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**Items on which the exchange of views and data should
continue or begin – Harmonization of side impact dummies**

First progress report of the informal group on harmonized WorldSID dummies

Submitted by the representative of United States of America*

This document contains the first progress report of the informal group on the development of the 50th percentile male and 5th percentile female WorldSID dummies. Based on the text of Informal document No. GRSP-47-30 distributed during the forty-seventh session of the Working Party on Passive Safety (GRSP), (ECE/TRANS/WP.29/GRSP/47, para. 12), it is submitted to the World Forum for Harmonization of Vehicle Regulations (WP.29) and the Executive Committee (AC.3) of the 1998 Agreement for consideration.

* In accordance with the programme of work of the Inland Transport Committee for 2006–2010 (ECE/TRANS/166/Add.1, programme activity 02.4), the World Forum will develop, harmonize and update Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.

I. Introduction

1. During the 126th session of WP.29 of March 2002, the Executive Committee of the 1998 Agreement adopted a programme of work, which includes the exchange of information on side impact issues. At the 148th session of WP.29 of June 2009, the importance of harmonizing test tools was discussed and there was general agreement to explore opportunities to complete the development of the world side impact dummy (WorldSID) 50th percentile male and 5th percentile female side impact dummies. The United States of America hosted a meeting in November 2009 to discuss the status of the dummies and develop a task list and tentative timeline. At the 149th session of WP.29 of November 2009, the representative of the United States of America (USA) submitted in an informal document proposing the establishment of an informal group to focus on the development of the two WorldSID dummies. WP.29 provided verbal approval of this informal group, pending the approval of the formal proposal (ECE/TRANS/WP.29/2010/82). The USA volunteered to lead the group's efforts.

2. The informal group met to discuss the development of the two WorldSID dummies on:

- (a) 5 November 2009, (Washington, D.C., USA)
- (b) 4 February 2010 (Tokyo, Japan); and
- (c) 12 April 2010 (Detroit, USA).

3. The Contracting Parties represented on the informal group are Australia, Canada, France, Japan, Germany, Netherlands, United Kingdom of Great Britain and Northern Ireland (UK), United States of America and the European Commission. Experts from European Association of Automotive Suppliers (CLEPA), International Organization of Motor Vehicle Manufacturers (OICA), and ISO are also participants.

4. The next meeting is scheduled for 22 September, 2010 in Germany.

5. This report summarizes the main issues discussed by the informal group in evaluating the proposal to develop a WorldSID 50th percentile male and a WorldSID 5th percentile female dummy.

II. History and description of the WorldSID dummies

A. WorldSID 50th percentile male

6. Development of the WorldSID 50th percentile male dummy began in June 1997 with a resolution by the International Organization for Standardization (ISO) ISO/TC22/SC12/WG5 to establish a task group. This task group consisted of many government and industry organizations worldwide. Through this collaboration, the group conducted extensive testing and evaluation, and prepared the drawings and users manual. In 2008, the task group finished the biofidelity assessment. They are currently working on risk curves for the injury measures and a practical seating procedure.

7. The WorldSID 50th percentile male dummy has a standing height of 1753 mm, seating height of 911 mm, and a mass of 77.3 kg. It has symmetrical response (left/right) and is able to be used in side impacts up to $\pm 30^\circ$ from the pure lateral impact direction. The dummy biofidelity was evaluated using both the ISO TR9790 method and the Highway Traffic Safety Administration (NHTSA) Biofidelity Ranking System (BioRank) method. In

both cases, the WorldSID dummy was shown to have considerably better biofidelity than the Euro Side Impact Rib Extension dummy (ES-2re). NHTSA's preliminary evaluation of the dummy's durability, repeatability, and reproducibility indicate that the dummy appears to be suitable for regulatory testing.

B. WorldSID 5th percentile female

8. The development of the WorldSID 5th percentile female dummy began in 2004 and was coordinated under the Advanced Protection Systems project (APROSYS). This group was a consortium of 51 partners, including automobile manufacturers, suppliers, research organizations, and universities, and led by the Nederlands Instituut voor Toegepaste Geowetenschappen (TNO). This group developed a working prototype of the dummy and conducted biofidelity, reproducibility, repeatability tests, and preliminary injury criteria. The group effort was completed in March 2009. Additional durability and component and system testing will be necessary.

9. The WorldSID 5th female dummy was designed to the anthropometric specifications defined in a study conducted for NHTSA and has a total weight of 48.3 kg. The biofidelic responses of the dummy female dummy were scaled from the WorldSID 50th male dummy. In biofidelity testing conducted by APROSYS, the WorldSID 5th female was found to have a similar biofidelity rating to that of the WorldSID male and superior biofidelity when compared to the Side Impact Dummy IIs (SID-IIs). A series of tests conducted on three dummies showed the results to be repeatable and reproducible. Additional pole tests conducted suggest the dummy is suitably robust.

C. Status of research on worldSID dummies

1. NHTSA

10. NHTSA has extensively tested the WorldSID 50th percentile male dummy for durability, repeatability, reproducibility and biofidelity. NHTSA concluded that WorldSID 50th percentile male dummy has better biofidelity than the ES-2re dummy and is continuing its testing of the WorldSID 50th percentile male dummy in full vehicle crash tests. NHTSA has published its analysis of WorldSID 50th at Enhanced Vehicle Safety 2009 and other venues. NHTSA is conducting the final review of the drawings and plans to complete the full evaluation of this dummy by mid 2011.

11. NHTSA has taken receipt of two WorldSID 5th percentile female dummy in April 2010, one of which has the updated legs. NHTSA has begun a full evaluation of the dummy per standard NHTSA protocol. First Technology Safety Systems (FTSS) has stated that should be able to provide the 5th percentile female dummy drawing package to NHTSA in the May/June 2010 timeframe, for a confidential review. With regard to public accessibility of the drawing of the 5th percentile female dummy, NHTSA is in discussions with FTSS at this time and hopes to have a resolution to the problem soon. The evaluation of the 5th female WorldSID is expected to take until the 3rd quarter of 2013.

2. Transport Canada

12. Transport Canada is currently focusing on several WorldSID activities which include evaluation of multi-point sensing techniques (e.g., Ribeye), onboard data acquisition, and finalization of the seating procedure (with ISO).

13. Additionally they are conducting crash testing and biofidelity assessment of the WorldSID 5th female dummy. Canada is working with FTSS to update their two 5th female

dummies. One will have the old legs; the other will have the revised legs. It will take several months to evaluate the test data before the results can be reported.

3. Ford

14. Ford has an early version of the WorldSID 5th percentile female dummy, but has no budget at this time to update it.

4. First Technology Safety Systems

15. FTSS has two fully updated WorldSID 5th percentile female dummies and has been conducting testing with Autoliv. Autoliv will share the results of these tests when analysis is completed. A two dimensions Infra-Red Telescoping Rod for the Assessment of Chest Compression (2D IR-TRACC) is now available for this dummy and a rib ballast clamp has been developed. There has been a lower leg update which is called the replacement leg. There was discussion about the various incarnations of the dummy and it was agreed that there was an original dummy, a revised dummy also called Phase II and now a replacement leg. The APROSYS work was done with both the original and revised dummies.

16. At the second WorldSID meeting in Tokyo, there was discussion concerning the difficulty in adjusting the feet of the 50th percentile male dummy. A preliminary design for the 50th ankle has been developed. This presentation discusses options for using a scaled version of the 50th ankle for the design of the 5th percentile female ankle. Neither the 50th percentile male or 5th percentile female ankle has been evaluated against biofidelity corridors. FTSS is open to comment and suggestions on these proposed modifications.

4. European Enhanced Vehicle-safety Committee (EEVC)

17. The WorldSID 50th percentile male dummy was extensively tested by European Enhanced Vehicle-safety Committee (EEVC) Working Group 12 (WG12). They concluded that the 50th percentile male dummy had better biofidelity than the ES-2 dummy and that the design requirements were fulfilled. There is some concern over the IR-TRACC deflection measurement method and also the WorldSID is smaller than the ES-2 dummy depending on the seating position used. EEVC is in the process of finalizing the report of the research project using the 50th percentile male dummy conducted by the Transport Research Laboratory (TRL) for the UK Department of Transport. WG12 would like to review NHTSA WorldSID test data when available, help in the analysis of injury risk curves and set up a test program to continue evaluation based on previous information.

18. At the recent Steering Committee meeting of EEVC, there was discussion of research focused on the WorldSID 5th female, but there are no firm programs in place.

5. European Commission

19. The APROSYS project was funded by the European Commission and its mission focused on the development and assessment of the WorldSID 5th female dummy. The dummy showed good biofidelity, repeatability, and reproducibility, although only a few dummies are available at this time for testing. Preliminary risk curves were developed but more test data is required to gain confidence in the data. Some crash reconstructions were performed with the dummy and it performed well while sustaining little damage from the severe tests. The EEVC recommends a coordinated evaluation program for the dummy to address the issues raised in the development. EEVC is preparing a status report on all the information relative to testing of this dummy and was to be available near the end of 2009. The European Commission is investigating whether they can fund a project to aid with the WorldSID research efforts. Early indicators are promising.

6. International Organization for Standardization

20. ISO WorldSID group is conducting their biofidelity rating process based on the results from the APROSYS 5th evaluation project. The existing tests included in the biofidelity study as specified in the ISO 9790 procedure were reviewed and it was noted that some are being deleted and others are being added. For the WorldSID 5th percentile female dummy, it was noted that the drop tests have not been done, because a testing organization has not yet been identified to conduct the testing. Additionally for impactor tests, the WorldSID seat should not be used and the dummy should be seated upright. Also, it was noted that the spherical impactor face should be used for pelvis tests. It is not clear which version of the dummy was used for the neck testing in the APROSYS tests. For sled testing, no foam supports should be used because they affect the dummy response as compared to the post mortem human subjects (PMHS) response. Mr. Jensen suggested that the prototype WorldSID 5th should not be used for either biofidelity or injury risk curve development. It is expected that the new ISO 9790 tests should be completed soon, but an exact date could not be specified.

21. There was a question on whether oblique tests would be conducted and it was noted that currently there are no oblique thoracic tests in the ISO procedure. It was agreed that this was important, but ISO 9790 requirements should be the priority.

22. It was recommended that there be detailed descriptions of the test conditions that are being performed such that others can be sure of what exactly is being measured so that there is no confusion or uncertainty with the results. Similarly, the data processing should be clearly described. It was stated that the collaboration on the WorldSID 50th percentile male dummy under the auspices of the ISO WorldSID Group, has been excellent and that it should be the model for the 5th evaluation. This statement met with general agreement.

7. Japan Automobile Manufacturers Association, Inc.

23. Japan Automobile Manufacturers Association, Inc. (JAMA) conducted an evaluation of the WorldSID 50th percentile male and the 5th female dummies. This work was completed in 2008-2009 and included shoulder and thoracic impact data. The results were quite good. Results from one Federal Motor Vehicle Safety standard (FMVSS) 214-type full-scale test were also presented. Some differences were noted between the WorldSID 5th and SID IIs response in the test, however the WorldSID 5th was judged to be quite good as compared to the SID IIs. It was indicated that the dummies were equipped with 1D IRTRACC versus 2D. JAMA will have further discussions on whether they will be able to conduct more testing using the 5th female, if one becomes available.

D. Task list

24. The informal group has developed a list of tasks the need to be completed for each dummy and an estimated schedule for completion (see Table 1).

1. Drawings

25. The ISO WorldSID group has indicated that they will modify then the drawings of the 50th percentile male dummy accordingly in collaboration with NHTSA to exclude vendor names, part numbers or product specific descriptions included. Until the on-board data acquisition specification effort is complete, the drawings cannot be finalized.

26. During the discussions, it was requested that the drawing package for both dummies would be in three dimensions. It was indicated this would be a desirable development for dummy drawings. The question was discussed with no conclusion.

2. User's manual

27. There are several versions of the WorldSID 50th percentile male dummy manual: ISO, WorldSID task group, and NHTSA. ISO was tasked to draft a manual in ISO format. Revision 1 of this manual is expected to be completed in the next couple of months. While the ISO manual is expensive, the manual developed by the WorldSID task group is free. Additionally, NHTSA is finalizing its Procedures for Assembly, Disassembly, and Inspection (PADI) manual. At this time there is no problem having the three manuals, as long as there are no contradictions, but the group will need to review various versions and decide on submission of a final package to WP.29.

3. Onboard data acquisition system

28. A need has been identified to allow for the use of an onboard data acquisition system (DAS) in both the 50th percentile male and 5th percentile female dummies. An ISO WorldSID meeting was held in the fall of 2009, in which an approach to resolving this issue was developed in collaboration with NHTSA personnel. Areas within the dummy envelope will be identified as "gray space" where data acquisition components can be located. These spaces will be similar to existing space used by the DAS components, but will be enlarged to the extent possible. Any data acquisition supplier can utilize this gray space for their equipment, but they cannot change the regional and overall mass properties of the dummy more than a given tolerance. That tolerance will be determined through an analytical modeling effort.

29. NHTSA and the Partnership for Dummy Technology and Biomechanics (PDB) have been communicating on how to go forward with a simulation effort. PDB has committed to supporting the project and held an internal PDB meeting to discuss how they would support. NHTSA, PDB, and ISO needed to discuss how to finalize the effort. FTSS has a Finite Element (FE) model for the 5th female, but it needs to be upgraded. A model of a 50th percentile male dummy has been in existence for some time. Status of efforts will be provided at the September 2010 meeting.

4. Seating procedure

30. The ISO group is continuing work to develop seating procedures for the 50th percentile male dummy in the front seat. They are having problems resolving differences in how to address seat back height and seat back angle. The group is currently incorporating new data and plan to provide an update on the efforts in September 2010. Once the issues are resolved, the ISO group will start the development of rear seat seating procedures for the 50th percentile male dummy and then start the seating procedures for the 5th percentile female dummy. It was brought up that a fundamental question is whether the seating position should be the most frequently observed or the one with the most injury risk.

5. Advanced instrumentation

31. There are some concerns about the one dimension (1D) IRTRACC's ability to measure deflection in the chest and there has been discussion on the replacement of the 1D IRTRACC with the 2D IRTRACC. The experts from Canada and the UK, with support from TRL, met at the end of April 2010 to discuss the status of vehicle testing using the 50th percentile male dummy with the 2D IRTRACC. Results are expected by September 2010. It was noted that there is interest from EEVC in this effort. NHTSA stated that they plan to conduct research with the 2D IRTRACC in the 5th percentile female dummy and plan to form a subgroup under the WorldSID group to focus on this issue. NHTSA plans to hold a subgroup meeting during summer 2010 and to provide more details during the September 2010 informal group meeting.

32. Transport Canada has also been conducting testing with the RibEye deflection measurement system. This testing has produced a lot of data that needs to be analyzed. The Medical College of Wisconsin has offered to assist in the data analysis. Additionally, they may be able to do some sled testing to compare the RibEye and the ITRACC measurement devices.

6. Data Repository for WorldSID 5th female data

33. The ISO group will verify that they can use the WorldSID 50th percentile dummy archive website to store data from the WorldSID 5th percentile dummy. Dynamic Research Inc. will provide more info on gaining access to the data repository.

7. Certification procedures for 5th female

34. FTSS has a 5th percentile female dummy User's Manual that they can provide to the group. This can be used as a starting point. The group will need to define a set of test procedures to ensure repeatability among labs. Before NHTSA begins the evaluation of its two 5th percentile female dummies, it will host a meeting to develop/define the reproducibility and repeatability procedures.

(a) Injury risk curves

35. The ISO group is continuing to work on developing injury risk curves and the work seems to be going quickly. Preliminary 50th percentile male dummy risk curves were published at the 2009 Stapp Conference and the ISO group is working on determining which curves best represent the data used. They also indicate that they will be starting the 5th percentile female dummy risk curve analysis using scaling techniques. ISO plans to provide a summary of the test configurations in which 5th percentile female dummy and PMHS data is still needed. An excel spreadsheet will be distributed with proposed tests. European Car Manufacturers Association (ACEA) has committed to begin funding this research in this area starting at the end of 2010.

