Evaluation of the small female side impact dummy in current and future side impact test procedures

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Evaluation of the small female side impact dummy in current and future side impact test procedures

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Publishable summary

The purpose of the APROSYS SP5.2 project was to develop an advanced worldwide accepted small female side impact dummy the WorldSID 5th female as a replacement for the current used SID-IIs. The project is also monitored by the WorldSID Task Group which developed a harmonized midsize male side impact dummy the WorldSID 50th male to ensure a worldwide acceptance.

The second evaluation phase of the revised WorldSID 5th female prototype comprised a series of full scale tests to assess the performance of the new dummy under real test conditions. Four Full scale vehicle tests were conducted according to the IIHS test protocol and the FMVSS214 75 degrees pole test.

This report describes the results of the full scale tests conducted.

The dummy found to be generally robust; however the tests also identified some shortcomings that need addressing on the short term. A broader evaluation should be started by OEM's and stakeholder groups. Further full scale testing should be executed. Further comparison of SID-IIs and WorldSID small female based on available injury criteria was recommended. For the longer term, an issue management process should be started, by maintaining a list of user feedback centrally for discussion and resolution by stakeholder groups. It was recommended to start working on evaluation based on 2D IR-Tracc or other multi-direction sensitive chest sensors as soon as possible. Also, it appeared that the WorldSID small female position procedure is not developed and that further activity is needed.

Acknowledgement

Following participants contributed to this deliverable report.

Company	**Representative**	**Chapters**
PDB	Bortenschlager K.	all
Daimler	Hartlieb M.	all
Volkswagen	Hohmann C.	1, 2, 3, 4
Audi	Kramberger D.	all
FTSS	Been B.	1, 4, 5, 6
ACTS	Pfeifer G.	4

Table of contents

1 Introduction

The purpose of the APROSYS SP5.2 project was to develop an advanced worldwide accepted small female side impact dummy the WorldSID 5th female as a replacement for the current used SID-IIs. The project is also monitored by the WorldSID Task Group which developed a harmonized midsize male side impact dummy the WorldSID 50th male to ensure a worldwide acceptance.

The second evaluation phase of the revised WorldSID 5th female prototype comprised a series of full scale tests to assess the performance of the new dummy under real test conditions. Two full scale vehicle tests were conducted under the test method of IIHS [i]. And one test was conducted under the 75 degrees pole test [ii]. Both test conditions are mandatory for vehicles on the North American market. However in those cases the tests are performed with the current generation small female dummy, the SID-IIs. Two WorldSID 5th female prototype dummies were positioned on the driver and rear seat in the IIHS test protocol. In the 75 degrees pole test only a driver dummy was present. These tests allow comparison to the small female side impact dummy of the first generation, the SID-IIs, as test data with this dummy are already available. Because of the very short period available for testing (1month), it was not possible to organize tests at individual OEM labs, because of the considerable packing-unpacking-, transportation- and preparation time involved. It was decided to run all the tests at an independent crash lab, ACTS, located at Sailauf, Germany. The tests were witnessed by the experts from the OEM's.

Preliminary Injury Criteria for the small female WorldSID were developed within the APROSYS project [iii]. The criteria were applied to the test data, to enable comparison of the two dummies.

This report provides a summary of the full scale vehicle test. Complete details of the tests can be found in separate technical reports, see Table 1: Report structure current deliverable.

Table 1: Report structure current deliverable

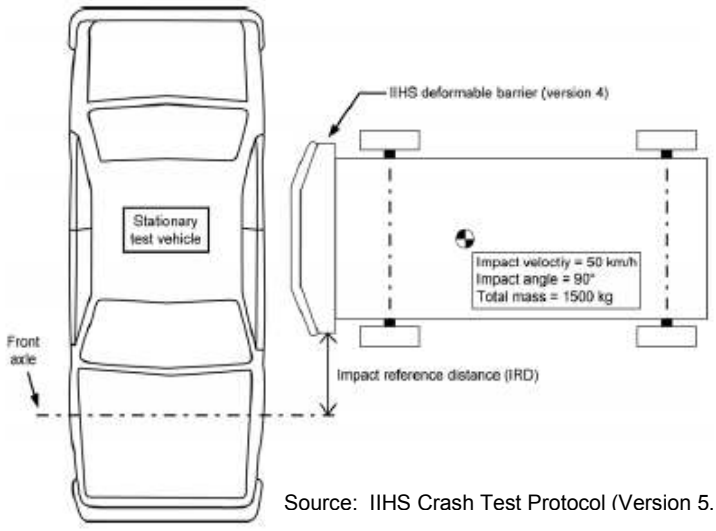
Deliverable	Report Nr	Title	Lead company
D5.2.11	AP-SP52-0063	Summary Report: Evaluation of the small female side impact dummy in current and future side impact test procedures	PDB
Technical report	AP-SP52-0075	Mercedes E-class in IIHS mobile deformable barrier	PDB
Technical report	AP-SP52-0066	Volkswagen EOS in IIHS mobile deformable barrier	PDB
Technical report	AP-SP52-0077	AUDI A4 in 75 degrees pole test	PDB

2 Objectives

The objective of these tests is to evaluate the WorldSID 5th female prototype under real full scale crash conditions. The tests conducted were chosen based on the actuality of the test procedures. IIHS barrier test (Figure 1) as well as the FMVSS 214 oblique pole impact test (Figure 2) is used to assess the occupant protection potential of cars by a lateral side impact. The IIHS test set-up consists of the stationary test vehicle on the driver's side impacted by a crash cart fitted with a deformable barrier element specified by IIHS which simulates the typical front end of a SUV or pickup. The FMVSS 214 oblique pole impact test was recently released by NHTSA. The test is a dynamic vehicle-to-pole test, where the test vehicle will propel sideways into a rigid pole at an angle of 75 degrees. This severe test procedure was introduced by NHTSA to improve side impact restraint systems for mid-size and small occupants.

The data obtained with the WorldSID 5th female prototype were compared with the currently used regulatory side impact dummy SID-IIs (Build Level D) in identical tests. An assessment of the dummy performance in terms of the sensitivity, durability and handling was also part of the evaluation.

IIHS Side Impact Crash Test Set-up



Source: IIHS Crash Test Protocol (Version 5. 2008)

Figure 1: Moving deformable barrier in allignment with test vehicle

FMVSS 214 Lateral Pole Impact Test Set-up

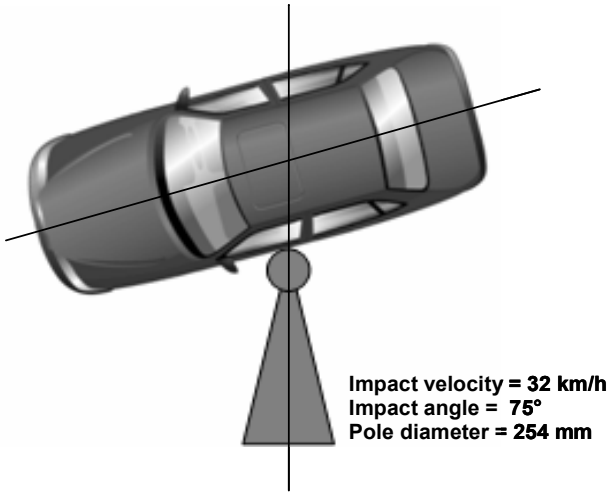


Figure 2: FMVSS 214 - Lateral Pole Impact

3 Test set up

3.1 IIHS

3.1.1 Mercedes E-class

Full Scale Side impact crash test, in accordance to IIHS (Version V, April 2008) with following vehicle:

	Daimler AG, E-Class
Type:	W211
Market:	-
Driver side:	LHD

Speed tolerance IIHS: 50 km/h ±0.8 Actual impact velocity: 50,08 km/h
Barrier weight: 1500 kg

Driver	Dummy type:	WorldSID 5th	Dummy No: WF SN002
Passenger	Dummy type:	WorldSID 5th	Dummy No: WF SN001

Figure 3: Crash set up overview E-class

Figure 4: Top view of crash set up E-class

Figure 5: Driver Overview E-class

Figure 6: Passenger Overview E-class

Figure 7: Driver Detail E-class

3.1.2 VW EOS

Full Scale Side impact crash test, in accordance to IIHS (Version IV, April 2005) with following vehicle:

Type:	Volkswagen, Eos
Market:	-
Driver side:	LHD
Vehicle Ident no.:	-
Vehicle no.:	-

Driver	Dummy type:	WorldSID 5th	Dummy No: WF SN001
Passenger	Dummy type:	WorldSID 5th	Dummy No: WF SN002

Speed tolerance IIHS: 50 km/h ±0.8 Actual impact velocity: 50.05km/h
Barrier weight: 1500 kg

Figure 8: Crash set up overview VW EOS

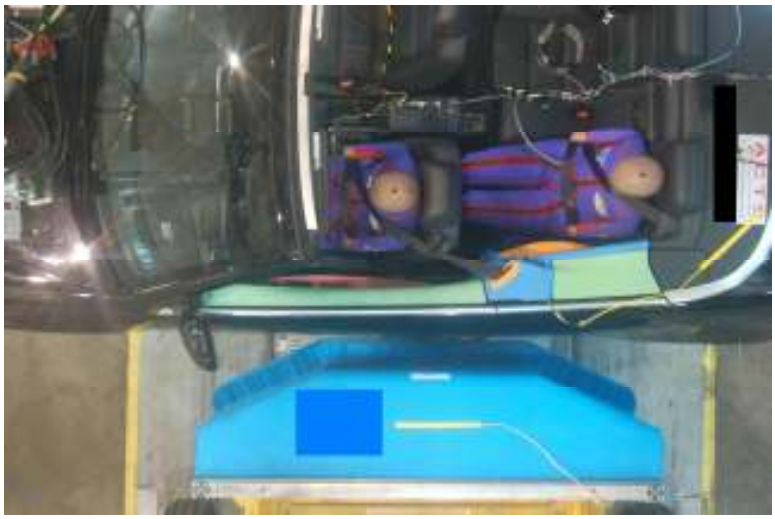


Figure 9: Top view VW EOS crash set up

Figure 10: Driver Overview EOS

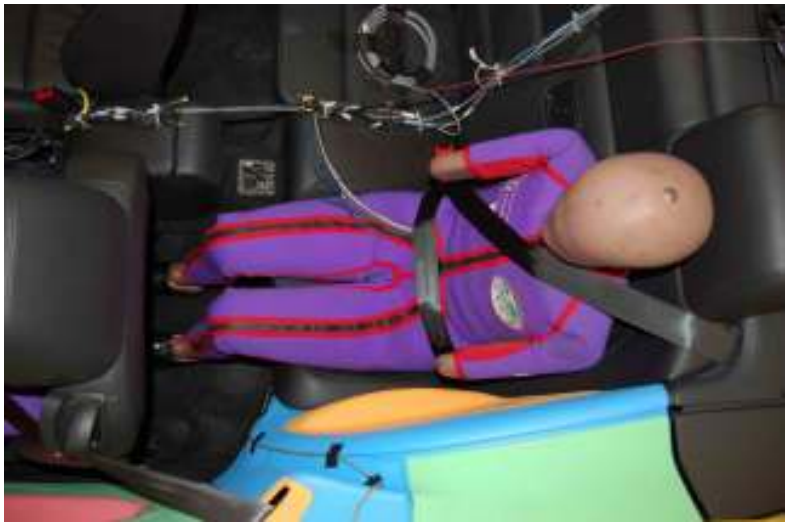


Figure 11: Top view passenger

Figure 12: Driver Detail EOS

Figure 13: Passenger Detail EOS

3.1.3 Mercedes C-class

Full Scale Side impact crash test, in accordance to IIHS (Version IV, April 2005) with following vehicle:

Type:	Daimler AG, C-class
Market:	-
Driver side:	LHD
Vehicle Ident no.:	-
Vehicle no.:	-

Driver Dummy type: WorldSID 5th Dummy No: WF SN002

Speed tolerance IIHS: 50 km/h ±0.8 Actual impact velocity: 50 km/h
Barrier weight: 1500 kg

3.2 75 degrees pole test

Testtype:	FMVSS 214 pole 75° side impact left (velocitiy 32 km/h)
Testobject:	Audi A4 (2008), 4-door mid size car
Driver Side:	LHD
Restraint – Systems:	3 point safety belt, pretensioner, side airbag (thorax), curtain (head)
Dummy:	WorldSID 5th percentile female dummy

Rated velocity FMVSS 214:	32 km/h
Actual impact velocity:	32.28 km/h

Figure 14: Top view oblique pole crash set-up

Figure 15: Driver position

4 Test results

4.1 Comparison based on injury criteria

4.1.1 Mercedes E-class IIHS driver and passenger

Driver data:

Unfortunately, no data from the WorldSID 5th female on the driver position could be obtained. The in-dummy data acquisition system triggered prior to the event, so that the record time was finished before the impact. No true reason could be found, even though ACTS and DTS did undertake extensive investigations.

Passenger data:

Segment	Criterion	SID-IIs	IIHS Limits for SID-IIs (Good to Acceptable)	Ratio criteria SID-IIs	Ratio criteria WS5F	Preliminary criteria APROSYS	WorldSID 5th REV1 Prototype
Head	HIC - 15		623			1000	
	res. Acceleration 3ms [g]					NA	
Shoulder		21					27
Thorax	Rib 1 [mm]	31			0.81	21	17
	Rib 2 [mm]	34			0.81	21	17
	Rib 3 [mm]	37			0.90	21	19
Abdomen	Rib 1 [mm]	34			0.46	37	17
	Rib 2 [mm]	27			0.32	37	12
	Average Rib Deflection	32.6	34	0.96			
	Acceleration T12 [g]						
Pelvis	Force Iliac + Acetabelum [kN]		5.1			1.24	
	Pelvis acceleration [G]					42	

4.1.2 VW EOS IIHS driver and passenger

Driver data:

Segment	Criterion	SID-IIs	IIHS Limits for SID-IIs (Good to Acceptable	Ratio criteria SID-IIs	Ratio criteria WS5F	Preliminary criteria APROSYS	WorldSID 5th REV1 Prototype
Head	HIC - 15		623			1000	
	res. Acceleration 3ms [g]					NA	
Shoulder		46.53					33.45
Thorax	Rib 1 [mm]	49.68			-	21	failure
	Rib 2 [mm]	47.88			-	21	failure
	Rib 3 [mm]	43.79			-	21	failure
Abdomen	Rib 1 [mm]	32.84			0.46	37	17.01
	Rib 2 [mm]	22.68			-	37	failure
	Average Rib Deflection	39.37	34	1.16			
	Acceleration T12 [g]						
Pelvis	Force Iliac + Acetabelum or Pubic force [kN]	0.54	5.1	0.11	0.50	1.24	0.62
	Pelvis acceleration [G]	66.8			1.63	42	68.54

Passenger data:

Segment	Criterion	SID-IIs	IIHS Limits for SID-IIs (Good to Acceptable	Ratio criteria SID-IIs	Ratio criteria WS5F	Preliminary criteria APROSYS	WorldSID 5th REV1 Prototype
Head	HIC - 15		623			1000	
	res. Acceleration 3ms [g]					NA	
Shoulder		39.65					42.77
Thorax	Rib 1 [mm]	34.73			0.76	21	15.97
	Rib 2 [mm]	32.99			0.52	21	10.87
	Rib 3 [mm]	25.84			0.24	21	5.06
Abdomen	Rib 1 [mm]	22.57			0.23	37	8.59
	Rib 2 [mm]	18.25			0.14	37	5.22
	Average Rib Deflection	26.88	34	0.79			
	Acceleration T12 [g]						
Pelvis	Force Iliac + Acetabelum or Pubic force [kN]	0.56	5.1	0.10	0.48	1.24	0.59
	Pelvis acceleration [G]	37.3			1.14	42	48.06

4.1.3 AUDI A4 FMVSS214

Driver data:

Segment	Criterion	SID-IIs	FMVSS 214 Limits for SID-IIs	Ratio criteria SID-IIs	Ratio criteria WS5F	Preliminary criteria APROSYS	WorldSID 5th REV1 Prototype
Head	HIC - 36	362	1000	0.36	0.34	1000	339
	res. Acceleration 3ms [g]	53				NA	52.83
Thorax	Rib 1 [mm]	25			0.76	21	15.94
	Rib 2 [mm]	17.8			-	21	failure
	Rib 3 [mm]	19.9			-	21	failure
Abdomen	Rib 1 [mm]	29.4			0.95	37	35.17
	Rib 2 [mm]	28.5			-	37	failure
	Acceleration T12 [g]	45	82	0.55			51.8
Pelvis	Force Iliac + Acetabelum or Pubic force [kN]	3.206	5.525	0.58		1.24	NA
	Pelvis acceleration [G]					42	

4.2 Dummy performance

4.2.1 Positive feedback

1. Easy to position.
2. Humanlike and realistic seating posture.
3. In general the handling and the construction of the dummies is good according to the dummy size.
4. Improvements based on the WorldSID 50th experience, like for example the neck angle adjustment mechanism and single rib sternum couplers are very helpful in the use.
5. Other than an IR-Tracc ball joint failure in the E-class IIHS test, no other mechanical failures were reported. The 75 degree pole test is generally accepeted as being a sever test condition and often leading to hardware problems with the SID-IIs dummy. The VW EOS driver dummy was loaded exceeding the preliminary SID-IIs assessment criteria by more than 40% in the thorax. It is a pitty that no chest deflection data were collected in the WS5F dummy because of electrical failures of the IR-Tracc, that could indicate the severity of the test for the WS5F dummy. However neither mechanical failures were sustained in the EOS (severe) test.

4.2.2 General problems Dummy Hardware

1. Exit cable bundle between chest and Pelvis position coincides with the lap seatbelt area.

2. Femur flesh is too small. The problem was investigated and it was found that the femur DAS structural replacement is too large for the cavity and needs a modification.

3. During lifting of the dummies the legs hang down and the pelvic flesh may be damaged if this occurs frequently. It was suggested to add a leg lifting support to the dummy lifting bracket.

4. The dummy suit appears to be very tight; the zipper at the upper body is under significant tension.

5. Holes in the suit for H-point tool were missing in one of the dummy suits. Only one of the suits was updated with additional holes.

6. Shoulder ball joint connection to shoulder bracket was not stable. A modification would be recommended, for instance machining from one piece raw material.

7. ACTS staff reported that the dummy lifting bracket is a great aid for dummy positioning, but it needs improvement in terms of handling. It is very difficult to align the dummy threaded holes with the tubular structure on the lifting bracket. Especially when the dummy is seated in the car, it was nearly impossible to mate the screws. It was proposed the split the bracket at the top, with a screw fixation. This would really improve attaching and dismounting the lifting bracket to and from the dummy.

8. Unclarity about pelvis angle measurement.

9. Positioning of the WorldSID 5th is different compared to SID-IIs especially the symmetrically adjustment of torso regarding the x-z-plane. While the SID-IIs is more or less a stiff dummy, the WorldSID has a very soft lumbar spine which results in a weak coupling of pelvis and torso. Therefore the tilt orientation of the WorldSID torso around x-axis is possible without any movement of the pelvis. So, it should strongly recommend to adjust separately the pelvis as well the torso symmetrically regarding the x-z-plane.

10. Missing click stop of arm.

11. Pelvis flesh is in contact with lower abdominal rib (Figure 16).

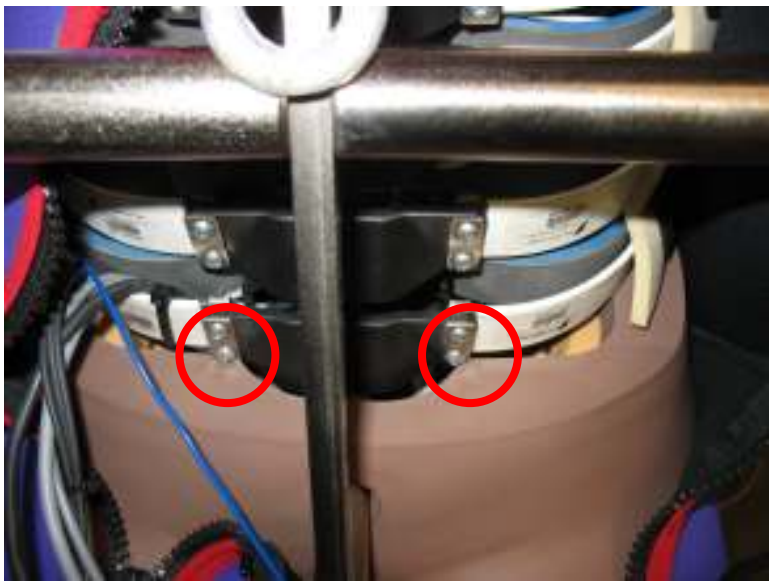


Figure 16: Pelvis flesh contacts lower abdominal rib

12. Pelvis belt slips over pelvis flesh into abdominal area – should be considered to take into account for the next dummy update.

13. Frequent loss of data of IR-Tracc were experienced in 2 out of 4 tests. Loss of IR-Tracc data occurred only with SN001 dummy and did not occur the first test, but in two consecutive tests after the first test. VW EOS 4 out of 5 ribs failed; AUDI 3 out of 5 IR-Traccs failed. In dummy SN002 no IR–Tracc data failed. The source of the failure has not been found. One thing remains a big puzzle, is that problems started with the second test and repeated in the third test. Because of general practice, we can assume that the data

was checked and the fault discovered and corrected before the third test. Yet the problem appeared again, so the following questions arise: was the problem discovered and corrected; was the problem such that in a dry test there is no problem and only appears under high accelerations in a vehicle? Possible hypothesis: a) problems with the Hybrid development state of the data acquisition and cable system in this dummy. The SN001 dummy used the old omnetics strip connectors, but the IR-Traccs were executed with new circular connectors with protected pins. The IR-Traccs were connected with an additional adaptor cable. b) Another possible source is the wire to the small end of the IR-Tracc. The outer sleeve was seen to be damaged sometimes causing potential shortcut problems, but not occurring all the time. Maybe the results is that the IR-Tracc works perfectly in a pre test run ('dry test') and fails during a crash because of higher mechanical load. This must be further investigated.

4.2.3 Test overview dummy positions and problems

Test 1 (Daimler IIHS) Position driver 1, Dummy #002, Position Rear seat passenger, Dummy #001

1. Loss of all test data from Dummy #002. Problem was investigated by ACTS and DTS but the true source was not identified.
2. Broken IR-Tracc ball joint. Thorax rib 1 due to large forward deflection of the IR-Tracc.

Test 2 (Audi Pole) Position 1, Dummy #001

- 3 IR-Traccs data failures dummy #001

Test 3 (VW IIHS) Position 1, Dummy #001, Position 4, Dummy #002

- 4 IR-Traccs data failures dummy #001

Test 4 (Daimler C-class IIHS) Position 1, Dummy #002

- The measurement equipment worked reliable. No failures and problems are reported..

4.3 Data acquisition system problems

1. ISO MME codes were not available for the IR-Tracc rotation.

2. About 60% of the Approx. 60% of the Data Acquisition preparation time is software-conditioned waiting period. Especially annoying with appearing error messages or ending of menu functions by the operator (f.i. trigger tests), always lead to a complete restart of the calibration and pre-test routines and related unnecessary waiting time and delays.

3. Complicated handling of DAS settings (f.i. changes in ISO codes, or channel position in the dummy). No helpful tool available for batch processing of sensor information, such as a text editor. All sensors must be adjusted manually. Risk of corruption of the Test Set-up File. (Note from editor: there is an MS-EXCEL editor possibility in DTS).

4. Strong noise level on measurement channels of about 1% of measurement range.

5. Unequivocal signal offset step at time zero, according to statement of DTS caused by a status change of an internal switch (light-emitting diode). This can be cured by an additional, internal wiring in the G5 module, according to DTS.

6. Default use of the entire memory (circular buffer mode, according Messring example) to have more possibilities for the data recovery after a trigger failure.

7. Some channels had a high offset from zero.

8. Charge status of internal battery and capacity is not indicated.

9. Kombi-Triggering (analog and threshold) is not possibly. Error message appears very late not earlier then at arming.

10. Saturation of IR-Tracc signal appeared.

5 Analyses/discussion

5.1 Mercedes E-class IIHS

The analyses of the test results were done in comparison with an identical test conducted with a SID-IIs dummy.

A seating procedure for the WorldSID 5th female is not available at this time. By using the UMTRI positioning procedure, almost the same final H-Point as in a comparative test (same vehicle) with SID-IIs could be achieved. The seating position of the WorldSID 5th is in a more automotive / slouched position than the SID-IIs. The positioning of both, the front and rear seated WorldSID 5th was easy.

Unfortunately, the WorldSID 5th which was positioned at the driver seat had experienced an unknown failure of the in-dummy DAS which results in a total loss of all dynamic measurements – no channel was recorded. Therefore, only a kinematic assessment could be made. The kinematic of the WorldSID 5th in the driver position was similar to the SID-IIs. However, the WorldSID 5th tends more to twist towards the impact zone. The reason for this twist behaviour can possibly be based on the softer lumbar spine of the WorldSID 5th which has the capability to decouple the upper and lower body.

Measurement data from the rear seated WorldSID 5th could be obtained without problems. The analysis of the dynamic responses exhibits significant lower rib deflections as in a comparative test with SID-IIs. Moments and forces show similar comparable values.

5.2 Mercedes C-class IIHS

One WorldSID 5th female prototype positioned on the drivers seat were used in this test. The seating procedure of the WorldSID 5th female were applied according to the UMTRI positioning procedure. The analysis of the test data is still ongoing, because of the scheduled test near the delivery deadline of this report. Therefore, no detailed results can be provided at this time. However, the WorldSID 5th female prototype worked reliable according to the information available so far.

As soon as the data are analysed, a report will be drafted and provided to the SP5.2 members.

5.3 Audi A4 FMVSS 214

The analyses of the test results were done in comparison with an identical test conducted with a SID-IIs dummy.

The seating position of the WorldSID 5th prototype compared to the SID-IIs was different. This is based on the differences in the anthropometry of both dummies. A seating procedure for the WorldSID 5th female is not available at this time. Therefore, the positioning of the WorldSID 5th female was focused on a comparable thorax position of the SID-IIs. This results in different values of the static measurement values. Due to the different pelvis shape, the H-Point of the WorldSID 5th was 30 mm more forward and 40 mm higher than compared with the SID-IIs. In order to keep the WorldSID 5th ribs horizontal the seat angle was adjusted to 15.3° which is 5.3° more backward than the seat angle measured with the SID-IIs. Therefore, the head CG of the WorldSID 5th female was located 30 mm more backward and 30 mm higher. An exact comparison of both dummies cannot be done because of the different locations of the dummy parts in the impact zone of the vehicle.

The WorldSID 5th female prototype exhibits slightly lower values in the head injury criterion HIC. A clear lower deflection in the upper rib of the WorldSID was measured compared to the SID-IIs. The deflection measurement of the middle and lower thorax ribs of the WorldSID 5th are missing due to an unknown failure. Abdominal rib 1 deflection exhibits higher values compared to the SID-IIs. The

measurement value of the abdominal rib 2 is also missing. The T12 acceleration of the WorldSID 5th exhibits higher values, too. The abdominal area of the WorldSID 5th female prototype seems to be more sensitive to the loading condition in the pole impact. This reason for this higher sensitivity can be the new design of the lumbar spine with a higher flexibility which has the capability to decouple the thorax-plevis complex.

5.4 VW Eos IIHS

The analysis of the results were done in comparison with an identical test conducted with a SID-IIs dummy.

Two WorldSID 5th female were used in this test. One dummy was positioned at the drivers seat and the second one was positioned at the rear seat on postion 4. A seating procedure for the WorldSID 5th female is not available at this time. Therefore, the UMTRI positioning procedure were applied to position the dummy in the drivers seat. By comparison of the static measurements of the WorldSID 5th and the SID-IIs in identical tests, the location of the H-point is almost the same. The WorldSID 5th female is sitting about 5 mm outside of the H-point tolerance window (±12.5 mm) in x direction and therefore more forward. A torso angle of 17.6° was adjusted in order to keep the WorldSID 5th ribs and the occipital condyle of the head horizontal. This is 6.3° more backwards than with a SID-IIs in an identical test. Hence, the head CG was located more backward which appeared to be a more realistic automotive slouched position compared to the SID-IIs seating position.

The analysis and comparison of the dynamic response of the WorldSID 5th female in the driver seat was difficult due to failure of 4 out of 5 IR-Traccs. Only the deflection of abdomen rib 1 was recorded, which was about 48% less compared to the SID-IIs response under similar test conditions. The shoulder deflection of the WorldSID 5th female is about 28% less than of the SID-IIs. Pelvis acceleration is almost the same for both dummy types. The pubic force of the WorldSID 5th is slightly higher compared to the SID-IIs. Thjs can be based of the wider pelvis shape due to the different anthropometry of the WorldSID 5th.

The dynamic response of the rear seated WorldSID 5th female were recorded without any failure. The significant low rib deflection responses of the WorldSID 5th female are noticable. The differences are up to 80% compared to SID-IIs rib deflection in an identical test. The shoulder deflection of the WorldSID 5th is slightly higher compared to the SID-IIs. Pelvis acceleration of the WorldSID 5th is about 30% higher than with the SID-IIs. The comparison of the pubic force show a slightly higher response value (5%) for the WorldSID 5th. The higher values of the pelvis responses indicates a higher load which can be based on the wider pelvis shape of the WorldSD 5th female.

6 Conclusions and recommendatios

6.1 Conclusions

Four full scale vehicle tests were conducted according to IIHS mobile deformable barrier test and a 75 degrees pole test according FMVSS214. The tests did not run totally without problems. The main problems were frequent IR-Tracc failures and one complete loss of data of one of the two dummies due to a trigger or Data Acquisition problem. The source was not identified, which does not help in trying to avoid the problem in future tests.
There is a large list of comments on the DTS data acquisition system. The DTS system is not well penetrated in the German OEM's. It is uncertain if the main reason for the user comments has to do with the limited experience of data acquisition staff or with real problems of the DTS system.

The IR-Tracc clearly needs further development work, as frequent failures occurred.
There were also positive points identified about the dummy, easy to position, well build, generally user friendly for the size of dummy, human like seating posture and some improvements with respect to WorldSID 50M were introduced.

The new feature, the 2 dimensional chest deflection system, 2D IR-Tracc was not recognized by the PDB group. A possible reason is that due to missing ISO MME codes of the rotation sensors, the data was not transferred from the test lab to the OEM's for their analyses and therefore the sensors and their data were not visible to the OEM's. In general the research partners within APROSYS were very positive about the potential of the system and its sensitivity to load direction. Clearly one remaining activity for OEM's, is to analyze the vehicle test results based on 2D IR-Tracc calculated lateral displacement and assess with pertaining APROSYS injury criteria. Further work is also necessary in development of a user friendly process or sub routine for calculating 2D IR-Tracc parameters.

The dummy's main work field is the application in full scale vehicle testing. The assessment by the PDB OEM's was therefore very important and identified some short comings of the dummy that were not found in biomechanical research testing. The assessment of the dummy by OEM's in a day to day use test environment resulted in useful feedback for further development of the dummy. It is important that the new dummy is further evaluated in a broader perspective and clearly also in full scale vehicle test environment. The feedback of the users should be well registered, with clear unambiguous description of the problem, preferably by one central person or organization, so that issues can be managed and problems can be discussed in international stakeholder groups and properly addressed by the dummy manufacturer.
The comparison of the injury data from 2 different dummies, the SID-IIs and the WorldSID small female was too small to draw general conclusions. Apart from electrical with the IR-Traccs and DAS failures, only one mechanical failure was sustained. At least one of the tests was quite severe, indicating the dummy is durable enough for further evaluation. The WorldSID small female dummy should be further investigated in a broader evaluation. This is an important activity for OEM's that operate on a global market and export and build cars in ASIA, North America and Europe, as these OEM's have more experience with the 1st generation dummy, the SID-IIs.

6.2 Recommendations

1. Broader evaluation should be started by OEM's and stakeholder groups. Further fulls scale testing should be executed.
2. Further comparison of SID-IIs and WorldSID small female based on available injury criteria.
3. Address issues that were found and need to be addressed immediaty on the short term. For the long term, an issue management process should be started, by centrally maintaining a list of user feedback and comments for discussion and resolution by stakeholder groups.
4. Start working on evaluation based on 2D IR-Tracc or other multidirection sensitive chest sensors as soon as possible.

5. It appears that the WorldSID small female position procedure is not developed and furhter activity is needed.

7 References

[i] IIHS, Insurance Institue for Highway Safety, Side impact crash testing, http://www.iihs.org/ratings/side_test_info.html

[ii] 49 Code Federal Regulation paragraph 571.214, Nat'l Highway Traffic Safety Admin. DOT, October 2008.

[iii] Carrol J., Martinez L., Eggers A., Been B., APROSYS Deliverable D5.2.11, WorldSID Small female Side Impact Injury Risk Functions for Thorax, Abdomen and Pelvis based on dummy biomechanical testing and existing injury data, Deliverable report AP-SP52-0062, February 2009.