

# NHTSA's WheelChair Safety Testing

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## Wheelchair Safety - Background

- CFR Title 49, Part 595 - allows modifications to vehicle to facilitate mobility for those with disabilities
  - For wheelchair seated driver, Part 595 allows air bags to be disabled if a securement device for the wheelchair and Type-2 safety belts (3 point belts) are installed
- UMTRI study (June 2016) - Wheelchair Occupant Studies -
  - <http://www.nhtsa.gov/Driving+Safety/Disabled+Drivers/disabled-drivers-and-passengers>
  - Crash data study
  - 21 disabled drivers seating study
  - Sled tests
  - Computer simulations
    - Properly restrained wheelchair seated drivers benefit from the air bag
- VRTC Study - Crash tests to verify benefits of air bags

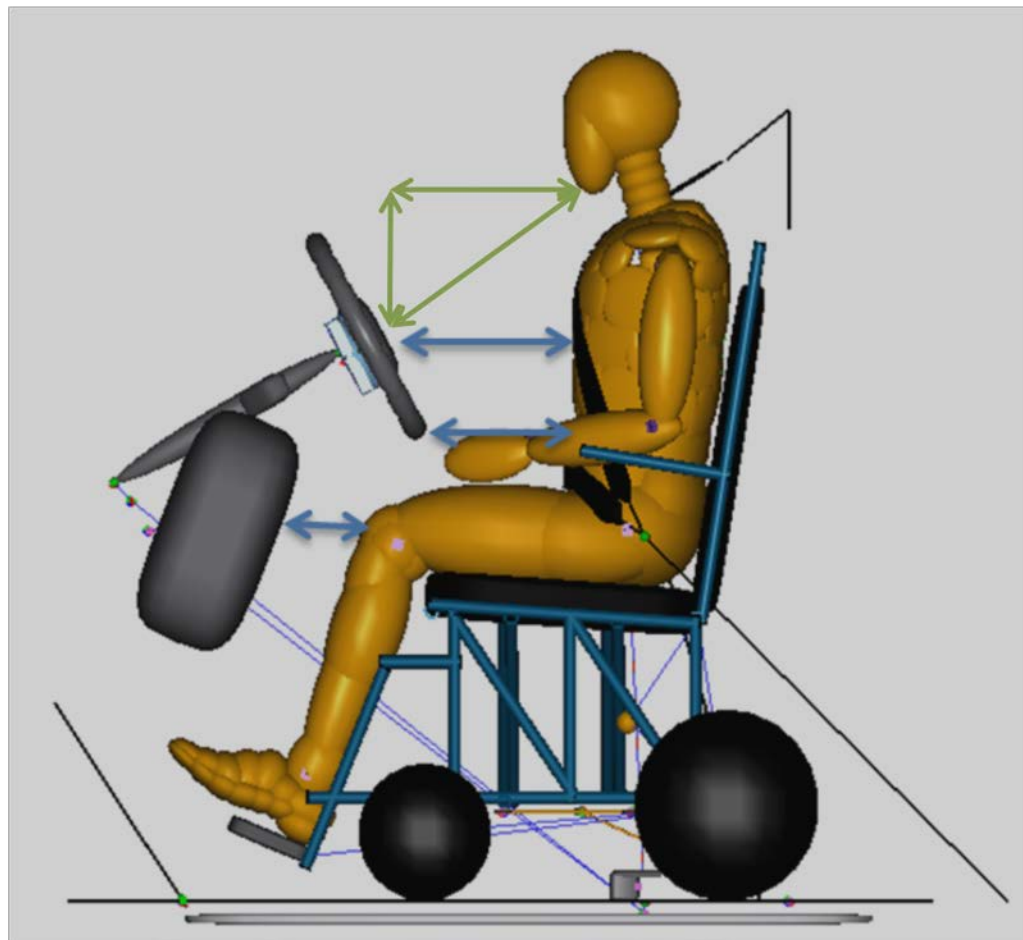
## Crash Test Setup

- 2 identical crash tests - With and without air bag
- 2015 Dodge Caravan Braun EVII Conversion Vans
- Quantum Q6 Edge 2.0 Wheelchair (WC19 compliant)
- Hybrid III 50<sup>th</sup> percentile male dummy
- Q'straint QLK-150 docking base (SAE J2249/WC 18) compliant

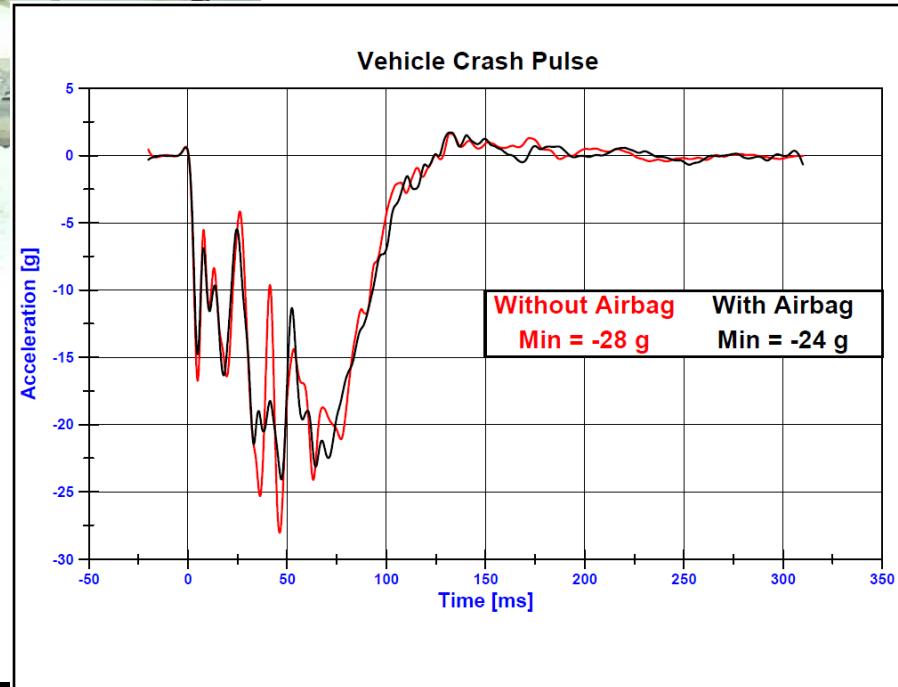


# Dummy Seating

- Replicate the average occupant position from the UMTRI study



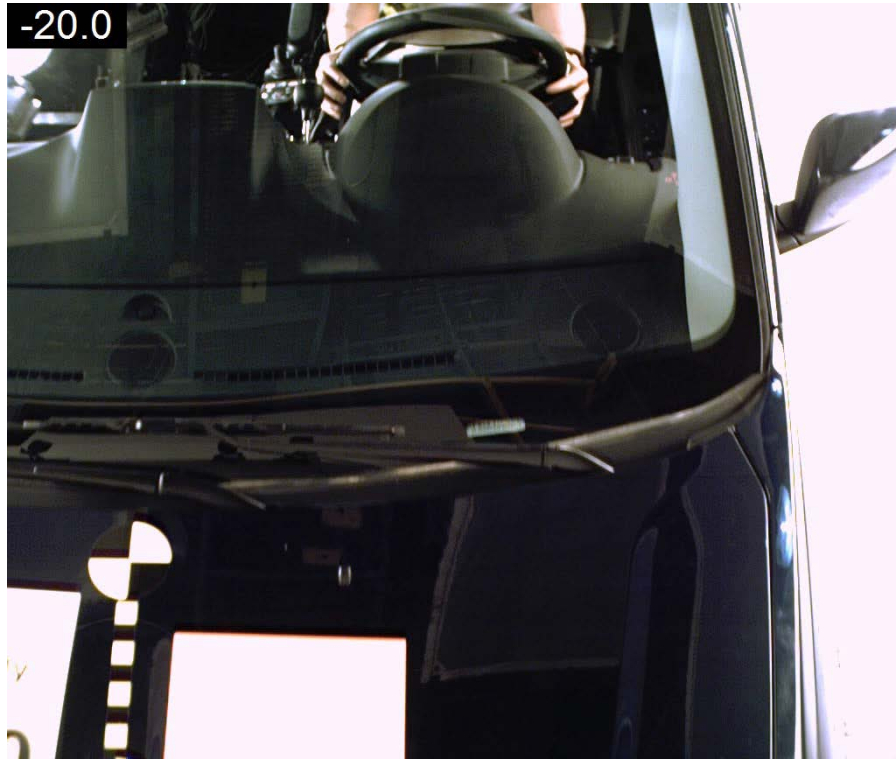
# Real-time Video



# Dummy Kinematics – Upper



# Dummy Kinematics - Head



# Dummy Kinematics - Lower







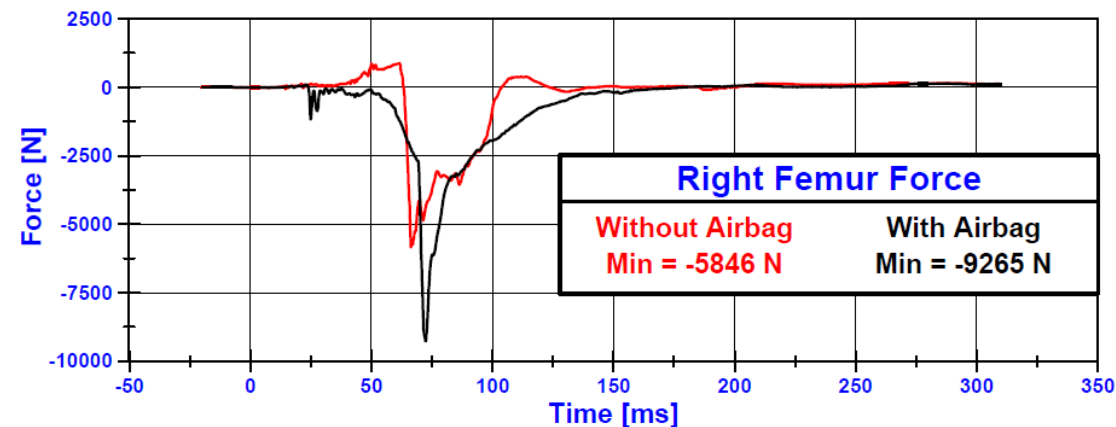
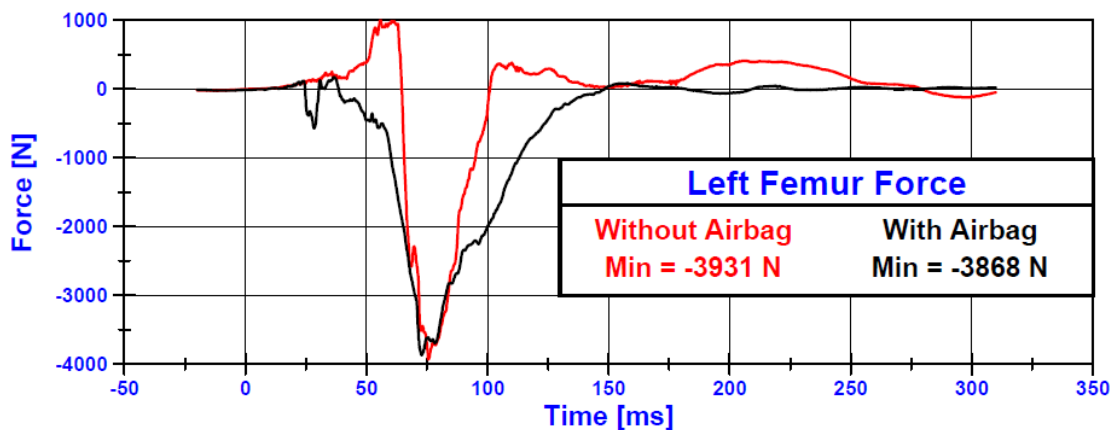
## Dummy Injury Assessments (No airbag vs. with airbag vs. FMVSS208)

Dummy IAV	IARV	Without air bags	With air bags	Percent change
HIC15	700	368	101	- 72 %
BrIC*	1.0	0.80	0.55	- 31 %
Nij	1.0	0.37	0.37	--
Chest g (3 ms)	60	58.4	44.2	- 24 %
Chest defln (mm)	63	47.5	38.9	- 18 %
Femur loads (N)	10000	5845	9265	+ 58 %

\* - Not in FMVSS

# Femur Loads

- Left femur loads - Similar in two tests
- Right femur loads - Higher with air bags
- Reason: Slightly different impact locations



# Dummy Excursions



Without airbag – 429 mm



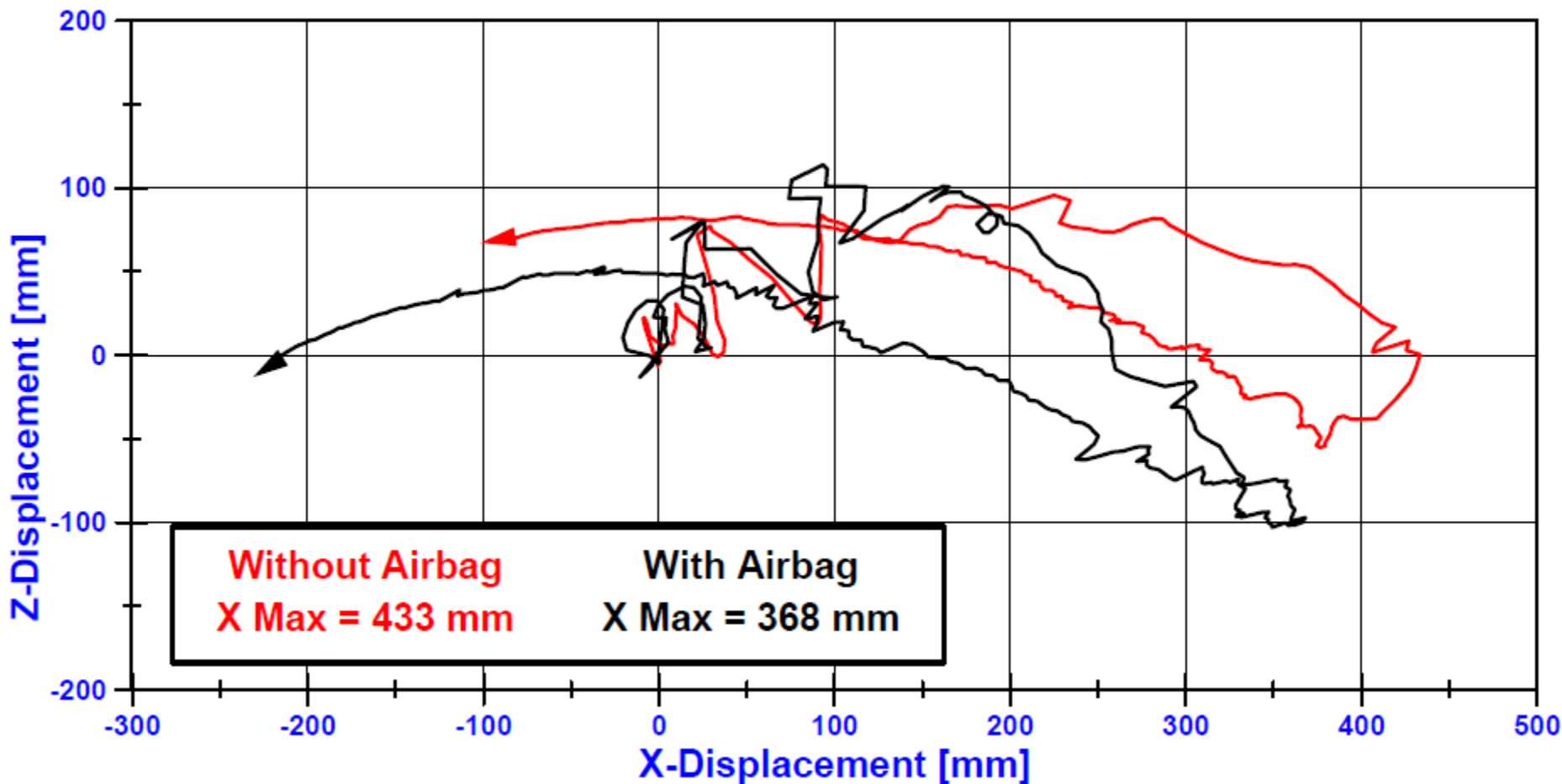
With airbag – 368 mm



# Head C.G. Excursion

- Using photogrammetry (6 - D)

## Head Trajectory

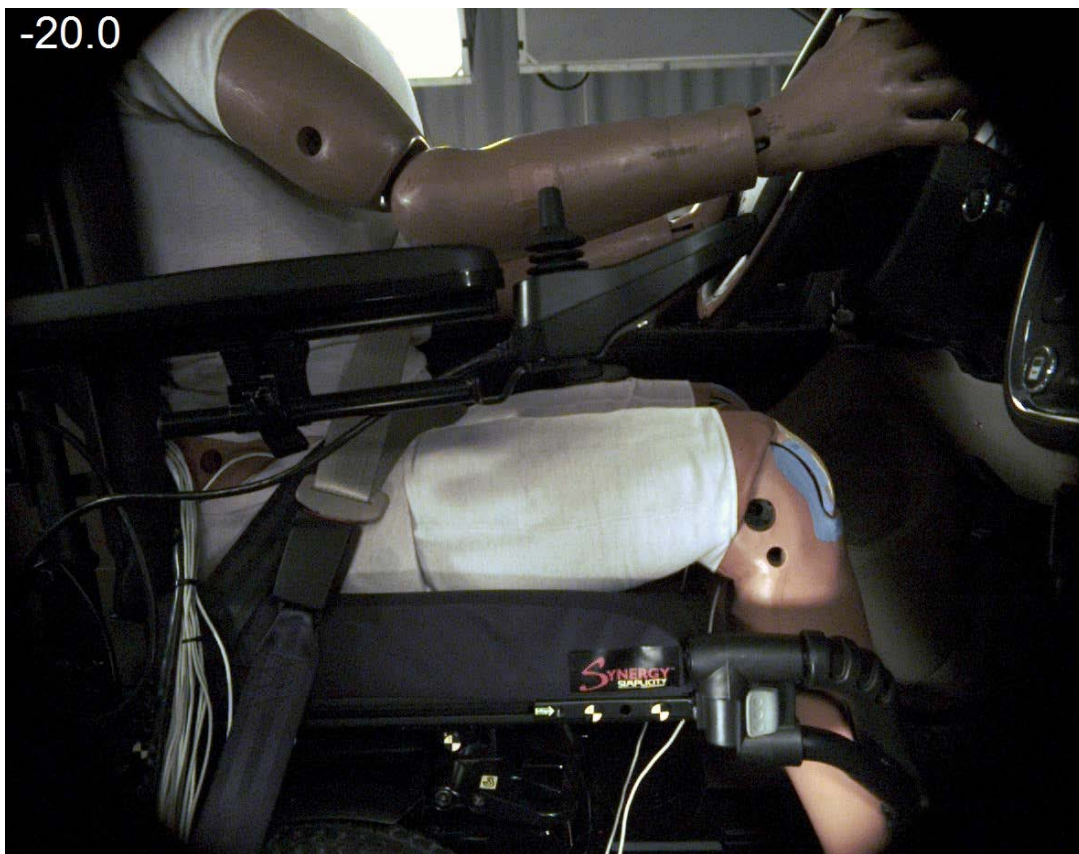


# Wheelchair Bracket Performance



# Wheelchair Seat Back Support Failures

- At ~ 100 ms
- Inertial loading
- Both crash tests



## Observations

- Air bags reduced dummy injury assessments for the head, chest
- Head rotation injury (BrIC) reduced from 80% to 55% of IARV (Injury Assessment Reference Value)
- Chest acceleration reduced from 97% to 74% of IARV
- Chest deflection reduced from 75% to 62% of IARV
- Neck injury assessment similar
- Right leg femur injury assessment higher with the airbags - possibly because the knees contact different structures
- Wheelchair seat back failure from inertial loading

Test reports, data, videos in VEHDB at <https://one.nhtsa.gov/Research/Databases-and-Software>  
Test # 10029, 10030

**NHTSA**



**THE END**