

# Seating positions of the H-III 5% dummy

## Test series with the Reference Vehicle

### GRSP IWG Frontal Impact

Thorsten Adolph  
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Bundesanstalt für Straßenwesen

## Background / Objective

- In the FMVSS the seating position for the 5% HIII dummy is most forward on the longitudinal track
- Discussion exists in the past whether the most forward position is useful to test the airbag aggressively (worst case) or if the seat shall be rather in the middle which is more representative
- Therefore the influence of different seating positions with smaller occupants in frontal crashes was investigated for the front seat passenger and the driver

## Who are smaller occupants?

- statistically\*: Women and elderly people
  - overall average of the body height: 1,72 m
  - body height of elderly people(>60J): 1,68 m
  - body height of women: 1,65 m
  - body height of women >60J : 1,63 m

Body height of the 5% HIII dummy: 1,50 m

()\* Mikrozensus 2009, Statistisches Bundesamt Wiesbaden 2012

## **Why is there a higher risk for smaller occupants?**

- Higher injury risk in real world accidents have been identified for the passenger side in previous studies
- In general the injury risk on the passenger side should be lower compared to the driver side
- Deviation from the average could be a greater challenge for the restraint system
- Smaller persons:
  - are positioned far in the front as the driver
    - > close to the steering wheel
  - can vary their seating position individual
- Elderly people can become weaker (e.g. osteoporosis)

## **Why 5<sup>th</sup> percentile Dummy?**

- Body height of 1,50 m is representative for smaller occupants
- Can sit in very different positions because of its dimensions
- Not used in European legal regulations so far

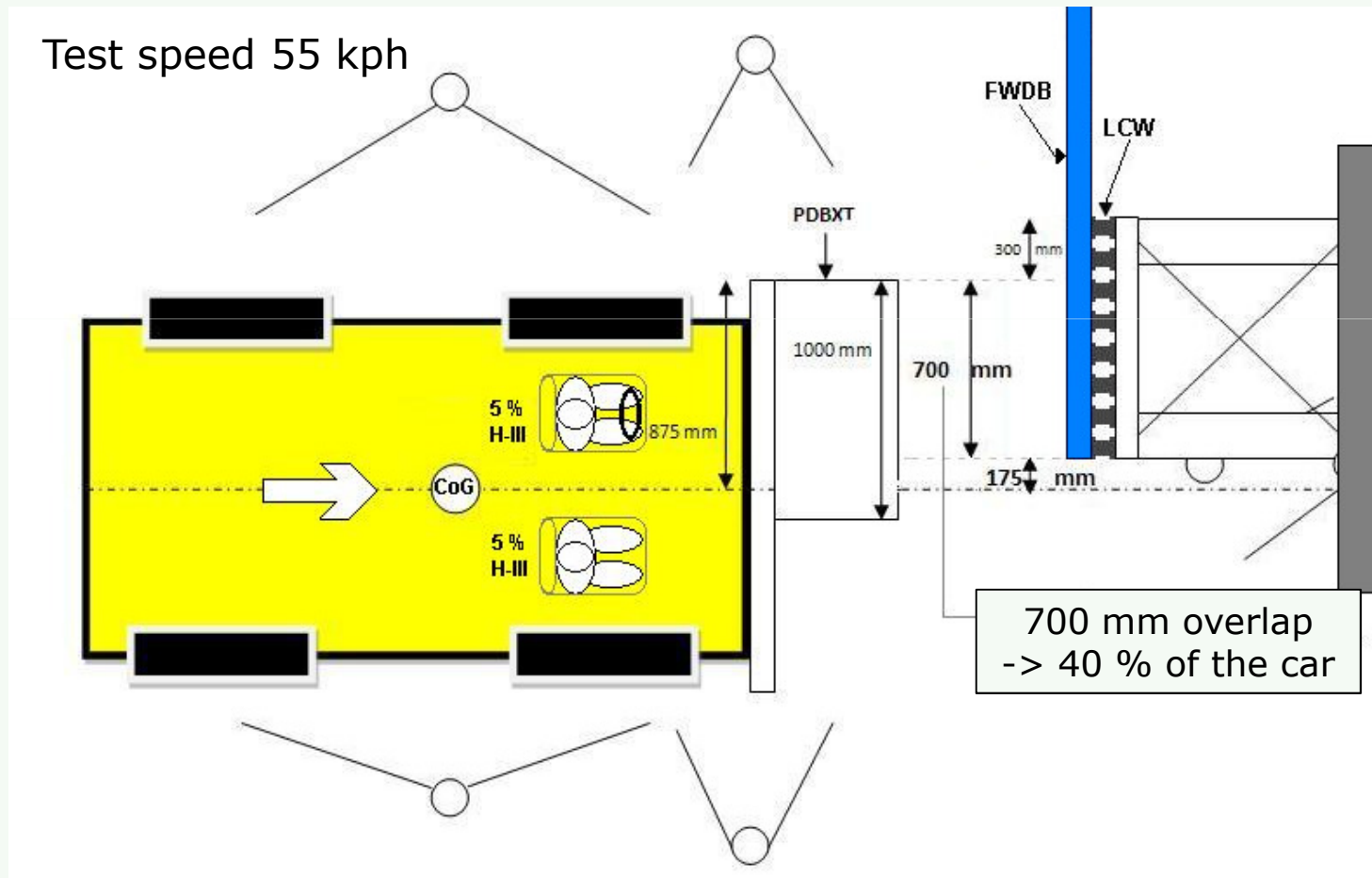
# Material

- Reference vehicle with restraint system and parts of interior (e.g. dashboard)
- 5<sup>th</sup> H-III Dummies as driver and passenger
- Barriers
  - PDB-XT v8 as the front structure of the vehicle
  - FWDB as the collision opponent on the LCW



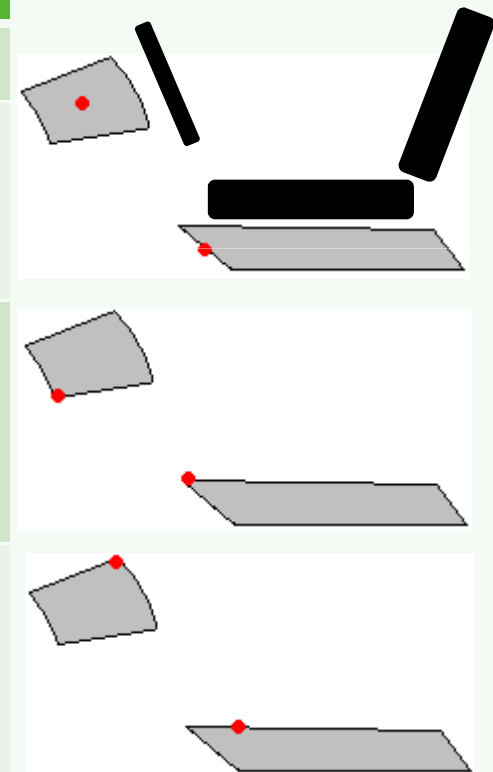
More information on the reference vehicle in adolph et al. ESV 2013

# Test configuration



# Driver seat positions

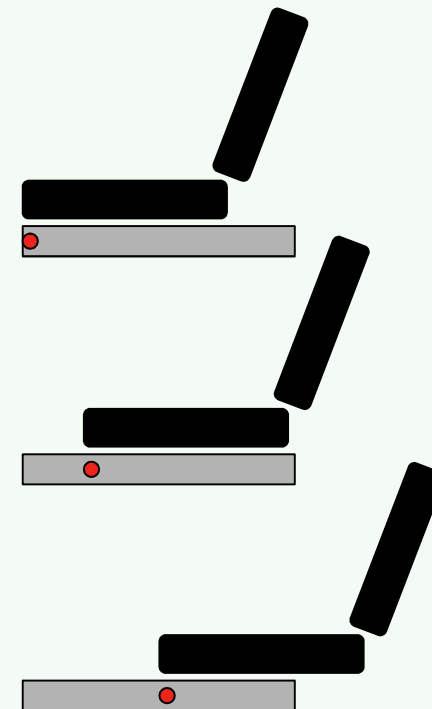
Test	Driver	
	Seat	Steering wheel
<b>1</b> FMVSS 208	X: full forward Z: mid position	X: mid position Z: mid position
<b>2</b> „Realistic“	X: full forward Z: up	Steering wheel: X: full forward Z: low
<b>3</b> Worst case	X: front -40 mm Z: up	Steering wheel: X: out Z: up





# Passenger Seat Positions

Test	Passenger
	Seat
<b>1</b>	Seat full forward (0%)
<b>2</b>	Quarter of the seat rail 25%)
<b>3</b>	Seat in mid position (50%)



## Analysis of the Reference Vehicle

- Validation of the airbag timings, fired 1<sup>st</sup> stage at 15ms, 2<sup>nd</sup> stage at 25ms
- Pictures taken at 40 ms

Test 1

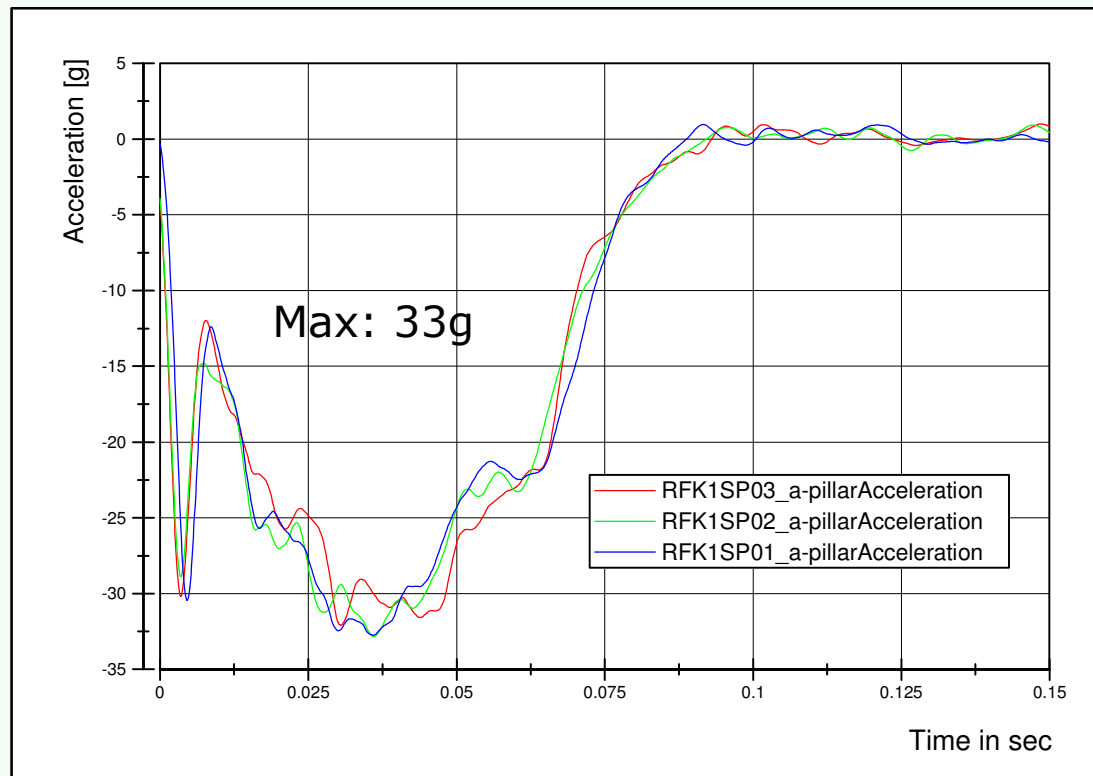
Test 2

Test 3



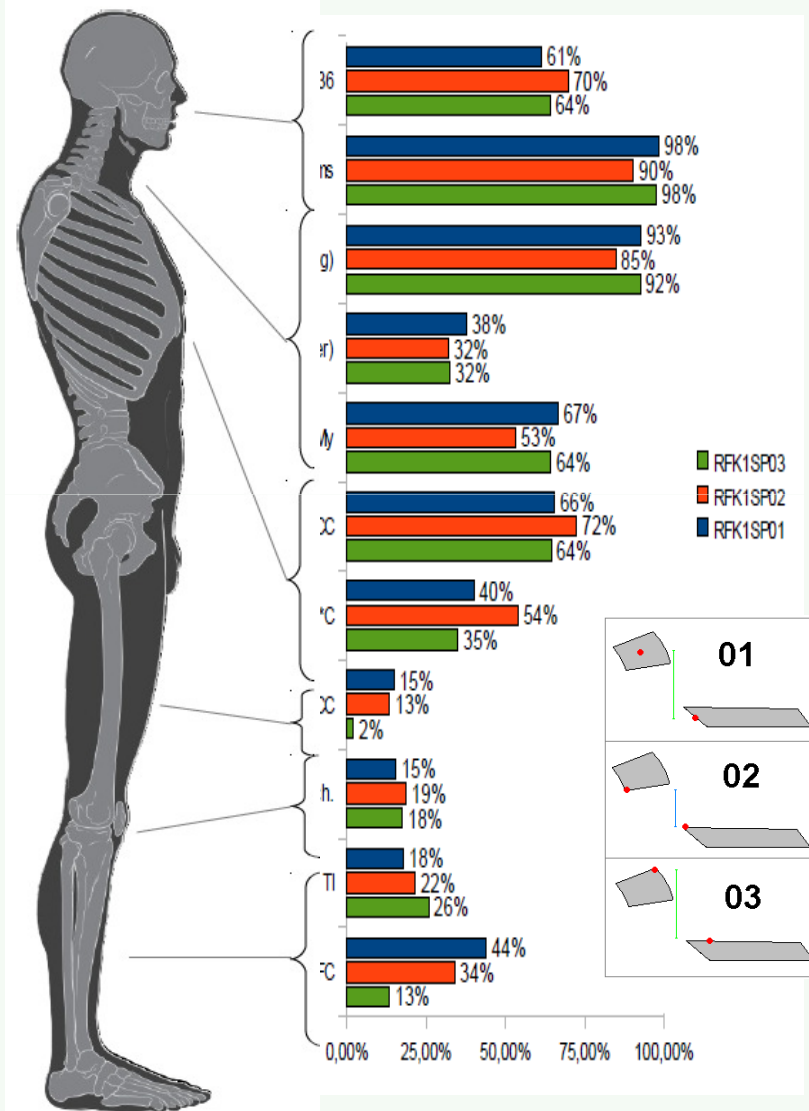
# Validation of the Vehicle Pulse

- The three tests are identical in the pulse
- Maximum deceleration of 33g



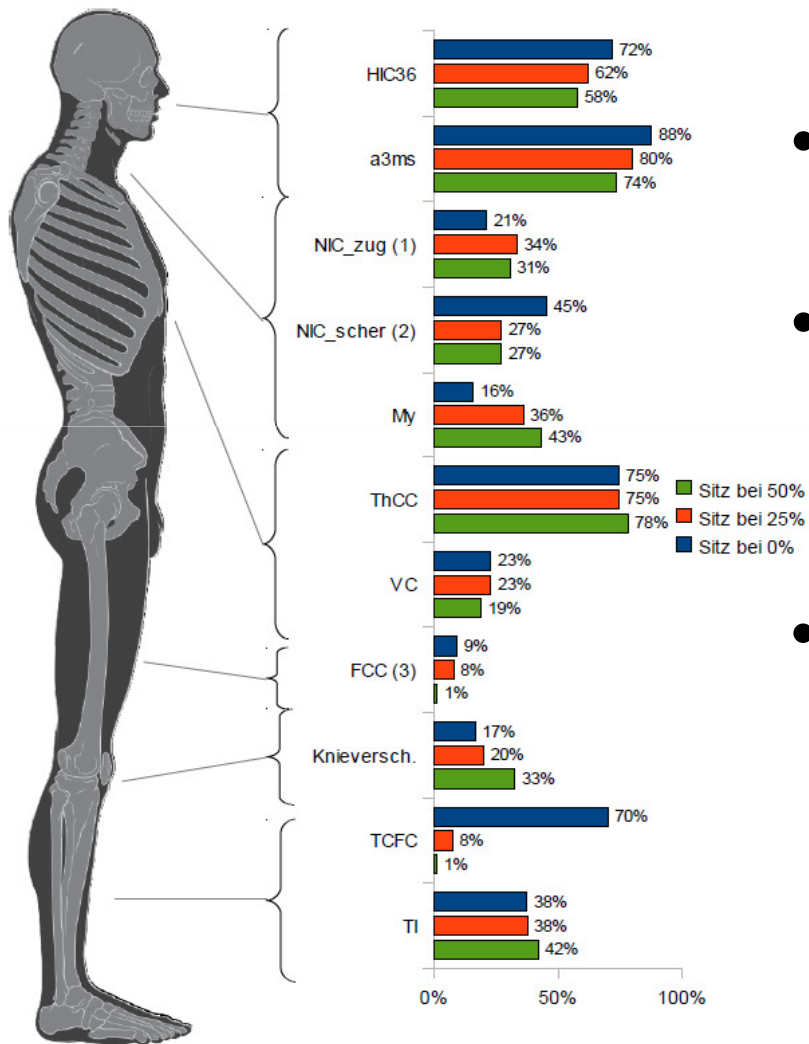
Acceleration  
Lower A-pillar (left)

## Results: Driver Dummy relative to ECE R-94

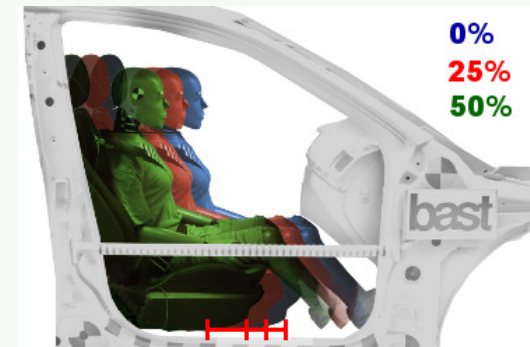


- Head and neck loading similar in position 1 and 3  
-> Steering wheel in both positions relatively high  
-> a3ms value close to the limit
- Neck loadings in position 02 slightly lower
- Chest loading in position 02 higher  
-> steering wheel with airbag aims to the chest because of its low position
- Tibia loadings in position 01 higher  
-> lowest seating position -> different leg position

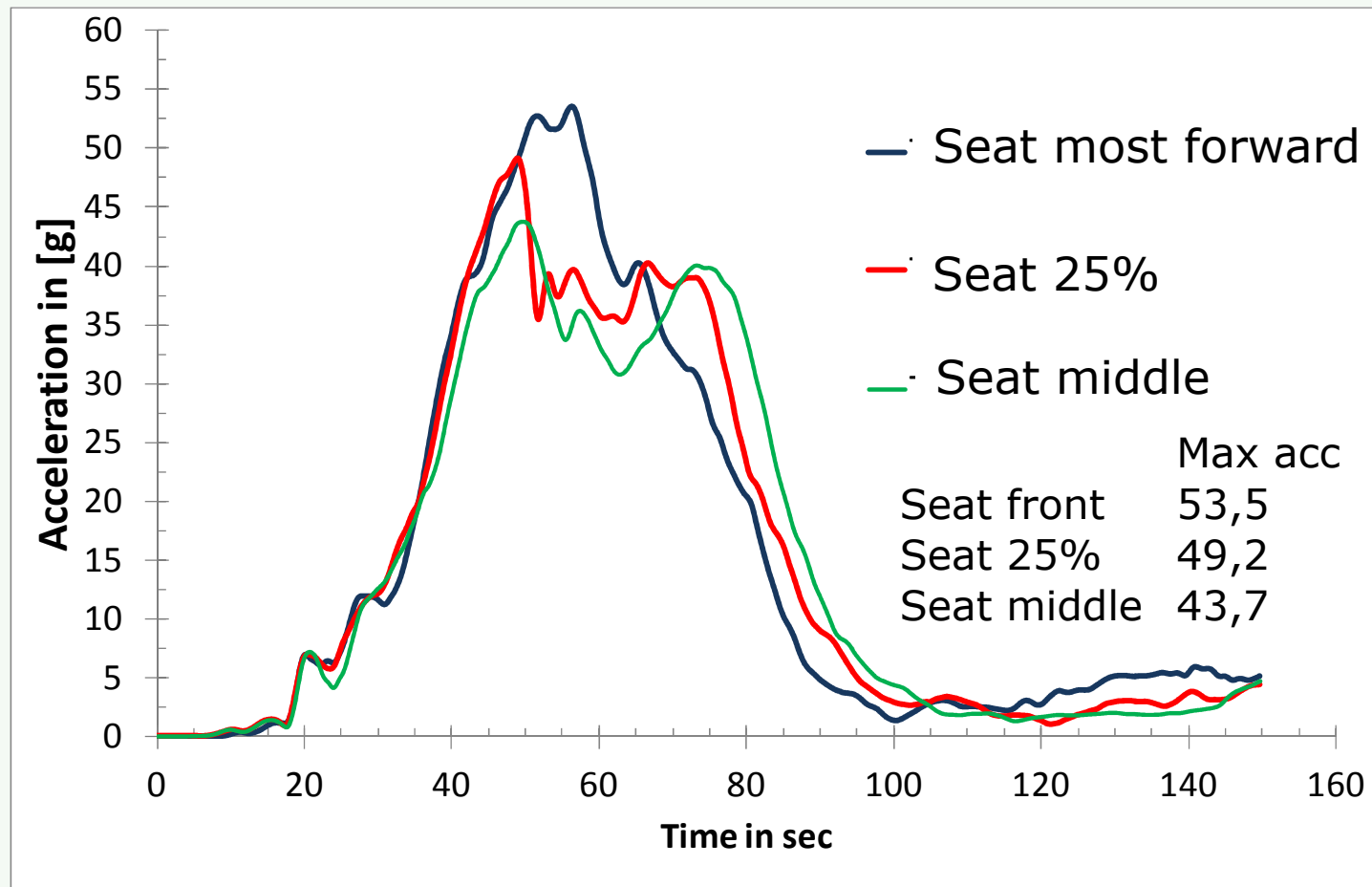
## Results: Passenger Dummy relative to ECE R-94



- Higher loadings of head and neck in the forward seat positions
- Chest compression similar in all positions, but chest acceleration much higher in forward positions (next slide)
- Knee and leg loadings higher in the back positions



## Results: Chest Acceleration Passenger



## Discussions

- The reference vehicle in combination with the restraint system shows reasonable results
- Time span between airbag opening and head contact was short (airbag triggering)
- Results were shown as percentage values based on the HIII 50% dummy
- No intrusions
  - measured tensile forces of the legs maybe unrealistic
  - How representative is the result for the lower extremities?

## Conclusions – Driver Side

- Driver:
  - No outsized differences in general
  - The loadings of the head ( $a_{3ms}$ ) and neck were close to ECE-R 94 limits (50% dummy)
  - Position of steering wheel had influence
  - Acceptable chest compression of 36 mm but high chest acceleration
  - Lower extremities were uncritical
- **Recommendation to test the driver position in seat position 2** (seat forward, upwards, steering wheel forward and downwards)
- **Use chest acceleration to evaluate thoracic loading**



## Conclusions – Passenger Side

- Passenger:
  - All positions had values below ECE-R 94 50% dummy limits
  - Head, neck (My) and chest were higher loaded in the forward positions and lower in the rearward positions
  - In particular chest acceleration shows higher loading in the most forward position
- **Recommendation to test in the 25% position as a compromise between real world seating and airbag aggressiveness**
- **Use chest acceleration to evaluate thoracic loading**

## **Seating positions of the H-III 5% dummy**

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**Thank you for your attention**

Dr. Thorsten Adolph  
Section "Passive Safety & Biomechanics"

adolph@bast.de

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