



THOR-50M Frontal Crash Tests: NCAP and FMVSS No. 208

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THOR-50M Background

THOR - Test Device for Human Occupant Restraint



THOR-50M Background

- *Development since 2001*
- *Updated package drawing 2023*
- *Multiple updates to improve biofidelity*
- *Advanced sensors*
- *Multiple points of data collection*
- *Repeatable testing*
- *Rulemaking*



THOR-50M – Part 572 Notice of Proposed Rulemaking

Anthropomorphic Test Devices: Test Device for Human Occupant Restraint 50th Percentile Adult Male Test Dummy; Incorporation by Reference



Federal Register Notice

- 88.FR.61896, September 7, 2023

www.Regulations.gov

- Docket ID No. NHTSA-2023-0031
- Comment period closed November 6, 2023

THOR-50M – Support for FMVSS No.208

Rulemakings

FMVSS No. 208 THOR-50M Compliance Option

RIN: 2127-AM21

U.S. New Car Assessment Program – NHTSA is considering THOR-50M implementation

(No further details at this time)



THOR-50M Current Use – Standard Testing

NCAPs

- Europe
- Korea
- Australia
- China

OE Manufacturers

About 300 THOR-50M in use worldwide

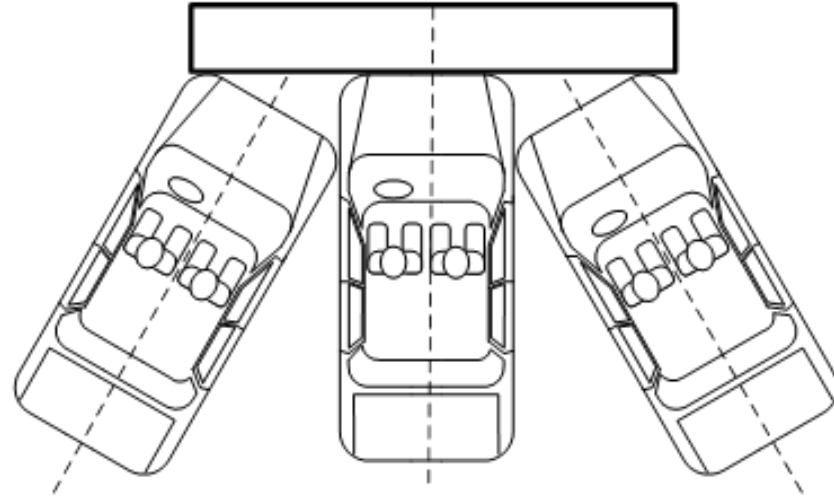
Improve future vehicle homologation



THOR-50M – Support for FMVSS No.208

Previous testing (2021)

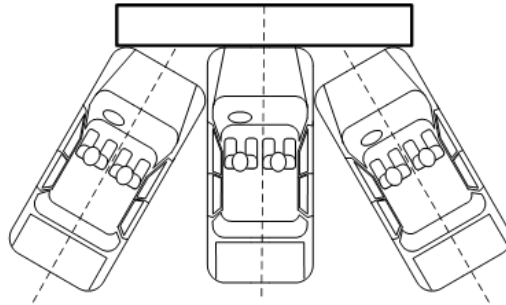
- *40 km/hr and 48 km/hr*
- *Flat and 30 deg angle barriers*
- *Far and near side*
- *Unbelted*
- *N = 19 tests*
- *THOR – 50M Seating procedure*
- *Purpose: Useability and durability*



THOR-50M – Support for FMVSS No.208

Previous testing results (2021 cont.)

- *No broken parts or replacements required through series*
- *Positioning was highly repeatable*
- *Sensor anomalies consistent with HIII*
- *Results indicated THOR-50M fit for use in standardized testing*

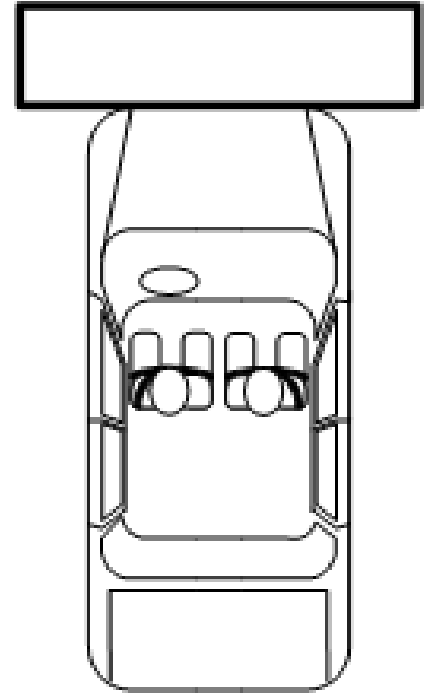


THOR-50M – Support for FMVSS No.208

Previous testing (2015)

Previous NCAP test vehicles

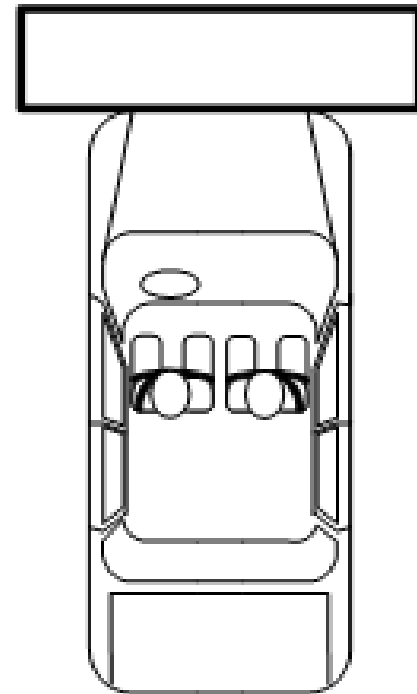
Purpose: 1 to 1 comparison to THOR-50M vs
HIII-50M ATD metrics within the vehicles
representing the U.S. fleet at that time



THOR-50M – Support for FMVSS No.208

Previous testing (2015 cont.)

- Previous FMVSS No. 208 and NCAP testing
- 56 km/hr
- **Belted THOR-50M**
- **N = 15 tests**
- **2015/2016 Model Year Vehicles**
- **Matched tests with HIII-50M**
- **Driver position only**



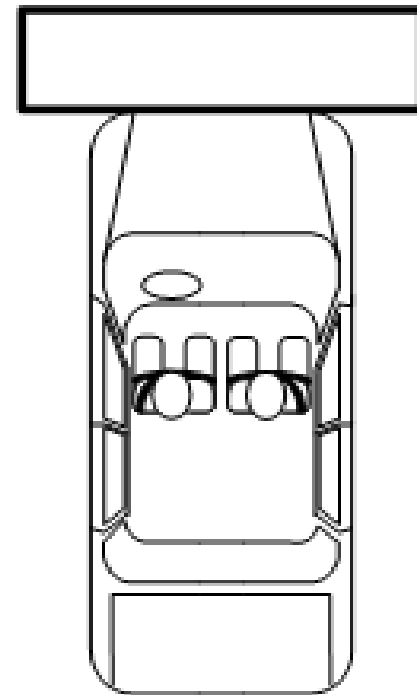
Ref: (1) Keon, T. (2016). Alternative approaches to occupant response evaluation in frontal impact crash testing. *SAE International journal of transportation safety*, 4(1), 202-217.

(2) Summers, S., Hall, I., Keon, T., & Parent, D. (2021, June). Occupant response evaluation in flat, full-frontal rigid barrier impact testing (Report No. DOT HS 813-014). National Highway Traffic Safety Administration.

THOR-50M – Support for FMVSS No.208

Current testing – (2023 cont.)

- **FMVSS No. 208 Flat frontal barrier**
- **56 km/hr**
- **Belted Driver**
- **N = 5**
- **THOR – 50M Seating procedure**
- **Driver and Passenger**
- **Varied body styles**



Test observations and results



THOR-50M TEST RESULTS

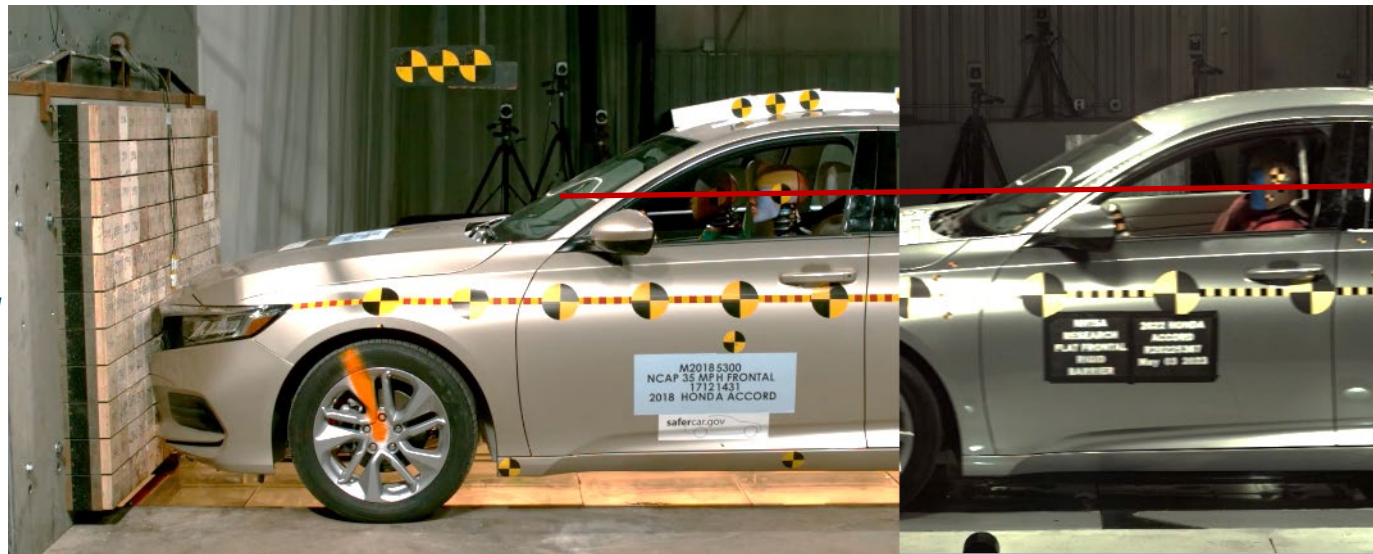
Vehicle	Test No.	Test Vel.	ATD	HIC15	BrIC	Neck Tension	Neck Comp.	Chest Deflt.	Left Femur	Right Femur	Knee AB	Lap Belt	Shoulder Belt
		km/hr	Driver			[N]	[N]	[mm]	[N]	[N]		[N]	[N]
2022 Honda Accord	14475	56	THOR-50M	321	0.68	1505	-457	43.9	-3627	-2719	Y	3948	3457
2023 Honda Accord	tbd	56	HIII-50M	203	n/a	1146	-159	17.5	-1088	-1201	Y	n/a	n/a
2018 Honda Accord	10191	56	HIII-50M	261	n/a	819	-328	18	-1027	-1503	Y	n/a	n/a
2023 Chevrolet Bolt	14476	56	THOR-50M	270	0.35	1406	-230	42.3	-653	-1231	Y	4538	3283
2022 Chevrolet Bolt	14218	56	HIII-50M	132	n/a	1035	-96	24.7	-743	-823	Y	6048	3378
2018 Chevrolet Bolt	10316	56	HIII-50M	250	n/a	1061	-76	26	-608	-833	Y	6241	3739
2023 VW ID4	14478	56	THOR-50M	281	0.34	963	-274	41.2	-460	-1433	N	n/a	4257
2021 VW ID4	11660	56	HIII-50M	169	n/a	840	-36	23	-174	-172	N	n/a	4087
2023 Tesla Model Y	14479	56	THOR-50M	135	0.45	1180	-300	41.1	-2081	-1832	Y	2988	3161
2020 Tesla Model Y	11288	56	HIII-50M	67	n/a	935	-302	18	-1327	-1901	Y	n/a	3198
2023 Ford F150 SuperCrew	14477	56	THOR-50M	315	0.51	1162	-376	49.2	-2529	-1940	Y	3180	4417
2022 Ford F150 SuperCrew HEV	14353	56	HIII-50M	367	n/a	975	-816	20.5	-644	-544	Y	n/a	n/a
2021 Ford F150 SuperCrew 4x4	10714	56	HIII-50M	275	n/a	1058	-70	21	-872	-1063	Y	n/a	n/a
2016 Ford F150 SuperCrew	9571	56	THOR-50M	250	0.53	1080	-310	39.8	-3712	-3030	N	3214	4578
2015 Ford F150 SuperCrew	9335	56	THOR-50M	205	0.58	1234	-300	39.3	-2875	-2973	N	4164	4172
2018 Ford F150 SuperCrew	9097	56	HIII-50M	263	n/a	1266	-363	21.7	-1677	-224	N	n/a	4736

THOR-50M TEST RESULTS

Observations from test series

THOR-50M

- *sits slightly higher*
- *sits slightly further rearward*



THOR-50M TEST RESULTS

*Observations from
test series*

THOR-50M

- *sits slightly higher*
- *sits slightly further rearward*

2018 & 2022 Honda Accord



THOR-50M TEST RESULTS

AB Contact

2018 & 2022 Chevrolet Bolt



HIII-50M



THOR-50M

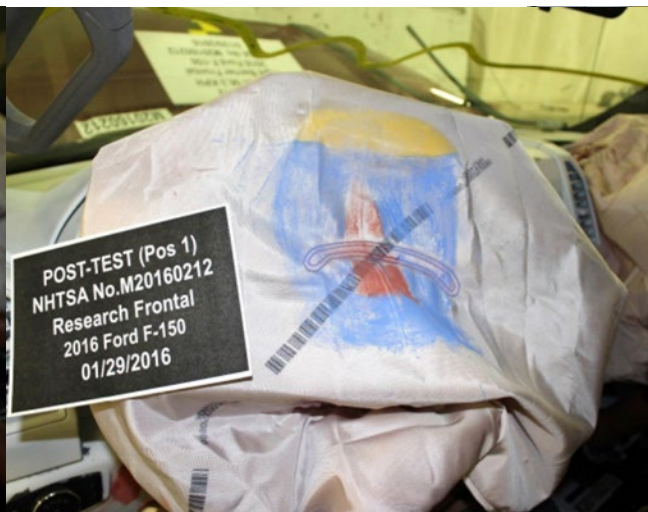
THOR-50M TEST RESULTS

AB Contact

2018, 2016 & 2015 Ford F150



HIII-50M



THOR-50M



THOR-50M

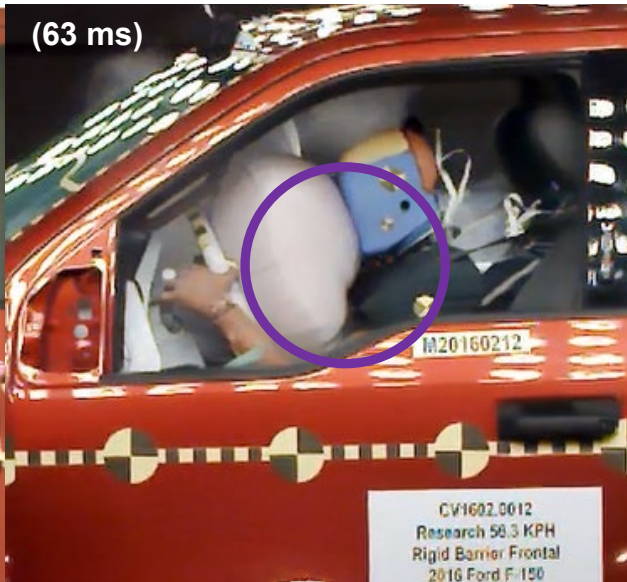
THOR-50M TEST RESULTS

AB Contact

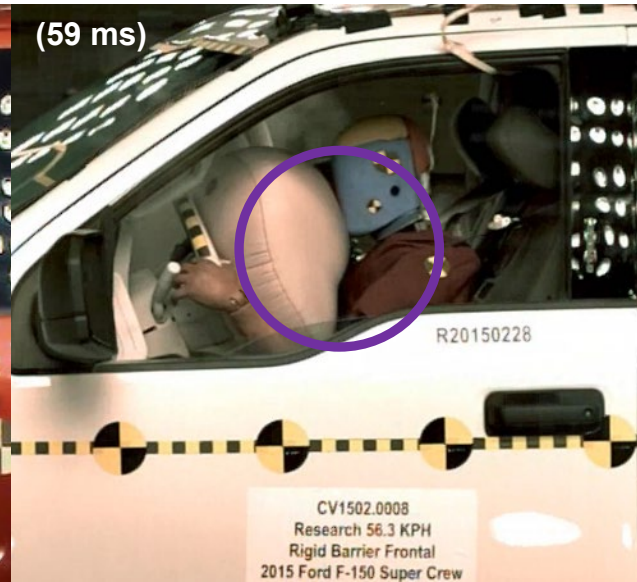
2018, 2016 & 2015 Ford F150



HIII-50M

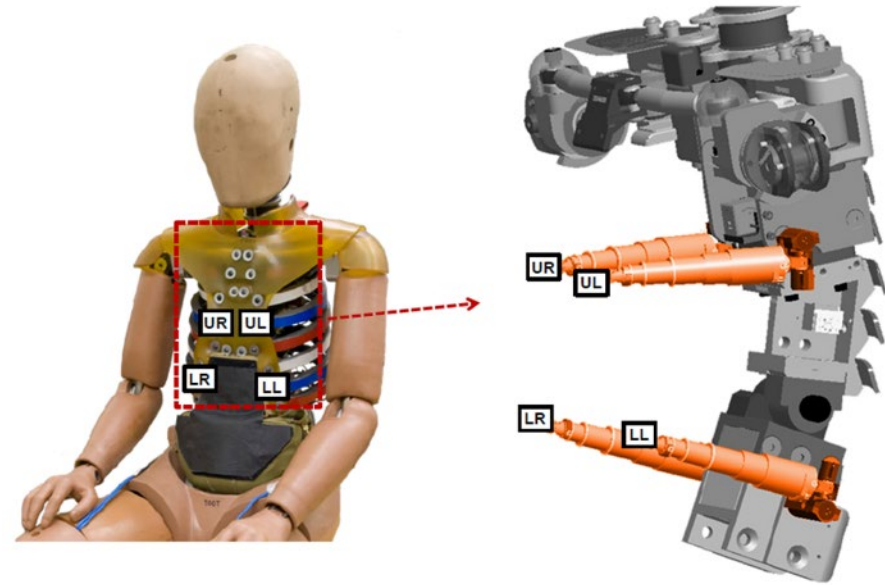
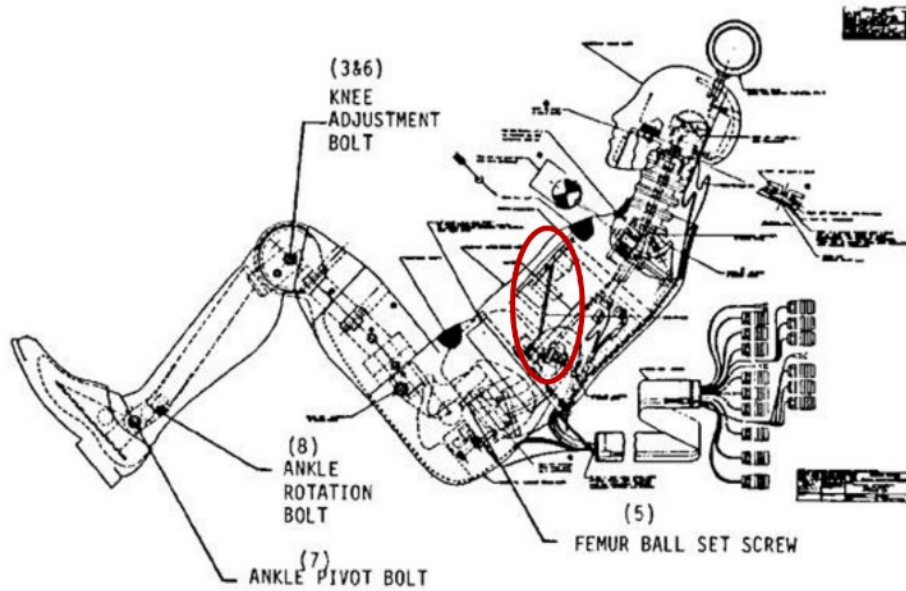


THOR-50M



THOR-50M

THOR-50M v HIII

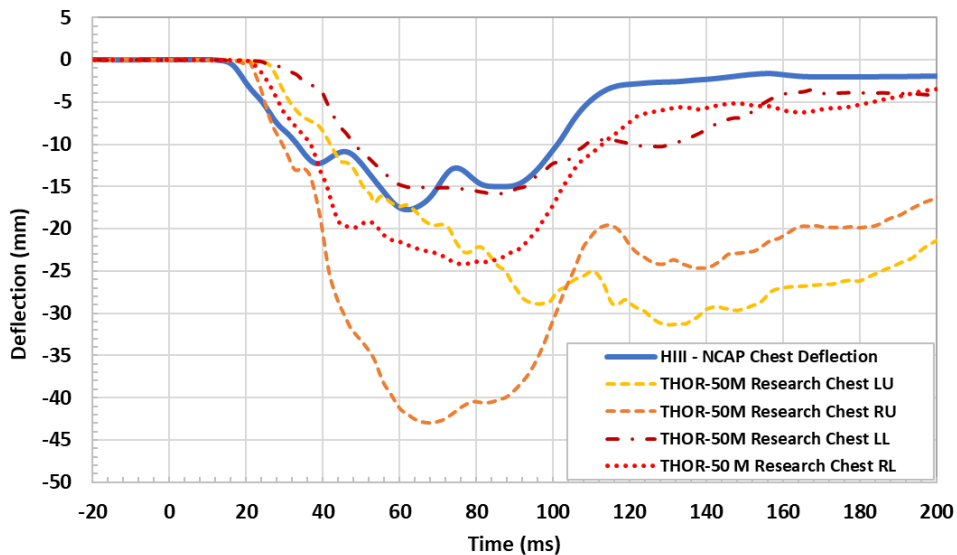


HIII-50M (l) v THOR-50M (r) thoracic deflection sensor locations

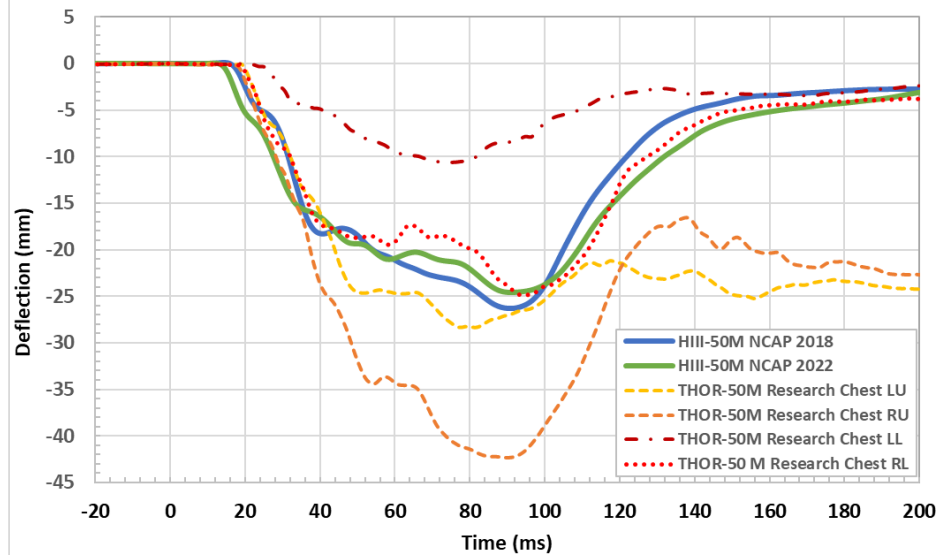
THOR-50M TEST RESULTS – Accord & Bolt

Chest Deflection - THOR-50M 4-point v HIII-50M single point

HIII v THOR Chest Deflections Accord (18 v 22)



HIII v THOR Chest Deflections Bolt (18, 22 v 23)



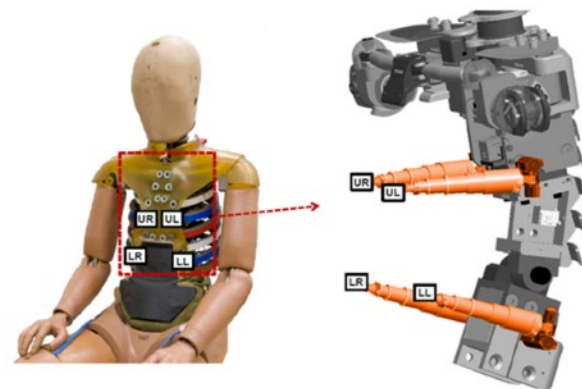
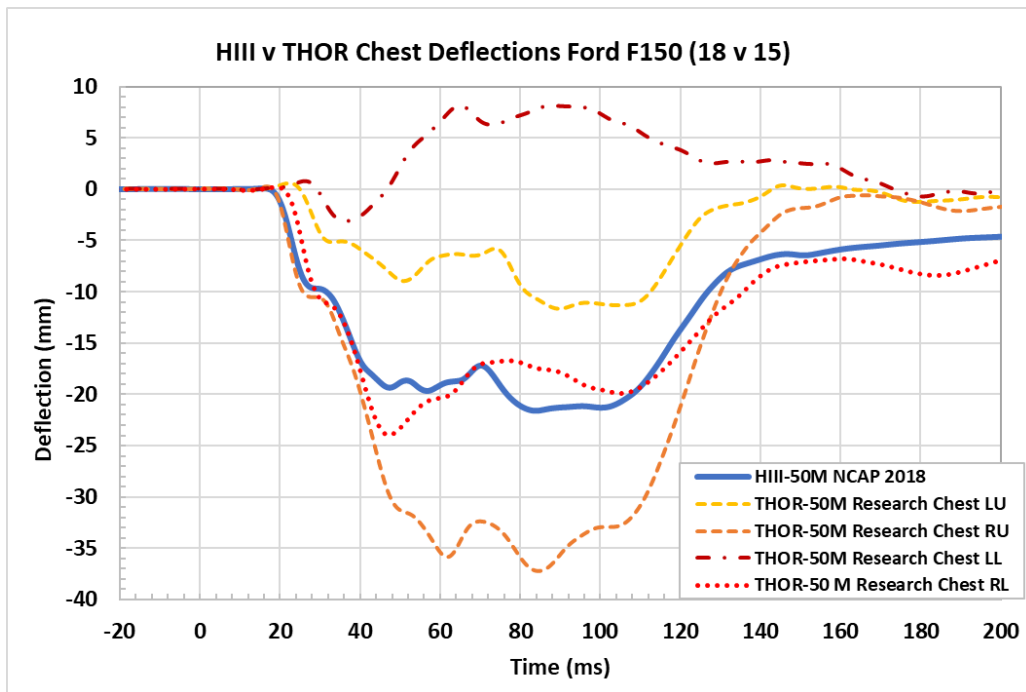
2018 vs 2022 Accord

2018, 2022 vs 2023 Bolt

THOR-50M TEST RESULTS – Sample F150

Chest Deflection - THOR-50M 4-point v HIII-50M single point

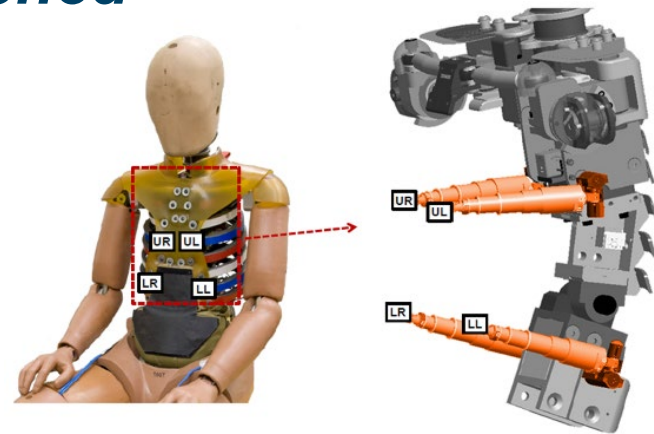
2018 vs 2015 F150



THOR-50M TEST RESULTS

Frontal barrier tests - Thorax

- *Right Upper had greatest deflection (LF)*
- *Similar trend in EuroNCAP MPDB test*
- *Right Lower and/ or Left Upper matched well with HIII-50M*



HIII-50M– 50M Frontal Barrier Chest Deflection

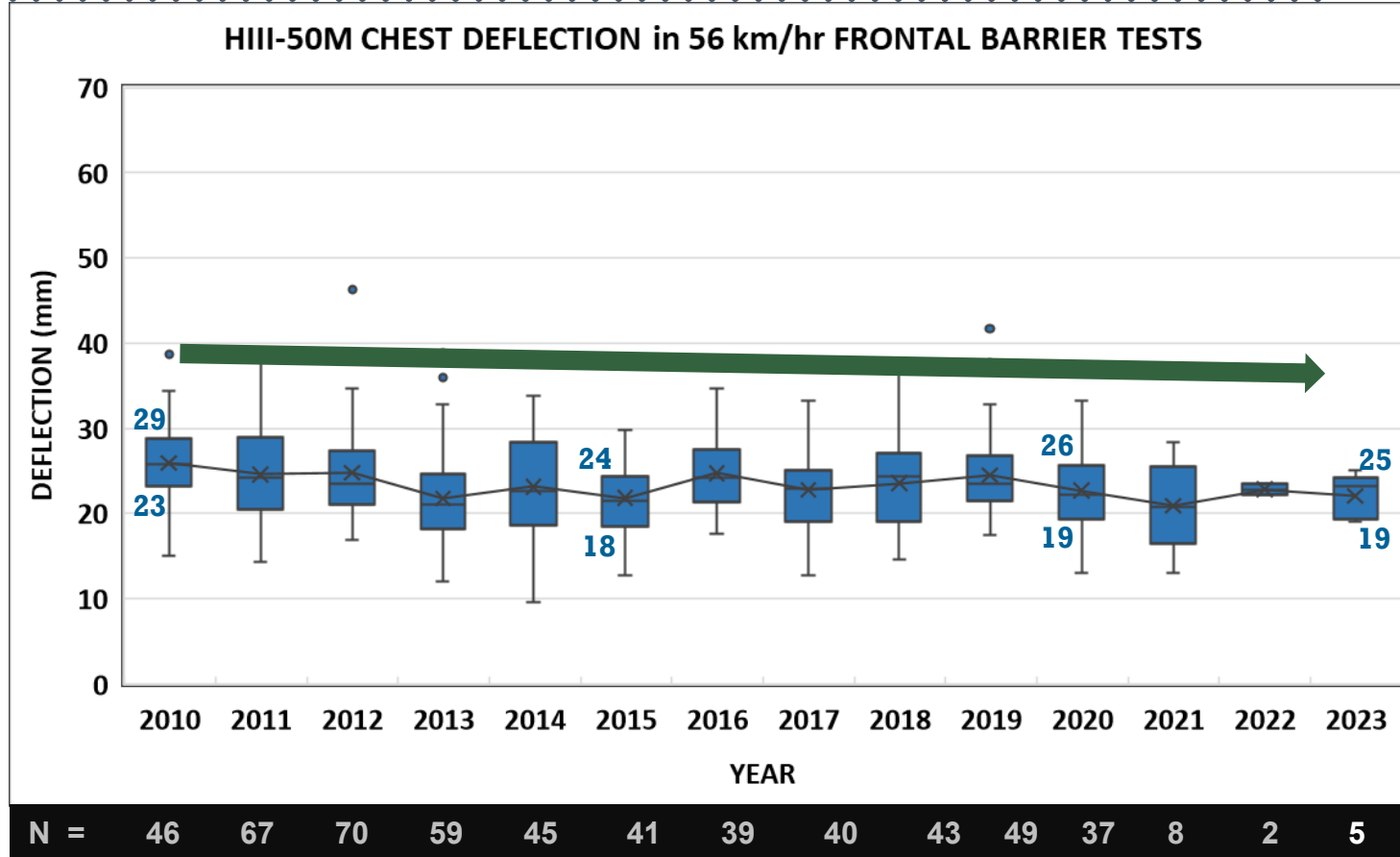
HIII-50M

2010 to 2023
~ 4mm decrease

2015 to 2023
~ same

2020-2023
~ same

**NOTE – HIII-50M
Optimized**

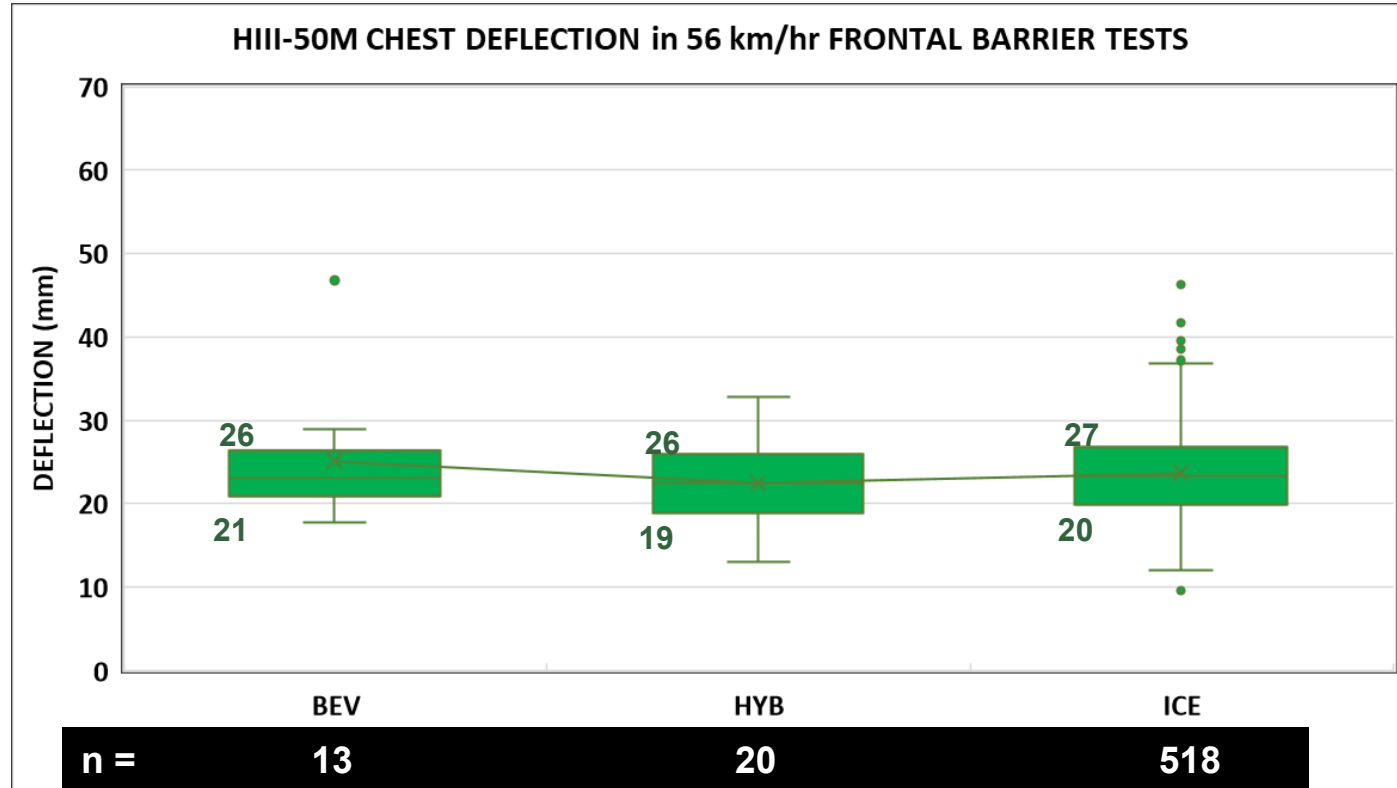


HIII – 50M Frontal Barrier Chest Deflection

HIII-50M

BEV vs HYB vs ICE

On Average –
similar results



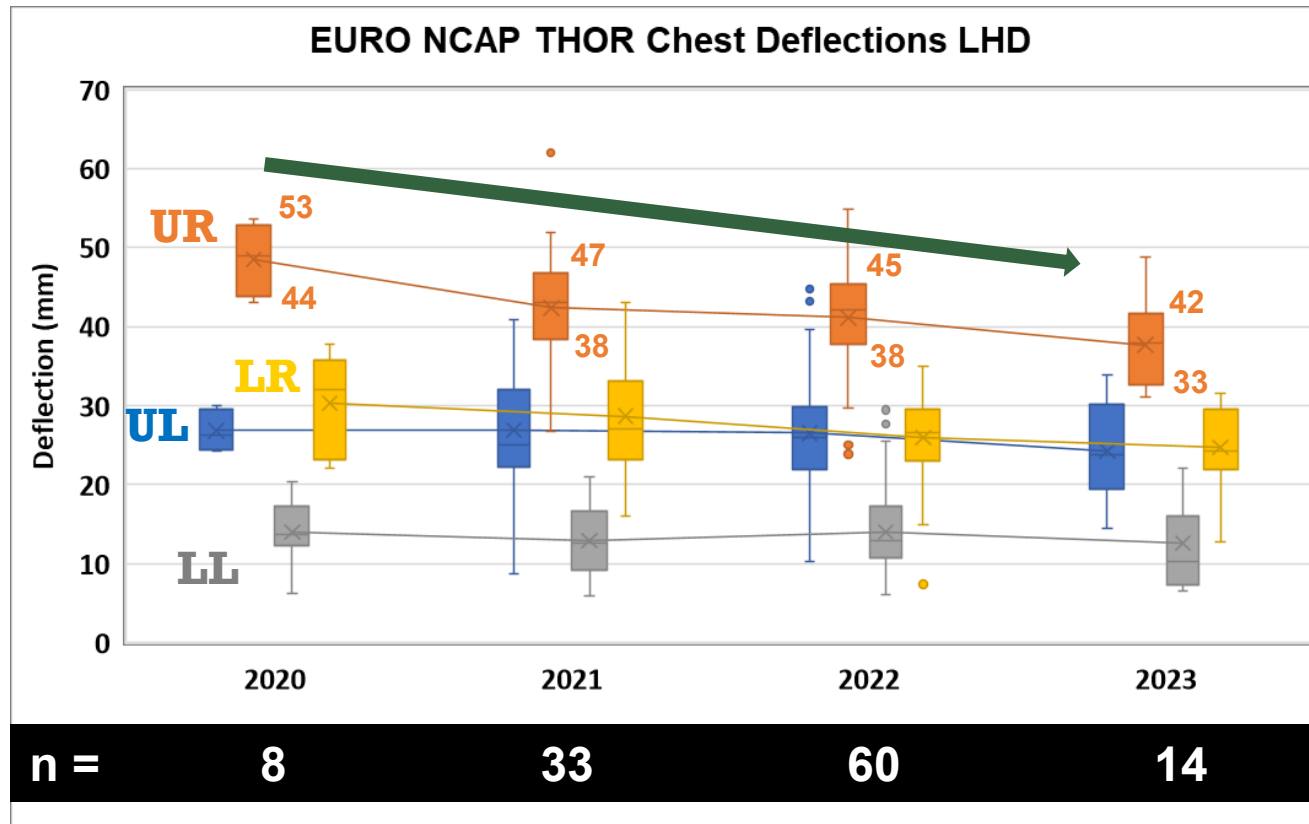
Euro NCAP (PDB) THOR-50M Chest

THOR-50M

Change in avg. max deflections from 2020 to 2023

UR ~ 11 mm decrease

Euro NCAP points
4 pts <35 mm
0 pts >60mm



Euro NCAP (PDB) THOR-50M Chest

THOR-50M

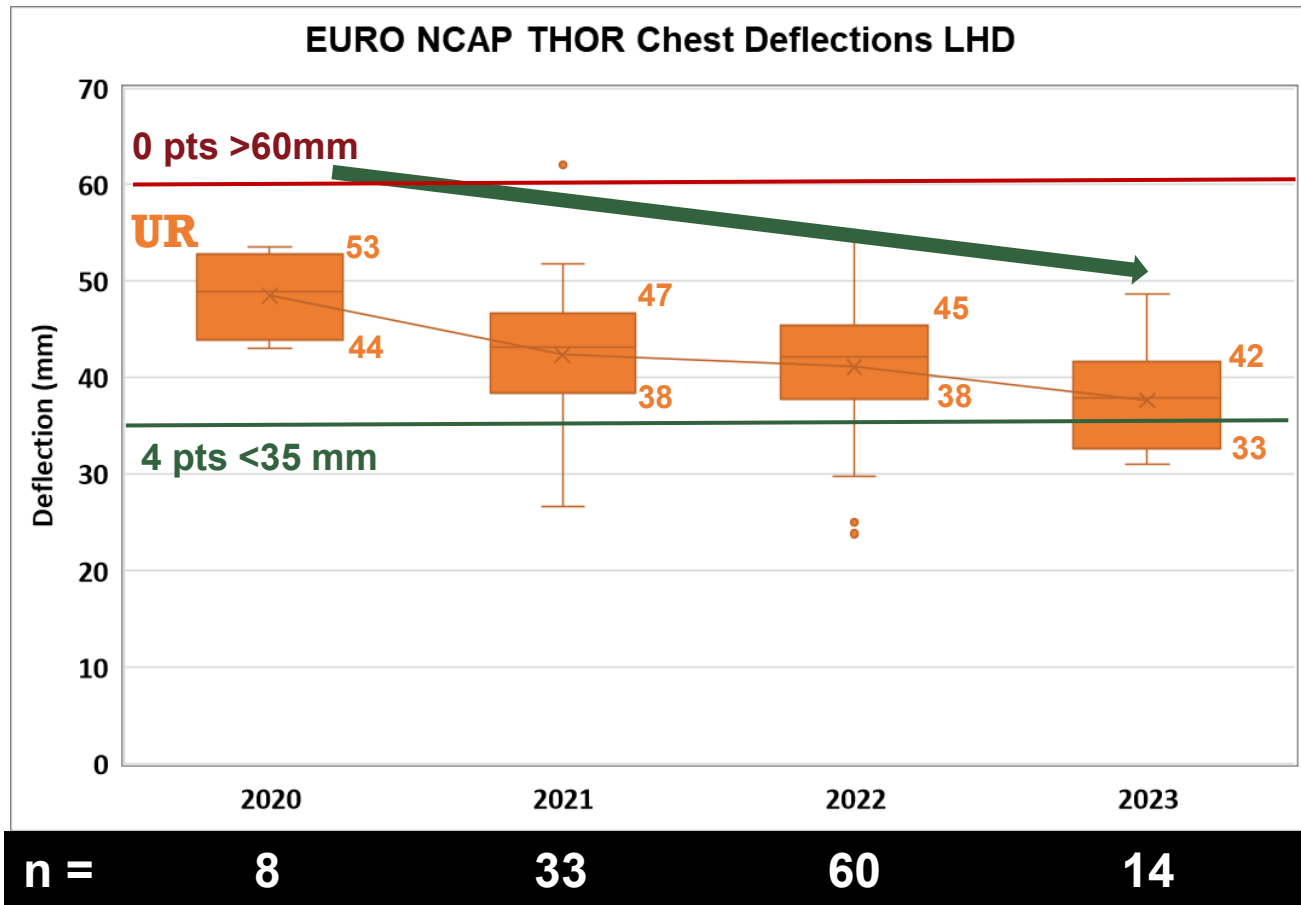
Change in avg. max deflections from 2020 to 2023

UR ~ 11 mm decrease

Euro NCAP

0 pts >60mm

4 pts <35 mm



THOR-50M TEST RESULTS

THOR 50M

Change max deflections from 2015 to 2023

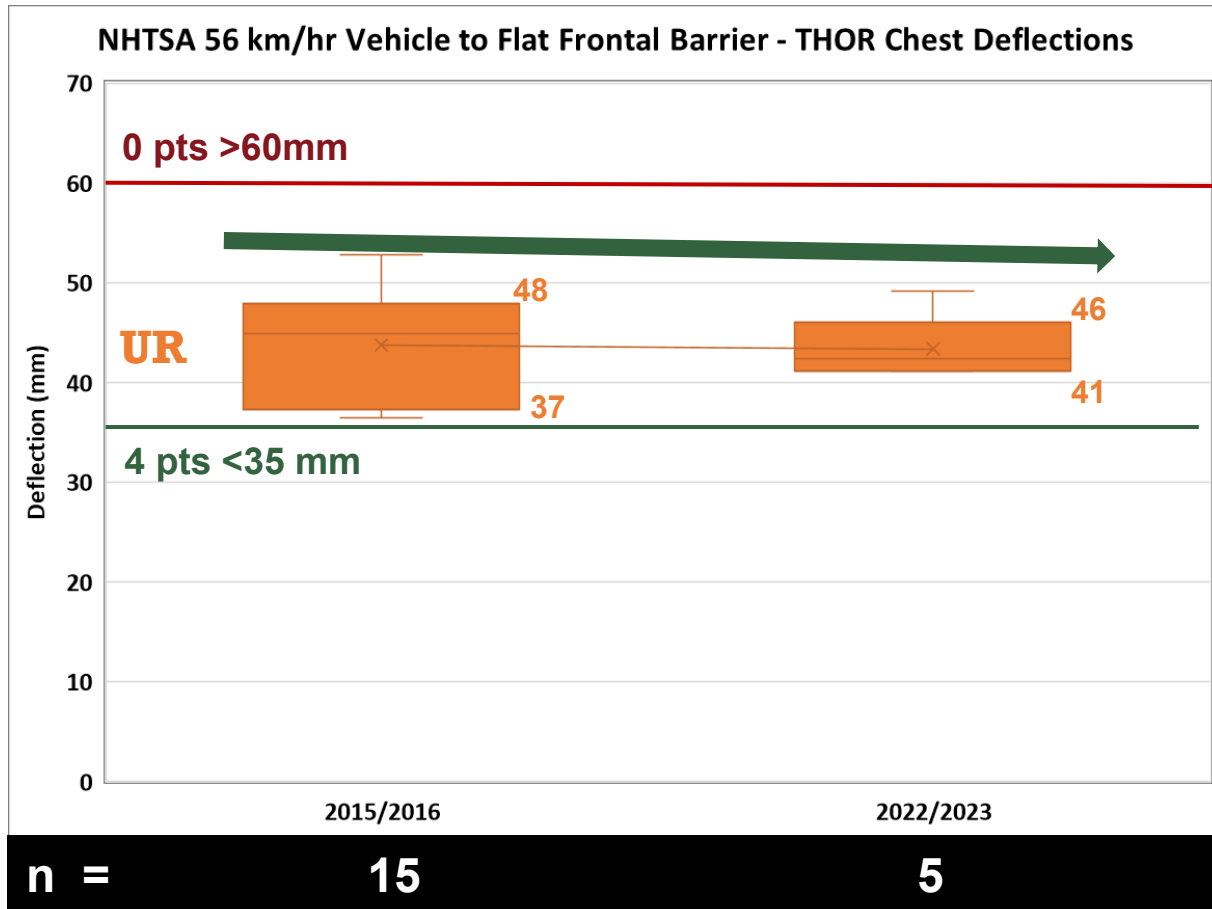
UR < 1 mm decrease

Euro NCAP points

0 pts >60mm

4 pts <35 mm

No vehicle would achieve 4 points in Euro NCAP



THOR 50M - Observations

- *Thorax UR higher than HIII-50M but THOR-50M more biofidelic*
- *HIII-50M used to optimize safety restraint systems, seat, belt, & airbags*
- *Chest deflection reductions were minimal for THOR-50M in frontal testing from 2015/16 to 2022/23 MY vehicles.*



THOR 50M - Conclusion

Current US tested vehicles have been optimized with the HIII-50M

Relative to 2015/16 vehicles, new vehicle generations (including BEVs) still present opportunities to reduce injury risks by using THOR-50M in FMVSS No. 208 standardized testing

Although current US vehicle fleet does not indicate much change in thoracic deflection values, Euro NCAP data appears to indicate engineering restraint changes which improved results

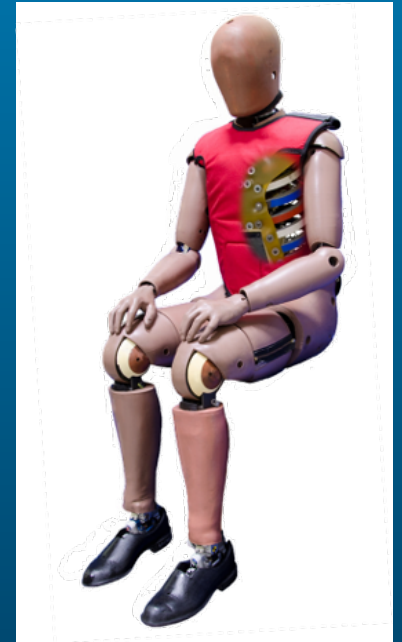
Use of THOR-50M should drive future restraint optimization, hence reduced injury values and future occupant safety



Thank you!

Questions?

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EXTRA SLIDES

