

Review of Tests on a 2008 Honda Accord for Inadvertent Deployment of the Inflatable Curtain

EA14-004

as presented to Honda R&D at VRTC
on 03/30/2015 with ODI on WebEx

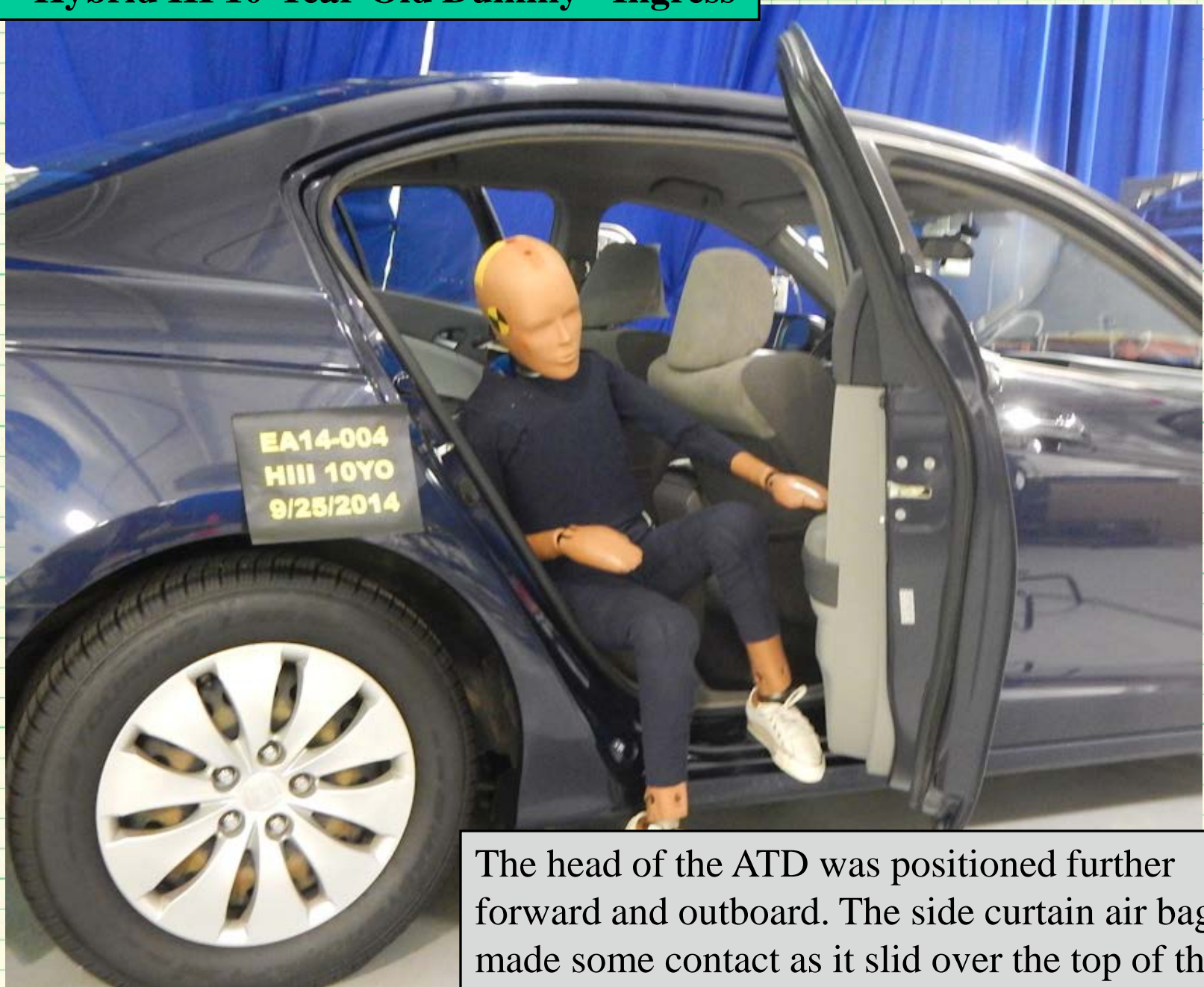


Test 1 - Hybrid III 10-Year-Old Dummy - Egress



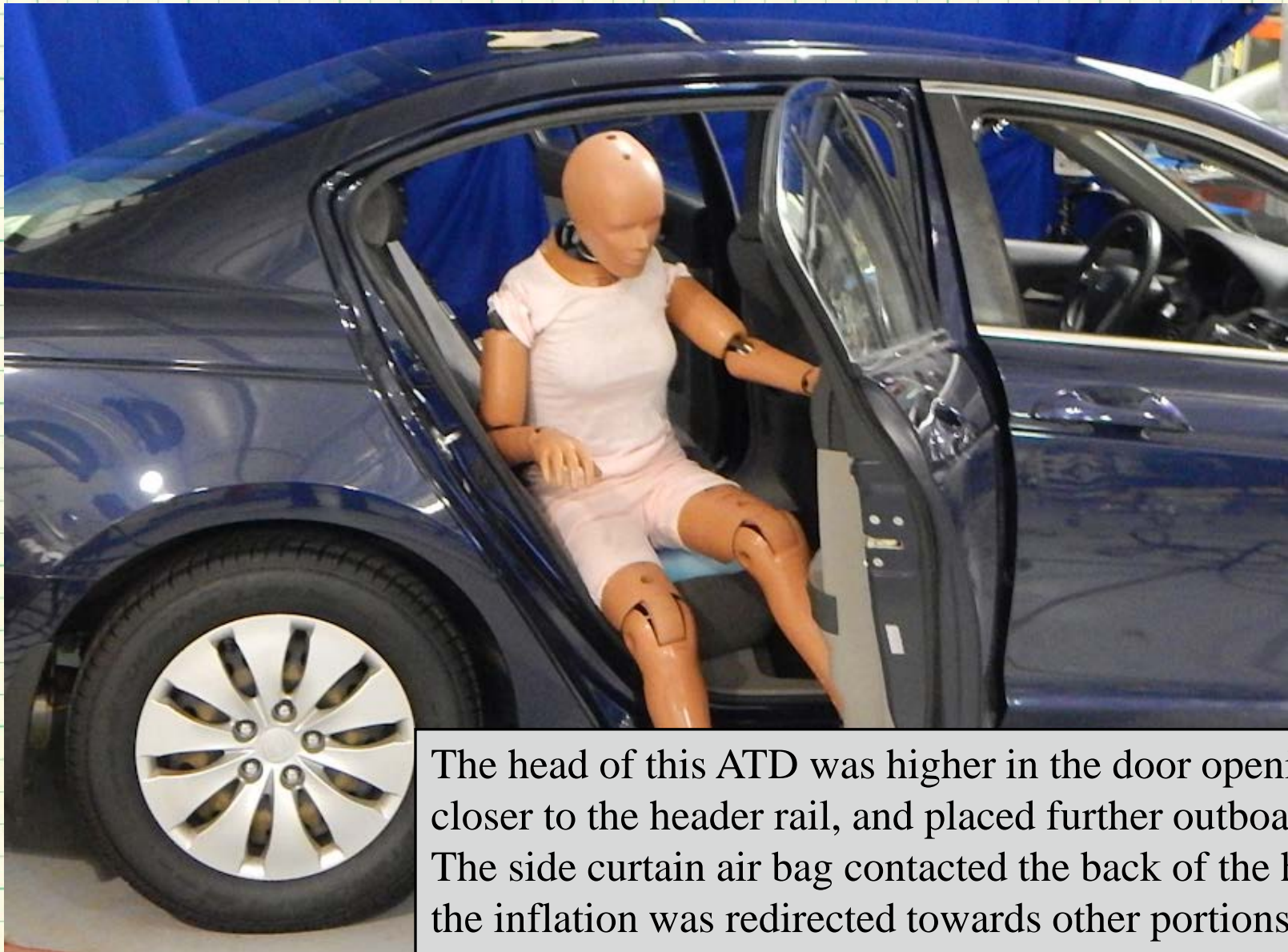
With the door open, the side curtain air bag deployed almost horizontally outward and barely touched the top of the head of the anthropomorphic test device (ATD). No significant injury values were recorded.

Test 2 - Hybrid III 10-Year-Old Dummy - Ingress



The head of the ATD was positioned further forward and outboard. The side curtain air bag made some contact as it slid over the top of the head. No significant injury values were recorded.

Test 3 - Hybrid III Fifth-Percentile Female - Egress



The head of this ATD was higher in the door opening, closer to the header rail, and placed further outboard. The side curtain air bag contacted the back of the head, the inflation was redirected towards other portions of the air bag, and it slid off the head. No significant injury values were recorded.

Test 4 - Hybrid III Fifth-Percentile Female – Seating Infant



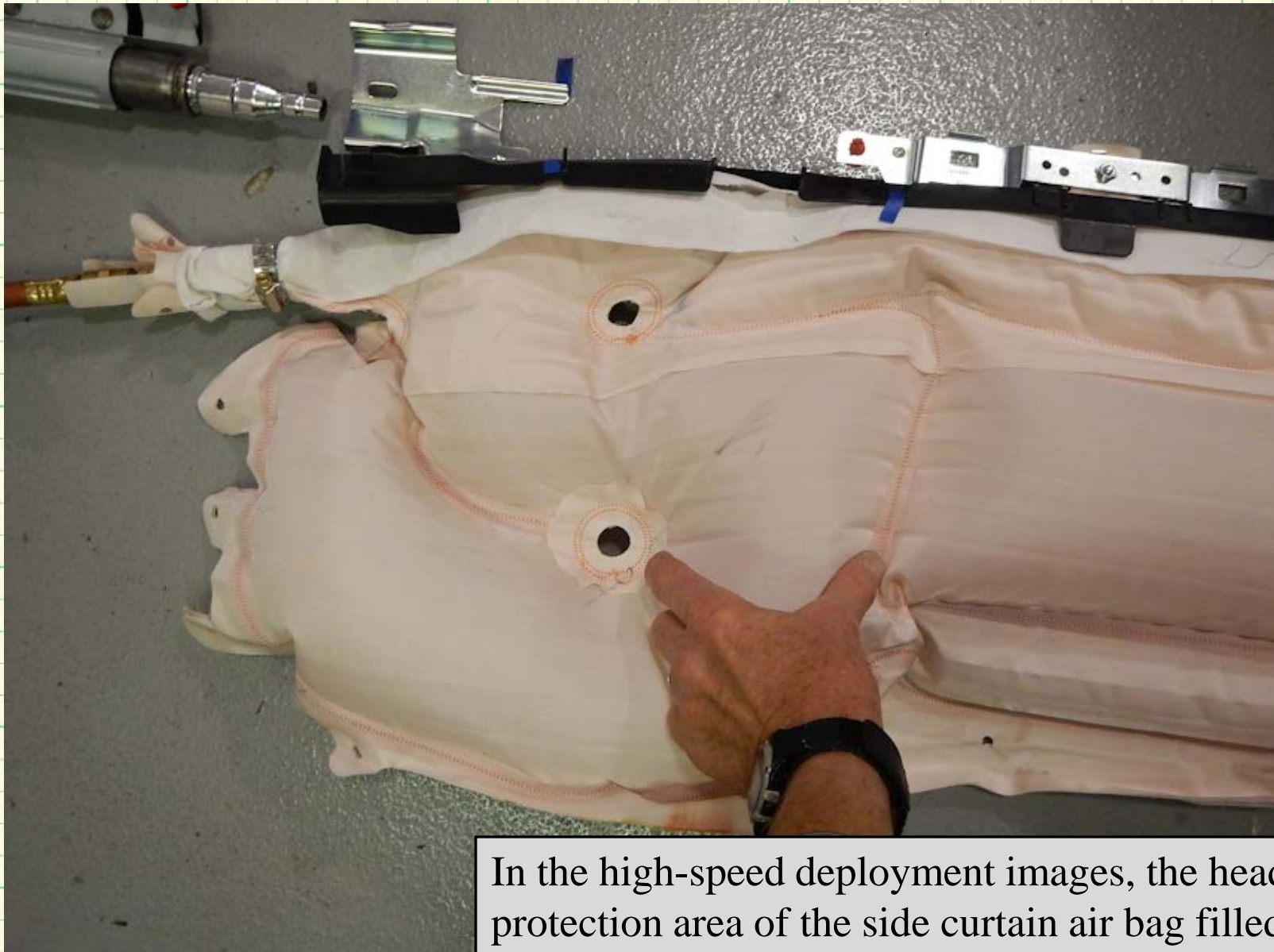
The ATD head was touching the header rail. The rubber on the pelvis was trimmed so ball-joint legs could be straightened. The ATD was suspended with a bungee cord. The side curtain air bag contacted the head but slid off. No significant injury values were recorded.

Test Results for EA14-004 - MY2008 Honda Accord-Inadvertent Side Curtain Air Bag Deployment

Test Conditions		Air Bag Deployment Results	Head Injury Criteria (HIC)	Rotational Brain Injury Criteria (BrIC)	Shear+Moment Neck Injury Criteria (Nkm)	Neck Injury Criteria (NIJ)
Hybrid 3 10-Year Old Dummy	Egress	glanced off head toward outboard	0.2	N/A	0.10	0.1
	Ingress	light impact top of head due	0.8	0.15	0.10	0.1
Hybrid 3 5th-Percentile Female Dummy	Egress	bounced off head toward inboard	9.6	0.48	0.46	0.1
	Seating Infant	glanced off head toward inboard	4.9	0.32	0.23	0.2

On the first four tests, the chance of head or neck injuries was found to be relatively low due to the position of the ATD head in relation to the side curtain air bag deployment path.

Preparation for Test 5 - Hybrid III Fifth-Percentile Female - Leaning In Doorway



In the high-speed deployment images, the head protection area of the side curtain air bag filled first. The segment identified here appeared to be the most likely position for forceful movement of the air bag.

Preparation for Test 5 - Hybrid III Fifth-Percentile Female - Leaning In Doorway



The position of most interest on the side curtain air bag was located and marked with tape on the door opening, to assist in positioning the ATD head.

Preparation for Test 5 - Hybrid III Fifth-Percentile Female - Leaning In Doorway



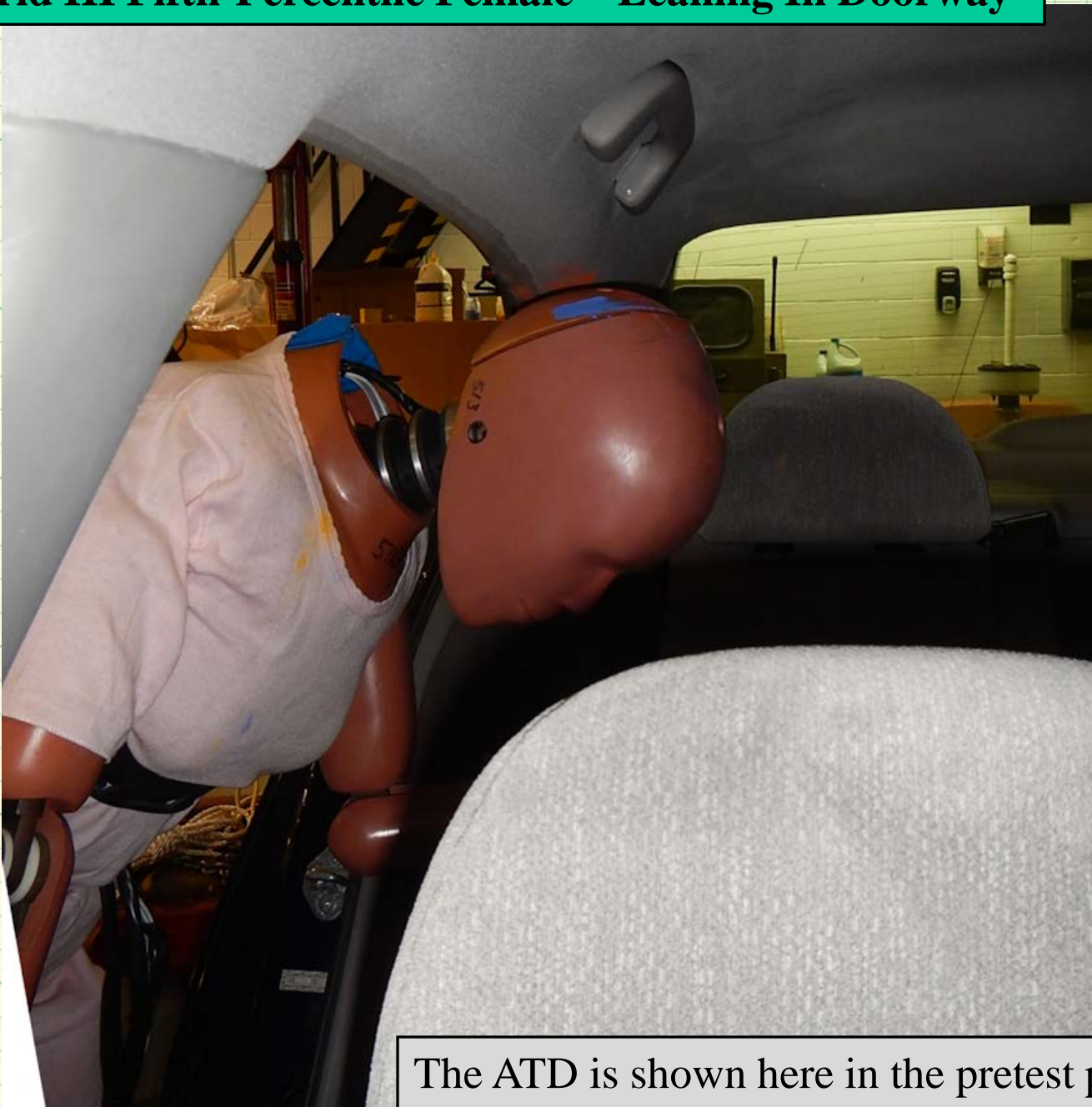
The ATD head was positioned at this location, just below, but not touching the header rail.

Test 5 - Hybrid III Fifth-Percentile Female – Leaning In Doorway



The ATD was positioned at the marked spot and supported by a bungee cord for Test 5.

Test 5 - Hybrid III Fifth-Percentile Female – Leaning In Doorway



The ATD is shown here in the pretest position for Test 5 from the interior of the vehicle.

Test 5 - Hybrid III Fifth-Percentile Female – Leaning In Doorway



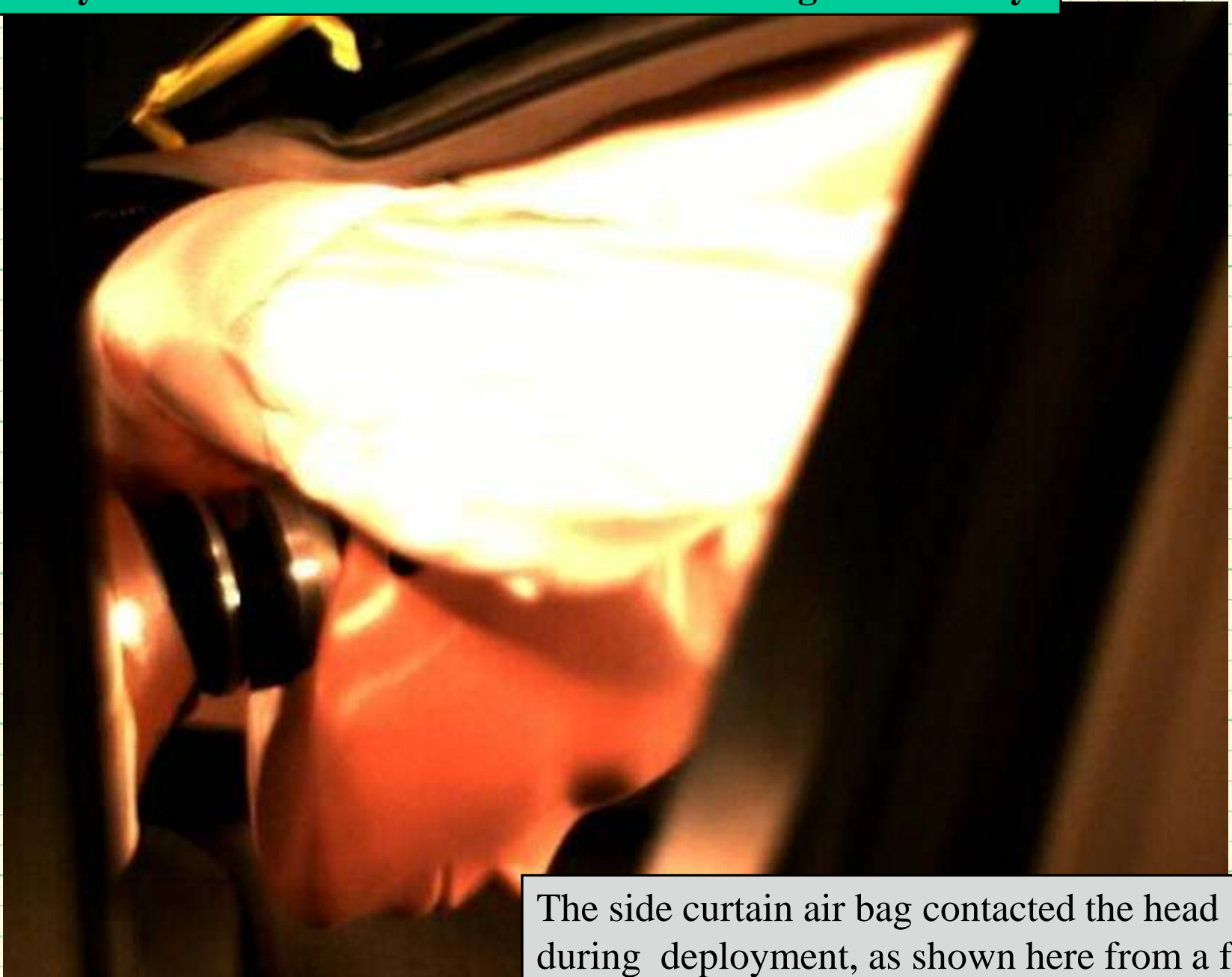
The side curtain air bag contacted the ATD head and accelerated it downward forcefully without slipping off.

Test 5 - Hybrid III Fifth-Percentile Female – Leaning In Doorway



During the side curtain air bag deployment, it struck the base of the ATD head and neck, as shown here from inside the vehicle.

Test 5 - Hybrid III Fifth-Percentile Female – Leaning In Doorway



The side curtain air bag contacted the head during deployment, as shown here from a front view outside the vehicle.

Test 5 - Hybrid III Fifth-Percentile Female – Leaning In Doorway



This post-test interior view shows the ATD's final position on the floor of the vehicle.

Test 5 - Hybrid III Fifth-Percentile Female – Leaning In Doorway



This post-test view shows the ATD's final position from the vehicle's exterior.

Test 5 - Hybrid III Fifth-Percentile Female – Leaning In Doorway



Chalk evidence from the ATD head indicated the side curtain air bag impact was at the desired location.

Test 5 - Hybrid III Fifth-Percentile Female – Leaning In Doorway



The chalk was transferred from the ATD head to the area of primary interest on the side curtain air bag indicating the ATD was positioned as planned.

Test 5 – Test Data Analysis

Test Results for EA14-004 - MY2008 Honda Accord-Inadvertent Side Curtain Air Bag Deployment						
Test Conditions		Air Bag Deployment	Head Injury Criteria (HIC)	Rotational Brain Injury Criteria (BrIC)	Shear+Moment Neck Injury Criteria (Nkm)	Neck Injury Criteria (NIJ)
Hybrid 3	Leaning	heavy	48.5	0.72	1.75	0.7
5th-Percentile	in Door-way	impact onto neck				
Female						
				BrIC Percent Chance Injury Would Result: from graph shown below	Nkm Percent Chance Injury Would Result:	NIJ Percent Chance Injury Would Result: from graph shown below
				100% for a minor (AIS1) brain injury risk	"With regard to a critical Nkm value, 1.0 was used taking into account that either a moment or a shear force exceeding the intercept value produces a risk of sustaining neck injuries." Schmitt, Muser, Neiderer page 4.	
				81% for a moderate (AIS2) brain injury risk		23% for a moderate (AIS2) neck injury risk
				34% for a serious (AIS3) brain injury risk		20% for a serious (AIS3) neck injury risk
				21% for a severe (AIS4) brain injury risk		13% for a severe (AIS4) neck injury risk
				18% for a critical (AIS5) brain injury risk		5% for a critical (AIS5) neck injury risk

The Abbreviated Injury Scale (AIS) provides a tool for ranking injury severity. The AIS is an anatomically based severity coding system to classify and describe the severity of injuries.

Test 5 – Test Data Analysis

BrIC Percent Chance Injury Would Result: from graph shown below	Nkm Percent Chance Injury Would Result:	NIJ Percent Chance Injury Would Result: from graph shown below
100% for a minor (AIS1) brain injury risk	"With regard to a critical Nkm value, 1.0 was used taking into account that either a moment or a shear force exceeding the intercept value produces a risk of sustaining neck injuries." Schmitt, Muser, Neiderer page 4.	
81% for a moderate (AIS2) brain injury risk		23% for a moderate (AIS2) neck injury risk
34% for a serious (AIS3) brain injury risk		20% for a serious (AIS3) neck injury risk
21% for a severe (AIS4) brain injury risk		13% for a severe (AIS4) neck injury risk
18% for a critical (AIS5) brain injury risk		5% for a critical (AIS5) neck injury risk

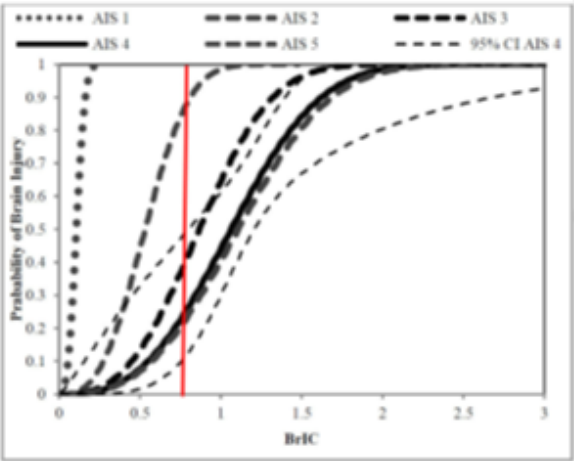
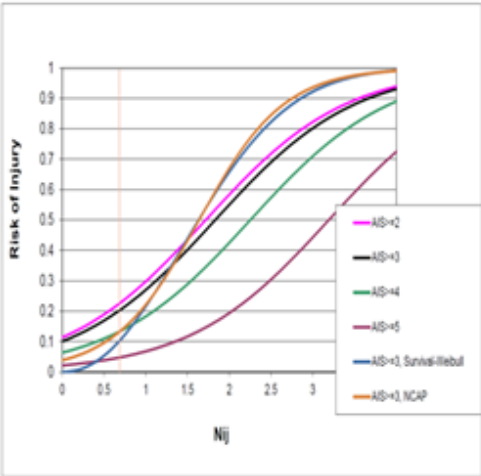


Figure 20. BrIC based on MPS and formulation given by equation 4 (average critical angular velocities Stapp Car Crash Journal, Vol. 57 (2013), "Development of Brain Injury Criteria (BrIC)", by Takhounts, Craig, Moorhouse, McFadden (NHTSA), Hasiija (Bowhead Systems Management, Inc.), Figure 20

"A New Neck Injury Crierion Candidate for Rear-End Collisions Taking Into Account Shear Forces and Bending Moments", Schmitt, Muser, Neiderer, 2002, used Hybrid III 50-percentile male



The tests discussed in this paper were conducted on Hybrid III male 50th-percentile male. It could be assumed that injuries to a 5th-percentile female would be worse.

from Shashi Kuppa
FRE Report for the
advancec air bag rule

AIS values are repeated here and shown with their reference sources.

Simplified GHBM 50th Male in WOOPS set up

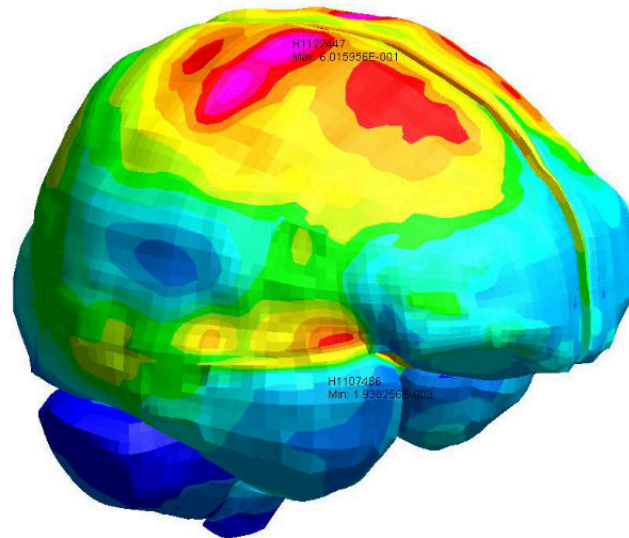


Click on the images to run videos

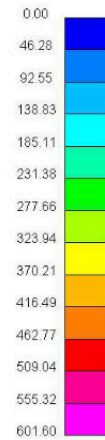
These still images from two views of a simulation show an air bag deployment causing the rotational movement of the head.

Strains in the Brain

D3PLOT: GHBMC_Head
1: Max H1122447 : 6.015956E-001, Min H1107486 : 1.938256E-003



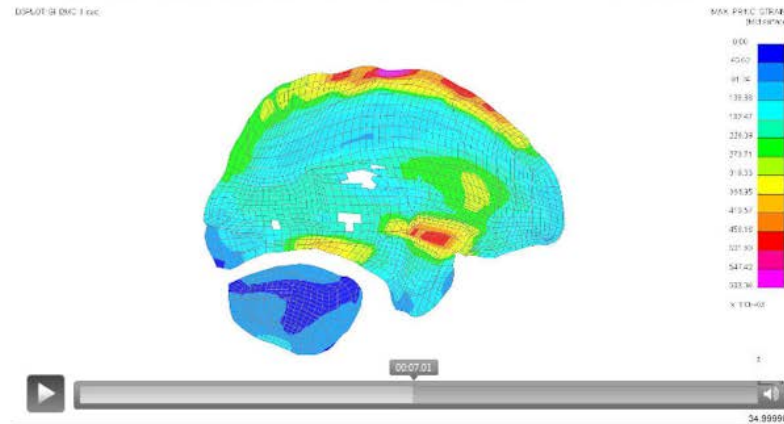
MAX_PRINC_STRAIN
(Mid surface)



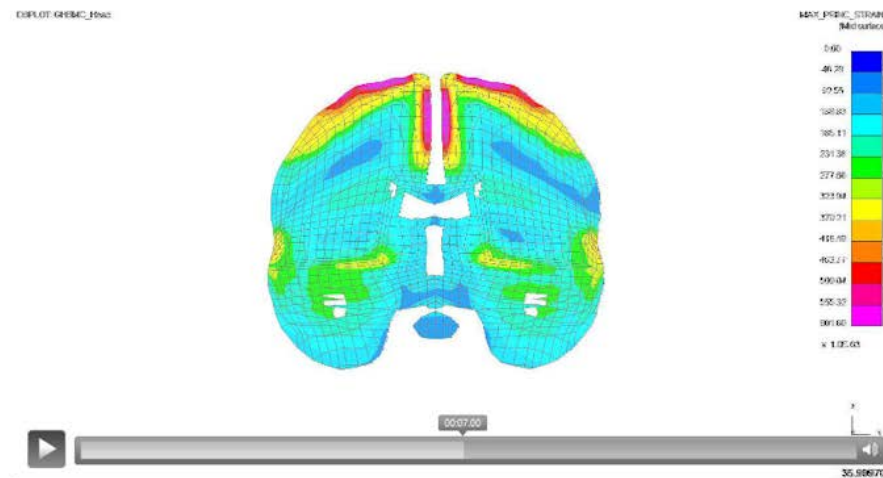
33.999802

This still image from a Global Human Body Model Consortium (GHBMC) brain finite element model simulation demonstrates the occurrence of high maximum principal strains (MPS) in the brain due to the rotational head kinematic demonstrated in the previous slide.

Strains in the Brain



Click on the
images to run
videos



Strains in the Brain: Conclusion

- High likelihood of subdural/subarachnoid hematoma (SDH/SAH) especially for older people.
- Turning head by 15 degrees (not presented here) increased the BrIC from 0.78 to 0.82 making the occupants more susceptible to brain injuries.

Information Provided by:



National Highway Traffic Safety Administration

Daniel G. Pearse

Mechanical Engineer

Defects Analysis and Crashworthiness Division

Vehicle Research and Test Center

P.O. Box B-37

10820 SR 347

East Liberty, OH 43319-0337

(937) 666-4511

Fax: (937) 666-3590

dan.pearse@nhtsa.dot.gov



National Highway Traffic Safety Administration

Erik G. Takhounts, Ph.D.

Human Injury Research Division

U.S. DOT, NVS-323, W46-312

1200 New Jersey Avenue, SE

Washington, D.C. 20590

Phone: (202) 366-4737

Fax: (202) 366-8546

Erik.Takhounts@DOT.GOV