Update of Global BioRID-II User's Meeting (GBUM)

Mike Beebe - GBUM Chairman

Alex Schmitt – Europe Advisor

Paul Depinet

Friday November 6, 2009

DENTON

Agendas

- **Background**
  - **Formation of GBUM**
  - **Purpose of GBUM Dummy Preparation Process**
  - **Update March 09 to Oct 09**
- **Certification Test Project update**
  - Update of equipment
  - Update of procedure
  - Update of Current RR testing throughout the world

DENTON

Formation of Regional BUM Groups

1. European BUM Group (March 2002)
2. North America Group (2003)
3. Japan Group (2004)
4. Korean Group (2008)
5. Call for International BUM meeting (June 25, 2008)

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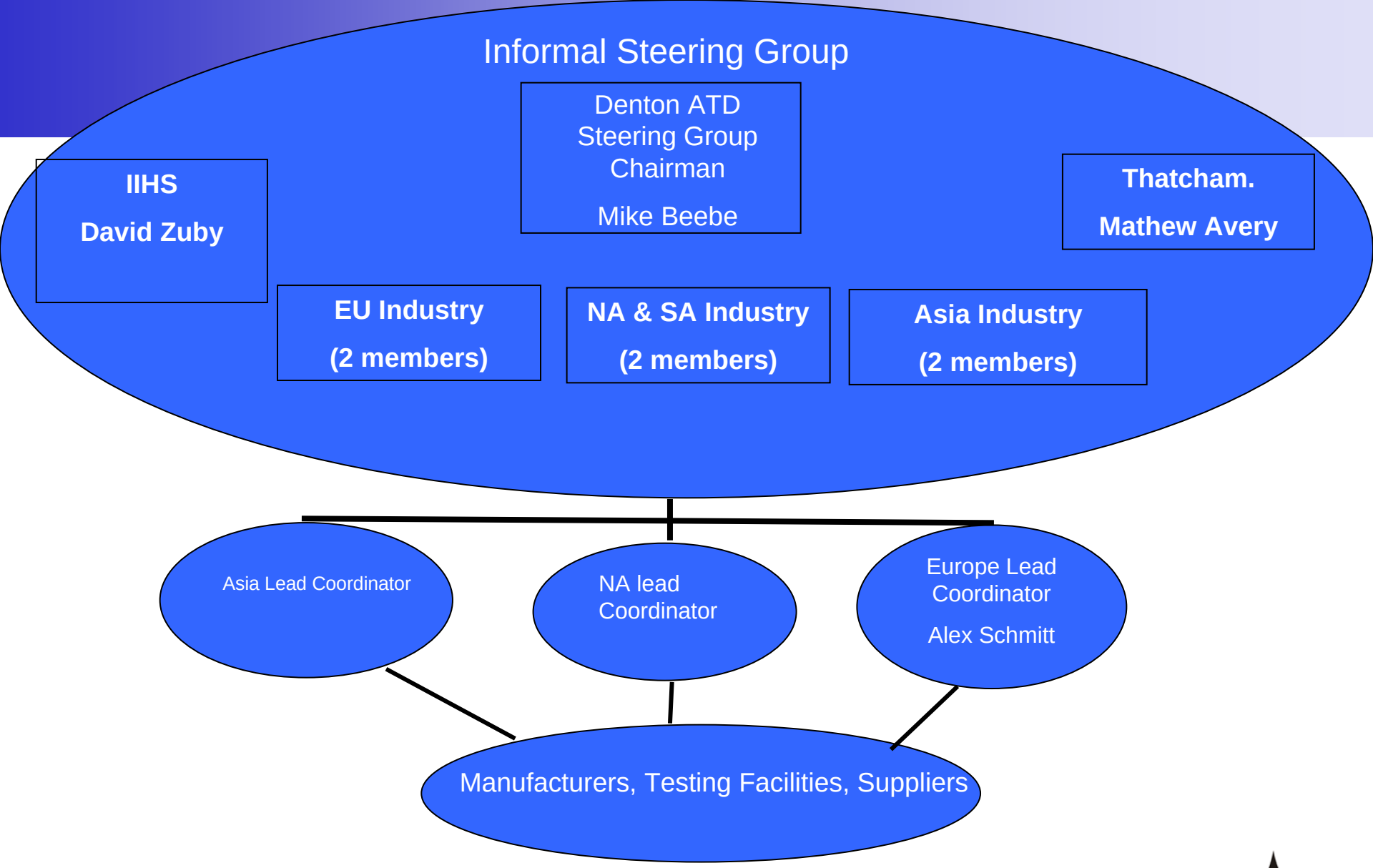

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GBUM Dummy Preparation Process

Goal: Updates were done to make dummy easier to use, more durable, and reproducible without changing the biofidelity

- Once a month worldwide webex meetings
- Revise hardware as required based on users feedback
- Drawings
- Certification Testing
- R&R
- PADI/Users Manual

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DENTON

April 2009

1. Dummy Technical Updates

Reviewed Clothing specifications and updated manual

Discussed Muscle tensioner placement relative to SHCS of spine

Head with cable exit through side with increased clearance in the chin

Reviewed proposed skull cap switch

Reviewed proposed Thorax Flesh

Reviewed Proposed Sled Testing program for evaluation of proposed head and Thorax Flesh

2. Certification Testing

Static spine set up procedure tools

Dynamic Certification Test

- **Update of new fixture**
- **Update of Foam replacement**

***Manual Updates (*Addition of dummy definition section)**

3. Other Dummy issues

Third Party dummy specification

Seating Procedure

FX & My repeatability

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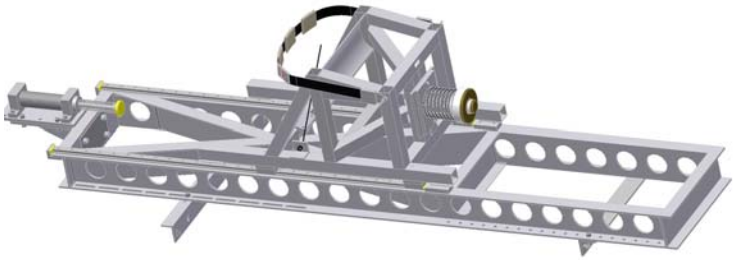
May 2009

1. Discussed with SAE if they could hold drawings
2. Update of volunteers to perform sled tests with revised jacket and head assembly
   - components have already be sent to one volunteer
3. Update on Certification Test Updates
   -Review first results with spring and guide rail system
4. Reviewed issue of pelvis shrinkage over time.
5. Developed a Shoe Specification for the manual



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June 2009

1. Seat Procedure Update

Update of seating procedure for commercial seating

2. Update of Proposed Head and Torso Jacket Component Testing

Lear testing results

Next testing Group

3. FX variation Discussion

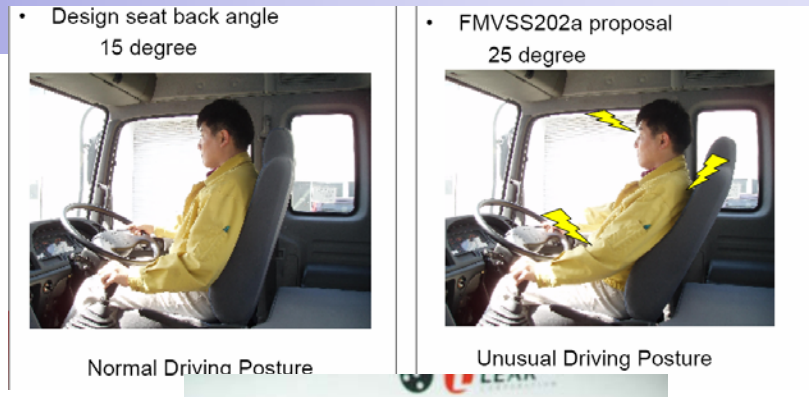
Review of PDB ESV paper

Determine to develop a certification test with head rest

4. Update on Certification Test Study

Spring/Track evaluation

5. Pelvis Indicator



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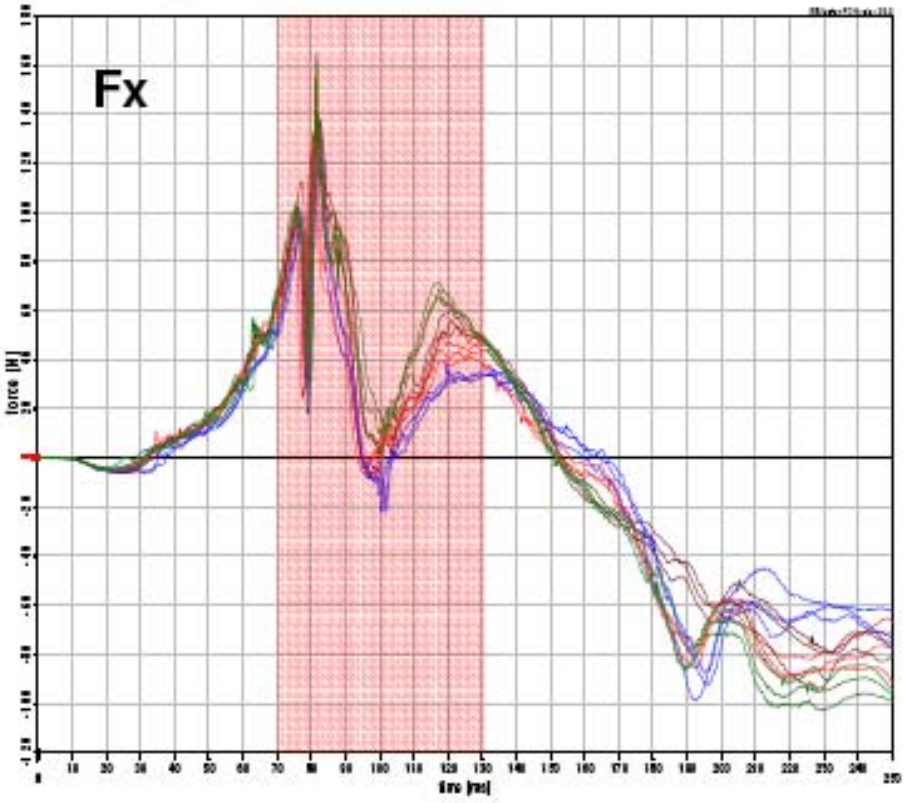
Need for the Certification Head Rest Test Review

The PDB study clearly shows that only difference from dummy to dummy Fx value occurs during contact with the head rest. Therefore a head rest should be added to the certification tests.

Results

- Dynamic measurements:



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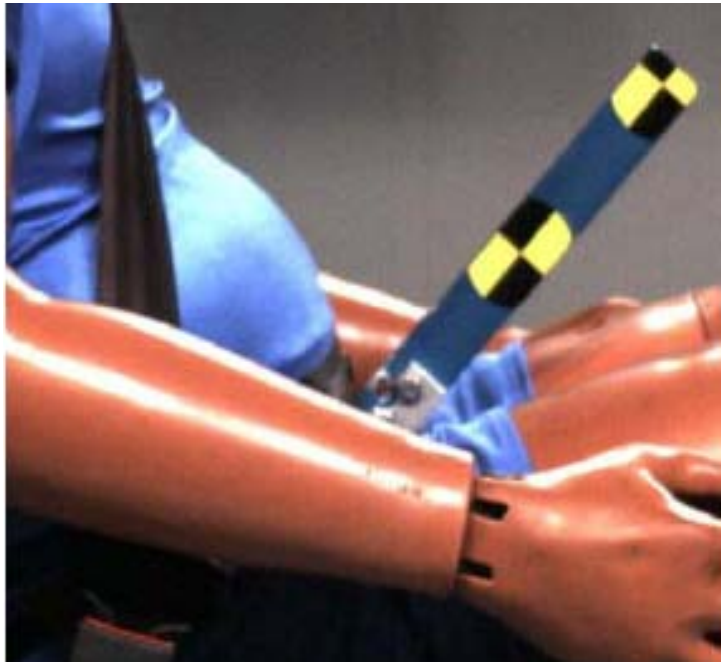
Pelvis Angle Indicator



Original design

Revised Design

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August 2009

1. **SAE/Geneva Drawing package/users manual**

2. **Seat Procedure Update**
   Update of seating procedure for commercial seating

3. **Head Contact Switch update**

4. **FX variation**

5. **Certification test study discussion**
   - **Creation of a repeatable and reproducible test**
   - **Energy transfer device**
   - **Head rest device added**

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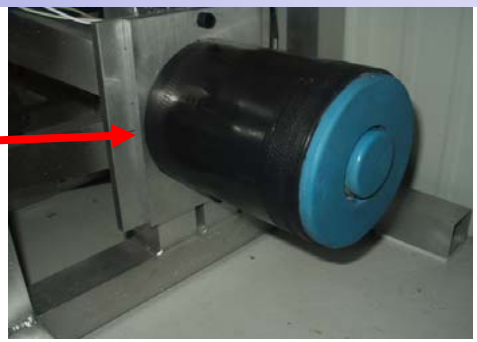
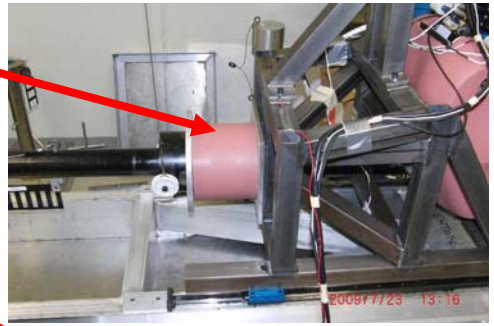
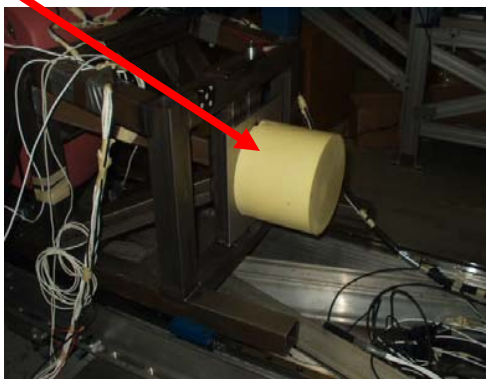
Energy Transfer Device Investigation

- Initial Investigation
  - Spring
  - Silcone
  - Dentonthane (Denton developed energy absorbing material)







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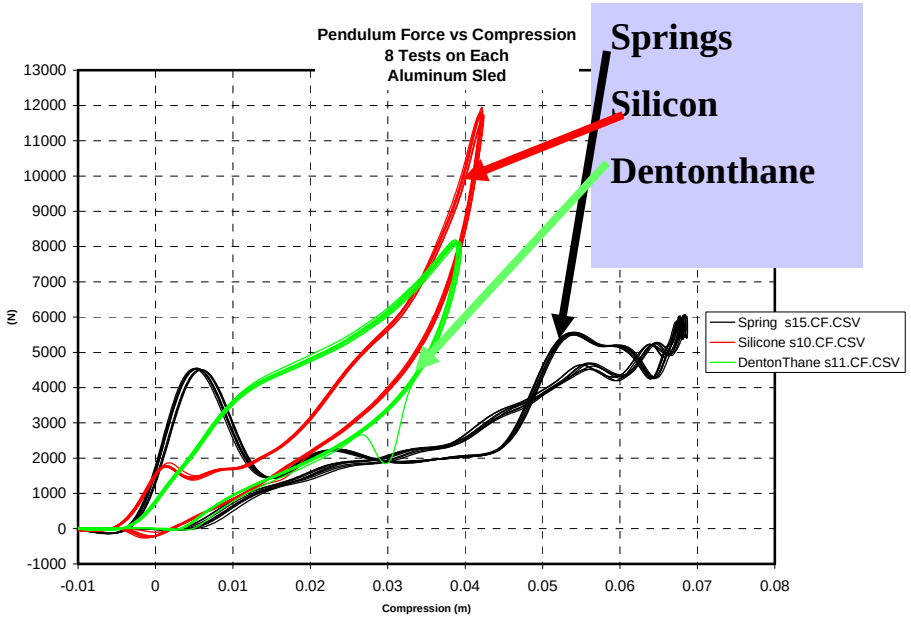
Energy Transfer Device Selection

- Conclusions:
  - Springs have inertial spike and creates more oscillations then the others
  - Silicon has a smaller inertial spike, good repeatability, good durability, but higher cost
  - Dentonthane has no inertial spike, good repeatability, good durability, but lower cost then silicone.
  - Dentonthane was recommended because of the lower cost and repeatability.
  - Denton will continue to study both during this process



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Rail and Sled Certification

- Rail certification with weight package fixed to the sled Prior to running any dummy test, ensure the sled is set up properly.
  - Compare results to a tight peak corridor for Pendulum Force and Sled Acceleration to ensure DentonThane is not changed
  - Compare results of deceleration slope to a tight corridor to ensure the friction of the system is within requirements
  - This procedure will ensure repeatable inputs, and reproducible results between rail systems.

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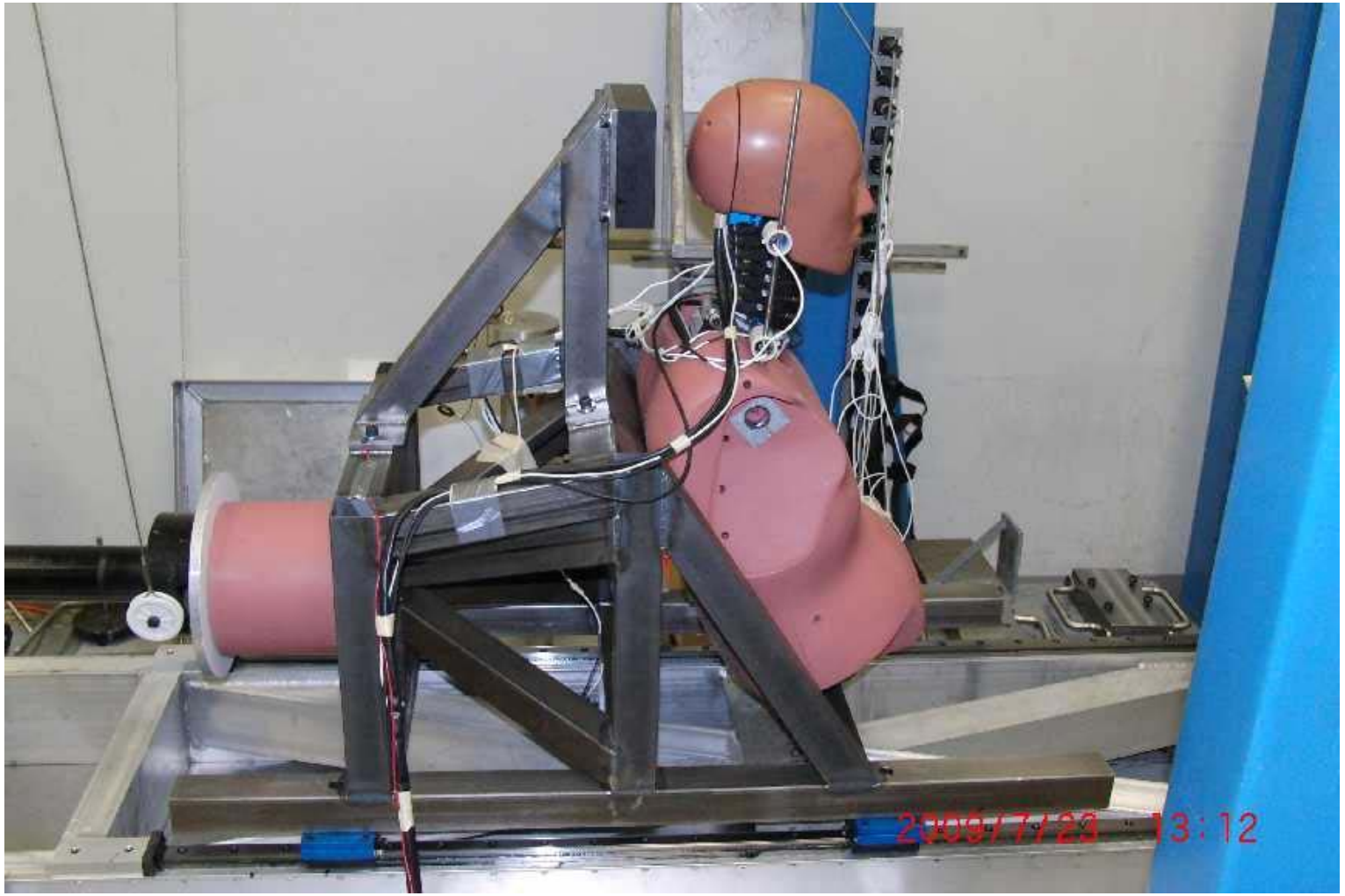
Dummy Certification with Head Rest



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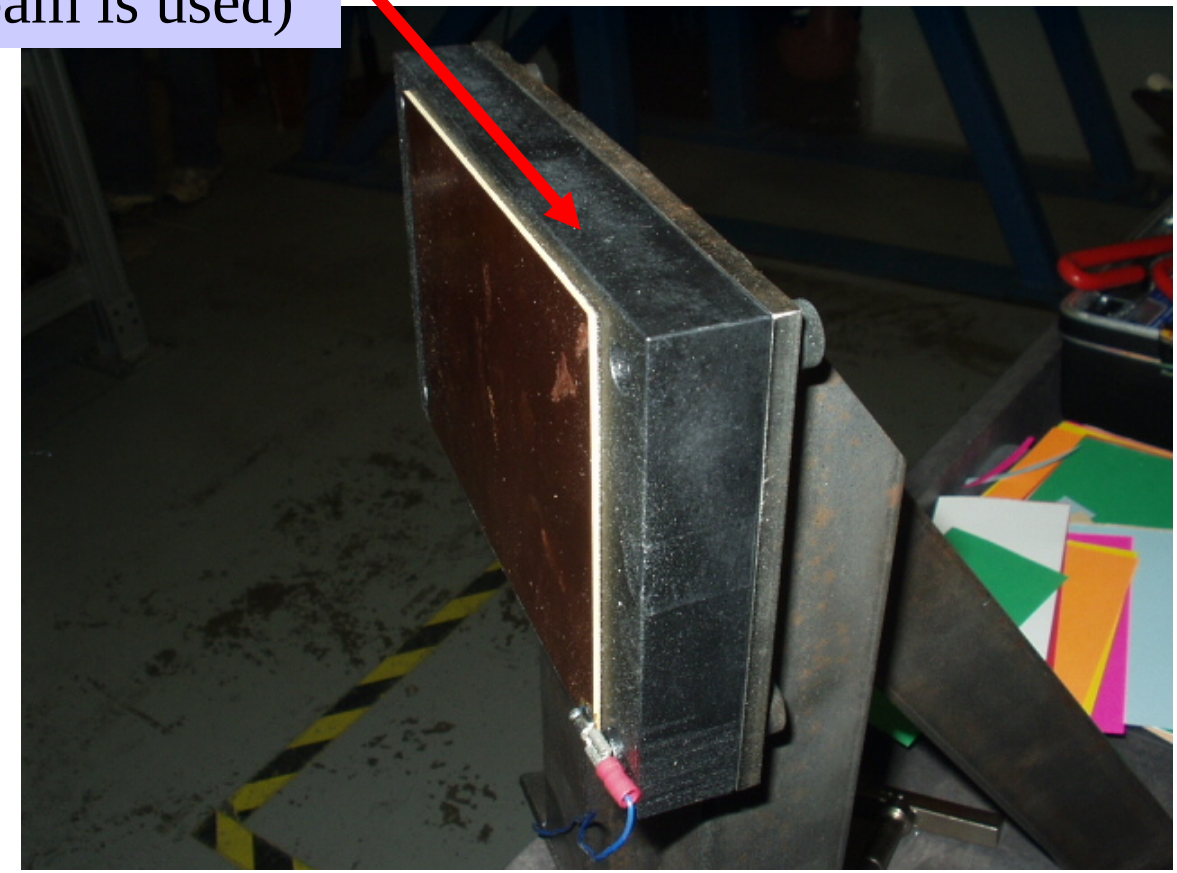
Head Rest Description

High Density Solid Delrin Block backed by Steel, (no foam is used)



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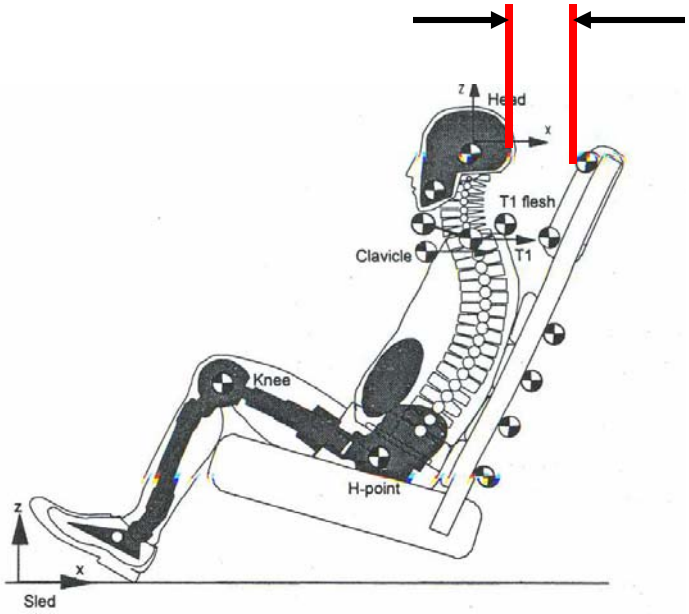
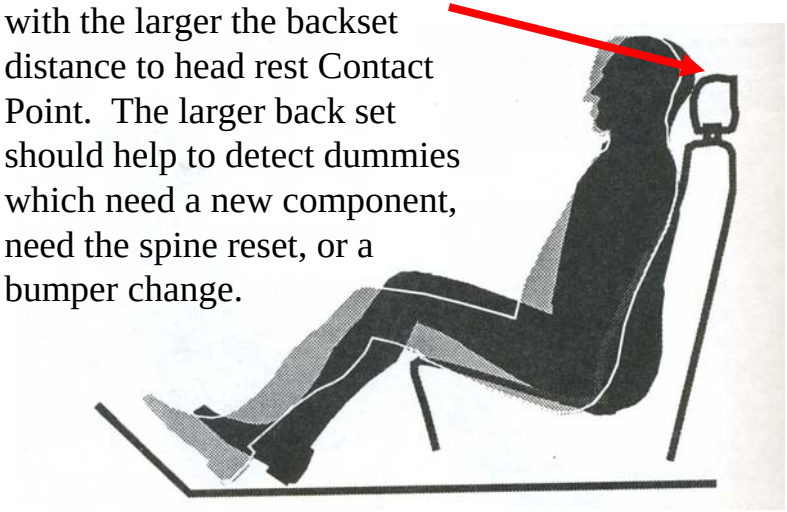
Head to Headrest Distance Discussion



More variation is expected with the larger the backset distance to head rest Contact Point. The larger back set should help to detect dummies which need a new component, need the spine reset, or a bumper change.



For round robin testing the head rest has been set to 70 mm to compare with PDB testing.

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Certify Dummy with Headrest update

- Performed tests with tightly controlled velocity corridor using DentonThane for consistent input.
- Measured Head Forces and Moments, Lower Neck Forces and Moments and headrest contact times to determine if dummy is performing adequately
- Reviewed the variability of Skull Cap to Headrest Distance. 70mm +/- 2mm
- Will finalize corridor upon completion of round robin testing.

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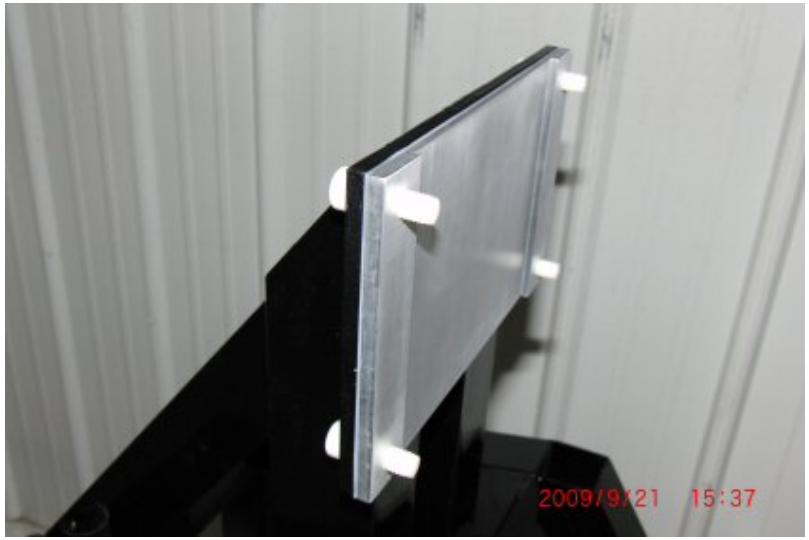
Head Rest Description

Gap Set up Tool

Aluminum Pad with insulator



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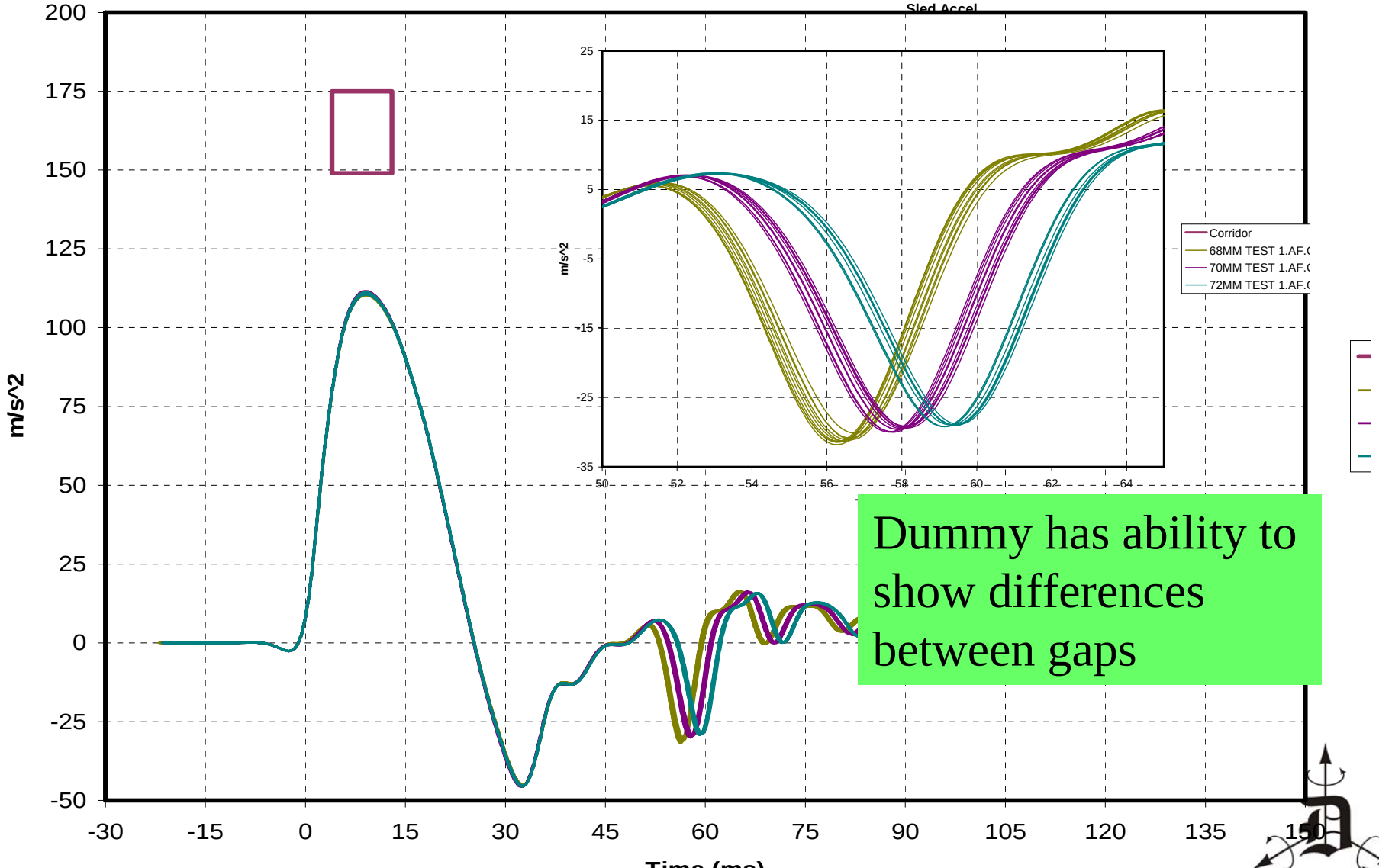
Headrest test development
Sled Accel 70 +/- 2 mm Gap



Dummy has ability to show differences between gaps

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September 2009

1. Geneva Drawing package/users manual

2. Seat Procedure Update

Update of seating procedure for commercial seating

3. Head Contact Switch update

4. Certification Testing update

Update of results

Test Plans for each location using new sled

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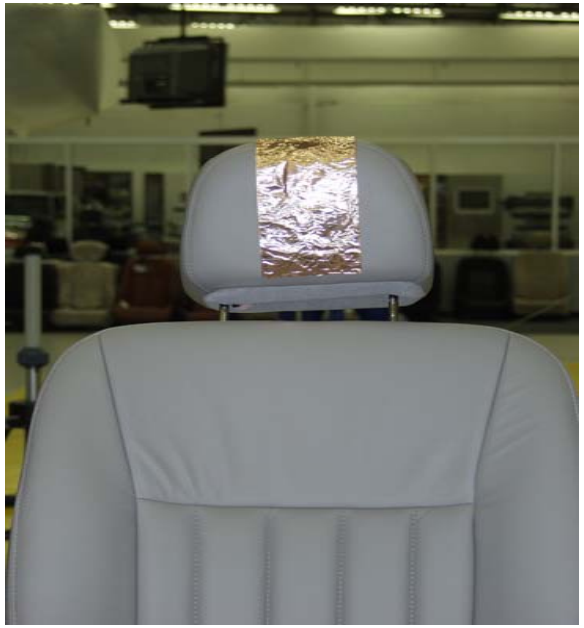
Contact Switch Discussion

- **Two halves**
- **Wires connected to cap (triple redundant)**
- **Wired in a bridge**
- **Use one piece of tape on seat**



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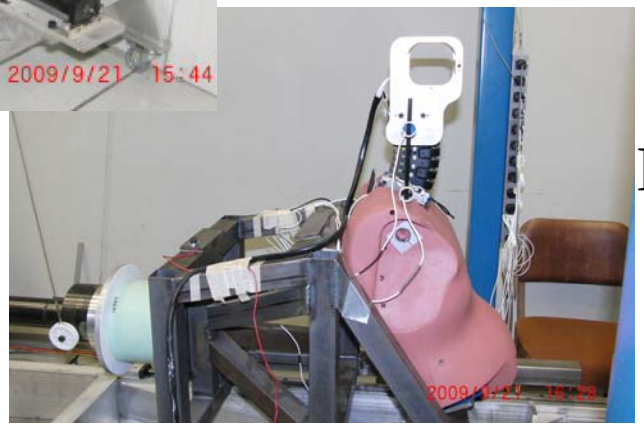
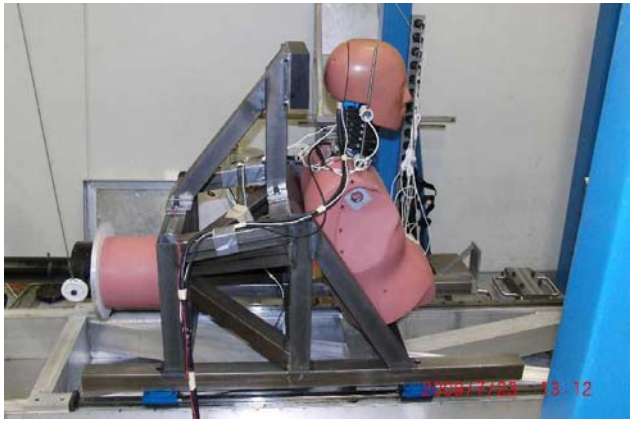
Development of a certification test

Sled and Rail Certification

Dummy Neck/Spine Certification



Dummy Headrest Certification



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Next Steps

- Deliver Track Systems to
  - Katri - Korea
  - FITP - Japan
  - COE - Europe
  - Denton ATD – Ohio/DTC
  - Sled systems will be shipped September 25, (this Friday)
- A Denton ATD Service Engineer will be dispatched to Korea and Japan to set up the new Sled System the week of Oct 5, 2009

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Test Plan for each Test Site

- Test as many dummies as possible
  - 12 tests per dummy
    - Perform the Rail and Sled system certification tests
    - Perform Dummy Certification without head rest – 6 tests
    - Perform Dummy with head rest – 6 tests
- Submit data back to Denton
- Determine appropriate corridors
- Need for Gage R&R to measure differences between labs.

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Channel List for Testing

channel	weight pkg	std cert	head rest cert
1	velocity	velocity	velocity
2	pend accel	pend accel	pend accel
3	sled accel	sled accel	sled accel
4	n/a	pot A	Upper neck Fx
5	n/a	pot B	Upper neck Fz
6	n/a	Pot C	Upper neck My
7	n/a	pot D	Lower neck Fx
8	n/a	Upper neck Mz	Lower neck Fz
9	n/a	T1 accel	Head contact sw
10	n/a	Upper neck Mx	Lower neck My
11	n/a	Upper neck Fx	Skull cap Fx
12	n/a	Upper neck Fz	Skull cap Fz
13	n/a	Upper neck My	Skull cap Fy
14	n/a	n/a	Upper neck Mz
15	n/a	n/a	Upper neck Mx
16	n/a	n/a	n/a

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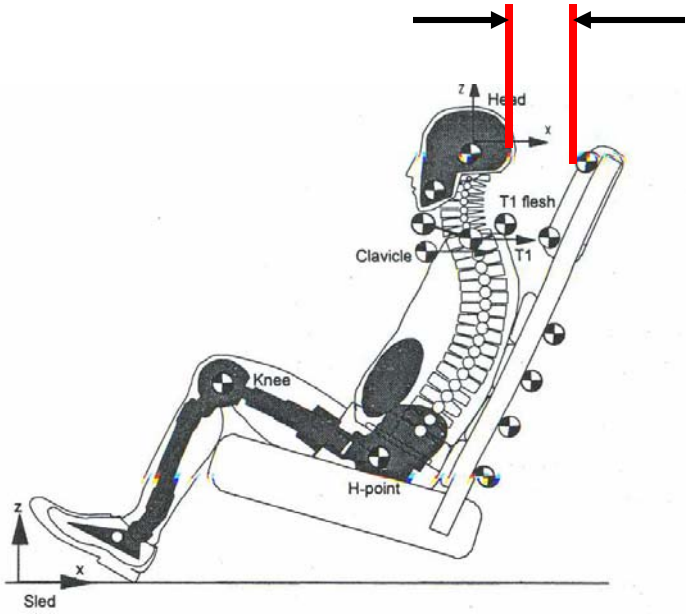
Head to Headrest Distance Discussion



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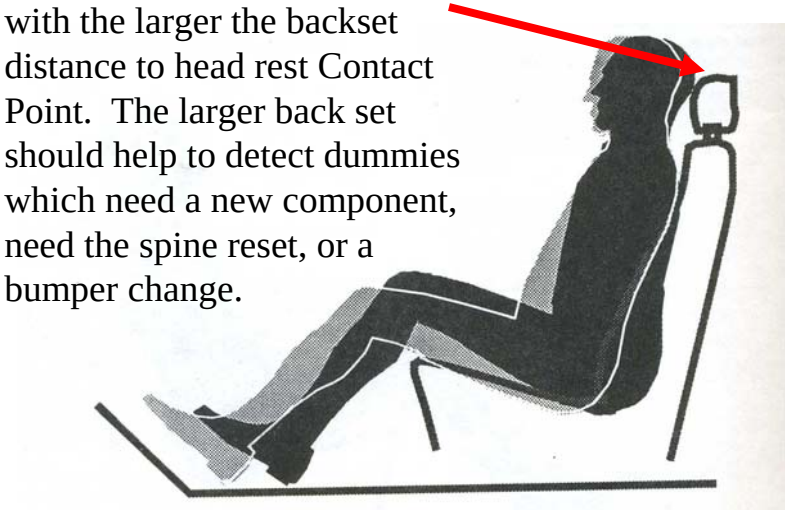

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October 2009

1.

2. Seat Procedure Update

Update of seating procedure for commercial seating

Dummy adjustment

3. Certification Testing update

Update of results

Test Plans for each location using new sled

4. **Accelerometers**

5. **Spring Cable**

6. GTR Washington DC

DENTON

Accelerometer Recommendation

Accelerometer Use in BioRID ATD`s

Alex Schmitt – Europe Advisor

Thursday, October 22, 2009

Denton ATD, Inc.

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Background

- The German AK 5 group requested to Denton COE to get an overview on the types of accelerometers and accelerometer mounts used in the BioRID II ATD`s in Germany and Europe.

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Background

Denton COE sent a form to all European BioRID users/owners, information received from 50% of users as of today.

Accelerometers used in BioRID ATD's

Company:		
Dummy serial number:		
	Model	Manufacturer
ACC Head AX		
ACC Head AY		
ACC Head AZ		
ACC Head AX redundant		
Accelerometer Mount		
ACC C4 AX		
ACC C4 AZ		
Accelerometer Mount		
ACC T1 left AX		
ACC T1 left AZ		
Accelerometer Mount		
ACC T1 right AX		
ACC T1 right AZ		
Accelerometer Mount		
ACC T8 AX		
ACC T8 AZ		
Accelerometer Mount		
ACC L1 AX		
ACC L1 AZ		
Accelerometer Mount		
ACC Pelvis AX		
ACC Pelvis AY		
ACC Pelvis AZ		
Accelerometer Mount		
Others		

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EuroNCAP Protocol

No requirement from EuroNCAP for specific accelerometers / ranges, only CAC given for the channels taken for rating criteria.

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RCAR - IIWPG Protocol

- RCAR – IIWPG Recommendation

Biorid Instrumentation-Required for RCAR-IIWPG Evaluation

Measurement Location	Sensor Type
Back of Head	Switch to indicate contact with head restraint
Upper Neck	Load cell (RA Denton Model 4985J)
T1 Vertebra-left side	Acceleration X-direction (eg Endevco 7264B-500)
T1 Vertebra-right side	Acceleration X-direction (eg Endevco 7264B-500)
Sled acceleration	Acceleration X-direction (eg Endevco 7264B-500)

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Analysis of BioRID Users Information

- **Head Ax and T1 Ax:** most European Dummies are equipped with Endevco model 7264-200 accelerometers due to the low values measured
- **Other ACC locations:** most European Dummies are equipped with Endevco model 7264B-500/2000 accelerometers

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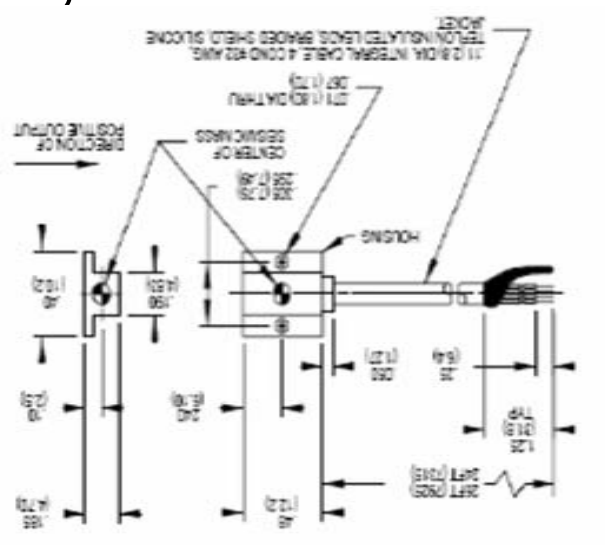
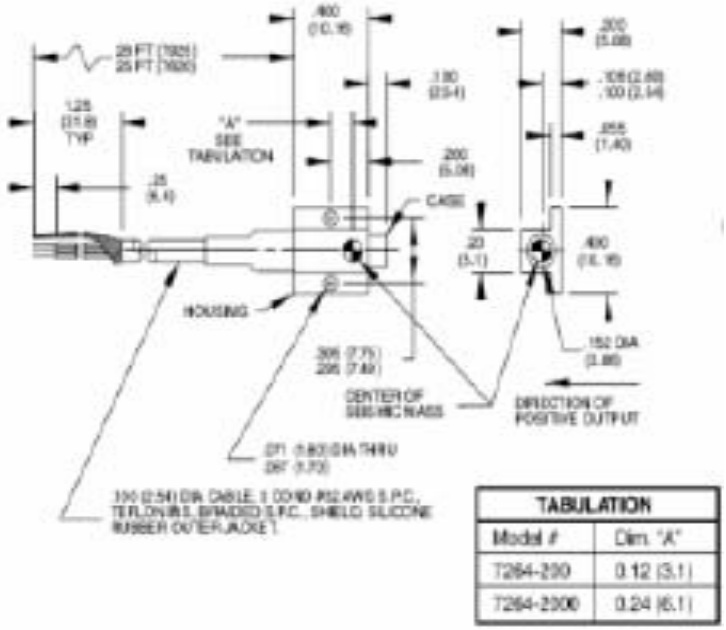
Combination of accelerometers

- When using the combination of Endevco 7264-200 and 7264B-xxxx on the 7264-B mounting block, the CG position differs by 3,1mm



7264B



TABULATION	
Model #	Dim. "A"
7264-200	0.12 (3.1)
7264-2000	0.24 (6.1)

7264

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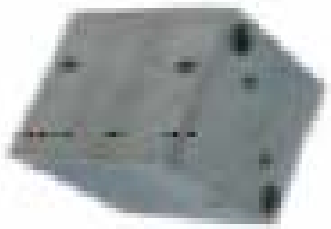
Mounting Cubes 7264-A and 7264-B

- 7264-B, CG`s line up in center



•7264-A, CG`s line up in corner

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Consequences & Questions

- Head & T1: possible need for modified mounting cube for the use of combination 7264B/C or equivalent and 7264-200
- Spine ACC locations: when using an accelerometer with a non-center CG, the center of the AX/AZ axis is different from the center CG mounts since the blocs are made for a triax configuration
- Question to users: is there a need to do some more investigation on possible differences due to a slight difference in the ACC CG locations?

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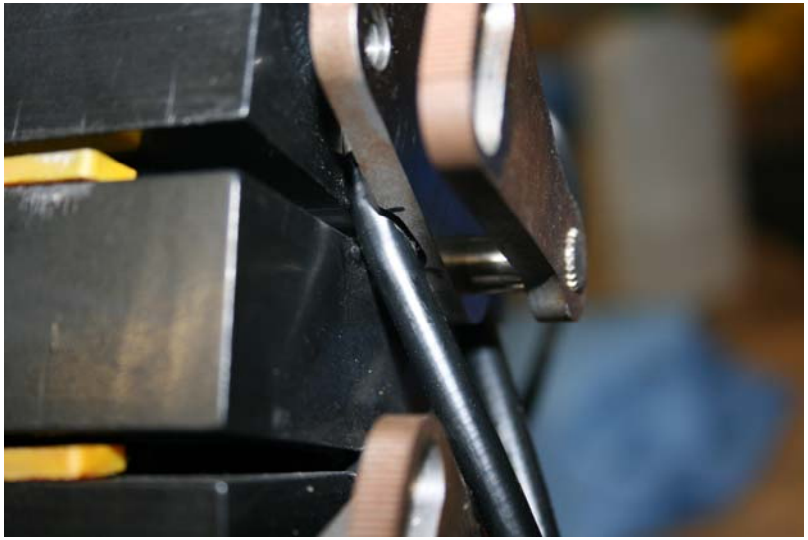
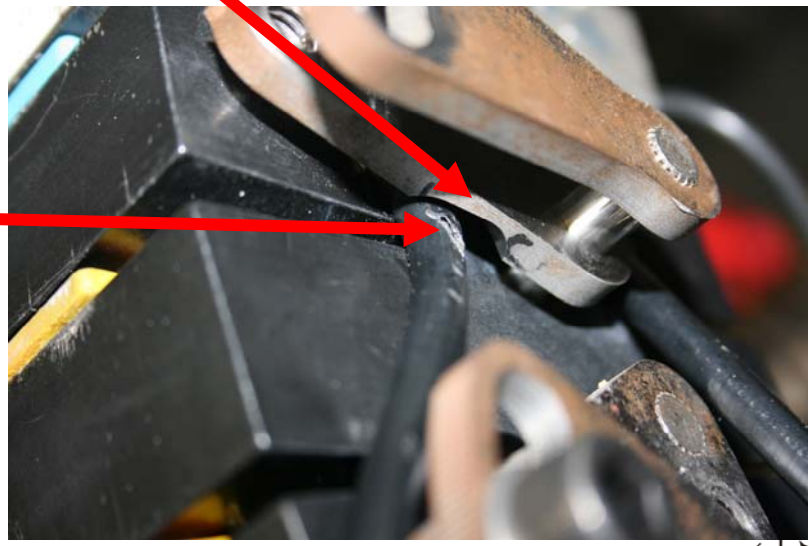
Muscle Tension Cable



To prevent damage it is recommended that a cut out be added to side plate

Outer cable conduit has been found to be damaged by side plate



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Goals for Certification Tests Revisions

- Revise sled design to eliminate sled bounce
- Revise sled to eliminate Jacket motion affect on third Velocity Corridor and sled acceleration
- Replace crushable foam with a reusable energy transfer device
- A head form should be used in place of the head for better repeatability and ease of final cable adjustment on sled.
- Add sled certification test
- Add head rest certification test

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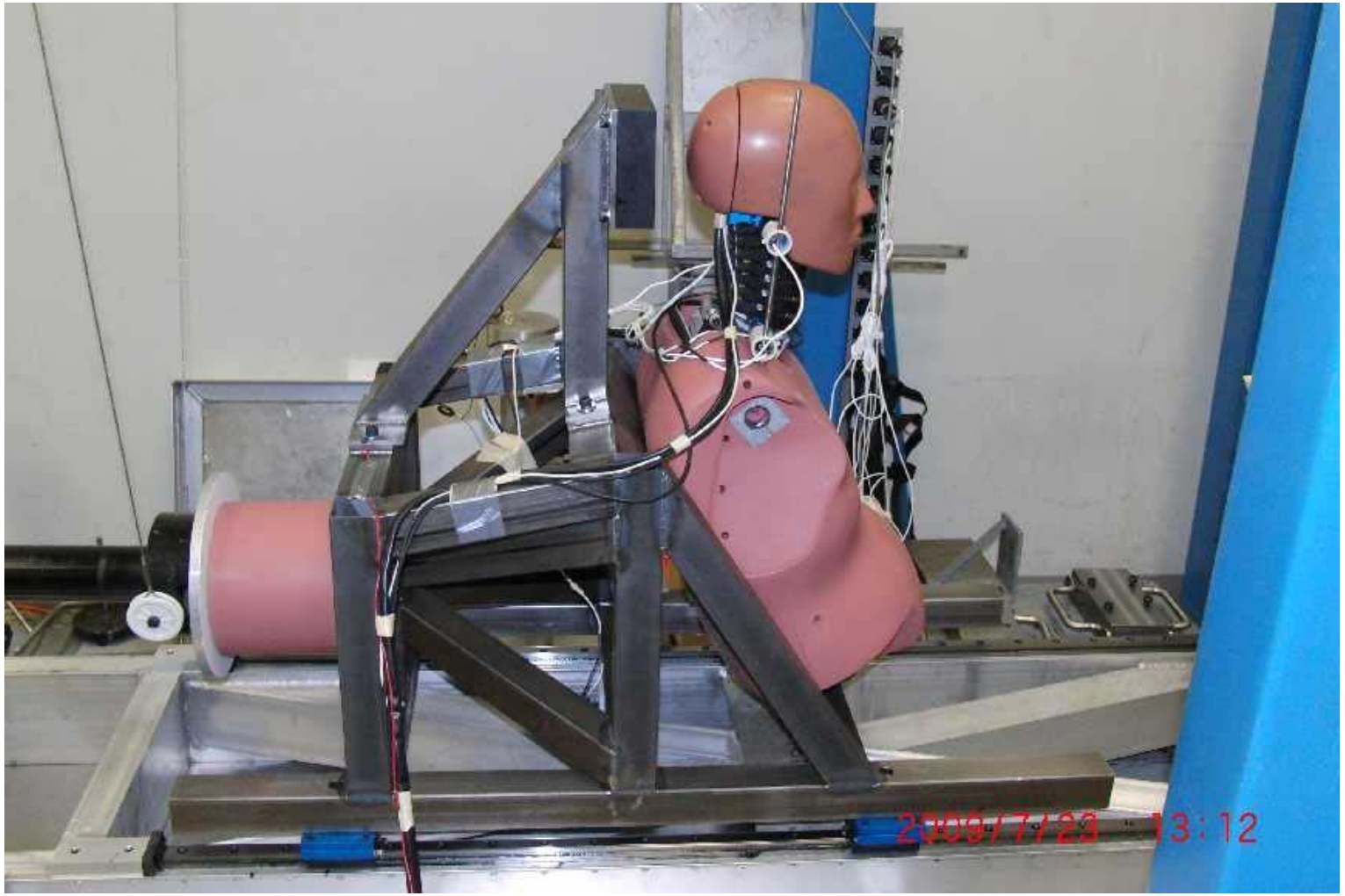
Dummy Certification with Head Rest



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Lab testing update

- Korea, Japan, Germany, Denton ATD
- Testing has begun
- Preliminary data review at GTR
- Data summary at next GBUM in November
- IIHS

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Channel List for Testing

channel	weight pkg	std cert	head rest cert
1	velocity	velocity	velocity
2	pend accel	pend accel	pend accel
3	sled accel	sled accel	sled accel
4	n/a	pot A	Upper neck Fx
5	n/a	pot B	Upper neck Fz
6	n/a	Pot C	Upper neck My
7	n/a	pot D	Lower neck Fx
8	n/a	Upper neck Mz	Lower neck Fz
9	n/a	T1 accel	Head contact sw
10	n/a	Upper neck Mx	Lower neck My
11	n/a	Upper neck Fx	Skull cap Fx
12	n/a	Upper neck Fz	Skull cap Fz
13	n/a	Upper neck My	Skull cap Fy
14	n/a	n/a	Upper neck Mz
15	n/a	n/a	Upper neck Mx
16	n/a	n/a	n/a

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Data Analysis

- Currently testing underway in Europe, Japan, Korea, ATD, and IIHS
- Will consolidate data for analysis as soon as it is available

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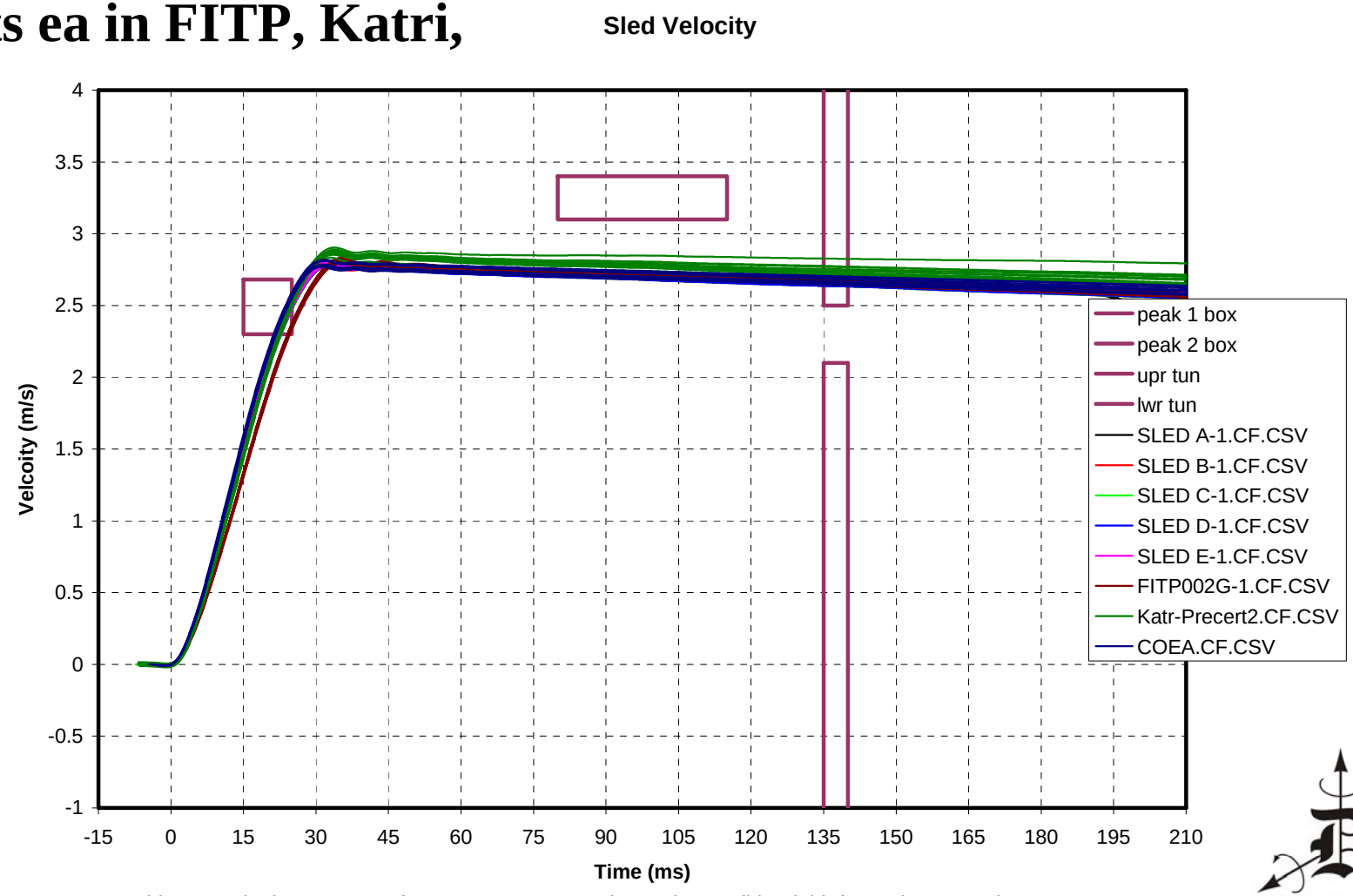
First Look at Weight Package Test

5 sleds 6 tests ea at Denton

10 tests ea in FITP, Katri, COE



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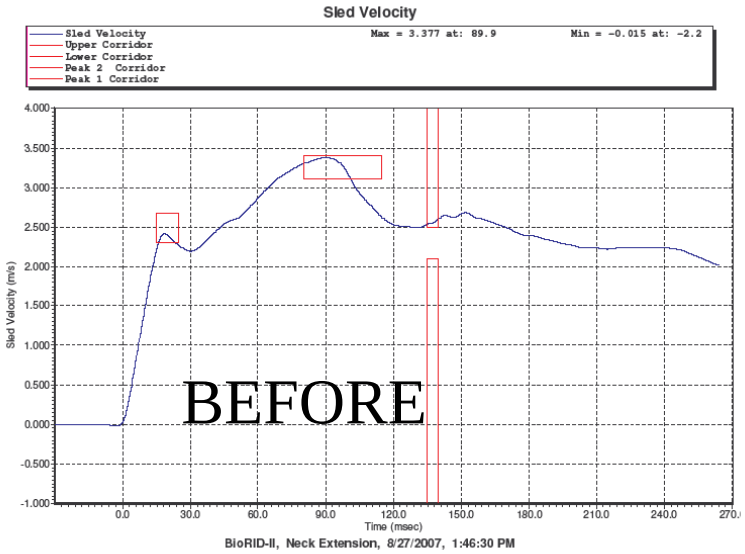
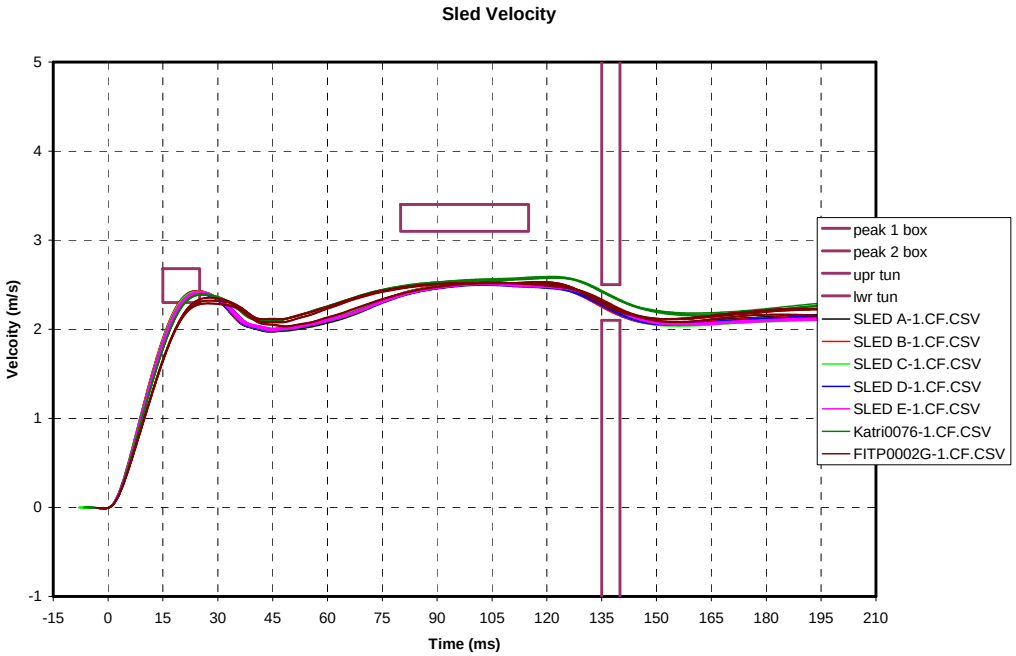
First Look - Dummy Test – No Headrest





39 tests

5 sleds

4 dummies

3 labs

Preliminary results

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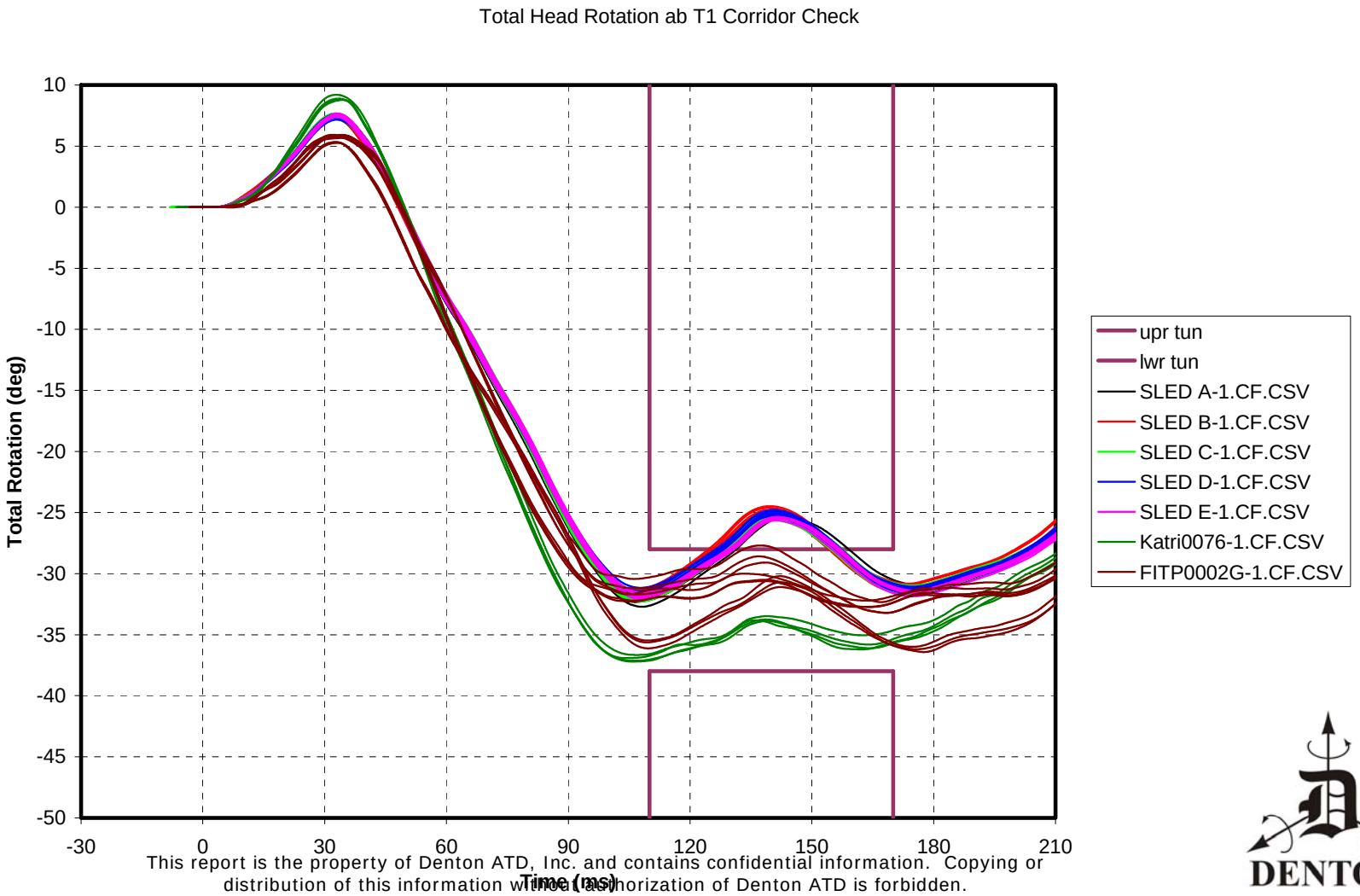
First Look -Dummy Test – No Headrest



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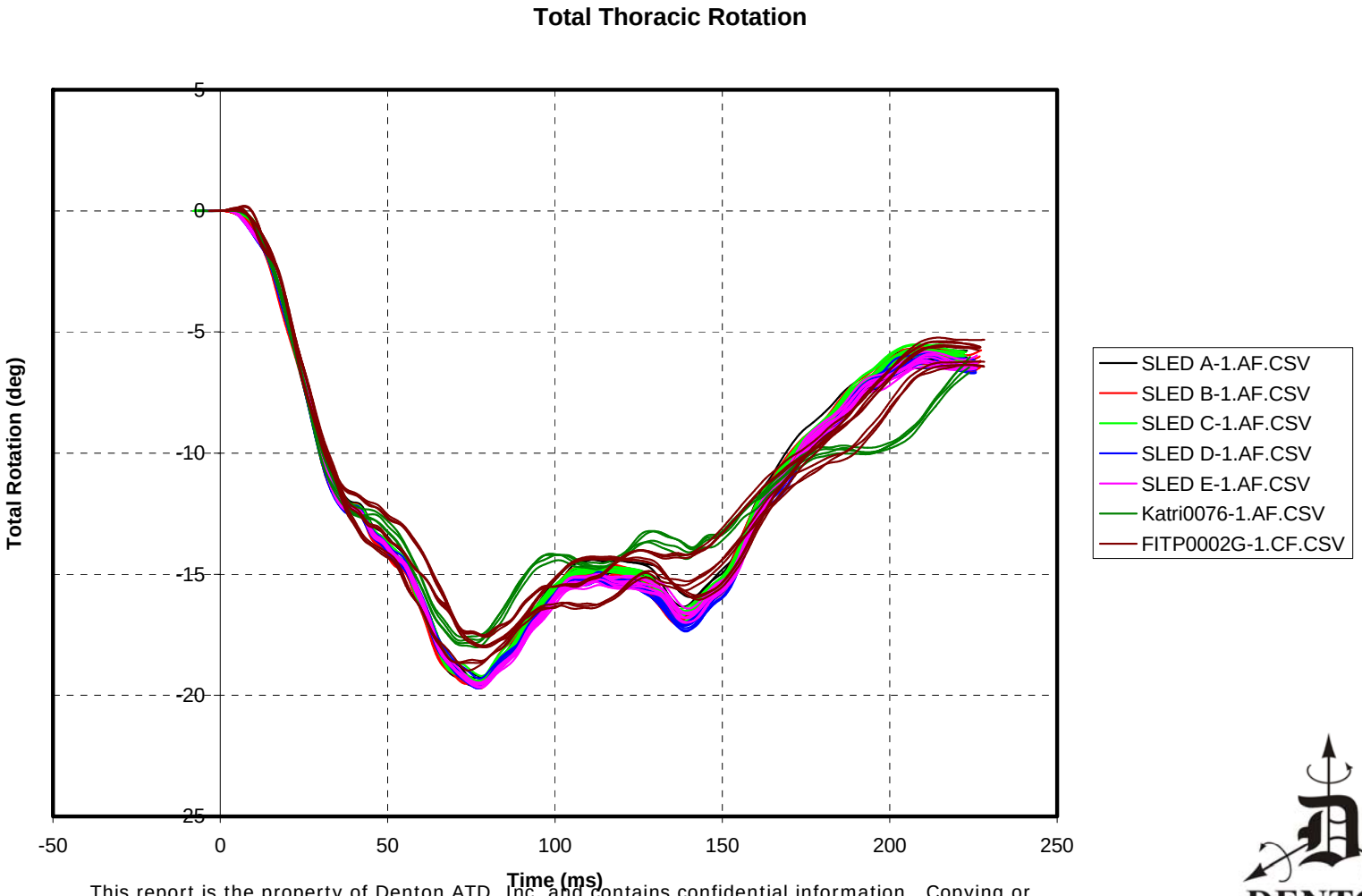

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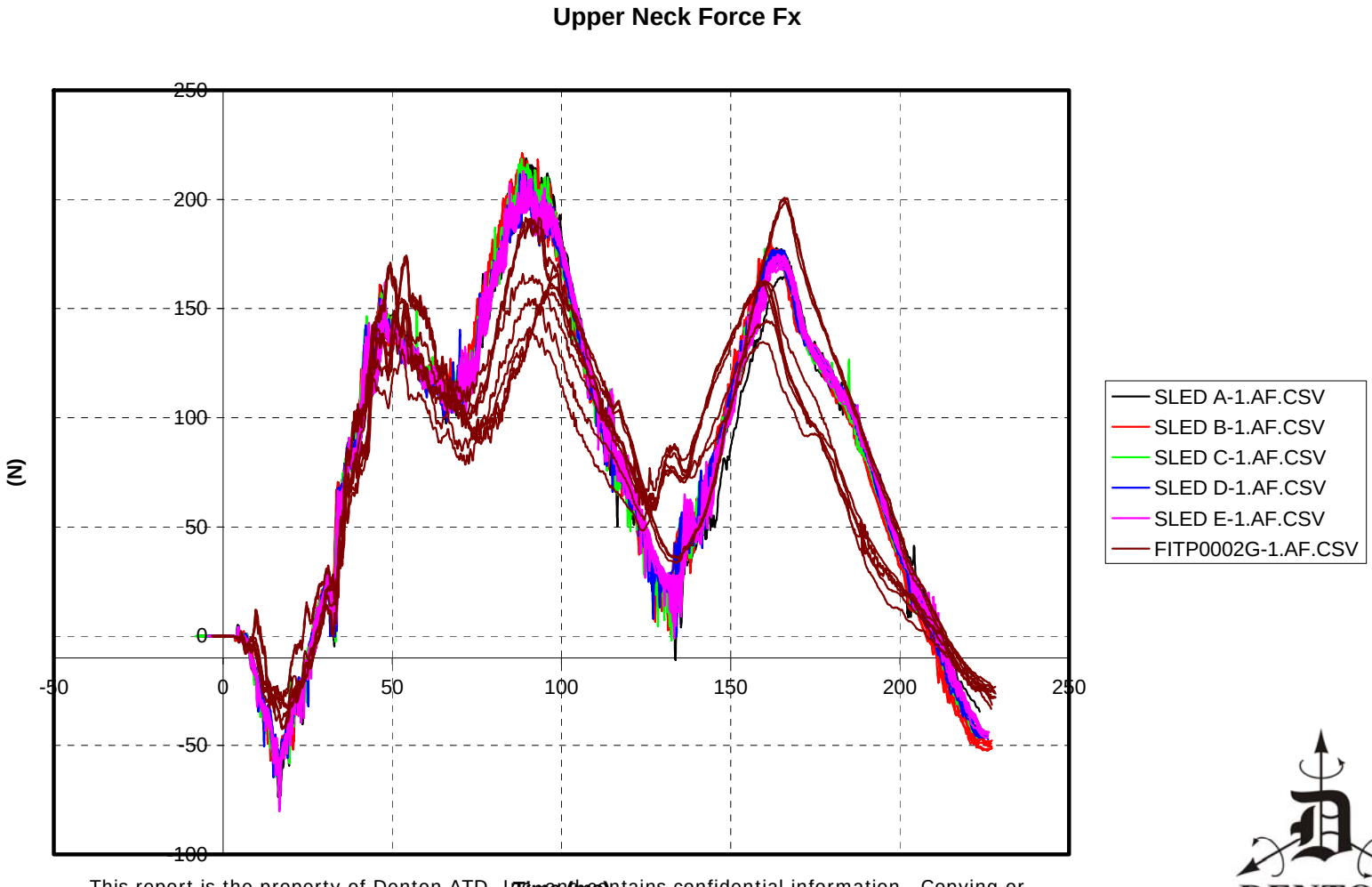
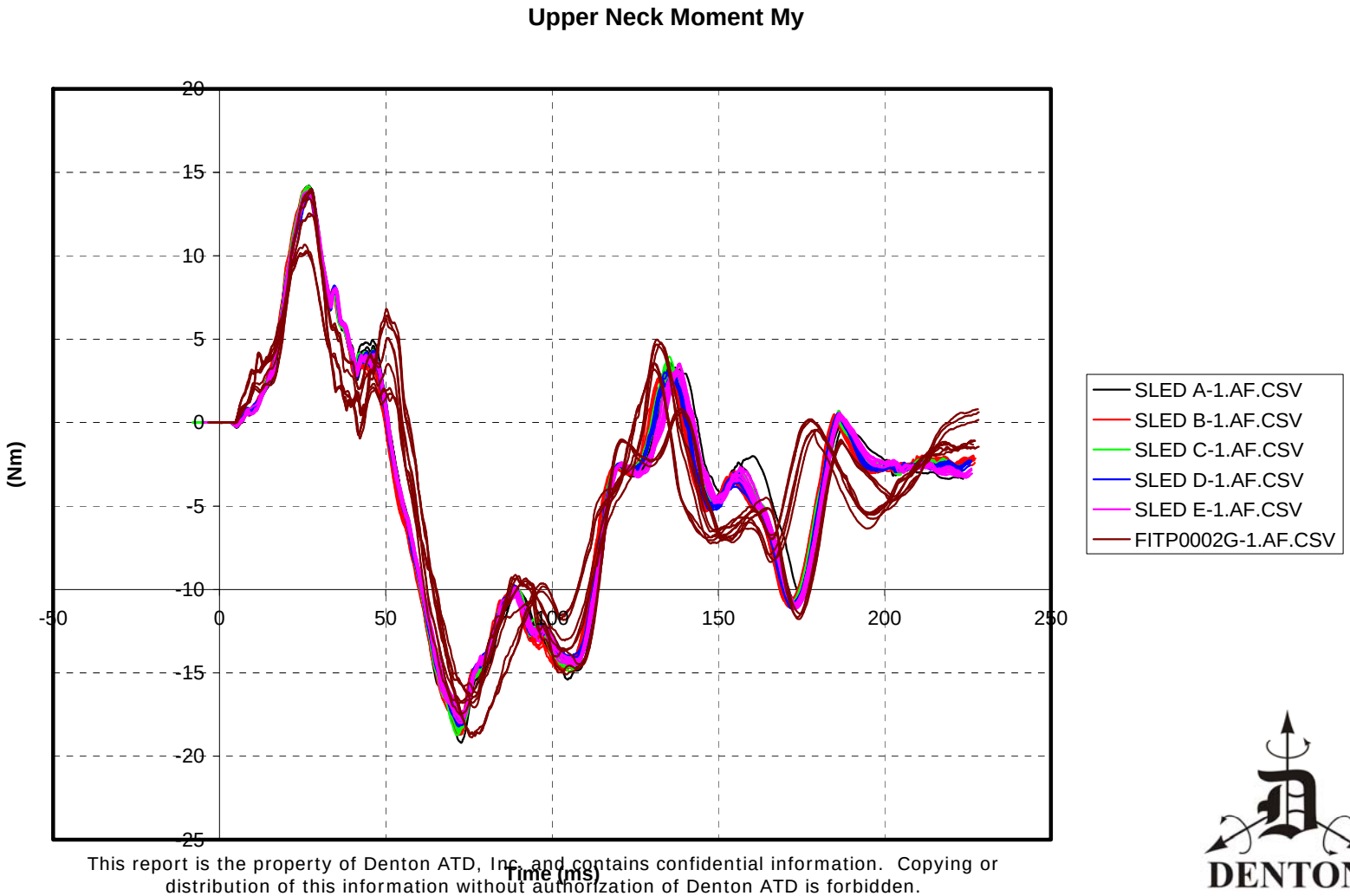


DENTON

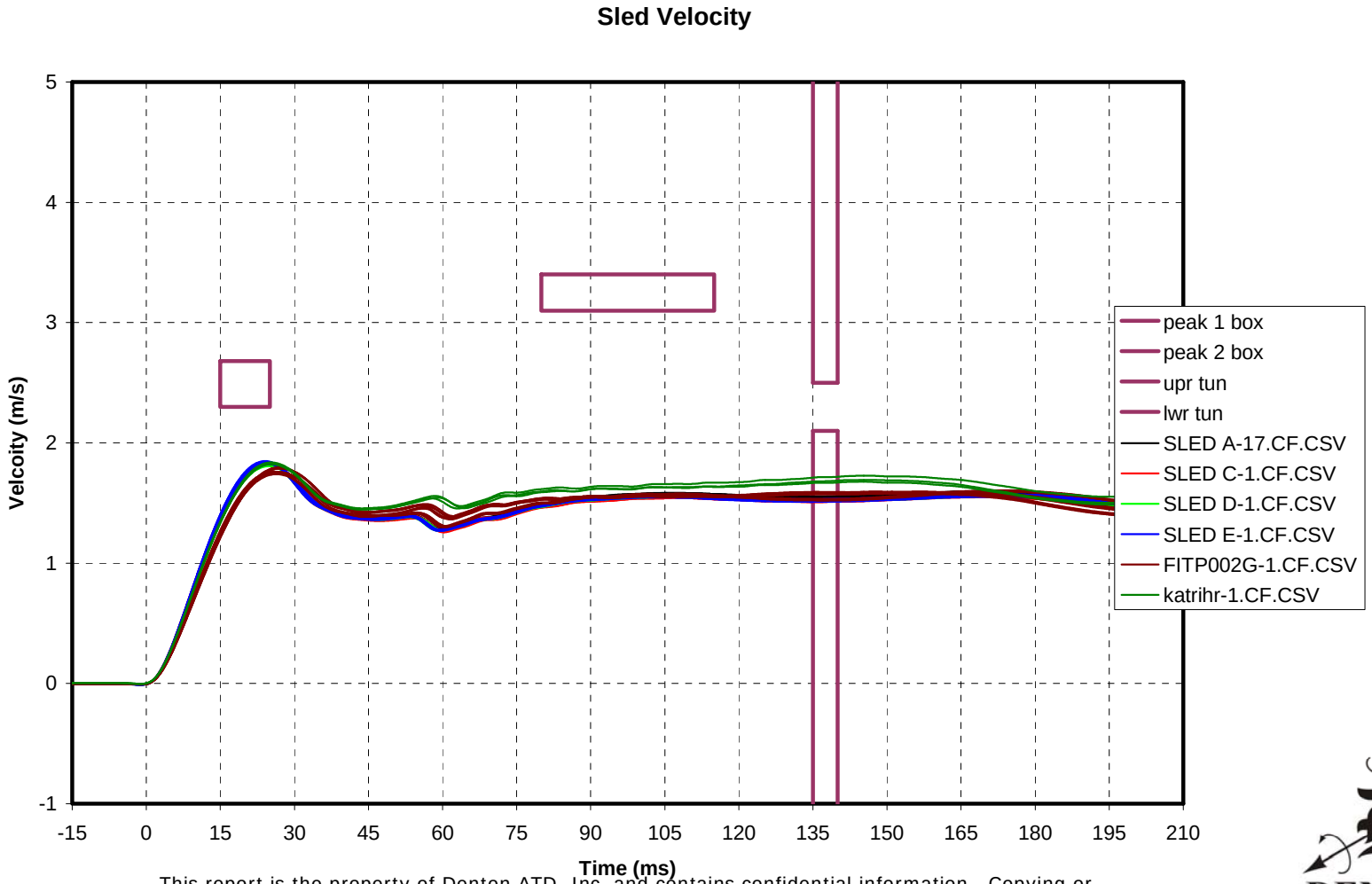
First Look - Dummy Test – No Headrest



DENTON

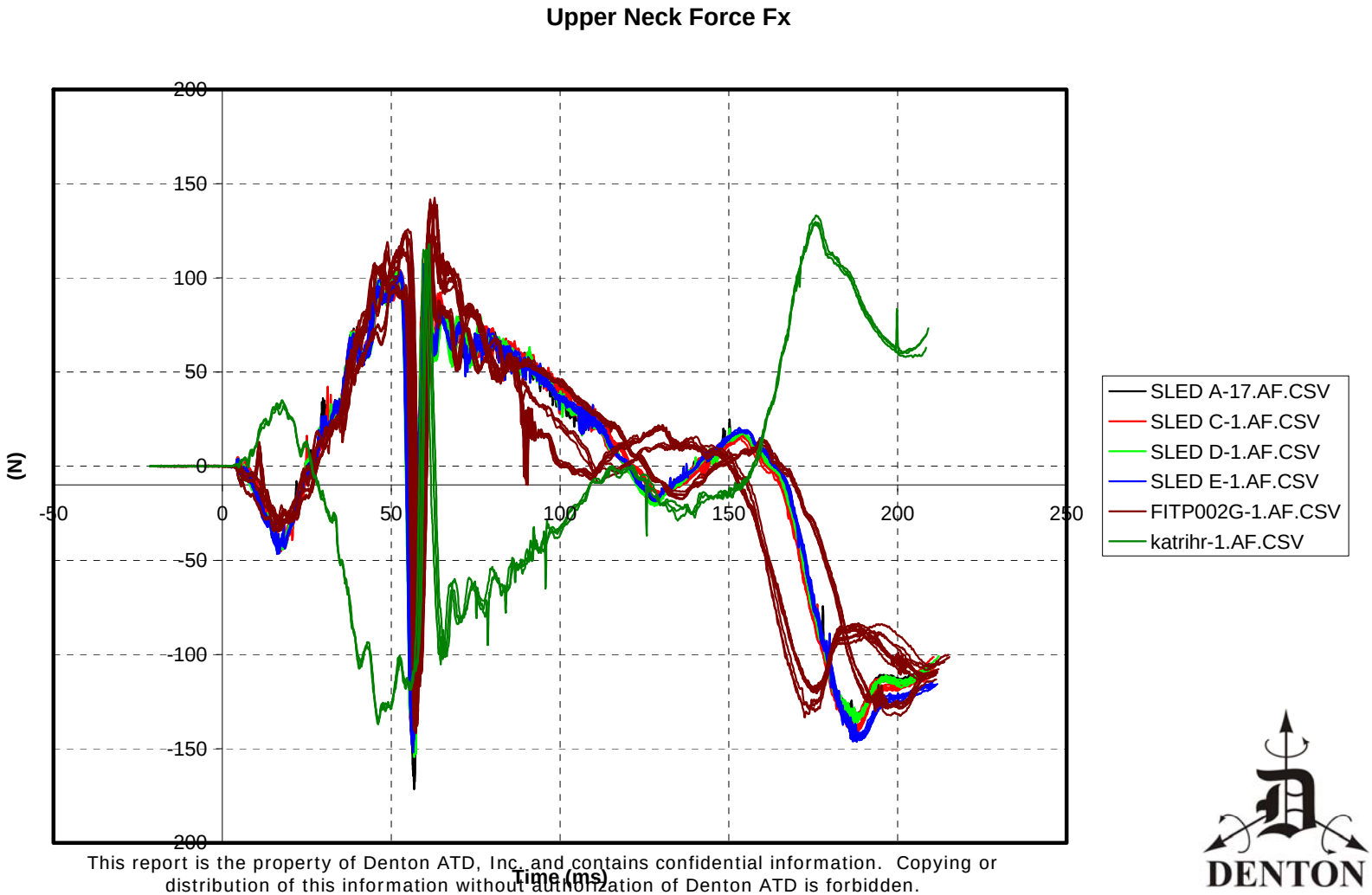
First Look - Dummy Headrest Test

4 dummies, 4 sleds,
3 labs, 31 tests



DENTON

First Look - Dummy Headrest Test



DENTON

Next Steps (Next two Months)

- Analysis and report finding from Round Robin testing
- Create & finalize corridors for head rest certification tests
- Revise & finalize corridors for standard certification tests
- Adopt headform for certification testing
- Revise manual with revision and new certification requirements
- Finalize drawings and manual and place in Geneva
- Adopt new head design for cable exit on the side
- Adopt new torso flesh with single flap opening in the rear.

DENTON

Agendas

- **Background**
  - GBUM Progress from April to Oct 2009
- **Certification Test Project update**
  - Update of equipment
  - Update of procedure
  - Update of Current RR testing throughout the world
- **Commercial Seating Procedure update**
  - Adjust Seating Procedure vs Adjustment of Dummy

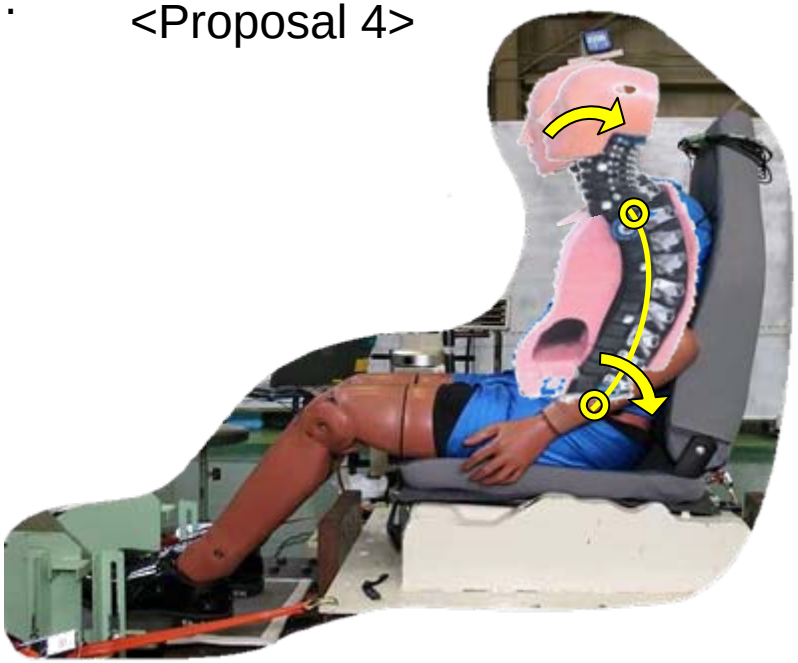
DENTON

Smaller Design Torso Angle seat seating trial

Recommendation

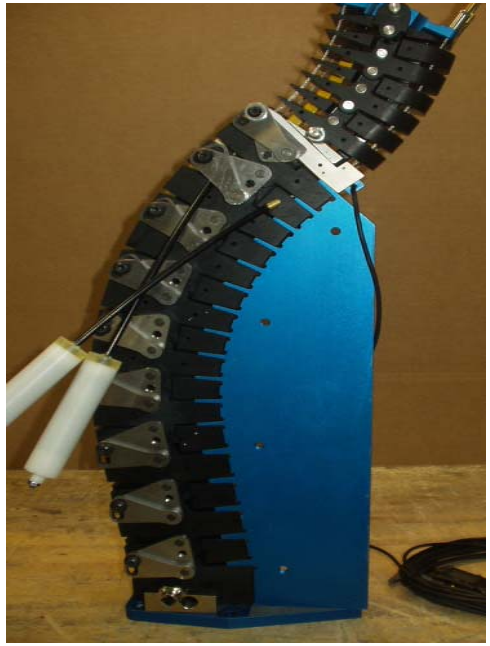
- ✓Proposal 4:
  - This proposal could be reasonable for permanent solution.
  - Tentative solution may need to consider depend on the modification difficulty.

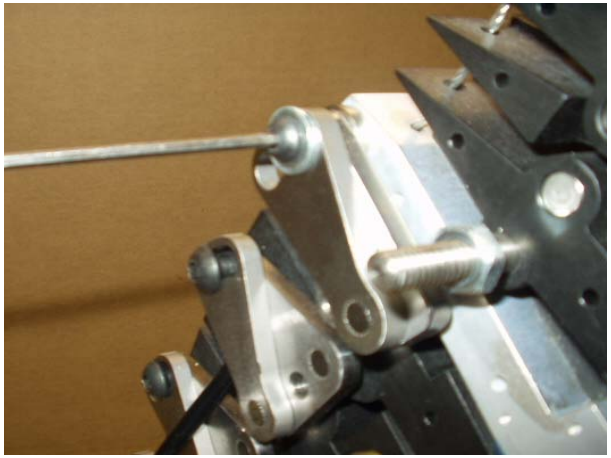
<Proposal 4>

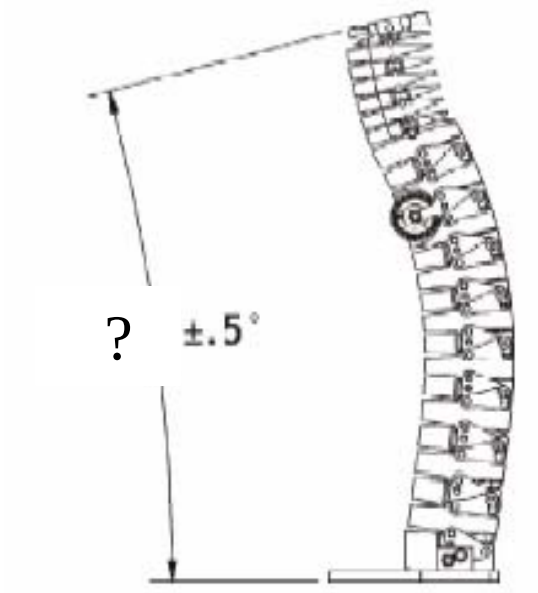


DENTON

Original Concept was to be able to adjust spine, (develop a new comb to adjust spine)







DENTON

GBUM Dummy Preparation Process

Goal: Updates were done to make dummy easier to use, more durable, and reproducible without changing the biofidelity

Revise hardware as required based on users feedback

Drawings

Certification Testing

R&R

PADI/Users Manual

DENTON

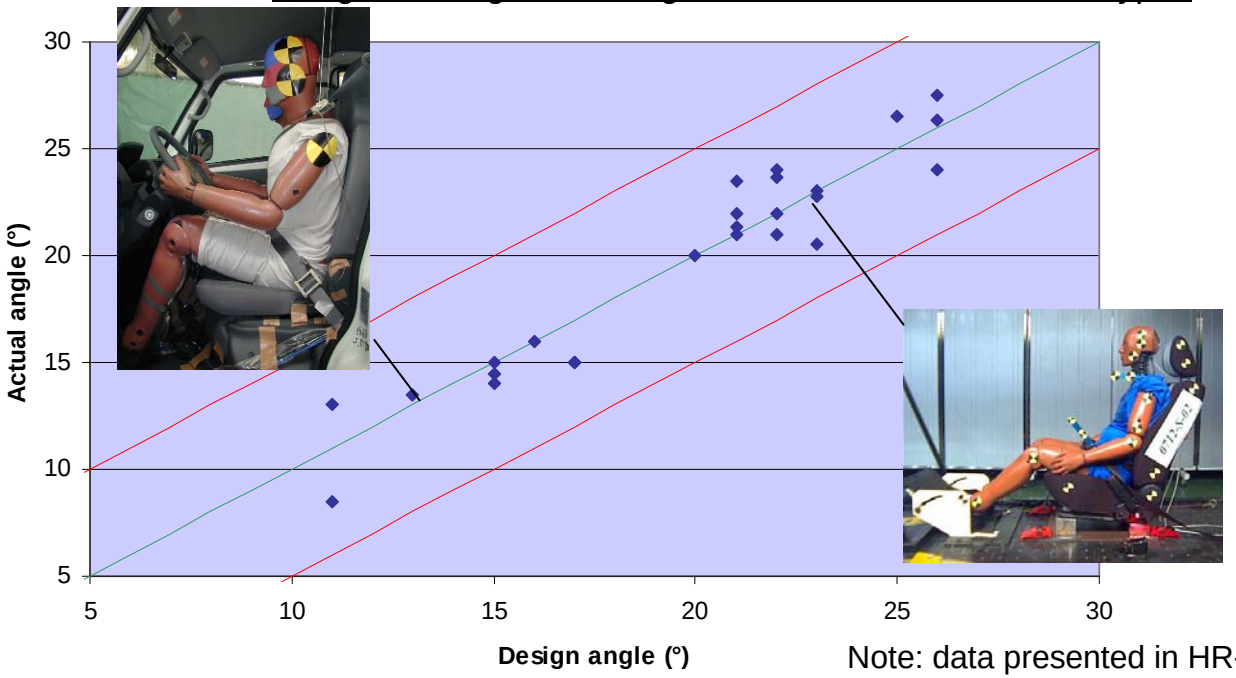
THANK YOU
for your attention

DENTON

Background of Design Torso Angle Proposal

Note: presented in HR-6-13

Range of design torso angles used in different vehicle types



Note: data presented in HR-4-13

- Design torso angle is specified based on typical driving posture for each type of vehicles and seating height, and it is varied from 10° to 30.
  - For certain seat designs 25° bears no relation to the real world seating position and in some cases may even not be physically achievable
  - Advise to use the procedure specified in ECE17 Annex 3
- All other safety tests, including vehicle crash test, are conducted with design torso angle.

DENTON

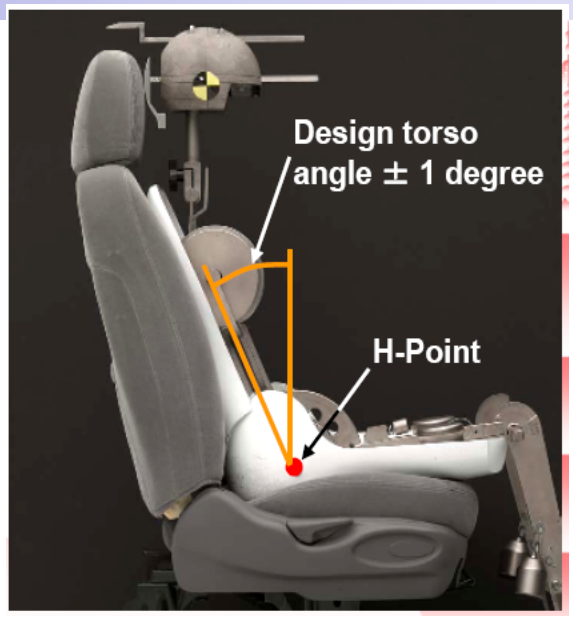
Seating Procedure Update

- Design seat back angle
  15 degree

Normal Driving Posture

- FMVSS202a proposal
  25 degree

Unusual Driving Posture



DENTON

Smaller Design Torso Angle seat seating trial

Purpose:

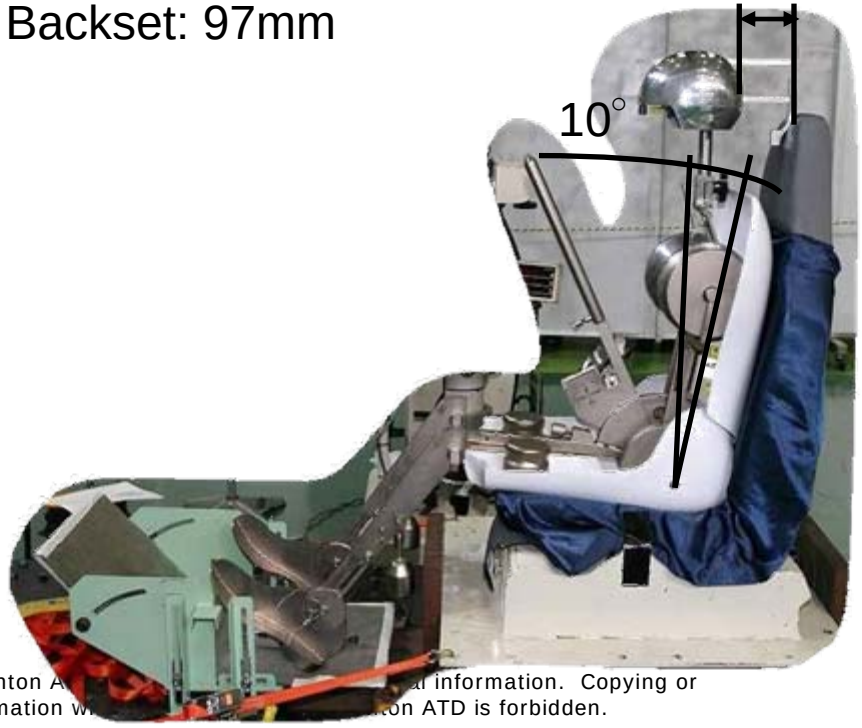
- To find out actual problem for Bio RID II seating procedure in case of smaller design torso angle seat, (less than 20 degree).
- To study route cause and countermeasure proposal

Sample seat

Small van

13 degree design torso angle seat

- Actual torso angle : 10 degree
- Backset: 97mm

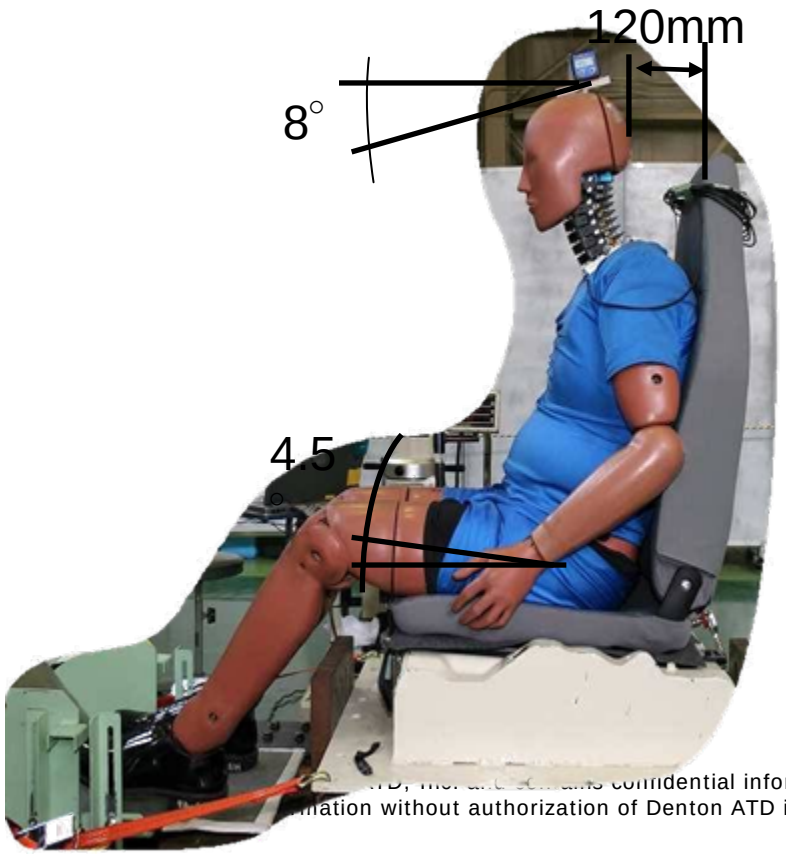


DENTON

Smaller Design Torso Angle seat seating trial

Problem:

- Head can not keep **laterally level.**
- Distance between head and head restraint is bigger than backset+15mm (112mm).
- Pelvis angle can not keep torso angle + 1.5 degree.

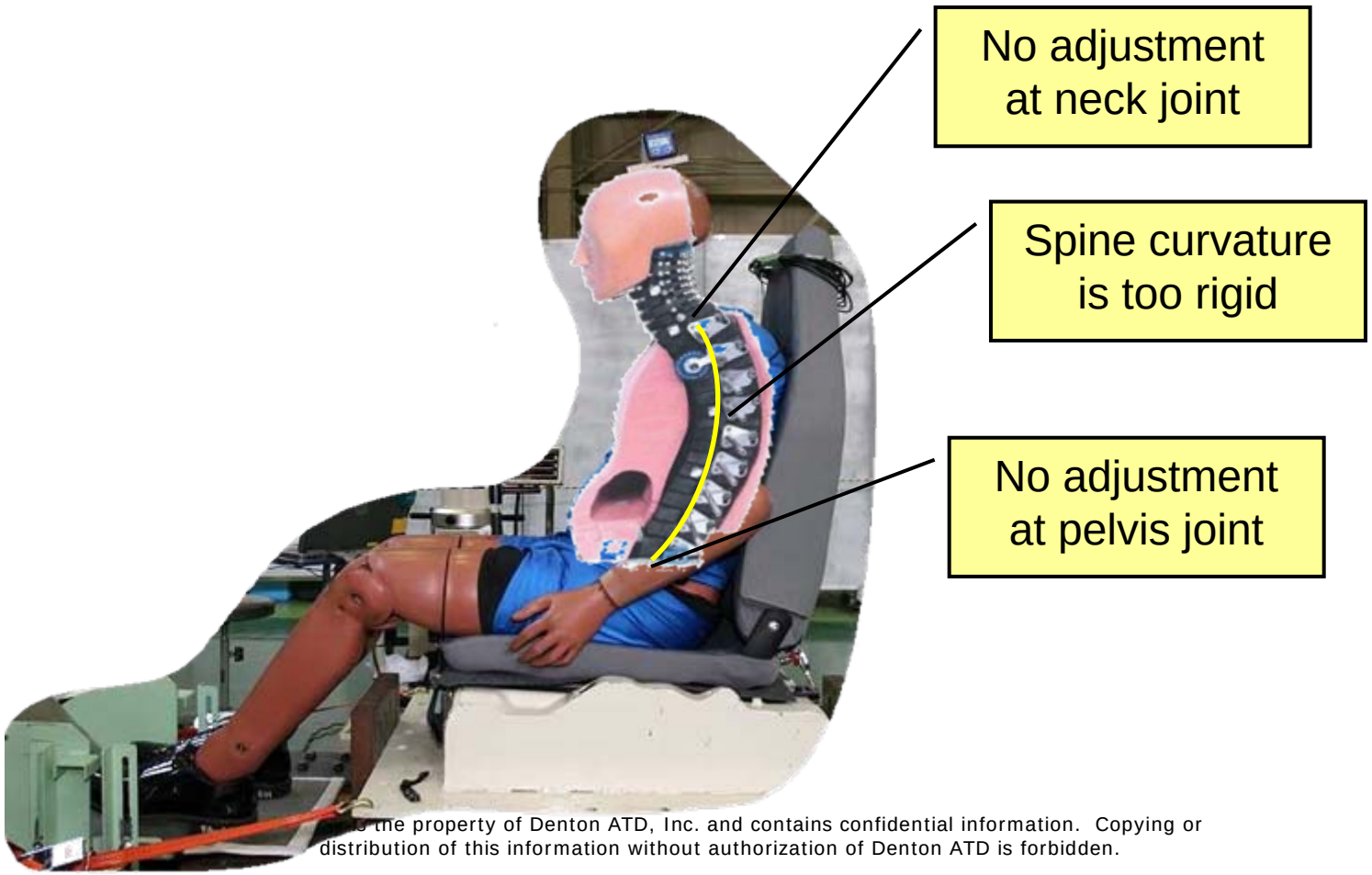


DENTON

Smaller Design Torso Angle seat seating trial

Route cause study

- Spine curvature is less flexibility due to the rigid design for 25 degree seating posture.
- There is no adjustment capability at neck joint and/or pelvis joint.



DENTON

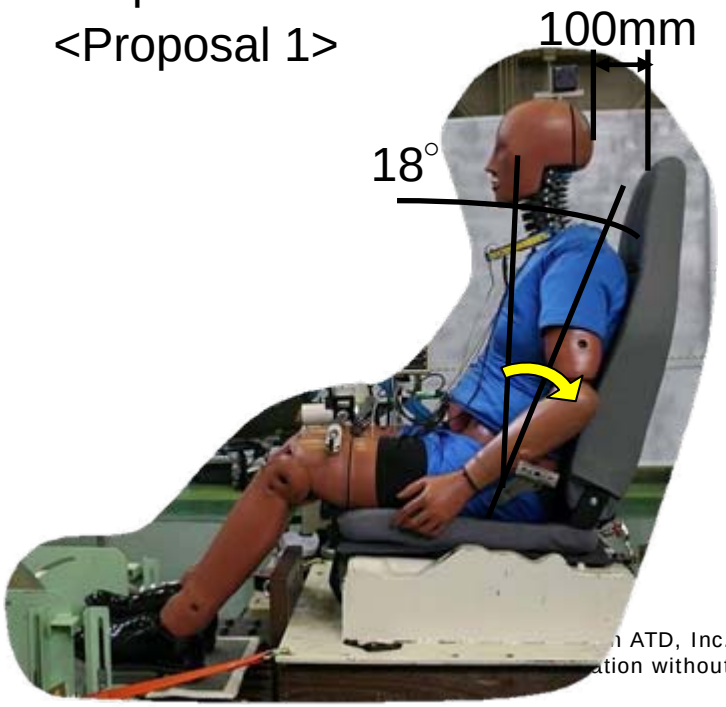
Smaller Design Torso Angle seat seating trial

Countermeasure proposal

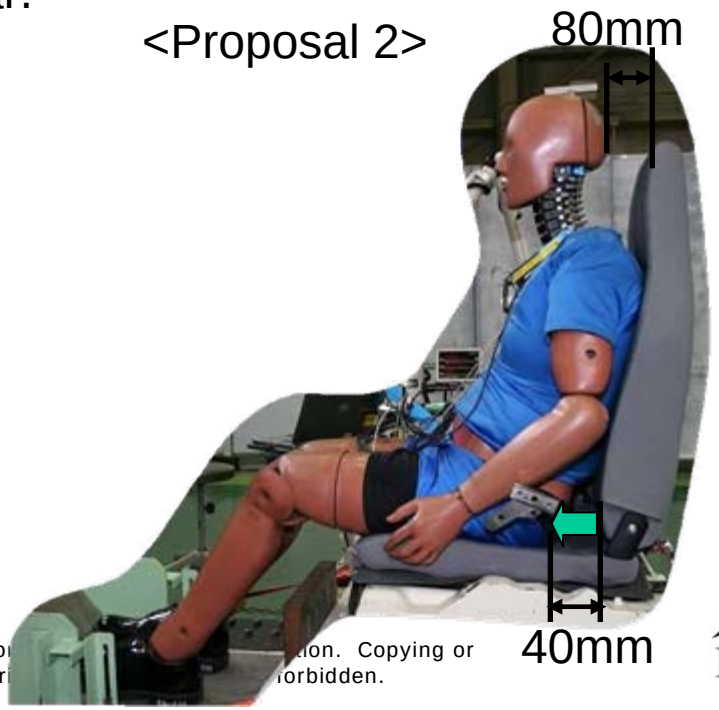
- Proposal 1: Recline the Seat Back until the head keeping laterally level.
  - ➲ Seating posture can not represent Actual driving posture.

- Proposal 2: Move the dummy Hip until the head keeping laterally level.
  - ➲ Seating posture could be reasonable. The gap between head and head restraint is closer than Backset +15mm. The gap between hip and seat back effect for dynamic behavior and reactive head restraint performance from the is unclear.

<Proposal 1>



<Proposal 2>



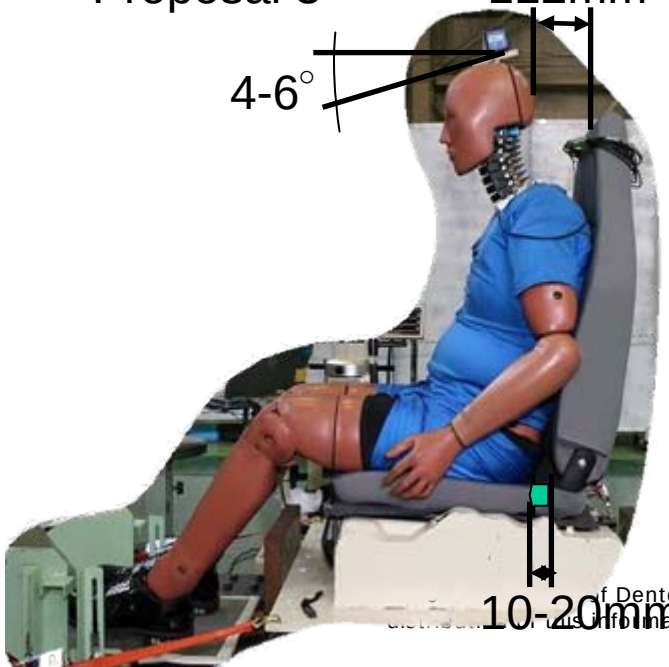
DENTON

Smaller Design Torso Angle seat seating trial

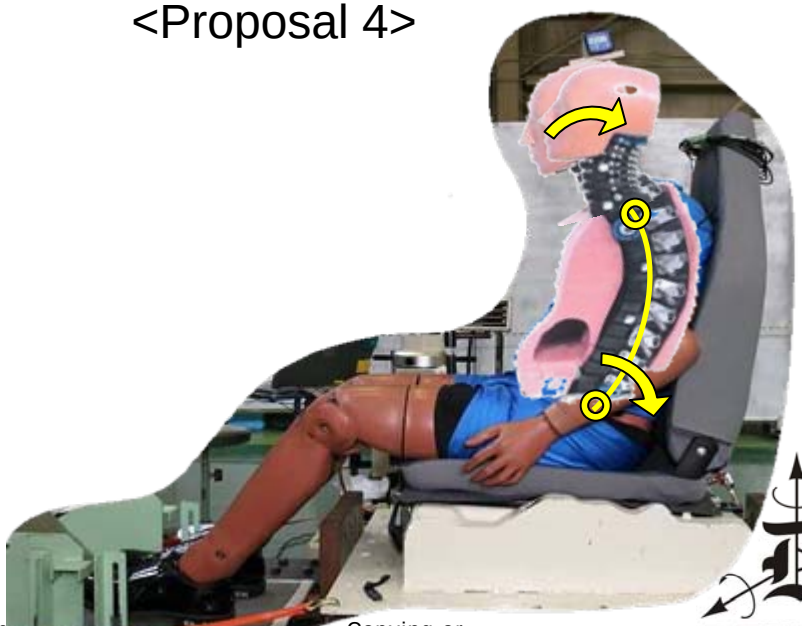
Countermeasure proposal

- Proposal 3: Move the dummy Hip until the gap between head and head restraint becoming Backset +15mm.
  - ➲ Seating posture and head position could be reasonable. The gap between hip and seat back effect for dynamic behavior and reactive head restraint performance from the is unclear.
- Proposal 4: Add neck and/or pelvis angle adjust feature to Bio RID II dummy.
  - ➲ Seating posture and head position could be reasonable. Dummy modification capability is unclear.

<Proposal 3>



<Proposal 4>



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