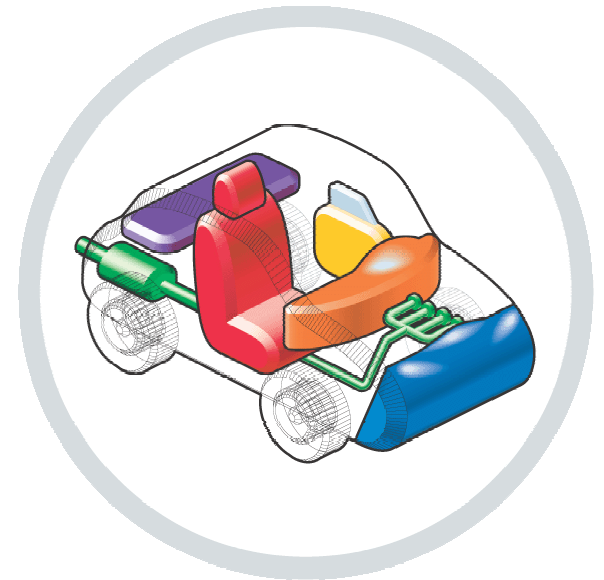


Technical perfection, automotive passion.

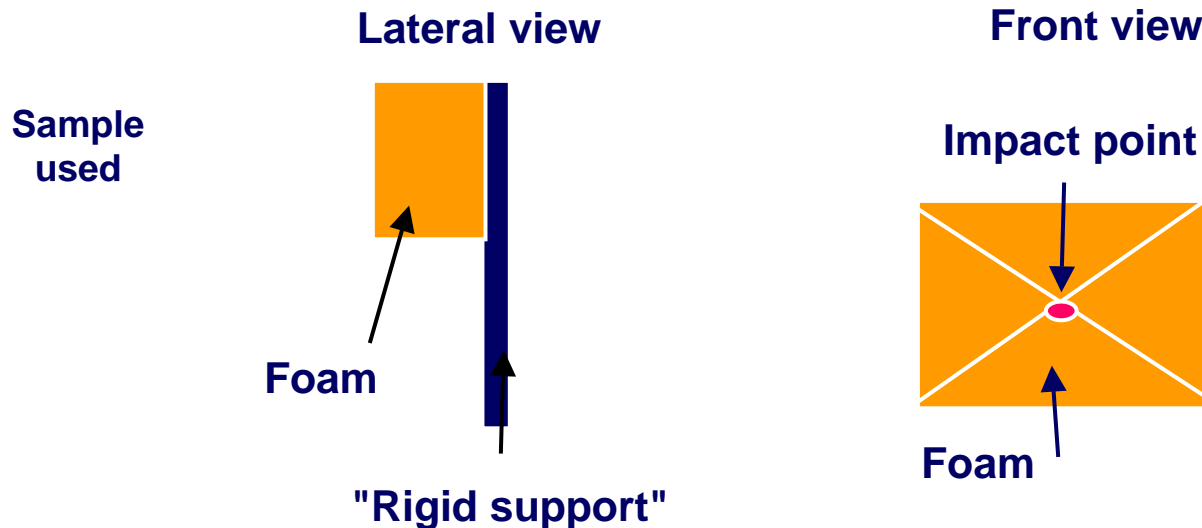
## GTR HR

**Comparison between the Pendulum  
and the Free Motion Headform (FMH)  
energy dissipation test**



## Goal of this study

- The comparison tests were accomplished in accordance with ECE R17/ECE R25 Dissipation test and FMVSS 202a.
  - 3 tests with the pendulum head impact testing equipment (1 foam)
  - 3 tests with the Free Motion Head form (FMH) (1 foam)
- Ambient temperature.
- Kind of sample used : defined foam block mounted on a rigid support (steel) simulating head restraints.
- Same Impact point



## GTR HR – Dissipation test comparison

### Method / Procedure

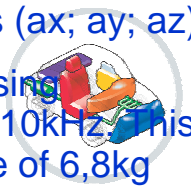
#### Test conditions:

##### Pendulum head impact testing

- An aluminum head hemisphere 6,8kg reduced mass
- The acceleration signals is obtained by means of two Accelerometer (type HBM) in X direction (x1 left; x2 right).
- Filter class used: CFC1000

### Free Motion Headform (FMH) testing equipment

- FMH is composed by an accelerator and an exchangeable impactor. The impactor used for this test is an aluminum sphere with a mass of 6,8kg.
- The center of gravity of the impactor and the impact point are on the same line
- The point of impact was determined with a laser positioning mechanism, in order to be precise and reproducible.
- The acceleration of the FMH is reached by means of a hydraulic generator.
- The free flight phase is 140mm.
- The desired impact speed was defined before the test by an external speed light barrier, in order to determine the necessary firing pressure of the device.
- During the test, we can measure:
  - the acceleration signals in the three local space directions ( $a_x$ ;  $a_y$ ;  $a_z$ )
  - and acceleration signals in x-direction (x1 left; x2 right) using Accelerometer (type Endevco 7264 C) with a frequency of 10kHz. This accelerometer are installed in the FMH's head hemisphere of 6,8kg
- Filter class CFC1000



## GTR HR – Dissipation test comparison

### Method / Procedure

- Test conditions:

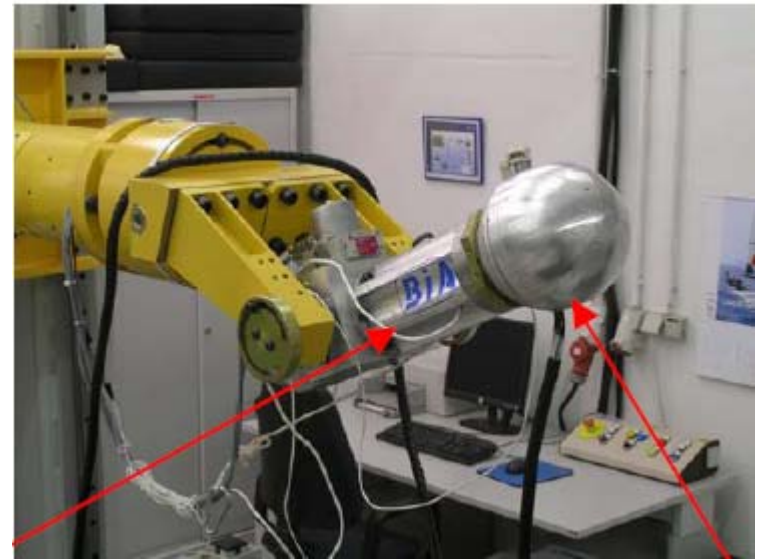
#### Pendulum head impact testing



Pendulum  
reduced  
mass  
6,8kg.

Light barrier for the  
determination of the  
impact speed [ v ]

#### Free Motion Headform testing equipment



Accelerator

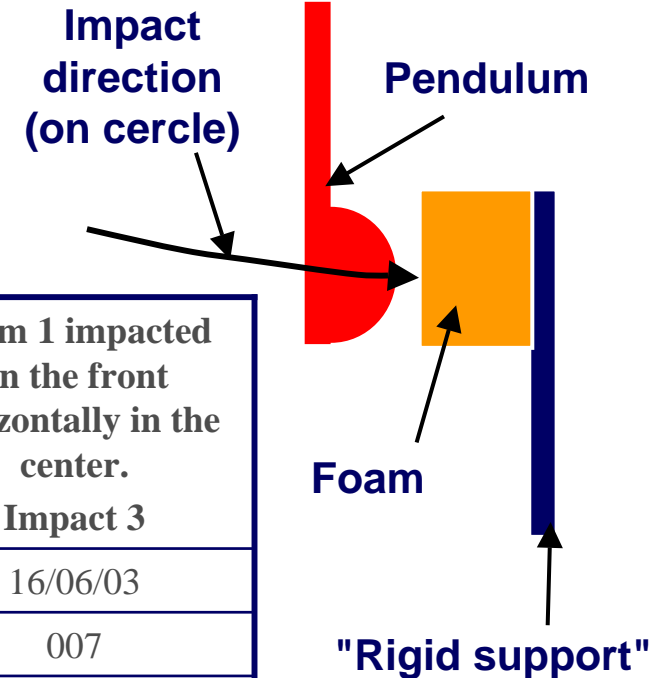
Impactor  
(exchangeable)

## GTR HR – Dissipation test comparison

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## Results : Pendulum impact

→ 3 impact tests on identical part



Results	Foam 1 impacted on the front horizontally in the center. Impact 1	Foam 1 impacted on the front horizontally in the center. Impact 2	Foam 1 impacted on the front horizontally in the center. Impact 3
Date	16/06/03	16/06/03	16/06/03
Test number	005	006	007
Vertical angle (°)	0	0	0
Horizontal angle (°)	0	0	0
Speed (km/h)	24,2	24,2	24,2
Type of impactor	pendulum	pendulum	pendulum
Max Acceleration (g)	95,6	99,8	101,3
Time – 80g	6,13 ms	6,36 ms	6,36 ms

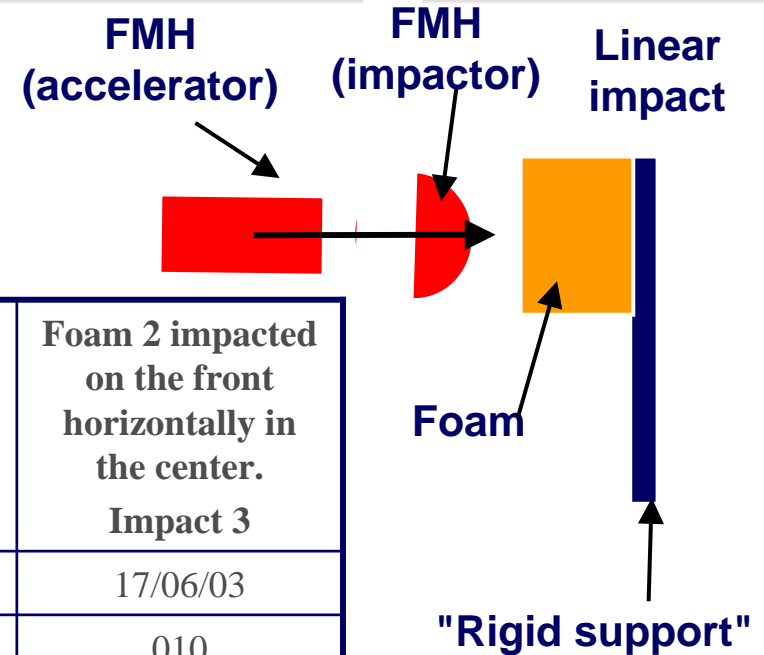
**Acceleration average = 98,9 g**  
**Time – 80g = 6,28 ms**

## GTR HR – Dissipation test comparison

Technical perfection, automotive passion.

## Results : Free Motion Headform

→ 3 impact tests on identical parts



Goal	Foam 2 impacted on the front horizontally in the center. Impact 1	Foam 2 impacted on the front horizontally in the center. Impact 2	Foam 2 impacted on the front horizontally in the center. Impact 3
Date	17/06/03	17/06/03	17/06/03
Test number	008	009	010
Vertical angle (°)	0	0	0
Horizontal angle (°)	0	0	0
Speed (km/h)	24,49	24,15	24,22
Type of impactor	Head hemisphere 6,8kg	Head hemisphere 6,8kg	Head hemisphere 6,8kg
Max Acceleration (g)	99,0	100,0	101,0
Time – 80g	6,42 ms	6,43 ms	6,19 ms

**Acceleration average= 100 g**  
**Time – 80g = 6,34 ms**

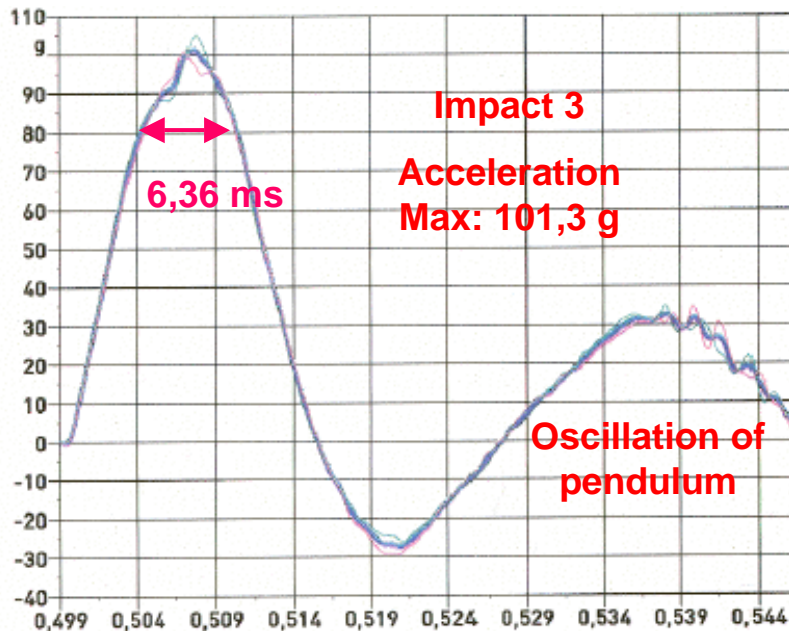
## GTR HR – Dissipation test comparison

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## Results

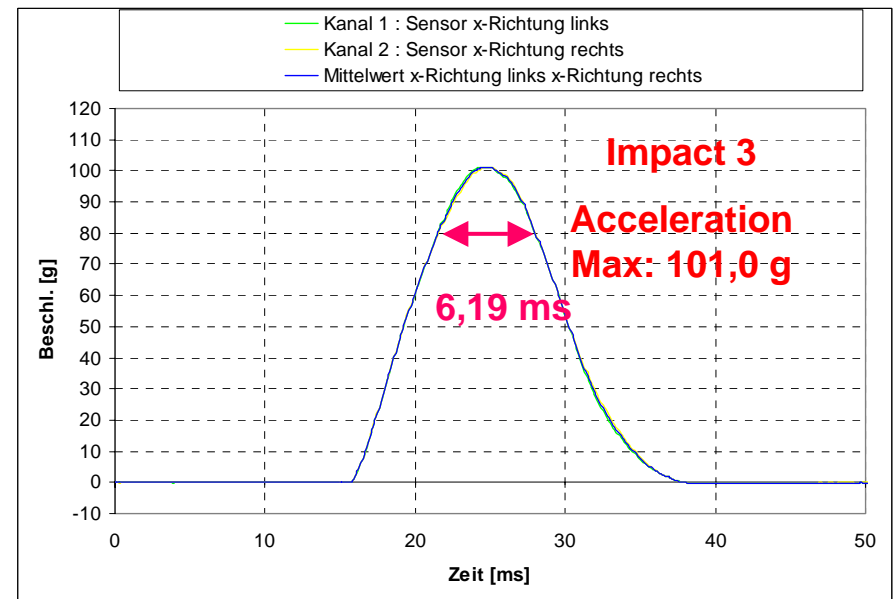
## ▪ Impact graphs:

## Pendulum head impact testing

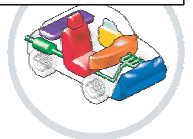


- X acceleration left [g]
- X acceleration right [g]
- X acceleration average [g]

## Free Motion Headform testing



- Kanal 1 : Sensor x-Richtung links
- Kanal 2 : Sensor x-Richtung rechts
- Mittelwert x-Richtung links x-Richtung rechts
- X acceleration left [g]
- X acceleration right [g]
- X acceleration average [g]



## Conclusions

- Reproducibility of the FMH is achieved.
  - There is an influence of the foam (the values are rising during the test series)
  - There is an influence of the pendulum shaft due to vibrations
- Pendulum and FMH are comparable for :
  - the **maximum acceleration** => FMH = 100g & Pendulum = 98,9g.
  - The **time – 80g** => FMH = 6,34 ms & Pendulum = 6,28 ms

The use of both pendulum and FMH as equivalent test equipments should be allowed in the GTR Head Restraints.

