

REPORT NUMBER: TWG-MGA-2016-002

**SIDE AIRBAG OUT-OF-POSITION INJURY
TECHNICAL WORKING GROUP**

**Hyundai Motor Company
2016 Hyundai Tucson SE AWD 5-Dr. SUV
NHTSA No.: M20164203TWG2**

TEST DATE: MAY 17, 2016

FINAL REPORT DATE: JUNE 3, 2016

FINAL REPORT

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The results presented in this report relate only to the specified test items.

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SECTION 1

PURPOSE AND SUMMARY OF TEST

PURPOSE

The purpose of this test was to obtain data in a static out-of-position side air bag deployment. These data constitute part of the general consumer information collected by Alpha Technology Associate, Inc.

SUMMARY

The effects of both a curtain and torso airbag deployment in a 2016 Hyundai Tucson SE AWD 5-Door SUV with an out-of-position Hybrid III 6-Year-Old child dummy were evaluated. The curtain and seat airbags were fired remotely. The test was performed by MGA Research Corporation on May 17, 2016. Pre-test and post-test photographs of the vehicle and dummy can be found in Appendix A.

Three high-speed cameras (1000 fps) were used to document the side airbag deployment event. The following camera locations were used:

- Left Side Through Removed Driver Door
- Front Through Windshield
- Left Side $\frac{3}{4}$ View Through Windshield

One Hybrid III 6-Year-Old child dummy (Serial Number 144) was placed in the right front passenger seat situated in the inboard-facing position along the outboard edge of the seat per Section 3.3.5.1 according to dummy placement instructions specified in the Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags as prepared by the Side Airbag Out-of-Position Injury Technical Working Group (TWG).

The dummy was instrumented with the following instrumentation:

- Head Accelerations
- Upper Neck Load Cell
- Lower Neck Load Cell

The 15 channels of data were recorded on an on-board data acquisition system. Appendix B contains the dummy data traces.

The Hybrid III 6-Year-Old child dummy's visible contact points were as follows:

- Curtain airbag to top and back of head
- Torso bag to left side of shoulder, torso, and pelvis

The Hybrid III 6-Year-Old child dummy was placed in the right front passenger seat along the outboard edge of the foam block, facing inboard with its legs extended and arms hanging at its sides. The seat track was positioned forward to maximize the cushion to head interaction. The dummy's pelvis was slid outboard until the dummy's back contacted the door trim panel or armrest and the center of gravity of the head was centered in the deployment trajectory of the airbag. The head remained in its neutral orientation. A vertical plane through the centerline of the dummy's shoulder bolts was parallel to the vehicle centerline. The dummy's arms were bent at the elbow until the fingertips contacted the foam block.

The dummy's skullcap seam was taped with 4mm electrical tape to prevent the airbag from getting caught in the seam. The dummy's headskin was cleaned with alcohol and dusted with baby powder to achieve acceptable frictional characteristics.

This orientation complies with Section 3.3.5.1 of the TWG Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags as defined by Lund, et al and the Technical Working Group First Revision dated July, 2003.

SECTION 2
OCCUPANT AND VEHICLE INFORMATION / DATA SHEETS

DATA SHEET NO. 1
TEST SUMMARY

	Test Data	Description
Seating Position	P2	Right Front Seating Position
Test	3.3.5.1*	Inboard-facing child dummy
Curtain Airbag	Roof-Rail Mounted	Side Airbag
Torso Airbag	Seat Mounted	Side Airbag
ATD Type/Serial No.	Hybrid III 6 Year Old / 144	Child Dummy

* Procedure as defined by Lund, et al and the Technical Working Group dated July, 2003

Number of Dummy Data Channels	15
Number of Airbag Channels	4
Number of High-Speed Videos	3

Visible Dummy Contact Points	
Head Contact	Curtain airbag to top and back of head
Left Shoulder Contact	Torso bag
Left Torso Contact	Torso bag
Left Pelvis Contact	Torso bag

DATA SHEET NO. 2**TEST VEHICLE INFORMATION**

Please note that this vehicle had previously been tested in an
NCAP Frontal Impact on October 5, 2015.

TEST VEHICLE INFORMATION**TEST VEHICLE OPTIONS**

Manufacturer	Hyundai	Driver Front Airbag	Yes
Model	Tucson	Driver Side Curtain Airbag	Yes
Body Style	5 Door SUV	Driver Side Torso/Pelvis Airbag	Yes
NHTSA No.	M20164203	Rear Passenger Side Curtain Airbag	Yes
VIN	KM8J3CA45GU055511	Rear Passenger Side Torso/Pelvis Airbag	No
Color	Mojave Sand	Force Limiter	Yes
Delivery Date	9/14/2015	Pretensioner	Yes
Odometer Reading (mile)	59	Power Steering	Yes
Dealer	Boucher Fleet Group	Power Door Locks	Yes
Transmission	Automatic	Tilt Wheel	Yes
Final Drive	AWD	Air Conditioning	Yes
Number of Cylinders	4	Anti-lock Brakes	Yes
Engine Displacement (L)	2.0	Traction Control	Yes
Engine Placement	Lateral	All-Wheel Drive	Yes
Automatic Door Lock (ADL)	Yes	Power Seats	No
Owner's Manual Details Instructions on Disabling ADLs	No		
Bucket Seats	Yes		

DATA FROM CERTIFICATION LABEL

Manufactured By	Hyundai Motor Company	GVWR (kg)	2150
Date of Manufacture	07/15	GAWR Front (kg)	1280
		GAWR Rear (kg)	1150

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Contoured		
Number of Occupants	2	3		5
Capacity Wt. (VCW) (kg)				440
Cargo Wt. (RCLW) (kg)				100

DATA SHEET NO. 3
DUMMY POSITIONING IN VEHICLE

Measurement		Value
Seat Position		9 of 38 detents
Seat Height Position		Non-Adjustable
Placed in Position No. 2		---
Seat Back Angle (at headrest post)	SA (°)	1.9
Top of Curtain Airbag Module to Head/Neck Junction	AN (mm)	244
Top of Seat Airbag Module to Head/Neck Junction	AN (mm)	128
Head CG to Door Window	HD (mm)	179
Head to Seat Back Centerline	HSC (mm)	215
Chest to Dash	CD (mm)	507
Chest to Seatback	CS (mm)	225
Right Arm to Seat Back Centerline	RACL (mm)	258
Left Arm to Seat Back Centerline	LACL (mm)	274
Right Arm to Door Panel	RA (mm)	101
Left Arm to Door Panel	LA (mm)	87
Knee to Knee	KK (mm)	116
Toe to Toe	TT (mm)	82
Right Knee to Seat Cushion Centerline	KSCR (mm)	14
Left Knee to Seat Cushion Centerline	KSCL (mm)	13
Right Toe to Seat Cushion Centerline	TSCR (mm)	280
Left Toe to Seat Cushion Centerline	TSCL (mm)	271
Nose to Dash	ND (mm)	564
Nose to Headrest	NS (mm)	251
Top of Head to Headliner	HH (mm)	123

DATA SHEET NO. 4
DUMMY INJURY CRITERIA VALUES

NHTSA No. M20164203TWG2

		MAXIMUM VALUE			
		Position No. 2			
DESCRIPTION	UNIT	MAXIMUM	TIME (ms)	MINIMUM	TIME (ms)
Head X	g	78.5	11.8	-18.8	12.1
Head Y	g	20.4	11.5	-15.9	12.1
Head Z	g	27.9	11.2	-12.1	11.9
Head Resultant	g	78.8	11.8		
Upper Neck Fx	N	137.7	208.7	-432.3	28.5
Upper Neck Fy	N	457.1	30.1	-131.0	171.2
Upper Neck Fz	N	291.8	176.7	-965.5	20.1
Upper Neck F Resultant	N	1076.6	21.0		
Upper Neck Mx	Nm	21.2	52.1	-26.2	12.2
Upper Neck My	Nm	6.3	210.4	-26.8	28.7
Upper Neck Mz	Nm	13.2	119.6	-22.6	54.9
Upper Neck M Resultant	Nm	31.0	52.4		
Lower Neck Fx	N	97.9	212.3	-290.2	10.1
Lower Neck Fy	N	267.8	7.8	-365.8	34.1
Lower Neck Fz	N	344.3	175.8	-785.3	21.0
Lower Neck F Resultant	N	833.5	33.2		
Lower Neck Mx	Nm	38.1	42.7	-30.4	190.5
Lower Neck My	Nm	56.5	33.2	-18.8	181.2
Lower Neck Mz	Nm	11.2	117.4	-23.9	52.1
Lower Neck M Resultant	Nm	68.1	33.1		

DATA SHEET NO. 4 (continued)
DUMMY INJURY CRITERIA VALUES

NHTSA No. M20164203TWG2

ATD position	HEAD INJURY CRITERIA (HIC)					
	HIC15			HIC36		
	HIC	T ¹ (msec)	T ² (msec)	HIC	T ¹ (msec)	T ² (msec)
No. 2 Right Front	20.69	10.8	23.4	22.71	10.7	32.5

Position 2 Neck Injury Summary (6-Year-Old – Out-Of-Position)

	Nij	Time (msec)	Z Force (N) (CFC 600)	X Force (N) (CFC 600)	Y Moment (N-m) (CFC 600)
Ntf	0.08	99.0	63.72	-26.86	4.74
Nte	0.24	167.5	254.52	-14.69	-5.84
Ncf	0.08	211.3	-115.80	129.21	6.31
Nce	0.83	32.9	-837.22	-382.19	-26.59
Peak Tension (CFC1000)		291.8 N	Peak Compression (CFC 1000)		-965.5 N

Critical Values

Nij Intercepts				Peak Limits	
Tension (CVt)	2800 N	Extension (mCVe)	37 N-m	Tension	1490 N
Compression (CVc)	2800 N	Flexion (mCVf)	93 N-m	Compression	1820 N
Condyle Offset	0.01778 m				

APPENDIX A PHOTOGRAPHS

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Photo No. 1. Right ¾ Front View of Vehicle, As Received



Photo No. 2. Vehicle Certification Label



Photo No. 3. Pre-Test Vehicle Left Side View



Photo No. 4. Post-Test Vehicle Left Side View



Photo No. 5. Pre-Test 6-Year-Old Child Dummy Left Side View



Photo No. 6. Post-Test 6-Year-Old Child Dummy Left Side View



Photo No. 7. Pre-Test 6-Year-Old Child Dummy Left Side Closeup View

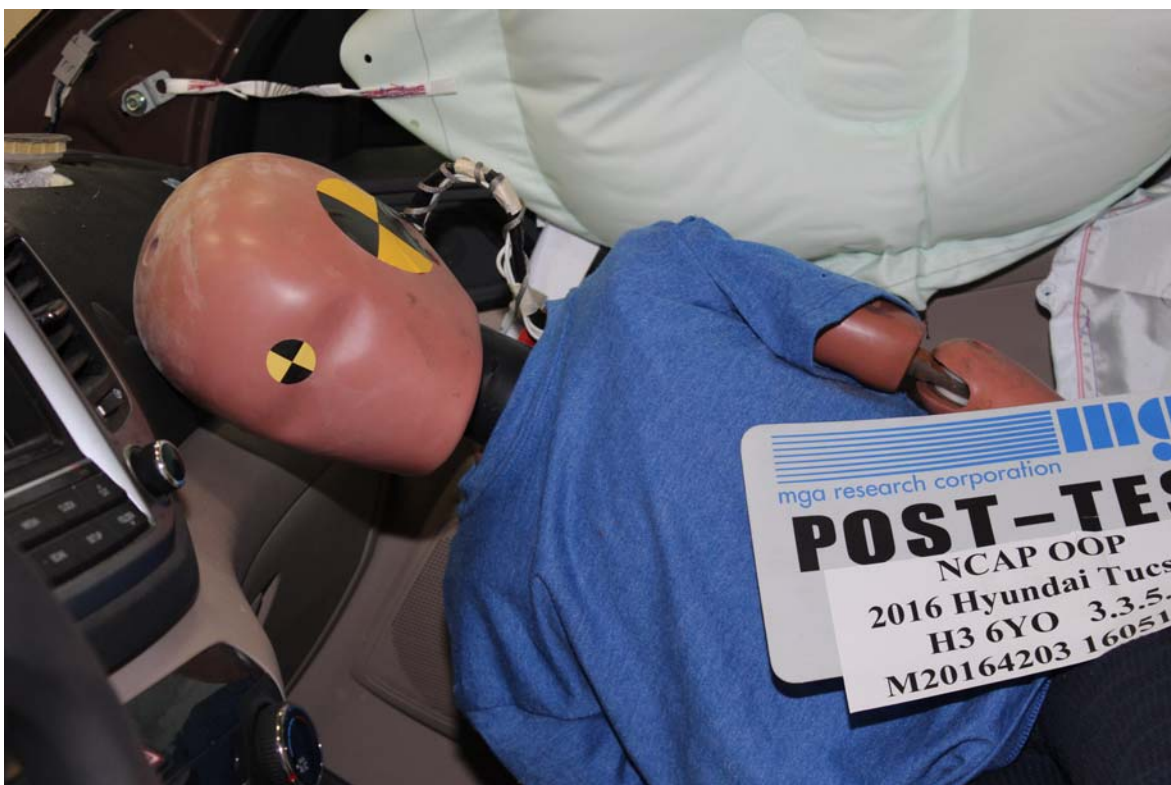


Photo No. 8. Post-Test 6-Year-Old Child Dummy Left Side Closeup View



Photo No. 9. Pre-Test 6-Year-Old Child Dummy Left $\frac{3}{4}$ Front View



Photo No. 10. Post-Test 6-Year-Old Child Dummy Left $\frac{3}{4}$ Front View



Photo No. 11. Pre-Test 6-Year-Old Child Dummy Left $\frac{3}{4}$ Front Closeup View



Photo No. 12. Post-Test 6-Year-Old Child Dummy Left $\frac{3}{4}$ Front Closeup View



Photo No. 13. Pre-Test 6-Year-Old Child Dummy Front View



Photo No. 14. Post-Test 6-Year-Old Child Dummy Front View



Photo No. 15. Pre-Test 6-Year-Old Child Dummy Front Closeup View

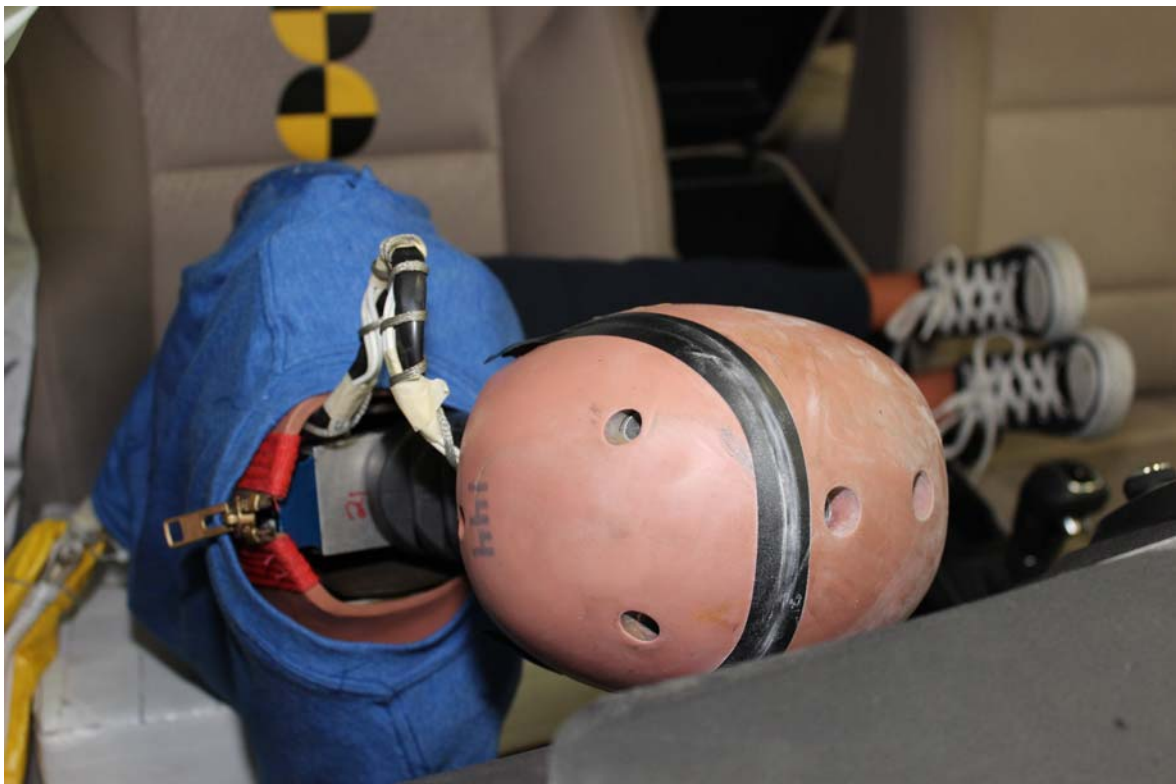


Photo No. 16. Post-Test 6-Year-Old Child Dummy Front Closeup View



Photo No. 17. Pre-Test 6-Year-Old Child Dummy Right $\frac{3}{4}$ Front View



Photo No. 18. Post-Test 6-Year-Old Child Dummy Right $\frac{3}{4}$ Front View



Photo No. 19. Pre-Test 6-Year-Old Child Dummy Right Side View



Photo No. 20. Post-Test 6-Year-Old Child Dummy Right Side View



Photo No. 21. Post-Test 6-Year-Old Child Dummy Right Side View (Door Open)



Photo No. 22. Post-Test Curtain Airbag Left Side View



Photo No. 23. Post-Test Curtain Airbag Left $\frac{3}{4}$ Front View



Photo No. 24. Post-Test Curtain Airbag Front View



Photo No. 25. Post-Test Curtain Airbag Right Side View (Door Open)

APPENDIX B

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