

## Development of BioRID-II Dummy Model in Cooperation with the German Automotive Industry

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## FAT BioRID-II Model

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- Schedule for development
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## FAT BioRID-II Model

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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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### FAT BioRID-II Model

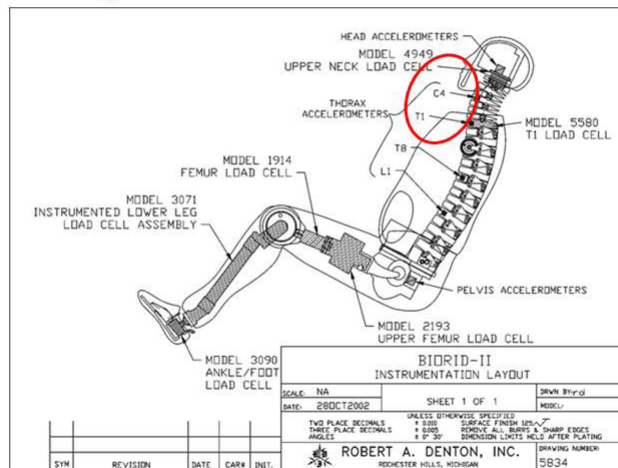
#### BioRID-II Dummy

- Shares extremities with HIII 50% dummy
- Equipped with modified head and pelvis from HIII dummy
- Detailed spine
- Complex cervical spine
- Pre-stress in spine to model muscles



### FAT BioRID-II Model

#### BioRID-II dummy load cells



## FAT BioRID-II Model

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### BioRID-II Dummy injury criteria

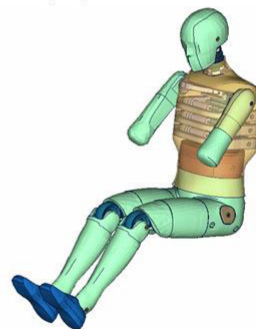
- Neck Injury Criterion  
NIC = f (relative movement of neck)
  
- Neck Criterion Rear Impact  
Nkm = f (moment and force, upper neck)
  
- Lower Neck Load Index  
LNL = f (moments and forces, lower neck)

## FAT BioRID-II Model

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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



## FAT BioRID-II Model

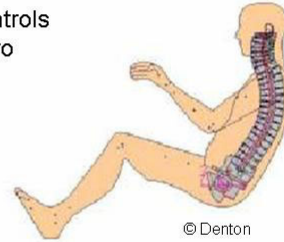
### Participating Companies from the FAT

#### 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-II working group is from Volkswagen

## FAT BioRID-II Model

### 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 1/s



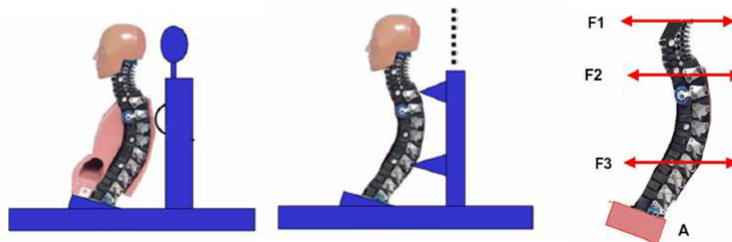
(all relevant foams and rubbers will be tested)



### FAT BioRID-II Model

#### 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



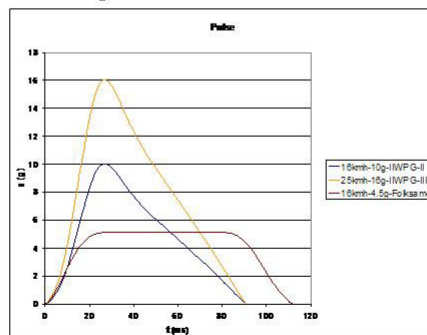
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### FAT BioRID-II Model

#### Sled Tests

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



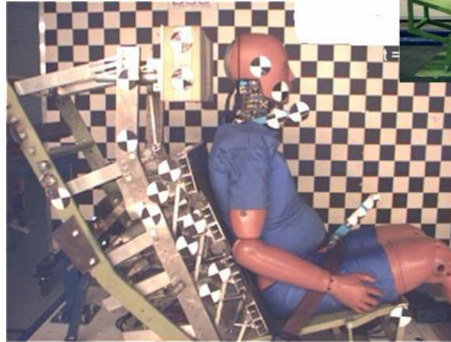
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### Chalmers Seat

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



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## FAT BioRID-II Model

### 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.

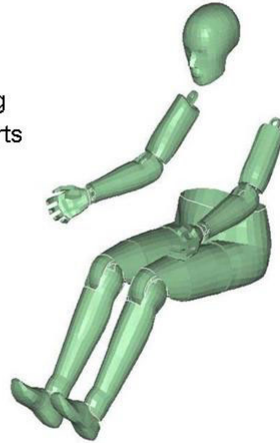
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## FAT BioRID-II Model

### Model Details

- HIII parts for first release from NCAC model
- Model is based on CAD data from Denton
- Further CAD data generated by 3D scanning
- Further releases will use re-modeled HIII parts
- Spine will be modeled with pre-stress
- Time-step = 0.8 microseconds

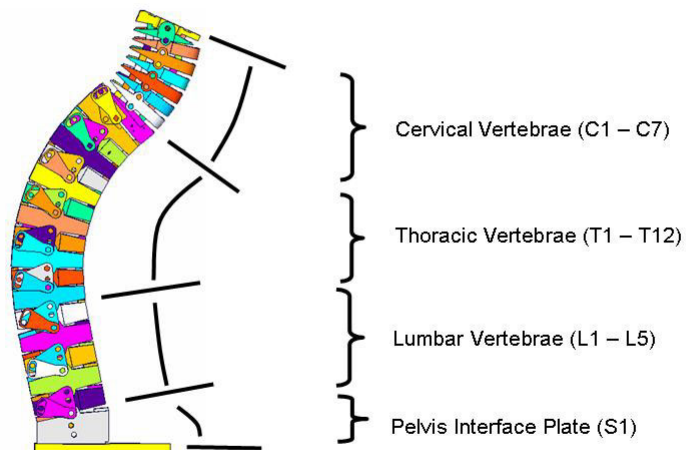


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## FAT BioRID-II Model

### Model Details



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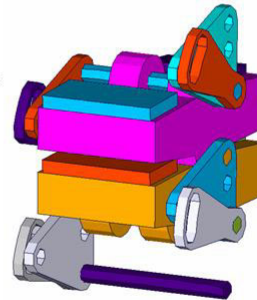
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## FAT BioRID-II Model

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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 connecting beams
- Bending of spine during positioning introduces stresses in the thoracic and lumbar spine



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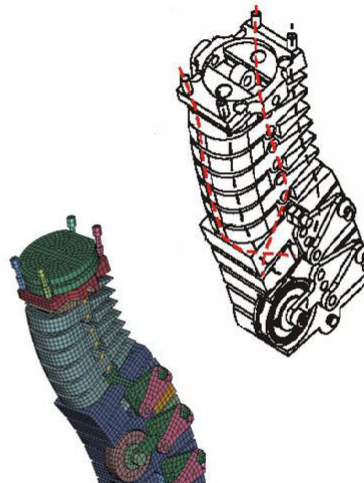
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## FAT BioRID-II Model

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### Model Details

- C1-C7 are connected through bolts
- Rotations limited by rubber stoppers
- Neck is pre-stressed by a cable
- Stress models muscles
- Calibration due to different pre-stress



Neck model:

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### First Simulations

- First investigations focus to evaluate influence of pre-stress
- Results will be presented at the 5th European Conference
- First correlation results with 'Chalmers' seat will be also presented at the Conference



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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
- Models will be available through local LS-DYNA distributors



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