

FINAL REPORT NUMBER 201UI-MGA-15-06

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

**TOYOTA MOTOR MANUFACTURING
2015 Toyota Camry
NHTSA No. C20155105**

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



Test Dates: July 21, October 20, 2015
Report Date: October 23, 2015

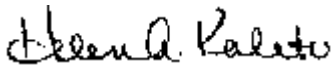
FINAL REPORT

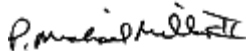
PREPARED FOR:

**U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
ENFORCEMENT
OFFICE OF VEHICLE SAFETY COMPLIANCE
1200 New Jersey Avenue, SE
West Building
WASHINGTON, D.C. 20590**

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FINAL REPORT ACCEPTANCE BY OVSC:

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Acceptance Date: 01.19.2016

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No. 201UI-MGA-15-06		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle Final Report of FMVSS 201 Compliance Testing of a 2015 Toyota Camry, NHTSA No. C20155105				5. Report Date July 27, 2015	
				6. Performing Organization Code MGA	
7. Author(s) Helen A. Kaleto, Project Manager Sean Fortnam, Project Engineer				8. Performing Organization Report No. 201UI-MGA-15-06	
9. Performing Organization Name and Address MGA Research Corporation 446 Executive Drive Troy, Michigan 48083				10. Work Unit No.	
				11. Contract or Grant No. DTNH22-11-D-00246	
12. Sponsoring Agency Name and Address U.S. Department Of Transportation National Highway Traffic Safety Administration Enforcement Office of Vehicle Safety Compliance 1200 New Jersey Avenue, SE West Building, 4 th Floor Washington, D.C. 20590				13. Type of Report and Period Covered Final Test Report	
				14. Sponsoring Agency Code NVS-220	
15. Supplementary Notes					
16. Abstract A compliance test series was conducted on the subject 2015 Toyota Camry, NHTSA No. C20155105, in accordance with the specifications of the Office of Vehicle Safety Compliance Test Procedure No. TP-201U-01. The testing was conducted at MGA Research Corporation in Troy, Michigan on July 21 and October 20, 2015. Test failures identified were as follows: UR12@SR3-2					
17. Key Words Compliance Testing Safety Engineering FMVSS 201UI 2015 Toyota Camry				18. Distribution Statement Copies of this report are available from: NHTSA Technical Reference Division, Mail Code: NIO-120 1200 New Jersey Avenue, SE West Building Washington, D.C. 20590	
19. Security Classif. (of this report) Unclassified		20. Security Classif. (of this page) Unclassified		21. No. of Pages 168	22. Price N/A

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1.0 PURPOSE OF COMPLIANCE TEST

The FMVSS 201 upper interior compliance test sponsored by the National Highway Traffic Safety Administration (NHTSA) was conducted under Contract DTNH22-11-D-00246. The purpose of this test was to evaluate upper interior head impact protection performance of a 2015 Toyota Camry.

Tests were conducted on July 21 and October 20, 2015 on a 2015 Toyota Camry, manufactured by Toyota Motor Corporation.

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 May 8, 2012.

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 2015 Toyota Camry was equipped with A, B and rear pillars, an adjustable seat belt anchorage on each B-pillar, and grab handles located on the driver and passenger front side rails and rear side rails.

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:

AP1	BP2	RH	UR5@SR3-1
AP2	BP4	UR2@SR1	UR9@SR2A
BP1	FH1	UR4@BP	UR12@SR3-2

The 2015 Toyota Camry 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: 2015 Toyota Camry

VEH. NHTSA NO.: C20155105 VIN: 4T4BF1FK4FR489589

COLOR: Midnight Black Metallic VEH. BUILD DATE: March, 2015

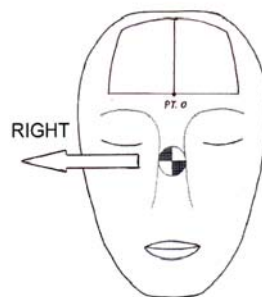
TEST DATES: July 21, October 20, 2015

TEST LABORATORY: MGA Research Corp.

OBSERVERS: Helen Kaleto, Sean Fortnam, David Burkett, Ryan Jones, Kurt Reichert

TARGET	VEHICLE SIDE	HORIZONTAL ANGLE (deg)	VERTICAL ANGLE (deg)	VELOCITY (kph)	HIC(d)	FMH HIC	IMPACT ON FMH (mm)	
							Above	Left/Right
AP1	Left	252	45	18.9	652	643	26	1 R
AP2	Right	157	50	18.5	438	360	11	3 L
BP1	Right	90	20	19.2	477	412	55	7 L
BP2	Left	270	0	24.0	444	359	30	0
BP4	Right	160	0	23.5	677	676	10	7 L
FH1	Right	180	50	23.7	748	771	19	8 R
RH	Left	0	50	23.6	382	286	32	0
UR2@SR1	Left	270	50	23.9	755	780	40	20 R
UR4@BP	Left	270	50	24.1	812	856	21	5 R
UR5@SR3-1	Left	270	50	23.9	841	895	44	1 L
UR9@SR2A	Right	90	50	24.1	979	1077	40	8 L
UR12@SR3-2	Right	90	50	23.5	1019	1130	63	0

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: A-pillar dislodged.

BP2 Left: Seat belt adjuster damaged.

RH Left: Headliner clip dislodged.

UR2@SR1 Left: Grab handle pushed in.

UR5@SR3-1 Left: Grab handle pushed in.

UR9@SR2A Right: Grab handle pushed in.

UR12@SR3-2 Right: Grab handle pushed in.

REMARKS:

The targets listed were impacted in the following order:

Left: AP1, UR2@SR1, UR4@BP, BP2, UR5@SR3-1, RH

Right: UR12@SR3-2, BP4, BP1, UR9@SR2A, AP2, FH1

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

Recorded By:  Approved By: 

Date: October 20, 2015

TABLE 2-2

GENERAL TEST AND VEHICLE PARAMETER DATA

VEH. MOD YR/MAKE/MODEL/BODY: 2015 Toyota Camry

VEH. NHTSA NO.: C20155105 VIN: 4T4BF1FK4FR489589

COLOR: Midnight Black Metallic VEH. BUILD DATE: March, 2015

TEST DATES: July 21, October 20, 2015

TEST LABORATORY: MGA Research Corp.

OBSERVERS: Helen Kaleto, Sean Fortnam, David Burkett, Ryan Jones, Kurt Reichert

INTERIOR TRIM INFORMATION: A, B and rear pillars, an adjustable seat belt anchorage on each B-pillar, and grab handles located on the driver and passenger front side rails and rear side rails.

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: June 24, 2015; Odometer Reading 11 miles

DATA FROM VEHICLE'S CERTIFICATION LABEL:

Vehicle Manufactured By: Toyota Motor Corporation

Date of Manufacture: March, 2015; VIN: 4T4BF1FK4FR489589

GVWR: 2100 kg; GAWR FRONT: 1191 kg;

GAWR REAR: 1191 kg;

DATA FROM TIRE PLACARD:

Tire Pressure with Maximum Capacity Vehicle Load:

FRONT: 240 kPa REAR: 240 kPa

Recommended Tire Size: P205/65R16

Recommended Cold Tire Pressure:

FRONT: 240 kPa REAR: 240 kPa

Size of Tire on Test Vehicle: P205/65R16

Type of Spare Tire: T155/70D17; Space Saver: X; Standard

VEHICLE CAPACITY DATA:

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

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

VEHICLE CAPACITY WEIGHT:

Vehicle Capacity Weight (VCW) = 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 = 438.0 kg Right Rear = 276.5 kg

Left Front = 465.5 kg Left Rear = 285.5 kg

TOTAL FRONT = 903.5 kg TOTAL REAR = 562.0 kg

% Total Weight = 62.0 % % Total Weight = 38.0 %

TOTAL DELIVERED WEIGHT = 1465.5 kg

CALCULATION OF VEHICLE'S TARGET TEST WEIGHT:

Total Delivered Weight = 1465.5 kg

Max. Test Cargo/Luggage Weight = 70.0 kg

Target Test Weight = 1535.5 kg

WEIGHT OF TEST VEHICLE FULLY LOADED:

Right Front =	<u>436.0</u> kg	Right Rear =	<u>314.0</u> kg
Left Front =	<u>462.5</u> kg	Left Rear =	<u>322.0</u> kg
TOTAL FRONT =	<u>898.5</u> kg	TOTAL REAR =	<u>636.0</u> kg
% Total Weight =	<u>59.0</u> %	% Total Weight =	<u>41.0</u> %

TOTAL TEST WEIGHT = 1534.5 kg

Weight of ballast secured in vehicle's cargo area = 69.0 kg

TEST VEHICLE ATTITUDE:

AS DELIVERED: Right Front 725 mm; Left Front 725 mm;
Right Rear 722 mm; Left Rear 722 mm;
Pitch Angle at Right Door Sill = 0.2 Rear is higher
Pitch Angle at Left Door Sill = 0.2 Rear is higher
Roll Angle at Front Bumper = 0.5 Right is higher
Roll Angle at Rear Bumper = 0.1 Left is higher

FULLY LOADED: Right Front 729 mm; Left Front 722 mm;
Right Rear 712 mm; Left Rear 709 mm;
Pitch Angle at Right Door Sill = 0.0
Pitch Angle at Left Door Sill = 0.0
Roll Angle at Front Bumper = 0.4 Right is higher
Roll Angle at Rear Bumper = 0.3 Left is higher

AS TARGETED: Right Front 867 mm; Left Front 865 mm;
Right Rear 842 mm; Left Rear 845 mm;
Pitch Angle at Right Door Sill = 0.0
Pitch Angle at Left Door Sill = 0.0
Roll Angle at Front Bumper = 0.4 Right is higher
Roll Angle at Rear Bumper = 0.1 Left is higher

AS TESTED ON RIGHT SIDE:

Pitch Angle at Right Door Sill = 0.0
Pitch Angle at Left Door Sill = 0.1 Rear is higher
Roll Angle at Front Bumper = 0.4 Right is higher
Roll Angle at Rear Bumper = 0.2 Left is higher

AS TESTED ON LEFT SIDE:

Pitch Angle at Right Door Sill = 0.0
Pitch Angle at Left Door Sill = 0.0
Roll Angle at Front Bumper = 0.4 Right is higher
Roll Angle at Rear Bumper = 0.3 Left is higher

VEHICLE WHEELBASE = 2775 mm

REMARKS: The seat travel distance was measured to be 240 mm for the driver front seat and 240 mm for the passenger front seat.

Recorded By:  Approved By: 

Date: October 20, 2015

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

VEH. MOD YR/MAKE/MODEL/BODY: 2015 Toyota Camry

VEH. NHTSA NO.: C20155105 VIN: 4T4BF1FK4FR489589

COLOR: Midnight Black Metallic VEH. BUILD DATE: March, 2015

TEST DATES: July 21, October 20, 2015

TEST LABORATORY: MGA Research Corp.

OBSERVERS: Helen Kaleto, Sean Fortnam, David Burkett, Ryan Jones, Kurt Reichert

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 202.8°	L 252.0°
	R 105°-165°	R 108.1°	R 157.1°
B-PILLAR	L 195°-345°	L 199.2°	L 288.4°
	R 15°-165°	R 71.3°	R 160.6°

AS DETERMINED USING THE PROCEDURES SPECIFIED IN S8.13.4.1

REMARKS:

Recorded By:  Approved By: 

Date: October 20, 2015

TABLE 2-4

VERTICAL IMPACT ANGLE RANGES

VEH. MOD YR/MAKE/MODEL/BODY: 2015 Toyota Camry

VEH. NHTSA NO.: C20155105 VIN: 4T4BF1FK4FR489589

COLOR: Midnight Black Metallic VEH. BUILD DATE: March, 2015

TEST DATES: July 21, October 20, 2015

TEST LABORATORY: MGA Research Corp.

OBSERVERS: Helen Kaleto, Sean Fortnam, David Burkett, Ryan Jones, Kurt Reichert

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	33°	
		R	0°-50°	R	0°	R	33°	
	SR2A	L	0°-50°	L	0°	L	45°	
		R	0°-50°	R	0°	R	45°	
	SR2B	L	0°-50°	L	0°	L	43°	
		R	0°-50°	R	0°	R	43°	
	SR3-1	L	0°-50°	L	0°	L	33°	
		R	0°-50°	R	0°	R	33°	
	SR3-2	L	0°-50°	L	0°	L	33°	
		R	0°-50°	R	0°	R	33°	
	REAR HEADER	RH	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	45°	
		R	-5°-50°	R	-5°	R	45°	
	AP2	L	-5°-50°	L	-5°	L	50°	
		R	-5°-50°	R	-5°	R	50°	
	AP3	L	-5°-50°	L	-5°	L	47°	
		R	-5°-50°	R	-5°	R	47°	
B-PILLAR	BP1	L	-10°-50°	L	-10°	L	20°	
		R	-10°-50°	R	-10°	R	20°	
	BP2*	L	0°-50°	L	0°	L	0°	
		R	0°-50°	R	0°	R	0°	
	BP3	L	-10°-50°	L	-10°	L	0°	
		R	-10°-50°	R	-10°	R	0°	
	BP4	L	-10°-50°	L	-10°	L	0°	
		R	-10°-50°	R	-10°	R	0°	
	REAR PILLAR	RP1	L	-10°-50°	L	-10°	L	16°
			R	-10°-50°	R	-10°	R	16°
RP2		L	-10°-50°	L	-10°	L	28°	
		R	-10°-50°	R	-10°	R	28°	
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°		
UPPER ROOF 7		0°-50°		0°		50°		
UPPER ROOF 8		0°-50°		0°		50°		
UPPER ROOF 9		0°-50°		0°		50°		

	VERTICAL ANGLE SPECIFIED RANGE	MINIMUM VERTICAL ANGLE	MAXIMUM VERTICAL ANGLE
UPPER ROOF 10	0°-50°	0°	50°
UPPER ROOF 11	0°-50°	0°	50°
UPPER ROOF 12	0°-50°	0°	50°

As determined using the Procedures specified in S8.13.4.2. *Target BP2 is a seat belt anchorage location.

Recorded By:  Approved By: 

Date: October 20, 2015

TABLE 2-5

TARGET MEASUREMENTS

VEH. MOD YR/MAKE/MODEL/BODY: 2015 Toyota Camry

VEH. NHTSA NO.: C20155105 VIN: 4T4BF1FK4FR489589

COLOR: Midnight Black Metallic VEH. BUILD DATE: March, 2015

TEST DATES: July 21, October 20, 2015

TEST LABORATORY: MGA Research Corp.

OBSERVERS: Helen Kaleto, Sean Fortnam, David Burkett, Ryan Jones, Kurt Reichert

Measurement	Description	Left Side	Right Side
M	Seat Fore/Aft Travel (Front seats)	240 mm	240 mm
T°	Horizontal < {CG-F1 (Left Seat) to (Right A-Pillar)}	108.0°	--
A1°	360° - T°	252.0°	--
W°	Horizontal < {CG-2 (Left Seat) to (Left A-Pillar)}	202.8°	--
A2°	A2° = W°	202.8°	--
U°	Horizontal < {CG-2 (Left Seat) to (Left B-Pillar)}	288.4°	--
B1°	B1° = U°	288.4°	--
V°	Horizontal < {CG-R (Left Seat) to (Left B-Pillar)}	199.2°	--
B2°	B2° = V°	199.2°	--
W° (right)	Horizontal < {CG-F2 (Right Seat) to (Right A-Pillar)}	--	157.1°
A1° (right)	A1° (right) = W° (right)	--	157.1°
T ° (right)	Horizontal < {CG-F1 (Right Seat) to (Left A-Pillar)}	--	251.9°
A2° (right)	360°-T° (right)	--	108.1°
V ° (right)	Horizontal < {CG-R (Right Seat) to (Right B-Pillar)}	--	160.6°
B1° (right)	B1° (right) = V° (right)	--	160.6°
U° (right)	Horizontal < {CG-F2 (Right Seat) to (Right B-Pillar)}	--	71.3°
B2° (right)	B2° (right) = U° (right)	--	71.3°
J	A-Pillar {(Plane 3) – (Plane 5)}	315.1 mm	318.2 mm
J/2	J ÷ 2	157.6 mm	159.1 mm
D1	Upper Roof {(Plane A) – (Plane B)}	1596.9 mm	
D1/2	D1 ÷ 2	798.5 mm	

Measurement	Description	Left Side	Right Side
D2	Upper Roof {(Plane C) – (Plane D)}	1182.1 mm	
D2/2	D2 ÷ 2	591.1 mm	
.35D1	.35 x D1	558.9 mm	
.35D2	.35 x D2	413.7 mm	
N	B-Pillar {(BPR) – (lowest point on daylight opening forward of B-Pillar)}	396.5 mm	397.4 mm
N/2	B-Pillar {(BP3) – (lowest point on daylight opening forward of B-Pillar)}	198.3 mm	198.7 mm
N/4	B-Pillar {(BP4) – (lowest point on daylight opening forward of B-Pillar)}	99.1 mm	99.4 mm
D	R-Pillar (Point 7 – Point M)	706.0 mm	--
3D/7	3 D / 7	302.6 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	2371.6	-375.0	1293.4	2371.6	375.0	1293.4
Rear	3264.4	-365.0	1291.0	3264.4	365.0	1291.0

SgRP Locations (vehicle coordinates)						
	Left (mm)			Right (mm)		
	x	y	z	x	y	z
Front	2371.6	-375.0	1293.4	2371.6	375.0	1293.4
Rear	3264.4	-365.0	1291.0	3264.4	365.0	1291.0

CG Locations (world coordinates)						
	Left (mm)			Right (mm)		
	x	y	z	x	y	z
CGF1	2291.6	-375.0	1953.4	2291.6	375.0	1953.4
CGF2	2531.6	-375.0	1953.4	2531.6	375.0	1953.4
CGR	3424.4	-365.0	1951.0	3424.4	365.0	1951.0

REFERENCE FOR VEHICLE COORDINATE SYSTEM (measured in millimeters):

Right-hand front outboard seat anchorage (x, y, z) = 2042.6, 592.0, 1054.3

Left-hand front outboard seat anchorage (x, y, z) = 2042.6, -592.0, 1054.3

Left-hand front upper striker hole (x, y, z) = 2557.9, -804.0, 1551.7

REMARKS:

Recorded By:  Approved By: 

Date: October 20, 2015

TABLE 2-6

SUMMARY OF TARGETING RESULTS

VEH. MOD YR/MAKE/MODEL/BODY: 2015 Toyota Camry

VEH. NHTSA NO.: C20155105 VIN: 4T4BF1FK4FR489589

COLOR: Midnight Black Metallic VEH. BUILD DATE: March, 2015

TEST DATES: July 21, October 20, 2015

TEST LABORATORY: MGA Research Corp.

OBSERVERS: Helen Kaleto, Sean Fortnam, David Burkett, Ryan Jones, Kurt Reichert

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	2168.1	-526.5	2074.5	--	--	Yes	--	--
REL	2174.9	-553.2	2039.2	252	45	--	2	Yes
AP2	2054.8	-592.4	1986.4	203	50	No	--	No
AP3	1902.7	-626.6	1917.9	203	47	No	--	No
A-Pillar Right Side								
AP1	2168.1	526.2	2075.0	--	--	Yes	--	--
REL	2173.9	553.7	2037.5	109	45	--	2	No
AP2	2058.2	589.2	1986.2	157	50	No	--	Yes
AP3	1903.5	624.4	1916.5	157	47	No	--	No
B-Pillar Left Side								
BP1	2679.3	-477.4	2124.1	270	20	No	--	No
BP2	2655.8	-610.2	1890.4	270	0	No	--	Yes
BP3	2624.2	-595.7	1926.8	270	0	No	--	No
BP4	2707.4	-663.1	1827.5	200	0	No	--	No
B-Pillar Right Side								
BP1	2680.7	479.8	2123.6	90	20	No	--	Yes
BP2	2656.1	610.2	1891.0	90	0	No	--	No
BP3	2623.5	597.1	1925.0	90	0	No	--	No

SUMMARY OF TARGETING RESULTS								
Target	Location (mm)			Horizontal Angle (deg)	Vertical Angle (deg)	Relocation (Yes/No)	Extension (# of 25 mm Spheres)	Impact (Yes/No)
	x	y	z					
BP4	2705.2	662.3	1826.6	160	0	No	--	Yes
Rear Pillar Left Side								
RP1	3440.8	-497.8	2113.0	--	--	Yes	--	--
REL	3437.3	-525.5	2070.1	270	16	--	2	No
RP2	3490.4	-598.9	1964.0	270	28	No	--	No
Rear Pillar Right Side								
RP1	3442.8	497.4	2114.7	--	--	Yes	--	--
REL	3437.9	525.9	2074.9	90	16	--	2	No
RP2	3490.9	598.5	1965.0	90	28	No	--	No
Front Header Left Side								
FH1	2072.2	-416.1	2077.7	180	50	No	--	No
FH2	2045.6	-268.5	2081.7	180	50	No	--	No
Front Header Right Side								
FH1	2074.2	418.9	2077.5	180	50	No	--	Yes
FH2	2047.3	271.3	2082.0	180	50	No	--	No
Side Rail Left Side								
SR1	2318.7	-491.8	2108.7	--	--	Yes	--	--
REL	2328.6	-502.4	2086.3	270	33	--	1	No
SR2A	2469.0	-489.7	2137.5	--	--	Yes	--	--
REL	2469.2	-482.5	2117.0	270	45	--	1	No
SR2B	2378.9	-495.5	2130.4	--	--	Yes	--	--
REL	2382.3	-486.0	2111.4	270	43	--	1	No
SR3-1	3092.7	-498.7	2096.2	270	33	No	--	No
SR3-2	3283.6	-505.2	2076.1	270	33	No	--	No
Side Rail Right Side								
SR1	2317.7	492.3	2110.7	--	--	Yes	--	--
REL	2328.9	500.3	2088.9	90	33	--	1	No
SR2A	2468.7	494.4	2136.6	--	--	Yes	--	--
REL	2467.6	482.4	2119.9	90	45	--	1	No

SUMMARY OF TARGETING RESULTS								
Target	Location (mm)			Horizontal Angle (deg)	Vertical Angle (deg)	Relocation (Yes/No)	Extension (# of 25 mm Spheres)	Impact (Yes/No)
	x	y	z					
SR2B	2380.4	497.0	2129.6	--	--	Yes	--	--
REL	2382.9	485.7	2111.7	90	43	--	1	No
SR3-1	3093.4	499.6	2095.0	90	33	No	--	No
SR3-2	3284.0	506.4	2075.6	90	33	No	--	No
Rear Header Left Side								
RH	3428.0	-365.4	2145.6	0	50	No	--	Yes
Rear Header Right Side								
RH	3429.5	365.0	2144.9	0	50	No	--	No
Upper Roof Left Side								
UR1@x=2256	2255.5	-91.3	2131.6	180	50	No	--	No
UR2@SR1	2310.8	-386.4	2130.4	270	50	No	--	Yes
UR3@SR2A	2509.7	-353.7	2170.0	270	50	No	--	No
UR4@BP	2682.2	-394.1	2151.3	270	50	No	--	Yes
UR5@SR3-1	3094.8	-352.5	2176.6	270	50	No	--	Yes
UR6@SR3-2	3283.1	-338.0	2167.9	270	50	No	--	No
Upper Roof Right Side								
UR7@x=2256	2255.6	91.3	2131.5	180	50	No	--	No
UR8@SR1	2312.9	386.3	2130.8	90	50	No	--	No
UR9@SR2A	2509.6	355.9	2169.9	90	50	No	--	Yes
UR10@BP	2682.4	394.1	2151.8	90	50	No	--	No
UR11@SR3-1	3094.9	351.4	2177.0	90	50	No	--	No
UR12@SR3-2	3282.2	338.2	2168.5	90	50	No	--	Yes

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

Recorded By:  Approved By: 

Date: October 20, 2015

3.0 TEST DATA (Including Acceleration and Velocity Plots)

Test U15143 Data



FMVSS 201U

Test No.: U15143
Customer: NHTSA

Report No.: G15I7-001.6
Date: 07/21/15

Summary of the Test

Setup Information

Sample Description: 2015 Toyota Camry

Test Sequence No.: 1

Time: 9:31am

Horizontal Approach Angle: 252 deg

Temperature: 21.6 °C

Vertical Approach Angle: 45 deg

Humidity: 43.2 %RH

Impact Form ID No.: 35

Impact Form Mass: 4.51 kg

Target Location: Left AP1

Additional Description:

Test Results

Impact Velocity: 18.93 km/h

HIC Type	HIC Value	Time 1 (ms)	Time 2 (ms)	Delta-T (ms)
HIC 36	643.47	86.8	89.8	3
HIC 15	643.47	86.8	89.8	3
HIC (d)	651.87	86.8	89.8	3

3 ms Clip = 83.13 G , Time 1 = 86.78 ms , Time 2 = 89.78 ms

Impact Location on FMH: 26 mm Above Pt. 0 , 1 Right mm Lateral of Pt. 0

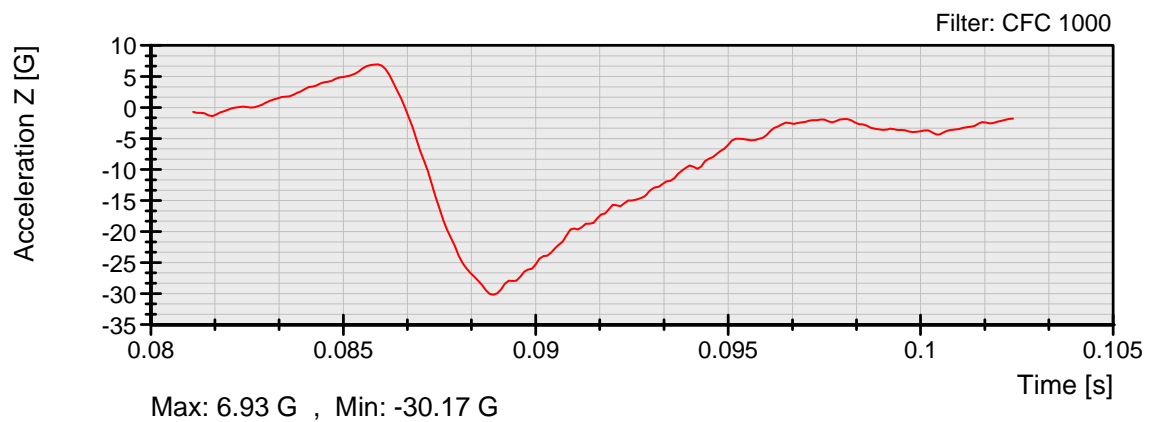
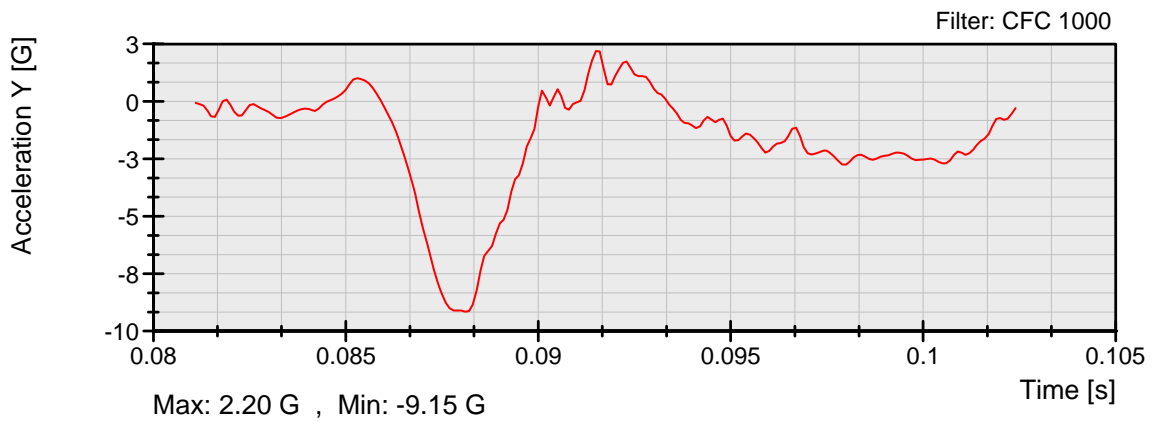
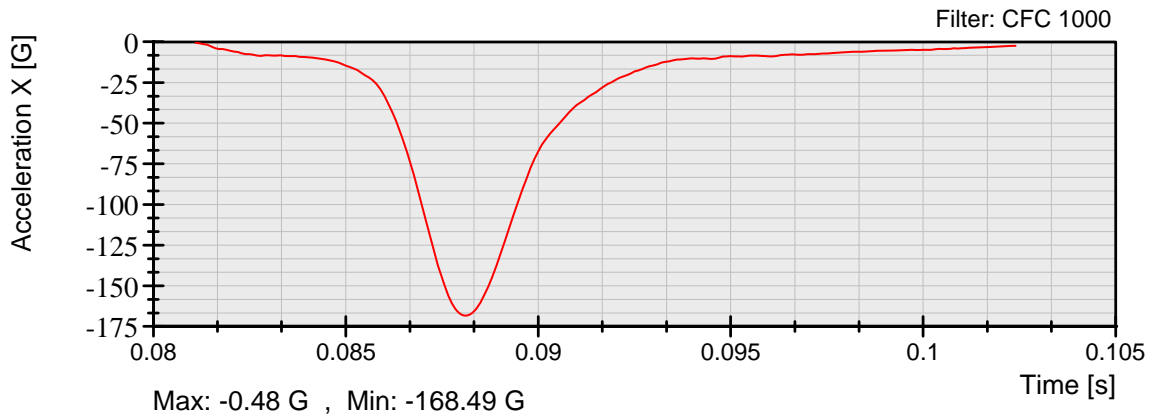
Post-Test Comments: No visible damage.

Test Series Performed By: DB, KR



FMVSS 201U
Test No.: U15143
Customer: NHTSA

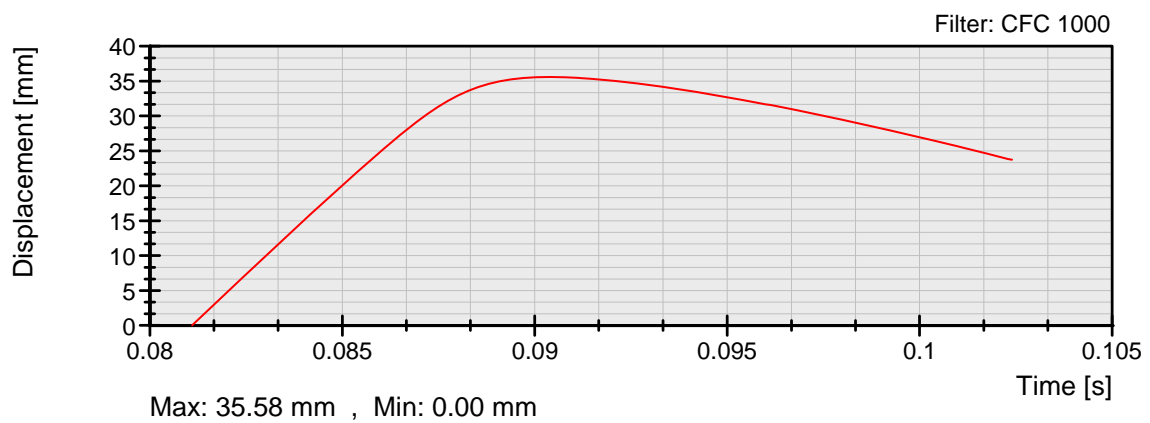
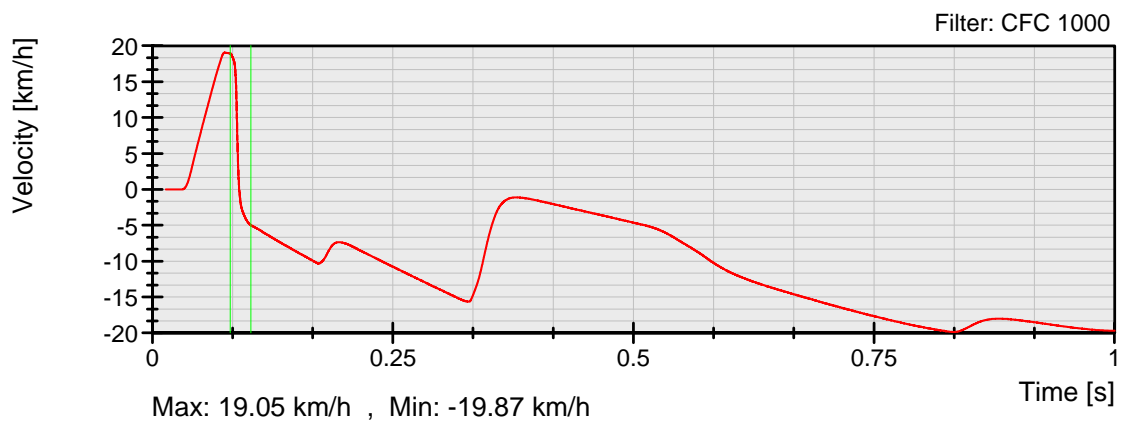
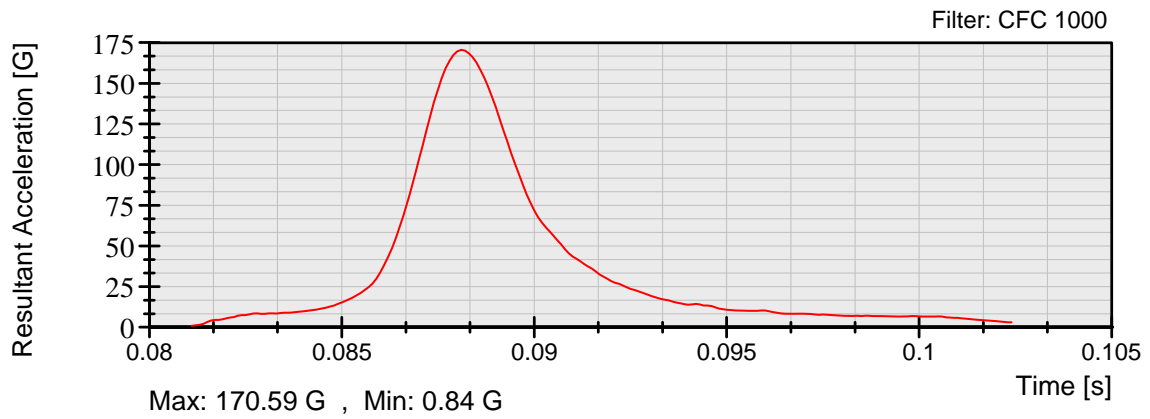
Report No.: G15I7-001.6
Date: 07/21/15

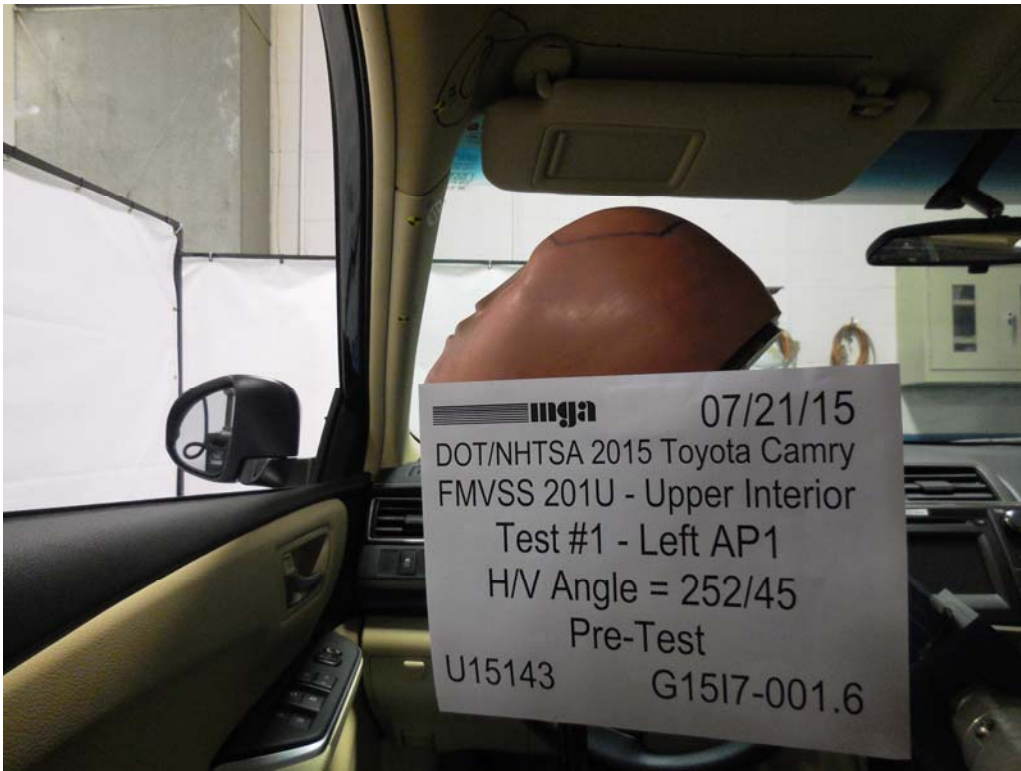


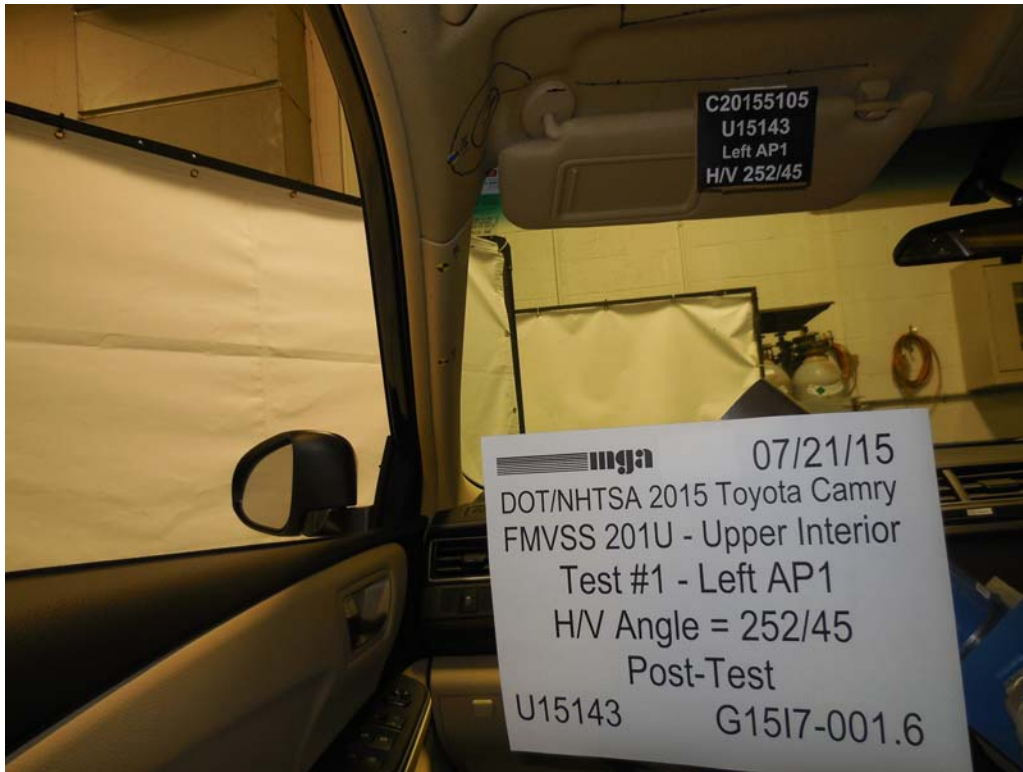


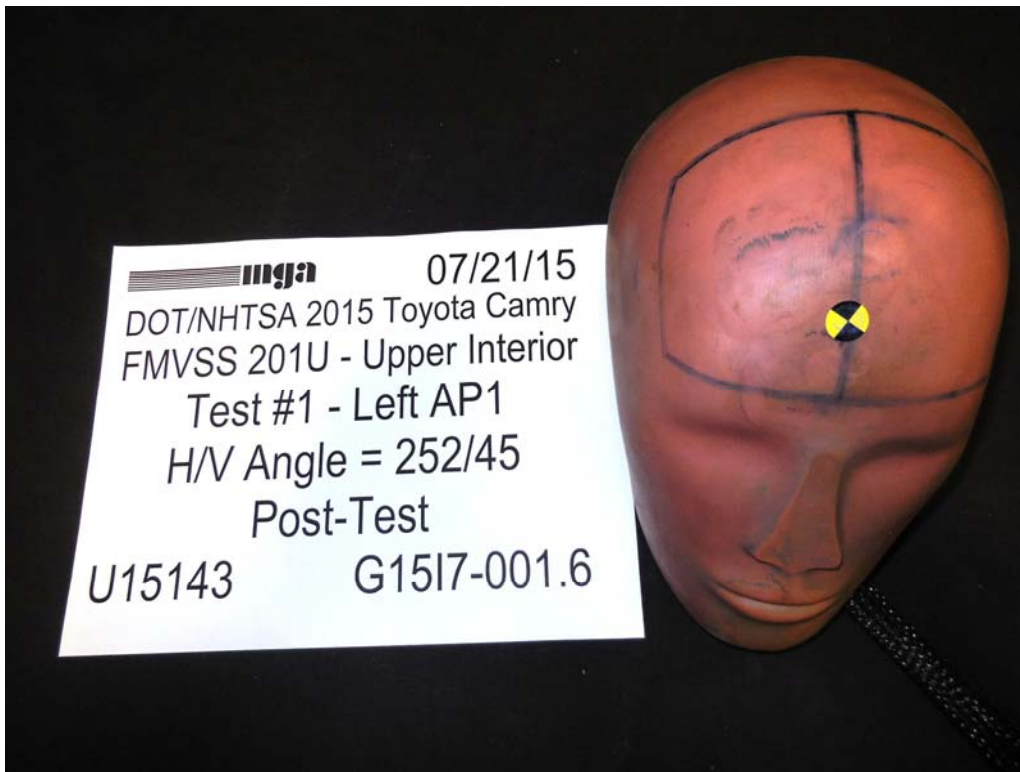
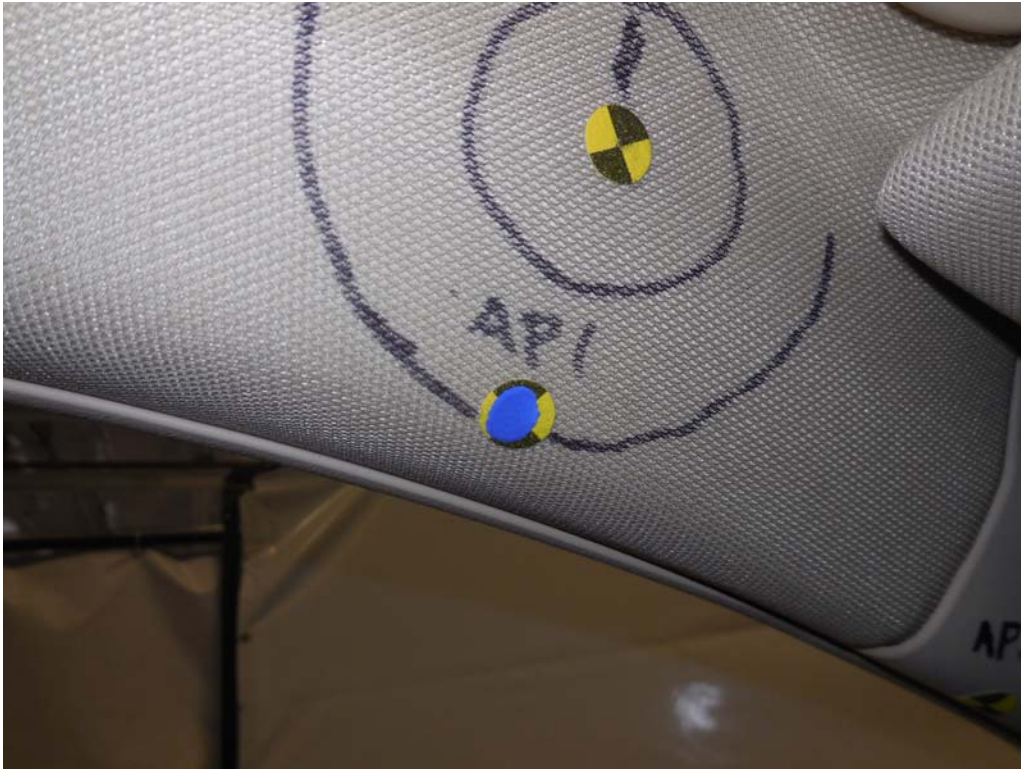
FMVSS 201U
Test No.: U15143
Customer: NHTSA

Report No.: G15I7-001.6
Date: 07/21/15





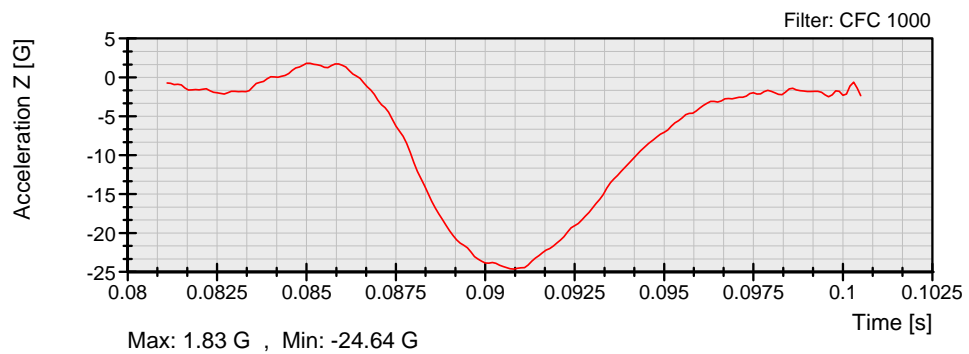
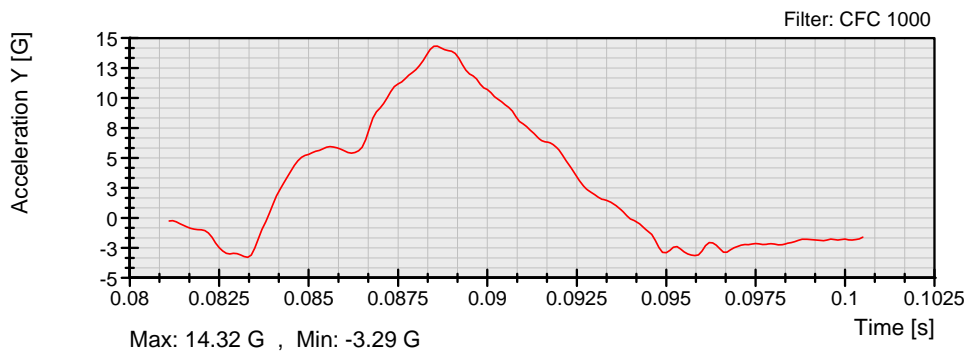
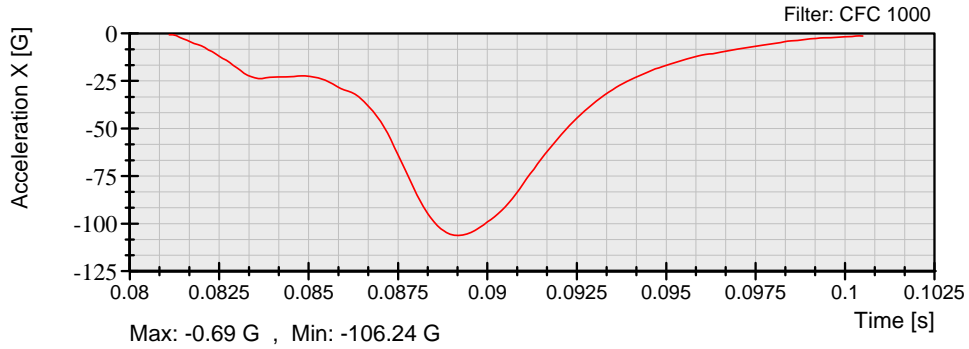






FMVSS 201U
Test No.: U15249
Customer: NHTSA

Report No.: G1517-001.6
Date: 10/20/2015



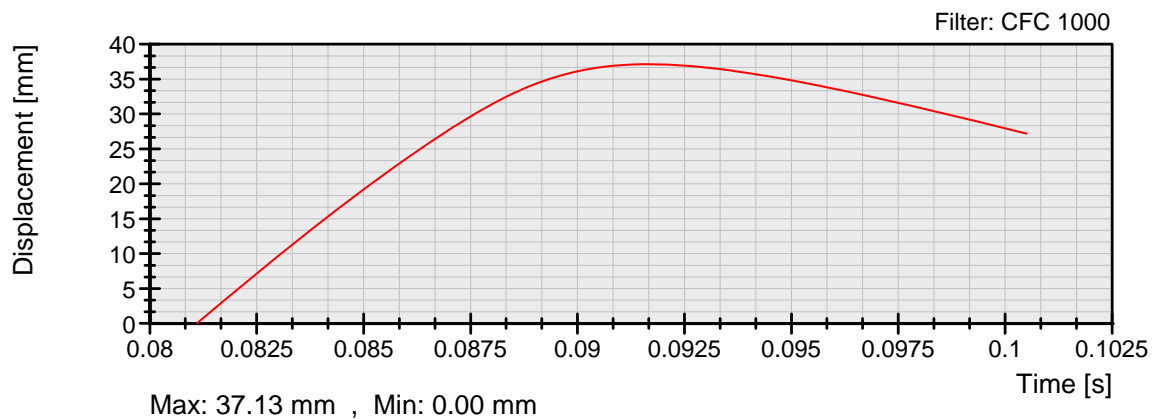
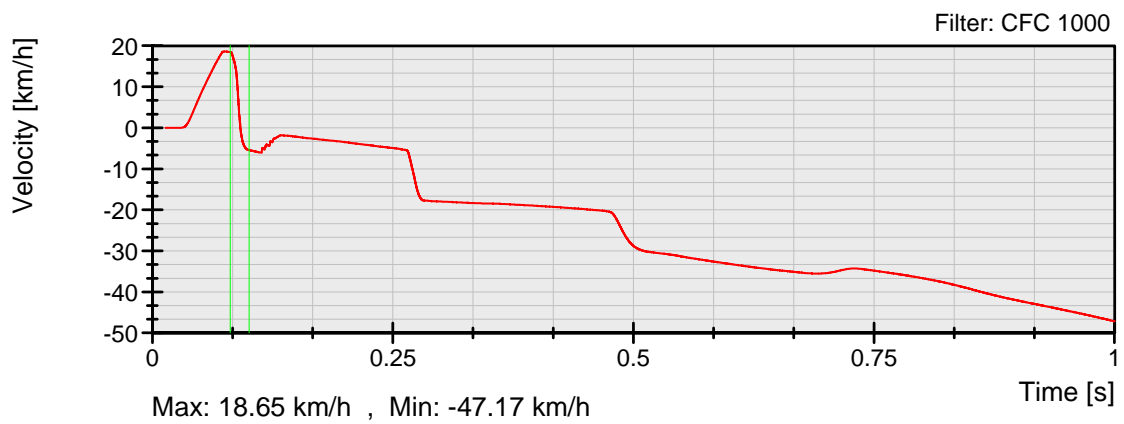
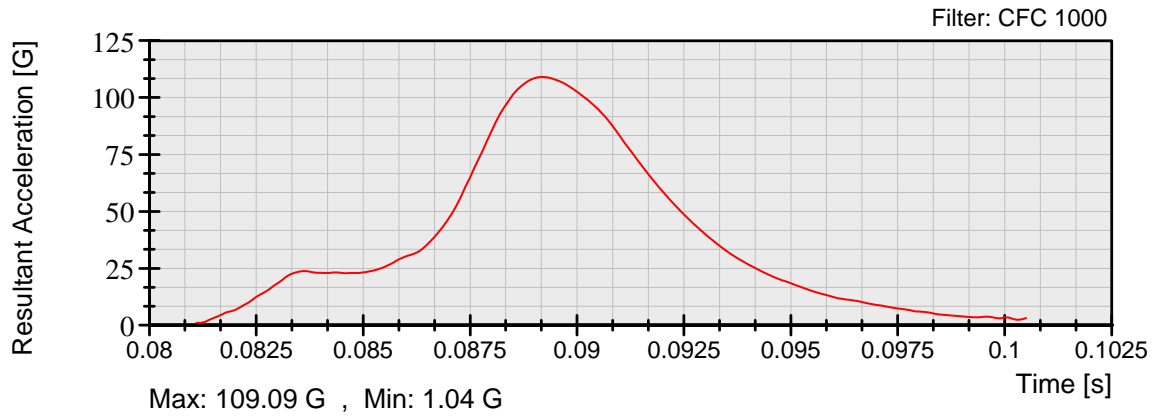
Recorded By: *Dan B...* Approved By: *Alexander Kalato*

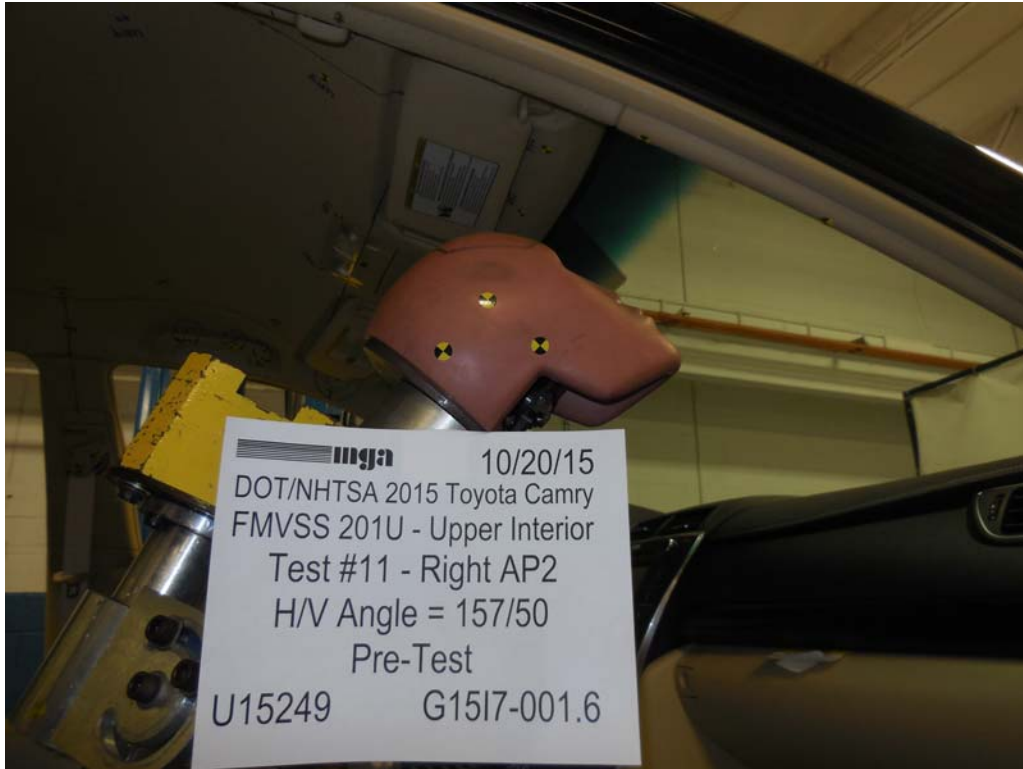
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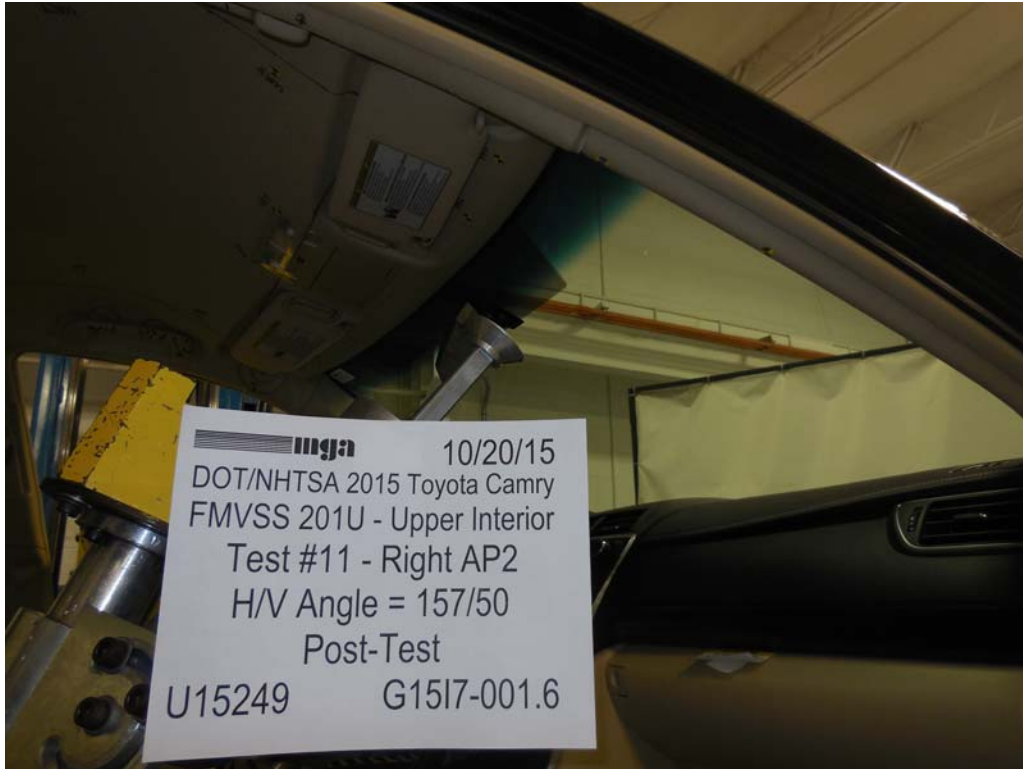


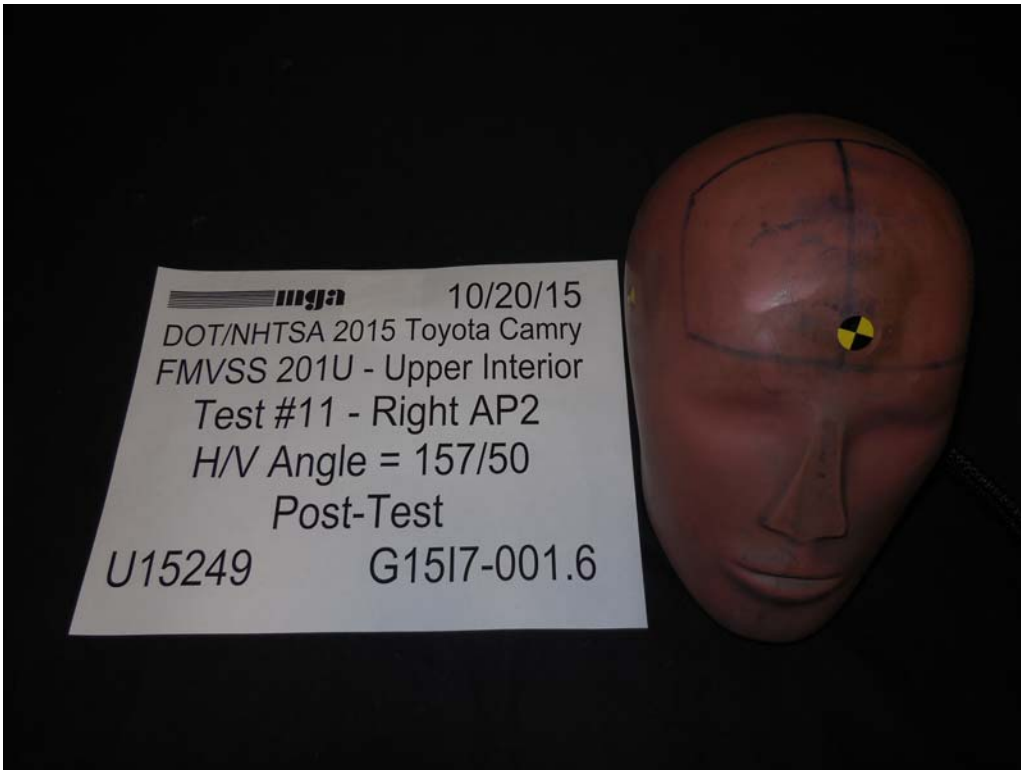
FMVSS 201U
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Customer: NHTSA

Report No.: G15I7-001.6
Date: 10/20/2015





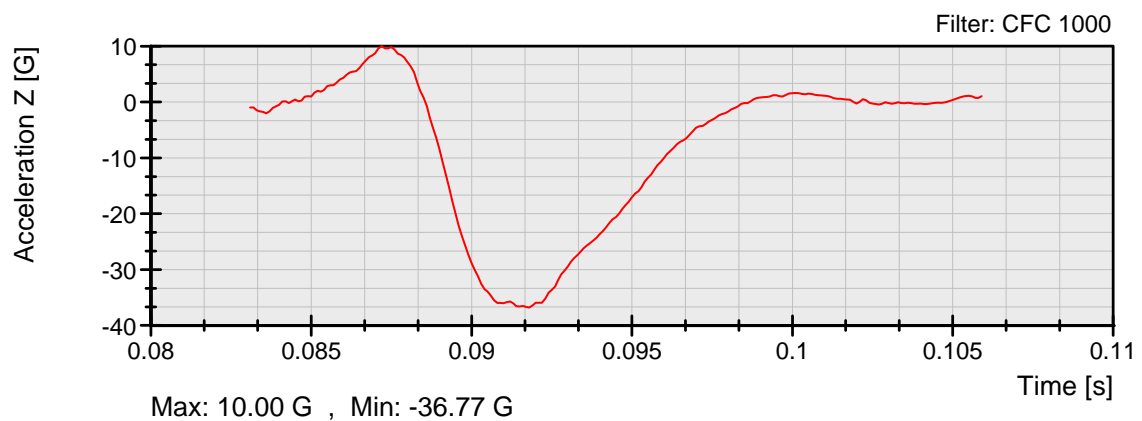
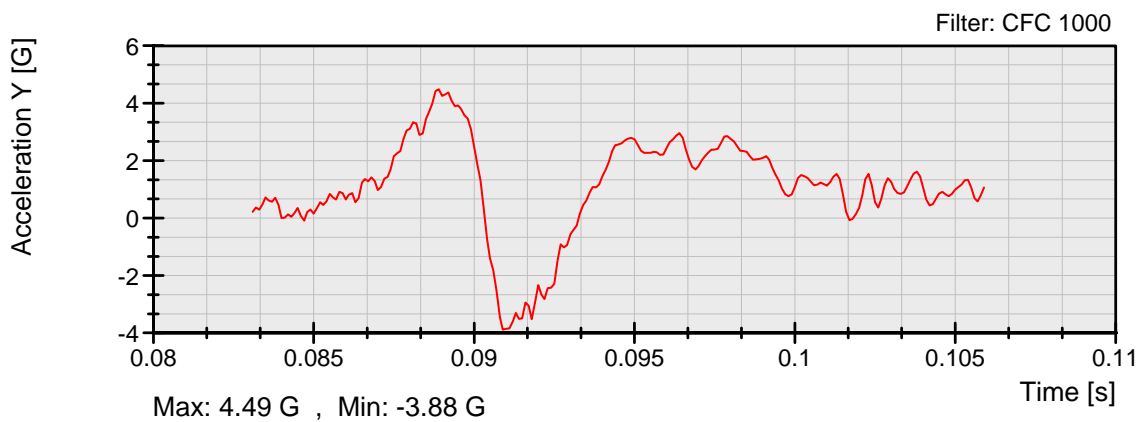
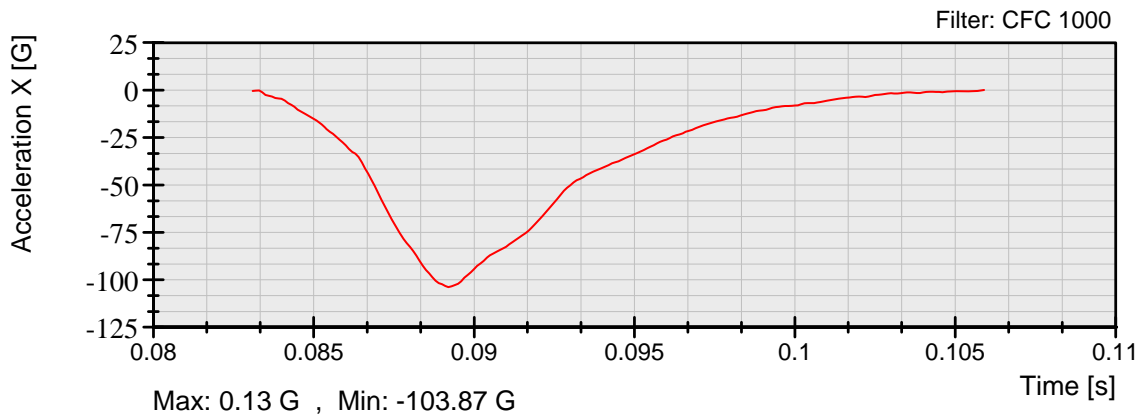






FMVSS 201U
Test No.: U15247
Customer: NHTSA

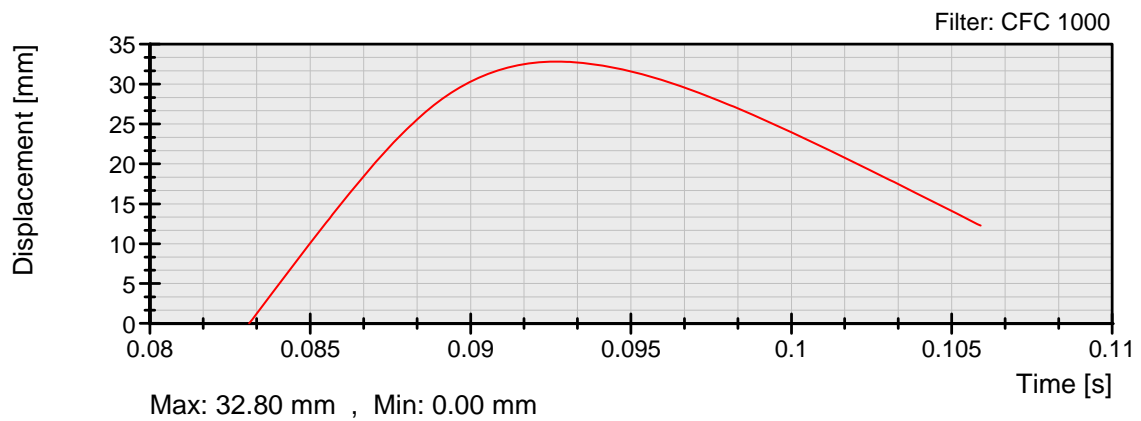
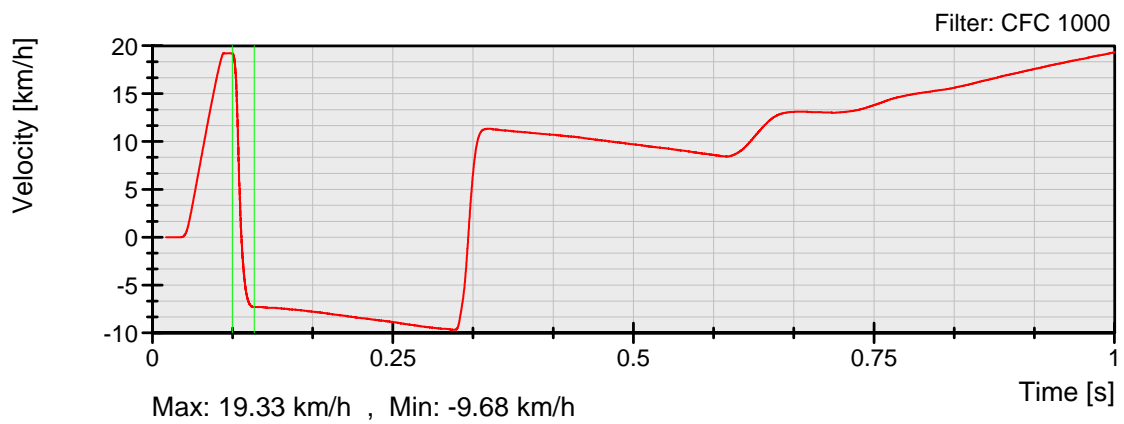
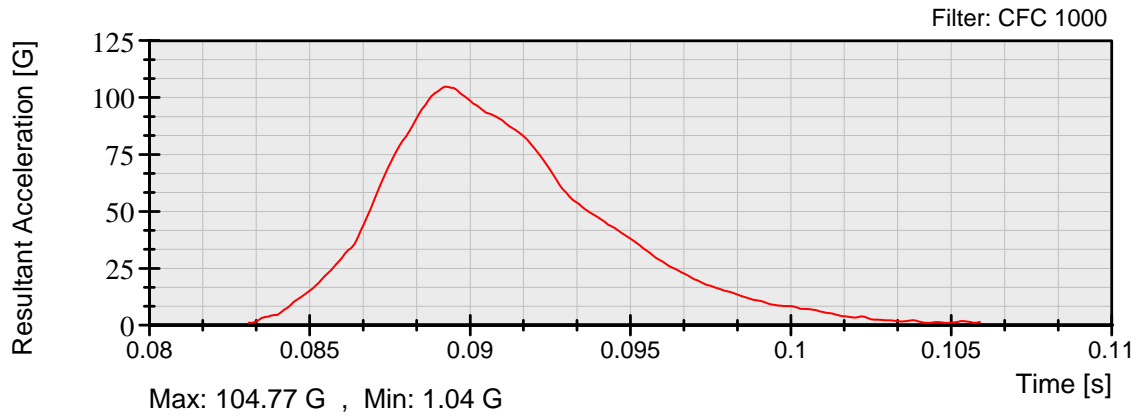
Report No.: G15I7-001.6
Date: 10/20/2015

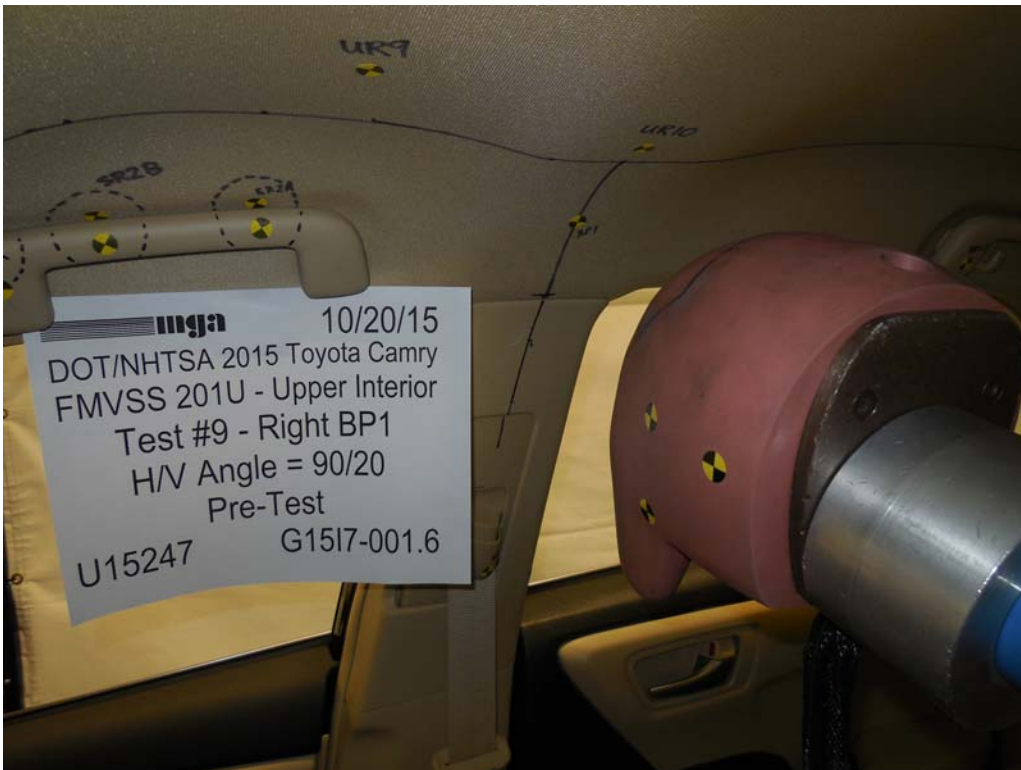
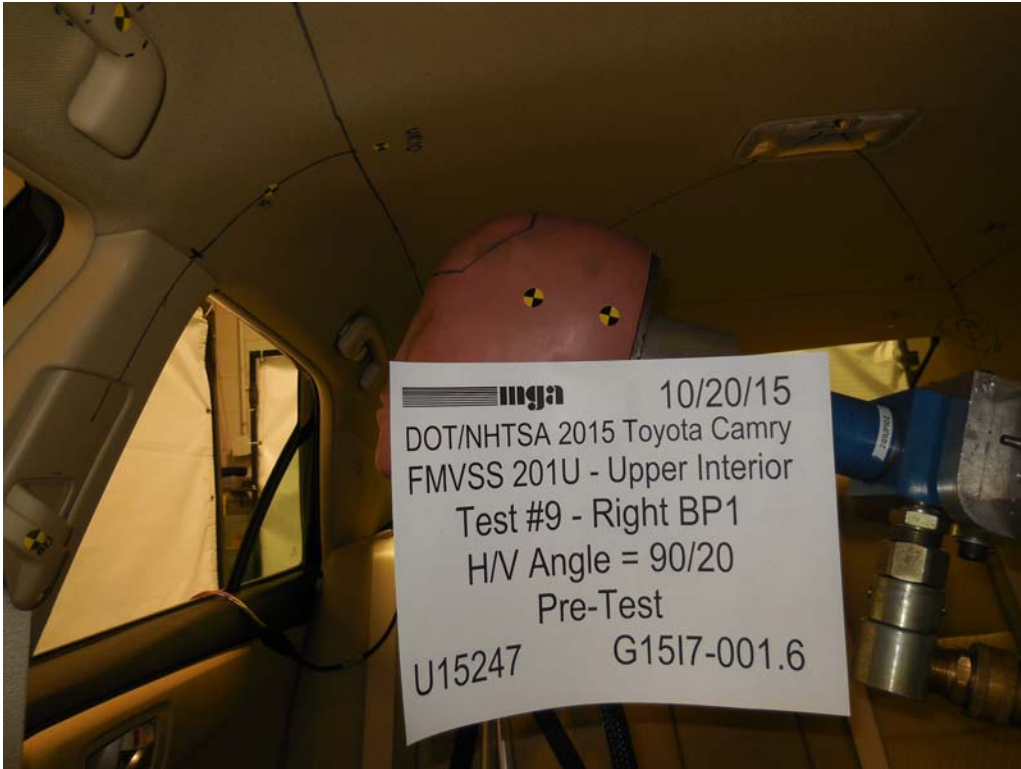


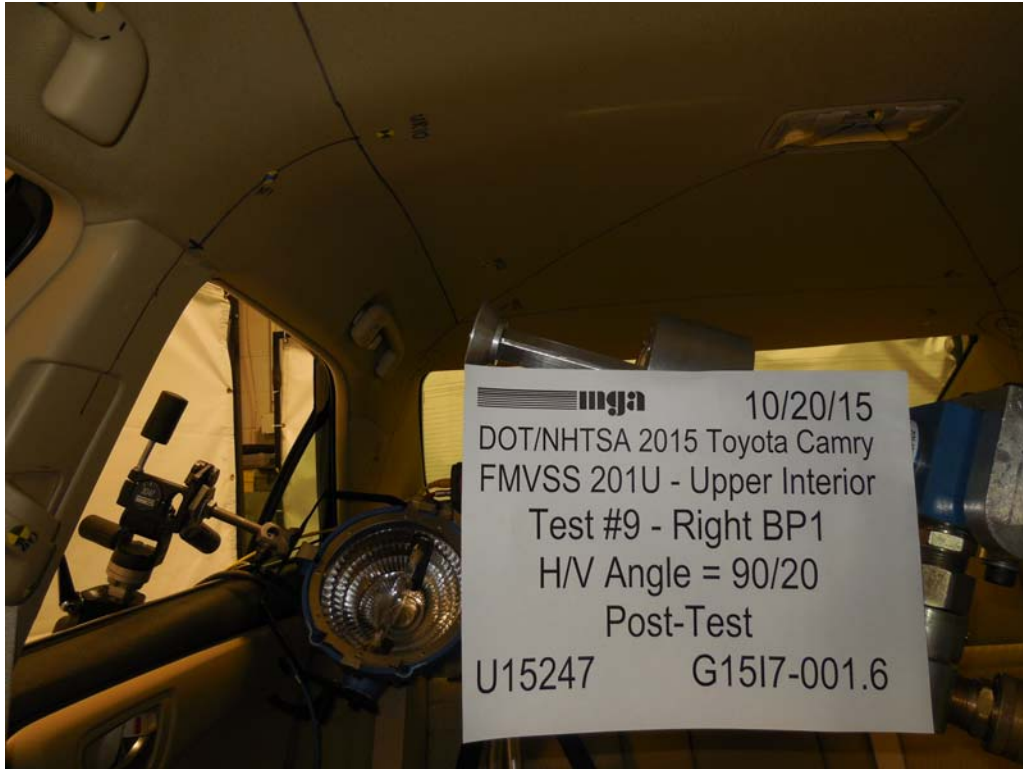


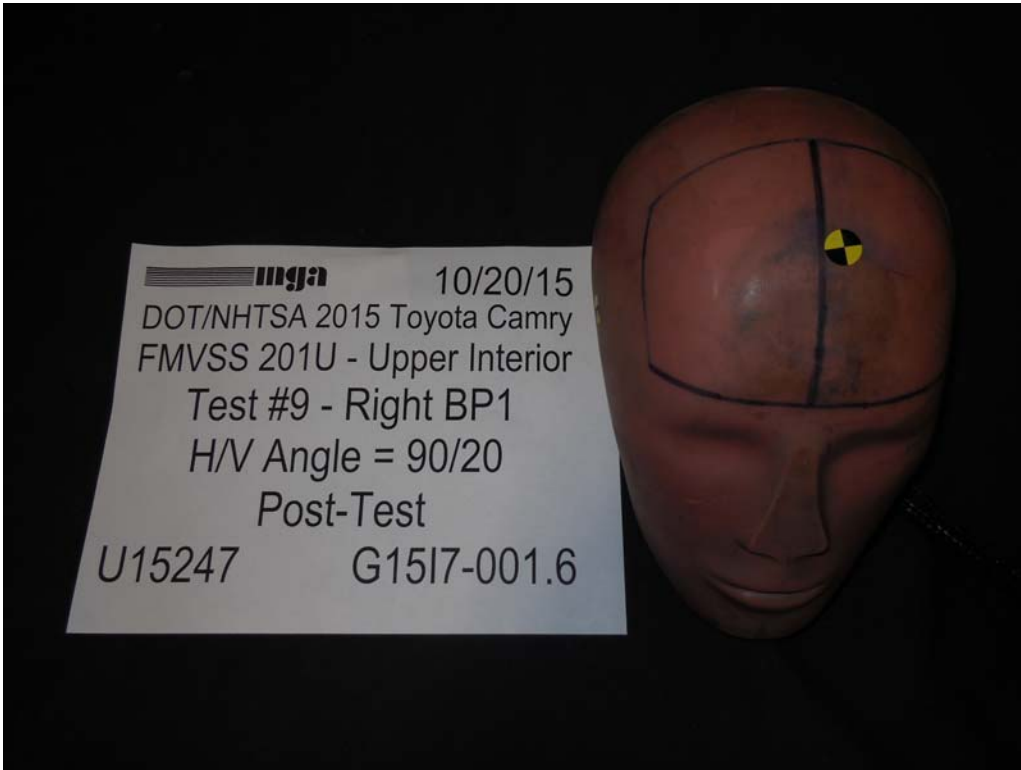
FMVSS 201U
Test No.: U15247
Customer: NHTSA

Report No.: G15I7-001.6
Date: 10/20/2015












Test U15146 Data

	<p>FMVSS 201U Test No.: U15146 Report No.: G15I7-001.6 Customer: NHTSA Date: 07/21/15</p>																				
<p>Summary of the Test</p> <p>Setup Information</p> <p>Sample Description: 2015 Toyota Camry</p> <p>Test Sequence No.: 4 Time: 1:14pm</p> <p>Horizontal Approach Angle: 270 deg Temperature: 21.5 °C</p> <p>Vertical Approach Angle: 0 deg Humidity: 41.2 %RH</p> <p>Impact Form ID No.: 35 Impact Form Mass: 4.51 kg</p> <p>Target Location: Left BP2</p> <p>Additional Description:</p> <p>Test Results</p> <p>Impact Velocity: 24.01 km/h</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <thead> <tr> <th>HIC Type</th> <th>HIC Value</th> <th>Time 1 (ms)</th> <th>Time 2 (ms)</th> <th>Delta-T (ms)</th> </tr> </thead> <tbody> <tr> <td>HIC 36</td> <td>368.06</td> <td>74.1</td> <td>90.7</td> <td>16.6</td> </tr> <tr> <td>HIC 15</td> <td>358.88</td> <td>74.4</td> <td>89.4</td> <td>15</td> </tr> <tr> <td>HIC (d)</td> <td>444.09</td> <td>74.1</td> <td>90.7</td> <td>16.6</td> </tr> </tbody> </table> <p>3 ms Clip = 76.49 G , Time 1 = 76.53 ms , Time 2 = 79.63 ms</p> <p>Impact Location on FMH: 30 mm Above Pt. 0 , 0 mm Lateral of Pt. 0</p> <p>Post-Test Comments: Seat belt adjuster damaged.</p> <p>Test Series Performed By: DB, KR</p>		HIC Type	HIC Value	Time 1 (ms)	Time 2 (ms)	Delta-T (ms)	HIC 36	368.06	74.1	90.7	16.6	HIC 15	358.88	74.4	89.4	15	HIC (d)	444.09	74.1	90.7	16.6
HIC Type	HIC Value	Time 1 (ms)	Time 2 (ms)	Delta-T (ms)																	
HIC 36	368.06	74.1	90.7	16.6																	
HIC 15	358.88	74.4	89.4	15																	
HIC (d)	444.09	74.1	90.7	16.6																	
<p>Page 1 of 3</p>																					

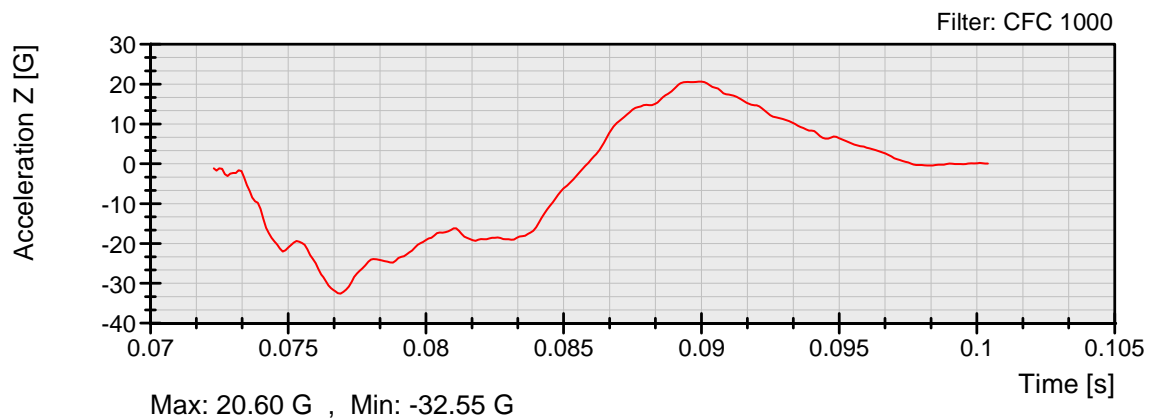
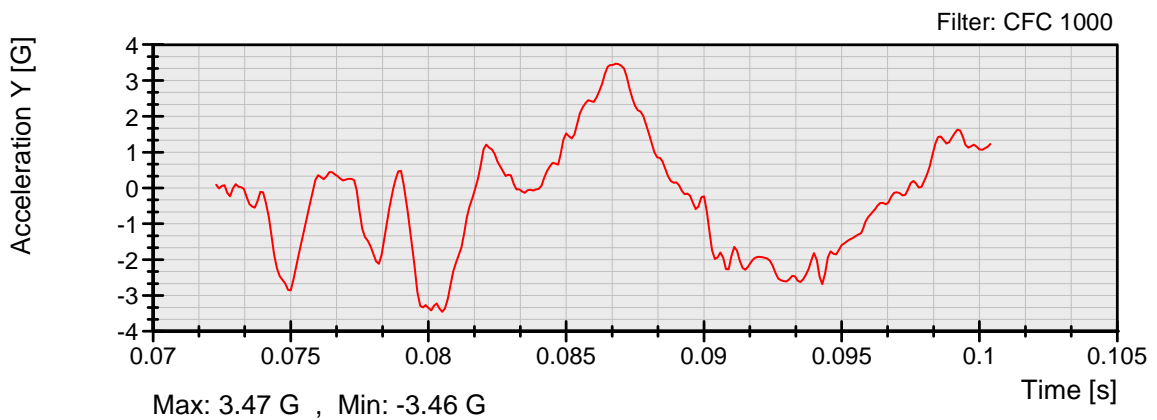
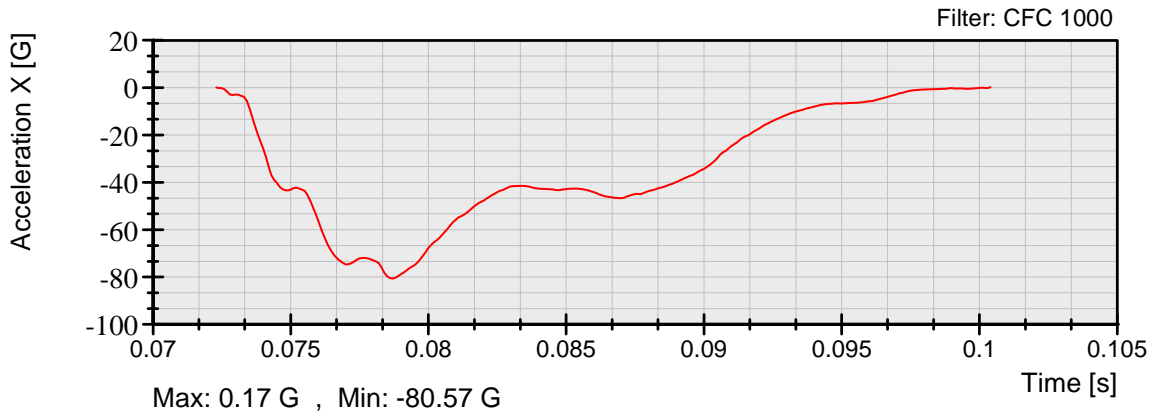
Recorded By:  Approved By: 

Date: July 21, 2015



FMVSS 201U
Test No.: U15146
Customer: NHTSA

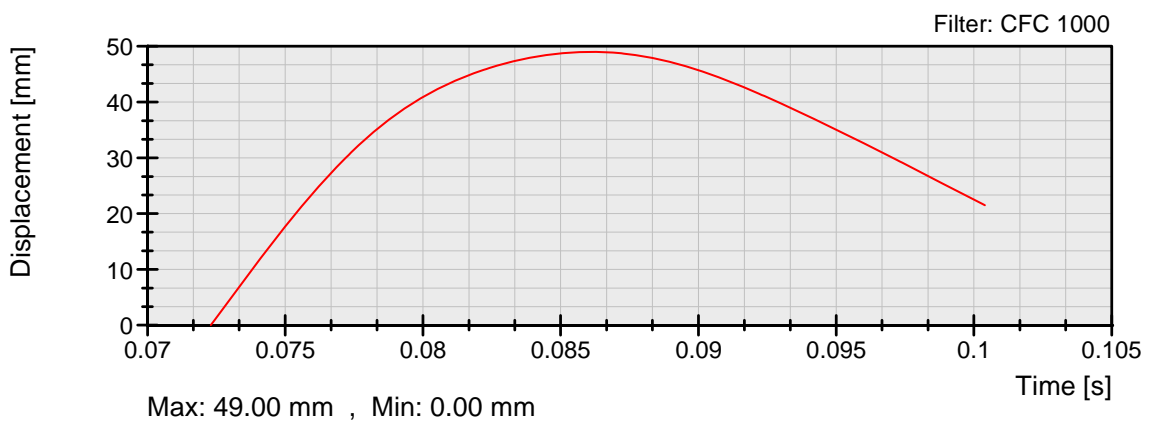
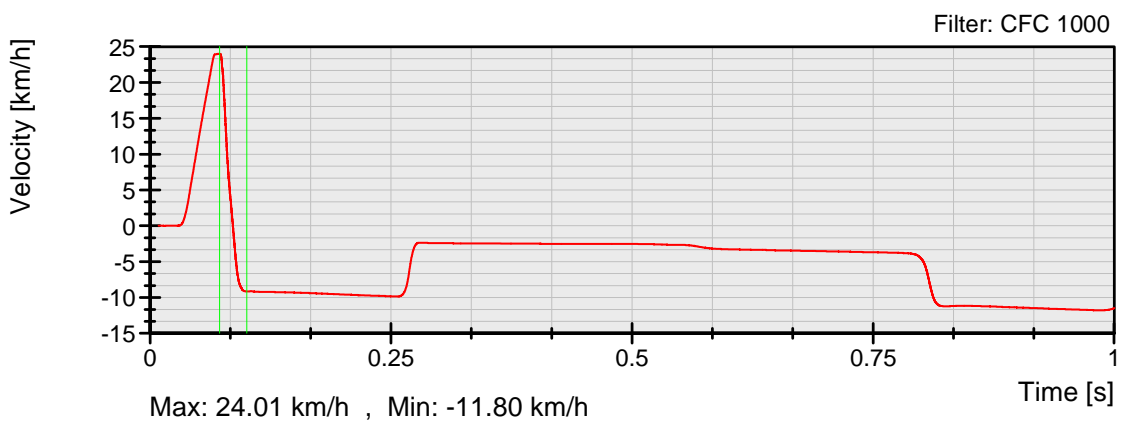
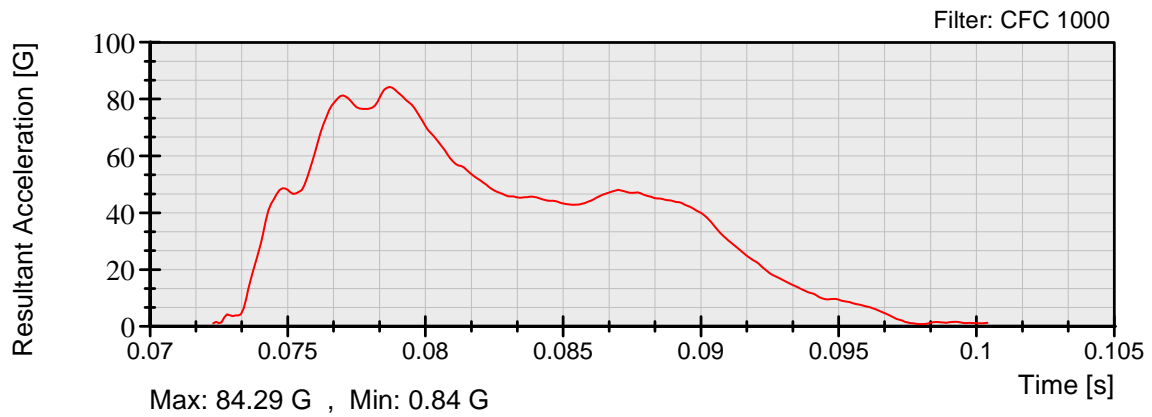
Report No.: G15I7-001.6
Date: 07/21/15



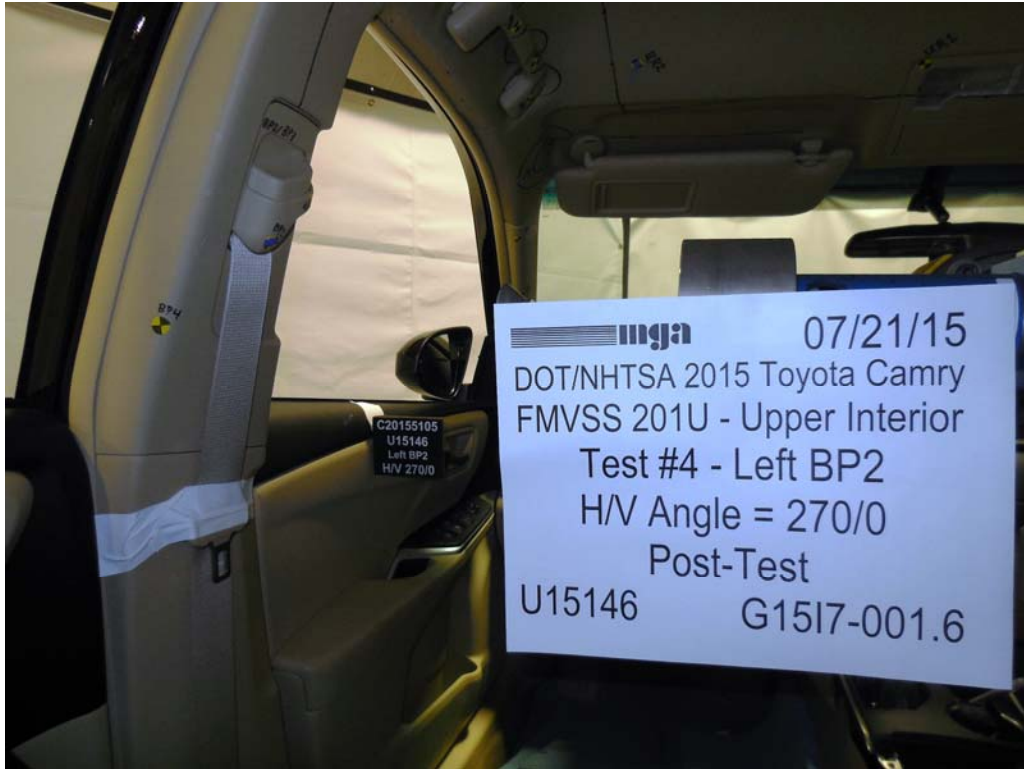


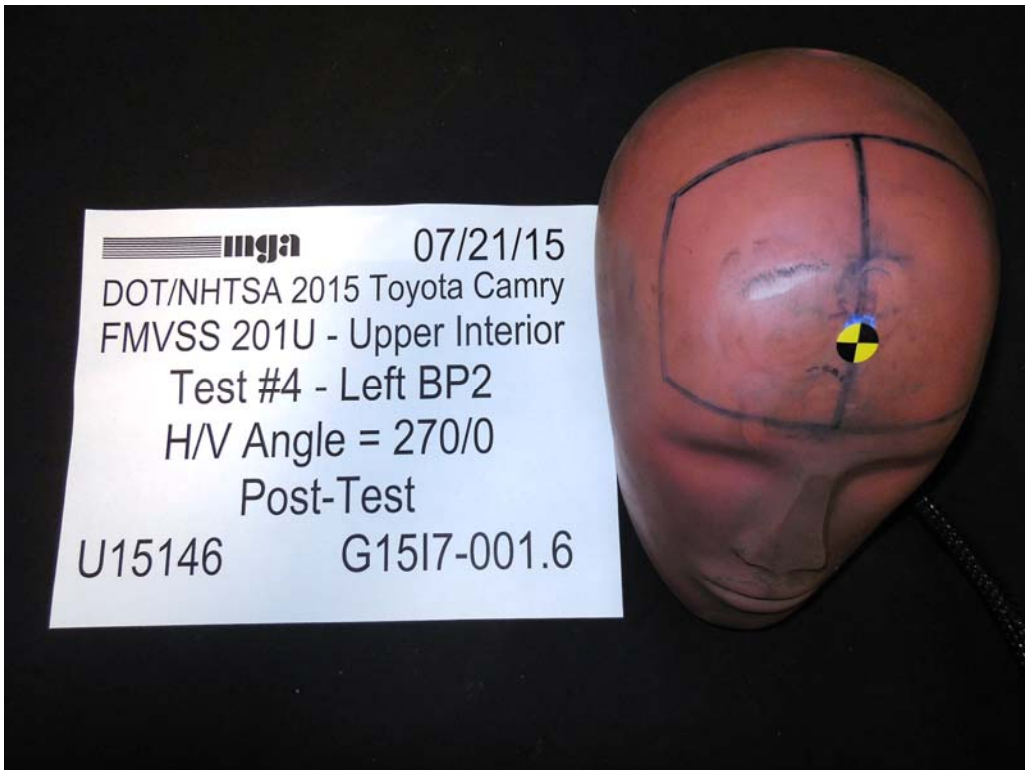
FMVSS 201U
Test No.: U15146
Customer: NHTSA

Report No.: G15I7-001.6
Date: 07/21/15





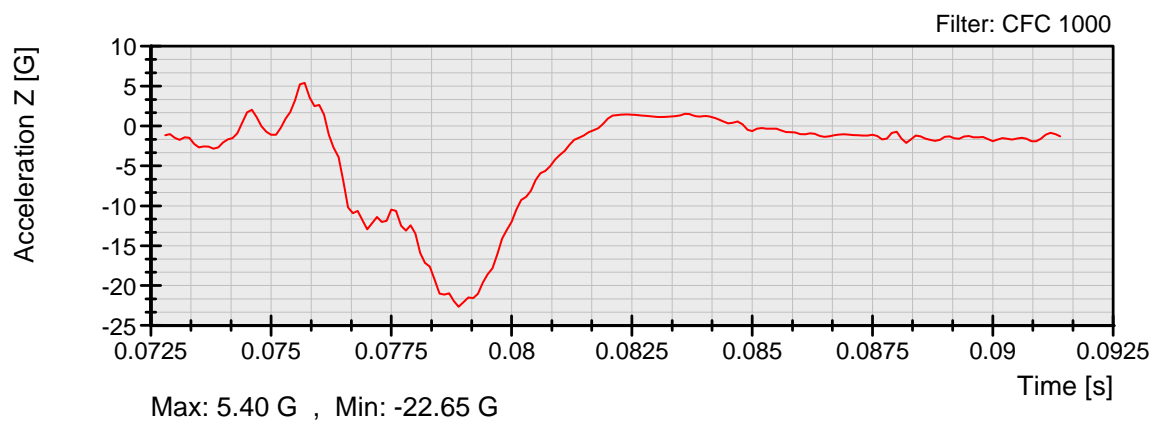
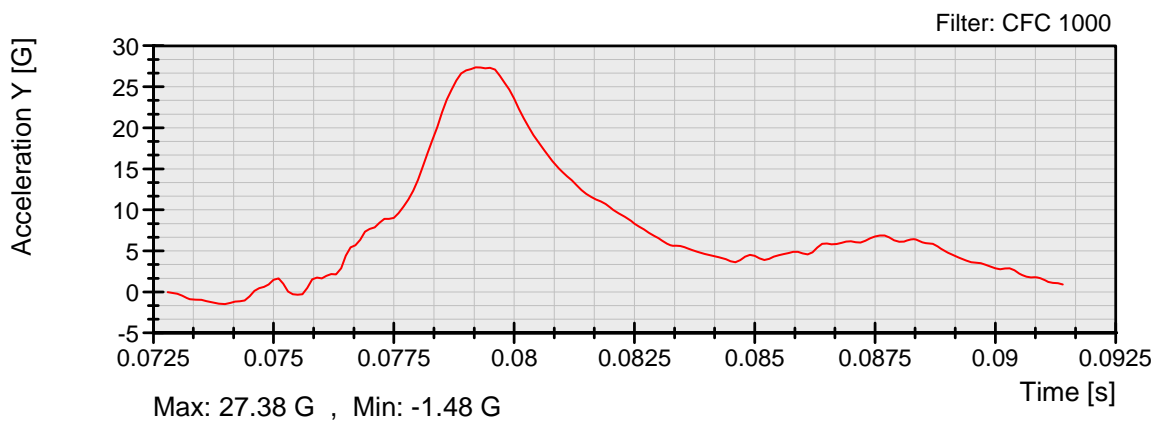
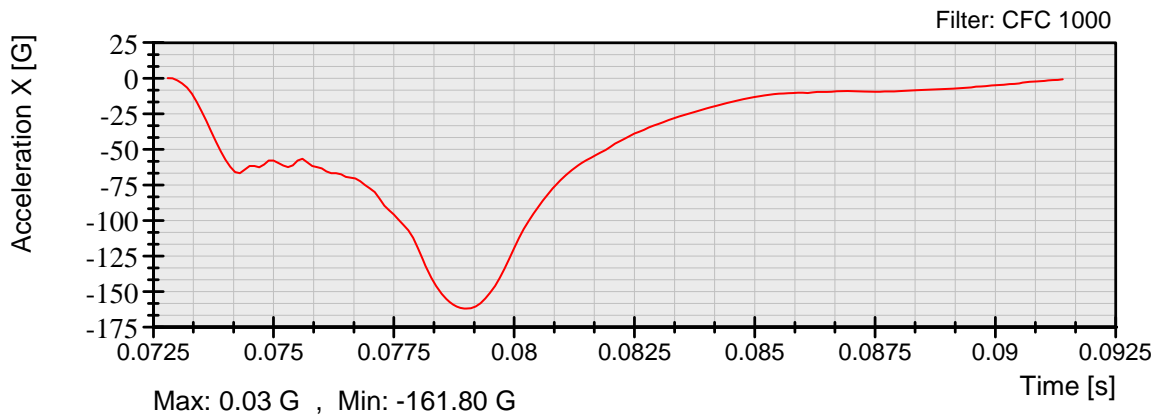






FMVSS 201U
Test No.: U15246
Customer: NHTSA

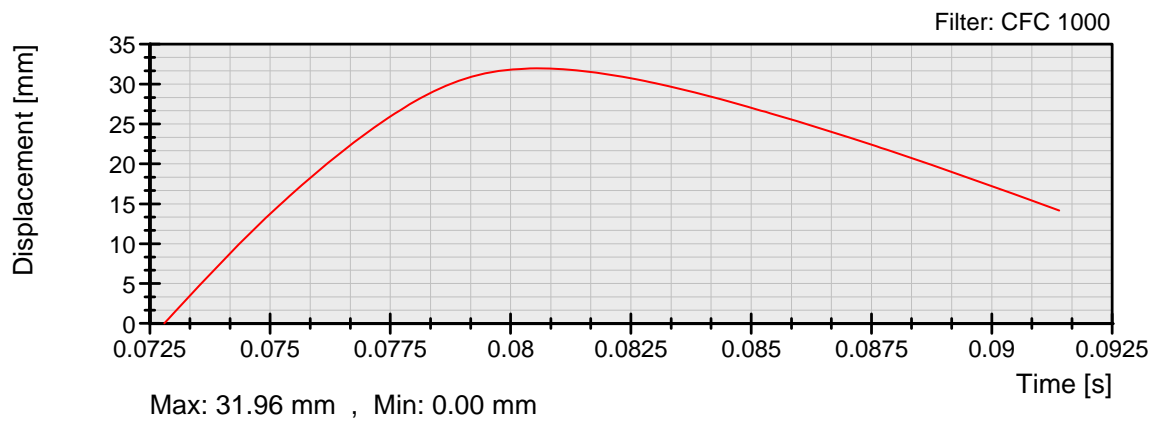
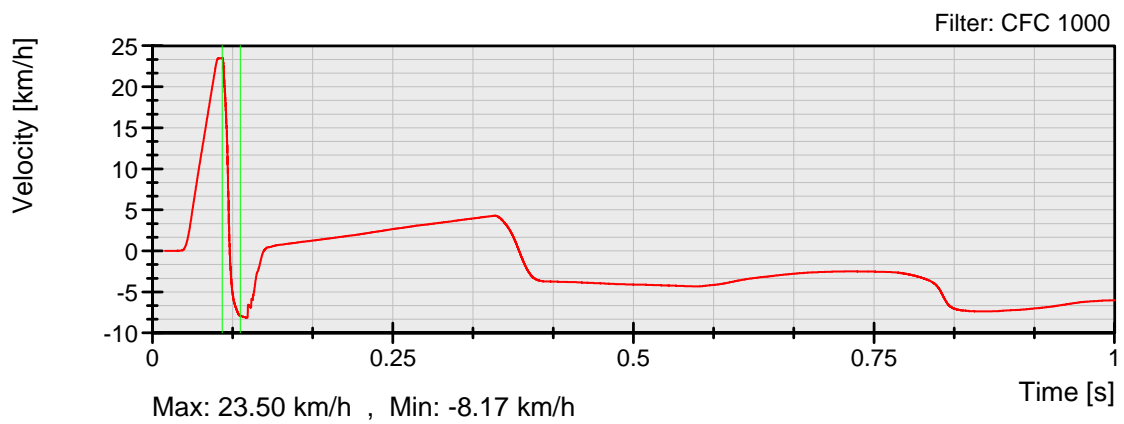
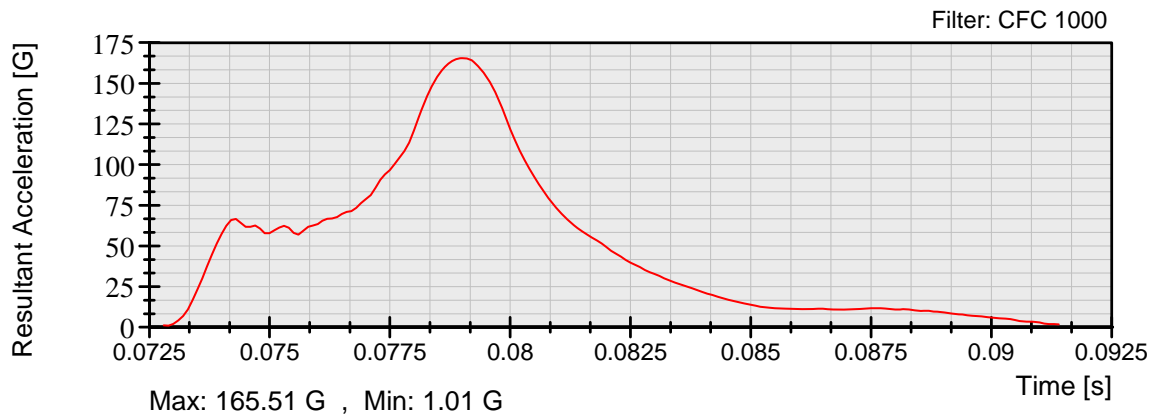
Report No.: G15I7-001.6
Date: 10/20/2015

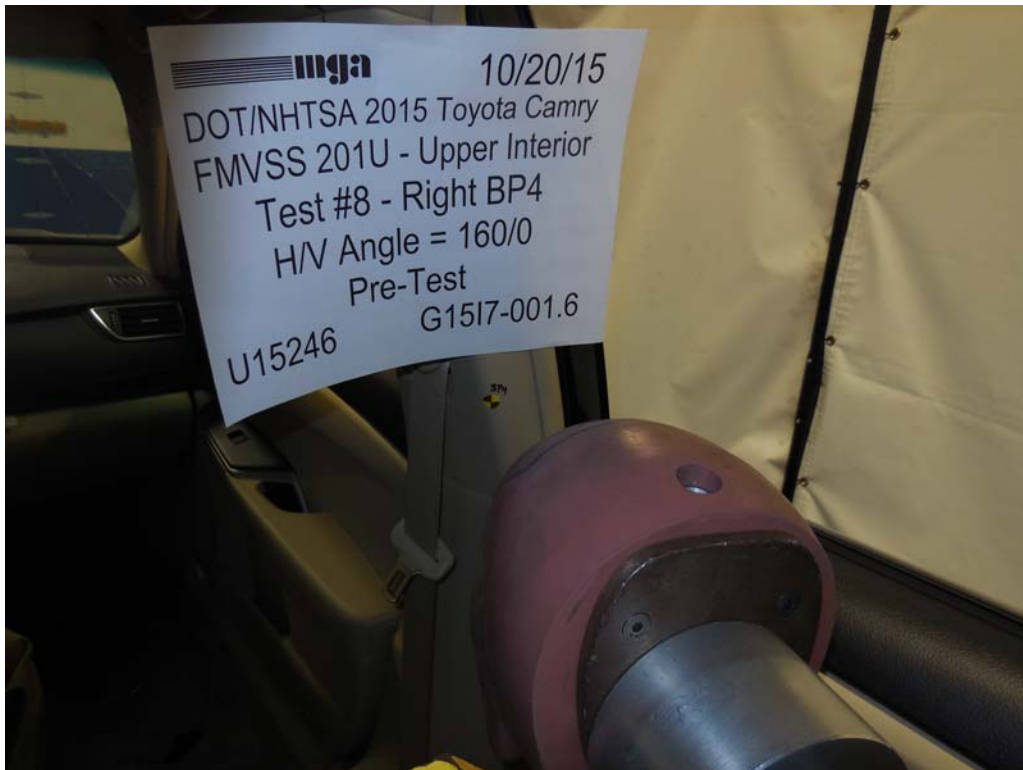
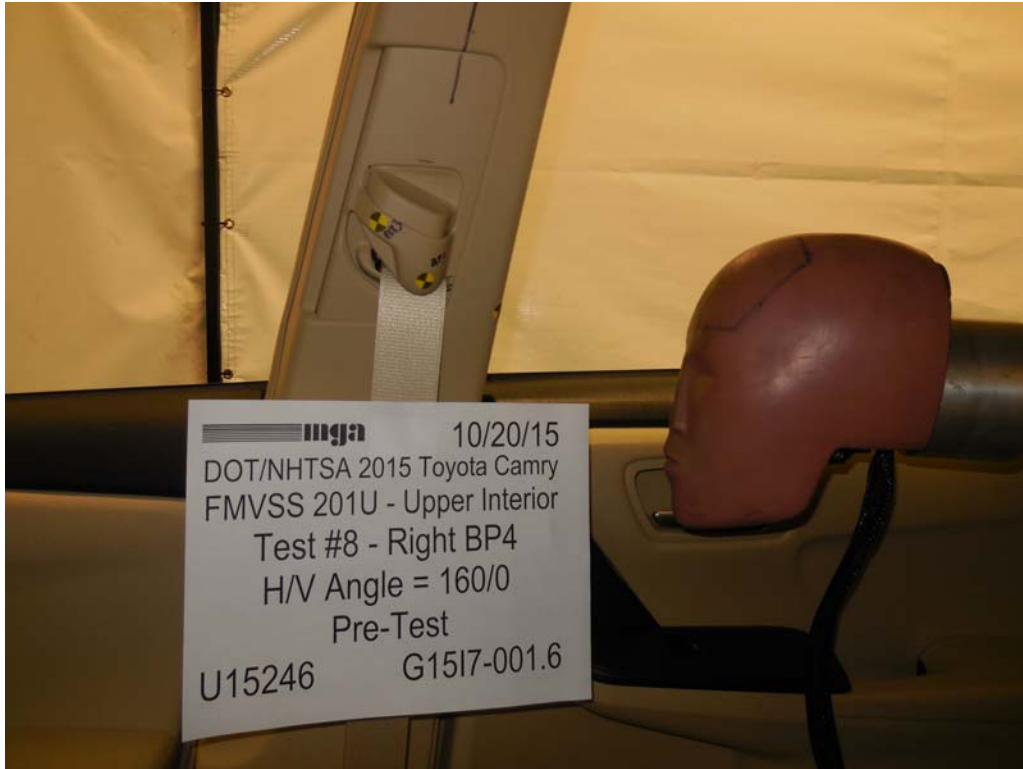


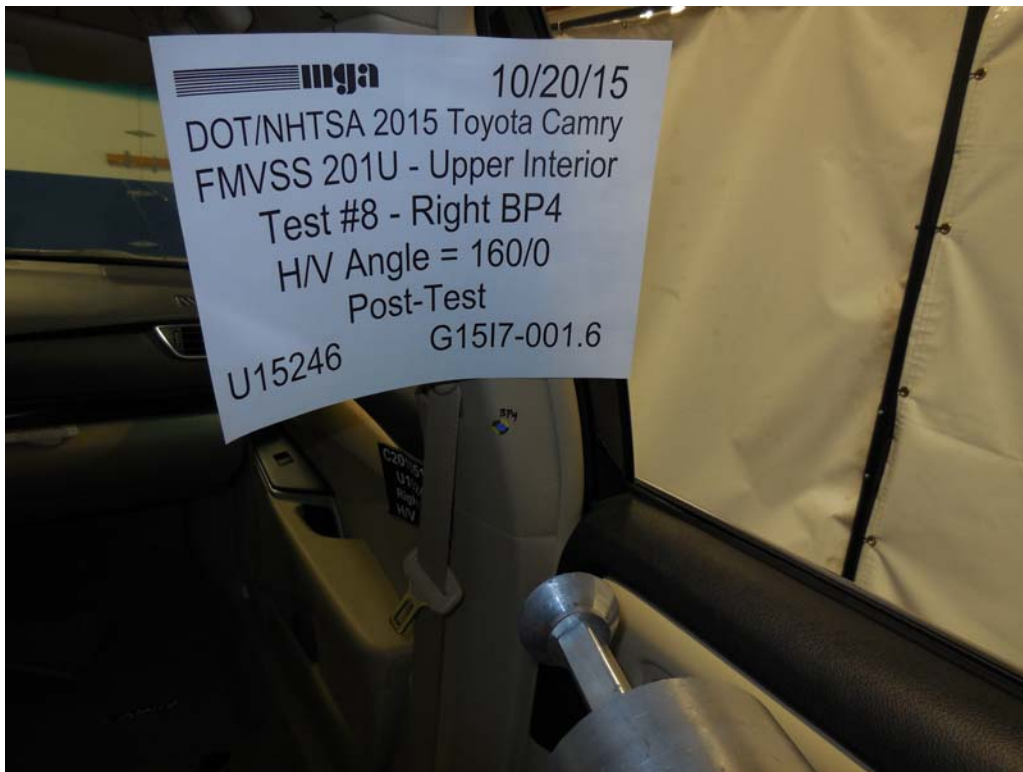


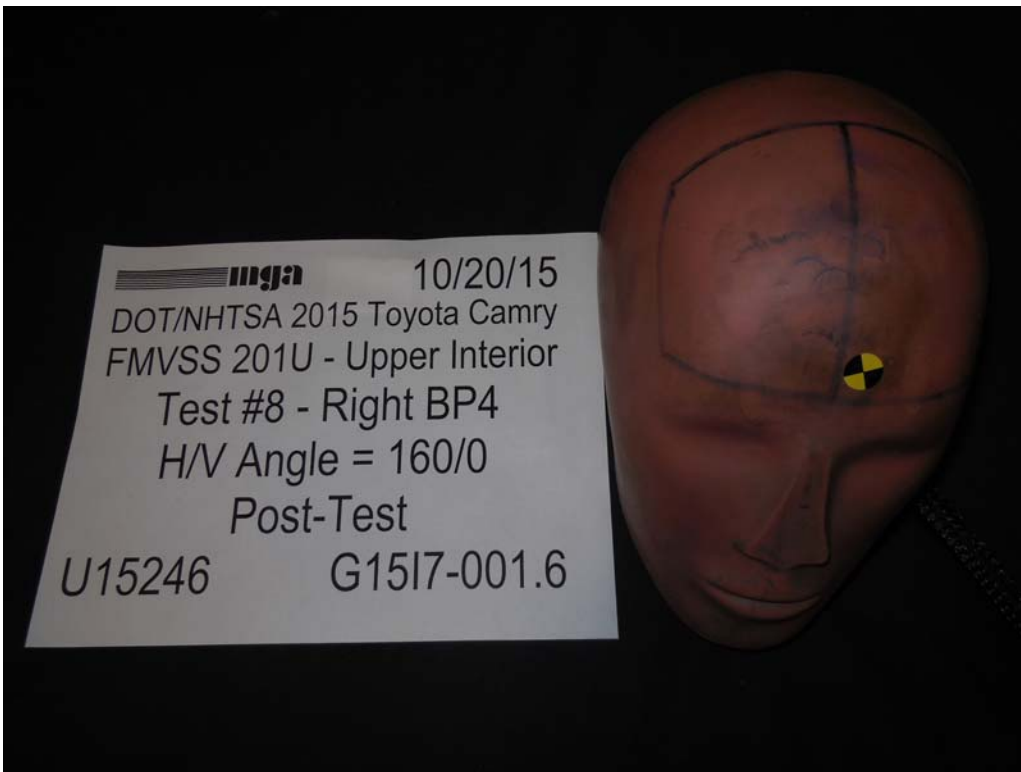
FMVSS 201U
Test No.: U15246
Customer: NHTSA

Report No.: G15I7-001.6
Date: 10/20/2015










Test U15250 Data

	FMVSS 201U	Report No.: G15I7-001.6
	Test No.: U15250 Customer: NHTSA	Date: 10/20/2015

Summary of the Test

Setup Information

Sample Description: 2015 Toyota Camry

Test Sequence No.: 12

Time: 3:21pm

Horizontal Approach Angle: 180 deg

Temperature: 22.3 °C

Vertical Approach Angle: 50 deg

Humidity: 32.4 %RH

Impact Form ID No.: 37

Impact Form Mass: 4.54 kg

Target Location: Right FH1

Additional Description:

Test Results

Impact Velocity: 23.67 km/h



HIC Type	HIC Value	Time 1 (ms)	Time 2 (ms)	Delta-T (ms)
HIC 36	771.18	76	79.5	3.5
HIC 15	771.18	76	79.5	3.5
HIC (d)	748.23	76	79.5	3.5

3 ms Clip = 94.12 G , Time 1 = 76.11 ms , Time 2 = 79.11 ms

Impact Location on FMH: 19 mm Above Pt. 0 , 8 Right mm Lateral of Pt. 0

Post-Test Comments: No visible damage.

Test Series Performed By: DB, KR

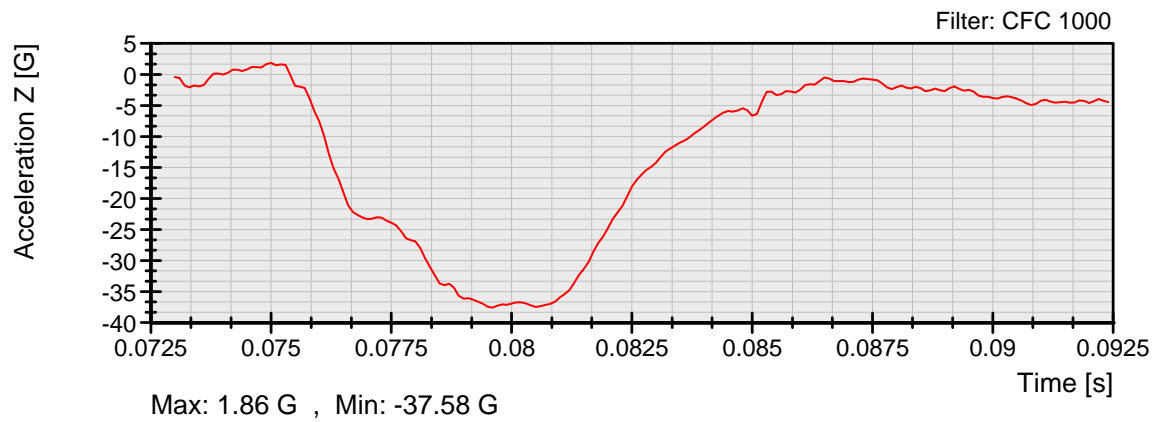
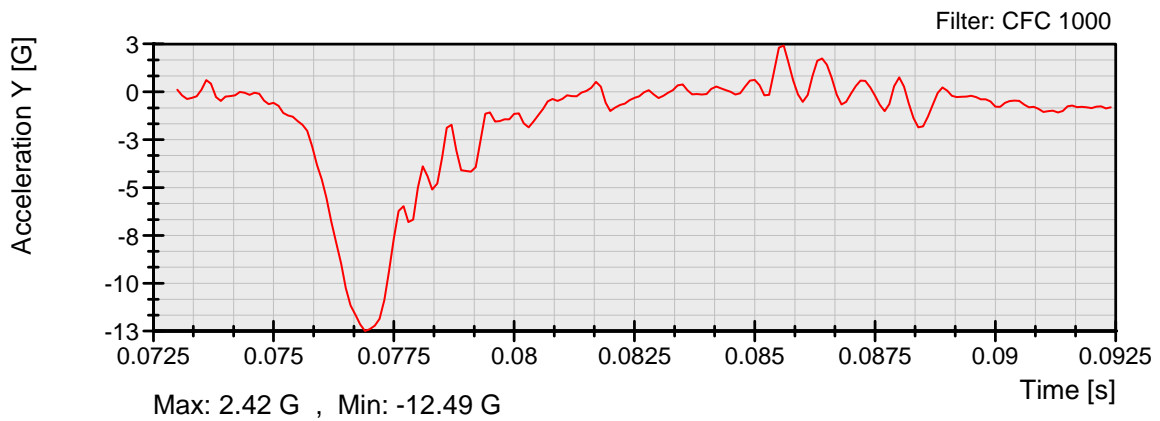
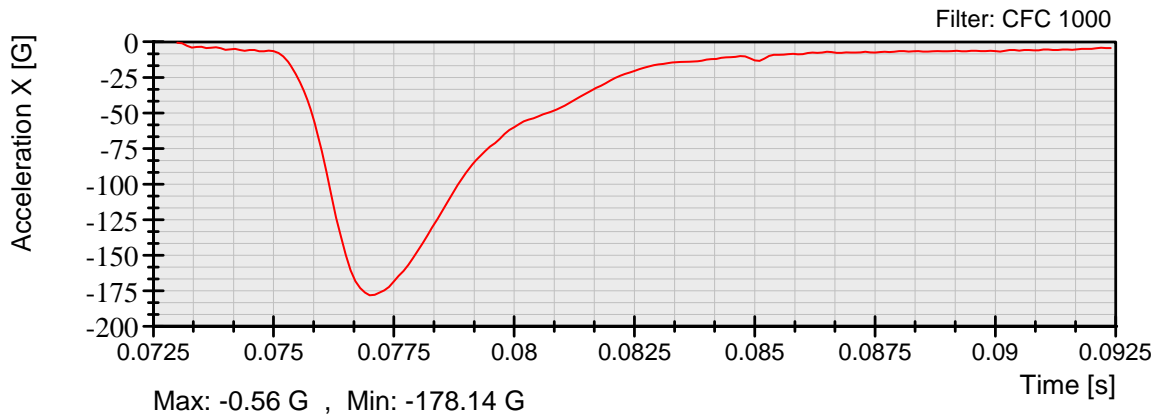
Recorded By:  Approved By: 

Date: October 20, 2015



FMVSS 201U
Test No.: U15250
Customer: NHTSA

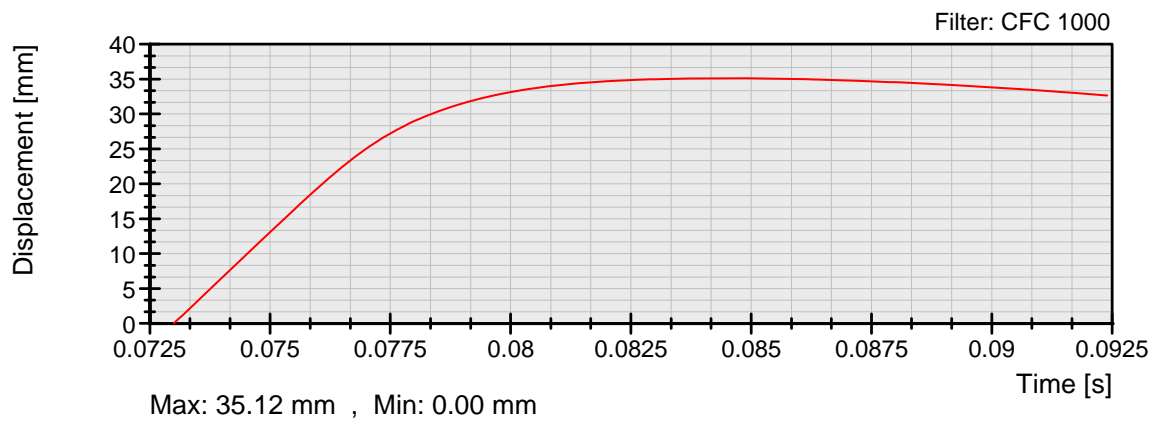
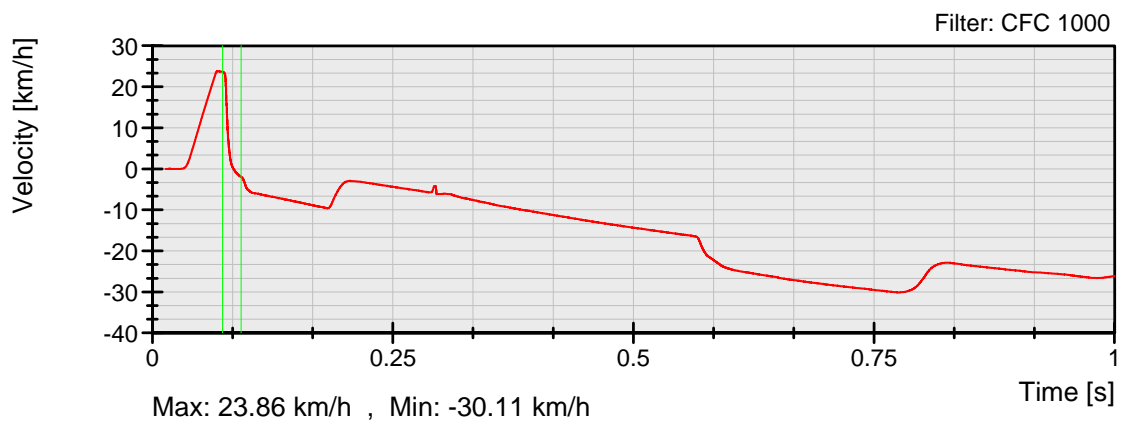
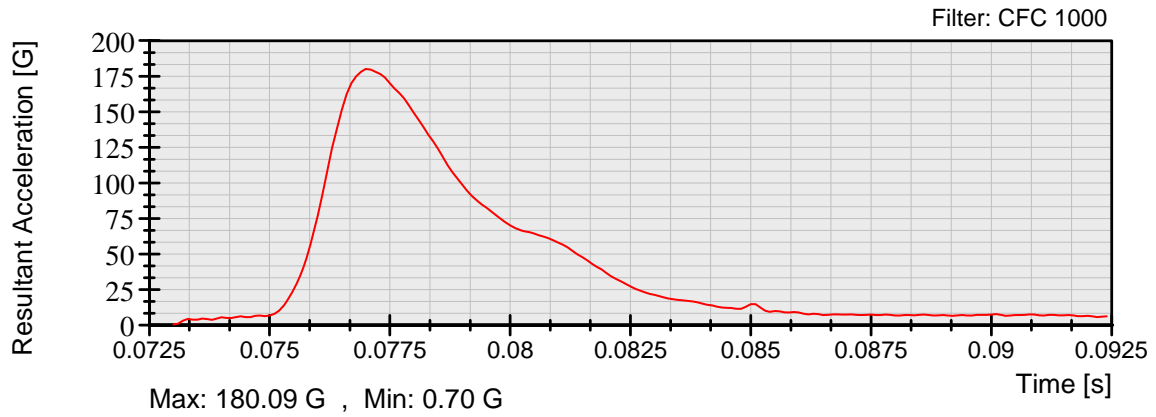
Report No.: G15I7-001.6
Date: 10/20/2015

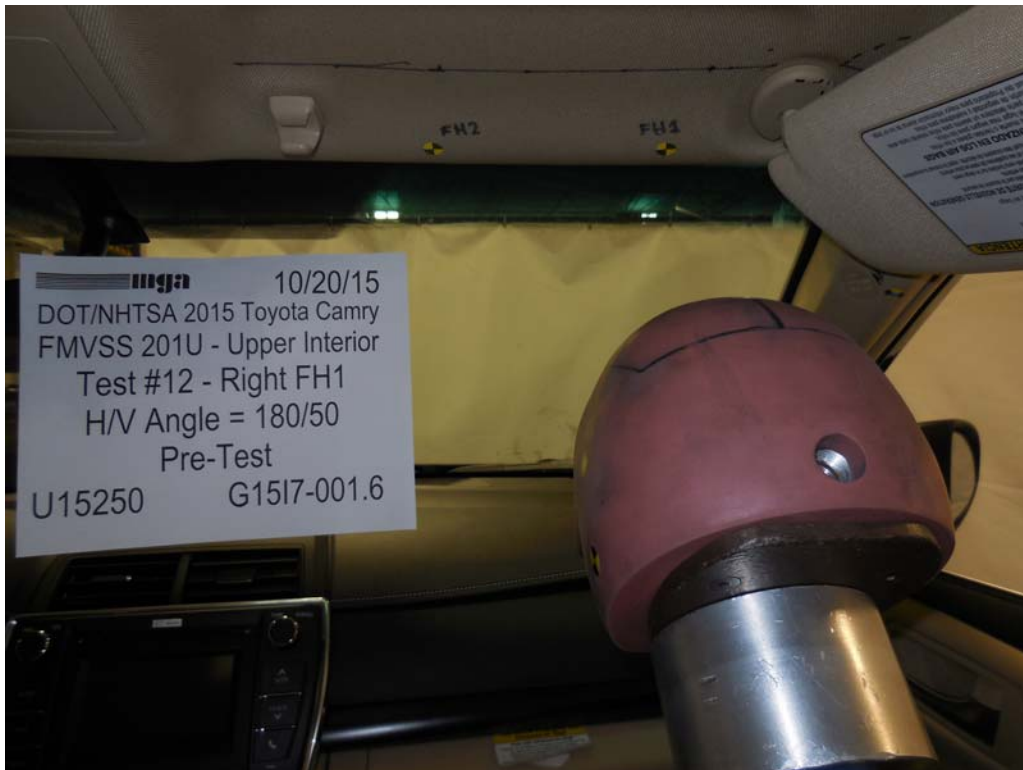
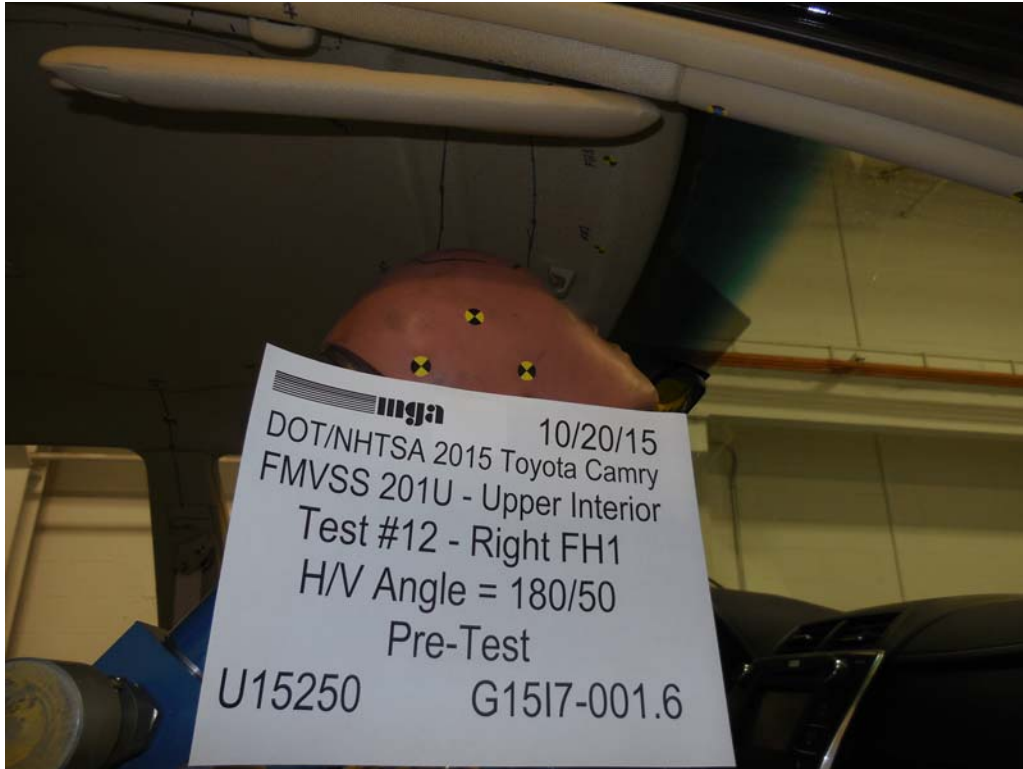


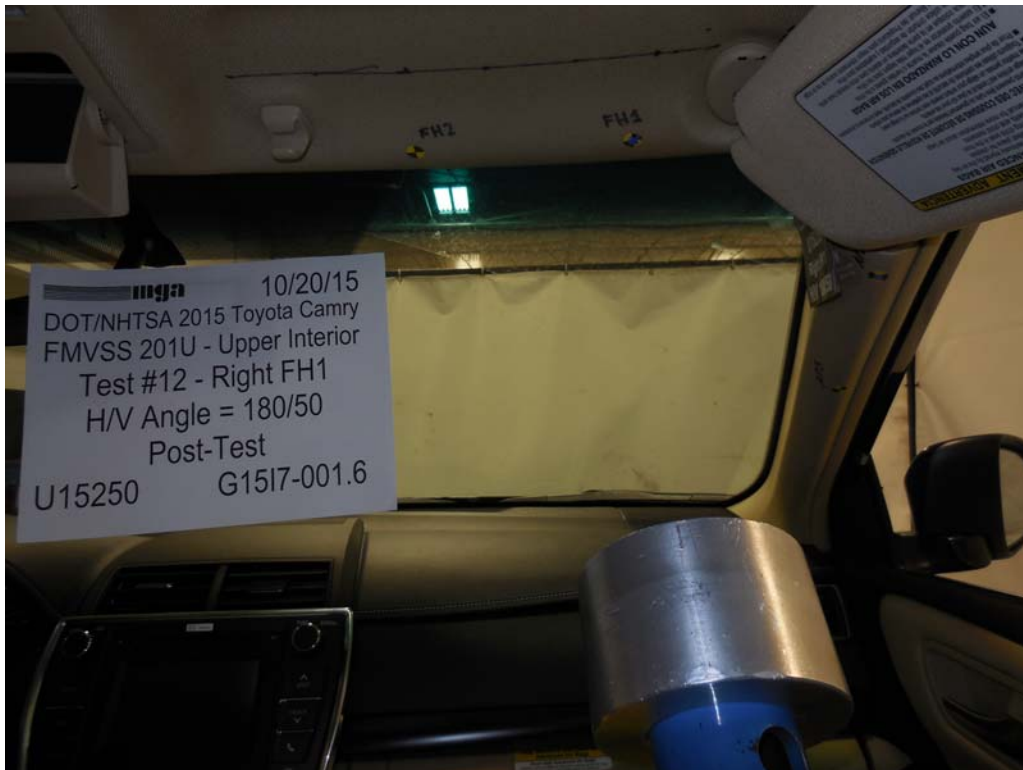
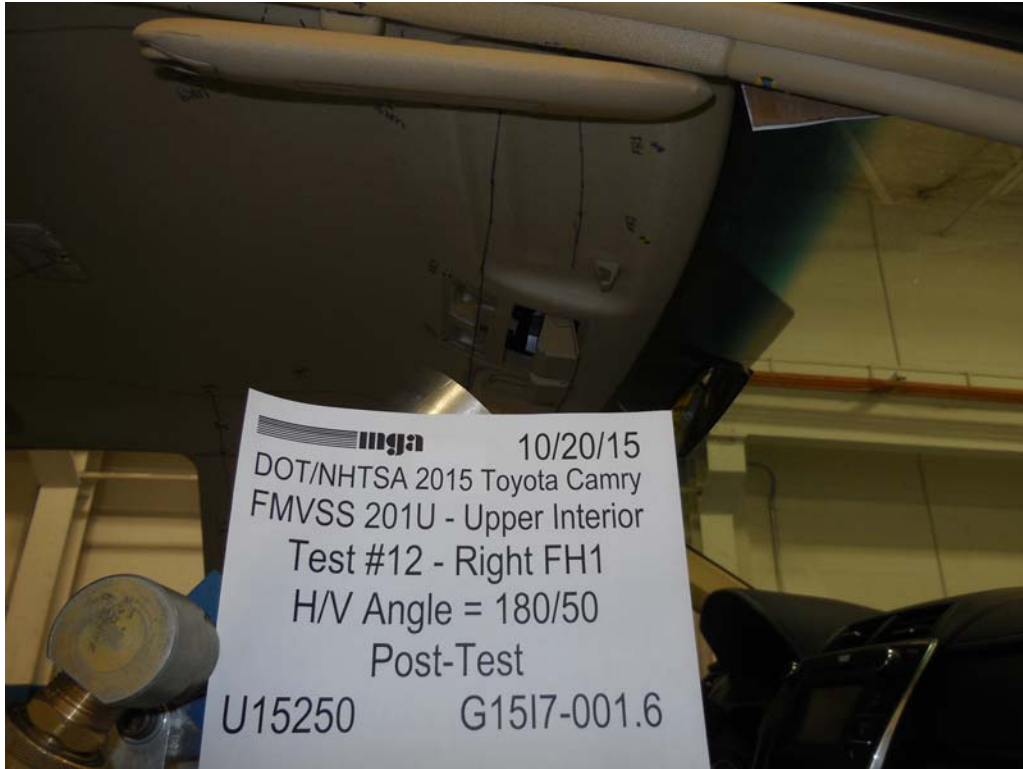


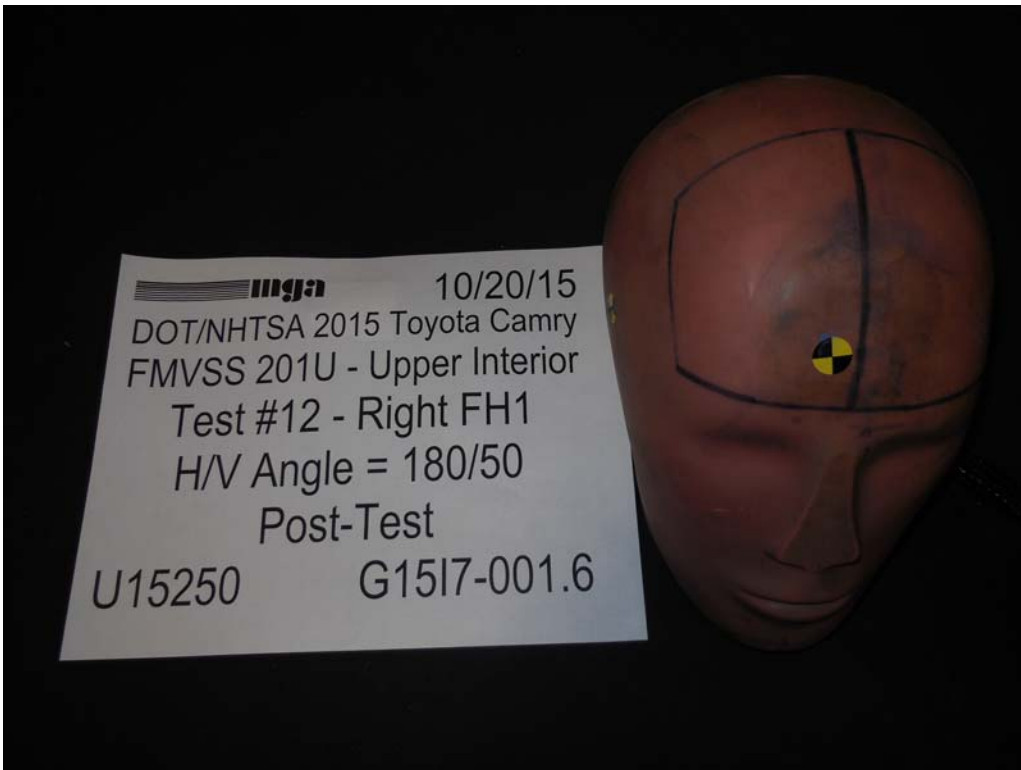
FMVSS 201U
Test No.: U15250
Customer: NHTSA

Report No.: G15I7-001.6
Date: 10/20/2015





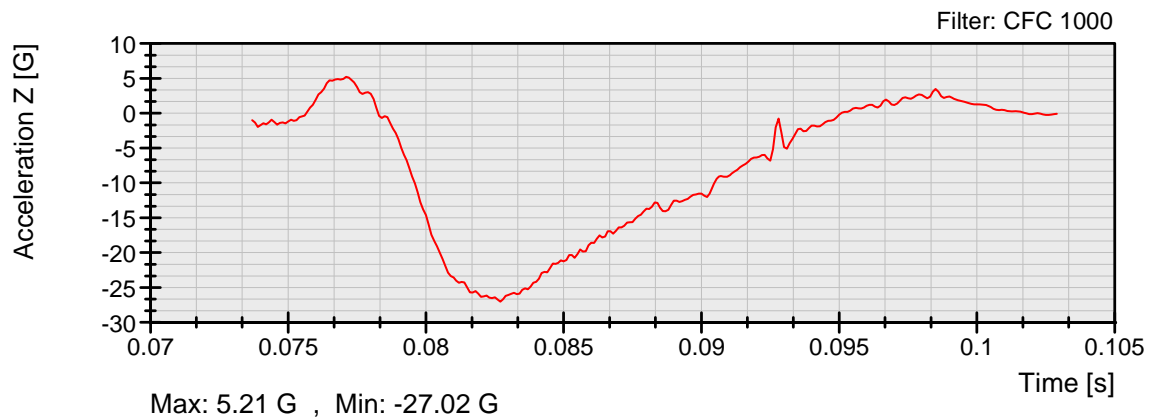
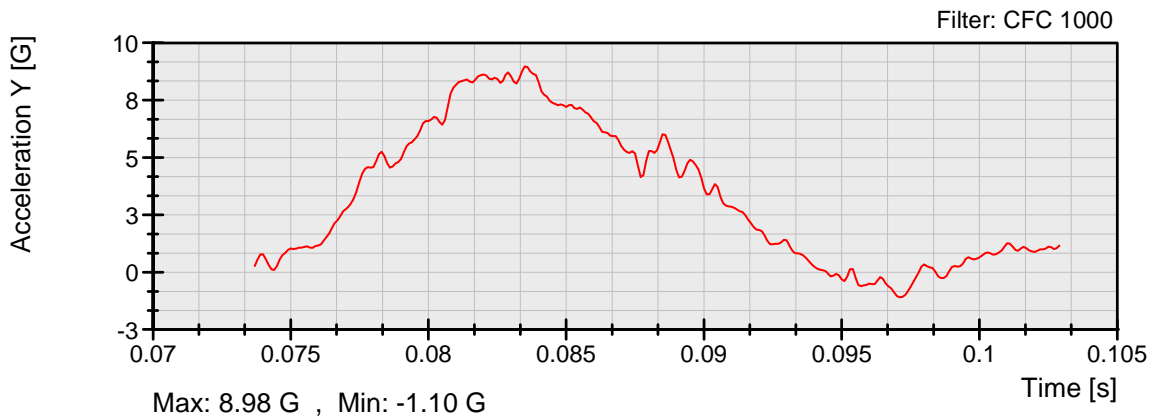
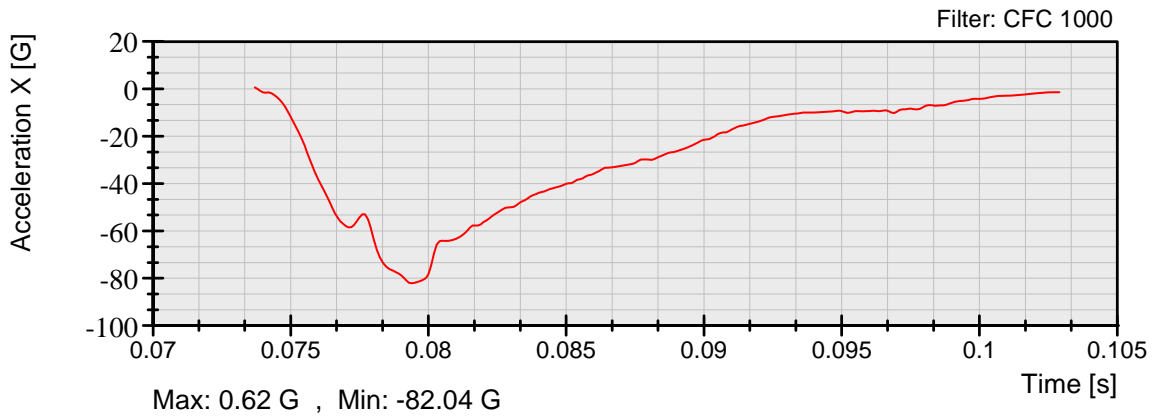






FMVSS 201U
Test No.: U15148
Customer: NHTSA

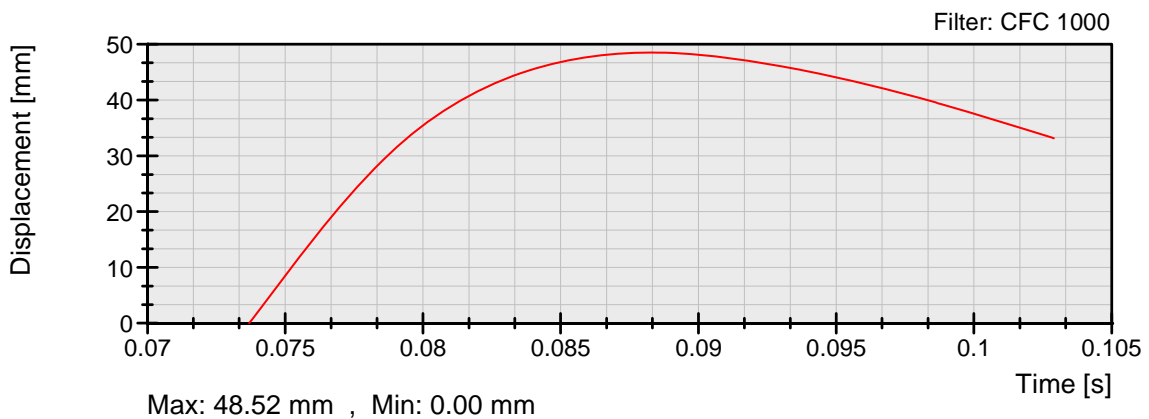
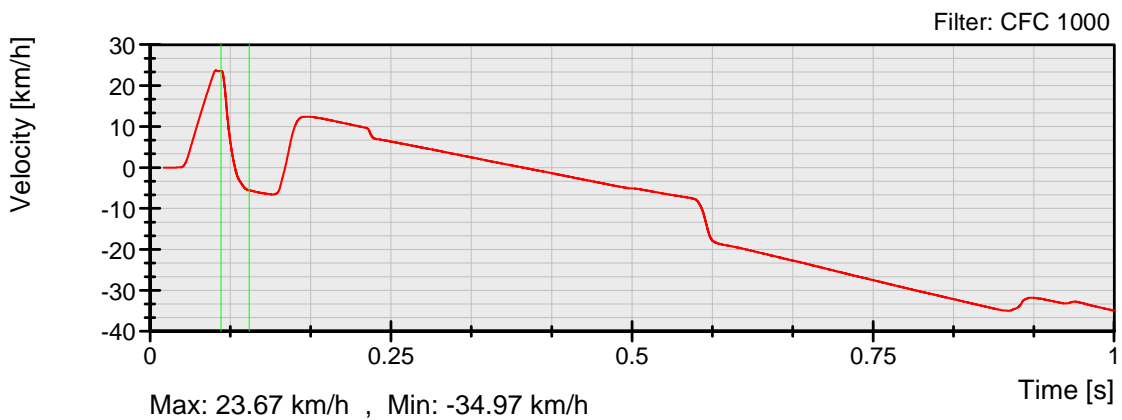
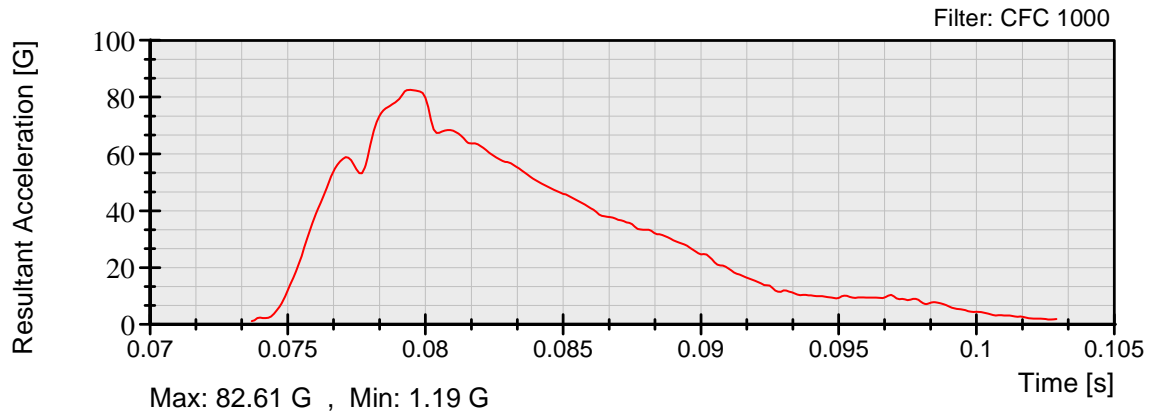
Report No.: G15I7-001.6
Date: 07/21/15

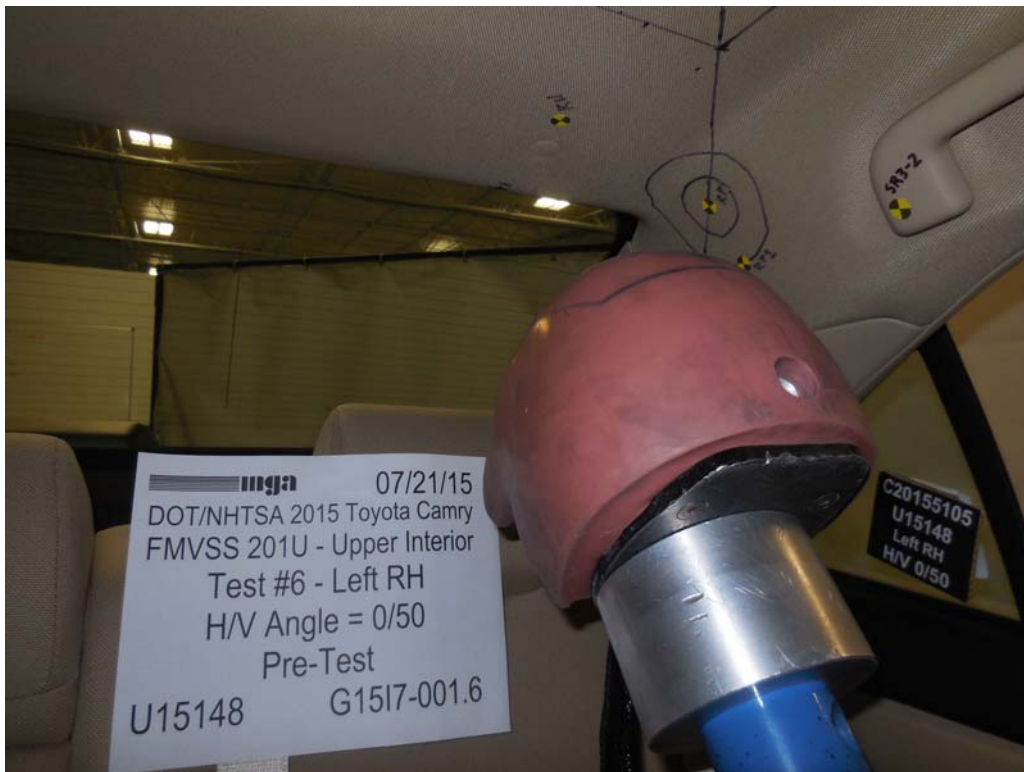
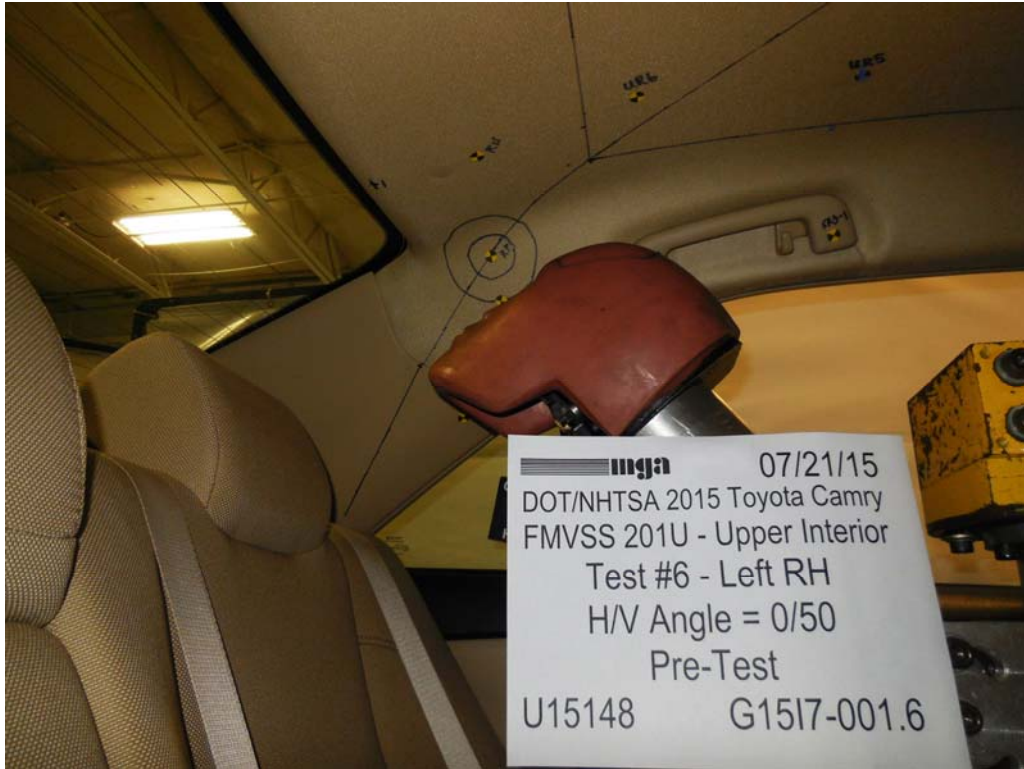


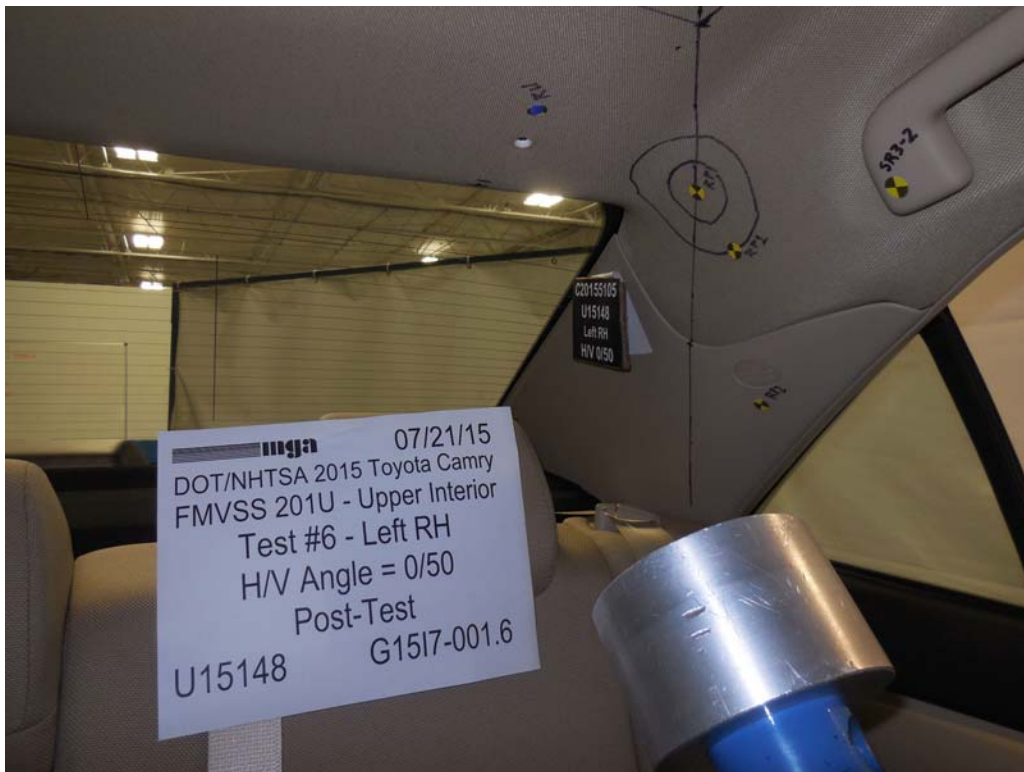
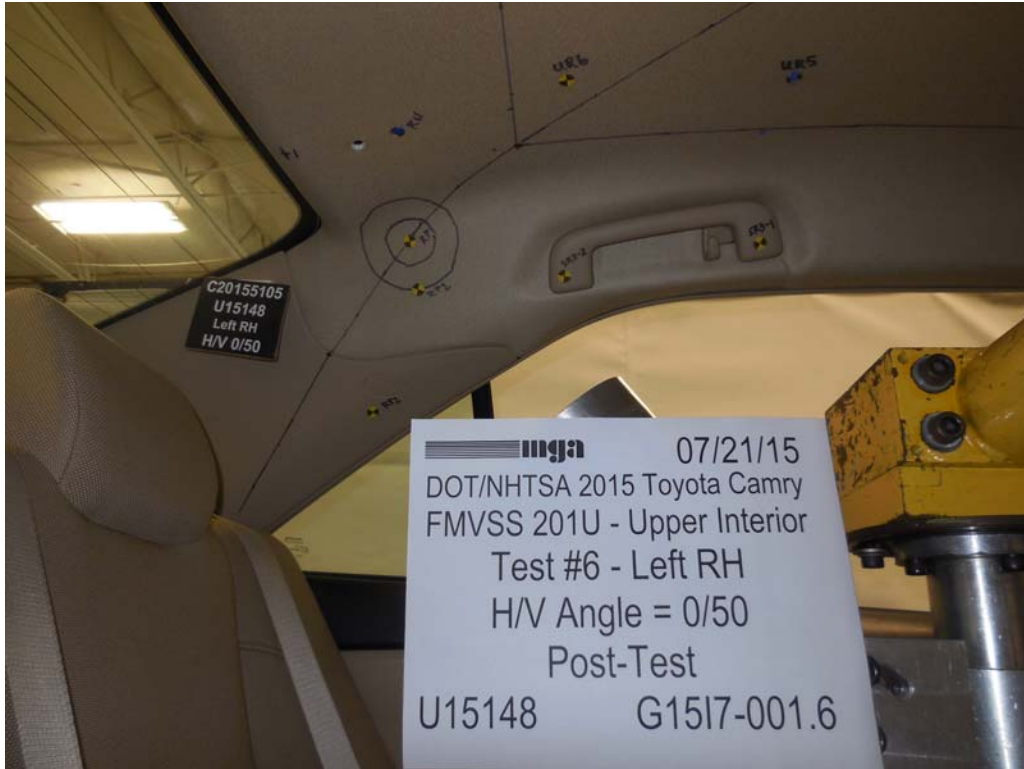


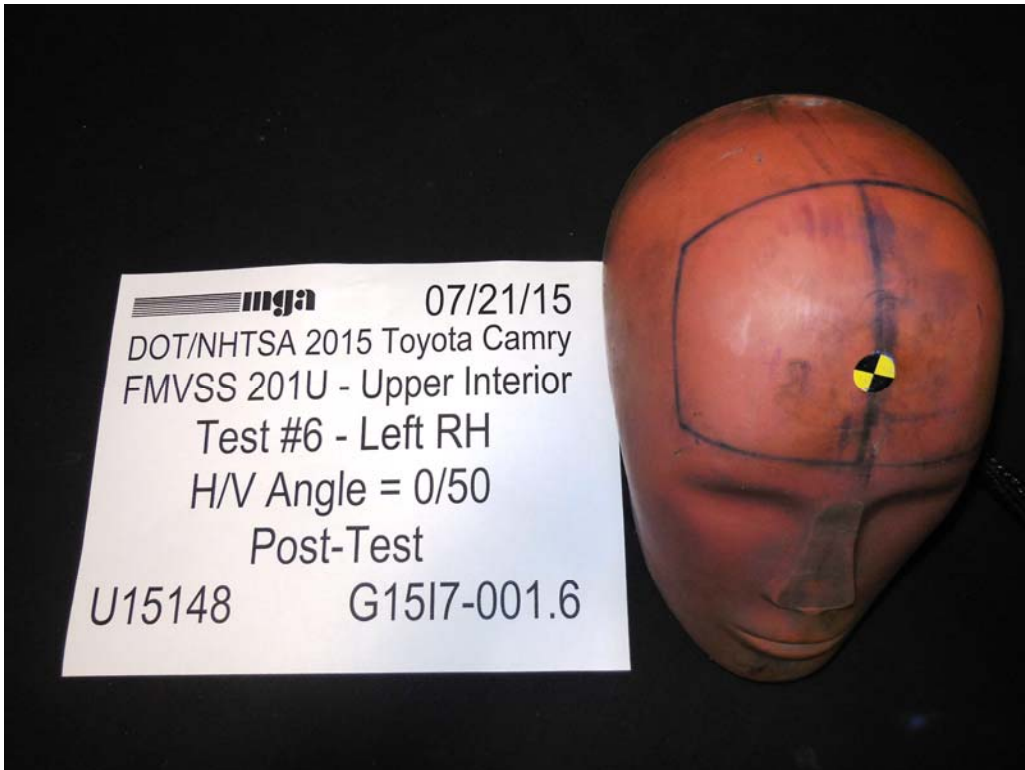
FMVSS 201U
Test No.: U15148
Customer: NHTSA

Report No.: G15I7-001.6
Date: 07/21/15










Test U15144 Data

	FMVSS 201U	Report No.: G15I7-001.6
	Test No.: U15144 Customer: NHTSA	Date: 07/21/15

Summary of the Test

Setup Information

Sample Description: 2015 Toyota Camry

Test Sequence No.: 2

Time: 10:05am

Horizontal Approach Angle: 270 deg

Temperature: 21.9 °C

Vertical Approach Angle: 50 deg

Humidity: 41.5 %RH

Impact Form ID No.: 37

Impact Form Mass: 4.54 kg

Target Location: Left UR2 @ SR1

Additional Description:

Test Results

Impact Velocity: 23.86 km/h

HIC Type	HIC Value	Time 1 (ms)	Time 2 (ms)	Delta-T (ms)
HIC 36	779.52	77.2	84.9	7.7
HIC 15	779.52	77.2	84.9	7.7
HIC (d)	754.51	77.2	84.9	7.7

3 ms Clip = 113.39 G , Time 1 = 78.29 ms , Time 2 = 81.49 ms

Impact Location on FMH: 40 mm Above Pt. 0 , 20 Right mm Lateral of Pt. 0

Post-Test Comments: Grab handle pushed in.

Test Series Performed By: DB, KR

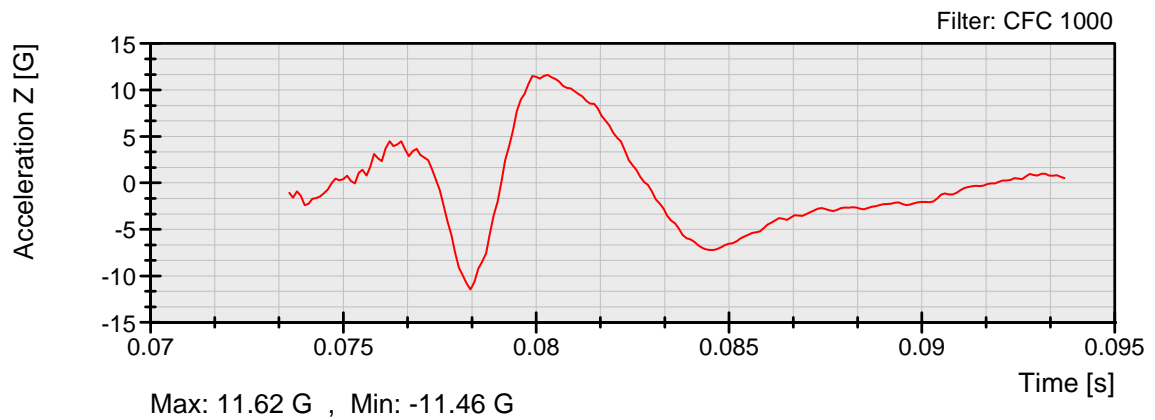
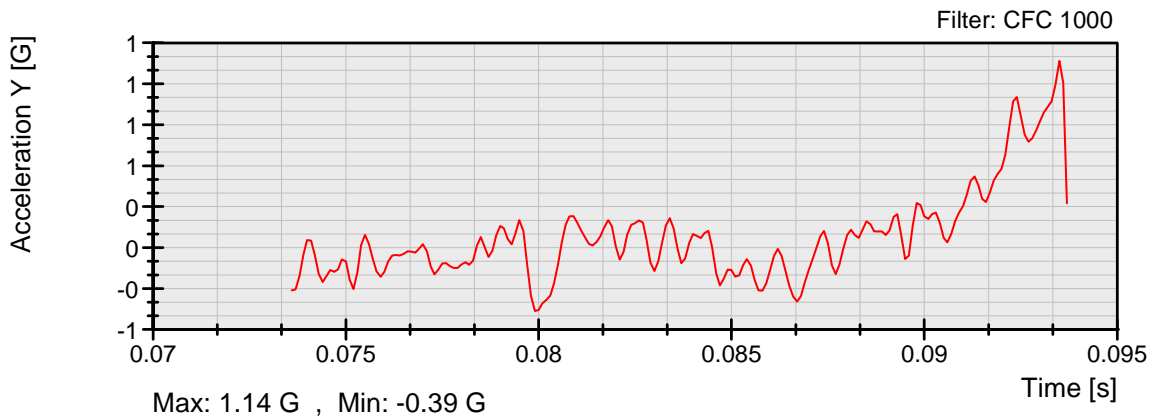
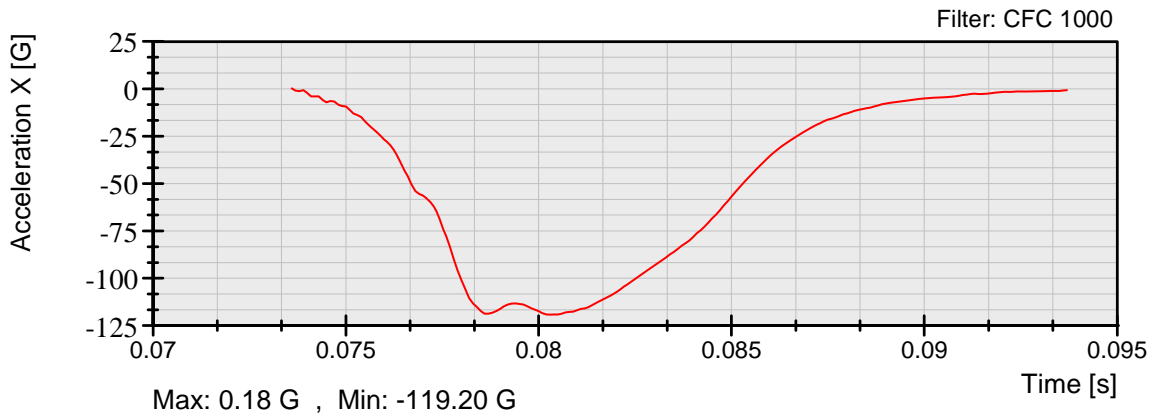
Recorded By:  Approved By: 

Date: July 21, 2015



FMVSS 201U
Test No.: U15144
Customer: NHTSA

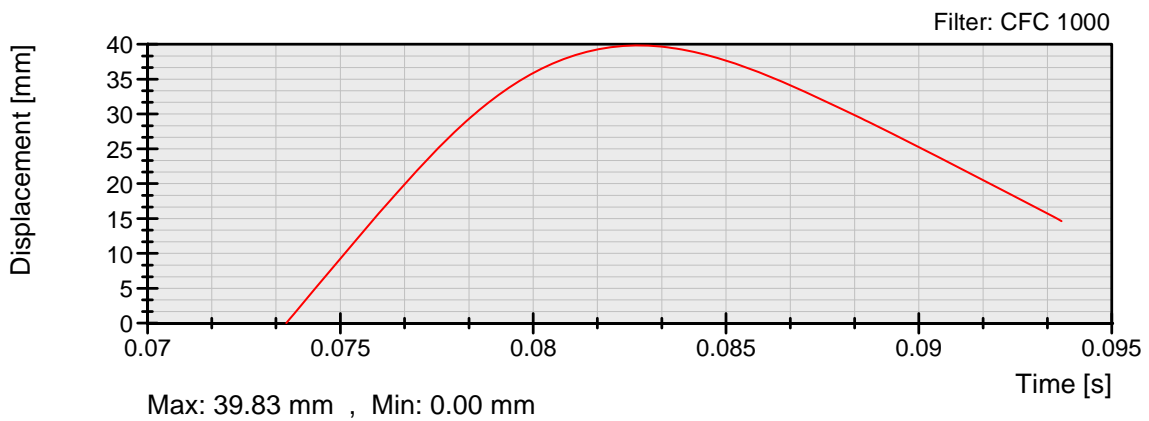
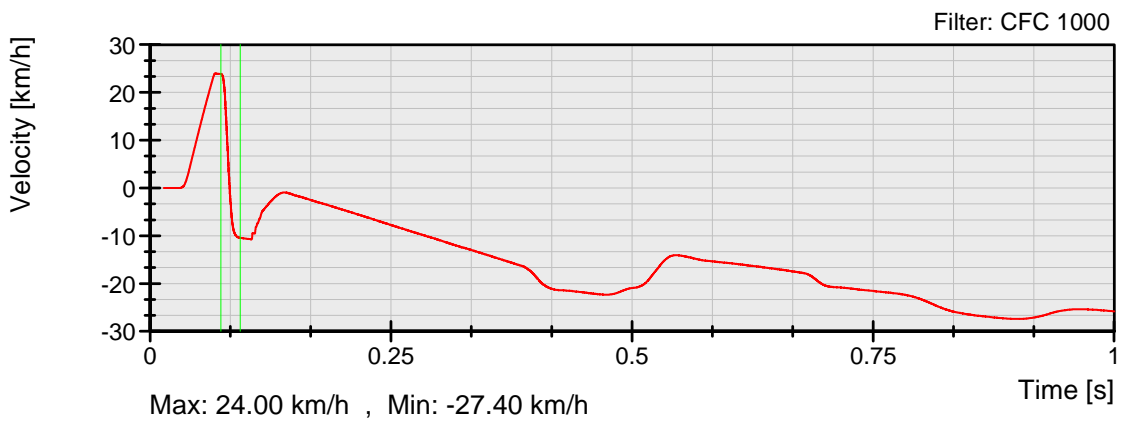
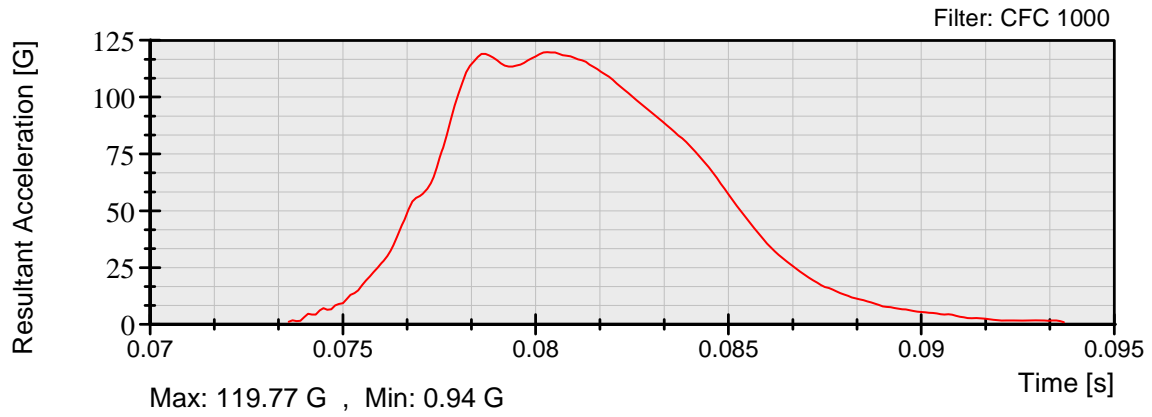
Report No.: G15I7-001.6
Date: 07/21/15

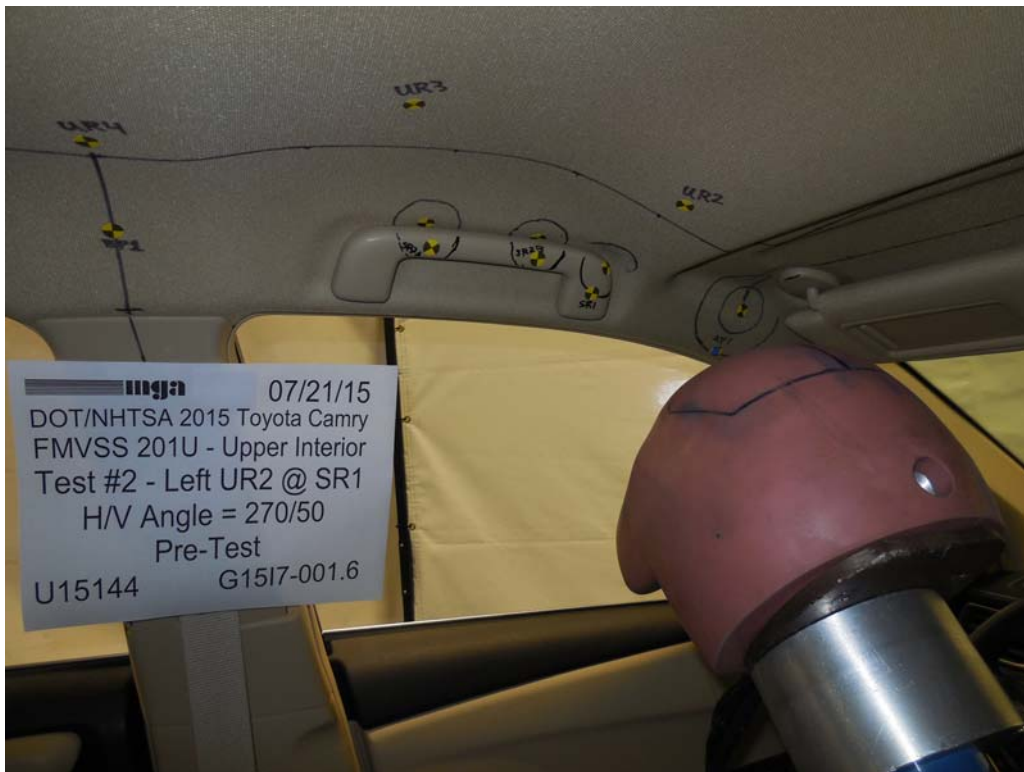


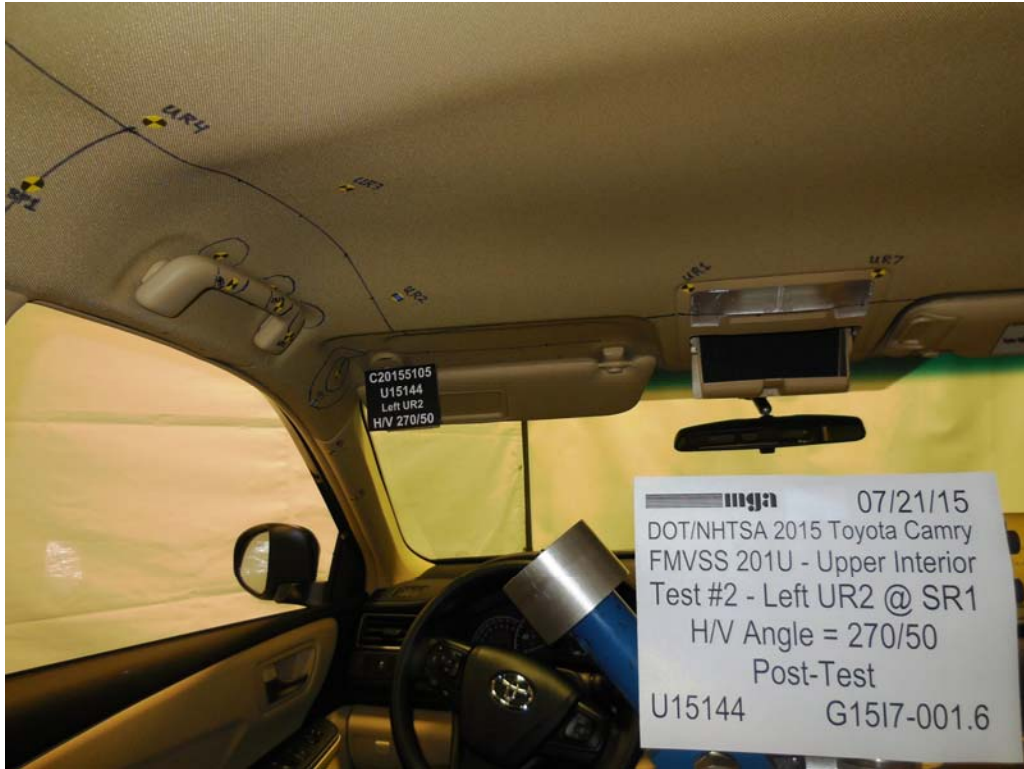


FMVSS 201U
Test No.: U15144
Customer: NHTSA

Report No.: G15I7-001.6
Date: 07/21/15







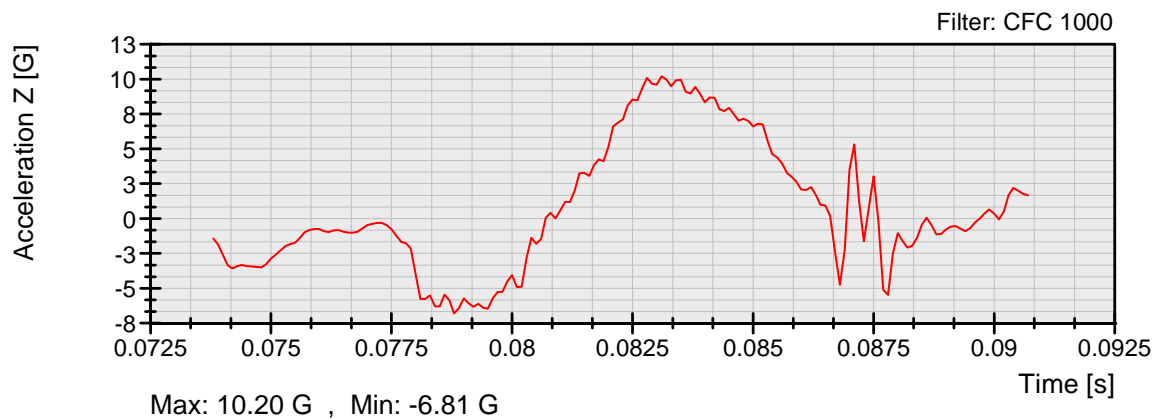
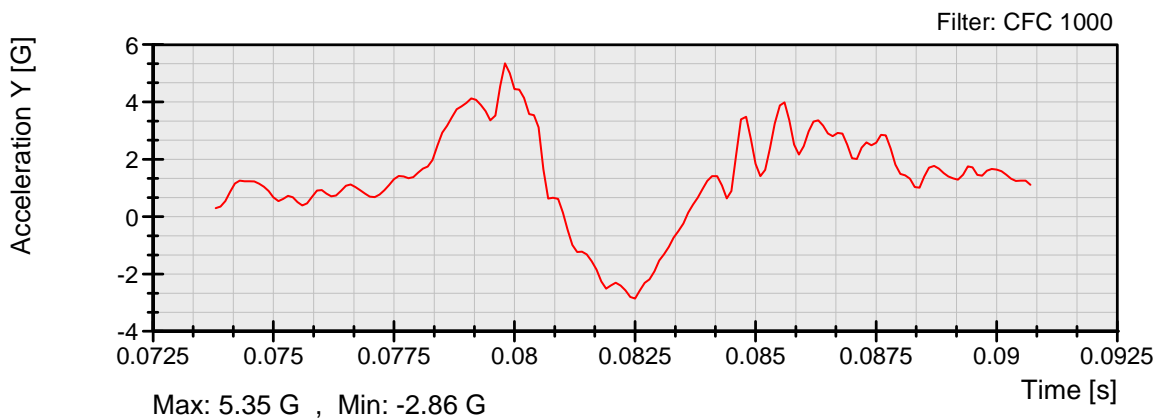
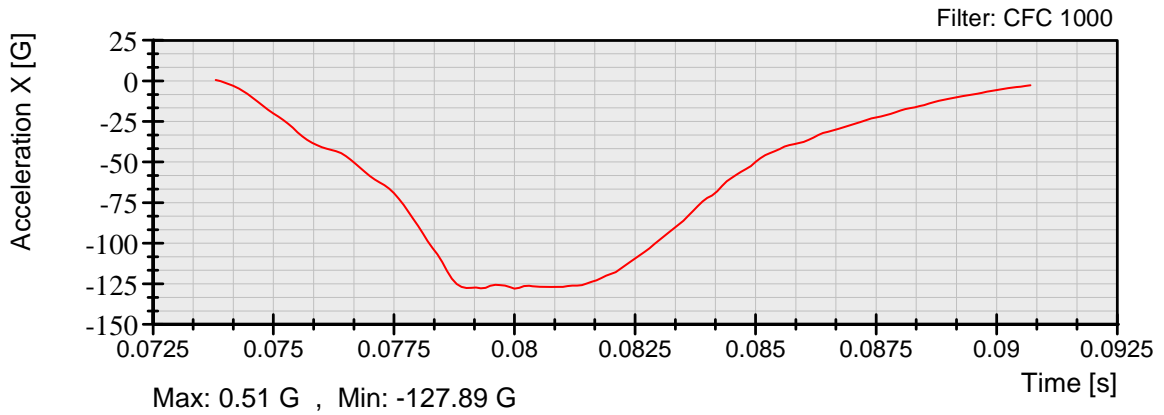




FMVSS 201U

Test No.: U15145
Customer: NHTSA

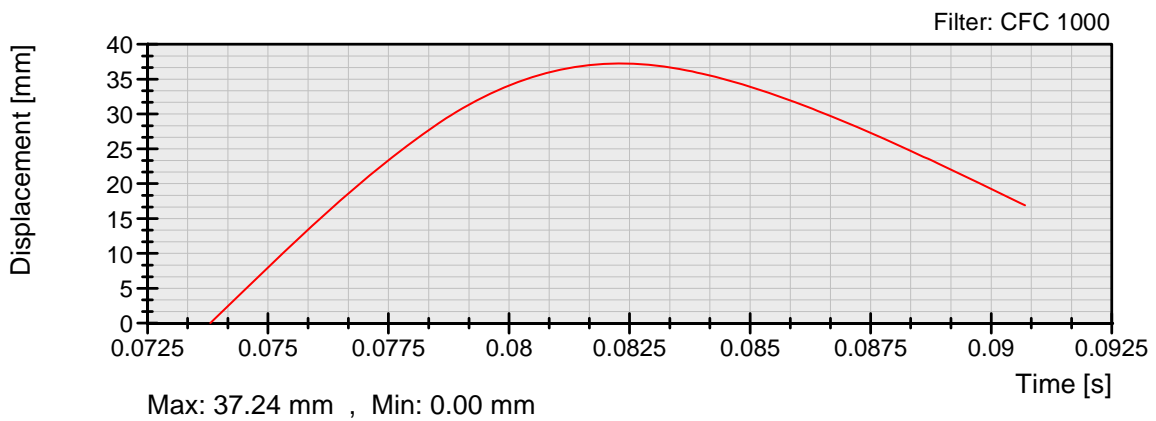
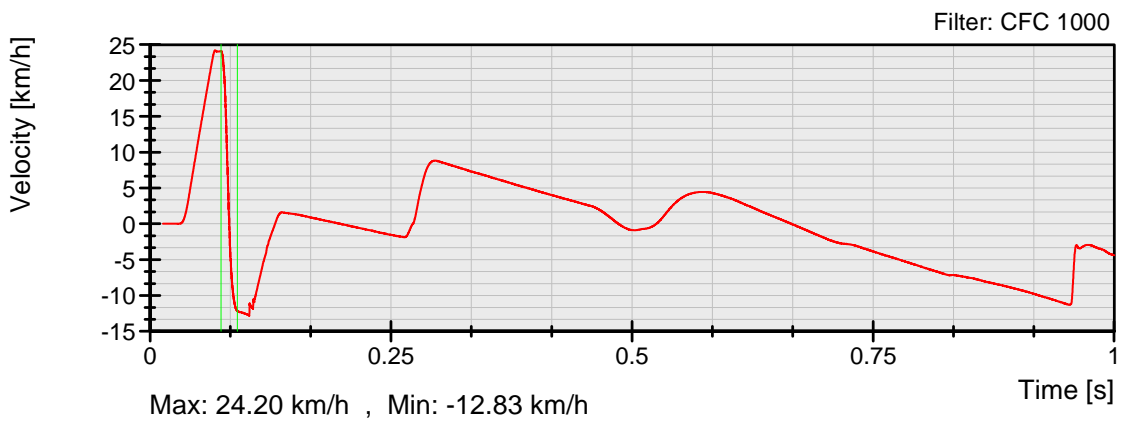
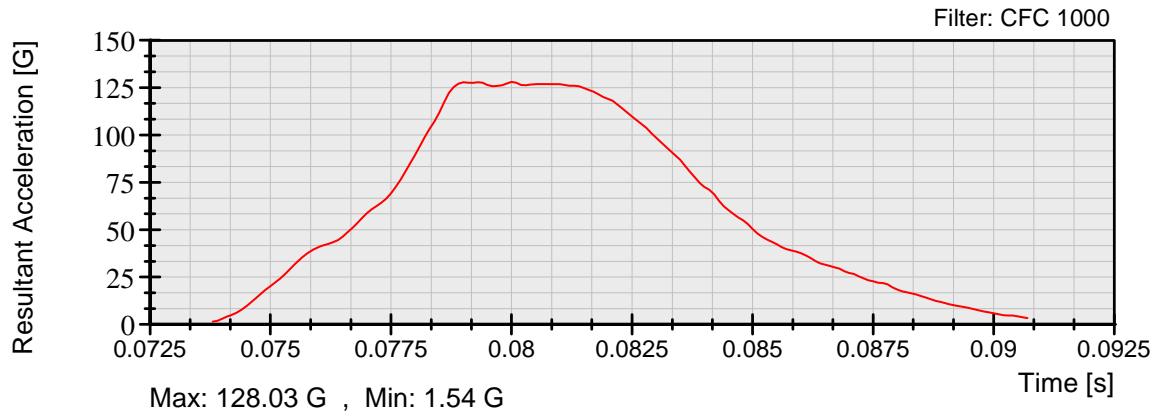
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Date: 07/21/15



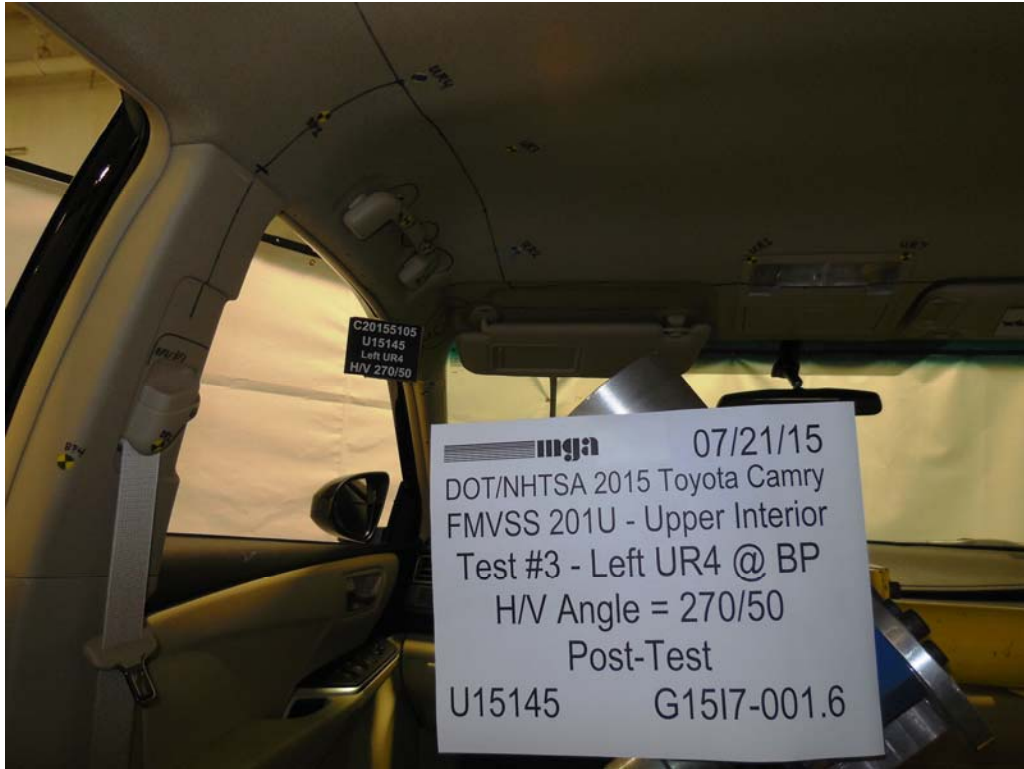


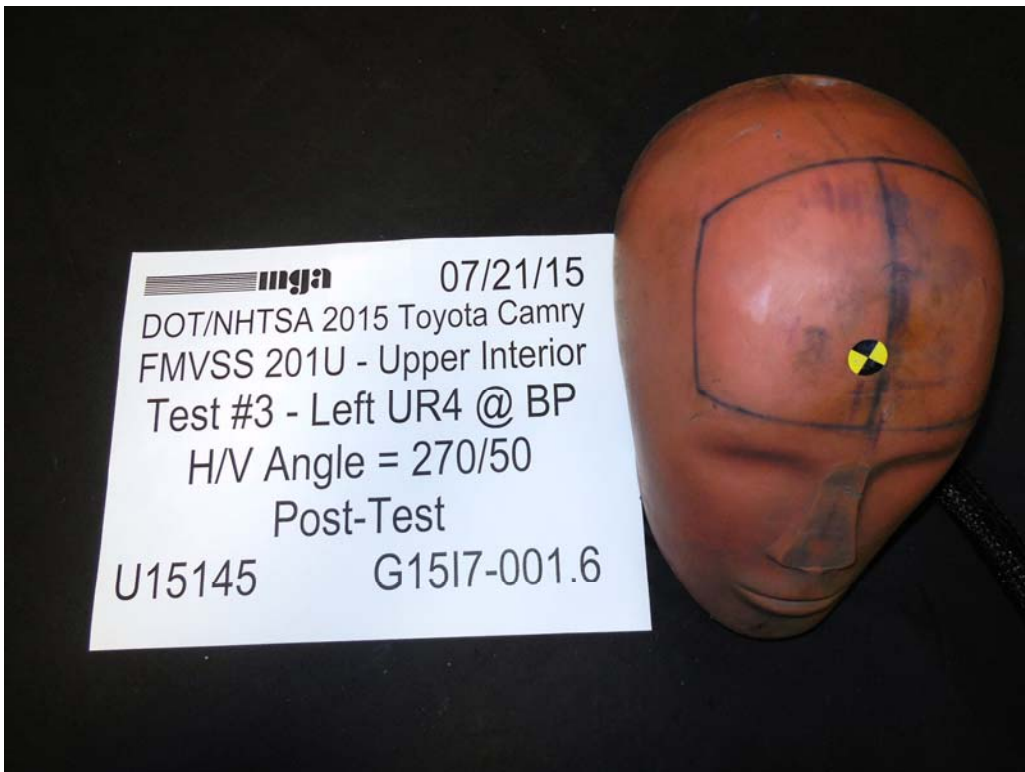
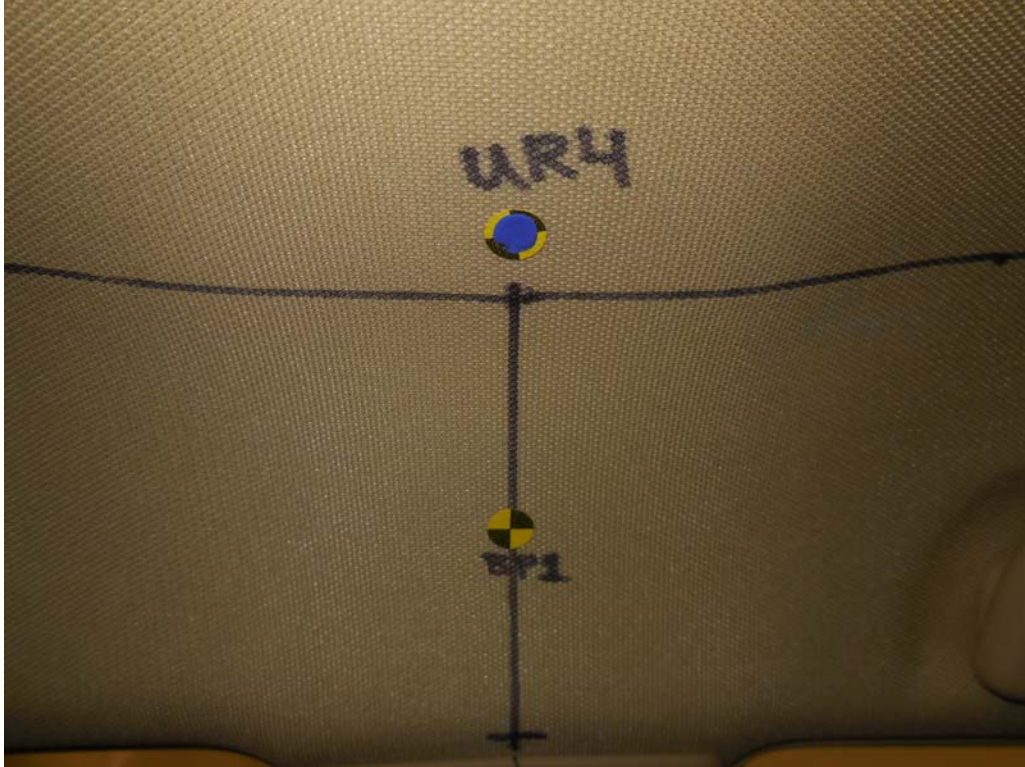
FMVSS 201U
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Customer: NHTSA

Report No.: G15I7-001.6
Date: 07/21/15





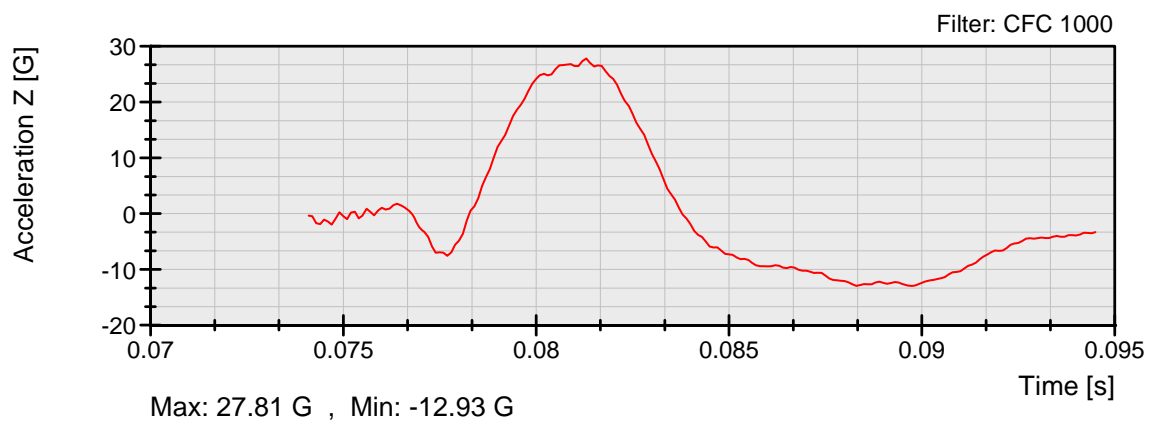
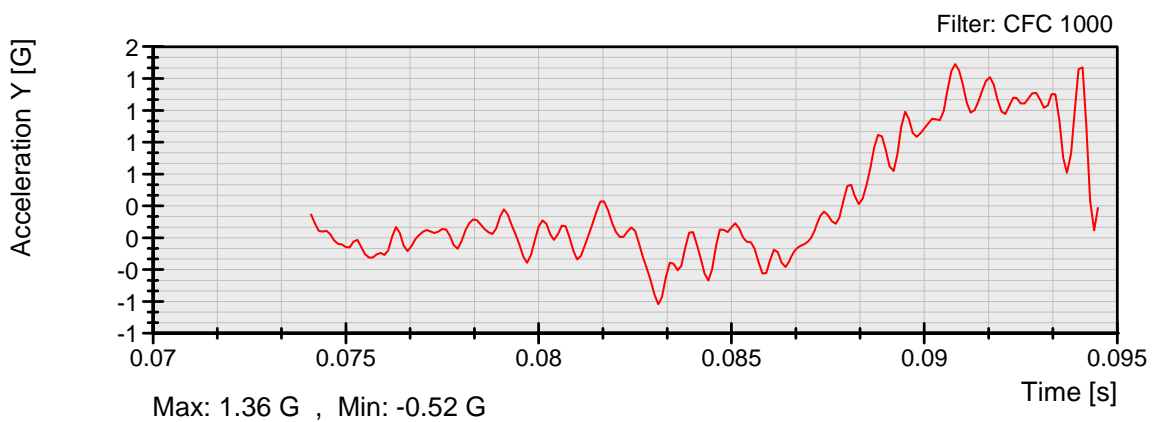
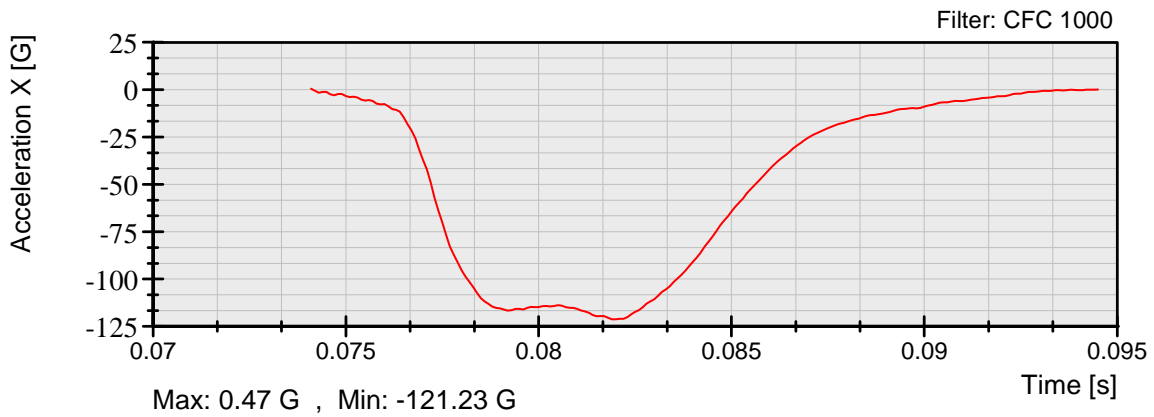






FMVSS 201U
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Customer: NHTSA

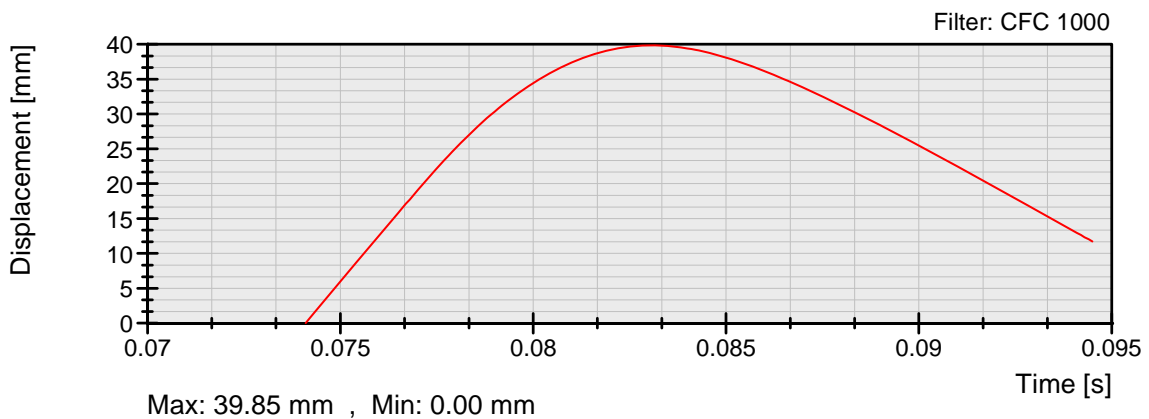
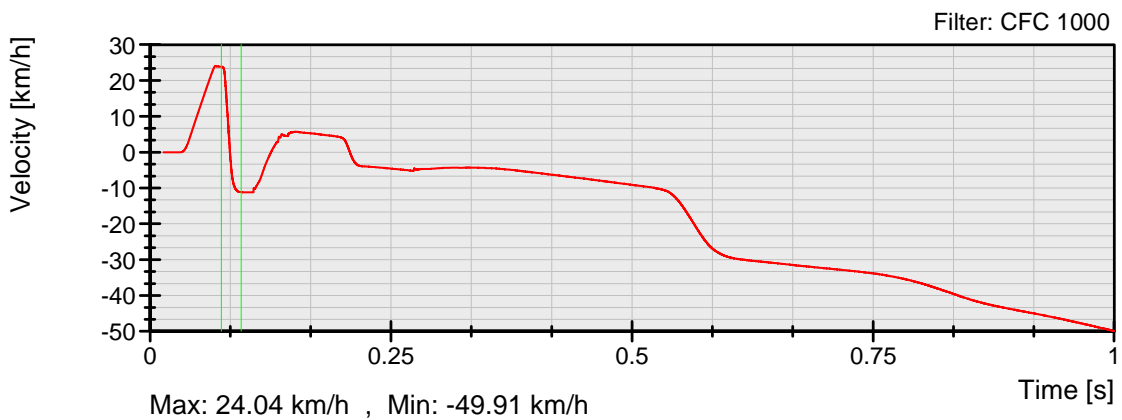
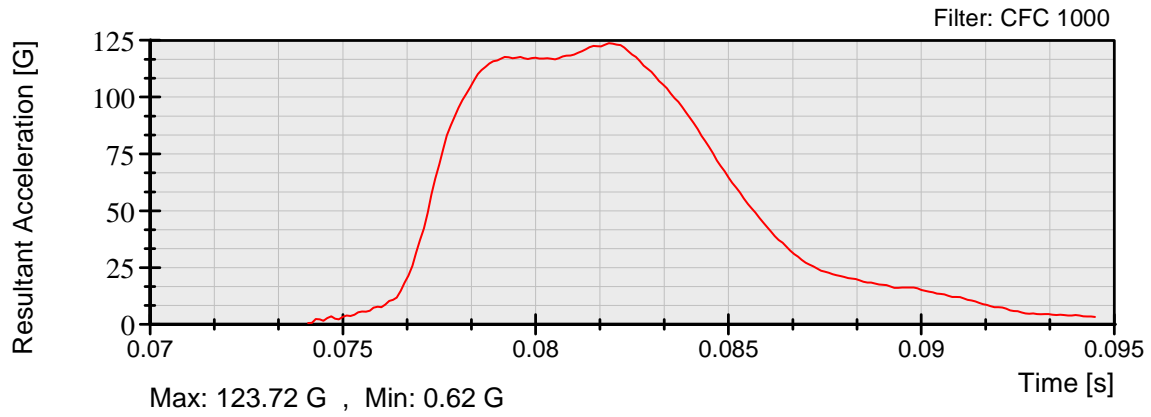
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Date: 07/21/15

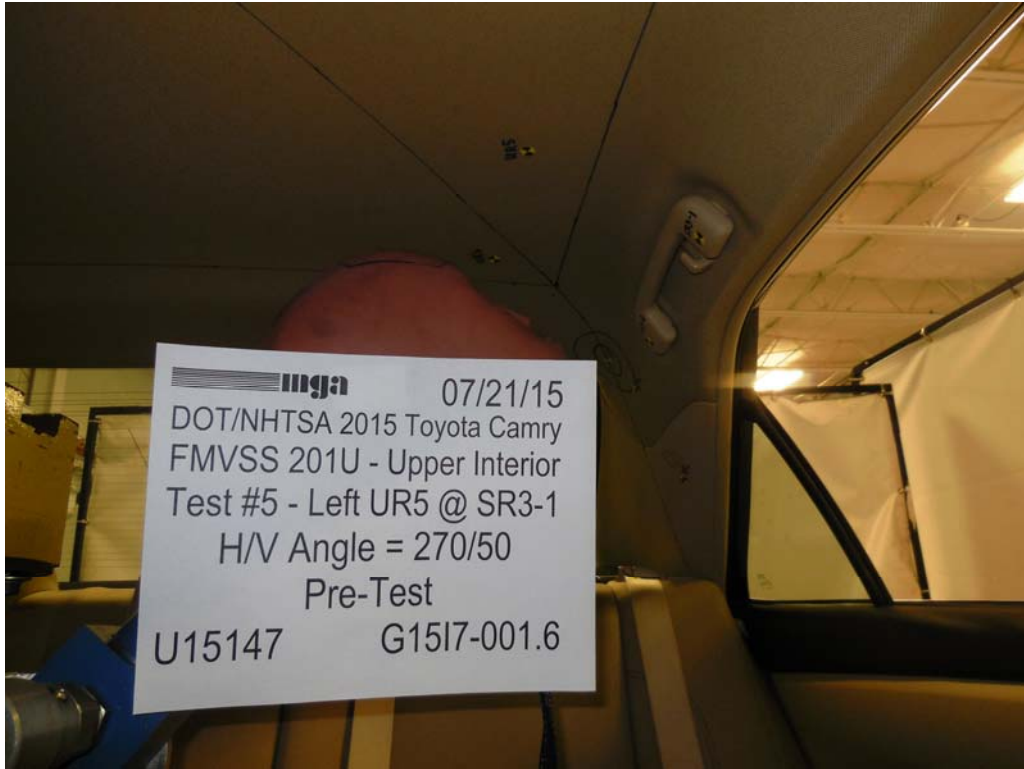


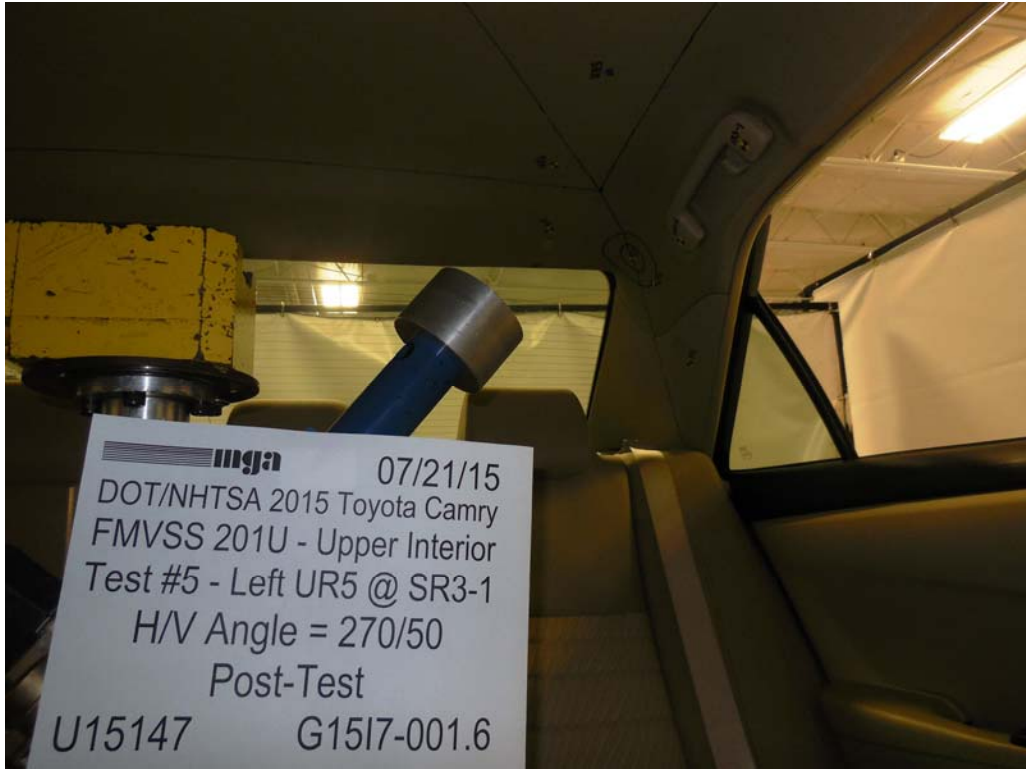


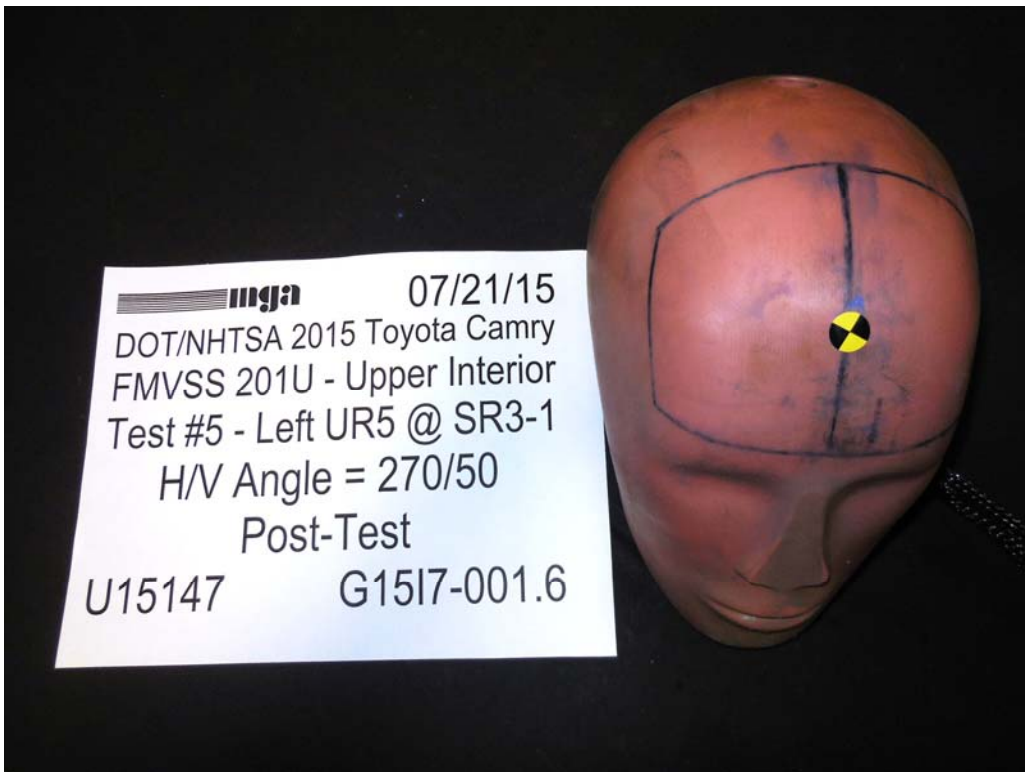
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Test No.: U15147
Customer: NHTSA

Report No.: G15I7-001.6
Date: 07/21/15





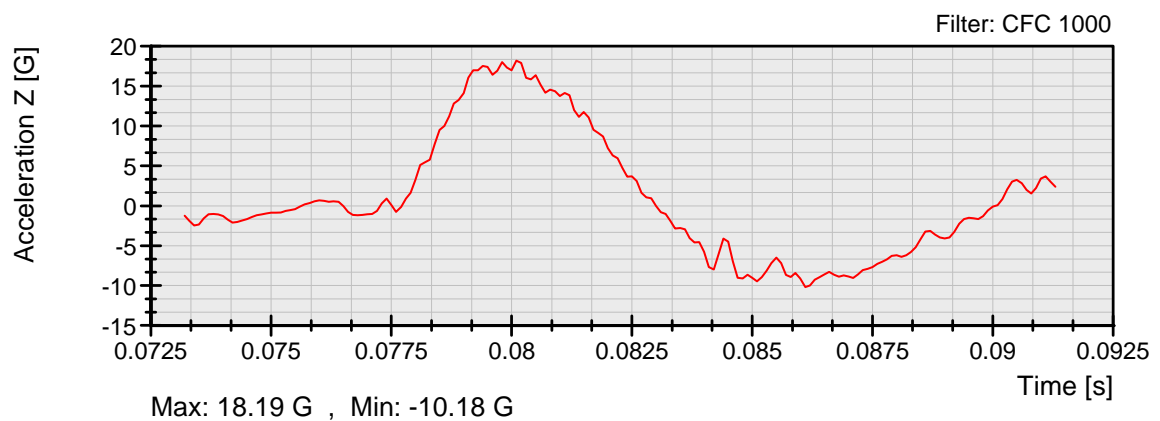
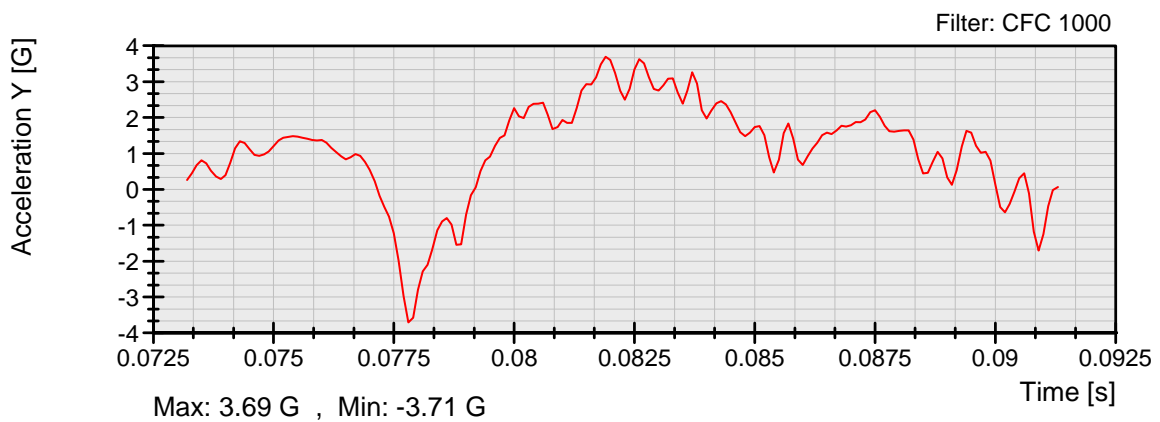
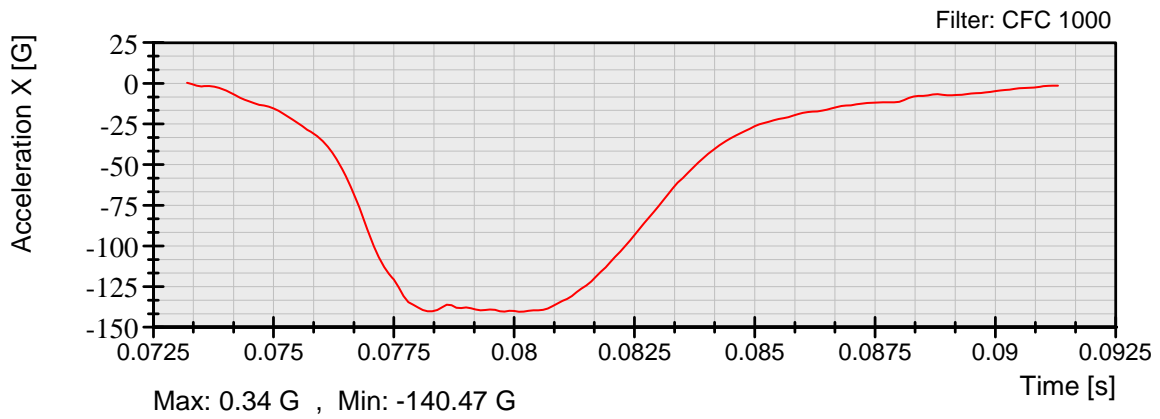






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Customer: NHTSA

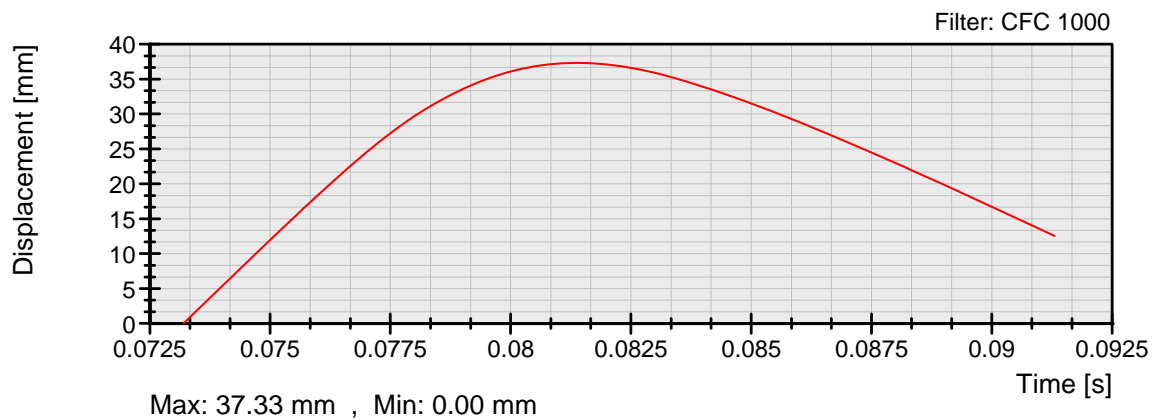
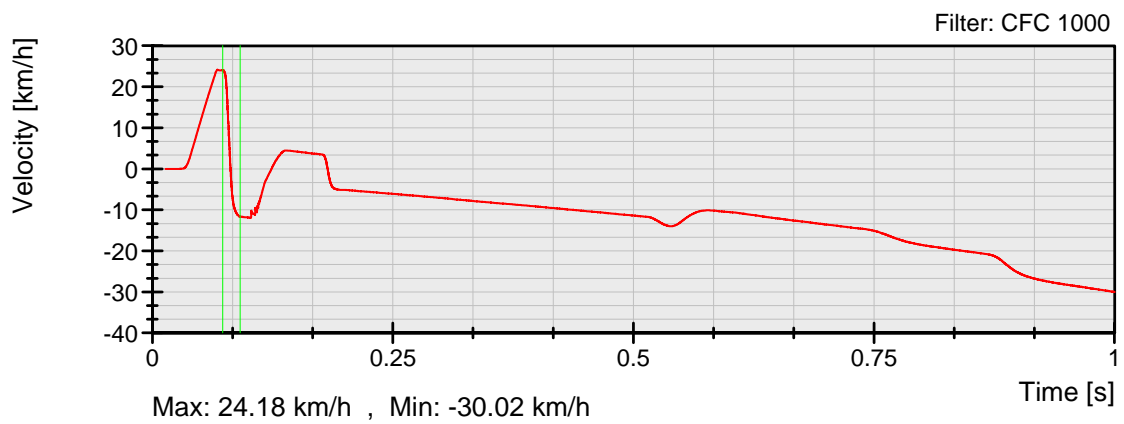
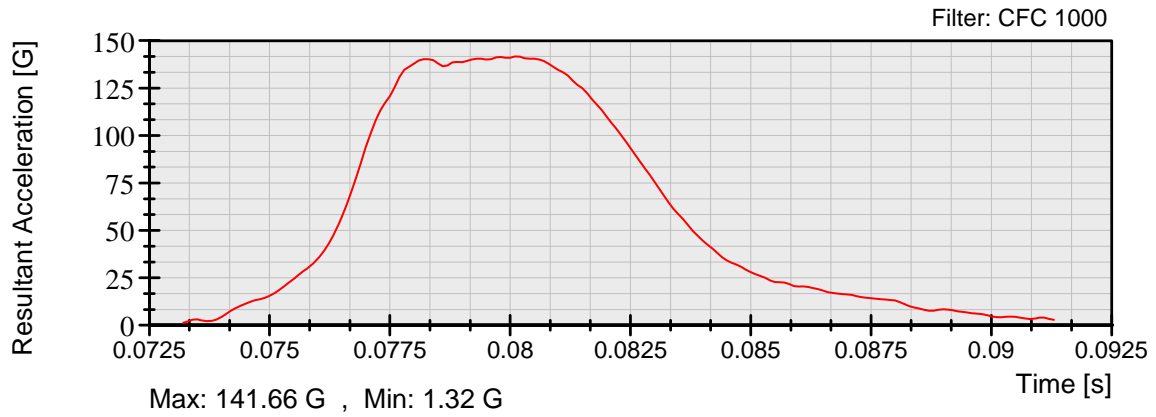
Report No.: G15I7-001.6
Date: 10/20/2015

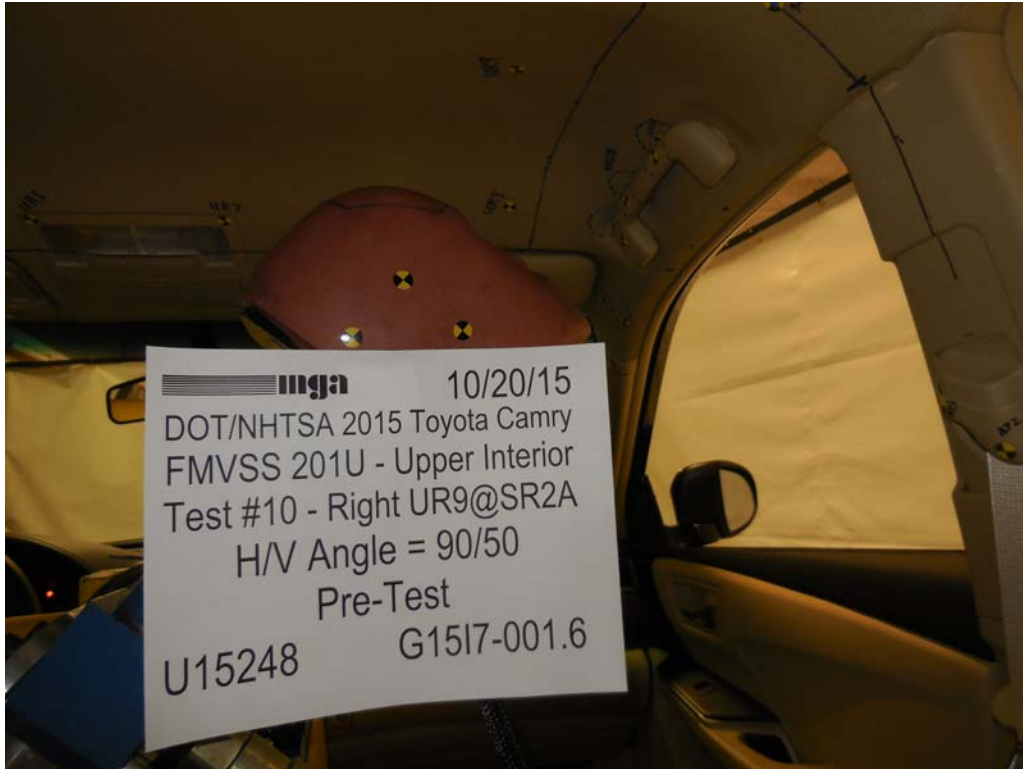


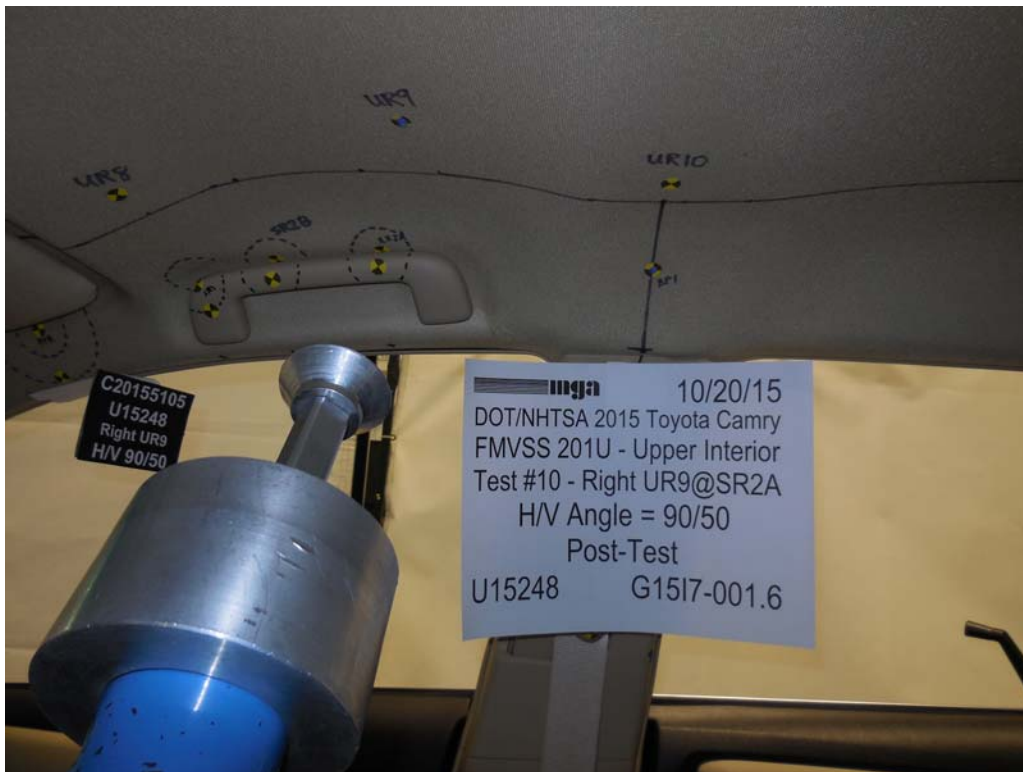
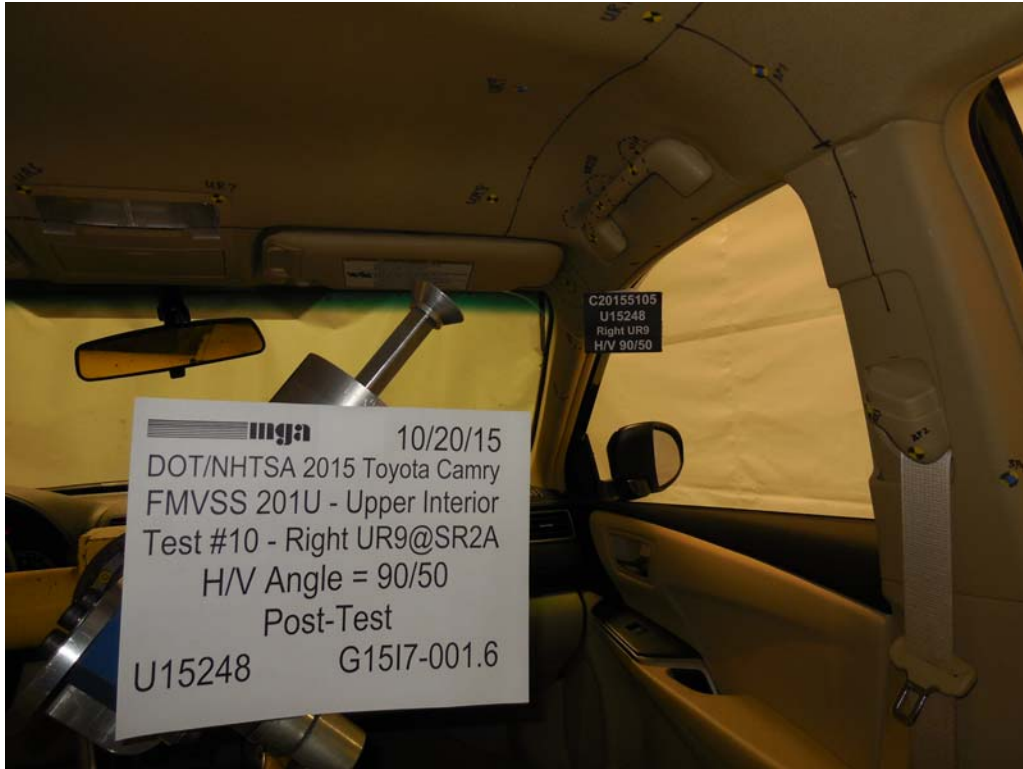


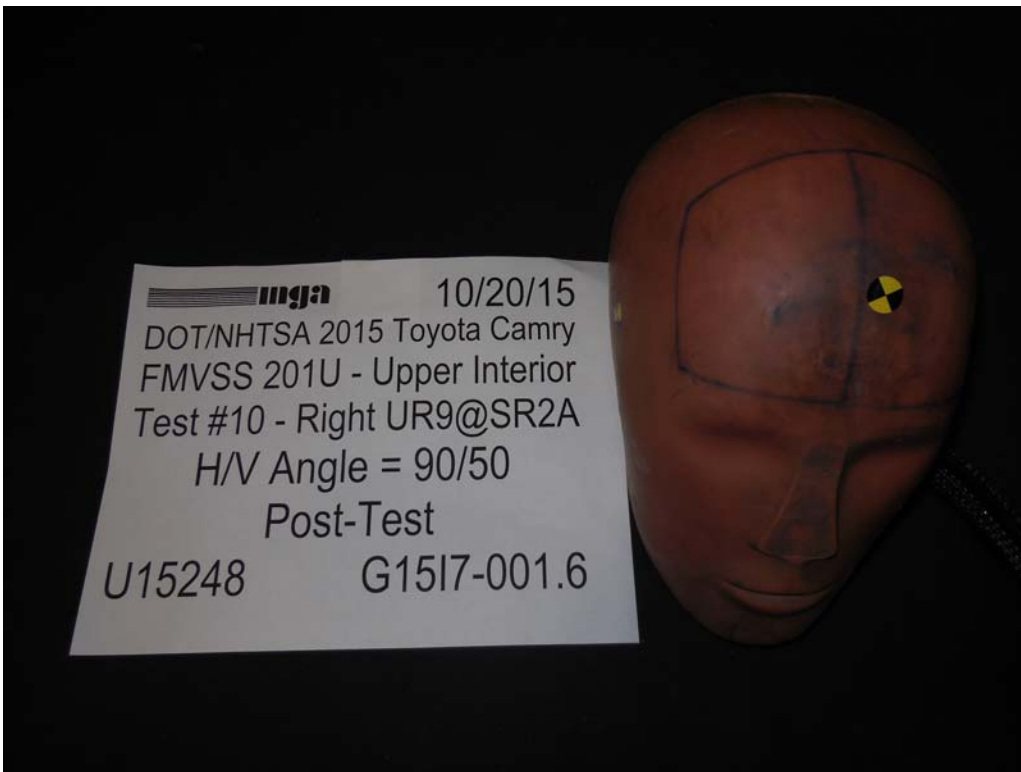
FMVSS 201U
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Customer: NHTSA

Report No.: G15I7-001.6
Date: 10/20/2015





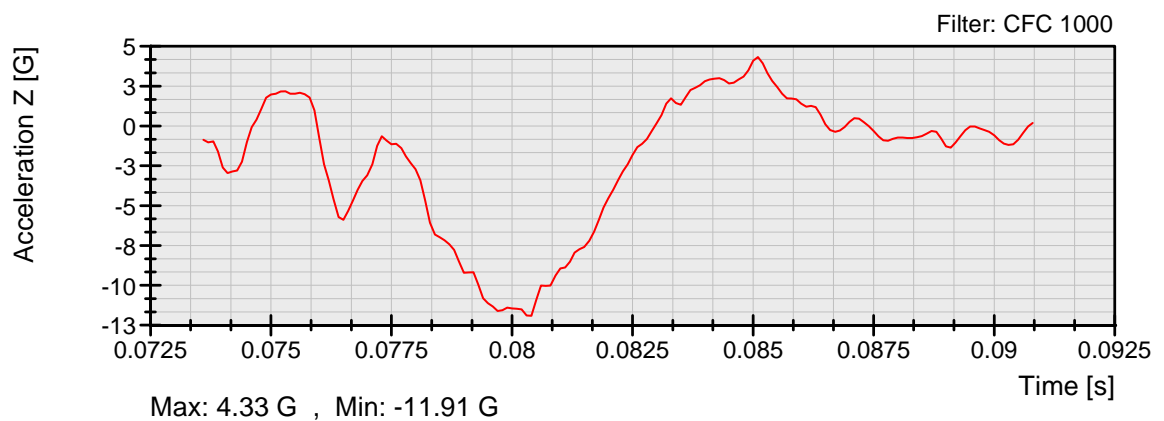
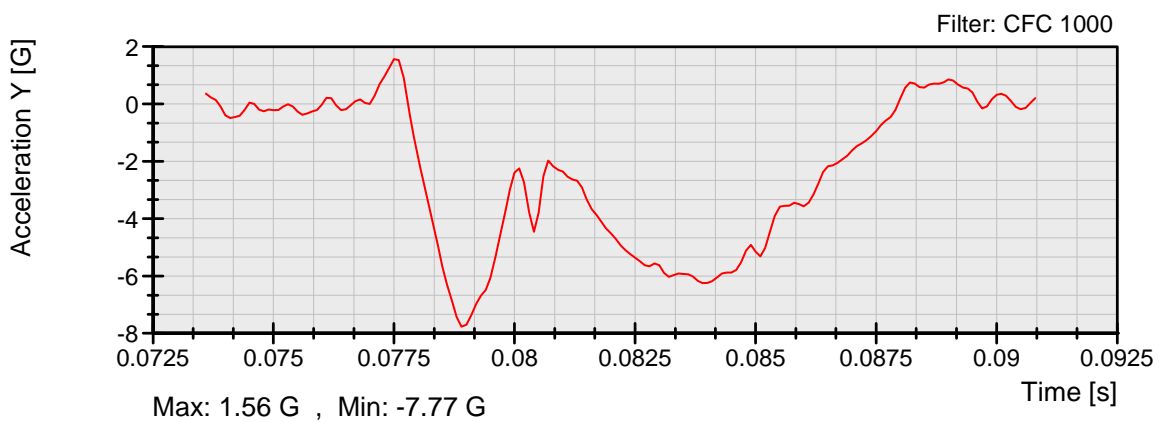
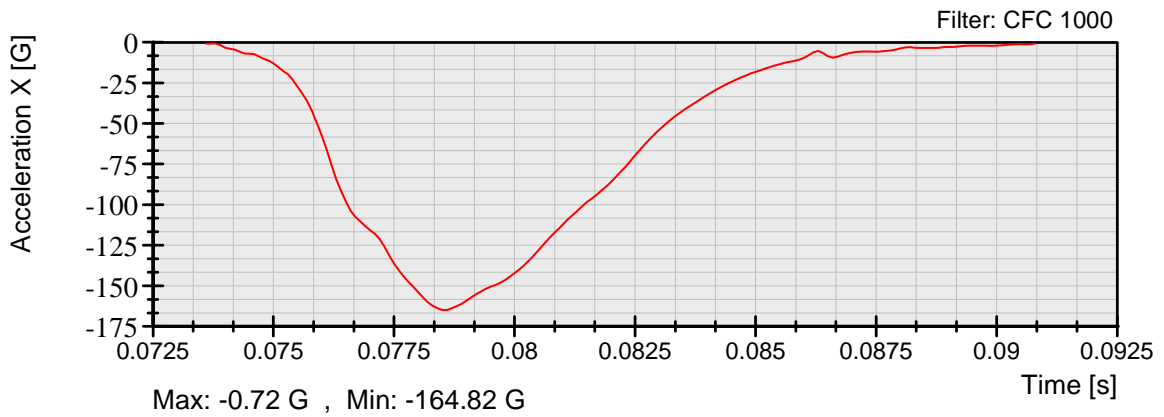






FMVSS 201U
Test No.: U15149
Customer: NHTSA

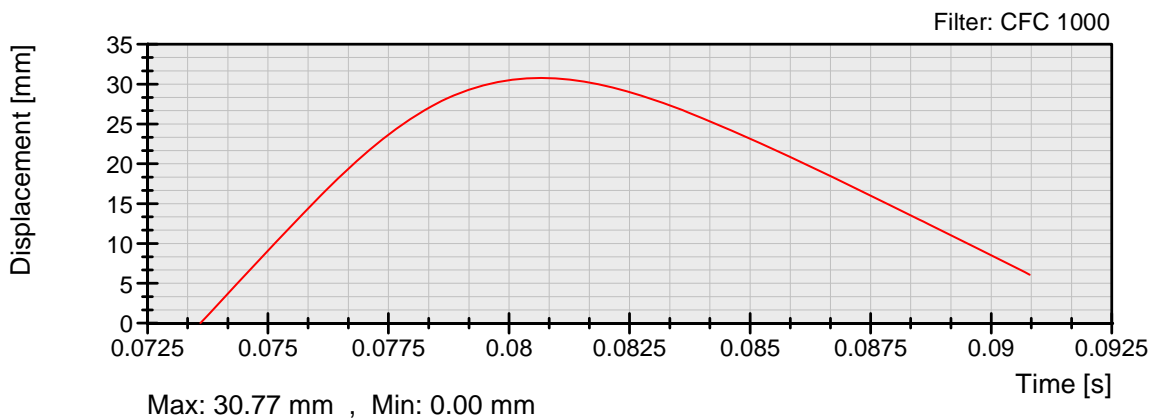
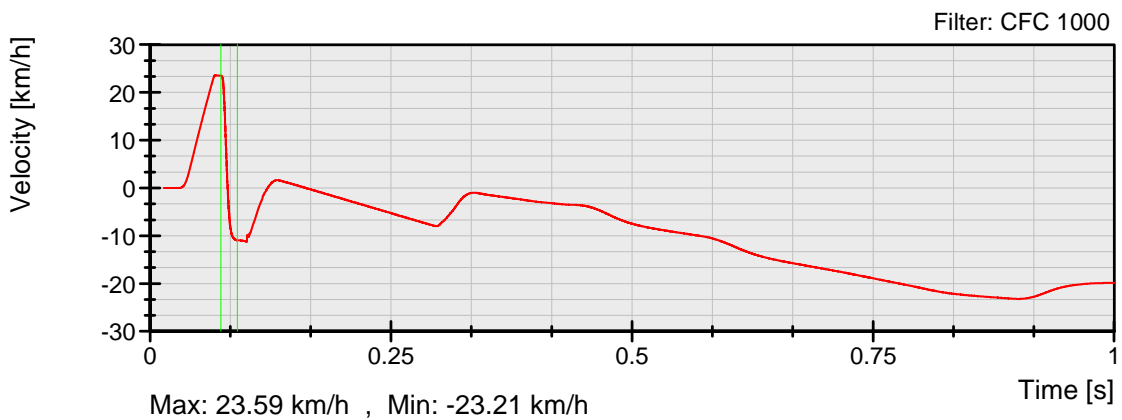
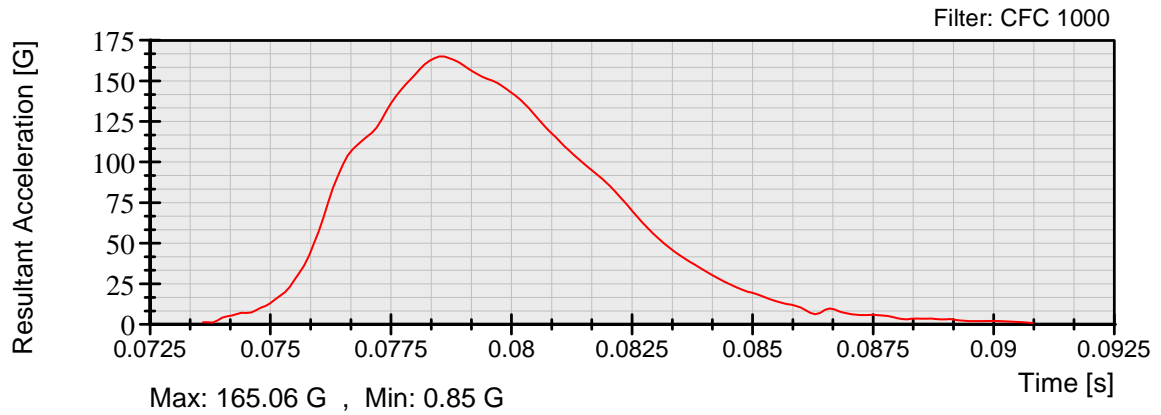
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Date: 07/21/15

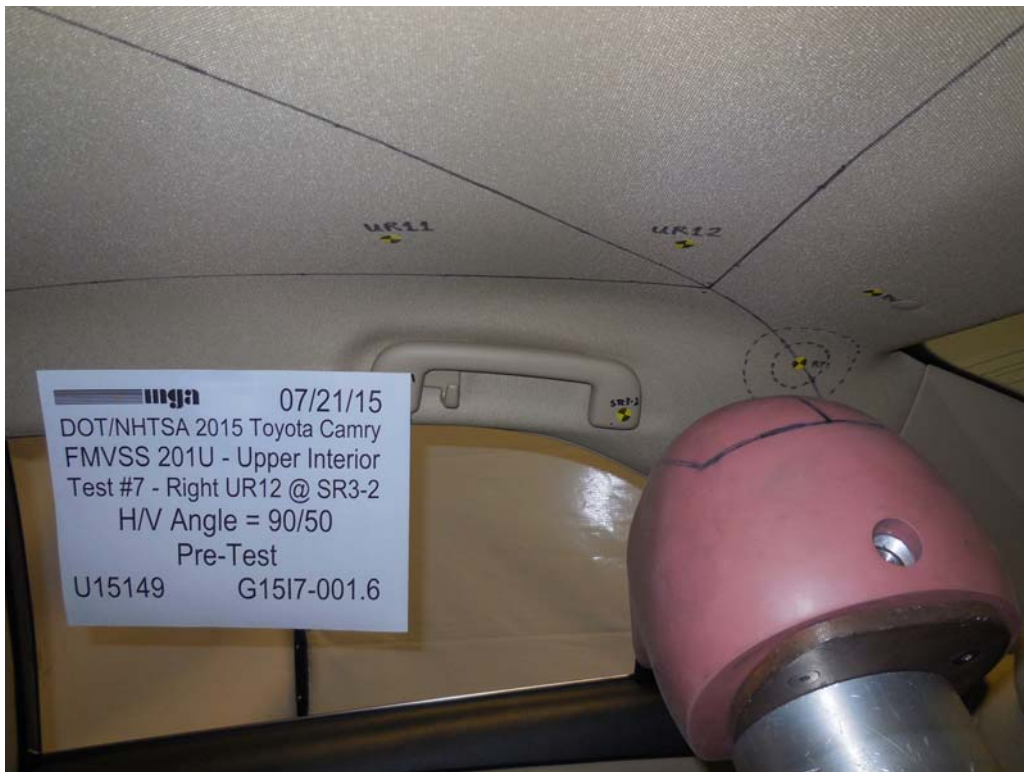
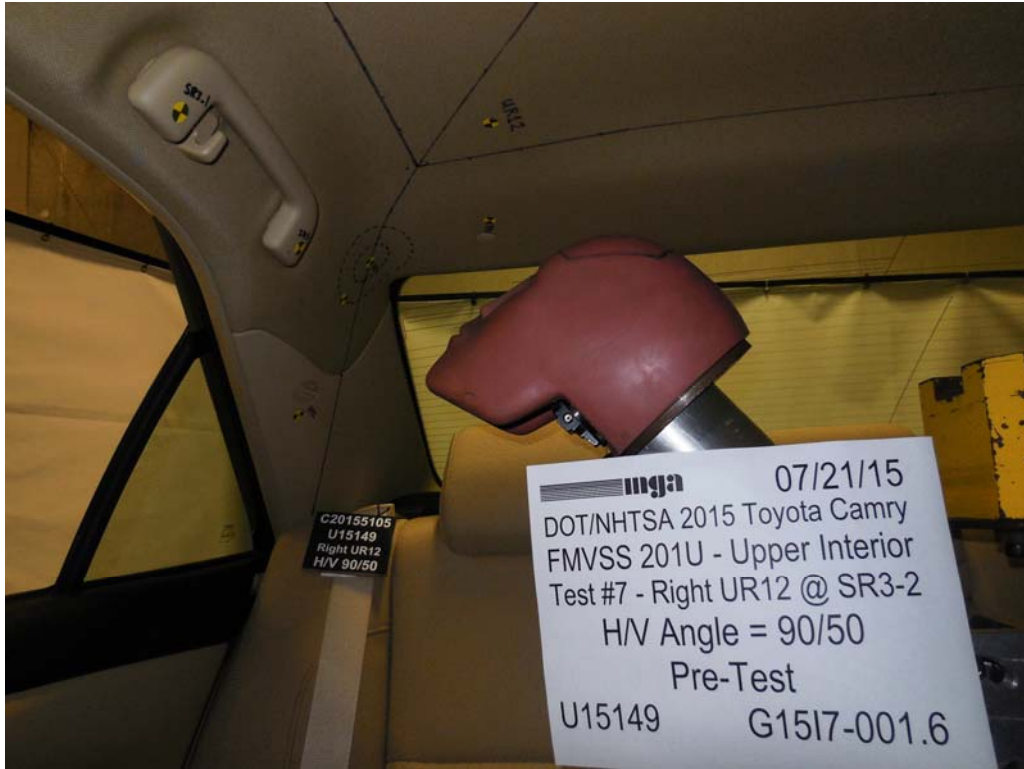


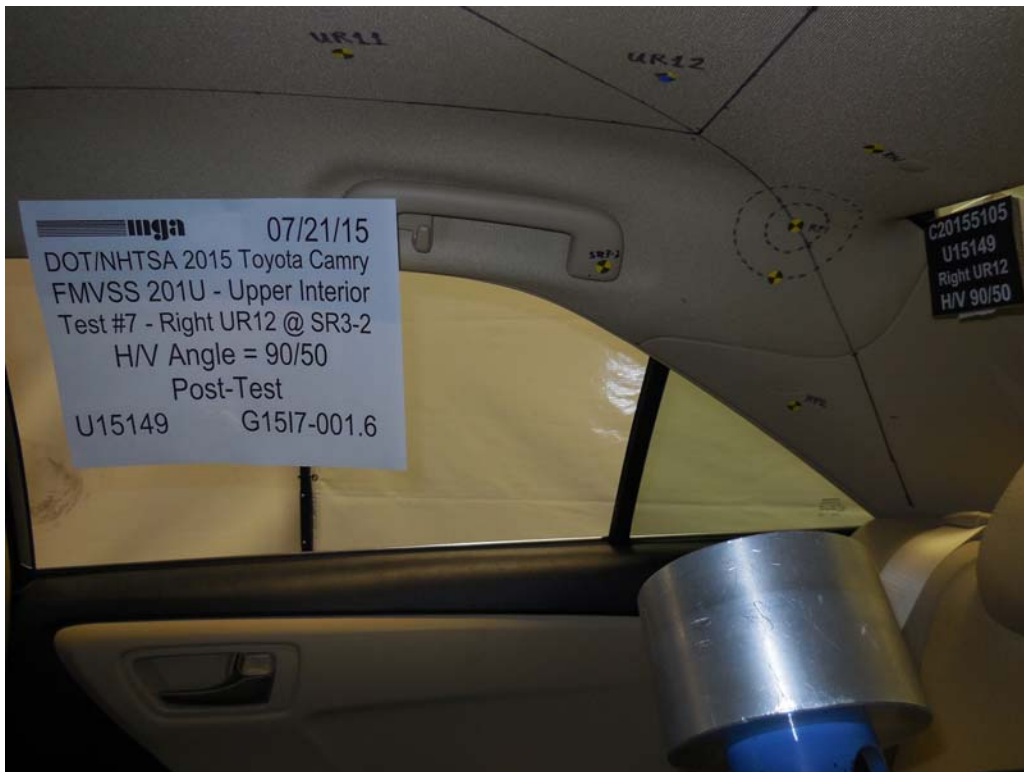
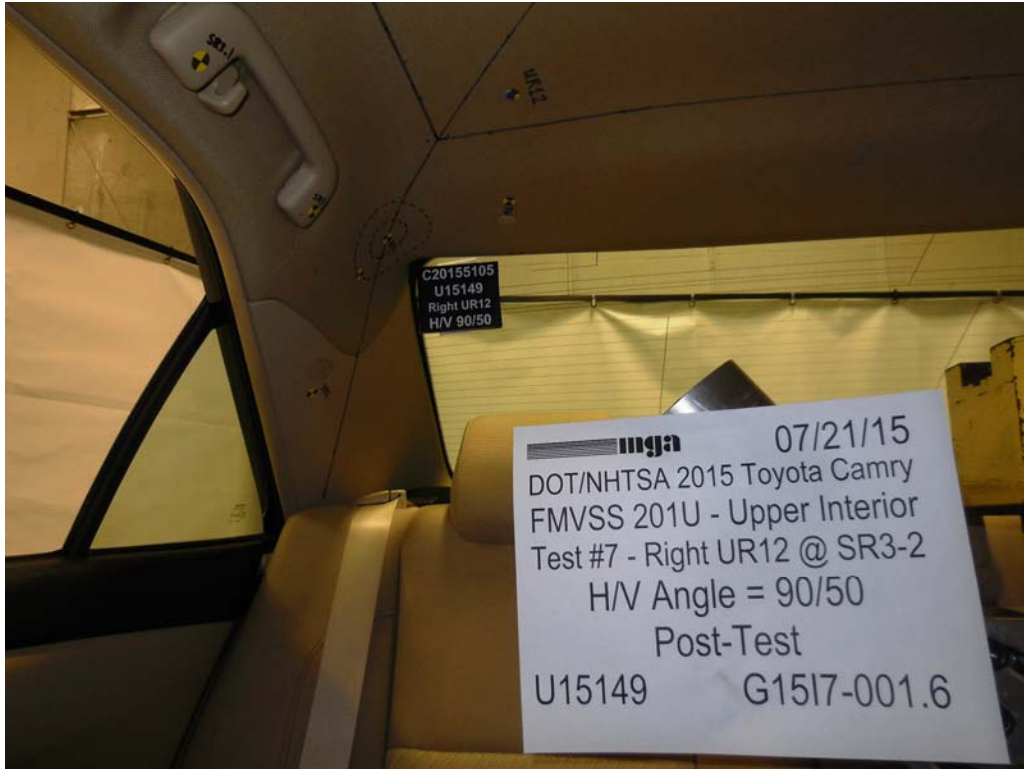


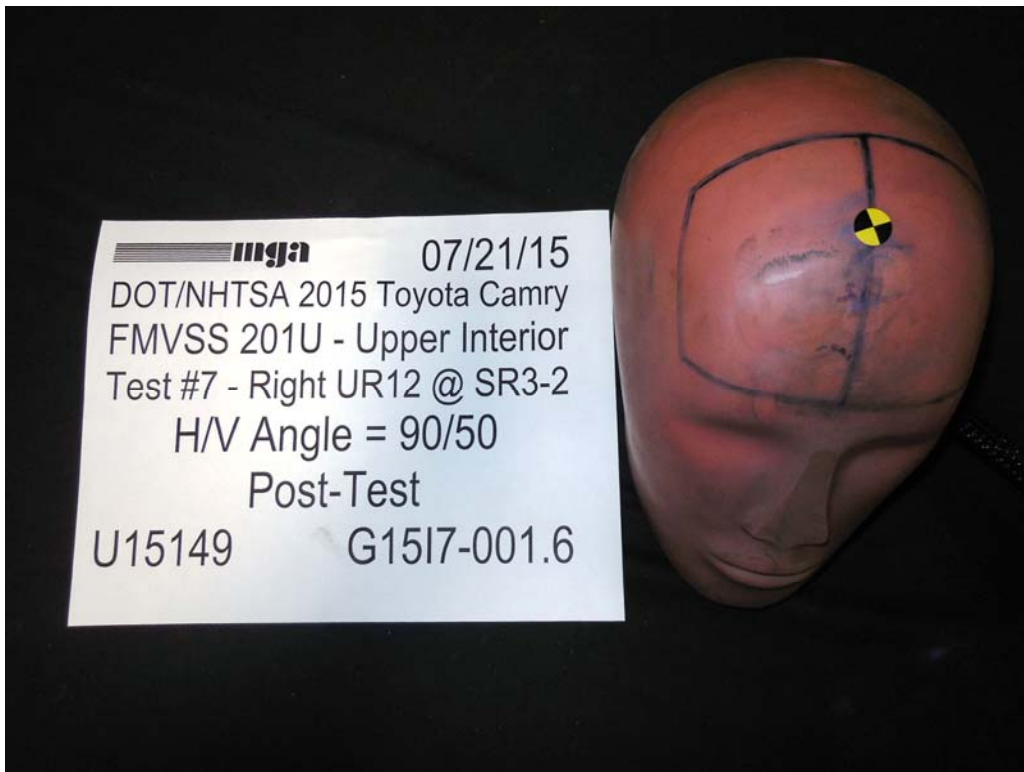
FMVSS 201U
Test No.: U15149
Customer: NHTSA

Report No.: G15I7-001.6
Date: 07/21/15









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)	TDAS	LM0321	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	P08-05-10-26072	Targeting	0.1 mm	Annual
Measuring Devices: - Tape Measure - Plumb Bobs - Digital Protractor	Stanley N/A Mitutoyo	TPM001-70 -- MGA00821	Measurement Targeting FMH setup Horizontal Measurement	1 mm N/A 0.5°	Annual
*Temperature/RH Data Logger	Omega	0514B1305F	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 (kg)	Temp (°C)	% Humidity	Peak Resultant Acceleration (G's)	Peak Lateral Acceleration (G's)	Unimodal
35	Pre	07/20/15	4.51	21.6	44.1	268.15	4.18	Yes
35	Post	07/23/15	4.51	21.6	44.1	260.40	7.04	Yes
37	Pre	07/20/15	4.54	21.1	44.8	272.80	2.57	Yes
37	Post	07/29/15	4.54	20.0	57.8	235.94	1.77	Yes
38	Pre	07/20/15	4.51	21.1	45.3	273.31	12.01	Yes
38	Post	07/29/15	4.51	20.6	53.5	272.32	14.27	Yes
35	Pre	10/19/15	4.51	20.5	26.5	273.63	8.64	Yes
35	Post	10/21/15	4.51	22.9	37.0	262.35	3.54	Yes
37	Pre	10/19/15	4.54	20.4	26.6	260.98	6.55	Yes
37	Post	10/21/15	4.54	22.9	37.4	270.54	7.21	Yes
38	Pre	10/19/15	4.51	20.5	26.6	256.83	14.88	Yes
38	Post	10/21/15	4.51	22.6	38.3	263.86	11.04	Yes

4-1 Pre-Test Calibration

	Calibration Series: FMVSS 201U FMH	
	Test No.: H35012	Report No.: G15I7-001.6
	Customer: NHTSA	Date: 7/20/2015

Summary of Results:

Impact Form ID No.: H35

Item Description	Result	Requirement
Temperature (°C)	21.6 °C	19°C and 26°C
Humidity (%RH)	44.1 % RH	10% to 70% RH
Impact Form Mass (kg)	4.51 kg	4.54 ± 0.05 kg
Resultant Acceleration (G)	268.15 G	225 to 275 G
Peak Y-Acceleration (G)	4.18 G	< 15 G
Unimodal?	Yes	Yes

Calibration Performed By: KR
 Comments: NA

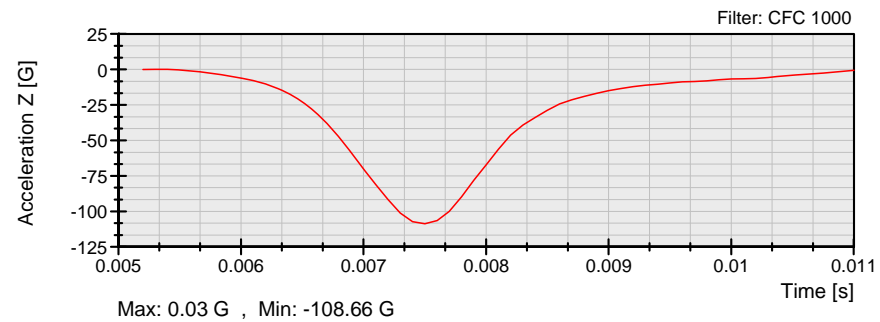
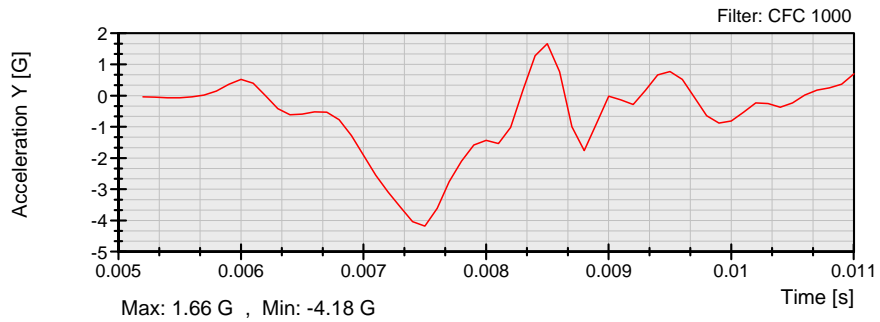
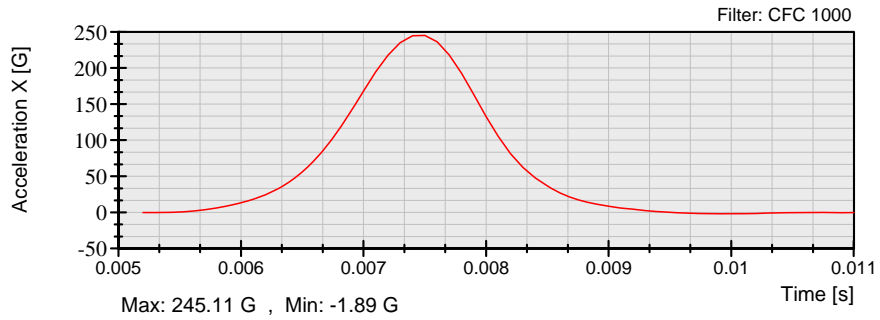
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Page 1 of 2

Calibration Series: FMVSS 201U FMH

Test No: H35012
Customer: NHTSA

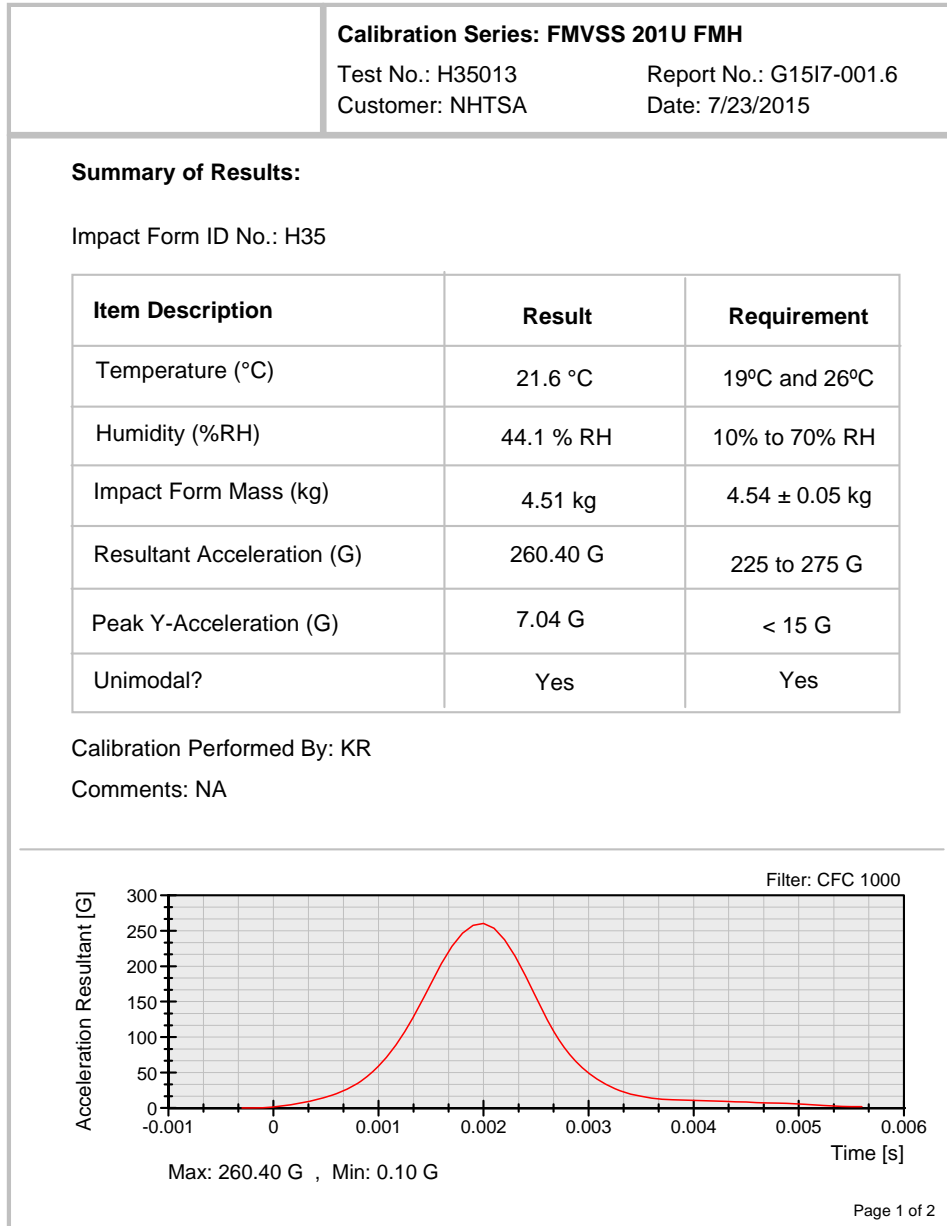
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Date: 7/20/2015



Recorded By: *Dail B...*
Date: July 20, 2015

Approved By: *Ben J...*

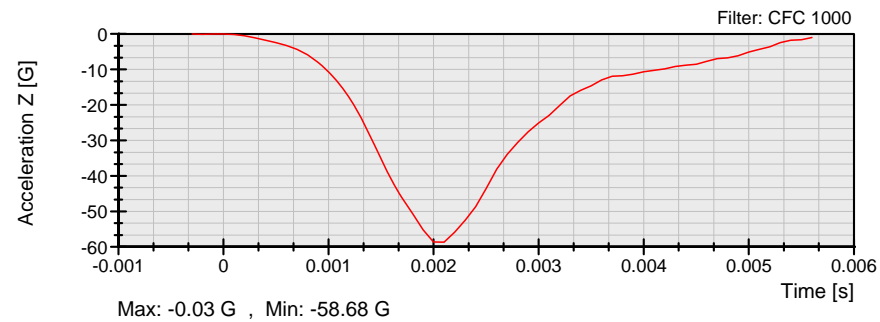
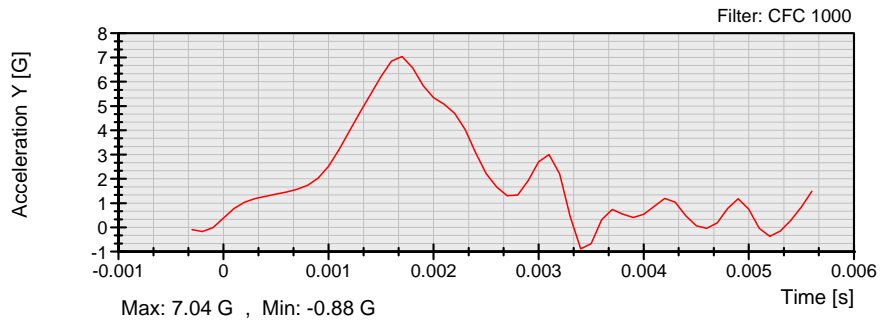
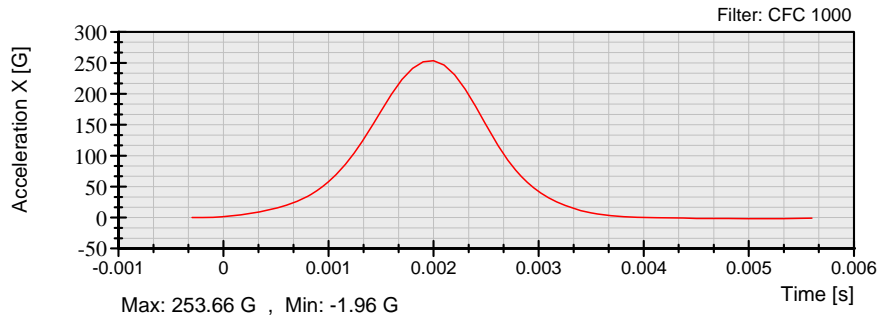
4-2 Post-Test Calibration



Calibration Series: FMVSS 201U FMH

Test No: H35013
Customer: NHTSA

Report No.: G15I7-001.6
Date: 7/23/2015



Recorded By: *Dave B...*
Date: July 23, 2015

Approved By: *Ben J...*

4-3 Pre-Test Calibration

Calibration Series: FMVSS 201U FMH	
Test No.: H37011	Report No.: G15I7-001.6
Customer: NHTSA	Date: 7/20/2015

Summary of Results:

Impact Form ID No.: H37

Item Description	Result	Requirement
Temperature (°C)	21.1 °C	19°C and 26°C
Humidity (%RH)	44.8 % RH	10% to 70% RH
Impact Form Mass (kg)	4.54 kg	4.54 ± 0.05 kg
Resultant Acceleration (G)	272.80 G	225 to 275 G
Peak Y-Acceleration (G)	2.57 G	< 15 G
Unimodal?	Yes	Yes

Calibration Performed By: KR
 Comments: NA

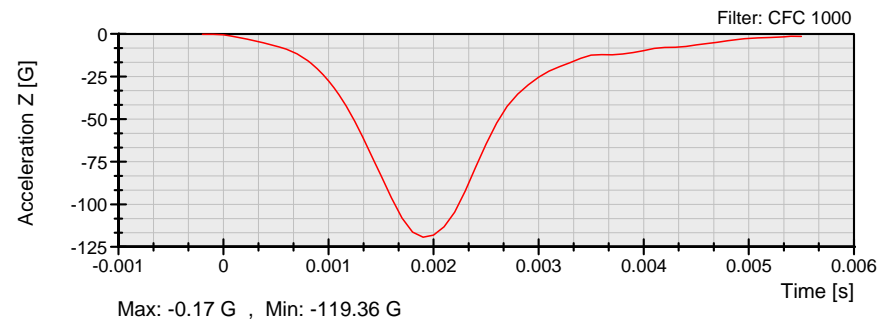
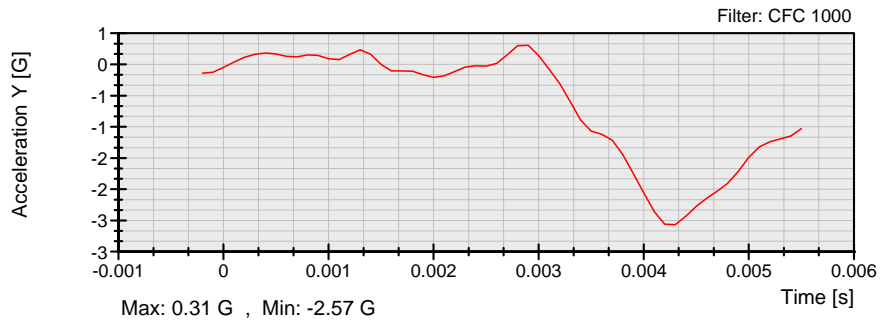
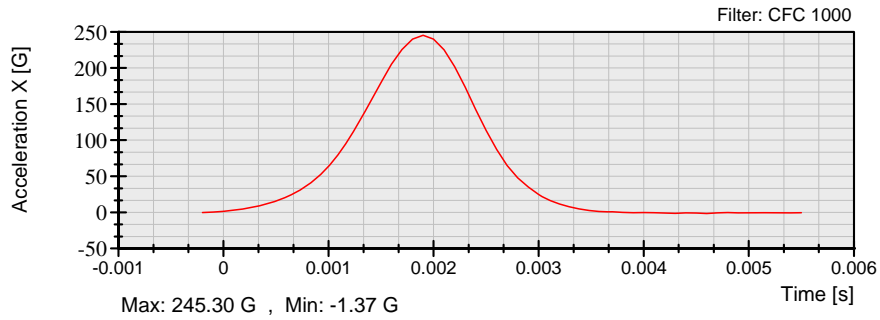
Max: 272.80 G , Min: 0.23 G

Page 1 of 2

Calibration Series: FMVSS 201U FMH

Test No: H37011
Customer: NHTSA

Report No.: G15I7-001.6
Date: 7/20/2015



Recorded By: *Dail B...*
Date: July 20, 2015

Approved By: *Sean J...*

4-4 Post-Test Calibration

	Calibration Series: FMVSS 201U FMH	
	Test No.: H37012	Report No.: G15I7-001.6
	Customer: NHTSA	Date: 7/29/2015

Summary of Results:

Impact Form ID No.: H37

Item Description	Result	Requirement
Temperature (°C)	20.0 °C	19°C and 26°C
Humidity (%RH)	57.8 % RH	10% to 70% RH
Impact Form Mass (kg)	4.54 kg	4.54 ± 0.05 kg
Resultant Acceleration (G)	235.94 G	225 to 275 G
Peak Y-Acceleration (G)	1.77 G	< 15 G
Unimodal?	Yes	Yes

Calibration Performed By: KR
 Comments: NA

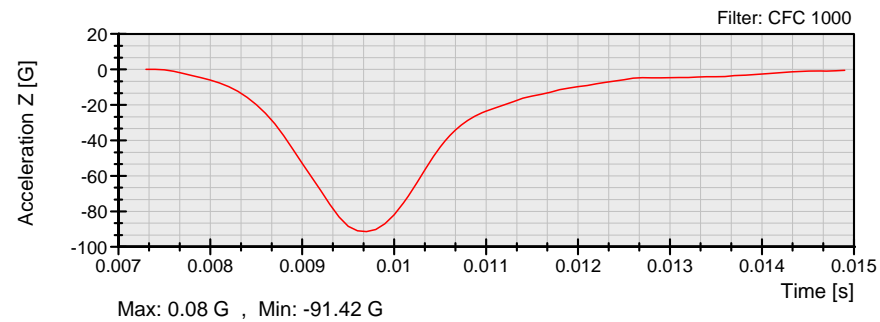
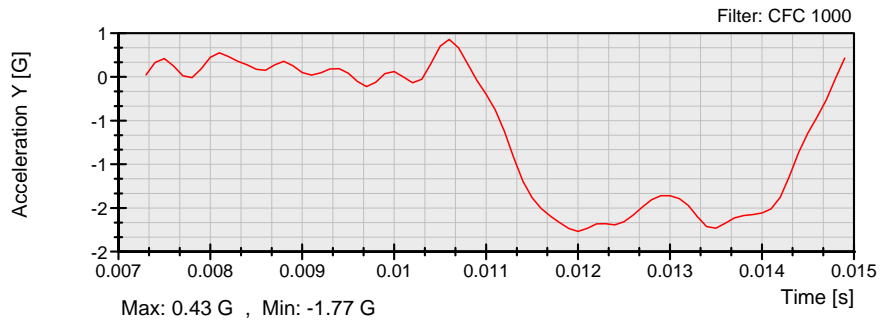
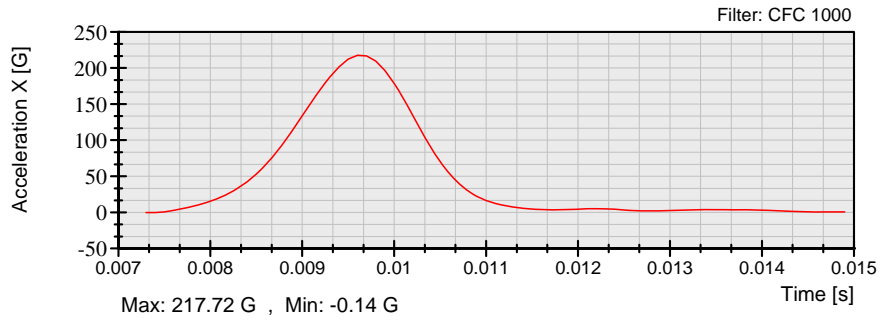
Max: 235.94 G , Min: 0.16 G

Page 1 of 2

Calibration Series: FMVSS 201U FMH

Test No: H37012
Customer: NHTSA

Report No.: G15I7-001.6
Date: 7/29/2015



Recorded By: *Dail B...*
Date: July 20, 2015

Approved By: *Ben J...*

4-5 Pre-Test Calibration

	Calibration Series: FMVSS 201U FMH	
	Test No.: H38012	Report No.: G15I7-001.6
	Customer: NHTSA	Date: 7/20/2015

Summary of Results:

Impact Form ID No.: H38

Item Description	Result	Requirement
Temperature (°C)	21.1 °C	19°C and 26°C
Humidity (%RH)	45.3 % RH	10% to 70% RH
Impact Form Mass (kg)	4.51 kg	4.54 ± 0.05 kg
Resultant Acceleration (G)	273.31 G	225 to 275 G
Peak Y-Acceleration (G)	12.01 G	< 15 G
Unimodal?	Yes	Yes

Calibration Performed By: KR
 Comments: NA

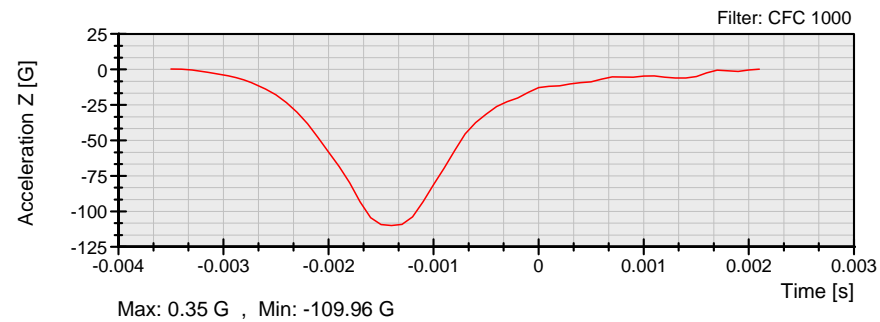
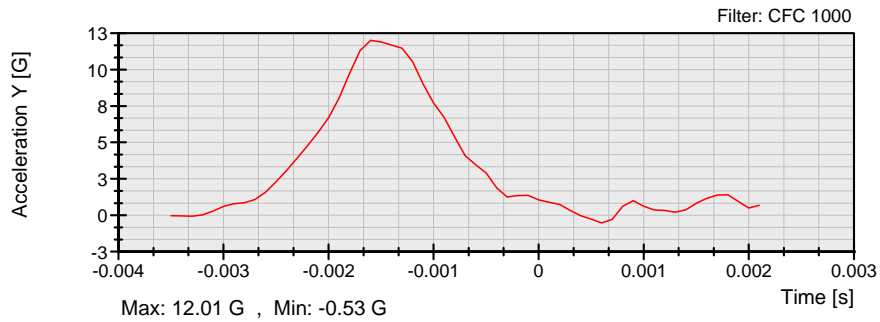
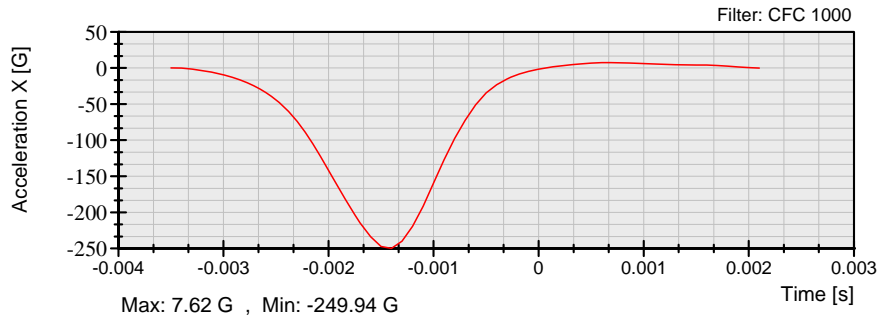
Max: 273.31 G , Min: 0.34 G

Page 1 of 2

Calibration Series: FMVSS 201U FMH

Test No: H38012
Customer: NHTSA

Report No.: G15I7-001.6
Date: 7/20/2015



Recorded By: *Dail B...*
Date: July 20, 2015

Approved By: *Sam J...*

4-6 Post-Test Calibration

	Calibration Series: FMVSS 201U FMH	
	Test No.: H38012	Report No.: G15I7-001.6
	Customer: NHTSA	Date: 7/29/2015

Summary of Results:

Impact Form ID No.: H38

Item Description	Result	Requirement
Temperature (°C)	20.6 °C	19°C and 26°C
Humidity (%RH)	53.5 % RH	10% to 70% RH
Impact Form Mass (kg)	4.51 kg	4.54 ± 0.05 kg
Resultant Acceleration (G)	272.32 G	225 to 275 G
Peak Y-Acceleration (G)	14.27 G	< 15 G
Unimodal?	Yes	Yes

Calibration Performed By: KR
 Comments: NA

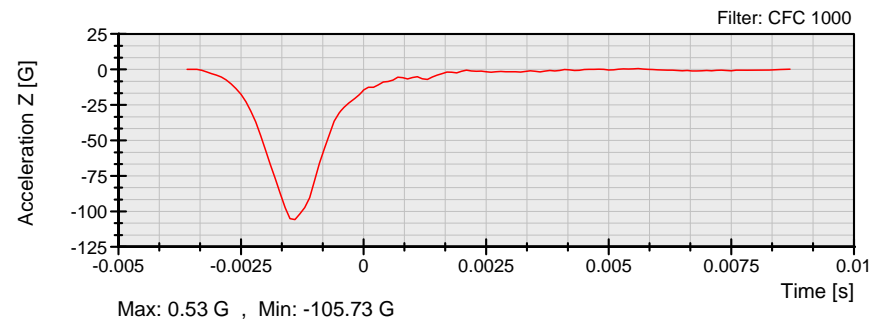
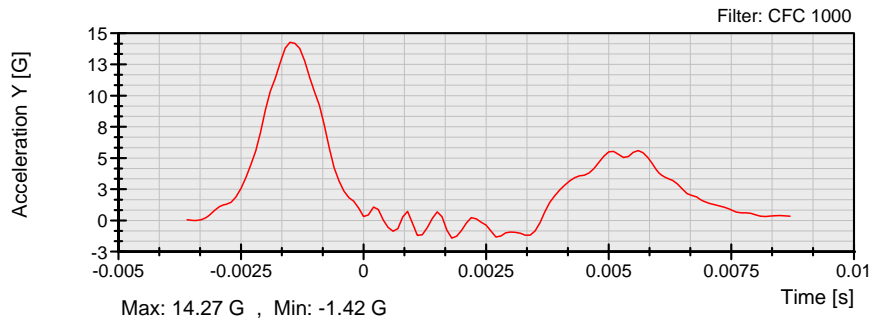
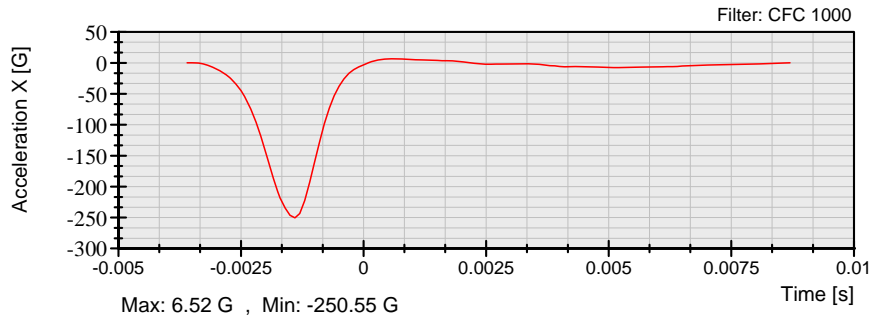
Max: 272.32 G , Min: 0.02 G

Page 1 of 2

Calibration Series: FMVSS 201U FMH

Test No: H38012
Customer: NHTSA

Report No.: G15I7-001.6
Date: 7/29/2015



Recorded By: *Dan B...*
Date: July 29, 2015

Approved By: *Sean J...*

4-7 Pre-Test Calibration

	Calibration Series: FMVSS 201U FMH	
	Test No.: H35025	Report No.: G15I7-001.6
	Customer: NHTSA	Date: 10/19/2015

Summary of Results:

Impact Form ID No.: H35

Item Description	Result	Requirement
Temperature (°C)	20.5 °C	19°C and 26°C
Humidity (%RH)	26.5 % RH	10% to 70% RH
Impact Form Mass (kg)	4.51 kg	4.54 ± 0.05 kg
Resultant Acceleration (G)	273.63 G	225 to 275 G
Peak Y-Acceleration (G)	8.64 G	< 15 G
Unimodal?	Yes	Yes

Calibration Performed By: KR
 Comments: NA

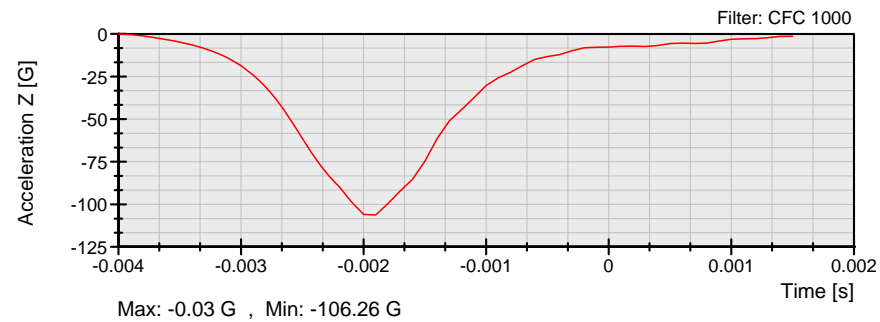
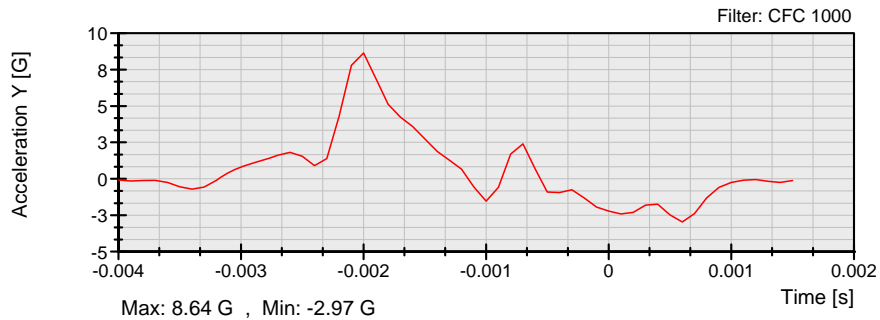
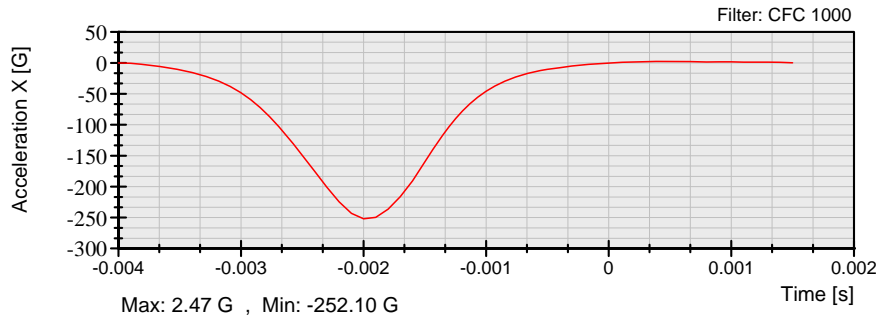
Max: 273.63 G , Min: 0.17 G

Page 1 of 2

Calibration Series: FMVSS 201U FMH

Test No: H35025
Customer: NHTSA

Report No.: G15I7-001.6
Date: 10/19/2015



Recorded By: *Dail Br...*

Approved By: *Ben J...*

Date: October 19, 2015

4-8 Post-Test Calibration

	Calibration Series: FMVSS 201U FMH	
	Test No.: H35026	Report No.: G1517-001.6
	Customer: NHTSA	Date: 10/21/2015

Summary of Results:

Impact Form ID No.: H35

Item Description	Result	Requirement
Temperature (°C)	22.9 °C	19°C and 26°C
Humidity (%RH)	37 % RH	10% to 70% RH
Impact Form Mass (kg)	4.51 kg	4.54 ± 0.05 kg
Resultant Acceleration (G)	262.35 G	225 to 275 G
Peak Y-Acceleration (G)	3.54 G	< 15 G
Unimodal?	Yes	Yes

Calibration Performed By: KR
 Comments: NA

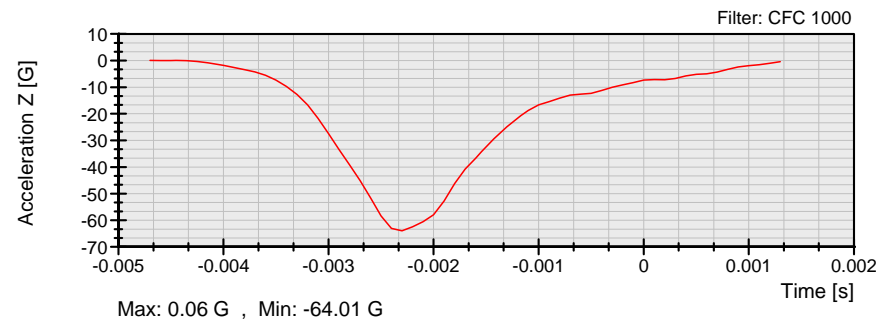
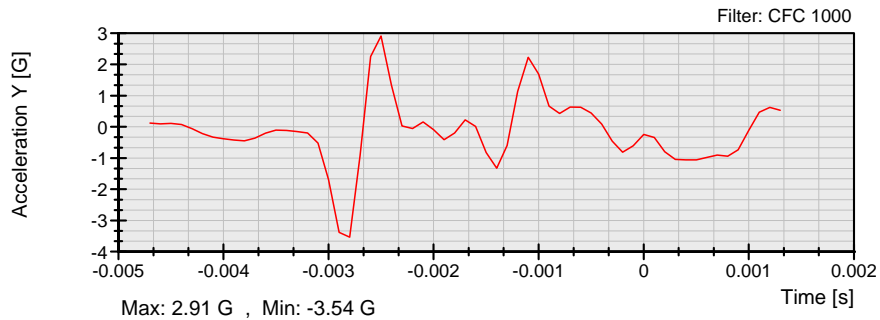
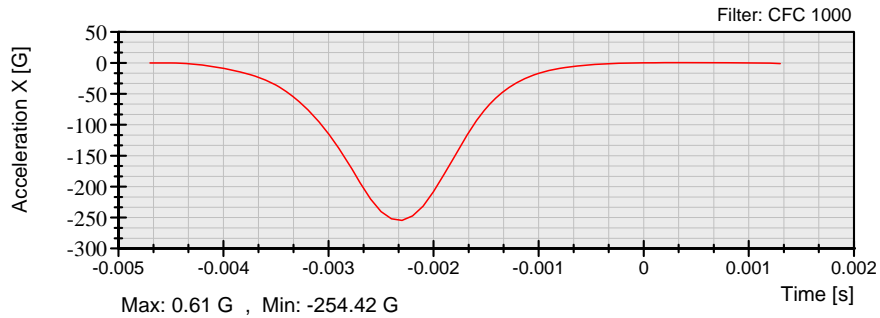
Max: 262.35 G , Min: 0.10 G

Page 1 of 2

Calibration Series: FMVSS 201U FMH

Test No: H35026
Customer: NHTSA

Report No.: G15I7-001.6
Date: 10/21/2015



Recorded By: *Dan B...*

Approved By: *Sam J...*

Date: October 21, 2015

4-9 Pre-Test Calibration

	Calibration Series: FMVSS 201U FMH	
	Test No.: H37023	Report No.: G15I7-001.6
	Customer: NHTSA	Date: 10/19/2015

Summary of Results:

Impact Form ID No.: H37

Item Description	Result	Requirement
Temperature (°C)	20.4 °C	19°C and 26°C
Humidity (%RH)	26.6 % RH	10% to 70% RH
Impact Form Mass (kg)	4.54 kg	4.54 ± 0.05 kg
Resultant Acceleration (G)	260.98 G	225 to 275 G
Peak Y-Acceleration (G)	6.55 G	< 15 G
Unimodal?	Yes	Yes

Calibration Performed By: KR
 Comments: NA

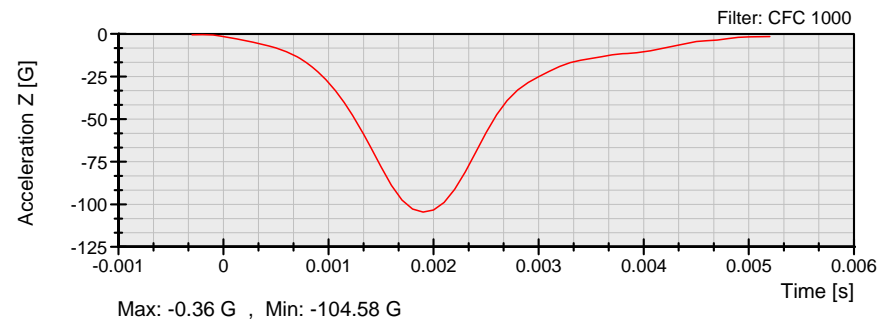
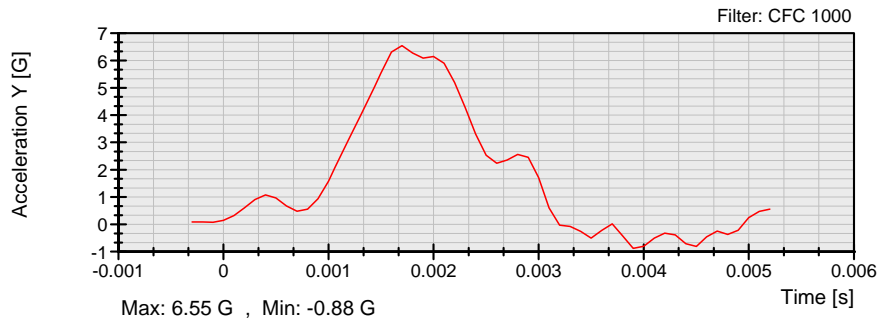
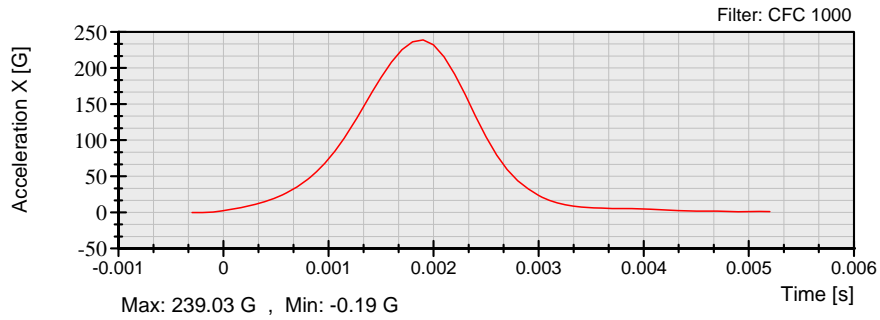
Max: 260.98 G , Min: 0.40 G

Page 1 of 2

Calibration Series: FMVSS 201U FMH

Test No: H37023
Customer: NHTSA

Report No.: G15I7-001.6
Date: 10/19/2015



Recorded By: *Dail B...*
Date: October 19, 2015

Approved By: *Sean J...*

4-10 Post-Test Calibration

	Calibration Series: FMVSS 201U FMH	
	Test No.: H37024	Report No.: G15I7-001.6
	Customer: NHTSA	Date: 10/21/2015

Summary of Results:

Impact Form ID No.: H37

Item Description	Result	Requirement
Temperature (°C)	22.9 °C	19°C and 26°C
Humidity (%RH)	37.4 % RH	10% to 70% RH
Impact Form Mass (kg)	4.54 kg	4.54 ± 0.05 kg
Resultant Acceleration (G)	270.54 G	225 to 275 G
Peak Y-Acceleration (G)	7.21 G	< 15 G
Unimodal?	Yes	Yes

Calibration Performed By: KR
 Comments: NA

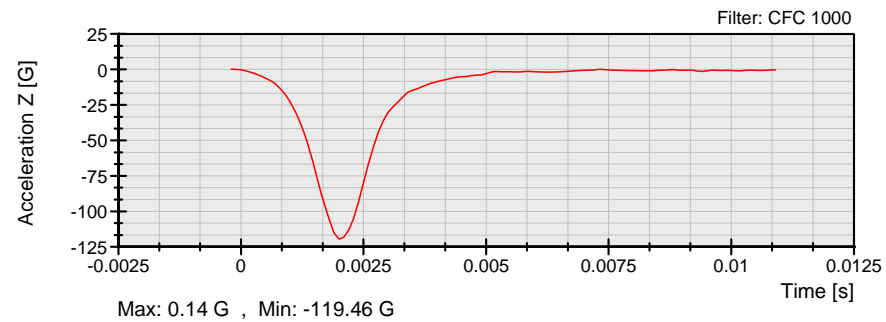
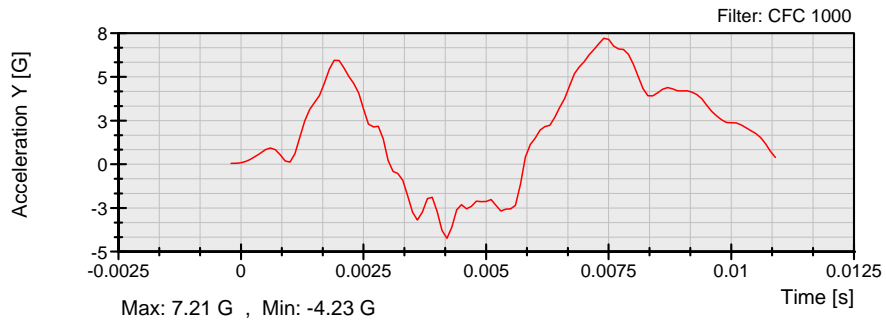
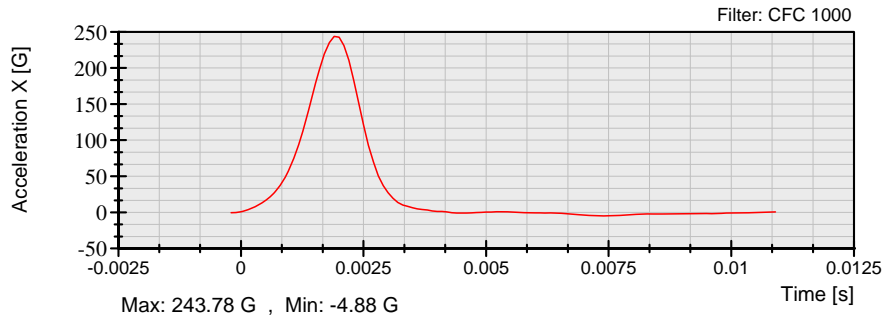
Max: 270.54 G , Min: 0.09 G

Page 1 of 2

Calibration Series: FMVSS 201U FMH

Test No: H37024
Customer: NHTSA

Report No.: G15I7-001.6
Date: 10/21/2015



Recorded By: *Dan B...*
Date: October 21, 2015

Approved By: *Sean J...*

4-11 Pre-Test Calibration

	Calibration Series: FMVSS 201U FMH	
	Test No.: H38024	Report No.: G15I7-001.6
	Customer: NHTSA	Date: 10/19/2015

Summary of Results:

Impact Form ID No.: H38

Item Description	Result	Requirement
Temperature (°C)	20.5 °C	19°C and 26°C
Humidity (%RH)	26.6 % RH	10% to 70% RH
Impact Form Mass (kg)	4.51 kg	4.54 ± 0.05 kg
Resultant Acceleration (G)	256.83 G	225 to 275 G
Peak Y-Acceleration (G)	14.88 G	< 15 G
Unimodal?	Yes	Yes

Calibration Performed By: KR
 Comments: NA

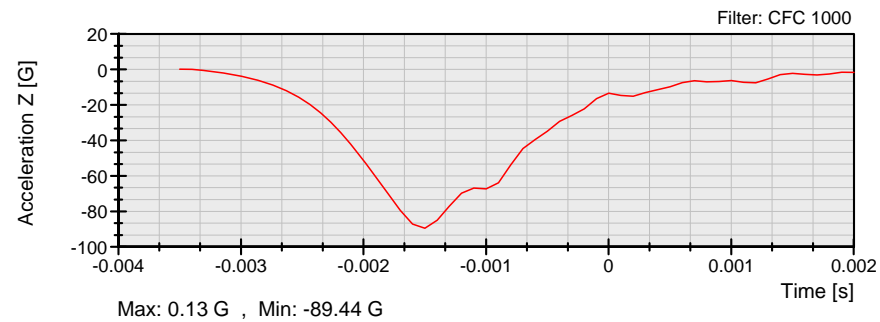
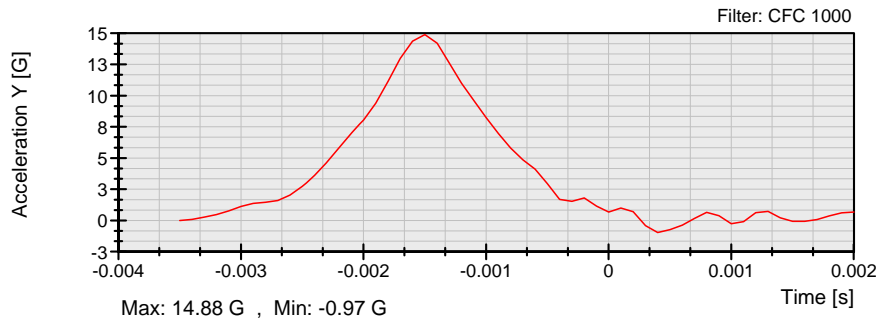
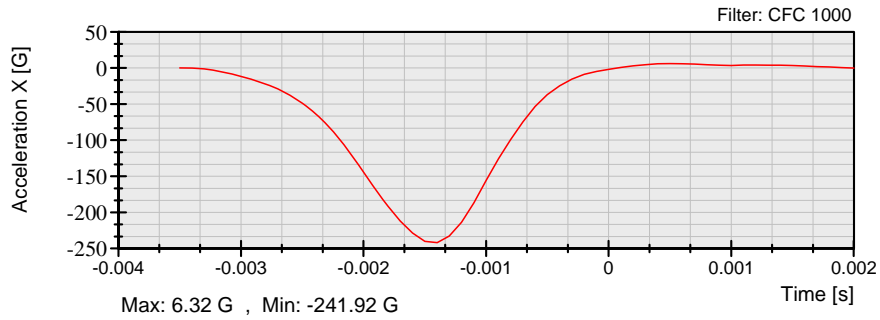
Max: 256.83 G , Min: 0.10 G

Page 1 of 2

Calibration Series: FMVSS 201U FMH

Test No: H38024
Customer: NHTSA

Report No.: G15I7-001.6
Date: 10/19/2015



Recorded By: *Dail B...*
Date: October 19, 2015

Approved By: *Sean J...*

4-12 Post-Test Calibration

	Calibration Series: FMVSS 201U FMH	
	Test No.: H38025	Report No.: G15I7-001.6
	Customer: NHTSA	Date: 10/21/2015

Summary of Results:

Impact Form ID No.: H38

Item Description	Result	Requirement
Temperature (°C)	22.6 °C	19°C and 26°C
Humidity (%RH)	38.3 % RH	10% to 70% RH
Impact Form Mass (kg)	4.51 kg	4.54 ± 0.05 kg
Resultant Acceleration (G)	263.86 G	225 to 275 G
Peak Y-Acceleration (G)	11.04 G	< 15 G
Unimodal?	Yes	Yes

Calibration Performed By: KR
 Comments: NA

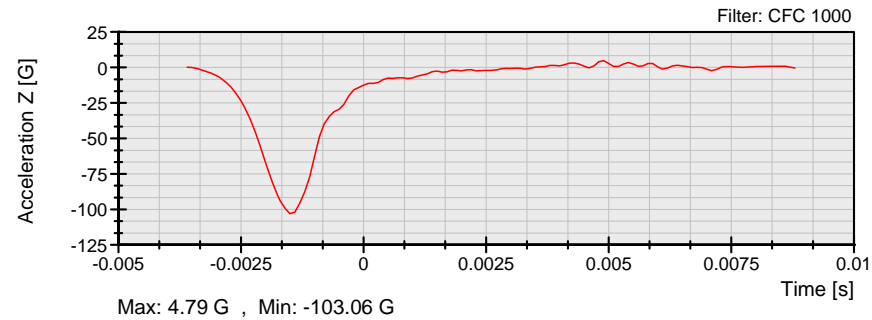
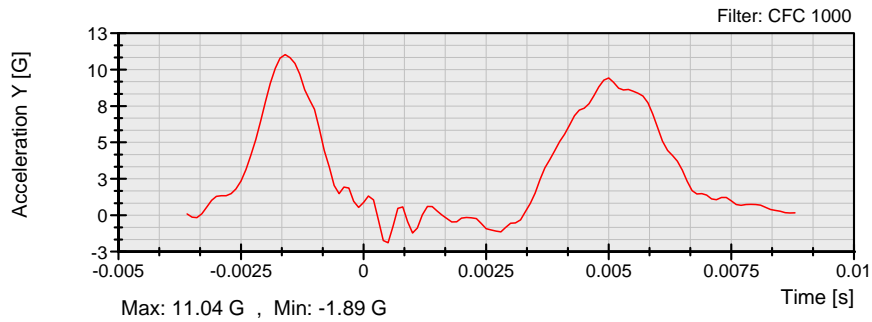
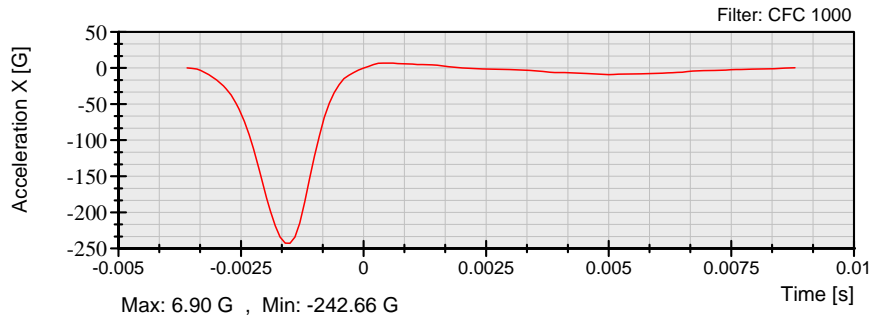
Max: 263.86 G , Min: 0.20 G

Page 1 of 2

Calibration Series: FMVSS 201U FMH

Test No: H38025
Customer: NHTSA

Report No.: G15I7-001.6
Date: 10/21/2015



Recorded By: *Dan B...*
Date: October 21, 2015

Approved By: *Ben J...*

5.0 PHOTOGRAPHS



As Delivered – Left Side View



As Delivered – Right Side View



As Delivered – 3/4 Front View From Left Side



As Delivered – 3/4 Rear View From Right Side

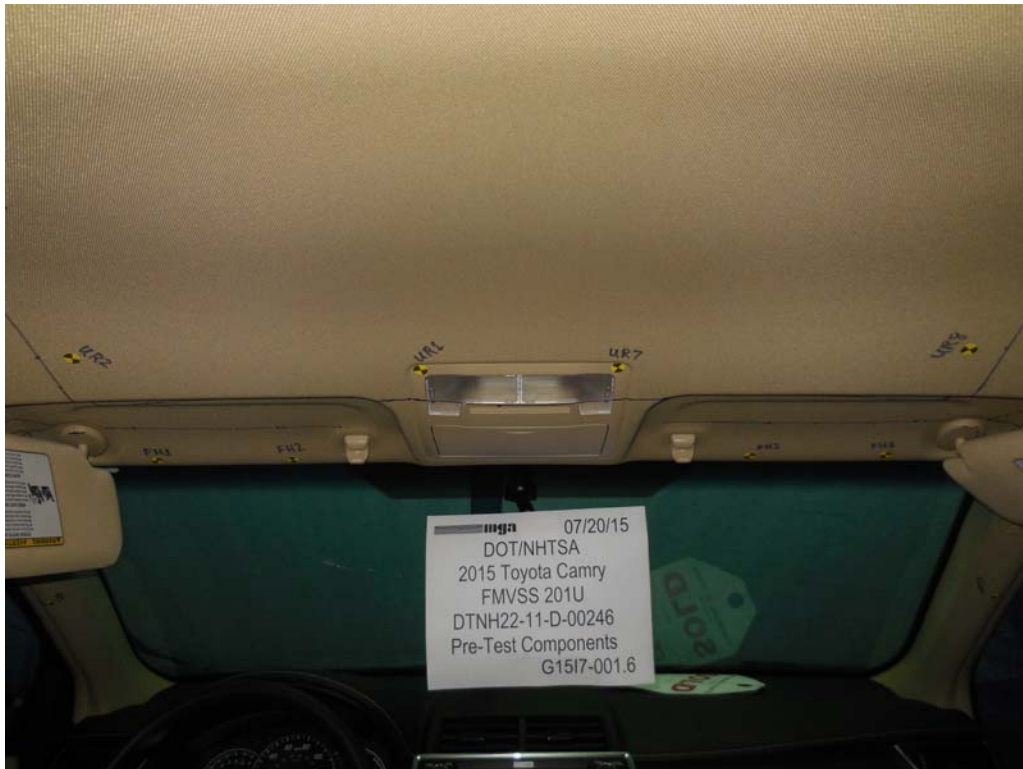


As Delivered – Vehicle’s Certification Label

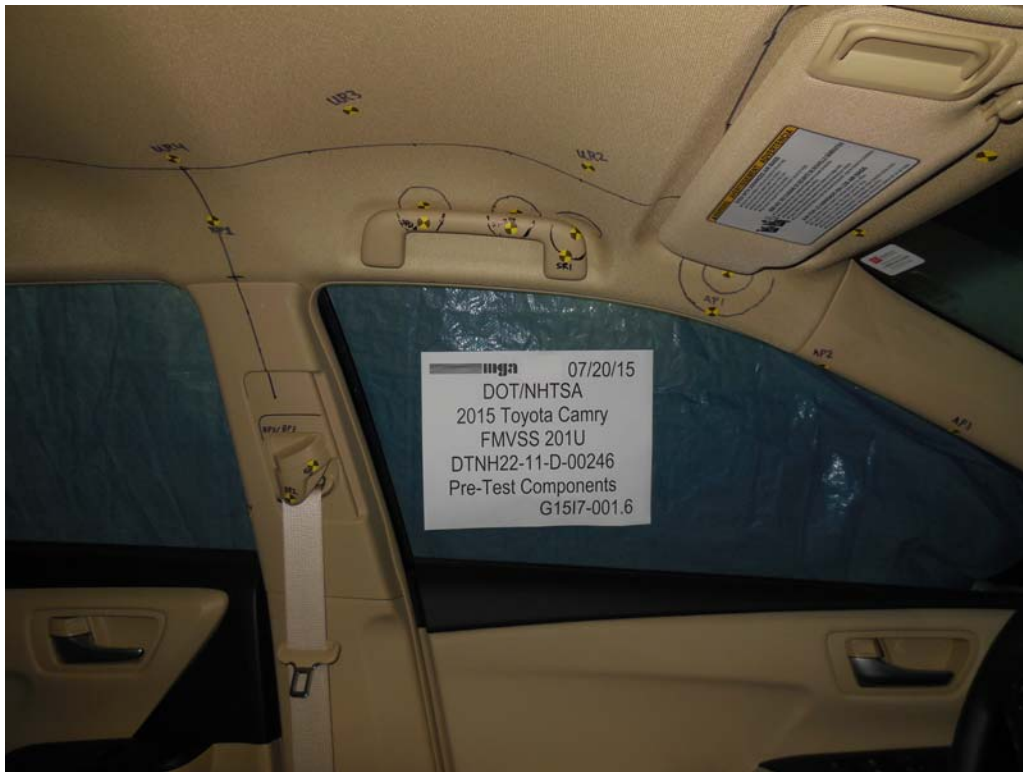
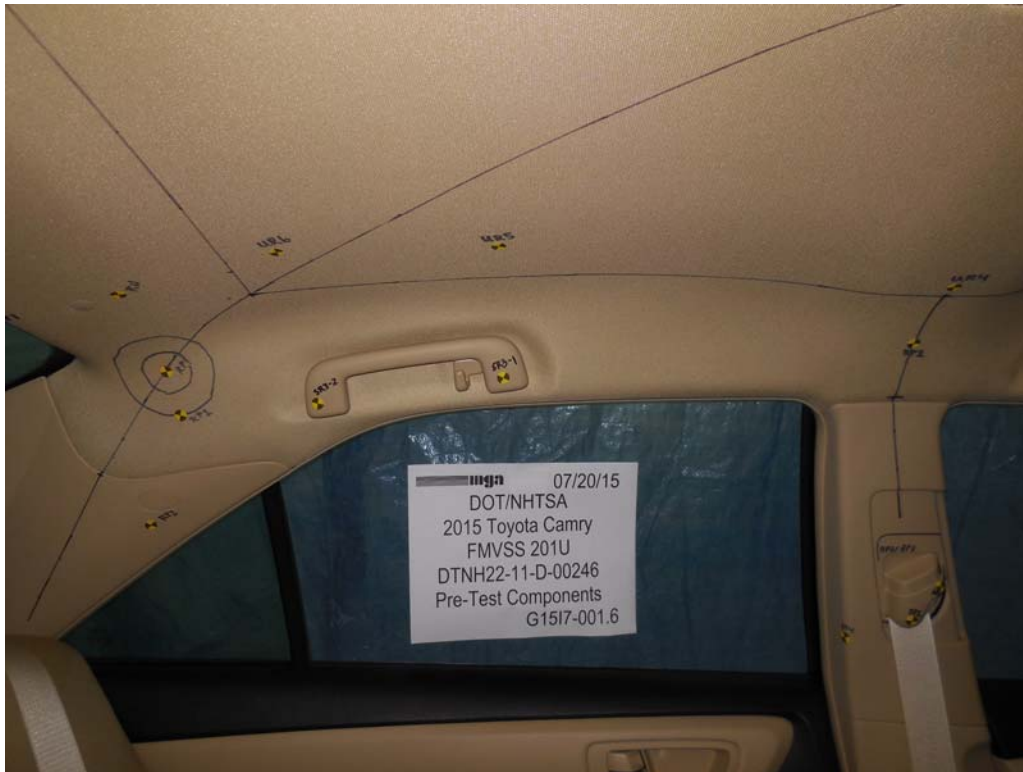


As Delivered – Vehicle’s Tire Information Label

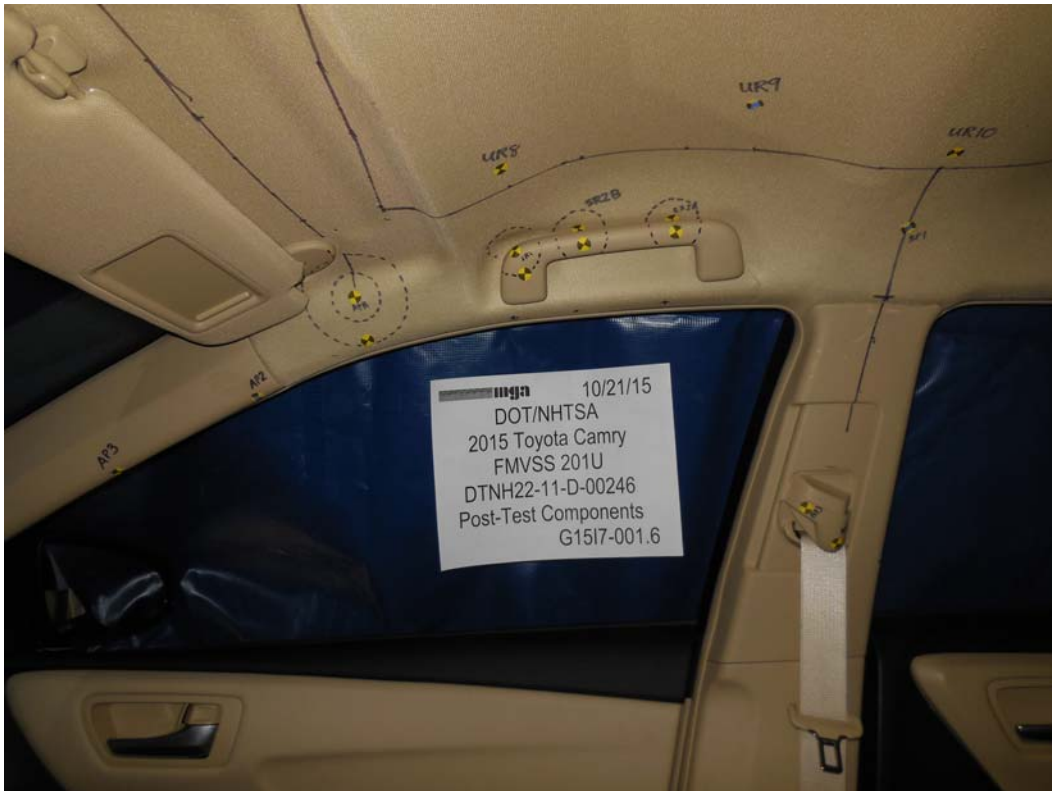
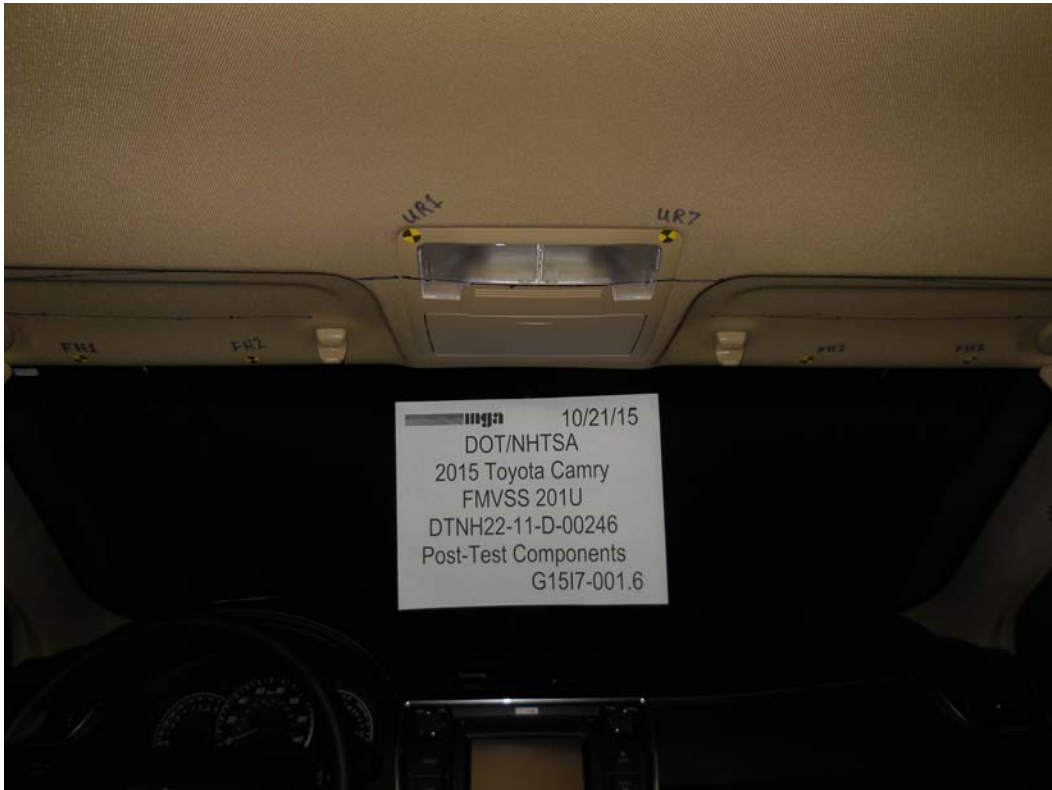
Pre-Test Component Photographs







Post-Test Component Photographs







6.0 TEST VEHICLE FAILURE NOTICE

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16. FORMS....Continued

LABORATORY NOTICE OF APPARENT TEST FAILURE TO OVSC

FMVSS NO.: 201U

TEST DATE: 7/21/15

LABORATORY: MCA Research

CONTRACT NO.: DTNH22-11-D00246L; DELV. ORDER NO: 0017

LABORATORY PROJECT ENGINEER'S NAME: Sean Fortnam

TEST SPECIMEN DESCRIPTION: 2015 Toyota Camry

VEHICLE NHTSA NO.: C20155105 VIN: 4T4BF1FK4ER489589

MFR: Toyota

APPARENT TEST FAILURE DESCRIPTION: HIC (d) value of 1018.98
on an impact of UR12 @ SR3-2 on the right
side of vehicle

FMVSS REQUIREMENT, PARAGRAPH S.7: "The HIC (d) shall not exceed
1000 when calculated in accordance with the following formula:

$$HIC = \left[\frac{1}{(t_2 + t_1)} \int_{t_1}^{t_2} a dt \right]^{2.5} (t_2 - t_1) "$$

NOTIFICATION TO NHTSA (COTR): Karen Nuschler

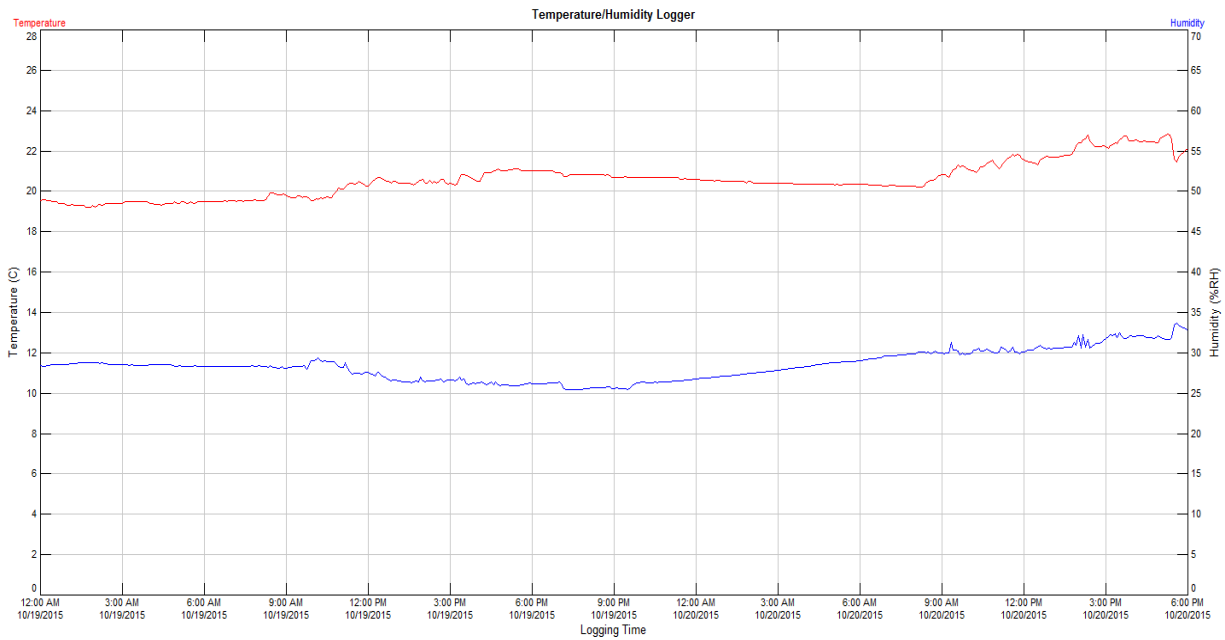
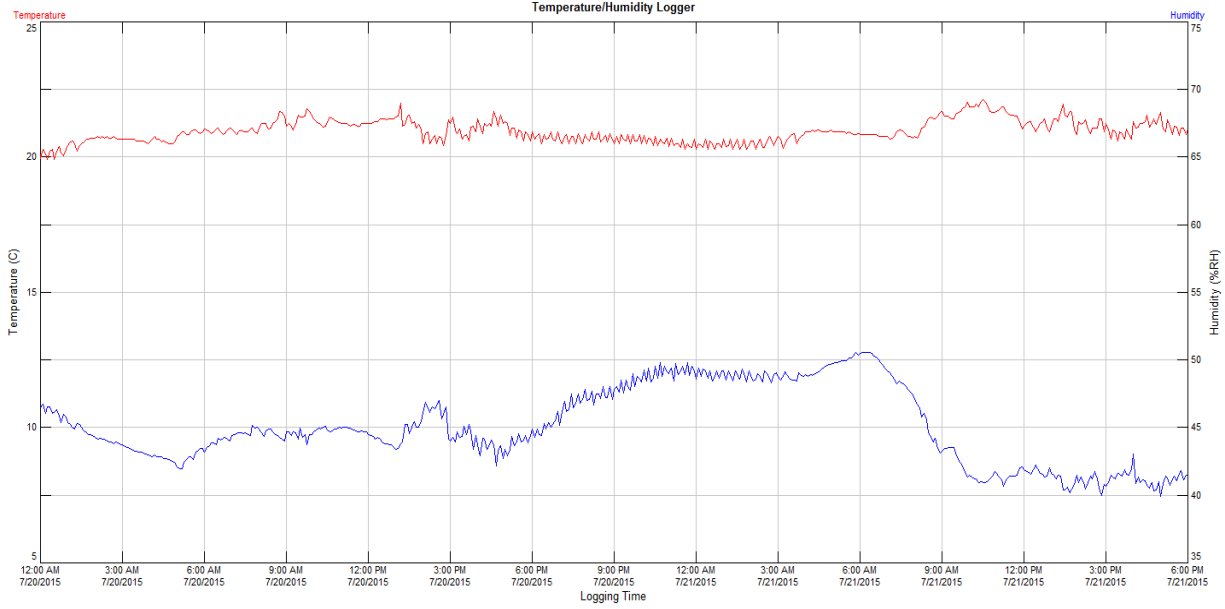
DATE: 8/6/15

BY: Sean Fortnam

REMARKS: Notice submitted after test deemed a failure.

Appendix A – Temperature Trace

C20155105 2015 Toyota Camry FMVSS 201U



Appendix B – Calibration Certificates



Calibration Certificate



35200 Plymouth Rd. / Livonia, MI 48150



Certificate # Z54778:103835

PCB 352C03 ACCELEROMETER	
SERIAL NUMBER: 95980	WORK ORDER: TC081814009
ASSET NUMBER: Z54778	TEST RESULT: PASS
CUST ASSET NUMBER: N/A	PERFORMED ON: 08/18/14
PROCEDURE NAME: MOD 9150	CAL DUE DATE: 08/18/15
PROCEDURE REV: D	DATA TYPE: FOUND-LEFT
CALIBRATED BY: Thomas Cairns	TEMPERATURE: 23.00 °C
CUSTOMER: MGA RESEARCH 446 EXECUTIVE DRIVE TROY, MI 48083	HUMIDITY: 47 %
PRIMARY CONTACT: SCOTT ARSEN	

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 ISO/IEC 17025:2005 and ANSI/INCSL 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	REMARKS:
AS RETURNED CONDITION: IN TOLERANCE	
ACTION TAKEN: FULL CALIBRATION	

Standards Used

Asset #	Cert #	Description	Cal Date	Due Date
002664	002664:1091515041	VERITEQ 5000A-RH/T RH/TEMPERATURE DATA LOGGER	03/18/2014	03/18/2015
1727	1727:1193650836	MODAL SHOP 9150C ACCELEROMETER CAL SYSTEM	10/29/2013	10/29/2014

QA Signature:  Date: 8/20/2014

8/22/2014


- Calibration Certificate -

ID Number TC081814009
 Manufacturer PCB
 Model No. 352C03
 Serial No. 95980

Uncertainty @95%K=2; 2.1% @ 5-2000Hz, 2.7 @ 2-10KHz

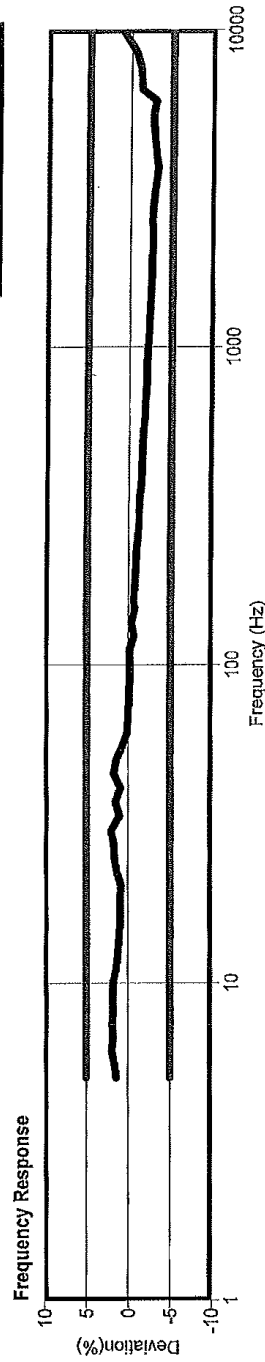
Key Specifications:
 Range 500 +/- g
 Resolution .00005 g
 Temperature Range -65/+260 °F

Calibration Data:
 Voltage Sensitivity 9.950 mV/g
 Test Accel. Level 1 g

Deviation Table	
Frequency(Hz)	Deviation(%)
5	1.370
10	1.770
15	0.968
30	2.048
50	1.448
100	0.000
300	-1.191
500	-1.644
1000	-2.174
3000	-2.780
5000	-2.676
7000	0.000
10000	1.121

Ref Freq.

Notes:



NovaStar Solutions
 Metrology Management Services

Calibration Date: 08/18/2014
 Due Date:
 Calibrated by: Tom Cairns



Certificate of Calibration

Test Accelerometer:

Serial No.: J22700
Model No.: Endevco 7264-2000TZ
Capacity (G's): 500
Calibration Date: 5/8/2015
Calibrated By: Scott Arsen
Calibration Time: 12:16:57

Reference Accelerometer:

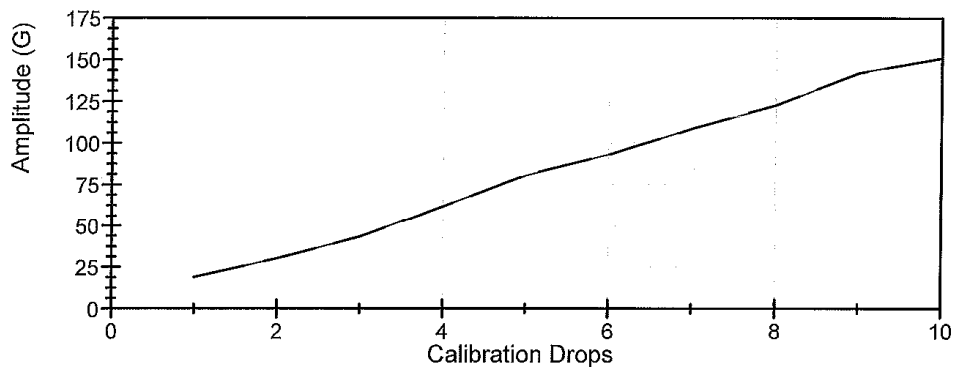
Serial No.: 95980
Model No.: PCB 352C03
Capacity (G's): 250
Calibration Date: 8/18/2014
Calibrated By: Novastar

Certificate No.: J22700_2015-05-08

Sensitivity :	0.0260 mV/V/g	New vs Old	-1.16 %
DLR (100K Shunt):	95.73 g		1.02 %
Excitation Voltage: 10 V		Temperature: 23.7 °C	
Error: 0.2459 %		Relative Humidity: 44.0 %RH	
Linearity (R-Squared): 1.0000		Software Version: CalDLR.vbs v2014.03.05	

Approved By: Scott Arsen

Reference (g) vs Predicted (g)



All calibrations are traceable to the National Institute of Standards and Technology.
Estimated uncertainty of the measurement is $\pm 3.641\%$. All certification data and equipment are on file for inspection at your request.
Best uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor $k=2$.



Certificate of Calibration

Test Accelerometer:

Serial No.: J36197
Model No.: Endevco 7264-2000TZ
Capacity (G's): 500
Calibration Date: 5/8/2015
Calibrated By: Scott Arsen
Calibration Time: 12:16:57

Reference Accelerometer:

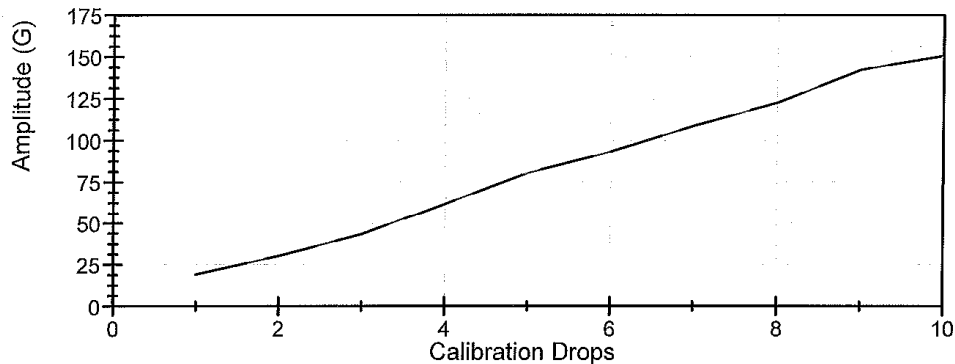
Serial No.: 95980
Model No.: PCB 352C03
Capacity (G's): 250
Calibration Date: 8/18/2014
Calibrated By: Novastar

Certificate No.: J36197_2015-05-08

Sensitivity :	0.0231 mV/V/g	New vs Old	0.33 %
DLR (100K Shunt):	107.79 g		-0.25 %
Excitation Voltage:	10 V	Temperature:	23.7 °C
Error:	0.0691 %	Relative Humidity:	44.0 %RH
Linearity (R-Squared):	1.0000	Software Version:	CalDLR.vbs v2014.03.05

Approved By: Scott Arsen

Reference (g) vs Predicted (g)



All calibrations are traceable to the National Institute of Standards and Technology.
Estimated uncertainty of the measurement is $\pm 3.641\%$. All certification data and equipment are on file for inspection at your request.
Best uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor $k=2$.



Certificate of Calibration

Test Accelerometer:

Serial No.: J36353
Model No.: Endevco 7264-2000TZ
Capacity (G's): 500
Calibration Date: 5/8/2015
Calibrated By: Scott Arsen
Calibration Time: 12:16:57

Reference Accelerometer:

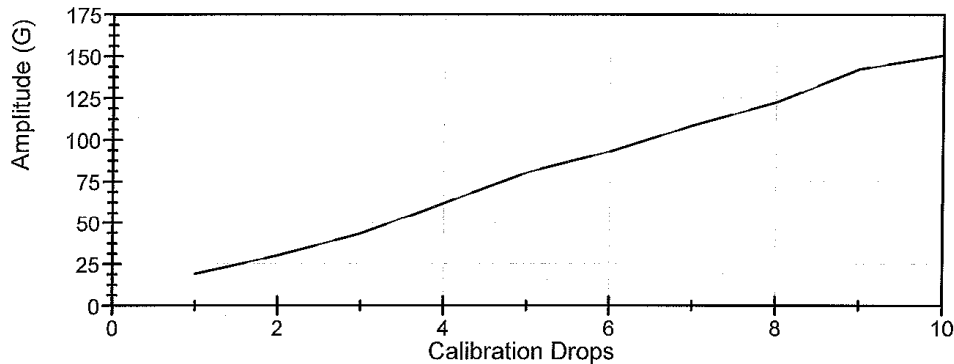
Serial No.: 95980
Model No.: PCB 352C03
Capacity (G's): 250
Calibration Date: 8/18/2014
Calibrated By: Novastar

Certificate No.: J36353_2015-05-08

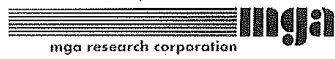
Sensitivity :	0.0254 mV/V/g	New vs Old	-0.33 %
DLR (100K Shunt):	98.15 g		0.51 %
Excitation Voltage:	10 V	Temperature:	23.7 °C
Error:	0.1609 %	Relative Humidity:	44.0 %RH
Linearity (R-Squared):	1.0000	Software Version:	CalDLR.vbs v2014.03.05

Approved By: Scott Arsen

Reference (g) vs Predicted (g)



All calibrations are traceable to the National Institute of Standards and Technology.
Estimated uncertainty of the measurement is $\pm 3.641\%$. All certification data and equipment are on file for inspection at your request.
Best uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor $k=2$.



Certificate of Calibration

Test Accelerometer:

Serial No.: J40831
Model No.: Endevco 7264-2000TZ
Capacity (G's): 500
Calibration Date: 5/8/2015
Calibrated By: Scott Arsen
Calibration Time: 12:16:57

Reference Accelerometer:

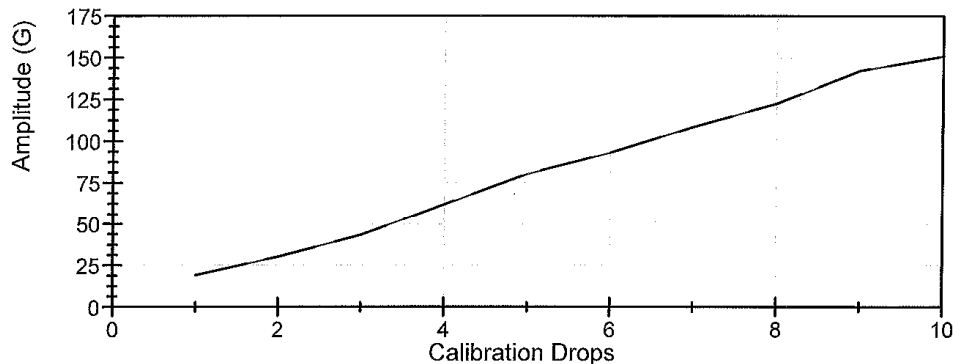
Serial No.: 95980
Model No.: PCB 352C03
Capacity (G's): 250
Calibration Date: 8/18/2014
Calibrated By: Novastar

Certificate No.: J40831_2015-05-08

Sensitivity :	0.0259 mV/V/g	New vs Old	0.05 %
DLR (100K Shunt):	96.05 g		0.14 %
Excitation Voltage:	10 V	Temperature:	23.7 °C
Error:	0.1029 %	Relative Humidity:	44.0 %RH
Linearity (R-Squared):	1.0000	Software Version:	CalDLR.vbs v2014.03.05

Approved By: Scott Arsen

Reference (g) vs Predicted (g)



All calibrations are traceable to the National Institute of Standards and Technology.
Estimated uncertainty of the measurement is $\pm 3.641\%$. All certification data and equipment are on file for inspection at your request.
Best uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor $k=2$.



Certificate of Calibration

Test Accelerometer:

Serial No.: J40834
Model No.: Endevco 7264-2000TZ
Capacity (G's): 500
Calibration Date: 5/8/2015
Calibrated By: Scott Arsen
Calibration Time: 12:16:57

Reference Accelerometer:

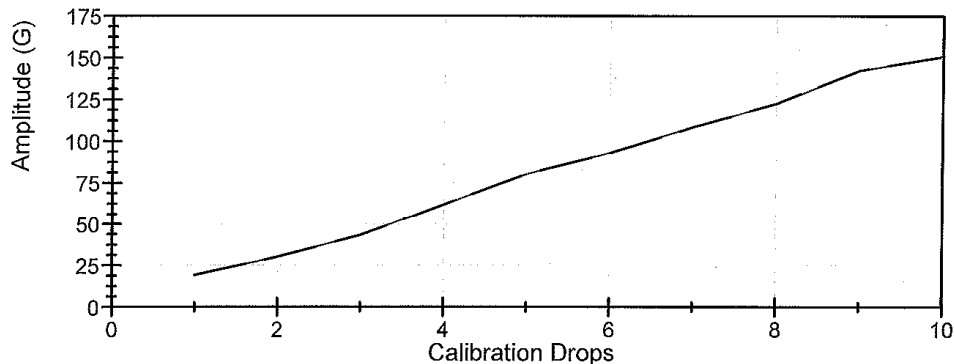
Serial No.: 95980
Model No.: PCB 352C03
Capacity (G's): 250
Calibration Date: 8/18/2014
Calibrated By: Novastar

Certificate No.: J40834_2015-05-08

Sensitivity :	0.0283 mV/V/g	New vs Old	0.27 %
DLR (100K Shunt):	88.18 g		-0.19 %
Excitation Voltage:	10 V	Temperature:	23.7 °C
Error:	0.1532 %	Relative Humidity:	44.0 %RH
Linearity (R-Squared):	1.0000	Software Version:	CalDLR.vbs v2014.03.05

Approved By: Scott Arsen

Reference (g) vs Predicted (g)



All calibrations are traceable to the National Institute of Standards and Technology.
Estimated uncertainty of the measurement is $\pm 3.641\%$. All certification data and equipment are on file for inspection at your request.
Best uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor $k=2$.



Certificate of Calibration

Test Accelerometer:

Serial No.: J40819
Model No.: Endevco 7264-2000TZ
Capacity (G's): 500
Calibration Date: 5/8/2015
Calibrated By: Scott Arsen
Calibration Time: 12:16:57

Reference Accelerometer:

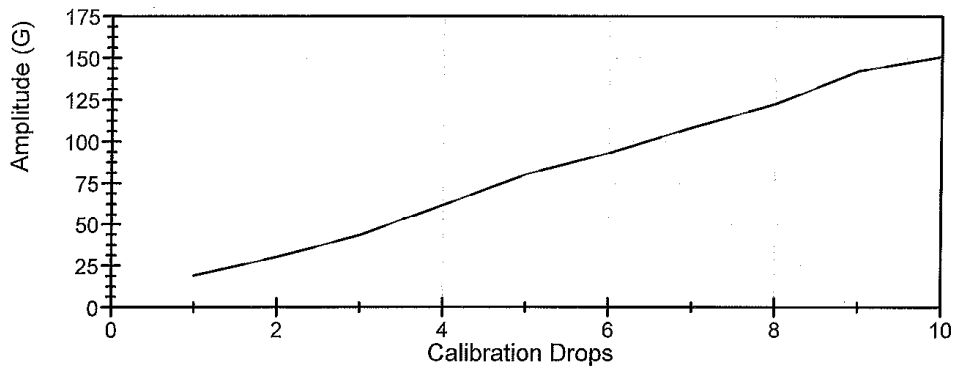
Serial No.: 95980
Model No.: PCB 352C03
Capacity (G's): 250
Calibration Date: 8/18/2014
Calibrated By: Novastar

Certificate No.: J40819_2015-05-08

Sensitivity :	0.0229 mV/V/g	New vs Old	-0.13 %
DLR (100K Shunt):	108.87 g		0.19 %
Excitation Voltage:	10 V	Temperature:	23.7 °C
Error:	0.1412 %	Relative Humidity:	44.0 %RH
Linearity (R-Squared):	1.0000	Software Version:	CalDLR.vbs v2014.03.05

Approved By: Scott Arsen

Reference (g) vs Predicted (g)



All calibrations are traceable to the National Institute of Standards and Technology.
Estimated uncertainty of the measurement is $\pm 3.641\%$. All certification data and equipment are on file for inspection at your request.
Best uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor $k=2$.



Certificate of Calibration

Test Accelerometer:

Serial No.: J32173
Model No.: Endevco 7264-2000
Capacity (G's): 2,000
Calibration Date: 3/19/2015
Calibrated By: Scott Arsen
Calibration Time: 13:08:48

Reference Accelerometer:

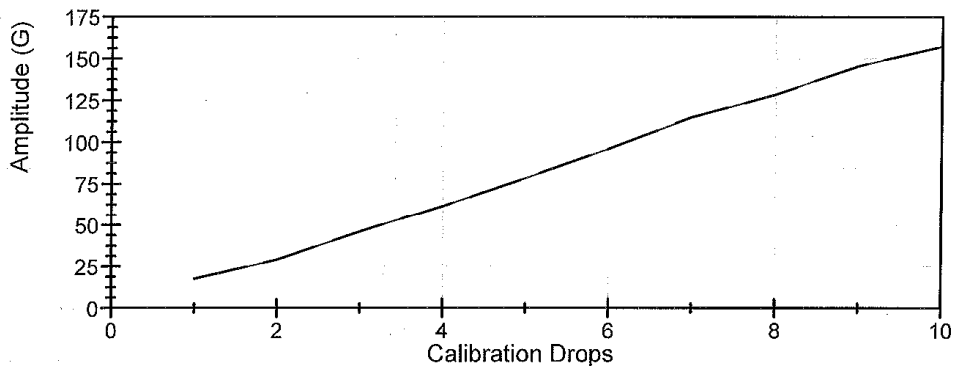
Serial No.: 95980
Model No.: PCB 352C03
Capacity (G's): 250
Calibration Date: 8/18/2014
Calibrated By: Novastar

Certificate No.: J32173_2015-03-19

Sensitivity :	0.0244 mV/V/g	New vs Old	-0.07 %
DLR (100K Shunt):	102.19 g		0.28 %
Excitation Voltage:	10 V	Temperature:	21.0 °C
Error:	0.1886 %	Relative Humidity:	31.0 %RH
Linearity (R-Squared):	1.0000	Software Version:	CalDLR.vbs v2014.03.05

Approved By: Scott Arsen

Reference (g) vs Predicted (g)



All calibrations are traceable to the National Institute of Standards and Technology.
Estimated uncertainty of the measurement is $\pm 3.641\%$. All certification data and equipment are on file for inspection at your request.
Best uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor $k=2$.



Certificate of Calibration

Test Accelerometer:

Serial No.: J32173
Model No.: Endevco 7264-2000
Capacity (G's): 500
Calibration Date: 9/18/2015
Calibrated By: Scott Arsen
Calibration Time: 12:58:16

Reference Accelerometer:

Serial No.: 95980
Model No.: PCB 352C03
Capacity (G's): 250
Calibration Date: 9/2/2015
Calibrated By: Novastar

Certificate No.: J32173_2015-09-18

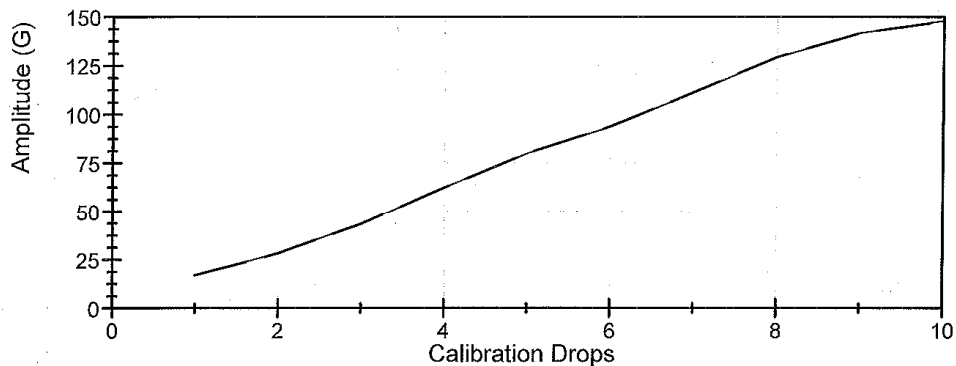
Sensitivity :	0.0243 mV/V/g	New vs Old	-0.60 %
DLR (100K Shunt):	102.80 g		0.60 %

Excitation Voltage: 10 V
Error: 0.2073 %
Linearity (R-Squared): 1.0000

Temperature: 23.2 °C
Relative Humidity: 44.0 %RH
Software Version: CalDLR.vbs v2014.03.05

Approved By: Scott Arsen

Reference (g) vs Predicted (g)



All calibrations are traceable to the National Institute of Standards and Technology.
Estimated uncertainty of the measurement is $\pm 3.641\%$. All certification data and equipment are on file for inspection at your request.
Best uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor $k=2$.



Certificate of Calibration

Test Accelerometer:

Serial No.: J40863
Model No.: Endevco 7264-2000TZ
Capacity (G's): 500
Calibration Date: 5/8/2015
Calibrated By: Scott Arsen
Calibration Time: 16:37:41

Reference Accelerometer:

Serial No.: 95980
Model No.: PCB 352C03
Capacity (G's): 250
Calibration Date: 8/18/2014
Calibrated By: Novastar

Certificate No.: J40863_2015-05-08

Sensitivity : 0.0320 mV/V/g
DLR (100K Shunt): 77.71 g

New vs Old

-0.19 %

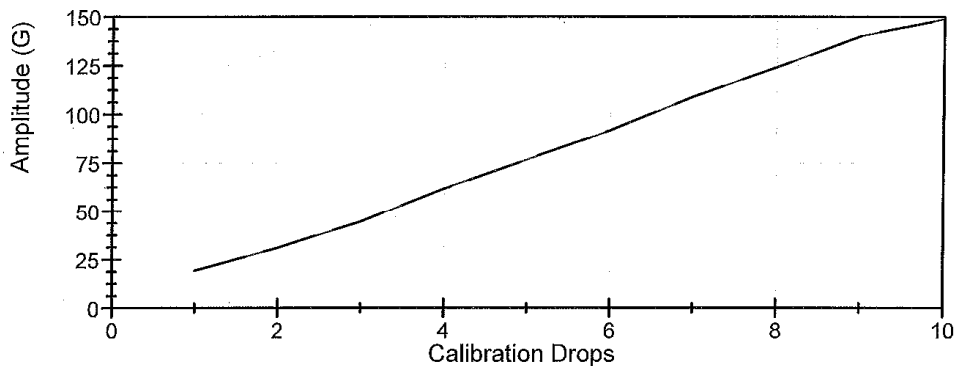
-0.04 %

Excitation Voltage: 10 V
Error: 0.1143 %
Linearity (R-Squared): 1.0000

Temperature: 23.7 °C
Relative Humidity: 44.0 %RH
Software Version: CalDLR.vbs v2014.03.05

Approved By: Scott Arsen

Reference (g) vs Predicted (g)



All calibrations are traceable to the National Institute of Standards and Technology.
Estimated uncertainty of the measurement is $\pm 3.641\%$. All certification data and equipment are on file for inspection at your request.
Best uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor $k=2$.



Certificate of Calibration

Test Accelerometer:

Serial No.: J40883
Model No.: Endevco 7264-2000TZ
Capacity (G's): 500
Calibration Date: 5/8/2015
Calibrated By: Scott Arsen
Calibration Time: 16:37:41

Reference Accelerometer:

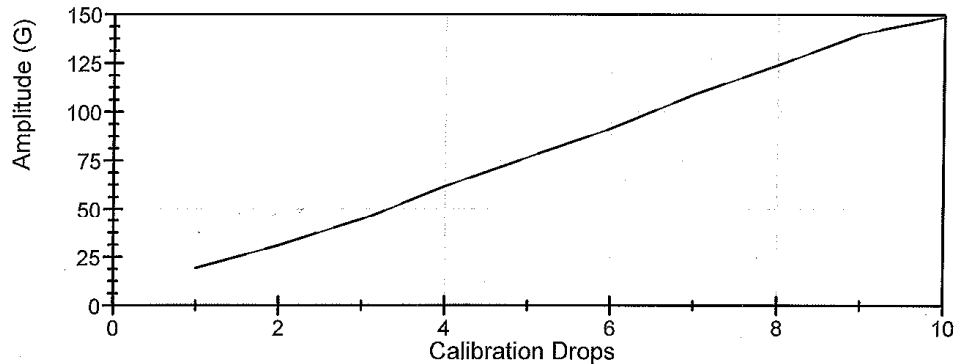
Serial No.: 95980
Model No.: PCB 352C03
Capacity (G's): 250
Calibration Date: 8/18/2014
Calibrated By: Novastar

Certificate No.: J40883_2015-05-08

Sensitivity :	0.0226 mV/V/g	New vs Old	0.01 %
DLR (100K Shunt):	110.03 g		0.14 %
Excitation Voltage:	10 V	Temperature:	23.7 °C
Error:	0.0676 %	Relative Humidity:	44.0 %RH
Linearity (R-Squared):	1.0000	Software Version:	CalDLR.vbs v2014.03.05

Approved By: Scott Arsen

Reference (g) vs Predicted (g)



All calibrations are traceable to the National Institute of Standards and Technology.
Estimated uncertainty of the measurement is $\pm 3.641\%$. All certification data and equipment are on file for inspection at your request.
Best uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor $k=2$.



Certificate of Calibration

Test Accelerometer:

Serial No.: J40863
Model No.: Endevco 7264-2000
Capacity (G's): 500
Calibration Date: 9/18/2015
Calibrated By: Scott Arsen
Calibration Time: 12:58:16

Reference Accelerometer:

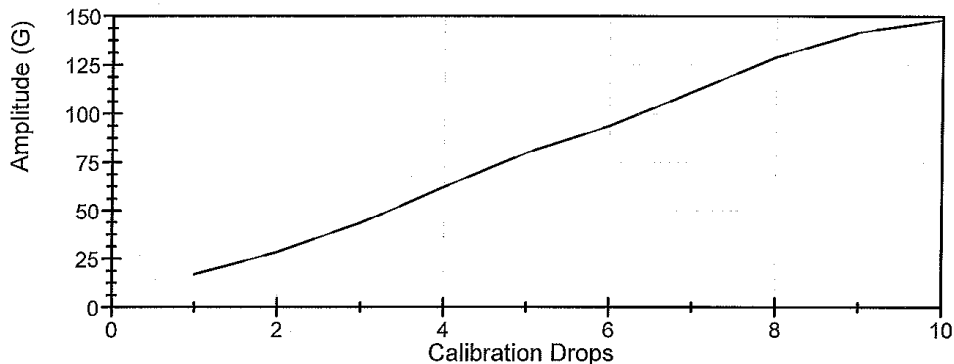
Serial No.: 95980
Model No.: PCB 352C03
Capacity (G's): 250
Calibration Date: 9/2/2015
Calibrated By: Novastar

Certificate No.: J40863_2015-09-18

Sensitivity :	0.0320 mV/V/g	New vs Old	-0.08 %
DLR (100K Shunt):	77.89 g		0.23 %
Excitation Voltage:	10 V	Temperature:	23.2 °C
Error:	0.0896 %	Relative Humidity:	44.0 %RH
Linearity (R-Squared):	1.0000	Software Version:	CalDLR.vbs v2014.03.05

Approved By: Scott Arsen

Reference (g) vs Predicted (g)



All calibrations are traceable to the National Institute of Standards and Technology.
Estimated uncertainty of the measurement is $\pm 3.641\%$. All certification data and equipment are on file for inspection at your request.
Best uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor $k=2$.



Certificate of Calibration

Test Accelerometer:

Serial No.: J45309
Model No.: Endevco 7264-2000TZ
Capacity (G's): 500
Calibration Date: 5/8/2015
Calibrated By: Scott Arsen
Calibration Time: 16:37:41

Reference Accelerometer:

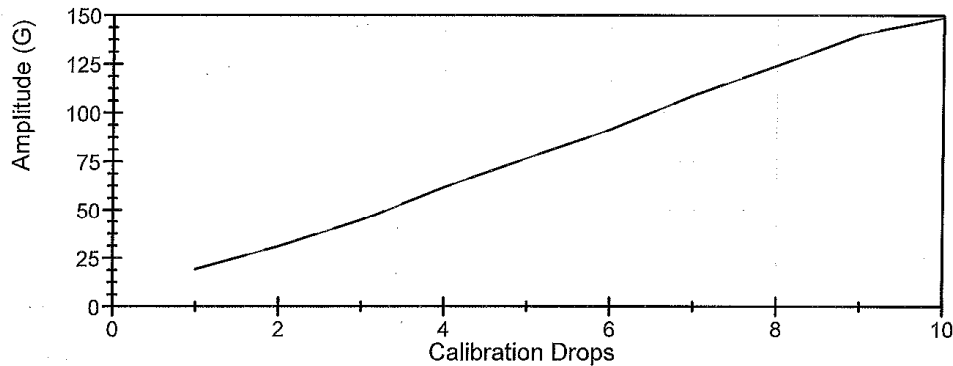
Serial No.: 95980
Model No.: PCB 352C03
Capacity (G's): 250
Calibration Date: 8/18/2014
Calibrated By: Novastar

Certificate No.: J45309_2015-05-08

Sensitivity :	0.0240 mV/V/g	New vs Old	-0.39 %
DLR (100K Shunt):	103.73 g		0.19 %
Excitation Voltage:	10 V	Temperature:	23.7 °C
Error: 0.1263 %		Relative Humidity:	44.0 %RH
Linearity (R-Squared):	1.0000	Software Version:	CalDLR.vbs v2014.03.05

Approved By: Scott Arsen

Reference (g) vs Predicted (g)



All calibrations are traceable to the National Institute of Standards and Technology.
Estimated uncertainty of the measurement is $\pm 3.641\%$. All certification data and equipment are on file for inspection at your request.
Best uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor $k=2$.



Certificate of Calibration

Test Accelerometer:

Serial No.: J45309
Model No.: Endevco 7264-2000
Capacity (G's): 500
Calibration Date: 9/18/2015
Calibrated By: Scott Arsen
Calibration Time: 12:58:16

Reference Accelerometer:

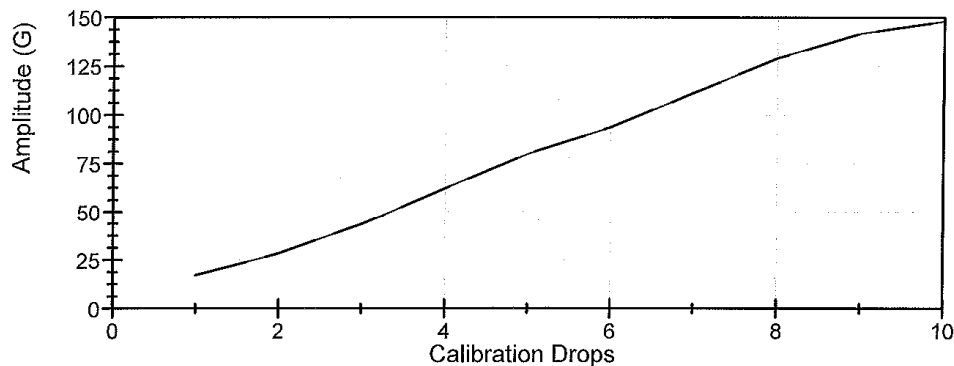
Serial No.: 95980
Model No.: PCB 352C03
Capacity (G's): 250
Calibration Date: 9/2/2015
Calibrated By: Novastar

Certificate No.: J45309_2015-09-18

Sensitivity :	0.0240 mV/V/g	New vs Old	-0.00 %
DLR (100K Shunt):	103.68 g		-0.05 %
Excitation Voltage:	10 V	Temperature:	23.2 °C
Error:	0.0784 %	Relative Humidity:	44.0 %RH
Linearity (R-Squared):	1.0000	Software Version:	CalDLR.vbs v2014.03.05

Approved By: Scott Arsen

Reference (g) vs Predicted (g)



All calibrations are traceable to the National Institute of Standards and Technology.
Estimated uncertainty of the measurement is $\pm 3.641\%$. All certification data and equipment are on file for inspection at your request.
Best uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor $k=2$.



Certificate of Calibration

Model #: Sensor Input Module	Certificate #: 2015319LM0321
Serial #: LM0321	Date Received: 15 March 2015
Firmware: 07E4	Date Calibrated: 19 March 2015
Procedure Name: SIM Calibration	Revision: 2.2
Order Number: RA27091	Next Calibration: 19 March 2016
Customer: MGA Troy	Item Received: In Tolerance
446 Executive Drive	Item Returned: In Tolerance
Troy, MI 48083	Temperature: 77 °F/25.0 °C
	Humidity: 28 %

DTS has been audited by the American Association for Laboratory Accreditation (A2LA) and found in compliance with ISO/IEC 17025:2005. Accredited calibrations performed within the DTS Scope of Accreditation are indicated by the presence of the A2LA Logo and Certificate Number on this Certificate of Calibration.

DTS reference standards are processed and calibrated in accordance with the DTS Quality Assurance System, and traceable to the National Institute of Standards and Technology (NIST).

All calibrations have been performed using processes having a test uncertainty ratio of four or more times greater than the unit calibrated, unless otherwise noted on the report. Uncertainties have been estimated at a 95 percent confidence level (k=2). Calibration at a 4:1 TUR provides reasonable confidence that the instrument is within the manufacturer's published specifications.

The reported data is the raw recorded data and is not corrected for uncertainty or environmental effects. Any number of factors can cause a unit to drift out of tolerance at any time following its calibration.

This report only applies only to the item(s) identified above, and shall not be reproduced except in full, without the written approval of DTS. Limitations on the uses of this instrument are detailed in the manufacturer's operating instructions.

Remarks:

Standards Used

Serial #	Manufacturer	Model #	Description	Cal Date	Due Date
MY42006281	Agilent	34420A	Nano Volt, Micro-Ohm Meter, 7.5 Digit	1-Nov-2014	1-Nov-2015
MY44062354	Agilent	33220A	Function/Arbitrary Waveform Generator, 20 MHz	28-Oct-2014	28-Oct-2015
CAL005	DTS	CALSTAT	TDAS Calibration Station	24-Nov-2014	24-Nov-2015

Results

Test Description	Test Result	
	As Received	As Returned
Battery Charged	N/A	N/A
Visual Inspection	Pass	Pass
Basic Channel Functions	Pass	Pass
Calibration DAC Accuracy	Pass	Pass
Shunt Resistor Accuracy	Pass	Pass
Excitation Sources	Pass	Pass
Gain Accuracy	Pass	Pass
Frequency Response	Pass	Pass
Timebase Accuracy	Pass	Pass
T=0 Trigger Function	Pass	Pass
Time Skew	Pass	Pass
Noise Level	Pass	Pass

Calibration Site: 41204 Bridge Street
 Novi, MI 48375

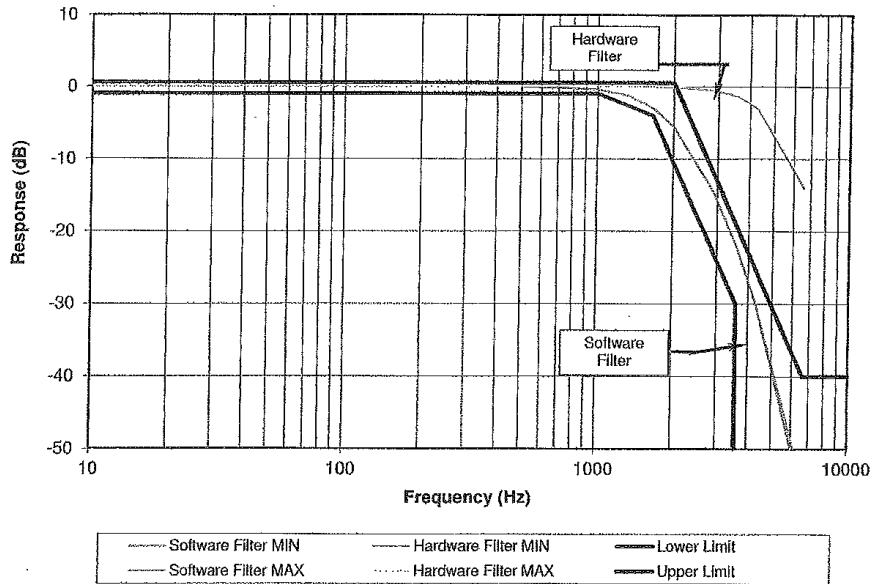
Calibrated By: Bob Colenso
 Bob Colenso
 Technical Support Engineer

B 3/24/15



Serial #: LM0321
 Order #: RA27091
 Date: 19 March 2015

Class 1000 System Response vs. SAE J211 (March 2014)
 All 8 channels typically overlap due to very tight control of component tolerances.
 Only the minimum and maximum response of the 8 channels are shown for clarity.



Test Description

Filter Response-Software

Channel 1	Limit		As Received/Returned				Pass/ Fail
			Std	db	Uncertainty (mV)		
10Hz	0.5db	-0.75db	1.414 mV	0.000	2.1E-04	Pass	
500Hz	0.5db	-0.96db	1.414 mV	-0.003	1.2E-03	Pass	
1000Hz	0.5db	-1db	1.347 mV	-0.422	2.2E-03	Pass	
1325Hz	0.5db	-2.69db	1.218 mV	-1.296	3.7E-03	Pass	
1650Hz	0.5db	-4db	1.013 mV	-2.899	2.7E-03	Pass	
2000Hz	0.5db	-10.66db	0.750 mV	-5.510	2.5E-03	Pass	
2900Hz	-12.37db	-23.53db	0.265 mV	-14.558	1.8E-03	Pass	
3575Hz	-19.61db	-999db	0.112 mV	-22.004	1.0E-03	Pass	
4300Hz	-26db	-999db	0.044 mV	-30.066	5.0E-04	Pass	
6600Hz	-40db	-999db	0.003 mV	-54.053	5.6E-04	Pass	



Serial #: LM0321
 Order #: RA27091
 Date: 19 March 2015

Test Description		As Received/Returned					
Filter Response-Software		Llimit	Std	db	Uncertainty	Pass/	
					(mV)	Fail	
Channel 2							
10Hz	0.5db	-0.75db	1.414 mV	0.000	2.1E-04	Pass	
500Hz	0.5db	-0.96db	1.413 mV	-0.005	1.3E-03	Pass	
1000Hz	0.5db	-1db	1.346 mV	-0.005	2.2E-03	Pass	
1325Hz	0.5db	-2.69db	1.216 mV	-1.310	4.0E-03	Pass	
1650Hz	0.5db	-4db	1.011 mV	-2.918	2.6E-03	Pass	
2000Hz	0.5db	-10.66db	0.748 mV	-5.536	2.9E-03	Pass	
2900Hz	-12.37db	-23.53db	0.263 mV	-14.596	2.1E-03	Pass	
3575Hz	-19.61db	-999db	0.112 mV	-22.032	1.1E-03	Pass	
4300Hz	-26db	-999db	0.044 mV	-30.057	6.3E-04	Pass	
6600Hz	-40db	-999db	0.003 mV	-54.503	5.1E-04	Pass	
Channel 3							
10Hz	0.5db	-0.75db	1.414 mV	0.000	2.1E-04	Pass	
500Hz	0.5db	-0.96db	1.414 mV	-0.003	1.3E-03	Pass	
1000Hz	0.5db	-1db	1.347 mV	-0.003	2.1E-03	Pass	
1325Hz	0.5db	-2.69db	1.218 mV	-1.296	3.0E-03	Pass	
1650Hz	0.5db	-4db	1.013 mV	-2.696	2.6E-03	Pass	
2000Hz	0.5db	-10.66db	0.750 mV	-5.507	9.1E-04	Pass	
2900Hz	-12.37db	-23.53db	0.265 mV	-14.559	1.6E-03	Pass	
3575Hz	-19.61db	-999db	0.112 mV	-22.009	9.1E-04	Pass	
4300Hz	-26db	-999db	0.044 mV	-30.082	5.9E-04	Pass	
6600Hz	-40db	-999db	0.002 mV	-55.105	4.5E-04	Pass	
Channel 4							
10Hz	0.5db	-0.75db	1.414 mV	0.000	1.8E-04	Pass	
500Hz	0.5db	-0.96db	1.414 mV	-0.004	1.3E-03	Pass	
1000Hz	0.5db	-1db	1.346 mV	-0.004	2.0E-03	Pass	
1325Hz	0.5db	-2.69db	1.217 mV	-1.306	3.7E-03	Pass	
1650Hz	0.5db	-4db	1.012 mV	-2.910	2.4E-03	Pass	
2000Hz	0.5db	-10.66db	0.749 mV	-5.524	2.1E-03	Pass	
2900Hz	-12.37db	-23.53db	0.264 mV	-14.581	1.6E-03	Pass	
3575Hz	-19.61db	-999db	0.112 mV	-22.023	9.6E-04	Pass	
4300Hz	-26db	-999db	0.044 mV	-30.066	5.2E-04	Pass	
6600Hz	-40db	-999db	0.002 mV	-55.555	4.6E-04	Pass	
Channel 5							
10Hz	0.5db	-0.75db	1.414 mV	0.000	2.2E-04	Pass	
500Hz	0.5db	-0.96db	1.413 mV	-0.005	1.3E-03	Pass	
1000Hz	0.5db	-1db	1.346 mV	-0.005	2.4E-03	Pass	
1325Hz	0.5db	-2.69db	1.216 mV	-1.313	3.9E-03	Pass	
1650Hz	0.5db	-4db	1.011 mV	-2.918	2.7E-03	Pass	
2000Hz	0.5db	-10.66db	0.748 mV	-5.533	2.7E-03	Pass	
2900Hz	-12.37db	-23.53db	0.264 mV	-14.594	1.9E-03	Pass	
3575Hz	-19.61db	-999db	0.112 mV	-22.030	1.1E-03	Pass	
4300Hz	-26db	-999db	0.044 mV	-30.051	5.9E-04	Pass	
6600Hz	-40db	-999db	0.002 mV	-55.892	3.7E-04	Pass	



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Test Description

Filter Response-Software

	Limit		As Received/Returned			
			Std	db	Uncertainty (mV)	Pass/Fail
Channel 6						
10Hz	0.5db	-0.75db	1.414 mV	0.000	2.3E-04	Pass
500Hz	0.5db	-0.96db	1.414 mV	-0.003	1.4E-03	Pass
1000Hz	0.5db	-1db	1.346 mV	-0.003	1.9E-03	Pass
1325Hz	0.5db	-2.69db	1.217 mV	-1.304	3.8E-03	Pass
1650Hz	0.5db	-4db	1.012 mV	-2.903	2.5E-03	Pass
2000Hz	0.5db	-10.66db	0.750 mV	-5.511	2.5E-03	Pass
2900Hz	-12.37db	-23.53db	0.265 mV	-14.550	1.9E-03	Pass
3575Hz	-19.61db	-999db	0.113 mV	-21.969	1.2E-03	Pass
4300Hz	-26db	-999db	0.045 mV	-29.977	6.6E-04	Pass
6600Hz	-40db	-999db	0.002 mV	-55.872	4.0E-04	Pass
Channel 7						
10Hz	0.5db	-0.75db	1.414 mV	0.000	1.8E-04	Pass
500Hz	0.5db	-0.96db	1.414 mV	-0.003	1.2E-03	Pass
1000Hz	0.5db	-1db	1.346 mV	-0.003	2.3E-03	Pass
1325Hz	0.5db	-2.69db	1.217 mV	-1.304	3.8E-03	Pass
1650Hz	0.5db	-4db	1.013 mV	-2.902	2.7E-03	Pass
2000Hz	0.5db	-10.66db	0.750 mV	-5.509	2.5E-03	Pass
2900Hz	-12.37db	-23.53db	0.265 mV	-14.550	1.7E-03	Pass
3575Hz	-19.61db	-999db	0.113 mV	-21.972	1.0E-03	Pass
4300Hz	-26db	-999db	0.045 mV	-29.990	6.1E-04	Pass
6600Hz	-40db	-999db	0.002 mV	-55.822	4.8E-04	Pass
Channel 8						
10Hz	0.5db	-0.75db	1.414 mV	0.000	2.1E-04	Pass
500Hz	0.5db	-0.96db	1.414 mV	-0.002	1.3E-03	Pass
1000Hz	0.5db	-1db	1.347 mV	-0.002	2.1E-03	Pass
1325Hz	0.5db	-2.69db	1.218 mV	-1.299	3.9E-03	Pass
1650Hz	0.5db	-4db	1.013 mV	-2.894	2.4E-03	Pass
2000Hz	0.5db	-10.66db	0.751 mV	-5.495	2.4E-03	Pass
2900Hz	-12.37db	-23.53db	0.266 mV	-14.518	1.8E-03	Pass
3575Hz	-19.61db	-999db	0.113 mV	-21.922	1.1E-03	Pass
4300Hz	-26db	-999db	0.045 mV	-29.917	7.1E-04	Pass
6600Hz	-40db	-999db	0.002 mV	-55.266	5.4E-04	Pass

Cal DAC	Limit		As Received/Returned		
	Lower Limit	Upper Limit	UUT	Uncertainty (Vdc)	Pass/Fail
0 Vdc	-0.0005 Vdc	0.0005 Vdc	0.0000 Vdc	6.2E-05	Pass
1.2 Vdc	1.1975 Vdc	1.2025 Vdc	1.1997 Vdc	9.1E-05	Pass
2.4 Vdc	2.3975 Vdc	2.4025 Vdc	2.3996 Vdc	1.1E-04	Pass

10V Excitation Short Circuit Recovery

Channel	Lower Limit	Upper Limit	UUT	Uncertainty	Pass/Fail
Channel 1	9.8 Vdc	N/A	9.982 Vdc	1.3E-02	Pass
Channel 2	9.8 Vdc	N/A	9.978 Vdc	9.8E-03	Pass
Channel 3	9.8 Vdc	N/A	9.975 Vdc	1.1E-02	Pass
Channel 4	9.8 Vdc	N/A	9.982 Vdc	9.6E-03	Pass
Channel 5	9.8 Vdc	N/A	9.985 Vdc	1.1E-02	Pass
Channel 6	9.8 Vdc	N/A	9.982 Vdc	1.3E-02	Pass
Channel 7	9.8 Vdc	N/A	9.981 Vdc	1.0E-02	Pass
Channel 8	9.8 Vdc	N/A	9.974 Vdc	9.2E-03	Pass



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	Lower Limit	Upper Limit	As Received/Returned		
			UUT	Uncertainty (Vdc)	Pass/Fail
10V Excitation 154 Ohm Startup Load					
Channel 1	9.8 Vdc	N/A	9.982 Vdc	1.3E-02	Pass
Channel 2	9.8 Vdc	N/A	9.978 Vdc	1.0E-02	Pass
Channel 3	9.8 Vdc	N/A	9.975 Vdc	1.2E-02	Pass
Channel 4	9.8 Vdc	N/A	9.982 Vdc	9.7E-03	Pass
Channel 5	9.8 Vdc	N/A	9.985 Vdc	1.1E-02	Pass
Channel 6	9.8 Vdc	N/A	9.982 Vdc	1.3E-02	Pass
Channel 7	9.8 Vdc	N/A	9.981 Vdc	1.1E-02	Pass
Channel 8	9.8 Vdc	N/A	9.974 Vdc	9.7E-03	Pass
10V Excitation 350 Ohm Load Test					
Channel 1	9.95 Vdc	10.05 Vdc	9.983 Vdc	1.3E-02	Pass
Channel 2	9.95 Vdc	10.05 Vdc	9.978 Vdc	9.8E-03	Pass
Channel 3	9.95 Vdc	10.05 Vdc	9.976 Vdc	1.1E-02	Pass
Channel 4	9.95 Vdc	10.05 Vdc	9.983 Vdc	9.8E-03	Pass
Channel 5	9.95 Vdc	10.05 Vdc	9.984 Vdc	1.1E-02	Pass
Channel 6	9.95 Vdc	10.05 Vdc	9.983 Vdc	1.3E-02	Pass
Channel 7	9.95 Vdc	10.05 Vdc	9.981 Vdc	1.0E-02	Pass
Channel 8	9.95 Vdc	10.05 Vdc	9.975 Vdc	9.1E-03	Pass
10V Excitation 200 Ohm Load Test					
Channel 1	9.9 Vdc	10.1 Vdc	9.978 Vdc	1.3E-02	Pass
Channel 2	9.9 Vdc	10.1 Vdc	9.971 Vdc	1.0E-02	Pass
Channel 3	9.9 Vdc	10.1 Vdc	9.970 Vdc	1.1E-02	Pass
Channel 4	9.9 Vdc	10.1 Vdc	9.978 Vdc	1.0E-02	Pass
Channel 5	9.9 Vdc	10.1 Vdc	9.979 Vdc	1.1E-02	Pass
Channel 6	9.9 Vdc	10.1 Vdc	9.977 Vdc	1.4E-02	Pass
Channel 7	9.9 Vdc	10.1 Vdc	9.975 Vdc	1.1E-02	Pass
Channel 8	9.9 Vdc	10.1 Vdc	9.968 Vdc	9.6E-03	Pass
5V Excitation Short Circuit Recovery					
Channel 1	4.9 Vdc	N/A	4.990 Vdc	1.2E-02	Pass
Channel 2	4.9 Vdc	N/A	4.991 Vdc	9.7E-03	Pass
Channel 3	4.9 Vdc	N/A	4.988 Vdc	1.0E-02	Pass
Channel 4	4.9 Vdc	N/A	4.995 Vdc	8.3E-03	Pass
Channel 5	4.9 Vdc	N/A	4.992 Vdc	9.8E-03	Pass
Channel 6	4.9 Vdc	N/A	4.992 Vdc	1.2E-02	Pass
Channel 7	4.9 Vdc	N/A	4.996 Vdc	1.0E-02	Pass
Channel 8	4.9 Vdc	N/A	4.981 Vdc	7.6E-03	Pass
5V Excitation 100 Ohm Load					
Channel 1	4.9 Vdc	5.1 Vdc	4.974 Vdc	1.3E-02	Pass
Channel 2	4.9 Vdc	5.1 Vdc	4.975 Vdc	1.0E-02	Pass
Channel 3	4.9 Vdc	5.1 Vdc	4.972 Vdc	1.1E-02	Pass
Channel 4	4.9 Vdc	5.1 Vdc	4.977 Vdc	8.5E-03	Pass
Channel 5	4.9 Vdc	5.1 Vdc	4.979 Vdc	1.2E-02	Pass
Channel 6	4.9 Vdc	5.1 Vdc	4.974 Vdc	1.3E-02	Pass
Channel 7	4.9 Vdc	5.1 Vdc	4.981 Vdc	1.0E-02	Pass
Channel 8	4.9 Vdc	5.1 Vdc	4.959 Vdc	8.9E-03	Pass



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Test Description

	Lower Limit	Upper Limit	As Received/Returned		
			UUT	Uncertainty (Vdc)	Pass/Fail
5V Excitation 350 Ohm Load Test					
Channel 1	4.95 Vdc	5.05 Vdc	4.990 Vdc	1.2E-02	Pass
Channel 2	4.95 Vdc	5.05 Vdc	4.991 Vdc	9.7E-03	Pass
Channel 3	4.95 Vdc	5.05 Vdc	4.988 Vdc	1.0E-02	Pass
Channel 4	4.95 Vdc	5.05 Vdc	4.994 Vdc	8.3E-03	Pass
Channel 5	4.95 Vdc	5.05 Vdc	4.992 Vdc	9.9E-03	Pass
Channel 6	4.95 Vdc	5.05 Vdc	4.992 Vdc	1.2E-02	Pass
Channel 7	4.95 Vdc	5.05 Vdc	4.996 Vdc	1.0E-02	Pass
Channel 8	4.95 Vdc	5.05 Vdc	4.981 Vdc	7.6E-03	Pass

Gain Response

Gain of 5: 1000mV

Channel	Limit	Std (mV)	As Received/Returned			
			UUT (mV)	Deviation (%)	Uncertainty (mV)	Pass/Fail
Channel 1						
-70%	+/-0.5%	-699.71	-700.21	-0.050	2.7E-01	Pass
-35%	+/-0.5%	-349.84	-350.12	-0.028	1.9E-01	Pass
35%	+/-0.5%	349.70	349.88	0.017	2.0E-01	Pass
70%	+/-0.5%	699.57	699.78	0.021	2.4E-01	Pass
Channel 2						
-70%	+/-0.5%	-699.71	-700.19	-0.048	2.1E-01	Pass
-35%	+/-0.5%	-349.84	-350.02	-0.018	1.6E-01	Pass
35%	+/-0.5%	349.70	349.96	0.026	1.7E-01	Pass
70%	+/-0.5%	699.57	699.83	0.025	2.1E-01	Pass
Channel 3						
-70%	+/-0.5%	-699.71	-700.12	-0.041	2.5E-01	Pass
-35%	+/-0.5%	-349.84	-350.01	-0.018	1.7E-01	Pass
35%	+/-0.5%	349.70	349.80	0.010	2.0E-01	Pass
70%	+/-0.5%	699.57	699.78	0.021	2.3E-01	Pass
Channel 4						
-70%	+/-0.5%	-699.71	-700.23	-0.051	2.2E-01	Pass
-35%	+/-0.5%	-349.84	-350.10	-0.026	1.9E-01	Pass
35%	+/-0.5%	349.70	349.92	0.021	1.8E-01	Pass
70%	+/-0.5%	699.57	699.80	0.023	2.9E-01	Pass
Channel 5						
-70%	+/-0.5%	-699.71	-700.14	-0.043	2.7E-01	Pass
-35%	+/-0.5%	-349.84	-350.03	-0.019	2.1E-01	Pass
35%	+/-0.5%	349.70	349.84	0.014	2.1E-01	Pass
70%	+/-0.5%	699.57	699.81	0.024	2.4E-01	Pass
Channel 6						
-70%	+/-0.5%	-699.71	-700.14	-0.043	2.2E-01	Pass
-35%	+/-0.5%	-349.84	-350.01	-0.018	1.3E-01	Pass
35%	+/-0.5%	349.70	349.83	0.013	2.2E-01	Pass
70%	+/-0.5%	699.57	699.81	0.024	2.4E-01	Pass
Channel 7						
-70%	+/-0.5%	-699.71	-700.19	-0.048	2.0E-01	Pass
-35%	+/-0.5%	-349.84	-350.07	-0.023	1.6E-01	Pass
35%	+/-0.5%	349.70	349.88	0.018	1.9E-01	Pass
70%	+/-0.5%	699.57	699.85	0.028	2.4E-01	Pass



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Test Description

Gain Response

Gain of 5: 1000mV

Channel 8	Limit	As Received/Returned					Pass/ Fail
		Std (mV)	UUT (mV)	Deviation (%)	Uncertainty (mV)		
-70%	+/-0.5%	-699.71	-700.09	-0.037	2.0E-01	Pass	
-35%	+/-0.5%	-349.84	-350.07	-0.024	1.5E-01	Pass	
35%	+/-0.5%	349.70	349.86	0.016	2.0E-01	Pass	
70%	+/-0.5%	699.57	699.81	0.024	2.1E-01	Pass	

Gain Response

Gain of 16: 312.5mV

Channel	Limit	Std (mV)	UUT (mV)	Deviation (%)	Uncertainty (mV)	Pass/ Fail
Channel 1						
-70%	+/-0.5%	-218.76	-218.84	-0.026	1.1E-01	Pass
-35%	+/-0.5%	-109.46	-109.51	-0.016	8.4E-02	Pass
35%	+/-0.5%	109.30	109.31	0.004	8.8E-02	Pass
70%	+/-0.5%	218.60	218.67	0.023	9.4E-02	Pass
Channel 2						
-70%	+/-0.5%	-218.76	-218.82	-0.020	9.3E-02	Pass
-35%	+/-0.5%	-109.46	-109.49	-0.009	8.9E-02	Pass
35%	+/-0.5%	109.30	109.34	0.014	9.7E-02	Pass
70%	+/-0.5%	218.60	218.64	0.013	8.1E-02	Pass
Channel 3						
-70%	+/-0.5%	-218.76	-218.79	-0.011	7.7E-02	Pass
-35%	+/-0.5%	-109.46	-109.53	-0.021	9.5E-02	Pass
35%	+/-0.5%	109.30	109.32	0.005	8.4E-02	Pass
70%	+/-0.5%	218.60	218.64	0.014	1.0E-01	Pass
Channel 4						
-70%	+/-0.5%	-218.76	-218.85	-0.029	1.3E-01	Pass
-35%	+/-0.5%	-109.46	-109.50	-0.012	1.1E-01	Pass
35%	+/-0.5%	109.30	109.33	0.011	1.1E-01	Pass
70%	+/-0.5%	218.60	218.62	0.007	1.4E-01	Pass
Channel 5						
-70%	+/-0.5%	-218.76	-218.77	-0.005	1.0E-01	Pass
-35%	+/-0.5%	-109.46	-109.48	-0.006	1.1E-01	Pass
35%	+/-0.5%	109.30	109.30	0.002	8.9E-02	Pass
70%	+/-0.5%	218.60	218.59	-0.002	1.1E-01	Pass
Channel 6						
-70%	+/-0.5%	-218.76	-218.80	-0.015	1.1E-01	Pass
-35%	+/-0.5%	-109.46	-109.49	-0.009	9.4E-02	Pass
35%	+/-0.5%	109.30	109.34	0.012	8.2E-02	Pass
70%	+/-0.5%	218.60	218.60	0.002	9.1E-02	Pass
Channel 7						
-70%	+/-0.5%	-218.76	-218.80	-0.014	9.9E-02	Pass
-35%	+/-0.5%	-109.46	-109.52	-0.020	9.6E-02	Pass
35%	+/-0.5%	109.30	109.31	0.003	1.0E-01	Pass
70%	+/-0.5%	218.60	218.66	0.019	9.3E-02	Pass
Channel 8						
-70%	+/-0.5%	-218.76	-218.78	-0.007	9.9E-02	Pass
-35%	+/-0.5%	-109.46	-109.48	-0.008	1.0E-01	Pass
35%	+/-0.5%	109.30	109.28	-0.007	1.1E-01	Pass
70%	+/-0.5%	218.60	218.60	0.001	1.1E-01	Pass



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Test Description

Gain Response

Gain of 32: 156.25mV

	Limit	As Received/Returned				Pass/ Fail
		Std (mV)	UUT (mV)	Deviation (%)	Uncertainty (mV)	
Channel 1						
-70%	+/-0.5%	-109.46	-109.55	-0.056	4.7E-02	Pass
-35%	+/-0.5%	-54.71	-54.74	-0.019	2.1E-02	Pass
35%	+/-0.5%	54.57	54.59	0.011	3.9E-02	Pass
70%	+/-0.5%	109.29	109.36	0.044	3.5E-02	Pass
Channel 2						
-70%	+/-0.5%	-109.46	-109.56	-0.065	3.8E-02	Pass
-35%	+/-0.5%	-54.71	-54.74	-0.020	1.7E-02	Pass
35%	+/-0.5%	54.57	54.59	0.009	3.6E-02	Pass
70%	+/-0.5%	109.29	109.36	0.043	3.1E-02	Pass
Channel 3						
-70%	+/-0.5%	-109.46	-109.55	-0.059	4.5E-02	Pass
-35%	+/-0.5%	-54.71	-54.74	-0.022	2.1E-02	Pass
35%	+/-0.5%	54.57	54.60	0.015	3.5E-02	Pass
70%	+/-0.5%	109.29	109.35	0.041	3.1E-02	Pass
Channel 4						
-70%	+/-0.5%	-109.46	-109.56	-0.061	4.5E-02	Pass
-35%	+/-0.5%	-54.71	-54.74	-0.025	2.4E-02	Pass
35%	+/-0.5%	54.57	54.60	0.014	3.7E-02	Pass
70%	+/-0.5%	109.29	109.35	0.040	3.3E-02	Pass
Channel 5						
-70%	+/-0.5%	-109.46	-109.54	-0.052	4.7E-02	Pass
-35%	+/-0.5%	-54.71	-54.73	-0.012	2.2E-02	Pass
35%	+/-0.5%	54.57	54.60	0.014	3.7E-02	Pass
70%	+/-0.5%	109.29	109.34	0.037	3.8E-02	Pass
Channel 6						
-70%	+/-0.5%	-109.46	-109.54	-0.054	4.4E-02	Pass
-35%	+/-0.5%	-54.71	-54.73	-0.018	2.0E-02	Pass
35%	+/-0.5%	54.57	54.60	0.014	3.8E-02	Pass
70%	+/-0.5%	109.29	109.35	0.039	3.3E-02	Pass
Channel 7						
-70%	+/-0.5%	-109.46	-109.54	-0.051	4.6E-02	Pass
-35%	+/-0.5%	-54.71	-54.73	-0.013	2.0E-02	Pass
35%	+/-0.5%	54.57	54.59	0.012	3.7E-02	Pass
70%	+/-0.5%	109.29	109.35	0.038	3.3E-02	Pass
Channel 8						
-70%	+/-0.5%	-109.46	-109.54	-0.050	4.9E-02	Pass
-35%	+/-0.5%	-54.71	-54.73	-0.013	2.1E-02	Pass
35%	+/-0.5%	54.57	54.59	0.009	4.0E-02	Pass
70%	+/-0.5%	109.29	109.34	0.032	3.3E-02	Pass

Gain Response

Gain of 128: 39.0625mV

Channel 1						
-70%	+/-0.5%	-27.355	-27.417	-0.158	3.0E-02	Pass
-35%	+/-0.5%	-13.836	-13.869	-0.085	5.1E-02	Pass
35%	+/-0.5%	13.690	13.715	0.063	1.6E-02	Pass
70%	+/-0.5%	27.172	27.228	0.143	4.7E-02	Pass



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Test Description

Gain Response

Gain of 128: 39.0625mV		As Received/Returned				Pass/
Channel 2	Limit	Std (mV)	UUT (mV)	Deviation (%)	Uncertainty (mV)	Fail
-70%	+/-0.5%	-27.355	-27.419	-0.163	2.8E-02	Pass
-35%	+/-0.5%	-13.836	-13.870	-0.086	4.9E-02	Pass
35%	+/-0.5%	13.690	13.715	0.064	1.4E-02	Pass
70%	+/-0.5%	27.172	27.228	0.143	4.7E-02	Pass
Channel 3						
-70%	+/-0.5%	-27.355	-27.411	-0.143	2.5E-02	Pass
-35%	+/-0.5%	-13.836	-13.866	-0.076	5.1E-02	Pass
35%	+/-0.5%	13.690	13.714	0.060	1.6E-02	Pass
70%	+/-0.5%	27.172	27.225	0.138	4.5E-02	Pass
Channel 4						
-70%	+/-0.5%	-27.355	-27.418	-0.161	3.1E-02	Pass
-35%	+/-0.5%	-13.836	-13.869	-0.085	4.9E-02	Pass
35%	+/-0.5%	13.690	13.716	0.066	1.8E-02	Pass
70%	+/-0.5%	27.172	27.226	0.140	4.6E-02	Pass
Channel 5						
-70%	+/-0.5%	-27.355	-27.411	-0.143	2.6E-02	Pass
-35%	+/-0.5%	-13.836	-13.866	-0.077	5.0E-02	Pass
35%	+/-0.5%	13.690	13.710	0.050	1.5E-02	Pass
70%	+/-0.5%	27.172	27.223	0.133	4.4E-02	Pass
Channel 6						
-70%	+/-0.5%	-27.355	-27.417	-0.159	2.6E-02	Pass
-35%	+/-0.5%	-13.836	-13.866	-0.076	4.6E-02	Pass
35%	+/-0.5%	13.690	13.716	0.065	1.8E-02	Pass
70%	+/-0.5%	27.172	27.227	0.141	4.6E-02	Pass
Channel 7						
-70%	+/-0.5%	-27.355	-27.416	-0.155	2.6E-02	Pass
-35%	+/-0.5%	-13.836	-13.866	-0.077	4.8E-02	Pass
35%	+/-0.5%	13.690	13.713	0.058	1.5E-02	Pass
70%	+/-0.5%	27.172	27.227	0.143	4.8E-02	Pass
Channel 8						
-70%	+/-0.5%	-27.355	-27.413	-0.148	2.4E-02	Pass
-35%	+/-0.5%	-13.836	-13.869	-0.083	5.1E-02	Pass
35%	+/-0.5%	13.690	13.714	0.062	1.5E-02	Pass
70%	+/-0.5%	27.172	27.224	0.134	4.7E-02	Pass

Gain Response

Gain of 512: 9.765625mV

Channel 1		Std	UUT	Deviation	Uncertainty	Pass/
-70%	+/-1.5%	-6.846	-6.848	-0.023	1.5E-02	Pass
-35%	+/-1.5%	-3.511	-3.516	-0.045	2.8E-02	Pass
35%	+/-1.5%	3.342	3.342	-0.005	2.3E-02	Pass
70%	+/-1.5%	6.688	6.696	0.089	3.3E-02	Pass
Channel 2						
-70%	+/-1.5%	-6.846	-6.851	-0.059	1.2E-02	Pass
-35%	+/-1.5%	-3.511	-3.518	-0.066	2.9E-02	Pass
35%	+/-1.5%	3.342	3.343	0.008	2.1E-02	Pass
70%	+/-1.5%	6.688	6.700	0.122	3.5E-02	Pass



Serial #: LM0321
 Order #: RA27091
 Date: 19 March 2015

Test Description		As Received/Returned					
Gain Response		Std	UUT	Deviation	Uncertainty	Pass/Fail	
Gain of 512: 9.765825mV							
Channel 3	Limit	(mV)	(mV)	(%)	(mV)		
-70%	+/-1.5%	-6.846	-6.851	-0.051	8.6E-03	Pass	
-35%	+/-1.5%	-3.511	-3.516	-0.045	3.0E-02	Pass	
35%	+/-1.5%	3.342	3.343	0.006	2.0E-02	Pass	
70%	+/-1.5%	6.688	6.698	0.106	2.9E-02	Pass	
Channel 4							
-70%	+/-1.5%	-6.846	-6.847	-0.013	1.2E-02	Pass	
-35%	+/-1.5%	-3.511	-3.515	-0.036	3.0E-02	Pass	
35%	+/-1.5%	3.342	3.342	-0.003	1.9E-02	Pass	
70%	+/-1.5%	6.688	6.695	0.078	3.0E-02	Pass	
Channel 5							
-70%	+/-1.5%	-6.846	-6.846	-0.003	1.1E-02	Pass	
-35%	+/-1.5%	-3.511	-3.514	-0.031	3.2E-02	Pass	
35%	+/-1.5%	3.342	3.343	0.002	2.2E-02	Pass	
70%	+/-1.5%	6.688	6.693	0.050	3.6E-02	Pass	
Channel 6							
-70%	+/-1.5%	-6.846	-6.847	-0.015	1.3E-02	Pass	
-35%	+/-1.5%	-3.511	-3.514	-0.029	2.6E-02	Pass	
35%	+/-1.5%	3.342	3.343	0.008	1.4E-02	Pass	
70%	+/-1.5%	6.688	6.695	0.073	3.5E-02	Pass	
Channel 7							
-70%	+/-1.5%	-6.846	-6.847	-0.018	1.1E-02	Pass	
-35%	+/-1.5%	-3.511	-3.515	-0.040	3.0E-02	Pass	
35%	+/-1.5%	3.342	3.342	-0.010	2.1E-02	Pass	
70%	+/-1.5%	6.688	6.696	0.084	3.4E-02	Pass	
Channel 8							
-70%	+/-1.5%	-6.846	-6.844	0.012	1.4E-02	Pass	
-35%	+/-1.5%	-3.511	-3.514	-0.022	2.6E-02	Pass	
35%	+/-1.5%	3.342	3.342	-0.008	1.9E-02	Pass	
70%	+/-1.5%	6.688	6.692	0.047	4.1E-02	Pass	
Gain Response							
Gain of 2000: 2.5mV							
Channel 1							
-70%	+/-1.5%	-1.943	-1.949	-0.265	5.5E-02	Pass	
-35%	+/-1.5%	-1.054	-1.057	-0.136	4.7E-02	Pass	
35%	+/-1.5%	0.873	0.878	0.231	6.1E-03	Pass	
70%	+/-1.5%	1.768	1.765	-0.116	9.2E-03	Pass	
Channel 2							
-70%	+/-1.5%	-1.943	-1.947	-0.187	5.0E-02	Pass	
-35%	+/-1.5%	-1.054	-1.057	-0.148	4.8E-02	Pass	
35%	+/-1.5%	0.873	0.878	0.208	7.8E-03	Pass	
70%	+/-1.5%	1.768	1.764	-0.159	1.2E-02	Pass	
Channel 3							
-70%	+/-1.5%	-1.943	-1.951	-0.343	7.0E-02	Pass	
-35%	+/-1.5%	-1.054	-1.059	-0.223	4.4E-02	Pass	
35%	+/-1.5%	0.873	0.878	0.233	6.3E-03	Pass	
70%	+/-1.5%	1.768	1.767	-0.038	6.7E-03	Pass	



Serial #: LM0321
 Order #: RA27091
 Date: 19 March 2015

Test Description		As Received/Returned					
Gain Response		Std	UUT	Deviation	Uncertainty	Pass/Fail	
Gain of 2000: 2.5mV	Limit	(mV)	(mV)	(%)	(mV)		
Channel 4							
-70%	+/-1.5%	-1.943	-1.947	-0.167	5.4E-02	Pass	
-35%	+/-1.5%	-1.054	-1.056	-0.094	4.8E-02	Pass	
35%	+/-1.5%	0.873	0.877	0.181	8.0E-03	Pass	
70%	+/-1.5%	1.768	1.763	-0.185	9.0E-03	Pass	
Channel 5							
-70%	+/-1.5%	-1.943	-1.948	-0.214	5.9E-02	Pass	
-35%	+/-1.5%	-1.054	-1.056	-0.104	4.7E-02	Pass	
35%	+/-1.5%	0.873	0.877	0.175	4.7E-03	Pass	
70%	+/-1.5%	1.768	1.763	-0.211	6.1E-03	Pass	
Channel 6							
-70%	+/-1.5%	-1.943	-1.946	-0.153	5.4E-02	Pass	
-35%	+/-1.5%	-1.054	-1.054	-0.011	4.4E-02	Pass	
35%	+/-1.5%	0.873	0.876	0.150	4.5E-03	Pass	
70%	+/-1.5%	1.768	1.763	-0.212	1.1E-02	Pass	
Channel 7							
-70%	+/-1.5%	-1.943	-1.946	-0.152	5.5E-02	Pass	
-35%	+/-1.5%	-1.054	-1.054	-0.035	4.6E-02	Pass	
35%	+/-1.5%	0.873	0.877	0.189	4.1E-03	Pass	
70%	+/-1.5%	1.768	1.763	-0.198	1.1E-02	Pass	
Channel 8							
-70%	+/-1.5%	-1.943	-1.948	-0.232	5.7E-02	Pass	
-35%	+/-1.5%	-1.054	-1.055	-0.071	4.9E-02	Pass	
35%	+/-1.5%	0.873	0.878	0.234	4.9E-03	Pass	
70%	+/-1.5%	1.768	1.764	-0.142	1.1E-02	Pass	

End of Report

Calibration Certificate

Part Description: Platinum Certification Date: 2014-11-21 Serial#: P08-05-10-26072
 Single Point - (Max-Min)/2 Specification: P08-05 0.03mm (0.0012") Certificate#: F08051026072-11212014-908A
 Volumetric (Max Deviation) Specification: P08-05 +/-0.043mm (+/-0.0017") Temperature: See attached data

Measurement Standards Traceability

Kinematic Scale Bar - Short	Asset Number: TQ1364	Calibration Due: 2/28/2015	*SI Traceability: 9a45660e-7067-4e68-e6e8-057bc59cc03f
Kinematic Scale Bar - Long	Asset Number: TQ1378	Calibration Due: 2/28/2015	*SI Traceability: d121cd94-f79b-48a5-9fbb-e77addb18404
Thermometer	Asset Number: TQ1510	Calibration Due: 7/24/2015	*SI Traceability: 6581f681
Calibration Probe	Asset Number: 12558	Calibration Due: 1/7/2016	*SI Traceability: 52304
Reference Sphere	Asset Number: TQ1956	Calibration Due: 9/5/2015	*SI Traceability: 13-298-00283

The anchors above have been calibrated with a device traceable to the International System of Units (SI) through a National Metrological Institute (NMI) or through an ISO17025 Accredited Laboratory. Calibration was performed following procedure listed in 07946015. This procedure was developed in accordance with ASME B89.4.23-2004. See attached data for measurement results.

Calibration Results*

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

Instrument condition as received:
 Not within specifications

Instrument condition outgoing:
 Within specifications

Approved By: Allen Minock Cal Cert Technician
46998 Magellan Drive Peter: 2014-11-21
Wixom, MI 48393 USA

FARO Technologies, Inc.
 PH: 248-669-8620
 FAX: 248-669-8656





Calibration Certificate



35200 Plymouth Rd. / Livonia, MI 48150



Certificate # Z52538:116342

GENERIC PRO 360 DIGITAL PROTRACTOR	
SERIAL NUMBER: N/A	WORK ORDER: 116342
ASSET NUMBER: Z52538	TEST RESULT: PASS
CUST ASSET NUMBER: MGA00821	PERFORMED ON: 03/30/15
PROCEDURE NAME: MIT - PRO 360 - MMC	CAL DUE DATE: 03/30/16
PROCEDURE REV: 1.0	DATA TYPE: FOUND-LEFT
CALIBRATED BY: Joseph Giordano	TEMPERATURE: 22.72 °C
CUSTOMER: MGA RESEARCH 446 EXECUTIVE DRIVE TROY, MI 48083	HUMIDITY: 28 %
PRIMARY CONTACT: SCOTT ARSEN	

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 ISO/IEC 17025:2005 and ANSI/NCCL 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 REMARKS:
 AS RETURNED CONDITION: IN TOLERANCE
 ACTION TAKEN: FULL CALIBRATION

Standards Used

Asset #	Cert #	Description	Cal Date	Due Date
1577	1577:1193650836	RAHN SUPER 100 SURFACE PLATE	02/09/2015	02/09/2016
1437	1437:1193650835	PHASE 2 220-006 ROTARY TABLE	02/13/2013	02/13/2017

QA Signature: *Je M...* Date: 4/1/2015

4/6/2015



Report of Calibration

NovaStar Solutions
 35200 Plymouth Rd.
 Livonia, MI 48150



GENERIC PRO 360 DIGITAL PROTRACTOR	WORK ORDER #: 116342
SERIAL NUMBER: N/A	TEST RESULT: PASS
ASSET NUMBER: Z52538	PERFORMED ON: 3/30/2015
CUST. ASSET NUM: MGA00821	CAL DUE DATE: 3/30/2016
PROCEDURE NAME: MIT - PRO 360 - MMC	DATA TYPE: FOUND-LEFT
PROCEDURE REV: 1.0	TEMPERATURE: 22.72 °C
CALIBRATED BY: Joseph Giordano	HUMIDITY: 28 %
CUSTOMER: MGA RESEARCH 446 EXECUTIVE DRIVE TROY MI 48083	
PRIMARY CONTACT: SCOTT ARSEN	

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.

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).

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REMARKS:

Test Results for Calibration with Certificate#: Z52538:116342

Standards Used

Asset #	Cert#	Description	Cal Date	Due Date
1437	1437:1193650835	PHASE 2 220-006 ROTARY TABLE	2/13/2013	2/13/2017
1577	1577:1193650836	RAHN SUPER 100 SURFACE PLATE	2/9/2015	2/9/2016

Test Procedure Results

Test Description	Nominal	Test Result	Lower Limit	Upper Limit	Units	Exp Uncert	Pass/Fail
LINEARITY CHECK							
0° REFERENCE	0.0	0.0	-0.1	0.1	°		Pass
5°	5.0	5.0	4.9	5.1	°	0.02° + .6R	Pass
30°	30.0	30.0	29.8	30.2	°	0.02° + .6R	Pass
60°	60.0	60.0	59.8	60.2	°	0.02° + .6R	Pass
90°	90.0	89.9	89.9	90.1	°	0.02° + .6R	Pass

Test Results for Calibration with Certificate#: Z52538:116342

Test Procedure Results

Test Description	Nominal	Test Result	Lower Limit	Upper Limit	Units	Exp Uncert	Pass/Fail
60°	60.0	60.0	59.8	60.2	°	0.02° + .6R	Pass
30°	30.0	30.0	29.8	30.2	°	0.02° + .6R	Pass
5°	5.0	5.0	4.9	5.1	°	0.02° + .6R	Pass
0°	0.0	0.0	-0.1	0.1	°		Pass
5°	5.0	5.0	4.9	5.1	°	0.02° + .6R	Pass
30°	30.0	30.0	29.8	30.2	°	0.02° + .6R	Pass
60°	60.0	59.9	59.8	60.2	°	0.02° + .6R	Pass
90°	90.0	90.0	89.9	90.1	°	0.02° + .6R	Pass
60°	60.0	60.0	59.8	60.2	°	0.02° + .6R	Pass
30°	30.0	30.0	29.8	30.2	°	0.02° + .6R	Pass
5°	5.0	5.0	4.9	5.1	°	0.02° + .6R	Pass
0°	0.0	0.0	-0.1	0.1	°		Pass
ABSOLUTE ZERO ANGLE	0.0	0.0	-0.1	0.1	°		Pass

***** End of Report *****

MICHIGAN OPERATIONS
 DATE: 4/4/2013
 SUPERCEDES: MGATPTMC.6

DOC. NO.: MGATP_TMC
 REVISION NO.: 7
 PAGE 3 OF 3

Tape Measure Calibration Certificate

Reference Steel Rule

Brand: Sturgeson
 S/N: 178-A00799
 Calibration Date: 5/21/2014

Subject Tape Measure

Brand: Stanley
 S/N: TPM001-70
 Calibration Date: 1/27/2015

Reference in (mm)	Subject Tape Measure		Difference		Reference in (mm)	Subject Tape Measure		Difference	
	Pull	Push	Pull	Push		Pull	Push	Pull	Push
0 (0)	0	0	0	0	18 (450)	450	449	0	-1
1 (25)	25	24	0	-1	19 (475)	475	474	0	-1
2 (50)	50	49	0	-1	20 (500)	500	499	0	-1
3 (75)	75	74	0	-1	21 (525)	525	524	0	-1
4 (100)	100	99	0	-1	22 (550)	550	549	0	-1
5 (125)	125	124	0	-1	23 (575)	575	574	0	-1
6 (150)	150	149	0	-1	24 (600)	600	599	0	-1
7 (175)	175	174	0	-1	25 (625)	625	624	0	-1
8 (200)	200	199	0	-1	26 (650)	650	649	0	-1
9 (225)	225	224	0	-1	27 (675)	675	674	0	-1
10 (250)	250	249	0	-1	28 (700)	700	699	0	-1
11 (275)	275	274	0	-1	29 (725)	725	724	0	-1
12 (300)	300	299	0	-1	30 (750)	750	749	0	-1
13 (325)	325	324	0	-1	31 (775)	775	774	0	-1
14 (350)	350	349	0	-1	32 (800)	800	799	0	-1
15 (375)	375	374	0	-1	33 (825)	825	824	0	-1
16 (400)	400	399	0	-1	34 (850)	850	849	0	-1
17 (425)	425	424	0	-1	35 (875)	875	874	0	-1

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

Pass Fail Maximum Difference = -1

Date: 1/27/2015

Performed By: [Signature]

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



Calibration Certificate



35200 Plymouth Rd. / Livonia, MI 48150



Certificate # Z73658:116132

OMEGA OM-73 TEMPERATURE/RH DATA LOGGER

SERIAL NUMBER: 0514B1305F	WORK ORDER: 116132
ASSET NUMBER: Z73658	TEST RESULT: PASS
CUST ASSET NUMBER: 0514B1305F	PERFORMED ON: 03/26/15
PROCEDURE NAME: OME - OM-73 - MMC	CAL DUE DATE: 03/26/16
PROCEDURE REV: 1.0	DATA TYPE: FOUND-LEFT
CALIBRATED BY: JUSTIN BURDICK	TEMPERATURE: 23.01 °C
CUSTOMER: MGA RESEARCH 446 EXECUTIVE DRIVE TROY, MI 48083	HUMIDITY: 44 %
PRIMARY CONTACT: SCOTT ARSEN	

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 ISO/IEC 17025:2005 and ANSI/NCCL 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 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 REMARKS:
AS RETURNED CONDITION: IN TOLERANCE
ACTION TAKEN: FULL CALIBRATION

Standards Used

Asset #	Cert #	Description	Cal Date	Due Date
002664	002664:1091515041	VERITEQ 5000A-RH/T RH/TEMPERATURE DATA LOGGER	03/16/2015	03/16/2016
1917	1917:1263999738	VAISALA M170/HMP76 INDICATOR/PROBE	12/12/2014	12/12/2015

QA Signature: *Je Mumm* Date: 3/26/2015

3/26/2015
AS



Report of Calibration

NovaStar Solutions
 35200 Plymouth Rd.
 Livonia, MI 48150



OMEGA OM-73 TEMPERATURE/RH DATA LOGGER		WORK ORDER #:	116132
SERIAL NUMBER:	0514B1305F	TEST RESULT:	PASS
ASSET NUMBER:	Z73658	PERFORMED ON:	3/26/2015
CUST. ASSET NUM:	0514B1305F	CAL DUE DATE:	3/26/2016
PROCEDURE NAME:	OME - OM-73 - MMC	DATA TYPE:	FOUND-LEFT
PROCEDURE REV:	1.0	TEMPERATURE:	23.01 °C
CALIBRATED BY:	JUSTIN BURDICK	HUMIDITY:	44 %
CUSTOMER:	MGA RESEARCH 446 EXECUTIVE DRIVE TROY MI 48083		
PRIMARY CONTACT:	SCOTT ARSEN		

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 Z.540-1-1994.

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.

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.

REMARKS:

Test Results for Calibration with Certificate# : Z73658:116132

Standards Used

Asset #	Cert#	Description	Cal Date	Due Date
002664	002664:1091515041	VERITEQ 5000A-RH/T RH/TEMPERATURE DATA LOGGER	3/16/2015	3/16/2016
1917	1917:1263999738	VAISALA M170/HMP76 INDICATOR/PROBE	12/12/2014	12/12/2015

Test Procedure Results

Test Description	Nominal	Test Result	Lower Limit	Upper Limit	Units	Exp Uncert	Pass/Fail
Relative Humidity	13.3	15.1	11.3	15.3	%RH	2.2E+00	Pass
	46.3	46.1	44.3	48.3	%RH	2.2E+00	Pass
	69.8	70.4	67.8	71.8	%RH	2.2E+00	Pass
Temperature	22.2	22.5	21.7	22.7	°C	4.0E-01	Pass

***** End of Report *****



Calibration Certificate



35200 Plymouth Rd. / Livonia, MI 48150



Certificate # Z54487:107382

DETECTO AP-20 SCALE	
SERIAL NUMBER: E10807-0187	WORK ORDER: 107382
ASSET NUMBER: Z54487	TEST RESULT: PASS
CUST ASSET NUMBER: MGA00783	PERFORMED ON: 10/27/14
PROCEDURE NAME: 122-040	CAL DUE DATE: 10/27/15
PROCEDURE REV: B	DATA TYPE: FOUND-LEFT
CALIBRATED BY: Joseph Giordano	TEMPERATURE: 23.00 °C
CUSTOMER: MGA RESEARCH 446 EXECUTIVE DRIVE TROY, MI 48083	HUMIDITY: 40 %
PRIMARY CONTACT: SCOTT ARSEN	

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 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).

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AS RECEIVED CONDITION: IN TOLERANCE REMARKS:
 AS RETURNED CONDITION: IN TOLERANCE
 ACTION TAKEN: FULL CALIBRATION

Standards Used

Asset #	Cert #	Description	Cal Date	Due Date
1081	1081:1193650835	RICE LAKE CLASS 6 18 PC WEIGHT SET	03/18/2013	03/18/2015
1633	1633:1193663220	RICE LAKE CLASS 6 17 PC WEIGHT SET	06/04/2013	12/04/2014

QA Signature: *Duke Payne* Date: 10/29/2014

10/31/2014
SA

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

Test report for commercial device

F410/12-4
 Rev. Date 7/28/08



accredited for calibration 1448.01

Customer: MGA Research **Cert#** 14-2713 **Temp/Humidity:** OK
Location of Calibration: 2839 Elliot Ave. Troy, Mi. 48063
Calibration Date: 8/15/2014 **Cal Due:** Aug-15 **Condition of Item:** good
Equipment Make: Intercomp **Model:** SW Deluxe **Serial:** 26032389 **Capacity:** 8800lb x 1lb
NTEP: **Class:** **COC #:** section- 2200lb x 1lb

Applied Test Wt	Before Adjustment	Tolerance	In-Tolerance Y/N	After Adjustment	In-Tolerance Y/N	Unc	
100lb	100lb	1lb	y	100lb	y	.11lb	LF
1000lb	1000lb	2lb	y	1000lb	y	.5lb	
100lb	100lb	1lb	y	100lb	y	.11lb	RF
1000lb	1000lb	2lb	y	1000lb	y	.5lb	
100lb	100lb	1lb	y	100lb	y	.11lb	LR
1000lb	1000lb	2lb	y	1000lb	y	.5lb	
100lb	100lb	1lb	y	100lb	y	.11lb	RR
1000lb	1000lb	2lb	y	1000lb	y	.5lb	

shift test
 N/A
 Wheel Weigh

Platform #1 Platform #2 Platform #3

Pass Pass Pass
 Fail Fail Fail

Tests performed: Repeatability Linearity Sensitivity Discrimination

Technician comments: Scale passed all tests performed

Traceable certificate for weights used: 50lb wts.- 1163,1168 1k wt.- 10002

Scale Certified

Scale Rejected

Sterling Scale Service Rep: Dan W

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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.

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 for this reason Sterling Scale does not warranty calibration.

This report shall not be reproduced, except in full without approval of the laboratory

Tolerances followed are maintenance/acceptance per HB 44 or customer specific.

Ron Bunt 8/15/14