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Status of NHTSA's Roof Crush Research

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Roof Crush

- **Phase 1 – Determine Plate Angles**
- **Phase 2 – Initial Fleet Evaluation**
- **Phase 3 – Expanded Fleet Evaluation**

Roof Crush
Phase 1 - Approach

- **Computer Simulation to Select Test Conditions**
  - 5° pitch, 25° roll
  - 10° pitch, 45° roll
- **Tested 3 Pairs of Vehicles**
  - 1997 Dodge Grand Caravan
  - 1998 Chevrolet S-10 Pickup
  - 2002 Ford Explorer
- **Compared Force vs. Displacements**
- **Compared Damage to Real World**

Roof Crush
Phase 1 - Summary

- **No Trend in Energy ‘Absorbed’**
- **No Trend in Peak Force**
- **No Trend in Far-Side Lateral Crush**
- **More Vertical Crush in 5° x 25°**
- **Any Differences Were Very Subtle**
  - Not distinguishable in subjective evaluation of photographs of roof damage

Roof Crush
Phase 2 - Approach

- **Test 10 Recent Model Vehicles**
- **Load Plate Angles - 5° pitch, 25° roll**
- **Test to 254 mm of Load Plate Displacement**
- **Collect Force vs. Displacement Data**
- **Collect Headroom Measurement Data**

Roof Crush
Phase 2 - Vehicles: One From Each Type/Size

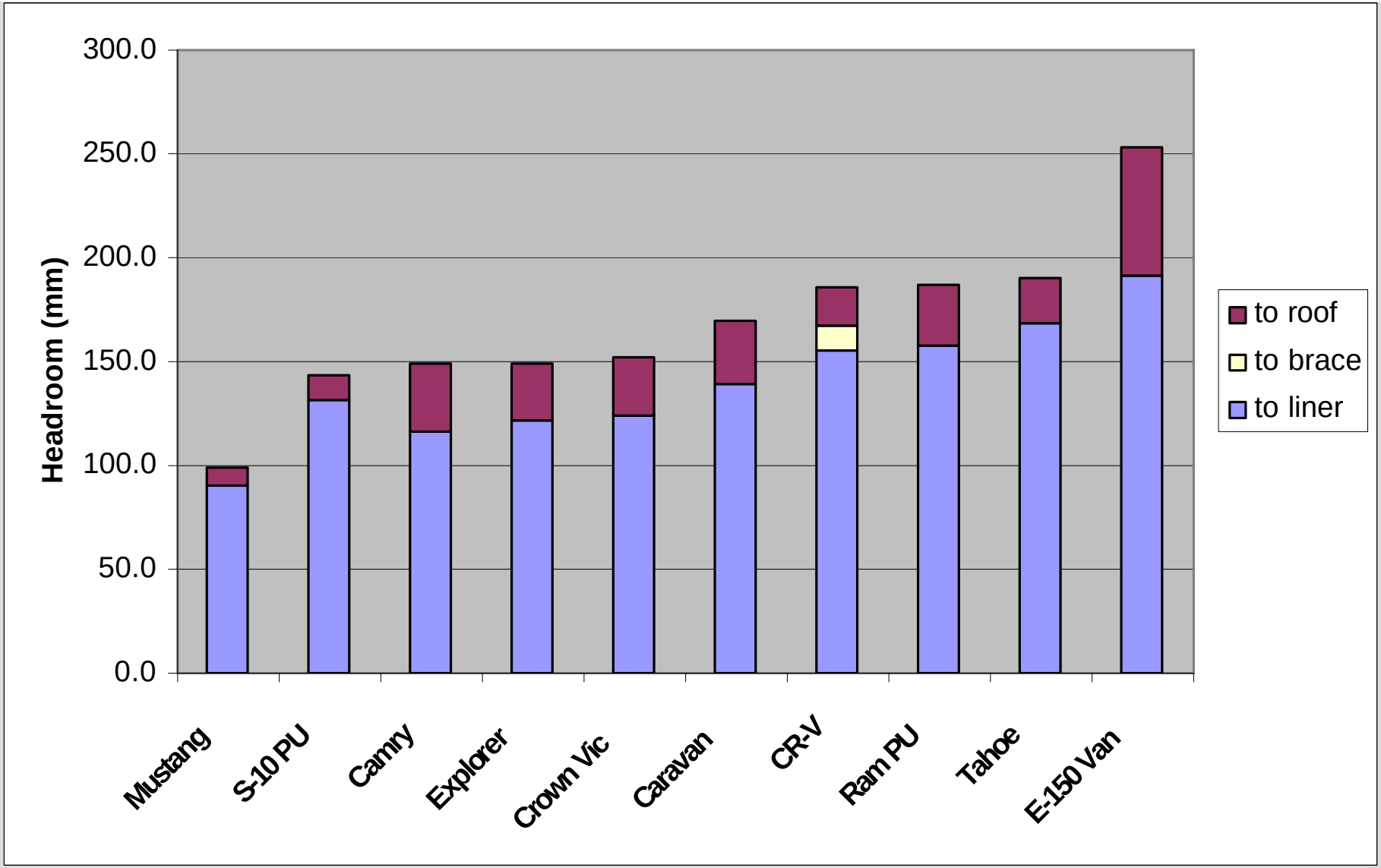
- **Passenger Cars:**
  - 2002 Ford Mustang
  - 2002 Toyota Camry
  - 2001 Ford Crown Victoria
- **Sport Utility Vehicles:**
  - 2002 Honda CR-V
  - 2002 Ford Explorer*
  - 2001 Chevrolet Tahoe
- **Pickup Trucks:**
  - 1998 Chevrolet S-10 Pickup*
  - 2002 Dodge Ram 1500 Pickup
- **Vans:**
  - 1997 Dodge Grand Caravan*
  - 1999 Ford E-150 Econoline Van

*** Data from Phase 1**

Roof Crush
Phase 2 - Roof Attachment Point

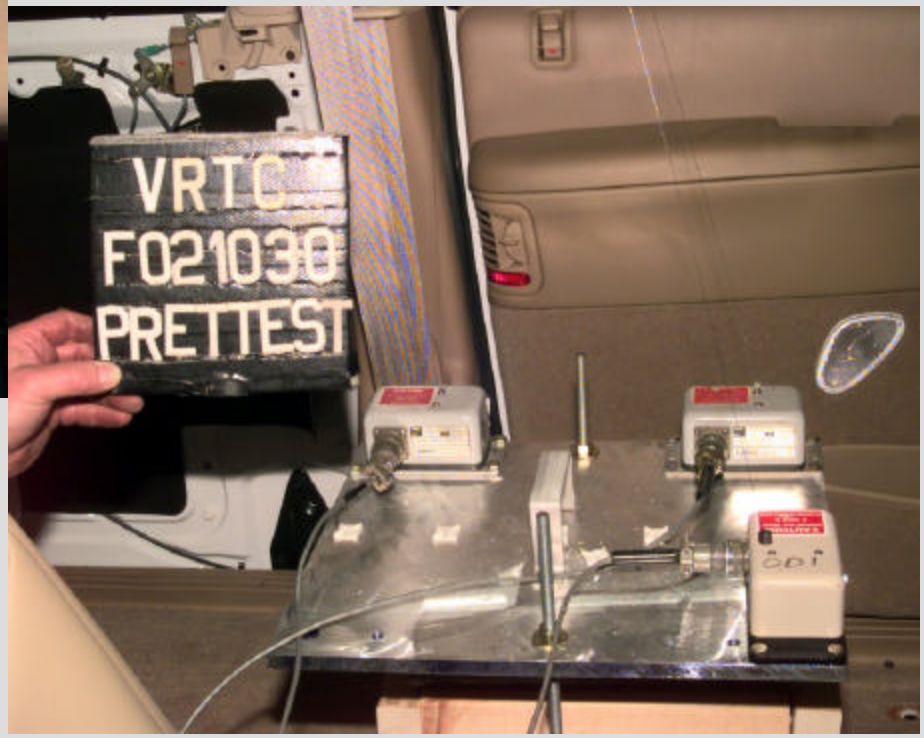
- **Seat Track Position & Seat Back Angle for 50th Male per FMVSS 208**
- **Locate H-Point Using OSCAR Device**
  - x and z coordinates
- **Identify 'Top of Head'**
  - Located for first vehicle by seating H-3 dummy
  - Used translation of OSCAR x and z coordinates for remaining vehicles
  - y coordinate from centerline of seat
- **Locate Point Vertically Above 'Top of Head'**
  - On interior roof liner
  - On exterior hard roof

Roof Crush
Phase 2 – Initial Headroom



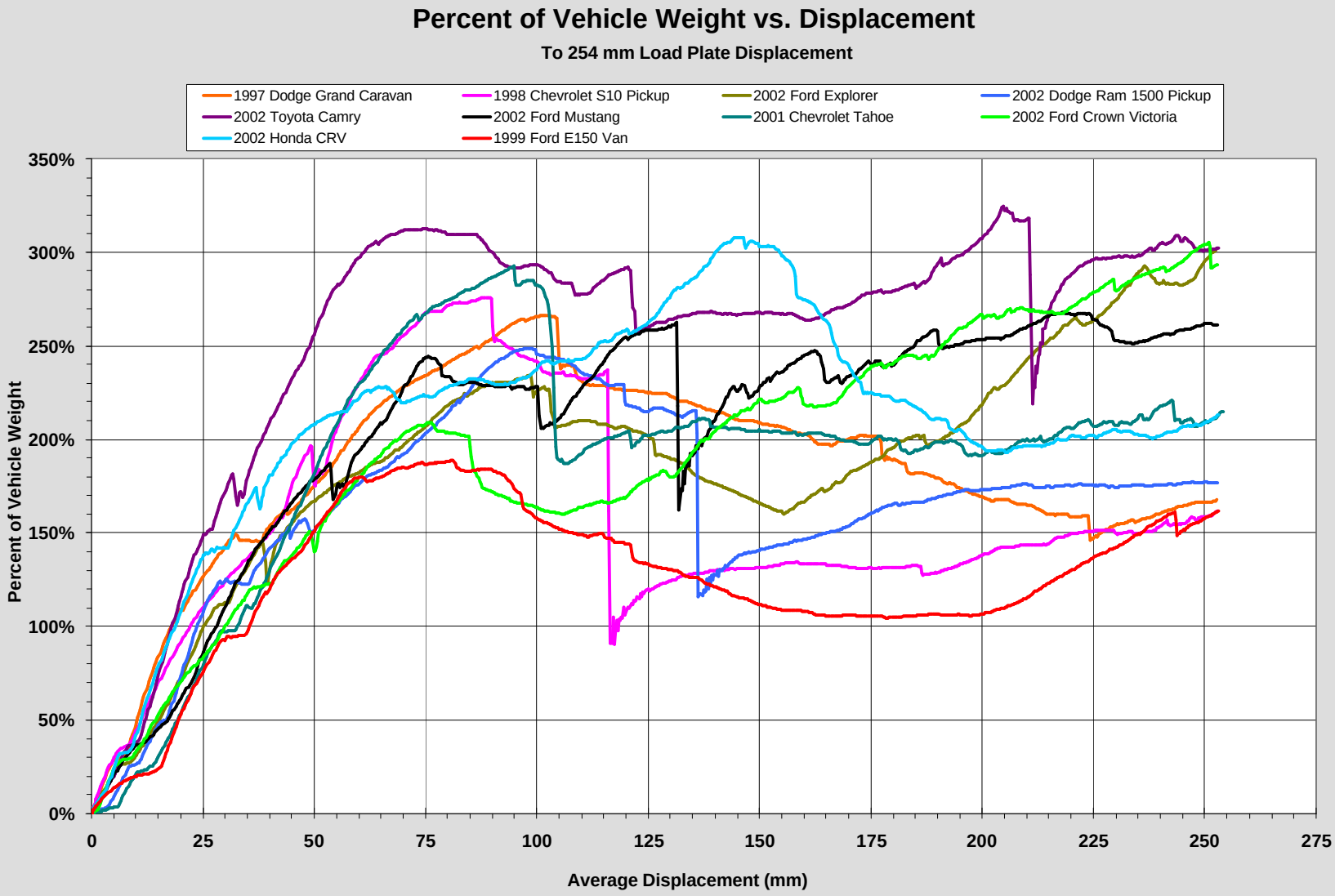
Roof Crush

Phase 2 – String Potentiometer Attachment

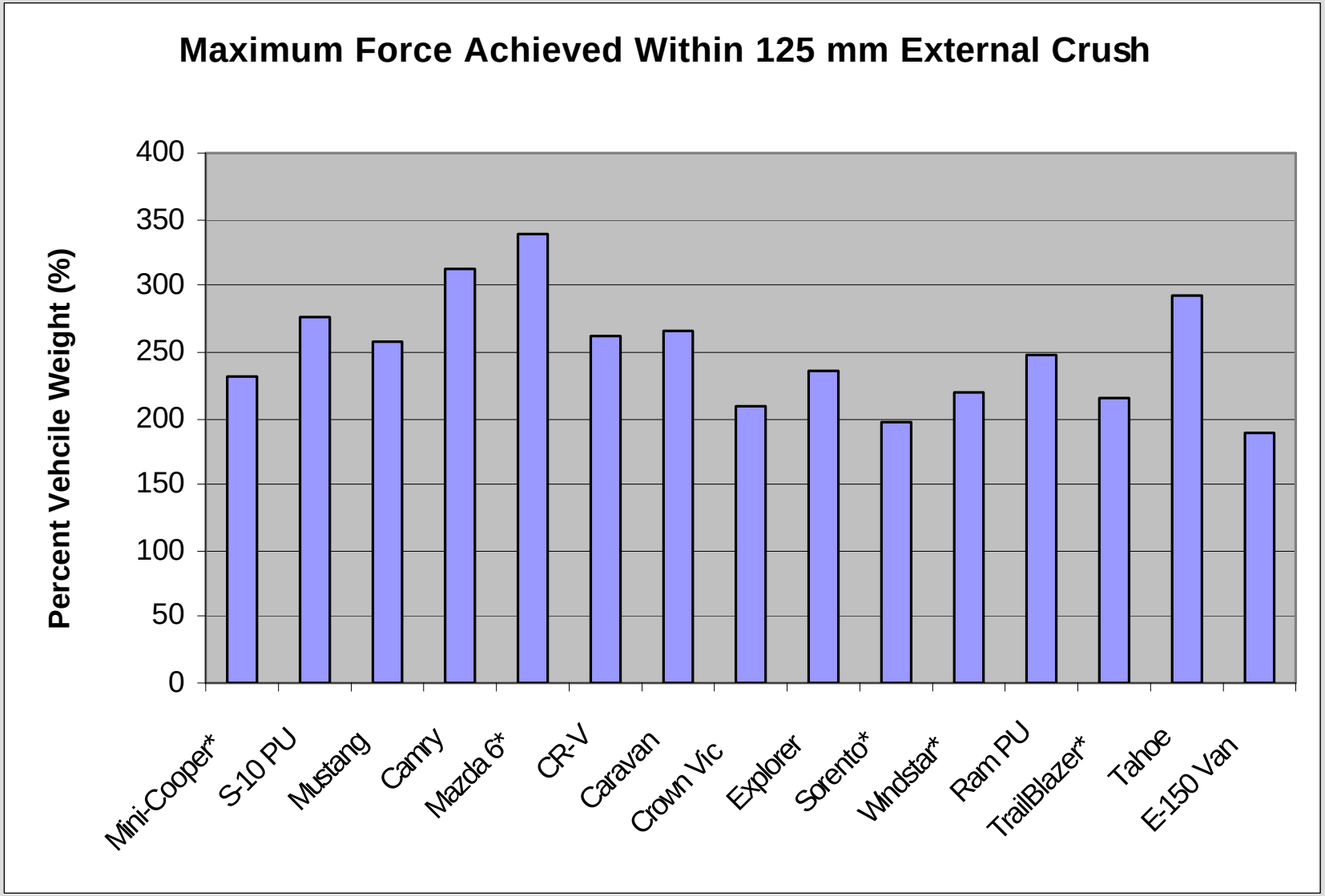


3 string potentiometers were used to track the roof point initially above the drivers head

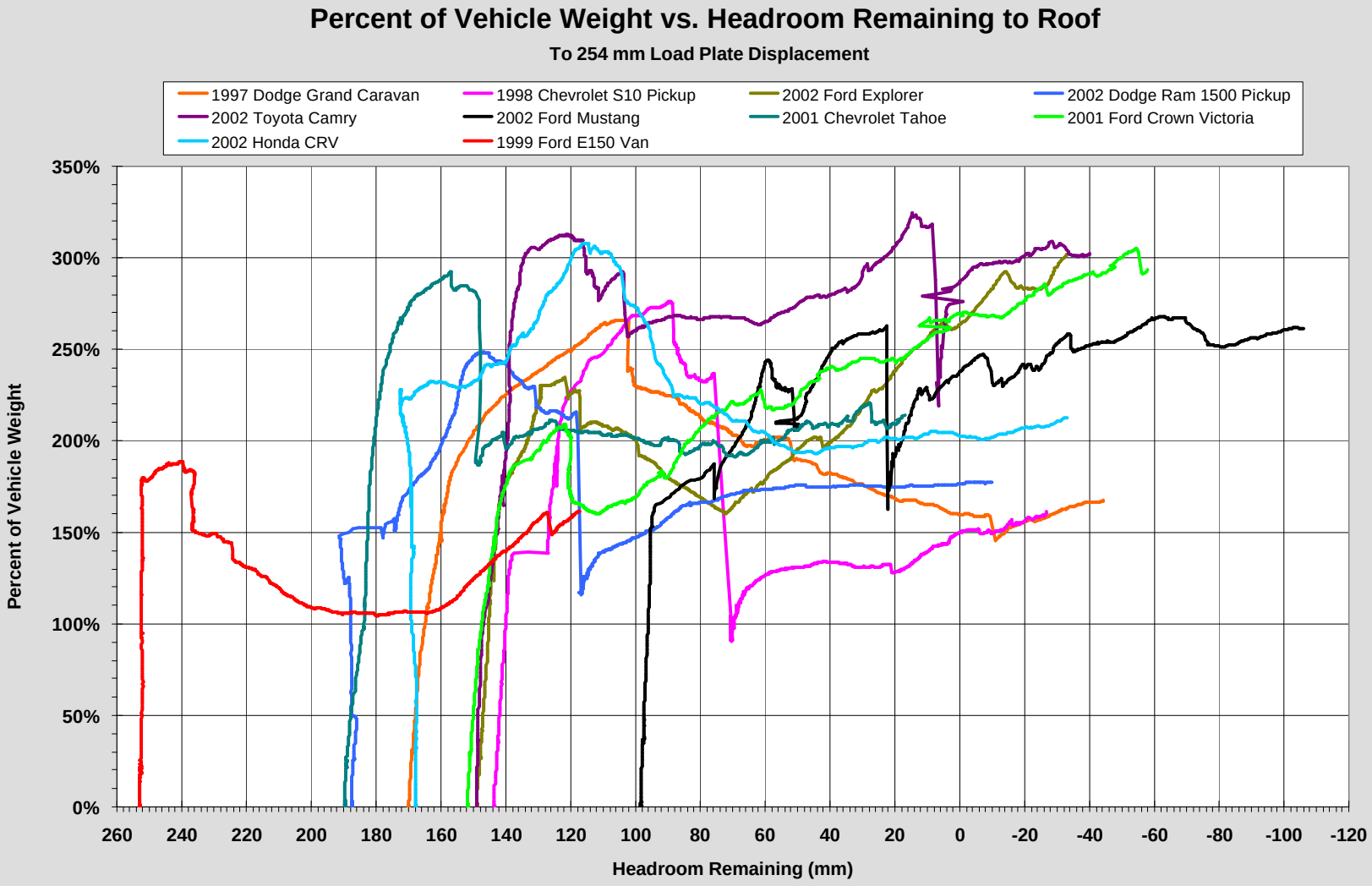
Roof Crush
Phase 2 - Results

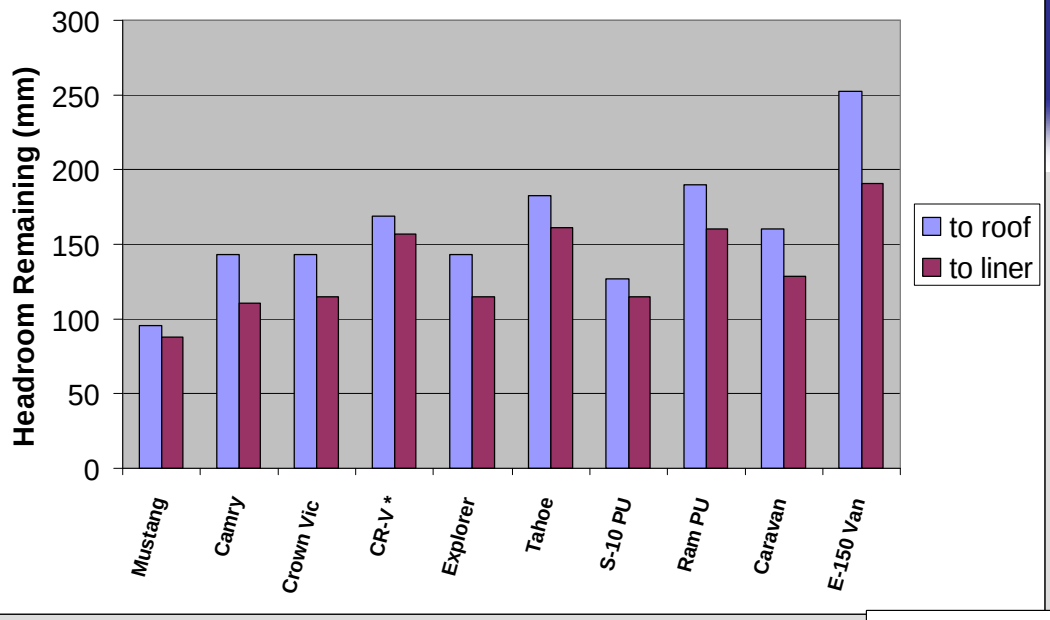


Roof Crush
Phase 2 - Results



Roof Crush
Phase 2 - Results

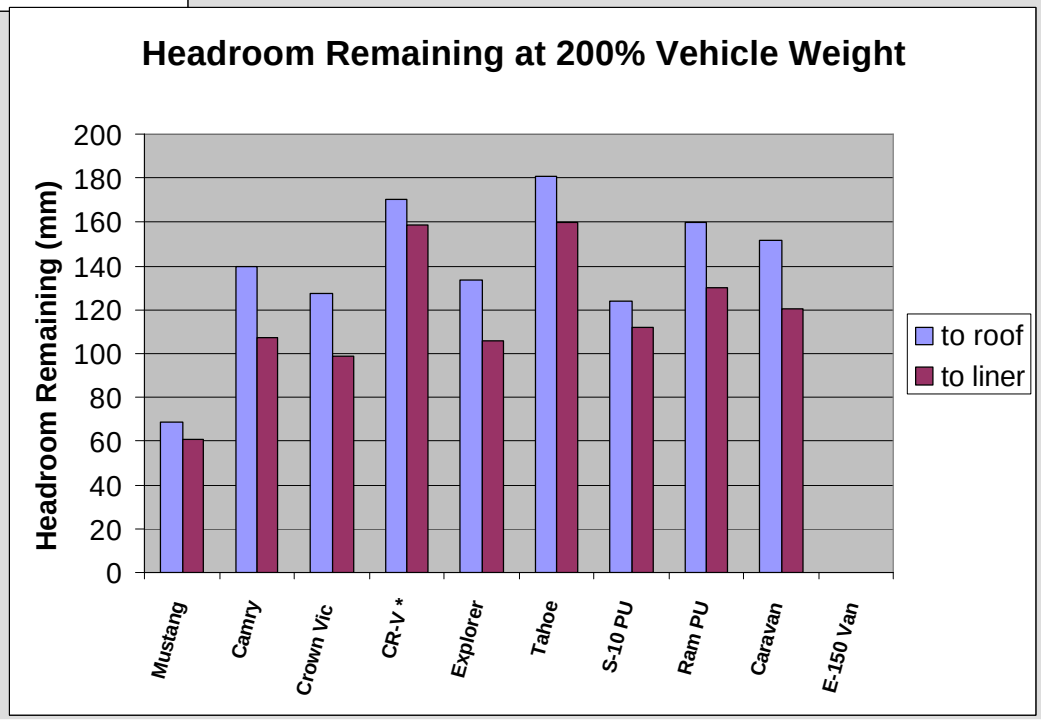


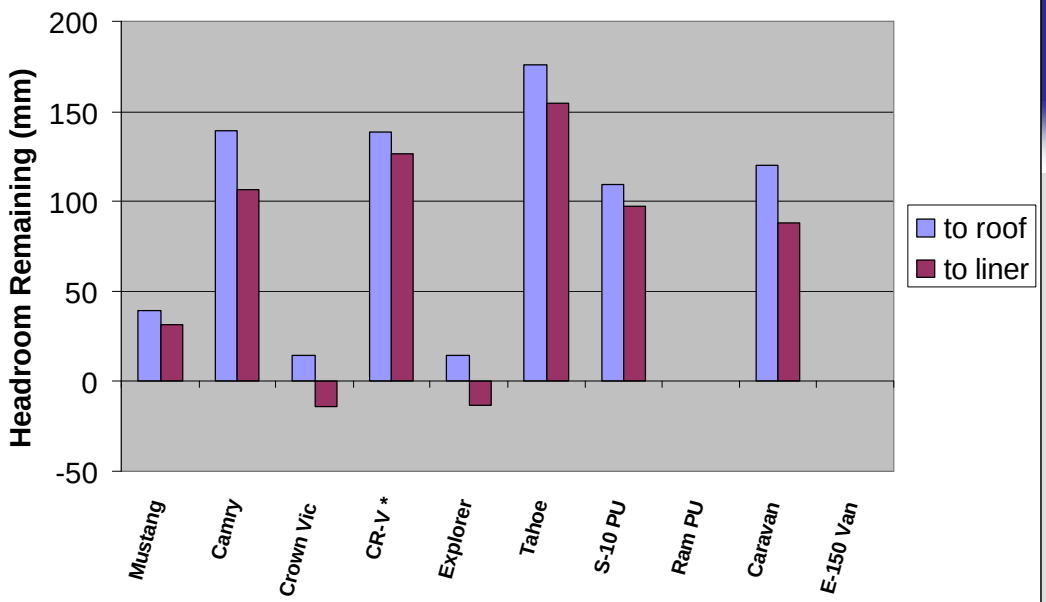


All vehicles reached 150% of vehicle weight with significant head room remaining

* to brace

Only 1 vehicle did not have a peak force above 200% of vehicle weight, but it still had positive head room at the end of the test

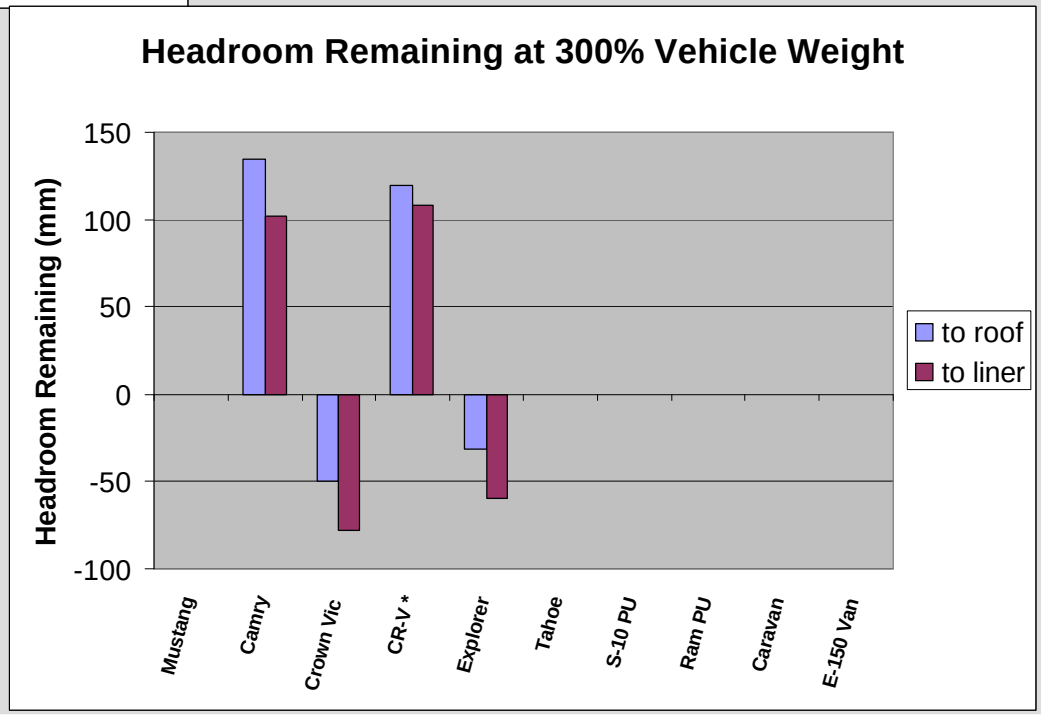




8 of the 10 vehicles had a peak force above 250% of vehicle weight, and 6 of these had positive head room remaining

* to brace

4 vehicles had a peak force above 300% of vehicle weight, and 2 of these had positive head room remaining



Roof Crush
Phase 3 - Approach

- **Test 10 Recent Model Vehicles**
- **Load Plate Angles - 5° pitch, 25° roll**
- **Test to 254 mm of Load Plate Displacement**
- **Collect Force vs. Displacement Data**
- **Document Time of Liner-to-Head Contact**

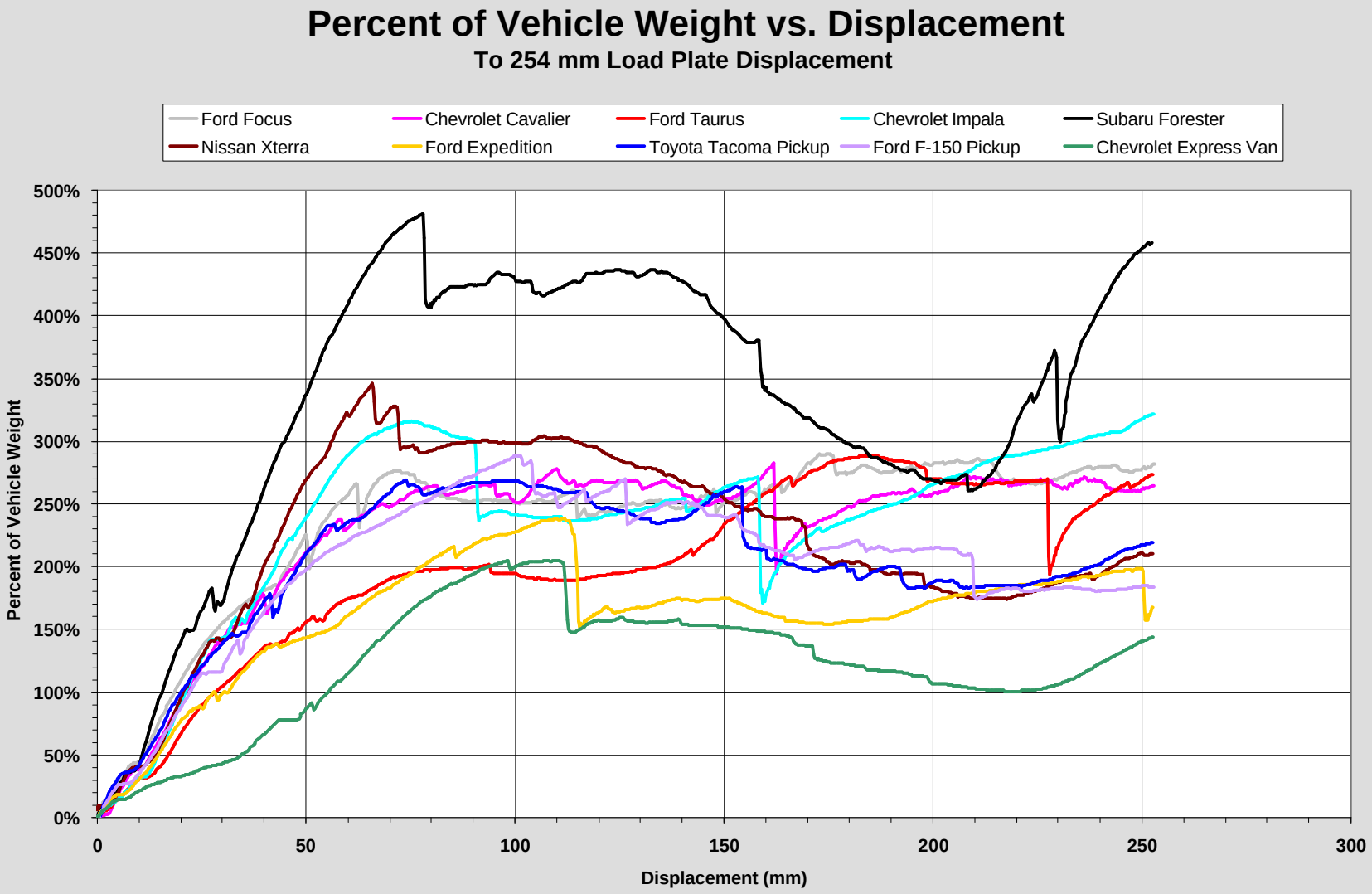
Roof Crush
Phase 3 - Vehicles

- **Passenger Cars:**
  - 2003 Ford Focus
  - 2003 Chevrolet Cavalier
  - 2001 Ford Taurus
  - 2003 Chevrolet Impala
- **Sport Utility Vehicles:**
  - 2003 Subaru Forester
  - 2002 Nissan Xterra
  - 2003 Ford Expedition
- **Pickup Trucks:**
  - 2003 Toyota Tacoma
  - 2003 Ford F-150
- **Van:**
  - 2003 Chevrolet Express (15-passenger)

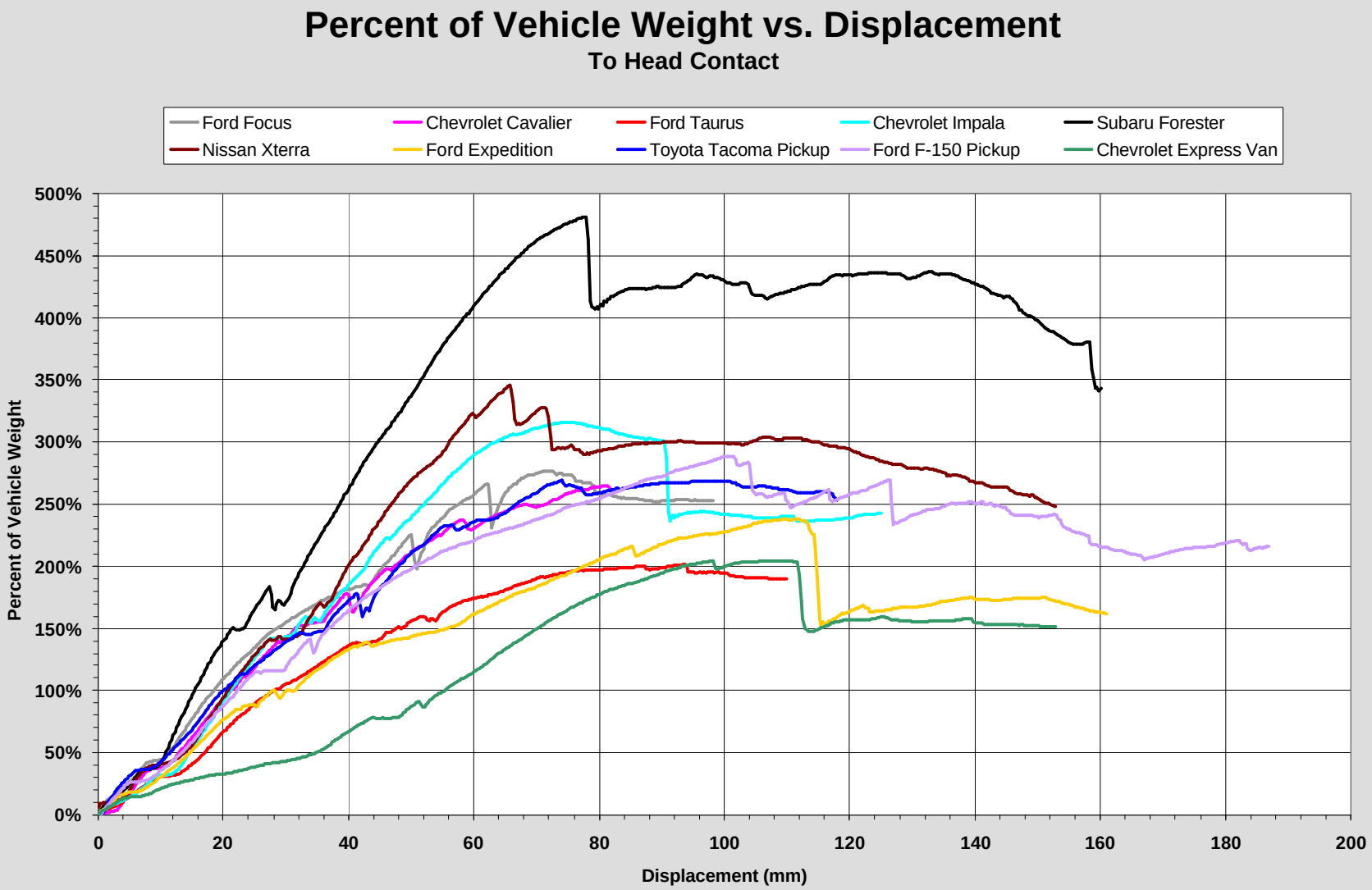
Roof Crush
Phase 3 – Dummy Placement

- **Hybrid-III 50th Male**
- **Positioned per FMVSS 208**
- **Arms and Legs Removed**
- **Contact Switch on Head and Liner**

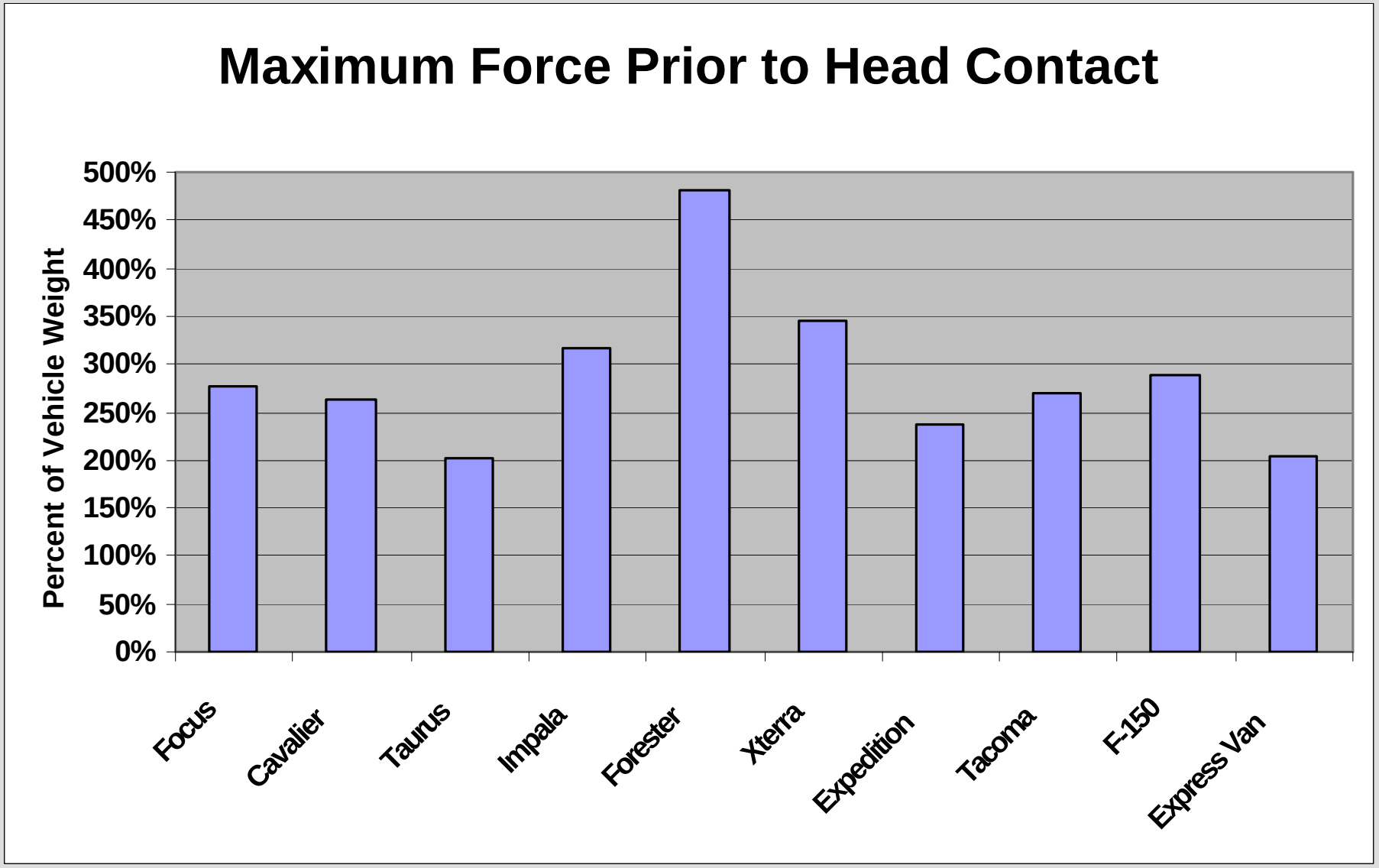
Roof Crush
Phase 3 - Results



Roof Crush
Phase 3 - Results



Roof Crush
Phase 3 - Results



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