

FINAL REPORT NUMBER 201UI-MGA-11-09

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

**BAYERISCHE MOTORENWERKE AG
2011 BMW X3 xDrive28i
NHTSA No. CB0505**

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



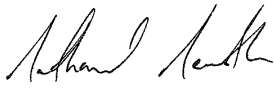
Test Dates: May 19-20, 2011
Report Date: May 23, 2011


FINAL REPORT

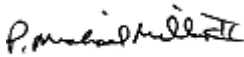
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NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
ENFORCEMENT
OFFICE OF VEHICLE SAFETY COMPLIANCE
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16. Abstract A compliance test series was conducted on the subject 2011 BMW X3 xDrive28i, NHTSA No. CB0505, 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 May 19-20, 2011. Test failures identified were as follows: None The data recorded indicates that the 2011 BMW X3 xDrive28i 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 2011 BMW X3 xDrive28i, meets the performance requirements of FMVSS 201, Occupant Protection in Interior Impact - Upper Interior Head Impact Protection.

Tests were conducted on May 19-20, 2011 on a 2011 BMW X3 xDrive28i, manufactured by Bayerische Motorenwerke AG.

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 November 9, 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 9, 2009.

2.0 COMPLIANCE TEST DATA SUMMARY

The 2011 BMW X3 xDrive28i was equipped with A, B, O, and rear-pillars, a fixed seat belt anchorage on each B-pillar, and grab handles located above each door (front and rear).

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	OP1	SR2A	UR2@SR2A
BP2	OP2	SR3-3	UR5@SR3-2
BP3	FH1	UR1@SR1	UR6@OP

The 2011 BMW X3 xDrive28i 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: 2011 BMW X3 xDrive28i

VEH. NHTSA NO.: CB0505 VIN: 5UXWX5C5XBL701199 COLOR: Vermillion Red Met.

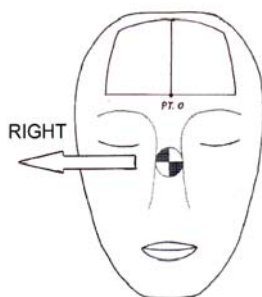
VEH. BUILD DATE: February, 2011 TEST DATES: May 19-20, 2011

TEST LABORATORY: MGA Research Corporation

OBSERVERS: Helen Kaleto, Nathaniel Newth, Kevin McKenna, Sean Moran, Ryan Jones

TARGET	VEHICLE SIDE	HORIZONTAL ANGLE (deg)	VERTICAL ANGLE (deg)	VELOCITY (kph)	HIC(d)	FMH HIC	IMPACT ON FMH (mm)	
							Above	Left/Right
AP2	Right	158	45	18.9	337	226	19	4 Left
BP2	Left	270	-9	23.7	708	717	23	0
BP3	Right	77	-8	23.9	672	670	25	2 Left
OP1	Left	270	24	18.4	665	660	58	3 Right
OP2	Right	90	0	24.0	578	545	8	11 Right
FH1	Left	180	50	23.5	558	519	23	5 Left
SR2A	Left	270	48	18.9	506	450	37	1 Left
SR3-3	Right	90	50	19.0	933	1015	34	5 Right
UR1@SR1	Left	270	50	23.7	499	441	27	7 Right
UR2@SR2A	Right	90	50	23.8	565	528	26	0
UR5@SR3-2	Left	270	50	24.1	613	593	34	7 Left
UR6@OP	Right	90	50	24.0	564	527	31	2 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 Right: Dislodged trim.

BP3 Right: Dislodged trim.

SR2A Left: Grab handle depression.

UR5@SR3-2 Left: Dislodged headliner.

UR6@OP Right: Dislodged headliner.

REMARKS:

The targets listed were impacted in the following order:

Left: FH1, UR1@SR-1, SR2A, BP2, UR5@SR3-2, OP1

Right: AP2, BP3, UR2@SR2-A, OP2, UR6@OP, SR3-3

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

RECORDED BY: Nathaniel Newth

DATE: May 20, 2011

APPROVED BY: Helen A. Kaleto

TABLE 2-2

GENERAL TEST AND VEHICLE PARAMETER DATA

VEH. MOD YR/MAKE/MODEL/BODY: 2011 BMW X3 xDrive28i

VEH. NHTSA NO.: CB0505 VIN: 5UXWX5C5XBL701199 COLOR: Vermillion Red Met.

VEH. BUILD DATE: February, 2011 TEST DATES: May 19-20, 2011

TEST LABORATORY: MGA Research Corporation

OBSERVERS: Helen Kaleto, Nathaniel Newth, Kevin McKenna, Sean Moran, Ryan Jones

INTERIOR TRIM INFORMATION: A, B, O, and rear-pillars, a fixed seat belt anchorage on each B-pillar, and grab handles located above each door (front and rear).

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: March 15, 2011; Odometer Reading 56 miles

DATA FROM VEHICLE'S CERTIFICATION LABEL:

Vehicle Manufactured By: Bayerische Motorenwerke AG

Date of Manufacture: February, 2011; VIN: 5UXWX5C5XBL701199

GVWR: 2330 kg; GAWR FRONT: 1090 kg;

GAWR REAR: 1285 kg;

DATA FROM TIRE PLACARD:

Tire Pressure with Maximum Capacity Vehicle Load:

FRONT: 220 kPa REAR: 240 kPa

Recommended Tire Size: 245/50R18

Recommended Cold Tire Pressure:

FRONT: 220 kPa REAR: 240 kPa

Size of Tire on Test Vehicle: None

Type of Spare Tire: None; Space Saver: ; 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) = 410 kg

No. of Occupants x 68 kg = 340 kg

Rated Cargo/Luggage Weight (RCLW) = 70 kg (difference)

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

Right Front = 468.0 kg Right Rear = 473.0 kg

Left Front = 471.0 kg Left Rear = 462.0 kg

TOTAL FRONT = 939.0 kg TOTAL REAR = 935.0 kg

% Total Weight = 50.1 % % Total Weight = 49.9 %

TOTAL DELIVERED WEIGHT = 1874.0 kg

CALCULATION OF VEHICLE'S TARGET TEST WEIGHT:

Total Delivered Weight = 1874.0 kg

Max. Test Cargo/Luggage Weight = 70.0 kg

Target Test Weight = 1944.0 kg

WEIGHT OF TEST VEHICLE FULLY LOADED:

Right Front =	<u>460.5</u> kg	Right Rear =	<u>515.5</u> kg
Left Front =	<u>464.5</u> kg	Left Rear =	<u>503.5</u> kg
TOTAL FRONT =	<u>925.0</u> kg	TOTAL REAR =	<u>1019.0</u> kg
% Total Weight =	<u>47.6</u> %	% Total Weight =	<u>52.4</u> %

TOTAL TEST WEIGHT = 1944.0 kg

Weight of ballast secured in vehicle's cargo area = 70.0 kg

TEST VEHICLE ATTITUDE:

AS DELIVERED: Right Front 780 mm; Left Front 779 mm;
Right Rear 796 mm; Left Rear 797 mm;
Pitch Angle at Right Door Sill = 0.8 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 = 0.1 Left is higher

FULLY LOADED: Right Front 779 mm; Left Front 780 mm;
Right Rear 784 mm; Left Rear 785 mm;
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 = 0.0
Roll Angle at Rear Bumper = 0.1 Right is higher

AS TARGETED: Right Front 919 mm; Left Front 922 mm;
Right Rear 918 mm; Left Rear 920 mm;
Pitch Angle at Right Door Sill = 0.5 Rear is higher
Pitch Angle at Left Door Sill = 0.1 Rear is higher
Roll Angle at Front Bumper = 0.1 Right is higher
Roll Angle at Rear Bumper = 0.0

AS TESTED ON RIGHT 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 = 0.1 Right is higher
Roll Angle at Rear Bumper = 0.1 Left 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 = 0.0
Roll Angle at Rear Bumper = 0.1 Right is higher

VEHICLE WHEELBASE = 2811 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: Nathaniel Newth

DATE: May 13, 2011

APPROVED BY: Helen A. Kaleto

TABLE 2-3
HORIZONTAL IMPACT ANGLE RANGE FOR A AND B PILLARS

VEH. MOD YR/MAKE/MODEL/BODY: 2011 BMW X3 xDrive28i

VEH. NHTSA NO.: CB0505 VIN: 5UXWX5C5XBL701199 COLOR: Vermillion Red Met.

VEH. BUILD DATE: February, 2011 TEST DATES: May 19-20, 2011

TEST LABORATORY: MGA Research Corporation

OBSERVERS: Helen Kaleto, Nathaniel Newth, Kevin McKenna, Sean Moran, Ryan Jones

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 201.6°	L 251.7°
	R 105°-165°	R 108.2°	R 158.8°
B-PILLAR	L 195°-345°	L 205.0°	L 288.1°
	R 15°-165°	R 76.3°	R 155.6°

AS DETERMINED USING THE PROCEDURES SPECIFIED IN S8.13.4.1

REMARKS:

RECORDED BY: Nathaniel Newth

DATE: May 13, 2011

APPROVED BY: Helen A. Kaleto

TABLE 2-4

VERTICAL IMPACT ANGLE RANGES

VEH. MOD YR/MAKE/MODEL/BODY: 2011 BMW X3 xDrive28i

VEH. NHTSA NO.: CB0505 VIN: 5UXWX5C5XBL701199 COLOR: Vermillion Red Met.

VEH. BUILD DATE: February, 2011 TEST DATES: May 19-20, 2011

TEST LABORATORY: MGA Research Corporation

OBSERVERS: Helen Kaleto, Nathaniel Newth, Kevin McKenna, Sean Moran, Ryan Jones

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 35°
		R 0°-50°	R 0°	R 35°
	SR2A	L 0°-50°	L 0°	L 48°
		R 0°-50°	R 0°	R 48°
	SR2B	L 0°-50°	L 0°	L 48°
		R 0°-50°	R 0°	R 48°
	SR3-1	L 0°-50°	L 0°	L 50°
		R 0°-50°	R 0°	R 50°
	SR3-2	L 0°-50°	L 0°	L 50°
		R 0°-50°	R 0°	R 50°
	SR3-3	L 0°-50°	L 0°	L 50°
		R 0°-50°	R 0°	R 50°

		VERTICAL ANGLE SPECIFIED RANGE		MINIMUM VERTICAL ANGLE		MAXIMUM VERTICAL ANGLE		
A-PILLAR	AP1	L	-5°-50°	L	-5°	L	50°	
		R	-5°-50°	R	-5°	R	50°	
	AP2	L	-5°-50°	L	-5°	L	45°	
		R	-5°-50°	R	-5°	R	45°	
	AP3	L	-5°-50°	L	-5°	L	45°	
		R	-5°-50°	R	-5°	R	45°	
B-PILLAR	BP1	L	-10°-50°	L	-10°	L	14°	
		R	-10°-50°	R	-10°	R	14°	
	BP2*	L	-10°-50°	L	-10°	L	-9°	
		R	-10°-50°	R	-10°	R	-9°	
	BP3	L	-10°-50°	L	-10°	L	-8°	
		R	-10°-50°	R	-10°	R	-8°	
	BP4	L	-10°-50°	L	-10°	L	-6°	
		R	-10°-50°	R	-10°	R	-6°	
	OTHER PILLAR	OP1	L	-10°-50°	L	-10°	L	24°
			R	-10°-50°	R	-10°	R	24°
OP2		L	-10°-50°	L	-10°	L	0°	
		R	-10°-50°	R	-10°	R	0°	
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. *Target BP2 is a seat belt anchorage location treated as a pillar target with respect to horizontal and vertical angle ranges of Table 1, Approach Angle Limits.

RECORDED BY: Nathaniel Newth

DATE: May 13, 2011

APPROVED BY: Helen A. Kaleto

TABLE 2-5

TARGET MEASUREMENTS

VEH. MOD YR/MAKE/MODEL/BODY: 2011 BMW X3 xDrive28i

VEH. NHTSA NO.: CB0505 VIN: 5UXWX5C5XBL701199 COLOR: Vermillion Red Met.

VEH. BUILD DATE: February, 2011 TEST DATES: May 19-20, 2011

TEST LABORATORY: MGA Research Corporation

OBSERVERS: Helen Kaleto, Nathaniel Newth, Kevin McKenna, Sean Moran, Ryan Jones

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)}	108.3°	--
A1°	360° - T°	251.7°	--
W°	Horizontal < {CG-2 (Left Seat) to (Left A-Pillar)}	201.6°	--
A2°	A2° = W°	201.6°	--
U°	Horizontal < {CG-2 (Left Seat) to (Left B-Pillar)}	288.1°	--
B1°	B1° = U°	288.1°	--
V°	Horizontal < {CG-R (Left Seat) to (Left B-Pillar)}	205.0°	--
B2°	B2° = V°	205.0°	--
W° (right)	Horizontal < {CG-F2 (Right Seat) to (Right A-Pillar)}	--	158.8°
A1° (right)	A1° (right) = W° (right)	--	158.8°
T° (right)	Horizontal < {CG-F1 (Right Seat) to (Left A-Pillar)}	--	251.8°
A2° (right)	360°-T° (right)	--	108.2°
V° (right)	Horizontal < {CG-R (Right Seat) to (Right B-Pillar)}	--	155.6°
B1° (right)	B1° (right) = V° (right)	--	155.6°
U° (right)	Horizontal < {CG-F2 (Right Seat) to (Right B-Pillar)}	--	76.3°
B2° (right)	B2° (right) = U° (right)	--	76.3°
J	A-Pillar {(Plane 3) – (Plane 5)}	331.9 mm	327.6 mm
J/2	J ÷ 2	166.0 mm	163.8 mm
D1	Upper Roof {(Plane A) – (Plane B)}	2078.0 mm	
D1/2	D1 ÷ 2	1039.0 mm	

Measurement	Description	Left Side	Right Side
D2	Upper Roof {(Plane C) – (Plane D)}	1195.4 mm	
D2/2	D2 ÷ 2	597.7 mm	
.35D1	.35 x D1	727.3 mm	
.35D2	.35 x D2	418.4 mm	
N	B-Pillar {(BPR) – (lowest point on daylight opening forward of B-Pillar)}	458.5 mm	458.1 mm
N/2	B-Pillar {(BP3) – (lowest point on daylight opening forward of B-Pillar)}	229.3 mm	229.1 mm
N/4	B-Pillar {(BP4) – (lowest point on daylight opening forward of B-Pillar)}	114.6 mm	114.5 mm
Q	O-Pillar (Plane 13 – Plane 14)	401.1 mm	403.1 mm
Q/2	Q / 2	200.6 mm	201.6 mm
D	R-Pillar (Point 7 – Point M)	865.0 mm	865.0 mm
3D/7	3*D / 7	370.7 mm	370.7 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	1522.0	-375.0	309.0	1522.0	375.0	309.0
Rear	2352.0	-345.0	314.0	2352.0	345.0	314.0

SgRP Locations (vehicle coordinates)						
	Left (mm)			Right (mm)		
	x	y	z	x	y	z
Front	1522.0	-375.0	309.0	1522.0	375.0	309.0
Rear	2352.0	-345.0	314.0	2352.0	345.0	314.0

CG Locations (world coordinates)						
	Left (mm)			Right (mm)		
	x	y	z	X	y	z
CGF1	1432.0	-375.0	969.0	1432.0	375.0	969.0
CGF2	1682.0	-375.0	969.0	1682.0	375.0	969.0
CGR	2512.0	-345.0	974.0	2512.0	345.0	974.0

REFERENCE FOR VEHICLE COORDINATE SYSTEM (measured in millimeters):

Front driver seat outboard front anchorage (x, y, z) = 1190.2, -603.0, 91.7

Front passenger seat outboard front anchorage (x, y, z) = 1190.2, 603.0, 91.7

B-Pillar reference point (x, y, z) = 1625.0, -831.0, 75.0

REMARKS:

RECORDED BY: Nathaniel Newth

DATE: May 13, 2011

APPROVED BY: Helen A. Kaleto

TABLE 2-6
 SUMMARY OF TARGETING RESULTS

VEH. MOD YR/MAKE/MODEL/BODY: 2011 BMW X3 xDrive28i

VEH. NHTSA NO.: CB0505 VIN: 5UXWX5C5XBL701199 COLOR: Vermillion Red Met.

VEH. BUILD DATE: February, 2011 TEST DATES: May 19-20, 2011

TEST LABORATORY: MGA Research Corporation

OBSERVERS: Helen Kaleto, Nathaniel Newth, Kevin McKenna, Sean Moran, Ryan Jones

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	1258.2	-552.6	1079.0	--	--	Yes	--	--
REL	1271.7	-565.6	1061.2	251	50	--	1	No
AP2	1151.3	-591.3	992.0	202	45	No	--	No
AP3	1021.9	-618.4	912.9	202	45	No	--	No
A-Pillar Right Side								
AP1	1262.3	557.5	1075.6	--	--	Yes	--	--
REL	1279.9	568.3	1061.3	109	50	--	1	No
AP2	1145.4	592.5	988.2	158	45	No	--	Yes
AP3	1022.6	618.3	912.7	158	45	No	--	No
B-Pillar Left Side								
BP1	1851.7	-488.5	1158.6	270	14	No	--	No
BP2	1798.2	-622.1	910.9	270	-9	No	--	Yes
BP3	1748.4	-620.9	929.9	288	-8	No	--	No
BP4	1849.0	-645.2	816.3	205	-6	No	--	No
B-Pillar Right Side								
BP1	1855.4	488.1	1158.3	90	14	No	--	No
BP2	1803.3	619.6	912.9	90	-9	No	--	No
BP3	1751.1	620.0	929.8	77	-8	No	--	Yes

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					
BP4	1855.9	643.6	816.0	155	-6	No	--	No
Other Pillar Left Side								
OP1	2627.3	-469.1	1139.7	--	--	Yes	--	--
REL	2634.2	-468.6	1137.3	270	24	--	1	Yes
OP2	2674.3	-610.3	938.7	--	--	Yes	--	--
REL	2634.8	-601.0	965.1	270	0	--	2	No
Other Pillar Right Side								
OP1	2627.5	464.3	1141.7	--	--	Yes	--	--
REL	2637.5	463.5	1140.2	90	24	--	1	No
OP2	2679.4	605.4	939.2	--	--	Yes	--	--
REL	2638.6	595.4	969.2	90	0	--	2	Yes
Rear Pillar Left Side								
RP1*	3027.7	-511.9	1072.6	Target exempt from testing per S6.3(b).				No
RP2*	3050.9	-617.2	921.8	Target exempt from testing per S6.3(b).				No
Rear Pillar Right Side								
RP1*	3027.6	511.1	1075.0	Target exempt from testing per S6.3(b).				No
RP2*	3053.3	607.9	924.1	Target exempt from testing per S6.3(b).				No
Front Header Left Side								
FH1	1187.2	-446.6	1101.2	180	50	No	--	Yes
FH2	1170.0	-297.4	1108.3	180	50	No	--	No
Front Header Right Side								
FH1	1188.9	449.0	1102.0	180	50	No	--	No
FH2	1172.2	298.5	1109.9	180	50	No	--	No
Side Rail Left Side								
SR1	1408.3	-509.4	1135.5	270	35	No	--	No
SR2A	1558.9	-508.9	1177.0	--	--	Yes	--	--
REL	1588.4	-477.7	1162.2	270	48	--	2	Yes
SR2B	1551.2	-509.9	1176.9	--	--	Yes	--	--
REL	1515.3	-482.2	1153.7	270	48	--	2	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	2219.3	-509.4	1132.6	270	50	No	--	No
SR3-2	2390.0	-509.4	1124.6	270	50	No	--	No
SR3-3	2778.1	-505.1	1110.8	270	50	No	--	No
Side Rail Right Side								
SR1	1412.7	508.9	1133.0	90	35	No	--	No
SR2A	1562.3	509.7	1175.6	--	--	Yes	--	--
REL	1593.8	479.0	1161.1	90	48	--	2	No
SR2B	1554.5	510.5	1174.6	--	--	Yes	--	--
REL	1517.7	484.0	1153.4	90	48	--	2	No
SR3-1	2215.8	504.3	1132.8	90	50	No	--	No
SR3-2	2395.7	501.9	1124.6	90	50	No	--	No
SR3-3	2777.4	507.2	1114.3	90	50	No	--	Yes
Rear Header Left Side								
RH*	3021.4	-344.9	1090.0	Target exempt from testing per S6.3(b).				No
Rear Header Right Side								
RH*	3019.0	345.9	1094.3	Target exempt from testing per S6.3(b).				No
Upper Roof Left Side								
UR1@SR1	1416.0	-413.2	1149.5	270	50	No	--	Yes
UR3@BP	1850.1	-413.0	1168.4	270	50	No	--	No
UR5@SR3-2	2391.9	-410.2	1157.7	270	50	No	--	Yes
Upper Roof Right Side								
UR2@SR2A	1636.7	412.4	1169.0	90	50	No	--	Yes
UR4@SR3-1	2229.8	405.7	1160.3	90	50	No	--	No
UR6@OP	2569.5	407.4	1154.0	90	50	No	--	Yes

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

*Target is located rearward of a vertical plane 600 mm behind the rearmost design seating position and therefore is exempt from testing.

RECORDED BY: Nathaniel Newth

DATE: May 13, 2011

APPROVED BY: Helen A. Kaleto

3.0 TEST DATA (Including Acceleration and Velocity Plots)







SUMMARY OF FMVSS 201U TEST

JOB/NHTSA NO: G1117-001.9 VEHICLE YR/MAKE/MODEL:2011/DOT/NHTSA/BMW X3

GENERAL TEST PARAMETERS:

Target (Vehicle Side): AP2Right

MGA Test Reference No.:U11175

Approach Horizontal Angles:158°

Approach Vertical Angles:45°

Additional Description:

Test Number:#7

Temperature:22.1C

Humidity:58.9%

Time of Test:9:47:01 AM

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
337	226	11.3	18.9	19	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	-95.8	1.07	1.07
Y	6	J22664	94.2	0.85	0.85
Z	7	J35924	92.8	0.94	0.94

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

Dislodged trim

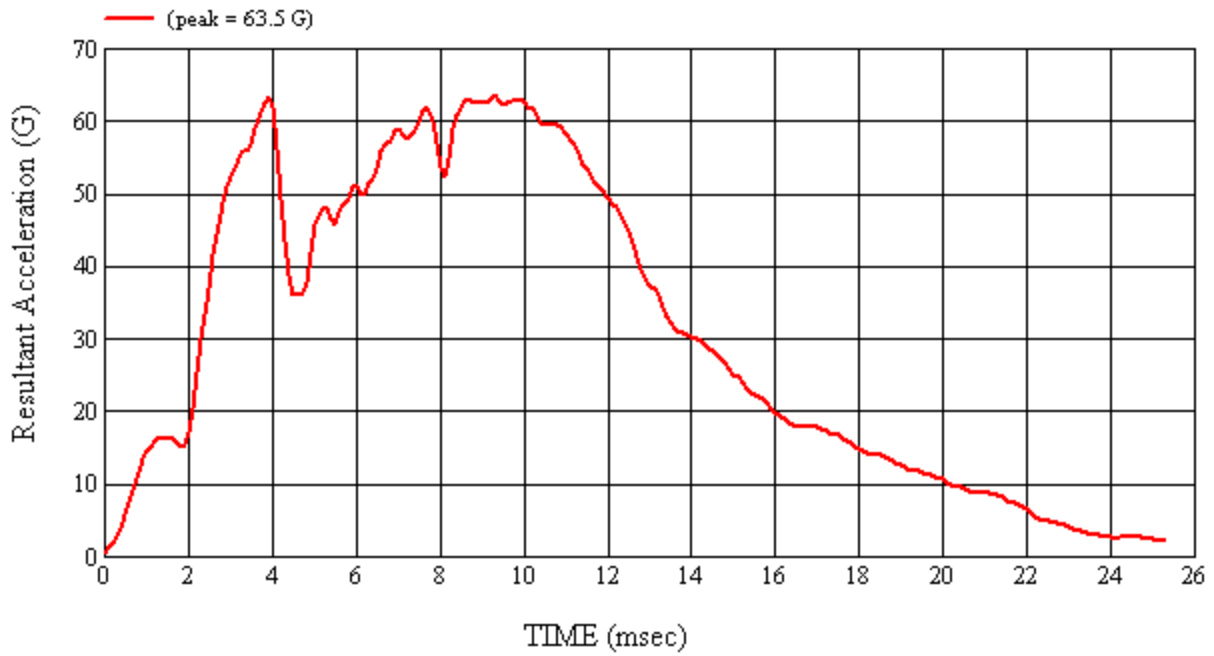
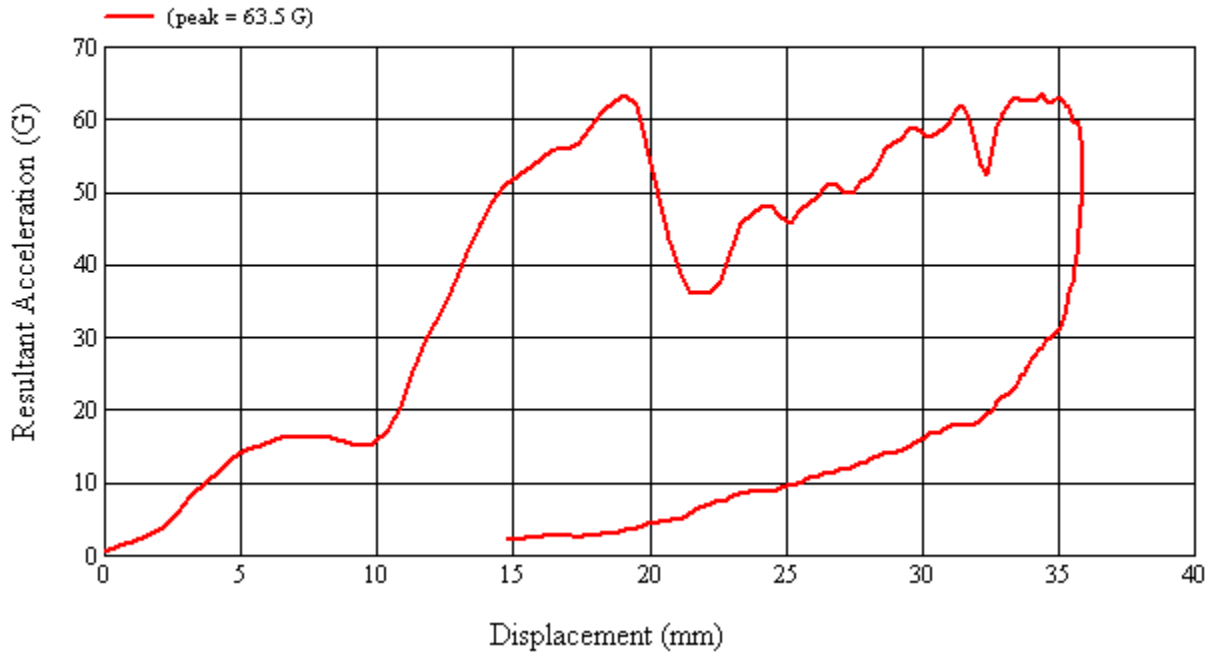
Recorded By:  Approved By*:  Date: 5/20/2011

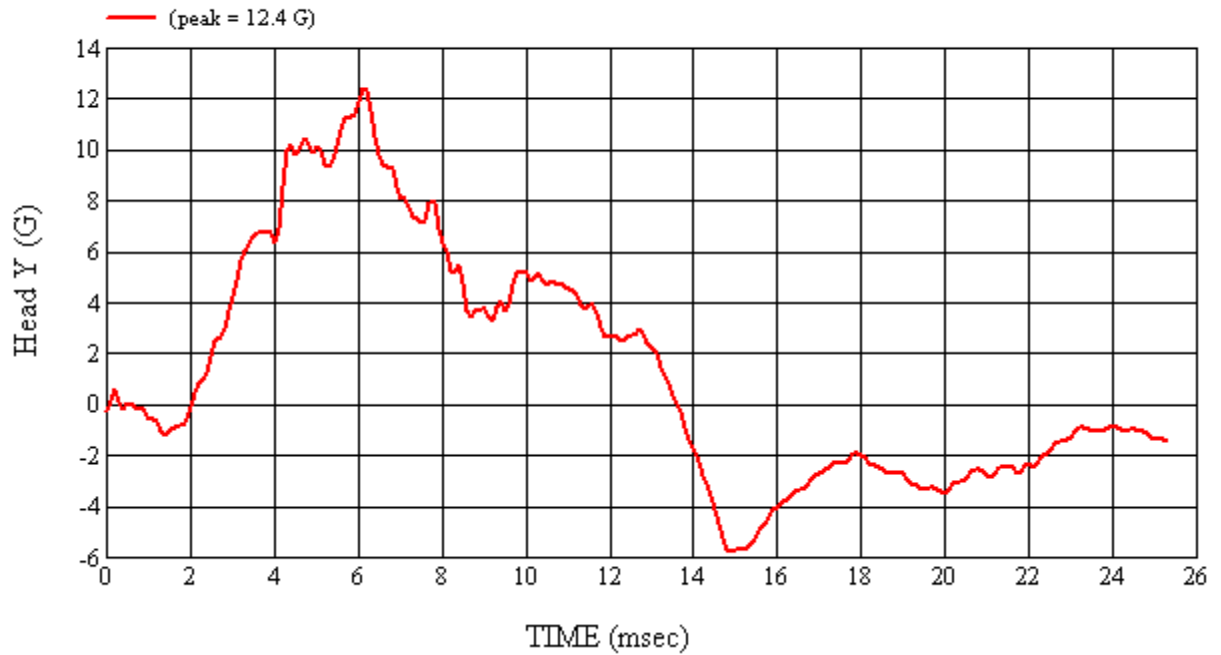
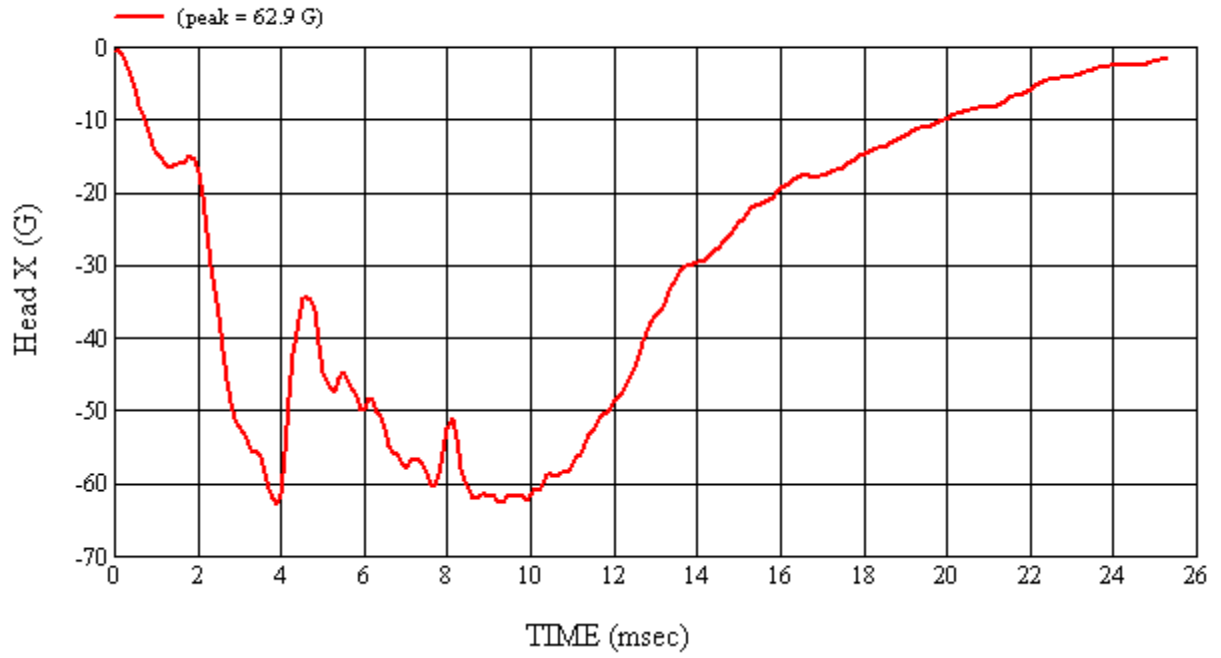
*Only necessary for NHTSA (Government) Compliance testing.

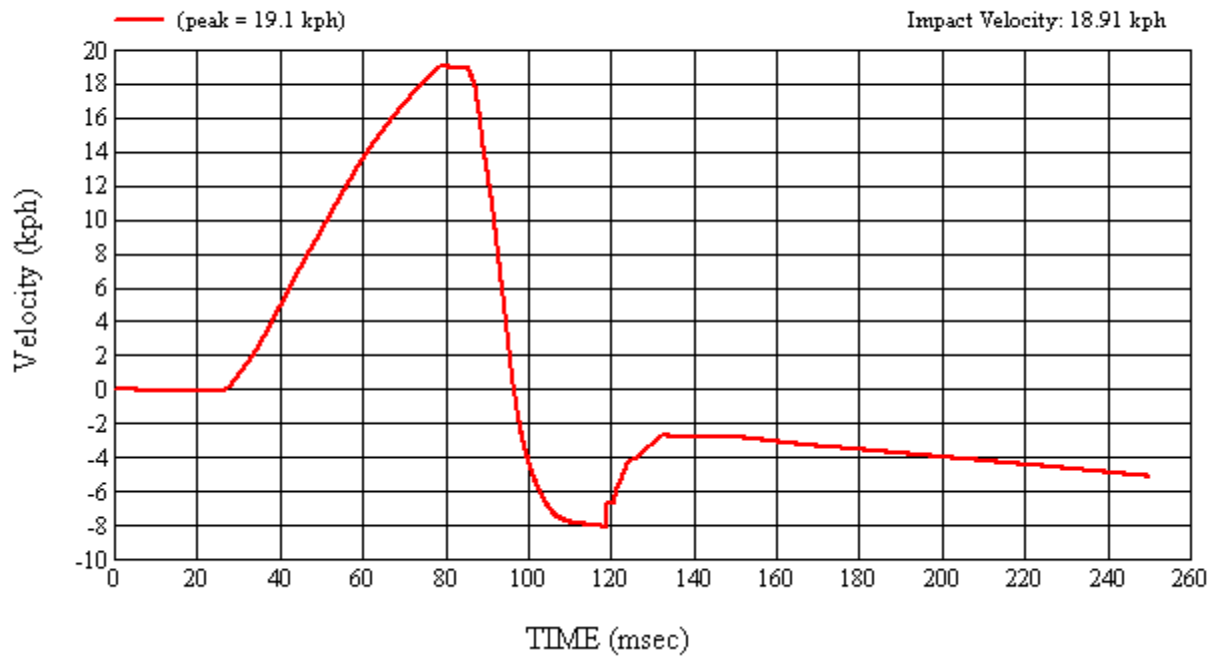
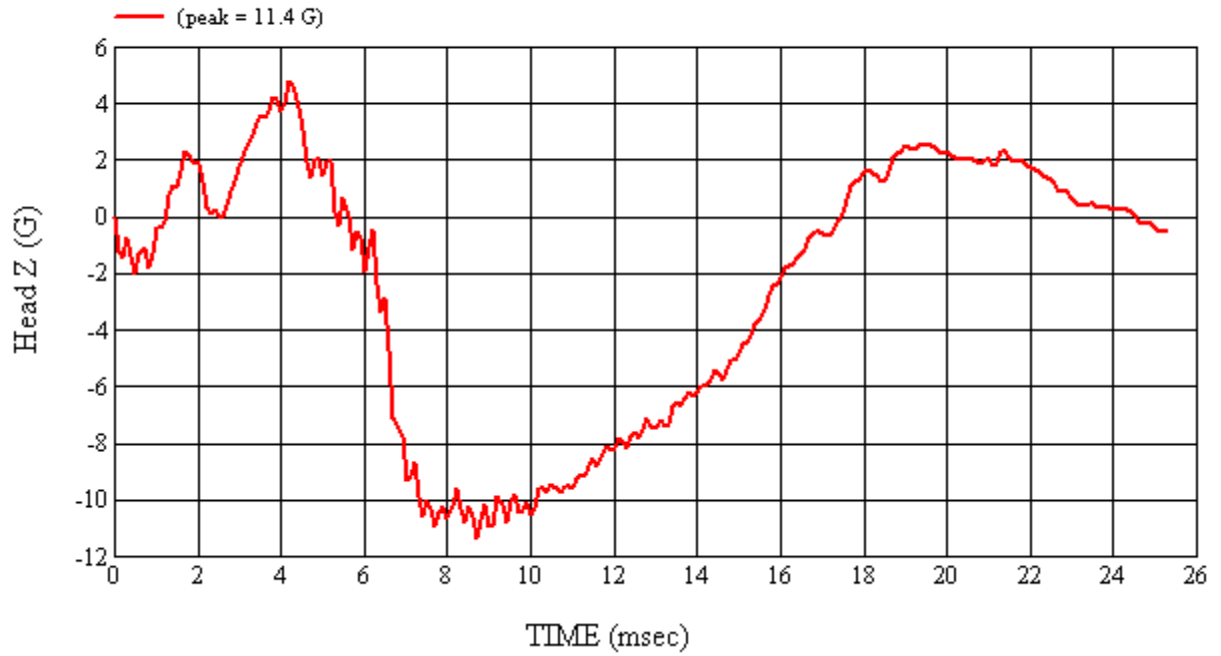
MGA Test #: U11175

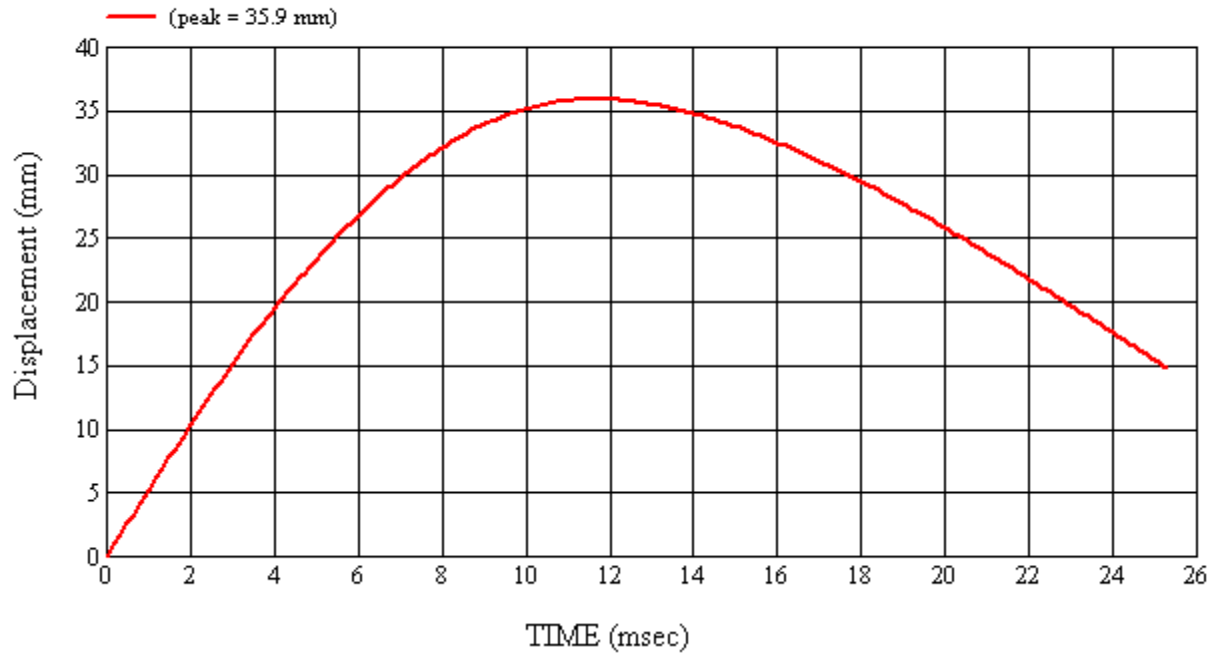
Target Location: AP2, Right Side

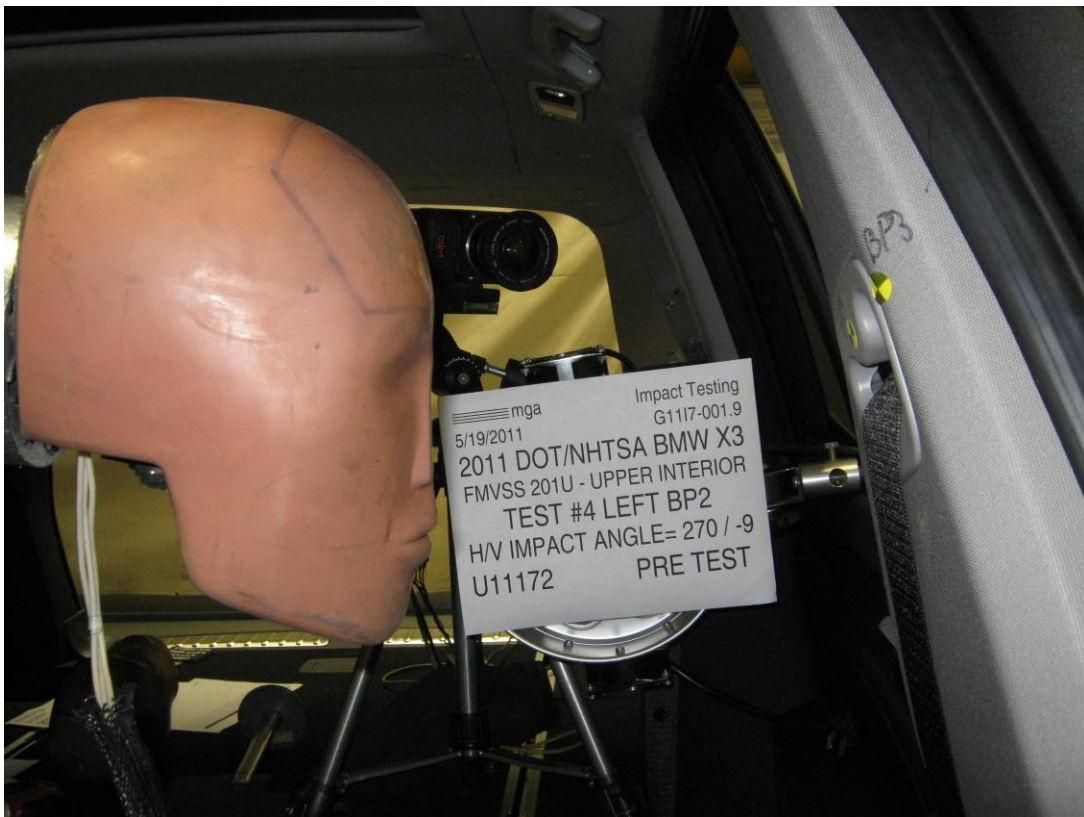
Test Date: 5/20/2011

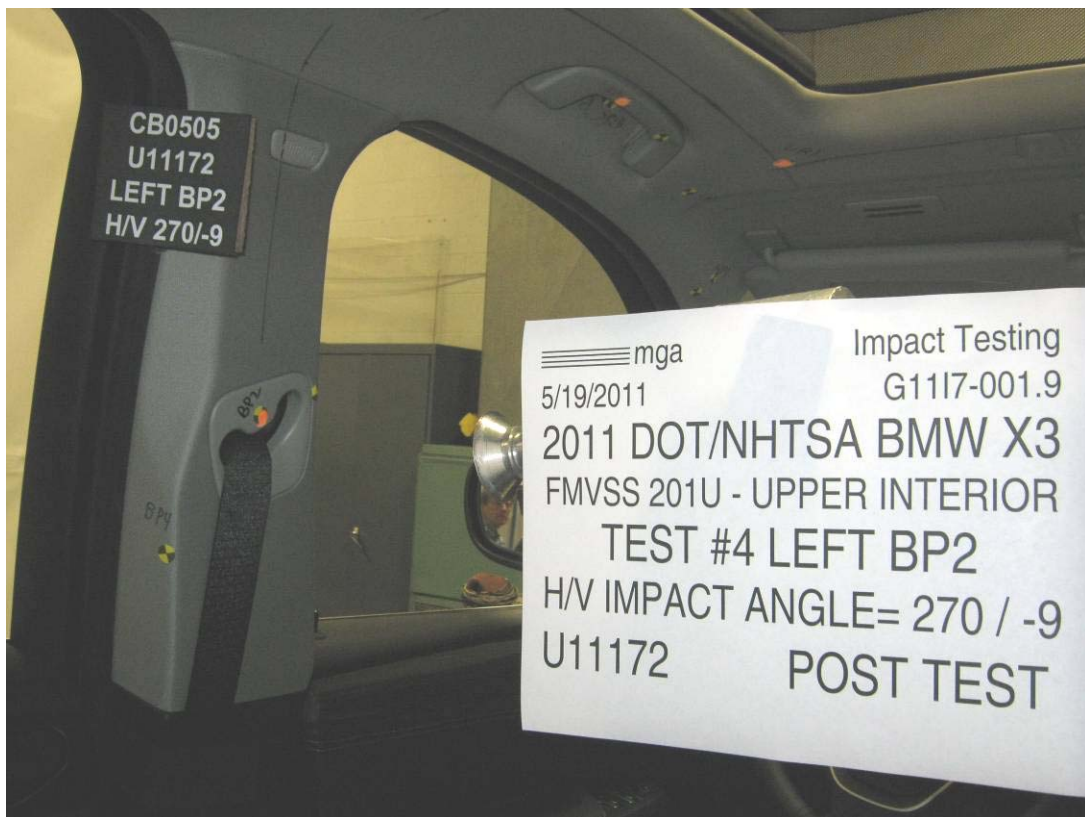






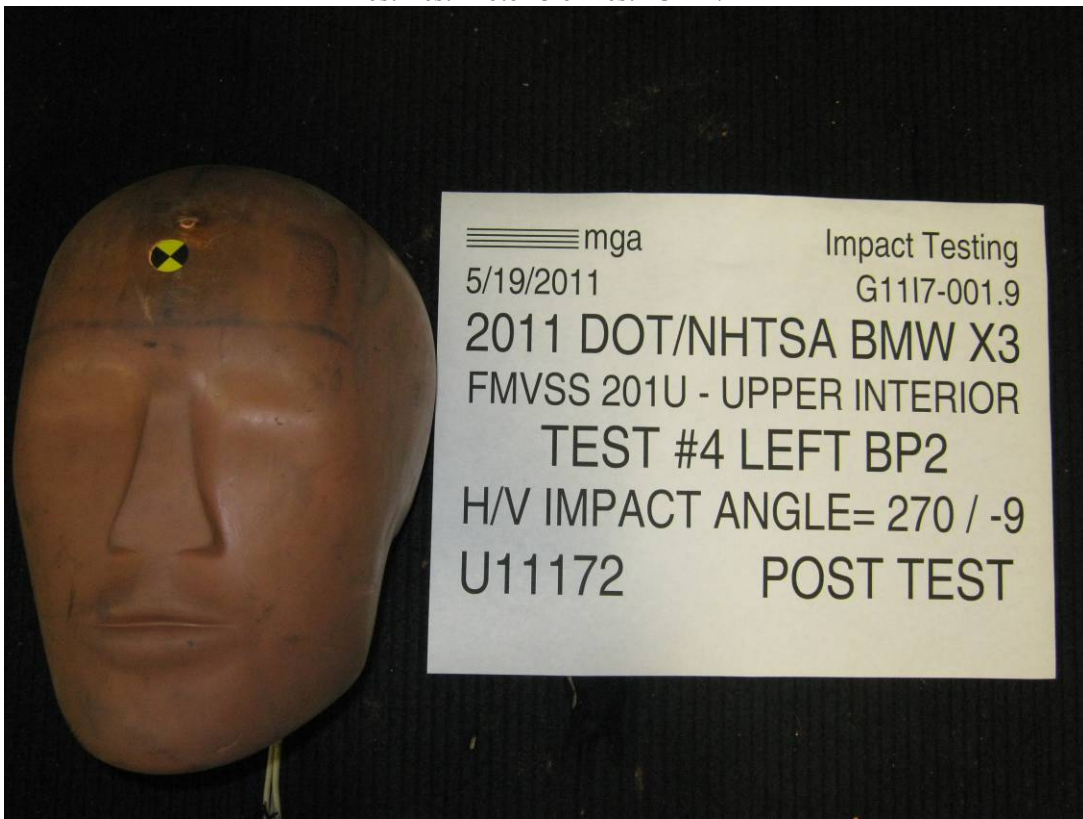








Post-Test Photo #3 of Test #U11172



SUMMARY OF FMVSS 201U TEST

JOB/NHTSA NO: G1117-001.9 VEHICLE YR/MAKE/MODEL:2011/DOT/NHTSA/BMW X3

GENERAL TEST PARAMETERS:

Target (Vehicle Side): BP2Left

MGA Test Reference No.:U11172

Approach Horizontal Angles:270°

Approach Vertical Angles:-9°

Additional Description:

Test Number:#4

Temperature:21.9C

Humidity:61.8%

Time of Test:1:40:36 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
708	717	8.7	23.7	23	0

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

Axis	Channel	Serial No.	DLR Value	ΔV Pre-Test	ΔV Post-Test
X	5	J35919	-95.8	1.07	1.07
Y	6	J22664	94.2	0.85	0.85
Z	7	J35924	92.8	0.94	0.94

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

No visible damage

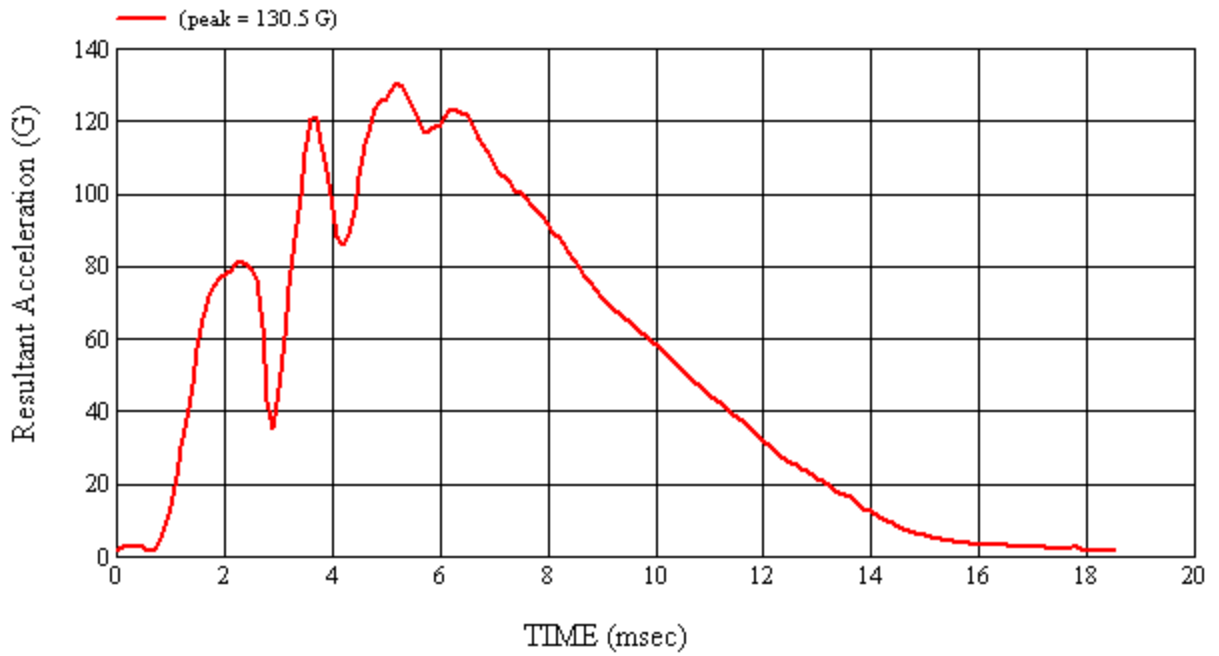
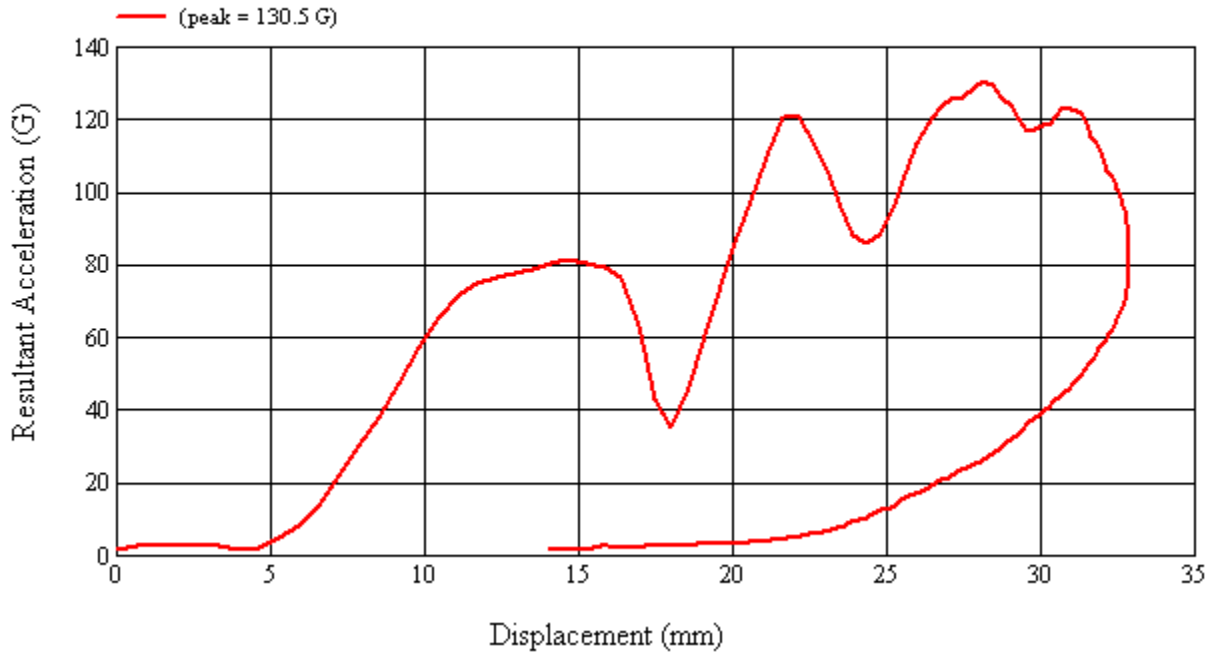
Recorded By: *Kevin D. McLean* Approved By*: *Richard I. Smith* Date: 5/19/2011

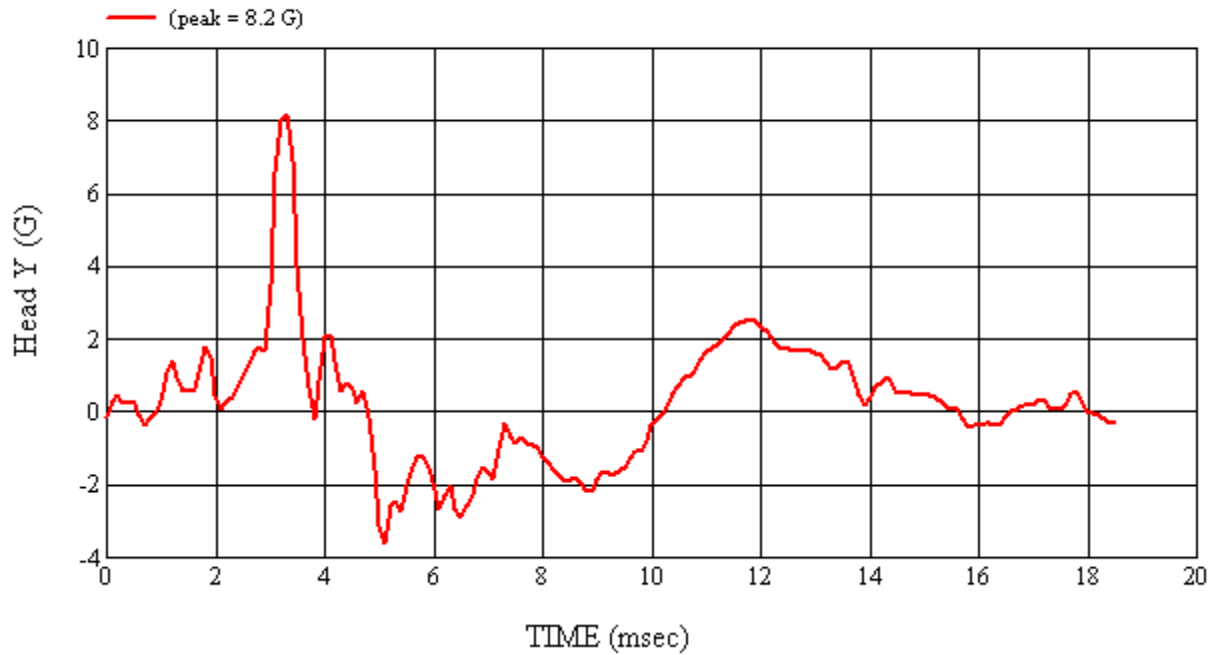
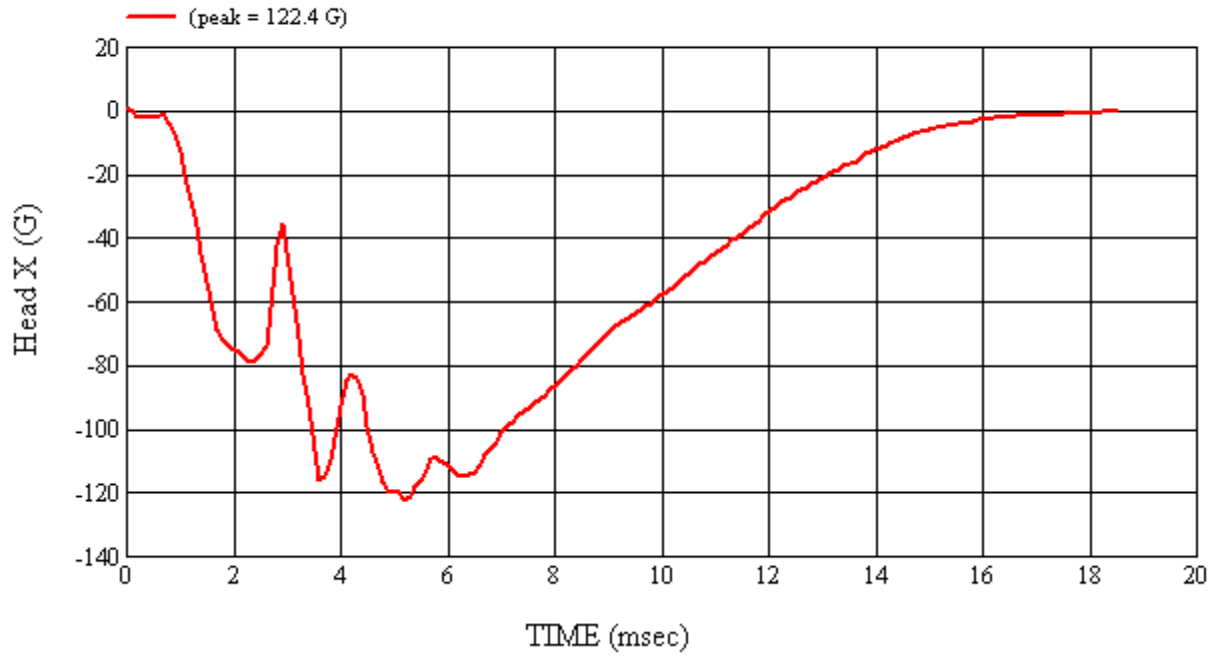
*Only necessary for NHTSA (Government) Compliance testing.

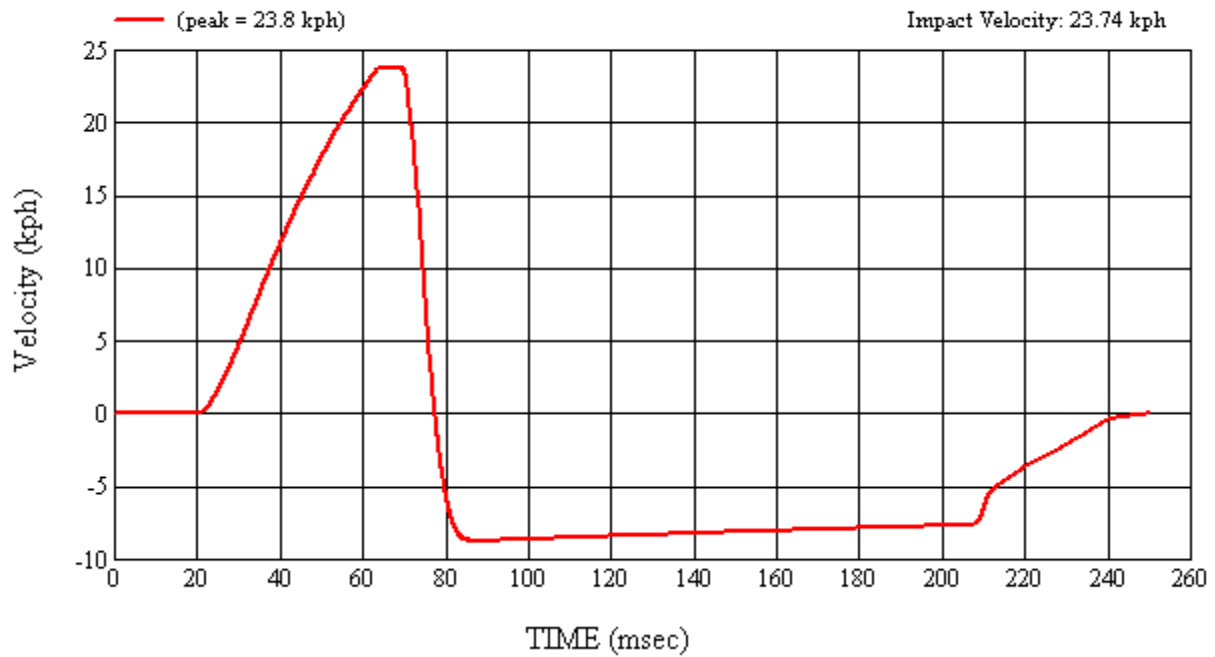
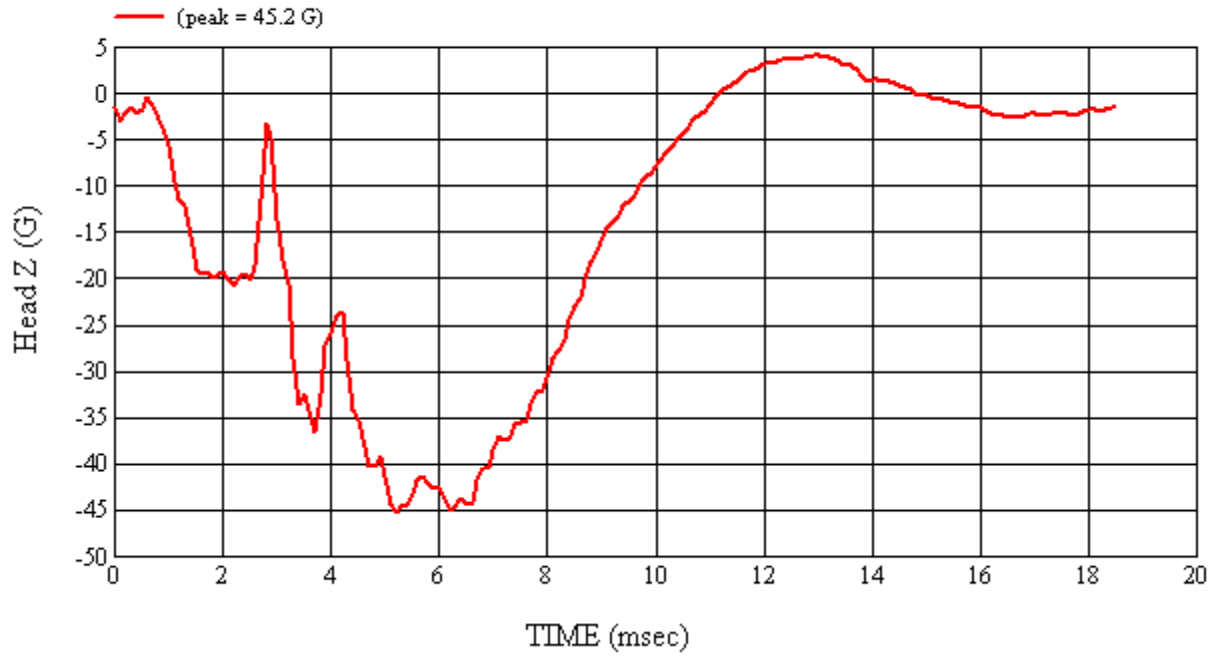
MGA Test #: U11172

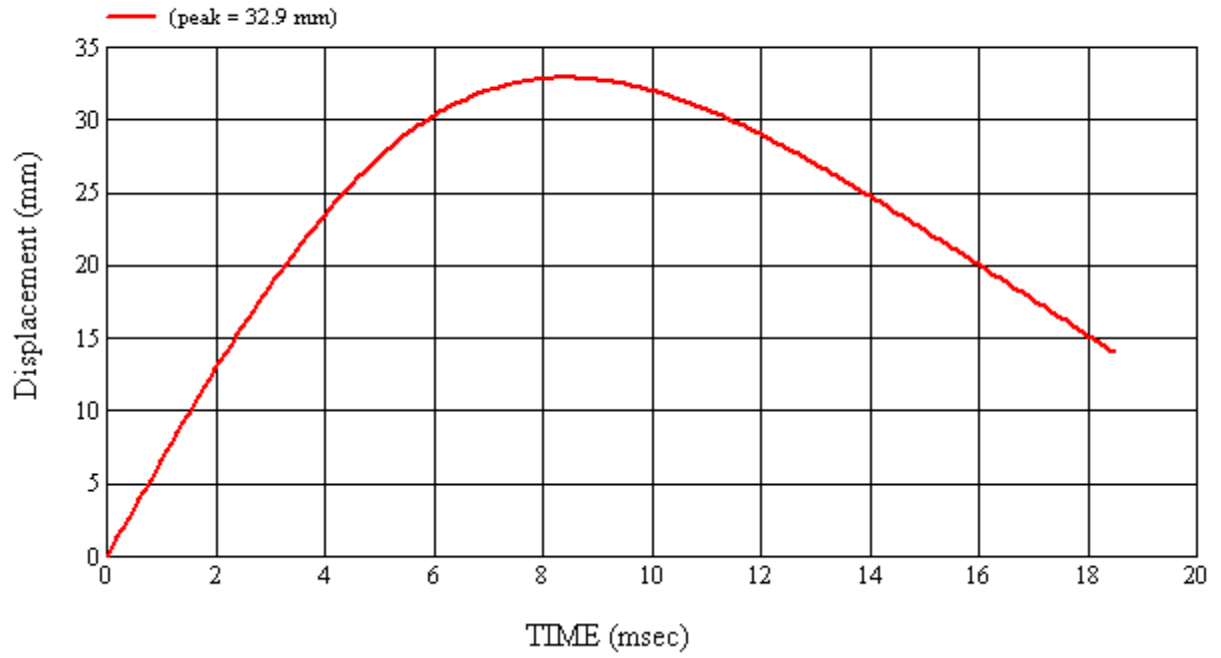
Target Location: BP2, Left Side

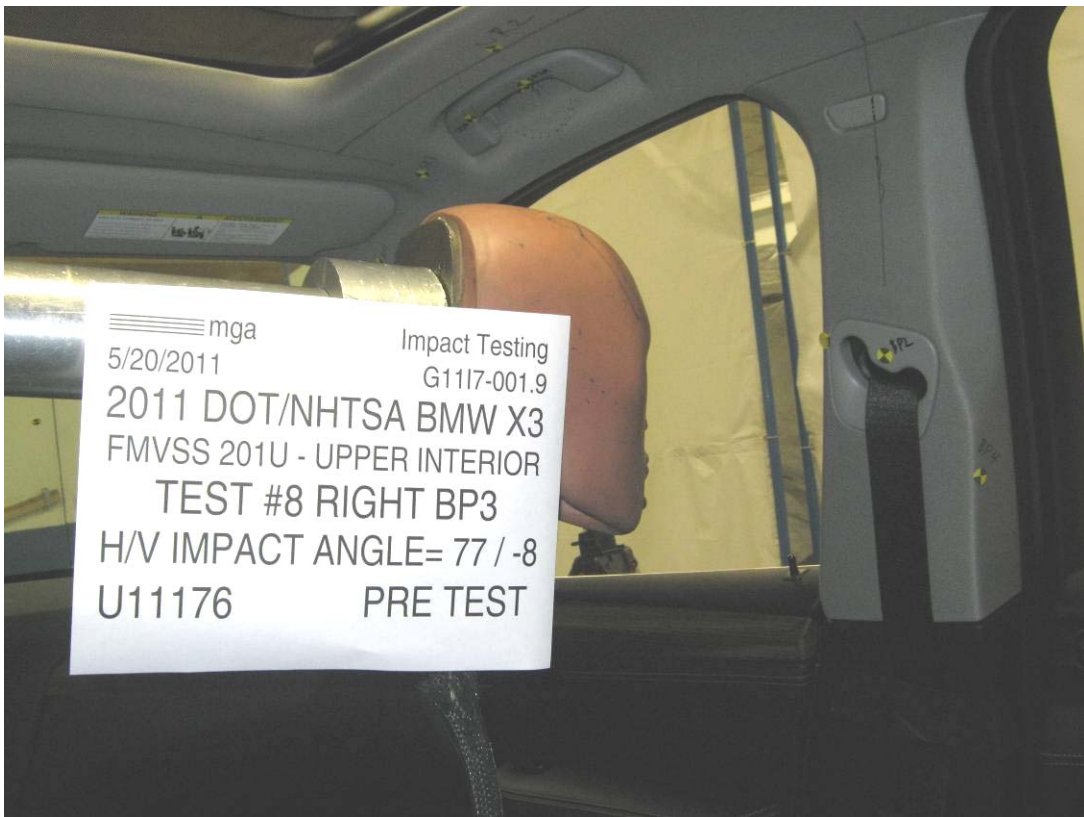
Test Date: 5/19/2011















SUMMARY OF FMVSS 201U TEST

JOB/NHTSA NO: G1117-001.9 VEHICLE YR/MAKE/MODEL:2011/DOT/NHTSA/BMW X3

GENERAL TEST PARAMETERS:

Test Number:#8

Target (Vehicle Side): BP3Right

Temperature:22.4C

MGA Test Reference No.:U11176

Humidity:58.5%

Approach Horizontal Angles:77°

Time of Test:10:41:33 AM

Approach Vertical Angles:-8°

FMH Serial No:[037]

Additional Description:

TEST RESULTS:

HIC(d)	HIC	Δt (msec)	Velocity (kph)	Impact location on FMH (mm)	
				Above Pt. O	Left/Right Pt. O
672	670	9.5	23.9	25	2 Left

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

Axis	Channel	Serial No.	DLR Value	ΔV Pre-Test	ΔV Post-Test
X	5	J32177	-113.7	1.07	1.07
Y	6	J14103	93.9	0.85	0.85
Z	7	J35800	97.8	0.94	0.94

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

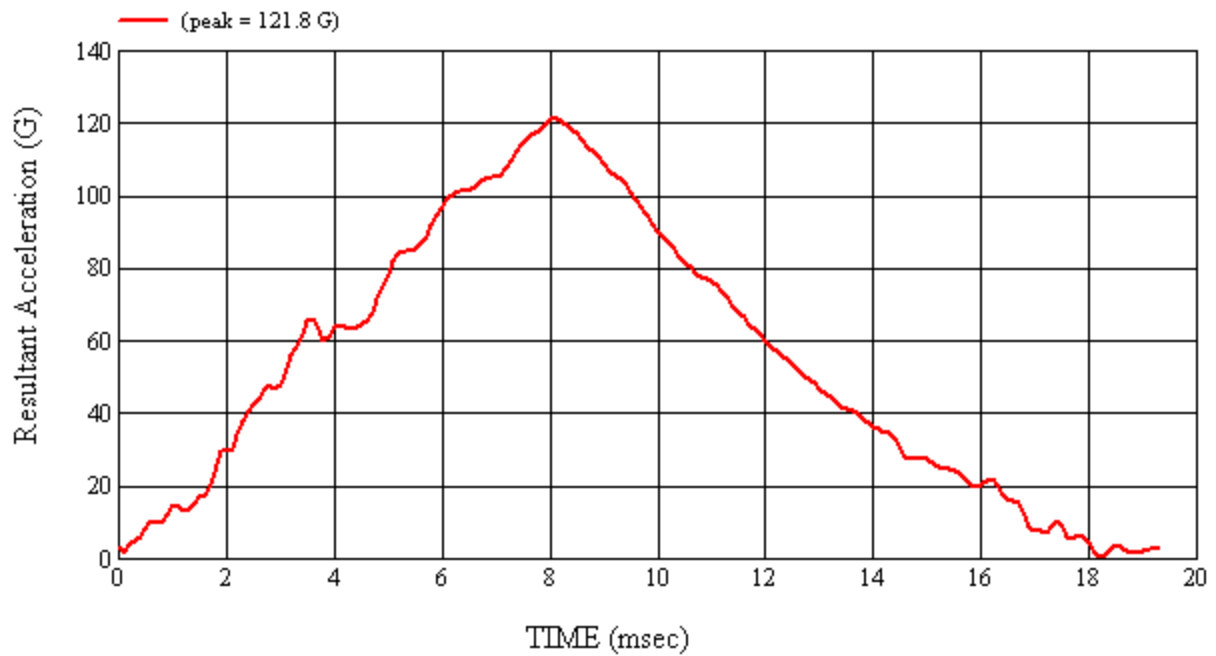
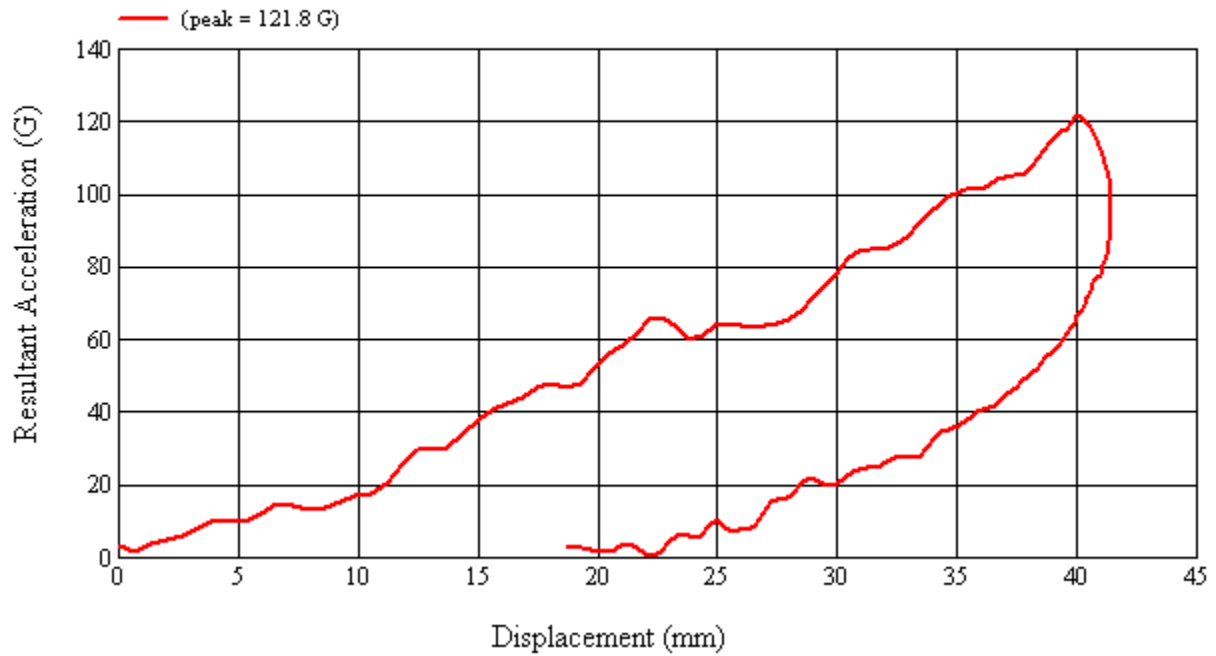
Dislodged trim

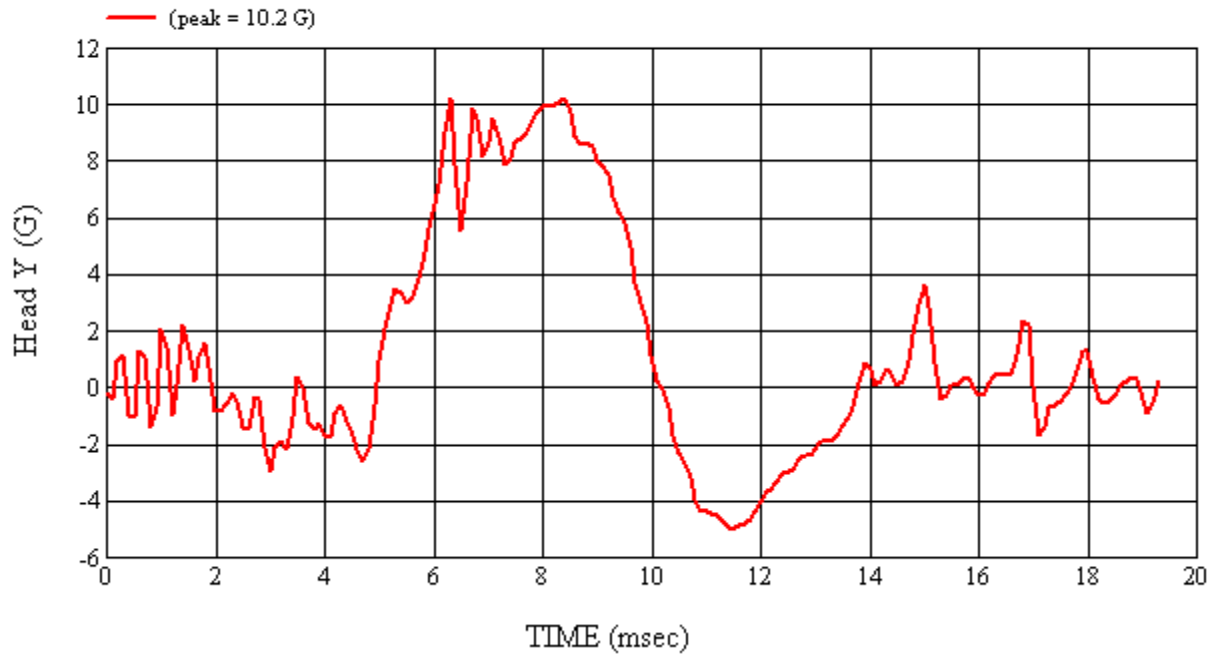
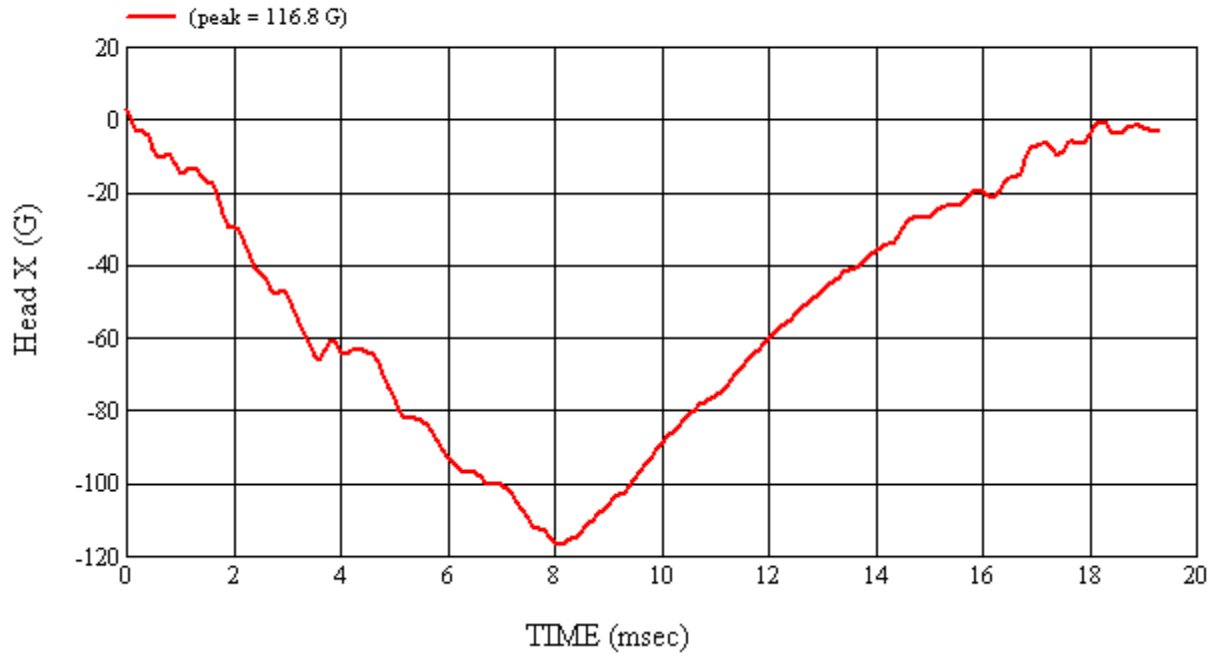
Recorded By: *Kevin D. McFerran* Approved By*: *Arthur I. Smith* Date: 5/20/2011
 *Only necessary for NHTSA (Government) Compliance testing.

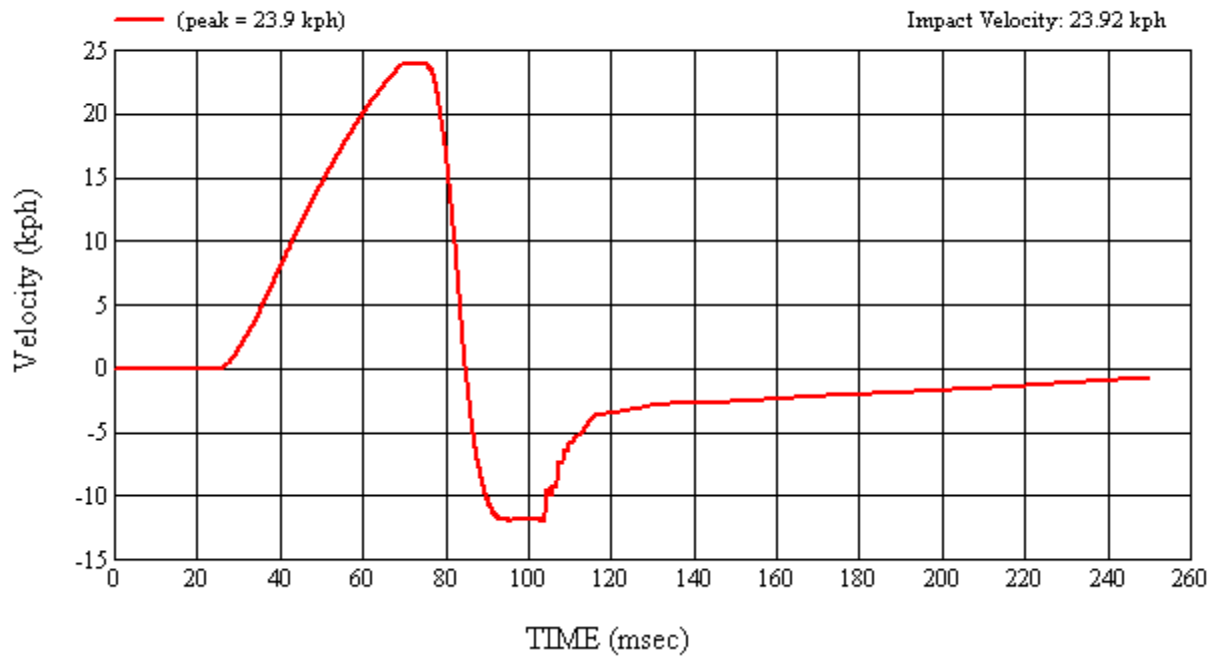
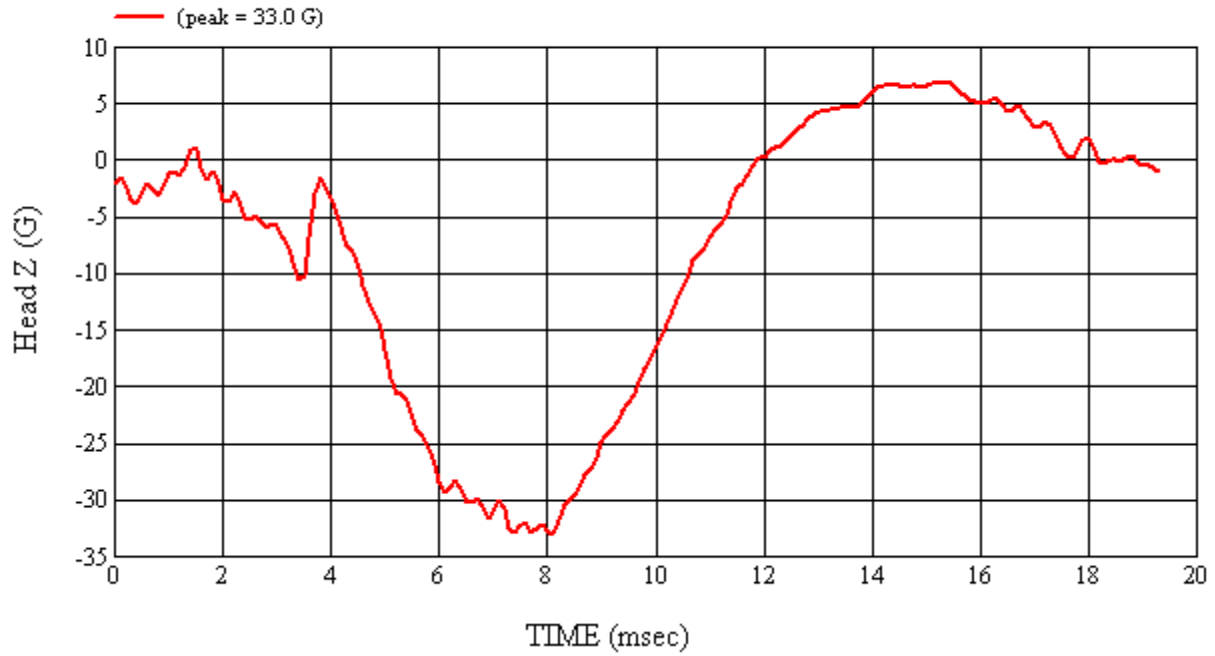
MGA Test #: U11176

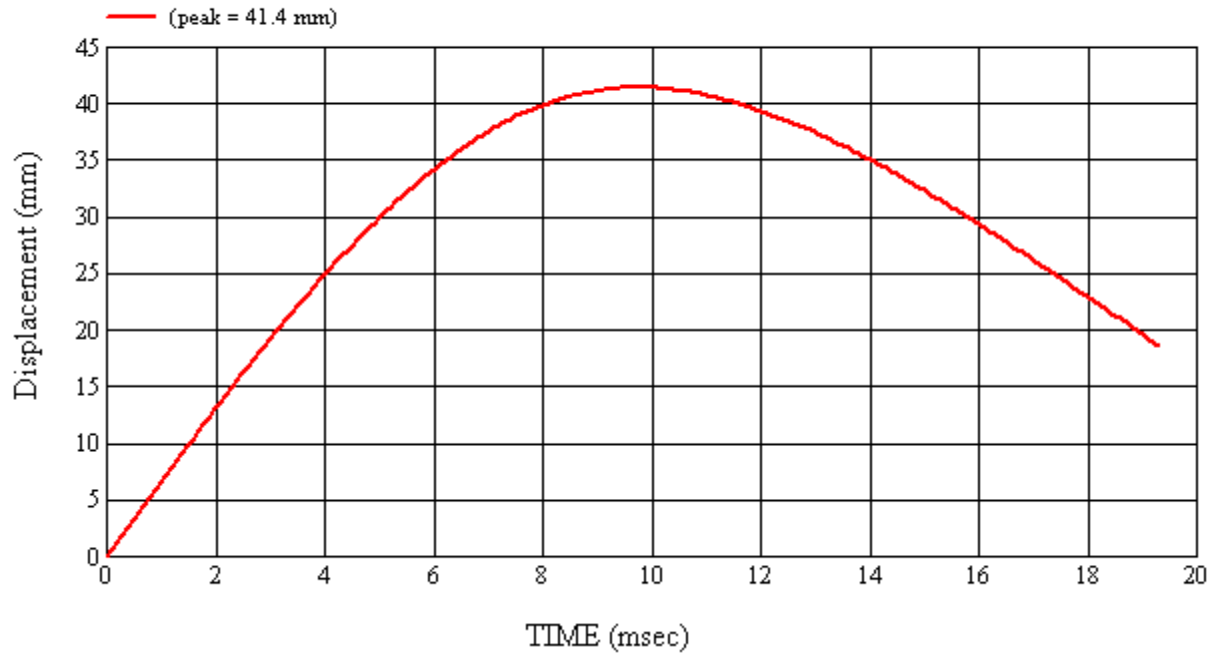
Target Location: BP3, Right Side

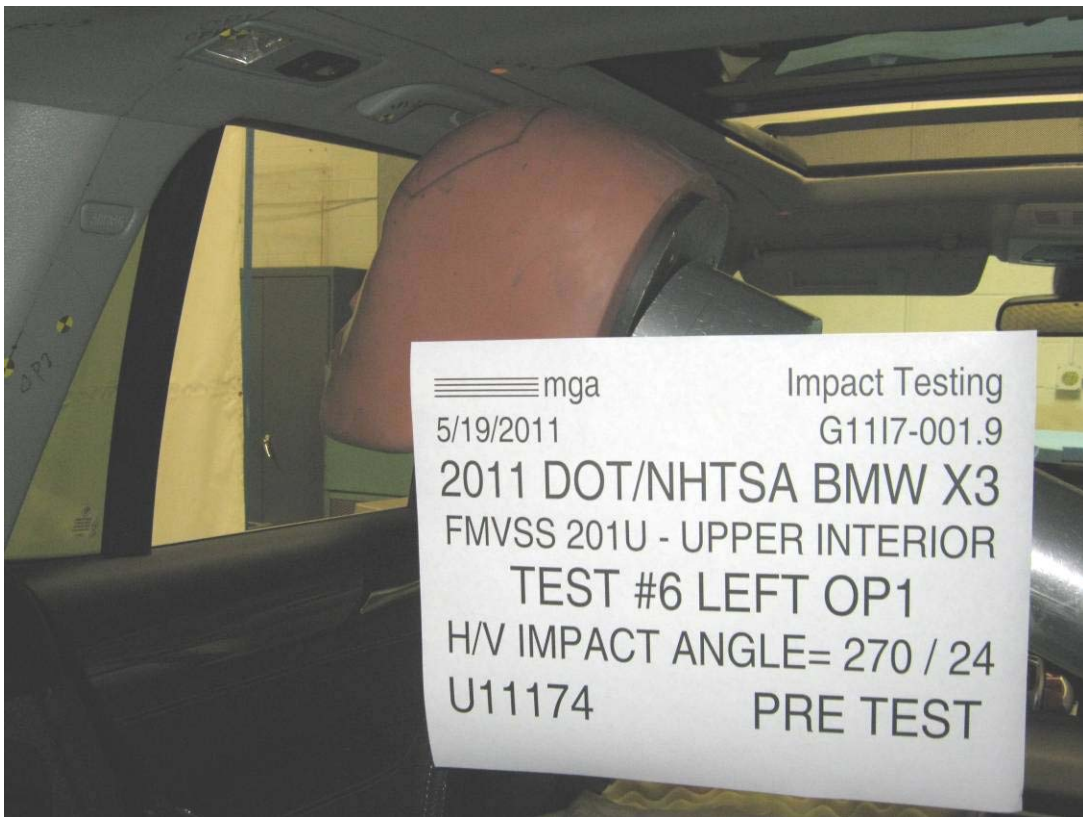
Test Date: 5/20/2011















SUMMARY OF FMVSS 201U TEST

JOB/NHTSA NO: G1117-001.9 VEHICLE YR/MAKE/MODEL:2011/DOT/NHTSA/BMW X3

GENERAL TEST PARAMETERS:

Target (Vehicle Side): OP1Left

MGA Test Reference No.:U11174

Approach Horizontal Angles:270°

Approach Vertical Angles:24°

Additional Description:

Test Number:#6

Temperature:22.5C

Humidity:61.2%

Time of Test:3:50:42 PM

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
665	660	4.6	18.4	58	3 Right

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

Axis	Channel	Serial No.	DLR Value	ΔV Pre-Test	ΔV Post-Test
X	5	J22700	-96.4	1.07	1.07
Y	6	J36197	108.7	0.85	0.85
Z	7	J36353	99.1	0.94	0.94

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

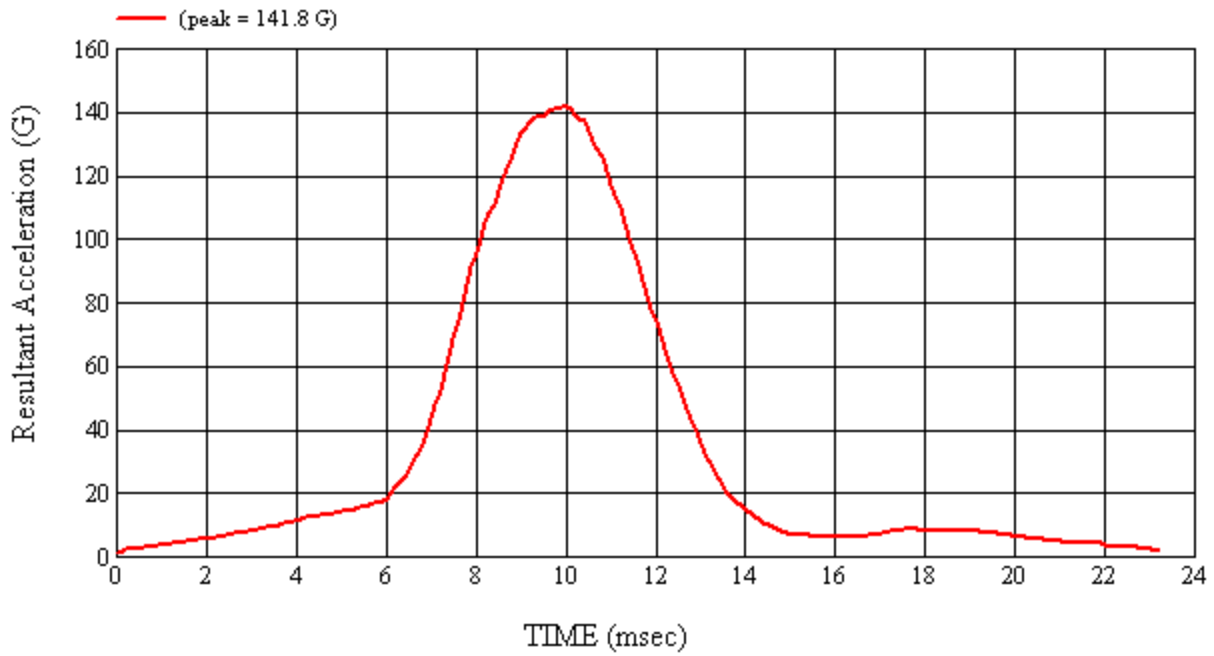
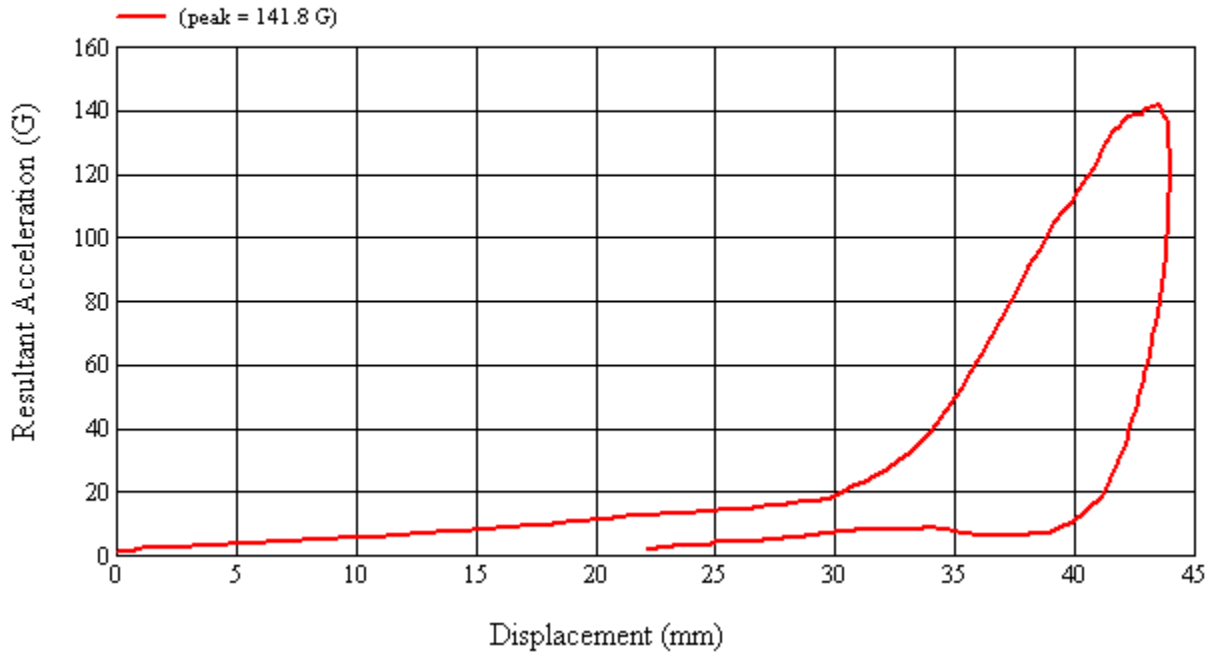
No visible damage

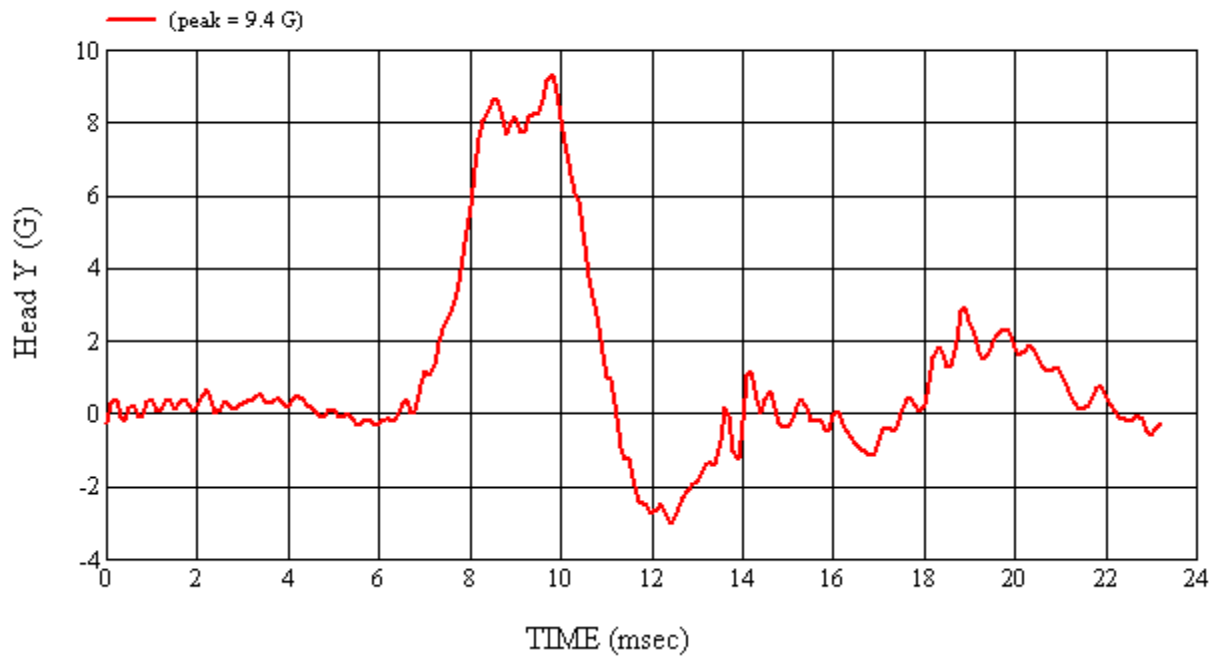
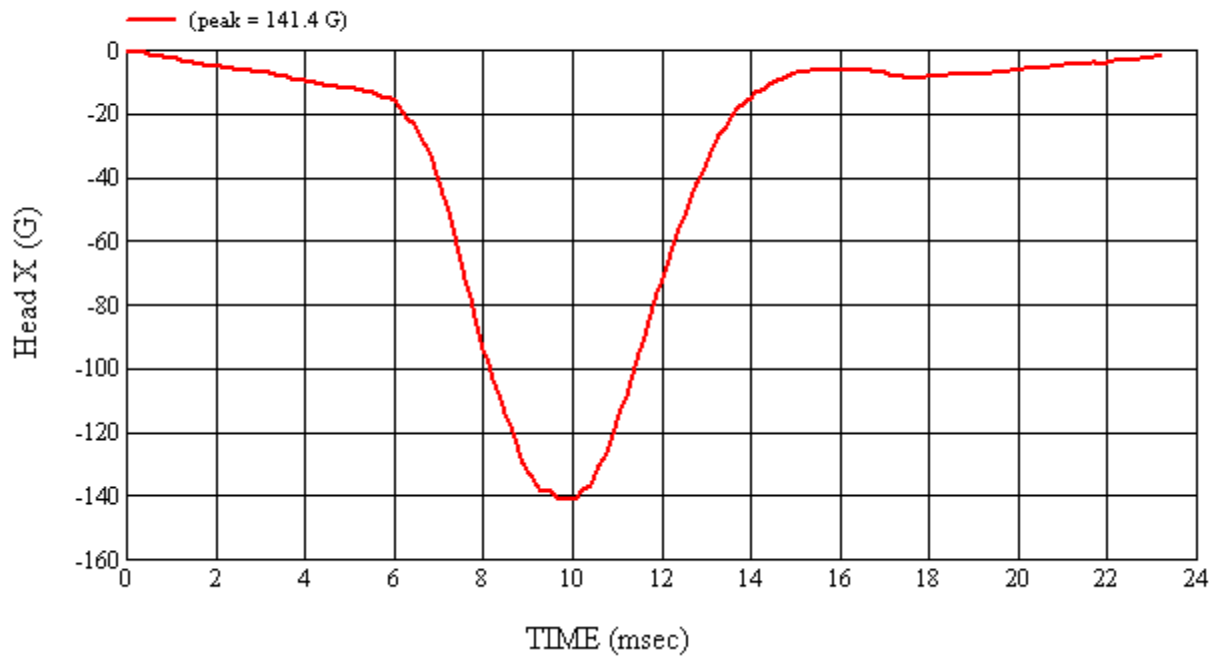
Recorded By: *Kevin D. McLean* Approved By*: *Arthur I. Smith* Date: 5/19/2011
 *Only necessary for NHTSA (Government) Compliance testing.

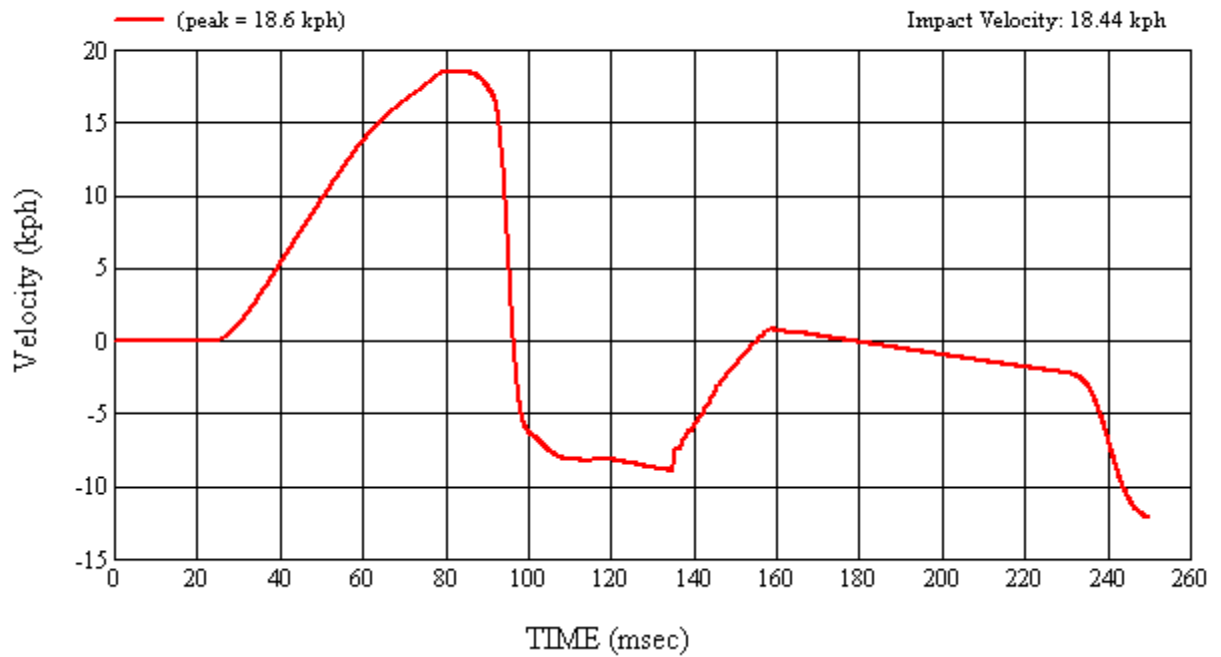
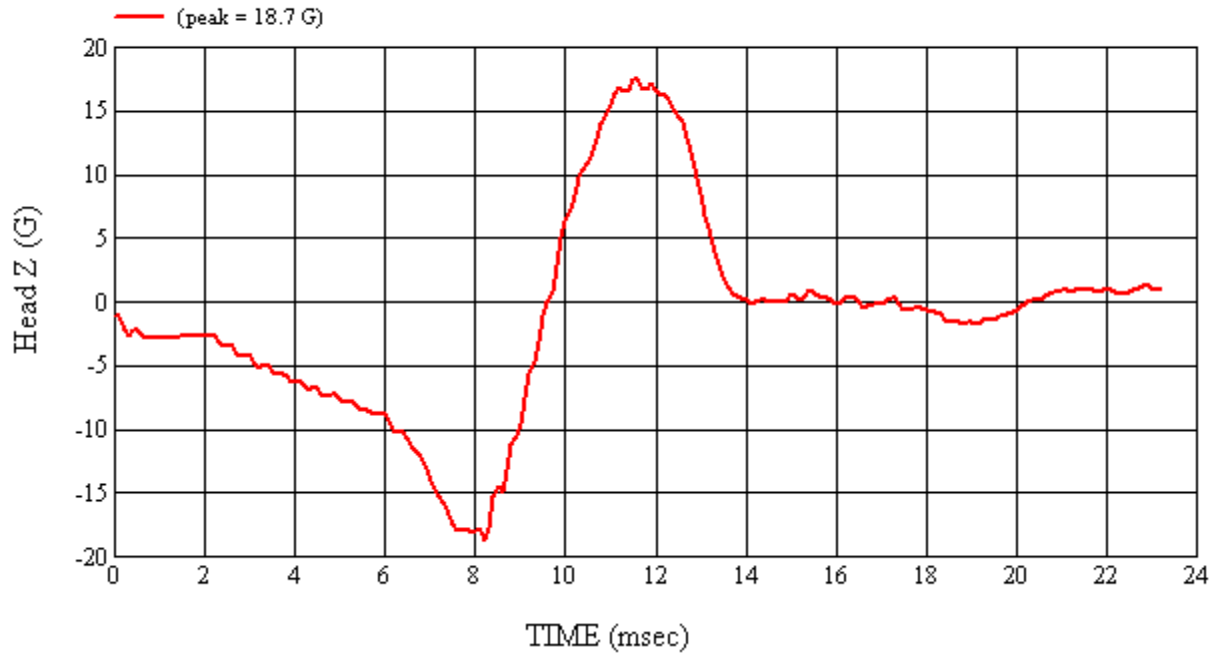
MGA Test #: U11174

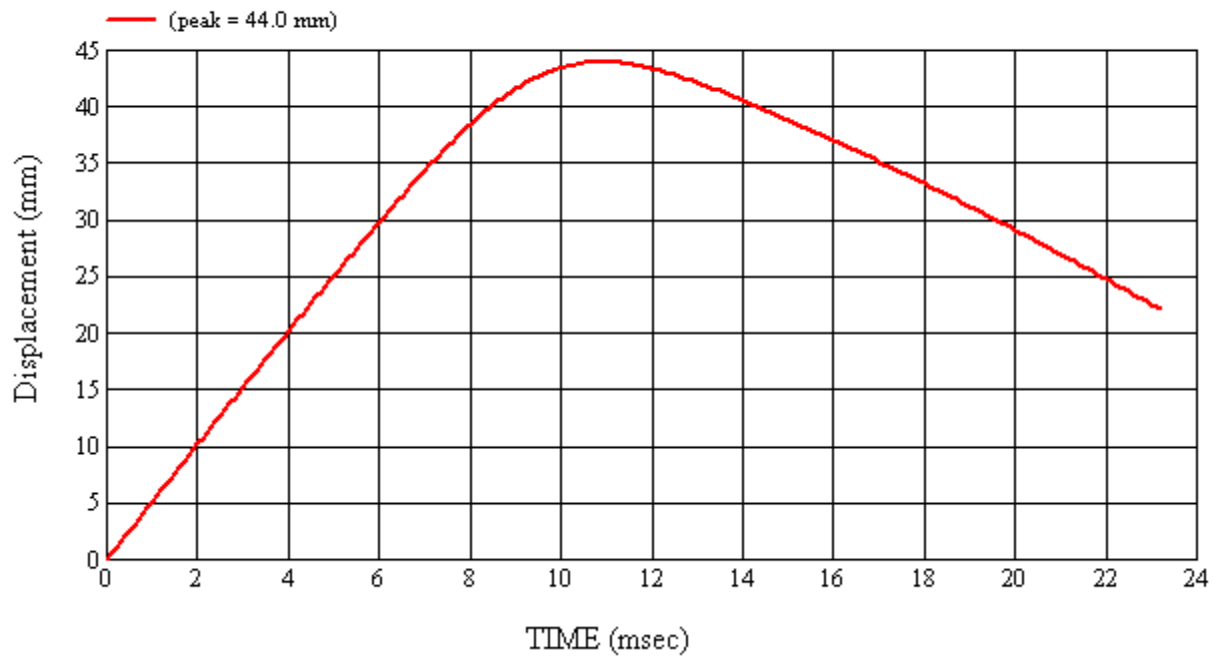
Target Location: OPI, Left Side

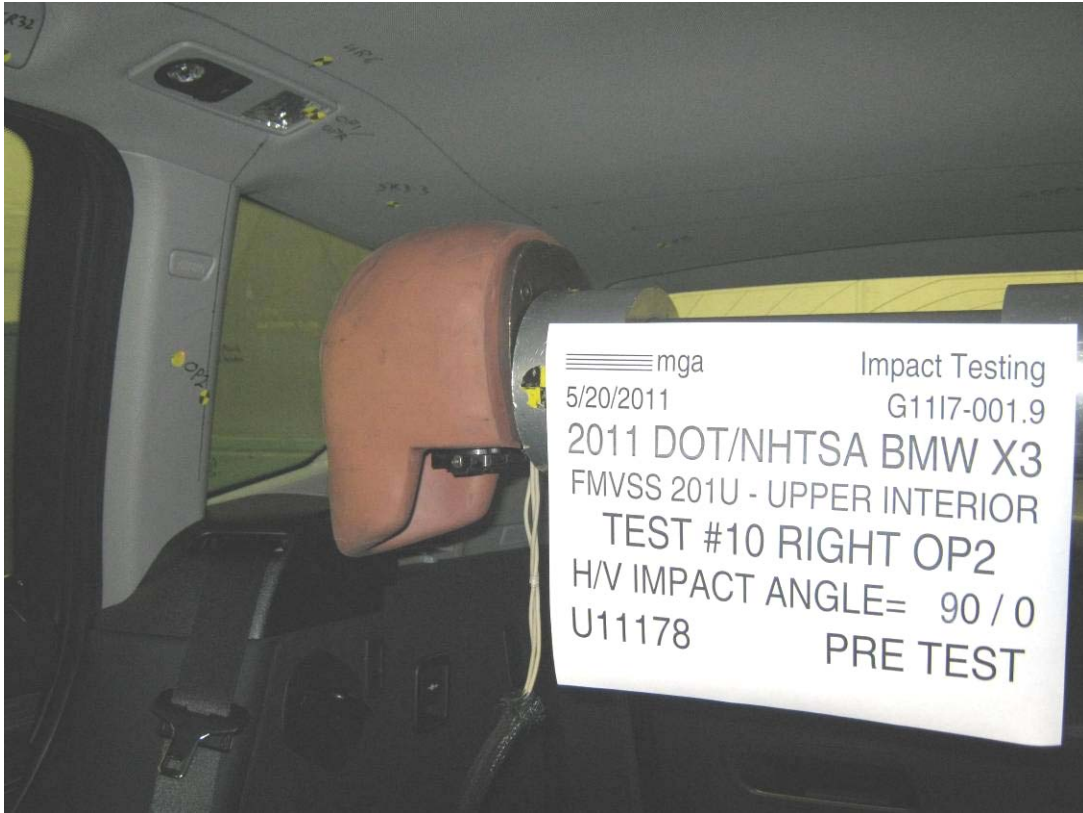
Test Date: 5/19/2011















SUMMARY OF FMVSS 201U TEST

JOB/NHTSA NO: G1117-001.9 VEHICLE YR/MAKE/MODEL:2011/DOT/NHTSA/BMW X3

GENERAL TEST PARAMETERS:

Target (Vehicle Side): OP2Right

MGA Test Reference No.:U11178

Approach Horizontal Angles:90°

Approach Vertical Angles:0°

Additional Description:

Test Number:#10

Temperature:23.3C

Humidity:57.7%

Time of Test:1:30:40 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
578	545	7.9	24.0	8	11 Right

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

Axis	Channel	Serial No.	DLR Value	ΔV Pre-Test	ΔV Post-Test
X	5	J35919	-95.8	1.07	1.07
Y	6	J22664	94.2	0.85	0.85
Z	7	J35924	92.8	0.94	0.94

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

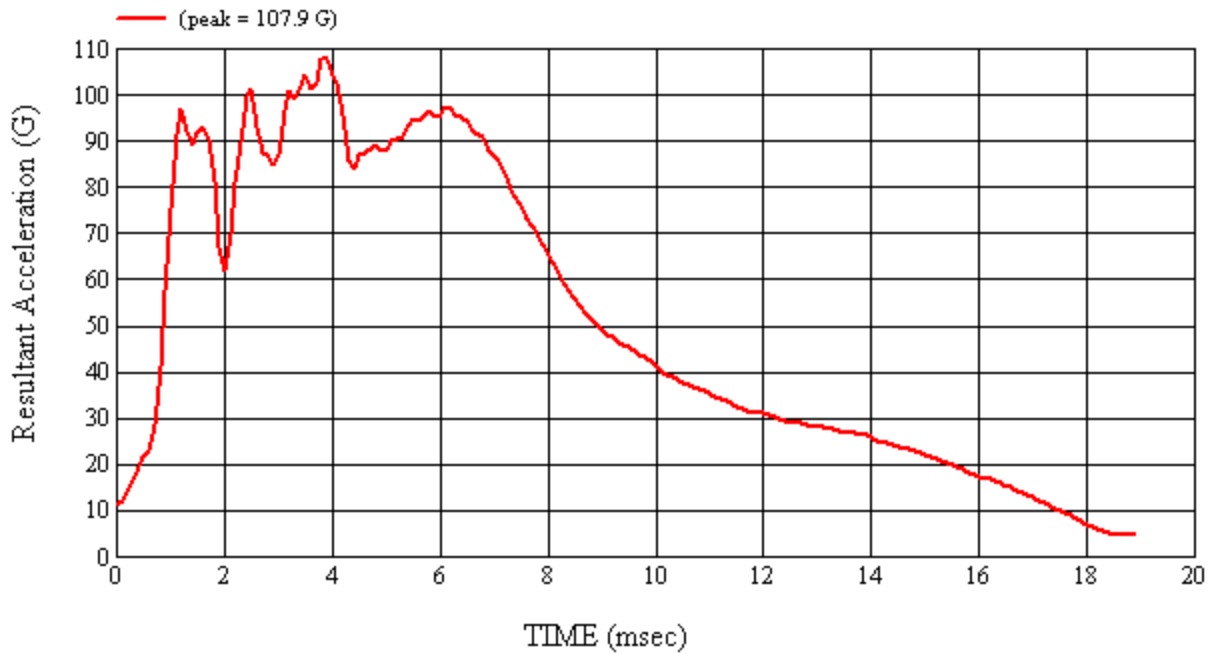
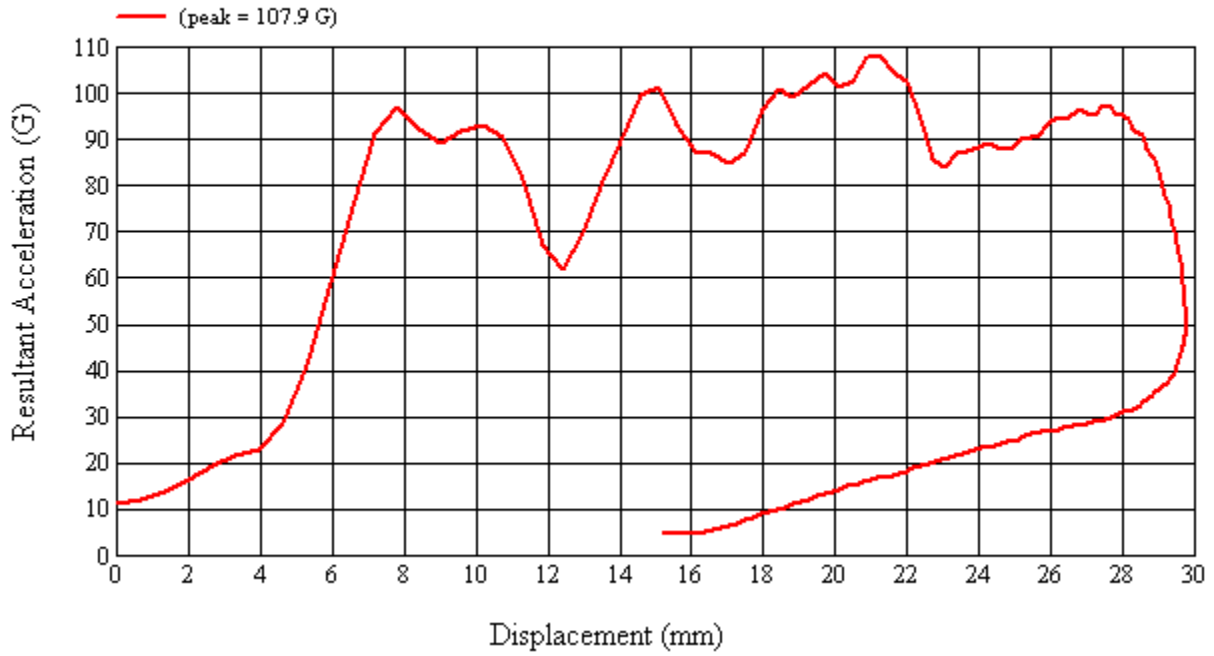
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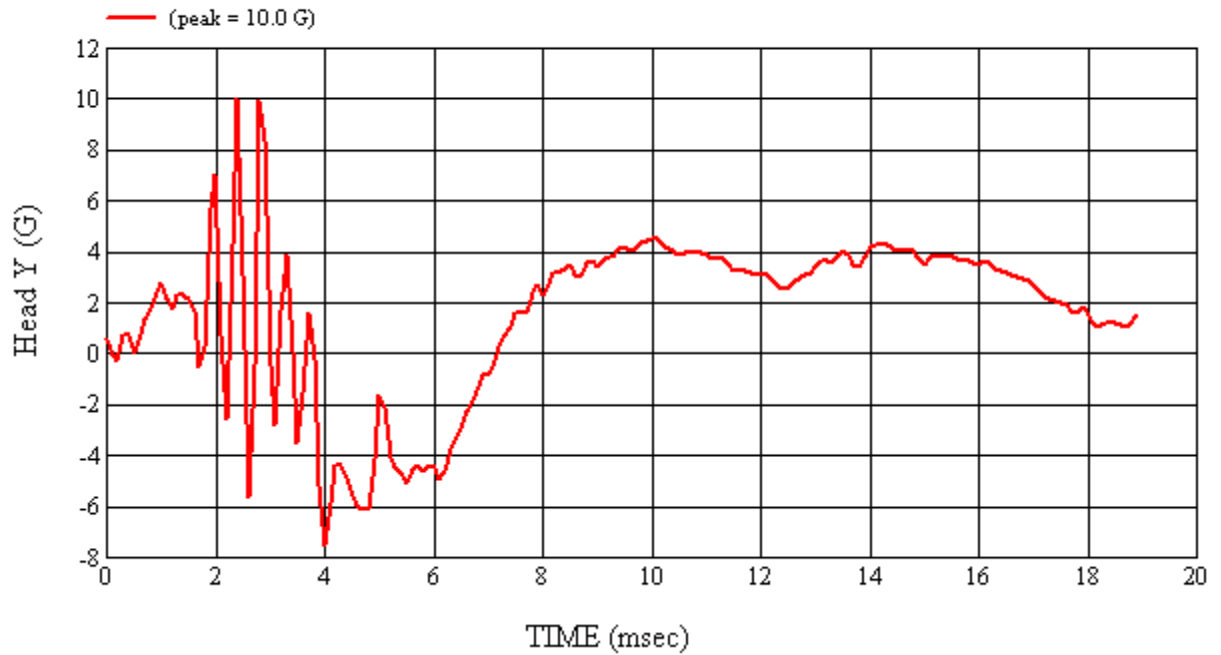
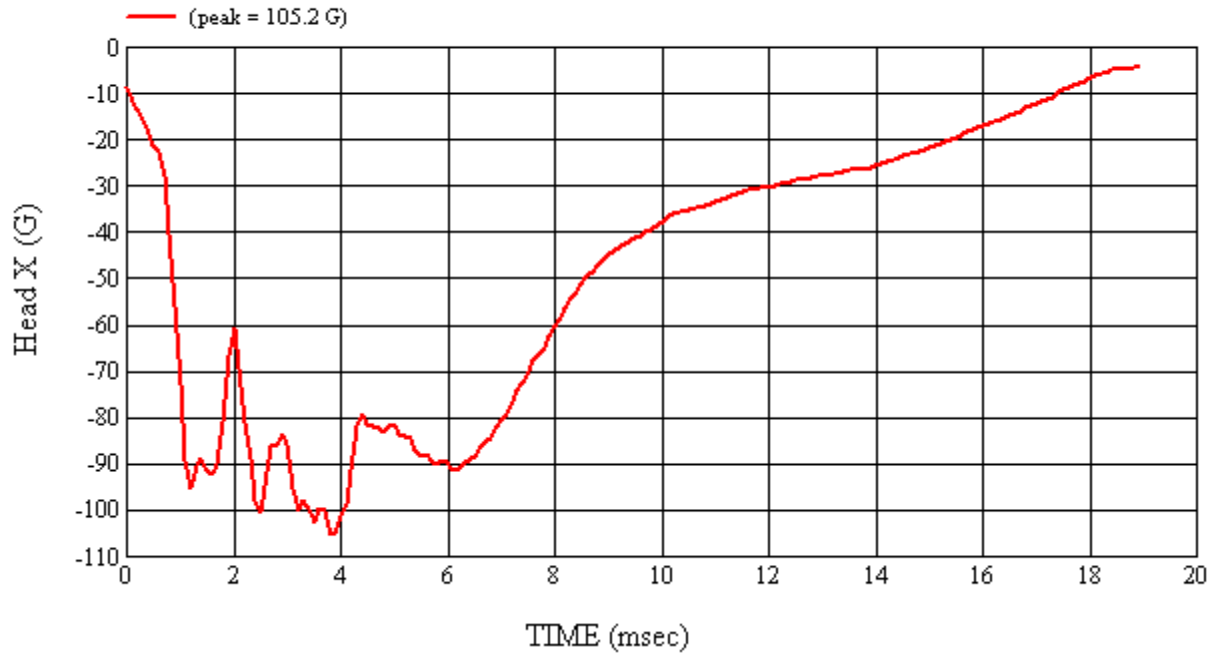
Recorded By: *Kevin D. McFerran* Approved By*: *Arthur I. Smith* Date: 5/20/2011
 *Only necessary for NHTSA (Government) Compliance testing.

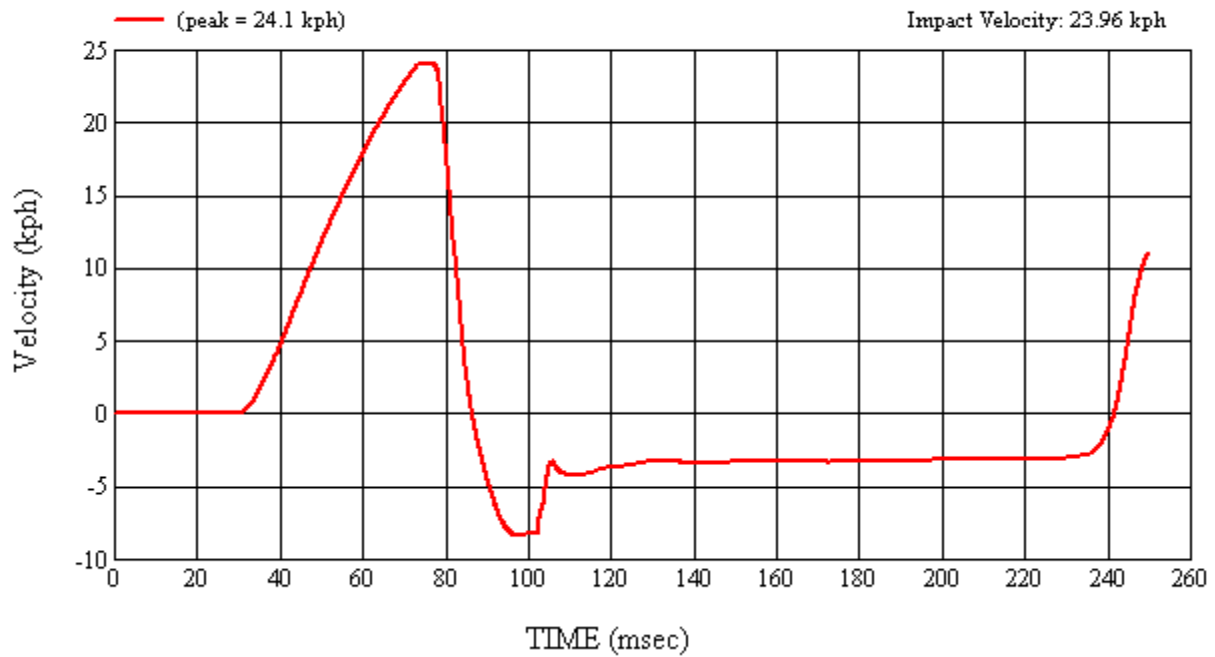
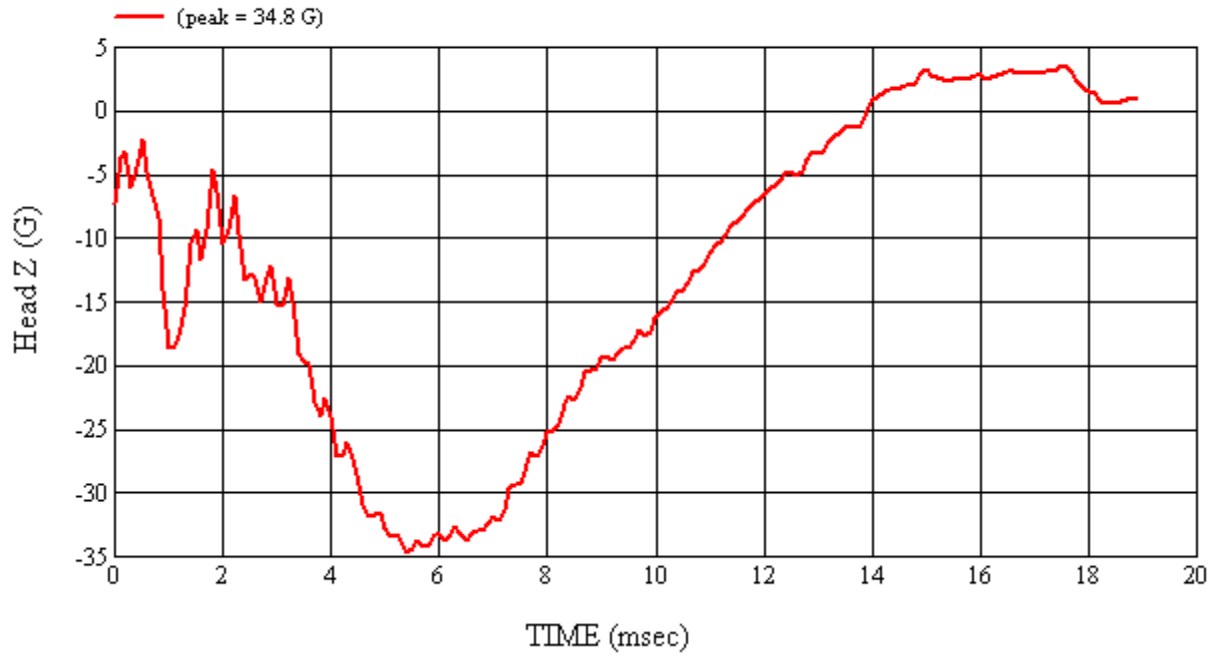
MGA Test #: U11178

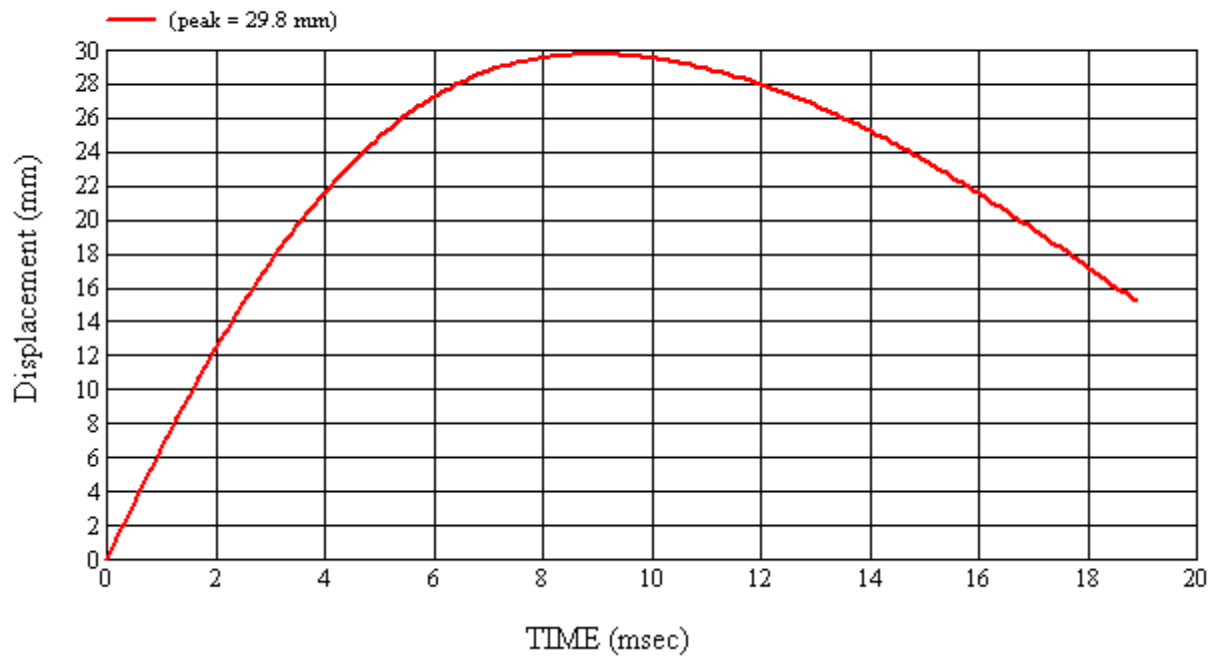
Target Location: OP2, Right Side

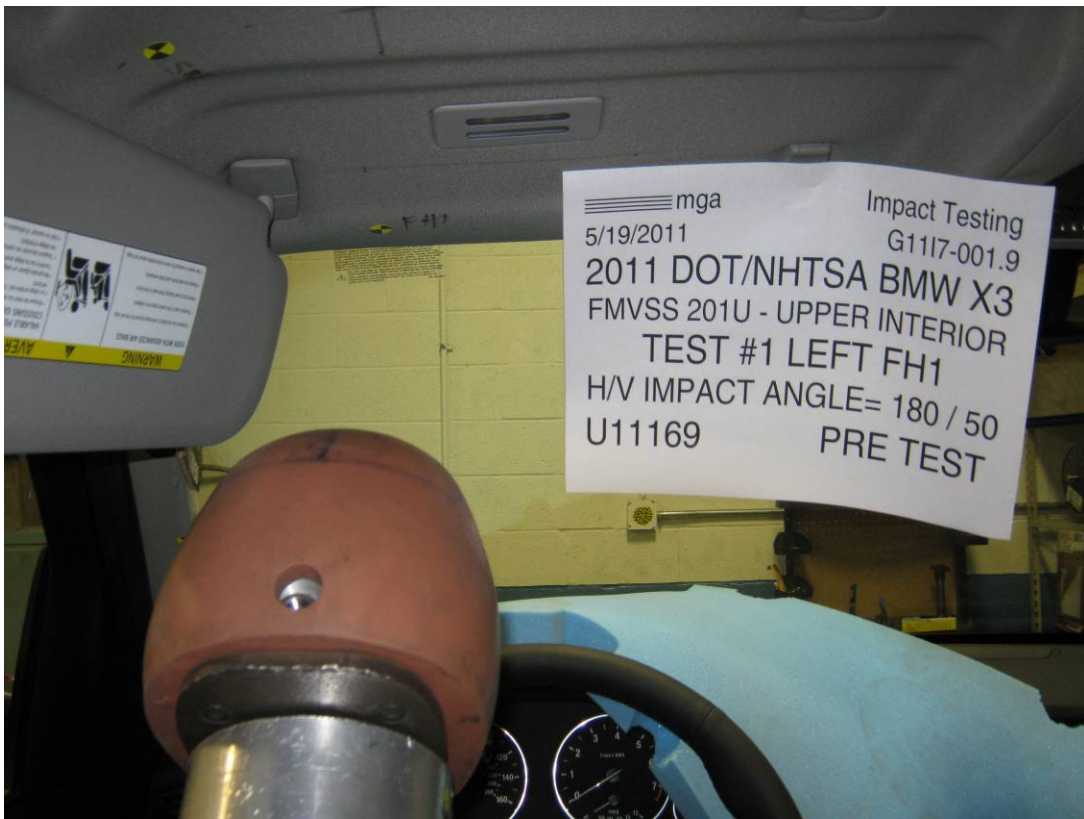
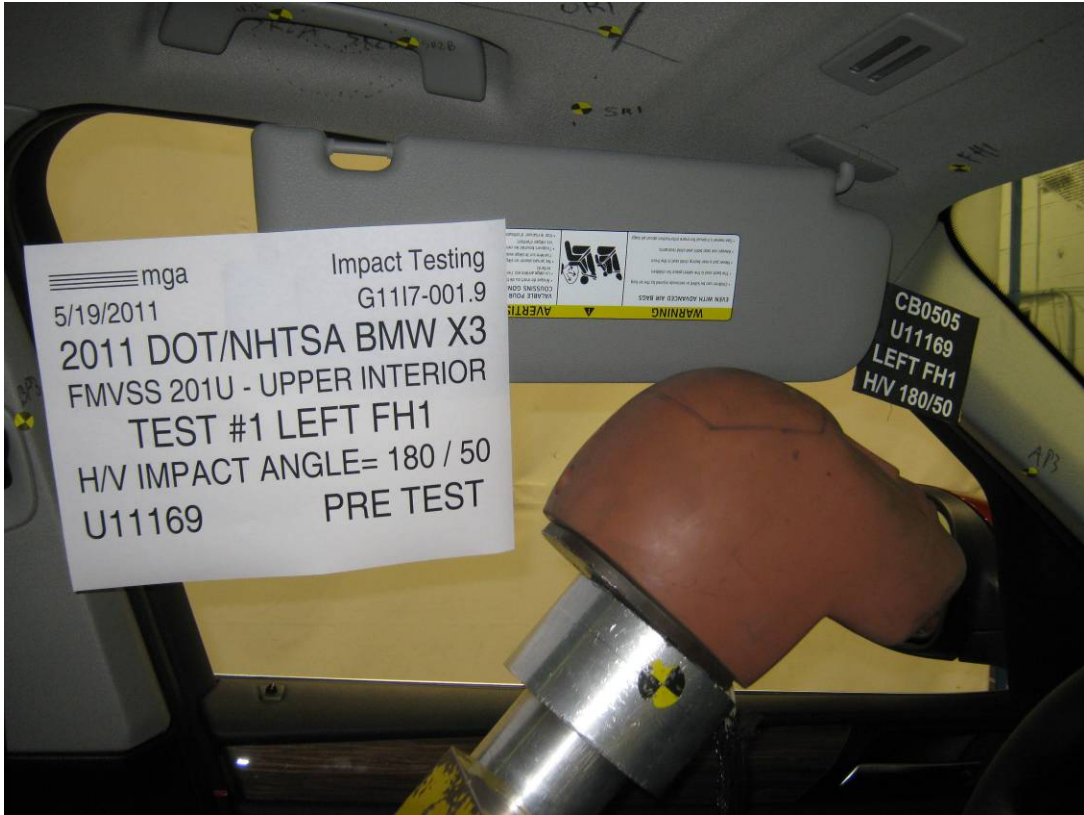
Test Date: 5/20/2011



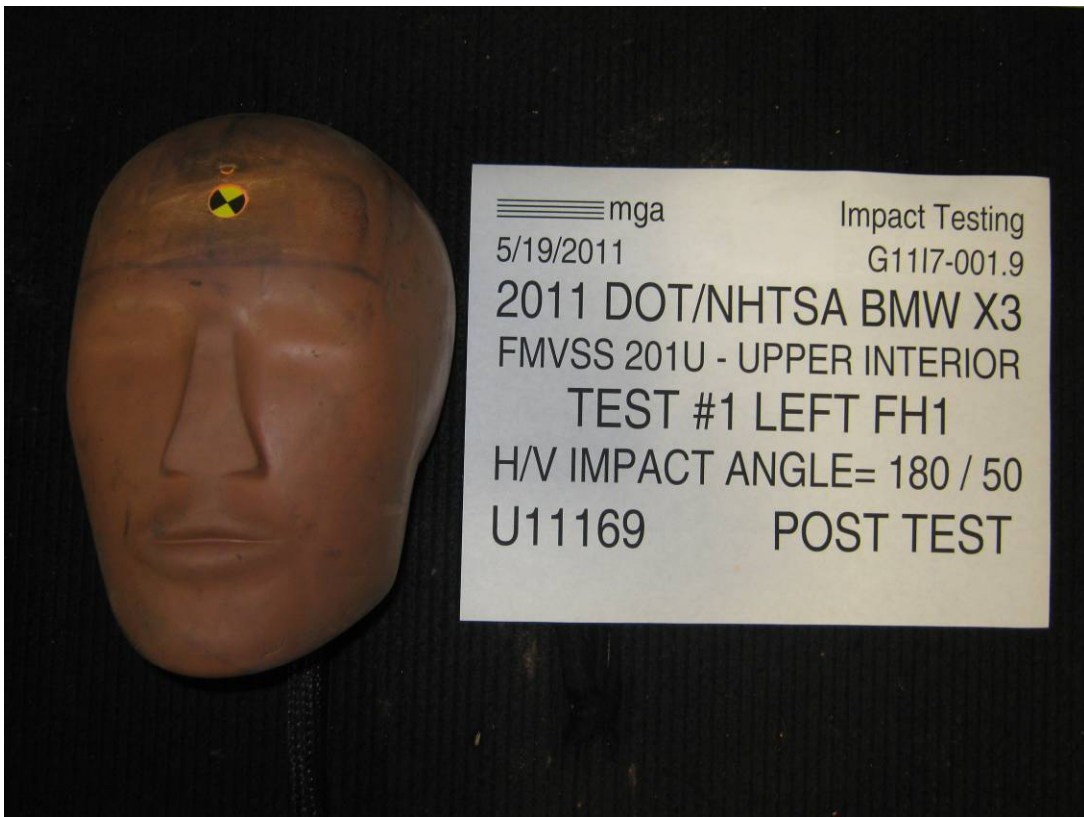












SUMMARY OF FMVSS 201U TEST

JOB/NHTSA NO: G1117-001.9 VEHICLE YR/MAKE/MODEL:2011/DOT/NHTSA/BMW X3

GENERAL TEST PARAMETERS:

Test Number:#1

Target (Vehicle Side): FH1Left

Temperature:21.2C

MGA Test Reference No.:U11169

Humidity:62.6%

Approach Horizontal Angles:180°

Time of Test:10:25:47 AM

Approach Vertical Angles:50°

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
558	519	6.3	23.5	23	5 Left

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

Axis	Channel	Serial No.	DLR Value	ΔV Pre-Test	ΔV Post-Test
X	5	J35919	-95.8	1.07	1.07
Y	6	J22664	94.2	0.85	0.85
Z	7	J35924	92.8	0.94	0.94

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

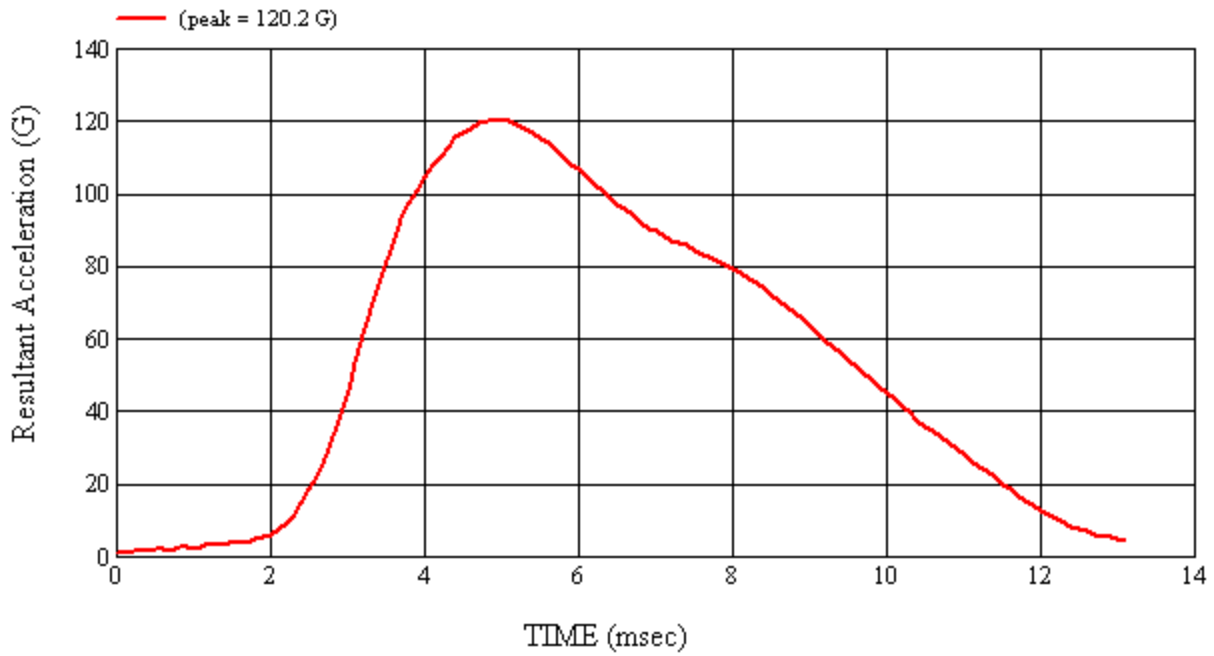
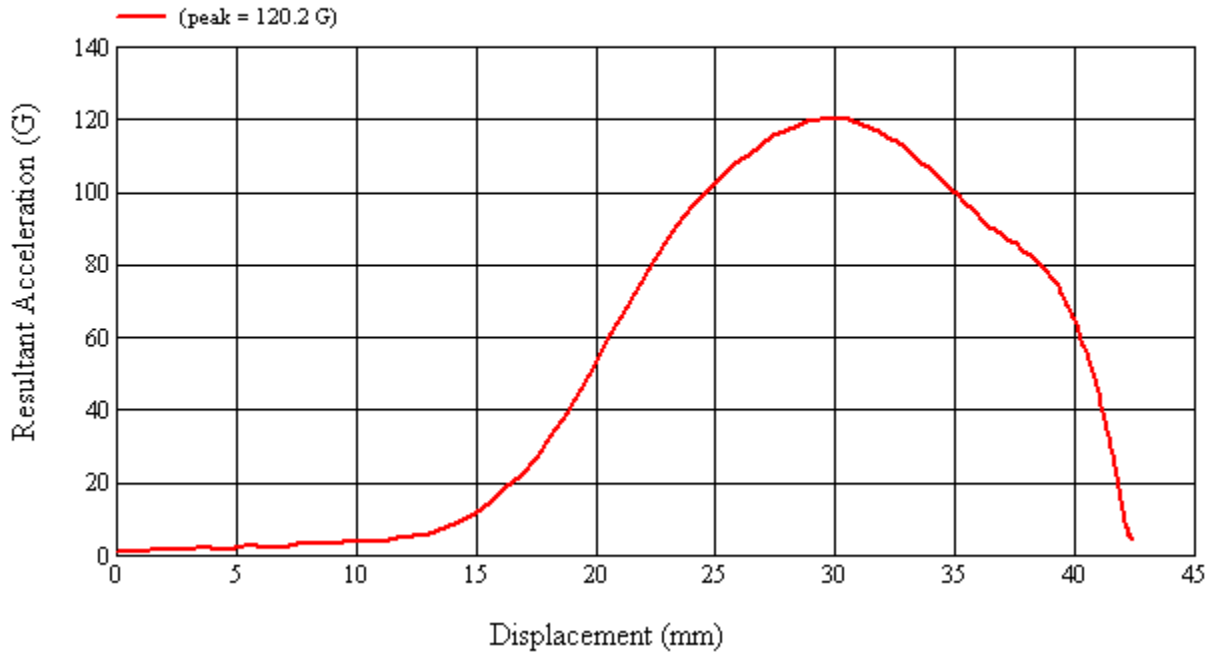
No visible damage

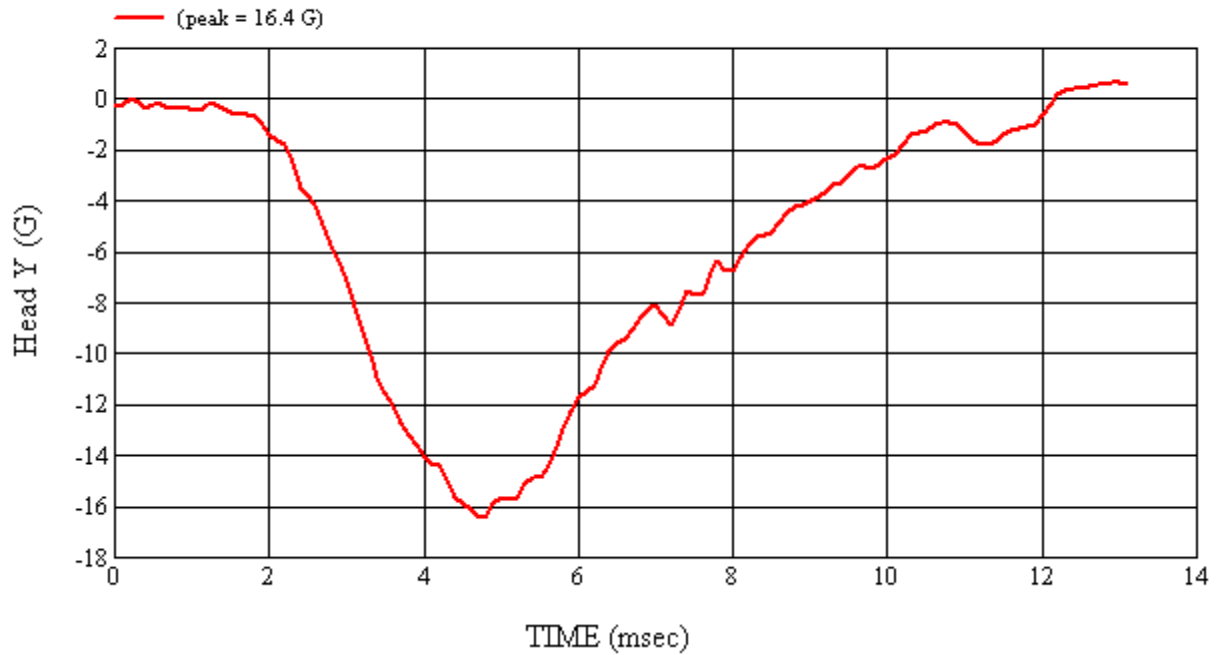
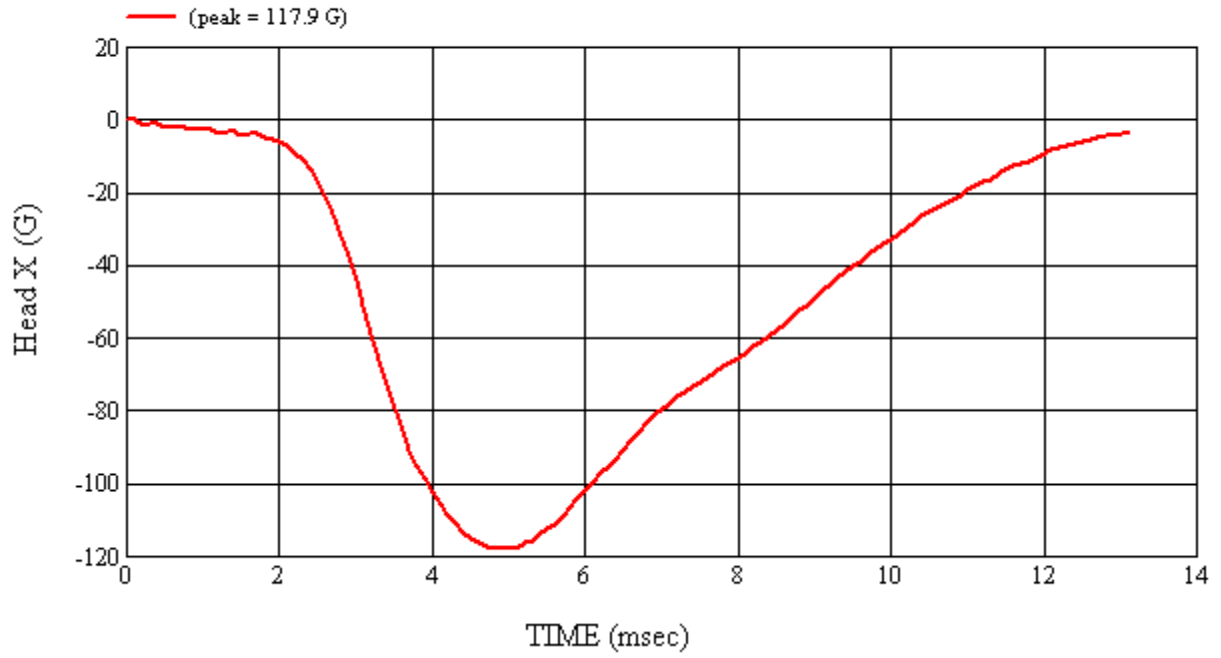
Recorded By: *Kevin D. McFerran* Approved By*: *Arthur I. Smith* Date: 5/19/2011
 *Only necessary for NHTSA (Government) Compliance testing.

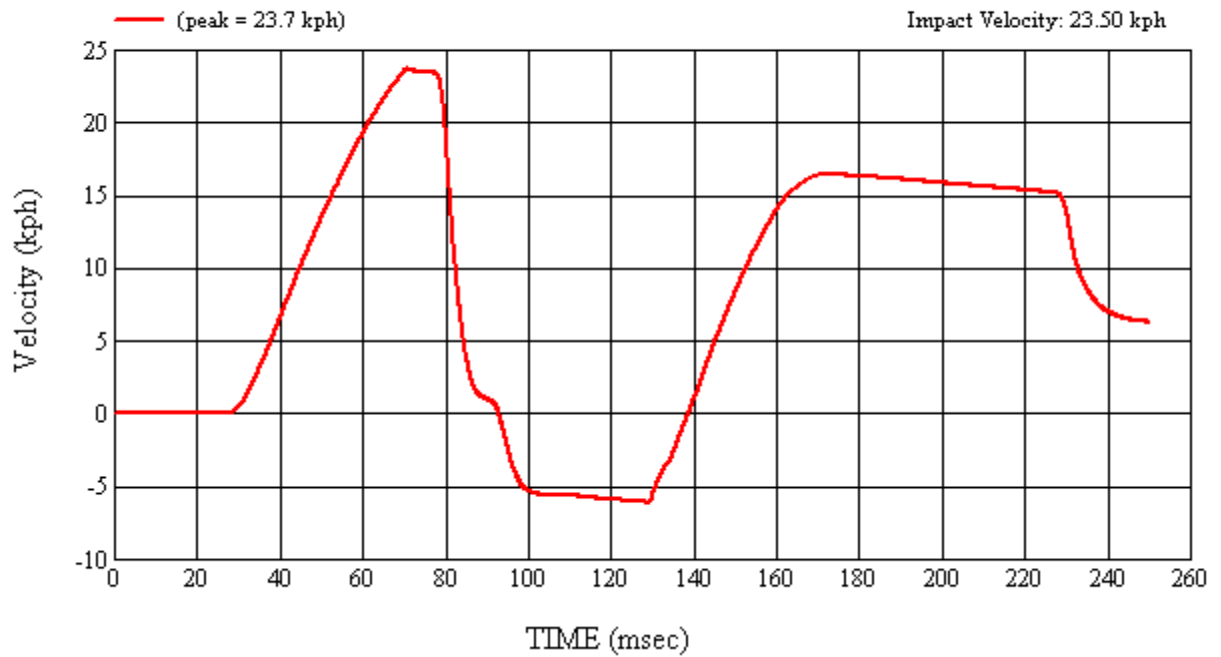
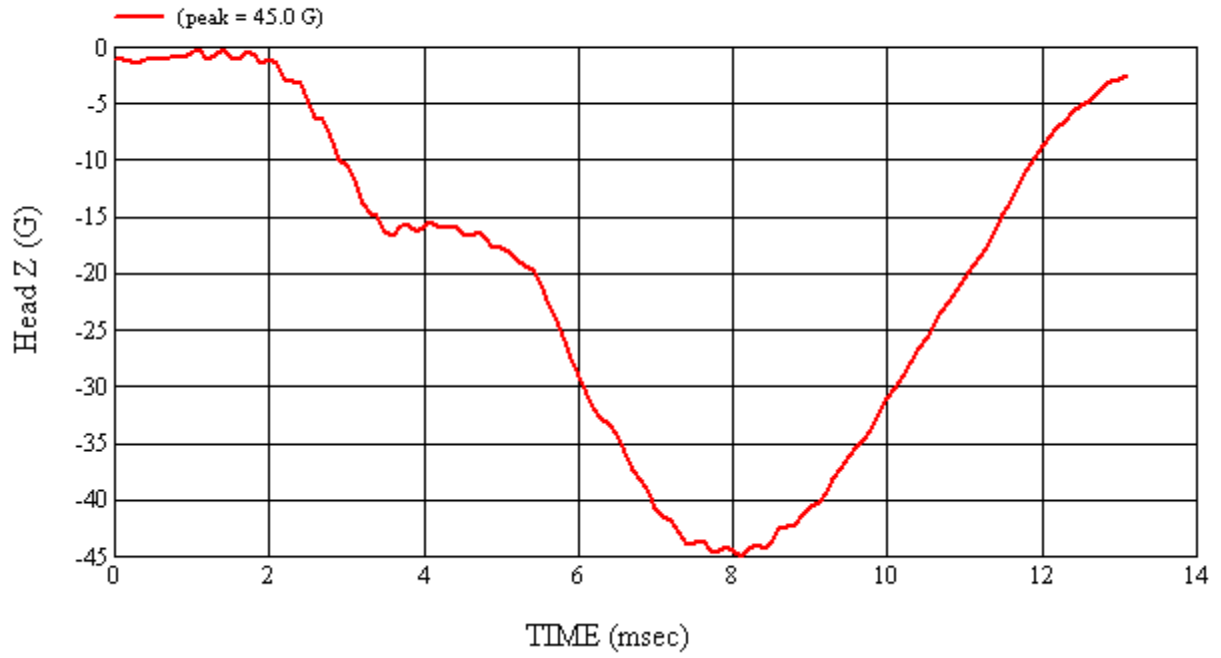
MGA Test #: U11169

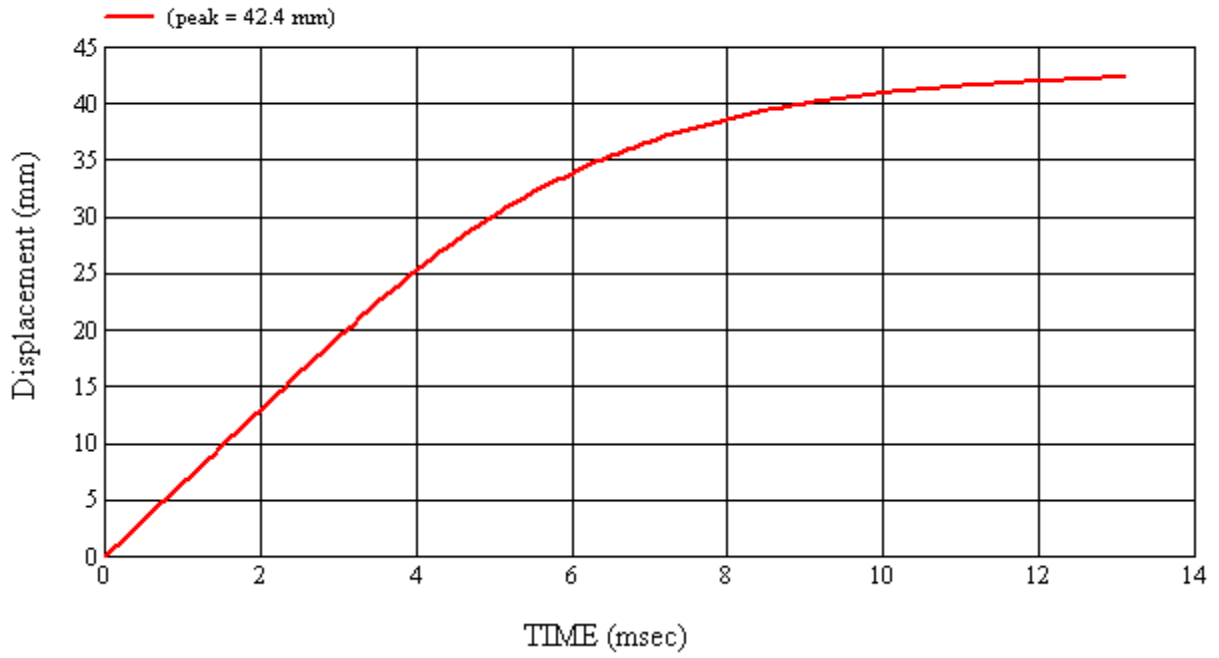
Target Location: FH1, Left Side

Test Date: 5/19/2011



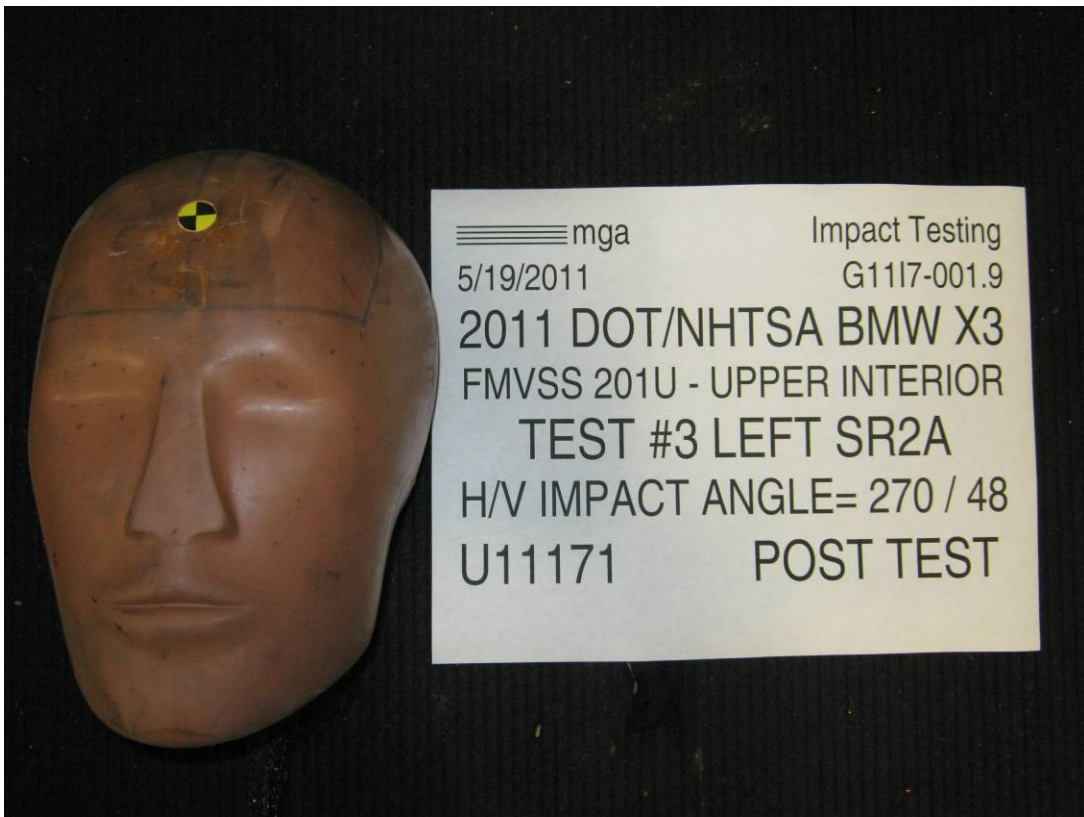












JOB/NHTSA NO: G1117-001.9 VEHICLE YR/MAKE/MODEL:2011/DOT/NHTSA/BMW X3

GENERAL TEST PARAMETERS:

Target (Vehicle Side): SR2ALeft

MGA Test Reference No.:U11171

Approach Horizontal Angles:270°

Approach Vertical Angles:48°

Additional Description:

Test Number:#3

Temperature:21.5C

Humidity:62.1%

Time of Test:12:08:19 PM

FMH Serial No:[038]

TEST RESULTS:


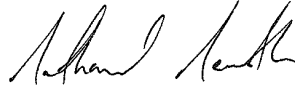
HIC(d)	HIC	Δt (msec)	Velocity (kph)	Impact location on FMH (mm)	
				Above Pt. O	Left/Right Pt. O
506	450	8.1	18.9	37	1 Left

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

Axis	Channel	Serial No.	DLR Value	ΔV Pre-Test	ΔV Post-Test
X	5	J22700	-96.4	1.07	1.07
Y	6	J36197	108.7	0.85	0.85
Z	7	J36353	99.1	0.94	0.94

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

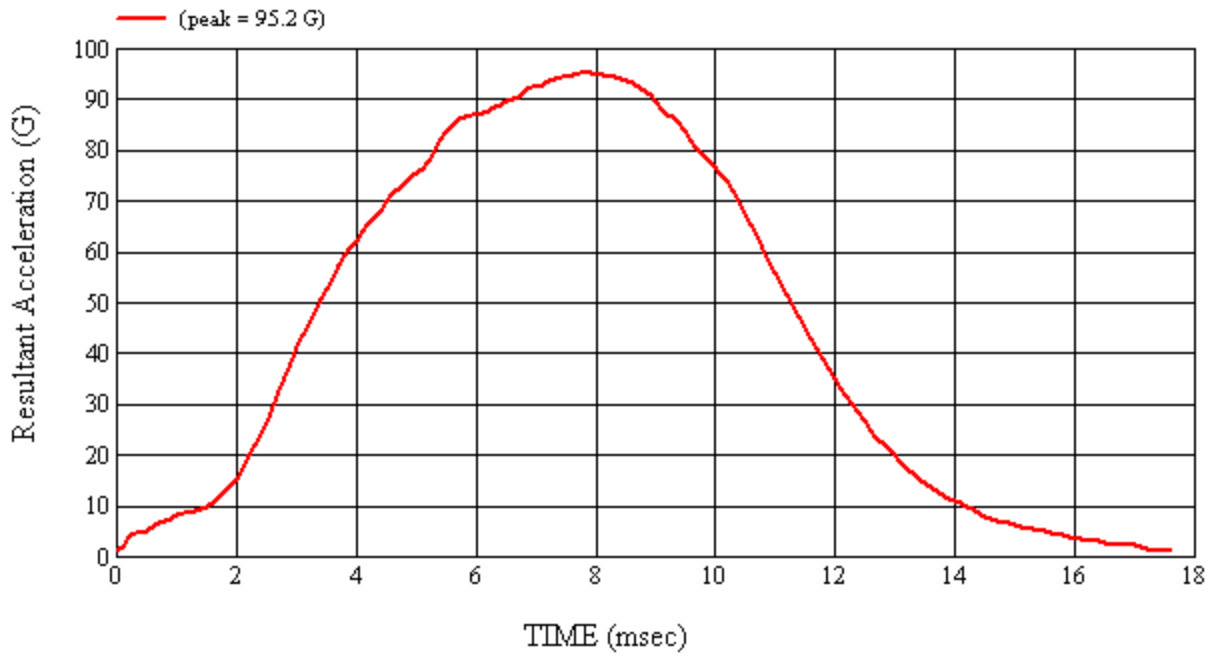
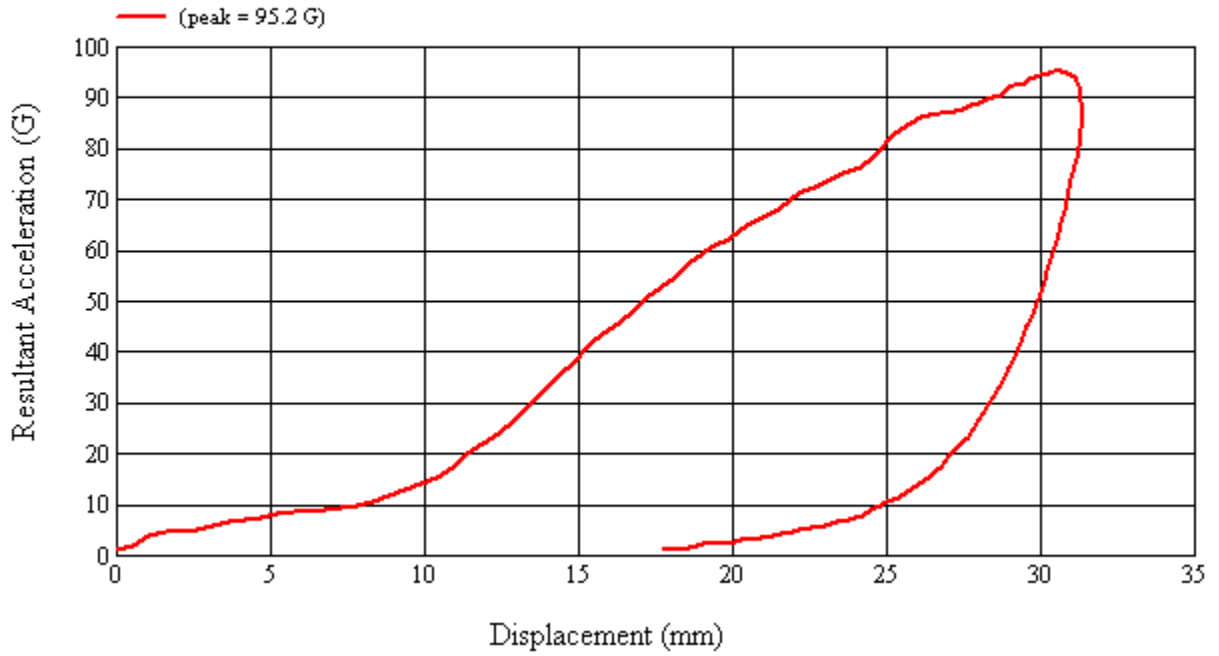
Grab handle depression

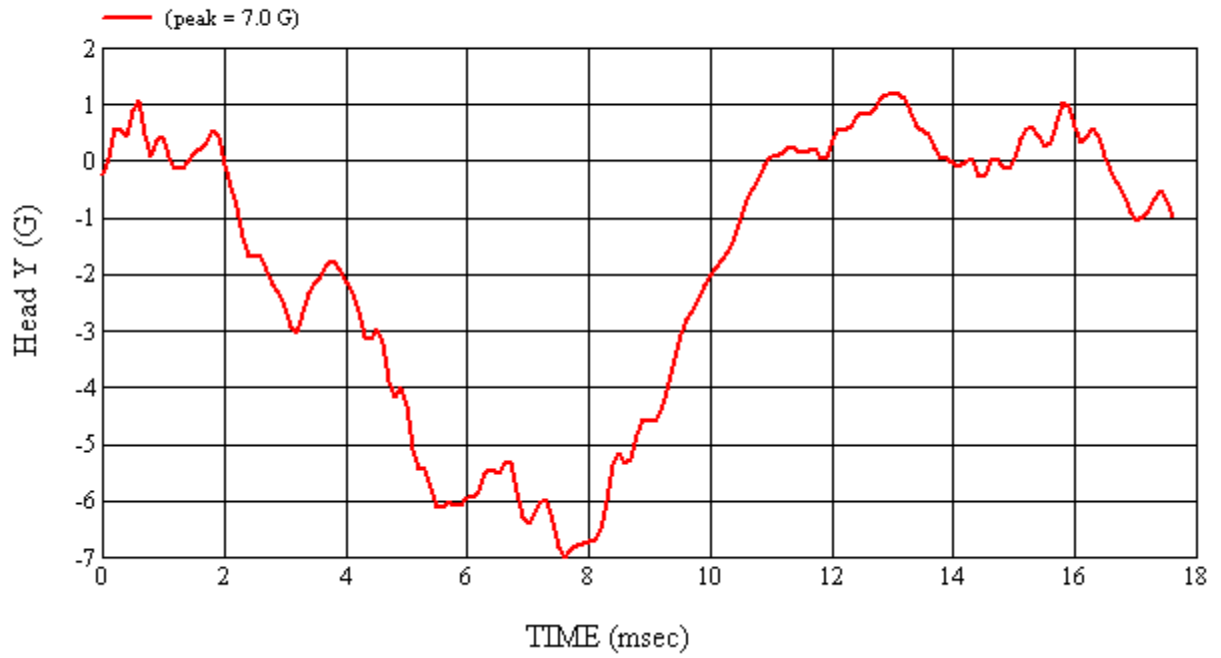
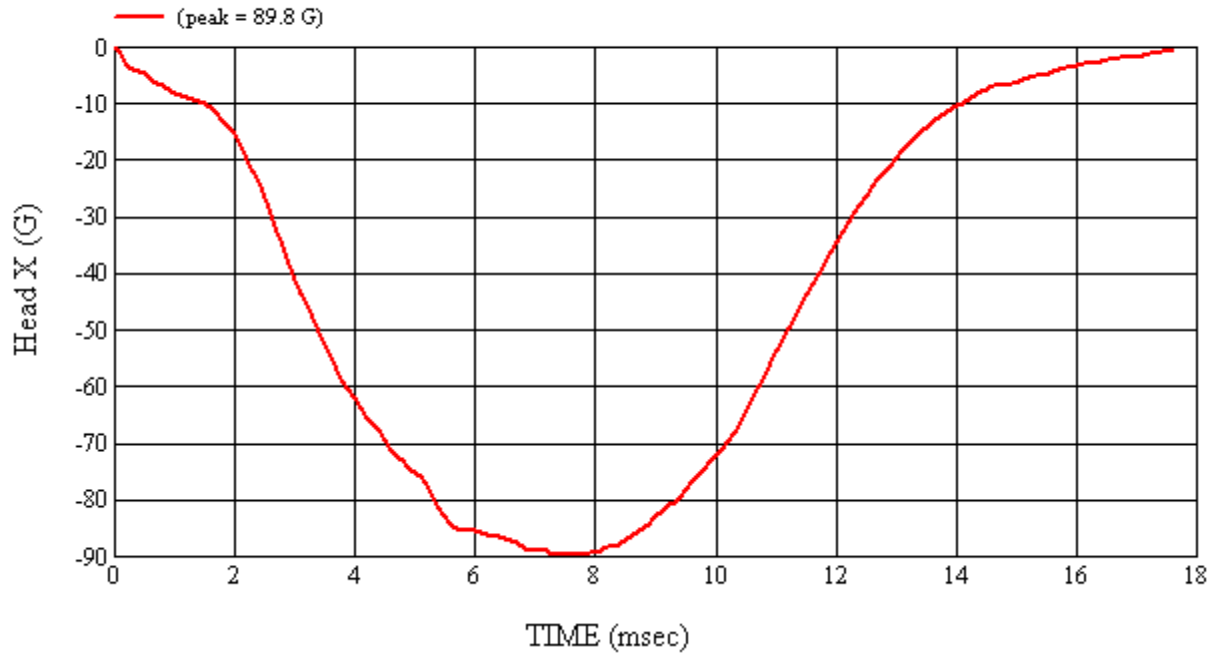
Recorded By:  Approved By*:  Date: 5/19/2011
 *Only necessary for NHTSA (Government) Compliance testing.

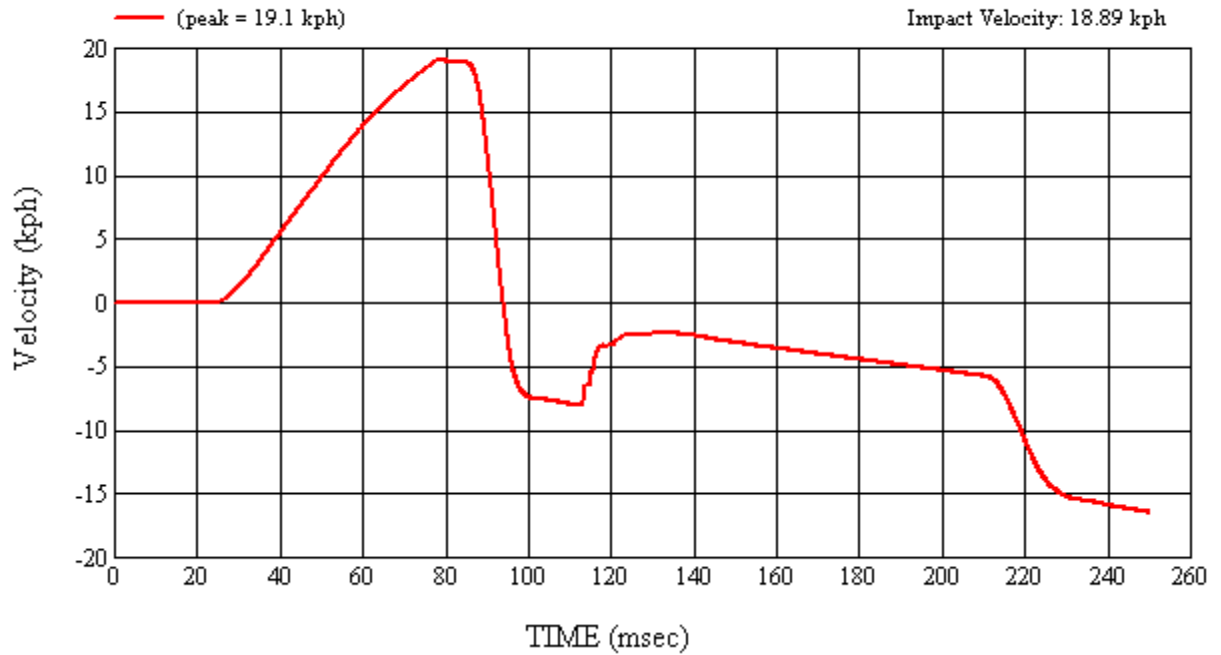
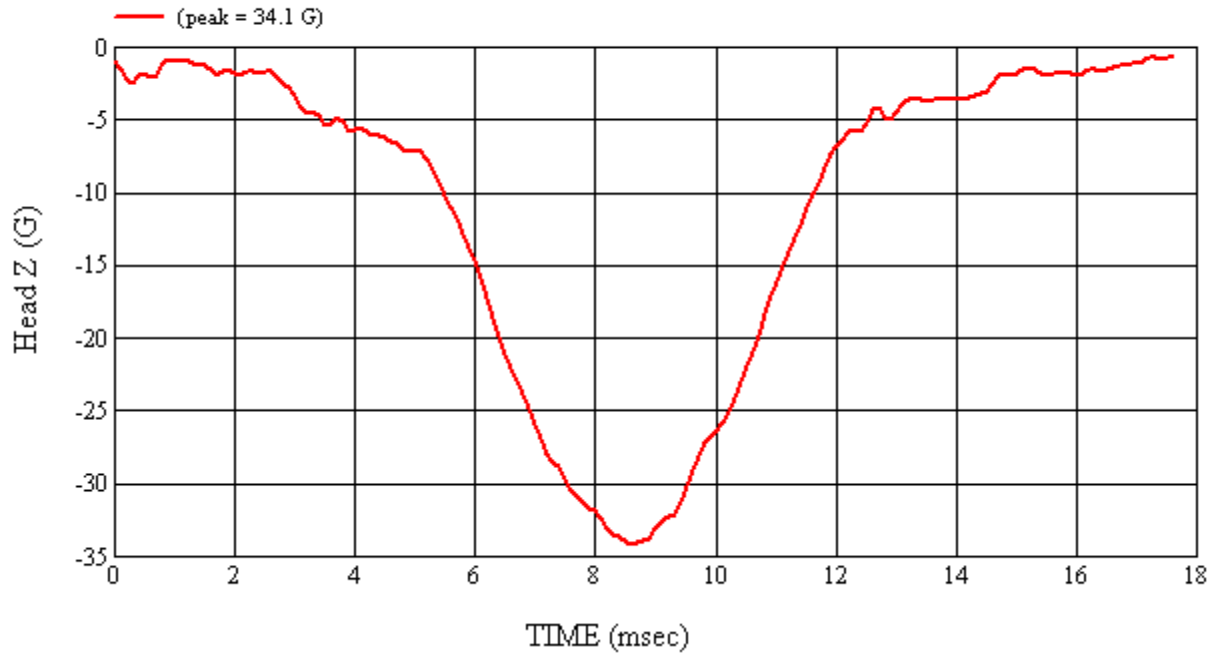
MGA Test #: U11171

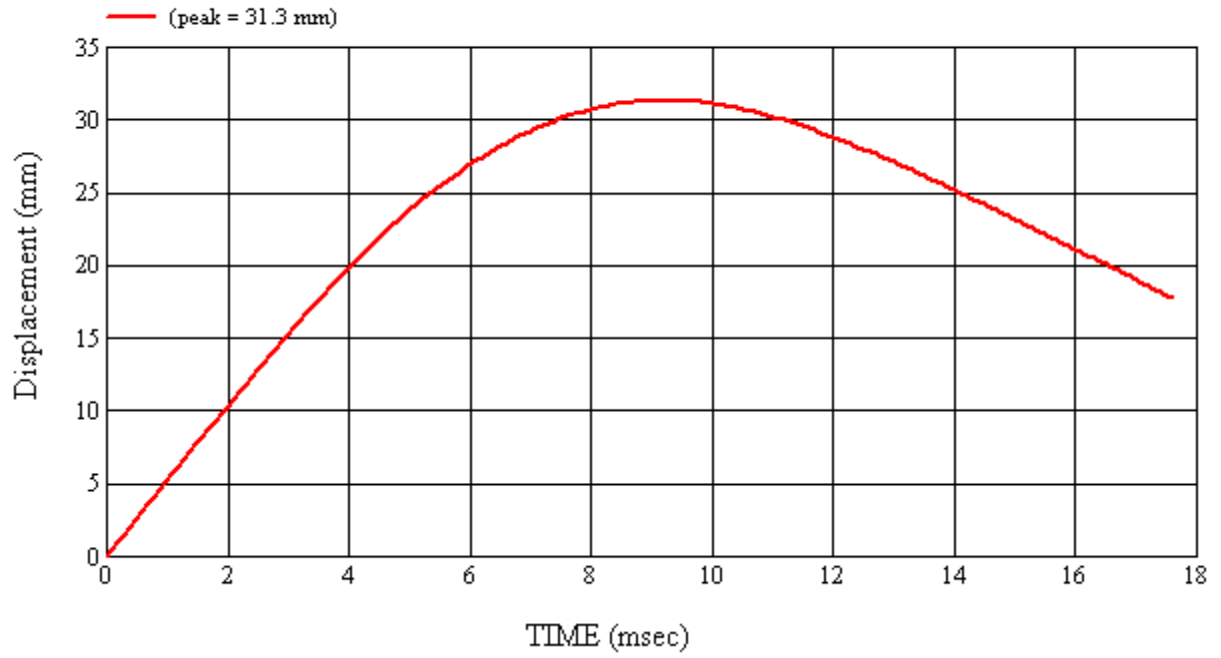
Target Location: SR2A, Left Side

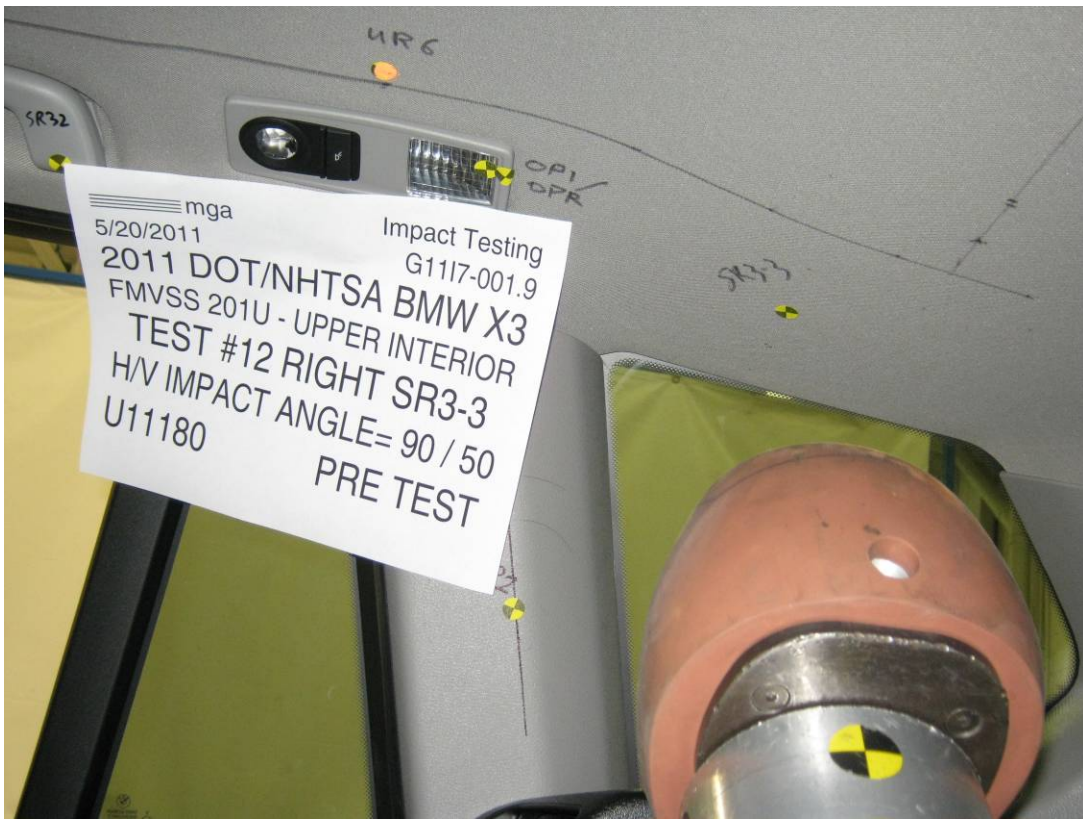
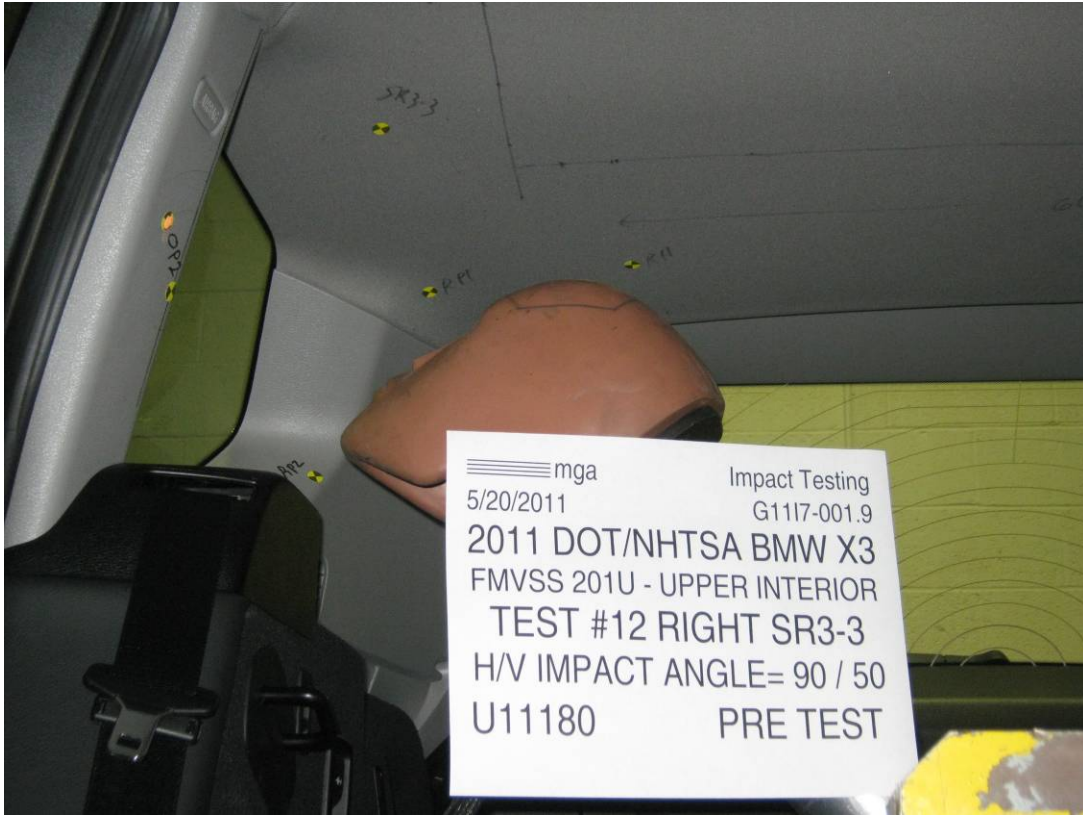
Test Date: 5/19/2011

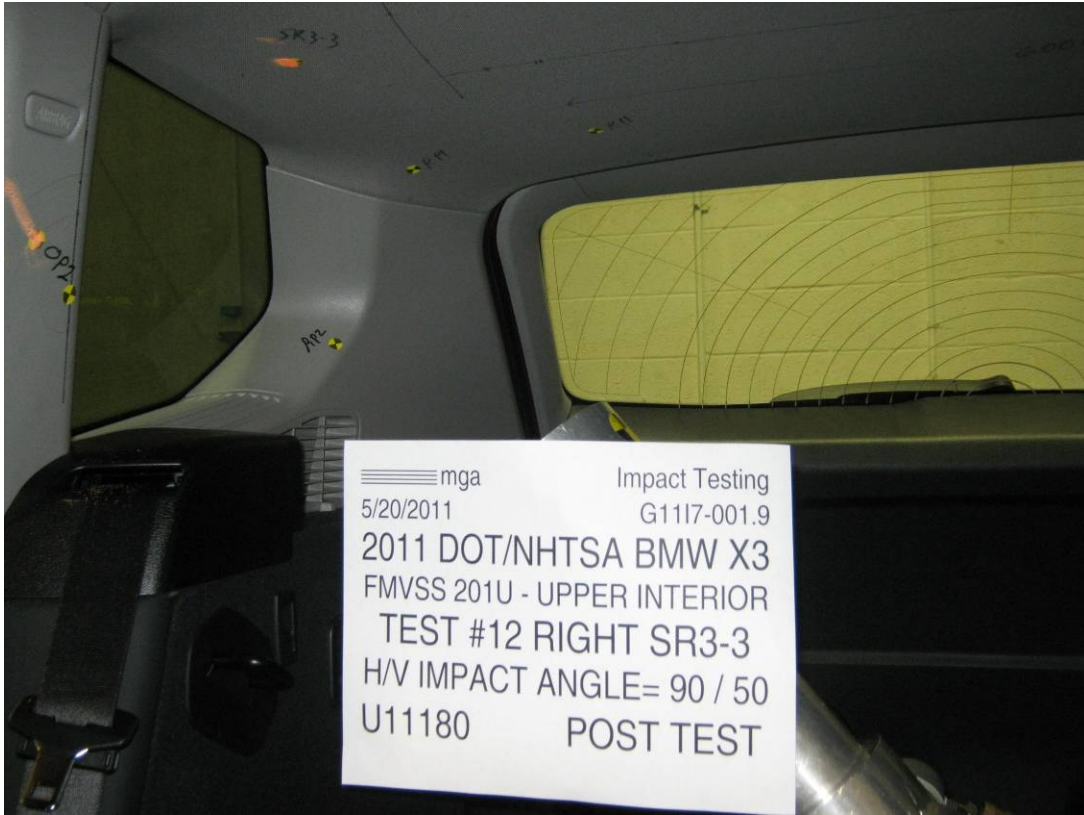


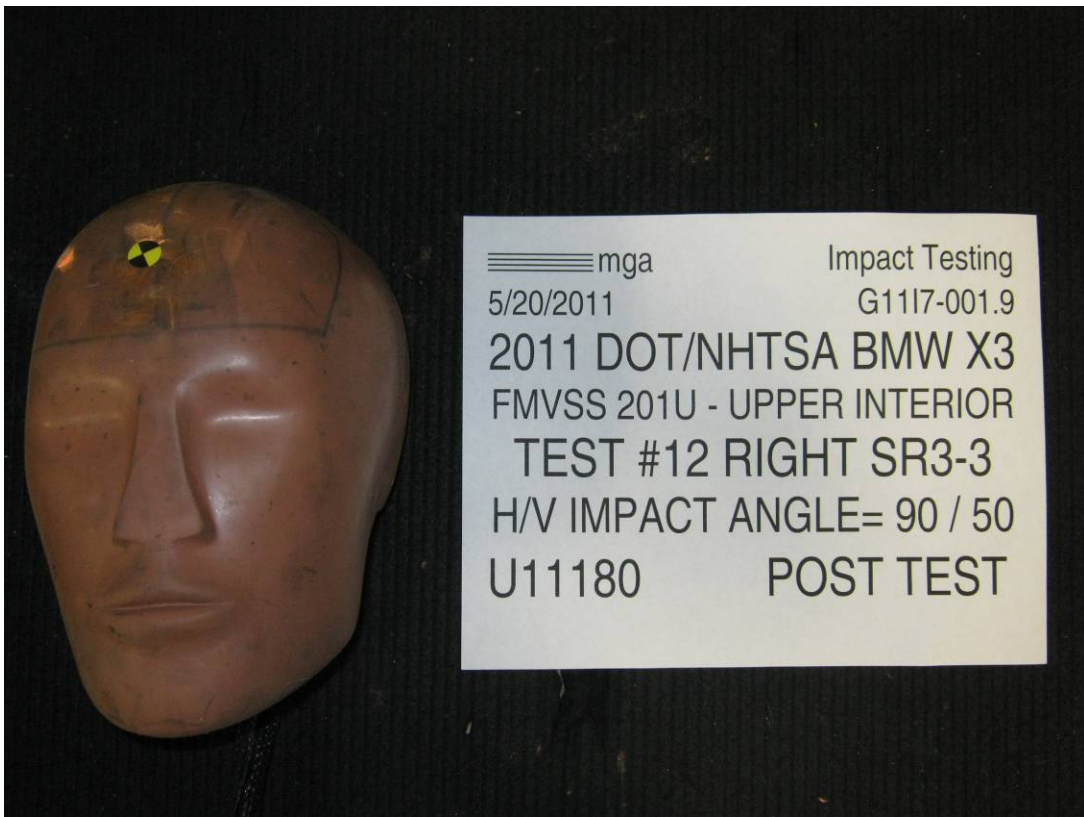












SUMMARY OF FMVSS 201U TEST

JOB/NHTSA NO: G1117-001.9 VEHICLE YR/MAKE/MODEL:2011/DOT/NHTSA/BMW X3

GENERAL TEST PARAMETERS:

Target (Vehicle Side): SR3-3Right

MGA Test Reference No.:U11180

Approach Horizontal Angles:90°

Approach Vertical Angles:50°

Additional Description:

Test Number:#12

Temperature:23.1C

Humidity:58.3%

Time of Test:3:23:41 PM

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
933	1015	4	19.0	34	5 Right

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

Axis	Channel	Serial No.	DLR Value	ΔV Pre-Test	ΔV Post-Test
X	5	J22700	-96.4	1.07	1.07
Y	6	J36197	108.7	0.85	0.85
Z	7	J36353	99.1	0.94	0.94

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

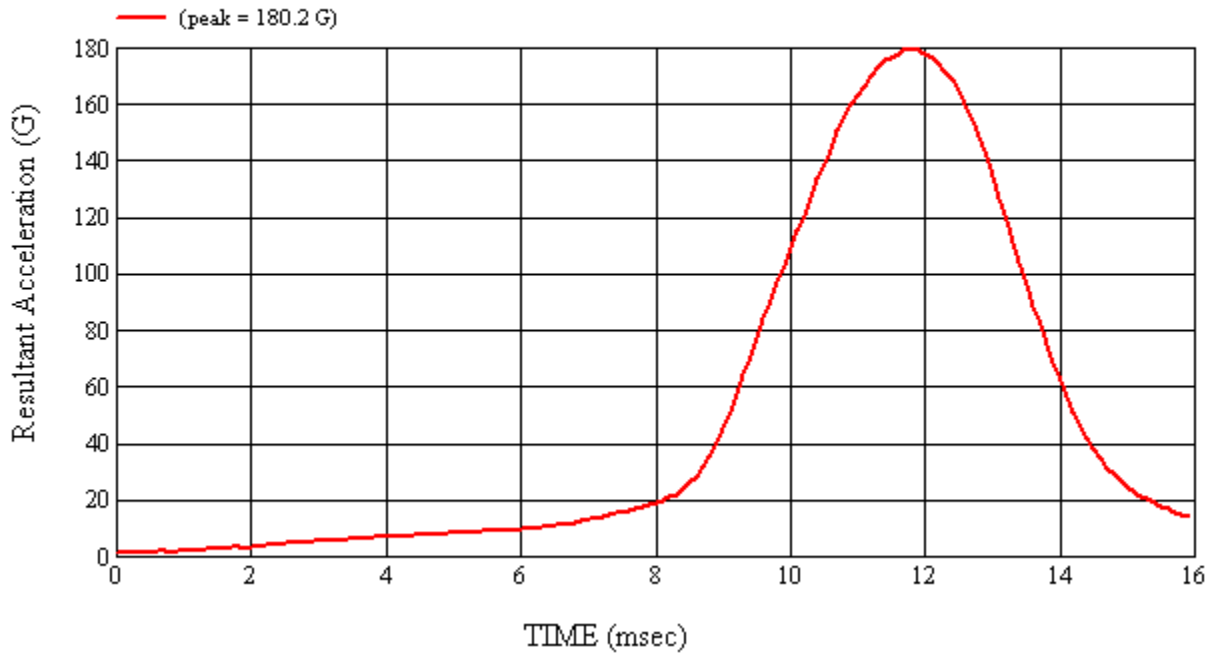
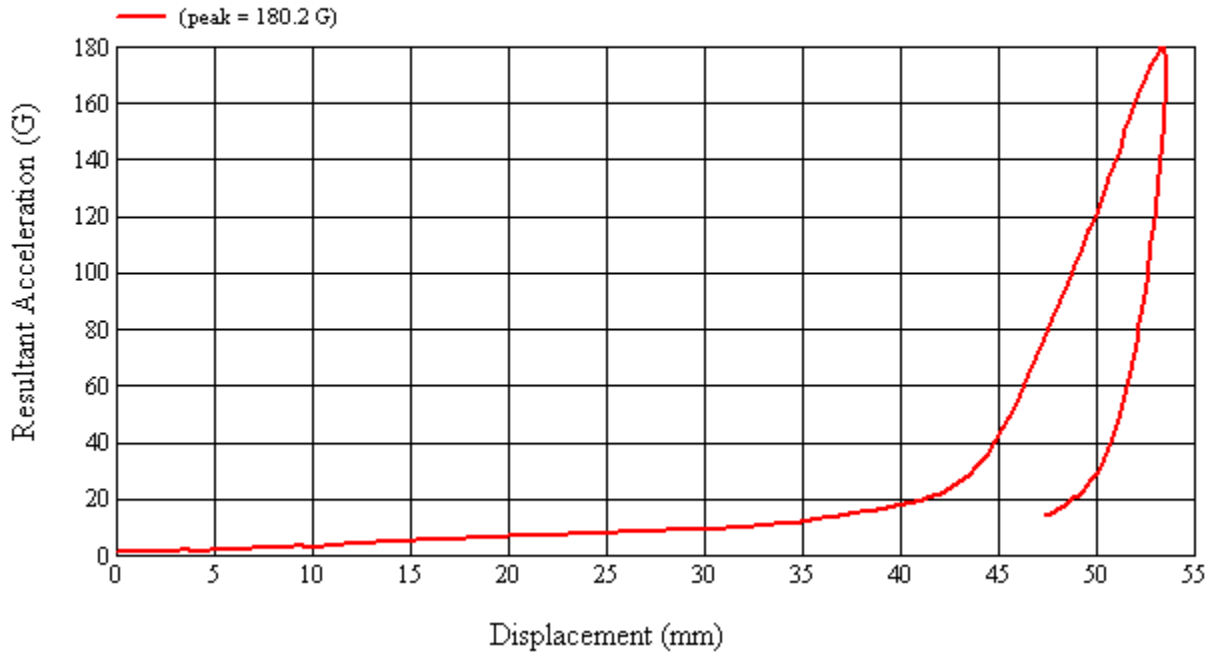
No visible damage

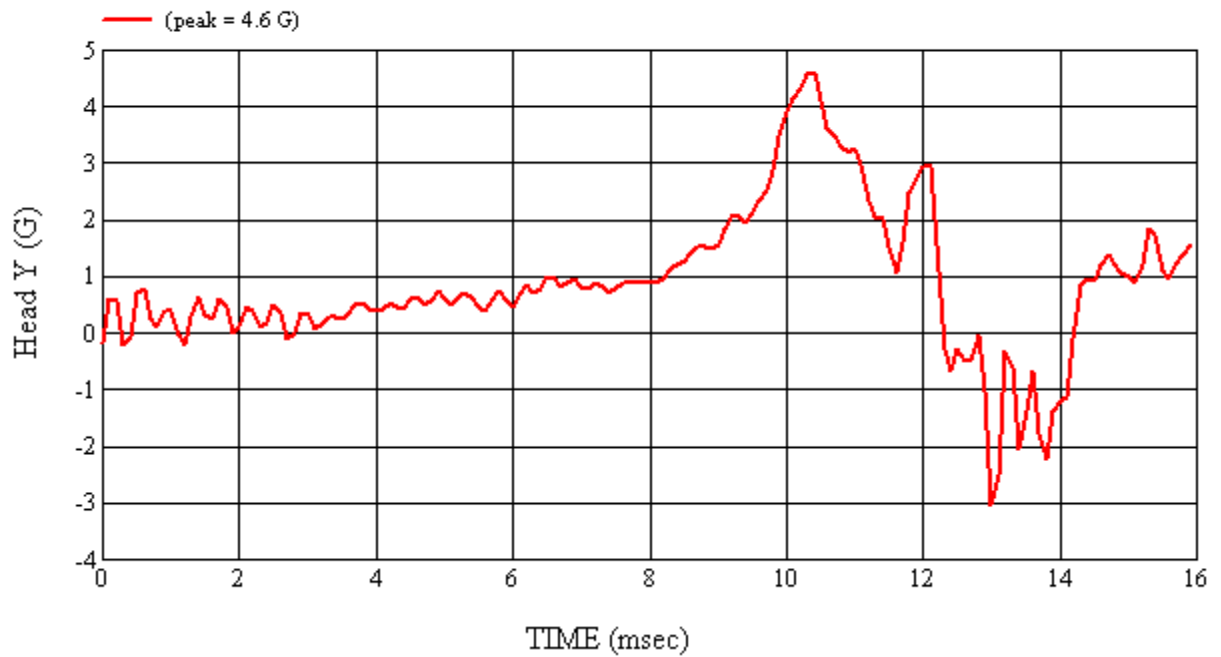
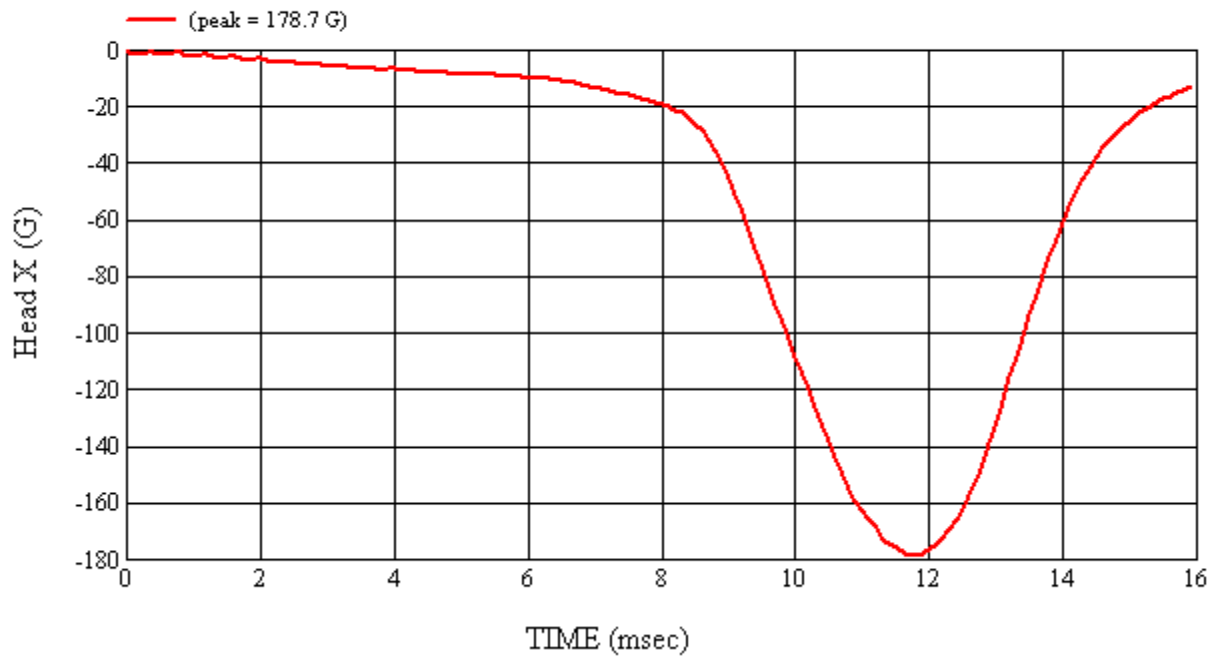
Recorded By: *Kevin D. McFerran* Approved By*: *Arthur I. Smith* Date: 5/20/2011
 *Only necessary for NHTSA (Government) Compliance testing.

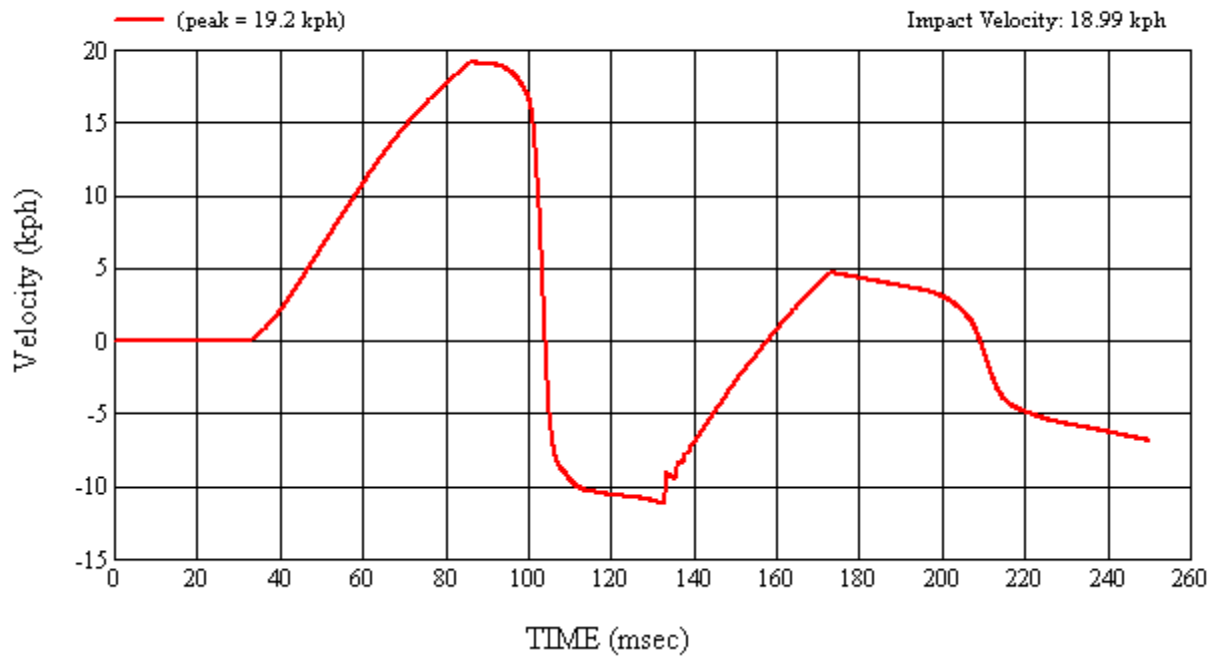
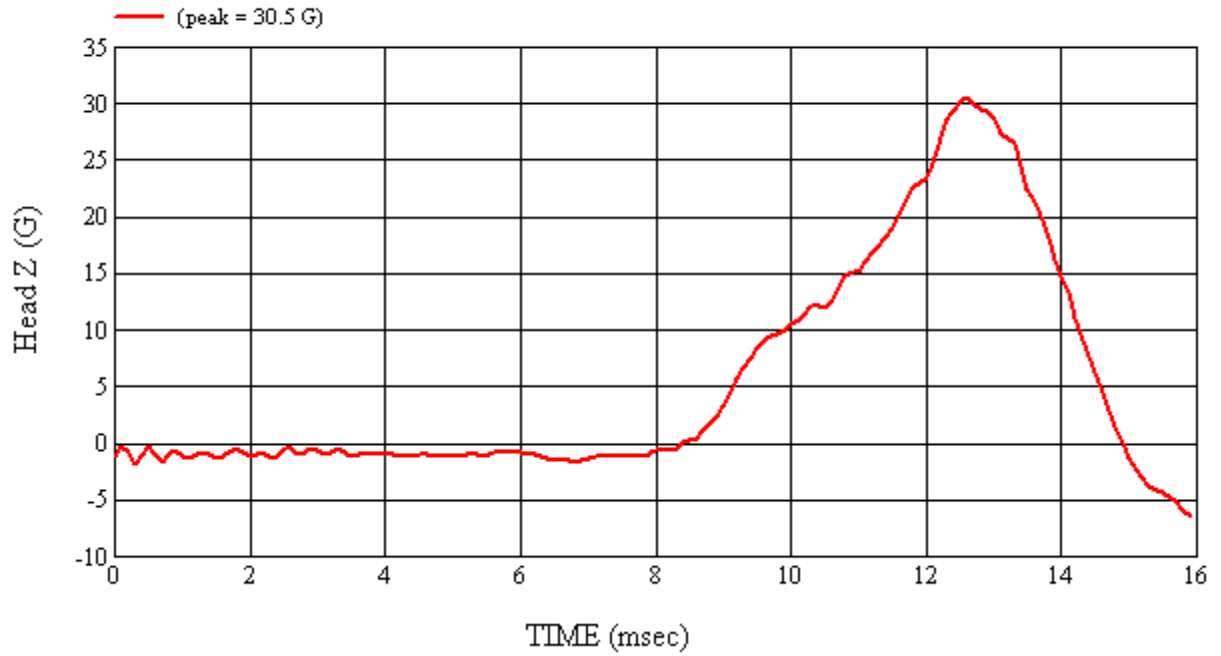
MGA Test #: U11180

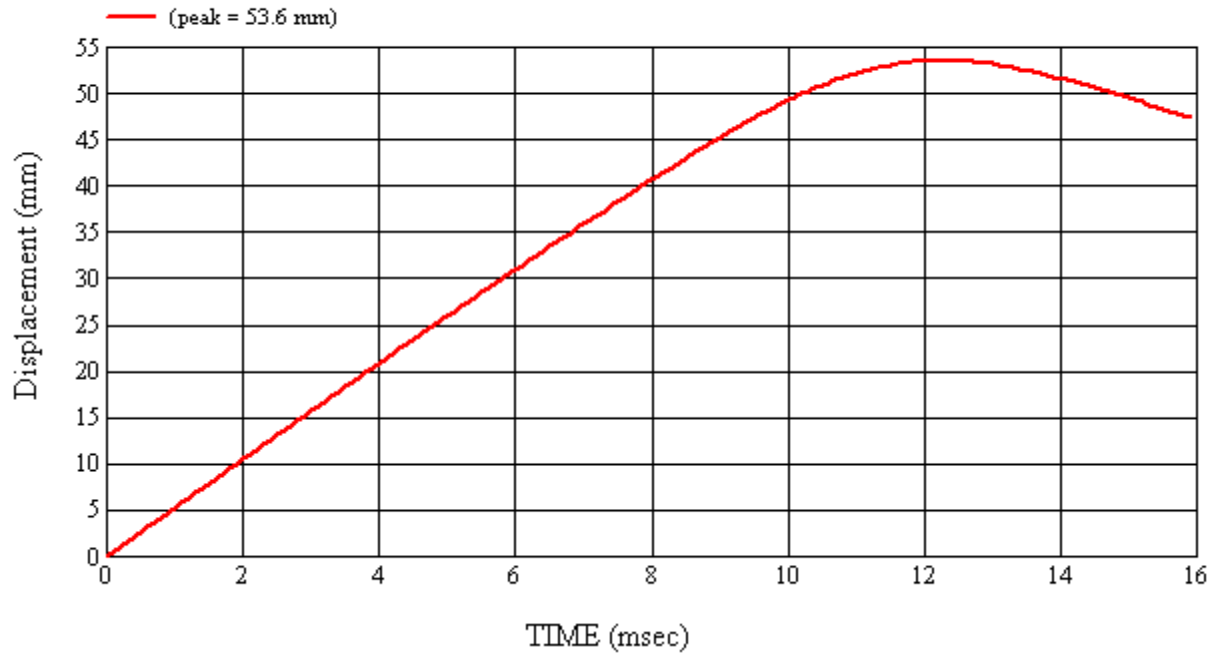
Target Location: SR3-3, Right Side

Test Date: 5/20/2011



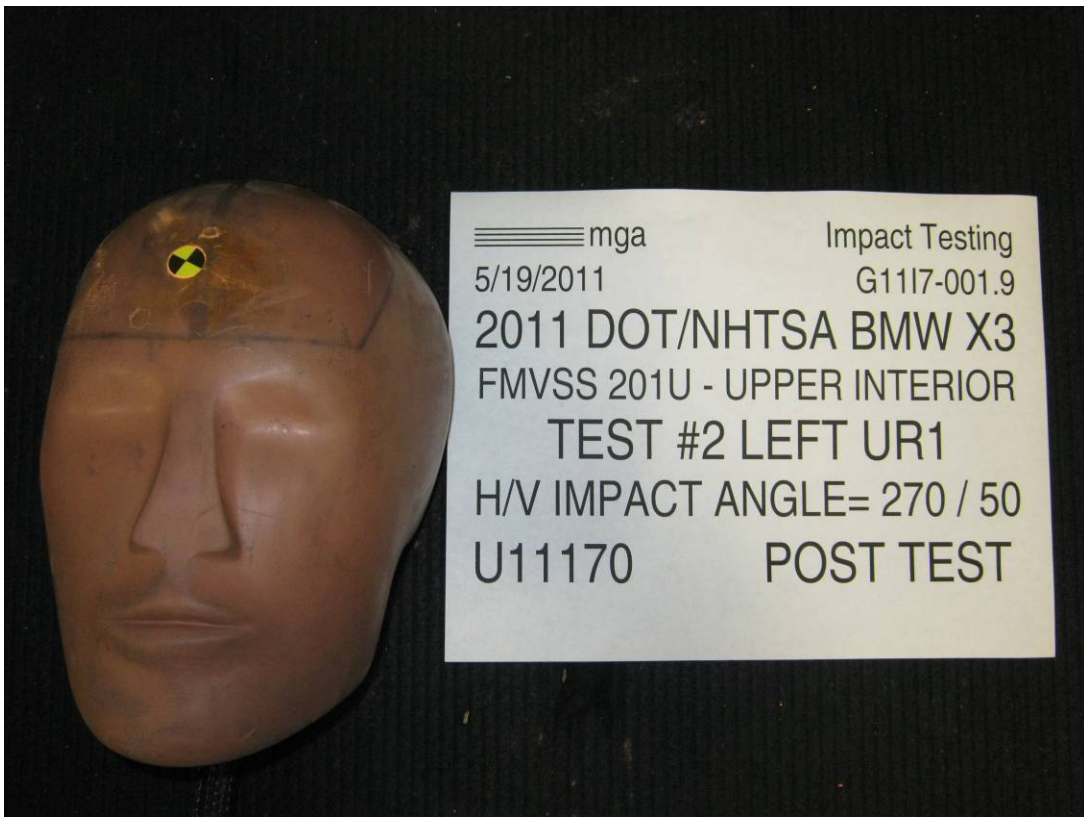












SUMMARY OF FMVSS 201U TEST

JOB/NHTSA NO: G1117-001.9 VEHICLE YR/MAKE/MODEL:2011/DOT/NHTSA/BMW X3

GENERAL TEST PARAMETERS:

Target (Vehicle Side): UR1Left

MGA Test Reference No.:U11170

Approach Horizontal Angles:270°

Approach Vertical Angles:50°

Additional Description:@ SR-1

Test Number:#2

Temperature:21.3C

Humidity:63.4%

Time of Test:11:12:52 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	10.9	23.7	27	7 Right

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

Axis	Channel	Serial No.	DLR Value	ΔV Pre-Test	ΔV Post-Test
X	5	J32177	-113.7	1.07	1.07
Y	6	J14103	93.9	0.85	0.85
Z	7	J35800	97.8	0.94	0.94

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

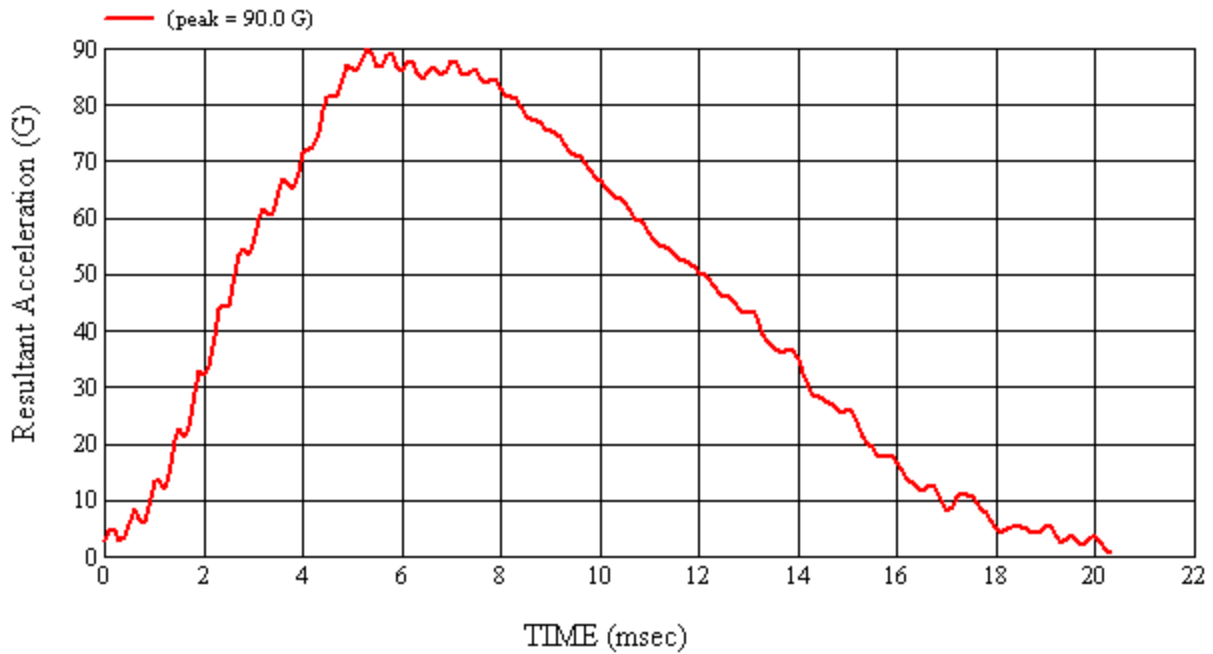
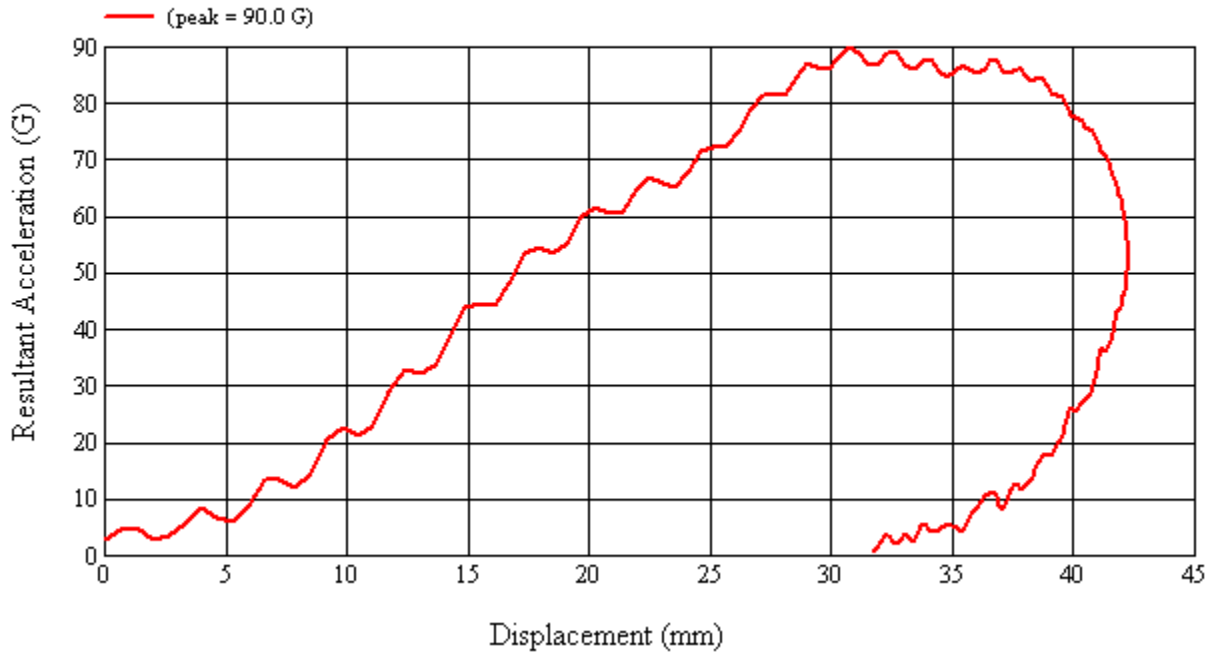
No visible damage

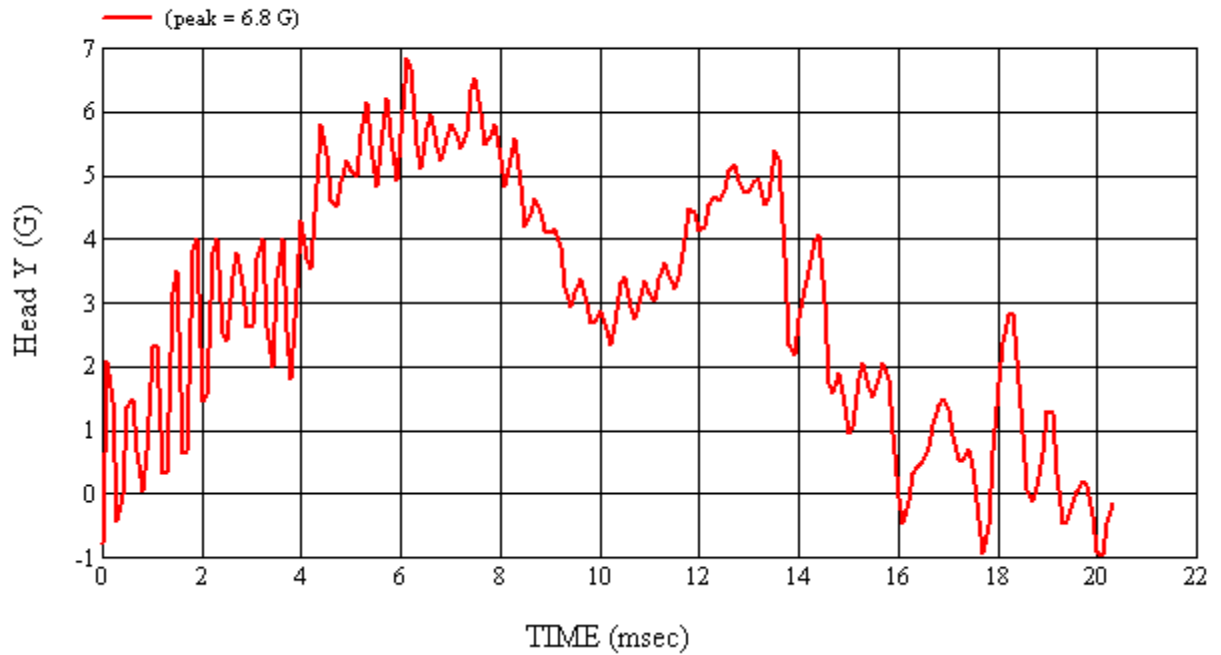
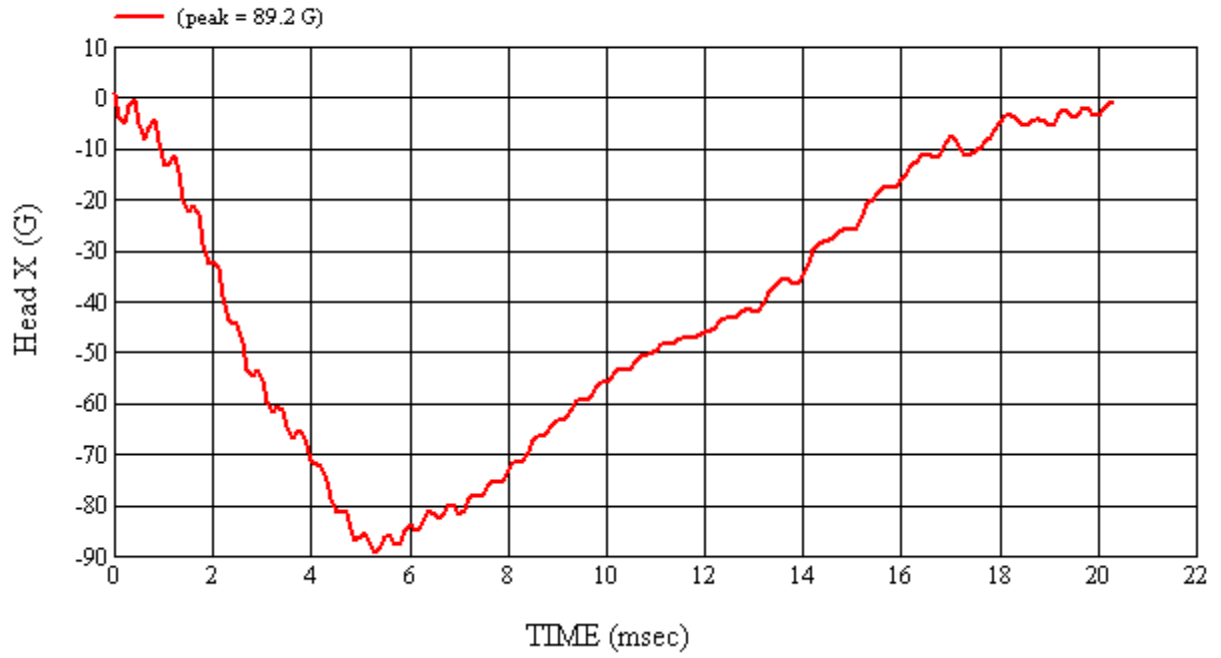
Recorded By: *Kevin D. McFerran* Approved By*: *Arthur I. Smith* Date: 5/19/2011
 *Only necessary for NHTSA (Government) Compliance testing.

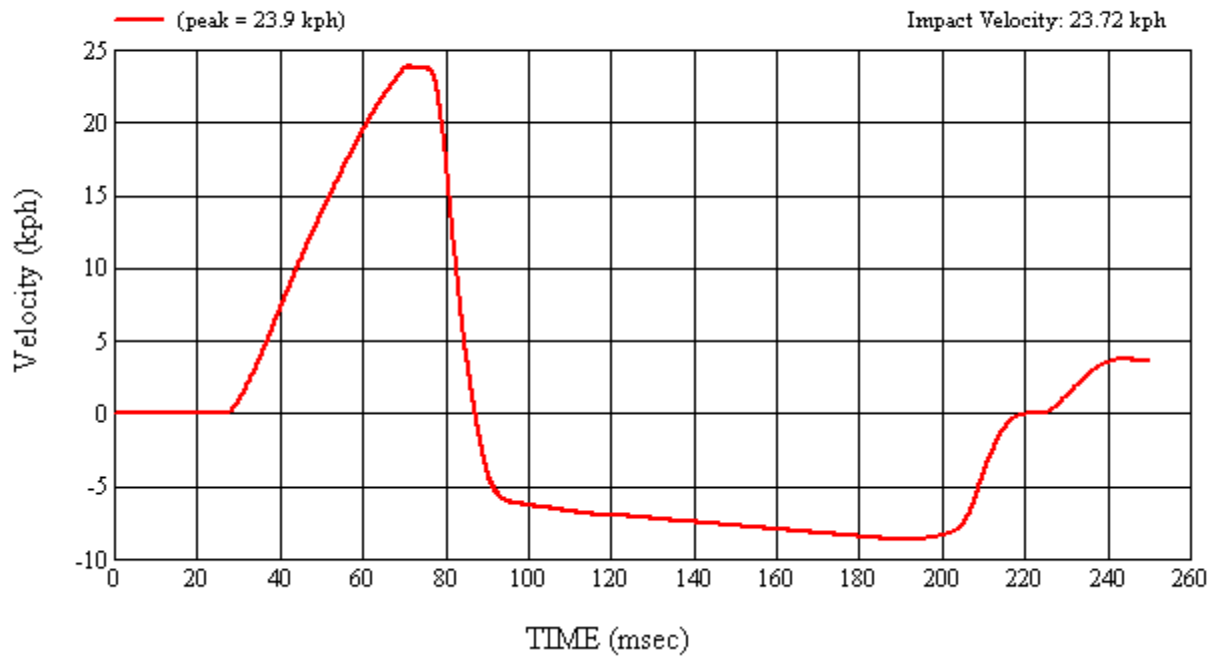
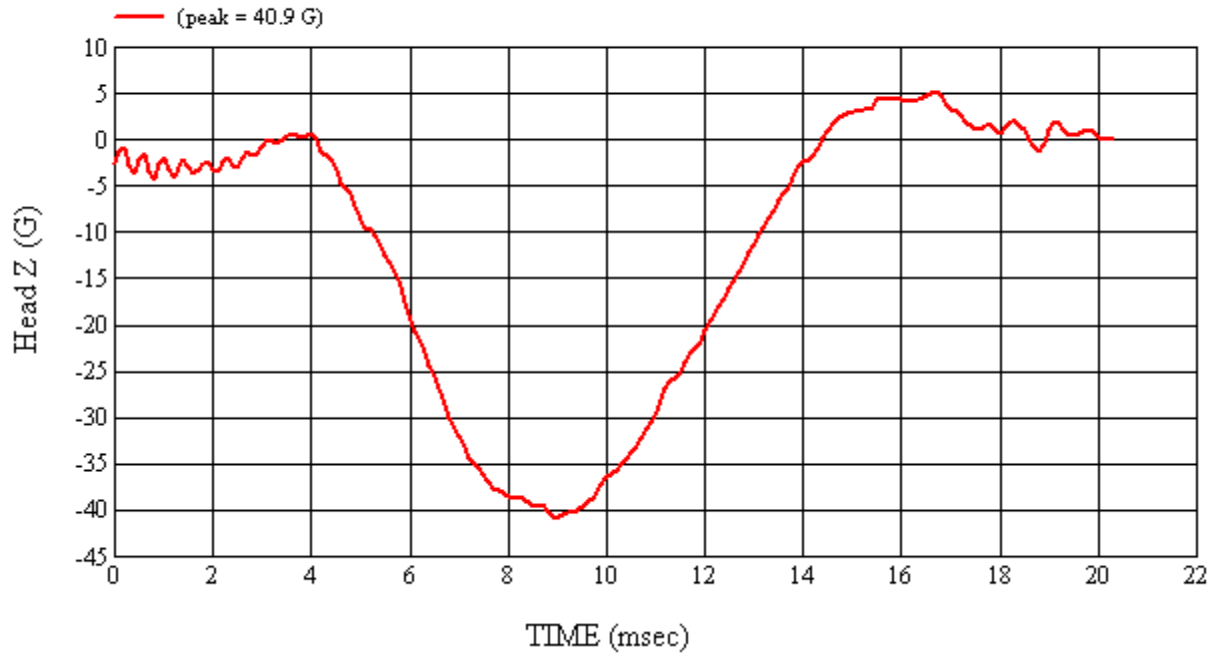
MGA Test #: U11170

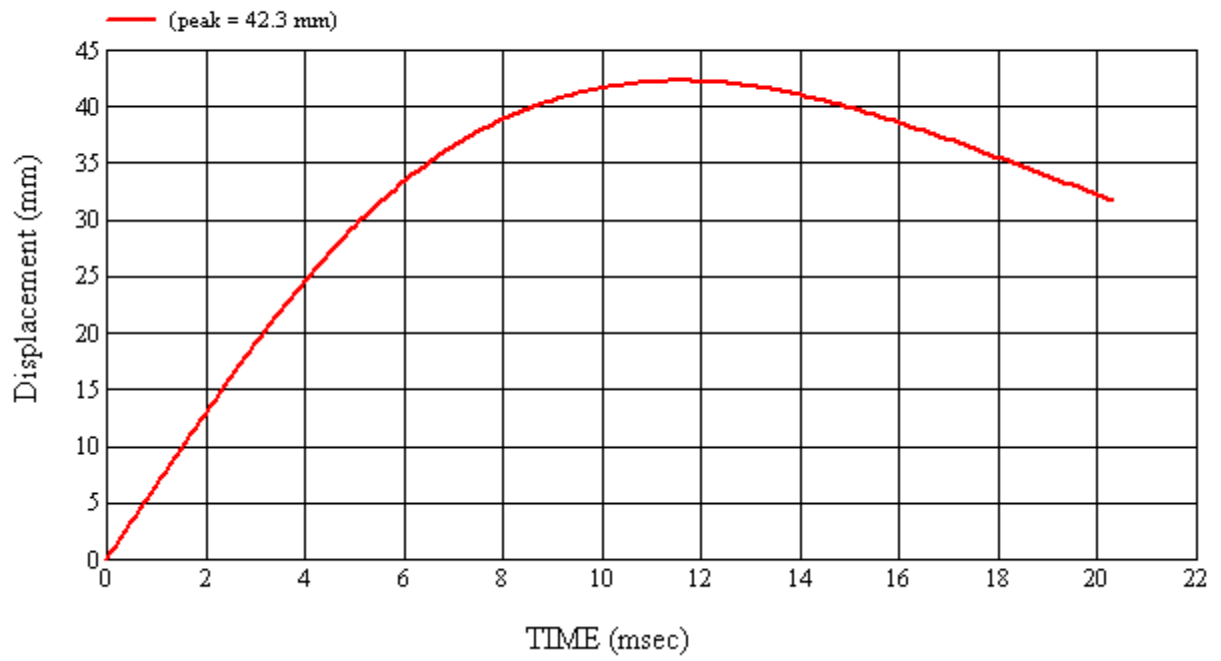
Target Location: UR1, Left Side

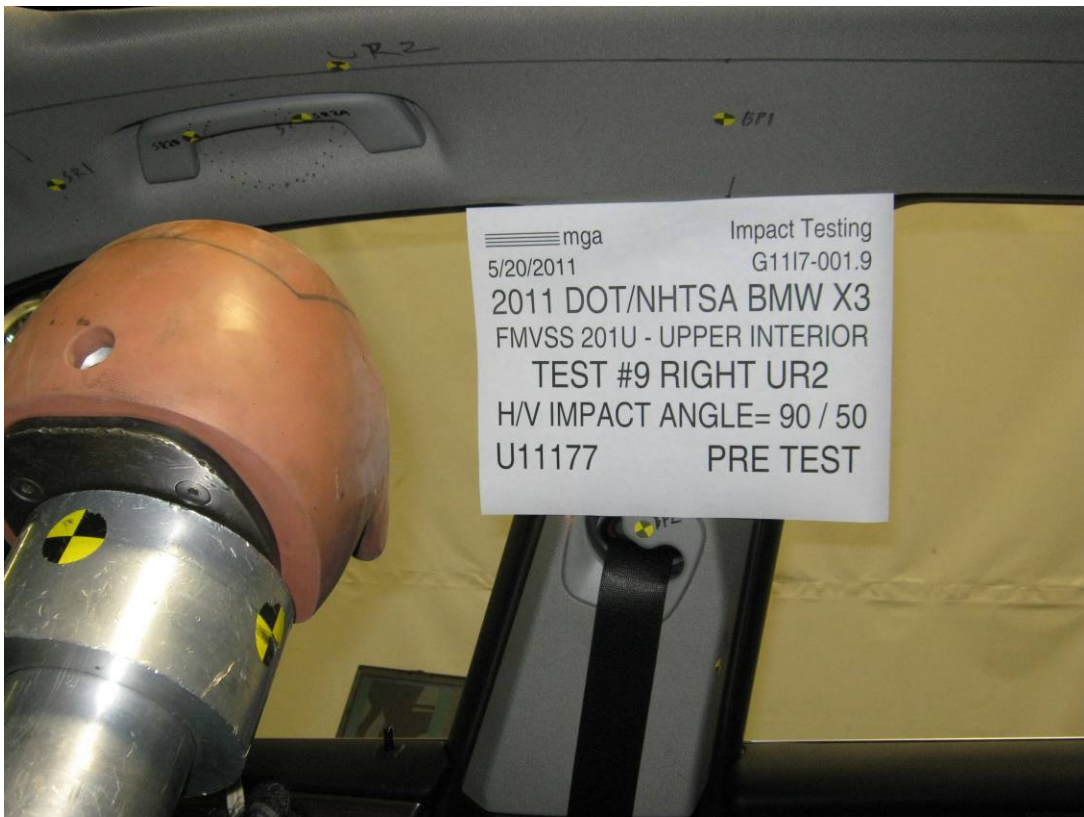
Test Date: 5/19/2011

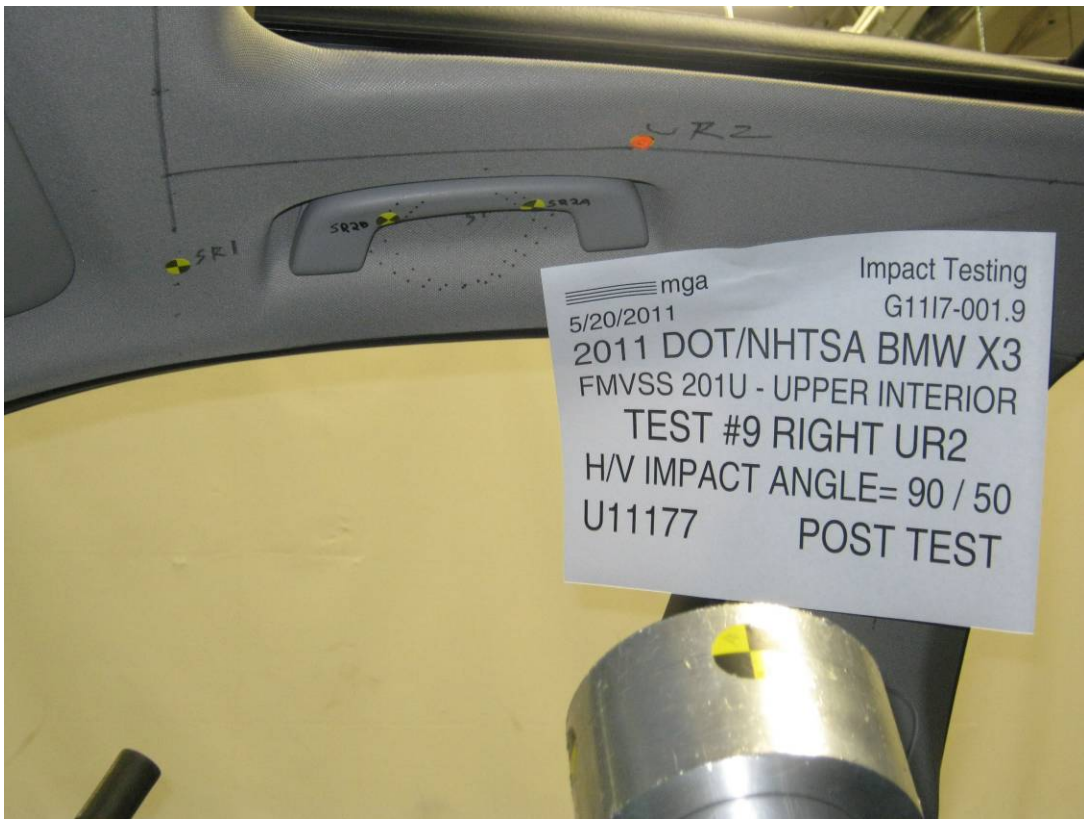


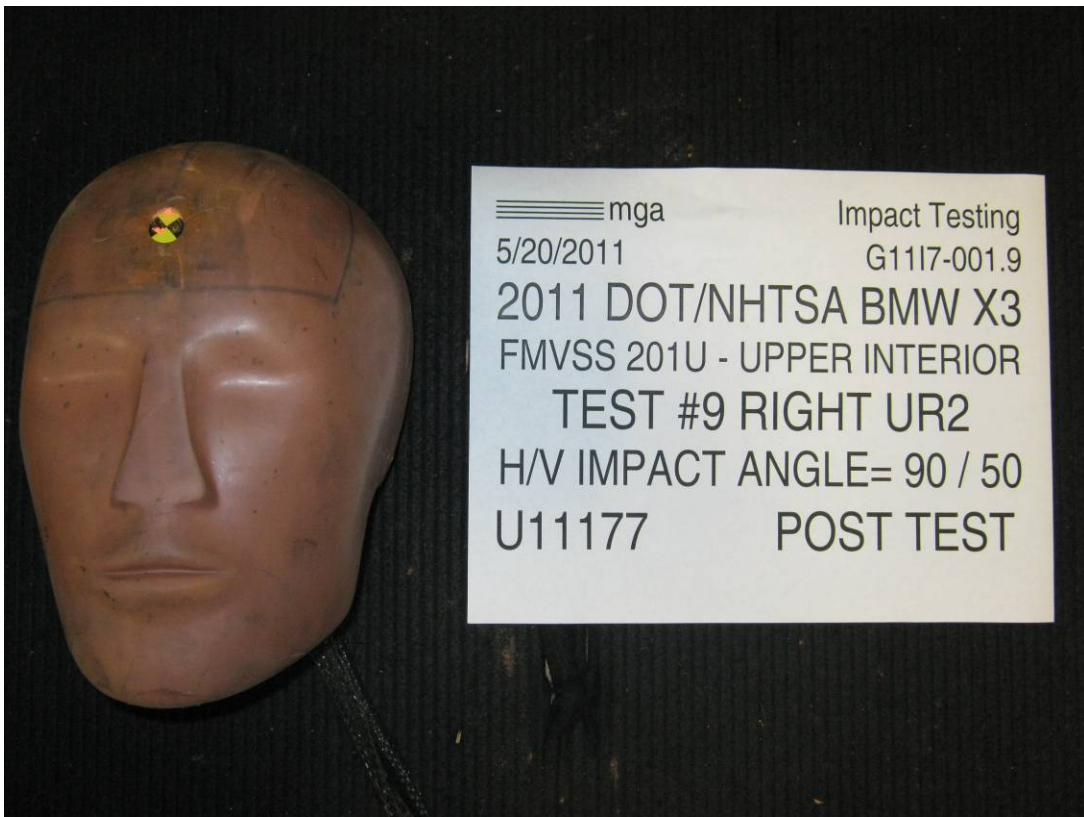
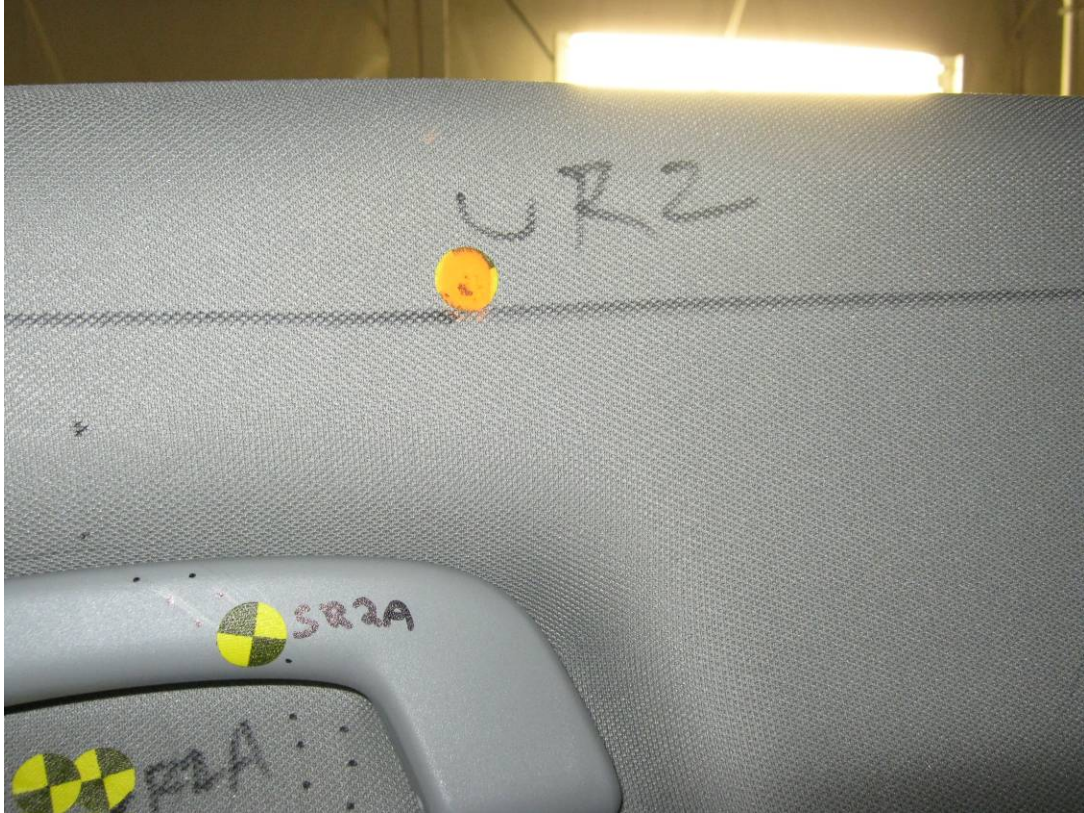












SUMMARY OF FMVSS 201U TEST

JOB/NHTSA NO: G1117-001.9 VEHICLE YR/MAKE/MODEL:2011/DOT/NHTSA/BMW X3

GENERAL TEST PARAMETERS:

Target (Vehicle Side): UR2Right

MGA Test Reference No.:U11177

Approach Horizontal Angles:90°

Approach Vertical Angles:50°

Additional Description:@ SR2-A

Test Number:#9

Temperature:22.7C

Humidity:58.0%

Time of Test:11:18:45 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
565	528	10.2	23.8	26	0

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

Axis	Channel	Serial No.	DLR Value	ΔV Pre-Test	ΔV Post-Test
X	5	J22700	-96.4	1.07	1.07
Y	6	J36197	108.7	0.85	0.85
Z	7	J36353	99.1	0.94	0.94

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

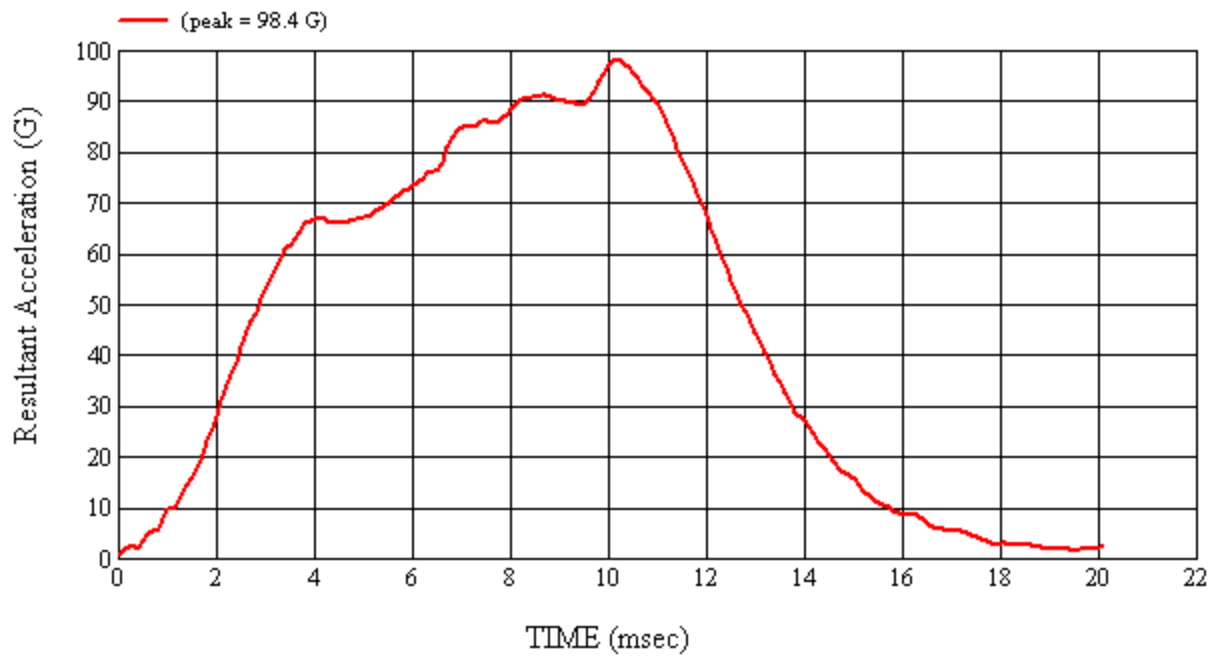
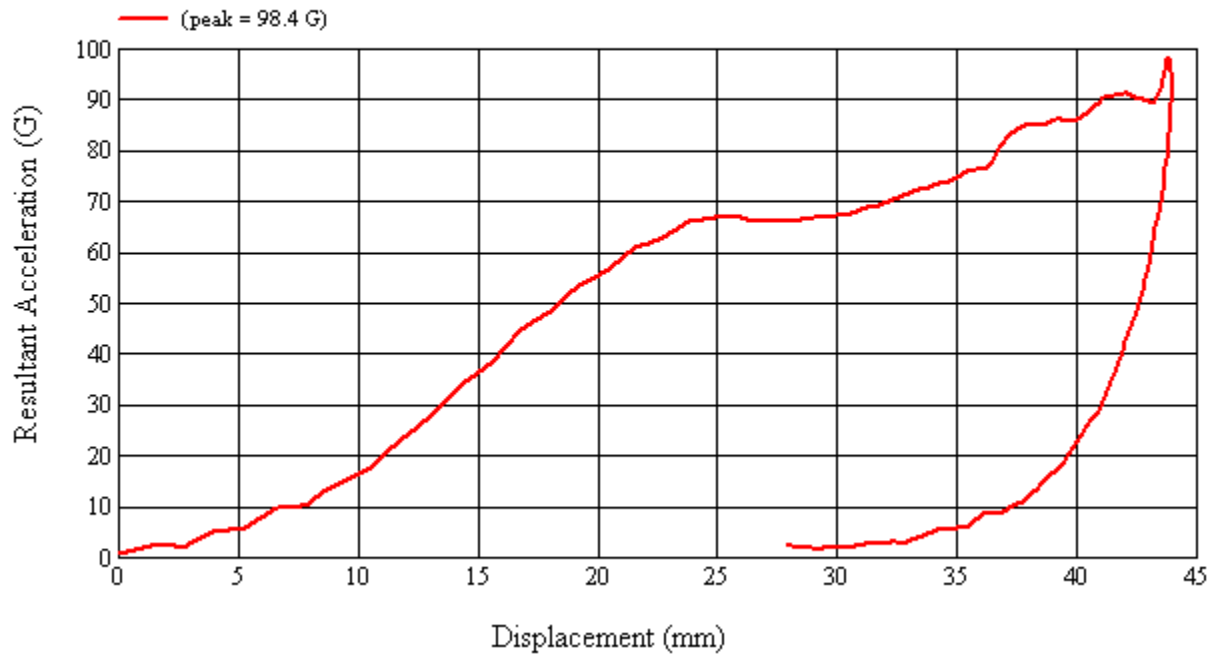
No visible damage

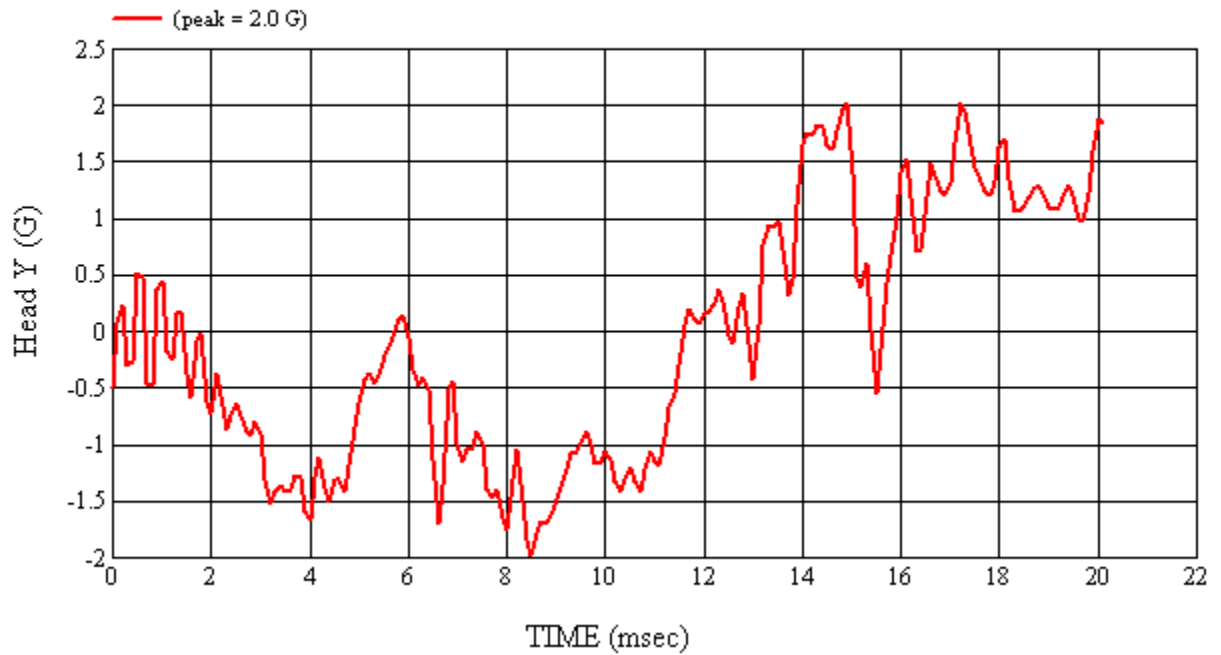
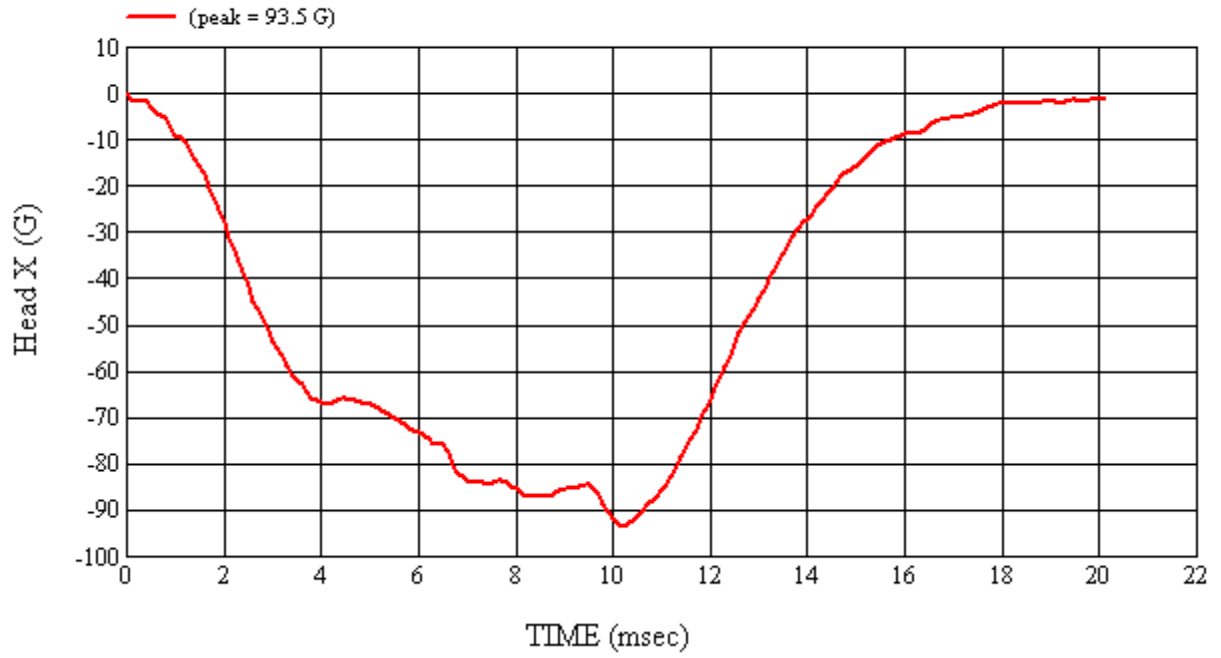
Recorded By:  Approved By*:  Date: 5/20/2011
 *Only necessary for NHTSA (Government) Compliance testing.

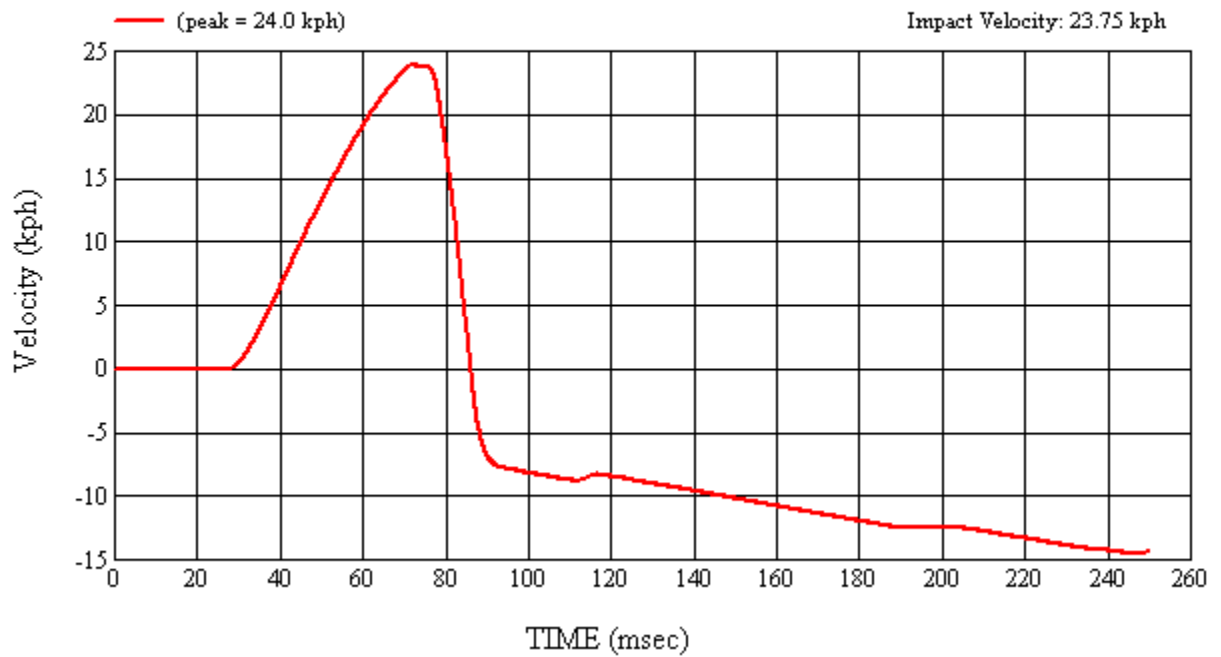
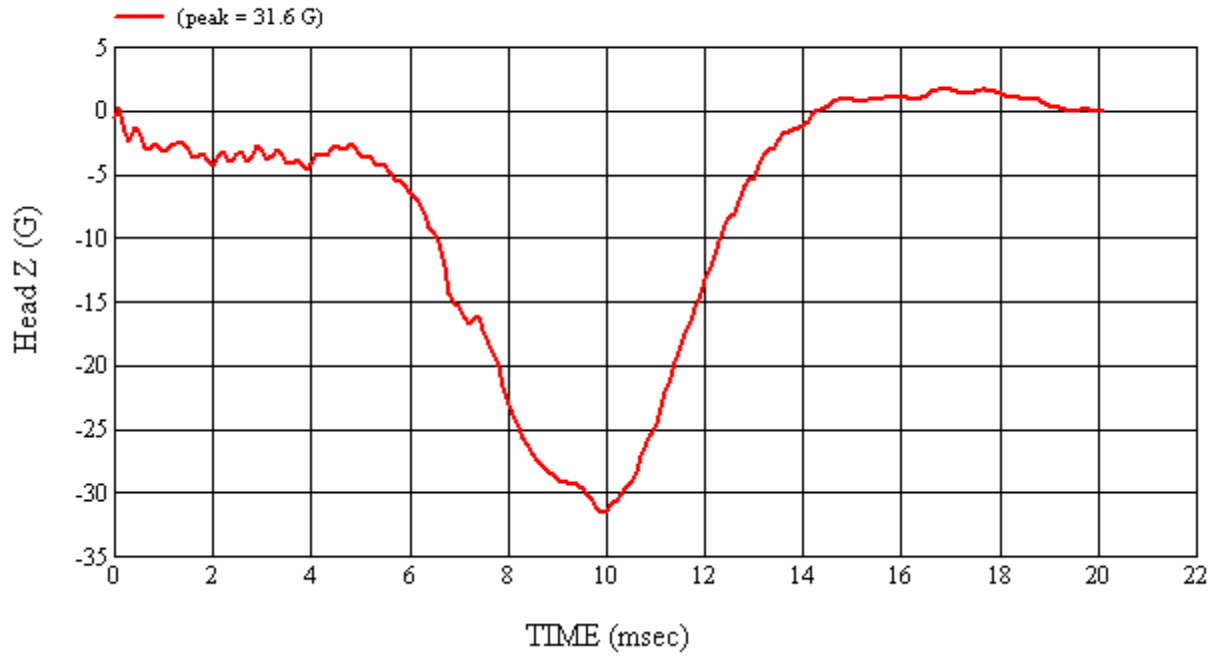
MGA Test #: U11177

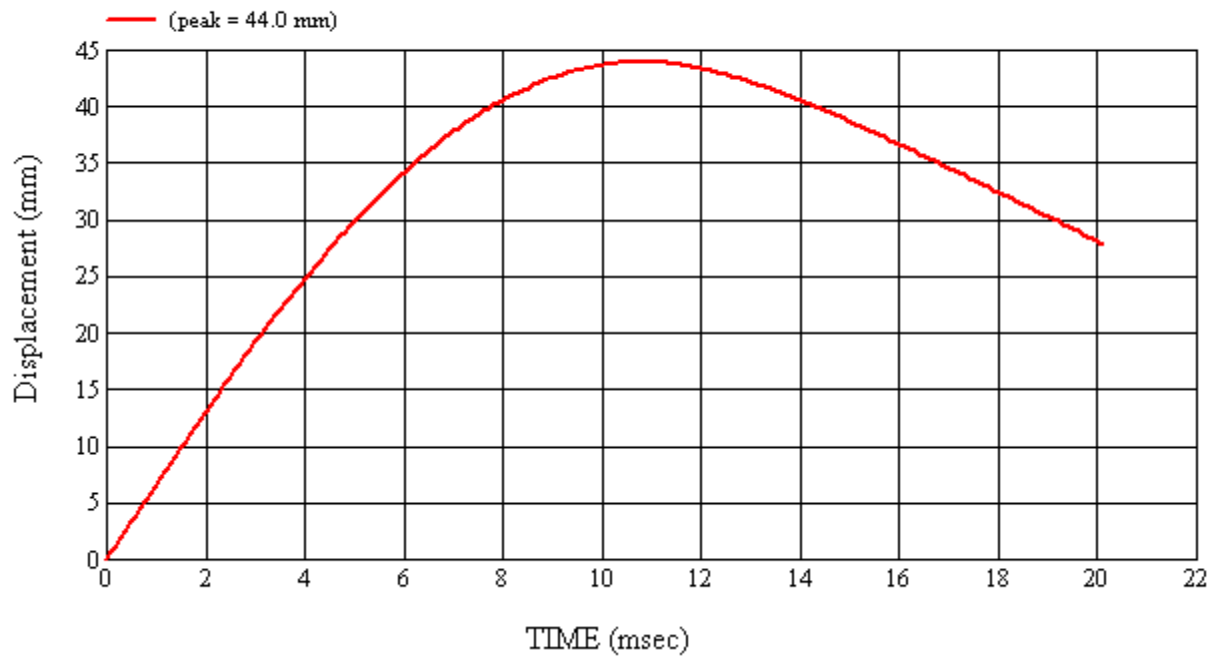
Target Location: UR2, Right Side

Test Date: 5/20/2011















SUMMARY OF FMVSS 201U TEST

JOB/NHTSA NO: G1117-001.9 VEHICLE YR/MAKE/MODEL:2011/DOT/NHTSA/BMW X3

GENERAL TEST PARAMETERS:

Target (Vehicle Side): UR5Left

MGA Test Reference No.:U11173

Approach Horizontal Angles:270°

Approach Vertical Angles:50°

Additional Description:@ SR3-2

Test Number:#5

Temperature:22.2C

Humidity:61.2%

Time of Test:2:29:53 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
613	593	8	24.1	34	7 Left

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

Axis	Channel	Serial No.	DLR Value	ΔV Pre-Test	ΔV Post-Test
X	5	J32177	-113.7	1.07	1.07
Y	6	J14103	93.9	0.85	0.85
Z	7	J35800	97.8	0.94	0.94

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

Dislodged headliner

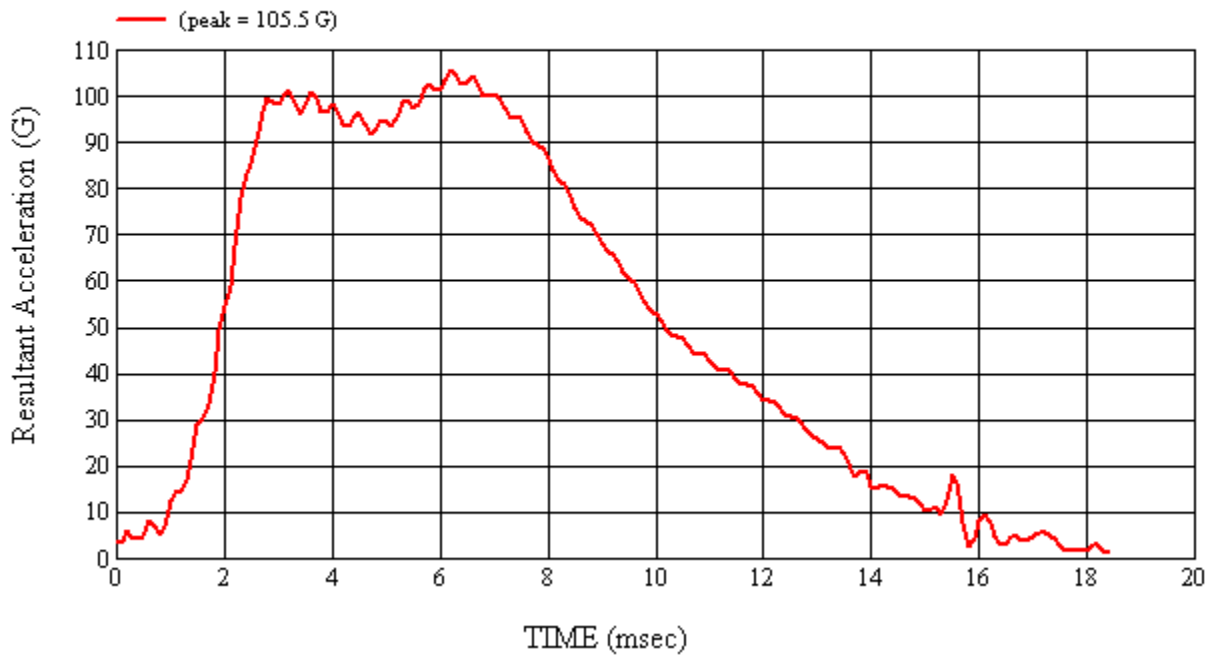
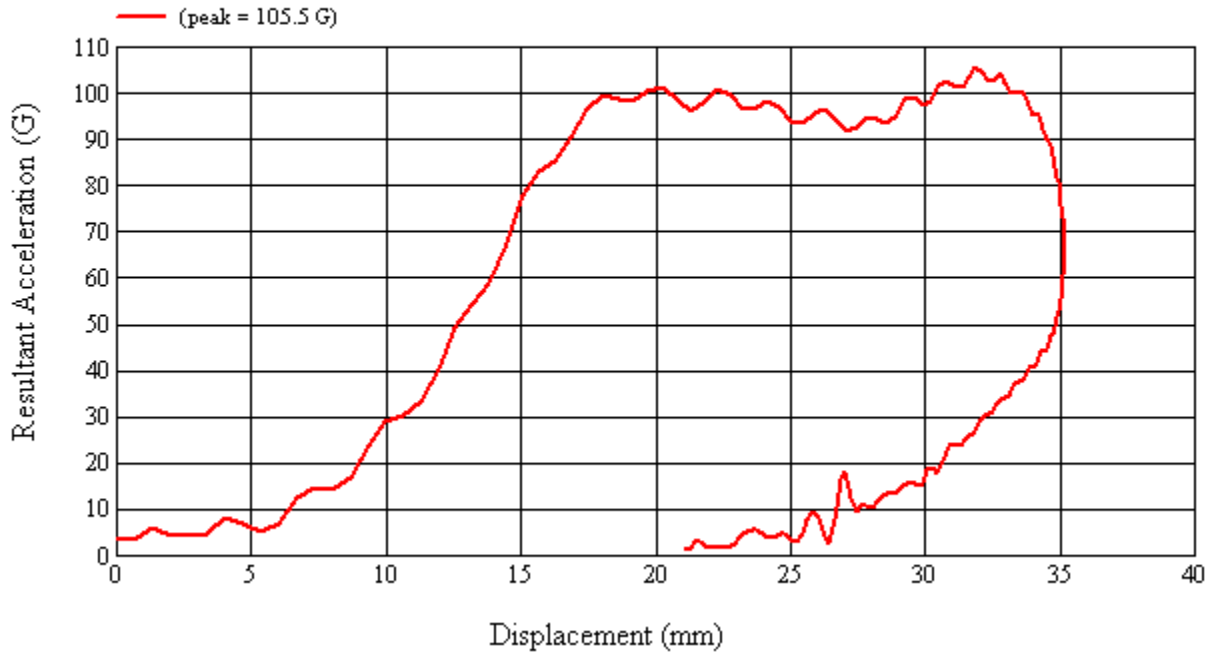
Recorded By: *Kevin D. McLean* Approved By*: *Richard I. Smith* Date: 5/19/2011

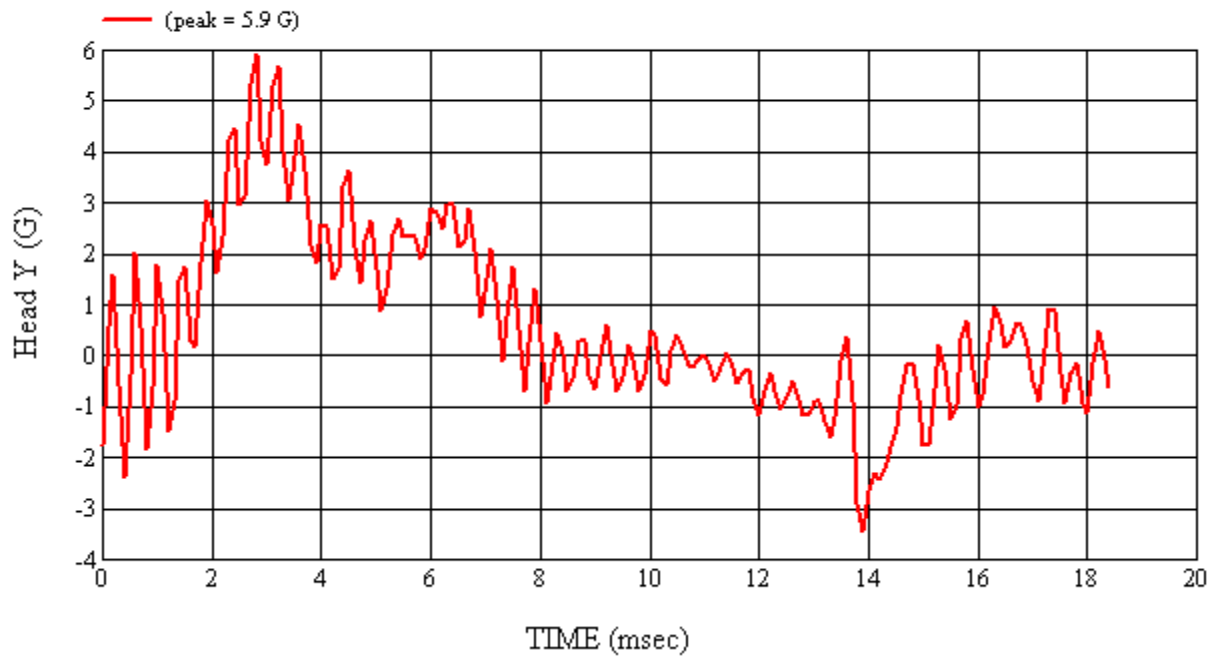
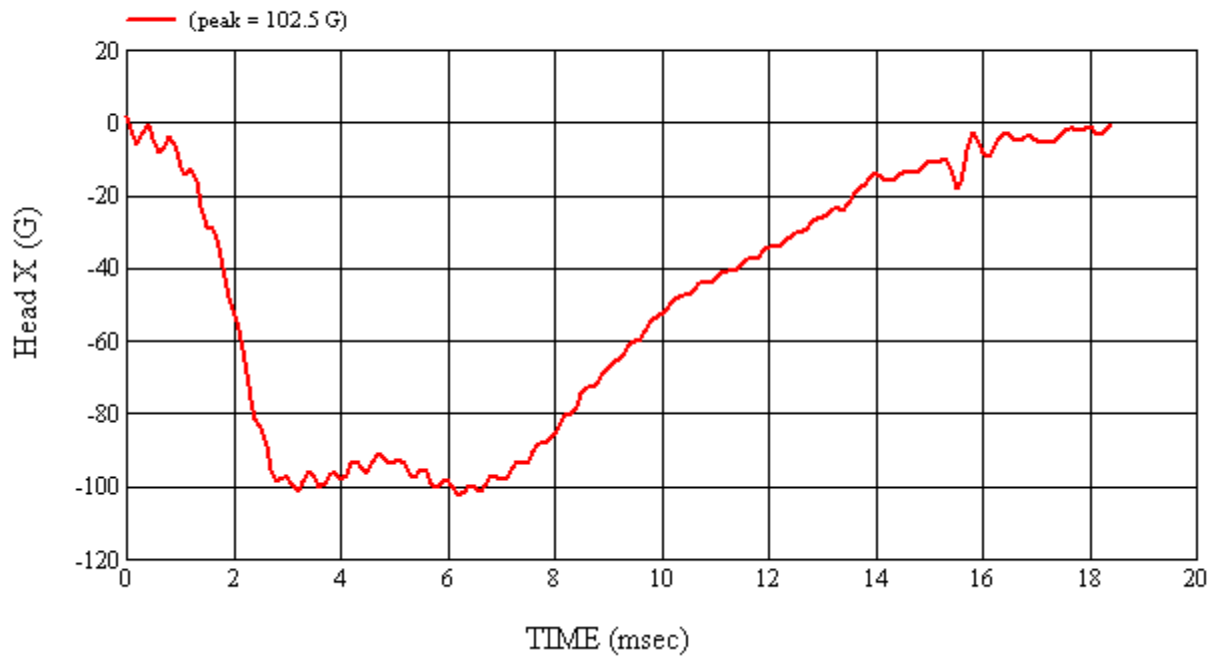
*Only necessary for NHTSA (Government) Compliance testing.

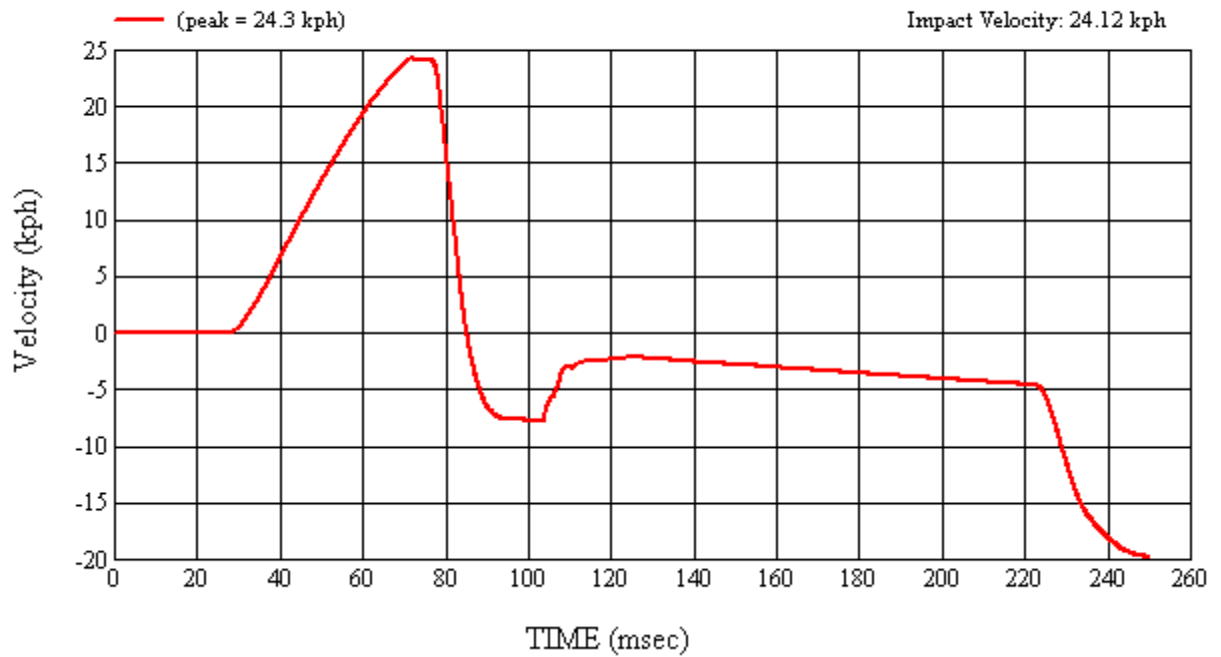
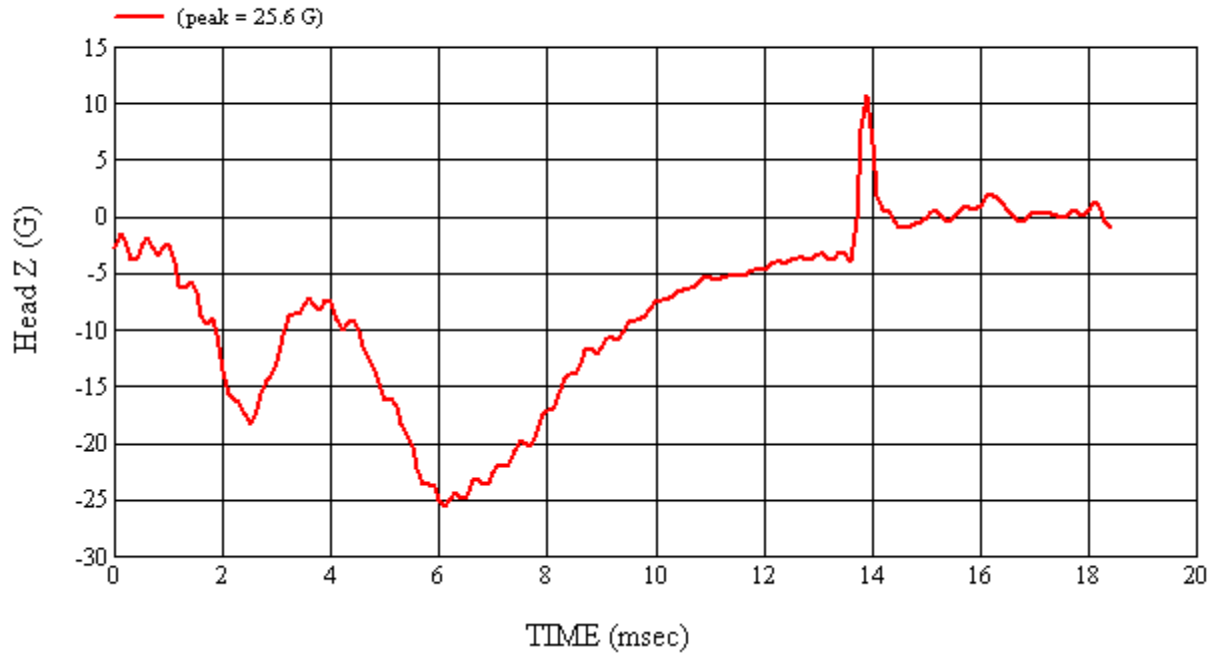
MGA Test #: U11173

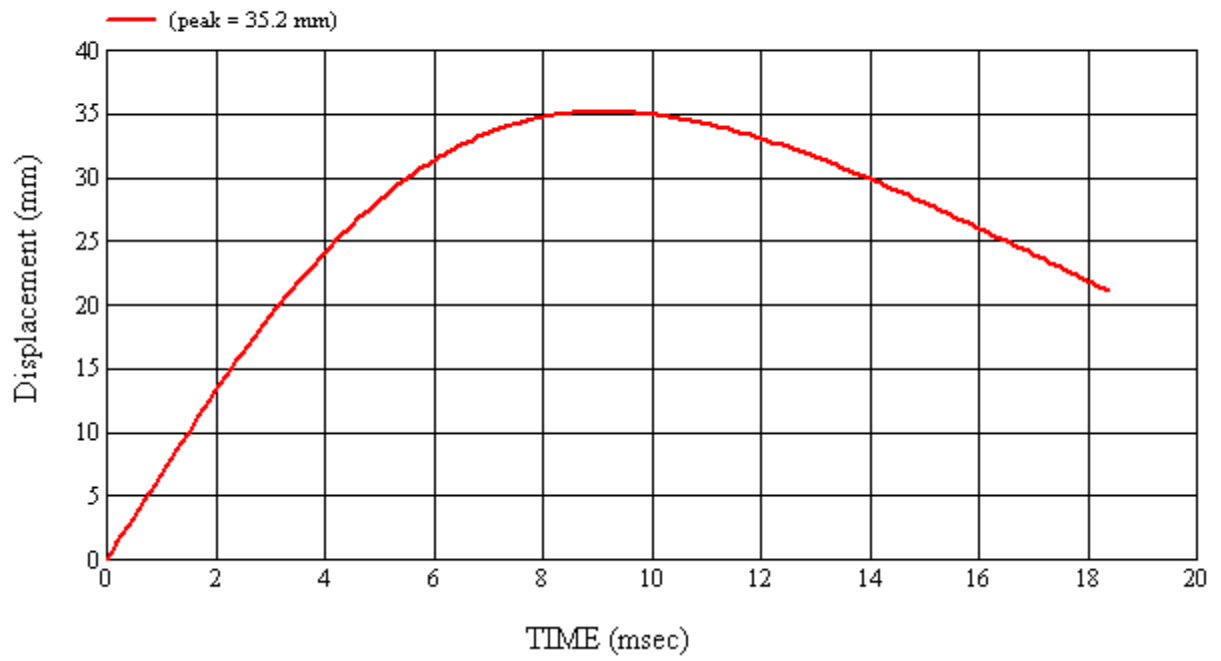
Target Location: UR5, Left Side

Test Date: 5/19/2011















SUMMARY OF FMVSS 201U TEST

JOB/NHTSA NO: G1117-001.9 VEHICLE YR/MAKE/MODEL:2011/DOT/NHTSA/BMW X3

GENERAL TEST PARAMETERS:

Target (Vehicle Side): UR6Right

MGA Test Reference No.:U11179

Approach Horizontal Angles:90°

Approach Vertical Angles:50°

Additional Description:@ OP

Test Number:#11

Temperature:23.6C

Humidity:57.6%

Time of Test:2:23:09 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
564	527	9.7	24.0	31	2 Left

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

Axis	Channel	Serial No.	DLR Value	ΔV Pre-Test	ΔV Post-Test
X	5	J32177	-113.7	1.07	1.07
Y	6	J14103	93.9	0.85	0.85
Z	7	J35800	97.8	0.94	0.94

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

Dislodged headliner

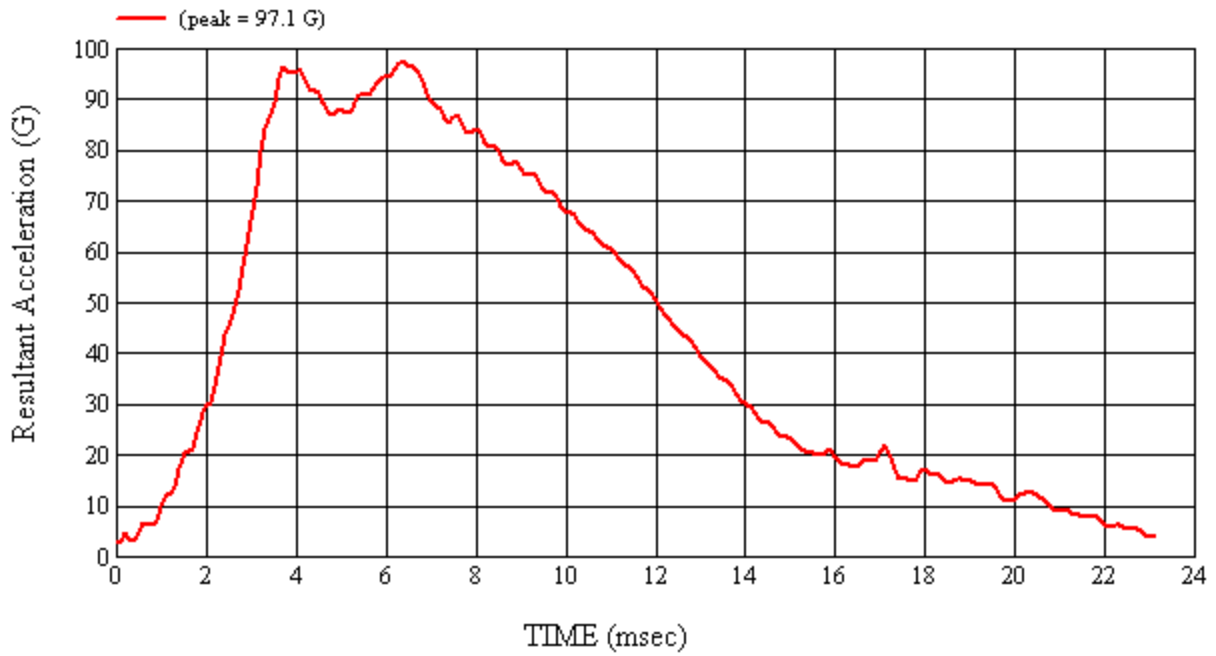
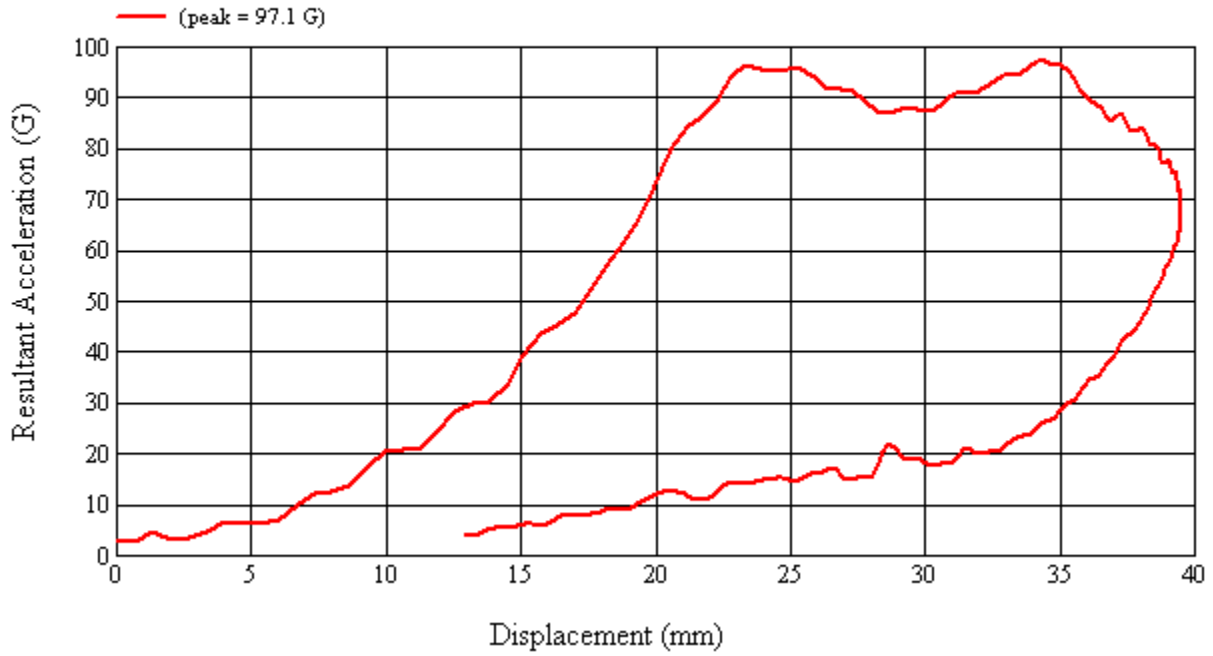
Recorded By: *Kevin D. McLean* Approved By*: *Richard I. Smith* Date: 5/20/2011

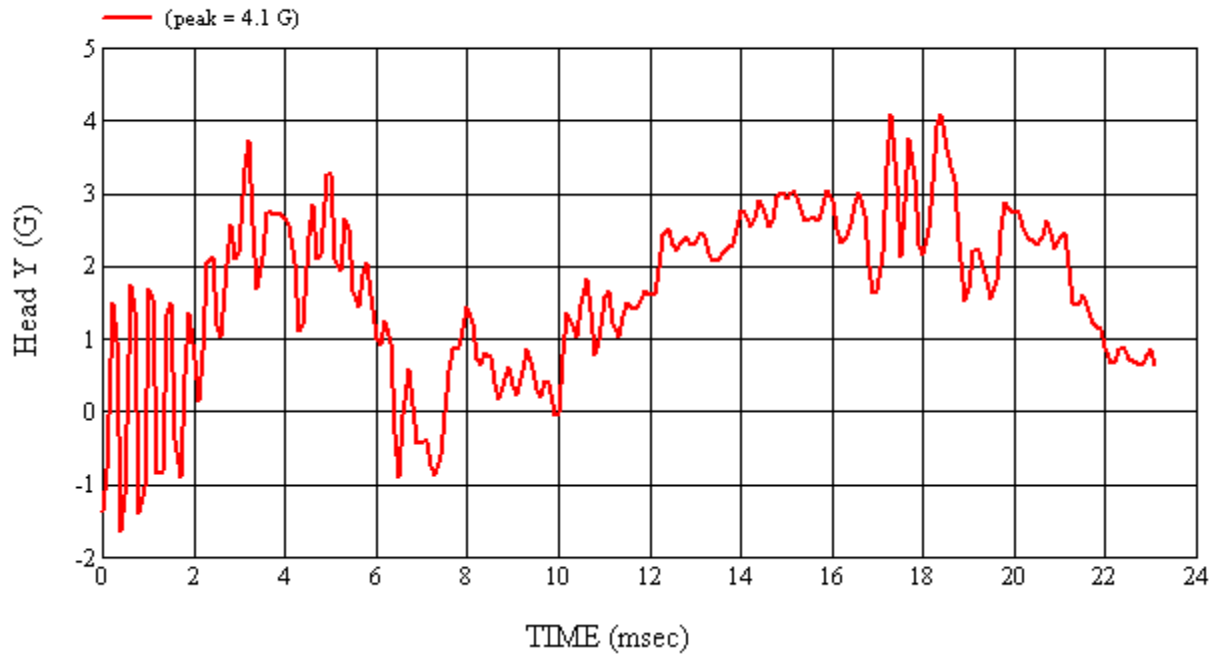
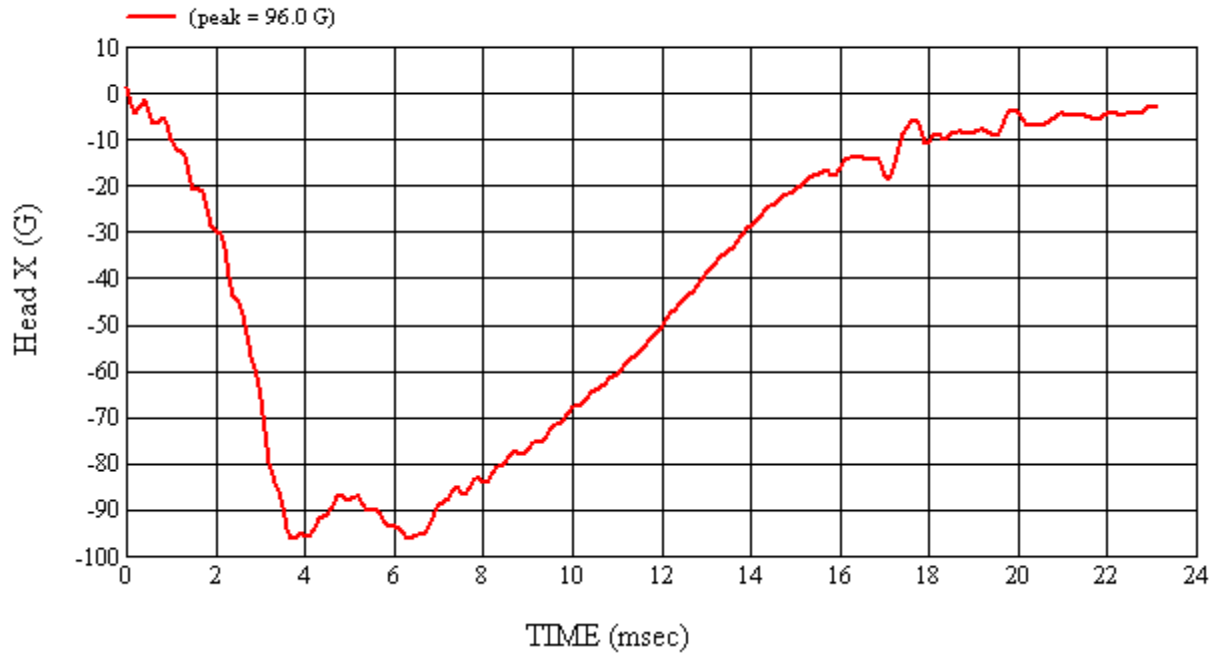
*Only necessary for NHTSA (Government) Compliance testing.

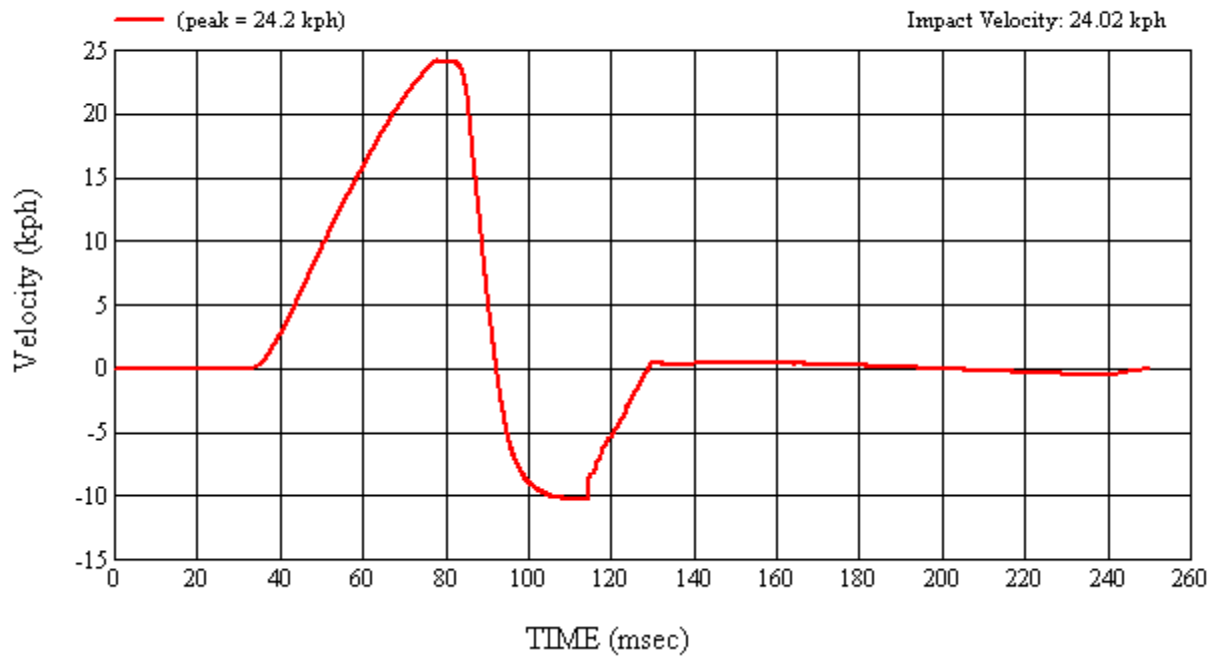
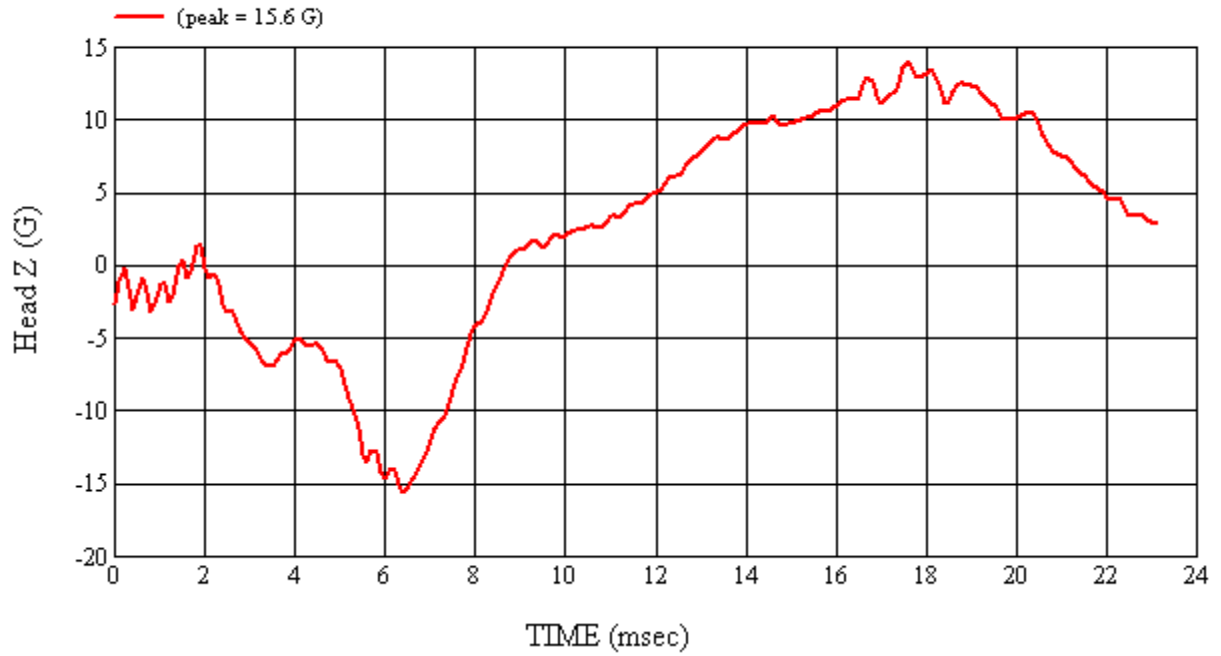
MGA Test #: U11179

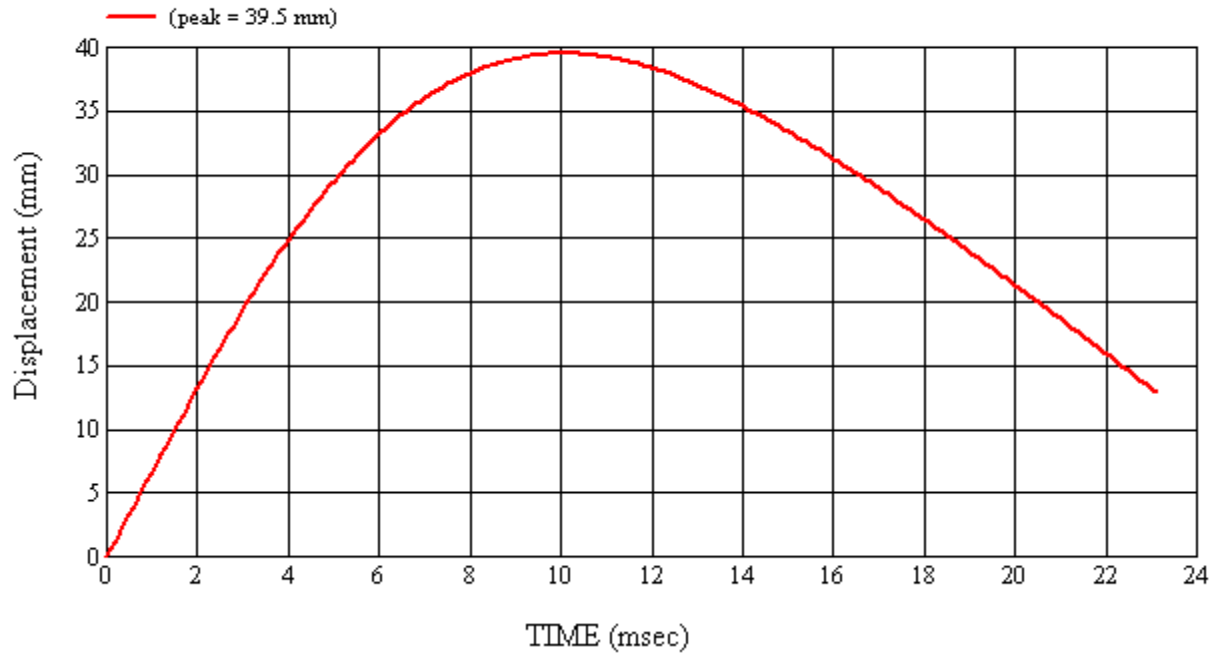
Target Location: UR6, Right Side

Test Date: 5/20/2011









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	G10020001619	Targeting	0.1 mm	Annual
Measuring Devices: - Tape Measure - Plumb Bobs - Digital Protractor	Stanley N/A Mitutoyo	TPM992 -- MGA00049	Measurement Targeting FMH setup Horizontal Measurement	1 mm N/A 0.5°	Annual
*Temperature Recorder	Dickson	MGA00894	Record Temperature and Humidity	± 1°C ± 1% RH	Annual
* Scale	Detecto	MGA00783	Weigh FMH Head	± 0.01 lb	Annual
*Vehicle Scale	Intercomp	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	5/18/2011	9.90	20.5	58.3	250.6	3.0	Yes
Post	#035	5/23/2011	9.90	22.4	60.1	250.9	4.5	Yes
Pre	#037	5/18/2011	9.96	20.7	60.4	265.8	7.5	Yes
Post	#037	5/23/2011	9.96	22.2	60.2	266.2	8.0	Yes
Pre	#038	5/18/2011	9.90	20.6	62.0	271.0	9.5	Yes
Post	#038	5/23/2011	9.90	22.2	60.9	268.0	9.2	Yes

4-1 Pre-Test Calibration

**HEAD DROP TEST SUMMARY
 PART 572L**

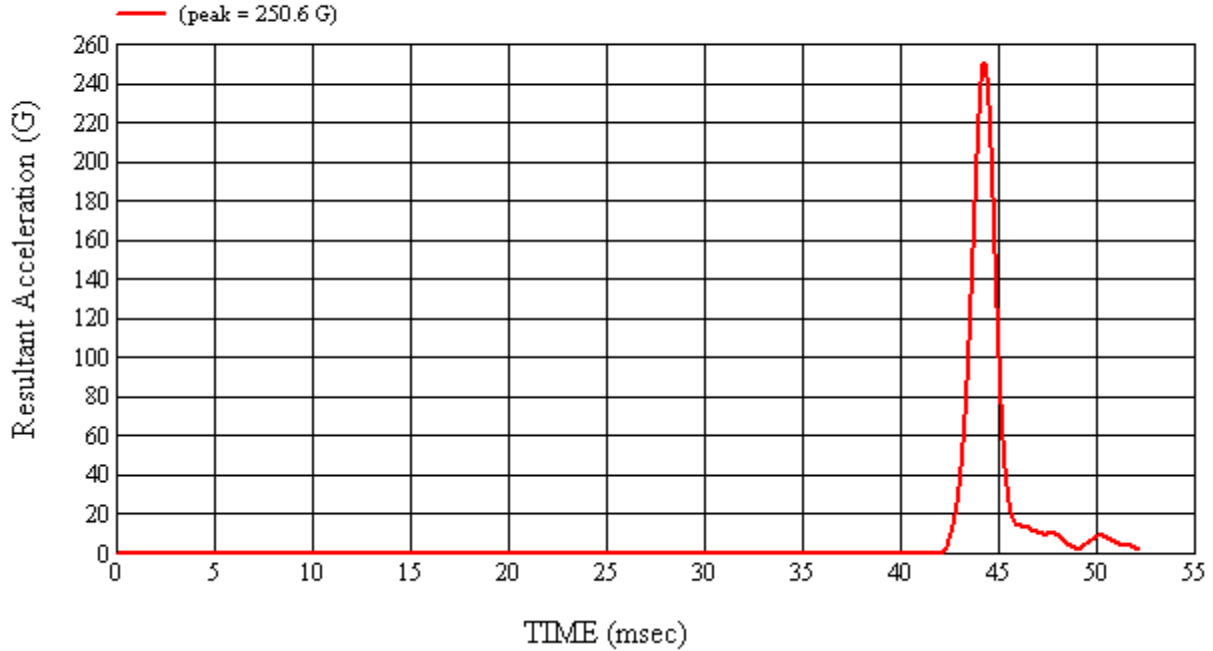
HEADFORM SERIAL NUMBER: 035		CALIBRATION DATE: 5/18/2011
CALIBRATION TIME: 10:01:52 AM		
TEST PARAMETER	SPECIFICATION	TEST RESULTS
Weight	9.90 to 10.10 lbs.	9.90
Temperature	19° C to 26° C	20.5
Relative Humidity	10% to 70%	58.3
Peak Resultant Acceleration	225 G's to 275 G's	250.6
Peak Lateral Acceleration	15 G's Maximum	3.0
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	02/04/11	08/04/11
2	ENDEVCO	7264-2000	J22664	02/04/11	08/04/11
3	ENDEVCO	7264-2000	J35924	02/04/11	08/04/11

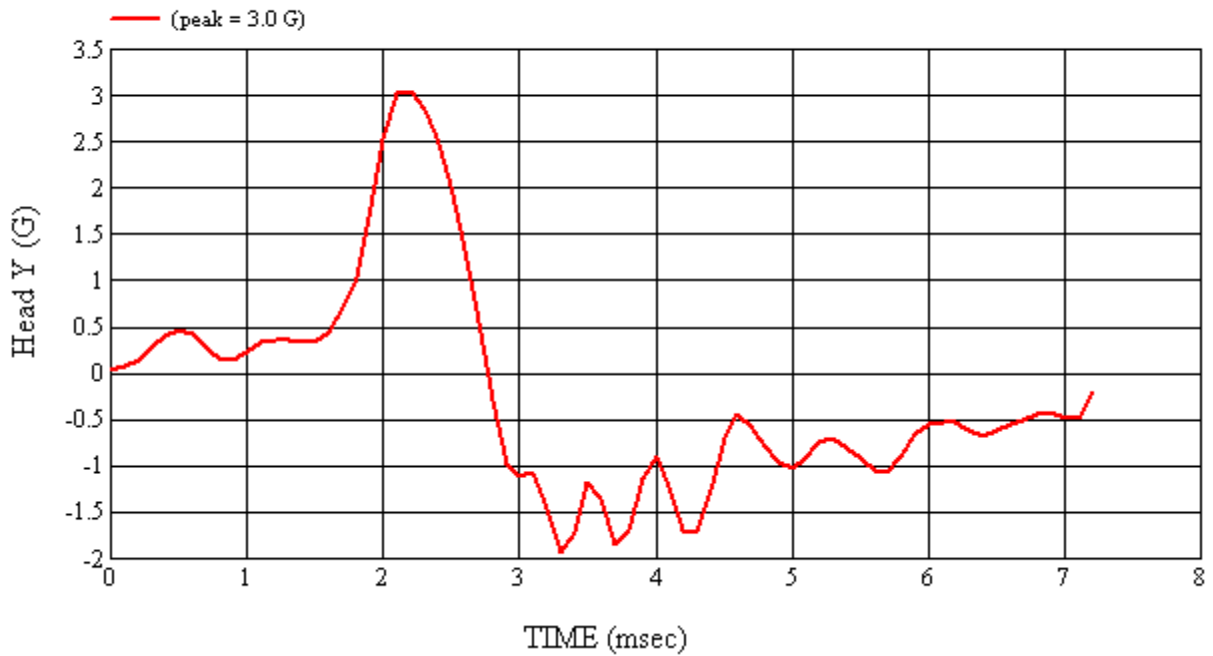
REMARKS:

RECORDED BY: *Keri D. McLean* DATE: 5/18/2011

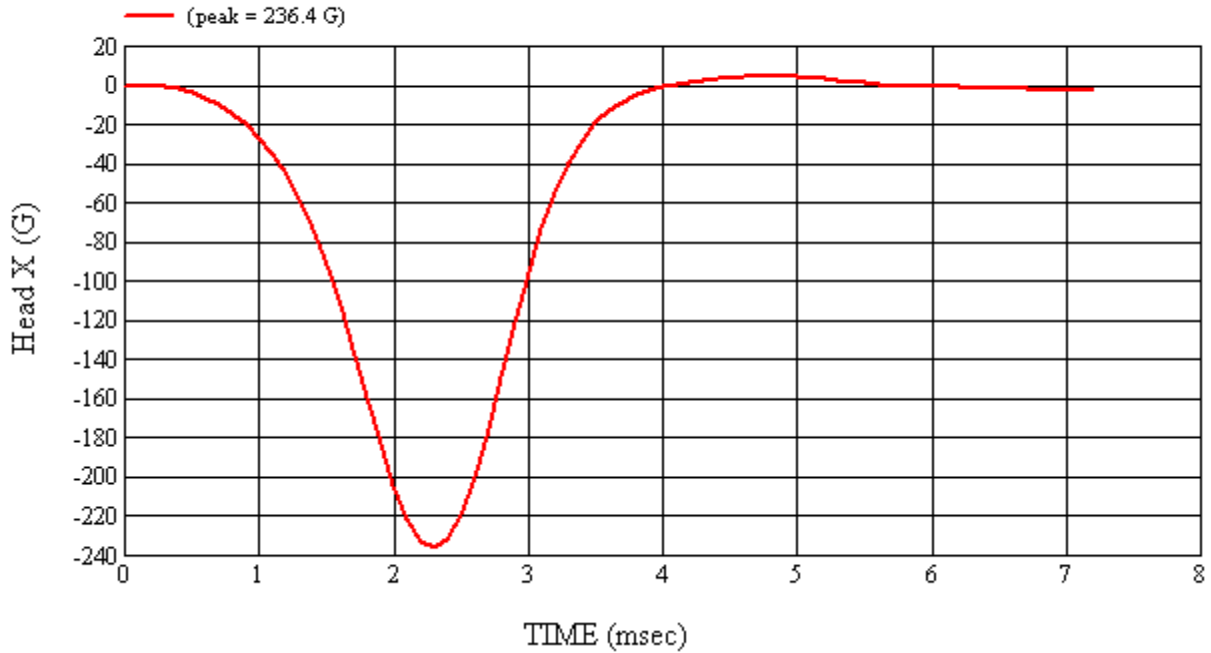
APPROVED BY: *Adrian I. Smith*



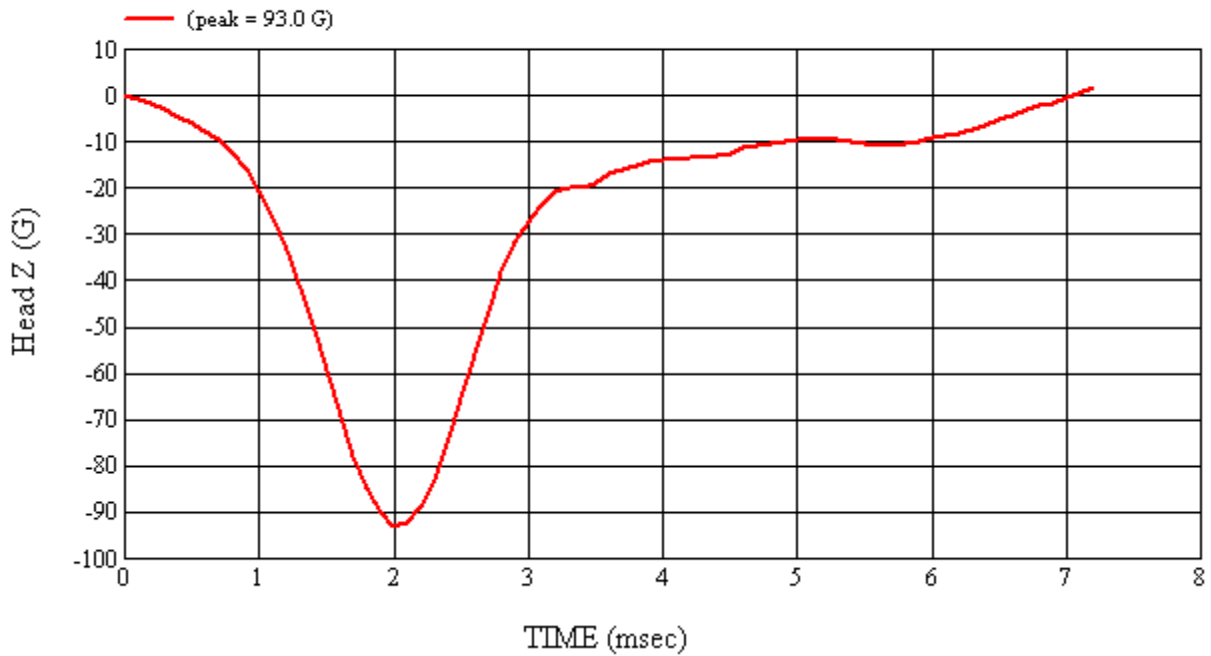
Head 035 (Pre) Calibration #H35021



Head 035 (Pre) Calibration #H35021



Head 035 (Pre) Calibration #H35021



Head 035 (Pre) Calibration #H35021

4-2 Post-Test Calibration

**HEAD DROP TEST SUMMARY
 PART 572L**

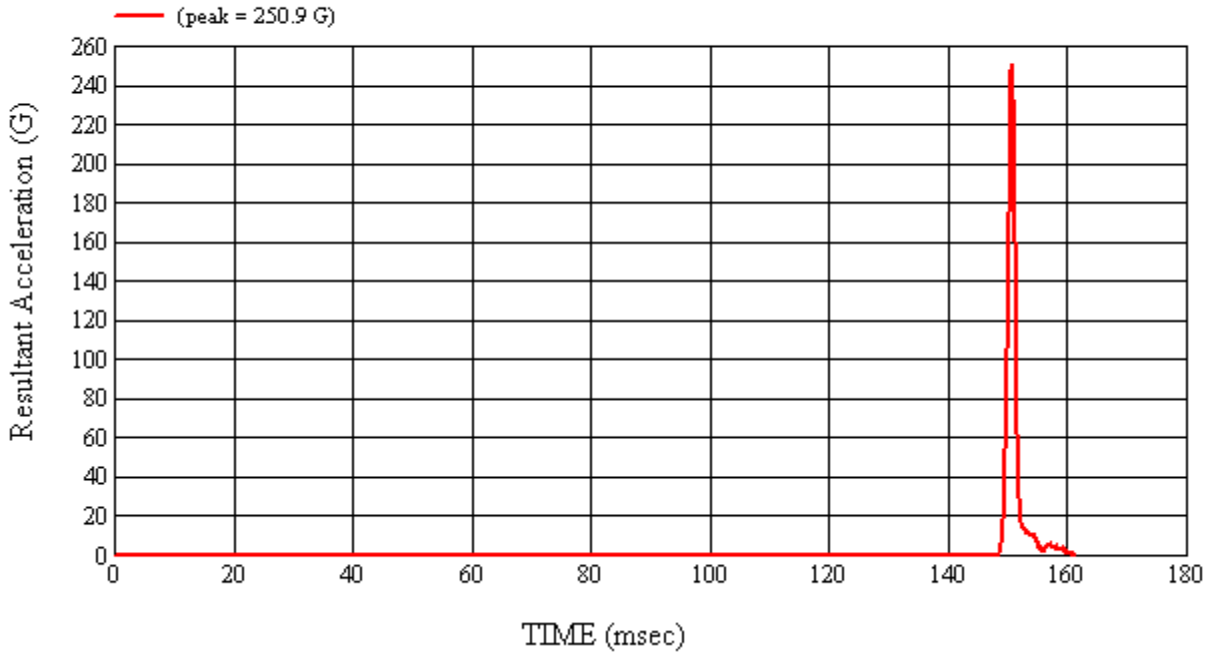
HEADFORM SERIAL NUMBER: 035		CALIBRATION DATE: 5/23/2011
CALIBRATION TIME: 9:56:44 AM		
TEST PARAMETER	SPECIFICATION	TEST RESULTS
Weight	9.90 to 10.10 lbs.	9.90
Temperature	19° C to 26° C	22.4
Relative Humidity	10% to 70%	60.1
Peak Resultant Acceleration	225 G's to 275 G's	250.9
Peak Lateral Acceleration	15 G's Maximum	4.5
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	02/04/11	08/04/11
2	ENDEVCO	7264-2000	J22664	02/04/11	08/04/11
3	ENDEVCO	7264-2000	J35924	02/04/11	08/04/11

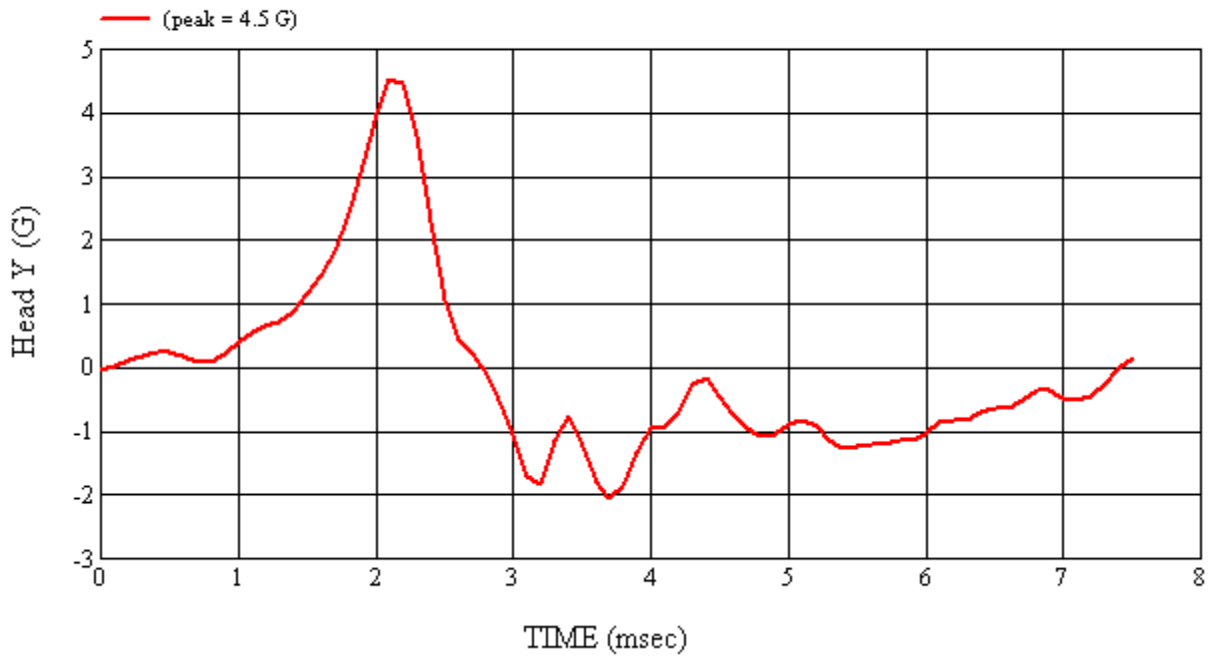
REMARKS:

RECORDED BY: *Keri D. McLean* DATE: 5/23/2011

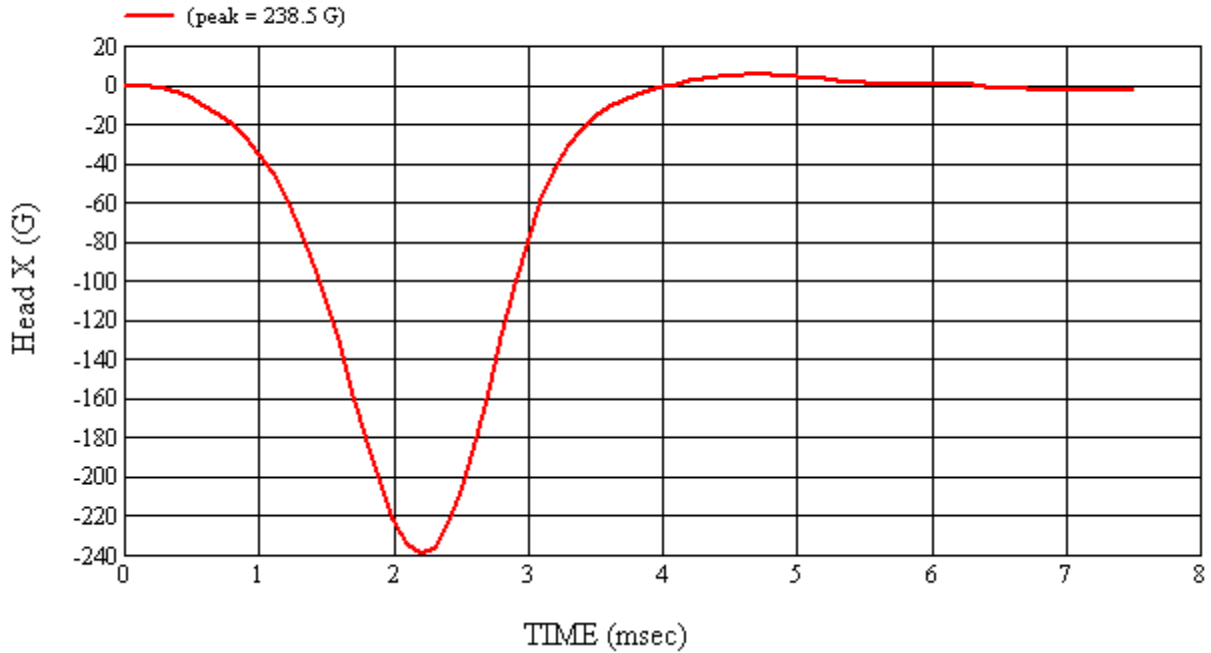
APPROVED BY: *Adrian I. Smith*



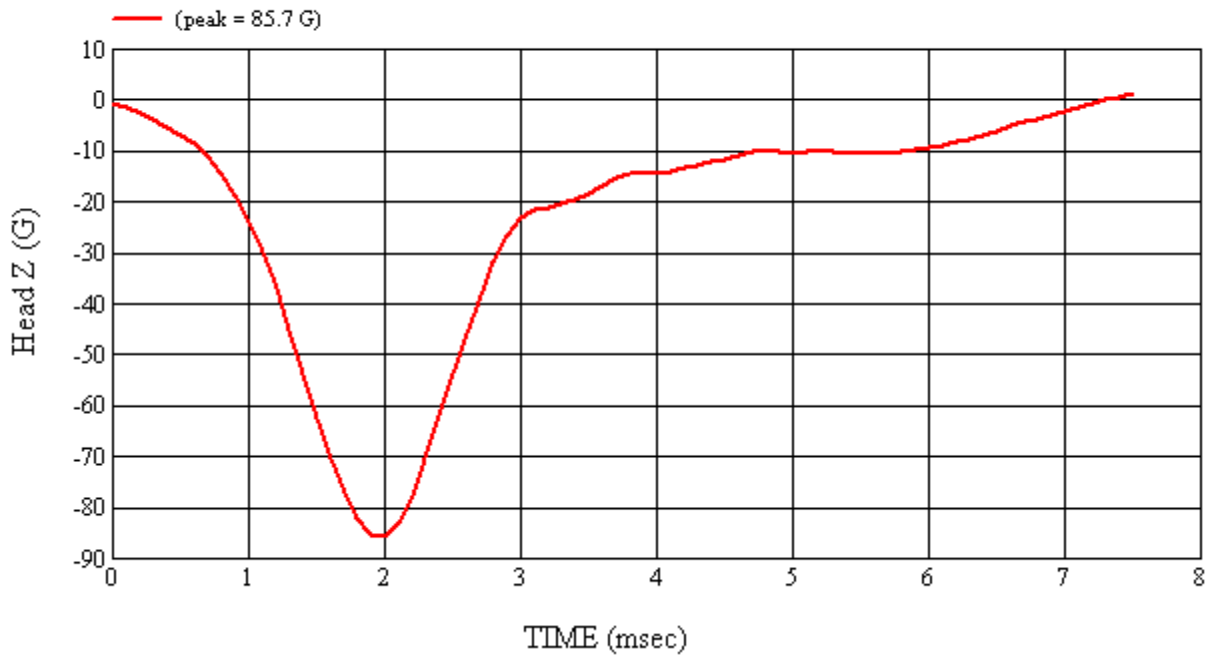
Head 035 (Post) Calibration #H35022



Head 035 (Post) Calibration #H35022



Head 035 (Post) Calibration #H35022



Head 035 (Post) Calibration #H35022

4-3 Pre-Test Calibration

**HEAD DROP TEST SUMMARY
 PART 572L**

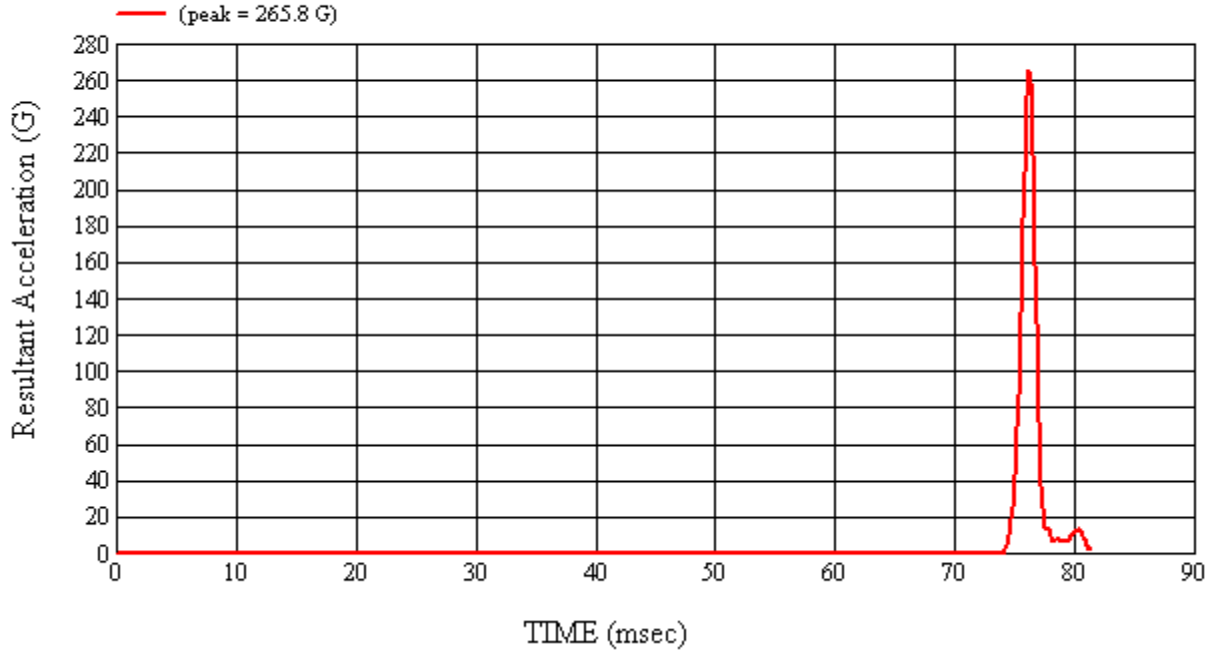
HEADFORM SERIAL NUMBER: 037		CALIBRATION DATE: 5/18/2011
CALIBRATION TIME: 11:23:41 AM		
TEST PARAMETER	SPECIFICATION	TEST RESULTS
Weight	9.90 to 10.10 lbs.	9.96
Temperature	19° C to 26° C	20.7
Relative Humidity	10% to 70%	60.4
Peak Resultant Acceleration	225 G's to 275 G's	265.8
Peak Lateral Acceleration	15 G's Maximum	7.5
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	J32177	02/04/11	08/04/11
2	ENDEVCO	7264-2000	J14103	02/04/11	08/04/11
3	ENDEVCO	7264-2000	J35800	02/04/11	08/04/11

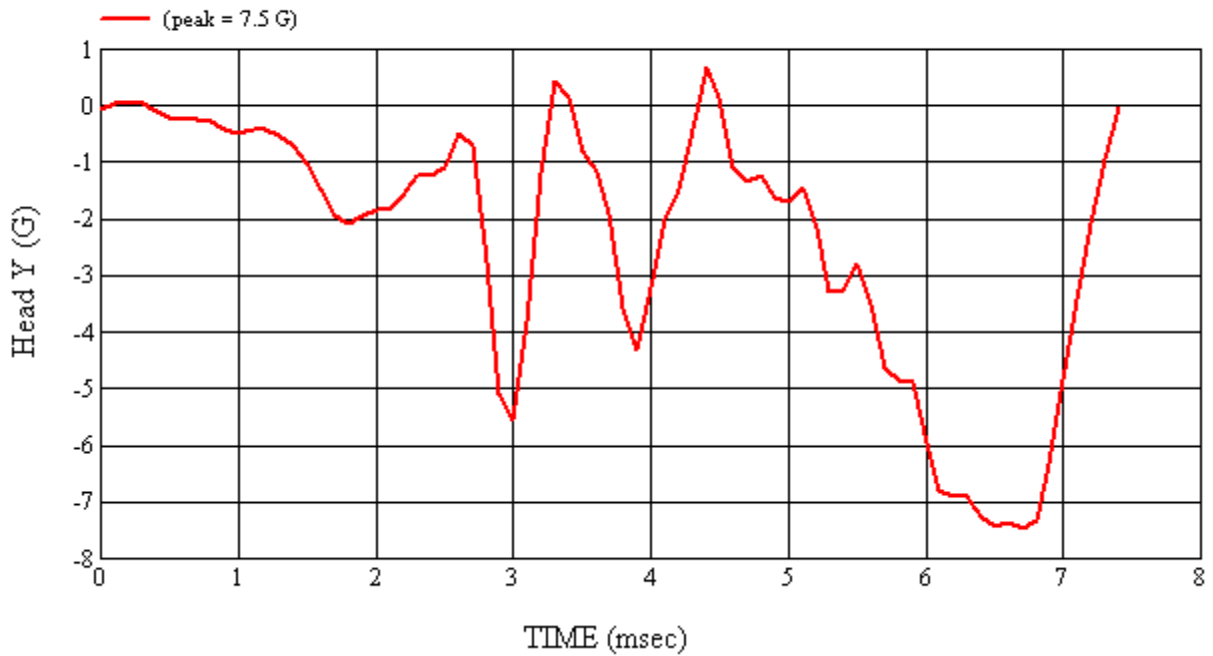
REMARKS:

RECORDED BY: *Kerid D. McLean* DATE: 5/18/2011

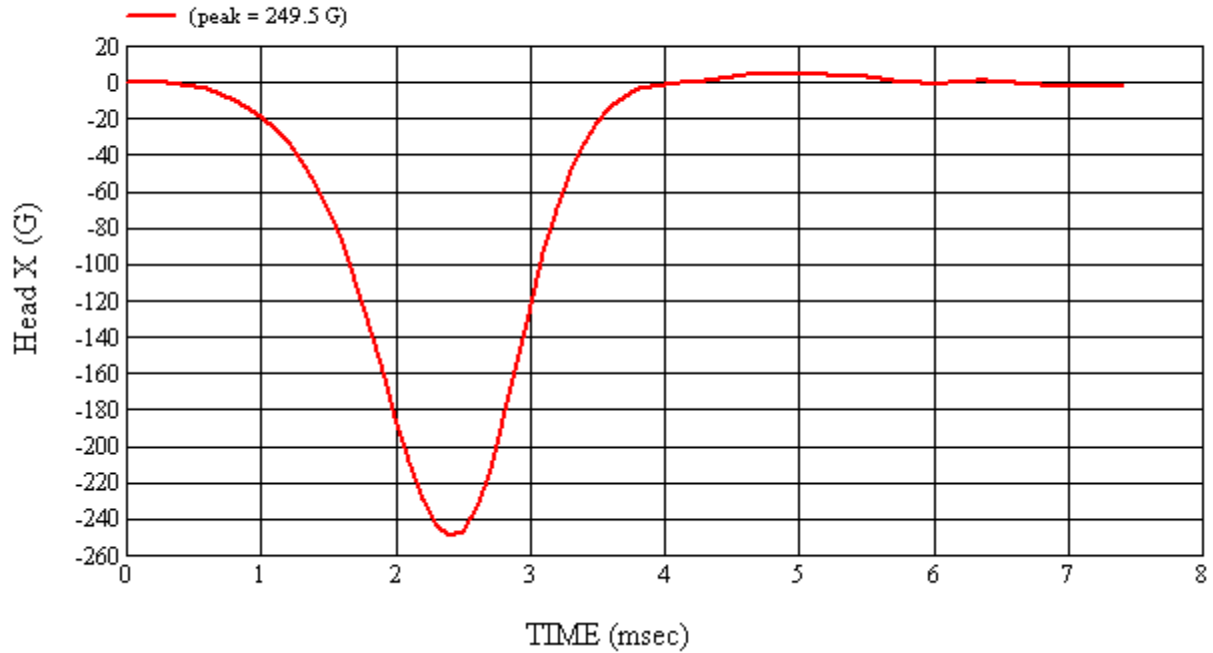
APPROVED BY: *Adham I. Smith*



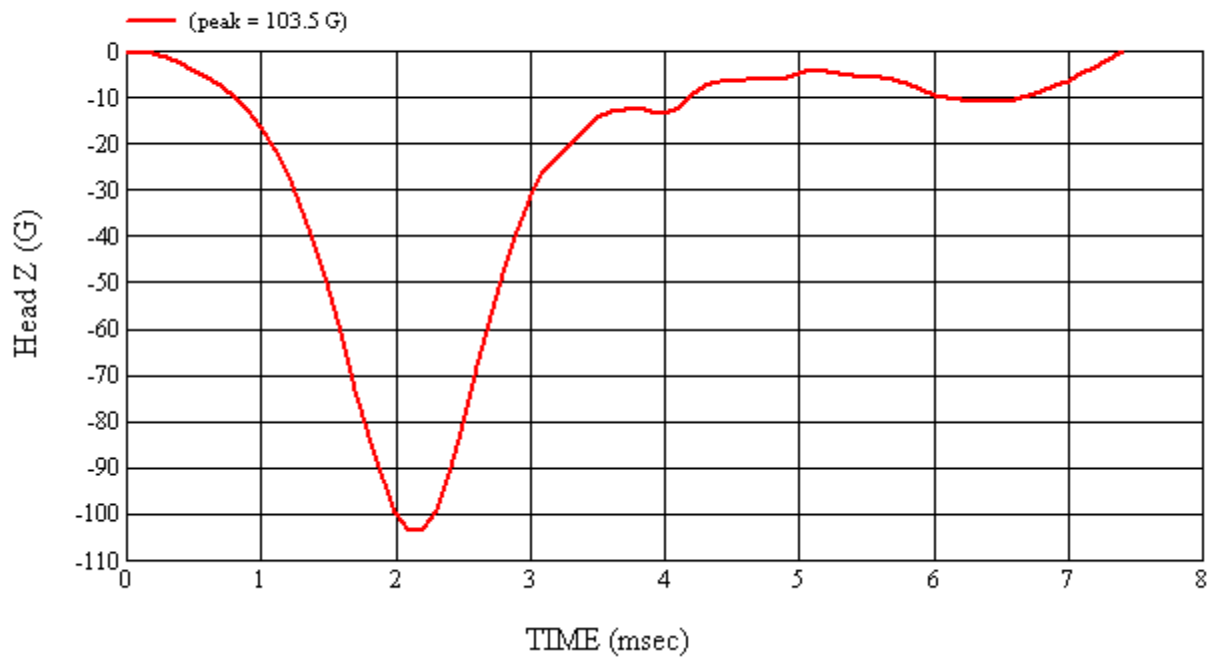
Head 037 (Pre) Calibration #H37021



Head 037 (Pre) Calibration #H37021



Head 037 (Pre) Calibration #H37021



Head 037 (Pre) Calibration #H37021

4-4 Post-Test Calibration

**HEAD DROP TEST SUMMARY
 PART 572L**

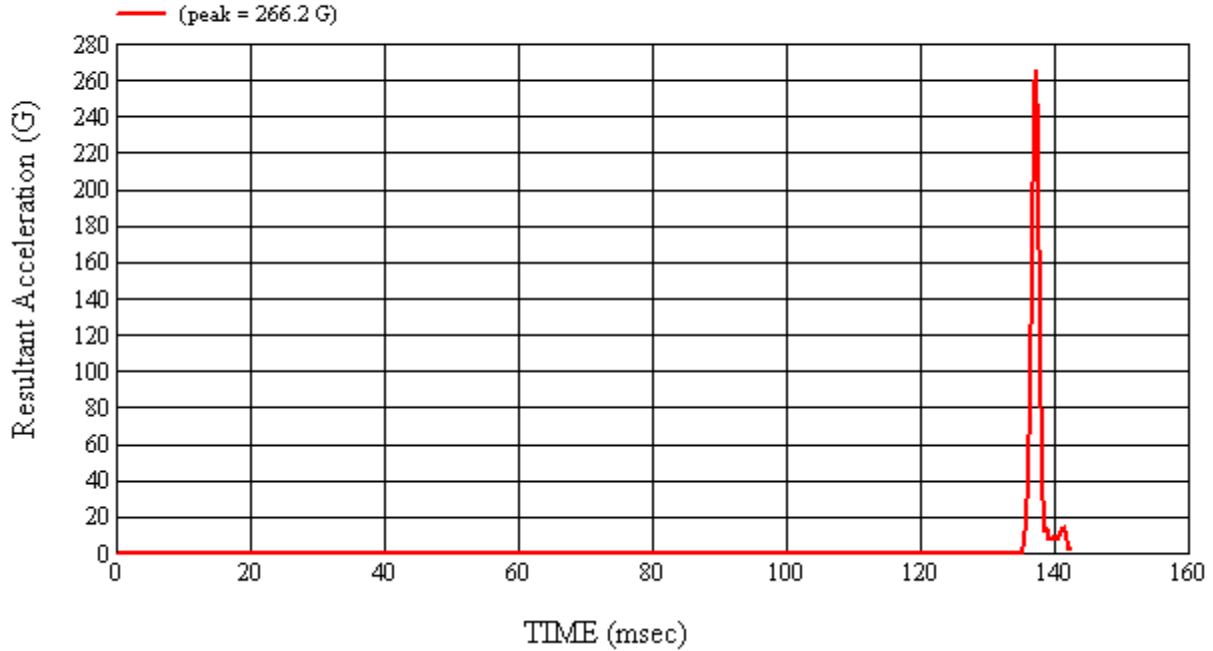
HEADFORM SERIAL NUMBER: 037		CALIBRATION DATE: 5/23/2011
CALIBRATION TIME: 10:13:44 AM		
TEST PARAMETER	SPECIFICATION	TEST RESULTS
Weight	9.90 to 10.10 lbs.	9.96
Temperature	19° C to 26° C	22.2
Relative Humidity	10% to 70%	60.2
Peak Resultant Acceleration	225 G's to 275 G's	266.2
Peak Lateral Acceleration	15 G's Maximum	8.0
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	J32177	02/04/11	08/04/11
2	ENDEVCO	7264-2000	J14103	02/04/11	08/04/11
3	ENDEVCO	7264-2000	J35800	02/04/11	08/04/11

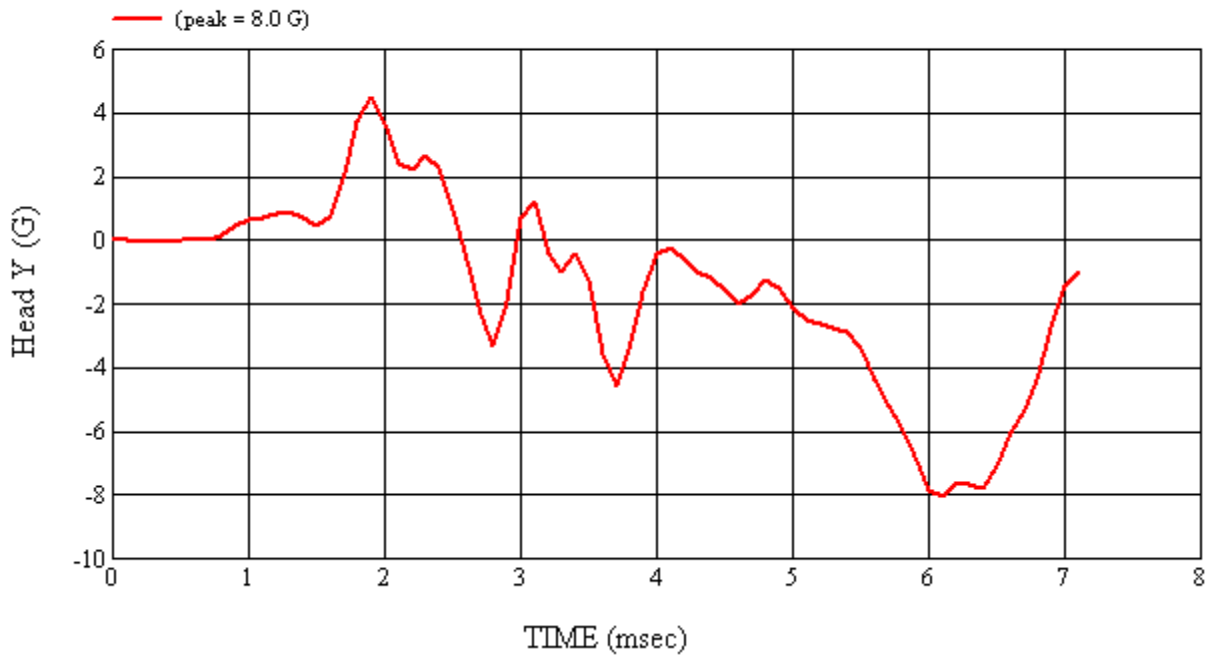
REMARKS:

RECORDED BY: *Keri D. McLean* DATE: 5/23/2011

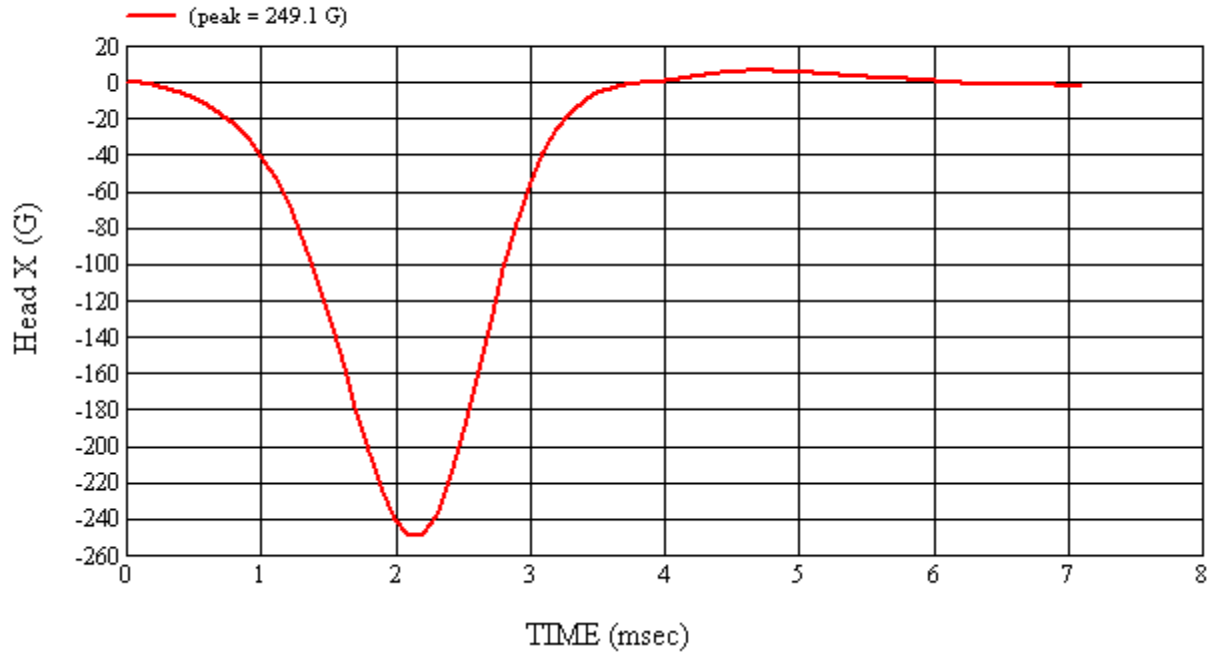
APPROVED BY: *Adrian I. Smith*



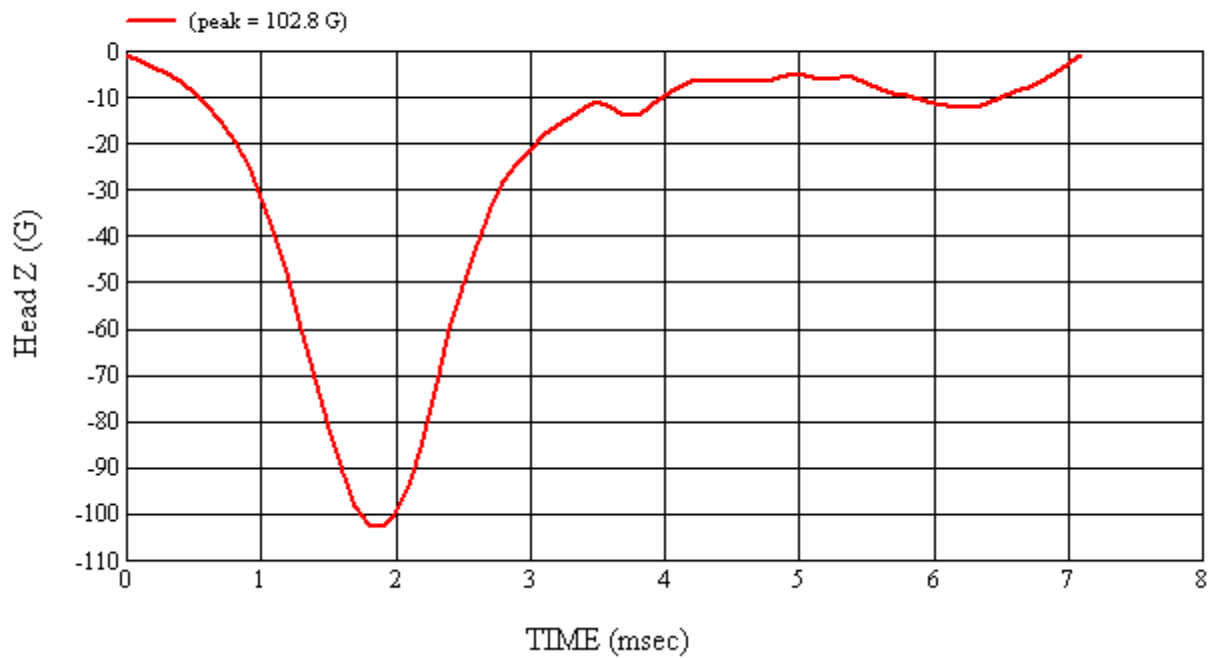
Head 037 (Post) Calibration #H37022



Head 037 (Post) Calibration #H37022



Head 037 (Post) Calibration #H37022



Head 037 (Post) Calibration #H37022

4-5 Pre-Test Calibration

**HEAD DROP TEST SUMMARY
PART 572L**

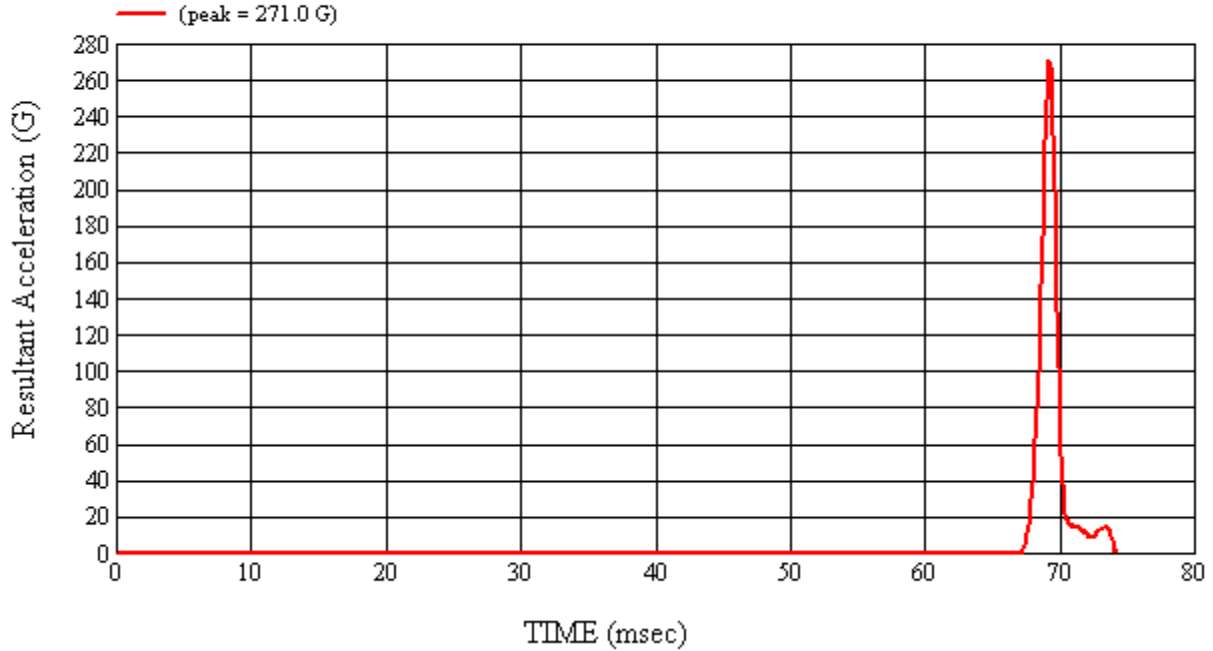
HEADFORM SERIAL NUMBER: 038		CALIBRATION DATE: 5/18/2011
CALIBRATION TIME: 11:45:51 AM		
TEST PARAMETER	SPECIFICATION	TEST RESULTS
Weight	9.90 to 10.10 lbs.	9.90
Temperature	19° C to 26° C	20.6
Relative Humidity	10% to 70%	62.0
Peak Resultant Acceleration	225 G's to 275 G's	271.0
Peak Lateral Acceleration	15 G's Maximum	9.5
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	02/07/11	08/07/11
2	ENDEVCO	7264-2000	J36197	02/07/11	08/07/11
3	ENDEVCO	7264-2000	J36353	02/07/11	08/07/11

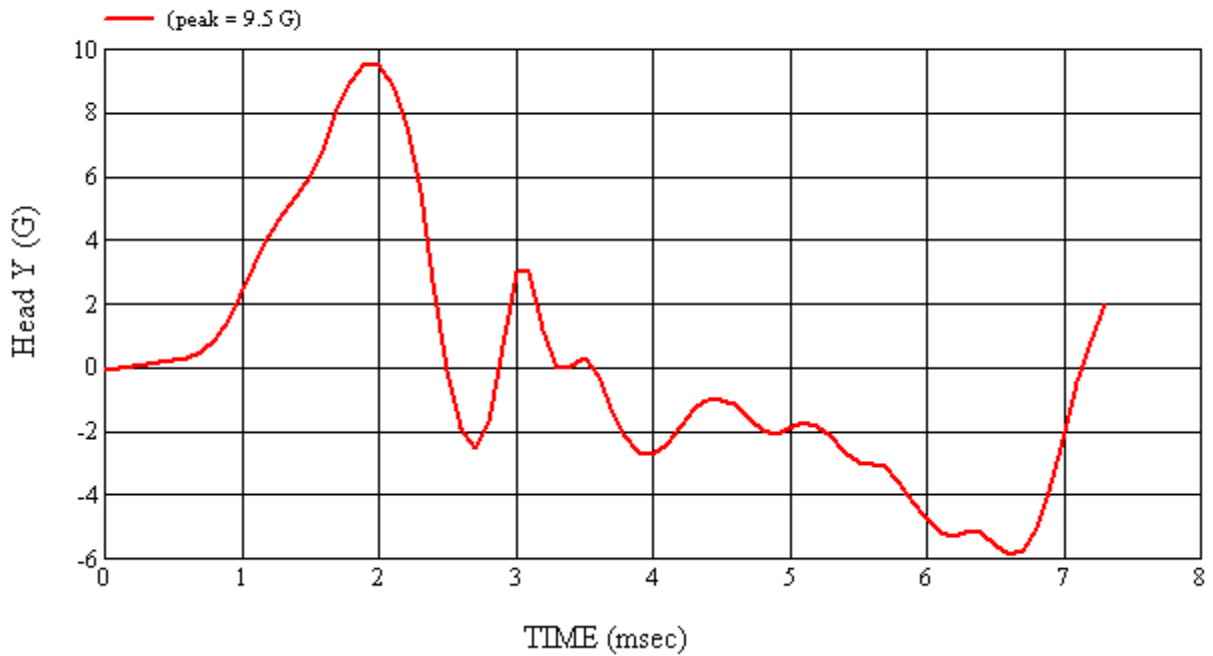
REMARKS:

RECORDED BY: *Keri D. McLean* DATE: 5/18/2011

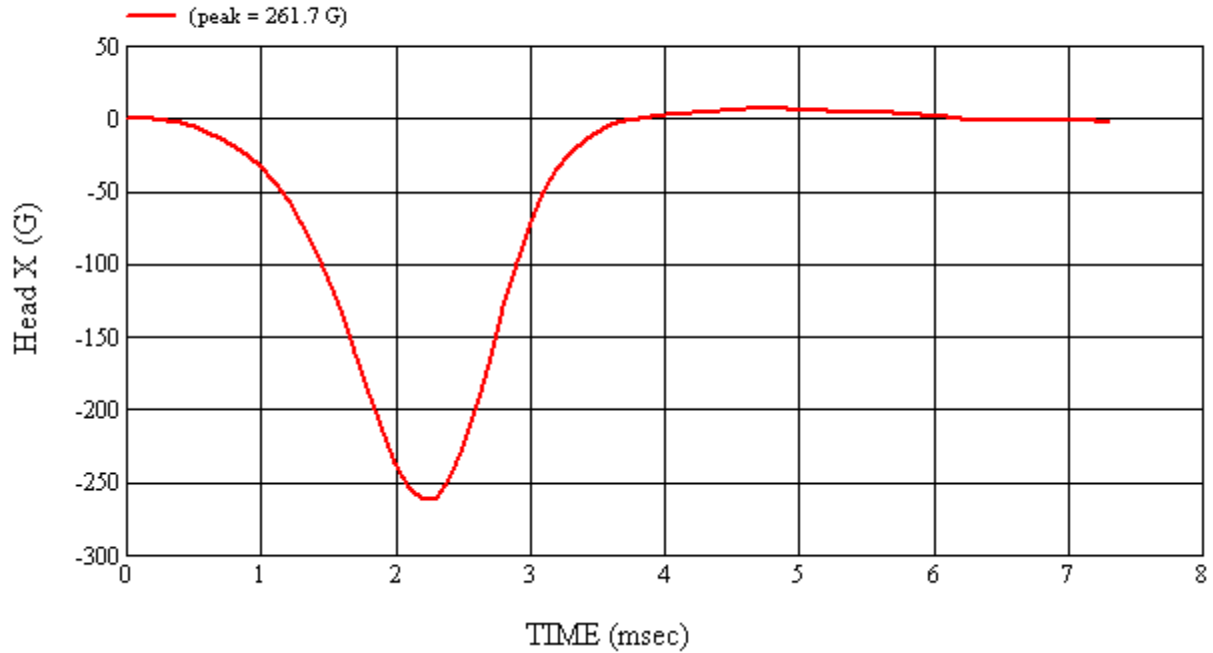
APPROVED BY: *Adrian I. Smith*



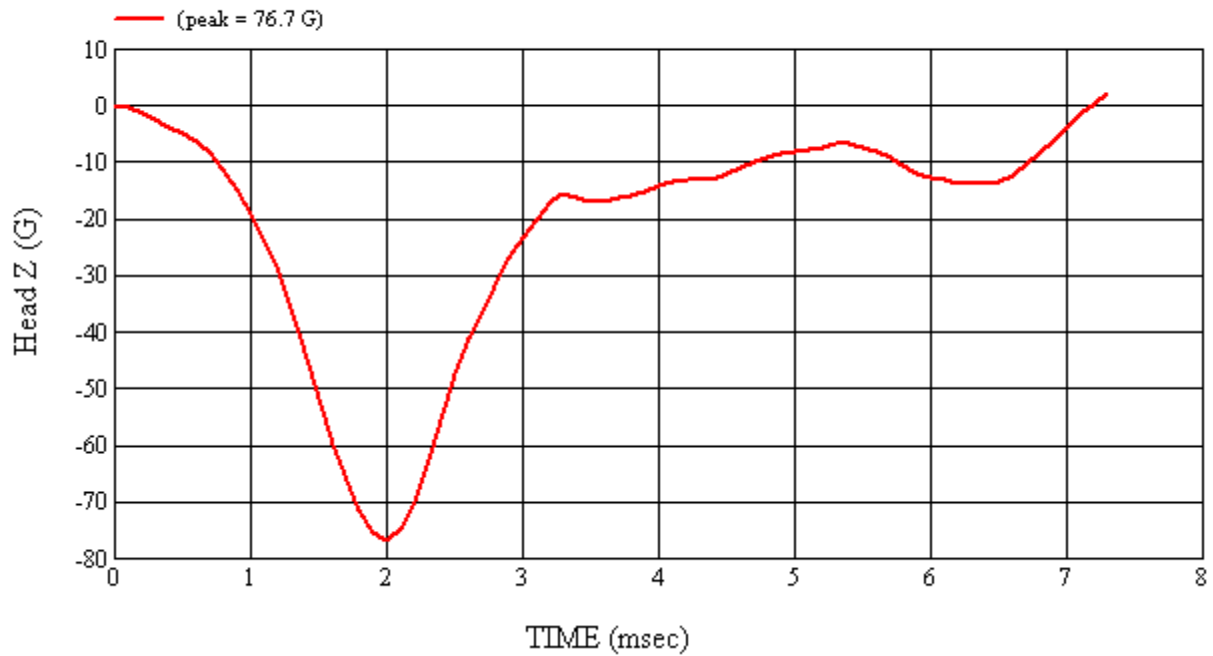
Head 038 (Pre) Calibration #H38021



Head 038 (Pre) Calibration #H38021



Head 038 (Pre) Calibration #H38021



Head 038 (Pre) Calibration #H38021

4-6 Post-Test Calibration

**HEAD DROP TEST SUMMARY
PART 572L**

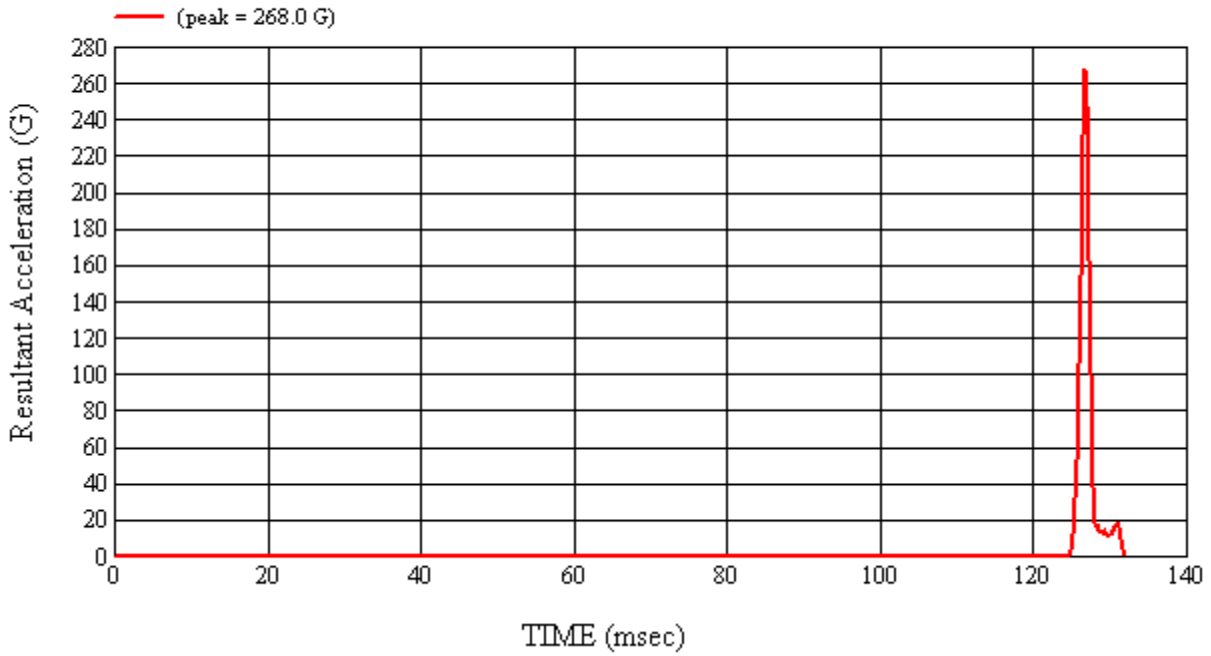
HEADFORM SERIAL NUMBER: 038		CALIBRATION DATE: 5/23/2011
CALIBRATION TIME: 10:34:26 AM		
TEST PARAMETER	SPECIFICATION	TEST RESULTS
Weight	9.90 to 10.10 lbs.	9.90
Temperature	19° C to 26° C	22.2
Relative Humidity	10% to 70%	60.9
Peak Resultant Acceleration	225 G's to 275 G's	268.0
Peak Lateral Acceleration	15 G's Maximum	9.2
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	02/07/11	08/07/11
2	ENDEVCO	7264-2000	J36197	02/07/11	08/07/11
3	ENDEVCO	7264-2000	J36353	02/07/11	08/07/11

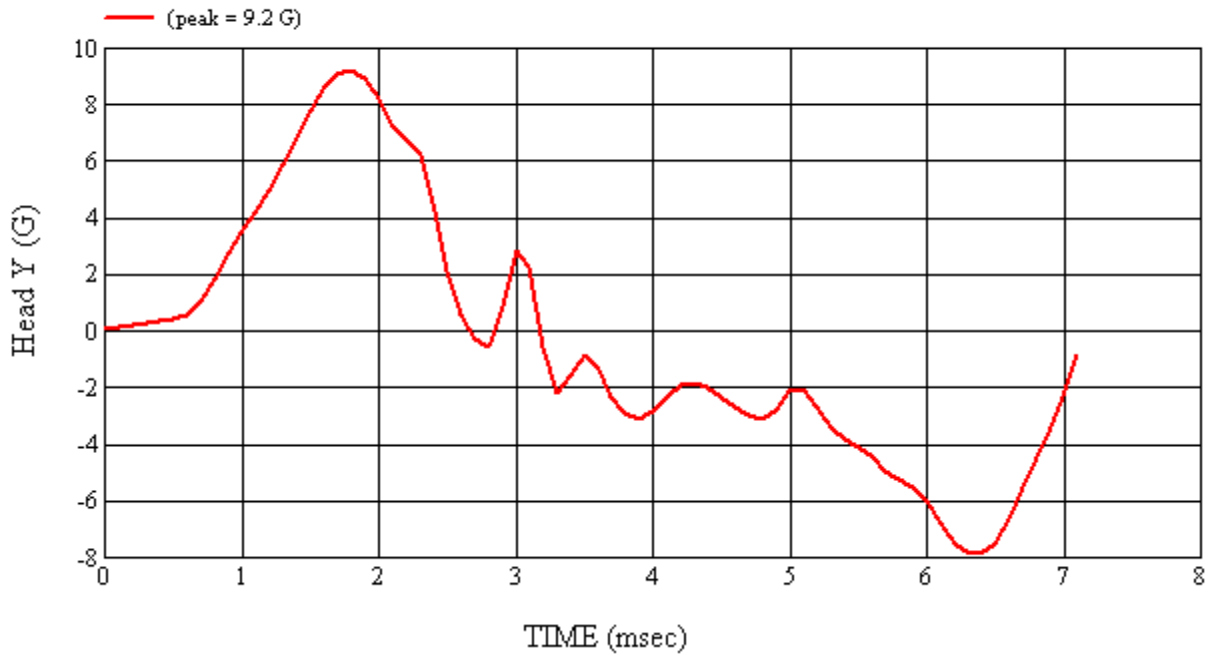
REMARKS:

RECORDED BY: *Keri D. McLean* DATE: 5/23/2011

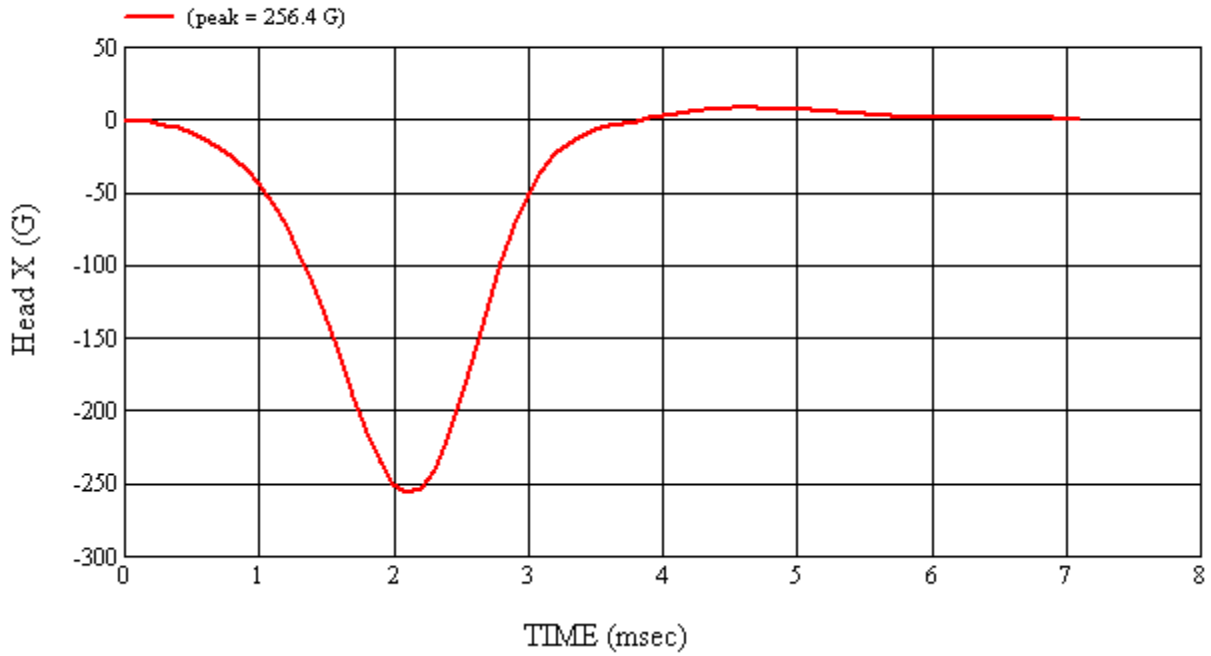
APPROVED BY: *Adrian I. Smith*



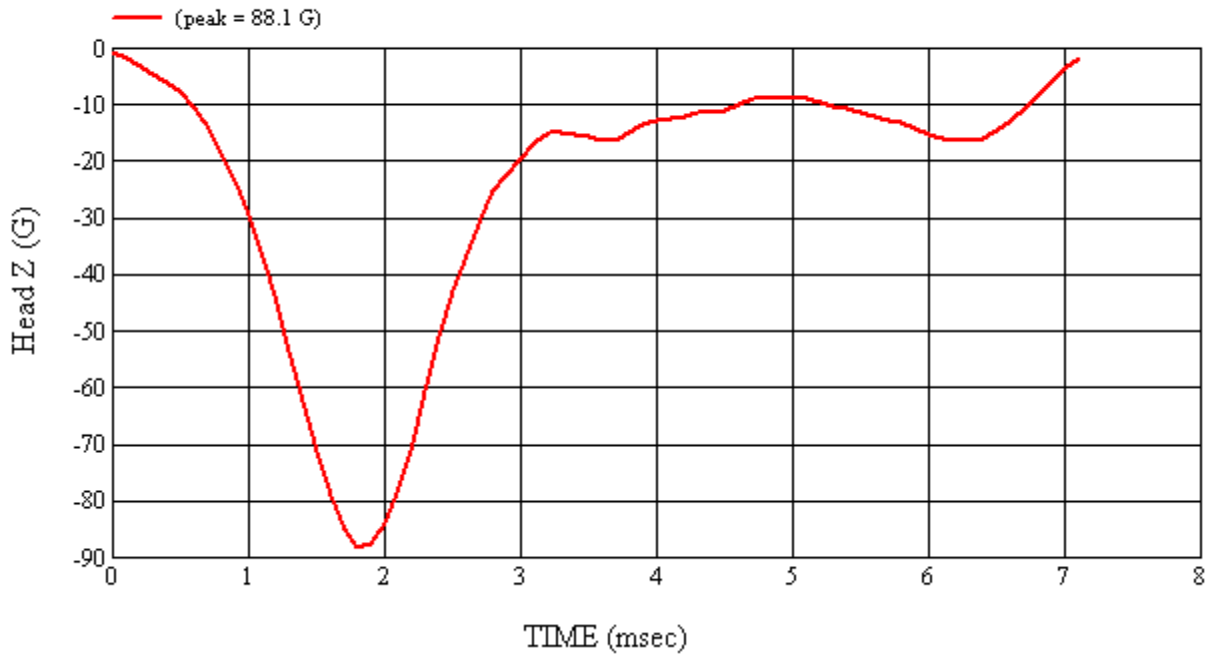
Head 038 (Post) Calibration #H38022



Head 038 (Post) Calibration #H38022



Head 038 (Post) Calibration #H38022



Head 038 (Post) Calibration #H38022

5.0 PHOTOGRAPHS



As Delivered – Left Side View



As Delivered – Right Side View



As Delivered – ¾ Front View From Left Side



As Delivered – ¾ Rear View From Right Side

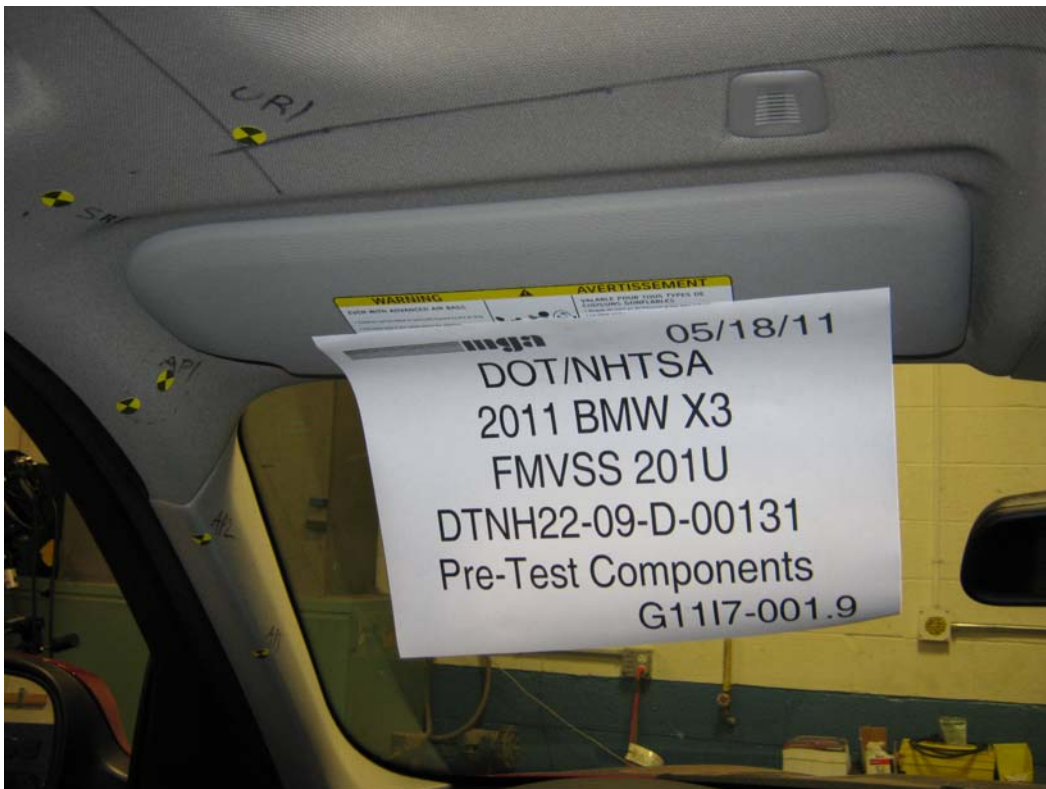
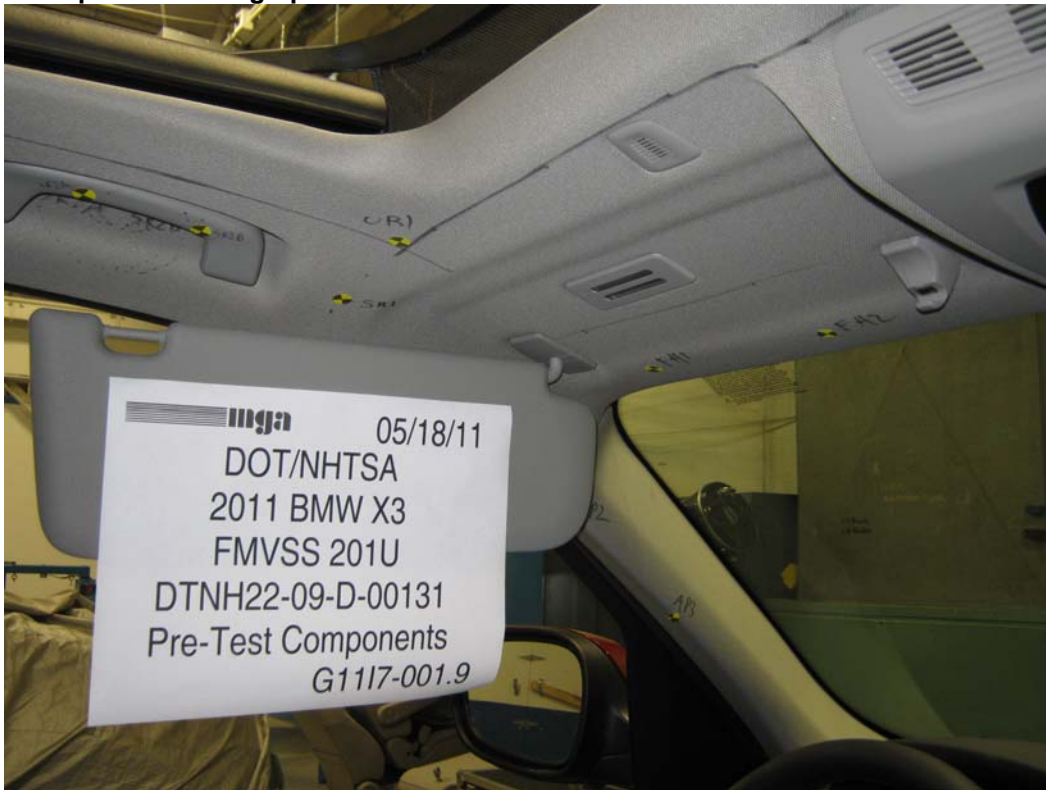


As Delivered – Vehicle’s Certification Label



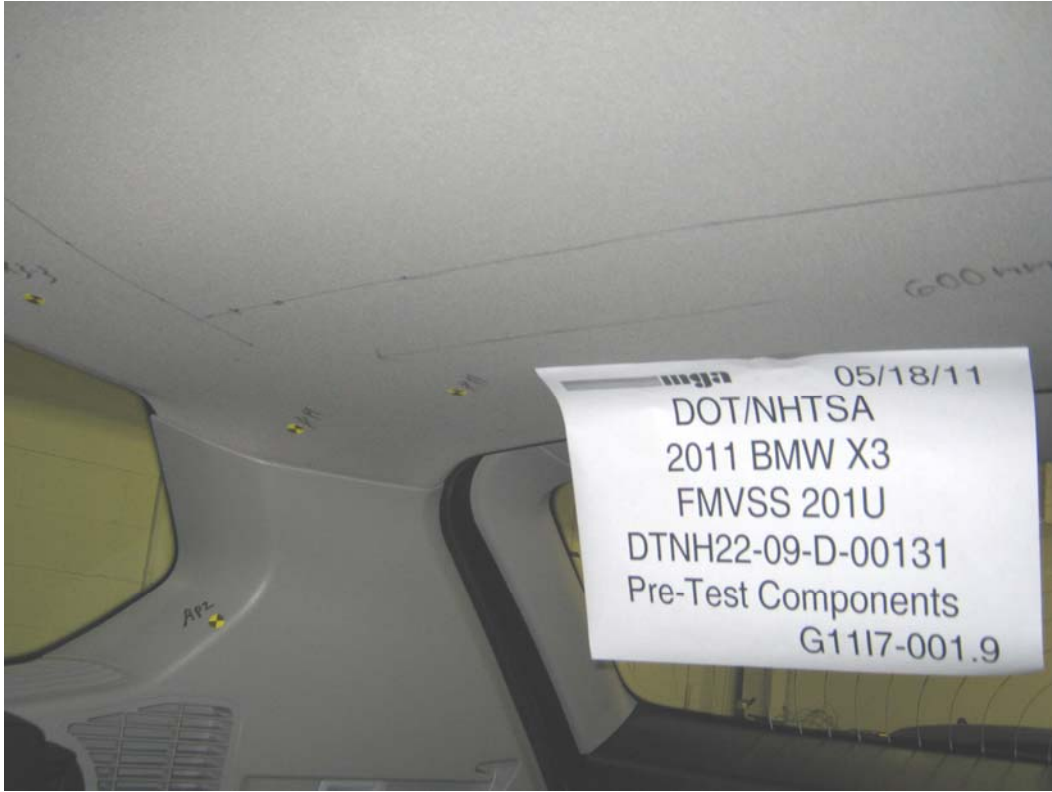
As Delivered – Vehicle’s Tire Information Label

Pre-Test Component Photographs









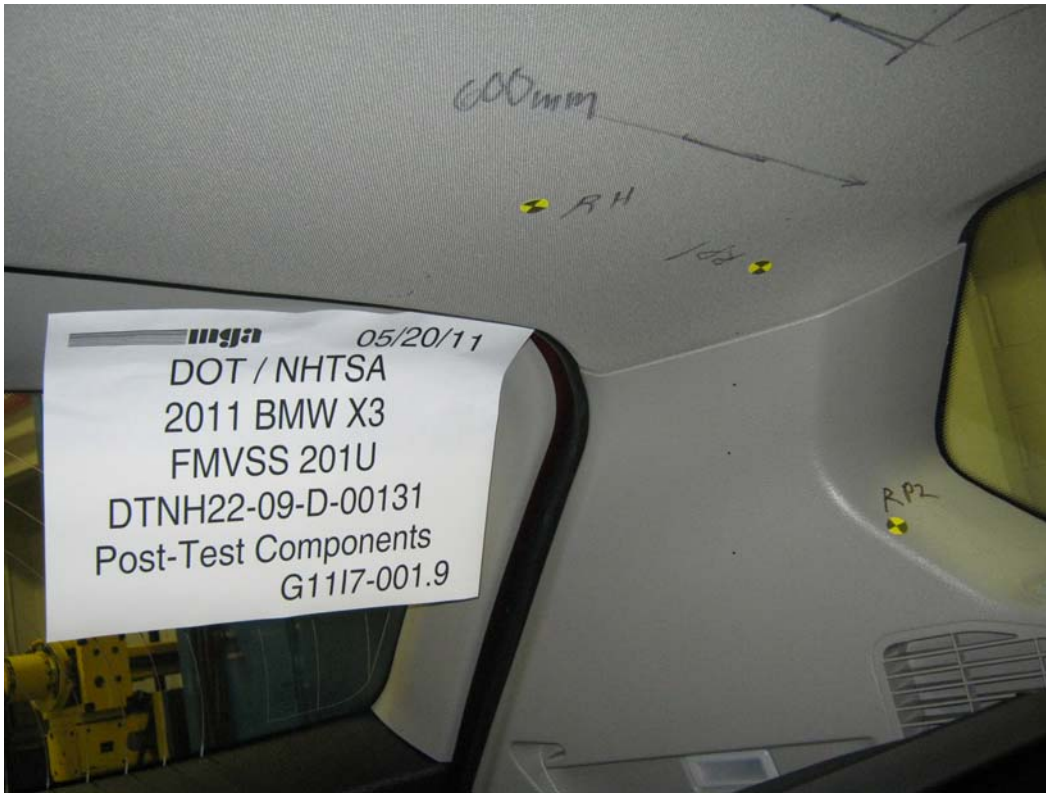




Post-Test Component Photographs





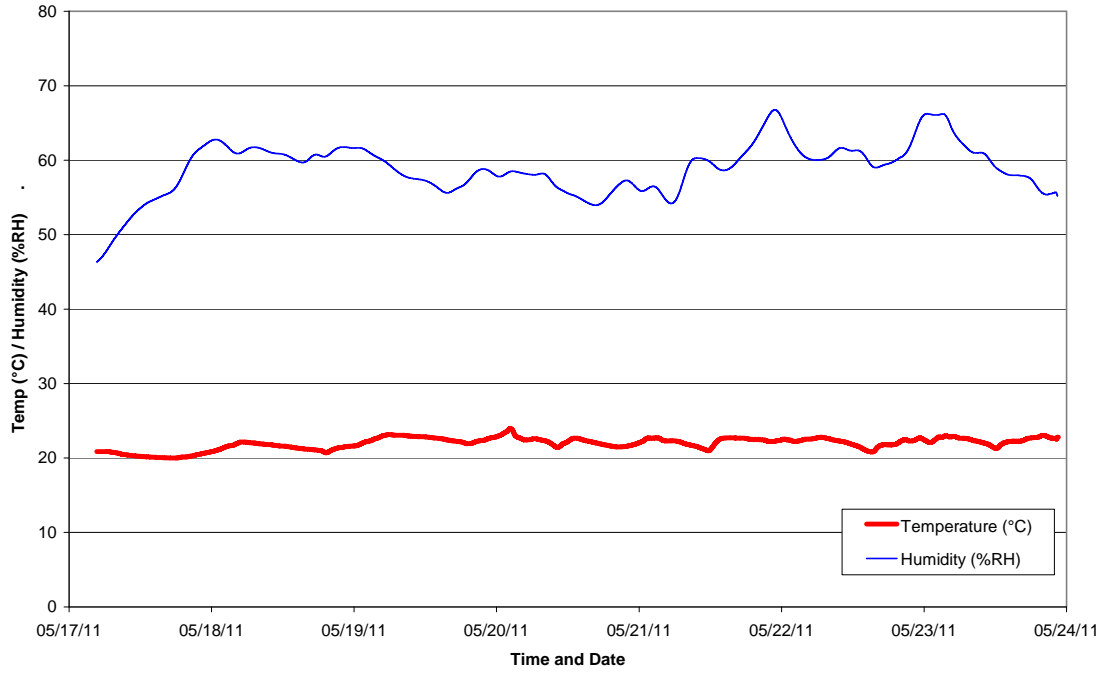






Appendix A – Temperature Trace

CB0505 - 2011 BMW X3 - FMVSS 201U





Appendix B – Calibration Certificates

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 #:	J35919
Calibration Date:	9/14/2010	Capacity/Range:	2,000 (G's)
Calibrated By:	Modal Shop		

Calibration Date: 2/4/2011
New DLR(Units:G'S) ¹ 95.8
100K SHUNT
Linearity: ² 0.99951
New vs Old Sensitivit (% Difference) 0.7
Temperature: 72 °F
Humidity: 20 %
Sensitivity (mV/V/G): 0.025975
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:	MGAMI
Model #	352C03	Manufacturer:	Endevco
Serial #:	95980	Model #:	7264-2000
Capacity:	G's:250	Serial #:	J22664
Calibration Date:	9/14/2010	Capacity/Range:	2,000 (G's)
Calibrated By:	Modal Shop		

Calibration Date: 2/4/2011
New DLR(Units:G'S) ¹ 94.2
100K SHUNT
Linearity:² 0.99938
New vs Old Sensitivit
(% Difference) 1.2
Temperature: 72 °F
Humidity: 20 %
Sensitivity (mV/V/G): 0.026447
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 #:	J35924
Calibration Date:	9/14/2010	Capacity/Range:	2,000 (G's)
Calibrated By:	Modal Shop		

Calibration Date: 2/4/2011

New DLR(Units:G'S) ¹ 92.8
100K SHUNT

Linearity: ² 0.99947

New vs Old Sensitivity (% Difference) 1.2

Temperature: 72 °F

Humidity: 20 %

Sensitivity (mV/V/G): 0.026824

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

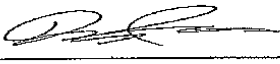
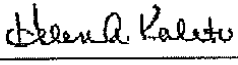
Calibration uncertainty no greater than 4.0 % at the 95% confidence level.

MGA Research Corporation-Calibration Certificate

ACCELEROMETER

Reference		Sensor	
Name:	Accel Standard	Name:	MGAMI
Model #	352C03	Manufacturer	Endevco
Serial #:	95980	Model #:	7264-2000
Capacity:	G's:250	Serial #:	J32177
Calibration Date:	9/14/2010	Capacity/Range:	2,000 (G's)
Calibrated By:	Modal Shop		

Calibration Date: 2/4/2011
New DLR(Units:G'S) ¹ 113.7
100K SHUNT
Linearity:² 0.9997
New vs Old Sensitivit (% Difference) -0.2
Temperature: 72 °F
Humidity: 20 %
Sensitivity (mV/V/G): 0.021883
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- (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:	MGAMI
Model #	352C03	Manufacturer	Endevco
Serial #:	95980	Model #:	7264-2000
Capacity:	G's:250	Serial #:	J14103
Calibration Date:	9/14/2010	Capacity/Range:	2,000 (G's)
Calibrated By:	Modal Shop		

Calibration Date: 2/4/2011
New DLR(Units:G'S) ¹ 93.9
100K SHUNT
Linearity: ² 0.99955
New vs Old Sensitivit (% Difference) -0.1
Temperature: 72 °F
Humidity: 20 %
Sensitivity (mV/V/G): 0.026479
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


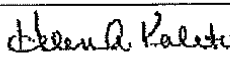
Calibration uncertainty no greater than 4.0 % at the 95% confidence level.

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 #:	J35800
Calibration Date:	9/14/2010	Capacity/Range:	2,000 (G's)
Calibrated By:	Modal Shop		

Calibration Date: 2/4/2011
New DLR(Units:G'S) ¹ 97.8
100K SHUNT
Linearity:² 0.9995
New vs Old Sensitivit
(% Difference) 0.6
Temperature: 72 °F
Humidity: 20 %
Sensitivity (mV/V/G): 0.025451
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:	MGAMI
Model #	352C03	Manufacturer	Endevco
Serial #:	95980	Model #:	7264-2000
Capacity:	G's:250	Serial #:	J22700
Calibration Date:	9/14/2010	Capacity/Range:	2,000 (G's)
Calibrated By:	Modal Shop		

Calibration Date: 2/7/2011

New DLR(Units:G'S) ¹ 96.4
100K SHUNT

Linearity: ² 0.99966

New vs Old Sensitivity
(% Difference) 0.5

Temperature: 70 °F

Humidity: 20 %

Sensitivity (mV/V/G): 0.025819

Calibrated By: Chris Collins

Signature: Chris Collins

Approved by: Aben D. Kalato

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:	MGAMI
Model #	352C03	Manufacturer	Endevco
Serial #:	95980	Model #:	7264-2000
Capacity:	G's:250	Serial #:	J36197
Calibration Date:	9/14/2010	Capacity/Range:	2,000 (G's)
Calibrated By:	Modal Shop		

Calibration Date: 2/7/2011

New DLR(Units:G'S) ¹ 108.7
100K SHUNT

Linearity: ² 0.99976

New vs Old Sensitivity (% Difference) 0.9

Temperature: 70 °F

Humidity: 20 %

Sensitivity (mV/V/G): 0.022869

Calibrated By: Chris Collins

Signature: Chris Collins

Approved by: Blair A. Kalish

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:	9/14/2010	Capacity/Range:	2,000 (G's)
Calibrated By:	Modal Shop		

Calibration Date: 2/7/2011

New DLR(Units:G'S) ¹ 99.1
100K SHUNT

Linearity:² 0.99988

New vs Old Sensitivit
(% Difference) 0.9

Temperature: 70 °F

Humidity: 20 %

Sensitivity (mV/W/G): 0.025114

Calibrated By: Chris Collins

Signature: Chris Collins


Approved by: Heaven A. Kalish

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.

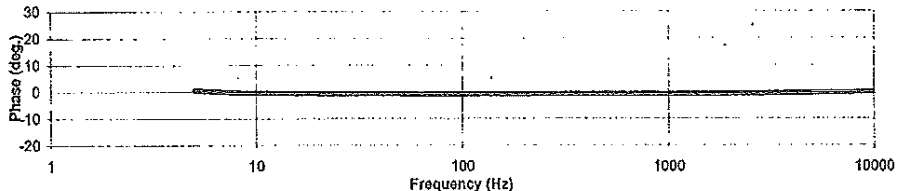


~Calibration Certificate~

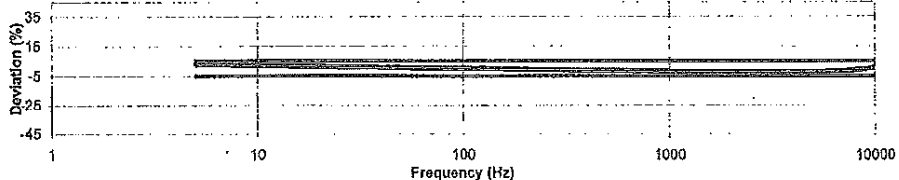
3149 East Kemper Rd.
 Cincinnati, OH 45241
 Ph : 513-351-9919
 Fax: 513-458-2172
 www.modalshop.com

Sensor Information Model Number: 352C03 Serial Number: 95980 Manufacturer: PCB ID Number: Description: ICP® Accelerometer	Calibration Data Sensitivity @ 100 Hz: 9.94 mV/g Phase @ 100 Hz: -0.87 deg. Test Level: 10.00 g	Transducer Specifications Amp. Range: ± 500 g Resolution: 0.0005 g Resonant Freq: ≥ 60000 Hz Temp. Range: -54 to 121 °C -65 to 250 °F Axis: Uni-Axial
---	---	--

Phase Response



Amplitude Response



Freq. (Hz)	Deviation (%)	Phase (deg)
5	3.15	0.41
10	2.18	-0.36
30	0.99	-0.71
50	0.62	-0.68
100	0.00	-0.87
300	-0.88	-0.81
500	-1.29	-0.77
1000	-1.87	-0.77
2000	-2.45	-0.68
3000	-2.46	-0.61
4000	-2.59	-0.49
5000	-2.40	-0.40
6000	-2.09	-0.26
7000	-1.63	-0.23
8000	-1.10	-0.13
9000	-0.30	0.02
10000	0.76	-0.01

Notes
 Results relate only to the items calibrated.
 This certificate may not be reproduced except in full, without written permission.
 Method: Calibration is performed in compliance with ISO 9001 and ISO 17025
 This calibration was performed with TMS 9155C Calibration Workstation version 4.6.1
 Calibration traceable to primary method which has been proficiency validated through interlaboratory comparison to NIST (project number 822/271196).
 Back-to-Back Comparison Calibration per ISO 16063-21
 Procedure Used: PRD-P220
 Measurement uncertainty (95% confidence level with coverage factor 2) for frequency ranges tested during calibration are as follows: 0.5-4.99 Hz; ± 3.00%, 5-9.99 Hz; ± 2.50%, 10-99 Hz; ± 1.70%, 100 Hz; ± 1.25%, 101-920 Hz; ± 1.40%, 921-5000 Hz; ± 1.70%, 5001-10,000 Hz; ± 2.20%, 10,001-15,000 Hz; ± 3.65%, 15,001-20,000 Hz; ± 4.75%.

Customer
 MGA Research Corp.


User Notes

Unit Condition
 As Found: In Tolerance
 As Left: In Tolerance

Lab Conditions
 Temperature: 73 (23) °F (°C)
 Humidity: 32 %

Approval Information
 Technician: Ed Devlin
 Approval: *Ed Devlin*

Cal Date: 9/14/2010
 Due Date:



Cal ID: 15803 2649 01

Page 1 of 2



~Calibration Certificate~

3149 East Kemper Rd.
 Cincinnati, OH 45244
 Ph: 513-351-9919
 Fax: 513-458-2172
 www.modalshop.com

Sensor Information

Model Number	352C03
Serial Number	95980
Manufacturer	PCB
ID Number	

Note

This certificate may not be reproduced
 except in full, without written
 permission.

Standards and/or Equipment Used During Calibration

Description	Manufacturer	Model	Serial	Due Date
Data Acquisition Card	NI	4461	15004324	6/29/2011
Std Accelerometer	PCB	080A200	110553	12/8/2010
Air Bearing Shaker	PCB	396C11	603	n/a
Std Sig Conditioner	PCB	442A102	173	12/8/2010
SUT Signal Conditioner	PCB	443B101	379	9/19/2010
Power Amplifier	TMS	2100E21-C	1002	n/a

Technician: Ed Devlin *Ed Devlin*

Cal Date: 9/14/2010

Customer: MGA Research Corp.

Due Date:



Cal ID: 16800

2009.01

Calibration Certificate

Part Description: Gold Serial: G10-02-00-01619
 Certification Date: 6/23/2010 RECEIVED
 Single Point - (Max-Min)/2 Specification: G10-02_084mm (.0033") Certificate#: G0161940352
 Volumetric (Max Deviation) Specification: G10-02 +/- .119mm. (+/- .0047") Temperature: See attached data

Measurement Standards Traceability
 Asset Number: 1041 Calibration Due: 8/10/2010 *SI Traceability: L20100310AB1
 Ball Bar Kit

Asset Number: 668 Calibration Due: 1/22/2011 *SI Traceability: A2LA-1001080562
 Thermometer

Asset Number: TQ225 Calibration Due: 10/17/2011 *SI Traceability: NIST 821/270114-04
 Reference Sphere

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 ISO 17025 Accredited Laboratory.
 Measurement uncertainty is $2.3\sigma \pm 2.5\%$ unless otherwise noted.
 Uncertainty is expressed at approximately a 95% Level of Confidence using $k=2.0$.

Calibration Results*
 3 Single Point Articulation Tests at $\leq 20\%$, $20\%-80\%$ and $\geq 80\%$ range. **PASSED**
 1 Effective diameter sphere test. **PASSED**
 20 Volumetric ball bar tests in 4 quadrants and 2 orientations. **PASSED**

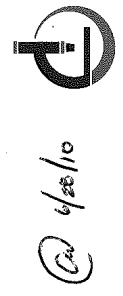
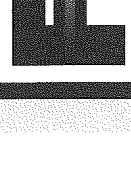
*Calibration conforms to procedures developed in accordance with ASME B89.4.22-2004. See attached data for measurement results.
Instrument condition as received:
 Within Specifications

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

Instrument condition outgoing:
 Within specifications
 Date: 6/23/10

Technician: Neil Yoculan

FARO Technologies, Inc.
 Michigan Regional Office
 PH1:248-669-8620
 FAX:248-669-8656
 L-A-B Cert Number:L1147.01-1



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

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

Tape Measure Calibration Certificate

Reference Steel Rule

Brand: SWANSON
 S/N: M6A 00799
 Calibration Date: 1/15/2010

Subject Tape Measure

Brand: STANLEY
 S/N: TPM 992
 Calibration Date: 5/27/10

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

Performed By: RJmill

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 $k=2$.




Metrology Management Services
Remit to address:

Calibration Certificate

35200 Plymouth Rd.
Livonia, MI 48150



CALIBRATION # 1277.01
Calibration Certificate #:
Z52545:1300708444

PRO PRO 360 PROTRACTOR		
SERIAL NUMBER:	N/A	WORK ORDER: 1300708444
ASSET NUMBER:	Z52545	
CUST. ASSET NUM:	MGA00049	
PROCEDURE NAME:	PRO 3600	
PROCEDURE REV:	A	TEST RESULT: PASS
CALIBRATED BY:	JOE McCONNAUGHAY	PERFORMED ON: 3/21/2011
CUSTOMER:	MGA RESEARCH 446 Executive Drive Troy, MI 48083	CAL DUE DATE: 3/21/2012
PRIMARY CONTACT:	BOB MILLER	DATA TYPE: FOUND-LEFT
		TEMPERATURE: 21.00 °C
		HUMIDITY: 38 %

This instrument has been processed and calibrated in accordance with the NovaStar Solutions Quality System Manual and is traceable to the National Institute of Standards and Technology (NIST), or to NIST accepted intrinsic standards of measurement, or derived by the ratio type of self-calibration techniques. The NovaStar Solutions quality system is accredited to ISO/IEC 17025:2005 and ANSI/NCSL Z540-1-1994.

The results reported herein apply only to the calibration of the item described above. No sampling plan was used for this calibration.

The ratio of the tolerance of the instrument or parameter being calibrated to the expanded uncertainty of the standard (TUR) is greater than 4:1 unless otherwise specified. Expanded uncertainties are expressed at the approximate 95% level of confidence using a K=2. Due to any number of factors, the recommended due date on the item does not imply continuing conformance to specifications during the recommended interval. Unless otherwise stated the unit under test meets or exceeds manufacturer specifications.

For range and best measurement capability specifications for the standards used to perform this calibration, see the most recent calibration report maintained by this calibration laboratory (available upon request).

This report may not be reproduced, except in full, without written approval from NovaStar Solutions.


As Received Condition: IN TOLERANCE As Returned Condition: IN TOLERANCE
Action Taken: FULL CALIBRATION


REMARKS:

Standards Used				
Asset #	Cert#	Description	Cal Date	Due Date
1437	1437:1232010439	PHASE 2 220-006 ROTARY TABLE	1/15/2009	1/15/2013
1541	1541:1300372477	NEWPORT CT485AL HYGROTHERMOGRAPH	3/17/2011	3/17/2012
1577	1577:1297694647	RAHN SUPER 100 SURFACE PLATE	2/14/2011	2/14/2012

***** End of Certificate *****

@ 3/20/11

QA approved: Steve Hall Date: 3-22-11
Signature: 

Asset Barcode: 



Calibration Certificate



Metrology Management Services
Remit to address:

35200 Plymouth Rd.
Livonia, MI 48150

CALIBRATION # 1277.01
Calibration Certificate #:
Z52549:1300715528

DICKSON TM325 TEMP/HUMD DISP		WORK ORDER: 1300715528
SERIAL NUMBER:	N/A	
ASSET NUMBER:	Z52549	
CUST. ASSET NUM:	MGA00894	TEST RESULT: PASS
PROCEDURE NAME:	1012	PERFORMED ON: 3/21/2011
PROCEDURE REV:	A	CAL DUE DATE: 3/21/2012
CALIBRATED BY:	JOE McCONNAUGHAY	DATA TYPE: FOUND-LEFT
CUSTOMER:	MGA RESEARCH 446 Executive Drive Troy, MI 48083	TEMPERATURE: 21.00 °C
PRIMARY CONTACT:	BOB MILLER	HUMIDITY: 38 %

This instrument has been processed and calibrated in accordance with the NovaStar Solutions Quality System Manual and is traceable to the National Institute of Standards and Technology (NIST), or to NIST accepted intrinsic standards of measurement, or derived by the ratio type of self-calibration techniques. The NovaStar Solutions quality system is accredited to ISO/IEC 17025:2005 and ANSI/NCSL Z540-1-1994.

The results reported herein apply only to the calibration of the item described above. No sampling plan was used for this calibration.

The ratio of the tolerance of the instrument or parameter being calibrated to the expanded uncertainty of the standard (TUR) is greater than 4:1 unless otherwise specified. Expanded uncertainties are expressed at the approximate 95% level of confidence using a K=2. Due to any number of factors, the recommended due date on the item does not imply continuing conformance to specifications during the recommended interval. Unless otherwise stated the unit under test meets or exceeds manufacturer specifications.

For range and best measurement capability specifications for the standards used to perform this calibration, see the most recent calibration report maintained by this calibration laboratory (available upon request).

This report may not be reproduced, except in full, without written approval from NovaStar Solutions.

As Received Condition: IN TOLERANCE

As Returned Condition: IN TOLERANCE

Action Taken: FULL CALIBRATION

REMARKS:

Asset #	Cert#	Description	Cal Date	Due Date
1504	1504:1296548177	HART SCIENTIFIC 1502A THERMOMETER READOUT	2/7/2011	2/7/2012
1541	1541:1300372477	NEWPORT CT485AL HYGROTHERMOGRAPH	3/17/2011	3/17/2012
1717	1717:1297150241	HART SCIENTIFIC 5614 PRT	2/7/2011	2/7/2012
1917	1917:1296319659	VAISALA M170/HMP76 MEASUREMENT INDICATOR/PROBE	1/29/2011	1/29/2012

***** End of Certificate *****

CA 3/28/11

QA approved: Steve Hall Date: 3-22-11

Signature: [Signature]

Asset Barcode:



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 48063

Order Number: 69370
 Certificate Number: 100826804
 Page: 1 of 1

Gauge Number: MGA00783
 Gauge Desc: 0 to 20lb x 0.01lb Digital Scale
 Manufacturer: Detecto
 Model Number: AP-20
 Serial Number: E10807-0187

Customer PO: N/A
 Last Calibration: 8/14/09
 Calibration Date: 8/28/10
 Next Calibration: 8/28/11

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/NCSL 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)

Standard Used	Cal. Date	Due Date	Traceable No.	Calibration Procedure Uncertainty Expressed at 95% confidence, (K=2)
Dead Weight Set	3/3/09	3/3/11	ID# 16992	+/-0.001% of Load
Weight Set	9/3/08	9/3/10	ID# 2463	+/-0.001% of Load

Results:

Tolerance used: Class III

Units: lbs TI Division/Increment: 0.01

Weight Test	As Found			As Left		
	Nominal	Indication	Deviation	Nominal	Indication	Deviation
Zero	0.00	0.00	0.00	0.00	0.00	0.00
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
1/2 load test	10.00	10.02	0.02	10.00	10.02	0.02
return to zero	0.00	0.00	0.00	0.00	0.00	0.00
4 quad/Shift Test: Pass				4 quad/Shift Test: Pass		

Comments: Environmental conditions during calibration: 75 °F, 89 % RH.
 The adapter that was sent in with the scale has loose components, be careful when using.
 No adjustments required.

Shannon Kubicek
 Shannon Kubicek
 Calibration Technician

Issued: 8/28/10

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

@ 9/8/10

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 Research Cert# 10-6914 Temp/Humidity: ok
 Location of Calibration: 2839 Elliot Rd Troy MI 48063
 Calibration Date: 7/21/2010 Due Date: Jul-11 Condition of Item: Fair
 Equipment Make: Intercomp Model: SW Deluxe Serial Number 26032389 Capacity: 2200 lb x 1 lb Per weigh pad
 8800 lb x 1 lb Scale system total capacity

Applied Test Wt	Before Adjustment	Tolerance	In-Tolerance Y/N	After Adjustment	In-Tolerance Y/N	Unc	
10 lb	9 lb	1 lb	y	n/a	y	0.002 lb	Right Rear Pad
100 lb	100 lb	1 lb	y	n/a	y	0.11 lb	
1000 lb	1000 lb	2 lb	y	n/a	y	0.14 lb	
10 lb	10 lb	1 lb	y	n/a	y	0.002 lb	Right Front Pad
100 lb	100 lb	1 lb	y	n/a	y	0.11 lb	
1000 lb	999 lb	2 lb	y	n/a	y	0.14 lb	

Shift test
 n/a

Platform #1 Platform #2 Platform #3
 Pass Pass Pass
 Fail Fail Fail

Tests performed: Repeatability Linearity Sensitivity Discrimination

Technician: This scale is a wheel weigh system, there are a total of 4 wheel pads. Each pad has a capacity of 2200lb. A lb. All 4 pads together have a total capacity of 8800 lb.
 COMMENTS/ Scale passes tests
 weights used sn on file
 Page 2 of 2

Scale Certified Scale Rejected

Sterling Scale Service Rep: E.Denny Date: 7/21/2010 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. Sterling Scale does not warranty calibration.