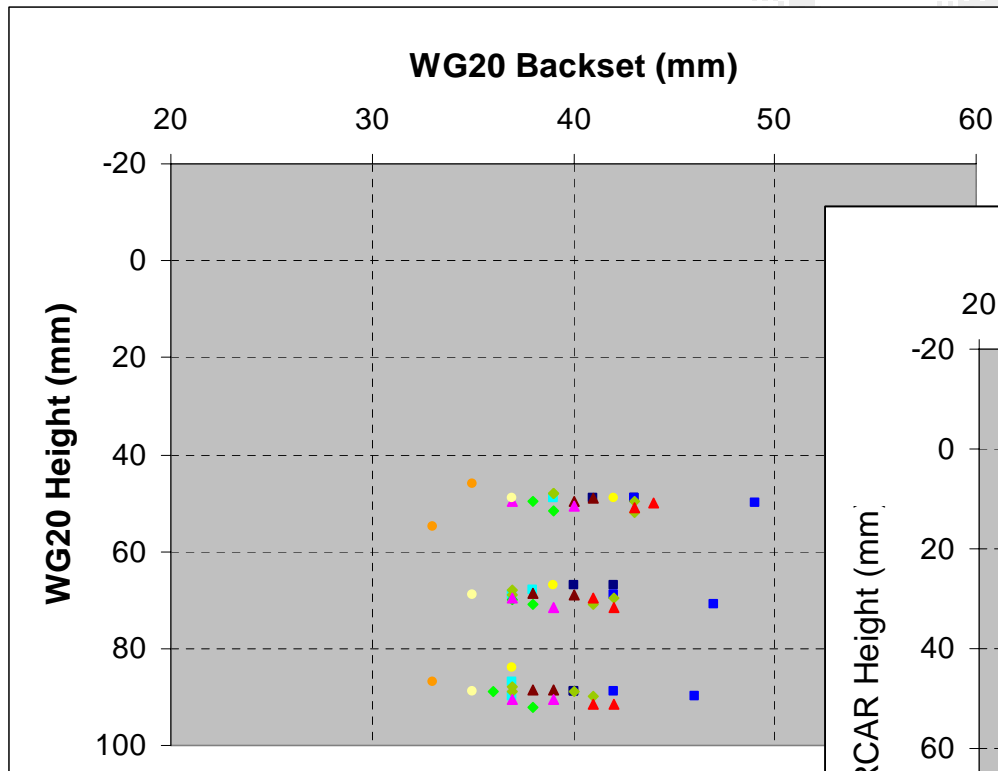
WG20 Progress

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

WG20 Progress

Geometric test procedure evaluation - conclusions

- **Experienced testers slightly better repeatability than inexperienced**
- **Reduce torso angle requirement**
  - **From 25° ± 1°   to   25° ± 0.5°**
- **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
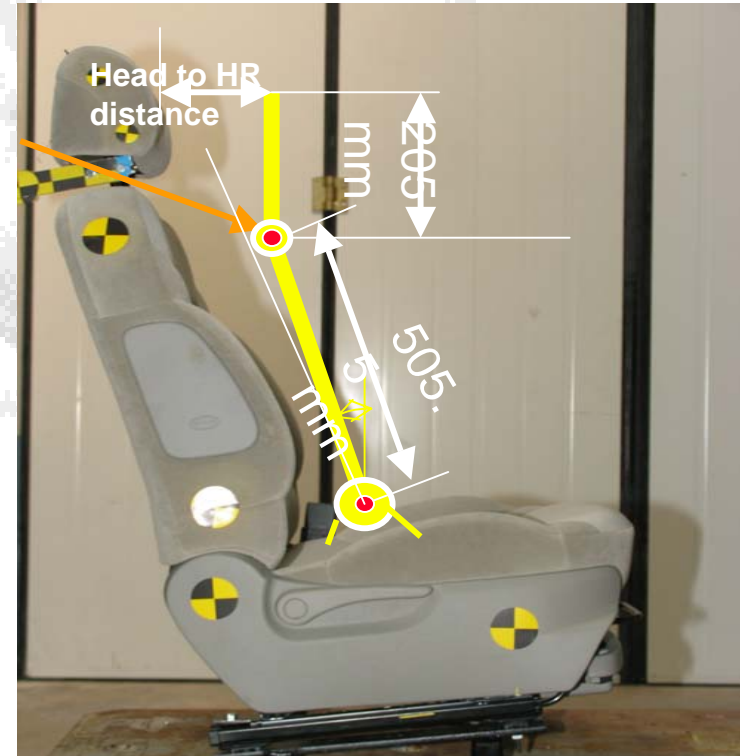 - Will come from cost-benefit study

  - 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**
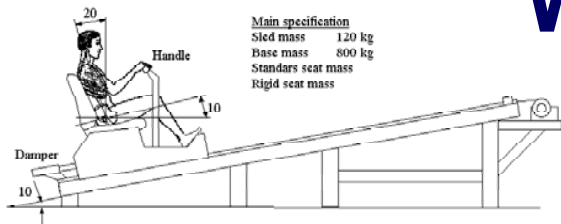
WG12 Progress

WG12 Progress

Dummy selection

- **Several dummies used in or proposed for low-speed rear impact test procedures**
    - **BioRID-2, RID^{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^{3D} and Hybrid III dummies**
        - **BioRID-2 and RID^{3D} included as purpose-designed rear impact dummies**
        - **Hybrid III included as proposed in rear impact GTR**
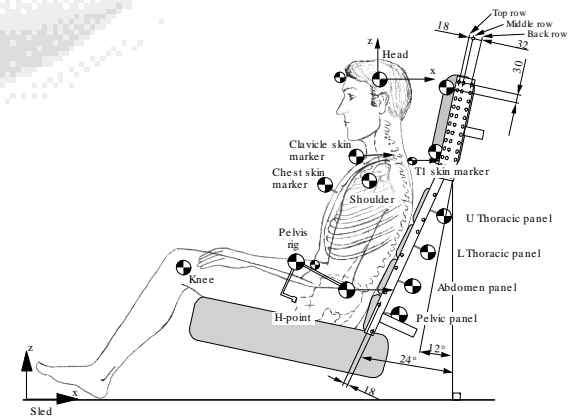
WG12 Progress

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, RID^{3D} 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

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