

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



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

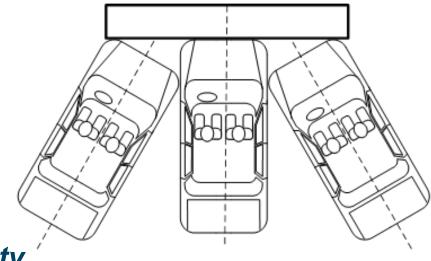
OE Manufacturers

About 300 THOR-50M in use worldwide Improve future vehicle homologation



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



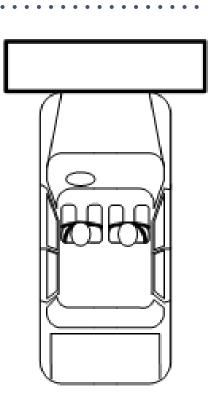
Previous testing results (2021 cont.)

- 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

Previous testing (2015)

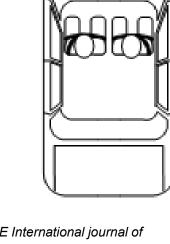
Previous NCAP test vehicles

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



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.

<u>Current</u> testing – (2023)

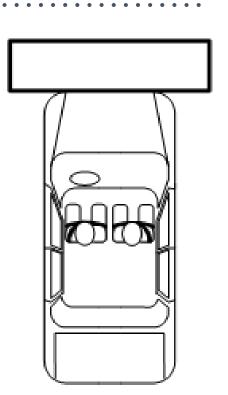
- Supplement previous testing
- Select BEVs on new platforms which may yield different dummy metrics
- Select vehicles previously tested to observe if new generations /newer platforms) yield different dummy metrics





<u>Current</u> 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

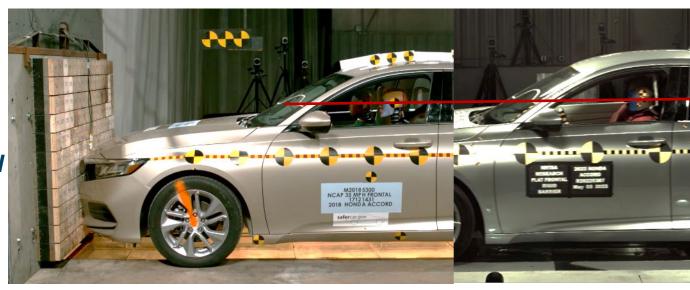


Test	Test				Neck	Neck	Chest	Left	Right	Knee	Lap	Shoulder
No.	Vel.	ATD	HIC15	BrIC	Tension	Comp.	Deflt.	Femur	Femur	AB	Belt	Belt
	km/hr	Driver			[N]	[N]	[mm]	[N]	[N]		[N]	[N]
14475	56	THOR-50M	321	0.68	1505	-457	43.9	-3627	-2719	Υ	3948	3457
tbd	56	HIII-50M	203	n/a	1146	-159	17.5	-1088	-1201	Υ	n/a	n/a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

THOR-50M

- sits slightly higher
- sits slightly further rearward



Observations from test series

THOR-50M

- sits slightly higher
- sits slightly further rearward



AB Contact

2018 & 2022 Chevrolet Bolt



HIII-50M

THOR-50M

AB Contact

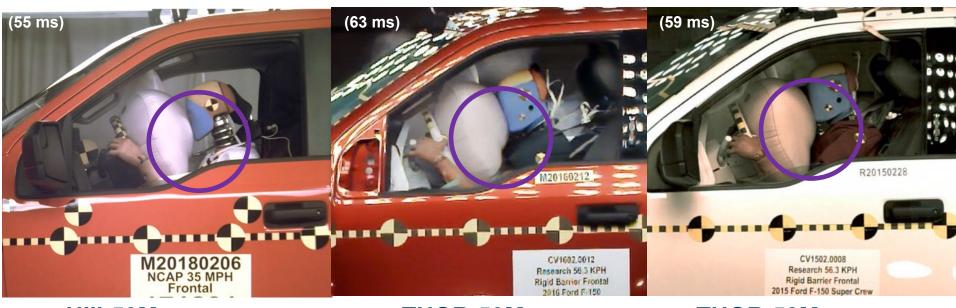
2018, 2016 & 2015 Ford F150



HIII-50M THOR-50M THOR-50M

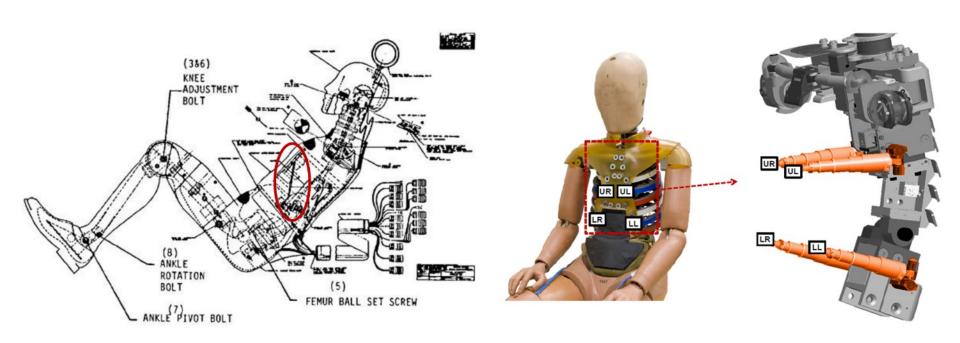
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HIII-50M THOR-50M THOR-50M

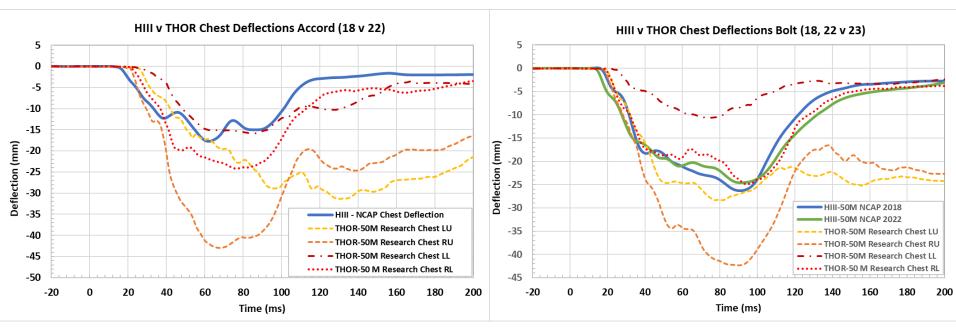
THOR-50M v HIII



HIII-50M (I) 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

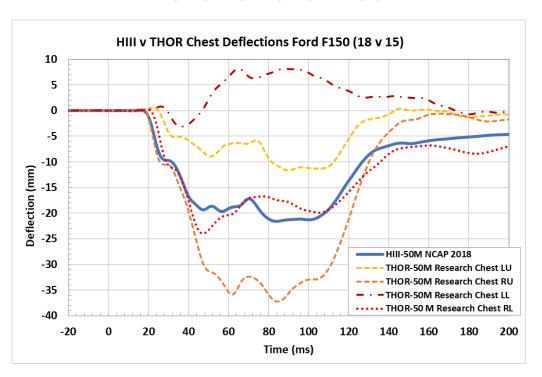


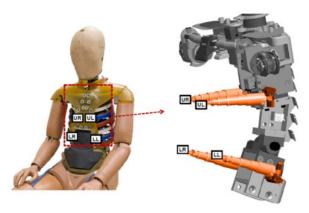
2018 vs 2022 Accord

2018, 2022 vs 2023 Bolt

THOR-50M TEST RESULTS – Sample F150

Chest Deflection - THOR-50M 4-point v HIII-50Msingle point 2018 vs 2015 F150





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

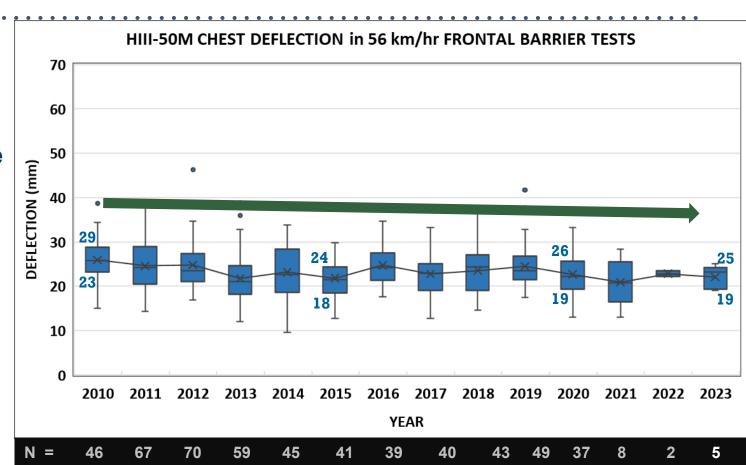
HIII-50M

2010 to 2023 ~ 4mm decrease

2015 to 2023 ~ same

2020-2023 ~ same

NOTE – HIII-50M Optimized

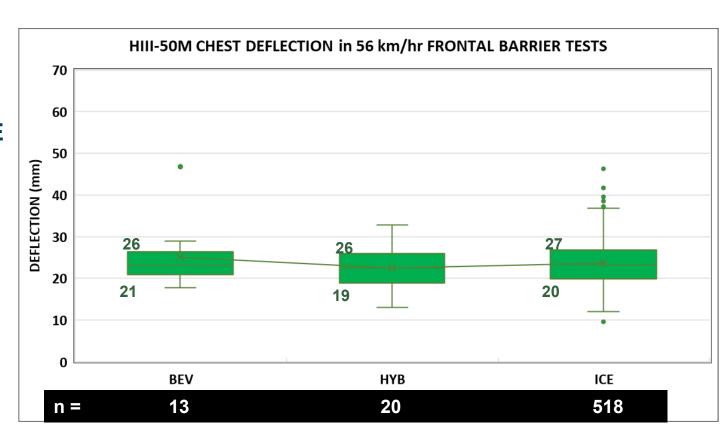


HIII - 50M Frontal Barrier Chest Deflection

HIII-50M

BEV vs HYB vs ICE

On Average – similar results



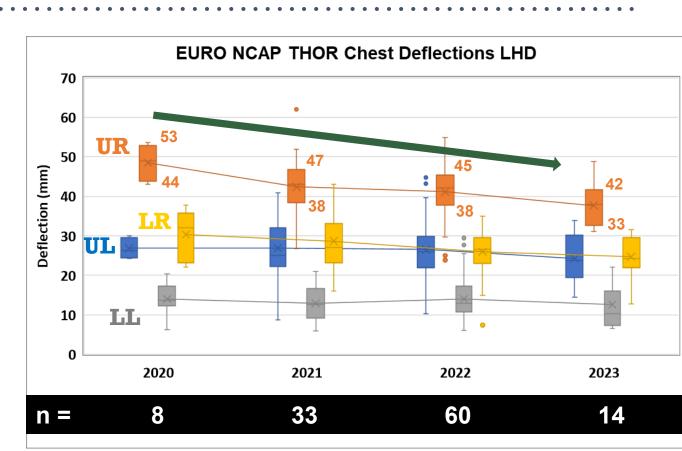
Euro NCAP (PDB) THOR-50M Chest

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

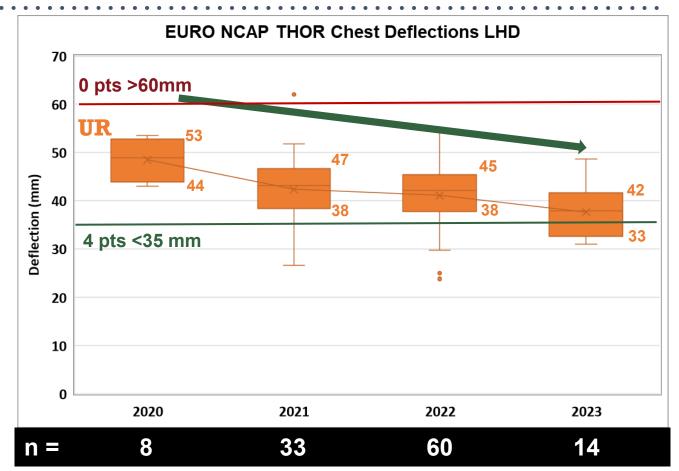
Change in avg. max deflections from 2020 to 2023

UR ~ 11 mm decrease

Euro NCAP

0 pts >60mm

4 pts <35 mm



THOR 50M

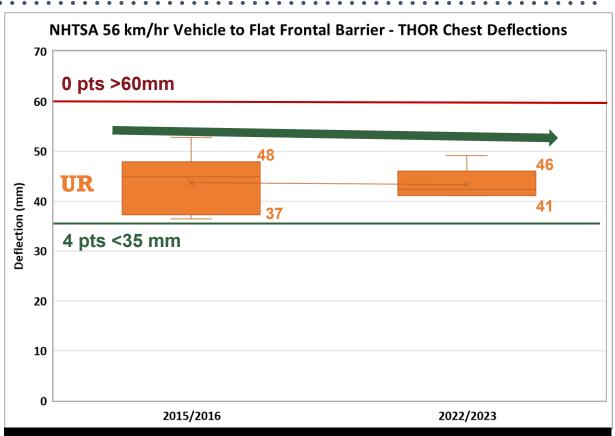
Change max deflections from 2015 to 2023

UR < 1 mm decrease

Euro NCAP points

0 pts >60mm
4 pts <35 mm</pre>

No vehicle would achieve 4 points in Euro NCAP



n = 15

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

