WorldSID – A Harmonised Advanced Side Impact Dummy

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The Hybrid III 50th percentile male dummy is used all over the world for frontal impact testing however, for side impact testing, several dummies are in use. For regulatory vehicle crash testing, either the DOT SID, Eurosid-1 or SID-HIII adult dummies are used, depending on the regulatory test procedure. In addition, two other dummies: the BioSID and the SID-IIs, are used for research and development. Efforts are being made by regulators to harmonise vehicle crash test procedures across the globe. For this to be achieved a single dummy must be universally adopted. The use of several such dummies is highly undesirable for the motor vehicle industry as vehicles intended for worldwide markets may have to be tested using different dummies, which increases the cost of vehicle development with no resulting benefit to passive safety. In some cases, test results may even be contradictory. Furthermore, the biofidelity of the existing mid-size male side impact dummies is somewhat limited.

In November of 1997, ISO (the International Organisation for Standardisation) initiated WorldSID, a global project operating under the auspices of the ISO vehicle safety subcommittee: TC22/SC12. The objective of the group was to develop a harmonised, advanced mid-size male side impact dummy $(1)^{v}$. The ISO working group on crash dummies (ISO/TC22/SC12/WG5) took the unprecedented step of inviting, not only ISO member organisations, but all those involved in crash testing to come together to develop an advanced dummy that would be universally acceptable. The working group that was formed, and which is still very active, consists of participants from car manufacturers, governmental organisations, research institutes, test houses and dummy and instrumentation manufacturers.

Due to the global nature of the project, it was decided that three regional groups should be formed: one for Europe, one for the Americas and one for the Asia-Pacific region. Participation in these regional advisory groups is open to all interested parties working in the vehicle safety field. Delegations from the three regional groups meet regularly as the WorldSID Task Group, which enables decisions to be made taking into account the views of all participants in the regional groups. The Task Group reports to ISO/TC22/SC12/WG5.

Whilst the Task Group gives direction on the requirements for the new dummy it cannot perform directly the actual development work. This part of the task is performed by the WorldSID Design Team. This Design Team brings together established dummy and instrumentation manufacturers from Europe and North America, along with a European Commission sponsored consortium: SID-2000^{si}, formed to develop side impact dummy improvements. The participating organisations were selected by the Task Group on the strength of dummy segment concepts that they presented following a request for proposals issued by the Task Group. As elements of the dummy are being developed by different organisations in different countries, co-ordination of these tasks is of the utmost importance. A Programme Manager was contracted by the Task Group to take on the role of Design Team co-ordinator and also to liase between the Design Team and the Task Group.

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The project has been financed, up to delivery of the first prototype dummy, by contributions from all three of the regions. The U. S., Japanese and European car industries have made large direct contributions to funding through their industry organisations: OSRP, JAMA and ACEA respectively. The European Commission has also made a significant contribution through the participation in the development of the dummy of the SID-2000 consortium. Contributions from Transport Canada, the Australian Department of Transport and Regional Services and the U. S. National Highway Transportation and Safety Administration are funding the evaluation testing of the first WorldSID prototype. Furthermore, all costs related to the participation of Task Group and Regional Advisory Group members are met by the individual participating organisations.

The development and fabrication of the first prototype dummy will be completed during the third quarter of 2000. A period of evaluation at test sites in Australia, North America and Europe will follow and is planned to last until the third quarter of 2001. This phase will involve biofidelity, certification and directional sensitivity testing. It is planned that the ensuing further development will be financed by the purchase, by various organisations from the three regions, of a set number of pre-production dummies. The Task Group is currently endeavouring to identify a sufficient number of potential buyers. Development of the pre-production dummy is planned to commence before the end of the prototype evaluation phase and new biomechanical specifications, such as those expected from IHRA, will be considered during the pre-production phase. Extensive evaluation testing of the pre-production dummy will be carried out within the three regions and will include evaluation of all aspects of the dummy. The release of the final specifications into the public domain will permit the manufacture of the final dummy by any interested party. Release of the final specification is planned for March 2004.

The aim of the WorldSID project is not only to produce a universally acceptable, harmonised, dummy but also to produce a dummy that is clearly superior to all those currently in use. In order to ensure this, the dummy is being designed to meet the side impact dummy biofidelity requirements laid out in the ISO Technical Report, ISO TR9790 (2). The dummy is required to obtain a rating of "good" to "excellent" on the dummy rating scale given in this report (whereas current mid male dummies are at best in the "acceptable" category),. Each individual segment must also obtain this level of biofidelity in isolation.

The International Harmonised Research Agenda (IHRA) has been developing a specification for a future harmonised, worldwide regulatory procedure for side impact vehicle crash testing. This body, composed of organisations representing regulators across the world, is also developing biofidelity requirements for a harmonised side impact dummy to be used in this future test procedure. It is the objective of the WorldSID project to develop a dummy that will meet the IHRA requirements that are expected to be finalised in the near future, in addition to meeting the existing ISO requirements mentioned above. For this reason, since the beginning of its activities, the group has striven to establish and maintain strong links with IHRA.

The WorldSID dummy, which represents a mid-sized adult male, is based on recent anthropometry and mass data published by UMTRI (3). The decision to use this data was made in consultation with IHRA and taking into account recommendations made by the EEVC following a comparative study of existing anthropometry data sources.

The dummy has been developed making extensive use of new materials and numerical modelling techniques. The different elements of the dummy are briefly described below.



Head (SID-2000)^{wi}: The head is made up of a one-piece polyurethane skull and a bonded skin with no split lines. Instrumentation is mounted on a central core which can be accessed easily by removing the skull.

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Neck (SID-2000): The neck is based on the ES-2 and Eurosid-1 design. A neck shield ensures correct external geometry.

Shoulder/Thorax/Abdomen (FTSS & SID-2000): This complex comprises, in addition to three thoracic ribs, a shoulder rib and

abdominal ribs. All of these are constructed from a super-elastic alloy with a bonded damping material. An

IR-TRACC infrared sensor unit is mounted on each rib to measure deflection.

Lumbar Spine (FTSS): An original lumbar spine design has been adopted to better represent the thorax-to-pelvis relative displacement observed in human-subject testing.

Pelvis (SID-2000): The pelvis has been designed for humanlike deflection under loading and its multiple load cells will allow the detection of all load paths.





Full Arms (Denton):

An optional, complete, instrumented upper extremity will allow the analysis of occupant to airbag interactions.

Half Arms (FTSS): A half arm can be fitted for full-scale or sled testing to improve the repeatability of the dummy when the full arm is not required.

Upper Legs (Denton): The mass distribution of the thigh has been improved over that of existing dummies. A purpose-designed side impact knee is included.

Lower Legs (Denton ATD): The lower leg is instrumented with load cells. Rotation of its humanlike ankle joint can be measured. The foot will include an integrated, moulded shoe.

Load Cells (Denton), Accelerometers (Endevco): A complete package of instrumentation has been developed as an integral part of the project.

In-Dummy Data Acquisition (DTS): Up to seven optional data acquisition modules can be mounted in the dummy, with a combined capacity of over 200 data channels.



References

- 1 ISO/TC22/SC12/WG5 N542, 36th Meeting, November 5-6, 1997, Orlando, Florida, Resolution 1
- 2 ISO/TR 9790: 1999(E), Road vehicles <u>Anthropomorphic side impact dummy Lateral impact response requirements</u> to assess the biofidelity of the dummy
- 3 Robbins D. H., <u>Anthromopetric Specifications for Mid-Sized Male Dummy</u>, Final report, contract DTNH22-80-C-07502, U. S. Department of Transportation National Highway Traffic Safety Administration, December 1983

ⁱⁱⁱ also representing OSRP

iv also representing JAMA

^v Numbers in brackets correspond to the references given at the end of the text.

^{vi} 'SID-2000': European Commission Framework Programme IV, Industrial and Materials Technologies (BRITE EURAM III) RTD Basic Research Project – Project partners : TNO, INRETS, TRL, Volvo, BMW, BASt, OTSP (FTSS UK)

^{vii} The Design Team member organisation responsible for development is shown in brackets

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[&]quot; also representing ACEA