

Status of WorldSID

50th Male and 5th Female

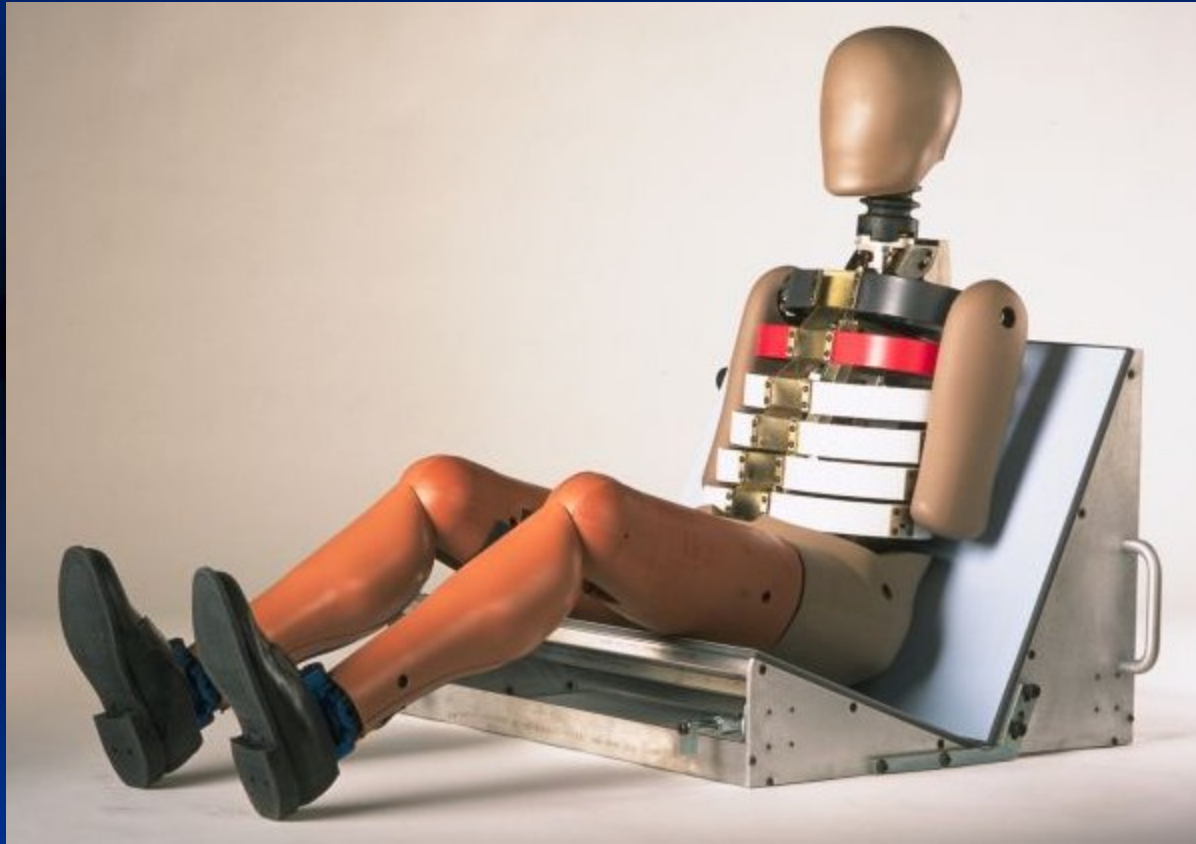
ATDs

Dan Rhule

National Highway Traffic Safety Administration
Vehicle Research and Test Center

November 5, 2009

WorldSID 50th Male



Background

- **NHTSA has participated in a collaborative effort to evaluate the WorldSID 50th male**
 - **NHTSA worked closely with the WorldSID Task Group using 2 dummies provided by OSRP**
 - **several improvements were made to the dummy during the evaluation**

Objectives

- **Assess suitability of the WorldSID 50th male dummy for possible incorporation into Part 572 of CFR**
 - Drawing Package
 - Certification
 - Durability
 - Repeatability & Reproducibility
 - Biofidelity
 - User's Manual (PADI)

50th Male Evaluation

■ Certification

- Tests conducted before and after FMVSS tests to ensure dummy's components are functioning properly
- Evaluate components whose response are of consequence to the FMVSS application



50th Male Evaluation

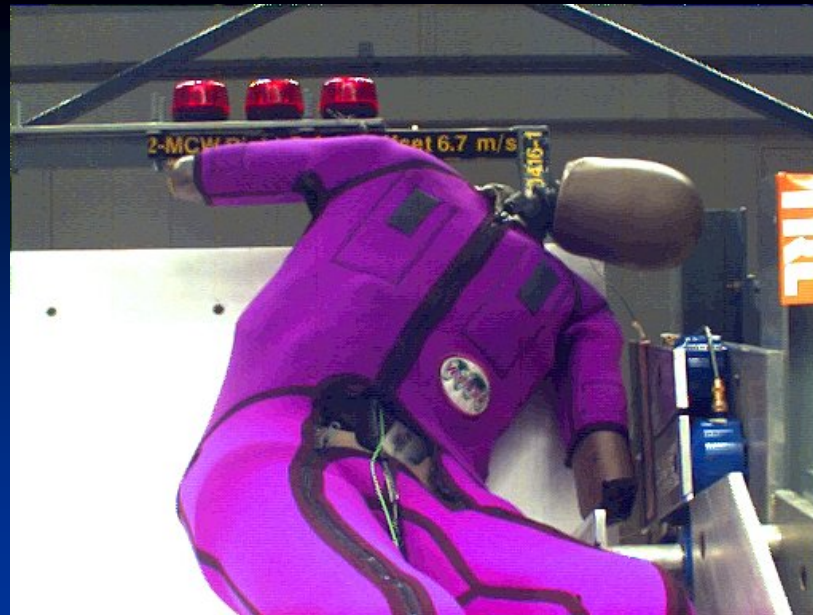
■ Certification

- ISO/CD 15830-2, rev. 25-Oct-04
- Tests includes:
 - Head drop, frontal and lateral
 - Neck lateral flexion
 - Shoulder impact
 - Thorax impacts, with and without half-arm
 - Abdomen impact
 - Pelvis impact

50th Male Evaluation

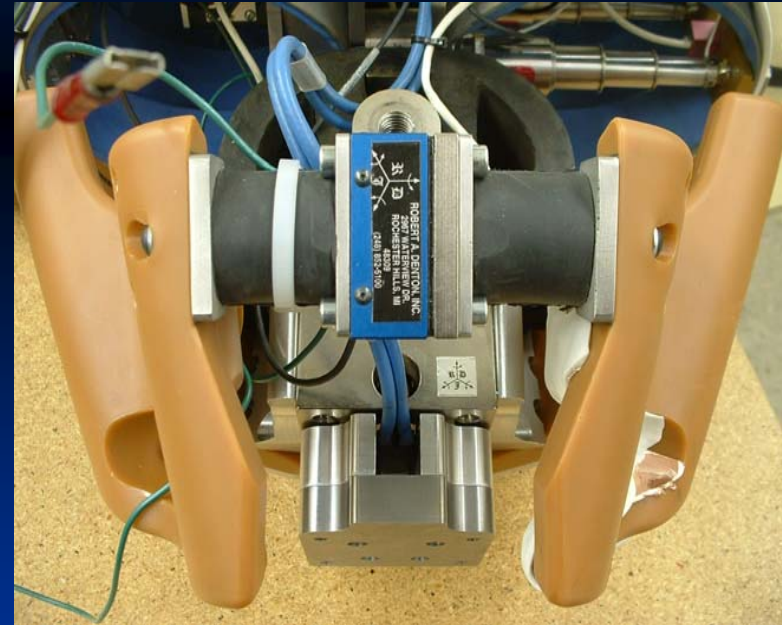
■ Durability

- Survive various test conditions and provide accurate response measures
- Withstand repeated tests with minimal maintenance and repair
- When problems are observed, either the test conditions or the dummy need to be modified



50th Male Evaluation

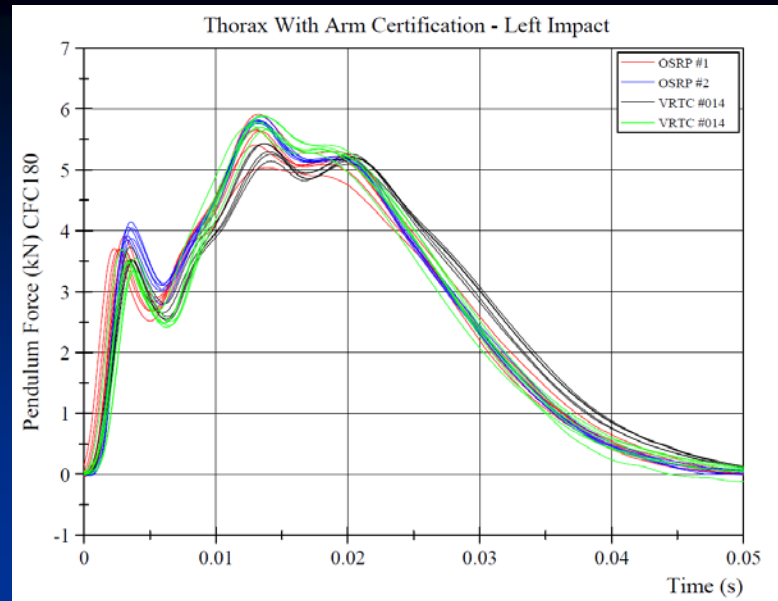
- **Durability Problems Addressed**
 - Rib Damping Material
 - Pelvis DAS Docking Station



50th Male Evaluation

■ Repeatability & Reproducibility

- Regulatory testing requires the dummy to have an acceptable level of R&R to instill confidence in the responses
- Preliminary R&R evaluation
 - Certification tests
 - Sled tests
- Preliminary R&R results are acceptable



50th Male Evaluation

- **Biofidelity**

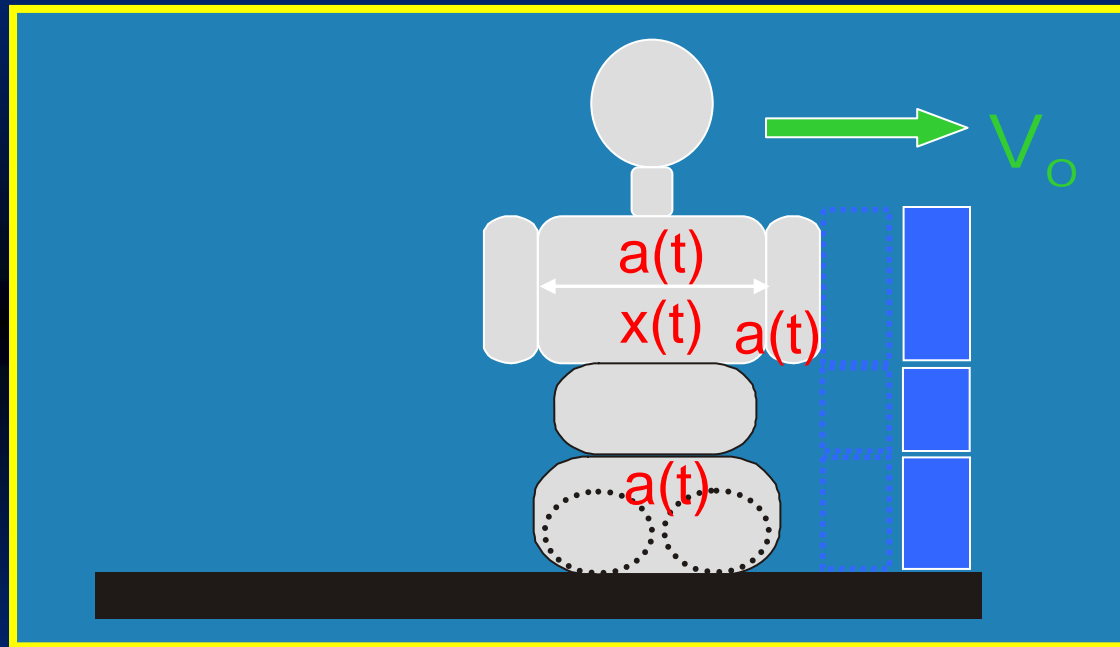
- How well does dummy replicate the response of a human.

- **Biofidelity Rank System – BioRank**

- Objectively quantifies biofidelity
- Accounts for:
 - Internal biofidelity
 - External biofidelity

Internal Biofidelity (IB)

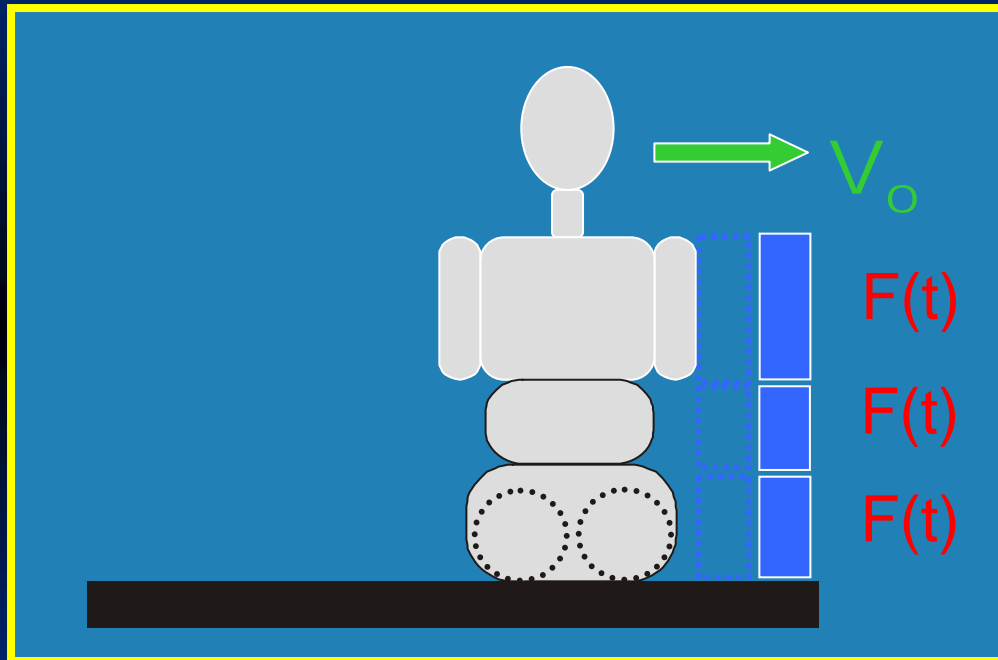
- Ability to replicate human internal response in a crash



- Internal measurements used for injury criteria

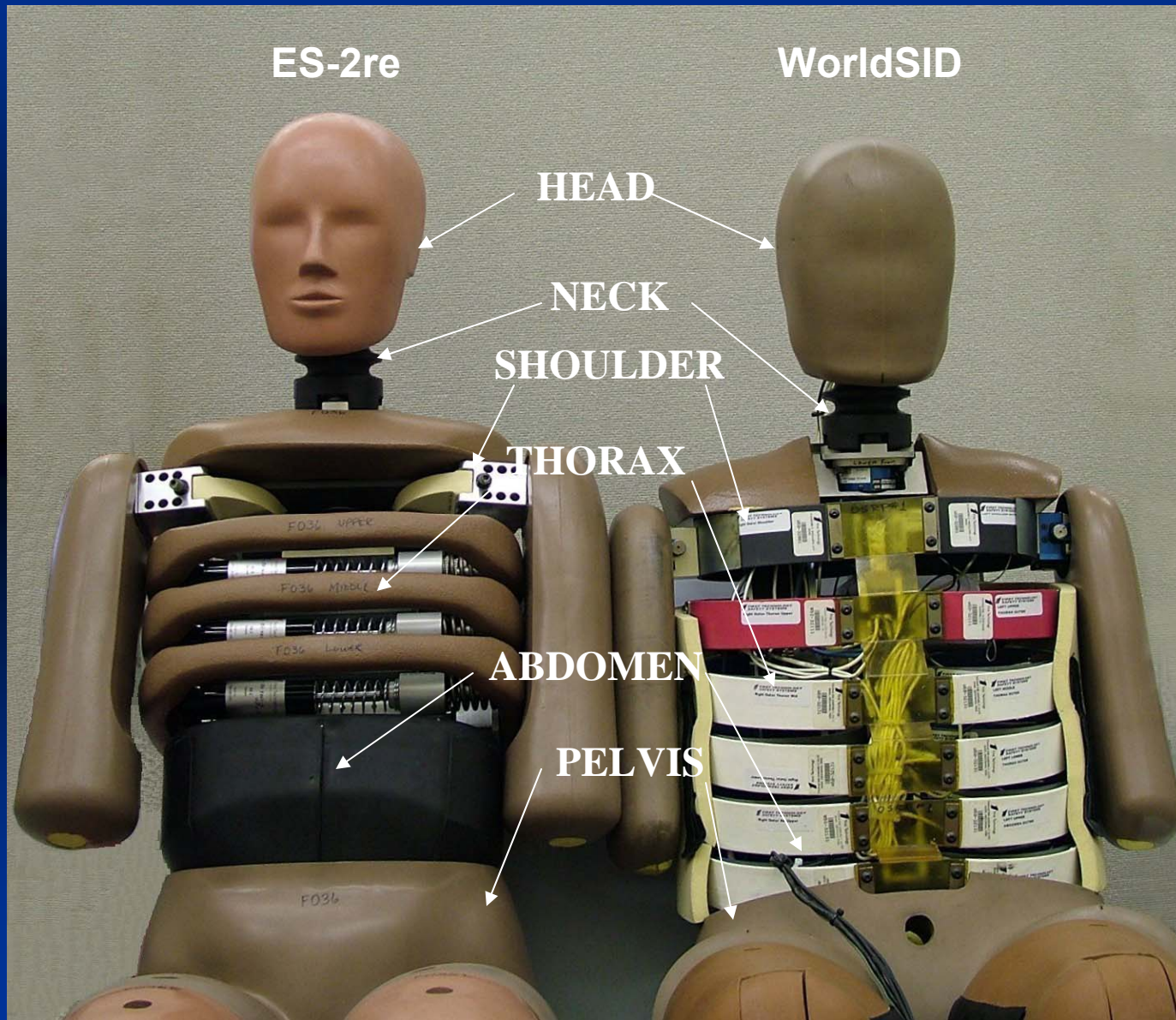
External Biofidelity (EB)

- Ability to replicate human loading of its environment in a crash

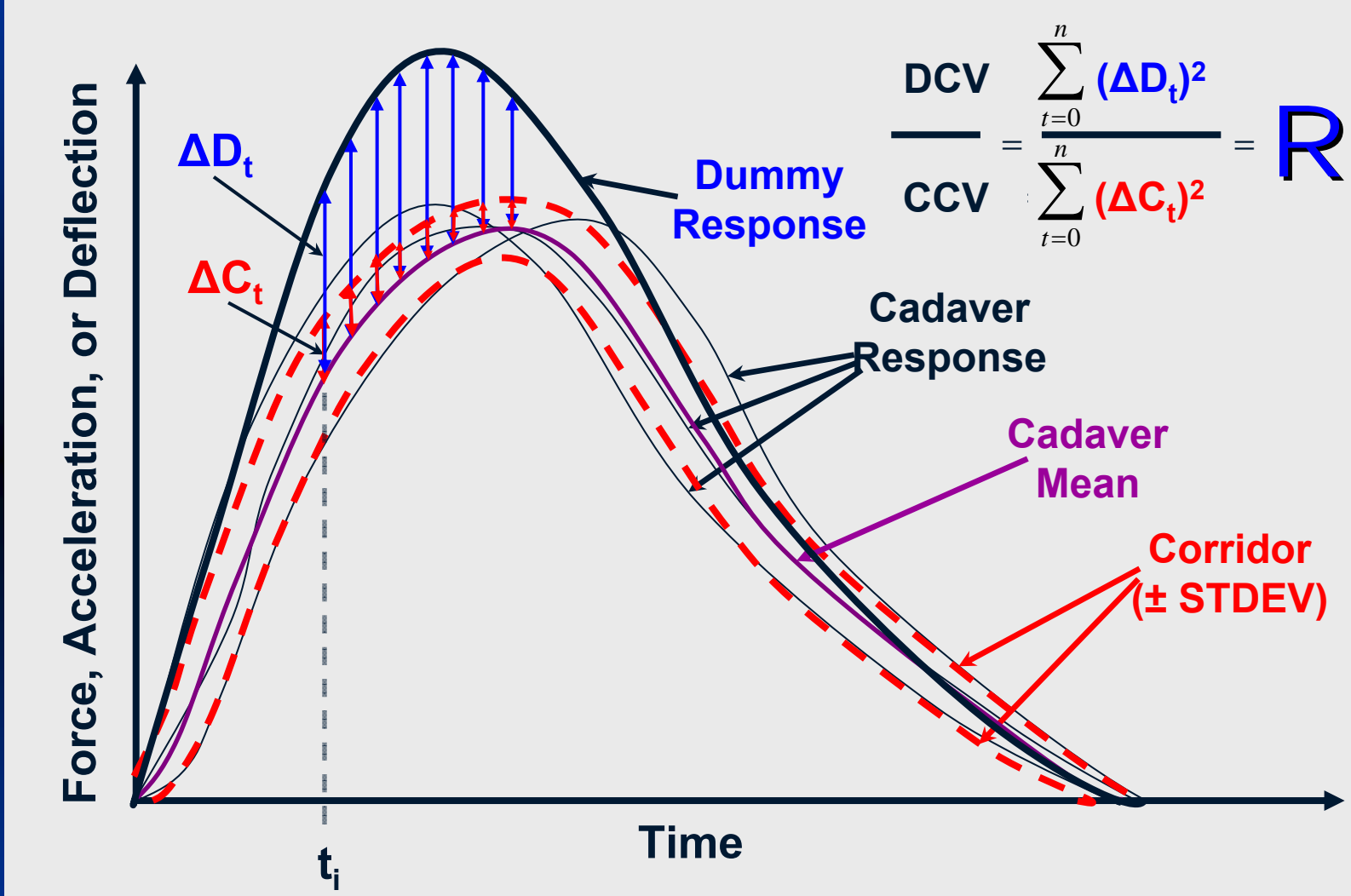


- Measurements made externally to human and dummy

Ranked Body Regions



Response Measurement Comparison (R)



* Morgan et al. 1986

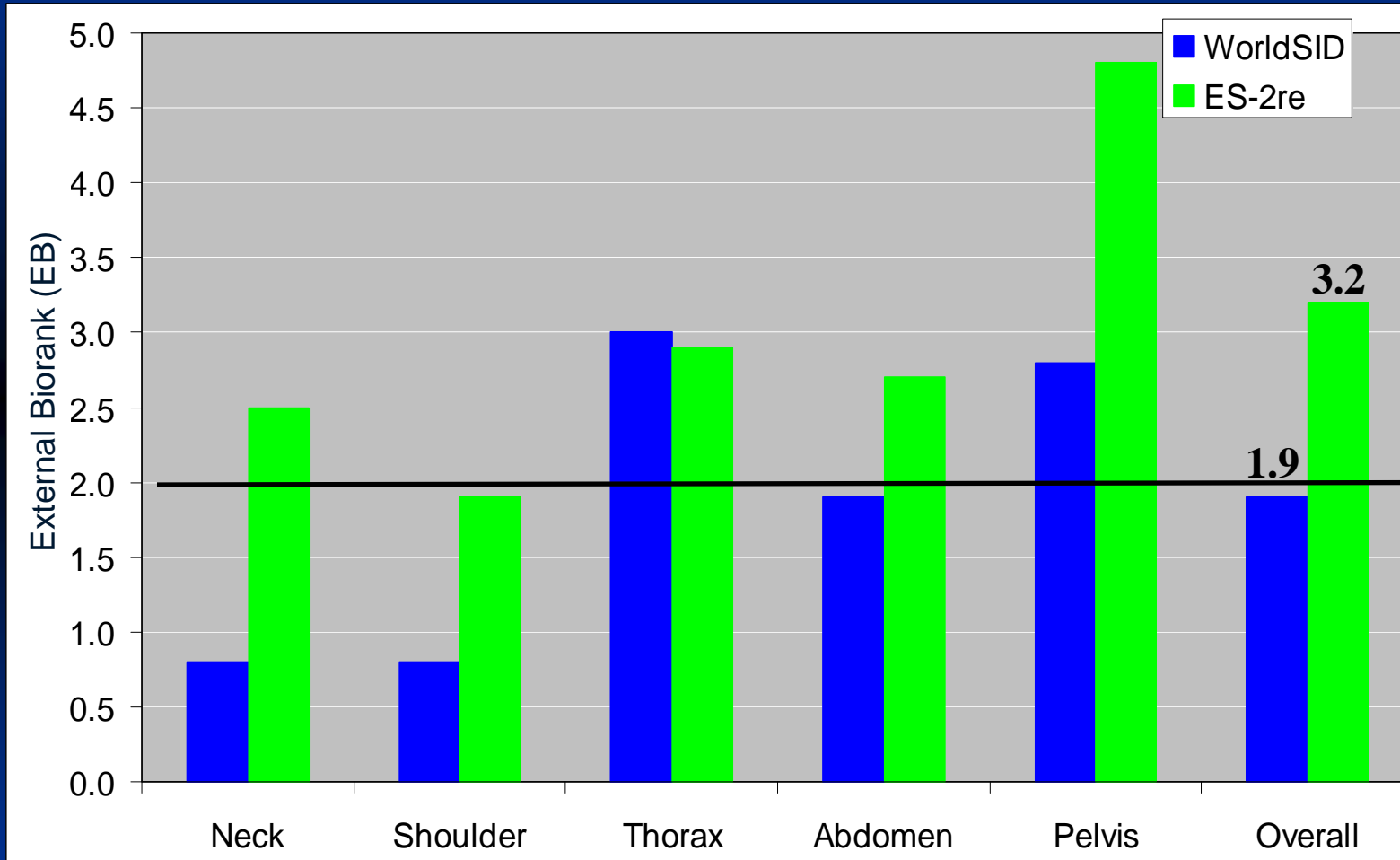
Bio Rank Test Matrix & References

Test Condition	Test Name	Reference
200 mm Rigid Lateral Head Drop	Head Test 1	ISO 9790 - Head Test 1
7.2 g Restrained Occupant Sled	Neck Test 1	ISO 9790 - Neck Test 1 & Shoulder Test 2
12.2 g Restrained Occupant Sled	Neck Test 3	ISO 9790 - Neck Test 3 & Shoulder Test 3
4.3 m/s Rigid Pendulum Lateral Thorax Impact	Thorax Test 1	ISO 9790 - Thorax Test 1
6.8 m/s Rigid Wall Sled	Heidelberg Sled Test	ISO 9790 - Thorax Test 5 & Pelvis Test 7
6.8 m/s Rigid Wall Sled	Wayne State Sled Test	ISO 9790 - Abdomen Test 3 & Pelvis Test 10
6 m/s Rigid Pendulum Pelvis Impact	Pelvis Test 1	ISO 9790 - Pelvis Test 1
10 m/s Rigid Pendulum Pelvis Impact	Pelvis Test 2	ISO 9790 - Pelvis Test 2

Bio Rank Test Matrix & References

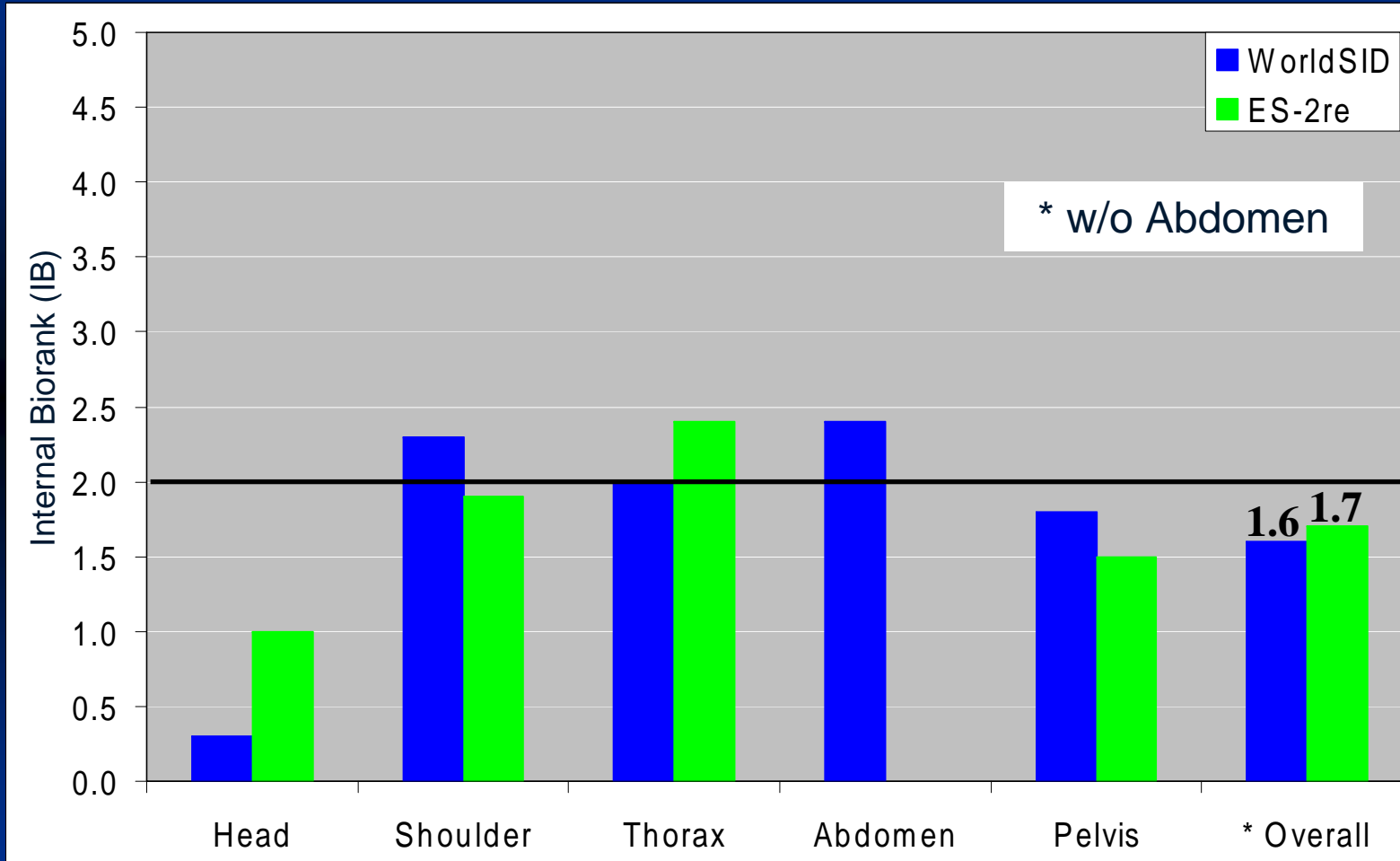
Test Condition	Test Name	Reference
≈ 90 Impactor Tests		
Oblique Thorax Impact	Thorax Test	Shaw et al. 2006
6.7 m/s Flat Rigid Wall Sled	NHTSA LS FR	Maltese et al. 2002
6.7 m/s Flat Padded Wall Sled	≈ 40 Sled Tests w/ 2 occupant sled buck	
6.7 m/s Rigid Abdomen Offset Sled		
6.7 m/s Rigid Pelvis Offset Sled		
8.9 m/s Flat Padded Wall Sled		

External Biofidelity



**Better
Biofidelity**

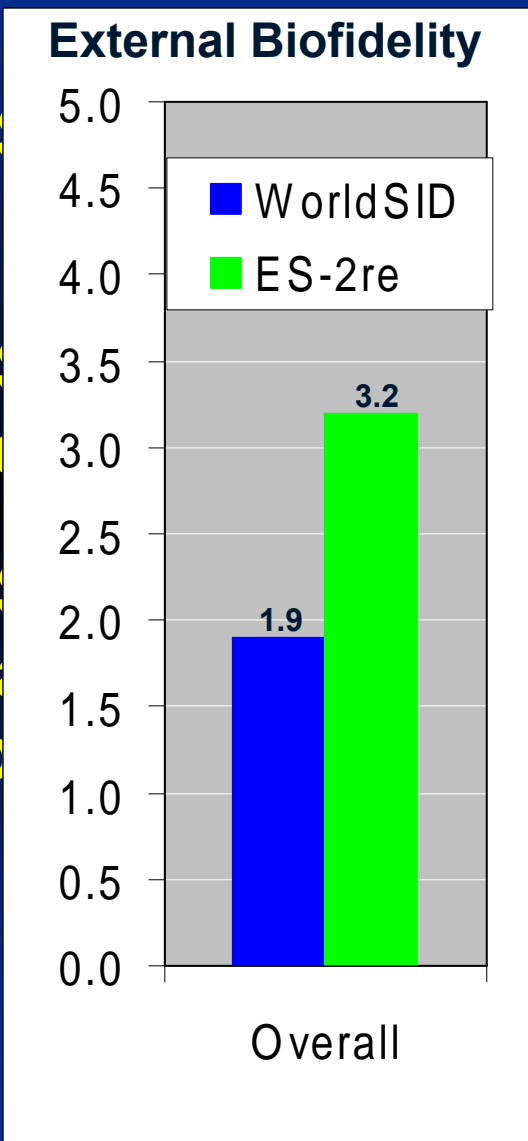
Internal Biofidelity



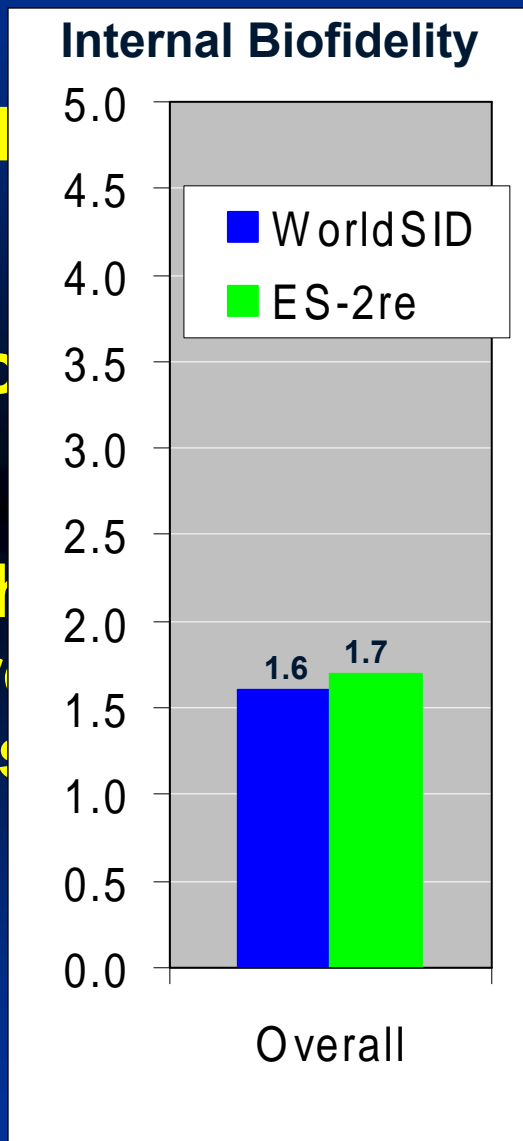
Better Biofidelity

BioRank Conclusions & Observations

- We
- is
- We
- me
- We
- re
- ob



Internal and
2re
as impro
cement
thorax
nd impro
respons



elity

BioRank Conclusions & Observations

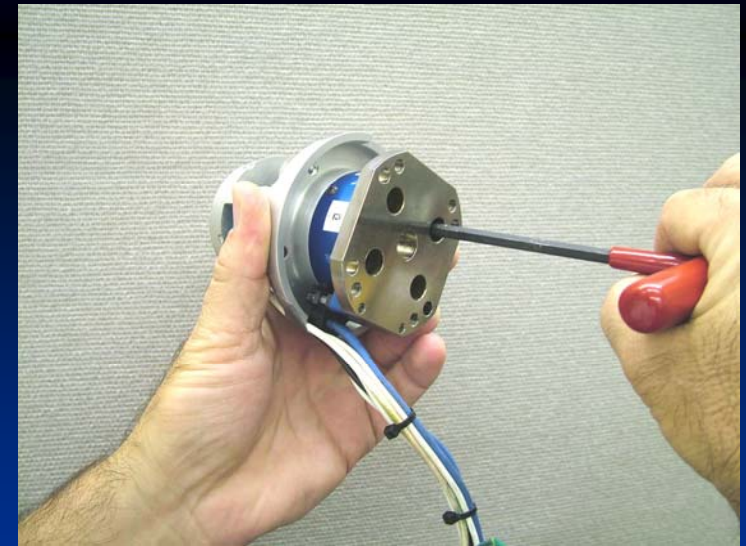
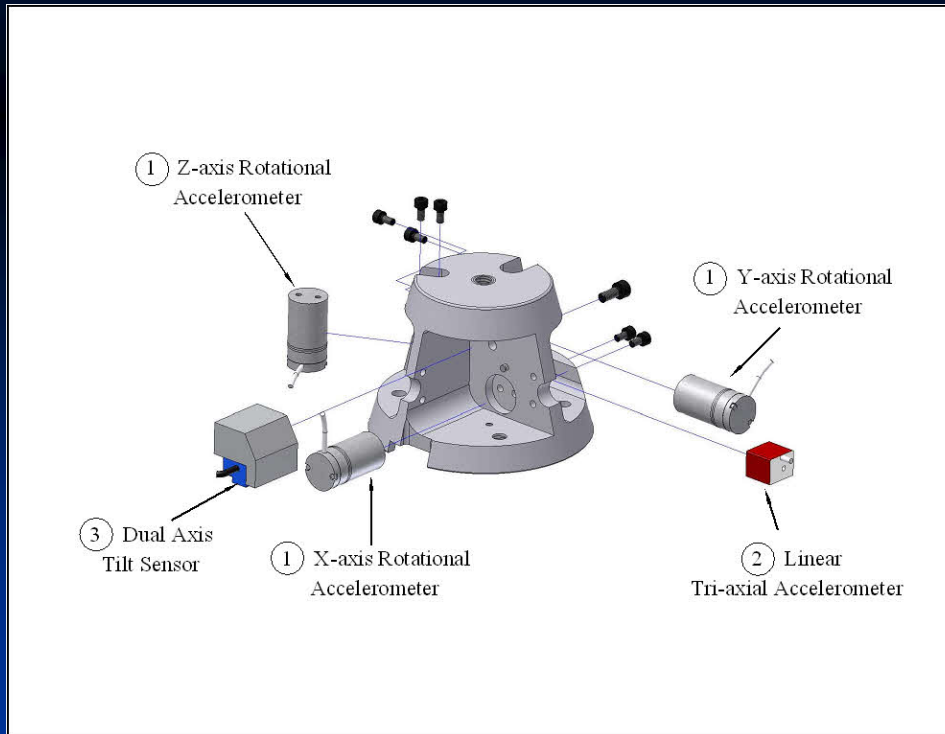
- **WSID abdomen measures displacement**

The WorldSID 50th male dummy is more biofidelic than the ES-2re dummy and its level of biofidelity is acceptable for regulatory purposes.

50th Male Evaluation

■ PADI

- Procedures for Assembly, Disassembly, and Inspection
- Illustrates how the dummy is put together, taken apart, instrumented, and inspected
- Serves as reference to users



50th Male Evaluation

■ Drawing Package

- Physical dimensions
- Weight and CG of segments
- Must be freely available to public without restrictions
- Must not endorse any manufacturer

■ Issue: Onboard DAS

- Public meeting
- Suggestion:
 - specify these parameters by body region:
 - Use CAD to determine
 - » Mass
 - » CG location
 - » Mass Moment of Inertia (MMI)
 - » Space (volume) where DAS can be mounted
 - Electronic performance requirements
 - define acceptable tolerances based on simulations

WorldSID 5th Female



5th Female Evaluation

- **NHTSA to acquire at least one dummy**
- **Initiate Standard Evaluation**
 - Drawing Package
 - Certification
 - Durability
 - Repeatability & Reproducibility
 - Biofidelity
 - User's Manual (PADI)

5th Female Evaluation

- **APROSYS Work**
 - Anthropometry
 - Biofidelity
 - Certification
 - Injury Risk Functions
- **ISO Biofidelity Ranking = 7.6**
- **Apply NHTSA BioRank?**

Project Timing

		'08	2009				2010				2011				2012				2013		
Item		Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3
50th Male	Certification	◆																			
	Biofidelity		◆																		
	R & R			◆																	
	Durability			◆																	
	PADI																				
	DAS Specs																				
	Drawing Package																				
	Part 572 NPRM																				
	Receive Dummy						◆														
5th Female	Certification																				
	Biofidelity																				
	R & R																				
	Durability																				
	PADI																				
	Drawing Package																				
	Part 572 NPRM																				◆

Thank You

Questions?

