

# Lower Interior Impacts to Seat Backs and B- Pillars

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# Presentation Outline

- Target Population
  - Rear seat injuries
- Current standards
  - FMVSS 201/ FMVSS 201U
- Test Procedure Development
  - Headform selection
  - Test locations
  - Test speeds
- Initial Vehicle Testing
- Ongoing Research



# Rear Seat Exposure

## Inclusion Data Criteria

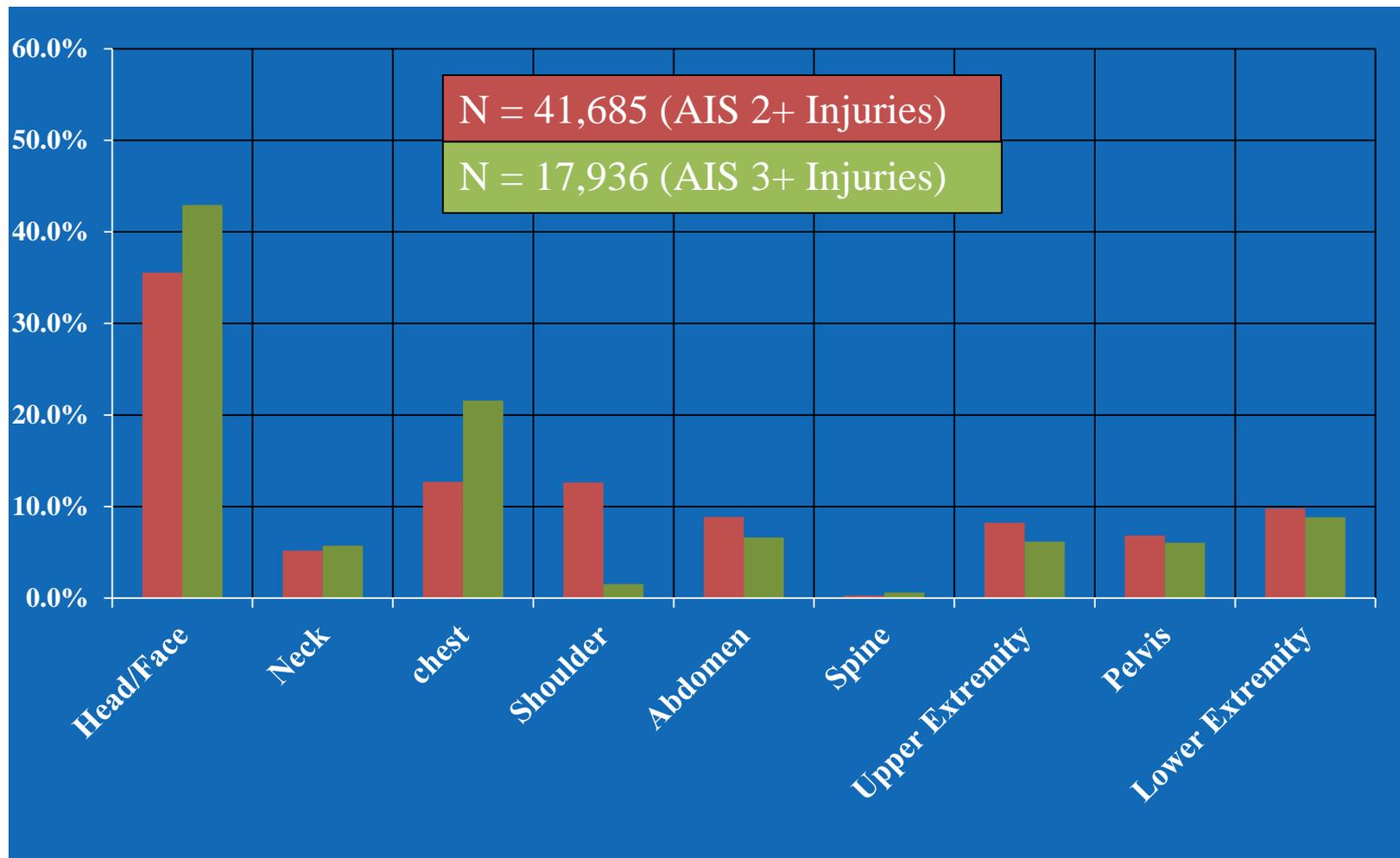
- NASS CDS- 1997 - 2013
- Model Year 1985 + ( $\leq$  10,000 lbs)
- No age restrictions
- Rear seat occupants
- Restrained and unrestrained occupants
- All crash modes

Rear Seat Injured Occupant Exposure	Annual Average Occupant Count (Weighted)
Total Rear Seat Occupants (Exposure) (from NASS-CDS)	451,213 (100%)
Total Injured Occupants (MAIS 2+)	17,203 (3.8%)
Total Injured Occupants (MAIS 3+)	7,418 (1.6%)

## Annual Average Rear Seat Fatalities: 2,569

- 6.6% of all traffic fatalities in ages 0-98
- FARS 2000-2013

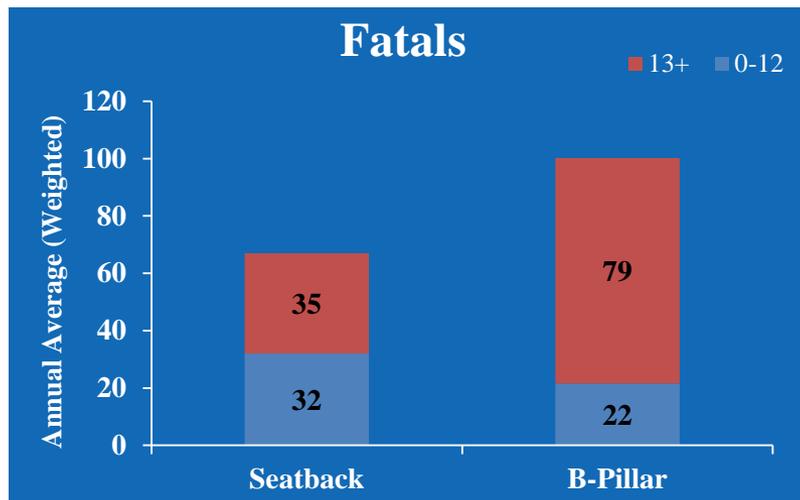
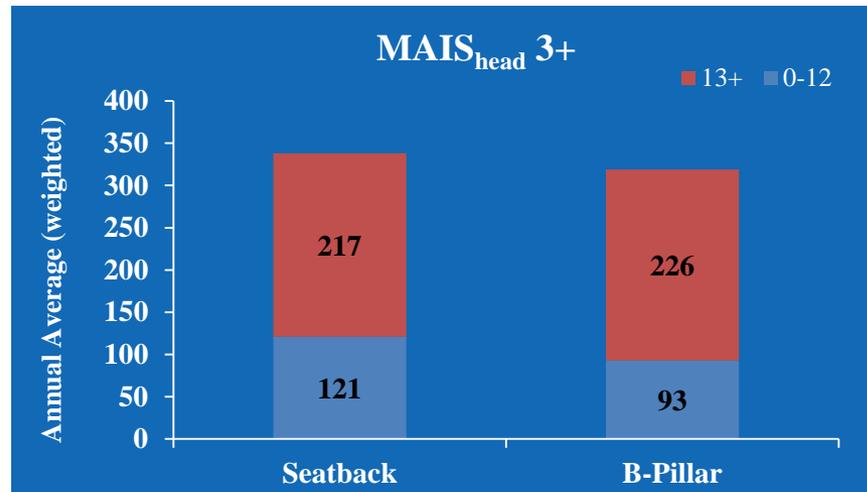
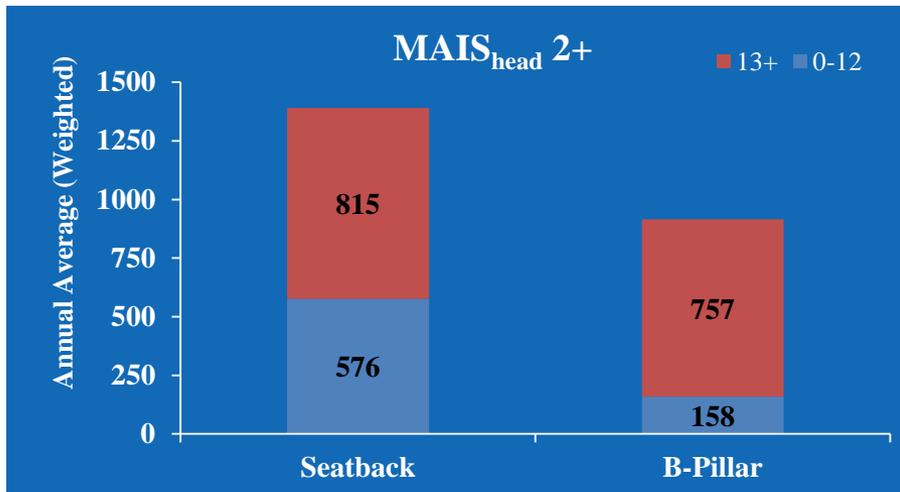
# Distribution of Injuries by Body Region



- 48% of all AIS 2+ Injuries are to Head and Chest
- 65% of all AIS 3+ Injuries are to Head and Chest



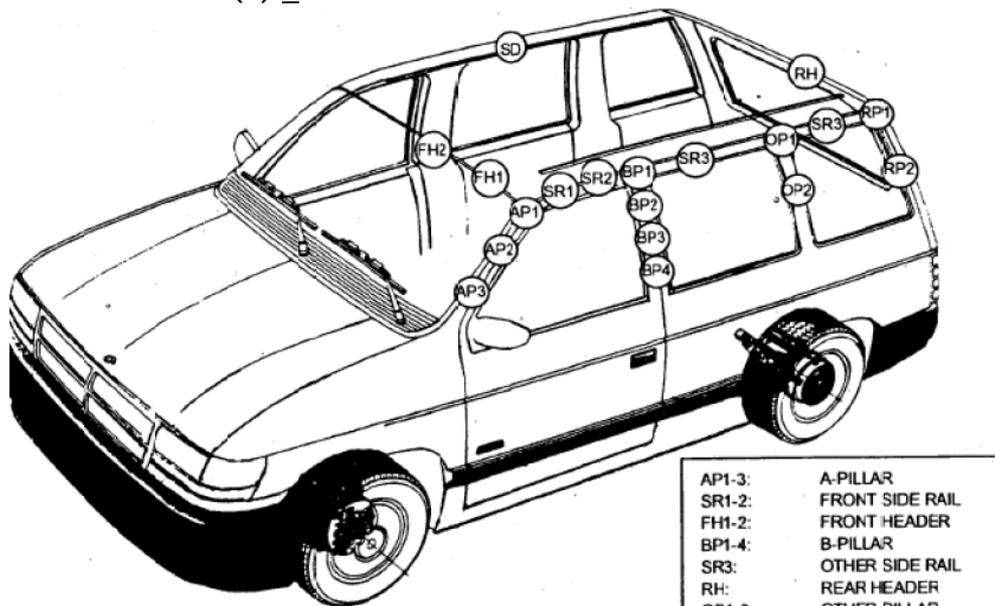
# Head Injury by Contact Source



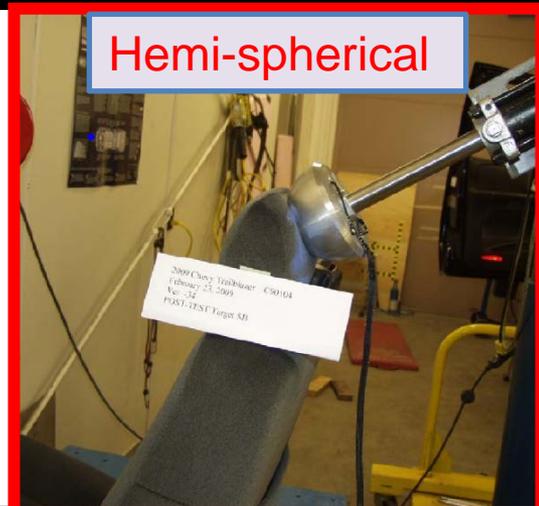
Fatalities estimate scaled to the FARS data

# Current Standards

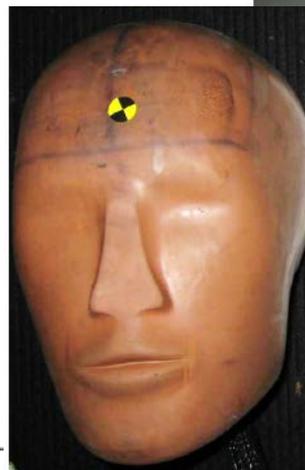
- FMVSS 201- Seat Back
  - 15 lbs (6.8 kg), 165 mm diameter hemi-spherical headform at 15 mph (24 kph)
  - Impact location within the head impact area (center of head rest)
  - 80 g's/3 ms criterion
- FMVSS 201U
  - 10 lbs (4.5 kg), free-motion headform (FMH) at 15 mph (24 kph)
  - Impacts at various upper interior locations above the window sill
  - $HIC(d) \leq 1000$



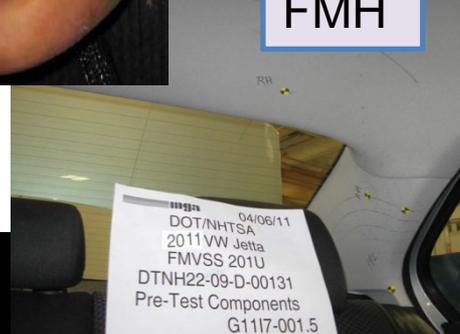
AP1-3:	A-PILLAR
SR1-2:	FRONT SIDE RAIL
FH1-2:	FRONT HEADER
BP1-4:	B-PILLAR
SR3:	OTHER SIDE RAIL
RH:	REAR HEADER
OP1-2:	OTHER PILLAR
RP1-2:	REAR PILLAR
SD:	SLIDING DOOR TRACK
UR:	UPPER ROOF (NOT SHOWN)



Hemi-spherical



FMH



# Test Procedure Development

- Goal- Develop a repeatable testing method to assess the injury potential from head contact on seat backs and lower B-pillars
- Test Parameter Decisions
  - Type of headform/impactor
    - Current FMVSS 201 FMH (modified 50<sup>th</sup> male Hybrid-III head)
    - Pedestrian child headform (hemi-spherical)
      - Specified in GTR9/R127/EuroNCAP
  - Specific impact locations
  - Test speeds

# Test Procedure Development

## Headforms

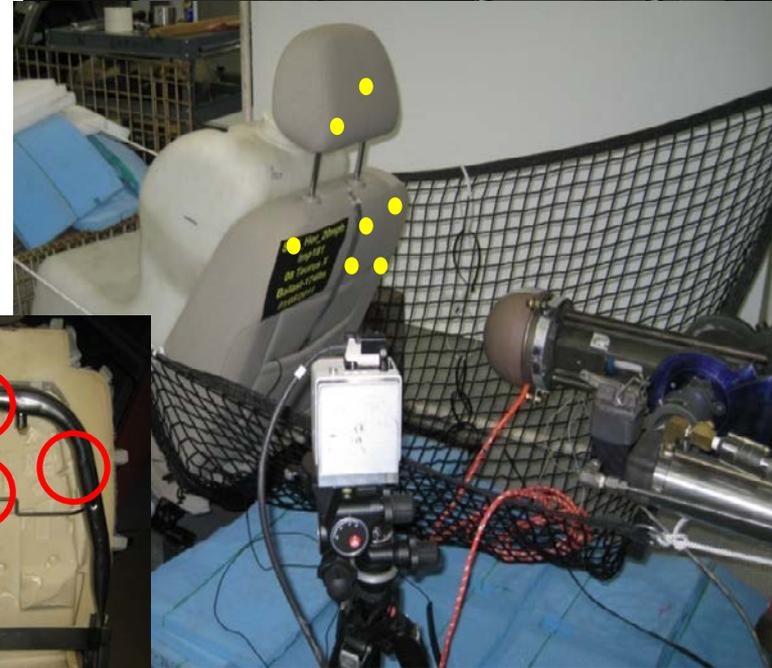
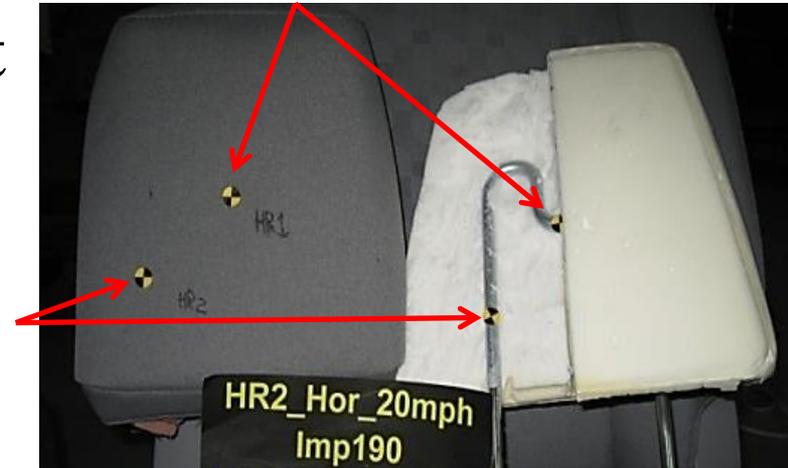
- Child-size free-motion
  - 6 YO (7.7 lbs, 3.5 kg), hemispherical, 165 mm diameter
  - Instrumentation:
    - 3 accelerometers (XYZ)
  
- FMVSS 201 FMH
  - Adult size (10 lbs, 4.5 kg),
  - Instrumentation:
    - 3 accelerometers (XYZ)



# Test Procedure Development

## Impact Locations

- Seat back and headrest locations were chosen based on different surfaces under the seat fabric with the focus on the upper quadrant of the vehicle seats
  - Hard structures such as frames and airbag mounting locations
  - Headrest post locations
  - Advanced head rest equipment



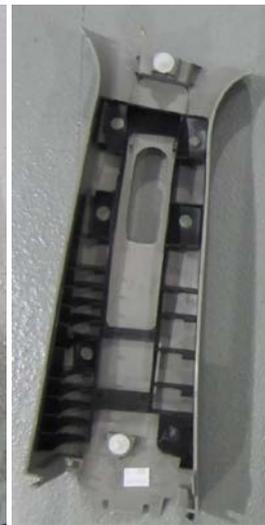
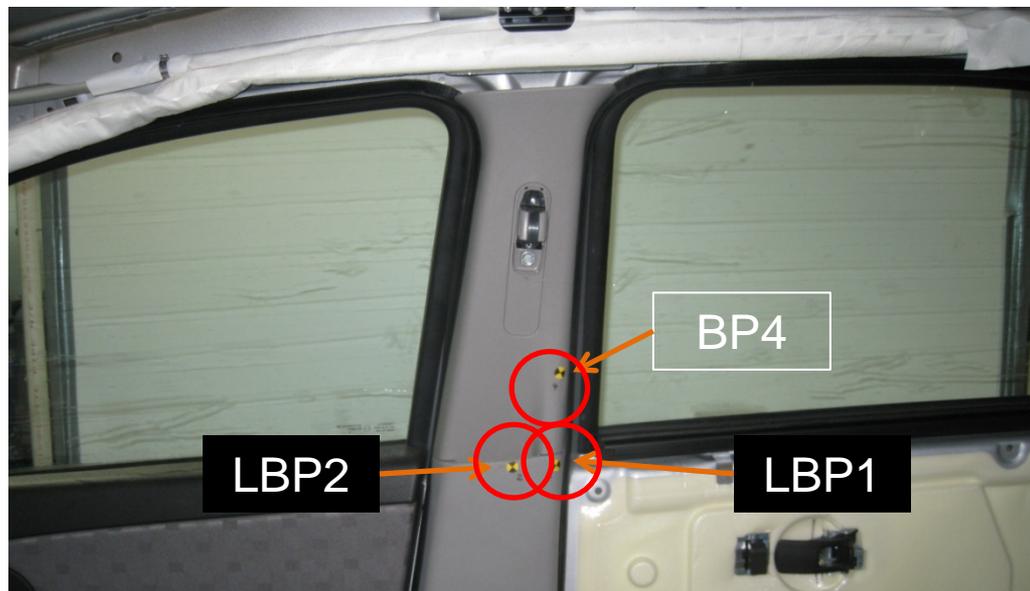
# Test Procedure Development

## Impact Locations: Positions of Rear Occupants



# Test Procedure Development Impact Locations

- B-pillar impact sites were chosen based on window sill line and where the upper and lower B-pillars overlap
  - BP4 is approximately the lowest position in the current standard (FMVSS 201)
  - LBP1 & LBP2 (shown) are where upper and lower pillars overlap
  - Lower B-pillar trim do not have all of the ribbing that is currently in the upper interior trim



# Test Procedure Development

## Test Speeds

- Initial test speeds
  - 15 mph (24.1 kph) & 20 mph (32.2 kph)
- Supporting analysis
  - 15 mph FMH impact speed in FMVSS 201
  - NASS delta-v's - frontal impacts
  - Child dummy head speeds from frontal NCAP tests
- Analysis shows that higher test speeds (above 20 mph) for seat back/head restraint impacts could be justified

Program	Measurement	Velocity (mph)
FMVSS 201U Current Standard	FMH impact speed	15
NASS Data- Frontal Impacts	Vehicle Delta-V	11-25
Frontal NCAP Tests (with add-on rear occupants)	Maximum head velocity	20-27

# Initial Vehicle Testing

## Child Headform

- Baseline testing
  - 12 vehicles (MY 2004-08)
  - 15 and 20 mph
- Countermeasure testing
  - Several types of EA materials tested on 3 vehicle platforms
    - Seat backs, B-pillars, and head restraints
  - Lowered the air curtain
    - B-pillar



1" Skydex



~1" Cones



2" Woodbridge 3.0



2" United #4



Large cone w/United #4

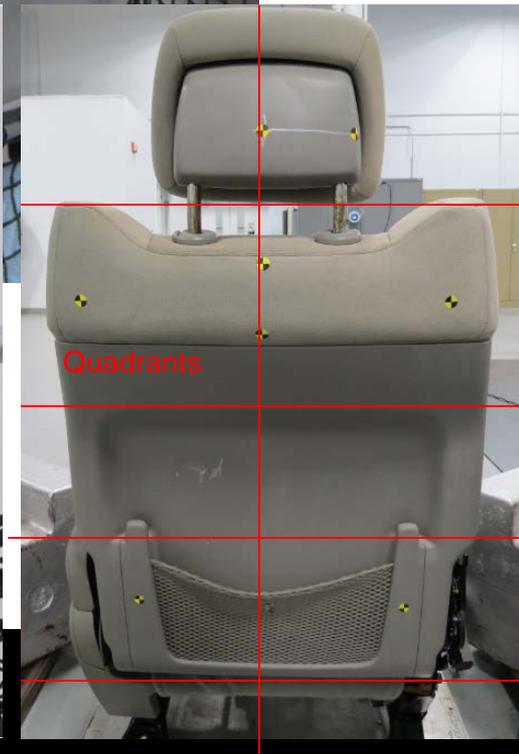
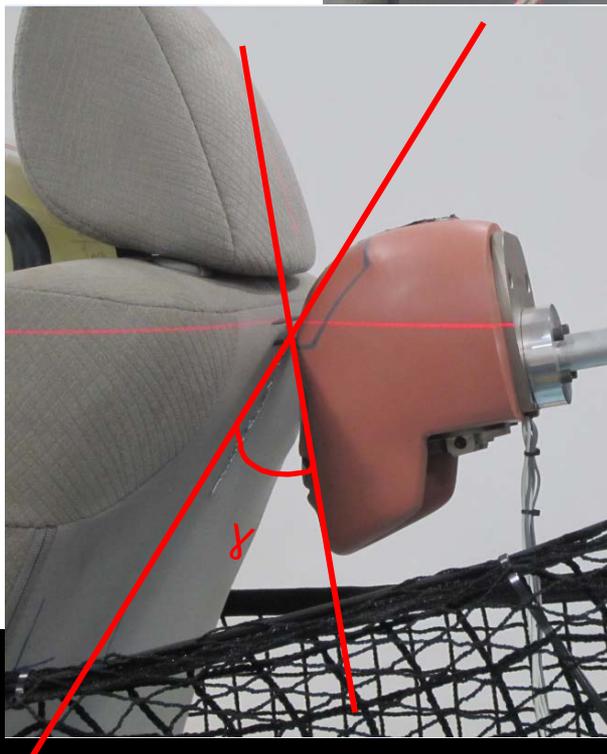
# Initial Vehicle Testing

## Child Headform Results

- At 15 mph, only the B-pillars produced HIC15 over 700 (10 of 12)
- At 20 mph, B-pillars produced HIC15 results of over 700 in all tests (6 of 6)
  - Lowered air curtain reduced results by 26% (2692 to 1990)
  - 2 inches of EA material reduced HIC15 by 43% (2692 to 1521)
- At 20 mph, some seatbacks produced HIC15 over 700 (8 of 48)
  - Higher HIC responses would be expected if test speed was increased
  - Countermeasures reduced HIC15 responses (average = 33%)
    - Of the 8 baseline tests with HIC15 over 700, 5 were reduced below that level
    - 2 of those 5 required just 1 inch of EA material

# Ongoing Research

- Evaluate seat backs/head restraints and B-pillars from more recent vehicles with the two headforms
- Select the headform
- Select test parameters
  - Specific impact locations
  - Test speeds
- Assess countermeasure effectiveness



**NHTSA**

**THANKS FOR  
YOUR  
ATTENTION**



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