Development and Evaluation of EUROSID-2 (ES-2) Dummy

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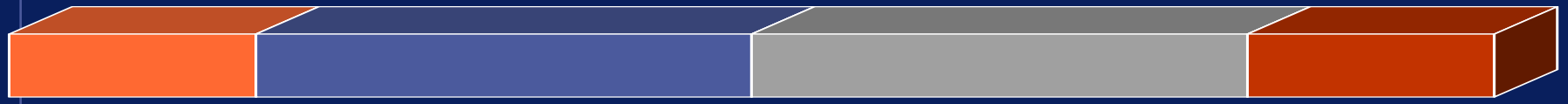
on behalf of

European Enhanced Vehicle-safety Committee

Side Impact Dummies

- ECE Regulation 95 uses EUROSID-1 Side Impact Dummy as of October 1, 1998
- Accepted in Europe and Japan but not used in FMVSS 214
- EUROSID-1 and US.SID both represent 50th percentile male adult

History EUROSID-1 Development



1980 1985 1990

1978-1981

EEVC Biomechanics

MIRA-ONSER50-APROD

1983-1985

EEVC/EC Component Development

EUROSID prototype

1986-1989

EEVC/EC Evaluation/Production

EUROSID-1 production dummy

Harmonisation Goal

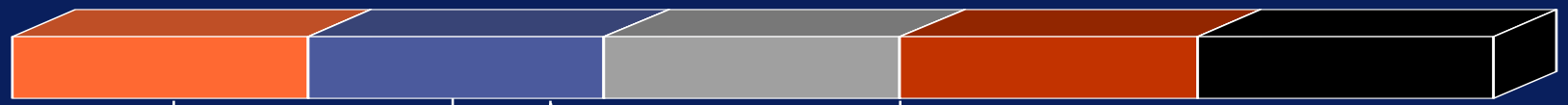
- Provide improved side impact dummy design based on EUROSID-1 that is world-wide acceptable in the interim up to the moment that a more advanced tool is introduced

Motivation

- "WorldSID" dummy is being developed but harmonisation could be reached earlier based on existing design
- EUROSID-1 is most widely used regulatory side impact dummy
- Deficiencies that prevent acceptance world-wide are known and can be addressed in the short term
  - Rib binding, torso back plate interference, knee interaction, etc.

ES-2 Development Program

Milestones



List of EUROSID-1 deficiencies

Release of EUROSID-1 'research' tools

NHTSA petitioned to consider EUROSID

Release of 4 ES-2 prototypes and start of global evaluation tests

ES-2 Prototype

Upper neck load cell

Coated plates and flexible clavicles

New back plate and load cell

T12 load cell

Needle bearing rib module guide system

Hip end stop buffers

Re-designed upper leg

- New positioning tools

Evaluation Program

- **Co-ordinated by EEVC and NHTSA**
  - Involves governments and industry
- **Extensive testing in US, Europe, Canada, Japan and Australia**
- **EEVC objectives**
  - Have the deficiencies of EUROSID-1 been solved?
  - Is biofidelity of EUROSID-1 maintained?
  - What is ES-2's usefulness as regulatory test device?

European Tests

TEST CONDITION

Biofidelity
Thorax - pendulum
Thorax/abdomen/pelvis - Heidelberg sled
Pelvis - pendulum

Sensitivity/Repeatability
Shoulder/thorax/abdomen/pelvis - pendulum

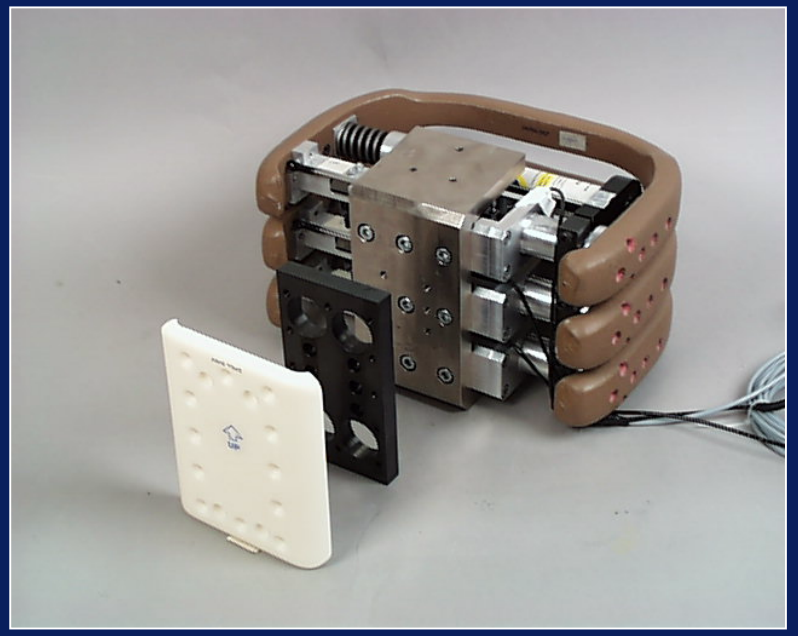
Certification
ES-2 procedures

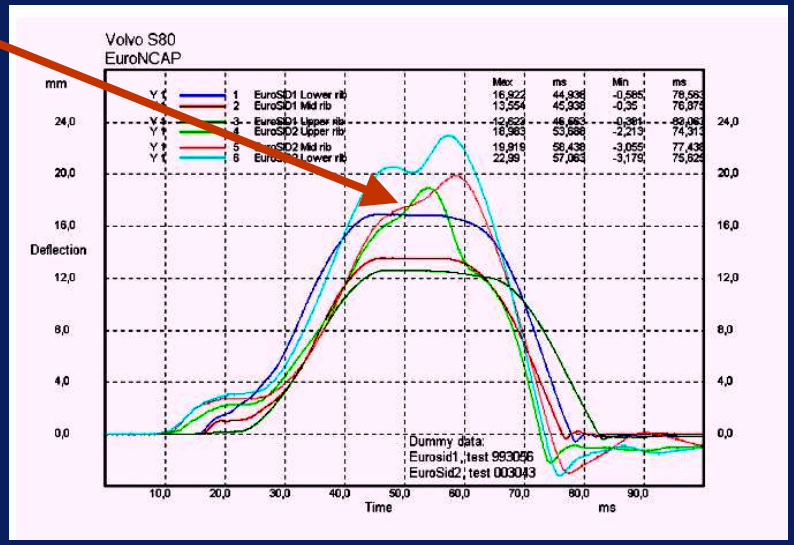
Full-Scale Performance
ECE R95 @ 50 km/h
EuroNCAP @ 50 km/h
FMVSS 214 @ 54.7 km/h
FMVSS 201 @ 32.2 km/h

Main Results (1)

Rib Binding

- **Evaluated in 13 full scale tests**
  - EU/US test conditions
  - 9 vehicle models
- **Flat top disappeared**
- **Higher deflections and V*C for ES-2**
  - Increased sensitivity to load direction and on-set

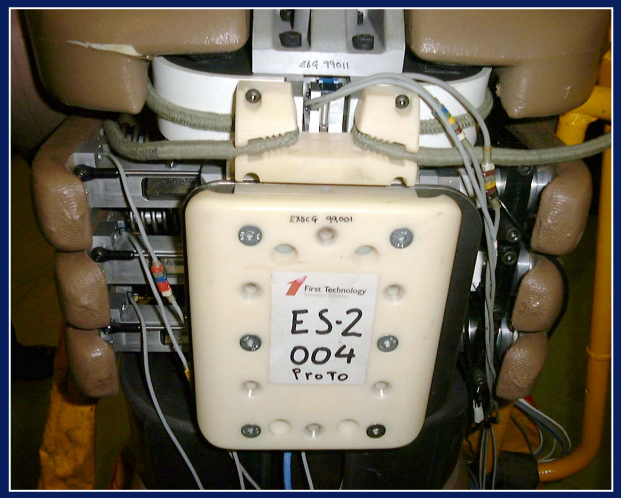


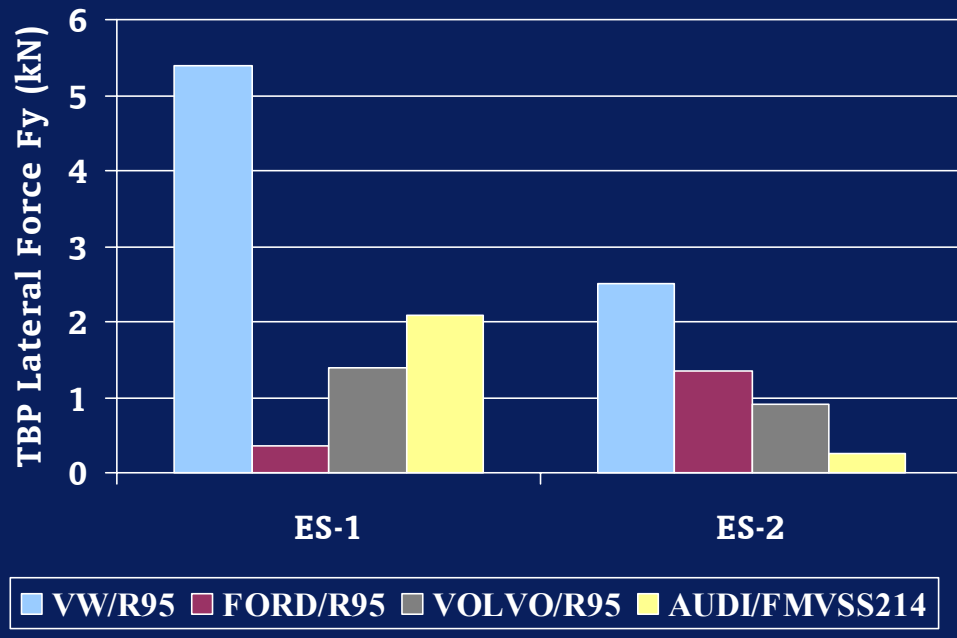


Main Results (2)

Back Plate Loads

- Loads can now be measured
- Comparative study on EU vehicles
- Average decrease of 59% in lateral force in ECE test conditions

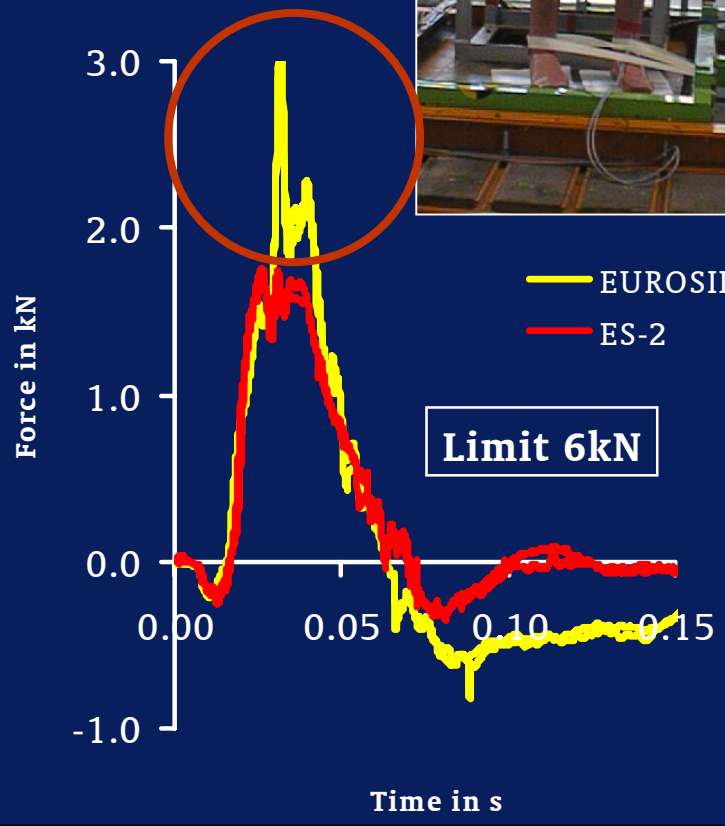




Main Results (3)

Knee Interaction

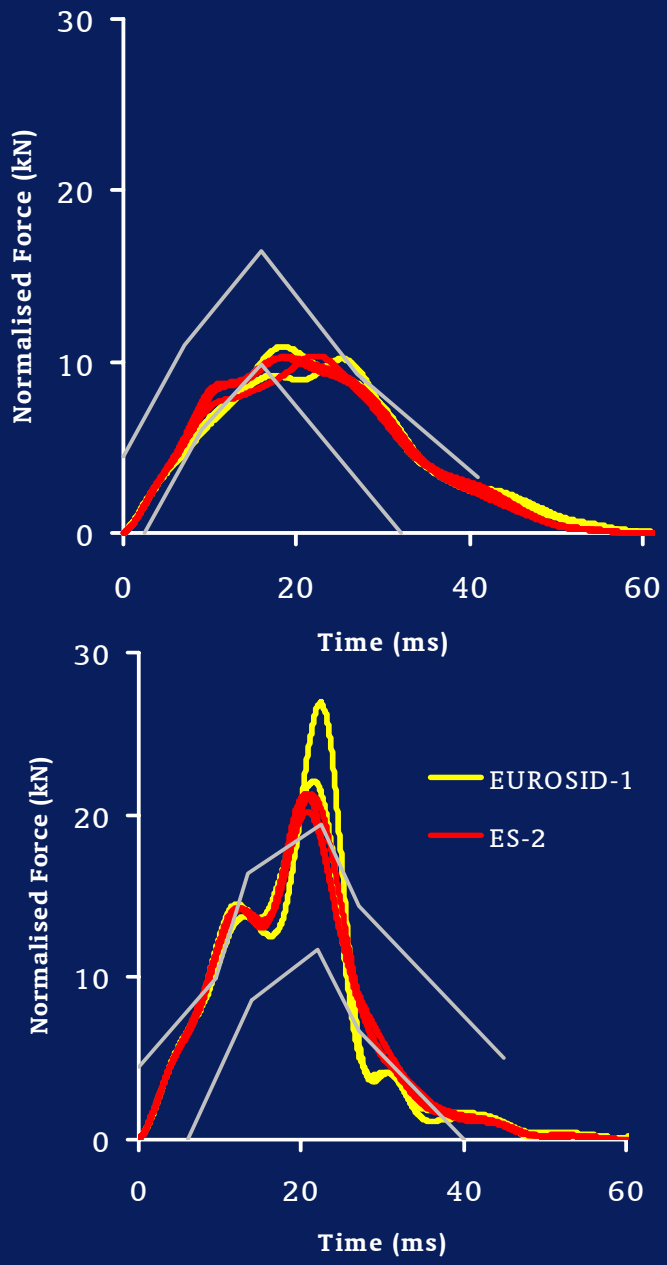
- Evaluated in full-scale and impactor-sled tests
- Peak in pelvic symphysis load significantly reduced for ES-2



Main Results (4)

Biofidelity

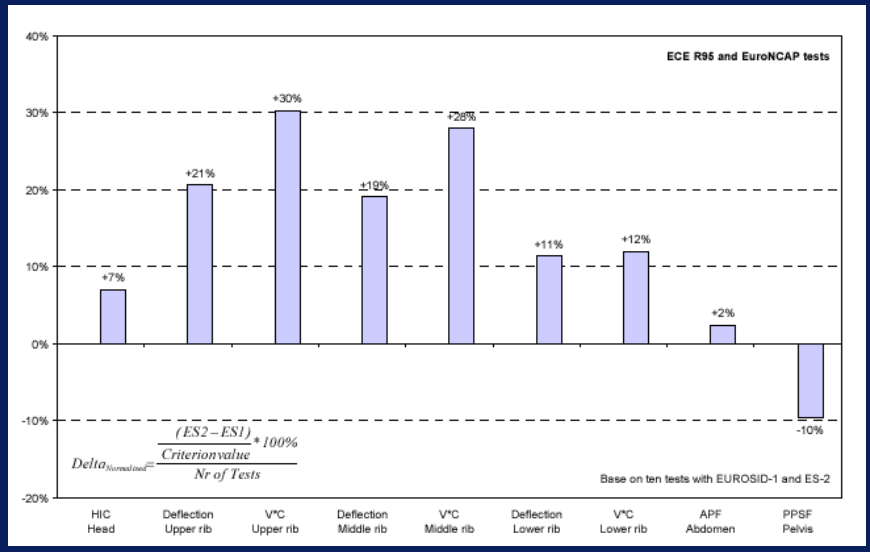
- **Focus on modified parts**
  - Thorax
  - Pelvis/upper legs
- **EEVC (WG9) requirements**
  - 23.4 kg mass pendulum
  - Heidelberg padded/rigid wall sled
- **Equal biofidelity as EUROSID-1 found for ES-2**
  - No assessment of V*C



Main Results (5)

Criteria

- **Generally higher values**
  - Rib deflections and V*C
  - Elimination of rib binding, reduction of back plate interference and higher sensitivity of new ribs
- **Little effect on pass/fail with respect to regulatory limits**
  - Based 11 vehicle models



Normalised Differences (%)	
Rib deflection	+ 17
Rib V*C	+ 23
Pelvis Pubic load	-10%

Conclusions

- The most important deficiencies of the EUROSID-1 have been addressed with ES-2
- ES-2 is superior to EUROSID-1 in terms of injury assessment capabilities, durability and handling
- The biofidelity of ES-2 has not significantly changed compared to EUROSID-1
- Reduced friction in the rib modules, reduced back plate grabbing and higher rib sensitivity lead to higher values for critical thorax parameters

Recommendations

- EEVC recommends to replace EUROSID-1 by ES-2 dummy
- EEVC recommends to measure back plate loads in full vehicle assessment
- EEVC endorses the ES-2 dummy as candidate for interim harmonisation

Reference

- ES-2 document is downloadable from the EEVC web site: www.eevc.org