

FINAL REPORT NUMBER 201UI-MGA-10-05

**SAFETY COMPLIANCE TESTING FOR FMVSS 201
Occupant Protection In Interior Impact
Upper Interior Head Impact Protection**

**FUJI HEAVY INDUSTRIES, LTD.
2010 Subaru Outback MPV
NHTSA No. CA5501**

**MGA RESEARCH CORPORATION
446 Executive Drive
Troy, Michigan 48083**




Test Dates: April 19-20, 2010
Report Date: May 24, 2010

FINAL REPORT


PREPARED FOR:

**U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
ENFORCEMENT
OFFICE OF VEHICLE SAFETY COMPLIANCE
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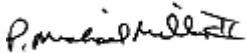
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16. Abstract A compliance test series was conducted on the subject 2010 Subaru Outback MPV, NHTSA No. CA5501, in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP-201U-01 for the determination of FMVSS 201 compliance. The testing was conducted at MGA Research Corporation in Troy, Michigan on April 19-20, 2010. Test failures identified were as follows: None The data recorded indicates that the 2010 Subaru Outback MPV tested appears to comply with the upper interior requirements of FMVSS 201.					
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1.0 PURPOSE OF COMPLIANCE TEST

The purpose of this head impact compliance test was to determine whether the subject vehicle, a 2010 Subaru Outback MPV, meets the performance requirements of FMVSS 201, Occupant Protection in Interior Impact - Upper Interior Head Impact Protection.

Tests were conducted on April 19-20, 2010 on a 2010 Subaru Outback MPV, manufactured by Fuji Heavy Industries, Ltd.

All tests were conducted in accordance with the U. S. Department of Transportation, National Highway Traffic Safety Administration's Laboratory Test Procedure TP-201U-01 dated April 3, 1998 and the corresponding MGA Research Corporation's FMVSS 201U procedure number MGATP201U_FRAME#2 dated August 21, 2009.

All tests were conducted at MGA Research Corporation in Troy, Michigan and were performed by MGA engineers and technicians. The FMVSS 201U impactor test machine was used to conduct the testing. Target locations were determined by using a Coordinate Measurement Machine in conjunction with the MGA EZ-Target™ program and MGA procedure MGATP201U_Test Series dated November 11, 2009.

2.0 COMPLIANCE TEST DATA SUMMARY

The 2010 Subaru Outback MPV was equipped with A, B, O (Other), and rear-pillars, an adjustable seat belt anchorage on each B-pillar, a fixed seat belt anchorage on each O-pillar, a fixed seat belt anchorage at the right rear corner of the upper roof zone, a grab handle located on the side rail above each door (front and rear), and a front overhead console and a dome light located on the upper roof.

Upon completion of targeting the test vehicle, twelve (12) targets were chosen to be impacted based upon engineering judgment and certification test data provided by the manufacturer. The twelve (12) targets chosen were:

AP2	BP3	FH1	UR2@BP
AP3	BP4	SR1	UR5@OP
BP2	OP2	UR1@SR1	UR4@SR3-1

The 2010 Subaru Outback MPV, tested appears to comply with the upper interior performance criteria for FMVSS 201. The HIC(d) measured using the Part 572L (Free Motion Headform) was below 1000 for each tested component.

TABLE 2-1

SUMMARY TABLE OF TEST RESULTS

VEH. MOD YR/MAKE/MODEL/BODY: 2010 Subaru Outback MPV

VEH. NHTSA NO.: CA5501 VIN: 4S4BRBAC1A3349036 COLOR: Black

VEH. BUILD DATE: December, 2009 TEST DATES: April 19-20, 2010

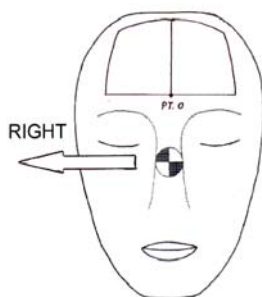
TEST LABORATORY: MGA Research Corporation

OBSERVERS: Andrew Gould, Ryan Jones, Helen A. Kaleto, Nathaniel Newth,

Donald J. Whiteside

TARGET	VEHICLE SIDE	HORIZONTAL ANGLE (deg)	VERTICAL ANGLE (deg)	VELOCITY (kph)	HIC(d)	FMH HIC	IMPACT ON FMH (mm)	
							Above	Left/Right
AP2	Left	205	49	19.0	394	301	21	3 Left
AP3	Right	156	44	19.0	390	296	15	7 Left
BP2	Right	90	6	24.1	499	441	24	1 Left
BP3	Left	285	7	23.9	619	600	9	2 Left
BP4	Left	202	-5	23.6	410	322	10	14 Left
OP2	Right	90	2	23.8	615	595	10	4 Left
FH1	Left	180	50	23.7	572	538	17	12 Left
SR1	Left	270	39	18.9	318	201	14	2 Left
UR1@SR1	Right	90	50	24.0	566	529	28	12 Left
UR2@BP	Left	270	50	23.6	549	507	24	4 Left
UR4@SR3-1	Left	270	50	23.8	533	486	35	6 Left
UR5@OP	Right	90	50	23.5	419	335	20	6 Left

Above and left/right refers to the position relative to reference pt. 0 where the target made contact with the Free Motion Headform. See the diagram below for details.



POST TEST COMMENTS:

The following description lists any post-test damage or other test observations for each target.

AP2 Left: A-pillar trim dislodged.

BP2 Right: Anchorage compression; adjuster partially functional.

BP3 Left: Seat belt anchorage compression; non-functional adjuster.

FH1 Left: Slight headliner deformation; sunglass holder opened.

SR1 Left: Minor headliner deformation; grab handle compression.

UR1 Right: Grab handle compression; headliner deformation.

UR2 Left: Headliner deformation.

UR4 Left: Headliner deformation, grab handle compression.

UR5 Right: Headliner deformation.

REMARKS:

The targets listed were impacted in the following order:

Right: AP3, BP2, UR1@SR1, OP2, UR5@OP

Left: FH1, AP2, SR1, UR4@SR3-1, BP4, BP3, UR2@BP

The 150 mm rule was observed for targets horizontal to each other and the 200 mm rule was observed for vertical components.

RECORDED BY: Donald J. Whiteside

DATE: April 20, 2010

APPROVED BY: Helen A. Kaleto

TABLE 2-2

GENERAL TEST AND VEHICLE PARAMETER DATA

VEH. MOD YR/MAKE/MODEL/BODY: 2010 Subaru Outback MPV

VEH. NHTSA NO.: CA5501 VIN: 4S4BRBAC1A3349036 COLOR: Black

VEH. BUILD DATE: December, 2009 TEST DATES: April 19-20, 2010

TEST LABORATORY: MGA Research Corporation

OBSERVERS: Andrew Gould, Ryan Jones, Helen A. Kaleto, Nathaniel Newth,
Donald J. Whiteside

INTERIOR TRIM INFORMATION: A, B, O (Other), and rear-pillars, an adjustable seat belt anchorage on each B-pillar, a fixed seat belt anchorage on each O-pillar, a fixed seat belt anchorage at the right rear corner of the upper roof zone, a grab handle located on the side rail above each door (front and rear), and a front overhead console and a dome light located on the upper roof.

SUNROOF INFORMATION:

Installed: Yes No

Operation: Electric Manual

SIDE RAIL CURTAIN AIRBAG INFORMATION:

Installed: Yes No

ROLL-BAR INFORMATION:

Installed: Yes No

Padded: Yes No

Braces: Yes No

GENERAL INFORMATION:

Date Received: January 18, 2010; Odometer Reading 10 miles

DATA FROM VEHICLE'S CERTIFICATION LABEL:

Vehicle Manufactured By: Fuji Heavy Industries, Inc.

Date of Manufacture: December, 2009; VIN: 4S4BRBAC1A3349036

GVWR: 2080 kg; GAWR FRONT: 1070 kg;
GAWR REAR: 1060 kg;

DATA FROM TIRE PLACARD:

Tire Pressure with Maximum Capacity Vehicle Load:

FRONT: 220 kPa REAR: 210 kPa

Recommended Tire Size: P215/70R16

Recommended Cold Tire Pressure:

FRONT: 220 kPa REAR: 210 kPa

Size of Tire on Test Vehicle: P215/70R16

Type of Spare Tire: T145/80R17; Space Saver: X; Standard

VEHICLE CAPACITY DATA:

Type of Front Seats: Bench ; Bucket X; Split Bench

Number of Occupants: Front 2; Rear 3; TOTAL 5

VEHICLE CAPACITY WEIGHT:

Vehicle Capacity Weight (VCW) = 408 kg

No. of Occupants x 68 kg = 340 kg

Rated Cargo/Luggage Weight (RCLW) = 68 kg (difference)

WEIGHT OF TEST VEHICLE AS DELIVERED AT LABORATORY: (with maximum fluids)

Right Front = 433.5 kg Right Rear = 343.0 kg

Left Front = 458.5 kg Left Rear = 350.0 kg

TOTAL FRONT = 892.0 kg TOTAL REAR = 693.0 kg

% Total Weight = 56.3 % % Total Weight = 43.7 %

TOTAL DELIVERED WEIGHT = 1585.0 kg

CALCULATION OF VEHICLE'S TARGET TEST WEIGHT:

Total Delivered Weight = 1585.0 kg

Max. Test Cargo/Luggage Weight = 68.0 kg

Target Test Weight = 1653.0 kg

WEIGHT OF TEST VEHICLE FULLY LOADED:

Right Front =	<u>429.0</u> kg	Right Rear =	<u>381.0</u> kg
Left Front =	<u>453.0</u> kg	Left Rear =	<u>389.5</u> kg
TOTAL FRONT =	<u>882.0</u> kg	TOTAL REAR =	<u>770.5</u> kg
% Total Weight =	<u>53.4</u> %	% Total Weight =	<u>46.6</u> %

TOTAL TEST WEIGHT = 1652.5 kg

Weight of ballast secured in vehicle's cargo area = 67.5 kg

TEST VEHICLE ATTITUDE:

AS DELIVERED: Right Front 795 mm; Left Front 784 mm;
Right Rear 816 mm; Left Rear 810 mm;
Pitch Angle at Right Door Sill = 0.7 Rear is higher
Pitch Angle at Left Door Sill = 0.3 Rear is higher
Roll Angle at Front Bumper = 0.2 Right is higher
Roll Angle at Rear Bumper = 0.2 Right is higher

FULLY LOADED: Right Front 799 mm; Left Front 788 mm;
Right Rear 802 mm; Left Rear 796 mm;
Pitch Angle at Right Door Sill = 0.4 Rear is higher
Pitch Angle at Left Door Sill = 0.0
Roll Angle at Front Bumper = 0.4 Right is higher
Roll Angle at Rear Bumper = 0.4 Right is higher

AS TARGETED: Right Front 901 mm; Left Front 902 mm;
Right Rear 895 mm; Left Rear 895 mm;
Pitch Angle at Right Door Sill = 0.4 Rear is higher
Pitch Angle at Left Door Sill = 0.0
Roll Angle at Front Bumper = 0.2 Right is higher
Roll Angle at Rear Bumper = 0.3 Right is higher

AS TESTED ON RIGHT SIDE:

Pitch Angle at Right Door Sill = 0.4 Rear is higher

Pitch Angle at Left Door Sill = 0.0

Roll Angle at Front Bumper = 0.3 Right is higher

Roll Angle at Rear Bumper = 0.3 Right is higher

AS TESTED ON LEFT SIDE:

Pitch Angle at Right Door Sill = 0.4 Rear is higher

Pitch Angle at Left Door Sill = 0.1 Rear is higher

Roll Angle at Front Bumper = 0.3 Right is higher

Roll Angle at Rear Bumper = 0.3 Right is higher

VEHICLE WHEELBASE = 2744 mm

REMARKS: The seat travel distance was measured to be 250 mm for the driver front seat and 250 mm for the passenger front seat.

RECORDED BY: Donald J. Whiteside

DATE: April 8, 2010

APPROVED BY: Helen A. Kaleto

TABLE 2-3

HORIZONTAL IMPACT ANGLE RANGE FOR A AND B PILLARS

VEH. MOD YR/MAKE/MODEL/BODY: 2010 Subaru Outback MPV

VEH. NHTSA NO.: CA5501 VIN: 4S4BRBAC1A3349036 COLOR: Black

VEH. BUILD DATE: December, 2009 TEST DATES: April 19-20, 2010

TEST LABORATORY: MGA Research Corporation

OBSERVERS: Andrew Gould, Ryan Jones, Helen A. Kaleto, Nathaniel Newth,
Donald J. Whiteside

HORIZONTAL IMPACT ANGLE RANGE FOR A AND B PILLARS

	HORIZONTAL ANGLE SPECIFIED RANGE	MINIMUM HORIZONTAL ANGLE	MAXIMUM HORIZONTAL ANGLE
A-PILLAR	L 195°-255°	L 203.9°	L 251.6°
	R 105°-165°	R 110.7°	R 157.7°
B-PILLAR	L 195°-345°	L 200.1°	L 293.2°
	R 15°-165°	R 66.8°	R 160.3°

AS DETERMINED USING THE PROCEDURES SPECIFIED IN S8.13.4.1

REMARKS:

RECORDED BY: Donald J. Whiteside

DATE: April 8, 2010

APPROVED BY: Helen A. Kaleto

TABLE 2-4

VERTICAL IMPACT ANGLE RANGES

VEH. MOD YR/MAKE/MODEL/BODY: 2010 Subaru Outback MPV

VEH. NHTSA NO.: CA5501 VIN: 4S4BRBAC1A3349036 COLOR: Black

VEH. BUILD DATE: December, 2009 TEST DATES: April 19-20, 2010

TEST LABORATORY: MGA Research Corporation

OBSERVERS: Andrew Gould, Ryan Jones, Helen A. Kaleto, Nathaniel Newth,

Donald J. Whiteside

VERTICAL IMPACT ANGLE RANGES

		VERTICAL ANGLE SPECIFIED RANGE		MINIMUM VERTICAL ANGLE		MAXIMUM VERTICAL ANGLE	
FRONT HEADER	FH1	L	0°-50°	L	0°	L	50°
		R	0°-50°	R	0°	R	50°
	FH2	L	0°-50°	L	0°	L	50°
		R	0°-50°	R	0°	R	50°
SIDE RAIL	SR1	L	0°-50°	L	0°	L	39°
		R	0°-50°	R	0°	R	39°
	SR2A	L	0°-50°	L	0°	L	44°
		R	0°-50°	R	0°	R	44°
	SR2B	L	0°-50°	L	0°	L	42°
		R	0°-50°	R	0°	R	42°
	SR3-1	L	0°-50°	L	0°	L	44°
		R	0°-50°	R	0°	R	44°
	SR3-2	L	0°-50°	L	0°	L	43°
		R	0°-50°	R	0°	R	43°
	SR3-3	L	0°-50°	L	0°	L	49°
		R	0°-50°	R	0°	R	39°

		VERTICAL ANGLE SPECIFIED RANGE		MINIMUM VERTICAL ANGLE		MAXIMUM VERTICAL ANGLE	
A-PILLAR	AP1	L	-5°-50°	L	-5°	L	23°
		R	-5°-50°	R	-5°	R	23°
	AP2	L	-5°-50°	L	-5°	L	49°
		R	-5°-50°	R	-5°	R	49°
	AP3	L	-5°-50°	L	-5°	L	44°
		R	-5°-50°	R	-5°	R	44°
B-PILLAR	BP1	L	-10°-50°	L	-10°	L	21°
		R	-10°-50°	R	-10°	R	21°
	BP2*	L	0°-50°	L	0°	L	6°
		R	0°-50°	R	0°	R	6°
	BP3*	L	0°-50°	L	0°	L	7°
		R	0°-50°	R	0°	R	7°
	BP4	L	-10°-50°	L	-10°	L	-5°
		R	-10°-50°	R	-10°	R	-5°
OTHER-PILLAR	OP1	L	-10°-50°	L	-10°	L	-2°
		R	-10°-50°	R	-10°	R	-2°
	OP2	L	-10°-50°	L	-10°	L	2°
		R	-10°-50°	R	-10°	R	2°
UPPER ROOF 1		0°-50°		0°		50°	
UPPER ROOF 2		0°-50°		0°		50°	
UPPER ROOF 3		0°-50°		0°		50°	
UPPER ROOF 4		0°-50°		0°		50°	
UPPER ROOF 5		0°-50°		0°		50°	
UPPER ROOF 6		0°-50°		0°		50°	

As determined using the Procedures specified in S8.13.4.2. *Targets BP2 and BP3 are seat belt anchorage locations.

RECORDED BY: Donald J. Whiteside

DATE: April 8, 2010

APPROVED BY: Helen A. Kalet

TABLE 2-5

TARGET MEASUREMENTS

VEH. MOD YR/MAKE/MODEL/BODY: 2010 Subaru Outback MPV

VEH. NHTSA NO.: CA5501 VIN: 4S4BRBAC1A3349036 COLOR: Black

VEH. BUILD DATE: December, 2009 TEST DATES: April 19-20, 2010

TEST LABORATORY: MGA Research Corporation

OBSERVERS: Andrew Gould, Ryan Jones, Helen A. Kaleto, Nathaniel Newth,

Donald J. Whiteside

Measurement	Description	Left Side	Right Side
M	Seat Fore/Aft Travel (Front seats)	250 mm	250 mm
T°	Horizontal < {CG-F1 (Left Seat) to (Right A-Pillar)}	108.4°	--
A1°	360° - T°	251.6°	--
W°	Horizontal < {CG-2 (Left Seat) to (Left A-Pillar)}	203.9°	--
A2°	A2° = W°	203.9°	--
U°	Horizontal < {CG-2 (Left Seat) to (Left B-Pillar)}	293.2°	--
B1°	B1° = U°	293.2°	--
V°	Horizontal < {CG-R (Left Seat) to (Left B-Pillar)}	200.1°	--
B2°	B2° = V°	200.1°	--
W° (right)	Horizontal < {CG-F2 (Right Seat) to (Right A-Pillar)}	--	157.7°
A1° (right)	A1° (right) = W° (right)	--	157.7°
T ° (right)	Horizontal < {CG-F1 (Right Seat) to (Left A-Pillar)}	--	249.3°
A2° (right)	360°-T° (right)	--	110.7°
V ° (right)	Horizontal < {CG-R (Right Seat) to (Right B-Pillar)}	--	160.3°
B1° (right)	B1° (right) = V° (right)	--	160.3°
U ° (right)	Horizontal < {CG-F2 (Right Seat) to (Right B-Pillar)}	--	66.8°
B2° (right)	B2° (right) = U° (right)	--	66.8°
J	A-Pillar {(Plane 3) – (Plane 5)}	343.5 mm	341.2 mm
J/2	J ÷ 2	171.8 mm	170.6 mm
D1	Upper Roof {(Plane A) – (Plane B)}	2210.0 mm	
D1/2	D1 ÷ 2	1105.0 mm	

Measurement	Description	Left Side	Right Side
D2	Upper Roof {(Plane C) – (Plane D)}	1229.2 mm	
D2/2	D2 ÷ 2	614.6 mm	
.35D1	.35 x D1	773.5 mm	
.35D2	.35 x D2	430.2 mm	
N	B-Pillar {(BPR) – (lowest point on daylight opening forward of B-Pillar)}	436.6 mm	434.4 mm
N/2	B-Pillar {(BP3) – (lowest point on daylight opening forward of B-Pillar)}	218.3 mm	217.2 mm
N/4	B-Pillar {(BP4) – (lowest point on daylight opening forward of B-Pillar)}	109.2 mm	108.6 mm
Q	O-Pillar (Plane 13 – Plane 14)	380.2 mm	383.6 mm
Q/2	Q / 2	190.1 mm	191.8 mm
D	R-Pillar (Point 7 – Point M)	900.0 mm	914.0 mm
3D/7	3*D / 7	385.7 mm	391.7 mm

As determined using the Procedures specified in S10.1-10.13.

SgRP Locations (world coordinates)						
	Left (mm)			Right (mm)		
	x	y	z	x	y	z
Front	1279.5	-370.0	294.8	1288.8	370.0	270.8
Rear	2155.0	-366.0	306.0	2155.0	366.0	306.0

SgRP Locations (vehicle coordinates)						
	Left (mm)			Right (mm)		
	x	y	z	x	y	z
Front	1279.5	-370.0	294.8	1288.8	370.0	270.8
Rear	2155.0	-366.0	306.0	2155.0	366.0	306.0

CG Locations (world coordinates)						
	Left (mm)			Right (mm)		
	x	y	z	x	y	z
CGF1	1189.5	-370.0	954.8	1198.8	370.0	930.8
CGF2	1439.5	-370.0	954.8	1448.8	370.0	930.8
CGR	2315.0	-366.0	966.0	2315.0	366.0	966.0

REFERENCE FOR VEHICLE COORDINATE SYSTEM (measured in millimeters):

Driver side door striker upper bolt hole (x, y, z) = 1457.9, -782.5, 457.3

Driver side door sill drain hole (x, y, z) = 780.0, -763.0, 66.7

Passenger side door check bolt hole (x, y, z) = 434.5, 746.6, 399.0

REMARKS:

RECORDED BY: Donald J. Whiteside

DATE: April 8, 2010

APPROVED BY: Helen A. Kaleta

TABLE 2-6

SUMMARY OF TARGETING RESULTS

VEH. MOD YR/MAKE/MODEL/BODY: 2010 Subaru Outback MPV

VEH. NHTSA NO.: CA5501 VIN: 4S4BRBAC1A3349036 COLOR: Black

VEH. BUILD DATE: December, 2009 TEST DATES: April 19-20, 2010

TEST LABORATORY: MGA Research Corporation

OBSERVERS: Andrew Gould, Ryan Jones, Helen A. Kaleto, Nathaniel Newth,
 Donald J. Whiteside

SUMMARY OF TARGETING RESULTS								
Target	Location (mm)			Horizontal Angle (deg)	Vertical Angle (deg)	Relocation (Yes/No)	Extension (# of 25 mm Spheres)	Impact (Yes/No)
	x	y	z					
A-Pillar Left Side								
AP1	1059.6	-554.3	1077.8	--	--	Yes	--	--
REL	1077.2	-560.5	1058.5	250	23	--	1	No
AP2	952.4	-599.3	990.8	205	49	No	--	Yes
AP3	787.1	-631.2	906.6	205	44	No	--	No
A-Pillar Right Side								
AP1	1056.7	551.6	1078.4	--	--	Yes	--	--
REL	1077.1	561.6	1065.5	112	23	--	1	No
AP2	954.9	601.4	991.2	156	49	No	--	No
AP3	786.8	626.2	908.3	156	44	No	--	Yes
B-Pillar Left Side								
BP1	1586.2	-489.4	1138.3	270	21	No	--	No
BP2	1552.8	-612.6	917.1	270	6	No	--	No
BP3	1541.8	-613.8	920.4	--	--	Yes	--	--
REL	1542.2	-605.8	937.9	285	7	--	1	Yes
BP4	1613.7	-663.2	812.1	202	-5	No	--	Yes
B-Pillar Right Side								
BP1	1583.3	487.9	1139.2	90	21	No	--	No

SUMMARY OF TARGETING RESULTS								
Target	Location (mm)			Horizontal Angle (deg)	Vertical Angle (deg)	Relocation (Yes/No)	Extension (# of 25 mm Spheres)	Impact (Yes/No)
	x	y	z					
BP2	1556.1	613.0	915.6	90	6	No	--	Yes
BP3	1541.4	614.0	923.0	--	--	Yes	--	No
REL	1544.0	602.9	944.1	75	7	--	1	No
BP4	1615.6	663.0	815.4	159	-5	No	--	No
Other Pillar Left Side								
OP1	2538.0	-636.5	906.8	--	--	Yes	--	--
REL	2512.2	-623.6	954.4	270	-2	--	3	No
OP2	2497.2	-623.9	951.8	270	2	No	--	No
Other Pillar Right Side								
OP1	2537.1	636.5	904.3	--	--	Yes	--	--
REL	2514.0	623.4	953.8	90	-2	--	3	No
OP2	2497.2	622.5	952.5	90	2	No	--	Yes
Rear Pillar Left Side								
RP1	2940.3	-519.2	1054.1	Target exempt from testing per S6.3(b).				
RP2	3052.1	-637.5	905.0	Target exempt from testing per S6.3(b).				
Rear Pillar Right Side								
RP1	2949.1	521.6	1056.0	Target exempt from testing per S6.3(b).				
RP2	3054.5	634.1	905.8	Target exempt from testing per S6.3(b).				
Front Header Left Side								
FH1	995.2	-445.8	1103.7	180	50	No	--	Yes
FH2	974.3	-296.8	1107.6	180	50	No	--	No
Front Header Right Side								
FH1	989.0	444.1	1099.6	180	50	No	--	No
FH2	974.2	297.3	1107.3	180	50	No	--	No
Side Rail Left Side								
SR1	1209.5	-515.8	1094.6	270	39	No	--	Yes
SR2A	1359.1	-497.7	1120.2	270	44	No	--	No
SR2B	1286.6	-518.7	1124.3	--	--	Yes	--	--
REL	1289.7	-494.7	1117.5	270	42	--	1	No

SUMMARY OF TARGETING RESULTS								
Target	Location (mm)			Horizontal Angle (deg)	Vertical Angle (deg)	Relocation (Yes/No)	Extension (# of 25 mm Spheres)	Impact (Yes/No)
	x	y	z					
SR3-1	2002.6	-494.8	1133.5	270	44	No	--	No
SR3-2	2174.6	-494.0	1128.2	270	43	No	--	No
SR3-3	2578.4	-527.8	1093.2	270	49	No	--	No
Side Rail Right Side								
SR1	1206.1	512.6	1095.2	90	39	No	--	No
SR2A	1355.8	499.1	1117.7	90	44	No	--	No
SR2B	1283.9	517.6	1125.3	--	--	Yes	--	--
REL	1287.7	493.5	1118.1	90	42	--	1	No
SR3-1	1995.8	496.2	1134.1	90	44	No	--	No
SR3-2	2171.5	495.4	1128.9	90	43	No	--	No
SR3-3	2581.1	531.7	1092.9	90	39	No	--	No
Rear Header Left Side								
RH	2879.6	-365.7	1109.7	Target exempt from testing per S6.3(b).				
Rear Header Right Side								
RH	2877.5	365.7	1092.8	Target exempt from testing per S6.3(b).				
Upper Roof Left Side								
UR2@BP	1589.2	-380.0	1182.6	270	50	No	--	Yes
UR4@SR3-1	2017.0	-365.1	1205.0	270	50	No	--	Yes
UR6@SR3-3	2576.4	-378.6	1171.2	270	50	No	--	No
Upper Roof Right Side								
UR1@SR1	1246.6	392.2	1151.3	90	50	No	--	Yes
UR3@SR	1856.1	381.3	1203.2	90	50	No	--	No
UR5@OP	2429.8	381.6	1191.5	90	50	No	--	Yes

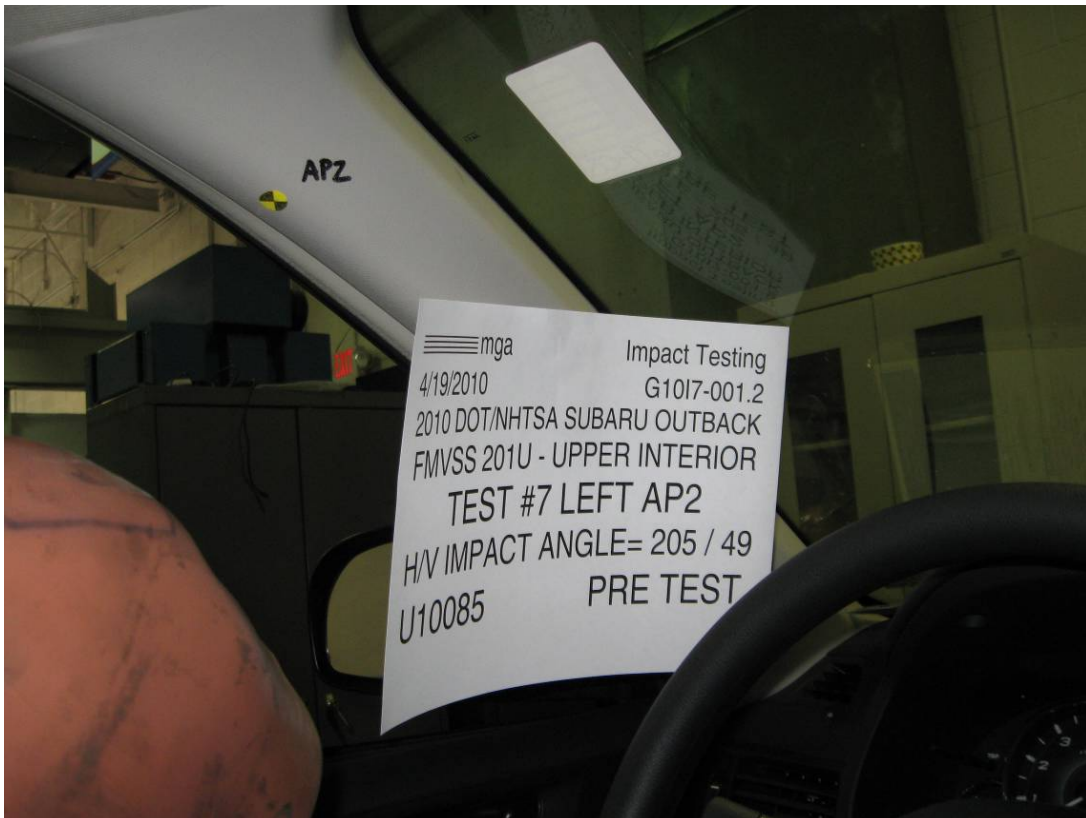
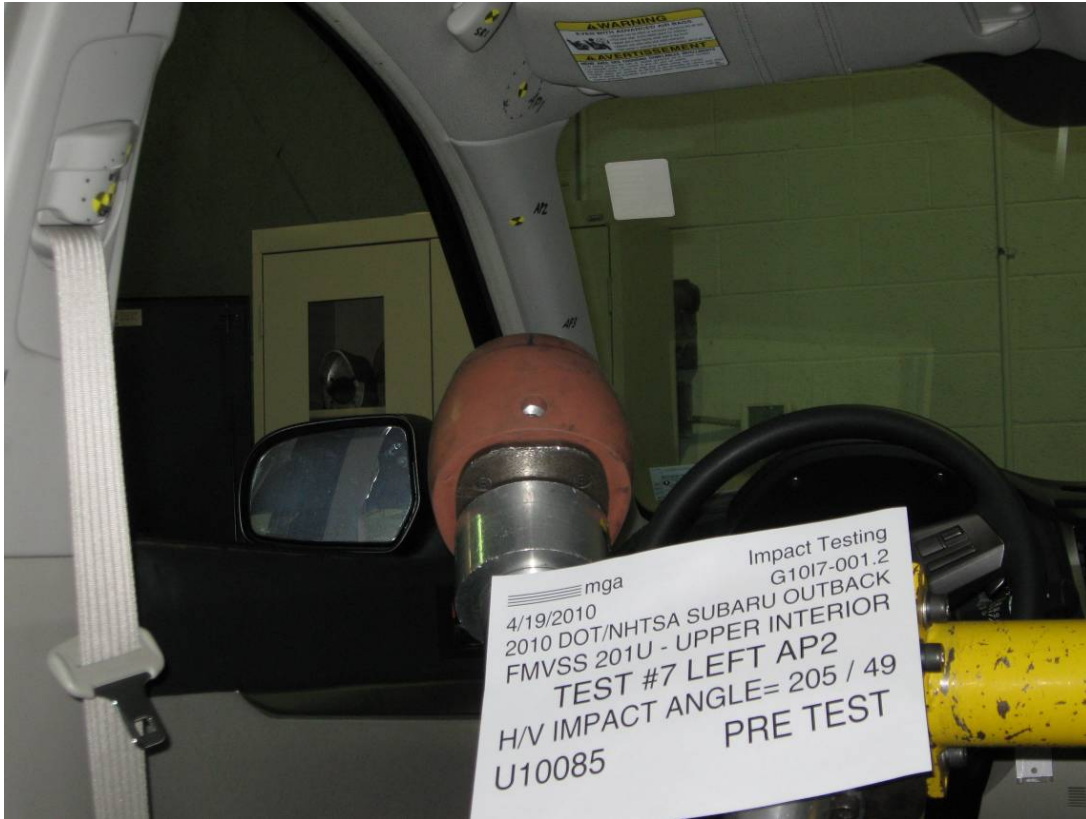
As determined using the Procedures specified in S10.1-10.13.

RECORDED BY: Donald J. Whiteside

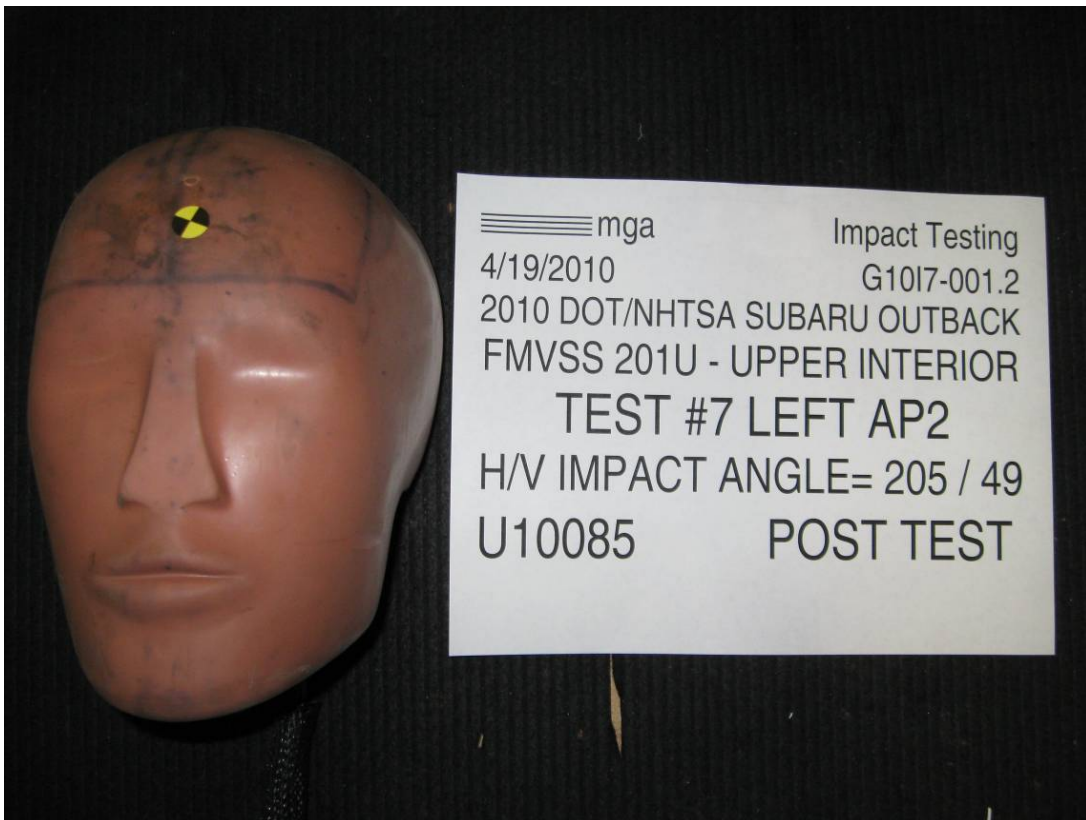
DATE: April 8, 2010

APPROVED BY: Helen A. Kaleto

3.0 TEST DATA (Including Acceleration and Velocity Plots)







SUMMARY OF FMVSS 201U TEST

JOB/NHTSA NO: G10I7-001.2 VEHICLE YR/MAKE/MODEL:2010/DOT/NHTSA/Subaru Outback

GENERAL TEST PARAMETERS:

Target (Vehicle Side): AP2Left

MGA Test Reference No.:U10085

Approach Horizontal Angles:205°

Approach Vertical Angles:49°

Additional Description:

Test Number:#7

Temperature:23.0C

Humidity:34.9%

Time of Test:4:22:03 PM

FMH Serial No:[035]

TEST RESULTS:

HIC(d)	HIC	Δt (msec)	Velocity (kph)	Impact location on FMH (mm)	
				Above Pt. O	Left/Right Pt. O
394	301	8.9	19.0	21	3 Left

INSTRUMENTATION INFORMATION: (all accelerometers are Endevco 7264-2000)

Axis	Channel	Serial No.	DLR Value	ΔV Pre-Test	ΔV Post-Test
X	5	J35919	-96.3	1.06	1.06
Y	6	J22664	95.2	0.85	0.85
Z	7	J35924	93.8	0.94	0.94

REMARKS (Summary of test, damage, non-compliance, invalid test, etc.):

A-pillar trim dislodged

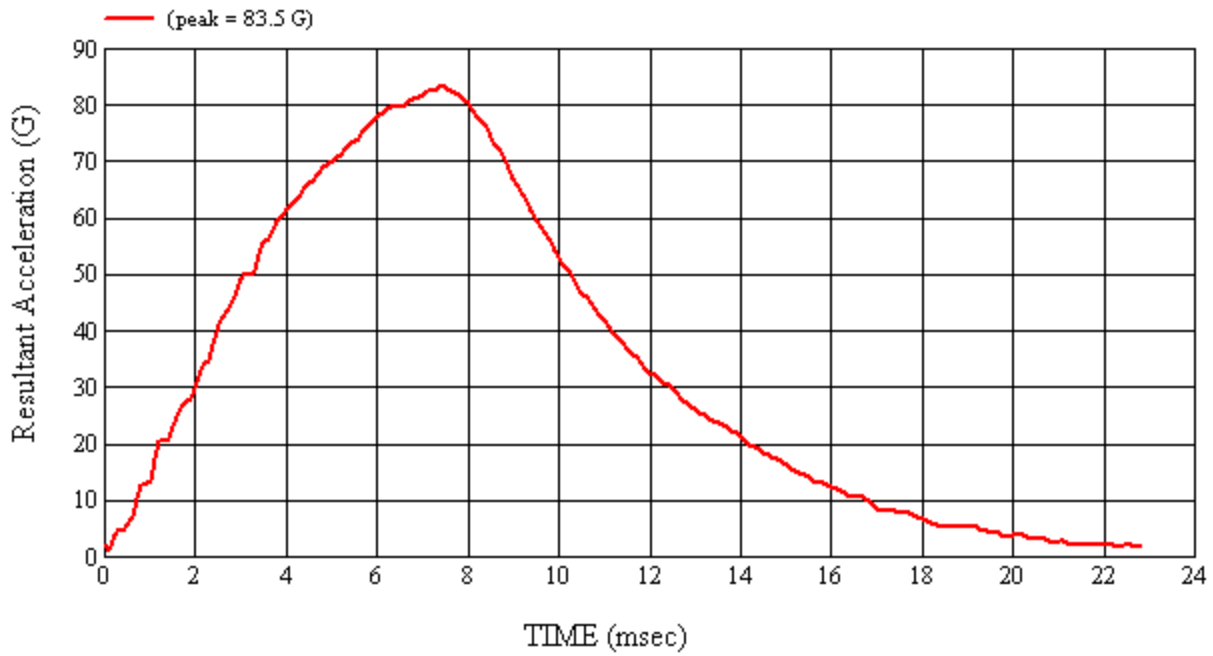
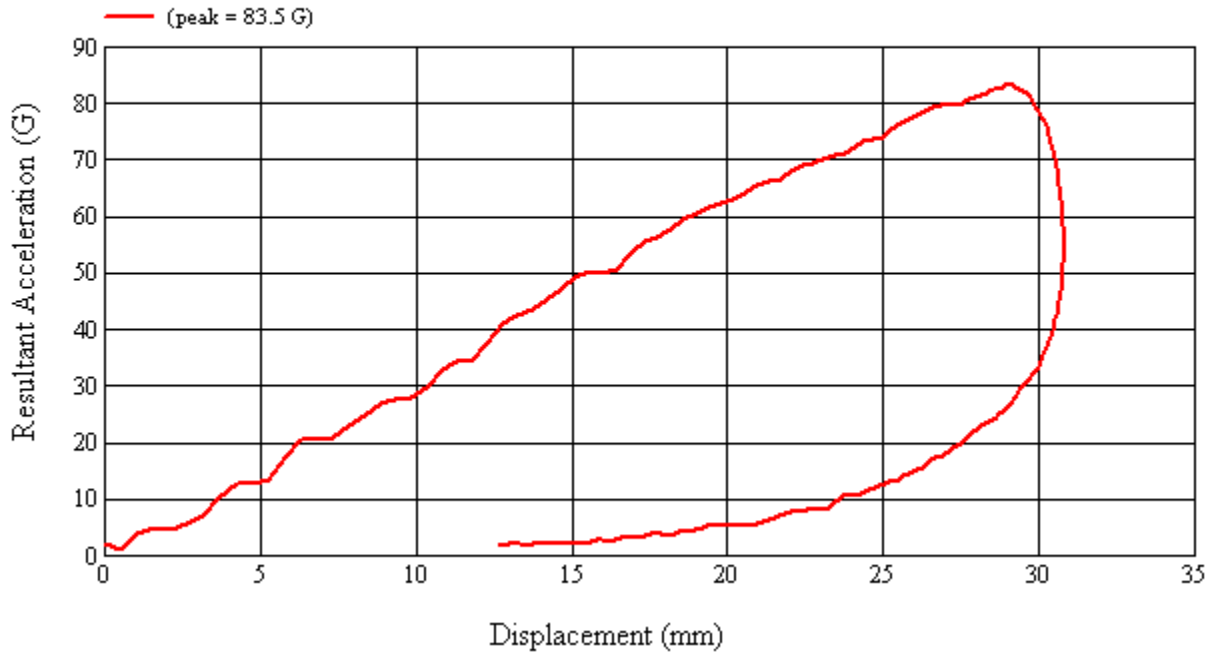
Recorded By: *Mathew hkr* Approved By*: *Aileen A. Kalito* Date: 4/19/2010

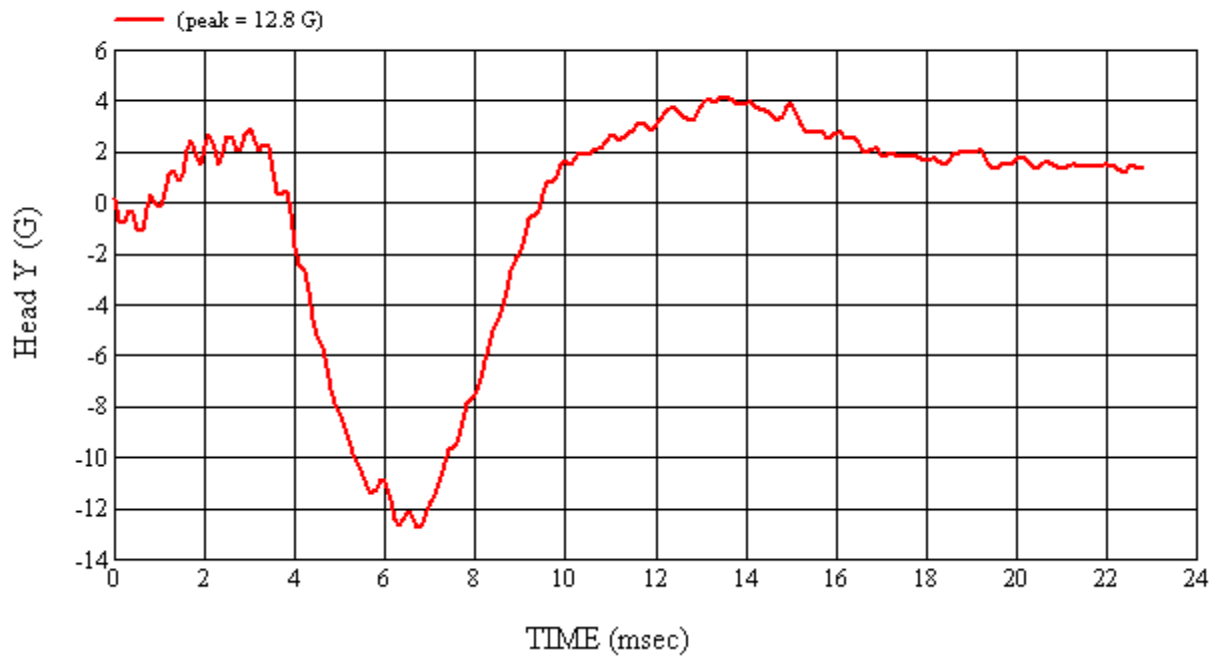
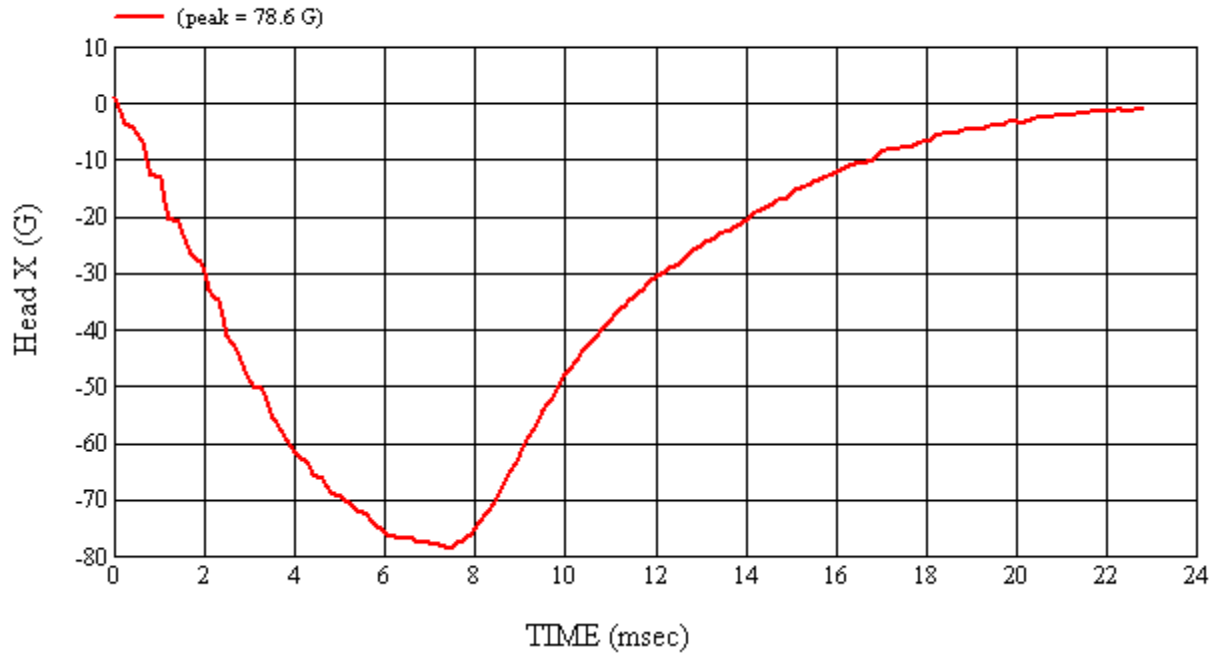
*Only necessary for NHTSA (Government) Compliance testing.

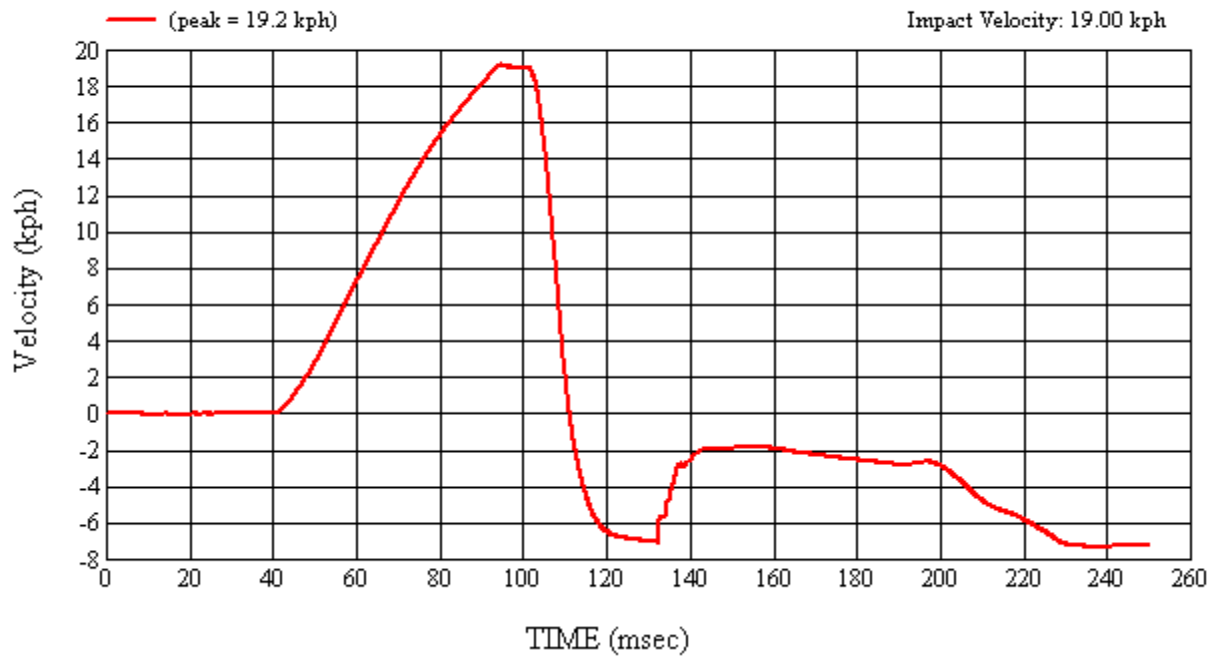
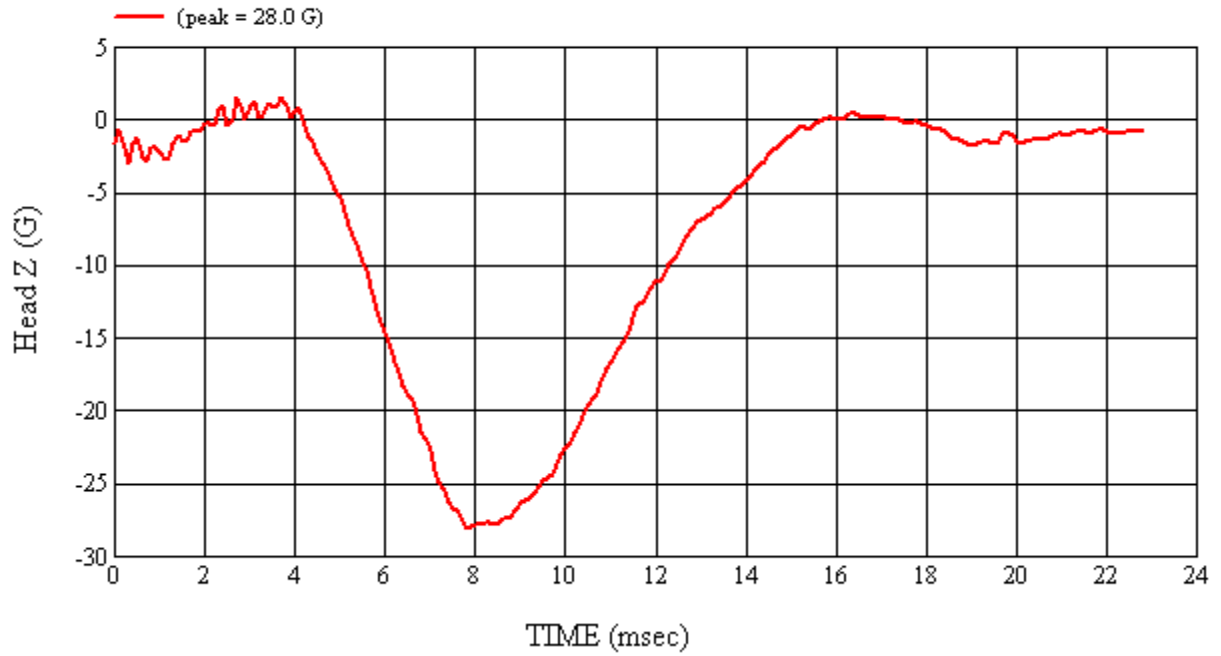
MGA Test #: U10085

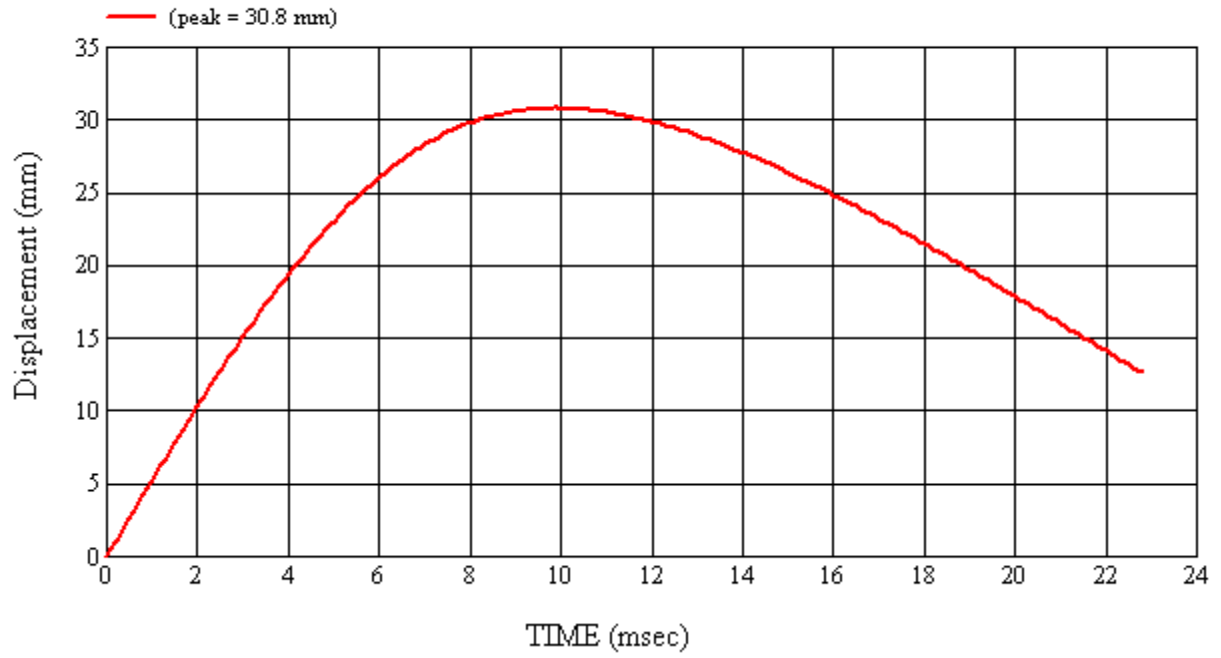
Target Location: AP2, Left Side

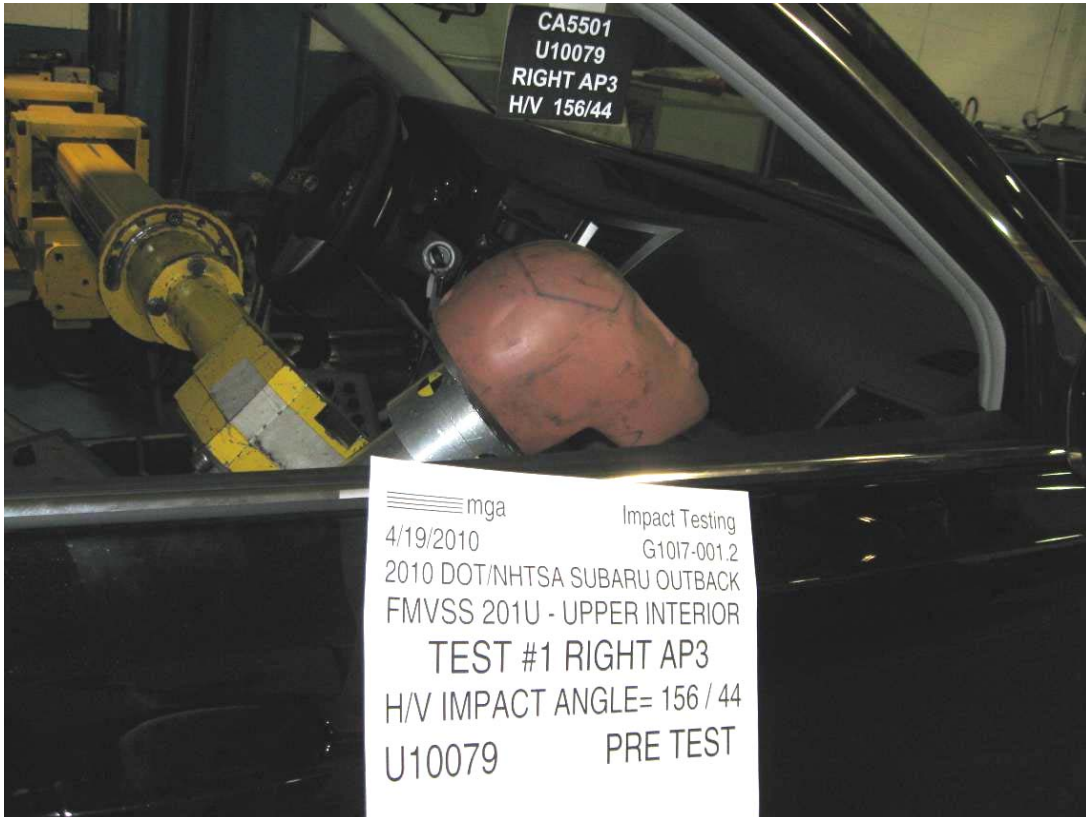
Test Date: 4/19/2010

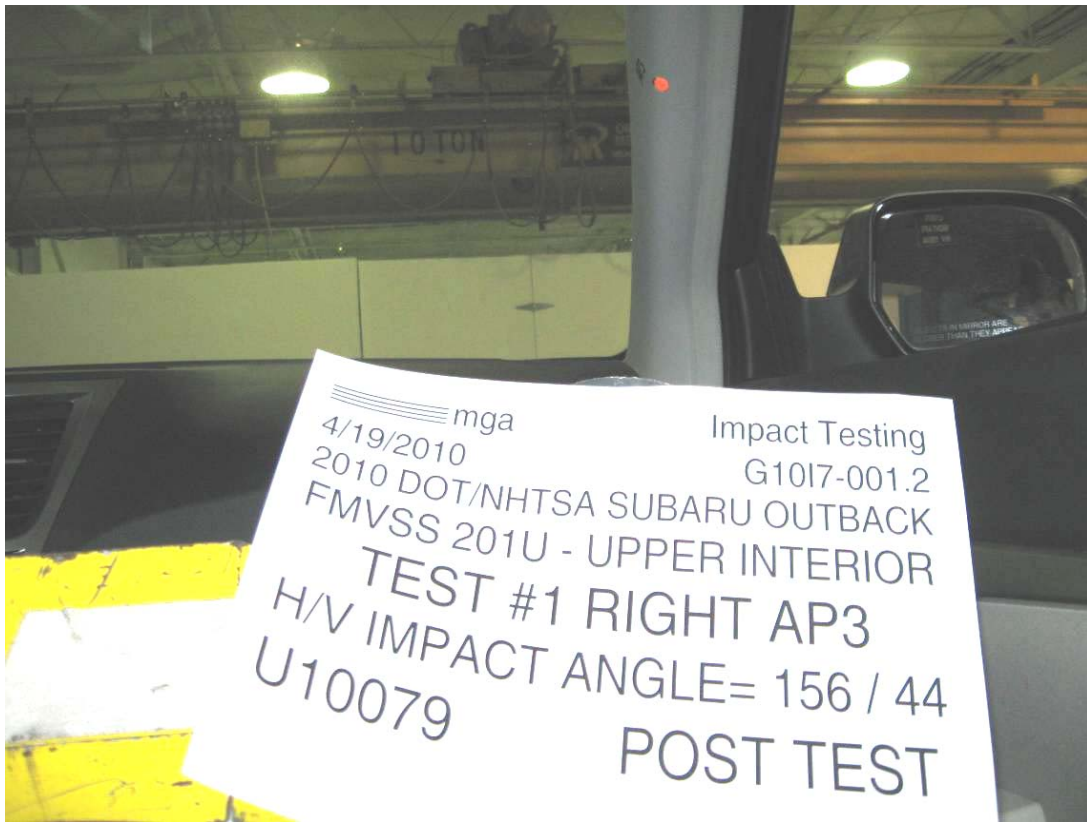


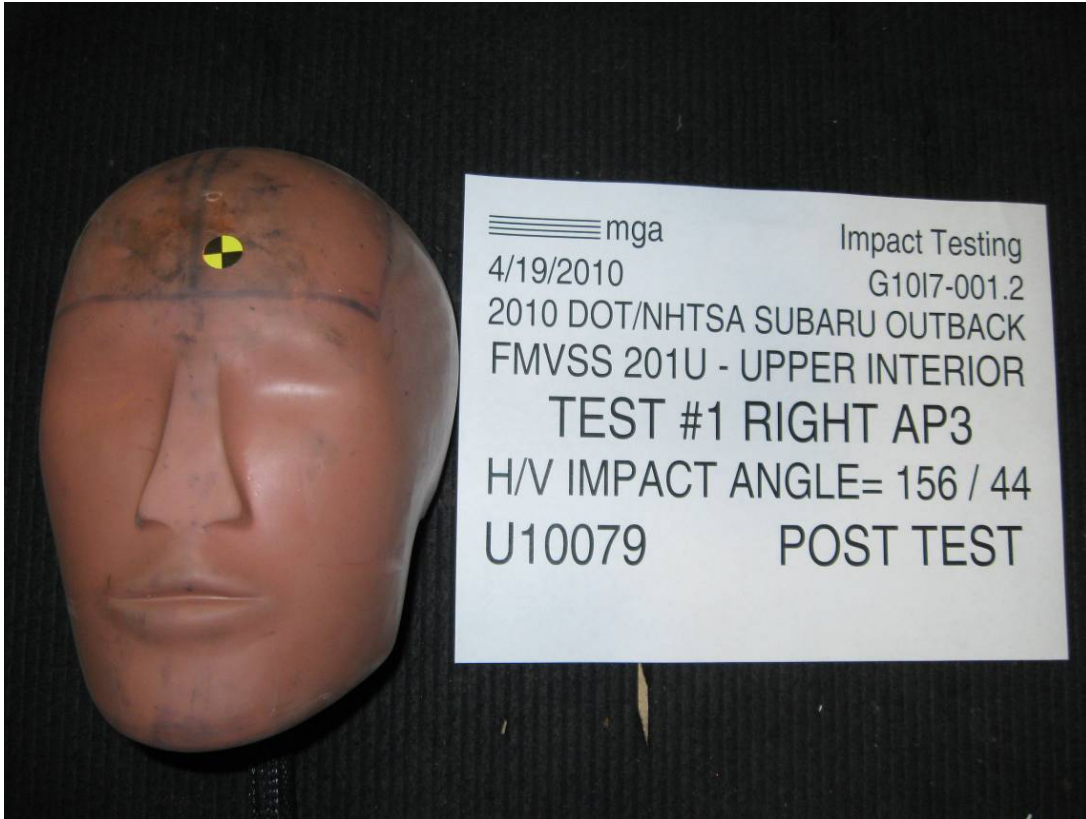












SUMMARY OF FMVSS 201U TEST

JOB/NHTSA NO: G10I7-001.2 VEHICLE YR/MAKE/MODEL:2010/DOT/NHTSA/Subaru Outback

GENERAL TEST PARAMETERS:

Test Number:#1

Target (Vehicle Side): AP3Right

Temperature:22.0C

MGA Test Reference No.:U10079

Humidity:33.6%

Approach Horizontal Angles:156°

Time of Test:8:54:18 AM

Approach Vertical Angles:44°

FMH Serial No:[035]

Additional Description:

TEST RESULTS:



HIC(d)	HIC	Δt (msec)	Velocity (kph)	Impact location on FMH (mm)	
				Above Pt. O	Left/Right Pt. O
390	296	9.6	19.0	15	7 Left

INSTRUMENTATION INFORMATION: (all accelerometers are Endevco 7264-2000)

Axis	Channel	Serial No.	DLR Value	ΔV Pre-Test	ΔV Post-Test
X	5	J35919	-96.3	1.06	1.06
Y	6	J22664	95.2	0.85	0.85
Z	7	J35924	93.8	0.94	0.94

REMARKS (Summary of test, damage, non-compliance, invalid test, etc.):

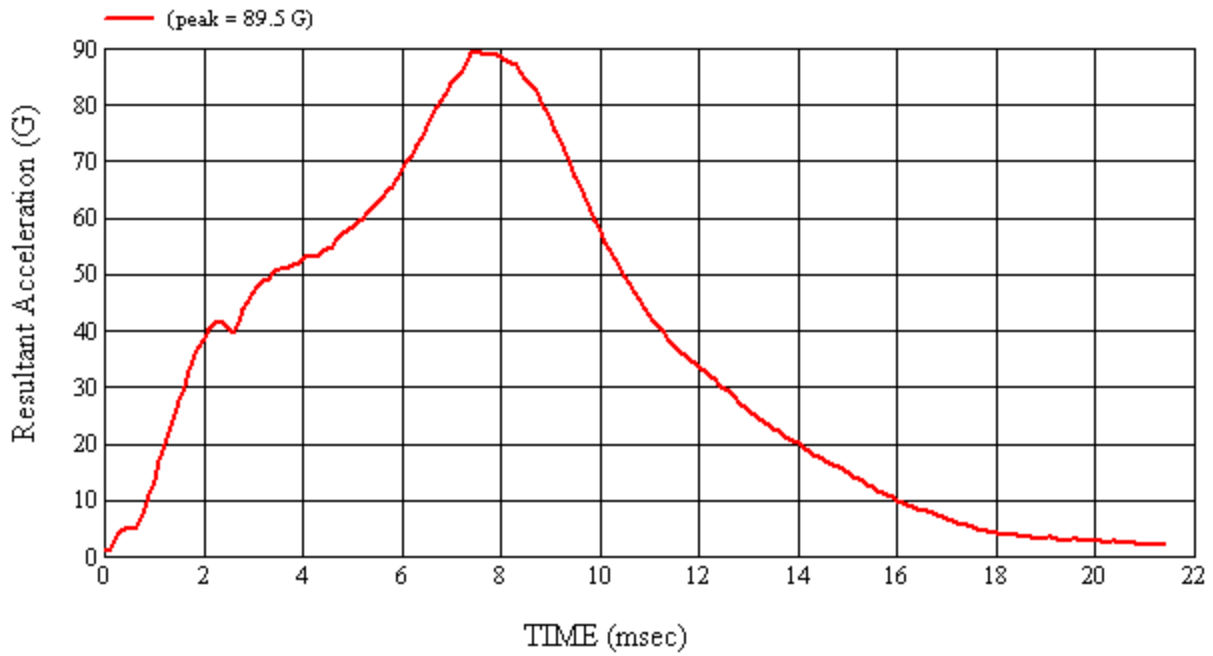
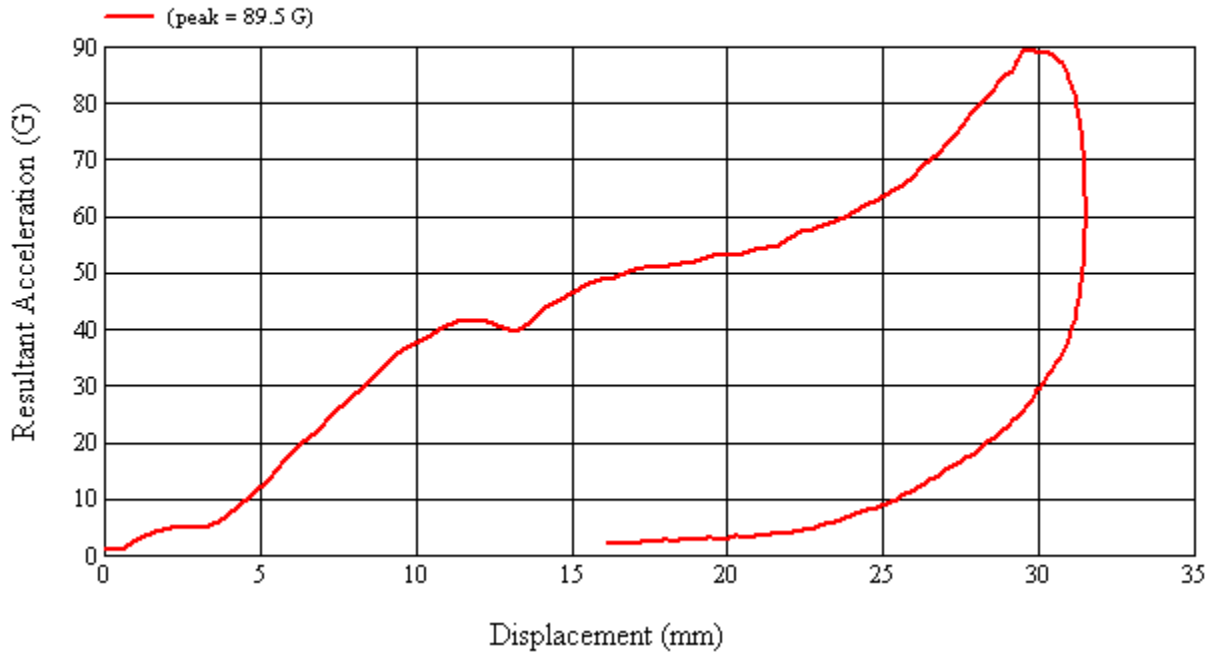
No visible damage

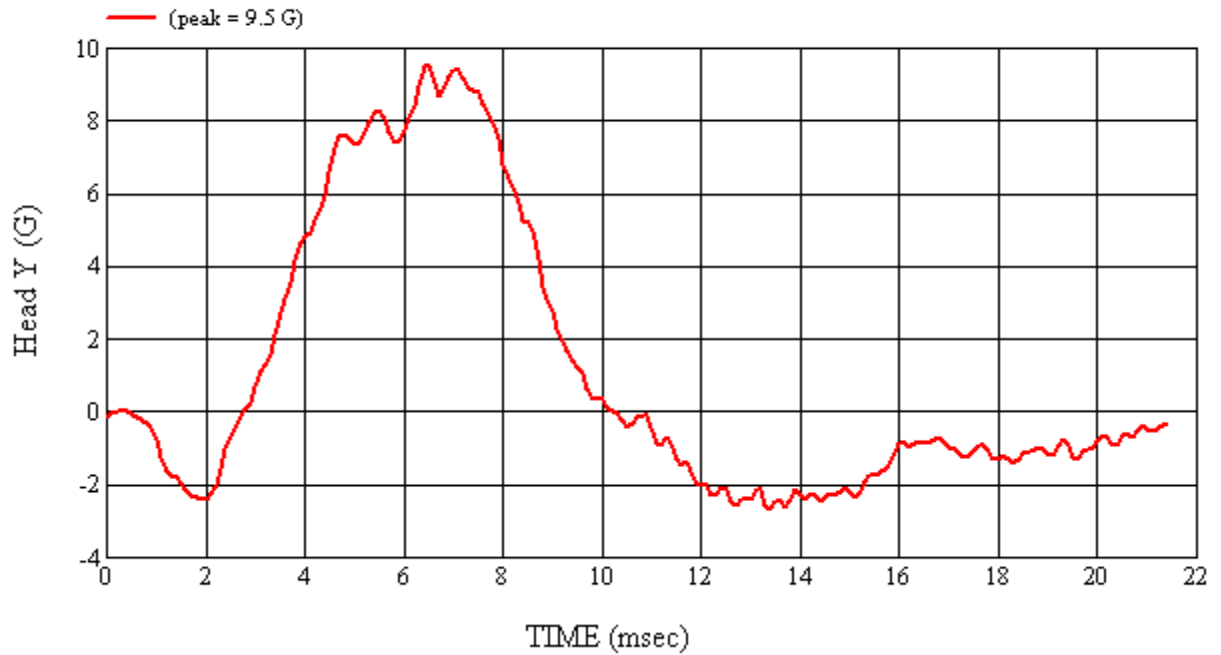
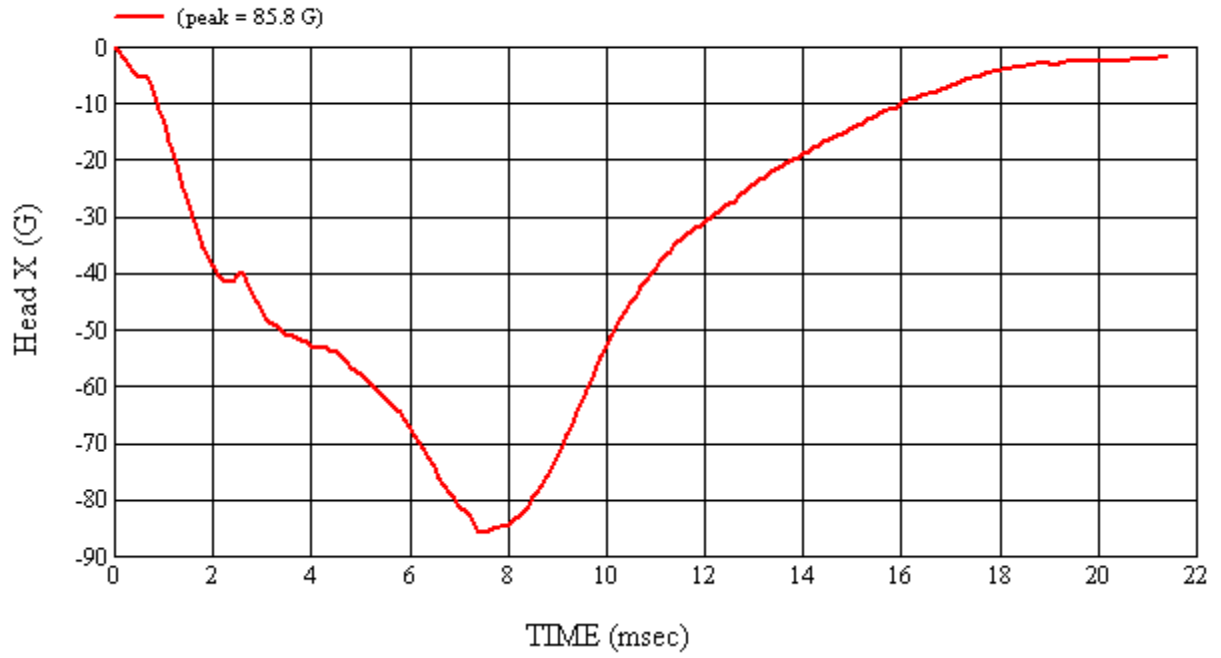
Recorded By:  Approved By*:  Date: 4/19/2010
*Only necessary for NHTSA (Government) Compliance testing.

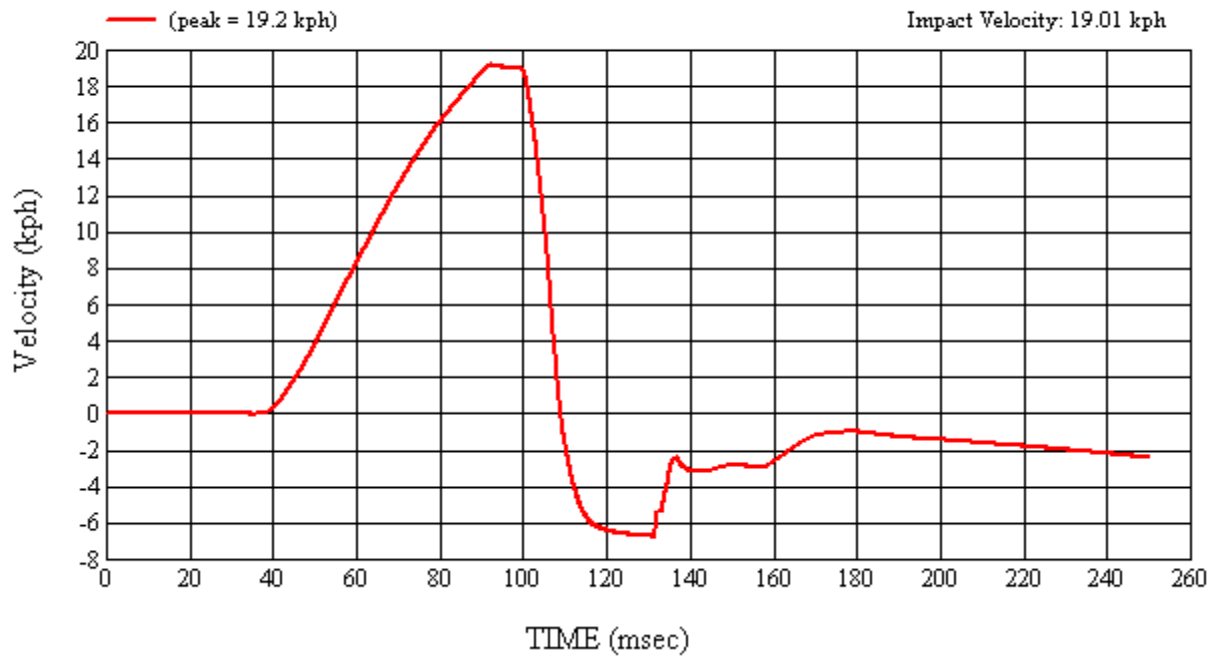
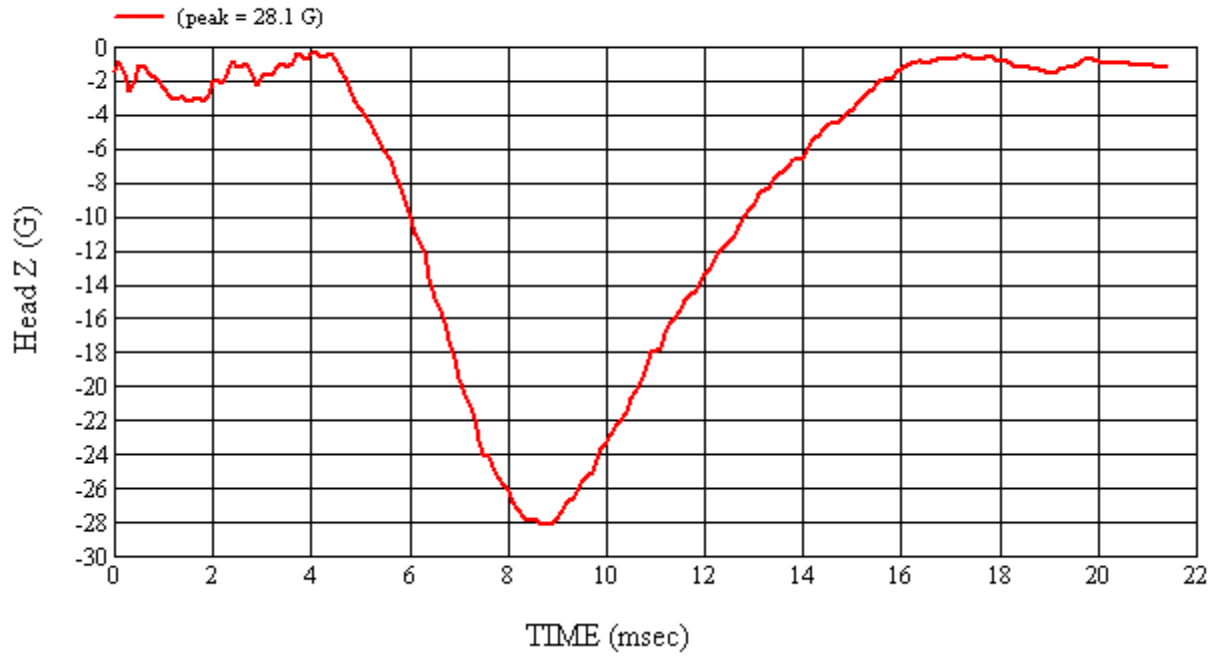
MGA Test #: U10079

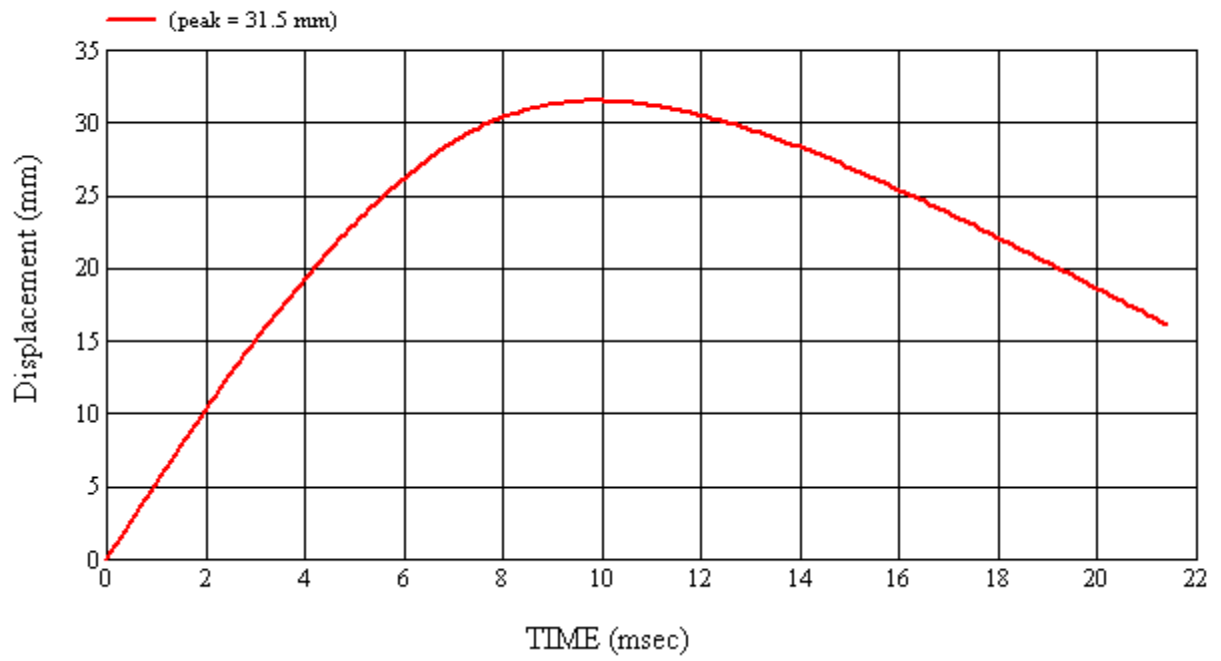
Target Location: AP3, Right Side

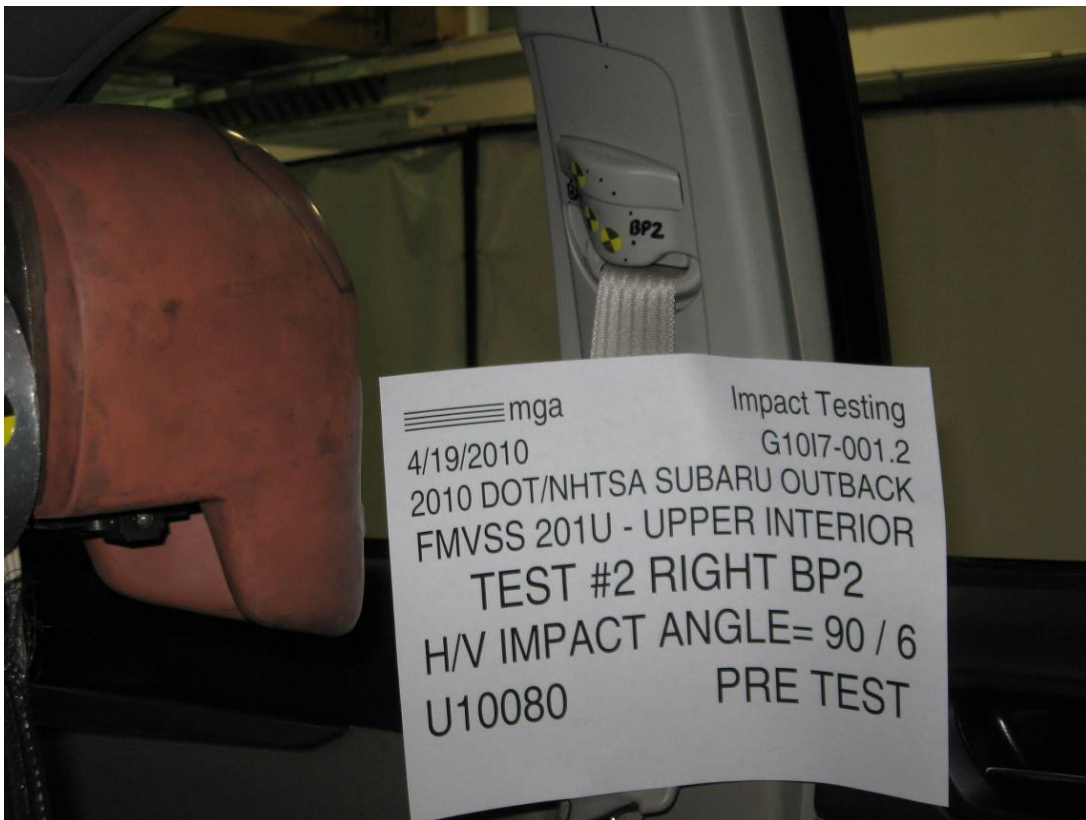
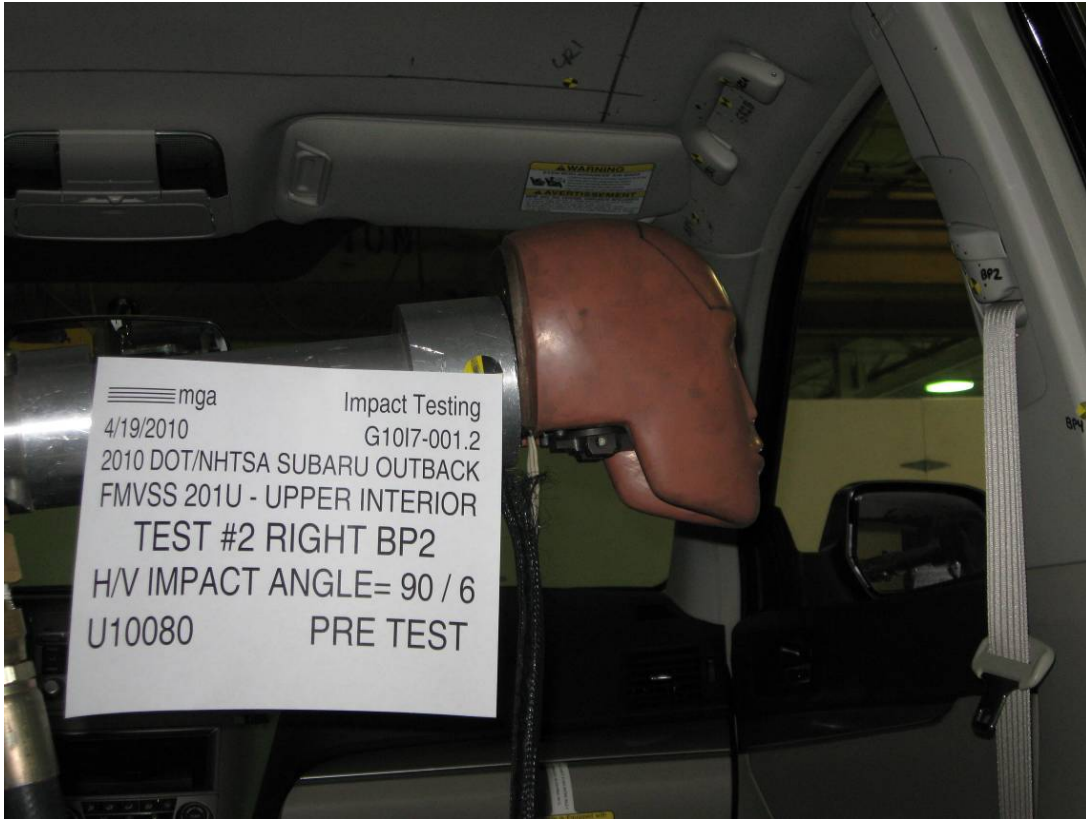
Test Date: 4/19/2010



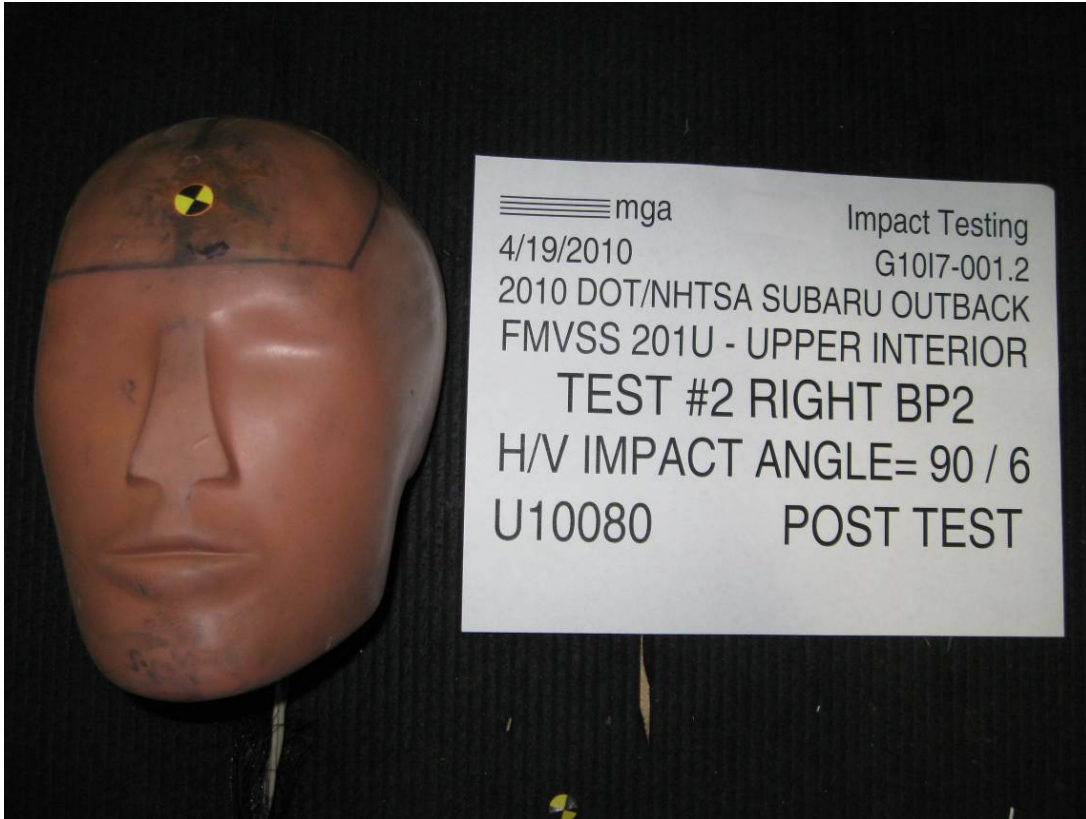












JOB/NHTSA NO: G10I7-001.2 VEHICLE YR/MAKE/MODEL:2010/DOT/NHTSA/Subaru Outback

GENERAL TEST PARAMETERS:

Target (Vehicle Side): BP2Right

MGA Test Reference No.:U10080

Approach Horizontal Angles:90°

Approach Vertical Angles:6°

Additional Description: Seat belt in mid-position.

Test Number:#2

Temperature:22.1C

Humidity:35.1%

Time of Test:10:38:19 AM

FMH Serial No:[037]

TEST RESULTS:

HIC(d)	HIC	Δt (msec)	Velocity (kph)	Impact location on FMH (mm)	
				Above Pt. O	Left/Right Pt. O
499	441	11.8	24.1	24	1 Left

INSTRUMENTATION INFORMATION: (all accelerometers are Endevco 7264-2000)

Axis	Channel	Serial No.	DLR Value	ΔV Pre-Test	ΔV Post-Test
X	5	AHTB2	-116.9	1.06	1.06
Y	6	J14103	94.2	0.85	0.85
Z	7	J35800	98.2	0.94	0.94

REMARKS (Summary of test, damage, non-compliance, invalid test, etc.):

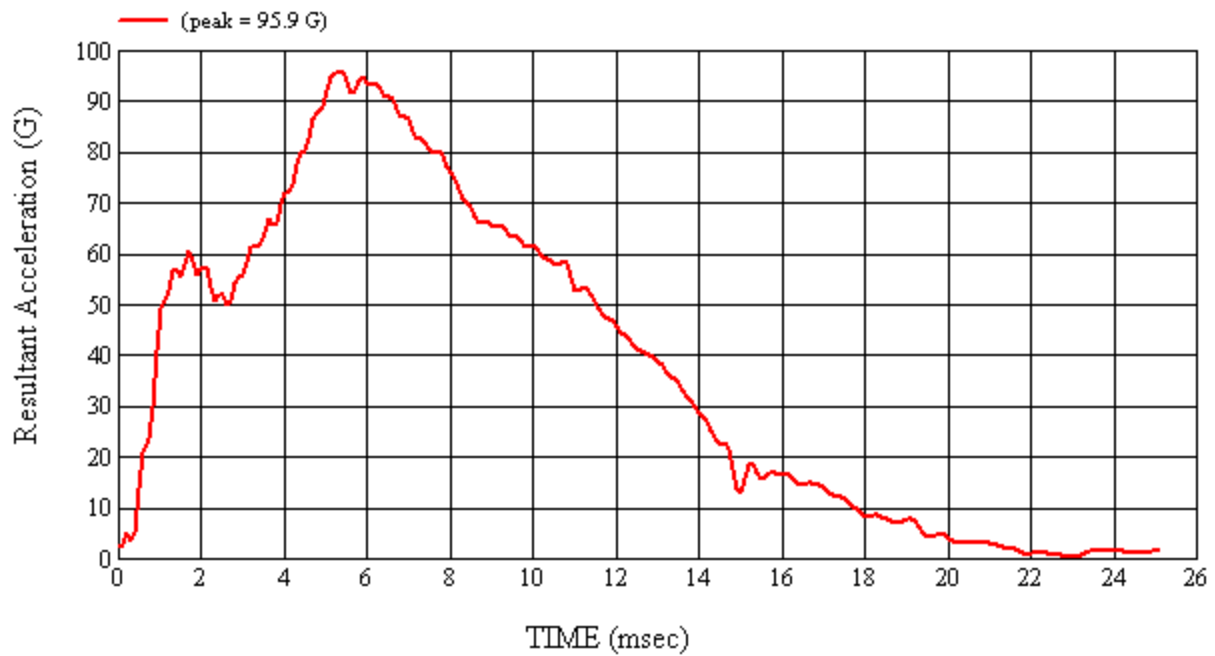
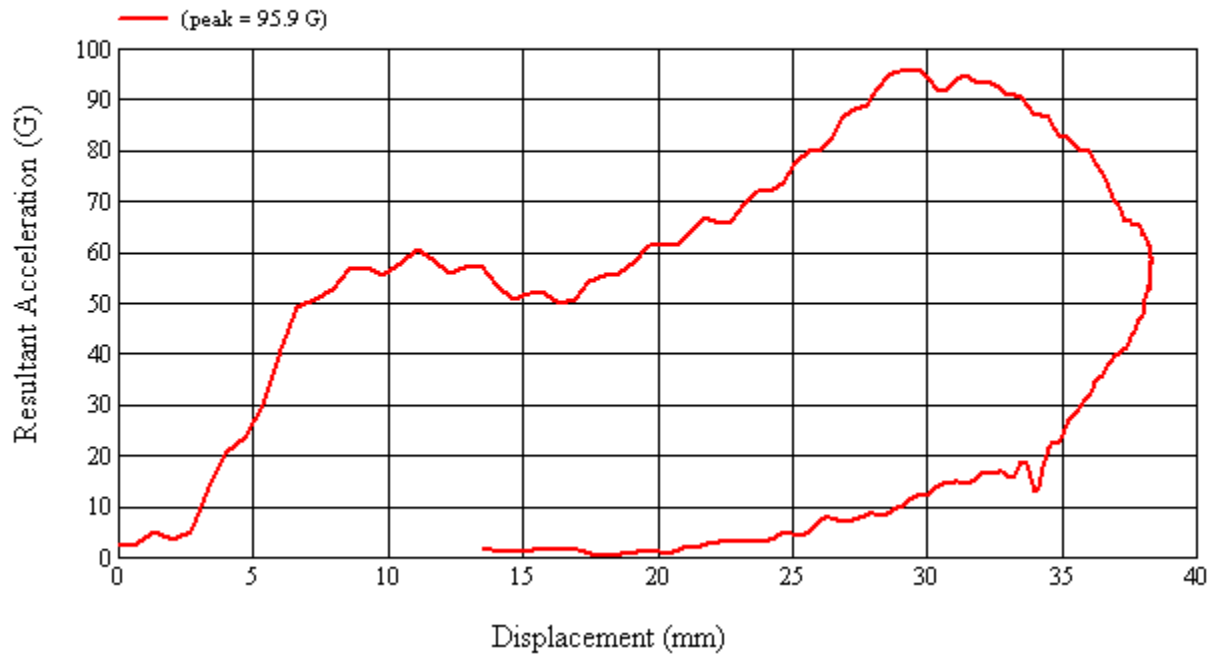
Anchorage compression, adjuster partially functional

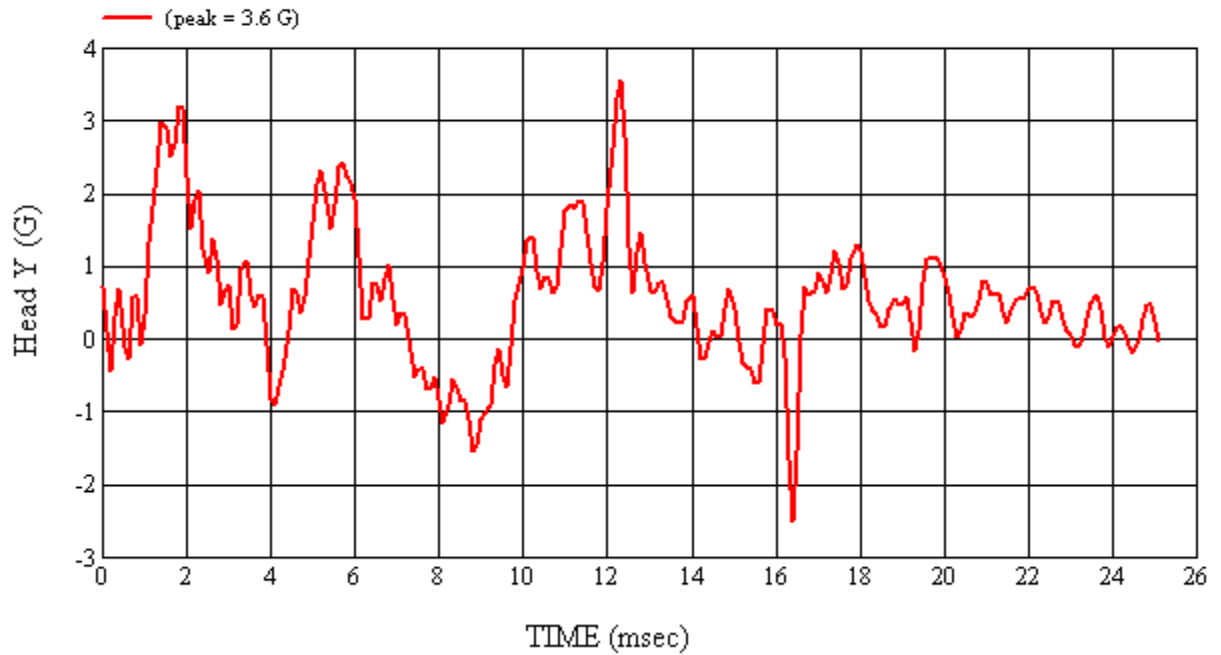
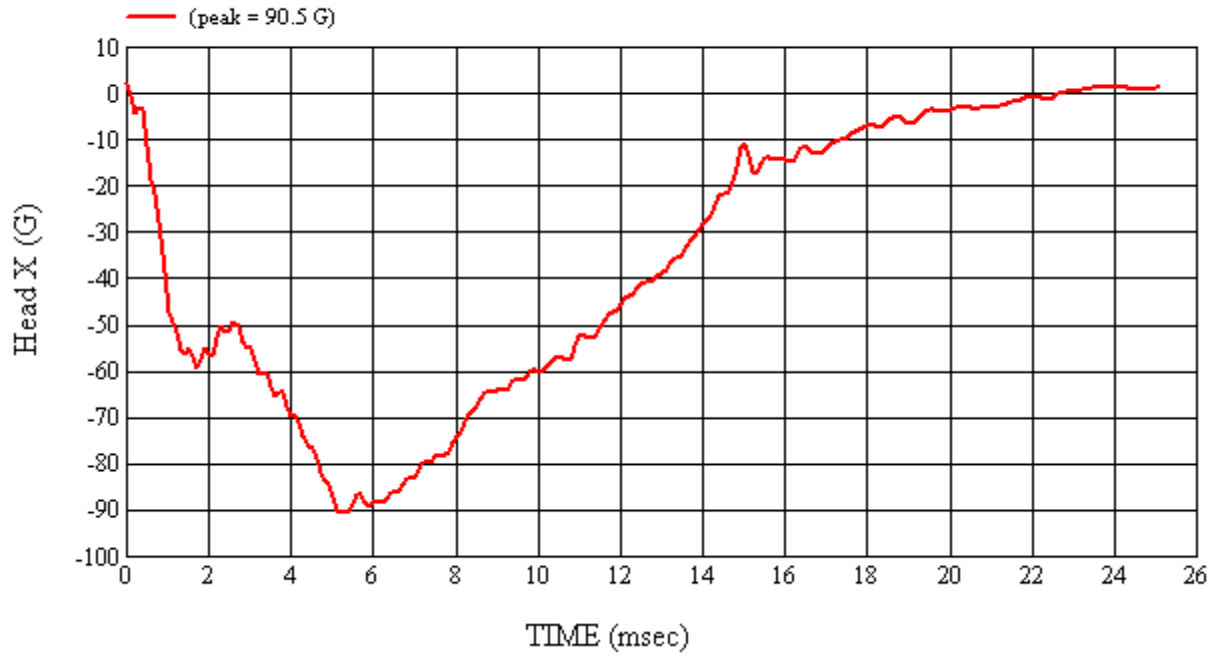
Recorded By: *Nathaniel* Approved By*: *Aileen A. Kalato* Date: 4/19/2010
 *Only necessary for NHTSA (Government) Compliance testing.

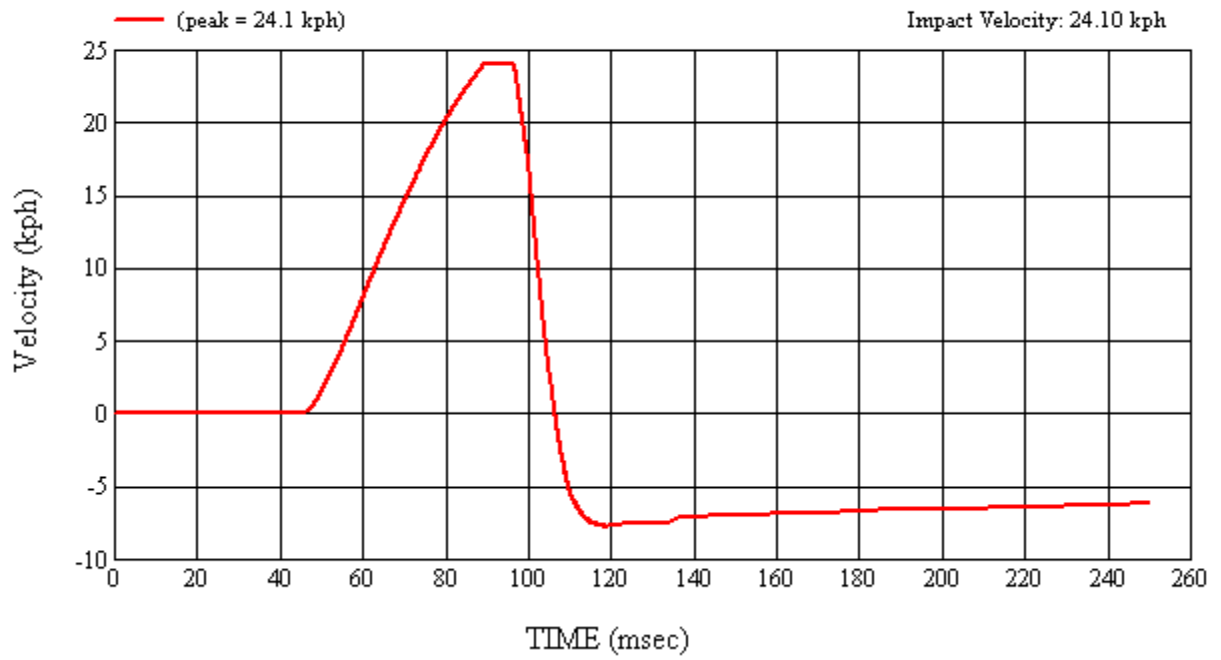
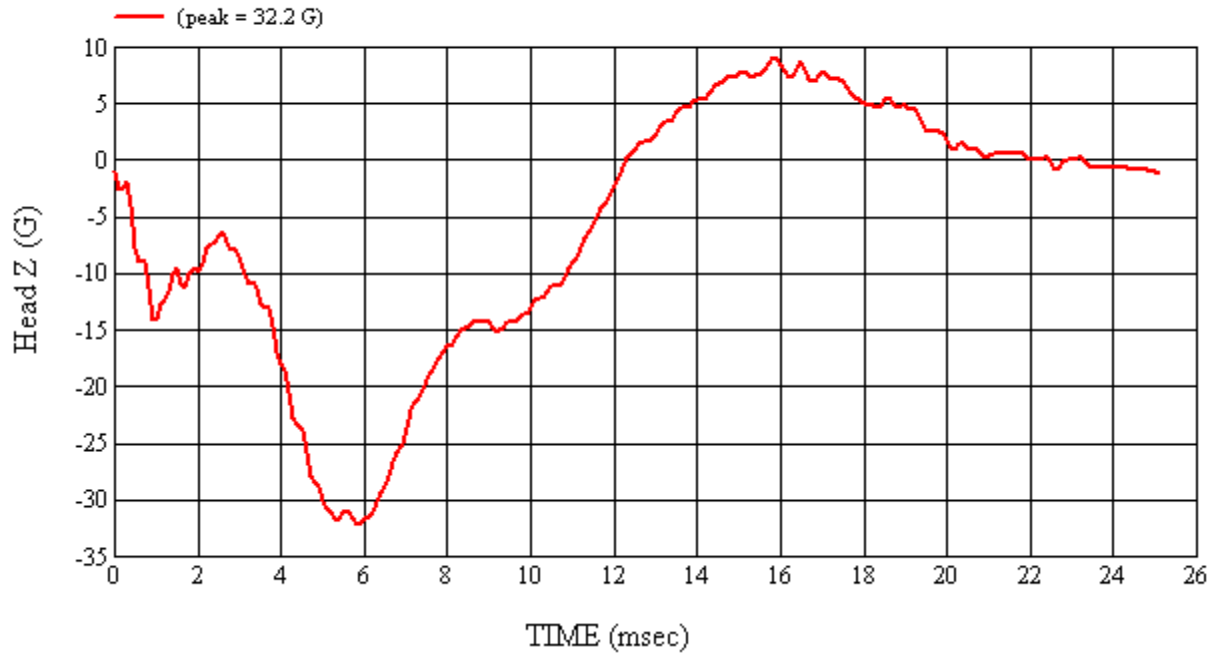
MGA Test #: U10080

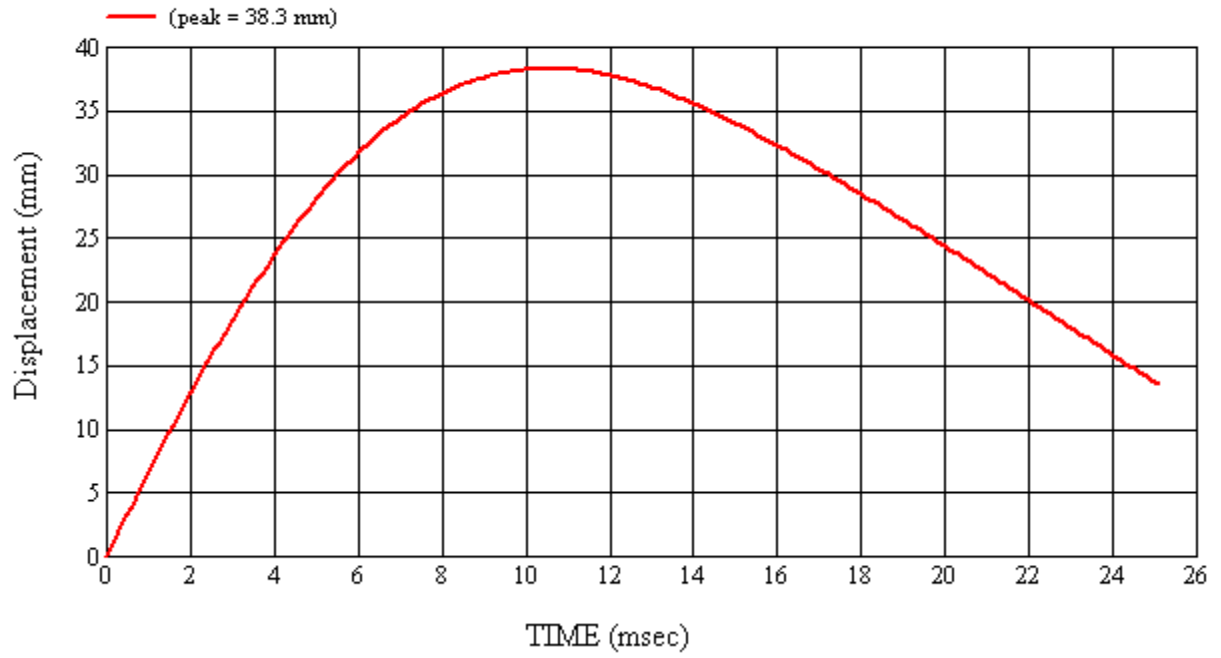
Target Location: BP2, Right Side

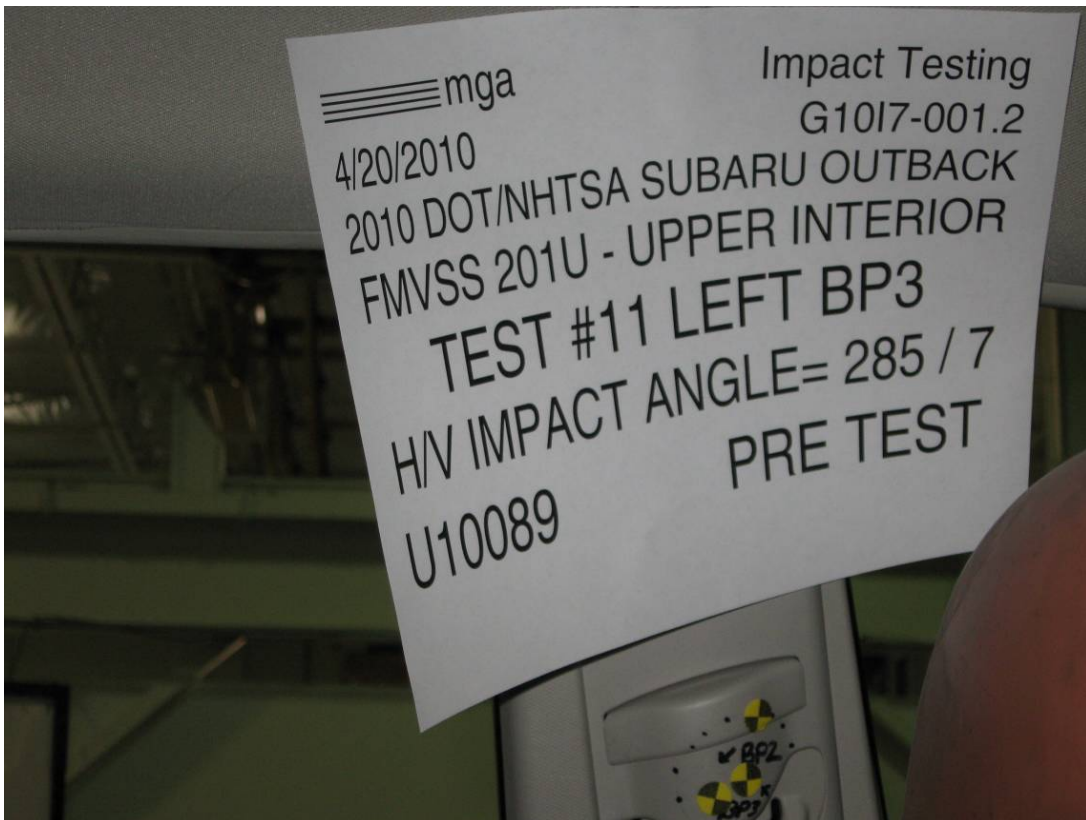
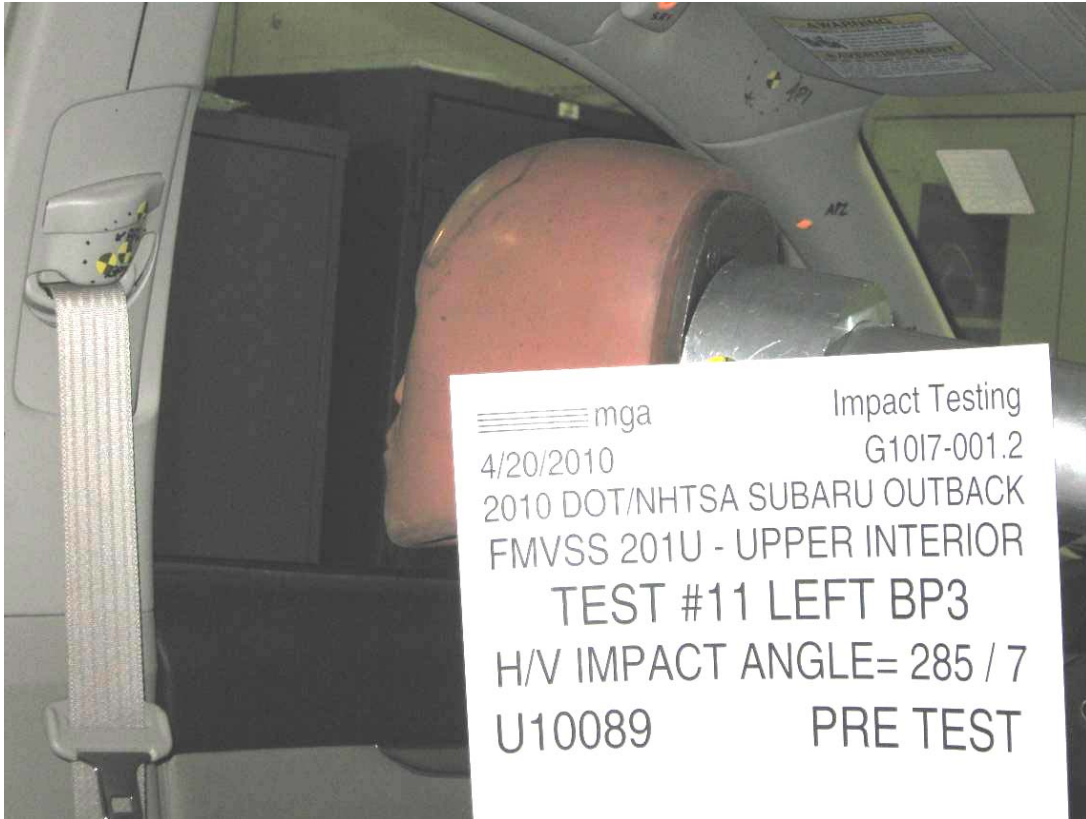
Test Date: 4/19/2010

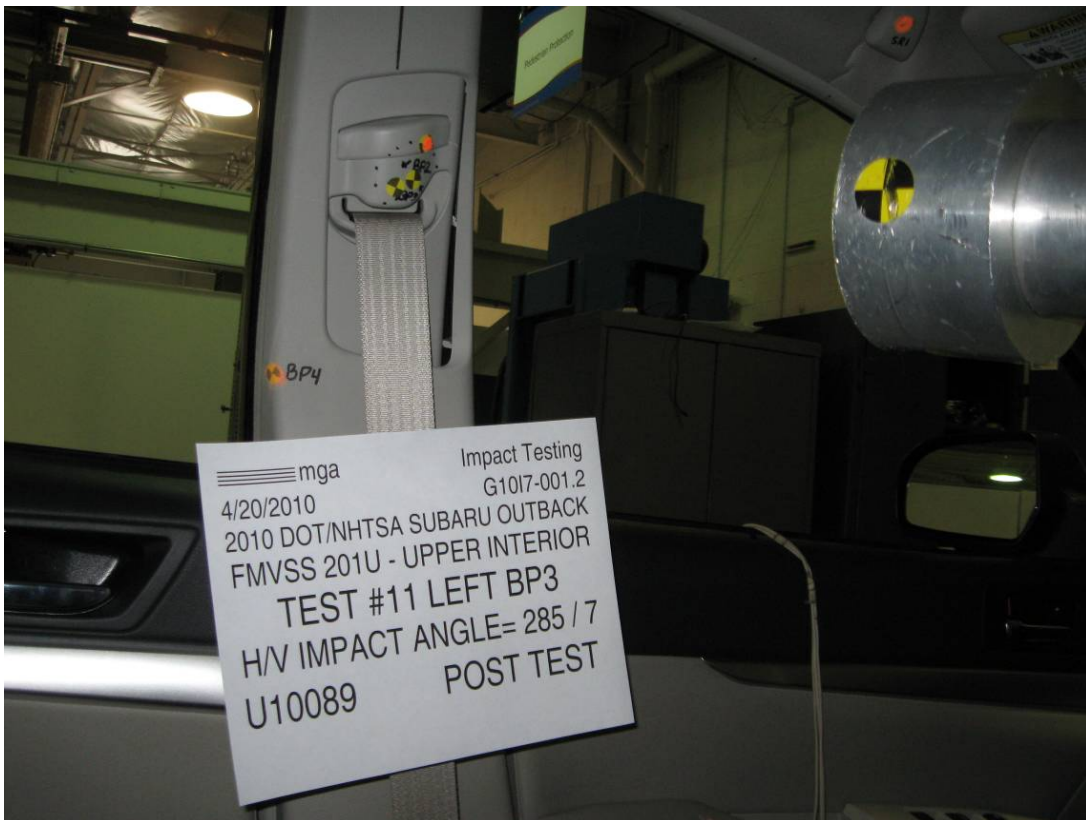
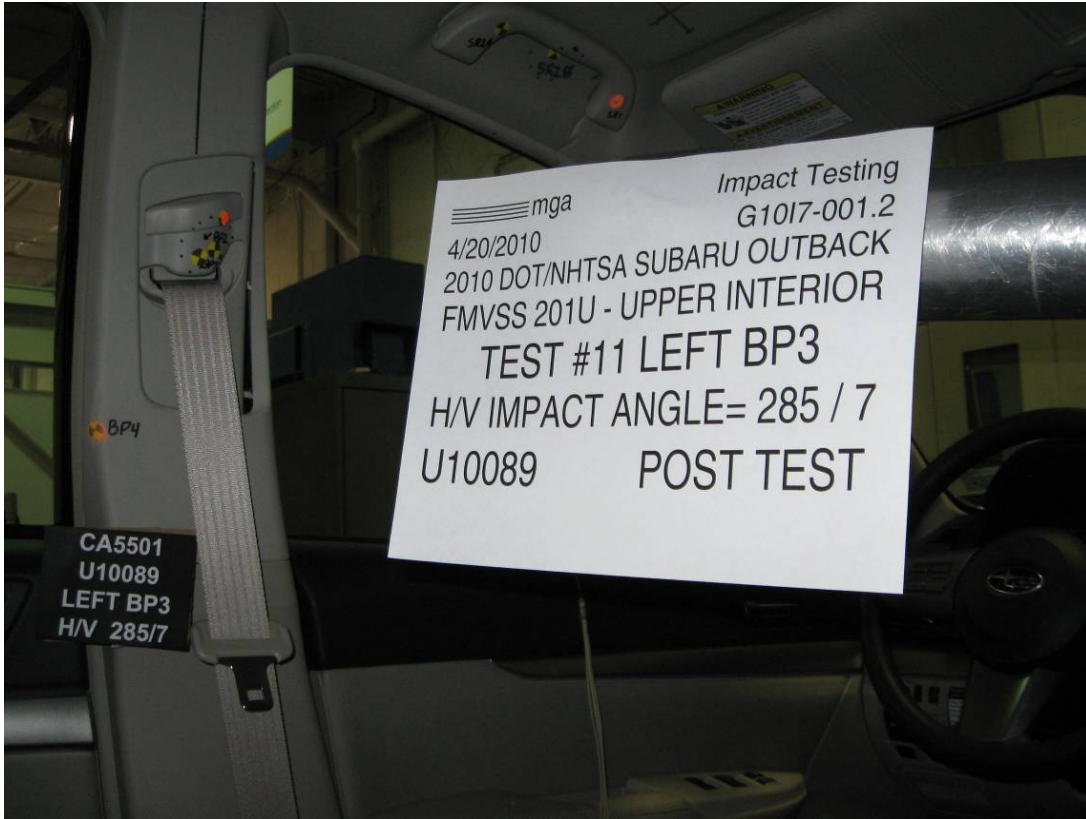


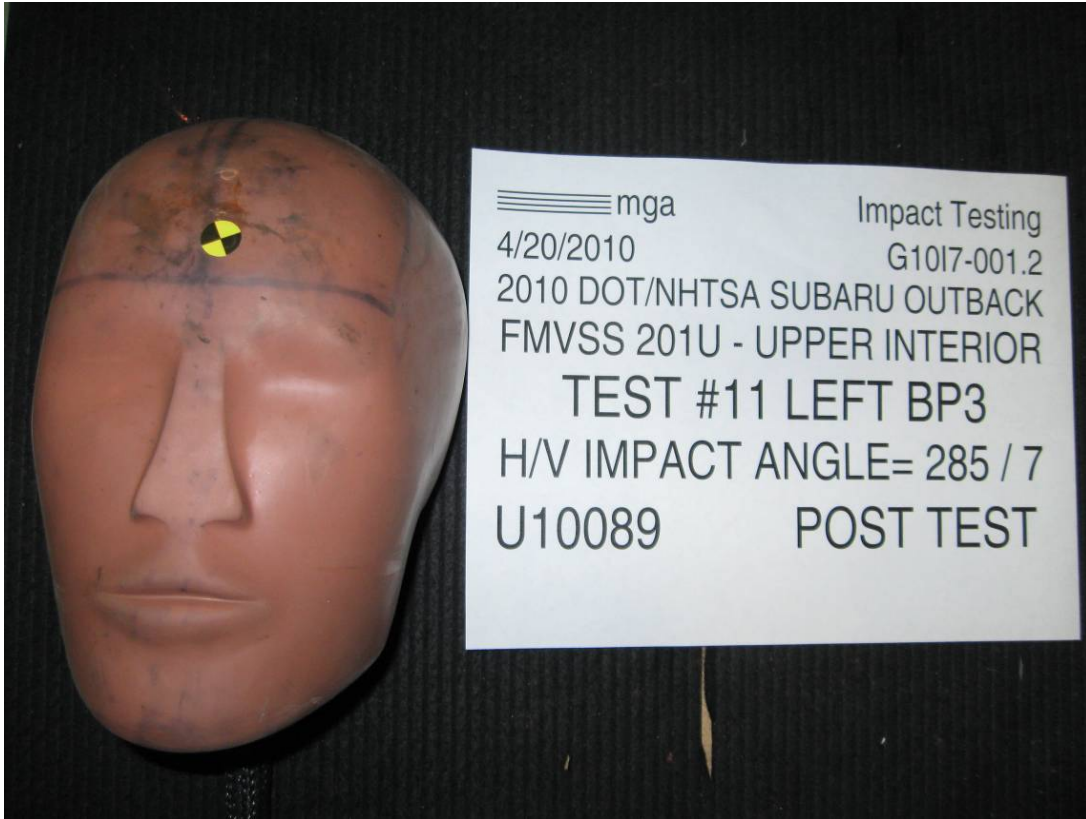












SUMMARY OF FMVSS 201U TEST

JOB/NHTSA NO: G10I7-001.2 VEHICLE YR/MAKE/MODEL:2010/DOT/NHTSA/Subaru Outback

GENERAL TEST PARAMETERS:

Test Number:#11

Target (Vehicle Side): BP3Left

Temperature:22.0C

MGA Test Reference No.:U10089

Humidity:34.2%

Approach Horizontal Angles:285°

Time of Test:11:59:56 AM

Approach Vertical Angles:7°

FMH Serial No:[035]

Additional Description:1 Relocation sphere and seat belt anchorage in mid position

TEST RESULTS:



HIC(d)	HIC	Δt (msec)	Velocity (kph)	Impact location on FMH (mm)	
				Above Pt. O	Left/Right Pt. O
619	600	8.6	23.9	9	2 Left

INSTRUMENTATION INFORMATION: (all accelerometers are Endevco 7264-2000)

Axis	Channel	Serial No.	DLR Value	ΔV Pre-Test	ΔV Post-Test
X	5	J35919	-96.3	1.06	1.06
Y	6	J22664	95.2	0.85	0.85
Z	7	J35924	93.8	0.94	0.94

REMARKS (Summary of test, damage, non-compliance, invalid test, etc.):

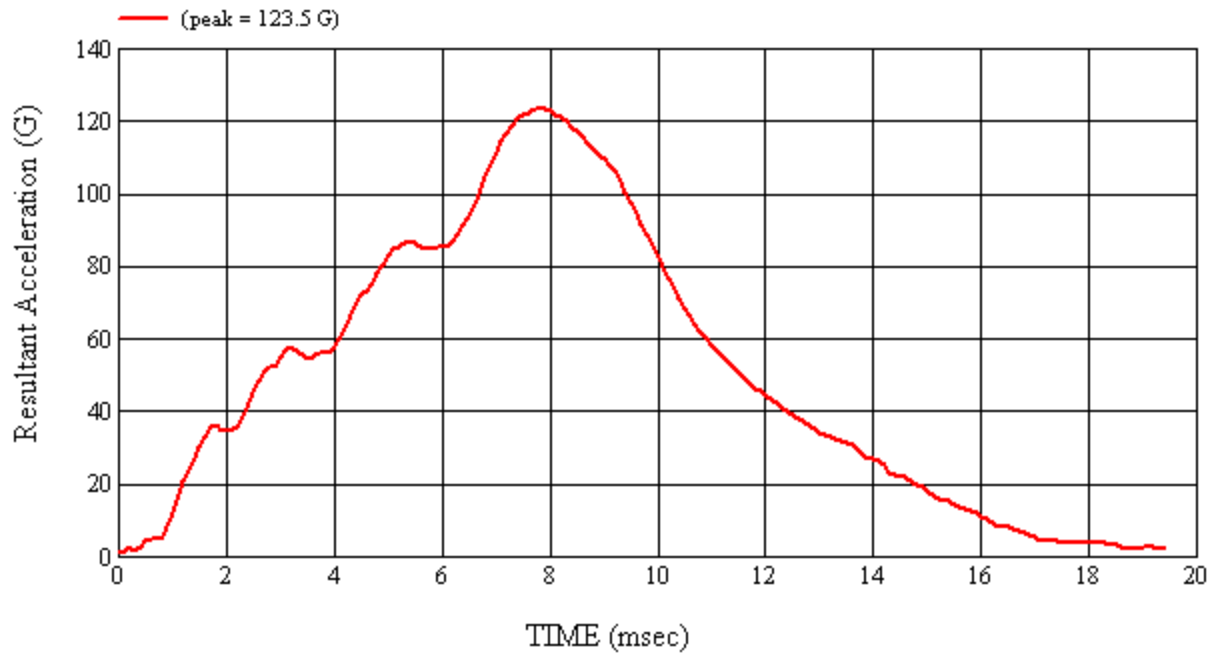
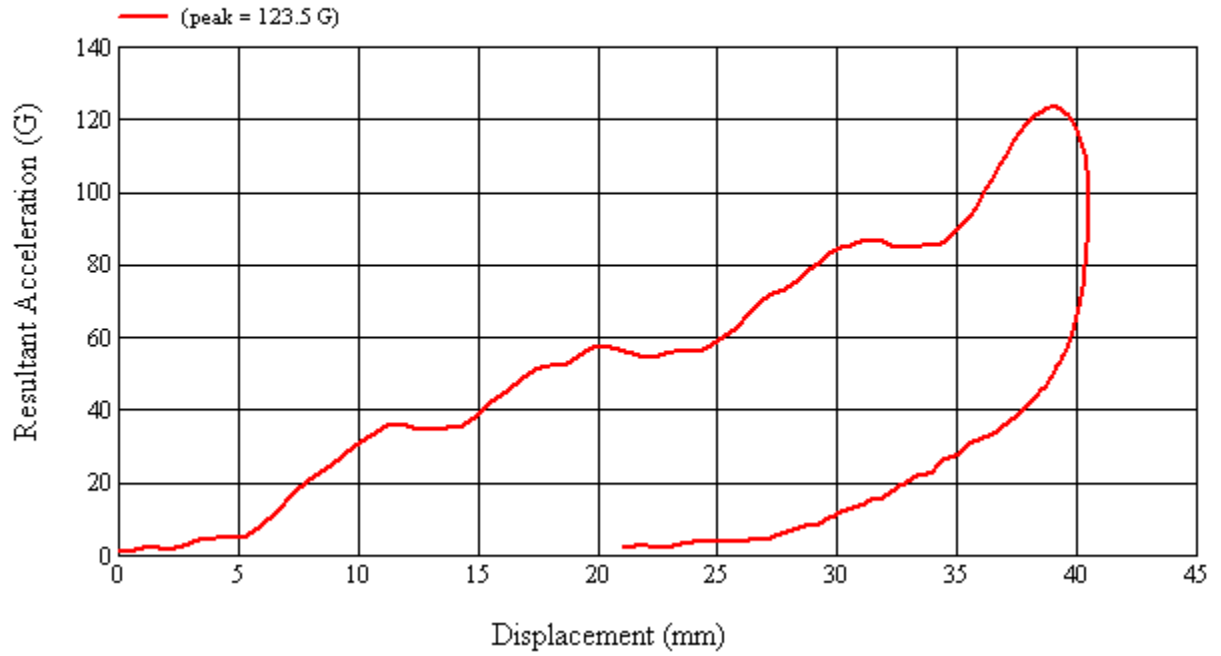
Seat belt anchorage compression, non-functional adjuster

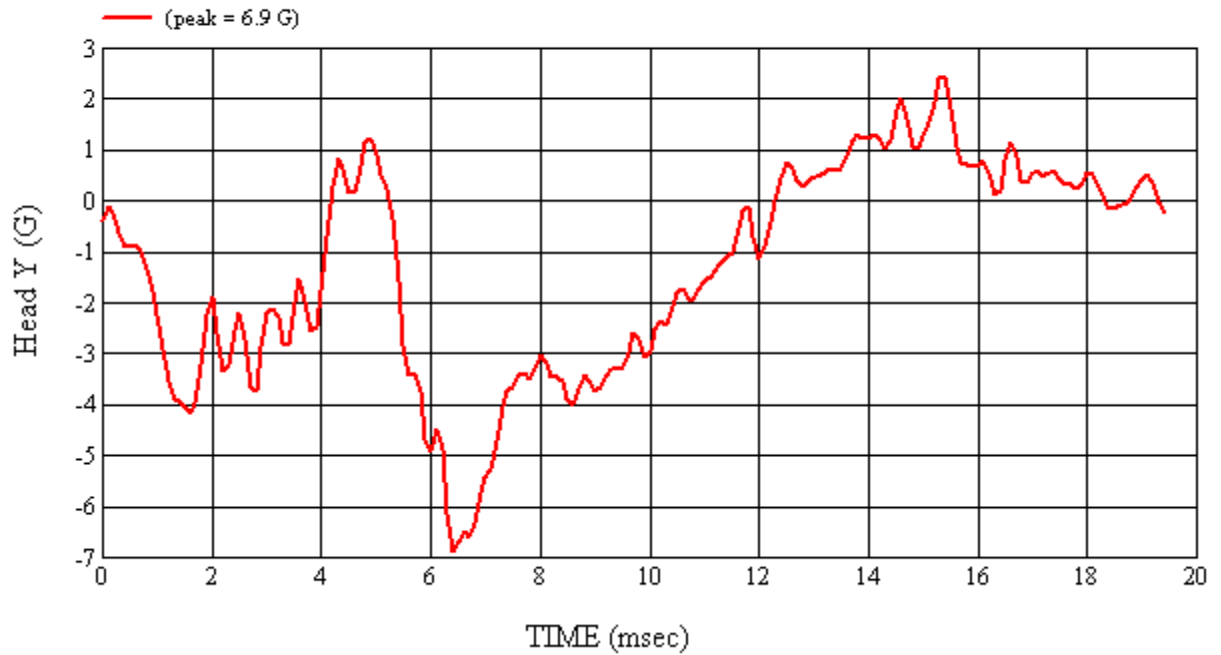
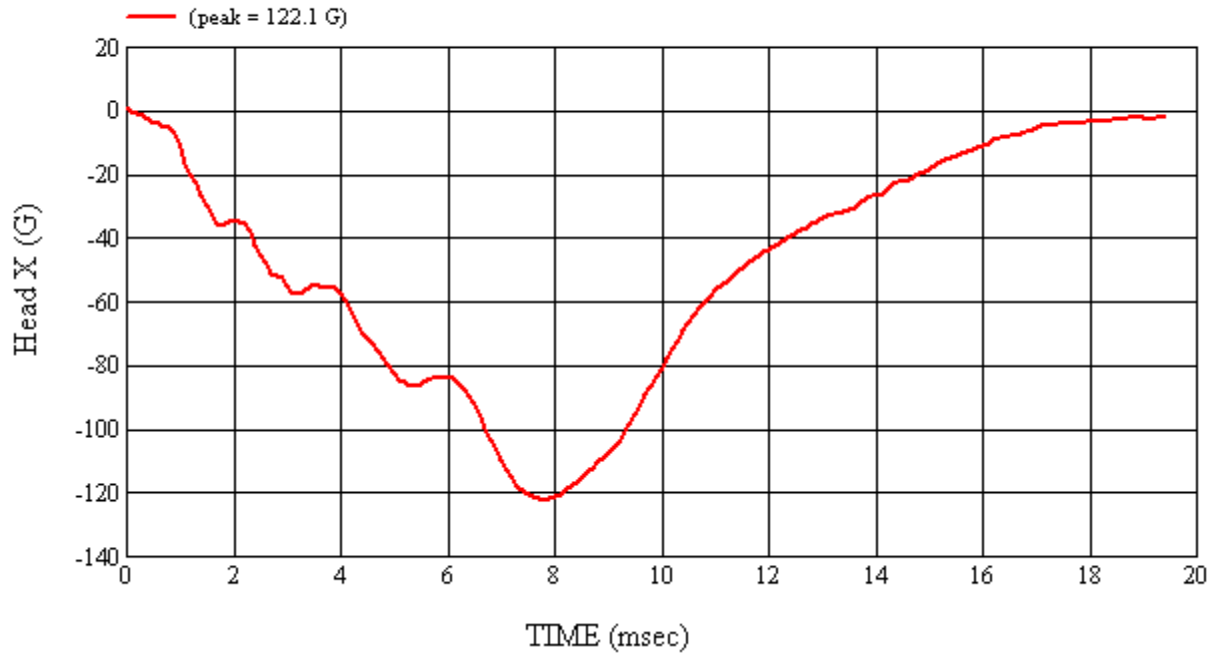
Recorded By:  Approved By*:  Date: 4/20/2010
 *Only necessary for NHTSA (Government) Compliance testing.

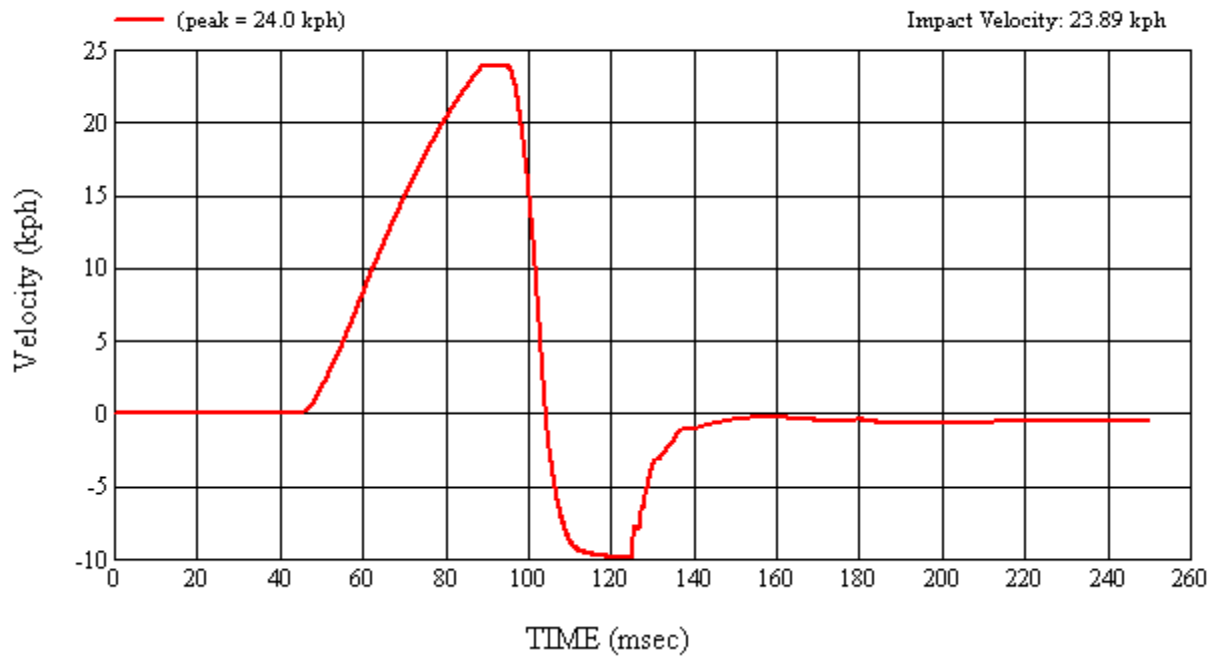
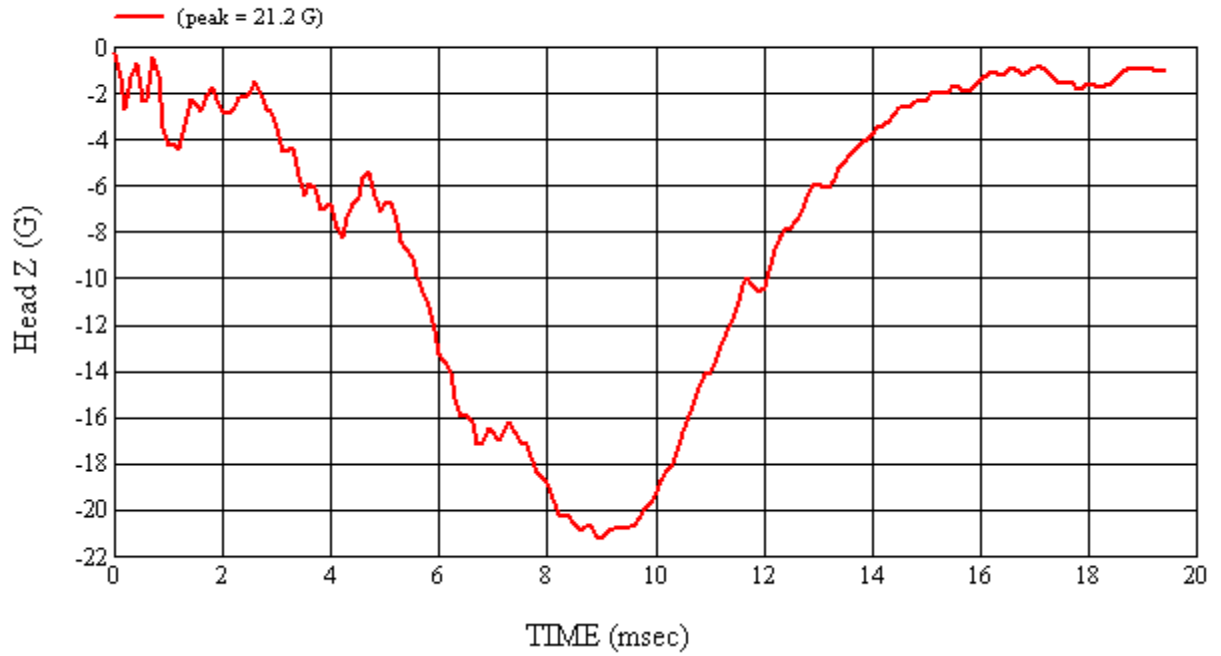
MGA Test #: U10089

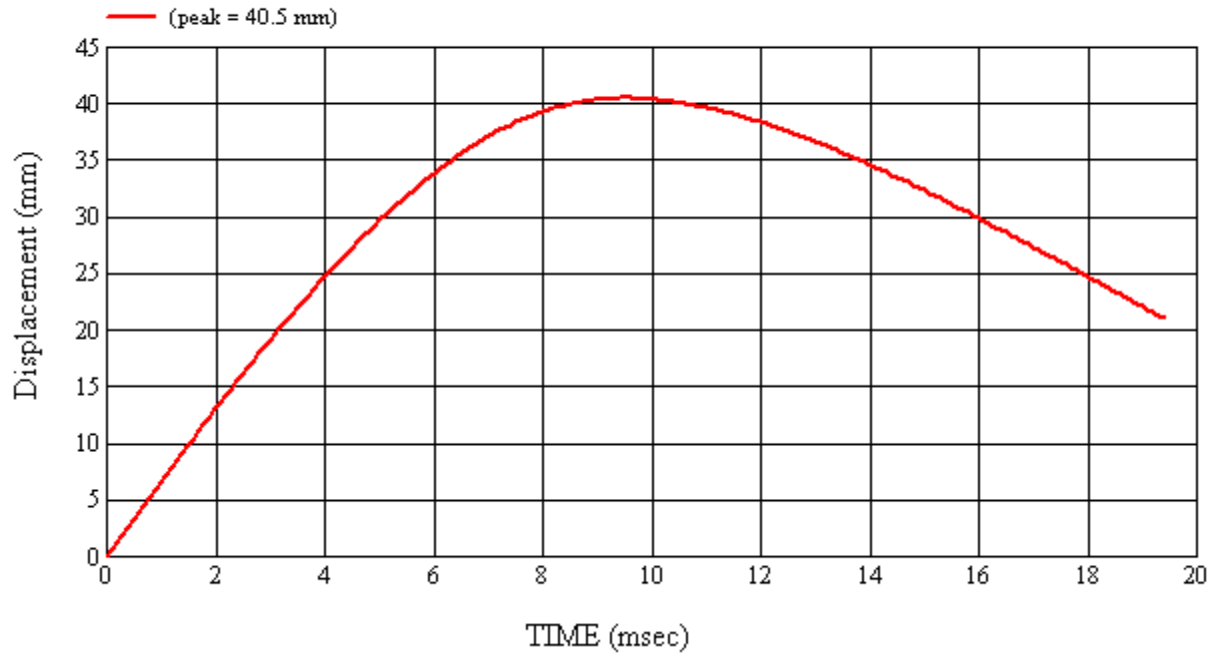
Target Location: BP3, Left Side

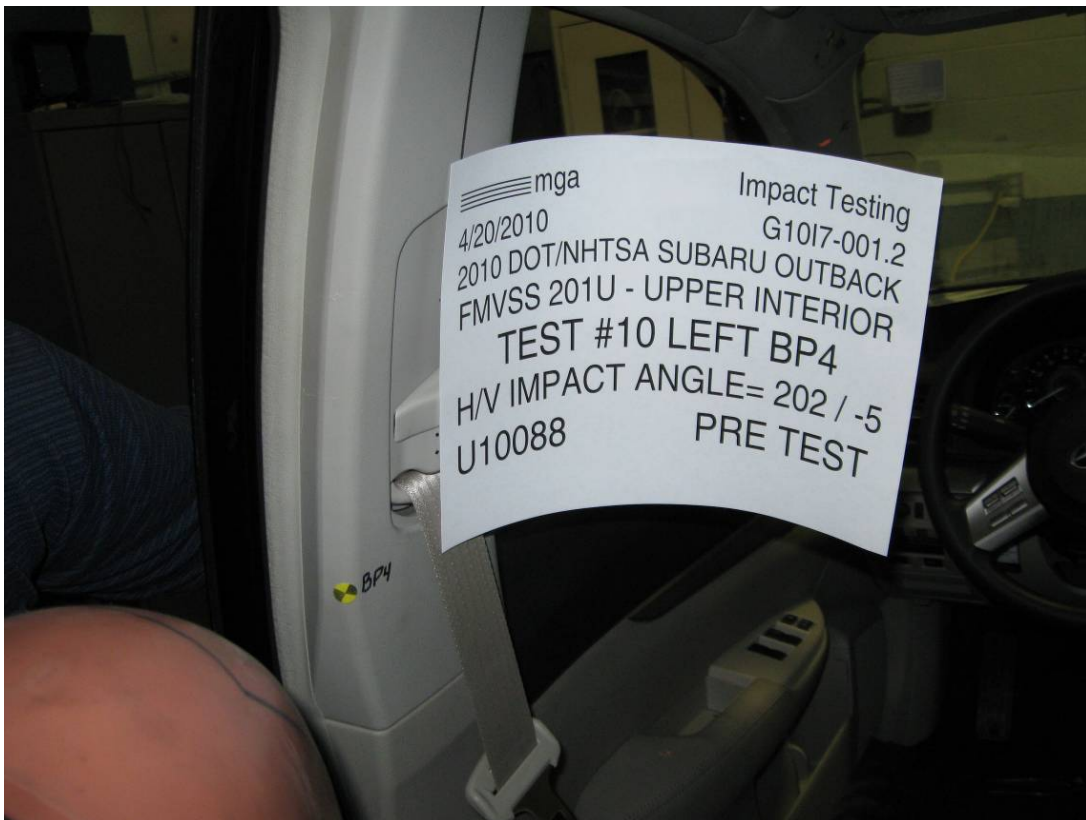
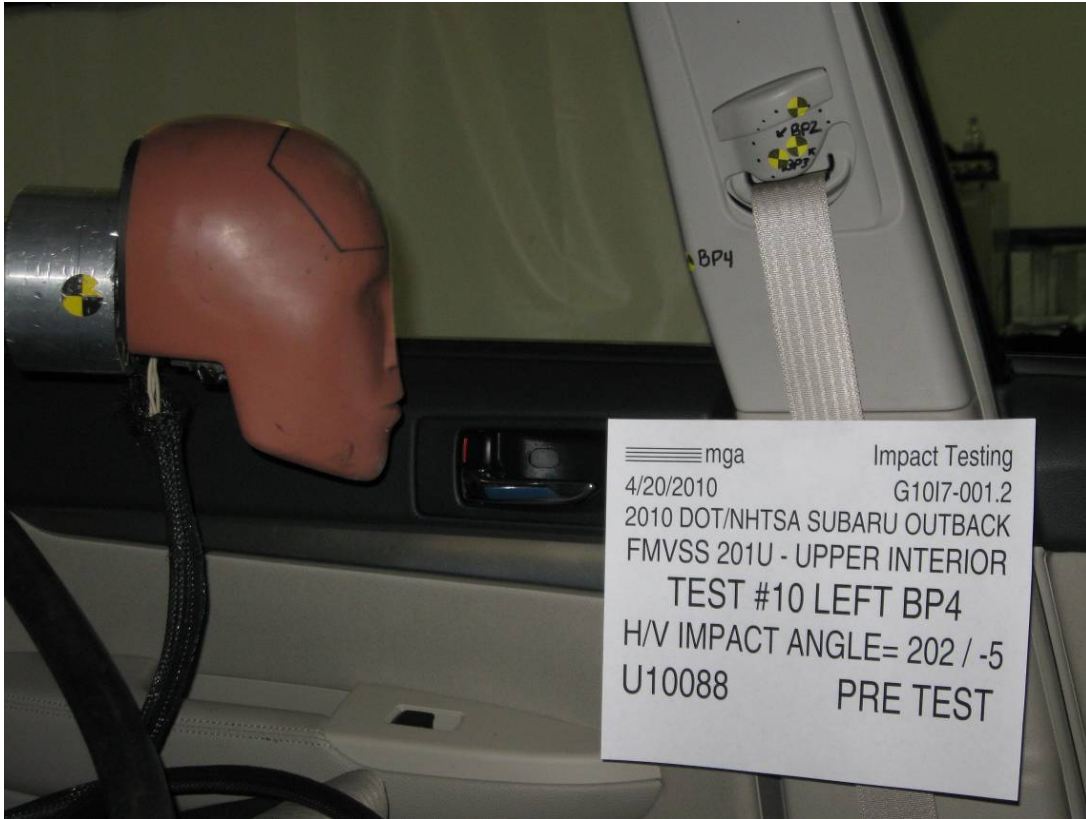
Test Date: 4/20/2010

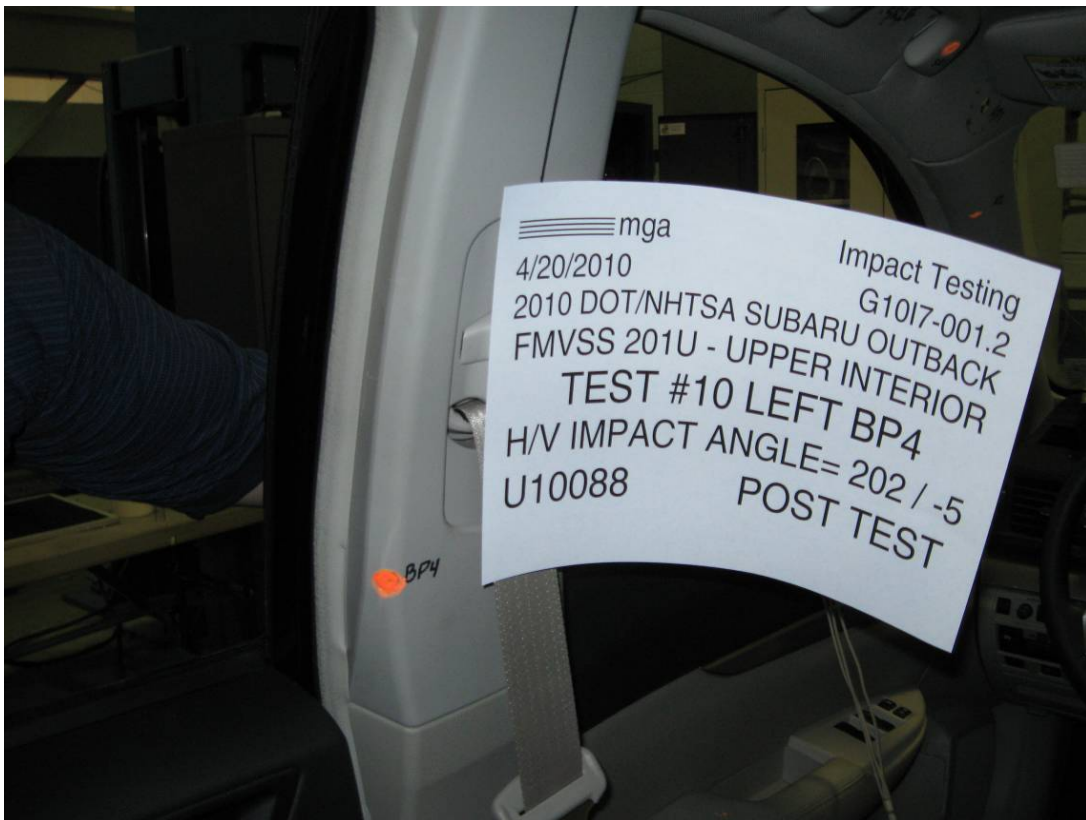
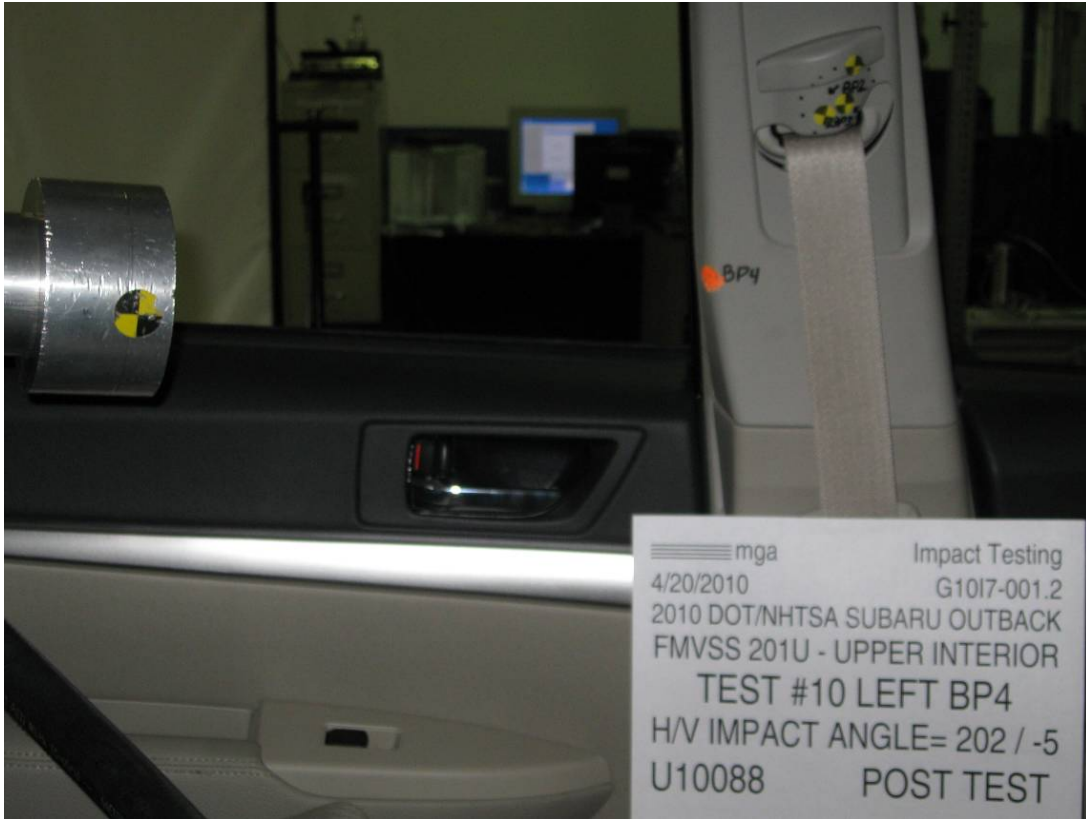


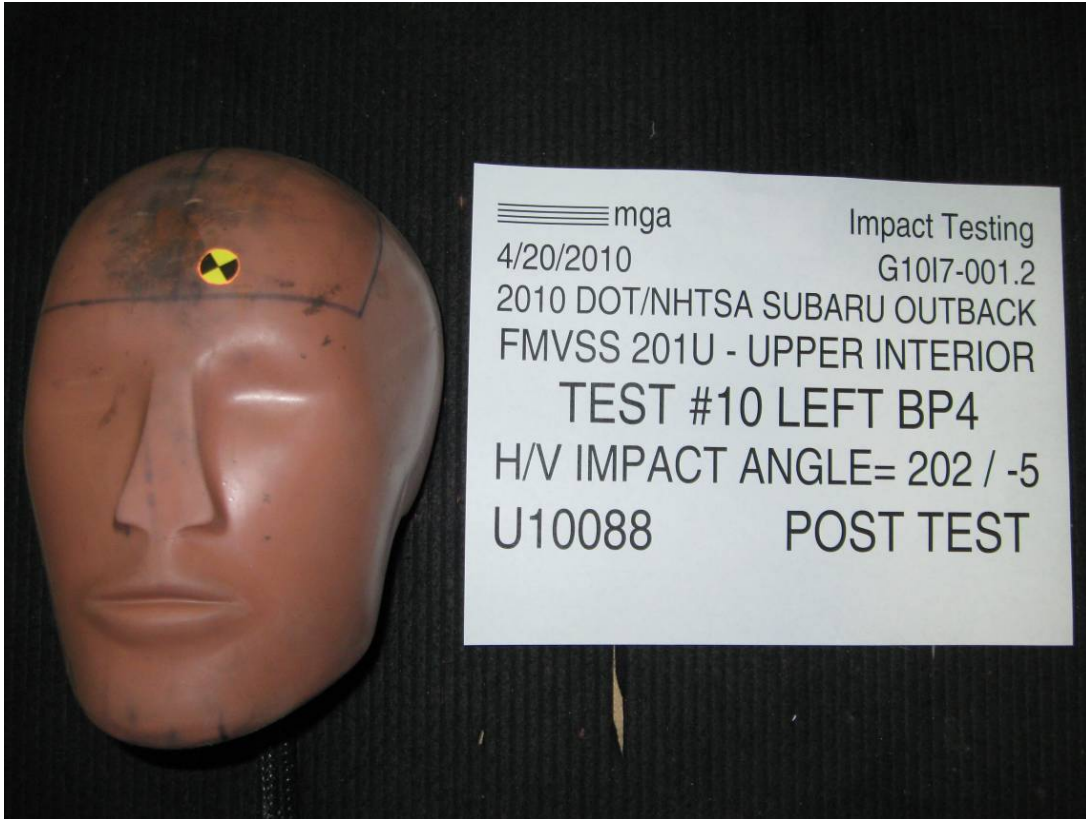












SUMMARY OF FMVSS 201U TEST

JOB/NHTSA NO: G10I7-001.2 VEHICLE YR/MAKE/MODEL:2010/DOT/NHTSA/Subaru Outback

GENERAL TEST PARAMETERS:

Test Number:#10

Target (Vehicle Side): BP4Left

Temperature:21.1C

MGA Test Reference No.:U10088

Humidity:35.4%

Approach Horizontal Angles:202°

Time of Test:10:48:08 AM

Approach Vertical Angles:-5°

FMH Serial No:[038]

Additional Description: Seat belt anchorage full down

TEST RESULTS:

HIC(d)	HIC	Δt (msec)	Velocity (kph)	Impact location on FMH (mm)	
				Above Pt. O	Left/Right Pt. O
410	322	11.4	23.6	10	14 Left

INSTRUMENTATION INFORMATION: (all accelerometers are Endevco 7264-2000)

Axis	Channel	Serial No.	DLR Value	ΔV Pre-Test	ΔV Post-Test
X	5	J22700	-96.5	1.06	1.06
Y	6	J36197	109.5	0.85	0.85
Z	7	J36353	99.5	0.94	0.94

REMARKS (Summary of test, damage, non-compliance, invalid test, etc.):

No visible damage

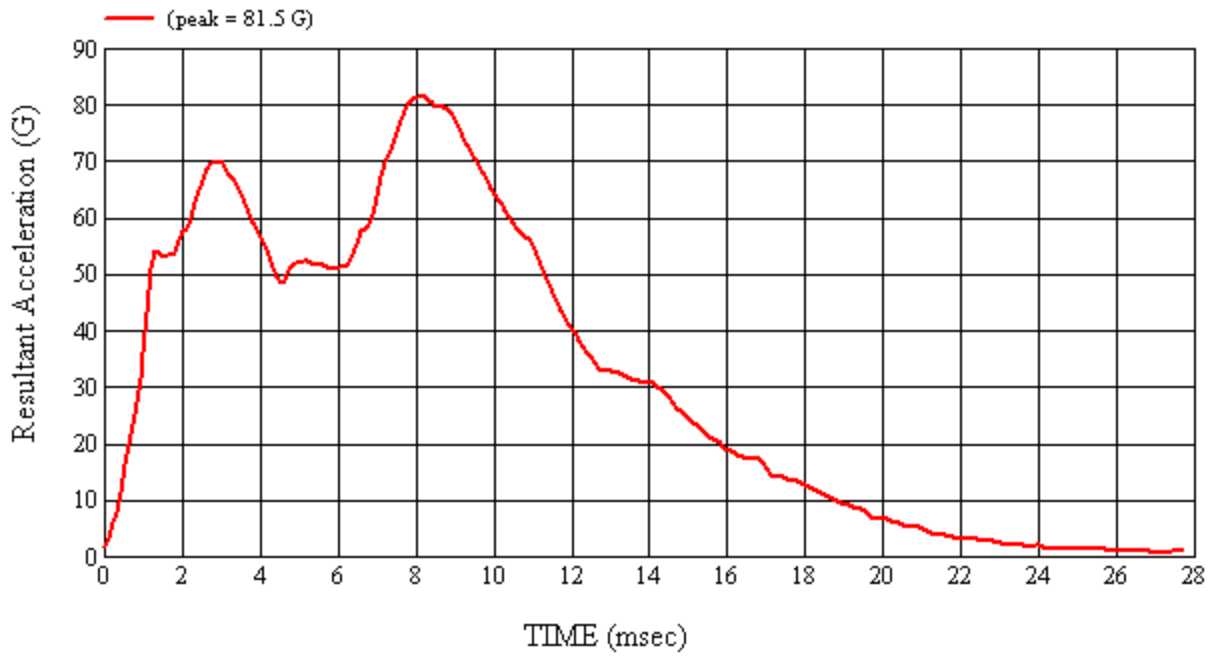
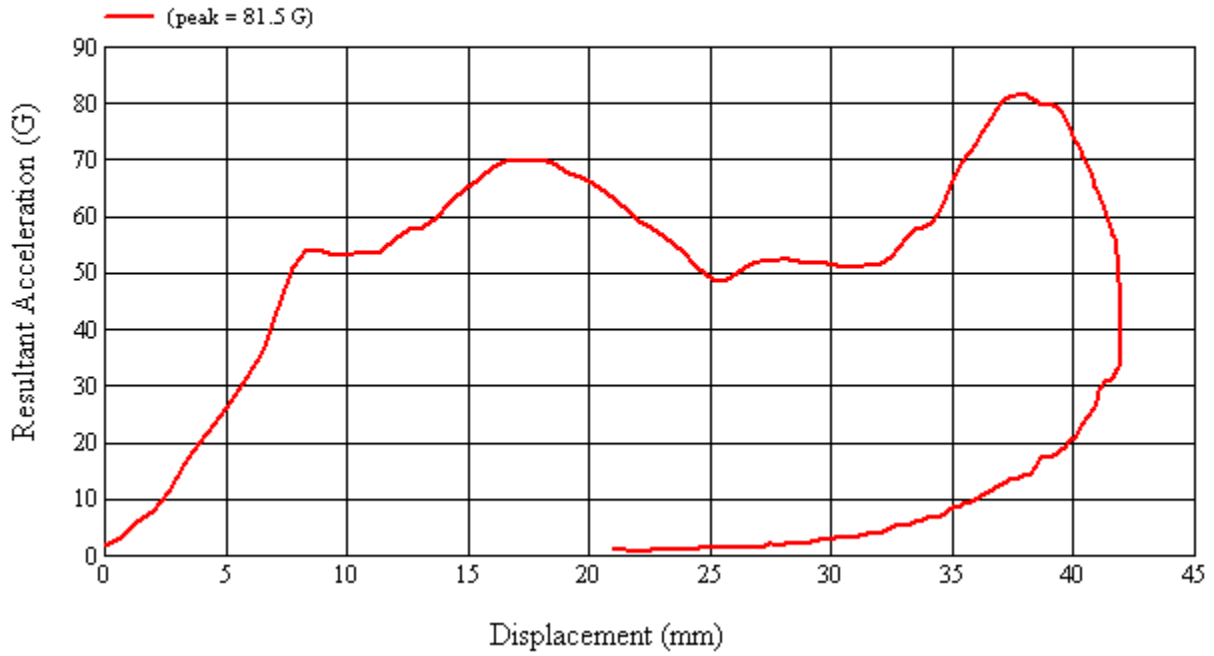
Recorded By: *Matthew H. K.* Approved By*: *Aileen A. Kalato* Date: 4/20/2010

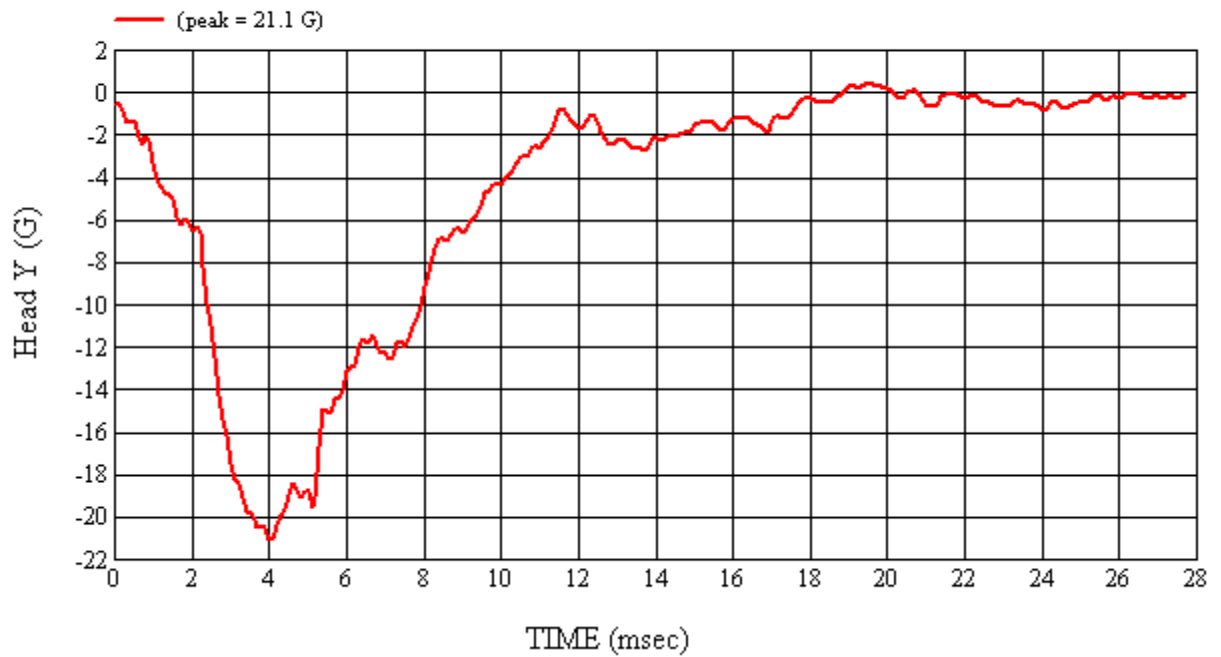
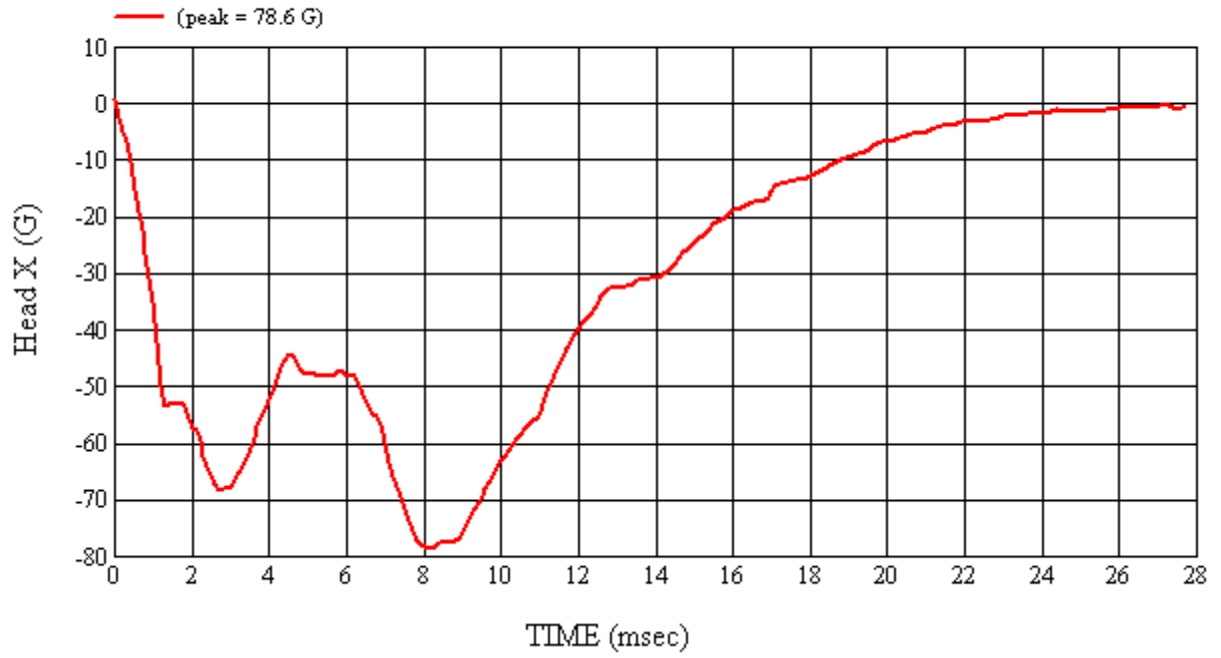
*Only necessary for NHTSA (Government) Compliance testing.

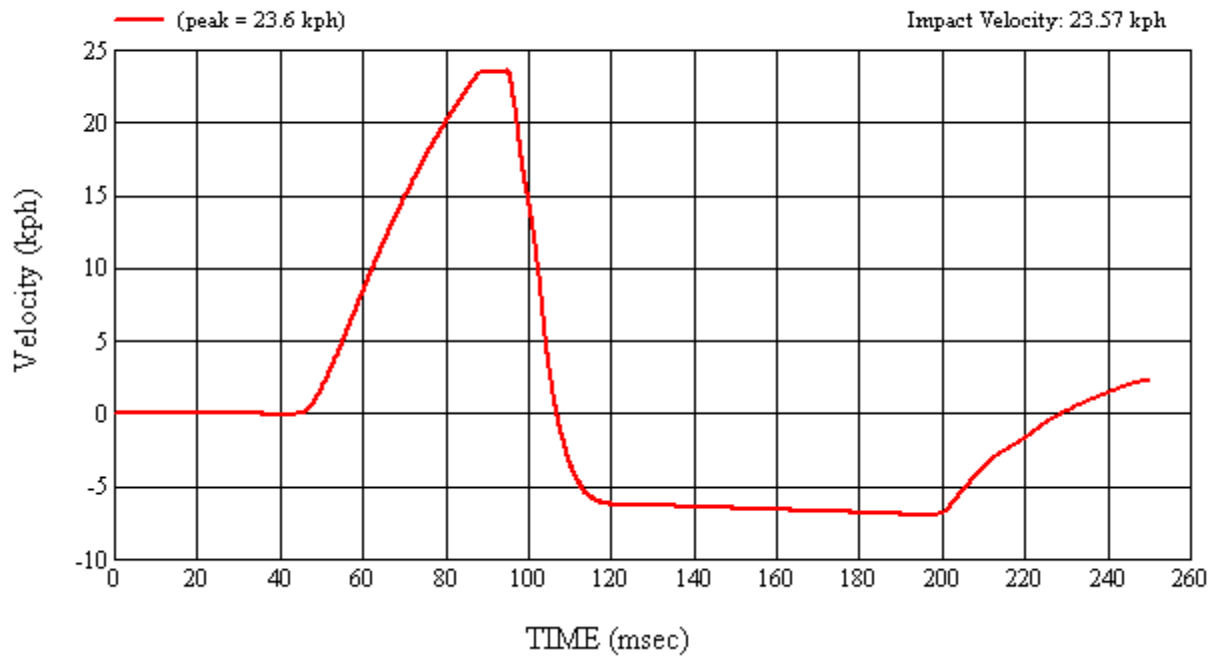
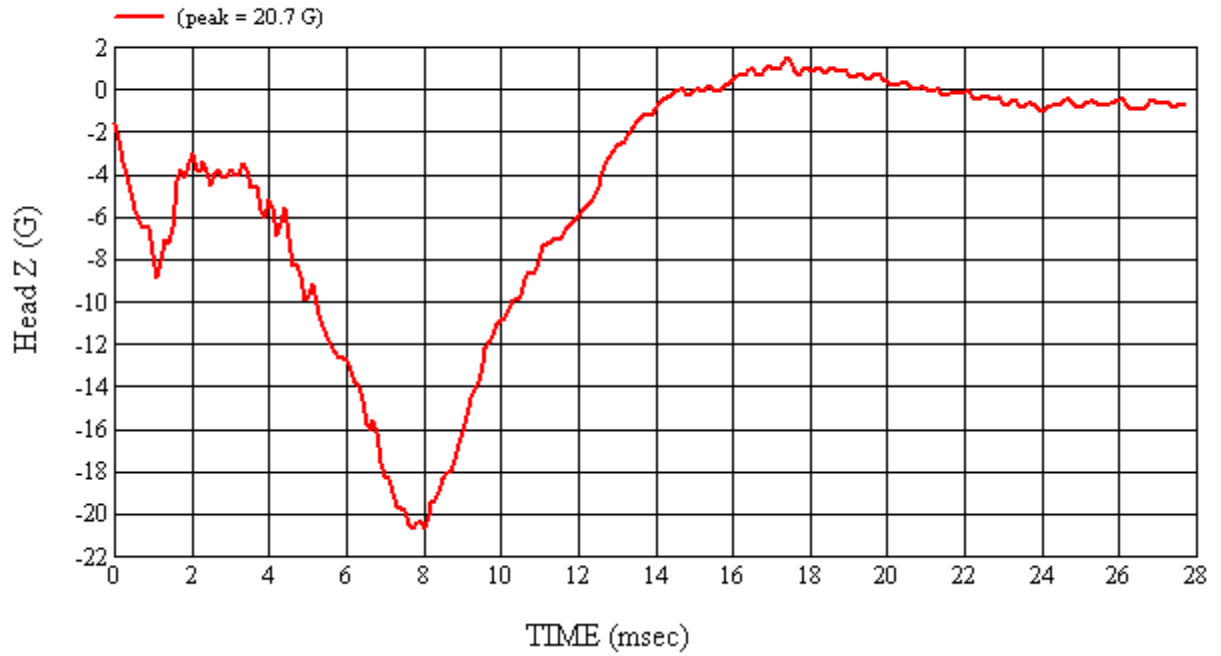
MGA Test #: U10088

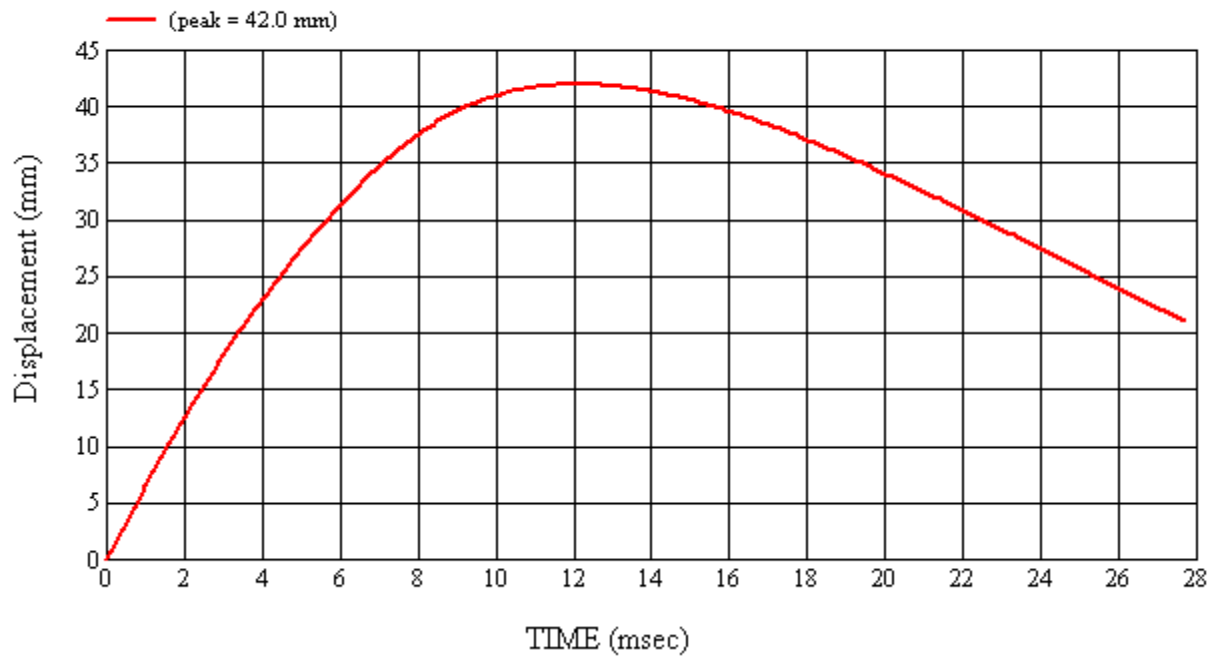
Target Location: BP4, Left Side

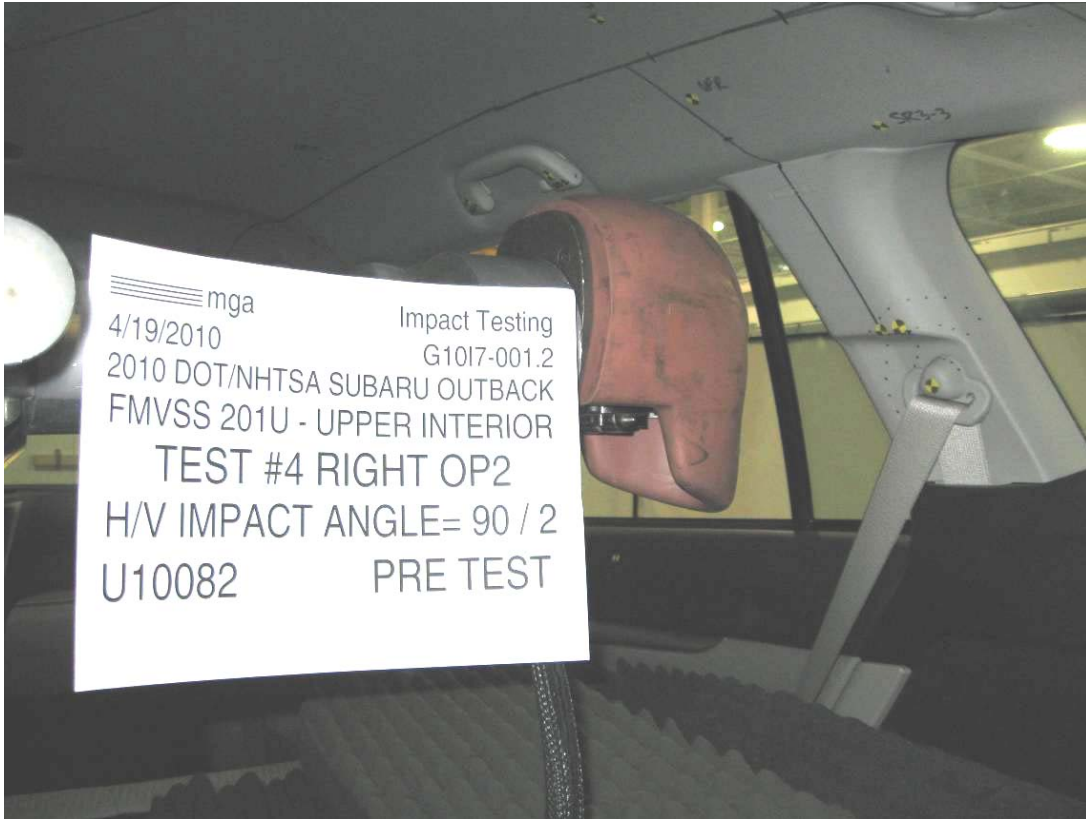
Test Date: 4/20/2010

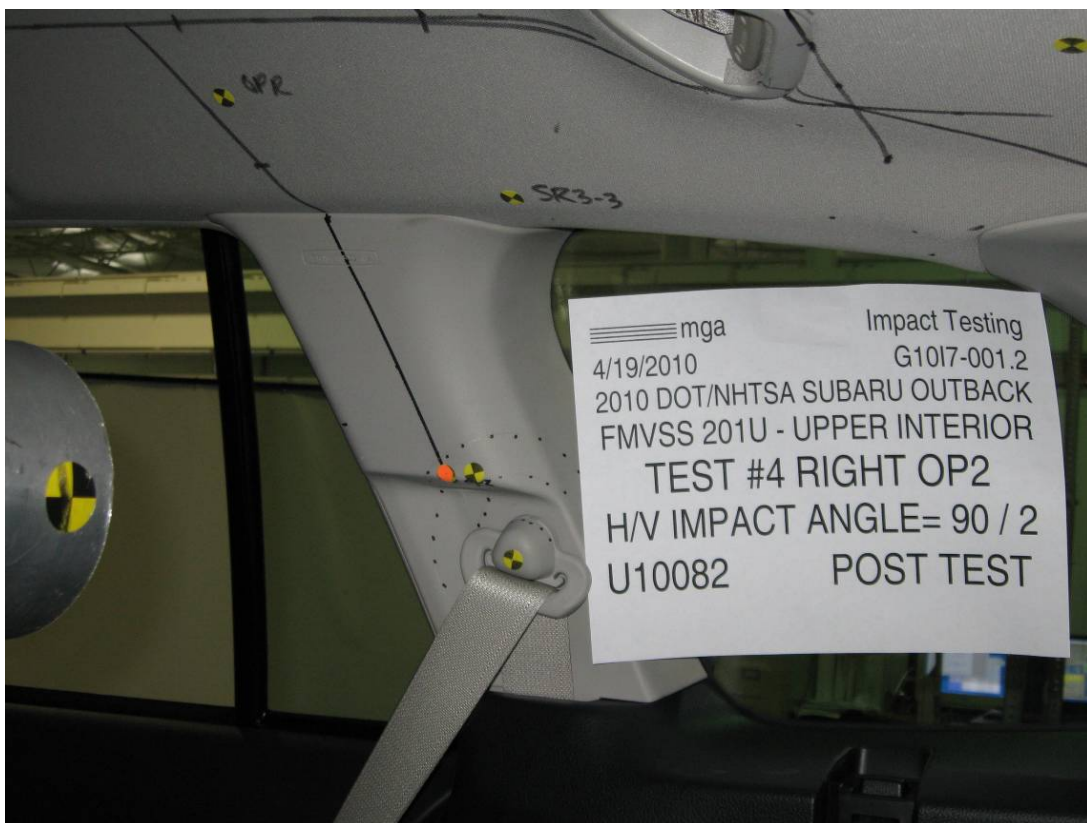
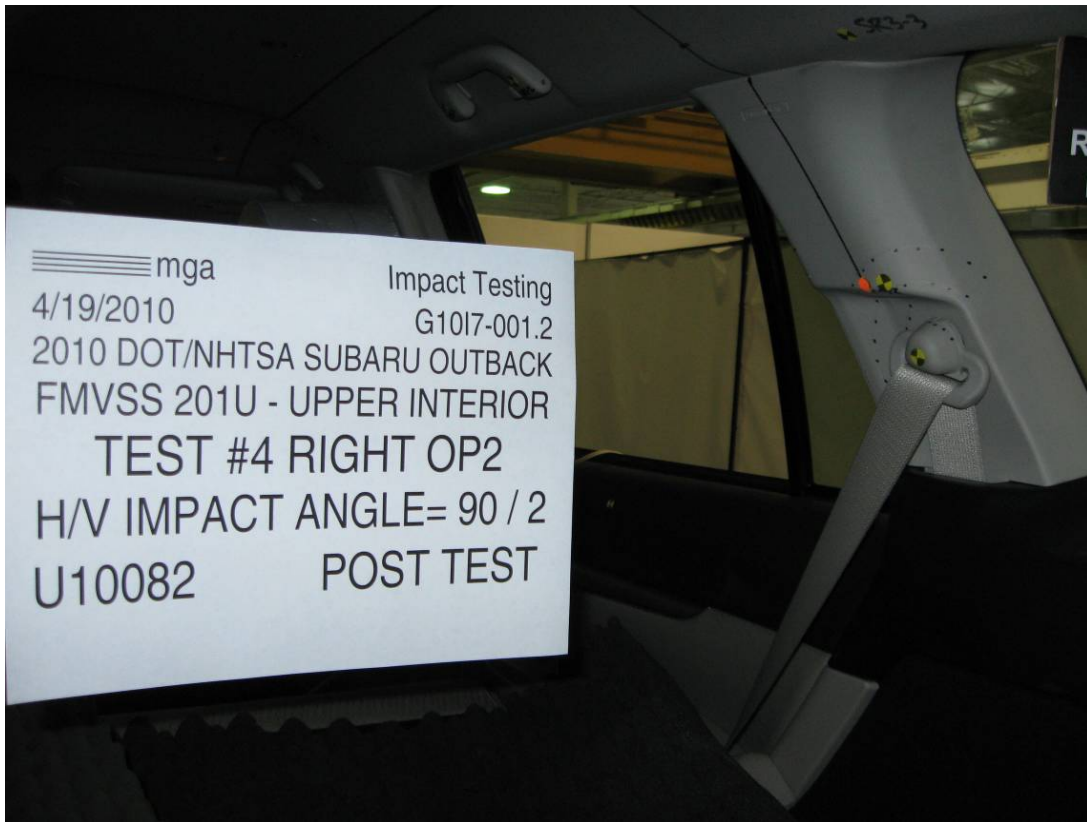














JOB/NHTSA NO: G10I7-001.2 VEHICLE YR/MAKE/MODEL:2010/DOT/NHTSA/Subaru Outback

GENERAL TEST PARAMETERS:

Target (Vehicle Side): OP2Right

MGA Test Reference No.:U10082

Approach Horizontal Angles:90°

Approach Vertical Angles:2°

Additional Description:

Test Number:#4

Temperature:22.4C

Humidity:35.7%

Time of Test:12:14:23 PM

FMH Serial No:[035]

TEST RESULTS:



HIC(d)	HIC	Δt (msec)	Velocity (kph)	Impact location on FMH (mm)	
				Above Pt. O	Left/Right Pt. O
615	595	11	23.8	10	4 Left

INSTRUMENTATION INFORMATION: (all accelerometers are Endevco 7264-2000)

Axis	Channel	Serial No.	DLR Value	ΔV Pre-Test	ΔV Post-Test
X	5	J35919	-96.3	1.06	1.06
Y	6	J22664	95.2	0.85	0.85
Z	7	J35924	93.8	0.94	0.94

REMARKS (Summary of test, damage, non-compliance, invalid test, etc.):

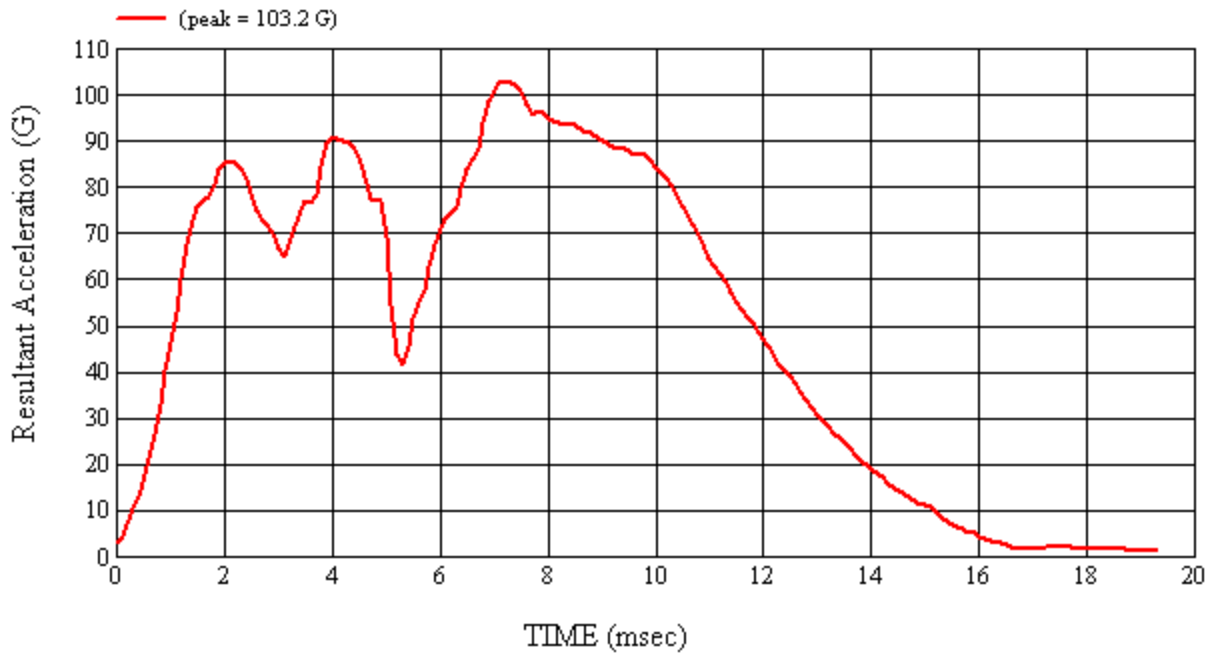
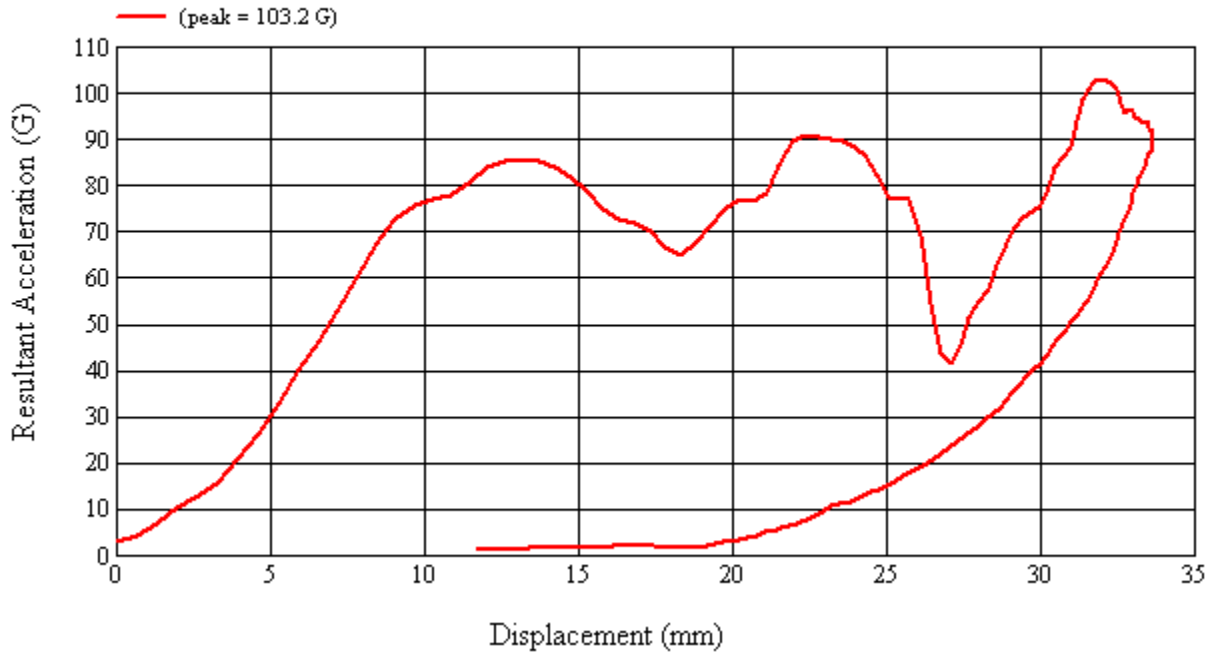
No visible damage

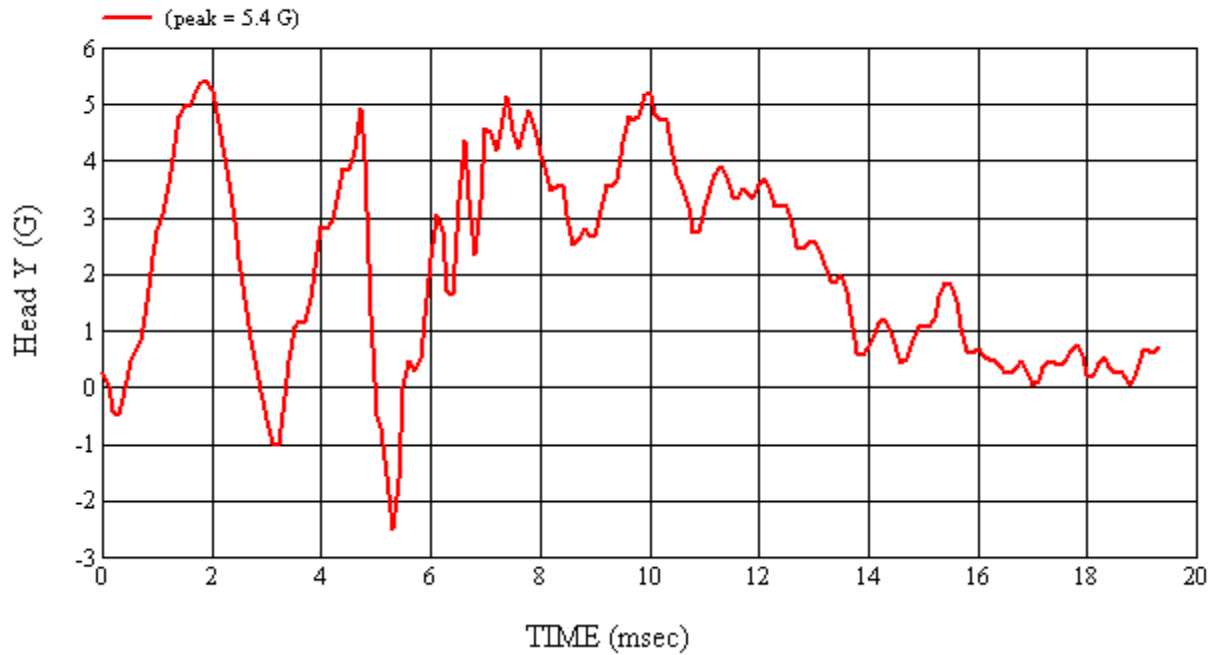
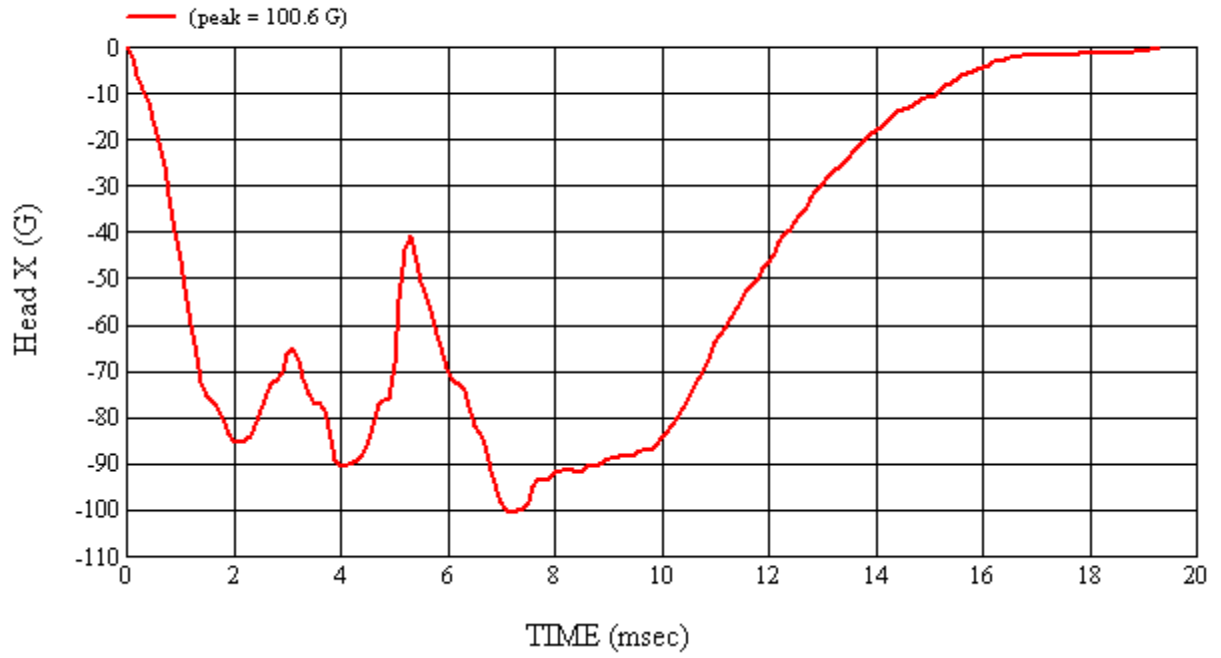
Recorded By:  Approved By*:  Date: 4/19/2010
*Only necessary for NHTSA (Government) Compliance testing.

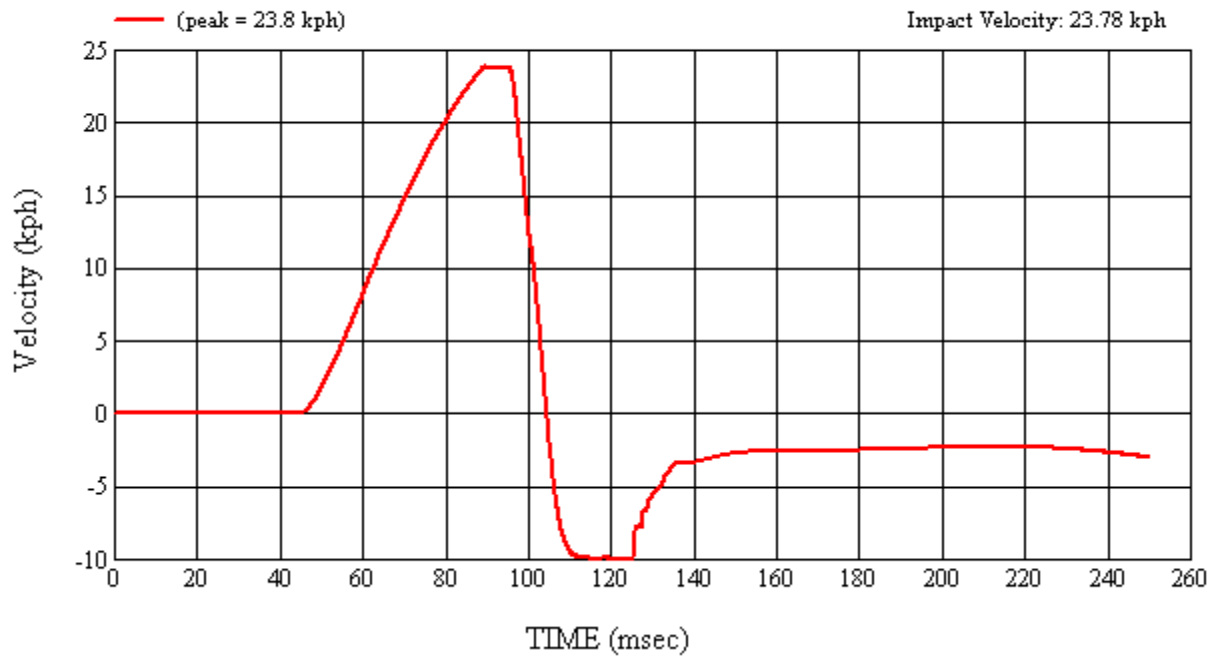
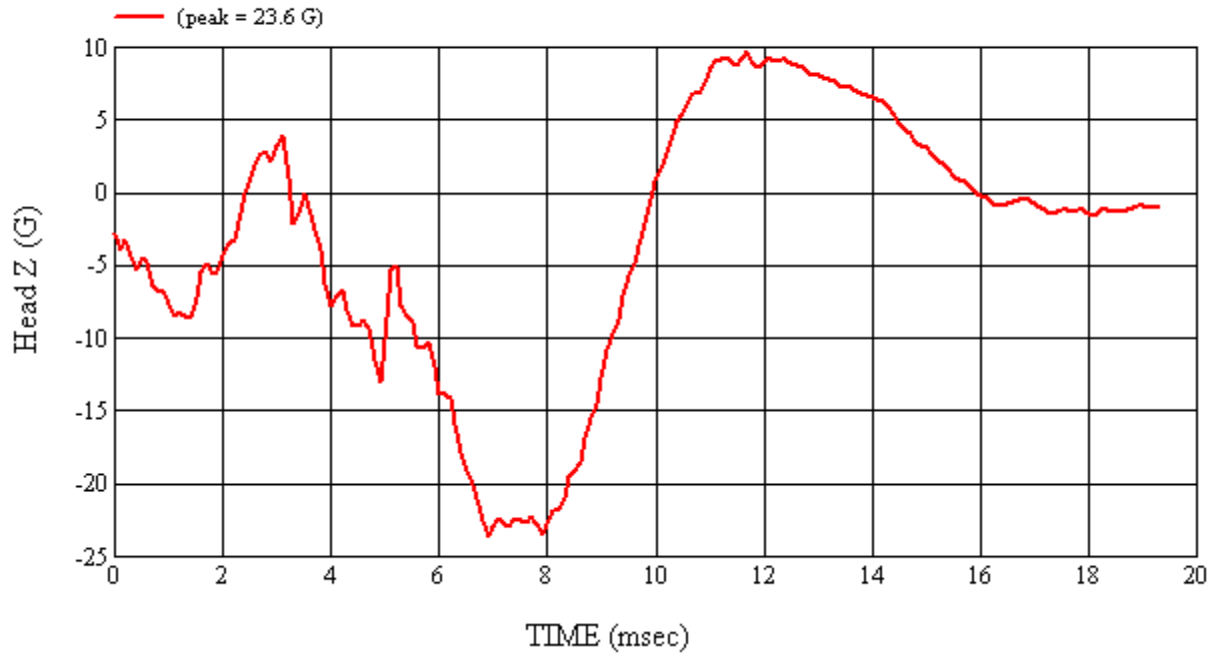
MGA Test #: U10082

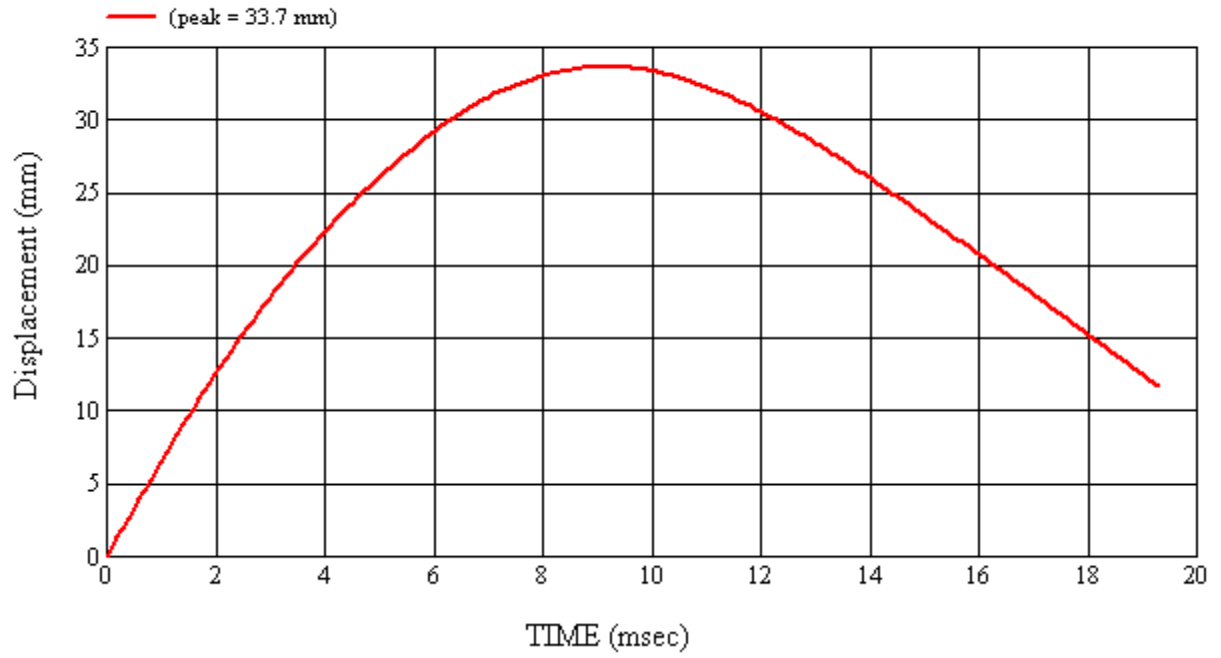
Target Location: OP2, Right Side

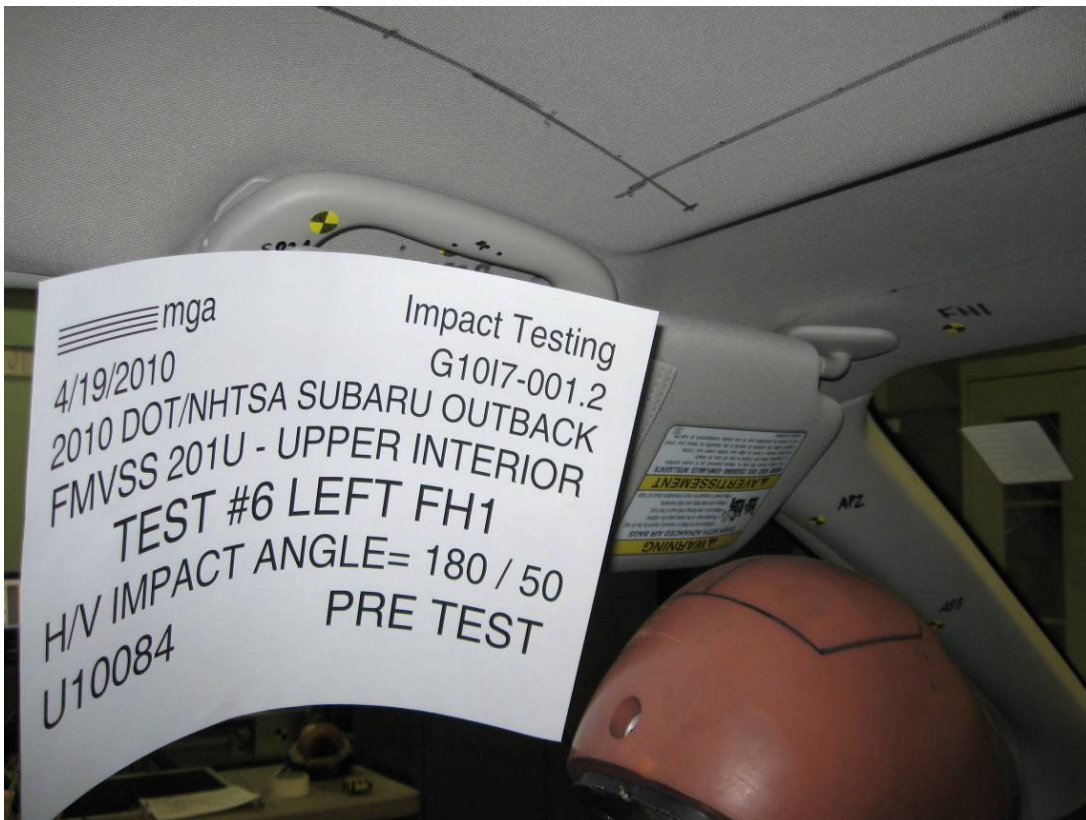
Test Date: 4/19/2010

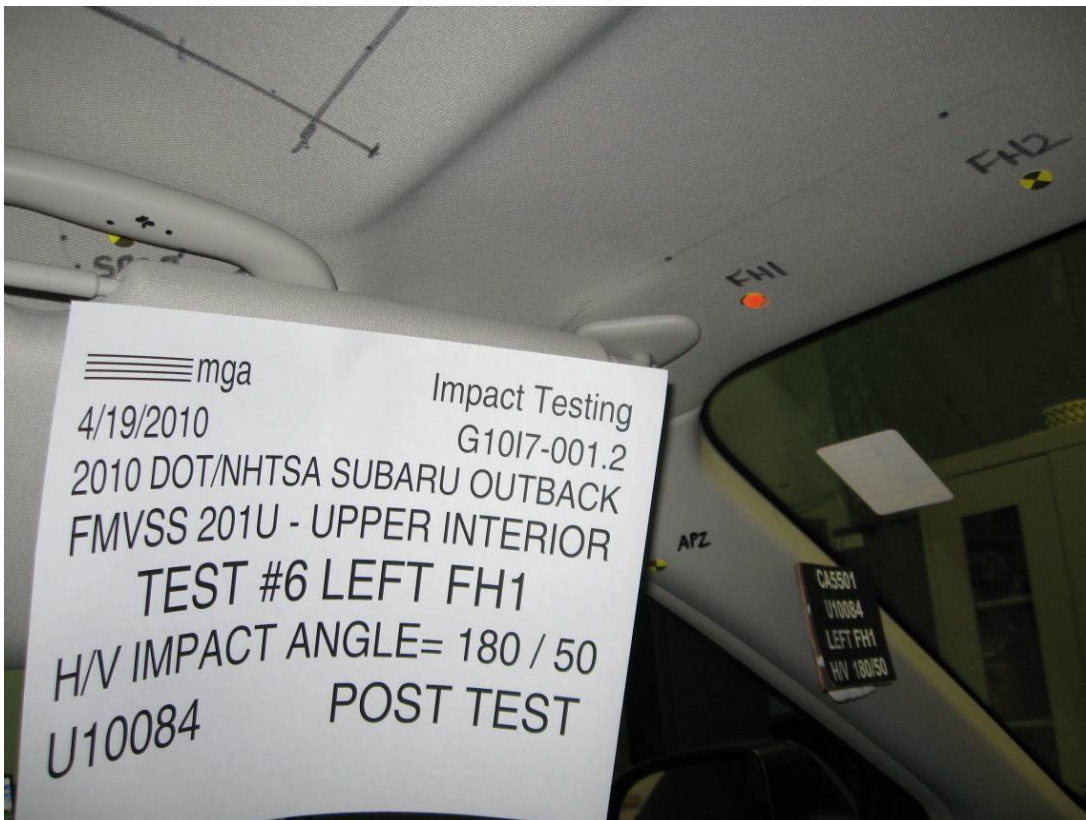
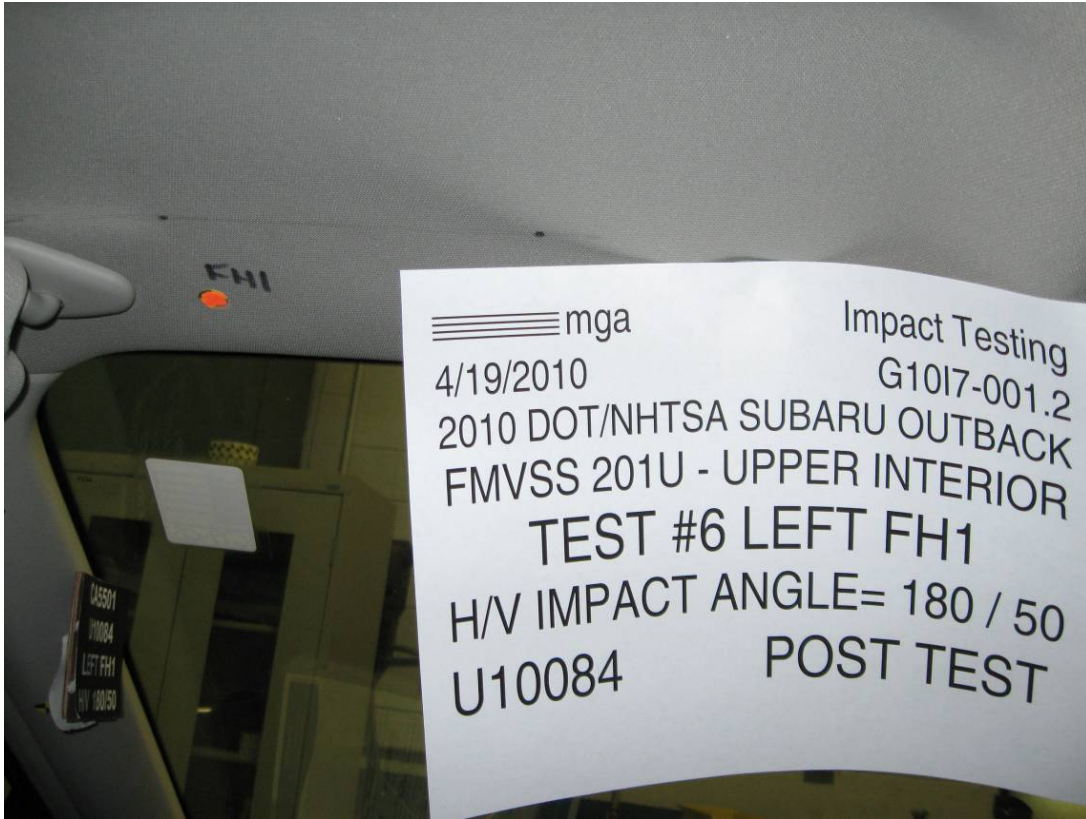


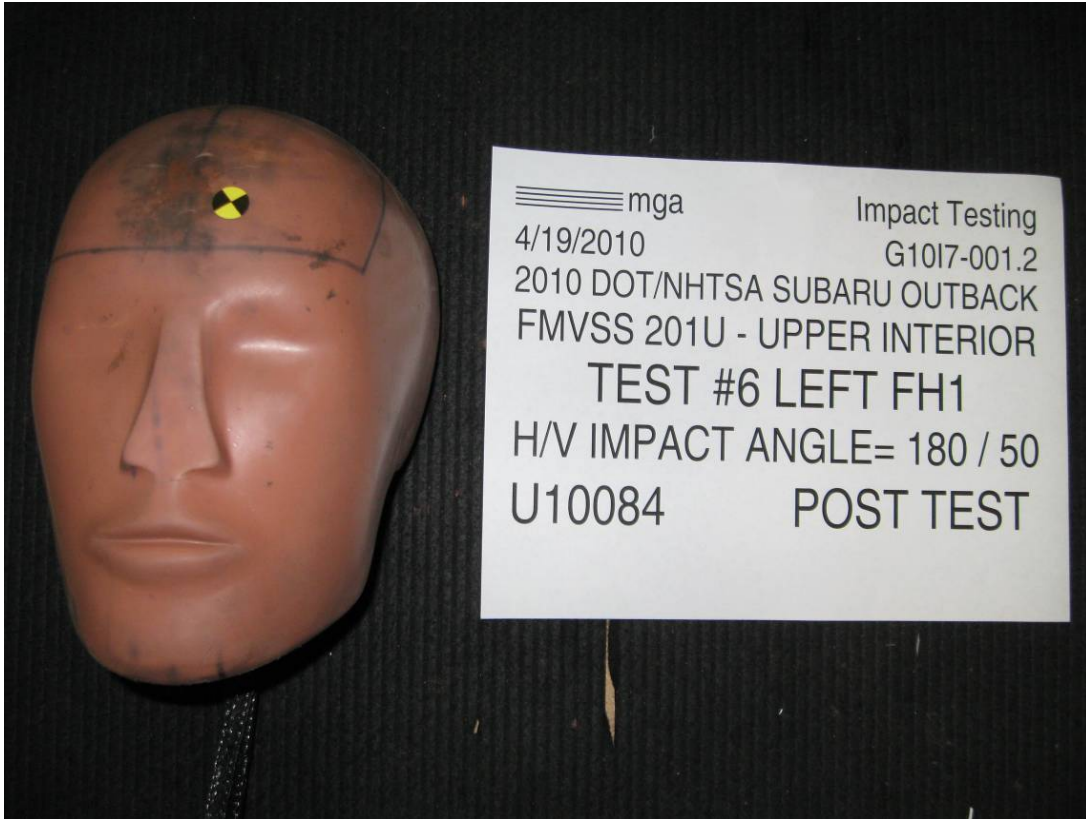












SUMMARY OF FMVSS 201U TEST

JOB/NHTSA NO: G10I7-001.2 VEHICLE YR/MAKE/MODEL:2010/DOT/NHTSA/Subaru Outback

GENERAL TEST PARAMETERS:

Test Number:#6

Target (Vehicle Side): FH1Left

Temperature:22.8C

MGA Test Reference No.:U10084

Humidity:35.3%

Approach Horizontal Angles:180°

Time of Test:3:23:35 PM

Approach Vertical Angles:50°

FMH Serial No:[038]

Additional Description:

TEST RESULTS:



HIC(d)	HIC	Δt (msec)	Velocity (kph)	Impact location on FMH (mm)	
				Above Pt. O	Left/Right Pt. O
572	538	6.9	23.7	17	12 Left

INSTRUMENTATION INFORMATION: (all accelerometers are Endevco 7264-2000)

Axis	Channel	Serial No.	DLR Value	ΔV Pre-Test	ΔV Post-Test
X	5	J22700	-96.5	1.06	1.06
Y	6	J36197	109.5	0.85	0.85
Z	7	J36353	99.5	0.94	0.94

REMARKS (Summary of test, damage, non-compliance, invalid test, etc.):

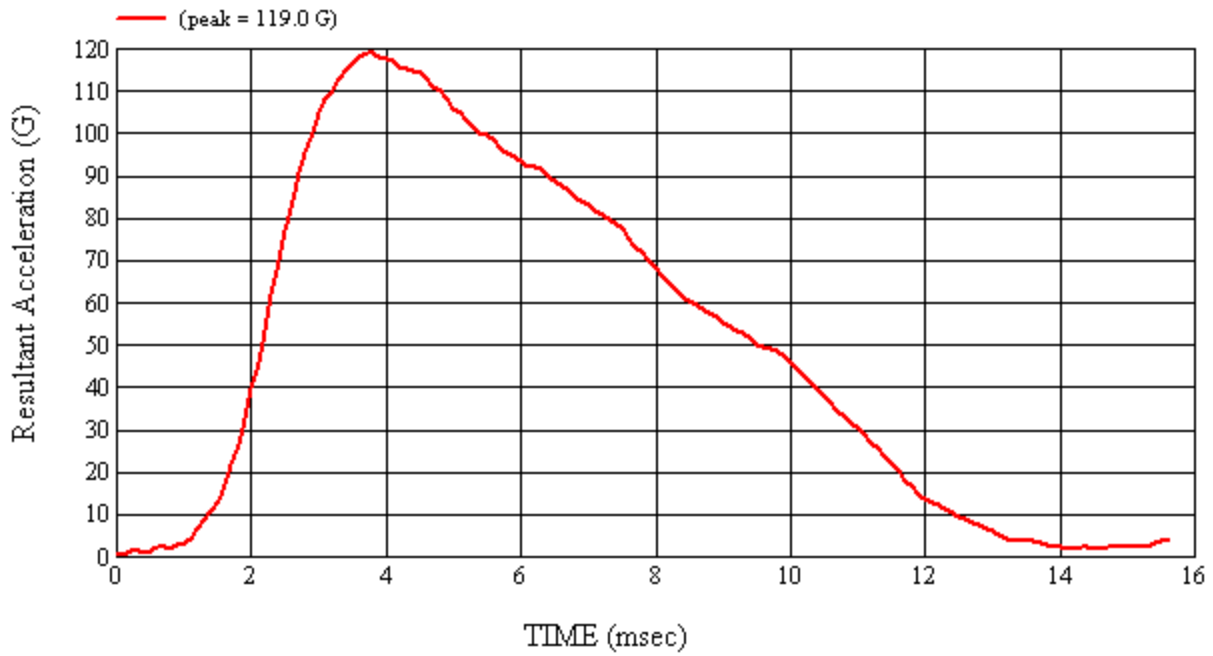
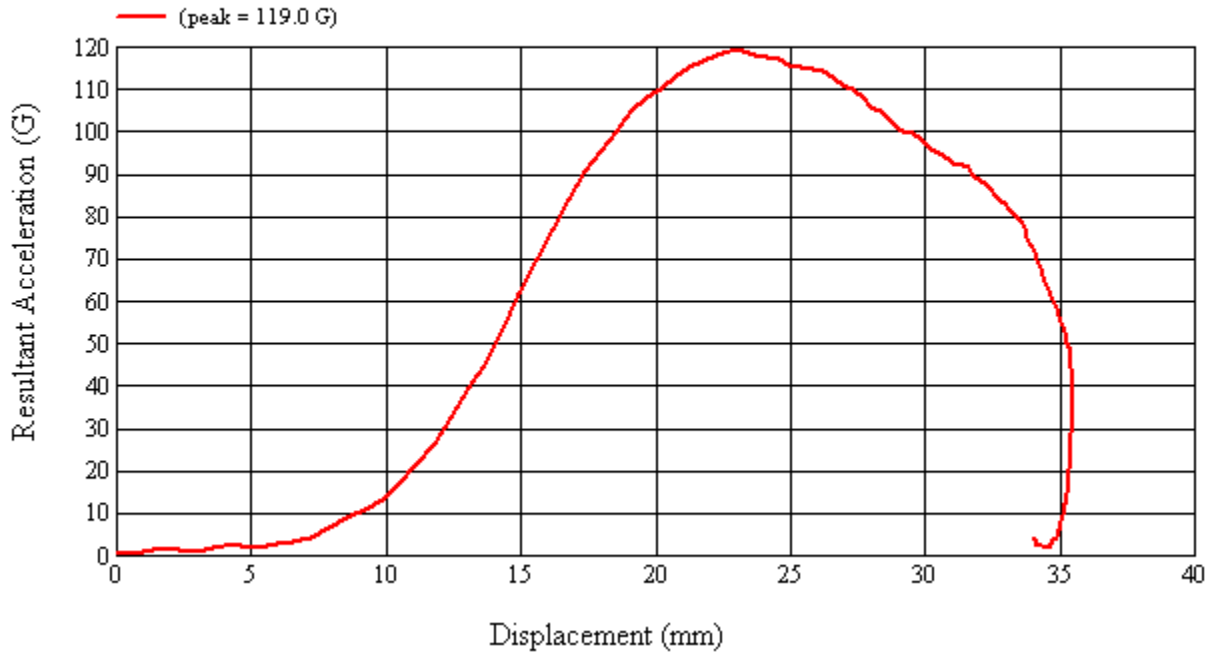
Slight headliner deformation, sunglass holder opened

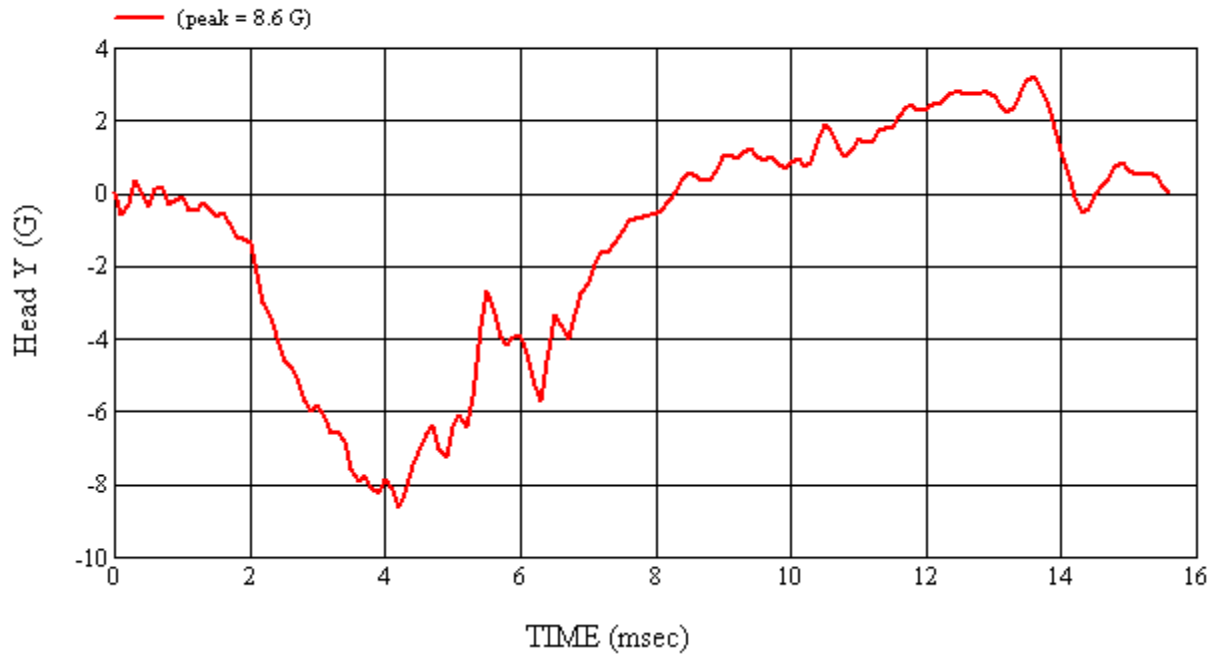
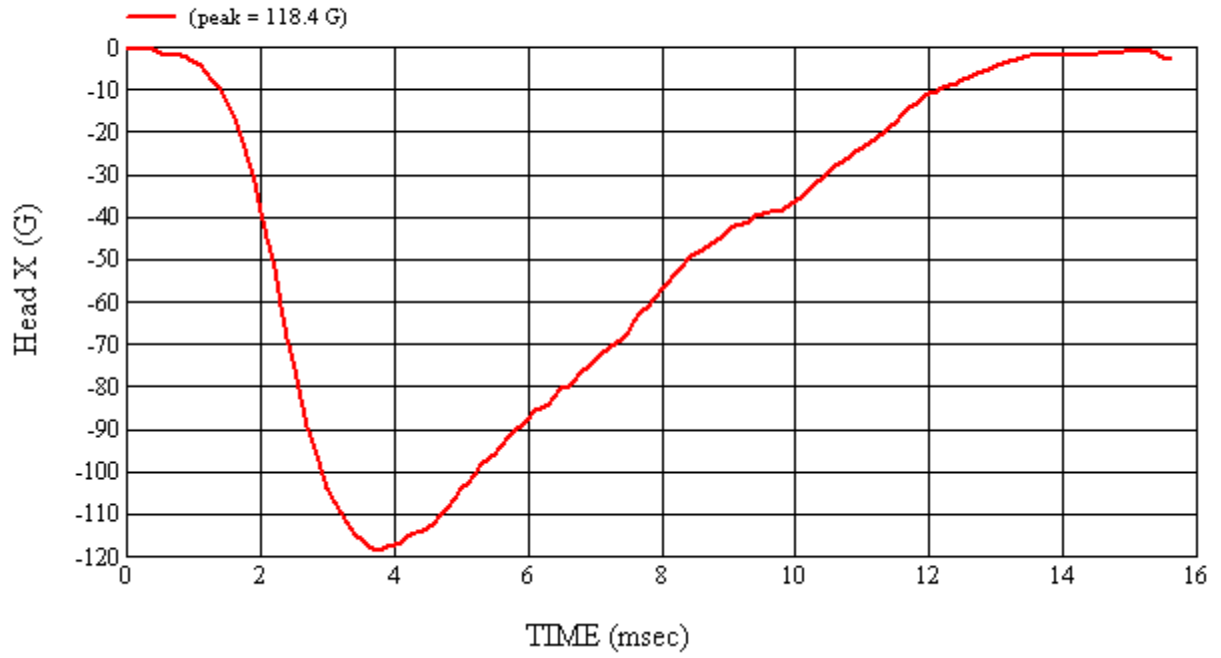
Recorded By:  Approved By*:  Date: 4/19/2010
 *Only necessary for NHTSA (Government) Compliance testing.

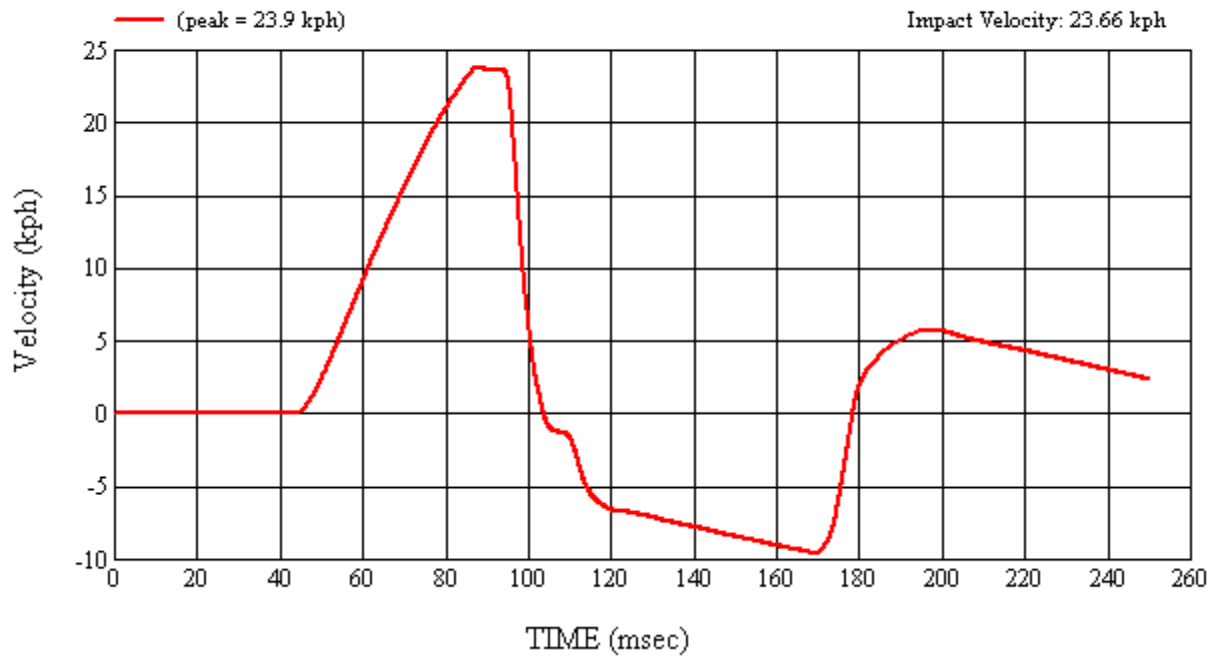
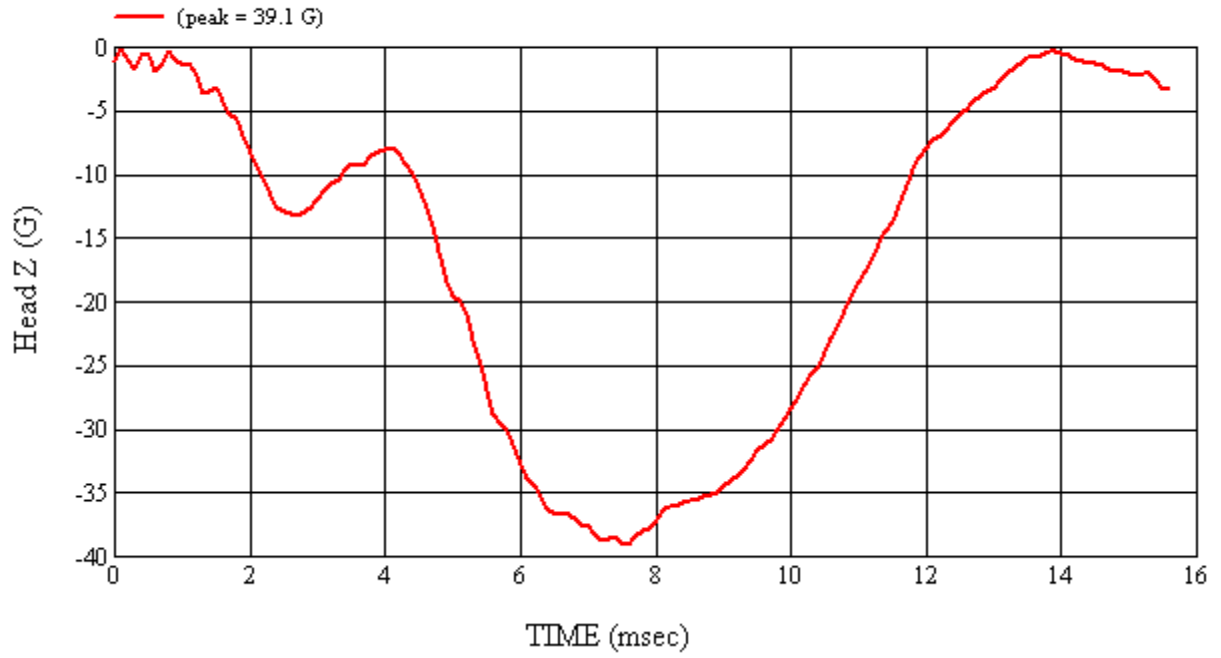
MGA Test #: U10084

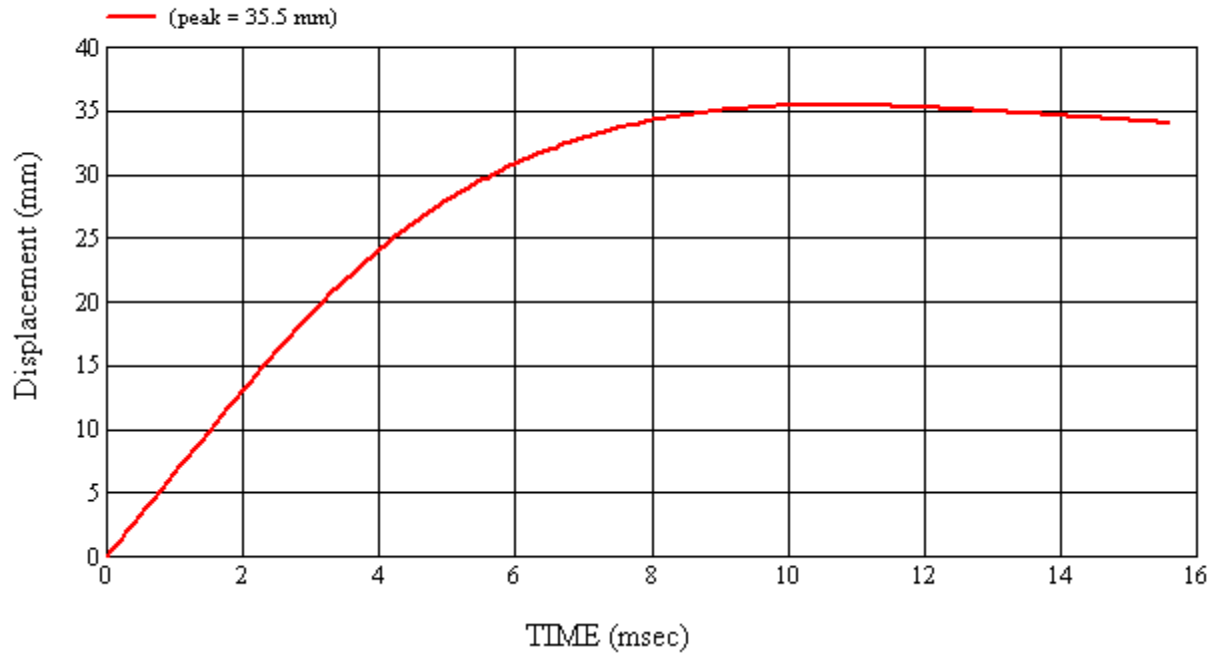
Target Location: FH1, Left Side

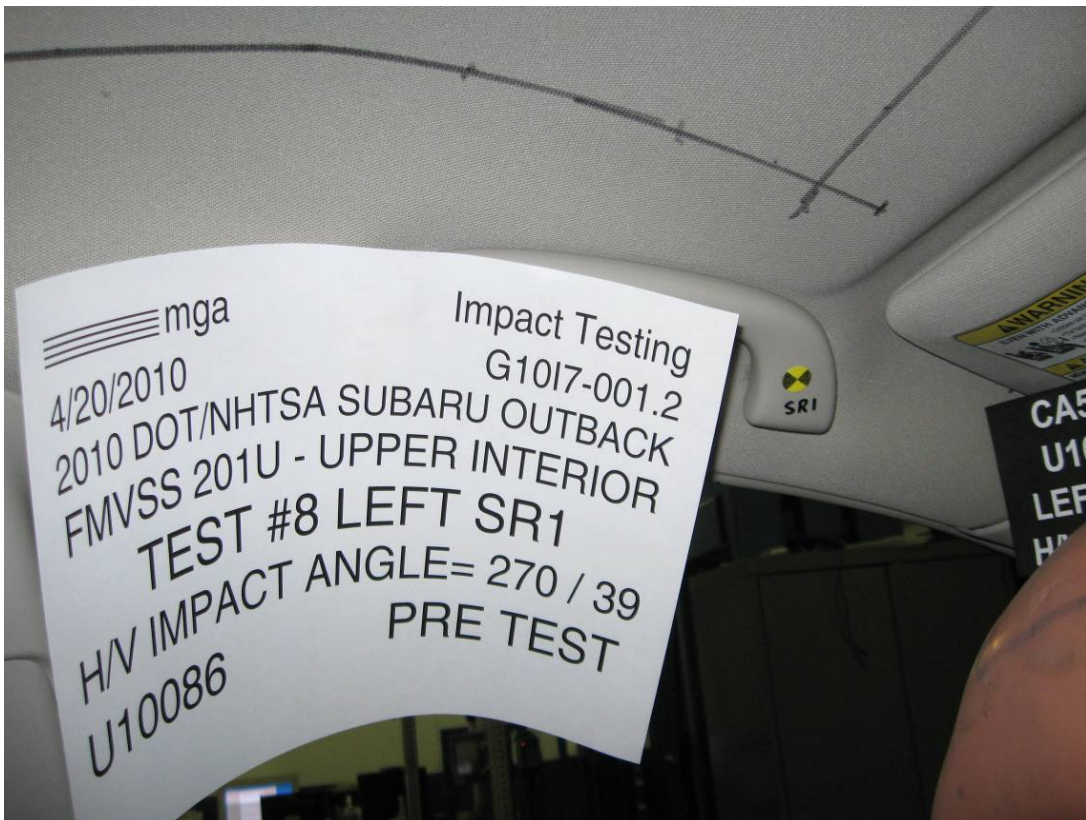
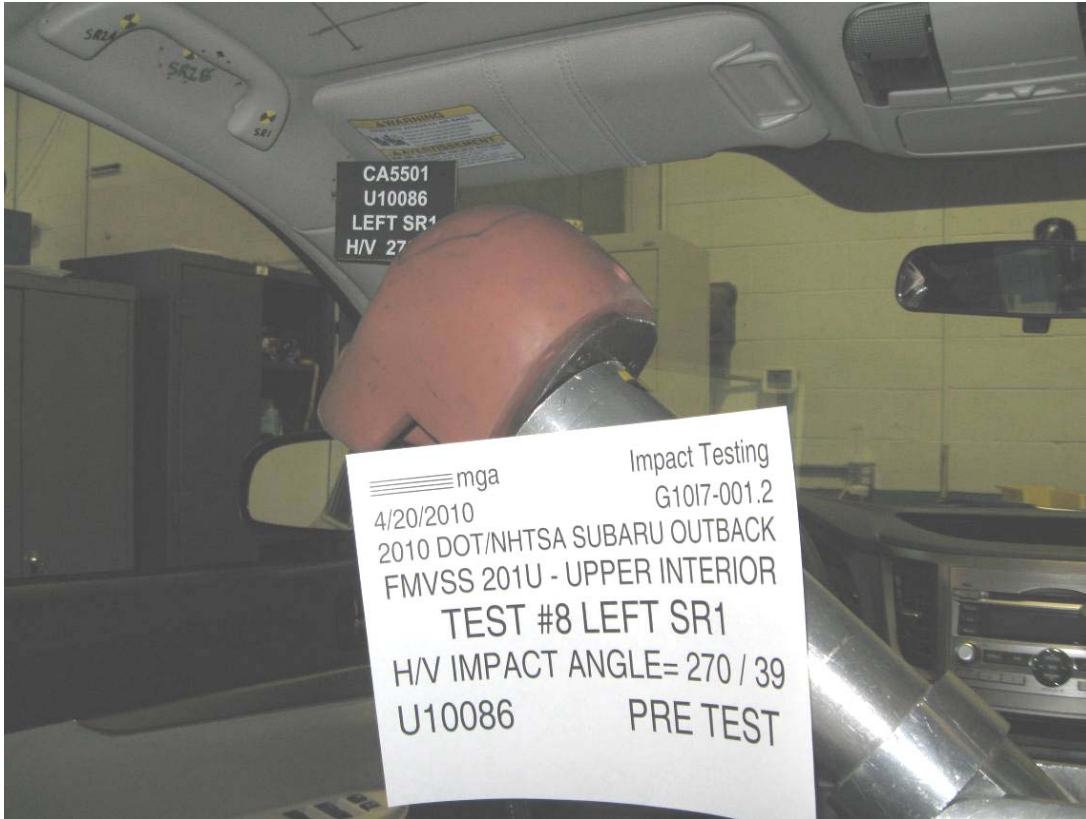
Test Date: 4/19/2010

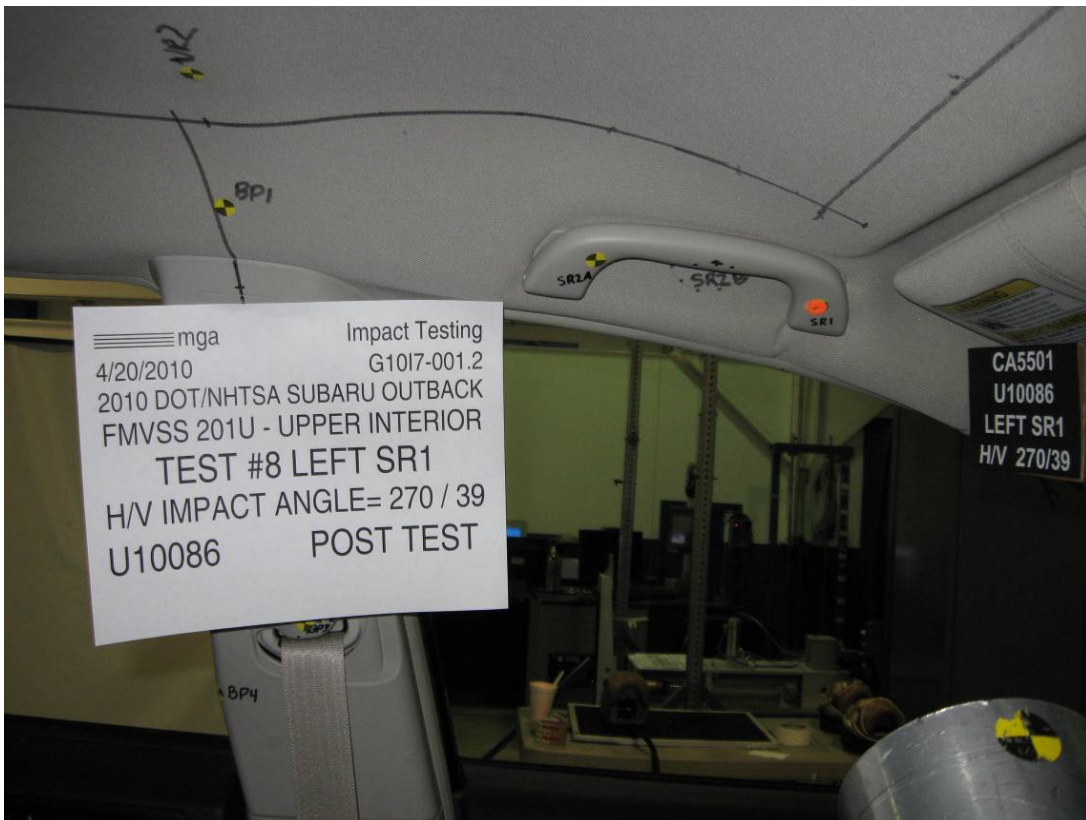
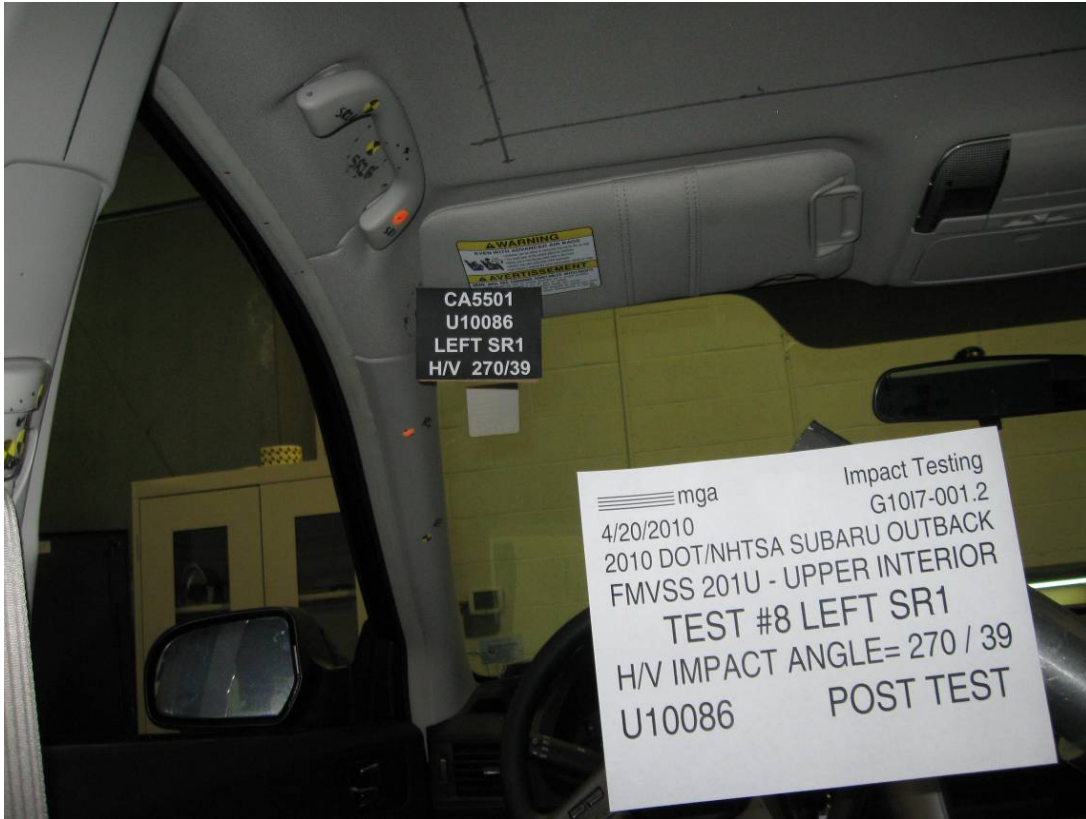


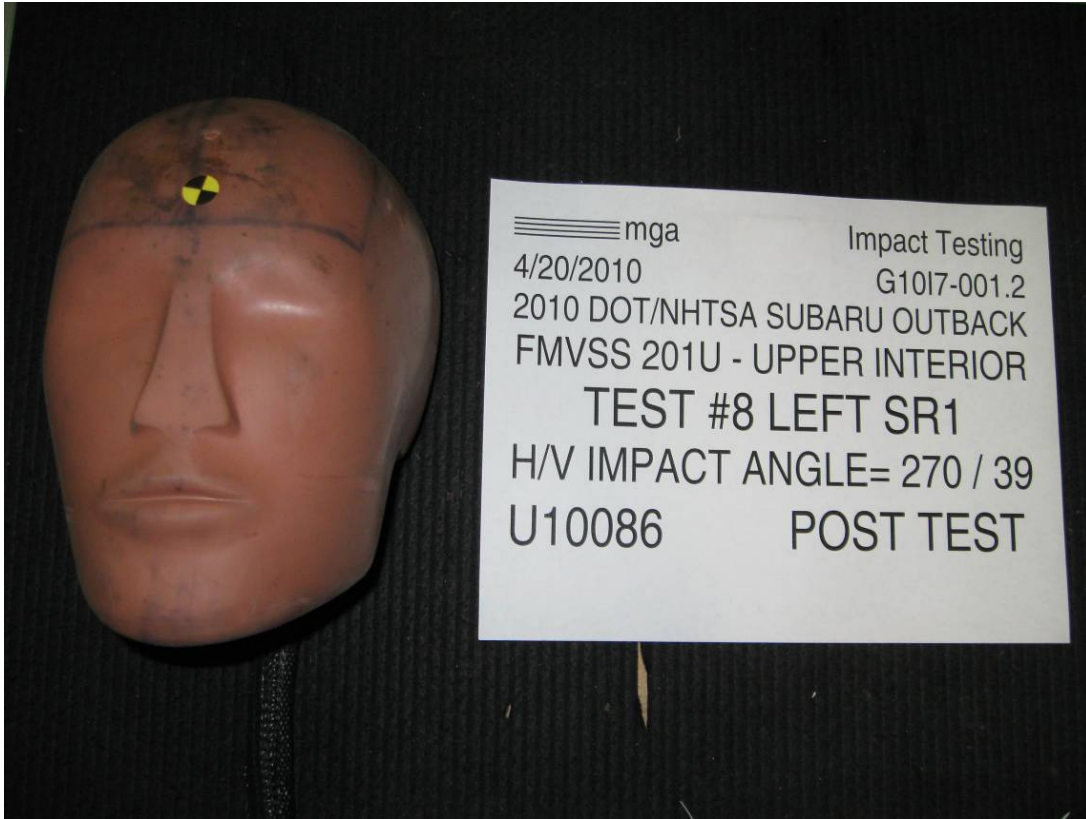












SUMMARY OF FMVSS 201U TEST

JOB/NHTSA NO: G10I7-001.2 VEHICLE YR/MAKE/MODEL:2010/DOT/NHTSA/Subaru Outback

GENERAL TEST PARAMETERS:

Test Number:#8

Target (Vehicle Side): SR1Left

Temperature:21.0C

MGA Test Reference No.:U10086

Humidity:35.1%

Approach Horizontal Angles:270°

Time of Test:8:49:28 AM

Approach Vertical Angles:39°

FMH Serial No:[035]

Additional Description:

TEST RESULTS:



HIC(d)	HIC	Δt (msec)	Velocity (kph)	Impact location on FMH (mm)	
				Above Pt. O	Left/Right Pt. O
318	201	9.9	18.9	14	2 Left

INSTRUMENTATION INFORMATION: (all accelerometers are Endevco 7264-2000)

Axis	Channel	Serial No.	DLR Value	ΔV Pre-Test	ΔV Post-Test
X	5	J35919	-96.3	1.06	1.06
Y	6	J22664	95.2	0.85	0.85
Z	7	J35924	93.8	0.94	0.94

REMARKS (Summary of test, damage, non-compliance, invalid test, etc.):

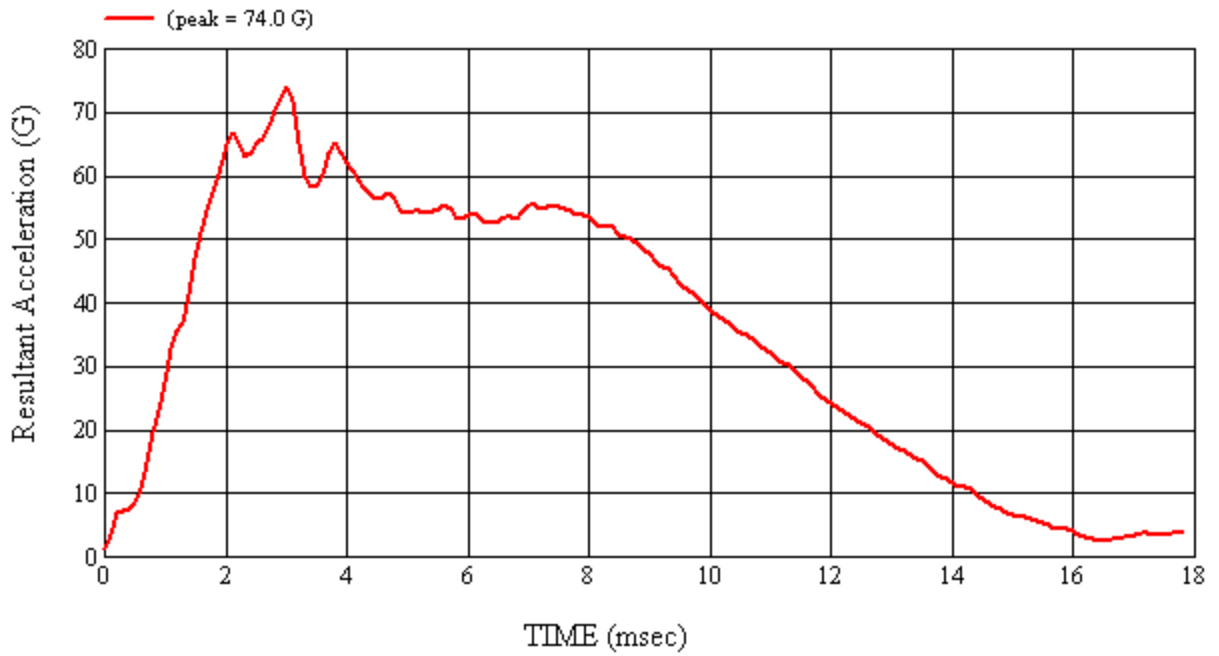
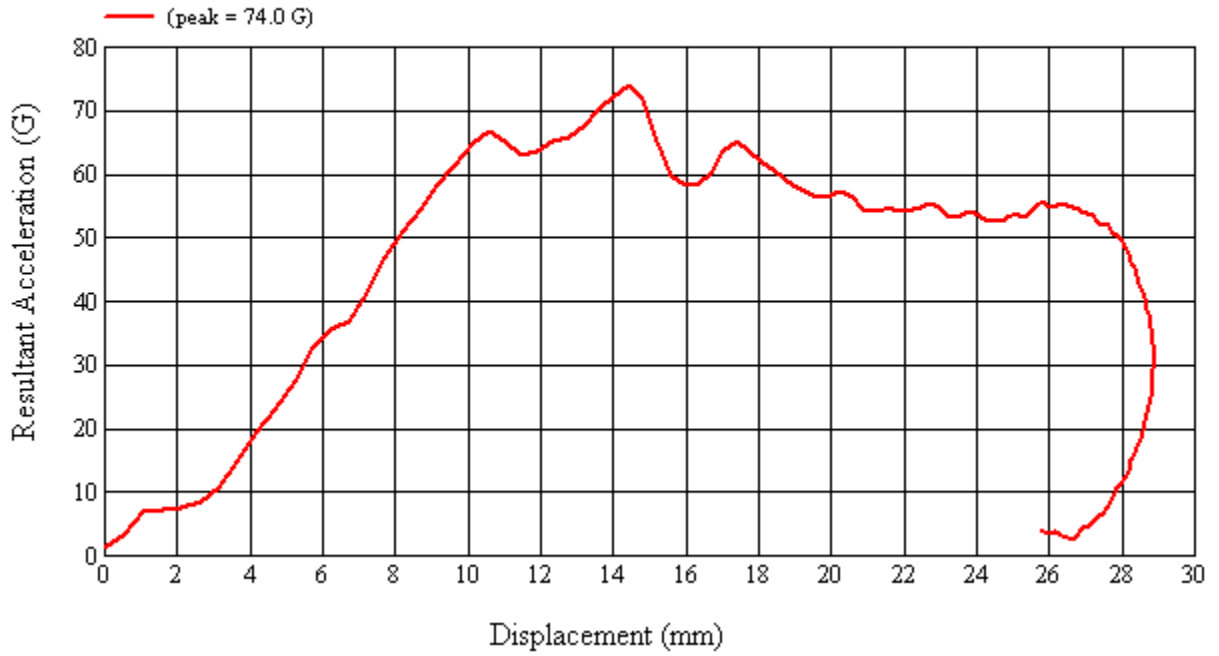
Minor headliner deformation, grab handle compression

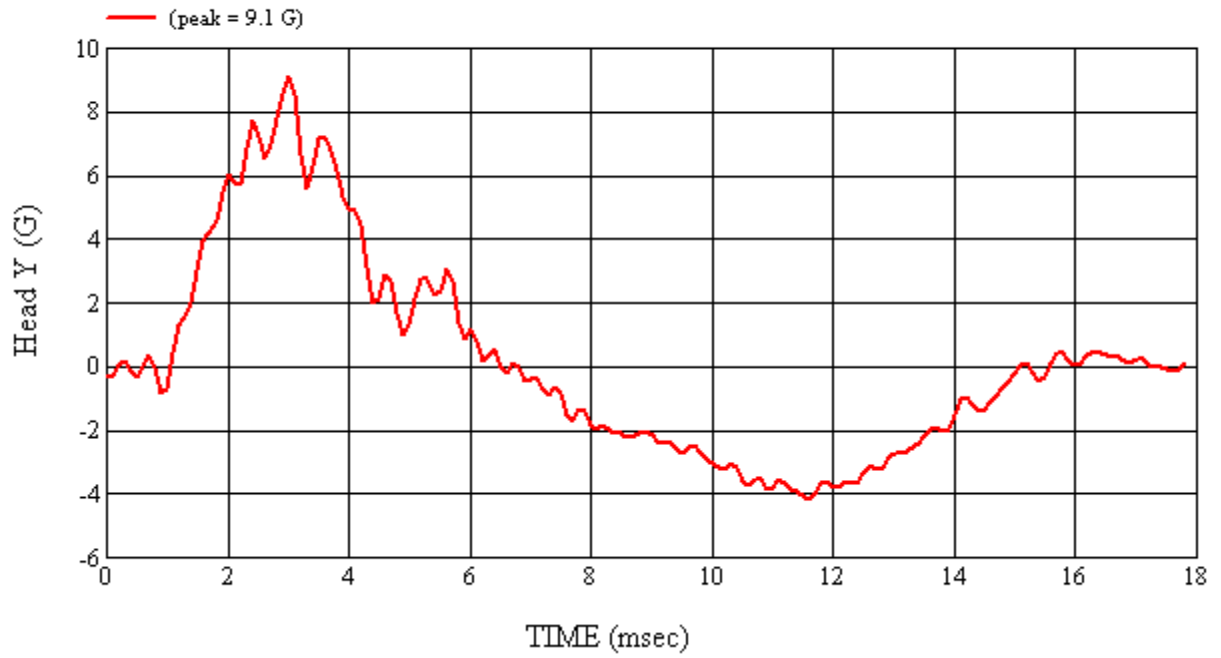
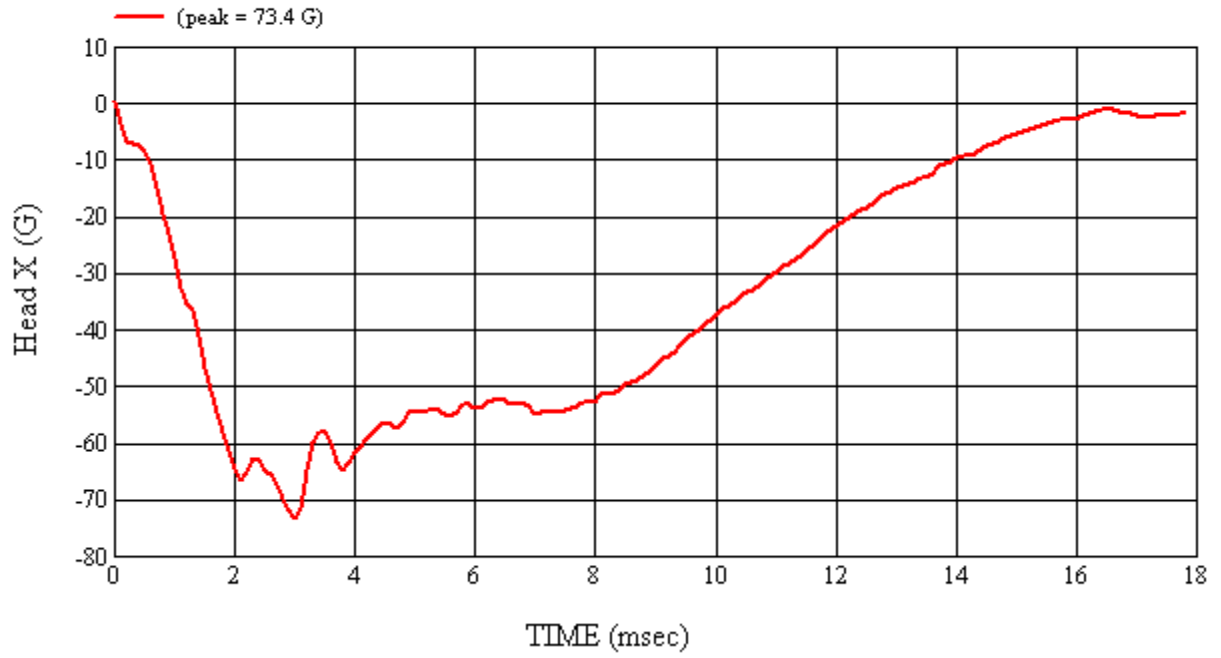
Recorded By:  Approved By*:  Date: 4/20/2010
 *Only necessary for NHTSA (Government) Compliance testing.

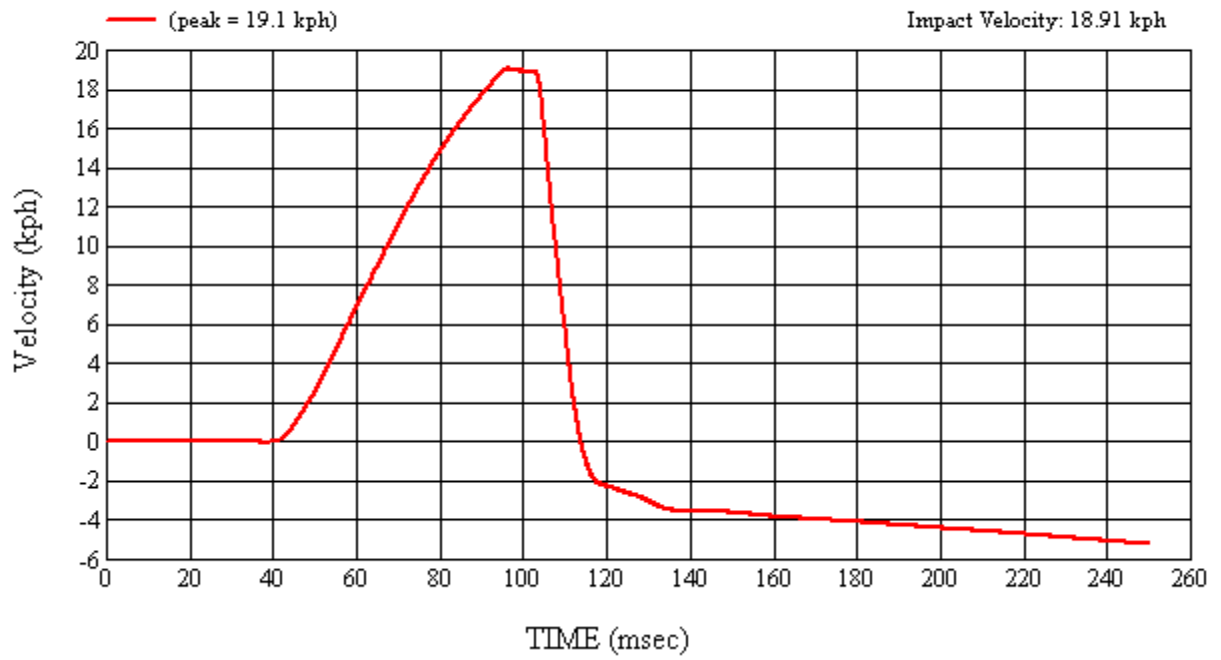
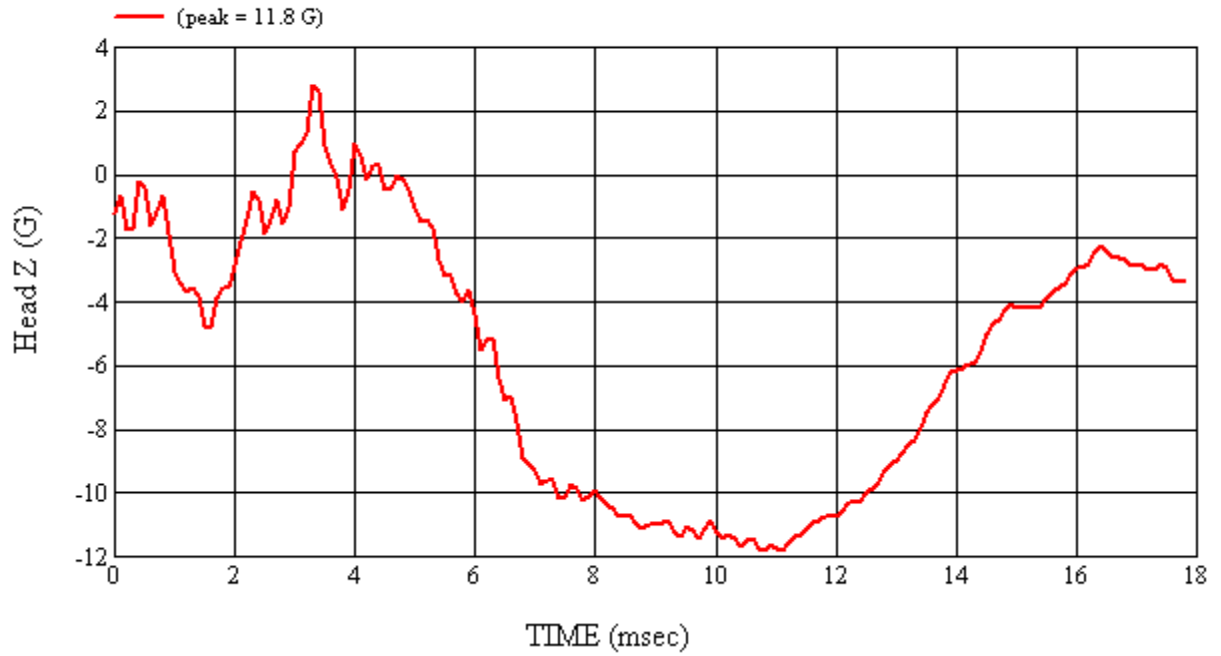
MGA Test #: U10086

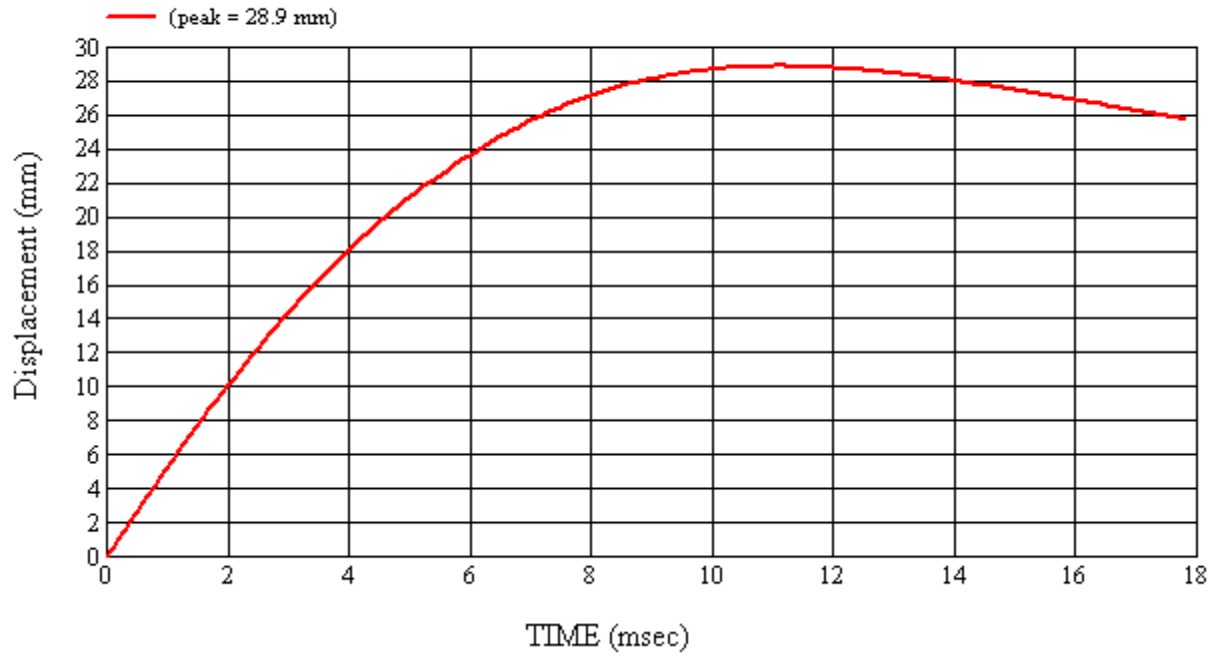
Target Location: SR1, Left Side

Test Date: 4/20/2010

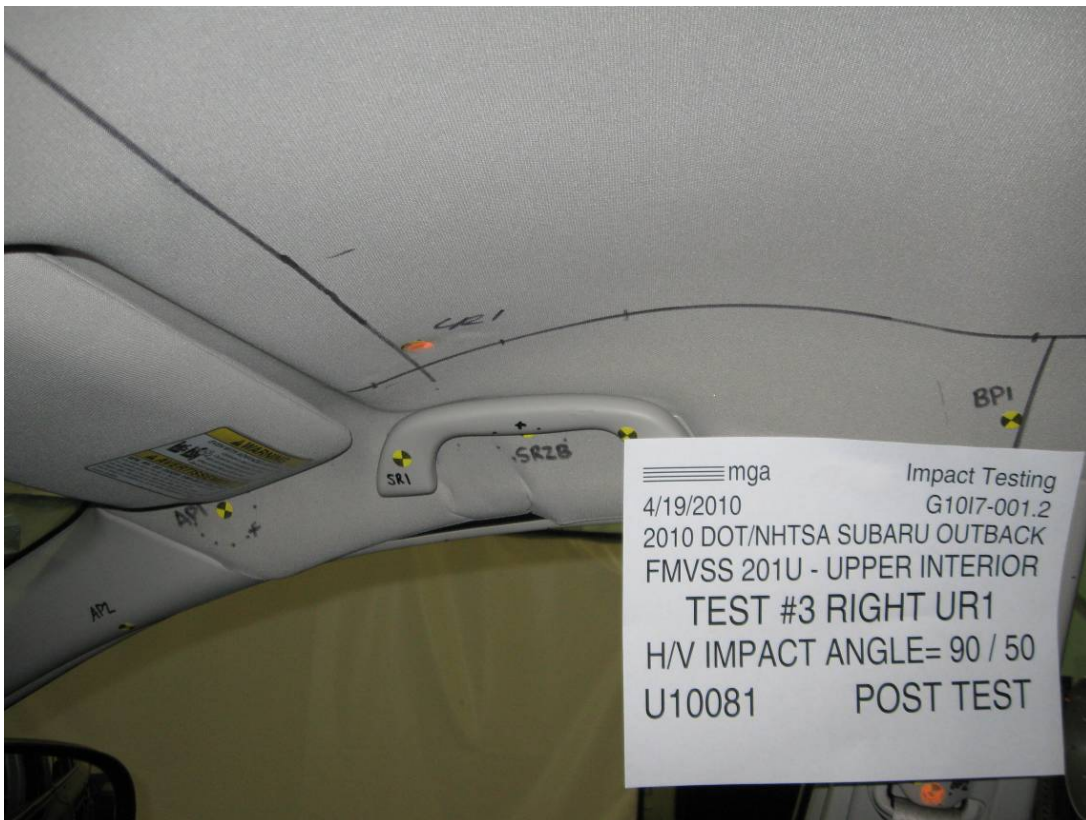


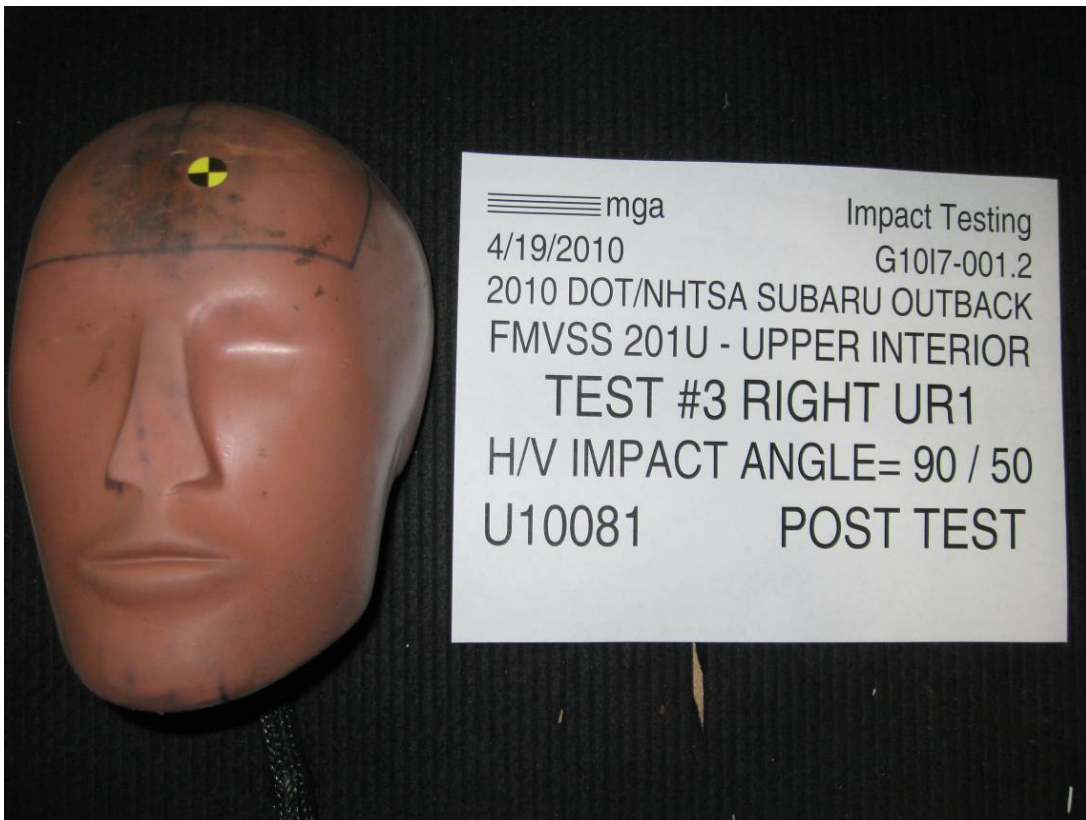












JOB/NHTSA NO: G10I7-001.2 VEHICLE YR/MAKE/MODEL:2010/DOT/NHTSA/Subaru Outback

GENERAL TEST PARAMETERS:

Target (Vehicle Side): UR1Right

MGA Test Reference No.:U10081

Approach Horizontal Angles:90°

Approach Vertical Angles:50°

Additional Description: At SR1

Test Number:#3

Temperature:21.9C

Humidity:35.7%

Time of Test:11:20:35 AM

FMH Serial No:[038]

TEST RESULTS:



HIC(d)	HIC	Δt (msec)	Velocity (kph)	Impact location on FMH (mm)	
				Above Pt. O	Left/Right Pt. O
566	529	9	24.0	28	12 Left

INSTRUMENTATION INFORMATION: (all accelerometers are Endevco 7264-2000)

Axis	Channel	Serial No.	DLR Value	ΔV Pre-Test	ΔV Post-Test
X	5	J22700	-96.5	1.06	1.06
Y	6	J36197	109.5	0.85	0.85
Z	7	J36353	99.5	0.94	0.94

REMARKS (Summary of test, damage, non-compliance, invalid test, etc.):

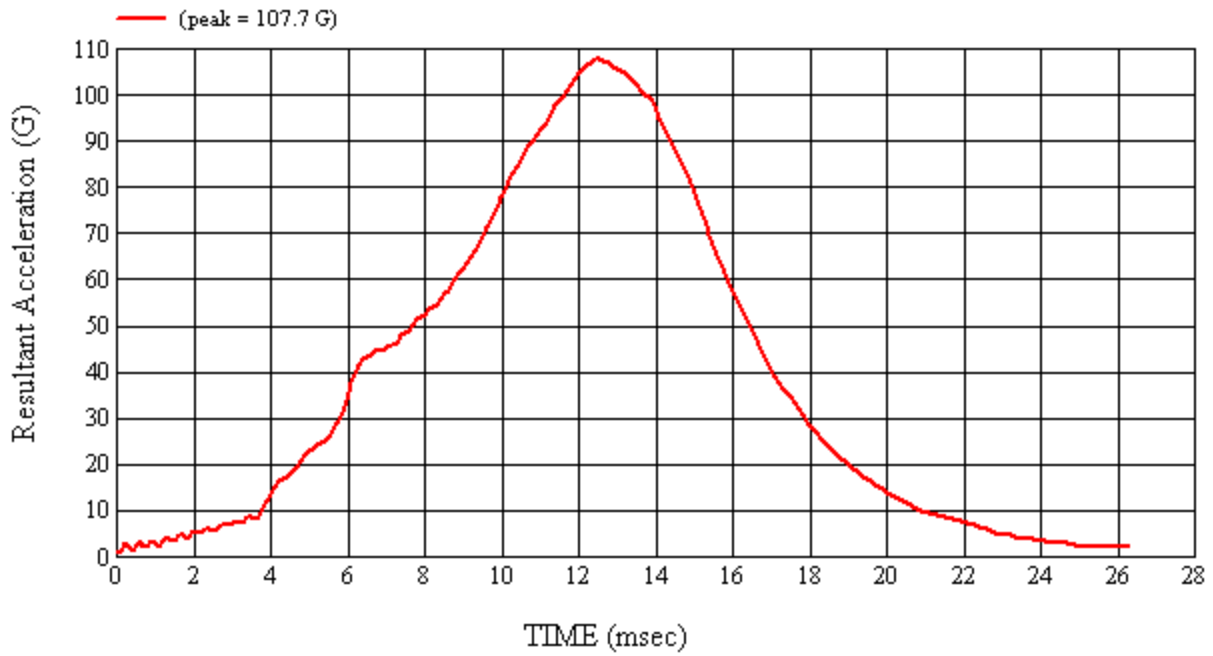
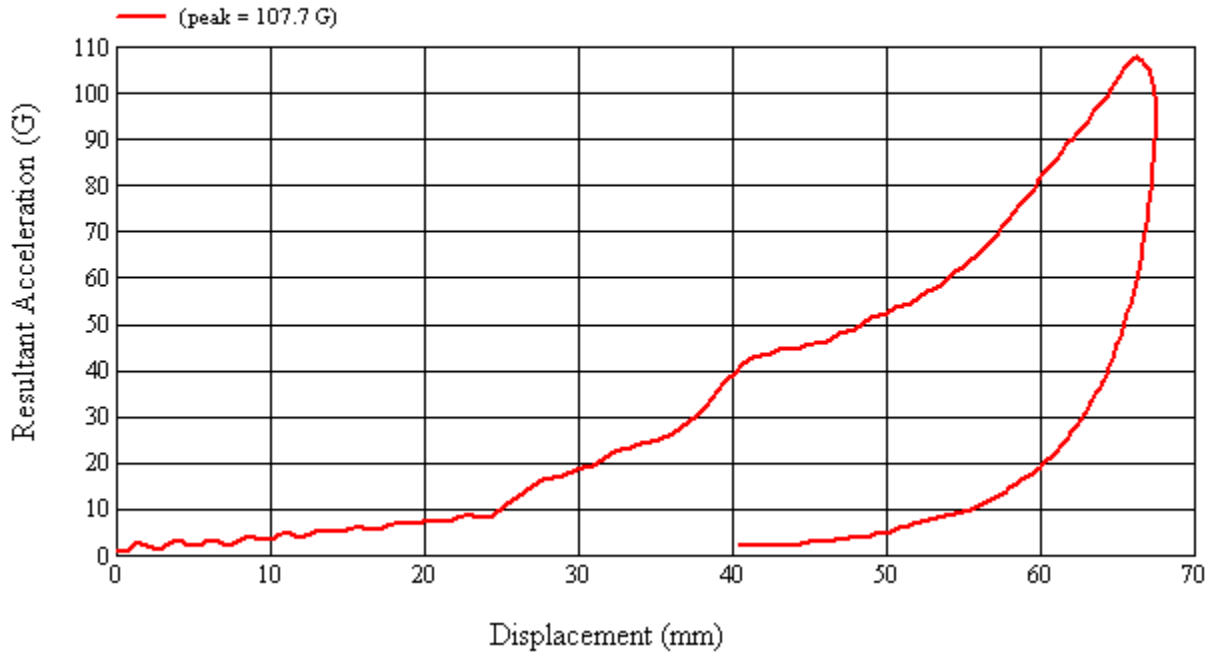
Grab handle compression, headliner deformation

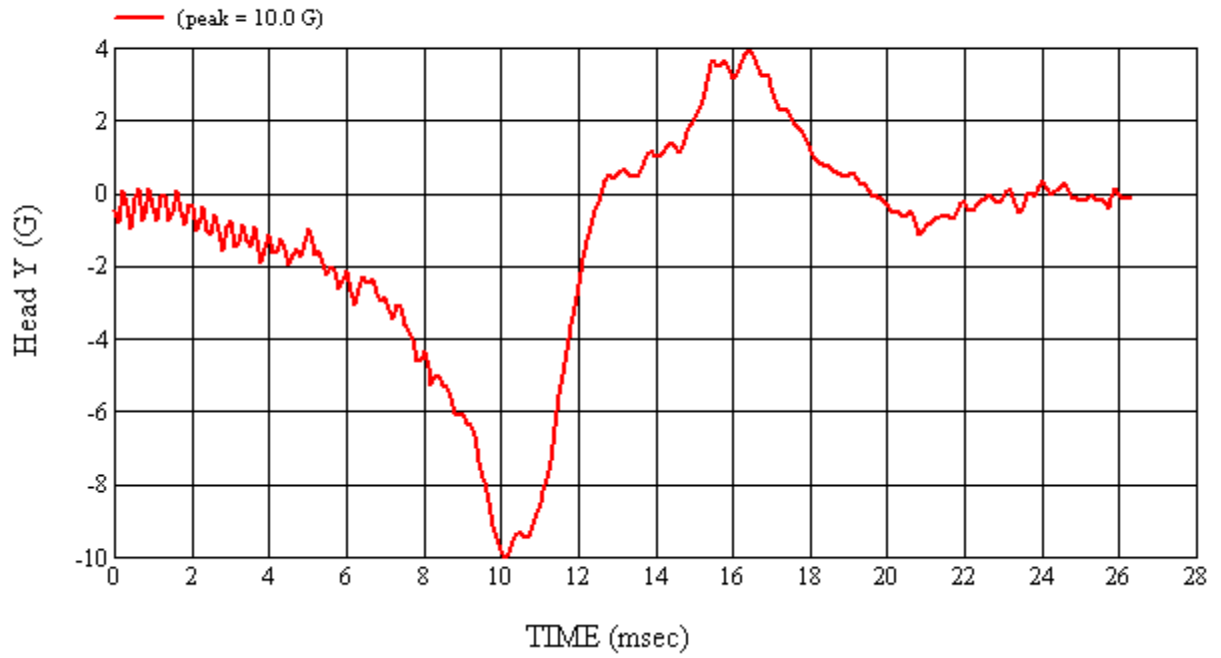
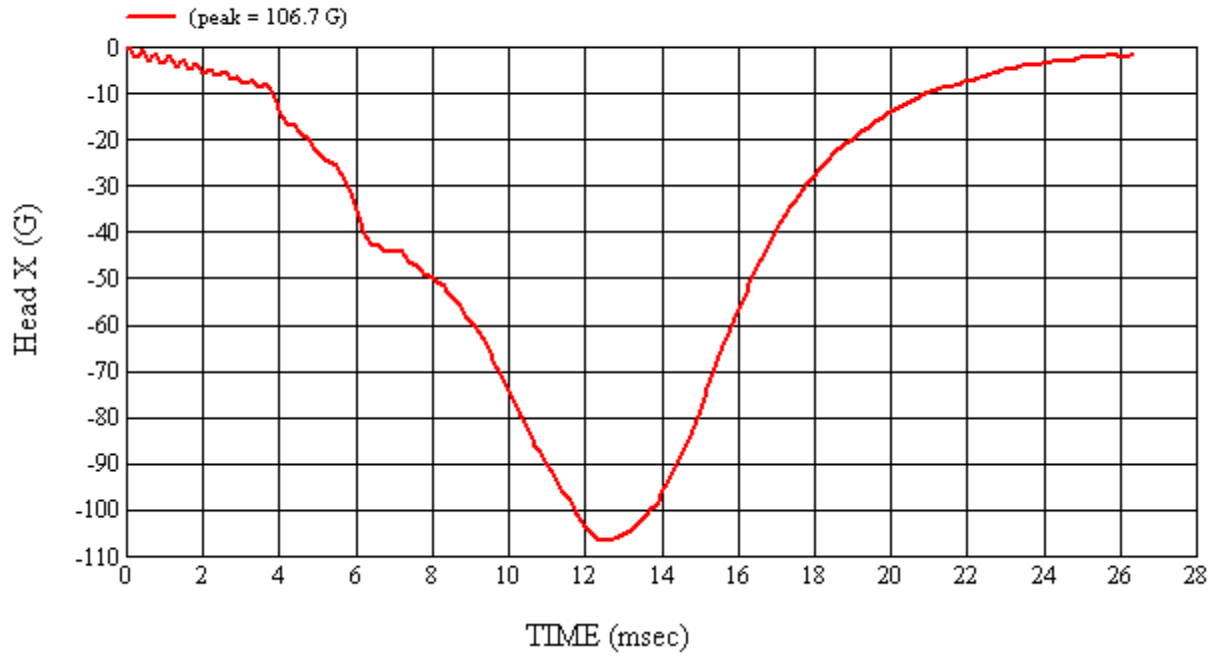
Recorded By:  Approved By*:  Date: 4/19/2010
*Only necessary for NHTSA (Government) Compliance testing.

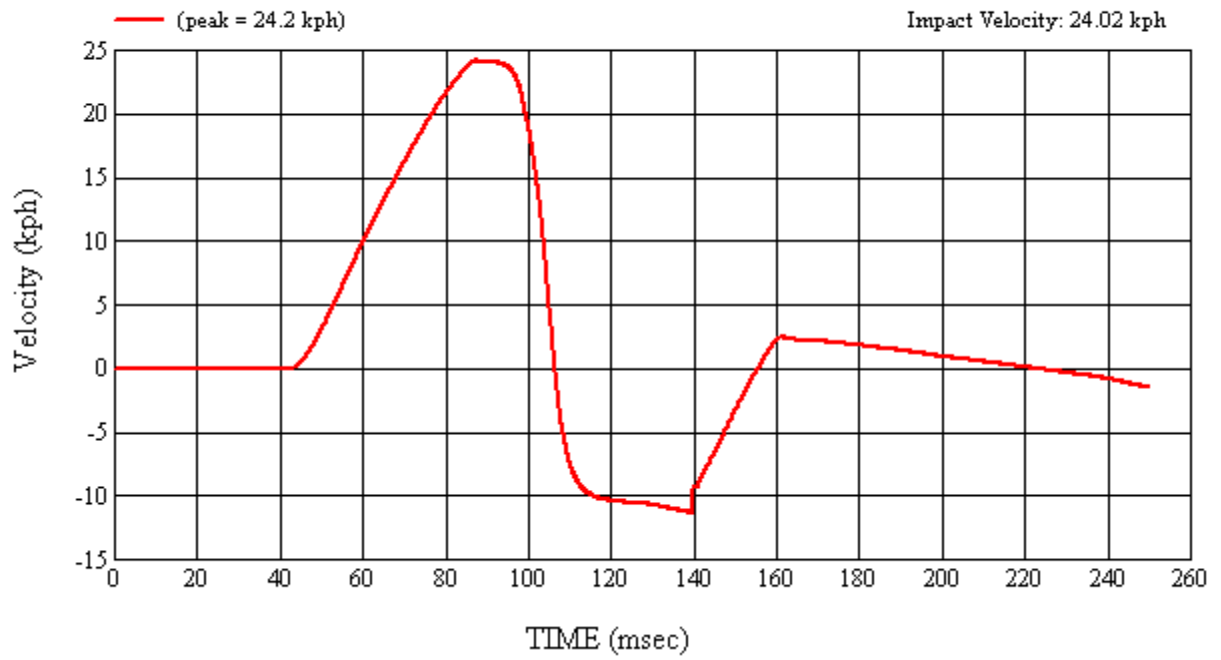
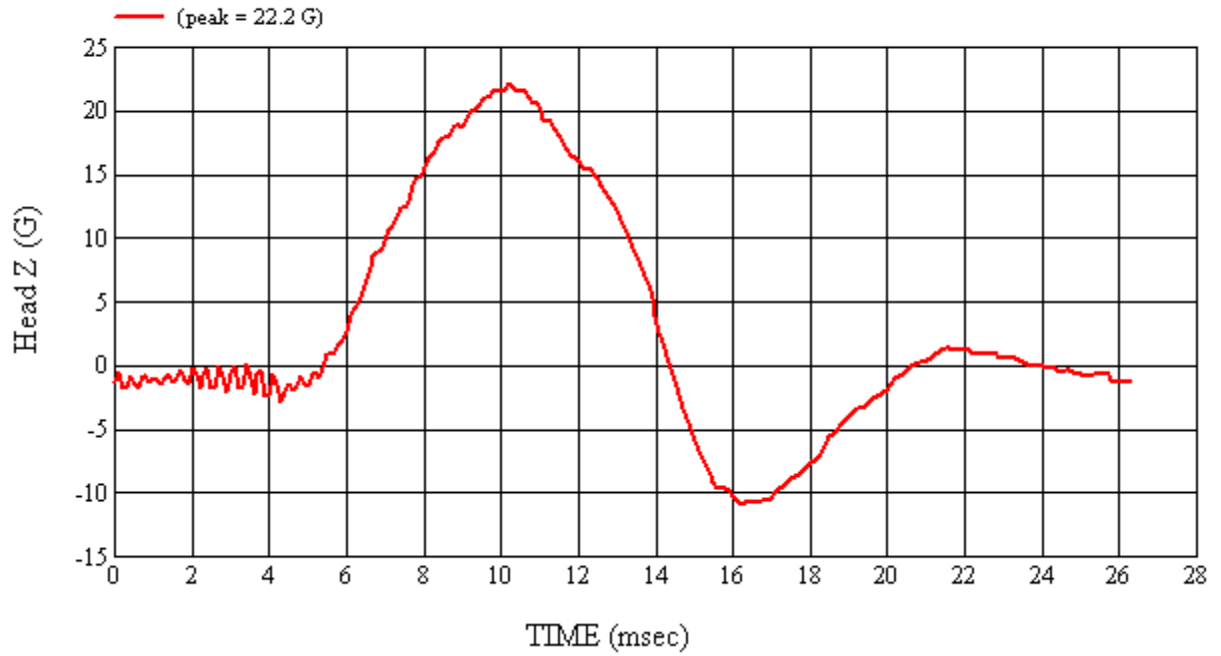
MGA Test #: U10081

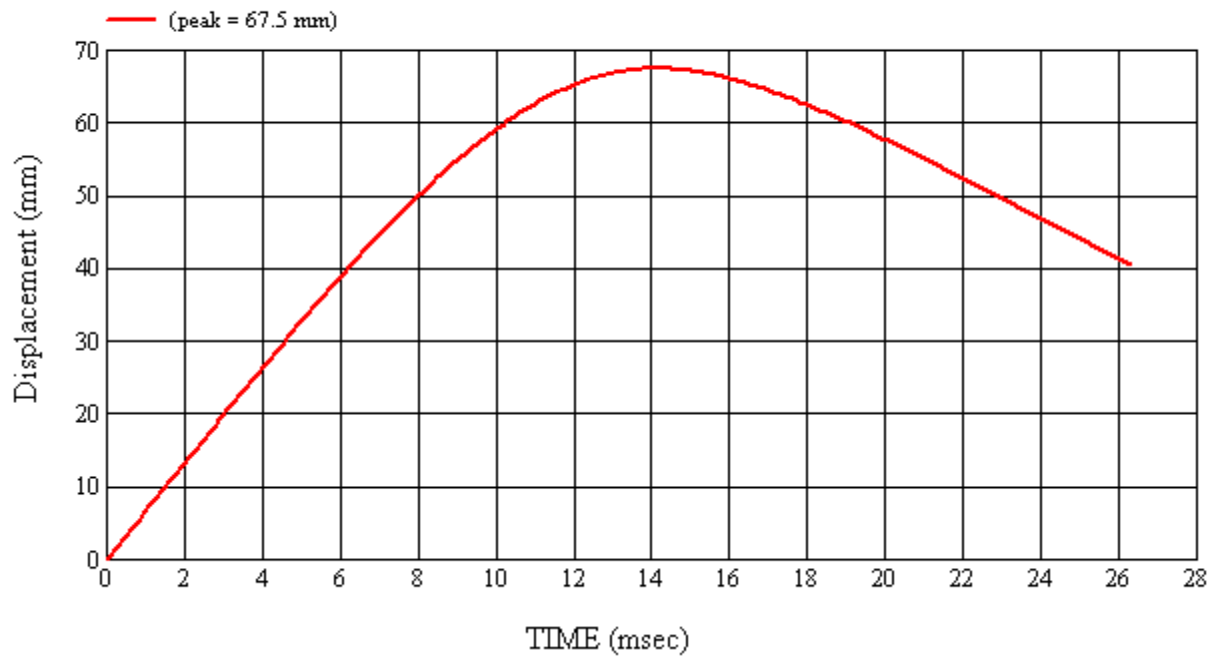
Target Location: UR1, Right Side

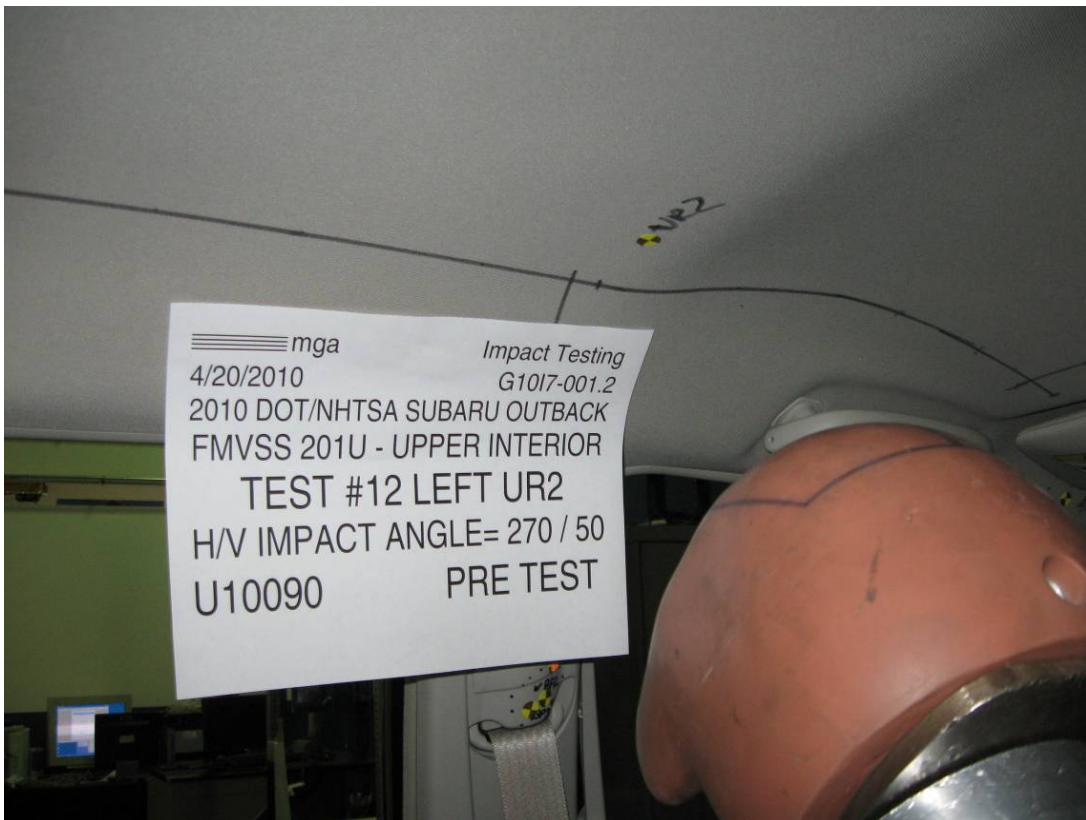
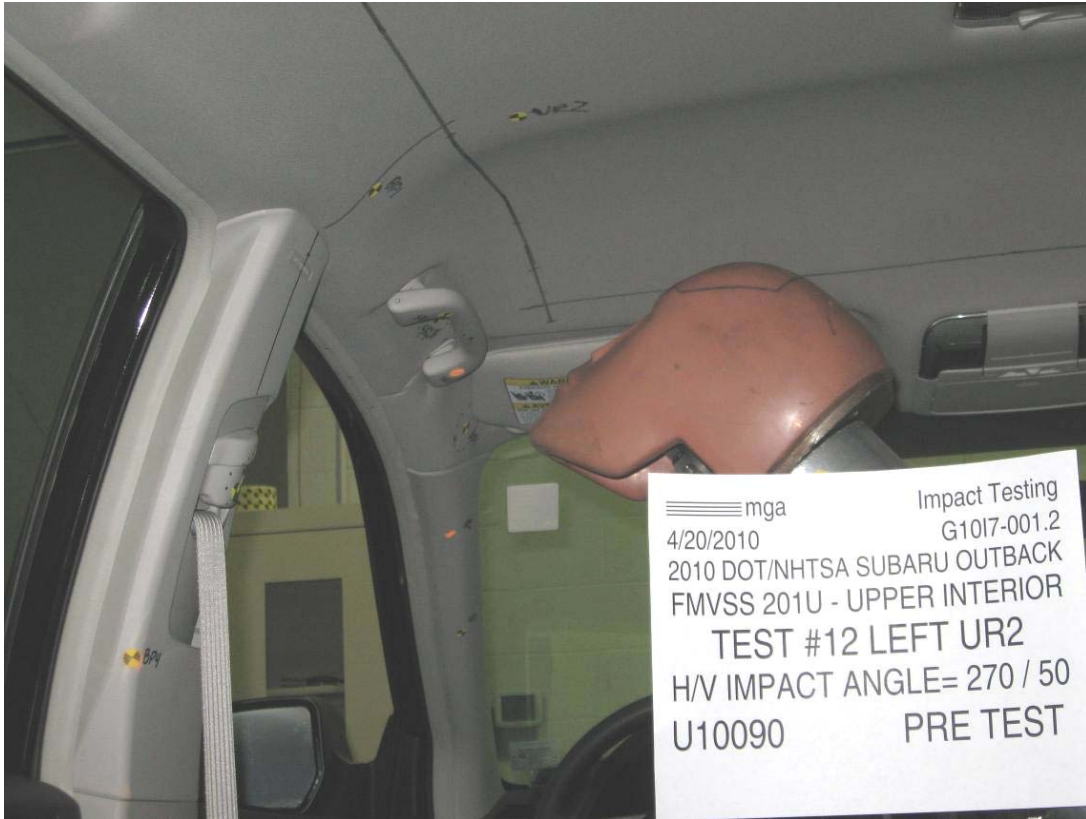
Test Date: 4/19/2010

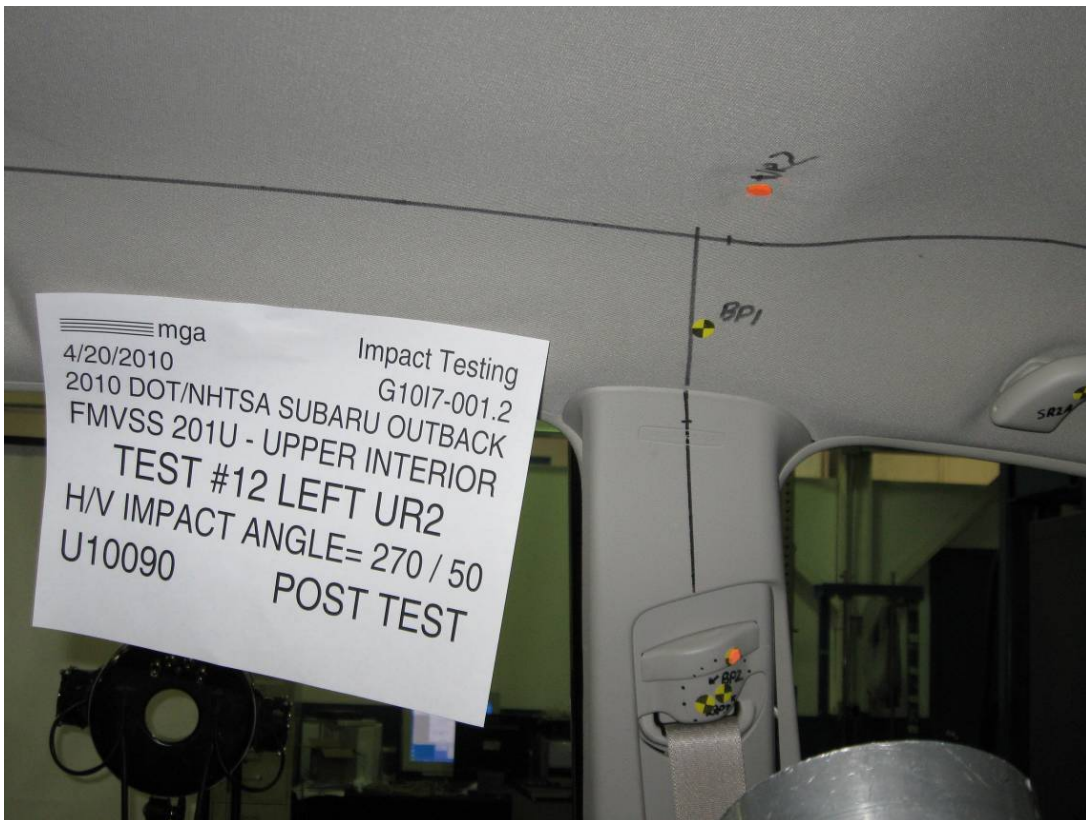


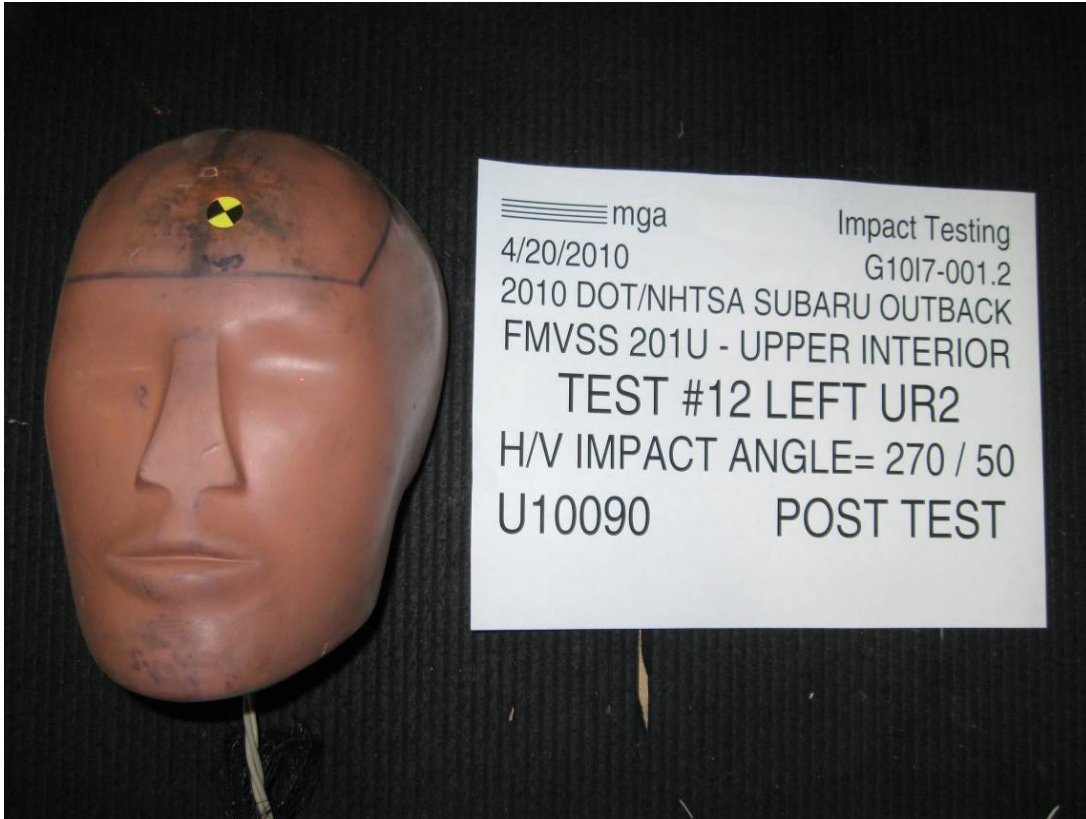












SUMMARY OF FMVSS 201U TEST

JOB/NHTSA NO: G10I7-001.2 VEHICLE YR/MAKE/MODEL:2010/DOT/NHTSA/Subaru Outback

GENERAL TEST PARAMETERS:

Target (Vehicle Side): UR2Left

MGA Test Reference No.:U10090

Approach Horizontal Angles:270°

Approach Vertical Angles:50°

Additional Description: At BP

Test Number:#12

Temperature:22.2C

Humidity:33.2%

Time of Test:2:16:10 PM

FMH Serial No:[037]

TEST RESULTS:

HIC(d)	HIC	Δt (msec)	Velocity (kph)	Impact location on FMH (mm)	
				Above Pt. O	Left/Right Pt. O
549	507	9.6	23.6	24	4 Left

INSTRUMENTATION INFORMATION: (all accelerometers are Endevco 7264-2000)

Axis	Channel	Serial No.	DLR Value	ΔV Pre-Test	ΔV Post-Test
X	5	AHTB2	-116.9	1.06	1.06
Y	6	J14103	94.2	0.85	0.85
Z	7	J35800	98.2	0.94	0.94

REMARKS (Summary of test, damage, non-compliance, invalid test, etc.):

Headliner deformation

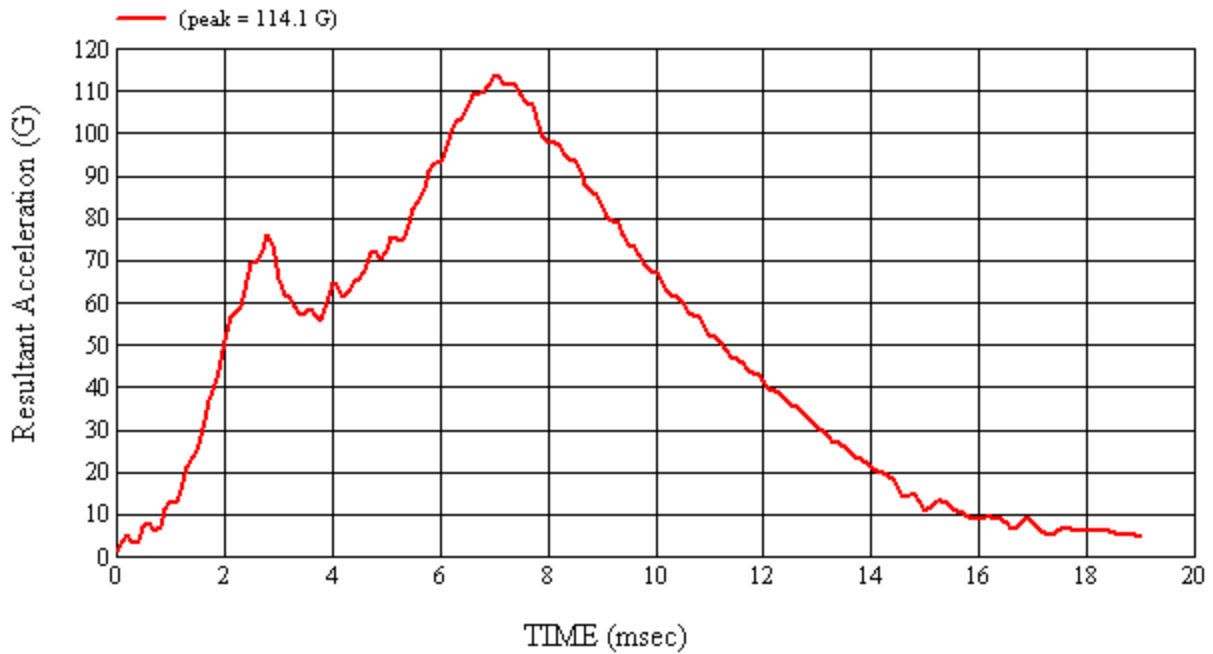
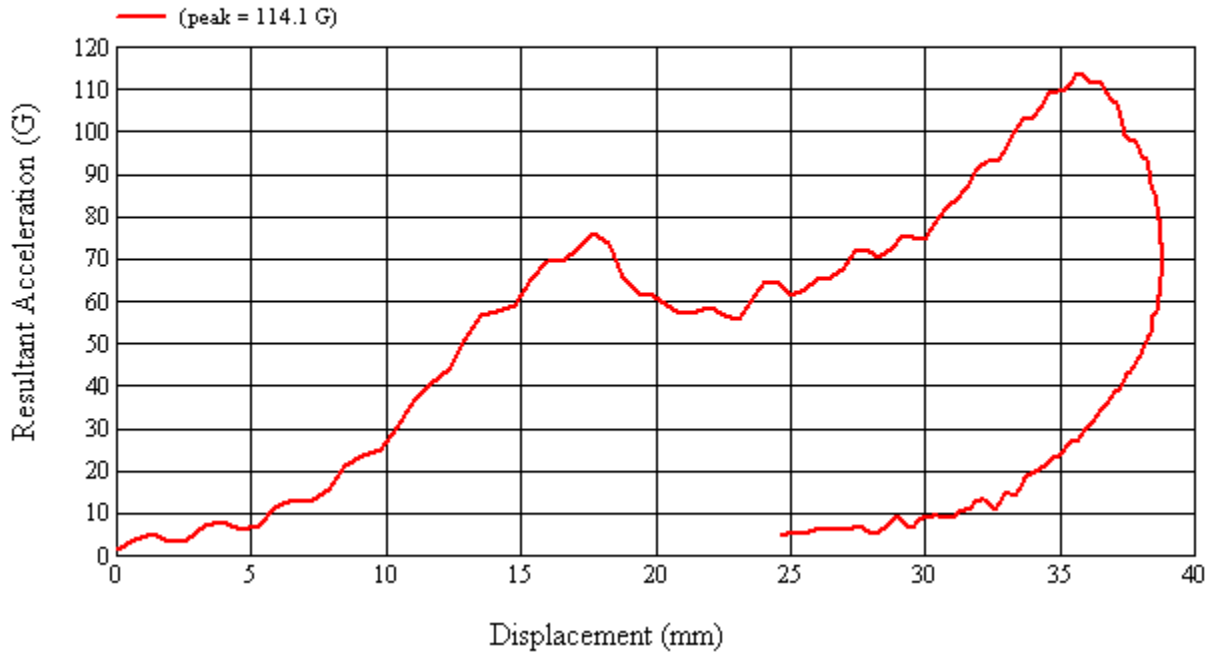
Recorded By: *Matthew H. K.* Approved By*: *Aileen A. Kalato* Date: 4/20/2010

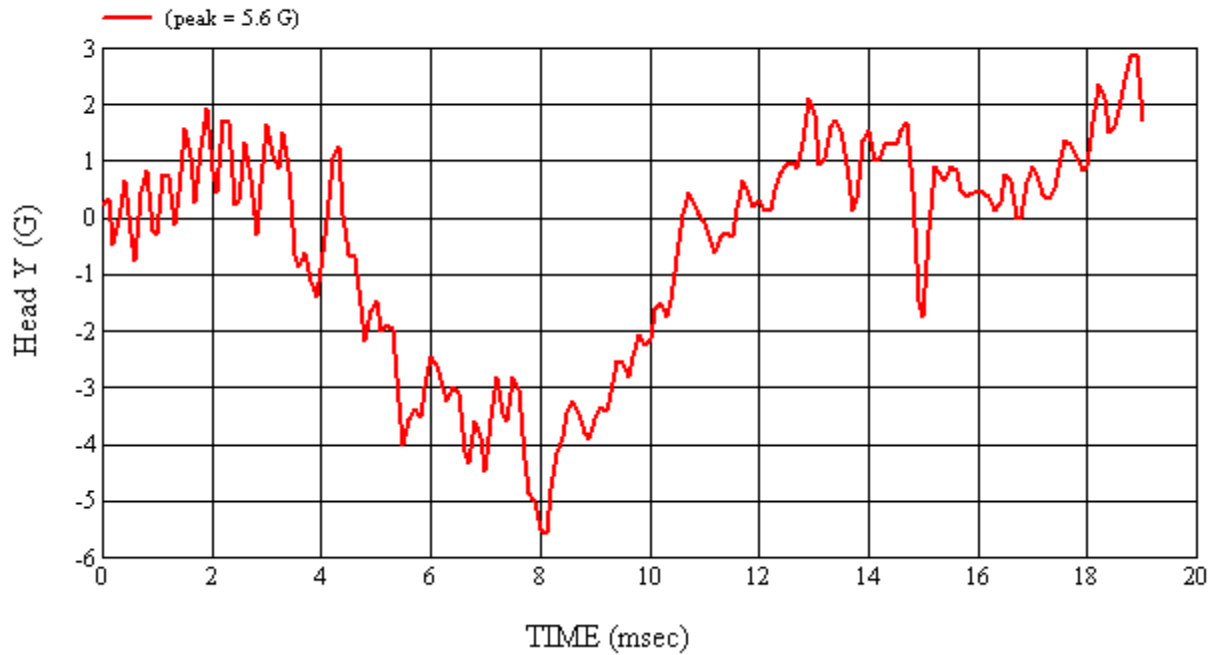
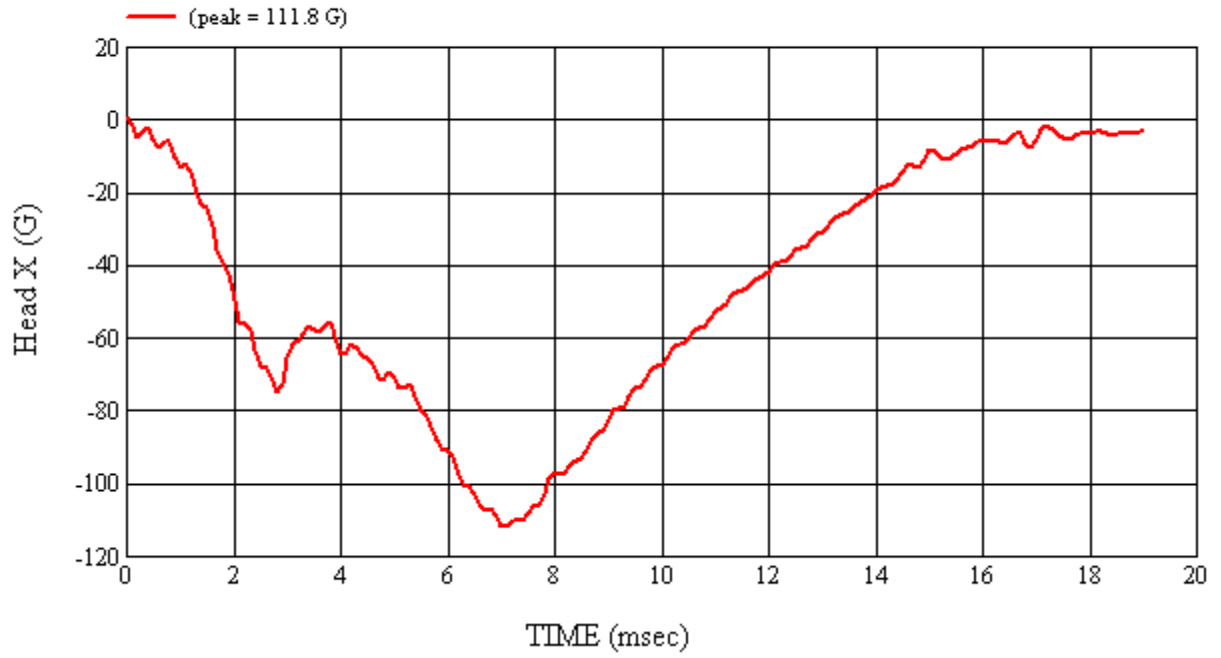
*Only necessary for NHTSA (Government) Compliance testing.

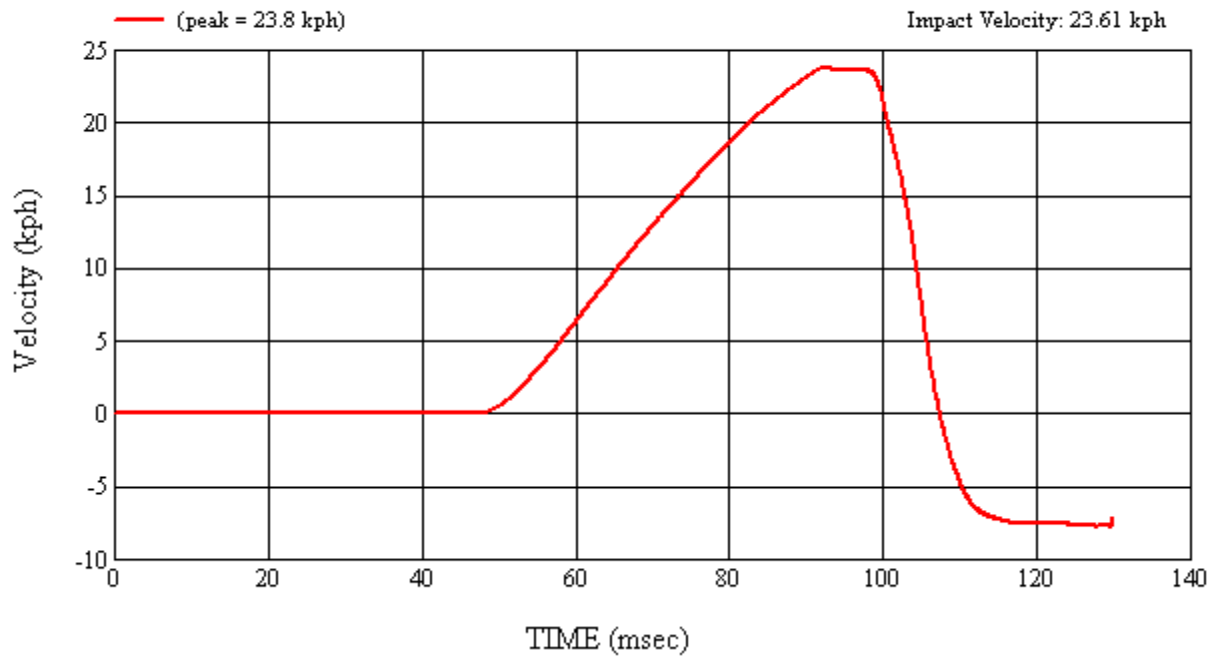
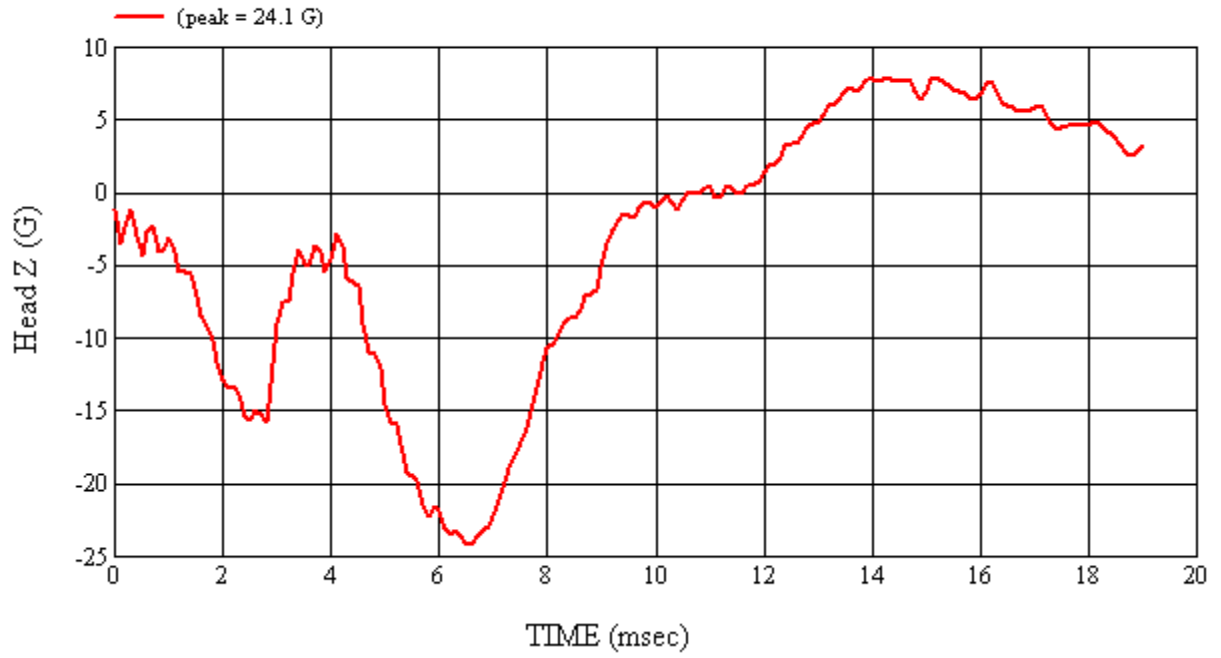
MGA Test #: U10090

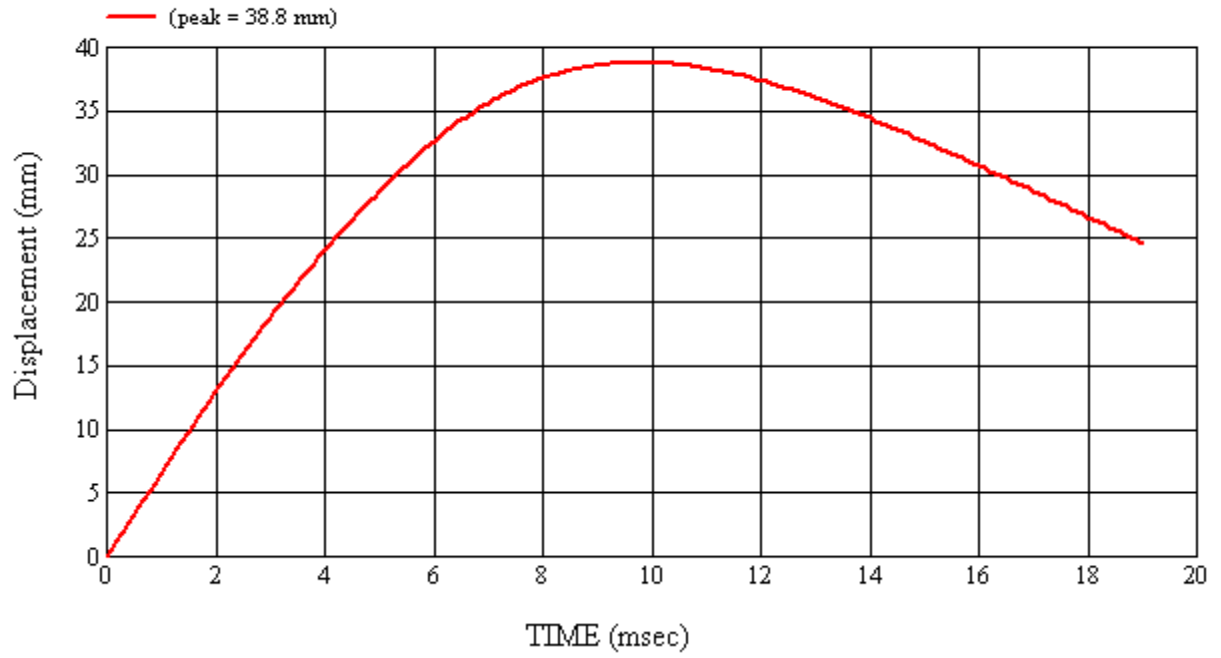
Target Location: UR2, Left Side

Test Date: 4/20/2010











SUMMARY OF FMVSS 201U TEST

JOB/NHTSA NO: G10I7-001.2 VEHICLE YR/MAKE/MODEL:2010/DOT/NHTSA/Subaru Outback

GENERAL TEST PARAMETERS:

Test Number:#9

Target (Vehicle Side): UR4Left

Temperature:21.0C

MGA Test Reference No.:U10087

Humidity:35.1%

Approach Horizontal Angles:270°

Time of Test:9:48:17 AM

Approach Vertical Angles:50°

FMH Serial No:[037]

Additional Description:At SR3-1

TEST RESULTS:

HIC(d)	HIC	Δt (msec)	Velocity (kph)	Impact location on FMH (mm)	
				Above Pt. O	Left/Right Pt. O
533	486	10.1	23.8	35	6 Left

INSTRUMENTATION INFORMATION: (all accelerometers are Endevco 7264-2000)

Axis	Channel	Serial No.	DLR Value	ΔV Pre-Test	ΔV Post-Test
X	5	AHTB2	-116.9	1.06	1.06
Y	6	J14103	94.2	0.85	0.85
Z	7	J35800	98.2	0.94	0.94

REMARKS (Summary of test, damage, non-compliance, invalid test, etc.):

Headliner deformation, grab handle compression

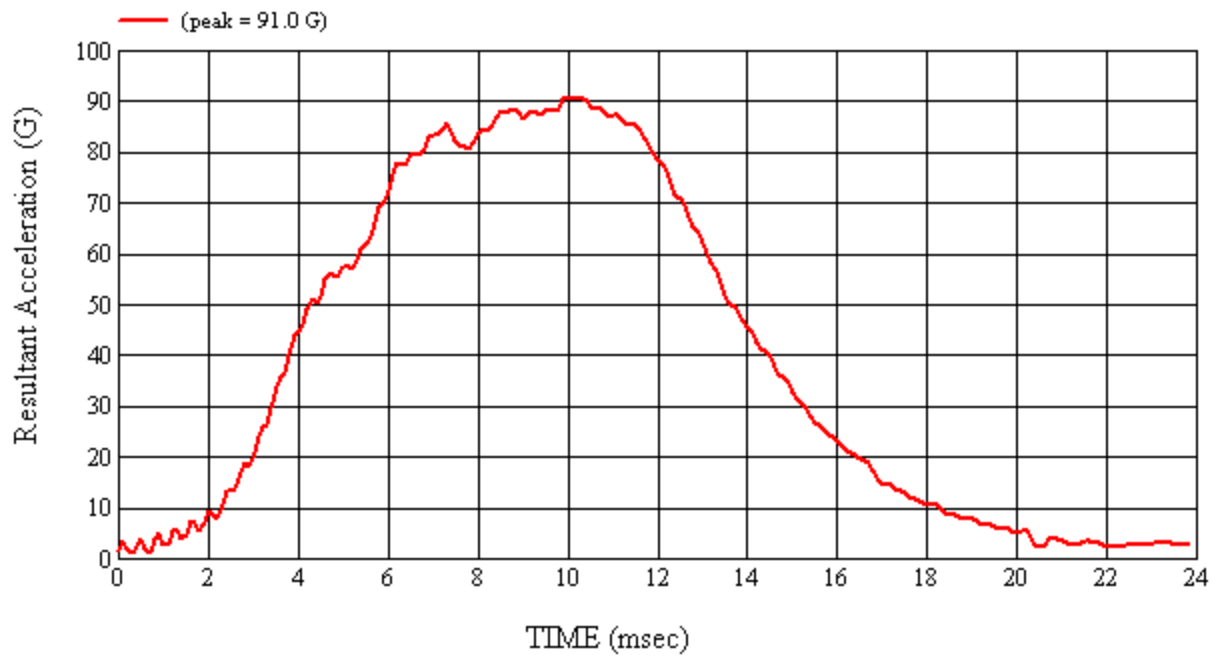
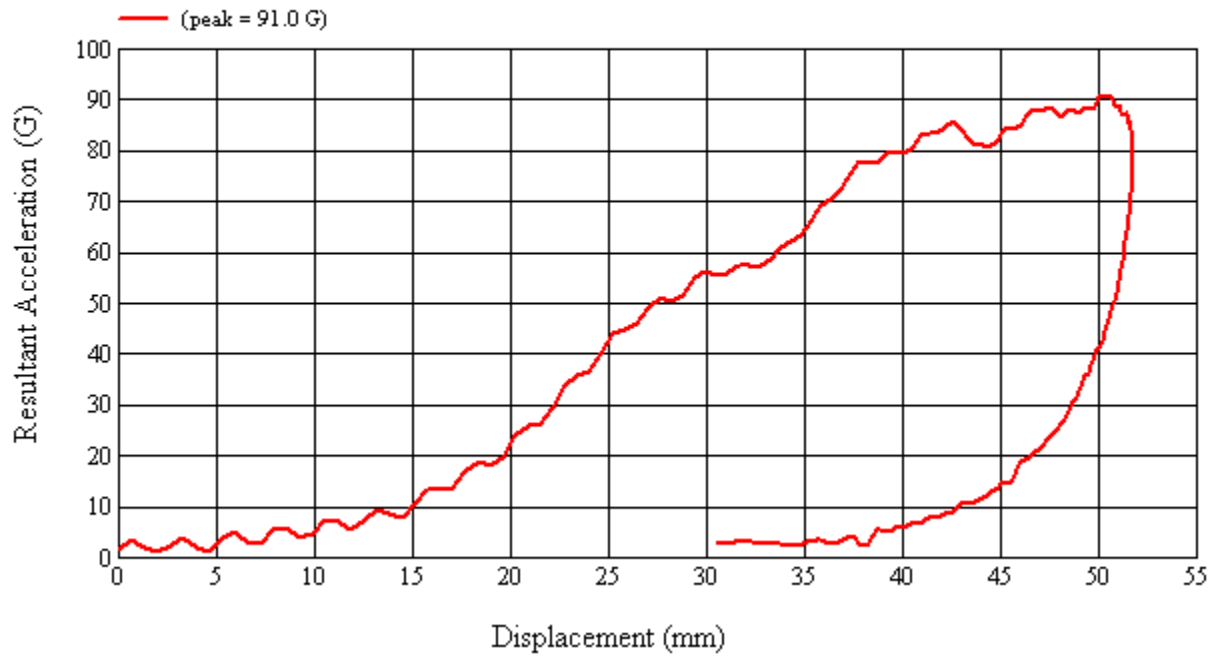
Recorded By:  Approved By*:  Date: 4/20/2010

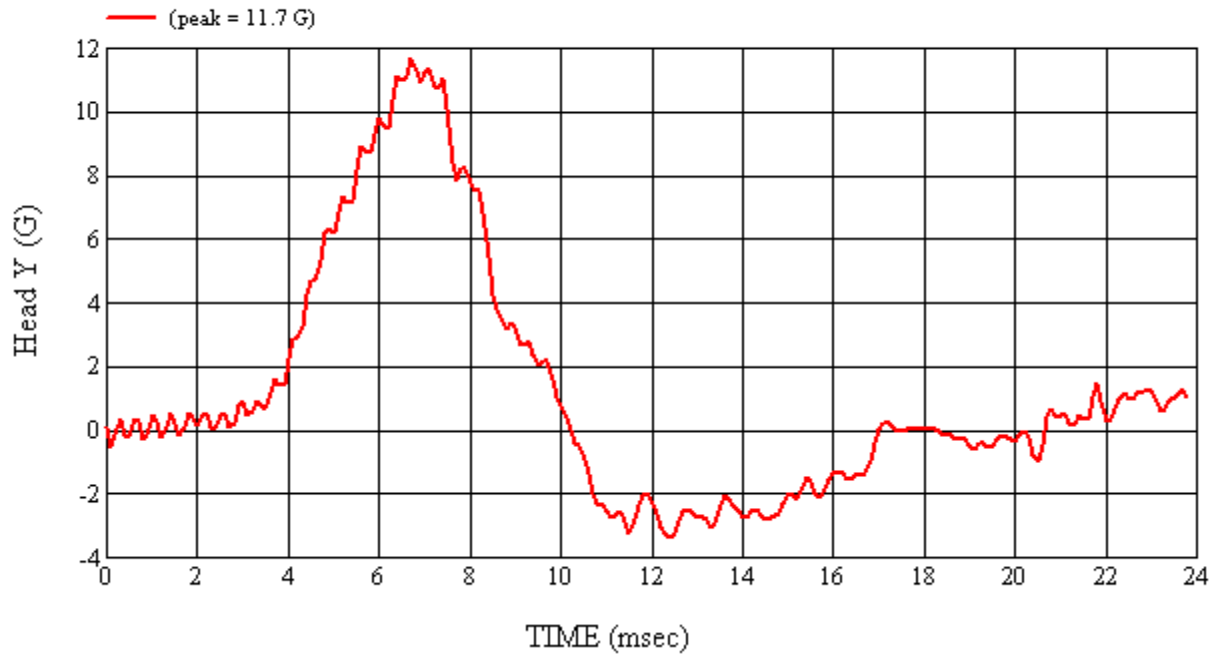
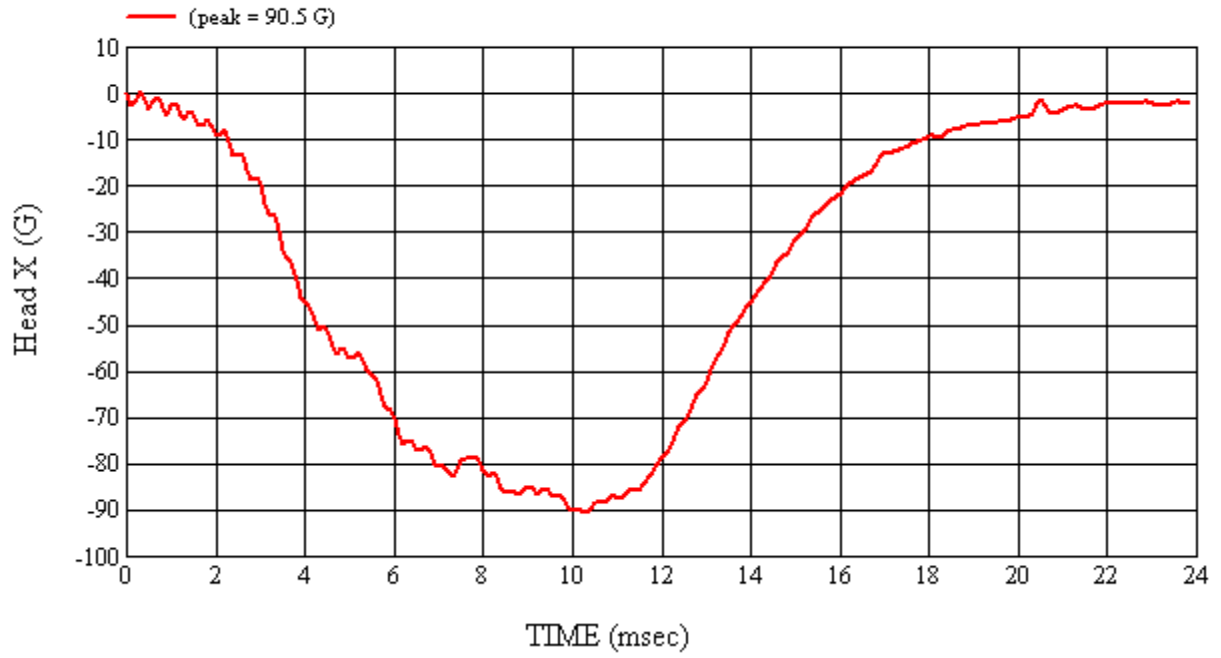
*Only necessary for NHTSA (Government) Compliance testing.

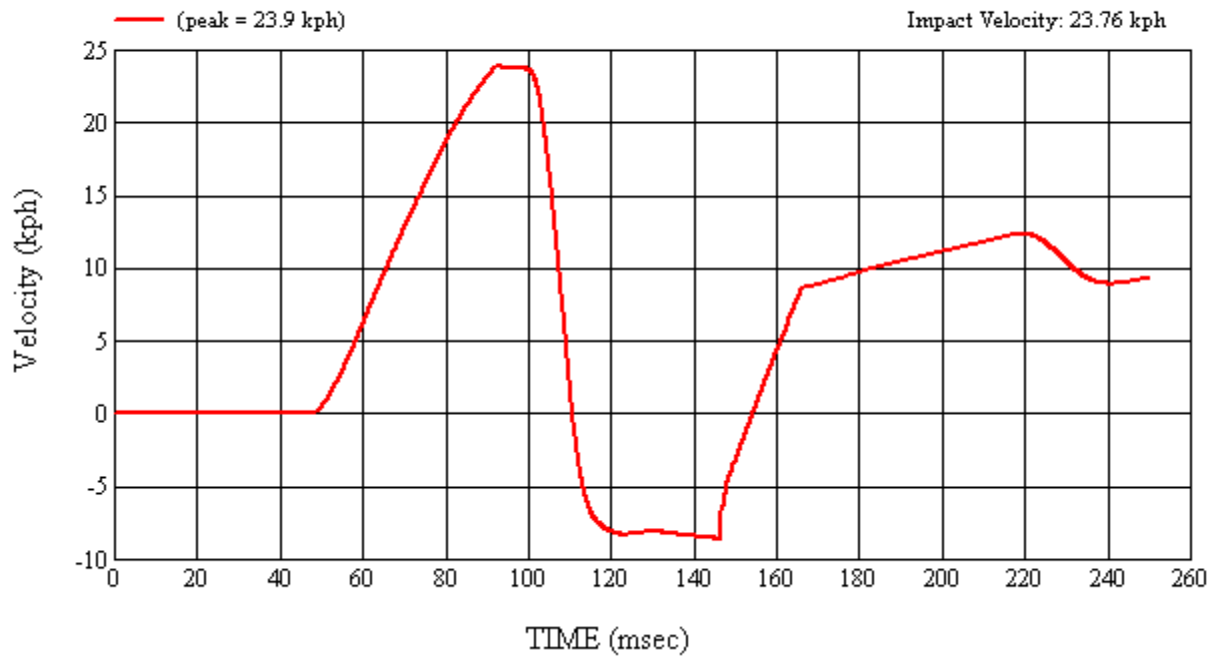
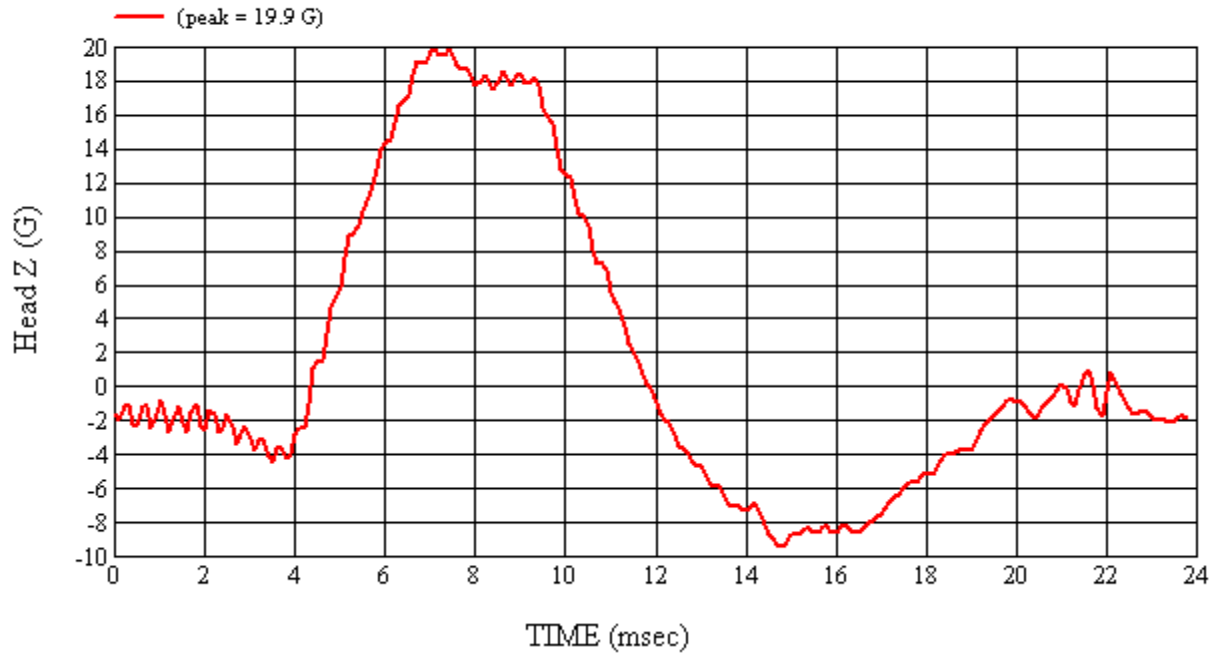
MGA Test #: U10087

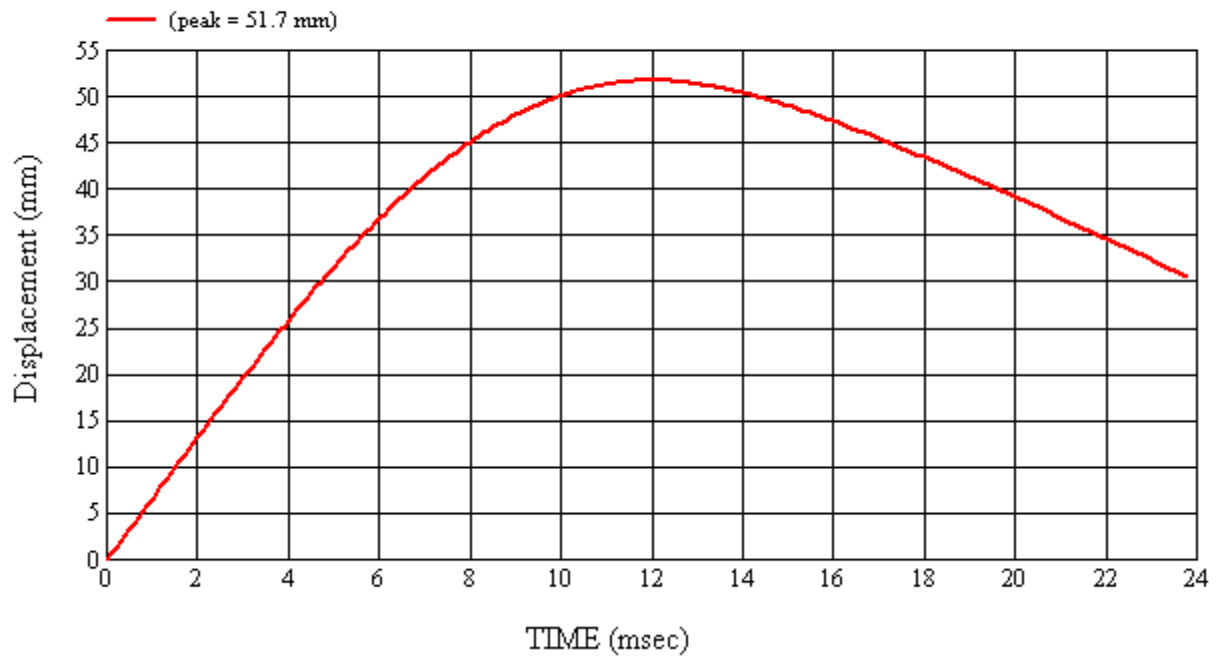
Target Location: UR4, Left Side

Test Date: 4/20/2010

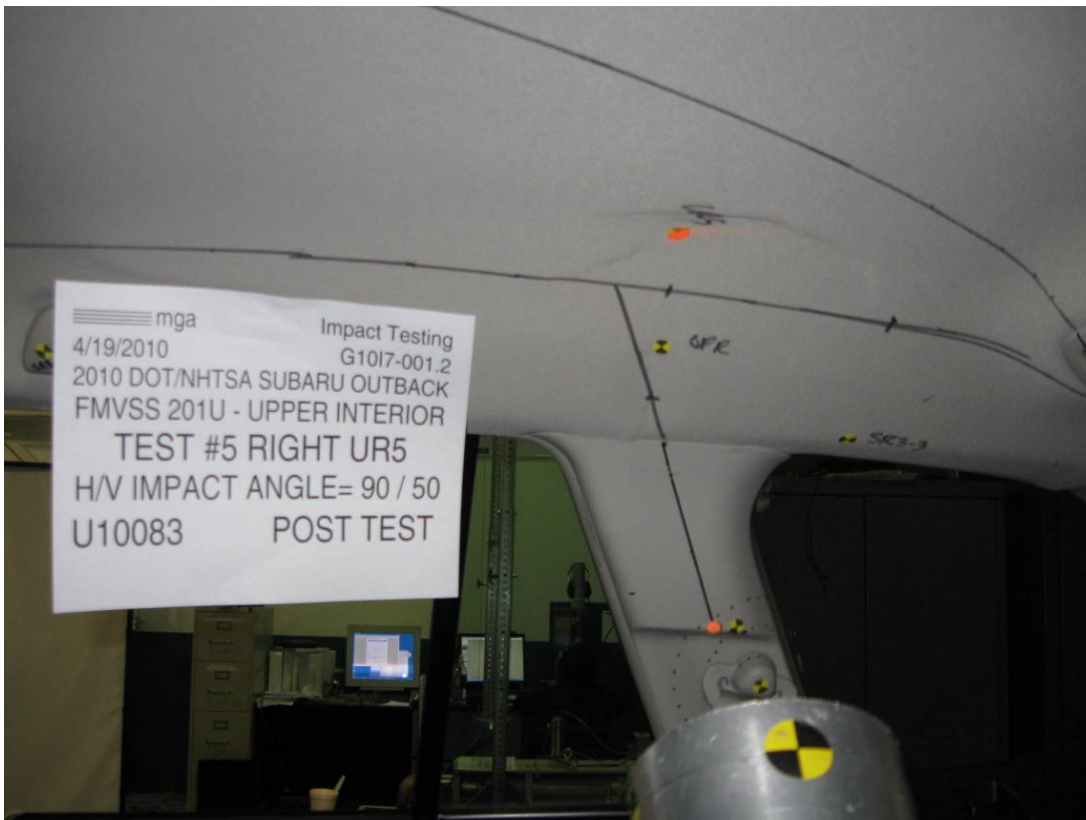
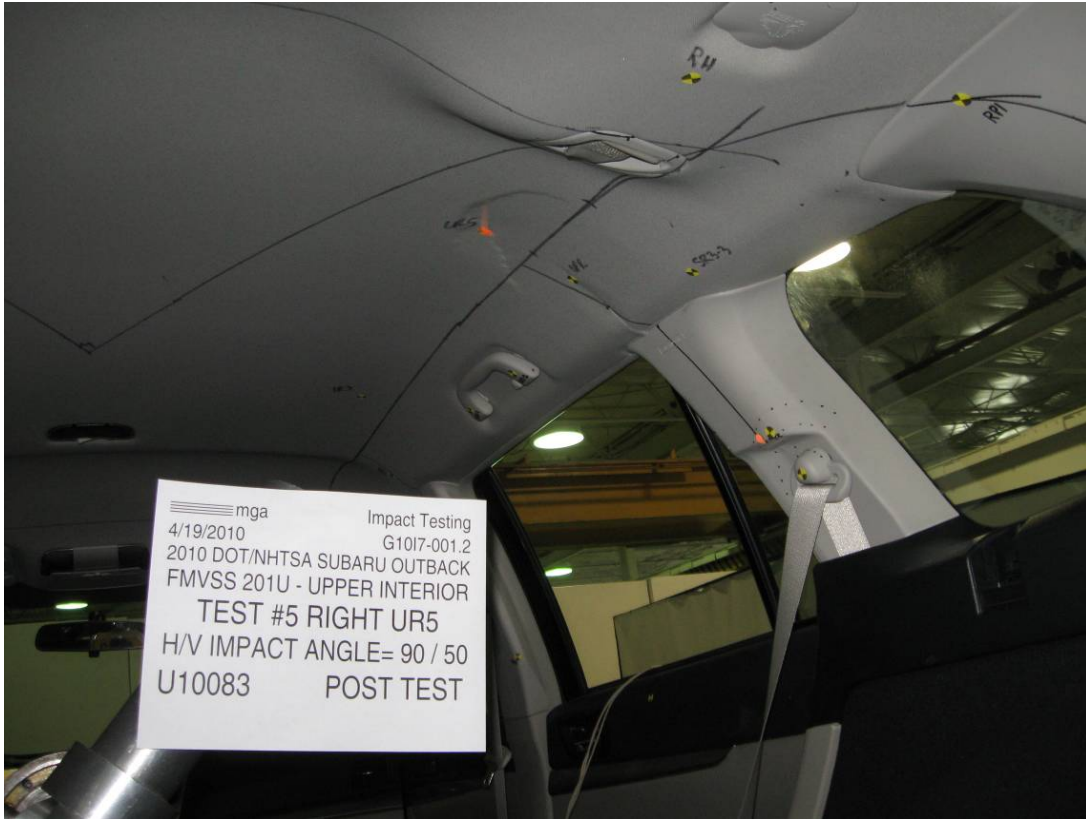


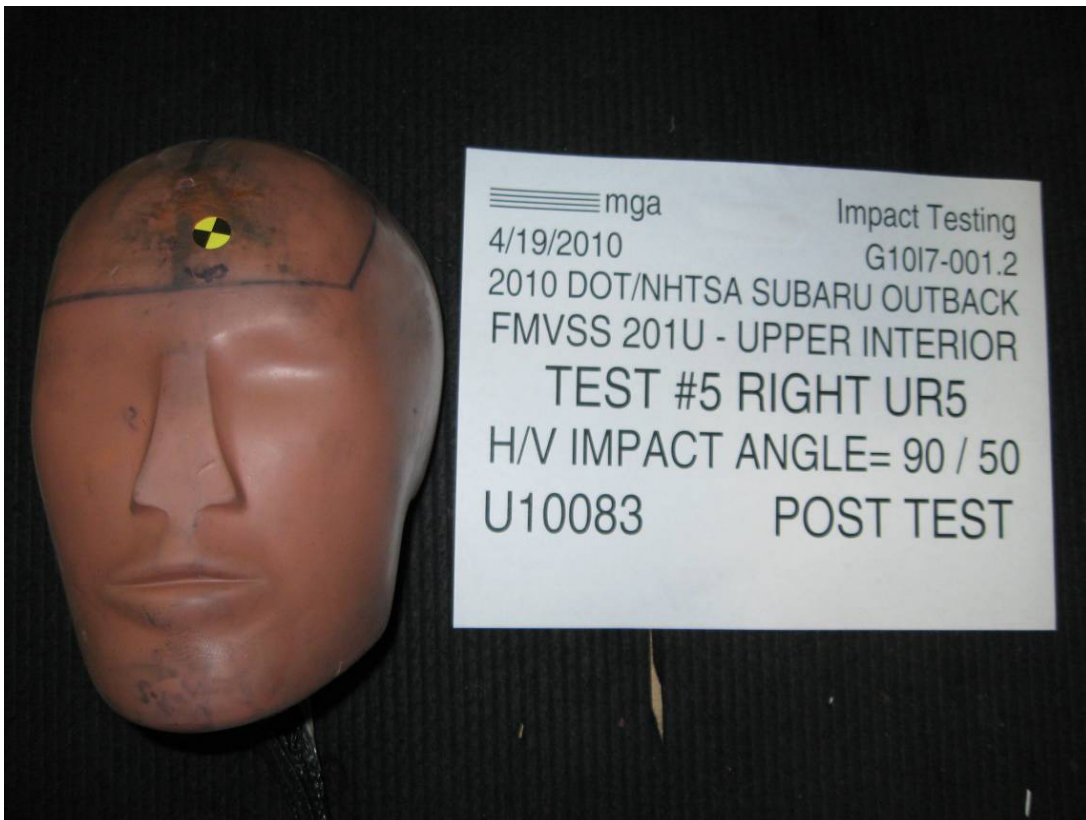
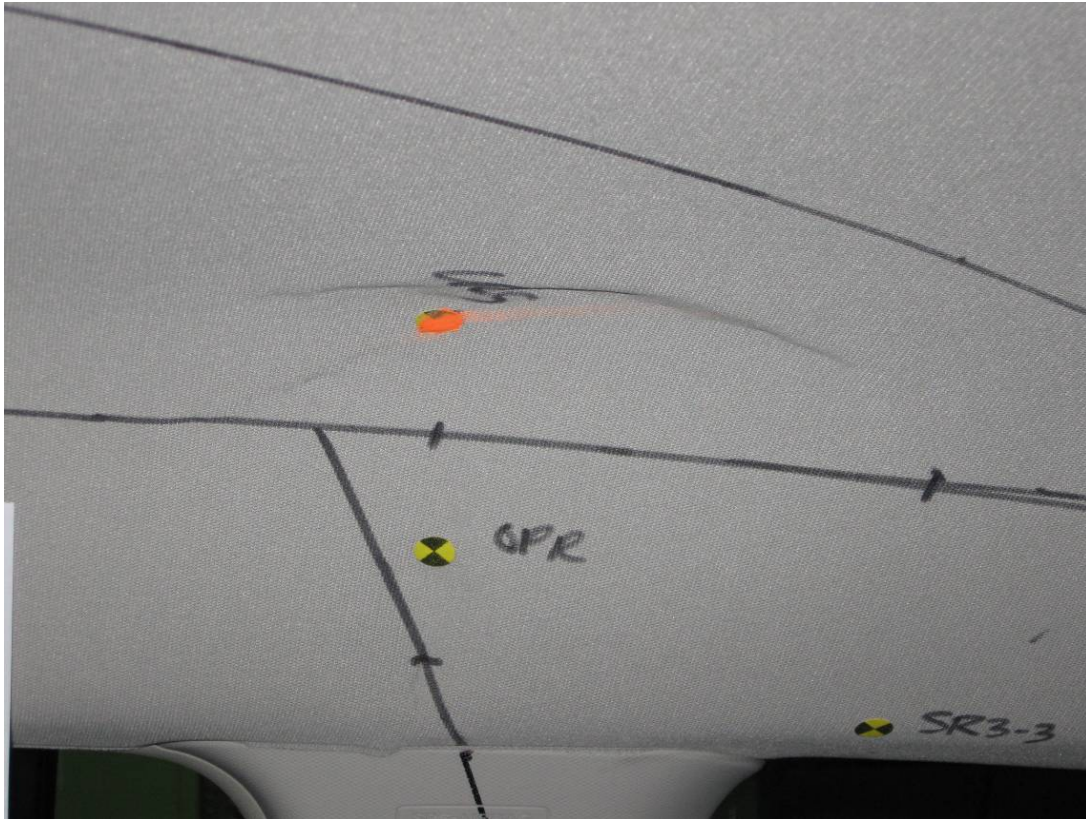












SUMMARY OF FMVSS 201U TEST

JOB/NHTSA NO: G10I7-001.2 VEHICLE YR/MAKE/MODEL:2010/DOT/NHTSA/Subaru Outback

GENERAL TEST PARAMETERS:

Target (Vehicle Side): UR5Right

MGA Test Reference No.:U10083

Approach Horizontal Angles:90°

Approach Vertical Angles:50°

Additional Description:At OP

Test Number:#5

Temperature:22.5C

Humidity:35.2%

Time of Test:1:42:53 PM

FMH Serial No:[037]

TEST RESULTS:

HIC(d)	HIC	Δt (msec)	Velocity (kph)	Impact location on FMH (mm)	
				Above Pt. O	Left/Right Pt. O
419	335	9.8	23.5	20	6 Left

INSTRUMENTATION INFORMATION: (all accelerometers are Endevco 7264-2000)

Axis	Channel	Serial No.	DLR Value	ΔV Pre-Test	ΔV Post-Test
X	5	AHTB2	-116.9	1.06	1.06
Y	6	J14103	94.2	0.85	0.85
Z	7	J35800	98.2	0.94	0.94

REMARKS (Summary of test, damage, non-compliance, invalid test, etc.):

Headliner deformation

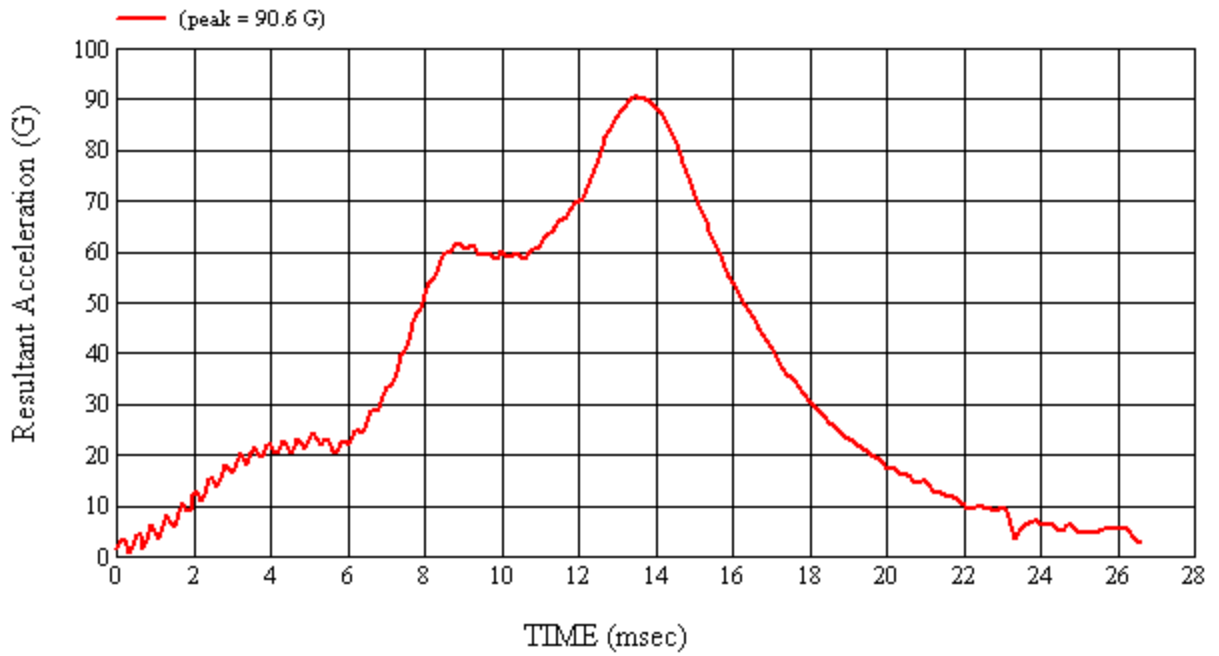
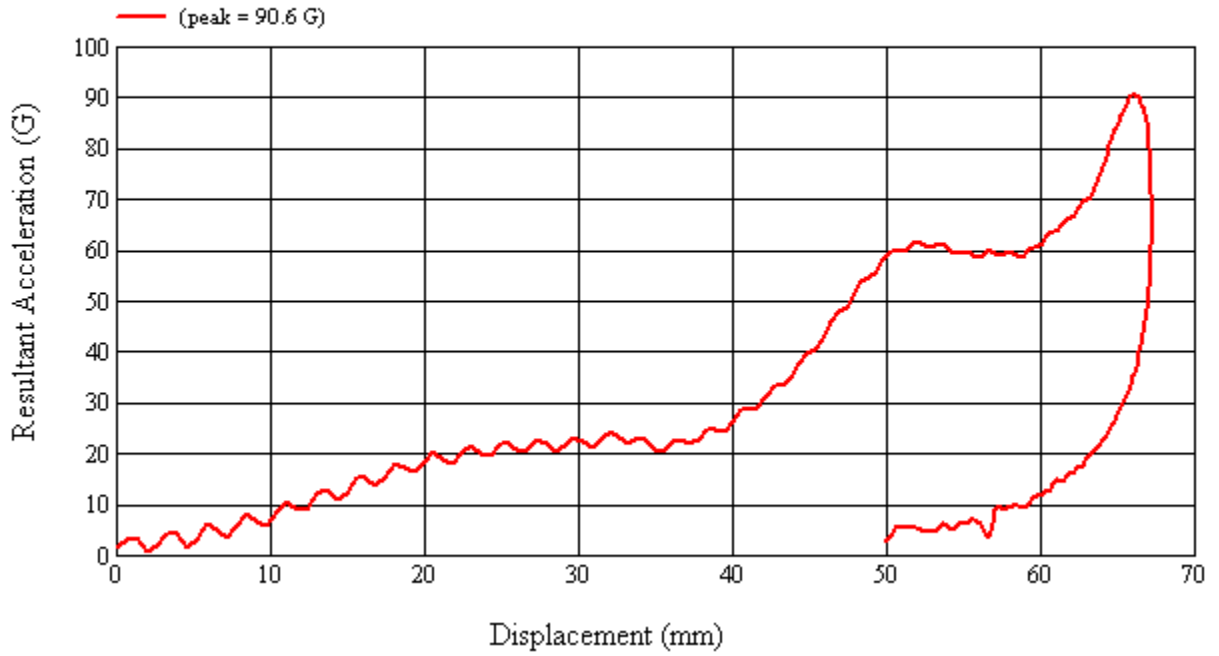
Recorded By: *Matthew H. K.* Approved By*: *Aileen A. Kalato* Date: 4/19/2010

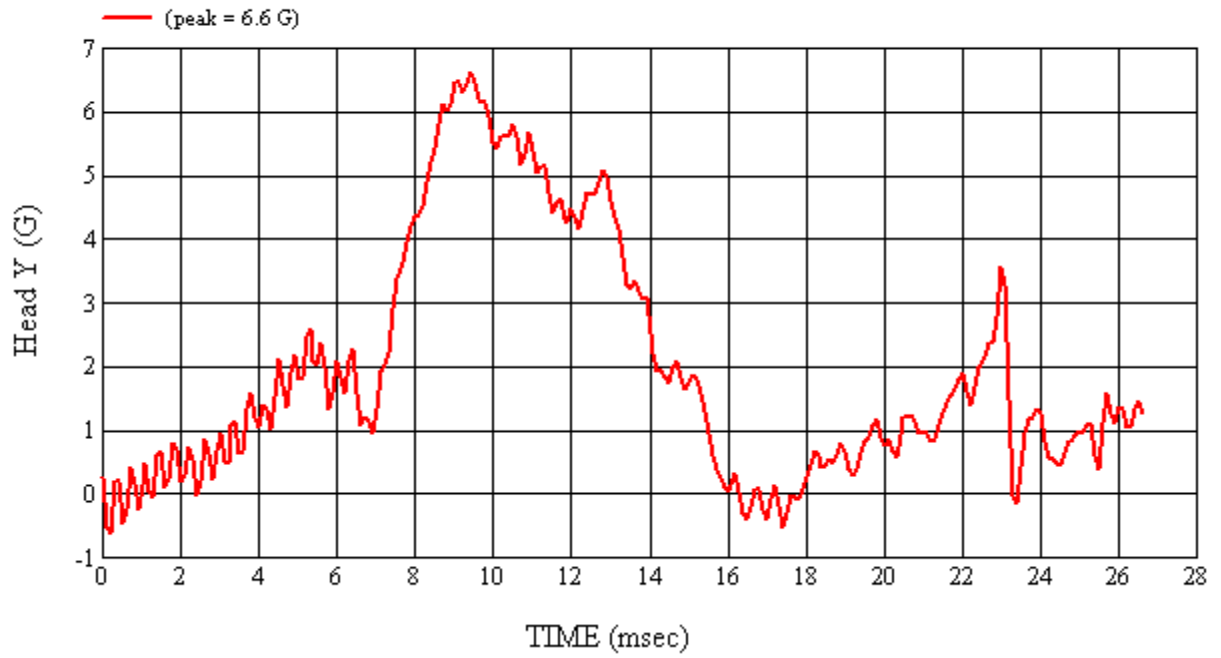
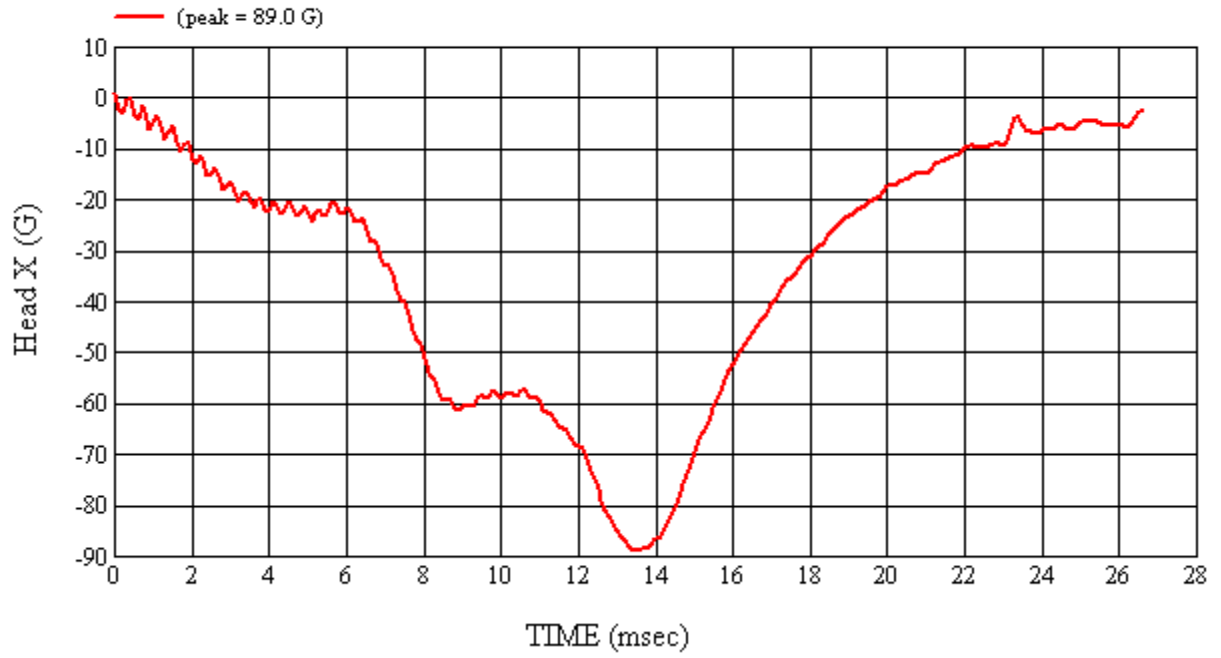
*Only necessary for NHTSA (Government) Compliance testing.

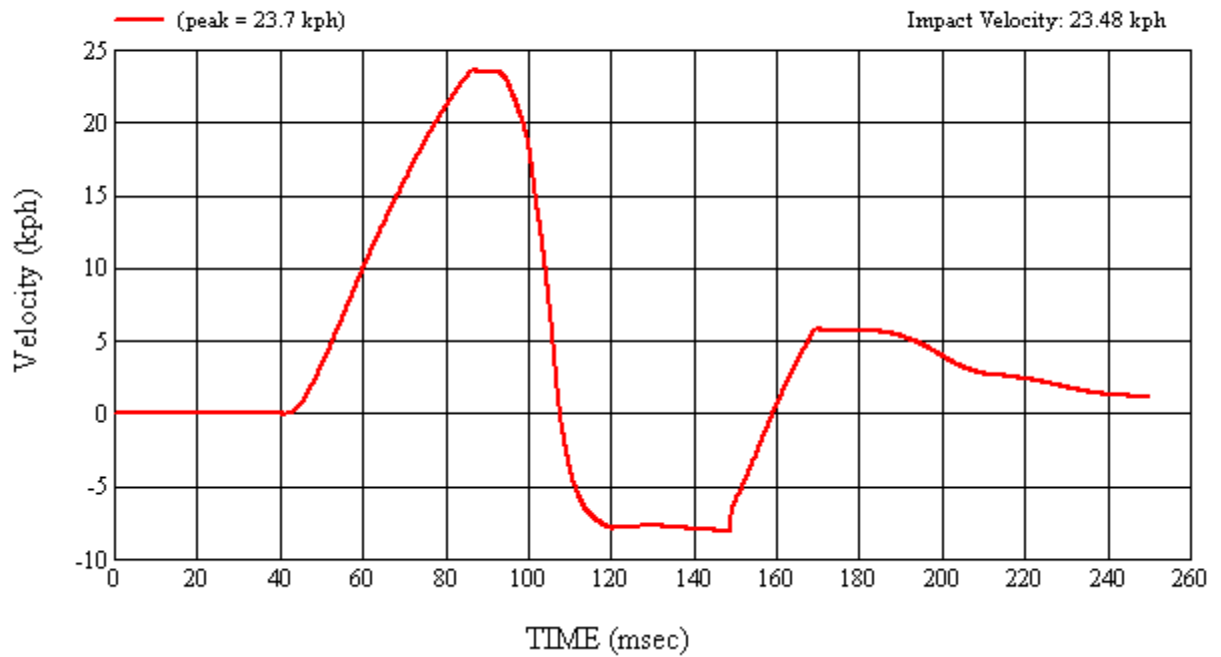
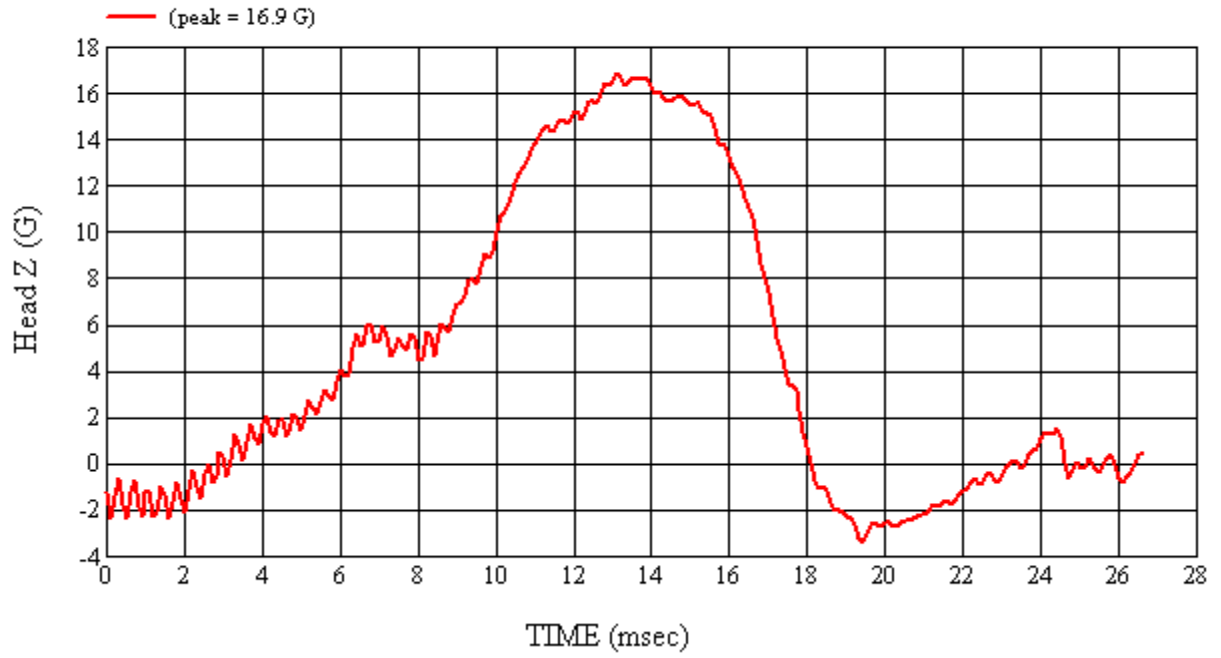
MGA Test #: U10083

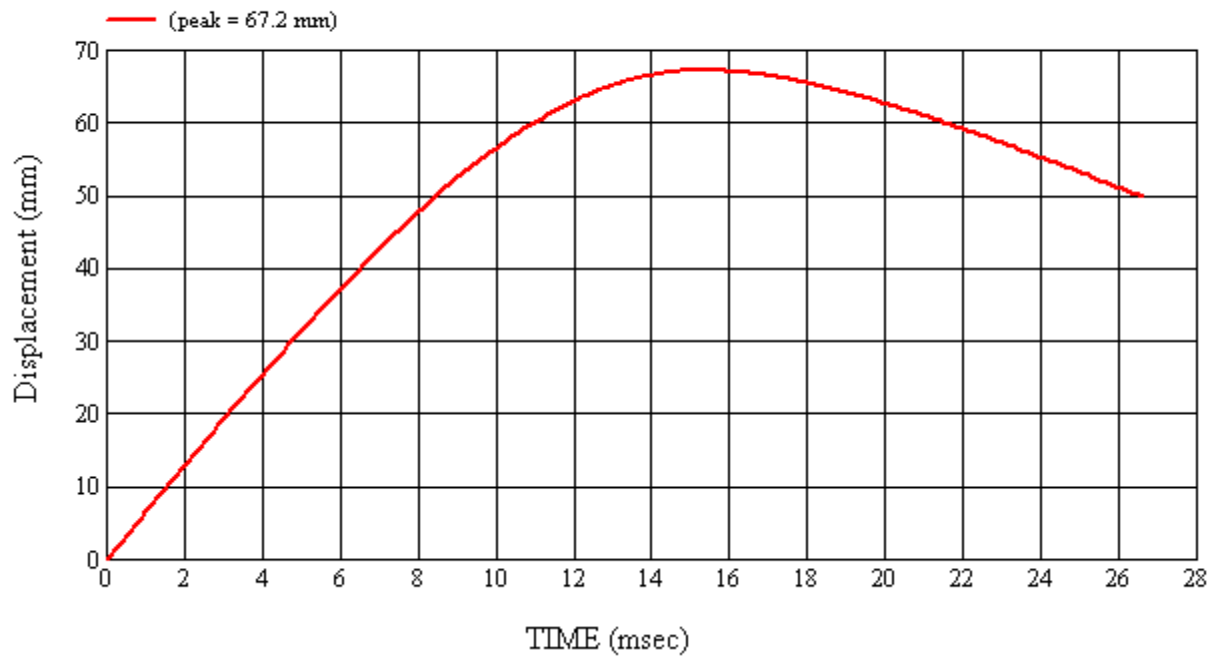
Target Location: UR5, Right Side

Test Date: 4/19/2010









4.0 TEST EQUIPMENT LIST AND CALIBRATION INFORMATION

The following section lists the test equipment for the compliance test series. Items marked with an asterisk are calibrated by an external lab. An additional summary table is given for the pre and post-test calibration data for the Free Motion Headforms. The temperature trace to confirm testing was conducted between 66°F and 78°F (19°C – 26°C) is included in Appendix A. Calibration certificates can be found in Appendix B.

TABLE 4-1 LIST OF ITEMS USED

ITEM	MANUFACTURER NAME	MODEL #	FUNCTION OF ITEM	ACCURACY	CAL. INTERNAL
Head Drop Tower (includes test frame and DAS)	MGA Research Corp.	MGA-100-DC	FMH Calibration	N/A	N/A
Accelerometers	Endevco	7264-2000	Acceleration Data	±0.5%	6 months
FMVSS 201U Test Frame (includes the propulsion control system, actuator, test frame, and DAS)	MGA Research Corp.	MGA-100-FMH	Test System	N/A	N/A
Free Motion Headforms	UTAMA UTAMA UTAMA	035 037 038	Test Device	N/A	Pre and Post-Test Series
High Speed Video	Vision Research	Miro Ex4	Record Event	N/A	N/A
*FARO™	Faro Technologies	S08059801273	Targeting	0.1 mm	Annual
Measuring Devices: - Tape Measure - Plumb Bobs - Digital Protractor	Stanley N/A Mitutoyo	TPM926 -- MGA00048	Measurement Targeting FMH setup Horizontal Measurement	1 mm N/A 0.5°	Annual
*Temperature Recorder	Dickson	MGA00152	Record Temperature and Humidity	± 1°C ± 1% RH	Annual
* Scale	Detecto	MGA00783	Weigh FMH Head	± 0.01 lb	Annual
*Vehicle Scale	Sterling Scale Co.	26032389	Weighing Vehicle	± .5 kg	Annual

Each headform was calibrated by an engineer after the headform had soaked in an environment of 66°F to 78°F (19°C to 26°C) for a period of at least four hours.

Each headform was found to comply with the performance criteria under Part 572L for pre and post-test calibrations. That is, the peak resultant acceleration was between 225 and 275 G's, the peak lateral acceleration was less than 15 G's, the headform weighed between 9.9 and 10.1 lbs., the pulse was determined to be unimodal, and there was no major damage to the headform.

TABLE 4-2 FMH CALIBRATION SUMMARY

FMH Serial #		Headform Calibration Date	Weight (lbs)	Temp (°C)	% Humidity	Peak Resultant Acceleration (G's)	Peak Lateral Acceleration (G's)	Unimodal
Pre	#035	4/16/2010	9.90	22.4	40.8	251.0	3.1	Yes
Post	#035	4/20/2010	9.90	22.7	31.6	254.0	8.6	Yes
Pre	#037	4/16/2010	9.96	22.7	41.0	244.9	4.7	Yes
Post	#037	4/20/2010	9.96	22.9	31.1	251.2	3.7	Yes
Pre	#038	4/16/2010	9.90	21.6	39.6	258.2	10.3	Yes
Post	#038	4/20/2010	9.90	22.8	31.8	260.7	13.9	Yes

4-1 Pre-Test Calibration

**HEAD DROP TEST SUMMARY
 PART 572L**

HEADFORM SERIAL NUMBER: 035		CALIBRATION DATE: 4/16/2010
CALIBRATION TIME: 2:54:25 PM		
TEST PARAMETER	SPECIFICATION	TEST RESULTS
Weight	9.90 to 10.10 lbs.	9.90
Temperature	19° C to 26° C	22.4
Relative Humidity	10% to 70%	40.8
Peak Resultant Acceleration	225 G's to 275 G's	251.0
Peak Lateral Acceleration	15 G's Maximum	3.1
Unimodal Acceleration Curve	YES	YES

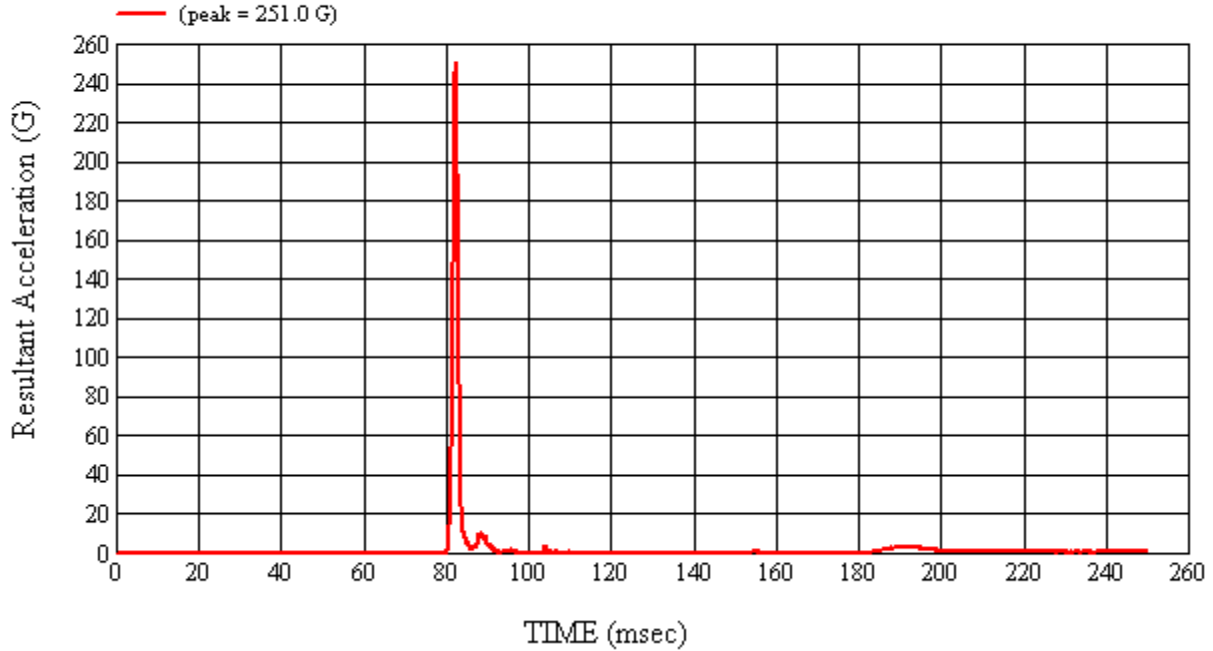
FMH INSTRUMENTATION					
HEAD ACCELEROMETERS					
Channel Number	Manufacturer	Model Number	Serial Number	Date of Last Calibration	Date of Next Calibration
1	ENDEVCO	7264-2000	J35919	02/17/10	08/17/10
2	ENDEVCO	7264-2000	J22664	02/17/10	08/17/10
3	ENDEVCO	7264-2000	J35924	02/17/10	08/17/10

REMARKS:

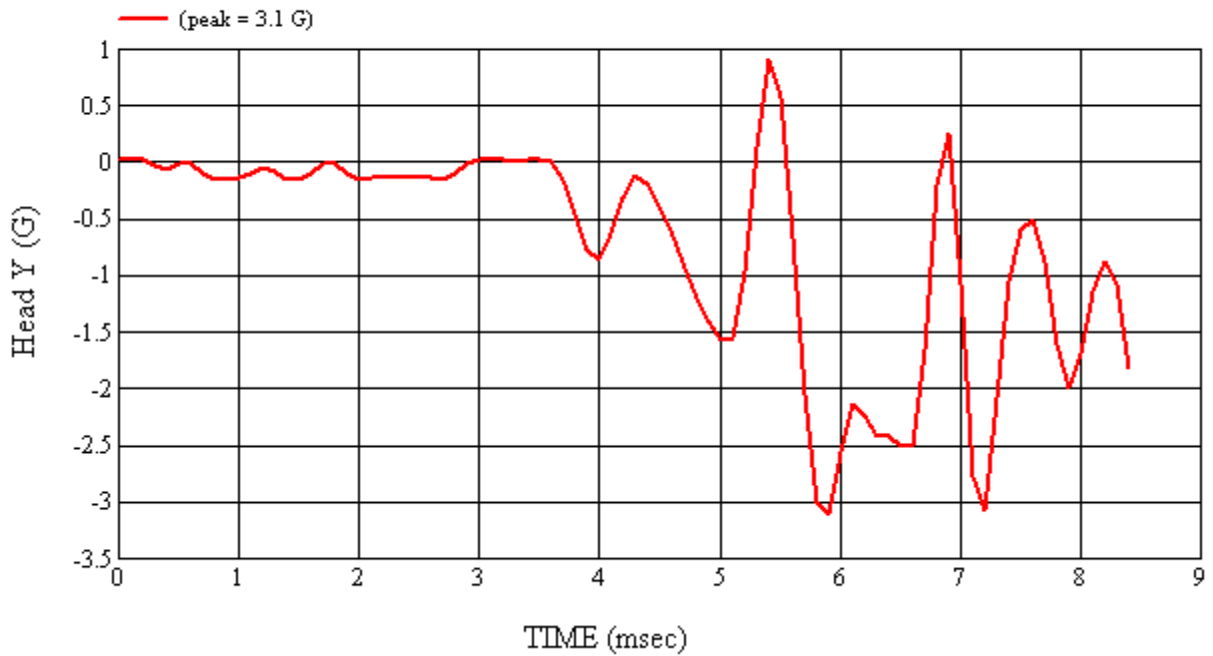
RECORDED BY:  _____

DATE: 4/16/2010

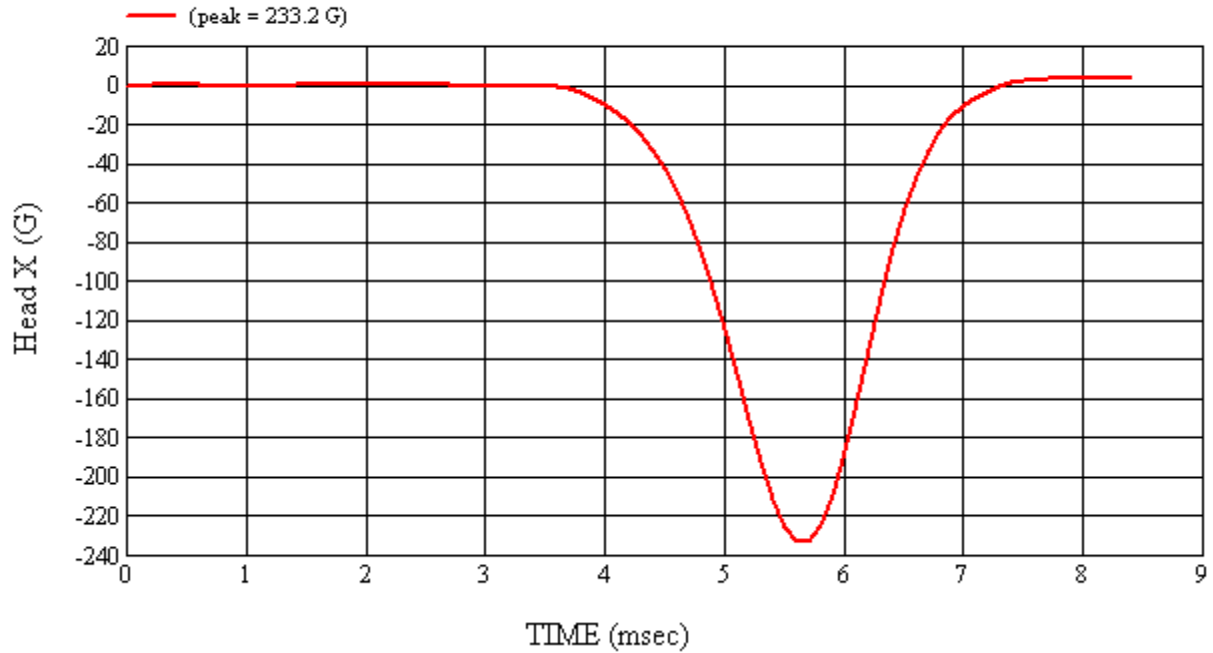
APPROVED BY:  _____



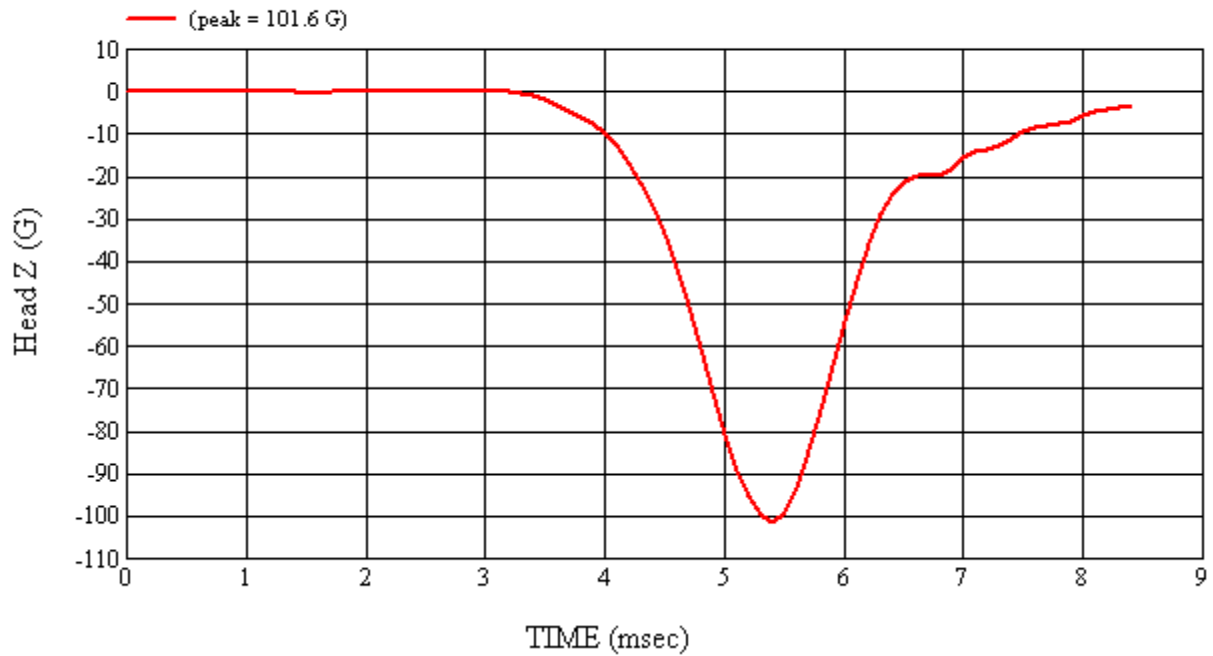
Head 035 (Pre) Calibration #H35010



Head 035 (Pre) Calibration #H35010



Head 035 (Pre) Calibration #H35010



Head 035 (Pre) Calibration #H35010

**4-2 Post -Test Calibration HEAD DROP TEST SUMMARY
 PART 572L**

HEADFORM SERIAL NUMBER: 035		CALIBRATION DATE: 4/20/2010
CALIBRATION TIME: 4:00:33 PM		
TEST PARAMETER	SPECIFICATION	TEST RESULTS
Weight	9.90 to 10.10 lbs.	9.90
Temperature	19° C to 26° C	22.7
Relative Humidity	10% to 70%	31.6
Peak Resultant Acceleration	225 G's to 275 G's	254.0
Peak Lateral Acceleration	15 G's Maximum	8.6
Unimodal Acceleration Curve	YES	YES

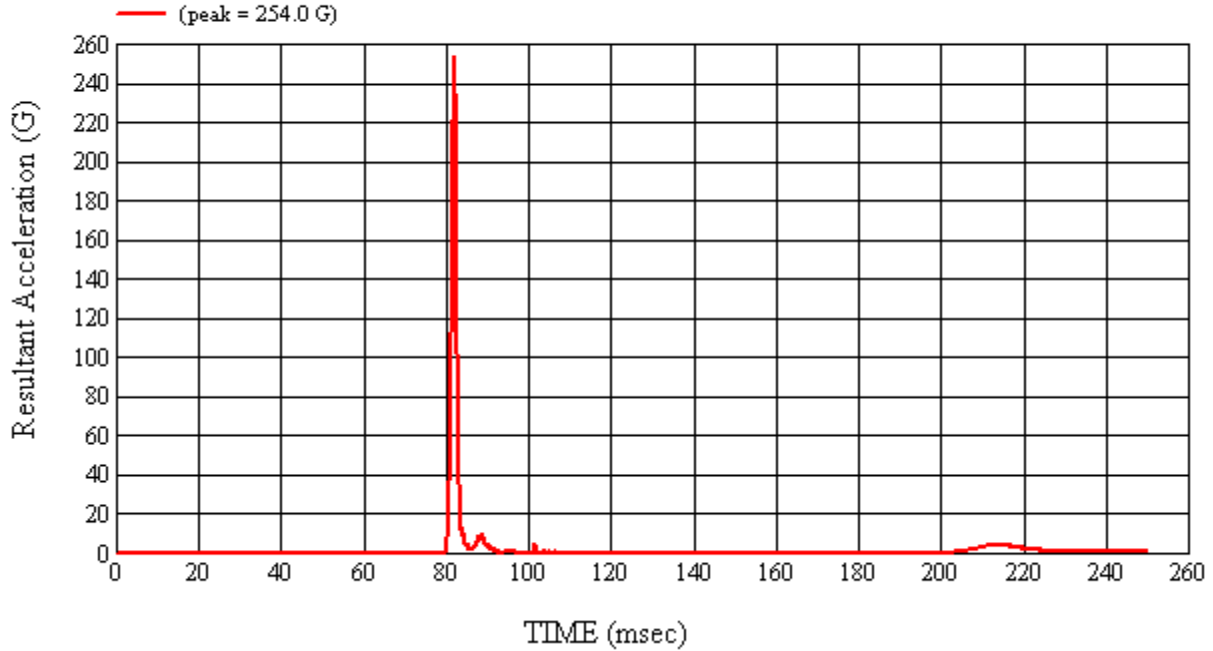
FMH INSTRUMENTATION					
HEAD ACCELEROMETERS					
Channel Number	Manufacturer	Model Number	Serial Number	Date of Last Calibration	Date of Next Calibration
1	ENDEVCO	7264-2000	J35919	02/17/10	08/17/10
2	ENDEVCO	7264-2000	J22664	02/17/10	08/17/10
3	ENDEVCO	7264-2000	J35924	02/17/10	08/17/10

REMARKS:

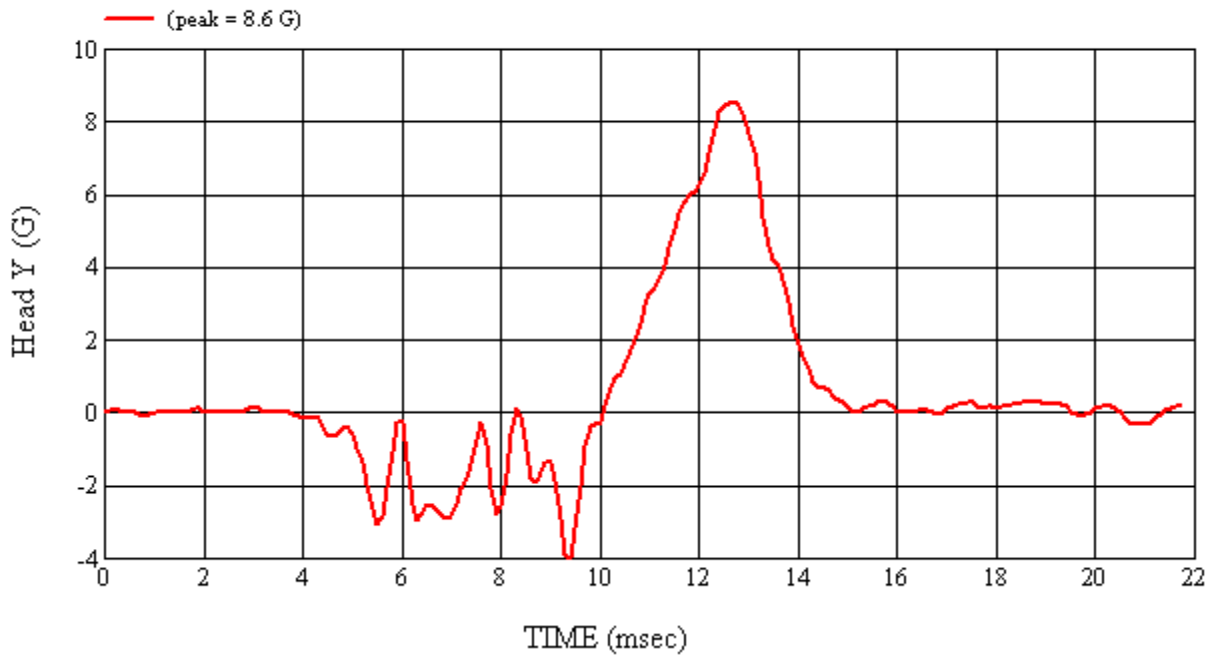
RECORDED BY:  _____

DATE: 4/20/2010

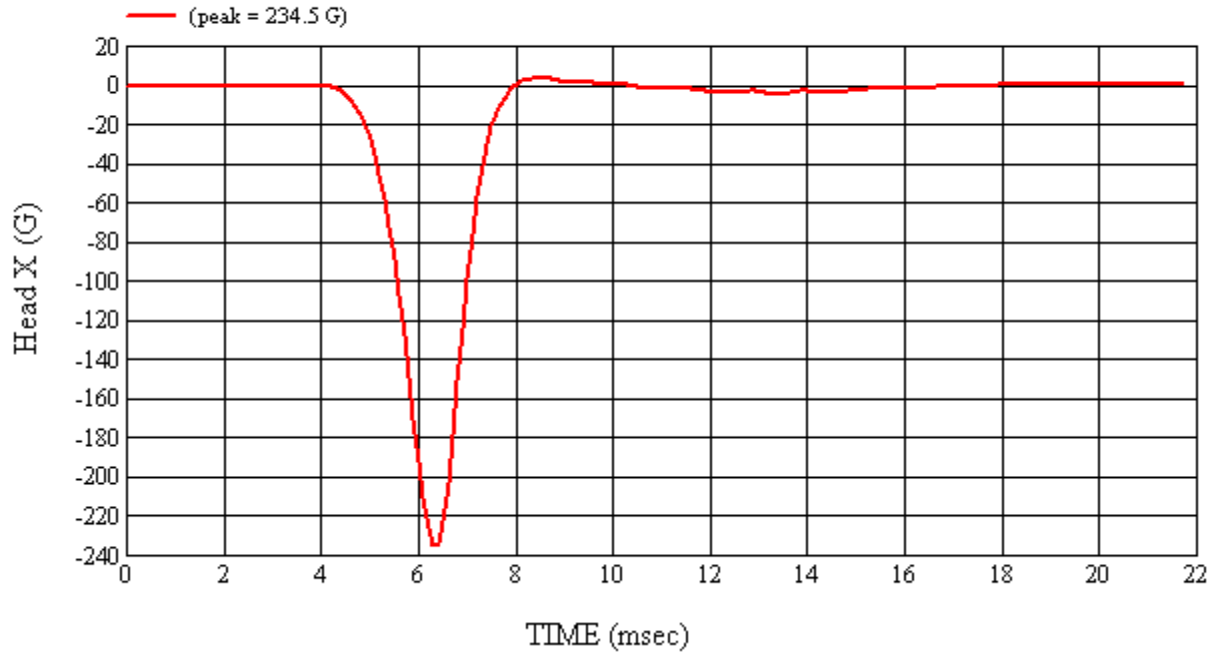
APPROVED BY:  _____



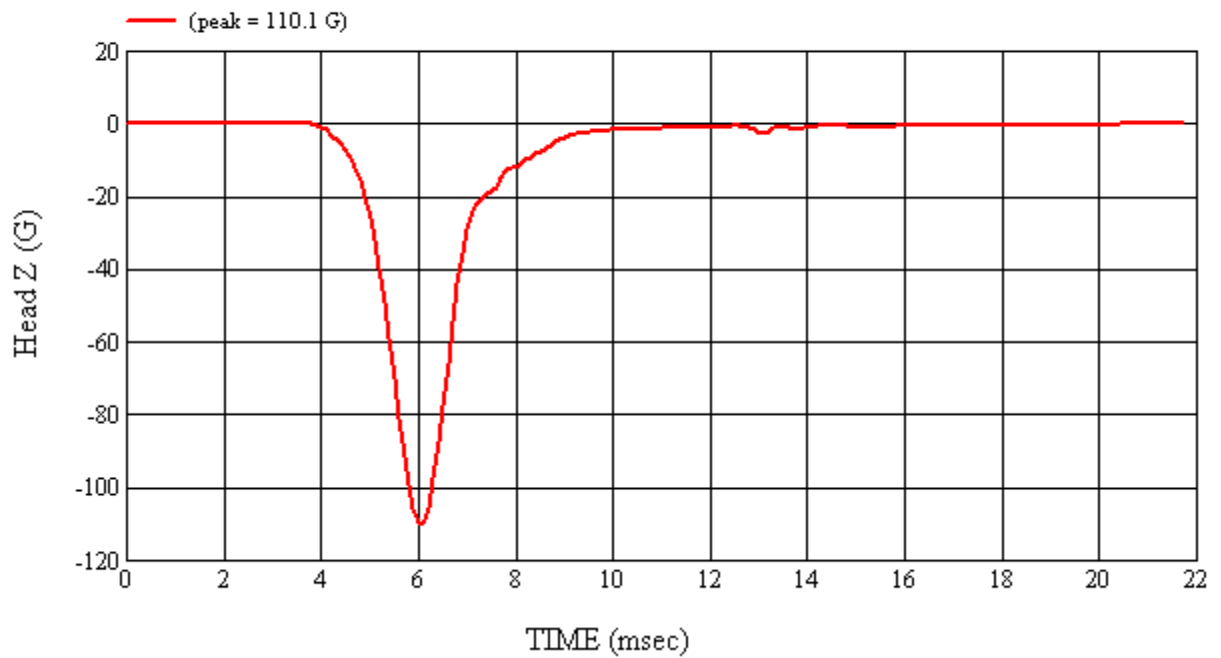
Head 035 (Post) Calibration #H35011



Head 035 (Post) Calibration #H35011



Head 035 (Post) Calibration #H35011



Head 035 (Post) Calibration #H35011

4-3 Pre-Test Calibration

**HEAD DROP TEST SUMMARY
 PART 572L**

HEADFORM SERIAL NUMBER: 037		CALIBRATION DATE: 4/16/2010
CALIBRATION TIME: 3:13:32 PM		
TEST PARAMETER	SPECIFICATION	TEST RESULTS
Weight	9.90 to 10.10 lbs.	9.96
Temperature	19° C to 26° C	22.7
Relative Humidity	10% to 70%	41.0
Peak Resultant Acceleration	225 G's to 275 G's	244.9
Peak Lateral Acceleration	15 G's Maximum	4.7
Unimodal Acceleration Curve	YES	YES

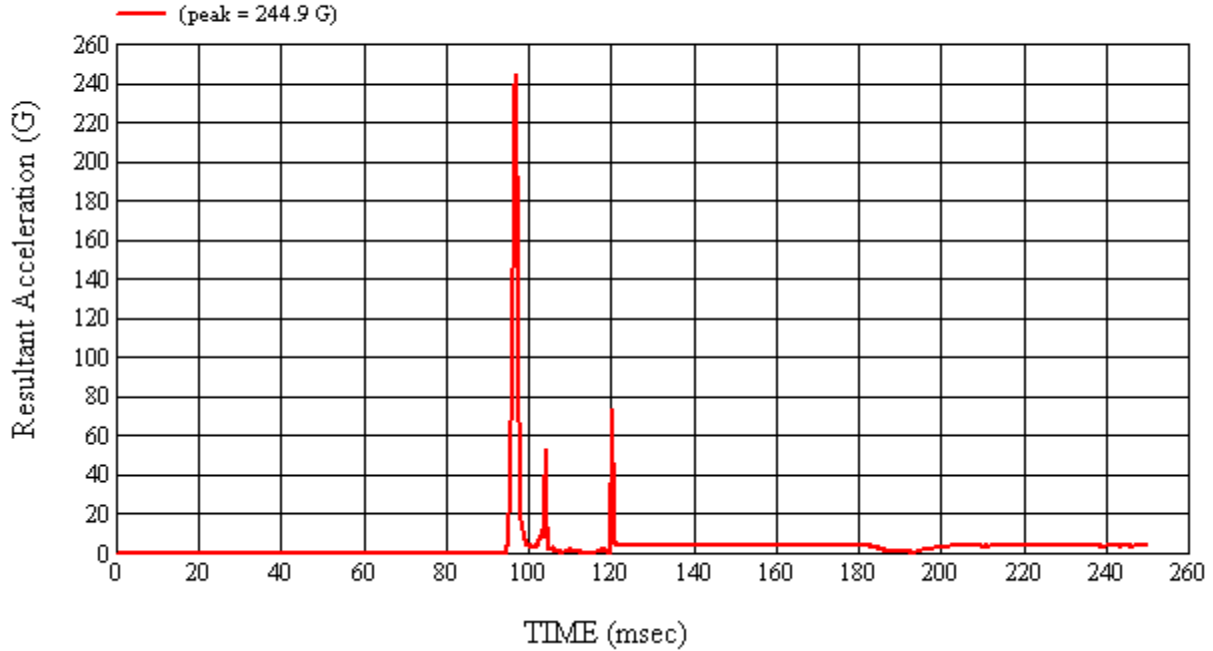
FMH INSTRUMENTATION					
HEAD ACCELEROMETERS					
Channel Number	Manufacturer	Model Number	Serial Number	Date of Last Calibration	Date of Next Calibration
1	ENDEVCO	7264-2000	AHTB2	02/17/10	08/17/10
2	ENDEVCO	7264-2000	J14103	02/17/10	08/17/10
3	ENDEVCO	7264-2000	J35800	02/17/10	08/17/10

REMARKS:

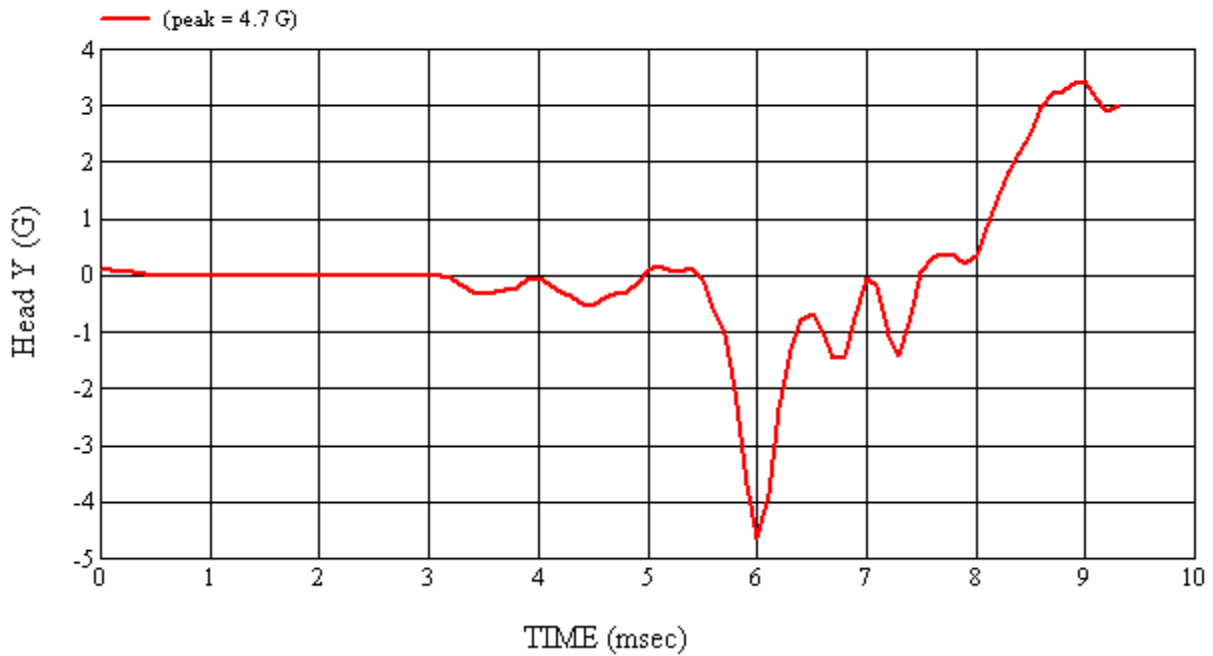
RECORDED BY:  _____

DATE: 4/16/2010

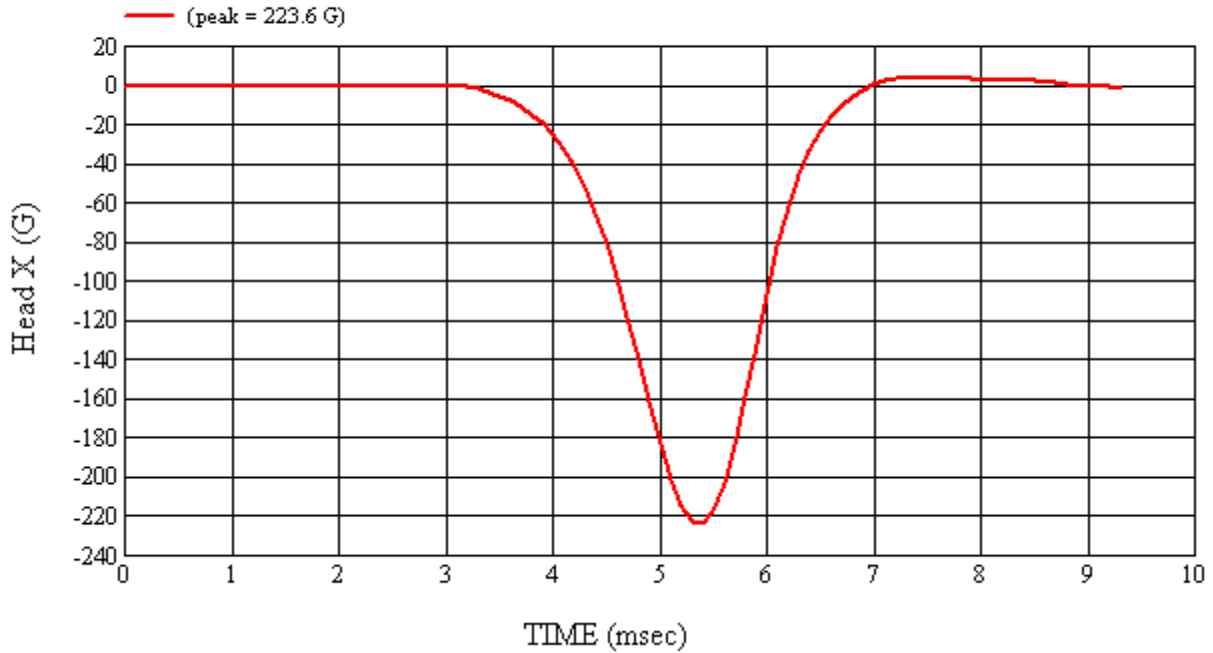
APPROVED BY:  _____



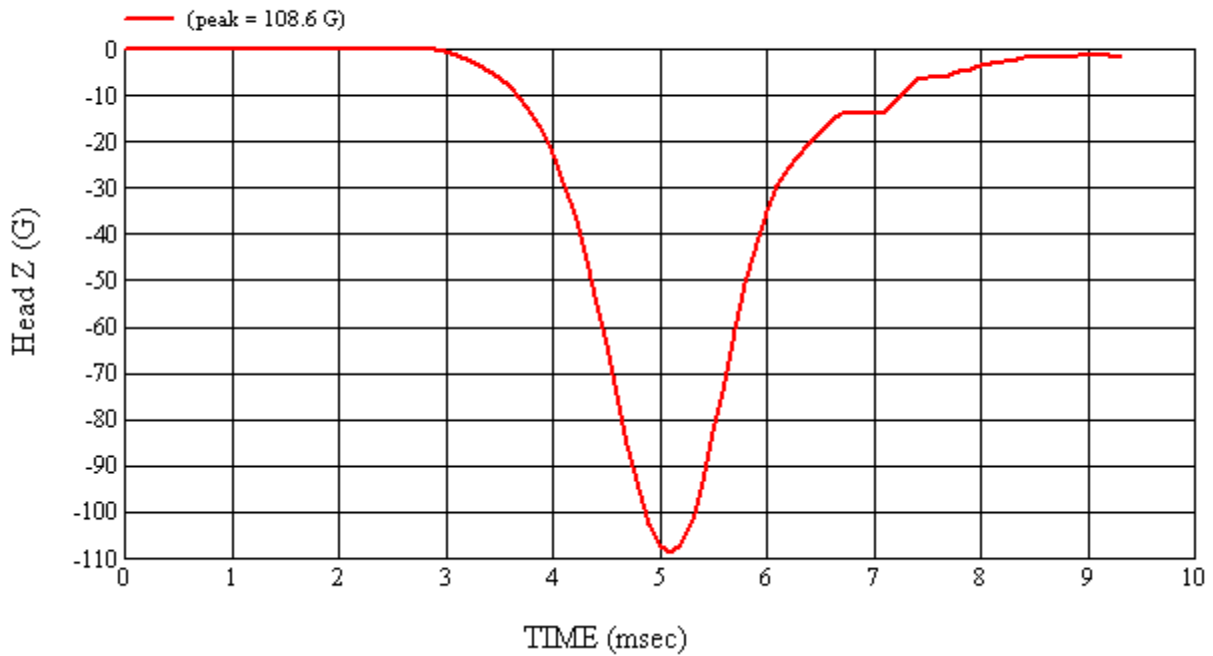
Head 037 (Pre) Calibration #H37010



Head 037 (Pre) Calibration #H37010



Head 037 (Pre) Calibration #H37010



Head 037 (Pre) Calibration #H37010

4-4 Post-Test Calibration

**HEAD DROP TEST SUMMARY
 PART 572L**

HEADFORM SERIAL NUMBER: 037		CALIBRATION DATE: 4/20/2010
CALIBRATION TIME: 5:17:50 PM		
TEST PARAMETER	SPECIFICATION	TEST RESULTS
Weight	9.90 to 10.10 lbs.	9.96
Temperature	19° C to 26° C	22.9
Relative Humidity	10% to 70%	31.1
Peak Resultant Acceleration	225 G's to 275 G's	251.2
Peak Lateral Acceleration	15 G's Maximum	3.7
Unimodal Acceleration Curve	YES	YES

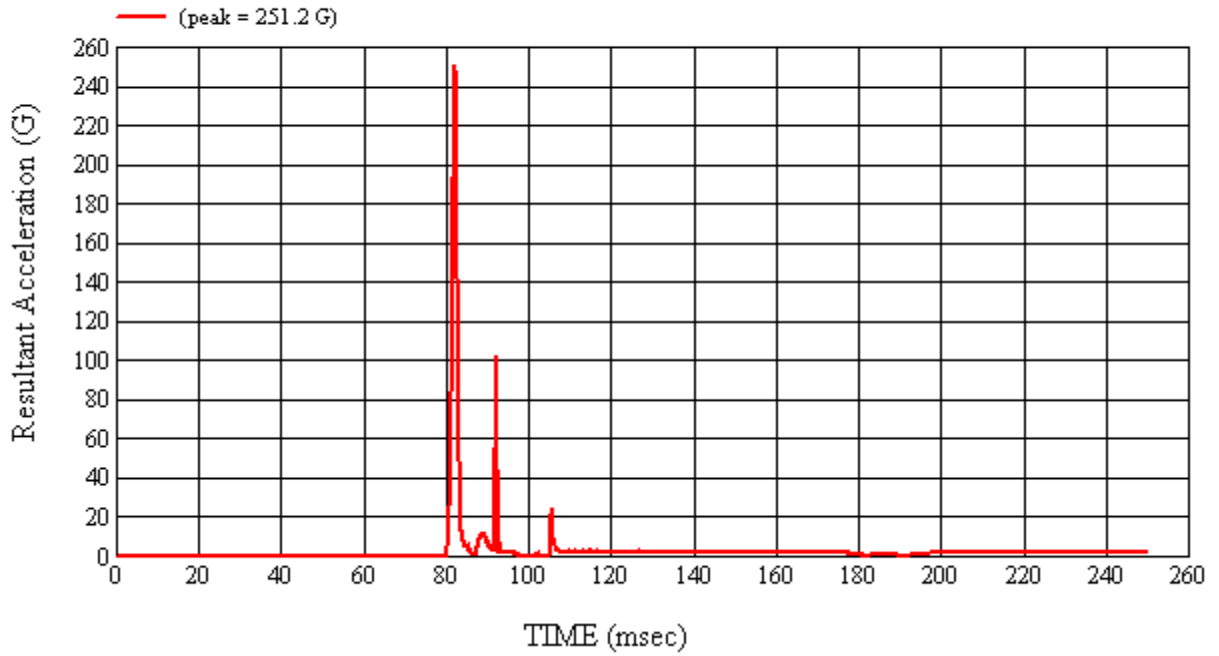
FMH INSTRUMENTATION					
HEAD ACCELEROMETERS					
Channel Number	Manufacturer	Model Number	Serial Number	Date of Last Calibration	Date of Next Calibration
1	ENDEVCO	7264-2000	AHTB2	02/17/10	08/17/10
2	ENDEVCO	7264-2000	J14103	02/17/10	08/17/10
3	ENDEVCO	7264-2000	J35800	02/17/10	08/17/10

REMARKS:

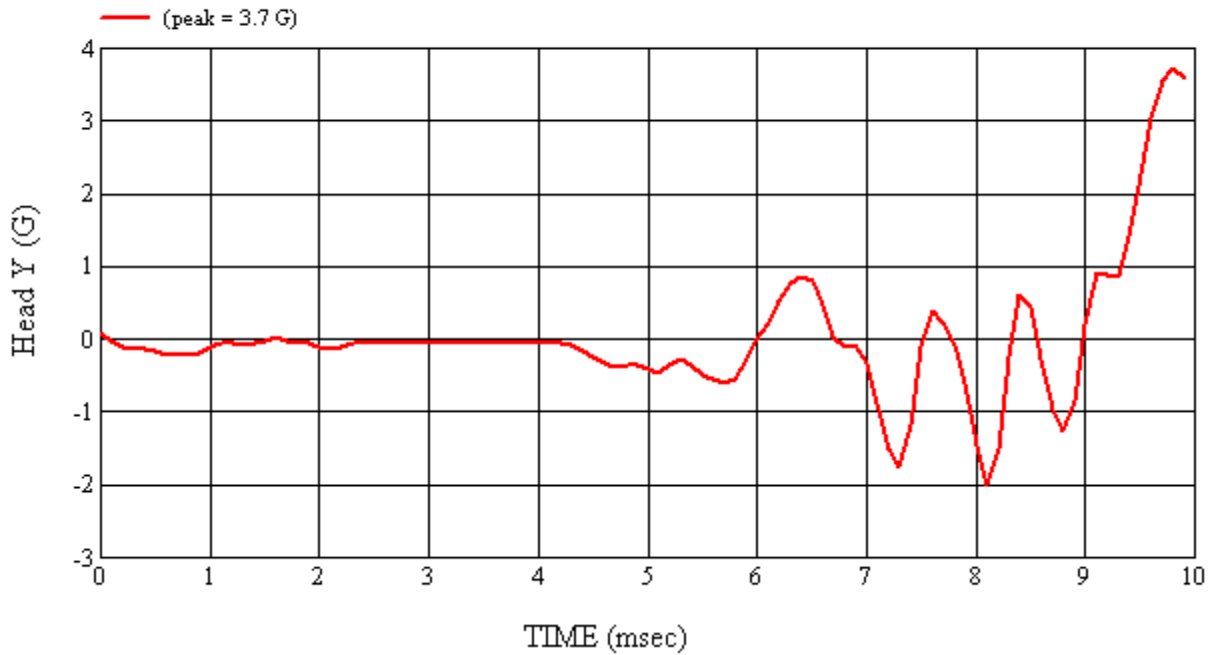
RECORDED BY: 

DATE: 4/20/2010

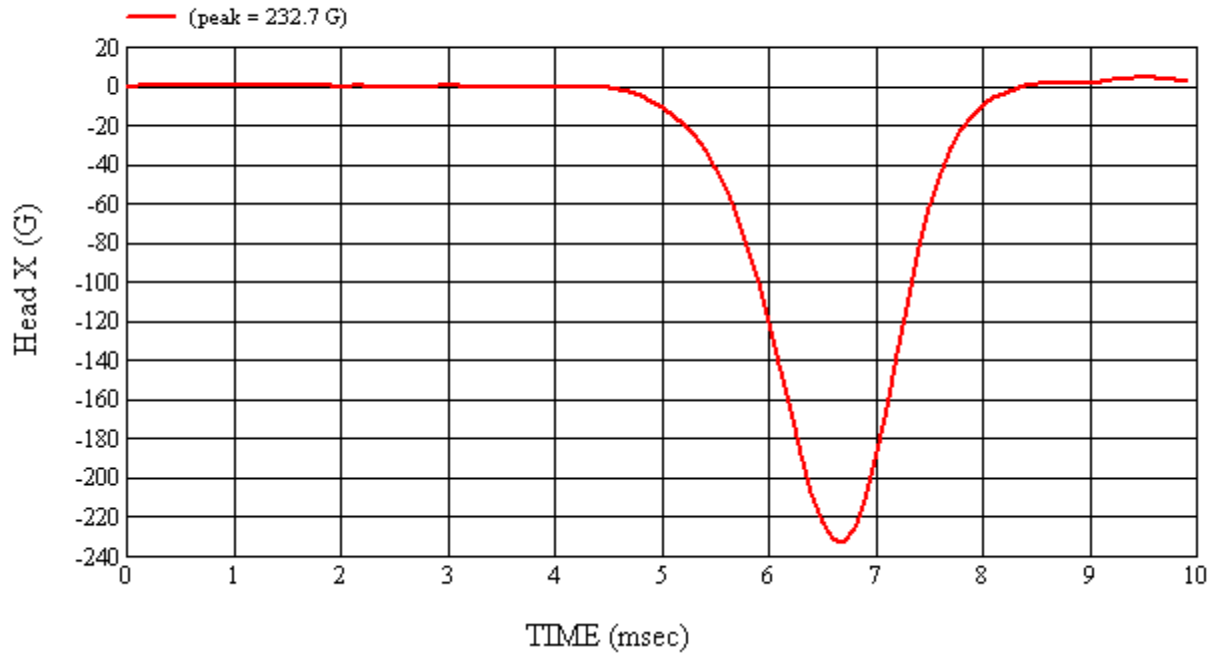
APPROVED BY: 



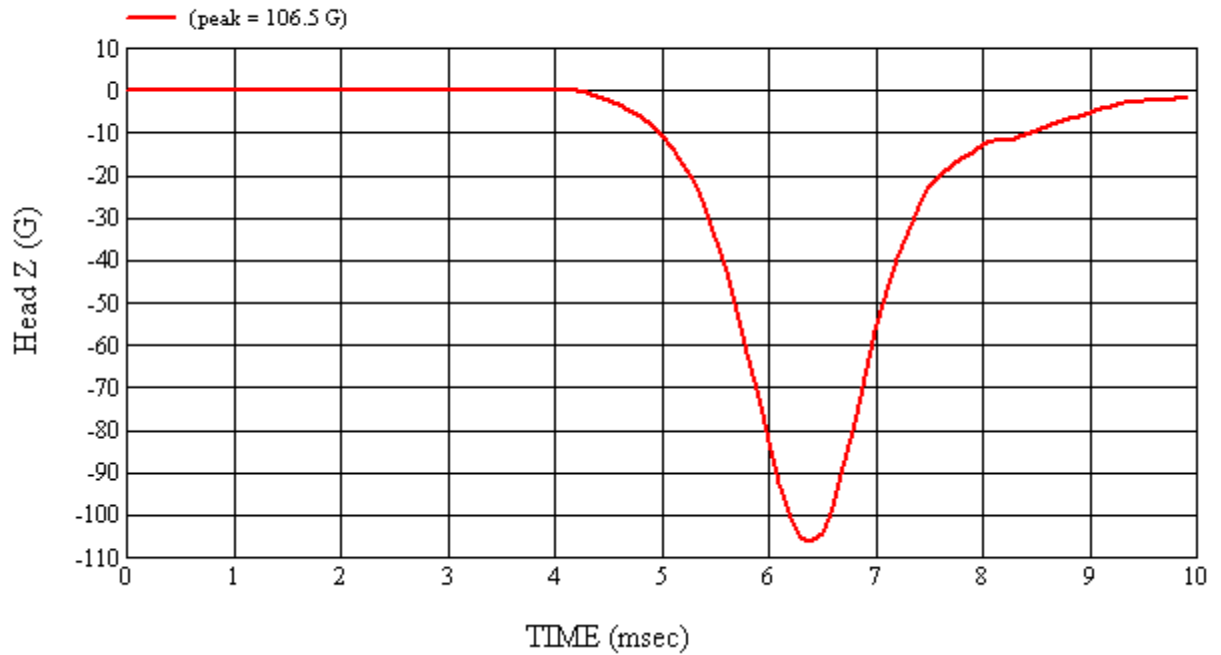
Head 037 (Post) Calibration #H37011



Head 037 (Post) Calibration #H37011



Head 037 (Post) Calibration #H37011



Head 037 (Post) Calibration #H37011


4-5 Pre-Test Calibration

**HEAD DROP TEST SUMMARY
 PART 572L**


HEADFORM SERIAL NUMBER: 038		CALIBRATION DATE: 4/16/2010
CALIBRATION TIME: 2:25:32 PM		
TEST PARAMETER	SPECIFICATION	TEST RESULTS
Weight	9.90 to 10.10 lbs.	9.90
Temperature	19° C to 26° C	21.6
Relative Humidity	10% to 70%	39.6
Peak Resultant Acceleration	225 G's to 275 G's	258.2
Peak Lateral Acceleration	15 G's Maximum	10.3
Unimodal Acceleration Curve	YES	YES

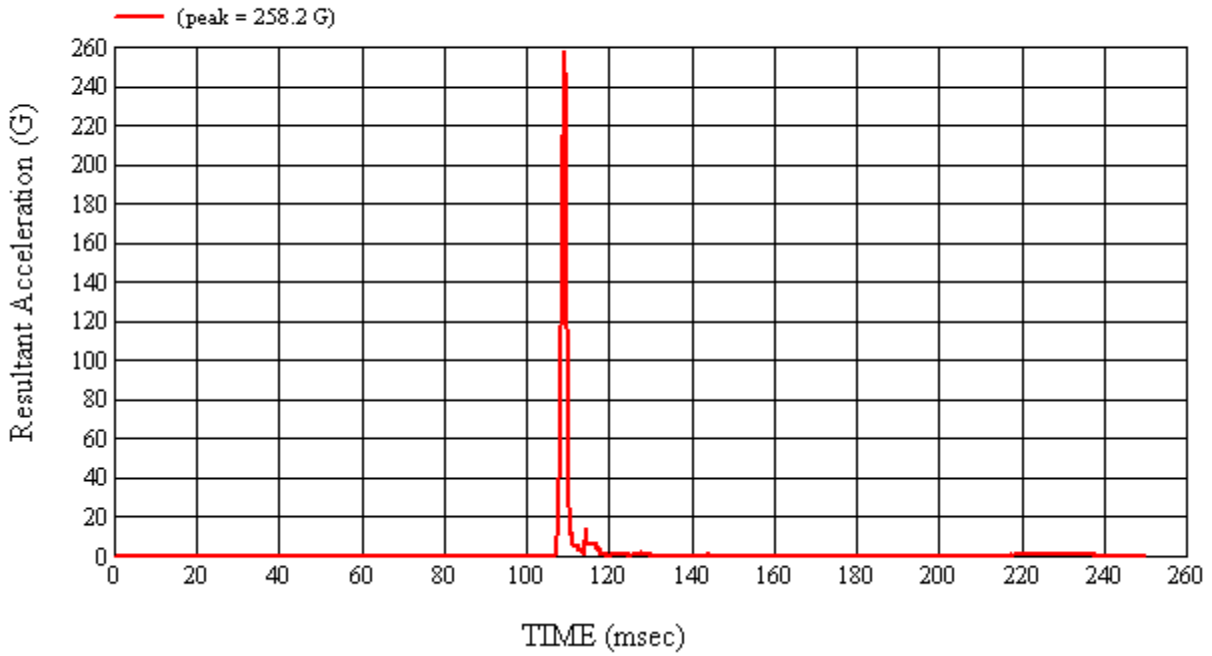
FMH INSTRUMENTATION					
HEAD ACCELEROMETERS					
Channel Number	Manufacturer	Model Number	Serial Number	Date of Last Calibration	Date of Next Calibration
1	ENDEVCO	7264-2000	J22700	03/12/10	09/12/10
2	ENDEVCO	7264-2000	J36197	03/12/10	09/12/10
3	ENDEVCO	7264-2000	J36353	03/12/10	09/12/10

REMARKS:

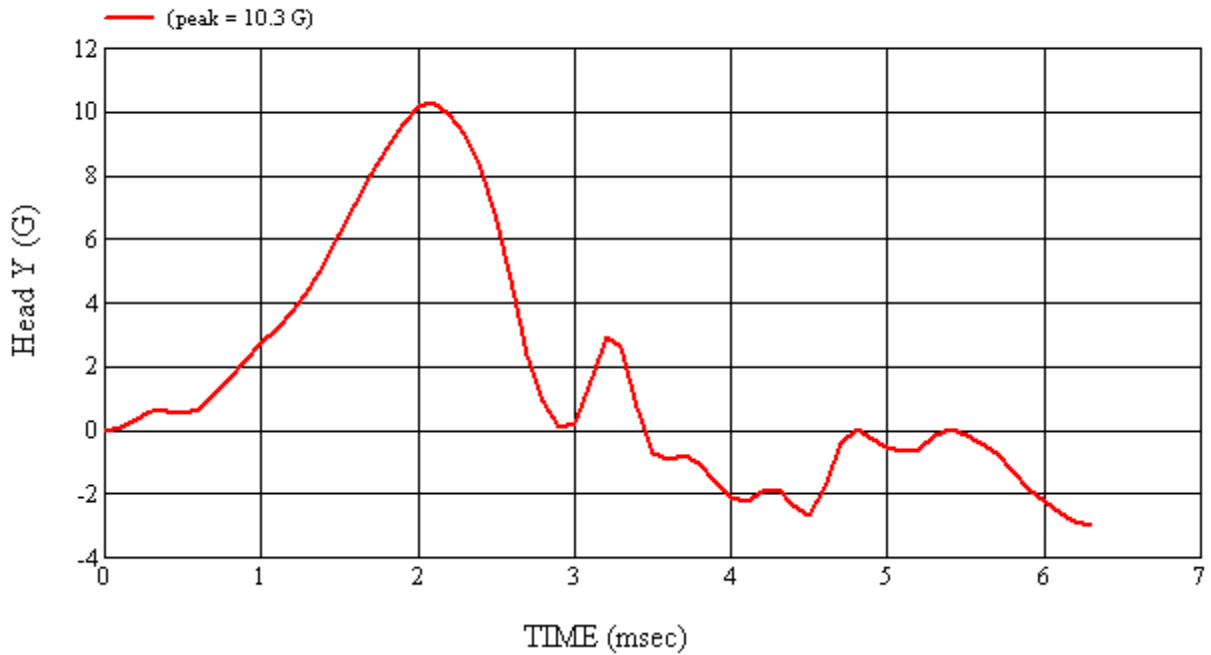
RECORDED BY:  _____

DATE: 4/16/2010

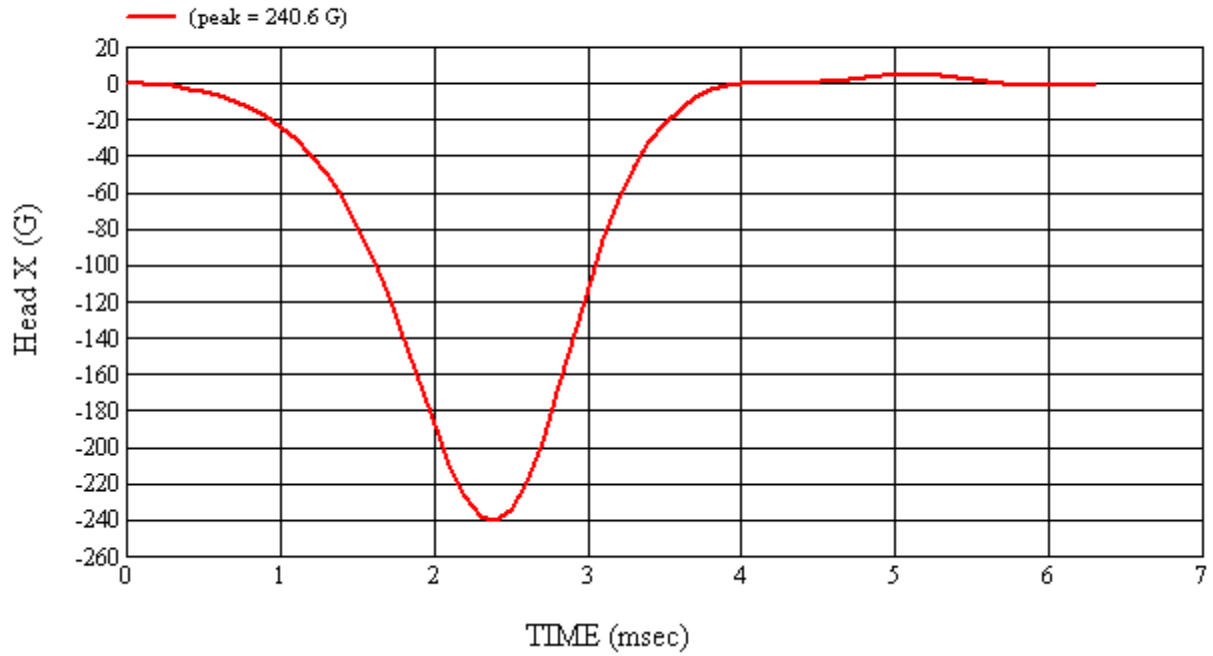
APPROVED BY:  _____



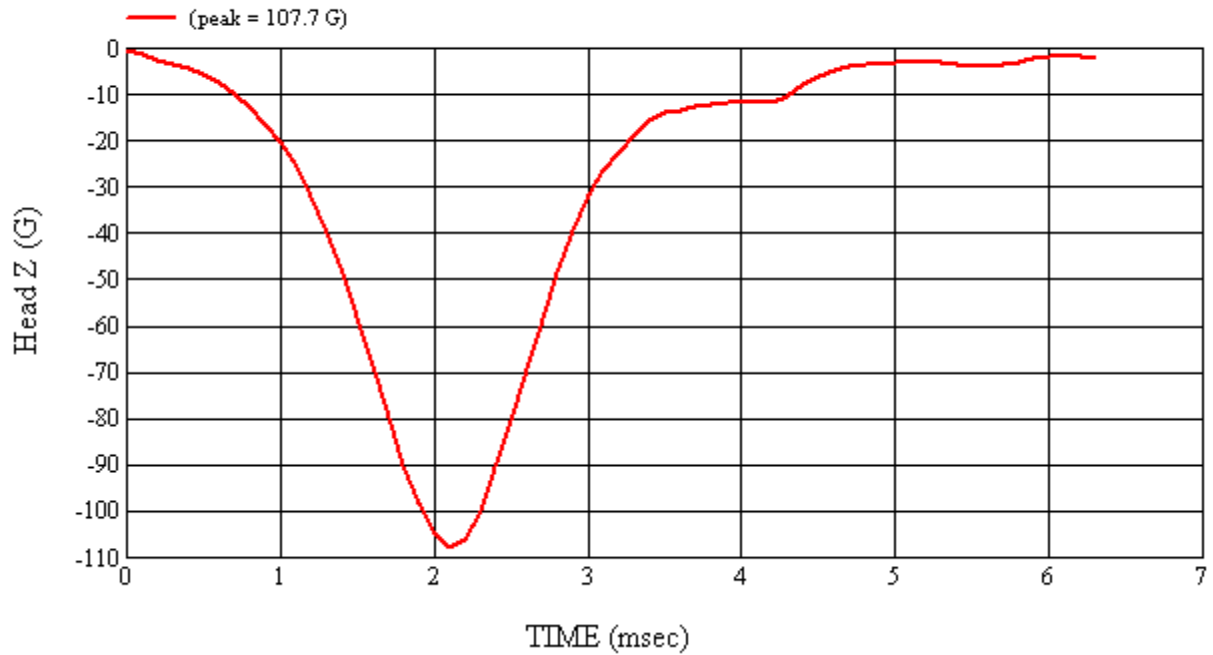
Head 038 (Pre) Calibration #H38009



Head 038 (Pre) Calibration #H38009



Head 038 (Pre) Calibration #H38009



Head 038 (Pre) Calibration #H38009


4-6 Post-Test Calibration

**HEAD DROP TEST SUMMARY
 PART 572L**


HEADFORM SERIAL NUMBER: 038		CALIBRATION DATE: 4/20/2010
CALIBRATION TIME: 4:16:48 PM		
TEST PARAMETER	SPECIFICATION	TEST RESULTS
Weight	9.90 to 10.10 lbs.	9.90
Temperature	19° C to 26° C	22.8
Relative Humidity	10% to 70%	31.8
Peak Resultant Acceleration	225 G's to 275 G's	260.7
Peak Lateral Acceleration	15 G's Maximum	13.9
Unimodal Acceleration Curve	YES	YES

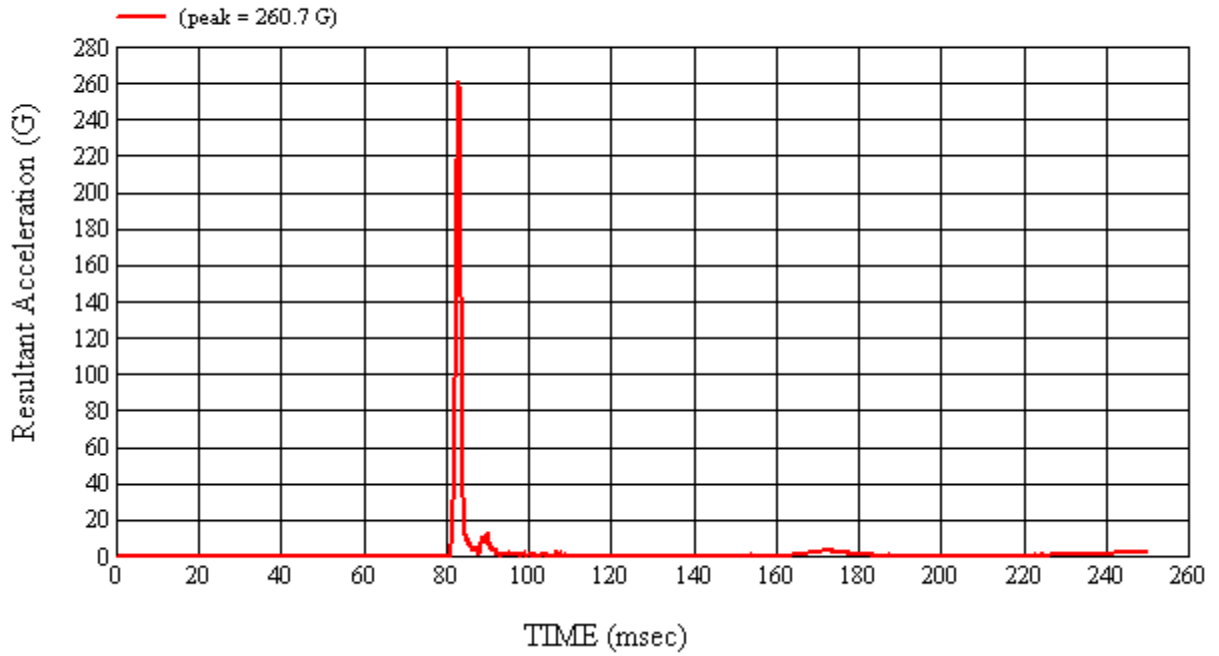
FMH INSTRUMENTATION					
HEAD ACCELEROMETERS					
Channel Number	Manufacturer	Model Number	Serial Number	Date of Last Calibration	Date of Next Calibration
1	ENDEVCO	7264-2000	J22700	03/12/10	09/12/10
2	ENDEVCO	7264-2000	J36197	03/12/10	09/12/10
3	ENDEVCO	7264-2000	J36353	03/12/10	09/12/10

REMARKS:

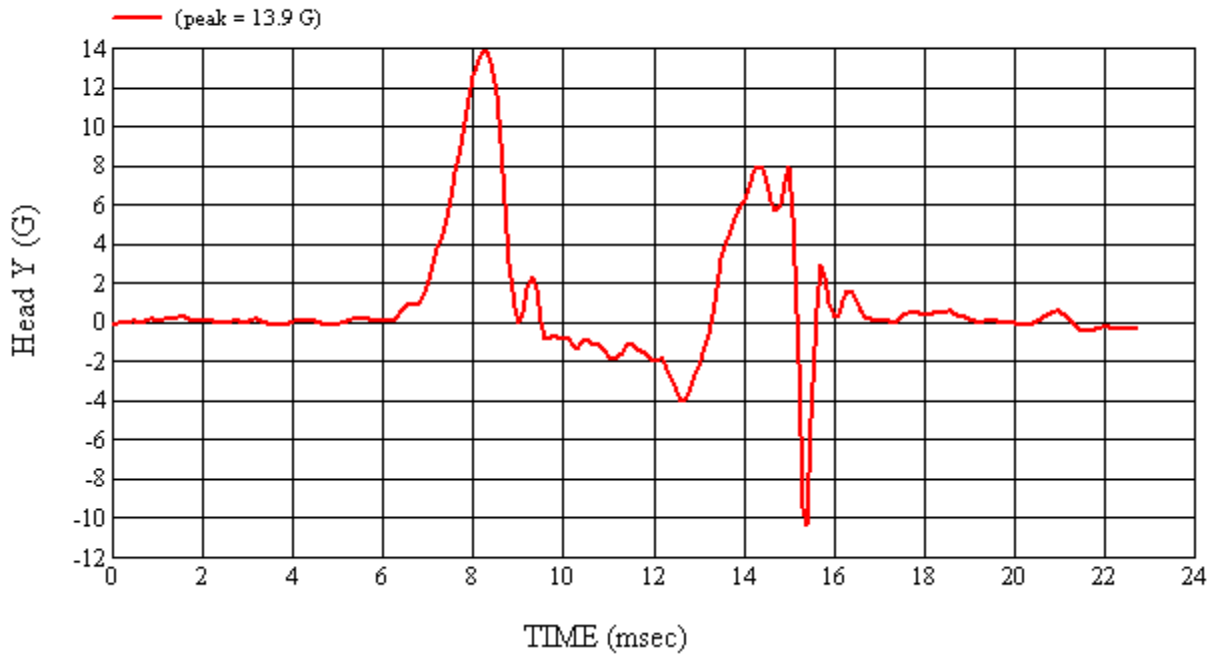
RECORDED BY:  _____

DATE: 4/20/2010

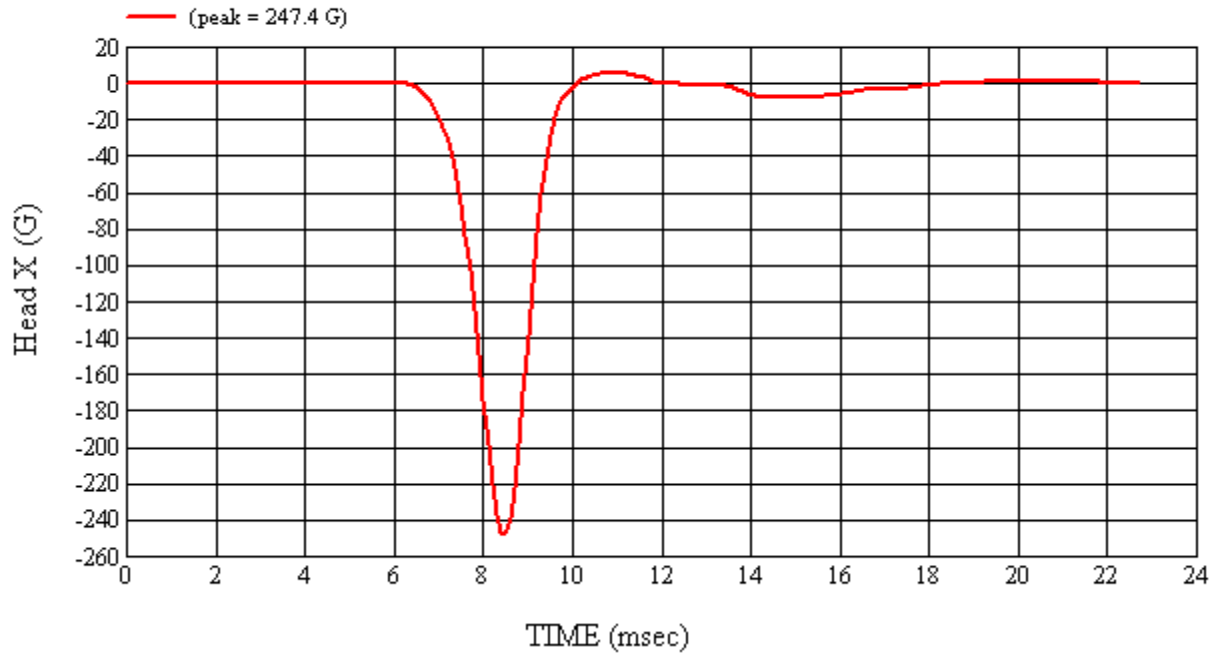
APPROVED BY:  _____



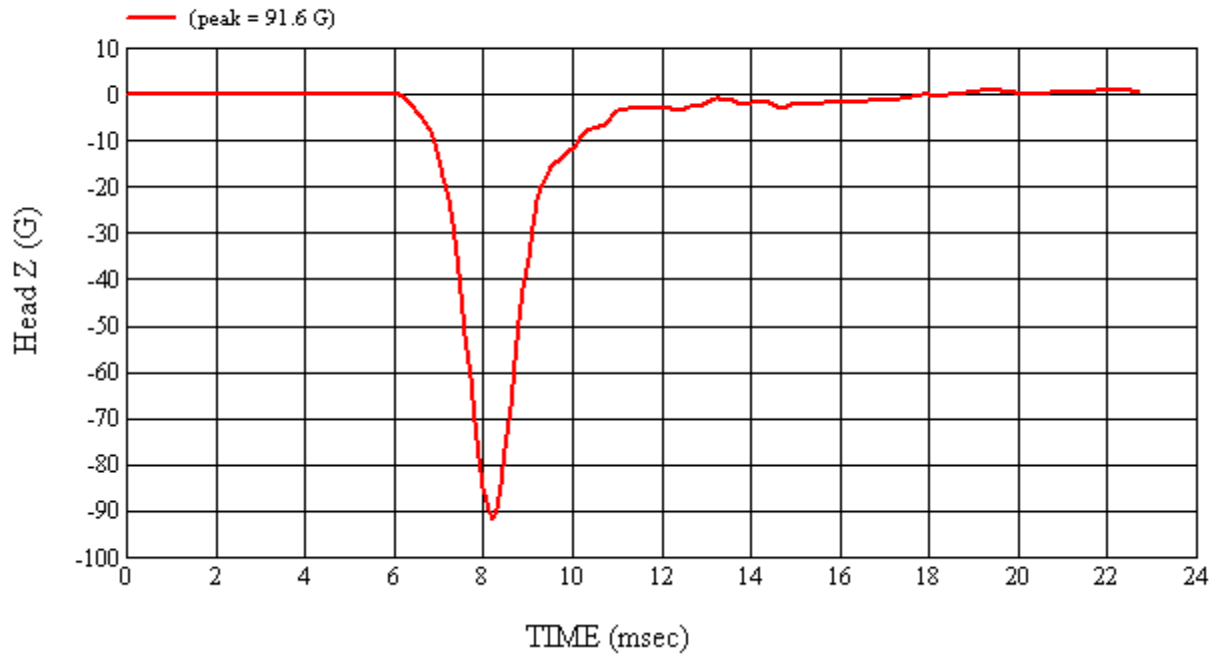
Head 038 (Post) Calibration #H38010



Head 038 (Post) Calibration #H38010



Head 038 (Post) Calibration #H38010



Head 038 (Post) Calibration #H38010

5.0 PHOTOGRAPHS



As Delivered – Left Side View



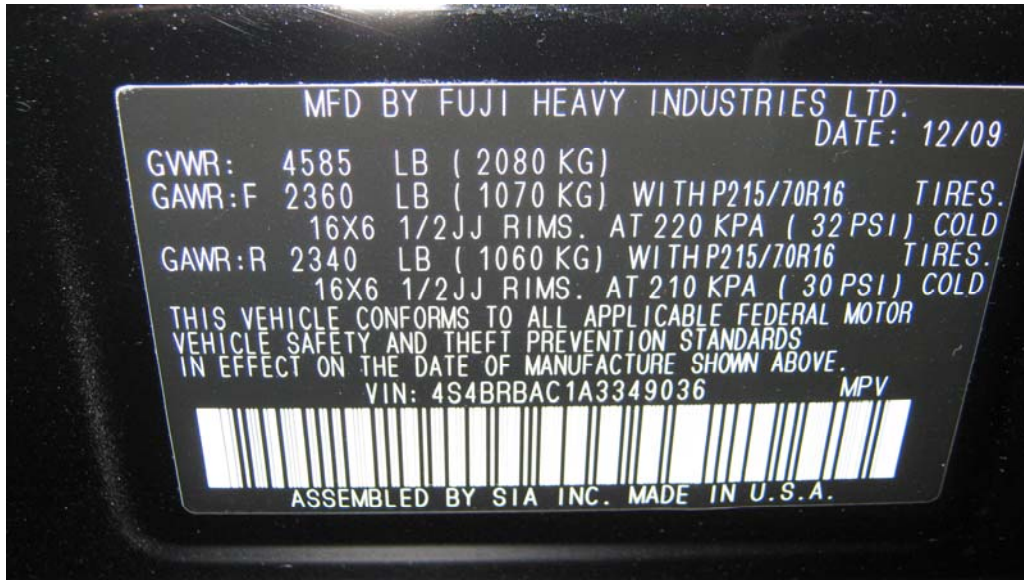
As Delivered – Right Side View



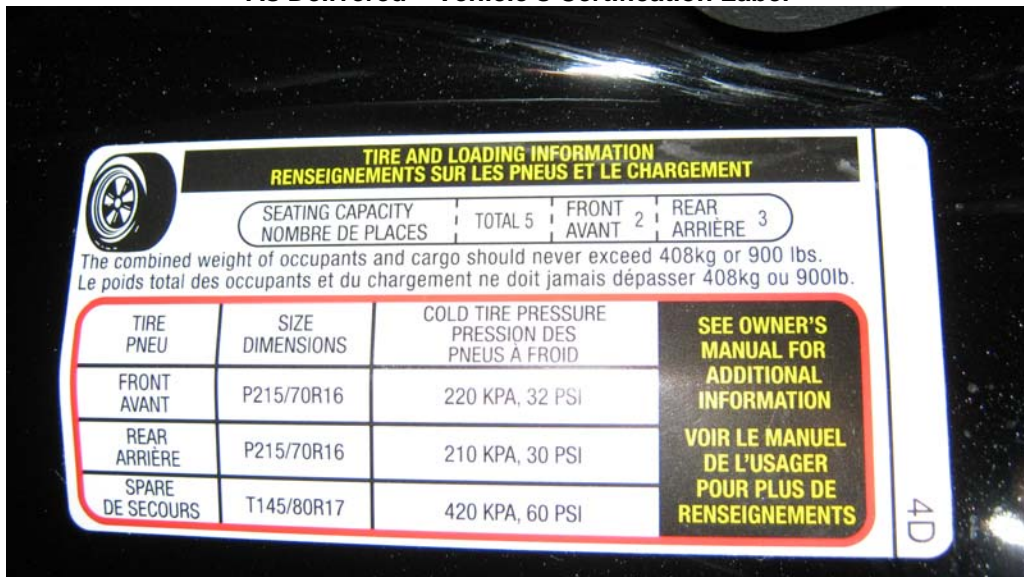
As Delivered – 3/4 Front View From Left Side



As Delivered – 3/4 Rear View From Right Side



As Delivered – Vehicle’s Certification Label



As Delivered – Vehicle’s Tire Information Label

Pre-Test Component Photographs



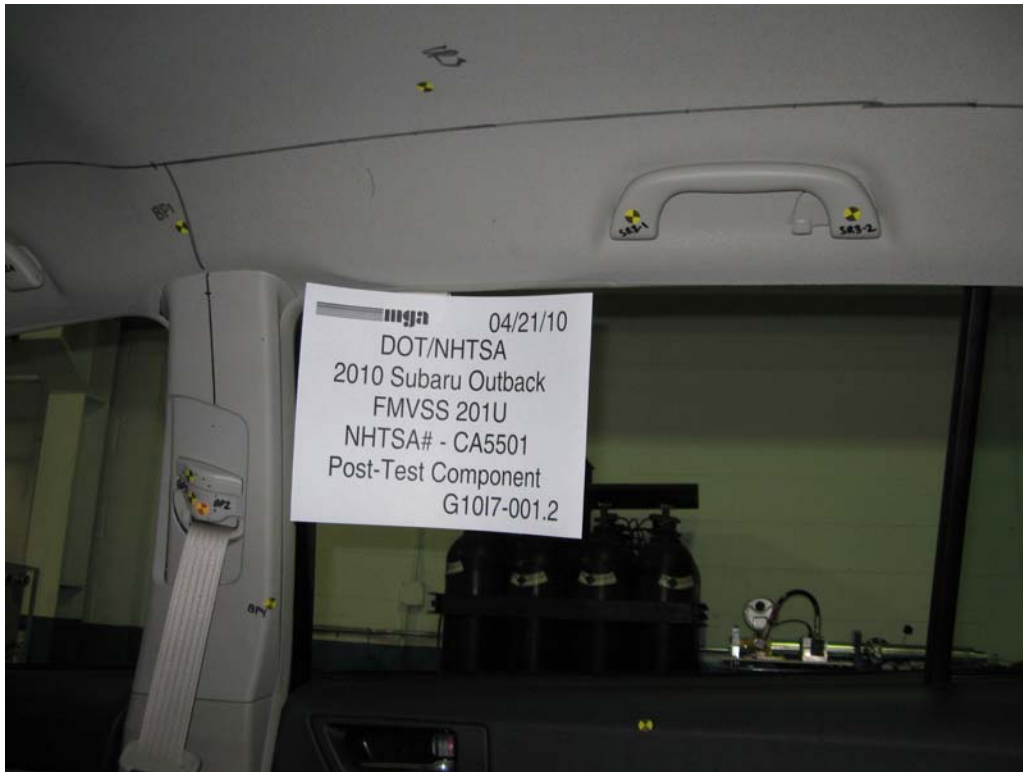




Post-Test Component Photographs

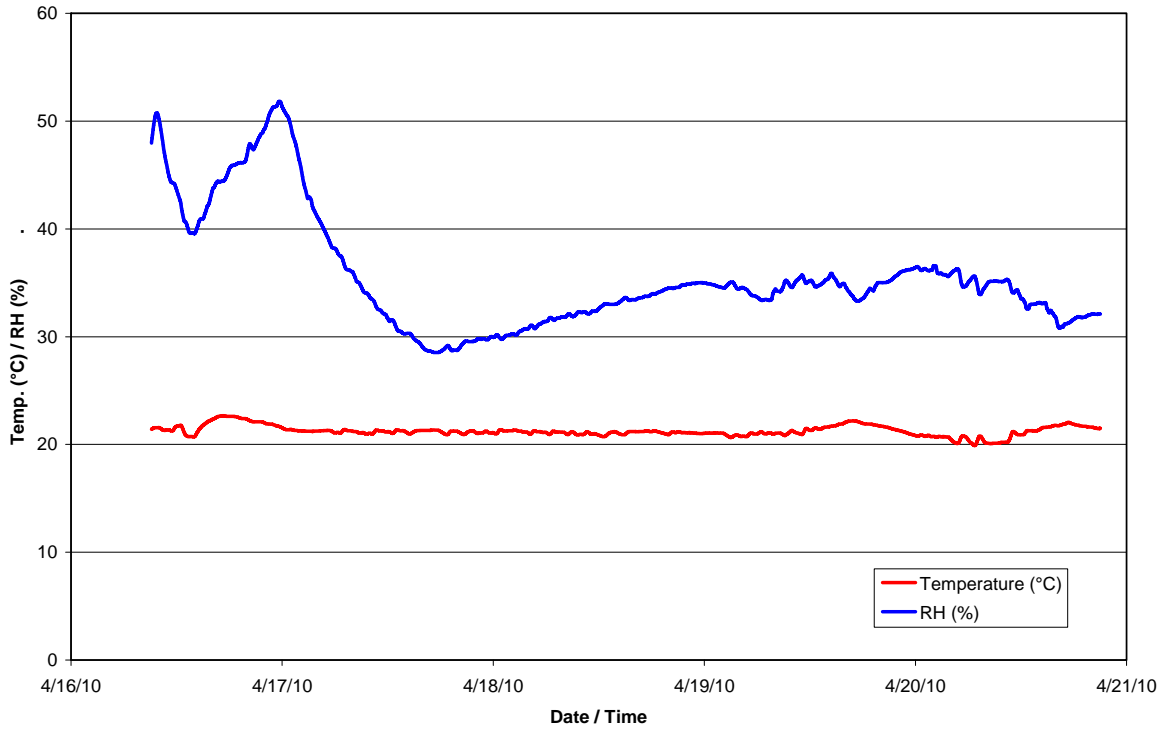






Appendix A – Temperature Trace

CA5501 - 2010 Subaru Outback - FMVSS 201U



Appendix B – Calibration Certificates

MGA Research Corporation-Calibration Certificate

ACCELEROMETER

Reference	Sensor
Name: Accel Standard	Name: MGA MI
Model #: 352C03	Manufacturer: Endeveco
Serial #: 95980	Model #: 7264-2000
Capacity: G's:250	Serial #: J35919
Calibration Date: 8/21/2009	Capacity/Range: 2,000 (G's)
Calibrated By: Schober	

Calibration Date: 2/17/2010

New DLR(Units:G'S) ¹ 96.3
100K SHUNT

Linearity:² 0.99974

New vs Old Sensitivit (% Difference) 0.8

Temperature: 70 °F

Humidity: 25 %

Sensitivity (mV/V/G): 0.025792

Calibrated By: Chris Collins

Signature: Chris Collins

Approved by: Donald Kalatu

1. Actual data of reference and sensor instruments is found in calibration files

2. Linearity is defined as $1 - (\text{Standard Deviation} / \text{Mean})$

All calibrations are traceable to the National Institute of Standards and Technology

Calibration uncertainty no greater than 4.0% at the 95% confidence level.

MGA Research Corporation-Calibration Certificate

ACCELEROMETER

Reference		Sensor	
Name:	Accel Standard	Name:	MGA MI
Model #	352C03	Manufacturer	Endevco
Serial #:	95980	Model #:	7264-2000
Capacity:	G's:250	Serial #:	J22664
Calibration Date:	8/21/2009	Capacity/Range:	2,000 (G's)
Calibrated By:	Schober		

Calibration Date: 2/17/2010

New DLR(Units:G'S) ¹ 95.2
100K SHUNT

Linearity: ² 0.99973

New vs Old Sensitivit
(% Difference) 0.6

Temperature: 70 °F

Humidity: 25 %

Sensitivity (mV/V/G): 0.026097

Calibrated By: Chris Collins

Signature: Chris Collins

Approved by: Aben A. Kalata

1. Actual data of reference and sensor instruments is found in calibration files

2. Linearity is defined as $1 - (\text{Standard Deviation} / \text{Mean})$

All calibrations are traceable to the National Institute of Standards and Technology

Calibration uncertainty no greater than 4.0% at the 95% confidence level.

MGA Research Corporation-Calibration Certificate

ACCELEROMETER

Reference		Sensor	
Name:	Accel Standard	Name:	MGA MI
Model #	352C03	Manufacturer	Endevco
Serial #:	95980	Model #:	7264-2000
Capacity:	G's:250	Serial #:	J35924
Calibration Date:	8/21/2009	Capacity/Range:	2,000 (G's)
Calibrated By:	Schober		

Calibration Date: 2/17/2010

New DLR(Units:G'S) ¹ 93.8
100K SHUNT

Linearity:² 0.99915

New vs Old Sensitivit
(% Difference) -0.1

Temperature: 70 °F

Humidity: 25 %

Sensitivity (mV/V/G): 0.026486

Calibrated By: Chris Collins

Signature: Chris Collins

Approved by: Aben A. Kalate

1. Actual data of reference and sensor instruments is found in calibration files

2. Linearity is defined as $1 - (\text{Standard Deviation} / \text{Mean})$

All calibrations are traceable to the National Institute of Standards and Technology

Calibration uncertainty no greater than 4.0% at the 95% confidence level.

MGA Research Corporation-Calibration Certificate

ACCELEROMETER

Reference		Sensor	
Name:	Accel Standard	Name:	MGA MI
Model #	352C03	Manufacturer	Endevco
Serial #:	95980	Model #:	7264-2000
Capacity:	G's:250	Serial #:	AHTB2
Calibration Date:	8/21/2009	Capacity/Range:	2,000 (G's)
Calibrated By:	Schober		

Calibration Date: 2/17/2010

New DLR(Units:G'S) ¹ 116.9
100K SHUNT

Linearity:² 0.99971

New vs Old Sensitivit
(% Difference) 0.3

Temperature: 70 °F

Humidity: 25 %

Sensitivity (mV/V/G): 0.021276

Calibrated By: Chris Collins

Signature: Chris Collins

Approved by: Heena K. Kato

1. Actual data of reference and sensor instruments is found in calibration files

2. Linearity is defined as $1 - (\text{Standard Deviation} / \text{Mean})$

All calibrations are traceable to the National Institute of Standards and Technology

Calibration uncertainty no greater than 4.0 % at the 95% confidence level.

MGA Research Corporation-Calibration Certificate

ACCELEROMETER

Reference		Sensor	
Name:	Accel Standard	Name:	MGA MI
Model #	352C03	Manufacturer	Endevco
Serial #:	95980	Model #:	7264-2000
Capacity:	G's:250	Serial #:	J14103
Calibration Date:	8/21/2009	Capacity/Range:	2,000 (G's)
Calibrated By:	Schober		

Calibration Date: 2/17/2010

New DLR(Units:G'S) ¹ 94.2
100K SHUNT

Linearity: ² 0.99963

New vs Old Sensitivit
(% Difference) 0.2

Temperature: 70 °F

Humidity: 25 %

Sensitivity (mV/V/G): 0.026374

Calibrated By: Chris Collins

Signature: Chris Collins

Approved by: Heaven D. Kaleski

1. Actual data of reference and sensor instruments is found in calibration files

2. Linearity is defined as $1 - (\text{Standard Deviation} / \text{Mean})$

All calibrations are traceable to the National Institute of Standards and Technology

Calibration uncertainty no greater than 4.0% at the 95% confidence level.

MGA Research Corporation-Calibration Certificate

ACCELEROMETER

Reference	Sensor
Name: Accel Standard	Name: MGA MI
Model #: 352C03	Manufacturer: Endeveco
Serial #: 95980	Model #: 7264-2000
Capacity: G's:250	Serial #: J35800
Calibration Date: 8/21/2009	Capacity/Range: 2,000 (G's)
Calibrated By: Schober	

Calibration Date: 2/17/2010

New DLR(Units:G'S) ¹ 98.2
100K SHUNT

Linearity:² 0.99961

New vs Old Sensitivit (% Difference) 0.4

Temperature: 70 °F

Humidity: 25 %

Sensitivity (mV/V/G): 0.02528

Calibrated By: Chris Collins

Signature: Chris Collins

Approved by: Heard Kalata

1. Actual data of reference and sensor instruments is found in calibration files

2. Linearity is defined as 1- (Standard Deviation/ Mean)

All calibrations are traceable to the National Institute of Standards and Technology

Calibration uncertainty no greater than 4.0% at the 95% confidence level.

MGA Research Corporation-Calibration Certificate

ACCELEROMETER

Reference		Sensor	
Name:	Accel Standard	Name:	MGA MI
Model #	352C03	Manufacturer	Endevco
Serial #:	95980	Model #:	7264-2000
Capacity:	G's:250	Serial #:	J22700
Calibration Date:	8/21/2009	Capacity/Range:	2,000 (G's)
Calibrated By:	Schober		

Calibration Date: 3/12/2010

New DLR(Units:G'S) ¹ 96.5
100K SHUNT

Linearity:² 0.99962

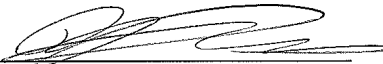
New vs Old Sensitivit
(% Difference) 0.7

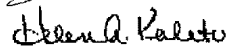
Temperature: 69 °F

Humidity: 46.9

Sensitivity (mV/V/G): 0.025769

Calibrated By: Ryan Jones

Signature: 

Approved by: 

1. Actual data of reference and sensor instruments is found in calibration files

2. Linearity is defined as $1 - (\text{Standard Deviation} / \text{Mean})$

All calibrations are traceable to the National Institute of Standards and Technology

Calibration uncertainty no greater than 4.0 % at the 95% confidence level.

MGA Research Corporation-Calibration Certificate

ACCELEROMETER

Reference		Sensor	
Name:	Accel Standard	Name:	MGA MI
Model #	352C03	Manufacturer	Endevco
Serial #:	95980	Model #:	7264-2000
Capacity:	G's:250	Serial #:	J36197
Calibration Date:	8/21/2009	Capacity/Range:	2,000 (G's)
Calibrated By:	Schober		

Calibration Date: 3/12/2010

New DLR(Units:G'S) ¹ 109.5
100K SHUNT

Linearity:² 0.99976

New vs Old Sensitivit
(% Difference) 0.5

Temperature: 69 °F

Humidity: 46.9

Sensitivity (mV/V/G): 0.022699

Calibrated By: Ryan Jones

Signature: _____

Approved by: _____

1. Actual data of reference and sensor instruments is found in calibration files

2. Linearity is defined as $1 - (\text{Standard Deviation} / \text{Mean})$

All calibrations are traceable to the National Institute of Standards and Technology

Calibration uncertainty no greater than 4.0 % at the 95% confidence level.

MGA Research Corporation-Calibration Certificate

ACCELEROMETER

Reference		Sensor	
Name:	Accel Standard	Name:	MGA MI
Model #:	352C03	Manufacturer:	Endevco
Serial #:	95980	Model #:	7264-2000
Capacity:	G's:250	Serial #:	J36353
Calibration Date:	8/21/2009	Capacity/Range:	2,000 (G's)
Calibrated By:	Schober		

Calibration Date: 3/12/2010

New DLR(Units:G'S) ¹ 99.5
100K SHUNT

Linearity:² 0.99945

New vs Old Sensitivit (% Difference) 0.6

Temperature: 69 °F

Humidity: 46.9

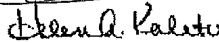
Sensitivity (mV/V/G): 0.024972

Calibrated By: Ryan Jones

Signature: _____



Approved by: _____

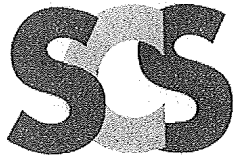


1. Actual data of reference and sensor instruments is found in calibration files

2. Linearity is defined as $1 - (\text{Standard Deviation} / \text{Mean})$

All calibrations are traceable to the National Institute of Standards and Technology

Calibration uncertainty no greater than 4.0 % at the 95% confidence level.



Certificate of Calibration

Schober Calibration Service, Inc.

28265 Beek Road, Unit C-22

Wixom, MI 48393

Phone: (248) 735-9600 FAX: (248) 735-9646



CALIBRATION 1563.01

Certificate Number: 0002580:1249117013

CUSTOMER: MGA Research Corporation

Calibration Location: In House

446 Executive Drive
Troy MI 48083

Contact: Thomas Hutter

Equipment Calibrated

Manufacturer: PCB	Date Received: 07/31/2009
Description: Accelerometer	Date Calibrated: 08/01/2009
Model Number: 352C03	Calibration Due Date: 08/01/2010
Serial Number: 95980	Calibration Procedure: CP0003
Asset Number:	Revision:
Received Status: Good	Performed By: Al Schober

Condition as Received: In Tolerance

Condition as Returned: In Tolerance

Notes:

Ambient Calibration Conditions

Ambient Temperature: 22 °C Relative Humidity: 51 % RH Barometric Pressure: mbar

Calibration Equipment Used

Asset Number:	Manufacturer:	Model:	Serial:	Cal Due:
RMS002	PCB	301A03	254	12 Jun 2010
RMS003	PCB	353B04	37067	09 Jun 2010
RMS005	Beran	801A	9506	18 Mar 2010
RMS006	Beran	801B	9701	18 Mar 2010
RMS007	Beran	475	182340	18 Mar 2010

The Uncertainty is estimated using expanded uncertainties and coverage factor (k) of 2, providing a confidence level of approximately 95%.
This calibration is traceable to the international system of units (SI) through standards calibrated by accredited laboratories, or through standards calibrated at NIST. This laboratory meets the requirements of ISO/IEC 17025-2005 and ANSI/NCSL Z540-1-1994. This certificate shall not be reproduced, except in full, without prior written approval by Schober Calibration Service.
Calibration interval determined by the customer. When determining the calibration interval, the customer should take into consideration that any number of factors may cause the calibration item to drift out of calibration before the calibration interval has expired.
The results herein apply only to the calibration of the item described above. No sampling plan was used for this calibration.

Approved By:

Quality Manager

Date:

8-21-09

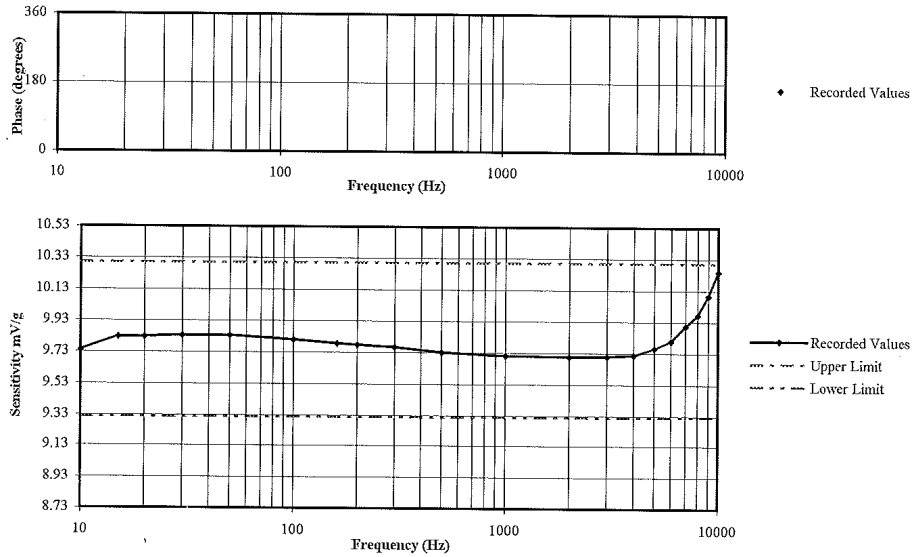
8/21/09
THH

Serial Number: 95980

Date: 8/1/09

Specifications: Nominal Sensitivity: 10mV/g±5%
 Frequency Reponse: 10 to 10000Hz ±5%

Results: Measured Nominal Sensitivity: 9.812 mV/g at 100 Hz 1 g Peak
 Test Profile: 10Hz - 10000Hz



Frequency Hz	Sensitivity mV/g	Phase Deg	Frequency Hz	Sensitivity mV/g	Phase Deg	Frequency Hz	Sensitivity mV/g	Phase Deg
10	9.74	-178.3°	300	9.76	-179.0°	7000	9.90	-178.9°
15	9.83	-178.5°	500	9.73	-179.1°	8000	9.97	-178.9°
20 [†]	9.83	-178.7°	1000	9.71	-179.0°	9000	10.09	-178.9°
30	9.84	-178.8°	2000	9.70	-179.0°	10000	10.25	-179.0°
50	9.84	-179.0°	3000	9.71	-178.9°	0	0.00	0.0°
100	9.81	-179.0°	4000	9.72	-178.9°	0	0.00	0.0°
160 [†]	9.79	-179.0°	5000	9.76	-179.1°	0	0.00	0.0°
200 [†]	9.78	-179.0°	6000 [†]	9.81	-179.0°	0	0.00	0.0°

[†] These frequencies are not traceable to NIST.

* These measurements are not within manufacturers stated specifications.

JMB
 8/1/09

Calibration Certificate

Part Description: Silver Certification Date: 10/1/2009 Serial#: S08-05-98-01273
PROPERTY
 Single Point - (Max-Min)/2 Specification: S08-05 .076mm (.0030") Certificate#: S0127940087
 Volumetric (Max Deviation) Specification: S08-05 +/- .108mm (+/- .0042") Temperature: See attached data

Measurement Standards Traceability
 Ball Bar Kit Asset Number: 1039 Calibration Due: 1/7/2010 *SI Traceability: METAS-L20081128MG1

Thermometer Asset Number: TQ023 Calibration Due: 12/30/2009 *SI Traceability: NVLAP-ABC21083-1

Reference Sphere Asset Number: TQ1176 Calibration Due: 5/31/2010 *SI Traceability: NIST-821/279114-04

The artifacts above have been calibrated with a device traceable to the International System of Units (SI) through a National Metrological Institute (NMI) or through an ISO17025 Accredited Laboratory.
 Measurement uncertainty is 3.0 + 5.0X micrometers, where X = length in meters.
 Uncertainty is expressed at approximately a 95% Level of Confidence using k=2.00.

Calibration Results*

- 3 Single Point Articulation Tests at <=20%, 20%-80% and >=80% range.
- 1 Effective diameter sphere test.
- 20 Volumetric ball bar tests in 4 quadrants and 2 orientations.

*Calibration conforms to procedures developed in accordance with ASME B89.4.23-2004. See attached data for measurement results.

Instrument condition as received:

Inoperative

Instrument condition upon leaving:

Within specifications

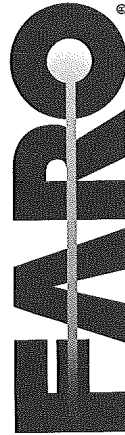
Technician: [Signature] Date: 10/1/09
 Harry Van Horn

This certificate shall not be reproduced, except in full, without permission of FARO Technologies, Inc.
 The results of this certificate apply only to the items calibrated or tested.

FARO Technologies, Inc.
 PH: 1-800-736-2771
 PH: 407-333-9911
 FAX: 407-333-8056
 L-A-B Cert Number: L1147-1

125 Technology Park
 Lake Mary, FL 32746
 USA

[Signature] 10/15/09





4700 Barden Court SE, Kentwood MI 49512, Telephone: 616-698-3124, Fax: 616-698-2364, www.metrocal.com

Certificate of Calibration

MGA Research
 446 Executive Drive
 Troy, MI 48083

Order Number: **67210**
 Certificate Number: **100216801**
 Page: **1 of 1**

Gauge Number: **MGA00048**
 Gauge Desc: **Digital Protractor**
 Manufacturer: **Mitutoyo**
 Model Number: **Pro 360**
 Serial Number: **N/A**

Customer PO: **N/A**
 Last Calibration: **12/12/08**
 Calibration Date: **2/16/10**
 Next Calibration: **2/16/11**

As Found Condition: **In Tolerance**

As Left Condition: **In Tolerance**

MetroCal, Inc maintains reference standards of measurement which are traceable to the National Institute of Standards and Technology, or other authorized National Standards. Calibration was performed in accordance with MetroCal Procedure CP045 and complies with the ANSI/NCSL Z540-1 and ISO/IEC 17025 Standards. Results shall not be reproduced, except in full, without the written approval of MetroCal, Inc. Results relate only to the item(s) calibrated. Any number of factors may cause the calibration item to drift out of calibration before the recommended interval has expired. Statements of compliance made using simple acceptance rule.

<u>Standard Used</u>	<u>Cal Date</u>	<u>Due Date</u>	<u>Traceable No.</u>	<u>Calibration Procedure</u> <u>Uncertainty Expressed at</u> <u>95% confidence (K=2)</u>
Gage Blk Set ID# 24281	1/4/10	1/4/11	Cert# 100104801	0.0015°
DoAll Sine Bar ID#1879	1/21/10	1/21/11	Cert# 100121125	0.0015°

Results:

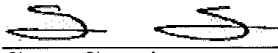
<u>Units</u>	<u>As Found Readings</u>		
	<u>Nominal</u>	<u>Actual</u>	<u>Deviation</u>
5.00	5.00	5.1	0.10
10.00	10.00	10.1	0.10
20.00	20.00	20.0	0.00
30.00	30.00	30.1	0.10
40.00	40.00	40.1	0.10

Reference Level Check: Within ± 0.1 degrees

<u>As Left Readings</u>		
<u>Nominal</u>	<u>Actual</u>	<u>Deviation</u>
5.00	5.1	0.10
10.00	10.1	0.10
20.00	20.0	0.00
30.00	30.1	0.10
40.00	40.1	0.10

Reference Level Check: Within ± 0.1 degrees

Comments: Environmental conditions during calibration: 68 °F, 40% RH.

 Issued: 2/16/10
 Shannon Shoemaker
 Calibration Technician

Checked box indicate this calibration was performed at the customers facility.

@ 2/22/10

MICHIGAN OPERATIONS
 DATE: 2/7/04
 SUPERCEDES: MGATPTMC.5

DOC. NO.: MGATPTMC
 REVISION NO.: 6
 PAGE 3 OF 3

Tape Measure Calibration Certificate

Reference Steel Rule

Brand: GEI
 S/N: MBA 00067
 Calibration Date: 1/23/09

Subject Tape Measure

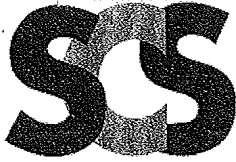
Brand: GW SHALE
 S/N: TPM 926
 Calibration Date: 5/26/09

Reference in (mm)	Subject Tape Measure	Difference	Reference in (mm)	Subject Tape Measure	Difference
0 (0)	0	0	18 (450)	450	0
1 (25)	25	0	19 (475)	475	0
2 (50)	50	0	20 (500)	500	0
3 (75)	75	0	21 (525)	525	0
4 (100)	100	0	22 (550)	550	0
5 (125)	125	0	23 (575)	575	0
6 (150)	150	0	24 (600)	600	0
7 (175)	175	0	25 (625)	625	0
8 (200)	200	0	26 (650)	650	0
9 (225)	225	0	27 (675)	675	0
10 (250)	250	0	28 (700)	700	0
11 (275)	275	0	29 (725)	725	0
12 (300)	300	0	30 (750)	750	0
13 (325)	325	0	31 (775)	775	0
14 (350)	350	0	32 (800)	800	0
15 (375)	375	0	33 (825)	825	0
16 (400)	400	0	34 (850)	850	0
17 (425)	425	0	35 (875)	875	0

If all differences are $\pm 1/32$ of an inch (1 mm), then the tape measure is acceptable.
 Pass Fail Maximum Difference = 0

Date: 5/26/09 Performed By: [Signature]

All calibrations are traceable to the National Institute of Standards and Technology. Estimated uncertainty of the measurement is $\pm 0.2\%$. All certification data and equipment are on file for inspection at your request. Best uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor k=2.



Certificate of Calibration

Schober Calibration Service, Inc.

2550 Oakley Park Road, Suite #300
Walled Lake, MI 48390

Phone: (248) 926-6000 FAX: (248) 926-6006



CALIBRATION 1563.01

Certificate Number: 0001591:1244035380

CUSTOMER: MGA Research Corporation Calibration Location: **On-site**
446 Executive Drive
Troy MI 48083
Contact: Thomas Hutter

Equipment Calibrated

Manufacturer: Dickson **Date Received:** 06/03/2009
Description: Temp/Humidity Recorder **Date Calibrated:** 06/03/2009
Model Number: FH125 **Calibration Due Date:** 06/03/2010
Serial Number: 06163263 **Calibration Procedure:** CP0001
Asset Number: MGA00152 **Revision:**
Received Status: Good **Performed By:** P. Vella

Condition as Received: In Tolerance

Condition as Returned: In Tolerance

Notes:

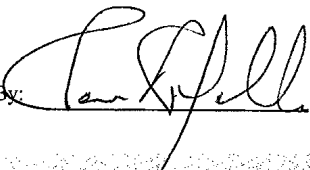
Ambient Calibration Conditions

Ambient Temperature: 23 °C **Relative Humidity:** 45 % RH **Barometric Pressure:** mbar

Calibration Equipment Used

Asset Number:	Manufacturer:	Model:	Serial:	Cal Due:
RMS042	Fluke/Hart	1502A	A6C537	24 Apr 2010
RMS043	Hart Scientific	5614	778109	24 Apr 2010
RMS045	Vaisala	HMP76	C0630009	27 Mar 2010

The Uncertainty is estimated using expanded uncertainties and coverage factor (k) of 2, providing a confidence level of approximately 95%.
This calibration is traceable to the international system of units (SI) through standards calibrated by accredited laboratories, or through standards calibrated at NIST. This laboratory meets the requirements of ISO/IEC 17025-2005 and ANSI/NCSL Z540-1-1994. This certificate shall not be reproduced, except in full, without prior written approval by Schober Calibration Service.
Calibration interval determined by the customer. When determining the calibration interval, the customer should take into consideration that any number of factors may cause the calibration item to drift out of calibration before the calibration interval has expired.
The results herein apply only to the calibration of the item described above. No sampling plan was used for this calibration.

Approved By:  Quality Manager

Date: 7-29-09

7/29/09

Calibration Data

MFG/MODEL: Dickson / FH125 Serial / ID #: 06163263 / MGA00152

Customer: MGA Research Date Calibrated: 06/03/09

Certificate No.: 0001591:1244035380

All calculations and data transfers have been reviewed for accuracy and completeness

Range	Nominal	Lower Limit	As Found	As Left	Upper Limit
Data Logger with Sensor System Tests					
Channel 1					
	-22.8° C	-23.8° C	-23.2° C	-23.2° C	-21.8° C
	23.8° C	22.8° C	24.0° C	24.0° C	24.8° C
	39.6° C	38.6° C	38.8° C	38.8° C	40.6° C
Channel 2 (RH @ 21° C)					
	41.4 %rh	39.4 %rh	42.8 %rh	42.8 %rh	43.4 %rh
	72.4 %rh	70.4 %rh	74.1 %rh	74.1 %rh	74.4 %rh
Calibration Performed By: P. Vella					

Bold Font Indicates Out Of Tolerance Condition.
 Temperature Measurement Standard Uncertainty $U_{temp} = 0.65^{\circ}C$
 Relative Humidity Measurement Standard Uncertainty $U_{rh} = 2.22\%$

Unless otherwise noted
 As Found = As Left

Calibration Data Report
 (Non-Automated)
 IF0097

Page 2 of 2

PVA
 7/17/09



4700 Barden Court SE, Kentwood MI 49512, Telephone: 616-698-3124, Fax: 616-698-2364, www.metrocal.com

Certificate of Calibration

MGA Research
 446 Executive Drive
 Troy, MI 48083

Order Number: **65274**
 Certificate Number: **090814711**
 Page: 1 of 1

Gauge Number: **MGA00783**
 Gauge Desc: **0 to 20 lb. X .01 lb. Digital Scale**
 Manufacturer: **Detecto**
 Model Number: **AP-20**
 Serial Number: **E10807-0187**

Customer PO: **A071735**
 Last Calibration: **7/24/08**
 Calibration Date: **8/14/09**
 Next Calibration: **8/14/10**

As Found Condition: **See Results**

As Left Condition: **See Results**

MetroCal Inc. maintains reference standards of measurement which are traceable to the National Institute of Standards and Technology, or other authorized National Standards. Calibration was performed in accordance with MetroCal Procedure CP042 and relevant sections of the manufacturer's manual. This calibration complies with ISO/IEC 17025 and ANSI/NC SL Z540-1 Standards. Results shall not be reproduced except in full without the written approval of MetroCal Inc. Results relate only to the item(s) calibrated. Any number of factors may cause the calibration item to drift out of calibration before the recommended interval has expired. Statements of compliance made using simple acceptance rule.

Calibration Procedure
Uncertainty Expressed at
95% confidence, (K=2)
 +/-0.001% of Load

Standard Used
 Weight Set ID# 2463

Cal. Date
 9/3/08

Due Date
 9/3/10

Traceable No.
 MI-07-07-8945

Results:
 Tolerance used: Class III

Units: lbs		TI Division/Increment: .01 lb.					
Weight Test	Nominal	As Found			As Left		
		Indication	Deviation		Nominal	Indication	Deviation
0-25% fs	5.00	5.01	0.01		5.00	5.01	0.01
26-50% fs	10.00	10.02	0.02		10.00	10.02	0.02
51-75% fs	15.00	15.02	0.02		15.00	15.02	0.02
76-100% fs	20.00	20.03	0.03		20.00	20.03	0.03
Shift Test:	Pass				Shift Test:	Pass	
Half Load Test:	Pass				Half Load Test:	Pass	

Comments: Environmental conditions during calibration: 68 °F, 40 % RH.

Bill Rinzema

Bill Rinzema
 Calibration Technician

Issued: 8/17/09

Checked box indicate this calibration was performed at the customers facility.

@ 8/18/09

Sterling Scale Co., Inc.
 20950 Boening St.
 Southfield, MI 48075

Certificate of Calibration

F410/12-3
 Rev. Date 11/23/05



calibration cert. 1448.01

Customer: MGA Cert# O9-5841 Temp/Humidity: 75/35
 Location of Calibration: 2839 Elliott Troy, MI 48083
 Calibration Date: 7/27/2009 Cal Due: Jul-10 Condition of Item: fair
 Equipment Make: Intercomp Model: SWD-Deluxe Serial/ID: 26032389 Capacity: 2200lb x 1lb

Applied Test Wt	Before Adus	Tolerance	In-Tolerance Y/N	After Adjustment	In-Tolerance Y/N	Unc
RF 100lb	100lb	1lb	y	100lb	y	.11lb
2000lb	2000lb	2lb	y	2000lb	y	.5lb
LF 100lb	100lb	1lb	y	100lb	y	.11lb
2000lb	2000lb	2lb	y	2000lb	y	.5lb
RR 100lb	100lb	1lb	y	100lb	y	.11lb
2000lb	2000lb	2lb	y	2000lb	y	.5lb
LR 100lb	100lb	1lb	y	100lb	y	.11lb
2000lb	2000lb	2lb	y	2000lb	y	.5lb

shift test
 N/A

Platform #1 Platform #2 Platform #3

Pass Pass Pass
 Fail Fail Fail

Tests performed: Repeat Linearity Sensitivity Discrimination

Technician: _____
 COMMENTS/
 weights used: Scale pass all test perform on it
 Scale have stable zero & weight reading.
 Our test weights are on file.

Scale Certified Scale Rejected

Sterling Scale Service Rep Wayne Date: 7/27/2009 1 of 1

The above item has been calibrated using the relevant EPO or OEM procedures utilizing test weights
 Traceable to International Systems of Units (SI), through the Michigan Department of Agriculture.
 Test numbers on file. Expanded uncertainty (k=2) confidence level of 95% as reported.
 Results relate only to items listed.
 The reported uncertainty is valid only for the environment in which it is determined.
 Any number of factors may cause the item to drift out of calibration before recommended interval has expired
 This report shall not be reproduced, except in full without approval of the laboratory
 Tolerances followed are maintenance/acceptance per HB 44 or as determined by the customer

7/27/09
 HAK