

REPORT NUMBER: TWG-MGA-2015-012

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

**FUJI HEAVY INDUSTRIES LTD.
2015 Subaru Legacy 4-Dr Sedan
NHTSA No.: M20155503TWG2**

TEST DATE: AUGUST 3, 2015

FINAL REPORT DATE: SEPTEMBER 15, 2015

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 2015 Subaru Legacy 4-Dr Sedan 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 August 3, 2015. 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 forward-facing position along the outboard edge of the seat per Section 3.3.3.5 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 right side of head
- Torso/pelvis bag to right 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, aligning the upper spine with the deployment trajectory of the airbag. The dummy's head was placed in between the seat bolster and pillar/side trim. The head remained in its neutral orientation. The legs were aligned so that they cross the heel placement points that were previously marked on the seat cushion. The feet were held in place and the pelvis slid forward and parallel to the centerline of the vehicle until the dummy's head/neck junction was aligned vertically with the top edge of the airbag module. The legs were then repositioned so that they cross the heel placement points. With the vehicle door closed, the dummy's outboard arm was raised to clear the armrest and the pelvis and upper torso was slid outboard until the pelvis or torso contacted the door. The outboard arm was placed on the armrest. The inboard arm was flexed so that the upper arm contacted the seat back and 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 3.3.3.5 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	3.3.3.5*	Forward-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 right side of head
Right Shoulder Contact	Seat Torso/Pelvis Bag
Right Torso Contact	Seat Torso/Pelvis Bag
Right Pelvis Contact	Seat Torso/Pelvis Bag

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

Please note that this vehicle had previously been tested in an
NCAP MDB Impact on September 2, 2014.

TEST VEHICLE INFORMATION**TEST VEHICLE OPTIONS**

Manufacturer	Subaru	Driver Front Airbag	Yes
Model	Legacy	Driver Side Curtain Airbag	Yes
Body Style	Sedan	Driver Side Torso/Pelvis Airbag	Yes
NHTSA No.	M20155503	Rear Passenger Side Curtain Airbag	Yes
VIN	4S3BNBA6XF3012107	Rear Passenger Side Torso/Pelvis Airbag	No
Color	Carbide Gray Metallic	Force Limiter	Yes
Delivery Date	8/26/2014	Pretensioner	Yes
Odometer Reading (mile)	148	Power Steering	Yes
Dealer	Liberty Subaru	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)	2.5	Traction Control	Yes
Engine Placement	Lateral	All-Wheel Drive	Yes
Automatic Door Lock (ADL)	No	Power Seats	No
Owner's Manual Details Instructions on Disabling ADLs	N/A		
Bucket Seats	Yes		

DATA FROM CERTIFICATION LABEL

Manufactured By	Fuji Heavy Industries Ltd.	GVWR (kg)	2050
Date of Manufacture	08/2014	GAWR Front (kg)	1150
		GAWR Rear (kg)	1200

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Split Bench		
Number of Occupants	2	3		5
Capacity Wt. (VCW) (kg)				385
Cargo Wt. (RCLW) (kg)				45

DATA SHEET NO. 3
DUMMY POSITIONING IN VEHICLE

Measurement		Value
Seat Position		13 of 25 detents
Seat Height Position		Non-Adjustable
Placed in Position No. 2		---
Seat Back Angle (at headrest post)	SA (°)	2.0
Top of Curtain Airbag Module to Head/Neck Junction	AN (mm)	324
Top of Seat Airbag Module to Head/Neck Junction	AN (mm)	128
Head CG to Door Window	HD (mm)	176
Head to Seat Back Centerline	HSC (mm)	198
Chest to Dash	CD (mm)	608
Chest to Seatback	CS (mm)	195
Right Arm to Seat Back Centerline	RACL (mm)	345
Left Arm to Seat Back Centerline	LACL (mm)	90
Right Arm to Door Panel	RA (mm)	Contact
Left Arm to Door Panel	LA (mm)	246
Knee to Knee	KK (mm)	139
Toe to Toe	TT (mm)	147
Right Knee to Seat Cushion Centerline	KSCR (mm)	122
Left Knee to Seat Cushion Centerline	KSCL (mm)	28
Right Toe to Seat Cushion Centerline	TSCR (mm)	12
Left Toe to Seat Cushion Centerline	TSCL (mm)	158
Nose to Dash	ND (mm)	713
Nose to Headrest	NS (mm)	252
Top of Head to Headliner	HH (mm)	182

DATA SHEET NO. 4
DUMMY INJURY CRITERIA VALUES

NHTSA No. M20155503TWG2

		MAXIMUM VALUE			
		Position No. 2			
DESCRIPTION	UNIT	MAXIMUM	TIME (ms)	MINIMUM	TIME (ms)
Head X	g	16.1	13.9	-23.1	29.6
Head Y	g	3.1	53.9	-15.2	23.1
Head Z	g	16.8	33.6	-11.9	7.5
Head Resultant	g	26.9	31.4		
Upper Neck Fx	N	453.2	44.4	-36.9	298.1
Upper Neck Fy	N	53.1	45.6	-219.5	18.0
Upper Neck Fz	N	735.7	58.7	-464.2	14.2
Upper Neck F Resultant	N	766.0	58.7		
Upper Neck Mx	Nm	14.8	12.3	-3.2	53.1
Upper Neck My	Nm	35.6	15.0	-24.8	33.2
Upper Neck Mz	Nm	3.0	133.0	-7.8	67.8
Upper Neck M Resultant	Nm	37.5	14.8		
Lower Neck Fx	N	341.0	17.2	-508.4	54.6
Lower Neck Fy	N	96.7	7.6	-146.8	14.4
Lower Neck Fz	N	119.8	166.4	-614.3	57.8
Lower Neck F Resultant	N	781.6	54.8		
Lower Neck Mx	Nm	6.7	164.7	-24.2	14.5
Lower Neck My	Nm	6.8	6.4	-72.5	57.9
Lower Neck Mz	Nm	3.3	37.7	-20.2	11.6
Lower Neck M Resultant	Nm	72.7	57.9		

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

NHTSA No. M20155503TWG2

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	38.89	21.3	36.3	44.53	10.5	38.2

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	0.04	182.6	72.32	-10.30	1.41
Nte	0.58	54.2	449.05	322.73	-9.93
Ncf	0.48	14.2	-459.66	344.60	35.22
Nce	0.72	33.9	-92.27	50.28	-24.57
Peak Tension (CFC1000)		735.7 N	Peak Compression (CFC 1000)		-464.2 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

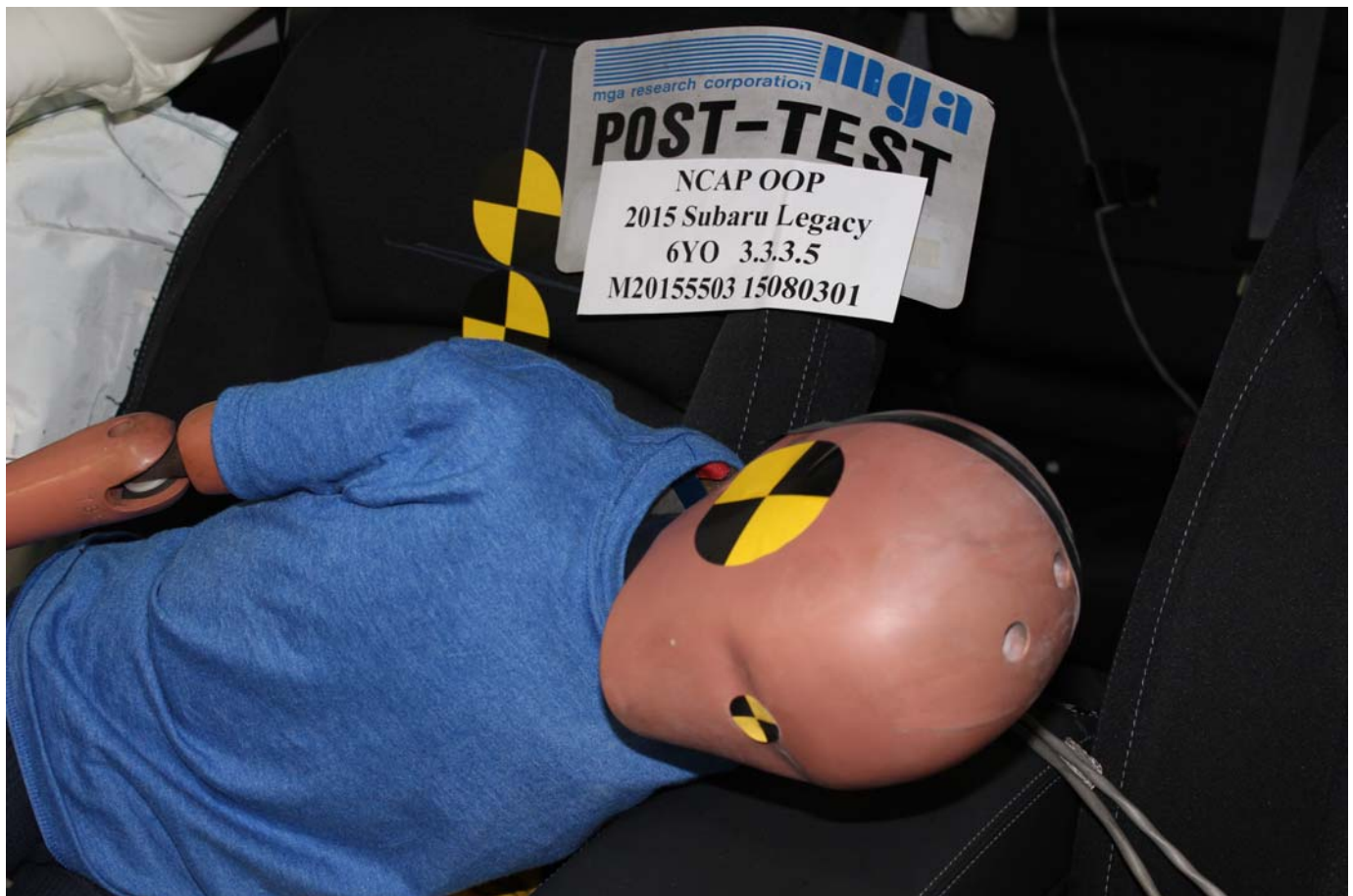


Photo No. 12 - Post-Test 6-Year-Old Child Dummy Left $\frac{3}{4}$ Front Closeup View



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

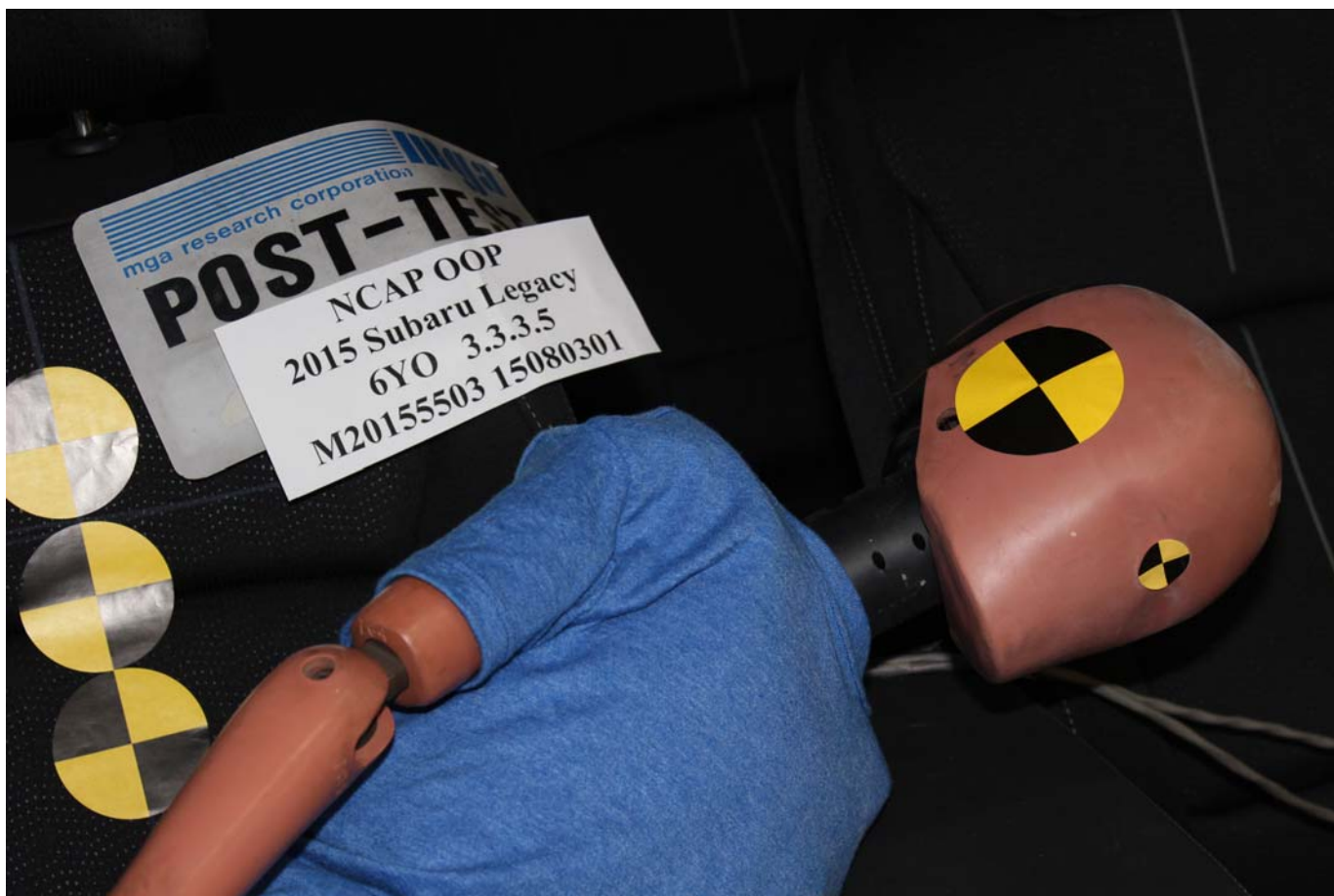


Photo No. 16 - Post-Test 6-Year-Old Child Dummy Front Closeup View



Photo No. 17 - Pre-Test 6-Year-Old Child Dummy Right ¾ Front View



Photo No. 18 - Post-Test 6-Year-Old Child Dummy Right ¾ 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 ¾ Front View



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



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

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