

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

**Chrysler Group LLC
2015 Chrysler 200
NHTSA No. C20150302**

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



**Test Dates: September 24-25, 2015
Report Date: October 2, 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**

This publication is distributed by the U.S. Department of Transportation, National Highway Traffic Safety Administration in the interest of information exchange. The opinions, findings and conclusions expressed in this publication are those of the author(s) and not necessarily those of the Department of Transportation or the National Highway Traffic Safety Administration. The United States Government assumes no liability for its contents or use thereof. If trade or manufacturers' names or products are mentioned, it is only because they are considered essential to the object of the publication and should not be construed as an endorsement. The United States Government does not endorse products or manufacturers.

Prepared By:

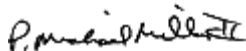


Sean Fortnam, Project Engineer



Helen A. Kaleto, Project Manager

Approved By:



Approval Date:

FINAL REPORT ACCEPTANCE BY OVSC:

Accepted By:

K. Nuschler

Acceptance Date:

1.8.2016

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No. 201UI-MGA-15-08	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Final Report of FMVSS 201 Compliance Testing of a 2015 Chrysler 200, NHTSA No. C20150302		5. Report Date October 2, 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-15-08	
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 Chrysler 200, NHTSA No. C20150302, 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 September 24-25, 2015. The data recorded indicates that the 2015 Chrysler 200 tested appears to comply with the upper interior requirements of FMVSS 201.			
17. Key Words Compliance Testing Safety Engineering FMVSS 201UI 2015 Chrysler 200		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 154	22. Price N/A

TABLE OF CONTENTS

<u>SECTION</u>	<u>DESCRIPTION</u>	<u>PAGE NO.</u>
1.0	PURPOSE OF COMPLIANCE TEST	6
2.0	COMPLIANCE TEST DATA SUMMARY	7
3.0	TEST DATA (Including Acceleration and Velocity Plots)	25
4.0	TEST EQUIPMENT LIST AND CALIBRATION INFORMATION	97
	4.1 Pre-Test Calibration FMH #35	
	4.2 Post-Test Calibration FMH #35	
	4.3 Pre-Test Calibration FMH #37	
	4.4 Post-Test Calibration FMH #37	
	4.5 Pre-Test Calibration FMH #38	
	4.6 Post-Test Calibration FMH #38	
5.0	PHOTOGRAPHS	111
	Appendix A - Temperature Trace	122
	Appendix B - Calibration Certificates	123

LIST OF TABLES

<u>TABLE</u>	<u>DESCRIPTION</u>	<u>PAGE NO.</u>
2-1	SUMMARY TABLE OF TEST RESULTS	8
2-2	GENERAL TEST AND VEHICLE PARAMETER DATA	10
2-3	HORIZONTAL IMPACT ANGLE RANGE FOR A- AND B-PILLARS	14
2-4	VERTICAL IMPACT ANGLE RANGES	15
2-5	TARGET MEASUREMENTS	18
2-6	SUMMARY OF TARGETING RESULTS	21
4-1	LIST OF ITEMS USED	97
4-2	FMH CALIBRATION SUMMARY	98

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 Chrysler 200.

Tests were conducted on September 24-25, 2015 on a 2015 Chrysler 200, manufactured by Chrysler Group LLC.

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 Chrysler 200 was equipped with A, B, O, and rear pillars, an adjustable seat belt anchorage on each B-pillar, and grab handles located on the passenger front side rails and driver and passenger 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:

AP2	BP2	OP2	UR9@SR2A
AP3	BP4	UR2@SR1	UR10@BP
BP1	OP1	UR5@BSR3-1	UR12@SR3-2

The 2015 Chrysler 200 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 Chrysler 200

VEH. NHTSA NO.: C20150302 VIN: 1C3CCCFB7FN587859

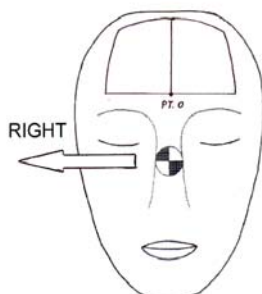
COLOR: Velvet Red VEH. BUILD DATE: September, 2014

TEST DATES: September 24-25, 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
AP2	Left	215	50	18.8	518	466	27	2 Right
AP3	Right	156	50	18.9	602	577	15	6 Left
BP1	Left	270	10	18.7	494	434	25	5 Left
BP2	Left	270	18	24.0	756	782	11	3 Right
BP4	Right	90	0	24.0	624	606	20	18 Left
OP1	Right	90	23	24.2	524	474	43	4 Right
OP2	Left	270	8	24.0	805	846	21	0
UR2@SR1	Left	270	50	24.0	610	588	49	4 Right
UR5@SR3-1	Left	270	50	24.1	603	578	47	4 Right
UR9@SR2A	Right	90	50	23.9	713	725	47	2 Left
UR10@BP	Right	90	50	24.1	575	542	44	1 Left
UR12@SR3-2	Right	90	50	24.2	540	496	38	4 Left

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



POST TEST COMMENTS:

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

AP2 Left: Headliner deformation.

BP2 Left: Seat belt adjuster damaged.

UR5@SR3-1 Left: Grab handle pushed in. Headliner deformation. Dome light dislodged.

UR9@SR2A Right: Grab handle pushed in. Headliner deformation.

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

REMARKS:

The targets listed were impacted in the following order:

Left: AP2, UR2@SR1, BP1, BP2, UR5@SR3-1, OP2

Right: OP1, UR12@SR3-2, BP4, UR10@BP, UR9@SR2A, AP3

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: September 25, 2015

TABLE 2-2

GENERAL TEST AND VEHICLE PARAMETER DATA

VEH. MOD YR/MAKE/MODEL/BODY: 2015 Chrysler 200

VEH. NHTSA NO.: C20150302 VIN: 1C3CCCFB7FN587859

COLOR: Velvet Red VEH. BUILD DATE: September, 2014

TEST DATES: September 24-25, 2015 TEST LABORATORY: MGA Research Corp.

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

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

SUNROOF INFORMATION:

Installed: Yes X No

Operation: Electric Manual

SIDE RAIL CURTAIN AIRBAG INFORMATION:

Installed: X Yes No

ROLL-BAR INFORMATION:

Installed: Yes X No

Padded: Yes No

Braces: Yes No

GENERAL INFORMATION:

Date Received: June 22, 2015; Odometer Reading 108 miles

DATA FROM VEHICLE'S CERTIFICATION LABEL:

Vehicle Manufactured By: Chrysler Group LLC.

Date of Manufacture: September, 2014; VIN: 1C3CCCFB7FN587859

GVWR: 2092 kg; GAWR FRONT: 1185 kg;

GAWR REAR: 1185 kg;

DATA FROM TIRE PLACARD:

Tire Pressure with Maximum Capacity Vehicle Load:

FRONT: 220 kPa REAR: 220 kPa

Recommended Tire Size: 215/55R17

Recommended Cold Tire Pressure:

FRONT: 220 kPa REAR: 220 kPa

Size of Tire on Test Vehicle: 215/55R17

Type of Spare Tire: N/A; Space Saver: ; Standard

VEHICLE CAPACITY DATA:

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

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

VEHICLE CAPACITY WEIGHT:

Vehicle Capacity Weight (VCW) = 408 kg

No. of Occupants x 68 kg = 340 kg

Rated Cargo/Luggage Weight (RCLW) = 78 kg (difference)

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

Right Front = 461.5 kg Right Rear = 308.0 kg

Left Front = 490.0 kg Left Rear = 298.5 kg

TOTAL FRONT = 951.5 kg TOTAL REAR = 606.5 kg

% Total Weight = 61.1 % % Total Weight = 38.9 %

TOTAL DELIVERED WEIGHT = 1558.0 kg

CALCULATION OF VEHICLE'S TARGET TEST WEIGHT:

Total Delivered Weight = 1558.0 kg

Max. Test Cargo/Luggage Weight = 68.0 kg

Target Test Weight = 1626.0 kg

WEIGHT OF TEST VEHICLE FULLY LOADED:

Right Front =	<u>458.5</u> kg	Right Rear =	<u>343.5</u> kg
Left Front =	<u>487.5</u> kg	Left Rear =	<u>335.0</u> kg
TOTAL FRONT =	<u>946.0</u> kg	TOTAL REAR =	<u>678.5</u> kg
% Total Weight =	<u>58.2</u> %	% Total Weight =	<u>41.8</u> %
TOTAL TEST WEIGHT = <u>1624.5</u> kg			
Weight of ballast secured in vehicle's cargo area = <u>66.5</u> kg			

TEST VEHICLE ATTITUDE:

AS DELIVERED: Right Front 718 mm; Left Front 718 mm;
Right Rear 719 mm; Left Rear 722 mm;
Pitch Angle at Right Door Sill = 0.6 Rear is higher
Pitch Angle at Left Door Sill = 1.0 Rear is higher
Roll Angle at Front Bumper = 0.1 Right is higher
Roll Angle at Rear Bumper = 0.1 Right is higher

FULLY LOADED: Right Front 719 mm; Left Front 723 mm;
Right Rear 706 mm; Left Rear 712 mm;
Pitch Angle at Right Door Sill = 0.3 Rear is higher
Pitch Angle at Left Door Sill = 0.7 Rear is higher
Roll Angle at Front Bumper = 0.1 Right is higher
Roll Angle at Rear Bumper = 0.1 Right is higher

AS TARGETED: Right Front 860 mm; Left Front 855 mm;
Right Rear 837 mm; Left Rear 845 mm;
Pitch Angle at Right Door Sill = 0.3 Rear is higher
Pitch Angle at Left Door Sill = 0.7 Rear is higher
Roll Angle at Front Bumper = 0.1 Right is higher
Roll Angle at Rear Bumper = 0.1 Right is higher

AS TESTED ON RIGHT SIDE:

Pitch Angle at Right Door Sill = 0.3 Rear is higher
Pitch Angle at Left Door Sill = 0.5 Rear is higher
Roll Angle at Front Bumper = 0.1 Right is higher
Roll Angle at Rear Bumper = 0.1 Right is higher

AS TESTED ON LEFT SIDE:

Pitch Angle at Right Door Sill = 0.3 Rear is higher
Pitch Angle at Left Door Sill = 0.5 Rear is higher
Roll Angle at Front Bumper = 0.1 Right is higher
Roll Angle at Rear Bumper = 0.1 Right is higher

VEHICLE WHEELBASE = 108"

REMARKS: The seat travel distance was measured to be 215 mm for the driver front seat and 215 mm for the passenger front seat.

Recorded By:  Approved By: 

Date: September 25, 2015

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

VEH. MOD YR/MAKE/MODEL/BODY: 2015 Chrysler 200

VEH. NHTSA NO.: C20150302 VIN: 1C3CCCFB7FN587859

COLOR: Velvet Red VEH. BUILD DATE: September, 2014

TEST DATES: September 24-25, 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 203.4°	L 252.2°
	R 105°-165°	R 107.9°	R 156.4°
B-PILLAR	L 195°-345°	L 199.7°	L 288.8°
	R 15°-165°	R 70.4°	R 160.2°

AS DETERMINED USING THE PROCEDURES SPECIFIED IN S8.13.4.1

REMARKS:

Recorded By: Sean Fortnam Approved By: Helen A. Kaleto

Date: September 25, 2015

TABLE 2-4

VERTICAL IMPACT ANGLE RANGES

VEH. MOD YR/MAKE/MODEL/BODY: 2015 Chrysler 200

VEH. NHTSA NO.: C20150302 VIN: 1C3CCCFB7FN587859

COLOR: Velvet Red VEH. BUILD DATE: September, 2014

TEST DATES: September 24-25, 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 25°
		R 0°-50°	R 0°	R 40°
	SR2A	L 0°-50°	L 0°	L 45°
		R 0°-50°	R 0°	R 40°
	SR2B	L 0°-50°	L 0°	L 28°
		R 0°-50°	R 0°	R 40°
	SR3-1	L 0°-50°	L 0°	L 38°
		R 0°-50°	R 0°	R 38°
	SR3-2	L 0°-50°	L 0°	L 35°
		R 0°-50°	R 0°	R 35°
REAR HEADER	RH	L 0°-50°	L 0°	L 50°
		R 0°-50°	R 0°	R 50°
A-PILLAR	AP1	L -5°-50°	L -5°	L 35°
		R -5°-50°	R -5°	R 35°

		VERTICAL ANGLE SPECIFIED RANGE		MINIMUM VERTICAL ANGLE		MAXIMUM VERTICAL ANGLE	
	AP2	L	-5°-50°	L	-5°	L	50°
		R	-5°-50°	R	-5°	R	50°
	AP3	L	-5°-50°	L	-5°	L	50°
		R	-5°-50°	R	-5°	R	50°
B-PILLAR	BP1	L	-10°-50°	L	-10°	L	10°
		R	-10°-50°	R	-10°	R	10°
	BP2*	L	0°-50°	L	0°	L	18°
		R	0°-50°	R	0°	R	18°
	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°
OTHER PILLAR	OP1	L	-10°-50°	L	-10°	L	23°
		R	-10°-50°	R	-10°	R	23°
	OP2	L	-10°-50°	L	-10°	L	8°
		R	-10°-50°	R	-10°	R	8°
REAR PILLAR	RP1	L	-10°-50°	L	-10°	L	50°
		R	-10°-50°	R	-10°	R	50°
	RP2	L	-10°-50°	L	-10°	L	18°
		R	-10°-50°	R	-10°	R	18°
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°	

	VERTICAL ANGLE SPECIFIED RANGE	MINIMUM VERTICAL ANGLE	MAXIMUM VERTICAL ANGLE
UPPER ROOF 8	0°-50°	0°	50°
UPPER ROOF 9	0°-50°	0°	50°
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: September 25, 201

TABLE 2-5

TARGET MEASUREMENTS

VEH. MOD YR/MAKE/MODEL/BODY: 2015 Chrysler 200

VEH. NHTSA NO.: C20150302 VIN: 1C3CCCFB7FN587859

COLOR: Velvet Red VEH. BUILD DATE: September, 2014

TEST DATES: September 24-25, 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)	215 mm	215 mm
T°	Horizontal < {CG-F1 (Left Seat) to (Right A-Pillar)}	107.8°	--
A1°	360° - T°	252.2°	--
W°	Horizontal < {CG-2 (Left Seat) to (Left A-Pillar)}	203.4°	--
A2°	A2° = W°	203.4°	--
U°	Horizontal < {CG-2 (Left Seat) to (Left B-Pillar)}	288.8°	--
B1°	B1° = U°	288.8°	--
V°	Horizontal < {CG-R (Left Seat) to (Left B-Pillar)}	199.7°	--
B2°	B2° = V°	199.7°	--
W° (right)	Horizontal < {CG-F2 (Right Seat) to (Right A-Pillar)}	--	156.4°
A1° (right)	A1° (right) = W° (right)	--	156.4°
T ° (right)	Horizontal < {CG-F1 (Right Seat) to (Left A-Pillar)}	--	252.1°
A2° (right)	360°-T° (right)	--	107.9°
V ° (right)	Horizontal < {CG-R (Right Seat) to (Right B-Pillar)}	--	160.2°
B1° (right)	B1° (right) = V° (right)	--	160.2°
U° (right)	Horizontal < {CG-F2 (Right Seat) to (Right B-Pillar)}	--	70.4°
B2° (right)	B2° (right) = U° (right)	--	70.4°
J	A-Pillar {(Plane 3) – (Plane 5)}	289.7 mm	291.5 mm
J/2	J ÷ 2	144.9 mm	145.8 mm
D1	Upper Roof {(Plane A) – (Plane B)}	1627.4 mm	
D1/2	D1 ÷ 2	813.7 mm	
D2	Upper Roof {(Plane C) – (Plane D)}	1227.5 mm	

Measurement	Description	Left Side	Right Side
D2/2	$D2 \div 2$	613.8 mm	
.35D1	.35 x D1	569.6 mm	
.35D2	.35 x D2	429.6 mm	
N	B-Pillar {(BPR) – (lowest point on daylight opening forward of B-Pillar)}	365.7 mm	363.2 mm
N/2	B-Pillar {(BP3) – (lowest point on daylight opening forward of B-Pillar)}	182.9 mm	181.6 mm
N/4	B-Pillar {(BP4) – (lowest point on daylight opening forward of B-Pillar)}	91.4 mm	90.8 mm
Q	O-Pillar (Plane 13 – Plane 14)	303.7 mm	305.9 mm
Q/2	$Q / 2$	151.9 mm	153.0 mm
D	R-Pillar (Point 7 – Point M)	720.0 mm	720.0 mm
3D/7	$3 D / 7$	308.6 mm	308.6 mm

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

CG Locations (world coordinates)						
	Left (mm)			Right (mm)		
	x	y	z	x	y	z
CGF1	1300.5	-375.0	914.4	1300.5	375.0	914.4
CGF2	1515.5	-375.0	914.4	1515.5	375.0	914.4
CGR	2388.0	-365.0	919.0	2388.0	365.0	919.0

REFERENCE FOR VEHICLE COORDINATE SYSTEM (measured in millimeters):

Left hand rear upper striker bolt hole (x, y, z) = 2517.54, -799.7, 549.9

Left hand front upper striker bolt hole (x, y, z) = 1503.75, -804.72, 399.01

Right hand front lower striker bolt hole (x, y, z) = 1493.76, 806.19, 360.31

REMARKS:

Recorded By:  Approved By: 

Date: September 25, 2015

TABLE 2-6

SUMMARY OF TARGETING RESULTS

VEH. MOD YR/MAKE/MODEL/BODY: 2015 Chrysler 200

VEH. NHTSA NO.: C20150302 VIN: 1C3CCCFB7FN587859

COLOR: Velvet Red VEH. BUILD DATE: September, 2014

TEST DATES: September 24-25, 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	1119.1	-545.9	1019.8	--	--	Yes	--	--
REL	1155.6	-554.1	988.3	252	35	--	2	No
AP2	1043.4	-588.9	932.7	215	50	No	--	Yes
AP3	891.1	-620.9	875.9	204	50	No	--	No
A-Pillar Right Side								
AP1	1120.4	545.9	1022.2	--	--	Yes	--	--
REL	1154.3	552.8	990.4	108	35	--	2	No
AP2	1051.6	591.5	934.1	145	50	No	--	No
AP3	896.9	622.8	877.1	156	50	No	--	Yes
B-Pillar Left Side								
BP1	1674.4	-505.5	1073.3	--	--	Yes	--	--
REL	1671.1	-520.6	1040.1	270	10	--	2	Yes
BP2	1650.7	-585.5	857.8	270	18	No	--	Yes
BP3	1632.1	-577.4	890.5	288	0	No	--	No
BP4	1723.4	-653.8	800.0	--	--	Yes	--	--
REL	1700.8	-640.7	794.8	270	0	--	1	No
B-Pillar Right Side								
BP1	1674.6	506.5	1072.6	--	--	Yes	--	--
REL	1671.0	520.7	1041.3	90	10	--	2	No

SUMMARY OF TARGETING RESULTS								
Target	Location (mm)			Horizontal Angle (deg)	Vertical Angle (deg)	Relocation (Yes/No)	Extension (# of 25 mm Spheres)	Impact (Yes/No)
	x	y	z					
BP2	1650.7	586.3	857.9	90	18	No	--	No
BP3	1635.5	576.7	890.5	71	0	No	--	No
BP4	1726.8	654.6	799.8	--	--	Yes	--	--
REL	1700.9	639.3	795.9	90	0	--	1	Yes
Other Pillar Left Side								
OPR	2373.3	-474.2	1038.4	270	23	No	--	No
OP1	2373.3	-474.2	1038.4	270	23	No	--	No
OP2	2448.4	-640.3	887.4	--	--	Yes	--	--
REL	2404.3	-627.4	866.0	270	8	--	2	Yes
Other Pillar Right Side								
OPR	2372.5	477.6	1039.0	90	23	No	--	No
OP1	2372.5	477.6	1039.0	90	23	No	--	Yes
OP2	2444.9	637.7	886.2	--	--	Yes	--	--
REL	2403.5	628.1	866.7	90	8	--	2	No
Rear Pillar Left Side								
RP1	2451.3	-510.1	1008.7	340	50	No	--	No
RP2	2669.2	-591.1	859.5	--	--	Yes	--	--
REL	2581.4	-572.1	903.3	270	18	--	4	No
Rear Pillar Right Side								
RP1	2451.0	508.7	1009.6	20	50	No	--	No
RP2	2666.9	589.2	860.4	--	--	Yes	--	--
REL	2580.0	572.4	903.0	90	18	--	4	No
Front Header Left Side								
FH1	1045.2	-434.2	1028.5	180	50	No	--	No
FH2	1024.7	-284.1	1035.8	180	50	No	--	No
Front Header Right Side								
FH1	1045.4	432.8	1029.1	180	50	No	--	No
FH2	1024.4	284.6	1036.4	180	50	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					
Side Rail Left Side								
SR1	1268.5	-530.3	1063.9	--	--	Yes	--	--
REL	1275.3	-545.7	1017.4	270	25	--	2	No
SR2A	1418.3	-522.4	1071.3	--	--	Yes	--	--
REL	1424.4	-539.5	1027.4	270	45	--	2	No
SR2B	1373.5	-522.0	1073.2	--	--	Yes	--	--
REL	1374.3	-540.7	1028.8	270	28	--	2	No
SR3-1	2038.7	-506.5	1030.3	270	38	No	--	No
SR3-2	2194.8	-512.7	1011.8	270	35	No	--	No
Side Rail Right Side								
SR1	1271.2	513.2	1030.5	90	40	No	--	No
SR2A	1420.5	503.5	1034.9	--	--	Yes	--	--
REL	1444.3	495.6	1050.1	90	40	--	1	No
SR2B	1374.6	518.7	1068.3	--	--	Yes	--	--
REL	1374.0	482.5	1058.1	90	40	--	1	No
SR3-1	2039.3	504.9	1033.4	90	38	No	--	No
SR3-2	2193.5	512.8	1012.8	90	35	No	--	No
Rear Header Left Side								
RH	2434.8	-364.2	1060.6	0	50	No	--	No
Rear Header Right Side								
RH	2435.9	365.0	1057.2	0	50	No	--	No
Upper Roof Left Side								
UR1@x=1265	1265.9	-95.6	1060.3	180	50	No	--	No
UR2@SR1	1275.5	-369.1	1086.5	270	50	No	--	Yes
UR3@SR2A	1428.0	-341.0	1122.2	270	50	No	--	No
UR4@BP	1675.4	-371.6	1101.3	270	50	No	--	No
UR5@SR3-1	2044.1	-357.0	1107.8	270	50	No	--	Yes
UR6@SR3-2	2201.2	-355.6	1093.9	270	50	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					
Upper Roof Right Side								
UR7@x=1265	1264.9	95.0	1058.0	180	50	No	--	No
UR8@SR1	1275.5	369.6	1084.1	90	50	No	--	No
UR9@SR2A	1427.0	341.4	1120.1	90	50	No	--	Yes
UR10@BP	1675.2	371.5	1098.4	90	50	No	--	Yes
UR11@SR3-1	2043.3	357.6	1105.9	90	50	No	--	No
UR12@SR3-2	2201.0	355.4	1092.2	90	50	No	--	Yes

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

Recorded By:  Approved By: 

Date: September 25, 2015

3.0 TEST DATA (Including Acceleration and Velocity Plots)

Test U15222 Data

	FMVSS 201U	
	Test No.: U15222 Customer: NHTSA	Report No.: G15I7-001.8 Date: 09/24/2015

Summary of the Test				
Setup Information				
Sample Description: 2015 Chrysler 200				
Test Sequence No.: 1		Time: 10:04am		
Horizontal Approach Angle: 215 deg		Temperature: 21.0 °C		
Vertical Approach Angle: 50 deg		Humidity: 47.7 %RH		
Impact Form ID No.: 35		Impact Form Mass: 4.51 kg		
Target Location: Left AP2				
Additional Description:				
Test Results				
Impact Velocity: 18.75 km/h				
HIC Type	HIC Value	Time 1 (ms)	Time 2 (ms)	Delta-T (ms)
HIC 36	466.39	88.6	93.3	4.7
HIC 15	466.39	88.6	93.3	4.7
HIC (d)	518.27	88.6	93.3	4.7

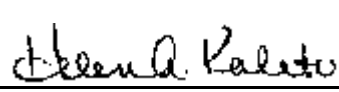
3 ms Clip = 90.83 G , Time 1 = 89.22 ms , Time 2 = 92.22 ms

Impact Location on FMH: 27 mm Above Pt. 0 , 2 Right mm Lateral of Pt. 0

Post-Test Comments: Headliner deformation.

Test Series Performed By: DB, KR

Page 1 of 3

Recorded By:  Approved By: 

Date: September 24, 2015



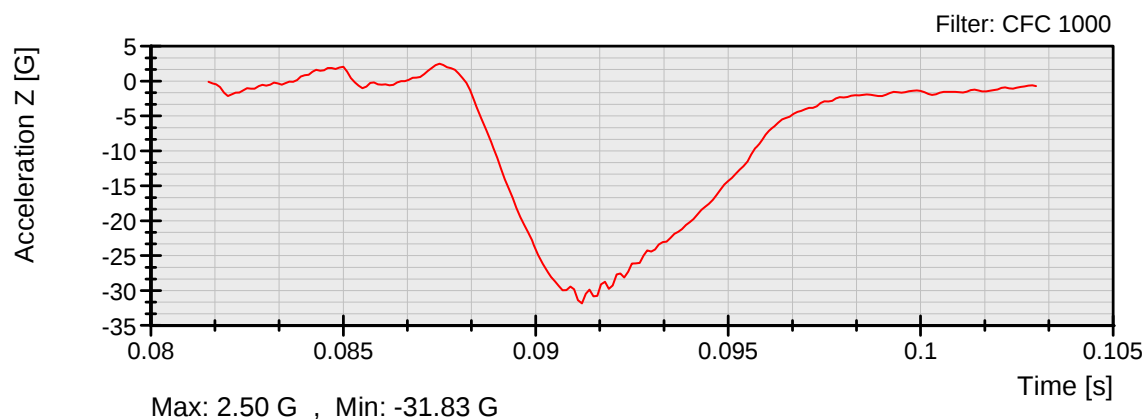
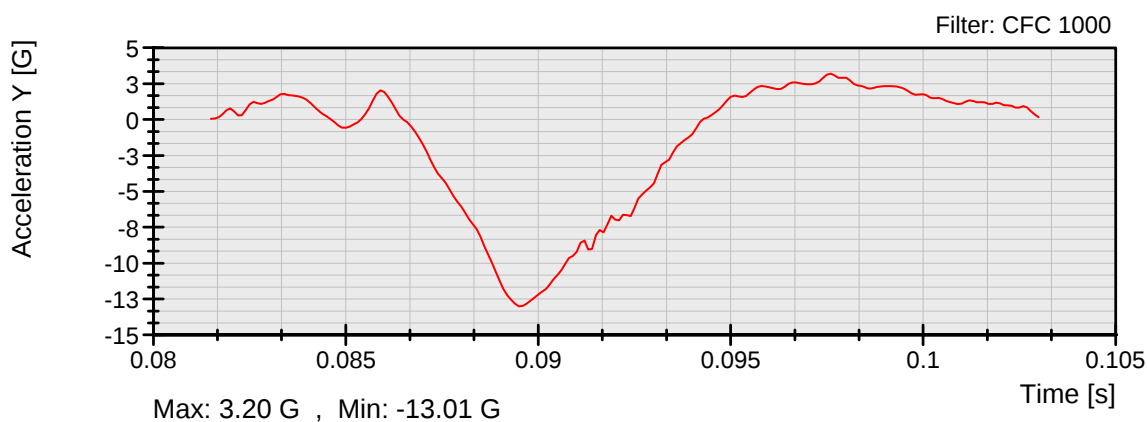
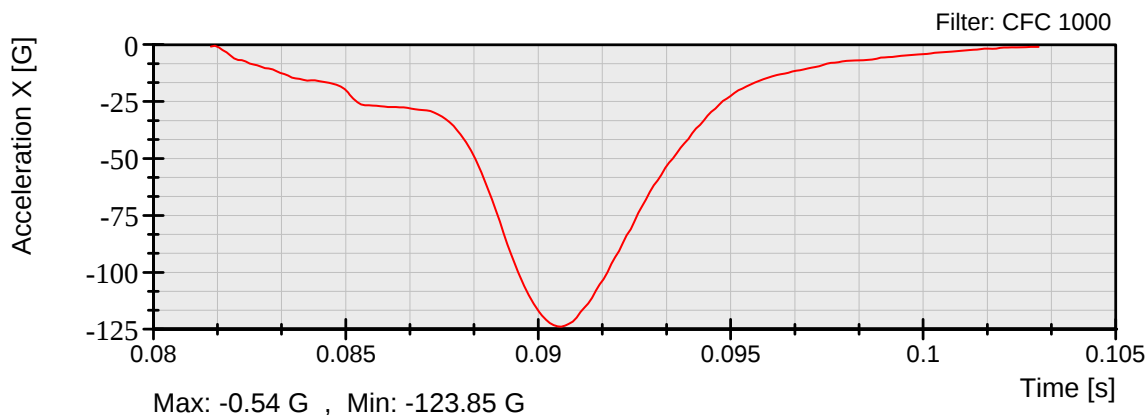
FMVSS 201U

Test No.: U15222

Customer: NHTSA

Report No.: G15I7-001.8

Date: 09/24/2015





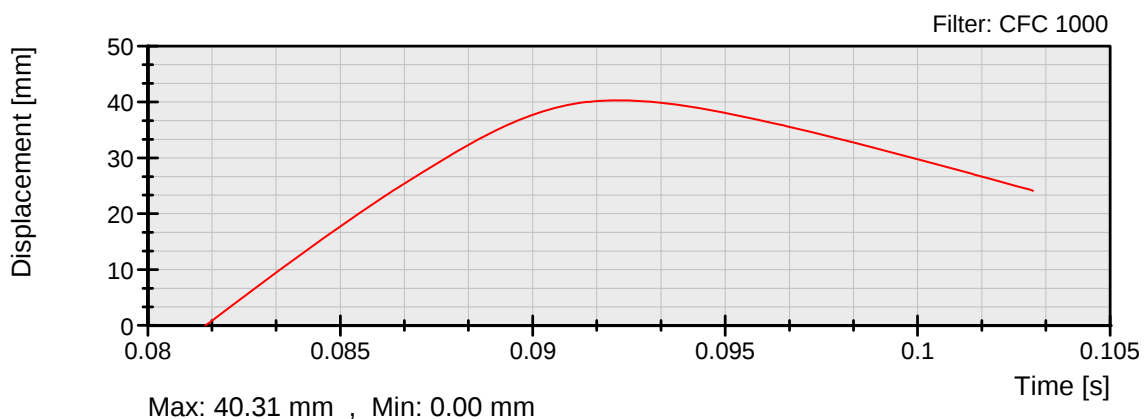
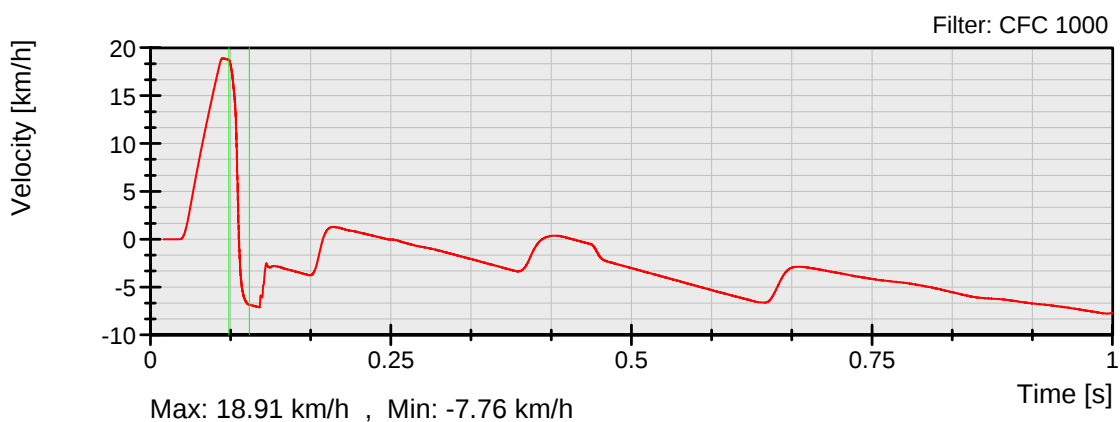
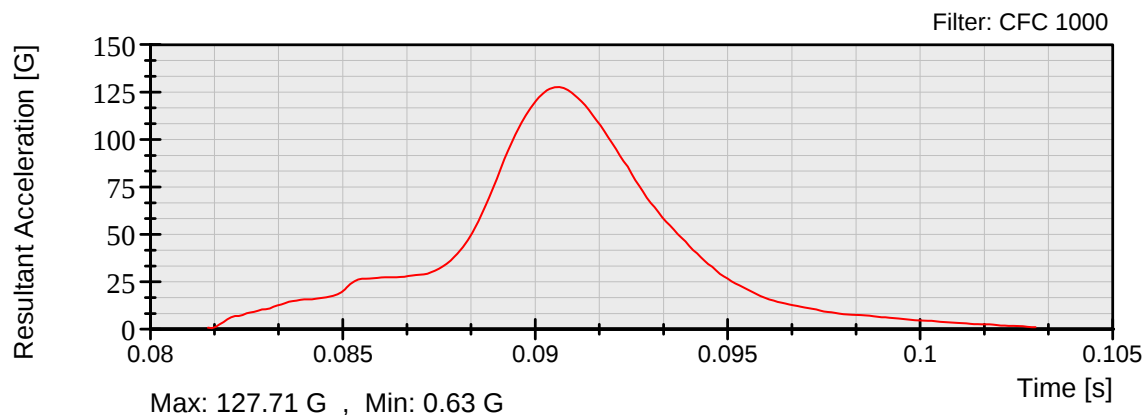
FMVSS 201U

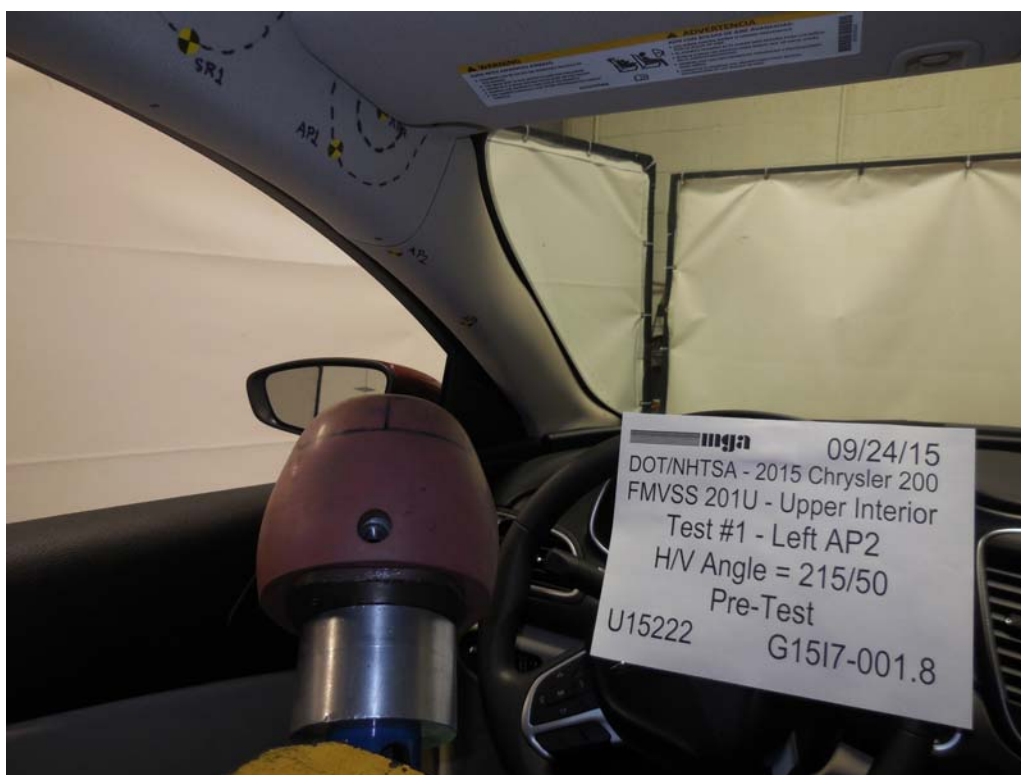
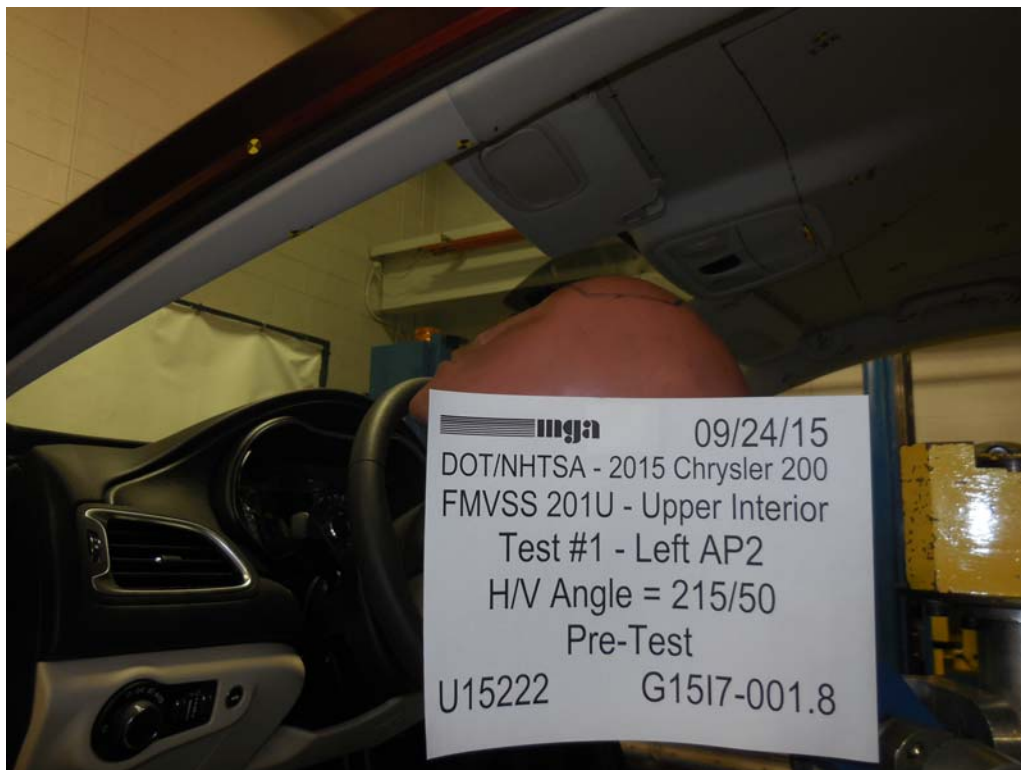
Test No.: U15222

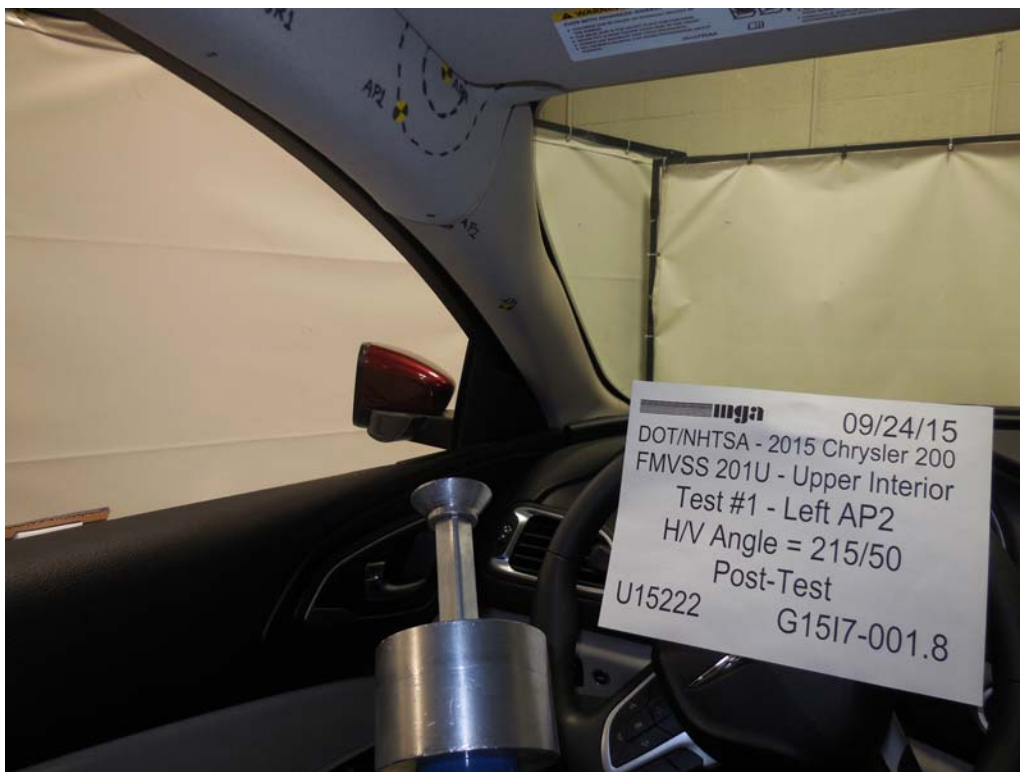
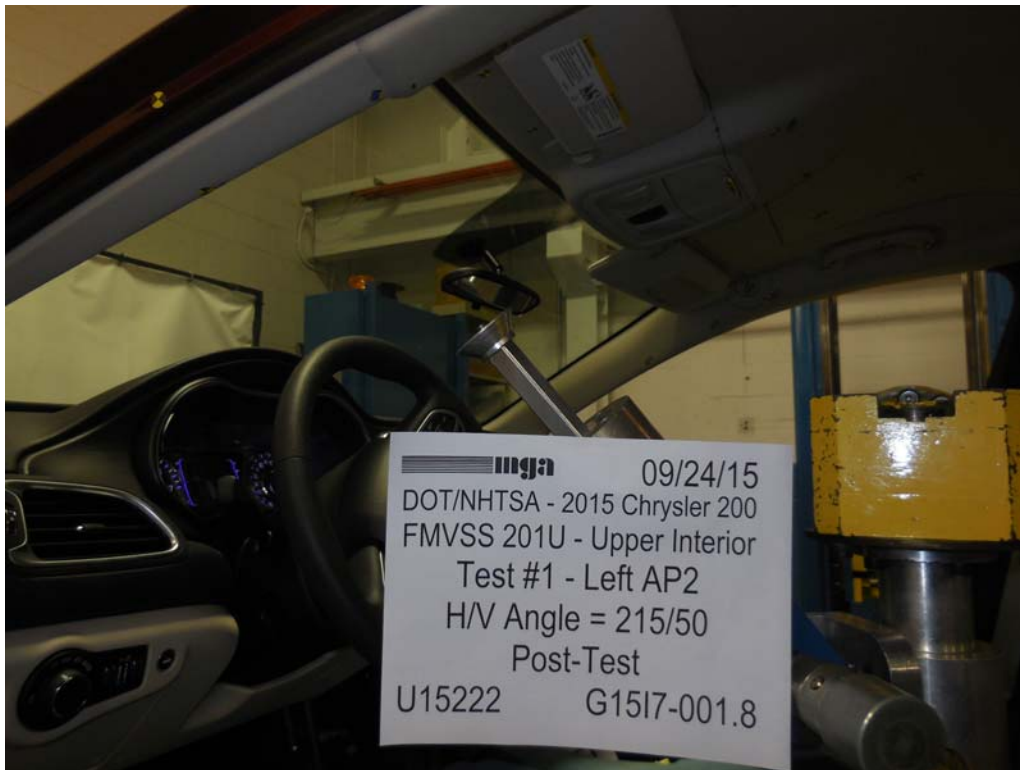
Customer: NHTSA

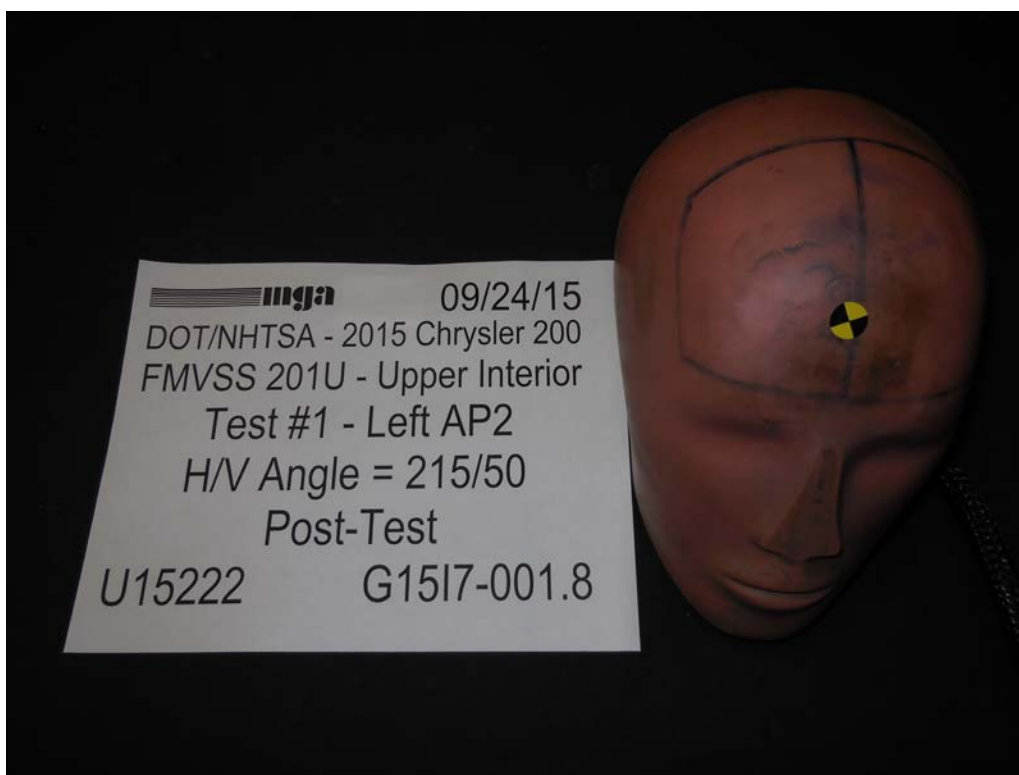
Report No.: G15I7-001.8

Date: 09/24/2015









Test U15233 Data



FMVSS 201U
Test No.: U15233
Customer: NHTSA

Report No.: G15I7-001.8
Date: 09/25/2015

Summary of the Test

Setup Information

Sample Description: 2015 Chrysler 200

Test Sequence No.: 12

Time: 3:47pm

Horizontal Approach Angle: 156 deg

Temperature: 21.7 °C

Vertical Approach Angle: 50 deg

Humidity: 42.8 %RH

Impact Form ID No.: 38

Impact Form Mass: 4.51 kg

Target Location: Right AP3

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	577.11	87.6	92.3	4.7
HIC 15	577.11	87.6	92.3	4.7
HIC (d)	601.81	87.6	92.3	4.7

3 ms Clip = 98.11 G , Time 1 = 88.22 ms , Time 2 = 91.22 ms

Impact Location on FMH: 15 mm Above Pt. 0 , 6 Left mm Lateral of Pt. 0

Post-Test Comments: No visible damage.

Test Series Performed By: DB, KR

Page 1 of 3

Recorded By:  Approved By: 

Date: September 25, 2015



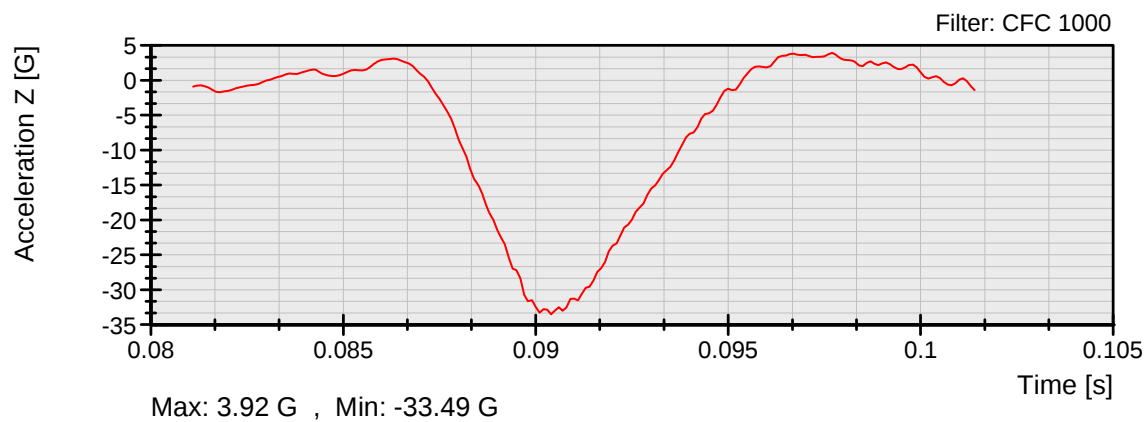
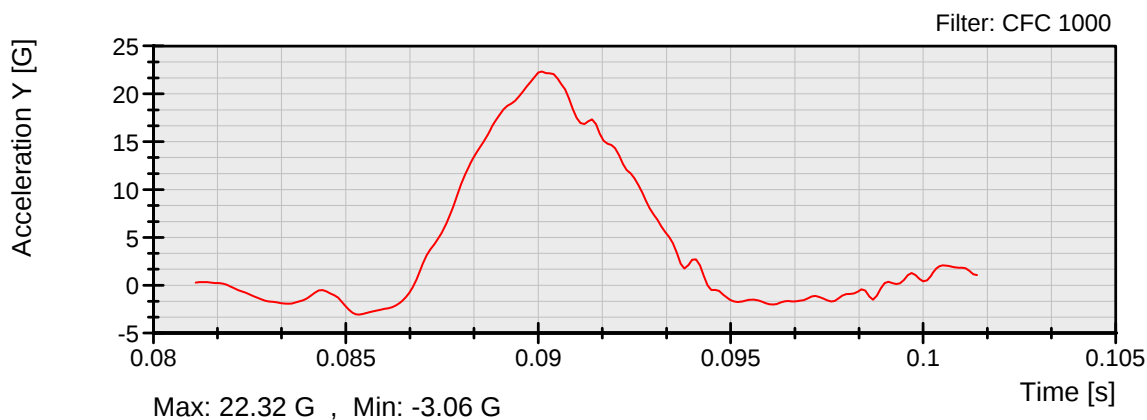
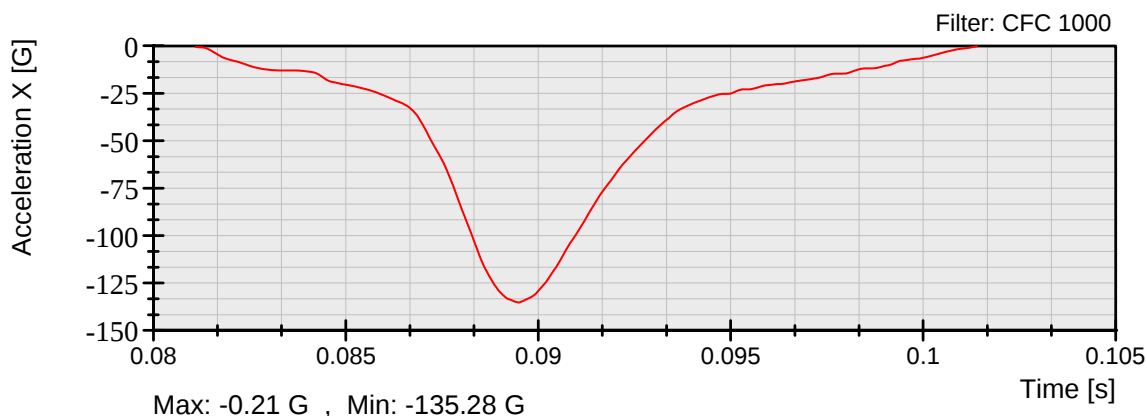
FMVSS 201U

Test No.: U15233

Customer: NHTSA

Report No.: G15I7-001.8

Date: 09/25/2015





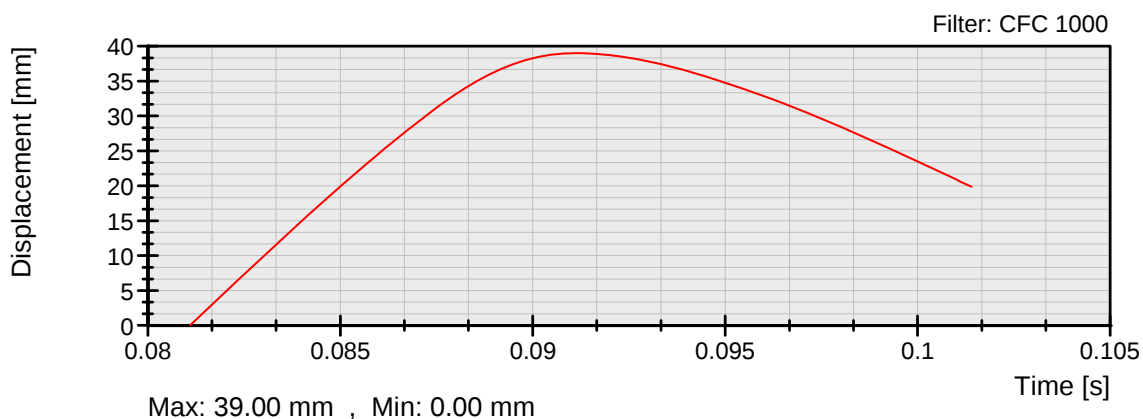
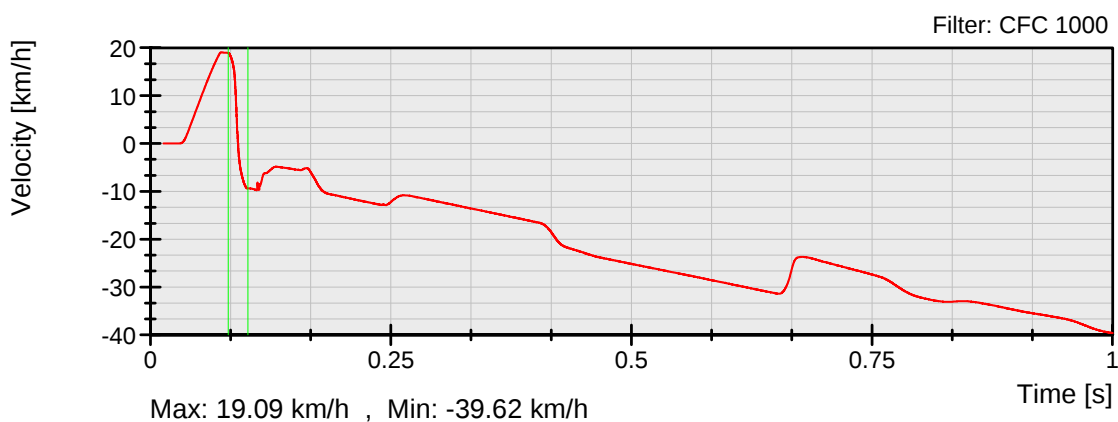
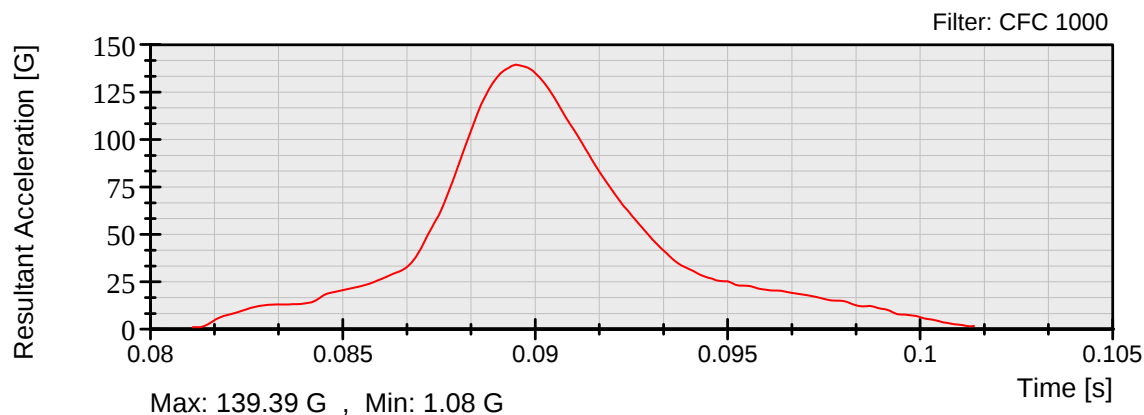
FMVSS 201U

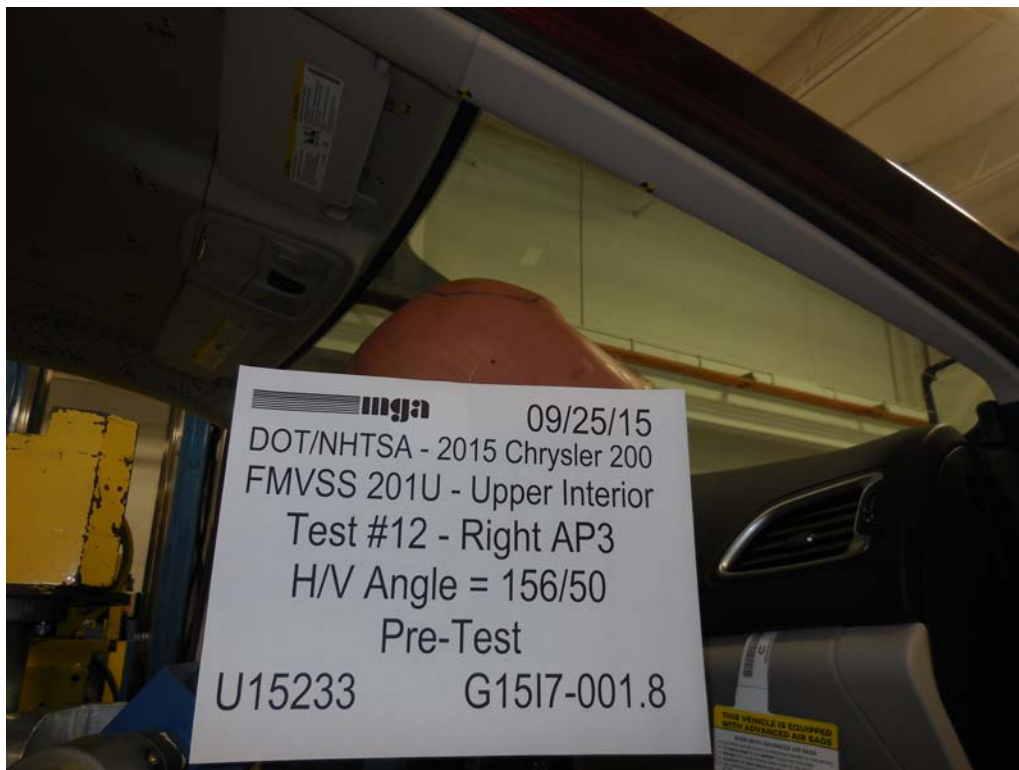
Test No.: U15233

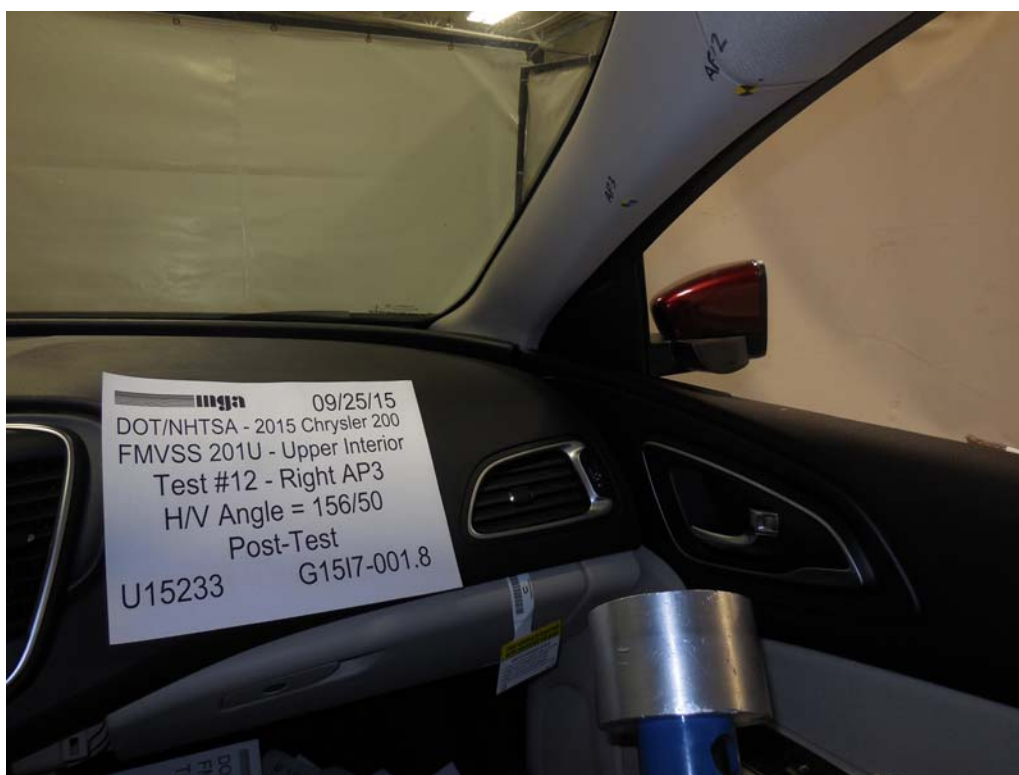
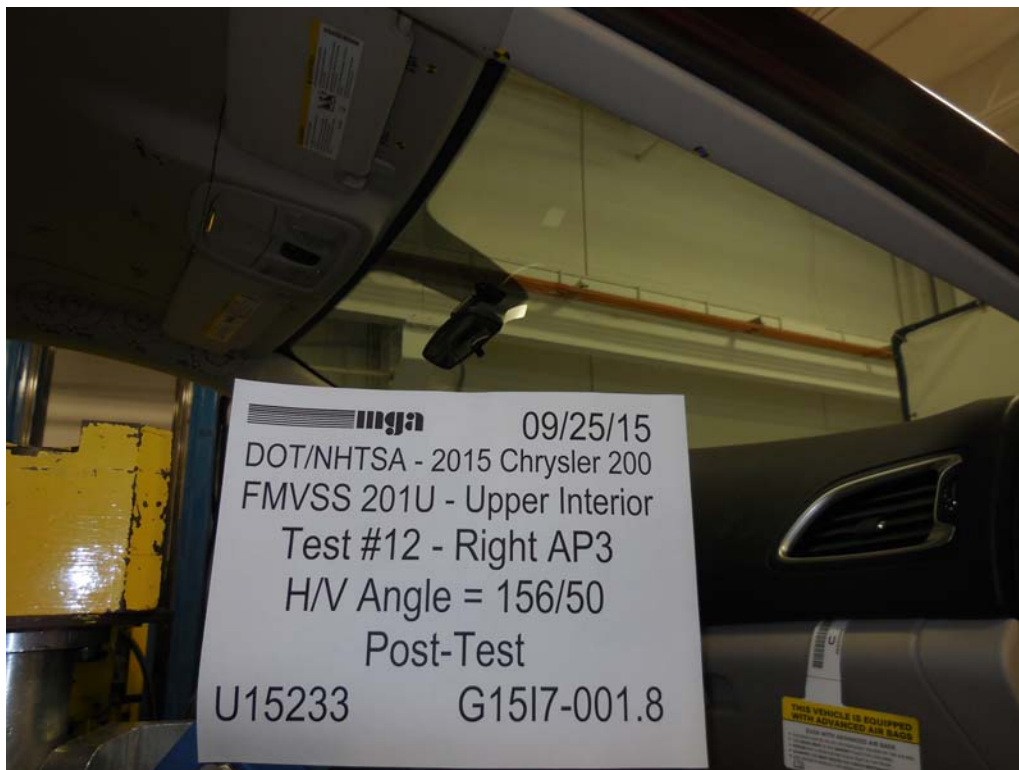
Customer: NHTSA

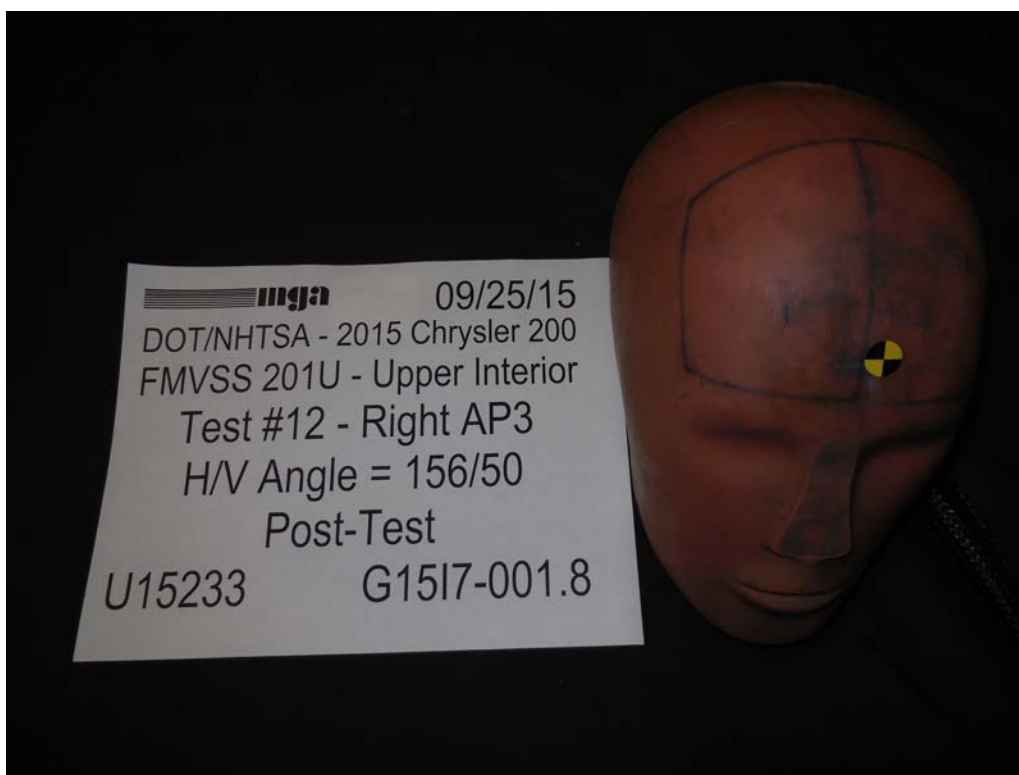
Report No.: G15I7-001.8

Date: 09/25/2015









Test U15224 Data



FMVSS 201U

Test No.: U15224
Customer: NHTSA

Report No.: G15I7-001.8
Date: 09/24/2015

Summary of the Test

Setup Information

Sample Description: 2015 Chrysler 200

Test Sequence No.: 3

Time: 11:41am

Horizontal Approach Angle: 270 deg

Temperature: 21.5 °C

Vertical Approach Angle: 10 deg

Humidity: 46.7 %RH

Impact Form ID No.: 38

Impact Form Mass: 4.51 kg

Target Location: Left BP1

Additional Description:

Test Results

Impact Velocity: 18.69 km/h

HIC Type	HIC Value	Time 1 (ms)	Time 2 (ms)	Delta-T (ms)
HIC 36	434.29	86.9	92	5.1
HIC 15	434.29	86.9	92	5.1
HIC (d)	494.05	86.9	92	5.1

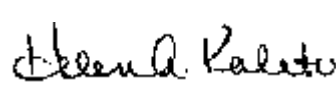
3 ms Clip = 88.34 G , Time 1 = 87.8 ms , Time 2 = 90.8 ms

Impact Location on FMH: 25 mm Above Pt. 0 , 5 Left mm Lateral of Pt. 0

Post-Test Comments: No visible damage.

Test Series Performed By: DB, KR

Page 1 of 3

Recorded By:  Approved By: 

Date: September 24, 2015



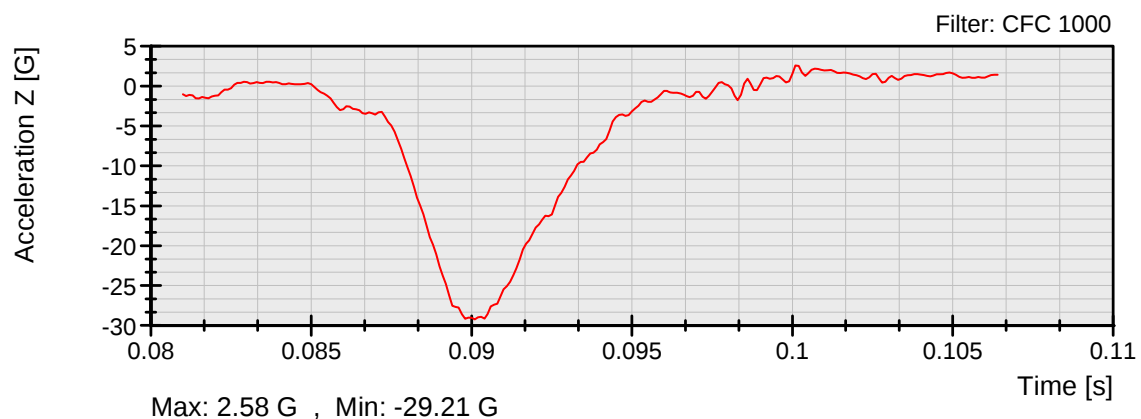
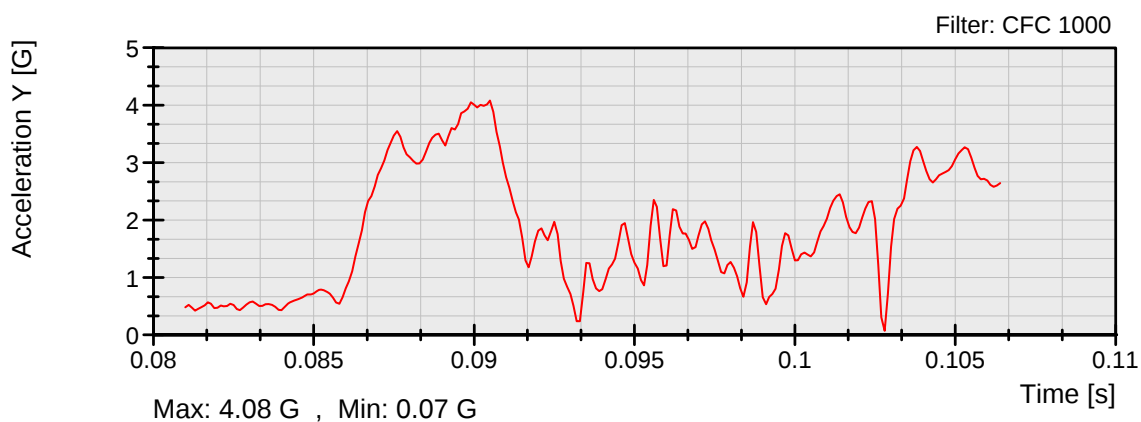
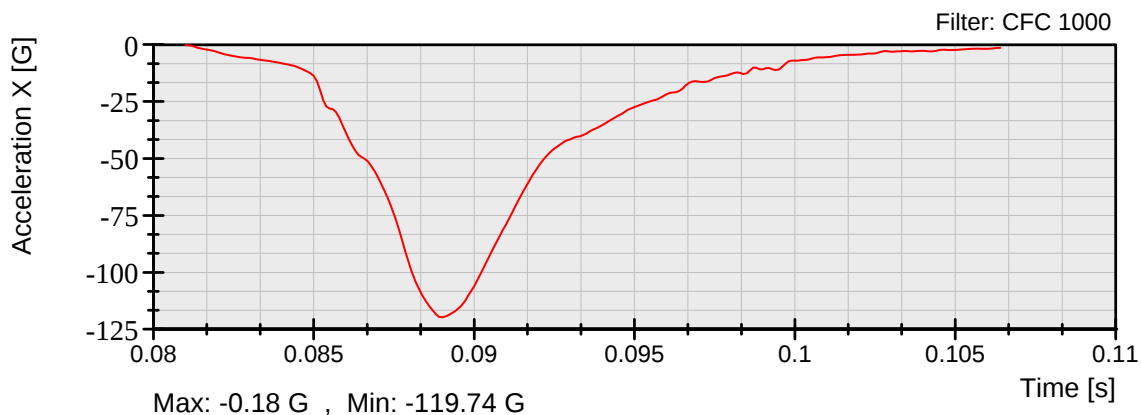
FMVSS 201U

Test No.: U15224

Customer: NHTSA

Report No.: G15I7-001.8

Date: 09/24/2015





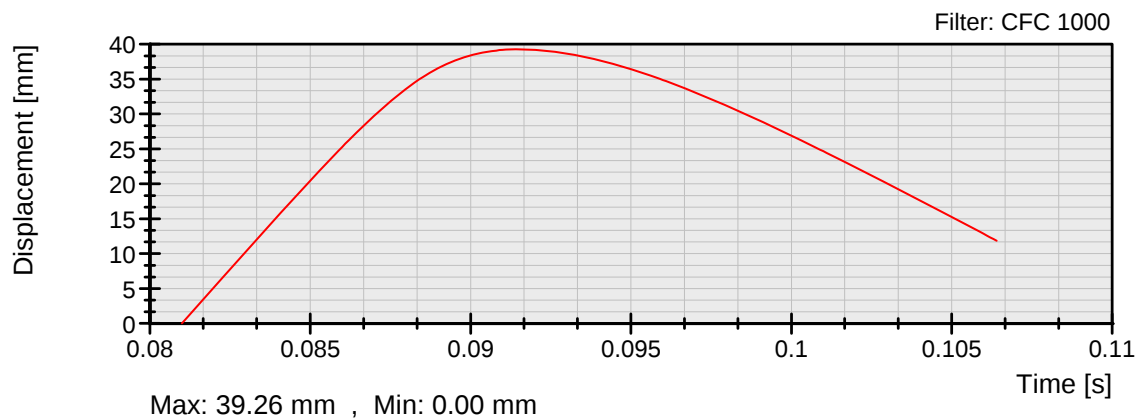
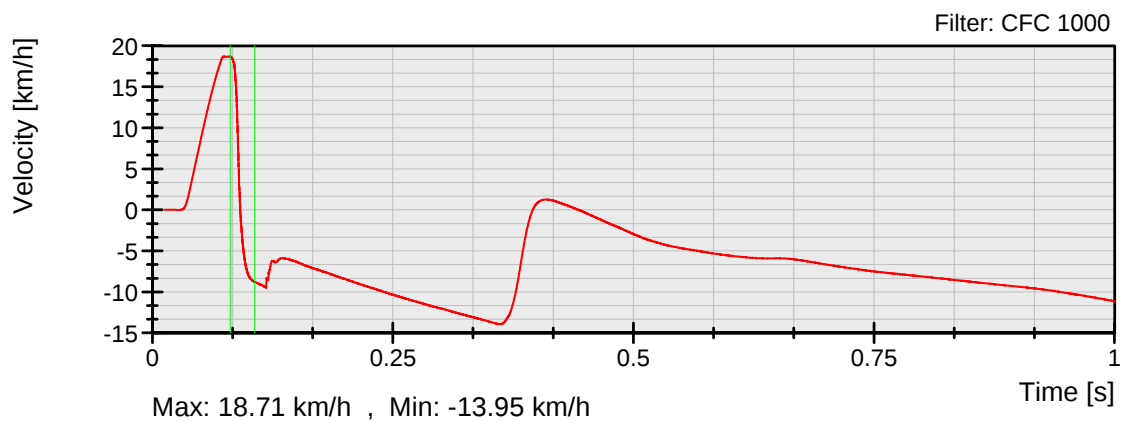
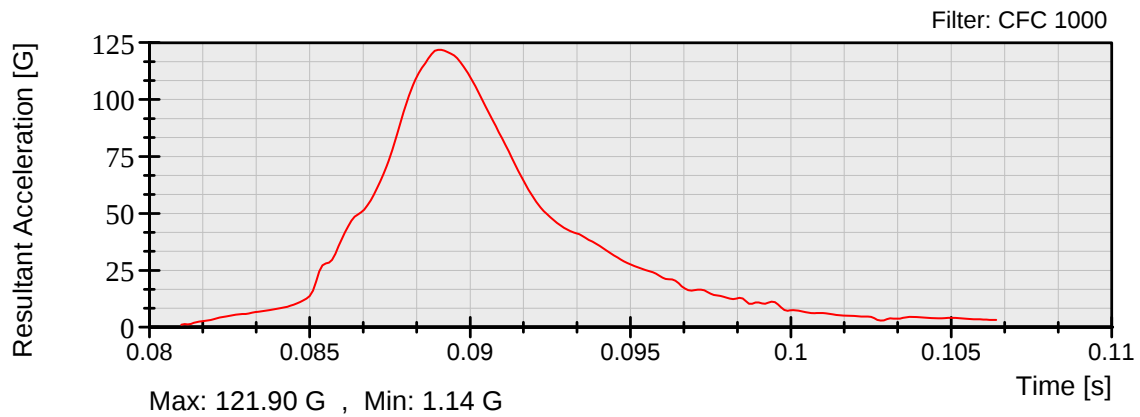
FMVSS 201U

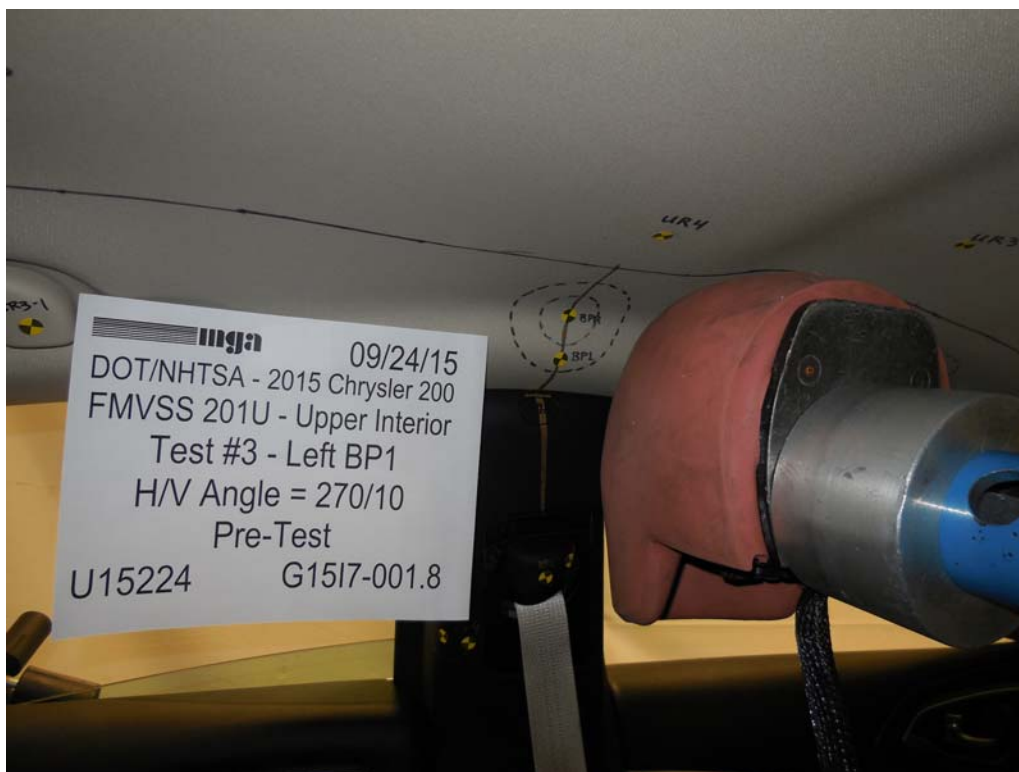
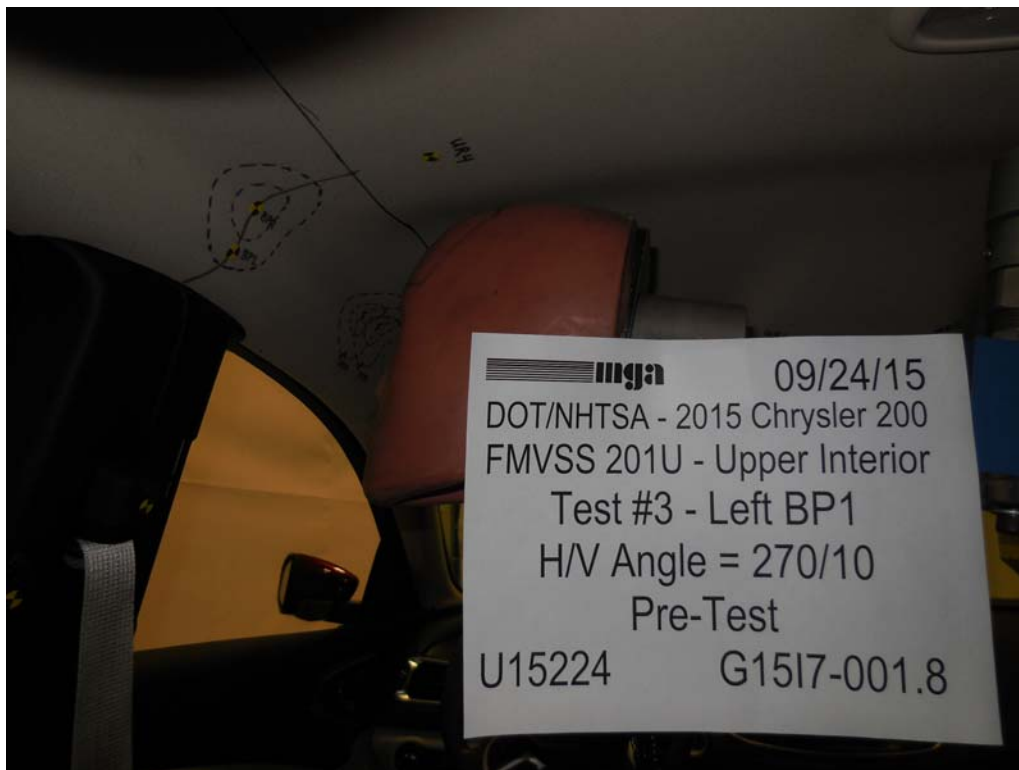
Test No.: U15224

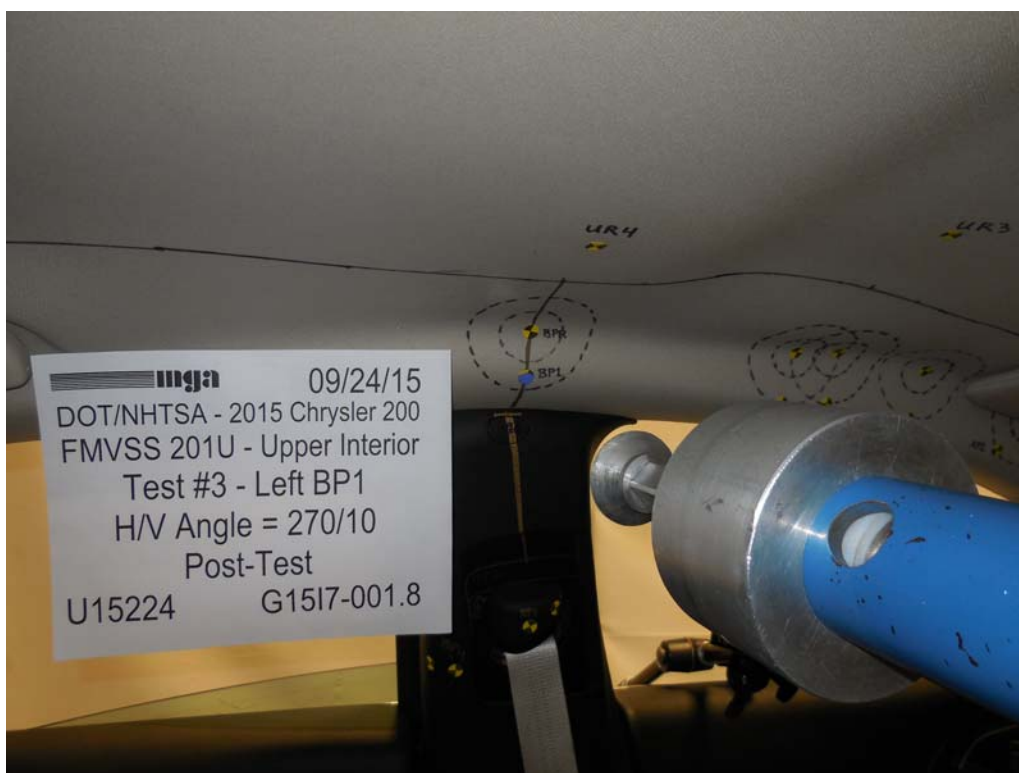
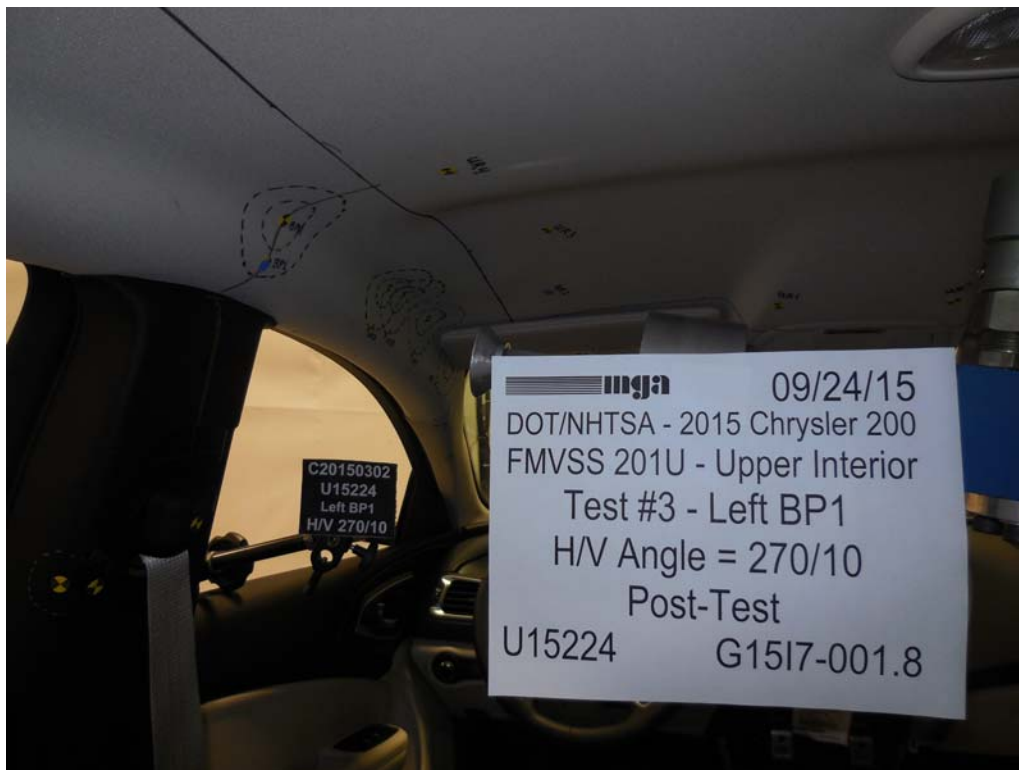
Customer: NHTSA

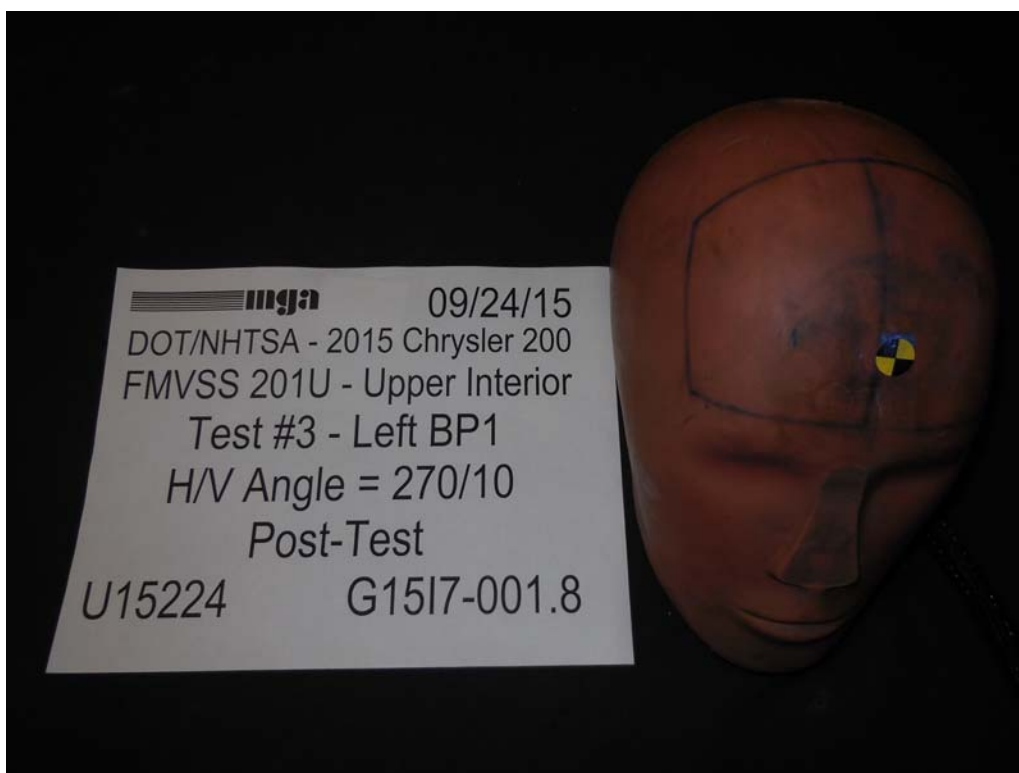
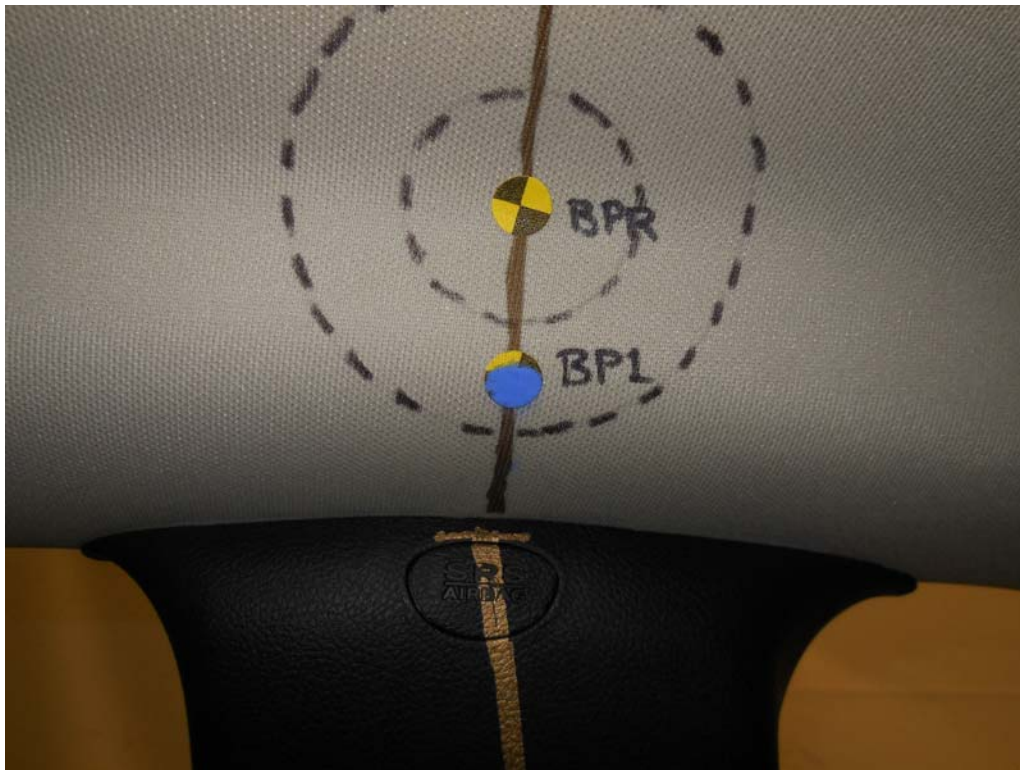
Report No.: G15I7-001.8

Date: 09/24/2015









Test U15225 Data



FMVSS 201U

Test No.: U15225
Customer: NHTSA

Report No.: G15I7-001.8
Date: 09/24/2015

Summary of the Test

Setup Information

Sample Description: 2015 Chrysler 200

Test Sequence No.: 4

Time: 1:50pm

Horizontal Approach Angle: 270 deg

Temperature: 21.1 °C

Vertical Approach Angle: 18 deg

Humidity: 44.4 %RH

Impact Form ID No.: 35

Impact Form Mass: 4.51 kg

Target Location: Left BP2

Additional Description:

Test Results

Impact Velocity: 23.97 km/h

HIC Type	HIC Value	Time 1 (ms)	Time 2 (ms)	Delta-T (ms)
HIC 36	781.51	74.1	80.5	6.4
HIC 15	781.51	74.1	80.5	6.4
HIC (d)	756.02	74.1	80.5	6.4

3 ms Clip = 100.7 G , Time 1 = 76.56 ms , Time 2 = 79.56 ms

Impact Location on FMH: 11 mm Above Pt. 0 , 3 Right mm Lateral of Pt. 0

Post-Test Comments: Seat belt adjuster damaged.

Test Series Performed By: DB, KR

Page 1 of 3

Recorded By:  Approved By: 

Date: September 24, 2015



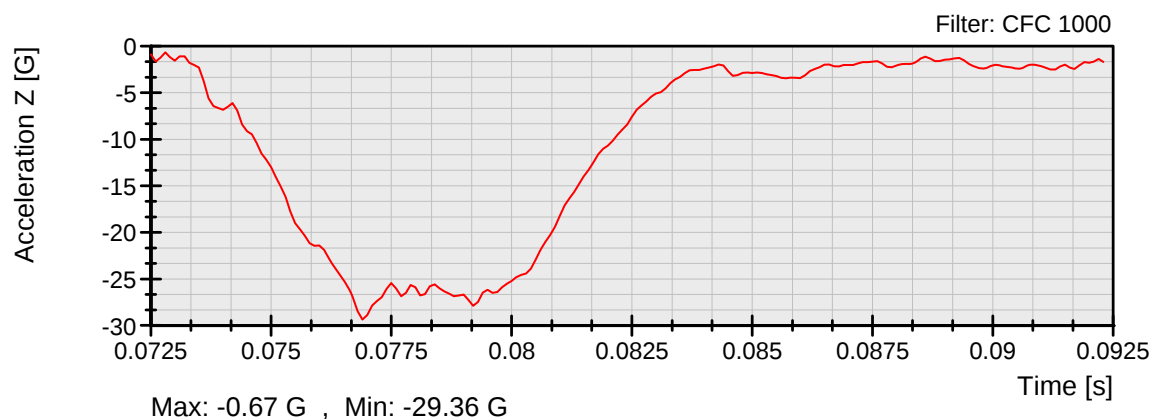
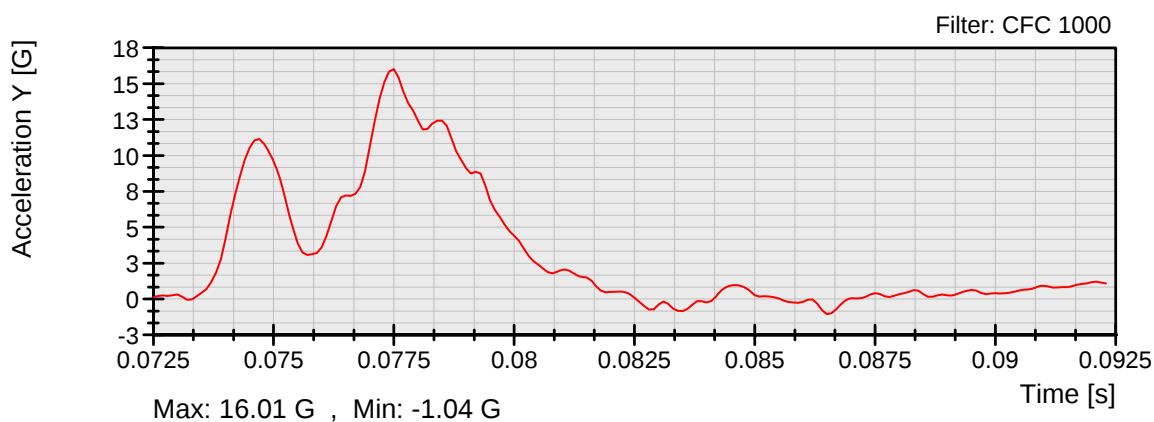
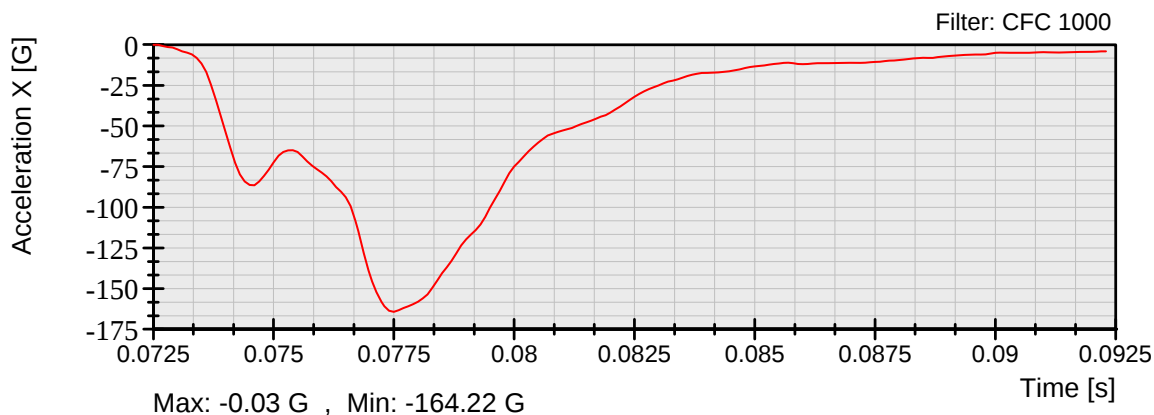
FMVSS 201U

Test No.: U15225

Customer: NHTSA

Report No.: G15I7-001.8

Date: 09/24/2015





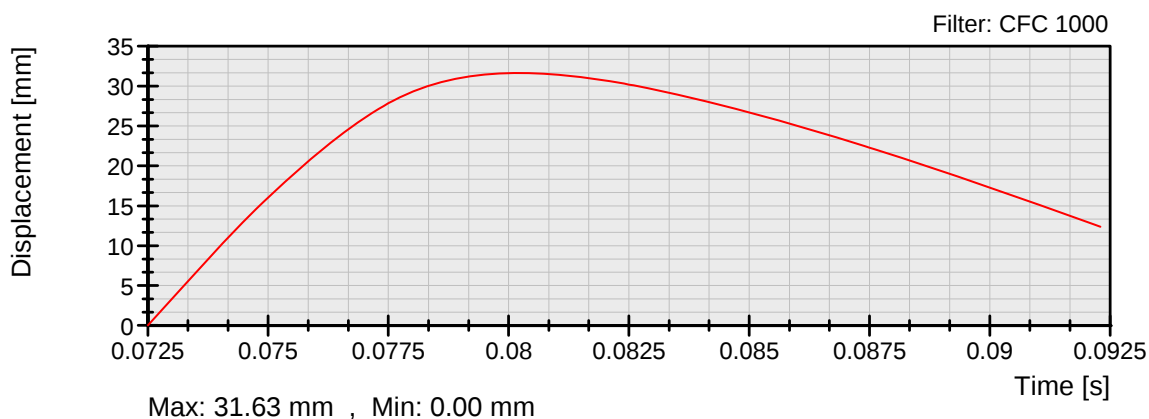
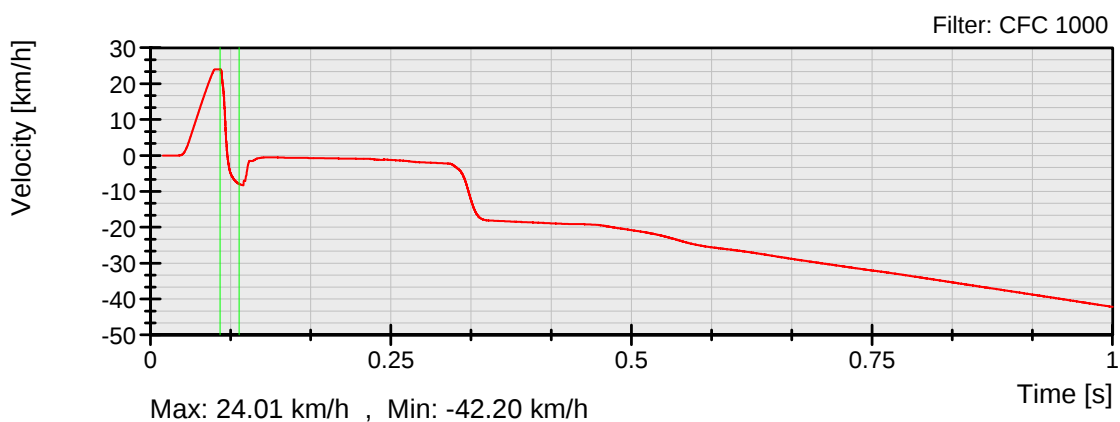
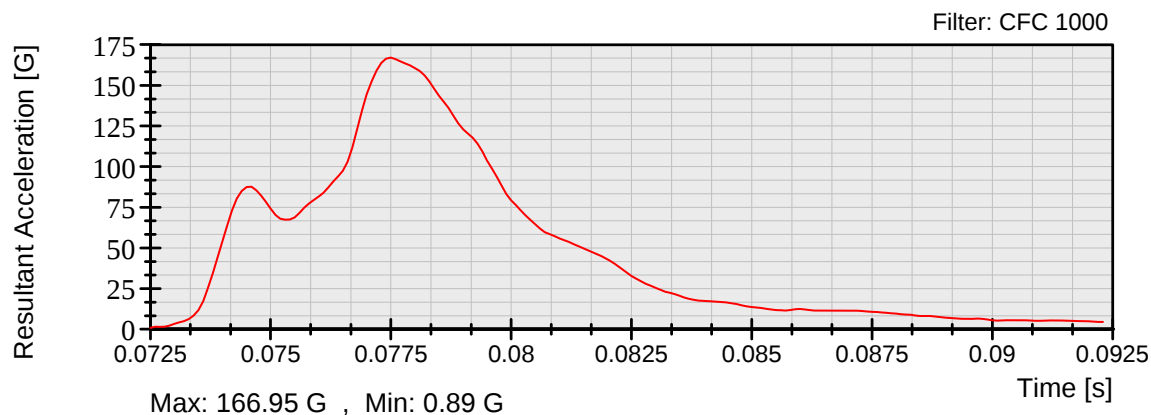
FMVSS 201U

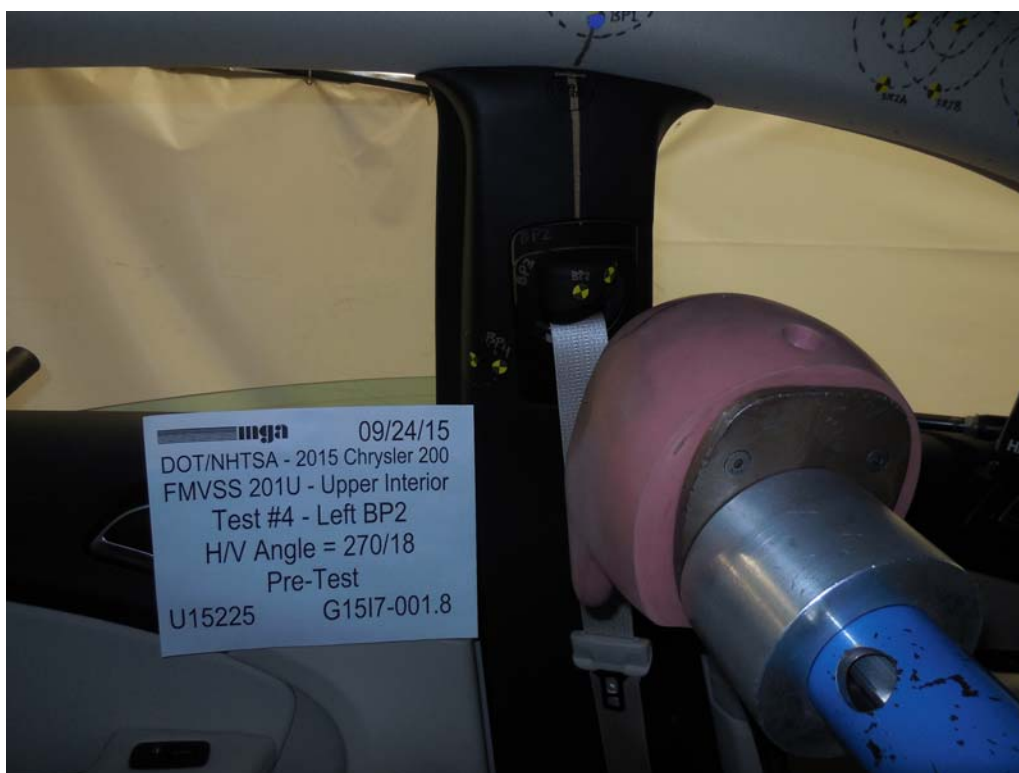
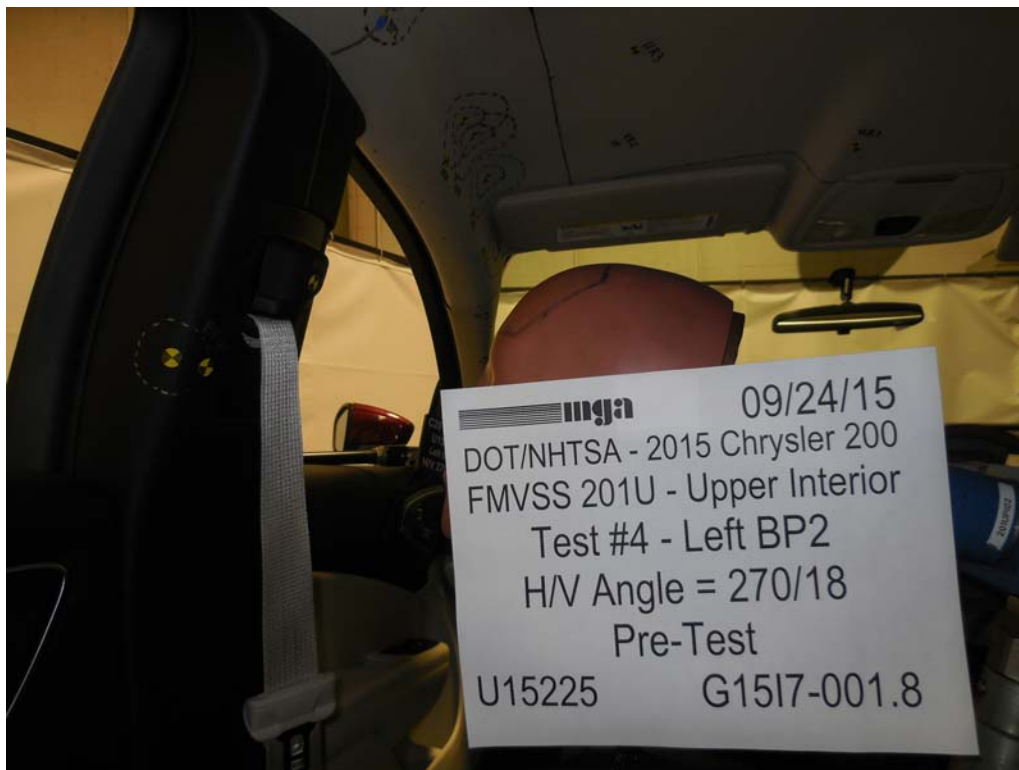
Test No.: U15225

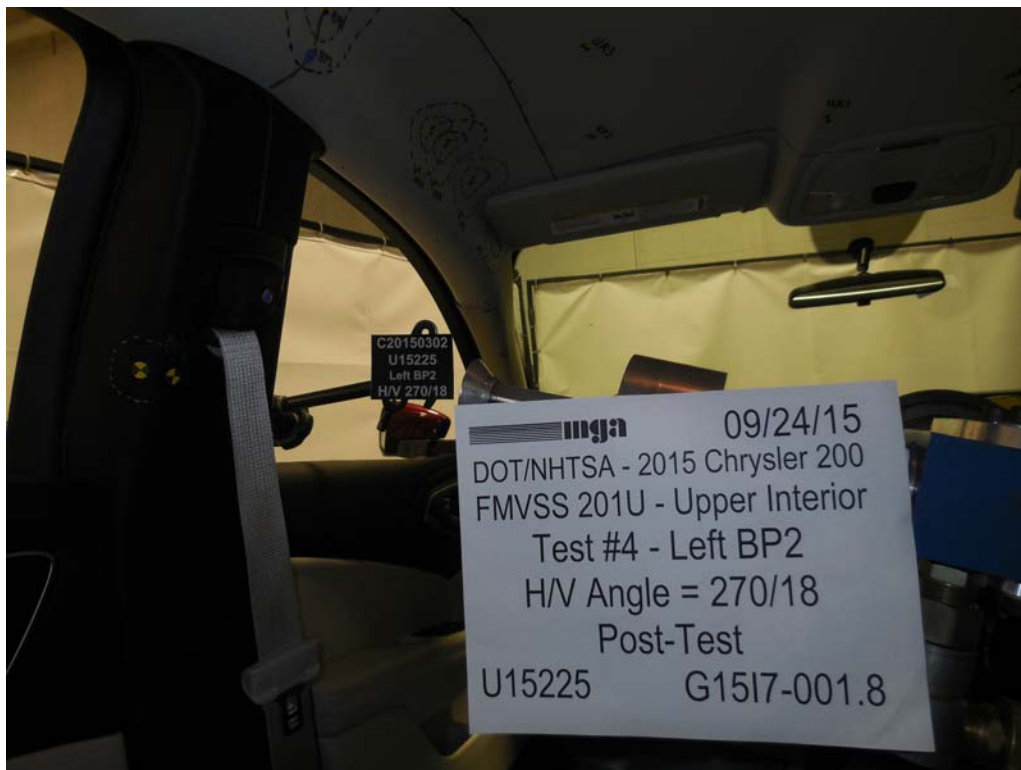
Customer: NHTSA

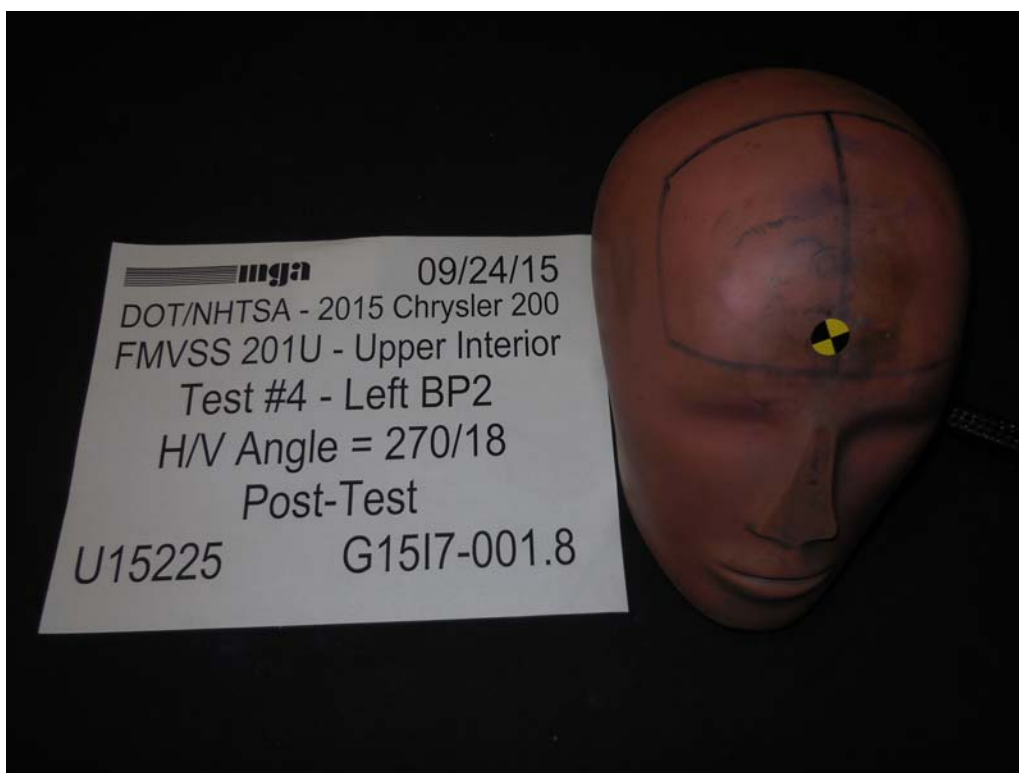
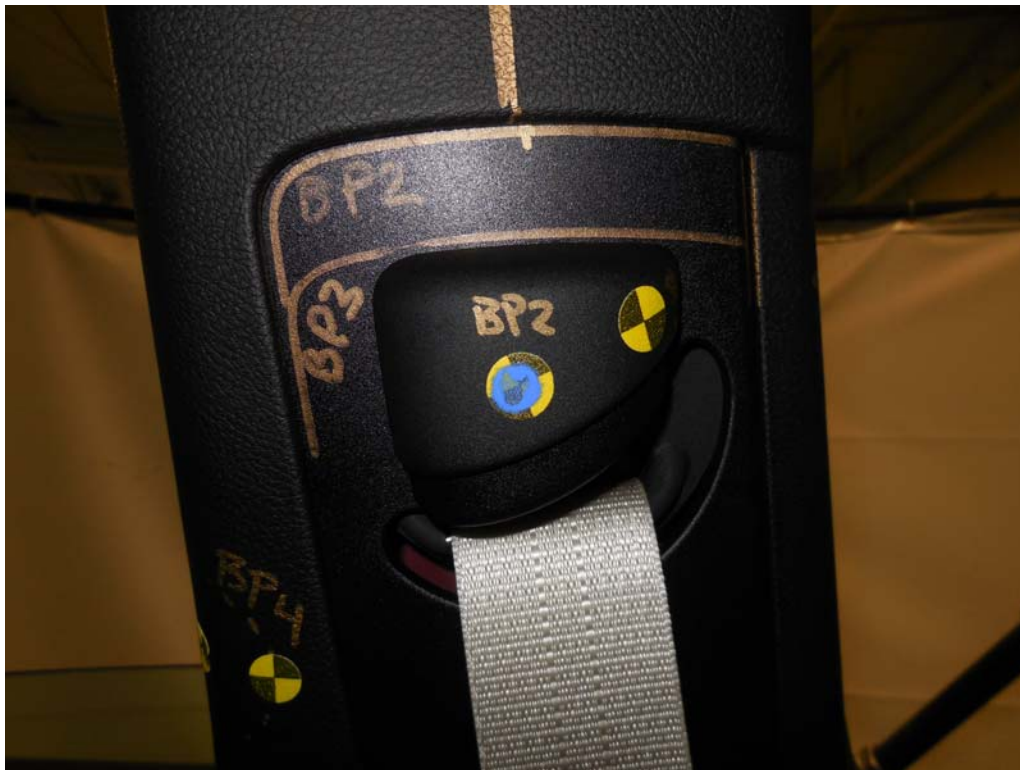
Report No.: G15I7-001.8

Date: 09/24/2015









Test U15230 Data



FMVSS 201U

Test No.: U15230
Customer: NHTSA

Report No.: G15I7-001.8
Date: 09/25/2015

Summary of the Test

Setup Information

Sample Description: 2015 Chrysler 200

Test Sequence No.: 9

Time: 10:27am

Horizontal Approach Angle: 90 deg

Temperature: 23.4 °C

Vertical Approach Angle: 0 deg

Humidity: 46.9 %RH

Impact Form ID No.: 38

Impact Form Mass: 4.51 kg

Target Location: Right BP4

Additional Description:

Test Results

Impact Velocity: 24.02 km/h

HIC Type	HIC Value	Time 1 (ms)	Time 2 (ms)	Delta-T (ms)
HIC 36	606.09	78.5	85.2	6.7
HIC 15	606.09	78.5	85.2	6.7
HIC (d)	623.67	78.5	85.2	6.7

3 ms Clip = 101.7 G , Time 1 = 80.25 ms , Time 2 = 83.25 ms

Impact Location on FMH: 20 mm Above Pt. 0 , 18 Left mm Lateral of Pt. 0

Post-Test Comments: No visible damage.

Test Series Performed By: DB, KR

Page 1 of 3

Recorded By:  Approved By: 

Date: September 25, 2015



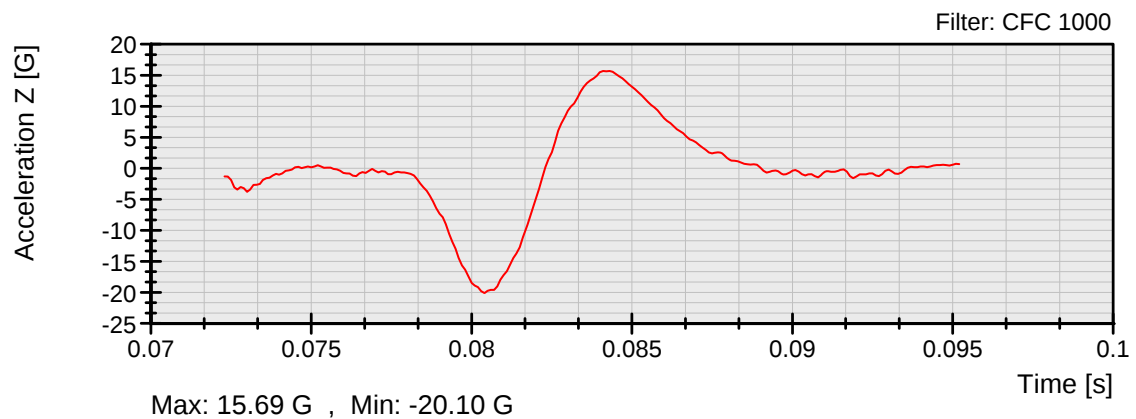
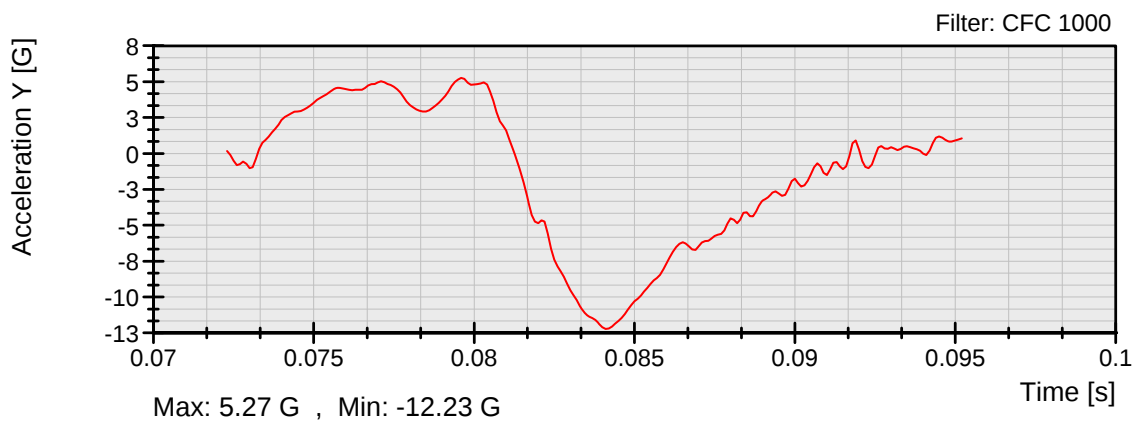
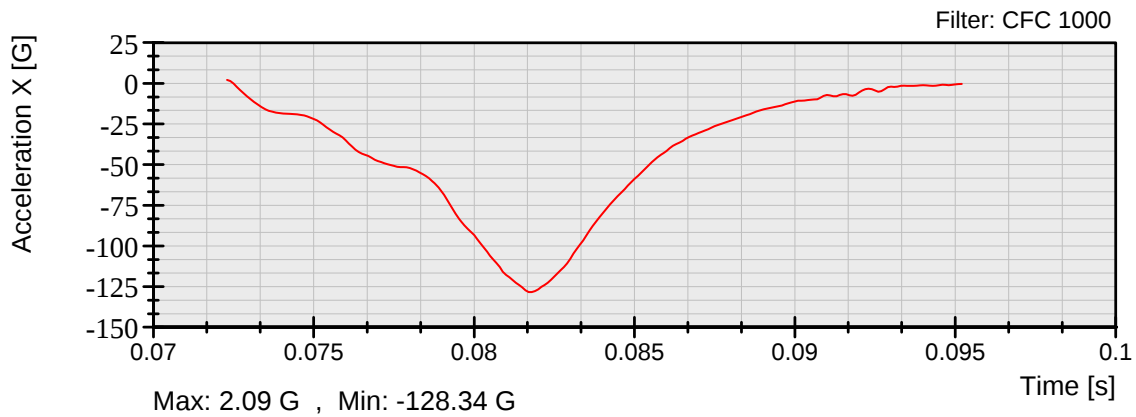
FMVSS 201U

Test No.: U15230

Customer: NHTSA

Report No.: G15I7-001.8

Date: 09/25/2015





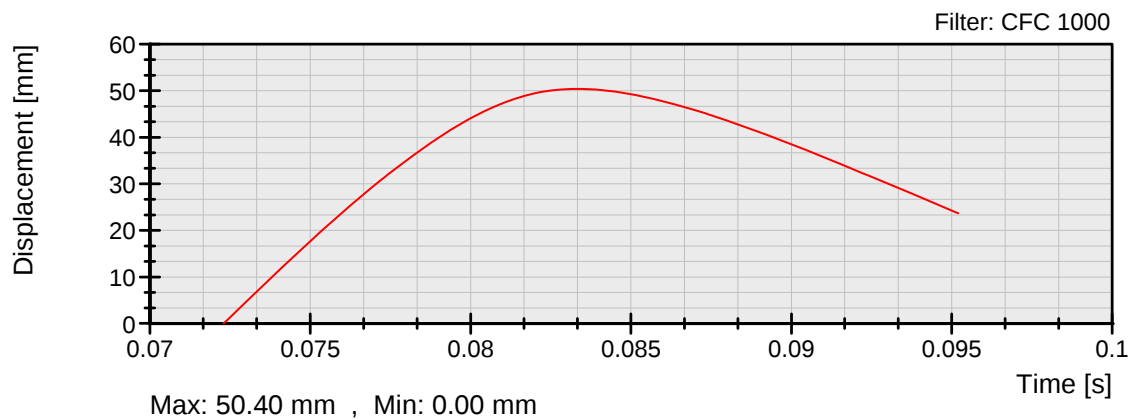
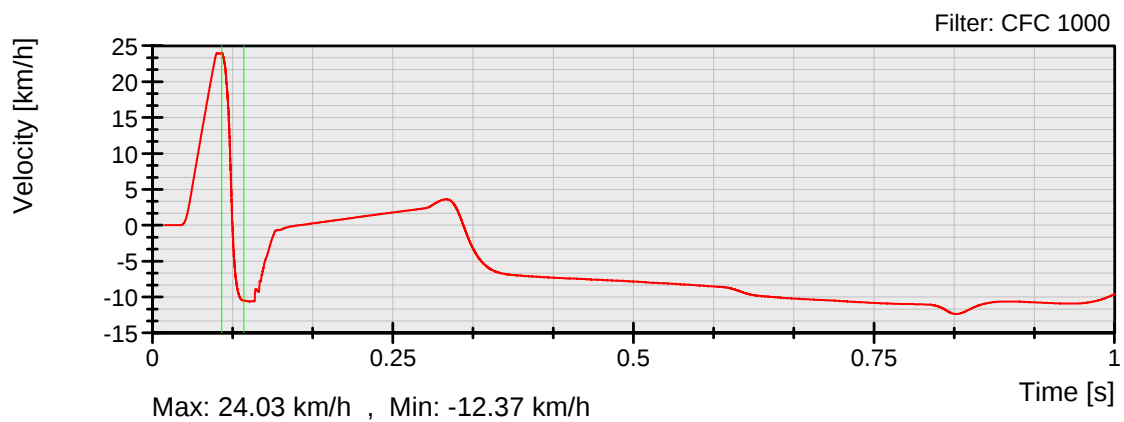
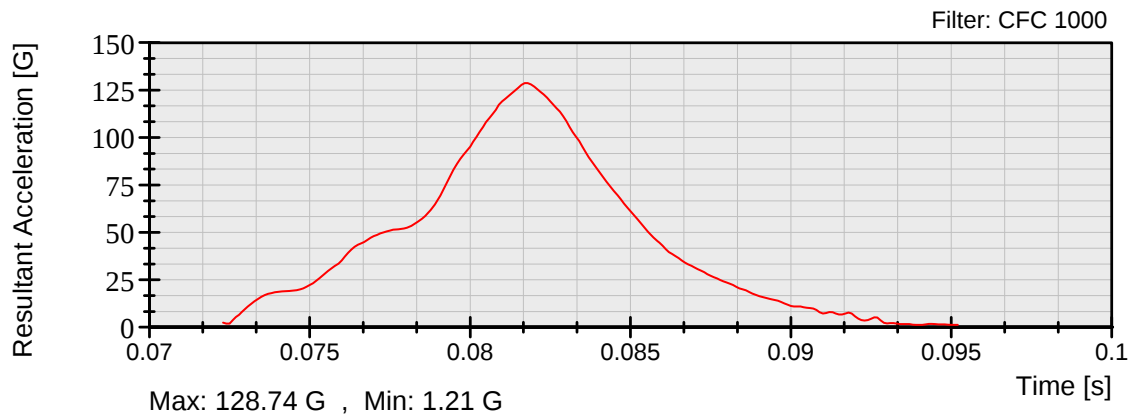
FMVSS 201U

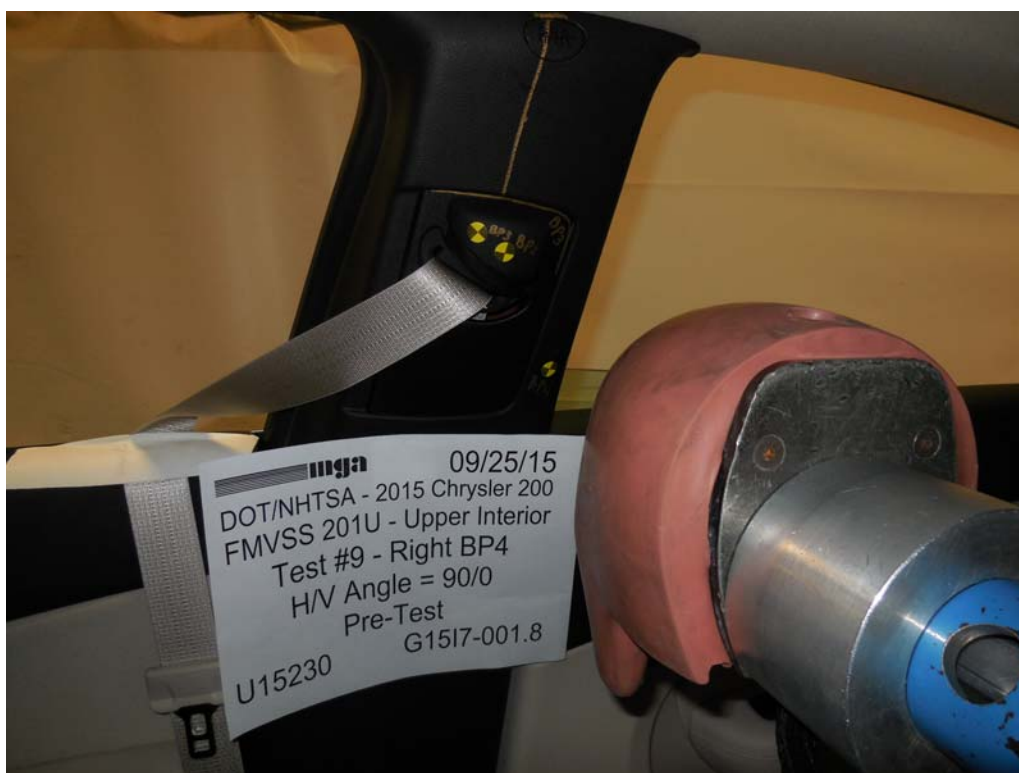
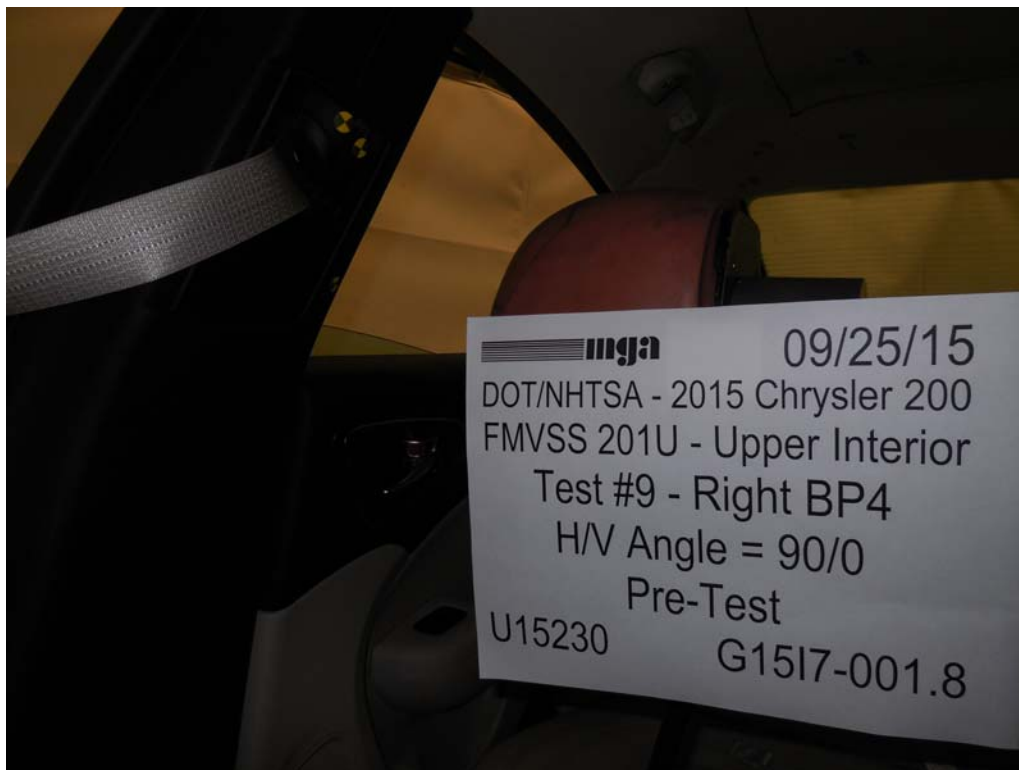
Test No.: U15230

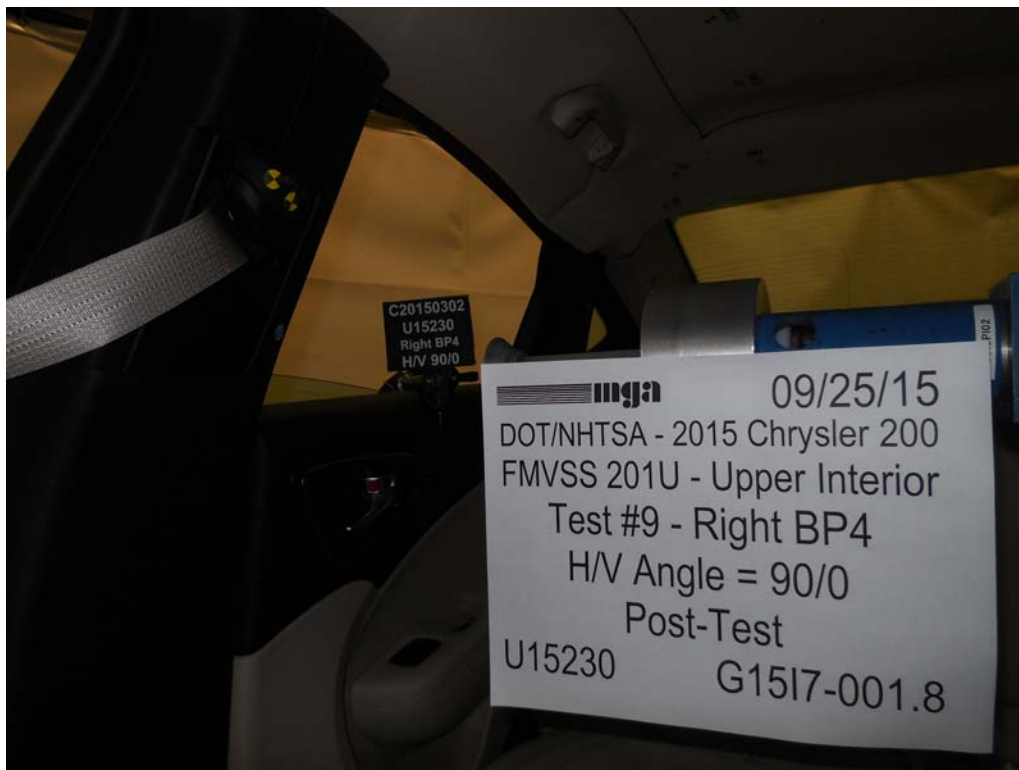
Customer: NHTSA

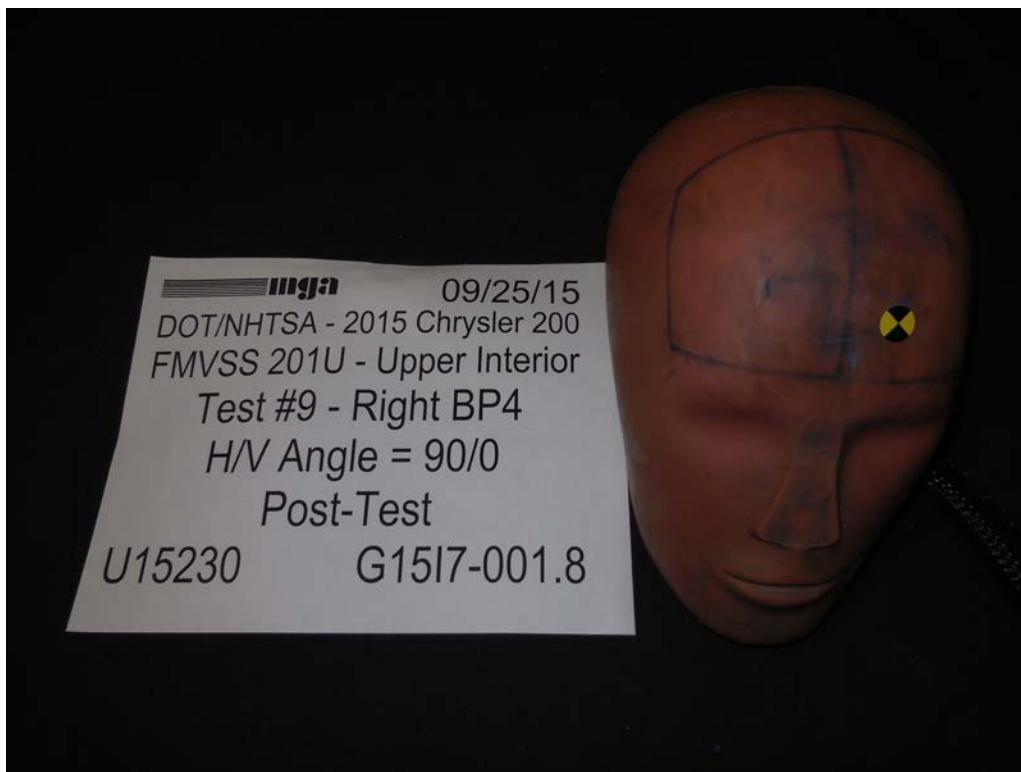
Report No.: G15I7-001.8

Date: 09/25/2015









Test U15228 Data



FMVSS 201U

Test No.: U15228
Customer: NHTSA

Report No.: G15I7-001.8
Date: 09/25/2015

Summary of the Test

Setup Information

Sample Description: 2015 Chrysler 200

Test Sequence No.: 7

Time: 9:25am

Horizontal Approach Angle: 90 deg

Temperature: 23.0 °C

Vertical Approach Angle: 23 deg

Humidity: 47.2 %RH

Impact Form ID No.: 35

Impact Form Mass: 4.51 kg

Target Location: Right OP1

Additional Description:

Test Results

Impact Velocity: 24.2 km/h

HIC Type	HIC Value	Time 1 (ms)	Time 2 (ms)	Delta-T (ms)
HIC 36	473.53	76	87.3	11.3
HIC 15	473.53	76	87.3	11.3
HIC (d)	523.66	76	87.3	11.3

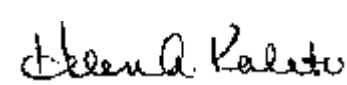
3 ms Clip = 74.98 G , Time 1 = 78.19 ms , Time 2 = 81.19 ms

Impact Location on FMH: 43 mm Above Pt. 0 , 4 Right mm Lateral of Pt. 0

Post-Test Comments: No visible damage.

Test Series Performed By: DB, KR

Page 1 of 3

Recorded By:  Approved By: 

Date: September 25, 2015



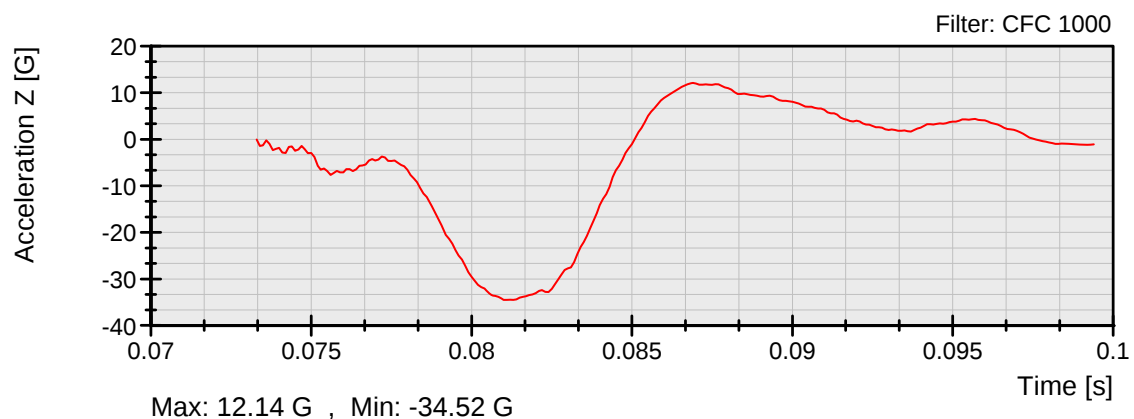
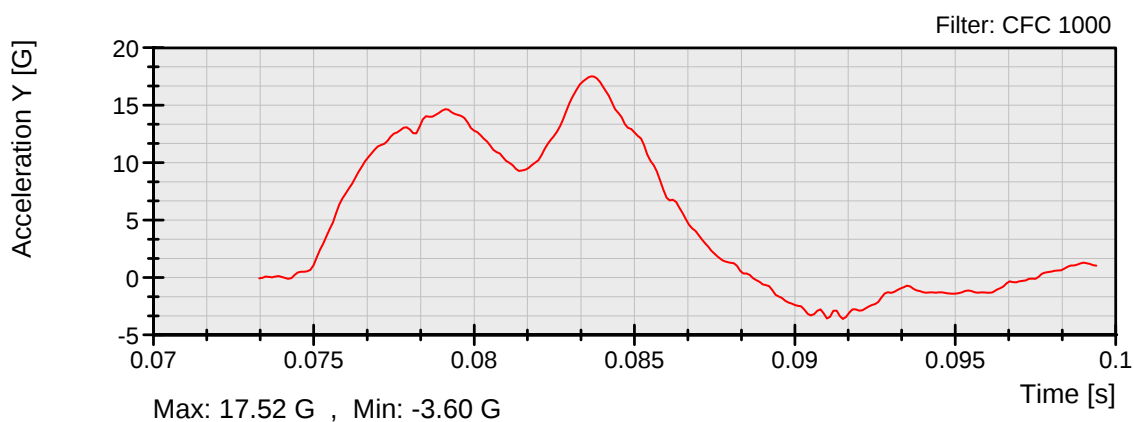
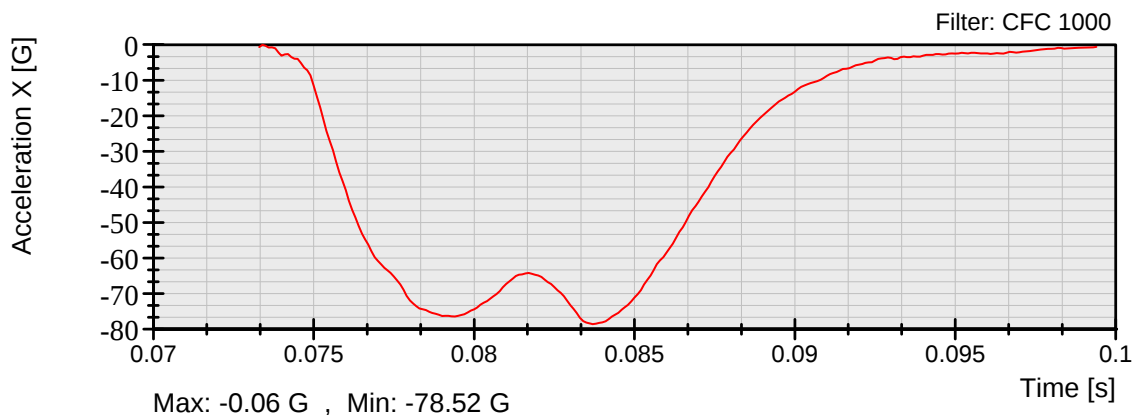
FMVSS 201U

Test No.: U15228

Customer: NHTSA

Report No.: G15I7-001.8

Date: 09/25/2015





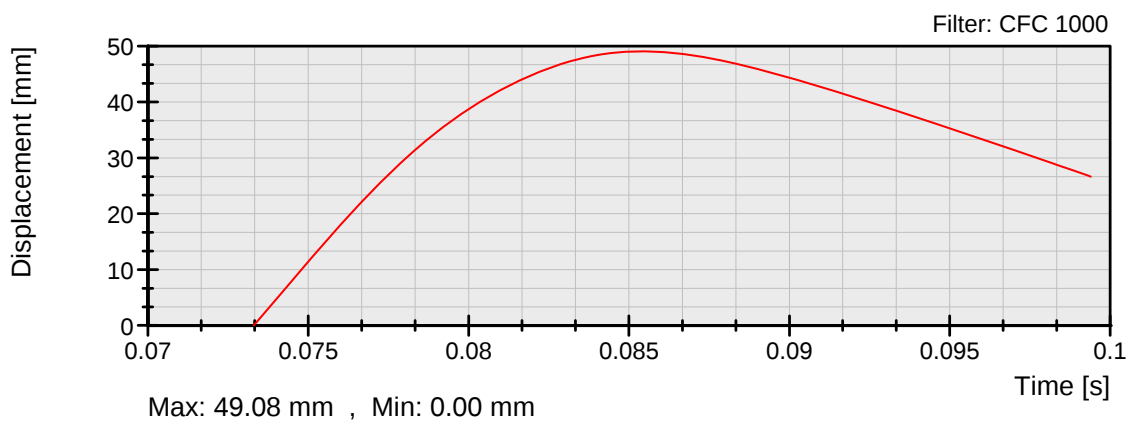
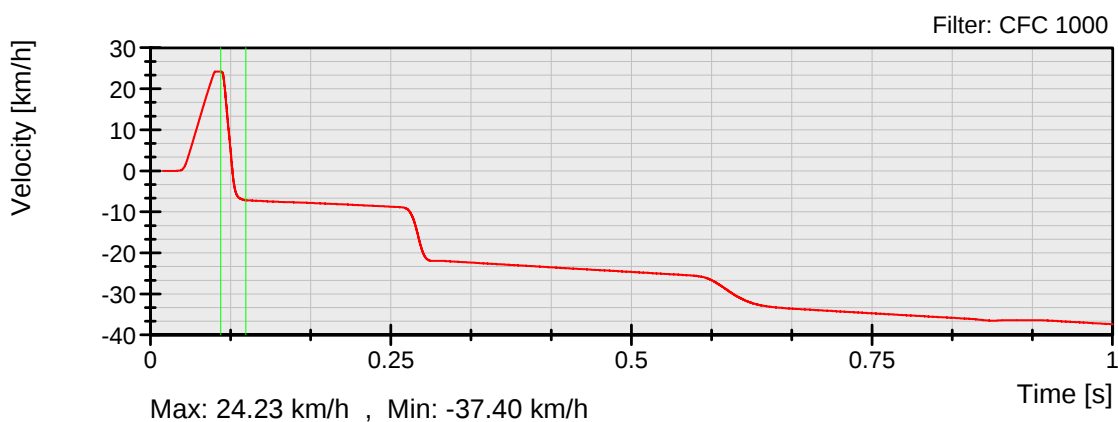
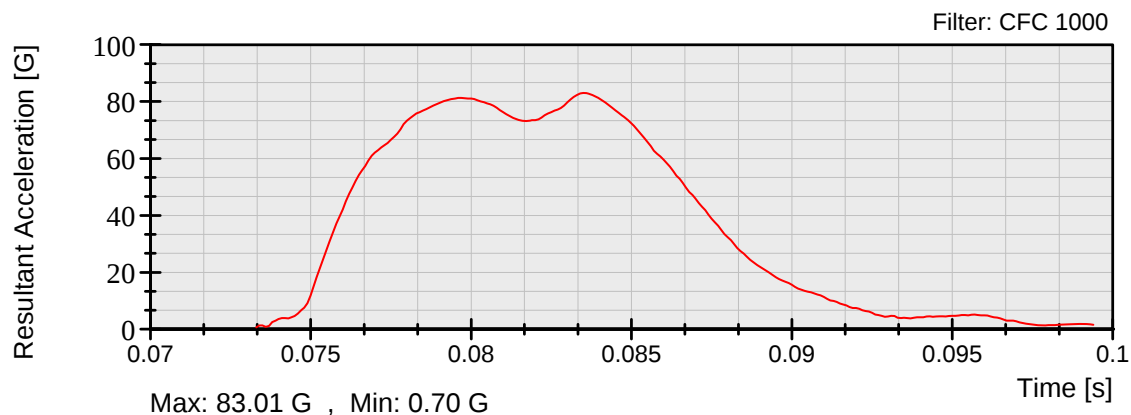
FMVSS 201U

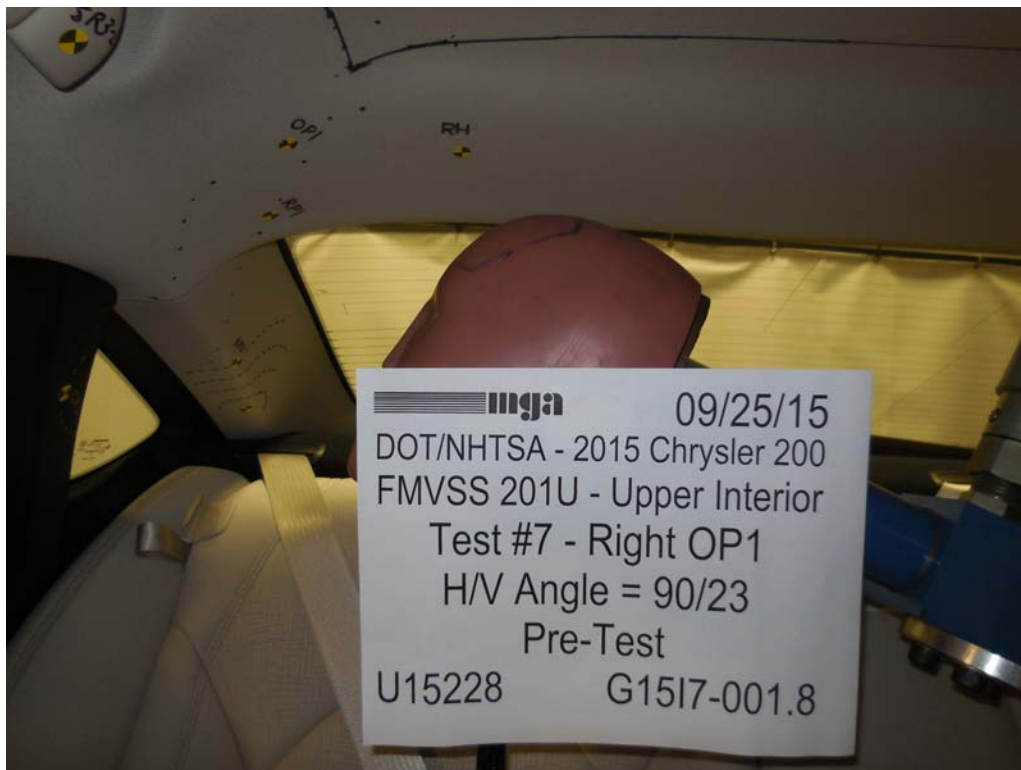
Test No.: U15228

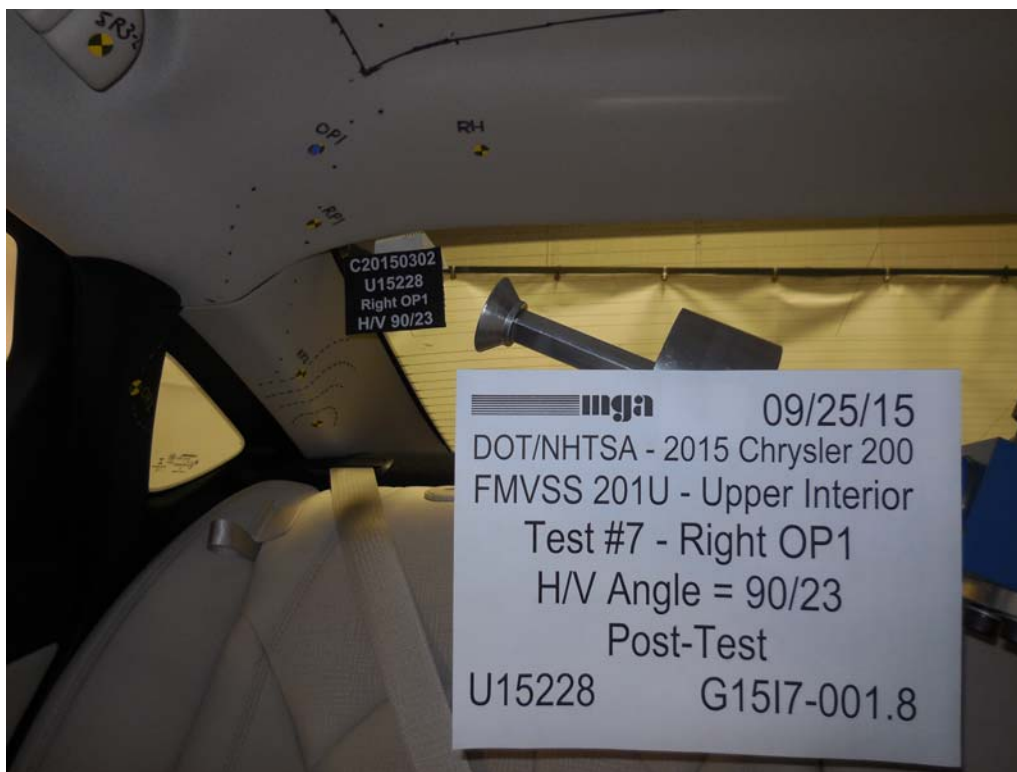
Customer: NHTSA

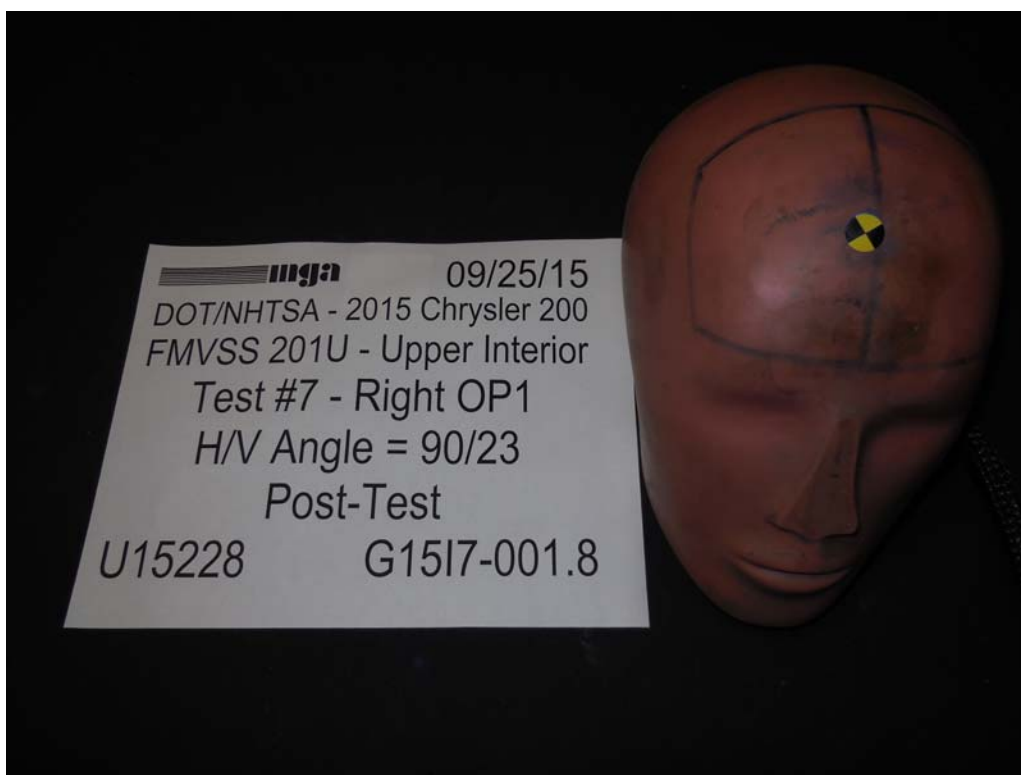
Report No.: G15I7-001.8

Date: 09/25/2015









Test U15227 Data



FMVSS 201U

Test No.: U15227
Customer: NHTSA

Report No.: G15I7-001.8
Date: 09/24/2015

Summary of the Test

Setup Information

Sample Description: 2015 Chrysler 200

Test Sequence No.: 6

Time: 3:52pm

Horizontal Approach Angle: 270 deg

Temperature: 22.2 °C

Vertical Approach Angle: 8 deg

Humidity: 41.0 %RH

Impact Form ID No.: 38

Impact Form Mass: 4.51 kg

Target Location: Left OP2

Additional Description:

Test Results

Impact Velocity: 23.97 km/h

HIC Type	HIC Value	Time 1 (ms)	Time 2 (ms)	Delta-T (ms)
HIC 36	846.3	76.8	81.1	4.3
HIC 15	846.3	76.8	81.1	4.3
HIC (d)	804.9	76.8	81.1	4.3

3 ms Clip = 113.25 G , Time 1 = 77.21 ms , Time 2 = 80.21 ms

Impact Location on FMH: 21 mm Above Pt. 0 , 0 mm Lateral of Pt. 0

Post-Test Comments: No visible damage.

Test Series Performed By: DB, KR

Page 1 of 3

Recorded By:  Approved By: 

Date: September 24, 2015



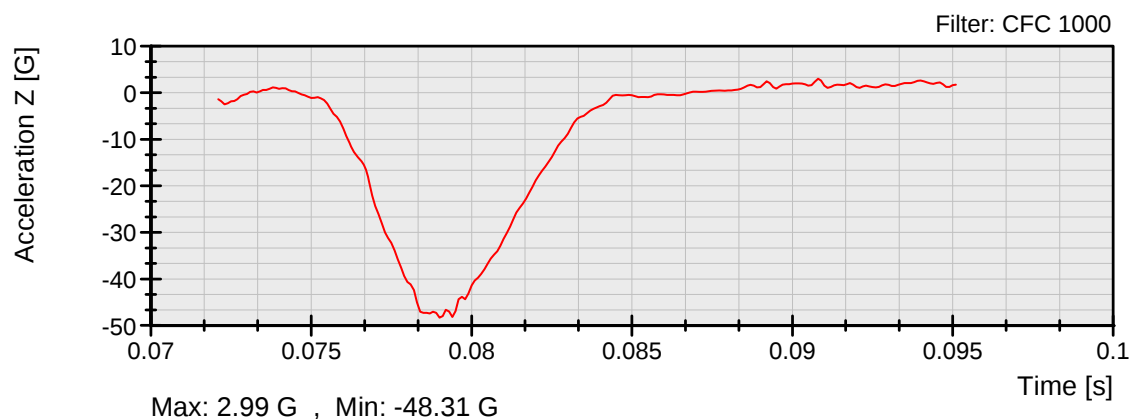
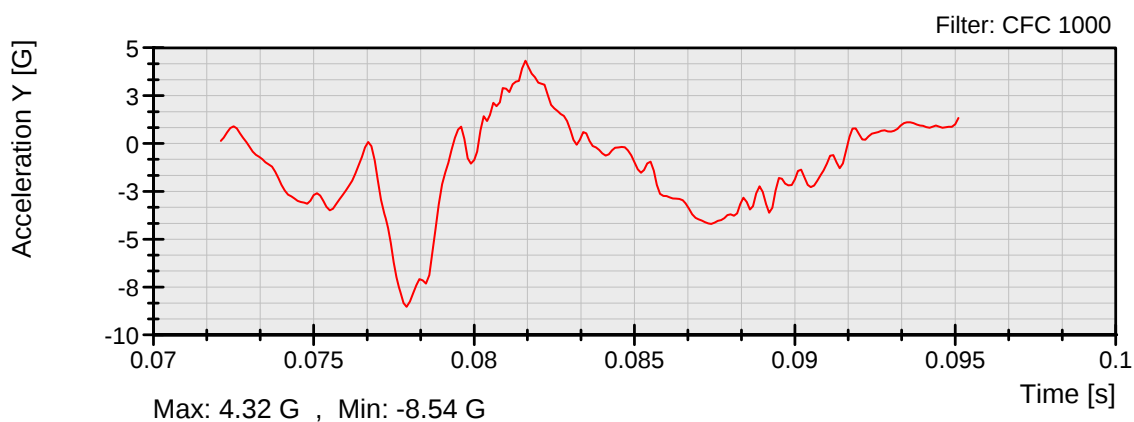
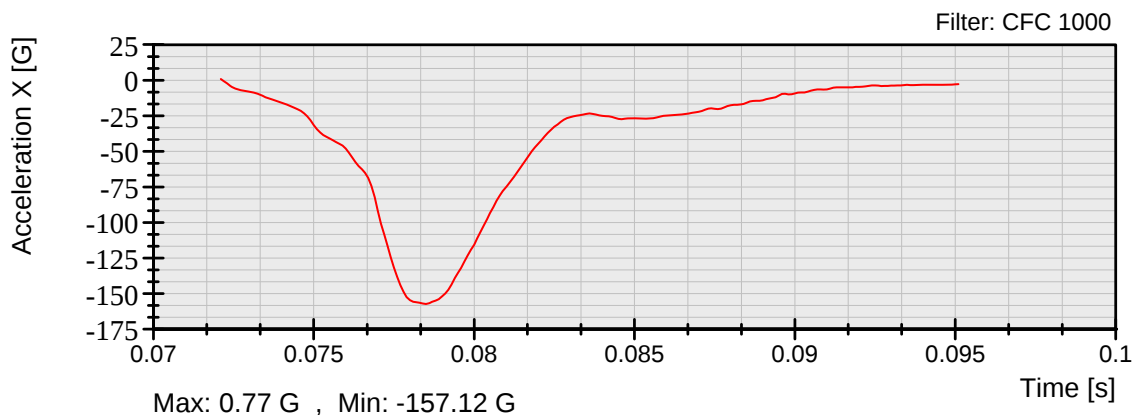
FMVSS 201U

Test No.: U15227

Customer: NHTSA

Report No.: G15I7-001.8

Date: 09/24/2015





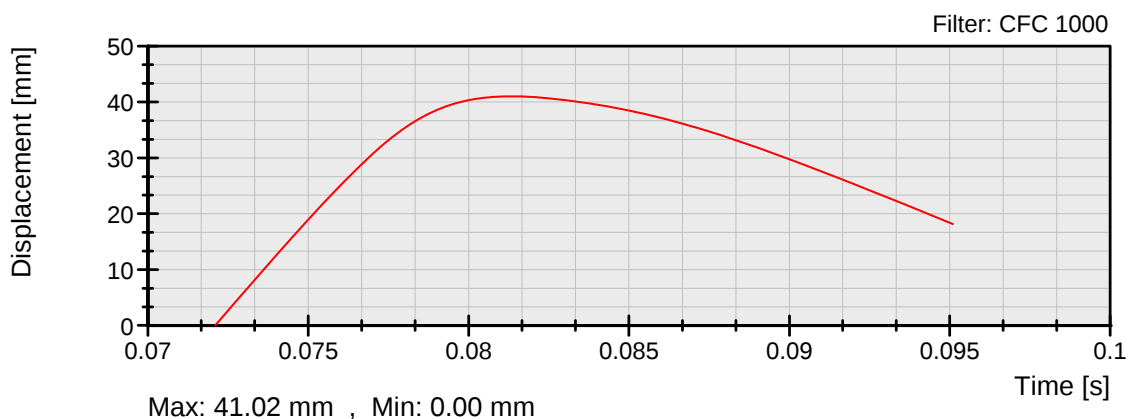
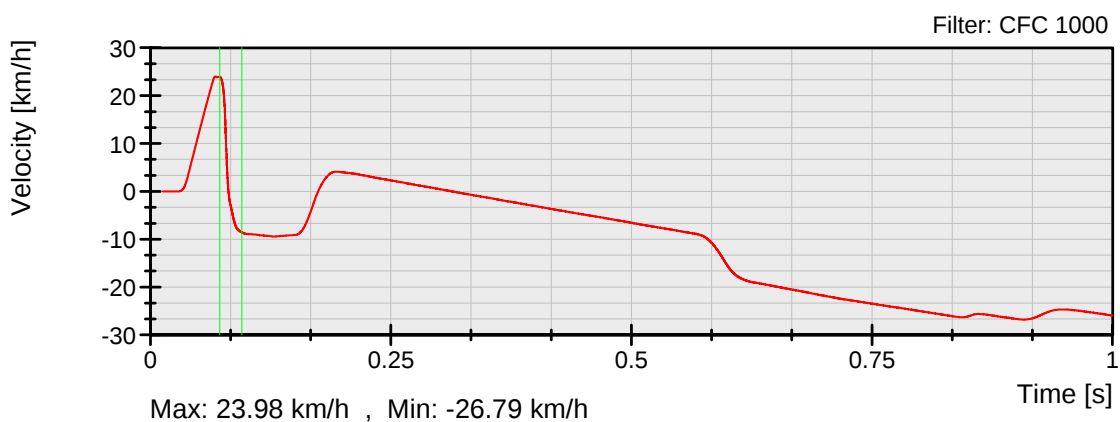
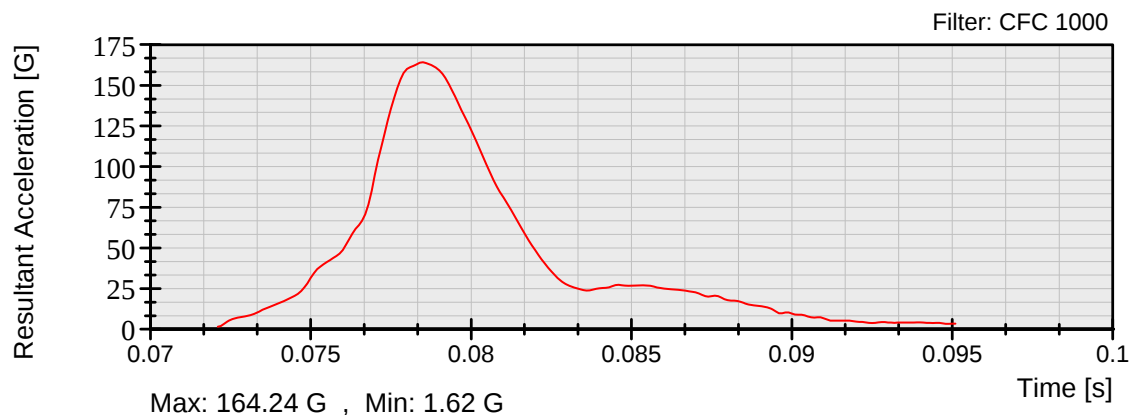
FMVSS 201U

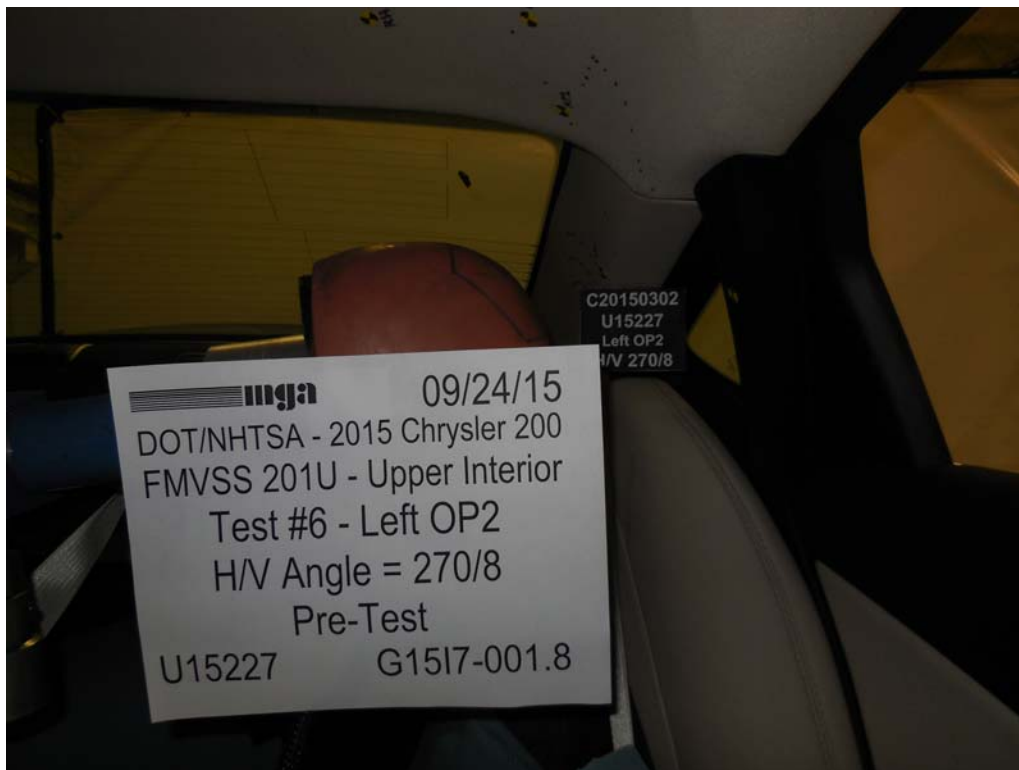
Test No.: U15227

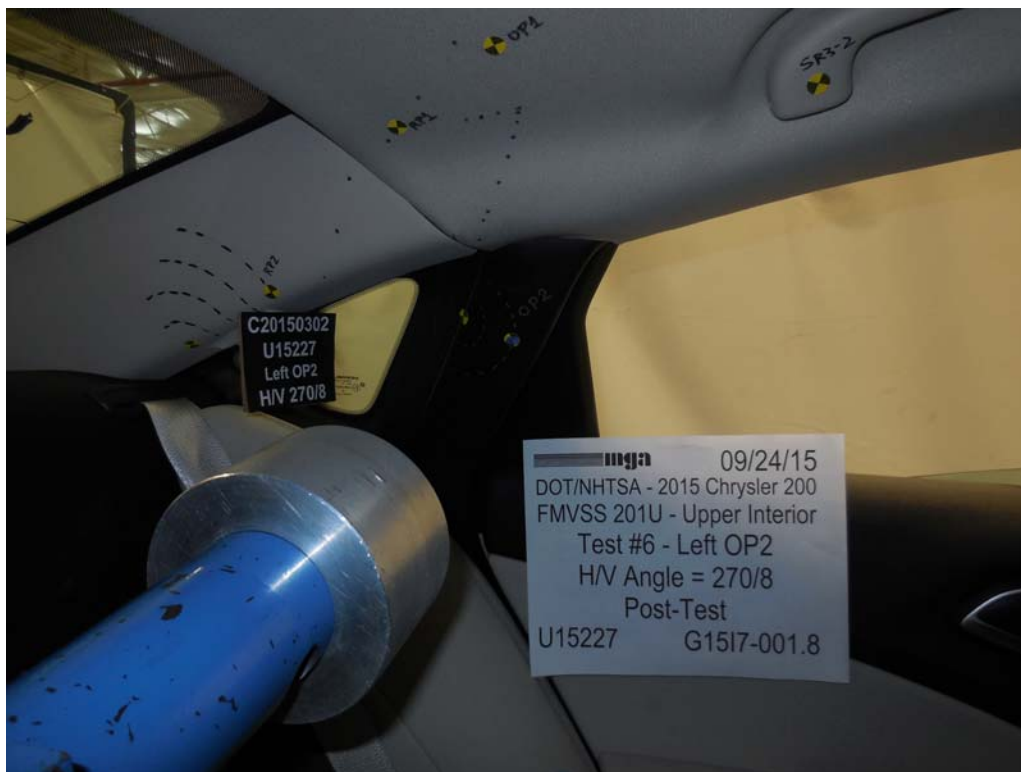
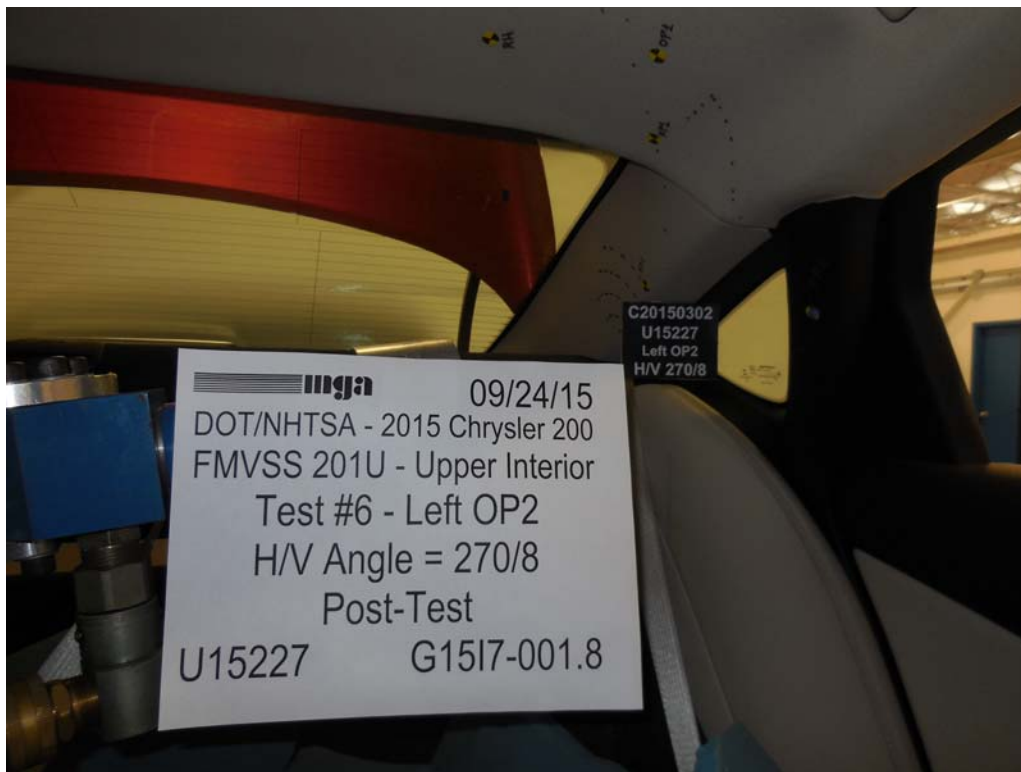
Customer: NHTSA

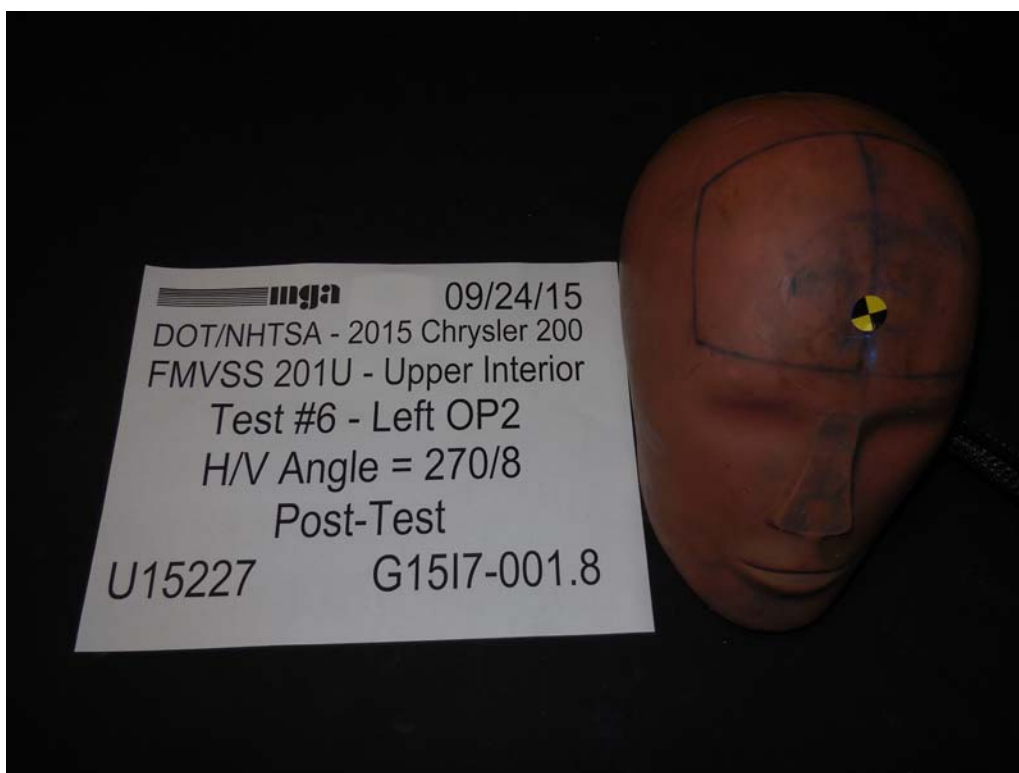
Report No.: G15I7-001.8

Date: 09/24/2015









Test U15223 Data



FMVSS 201U

Test No.: U15223
Customer: NHTSA

Report No.: G15I7-001.8
Date: 09/24/2015

Summary of the Test

Setup Information

Sample Description: 2015 Chrysler 200

Test Sequence No.: 2

Time: 10:50am

Horizontal Approach Angle: 270 deg

Temperature: 21.0 °C

Vertical Approach Angle: 50 deg

Humidity: 47.6 %RH

Impact Form ID No.: 37

Impact Form Mass: 4.54 kg

Target Location: Left UR2@SR1

Additional Description:

Test Results

Impact Velocity: 23.96 km/h

HIC Type	HIC Value	Time 1 (ms)	Time 2 (ms)	Delta-T (ms)
HIC 36	587.92	77.3	86	8.7
HIC 15	587.92	77.3	86	8.7
HIC (d)	609.96	77.3	86	8.7

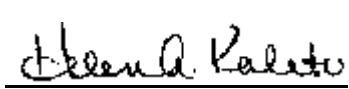
3 ms Clip = 93.03 G , Time 1 = 80.71 ms , Time 2 = 83.71 ms

Impact Location on FMH: 49 mm Above Pt. 0 , 4 Right mm Lateral of Pt. 0

Post-Test Comments: No visible damage.

Test Series Performed By: DB, KR

Page 1 of 3

Recorded By:  Approved By: 

Date: September 24, 2015



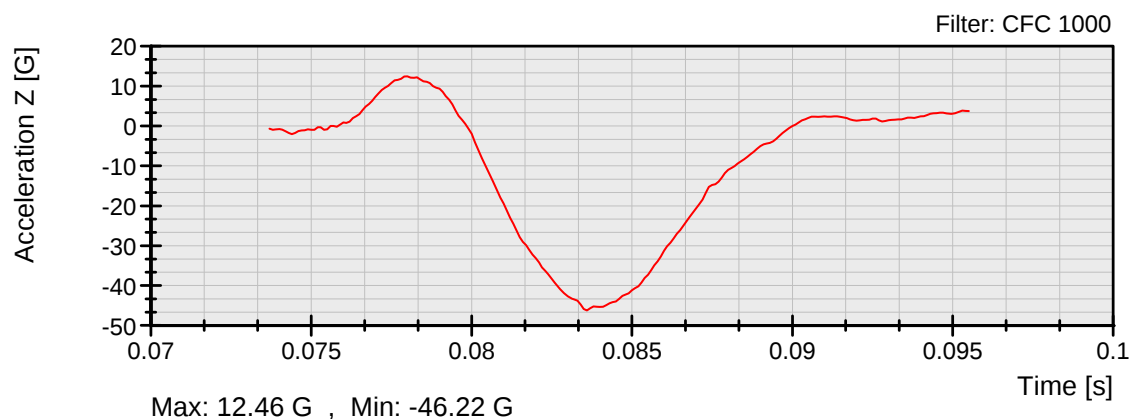
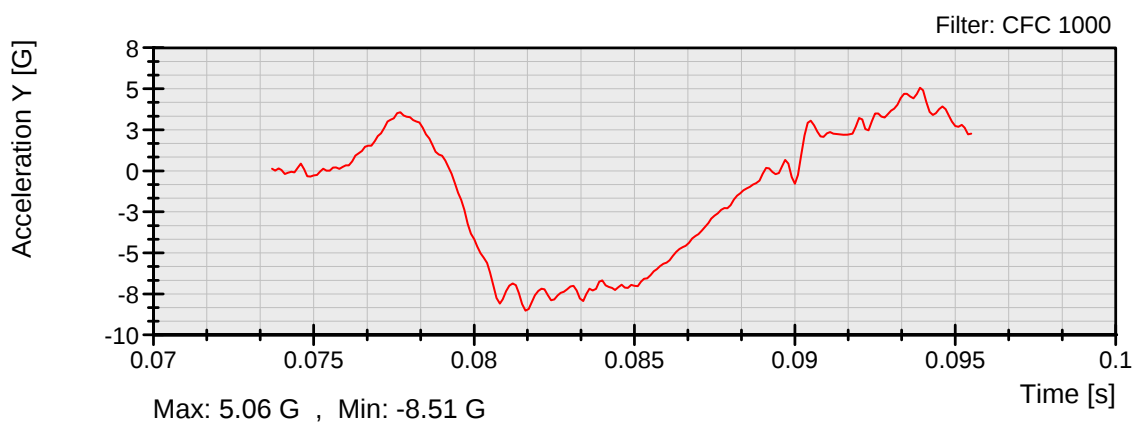
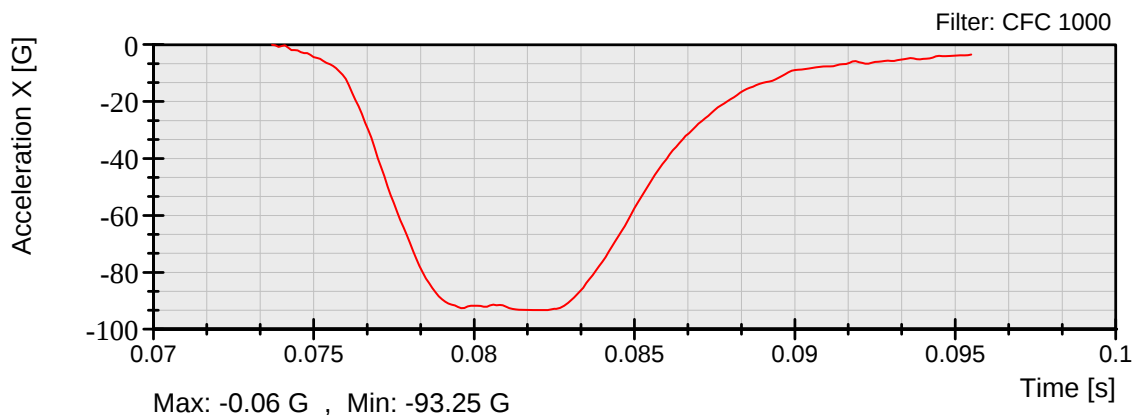
FMVSS 201U

Test No.: U15223

Customer: NHTSA

Report No.: G15I7-001.8

Date: 09/24/2015





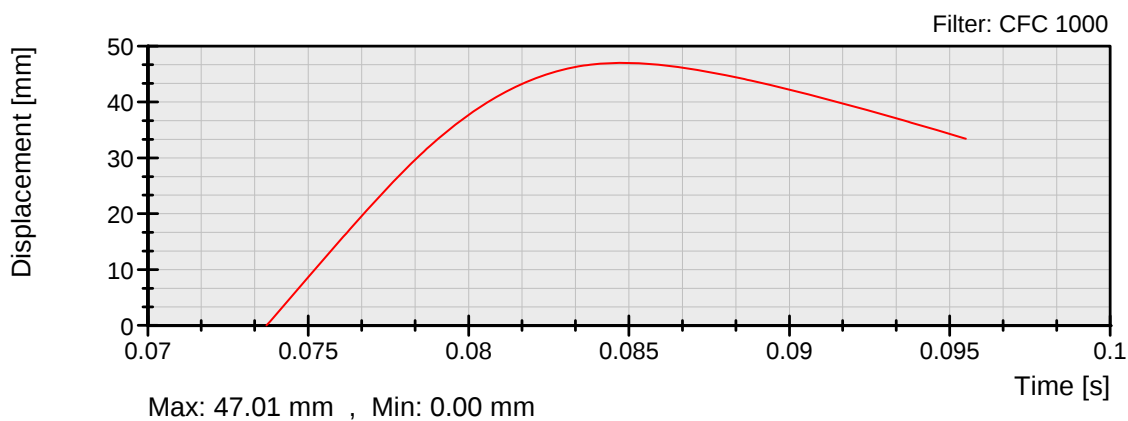
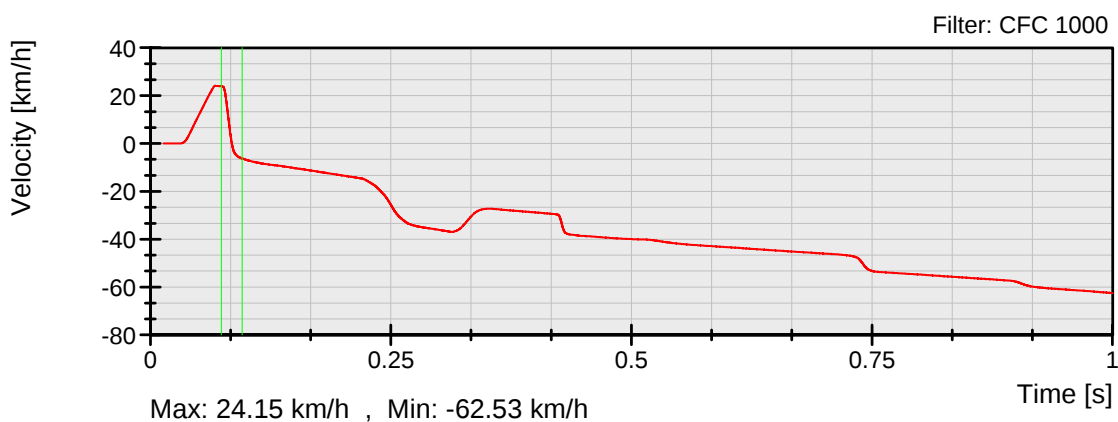
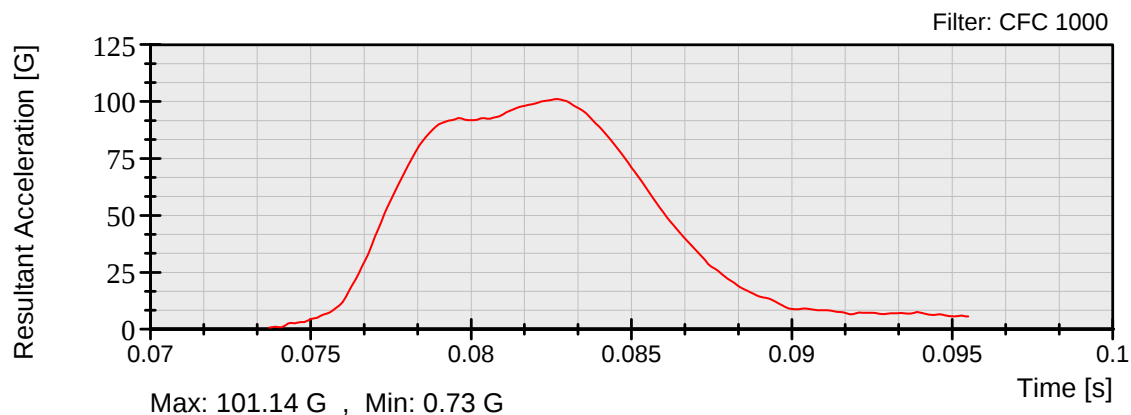
FMVSS 201U

Test No.: U15223

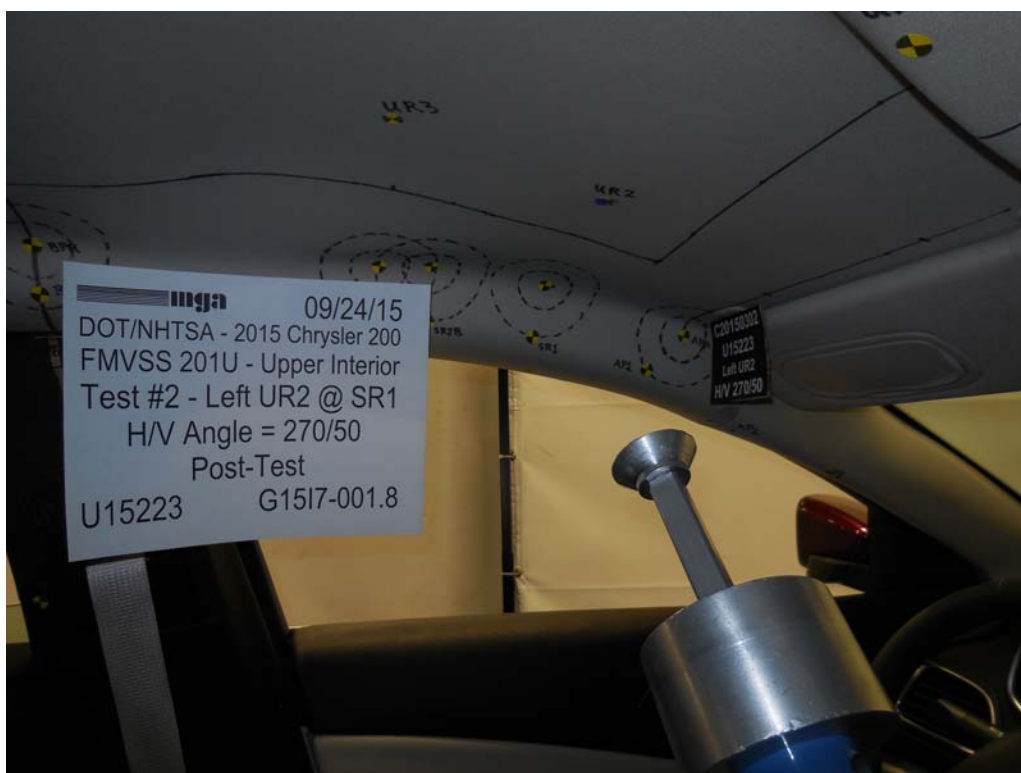
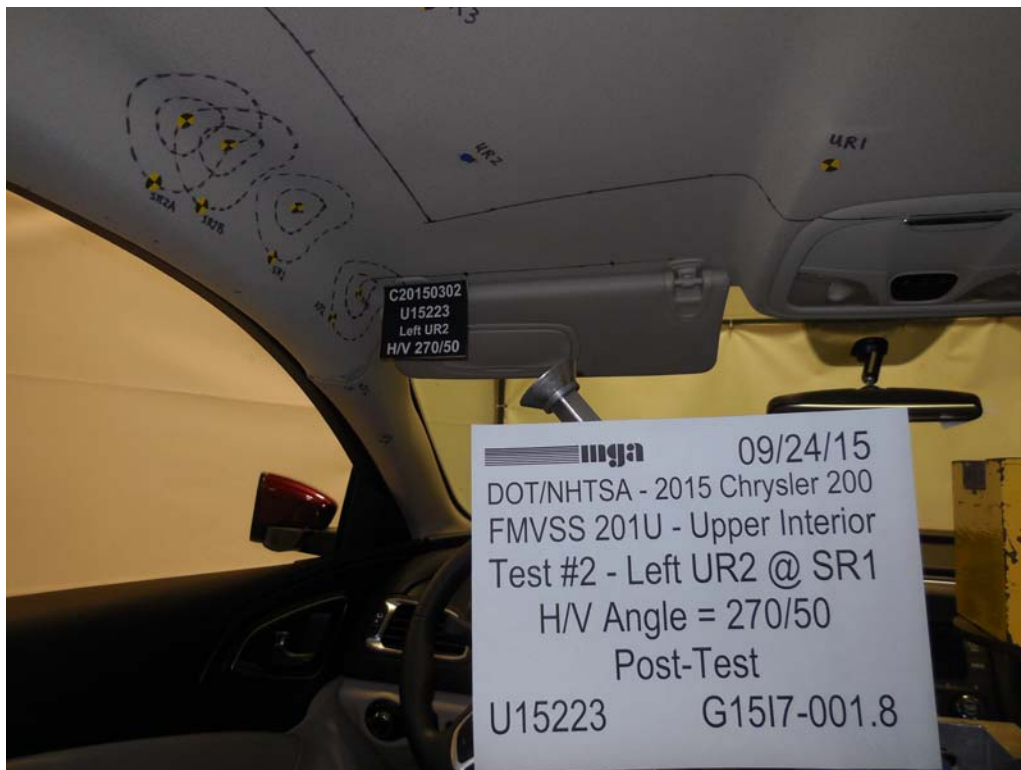
Customer: NHTSA

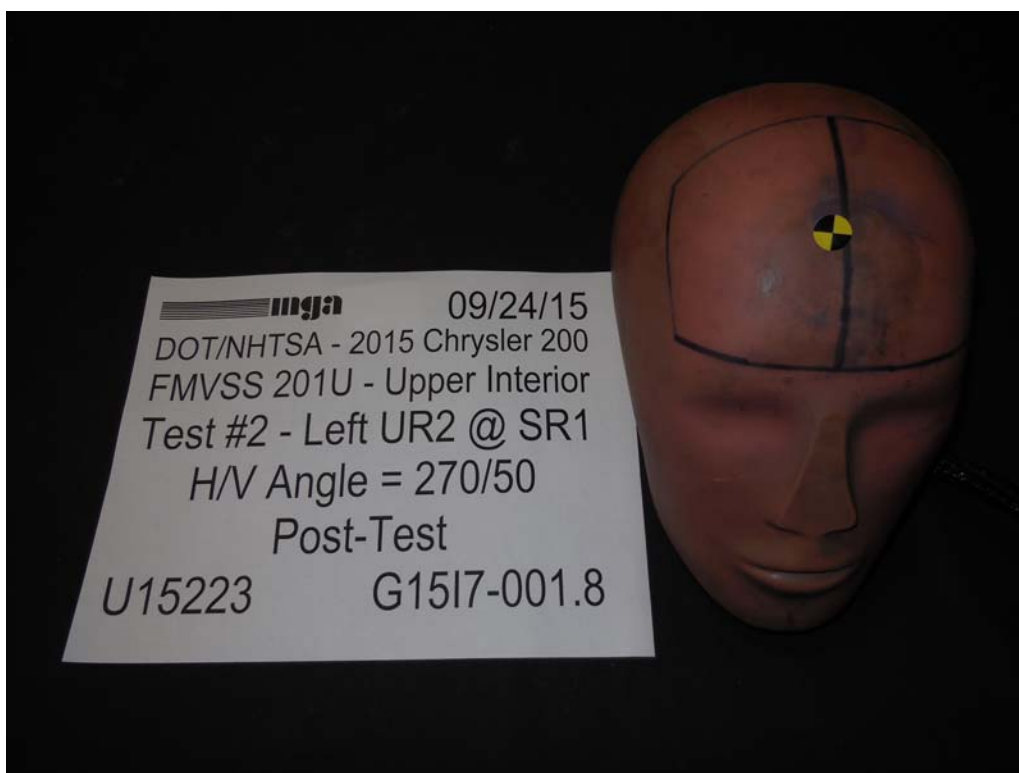
Report No.: G15I7-001.8

Date: 09/24/2015









Test U15226 Data



FMVSS 201U
Test No.: U15226
Customer: NHTSA

Report No.: G15I7-001.8
Date: 09/24/2015

Summary of the Test

Setup Information

Sample Description: 2015 Chrysler 200

Test Sequence No.: 5

Time: 2:44pm

Horizontal Approach Angle: 270 deg

Temperature: 22.8 °C

Vertical Approach Angle: 50 deg

Humidity: 44.9 %RH

Impact Form ID No.: 37

Impact Form Mass: 4.54 kg

Target Location: Left UR5@SR3-1

Additional Description:

Test Results

Impact Velocity: 24.08 km/h

HIC Type	HIC Value	Time 1 (ms)	Time 2 (ms)	Delta-T (ms)
HIC 36	578.04	77.3	86.5	9.2
HIC 15	578.04	77.3	86.5	9.2
HIC (d)	602.51	77.3	86.5	9.2

3 ms Clip = 93.63 G , Time 1 = 78.39 ms , Time 2 = 81.39 ms

Impact Location on FMH: 47 mm Above Pt. 0 , 4 Right mm Lateral of Pt. 0

Post-Test Comments: Grab handle pushed in; Headliner deformation; Dome light dislodged.

Test Series Performed By: DB, KR

Page 1 of 3

Recorded By:  Approved By: 

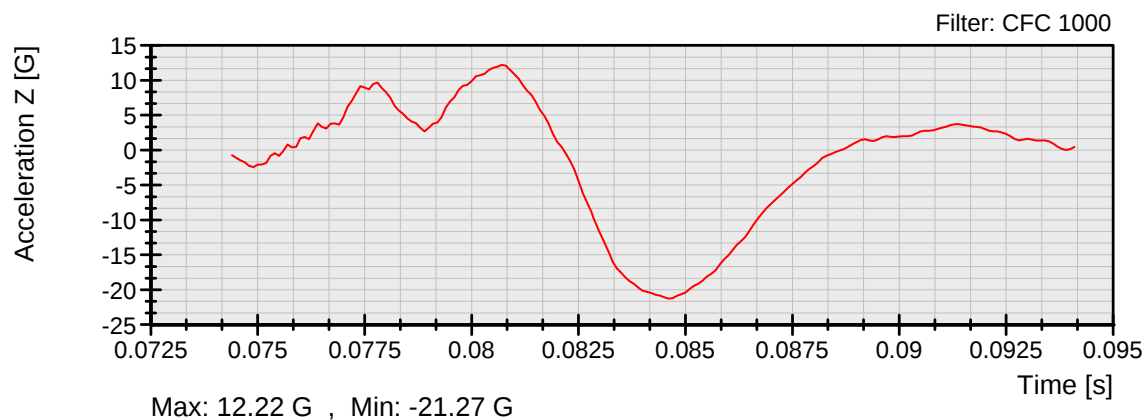
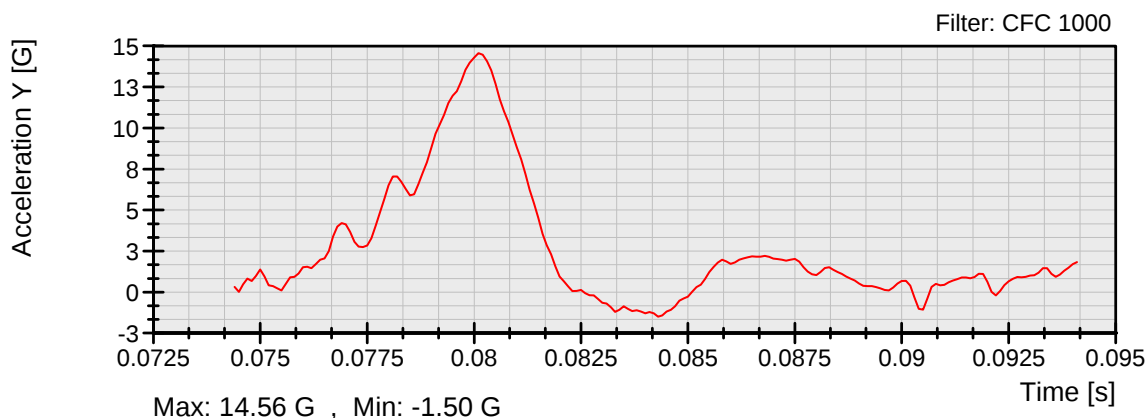
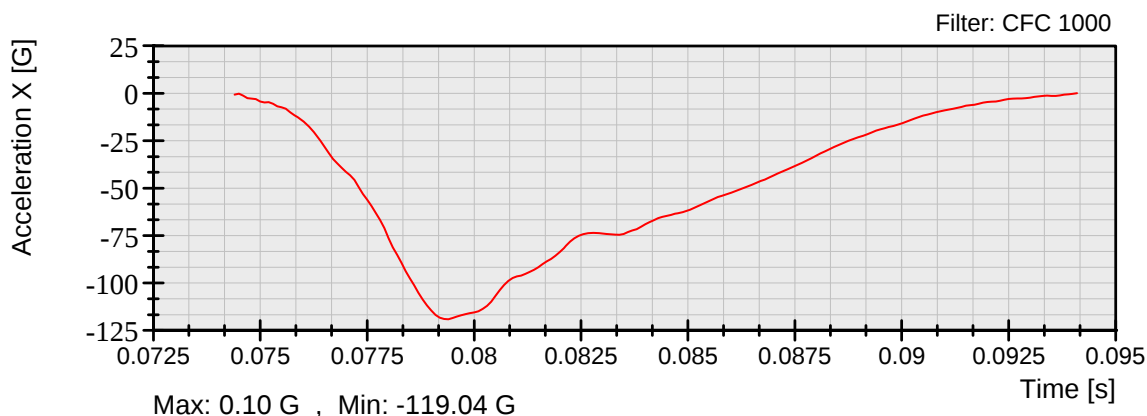
Date: September 24, 2015



FMVSS 201U

Test No.: U15226
Customer: NHTSA

Report No.: G15I7-001.8
Date: 09/24/2015





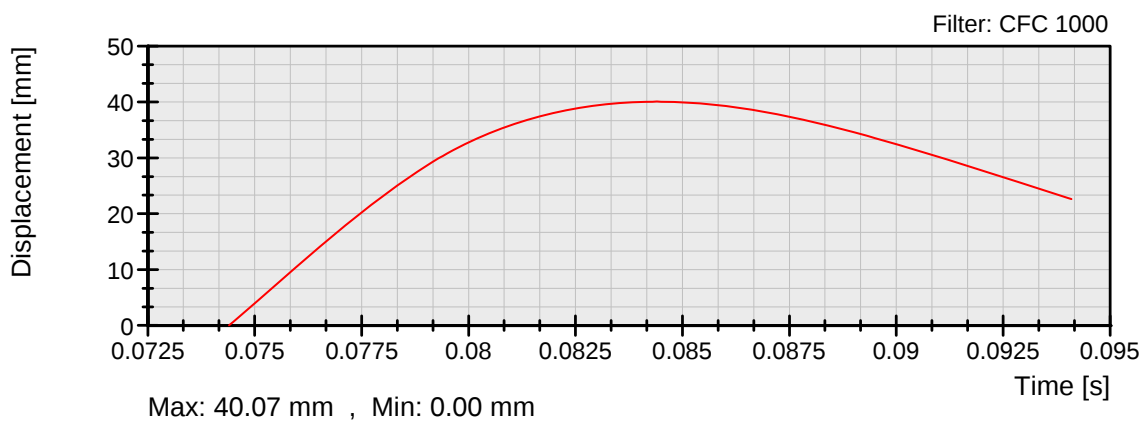
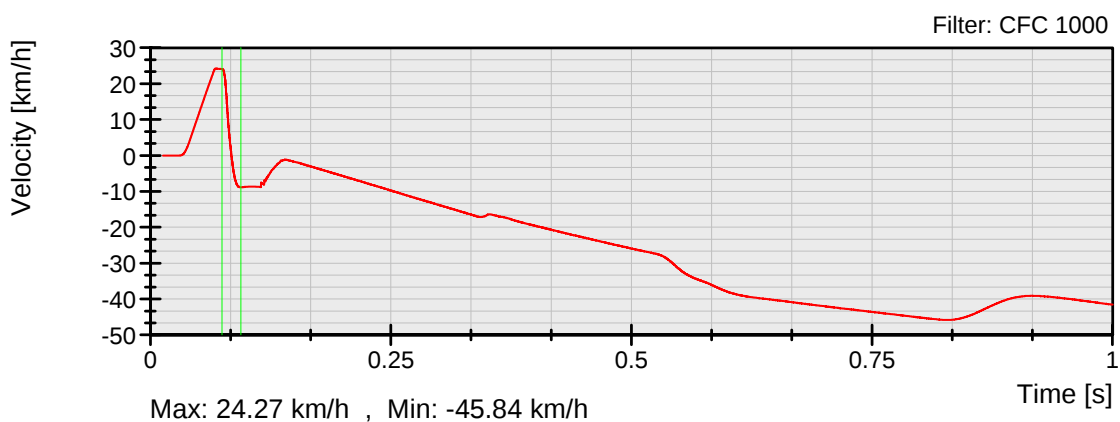
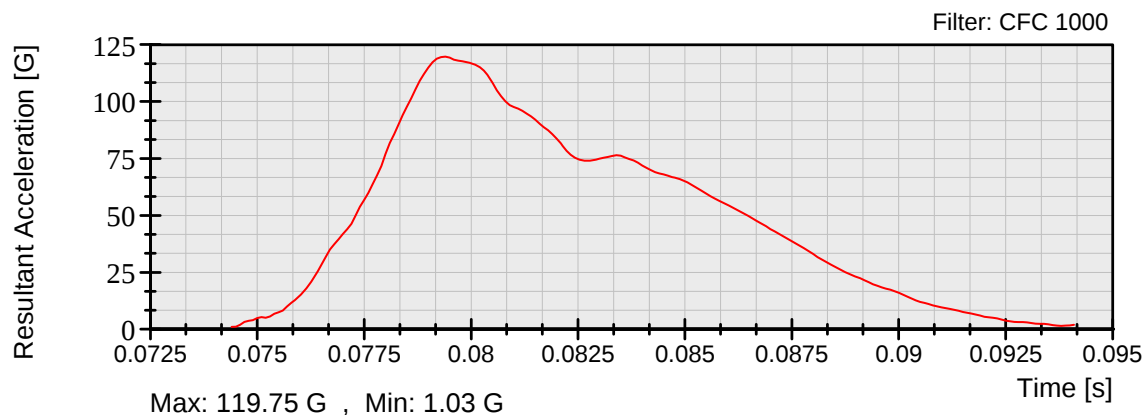
FMVSS 201U

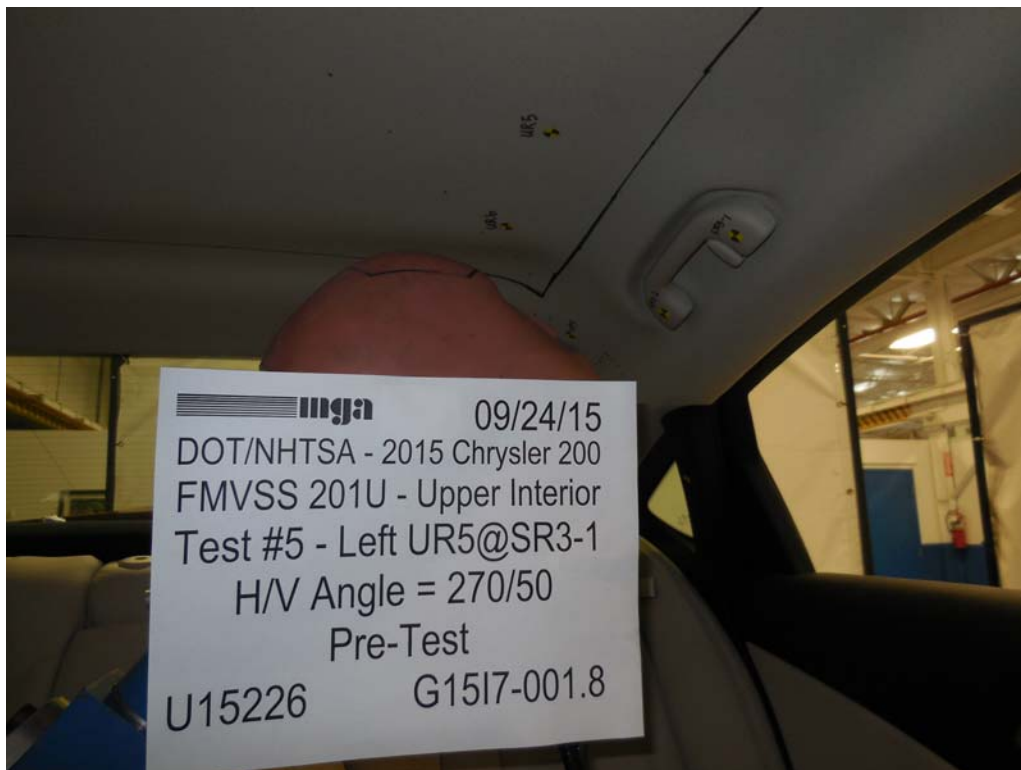
Test No.: U15226

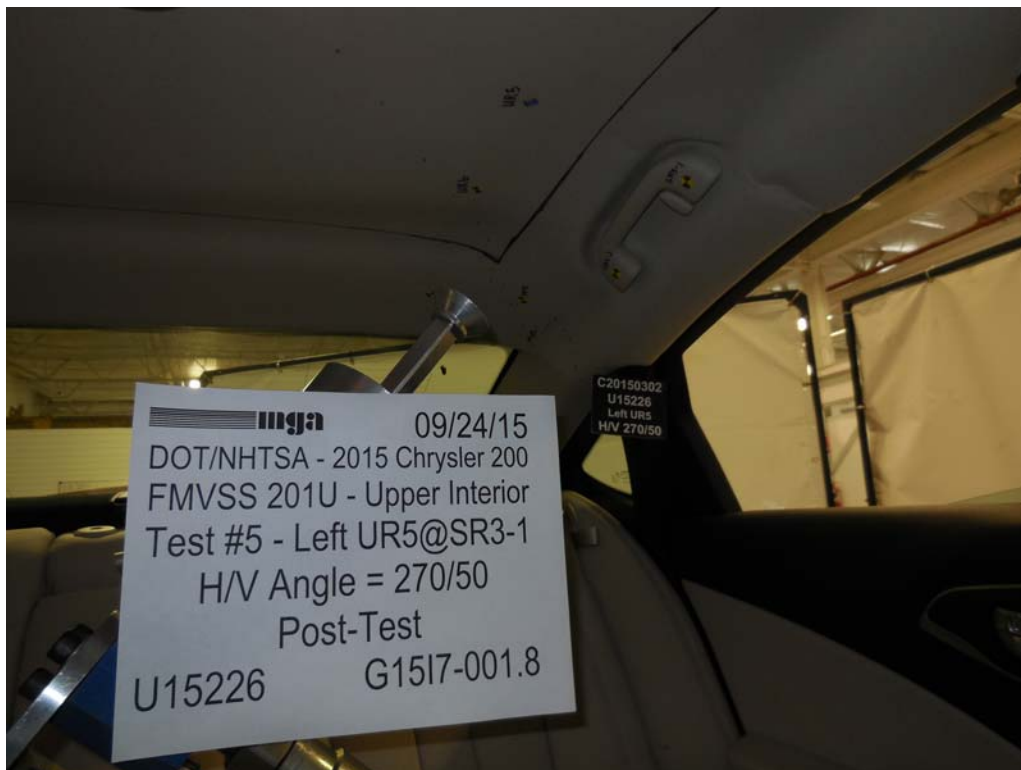
Customer: NHTSA

Report No.: G15I7-001.8

Date: 09/24/2015









Test U15232 Data



FMVSS 201U

Test No.: U15232
Customer: NHTSA

Report No.: G15I7-001.8
Date: 09/25/2015

Summary of the Test

Setup Information

Sample Description: 2015 Chrysler 200

Test Sequence No.: 11

Time: 2:54pm

Horizontal Approach Angle: 90 deg

Temperature: 21.7 °C

Vertical Approach Angle: 50 deg

Humidity: 44.2 %RH

Impact Form ID No.: 37

Impact Form Mass: 4.54 kg

Target Location: Right UR9@SR2A

Additional Description:

Test Results

Impact Velocity: 23.94 km/h

HIC Type	HIC Value	Time 1 (ms)	Time 2 (ms)	Delta-T (ms)
HIC 36	725	76.3	82.4	6.1
HIC 15	725	76.3	82.4	6.1
HIC (d)	713.38	76.3	82.4	6.1

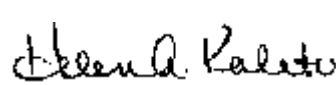
3 ms Clip = 109.89 G , Time 1 = 78.03 ms , Time 2 = 81.03 ms

Impact Location on FMH: 47 mm Above Pt. 0 , 2 Left mm Lateral of Pt. 0

Post-Test Comments: Grab handle pushed in; Headliner deformation.

Test Series Performed By: DB, KR

Page 1 of 3

Recorded By:  Approved By: 

Date: September 25, 2015



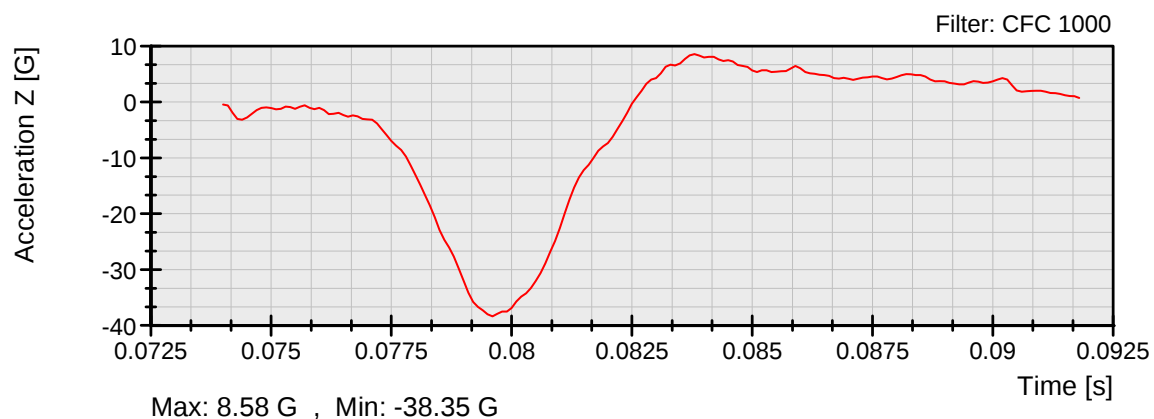
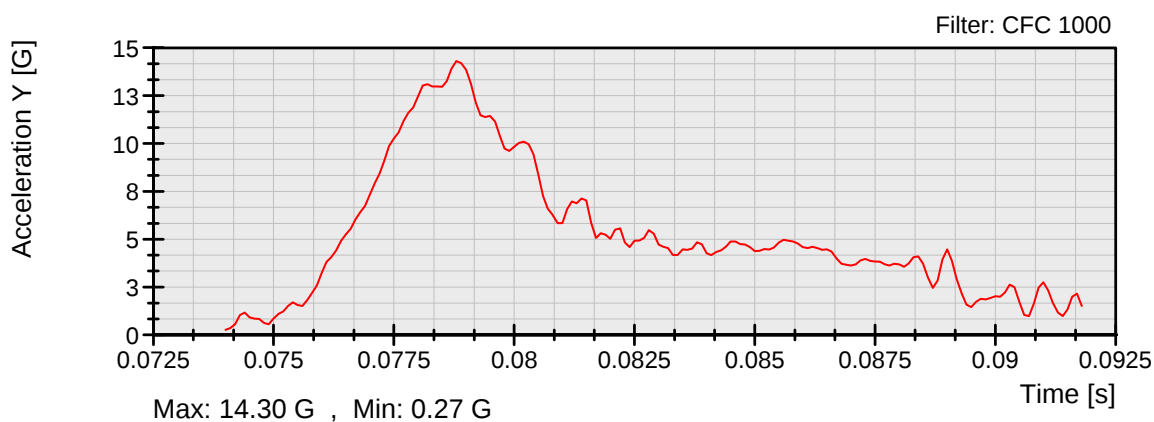
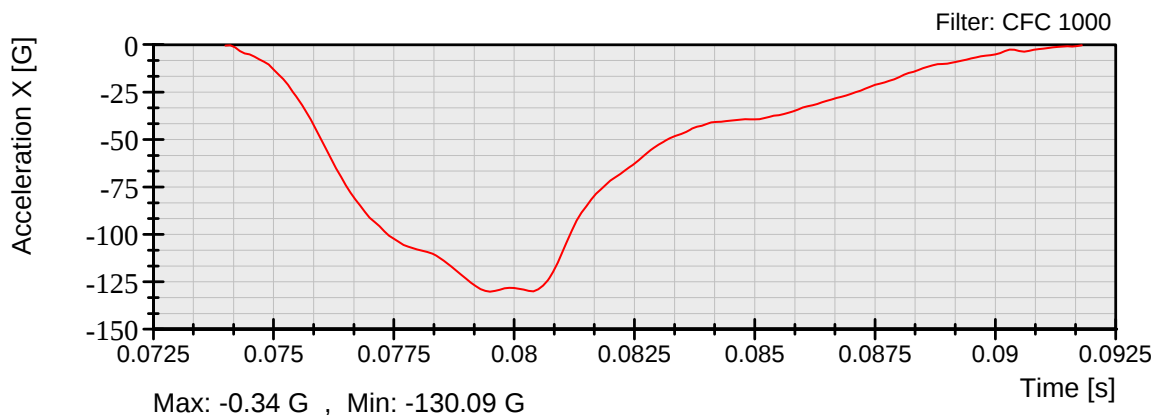
FMVSS 201U

Test No.: U15232

Customer: NHTSA

Report No.: G15I7-001.8

Date: 09/25/2015





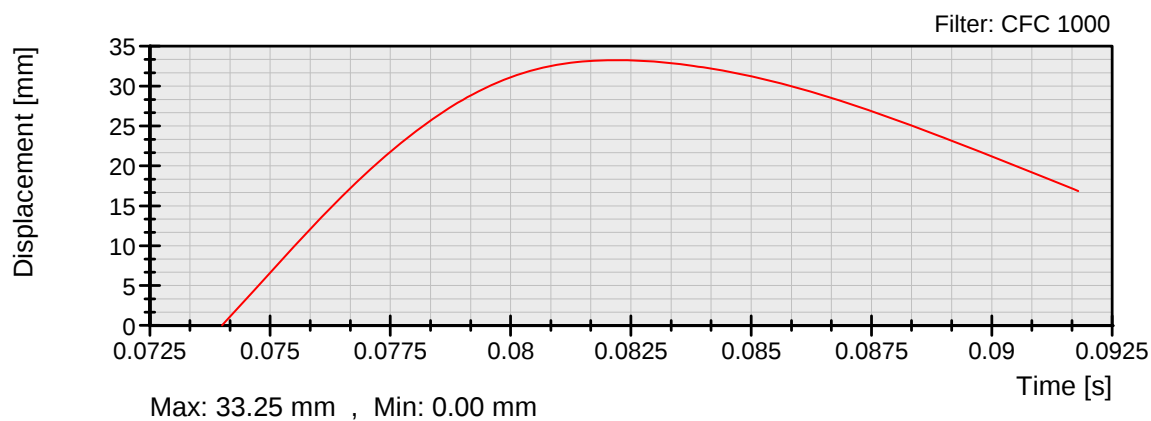
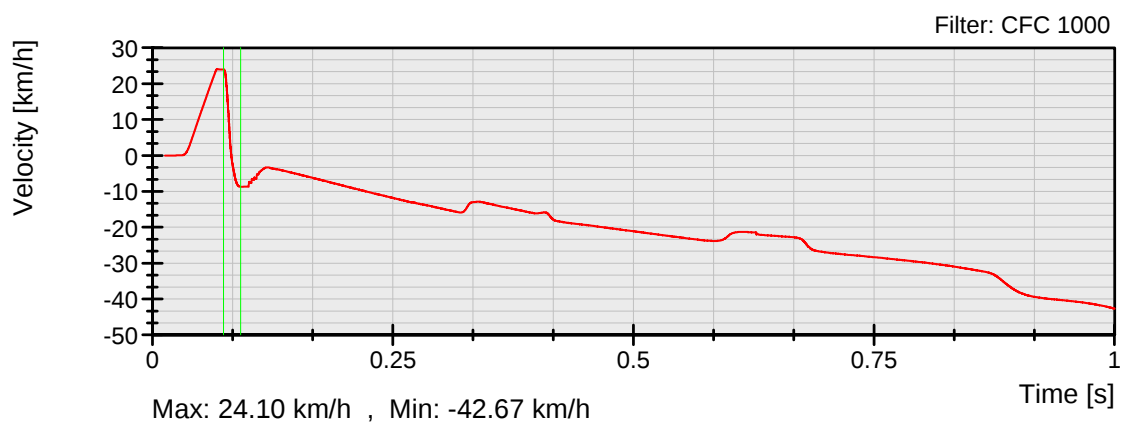
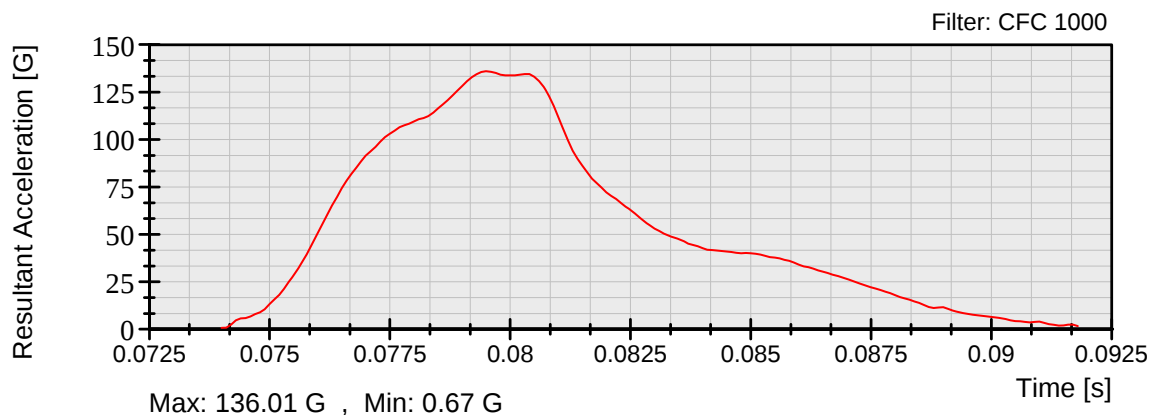
FMVSS 201U

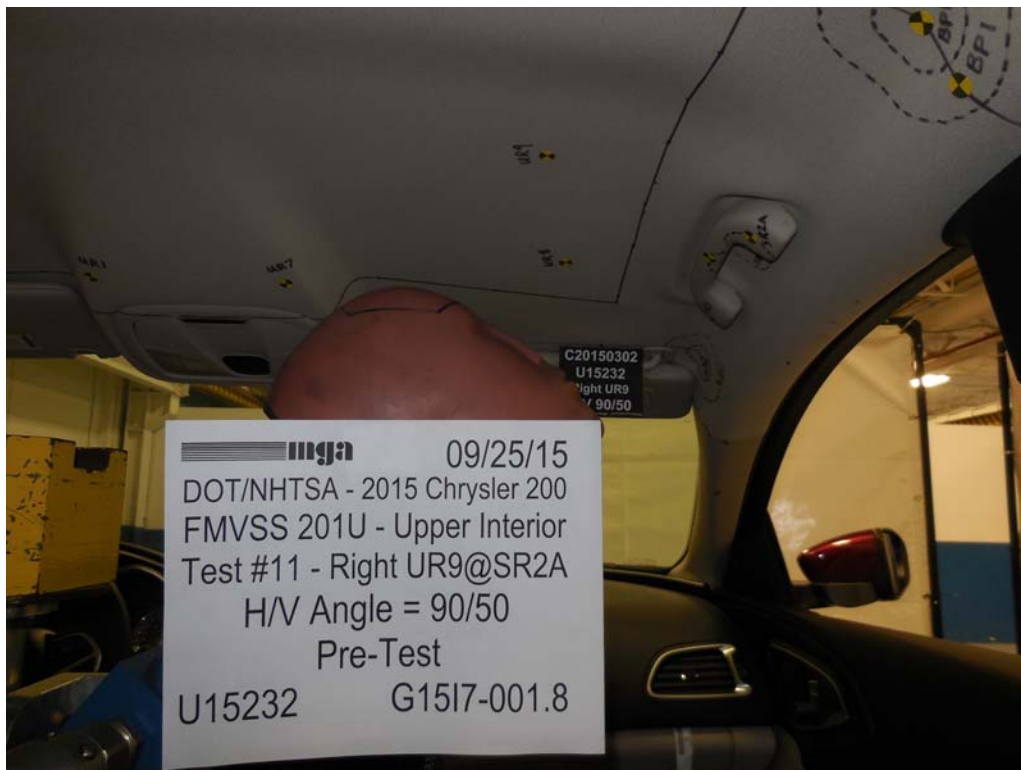
Test No.: U15232

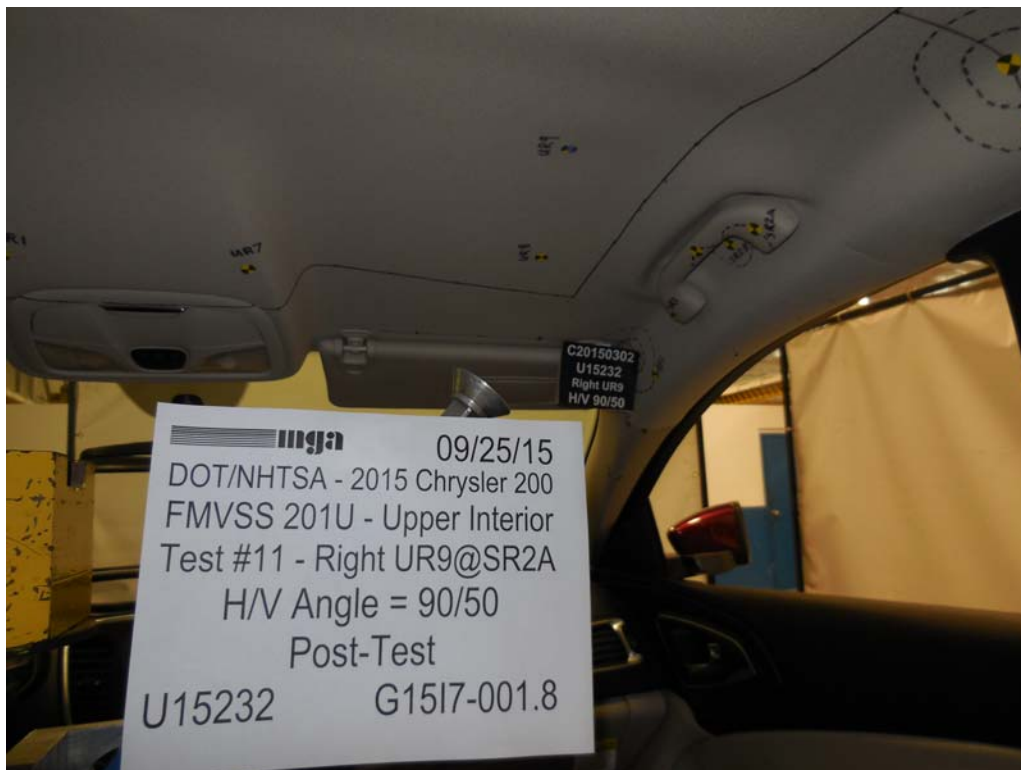
Customer: NHTSA

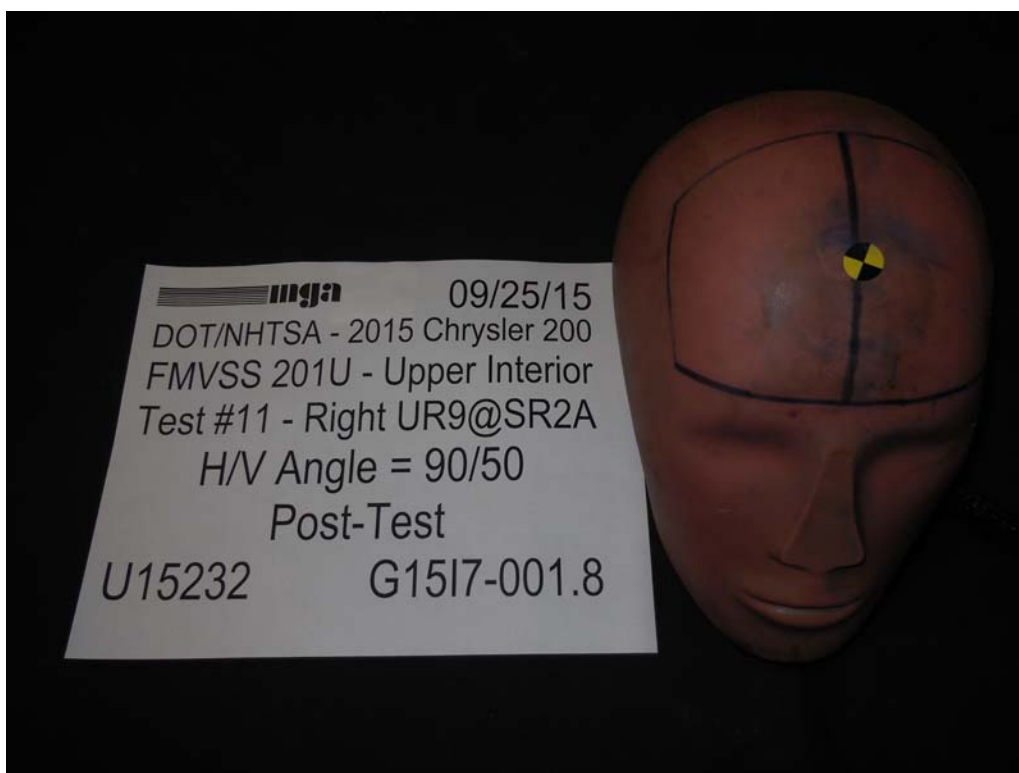
Report No.: G15I7-001.8

Date: 09/25/2015









Test U15231 Data



FMVSS 201U

Test No.: U15231
Customer: NHTSA

Report No.: G15I7-001.8
Date: 09/25/2015

Summary of the Test

Setup Information

Sample Description: 2015 Chrysler 200

Test Sequence No.: 10

Time: 2:14pm

Horizontal Approach Angle: 90 deg

Temperature: 21.4 °C

Vertical Approach Angle: 50 deg

Humidity: 45.5 %RH

Impact Form ID No.: 35

Impact Form Mass: 4.51 kg

Target Location: Right UR10@BP

Additional Description:

Test Results

Impact Velocity: 24.05 km/h

HIC Type	HIC Value	Time 1 (ms)	Time 2 (ms)	Delta-T (ms)
HIC 36	541.72	76.3	86.5	10.2
HIC 15	541.72	76.3	86.5	10.2
HIC (d)	575.11	76.3	86.5	10.2

3 ms Clip = 86.67 G , Time 1 = 79.48 ms , Time 2 = 83.78 ms

Impact Location on FMH: 44 mm Above Pt. 0 , 1 Left mm Lateral of Pt. 0

Post-Test Comments: No visible damage.

Test Series Performed By: DB, KR

Page 1 of 3

Recorded By:  Approved By: 

Date: September 25, 2015



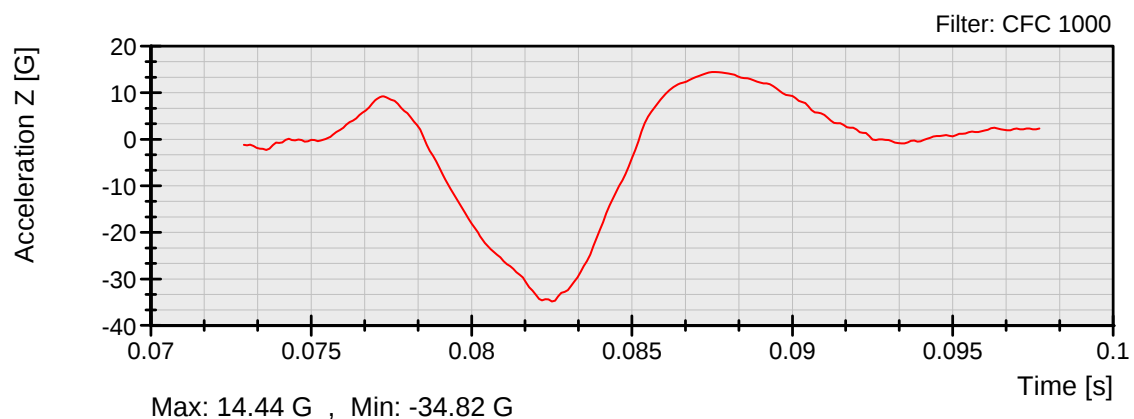
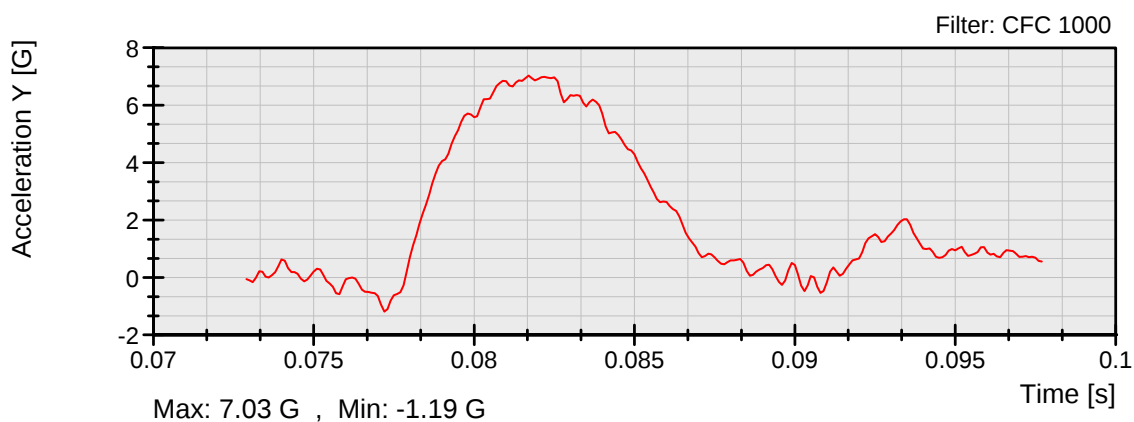
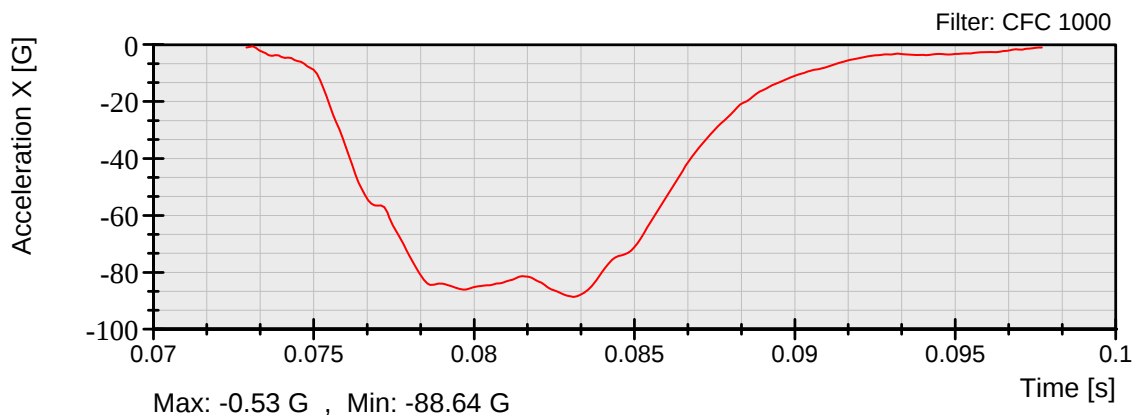
FMVSS 201U

Test No.: U15231

Customer: NHTSA

Report No.: G15I7-001.8

Date: 09/25/2015





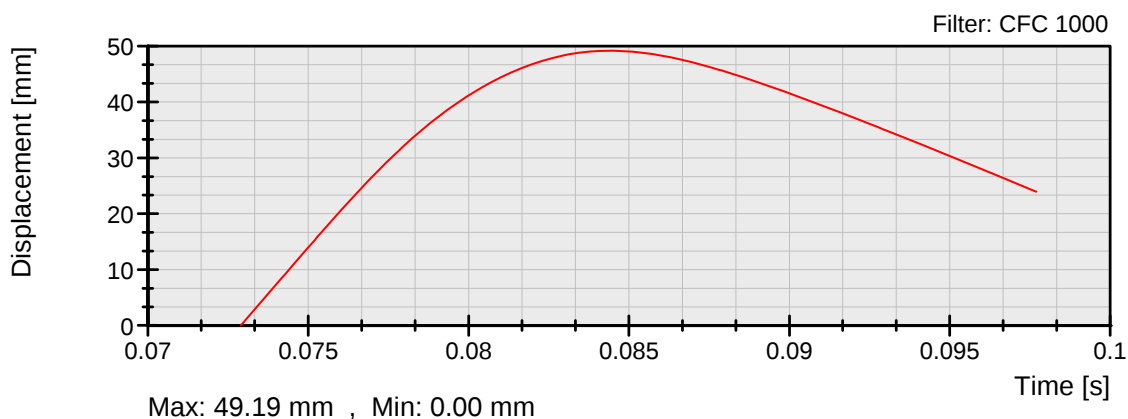
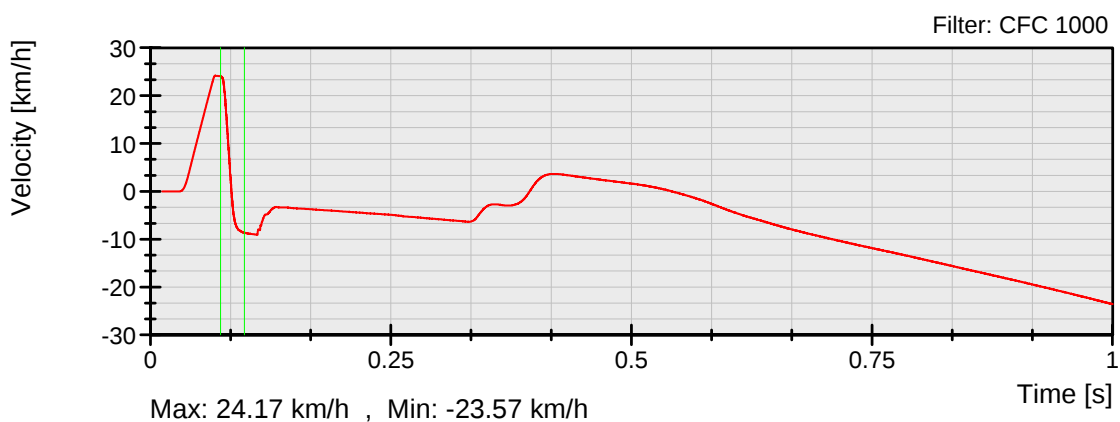
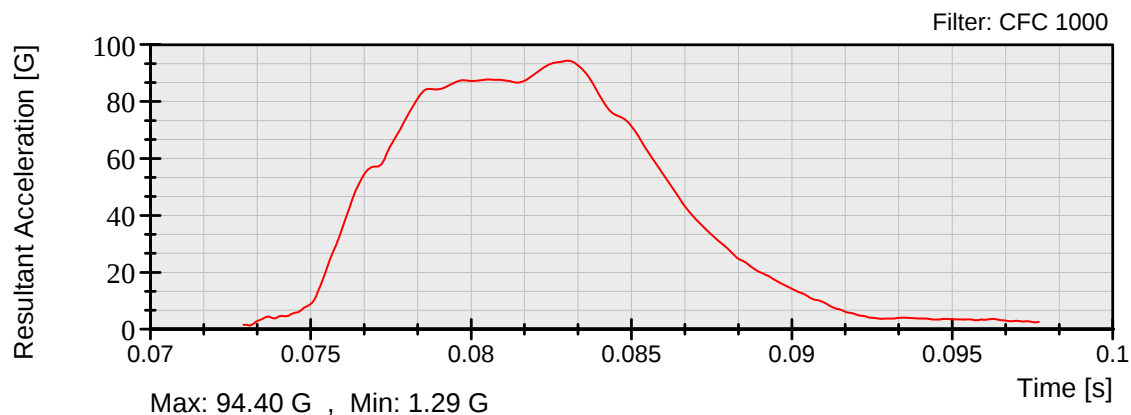
FMVSS 201U

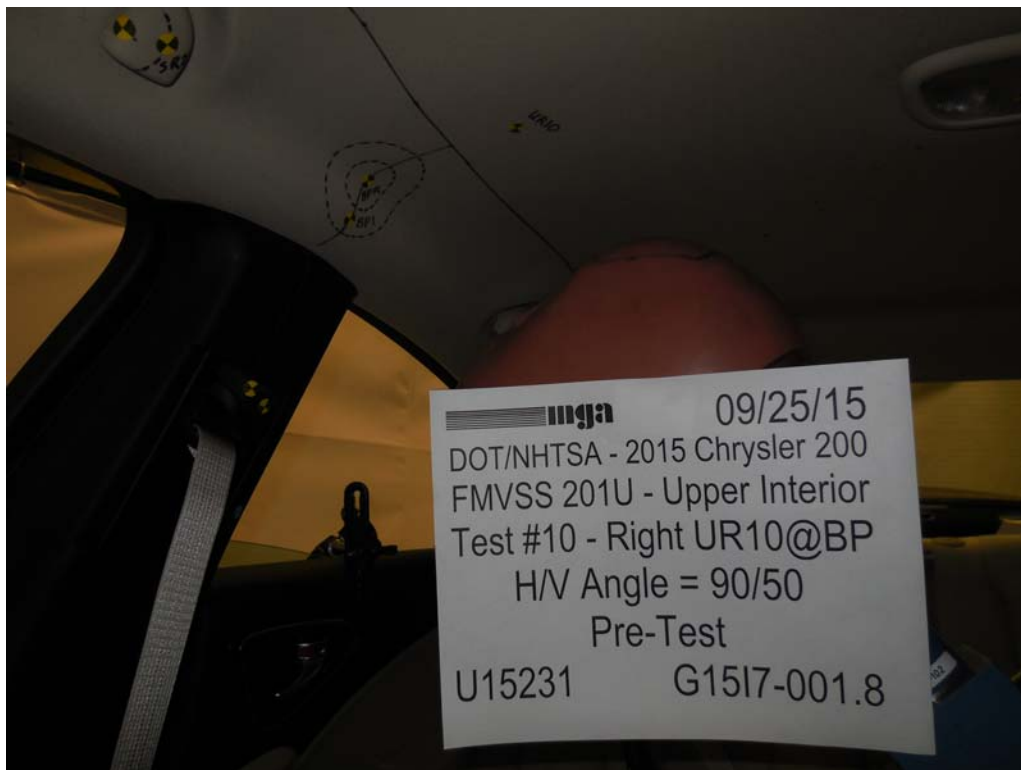
Test No.: U15231

Customer: NHTSA

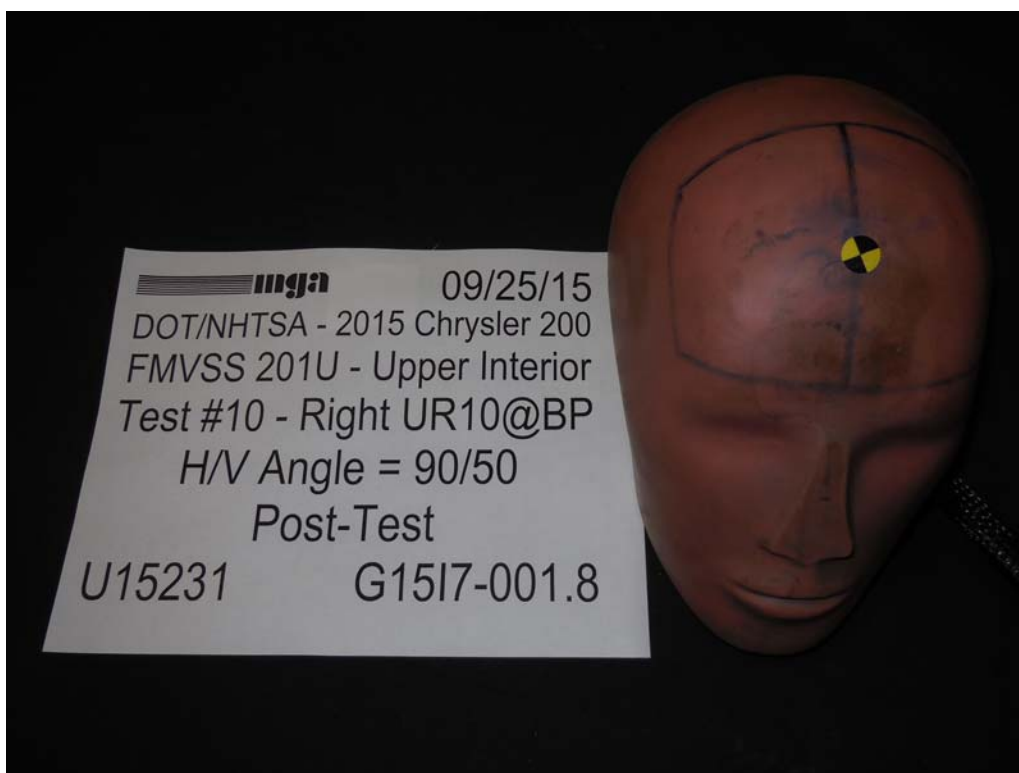
Report No.: G15I7-001.8

Date: 09/25/2015









Test U15229 Data



FMVSS 201U

Test No.: U15229
Customer: NHTSA

Report No.: G15I7-001.8
Date: 09/25/2015

Summary of the Test

Setup Information

Sample Description: 2015 Chrysler 200

Test Sequence No.: 8

Time: 9:51am

Horizontal Approach Angle: 90 deg

Temperature: 23.2 °C

Vertical Approach Angle: 50 deg

Humidity: 46.9 %RH

Impact Form ID No.: 37

Impact Form Mass: 4.54 kg

Target Location: Right UR12@SR3-2

Additional Description:

Test Results

Impact Velocity: 24.16 km/h

HIC Type	HIC Value	Time 1 (ms)	Time 2 (ms)	Delta-T (ms)
HIC 36	495.79	77.1	85.3	8.2
HIC 15	495.79	77.1	85.3	8.2
HIC (d)	540.45	77.1	85.3	8.2

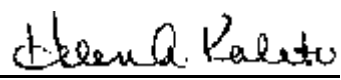
3 ms Clip = 88.03 G , Time 1 = 78.29 ms , Time 2 = 81.29 ms

Impact Location on FMH: 38 mm Above Pt. 0 , 4 Left mm Lateral of Pt. 0

Post-Test Comments: Grab handle pushed in: Headliner deformation.

Test Series Performed By: DB, KR

Page 1 of 3

Recorded By:  Approved By: 

Date: September 25, 2015



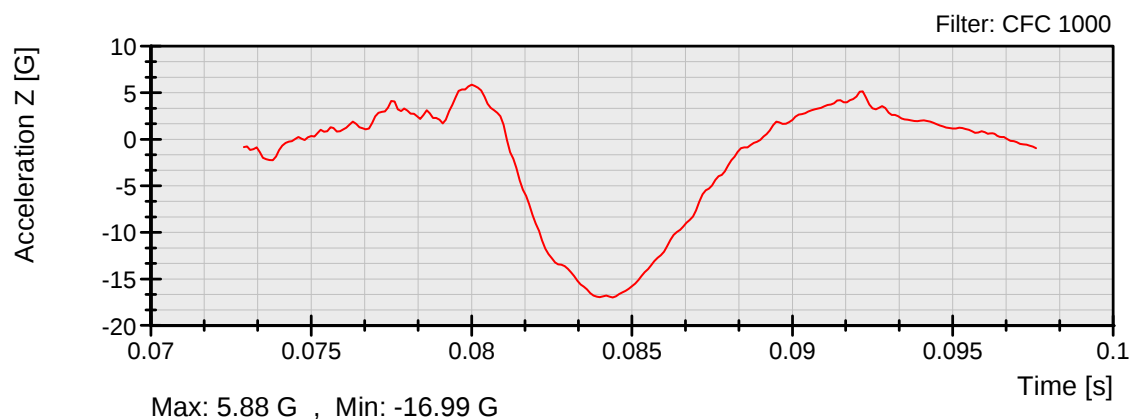
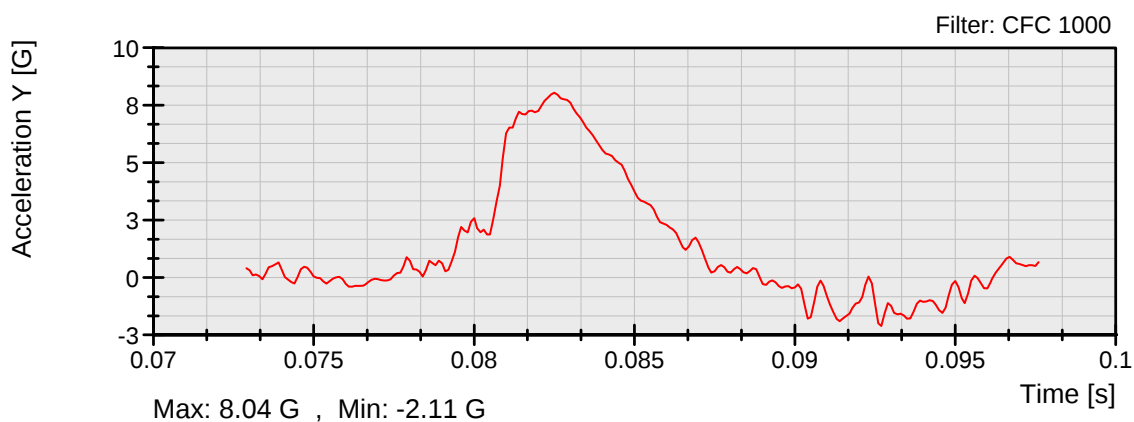
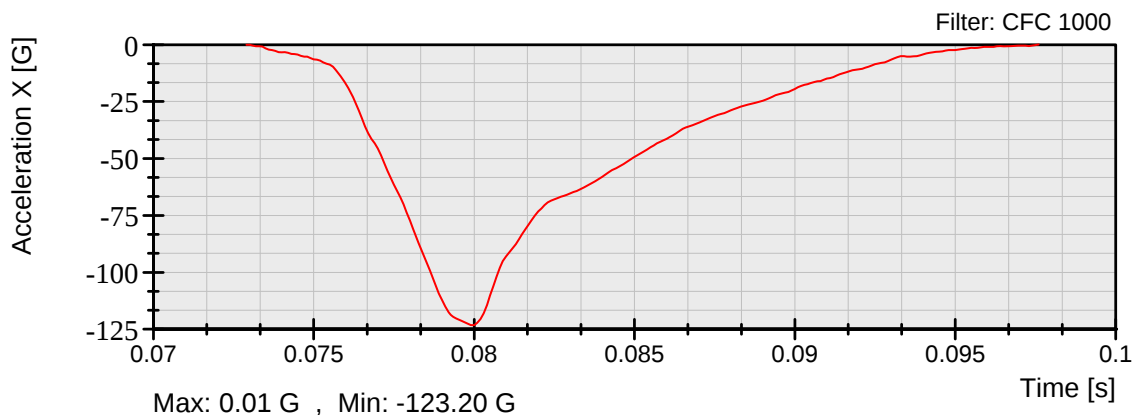
FMVSS 201U

Test No.: U15229

Customer: NHTSA

Report No.: G15I7-001.8

Date: 09/25/2015





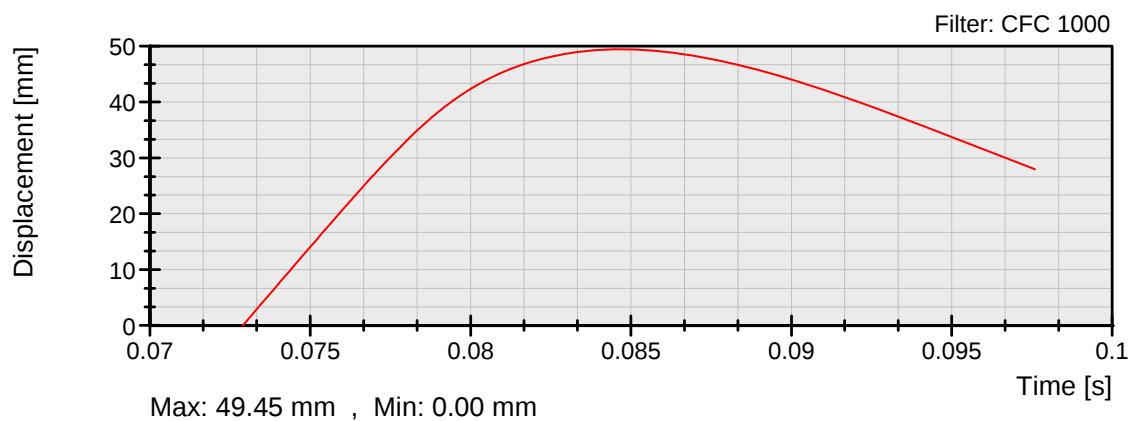
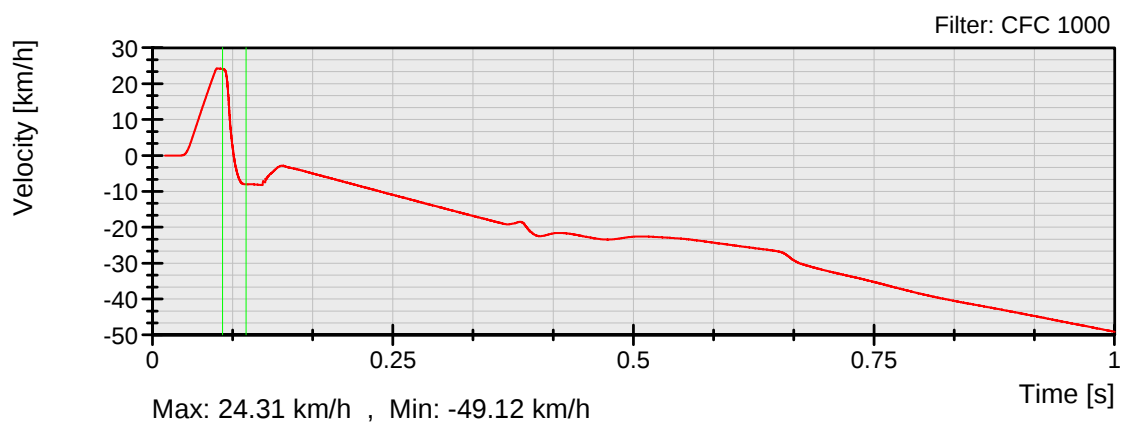
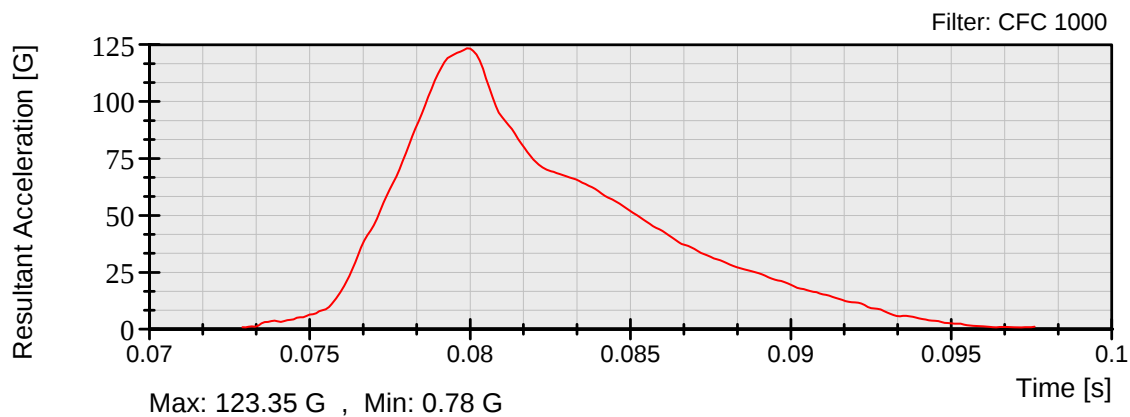
FMVSS 201U

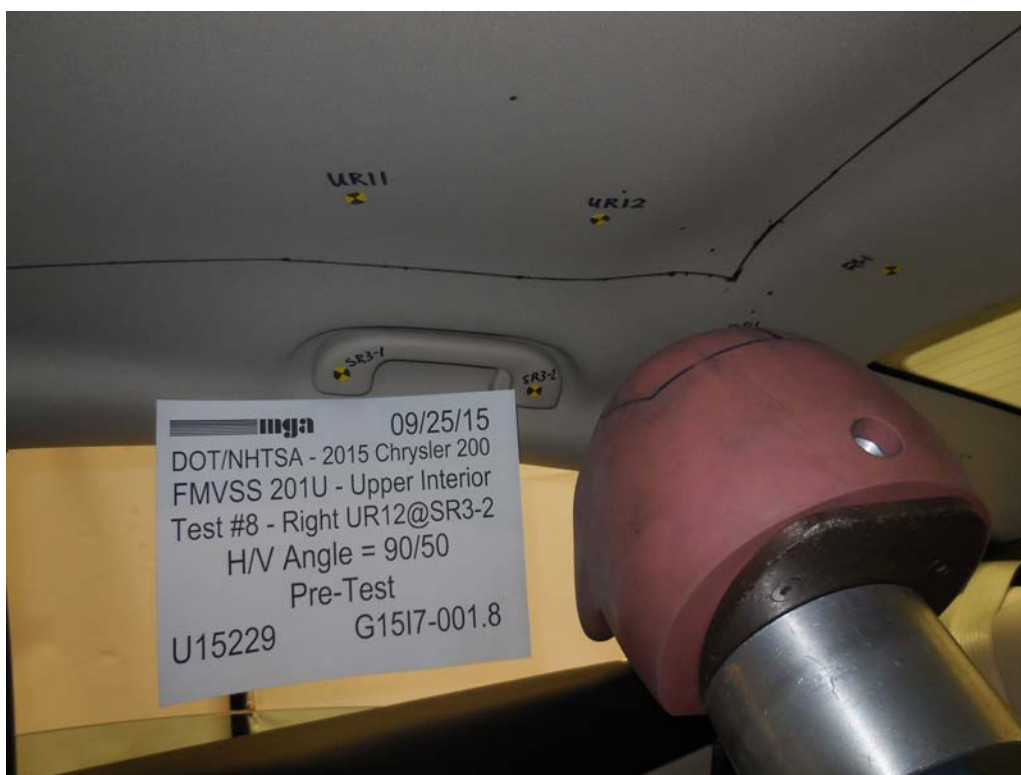
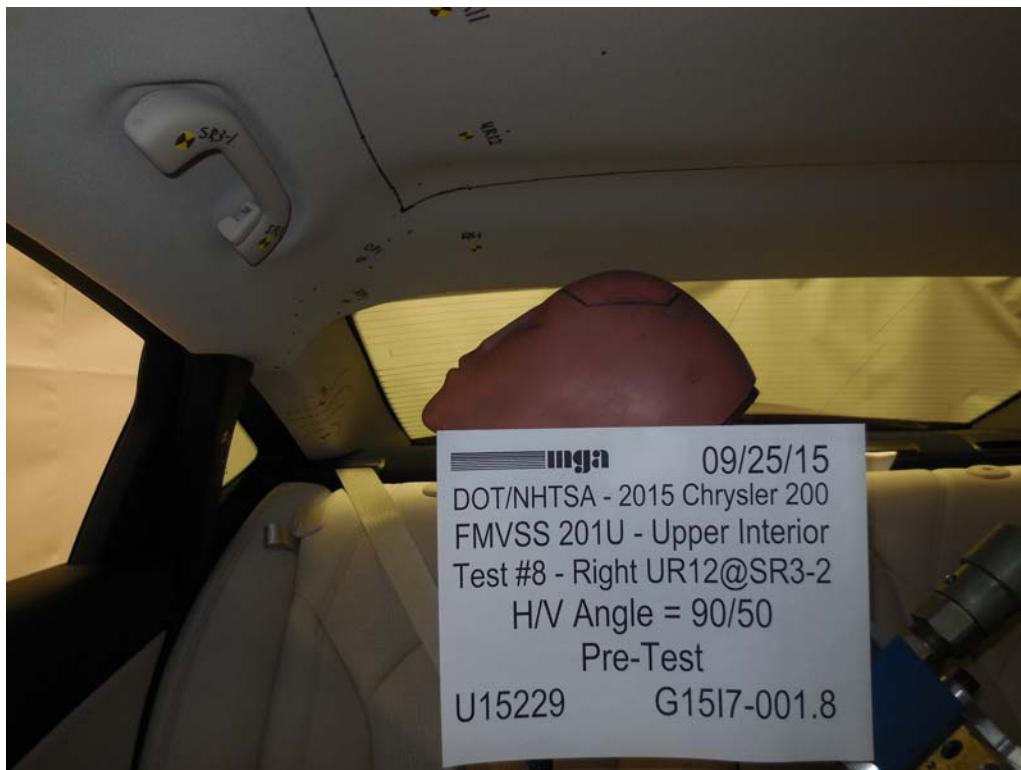
Test No.: U15229

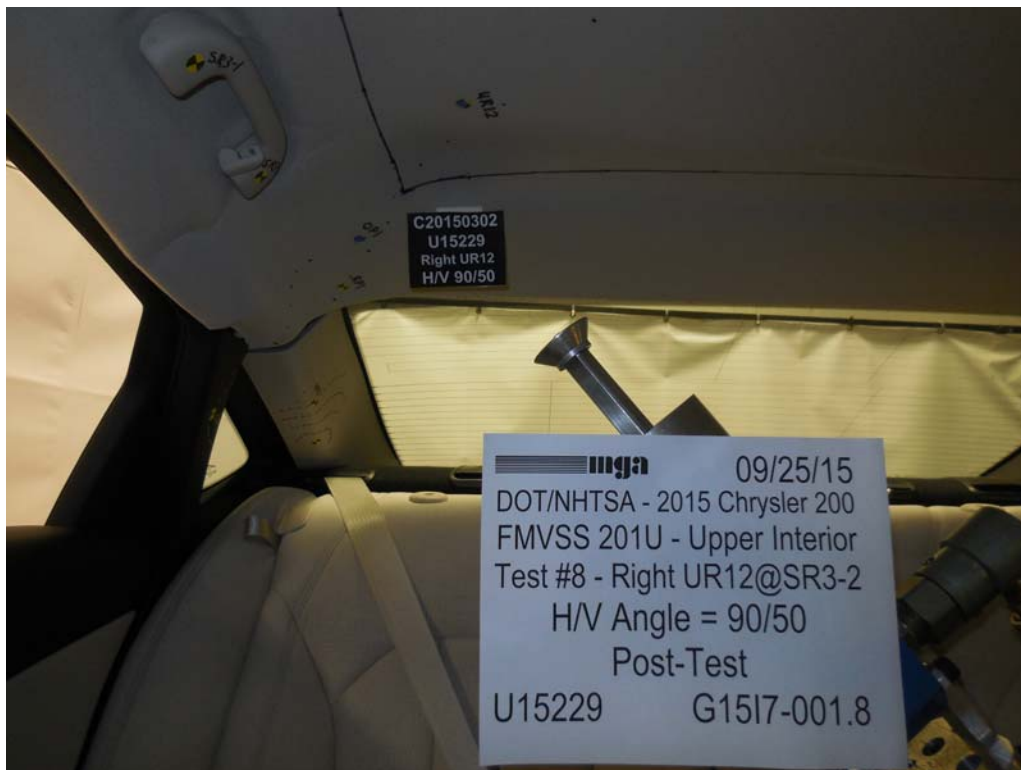
Customer: NHTSA

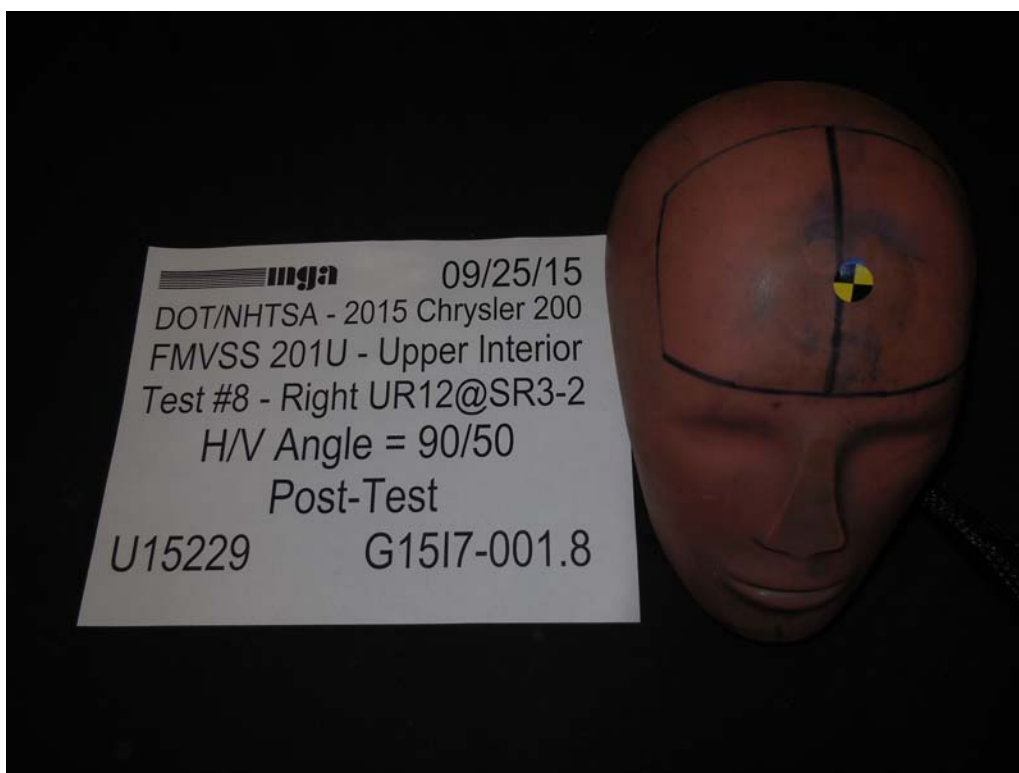
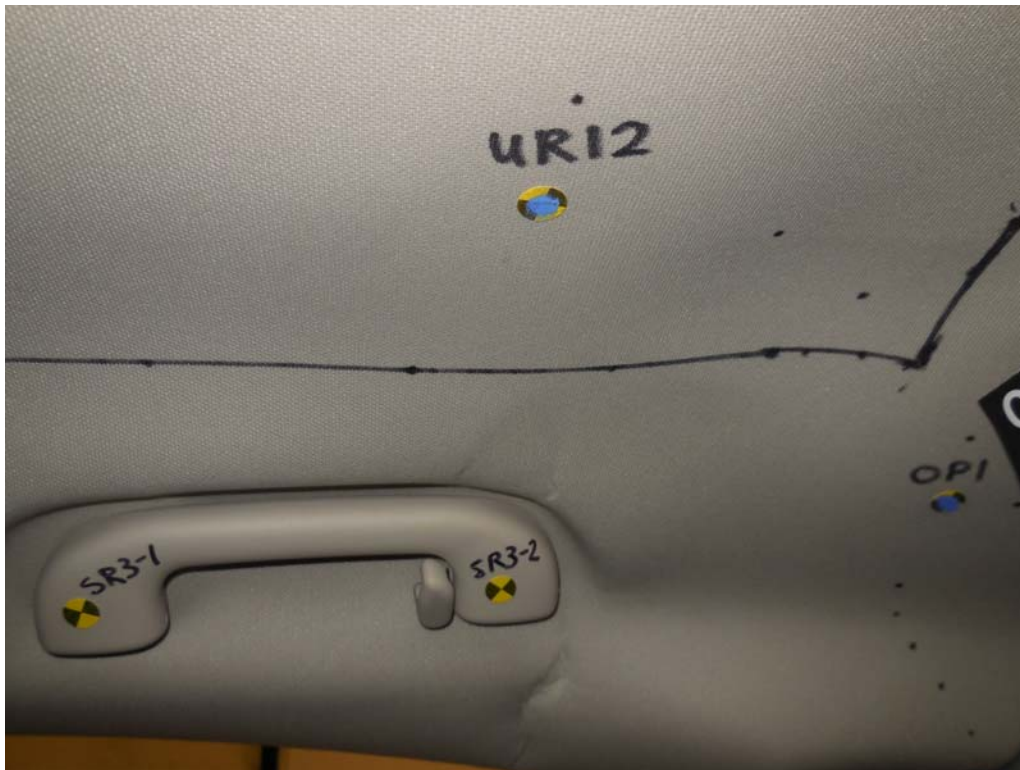
Report No.: G15I7-001.8

Date: 09/25/2015









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	C10-02-03-01351	Targeting	0.1 mm	Annual
Measuring Devices: - Tape Measure - Plumb Bobs - Digital Protractor	Stanley N/A Mitutoyo	TPM002-29 -- 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	09/23/2015	4.51	21.1	45.1	270.50	5.63	Yes
35	Post	09/28/2015	4.51	21.5	46.2	270.79	5.42	Yes
37	Pre	09/23/2015	4.54	21.1	45.6	230.15	12.76	Yes
37	Post	09/28/2015	4.54	21.3	46.1	271.65	13.60	Yes
38	Pre	09/23/2015	4.51	20.5	46.2	253.32	1.72	Yes
38	Post	09/28/2015	4.51	21.9	44.8	260.14	9.90	Yes

4-1 Pre-Test Calibration

Calibration Series: FMVSS 201U FMH

Test No.: H35021

Report No.: G15I7-001.8

Customer: DOT/NHTSA

Date: 9/23/2015

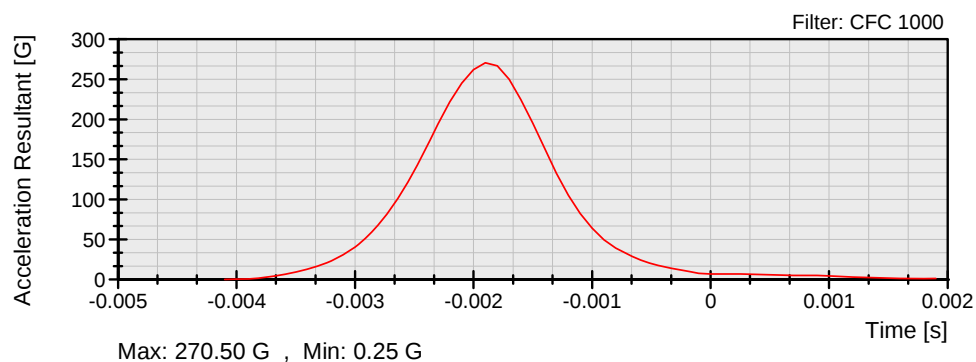
Summary of Results:

Impact Form ID No.: H35

Item Description	Result	Requirement
Temperature (°C)	21.1 °C	19°C and 26°C
Humidity (%RH)	45.1 % RH	10% to 70% RH
Impact Form Mass (kg)	4.51 kg	4.54 ± 0.05 kg
Resultant Acceleration (G)	270.50 G	225 to 275 G
Peak Y-Acceleration (G)	5.63 G	< 15 G
Unimodal?	Yes	Yes

Calibration Performed By: DB

Comments: NA



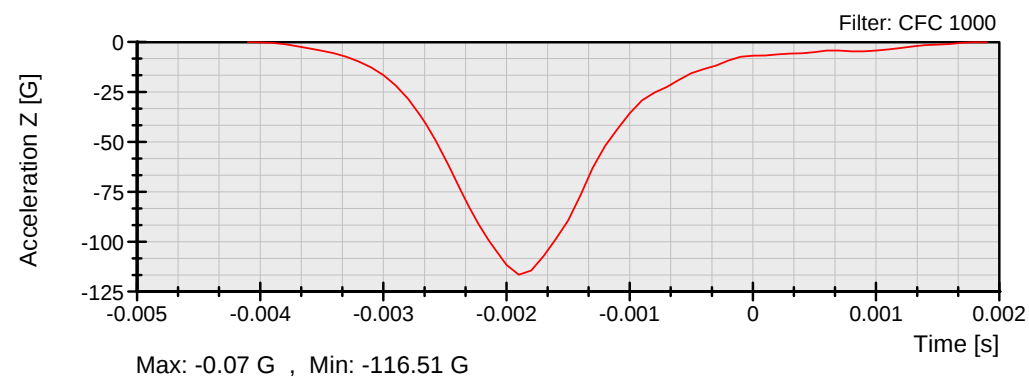
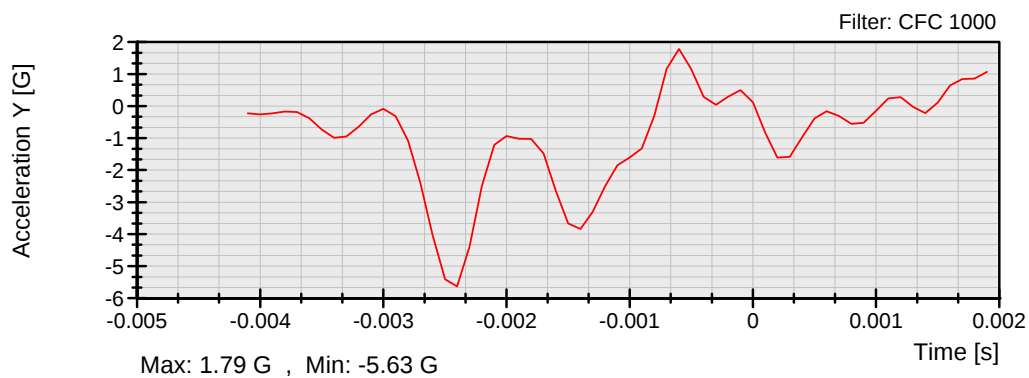
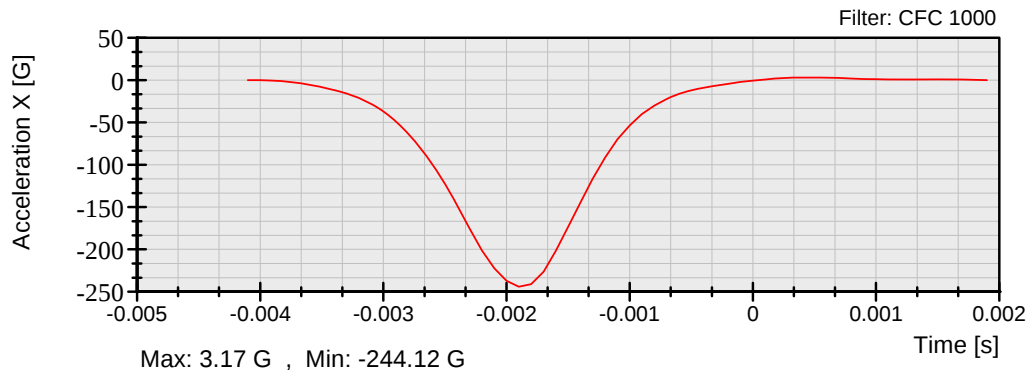
Calibration Series: FMVSS 201U FMH

Test No: H35021

Report No.: G15I7-001.8

Customer: DOT/NHTSA

Date: 9/23/2015



Recorded By: *Dan B...*
Date: September 23, 2015

Approved By: *Sam J...*

4-2 Post-Test Calibration

Calibration Series: FMVSS 201U FMH

Test No.: H35022

Report No.: G15I7-001.8

Customer: DOT/NHTSA

Date: 9/28/2015

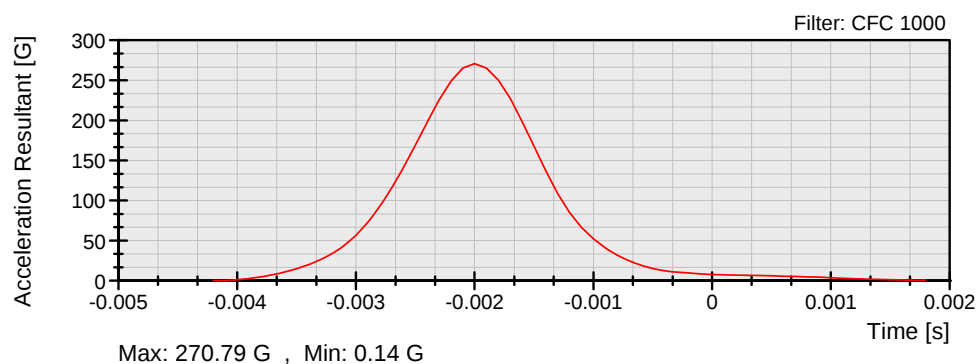
Summary of Results:

Impact Form ID No.: H35

Item Description	Result	Requirement
Temperature (°C)	21.5 °C	19°C and 26°C
Humidity (%RH)	46.2 % RH	10% to 70% RH
Impact Form Mass (kg)	4.51 kg	4.54 ± 0.05 kg
Resultant Acceleration (G)	270.79 G	225 to 275 G
Peak Y-Acceleration (G)	5.42 G	< 15 G
Unimodal?	Yes	Yes

Calibration Performed By: DB

Comments: NA



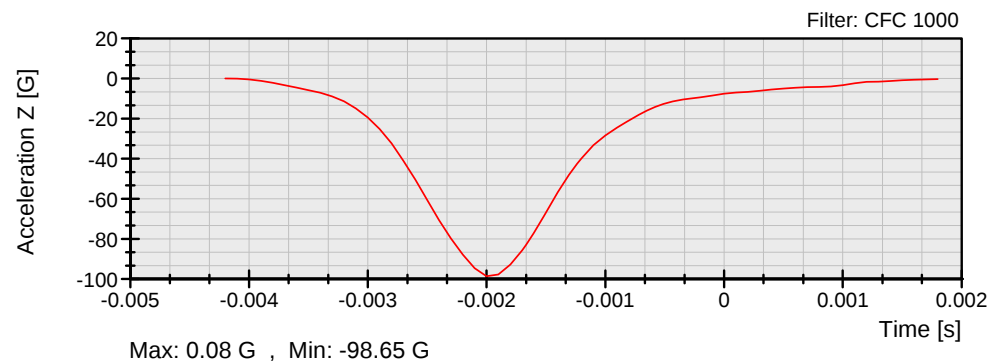
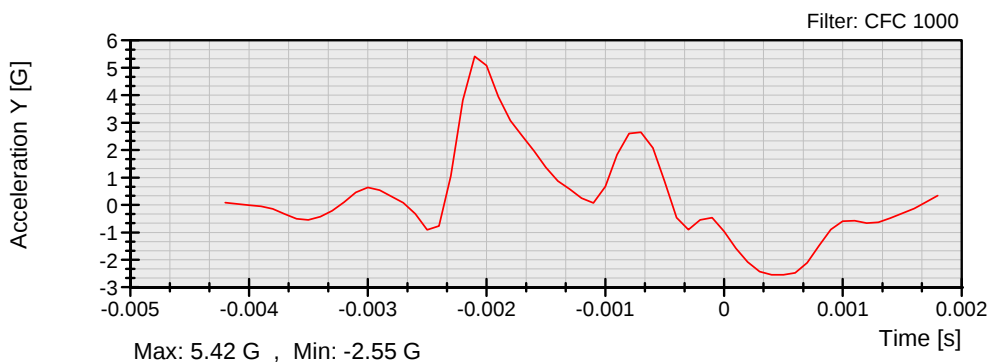
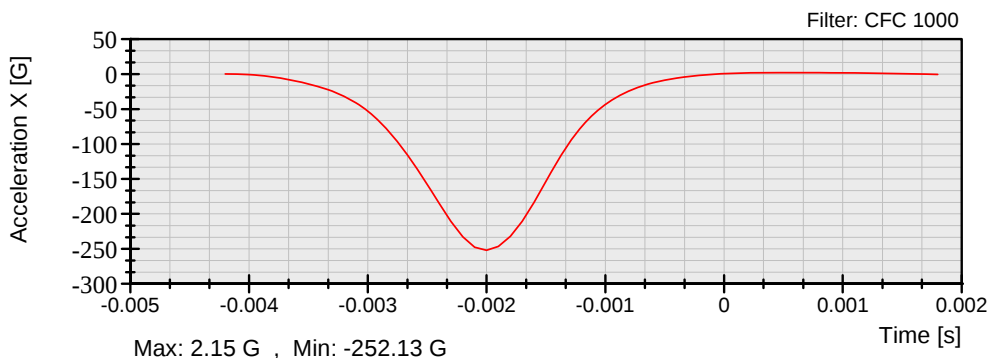
Calibration Series: FMVSS 201U FMH

Test No: H35022

Report No.: G15I7-001.8

Customer: DOT/NHTSA

Date: 9/28/2015



Page 2 of 2

Recorded By: Dan B...
Date: September 28, 2015

Approved By: Sam J...

4-3 Pre-Test Calibration

Calibration Series: FMVSS 201U FMH

Test No.: H37019

Report No.: G15I7-001.8

Customer: DOT/NHTSA

Date: 9/23/2015

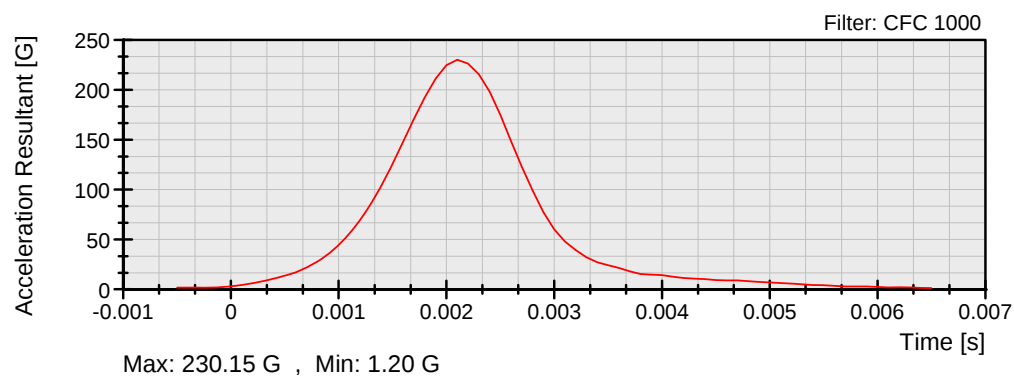
Summary of Results:

Impact Form ID No.: H37

Item Description	Result	Requirement
Temperature (°C)	21.1 °C	19°C and 26°C
Humidity (%RH)	45.6 % RH	10% to 70% RH
Impact Form Mass (kg)	4.54 kg	4.54 ± 0.05 kg
Resultant Acceleration (G)	230.15 G	225 to 275 G
Peak Y-Acceleration (G)	12.76 G	< 15 G
Unimodal?	Yes	Yes

Calibration Performed By: DB

Comments: NA



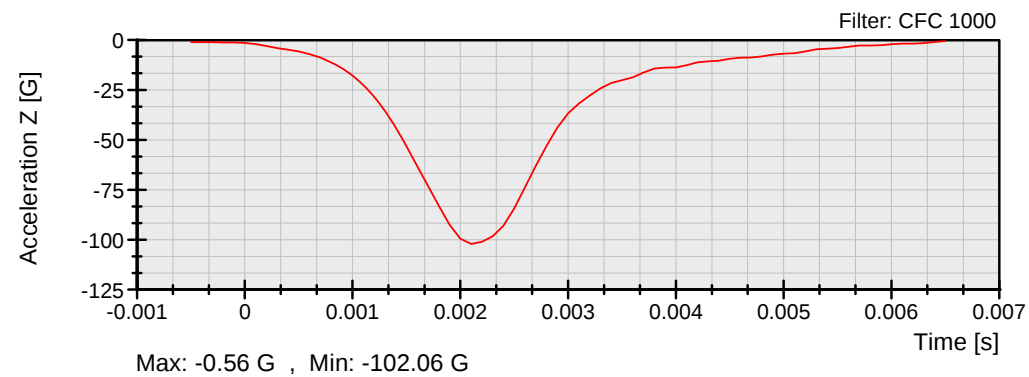
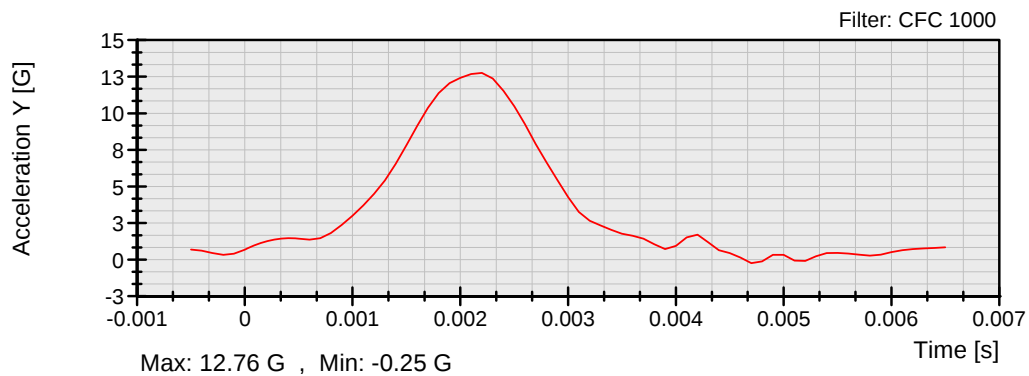
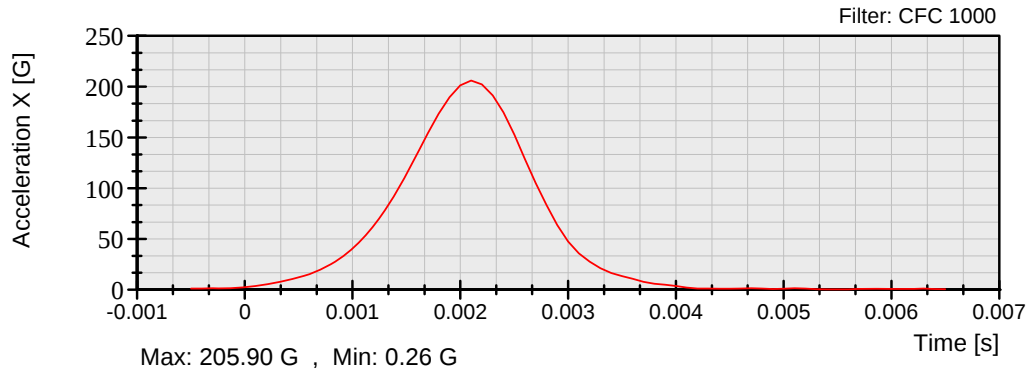
Calibration Series: FMVSS 201U FMH

Test No: H37019

Report No.: G15I7-001.8

Customer: DOT/NHTSA

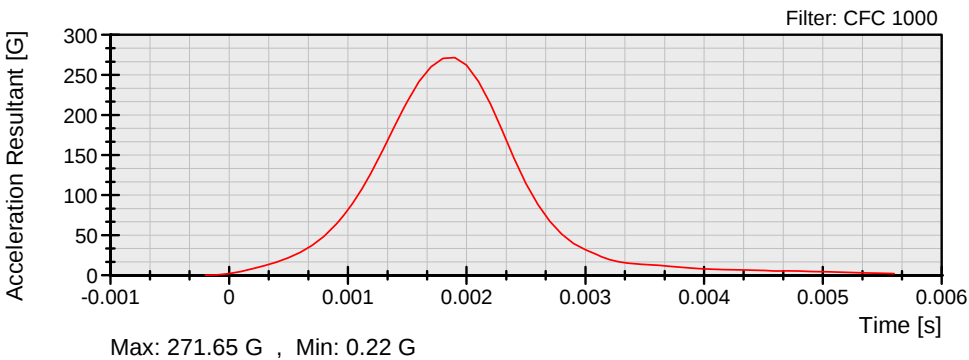
Date: 9/23/2015



Recorded By: *Dan B...*
Date: September 23, 2015

Approved By: *Ben J...*

4-4 Post-Test Calibration

Calibration Series: FMVSS 201U FMH		
Test No.: H37020	Report No.: G15I7-001.8	
Customer: DOT/NHTSA	Date: 9/28/2015	
Summary of Results:		
Impact Form ID No.: H37		
Item Description	Result	Requirement
Temperature (°C)	21.3 °C	19°C and 26°C
Humidity (%RH)	46.1 % RH	10% to 70% RH
Impact Form Mass (kg)	4.54 kg	4.54 ± 0.05 kg
Resultant Acceleration (G)	271.65 G	225 to 275 G
Peak Y-Acceleration (G)	13.60 G	< 15 G
Unimodal?	Yes	Yes
Calibration Performed By: DB		
Comments: NA		
 Filter: CFC 1000 Max: 271.65 G , Min: 0.22 G		

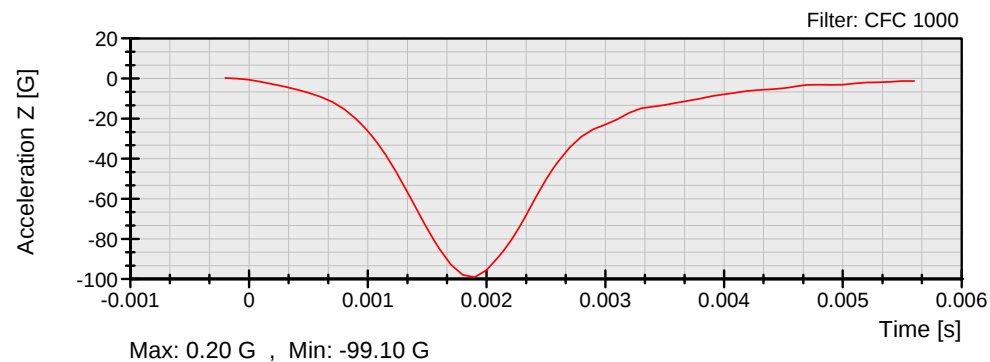
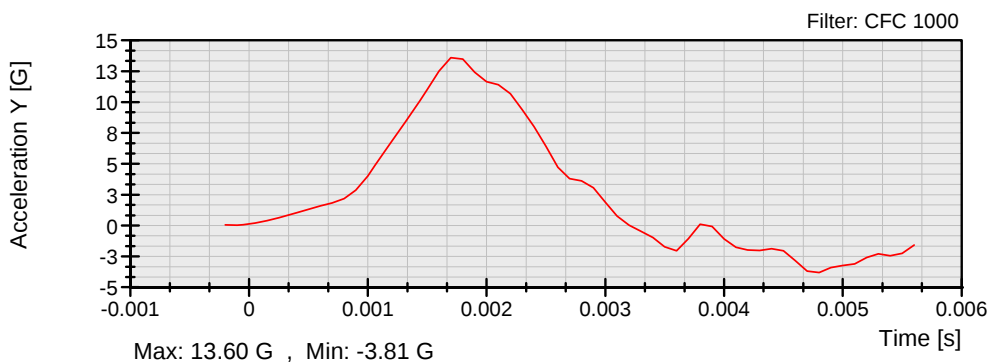
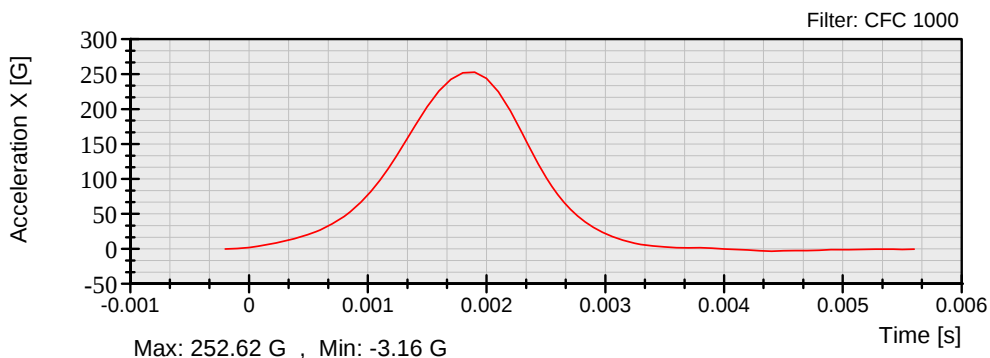
Calibration Series: FMVSS 201U FMH

Test No: H37020

Report No.: G15I7-001.8

Customer: DOT/NHTSA

Date: 9/28/2015



Page 2 of 2

Recorded By: *Dan B...*
Date: September 28, 2015

Approved By: *Sam J...*

4-5 Pre-Test Calibration

Calibration Series: FMVSS 201U FMH

Test No.: H38020

Report No.: G15I7-001.8

Customer: DOT/NHTSA

Date: 9/23/2015

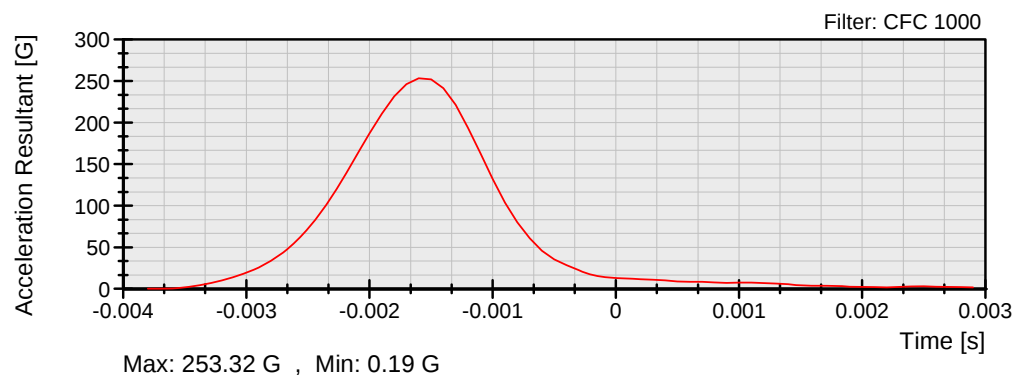
Summary of Results:

Impact Form ID No.: H38

Item Description	Result	Requirement
Temperature (°C)	20.5 °C	19°C and 26°C
Humidity (%RH)	46.2 % RH	10% to 70% RH
Impact Form Mass (kg)	4.51 kg	4.54 ± 0.05 kg
Resultant Acceleration (G)	253.32 G	225 to 275 G
Peak Y-Acceleration (G)	1.72 G	< 15 G
Unimodal?	Yes	Yes

Calibration Performed By: DB

Comments: NA



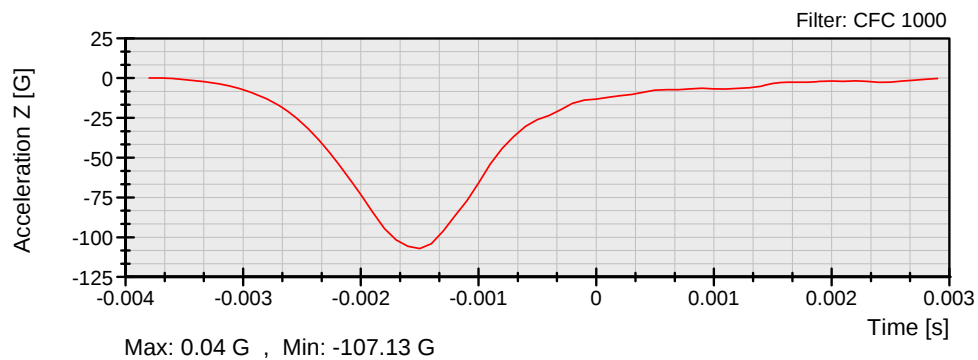
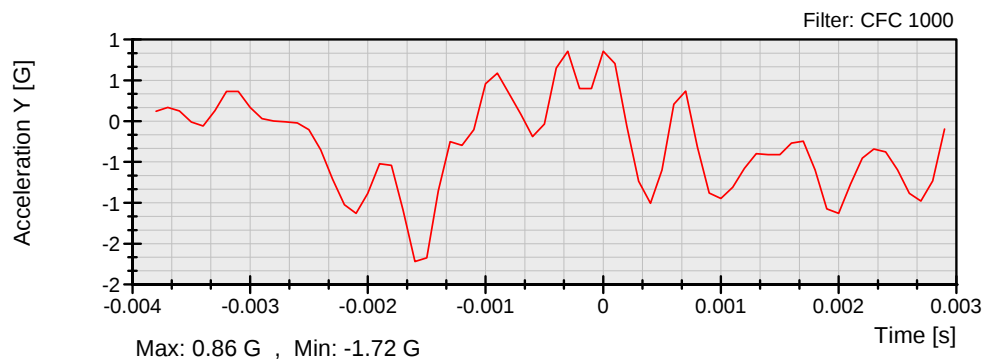
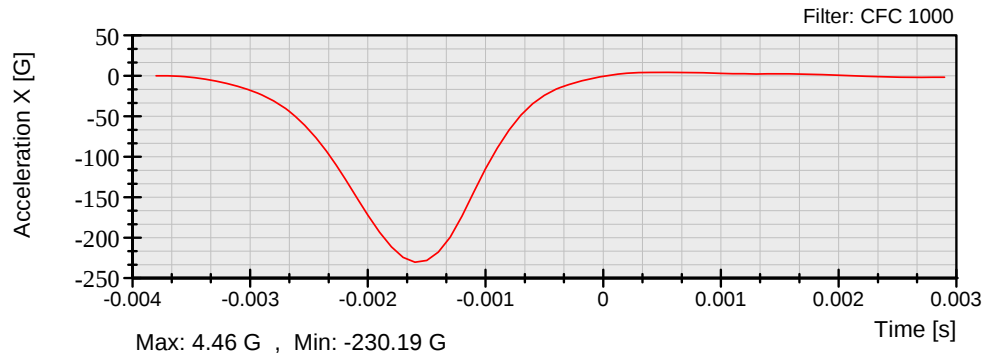
Calibration Series: FMVSS 201U FMH

Test No: H38020

Report No.: G15I7-001.8

Customer: DOT/NHTSA

Date: 9/23/2015



Page 2 of 2

Recorded By: *Don B...*
Date: September 23, 2015

Approved By: *Sam J...*

4-6 Post-Test Calibration

Calibration Series: FMVSS 201U FMH		
Test No.: H38021		Report No.: G15I7-001.8
Customer: DOT/NHTSA		Date: 9/28/2015
Summary of Results:		
Impact Form ID No.: H38		
Item Description	Result	Requirement
Temperature (°C)	21.9 °C	19°C and 26°C
Humidity (%RH)	44.8 % RH	10% to 70% RH
Impact Form Mass (kg)	4.51 kg	4.54 ± 0.05 kg
Resultant Acceleration (G)	260.14 G	225 to 275 G
Peak Y-Acceleration (G)	9.90 G	< 15 G
Unimodal?	Yes	Yes
Calibration Performed By: DB		
Comments: NA		
Filter: CFC 1000 Max: 260.14 G , Min: 0.10 G Page 1 of 2		

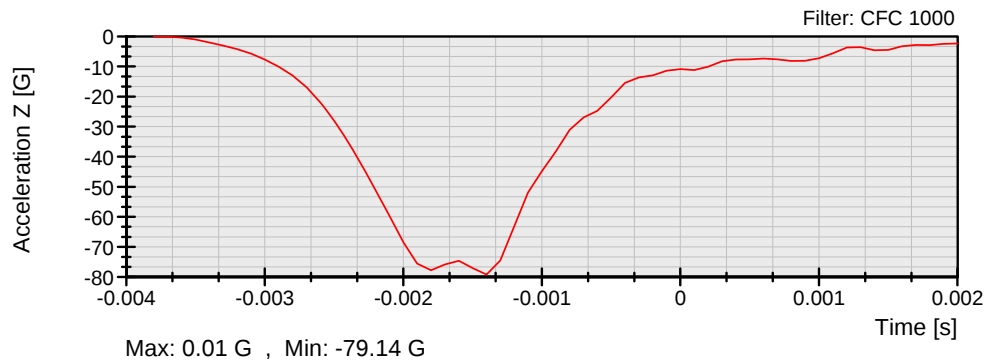
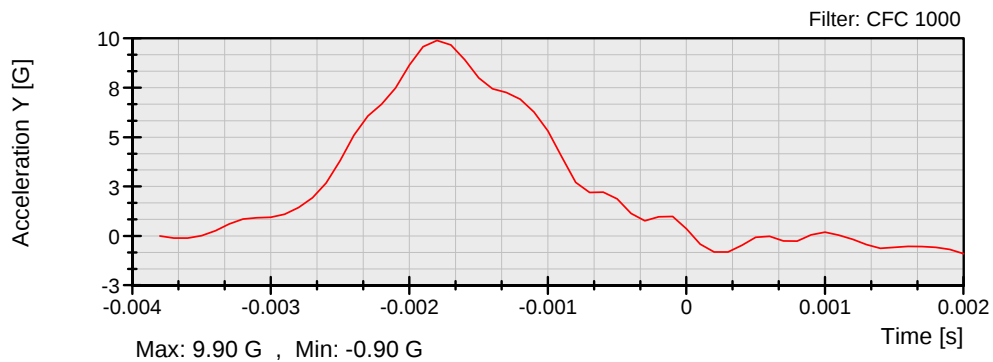
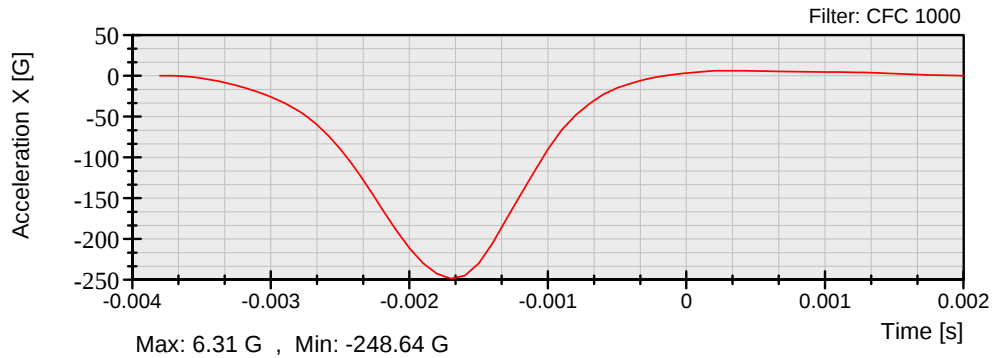
Calibration Series: FMVSS 201U FMH

Test No: H38021

Report No.: G15I7-001.8

Customer: DOT/NHTSA

Date: 9/28/2015



Page 2 of 2

Recorded By: *Don B...*
Date: September 28, 2015

Approved By: *Sean J...*

5.0 PHOTOGRAPHS



As Delivered – Left Side View



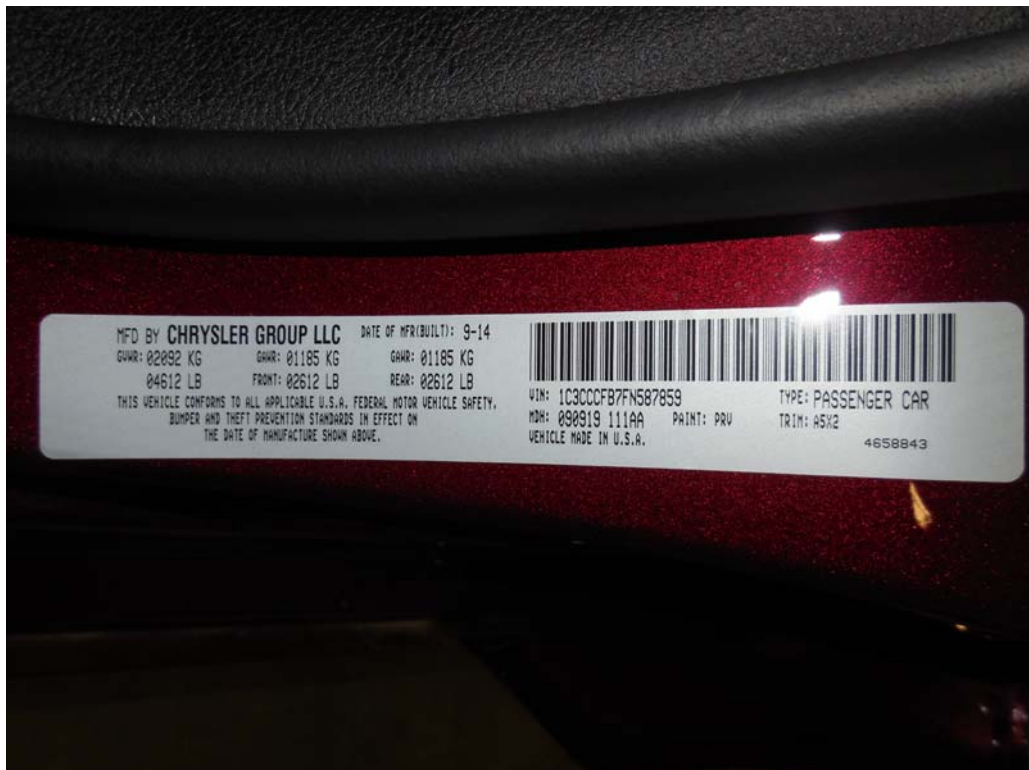
As Delivered – Right Side View



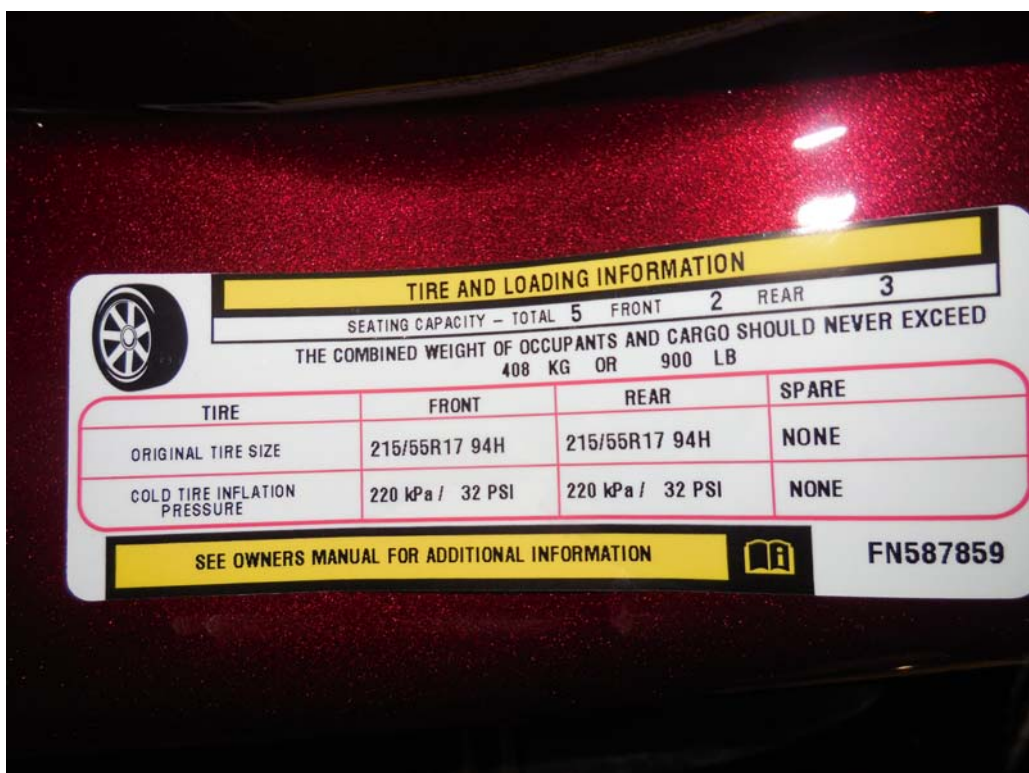
As Delivered – ¾ Front View From Left Side



As Delivered – ¾ Rear View From Right Side

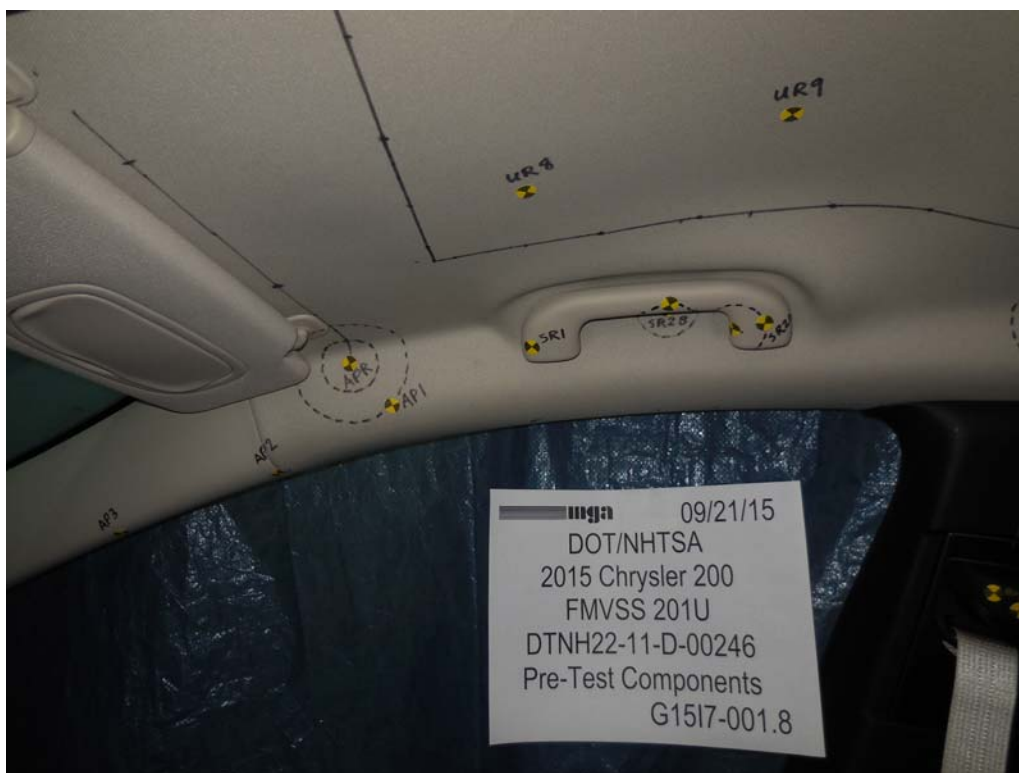


As Delivered – Vehicle's Certification Label



As Delivered – Vehicle's Tire Information Label

Pre-Test Component Photographs

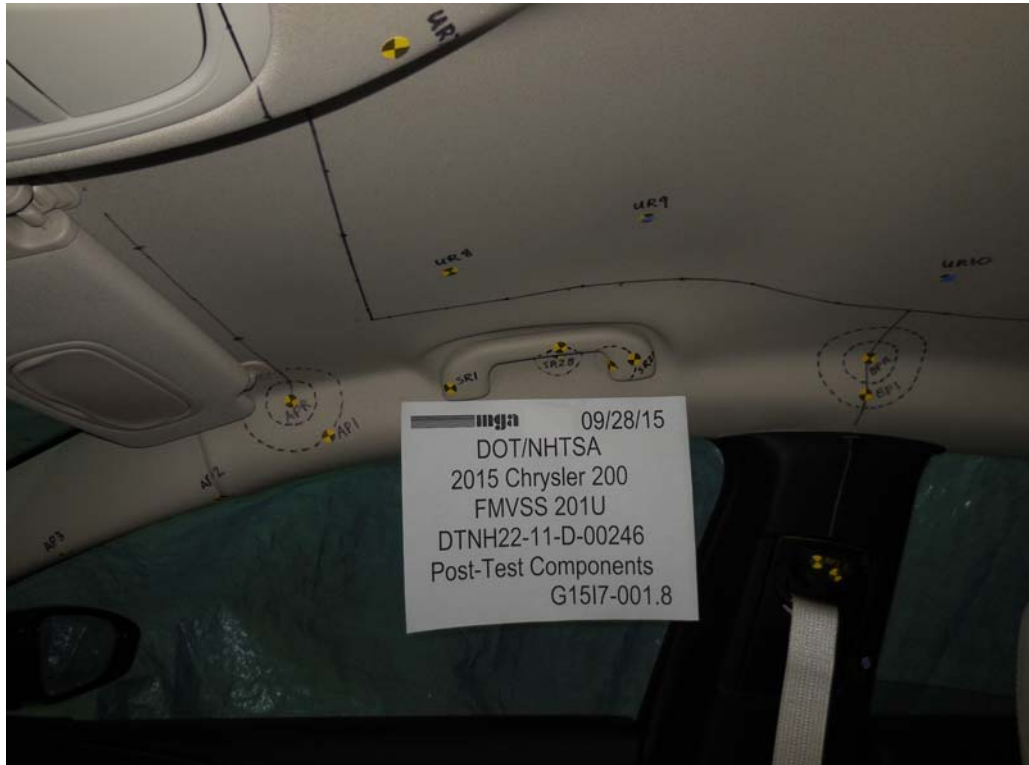
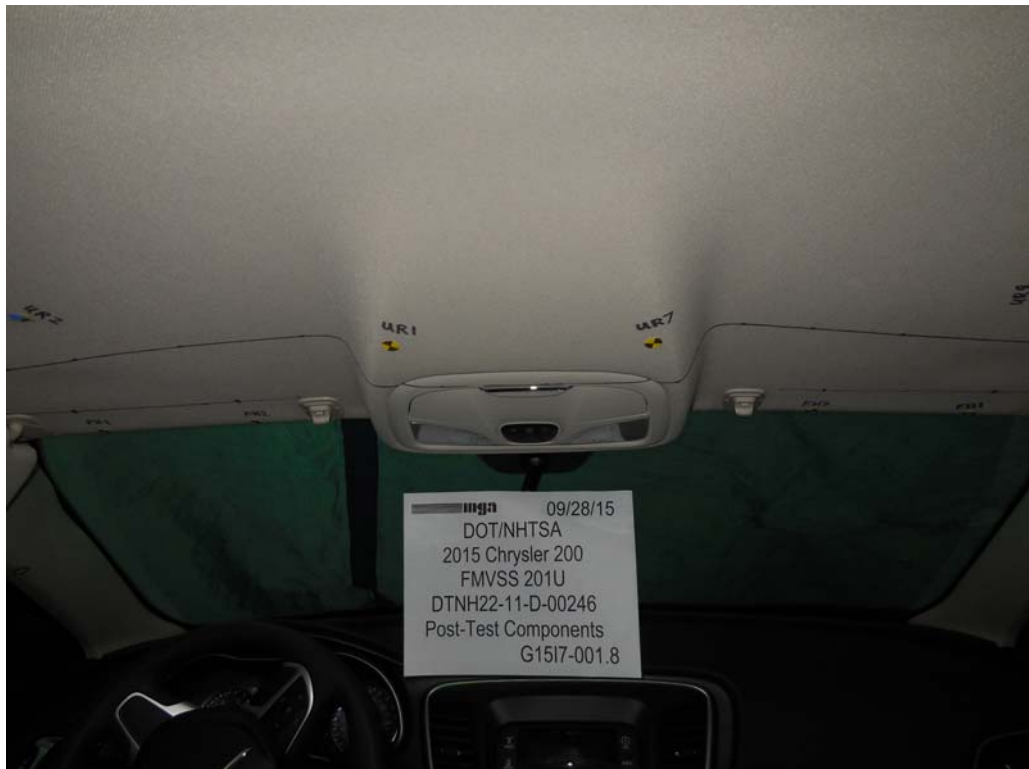






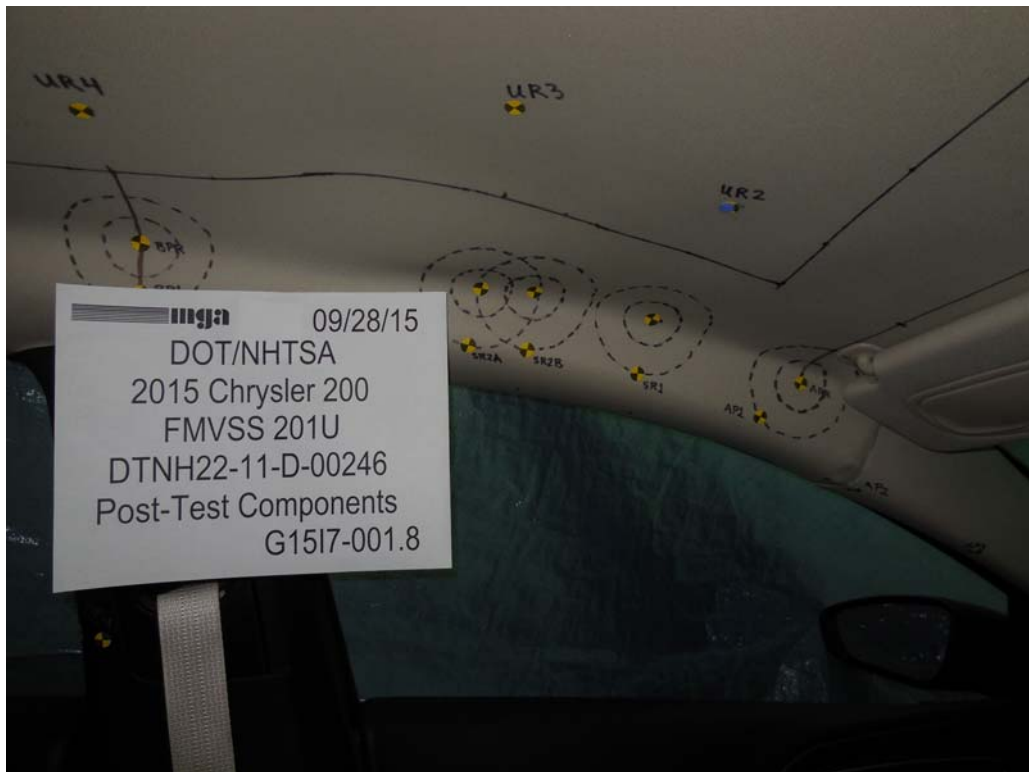


Post-Test Component Photographs



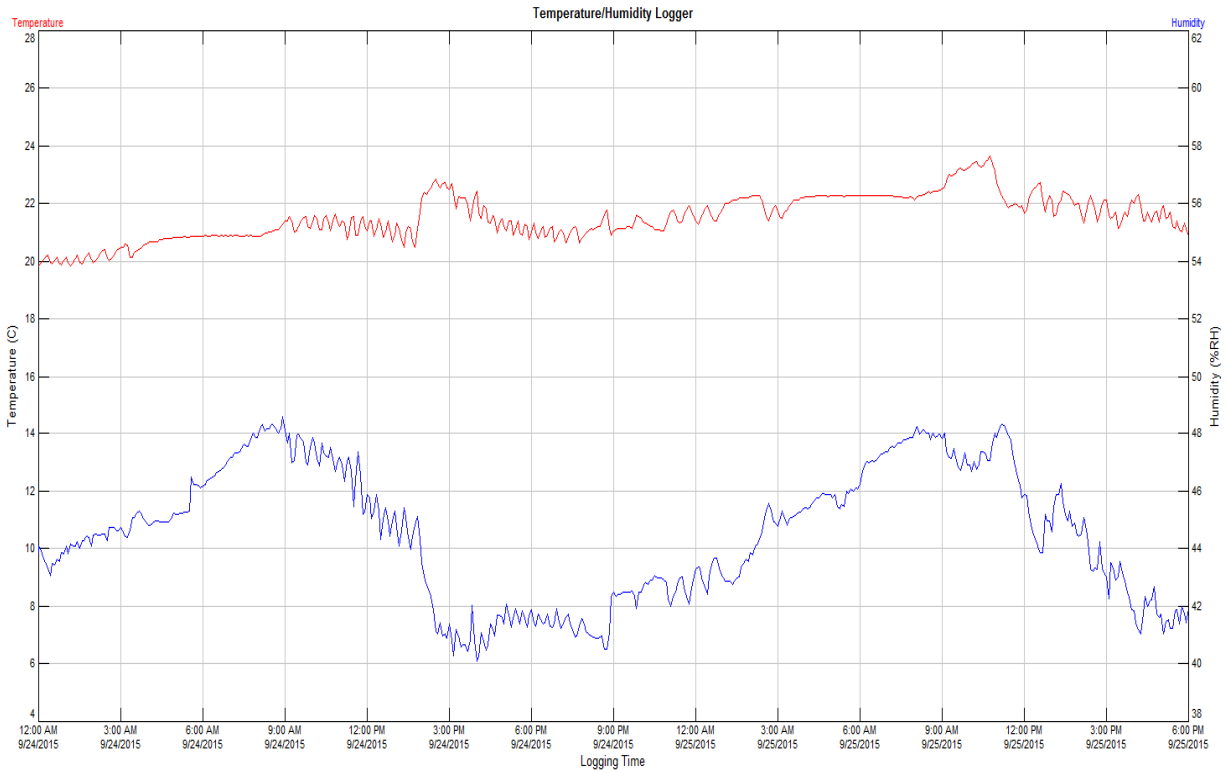






Appendix A – Temperature Trace

C20150302
2015 Chrysler 200
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 48063	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/NCSL Z540-1-1994.

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

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

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

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

AS RECEIVED CONDITION:	IN TOLERANCE	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

Key Specifications:
 Range 500 +/- g
 Resolution .00005 g
 Temperature Range -65/+250 °F

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

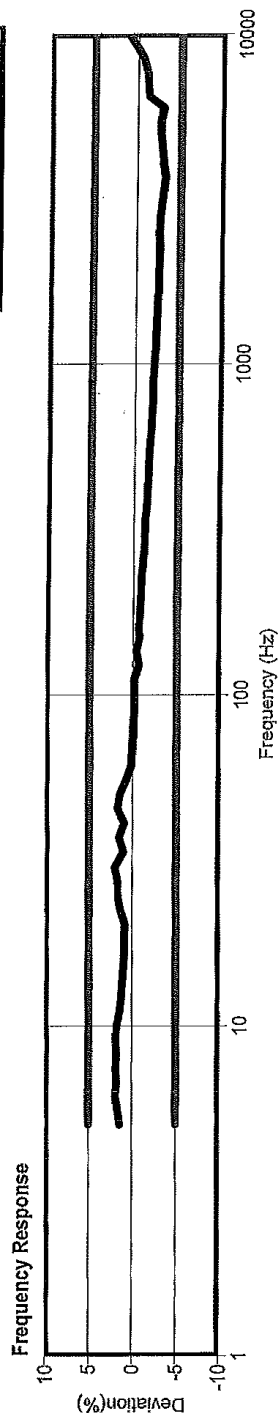
Calibration Data:
 Voltage Sensitivity 9.950 mV/g
 Test Accel. Level 1 g

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.: 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
DLR (100K Shunt): 96.05 g

New vs Old

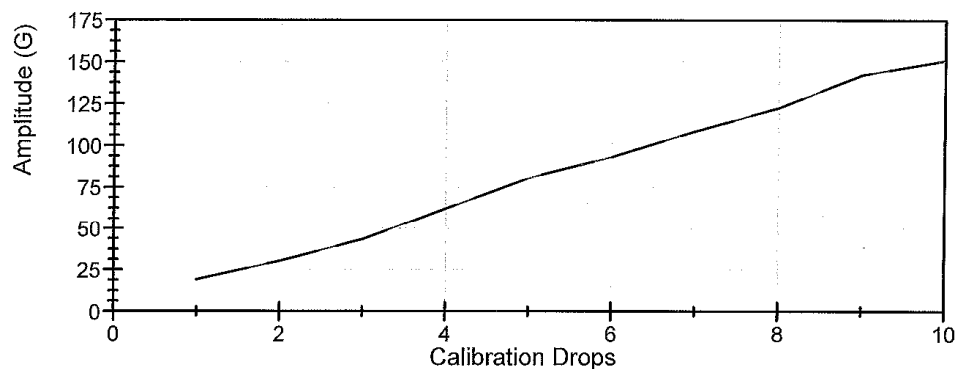
0.05 %
0.14 %

Excitation Voltage: 10 V
Error: 0.1029 %
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.: 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
DLR (100K Shunt): 88.18 g

New vs Old

0.27 %

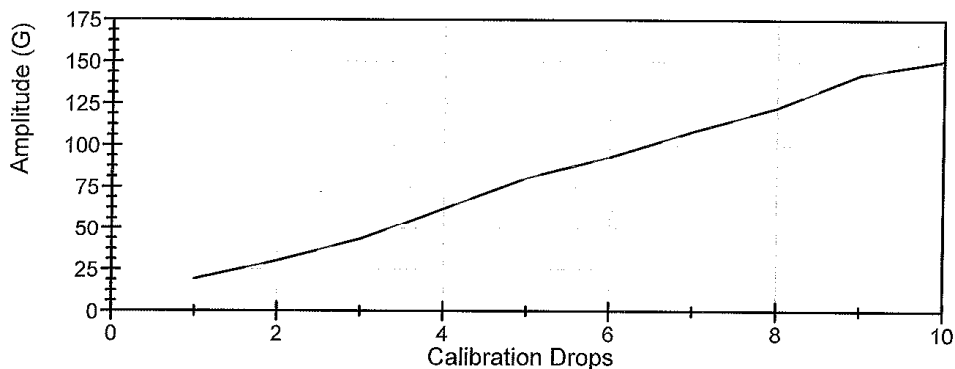
-0.19 %

Excitation Voltage: 10 V
Error: 0.1532 %
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.: 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
DLR (100K Shunt): 108.87 g

New vs Old

-0.13 %

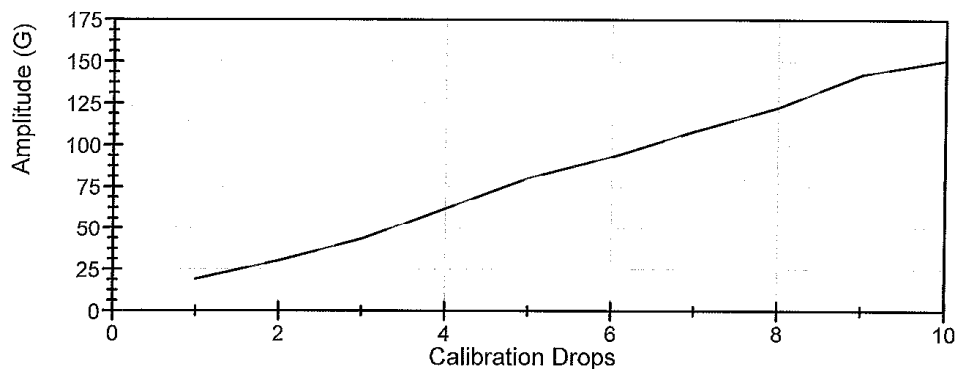
0.19 %

Excitation Voltage: 10 V
Error: 0.1412 %
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.: 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
DLR (100K Shunt): 95.73 g

New vs Old

-1.16 %

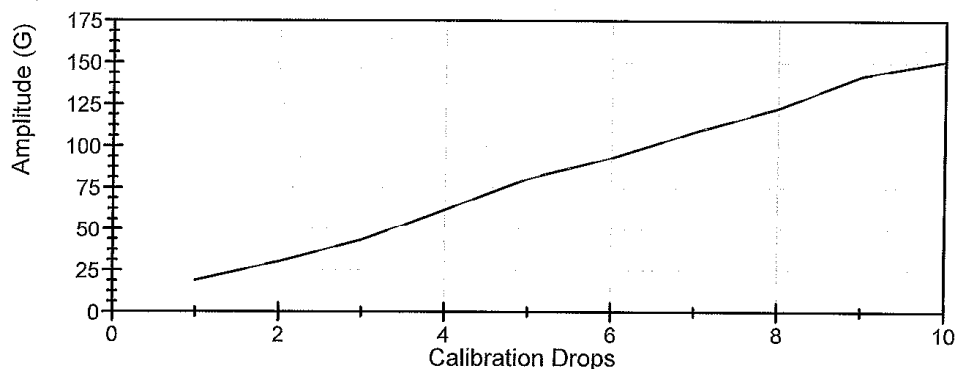
1.02 %

Excitation Voltage: 10 V
Error: 0.2459 %
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.: 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
DLR (100K Shunt): 107.79 g

New vs Old

0.33 %

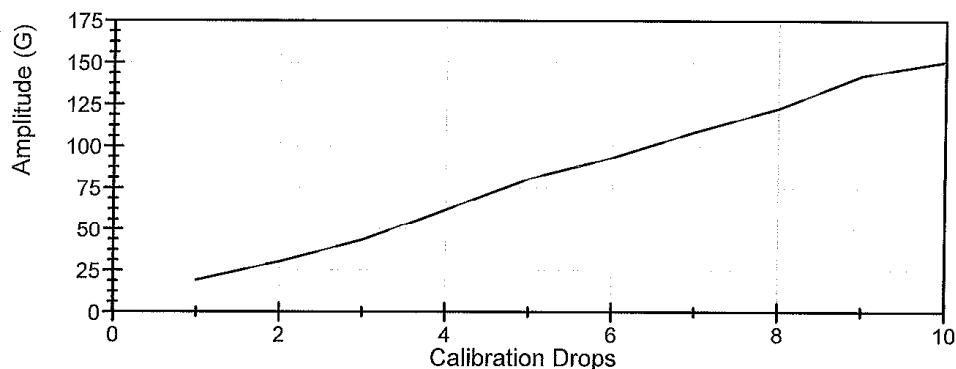
-0.25 %

Excitation Voltage: 10 V
Error: 0.0691 %
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.: 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
DLR (100K Shunt): 98.15 g

New vs Old

-0.33 %

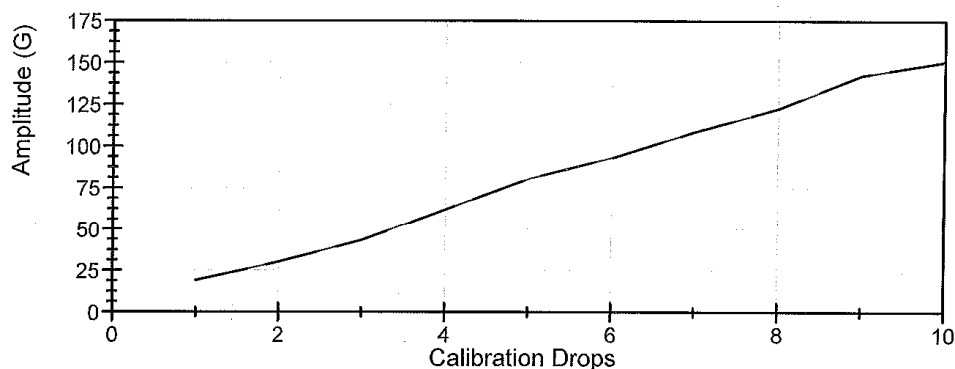
0.51 %

Excitation Voltage: 10 V
Error: 0.1609 %
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.: 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
DLR (100K Shunt): 102.19 g

New vs Old

-0.07 %

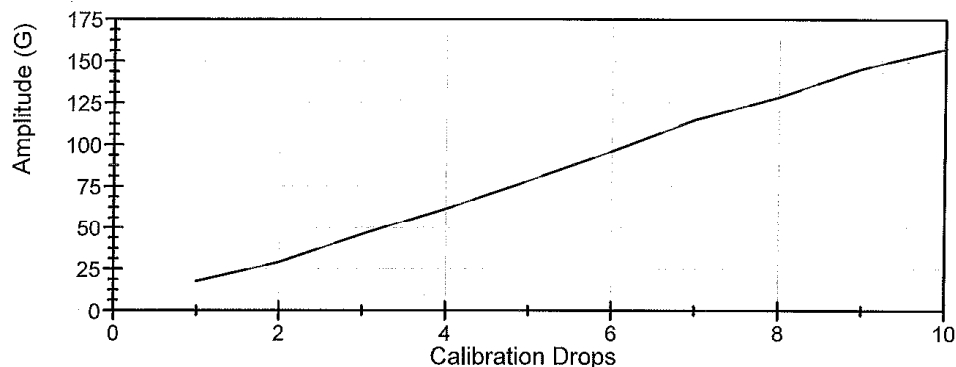
0.28 %

Excitation Voltage: 10 V
Error: 0.1886 %
Linearity (R-Squared): 1.0000

Temperature: 21.0 °C
Relative Humidity: 31.0 %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

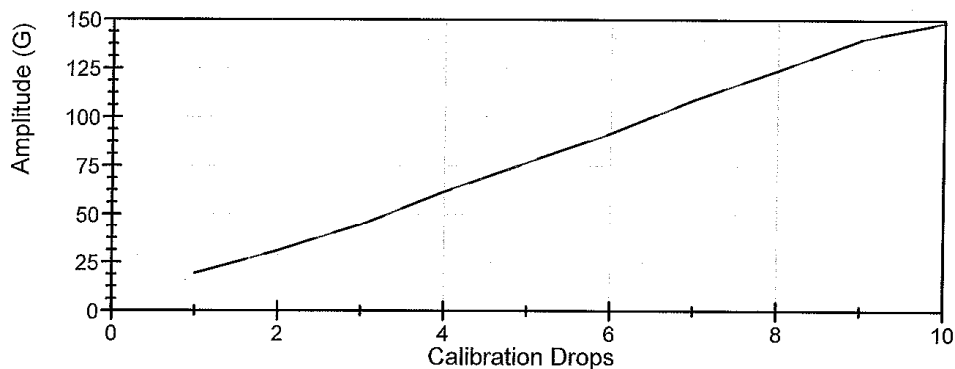
Temperature: 23.7 °C

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.: 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
DLR (100K Shunt): 103.73 g

New vs Old

-0.39 %

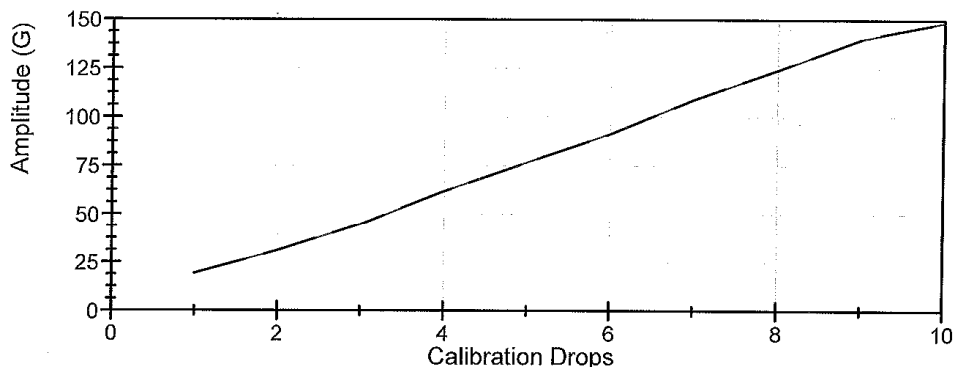
0.19 %

Excitation Voltage: 10 V
Error: 0.1263 %
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

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 Changed	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

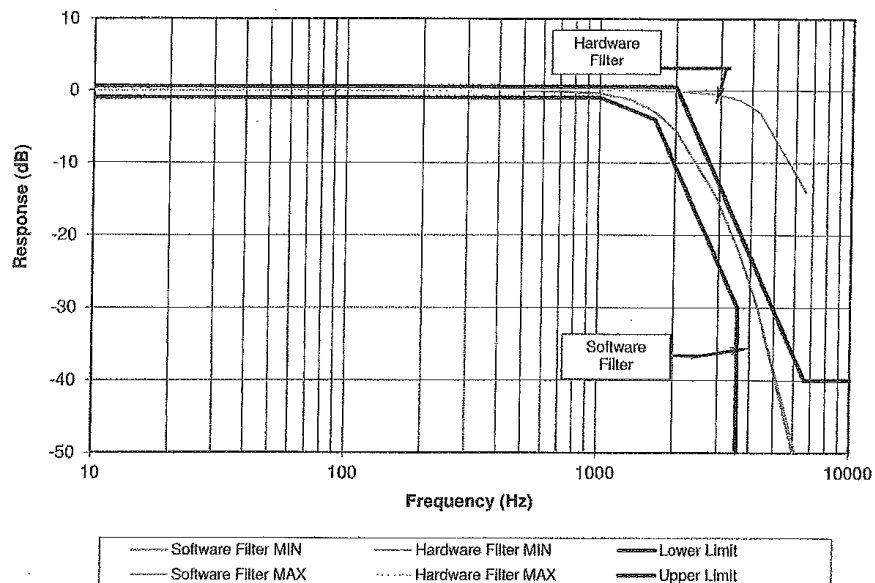
Calibrated By: Bob Colenso
Bob Colenso
Technical Support Engineer

JB 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						
	Limit		Std	db	Uncertainty (mV)	Pass/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	-2.896	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



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

Test Description

Filter Response-Software

As Received/Returned

	Limit		Std	db	Uncertainty	Pass/ Fail
Channel 6					(mV)	
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

	As Received/Returned				
Cal DAC	Lower Limit	Upper Limit	UUT	Uncertainty	Pass/ Fail
				(Vdc)	
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 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



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

Test Description

			As Received/Returned		
	Lower Limit	Upper Limit	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



Serial #: LM0321
 Order #: RA27091
 Date: 19 March 2016

Test Description

	Lower Limit	Upper Limit	As Received/Returned		
5V Excitation 350 Ohm Load Test			UUT	Uncertainty (Vdc)	Pass/Fail
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

Gain of 5: 1000mV		As Received/Returned				
	Limit	Std (mV)	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



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

Test Description

Gain Response

Gain of 5: 1000mV

Gain of 5: 1000mV		As Received/Returned				
Channel 8	Limit	Std	UUT	Deviation	Uncertainty	Pass/Fail
		(mV)	(mV)	(%)	(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 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



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

Test Description

Gain Response

Gain of 32: 156.25mV

		As Received/Returned				
	Limit	Std	UUT	Deviation	Uncertainty	Pass/Fail
		(mV)	(mV)	(%)	(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



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

Test Description

Gain Response

Gain of 128: 39.0625mV

Gain Response		As Received/Returned				
Gain of 128: 39.0625mV		Std	UUT	Deviation	Uncertainty	Pass/
Channel 2	Limit	(mV)	(mV)	(%)	(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						
-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

Gain Response

		As Received/Returned				
Gain of 512: 9.765825mV		Std	UUT	Deviation	Uncertainty	Pass/Fail
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

Gain Response

Gain of 2000: 2.5mV

As Received/Returned

		Std	UUT	Deviation	Uncertainty	Pass/Fail
	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: <u>Advantage</u>		Certification Date: <u>2015-04-23</u>	Serial#: <u>C10-02-03-01351</u>
Single Point - (Max-Min)/2 Specification: <u>C10-02 0.173mm (0.0068")</u>		Certificate#: <u>C10020301351-4232015-915A</u>	
Volumetric (Max Deviation) Specification: <u>C10-02 +/-0.244mm (+/-0.0096")</u>		Temperature: See attached data	
Measurement Standards Traceability			
Kinematic Scale Bar - Short	Asset Number: TQ1180	Calibration Due: 5/8/2015	*SI Traceability: 6d4b43f7-0478-4587-bb06-05c4f52f6993
Kinematic Scale Bar - Long	Asset Number: TQ1318	Calibration Due: 5/8/2015	*SI Traceability: 133bf97-0e48-43d4-9805-47cd12373604
Thermometer	Asset Number: 3308	Calibration Due: 5/16/2015	*SI Traceability: KELC-261787
Calibration Probe	Asset Number: 3072	Calibration Due: 1/23/2016	*SI Traceability: 14-298-00123
Reference Sphere	Asset Number: 1229	Calibration Due: 1/23/2016	*SI Traceability: 13-221-00269
The artifacts above have been calibrated with a device traceable to the International System of Units (SI) through a National Metrological Institute (NMI) or through an ISO17025 Accredited Laboratory. Calibration was performed following procedure listed on 67MAN015. This procedure was developed in accordance with ASME B89-A.23-2004. See attached data for measurement results.			
Calibration Results*			
3 Single Point Articulation Tests at <=20%, 20%-60% and >=60% range.			PASSED
1 Effective diameter sphere test.			PASSED
20 Volumetric ball bar tests in 4 quadrants and 2 orientations.			PASSED
Instrument condition as received:		Instrument condition outgoing:	
Within specifications		Within specifications	
This certificate invalidates all other certificates generated before: 4/23/2015 9:15:39 AM This certificate shall not be reproduced, except in full, without permission of FARO Technologies, Inc. The results of this certificate relate only to the items calibrated or tested.			
FARO Technologies, Inc. PH1: 1-800-736-2771 PH2: 407-333-9911 FAX: 407-333-8056		Approved By: <u>P Alvarez</u> 125 Technology Park Lake Mary, FL 32746 USA Cal Cert Technician Date: 2015-04-23	
		 Cert # L-1147-1 Calibration	

©2013 FARO

Page 1 of 9

f:\control\records\05manufa\partspec\XH08-0495.eps Rev4 RevDate: 04/02/13



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 48063	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/NCSL Z540-1-1994.

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

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

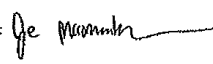
For range and best measurement capability specifications for the standards used to perform this calibration, see the most recent calibration report maintained by this calibration laboratory (available upon request).

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

AS RECEIVED CONDITION:	IN TOLERANCE	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:  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/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.

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#: 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

<u>Test Description</u>	<u>Nominal</u>	<u>Test Result</u>	<u>Lower Limit</u>	<u>Upper Limit</u>	<u>Units</u>	<u>Exp Uncert</u>	<u>Pass/Fail</u>
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: 4/1/2013
SUPERCEDES: MGATPTMC.6

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

Tape Measure Calibration Certificate

Reference Steel Rule

Brand: Stanley
S/N: 11E-AD8799
Calibration Date: 6/29/2015

Subject Tape Measure

Brand: Stanley
S/N: TP-1002-29
Calibration Date: 6/29/2015

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 = 1mm

Date: 6/29/2015

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
ASSET NUMBER: Z73658
CUST ASSET NUMBER: 0514B1305F
PROCEDURE NAME: OME - OM-73 - MMC
PROCEDURE REV: 1.0
CALIBRATED BY: JUSTIN BURDICK
CUSTOMER: MGA RESEARCH
446 EXECUTIVE DRIVE
TROY, MI 48083
PRIMARY CONTACT: SCOTT ARSEN

WORK ORDER: 116132
TEST RESULT: PASS
PERFORMED ON: 03/26/15
CAL DUE DATE: 03/26/16
DATA TYPE: FOUND-LEFT
TEMPERATURE: 23.01 °C
HUMIDITY: 44 %

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 unit under test meets or exceeds manufacturer specifications.

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

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

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

REMARKS:

Standards Used

Asset #	Cert #	Description	Cal Date	Due Date
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



Metrology Management Services
Remit to address:

Report of Calibration

NovaStar Solutions
35200 Plymouth Rd.
Livonia, MI 48150



OMEGA OM-73 TEMPERATURE/RH DATA LOGGER

SERIAL NUMBER: 0514B1305F
ASSET NUMBER: Z73658
CUST. ASSET NUM: 0514B1305F
PROCEDURE NAME: OME - OM-73 - MMC
PROCEDURE REV: 1.0
CALIBRATED BY: JUSTIN BURDICK
CUSTOMER: MGA RESEARCH
446 EXECUTIVE DRIVE
TROY MI 48083
PRIMARY CONTACT: SCOTT ARSEN

WORK ORDER #: 116132

TEST RESULT: PASS
PERFORMED ON: 3/26/2015
CAL DUE DATE: 3/26/2016
DATA TYPE: FOUND-LEFT
TEMPERATURE: 23.01 °C
HUMIDITY: 44 %

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).

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	19.3	%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
ASSET NUMBER: Z54487
CUST ASSET NUMBER: MGA00783
PROCEDURE NAME: 122-040
PROCEDURE REV: B
CALIBRATED BY: Joseph Giordano
CUSTOMER: MGA RESEARCH
446 EXECUTIVE DRIVE
TROY, MI 48063
PRIMARY CONTACT: SCOTT ARSEN

WORK ORDER: 107382
TEST RESULT: PASS
PERFORMED ON: 10/27/14
CAL DUE DATE: 10/27/15
DATA TYPE: FOUND-LEFT
TEMPERATURE: 23.00 °C
HUMIDITY: 40 %

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).

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

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

REMARKS:

Standards Used

Asset #	Cert #	Description	Cal Date	Due Date
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
\$

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:** 0k
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:** 8600lb 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

1 of 1

The above item has been calibrated using the relevant EPO or OEM procedures utilizing test weights
Traceable to International Systems of Units (SI), through the Michigan Department of Agriculture.

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.

Raul Bunt 8/15/14