



The world's best dummy

by Ken Wiley, Dynamic Research Inc., WorldSID Phase II Project Manager, and the WorldSID Tri-Chair Committee¹⁾

Crash testing of cars is a critically important step in the design, development, and fabrication of safer cars and the improvement of road safety. The crash dummy is the most important piece of equipment used in these tests, and no dummy is better than the WorldSID 50th percentile male dummy.

For the last 12 years, engineers and technicians from around the world have diligently worked to design, test and refine the 50th percentile male World Side Impact Dummy, known as **WorldSID**. Working under the direction of ISO technical committee ISO/TC 22, *Road vehicles*, subcommittee SC 12, *Passive safety crash protection systems*, working group WG 5, *Anthropomorphic test devices*, the WorldSID Task Group produced the first dummy harmonized for worldwide use, and the most technically advanced.

The WorldSID 50th development process has included four distinct revisions of the dummy. The initial prototype was followed by a pre-production model and a production model, and a revision 1 model was recently completed. Each version has incorporated improvements based on extensive test experience with the dummy. Testing has included nearly 1500 whole dummy biofidelity, vehicle, and component tests conducted in 16 different test labs in at least 10 different countries, including governmental agencies in Australia, Canada, Japan, and the USA.

1) **Klaus Bortenschlager**, Partnership for Dummy Technology and Biomechanics (PDB); **Markus Hartlieb**, Daimler; **Suzanne Tytko**, Transport Canada; **Jack Jensen**, General Motors; **Akihiko Akiyama**, Honda; **Takeshi Harigae**, Japan Automobile Research Institute (JARI).



WorldSID rib biofidelity pendulum impact test.

If a dummy is to provide engineers with information on potential human injuries it must accurately replicate the size, weight, shape, and sitting posture of a typical human (referred to as “anthropometry”), it must respond to impacts like a human body (“biofidelity”), and it must have a means of measuring, collecting and recording physical parameters, such as impact forces, moments, deflections, rotations, and accelerations — all of which have been shown to be related to human injuries.

“The WorldSID Task Group produced the first dummy harmonized for worldwide use, and the most technically advanced.”

A recently completed multi-year WorldSID test programme conducted by the US National Highway Traffic Safety Administration (NHTSA) involved multiple dummies used in durability, repeatability, reproducibility, biofidelity, and full-scale crash tests. Results indicated good durability, and improved anthropometry and biofidelity, leading NHTSA to conclude that in comparison to other dummies, “the WorldSID 50th male dummy is an improved side impact test dummy.”

Improved anthropometry and biofidelity

Under contract to the US government, the University of Michigan Transportation Research Institute performed an extensive study to quantify the size, weight, shape, and sitting posture of typical human automobile drivers. The results of this study (UMTRI-83-53-1) formed the basis for the WorldSID anthropometry design.

As shown in the overlay photo, the WorldSID is a nearly exact match to the average mid-size male driver as determined by UMTRI. The only differences are in the legs, due to the fact that the WorldSID includes shoes (the UMTRI model does not), which positions the dummy's feet and legs slightly higher than the shoeless model. With a WorldSID seated in a car, researchers can be confident that the dummy is a proper geometric representation of a human driver.

ISO/TR 9790:1999, *Road vehicles – Anthropomorphic side impact dummy – Lateral impact response requirements to assess the biofidelity of the dummy* (see also *ISO Focus*, July/August 2004 issue) specifies procedures for evaluating side impact dummy biofidelity performance using a series of laboratory tests. Studied in the evaluation are six different body

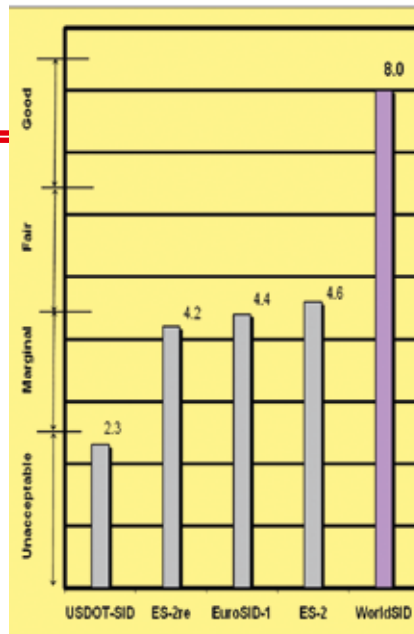
Main Focus

regions including the head, neck, shoulder, thorax, abdomen, and pelvis.

Based on the ISO/TR 9790 rating scale the WorldSID rating is 8.0 ("Good" on the 10-point scale). By comparison, other side impact dummies currently in use, USDOT-SID, ES2-re, EuroSID-1, and ES-2, have much lower ratings ranging from 2.3 to 4.6 (biofidelity details can be found in the 2009 Enhanced Safety of Vehicles (ESV) paper by Scherer et al).

Extensive data recording system

Human injuries are complex events dependent upon a variety of parameters. Head injuries can be caused by linear and rotational accelerations, while chest injuries tend to depend upon rib deflections. Leg bone fractures, on the other hand, are related to forces and moments. The WorldSID Task Group took advantage of the latest advances in miniaturized electronics to design an extensive electronic data collection and recording system for installation in the WorldSID. The WorldSID data collection system can record these types of potentially injurious loadings using a dispersed array of up to 224 electronic sensors, which are in turn wired to data recorders mounted within the dummy.



The WorldSID's biofidelity is the best of any side impact crash test dummy to date and far exceeds the performances of others.

With the data system self-contained inside the dummy, WorldSID is free to move within the car during a test without the encumbrances of the large electronic umbilical cords required with older systems that utilise external data recorders. More data sensors distributed around different body regions provide researchers with an increased understanding of crash dynamics.

Design and performance specifications

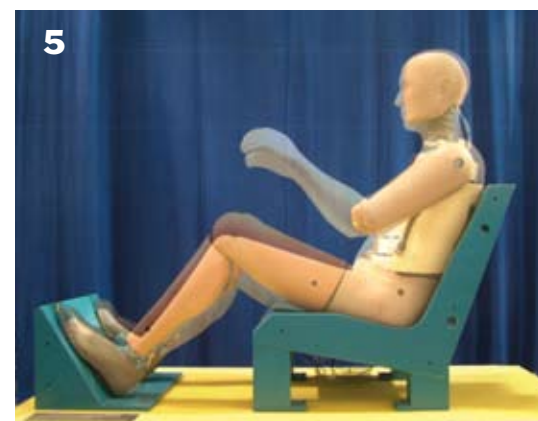
Even a technically superior dummy is of little use to the technical community if it is not well documented, easy-to-use and available. To ensure that the WorldSID is available to the worldwide research

community, the design details have been documented in ISO 15830:2005, which consists of four parts under the general title, *Design and performance specifications for a 50th percentile male side impact dummy* (WorldSID).

This documentation, consisting of nearly 500 pages plus 400 fabrication drawings and CAD files, includes all of the design details, material specifications, and performance standards required for the fabrication of the WorldSID. ISO 15830 also includes an extensive user manual and detailed step-by-step seating position procedures.

In addition to the technical items discussed above, one should not underestimate the importance of worldwide dummy harmonization. Humans are physically similar worldwide, so it is logical to have a single crash dummy to test vehicle safety. However, cars sold in different regions of the world currently utilize different safety designs because they are tested with different dummies. The introduction of a single universal dummy for regulatory and consumer testing in all regions enables manufacturers to focus and coordinate design resources to improve occupant safety rather than engineering different safety designs using different dummies.

Even a dummy can see that. ■



1. WorldSID during a full scale car air bag test. 2. WorldSID side impact biofidelity sled test. 3. WorldSID without a suit. 4. WorldSID with test suit. 5. Overlay of the WorldSID geometry and the UMTRI model.