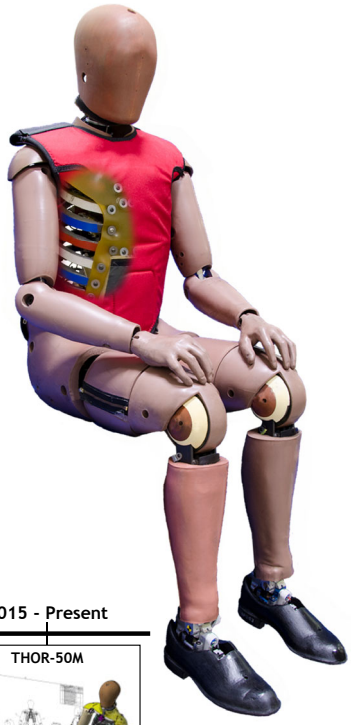
TEST DEVICE FOR HUMAN OCCUPANT RESTRAINT
THOR-50M - 50TH PERCENTILE MALE

NHTSA
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

What?
- Anthropomorphic Test Device (ATD, or crash test dummy)
- Represents male of average height and weight
- Designed for frontal and frontal oblique crash tests
- Measures risk of injury to occupants in a crash
- Used in hundreds of NHTSA research tests

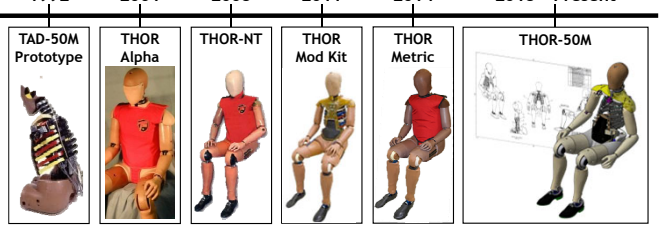
Why? THOR's **human-like characteristics** in a crash and state-of-the-art **measurement capability** make it the best choice to evaluate the advanced safety features in today's vehicles.



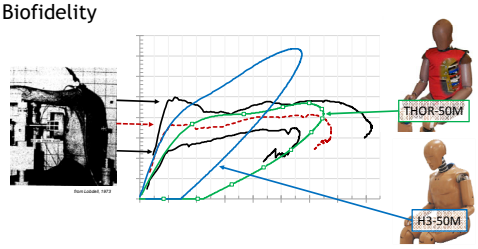
Human-Like Characteristics
- Neck that bends, twists, and stretches for realistic head motion
- Torso with anatomically correct ribcage and shoulder
- Flexible spine to allow proper upper body motion
- Abdomen and pelvis that mimic human seat belt interaction
- Legs that respond to impact of dashboard and pedal

Measurement Capability
Over 100 distinct measurements to help predict injury, including:
- Head acceleration and rotation
- Neck forces and moments
- Ribcage motion at four locations and three dimensions
- Abdomen motion at two locations and three dimensions
- Pelvis, thigh, shin, and ankle forces

History



Biofidelity



Body Region	THOR-50M	H3-50M
Head	Excellent	Poor
Neck	Good	Poor
Thorax	Excellent	Good
Abdomen	Marginal	Marginal
Knee/Thigh/Hip	Good	Poor
Lower Extremity	Good	Excellent
Whole-body	Good	Good

Parent, D., Craig, M., Moorhouse, K., "Biofidelity Evaluation of the THOR and Hybrid III 50th Percentile Male Frontal Impact Anthropomorphic Test Devices," 61st Stapp Car Crash Conference, November 2017.

Repeatability & Reproducibility

Qualification Tests

24 Test Modes (e.g. Face Impact, Neck Torsion Left Thorax, Right Ankle) × 5 Tests per ATD × 5 ATDs (3 ATDs at VRTC, 1 ATD at 2 other labs) = 600 Qualification Tests

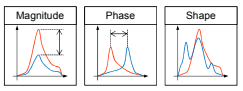
→ Qualification Specifications (Mean ±10%)

→ Assessment of Repeatability and Reproducibility:

$$CV = \frac{\sigma}{\mu} \times 100\%$$

Crash Tests

3 Test Labs × 3 Tests per Lab = 9 Oblique Crash Tests

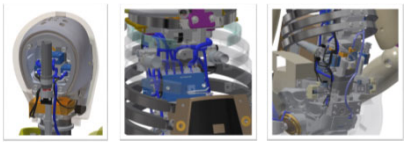


Saunders et al., 2018 SAE World Congress

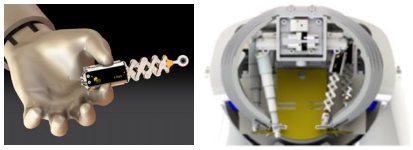
Finite Element Model
- Allows virtual crash tests, parametric analyses
- Developed by NHTSA with support from academic and industry partners
- Current work (University of Virginia Center for Applied Biomechanics)
  - Update hardware to current drawing package
  - Match response to current qualification specifications
  - Improve computational efficiency and stability

Enhancements

DTS — In-dummy Data Acquisition System (DAS)



ATD LabTech — Improved 3D thorax and abdomen measurement



SAFETY IN NUMBERS

8 THOR-50M ATDs owned by NHTSA, used in:

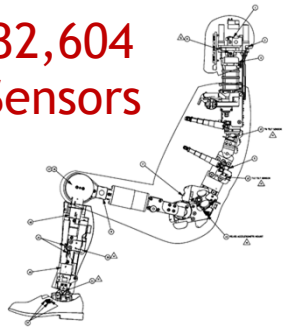
164 Vehicle Crash Tests

348 Crash Simulation Sled Tests

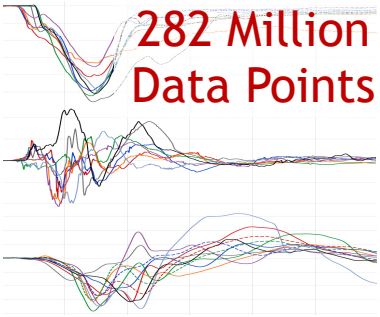
1013 Dynamic Component Tests

Data collected in these tests accounts for:

32,604 Sensors



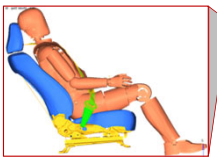
282 Million Data Points

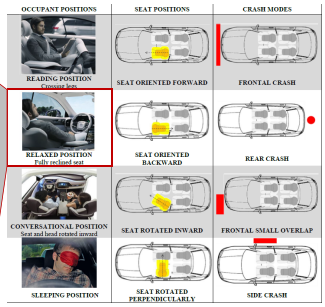


Data, photos, videos, and test reports are available to the public in the NHTSA Biomechanics and NHTSA Vehicle Crash Test Databases: https://www.nhtsa.gov/research-data/databases-and-software

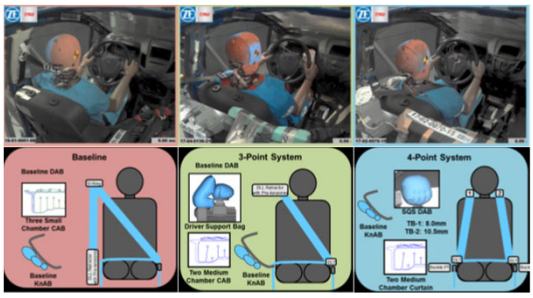
Application in NHTSA Research Projects

University of Virginia Center for Applied Biomechanics
Assessing Occupant Protection for Automated Vehicles





UMTRI University of Michigan Transportation Research Institute × ZF
Oblique Restraint Countermeasures



EDAG
Vehicle FE Model Development

For more information see Docket ID NHTSA-2019-0106 NHTSA Crashworthiness Research - THOR-50M Documentation