

A wireframe model of an H3 dummy is shown seated in a car, illustrating virtual crash testing. The dummy is rendered in a grid-like mesh, and the car's interior, including the steering wheel and dashboard, is visible in a semi-transparent blue overlay.

H3 Dummies For VT 9th Meeting EqOP Virtual Crash Testing

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Are the Dummy simulation models good enough for VT?

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ATD- Manufacturer perspective

OEM - perspective

1. Introduction ENCAP VT Load cases
2. Summary of TB CP510
3. Which scores need to be achieved?
4. Hand over to Dr. Marini

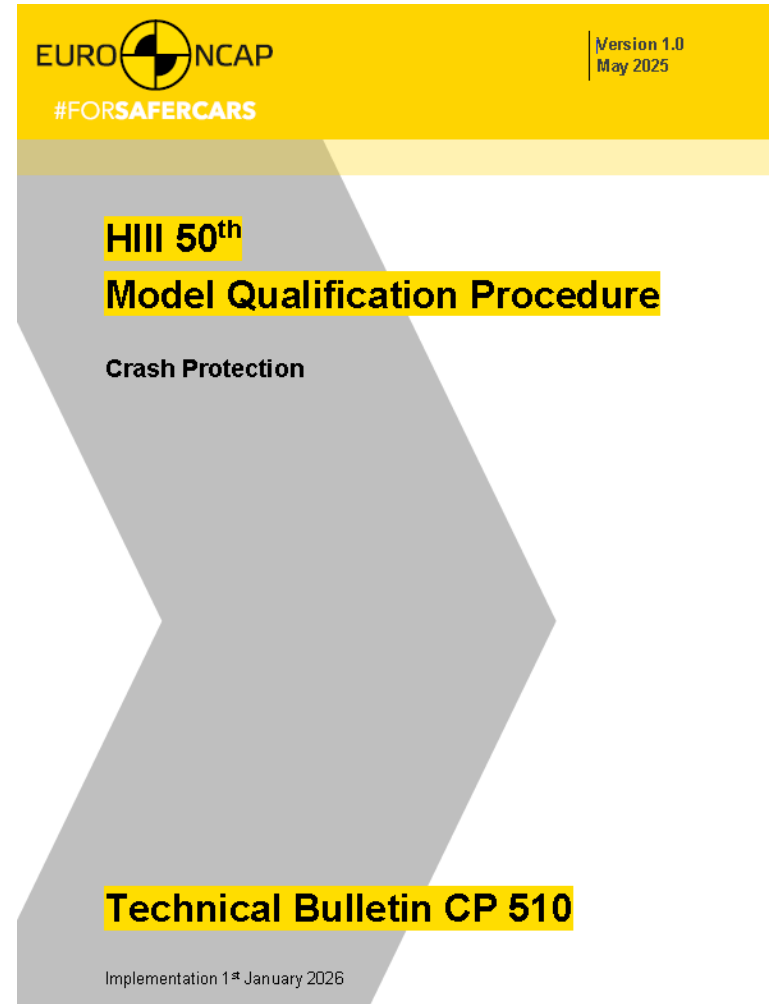
- **HIII-5F, HIII-50M and HIII-95M** will be used for the VT procedures(validation/robustness) for frontal impact (1st row) **starting in 2026**

	Full-Scale Crash Test		Hardware Sled & VT		VT			
	MPDB	FWDB	Validation 1	Validation 2	Robustness 1	Robustness 2	Robustness 3	HBM
Crash Severity	50kph	35 kph	50 kph (mid)	56 kph (high)	35 kph (low)	35 kph (low)	56 kph (high)	50 kph (mid)
1st row driver	THOR 50M	H-III 5F	H-III 50M	H-III 95M	H-III 50M	H-III 5F	H-III 5F	Mid-size
1st row passenger	H-III 5F	THOR 50M	H-III 95M	H-III 5F	H-III 5F	H-III 50M	H-III 95M	

- Humanetics is supporting the working group for HIII dummy qualification procedure for VT.
 - First version of Dummy Model Certification Procedure (TB CP510) is available since March 2025
 - Target ISO Scores to be fulfilled are described in TB CP510
- Humanetics
 - Hybrid III latest versions qualify for EuroNCAP Virtual Testing
 - Latest learnings from sled correlation have been added in an upcoming model release (v2.5) , which will include the scores

Euro NCAP Virtual Testing | H3 Dummy Model Certification

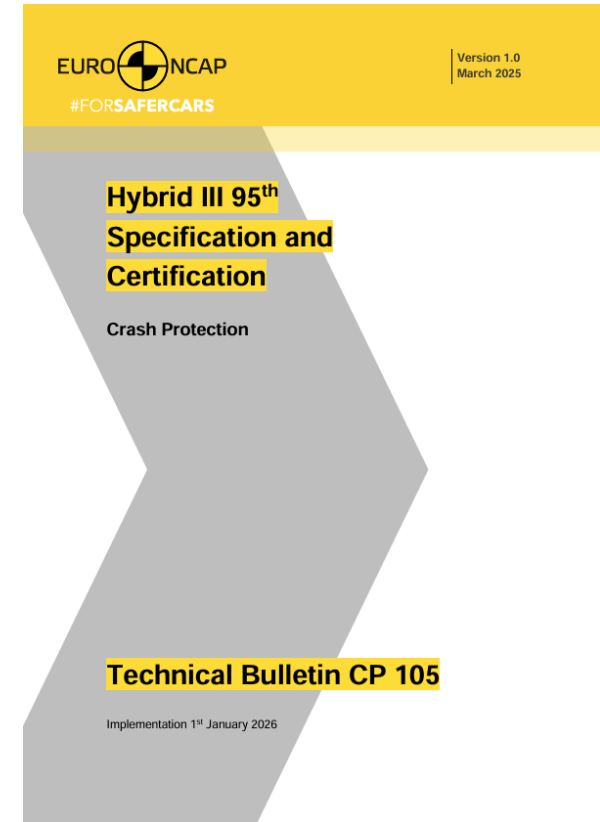
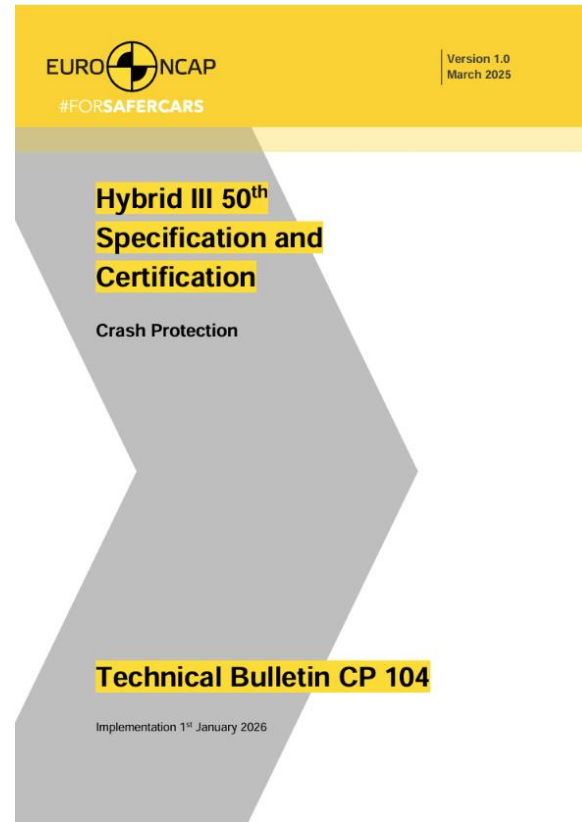
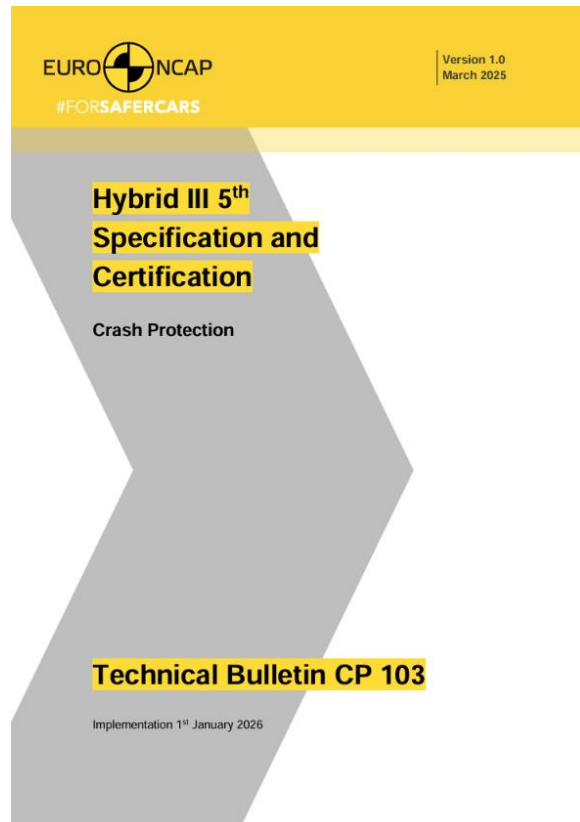
- TB CP510: HIII dummy qualifications like WS50 TB43 model qualification
 - 3 different stages and weighted Iso rating on specific channels
 - Stage 1: Normative Requirements- **Mass, dimensions and certification**
 - **Stage 2:** ISO rating based on specific **Component certification** tests
 - **Stage 3:** ISO rating based on **2 different full scale sled test configurations**



[HIII qualification · GitLab](#)

Stage 1 – Normative references

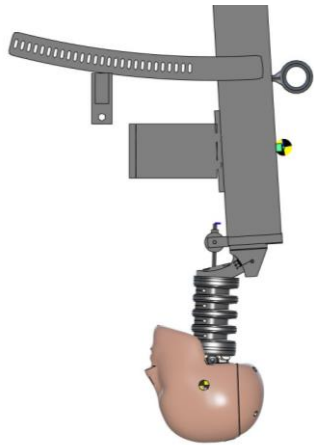
Mass, external dimensions, range of motion and qualification per ENCAP Crash Protection TB
As a hardware ATD should comply



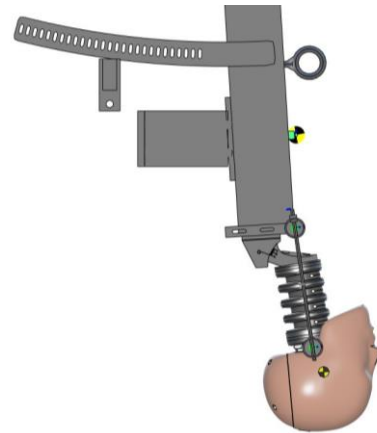
Stage 2 – Component load cases

Various test labs and hardware ATD were used for testing and score definition
 Component load cases taken from **certification** load cases

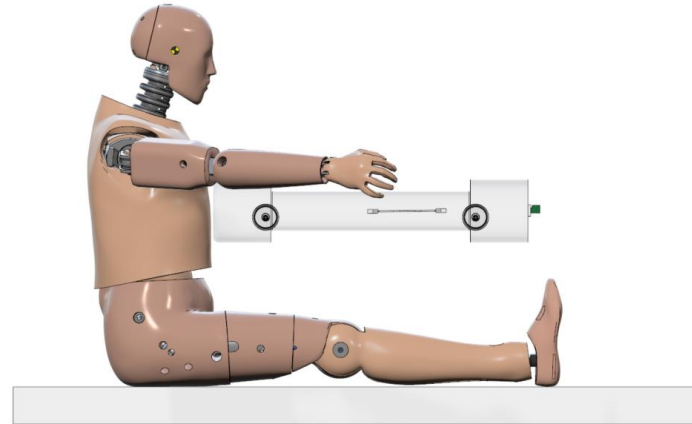
Neck Extension



Neck Frontal Flexion



Thorax Pendulum (High and Low Speed)



Knee Impact



Sensor	Test	ISO Score
Impactor acceleration	NEEX, NEFX, THLS, THHS, ULIL, ULIR	≥ 0.80
Chest acceleration	THLS, THHS	≥ 0.55
Angular rotation	NEEX, NEFX	≥ 0.75
Force	NEEX, NEFX	≥ 0.60
Moment	NEEX, NEFX	≥ 0.75
Chest displacement	THLS, THHS	≥ 0.85

- Hardware brand independent collected by PDB
- Lab variability accounted for
- Extracted mean curve from test data ISO Rating requirement -> overall curve matching, not only peak values
- Rating target is based on type of magnitude and observed test scatter
- Current scope of in-house validations exceeds it

Stage 3 – Full scale Sled load cases - Hardware

Full frontal 1st row sled representing EU midsize sedan

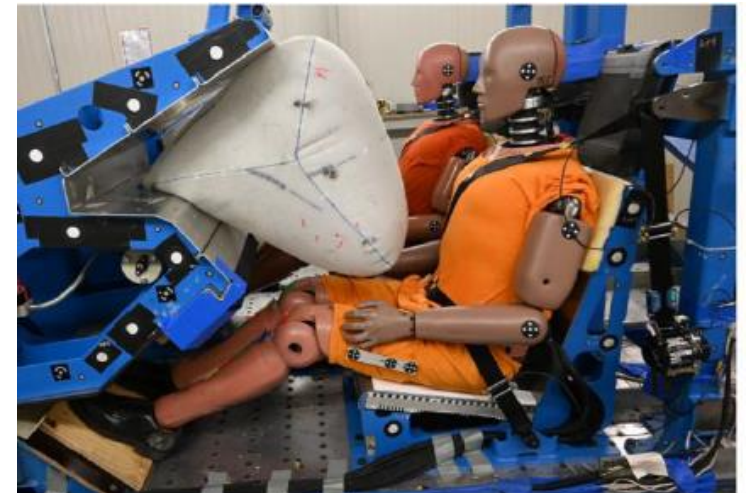
Type 1 - “PDB-BAST” - Passenger

- PDB sled test setup – tested at BaSt
- **Two full frontal pulse severities:**
 - Low Severity 35 kph ~ 18g peak - SENIORs experiments
 - High Severity 68 kph ~ 27g peak - VW ID4
- Belt with retractor pretensioner
 - Constant load limiter 4KN for HS
 - Switchable load limiter for LS (4.0 KN -> 2.0 KN)
 - No anchor pretensioner or locking tongue
 - D-Ring adjustable in Z
- Pre-deployed pressurized passenger airbag
- Seat:
 - Rigid flat seat with 5mm Teflon plate
 - Adjustable in X & Z
- Knee Bolster 60mm Foam plate of EPP 60g/l
- Feet support on rigid wooden floor- position adaptable

Applies to all 3 H-III ATDs !



H-III 5th



H-III 95th

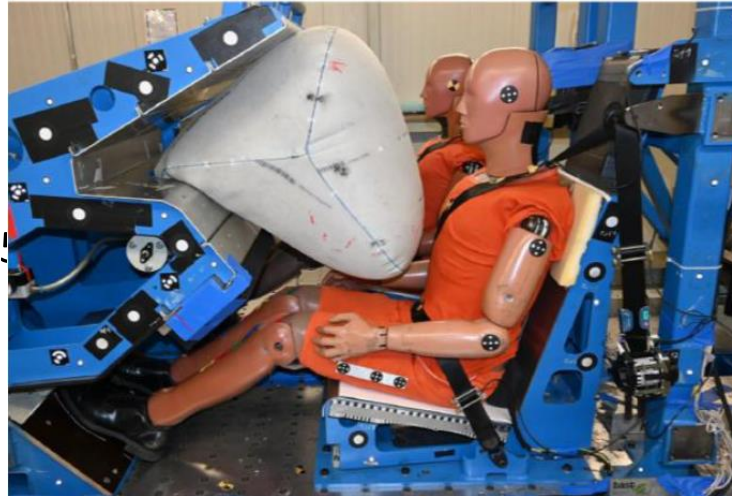
Stage 3 – Full scale Sled load cases - Hardware

Type 1 - “PDB-BAST” – Passenger – Sled adjustability

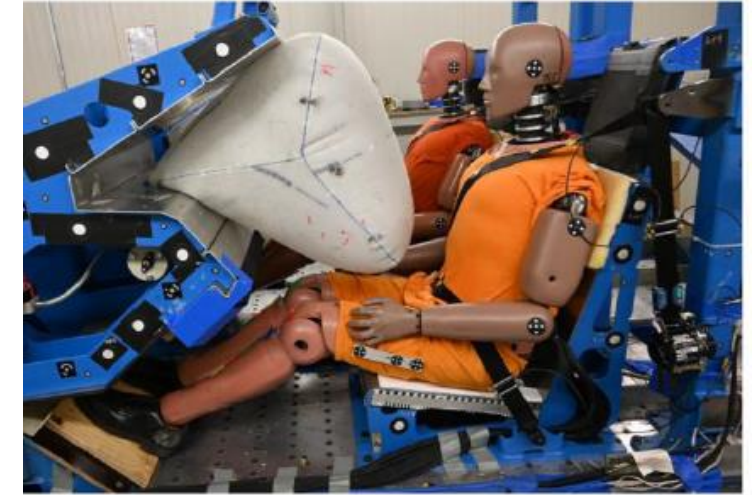
Dummy	Belt pillar position	Belt anchorage position	Seat x-position	Seat z-position	Wooden plate on foot rest	Plywood under the knee bolster
HF	nominal	high	100 mm forward	100 mm higher	additional foot rest and floor bolster	removed
H3	nominal	low	nominal	nominal	none	present
HM	100 mm rearward	low	100 mm rearward	nominal	18 mm thick plate wrt H3 sled config.	present



H-III 5th



H-III 50th



H-III 95th

Stage 3 – Full scale Sled load cases - Hardware

Full frontal 1st row sled representing EU midsize sedan

Type 2 - “Chalmers” - Driver

- Safe Up test setup – tested at Autoliv
- **Two full frontal pulse severities** – generic shape:
 - Low Severity: 40 kph ~ 28g peak
 - High Severity: 56 kph ~ 37g peak
- Belt with 2KN retractor pretensioner:
 - **Constant load limiter 4KN** for HS and LS
 - 2KN Anchor pretensioner
 - Buckle with locking tongue
 - D-Ring – fixed at typical mid-size EU sedan
- Driver Airbag: generic single chamber, 55L, coated, 2x35mm vents, two stage inflator
- Steering wheel: Volvo XC90 MY 2021- without cover
- Steering column: generic with 5.5KN ride down and 85 mm max stroke
- Semirigid LAB seat - dedicated spring controlled and separated seat pan (15°) and anti-sub ramp (26°) plates
- Knee Bolster 100mm thick polyethylene (PE) 35 g/l Ethafoam 220
- Generic 45° angle foot support
- Tied lower legs to increase pelvis and upper repeatability

Applies to all 3 H-III ATDs !



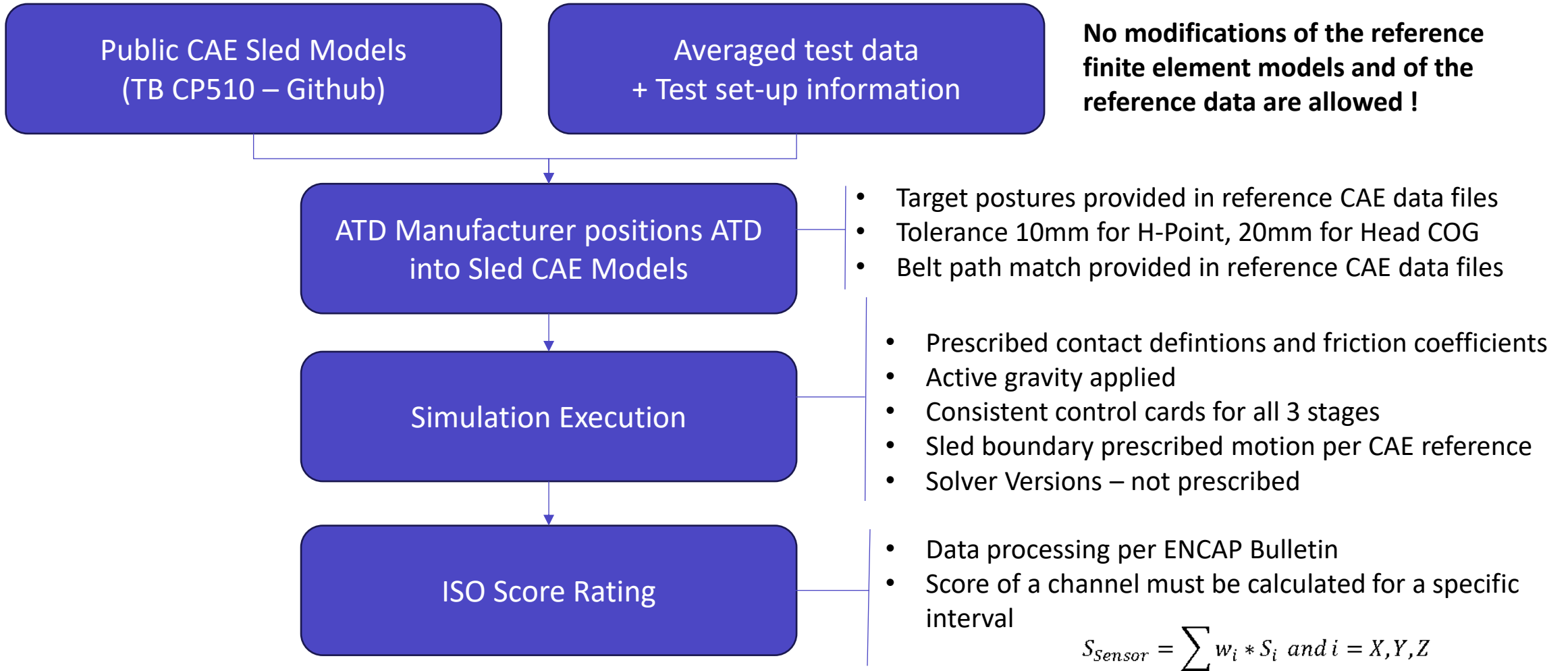
H-III 5th



H-III 95th

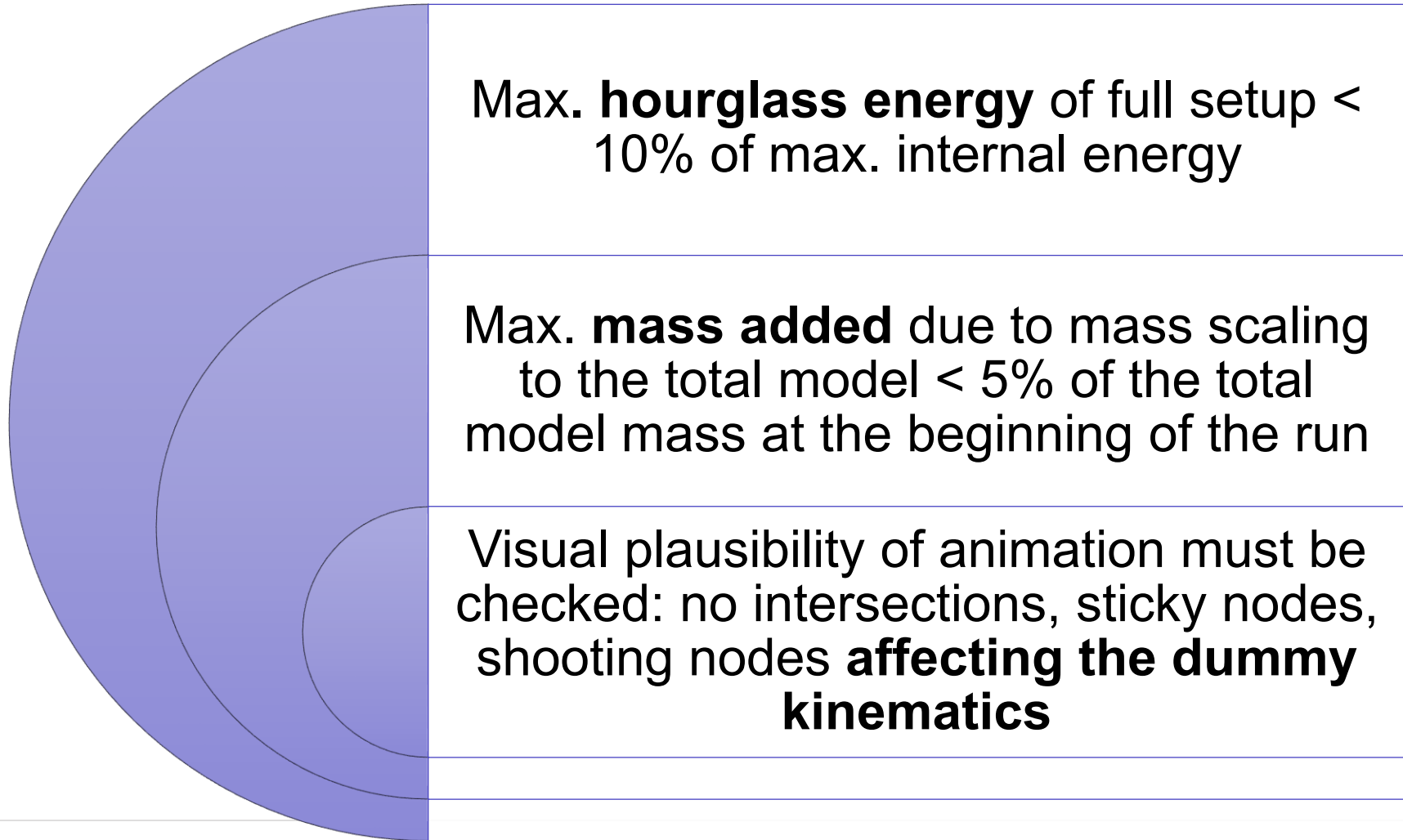
Stage 3 – Full scale Sled load cases – CAE Principals

CAE Implementation



Stage 3 – Full scale Sled load cases – CAE Principals

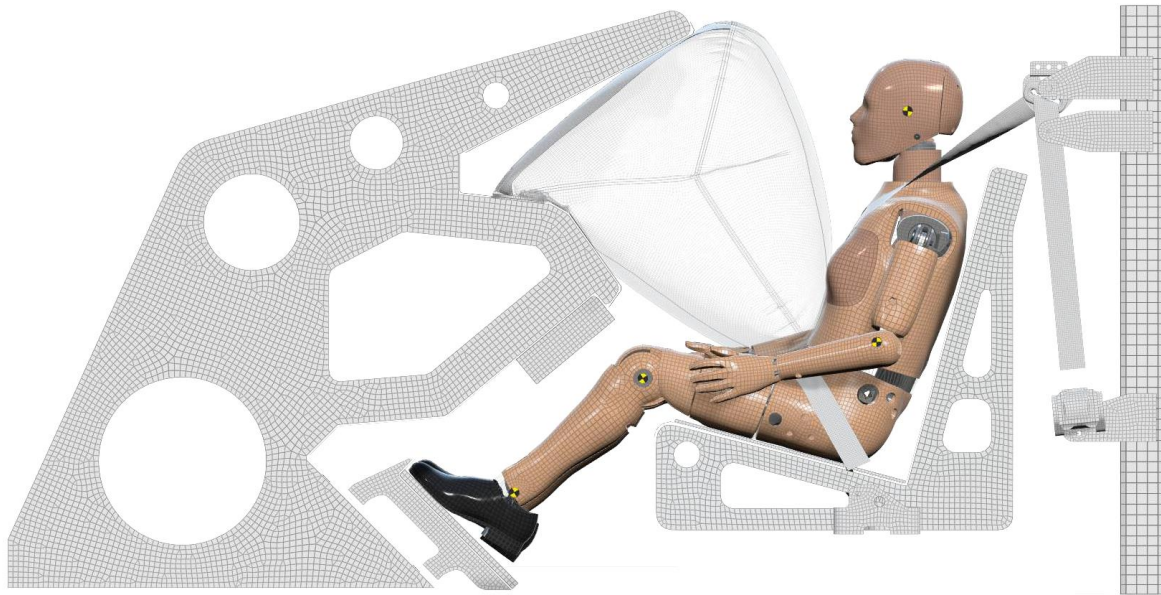
CAE Quality criteria control



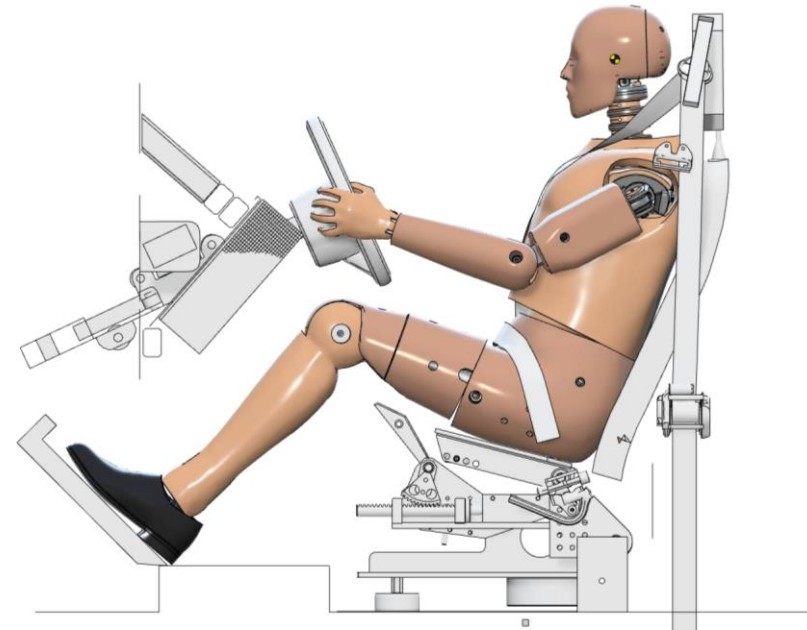
Stage 3 – sled load cases

Two different sled (driver/passenger) that apply to all 3 H-III ATDs

Type 1 - “PDB-BAST” - Passenger

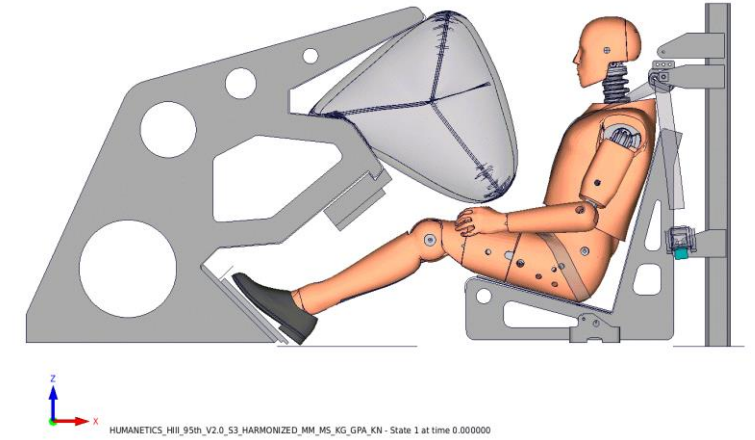
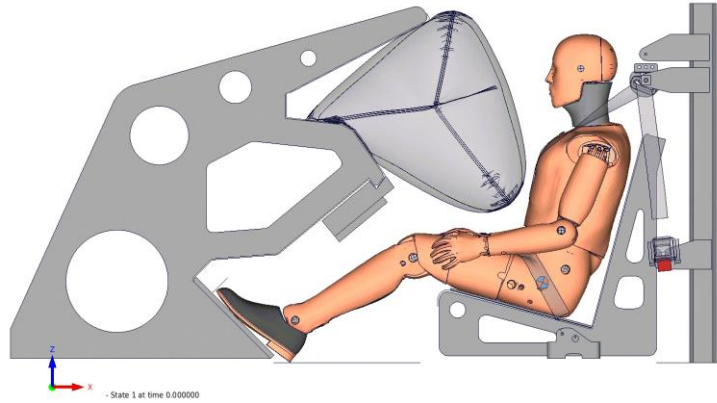
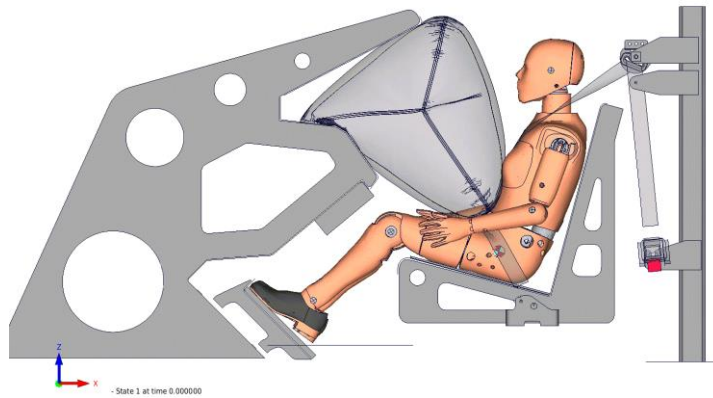


Type 2 - “Chalmers” - Driver

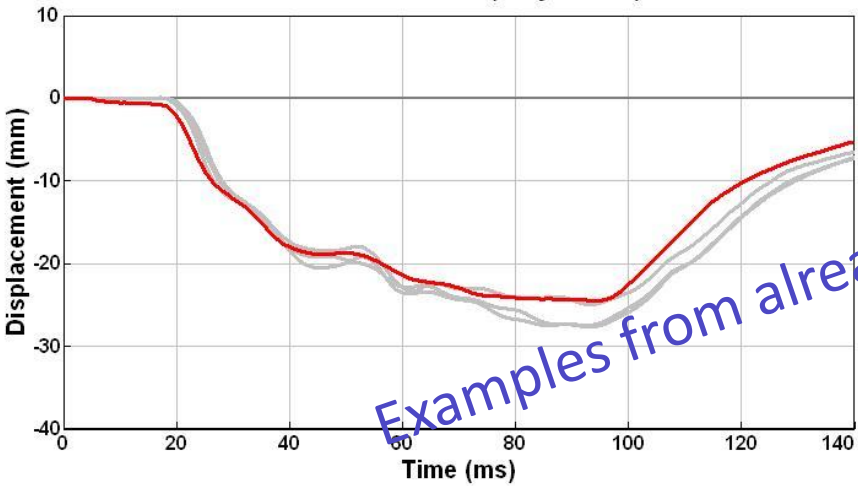


Stage 3 – sled load cases

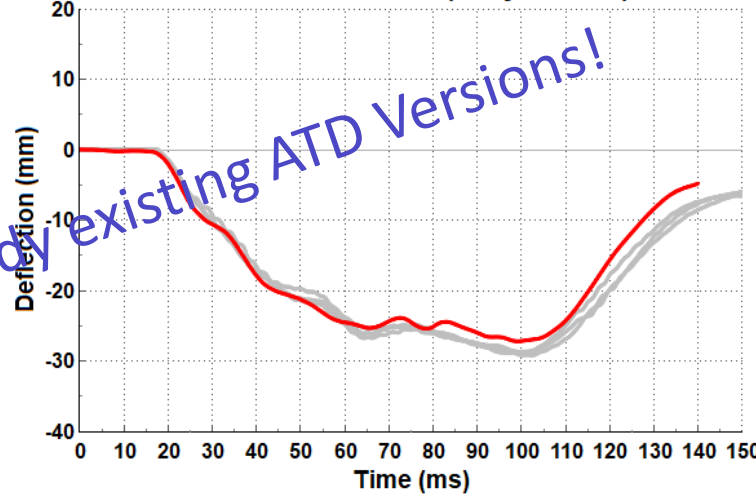
Virtual Testing Sled Configuration 1 Status



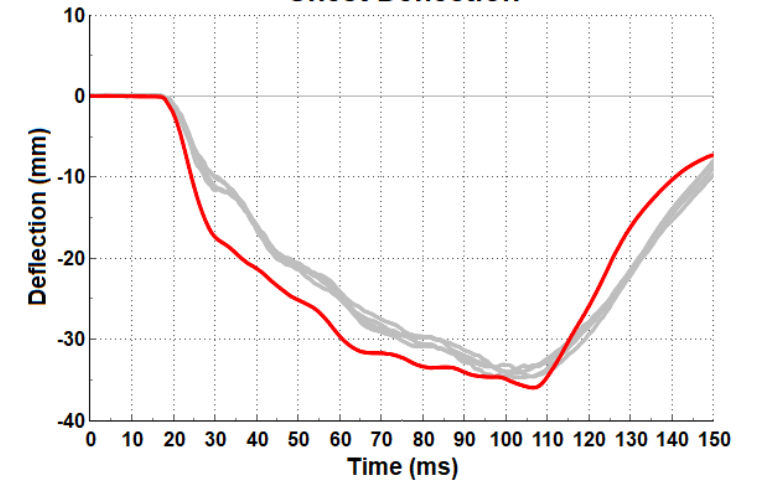
Chest Deflection (Polynomial)



Chest Deflection (Polynomial)



Chest Deflection



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Stage 3 – Full scale Sled load cases

Validation requirements apply to all 3 ATDs on both sleds

Dummy scores depend on body part and signal type

- **Head** requirements are 0.65 for head acceleration, 0.5 angular rates
 - But **slight degradation to 0.5 for LS acceptable**
- **Torso** is a fair 0.6 for compression and acceleration
 - But **slight degradation to 0.5 for LS acceptable**
- **Neck:** Forces and moments are at 0.5
- **Spine:** Force and moments mostly at 0.5
- **Femur:** Forces are rated at 0.5 – except monitoring for 95th
- **Tibias:** Forces are rated- Moments only monitored

Sled metrics




- **Belt forces** and **Airbag pressure** set to 0.7
- **Belt pullout** and **Steering column** displacement set to 0.6

		PDB/BASt	Chalmers
Acceleration	Head	≥ 0.65	≥ 0.65
	Chest	≥ 0.50 for low speed ≥ 0.60 for high speed	≥ 0.50 for low speed ≥ 0.60 for high speed
	Pelvis	≥ 0.60	≥ 0.60
Angular rates	Head	≥ 0.50	≥ 0.50
	Chest	≥ 0.65 (only HM)	-
	Pelvis	≥ 0.50	Monitoring
Forces	Upper neck	≥ 0.50	≥ 0.50
	Thoracic spine	≥ 0.50 (only HF)	-
	Lumbar spine	≥ 0.50 (only HF, H3)	≥ 0.50
	Iliac spine L/R*	≥ 0.50 (only HF)	≥ 0.50 (only HF)
	Femur L/R*,1	≥ 0.50	≥ 0.50 (only HF, H3); HM monitoring
	Upper & Lower Tibia+,1	≥ 0.50	≥ 0.50
Moments	Upper neck	≥ 0.50	≥ 0.50
	Thoracic spine	≥ 0.50 (only HF)	-
	Lumbar spine	≥ 0.60 (only HF, H3)	Monitoring
	Iliac spine L/R*	≥ 0.50 (only HF)	Monitoring
	Femur L/R*	Monitoring (only HF)	Monitoring
	Upper & Lower Tibia+	Monitoring	Monitoring
Displacement	Chest compression	≥ 0.65	≥ 0.65

			PDB/BASt	Chalmers
Miscellaneous	Force	Seatbelt	≥ 0.70 (B1, B3, B6)	≥ 0.70 (B1, B3, B6)
	Pullout	Seatbelt	≥ 0.60	≥ 0.60
	Pressure	Airbag	-	≥ 0.70
	Displacement	Steering column	-	≥ 0.65 only high speed

Are the Dummy simulation models good enough?

ENCAP VT has successfully set-up a frame for **ATD VT qualification for front impact**

- Stage 1: **Mass, dimensions and certification**  ○ Dummy CAE models are built as digital twins targeting an averaged hardware response
- Stage 2: **Component certification tests**  ○ ATD CAE component tests exceed ENCAP VT load case subset
- Stage 3: **2 different front impact full scale sled test configurations with two severities**  ○ ENCAP VT Sleds replicate typical EU mid size sedan restraint configurations
○ In the past Humanetics in-house sled testing and customer feedback used

Dummy CAE models achieve the scores and consider additional component load cases

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