NHTSA

NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

Update on Lower Interior Impacts to Seat Backs and B-pillars

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Presentation Outline

- *Background*
- *Test Matrix*
- *Impact Locations*
- *Test Procedures*
- *Results*
- *Countermeasure Test Matrix*
- *Countermeasure Results*
- *Ongoing Research*

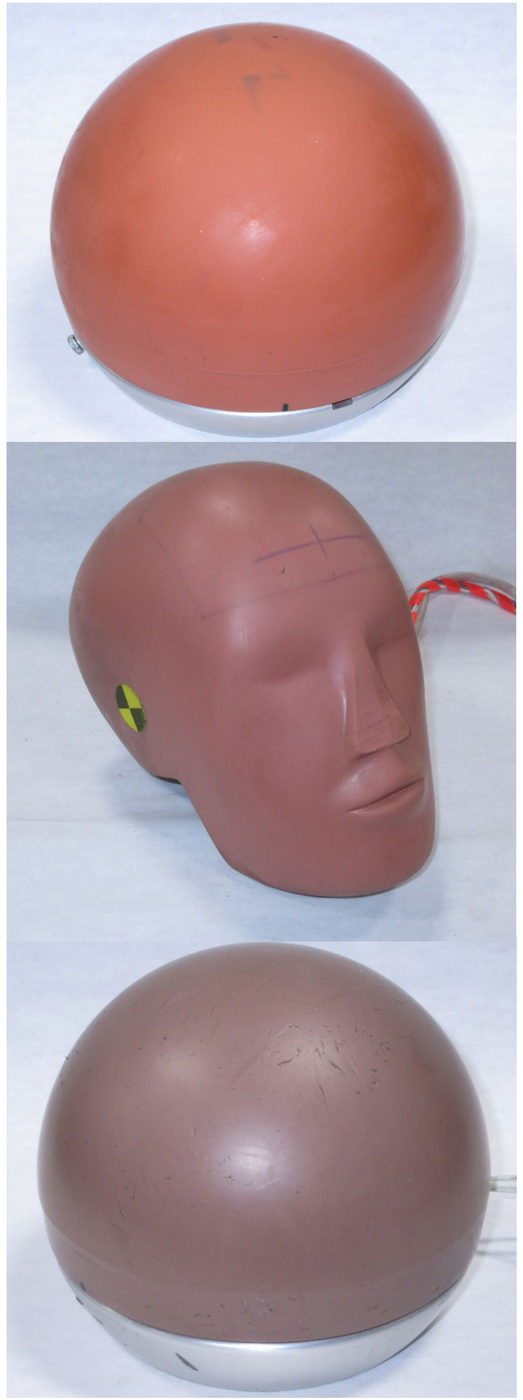
Background

- 2017 SAE Government-Industry Presentation (Louden et al.[1])
  - Total injured occupants (MAIS 3+) in the rear seat = 7,418 (1.6%)
  - Annual average rear seat fatalities: 2,569 (FARS 2000-2013)
  - 65% of all AIS 3+ injuries are to the head and chest
  - Injuries from contact to seat backs and B-pillars
  - Test procedure development
    - Objective: To develop a repeatable test method to assess the injury potential from head contact to seat backs/head restraints and lower B-pillars

[1] https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/sae2017alouden.pdf

Headforms

- Child-size pedestrian free motion headform (CPHF)
  - 3.5 kg (7.7 lbs), hemi-spherical, 165 mm diameter
- FMVSS No. 201 free motion headform (201HF)
  - 4.5 kg (10 lbs), nose-less Hybrid III head
- Adult-size pedestrian free motion headform (APHF)
  - 4.5 kg (10 lbs), hemi-spherical, 165 mm diameter



Initial Testing

Initial seat back/head restraint test series on two seat back designs

- Component Database[2] Nos. C01378-C01468
- 2014 Honda Odyssey and 2011 Jeep Grand Cherokee
- 201HF, APHF, CPHF
- 20 and 25 mph
- Exploratory approach angles

Initial lower B-pillar test series on two B-pillar designs

- Component Database[2] Nos. C01469-C01485
- 2016 Chevrolet Tahoe and 2016 Honda Fit
- 201HF and APHF
- 15 mph
- Exploratory impact locations

[2] https://www.nhtsa.gov/research-data/databases-and-software

Test Matrix

Fleet Vehicles:

1. 2016 Chevrolet Cruze
2. 2016 Mazda CX-5
3. 2017 Toyota Corolla
4. 2016 Chevrolet Malibu
5. 2016 Ford F-150
6. 2016 Nissan Rogue

Note: All vehicles tested were MDB crash tested vehicles

- Component Database[2] Nos. C01486-C01605

- 201HF and APHF

- Test lower B-pillars at BP4 (for comparison) and at rear edge windowsill plane at 15 mph

- Test seat backs at four impact locations: three impact locations on seat back and one on head restraint at 20 and 25 mph

[2] https://www.nhtsa.gov/research-data/databases-and-software

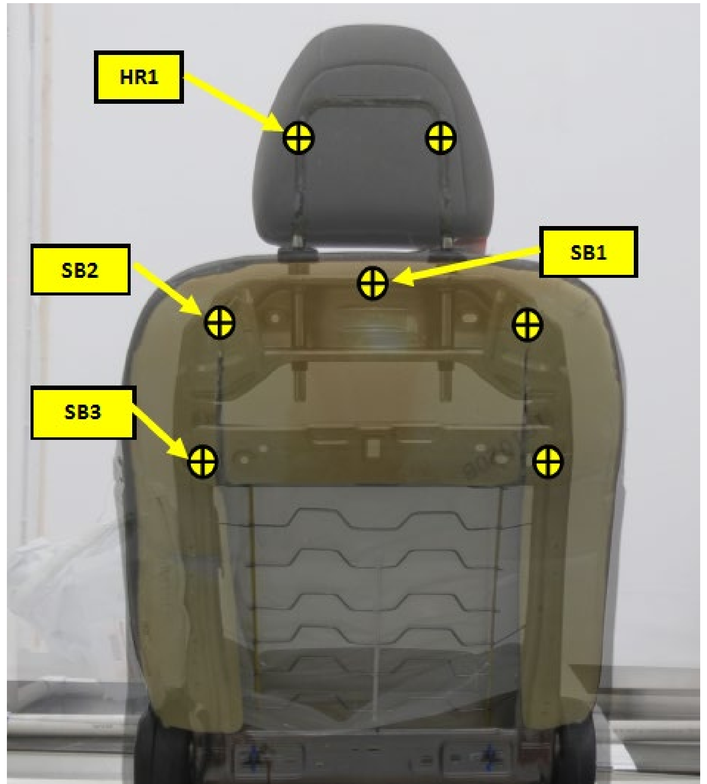
Impact Locations

B-pillar

1. BP4 from FMVSS No. 201 for comparison
2. Plane 9 – Rear Edge (P9R)

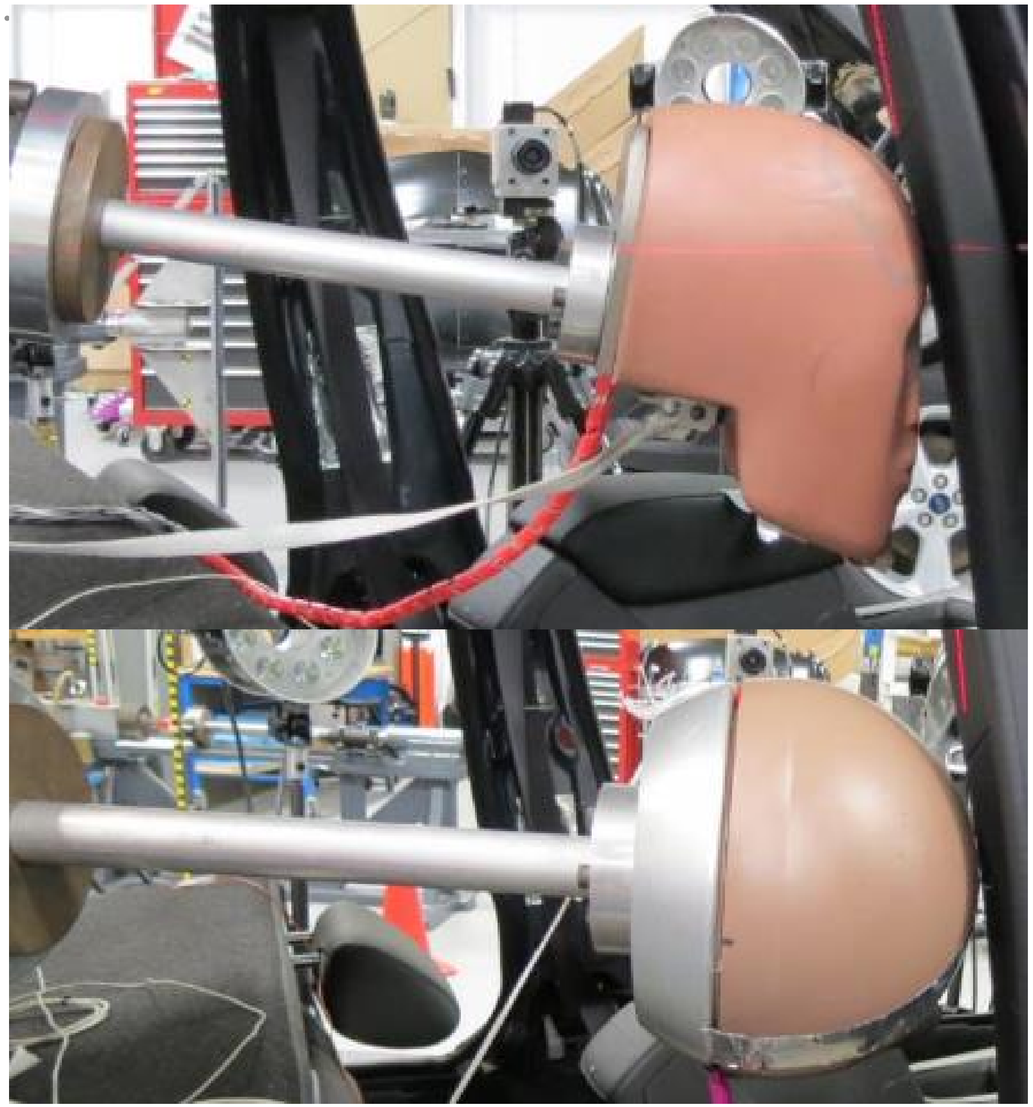
Seat Back/Head Restraint

1. SB1 – Mid-seat back
2. SB2 – Corner of seat back over weld/hard spot
3. SB3 – Lower on seat near weld/hard spot
4. HR1 – Over head restraint post, halfway up assembled head restraint



Test Procedures: Lower B-pillars

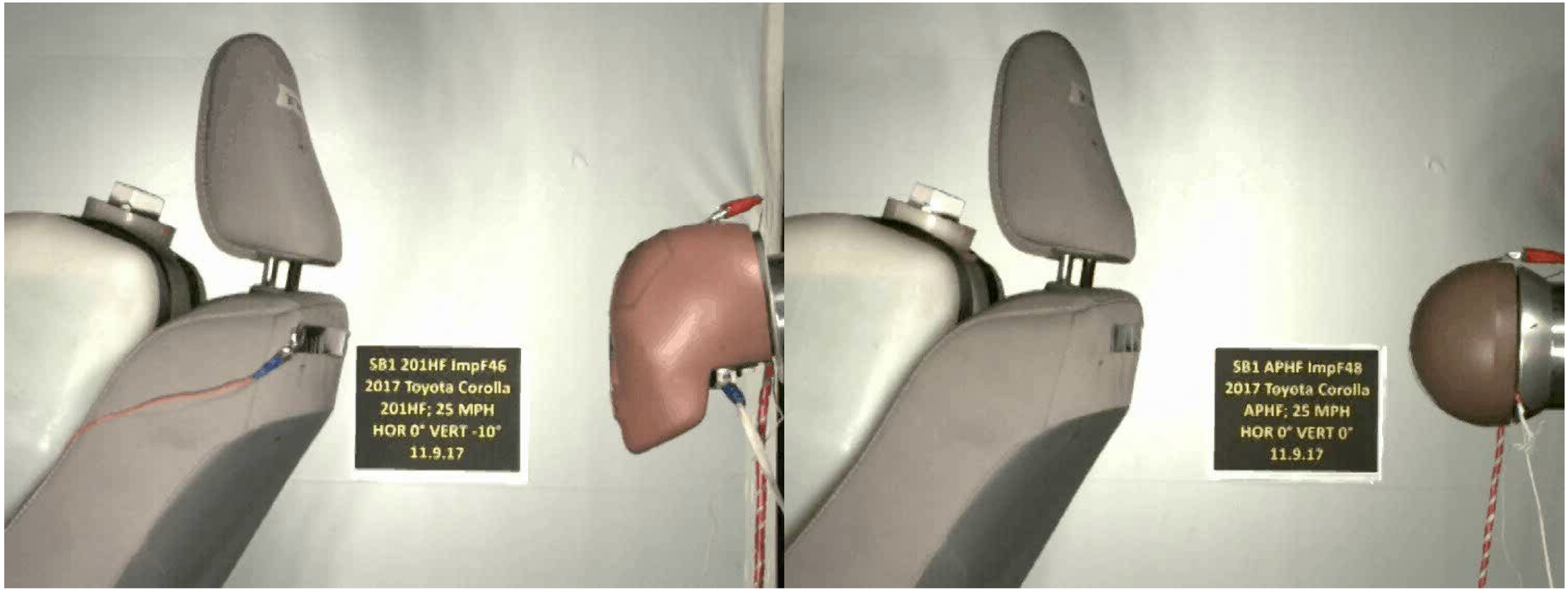
- Followed current FMVSS No. 201 test procedure for BP4
- Testing was completed within 201TP horizontal angle constraints
  - Horizontal angles determined by shortest distance between CG-R and impact locations
- Vertical angles were found by following 201HF procedure (but not constrained to limit for P9R location) or were perpendicular for APHF



Test Procedures: Seat Backs

- FMVSS No. 201 test procedure states “the launching angle should represent the most severe test condition”
- Testing was completed at various horizontal and vertical approach angles
  - As direct hit as possible to eliminate glancing blows
- SAE J826 OSCAR used to set seat angle to 25 degrees
- 175 lb water dummy to hold seat back in position

Test Video


SB1 201HF ImpF46
2017 Toyota Corolla
201HF; 25 MPH
HOR 0° VERT -10°
11.9.17
SB1 APHF ImpF48
2017 Toyota Corolla
APHF; 25 MPH
HOR 0° VERT 0°
11.9.17

Results

Calculated Head Injury Criteria, 36 millisecond limit (HIC36) to compare headform responses

Lower B-pillar impact location:

- 8 of 12 tests exceeded HIC36=1000
  - 5 of 6 vehicle models

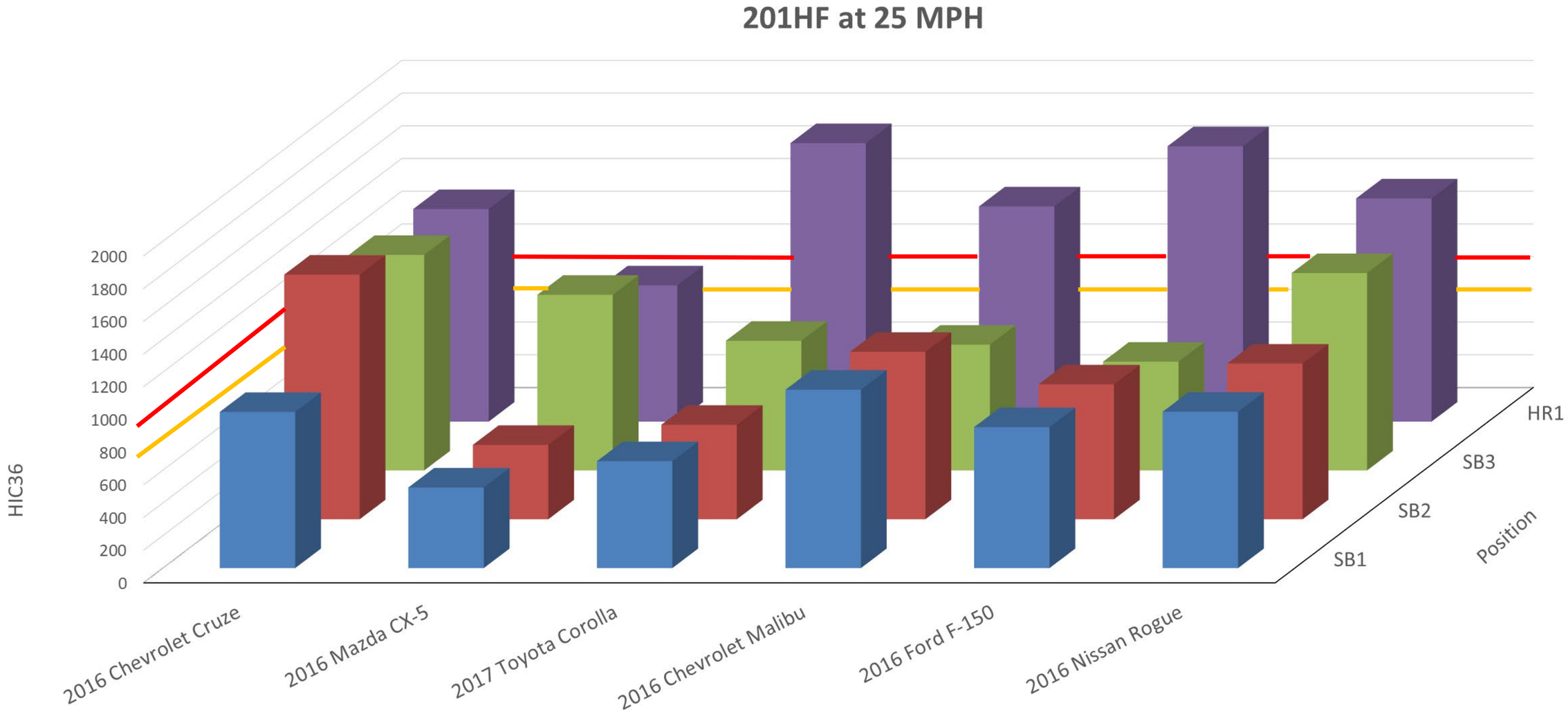
For seat back/head restraint impacts:

- At 20 mph, 0 of 48 tests exceeded HIC36=1000
  - 2 of 48 elevated HIC36 greater than 800
- At 25 mph, 21 of 48 tests exceeded HIC36=1000
  - 15 of 48 elevated HIC36 greater than 800

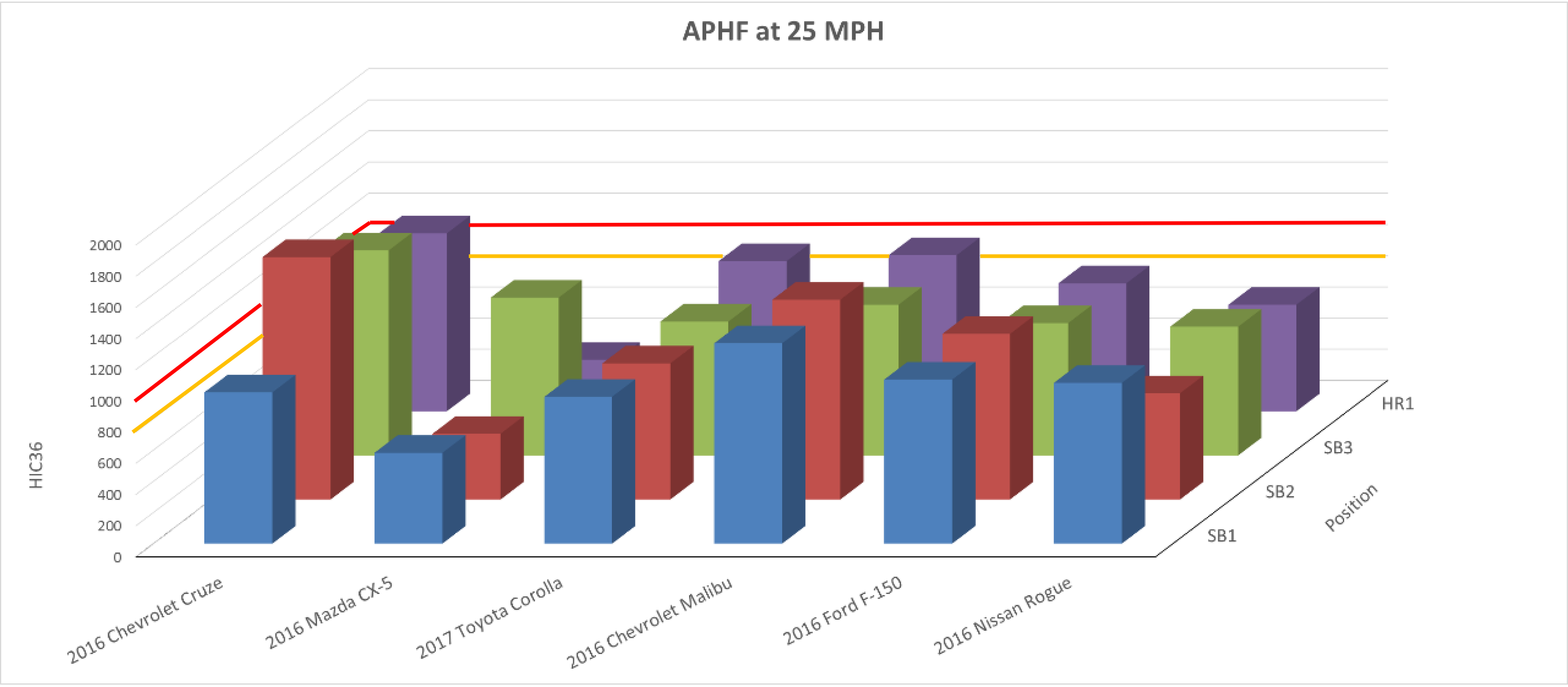
Observations

- HIC36 results nearly double when increasing speed to 25 mph for seat back/head restraint impacts
- Primarily elevated results with APHF compared to 201HF
  - Except for HR1 impact location

Results: 201HF on Seat Backs/Head Restraints

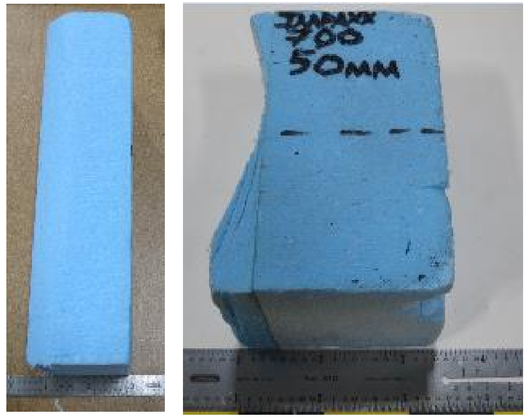


Results: APHF on Seat Backs/Head Restraints

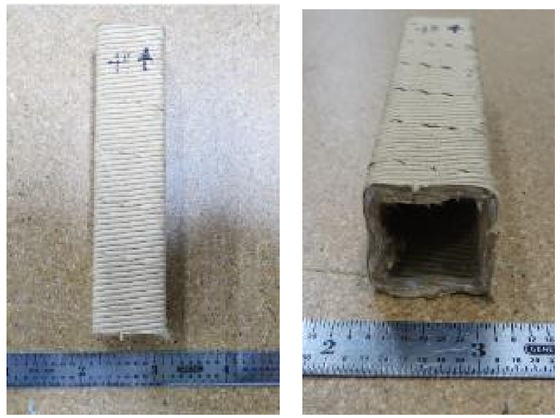


Countermeasure Test Matrix

- Objective: To find a countermeasure that lowers HIC36 to less than 800 for each impact location
- Component Database[2] Nos. C01606-C01697
- Lower B-pillar (15 mph)
  - 2016 Chevrolet Malibu, 2016 Ford F-150, and 2016 Nissan Rogue
- Seat Back/Head Restraint (25 mph)
  - 2016 Chevrolet Cruze, 2016 Ford F-150, and 2016 Nissan Rogue
- Repeated tests at angles from test matrix with added countermeasures



Coastal Automotive
IMPAXX 700
Extruded Polystyrene Friable Foam
Tested 25-75 mm thickness



O-Flex Tubing
Energy absorbing tube
Various aluminum foil thickness and compositions
Tested 23-56 mm thickness

Jeep Grand Cherokee Seat Back Foam Bezel
Expanded Polypropylene (EPP) Foam
Tested 35-38 mm thickness

[2] https://www.nhtsa.gov/research-data/databases-and-software

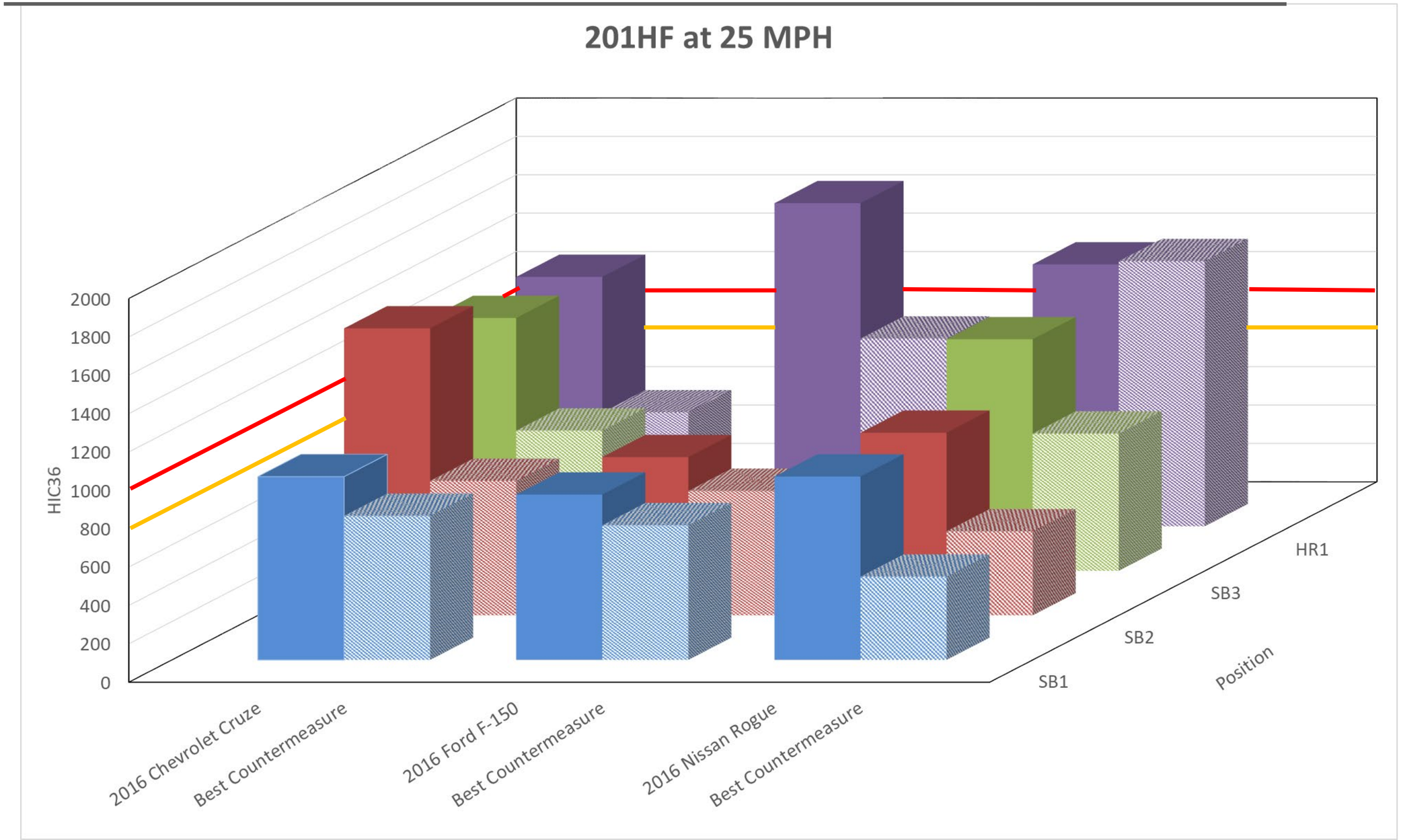
Countermeasure Results

- Found at least one countermeasure that resulted in HIC36<800 for 3 of 3 vehicles at lower B-pillar with 201HF and APHF
- Found at least one countermeasure that resulted in HIC36<800 for 9 of 11 impact locations/vehicles on seat backs/head restraints with 201HF
- Found at least one countermeasure that resulted in HIC36<800 for 6 of 9 impact locations/vehicles on seat backs/head restraints with APHF

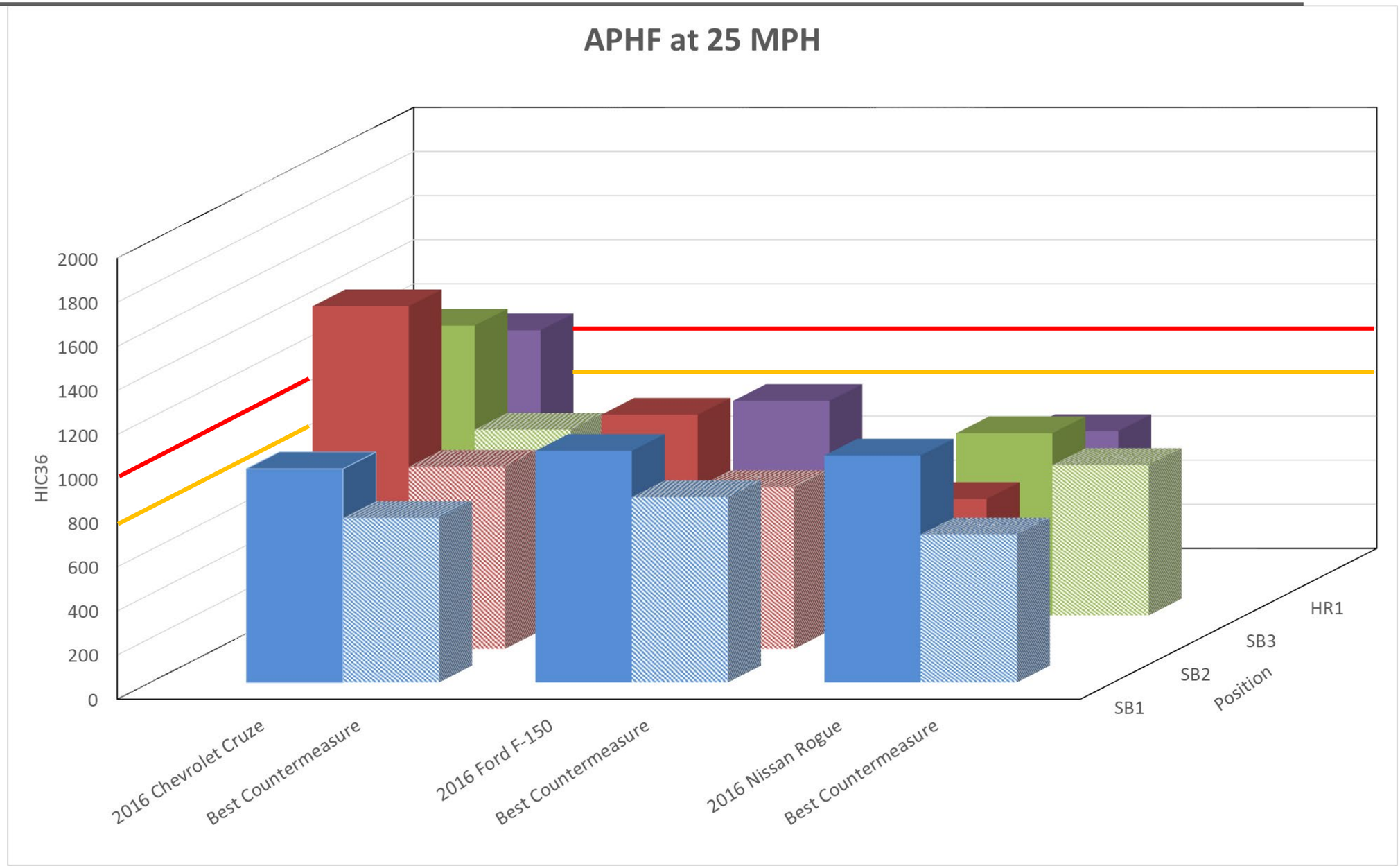
Observations

- APHF typically required more countermeasure solutions to achieve HIC36<800
- Head restraint was the most challenging position to reduce head injury with countermeasures
- Difficult to reduce head injury with 201HF at head restraint impact location

Countermeasure Results: 201HF on Seat Backs/Head Restraints

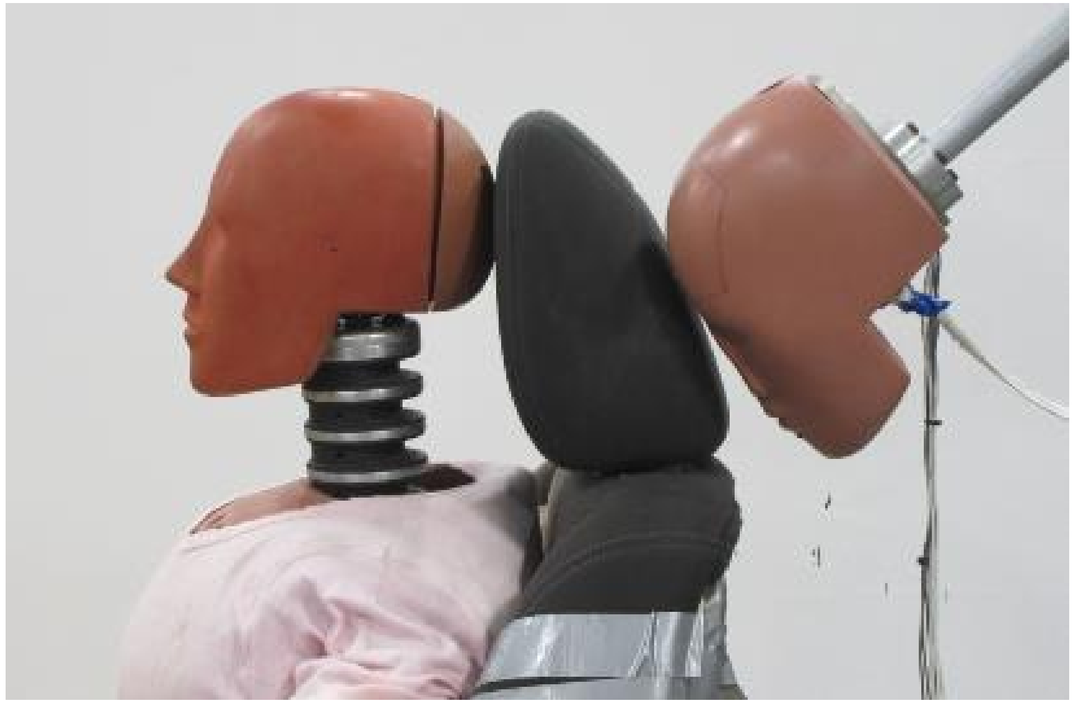


Countermeasure Results: APHF on Seat Backs/Head Restraints



Ongoing Research

- Different set-ups
- Additional vehicle platforms
- Additional countermeasures



Thank you for your attention.

Any questions?

Contact information:
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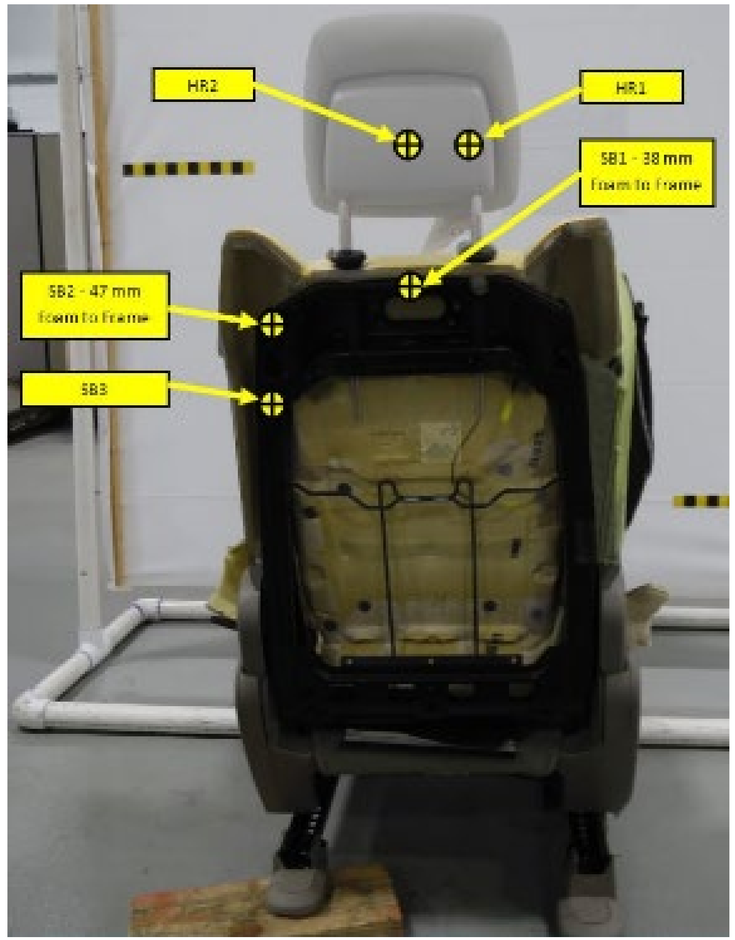
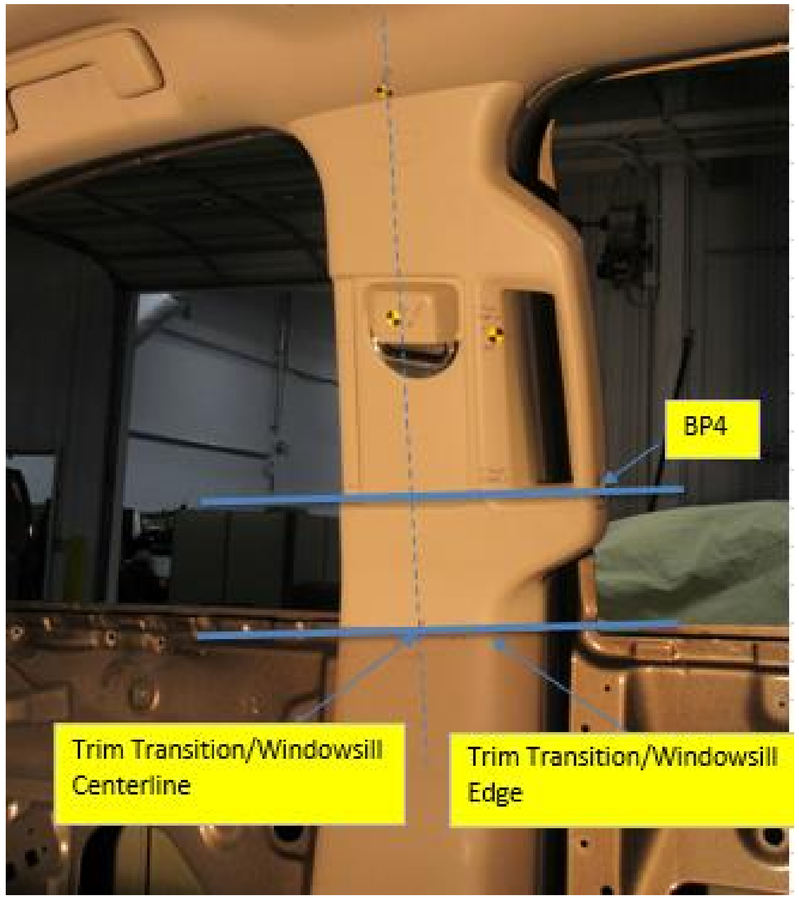
Initial Seat Back Testing

2014 Honda Odyssey



2011 Jeep Grand Cherokee

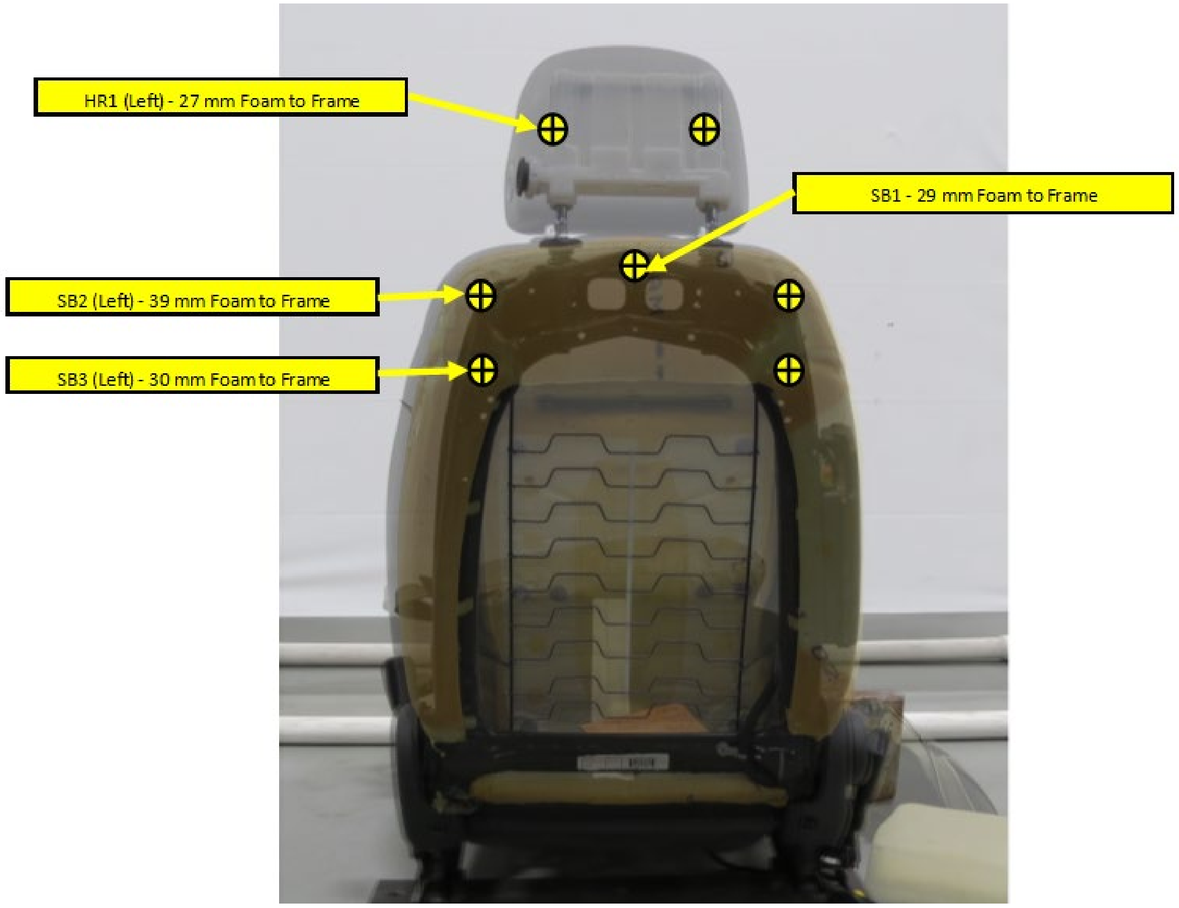
Initial Lower B-pillar Testing



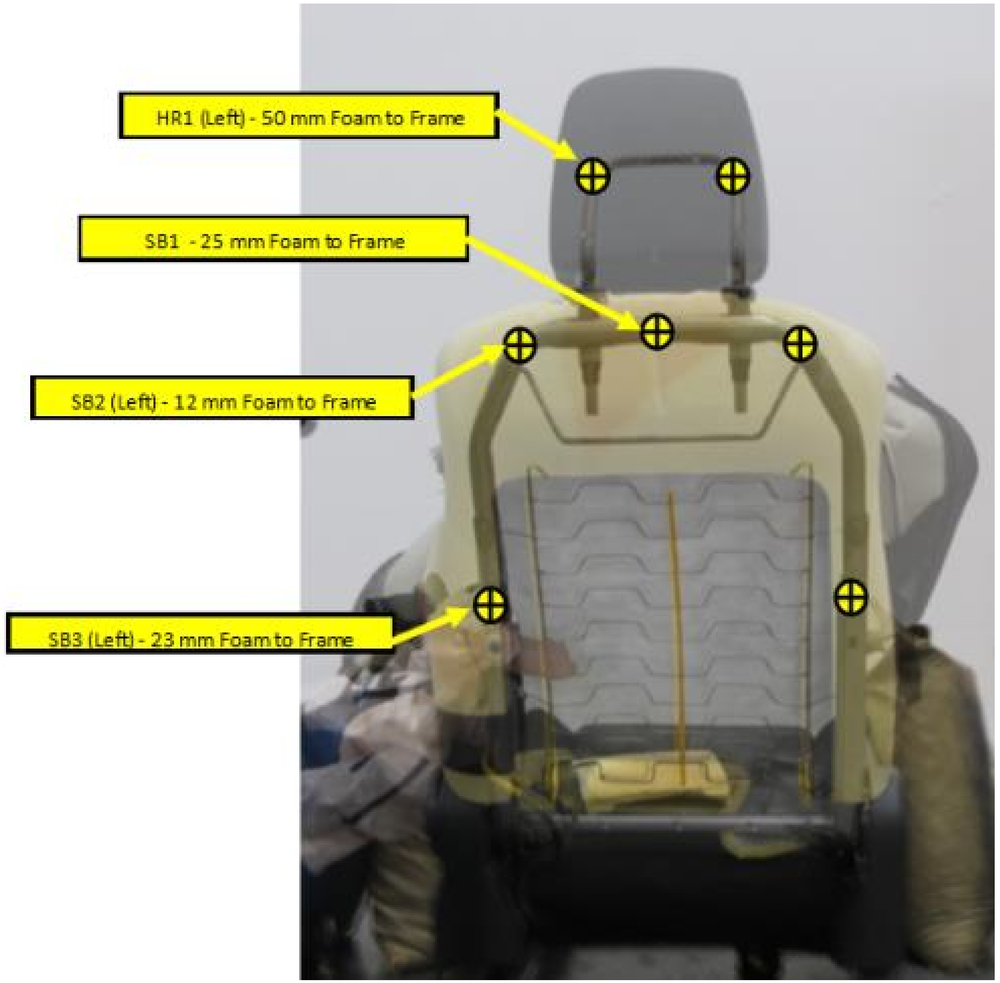
2016 Chevrolet Tahoe

2016 Honda Fit

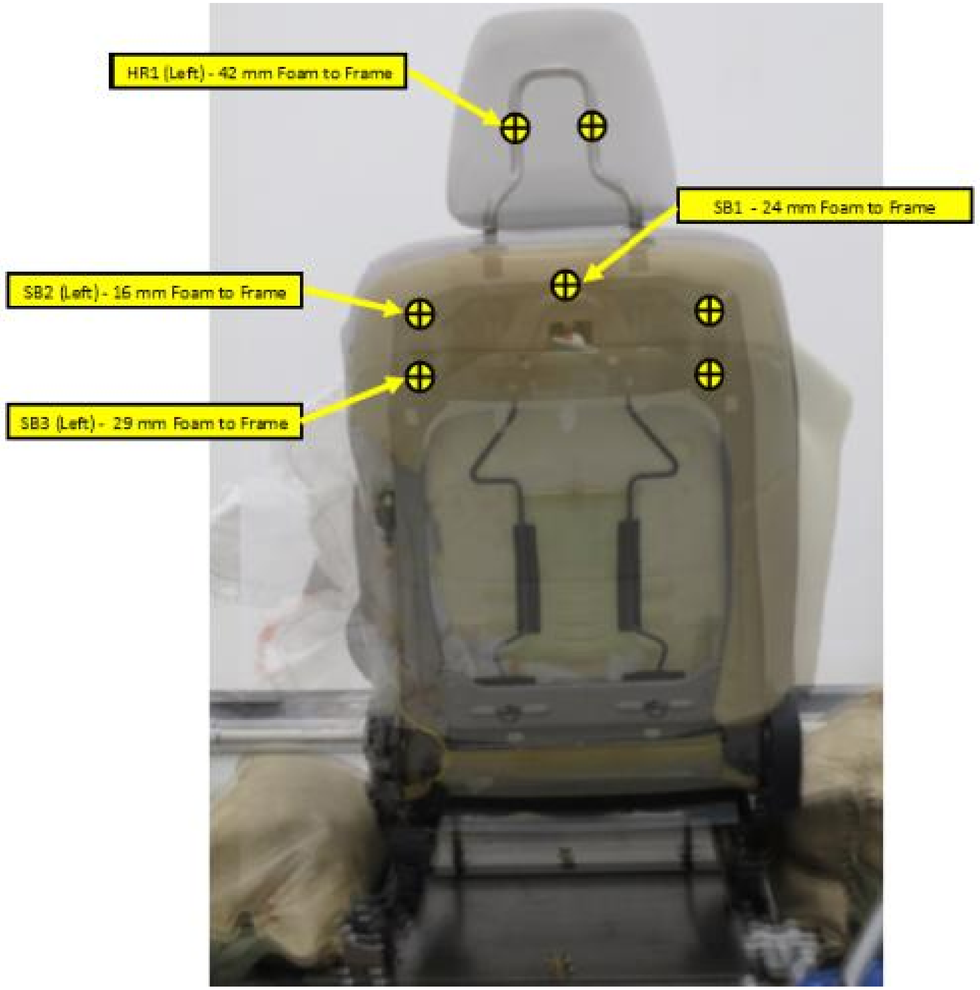
2016 Chevrolet Cruze



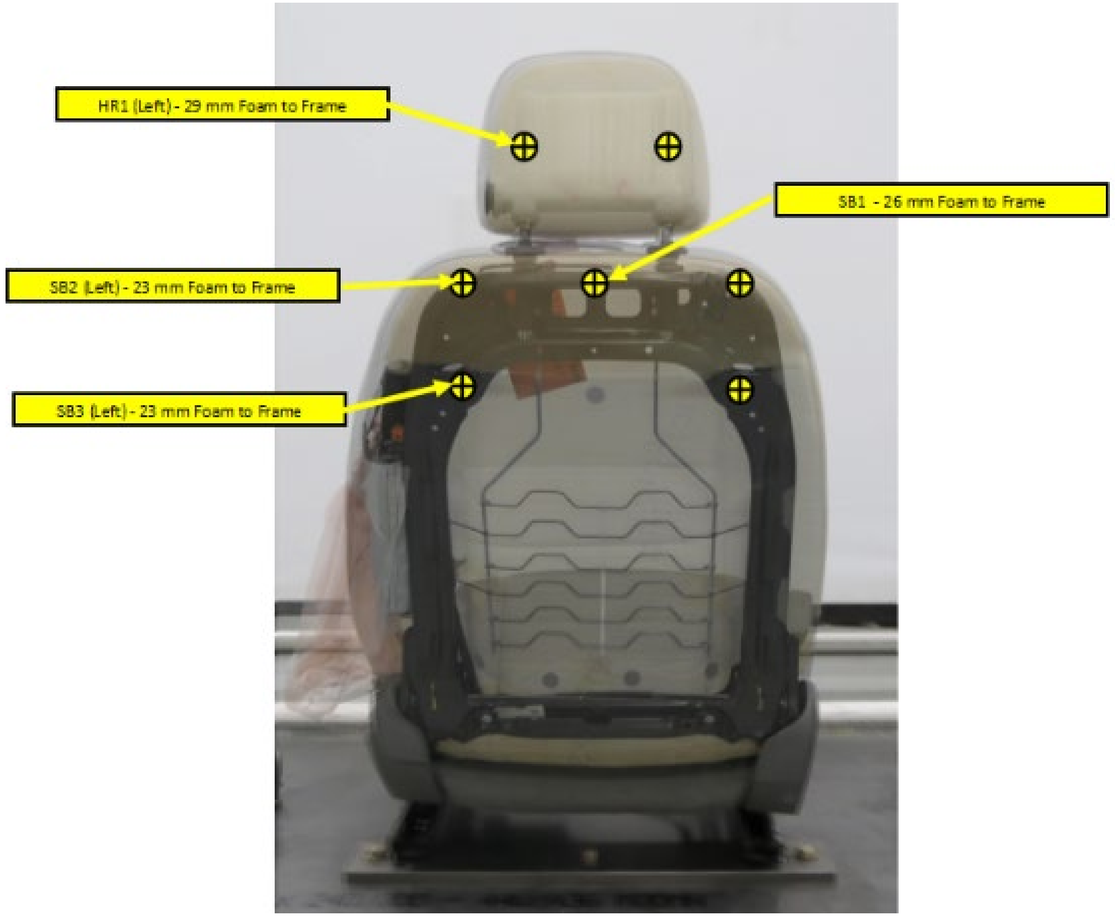
2016 Mazda CX-5



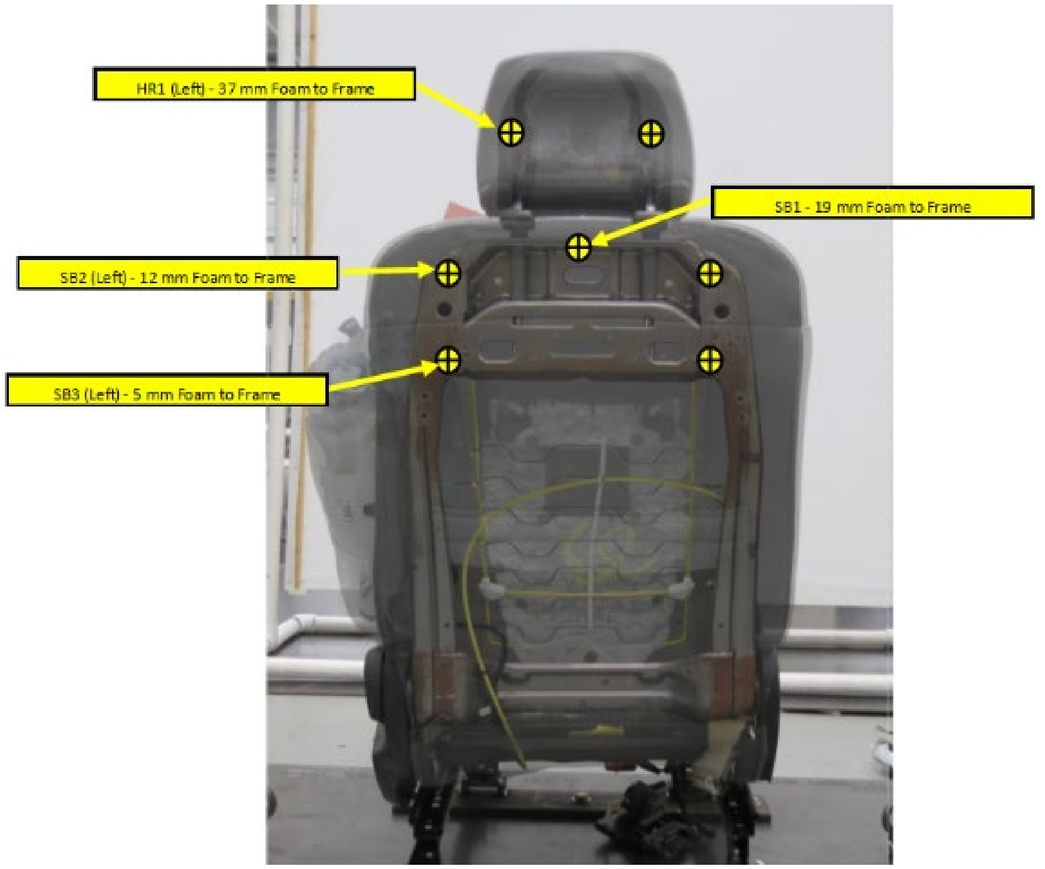
2017 Toyota Corolla



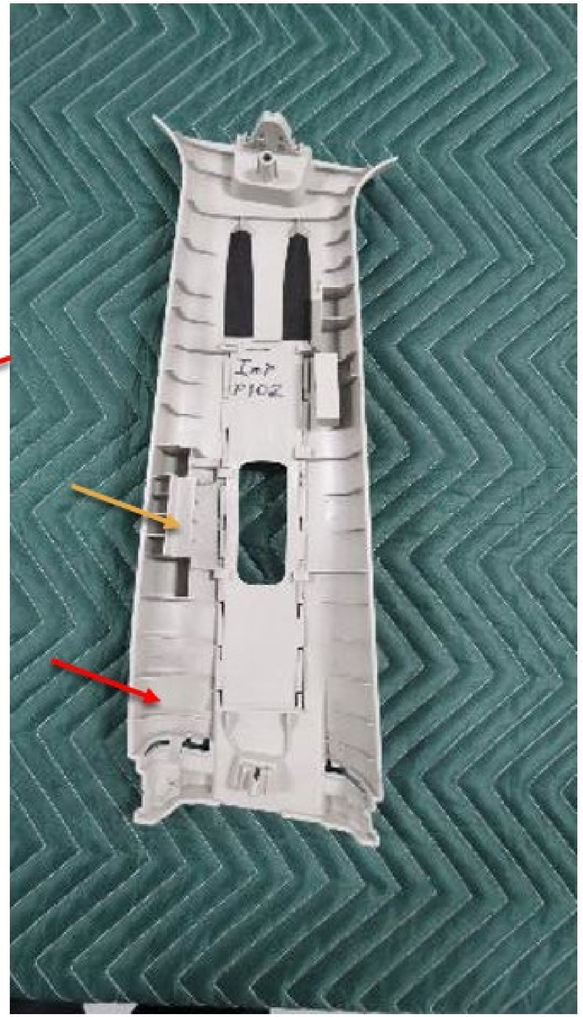
2016 Chevrolet Malibu

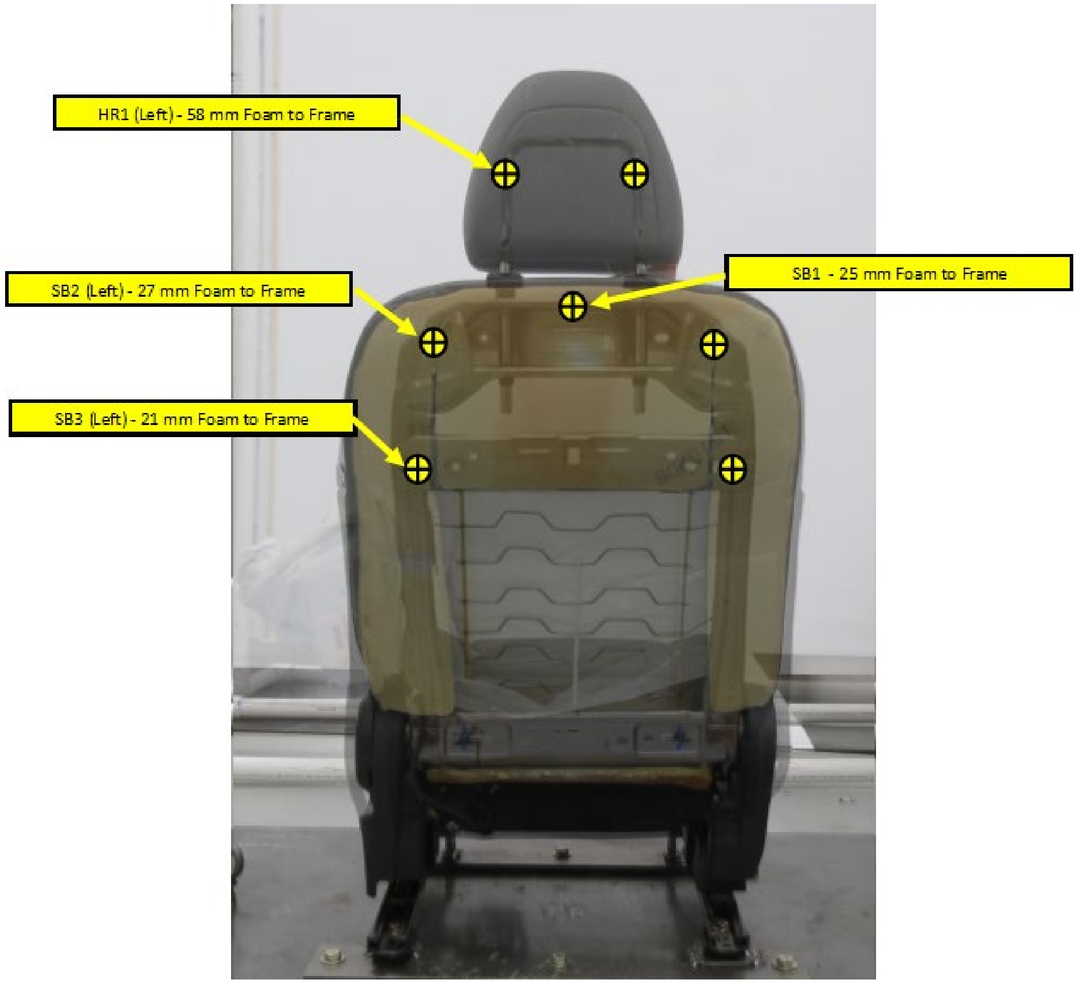


2016 Ford F-150



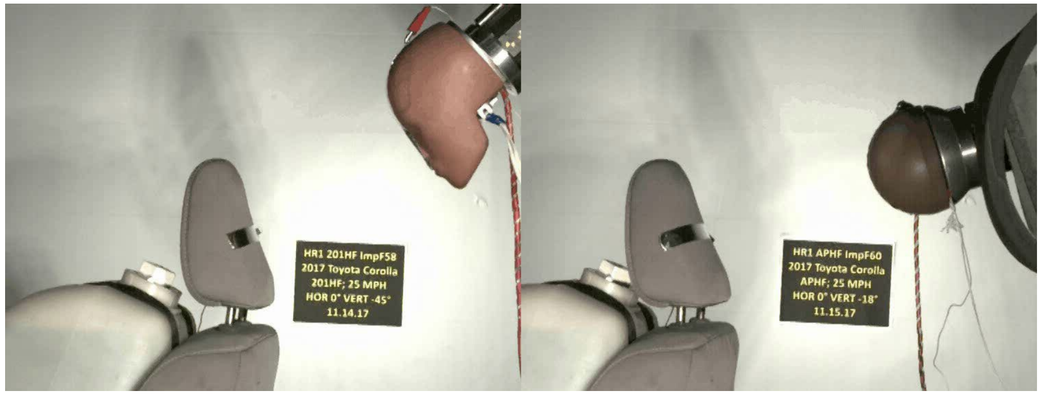
2016 Nissan Rogue






SB2 201HF ImpF110
2016 Nissan Rogue
201HF; 25 MPH
HOR 0° VERT -13°
12.18.17
SB2 APHF ImpF112
2016 Nissan Rogue
APHF; 25 MPH
HOR 0° VERT 0°
12.18.17
T+: +10.134 ms
File: ImpF110.mp4 Img#: 10 Img#FromFirst: 20 Cam: Phantom v.8021 AcqRes: 1920 x 1200 Rate: 1000 Exp: 200 µs
T+: +10.431 ms
File: ImpF112.mp4 Img#: 10 Img#FromFirst: 20 Cam: Phantom v.8021 AcqRes: 1920 x 1200 Rate: 1000 Exp: 200 µs


SB3 201HF ImpF114
2016 Nissan Rogue
201HF; 25 MPH
HOR 174° CW
VERT 6°
12.19.17
SB3 APHF ImpF116
2016 Nissan Rogue
APHF; 25 MPH
HOR 174° CW
VERT 15°
12.19.17
T+: +10.988 ms
File: ImpF114.mp4 Img#: 10 Img#FromFirst: 20 Cam: Phantom v.8021 AcqRes: 1920 x 1200 Rate: 1000 Exp: 200 µs
T+: +10.375 ms
File: ImpF116.mp4 Img#: 10 Img#FromFirst: 20 Cam: Phantom v.8021 AcqRes: 1920 x 1200 Rate: 1000 Exp: 200 µs


HR1 201HF ImpF58
2017 Toyota Corolla
201HF; 25 MPH
HOR 0° VERT -45°
11.14.17
HR1 APHF ImpF60
2017 Toyota Corolla
APHF; 25 MPH
HOR 0° VERT -18°
11.15.17


P9R 201HF ImpF83
2016 Ford F150
201HF; 15 MPH
HOR 157° CW
VERT -10°
11.20.17
P9R APHF ImpF84
2016 Ford F150
APHF; 15 MPH
HOR 157° CW
VERT 0°
11.21.17