

**Informal Working Group Meeting for Side Impact WorldSID Dummies
4th Meeting
Berlin, Germany, September 23, 2010**

Draft Summary Report

1. Welcome and Introductions

The chairperson, Mrs. Susan Meyerson, opened the meeting and welcomed everyone. Informal group delegates and representatives were introduced. A completed list of attendees is listed in Section 6.

2. Approval of Agenda

The agenda was approved after presentations from PDB, Australia, United Kingdom, and Humanetics were added.

3. Discussion

3.1 NHTSA evaluation of WorldSID 5th female (WS-4-2)

Bruce Donnelly (NHTSA) provided an update on the current status of the evaluation of their 2 WorldSID 5th female dummies. Preliminary inspections and certification testing of the dummies has begun. There are problems with the IR-TRACCs provided with the dummies and NHTSA is working with Humanetics to get them resolved. There is the potential for collaboration in many areas of the dummy development, including biofidelity, durability, certification, and data review. Work is estimated to be completed by the end of 2013. It was noted that the Occupant Safety Research Partnership (OSRP) funded by Ford, Chrysler, and General Motors will be working on the 5th female and will develop a collaborative plan relative to repeatability, reproducibility, and durability.

3.2 Status of WorldSID 5th Female dummies

There are currently 8 dummies: 2 at Humanetics, 1 at Ford, 2 at NHTSA, 2 at Transport Canada, and 1 on order for General Motors.

3.3 Injury Risk Curves

ACEA has funded Audrey Petitjean (CEESAR) to develop injury risk curves for the 5th Female, as she did for the 50th male dummy. The impactor size and corridors will be scaled for 5th female. Humanetics (B.Been) will distribute the anthropometry document created for APROSYS to help with impactor size.

3.4 Humanetics presentation on latest WorldSID 5th configuration (WS-4-3)

Bernard Been (Humanetics) gave a presentation outlining the most recent changes in the WorldSID 5th development. The most current version of the dummy is Build Level C (the APROSYS dummies were Build Level B). These changes include:

- Changing the shoulder bracket to eliminate play in the shoulder joint,

- Replacing the 1D-IRTRACC with the 2D-IRTRACC because it is more durable and the range of motion in the Z-axis is now 45 degrees (see section 3.3 for further details),
- Improving the dummy lifting bracket to make it easier to use,
- Modify the lower lumbar mounting bracket and the upper lumbar clamping bracket to reduce metal-to-metal contact,
- Pelvis ground leads were modified to improve usability, and
- Modified the Data Acquisition System (DAS) thigh structural replacement to improve fit.

Additionally, Humanetics is redesigning the WorldSID 5th ankle using the WorldSID 50th ankle as a basis. The 5th leg was scaled from THOR-Lx based on new targets developed with PDB (somewhat expanded but maybe easier to meet). The dorsi-flexion and plantar-flexion were modified using friction plates for positioning. The ankle will be fitted with rotation sensors, but certification tests for the ankle are not being considered at this time, primarily because there is less concern of lower leg injuries in side impacts. The design concept is complete and the prototype will go into the dummy purchased by General Motors (GM) that will be delivered by the end of 2010. The two dummies owned by Humanetics and the two dummies owned by NHTSA will also receive the updated legs.

There were some concerns expressed about the different shoulder designs of the 5th and 50th. There are two major differences, the arm and the shoulder joint. The WS5F arm was designed to meet biofidelity bending stiffness targets to address concerns raised by Toyota. The WS50M arm has no biofidelity targets. The WS50M shoulder design did not fit the narrower shoulder of the 5th female, therefore another design solution had to be made. The 5th female shoulder joint is 3 DOF (degrees of freedom), the WS50M is 2DOF. Humanetics believes there is no major difference in biofidelity between the 5th's shoulder and the 50th's. A request for firm detents was made.

3.5 Humanetics presentation on the new 2D IRTRACC design (WS-4-4)

Humanetics has updated the 2D-IRTRACC system in the WorldSID 50th dummy. There are now two versions of the measurement device: one for the shoulder and one for the thorax/abdomen. These devices can be used interchangeably on the left and right sides. The dummy can be instrumented with the devices on both sides or on one side with ballasts on the other side. The 2D system maintains the 75 mm compression range, but increased the range of motion to 45 degrees, thereby improving its durability. No modifications of the dummy are needed since the 2D system can be used as a direct replacement for the 1D system.

3.6 Autoliv presentation on testing with the WorldSID 5th and 50th (WS-4-5)

Celcelia Sunneväng presented the results of side impact testing using the WorldSID 5th and 50th dummies. Tests were used to assess side impact airbags and included Car-to-Car/SUV, high severity MDB, EuroNCAP MDB, and EuroNCAP pole tests. Autoliv used their own WorldSID 50th dummy and borrowed a WorldSID 5th female (Level B) from Humanetics. Both dummies had the 2D-IRTRACC installed to assess thorax displacement and rotation. The injury risk curves used for the WorldSID 5th were those developed in the APROSYS project. The seating for the WorldSID 5th and the SID-IIs were matched to the H-points. Based on this testing, Autoliv concluded that the WorldSID 5th and 50th dummies appear

to be a good tool. The 50th dummy showed better spine flexibility than the ES-2re. The dummies were also more sensitive to different airbag concepts than the ES-2. The dummies also responded well in low and high severity crashes. Autoliv is also working with the University of Virginia to examine rib rotation and shoulder kinematics of the WorldSID 50th and will compare results with an earlier cadaver study.

3.7 Australia presentation on the WorldSID 50th dummy in Side Impact Pole tests (WS-4-6)

Mark Terrell presented result of side impact pole tests using WorldSID 50th dummies in the front outboard seating positions. Six tests were conducted at 32 km/h, some tests were a perpendicular pole test, and the others were an oblique pole test. Both dummies were borrowed from Transport Canada. The driver dummy was instrumented with Ribeye and the front passenger dummy was instrumented with an IRTRACC in the thorax. The dummy was seated using the draft 5.2 WorldSID procedure, which seemed straightforward. The dummy was durable. There were some problems, but they were easily repaired.

An analysis of the Rib eye response showed the peak thorax and abdomen rib deflections were predominantly lateral in both oblique tests; there was very little movement in the vertical direction. The Ribeye lateral result matched the theoretical IRTRACC results. There was some loss of data at the higher deflections.

Further analysis and discussion will be presented at the November 2010 Pole GTR meeting in Bonn, Germany.

3.8 United Kingdom Presentation on WorldSID (1D- and 2D-IRTRACC and Ribeye) (WS-4-7)

David Hynd (TRL) presented results from tests using WorldSID 50th and WorldSID 5th dummies. The WorldSID 50th dummy was borrow from Transport Canada and incorporated Ribeye. The WorldSID 5th dummy was borrowed from FTSS (now Humanetics) and is Build Level B. The first part of the presentation evaluated the Ribeye system to address chest deflection and compared the results to 1-D and 2-D IRTRACC deflections. The second part of the presentation presented results using the 5th and 50th dummies in 60 km/h Moving Deformable Barrier (MDB) tests.

Oblique and offset pendulum impacts were used to compare deflection results from the Ribeye with those of the 1-D and 2-D IRTRACC. The Ribeye uses 3 LEDs to measure deflection in the x-, y-, and z-directions, at 3 points on the ribs. The 1-D IRTRACC measures deflection in the y-direction and the 2-D IRTRACC measures deflections in the x- and y-directions. There were some issues with durability of the Ribeye system with regard to the communication of the data between the dummy and computer. Overall, the Ribeye instrumentation worked well. In comparison, it was found that the 1D-IRTRACC seemed to underestimate the rib deflection, especially in oblique loads. The lateral movement measured with the 2D_IRTRACC was similar to the movement measured with Ribeye. There was only a small amount of movement in the z-direction measured. The benefit of using the Ribeye system over the IRTRACC will depend on the evaluation criteria chosen. During the discussion, Philippe Petit

(Renault/PSA) noted that there will be a Stapp paper on the effect of oblique loading on thoracic injury risk, which could have implications of instrumentation used.

Full scale Advanced European (AE) MDB were conducted to compare the responses of the WorldSID dummies with the ES-2 dummies. The AE-MDB impacted a Volkswagen Golf at 60 km/h on the driver side. The ES-2 dummy was positioned using the procedure defined in UN ECE R.95. The WorldSID dummies were positioned according to the draft ISO procedure. The WorldSID 50th was seated in the driver seat and the WorldSID 5th was seated behind the driver. The different seating procedures of the WorldSID 50th resulted in different head positions and the kinematics of the dummy in the test, especially in the shoulder area.

The WorldSID 50th dummy showed significantly higher loading in the shoulder than the ES-2, which is probably due to the different seating procedures and the door design. In addition to the high lateral compression shown by the Ribeye shoulder sensor, there was also significant vertical movement before it exceeded the range of the instrumentation. The lateral compression measured for the ES-2 and the Ribeye was similar. The Discussion of the results brought up the concerns expressed during the earlier discussion of the WorldSID 5th shoulder design (section 3.2). The high shoulder loading of the WorldSID 50th seems to reduce the loading on the thorax ribs. There were questions on whether the design of the 5th or the 50th has a more appropriate response. It was suggested that sled testing may be needed to compare shoulder designs.

The kinematics of the WorldSID pelvis indicated heavy loading but the injury values were lower than those for the ES-2. Bernard Been (Humanetics) stated that the associated load level for the equivalent risk in the WorldSID is lower than the ES-2.

During the test, the 5th female slide off the head airbag and contacted the door at the base of the window. It was requested that angular rate sensors be added to the head instrumentation so to better evaluate the head impacts.

3.9 PDB presentation on WorldSID seating position procedure (WS-4-8)

Markus Hartlieb (Partnership for Dummy Technology and Biomechanics (PDB)) presented an overview of the PDB activities/views within the ISO working group to finalize the seating procedure for the WorldSID 50th dummy. The ISO group is working on Draft 5.2 of the seating procedure for the 50th dummy. There are several issues that are still under discussion: position of seat pan (manufacturers recommended position (MRP) or full down), adjust of the seat back angle to achieve either a 0° or MRP thorax angle and adjust the neck bracket to achieve a level head.

3.10 Status of ISO Documentation of the WorldSID 50th (WS-4-9)

Klaus Bortenschlager (PDB) presented the status of the update to the ISO documentation of the WorldSID 50th dummy. A revision was necessary to incorporate changes to the dummy based on previous evaluation testing, such as moving the data acquisition unit and new rib damping material. A draft revision of ISO 15830 has been presented to the Tri-Chair committee and a ballot-ready version is expected to be submitted to the ISO upper committee within a couple weeks of this meeting.

3.11 Comparison of results of WorldSID 50th and Cadaver Testing (WS-4-10)

Steve Ridella (NHTSA) presented the status of research being conducted by UMTRI for NHTSA. This research program is testing both the WorldSID 50th dummy and cadavers in both low and high speed sled impacts and comparing the results. Abdomen and chest deflections are being measured with chest bands and IR-TRACCs. Preliminary results suggest the pelvis may be too stiff. Final results will be presented at the ESV Conference in June 2011.

3.12 Collaborative Data Storage Site

The group discussed the need for a data storage site to collect all the test data from the WorldSID 5th female, such as the one set up for the WorldSID 50th male. The ISO WorldSID group stated they can provide a simple data archival resource for the WorldSID 5th data even though it is not really under their charter. It could be set up and managed by Ken Wiley of Dynamic Research under contract to the WorldSID group. It will be very simple and essentially all input will be handled by the users. A data review and quality assessment function, similar to that which worked well on the 50th, would need to be conducted interested volunteers. It was agreed that the group would try this simple data archive approach with WebX data review and discussion meetings. The site could be set up at within a few weeks of the meeting and then participants could upload their data

3.13 Onboard Data Acquisition System specification

The group discussed the requirements for reserving a space within the dummies to allow the installation of an onboard data acquisition system (DAS). A generic environment, including space available, tolerances, mass, center of gravity, and moment of inertia, are to be set to allow a DAS from any manufacturer to be inserted. The PDB group has volunteered to help with the modeling of the parameters by using the PDB WorldSID 50th finite element model. Existing mass properties will be considered, but it is uncertain if tolerances for all properties exist. There was discussion on how to account for the wiring of the DAS systems; it was noted that the mass of the wiring would be included, but it is impractical to include the locations. Finally, it was noted that there may need to be a specification for the gray space and specifications for the dummy segment mass properties.

4.0 Action Items

- a. Australia to (with permission) provide data and rib displacement animations
- b. Review shoulder interactions in tests. Suggested to run sled tests comparing shoulder responses of dummy. Group should discuss.
- c. All 50ths and 5ths should be outfitted with angular rate sensors (in addition to linear triax) in head to get data for use in rotational brain injury assessment. NHTSA can provide a specification for rate sensor sensitivity.
- d. Seating procedure group (ISO) to meet and agree on modified setup. Share info with group when complete. Target to complete by Bonn meeting on Pole impact GTR.
- e. ISO to inquire on simplified data archive and set up data review of 5th female tests as they become available. Tests with 50th male WorldSID should be shared with WS org.

- f. ISO to setup review of biofidelity testing in conjunction with development of test curves.
Will help in prescribing appropriate test conditions.

5.0 Next meetings

- March 2, 2011 – Brussels, Belgium
- June 8, 2011 - Washington, D.C., USA

6.0 Attendance

Last Name	First Name	Country/Organization
Akiyama	Akihiko	Honda
Ammerlaan	Hans	RDW
Asada	Hiroyuki	JASIC/Japan
Been	Bernard	Humanetics
Belcher	Thomas	Australia
Bortenschlager	Klaus	PDB
Broertjes	Peter	EC
Constant	Myriam	PSA Peugeot Citroen
Damm	Richard	Germany/BMUBS (MOT)
Dausse	Irina	Renault
Depinet	Paul	Denton ATD
Donnelly	Bruce	NHTSA
Frost	Bernie	UK Dept for Transport
Gogate	Vinayak	Tata Motors
Gokhale	Ajit	Tata Motors
Hallbauer	Karsten	Takata
Hartlieb	Markus	PDB
Hynd	David	TRL/EEVC WG20
Ishida	Katsutoshi	JASIC Washington DC
Jensen	Jack	GM
Kinsky	Thomas	Opel
Lee	Eun Dok	KATRI
Locke	Gerry	Lear Corporation
Lorenz	Bernd	BASt
Martin	Peter	NHTSA
Meyerson	Susan	NHTSA
Okuda	Yuji	FTSS
Ono	Koshiro	Japan/JARI
Petit	Philippe	LAB PSA-Renault
Petitjean	Audrey	CEESAR/France
Pott	Ansgar	Hyundai Motor Europe
Ridella	Steve	NHTSA
Sato	Fusako	JARI
Sunnevang	Cecilia	Autoliv

Terrell	Mark	Australia
Wernicke	Philipp	PDB
Xi	Lan	Chrysler
Yamakawa	Takehisa	JAMA