

Biofidelity Tests for WorldSID 5th Female

GRSP Informal Meeting
February 4, 2010

Biofidelity Tests of ISO TR 9790

- Head
 - 200 mm Rigid Drop
 - 1200 mm Padded Drop
- Neck
 - 7.2 G Sled
 - 6.7 G Sled
 - 12.2 G Sled
- Shoulder
 - 4.5 m/s Pendulum
 - 7.2 G Sled
 - 12.2 G Sled
 - 8.9 m/s Padded Sled (WSU)
- Thorax
 - 4.3 m/s Pendulum
 - 6.0 m/s Pendulum,
 - 1.0 m Rigid Drop
 - 2.0 m Padded Drop
 - 6.8 m/s Rigid Sled (Heidelberg)
 - 8.9 m/s Padded Sled (WSU)
- Abdomen
 - 1.0 m Rigid Drop
 - 2.0 m Padded Drop
 - 6.8 m/s Rigid Sled (WSU)
 - 8.9 m/s Rigid Sled (WSU)
 - 8.9 m/s Padded Sled (WSU)
- Pelvis
 - 6.0 m/s Pendulum
 - 10.0 m/s Pendulum
 - 0.5 m Rigid Drop
 - 1.0 m Rigid Drop
 - 2.0 m Padded Drop
 - 3.0 m Padded Drop
 - 6.8 m/s Rigid Sled (Heidelberg)
 - 8.9 m/s Rigid Sled (Heidelberg)
 - 8.9 m/s Padded Sled (Heidelberg)
 - 6.8 m/s Rigid Sled (WSU)
 - 8.9 m/s Rigid Sled (WSU)
 - 8.9 m/s 15 psi Padded Sled (WSU)
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Padded Tests
 Deleted by
 WG5 Resolution
 10-25-2007

Padding
 Response

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Padded Tests
 Deleted by
 WG5 Resolution
 10-25-2007

8.9 m/s Rigid
 Sled Tests
 Deemed
 too Severe by
 WorldSID Task
 Group

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- Tests Completed
By APROSYS

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Tests Completed
By APROSYS

Tests That Need
to be Repeated

Additional Biofidelity Tests to Consider:

- Shoulder Pendulum Tests of OSU (Bolte)
- Arm Biofidelity Test
 - Proposed Addition to TR 9790 at Next Revision
 - Reference: ISO WG5 Documents N914 – N916
- Lateral Neck Pendulum Test
 - Reference: Irwin, et al. (2002) 46th Stapp

Additional Biofidelity Tests to Consider:

- MCW Sled Tests
 - ISO-like Normalization & Corridors will be Added to TR 9790 at Next Revision
 - Impact Surfaces & Corridors Must be Scaled for Small Female
 - Reference: Irwin, et al. (2005) 49th Stapp



Plan to Complete Drop Tests

Drop Test Description	Tests Complete	Tests Needed	Volunteer Organization(s)
200 mm Head	✓		
0.5 m Whole Body Drop (Pelvis)		✓	
1.0 m Whole Body Drop (Thorax & Pelvis)		✓	
1.0 m Whole Body Drop (Abdomen)		✓	

Plan to Complete Impactor Tests

Pendulum Test Description	Tests Complete	Tests Needed	Volunteer Organization(s)
4.5 m/s Shoulder	✓		
4.3 m/s Thorax	<u>Only use data from upright seated tests</u>		
6.0 m/s Thorax			
6.0 m/s Pelvis		<u>Use 10-kg, Spherical Face Probe</u>	
10.0 m/s Pelvis			
OSU Shoulder		?	
Arm Biofidelity Test		?	
Neck Pendulum		?	

Plan to Complete Neck Sled Tests

Neck Sled Test Description	Tests Complete	Tests Needed	Volunteer Organization(s)
7.2 G Sled (Neck & Shoulder)		Use Revision 1 Dummy	
6.7 G Sled (Neck)		& ISO corridors	
12.2 G Sled (Neck & Shoulder)		✓	

Plan to Complete Sled Tests

Sled Test Description	Tests Complete	Tests Needed	Volunteer Organization(s)
6.8 m/s Rigid (Heidelberg) (Thorax & Pelvis)		<u>6.8 m/s,</u> <u>w/o Extra</u> <u>Foam Pads,</u> do <u>not</u> normalize	
6.8 m/s Rigid (WSU) (Abdomen & Pelvis)	✓		
MCW Test Condition(s)		Use Scaled Impact Plates	

Suggestions for Additional Tests

- Set up the tests as closely as possible to the original PMHS tests
 - Extra contact surfaces, while protective for the dummy, interfere with the intended load distribution
 - Pendulum impacts for biofidelity assessment should not be conducted on bench
- Record all dummy instrumentation in the impacted body region(s), even if not required for biofidelity assessment
 - These data are needed to develop injury risk curves
- Do not normalize the test results

End of Presentation

Back Up Slides

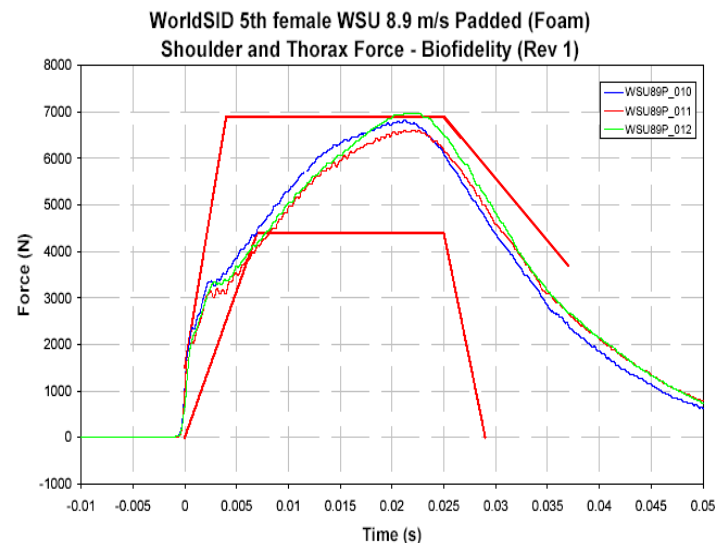
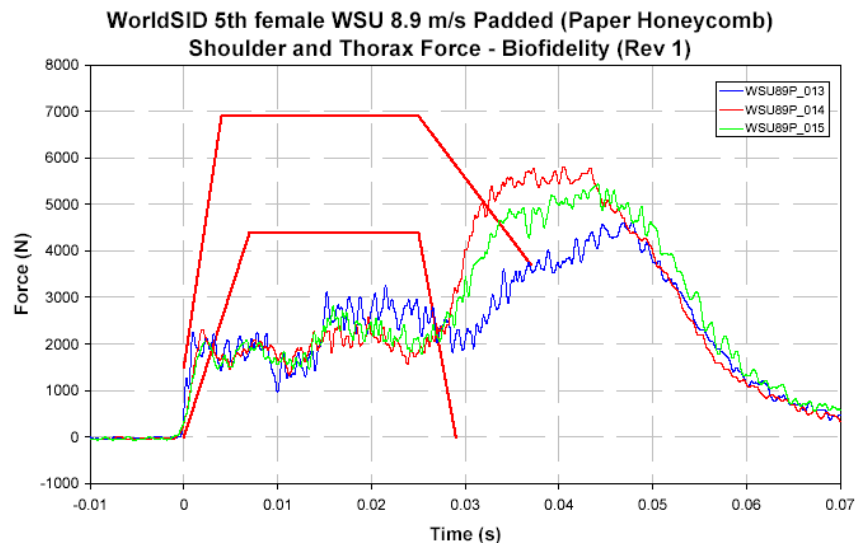
ISO WG5 Resolution to Delete Padded Tests from TR 9790

8.9 m/s Sled Test with 23 psi Paper Honeycomb

- Note step as each layer of honeycomb crushes

8.9 m/s Sled Test with 24 psi PE Foam Pad

- Response is dominated by pad, not dummy

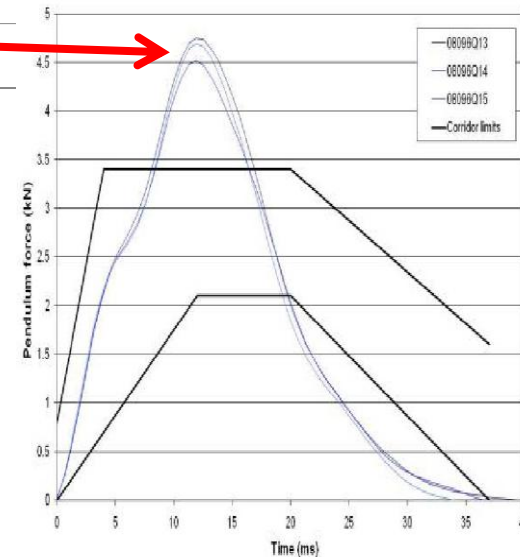
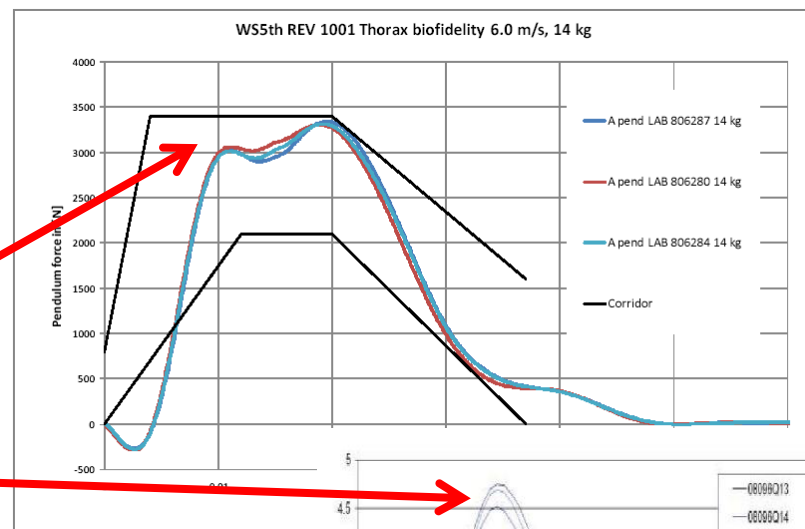


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ISO TR 9790 – Thorax Test 2

6.0 m/s Pendulum

- Tests Conducted:
 - Dummy Seated Upright as Specified by TR9790
 - Dummy Seated on WorldSID Bench
- Only Use Results from Dummy Seated Upright for ISO Biofidelity Assessment
- Same applies to 4.3 m/s



[Back to Test Plan](#)

ISO TR 9790 – Pelvis Tests 1 & 2

6.0 m/s Pendulum

- Tests Conducted with 14-kg, Flat Face Probe
- Tests Need to be Rerun with 10-kg, Spherical Face Probe

10.0 m/s Pendulum

- Tests Conducted with 14-kg, Flat Face Probe
- Maximum Pendulum Velocity was ~8.5 m/s
- Tests Need to be Rerun with 10-kg, Spherical Face Probe at Higher Velocity

WorldSID 5th Revision 1 Modifications

- Ribs – Reduced thickness of metal & added damping material
- Sternum – Material change from urethane to nylon
- Half arm – Longer with modified force-deflection characteristics
- Jacket – Removed replaced inner arm with thinner fabric
- Abdomen – Added mass
- Legs – Reduced “bone” mass

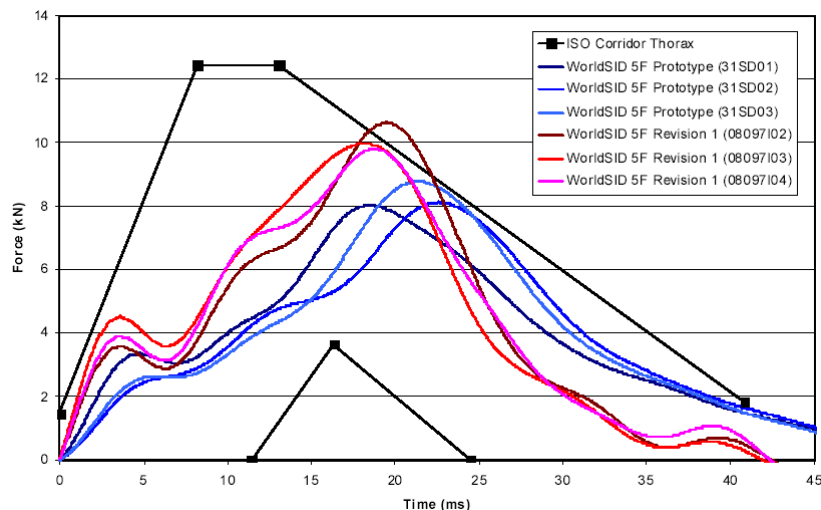


With the Exception of Head Drop, Do Not Use Results from Prototype for Biofidelity Assessment or Injury Risk Curve Development

Next

WorldSID 5th Revision 1 Modifications

Rigid Sled Test (Heidelberg) Conducted at 7.6 m/s



- Peak Thorax Plate Force is 20 – 25% Higher with Revision 1 WorldSID 5th (red curves), Compared to Prototype (blue curves)

**With the Exception of Head Drop;
Do Not Use Results from Prototype for Biofidelity Assessment
or Injury Risk Curve Development**

Back to Test Plan

ISO TR 9790 – Neck Tests

- Note that ISO WG5 has not adopted the APROSYS neck response corridors that were derived by regression analysis

ISO TR 9790

Thorax Test 5 & Pelvis Test 7

6.8 m/s Rigid Sled (Heidelberg)

- Tests Were Conducted at 7.6 m/s
- Tests Need to be Rerun at 6.8 m/s
- Impact Wall Should not have Extra Padded Blocks

