



REPORT NUMBER: TWG-MGA-2013-003

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

**KIA MOTORS MANUFACTURING GEORGIA, INC.
FOR HYUNDAI MOTOR COMPANY
2013 Hyundai Santa Fe Sport AWD SUV
NHTSA No.: MD0503TWG2**

TEST DATE: JANUARY 3, 2013

FINAL REPORT DATE: FEBRUARY 13, 2013

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 2013 Hyundai Santa Fe Sport AWD SUV with an out-of-position SID-IIs Build Level D were evaluated. The curtain and seat airbags were fired remotely. The test was performed by MGA Research Corporation on January 3, 2013. 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 SID-IIs Build Level D dummy (Serial Number 304) was placed in the right front passenger seat situated in the inboard-facing position per Section 3.3.5.3 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

The 9 channels of data were recorded using an on-board data acquisition system. Appendix B contains the dummy data traces.

The SID-IIs dummy's visible contact points were as follows:

- Curtain airbag to top and back of head
- Right shoulder to dash
- Torso bag to left torso and left pelvis

The SID-IIs dummy was placed in the right front passenger seat facing toward the center of the vehicle with its arm against the seatback. The arm was rotated horizontally in the forward direction with respect to the dummy. The seat track was adjusted forward to minimize the vertical distance between the dummy's head and curtain airbag. The dummy's pelvis was slid outboard until the dummy's back contacted the door trim panel or armrest and the CG of the head was centered in the deployment trajectory of the airbag. The vertical plane through the centerline of the dummy's rib-stiffener and shoulder bolt was parallel to the centerline of the vehicle. Masking tape was wrapped around the dummy's neck bracket to hold the dummy in place.

This orientation complies with Section 3.3.5.3 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	3.3.5.3*	Inboard Facing SID-IIs dummy
Curtain Airbag	Roof-Rail Mounted	Side Airbag
Torso Airbag	Seat Mounted	Side Airbag
ATD Type/Serial No.	SID-IIs Build Level D / 304	5 th Percentile Adult Female

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

Number of Data Channels	9
Number of Airbag Channels	4
Number of High-Speed Videos	3

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

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

Please note that this vehicle had previously been tested in an
NCAP Frontal Impact on October 10, 2012.

TEST VEHICLE INFORMATION

Manufacturer	Hyundai
Model	Santa Fe Sport
Body Style	SUV
NHTSA No.	MD0503TWG2
VIN	5XYZDLB7DG011581
Color	Cabo Bronze
Delivery Date	09/06/2012
Odometer Reading (mile)	53
Dealer	Boucher Fleet Group
Transmission	Automatic
Final Drive	AWD
Number of Cylinders	4
Engine Displacement (L)	2.4
Engine Placement	Lateral
Automatic Door Lock (ADL)	Yes
Owner's Manual Details Instructions on Disabling ADLs	Yes
Bucket Seats	Yes

TEST VEHICLE OPTIONS

Driver Front Airbag	Yes
Driver Side Curtain Airbag	Yes
Driver Side Torso/Pelvis Airbag	Yes
Rear Passenger Side Curtain Airbag	Yes
Rear Passenger Side Torso/Pelvis Airbag	No
Force Limiter	Yes
Pretensioner	Yes
Power Steering	Yes
Power Door Locks	Yes
Tilt Wheel	Yes
Air Conditioning	Yes
Anti-lock Brakes	Yes
Traction Control	Yes
All-Wheel Drive	Yes
Power Seats	No

DATA FROM CERTIFICATION LABEL

Manufactured By	Kia Motors Manufacturing Georgia, Inc. For Hyundai Motor Company
Date of Manufacture	AUG/21/12

GVWR (kg)	2300
GAWR Front (kg)	1350
GAWR Rear (kg)	1000

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Bench		
Number of Occupants	2	3		5
Capacity Wt. (VCW) (kg)				420
Cargo Wt. (RCLW) (kg)				80

DATA SHEET NO. 3
DUMMY POSITIONING IN VEHICLE

Measurement		Value
Seat Position		13 of 24 Detents from Full Rearward
Seat Height Position		Non-Adjustable
Placed in Position No. 2		---
Seat Back Angle (at headrest post)	SA (°)	-12.2
Top of Curtain Airbag Module to Head/Neck Junction	AN (mm)	220
Top of Seat Airbag Module to Head/Neck Junction	AN (mm)	123
Head CG to Door Window	HD (mm)	168
Head to Seat Back Centerline	HSC (mm)	165
Chest to Dash	CD (mm)	535
Chest to Seatback	CS (mm)	248
Right Arm to Seat Back Centerline	RACL (mm)	---
Left Arm to Seat Back Centerline	LACL (mm)	248
Right Arm to Door Panel	RA (mm)	---
Left Arm to Door Panel	LA (mm)	68
Knee to Knee	KK (mm)	140
Toe to Toe	TT (mm)	143
Right Knee to Seat Cushion Centerline	KSCR (mm)	145
Left Knee to Seat Cushion Centerline	KSCL (mm)	132
Right Toe to Seat Cushion Centerline	TSCR (mm)	544
Left Toe to Seat Cushion Centerline	TSCL (mm)	635
Nose to Dash	ND (mm)	662
Nose to Headrest	NS (mm)	220
Top of Head to Headliner	HH (mm)	104

DATA SHEET NO. 4
DUMMY INJURY CRITERIA VALUES

NHTSA No. MD0503TWG2

		MAXIMUM VALUE			
		Position No. 2			
DESCRIPTION	UNIT	MAXIMUM	TIME (ms)	MINIMUM	TIME (ms)
Head X	g	23.9	24.5	-6.1	256.8
Head Y	g	48.9	12.5	-17.7	246.8
Head Z	g	164.0	13.2	-33.1	14.1
Head Resultant	g	164.2	13.2		
Upper Neck Fx	N	142.1	21.3	-276.8	35.1
Upper Neck Fy	N	444.5	34.2	-92.5	142.6
Upper Neck Fz	N	250.4	116.5	-1309.1	15.5
Upper Neck F Resultant	N	1323.5	15.5		
Upper Neck Mx	Nm	18.3	74.2	-22.2	16.2
Upper Neck My	Nm	21.9	23.5	-39.0	39.6
Upper Neck Mz	Nm	10.4	283.7	-9.8	91.0
Upper Neck M Resultant	Nm	39.5	39.5		

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

NHTSA No. MD0503TWG2

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	121.71	13.0	13.8	121.71	13.0	13.8

Position 2 Neck Injury Summary (SID-IIs Build Level D – Out-Of-Position)

	Nij	Time (msec)	Z Force (N) (CFC 600)	X Force (N) (CFC 600)	Y Moment (N-m) (CFC 600)
Ntf	0.09	152.4	117.31	-135.87	7.45
Nte	0.17	65.9	0.45	41.72	-10.87
Ncf	0.36	16.2	-1257.22	13.88	5.59
Nce	0.72	39.7	-795.32	-247.67	-38.94
Peak Tension (CFC1000)	250.4 N		Peak Compression (CFC 1000)		-1309.1 N

Critical Values

Nij Intercepts				Peak Limits	
Tension (CVt)	3880 N	Extension (mCVe)	61 N-m	Tension	2070 N
Compression (CVc)	3880 N	Flexion (mCVf)	155 N-m	Compression	2520 N
Condyle Offset	0.01778 m				

APPENDIX A
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Right ¾ Front View of Vehicle, As Received



Vehicle Certification Placard



Pre-Test Vehicle Left Side View



Post-Test Vehicle Left Side View



Pre-Test SID-IIs Dummy Left Side View



Post-Test SID-IIs Dummy Left Side View



Pre-Test SID-IIs Dummy Left Side Closeup View



Post-Test SID-IIs Dummy Left Side Closeup View



Pre-Test SID-IIs Dummy Left ¾ Front View



Post-Test SID-IIs Dummy Left ¾ Front View



Pre-Test SID-IIs Dummy Left $\frac{3}{4}$ Front Closeup View



Post-Test SID-IIs Dummy Left $\frac{3}{4}$ Front Closeup View



Pre-Test SID-II's Dummy Front View



Post-Test SID-II's Dummy Front View



Pre-Test SID-IIs Dummy Front Closeup View



Post-Test SID-IIs Dummy Front Closeup View



Pre-Test SID-11s Dummy Right 3/4 Front View



Post-Test SID-11s Dummy Right 3/4 Front View



Pre-Test SID-IIs Dummy Right Side View



Post-Test SID-IIs Dummy Right Side View



Post-Test SID-II's Dummy Right Side View (Door Open)



Post-Test Curtain Airbag Left Side View



Post-Test Curtain Airbag Left ¾ Front View



Post-Test Curtain Airbag Front View



Post-Test Curtain Airbag Right Side View (Door Open)

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