Development of BioRID-II Dummy Model
In Cooperation with German Automotive Industry

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Content

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Introduction

" Whiplash is an acceleration-deceleration mechanism of energy transfer to the neck. It may result from rear end or side-impact motor vehicle collisions, but can also occur during diving and other mishaps. The impact may result in bony or soft-tissue injuries, this in turn may lead to a variety of clinical manifestations."

(*QTF, Spitzer*)

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Whiplash in vehicle crashes

" The MOST common injuries sustained in motor vehicle crashes are those to the soft tissue of the neck, commonly termed whiplash."

(*Thatcham, 2005*)

" Whiplash claims cost UK insurers 1.6 billion BP, US insurers pay 10 billion USD per annum"

(*Aspen Insurance UK, 2004*)

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Tests to asses seat performance

Many institutes and organizations propose rear impact tests

- Thatcham
- IIWPG (International Insurance Whiplash Prevention Group)
- AZT (Allianz-Zentrum für Technik)
- IIHS (Insurance Institute for Highway Safety)
- Folksam
- EU,…..

- Tests use different crash pulses to accelerate a seat
- All tests cause no extensive damage on the seat
- The influence of vehicle design on the pulse are not considered.
- Tests use BioRID-II Dummy

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BioRID-II Dummy

- Shares extremities with HIII 50% dummy
- Shares modified head and pelvis from HIII dummy
- Complex spine
- Complex upper neck model
- Pre-stress in spine to model muscels

Denton

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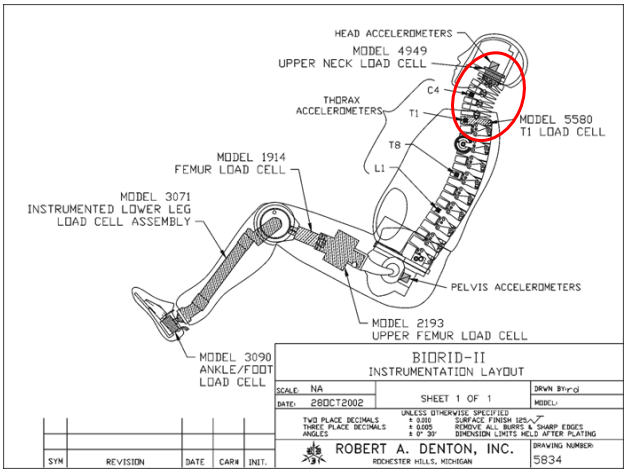
BioRID-II dummy load cells



Denton

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BioRID-II Dummy injury criteria

- Neck Injurity Criterion
  NIC = f (relative movement of neck)
- Neck Criterion Rear Impact
  Nkm = f (moment and force, upper neck)
- Lower Neck Load Index
  LNL = f (moments and forces, lower neck)

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BioRID-II Dummy Model Project

- FAT (German Research Organization of Automotive Industry)
- Project similar to former dummy model development projects
- Models from former FAT projects:
  - USSID
  - SIDHIII
  - Eurosid-1
  - ES-2
  - ES-2re
- New Project for development of BioRID II model

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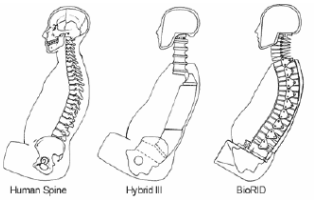
Participating Companies from the FAT

OEMs:

Audi
BMW
Mercedes
Opel
Porsche
Volkswagen
Karmann

Seat manufacturer:

CR Hammerstein
Johnson Controls
Keiper Recaro



Models will be commercially available.
Chairman of FAT BioRID working group is from Volkswagen

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Material tests for foams

- Static compression tests
- Dynamic compression tests
  - Strain rates 1, 10, 100, 500 1/s
  - 50 and 90% volumetric strain
- Static tension tests
- Dynamic tension tests
  - Strain rates 1, 10, 100, 500

(**all relevant foams** and **rubbers** will be tested)

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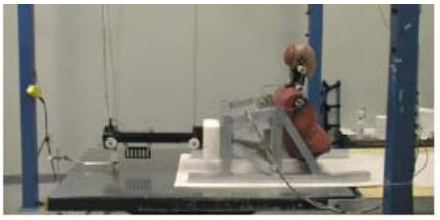
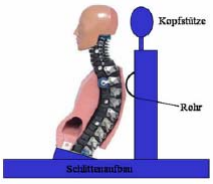
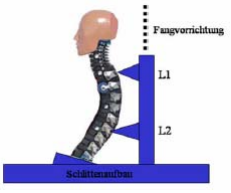
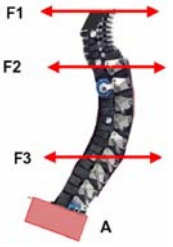
Component Tests

- High speed hydraulic impactors
- Static and dynamic tests with the spine
- Partial thorax tests
- Fully assembled thorax tests
- Each tests with 3 different dummies









April 2005

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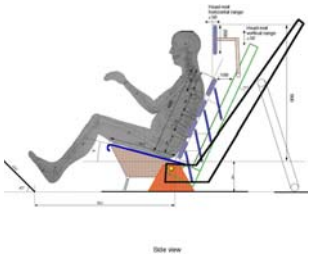
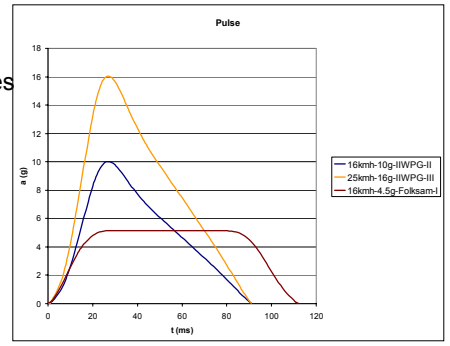
Sled Tests

- Each test with 3 different dummies
- Tests with 3 different pulses
- Tests with „Chalmers“ seat
- Tests with different neck rest geometries





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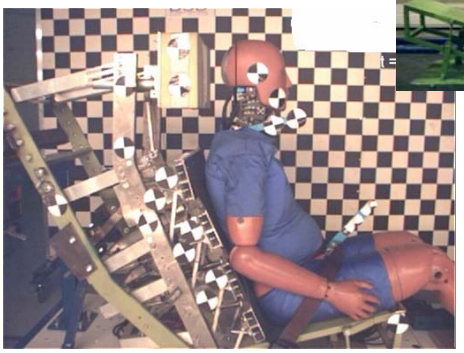
Chalmers Seat

- Seat used in dummy development
- Characteristics comparable to a seat
- High repeatability



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Project Schedule

- 1st official release will be ready in June 2005
- 2nd release 12/2005
- Further releases will follow in 6/2006 and 2007

Schedule very tight since OEMs want to have a first model ready in June.

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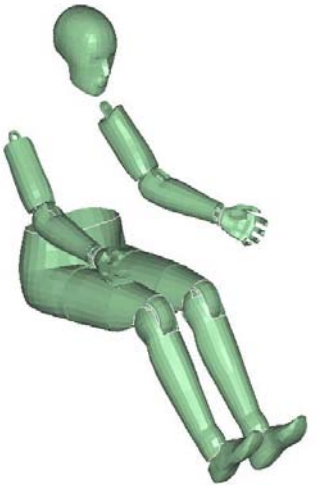
Model Details

- HIII parts for first release from NCAC model
- Model is based on CAD data from Denton
- Further releases will use re-modeled HIII parts
- Time-step = 0.8 microseconds



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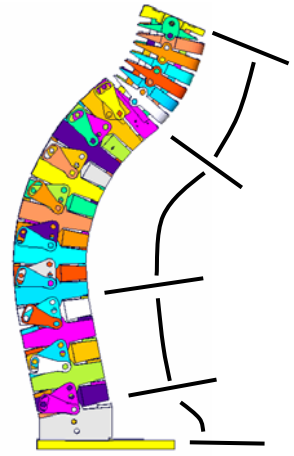
Model Details: Spine



Cervical Vertebrae (C1 – C7)

Thoracic Vertebrae (T1 – T12)

Lumbar Vertebrae (L1 – L5)

Pelvis Interface Plate (S1)

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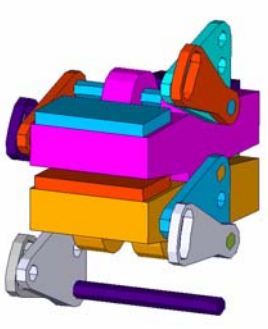
Model Details

- T1-T12 connected by a torsional beam
- L1-L5 connected by a torsional beam
- Beams are connected through washers
- Movements of vertebrae are limited by rubber stoppers and the beams



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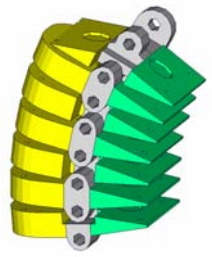
Model Details

- C1-C7 are connected through bolts
- Movement limited by rubber stoppers
- Neck pre-stresses via steel cable by springs



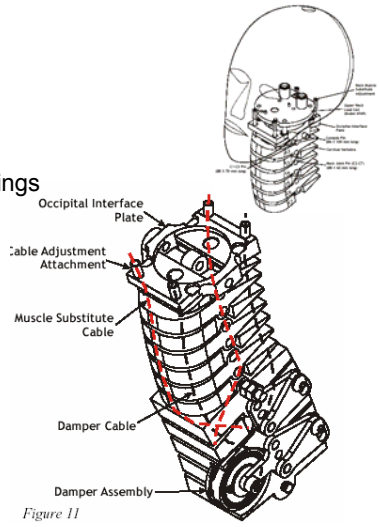


Figure 11

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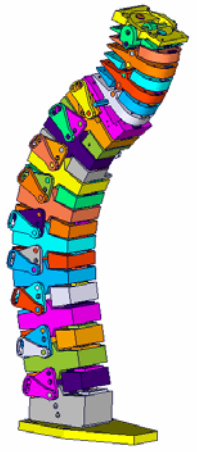
Conclusion

- LS-DYNA model will be developed by DYNAmore
- First model available in June 2005
- Extensive tests will be incorporated
- Model will be developed with material, component and sled tests



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