DTNH2215D00006- Task Order: DTNH2217F00118 Front Seat Modeling in Rear Impact Crashes

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Presentation Content

1. Project Objectives
2. Quasi-Static Tests, FEA Seat Modeling
3. Dynamic Rear Impact Sled Tests, FEA Modeling
4. Seat Back Strength Study
5. Countermeasures and Results
6. Cost Estimation
7. Project Summary, Conclusion

Objectives

Specifically, the objectives of this Task Order are to:

- Identify and select an appropriate vehicle seat design for teardown, testing, and model development. To select a seat representative of a typical front seat in current high volume US vehicles. To procure the necessary seat(s) for measurement, teardown and testing. To include any costs associated with obtaining the use of an LS-Dyna finite element model(s) of the BioRID ATD in the validation plans.

- To propose a test plan for static and dynamic testing of the selected seat(s) and its constituent materials. To include static testing in the test-plan similar to FMVSS No. 207, but extended to include both static and plastic deformation and include the seats unloading response, if any. To include dynamic testing in the test-plan sufficient to evaluate the seats resistance to occupant ramping and permanent deformation. To identify the specific test conditions and performance measure to be used for the dynamic testing of an actual seat, using a BioRID ATD[3] (to be provided by the NHTSA COR (TO) upon request). To utilize this seat model to evaluate the seat deformation before contact with a rear seat occupant.

- To develop a baseline seat model using LS-Dyna finite element code by obtaining and positioning a BioRID ATD model in the resulting seat. To validate the model against the static and dynamic testing previously conducted. To use an objective rating method, such as CORrelation and Analysis (CORA[4]), to compare the simulation and test results.

- To design seat changes to reduce the seat back rotation/deformation in the high speed test condition(s). To simulate the modified seat performance in the test condition(s) and compare the performance of the baseline and modified seats.

- To develop cost and weight estimates for the seat design changes.

Objectives

Objectives:

- Identify suitable vehicle and seats
- Identify and propose necessary static and dynamic seat tests
- Develop and validate front seat CAE models for seat strength study
- Design seat back strength improvements for reducing seat back dynamic rotation

Deliverables (TBD):

- Front seat CAE models
- Seat tests results
- Seat strength study CAE results
- Project report

Technical Approach

Choice of vehicle Mid Size sedan – MY 2014 Honda Accord. The front seats on this vehicle are equipped with dual recliner mechanisms

For this task two quasi static seat back strength tests and two dynamic sled tests with BioRID-2 V3.6 Dummy are proposed .

- Front seat manual adjuster – Quasi Static Rearward pull
- Front seat power adjuster – Quasi Static Rearward pull
- Front seat manual adjuster – Dynamic sled test with BioRID
- Front seat power adjuster Leather Trim – Dynamic sled test with BioRID

EDAG will establish a suitable pulse based on CAE runs

From the tests, in addition to failure mode identification, force versus seat back displacement will be measured. The dynamic sled test will provide BioRID injury and full motion analysis of the entire event. These results are used to validate the CAE models.

Seats Choice

Seats:

1. Fully trimmed manual
2. Fully trimmed power (leather)
3. Frame manual
4. Frame power

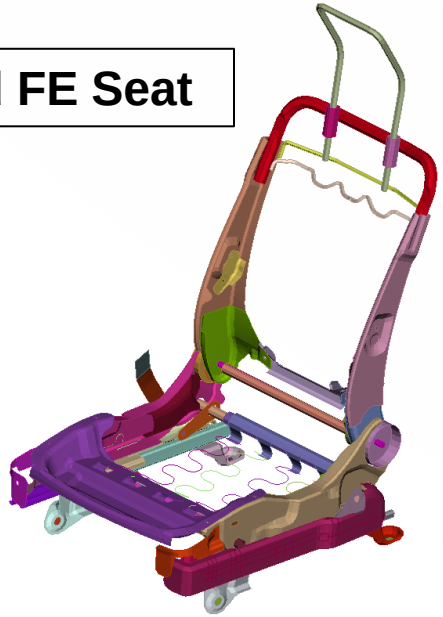





Seat base structural part geometry differences observed between the manual and power design

Seats Scanning

Old FE Seat



Power Seat (23.41 kg)

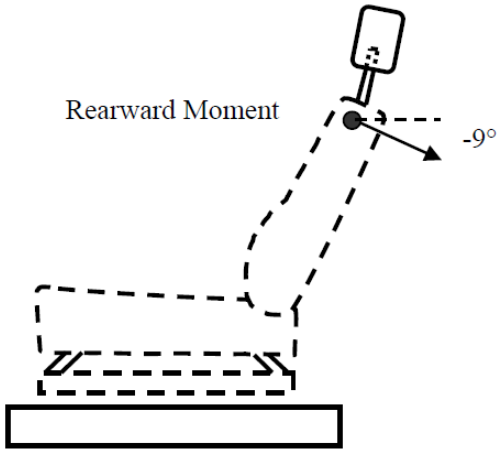
Manual Seat (18.81 kg)

Tests: Quasi-Static, Seat back pull test

Quasi-static Seat back pull test

& FEA Seat modeling

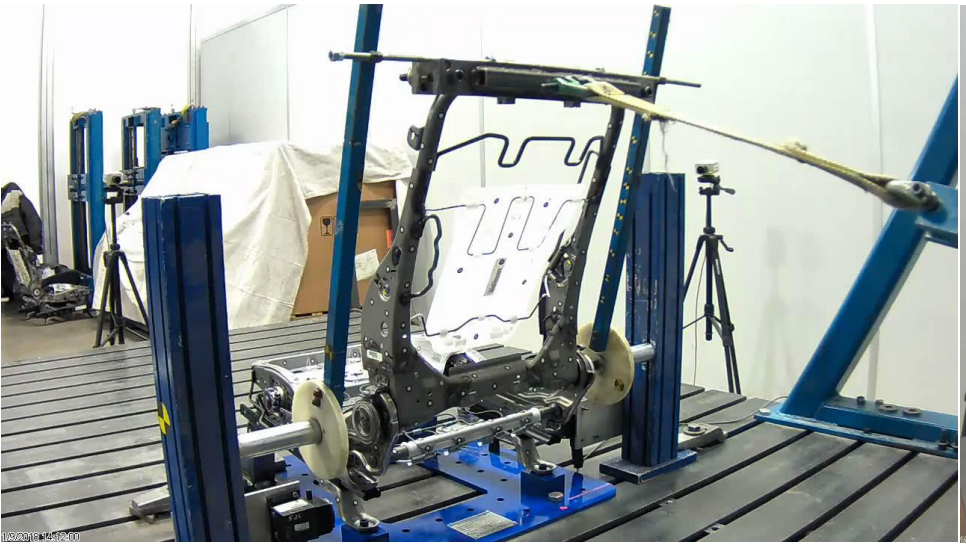
Quasi Static Seat Back Strength Test
Structure only without foam and plastic trim



Test No.	Sample Desc.	Max. Load (N)	Max. Moment (Nm)	Max. Cyl. Disp't. (mm)	Max. Angle (deg)		Post-Test Comments
					LH	RH	
M18000	1st Row 6 Way Manual Driver Seat	7,152	3,047	239.0	50.1	53.5	•Met the customer requirements. •The seatback collapsed/bent.
M18001	1st Row 8 Way Power Driver Seat	6,246	2,704	196.5	37.1	20.0	•Met the customer requirements. •The seatback collapsed/bent.

Quasi Static Seat Back Strength Test
Manual Seat

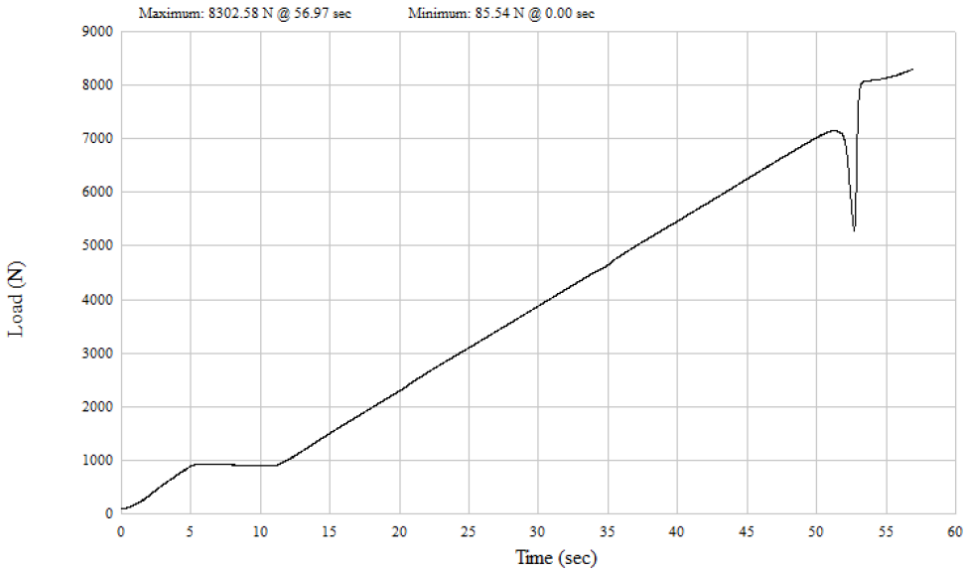
Test videos

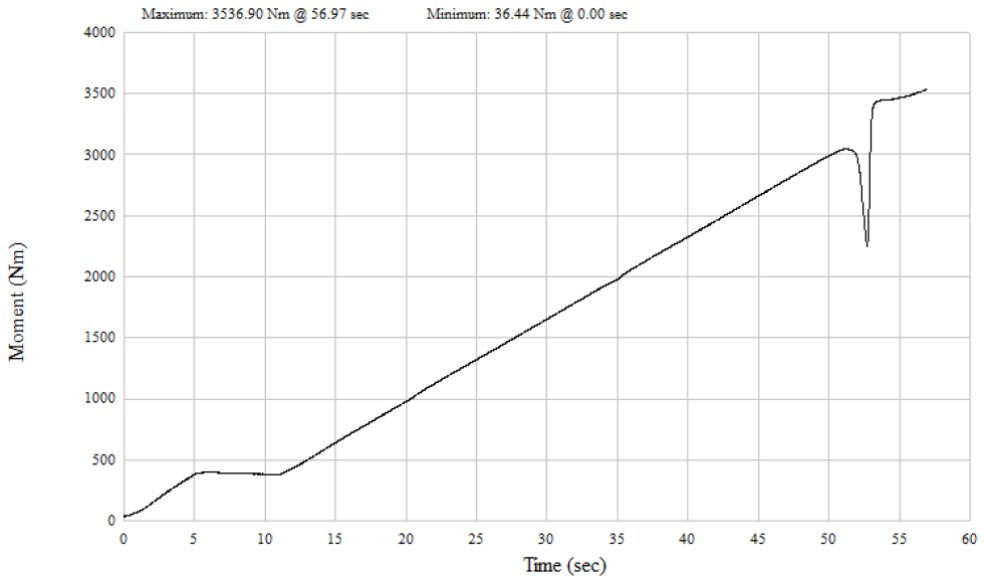


Seat Type: 1st Row 6 Way Manual Driver Seat	
Seat Function	**Test Position**
Track Position	Full Rearward
Vertical Position	Full Down
Seat Back Angle (Ref: See drawing)	18°
H-point (Ref: Rear lower cross tube)	159 mm Above
Moment Arm (Ref: H-Point)	426 mm Above
Load Angle	-9°
Temperature	72°F
Humidity	22%

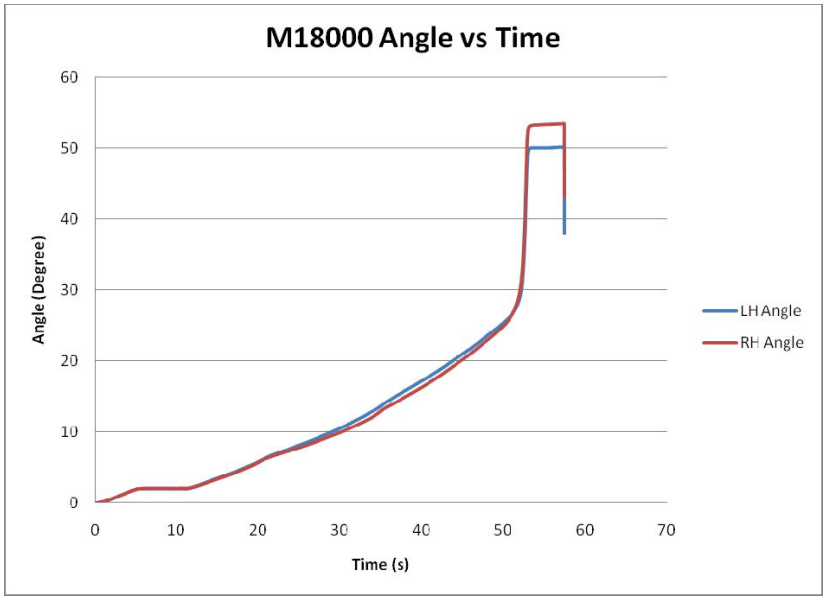
Load Profile	
Time (second)	**Load (N)**
0	88
5	875
11	875
132	20,000

Quasi Static Seat Back Strength Test
Manual Seat





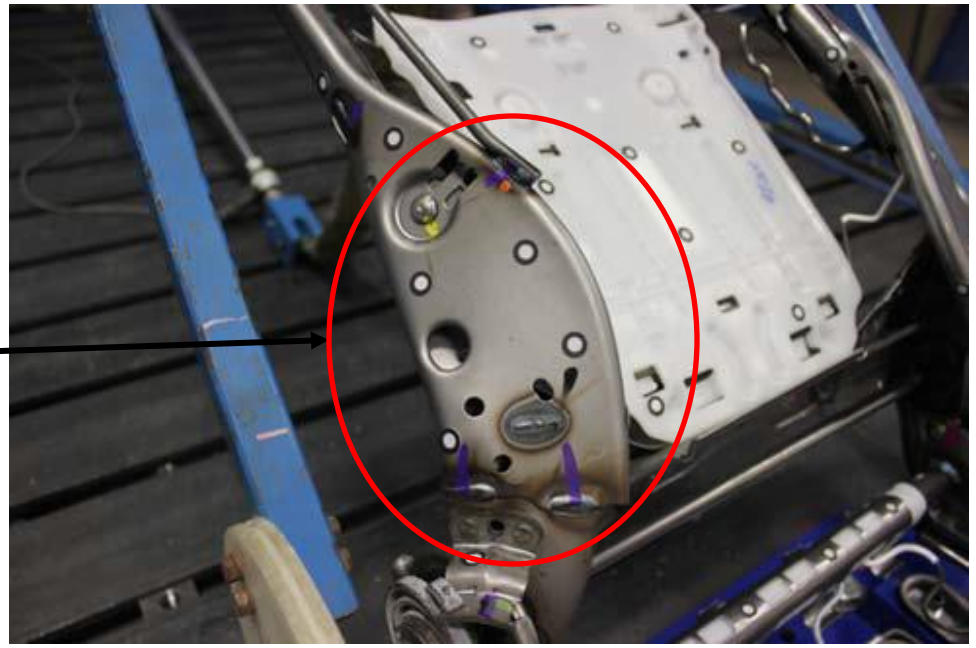
Seat collapsed @ 50.1°/
53.5° seat back angle



Quasi Static Seat Back Strength Test
Manual Seat

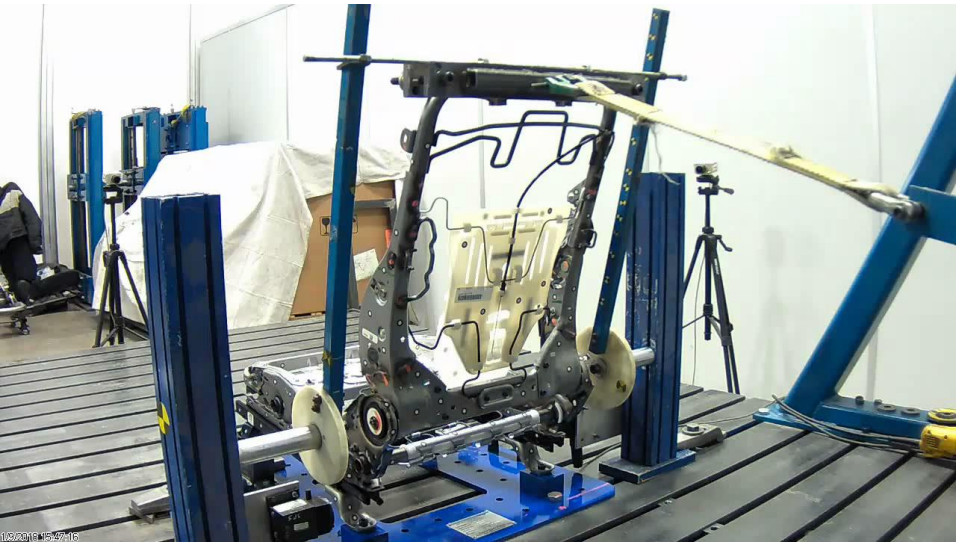
Seat collapsed @ 50.1°/
53.5° seat back angle

Failed symmetrically at
LHS and RHS frames



Quasi Static Seat Back Strength Test
Power Seat

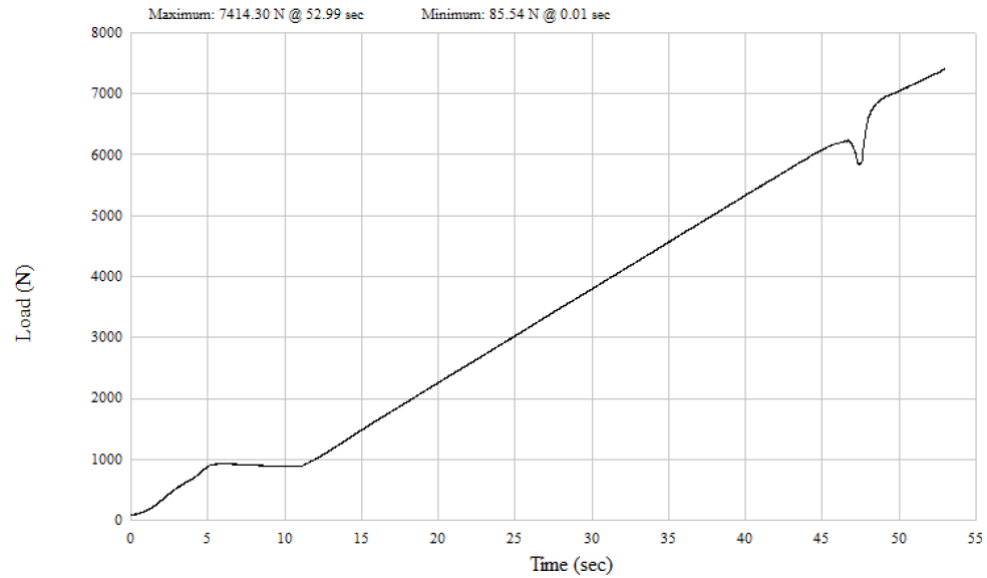
Test videos

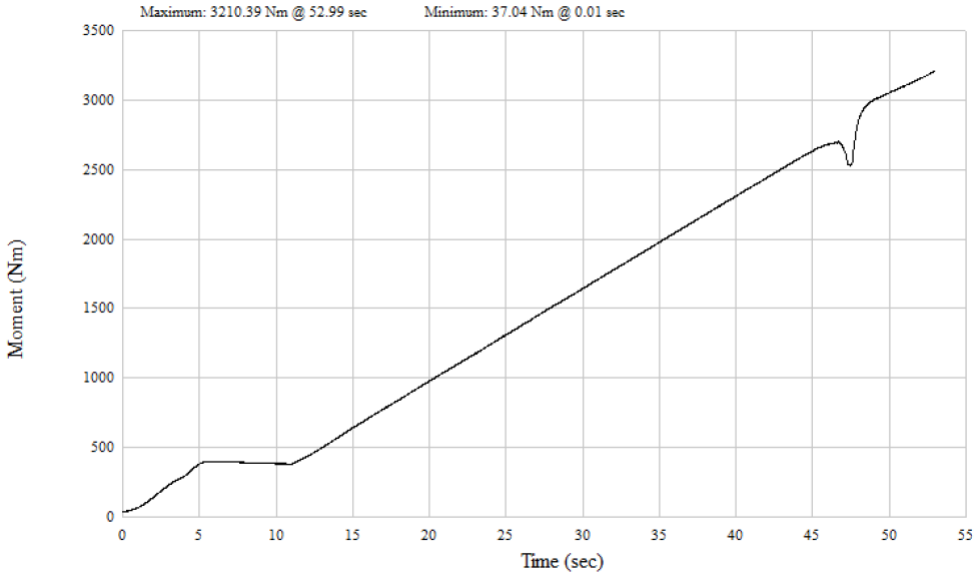


Seat Type: 1st Row 8 Way Power Driver Seat	
Seat Function	**Test Position**
Track Position	Full Rearward
Vertical Position	Full Down
Seat Back Angle (Ref: See drawing)	18°
H-point (Ref: Rear lower cross tube)	159 mm Above
Moment Arm (Ref: H-Point)	433 mm Above
Load Angle	-9°
Temperature	73°F
Humidity	22%

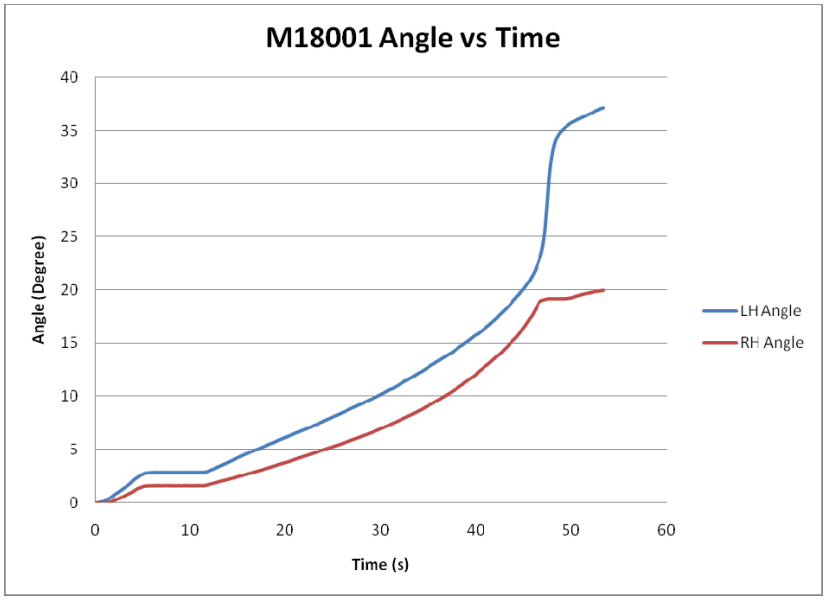
Load Profile	
Time (second)	**Load (N)**
0	86
5	861
11	861
132	20,000

Quasi Static Seat Back Strength Test
Power Seat

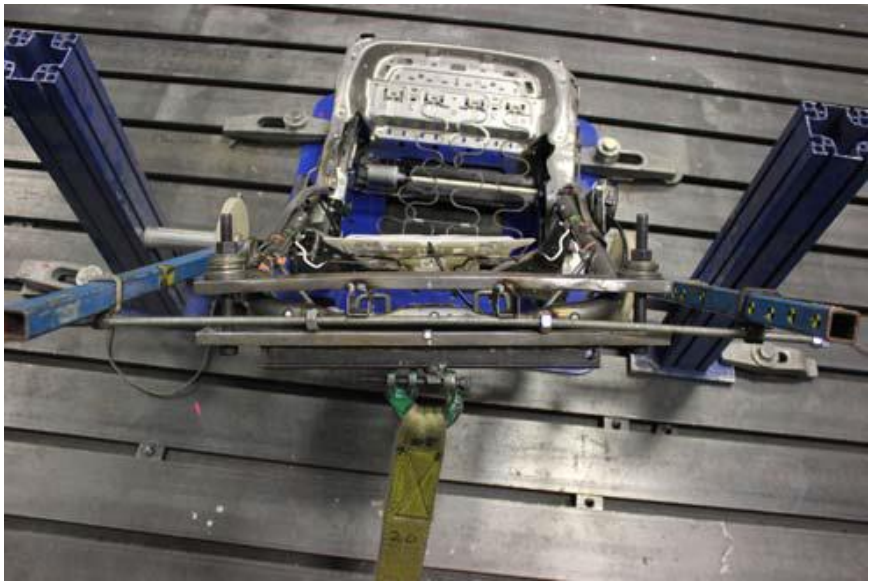




Seat collapsed @ 37.1° / 20° seat back angle

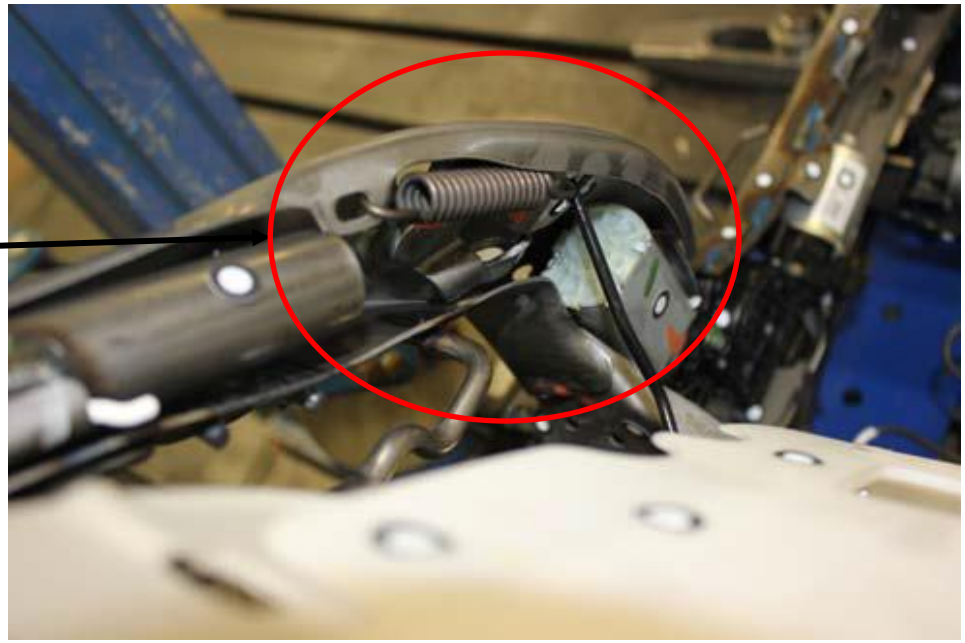


Quasi Static Seat Back Strength Test
Power Seat

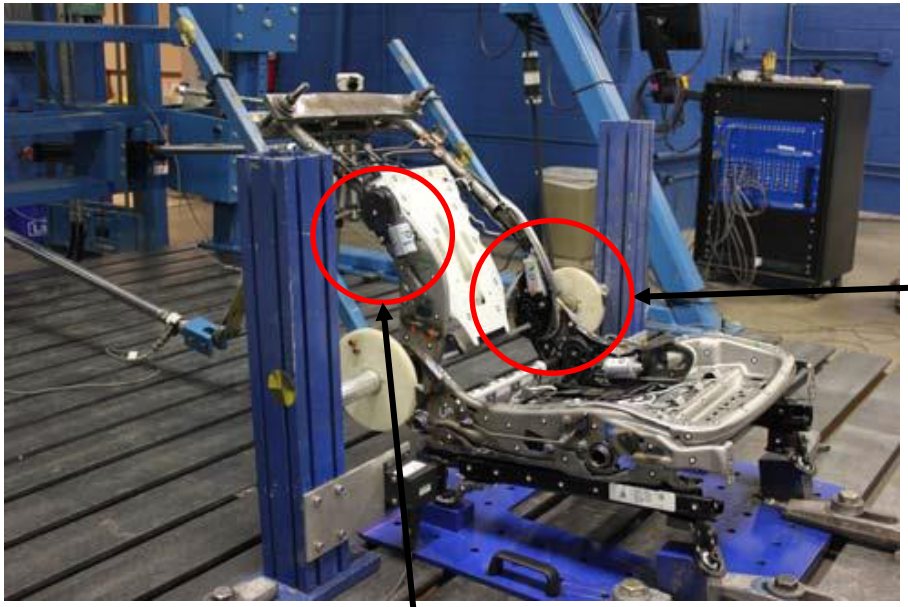


Seat collapsed @ 37.1° /
20° seat back angle

Failed LH frame after 37.1°,
stuck on the motor

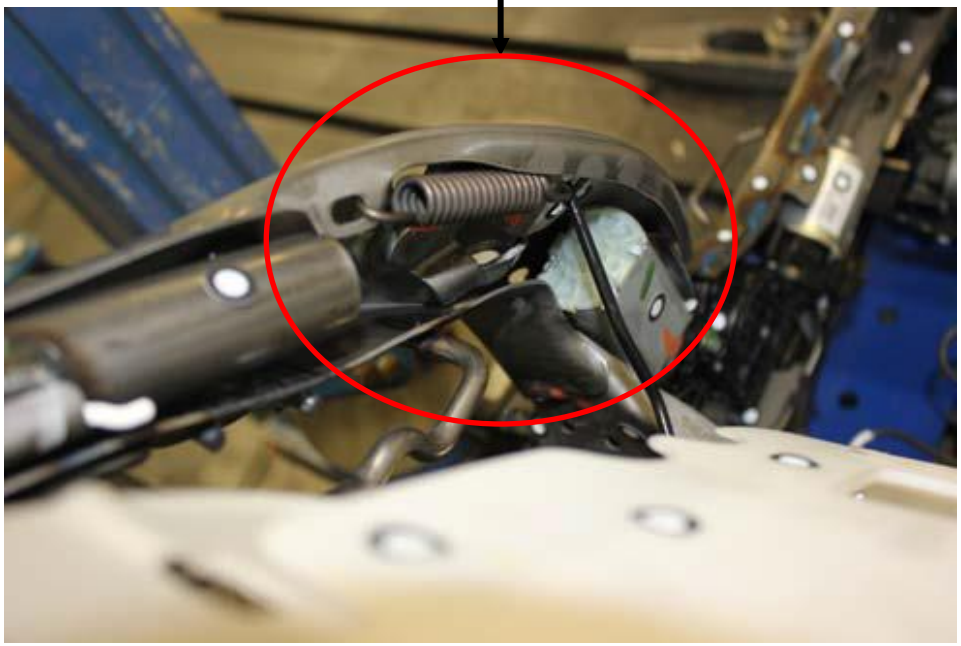


Quasi Static Seat Back Strength Test
Power Seat



Failed LH frame after 37.1°, stuck on the motor

Failed RH frame after 20°, just above motor

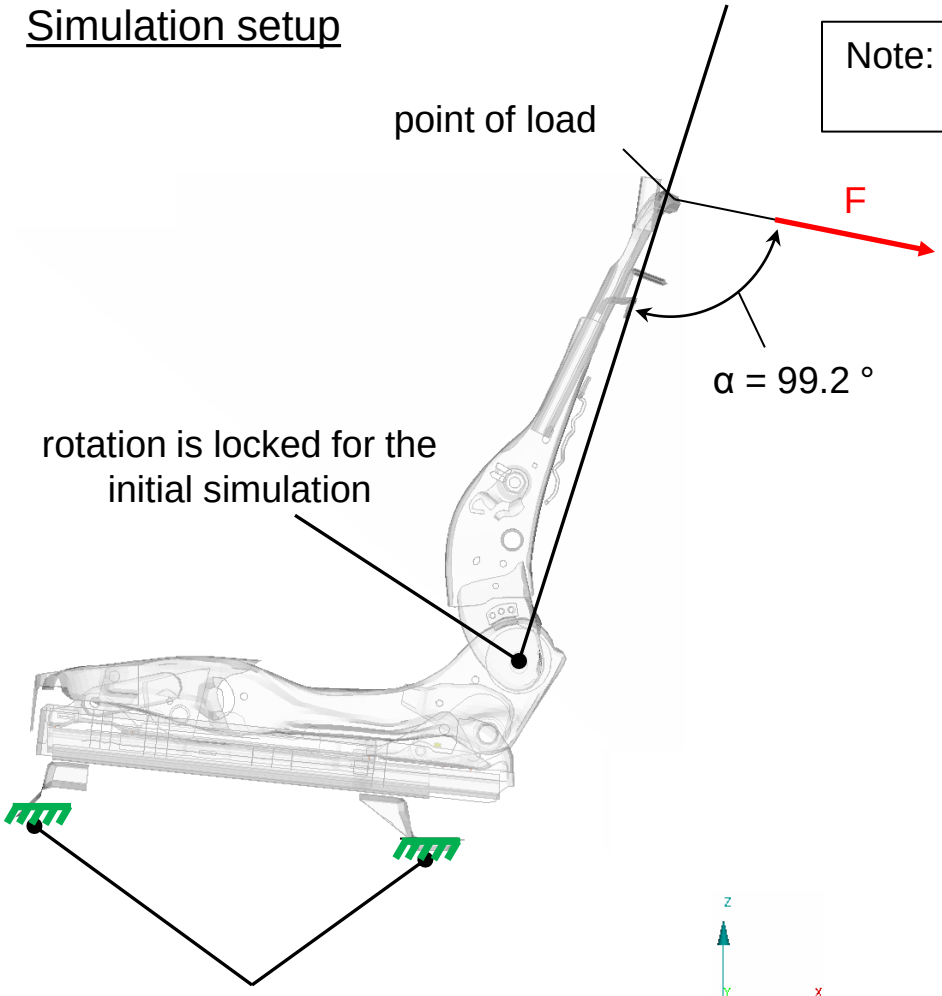


[Detailed Test Report]

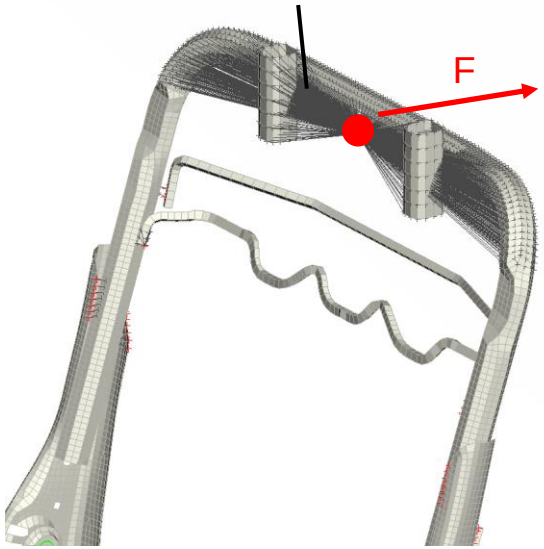
Simulation set up for FEA model

Simulation setup

Note: F is applied as a load curve (see. next slide)



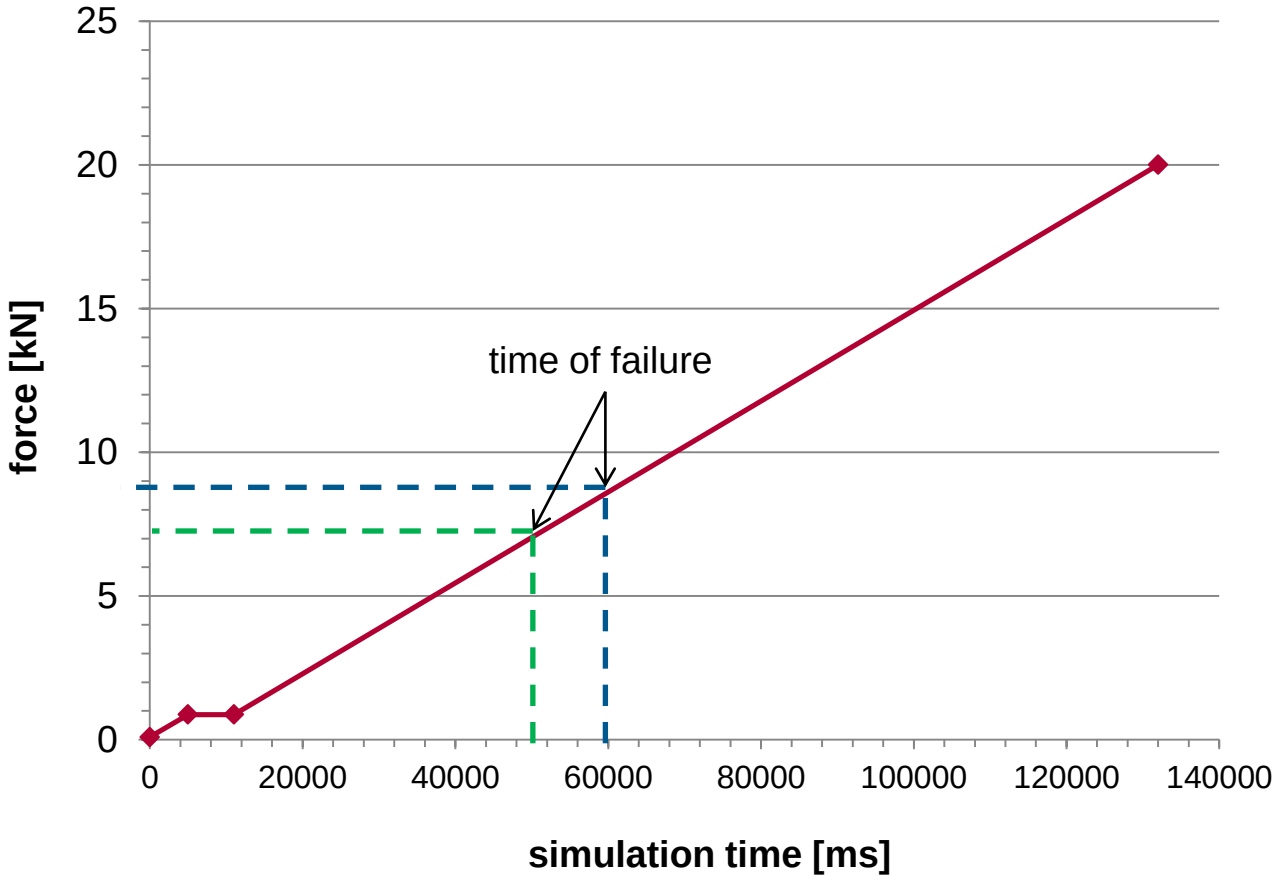
Mounting plate is modeled as *constrained nodal rigid body*



The force angle changes as the seat back is pulled rearward

Initial condition: Seat back pull load

Simulation setup



time [ms]	force [kN]
0	0.088
5	0.875
11	0.875
132	20

manual seat

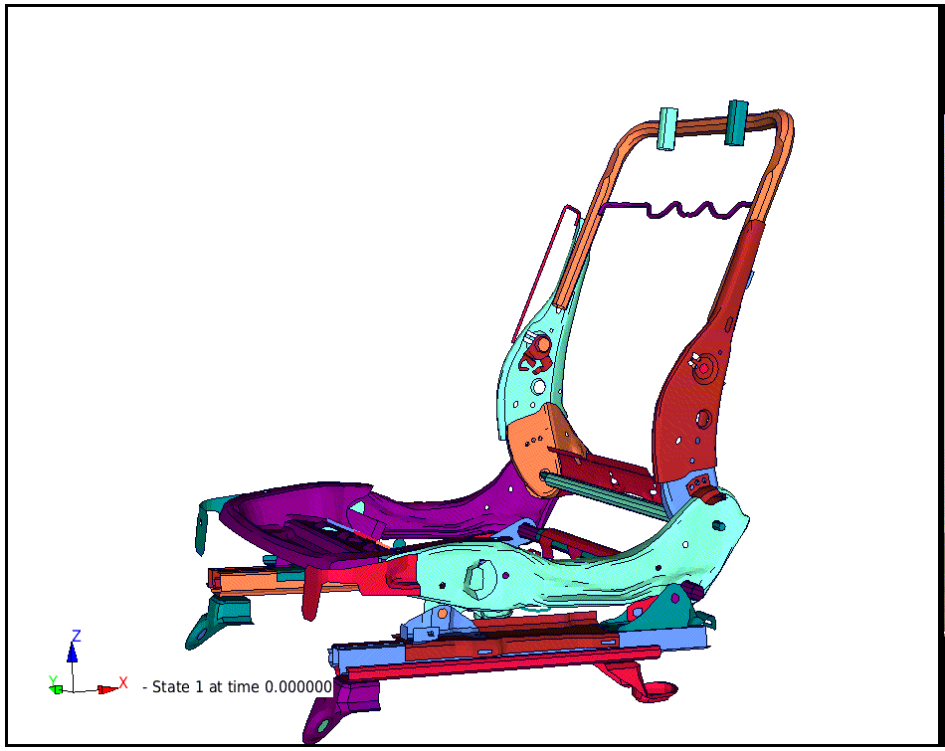
power seat

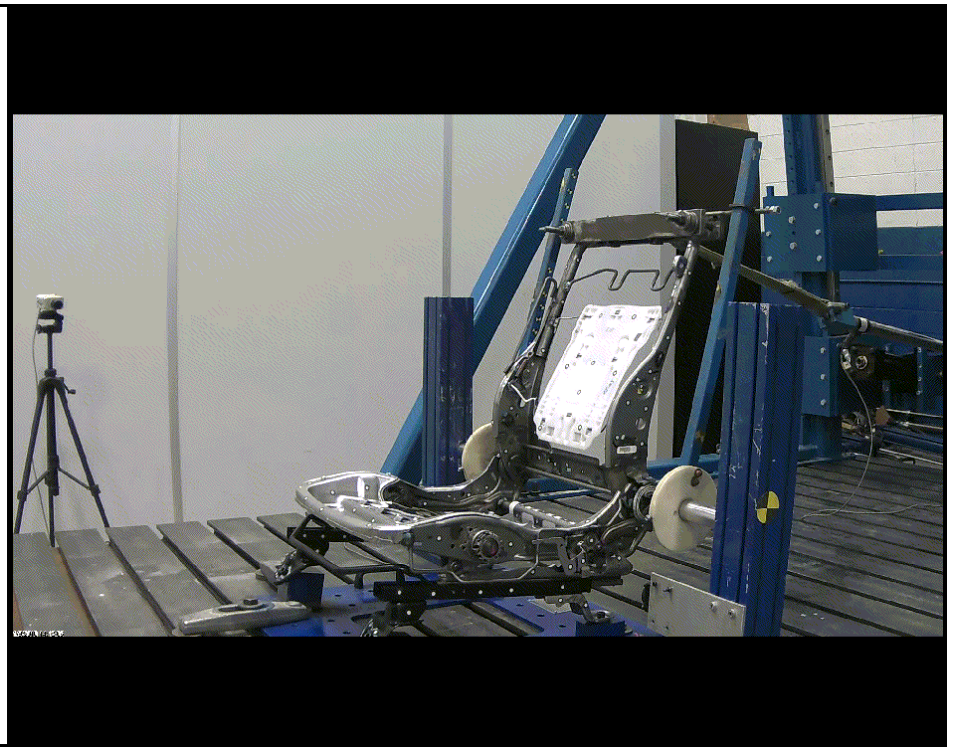
Simulation time is limited to the time of failure

Material data – Manual Seat

	HSLA 550-650
	IF 260-410
	HSLA 420-500
	DP 700-1000

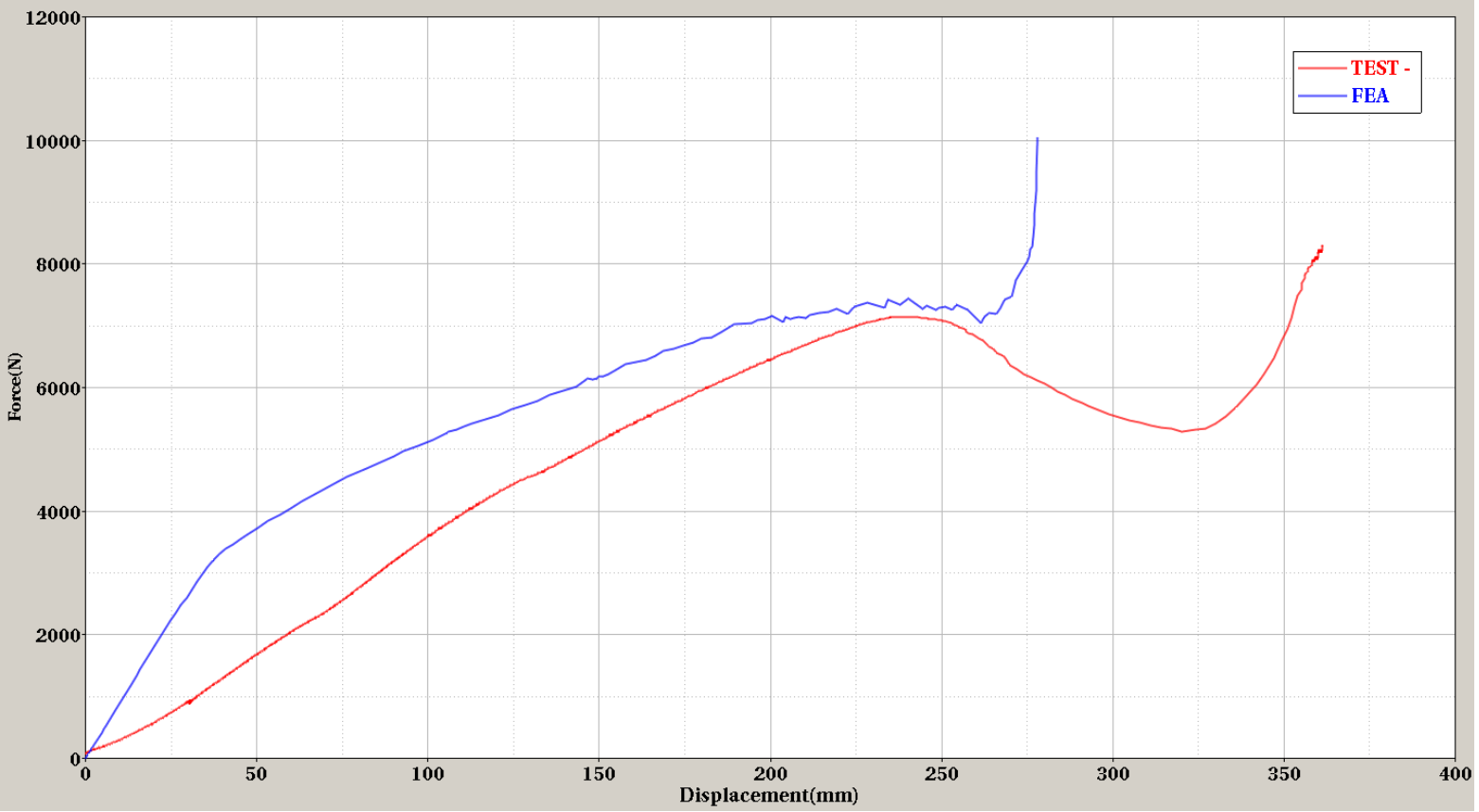
CAE Comparison – Animation & Test Video





Quasi Static Seat Back Strength Test
Manual Seat Overlay Animation

CAE Comparison – Load Curves

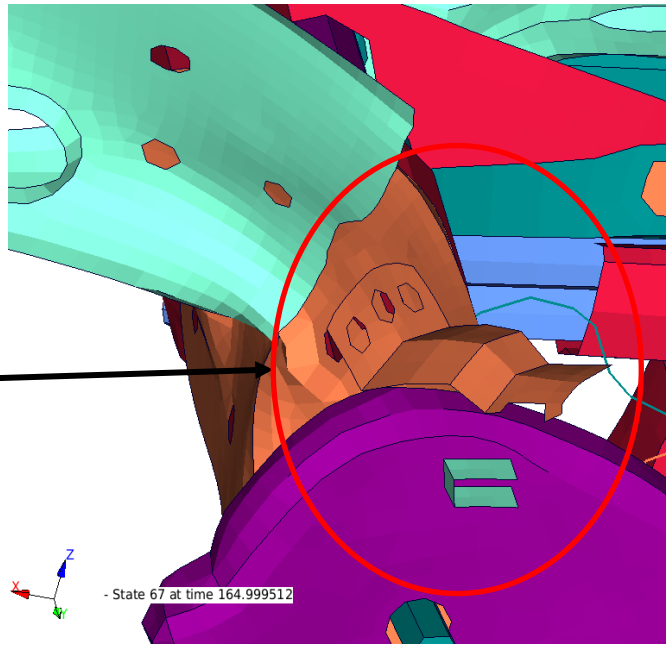


- Test displacement is the loading-cylinder displacement
- CAE displacement is measured at the loading point of the FEA model
- CAE model shows that the seat is stiffer, material iteration was carried out to get improved correlation

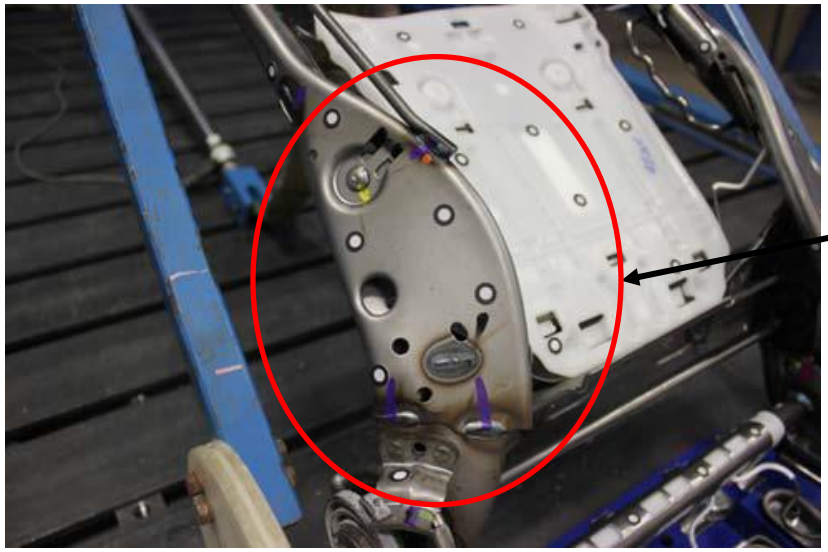
Quasi Static Seat Back Strength Test
Manual Seat

Seat collapsed @ 50.1°/
53.5° seat back angle

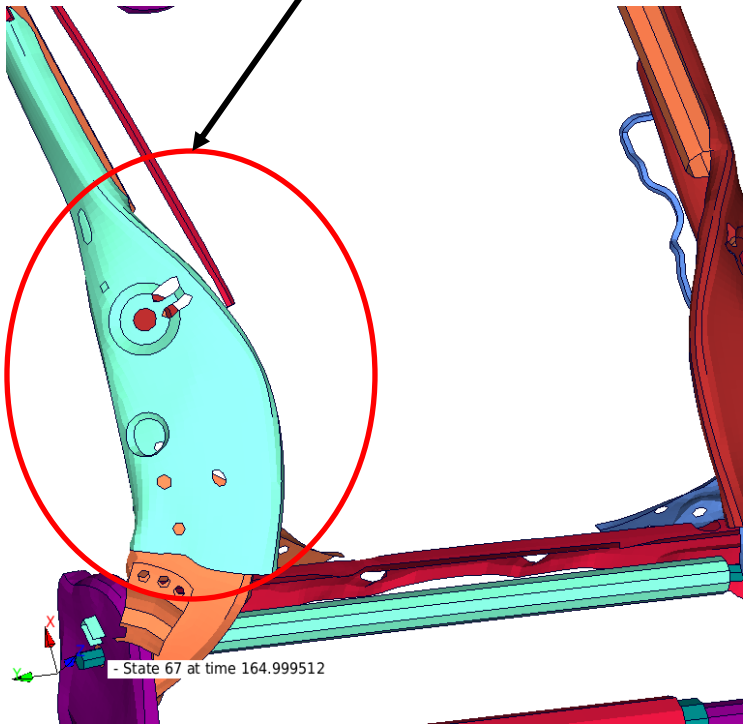
Connector flange
Slips away from the
stopper



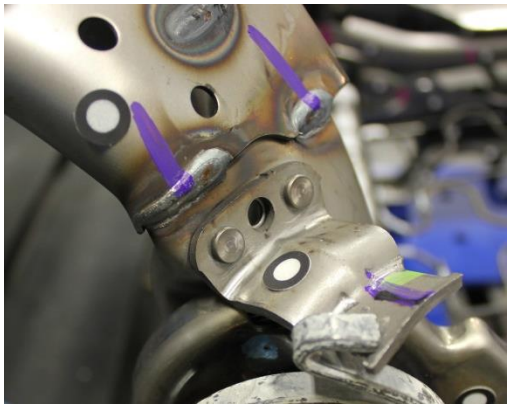
Quasi Static Seat Back Strength Test
Manual Seat

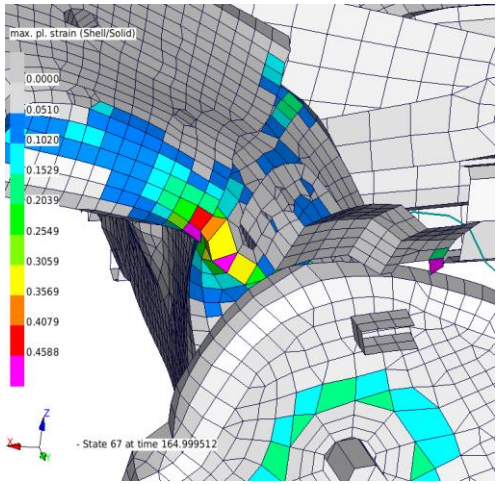


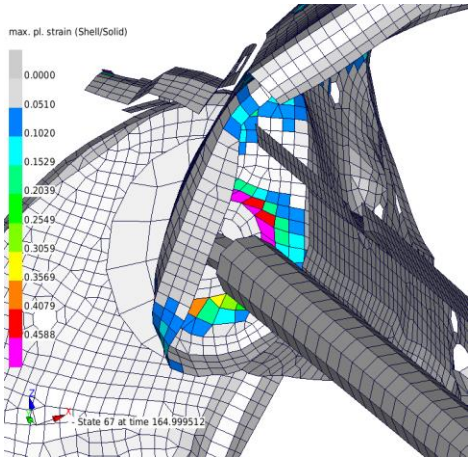
Collapsed at LHS
and RHS frames



CAE – Failure Areas

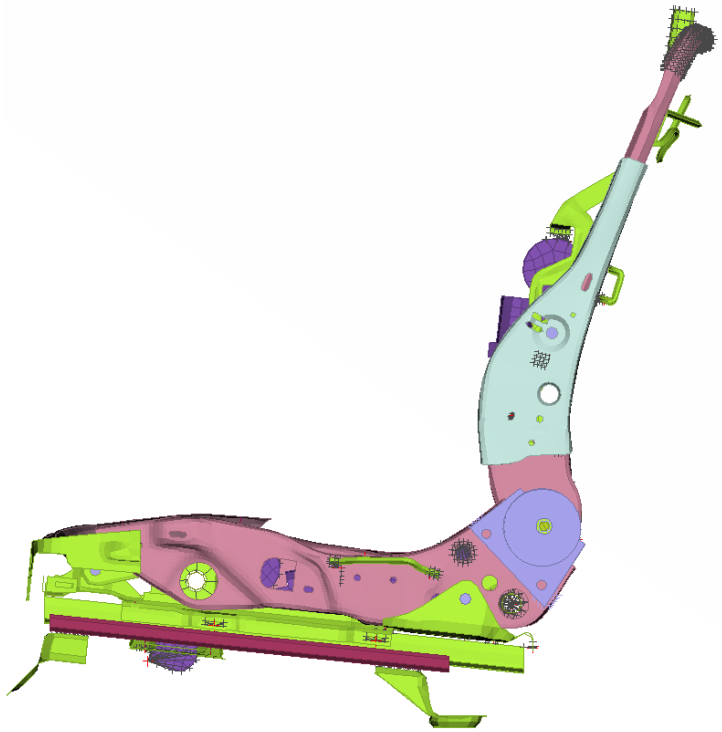






Failures regions of FEA are similar to Test

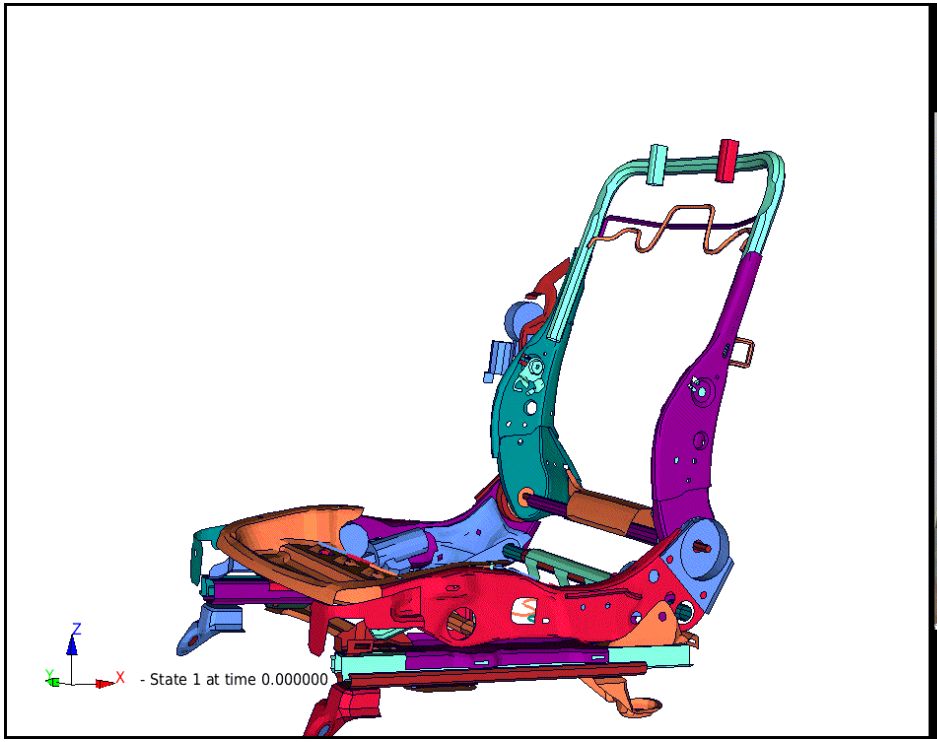
Material data – Power Seat

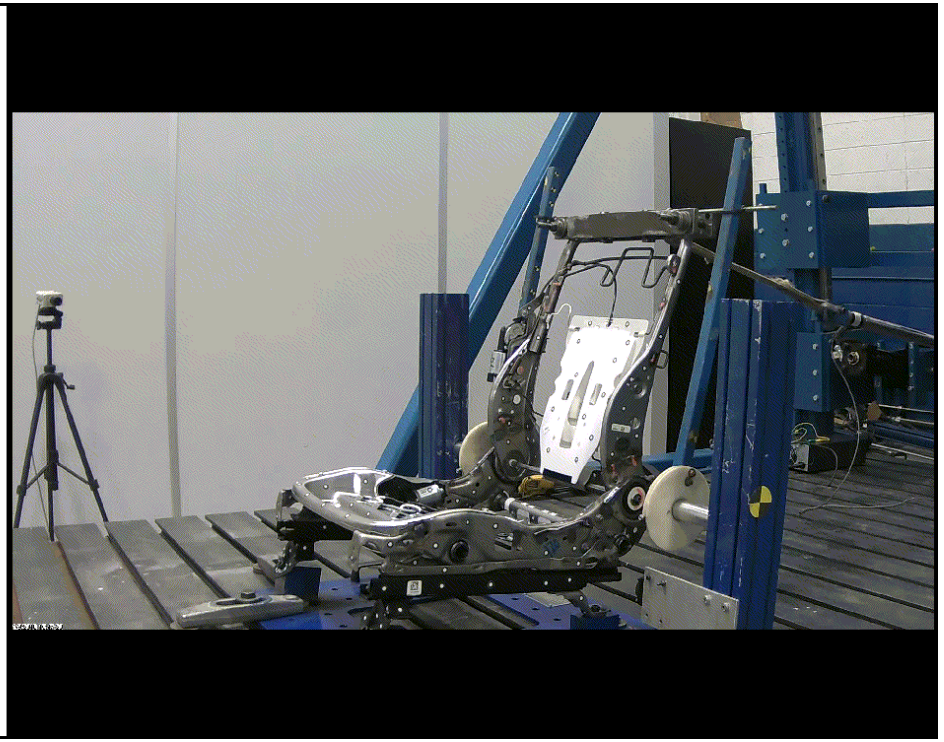


	HSLA 550-650
	IF 260-410
	HSLA 420-500
	DP 700-1000
	HLSA 350/450
	Plastic

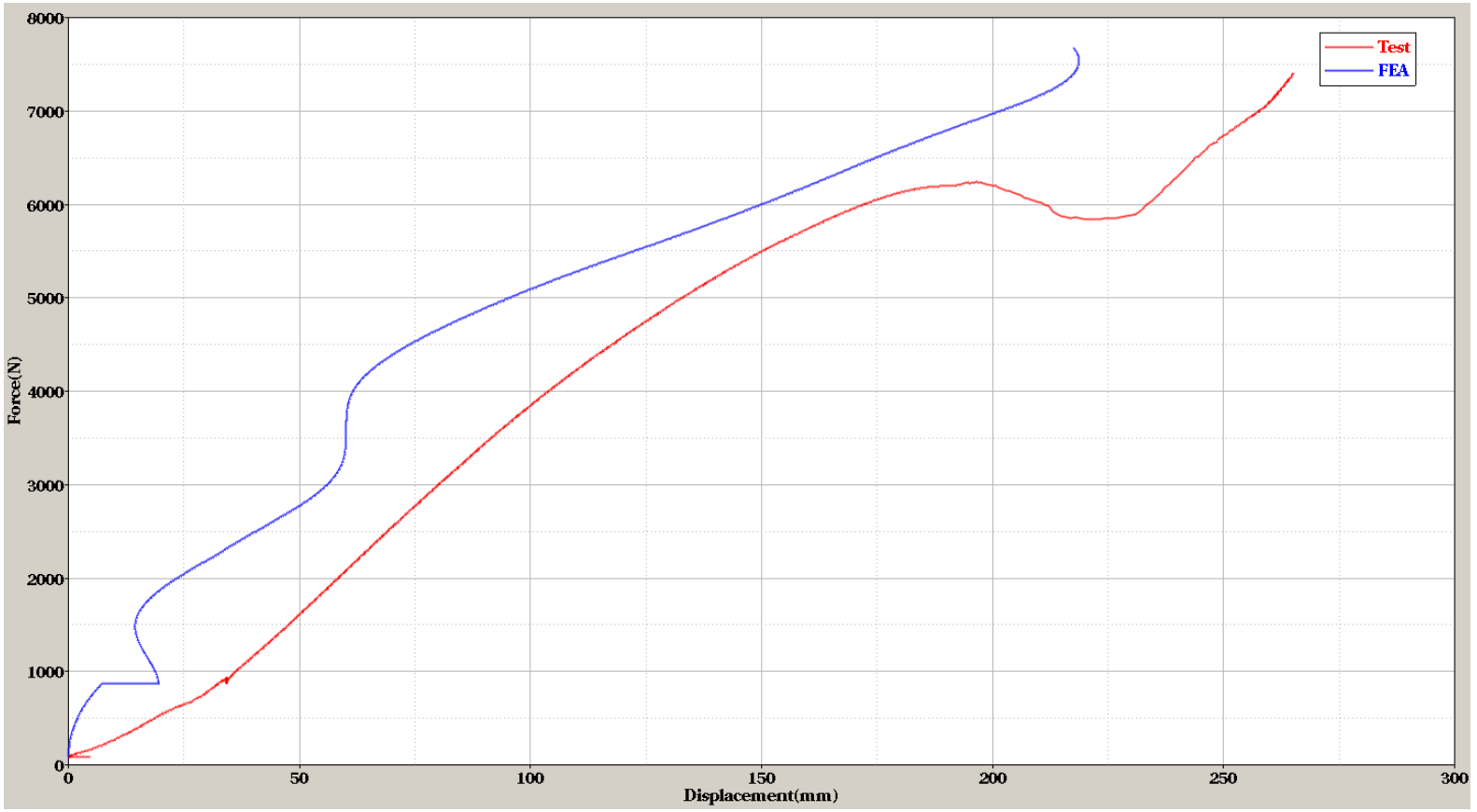
Quasi Static Seat Back Strength Test
Power Seat Overlay Animation

CAE Comparison – Animation & Test Video



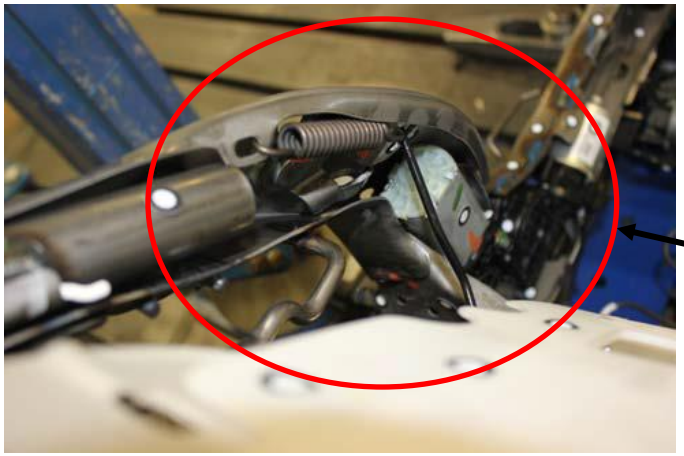


CAE Comparison – Load Curves



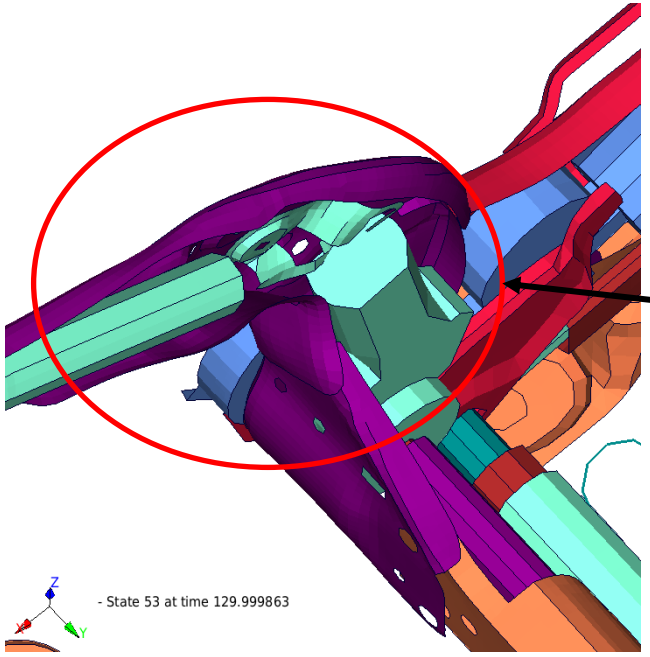
- Test displacement is the loading-cylinder displacement
- CAE displacement is measured at the loading point of the FEA model
- CAE model shows that the seat is stiffer, material iteration was carried out to get improved correlation

Quasi Static Seat Back Strength Test
Power Seat



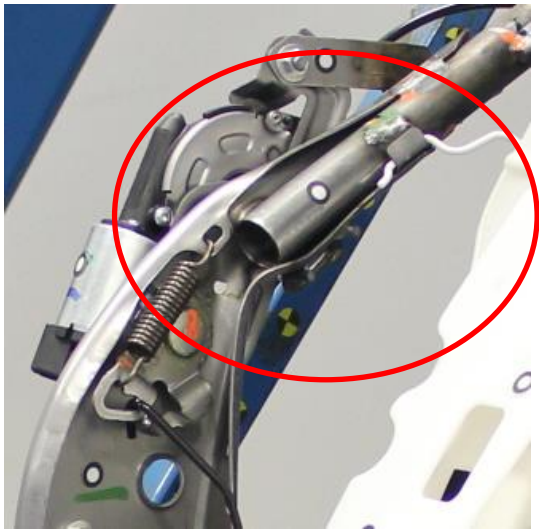
Seat collapsed @ 37.1° / 20° seat back angle

Failed LH frame after 37.1°, stuck on the motor

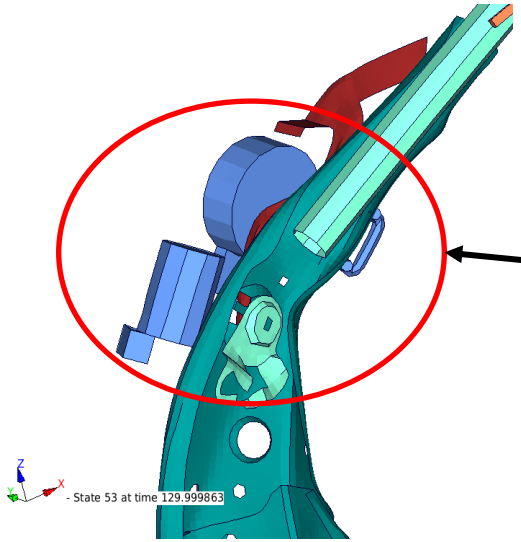


Failed LH frame stuck on the motor

Quasi Static Seat Back Strength Test
Power Seat

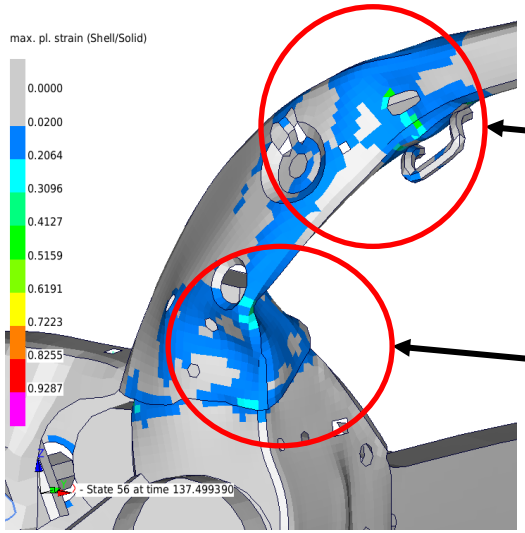


Failed RH frame after 20°, close to the motor



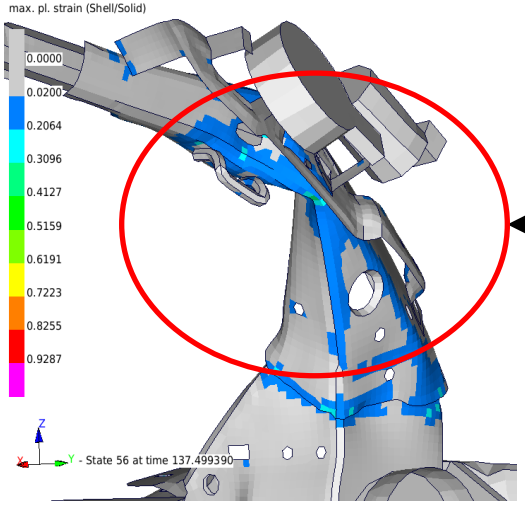
Failed RH frame at the same region compared to test

CAE Comparison – Failure Areas



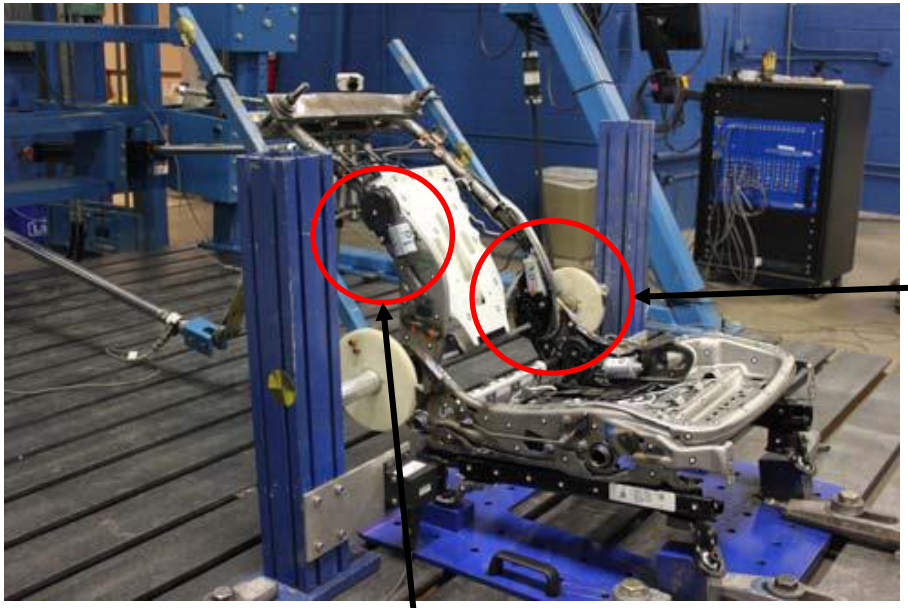
LHS-Failure near weld region

LHS- Failure happens as deflection is blocked by the bottom motor



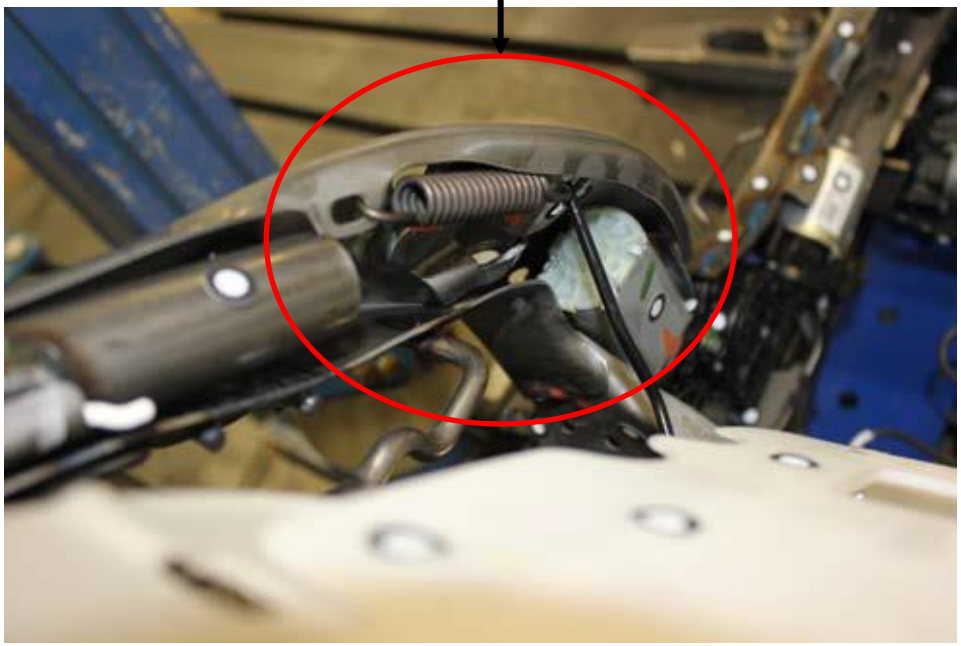
RHS-Failure region is close to the motor

Quasi Static Seat Back Strength Test
Power Seat



Failed LH frame after 37.1°, stuck on the motor

Failed RH frame after 20°, just above motor



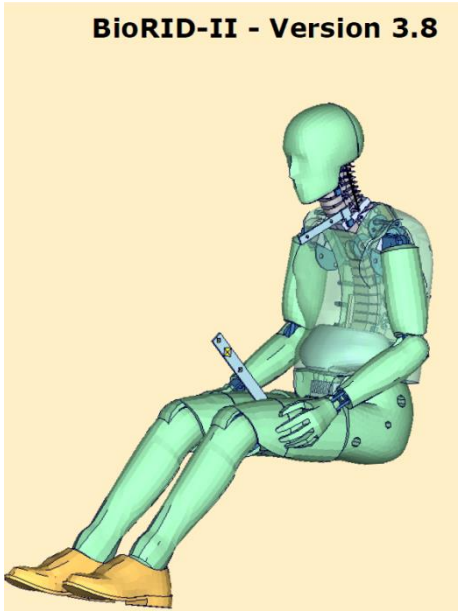
Tests : Dynamic, FMVSS301 Sled Test

Dynamic Sled Test (FMVSS 301 Rear Impact)

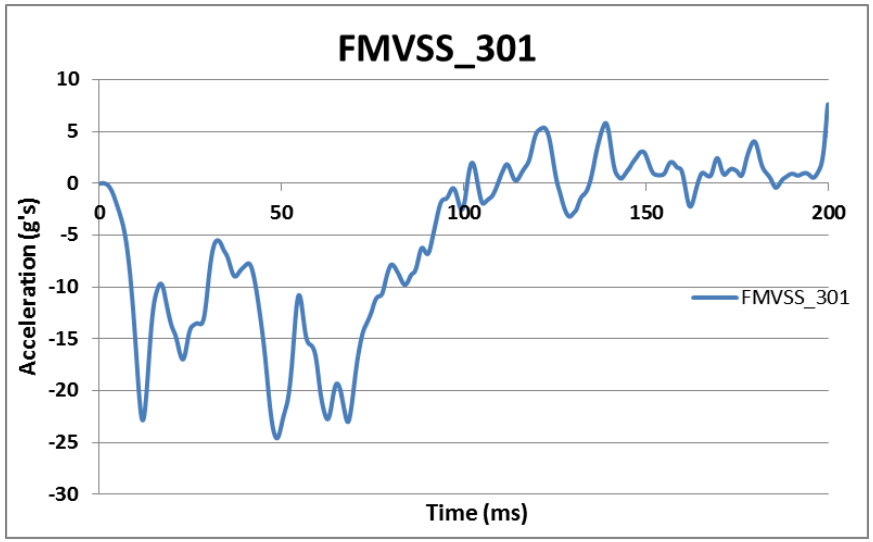
& FEA Modeling

FMVSS301 Rear Impact Sled Test

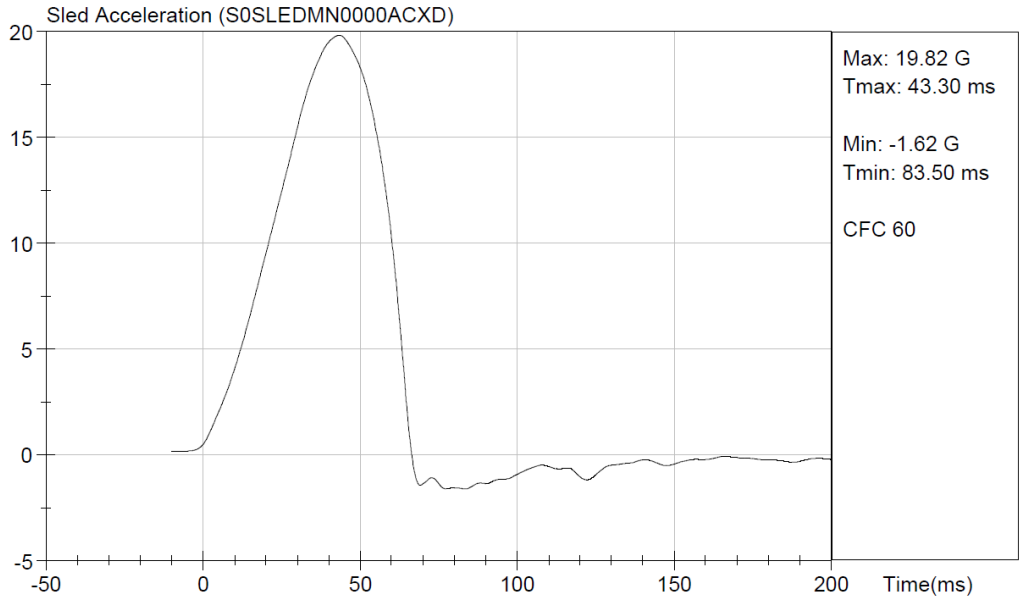
- FMVSS 301 Rear Impact Sled Tests were conducted by MGA on 03/26/2018
  - 2 tests, one for manual seat and other for power seat
- NHTSA delivered BioRID-II dummy with 22 LEMO connectors
  - Calibrated by Humanetics
- Most critical 22 channels/sensors were used in the dummy



FMVSS301 Rear Impact Sled Test



- Preliminary pulse from CAE simulation



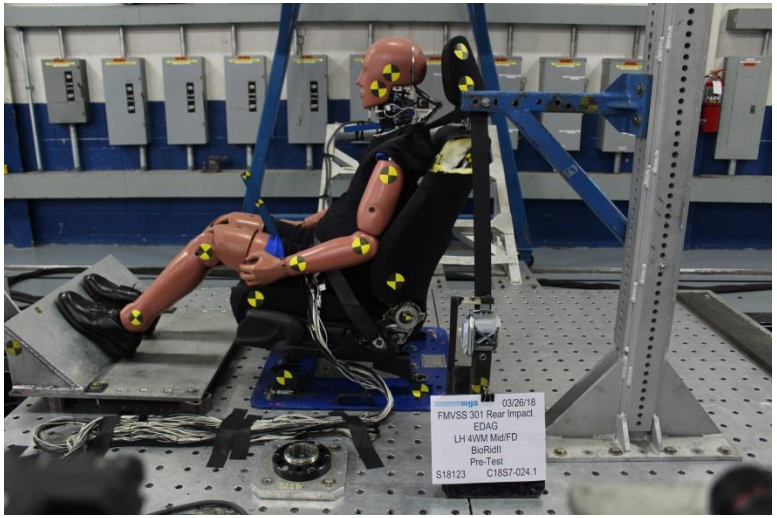
- Calibrated pulse for 20G
- Used in the test

Manual Seat

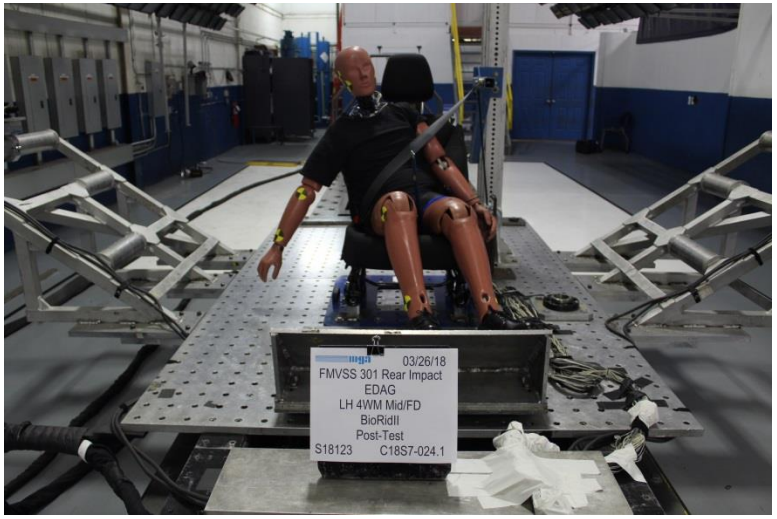
\NHTSA\FMVSS 301 BioRidII\Videos\S18123
\NHTSA\FMVSS 301 BioRidII\Photograph(s)\S18123
\NHTSA\FMVSS 301 BioRidII\Test Data\S18123

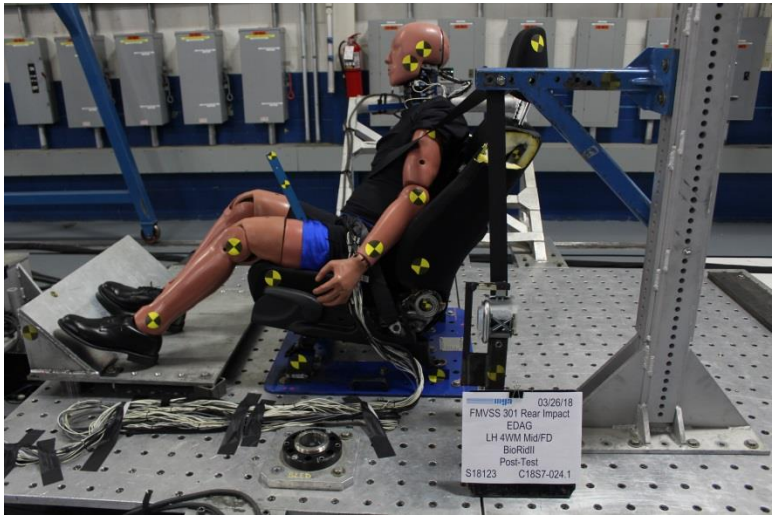
FMVSS301 Test w/ Bio-RID II Dummy
Manual Seat

Pre Test



Post Test



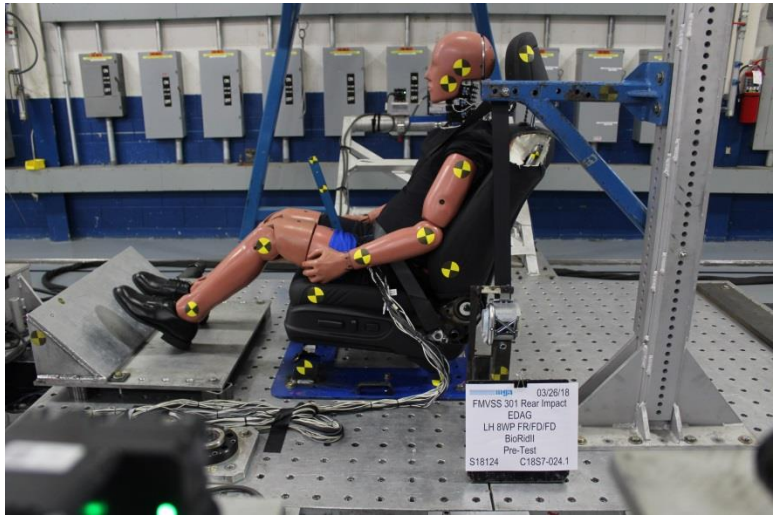


Power Seat

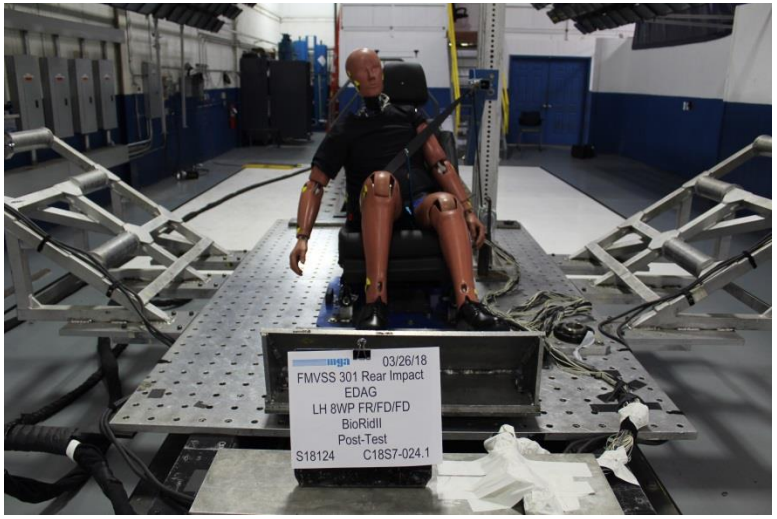
\NHTSA\FMVSS 301 BioRidII\Videos\S18124
\NHTSA\FMVSS 301 BioRidII\Photograph(s)\S18124
\NHTSA\FMVSS 301 BioRidII\Test Data\S18124

FMVSS301 Test w/ Bio-RID II Dummy Power Seat

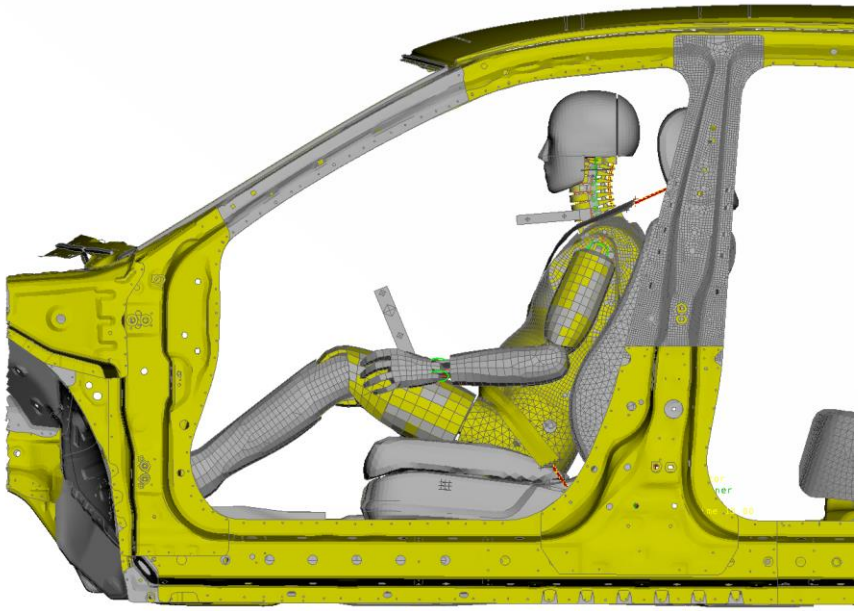
Pre Test



Post Test

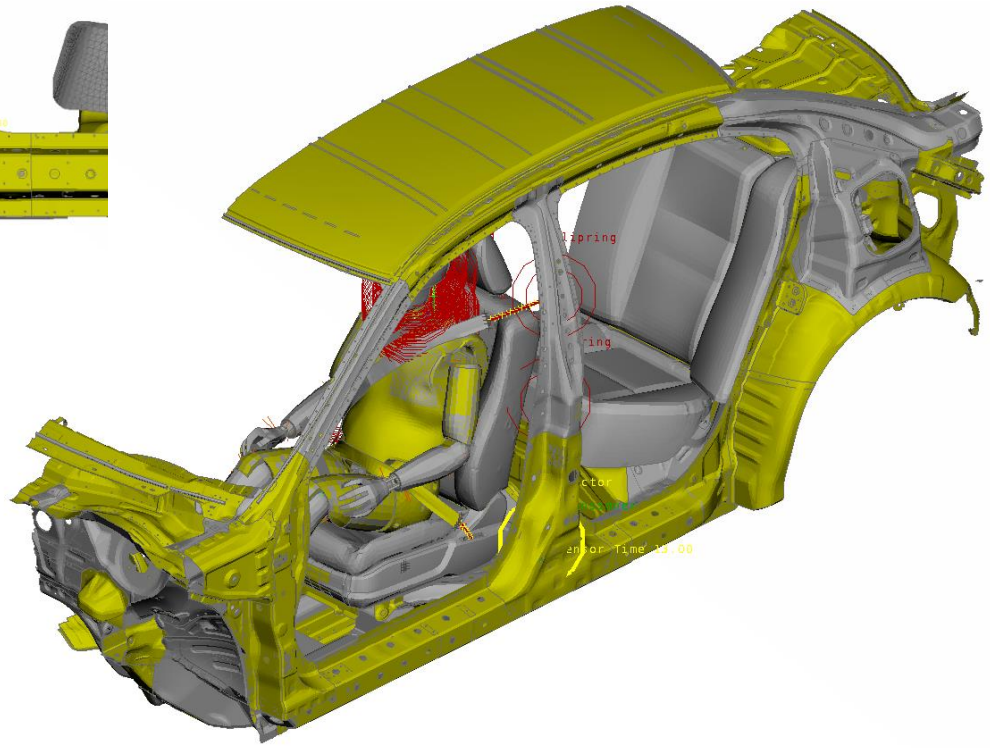


CAE Modeling

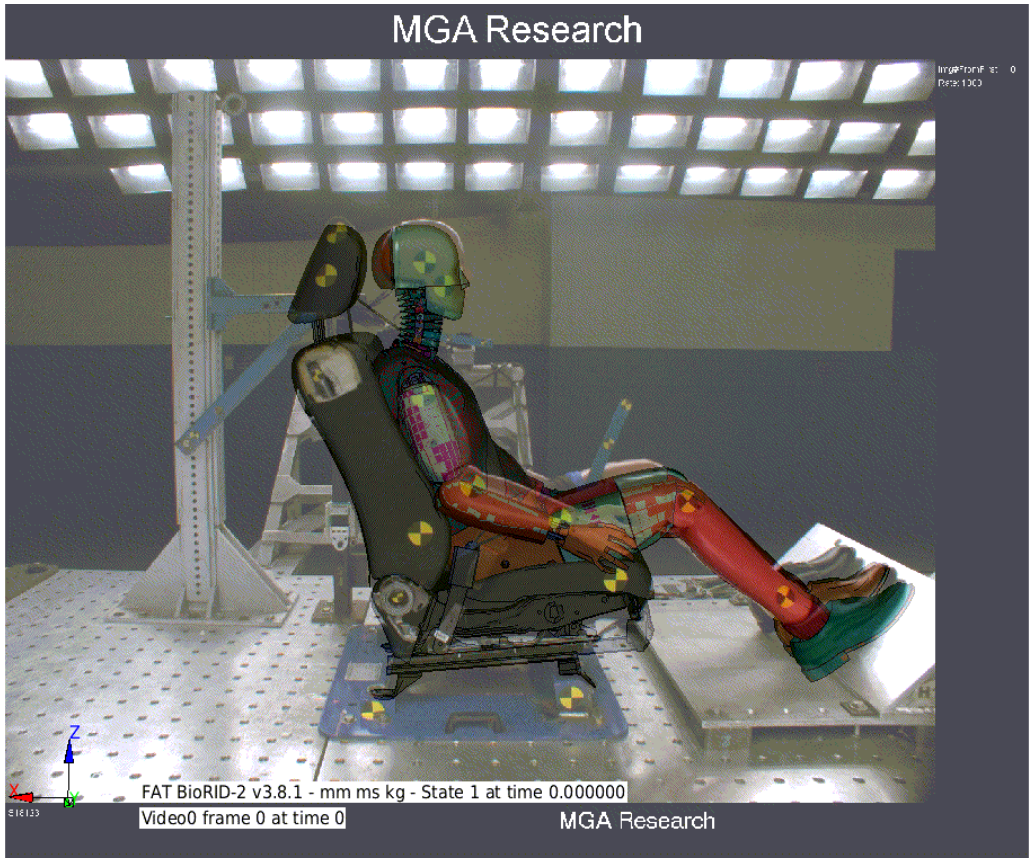


Humanetics BioRID Dummy 3.8

Rear seat geometry included in model



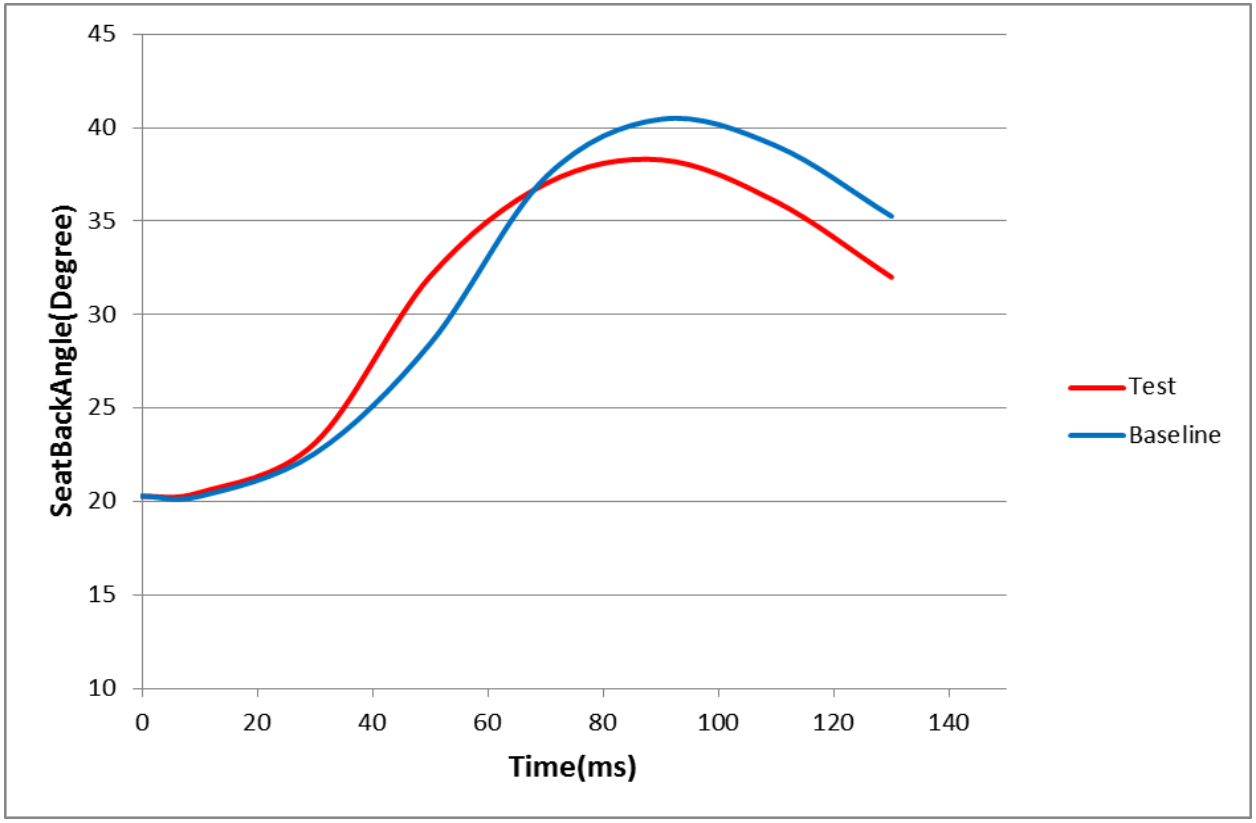
FMVSS301 Sled Test Simulation
Manual Seat



- Cloth Trim
- Full Down, Mid-Track
- Seat Back angle 18.1°
- Bio-RID II Dummy Pelvic angle 26.5°

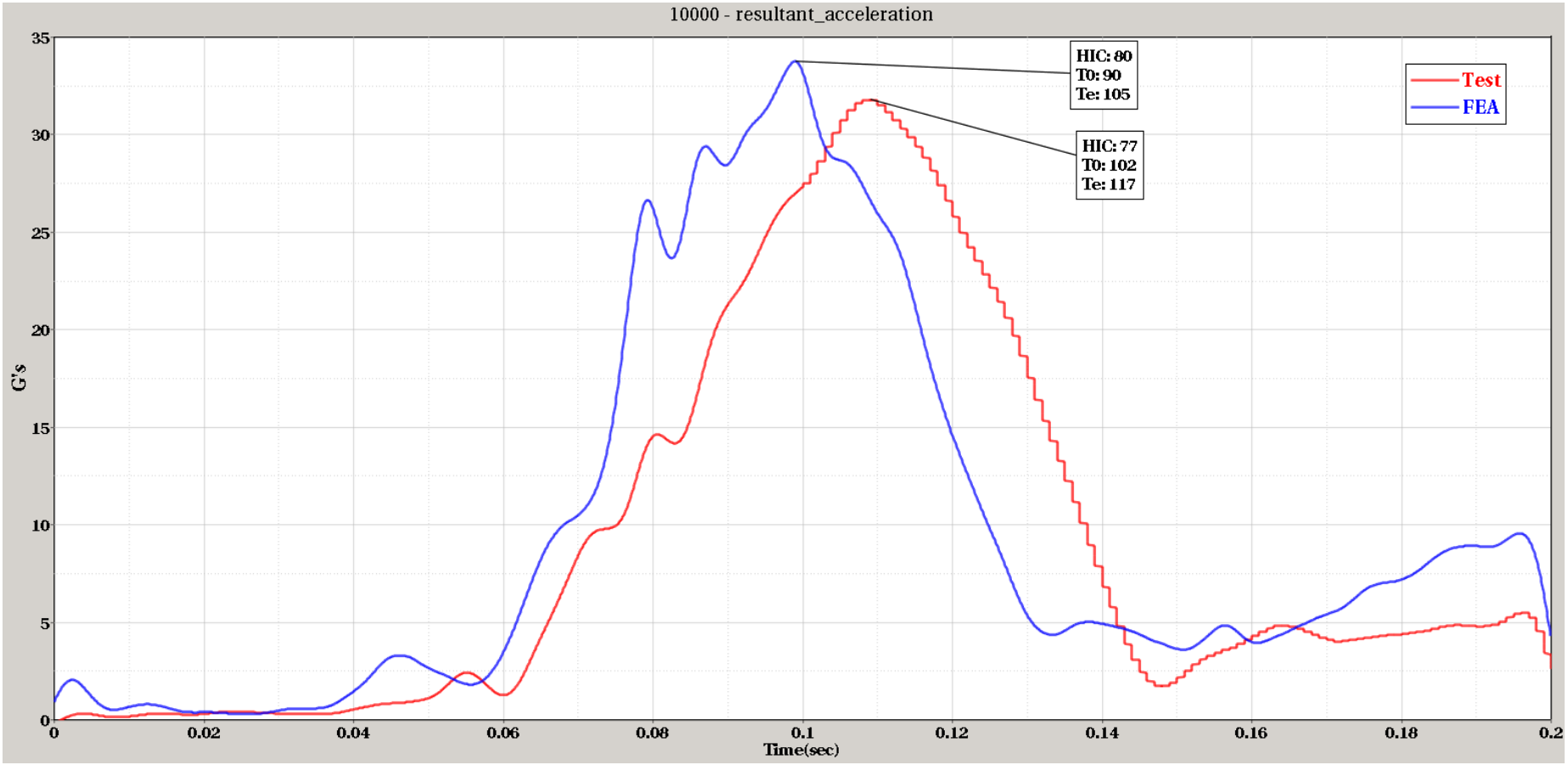
- Average Static Deflection = 9.4°
- Average Seat Back Rotation = 38°

FMVSS301 Sled Test Deflection
Manual Seat



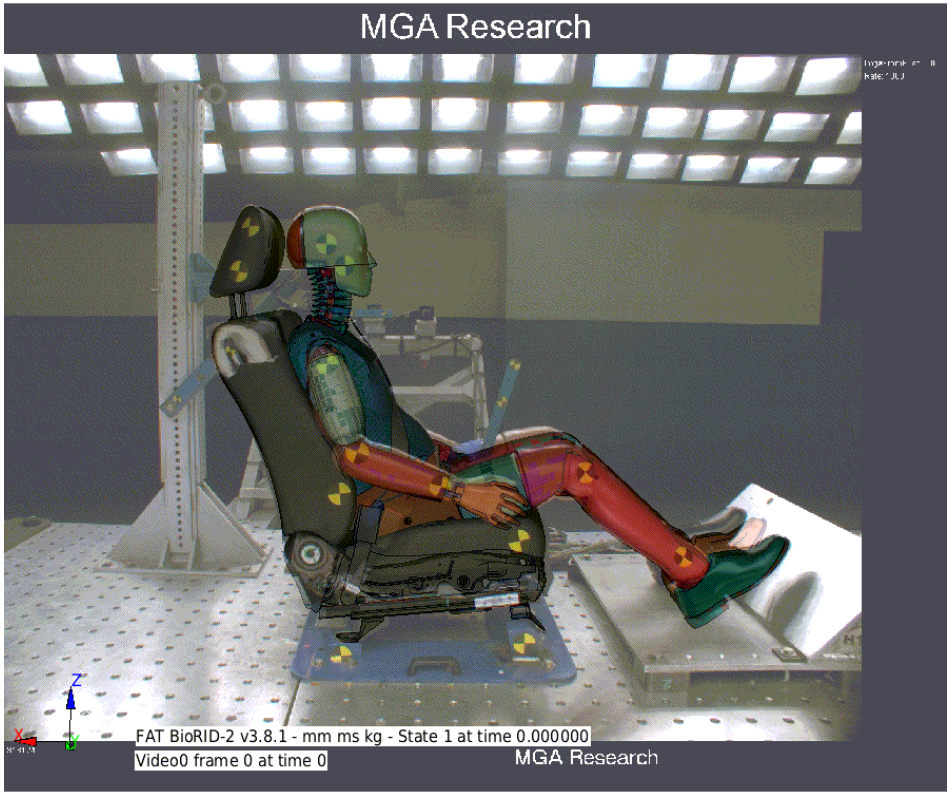
The seat back angle for the FEA matches the same trend compared to the test.

FMVSS301 Sled Test HIC
Manual Seat



	Injury Measures		
	Criteria	Test	FEA
HIC15 Value	500	77	80
NIJ	< 1.0	0.28	0.18

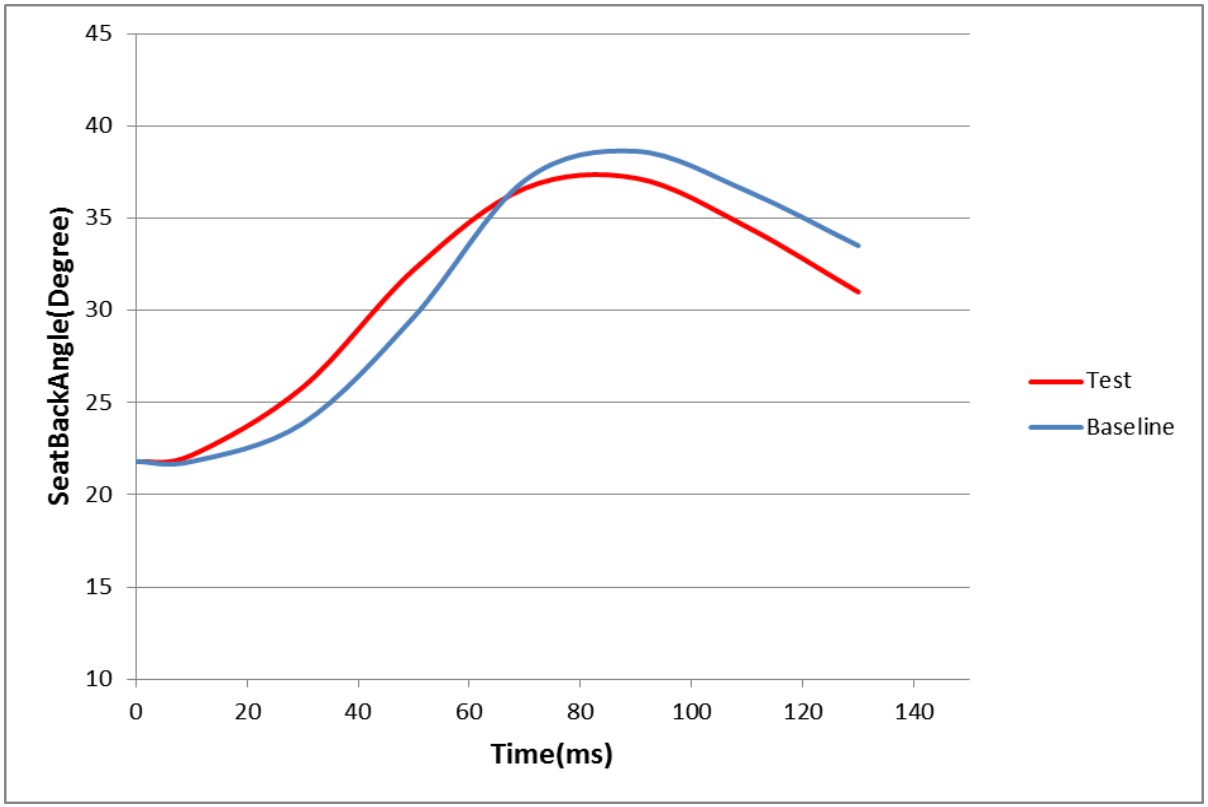
FMVSS301 Sled Test Simulation
Power Seat



- Leather Trim
- Full Down, Rear-Track
- Seat Back angle 18.1°
- Bio-RID II Dummy Pelvic angle 26.5°

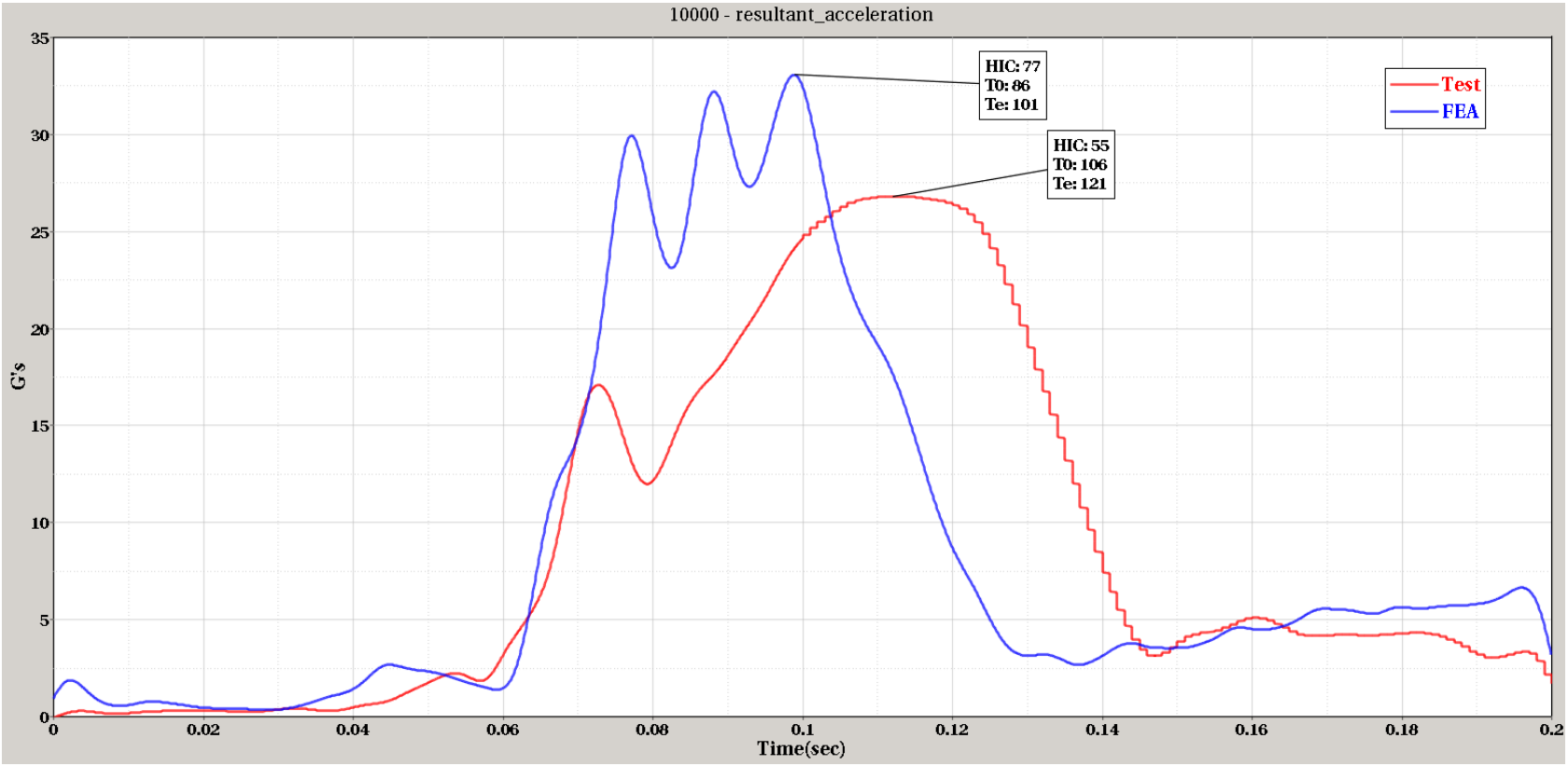
- Average Static Deflection = 9.0°
- Average Seat Back Rotation = 38°

FMVSS301 Sled Test Deflection
Power Seat



The seat back angle for the FEA matches the same trend compared to the test.

FMVSS301 Sled Test HIC
Power Seat

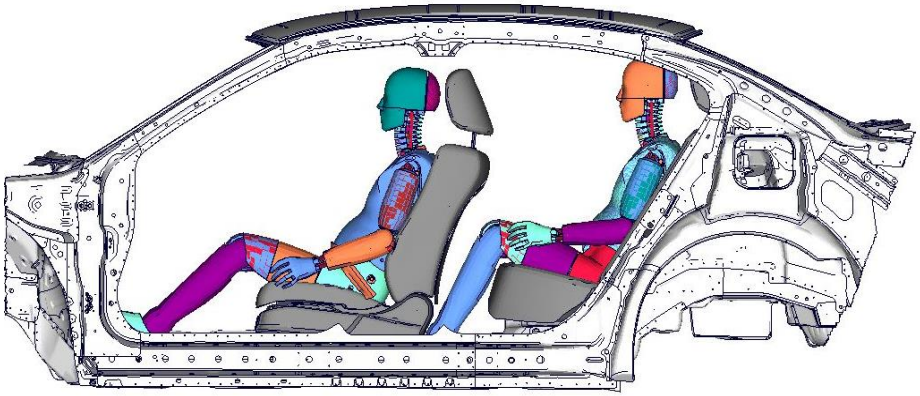


	Injury Measures		
	Criteria	**Test**	**FEA**
HIC15 Value	500	77	55
NIJ	< 1.0	0.17	0.21

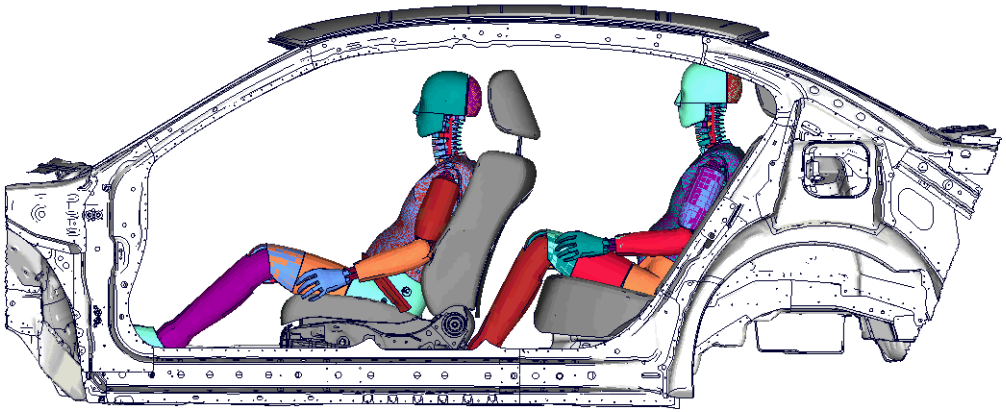
Seat Back Strength Study

& Countermeasures

Seatback Strength Study

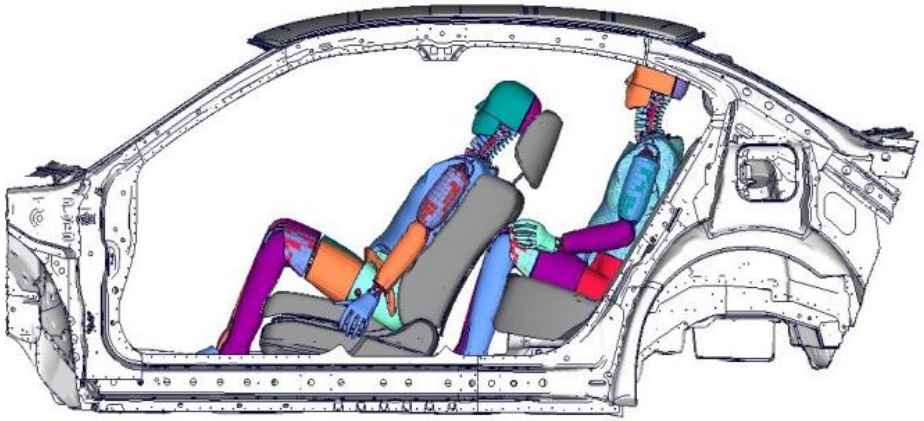


FEA Model - Manual front seat with rear seat passenger

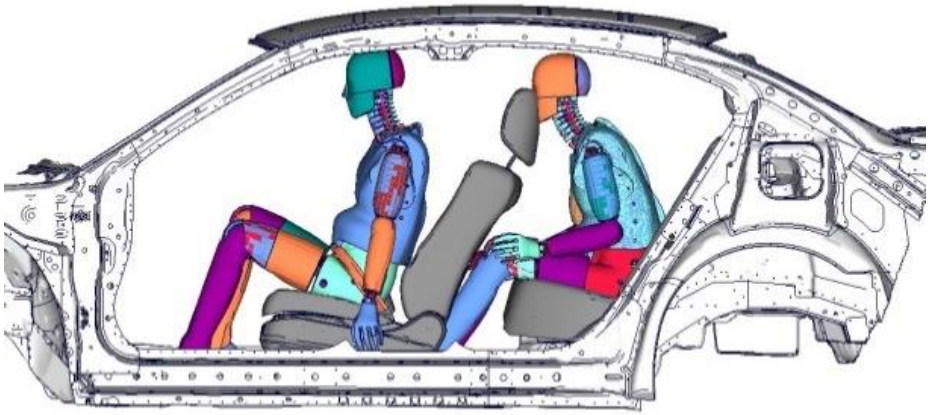


FEA Model - Power front seat with rear seat passenger

Seatback Strength Study
Manual Seat & Rear Seat Passenger

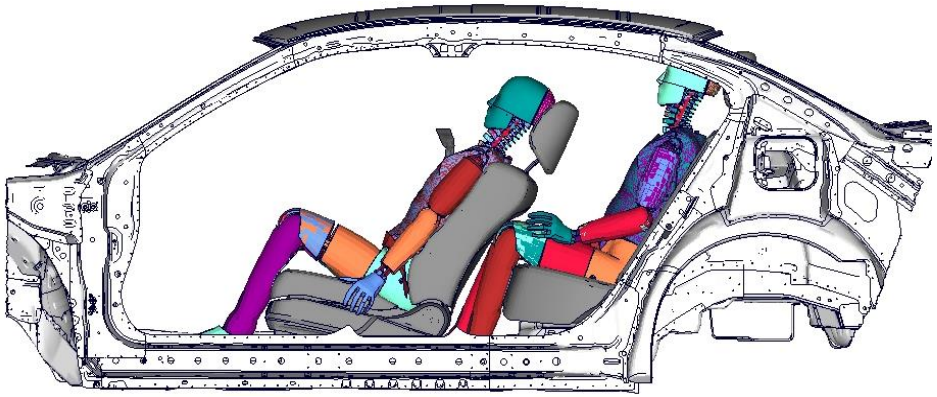


Manual front seat interaction w/ rear seat passenger – Knee Contact

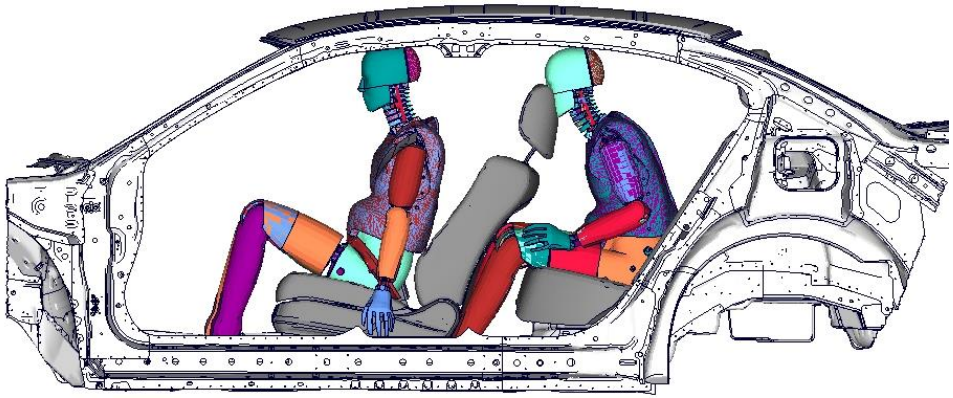


Manual front seat interaction w/ rear seat passenger – Head Contact

Seatback Strength Study
Power Seat & Rear Seat Passenger



Power front seat interaction w/ rear seat passenger – Knee Contact



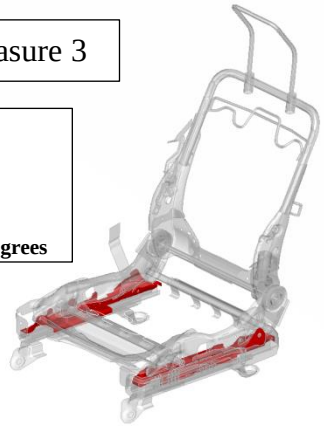
Power front seat interaction w/ rear seat passenger – Head Contact

Seatback Strength Study

- Seat back strength improvement targets

No.	Criteria	Target	Baseline	Improvements for
1	Seat back angle	< 35 deg	38.5 deg	No knee contact
2	Seat frame to Knee clearance	> 10 mm	3.76 mm	No knee contact
3	Femur force	< 1.5 kN	3.5 kN	Reduced knee impact

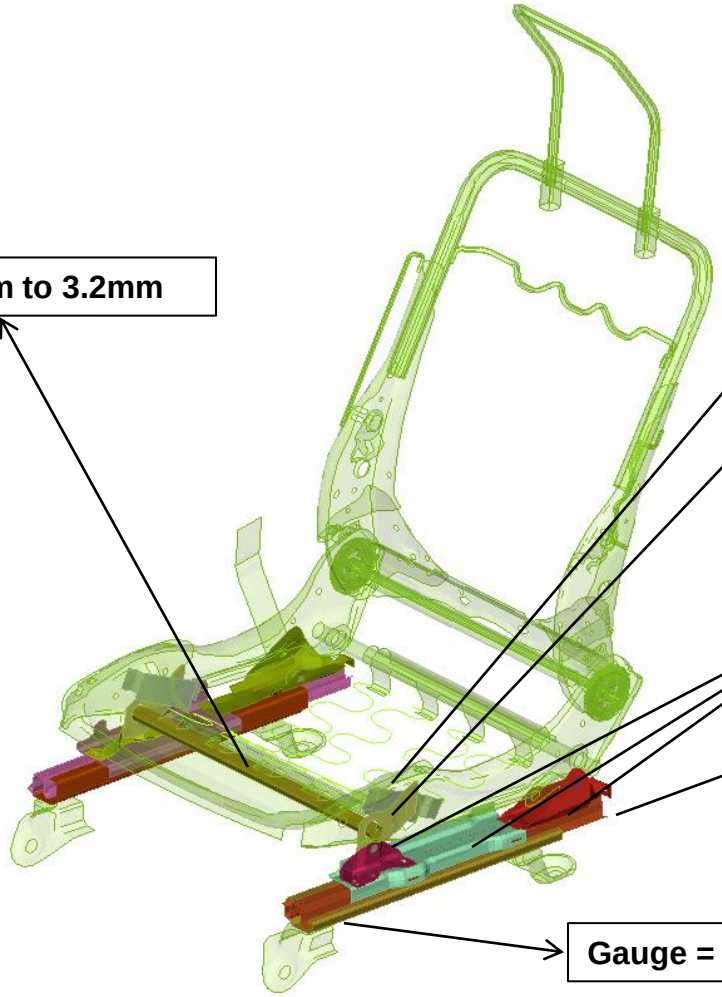
FMVSS301- Countermeasures

Countermeasure 1 **HSLA 350/450 to HSLA 420/500** **Max. Seat Back deflection=39degrees**	
Countermeasure 2 **Gauge= 1.6mm to 2mm** **Max. Seat Back deflection=39degrees**	
Countermeasure 3 **IF 260/410 to DP500/800** **Max. Seat Back deflection=38degrees**	
Countermeasure 4 **IF 260/410 to DP500/800** **Max. Seat Back deflection=39degrees**	

- Countermeasure 1 and 2: No significant change in seat back deflection,
- Countermeasure 3 and 4: Combined for reducing the seat back deflection.

FMVSS301 Sled Test –Manual Seat Countermeasures

Critical components that affect Seat back deflection



Gauge = 2mm to 4mm
HSLA 550-650 to DP500-800

Gauge = 3mm to 4mm

Gauge = 2mm to 3.2mm

Gauge = 1.5mm to 3mm
IF 260-410 to DP500-800

Gauge = 1.5mm to 2mm
IF 260-410 to DP500-800

Mass Increase= 2.13Kg

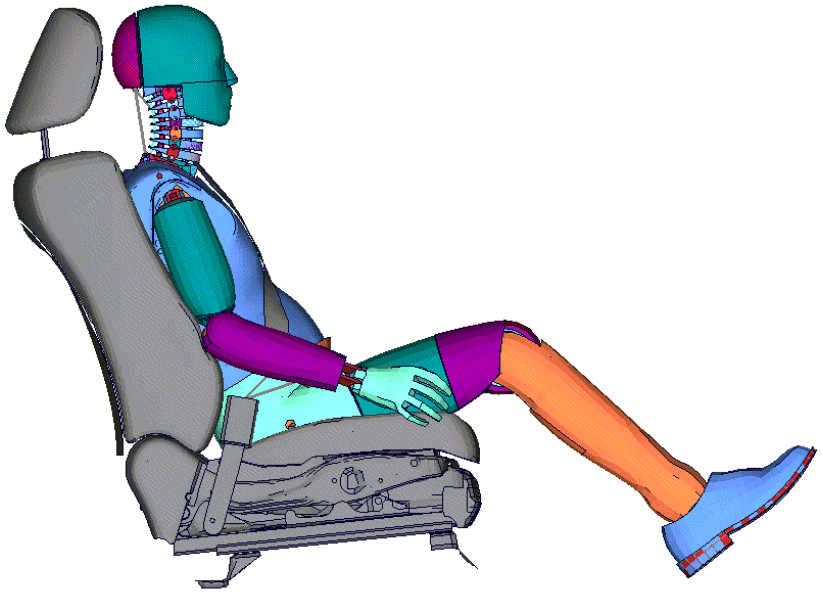
Gauge = 1.45mm to 2mm

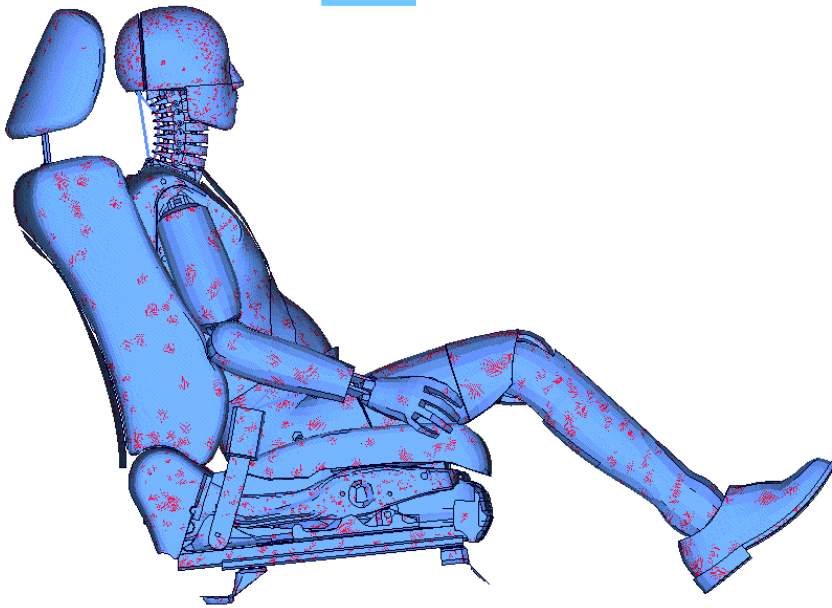
FMVSS301 Sled Test –Manual Seat
Baseline vs Countermeasure

Increasing the Gauge and Grade of bottom seat frame reduces the Seat back angle

Baseline

Countermeasure

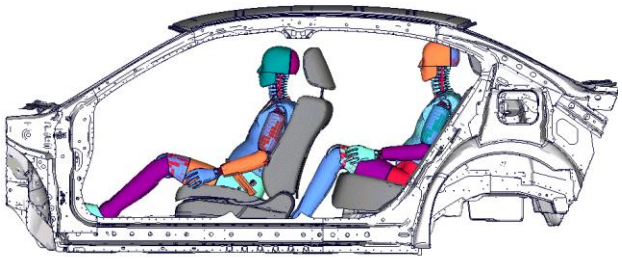


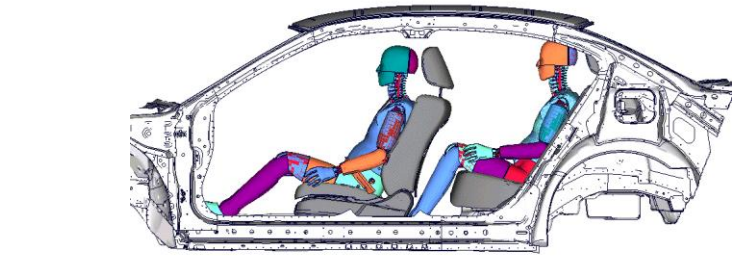


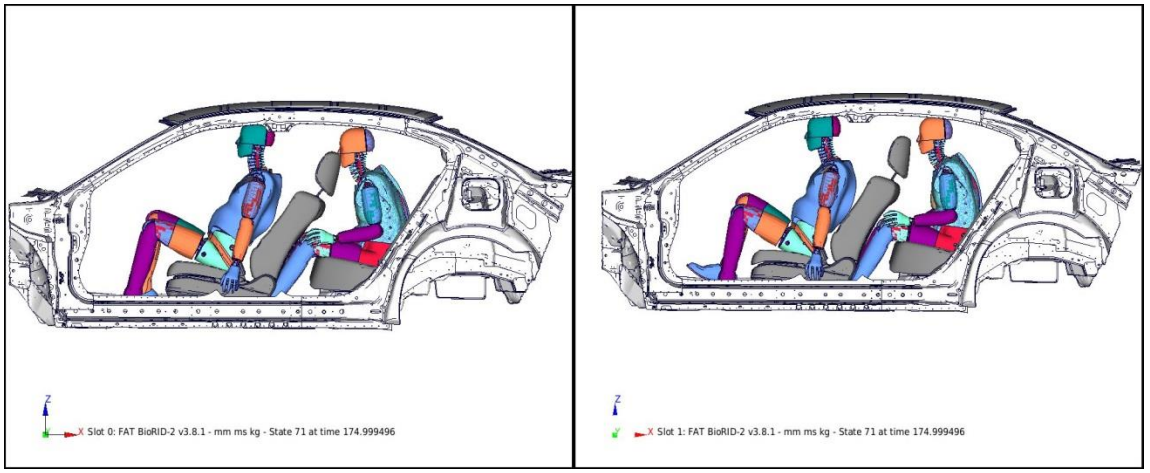
FMVSS301 Sled Test – Manual Seat
Baseline vs Countermeasure

Baseline

Countermeasure





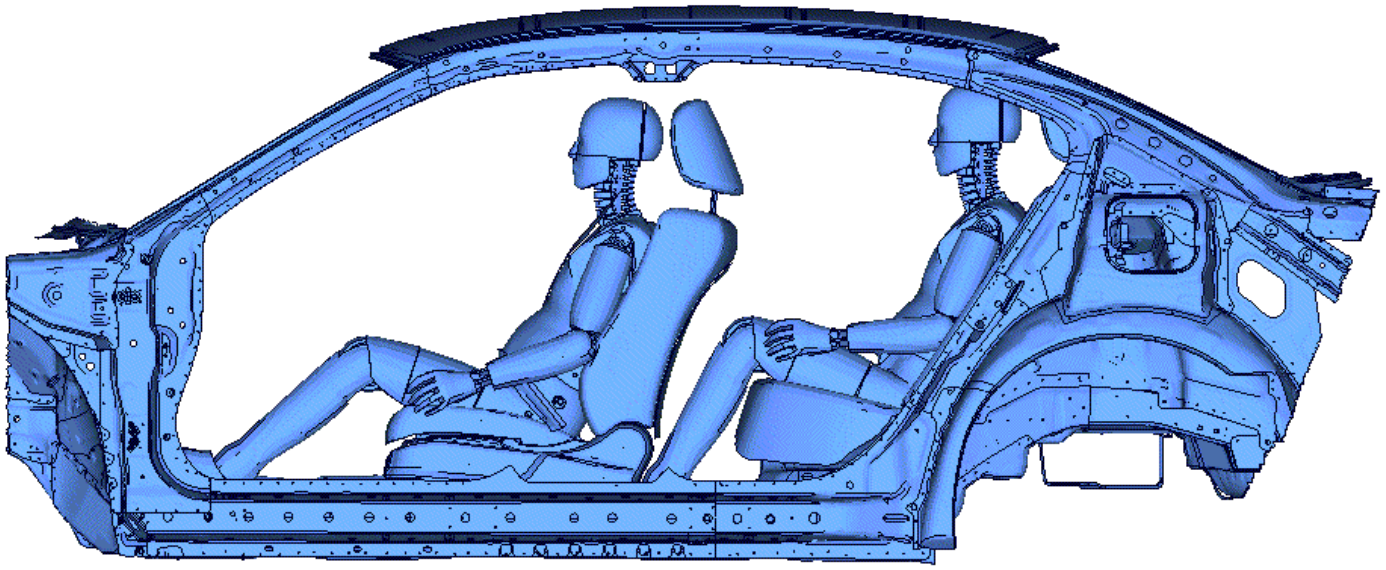


Max. Seat Back angle Test = 38.5 degrees
Max. Seat Back angle Baseline = 39 degrees
Max. Seat Back angle Countermeasure = 35.2 degrees

FMVSS301 Sled Test– Manual Seat
Baseline vs Countermeasure

Baseline

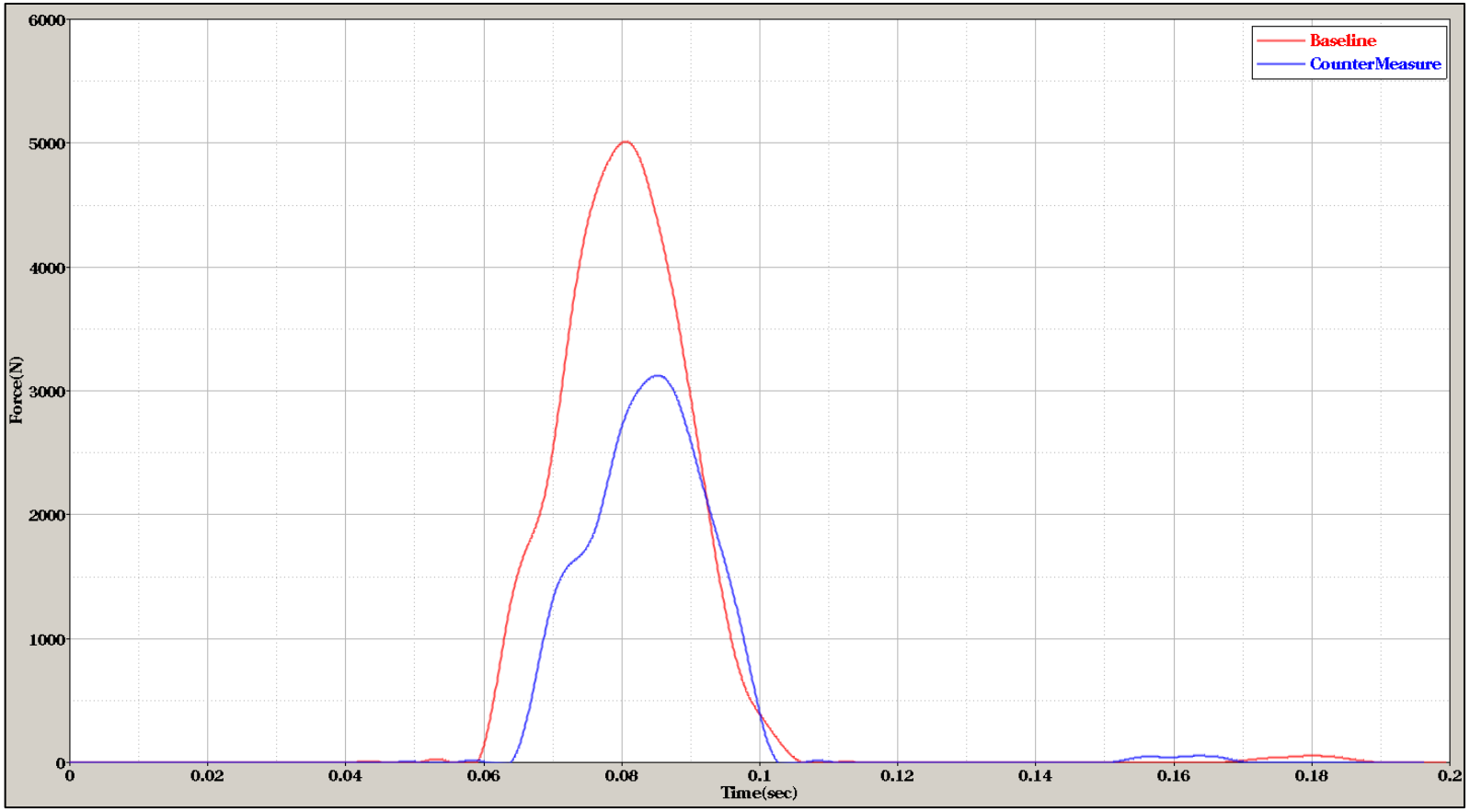
Countermeasure



Overlay Comparison of Baseline and Countermeasure

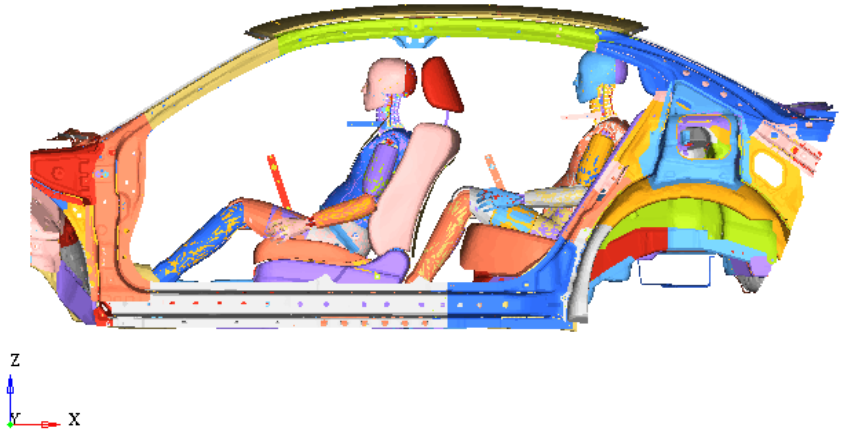
FMVSS301 Sled Test– Manual Seat Baseline vs Countermeasure

Knee Impact force of Front Seat on Rear Seat Passenger

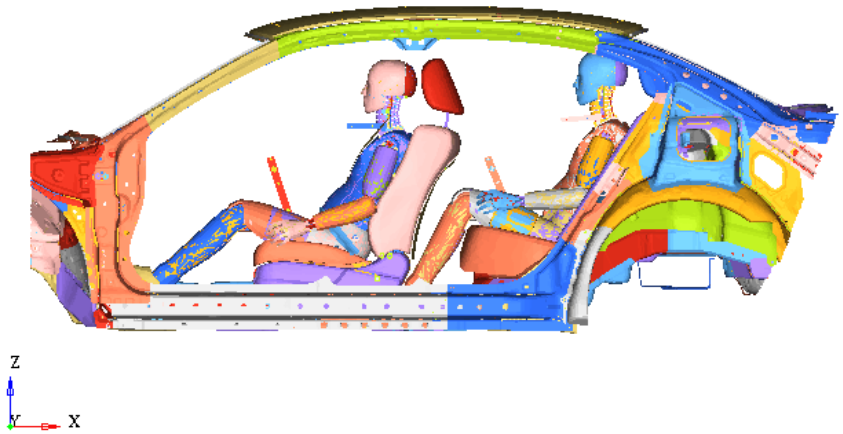


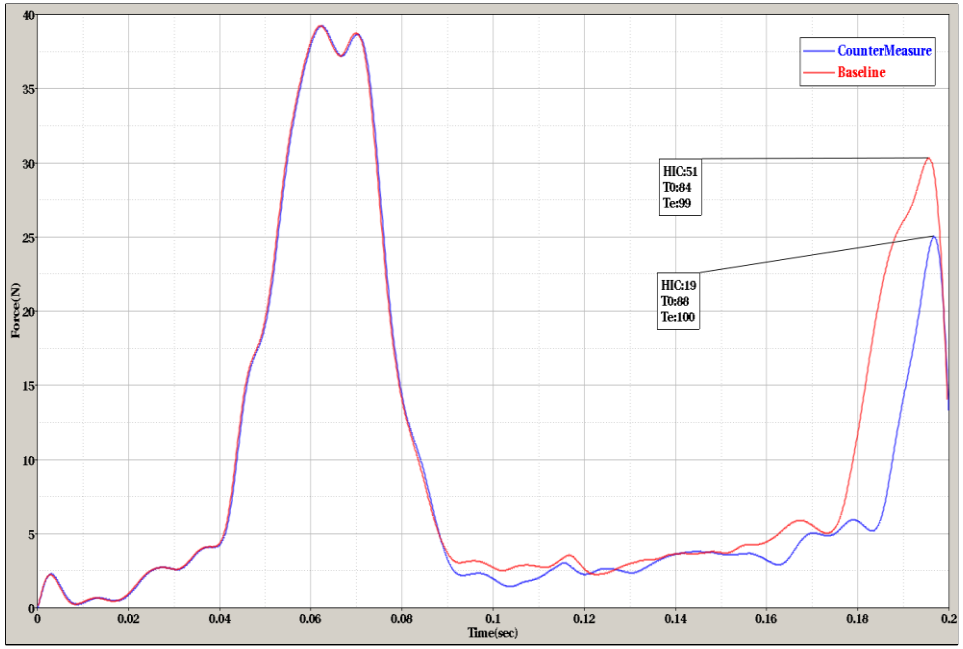
FMVSS301 Manual Seat Comparison with Baseline vs Countermeasure

1: FAT BioRID-2 v3.8.1 - mm ms kg
Loadcase 1 : Time = 0.000000 : Frame 1



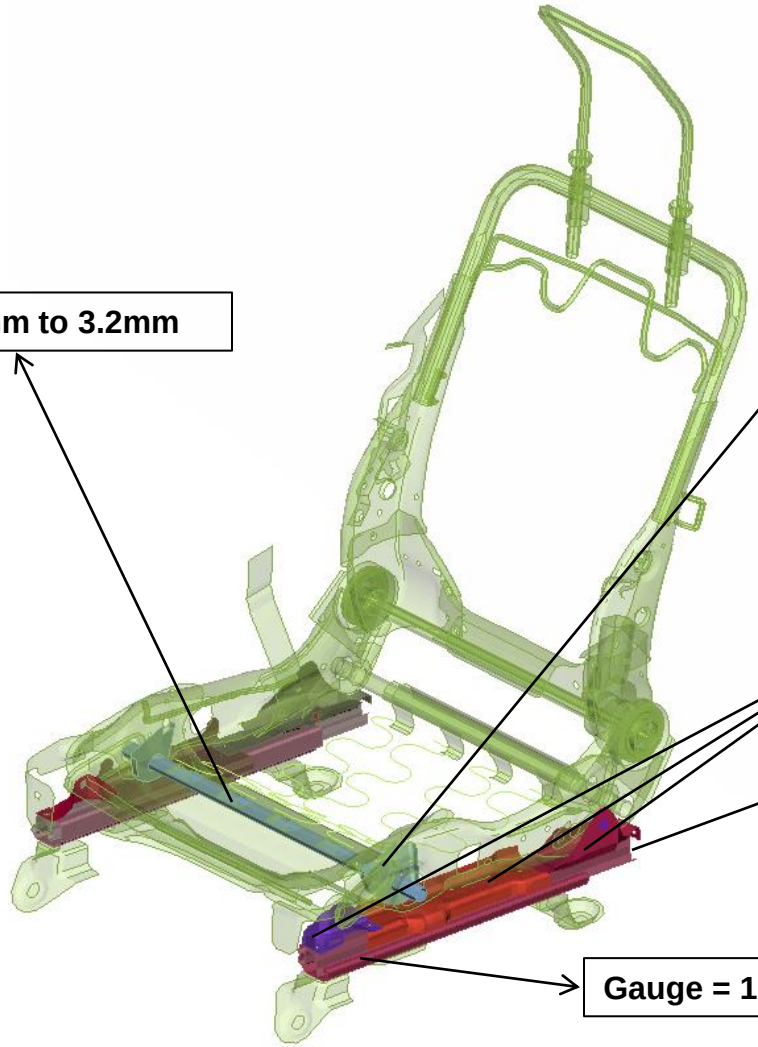
1: FAT BioRID-2 v3.8.1 - mm ms kg
Loadcase 1 : Time = 0.000000 : Frame 1





FMVSS301 Sled Test – Power Seat Countermeasures

Critical components that affect Seat back deflection



Gauge = 2.7mm to 4mm
IF 260-410 to DP500-800

Gauge = 2mm to 3.2mm

Gauge = 1.5mm to 3mm
IF 260-410 to DP500-800

Gauge = 1.93mm to 2mm
IF 260-410 to DP500-800

Mass Increase= 1.69Kg

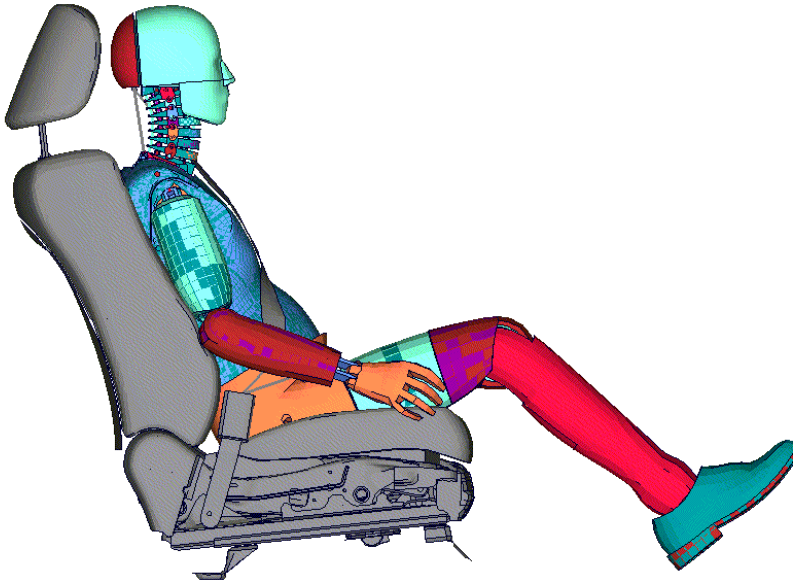
Gauge = 1.45mm to 2mm

FMVSS301 Sled Test – Power Seat
Baseline vs Countermeasure

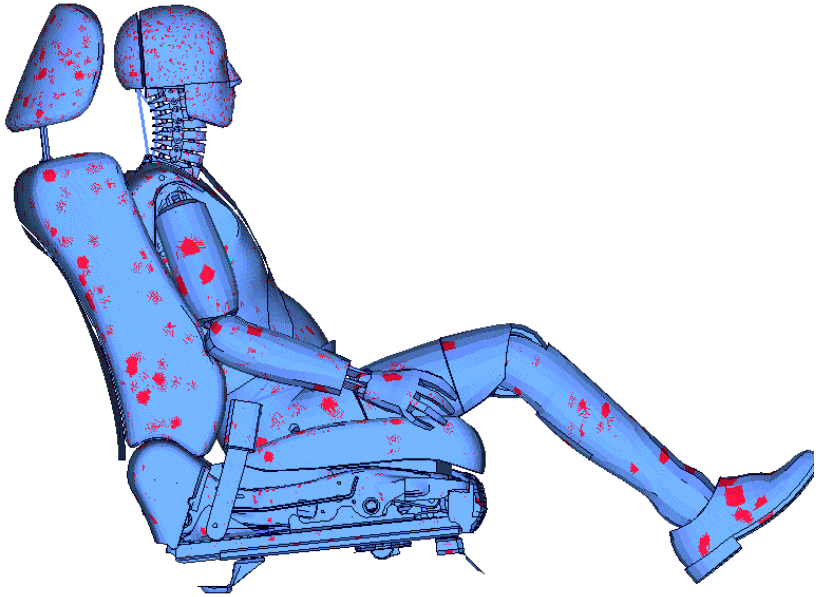
Increasing the Gauge and Grade of bottom seat frame reduces the Seat back angle

Baseline

Countermeasure



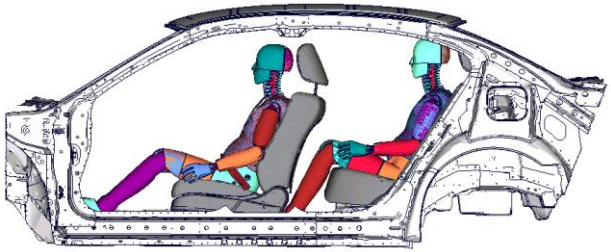
Slot 0: FAT BioRID-2 v3.8.1 - mm ms kg - State 1 at time 0.000000



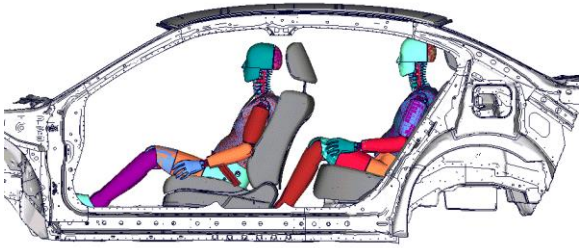
Slot 0: FAT BioRID-2 v3.8.1 - mm ms kg - State 1 at tim

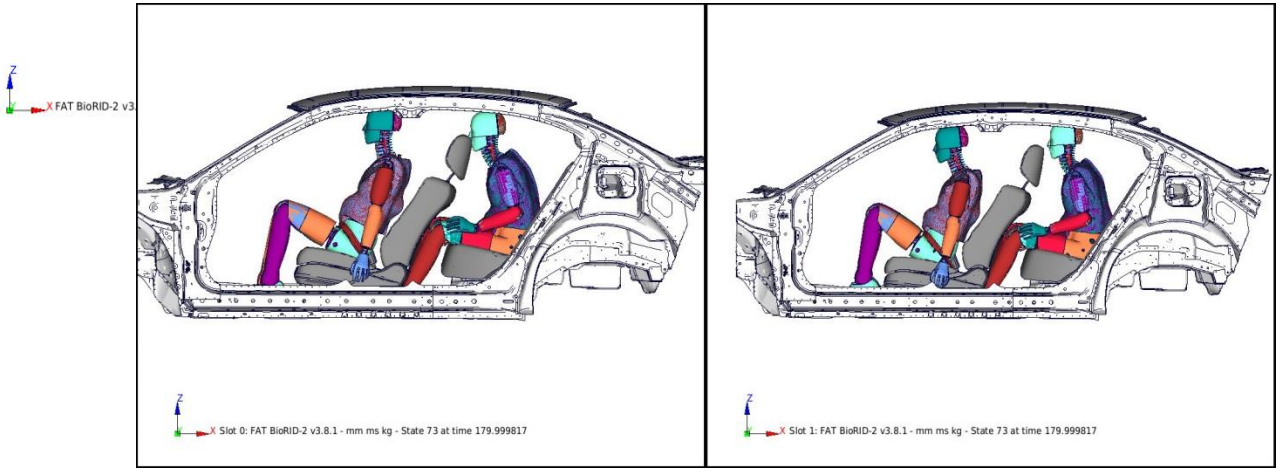
FMVSS301 Sled Test – Power Seat
Baseline vs Countermeasure

Baseline



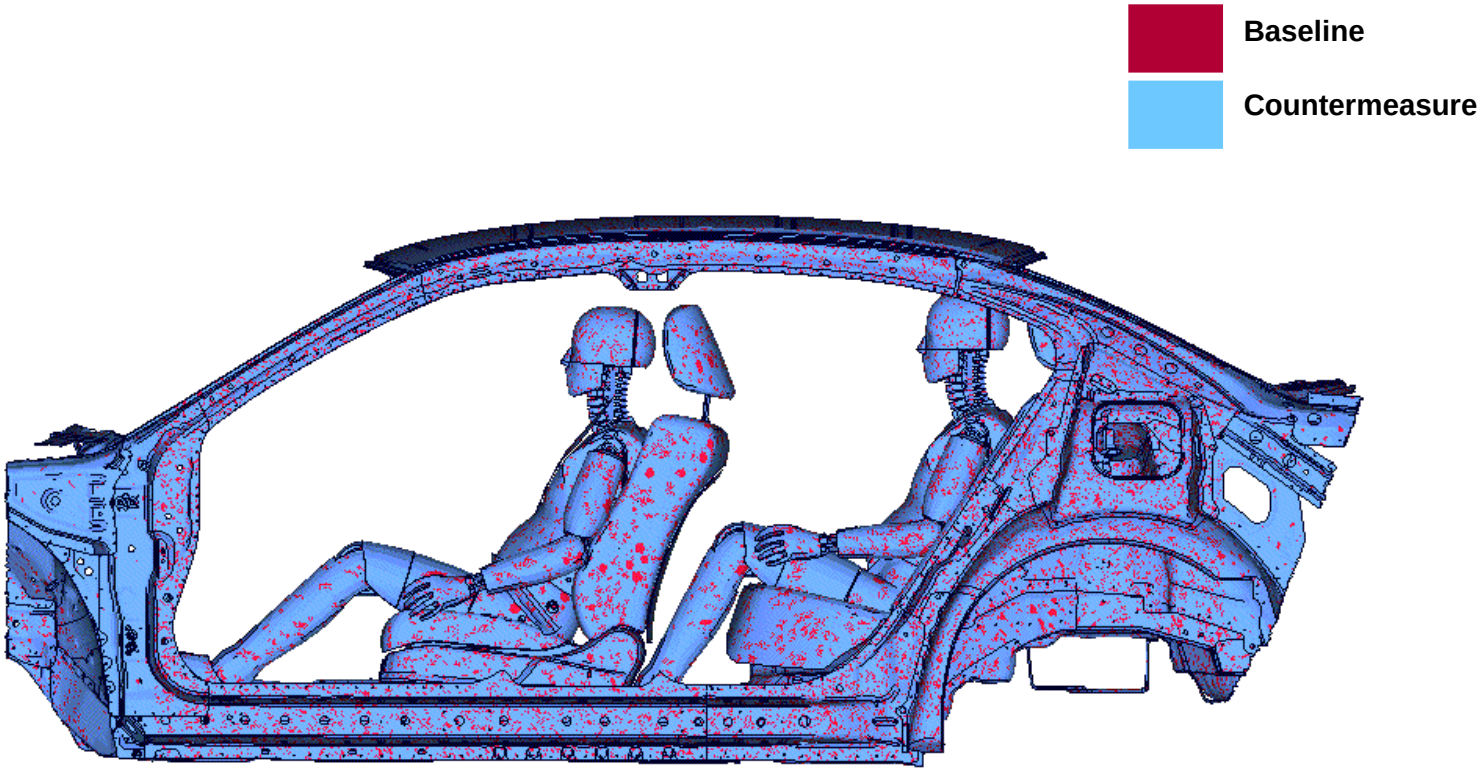
Countermeasure



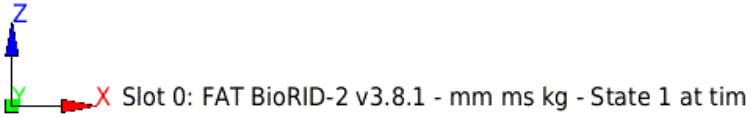


Max. Seat Back angle Test = 38.5 degrees
Max. Seat Back angle Baseline = 37.7 degrees
Max. Seat Back angle Countermeasure = 35.1 degrees

FMVSS301 Sled Test– Power Seat
Baseline vs Countermeasures

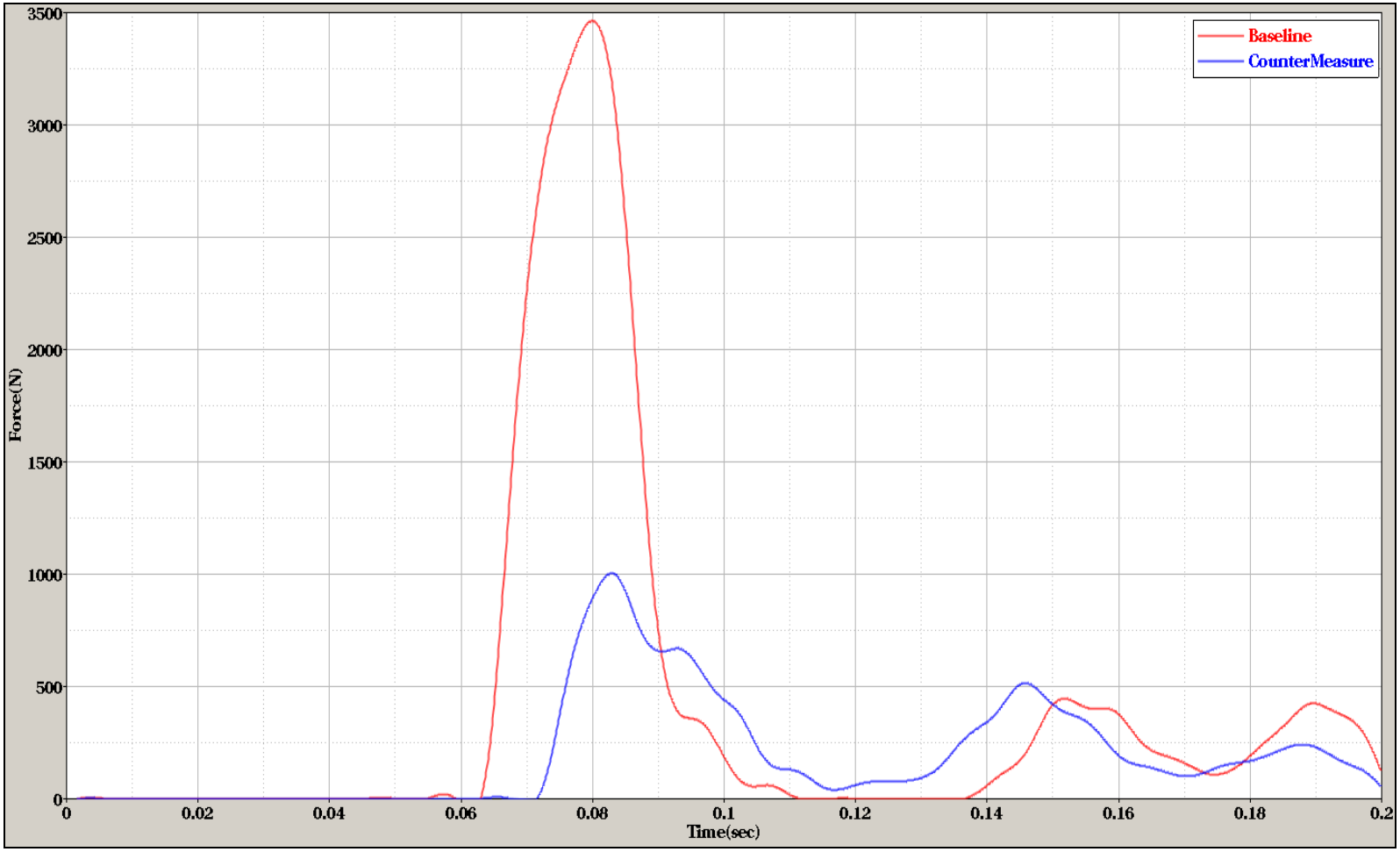


Overlay Comparison of Baseline and Countermeasure

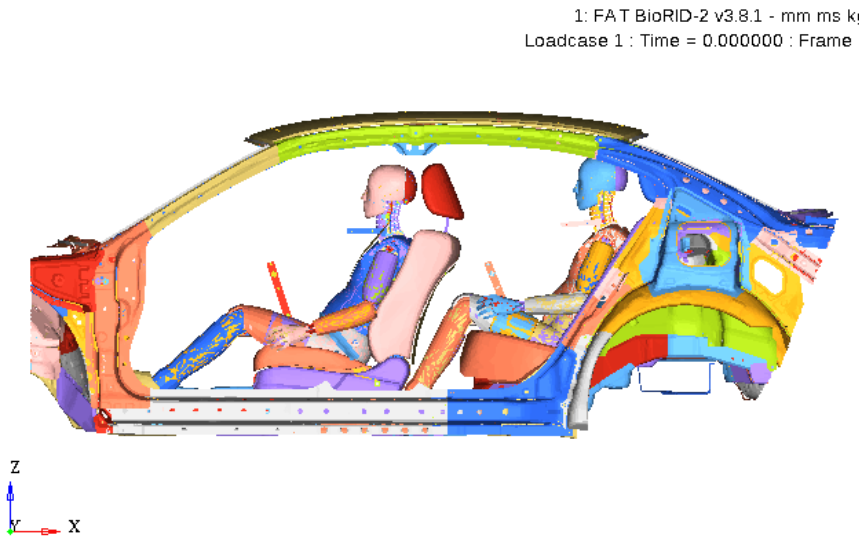


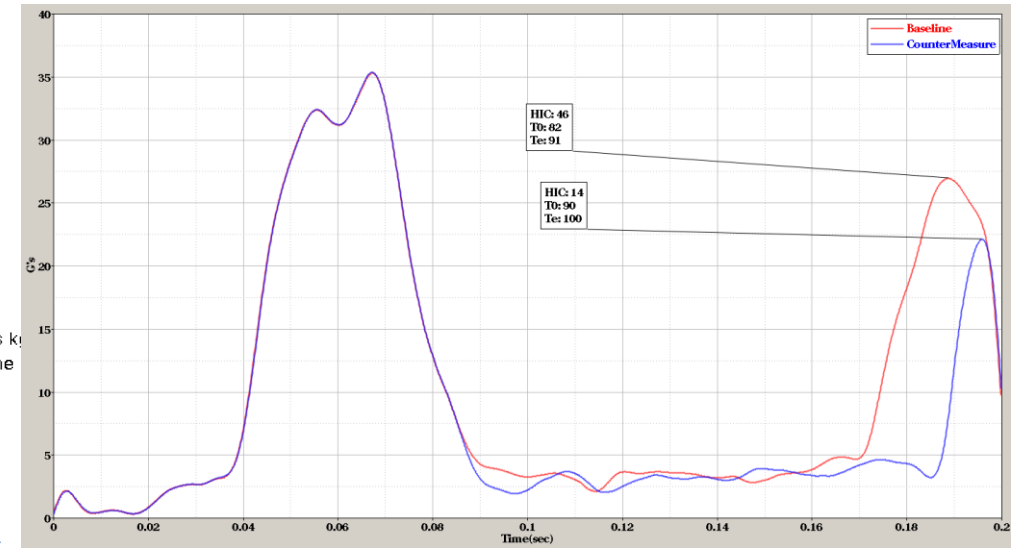
FMVSS301 Sled Test– Power Seat Baseline vs Counter Measures

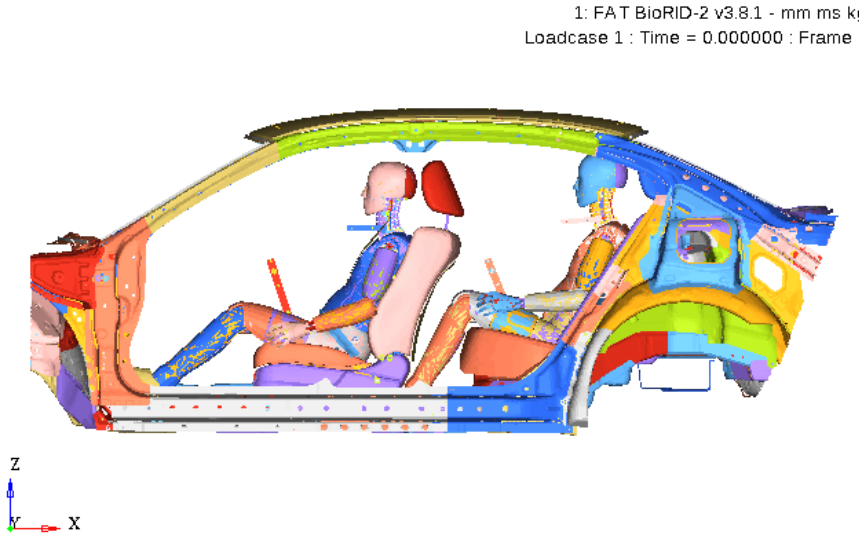
Knee Impact force of Front Seat on Rear Seat Passenger



FMVSS301 Power Seat Comparison with Baseline vs Countermeasure

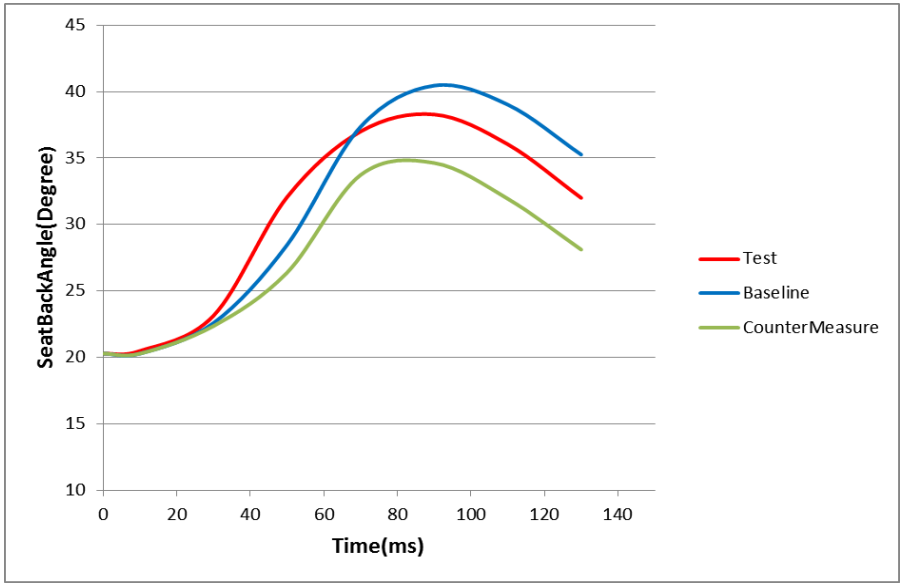




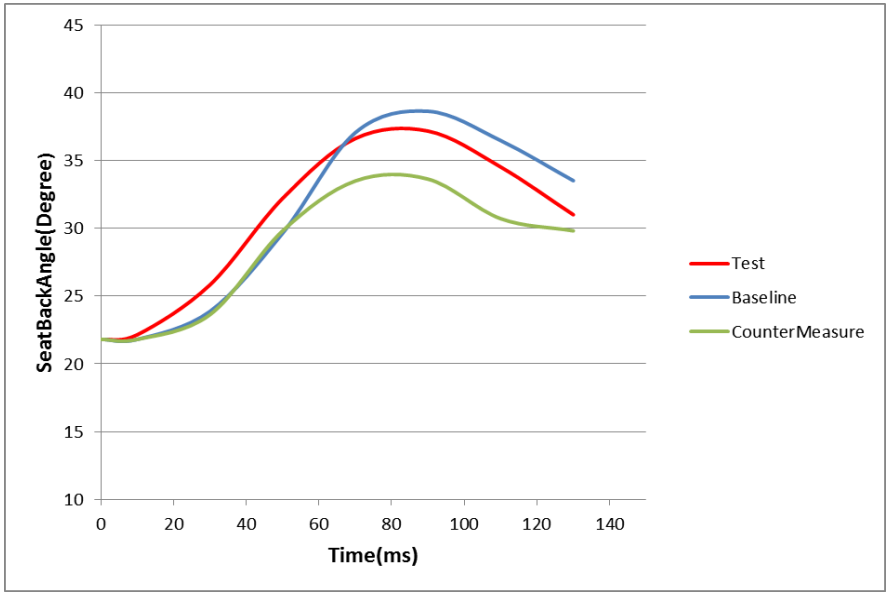


FMVSS301 Seat Back Angle for Manual Seat and Power Seat

Manual Seat



Power Seat



The deflection of the seat back is lower compared to the test and baseline reducing the Rear seat passenger Injury.

Seat back strength comparison Summary

Manual Seat

Key Criteria	EDAG Targets	Test	Baseline	Countermeasure
Max. Seat Back Angle(degree)	<35	38.4	39	35.2
Passenger Knee Clearance	>10	N/A	8.06	27.68
Max. Passenger Knee Impact Force (kN)	<1.5	N/A	5	3.1

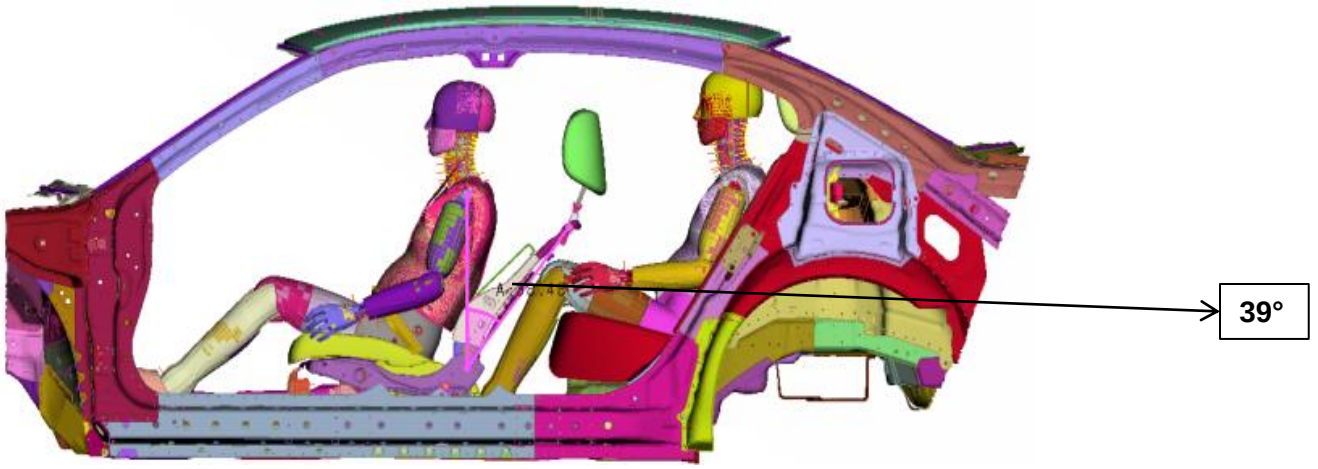
Power Seat

Key Criteria	EDAG Targets	Test	Baseline	Countermeasure
Max. Seat Back Angle(degree)	<35	38.5	37.7	35.1
Passenger Knee Clearance	>10	N/A	3.76	17.23
Max. Passenger Knee Impact Force (kN)	<1.5	N/A	3.5	1

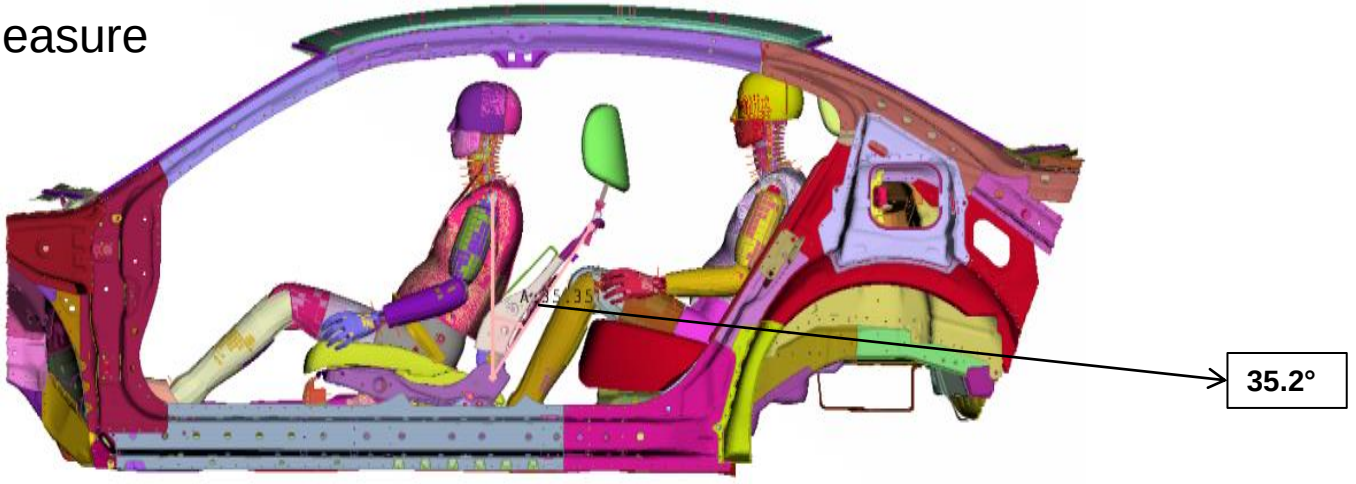
The Femur fracture force tolerance is 7.6 +/- 1.6kN

Seat Back Angle Measurement
Countermeasure Manual Seat

Baseline



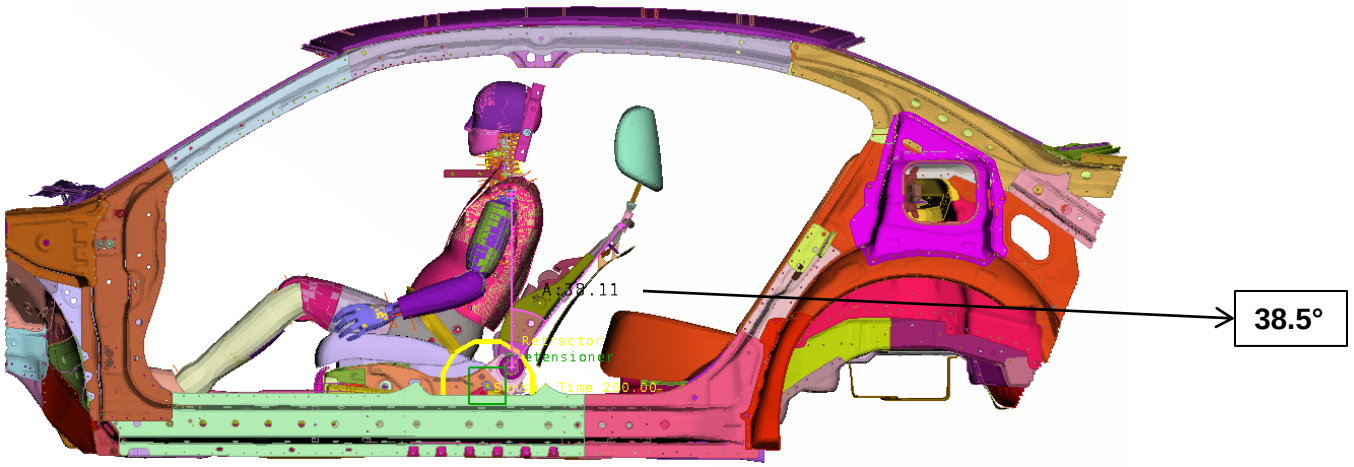
Countermeasure



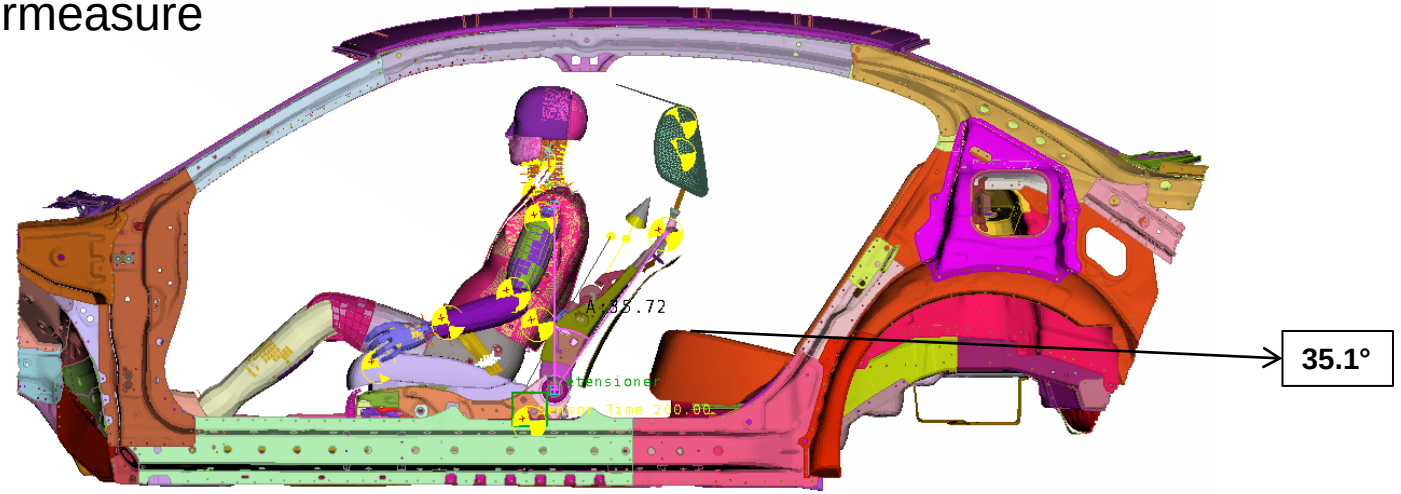
The Countermeasure has improved deflection of the Seat back

Seat Back Angle Measurement
Countermeasure Power Seat

Baseline

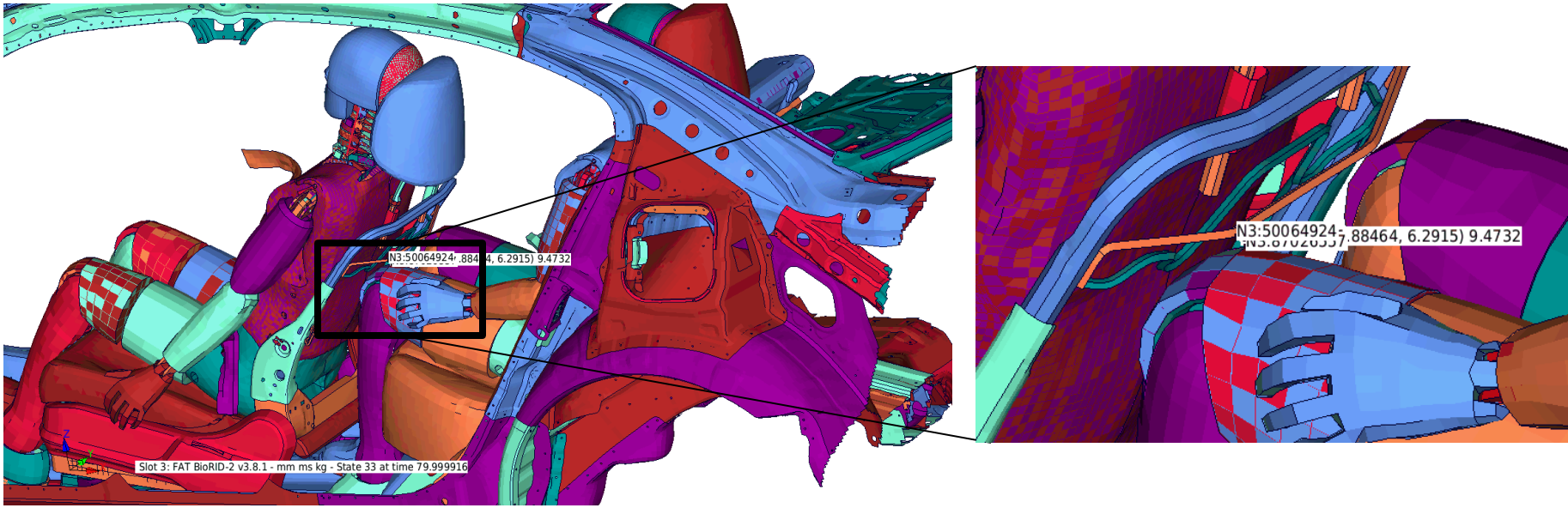


Countermeasure



The Countermeasure has improved deflection of the Seat back

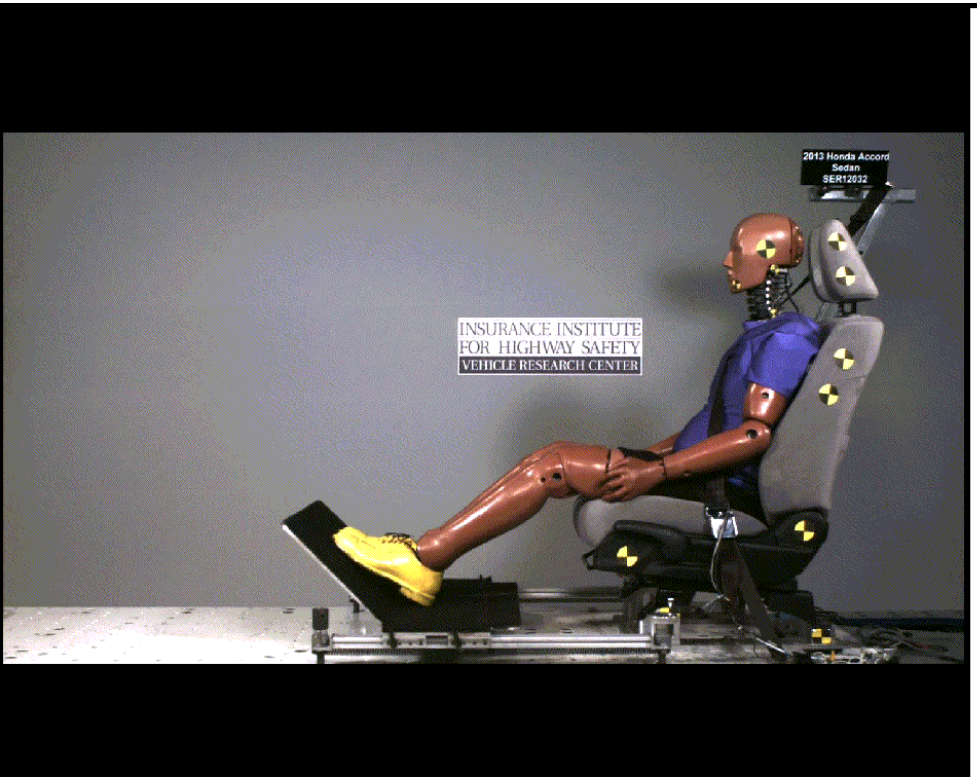
Maximum Passenger Knee Clearance

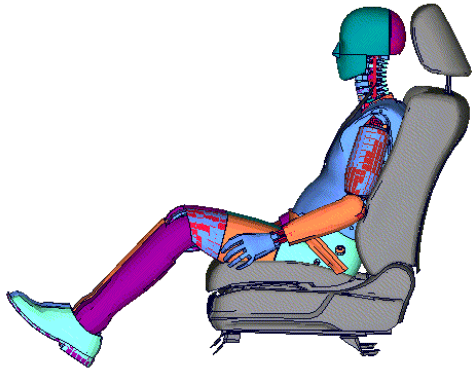


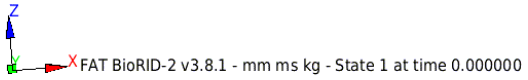
The Measurement is made between the Passenger Knee and cross member of the Front seat

Countermeasure Validation

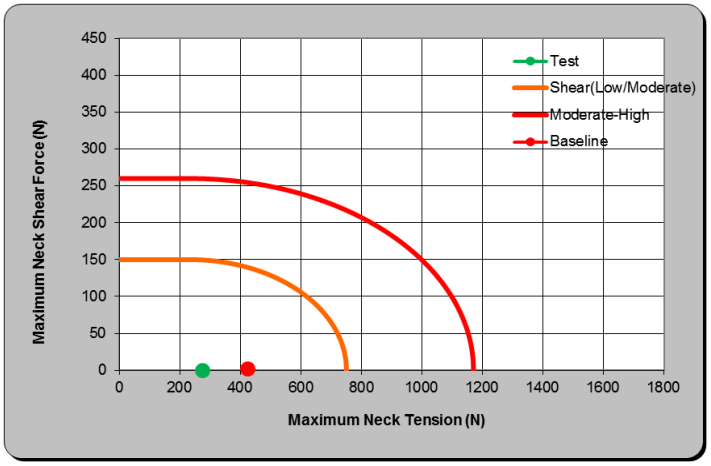
IIHS Head Restraint –Test Vs FEA
Manual Seat



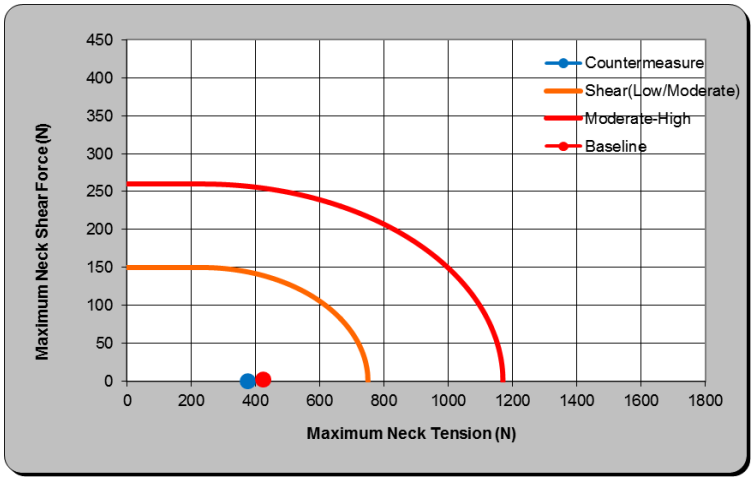




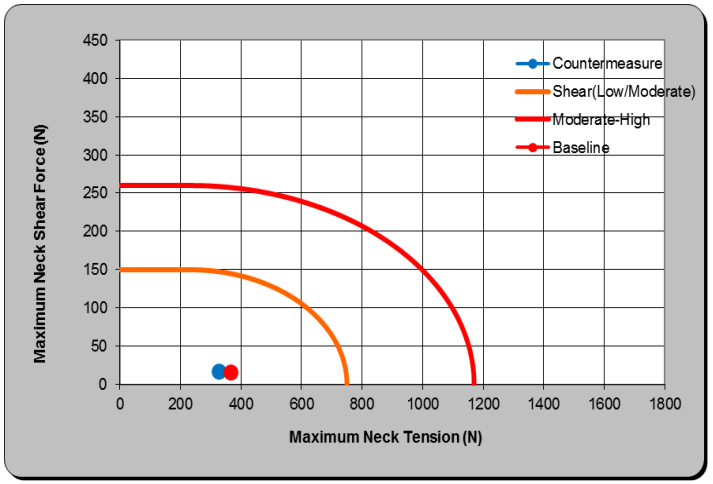
IIHS Head Restraint Test Neck Injury Rating Validation Summary



IIHS Vehicle Seat Head Restraint Test – Neck Injury Rating, Baseline vs. Test

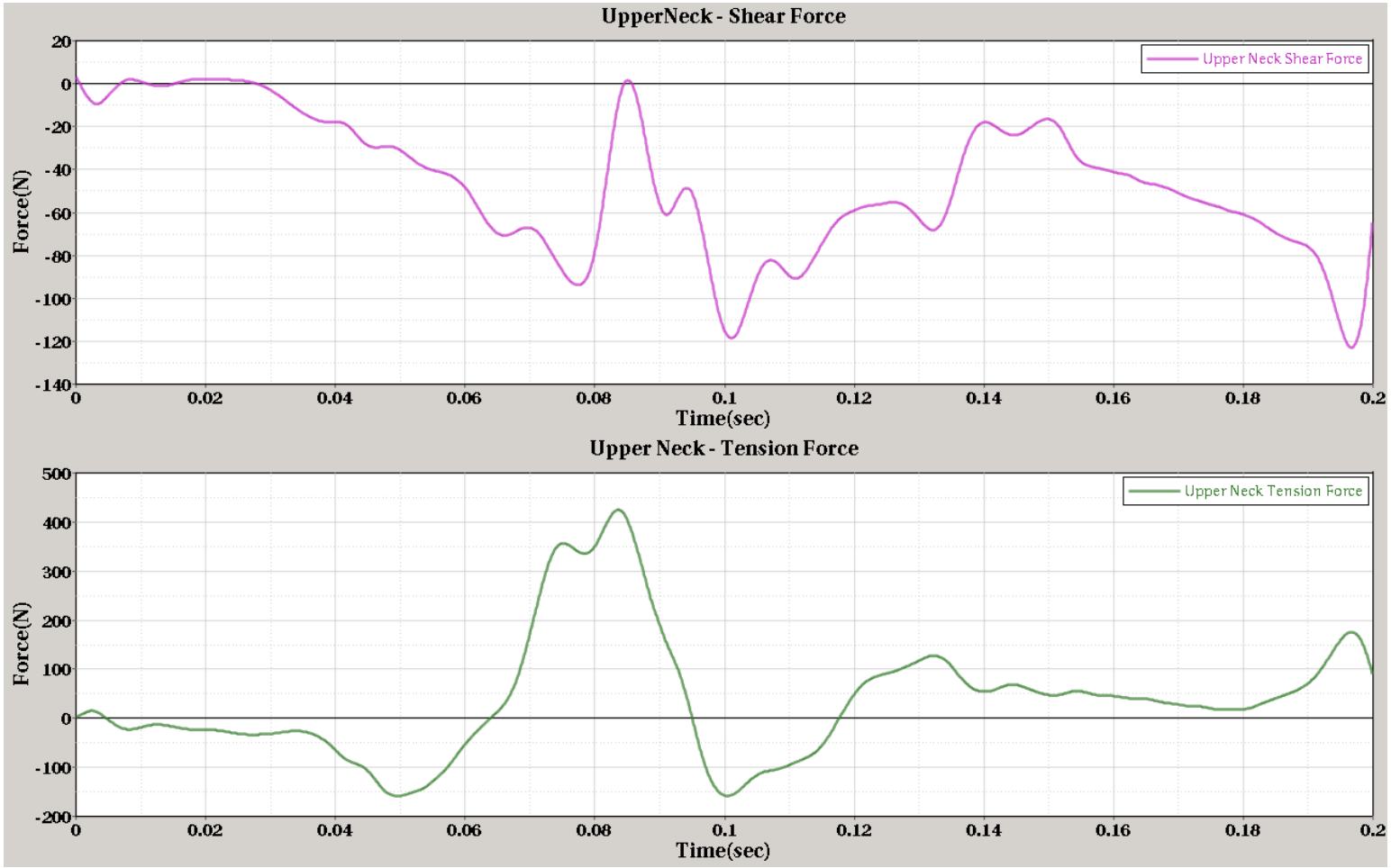


IIHS Neck Injury Rating Chart – Countermeasure vs. Baseline (Manual Seat)

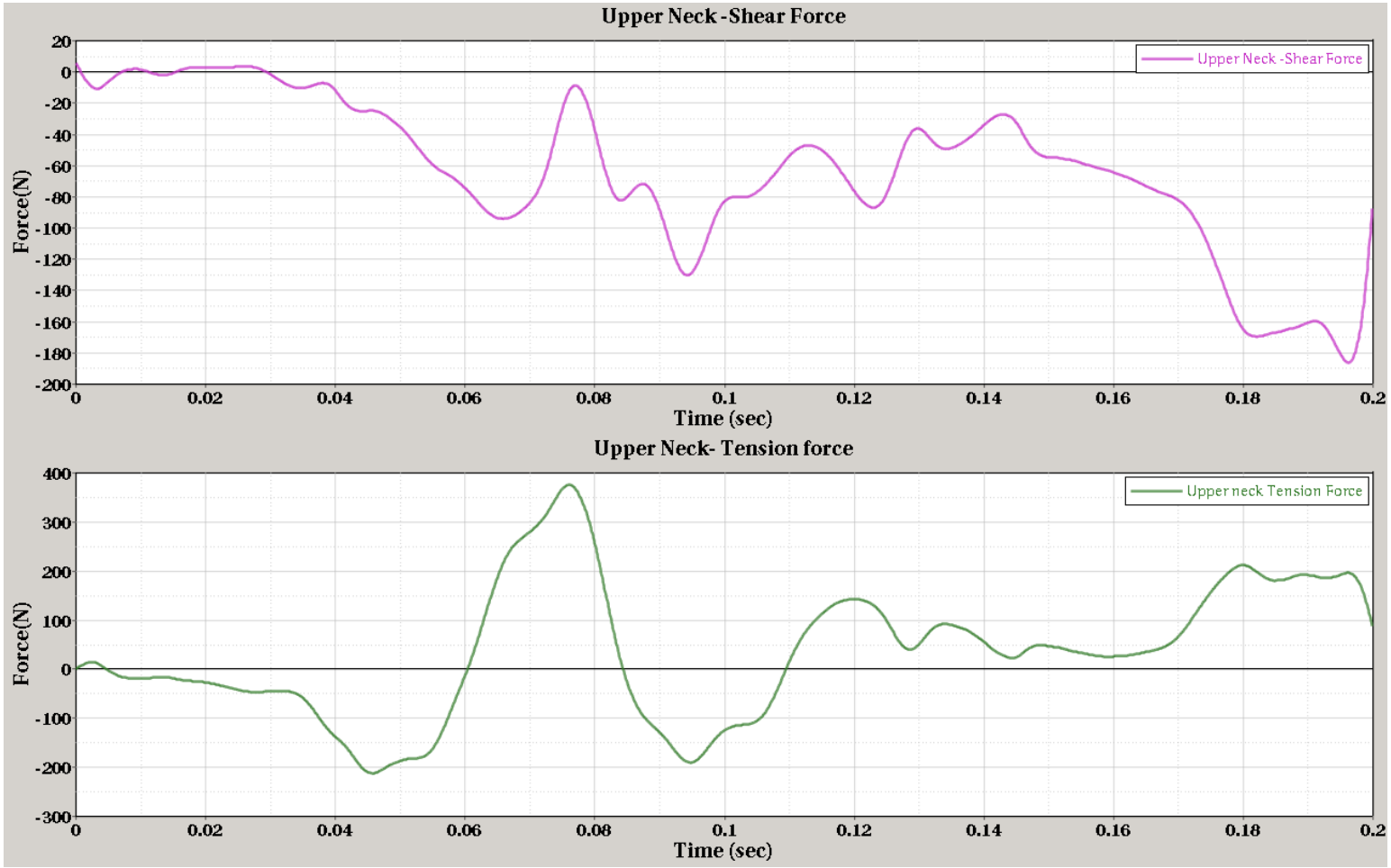


IIHS Neck Injury Rating Chart – Countermeasure vs. Baseline (Power Seat)

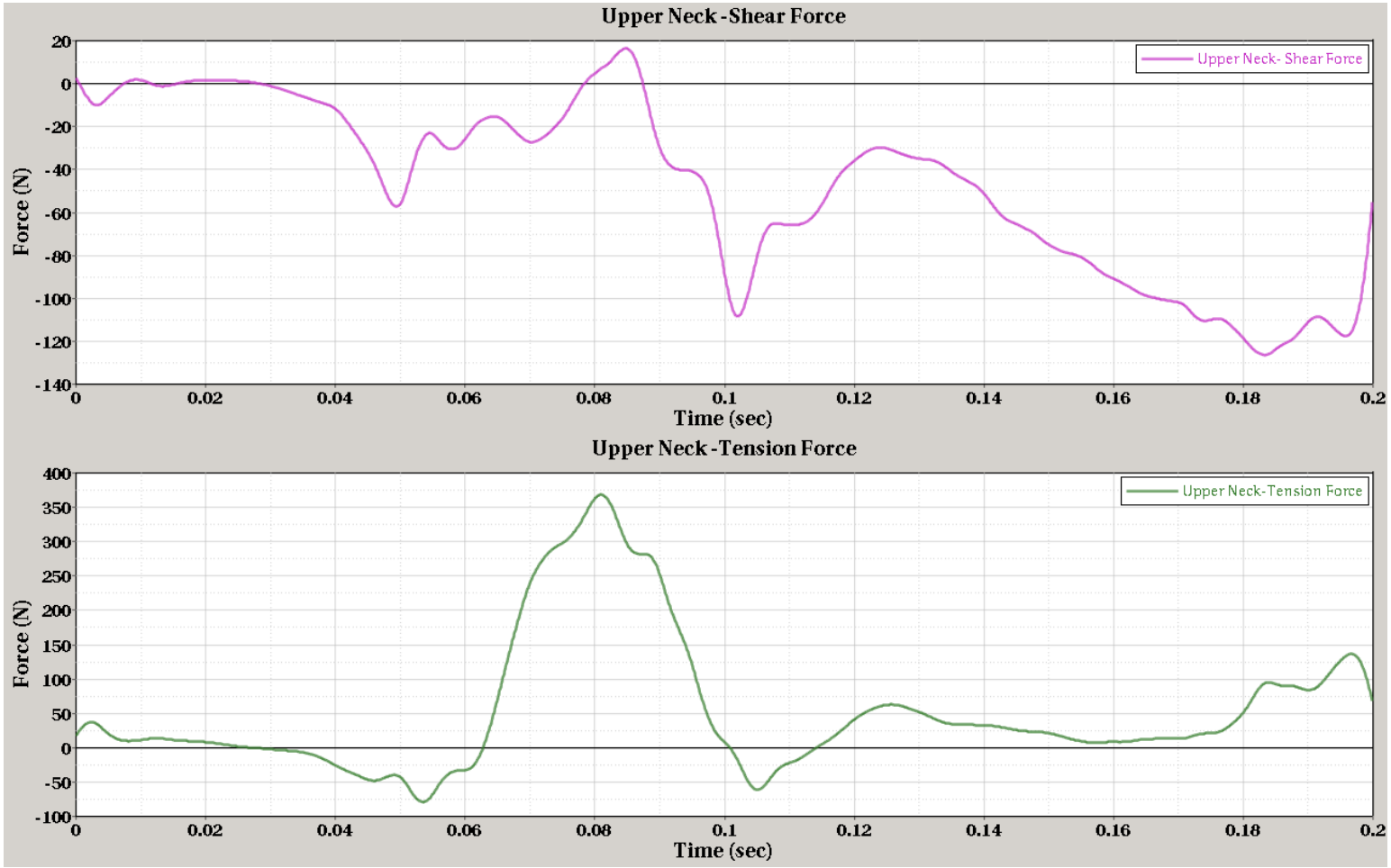
IIHS Head Restraint Test Neck Injury Rating
Upper neck forces – Manual Seat (Baseline)



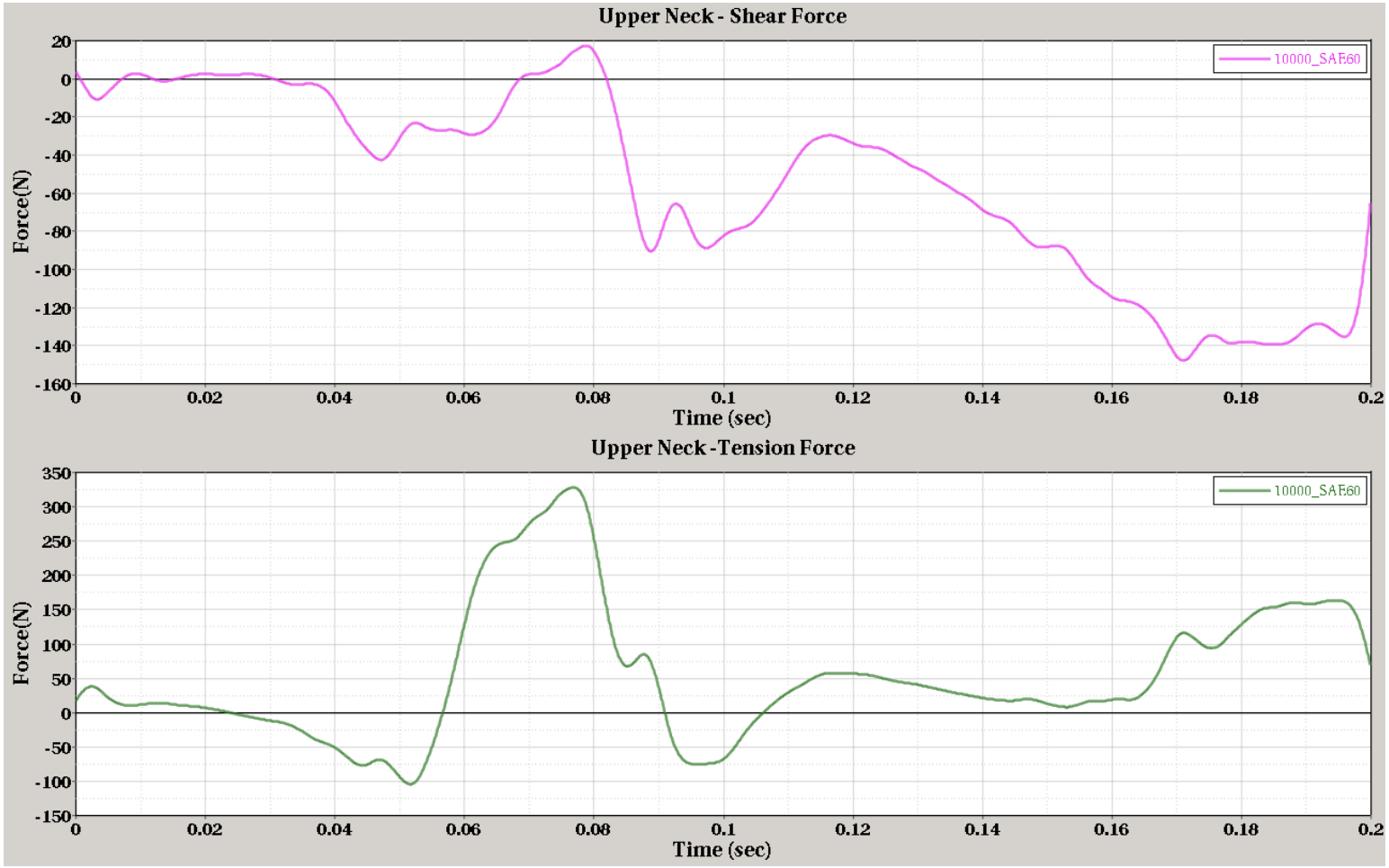
IIHS Head Restraint Test Neck Injury Rating
Upper neck forces – Manual Seat (CM)



IIHS Head Restraint Test Neck Injury Rating
Upper neck forces – Power Seat (Baseline)



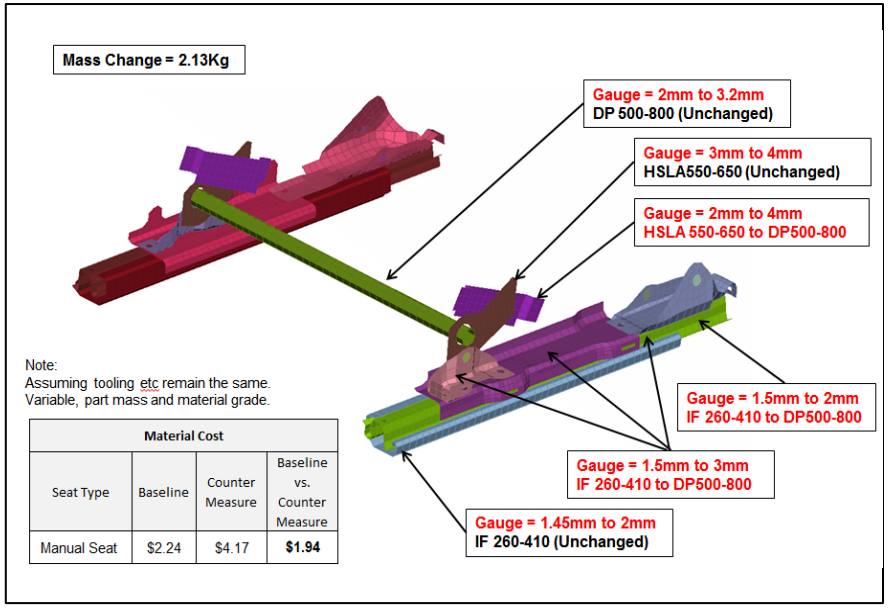
IIHS Head Restraint Test Neck Injury Rating
Upper neck forces – Power Seat (CM)



Cost Estimation

Cost Estimate for Manual Seat and Power Seat after Countermeasure

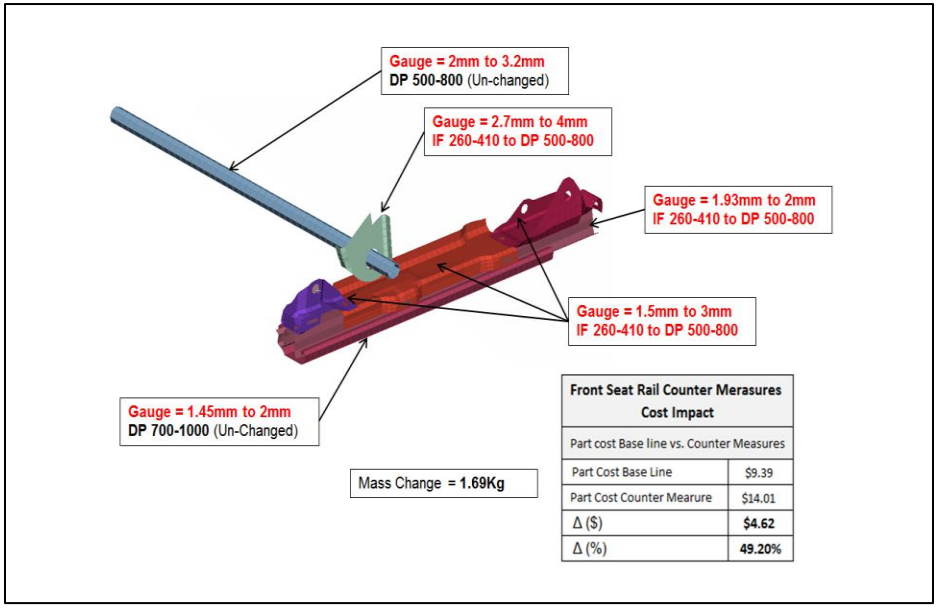
Manual Seat



Note:
Assuming tooling etc remain the same.
Variable, part mass and material grade.

Material Cost			
Seat Type	Baseline	Counter Measure	Baseline vs. Counter Measure
Manual Seat	$2.24	$4.17	**$1.94**

Power Seat



Front Seat Rail Counter Merasures Cost Impact	
Part cost Base line vs. Counter Measures	
Part Cost Base Line	$9.39
Part Cost Counter Mearure	$14.01
Δ ($)	**$4.62**
Δ (%)	**49.20%**

No.	Description	Manual Seat	Power Seat
1	Baseline seat weight (kg)	18.81	23.41
2	Countermeasure seat weight (kg)	20.94	25.10
3	Baseline weight of parts affected (kg)	3.87	4.13
4	Countermeasure weight of parts affected (kg)	6.00	5.82
5	**Δ weight (kg)**	**2.13**	**1.69**
6	Baseline cost of parts affected	$2.24	$ 9.39
7	Countermeasure cost of parts affected	$4.17	$ 14.01
8	**Δ cost**	**$1.94**	**$ 4.62**
9	Cost / kg increase	$0.91	$ 2.73

Illustration of different occupants

Injury potentials for different occupant
(Illustration Only)

Rear Seat Passenger dummies with max. seat back deflection

Illustration of Front Seat Interaction on 5th %ile Rear Seat Occupant

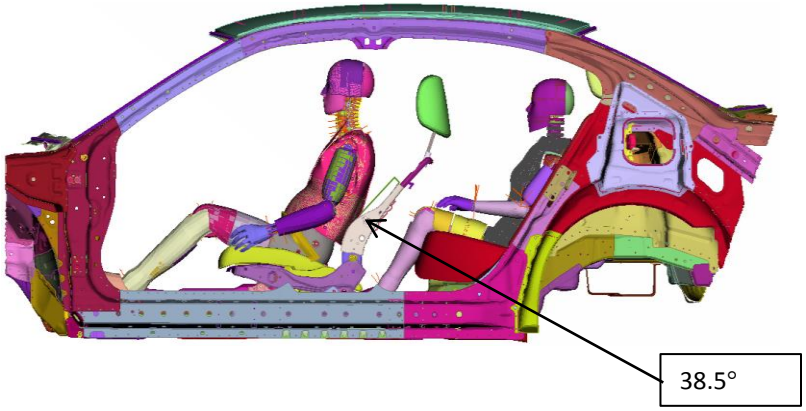


Illustration of Front Seat Interaction on 95th %ile Rear Seat Occupant

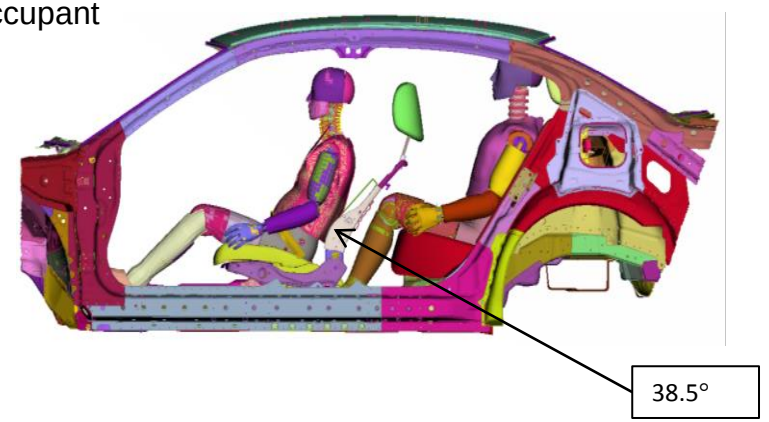
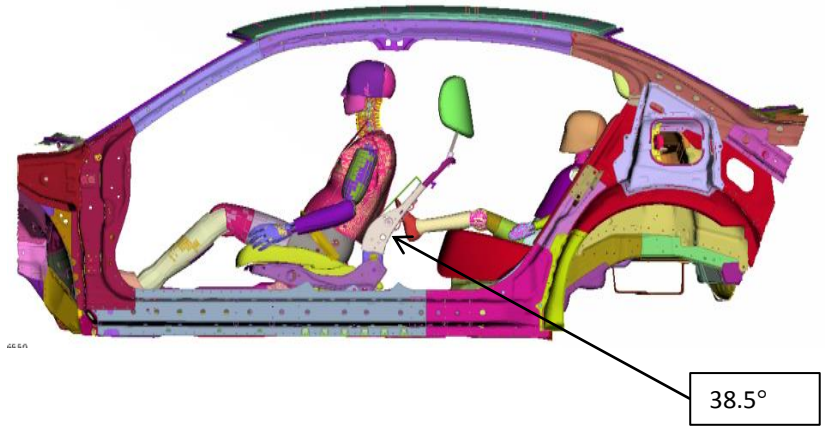


Illustration of Front Seat Interaction on Child Rear Seat Occupant



Current seat design will cause injuries to 50th, 95th and Child passengers
This study confirmed the need for seat strength improvements

Project Summary & Conclusion

- Honda Accord MY2014 Vehicle was selected
- CAE models of front seats were developed and validated
  - Quasi-static seat back pull test was conducted to correlate seat FEA models
  - Dynamic FMVSS 301 sled test was conducted to develop CAE model for seat back strength improvement study
- Seat back strength improvement areas were identified by necessary countermeasures
  - Gauge and Grade (2G) updates were primary tool for countermeasures
  - Modifications of seat back components showed little improvement
  - Modifications of seat bottom components revealed the target improvements
    - Seat back angle to be <35°, which is <20° from test angle.
    - Rear seat passenger knee clearance to be >10mm
    - Rear seat passenger knee impact force to be <1.5 kN
- Cost impact of seat modifications was estimated
  - $1.94 cost increase for manual seat gauge and grade modifications
  - $4.62 cost increase for power seat gauge and grade modifications
- Visual illustration of different rear seat passenger with >38.5° of front seat deflection showed injury potentials
  - Need for front seat strength improvement
  - Proposed target measure: max. dynamic seat back deflection to be <35°

Future Work

- The scope of the work is limited to the development front FEA models for seat back strength study which will help to re-examine the seat back improvements requirements and FMVSS regulation.
- This study provides directional outcome in terms of test proposals and countermeasure recommendation limited to 2G optimization and 50th %ile occupants.
- There is no major design updates of the seat components as the seat performance targets should be evaluated for different occupant types
- Extensive study will be needed for design updates and more countermeasures by including different occupant types.
- Since the proposed countermeasures are on seat bottom frame only, it shows an advantage to the seat manufacturers of keeping the seat back frame characteristics unchanged. However additional studies are recommended to investigate the seat back characteristics in high speed frontal crash events by integrating the proposed seat bottom countermeasures.
- Even though this study considered the mass changes within <15%, lightweighting approach by using gauge, grade and geometry optimization (3G Opt) and multi disciplinary design optimization (MDO) technics will reveal optimized countermeasures.

Project Tasks, Deliverables & Timing

Item No.	Section No.	Deliverables/Milestones	Due Date/After Task Order Award (ATOA)
1	C.5.1.1	Kick-off meeting (M)	2 weeks ATOA
2	C.5.1.1	Revised Technical Plan (D)	3 weeks ATOA
3	C.5.1.1	COR (TO) comments due to Contractor	4 weeks ATOA
4	C.5.1.1	Contractor incorporates COR (TO) recommended changes (if necessary) (D)	5 weeks ATOA
5	C.5.1.2	Monthly Progress Reports (D)	10th day of each month, following the month being reported
6	C.5.1.3	Conference Calls or Web Meetings (M)	Within one (1) week of submitting the monthly report
7	C.5.5	Modified seat design to reduce dynamic motion of seat back(M)	19 weeks ATOA
8	C.5.6	Draft Final Report (D)	20 weeks ATOA
9	C.5.6	Final Project Briefing (M)	20 weeks ATOA
10	C.5.6	COR (TO) comments due to Contractor (M)	24 weeks ATOA
11	C.5.7	Final Report (D)	26 weeks ATOA

09-27-2017

07-27-2018

07-24-2018

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