

REPORT NUMBER: T8001-MGA-2008-006

**VEHICLE TO DEFORMABLE BARRIER CRASH TESTS
IN SUPPORT OF NHTSA OFFSET FRONTAL PROGRAM**

**LEFT 40% OFFSET DEFORMABLE BARRIER IMPACT
R94 BARRIER**

**TEST DATE: MARCH 13, 2008
ORDER NUMBER: DTRTV-T8001**

2008 SATURN OUTLOOK FWD XE (R80176)

**PREPARED BY:
MGA RESEARCH CORPORATION
5000 WARREN ROAD
BURLINGTON, WI 53105**



**FINAL REPORT SUBMITTED:
AUGUST 22, 2008**

**PREPARED FOR:
U.S. DEPARTMENT OF TRANSPORTATION / RITA
VOLPE NATIONAL TRANSPORTATION SYSTEM CENTER
55 BROADWAY, RTV-3F
CAMBRIDGE, MA 02142-1001**

This final test report was prepared for the U.S. Department of Transportation, Volpe National Transportation System Center / RITA, in response to Contract Number DTRT57-05-D-30107.

This document is disseminated under the sponsorship of the U.S. Department of Transportation in the interest of information exchange. The United States Government assumes no liability for its content or use thereof.

Prepared By: *Jessica Gall*
Jessica Gall, Project Engineer

Reviewed By: *David Winkelbauer*
David Winkelbauer, Director of Operations

Approval Date: March 20, 2008

Technicians: Jamie Aide
 Tim Bratz
 Wayne Dahlke
 Jordan Haynes
 Matt Jacobson
 Tom Miller
 Chris Novak
 Daniel Sienko Jr.
 David Wilcox

Engineers: Ben Fischer
 Joe Fleck
 Tim Novak
 Dustin Underwood

Photographic: Chad Coss

Secretaries: Donna Janovicz
 Julie Ehlen

FINAL REPORT ACCEPTED BY:

Accepted By: _____
Contract Technical Manager

Acceptance Date: _____

MGA does not endorse or certify products. The manufacturer's name appears solely for identification purposes.

Technical Report Documentation Page

1. <i>Report No.</i> T8001-MGA-2008-006		2. <i>Government Accession No.</i>		3. <i>Recipient's Catalog No.</i>	
4. <i>Title and Subtitle</i> Final Report of a Left 40% Offset Deformable Barrier Impact of a 2008 Saturn Outlook FWD XE NHTSA No.: R80176		5. <i>Report Date</i> August 22, 2008		6. <i>Performing Organization Code</i> MGA	
		7. <i>Author(s)</i> Jessica Gall, Project Engineer		8. <i>Performing Organization Report No.</i> T8001-MGA-2008-006	
9. <i>Performing Organization Name and Address</i> MGA Research Corporation 5000 Warren Road Burlington, WI 53105		10. <i>Work Unit No.</i>		11. <i>Contract or Grant No.</i> DTRT57-05-D-30107	
		12. <i>Sponsoring Agency Name and Address</i> U.S. Department of Transportation / RITA Volpe National Transportation Systems Center 55 Broadway, RTV-3F Cambridge, MA 02142-1001		13. <i>Type of Report and Period Covered</i> Final Report 3/13/2008 – 8/22/2008	
		14. <i>Sponsoring Agency Code</i> RTV-3F		15. <i>Supplementary Notes</i>	
16. <i>Abstract</i> A 40% frontal offset barrier impact was conducted on a 2008 Saturn Outlook FWD XE, NHTSA No. R80176, at MGA Research Corporation on March 13, 2008. This test was conducted in accordance with Volpe Order No. DTRTV-T8001 for the evaluation of vehicle and occupant responses. The impact velocity was 55.8 km/h. The ambient temperature at the barrier face at the time of impact was 21 degrees Celsius. The vehicle's maximum static crush was 528 mm located to the left of the vehicle's centerline. The driver's 15 millisecond Head Injury Criteria (HIC) was 101. The driver's chest maximum resultant acceleration with three milliseconds minimum duration was 27.6 g. The driver's maximum chest deflection was -26 millimeters. The driver's left and right femur maximum axial compressive forces were -4122 N and -1484 N, respectively. The left rear passenger's 15 millisecond Head Injury Criteria (HIC) was 373. The left rear passenger's chest maximum resultant acceleration with three milliseconds minimum duration was 33.1 g.					
17. <i>Key Words</i> 40% Frontal Offset Barrier Impact 2008 Saturn Outlook FWD XE NHTSA No: R80176			18. <i>Distribution Statement</i> Copies of this report are available from: National Highway Traffic Safety Adm. Technical Ref. Division, 1200 New Jersey Ave, SE Washington, D.C. 20590		
19. <i>Security Classif. (of this report)</i> Unclassified		20. <i>Security Classif. (of this page)</i> Unclassified		21. <i>No. of Pages</i> 315	22. <i>Price</i>

TABLE OF CONTENTS

<u>Section</u>		<u>Page No</u>
1	Purpose and Summary of the Test	1
2	Left 40% Offset Deformable Barrier Impact Summary	3

<u>Data Sheet No.</u>		<u>Page No.</u>
1	Crash Vehicle Summary	6
2	General Test and Vehicle Parameter Data	7
3	Post Impact Data	11
4	Test Vehicle Information	12
5	Dummy Positioning in Vehicle	13
6	Vehicle Accelerometer Location and Data Summary	18
7	Dummy Injury Criteria Values	21
8	Summary of FMVSS 212/219 (Partial) Data	25
9	FMVSS 301 Fuel System Integrity Data	26
10	Test Vehicle Measurements	27
11	Photographic Data	42
12	Vehicle Reference Photo Target Locations	44
13	Post Test Air Bag Data	45
14	Accident Investigation Division Data	46
15	Offset Barrier and Vehicle Orientation	47
16	Deformable Barrier Honeycomb Crush	48
17	Deformable Barrier Load Cell Locations	50

<u>Appendix</u>		
A	Photographs	A-1
B	Dummy, Vehicle, and Barrier Data Plots	B-1
C	Dummy Configuration and Performance Verification Data	C-1
D	Customer Provided Seating Procedure	D-1
E	Barrier Certification	E-1
F	INSIA Report on Structural Measurements	F-1

SECTION 1

PURPOSE AND TEST PROCEDURE

PURPOSE

This 56.0 km/h (target speed) Left 40% Offset Deformable Barrier test was conducted for the Volpe National Transportation Systems Center (VNTSC) / RITA by MGA Research Corporation.

The purpose of this testing was to evaluate and compare vehicle and occupant responses during 40% frontal offset vehicle to deformable barrier crash tests. For this test, the subject vehicle was a 2008 Saturn Outlook FWD XE with one (1) 50th percentile dummy in the front seating position and one 10-year-old dummy in the left rear seating position. The deformable barrier used for this test was the R94 barrier.

TEST PROCEDURE

This test was conducted in accordance with VNTSC's instructions for a 40% offset vehicle to deformable barrier crash test. Data was obtained relative to FMVSS 208, "Occupant Crash Protection" performance, FMVSS 212, "Windshield Retention"; FMVSS 219, "Windshield Zone Intrusion"; and FMVSS 301, "Fuel System Integrity," performance.

The test vehicle, a 2008 Saturn Outlook FWD XE, was instrumented with twelve (12) accelerometers to measure longitudinal axis accelerations, four (4) accelerometers to measure lateral axis accelerations, and six (6) accelerometers to measure vertical axis accelerations. The driver's primary and secondary airbag signals were monitored with inductive pickups. The vehicle impacted a 40% left offset deformable barrier. The vehicle's specified impact velocity range was 55.2 to 56.8 km/h.

The test vehicle contained one (1) Part 572E 50th percentile adult male Hybrid III anthropomorphic test device (dummy) with Thor-Lx legs in the driver position. A Hybrid III 10-Year-Old dummy was placed in the left rear seating position. The 50th percentile dummy was positioned in the left front outboard designated seating position according to a procedure provided by the COTR. The seating procedure is included as Appendix D. The driver dummy was restrained with a 3-point seat belt and a front airbag. The left rear passenger dummy was in the Graco Highback Turbobooster child seat and restrained with the Type II seat belt.

The Hybrid III 50th dummy was instrumented with an array of twelve (12) accelerometers in the head, and six (6) accelerometers in the chest, oriented to measure longitudinal, lateral, and vertical accelerations. The dummy was also instrumented with 6-channel upper and lower neck moment and force load cells, left and right femur load cells to measure axial forces, a chest deflection potentiometer, and knee displacement potentiometers. The dummy was equipped with Thor-Lx legs, which included upper and lower tibia load cells to measure forces and moments, longitudinal and lateral tibia accelerometers, three (3) foot accelerometers on each foot to measure accelerations in three (3) axes and three (3) rotary potentiometers at each ankle to measure foot rotations about three (3) axes.

SECTION 1 (CONTINUED)
PURPOSE AND TEST PROCEDURE

TEST PROCEDURE (CONTINUED)

The Hybrid III 10-Year-Old child dummy was instrumented with tri-axial accelerometers in the head, chest, and pelvis oriented to measure longitudinal, lateral, and vertical accelerations. The dummy was also instrumented with 6-channel upper and lower neck moment and force load cells, left and right shoulder load cells, upper and lower sternum X accelerometers, upper and lower spine X accelerometers, 6-channel lumbar moment and force load cells, right/left upper and right/left lower asis load cells.

The vehicle impacted a deformable barrier instrumented with 90 load cells to measure longitudinal forces.

The 235 data channels were digitally sampled and recorded at 10,000 samples per second and processed per SAE J211 March 1995.

The crash event was recorded by one (1) real-time panning motion picture camera and thirteen (13) high-speed digital motion picture cameras. The pre-test and post-test conditions were recorded by one (1) real-time motion picture camera.

The left 40% offset deformable barrier crash test summary data and all occupant, camera, vehicle, and deformable barrier face measurements are presented in Section 2.0. Appendix A contains the still photographs. Appendix B contains the dummy, vehicle, and barrier data plots. Appendix C contains the dummy verification data. Appendix D contains customer provided seating procedure. Appendix E contains the barrier certification. Appendix F contains an INSIA report that was the basis for the Structural Measurements presented in Data Sheet 10 (page 30) of this report.

SECTION 2

LEFT 40% OFFSET DEFORMABLE BARRIER IMPACT SUMMARY

This 56.0 km/h (target speed) left 40% offset deformable barrier crash test was conducted by MGA Research Corporation on March 13, 2008.

The test vehicle, a 2008 Saturn Outlook FWD XE, NHTSA Number R80176, was equipped with a 3.6 L, 6-cylinder lateral engine, automatic transmission, power steering, power brakes, and front airbags. The vehicle's test weight was 2408.2 kg. The vehicle's impact speed was 55.8 km/h. The vehicle sustained 528 mm of static crush during the impact.

The occupant injury assessment values are summarized on the following page.

TEST NOTES

There was no valid data collected for:

- Driver Head Y – Front

- Driver Right Lower Tibia FY

- Driver Left Upper Tibia Force Z after 20 msec.

- DR LT Dorsi/Plantar Flexion between 50-140 msec.

- Left Brake Caliper X after 70 msec.

- Right Brake Caliper X

- Brake Pedal X after 40 msec.

- ODB Barrier Load Cells 31 through 62

CMM Reference: Rear Bumper Top @ Center
 +X Forward
 +Y Left
 +Z Up

SECTION 2 (CONTINUED)
LEFT 40% OFFSET DEFORMABLE BARRIER IMPACT SUMMARY

OCCUPANT INJURY ASSESSMENT VALUES

Injury Criteria	Limit	Driver
HIC 36	1000	201
T1 (msec)		97.3
T2 (msec)		133.3
HIC 15	700	101
T1 (msec)		98.9
T2 (msec)		113.9
Upper Neck Tension (N)	4170	924
Upper Neck Compression (N)	4000	-192
Neck Injury (NIJ) N_{te}	1.0	0.1
Neck Injury (NIJ) N_{tf}	1.0	0.2
Neck Injury (NIJ) N_{ce}	1.0	0.0
Neck Injury (NIJ) N_{cf}	1.0	0.1
Clip (g)	60	28
Chest Displacement (mm)	63	-26
Left Femur (N)	9,040	-4122
Right Femur (N)	9,040	-1484
Left Upper Tibia Index	0.91	
Right Upper Tibia Index	0.91	0.50
Left Lower Tibia Index	0.91	0.43
Right Lower Tibia Index	0.91	0.48
Left Upper Tibia Force (N)	-5600	
Right Upper Tibia Force (N)	-5600	-1765
Left Lower Tibia Force (N)	-5200	-1846
Right Lower Tibia Force (N)	-5200	-2619
Left Inversion (degrees)	-35	-11.2
Left Eversion (degrees)	35	33.1
Left Plantarflexion (degrees)		N/A
Left Dorsiflexion (degrees)	35	N/A
Left External Rotation (degrees)		-8.0
Left Internal Rotation (degrees)		9.7
Right Inversion (degrees)	35	24.1
Right Eversion (degrees)	-35	-12.1
Right Plantarflexion (degrees)		-22.4
Right Dorsiflexion (degrees)	35	6.0
Right External Rotation (degrees)		15.8
Right Internal Rotation (degrees)		-5.9
Left Knee Shear (mm)	-15	-0.1
Right Knee Shear (mm)	-15	-0.1

SECTION 2 (CONTINUED)
LEFT 40% OFFSET DEFORMABLE BARRIER IMPACT SUMMARY

OCCUPANT INJURY ASSESSMENT VALUES (CONTINUED)

Injury Criteria		Left Rear Passenger
HIC 36		717
	T1 (msec)	95.6
	T2 (msec)	131.6
HIC 15		373
	T1 (msec)	106.6
	T2 (msec)	121.6
Upper Neck Tension (N)		2374
Upper Neck Compression (N)		-68
Clip (g)		33

DATA SHEET 1
CRASH VEHICLE SUMMARY

Test Vehicle: 2008 Saturn Outlook FWD XE
Test Program: Left 40% Offset Deformable Barrier

NHTSA No.: R80176
Test Date: 3/13/2008

Description	Value
Test Time	12:14 p.m.
Temperature	21°C
Vehicle Year/ Make / Model / Body Style	2008 Saturn Outlook FWD XE
Vehicle Test Weight	2408.2 kg
Vehicle / Barrier Impact Angle	0°
Vehicle / Barrier Impact Accuracy	14 down / 0 mm left/right
Impact Velocity	55.8 km/h
Maximum Static Crush	528 mm to the left of the vehicle's C/L
Deformable Barrier	R94
Number of Data Channels	235
Number of Real-Time Cameras	1
Number of High-Speed Cameras	13

Dummies	Driver	Left Rear Passenger
Type/Serial No.	HIII / 202	HIII 10YO / D001
Type Lower Legs	Thor-Lx	
Serial Numbers of Legs	37R / 36L	
Restraint System	3-Point Seatbelt Front Airbag	Type II Belts Graco Highback Turbo booster

DATA SHEET 2

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2008 Saturn Outlook FWD XE
 Test Program: Left 40% Offset Deformable Barrier

NHTSA No.: R80176
 Test Date: 3/13/2008

TEST VEHICLE INFORMATION

Manufacturer	Saturn
Model	Outlook
Body Style	FWD XE
NHTSA No.	R80176
VIN	5GZER13728J192729
Color	Cocoa
Delivery Date	12/27/2007
Odometer Reading (mile)	38
Dealer	Boucher Fleet Group
Transmission	Automatic
Final Drive	Front
Number of Cylinders	6
Engine Displacement (L)	3.6
Engine Placement	Lateral
Automatic Door Lock (ADL)	Yes
Owners Manual Details Instructions on Disabling ADLs	Yes
Bucket Seats	Yes

TEST VEHICLE OPTIONS

Front Airbag	Yes
Driver Side Curtain Airbag	Yes
Driver Side Torso Airbag	Yes
Rear Passenger Side Curtain Airbag	Yes
Rear Passenger Side Torso Airbag	No
Force Limiter	Yes
Pretensioner	Yes
Power Steering	Yes
Power Door Locks	Yes
Tilt Wheel	Yes
Air Conditioning	Yes
Anti-lock Brakes	Yes
Traction Control	Yes
All Wheel Drive	No
Power Seats	No

DATA FROM CERTIFICATION LABEL

Manufactured By	General Motors Corporation
Date of Manufacture	11/07

GVWR (kg)	2908
GAWR Front (kg)	1450
GAWR Rear (kg)	1600

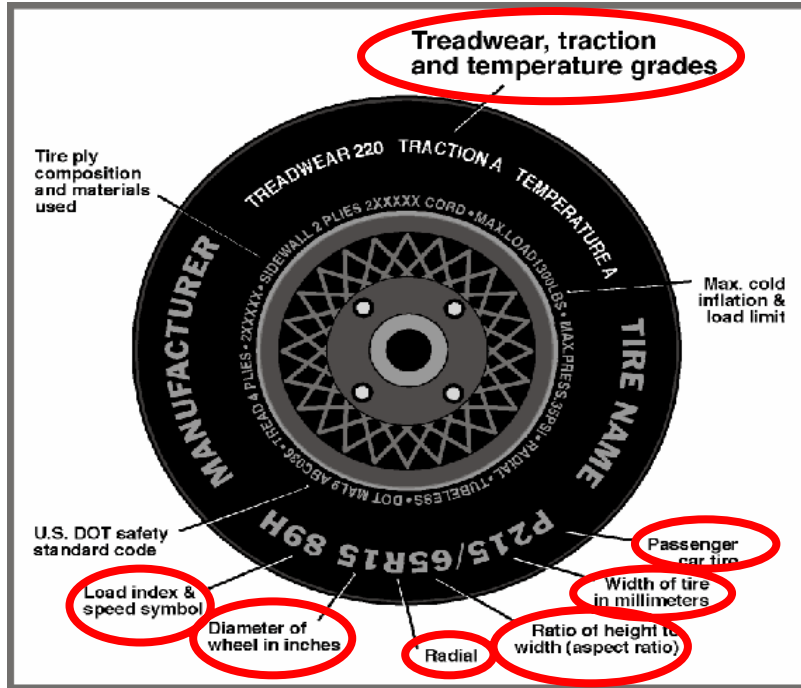
Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Split Bench	Split Bench	
Number of Occupants	2	3	3	8
Capacity Wt. (VCW) (kg)				768
Cargo Wt. (RCLW) (kg)				136

DATA SHEET 2 (CONTINUED)

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2008 Saturn Outlook FWD XE
 Test Program: Left 40% Offset Deformable Barrier

NHTSA No.: R80176
 Test Date: 3/13/2008



DATA FROM TIRE PLACARD

Measured Parameter	Front	Rear
Maximum Tire Pressure (kPa)	300	300
Cold Pressure (kPa)	240	240
Recommended Tire Size	P255/65R18	P255/65R18
Tire Size on Vehicle	P255/65R18	P255/65R18
Tire Manufacturer	Goodyear	Goodyear
Tire Name	FORTERA	FORTERA
Tire Type	Passenger	Passenger
Tire Width (mm)	255	255
Ratio of Height to Width (aspect ratio)	65	65
Radial	R	R
Wheel Diameter	18	18
Load Index & Speed Symbol	109S	109S
Treadwear	540	540
Traction Grade	A	A
Temperature Grade	B	B

DATA SHEET 2 (CONTINUED)

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2008 Saturn Outlook FWD XE NHTSA No.: R80176
 Test Program: Left 40% Offset Deformable Barrier Test Date: 3/13/2008

TEST VEHICLE WEIGHTS

	Units	As Delivered (UVW) (Axle)			As Tested (ATW) (Axle)		
		Front	Rear	Total	Front	Rear	Total
Left	kg	596.9	475.8		636.9	574.3	
Right	kg	600.6	457.7		643.2	553.8	
Ratio	%	56.2	43.8		53.2	46.8	
Totals	kg	1197.5	933.5	2131.0	1280.1	1128.1	2408.2

Note: As tested weight reflects the removal of the right front dummy.

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value
Total Delivered Weight (UVW)	kg	2131.0
Weight of 2 P572E ATDs & 1 10-Year-Old	kg	191.4
Rated Cargo/Luggage Weight (RCLW)	kg	136
Calculated Vehicle Target Weight (TVTW)	kg	2458.4

TEST VEHICLE ATTITUDES AND CG

	Units	LF	RF	LR	RR	CG (aft of front axle)
As Delivered	mm	856	858	881	883	1325
As Tested	mm	840	844	860	868	1417
Post Test	mm	840	836	865	860	

Vehicle Wheelbase (mm): 3025

Weight of Ballast secured in cargo area (kg): 0

Vehicle Components Removed: Third row seats, jack, and rear carpet

Ballast weight does not include instrumentation and data acquisition system.

DATA SHEET 2 (CONTINUED)

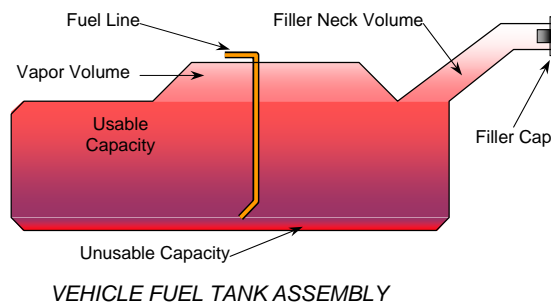
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle:	<u>2008 Saturn Outlook FWD XE</u>	NHTSA No.:	<u>R80176</u>
Test Program:	<u>Left 40% Offset Deformable Barrier</u>	Test Date:	<u>3/13/2008</u>

FUEL TANK CAPACITY

	Liters
Usable Capacity of "Standard Tank"	82.1
Usable Capacity of "Optional" Tank	
92-94% of Usable Capacity	75.5 to 77.2
Actual Amount of Solvent used	76.1
1/3 of Usable Capacity	27.4

The test vehicle is equipped with an electric fuel pump. Pump will run when the engine is running. Also, it will run briefly when the ignition key is turned to the "on" position without starting the engine.



BELT LENGTH DATA

Measurement Description	Units	Driver
Shoulder belt length as measured on ATD	mm	860
Lap belt length as measured on ATD	mm	650
Remainder of belt on reel	mm	1610
Total belt length for continuous webbing systems	mm	3120

SEAT TRACK INFORMATION

Description	Driver	Left Rear Passenger
Seat Track Shift (mm)	0	0
Seat Back Failure	None	None

DATA SHEET 3
POST IMPACT DATA

Test Vehicle: 2008 Saturn Outlook FWD XE
Test Program: Left 40% Offset Deformable Barrier

NHTSA No.: R80176
Test Date: 3/13/2008

DOOR OPENING AND GLAZING DAMAGE

Description	Left Side	Right Side
Locked/Unlocked Doors	Doors were unlocked	Doors were unlocked
Front Door Opening	Door remained closed and latched; Door did not open	Door remained closed and latched; Door opened without tools
Rear Door Opening	Door remained closed and latched; Door opened without tools	Door remained closed and latched; Door opened without tools
Glazing Damage	The windshield cracked	

DUMMY CONTACT POINTS

Description	Driver	Left Rear Passenger
Head Contact	Airbag, Headrest, Curtain Airbag	Child Seat, Curtain Airbag
Chest Contact	Airbag	None
Abdomen Contact	None	None
Left Knee Contact	Knee Bolster	Driver Seat Back
Right Knee Contact	Knee Bolster	Driver Seat Back

LEFT REAR (P4) CRS POST-TEST INSPECTION

Location	Damage	Remarks
Cracks on CRS	None	
Fabric Tears on CRS	None	
Vehicle Seat Structure	None	
Vehicle Seat Fabric Tears	None	
Child Dummy	None	10-Year-Old

DATA SHEET 4

TEST VEHICLE INFORMATION

Test Vehicle: 2008 Saturn Outlook FWD XE NHTSA No.: R80176
Test Program: Left 40% Offset Deformable Barrier Test Date: 3/13/2008

NORMAL DESIGN RIDING POSITION

Driver seat back angle: 0.8° at headrest post

Left Rear Passenger seat back angle: full forward position

SEAT FORE/AFT POSITIONING

	Total Fore/Aft Travel	Placed in Position #
Left Front Seat	24 detents	7 th detent (Rearwardmost as 0)
Left Rear Seat	10 detents	Rearwardmost

ADJUSTABLE D-RING POSITION

The driver D-ring was set at the uppermost position.

STEERING COLUMN POSITION

	Fore/Aft Position (mm)	Degrees
Lowermost position No. 1	0	67.0
Geometric center position No. 2	25	69.8
Uppermost position No. 3	50	72.5

ADJUSTABLE PEDALS

The pedals were set at the full forward position.

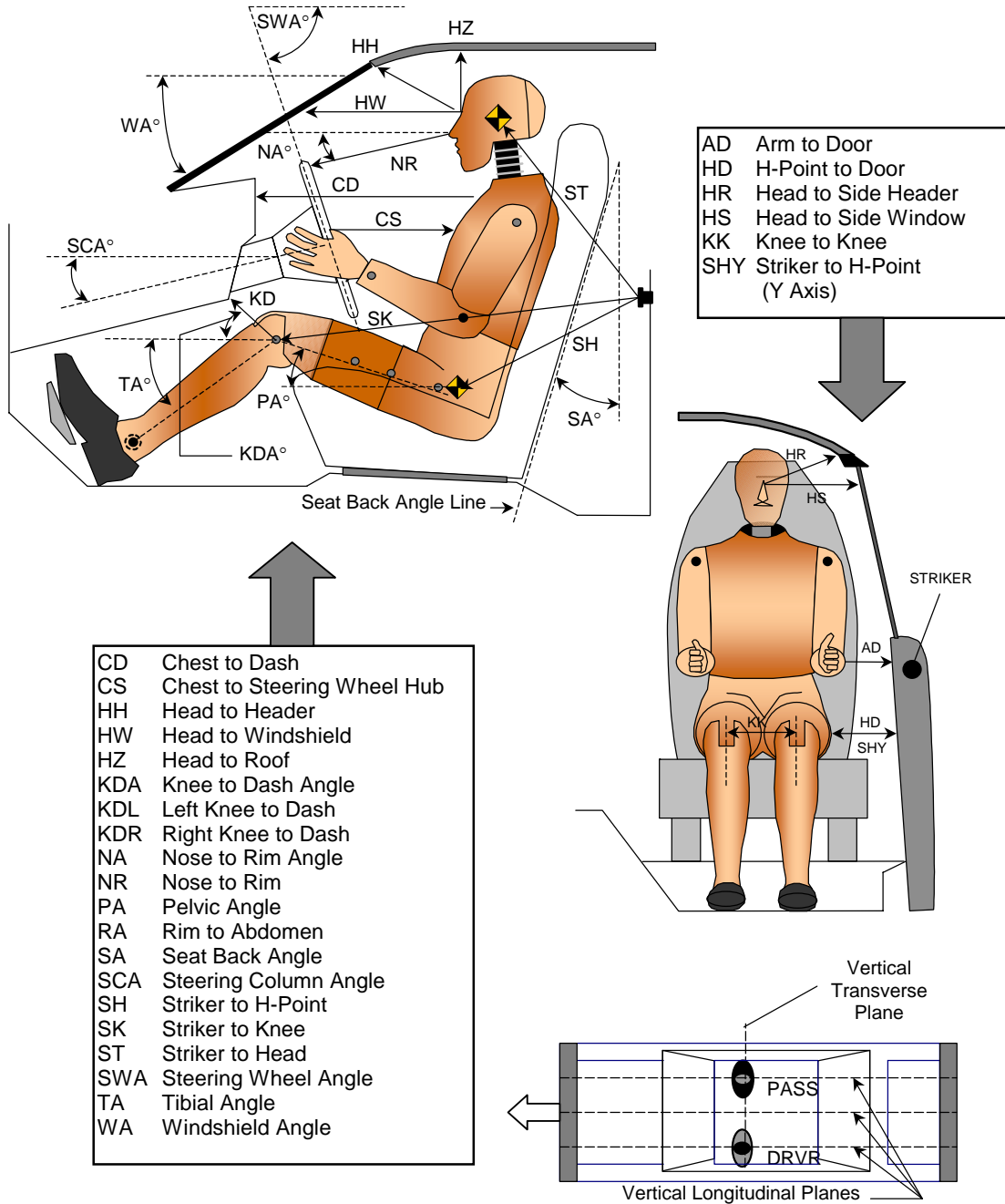
DATA SHEET 5

DUMMY POSITIONING IN VEHICLE

Test Vehicle: 2008 Saturn Outlook FWD XE
 Test Program: Left 40% Offset Deformable Barrier

NHTSA No.: R80176
 Test Date: 3/13/2008

DUMMY MEASUREMENTS FOR FRONT SEAT OCCUPANTS



DATA SHEET 5 (CONTINUED)
DUMMY POSITIONING IN VEHICLE

Test Vehicle: 2008 Saturn Outlook FWD XE
 Test Program: Left 40% Offset Deformable Barrier

NHTSA No.: R80176
 Test Date: 3/13/2008

TEST DUMMY POSITION MEASUREMENTS

Code	Measurement Description	Driver	
		Length (mm)	Angle (°)
WA	Windshield Angle		29.3
SWA	Steering Wheel Angle		69.8
SCA	Steering Column Angle		19.8
SA	Seat Back Angle (headrest post)		0.8
HZ	Head to Roof (Z)	249	90
HH	Head to Header	505	17.7
HW	Head to Windshield	824	0
HR	Head to Side Header (Y)	248	
NR	Nose to Rim	462	10.9
CD	Chest to Dash	656	
CS	Chest to Steering Hub	402	8.8
RA	Rim to Abdomen	253	0
KDL	Left Knee to Dash	188	20.2
KDR	Right Knee to Dash	178	
PA	Pelvic Angle		24.8
TA	Tibia Angle		41.2
KK	Knee to Knee (Y)	289	
SAN	Striker to Ankle	920	
SK	Striker to Knee	559	
ST	Striker to Head	616	
SH	Striker to H-Point	164	
SHY	Striker to H-Point (Y)	296	
HS	Head to Side Window	346	
HD	H-Point to Door (Y)	178	
AD	Arm to Door (Y)	157	
AA	Ankle to Ankle	271	

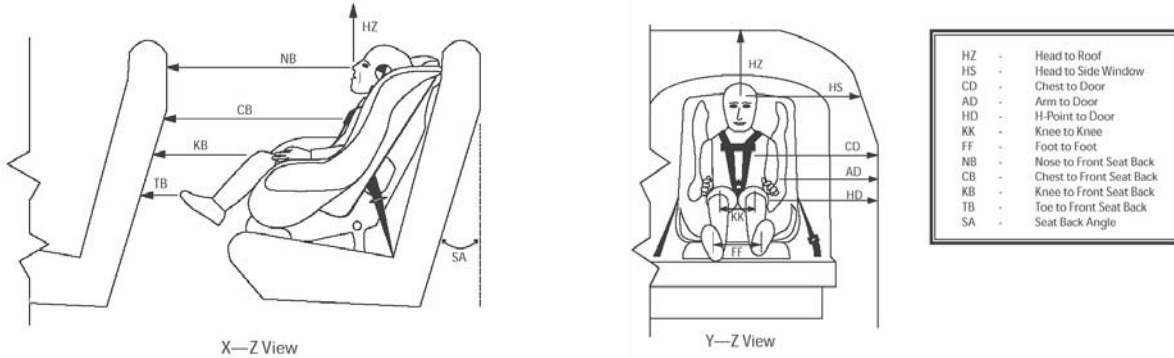
DATA SHEET 5 (CONTINUED)
DUMMY POSITIONING IN VEHICLE

Test Vehicle: 2008 Saturn Outlook FWD XE
 Test Program: Left 40% Offset Deformable Barrier

NHTSA No.: R80176
 Test Date: 3/13/2008

Child Restraint System (Position 4)	Graco Highback Turbobooster (Forward Facing)
Dummy Type / Serial Number	Hybrid III 10-Year-Old / D001

Dummy Measurements for CRS Passengers



Measurement	Pre-Test (mm)		Post-Test (mm)	
	P4 CRS		P4 CRS	
SA (deg)	15.9		15.2	
HS	357		556	
CD	368		429	
AD	224		218	
HD	275		270	
HZ	266		326	
NB	505		458	
CB	510		496	
KK	161		174	
FF	183		246	
KB - LEFT	238		267	
KB - RIGHT	228		293	
TB - LEFT	71		77	
TB - RIGHT	72		81	
Seat Top to Door	138		215	
Seat Bottom to Door	109		252	

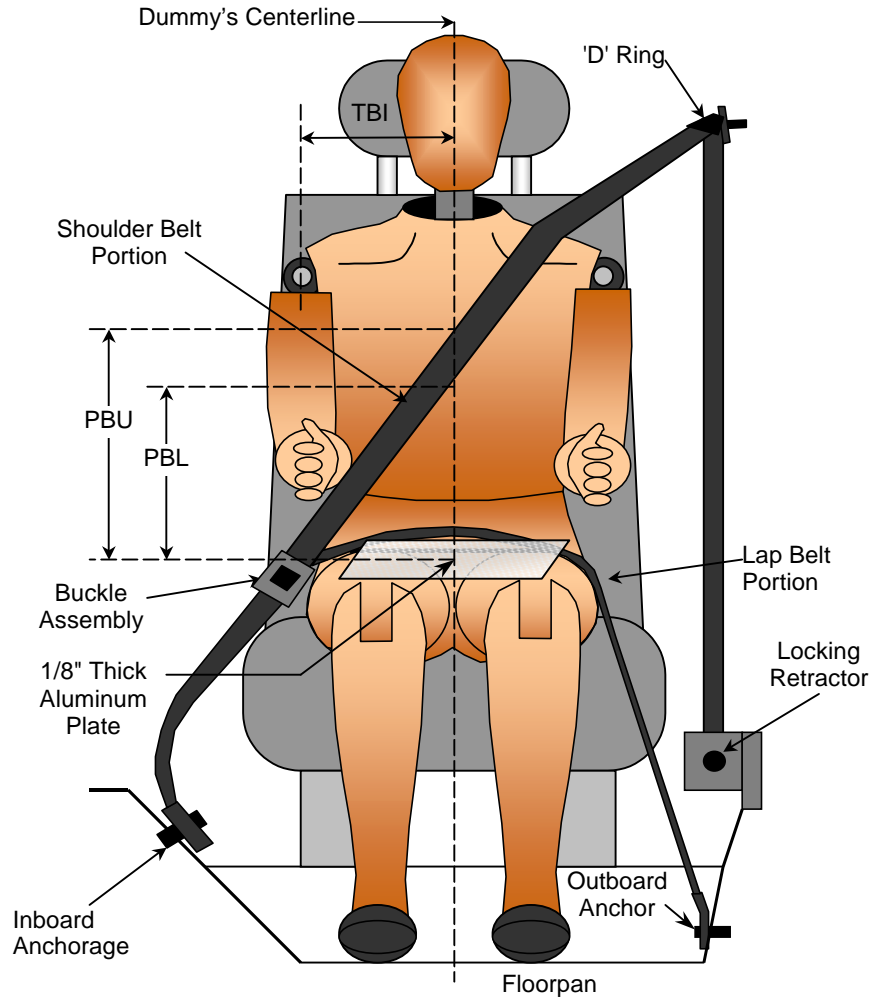
All dimensions in mm (unless noted)
 P4 – 2nd Row Left Rear Passenger (Forward Facing)

DATA SHEET 5 (CONTINUED)

DUMMY POSITIONING IN VEHICLE

Test Vehicle: 2008 Saturn Outlook FWD XE
 Test Program: Left 40% Offset Deformable Barrier

NHTSA No.: R80176
 Test Date: 3/13/2008



SEAT BELT POSITIONING MEASUREMENTS

Measurement Description	Units	Driver
PBU - Top surface of reference to belt upper edge	mm	355
PBL - Top surface of reference to belt lower edge	mm	280

DATA SHEET 5 (CONTINUED)
DUMMY POSITIONING IN VEHICLE

Test Vehicle: 2008 Saturn Outlook FWD XE
 Test Program: Left 40% Offset Deformable Barrier

NHTSA No.: R80176
 Test Date: 3/13/2008

	Driver			Left Rear Passenger		
	X	Y	Z	X	Y	Z
Head CG	2595	-478	-850	1705	-490	-843
Striker	2594	-866	-234	1603	-878	-327
Left Knee	3152	-561	-261	2104	-524	-458
Right Knee	3157	-336	-273			
Tip of Nose	2717	-401	-805	1806	-434	-810
H-Point	2751	-570	-188	1845	-552	-363
Left Ankle	3486	-554	-7			
Right Ankle						
Left Heel	3484	-538	120			
Right Heel	3479	-259	118			
Right Toe	3702	-253	-123	2382	-346	-156
Left Toe	3721	-503	-110	2380	-538	-157
Left Shoulder Bolt				1676	-516	-664
Right Shoulder Bolt				1677	-320	-661
Seat Belt Anchor				1690	-731	79
Left Child Seat Bolt				1776	-639	-261
Right Child Seat Bolt						

DATA SHEET 6

VEHICLE ACCELEROMETER LOCATION AND DATA SUMMARY

Test Vehicle: 2008 Saturn Outlook FWD XE
 Test Program: Left 40% Offset Deformable Barrier

NHTSA No.: R80176
 Test Date: 3/13/2008

VEHICLE ACCELEROMETER PRE-TEST LOCATIONS

Accelerometer Location	Measurements (mm)		
	X	Y	Z
Left Rear Seat Crossmember X	2158	-425	475
Left Rear Seat Crossmember Y			
Right Rear Seat Crossmember X	2134	383	475
Right Rear Seat Crossmember Y			
Vehicle Center of Gravity X	2684	26	409
Vehicle Center of Gravity Y			
Vehicle Center of Gravity Z			
Top of Engine Block X	4468	33	870
Bottom of Engine Block X	4281	82	260
Left Disc Brake Caliper X	4220	-755	297
Right Disc Brake Caliper X	4220	755	297
Instrument Panel X	3583	0	1242
Left Side Driver Mid Seat Track X	2498	-652	4532
Accelerator Pedal X (at midfoot)	3661	-272	610
Accelerator Pedal Y (at midfoot)			
Accelerator Pedal Z (at midfoot)			
Brake Pedal X (at midfoot)	3747	-405	668
Brake Pedal Y (at midfoot)			
Brake Pedal Z (at midfoot)			
Footrest X	3603	-672	645
Footrest Y			
Footrest Z			

Reference is on the following page.

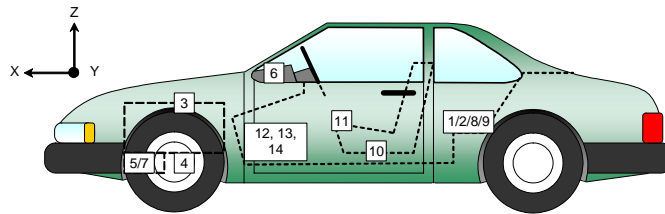
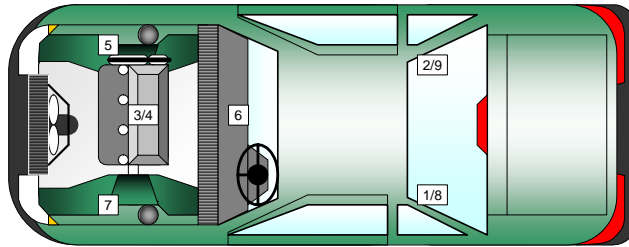
DATA SHEET 6 (CONTINUED)

VEHICLE ACCELEROMETER LOCATION AND DATA SUMMARY

Test Vehicle: 2008 Saturn Outlook FWD XE
Test Program: Left 40% Offset Deformable Barrier

NHTSA No.: R80176
Test Date: 3/13/2008

Reference Points: X - Rear Surface of Vehicle (+ forward)
Y - Vehicle Centerline (+ to right)
Z - Ground Plane (+ up)



DATA SHEET 6 (CONTINUED)

VEHICLE ACCELEROMETER LOCATION AND DATA SUMMARY

Test Vehicle: 2008 Saturn Outlook FWD XE
 Test Program: Left 40% Offset Deformable Barrier

NHTSA No.: R80176
 Test Date: 3/13/2008

Location Number	Description	Maximum Values (g's)			
		Positive	Time, ms	Negative	Time, ms
1	Left Rear Seat Cross Member X	1.6	176.4	-25.6	59.1
2	Right Rear Seat Cross Member X	1.0	194.2	-23.0	90.7
3	Top of Engine Block X	10.0	98.1	-55.3	73.6
4	Bottom of Engine Block X	33.4	88.7	-50.4	70.6
5	Disc Brake Caliper @ Right Side X	(1)	(1)	(1)	(1)
6	Instrument Panel X	2.8	188.0	-29.0	94.5
7	Disc Brake Caliper @ Left Side X	(2)	(2)	(2)	(2)
8	Left Rear Seat Cross Member Y	8.9	84.6	-2.9	90.3
9	Right Rear Seat Cross Member Y	9.6	69.7	-2.7	90.0
10	Left Side Driver Mid Seat Track X	1.8	177.6	-30.7	51.4
11	Vehicle Center of Gravity X	1.2	176.4	-24.2	91.0
	Vehicle Center of Gravity Y	10.7	83.4	-4.3	116.2
	Vehicle Center of Gravity Z	6.9	85.5	-13.3	70.6
	Vehicle Center of Gravity Resultant	24.4	90.7		
12	Accel Pedal Heel Location X	27.0	224.6	-52.1	74.4
	Accel Pedal Heel Location Y	26.7	76.2	-13.5	92.2
	Accel Pedal Heel Location Z	16.3	224.5	-27.0	75.5
	Accel Pedal Heel Location Resultant	62.5	75.2		
13	Brake Pedal Heel Location X	(3)	(3)	(3)	(3)
	Brake Pedal Heel Location Y	29.8	55.2	-26.3	62.8
	Brake Pedal Heel Location Z	16.8	60.8	-4.7	120.3
	Brake Pedal Heel Location Resultant	(3)	(3)		
14	Outside Footrest X	17.8	64.2	-49.0	59.8
	Outside Footrest Y	19.3	73.6	-20.9	63.5
	Outside Footrest Z	18.5	72.4	-14.0	68.0
	Outside Footrest Resultant	50.6	59.9		

(1) No valid data

(2) No valid data after 70 msec.

(3) No valid data after 40 msec.

**DATA SHEET 7
DUMMY INJURY CRITERIA VALUES**

Test Vehicle: 2008 Saturn Outlook FWD XE
Test Program: Left 40% Offset Deformable Barrier

NHTSA No.: R80176
Test Date: 3/13/2008

		Maximum Value			
		Driver			
Description	Unit	Positive	Time, ms	Negative	Time, ms
Head X	G	9.9	258.7	-36.1	103.2
Head Y	G	15.8	134.0	-4.2	285.4
Head Z	G	21.3	128.2	-0.8	32.6
Head Resultant	G	38.0	103.2		
Head (FT) Y	G	(1)	(1)	(1)	(1)
Head (FT) Z	G	18.6	132.1	-5.3	89.9
Head (LT) X	G	11.5	258.5	-32.8	104.9
Head (LT) Z	G	21.9	127.5	-2.7	175.1
Head (TP) X	G	15.3	258.7	-34.0	107.6
Head (TP) Y	G	18.0	133.6	-7.1	278.7
Head Redundant X	G	9.4	258.4	-35.0	106.0
Head Redundant Y	G	15.0	133.8	-4.5	282.0
Head Redundant Z	G	21.0	127.9	-0.9	34.0
Head Resultant Redundant	G	36.8	106.0		
Upper Neck Fx	N	123.4	260.5	-333.6	171.2
Upper Neck Fy	N	396.6	162.6	-161.6	280.1
Upper Neck Fz	N	923.9	127.3	-192.0	285.7
Upper Neck F Resultant	N	968.5	127.9		
Upper Neck Mx	N-m	26.0	169.4	-19.7	114.3
Upper Neck My	N-m	27.0	90.8	-12.6	74.3
Upper Neck Mz	N-m	11.2	196.9	-18.7	146.5
Upper Neck M Resultant	N-m	31.0	181.2		
Lower Neck Fx	N	318.0	53.9	-241.1	104.1
Lower Neck Fy	N	519.8	159.4	-139.3	293.3
Lower Neck Fz	N	1374.5	123.5	-447.2	186.1
Lower Neck F Resultant	N	1411.2	123.5		
Lower Neck Mx	N-m	89.6	159.2	-26.5	281.2
Lower Neck My	N-m	87.0	173.5	-49.9	128.3
Lower Neck Mz	N-m	21.4	54.5	-15.9	293.9
Lower Neck M Resultant	N-m	113.0	169.2		
Chest X	G	1.9	300.0	-27.1	90.0
Chest Y	G	13.5	119.3	-3.2	66.5
Chest Z	G	10.7	126.0	-7.9	88.9
Chest Resultant	G	28.3	89.6		
Chest Redundant X	G	1.7	300.0	-27.1	90.2
Chest Redundant Y	G	13.2	120.1	-2.9	64.1
Chest Redundant Z	G	10.6	125.7	-8.3	98.1
Chest Resultant Redundant	G	28.3	89.7		
Chest Displacement	mm			-26.1	125.7

⁽¹⁾ No Valid Data

DATA SHEET 7 (CONTINUED)
DUMMY INJURY CRITERIA VALUES

Test Vehicle: 2008 Saturn Outlook FWD XE NHTSA No.: R80176
 Test Program: Left 40% Offset Deformable Barrier Test Date: 3/13/2008

		Maximum Value			
		Driver			
Description	Unit	Positive	Time, ms	Negative	Time, ms
Pelvis X	G	0.5	153.4	-41.3	82.4
Pelvis Y	G	11.4	109.8	-4.0	53.5
Pelvis Z	G	2.3	286.9	-23.9	92.6
Pelvis Resultant	G	45.9	82.4		
Right Femur	N	448.5	54.5	-1484.0	85.7
Left Femur	N	651.5	66.8	-4122.3	83.0
Right Knee Shear	mm	0.9	126.1	-0.1	84.1
Left Knee Shear	mm	0.9	129.5	-0.1	35.2
Right Upper Tibia Fx	N	98.2	128.0	-229.9	82.6
Right Upper Tibia Fy	N	35.8	201.5	-279.2	77.2
Right Upper Tibia Fz	N	124.9	170.0	-1764.7	82.0
Right Upper Tibia F Resultant	N	1777.2	82.2		
Right Upper Tibia Mx	N-m	24.1	149.5	-64.1	88.4
Right Upper Tibia My	N-m	22.8	82.0	-29.0	152.1
Right Lower Tibia Fx	N	80.7	155.2	-439.6	93.1
Right Lower Tibia Fy	N	(1)	(1)	(1)	(1)
Right Lower Tibia Fz	N	105.5	257.0	-2618.5	77.7
Right Lower Tibia F Resultant	N	(1)	(1)		
Right Lower Tibia Mx	N-m	26.5	128.4	-20.1	76.6
Right Lower Tibia My	N-m	9.1	149.1	-44.9	92.5
Right Tibia Mid Shaft X	G	2.7	148.5	-36.5	77.1
Right Tibia Mid Shaft Y	G	16.6	82.6	-4.5	129.4
Rt Dorsi/Plantar Flexion	Deg	6.0	86.6	-22.4	263.2
Rt Inversion/Eversion	Deg	24.1	129.9	-12.1	286.8
Rt Internal/External	Deg	15.8	268.3	-5.9	110.2
Right Foot X – Front	G	24.9	77.5	-18.7	124.4
Right Foot Y – Front	G	6.2	56.3	-36.0	72.6
Right Foot Z – Front	G	55.1	76.1	-9.4	96.0
Right Foot - Front Resultant	G	59.4	74.6		
Left Upper Tibia Fx	N	21.3	30.7	-281.3	73.5
Left Upper Tibia Fy	N	55.3	102.1	-199.5	71.8
Left Upper Tibia Fz	N	(2)	(2)	(2)	(2)
Left Upper Tibia F Resultant	N	(2)	(2)		
Left Upper Tibia Mx	N-m	29.6	43.7	-31.5	125.0
Left Upper Tibia My	N-m	72.2	86.3	-13.1	151.2
Left Lower Tibia Fx	N	49.6	149.4	-419.2	86.7
Left Lower Tibia Fy	N	199.9	89.8	-24.3	128.6
Left Lower Tibia Fz	N	66.9	212.5	-1845.8	80.6
Left Lower Tibia F Resultant	N	1877.8	80.6		

(1) No Valid Data (2) No Valid Data after 20 msec.

DATA SHEET 7 (CONTINUED)
DUMMY INJURY CRITERIA VALUES

Test Vehicle: 2008 Saturn Outlook FWD XE
 Test Program: Left 40% Offset Deformable Barrier

NHTSA No.: R80176
 Test Date: 3/13/2008

		Maximum Value			
		Driver			
Description	Unit	Positive	Time, ms	Negative	Time, ms
Left Lower Tibia Mx	N-m	50.7	122.0	-10.9	226.5
Left Lower Tibia My	N-m	3.7	151.0	-43.9	86.6
Left Tibia Mid Shaft X	G	2.5	149.6	-31.5	73.0
Left Tibia Mid Shaft Y	G	9.0	104.5	-7.5	123.5
Lt Dorsi/Plantar Flexion	Deg	(1)	(1)	(1)	(1)
Lt Inversion/Eversion	Deg	33.1	123.4	-11.2	228.2
Lt Internal/External	Deg	9.7	241.0	-8.0	112.4
Left Foot X – Front	G	9.7	84.2	-48.7	65.1
Left Foot Y – Front	G	2.9	15.7	-32.2	73.3
Left Foot Z – Front	G	36.7	70.2	-9.5	15.1
Left Foot – Front Resultant	G	64.3	65.2		
Lap Belt Load	N	3409.7	76.2		
Shoulder Belt Load	N	4361.0	77.6		

(1) No Valid Data between 50-140 msec.

		Maximum Value			
		Left Rear Passenger			
Description	Unit	Positive	Time, ms	Negative	Time, ms
Head X	G	8.7	279.0	-38.8	129.7
Head Y	G	9.0	166.9	-5.4	129.4
Head Z	G	57.1	111.4	-1.8	40.9
Head Resultant	G	59.9	111.4		
Upper Neck Fx	N	23.7	57.6	-920.0	129.9
Upper Neck Fy	N	136.3	189.0	-171.4	122.6
Upper Neck Fz	N	2374.1	128.8	-68.4	41.6
Upper Neck F Resultant	N	2543.0	128.9		
Upper Neck Mx	N-m	9.9	137.6	-13.0	283.9
Upper Neck My	N-m	18.8	125.5	-43.3	90.4
Upper Neck Mz	N-m	4.1	131.0	-9.8	299.9
Upper Neck M Resultant	N-m	43.4	90.4		
Lower Neck Fx	N	33.5	65.9	-2406.8	128.9
Lower Neck Fy	N	47.4	65.4	-538.8	121.1
Lower Neck Fz	N	1723.4	97.4	-163.0	240.4
Lower Neck F Resultant	N	2608.4	120.8		
Lower Neck Mx	N-m	10.8	166.0	-43.1	119.1
Lower Neck My	N-m	221.8	129.1	-5.7	56.6
Lower Neck Mz	N-m	12.4	153.4	-12.6	300.0
Lower Neck M Resultant	N-m	224.7	129.1		

DATA SHEET 7 (CONTINUED)
DUMMY INJURY CRITERIA VALUES

Test Vehicle: 2008 Saturn Outlook FWD XE
 Test Program: Left 40% Offset Deformable Barrier

NHTSA No.: R80176
 Test Date: 3/13/2008

Description	Unit	Maximum Value			
		Left Rear Passenger			
		Positive	Time, ms	Negative	Time, ms
Right Shoulder Fx	N	115.3	89.9	-250.1	122.1
Right Shoulder Fz	N	426.7	121.7	-34.5	77.0
Left Shoulder Fx	N	141.3	200.2	-2546.8	118.0
Left Shoulder Fz	N	1083.8	108.2	-5.0	0.0
Chest X	G	9.3	239.0	-33.4	81.9
Chest Y	G	9.9	125.1	-5.0	98.4
Chest Z	G	8.9	115.4	-12.1	139.4
Chest Resultant	G	33.7	81.9		
Chest Displacement	mm			-26.9	128.5
Upper Sternum X	G	11.9	238.2	-39.9	86.4
Lower Sternum X	G	14.9	238.7	-49.8	72.2
Upper Spine X	G	8.4	239.2	-34.5	83.6
Lower Spine X	G	11.2	232.5	-34.0	81.6
Lumbar Fx	N	1232.7	133.9	-418.9	74.5
Lumbar Fy	N	33.3	238.2	-761.0	123.3
Lumbar Fz	N	685.4	184.5	-494.0	142.1
Lumbar F Resultant	N	1349.7	133.8		
Lumbar Mx	N-m	11.9	241.7	-103.9	123.0
Lumbar My	N-m	37.5	216.6	-45.3	132.2
Lumbar Mz	N-m	36.0	119.4	-3.4	247.0
Lumbar M Resultant	N-m	113.8	123.0		
Pelvis X	G	12.6	233.0	-24.3	72.0
Pelvis Y	G	16.0	122.3	-3.3	156.4
Pelvis Z	G	11.0	231.0	-16.8	79.8
Pelvis Resultant	G	28.0	120.6		
Right Upper Asis Fx	N	91.4	82.7	-248.4	136.4
Right Lower Asis Fx	N	525.1	100.7	-27.0	255.0
Left Upper Asis Fx	N	101.4	236.8	-84.4	177.8
Left Lower Asis Fx	N	209.7	78.3	-6.0	259.2
Shoulder Belt Load	N	1709.7	68.8		
Lap Belt Load	N	5662.9	117.1		

DATA SHEET 8

SUMMARY OF FMVSS 212/ 219 (PARTIAL) DATA

Test Vehicle: 2008 Saturn Outlook FWD XE
 Test Program: Left 40% Offset Deformable Barrier

NHTSA No.: R80176
 Test Date: 3/13/2008

Windshield Mounting Details:

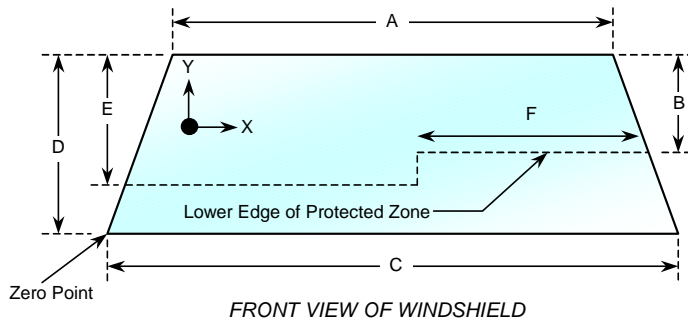
Windshield glass is secured to the vehicle frame with a rubber trim and glue.

The standard requires that the post-test retention measurement be a minimum of 75 percent of the pretest total periphery measurement for vehicles not equipped with occupant passive restraints and 50 percent for each side of the windshield for vehicles, which are equipped with occupant passive restraints.

Temperature of windshield molding during test: 21°C

WINDSHIELD PERIPHERY MEASUREMENTS

Measurement	Pre-Test (mm)	Post-Test (mm)	% of Retention
Left Side	2350	2350	100
Right Side	2350	2350	100
Total	4700	4700	100



Item	Units	Value
A	mm	1320
B	mm	559
C	mm	1680
D	mm	850
E	mm	573
F	mm	486

AREA OF PROTECTED ZONE FAILURES - NONE

A. Provide coordinates of the area that the protected zone was penetrated more than 0.25 inches by a vehicle component other than one that is normally in contact with the windshield. **None**

X	Y

B. Provide coordinates of the area beneath the protected zone that the inner surface of the windshield was penetrated by a vehicle component. **None**

X	Y

DATA SHEET 9

FMVSS 301 FUEL SYSTEM INTEGRITY DATA

Test Vehicle: 2008 Saturn Outlook FWD XE
 Test Program: Left 40% Offset Deformable Barrier

NHTSA No.: R80176
 Test Date: 3/13/2008

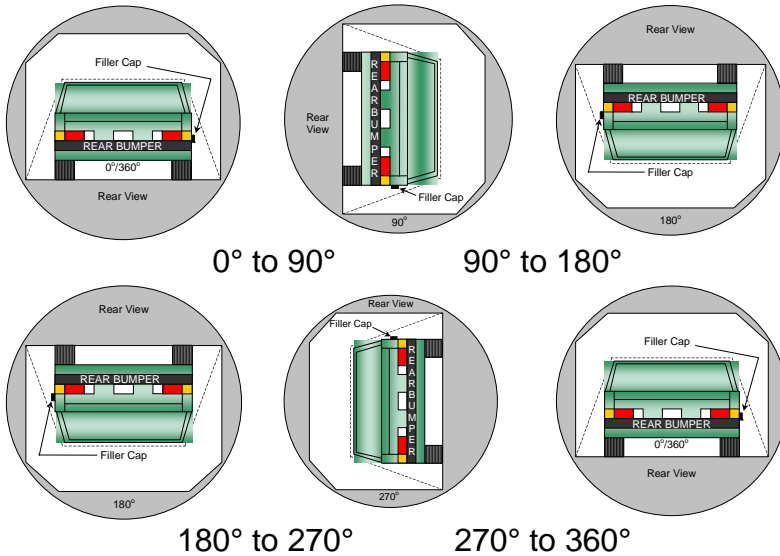
Temperature at Time of Impact: 21° C Test Time: 12:14 pm

Stoddard Solvent Spillage Measurements

- A. From impact until vehicle motion ceases: 0 oz.
 (Maximum Allowable = 1 ounce)
- B. For the 5 minute period after motion ceases: 0 oz.
 (Maximum Allowable = 5 ounces)
- C. For the following 25 minutes: 0 oz.
 (Maximum Allowable = 1 oz. /minute)
- D. Spillage: None

FMVSS 301 STATIC ROLLOVER DATA

NOT PERFORMED



1. The specified fixture rollover rate for each 90° of rotation is 60 to 180 seconds.

2. The position hold time at each position is 300 seconds (minimum).

3. Details of Stoddard Solvent spillage locations:

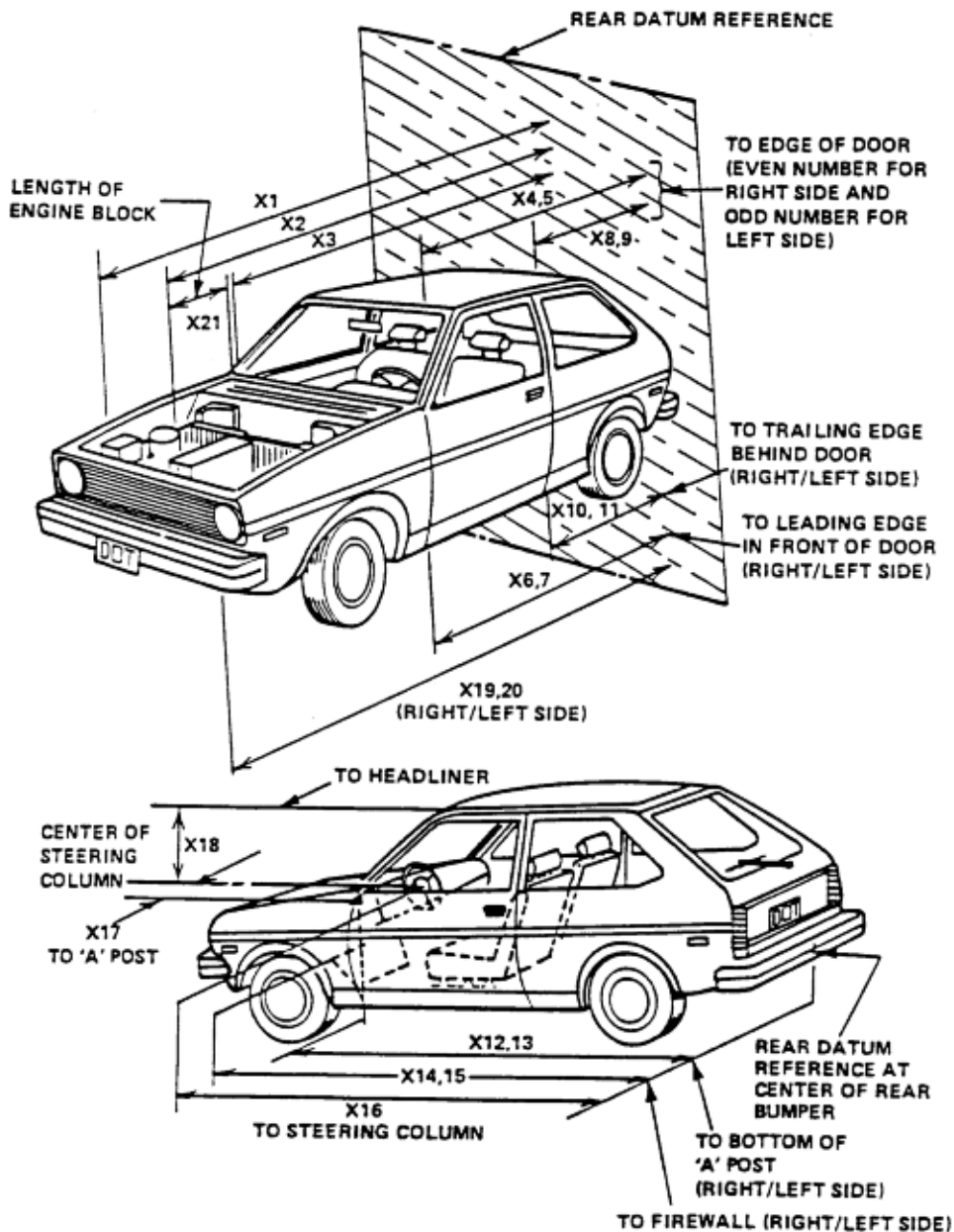
Test Phase	Rotation Time (sec.)	Hold Time (sec.)	Spillage (oz.)
0° to 90°	N/A		
90° to 180°	N/A		
180° to 270°	N/A		
270° to 360°	N/A		

DATA SHEET 10

TEST VEHICLE MEASUREMENTS

Test Vehicle: 2008 Saturn Outlook FWD XE
Test Program: Left 40% Offset Deformable Barrier

NHTSA No.: R80176
Test Date: 3/13/2008



DATA SHEET 10 (CONTINUED)
TEST VEHICLE MEASUREMENTS

Test Vehicle: 2008 Saturn Outlook FWD XE
 Test Program: Left 40% Offset Deformable Barrier

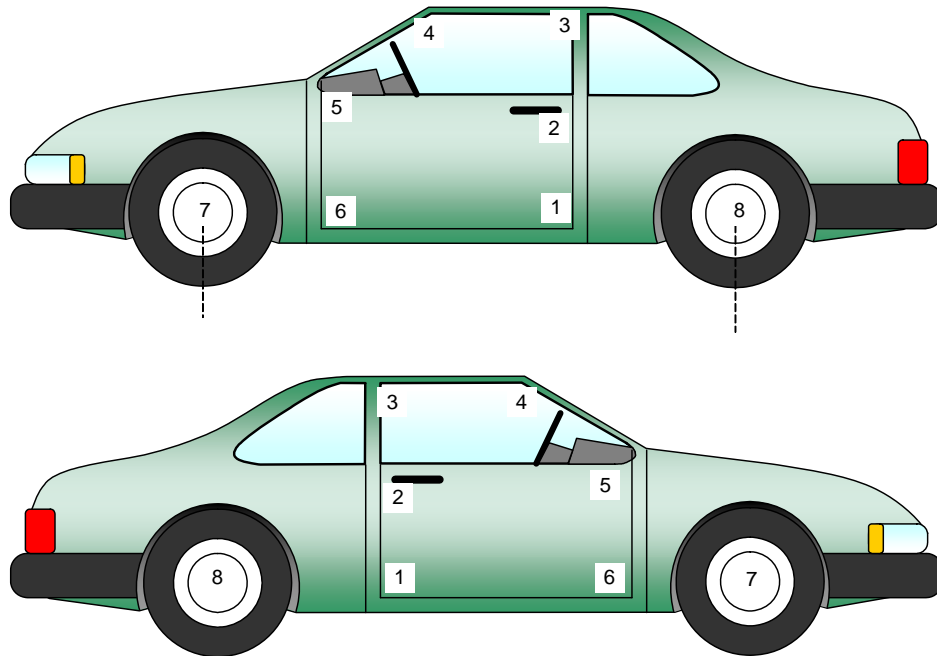
NHTSA No.: R80176
 Test Date: 3/13/2008

No.	Measurement Description	Pre-Test (mm)	Post-Test (mm)	Difference (mm)
1	Total length of vehicle at centerline	5051	4661	390
2	RSOV to front of engine	4486	4289	197
3	RSOV to firewall centerline	4171	4143	28
4	RSOV to leading edge of right door	3561	3567	-6
5	RSOV to leading edge of left door	3561	3556	5
6	RSOV to lower leading edge of right door	3551	3554	-3
7	RSOV to lower leading edge of left door	3551	3546	5
8	RSOV to upper leading edge of right door	2470	2473	-3
9	RSOV to upper leading edge of left door	2470	2466	4
10	RSOV to lower trailing edge of right door	2481	2479	2
11	RSOV to lower trailing edge of left door	2481	2473	8
12	RSOV to bottom of right 'A' pillar	3498	3498	0
13	RSOV to bottom of left 'A' pillar	3500	3489	11
14	RSOV to firewall on right side	4138	4137	1
15	RSOV to firewall on left side	4137	4083	54
16	RSOV to steering column	3073	3098	-25
17	Center of steering column to left 'A' pillar	440	454	-14
18	Center of steering column to headlining	480	494	-14
19	RSOV to right side of front bumper	4889	4968	-79
20	RSOV to left side of front bumper	4889	4497	392
21	Length of engine block	440	440	0
RD	RSOV to right side of dash panel	3375	3380	-5
CD	RSOV to center of dash panel	3295	3292	3
LD	RSOV to left side of dash panel	3373	3368	5

DATA SHEET 10 (CONTINUED)
TEST VEHICLE MEASUREMENTS

Test Vehicle: 2008 Saturn Outlook FWD XE
 Test Program: Left 40% Offset Deformable Barrier

NHTSA No.: R80176
 Test Date: 3/13/2008



LEFT FRONT

Point Location	Pre-Test (mm)			Post-Test (mm)			Difference (mm)		
	X	Y	Z	X	Y	Z	X	Y	Z
1	2782	-836	56	2781	-837	54	-1	1	2
2	2563	-817	-626	2562	-819	-629	-1	2	3
3	2550	-641	-1042	2550	-644	-1047	0	3	5
4	3040	-667	-982	3041	-671	-991	1	4	9
5	3491	-770	-702	3491	-777	-709	0	7	7
6	3420	-825	106	3420	-825	99	0	0	7
7	4126	-923	203	3997	-928	209	-129	5	-6
8	1106	-954	222	1112	-955	223	6	1	-1

RIGHT FRONT

Point Location	Pre-Test (mm)			Post-Test (mm)			Difference (mm)		
	X	Y	Z	X	Y	Z	X	Y	Z
1	2784	842	54	2782	846	56	-2	-4	-2
2	2564	835	-595	2562	836	-595	-2	-1	0
3	2548	643	-1046	2547	643	-1046	-1	0	0
4	3141	695	-941	3140	693	-943	-1	2	2
5	3483	776	-710	3484	776	-714	1	0	4
6	3447	839	95	3447	844	94	0	-5	1
7	4123	939	200	4122	933	194	-1	6	6
8	1104	959	219	1109	958	227	5	1	-8

DATA SHEET 10 (CONTINUED)
TEST VEHICLE MEASUREMENTS

Test Vehicle: 2008 Saturn Outlook FWD XE
 Test Program: Left 40% Offset Deformable Barrier

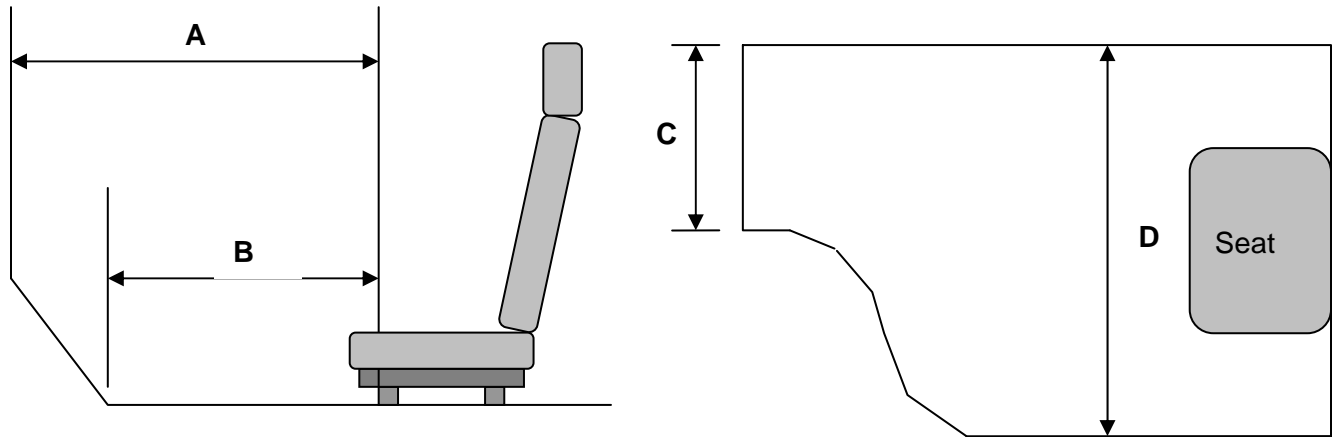
NHTSA No.: R80176
 Test Date: 3/13/2008

	Elements	Pre-Test (mm)
1	Total Length	5051
2	Total Width	2050
3	Bumper Top Height	655
4	Bumper Bottom Height	479
5	Longitudinal Member Top Height	640
6	Distance between Longitudinal Members	1064
7	Longitudinal Member Width	66
8	Engine Top Height	1060
9	Engine Bottom Height	259
10	Engine and gearbox width	767
11	Front bumper-engine distance	440
12	Front shock absorber fixing height	1048
13	Bonnet leading edge height	971
14	Front shock absorber fixing width	1293
15	Front bumper – front axle distance	957
16	Front axle – a pillar distance	495
17	A-pillar – B-pillar distance	1115
18	B-Pillar – rear axle distance	1411
19	B-pillar – C-pillar distance	990
20	Roof sill bottom height	1597
21	Roof sill top height	1720
22	Floor sill bottom height	325
23	Floor sill top height	462

DATA SHEET 10 (CONTINUED)
TEST VEHICLE MEASUREMENTS

Test Vehicle: 2008 Saturn Outlook FWD XE
 Test Program: Left 40% Offset Deformable Barrier

NHTSA No.: R80176
 Test Date: 3/13/2008



DRIVER

Measurements	Pre-Test (mm)	Post-Test (mm)	Difference (mm)
A	681	679	2
B	615	615	0
C	492	498	-6
D	534	537	-3

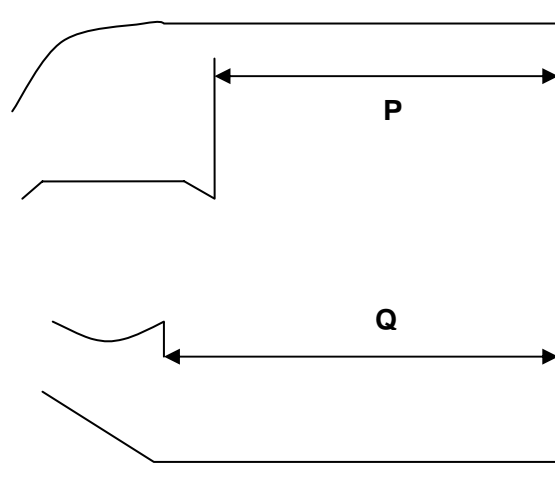
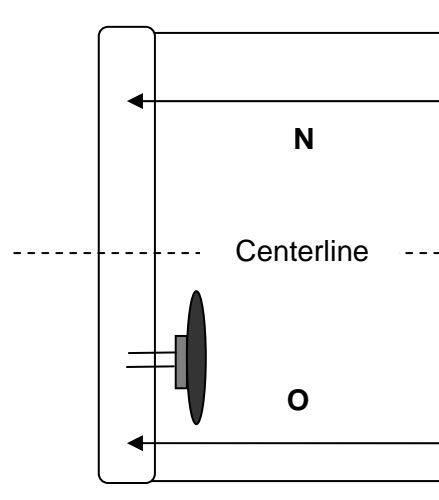
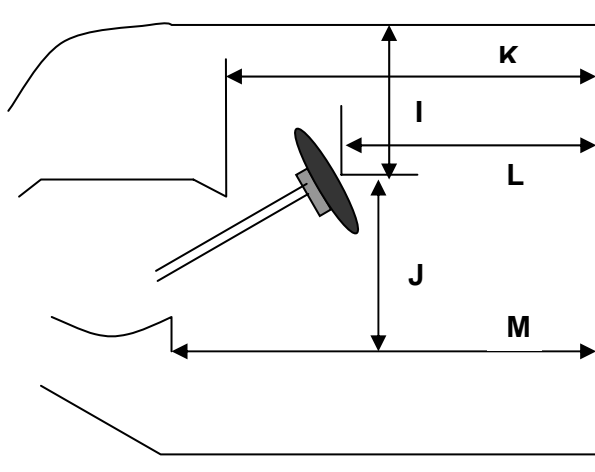
LEFT FRONT PASSENGER

Measurements	Pre-Test (mm)	Post-Test (mm)	Difference (mm)
A	689	689	0
B	588	588	0
C	413	413	0
D	548	548	0

DATA SHEET 10 (CONTINUED)
TEST VEHICLE MEASUREMENTS

Test Vehicle: 2008 Saturn Outlook FWD XE
 Test Program: Left 40% Offset Deformable Barrier

NHTSA No.: R80176
 Test Date: 3/13/2008



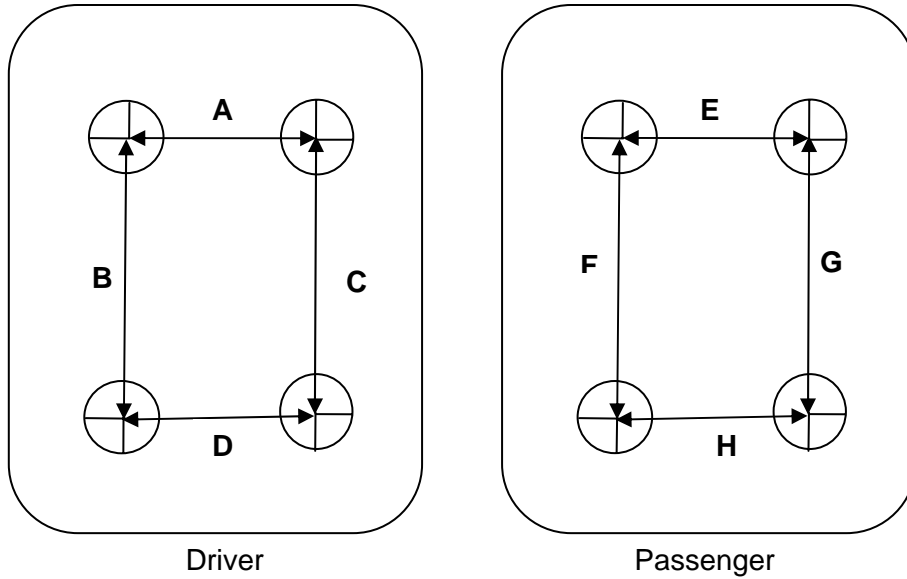
Measurements	Pre-Test (mm)	Post-Test (mm)	Difference (mm)
I	480	494	-14
J	650	644	6
K	1683	1681	2
L	1440	1452	-12
M	1692	1695	-3
N	2111	2112	-1
O	2098	2100	-2
P= K (PASS)	1693	1693	0
Q= M (PASS)	1674	1673	1

Measurements from C-Pillar Belt Anchorage

DATA SHEET 10 (CONTINUED)
TEST VEHICLE MEASUREMENTS

Test Vehicle: 2008 Saturn Outlook FWD XE
 Test Program: Left 40% Offset Deformable Barrier

NHTSA No.: R80176
 Test Date: 3/13/2008



UNDERBODY FLOORBOARD DEFORMATION

Measurement	Pre-Test (mm)	Post-Test (mm)	Difference (mm)
A	157	157	0
B	255	251	4
C	250	248	2
D	162	162	0
E	159	159	0
F	234	234	0
G	244	244	0
H	166	166	0

DATA SHEET 10 (CONTINUED)
TEST VEHICLE MEASUREMENTS

Test Vehicle: 2008 Saturn Outlook FWD XE
Test Program: Left 40% Offset Deformable Barrier

NHTSA No.: R80176
Test Date: 3/13/2008

	Points	Pre-Test (mm)			Post-Test (mm)			Difference (mm)		
		X	Y	Z	X	Y	Z	X	Y	Z
Lower Bumper Beam	1	4928	-608	21	4538	-594	20	-390	-14	1
	2	5013	-372	39	4538	-344	48	-475	-28	-9
	3	5075	-124	38	4576	-153	48	-499	29	-10
	4	5077	126	37	4767	4	38	-310	122	-1
	5	5013	373	38	4894	225	22	-119	148	16
	6	4931	606	20	4999	447	-9	68	159	29
Upper Bumper Beam	1	4925	-616	-83	4543	-603	-81	-382	-13	2
	2	5014	-371	-73	4544	-344	-62	-470	-27	11
	3	5071	-124	-72	4576	-158	-68	-495	34	4
	4	5073	126	-69	4765	-2	-73	-308	124	4
	5	5014	373	-72	4898	216	-88	-116	157	16
	6	4927	618	-79	5006	452	-109	79	166	30
Upper Radiator Support	1	4427	-717	-479	4371	-782	-494	-56	65	15
	2	4731	-414	-441	4420	-380	-346	-311	-34	-95
	3	4766	-144	-437	4481	-170	-407	-285	26	-30
	4	4766	147	-437	4611	86	-445	-155	61	8
	5	4732	414	-438	4680	344	-457	-52	70	19
	6	4434	717	-477	4436	692	-478	2	25	1
Front of Hood	1	4427	-811	-511	4340	-815	-779	-87	4	268
	2	4925	-486	-409	4554	-485	-429	-371	-1	20
	3	4989	-164	-410	4565	-170	-406	-424	6	-4
	4	4989	165	-409	4766	68	-430	-223	97	21
	5	4925	485	-406	4857	375	-487	-68	110	81
	6	4428	809	-513	4441	772	-600	13	37	87

Reference Photos on the Following Page

DATA SHEET 10 (CONTINUED)
TEST VEHICLE MEASUREMENTS

Test Vehicle: 2008 Saturn Outlook FWD XE
Test Program: Left 40% Offset Deformable Barrier

NHTSA No.: R80176
Test Date: 3/13/2008



Lower Bumper Beam / Upper Bumper Beam / Front of Hood



Upper Radiator Support

DATA SHEET 10 (CONTINUED)
TEST VEHICLE MEASUREMENTS

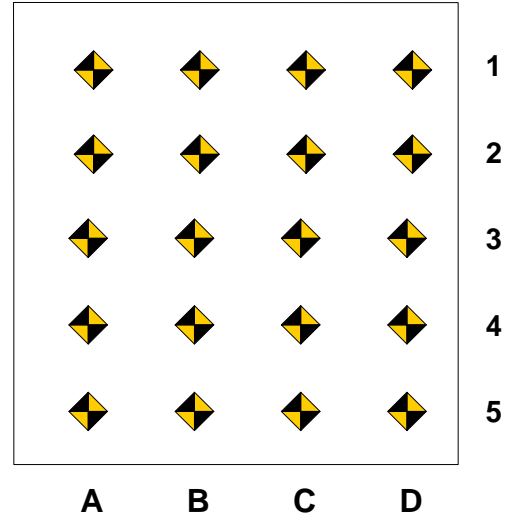
Test Vehicle: 2008 Saturn Outlook FWD XE
Test Program: Left 40% Offset Deformable Barrier

NHTSA No.: R80176
Test Date: 3/13/2008

Columns A through D are evenly spaced.

Rows 1 and 2 are on the toe kick portion of the floor pan. Rows 3, 4, and 5 are located on the most level portion of the floor pan.

Row 3 will be at the intersection of the toe kick and the level sections of the floor pan.



DRIVER'S SIDE TOE PAN FLOOR BOARD

Intrusion Location	Pre-Test (mm)			Post-Test (mm)			Difference (mm)		
	X	Y	Z	X	Y	Z	X	Y	Z
A1	3702	-624	21	3698	-630	4	-4	6	17
B1	3765	-505	19	3756	-505	-1	-9	0	20
C1	3772	-381	22	3764	-384	-2	-8	3	24
D1	3769	-254	25	3770	-254	8	1	0	17
A2	3686	-629	78	3683	-633	63	-3	4	15
B2	3705	-503	80	3703	-506	65	-2	3	15
C2	3698	-378	81	3694	-380	62	-4	2	19
D2	3706	-257	83	3703	-258	65	-3	1	18
A3	3604	-625	130	3604	-627	120	0	2	10
B3	3611	-502	134	3611	-505	123	0	3	11
C3	3593	-376	136	3591	-378	123	-2	2	13
D3	3620	-265	130	3620	-257	117	0	-8	13
A4	3515	-634	142	3515	-637	133	0	3	9
B4	3516	-508	149	3516	-510	138	0	2	11
C4	3520	-381	144	3520	-384	132	0	3	12
D4	3523	-257	148	3523	-259	137	0	2	11
A5	3410	-630	149	3408	-633	139	-2	3	10
B5	3415	-505	149	3414	-507	139	-1	2	10
C5	3418	-383	153	3417	-385	140	-1	2	13
D5	3414	-258	148	3414	-260	139	0	2	9
Brake Pedal	3609	-404	-74	3598	-410	-79	-11	6	5
IP Left	3337	-553	-441	3331	-557	-453	-6	4	12
IP Right	3333	-251	-436	3330	-257	-444	-3	6	8
Steering Column	3126	-404	-561	3151	-406	-546	25	2	-15
Front Outboard Bolt	2982	-622	92	3001	-671	99	19	49	7

DATA SHEET 10 (CONTINUED)
TEST VEHICLE MEASUREMENTS

Test Vehicle: 2008 Saturn Outlook FWD XE
 Test Program: Left 40% Offset Deformable Barrier

NHTSA No.: R80176
 Test Date: 3/13/2008

Driver's Side Toe Pan Floor Board
Additional Measurements

Points	Pre-Test (mm)			Post-Test (mm)			Difference (mm)		
	X	Y	Z	X	Y	Z	X	Y	Z
1	3695	-650	-63	3690	-660	-78	-5	10	15
2	3746	-576	-55	3729	-579	-76	-17	3	21
3	3794	-495	-30	3763	-487	-56	-31	-8	26
4	3799	-375	-14	3806	-398	-45	7	23	31
5	3797	-255	-10	3798	-257	-26	1	2	16
6	3795	-130	-10	3779	-138	-42	-16	8	32
7	3674	-677	-48	3666	-683	-61	-8	6	13
8	3665	-682	-7	3658	-686	-21	-7	4	14
9	3677	-658	39	3673	-663	25	-4	5	14
10	3718	-574	61	3712	-575	43	-6	1	18
11	3738	-437	43	3734	-440	25	-4	3	18
12	3740	-315	55	3732	-316	32	-8	1	23
13	3740	-188	51	3735	-190	30	-5	2	21
14	3767	-130	22	3753	-134	-8	-14	4	30
15	3646	-698	58	3643	-701	46	-3	3	12
16	3647	-670	108	3647	-672	95	0	2	13
17	3655	-563	114	3654	-565	101	-1	2	13
18	3654	-441	105	3653	-443	91	-1	2	14
19	3659	-316	111	3656	-316	94	-3	0	17
20	3664	-188	110	3662	-189	94	-2	1	16
21	3701	-130	82	3695	-132	60	-6	2	22
22	3623	-700	118	3624	-703	108	1	3	10
23	3580	-667	132	3581	-669	120	1	2	12
24	3568	-558	145	3569	-559	134	1	1	11
25	3562	-434	137	3561	-435	127	-1	1	10
26	3561	-326	145	3561	-327	133	0	1	12
27	3568	-192	145	3569	-193	134	1	1	11
28	3613	-128	135	3613	-129	122	0	1	13
29	3522	-706	131	3523	-708	120	1	2	11
30	3475	-672	132	3475	-674	124	0	2	8
31	3463	-566	145	3463	-567	134	0	1	11
32	3471	-445	142	3471	445	131	0	0	11
33	3467	-323	149	3467	-324	137	0	1	12
34	3472	-195	147	3473	-197	138	1	2	9
35	3524	-131	152	3526	-133	144	2	2	8
36	3411	-714	129	3412	-716	120	1	2	9
37	3404	-129	152	3405	-130	146	1	1	6
38	3279	-725	127	3279	-728	119	0	3	8
39	3282	-623	151	3283	-624	142	1	1	9
40	3281	-500	149	3281	-501	141	0	1	8

DATA SHEET 10 (CONTINUED)
TEST VEHICLE MEASUREMENTS

Test Vehicle: 2008 Saturn Outlook FWD XE
 Test Program: Left 40% Offset Deformable Barrier

NHTSA No.: R80176
 Test Date: 3/13/2008

Driver's Side Toe Pan Floor Board
Additional Measurements (Continued)

Points	Pre-Test (mm)			Post-Test (mm)			Difference (mm)		
	X	Y	Z	X	Y	Z	X	Y	Z
41	3281	-376	150	3281	-376	140	0	0	10
42	3282	-255	151	3282	-255	145	0	0	6
43	3285	-128	152	3286	-128	149	1	0	3
44	3163	-722	129	3163	-724	122	0	2	7
45	3162	-626	150	3162	-627	144	0	1	6
46	3163	-499	149	3163	-500	142	0	1	7
47	3164	-376	149	3163	-378	141	-1	2	8
48	3160	-253	145	3161	-254	141	1	1	4
49	3161	-126	148	3160	-127	144	-1	1	4
50	3034	-722	127	3036	-721	121	2	-1	6
51	3042	-626	140	3041	-627	134	-1	1	6
52	3044	-497	140	3042	-500	135	-2	3	5
53	3049	-376	140	3048	-380	134	-1	4	6
54	3043	-251	140	3043	-254	136	0	3	4
55	3045	-128	137	3045	-130	135	0	2	2
56	3701	-326	-139	3692	-332	-142	-9	6	3
57	3634	-403	-96	3625	-411	-100	-9	8	4
58	3594	-405	-45	3584	-412	-49	-10	7	4
59	3742	-251	-100	3735	-260	-102	-7	9	2
60	3695	-244	-65	3690	-252	-67	-5	8	2
61	3613	-260	31	3606	-267	28	-7	7	3
62	3677	-648	-60	3657	-641	-86	-20	-7	26
63	3687	-583	-60	3673	-577	-81	-14	-6	21
64	3573	-581	55	3570	-581	46	-3	0	9
65	3562	-660	49	3559	-659	39	-3	-1	10
66	3658	-668	-46	3639	-662	-71	-19	-6	25

DATA SHEET 10 (CONTINUED)
TEST VEHICLE MEASUREMENTS

Test Vehicle: 2008 Saturn Outlook FWD XE
Test Program: Left 40% Offset Deformable Barrier

NHTSA No.: R80176
Test Date: 3/13/2008

Driver's Side Toe Pan Floor Board



DATA SHEET 10 (CONTINUED)
TEST VEHICLE MEASUREMENTS

Test Vehicle: 2008 Saturn Outlook FWD XE
Test Program: Left 40% Offset Deformable Barrier

NHTSA No.: R80176
Test Date: 3/13/2008

Driver's Side Toe Pan Floor Board



DATA SHEET 10 (CONTINUED)
TEST VEHICLE MEASUREMENTS

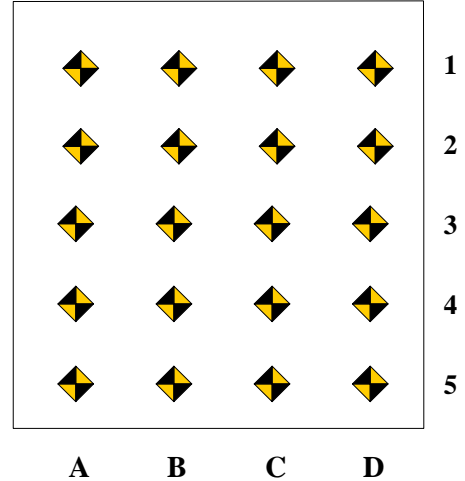
Test Vehicle: 2008 Saturn Outlook FWD XE
 Test Program: Left 40% Offset Deformable Barrier

NHTSA No.: R80176
 Test Date: 3/13/2008

Columns A through D are evenly spaced.

Rows 1 and 2 are on the toe kick portion of the floor pan. Rows 3, 4, and 5 are located on the most level portion of the floor pan.

Row 3 will be at the intersection of the toe kick and the level sections of the floor pan.



PASSENGER'S SIDE TOE PAN FLOOR BOARD

Intrusion Location	Pre-Test (mm)			Post-Test (mm)			Difference (mm)		
	X	Y	Z	X	Y	Z	X	Y	Z
A1	3774	254	21	3775	257	27	1	-3	-6
B1	3771	380	25	3772	383	28	1	-3	-3
C1	3768	508	21	3767	512	23	-1	-4	-2
D1	3706	627	21	3706	631	20	0	-4	1
A2	3700	259	80	3697	265	78	-3	-6	2
B2	3709	381	81	3710	385	84	1	-4	-3
C2	3703	502	75	3704	507	77	1	-5	-2
D2	3694	630	75	3694	636	73	0	-6	2
A3	3620	255	127	3616	264	120	-4	-9	7
B3	3593	381	138	3594	385	142	1	-4	-4
C3	3609	508	130	3610	513	133	1	-5	-3
D3	3615	625	125	3616	631	127	1	-6	-2
A4	3531	260	153	3522	262	153	-9	-2	0
B4	3520	385	146	3521	390	150	1	-5	-4
C4	3513	513	146	3513	519	149	0	-6	-3
D4	3517	635	146	3517	641	147	0	-6	-1
A5	3413	261	150	3415	265	151	2	-4	-1
B5	3418	383	152	3420	387	157	2	-4	-5
C5	3410	510	148	3410	514	151	0	-4	-3
D5	3410	633	148	3411	636	148	1	-3	0
Front Outboard Bolt	3987	635	96	3986	639	97	-1	-4	-1
IP Left	3354	261	-513	3353	261	-516	-1	0	3
IP Right	3356	562	-509	3356	562	-512	0	0	3

DATA SHEET 11
PHOTOGRAPHIC DATA

Test Vehicle: 2008 Saturn Outlook FWD XE
Test Program: Left 40% Offset Deformable Barrier

NHTSA No.: R80176
Test Date: 3/13/2008

No.	Camera View	Location (mm) *			Lens (mm)	Angle (deg)	Shutter (µs)	Speed (fps)
		X	Y	Z				
1	Left Front Half	610	-5060	1000	24	2.1	300	1000
2	Left SWC Bottom	775	-5550	965	50	1.3	350	1000
3	Left Angle 2	5815	-4600	2065	50	7.3	250	1000
4	Left Overall	1930	-7210	1225	19	4.2	750	1000
5	Right Front Half	462	5320	1040	24	2.2	350	1000
6	Onboard Driver Side				8	3.6	1000	1000
7	Onboard Driver Angle				6.5		1000	1000
8	Onboard Passenger Side				8	5.1	1000	1000
9	Windshield	-2285	0	2770	12.5	41.1	300	1000
10	Overhead Closeup	-610	-200	4440	50	90	250	1000
11	Overhead Overall	385	0	4630	14	90	600	1000
12	Pit Front	135	0	-3150	24	90	800	1000
13	Pit Rear	2150	0	-3150	24	90	800	1000
14	Real-Time Camera				13			24

*COORDINATES:

- +X = forward of impact plane
- +Y = right of monorail centerline
- +Z = above ground level

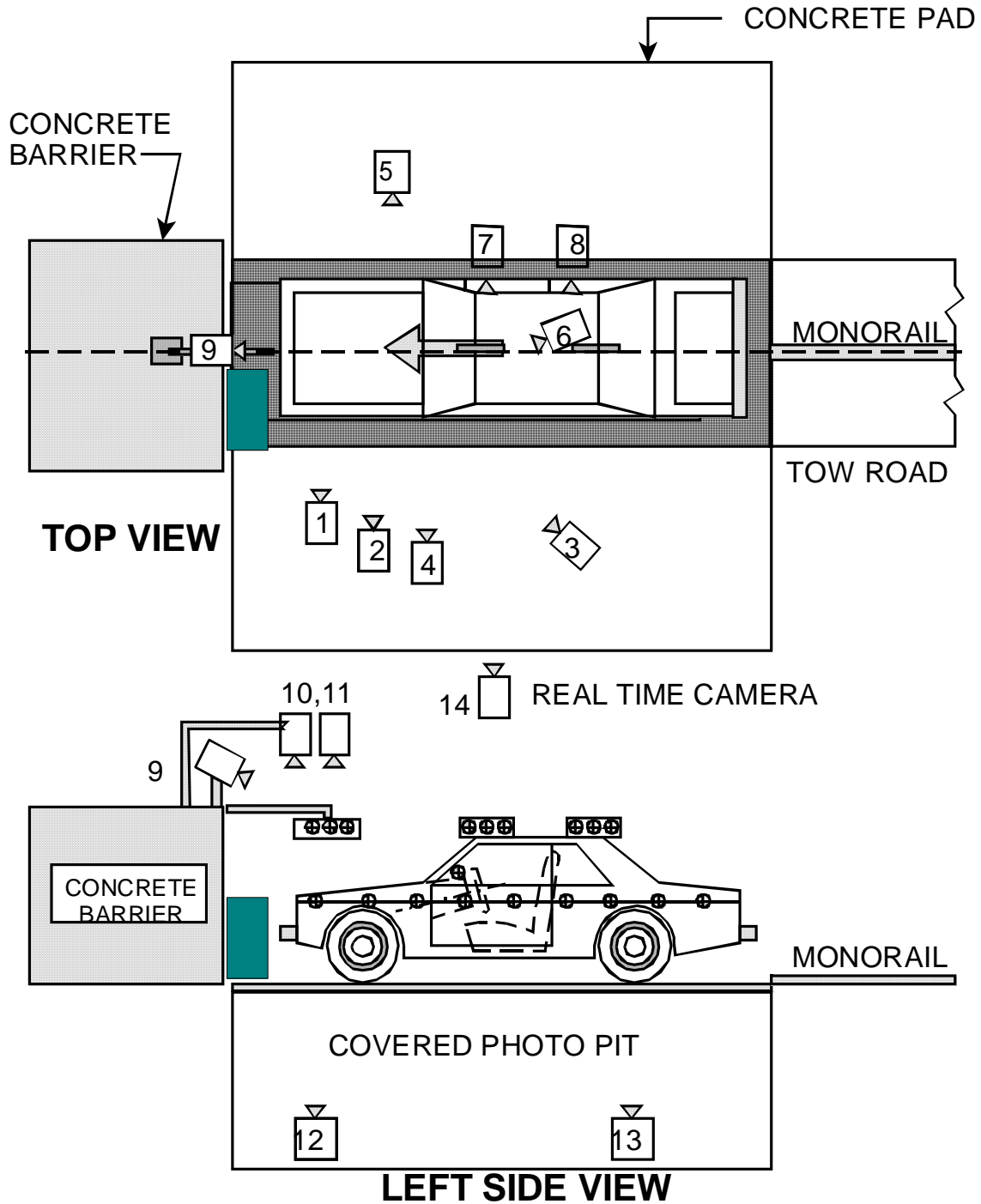
DATA SHEET 11 (CONTINUED)

PHOTOGRAPHIC DATA

Test Vehicle: 2008 Saturn Outlook FWD XE
Test Program: Left 40% Offset Deformable Barrier

NHTSA No.: R80176
Test Date: 3/13/2008

CAMERA POSITIONS FOR FRONTAL IMPACTS



DATA SHEET 12

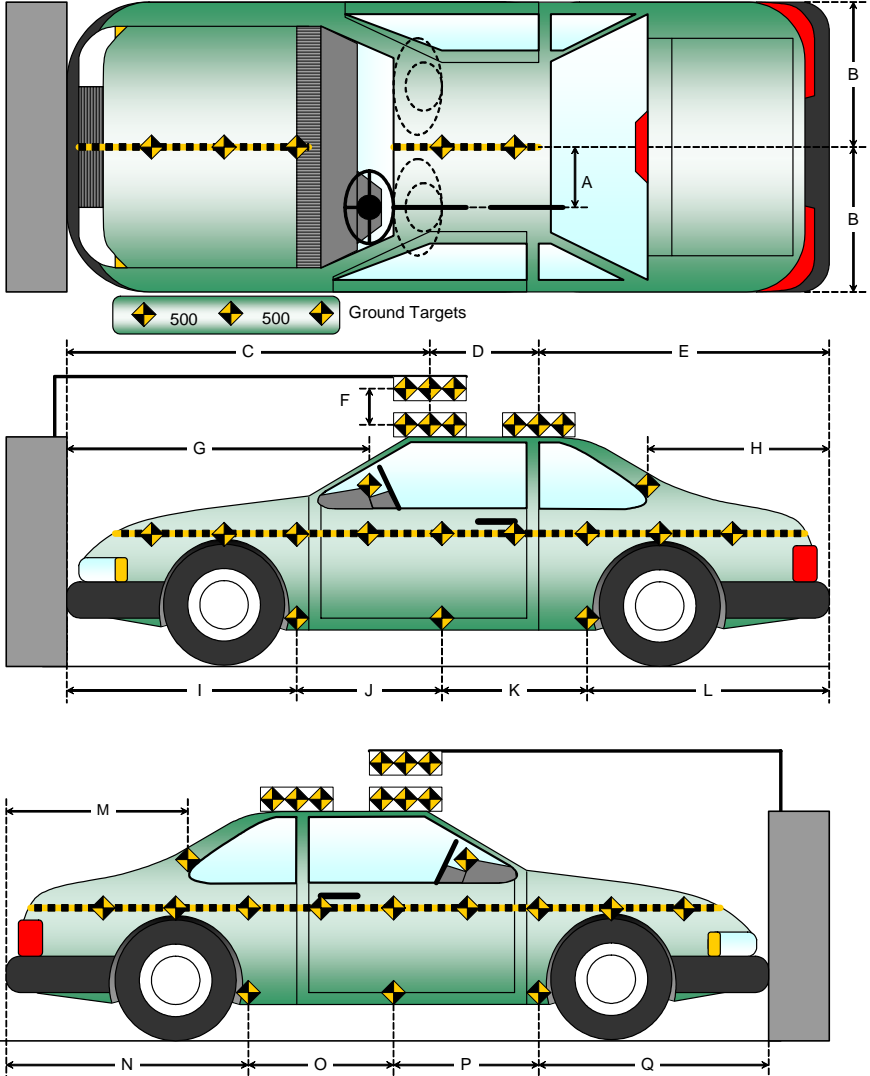
VEHICLE REFERENCE PHOTO TARGET LOCATIONS

Test Vehicle: 2008 Saturn Outlook FWD XE
 Test Program: Left 40% Offset Deformable Barrier

NHTSA No.: R80176
 Test Date: 3/13/2008

Measurement from roof to overhead cameras: 2860 mm

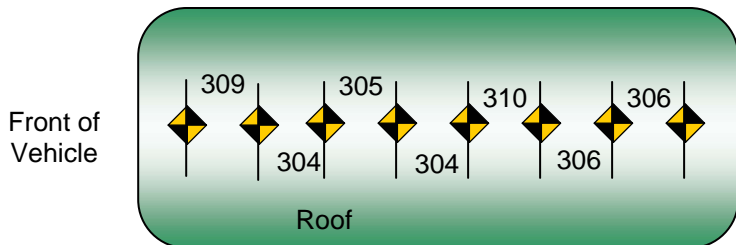
Item	Value
A	415
B	996
C	2495
D	915
E	1641
F	96
G	
H	1448
I	1467
J	1018
K	1022
L	1544
M	1468
N	1541
O	1025
P	1021
Q	1464



Distance between left rear door targets: 200 mm

Overhead camera to ground: 4630 mm

Measurement of roof targets:



DATA SHEET 13
POST TEST AIR BAG DATA

Test Vehicle: 2008 Saturn Outlook FWD XE
 Test Program: Left 40% Offset Deformable Barrier

NHTSA No.: R80176
 Test Date: 3/13/2008

Air Bag Data	Driver
Number of Vent Holes	2
Size of Vent Holes	30 mm diameter
Shape of Vent Holes	Round
Total Vent Area	1413 mm ²
Length of Deflated Airbag (if square)	
Width of Deflated Airbag (if square)	
Diameter of Deflated Airbag (if round)	610 mm
Is Airbag Tethered?	Yes
Length of Tethers	240 mm

Driver Airbag Part Numbers: MCBS2760967
 AB7219Z309710074
 0168510
 15777219

DATA SHEET 14

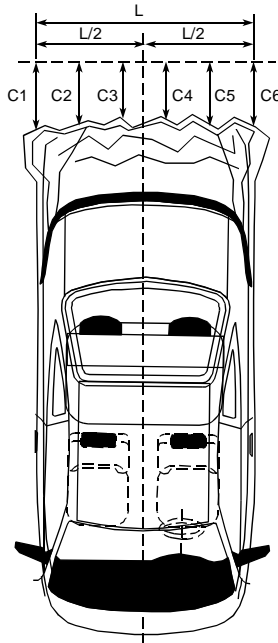
ACCIDENT INVESTIGATION DIVISION DATA

Test Vehicle: 2008 Saturn Outlook FWD XE
 Test Program: Left 40% Offset Deformable Barrier

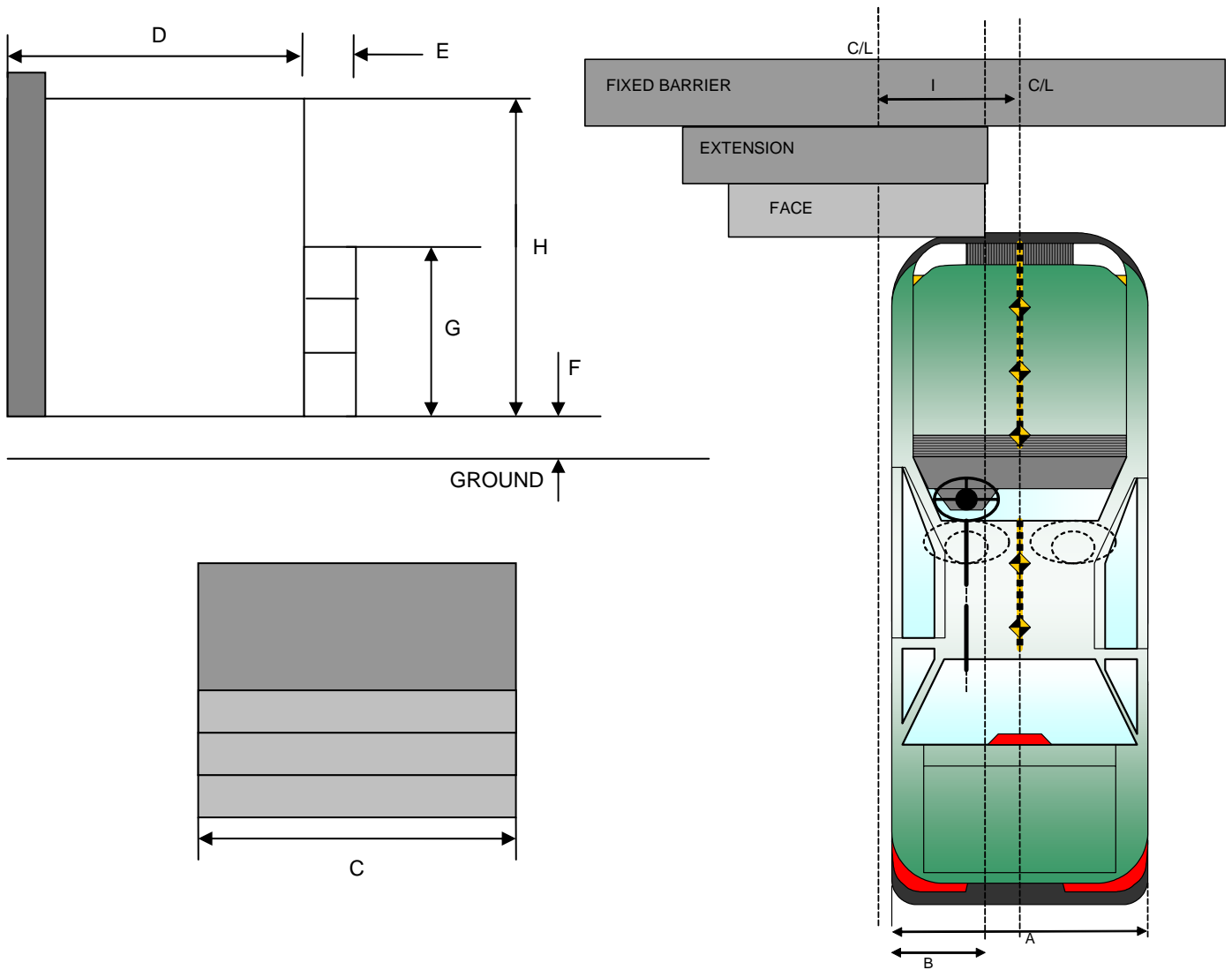
NHTSA No.: R80176
 Test Date: 3/13/2008

CRUSH DEPTH DIMENSIONS

No.	Measurement Description	Pre-Test (mm)	Post-Test (mm)	Difference (mm)
C1	Crush zone 1 at left side	4889	4497	392
C2	Crush zone 2 at left side	4969	4508	461
C3	Crush zone 3 at left side	5024	4496	528
C4	Crush zone 4 at right side	5026	4784	242
C5	Crush zone 5 at right side	4969	4891	78
C6	Crush zone 6 at right side	4889	4968	-79
L	C1 TO C6	1288	1158	130



DATA SHEET 15
OFFSET BARRIER AND VEHICLE ORIENTATION



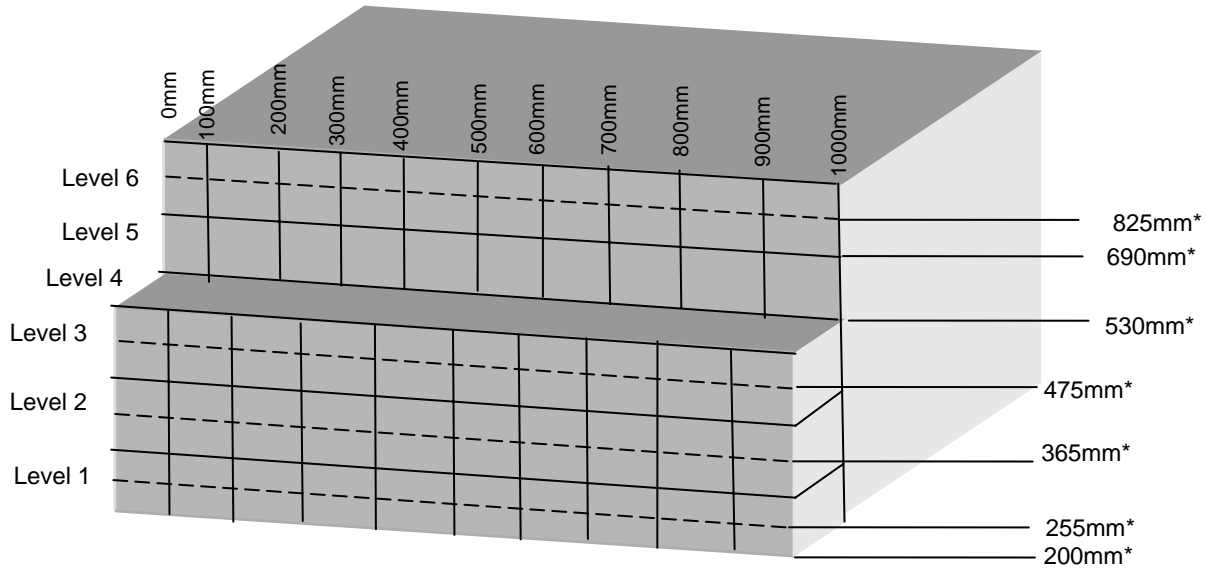
Location	Description	Measurement (mm)
A	Total Vehicle Width	2050
B	40% Overlap Distance	205
C	Deformable Face Width	1000
D	Single Stage Honeycomb Depth	450
E	Bumper Element Depth	90
F	Lower Edge Height From Ground	200
G	Bumper Element Height	330
H	Deformable Barrier Honeycomb Height	650
I	Offset Distance	705

DATA SHEET 16

DEFORMABLE BARRIER HONEYCOMB CRUSH

Test Vehicle: 2008 Saturn Outlook FWD XE
 Test Program: Left 40% Offset Deformable Barrier

NHTSA No.: R80176
 Test Date: 3/13/2008



*Measurement to Ground

	Points (mm)	Pre-Test (mm)	Post-Test (mm)	Difference (mm)
255 mm	0	545	417	128
	100	545	392	153
	200	545	369	176
	300	545	345	200
	400	545	320	225
	500	545	266	279
	600	545	119	426
	700	545	85	460
	800	545	72	473
	900	544	53	491
	1000	545	48	497
365 mm	0	545	444	101
	100	545	419	126
	200	545	393	152
	300	544	368	176
	400	544	355	189
	500	544	318	226
	600	544	146	398
	700	544	165	379
	800	544	156	388
	900	544	141	403
	1000	545	109	436

DATA SHEET 16 (CONTINUED)
DEFORMABLE BARRIER HONEYCOMB CRUSH

Test Vehicle: 2008 Saturn Outlook FWD XE
 Test Program: Left 40% Offset Deformable Barrier

NHTSA No.: R80176
 Test Date: 3/13/2008

	Points (mm)	Pre-Test (mm)	Post-Test (mm)	Difference (mm)
475 mm	0	545	445	100
	100	545	404	141
	200	544	380	164
	300	544	356	188
	400	544	322	222
	500	544	243	301
	600	544	85	459
	700	544	49	495
	800	544	84	460
	900	544	82	462
	1000	545	63	482
530 mm	0	454	413	41
	100	454	346	108
	200	454	313	141
	300	454	288	166
	400	453	263	190
	500	453	202	251
	600	453	61	392
	700	453	26	427
	800	453	37	416
	900	454	47	407
	1000	454	41	413
690 mm	0	454	449	5
	100	454	407	47
	200	454	355	99
	300	453	347	106
	400	453	335	118
	500	453	256	197
	600	453	156	297
	700	453	42	411
	800	453	49	404
	900	454	57	397
	1000	454	57	397
825 mm	0	454	457	-3
	100	454	438	16
	200	454	374	80
	300	453	370	83
	400	453	360	93
	500	453	281	172
	600	453	257	196
	700	453	215	238
	800	453	175	278
	900	453	122	331
	1000	454	165	289

DATA SHEET 17

DEFORMABLE BARRIER LOAD CELL LOCATIONS

Test Vehicle: 2008 Saturn Outlook FWD XE
Test Program: Left 40% Offset Deformable Barrier

NHTSA No.: R80176
Test Date: 3/13/2008

Row One	1	11	21	31	41	51	61	71	81
	2	12	22	32	42	52	62	72	82
	3	13	23	33	43	53	63	73	83
	4	14	24	34	44	54	64	74	84
	5	15	25	35	45	55	65	75	85
	6	16	26	36	46	56	66	76	86
	7	17	27	37	47	57	67	77	87
	8	18	28	38	48	58	68	78	88
	9	19	29	39	49	59	69	79	89
Row Ten	10	20	30	40	50	60	70	80	90

Track C/L

90 Load Cells
10 Rows
9 Columns

Front View

Load Cells measure 123 mm square and have a 1.5 mm gap.
Distance from LCB to ground measures 125 mm

APPENDIX A
PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

		<u>Page No.</u>
Photo No. 1.	Manufacturer's Label	A-1
Photo No. 2.	Tire Placard	A-1
Photo No. 3.	Left Front $\frac{3}{4}$ View, As Received	A-2
Photo No. 4.	Right Rear $\frac{3}{4}$ View, As Received	A-2
Photo No. 5.	Pre-Test Front View	A-3
Photo No. 6.	Post-Test Front View	A-3
Photo No. 7.	Pre-Test Left Side View	A-4
Photo No. 8.	Post-Test Left Side View	A-4
Photo No. 9.	Pre-Test Right Side View	A-5
Photo No. 10.	Post-Test Right Side View	A-5
Photo No. 11.	Pre-Test Right Front $\frac{3}{4}$ View	A-6
Photo No. 12.	Post-Test Right Front $\frac{3}{4}$ View	A-6
Photo No. 13.	Pre-Test Left Front $\frac{3}{4}$ View	A-7
Photo No. 14.	Post-Test Left Front $\frac{3}{4}$ View	A-7
Photo No. 15.	Pre-Test Left Rear $\frac{3}{4}$ View	A-8
Photo No. 16.	Post-Test Left Rear $\frac{3}{4}$ View	A-8
Photo No. 17.	Pre-Test Left Side $\frac{3}{4}$ View of Doors	A-9
Photo No. 18.	Post-Test Left Side $\frac{3}{4}$ View of Doors After Impact	A-9
Photo No. 19.	Pre-Test Right Side $\frac{3}{4}$ View of Doors	A-10
Photo No. 20.	Post-Test Right Side $\frac{3}{4}$ View of Doors After Impact	A-10
Photo No. 21.	Pre-Test Windshield View	A-11
Photo No. 22.	Post-Test Windshield View	A-11
Photo No. 23.	Pre-Test Engine Compartment View	A-12
Photo No. 24.	Post-Test Engine Compartment View	A-12
Photo No. 25.	Pre-Test Fuel Cap View	A-13
Photo No. 26.	Post-Test Fuel Cap View	A-13
Photo No. 27.	Pre-Test Front Underbody View	A-14
Photo No. 28.	Post-Test Front Underbody View	A-14

Page No.

Photo No. 29.	Pre-Test Mid Underbody View	A-15
Photo No. 30.	Post-Test Mid Underbody View	A-15
Photo No. 31.	Pre-Test Rear Underbody View	A-16
Photo No. 32.	Post-Test Rear Underbody View	A-16
Photo No. 33.	Pre-Test Driver Dummy Front View (Head Position)	A-17
Photo No. 34.	Post-Test Driver Dummy Front View (Head Position)	A-17
Photo No. 35.	Pre-Test Driver Dummy (Through Window)	A-18
Photo No. 36.	Post-Test Driver Dummy (Through Window)	A-18
Photo No. 37.	Pre-Test Driver Dummy (Door Open)	A-19
Photo No. 38.	Post-Test Driver Dummy (Door Open)	A-19
Photo No. 39.	Pre-Test Driver Dummy Abdomen View Close-Up	A-20
Photo No. 40.	Post-Test Driver Dummy Abdomen View Close-Up	A-20
Photo No. 41.	Pre-Test Driver Dummy Feet	A-21
Photo No. 42.	Post-Test Driver Dummy Feet	A-21
Photo No. 43.	Pre-Test Driver Dummy Foot/Leg Close-Up	A-22
Photo No. 44.	Post-Test Driver Dummy Foot/Leg Close-Up	A-22
Photo No. 45.	Pre-Test Driver Side Knee Bolster	A-23
Photo No. 46.	Post-Test Driver Side Knee Bolster	A-23
Photo No. 47.	Pre-Test Driver Side Floor Pan	A-24
Photo No. 48.	Post-Test Driver Side Floor Pan	A-24
Photo No. 49.	Post-Test Driver Dummy Head Contact (headrest and CAB)	A-25
Photo No. 50.	Post-Test Driver Dummy Knee Contact	A-25
Photo No. 51.	Post-Test Driver Dummy Airbag Contact	A-26
Photo No. 52.	Pre-Test Left Rear Passenger Dummy (Through Window)	A-27
Photo No. 53.	Post-Test Left Rear Passenger Dummy (Through Window)	A-27
Photo No. 54.	Pre-Test Left Rear Passenger Dummy (Door Open)	A-28
Photo No. 55.	Post-Test Left Rear Passenger Dummy (Door Open)	A-28
Photo No. 56.	Pre-Test Left Rear Passenger Dummy Leg Position View	A-29
Photo No. 57.	Post-Test Left Rear Passenger Dummy Leg Position View	A-29
Photo No. 58.	Pre-Test Left Rear Passenger Dummy Feet Position View	A-30

Page No.

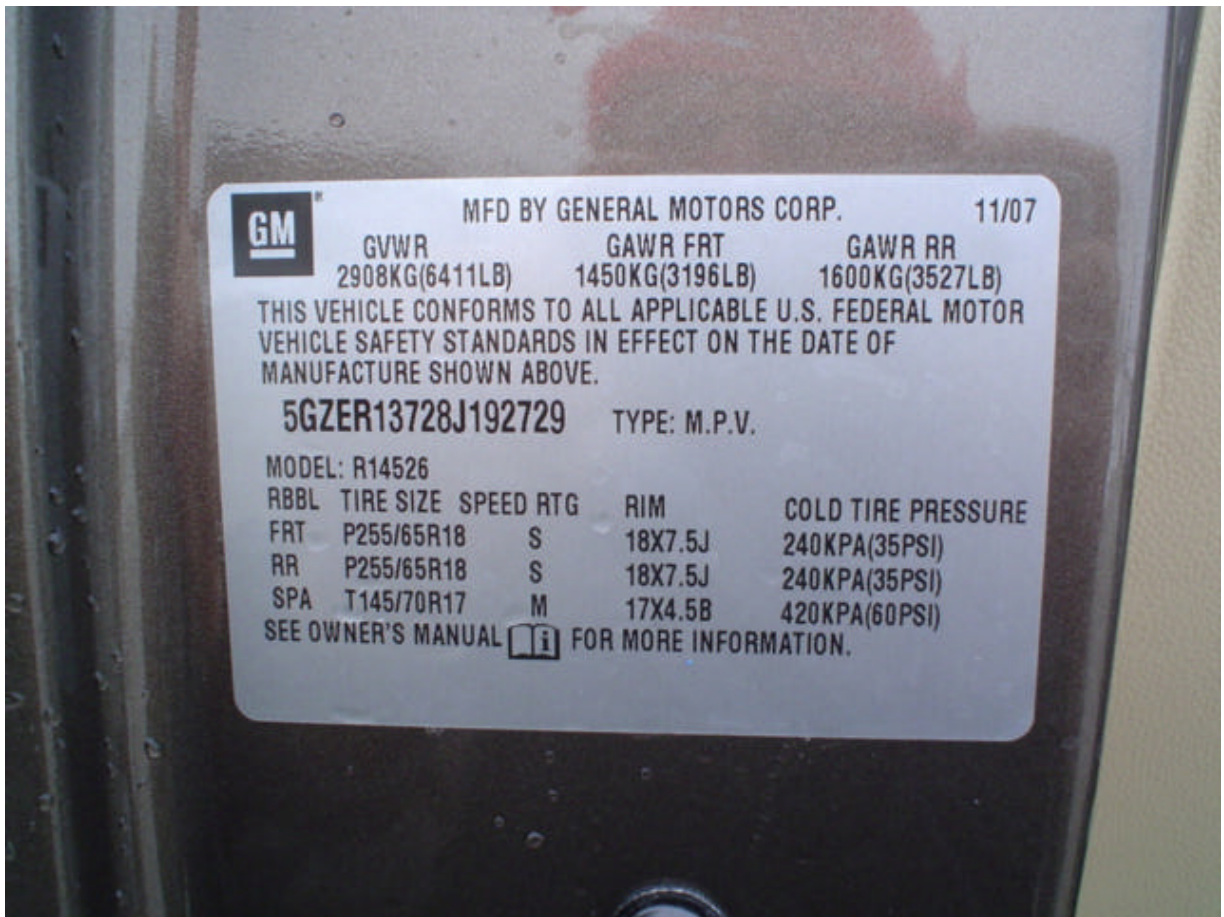
Photo No. 59.	Post-Test Left Rear Passenger Dummy Feet Position View	A-30
Photo No. 60.	Pre-Test Left Rear Passenger Dummy Right Side View	A-31
Photo No. 61.	Post-Test Left Rear Passenger Dummy Right Side View	A-31
Photo No. 62.	Post-Test Left Rear Passenger Dummy Head Contact View	A-32
Photo No. 63.	Post-Test Left Rear Passenger Dummy Foot Contact View	A-32
Photo No. 64.	Post-Test Offset Deformable Barrier Front View	A-33
Photo No. 65.	Post-Test Offset Deformable Barrier Left Side View	A-33
Photo No. 66.	Post-Test Offset Deformable Barrier Left Side $\frac{3}{4}$ View	A-34
Photo No. 67.	Post-Test Offset Deformable Barrier Right Side View	A-34
Photo No. 68.	Post-Test Offset Deformable Barrier Right Side $\frac{3}{4}$ View	A-35
Photo No. 69.	Post-Test Offset Deformable Barrier Overhead View	A-35
Photo No. 70.	Vehicle Impact	A-36
Photo No. 71.	Pre-Test Left Side A Pillar (Frontal View)	A-37
Photo No. 72.	Post-Test Left Side A Pillar (Frontal View)	A-37
Photo No. 73.	Pre-Test Left Side A Pillar ($\frac{3}{4}$ Frontal View)	A-38
Photo No. 74.	Post-Test Left Side A Pillar ($\frac{3}{4}$ Frontal View)	A-38
Photo No. 75.	Pre-Test Left Side A Pillar	A-39
Photo No. 76.	Post-Test Left Side A Pillar	A-39
Photo No. 77.	Pre-Test Left Side B Pillar (Side View)	A-40
Photo No. 78.	Post-Test Left Side B Pillar (Side View)	A-40
Photo No. 79.	Pre-Test Left Side B Pillar	A-41
Photo No. 80.	Post-Test Left Side B Pillar	A-41
Photo No. 81.	Pre-Test Left Side C Pillar	A-42
Photo No. 82.	Post-Test Left Side C Pillar	A-42
Photo No. 83.	Pre-Test Left Side Sill Front Half View	A-43
Photo No. 84.	Post-Test Left Side Sill Front Half View	A-43
Photo No. 85.	Pre-Test Left Side Sill Rear Half View	A-44
Photo No. 86.	Post-Test Left Side Sill Rear Half View	A-44
Photo No. 87.	Pre-Test Right Side A Pillar	A-45
Photo No. 88.	Post-Test Right Side A Pillar	A-45

Page No.

Photo No. 89.	Pre-Test Right Side B Pillar	A-46
Photo No. 90.	Post-Test Right Side B Pillar	A-46
Photo No. 91.	Pre-Test Right Side C Pillar	A-47
Photo No. 92.	Post-Test Right Side C Pillar	A-47
Photo No. 93.	Pre-Test Right Side Sill Front Half View	A-48
Photo No. 94.	Post-Test Right Side Sill Front Half View	A-48
Photo No. 95.	Pre-Test Right Side Sill Rear Half View	A-49
Photo No. 96.	Post-Test Right Side Sill Rear Half View	A-49
Photo No. 97.	Pre-Test Left Side Rocker View	A-50
Photo No. 98.	Post-Test Left Side Rocker View	A-50
Photo No. 99.	Pre-Test Left Front Wheel Well	A-51
Photo No. 100.	Post-Test Left Front Wheel Well	A-51
Photo No. 101.	Pre-Test Left Front Shotgun	A-52
Photo No. 102.	Post-Test Left Front Shotgun	A-52
Photo No. 103.	Pre-Test Steering Rack View	A-53
Photo No. 104.	Post-Test Steering Rack View	A-53
Photo No. 105.	Pre-Test Steering Rack $\frac{3}{4}$ Left Side View	A-54
Photo No. 106.	Post-Test Steering Rack $\frac{3}{4}$ Left Side View	A-54
Photo No. 107.	Pre-Test Steering Rack $\frac{3}{4}$ Right Side View	A-55
Photo No. 108.	Post-Test Steering Rack $\frac{3}{4}$ Right Side View	A-55
Photo No. 109.	Pre-Test Sway Bar View	A-56
Photo No. 110.	Post-Test Sway Bar View	A-56
Photo No. 111.	Pre-Test Sway Bar Left Side View	A-57
Photo No. 112.	Post-Test Sway Bar Left Side View	A-57
Photo No. 113.	Pre-Test Sway Bar Right Side View	A-58
Photo No. 114.	Post-Test Sway Bar Right Side View	A-58
Photo No. 115.	Pre-Test Bumper to Rail Attachment View	A-59
Photo No. 116.	Post-Test Bumper to Rail Attachment View	A-59
Photo No. 117.	Pre-Test Front Underbody	A-60
Photo No. 118.	Post-Test Front Underbody	A-60

Page No.

Photo No. 119.	Pre-Test Front Underbody Perpendicular View	A-61
Photo No. 120.	Post-Test Front Underbody Perpendicular View	A-61
Photo No. 121.	Pre-Test Mid Underbody Perpendicular View	A-62
Photo No. 122.	Post-Test Mid Underbody Perpendicular View	A-62
Photo No. 123.	Pre-Test Rear Underbody Perpendicular View	A-63
Photo No. 124.	Post-Test Rear Underbody Perpendicular View	A-63
Photo No. 125.	Pre-Test Left Front Wheel Contact View	A-64
Photo No. 126.	Post-Test Left Front Wheel Contact View	A-64
Photo No. 127.	Pre-Test Left Front Wheel Contact Close Up View	A-65
Photo No. 128.	Post-Test Left Front Wheel Contact Close Up View	A-65
Photo No. 129.	Pre-Test Over Toepan/ Floorpan Left of Seat, Seat Cushion Height	A-66
Photo No. 130.	Post-Test Over Toepan/ Floorpan Left of Seat, Seat Cushion Height	A-66
Photo No. 131.	Pre-Test Over Toepan/ Floorpan Left of Seat, Sill Height	A-67
Photo No. 132.	Post-Test Over Toepan/ Floorpan Left of Seat, Sill Height	A-67
Photo No. 133.	Pre-Test Over Toepan/ Floorpan Center of Seat, Seat Cushion Height	A-68
Photo No. 134.	Post-Test Over Toepan/ Floorpan Center of Seat, Seat Cushion Height	A-68
Photo No. 135.	Pre-Test Over Toepan/ Floorpan Right of Seat, Seat Cushion Height	A-69
Photo No. 136.	Post-Test Over Toepan/ Floorpan Right of Seat, Seat Cushion Height	A-69
Photo No. 137.	Pre-Test Over Toepan/ Floorpan Right of Seat, Sill Height	A-70
Photo No. 138.	Post-Test Over Toepan/ Floorpan Right of Seat, Sill Height	A-70
Photo No. 139.	Pre-Test Footrest Seat Cushion Height	A-71
Photo No. 140.	Post-Test Footrest Seat Cushion Height	A-71
Photo No. 141.	Pre-Test Footrest Seat Sill Height	A-72
Photo No. 142.	Post-Test Footrest Seat Sill Height	A-72
Photo No. 143.	Pre-Test Accelerometer Pedal Close Up	A-73
Photo No. 144.	Post-Test Accelerometer Pedal Close Up	A-73
Photo No. 145.	Pre-Test Accelerometer Pedal	A-74
Photo No. 146.	Post-Test Accelerometer Pedal	A-74
Photo No. 147.	Pre-Test Right Side Floorpan, Center of Seat, Seat Cushion Height	A-75
Photo No. 148.	Post-Test Right Side Floorpan, Center of Seat, Seat Cushion Height	A-75



Manufacturer's Label



Tire Placard



Left Front ¾ View, As Received



Right Rear ¾ View, As Received



Pre-Test Front View



Post-Test Front View



Pre-Test Left Side View



Post-Test Left Side View



Pre-Test Right Side View



Post-Test Right Side View



Pre-Test Right Front ¾ View



Post-Test Right Front ¾ View



Pre-Test Left Front $\frac{3}{4}$ View



Post-Test Left Front $\frac{3}{4}$ View



Pre-Test Left Rear 3/4 View



Post-Test Left Rear 3/4 View



Pre-Test Left Side $\frac{3}{4}$ View of Doors



Post-Test Left Side $\frac{3}{4}$ View of Doors After Impact



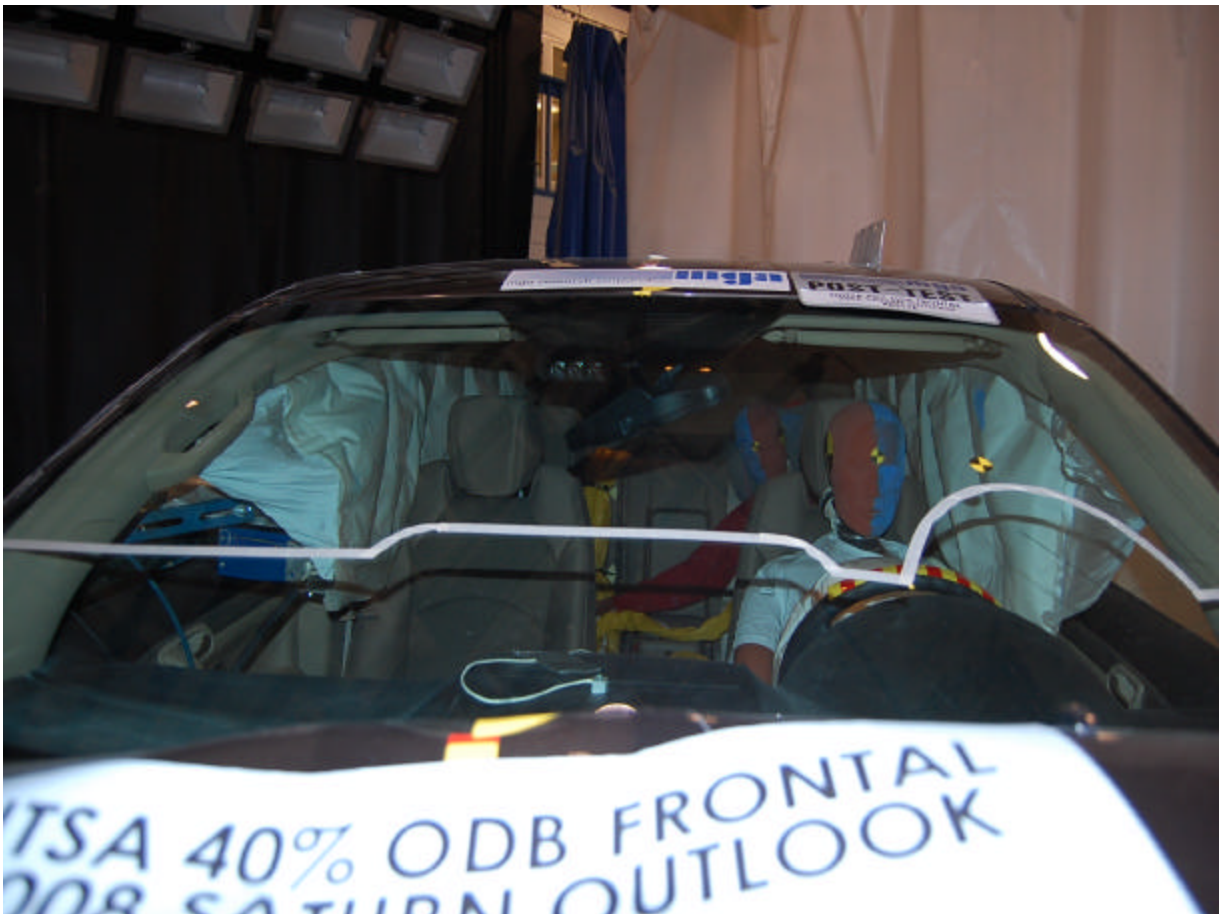
Pre-Test Right Side ¾ View of Doors



Post-Test Right Side ¾ View of Doors After Impact



Pre-Test Windshield View



Post-Test Windshield View



Pre-Test Engine Compartment View



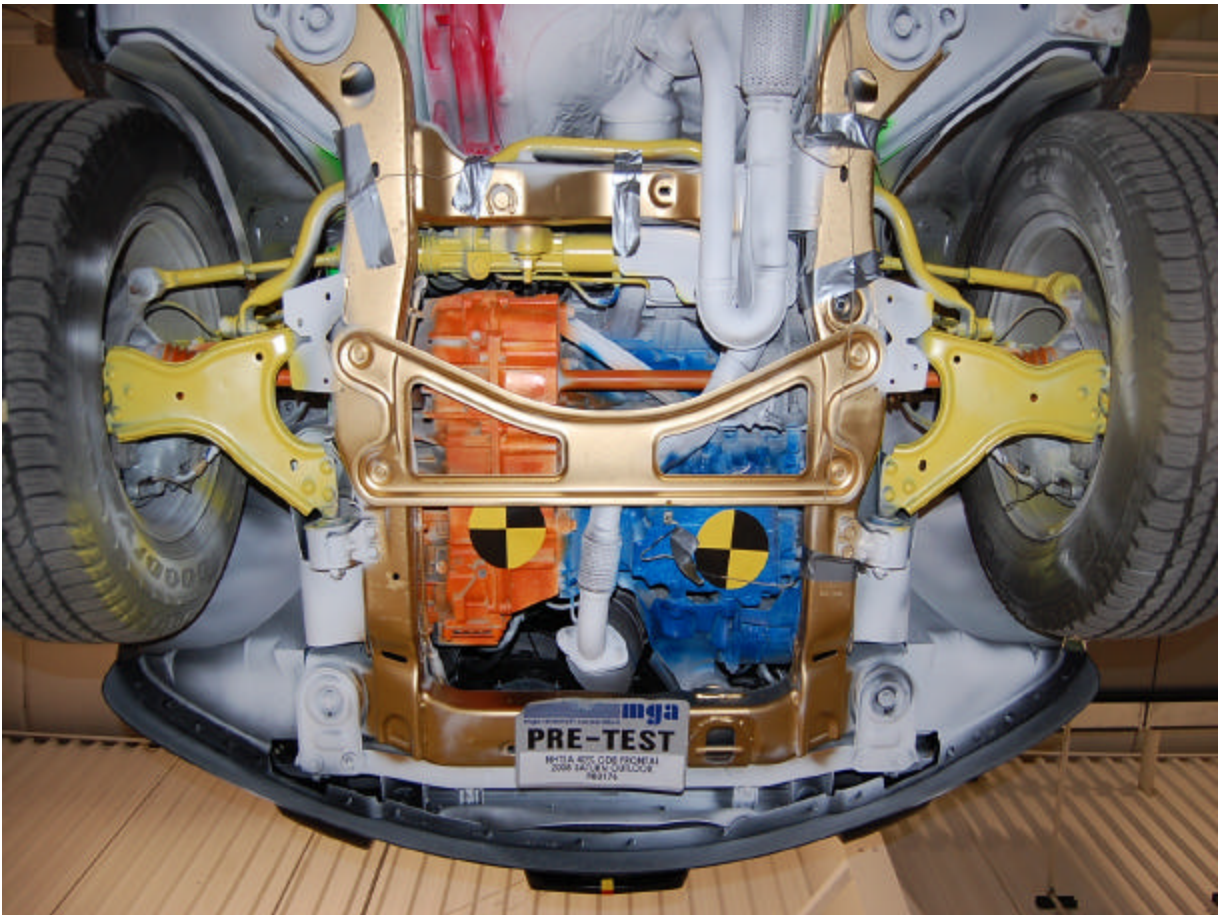
Post-Test Engine Compartment View



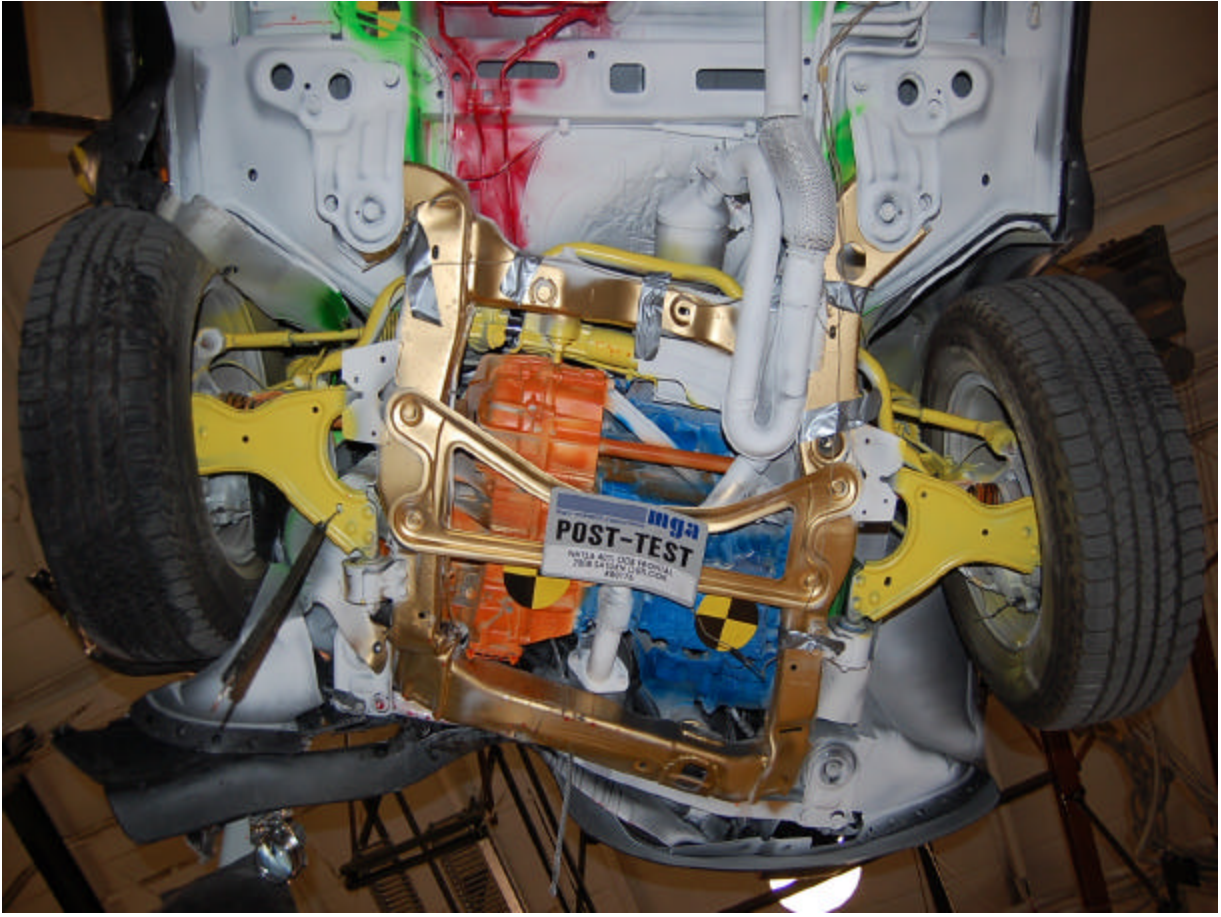
Pre-Test Fuel Cap View



Post-Test Fuel Cap View



Pre-Test Front Underbody View



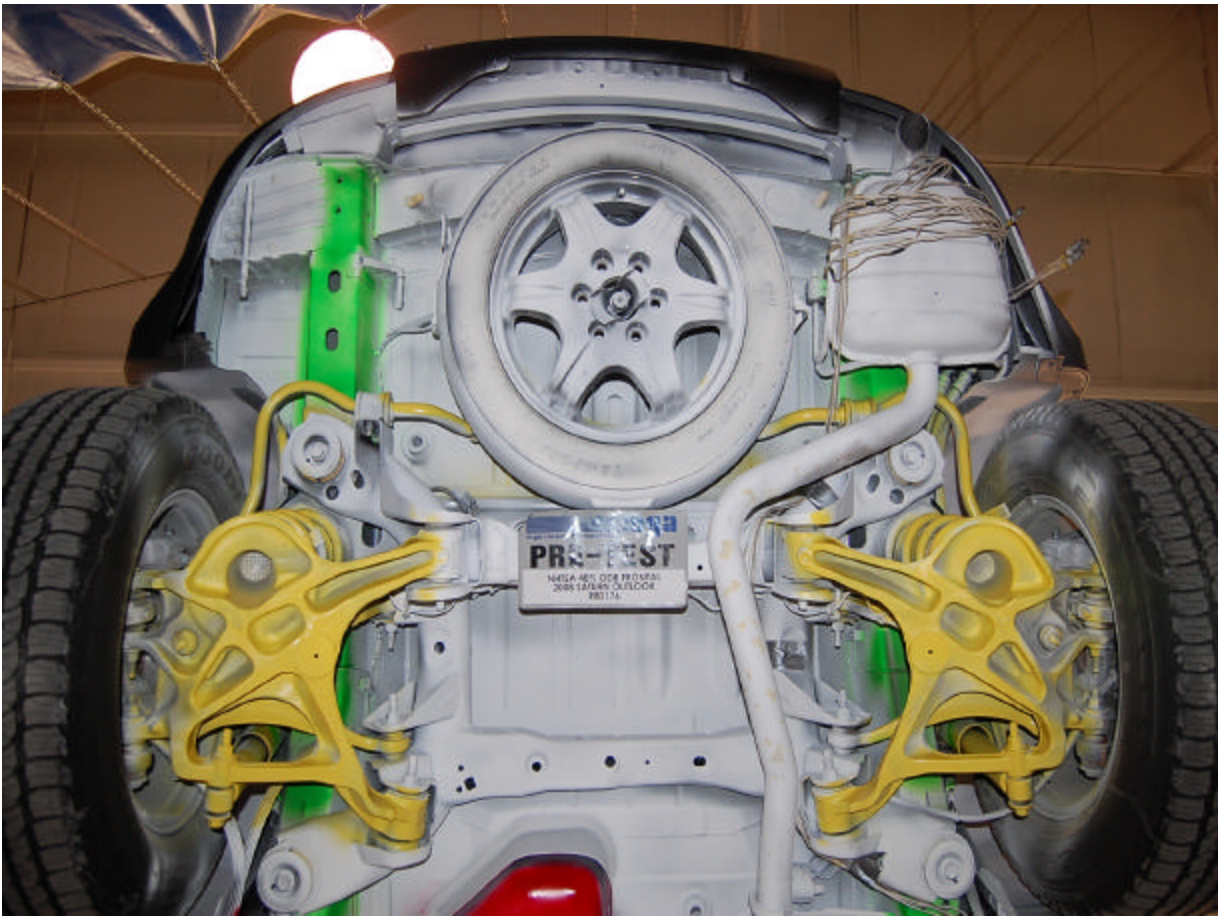
Post-Test Front Underbody View



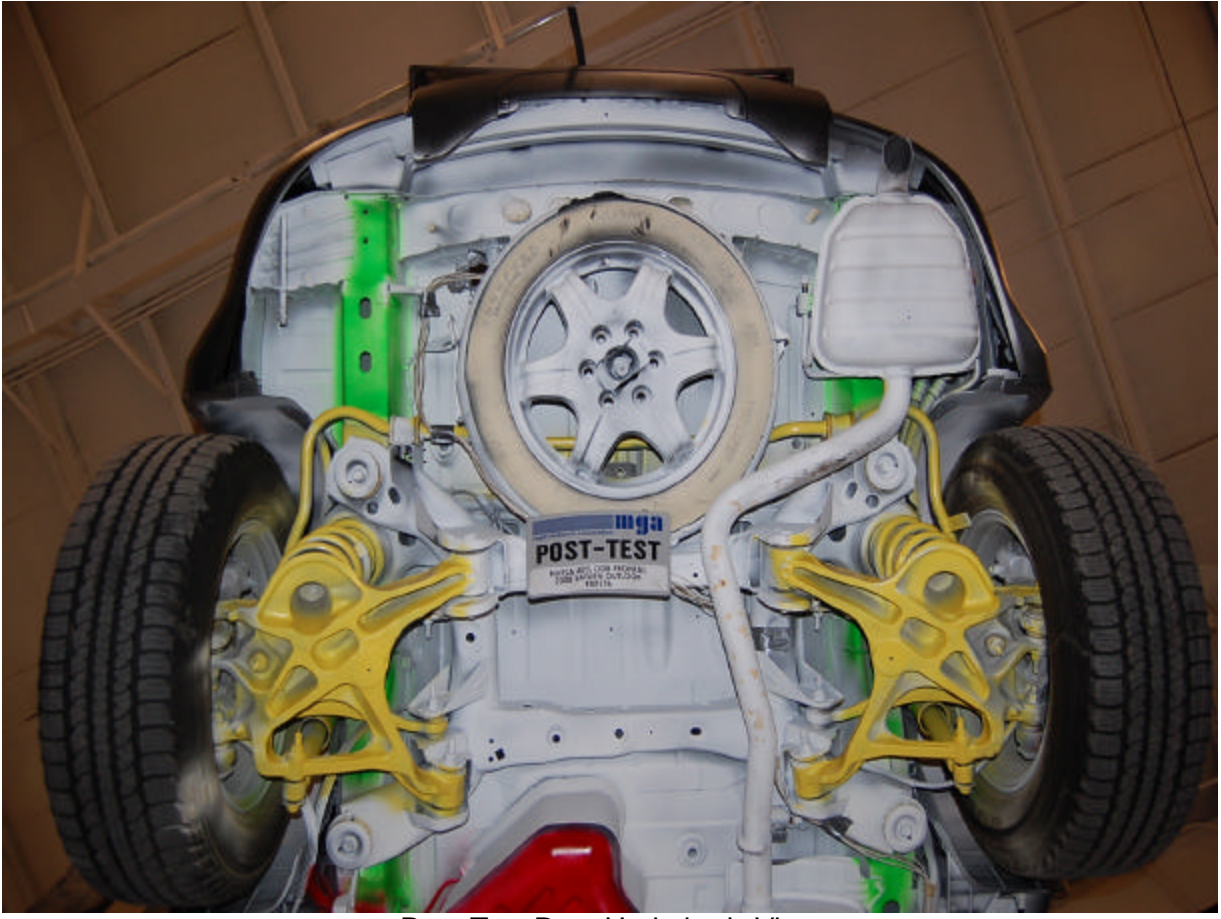
Pre-Test Mid Underbody View



Post-Test Mid Underbody View



Pre-Test Rear Underbody View



Post-Test Rear Underbody View



Pre-Test Driver Dummy Front View (Head Position)



Post-Test Driver Dummy Front View (Head Position)



Pre-Test Driver Dummy (Through Window)



Post-Test Driver Dummy (Through Window)



Pre-Test Driver Dummy (Door Open)



Post-Test Driver Dummy (Door Open)



Pre-Test Driver Dummy Abdomen View Close-Up



Post-Test Driver Dummy Abdomen View Close-Up



Pre-Test Driver Dummy Feet



Post-Test Driver Dummy Feet



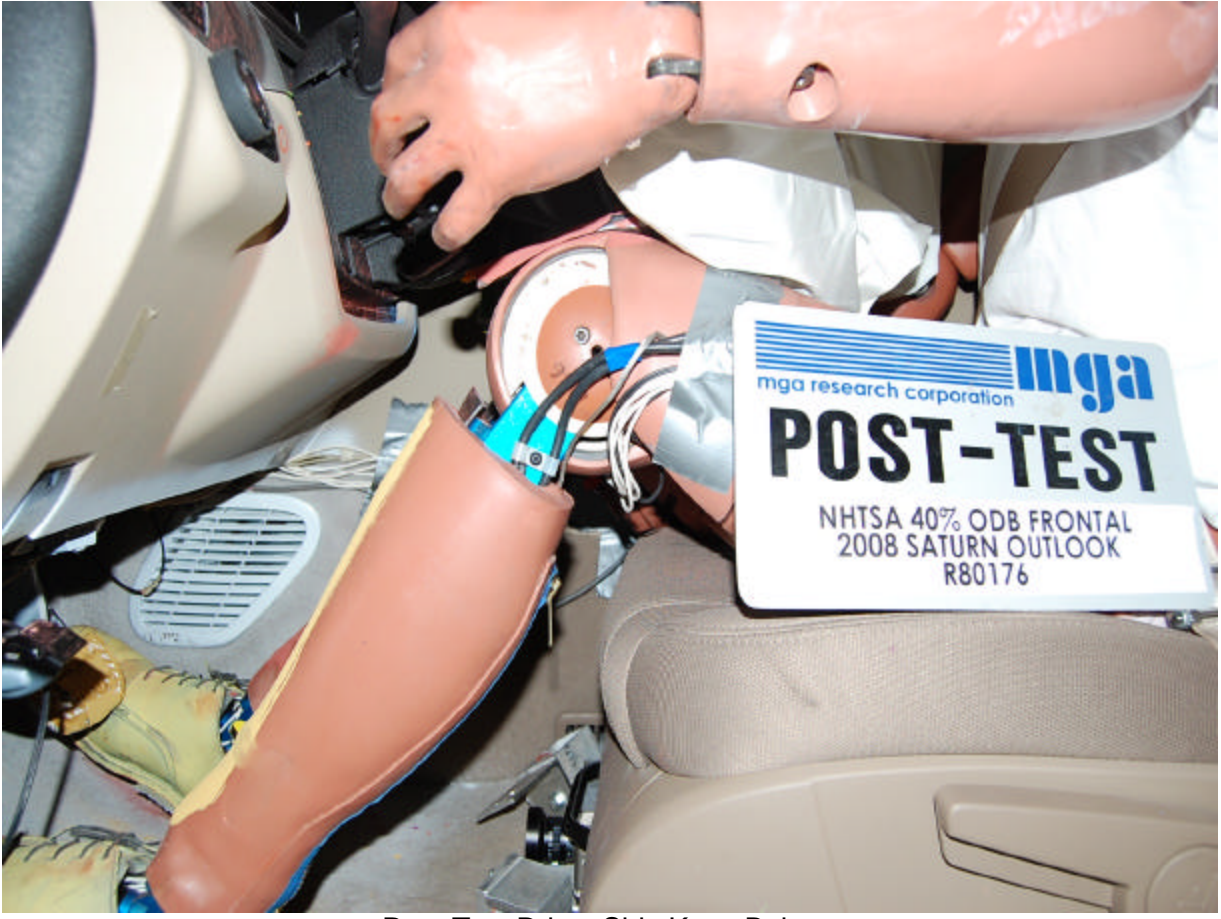
Pre-Test Driver Dummy Foot/Leg Close-Up



Post-Test Driver Dummy Foot/Leg Close-Up



Pre-Test Driver Side Knee Bolster



Post-Test Driver Side Knee Bolster



Pre-Test Driver Side Floor Pan



Post-Test Driver Side Floor Pan



Post-Test Driver Dummy Head Contact (headrest and CAB)



Post-Test Driver Dummy Knee Contact



Post-Test Driver Dummy Airbag Contact



Pre-Test Left Rear Passenger Dummy (Through Window)



Post-Test Left Rear Passenger Dummy (Left Side View)



Pre-Test Left Rear Passenger Dummy (Door Open)



Post-Test Left Rear Passenger Dummy (Door Open)



Pre-Test Left Rear Passenger Dummy Leg Position View



Post-Test Left Rear Passenger Dummy Leg Position View



Pre-Test Left Rear Passenger Dummy Feet Position View



Post-Test Left Rear Passenger Dummy Feet Position View



Pre-Test Left Rear Passenger Dummy Right Side View



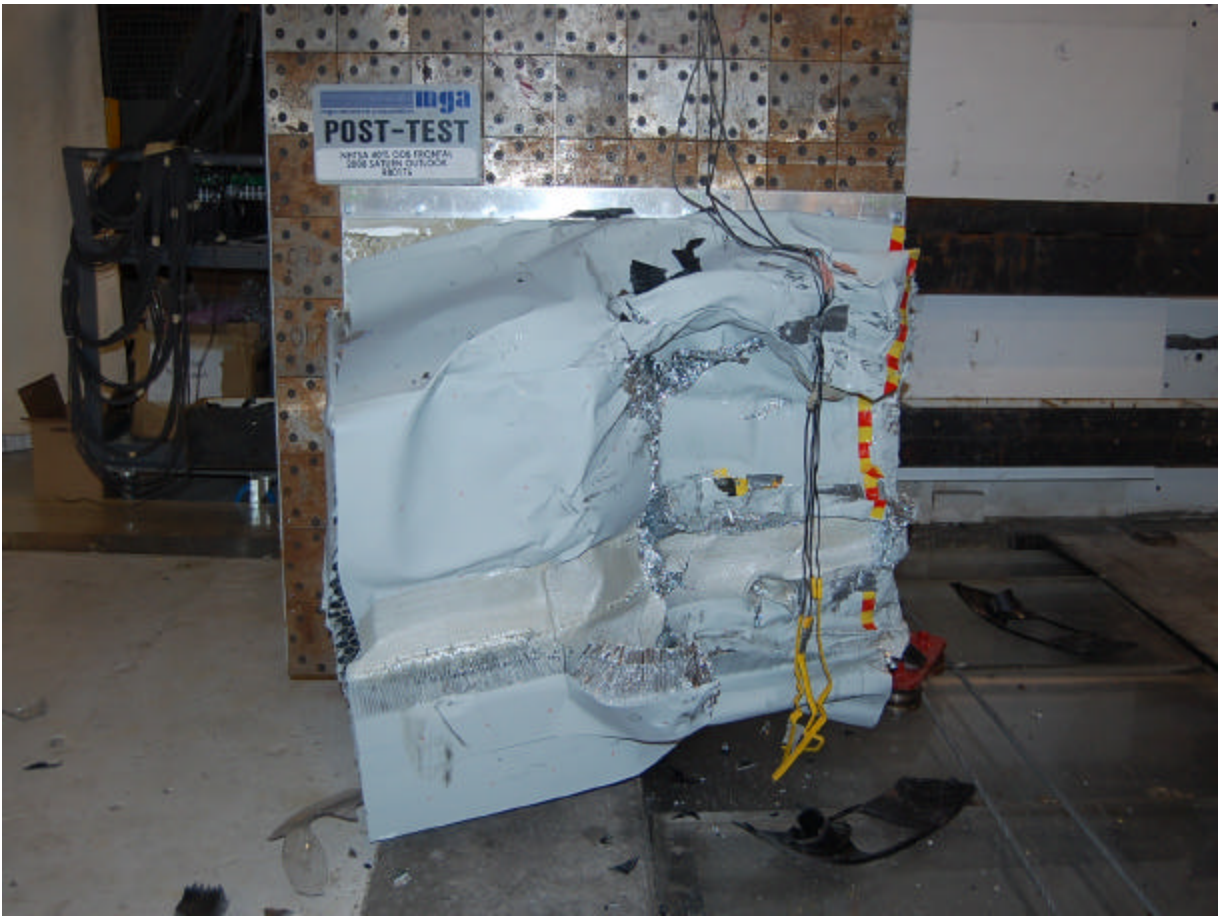
Post-Test Left Rear Passenger Dummy Right Side View



Post-Test Left Rear Passenger Dummy Head Contact View



Post-Test Left Rear Passenger Dummy Foot Contact View



Post-Test Offset Deformable Barrier Front View



Post-Test Offset Deformable Barrier Left Side View



Post-Test Offset Deformable Barrier Left Side ¾ View



Post-Test Offset Deformable Barrier Right Side View



Post-Test Offset Deformable Barrier Right Side $\frac{3}{4}$ View



Post-Test Offset Deformable Barrier Overhead View



Vehicle Impact



Pre-Test Left Side A Pillar (Frontal View)



Post-Test Left Side A Pillar (Frontal View)



Pre-Test Left Side A Pillar (3/4 Frontal View)



Post-Test Left Side A Pillar (3/4 Frontal View)



Pre-Test Left Side A Pillar



Post-Test Left Side A Pillar



Pre-Test Left Side B Pillar (Side View)



Post-Test Left Side B Pillar (Side View)



Pre-Test Left Side B Pillar



Post-Test Left Side B Pillar



Pre-Test Left Side C Pillar



Post-Test Left Side C Pillar



Pre-Test Left Side Sill Front Half View



Post-Test Left Side Sill Front Half View



Pre-Test Left Side Sill Rear Half View



Post-Test Left Side Sill Rear Half View



Pre-Test Right Side A Pillar



Post-Test Right Side A Pillar



Pre-Test Right Side B Pillar



Post-Test Right Side B Pillar



Pre-Test Right Side C Pillar



Post-Test Right Side C Pillar



Pre-Test Right Side Sill Front Half View



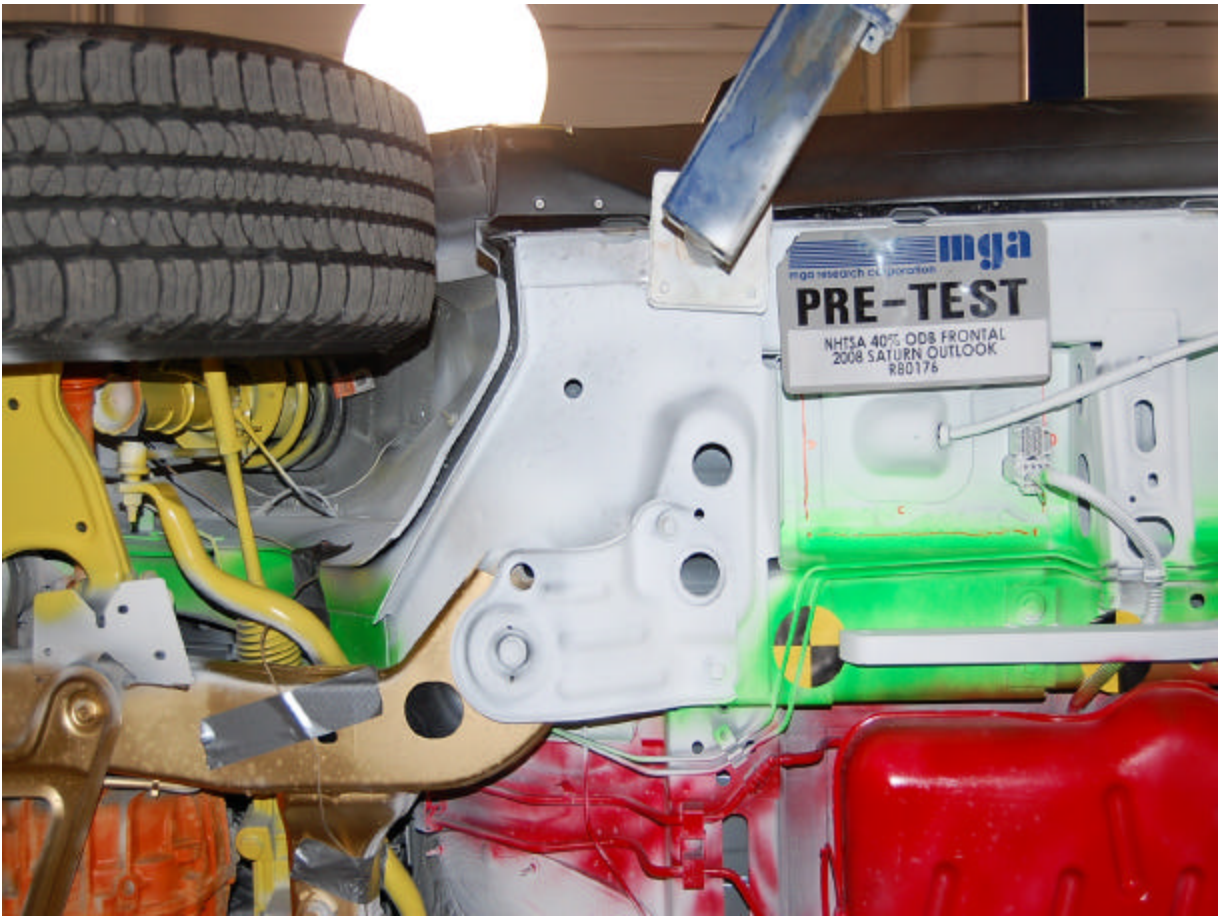
Post-Test Right Side Sill Front Half View



Pre-Test Right Side Sill Rear Half View



Post-Test Right Side Sill Rear Half View



Pre-Test Left Side Rocker View



Post-Test Left Side Rocker View



Pre-Test Left Front Wheel Well



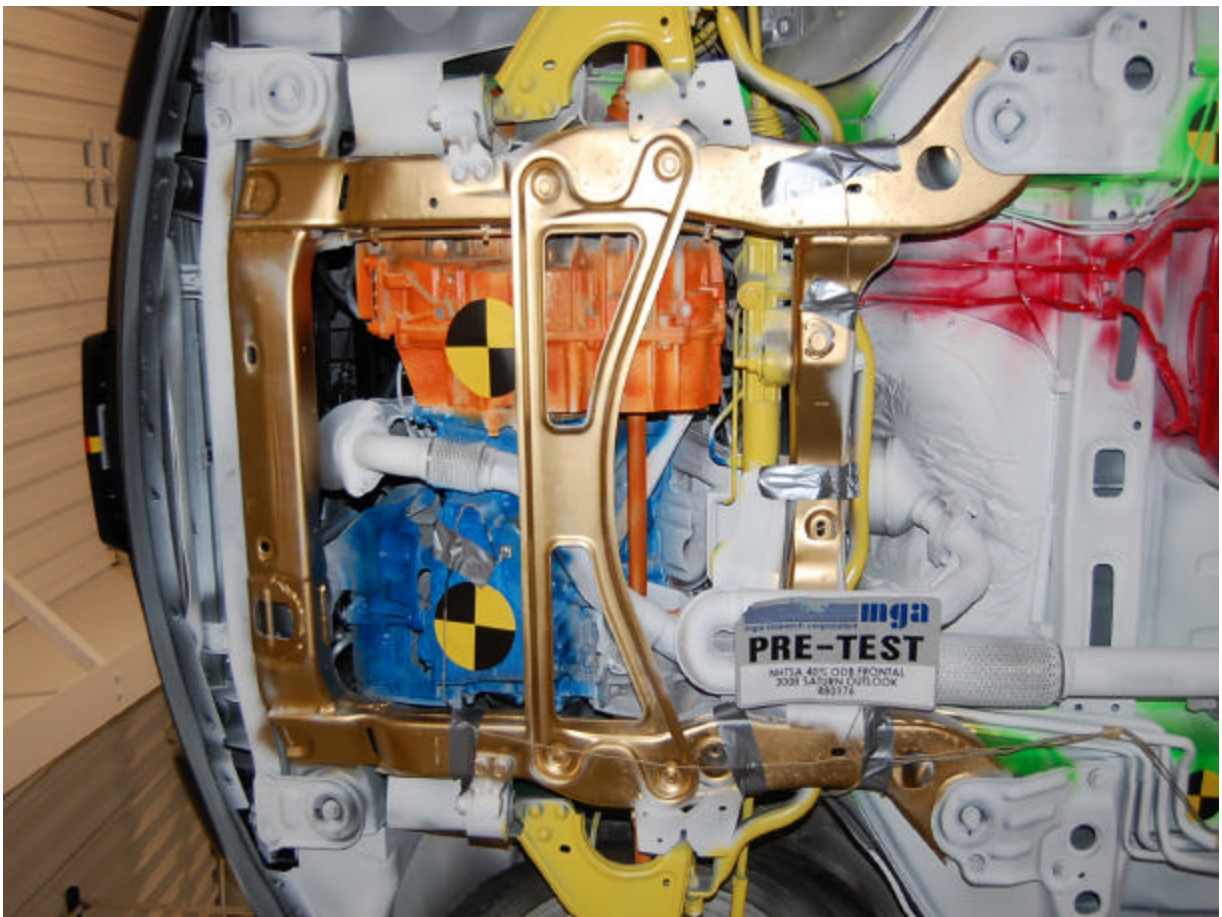
Post-Test Left Front Wheel Well



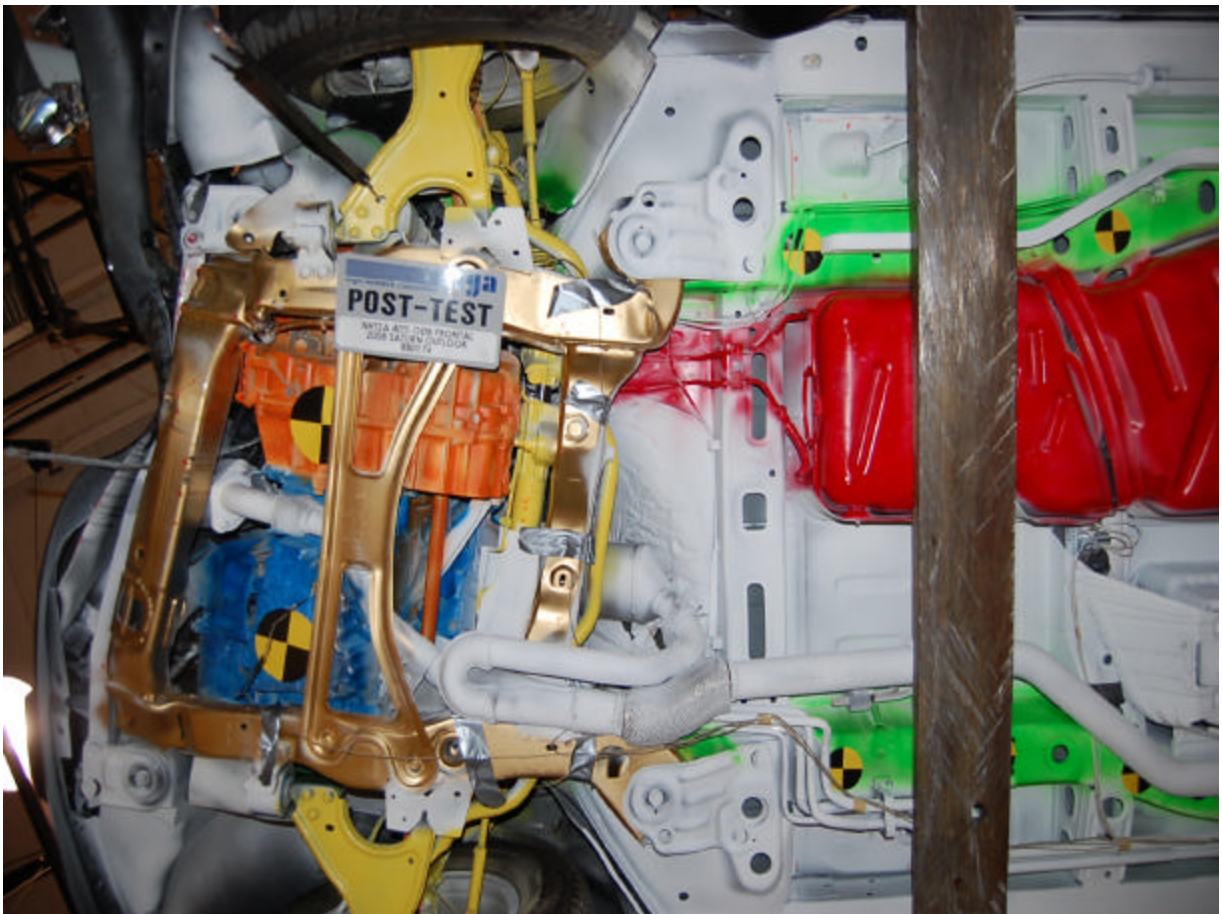
Pre-Test Left Front Shotgun



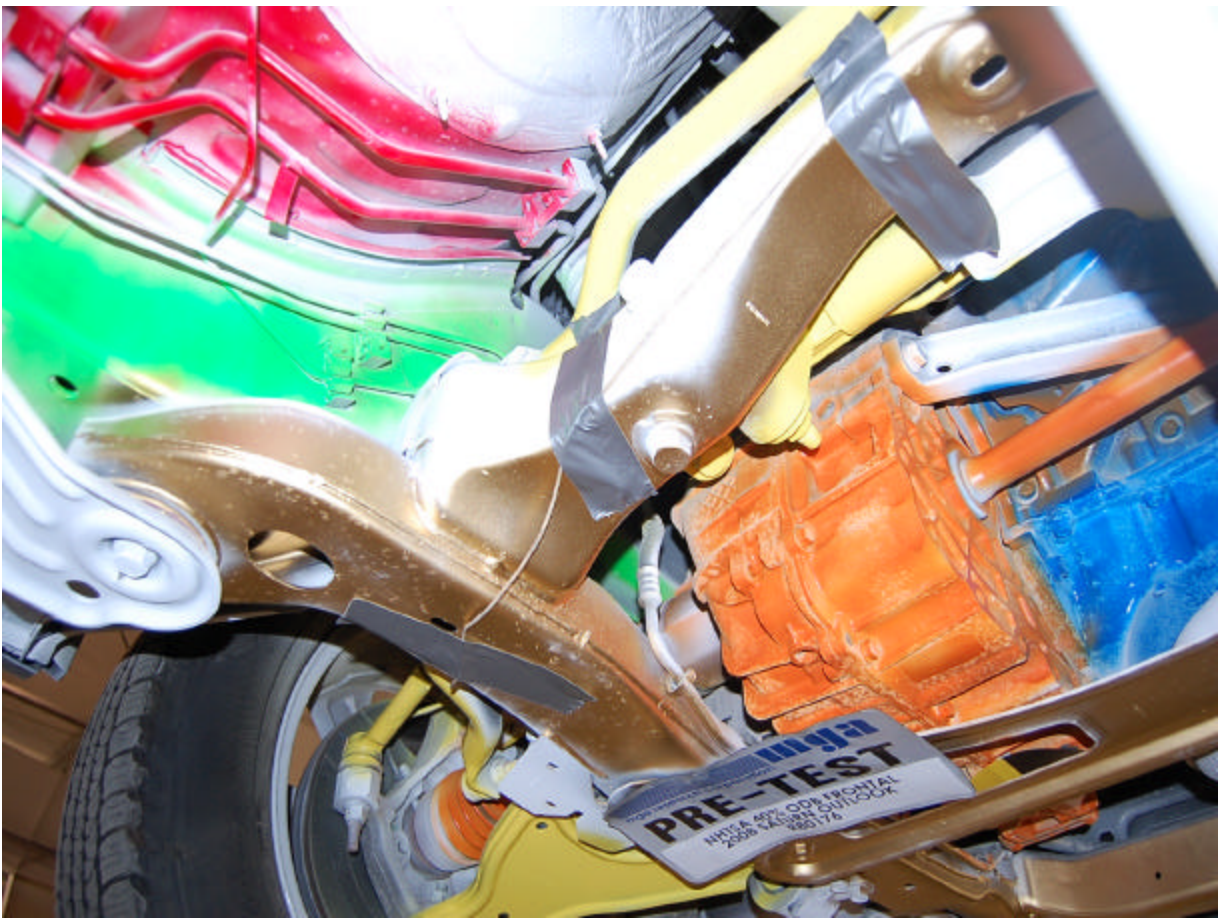
Post-Test Left Front Shotgun



Pre-Test Steering Rack View



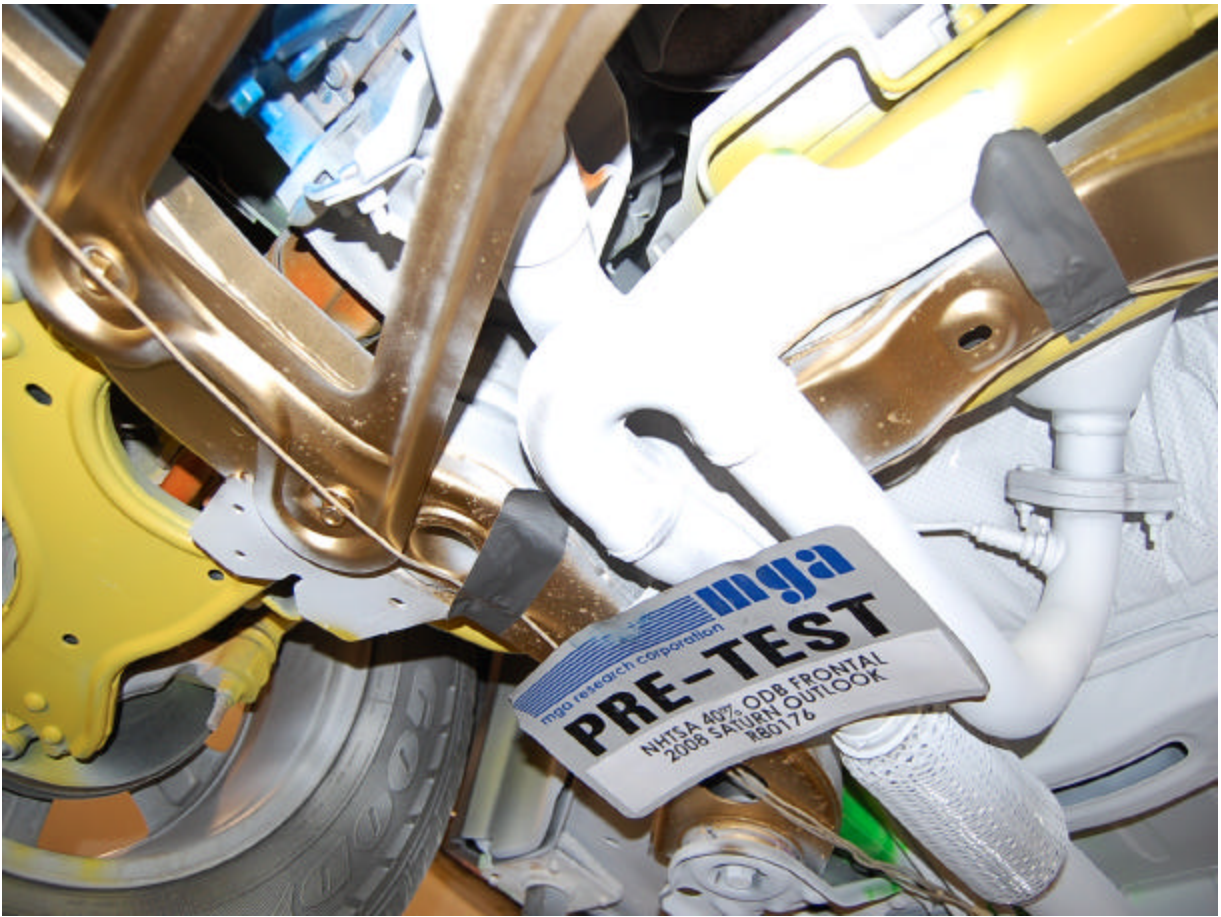
Post-Test Steering Rack View



Pre-Test Steering Rack $\frac{3}{4}$ Left Side View



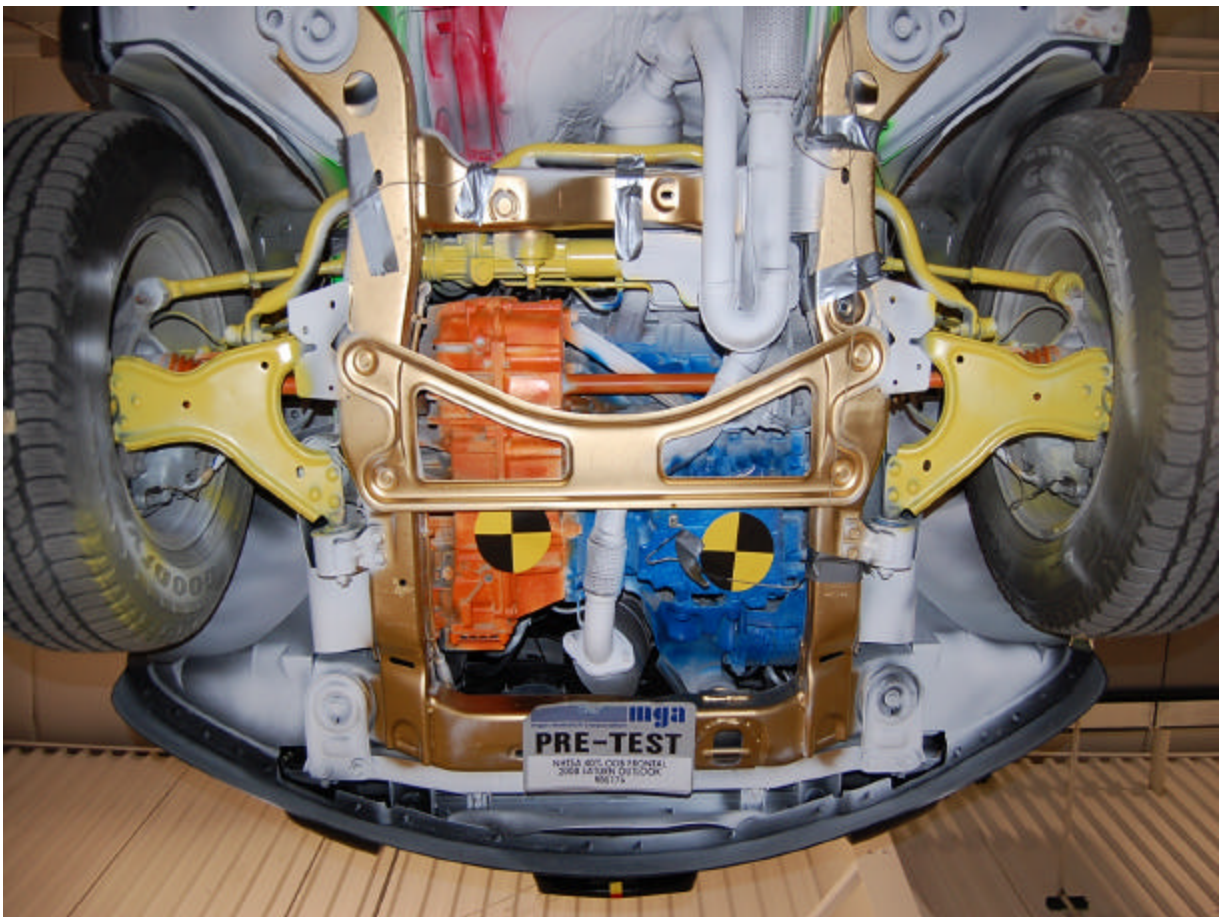
Post-Test Steering Rack $\frac{3}{4}$ Left Side View



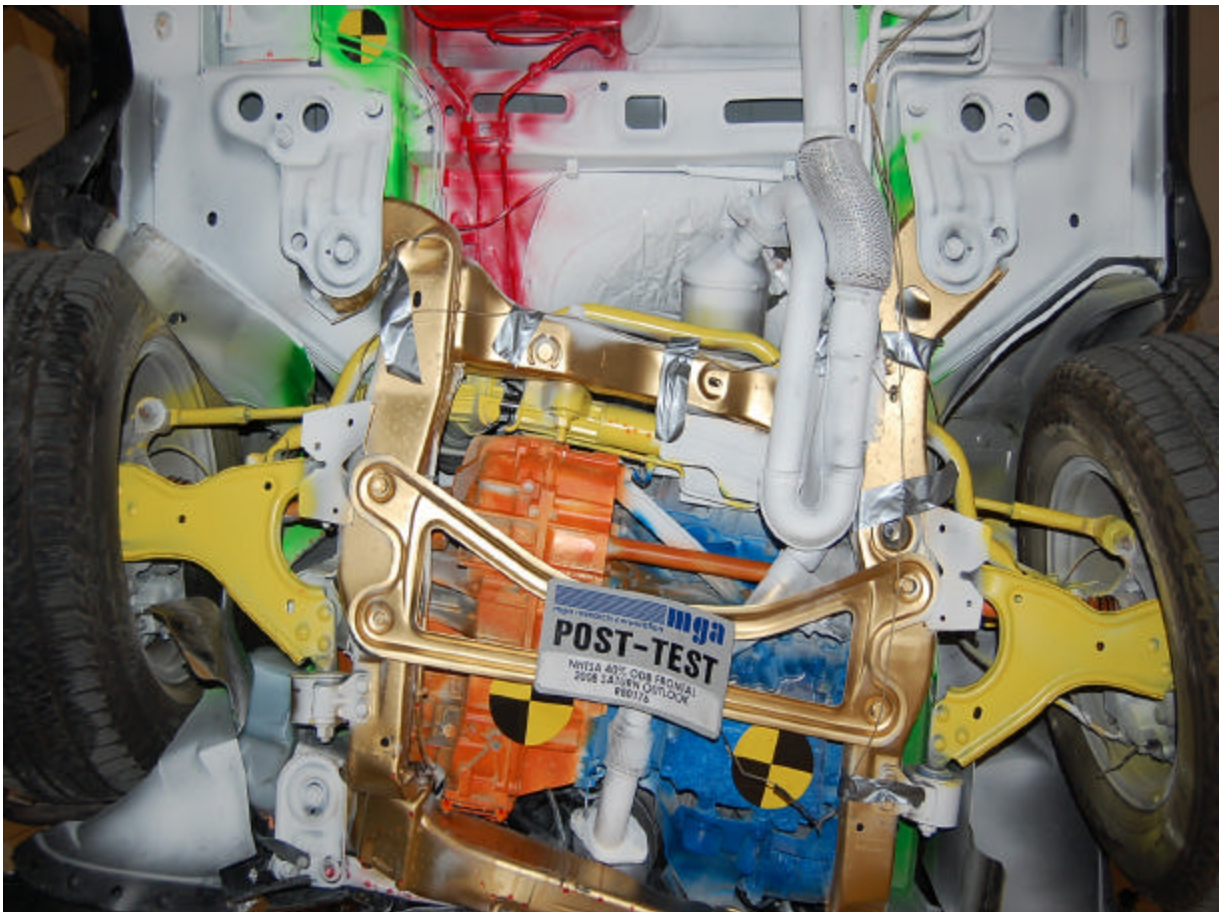
Pre-Test Steering Rack $\frac{3}{4}$ Right Side View



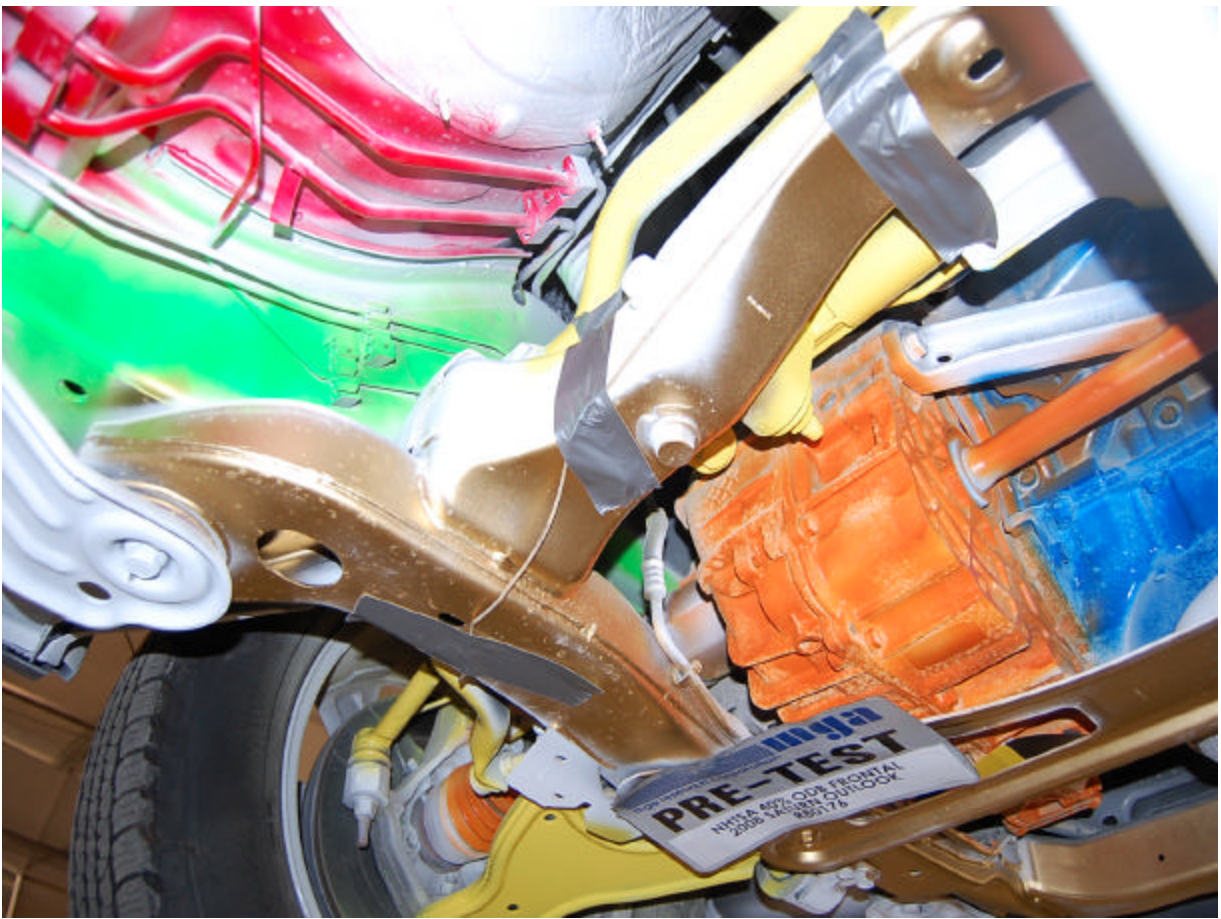
Post-Test Steering Rack $\frac{3}{4}$ Right Side View



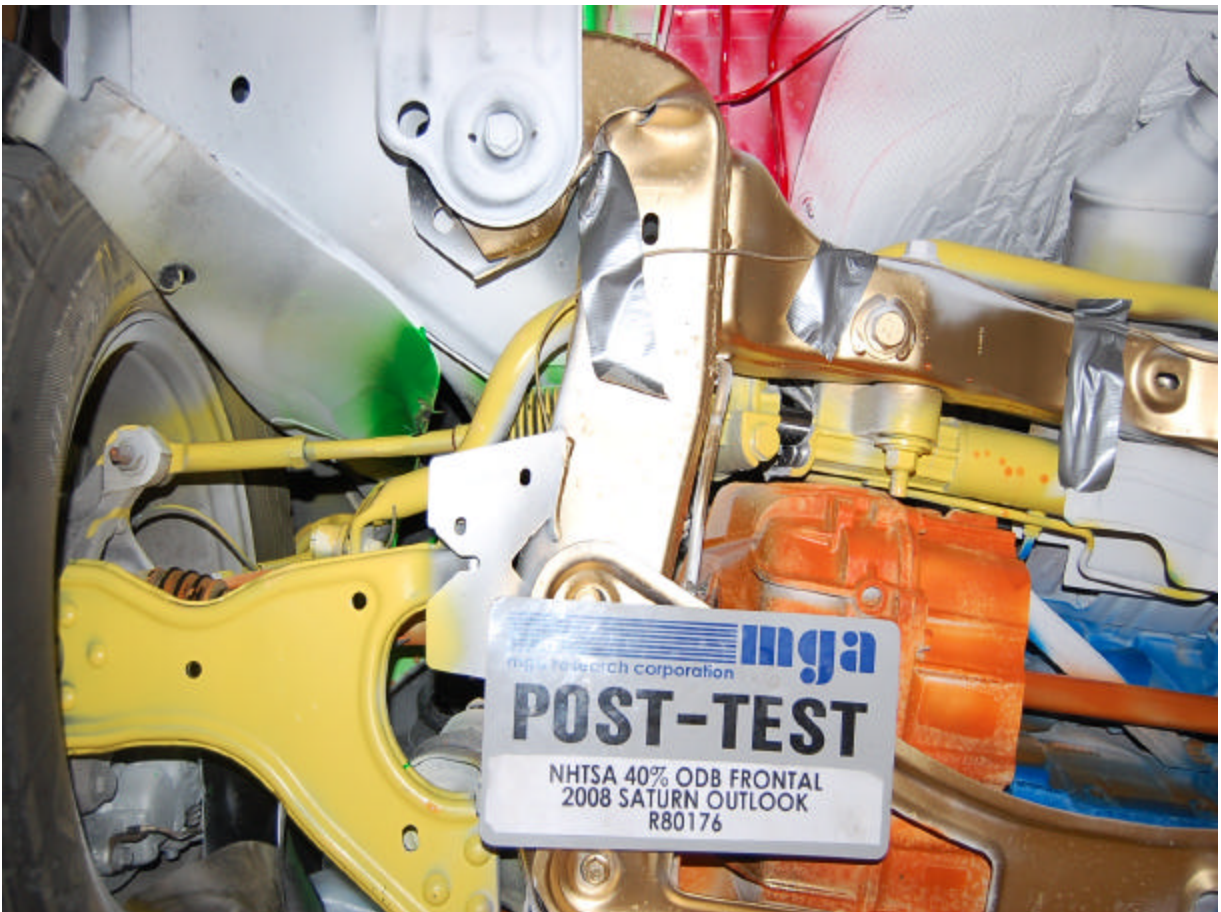
Pre-Test Sway Bar View



Post-Test Sway Bar View



Pre-Test Sway Bar Left Side View



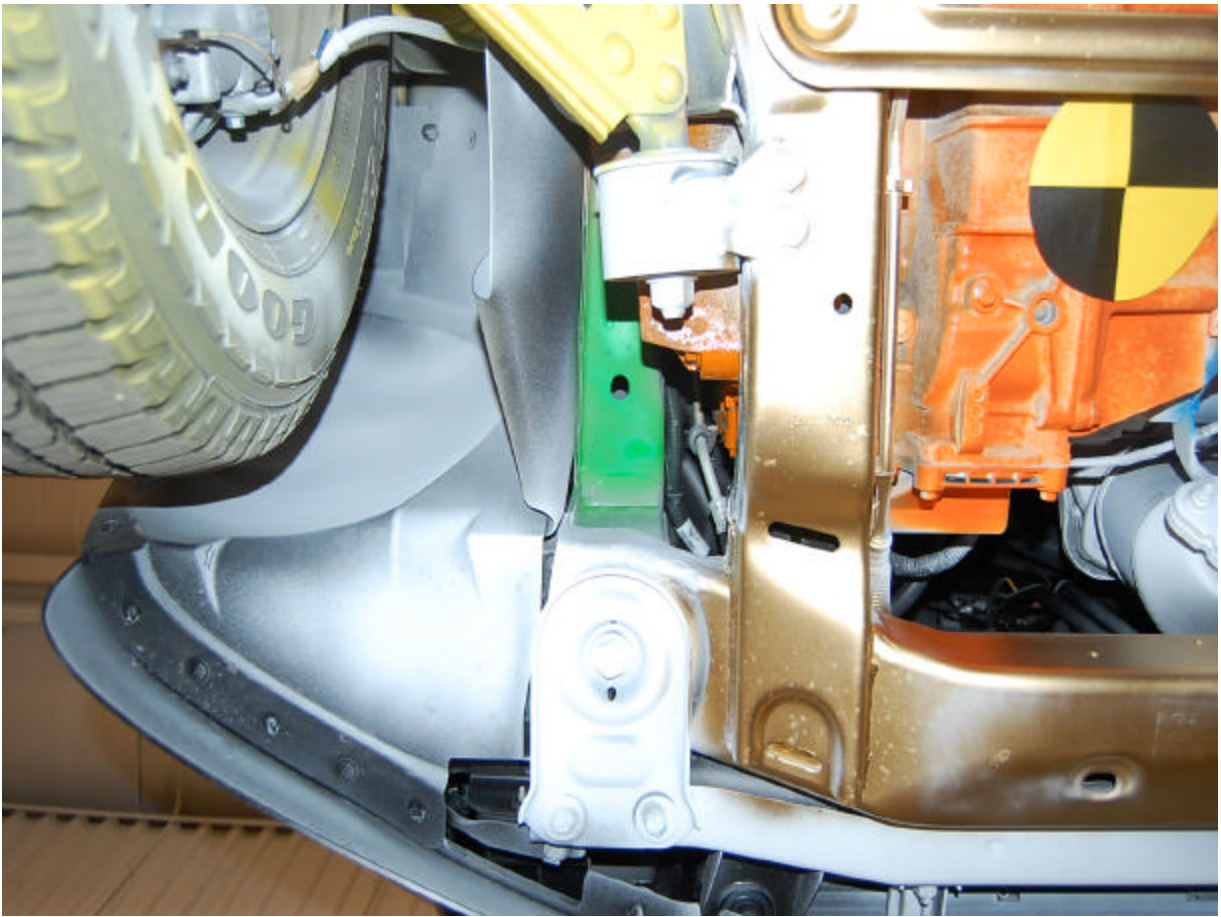
Post-Test Sway Bar Left Side View



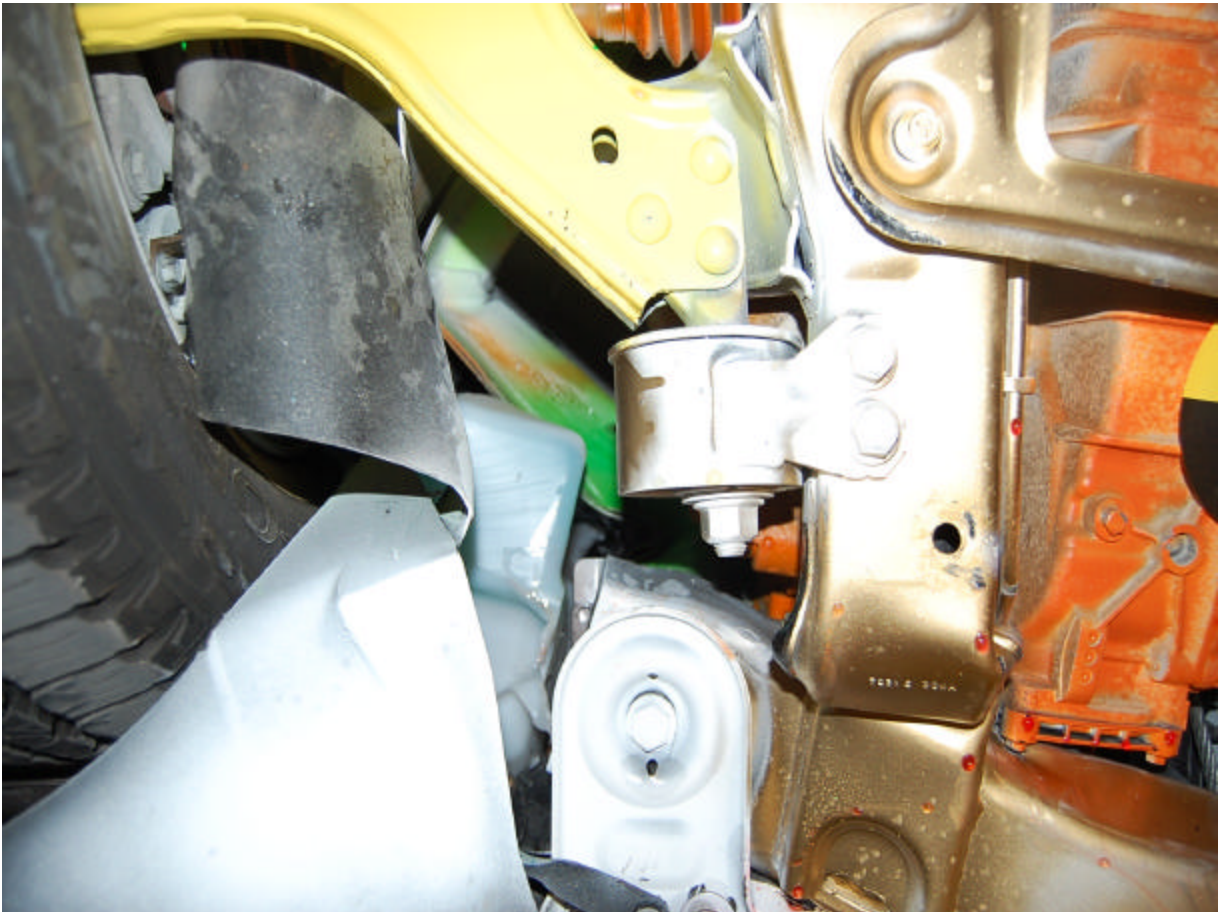
Pre-Test Sway Bar Right Side View



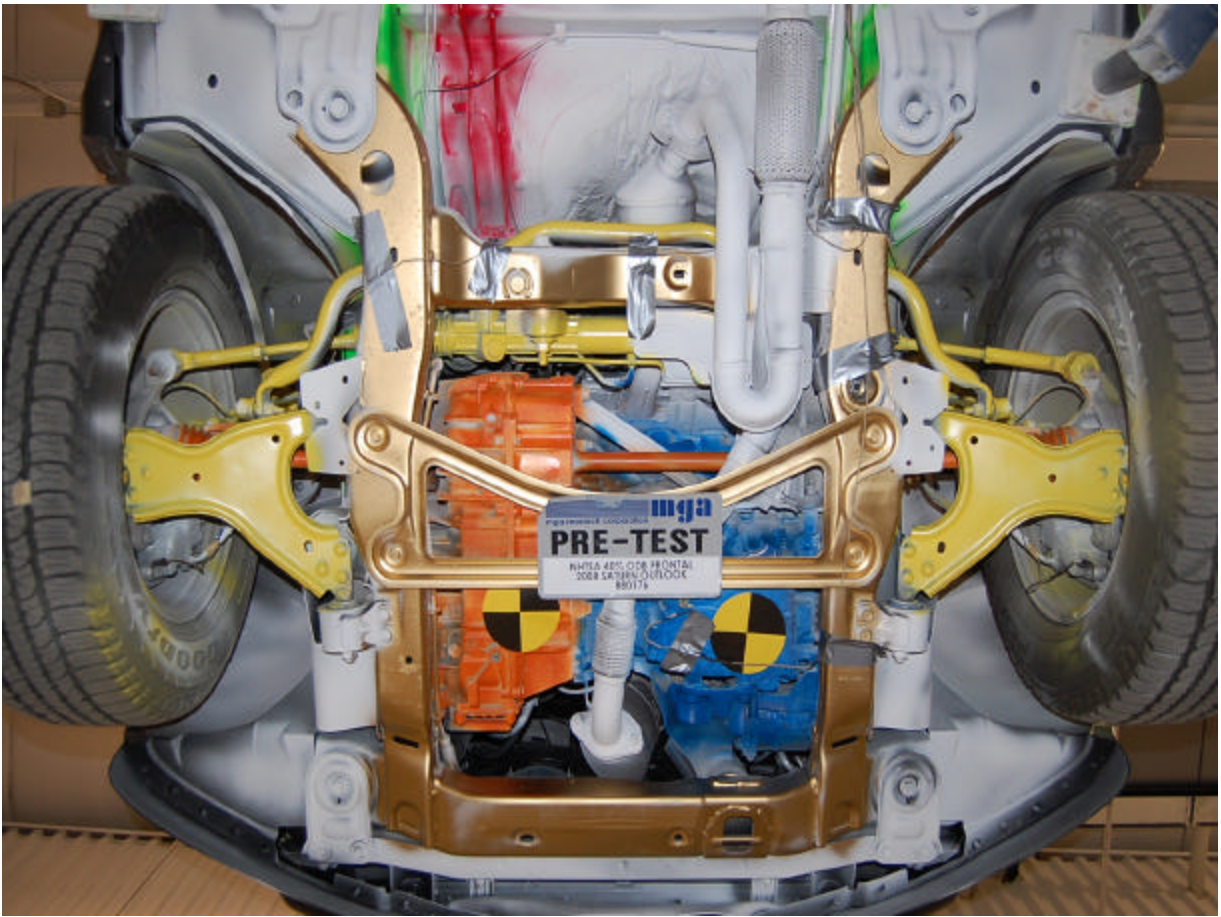
Post-Test Sway Bar Right Side View



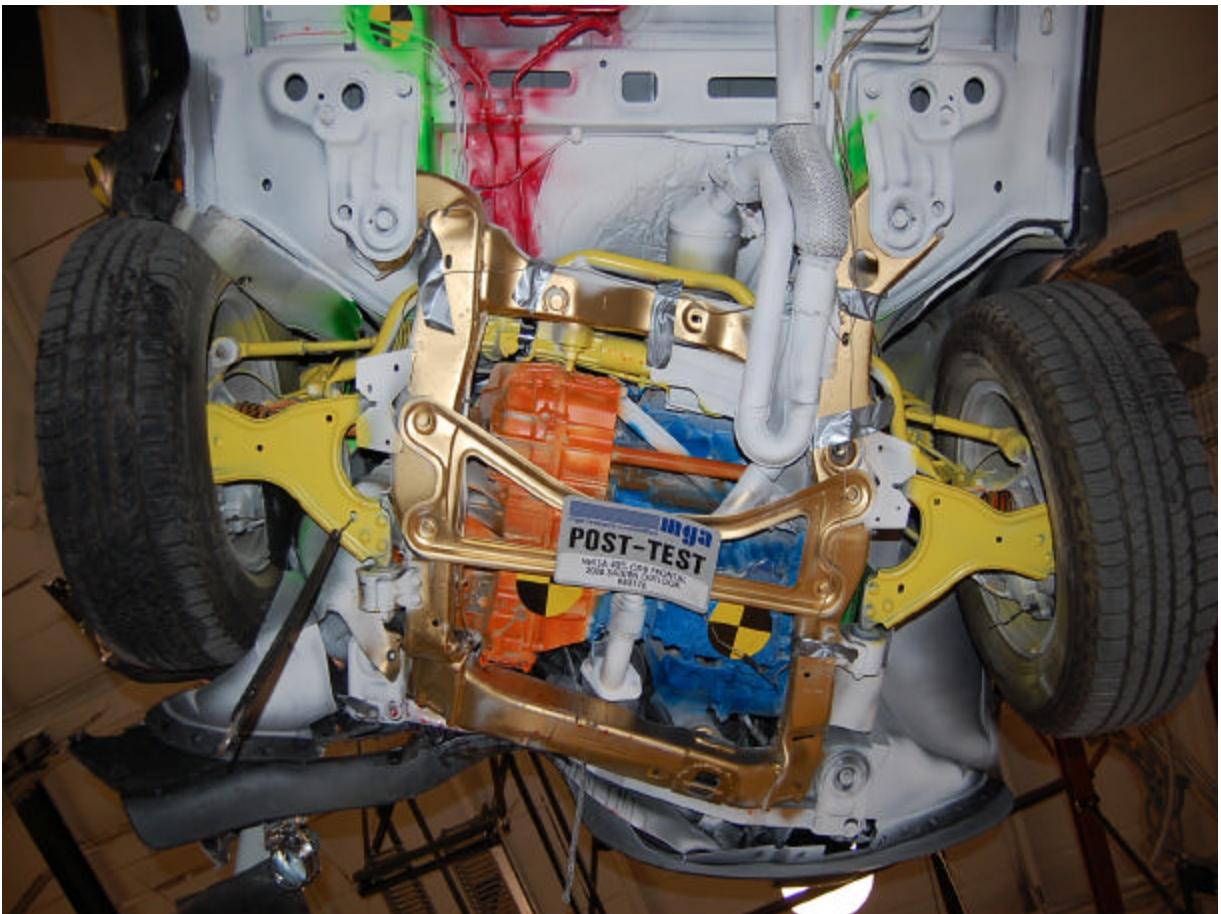
Pre-Test Bumper to Rail Attachment View



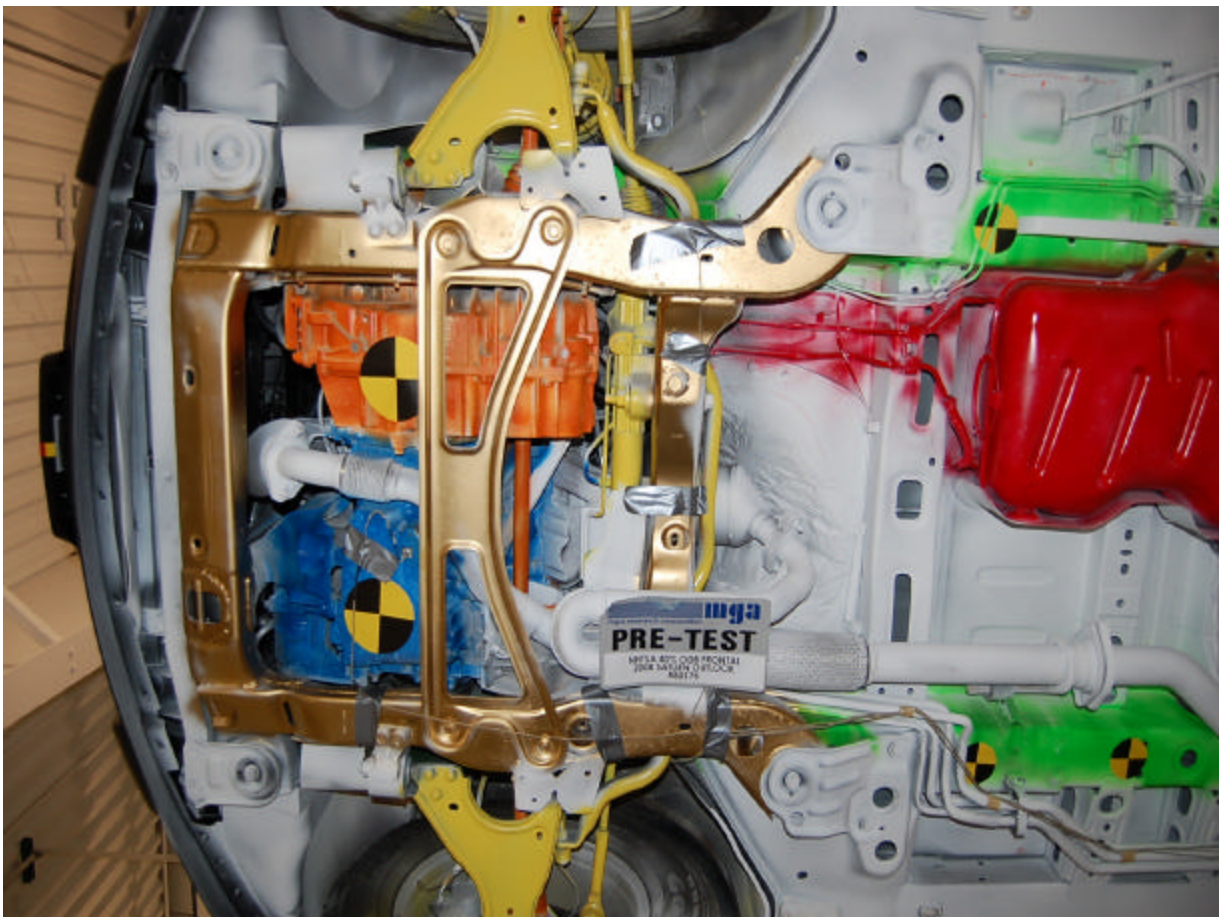
Post-Test Bumper to Rail Attachment View



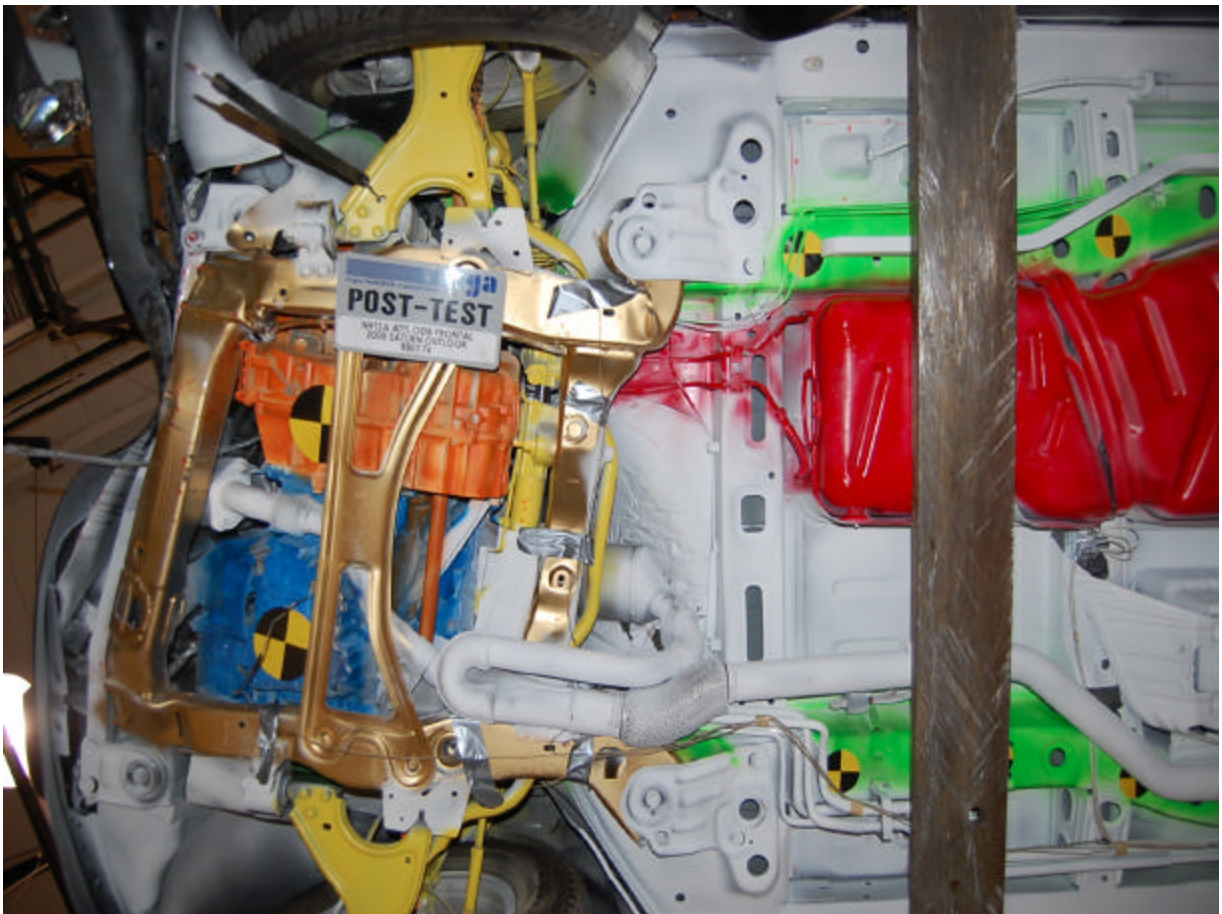
Pre-Test Front Underbody



Post-Test Front Underbody



Pre-Test Front Underbody Perpendicular View



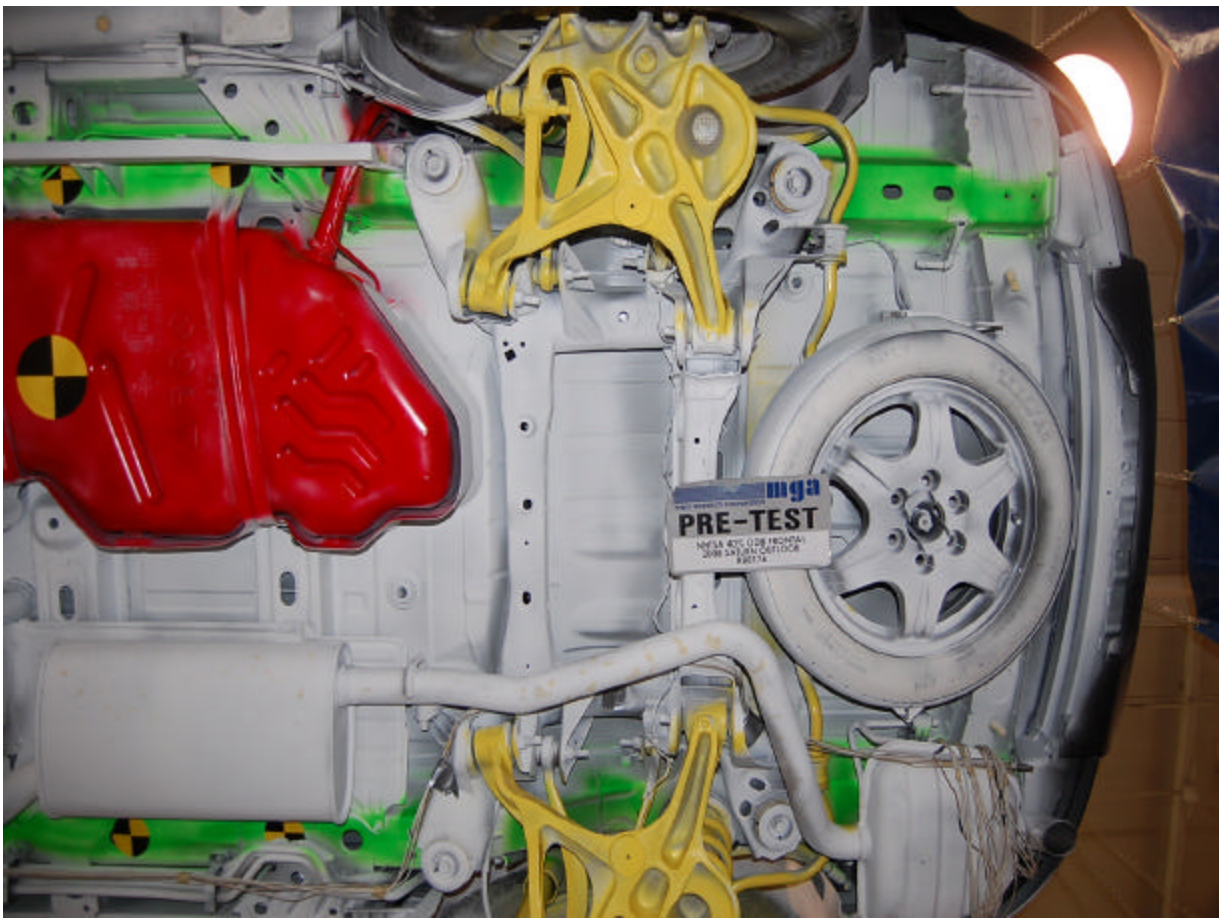
Post-Test Front Underbody Perpendicular View



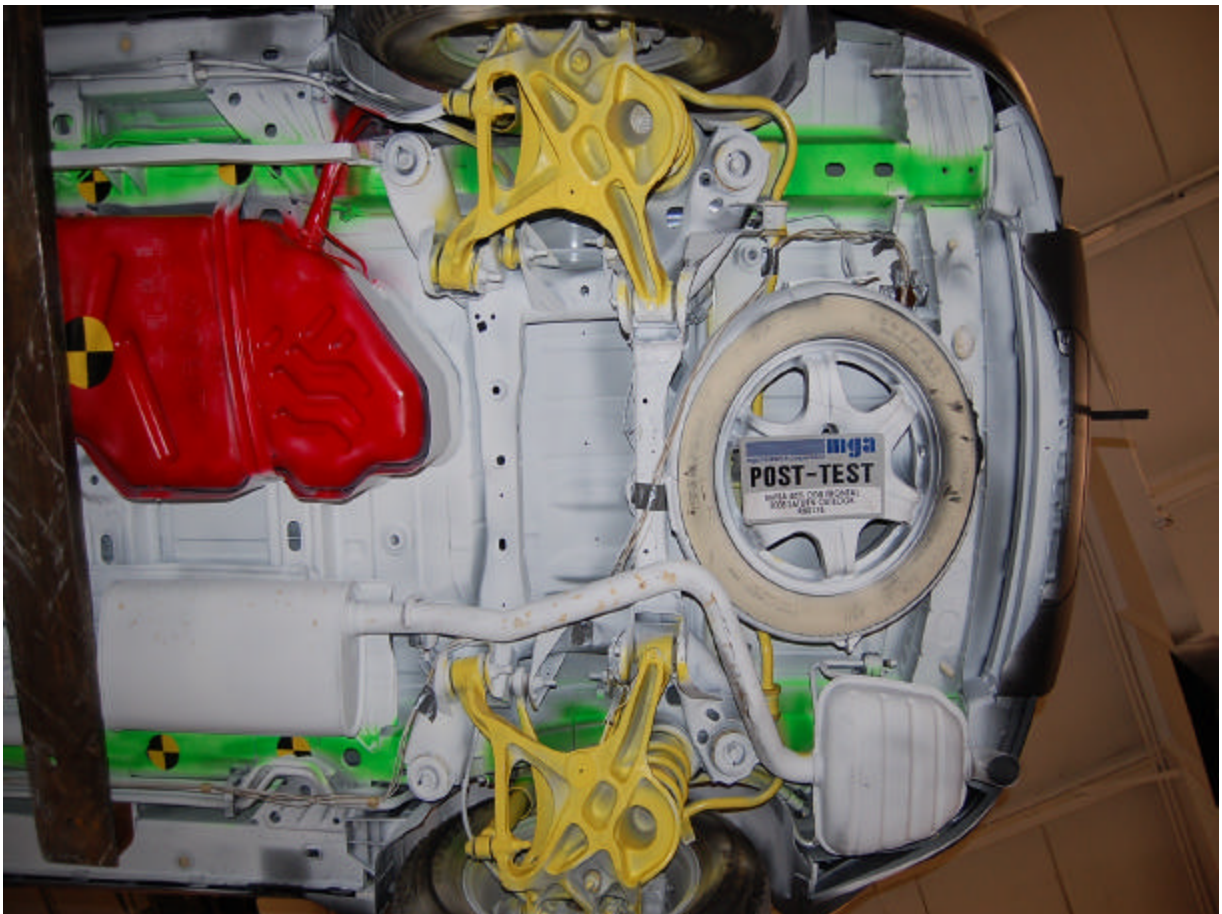
Pre-Test Mid Underbody Perpendicular View



Post-Test Mid Underbody Perpendicular View



Pre-Test Rear Underbody Perpendicular View



Post-Test Rear Underbody Perpendicular View



Pre-Test Left Front Wheel Contact View



Post-Test Left Front Wheel Contact View



Pre-Test Left Front Wheel Contact Close Up View



Post-Test Left Front Wheel Contact Close Up View



Pre-Test Over Toepan/ Floorpan Left of Seat, Seat Cushion Height



Post-Test Over Toepan/ Floorpan Left of Seat, Seat Cushion Height



Pre-Test Over Toepan/ Floorpan Left of Seat, Sill Height



Post-Test Over Toepan/ Floorpan Left of Seat, Sill Height



Pre-Test Over Toepan/ Floorpan Center of Seat, Seat Cushion Height



Post-Test Over Toepan/ Floorpan Center of Seat, Seat Cushion Height



Pre-Test Over Toeplan/ Floorpan Right of Seat, Seat Cushion Height



Post-Test Over Toeplan/ Floorpan Right of Seat, Seat Cushion Height



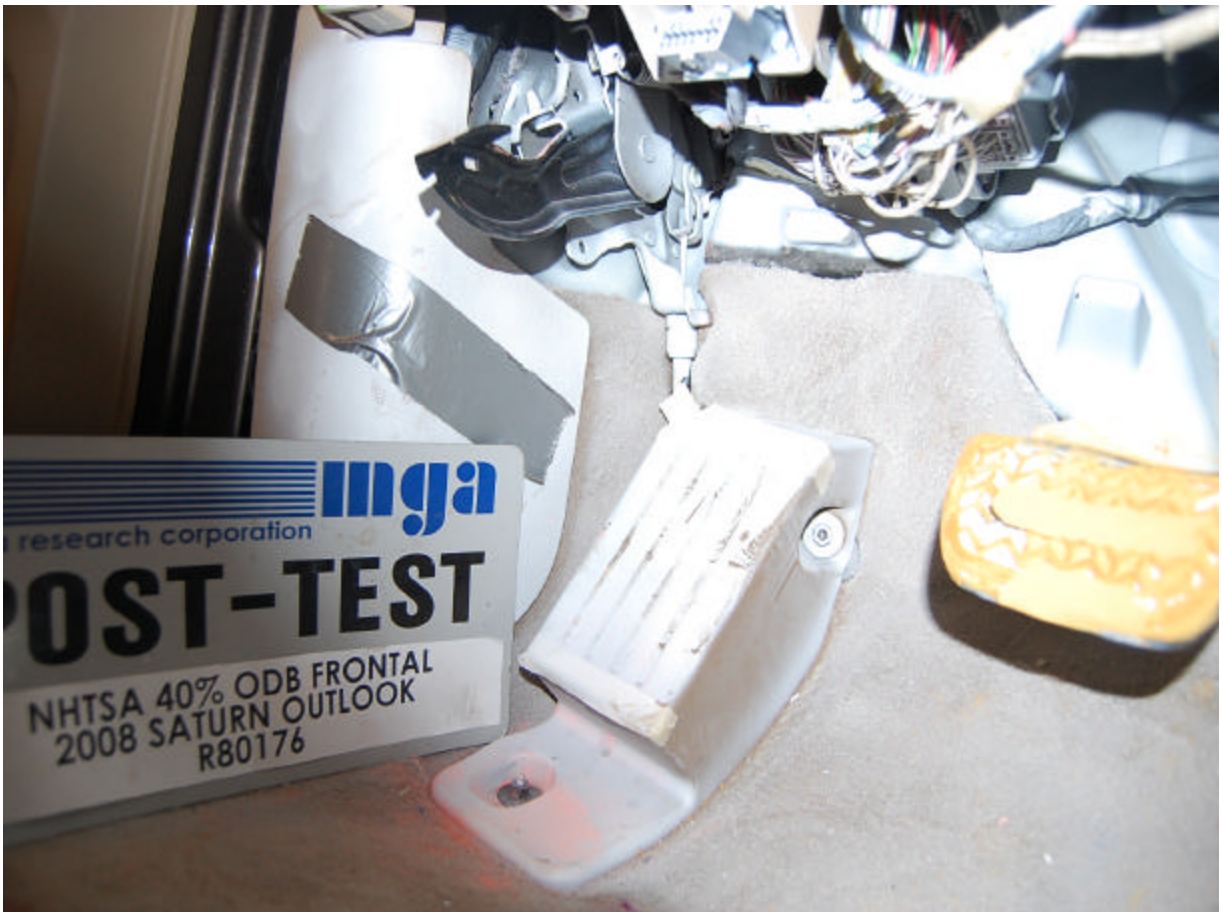
Pre-Test Over Toe pan/ Floorpan Right of Seat, Sill Height



Post-Test Over Toe pan/ Floorpan Right of Seat, Sill Height



Pre-Test Footrest Seat Cushion Height



Post-Test Footrest Seat Cushion Height



Pre-Test Footrest Seat Sill Height



Post-Test Footrest Seat Sill Height



Pre-Test Accelerometer Pedal Close Up



Post-Test Accelerometer Pedal Close Up



Pre-Test Accelerometer Pedal



Post-Test Accelerometer Pedal



Pre-Test Right Side Floorpan, Center of Seat, Seat Cushion Height



Post-Test Right Side Floorpan, Center of Seat, Seat Cushion Height

APPENDIX B

DUMMY, VEHICLE AND BARRIER DATA PLOTS

TABLE OF DATA PLOTS

		<u>Page No.</u>
Figure No. 1.	Driver Head X Acceleration vs. Time	B-1
Figure No. 2.	Driver Head Y Acceleration vs. Time	B-1
Figure No. 3.	Driver Head Z Acceleration vs. Time	B-1
Figure No. 4.	Driver Head Resultant Acceleration vs. Time	B-1
Figure No. 5.	Driver Head X Velocity vs. Time	B-2
Figure No. 6.	Driver Head Y Velocity vs. Time	B-2
Figure No. 7.	Driver Head Z Velocity vs. Time	B-2
Figure No. 8.	Driver Head Y - Front Acceleration vs. Time	B-3
Figure No. 9.	Driver Head Z - Front Acceleration vs. Time	B-3
Figure No. 10.	Driver Head Y - Front Velocity vs. Time	B-3
Figure No. 11.	Driver Head Z - Front Velocity vs. Time	B-3
Figure No. 12.	Driver Head X - Left Acceleration vs. Time	B-4
Figure No. 13.	Driver Head Z - Left Acceleration vs. Time	B-4
Figure No. 14.	Driver Head X - Left Velocity vs. Time	B-4
Figure No. 15.	Driver Head Z - Left Velocity vs. Time	B-4
Figure No. 16.	Driver Head X - Upper Acceleration vs. Time	B-5
Figure No. 17.	Driver Head Y - Upper Acceleration vs. Time	B-5
Figure No. 18.	Driver Head X - Upper Velocity vs. Time	B-5
Figure No. 19.	Driver Head Y - Upper Velocity vs. Time	B-5
Figure No. 20.	Driver Head X Redundant Acceleration vs. Time	B-6
Figure No. 21.	Driver Head Y Redundant Acceleration vs. Time	B-6
Figure No. 22.	Driver Head Z Redundant Acceleration vs. Time	B-6
Figure No. 23.	Driver Head Resultant Redundant Acceleration vs. Time	B-6
Figure No. 24.	Driver Head X Redundant Velocity vs. Time	B-7
Figure No. 25.	Driver Head Y Redundant Velocity vs. Time	B-7
Figure No. 26.	Driver Head Z Redundant Velocity vs. Time	B-7
Figure No. 27.	Driver Neck Force X vs. Time	B-8
Figure No. 28.	Driver Neck Force Y vs. Time	B-8
Figure No. 29.	Driver Neck Force Z vs. Time	B-8

Figure No. 30.	Driver Neck Force Resultant vs. Time	B-8
Figure No. 31.	Driver Neck Moment X vs. Time	B-9
Figure No. 32.	Driver Neck Moment Y vs. Time	B-9
Figure No. 33.	Driver Neck Moment Z vs. Time	B-9
Figure No. 34.	Driver Neck Moment Resultant vs. Time	B-9
Figure No. 35.	Driver Lower Neck Force X vs. Time	B-10
Figure No. 36.	Driver Lower Neck Force Y vs. Time	B-10
Figure No. 37.	Driver Lower Neck Force Z vs. Time	B-10
Figure No. 38.	Driver Lower Neck Force Resultant vs. Time	B-10
Figure No. 39.	Driver Lower Neck Moment X vs. Time	B-11
Figure No. 40.	Driver Lower Neck Moment Y vs. Time	B-11
Figure No. 41.	Driver Lower Neck Moment Z vs. Time	B-11
Figure No. 42.	Driver Lower Neck Moment Resultant vs. Time	B-11
Figure No. 43.	Driver Chest X Acceleration vs. Time	B-12
Figure No. 44.	Driver Chest Y Acceleration vs. Time	B-12
Figure No. 45.	Driver Chest Z Acceleration vs. Time	B-12
Figure No. 46.	Driver Chest Resultant Acceleration vs. Time	B-12
Figure No. 47.	Driver Chest X Velocity vs. Time	B-13
Figure No. 48.	Driver Chest Y Velocity vs. Time	B-13
Figure No. 49.	Driver Chest Z Velocity vs. Time	B-13
Figure No. 50.	Driver Chest X Redundant Acceleration vs. Time	B-14
Figure No. 51.	Driver Chest Y Redundant Acceleration vs. Time	B-14
Figure No. 52.	Driver Chest Z Redundant Acceleration vs. Time	B-14
Figure No. 53.	Driver Chest Resultant Redundant Acceleration vs. Time	B-14
Figure No. 54.	Driver Chest X Redundant Velocity vs. Time	B-15
Figure No. 55.	Driver Chest Y Redundant Velocity vs. Time	B-15
Figure No. 56.	Driver Chest Z Redundant Velocity vs. Time	B-15
Figure No. 57.	Driver Chest Displacement vs. Time	B-15
Figure No. 58.	Driver Pelvis X Acceleration vs. Time	B-16
Figure No. 59.	Driver Pelvis Y Acceleration vs. Time	B-16
Figure No. 60.	Driver Pelvis Z Acceleration vs. Time	B-16

Figure No. 61.	Driver Pelvis Resultant Acceleration vs. Time	B-16
Figure No. 62.	Driver Pelvis X Velocity vs. Time	B-17
Figure No. 63.	Driver Pelvis Y Velocity vs. Time	B-17
Figure No. 64.	Driver Pelvis Z Velocity vs. Time	B-17
Figure No. 65.	Driver Right Femur Force vs. Time	B-18
Figure No. 66.	Driver Left Femur Force vs. Time	B-18
Figure No. 67.	Driver Right Knee Shear vs. Time	B-18
Figure No. 68.	Driver Left Knee Shear vs. Time	B-18
Figure No. 69.	Driver Right Upper Tibia Force X vs. Time	B-19
Figure No. 70.	Driver Right Upper Tibia Force Y vs. Time	B-19
Figure No. 71.	Driver Right Upper Tibia Force Z vs. Time	B-19
Figure No. 72.	Driver Right Upper Tibia Force Resultant vs. Time	B-19
Figure No. 73.	Driver Right Upper Tibia Moment X vs. Time	B-20
Figure No. 74.	Driver Right Upper Tibia Moment Y vs. Time	B-20
Figure No. 75.	Driver Right Lower Tibia Force X vs. Time	B-21
Figure No. 76.	Driver Right Lower Tibia Force Y vs. Time	B-21
Figure No. 77.	Driver Right Lower Tibia Force Z vs. Time	B-21
Figure No. 78.	Driver Right Lower Tibia Force Resultant vs. Time	B-21
Figure No. 79.	Driver Right Lower Tibia Moment X vs. Time	B-22
Figure No. 80.	Driver Right Lower Tibia Moment Y vs. Time	B-22
Figure No. 81.	Driver Right Tibia Mid Shaft X Acceleration vs. Time	B-23
Figure No. 82.	Driver Right Tibia Mid Shaft Y Acceleration vs. Time	B-23
Figure No. 83.	Driver Right Tibia Mid Shaft X Velocity vs. Time	B-23
Figure No. 84.	Driver Right Tibia Mid Shaft Y Velocity vs. Time	B-23
Figure No. 85.	DR RT DORSI/PLANTAR FLEXION vs. Time	B-24
Figure No. 86.	DR RT INVERSION/EVERSION vs. Time	B-24
Figure No. 87.	DR RT INTERNAL/EXTERNAL vs. Time	B-24
Figure No. 88.	Driver Right Foot X - Front Acceleration vs. Time	B-25
Figure No. 89.	Driver Right Foot Y - Front Acceleration vs. Time	B-25
Figure No. 90.	Driver Right Foot Z - Front Acceleration vs. Time	B-25
Figure No. 91.	Driver Right Foot Resultant Front Acceleration vs. Time	B-25

Figure No. 92.	Driver Right Foot X - Front Velocity vs. Time	B-26
Figure No. 93.	Driver Right Foot Y - Front Velocity vs. Time	B-26
Figure No. 94.	Driver Right Foot Z - Front Velocity vs. Time	B-26
Figure No. 95.	Driver Left Upper Tibia Force X vs. Time	B-27
Figure No. 96.	Driver Left Upper Tibia Force Y vs. Time	B-27
Figure No. 97.	Driver Left Upper Tibia Force Z vs. Time	B-27
Figure No. 98.	Driver Left Upper Tibia Force Resultant vs. Time	B-27
Figure No. 99.	Driver Left Upper Tibia Moment X vs. Time	B-28
Figure No. 100.	Driver Left Upper Tibia Moment Y vs. Time	B-28
Figure No. 101.	Driver Left Lower Tibia Force X vs. Time	B-29
Figure No. 102.	Driver Left Lower Tibia Force Y vs. Time	B-29
Figure No. 103.	Driver Left Lower Tibia Force Z vs. Time	B-29
Figure No. 104.	Driver Left Lower Tibia Force Resultant vs. Time	B-29
Figure No. 105.	Driver Left Lower Tibia Moment X vs. Time	B-30
Figure No. 106.	Driver Left Lower Tibia Moment Y vs. Time	B-30
Figure No. 107.	Driver Left Tibia Mid Shaft X Acceleration vs. Time	B-31
Figure No. 108.	Driver Left Tibia Mid Shaft Y Acceleration vs. Time	B-31
Figure No. 109.	Driver Left Tibia Mid Shaft X Velocity vs. Time	B-31
Figure No. 110.	Driver Left Tibia Mid Shaft Y Velocity vs. Time	B-31
Figure No. 111.	DR LT DORSI/PLANTAR FLEXION vs. Time	B-32
Figure No. 112.	DR LT INVERSION/EVERSION vs. Time	B-32
Figure No. 113.	DR LT INTERNAL/EXTERNAL vs. Time	B-32
Figure No. 114.	Driver Left Foot X - Front Acceleration vs. Time	B-33
Figure No. 115.	Driver Left Foot Y - Front Acceleration vs. Time	B-33
Figure No. 116.	Driver Left Foot Z - Front Acceleration vs. Time	B-33
Figure No. 117.	Driver Left Foot Resultant Front Acceleration vs. Time	B-33
Figure No. 118.	Driver Left Foot X - Front Velocity vs. Time	B-34
Figure No. 119.	Driver Left Foot Y - Front Velocity vs. Time	B-34
Figure No. 120.	Driver Left Foot Z - Front Velocity vs. Time	B-34
Figure No. 121.	LRP Head X Acceleration vs. Time	B-35
Figure No. 122.	LRP Head Y Acceleration vs. Time	B-35

Figure No. 123.	LRP Head Z Acceleration vs. Time	B-35
Figure No. 124.	LRP Head Resultant Acceleration vs. Time	B-35
Figure No. 125.	LRP Head X Velocity vs. Time	B-36
Figure No. 126.	LRP Head Y Velocity vs. Time	B-36
Figure No. 127.	LRP Head Z Velocity vs. Time	B-36
Figure No. 128.	LRP Neck Force X vs. Time	B-37
Figure No. 129.	LRP Neck Force Y vs. Time	B-37
Figure No. 130.	LRP Neck Force Z vs. Time	B-37
Figure No. 131.	LRP Neck Force Resultant vs. Time	B-37
Figure No. 132.	LRP Neck Moment X vs. Time	B-38
Figure No. 133.	LRP Neck Moment Y vs. Time	B-38
Figure No. 134.	LRP Neck Moment Z vs. Time	B-38
Figure No. 135.	LRP Neck Moment Resultant vs. Time	B-38
Figure No. 136.	LRP Lower Neck Force X vs. Time	B-39
Figure No. 137.	LRP Lower Neck Force Y vs. Time	B-39
Figure No. 138.	LRP Lower Neck Force Z vs. Time	B-39
Figure No. 139.	LRP Lower Neck Force Resultant vs. Time	B-39
Figure No. 140.	LRP Lower Neck Moment X vs. Time	B-40
Figure No. 141.	LRP Lower Neck Moment Y vs. Time	B-40
Figure No. 142.	LRP Lower Neck Moment Z vs. Time	B-40
Figure No. 143.	LRP Lower Neck Moment Resultant vs. Time	B-40
Figure No. 144.	LRP Right Shoulder Force X vs. Time	B-41
Figure No. 145.	LRP Right Shoulder Force Z vs. Time	B-41
Figure No. 146.	LRP Left Shoulder Force X vs. Time	B-41
Figure No. 147.	LRP Left Shoulder Force Z vs. Time	B-41
Figure No. 148.	LRP Chest X Acceleration vs. Time	B-42
Figure No. 149.	LRP Chest Y Acceleration vs. Time	B-42
Figure No. 150.	LRP Chest Z Acceleration vs. Time	B-42
Figure No. 151.	LRP Chest Resultant Acceleration vs. Time	B-42
Figure No. 152.	LRP Chest X Velocity vs. Time	B-43
Figure No. 153.	LRP Chest Y Velocity vs. Time	B-43

Figure No. 154.	LRP Chest Z Velocity vs. Time	B-43
Figure No. 155.	LRP Chest Displacement vs. Time	B-43
Figure No. 156.	LRP Upper Sternum X Acceleration vs. Time	B-44
Figure No. 157.	LRP Lower Sternum X Acceleration vs. Time	B-44
Figure No. 158.	LRP Upper Sternum X Velocity vs. Time	B-44
Figure No. 159.	LRP Lower Sternum X Velocity vs. Time	B-44
Figure No. 160.	LRP Upper Spine X Acceleration vs. Time	B-45
Figure No. 161.	LRP Lower Spine X Acceleration vs. Time	B-45
Figure No. 162.	LRP Upper Spine X Velocity vs. Time	B-45
Figure No. 163.	LRP Lower Spine X Velocity vs. Time	B-45
Figure No. 164.	LRP Lumbar Force X vs. Time	B-46
Figure No. 165.	LRP Lumbar Force Y vs. Time	B-46
Figure No. 166.	LRP Lumbar Force Z vs. Time	B-46
Figure No. 167.	LRP Lumbar Force Resultant vs. Time	B-46
Figure No. 168.	LRP Lumbar Moment X vs. Time	B-47
Figure No. 169.	LRP Lumbar Moment Y vs. Time	B-47
Figure No. 170.	LRP Lumbar Moment Z vs. Time	B-47
Figure No. 171.	LRP Lumbar Moment Resultant vs. Time	B-47
Figure No. 172.	LRP Pelvis X Acceleration vs. Time	B-48
Figure No. 173.	LRP Pelvis Y Acceleration vs. Time	B-48
Figure No. 174.	LRP Pelvis Z Acceleration vs. Time	B-48
Figure No. 175.	LRP Pelvis Resultant Acceleration vs. Time	B-48
Figure No. 176.	LRP Pelvis X Velocity vs. Time	B-49
Figure No. 177.	LRP Pelvis Y Velocity vs. Time	B-49
Figure No. 178.	LRP Pelvis Z Velocity vs. Time	B-49
Figure No. 179.	LRP Right Upper ASIS Force X vs. Time	B-50
Figure No. 180.	LRP Right Lower ASIS Force X vs. Time	B-50
Figure No. 181.	LRP Left Upper ASIS Force X vs. Time	B-50
Figure No. 182.	LRP Left Lower ASIS Force X vs. Time	B-50
Figure No. 183.	Left Rear Seat Crossmember X Acceleration vs. Time	B-51
Figure No. 184.	Left Rear Seat Crossmember X Velocity vs. Time	B-51

Figure No. 185.	Left Rear Seat Crossmemeber Y Acceleration vs. Time	B-51
Figure No. 186.	Left Rear Seat Crossmember Y Velocity vs. Time	B-51
Figure No. 187.	Right Rear Seat Crossmember X Acceleration vs. Time	B-52
Figure No. 188.	Right Rear Seat Crossmember X Velocity vs. Time	B-52
Figure No. 189.	Right Rear Seat Crossmember Y Acceleration vs. Time	B-52
Figure No. 190.	Right Rear Seat Crossmember Y Velocity vs. Time	B-52
Figure No. 191.	Vehicle CG X Acceleration vs. Time	B-53
Figure No. 192.	Vehicle CG Y Acceleration vs. Time	B-53
Figure No. 193.	Vehicle CG Z Acceleration vs. Time	B-53
Figure No. 194.	Vehicle CG Resultant Acceleration vs. Time	B-53
Figure No. 195.	Vehicle CG X Velocity vs. Time	B-54
Figure No. 196.	Vehicle CG Y Velocity vs. Time	B-54
Figure No. 197.	Vehicle CG Z Velocity vs. Time	B-54
Figure No. 198.	Top of Engine X Acceleration vs. Time	B-55
Figure No. 199.	Top of Engine X Velocity vs. Time	B-55
Figure No. 200.	Bottom of Engine X Acceleration vs. Time	B-55
Figure No. 201.	Bottom of Engine X Velocity vs. Time	B-55
Figure No. 202.	Left Brake Caliper X Acceleration vs. Time	B-56
Figure No. 203.	Left Brake Caliper X Velocity vs. Time	B-56
Figure No. 204.	Right Brake Caliper X Acceleration vs. Time	B-56
Figure No. 205.	Right Brake Caliper X Velocity vs. Time	B-56
Figure No. 206.	Instrument Panel X Acceleration vs. Time	B-57
Figure No. 207.	Instrument Panel X Velocity vs. Time	B-57
Figure No. 208.	Driver Seat Track X Acceleration vs. Time	B-57
Figure No. 209.	Driver Seat Track X Velocity vs. Time	B-57
Figure No. 210.	Gas Pedal X Acceleration vs. Time	B-58
Figure No. 211.	Gas Pedal Y Acceleration vs. Time	B-58
Figure No. 212.	Gas Pedal Z Acceleration vs. Time	B-58
Figure No. 213.	Gas Pedal Resultant Acceleration vs. Time	B-58
Figure No. 214.	Gas Pedal X Velocity vs. Time	B-59
Figure No. 215.	Gas Pedal Y Velocity vs. Time	B-59

Figure No. 216.	Gas Pedal Z Velocity vs. Time	B-59
Figure No. 217.	Brake Pedal X Acceleration vs. Time	B-60
Figure No. 218.	Brake Pedal Y Acceleration vs. Time	B-60
Figure No. 219.	Brake Pedal Z Acceleration vs. Time	B-60
Figure No. 220.	Brake Pedal Resultant Acceleration vs. Time	B-60
Figure No. 221.	Brake Pedal X Velocity vs. Time	B-61
Figure No. 222.	Brake Pedal Y Velocity vs. Time	B-61
Figure No. 223.	Brake Pedal Z Velocity vs. Time	B-61
Figure No. 224.	Driver Left Foot Rest X Acceleration vs. Time	B-62
Figure No. 225.	Driver Left Foot Rest Y Acceleration vs. Time	B-62
Figure No. 226.	Driver Left Foot Rest Z Acceleration vs. Time	B-62
Figure No. 227.	Driver Left Foot Rest Resultant Acceleration vs. Time	B-62
Figure No. 228.	Driver Left Foot Rest X Velocity vs. Time	B-63
Figure No. 229.	Driver Left Foot Rest Y Velocity vs. Time	B-63
Figure No. 230.	Driver Left Foot Rest Z Velocity vs. Time	B-63
Figure No. 231.	Driver Airbag Timing (Stage 1) vs. Time	B-64
Figure No. 232.	Driver Airbag Timing (Stage 2) vs. Time	B-64
Figure No. 233.	Left Foot to Toepan Contact vs. Time	B-65
Figure No. 234.	Right Foot to Accel. Pedal Contact vs. Time	B-65
Figure No. 235.	Knee to Bolster Contact vs. Time	B-65
Figure No. 236.	Driver Shoulder Belt Force vs. Time	B-66
Figure No. 237.	Driver Lap Belt Force vs. Time	B-66
Figure No. 238.	LRP Shoulder Belt Force vs. Time	B-66
Figure No. 239.	LRP Lap Belt Force vs. Time	B-66
Figure No. 240.	ODB Barrier 1 Force vs. Time	B-67
Figure No. 241.	ODB Barrier 2 Force vs. Time	B-67
Figure No. 242.	ODB Barrier 3 Force vs. Time	B-67
Figure No. 243.	ODB Barrier 4 Force vs. Time	B-67
Figure No. 244.	ODB Barrier 5 Force vs. Time	B-68
Figure No. 245.	ODB Barrier 6 Force vs. Time	B-68
Figure No. 246.	ODB Barrier 7 Force vs. Time	B-68

Page No.

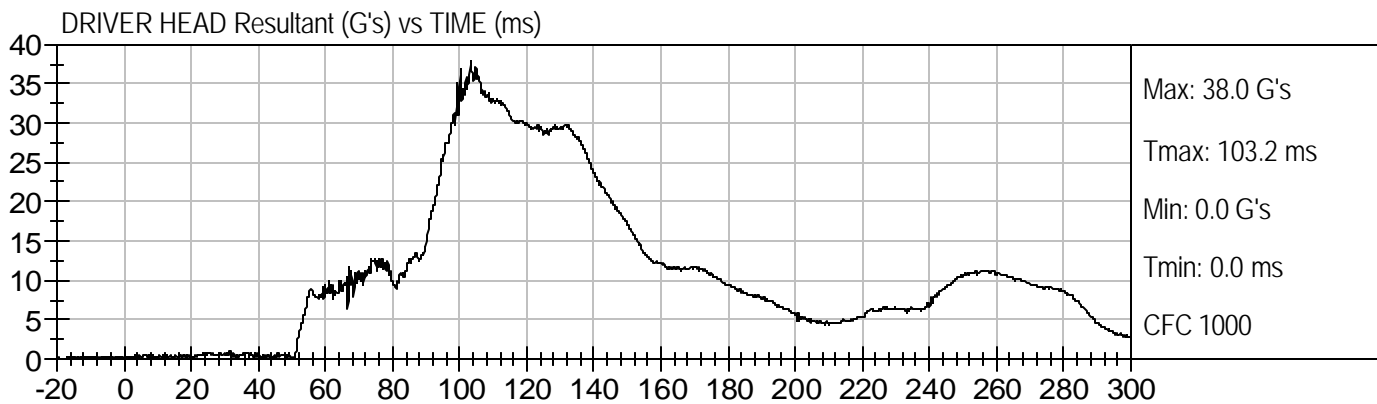
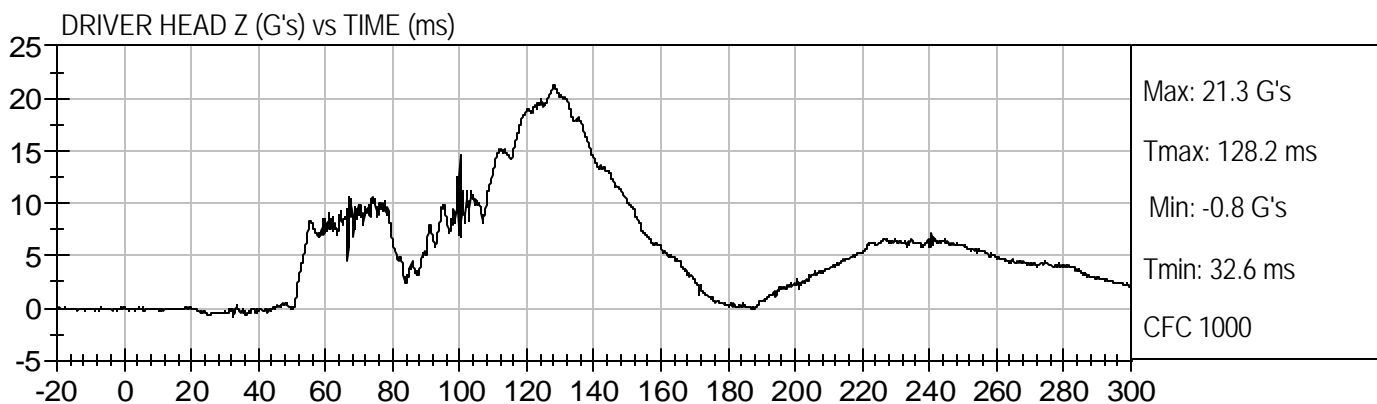
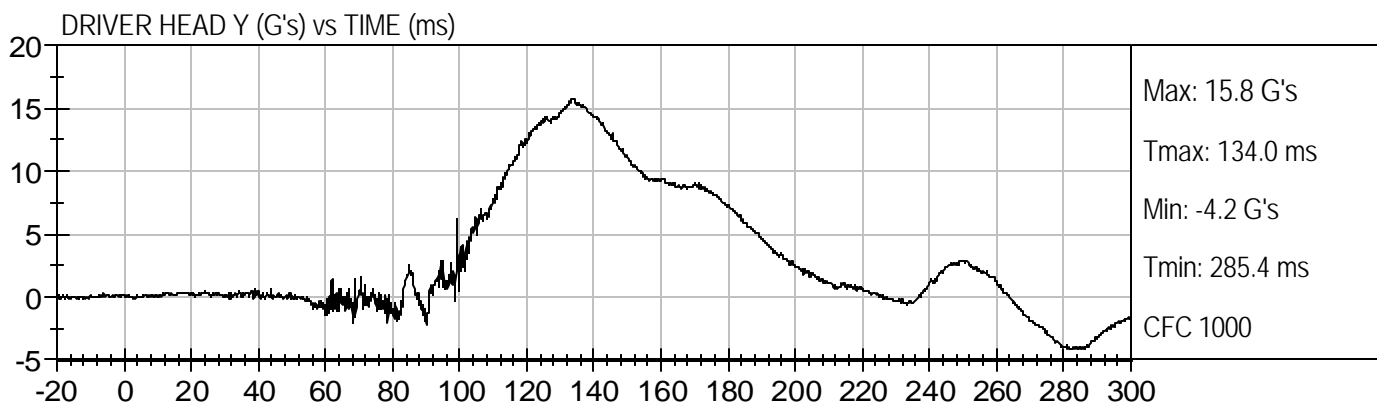
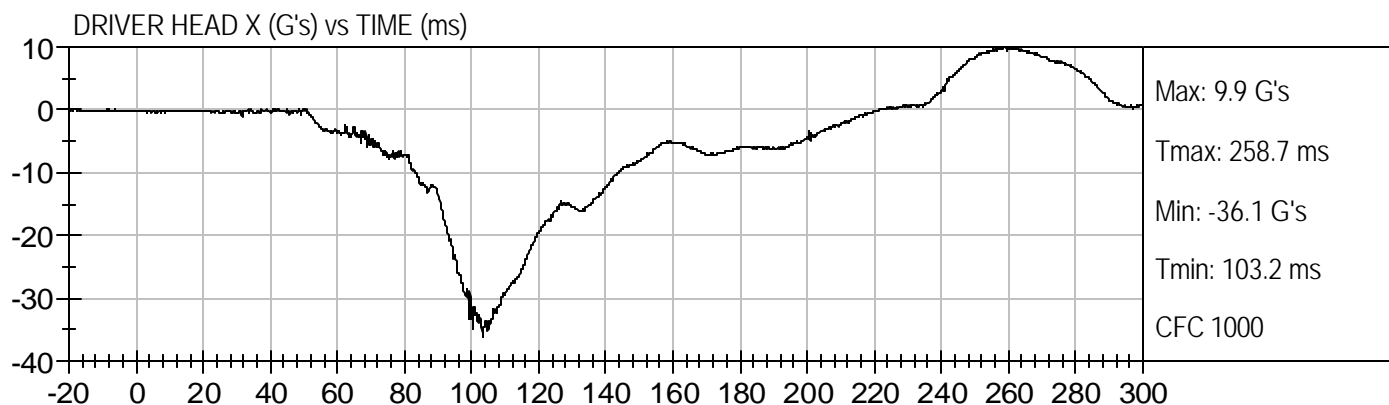
Figure No. 247.	ODB Barrier 8 Force vs. Time	B-68
Figure No. 248.	ODB Barrier 9 Force vs. Time	B-69
Figure No. 249.	ODB Barrier 10 Force vs. Time	B-69
Figure No. 250.	ODB Barrier 11 Force vs. Time	B-69
Figure No. 251.	ODB Barrier 12 Force vs. Time	B-69
Figure No. 252.	ODB Barrier 13 Force vs. Time	B-70
Figure No. 253.	ODB Barrier 14 Force vs. Time	B-70
Figure No. 254.	ODB Barrier 15 Force vs. Time	B-70
Figure No. 255.	ODB Barrier 16 Force vs. Time	B-70
Figure No. 256.	ODB Barrier 17 Force vs. Time	B-71
Figure No. 257.	ODB Barrier 18 Force vs. Time	B-71
Figure No. 258.	ODB Barrier 19 Force vs. Time	B-71
Figure No. 259.	ODB Barrier 20 Force vs. Time	B-71
Figure No. 260.	ODB Barrier 21 Force vs. Time	B-72
Figure No. 261.	ODB Barrier 22 Force vs. Time	B-72
Figure No. 262.	ODB Barrier 23 Force vs. Time	B-72
Figure No. 263.	ODB Barrier 24 Force vs. Time	B-72
Figure No. 264.	ODB Barrier 25 Force vs. Time	B-73
Figure No. 265.	ODB Barrier 26 Force vs. Time	B-73
Figure No. 266.	ODB Barrier 27 Force vs. Time	B-73
Figure No. 267.	ODB Barrier 28 Force vs. Time	B-73
Figure No. 268.	ODB Barrier 29 Force vs. Time	B-74
Figure No. 269.	ODB Barrier 30 Force vs. Time	B-74
Figure No. 270.	ODB Barrier 31 Force vs. Time	B-74
Figure No. 271.	ODB Barrier 32 Force vs. Time	B-74
Figure No. 272.	ODB Barrier 33 Force vs. Time	B-75
Figure No. 273.	ODB Barrier 34 Force vs. Time	B-75
Figure No. 274.	ODB Barrier 35 Force vs. Time	B-75
Figure No. 275.	ODB Barrier 36 Force vs. Time	B-75
Figure No. 276.	ODB Barrier 37 Force vs. Time	B-76
Figure No. 277.	ODB Barrier 38 Force vs. Time	B-76

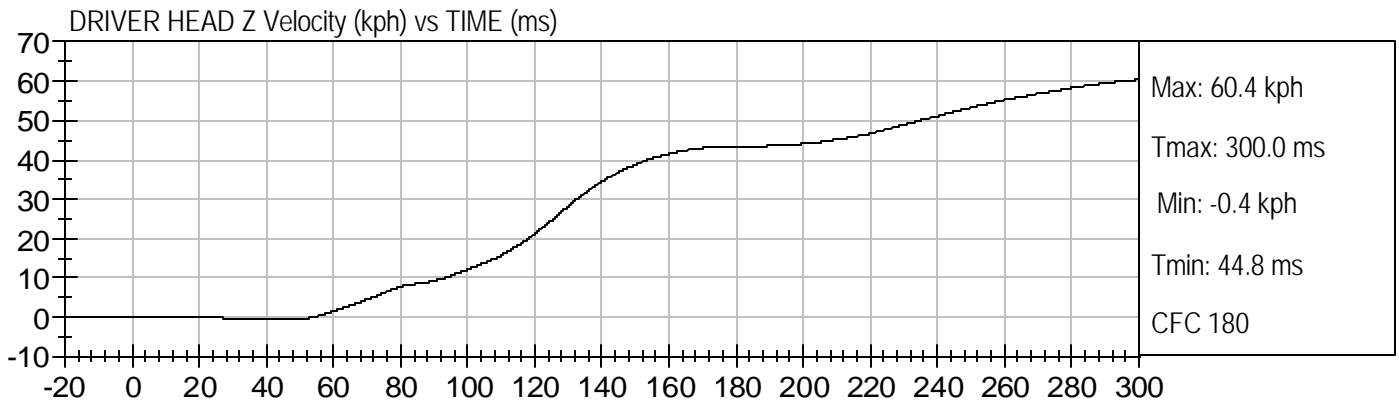
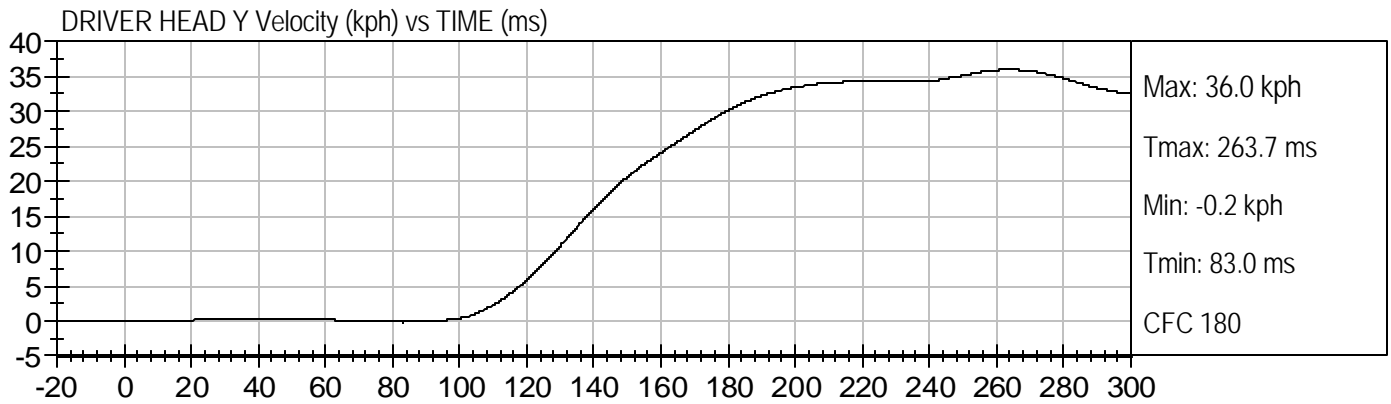
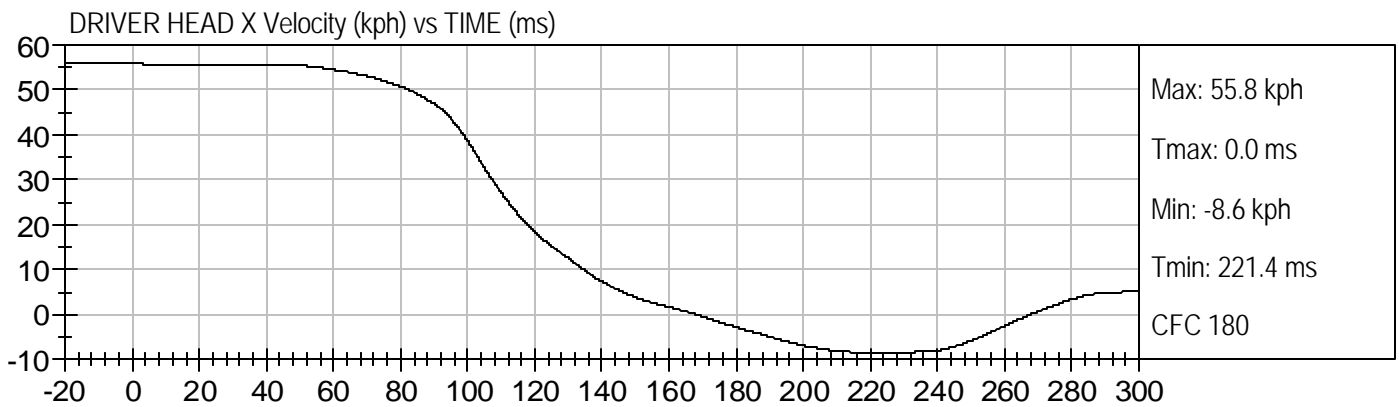
Page No.

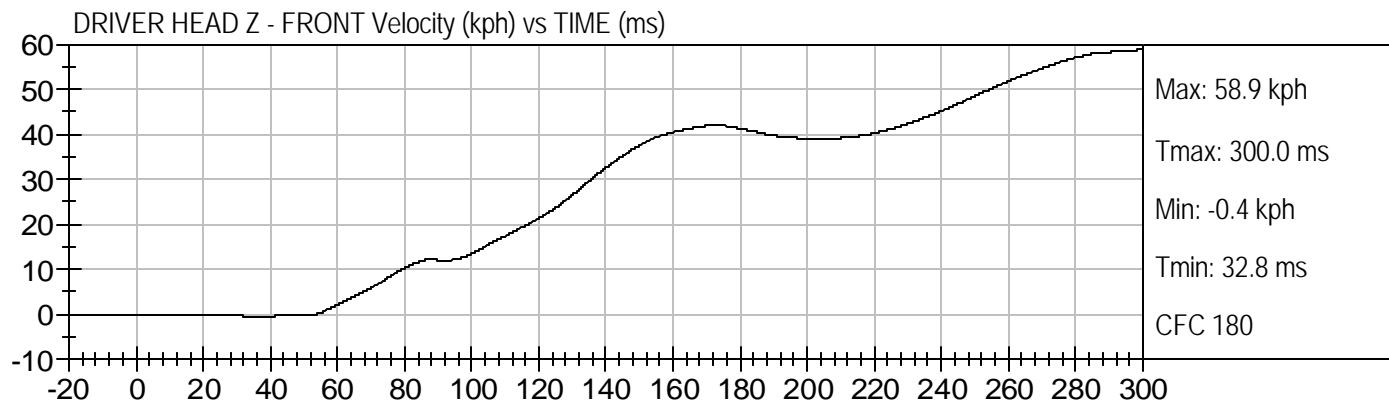
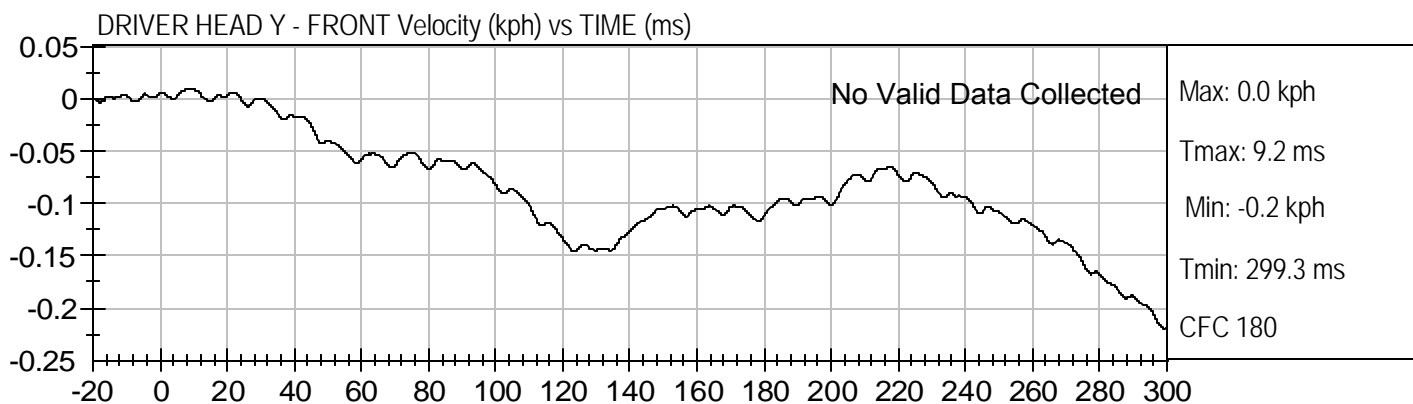
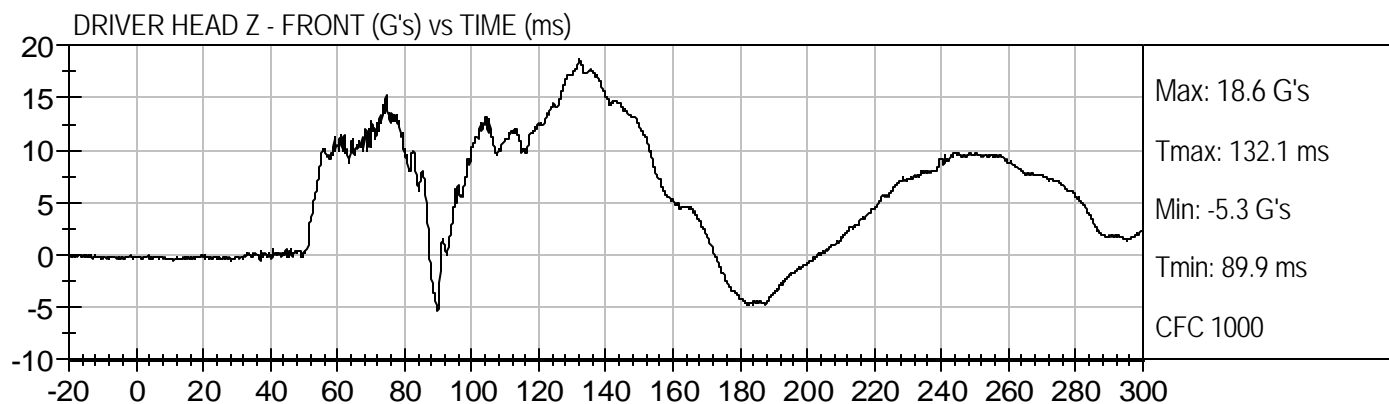
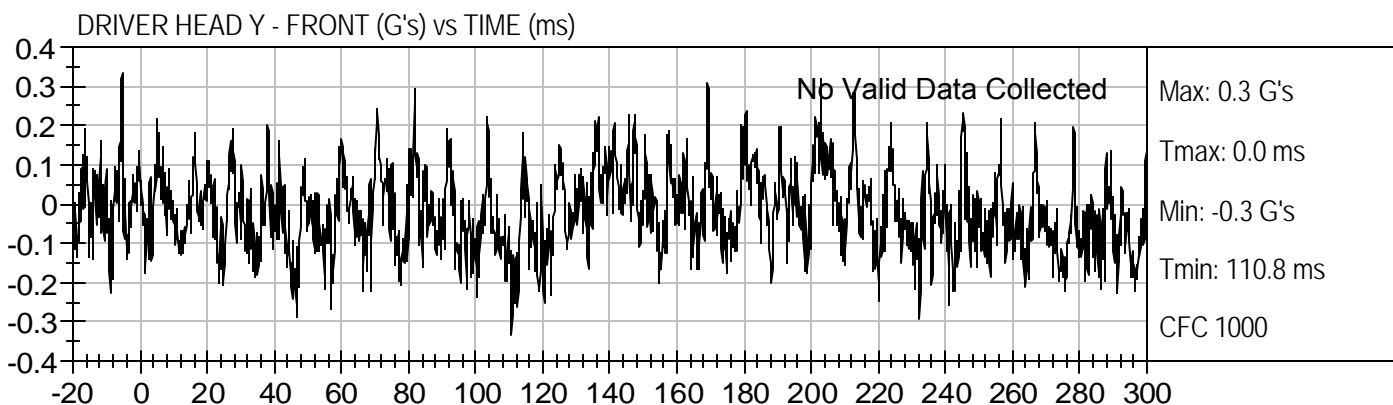
Figure No. 278.	ODB Barrier 39 Force vs. Time	B-76
Figure No. 279.	ODB Barrier 40 Force vs. Time	B-76
Figure No. 280.	ODB Barrier 41 Force vs. Time	B-77
Figure No. 281.	ODB Barrier 42 Force vs. Time	B-77
Figure No. 282.	ODB Barrier 43 Force vs. Time	B-77
Figure No. 283.	ODB Barrier 44 Force vs. Time	B-77
Figure No. 284.	ODB Barrier 45 Force vs. Time	B-78
Figure No. 285.	ODB Barrier 46 Force vs. Time	B-78
Figure No. 286.	ODB Barrier 47 Force vs. Time	B-78
Figure No. 287.	ODB Barrier 48 Force vs. Time	B-78
Figure No. 288.	ODB Barrier 49 Force vs. Time	B-79
Figure No. 289.	ODB Barrier 50 Force vs. Time	B-79
Figure No. 290.	ODB Barrier 51 Force vs. Time	B-79
Figure No. 291.	ODB Barrier 52 Force vs. Time	B-79
Figure No. 292.	ODB Barrier 53 Force vs. Time	B-80
Figure No. 293.	ODB Barrier 54 Force vs. Time	B-80
Figure No. 294.	ODB Barrier 55 Force vs. Time	B-80
Figure No. 295.	ODB Barrier 56 Force vs. Time	B-80
Figure No. 296.	ODB Barrier 57 Force vs. Time	B-81
Figure No. 297.	ODB Barrier 58 Force vs. Time	B-81
Figure No. 298.	ODB Barrier 59 Force vs. Time	B-81
Figure No. 299.	ODB Barrier 60 Force vs. Time	B-81
Figure No. 300.	ODB Barrier 61 Force vs. Time	B-82
Figure No. 301.	ODB Barrier 62 Force vs. Time	B-82
Figure No. 302.	ODB Barrier 63 Force vs. Time	B-82
Figure No. 303.	ODB Barrier 64 Force vs. Time	B-82
Figure No. 304.	ODB Barrier 65 Force vs. Time	B-83
Figure No. 305.	ODB Barrier 66 Force vs. Time	B-83
Figure No. 306.	ODB Barrier 67 Force vs. Time	B-83
Figure No. 307.	ODB Barrier 68 Force vs. Time	B-83
Figure No. 308.	ODB Barrier 69 Force vs. Time	B-84

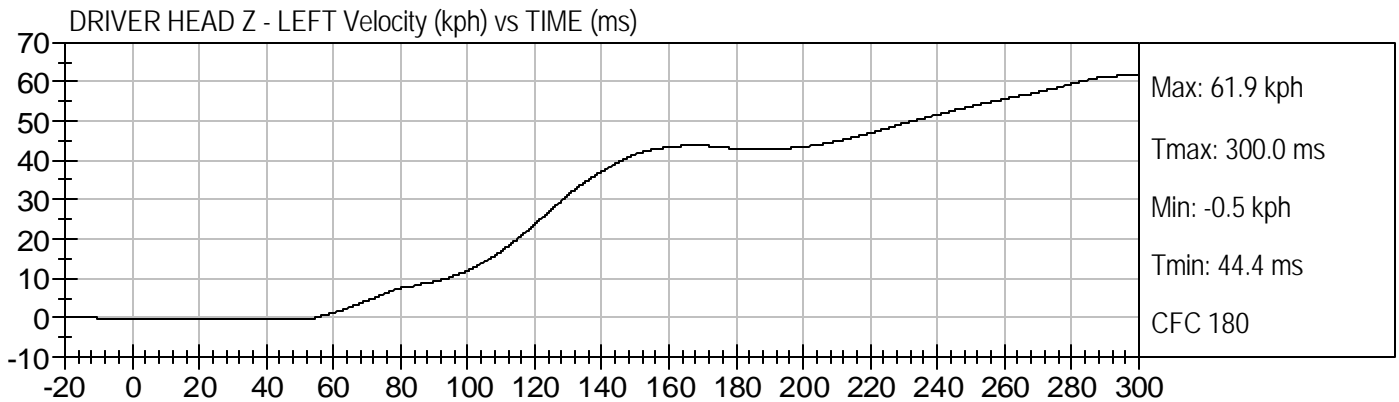
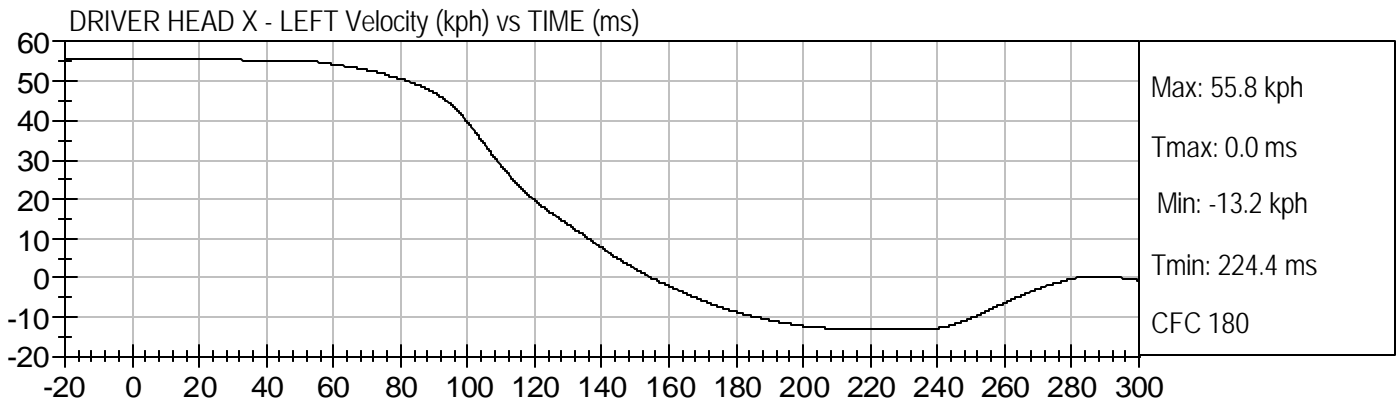
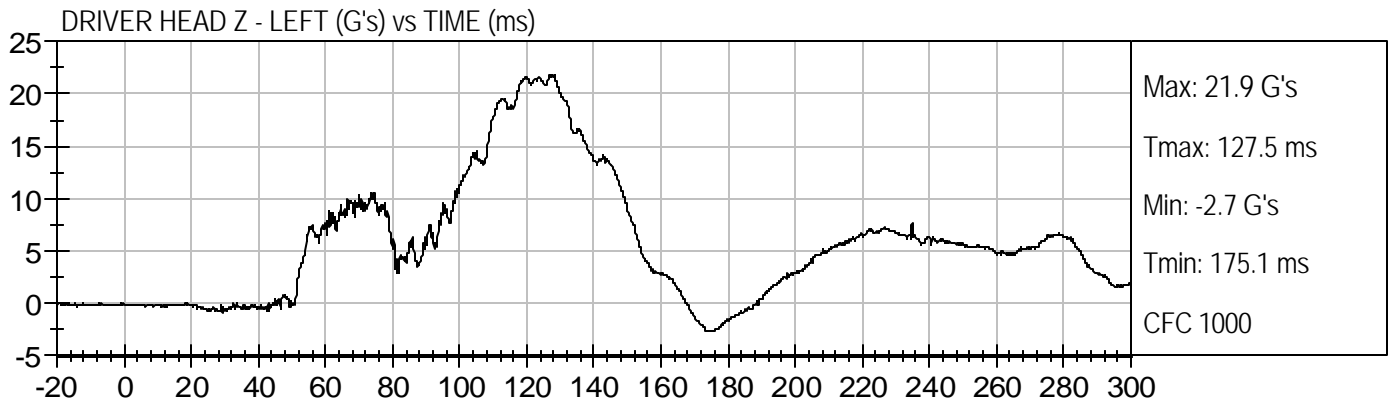
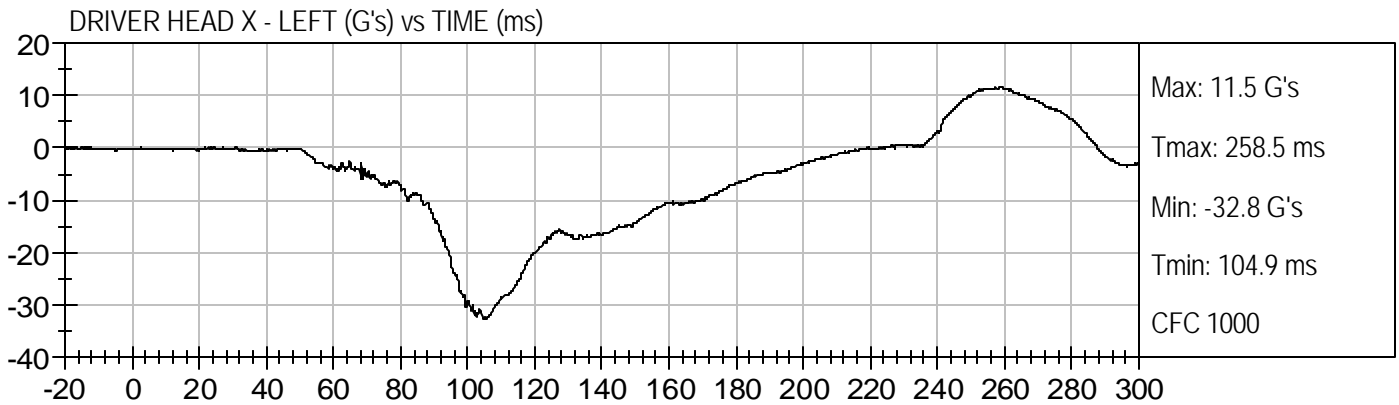
Page No.

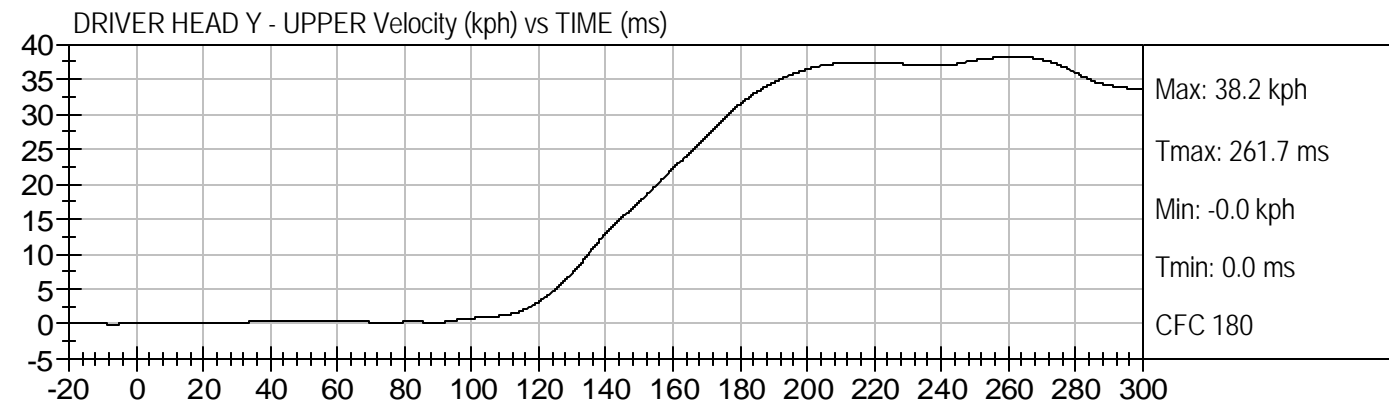
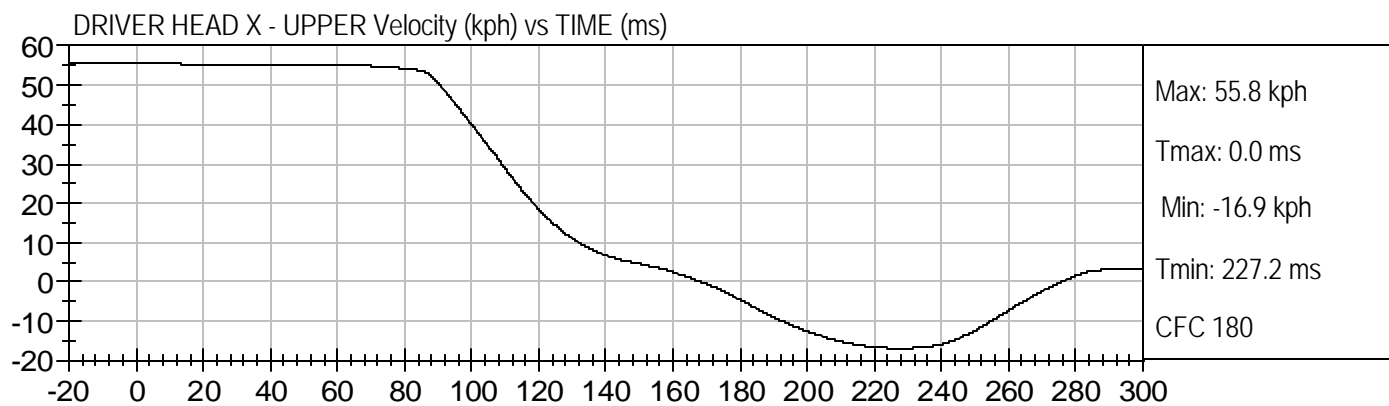
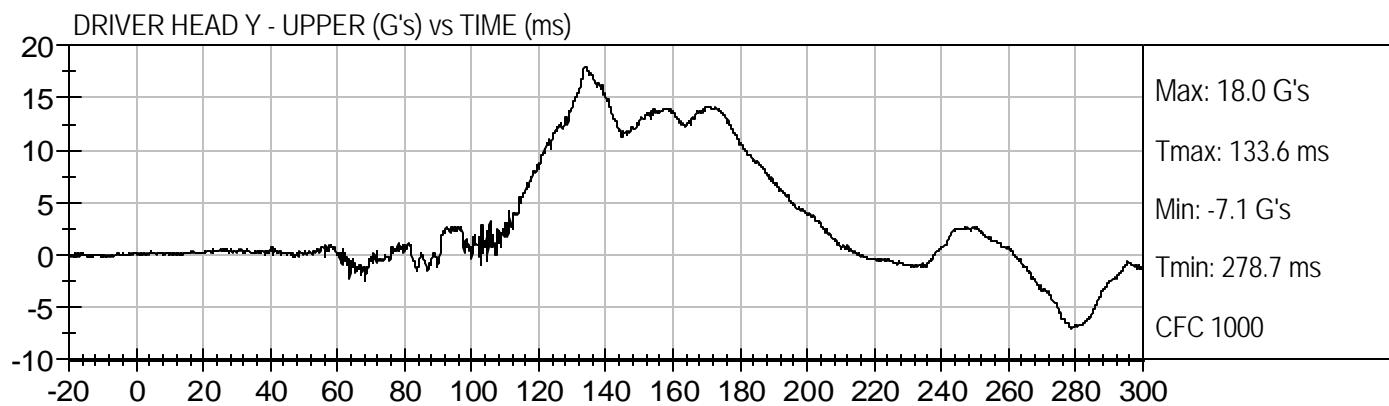
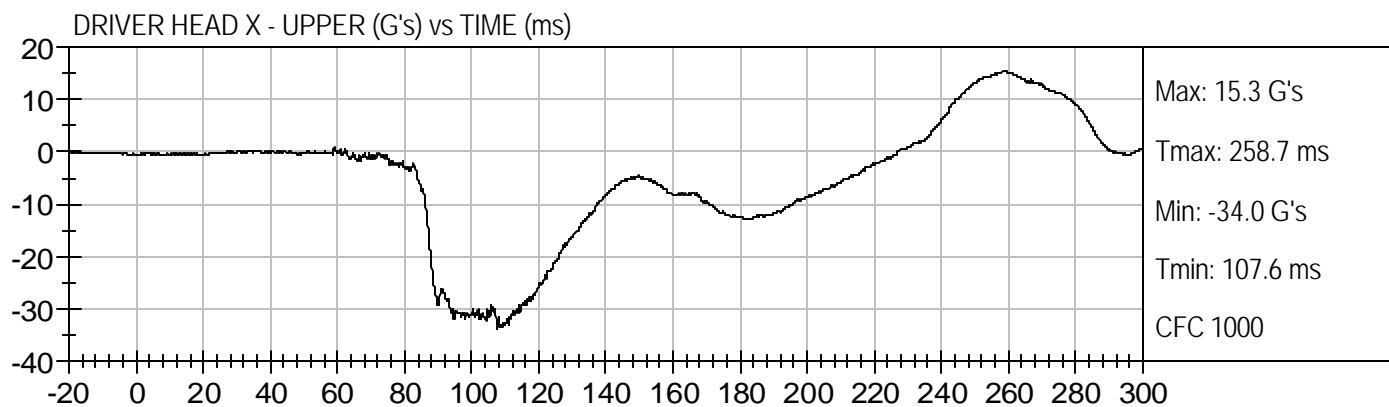
Figure No. 309.	ODB Barrier 70 Force vs. Time	B-84
Figure No. 310.	ODB Barrier 71 Force vs. Time	B-84
Figure No. 311.	ODB Barrier 72 Force vs. Time	B-84
Figure No. 312.	ODB Barrier 73 Force vs. Time	B-85
Figure No. 313.	ODB Barrier 74 Force vs. Time	B-85
Figure No. 314.	ODB Barrier 75 Force vs. Time	B-85
Figure No. 315.	ODB Barrier 76 Force vs. Time	B-85
Figure No. 316.	ODB Barrier 77 Force vs. Time	B-86
Figure No. 317.	ODB Barrier 78 Force vs. Time	B-86
Figure No. 318.	ODB Barrier 79 Force vs. Time	B-86
Figure No. 319.	ODB Barrier 80 Force vs. Time	B-86
Figure No. 320.	ODB Barrier 81 Force vs. Time	B-87
Figure No. 321.	ODB Barrier 82 Force vs. Time	B-87
Figure No. 322.	ODB Barrier 83 Force vs. Time	B-87
Figure No. 323.	ODB Barrier 84 Force vs. Time	B-87
Figure No. 324.	ODB Barrier 85 Force vs. Time	B-88
Figure No. 325.	ODB Barrier 86 Force vs. Time	B-88
Figure No. 326.	ODB Barrier 87 Force vs. Time	B-88
Figure No. 327.	ODB Barrier 88 Force vs. Time	B-88
Figure No. 328.	ODB Barrier 89 Force vs. Time	B-89
Figure No. 329.	ODB Barrier 90 Force vs. Time	B-89

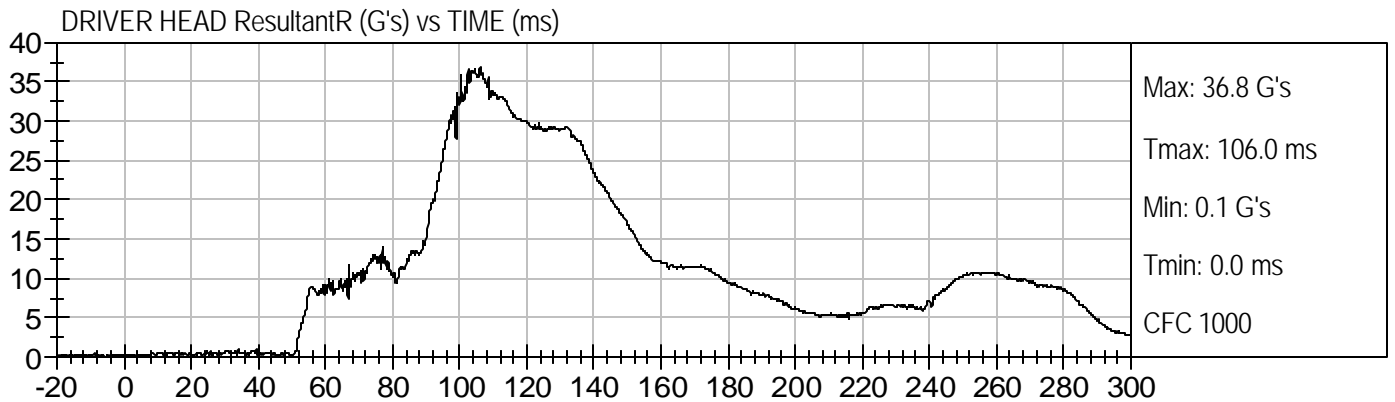
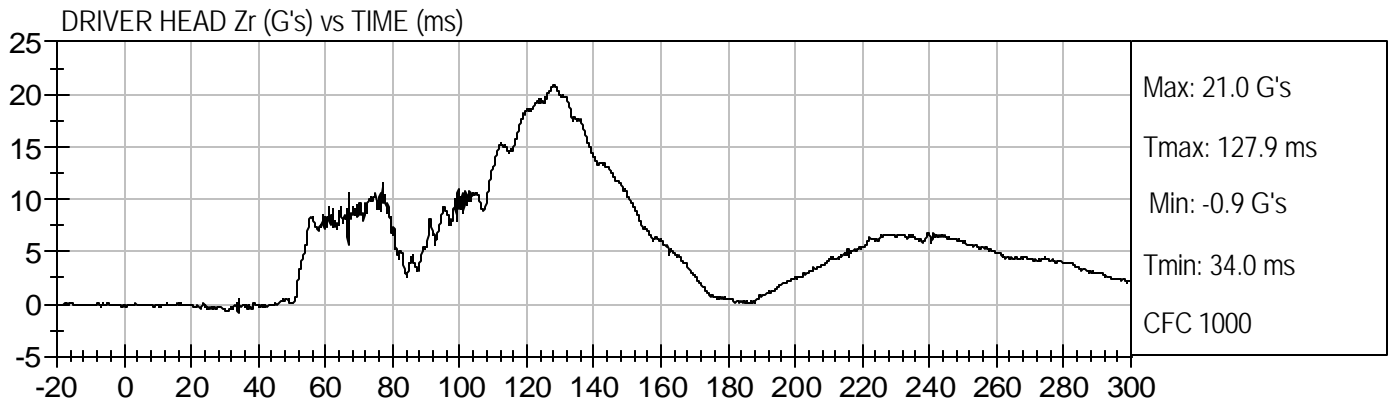
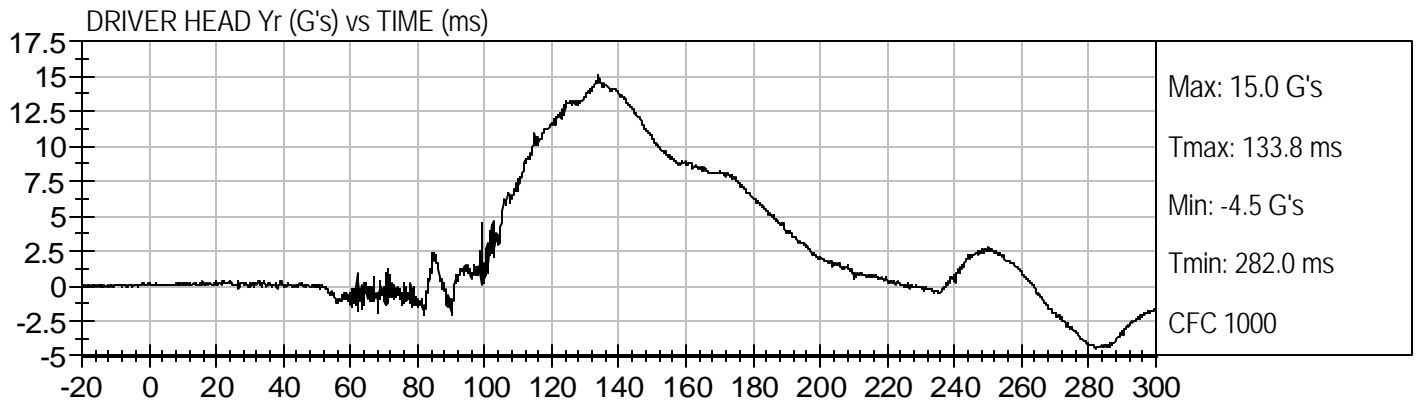
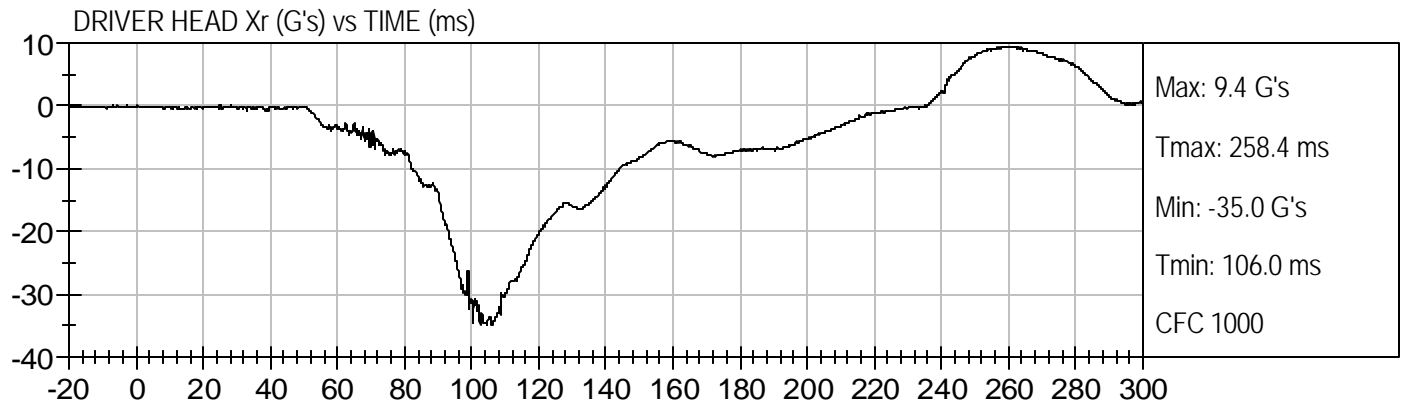


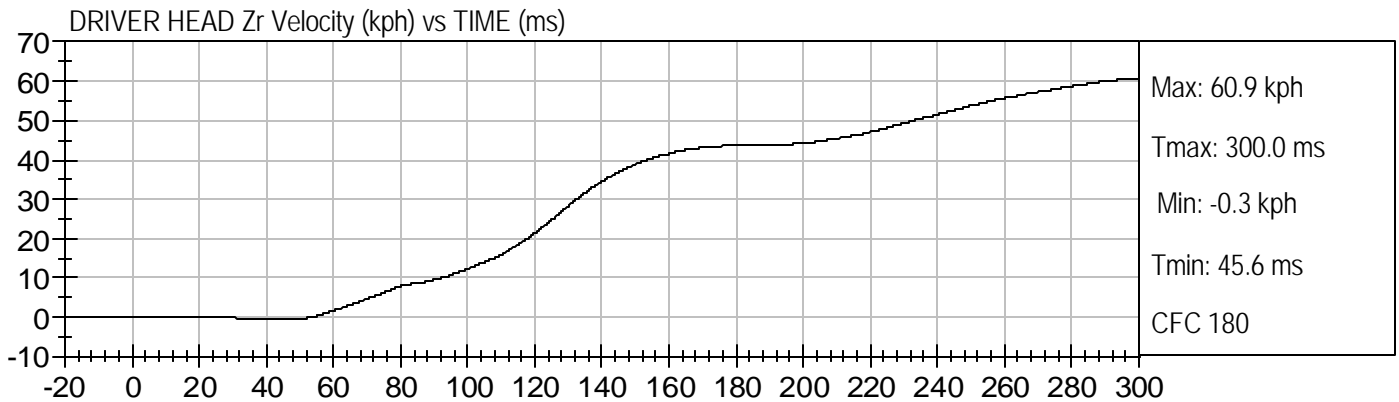
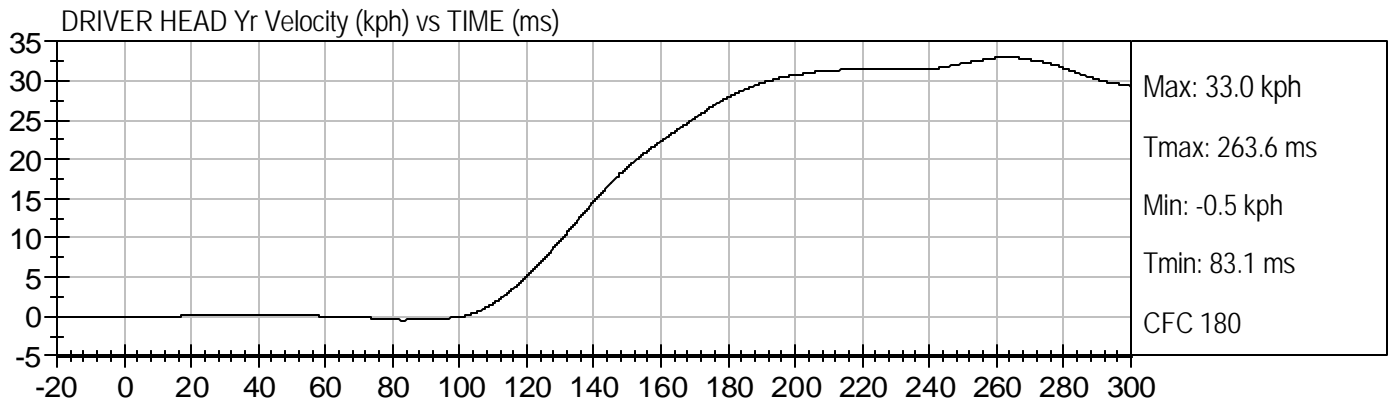
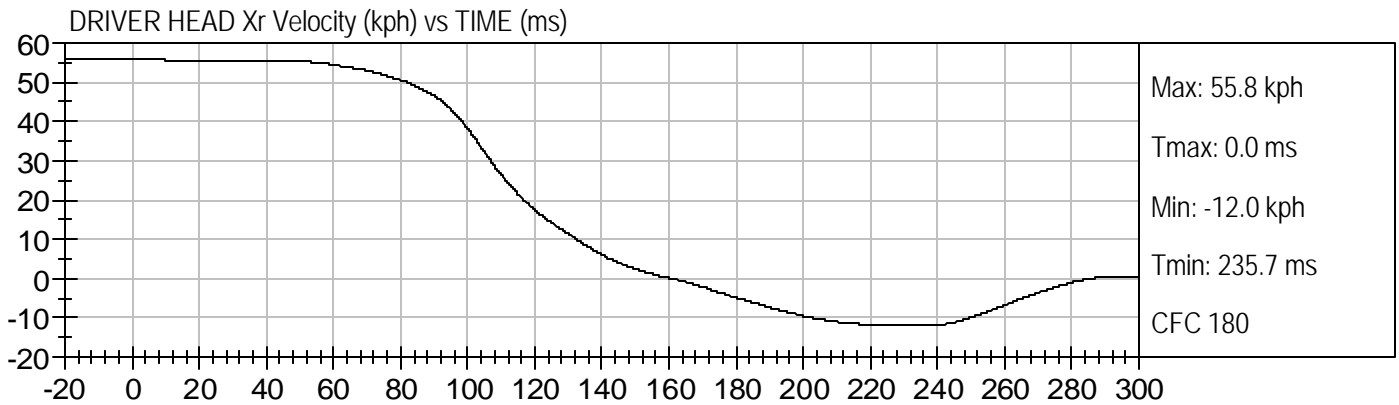


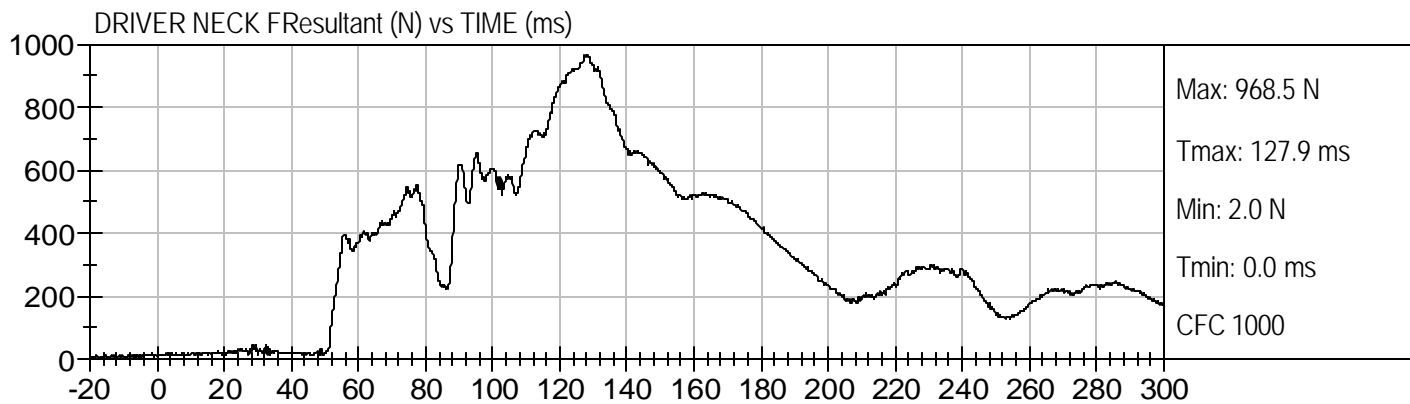
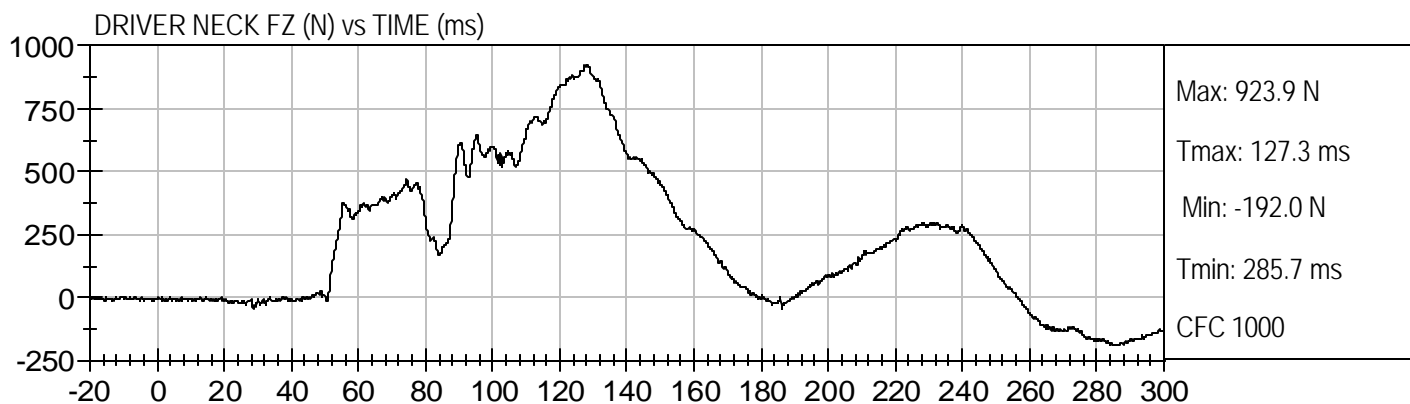
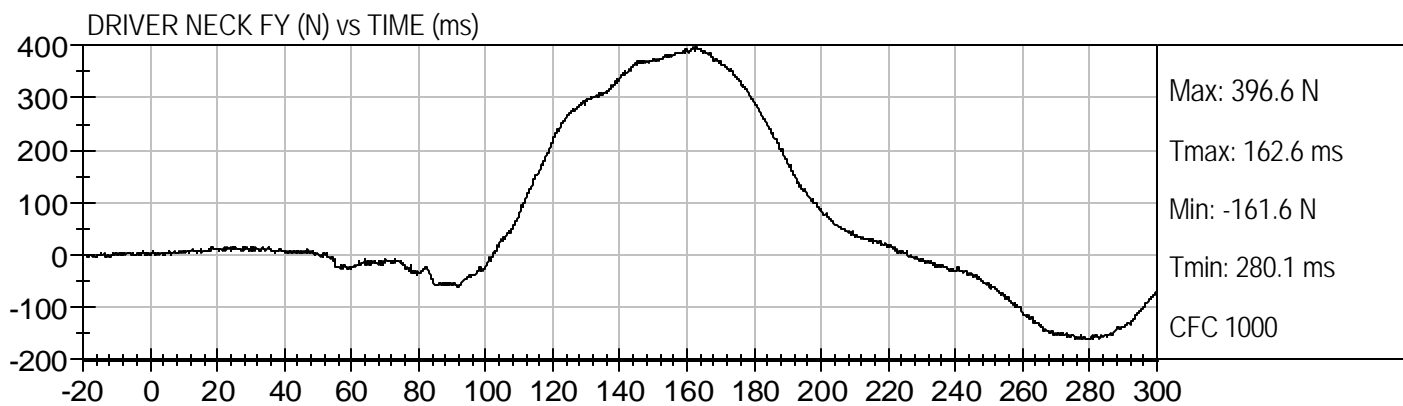
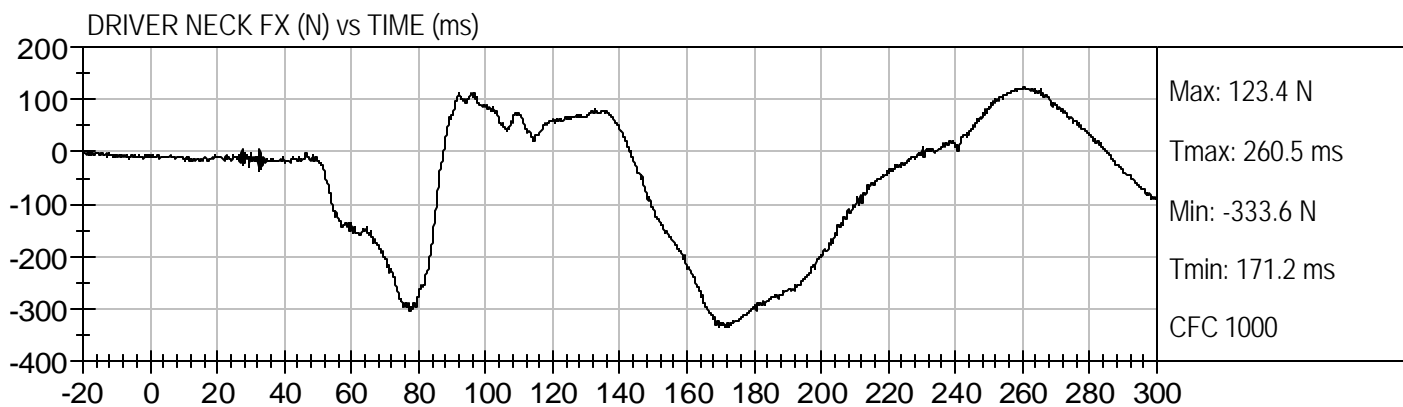


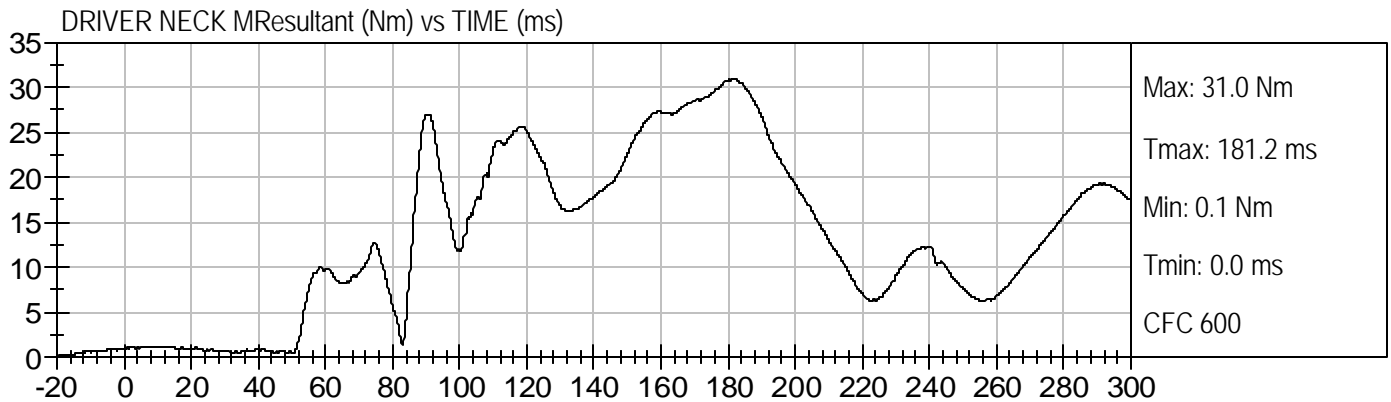
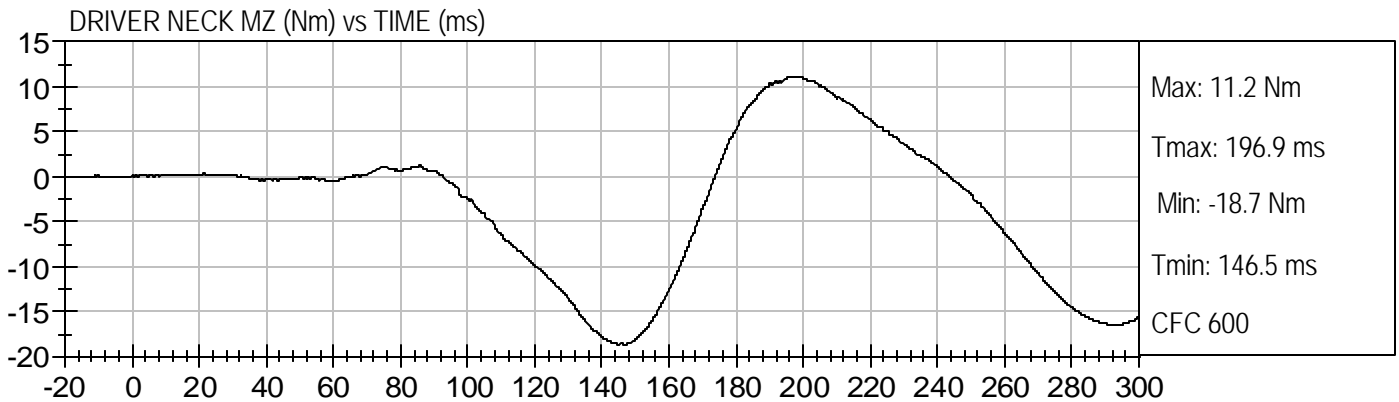
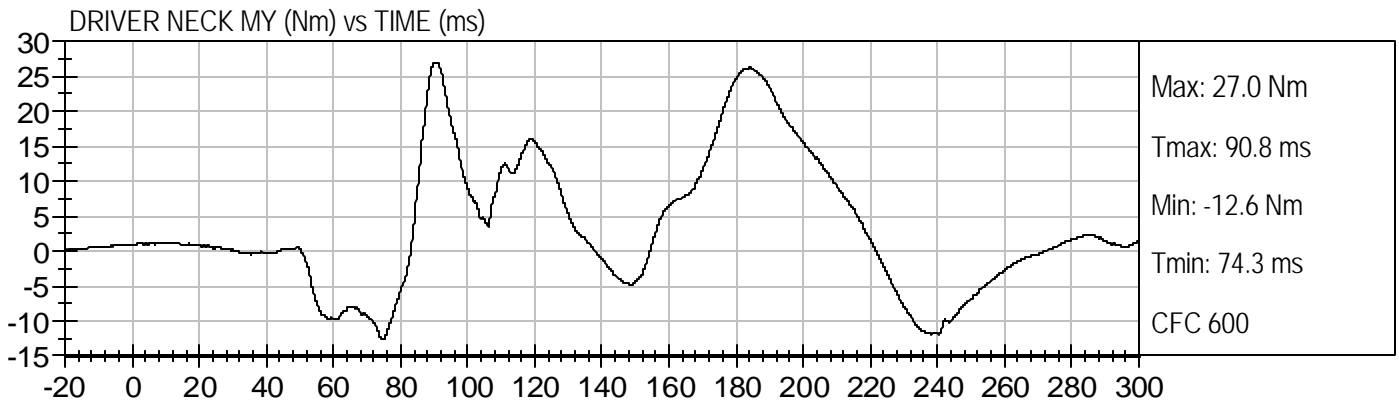
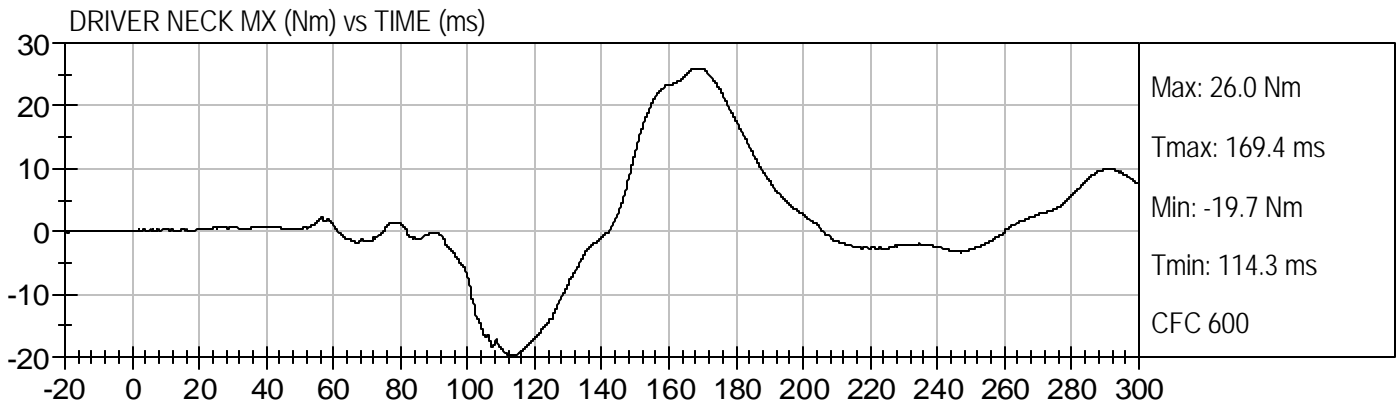


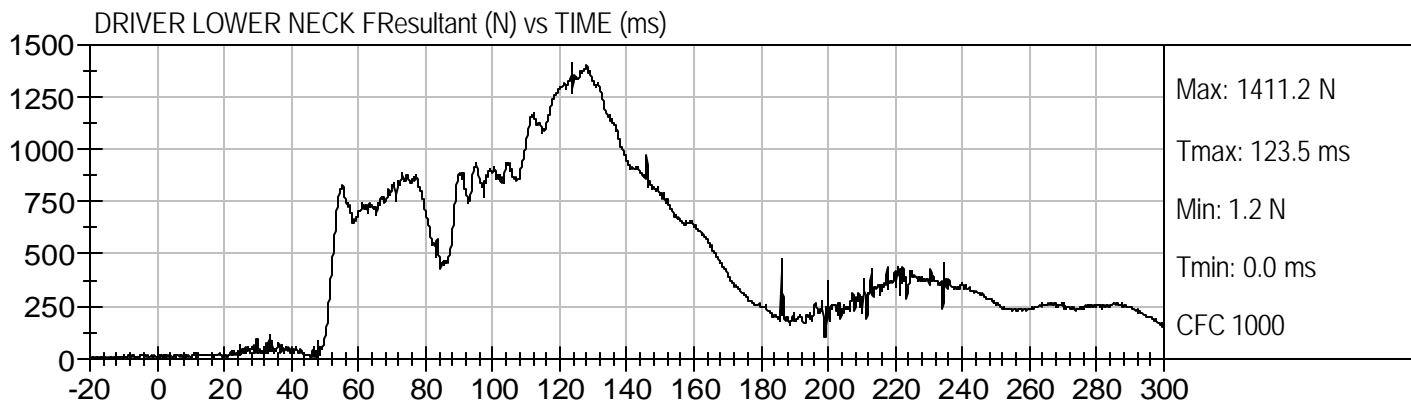
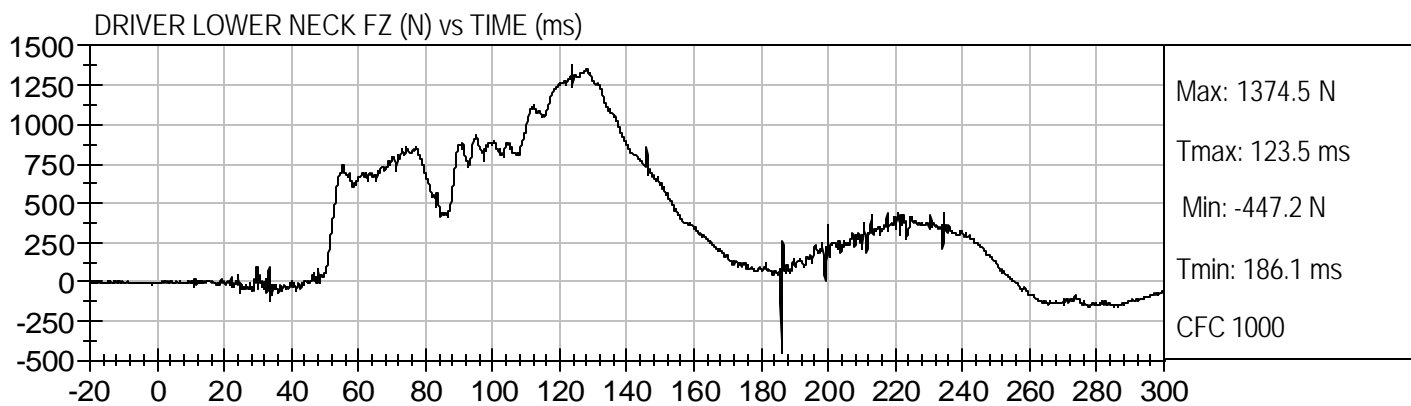
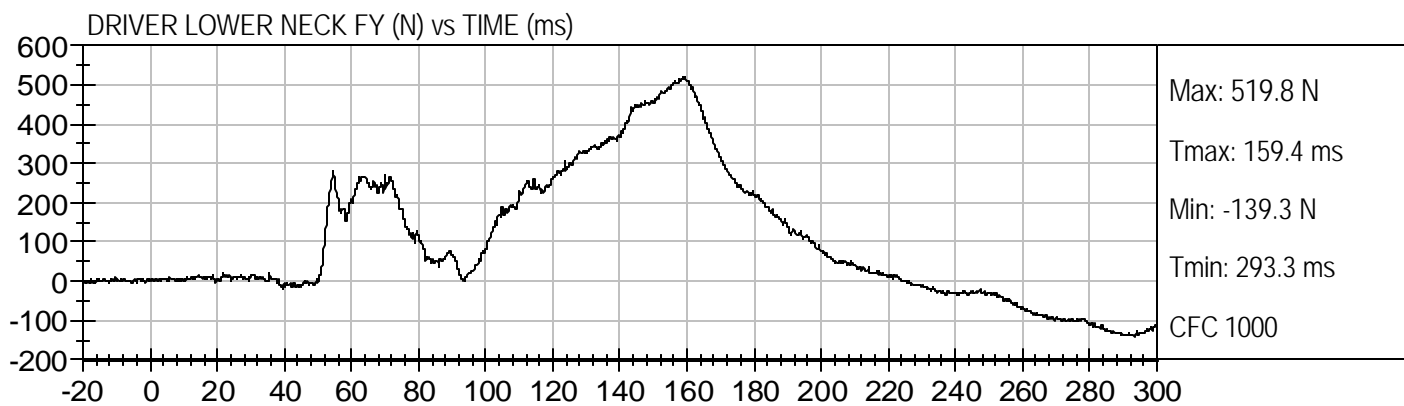
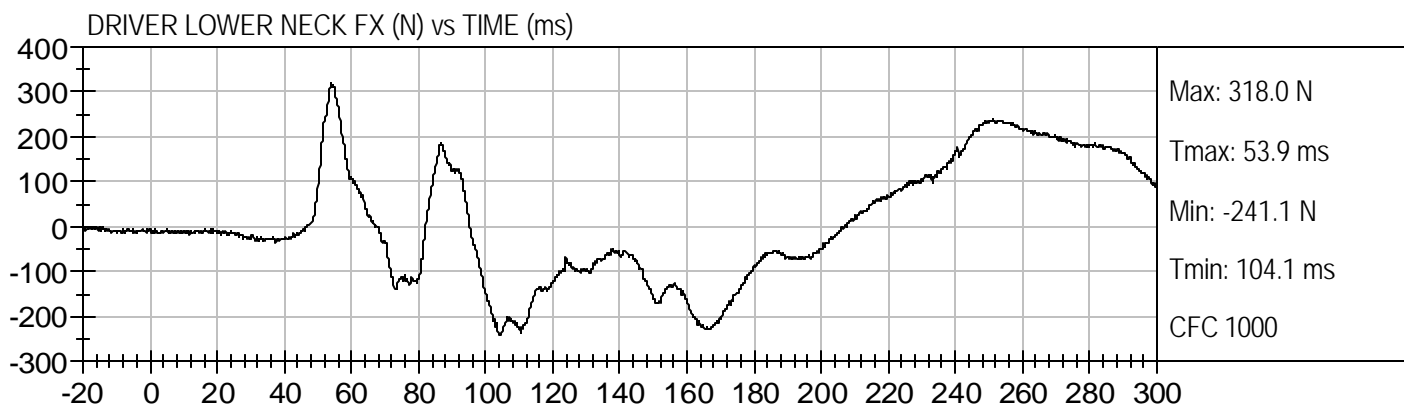


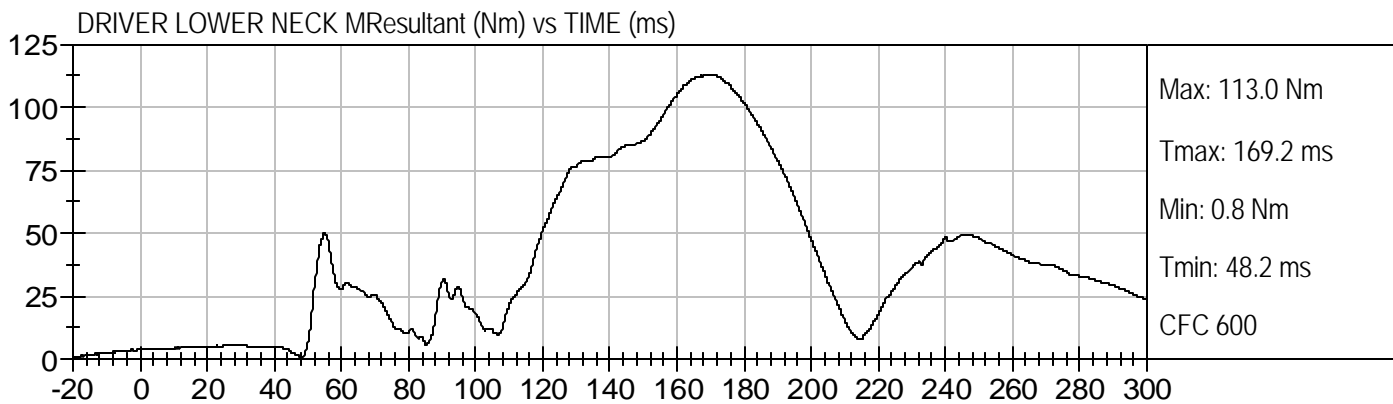
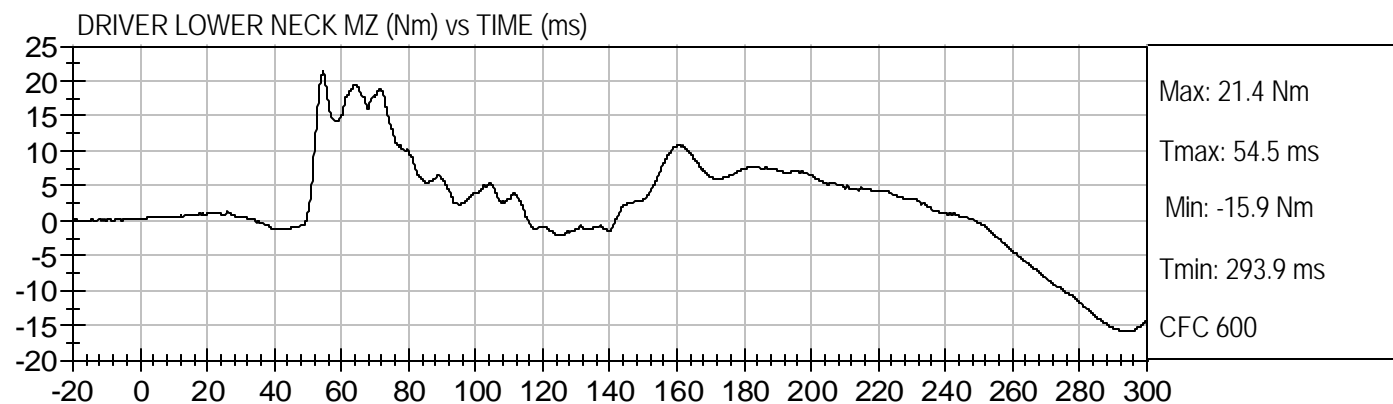
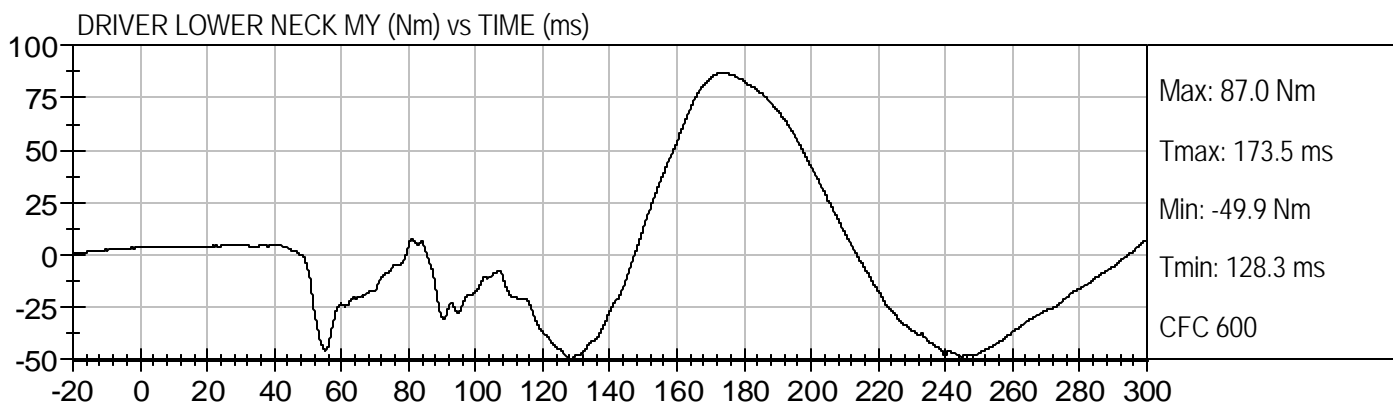
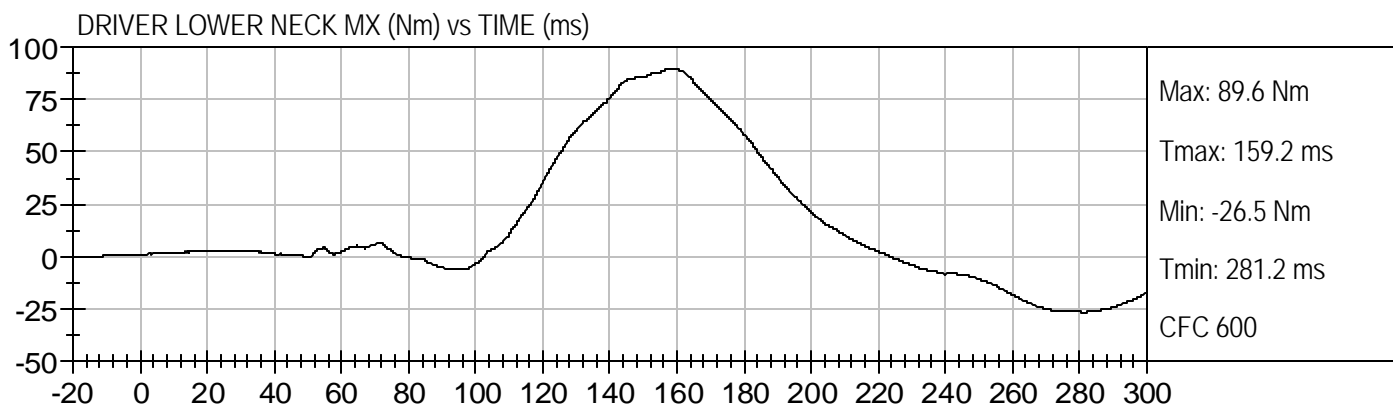


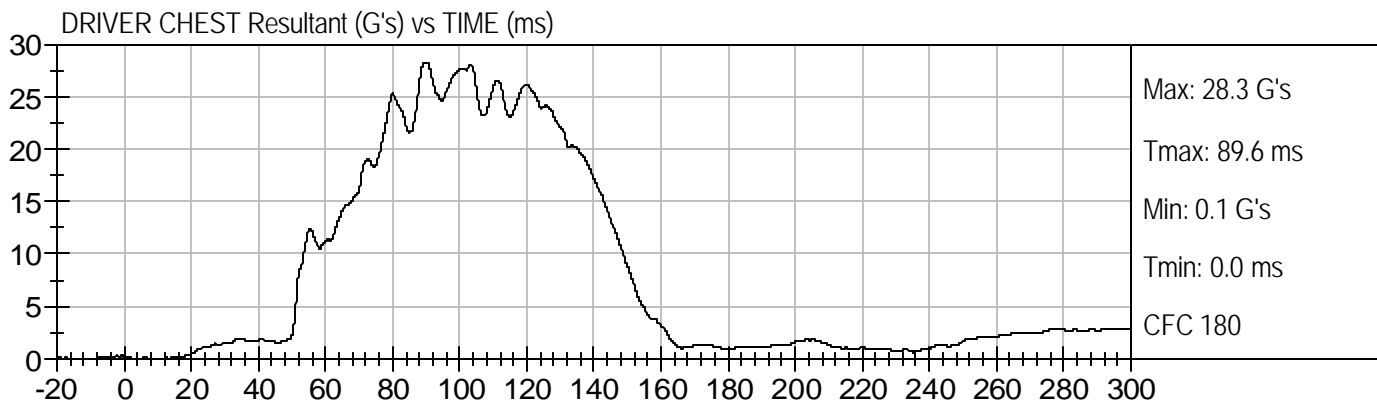
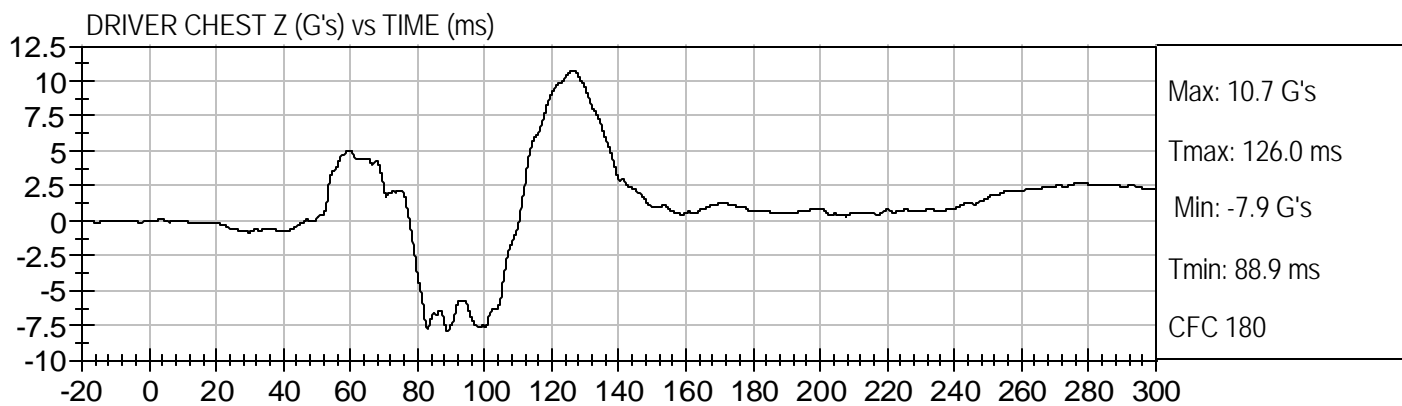
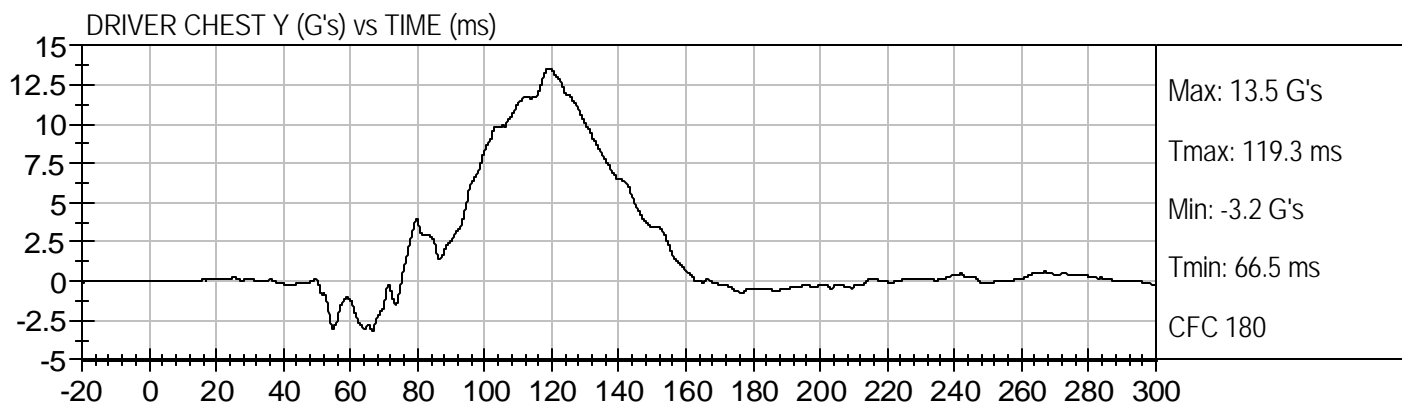
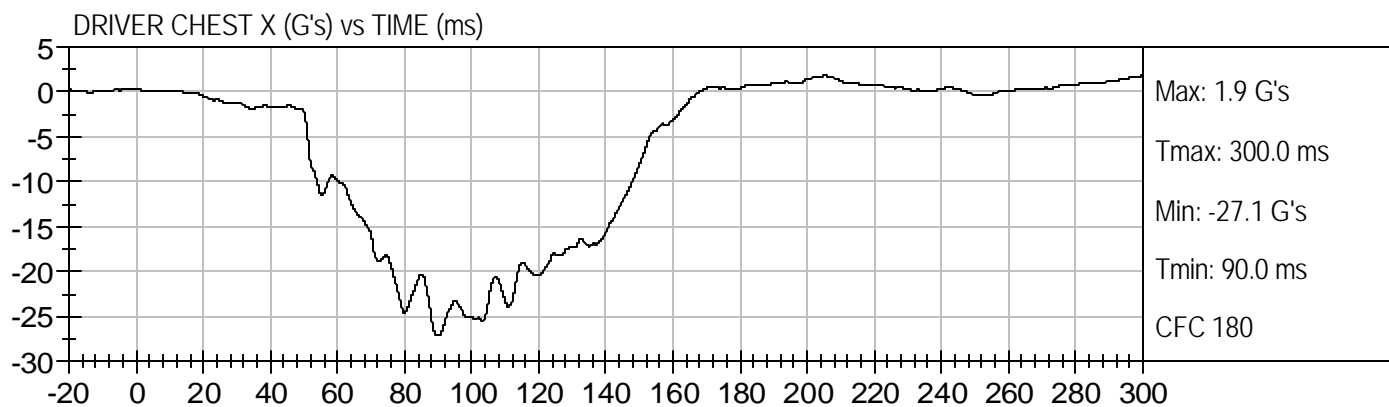


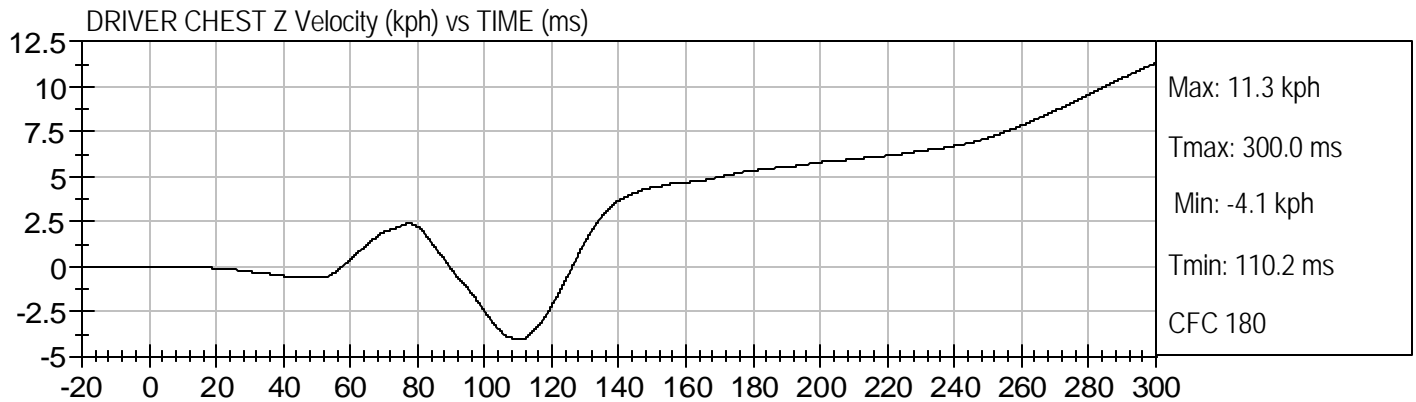
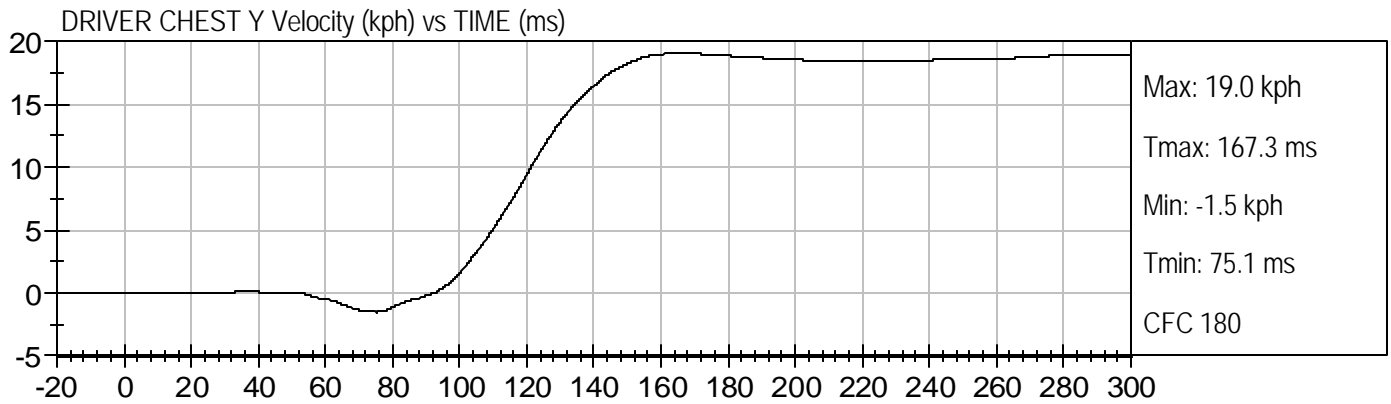
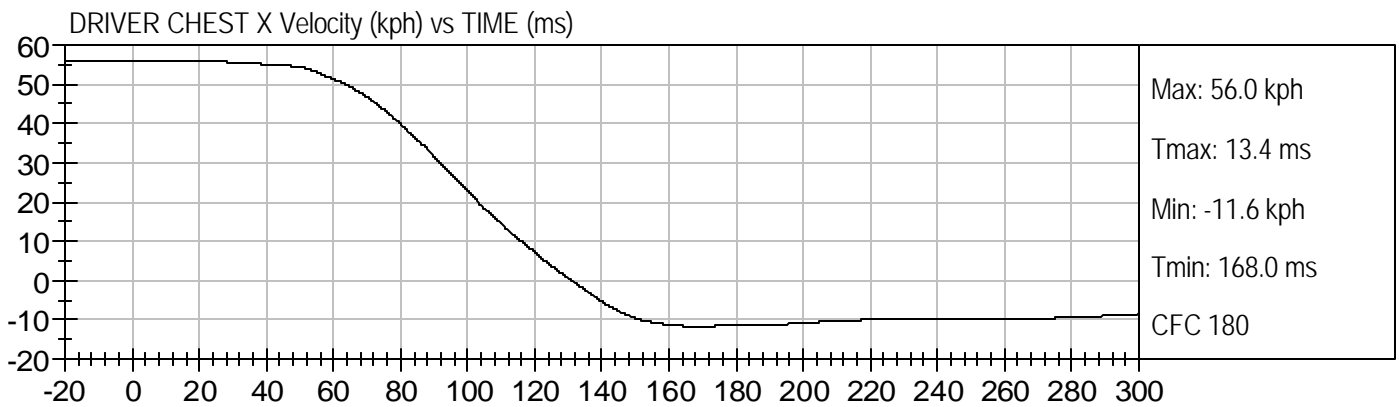


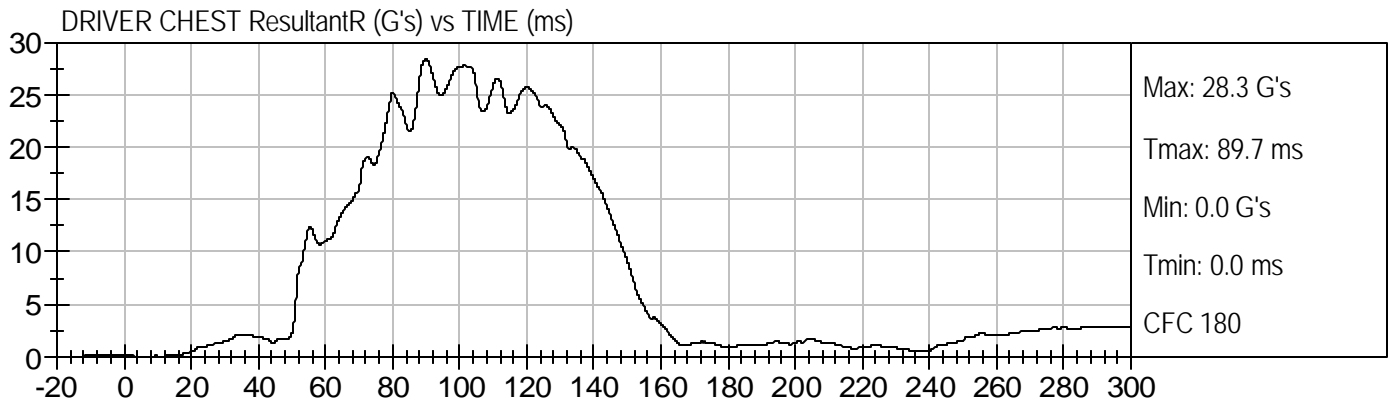
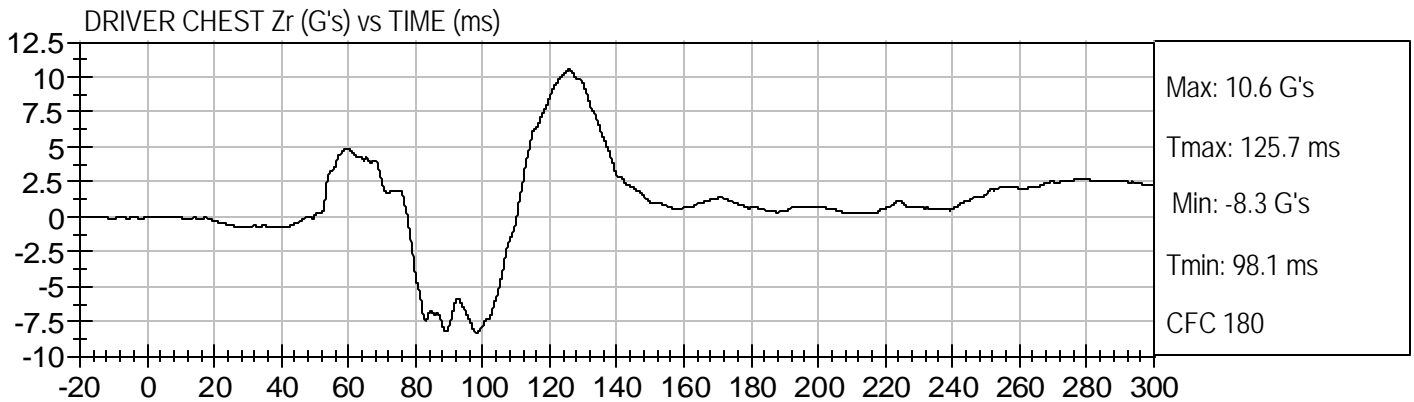
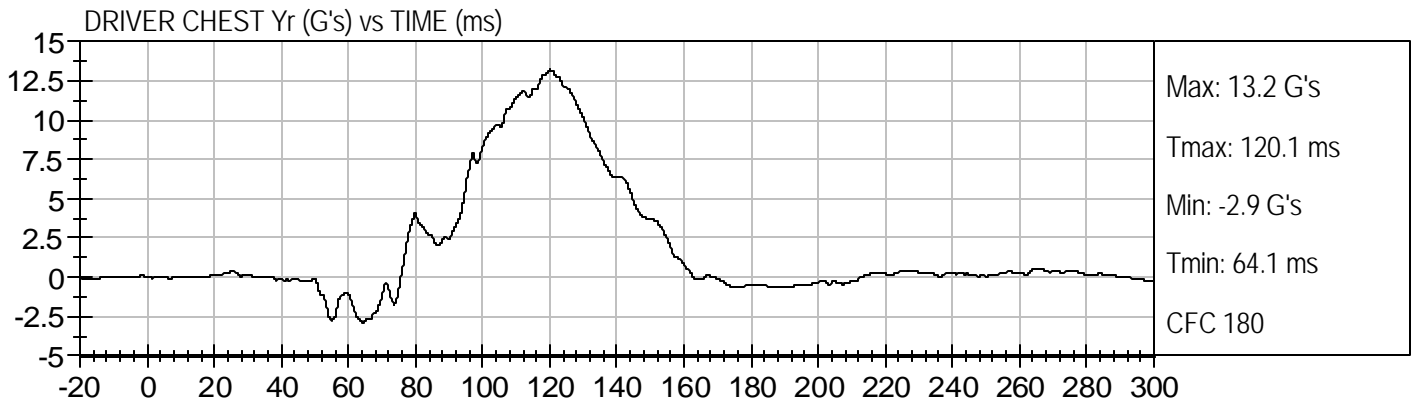
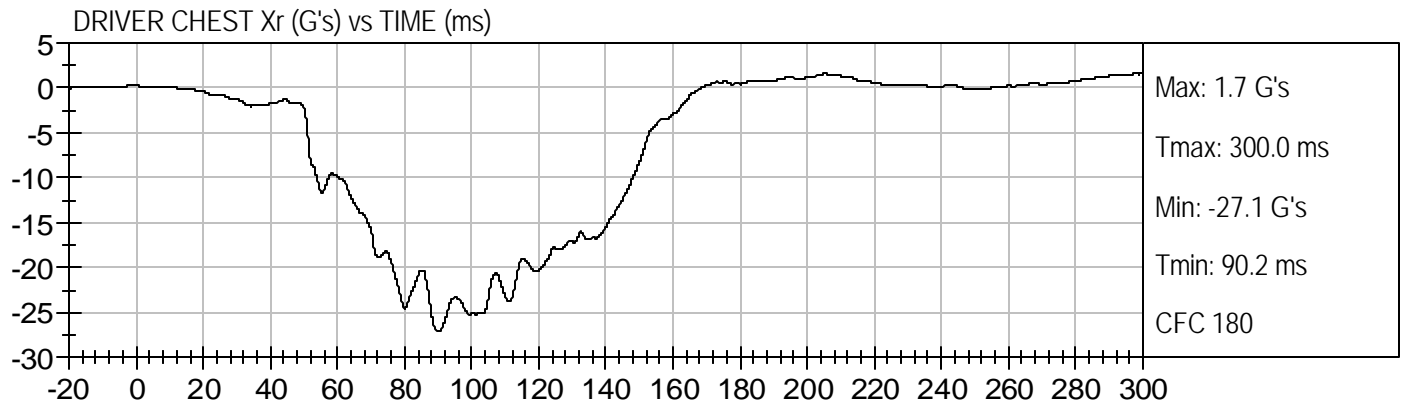


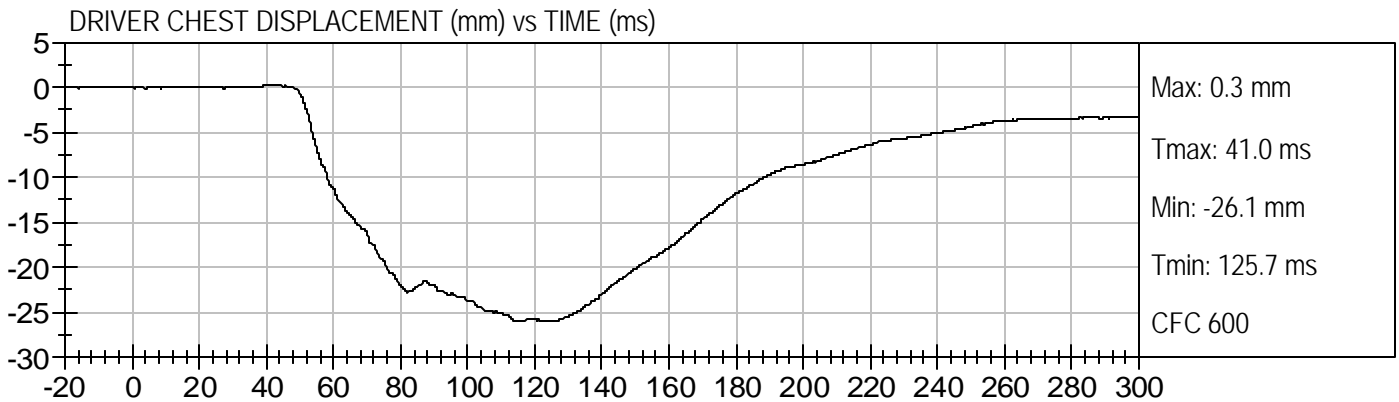
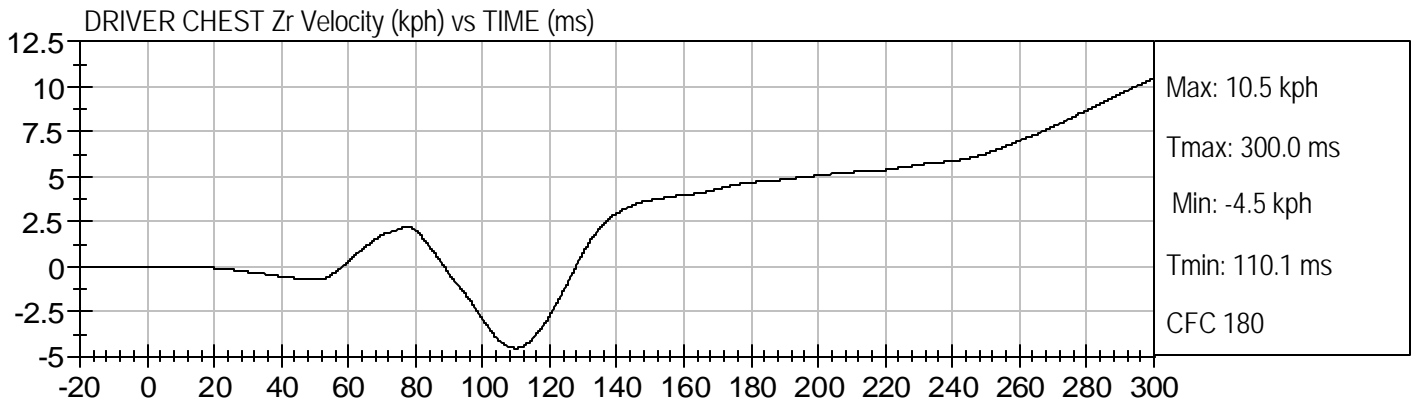
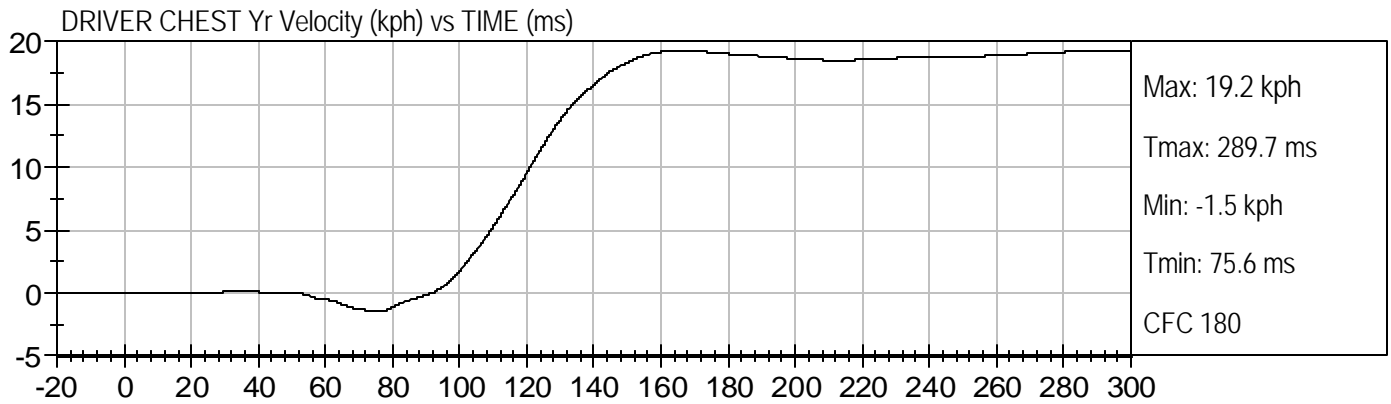
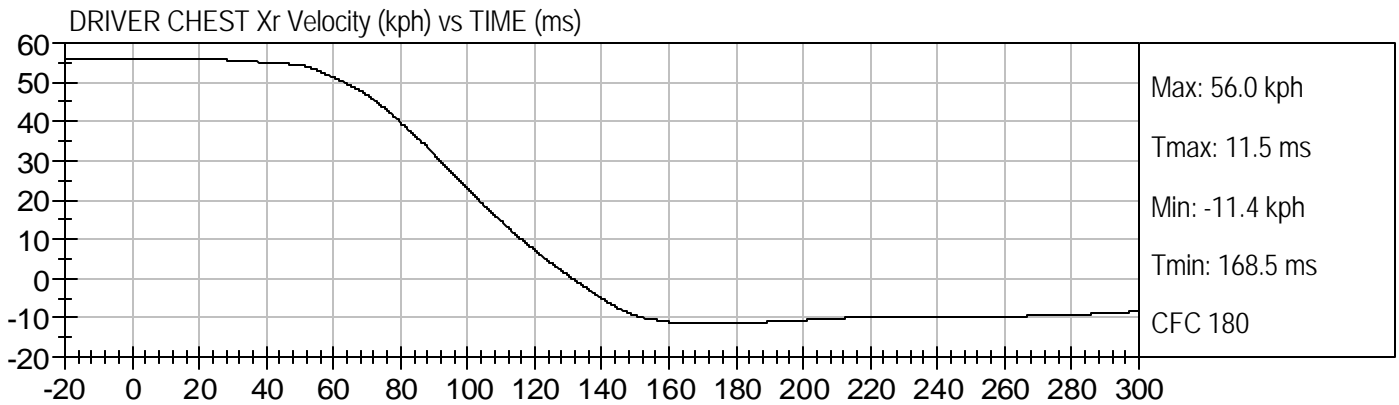


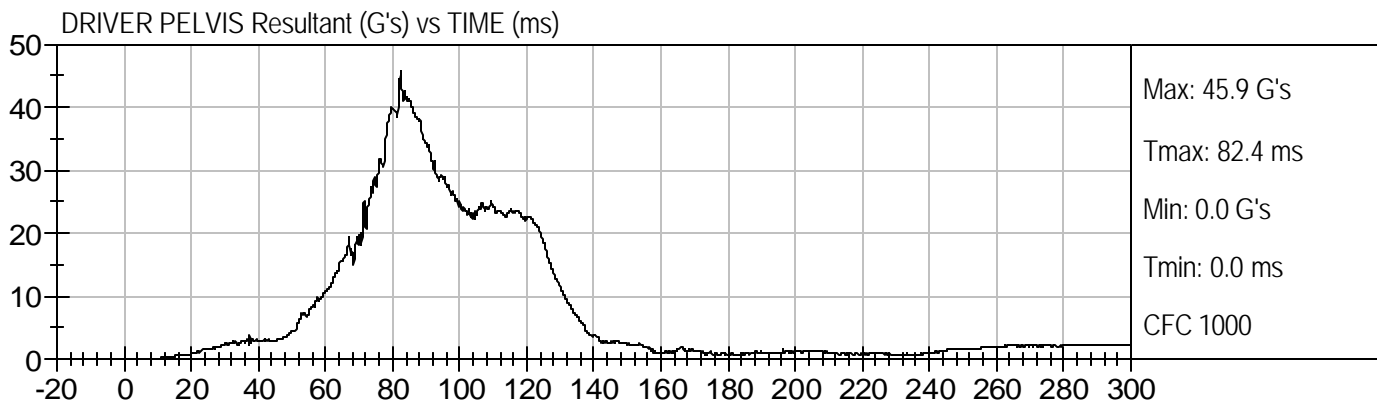
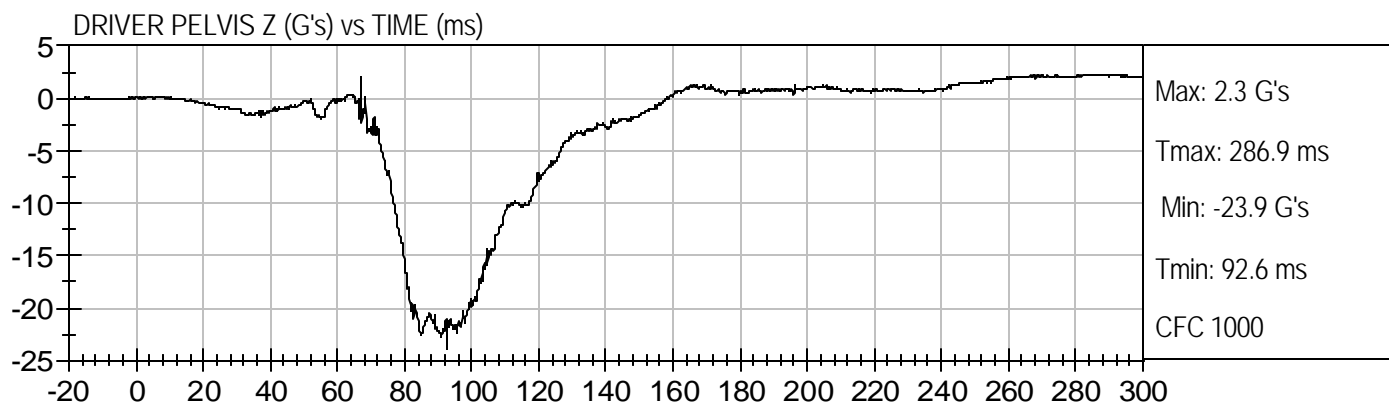
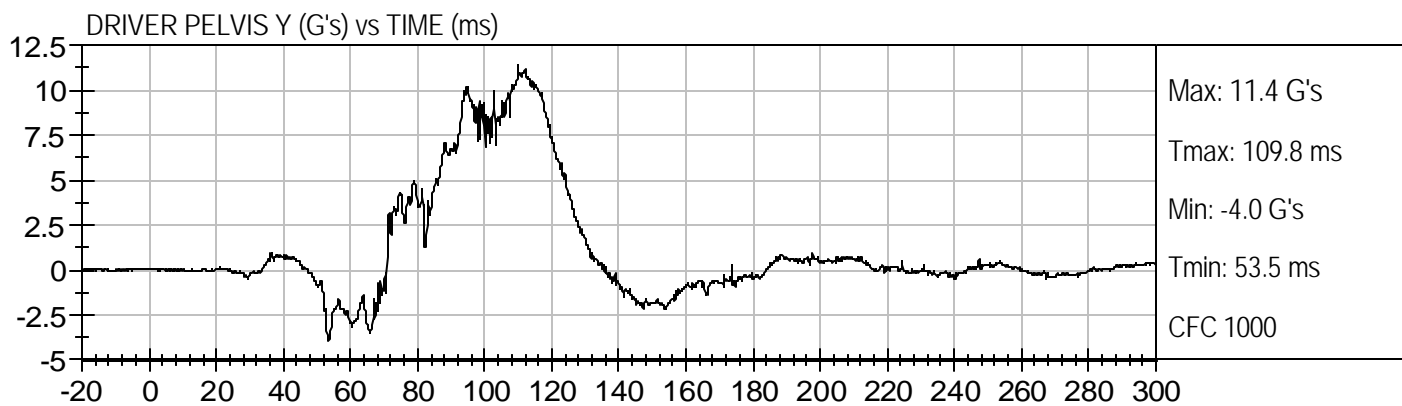
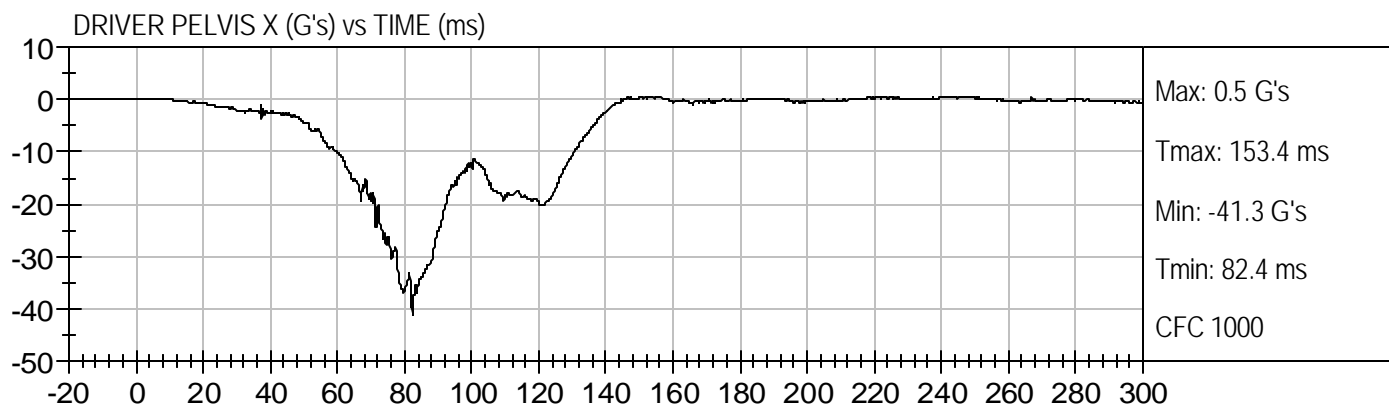


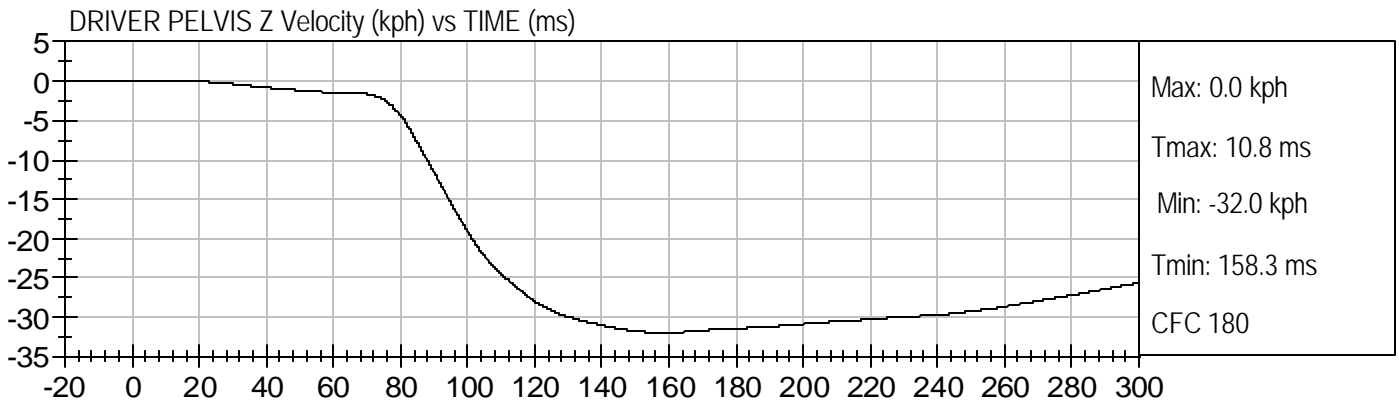
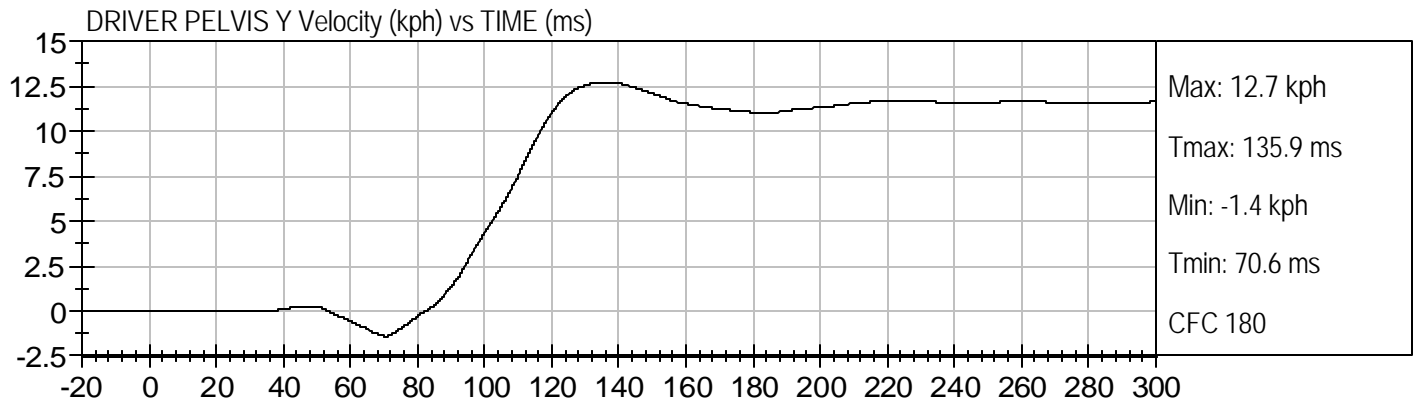
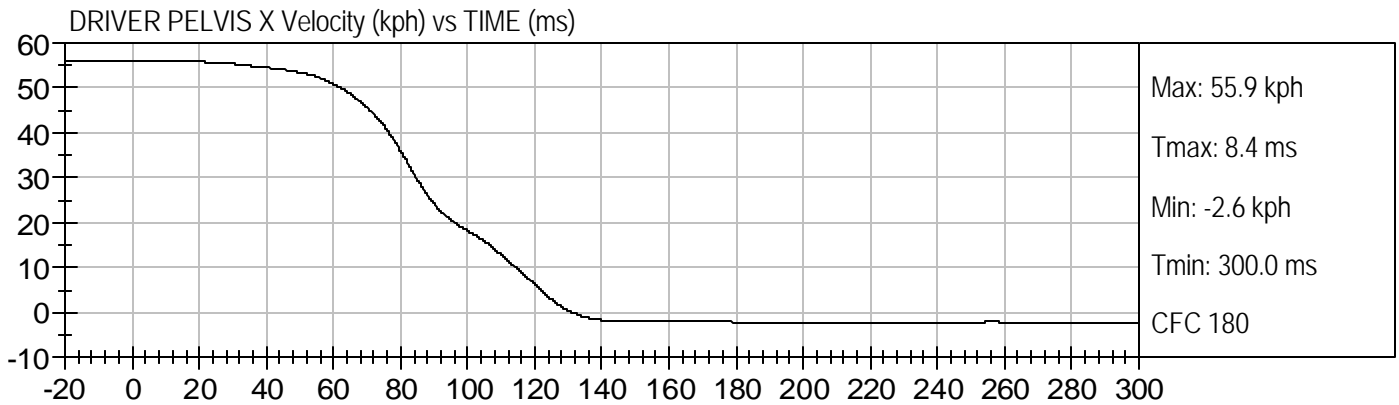


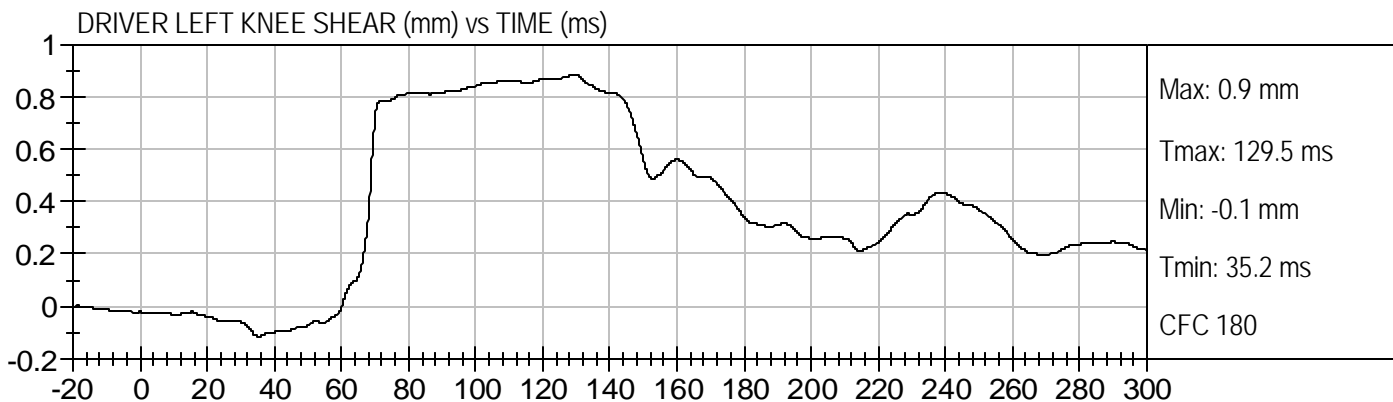
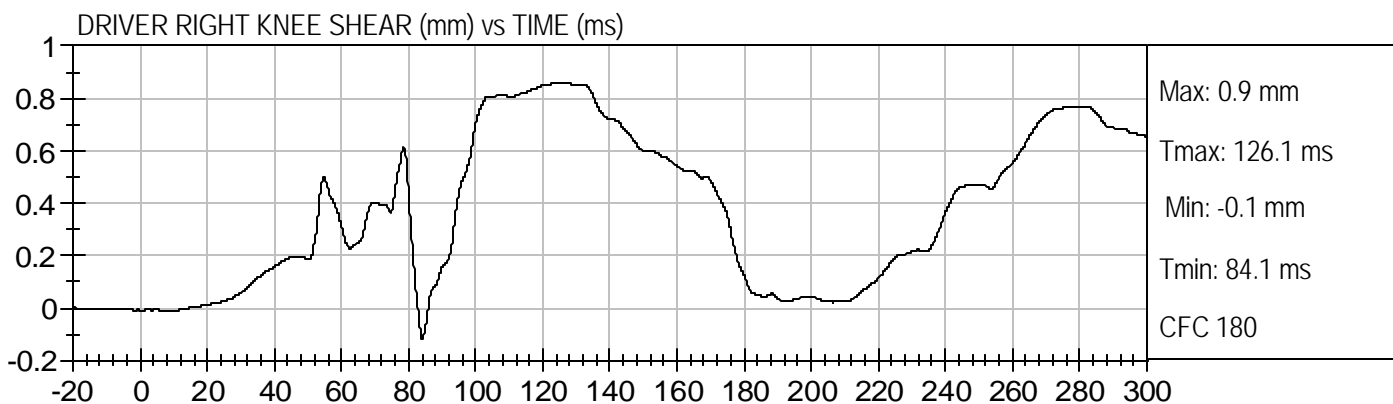
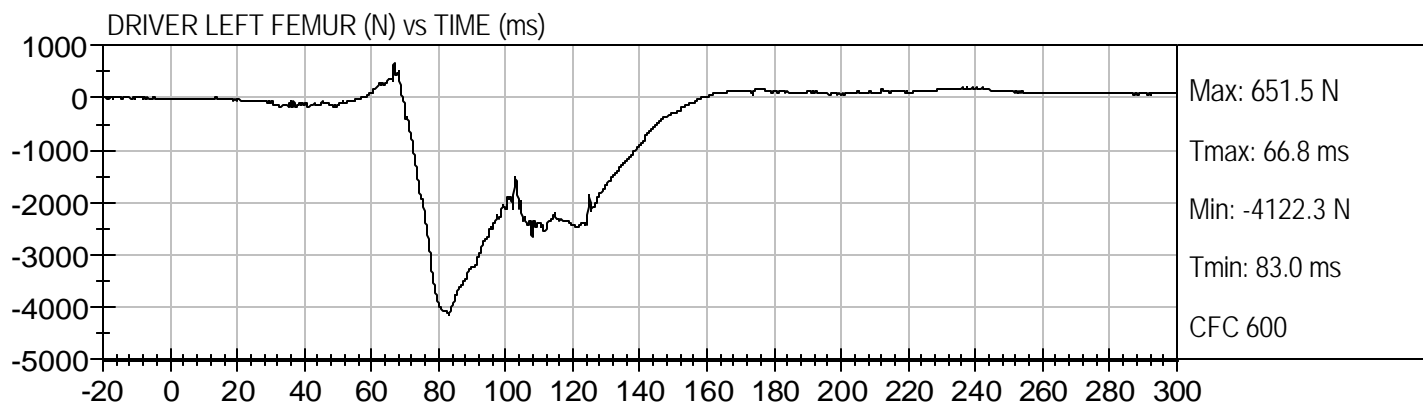
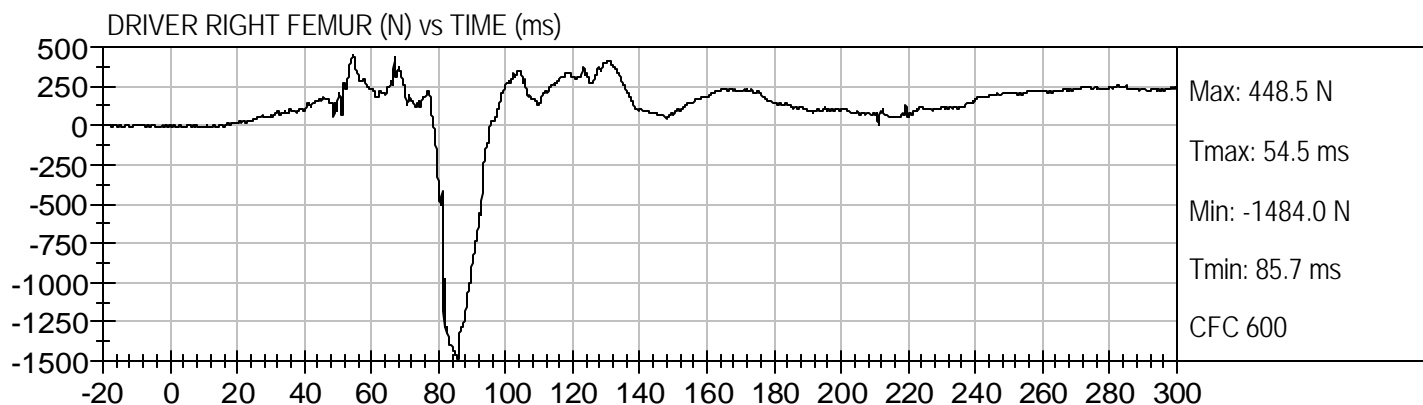


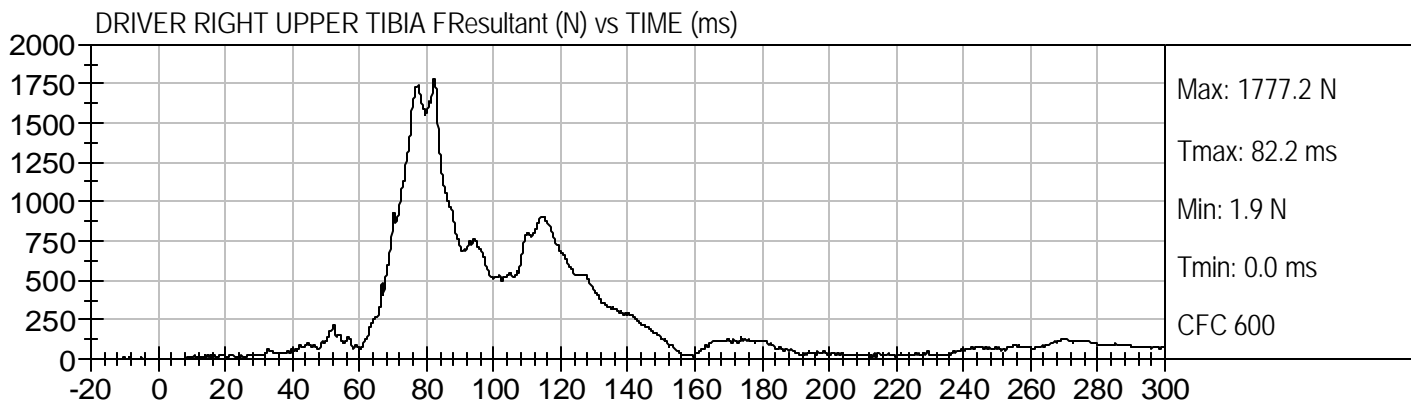
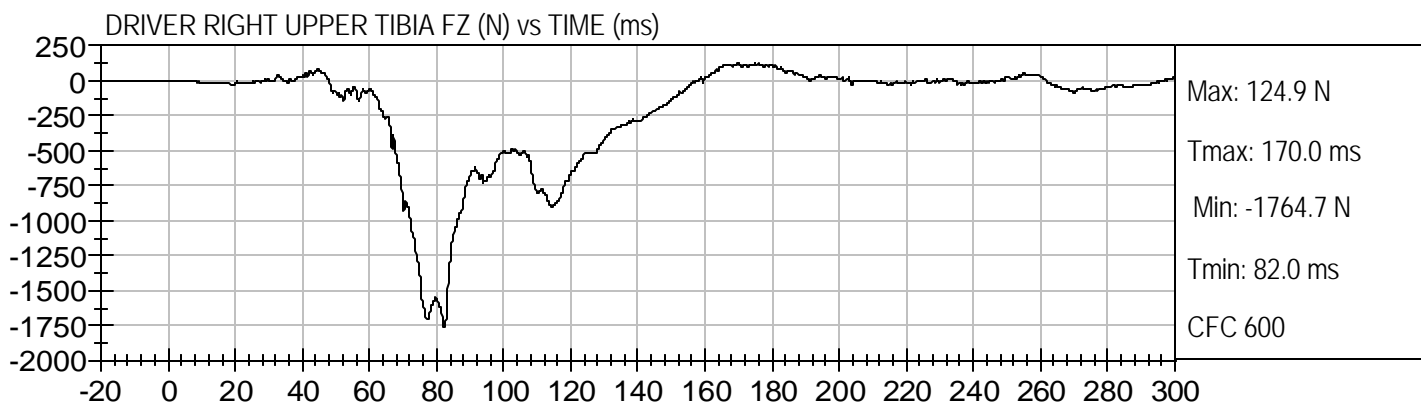
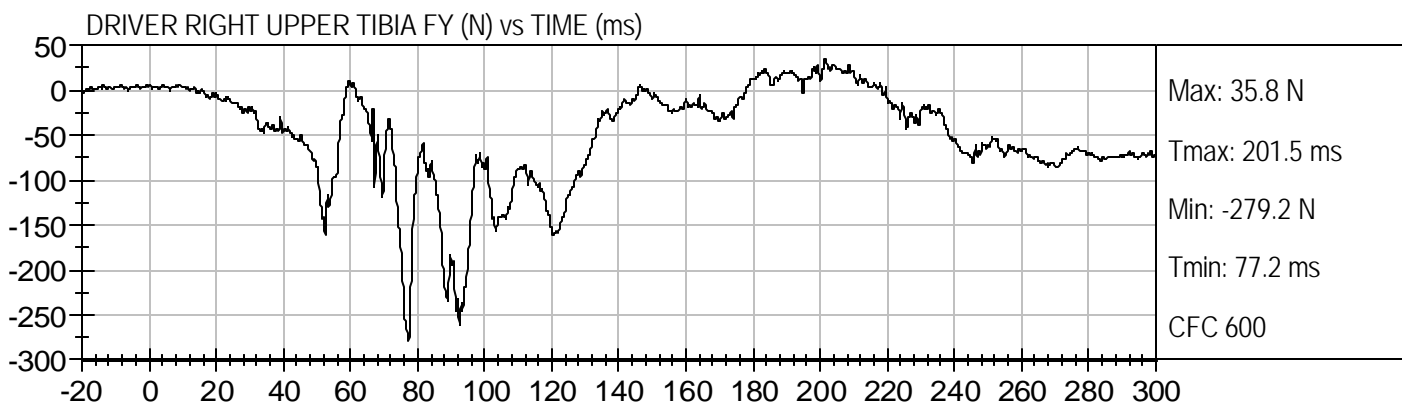
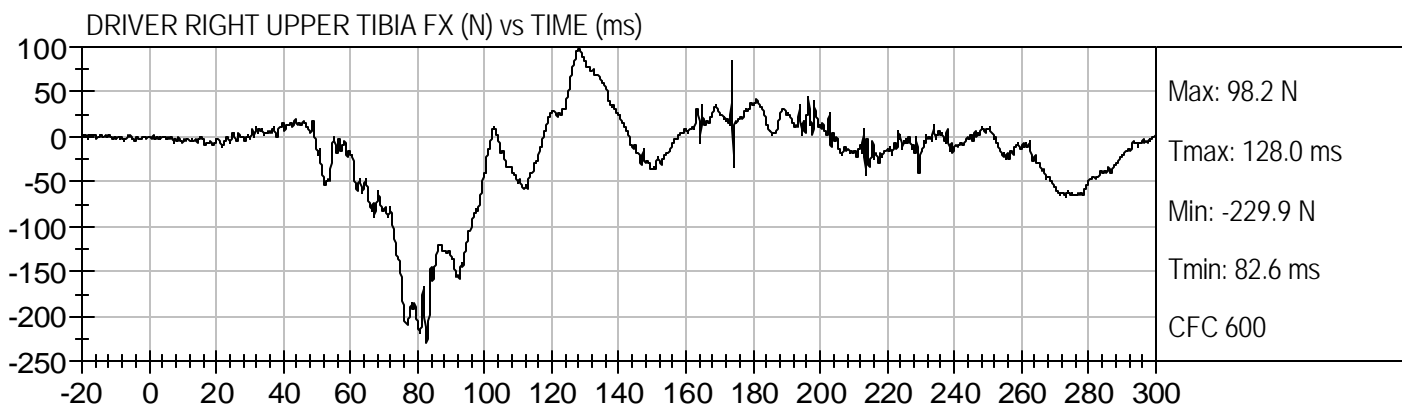


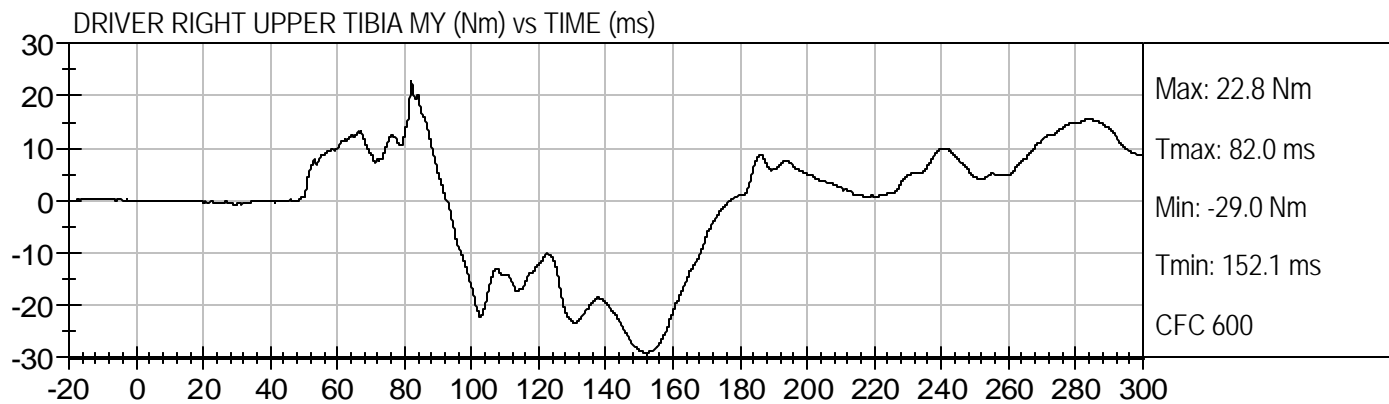
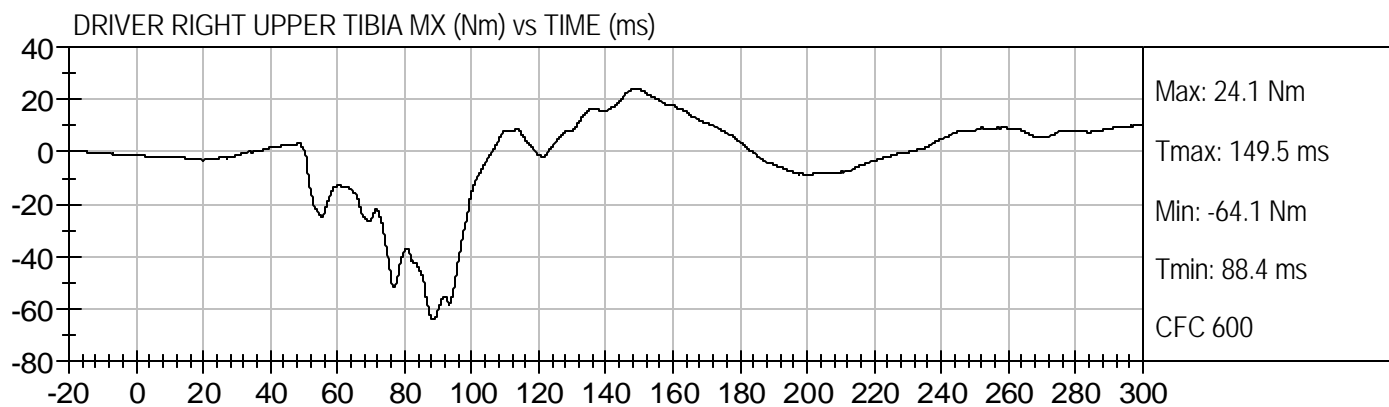


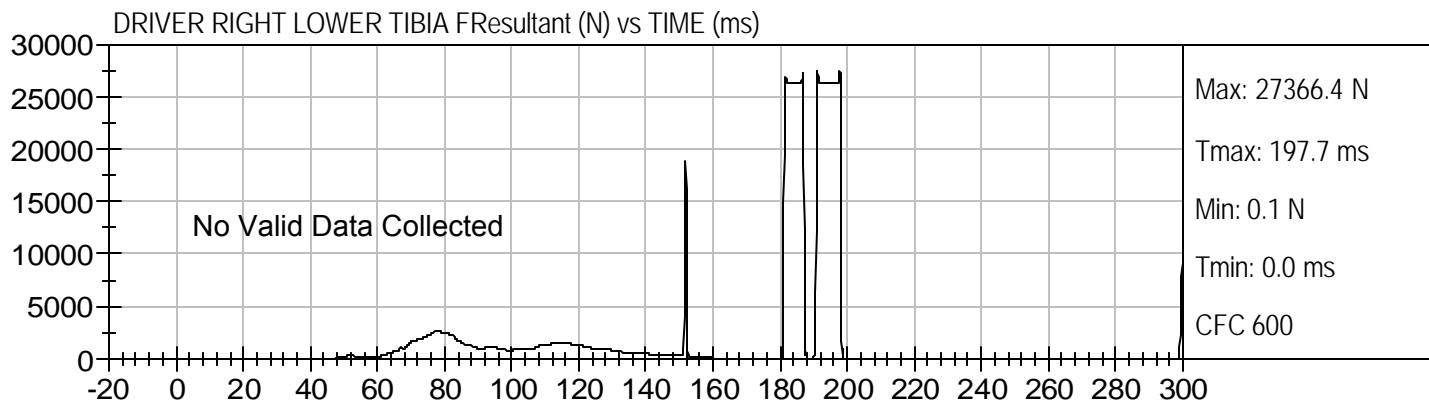
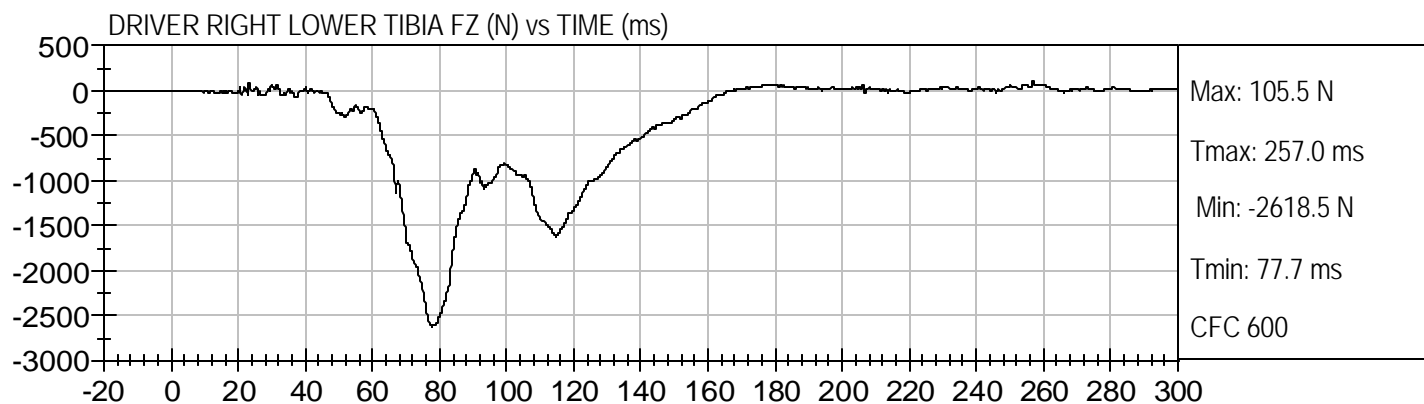
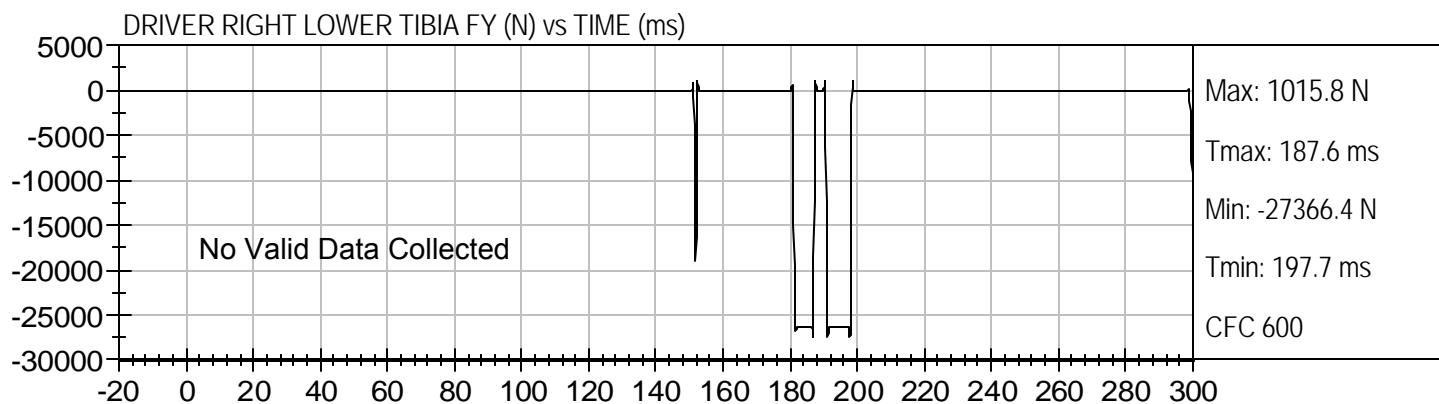
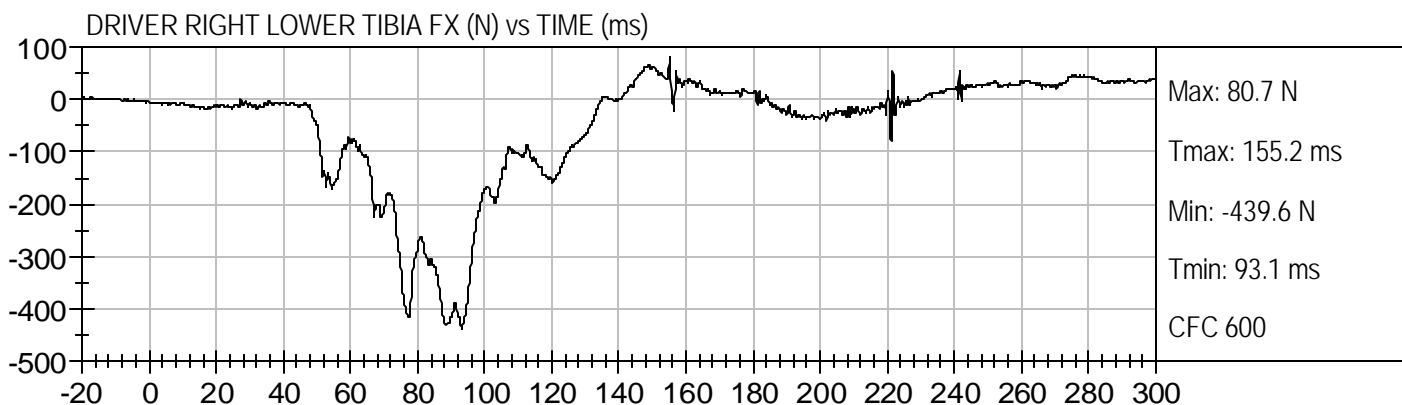


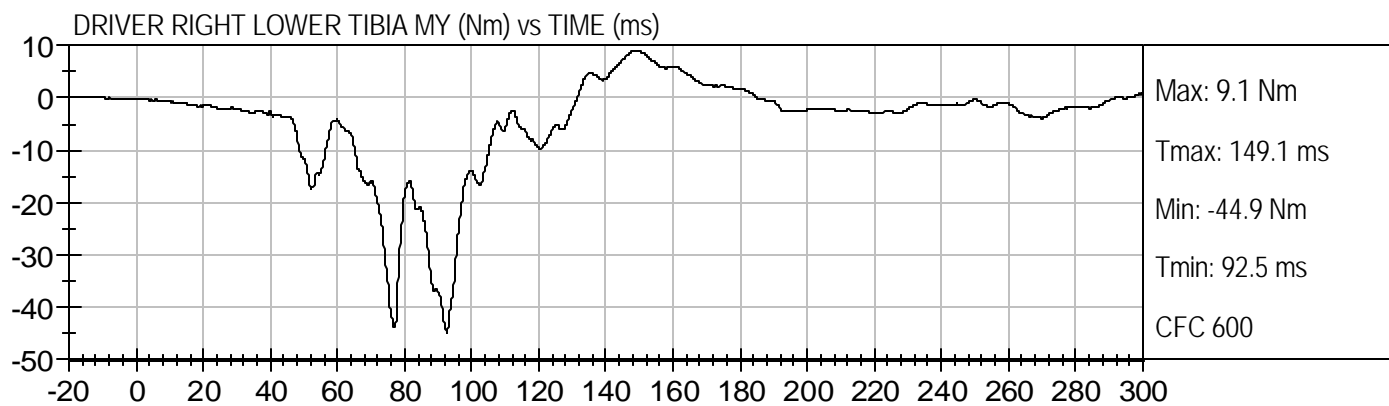
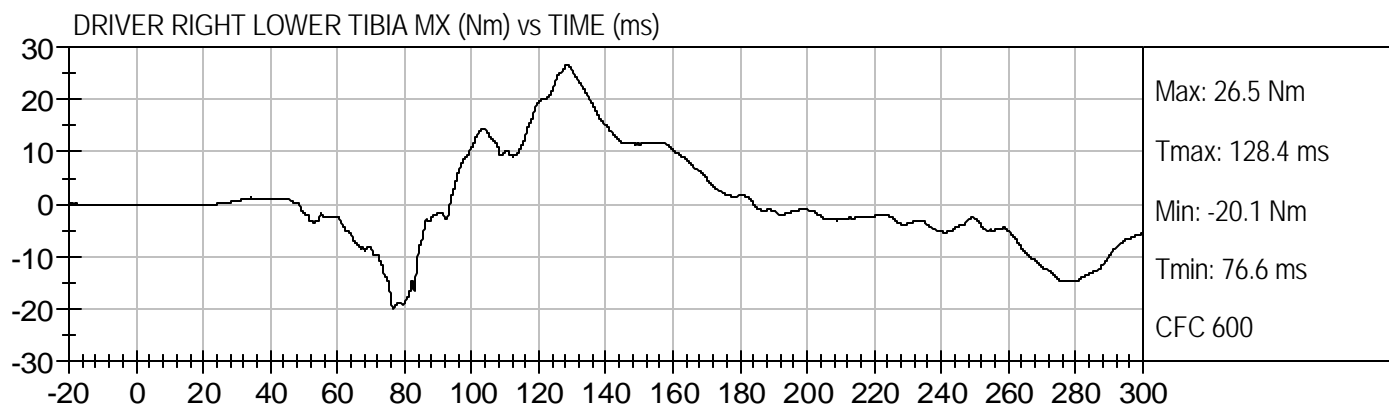


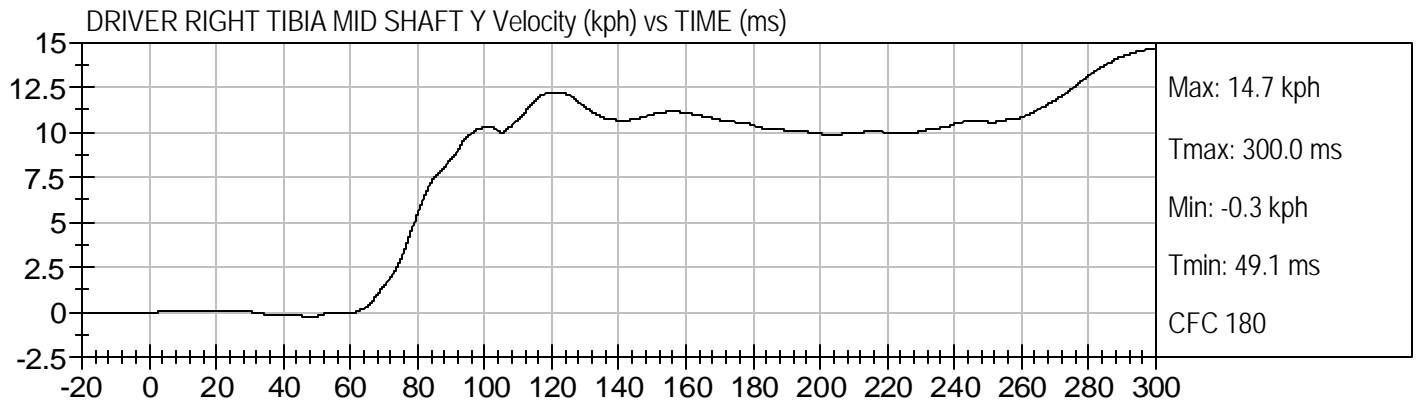
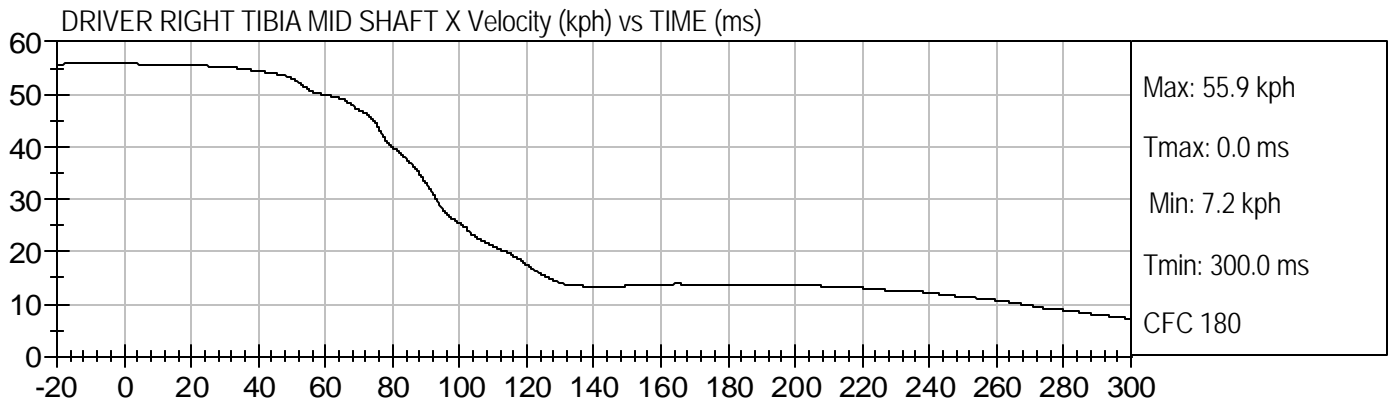
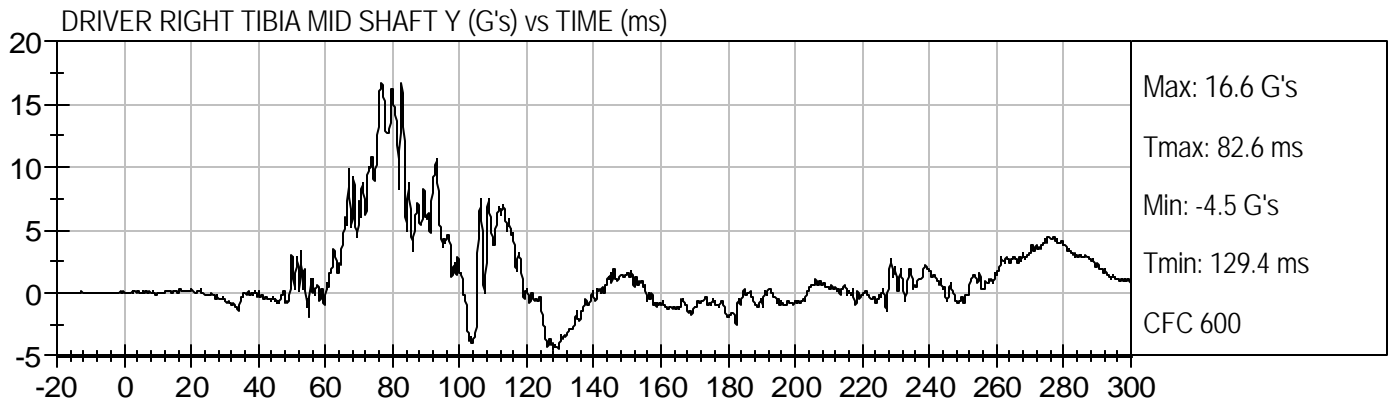
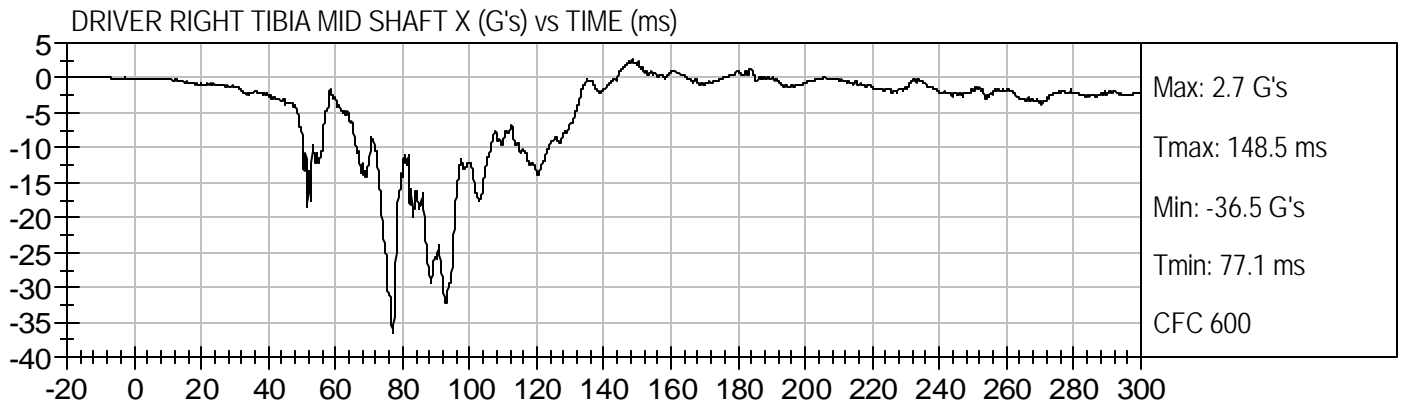


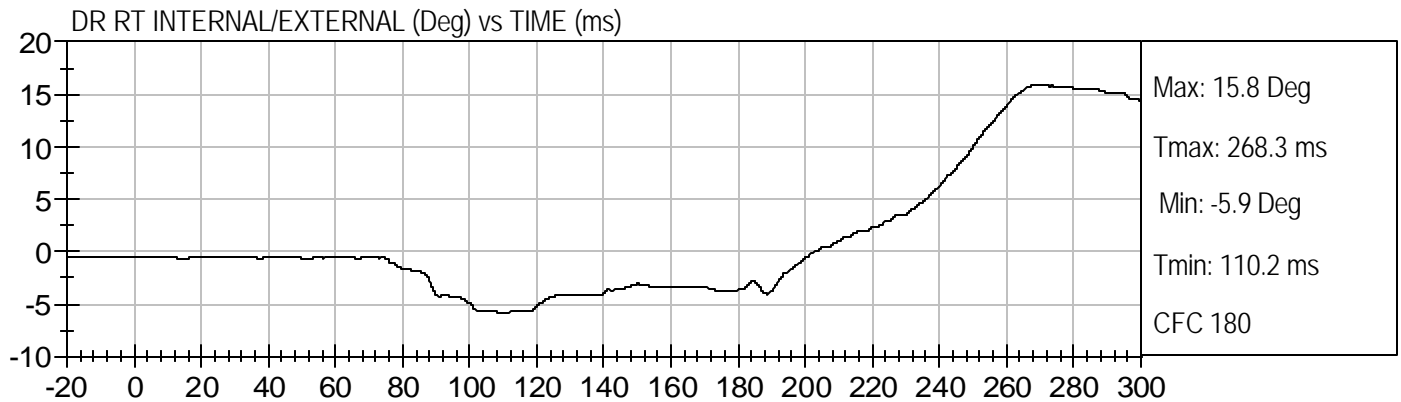
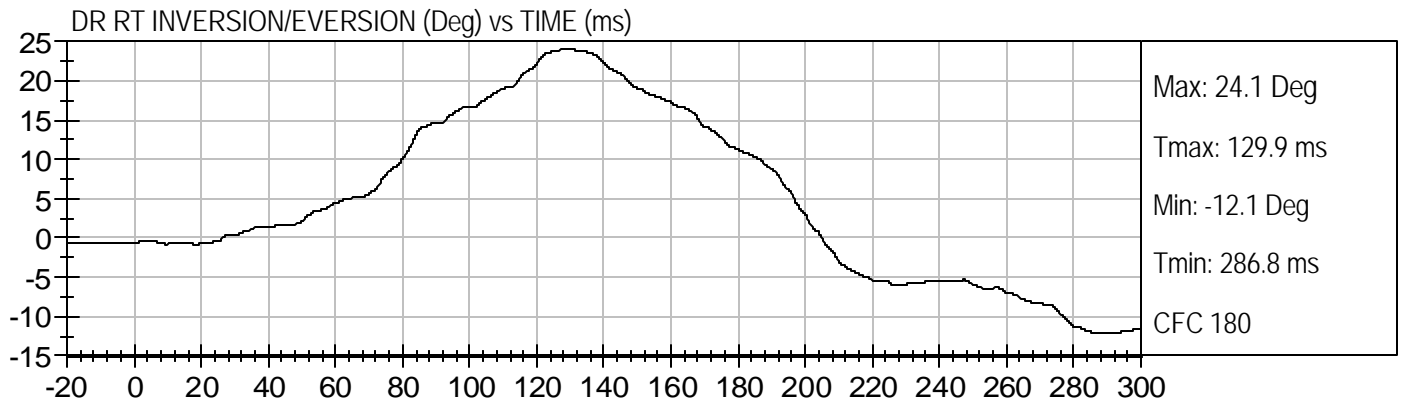
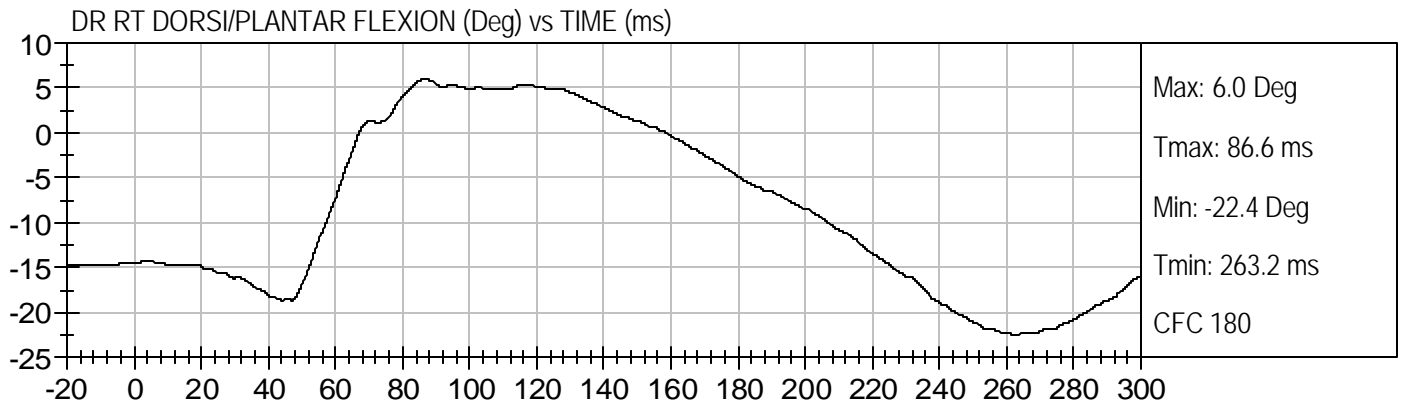


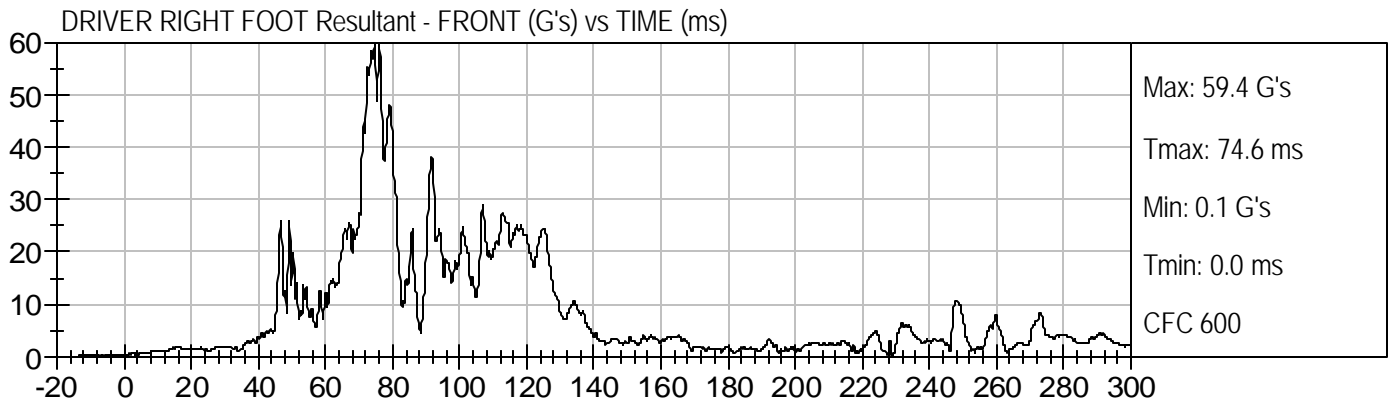
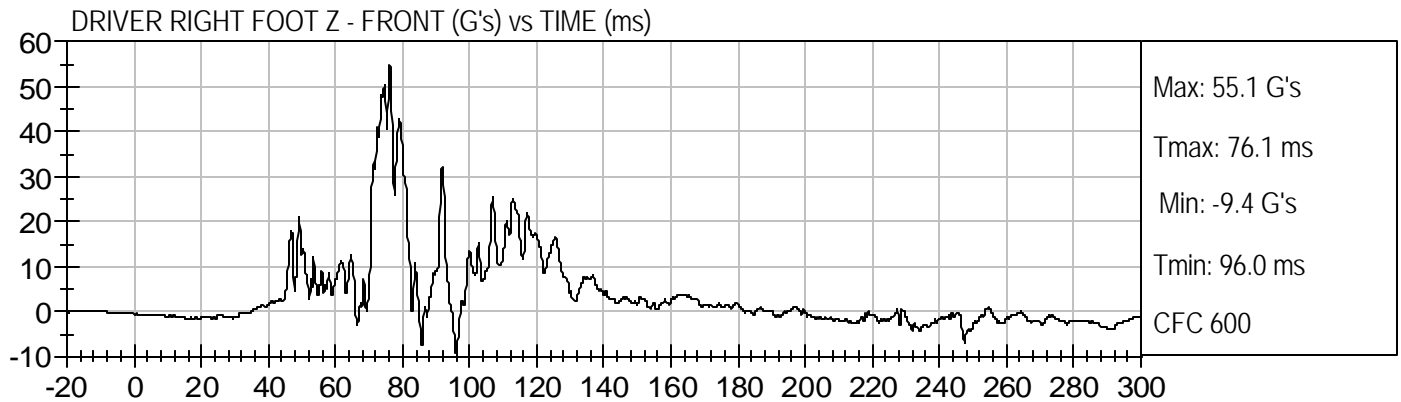
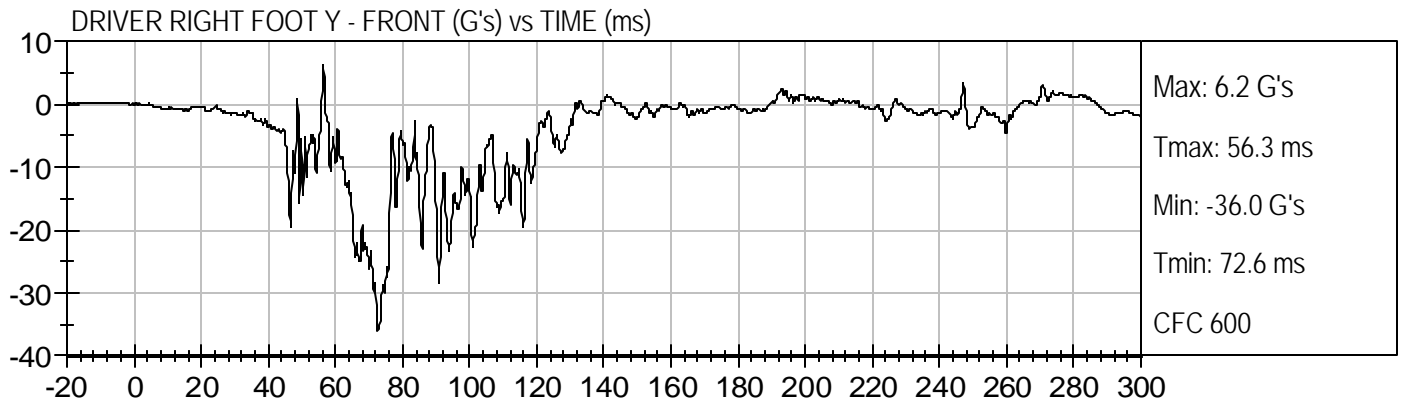
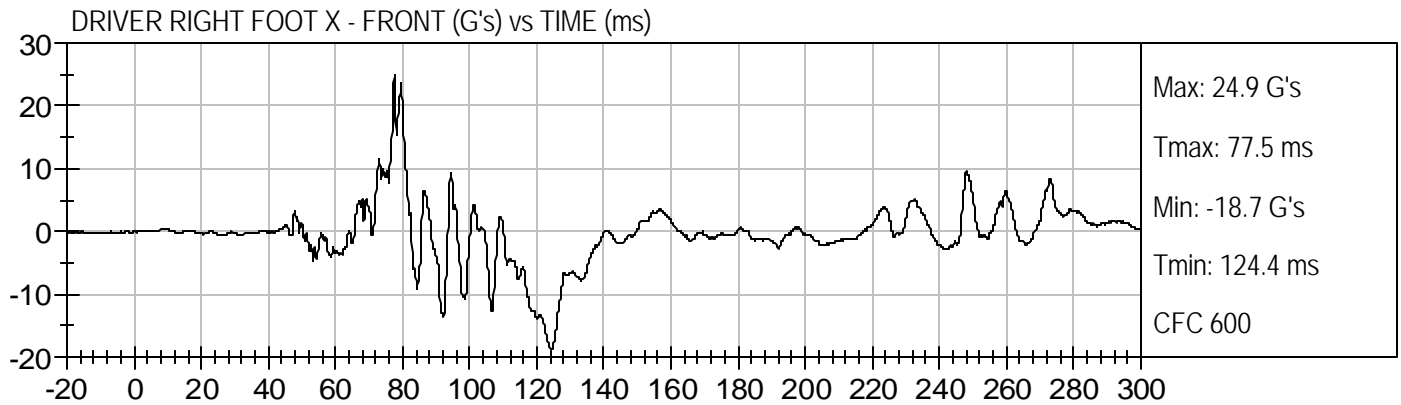


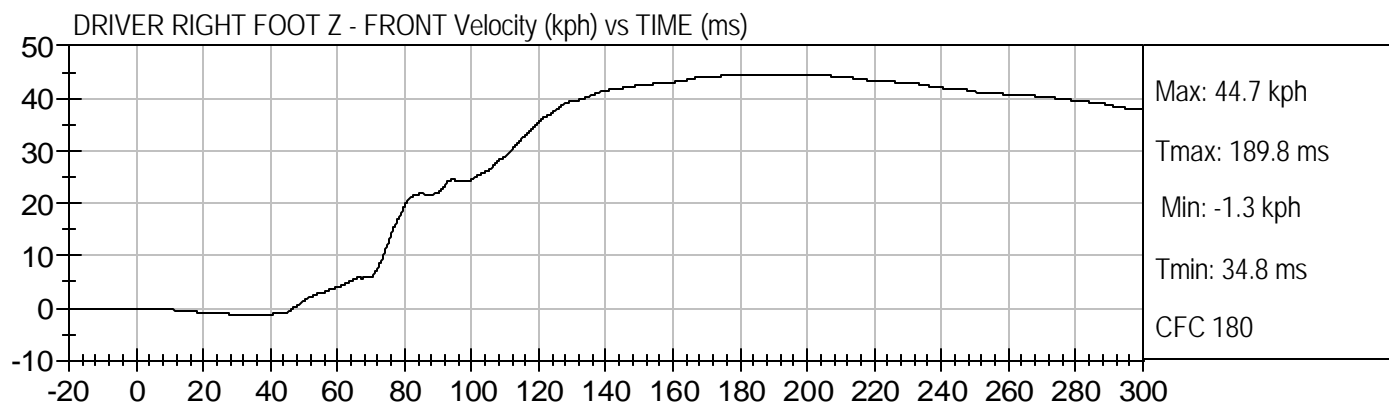
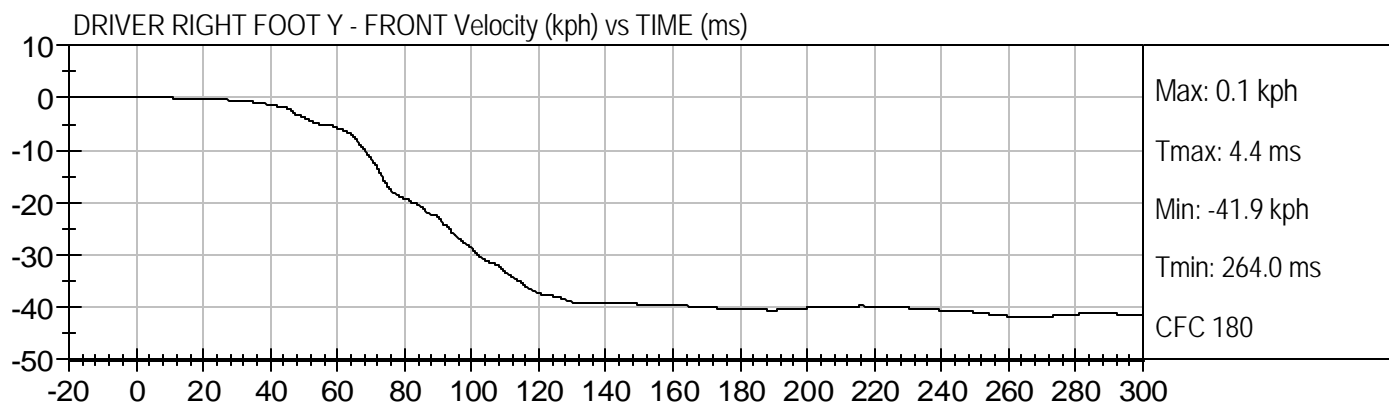
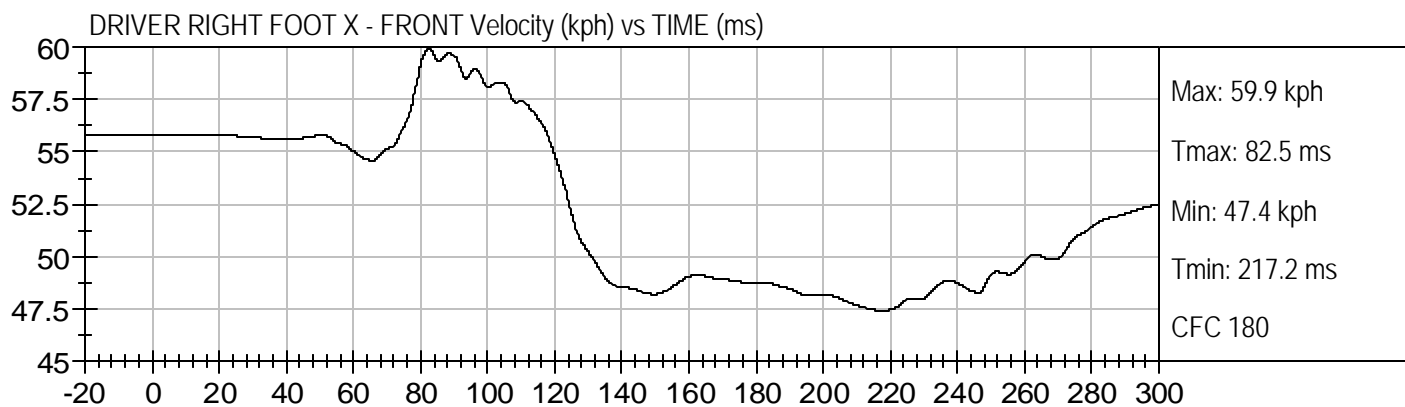


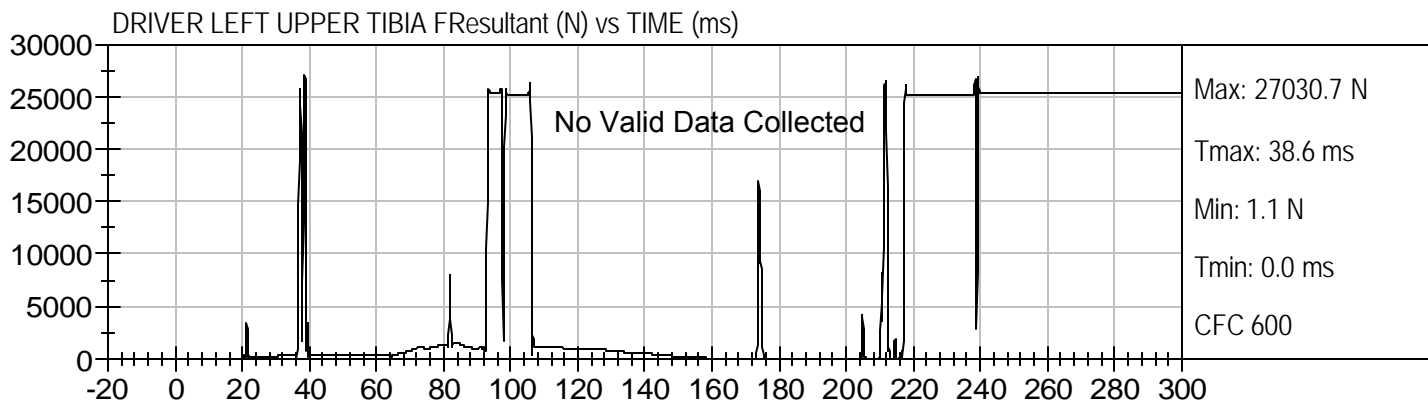
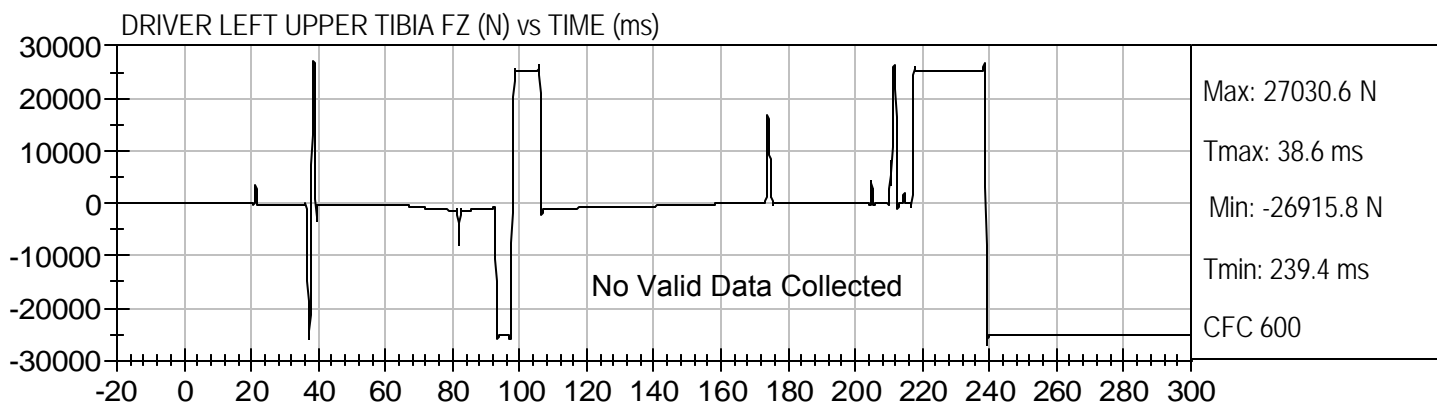
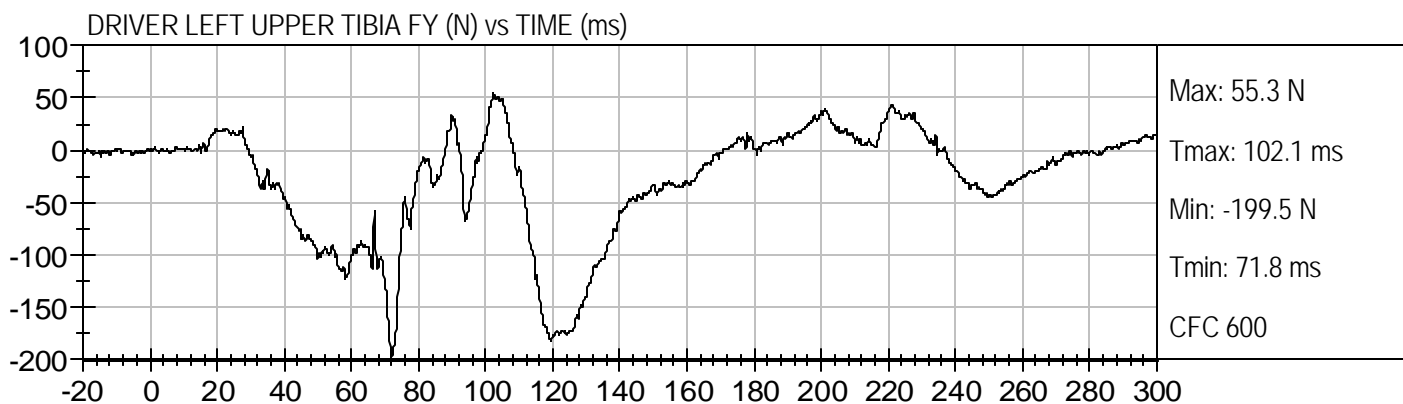
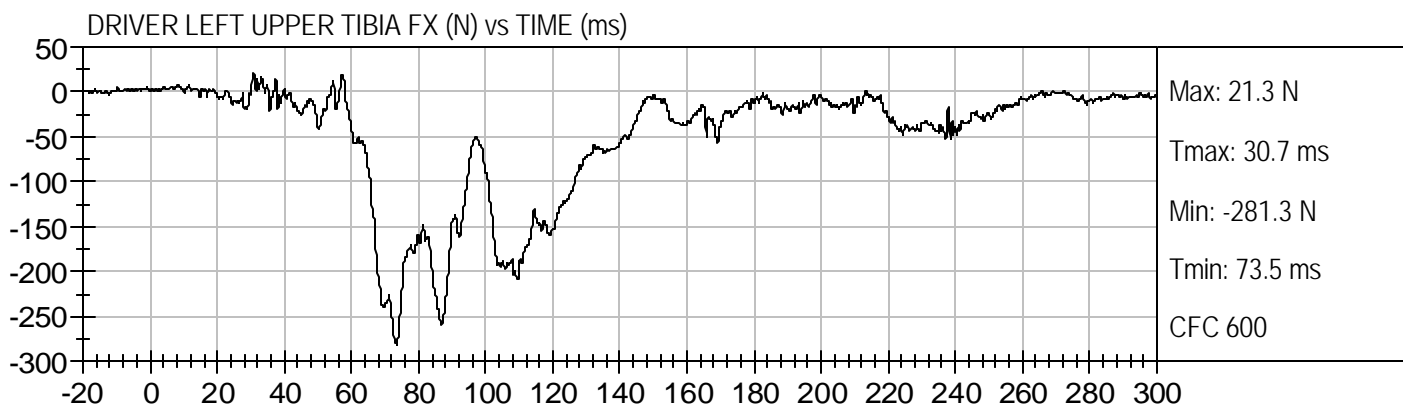


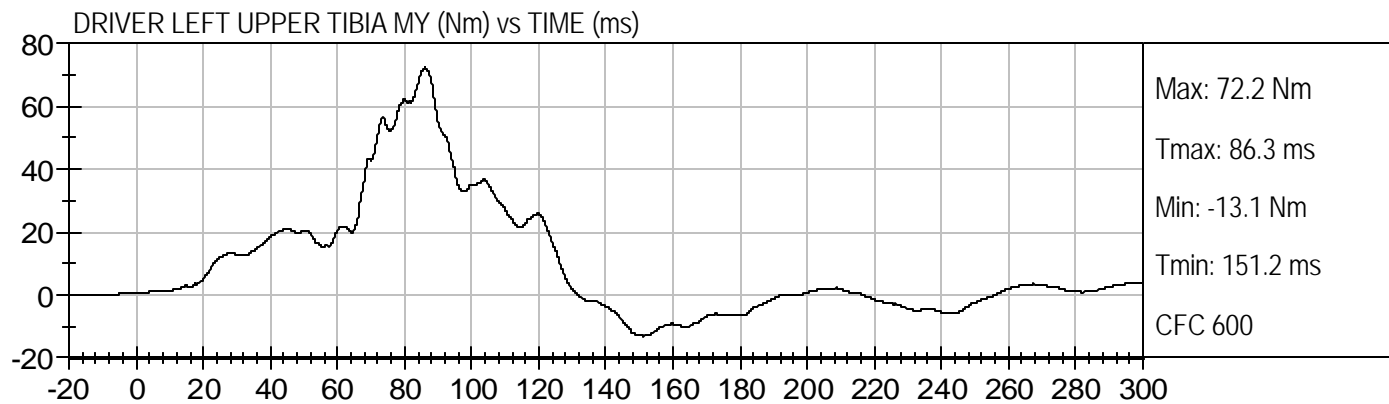
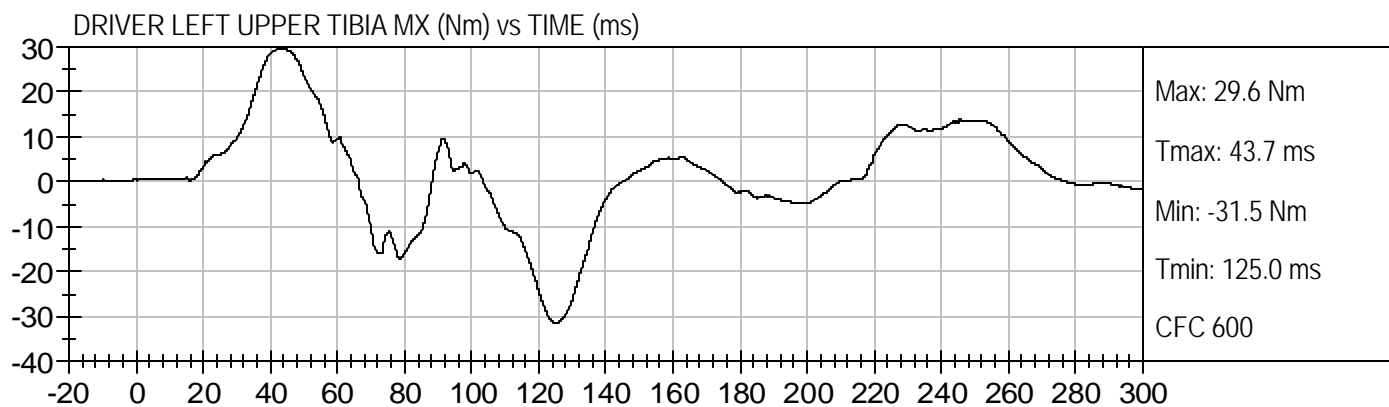


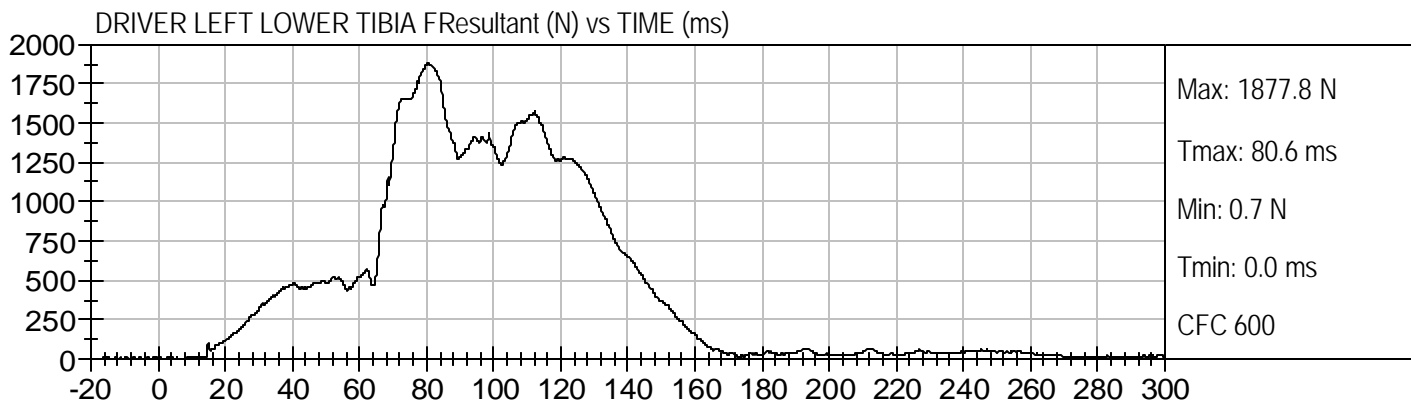
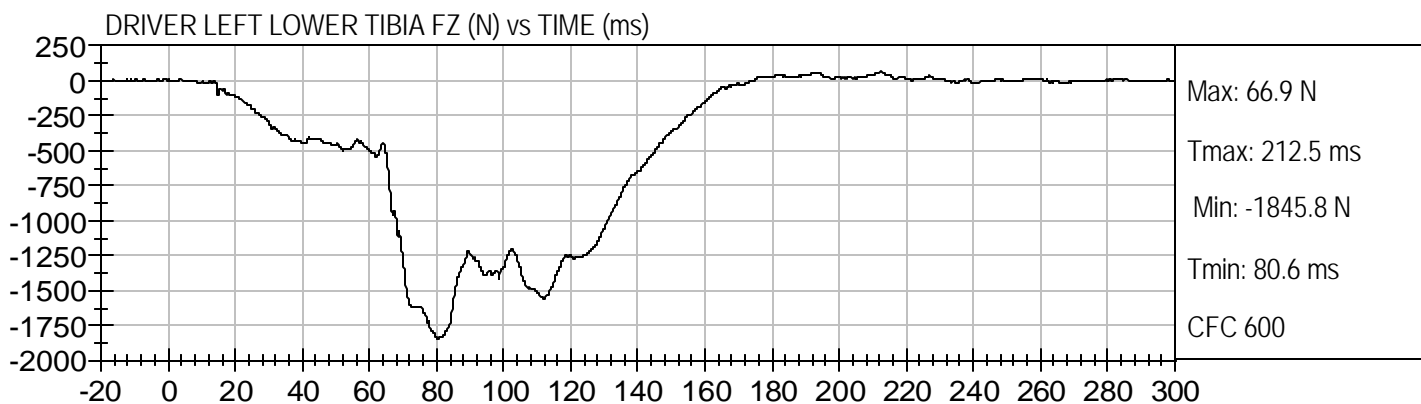
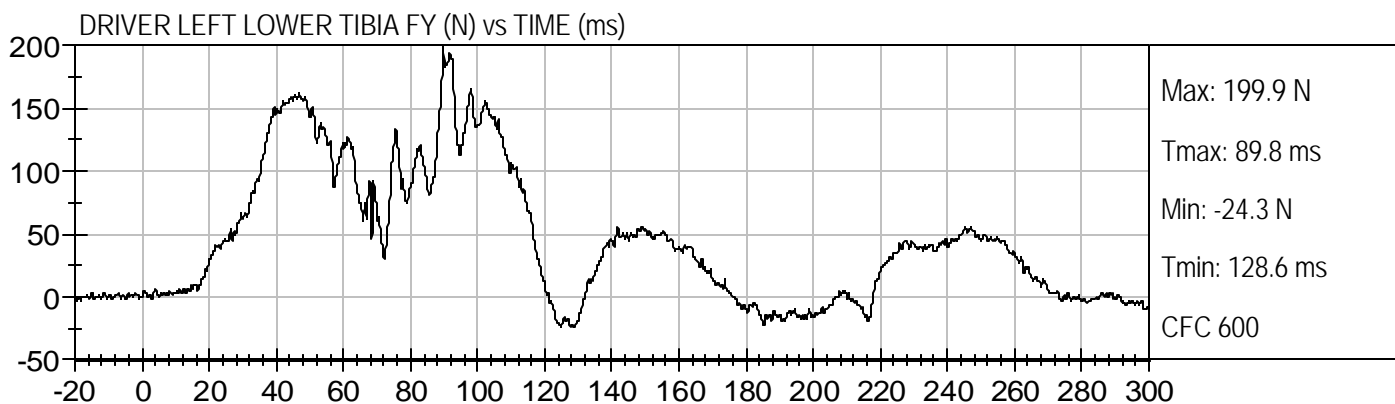
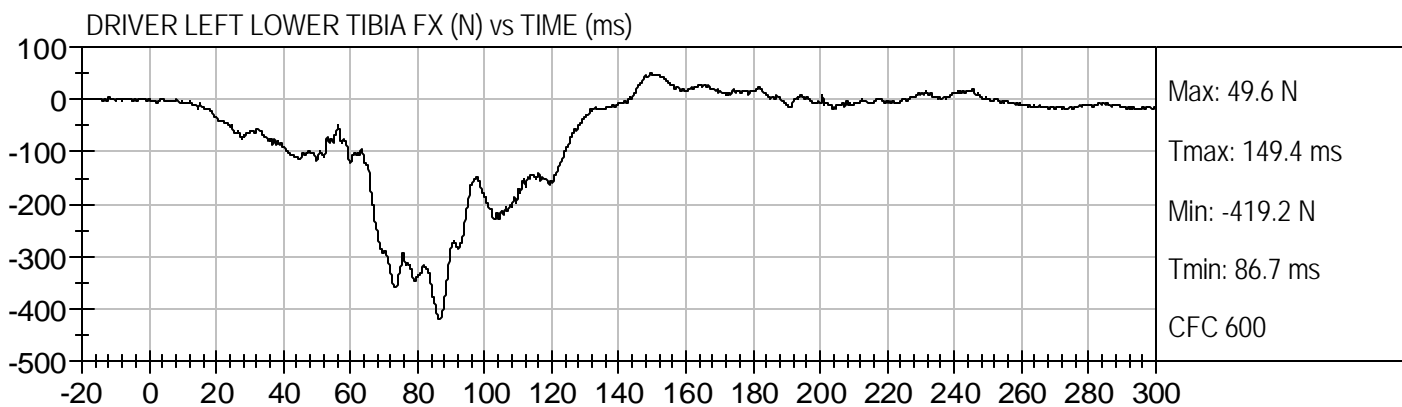


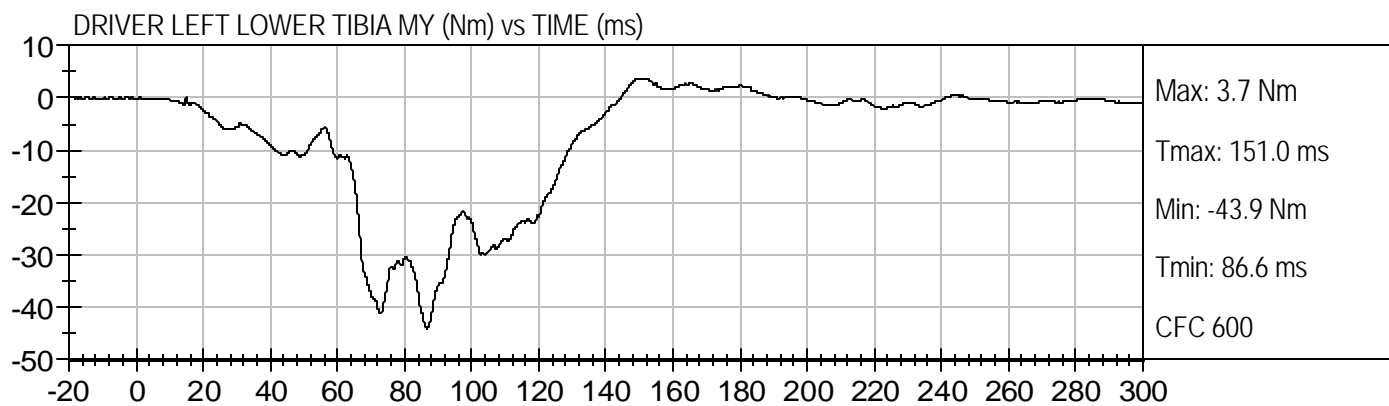
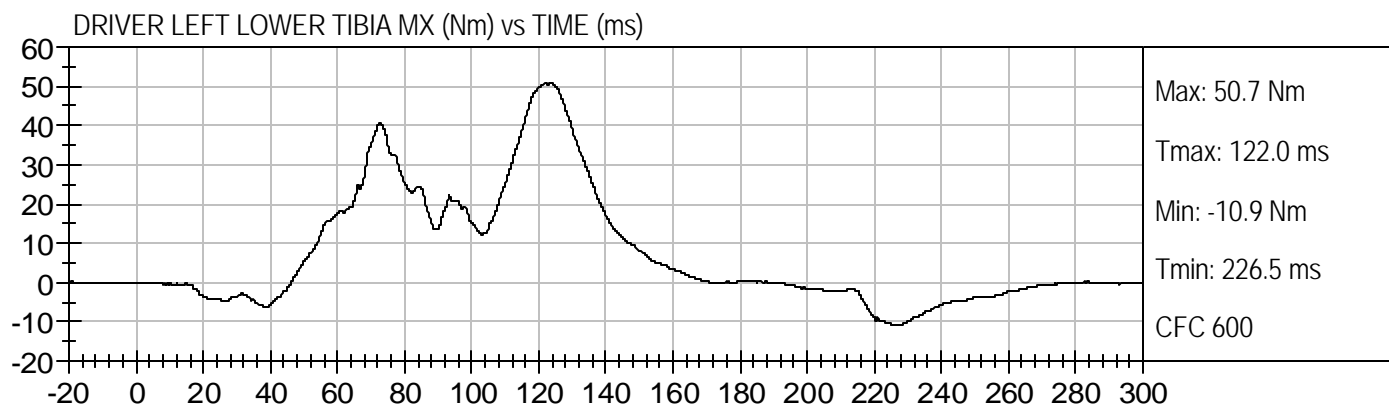


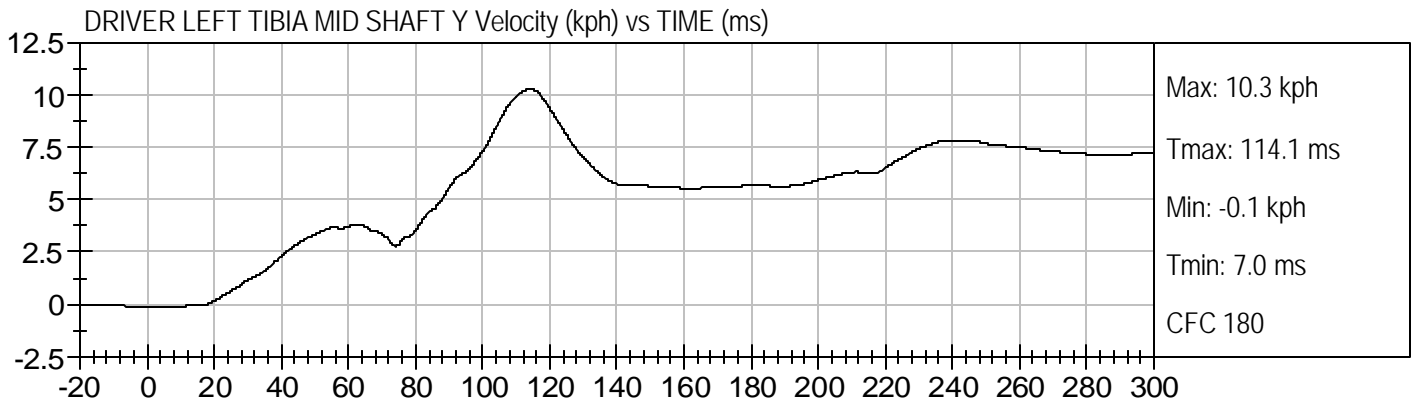
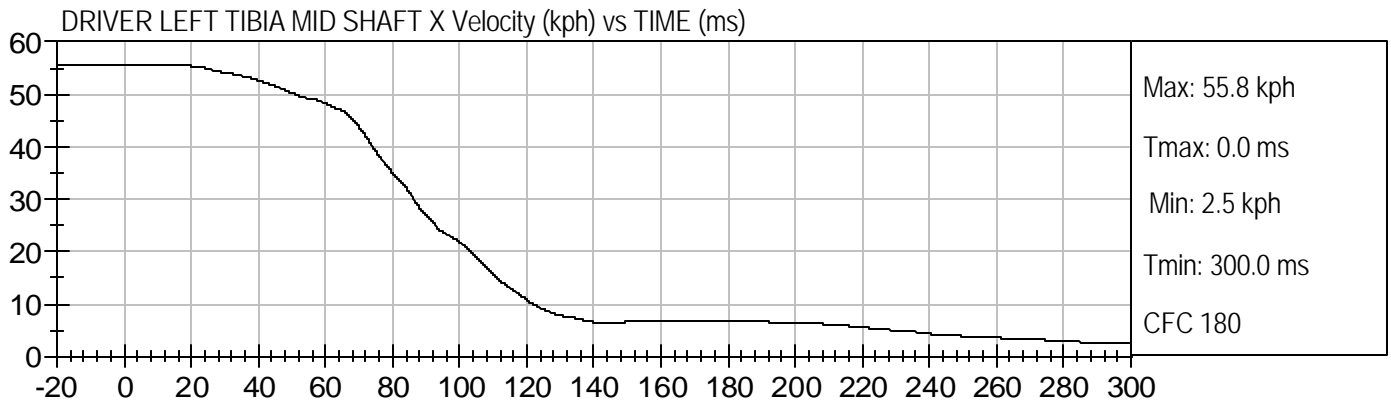
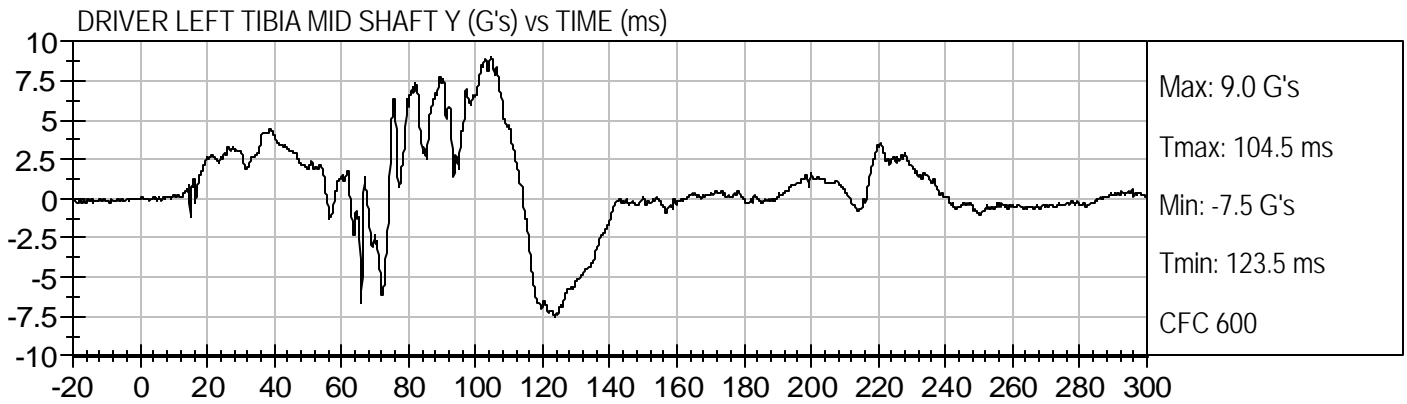
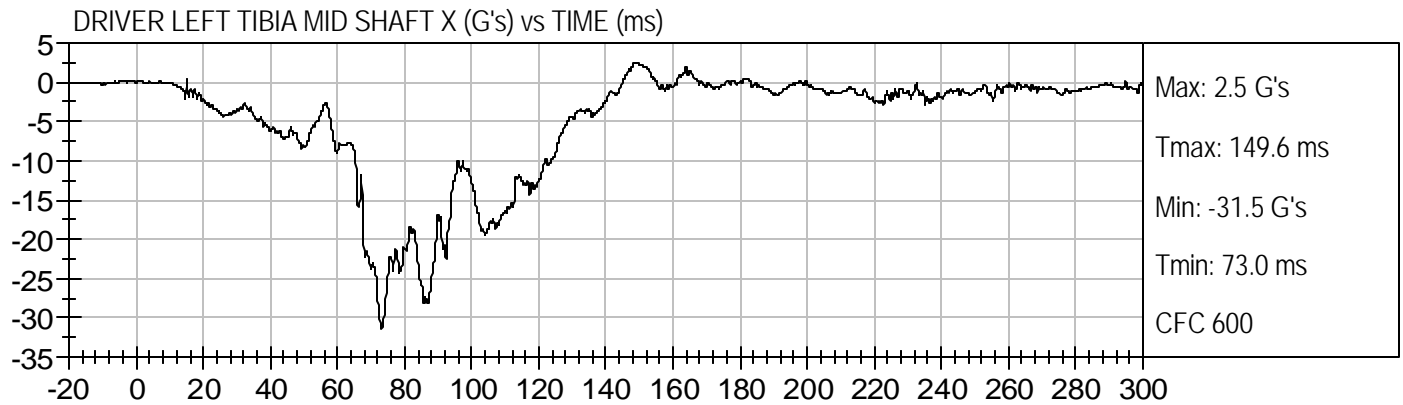


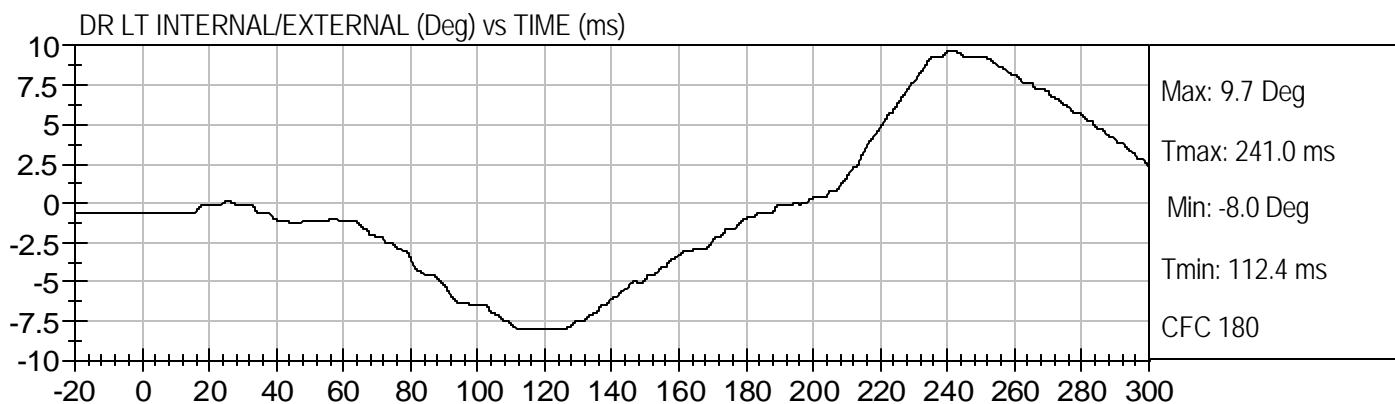
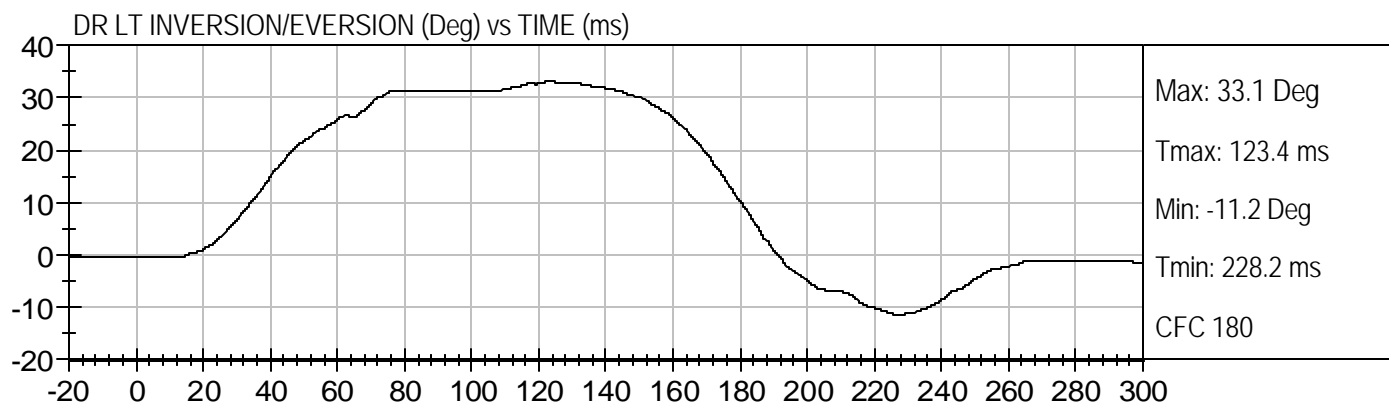
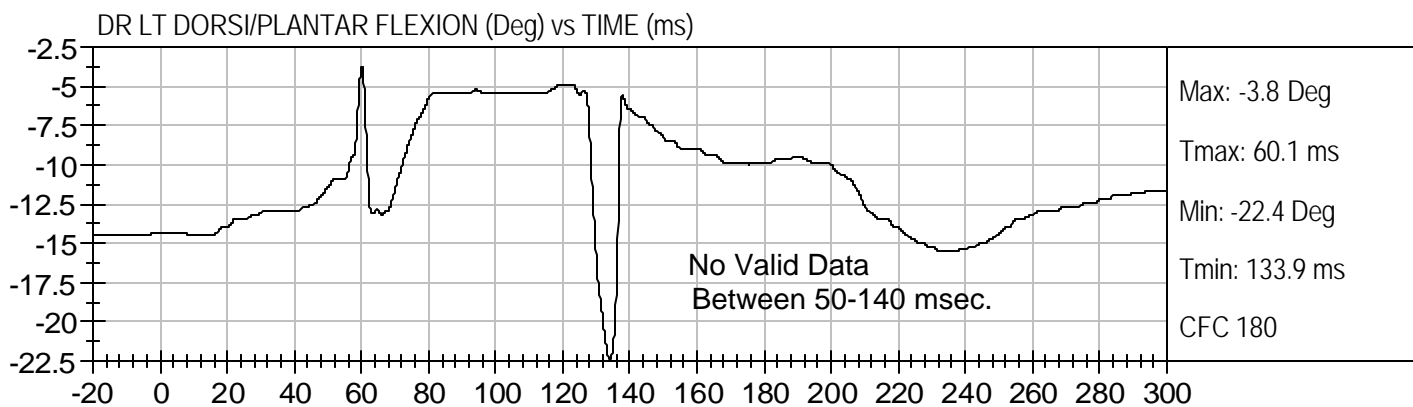


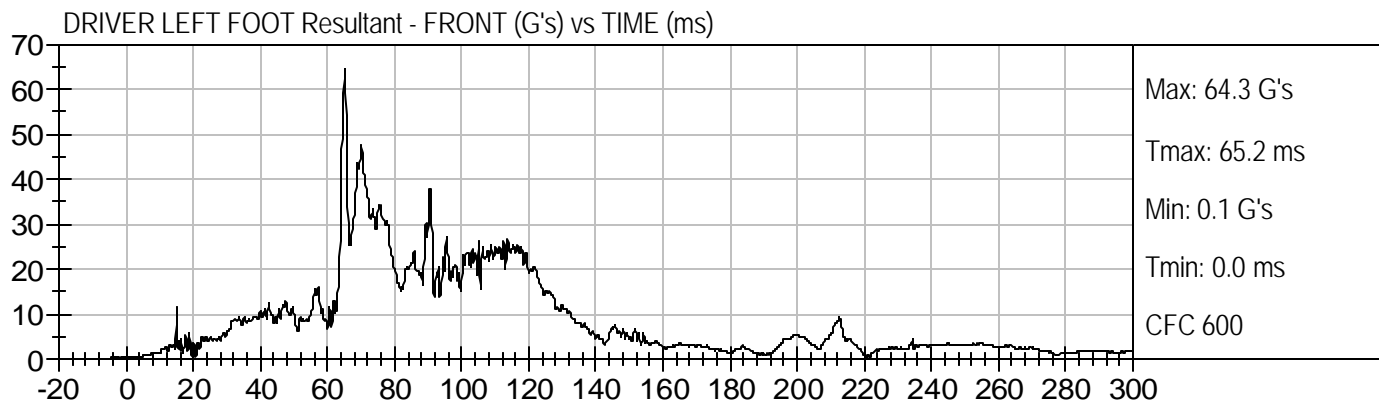
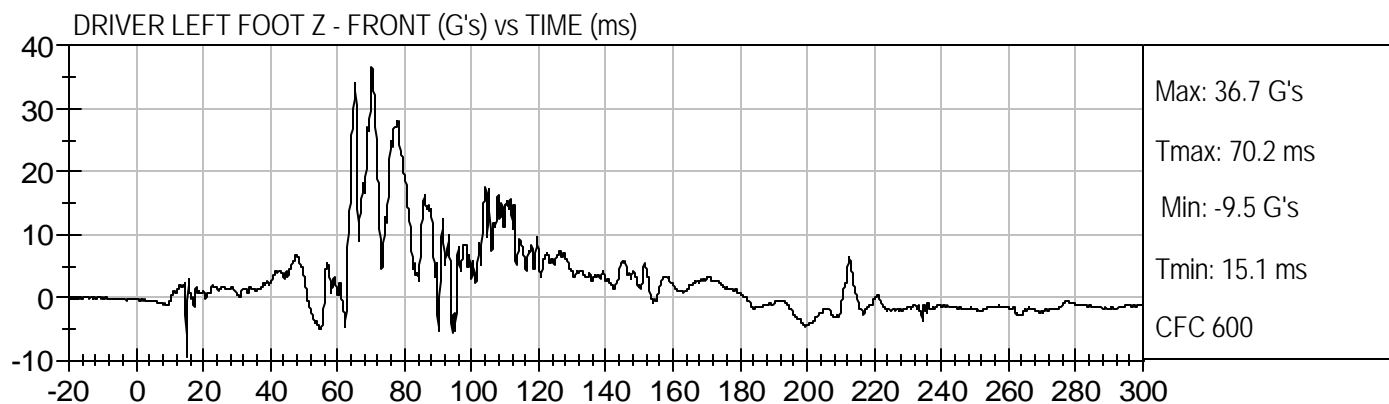
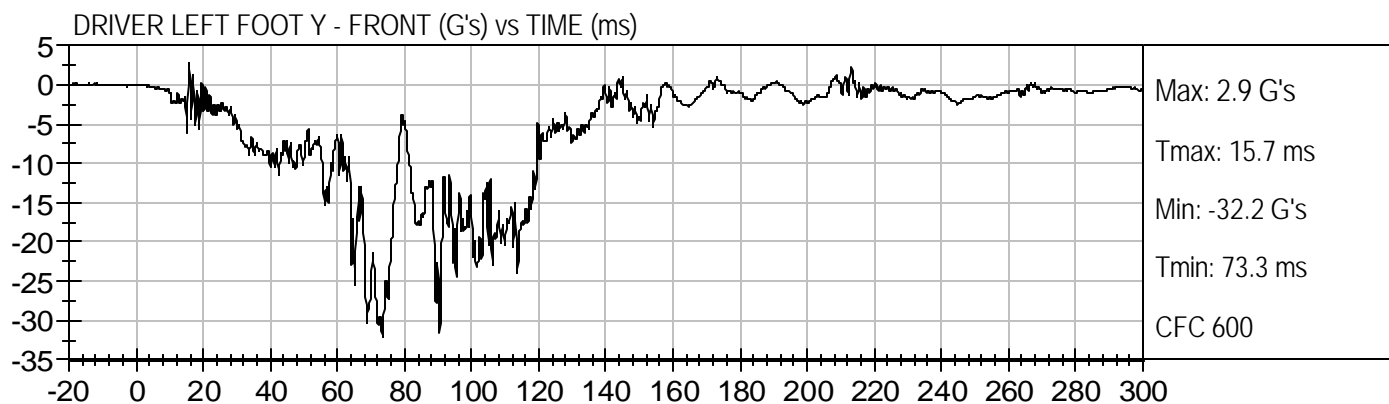
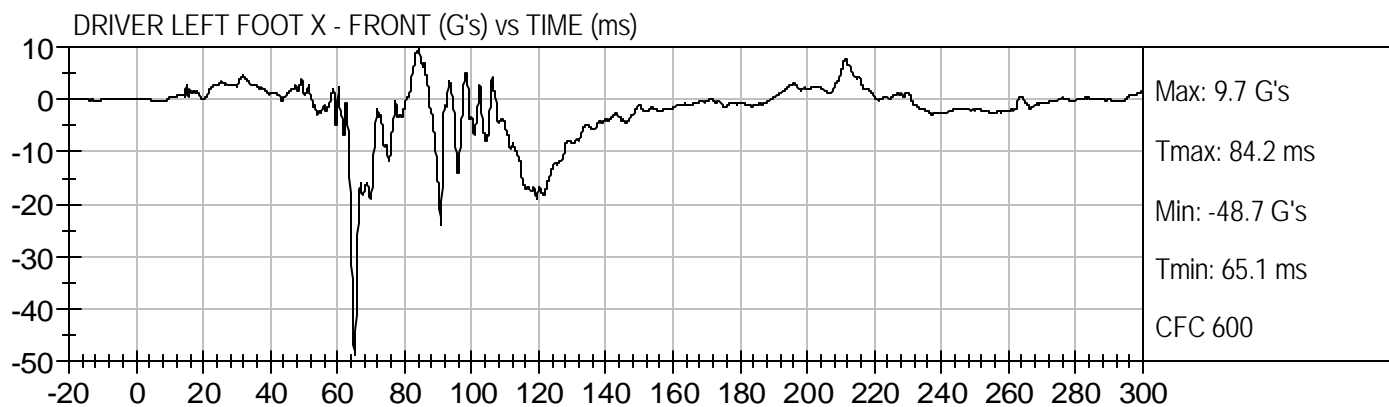


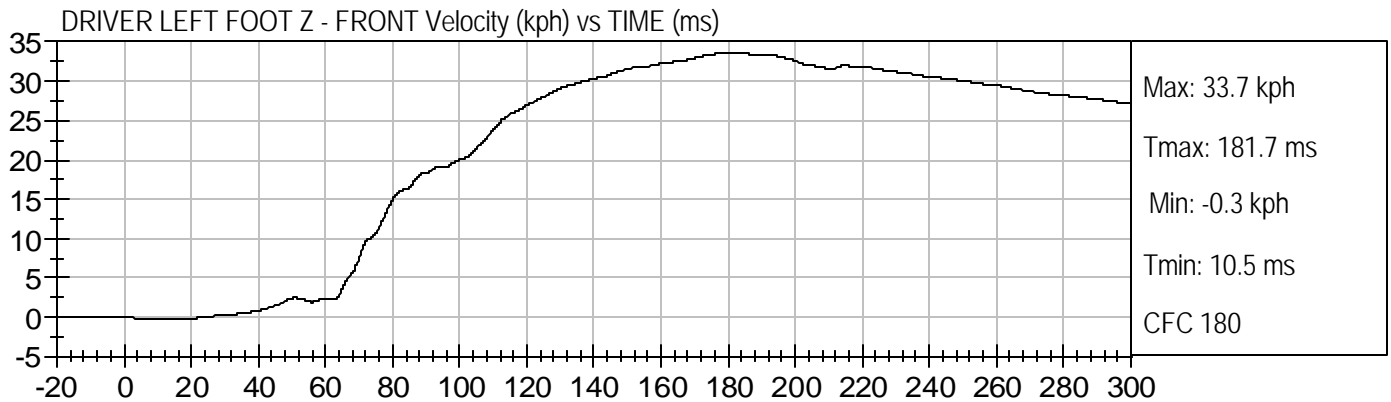
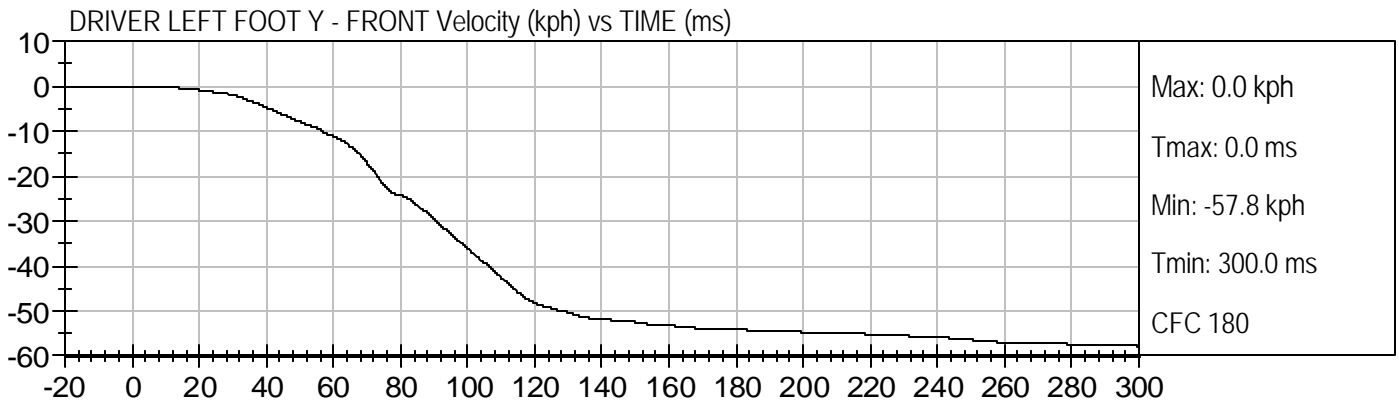
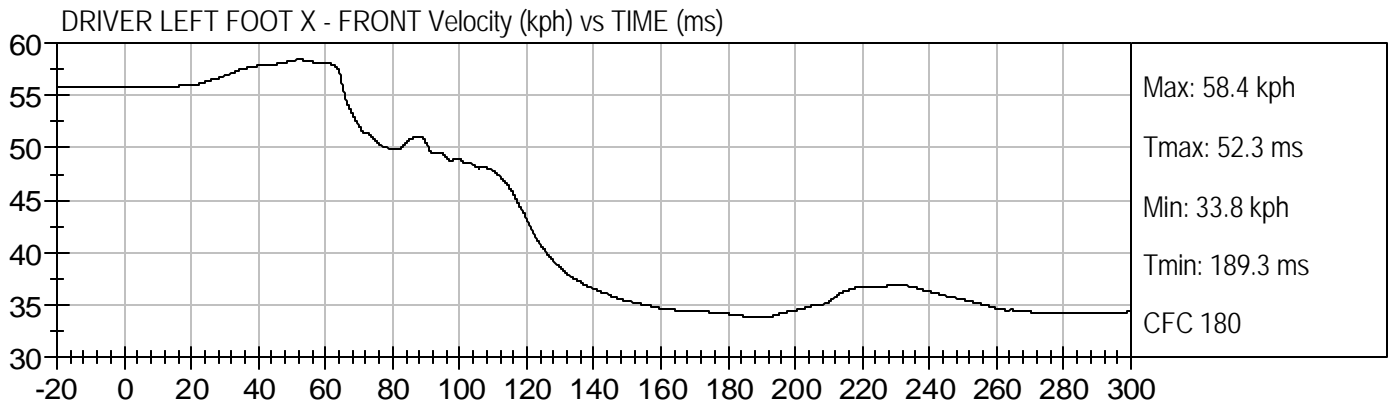


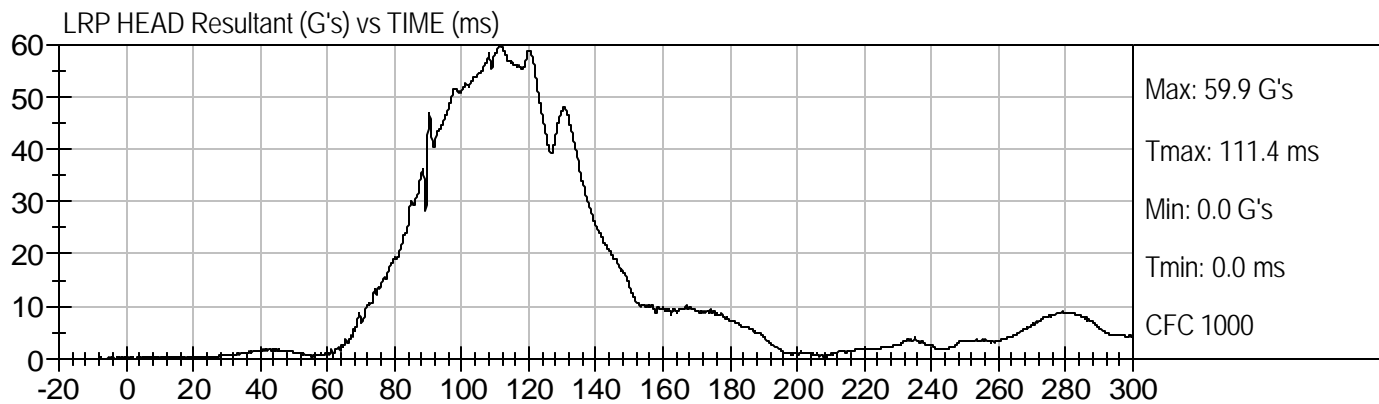
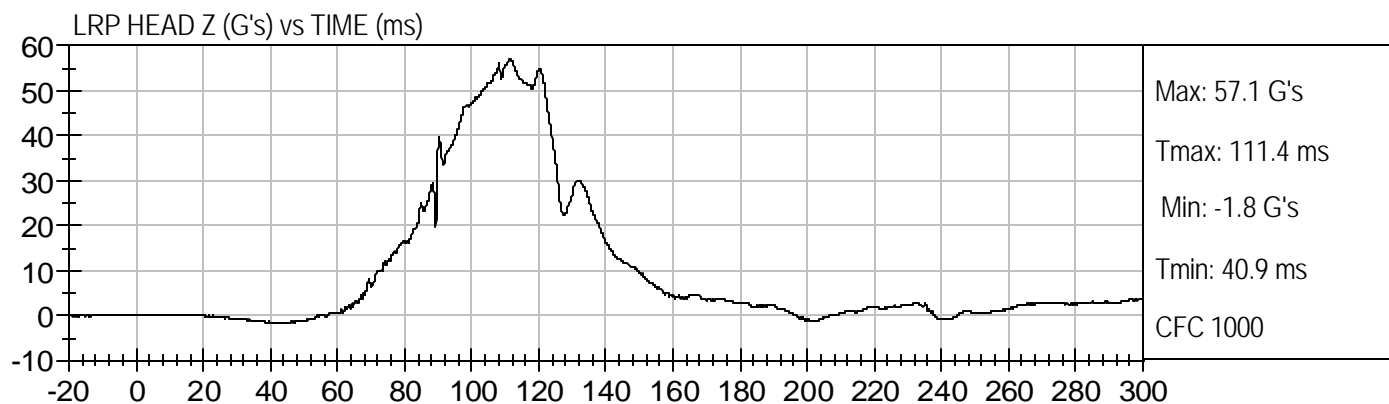
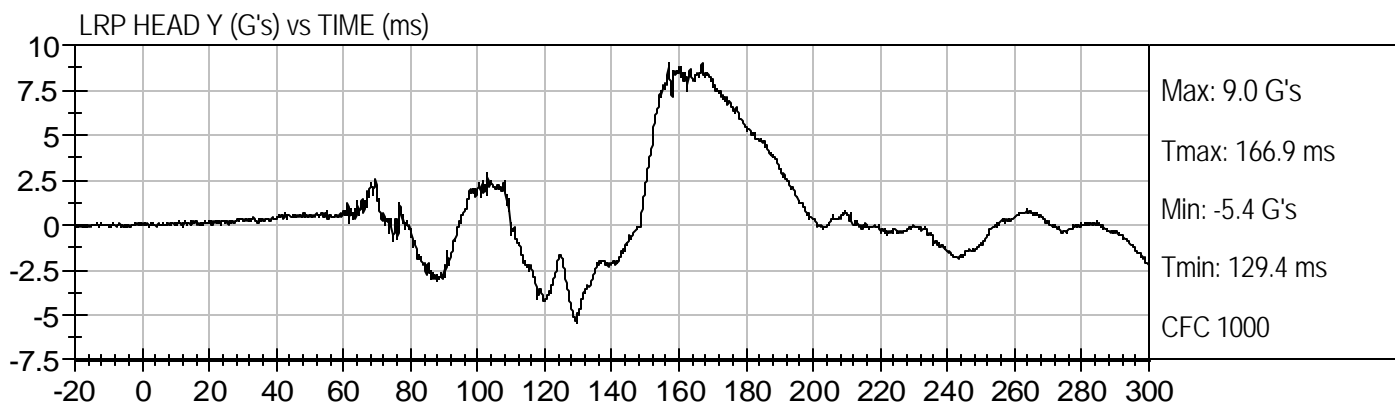
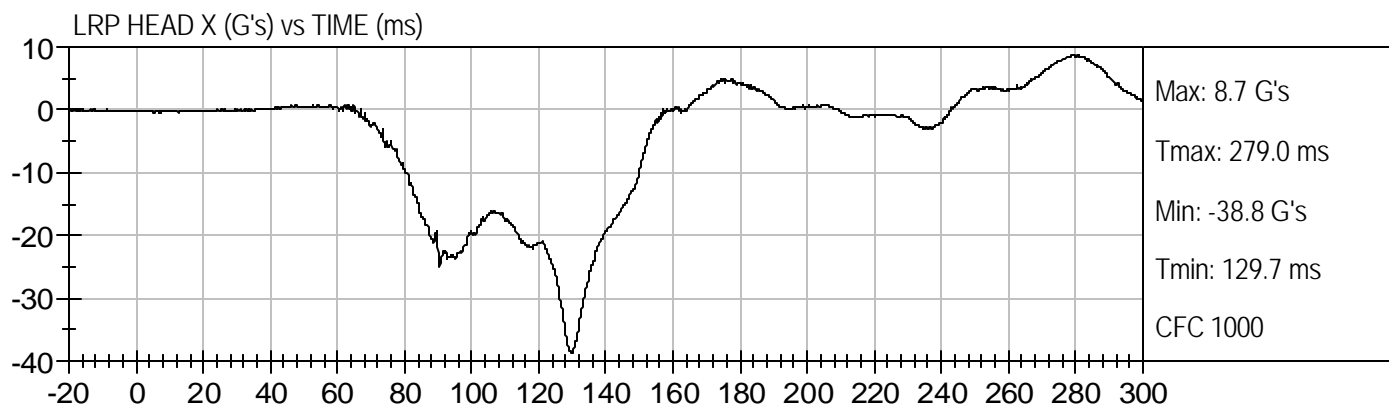


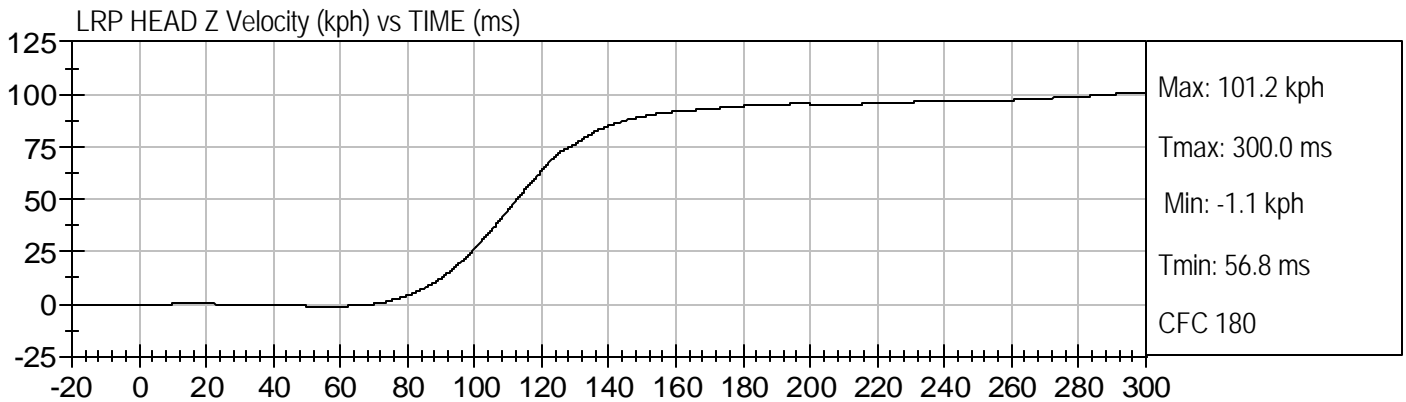
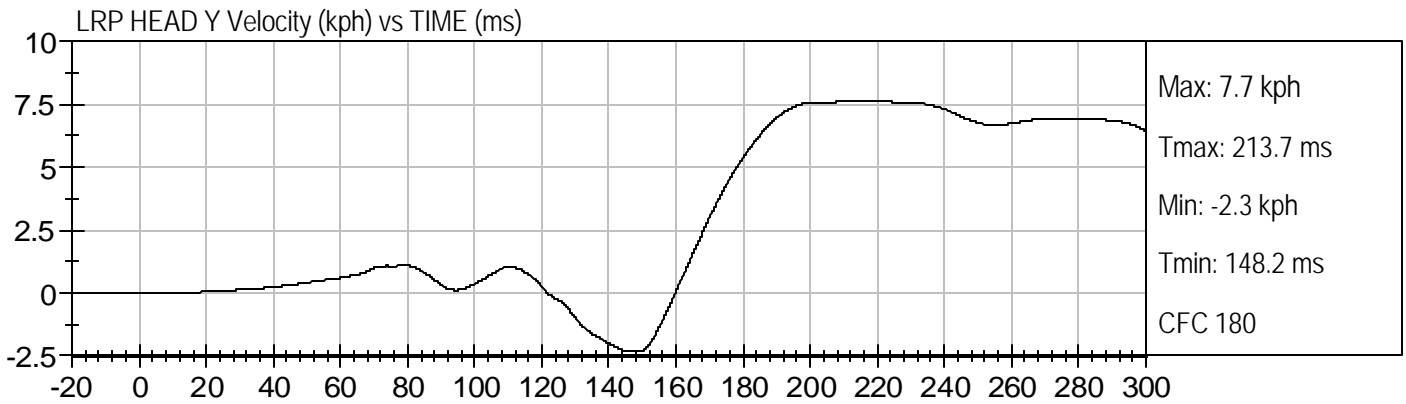
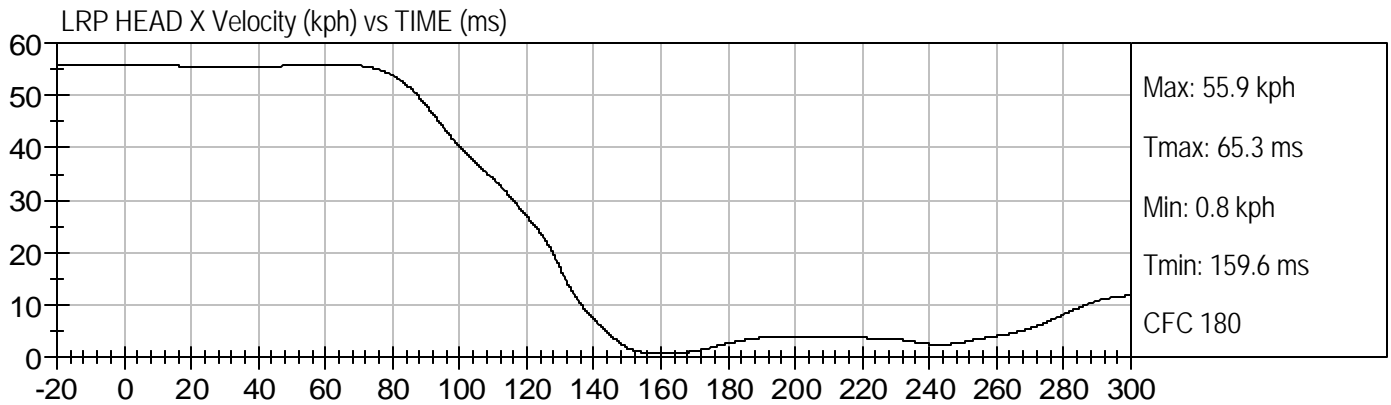


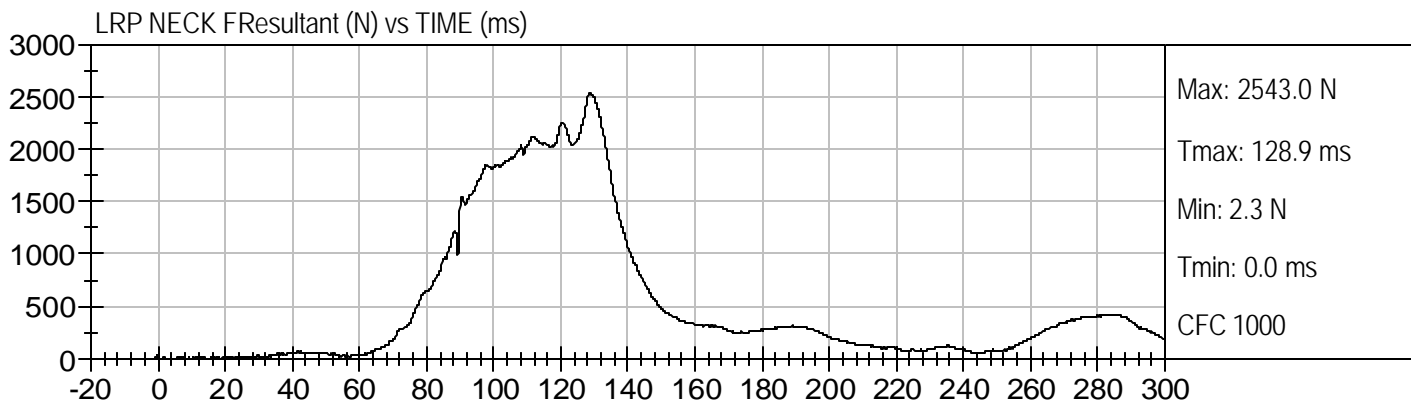
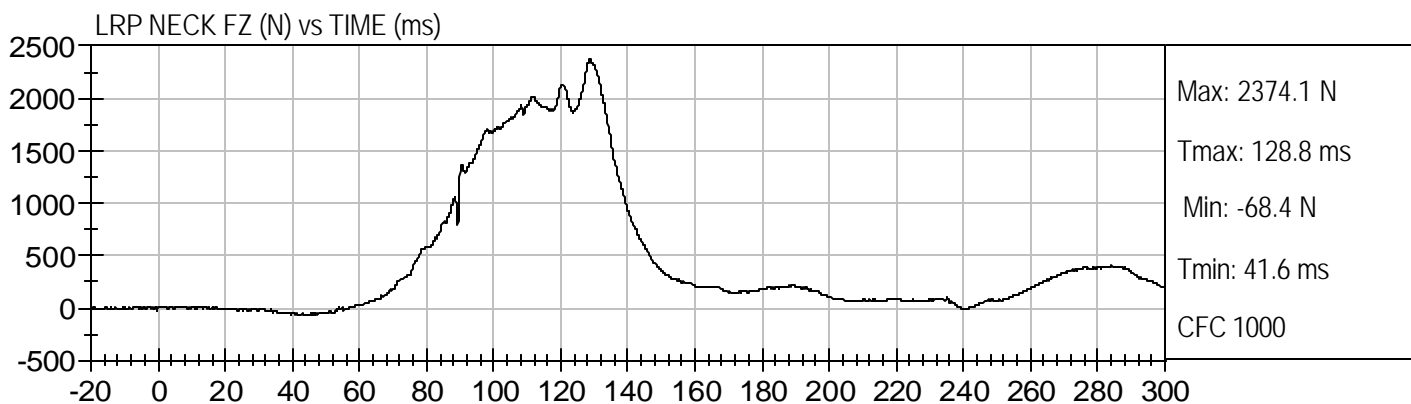
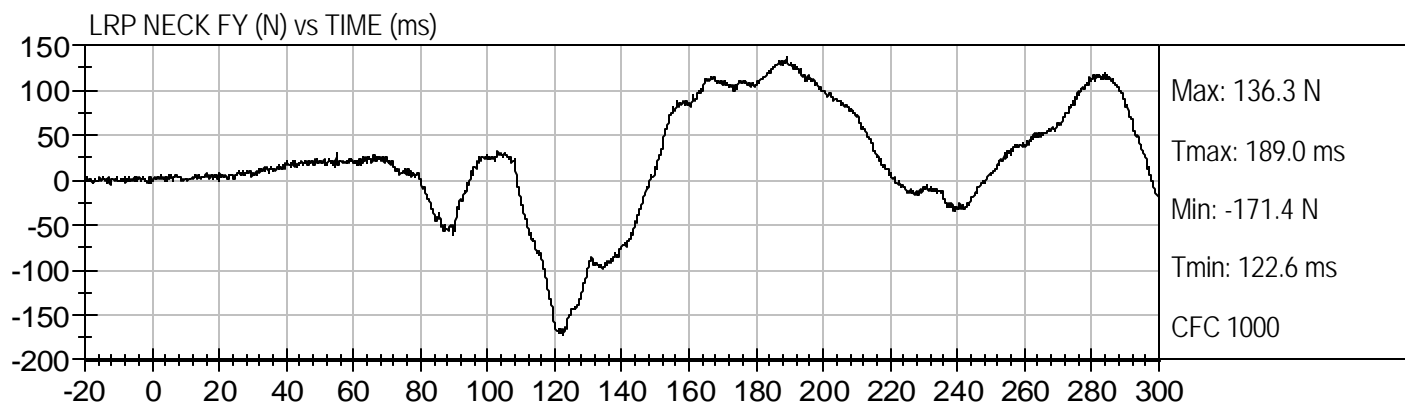
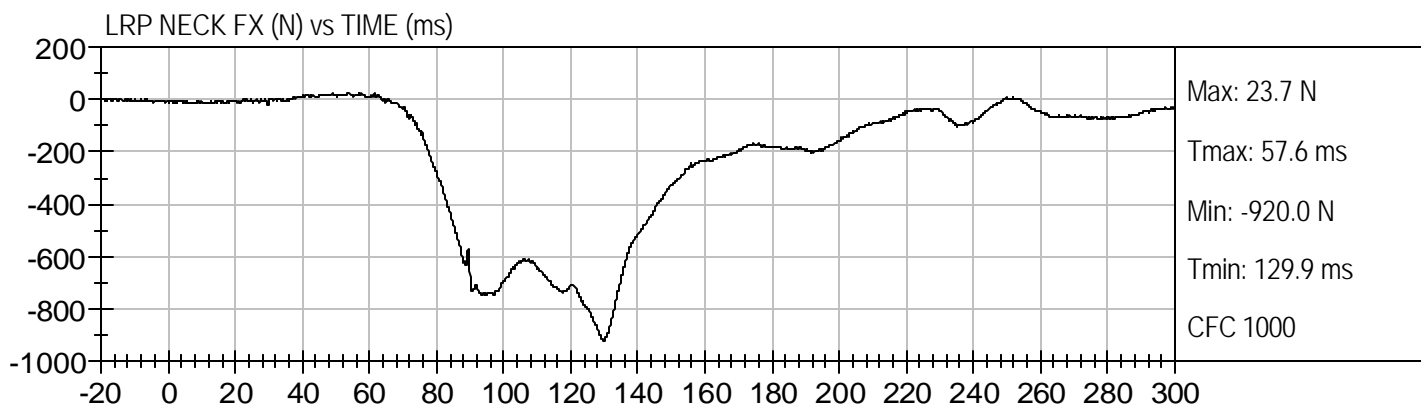


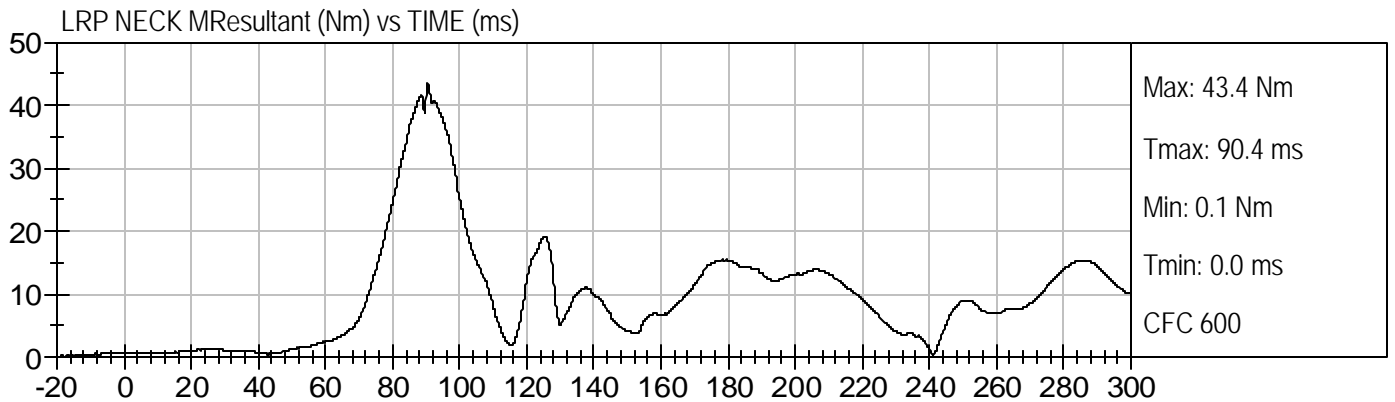
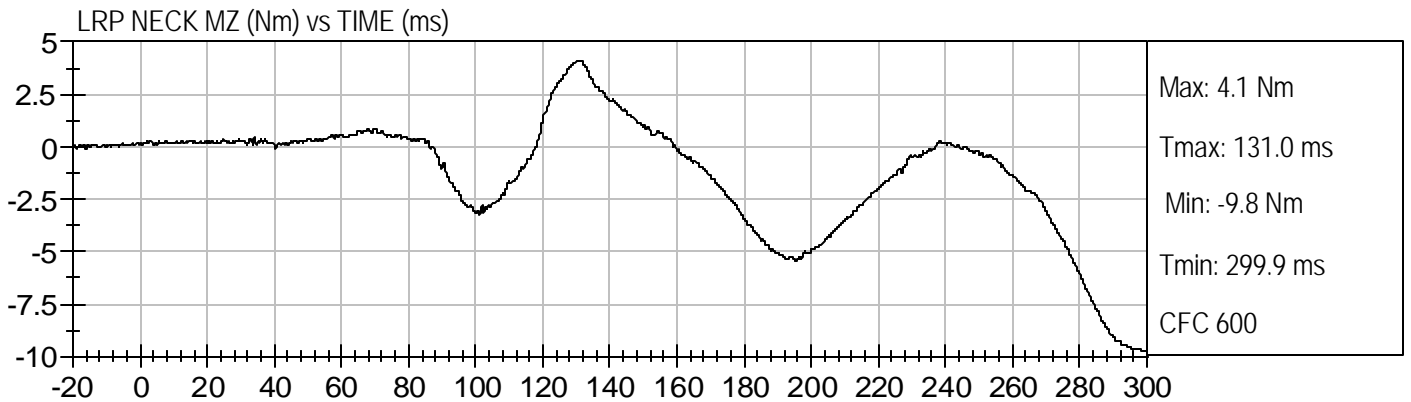
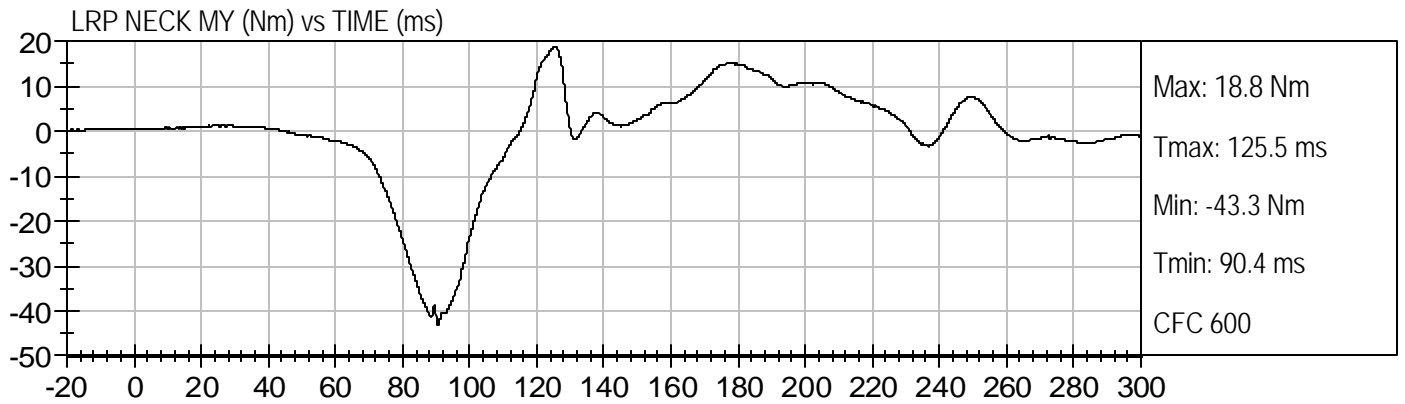
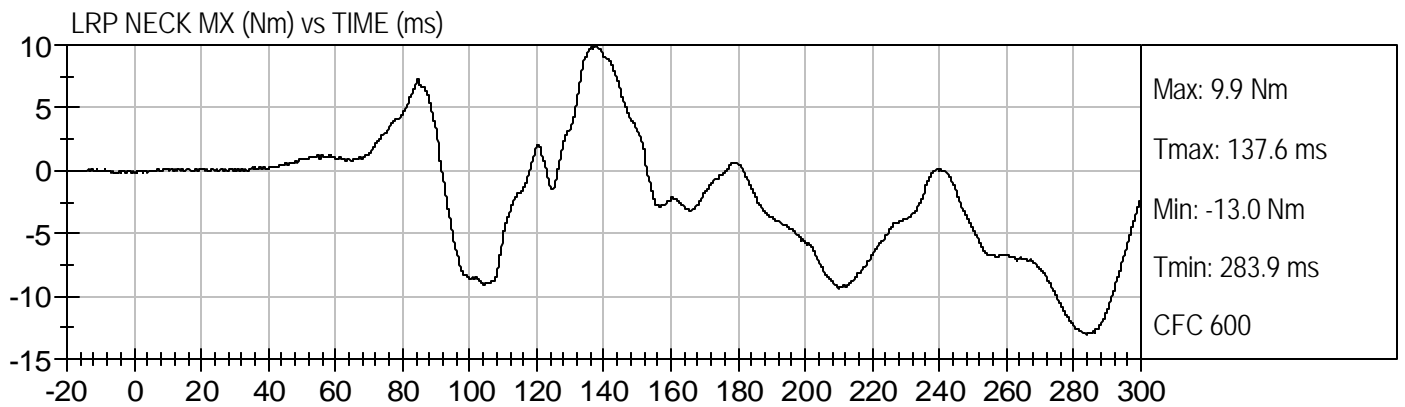


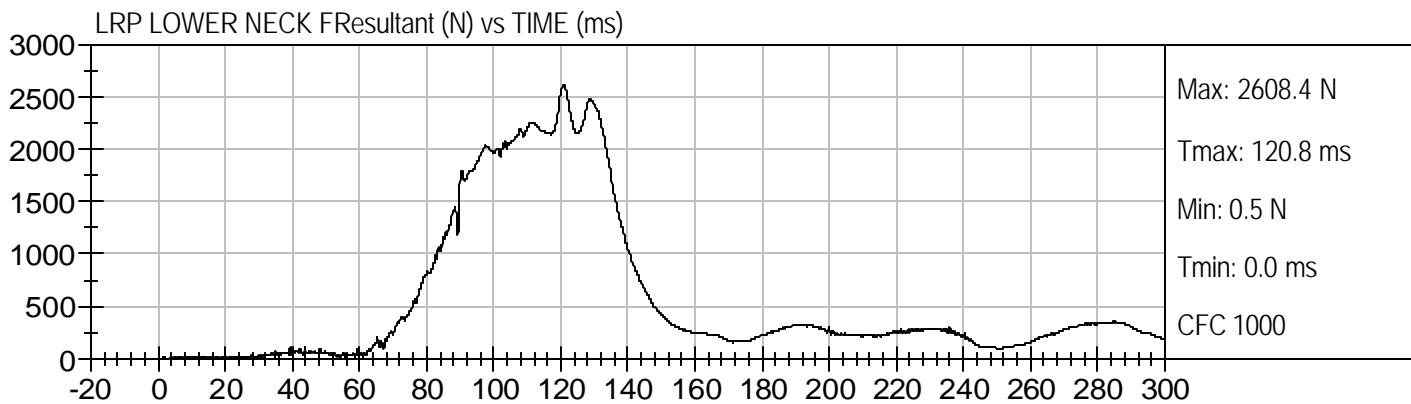
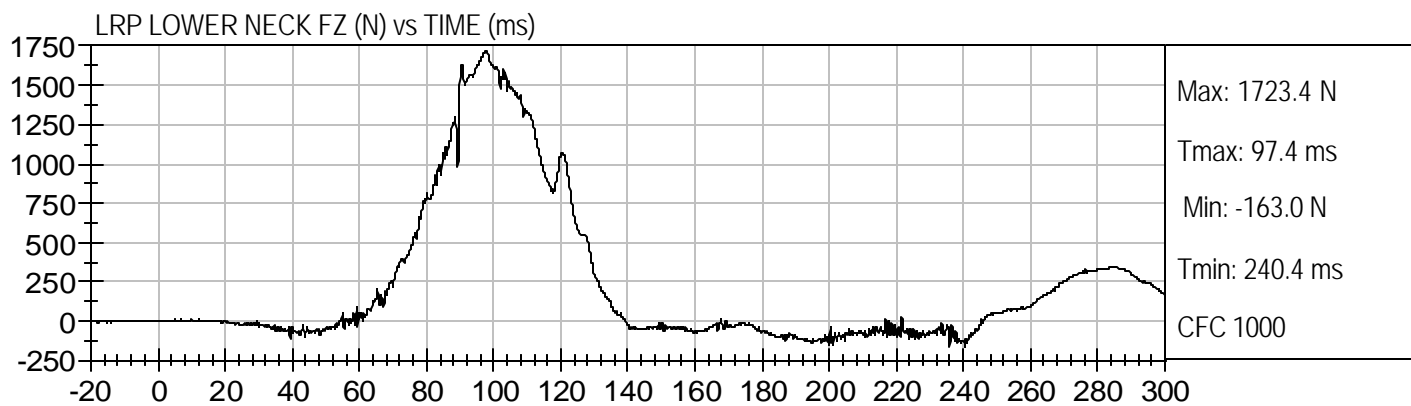
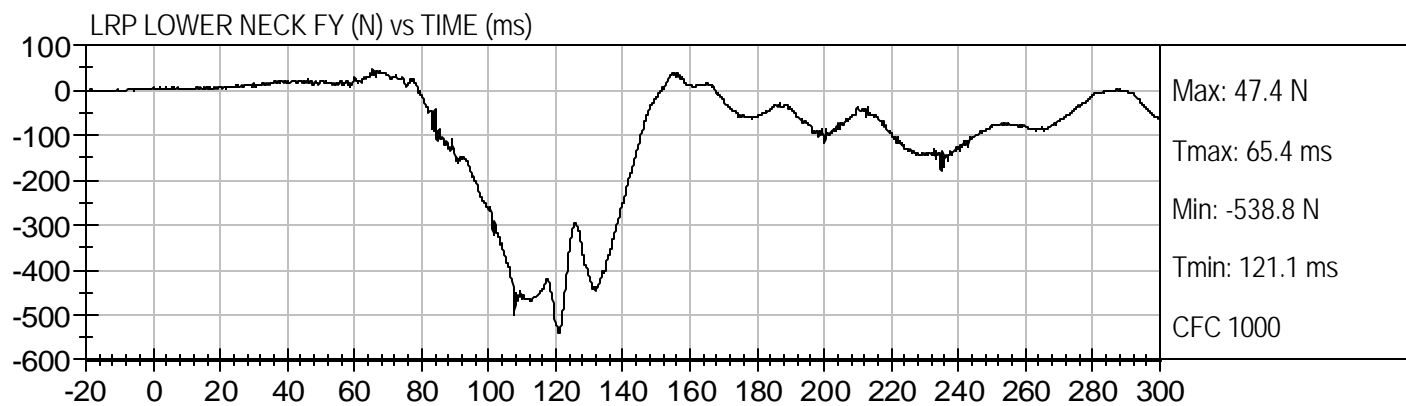
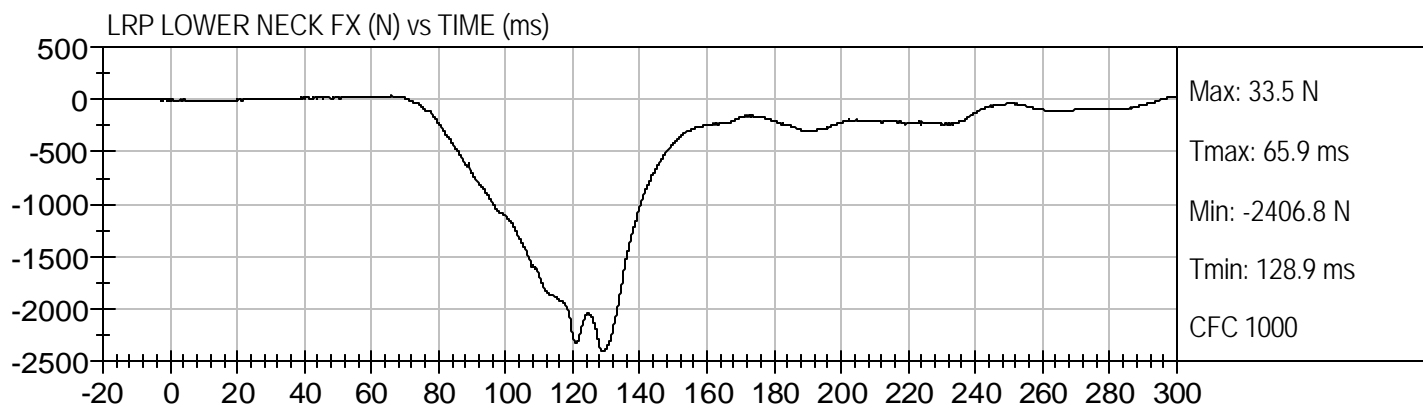


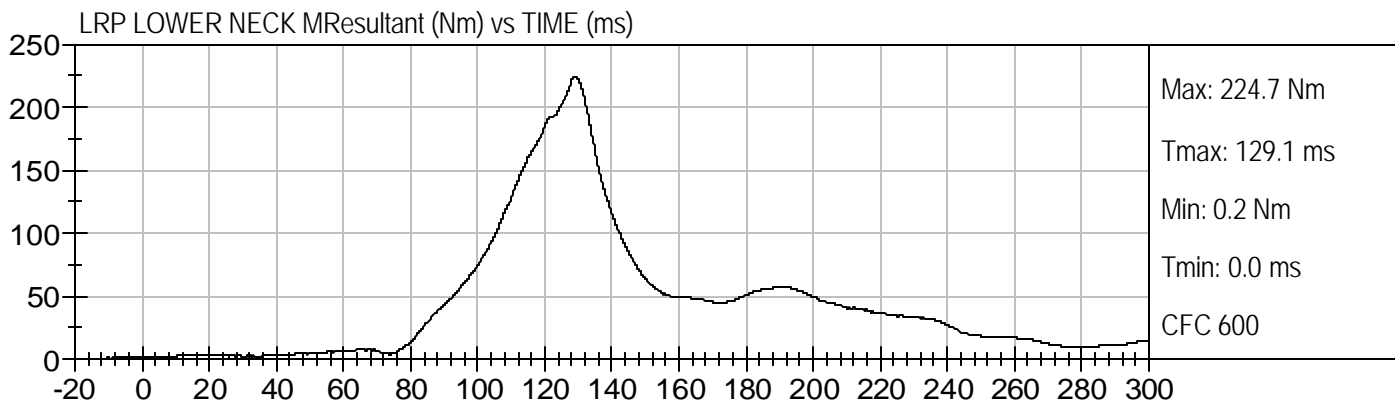
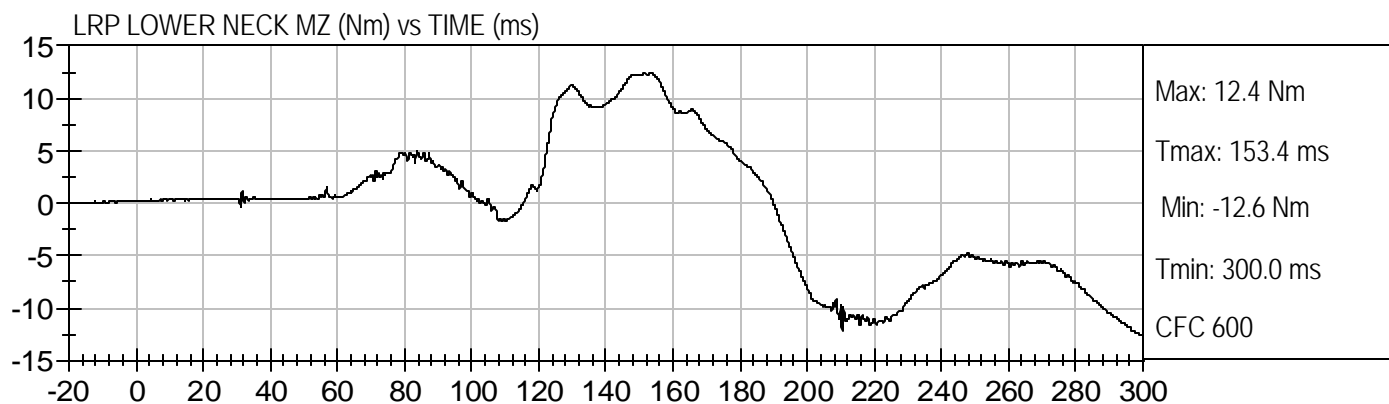
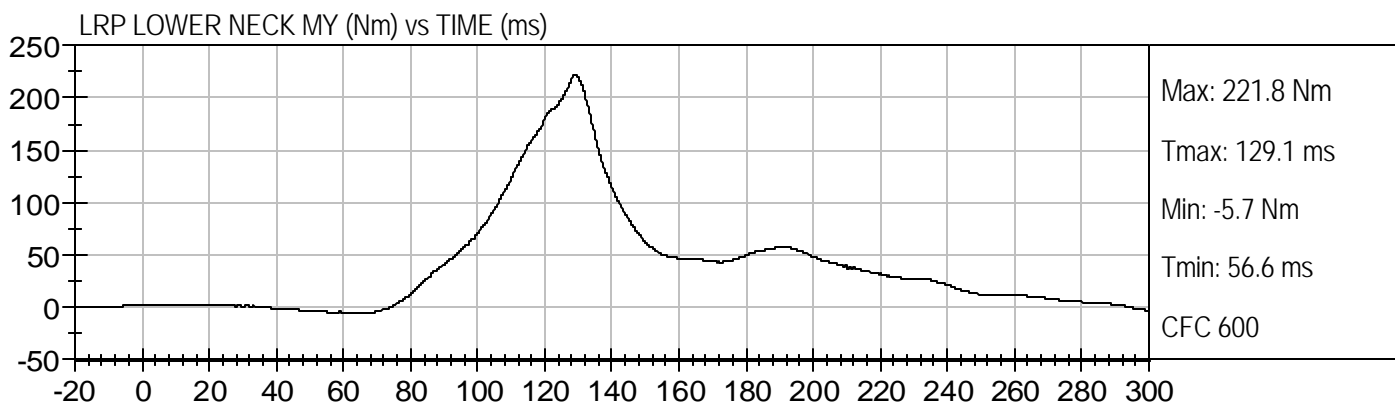
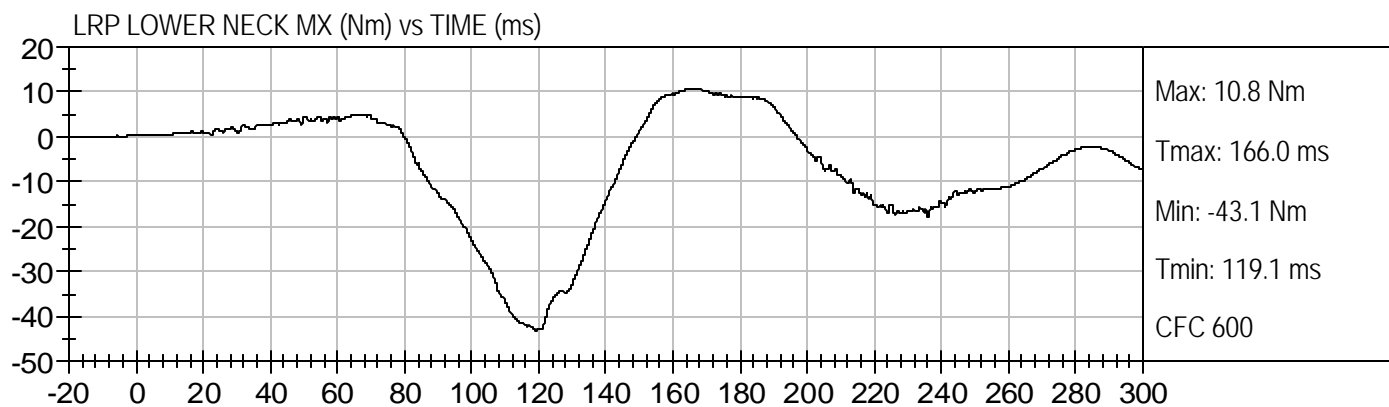


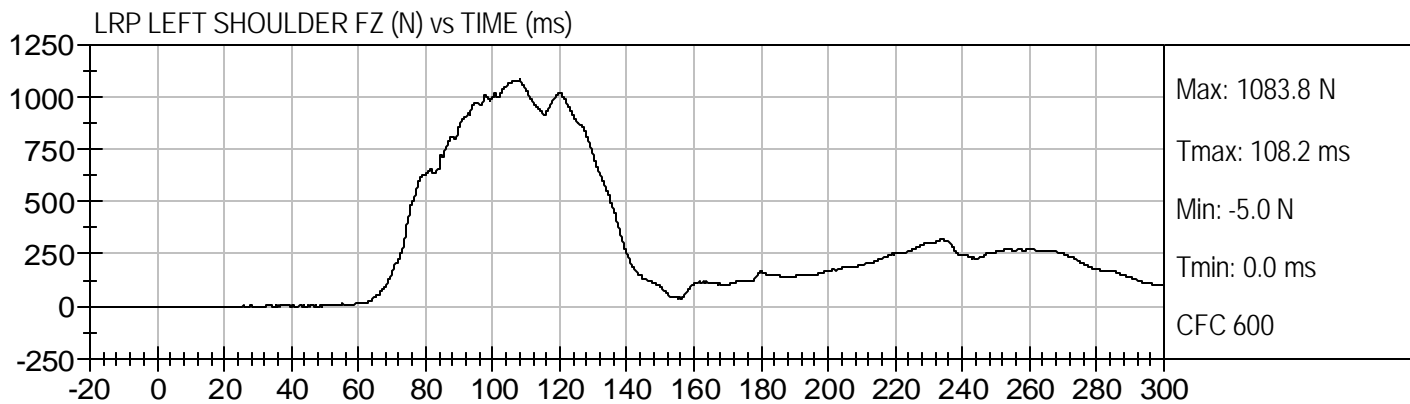
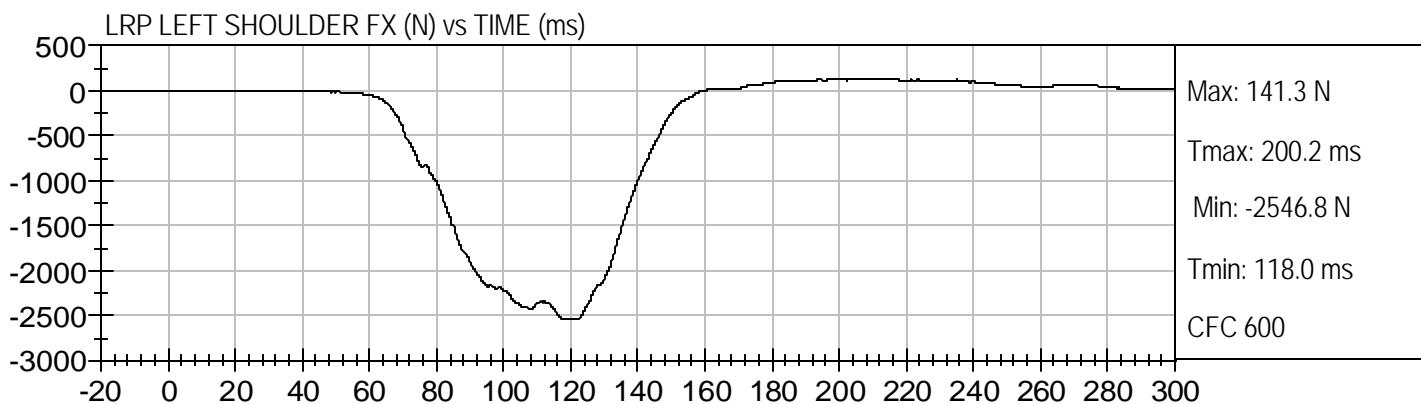
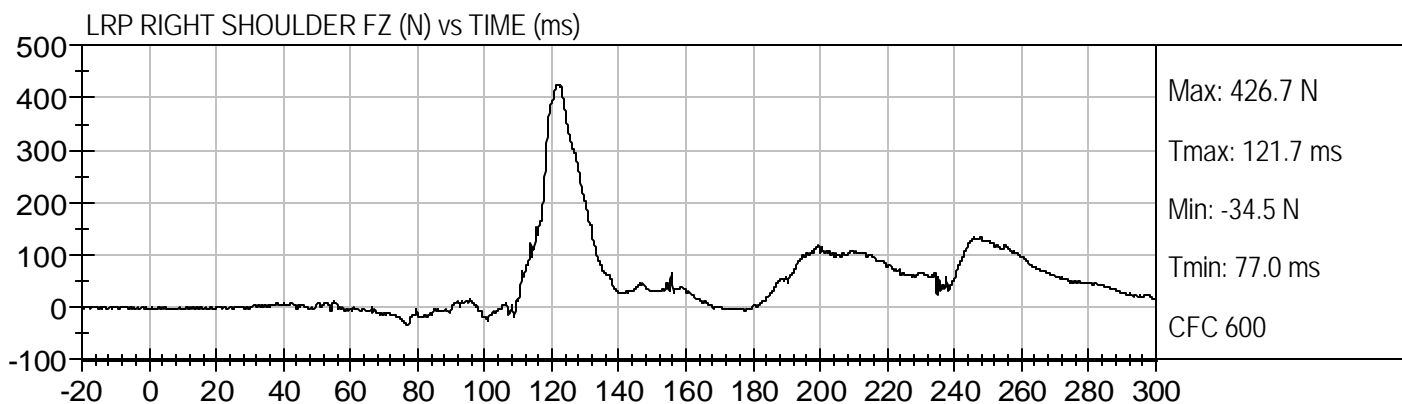
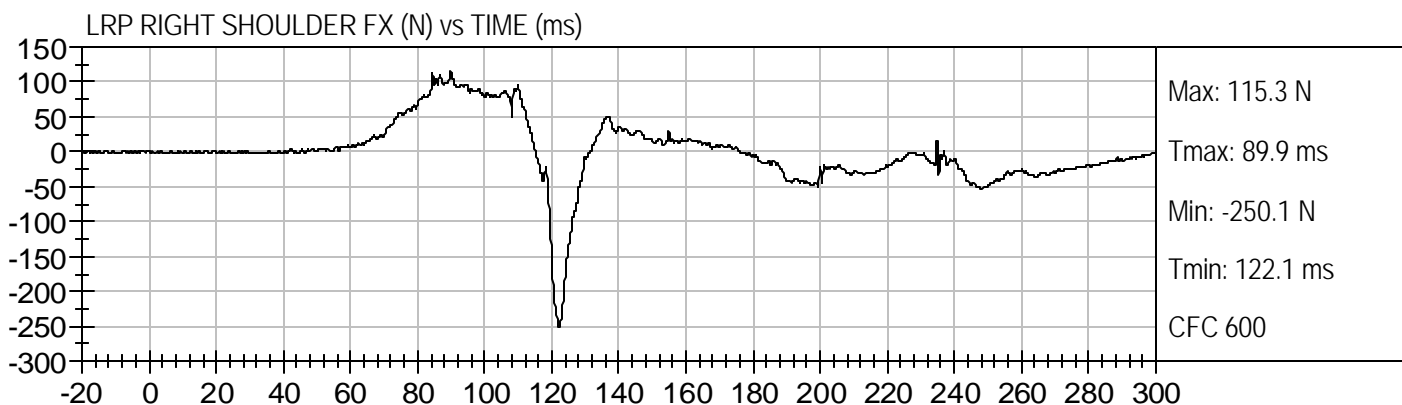


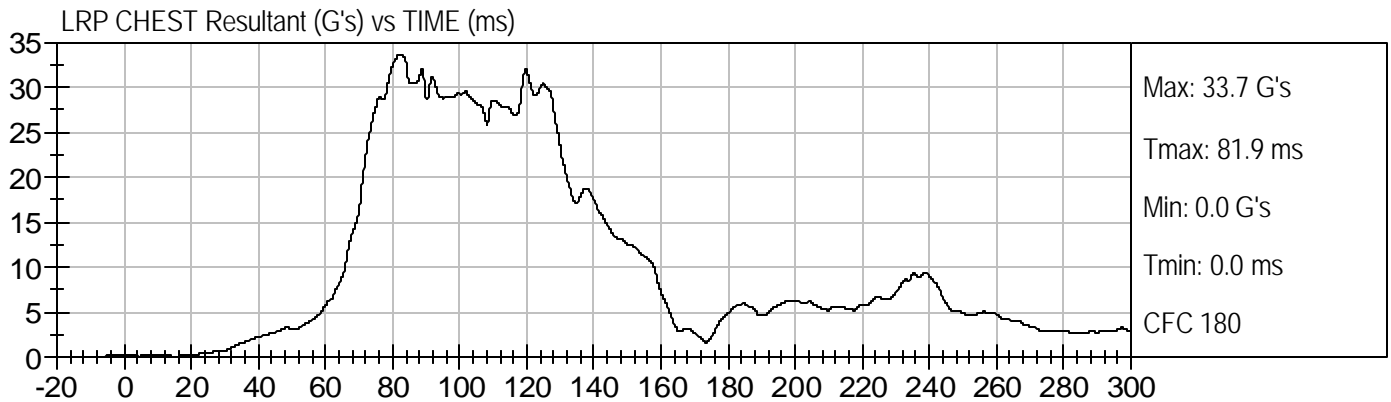
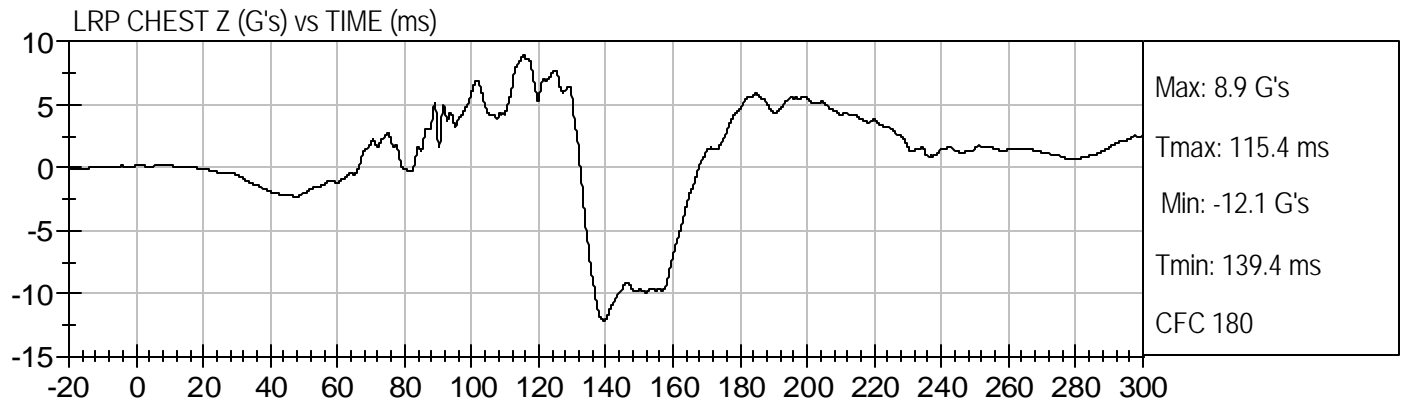
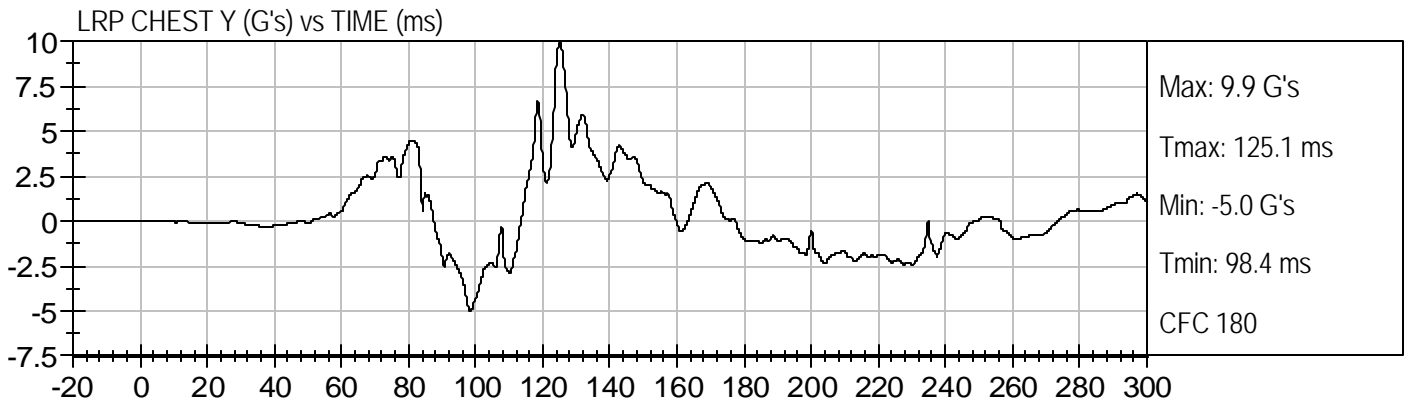
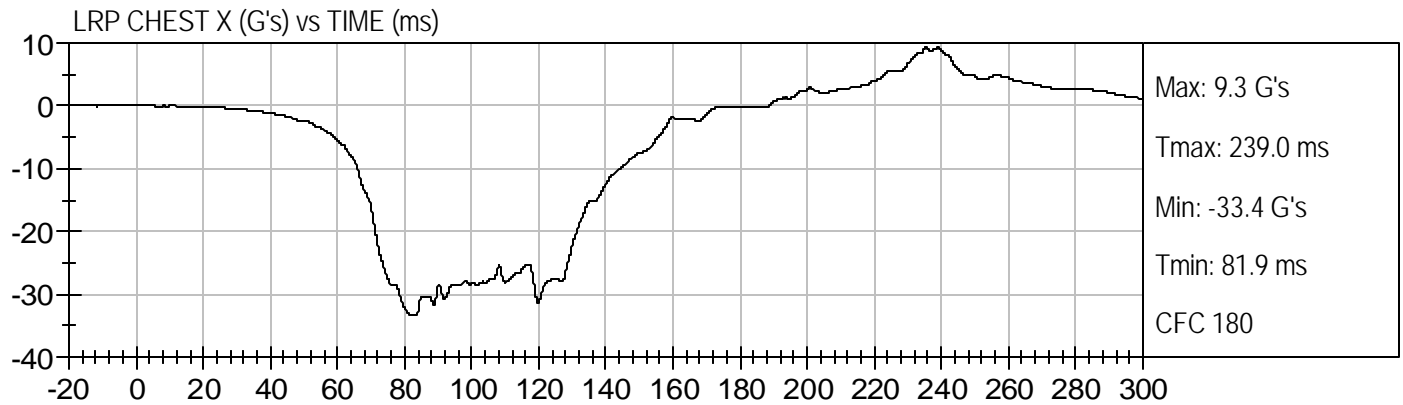


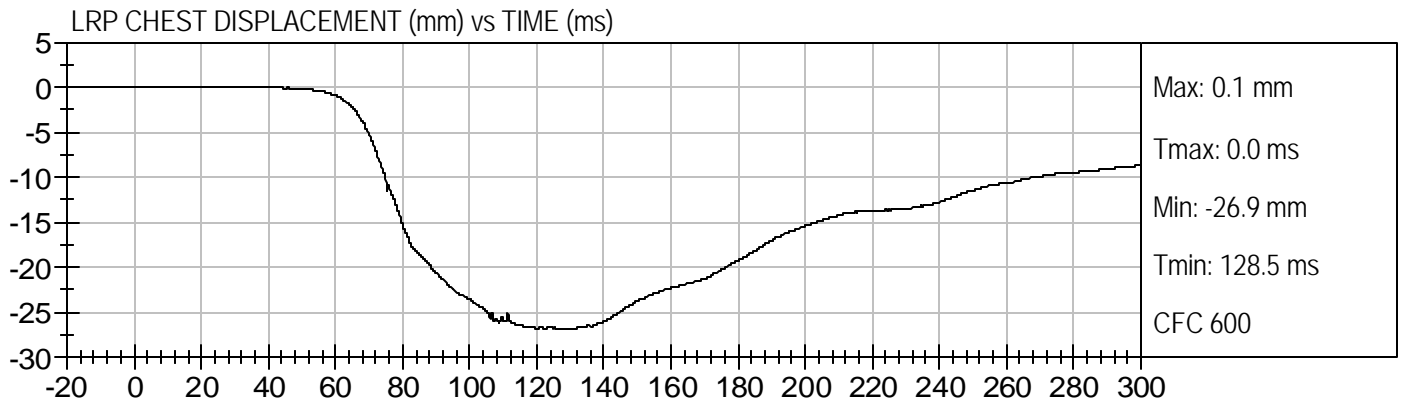
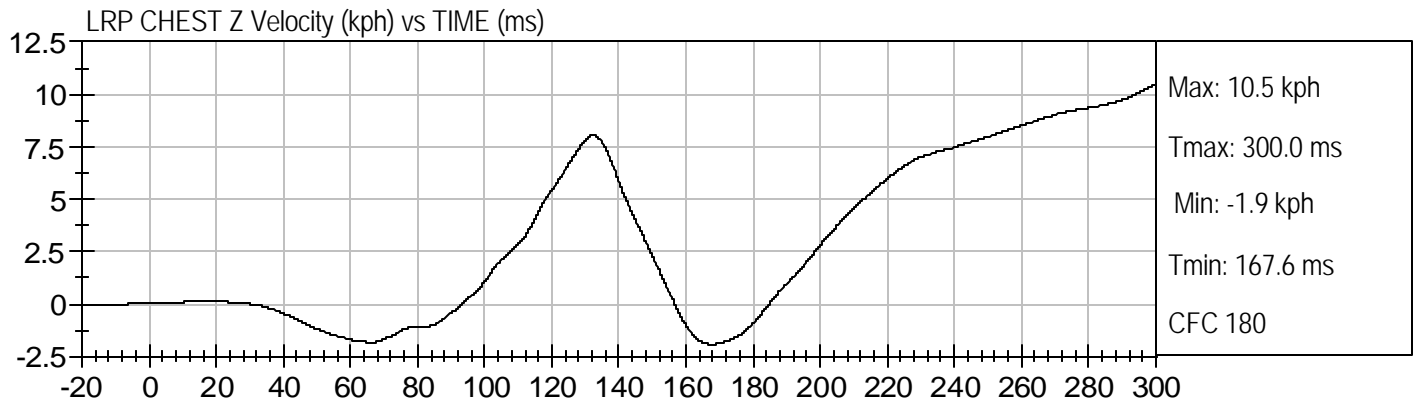
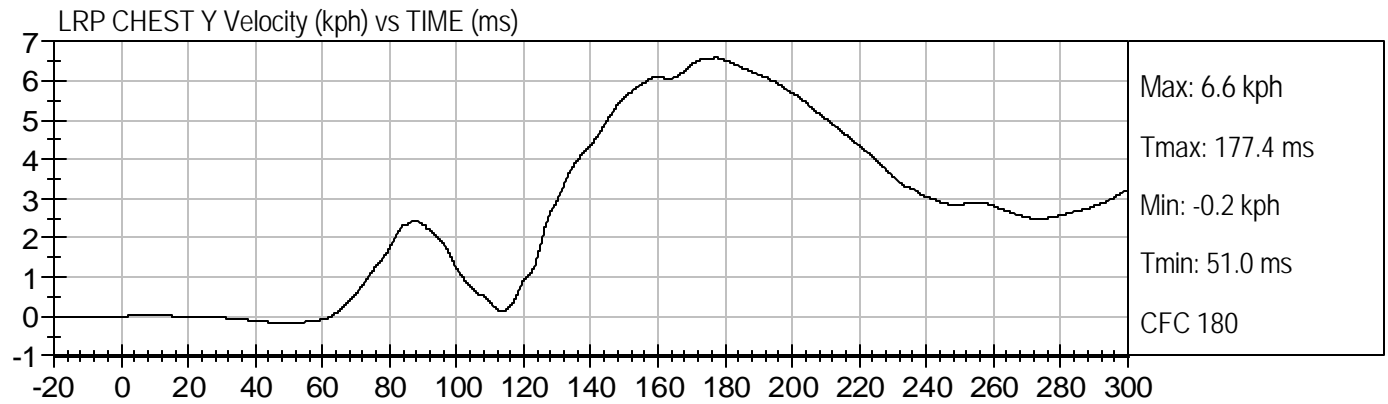
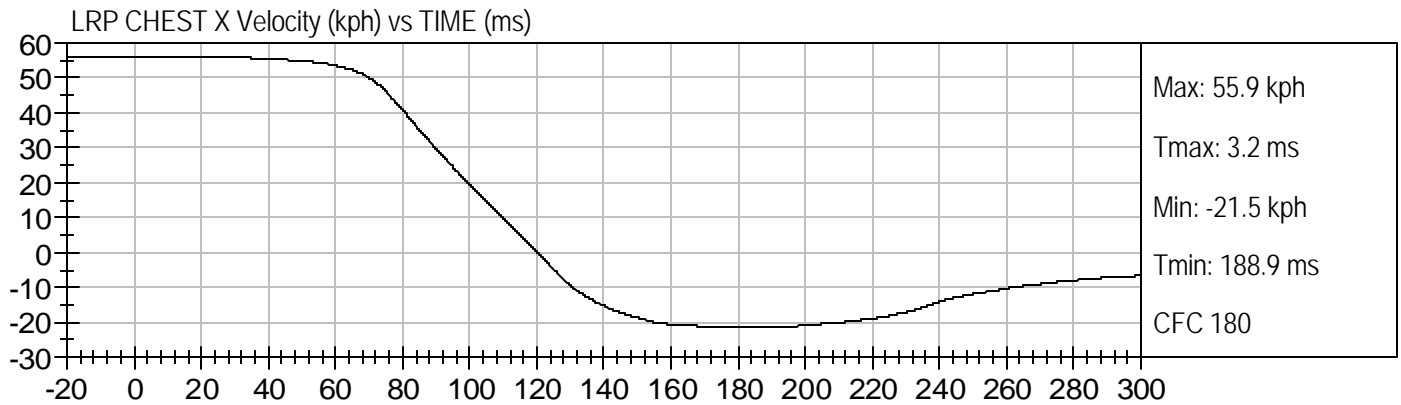


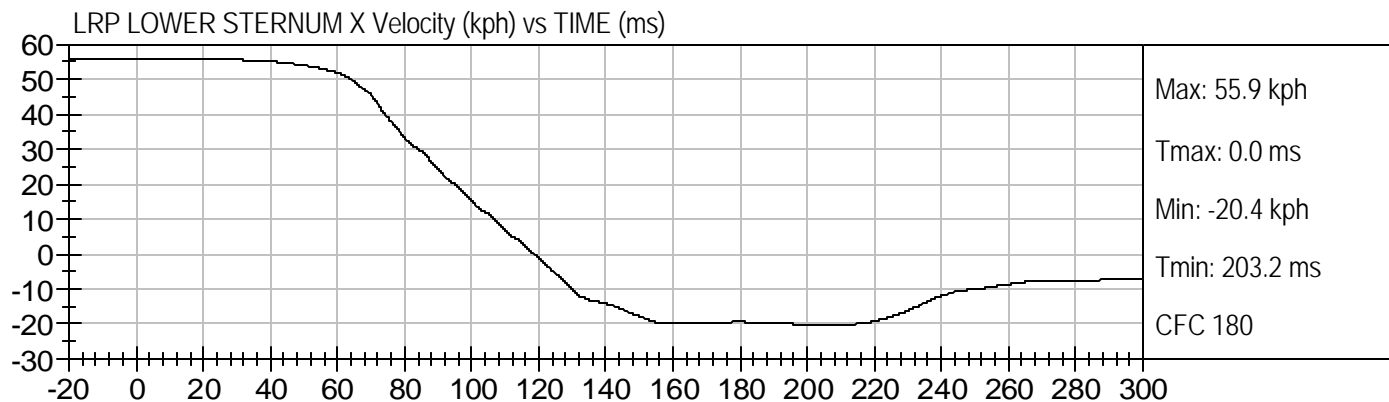
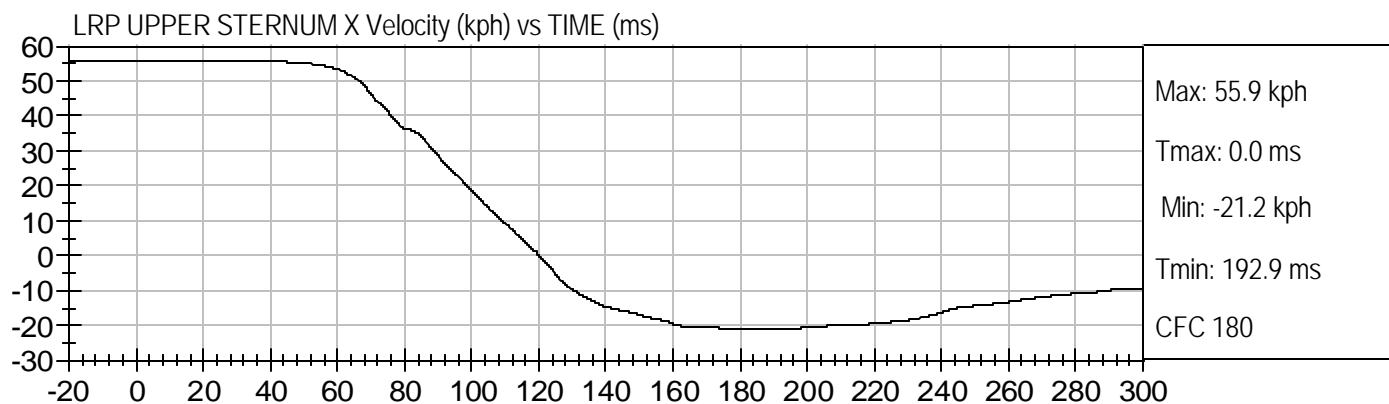
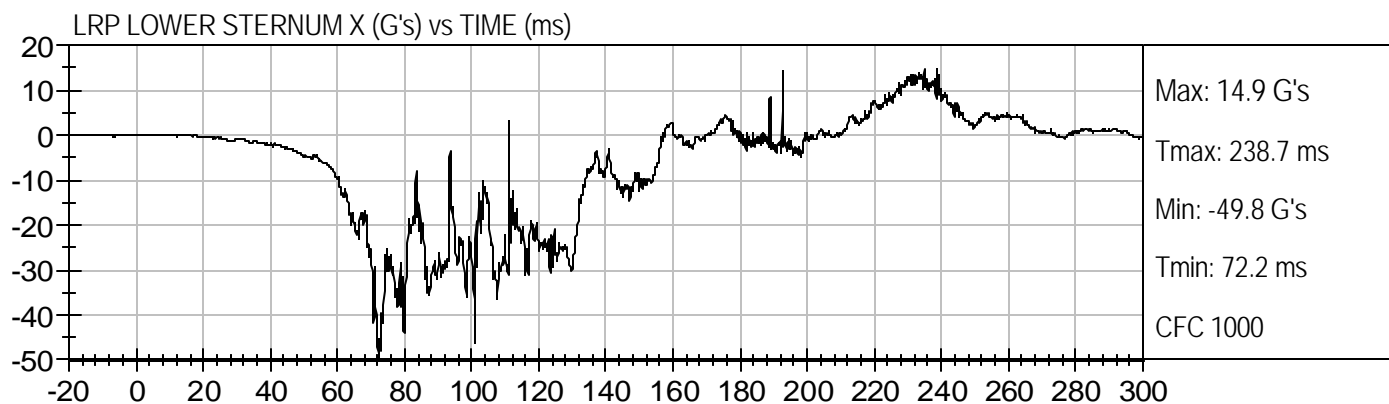
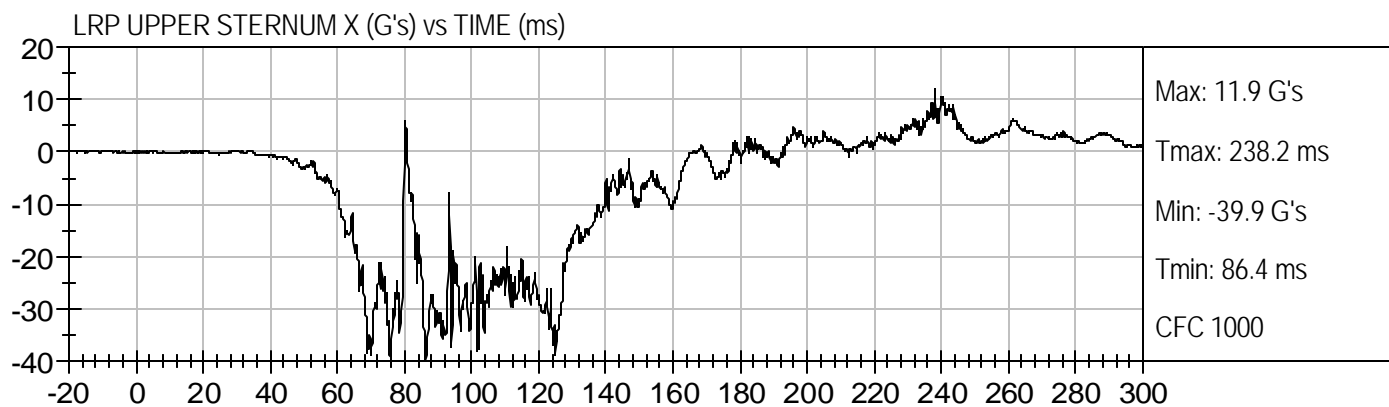


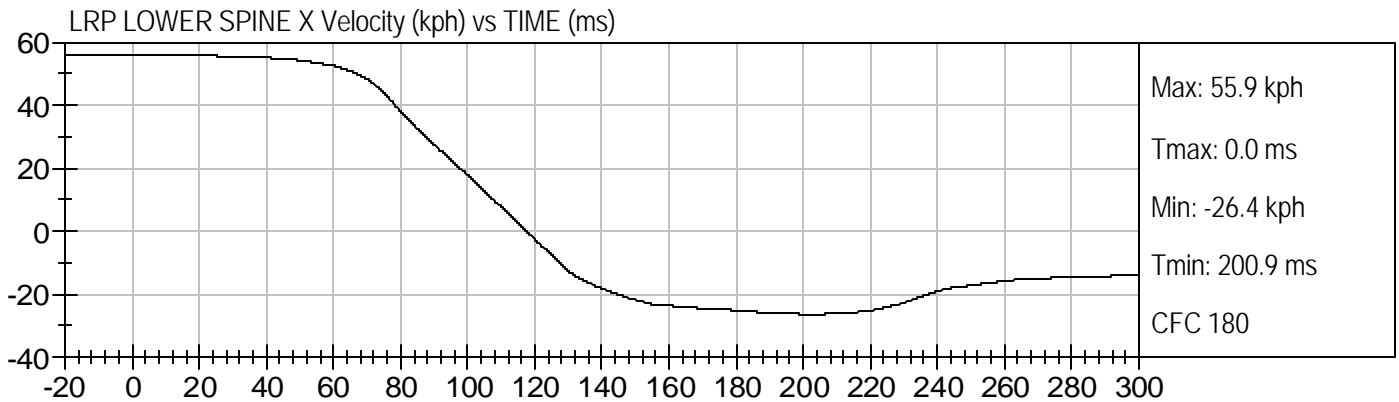
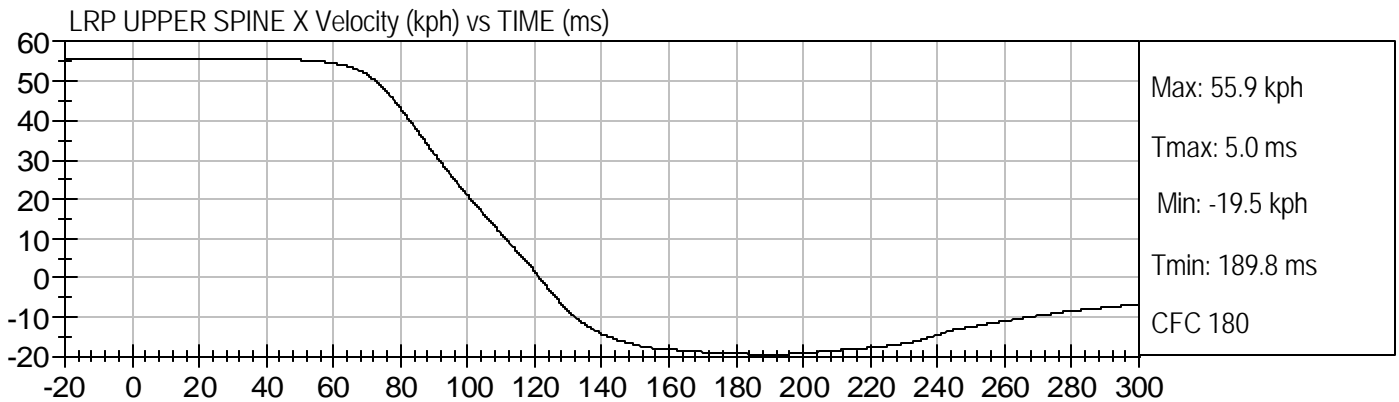
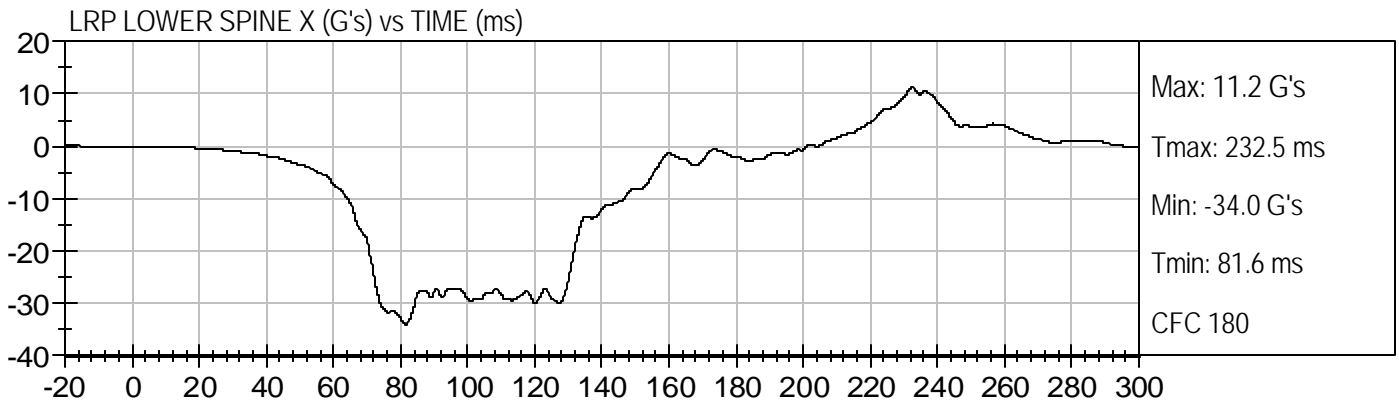
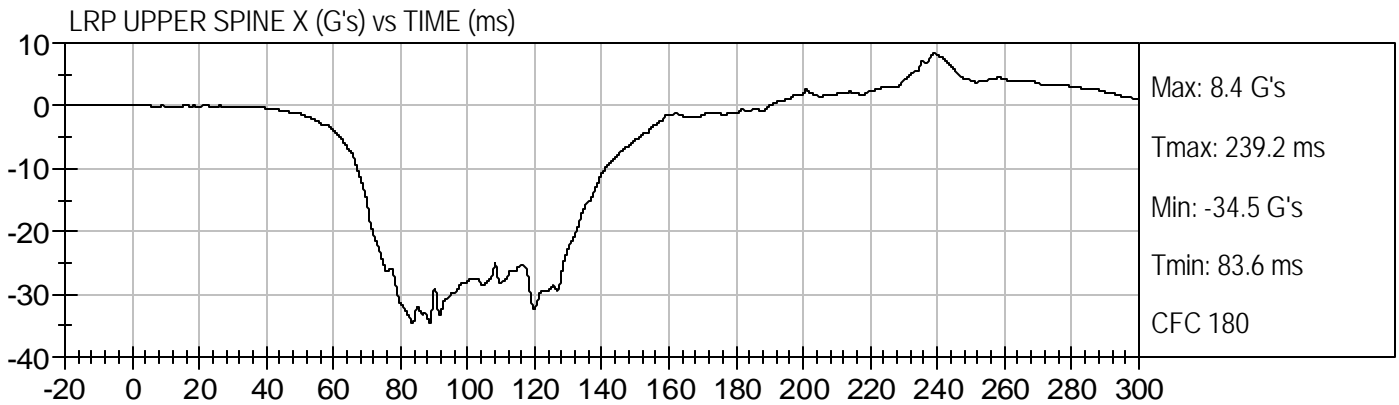


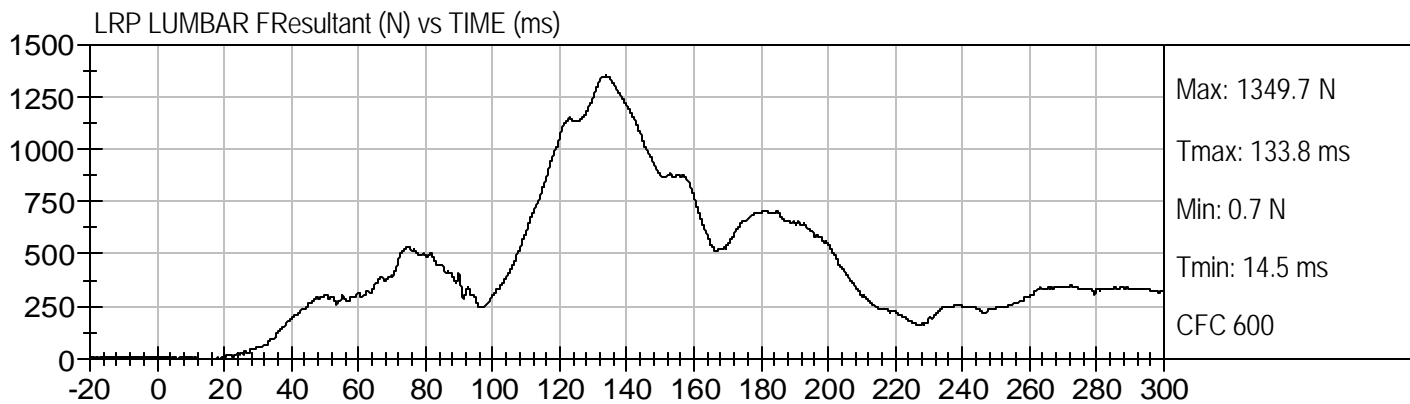
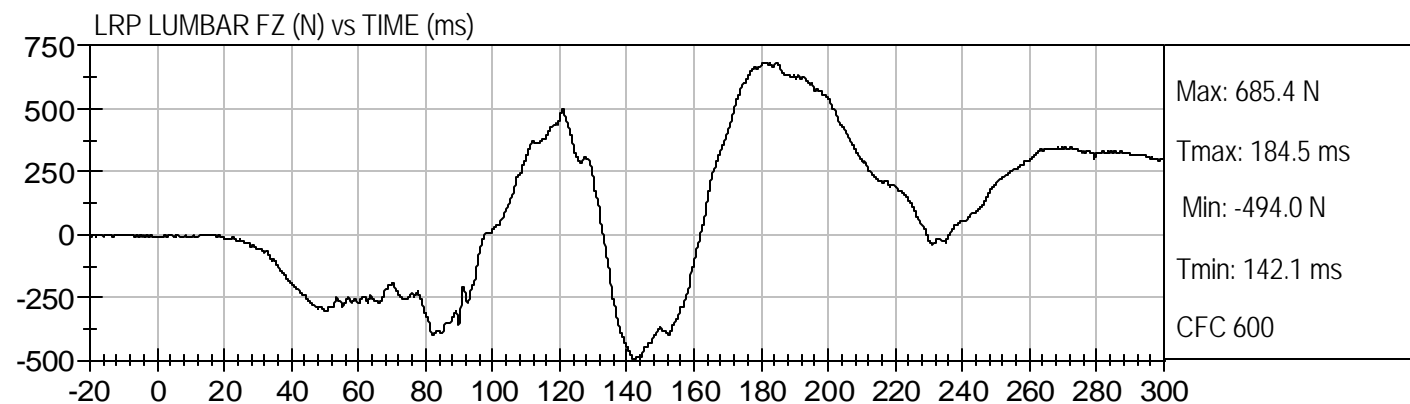
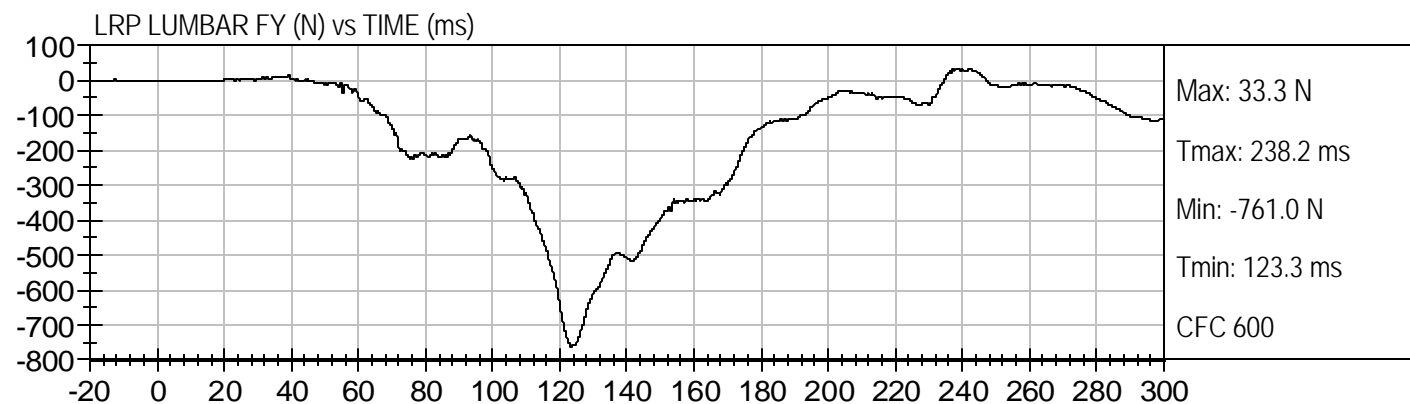
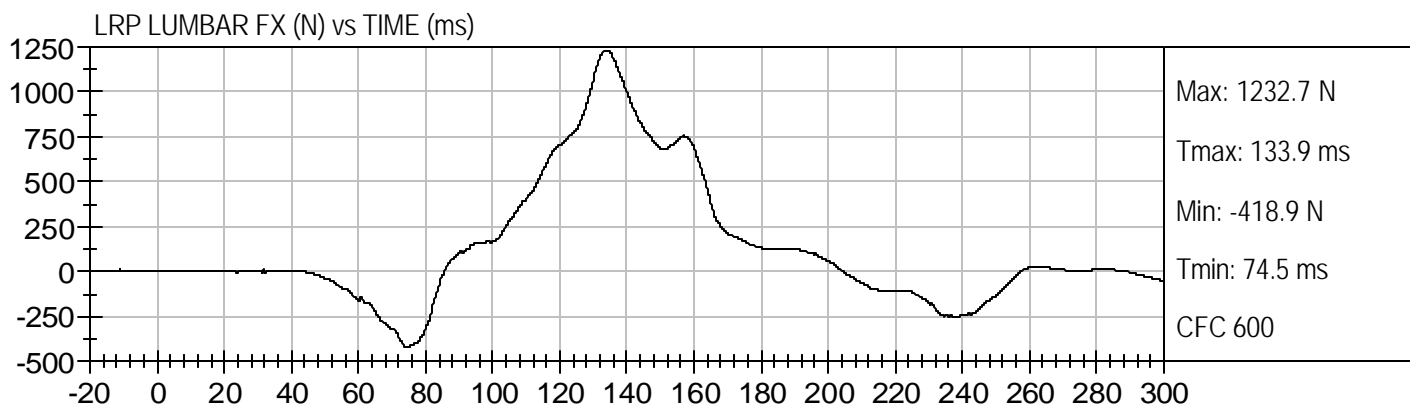


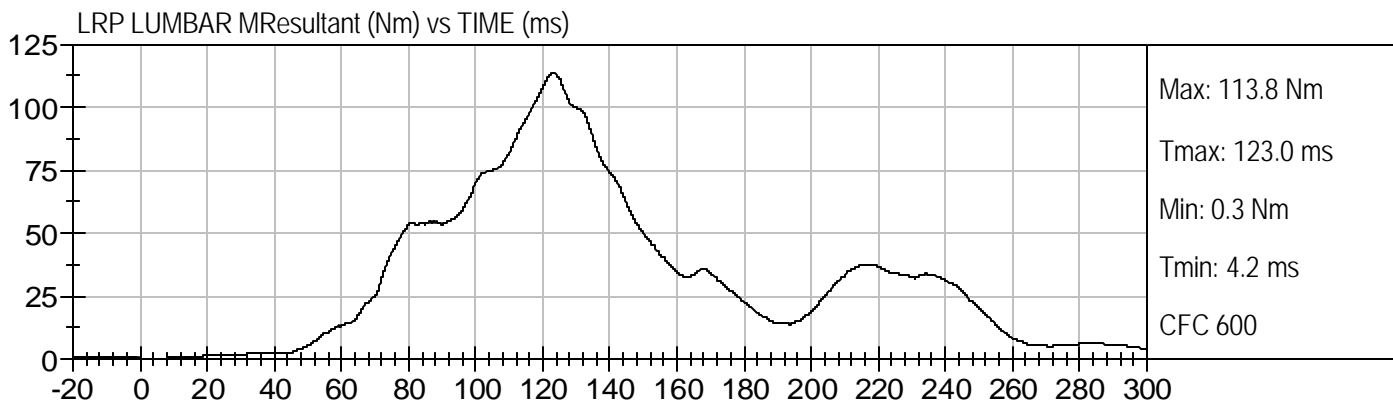
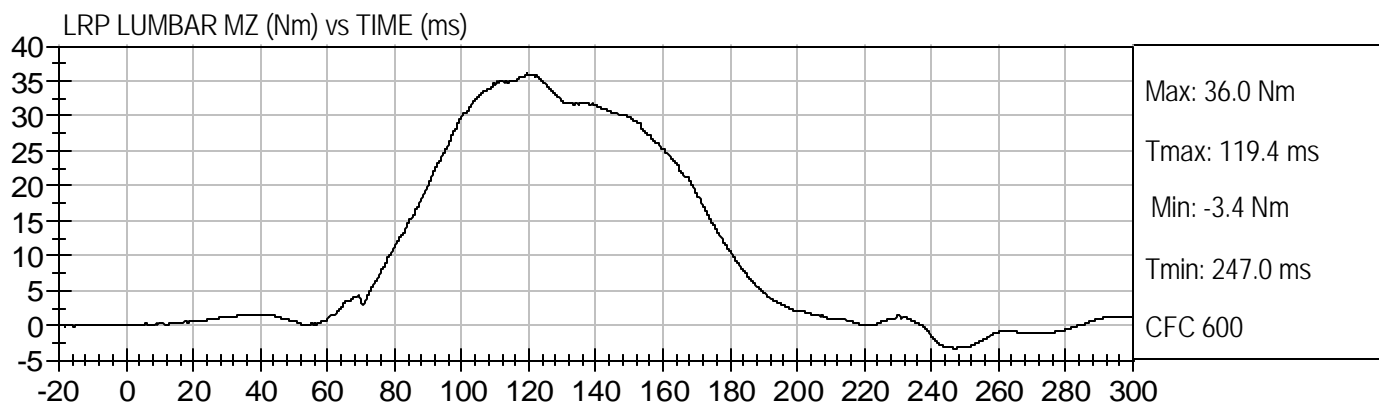
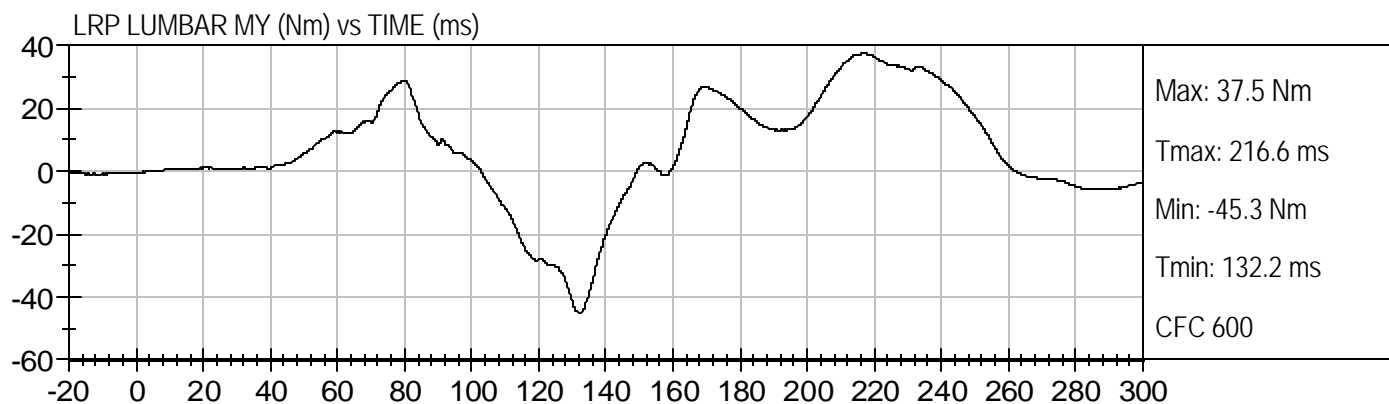
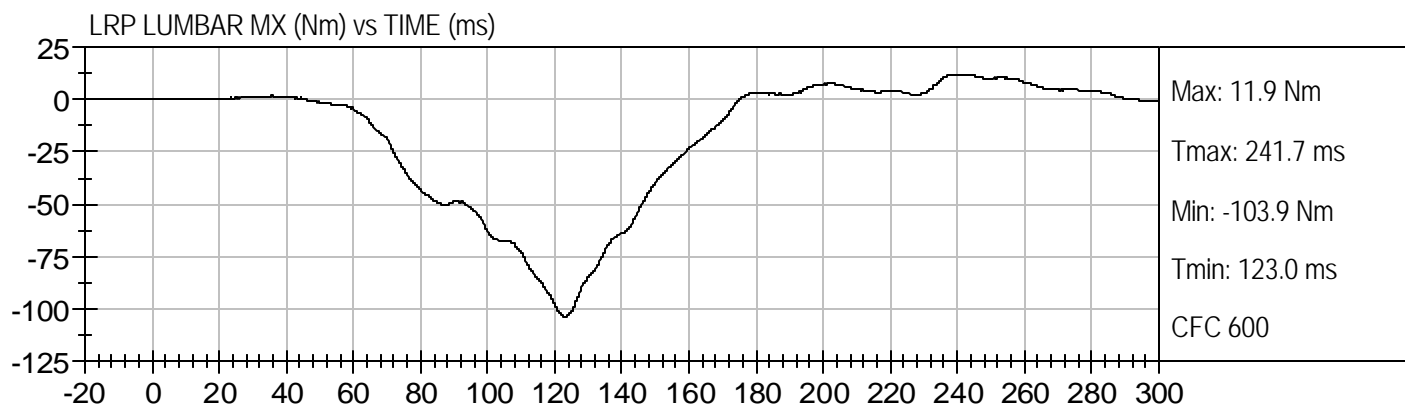


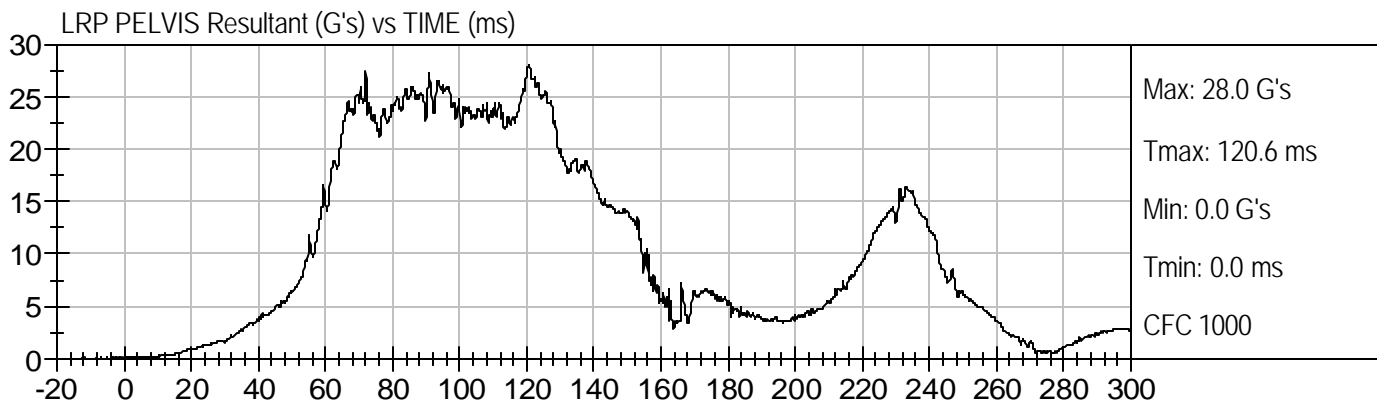
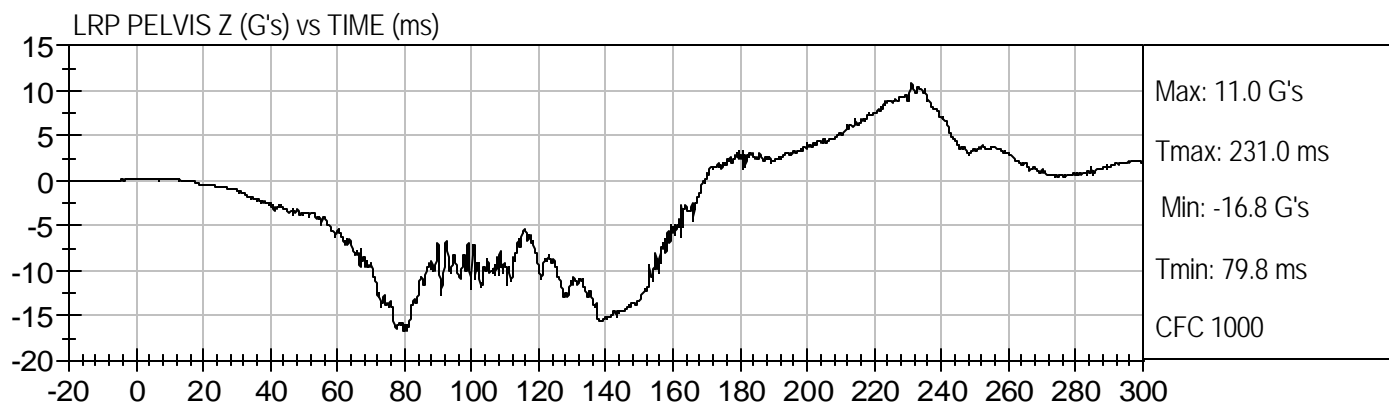
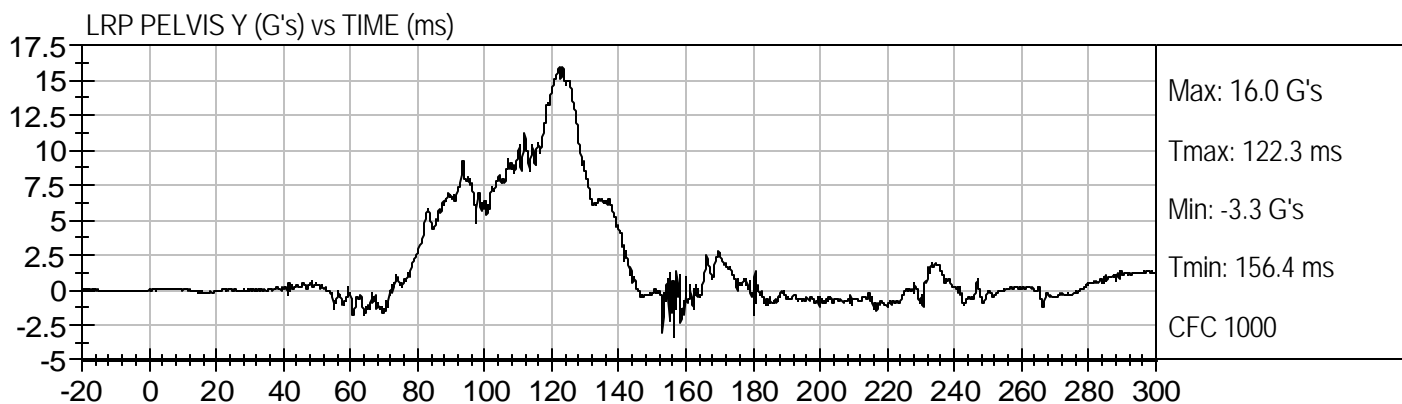
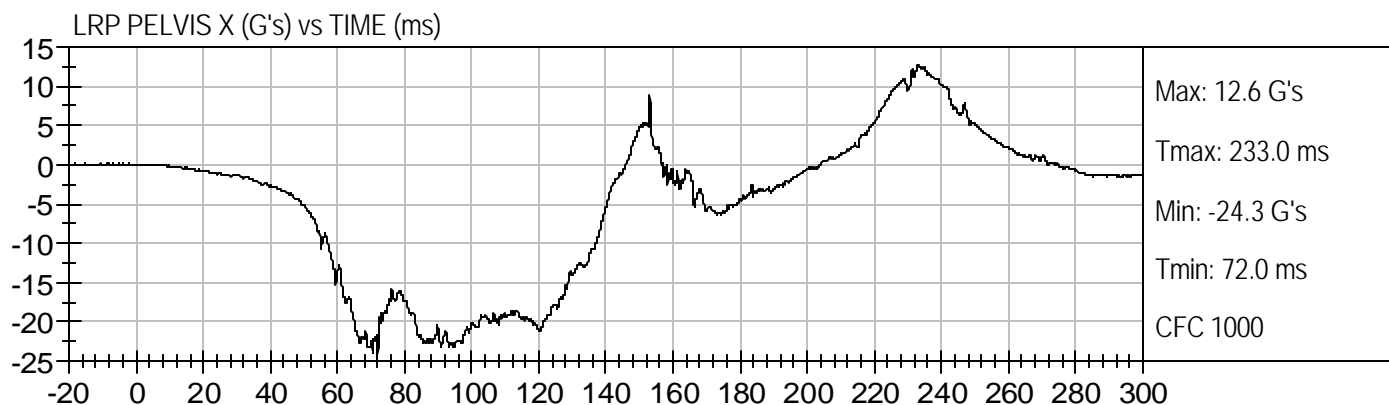


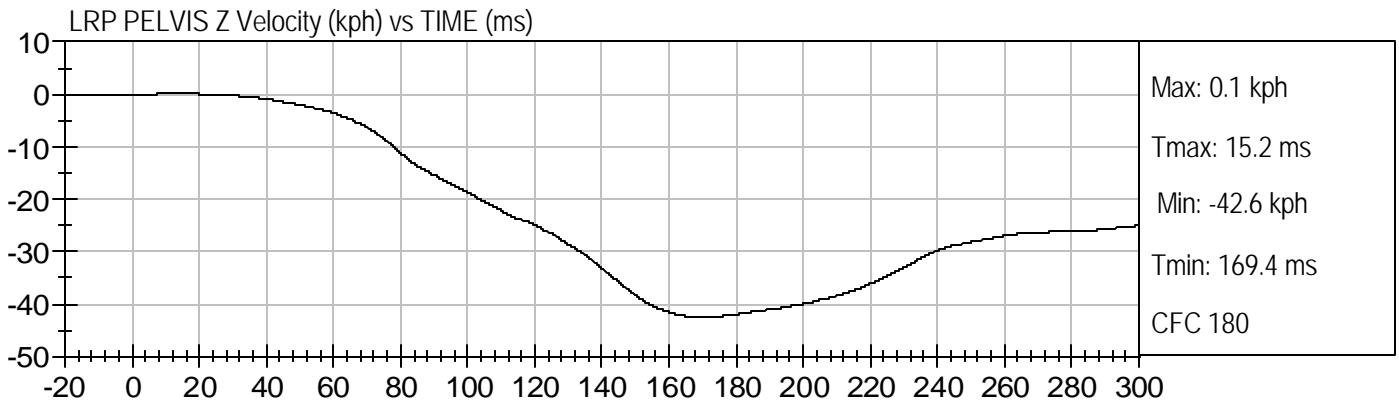
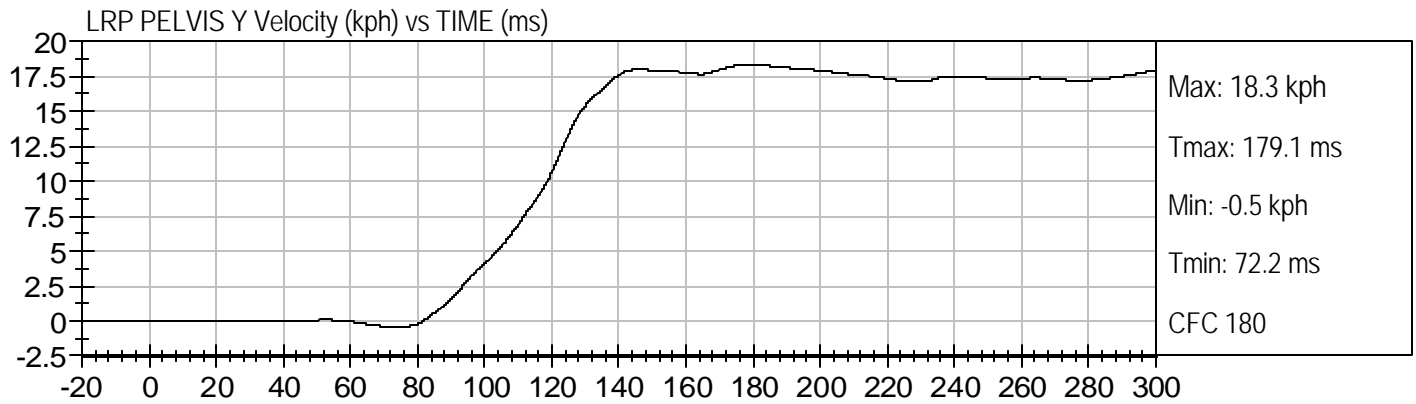
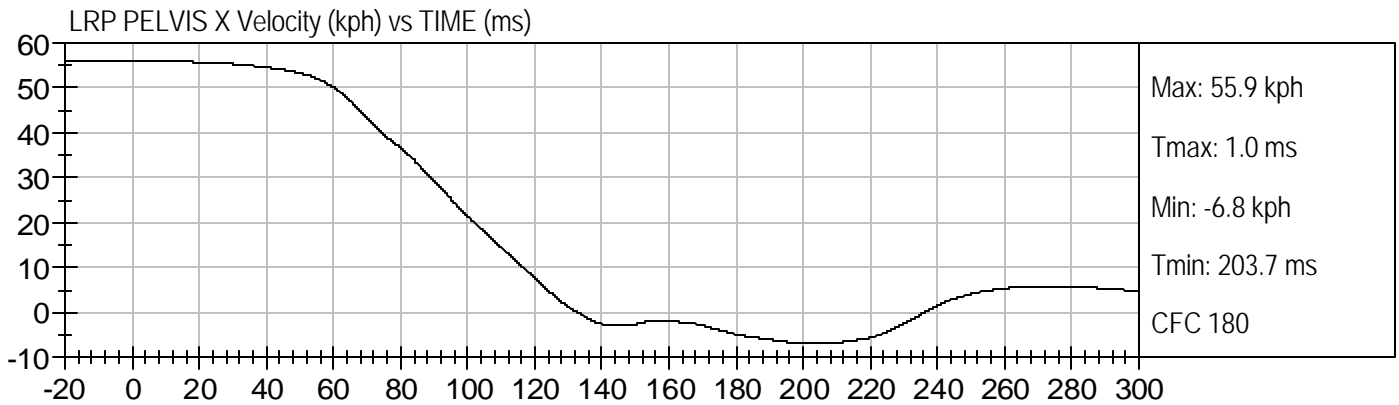


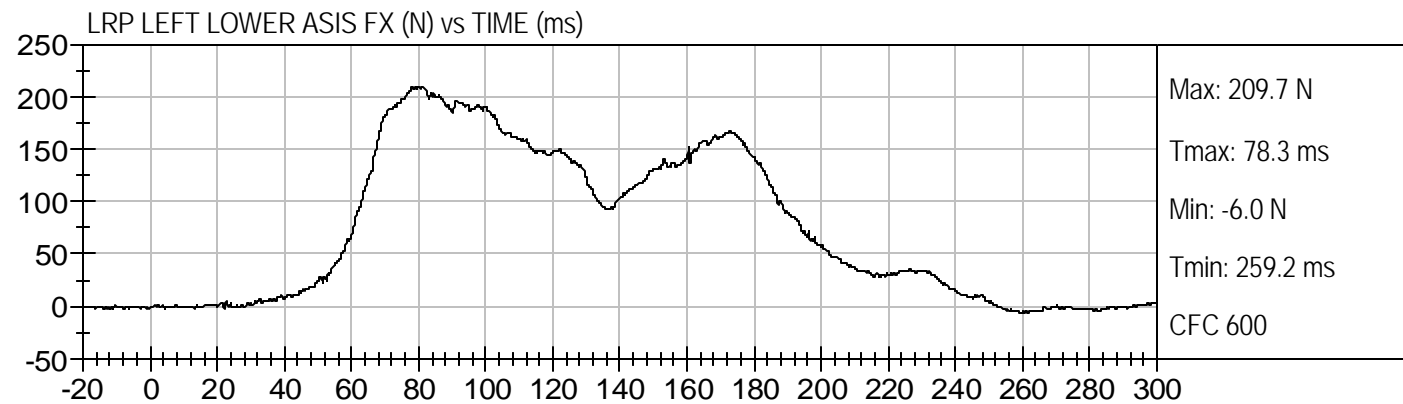
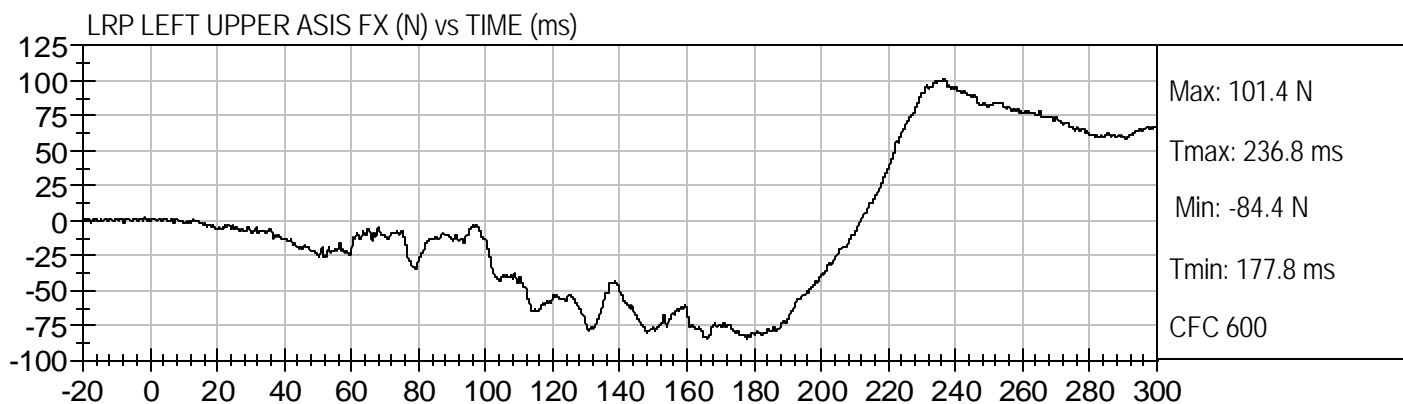
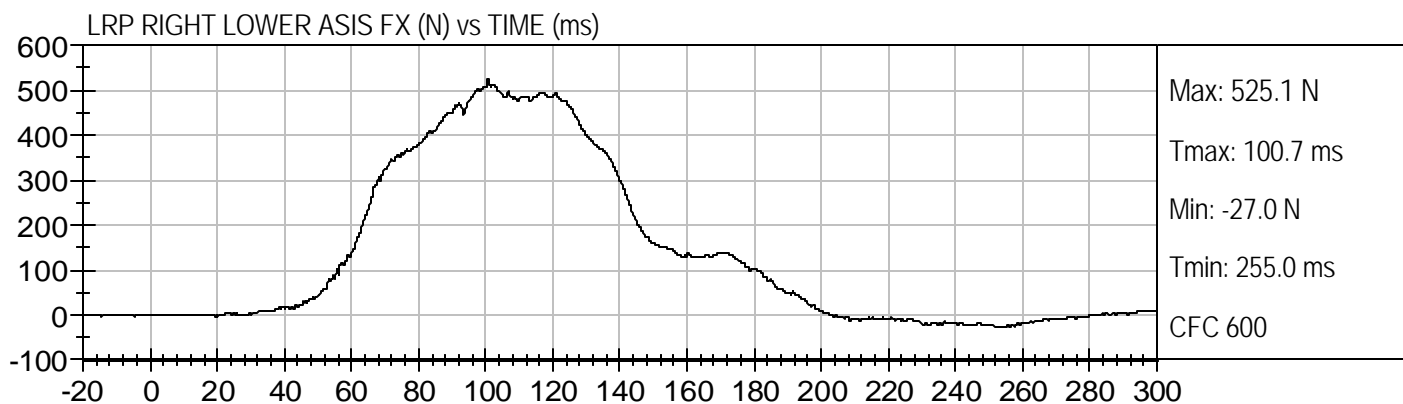
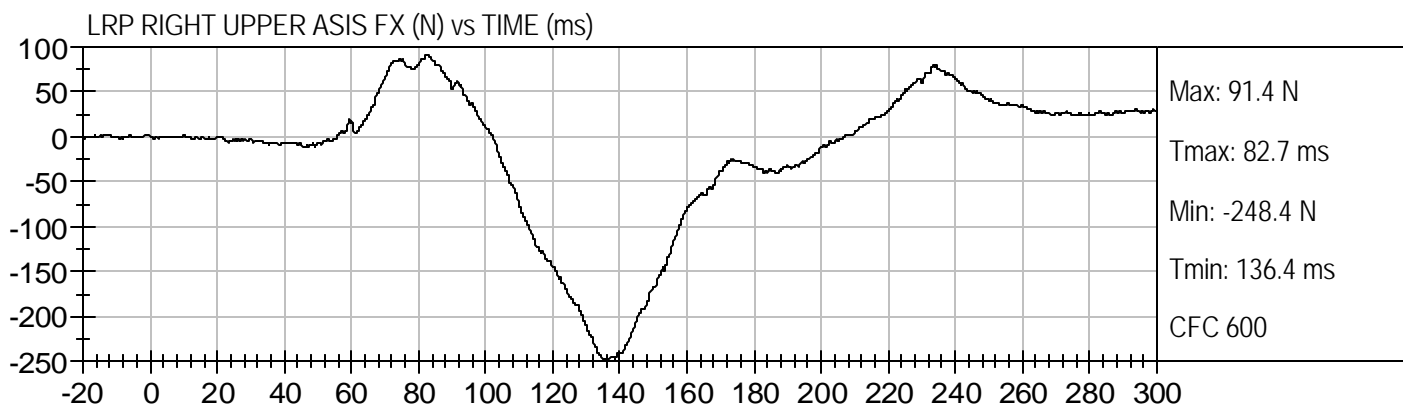


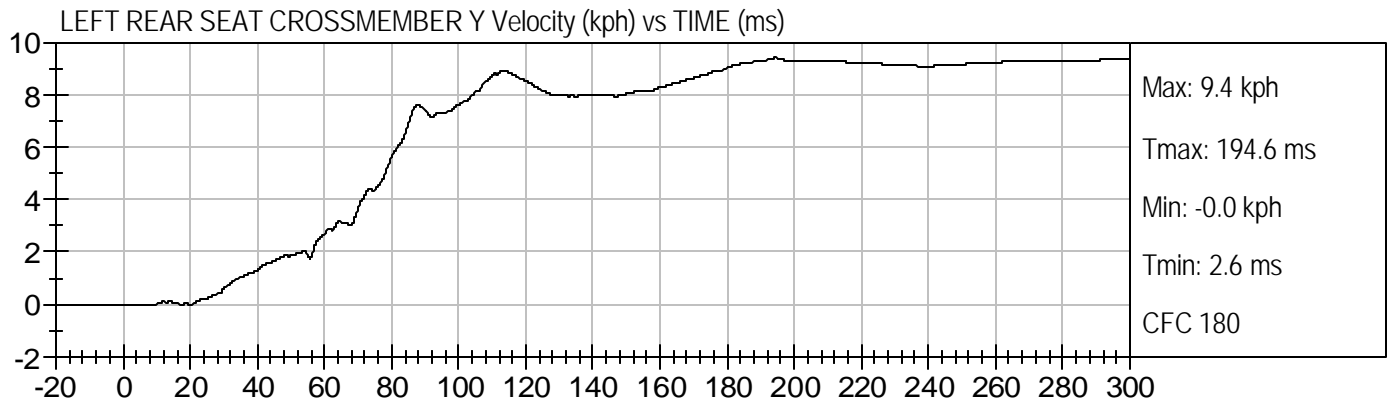
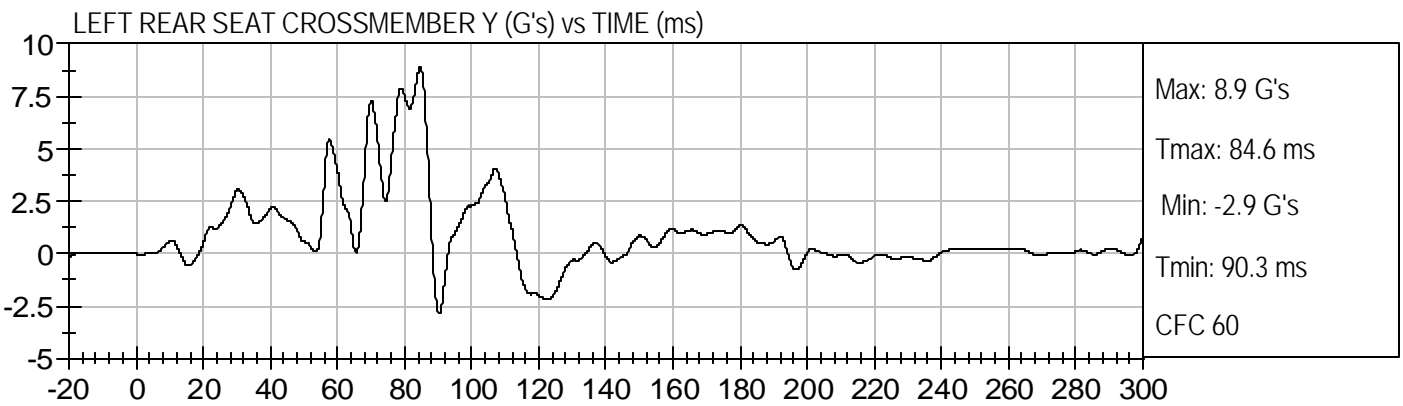
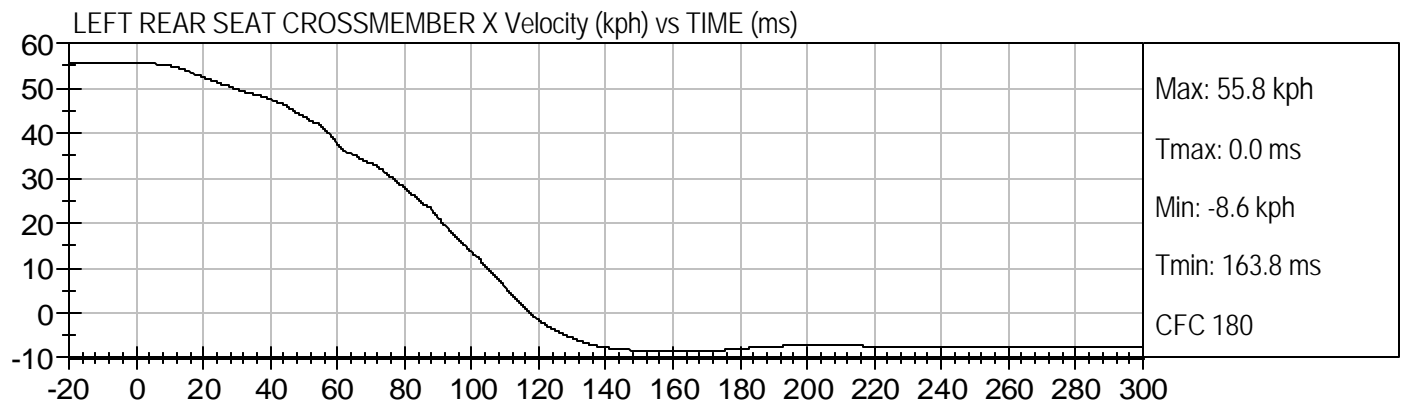
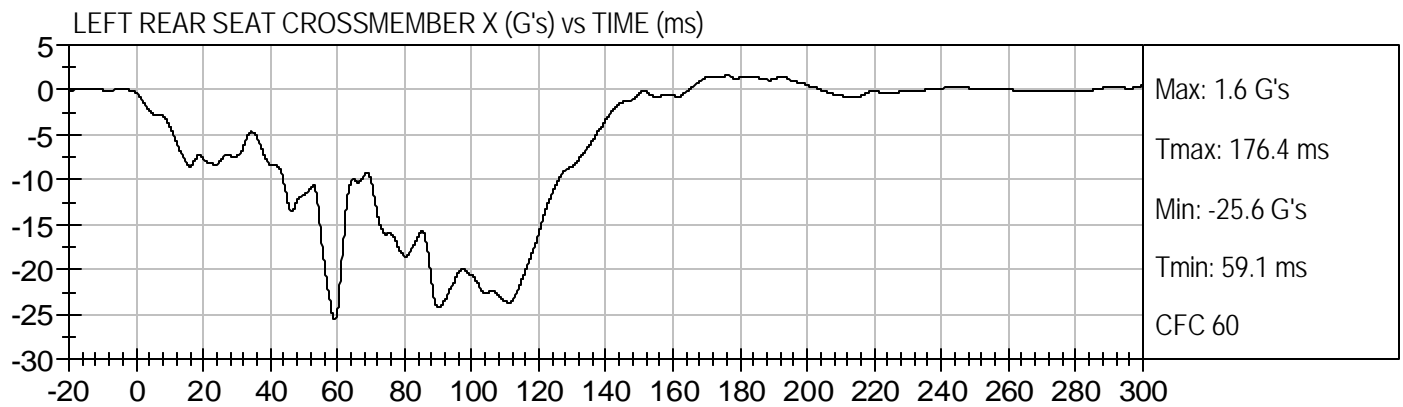


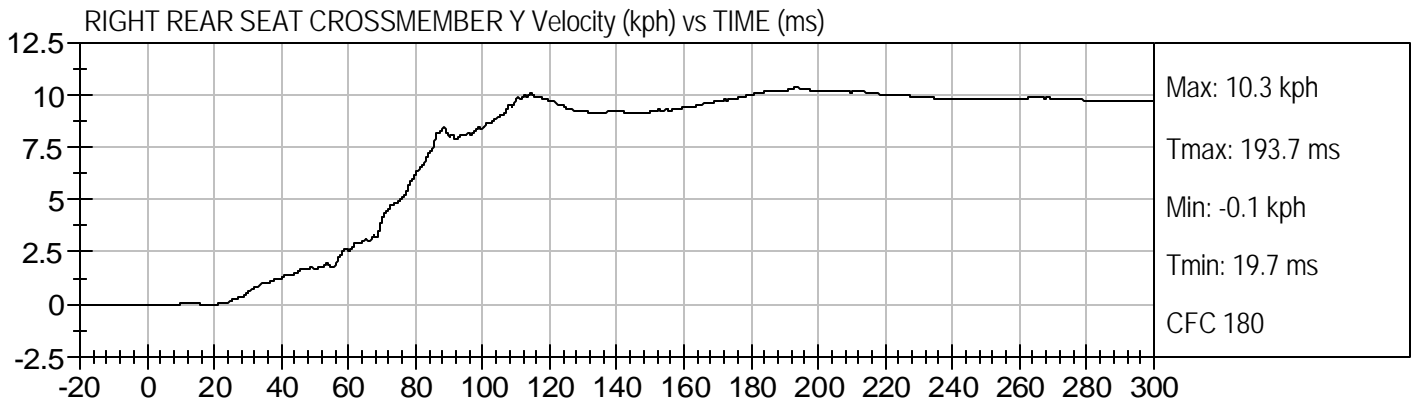
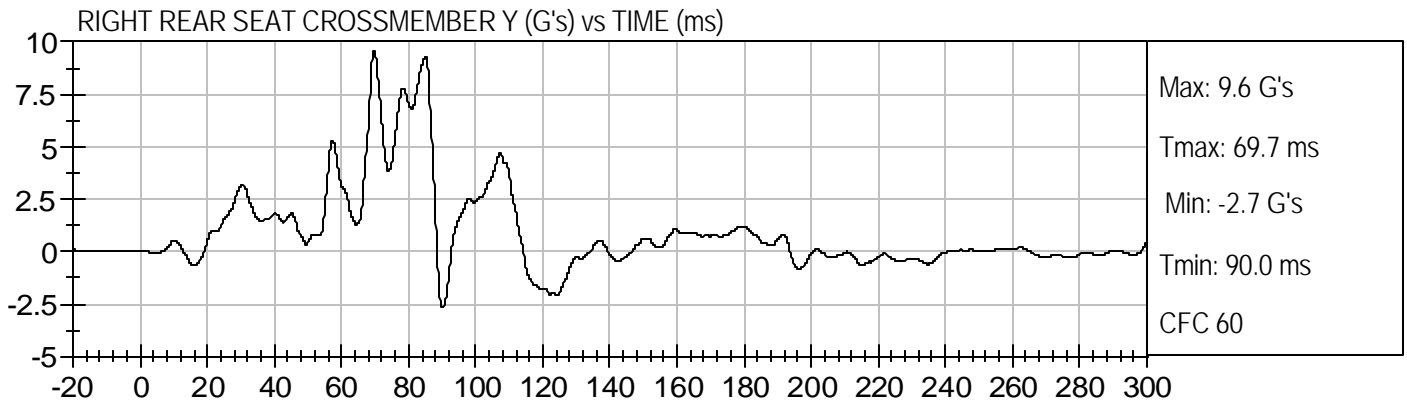
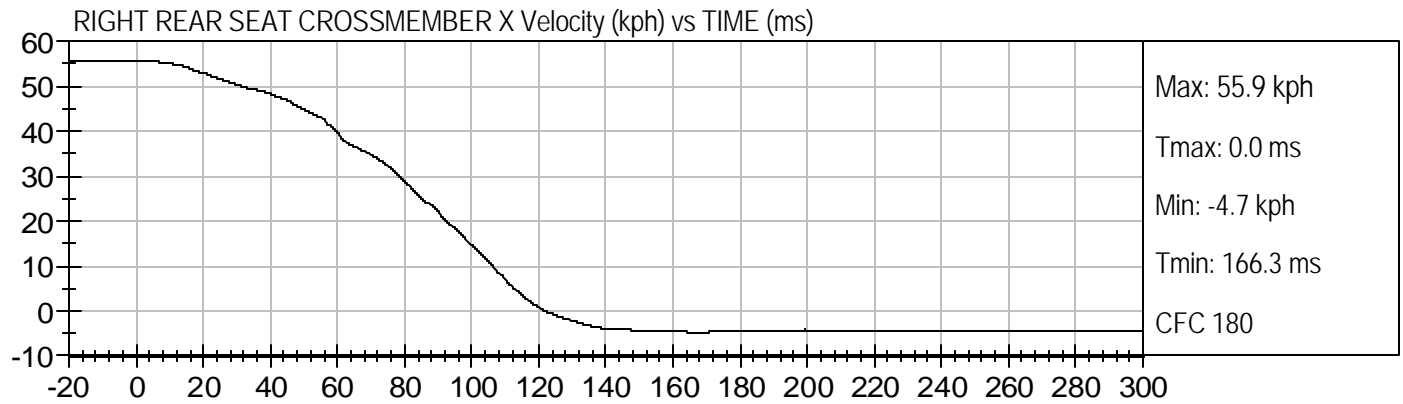
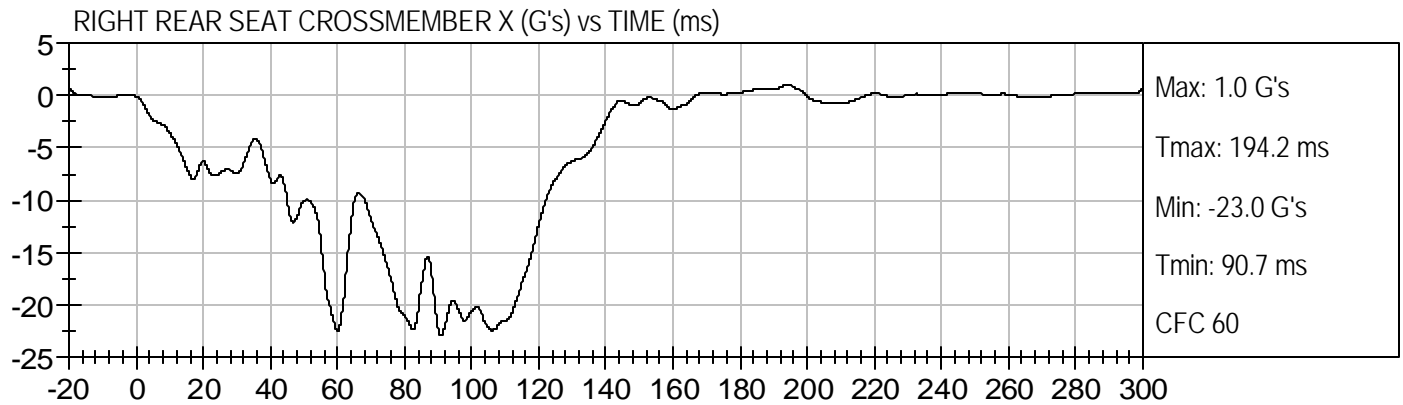


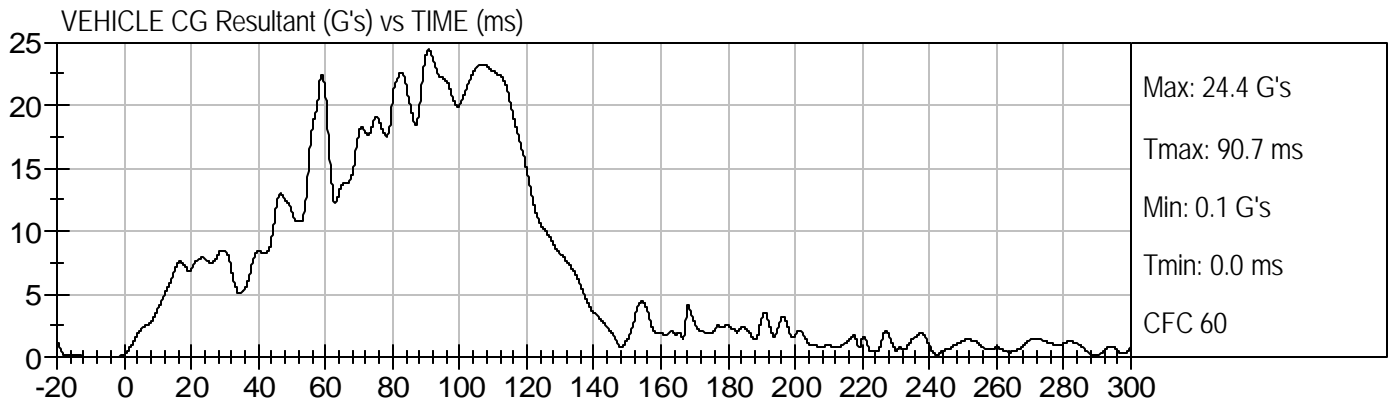
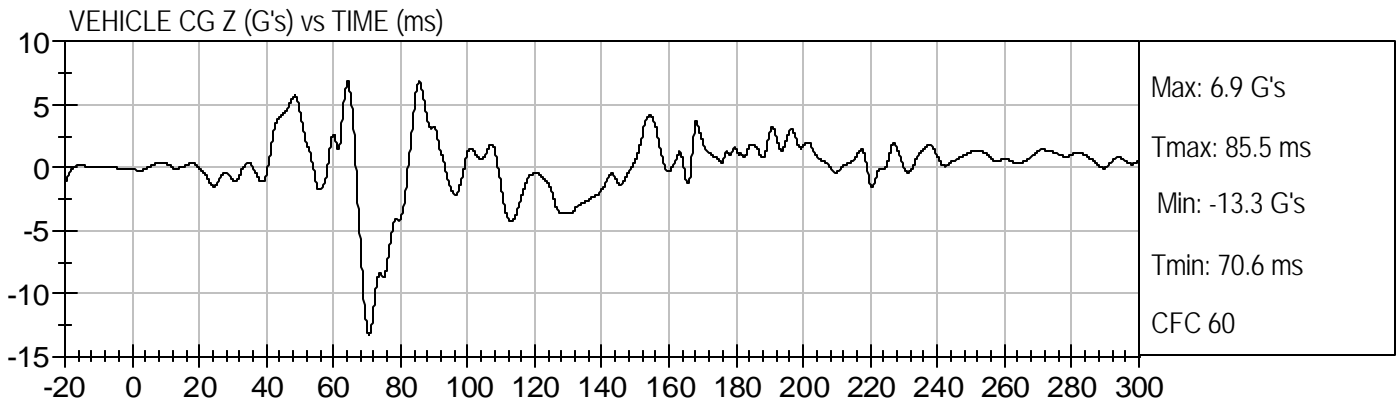
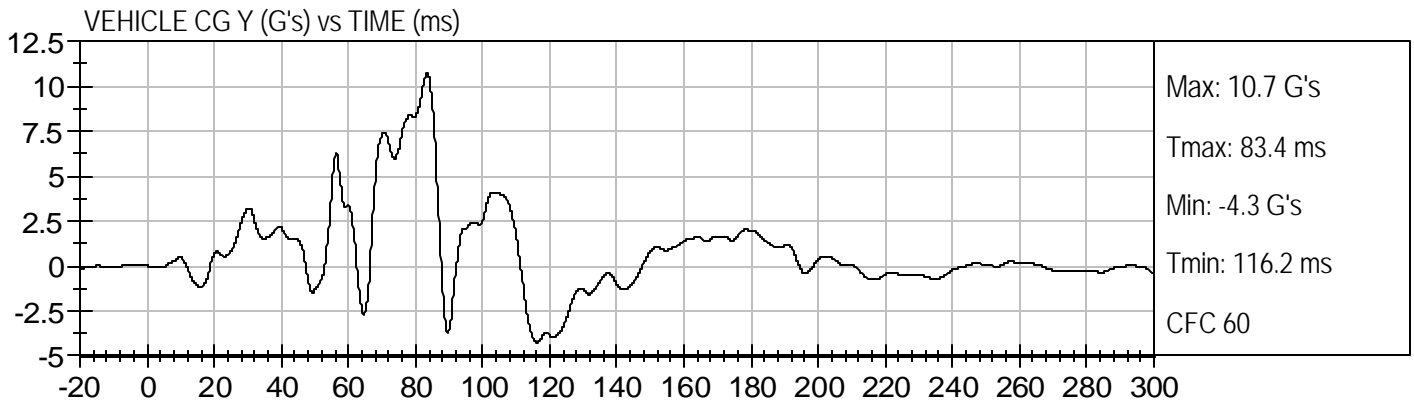
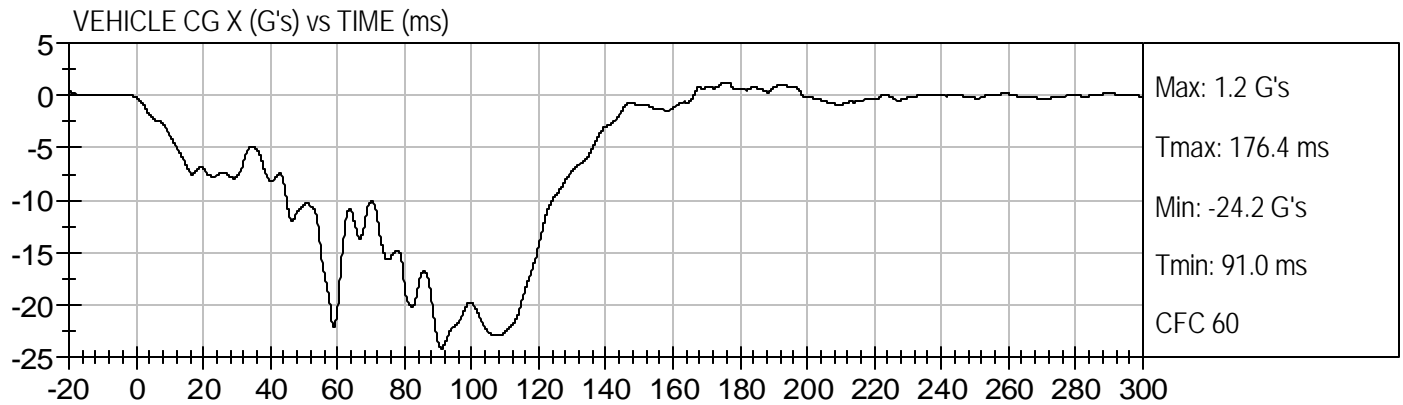


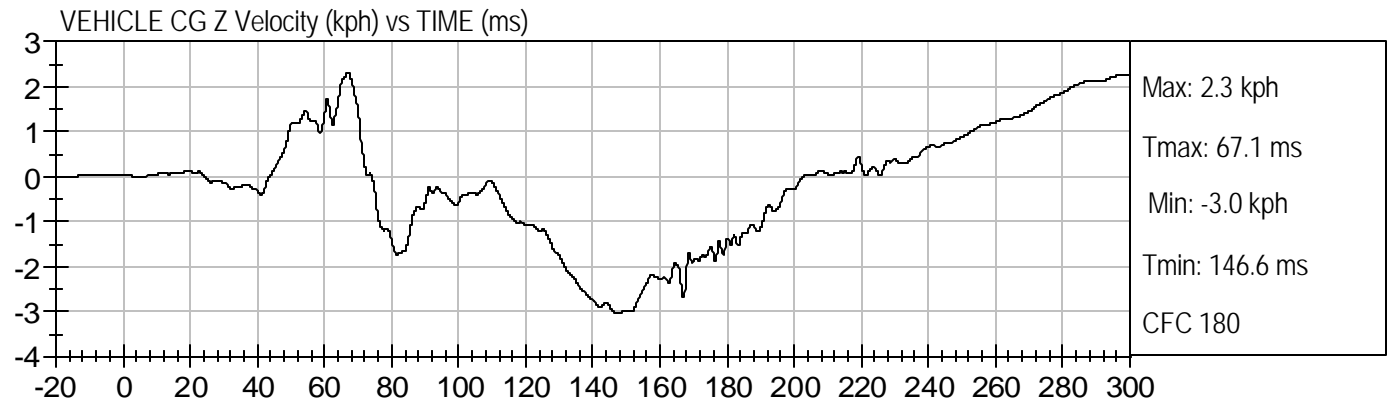
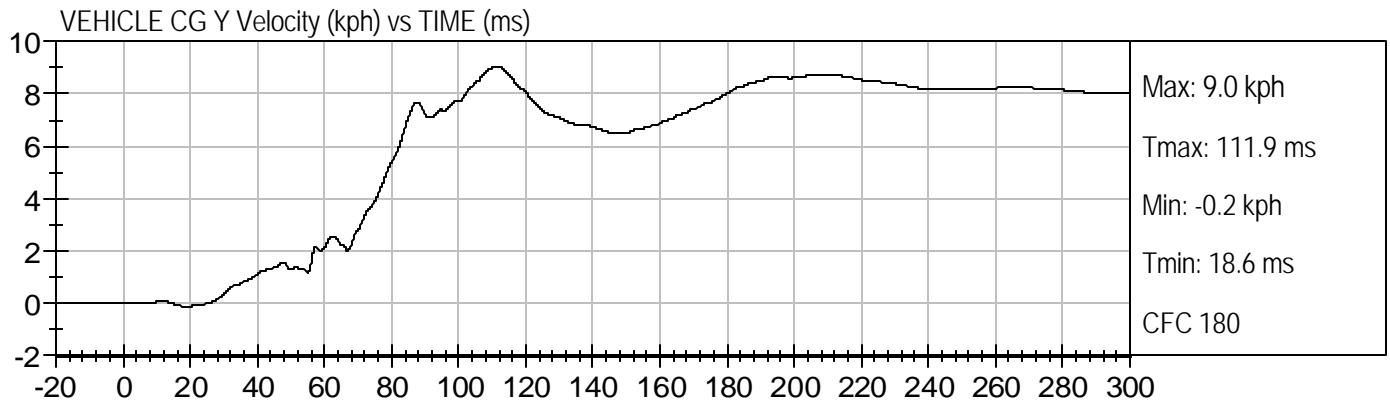
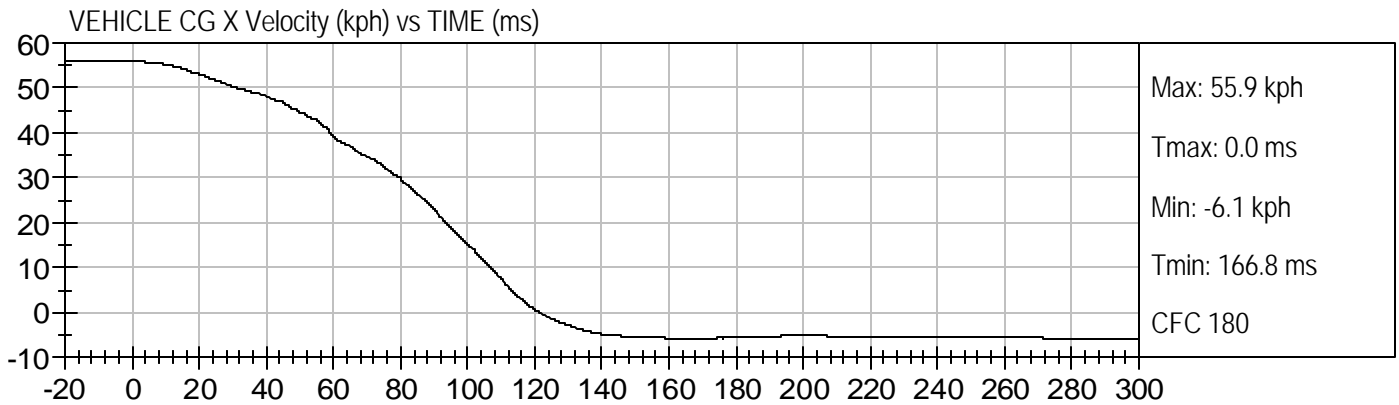


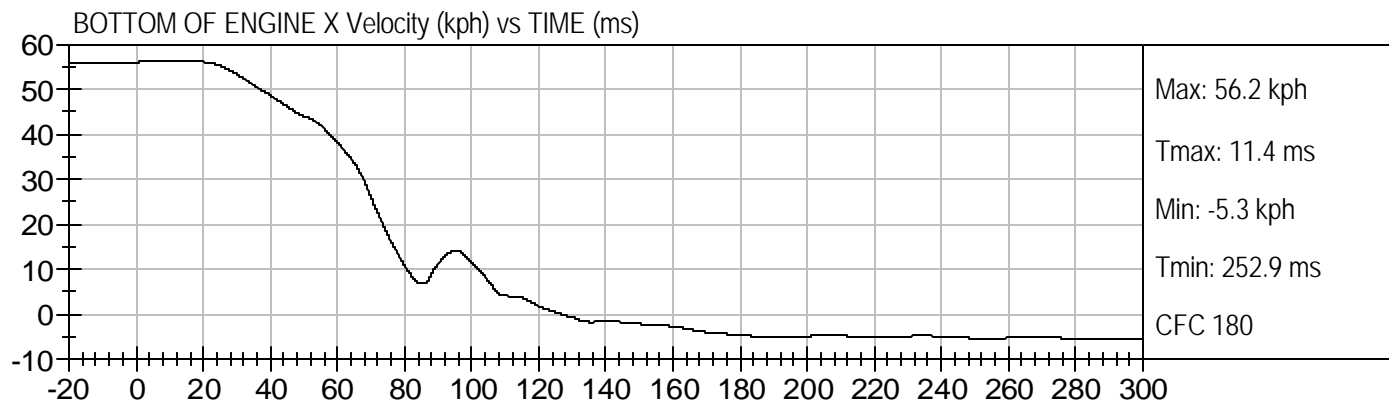
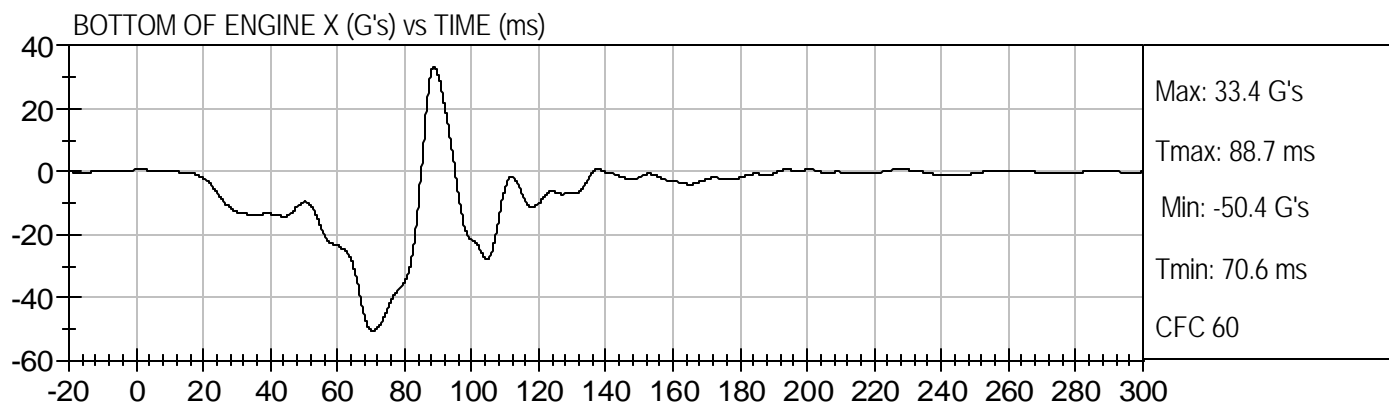
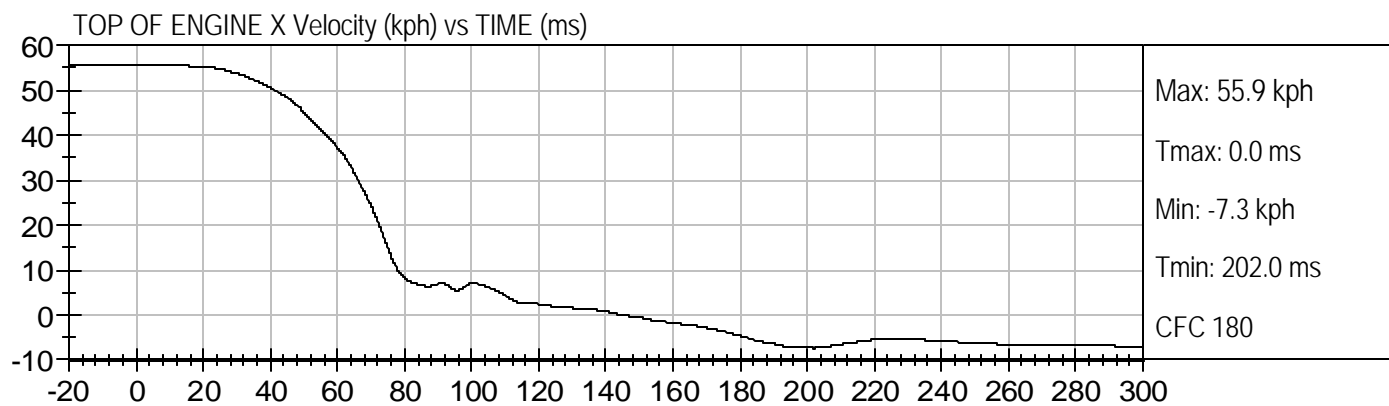
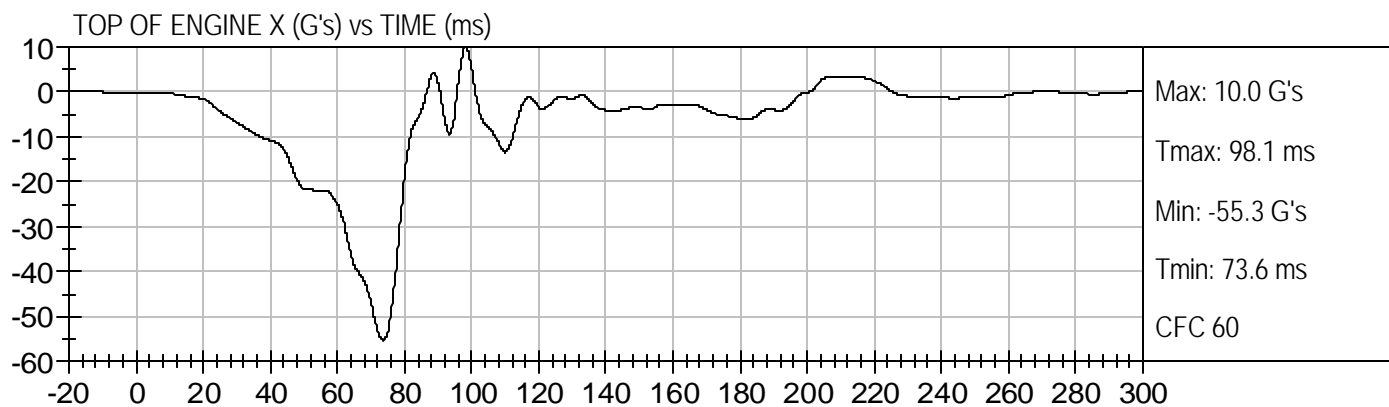


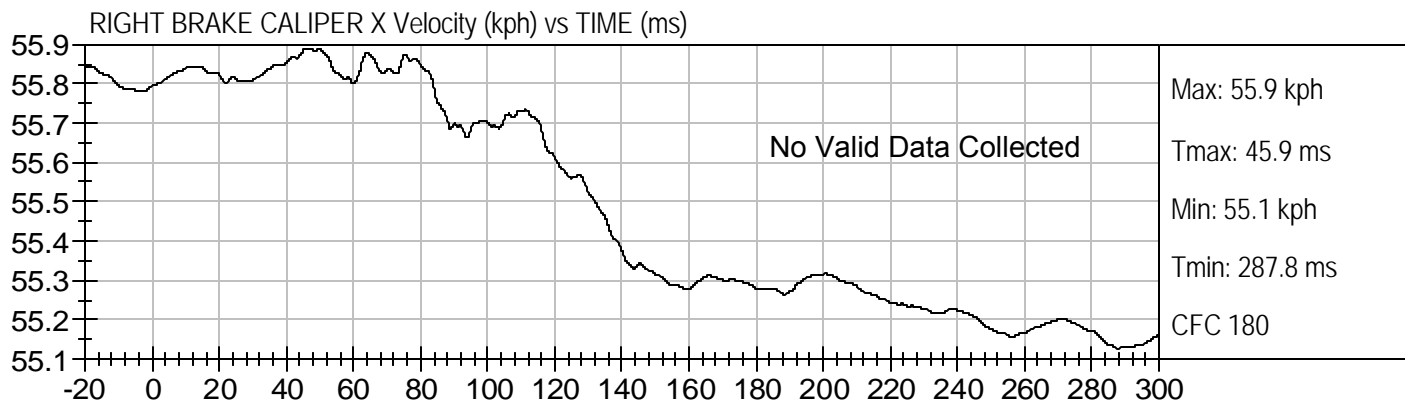
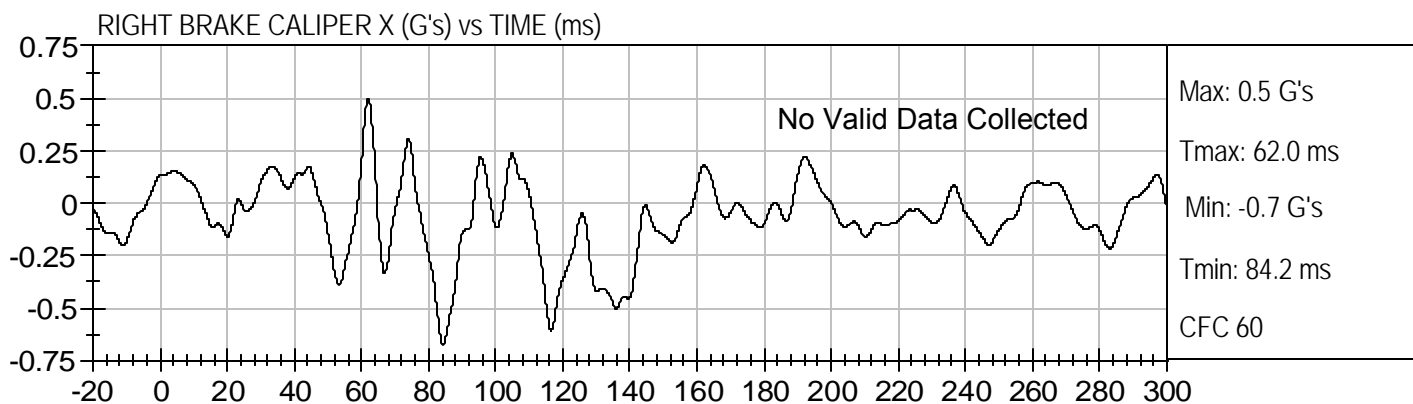
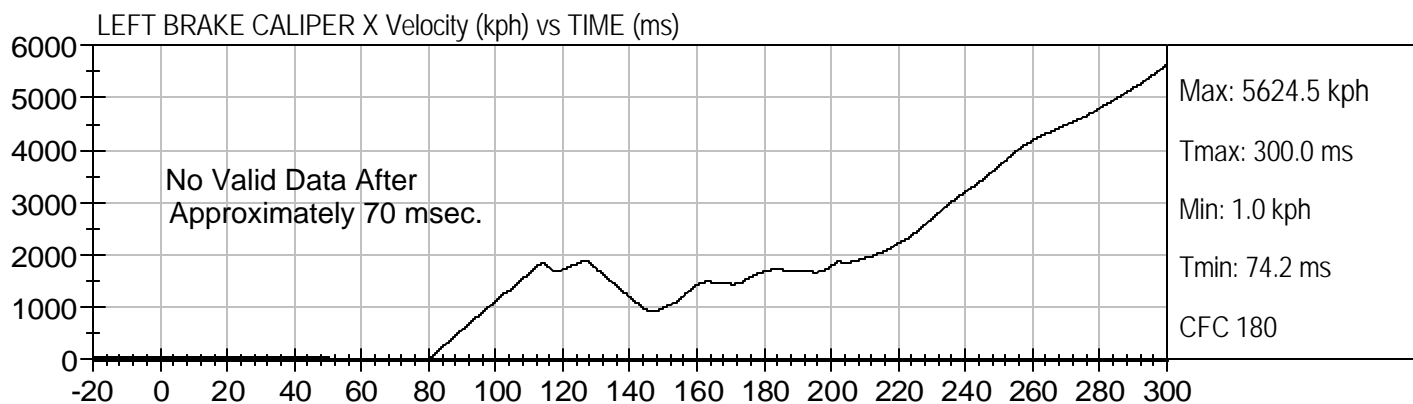
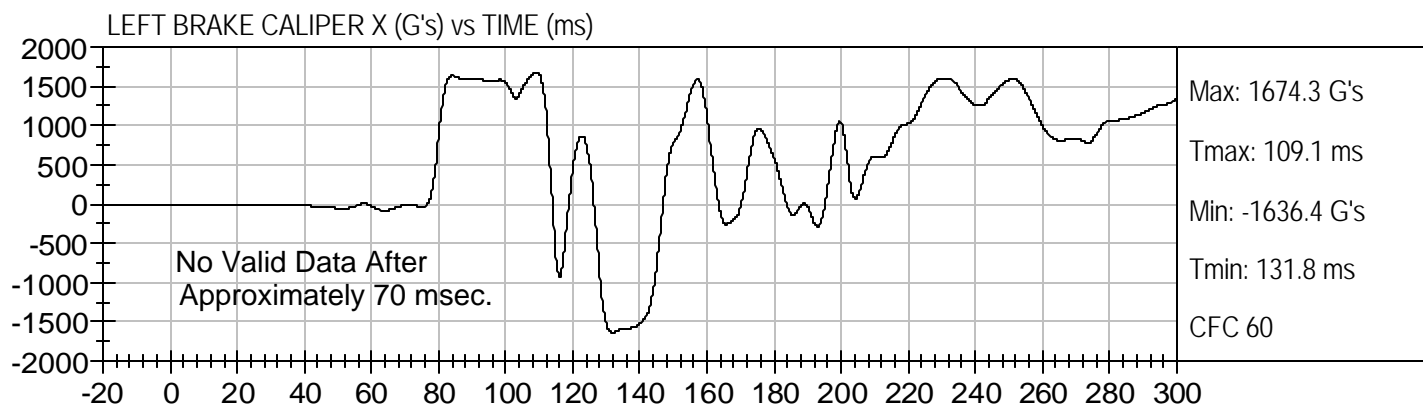


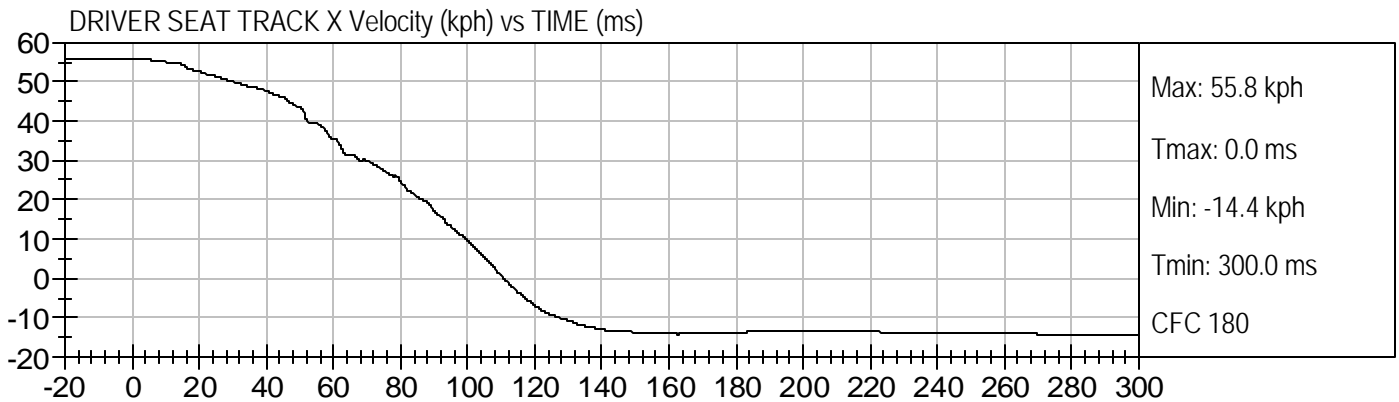
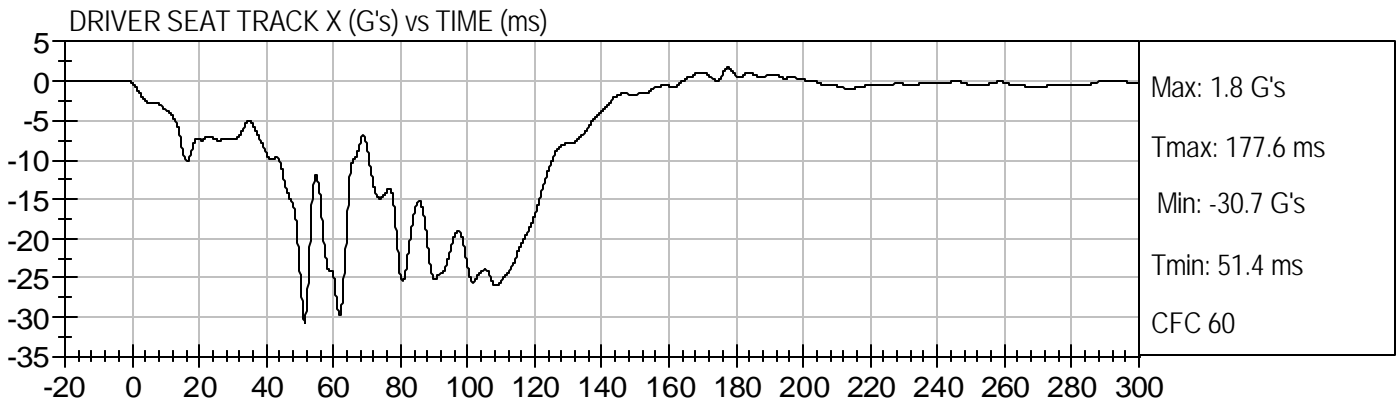
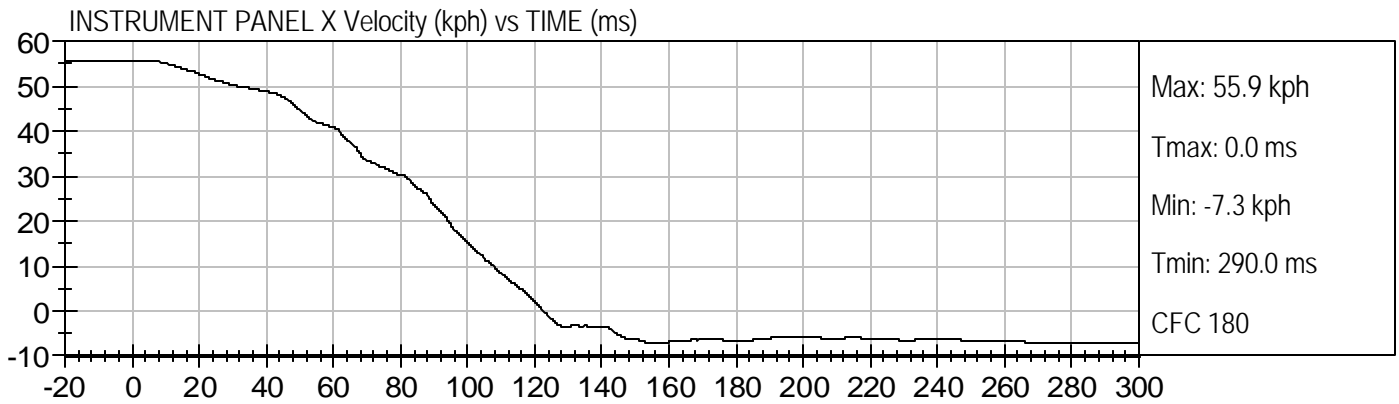
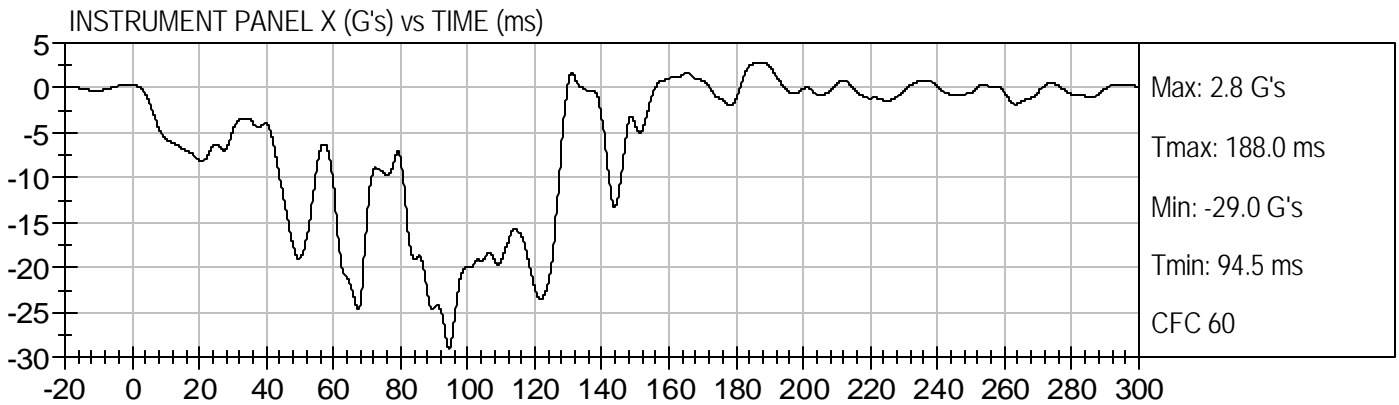


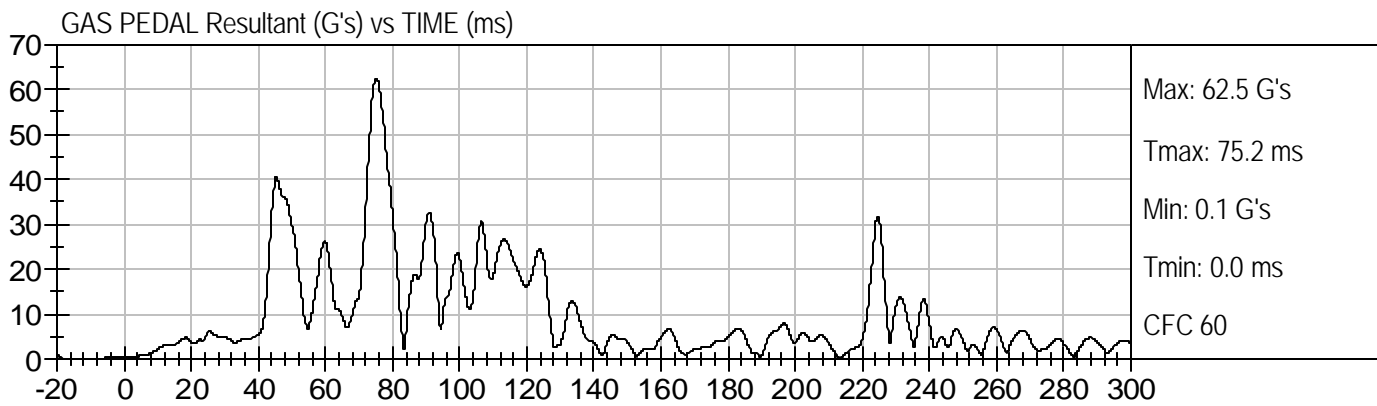
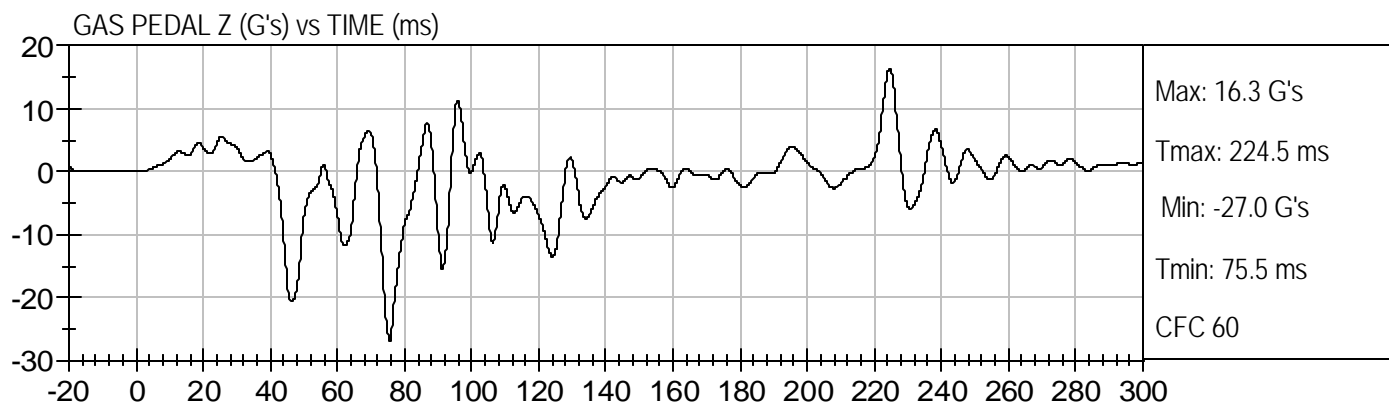
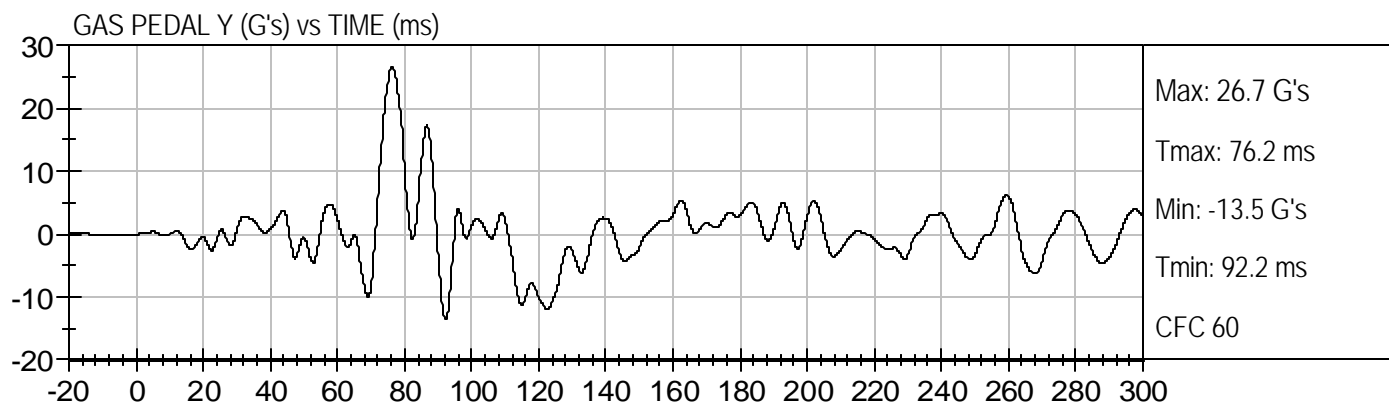
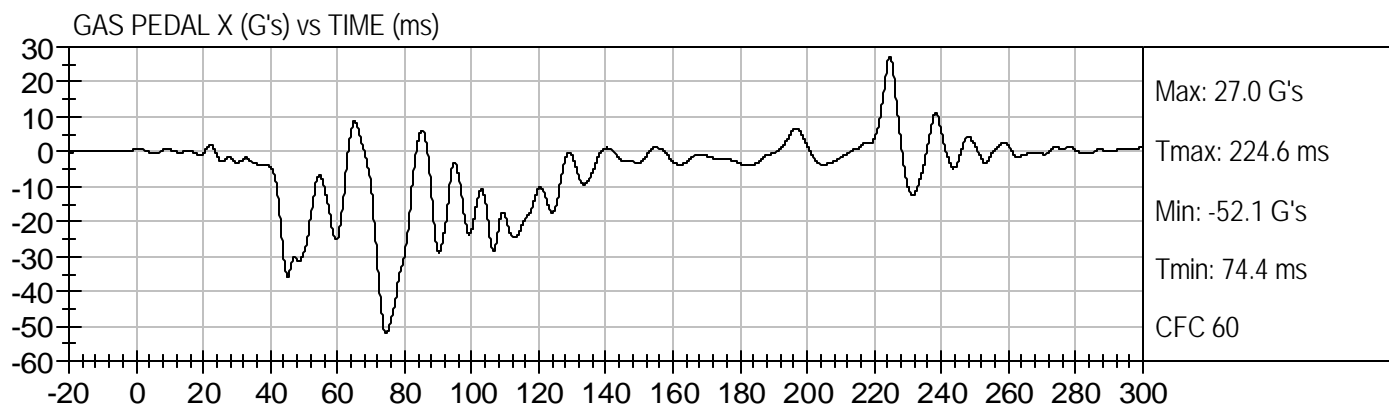


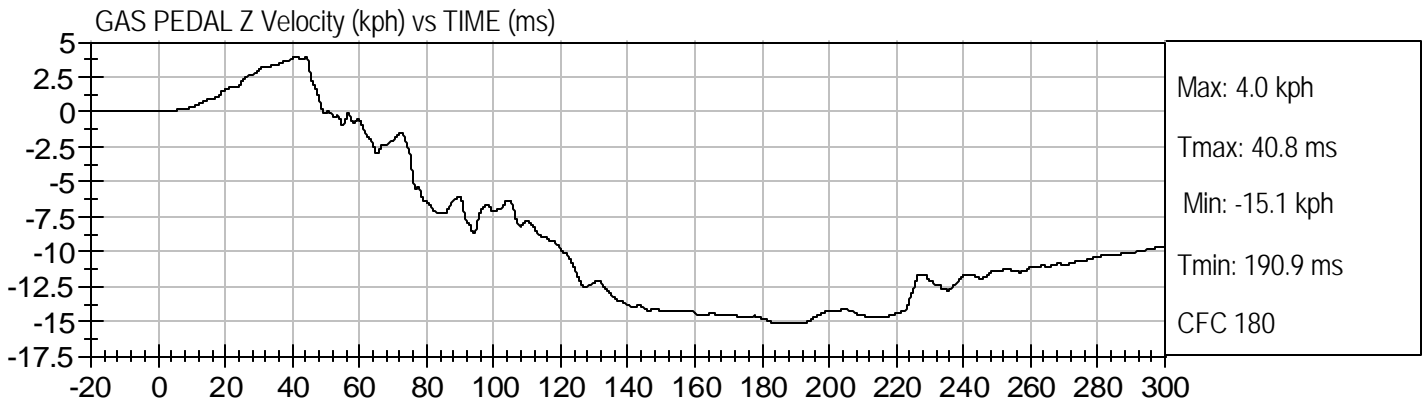
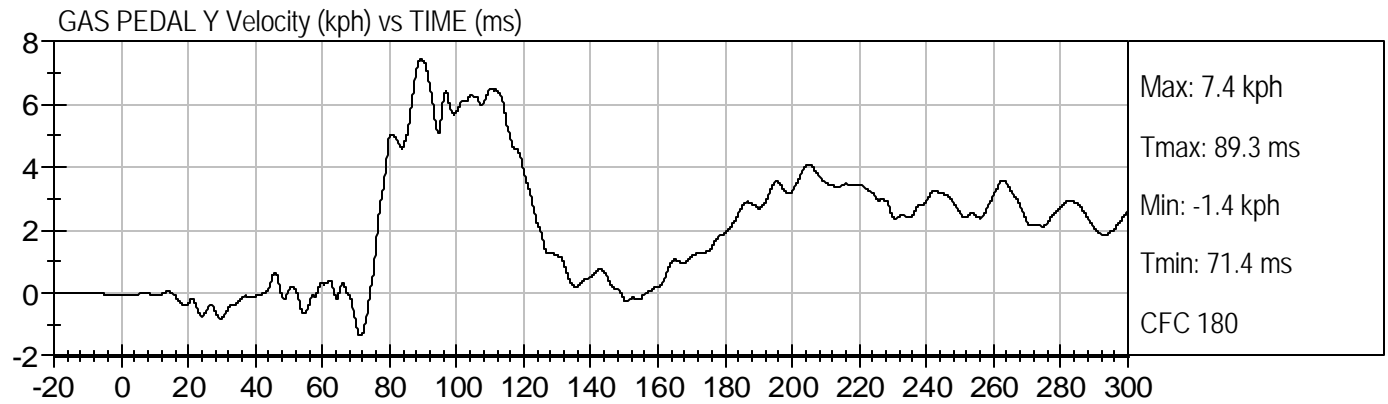
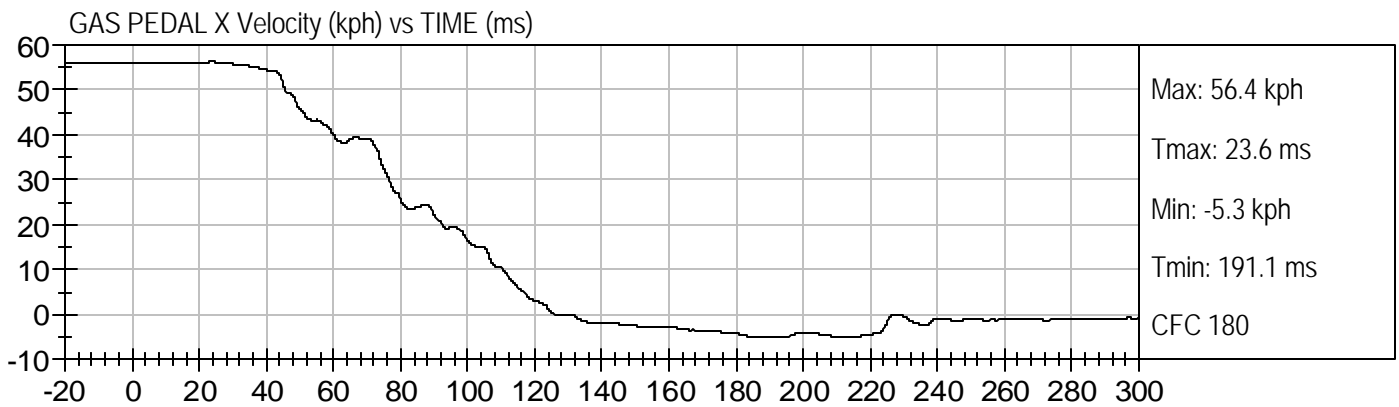


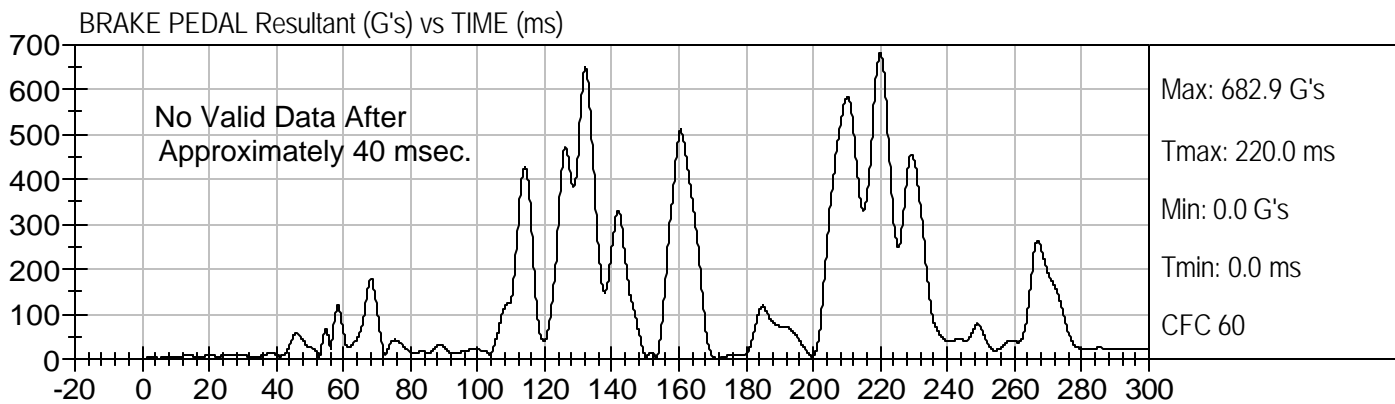
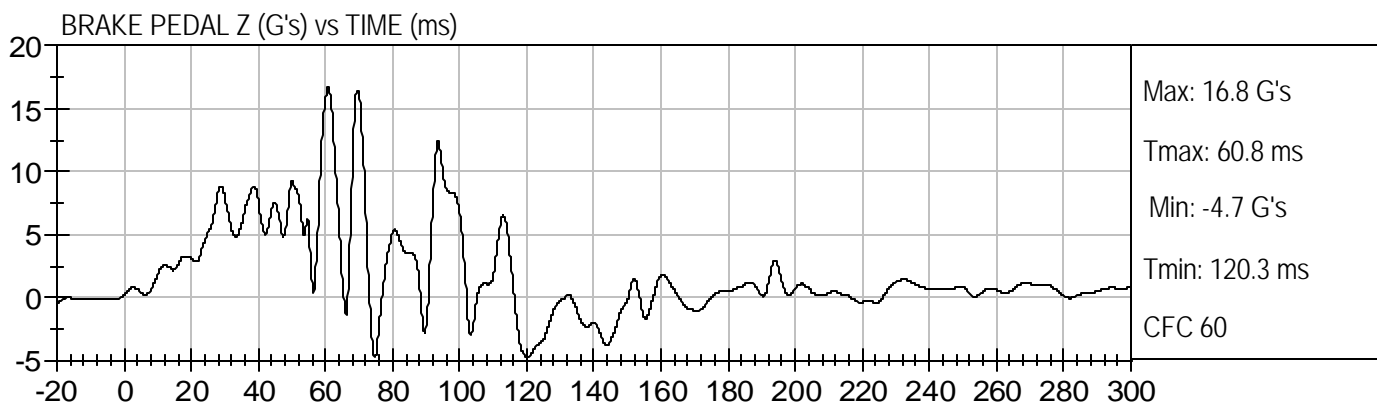
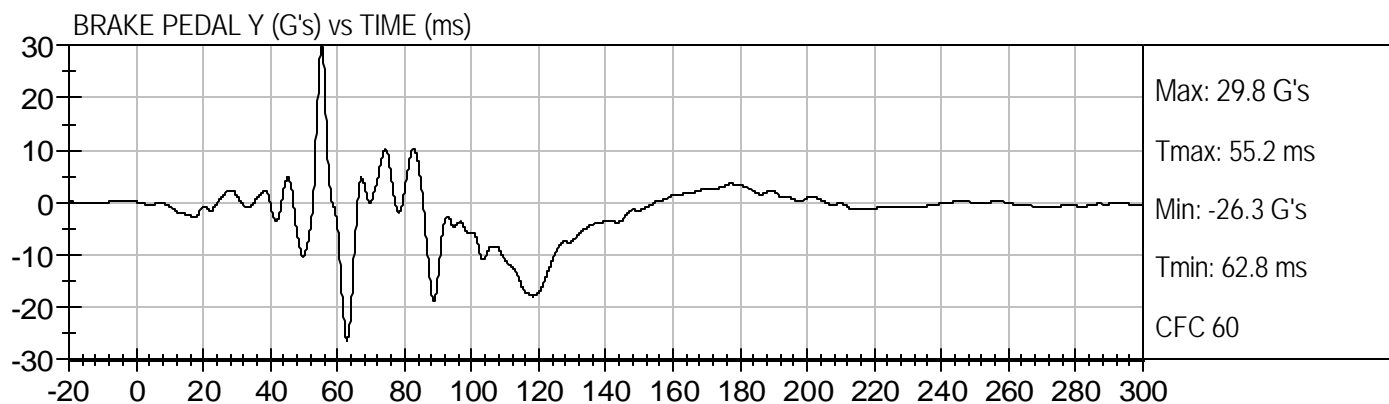
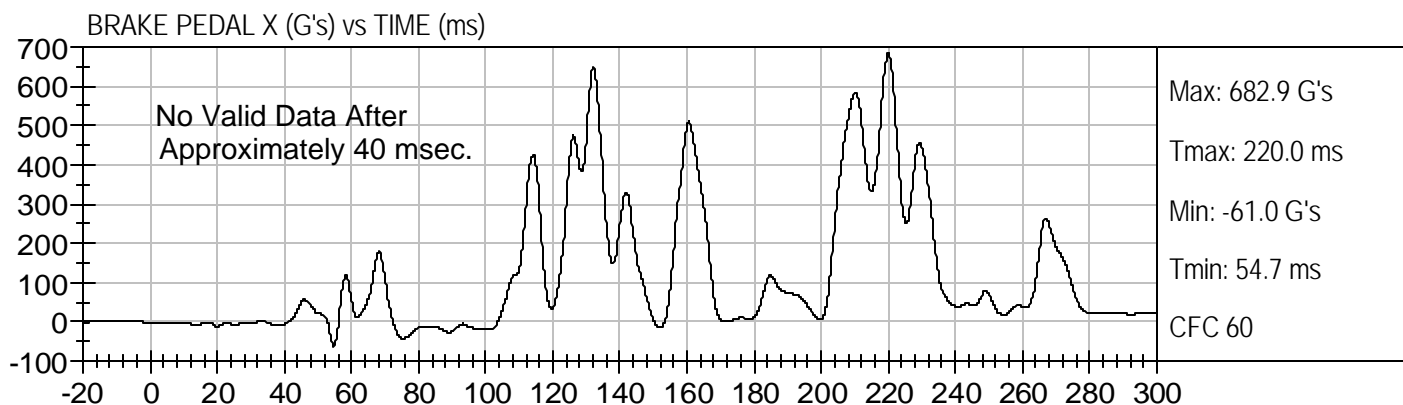


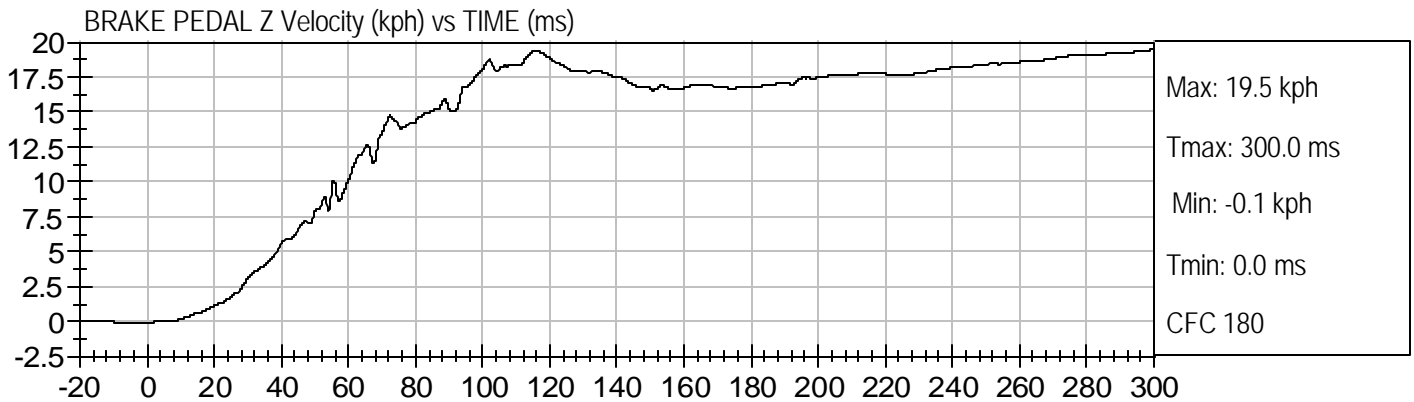
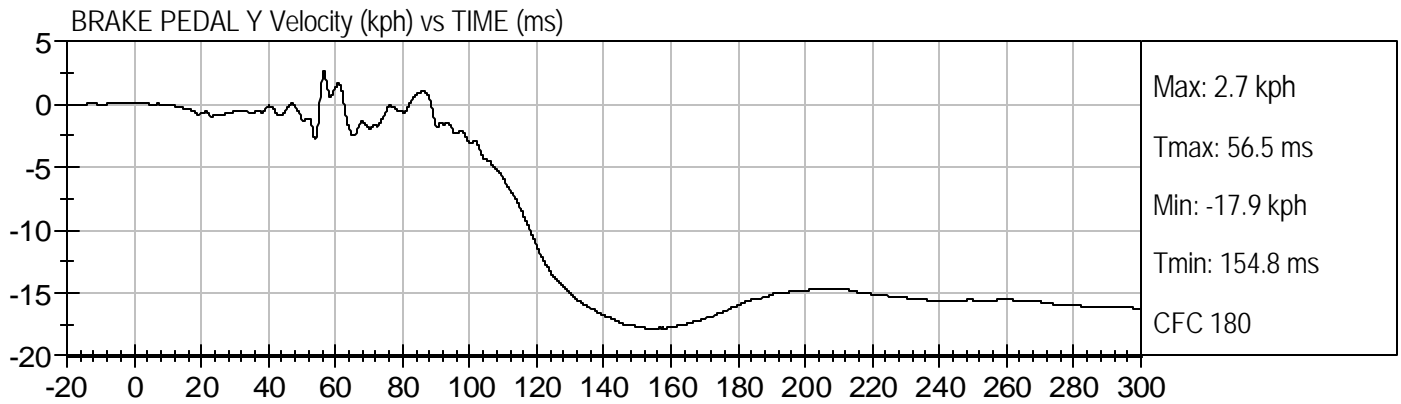
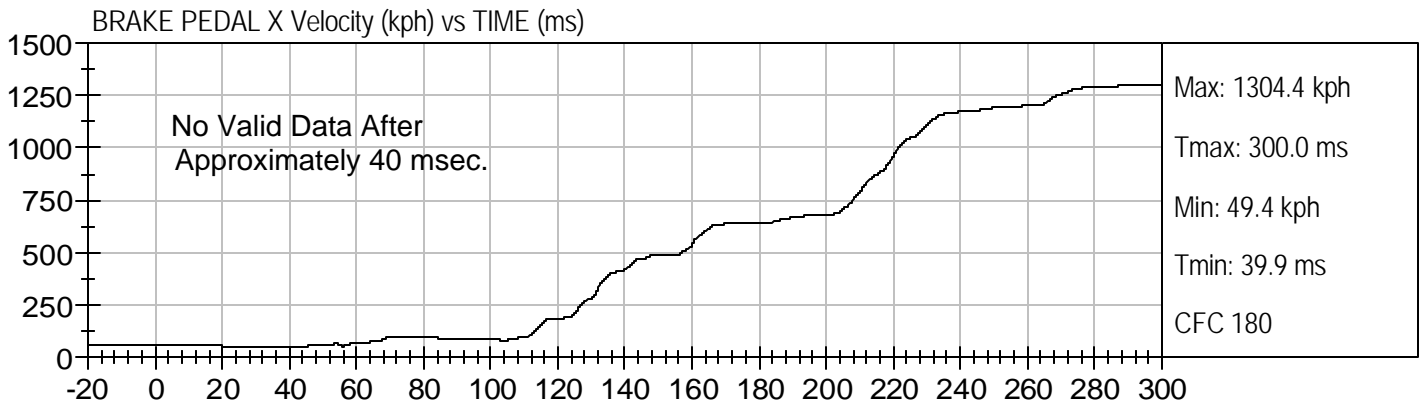


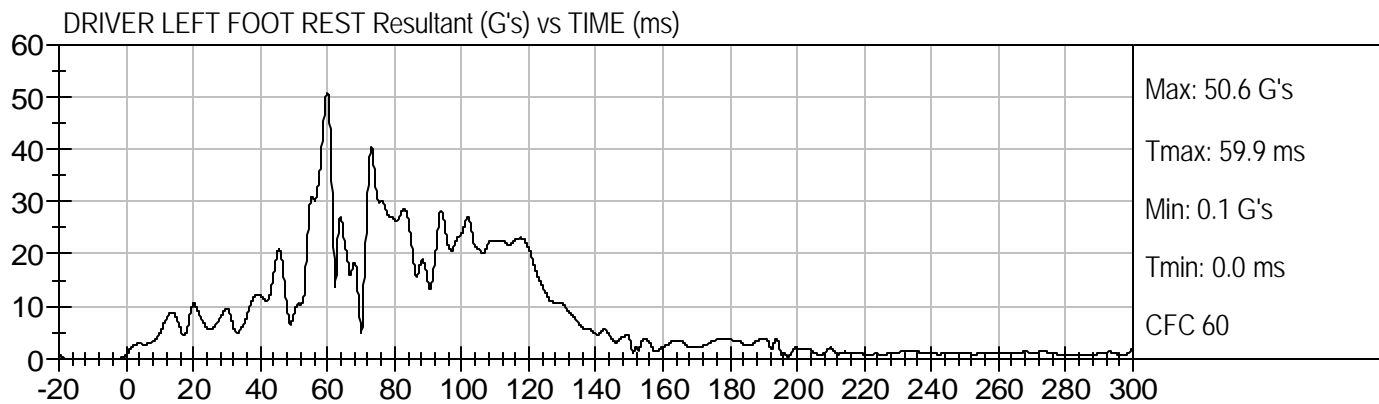
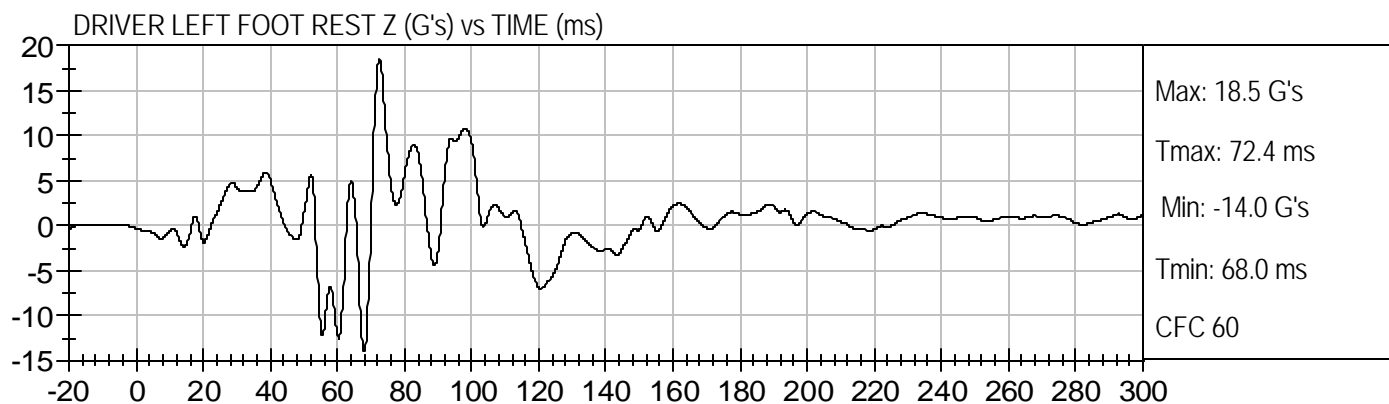
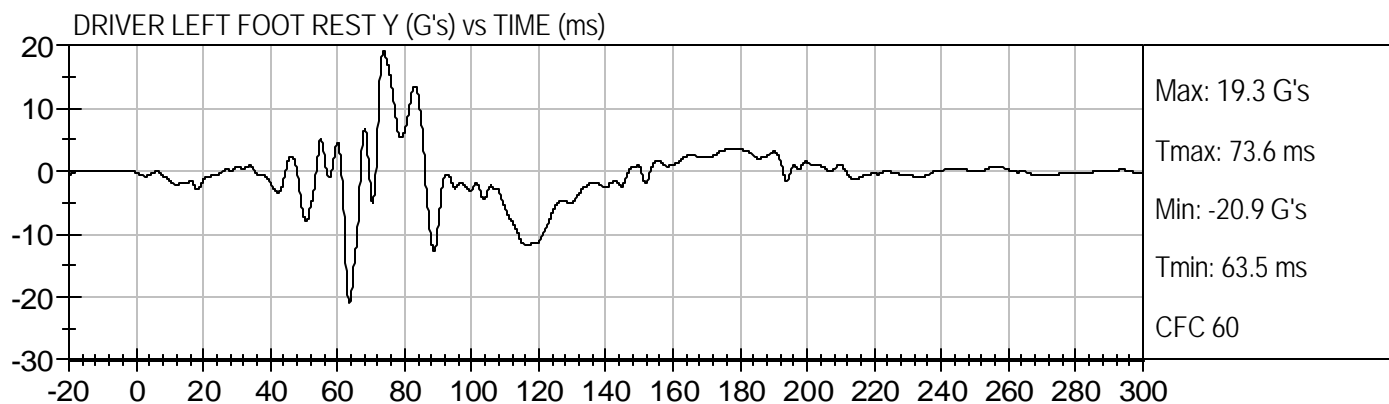
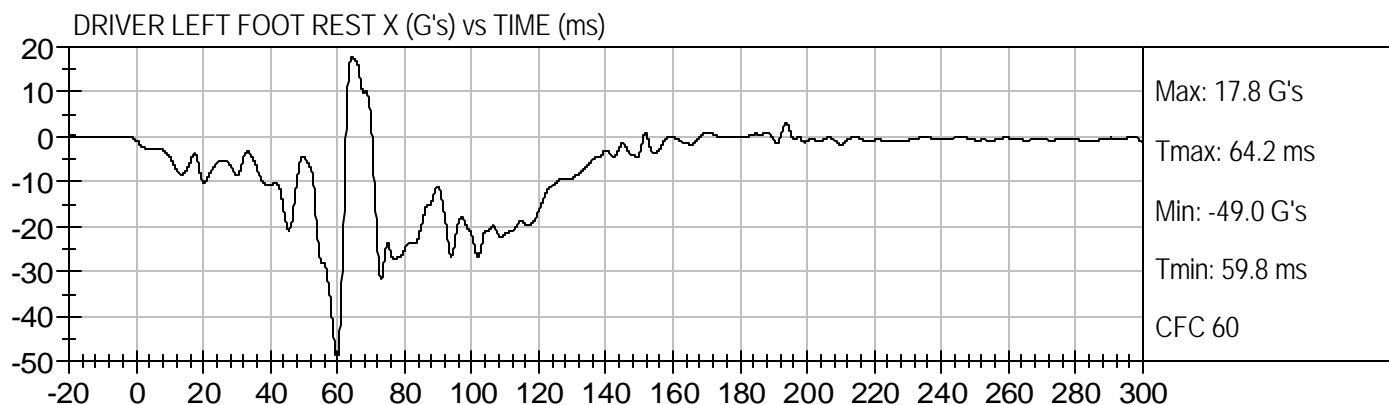


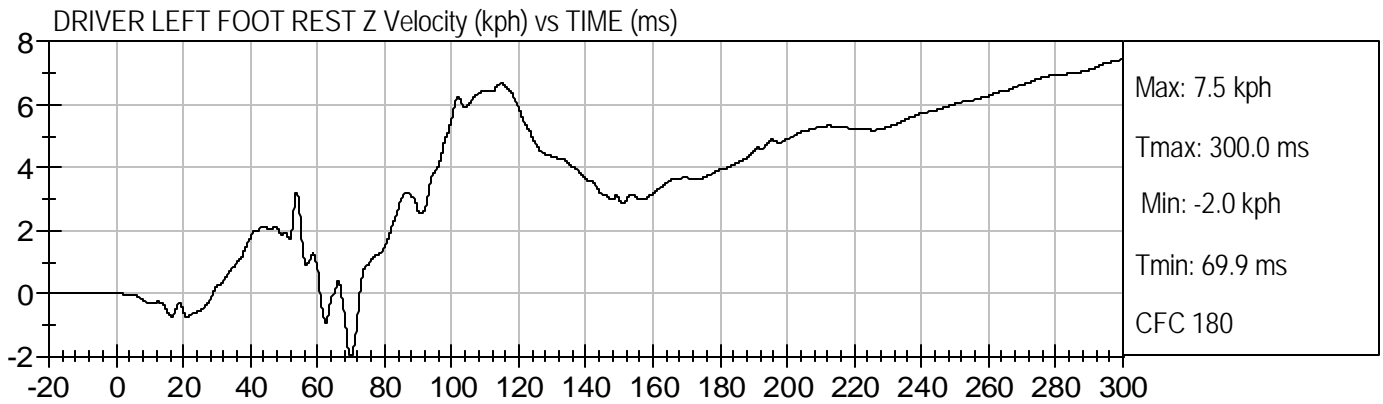
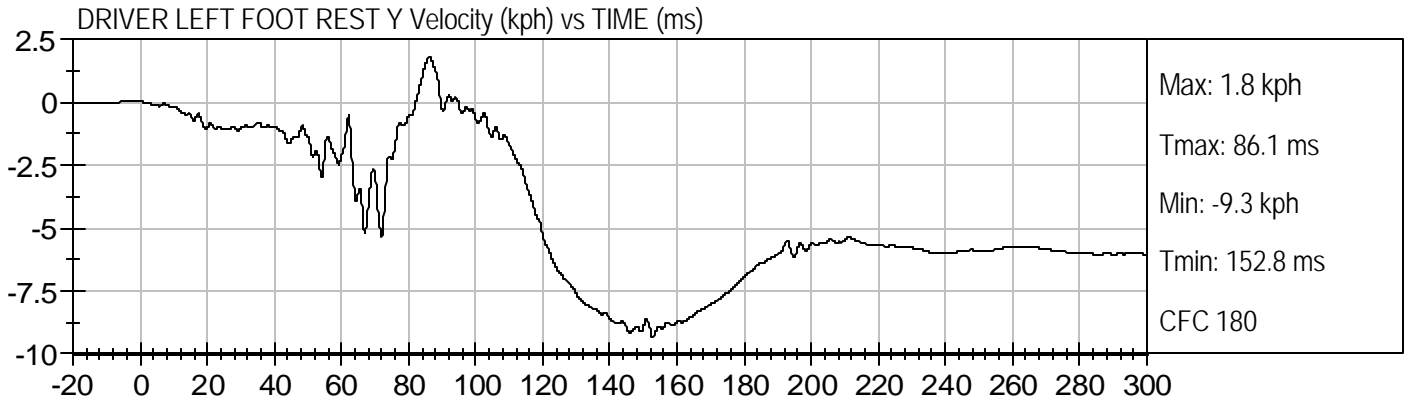
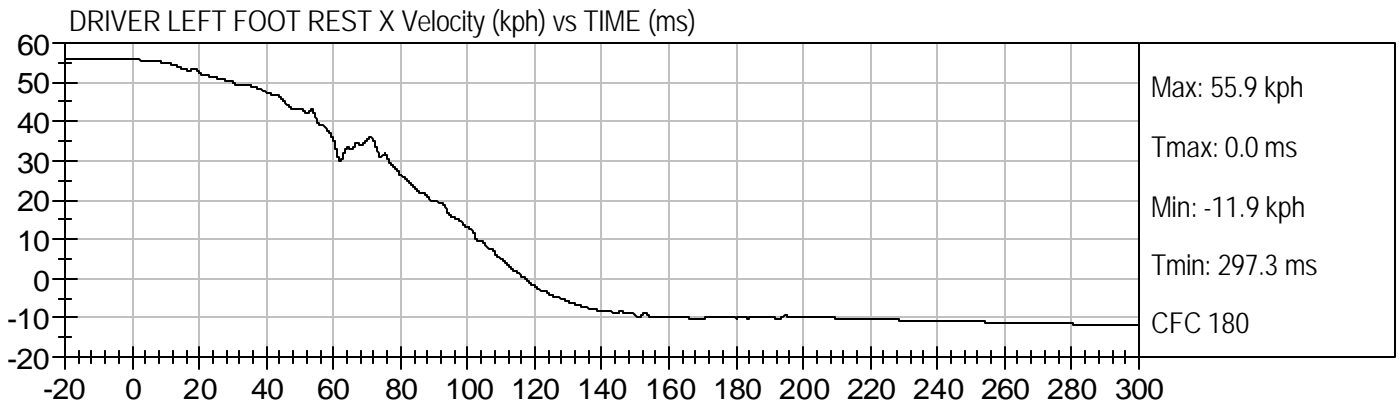






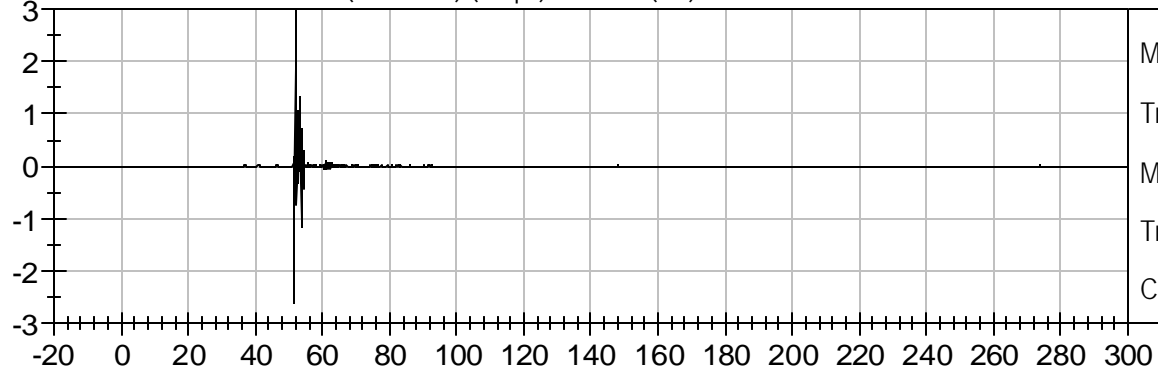




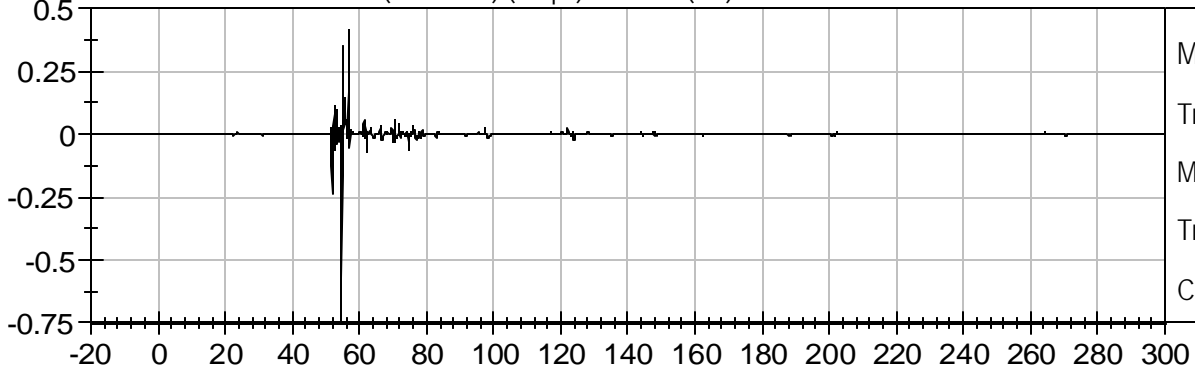


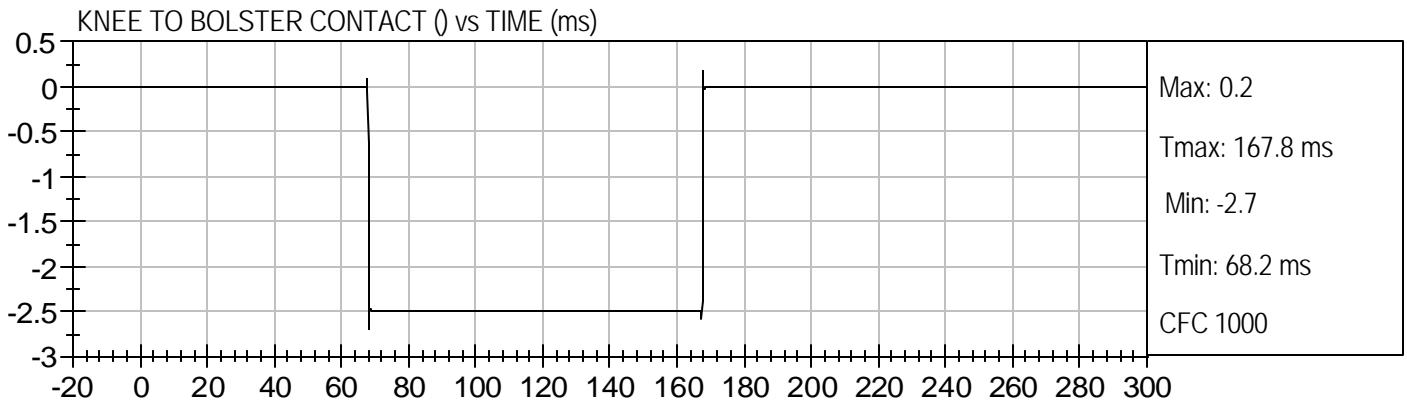
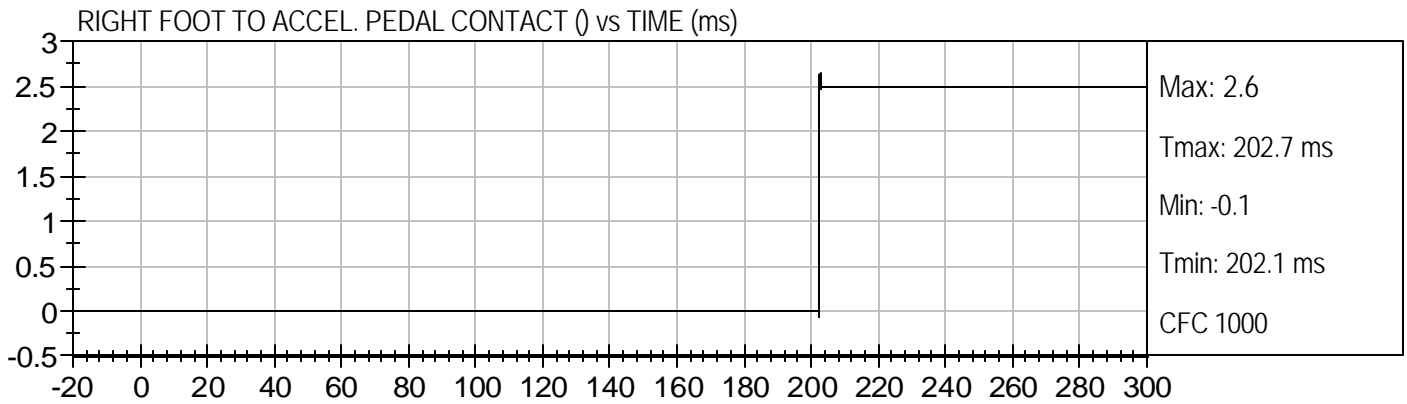
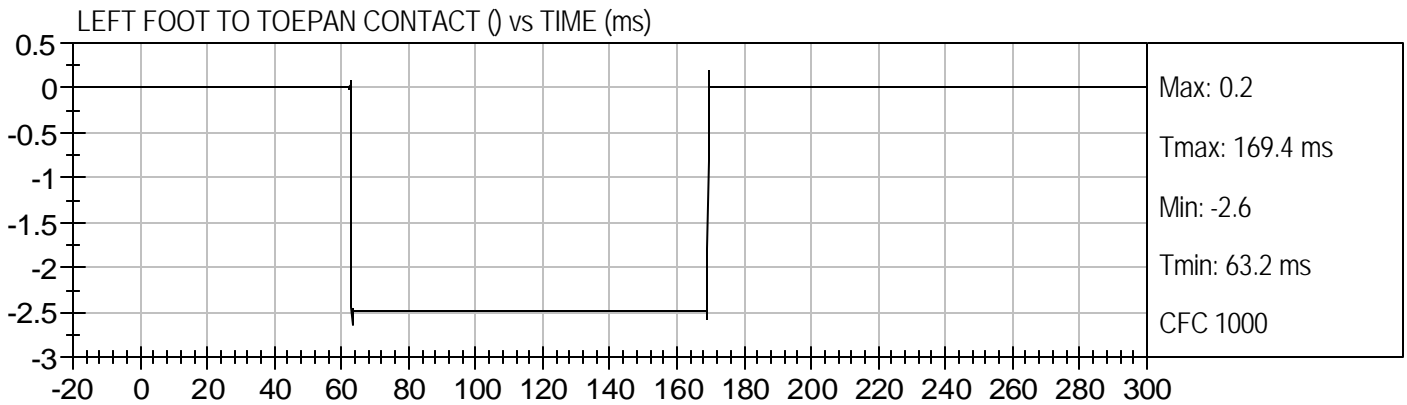


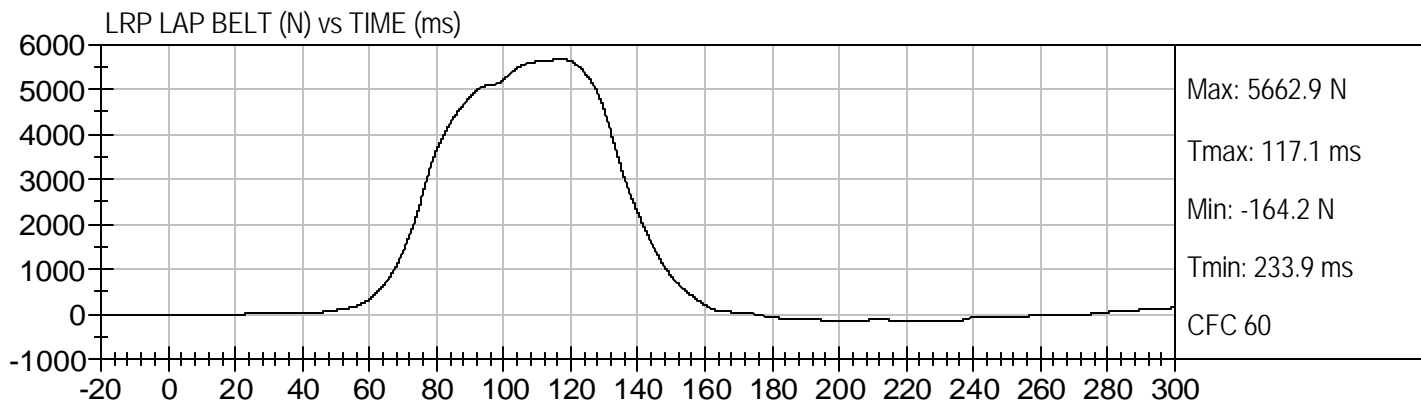
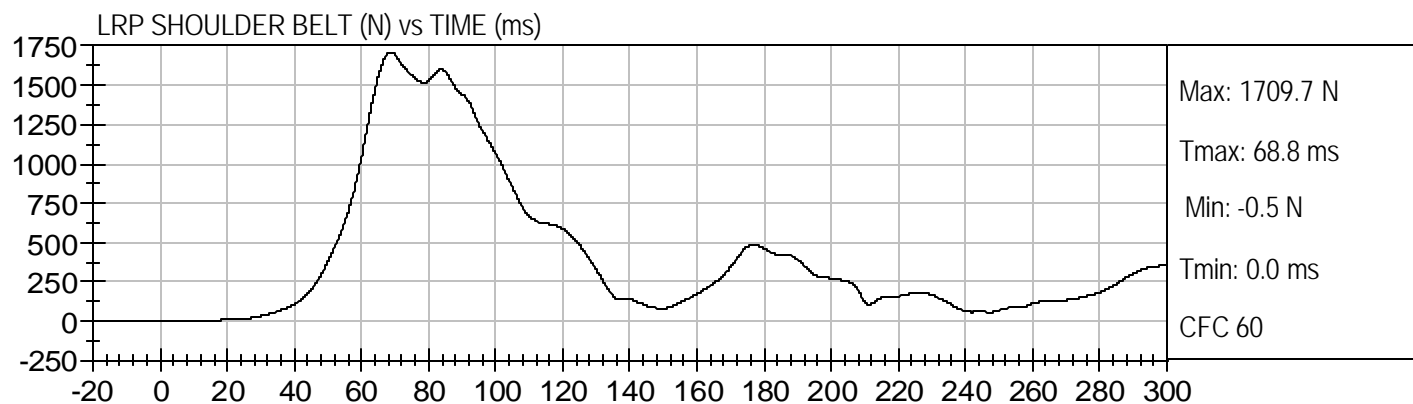
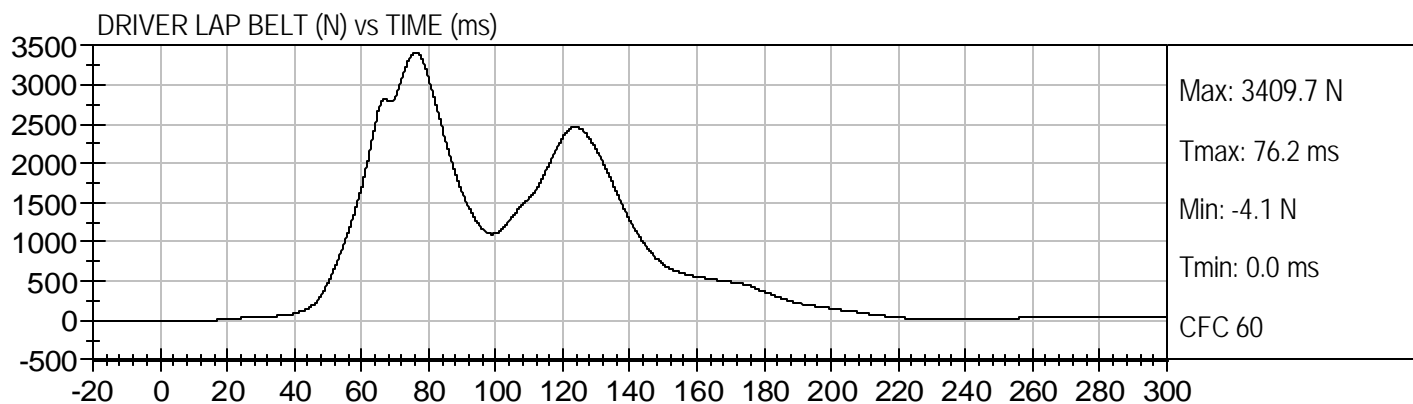
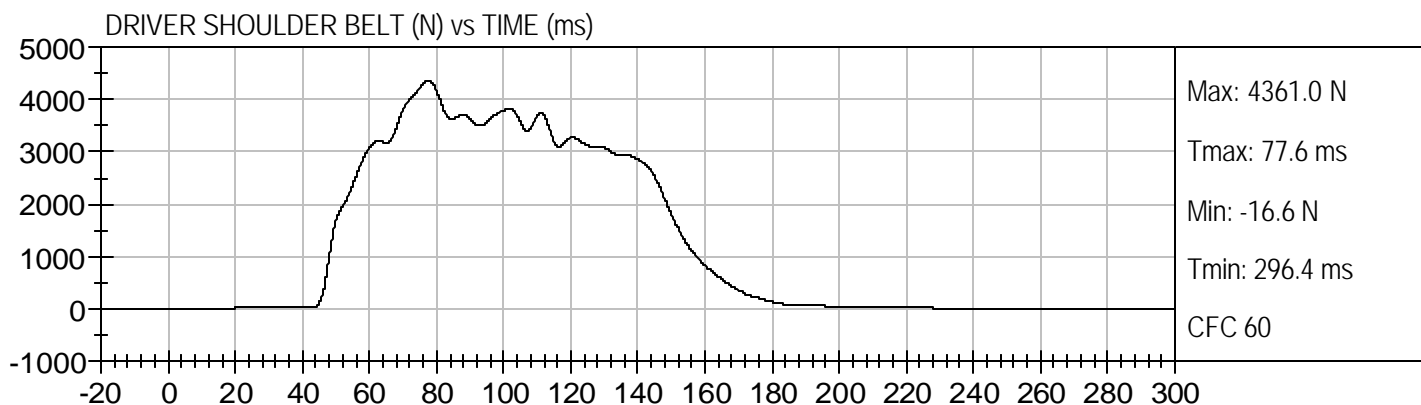
DRIVER AIRBAG TIMING (STAGE 1) (Amps) vs TIME (ms)

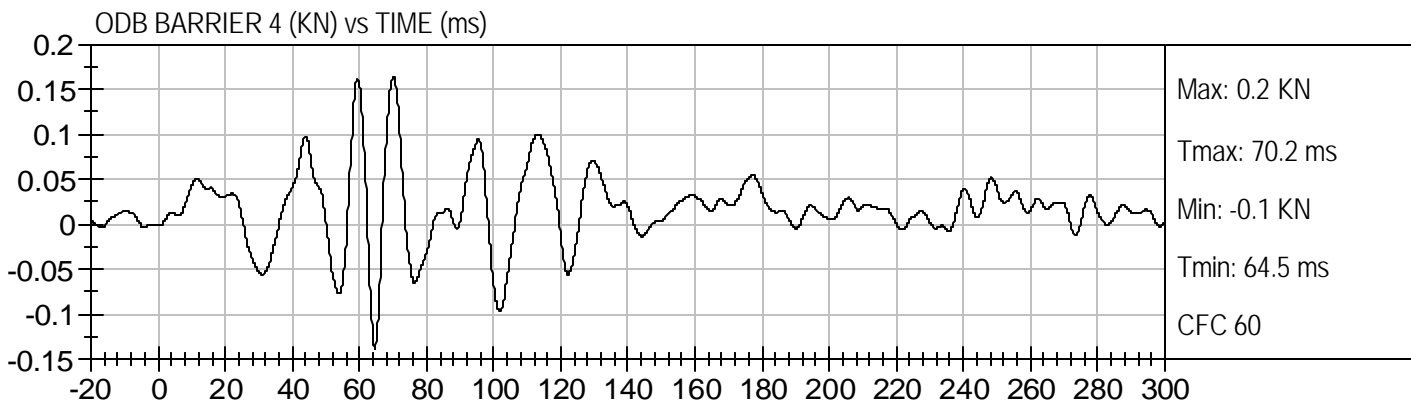
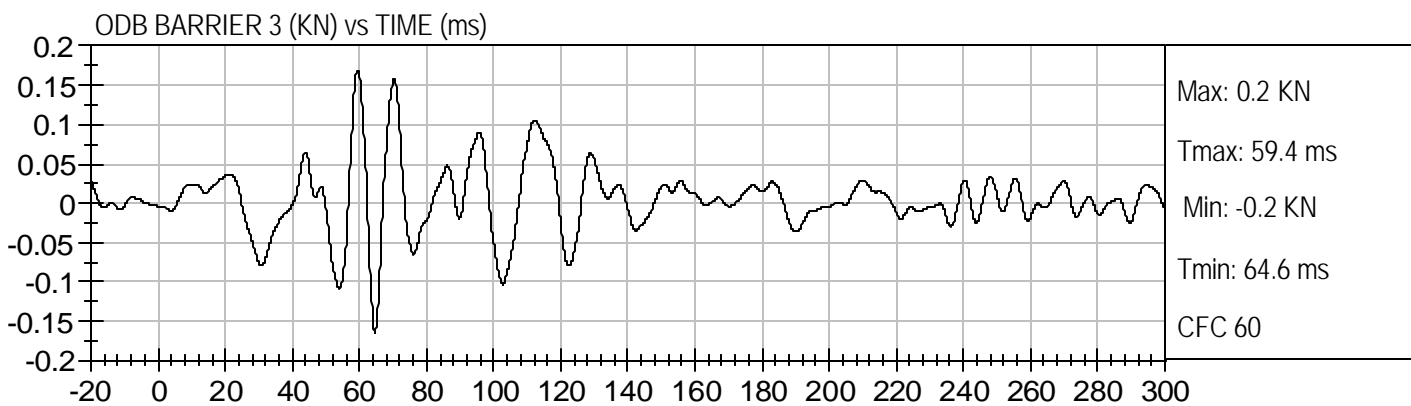
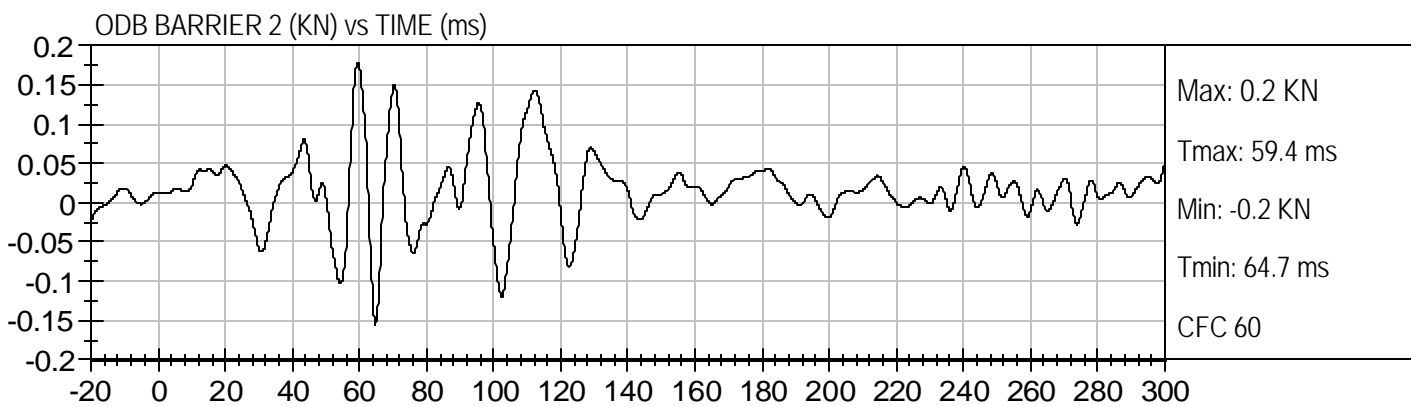
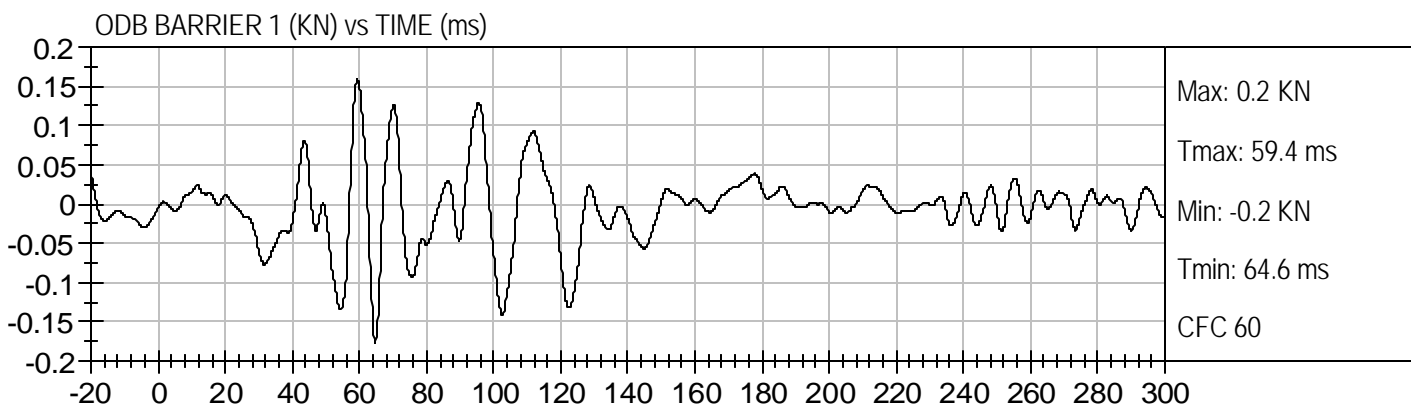


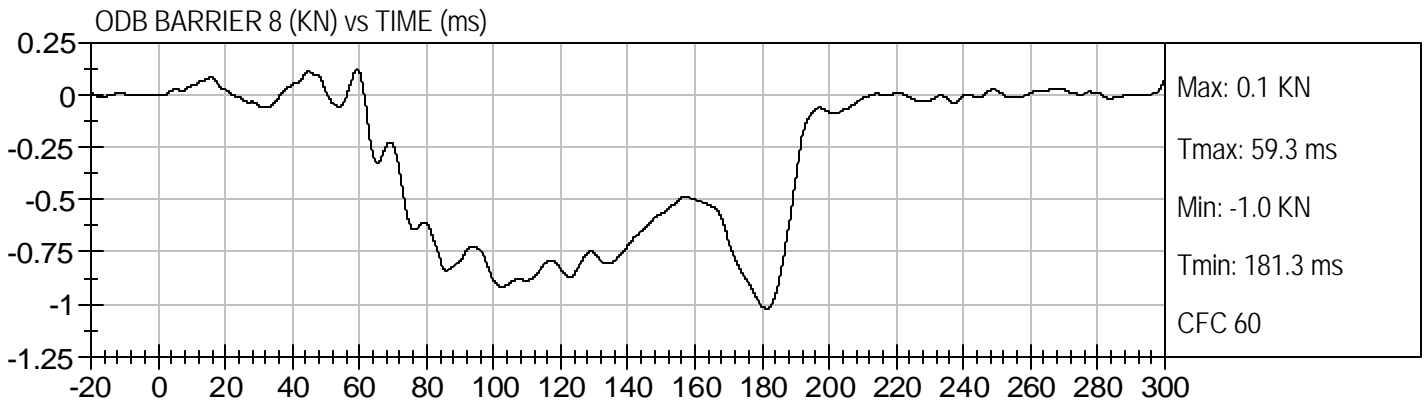
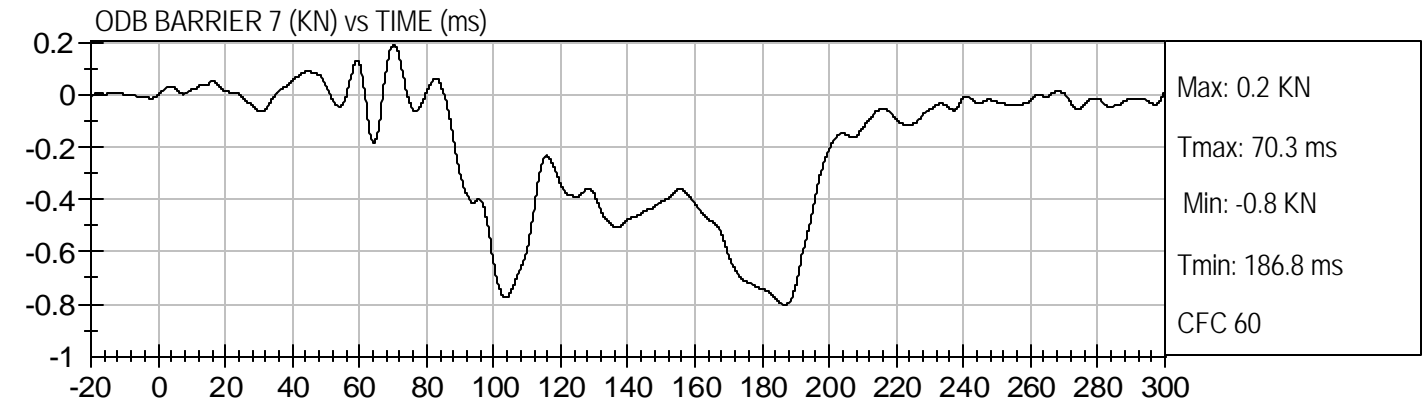
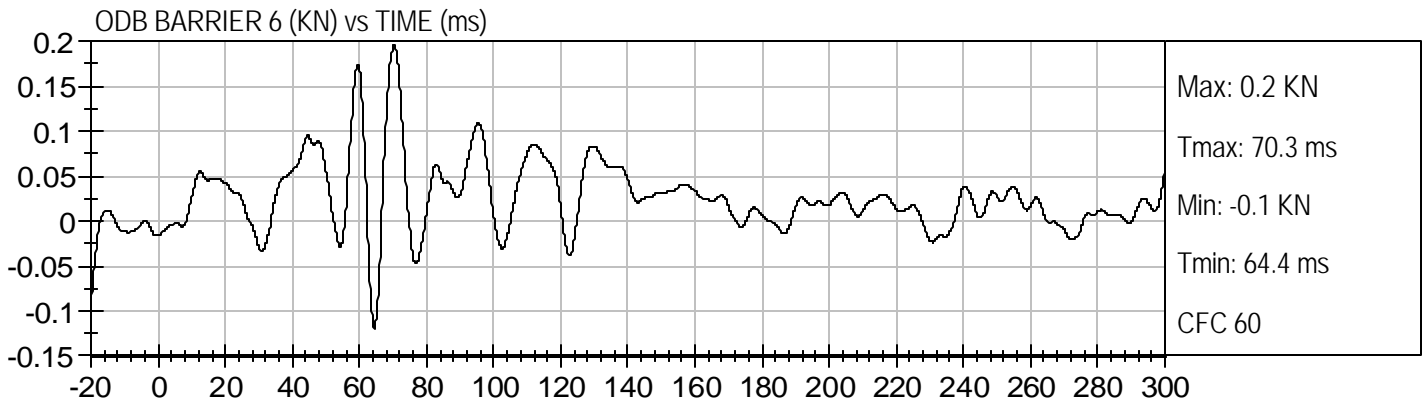
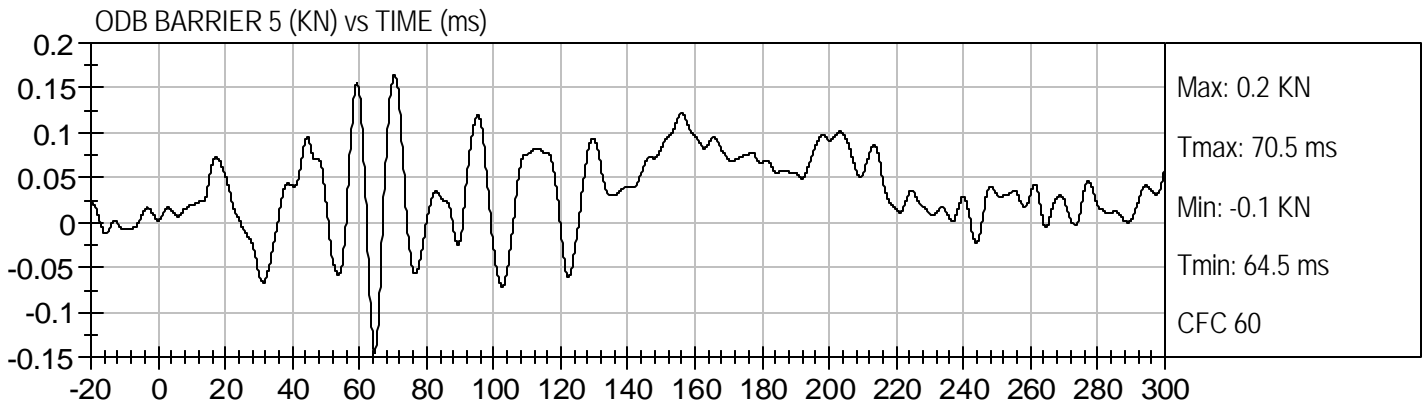
DRIVER AIRBAG TIMING (STAGE 2) (Amps) vs TIME (ms)





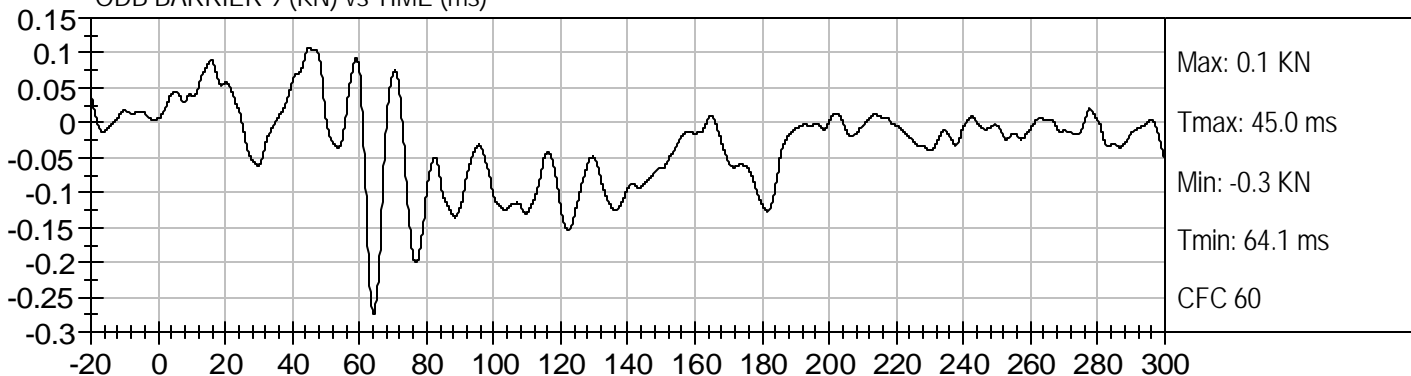




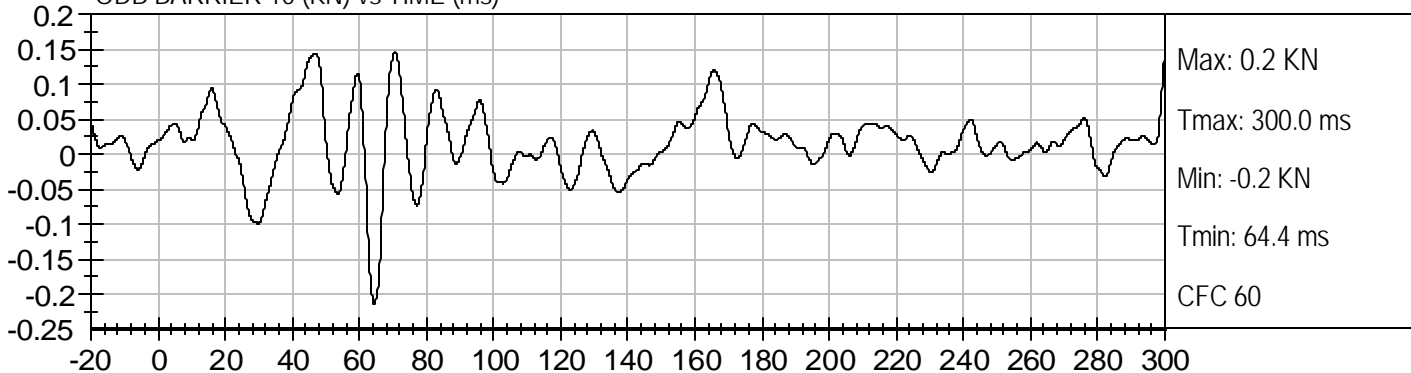




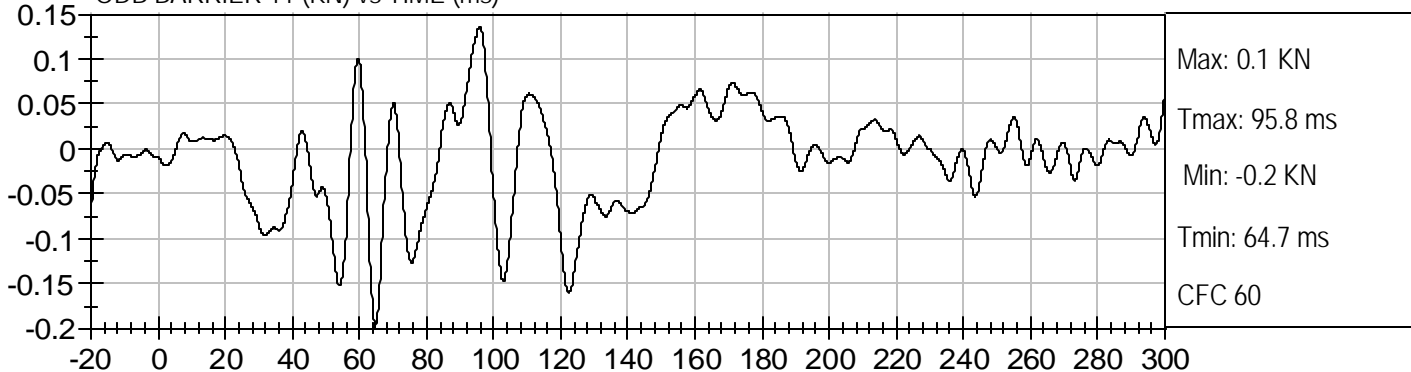
ODB BARRIER 9 (KN) vs TIME (ms)



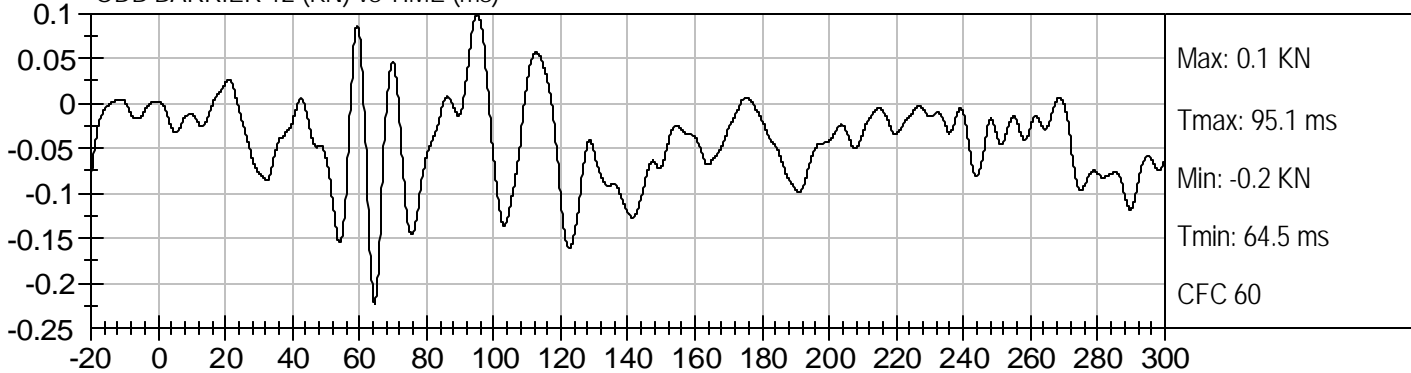
ODB BARRIER 10 (KN) vs TIME (ms)

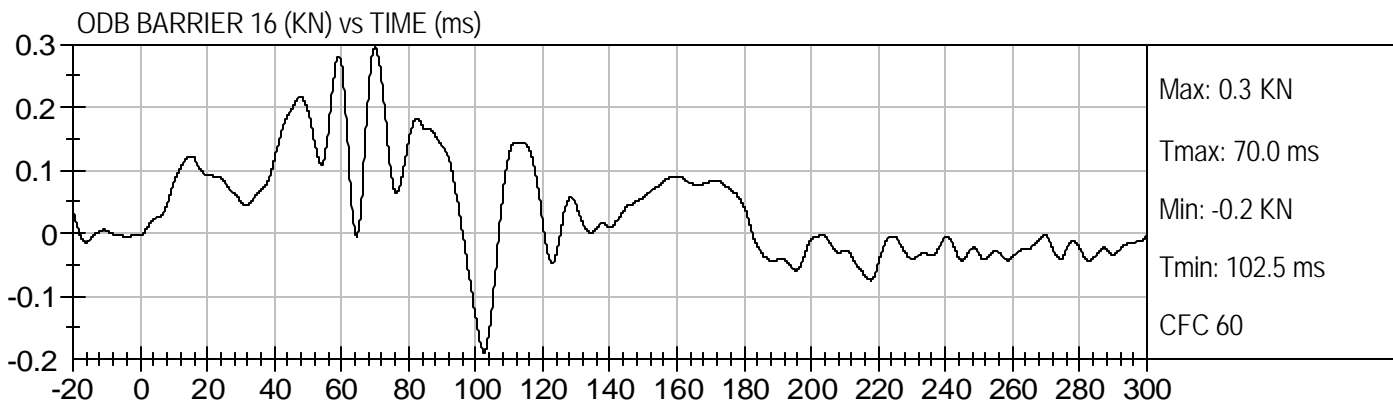
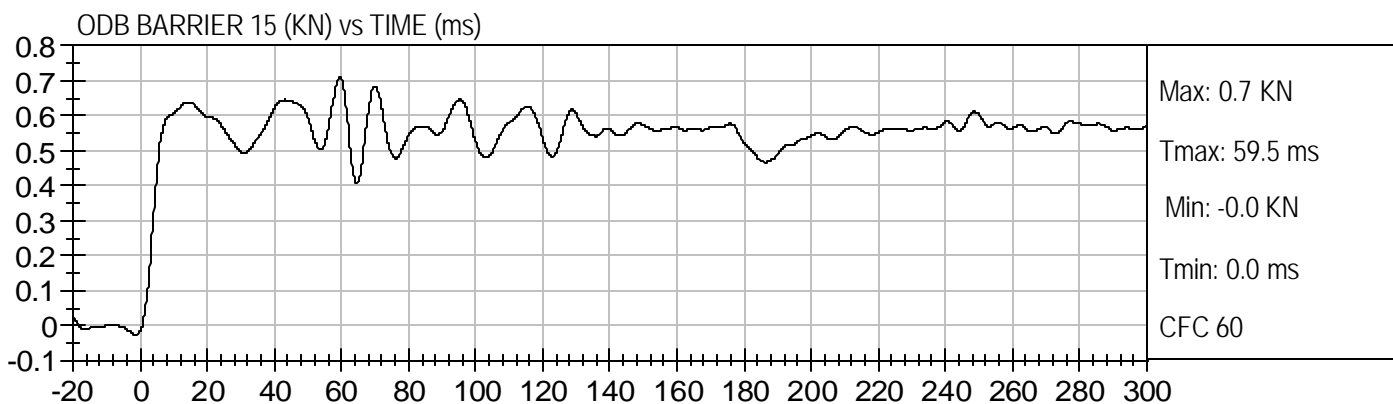
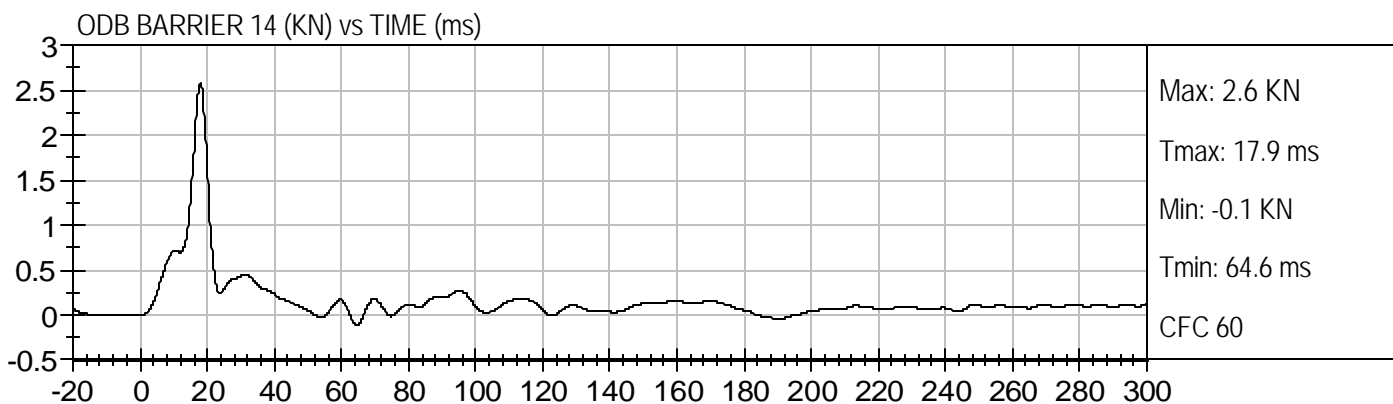
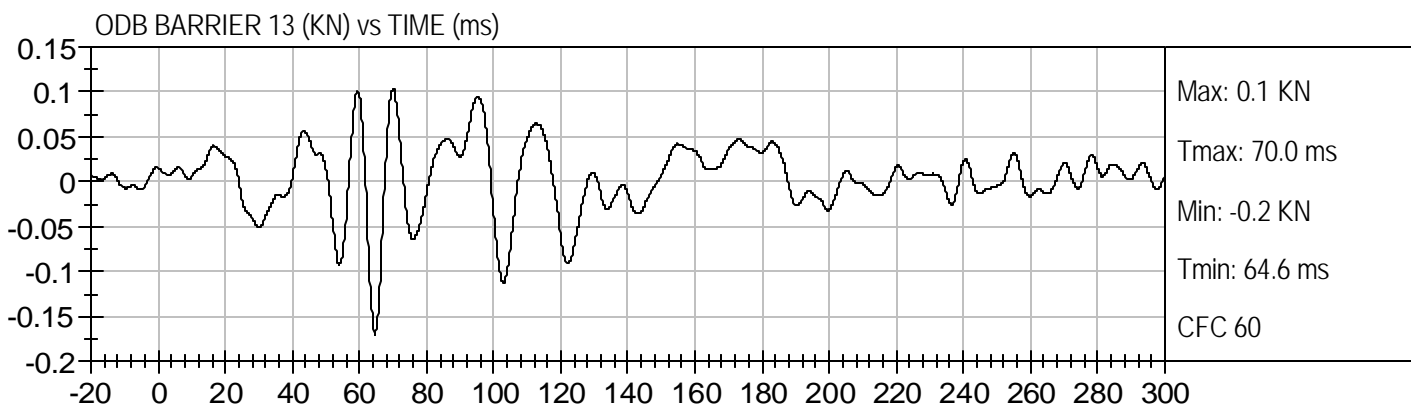


ODB BARRIER 11 (KN) vs TIME (ms)



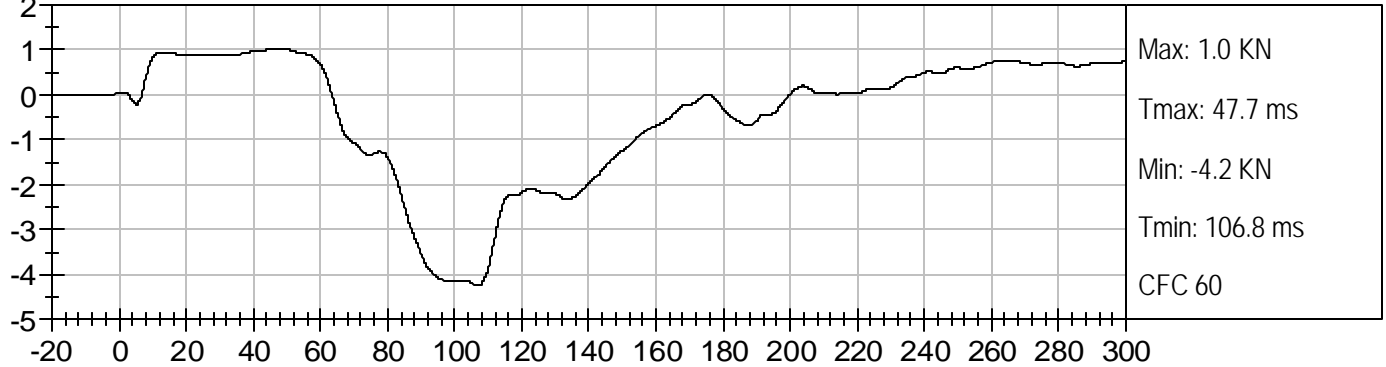
ODB BARRIER 12 (KN) vs TIME (ms)



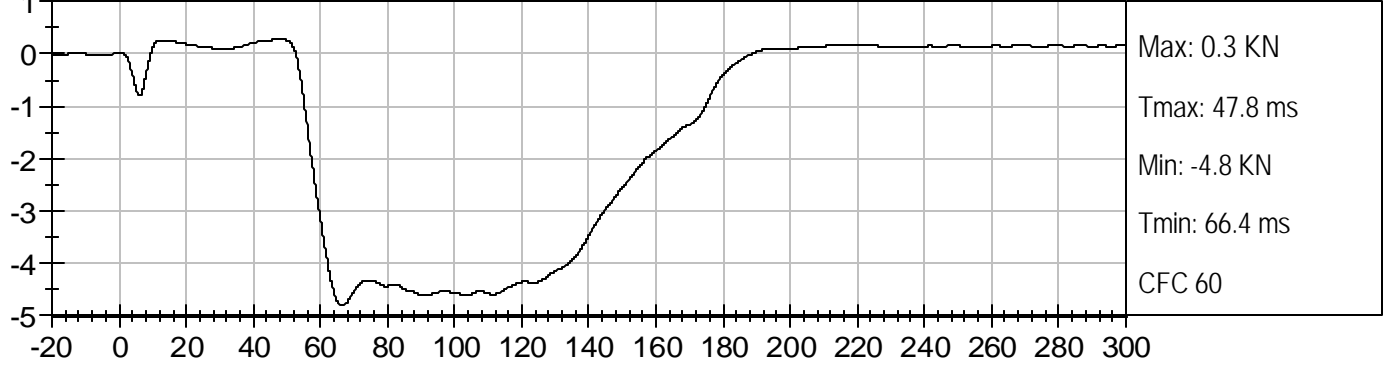




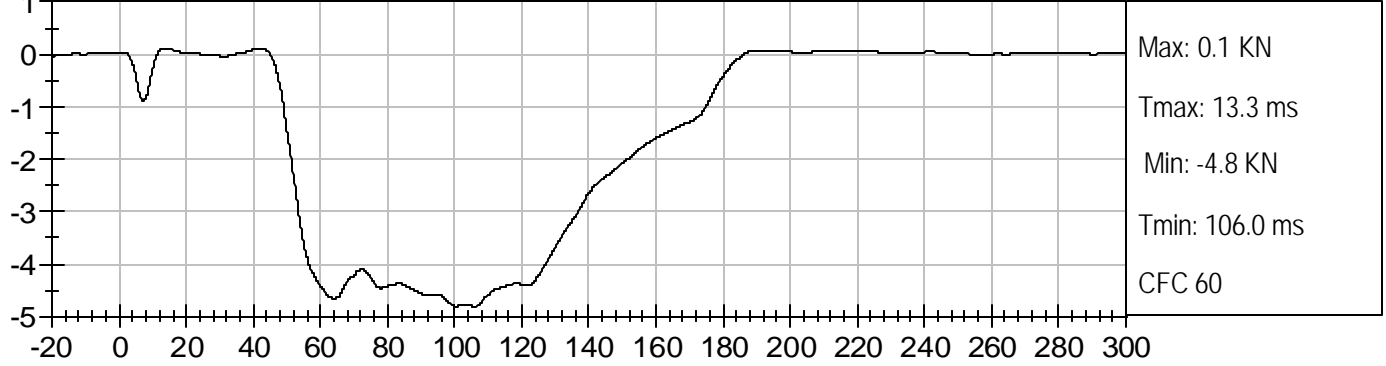
ODB BARRIER 17 (KN) vs TIME (ms)



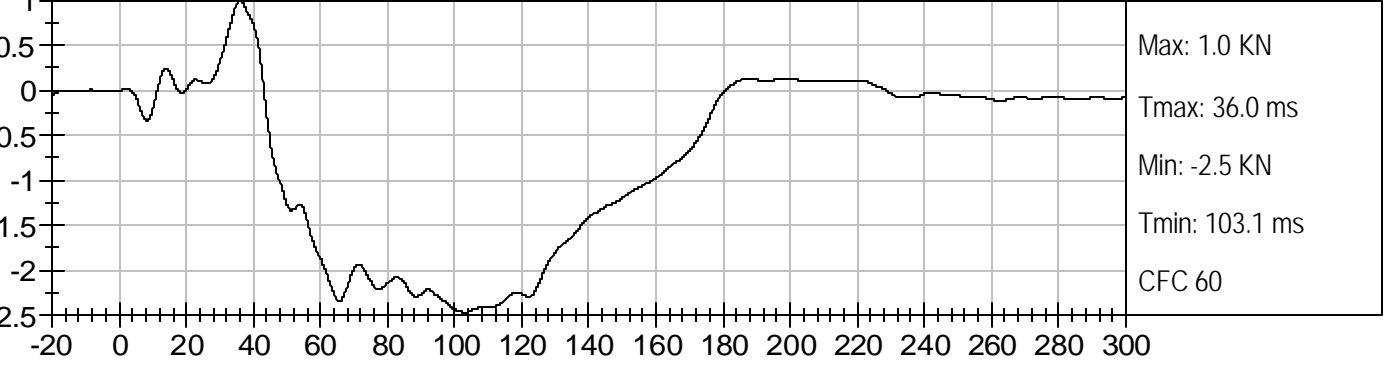
ODB BARRIER 18 (KN) vs TIME (ms)

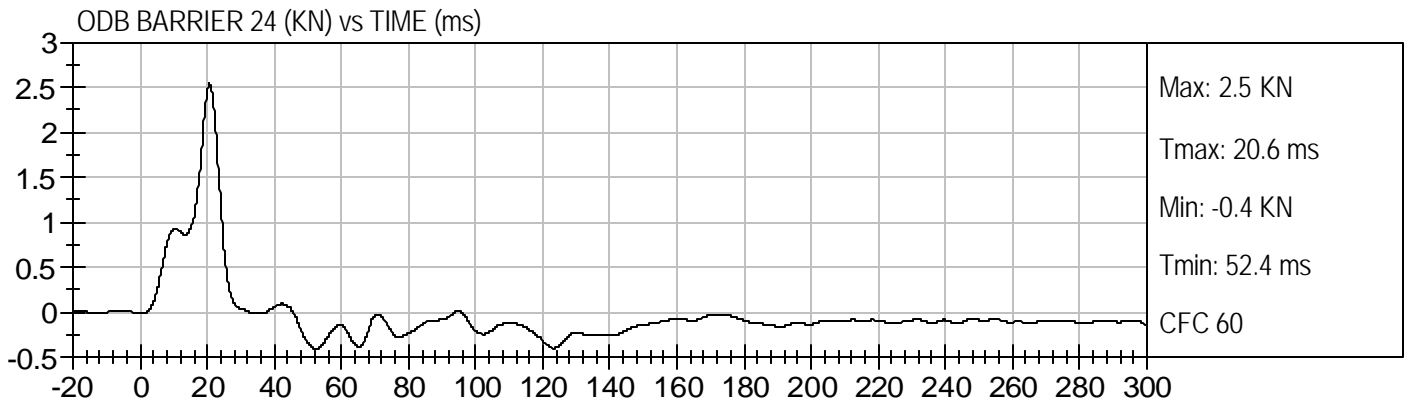
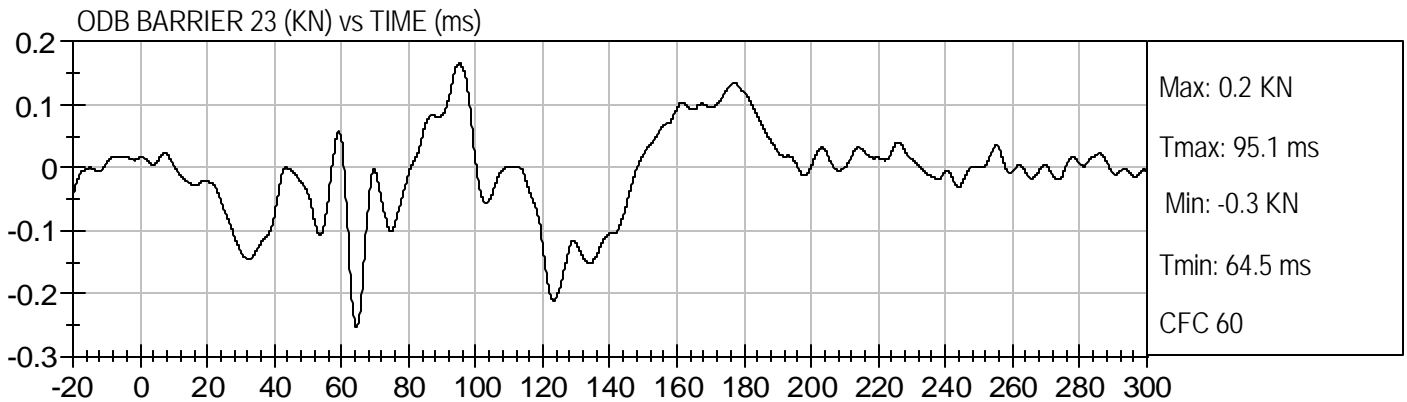
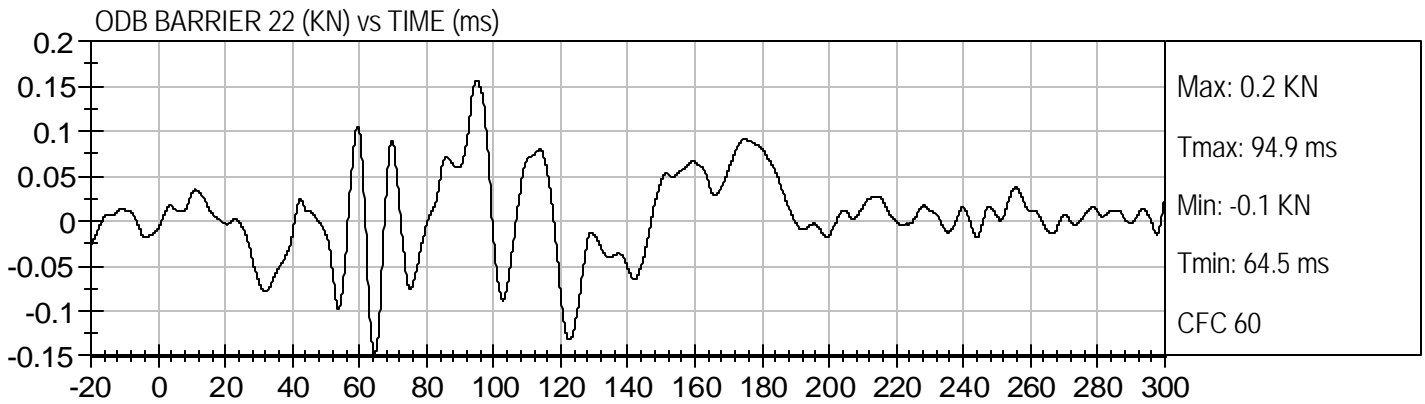
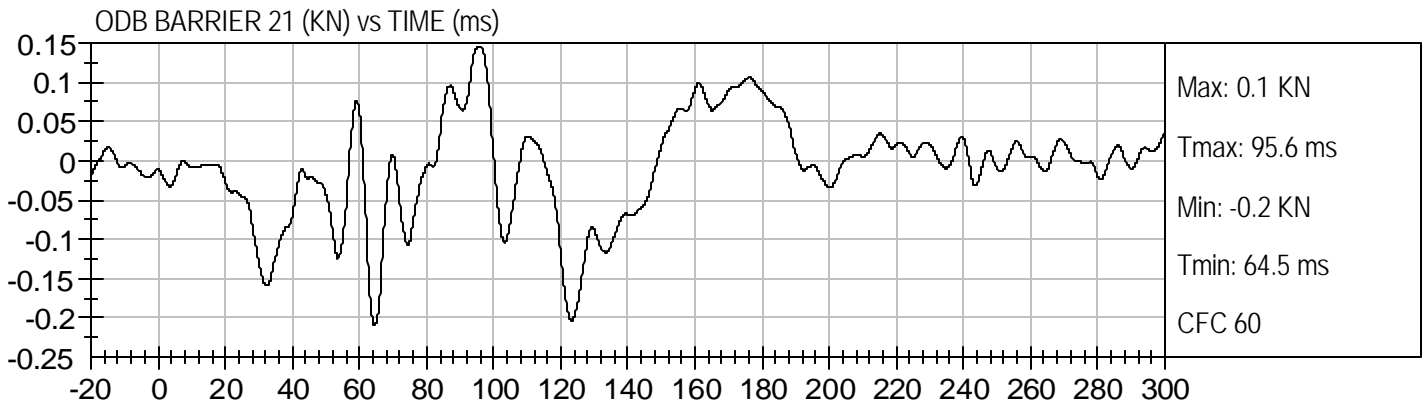


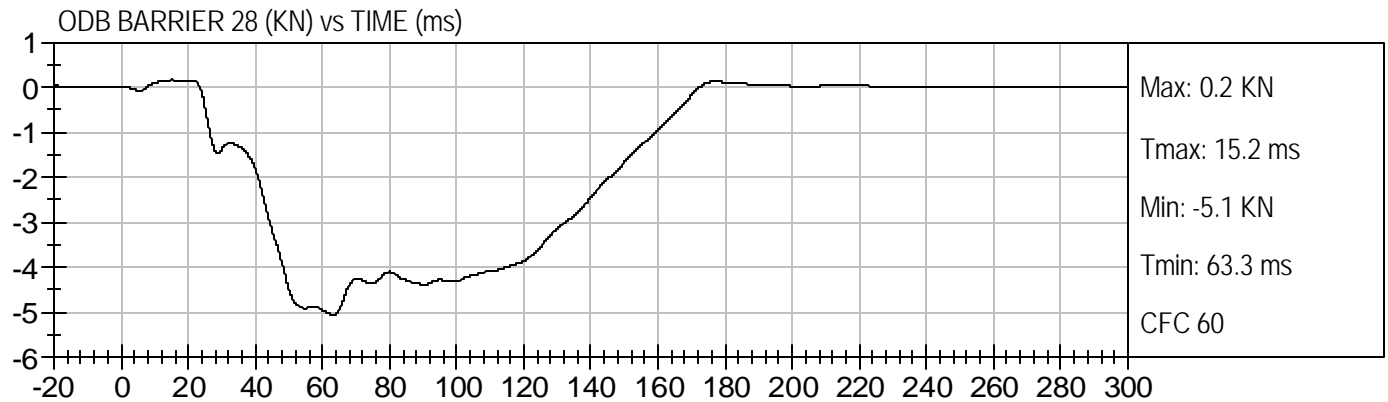
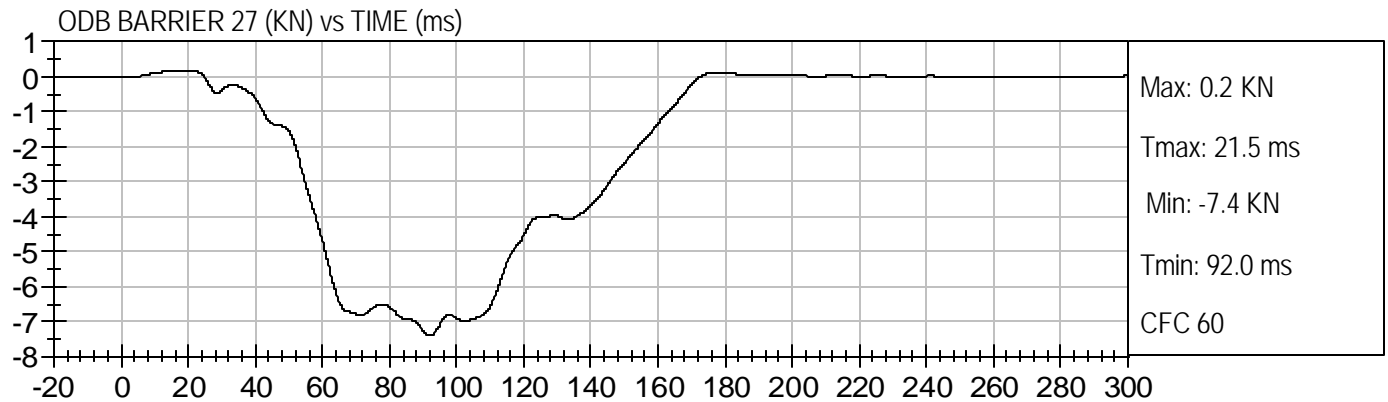
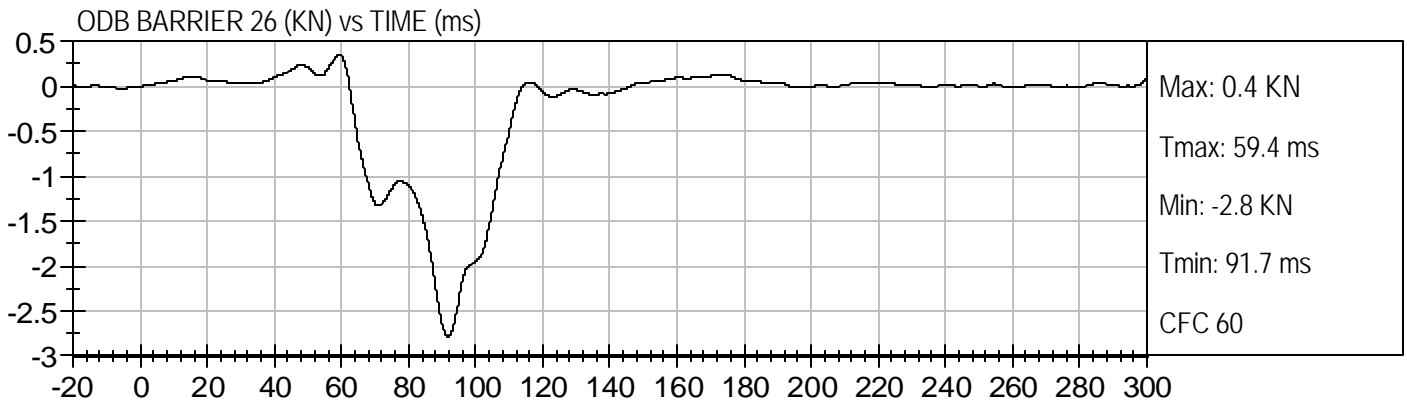
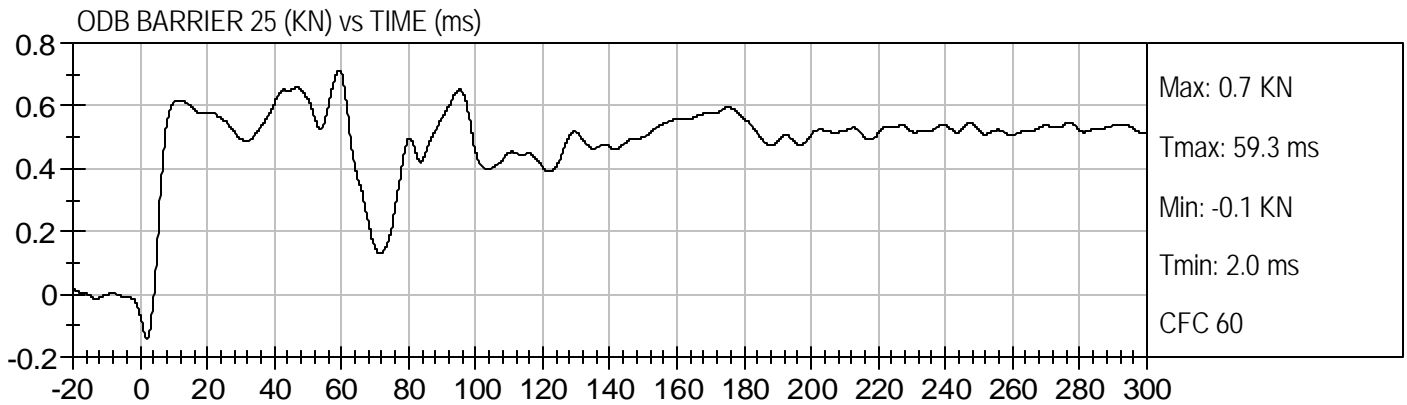
ODB BARRIER 19 (KN) vs TIME (ms)



ODB BARRIER 20 (KN) vs TIME (ms)

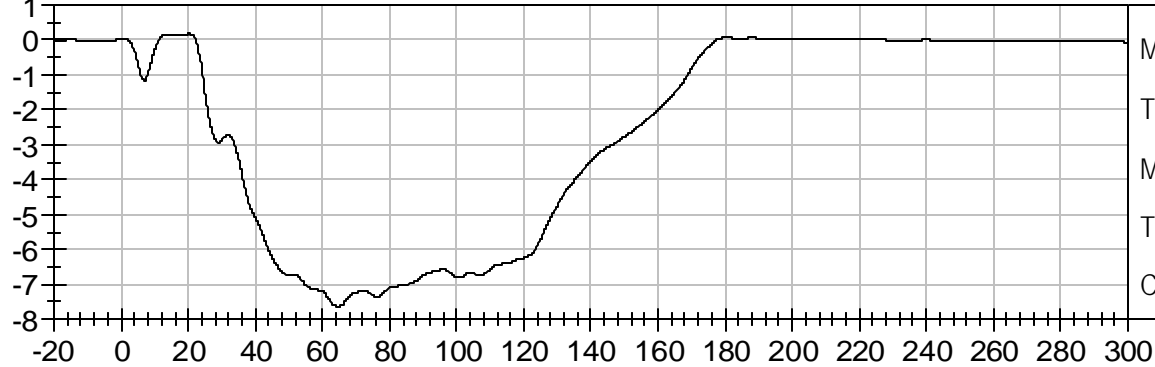






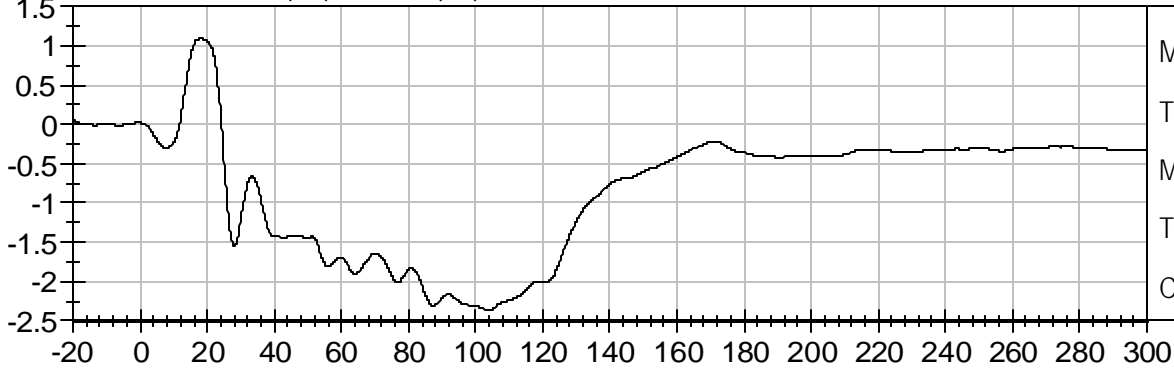


ODB BARRIER 29 (KN) vs TIME (ms)



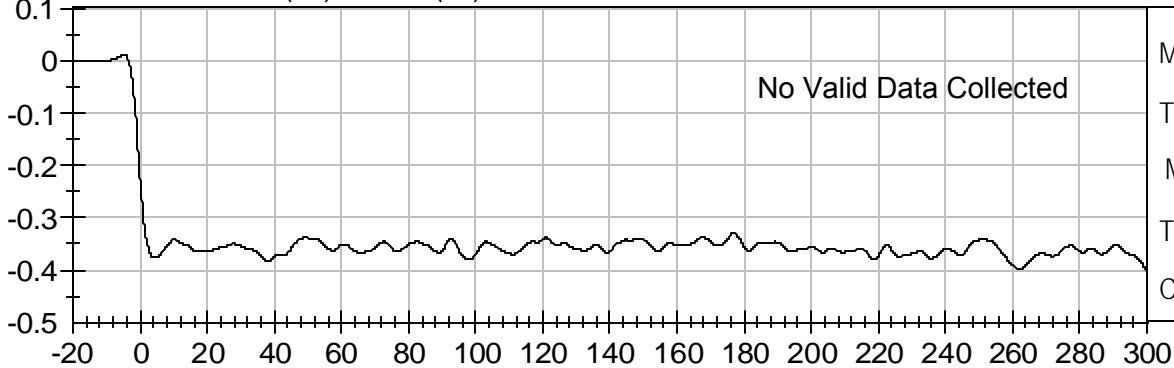
Max: 0.2 KN
Tmax: 20.1 ms
Min: -7.6 KN
Tmin: 64.4 ms
CFC 60

ODB BARRIER 30 (KN) vs TIME (ms)



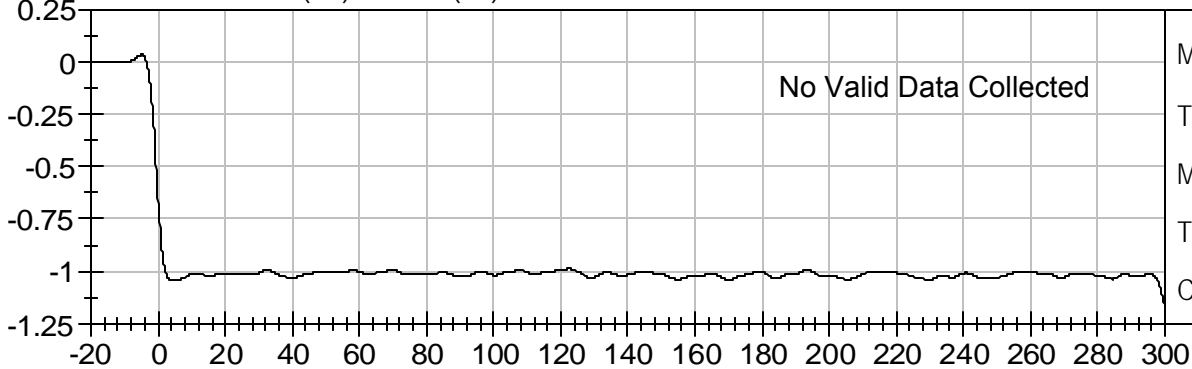
Max: 1.1 KN
Tmax: 17.9 ms
Min: -2.4 KN
Tmin: 103.8 ms
CFC 60

ODB BARRIER 31 (KN) vs TIME (ms)

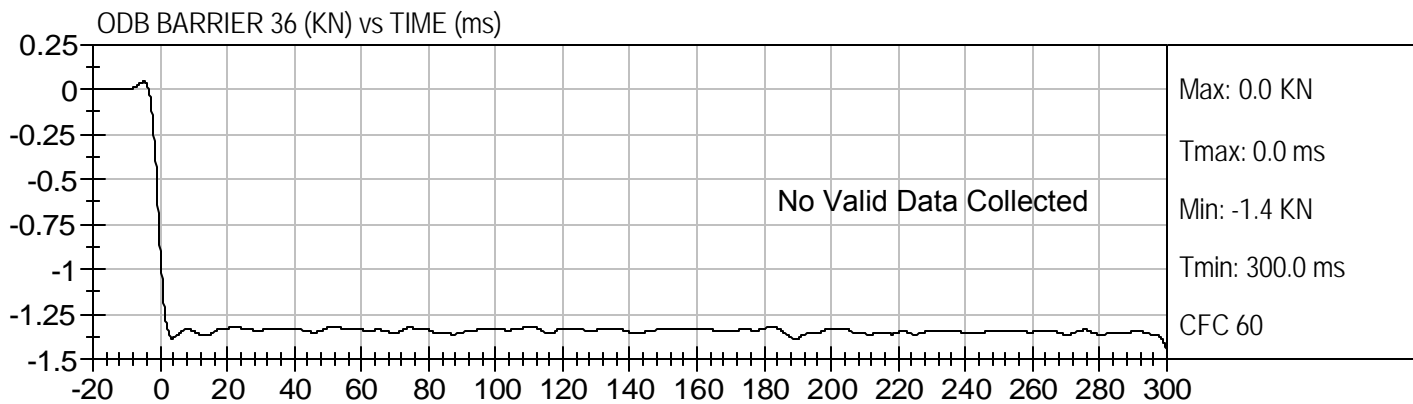
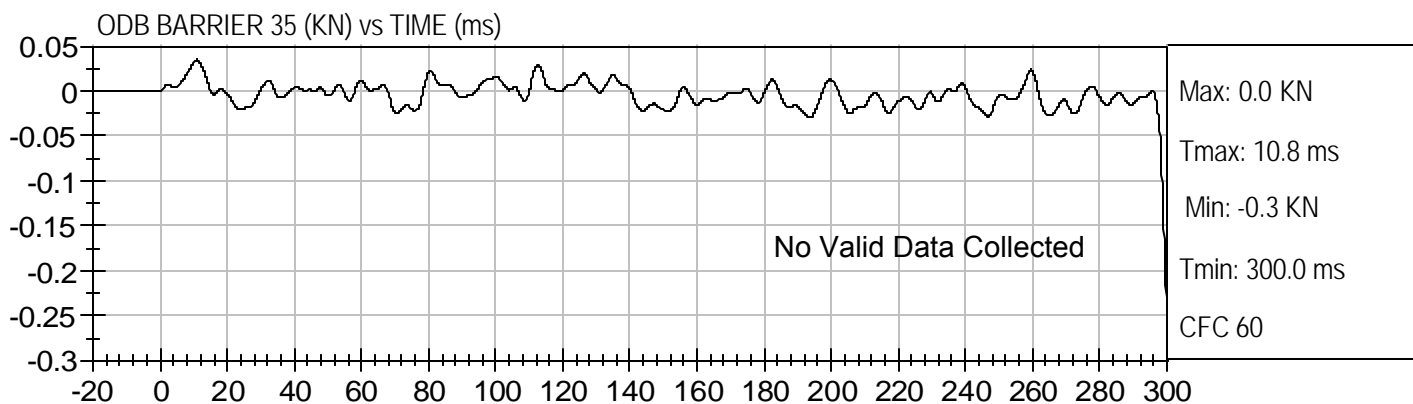
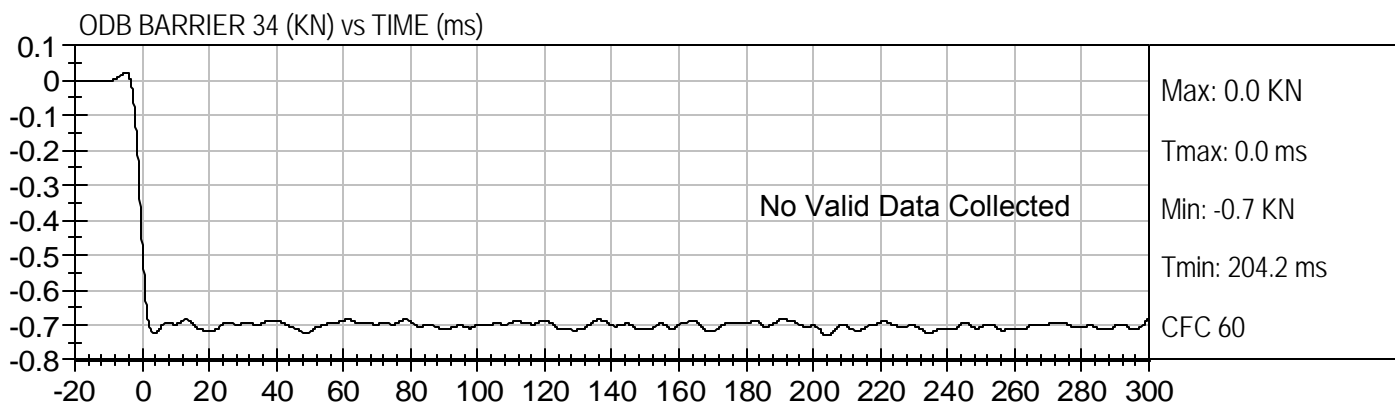
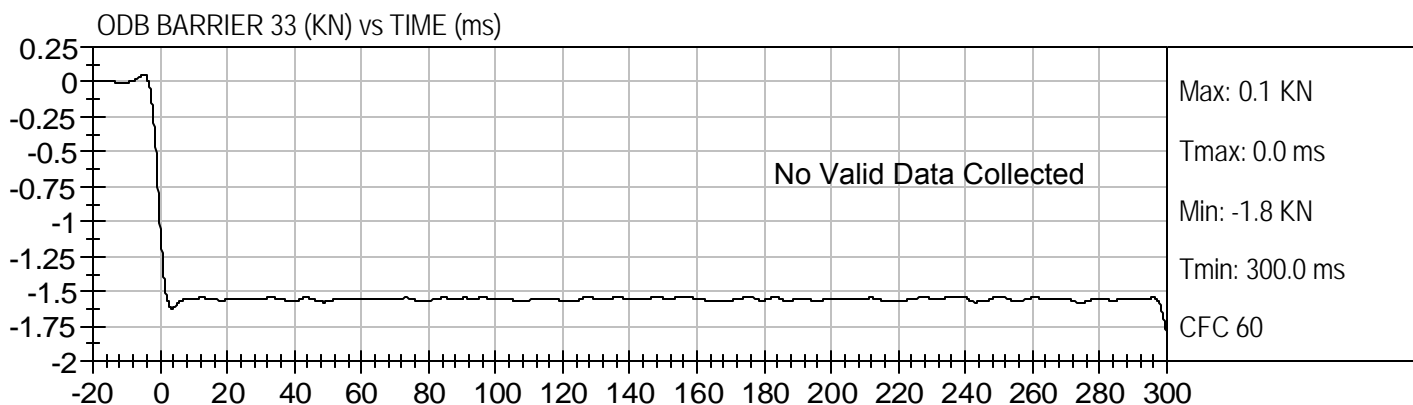


Max: 0.0 KN
Tmax: 0.0 ms
Min: -0.4 KN
Tmin: 300.0 ms
CFC 60

ODB BARRIER 32 (KN) vs TIME (ms)

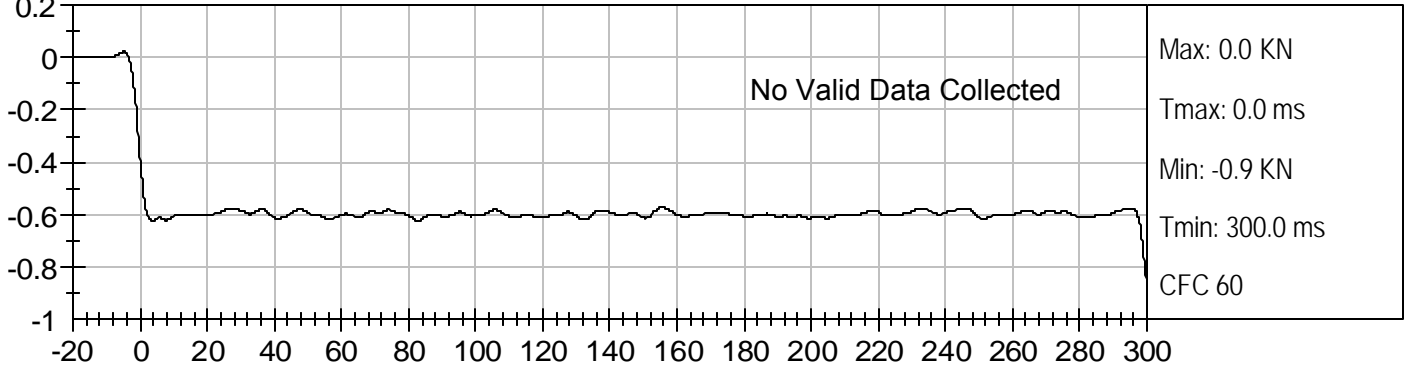


Max: 0.0 KN
Tmax: 0.0 ms
Min: -1.2 KN
Tmin: 300.0 ms
CFC 60

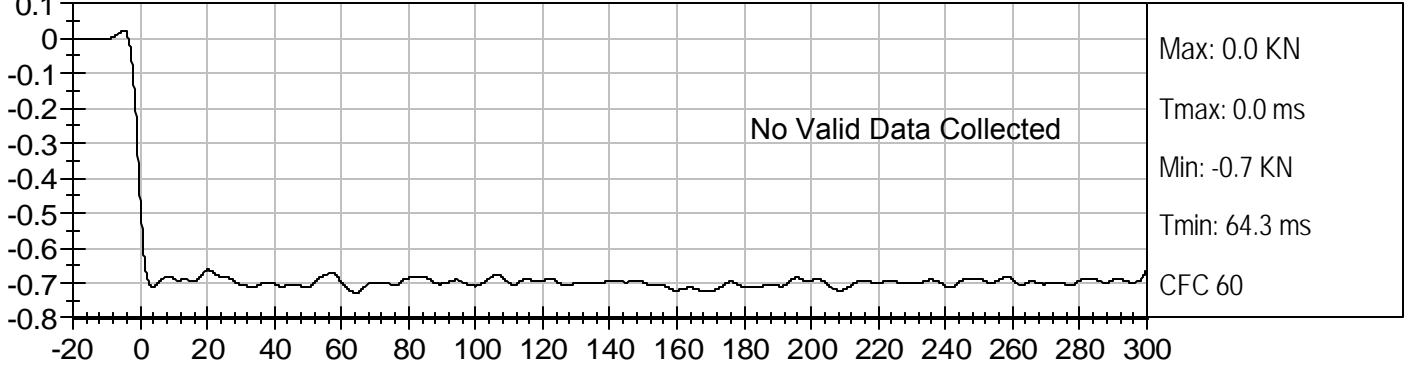




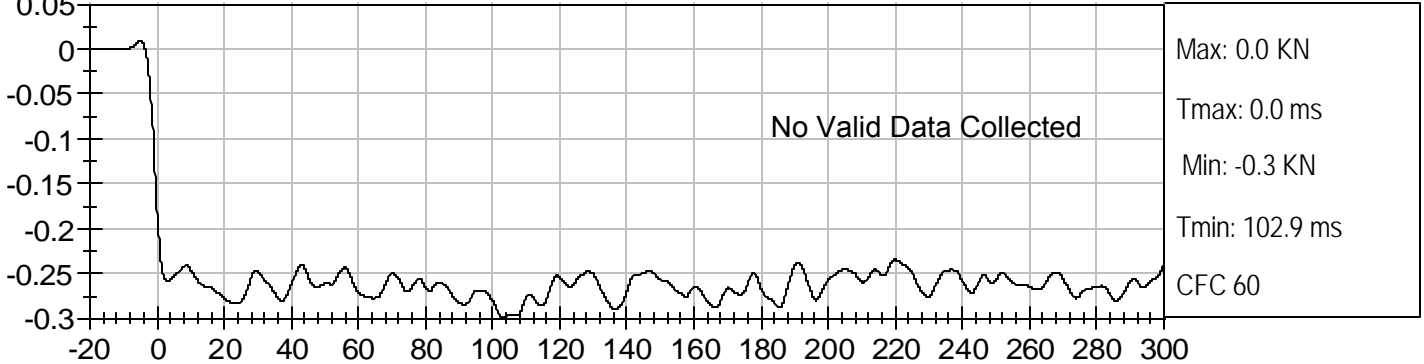
ODB BARRIER 37 (KN) vs TIME (ms)



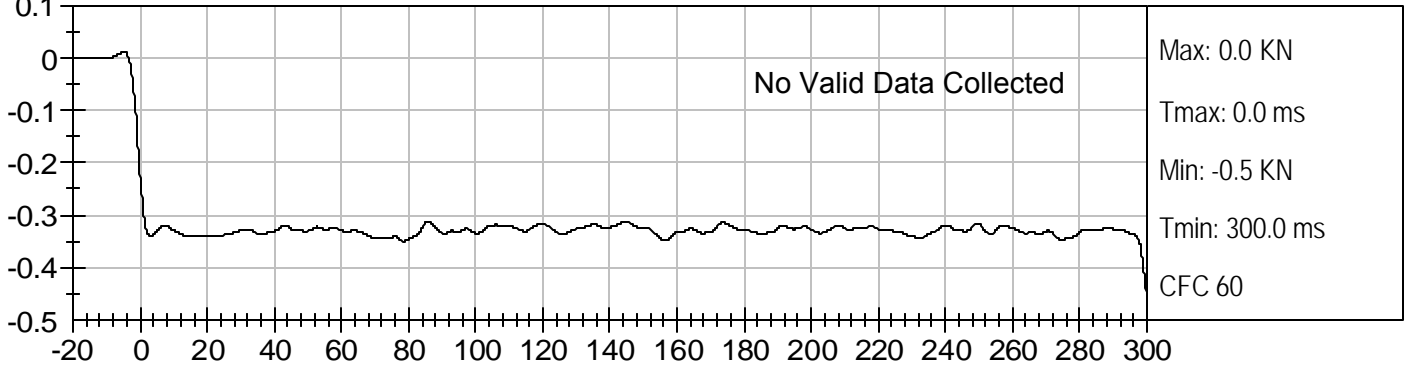
ODB BARRIER 38 (KN) vs TIME (ms)

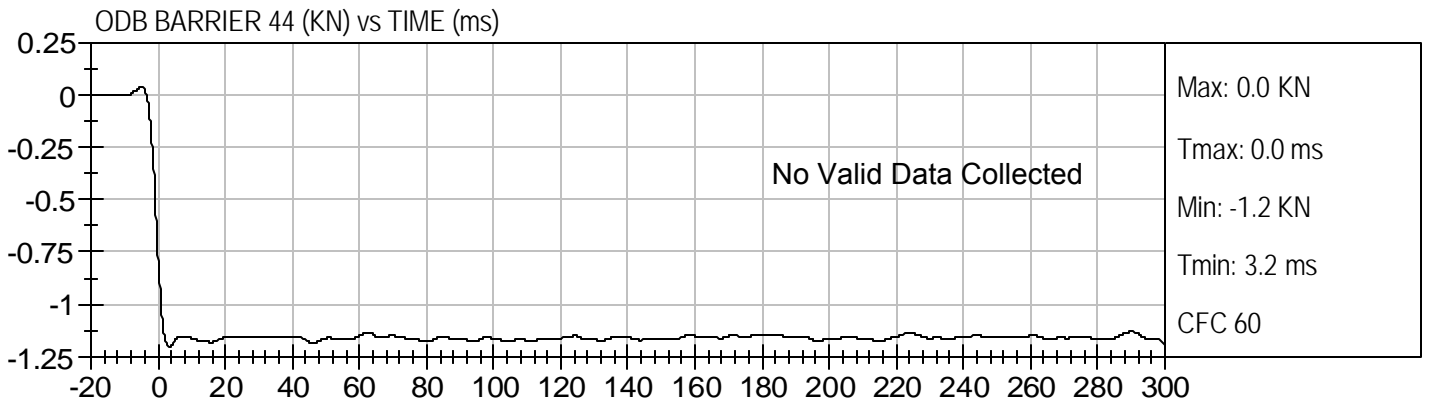
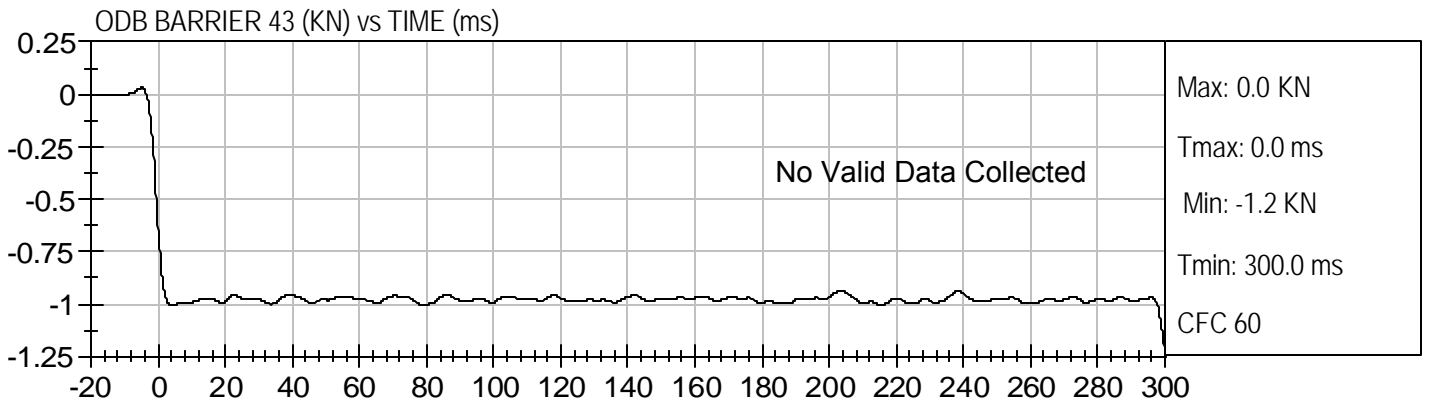
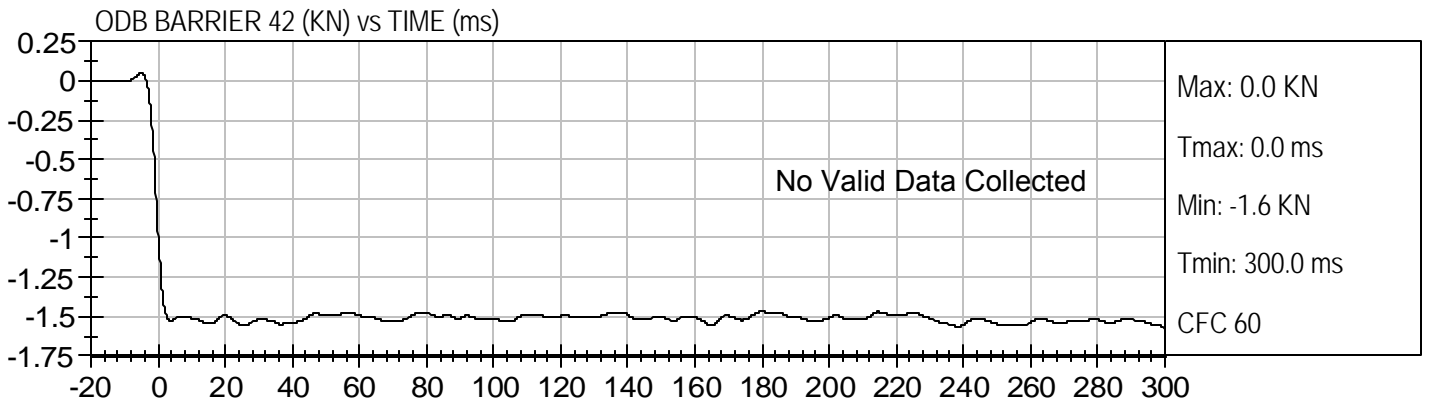
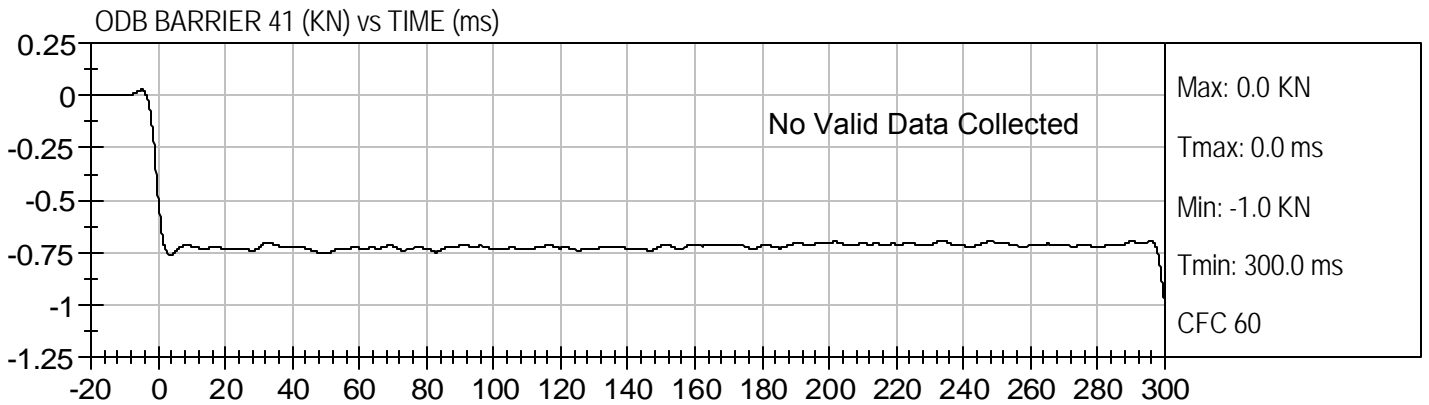


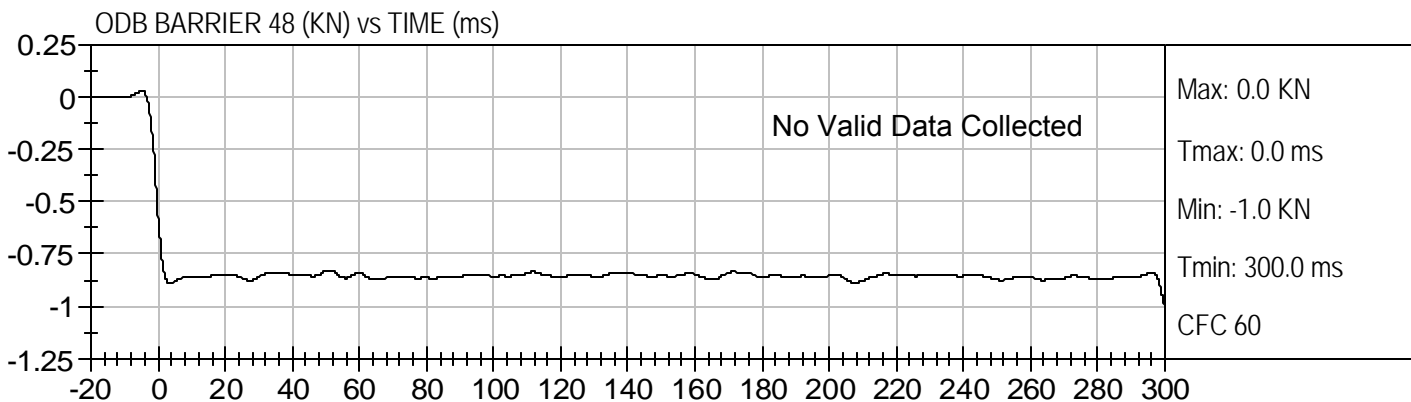
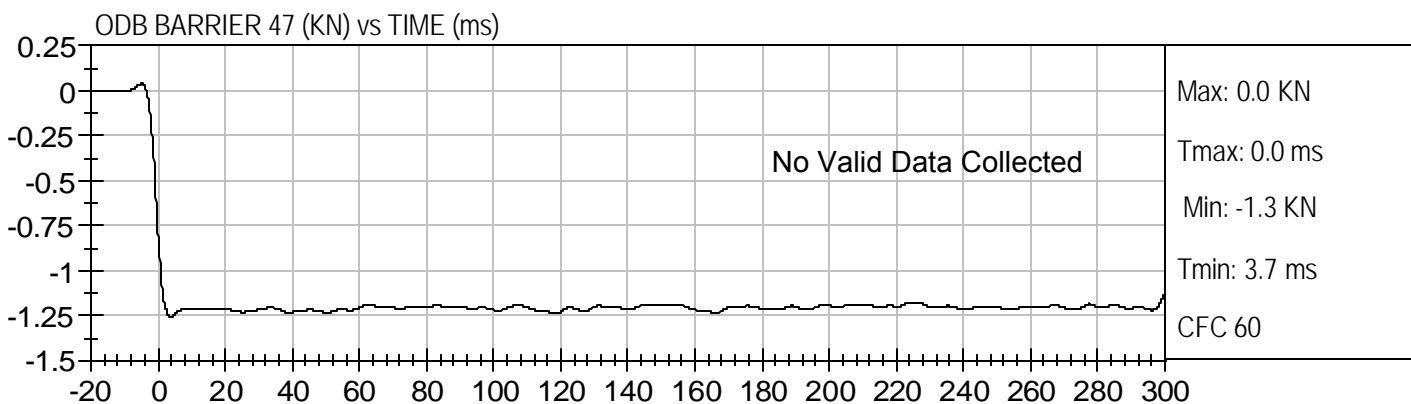
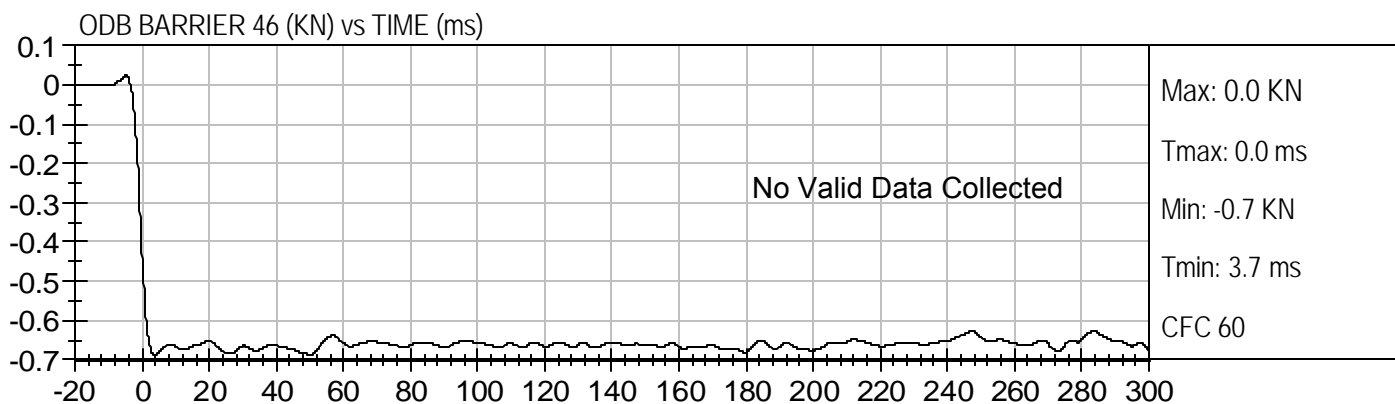
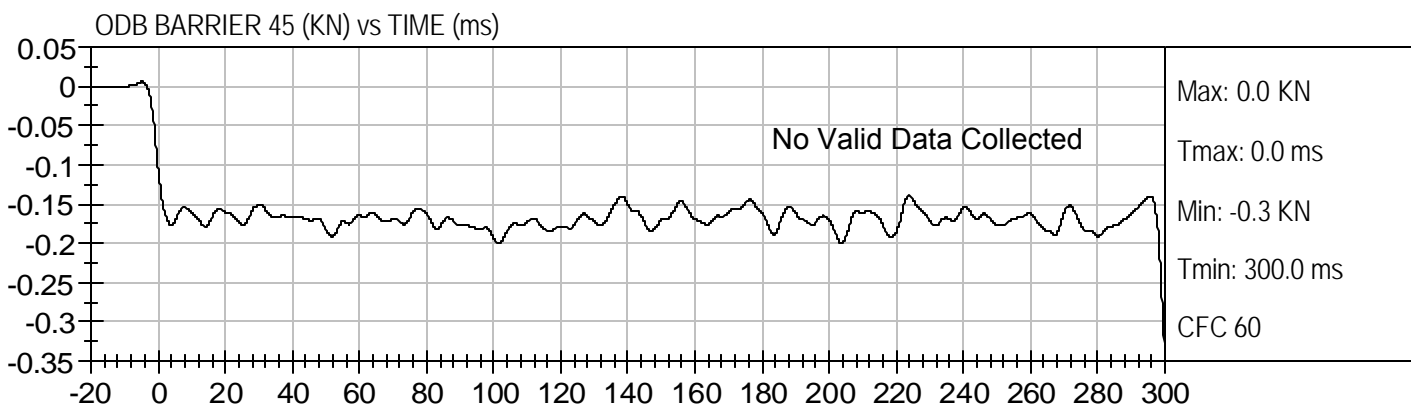
ODB BARRIER 39 (KN) vs TIME (ms)

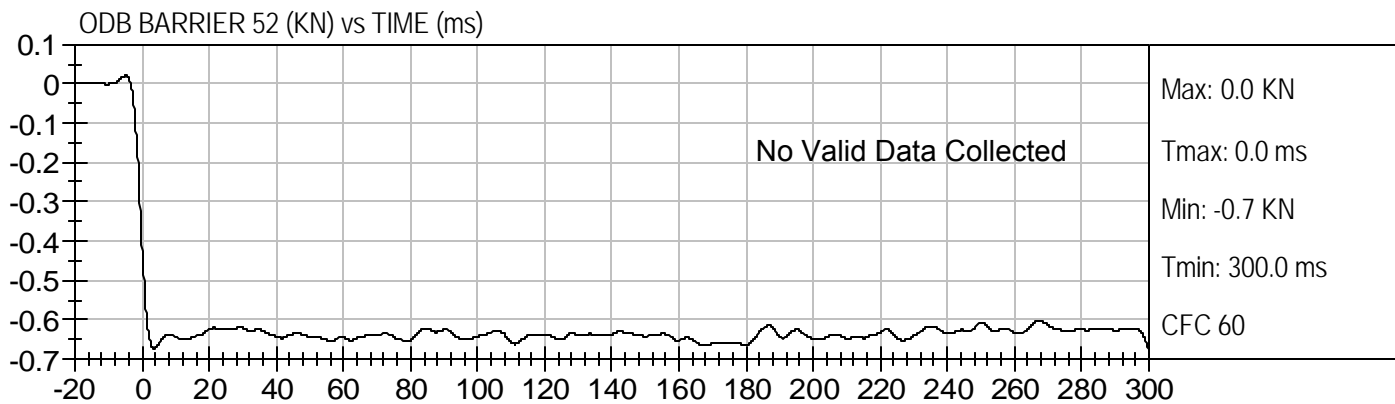
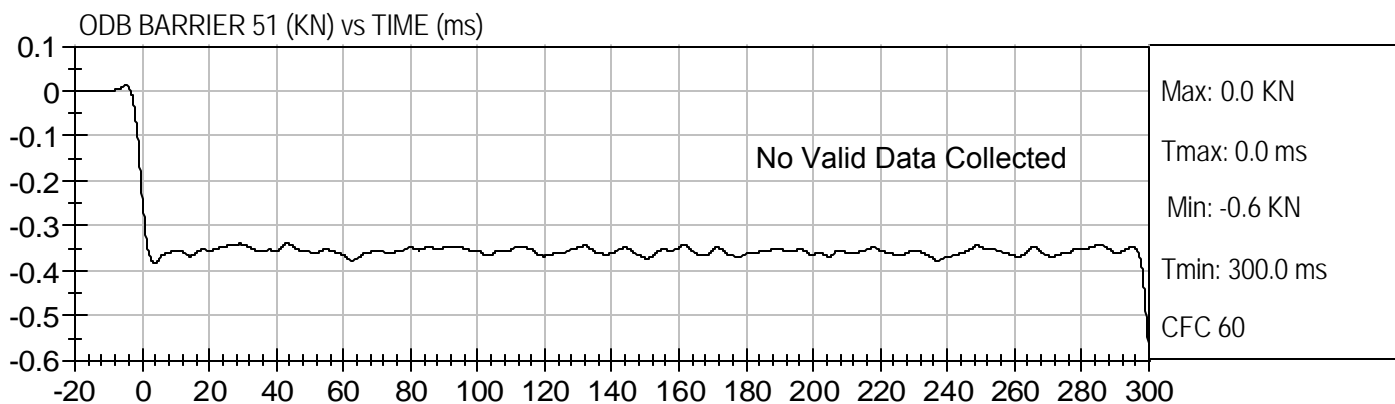
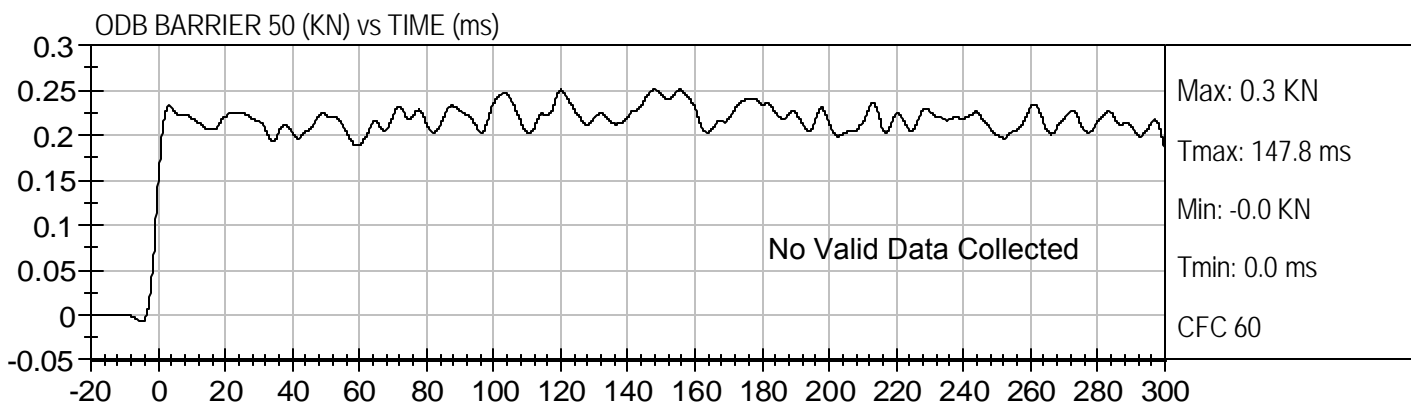
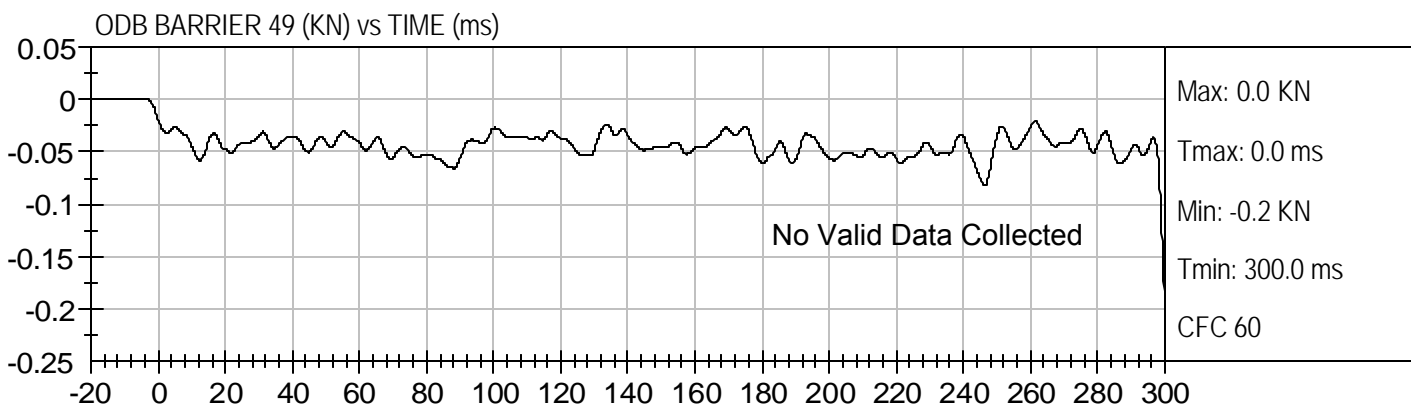


ODB BARRIER 40 (KN) vs TIME (ms)



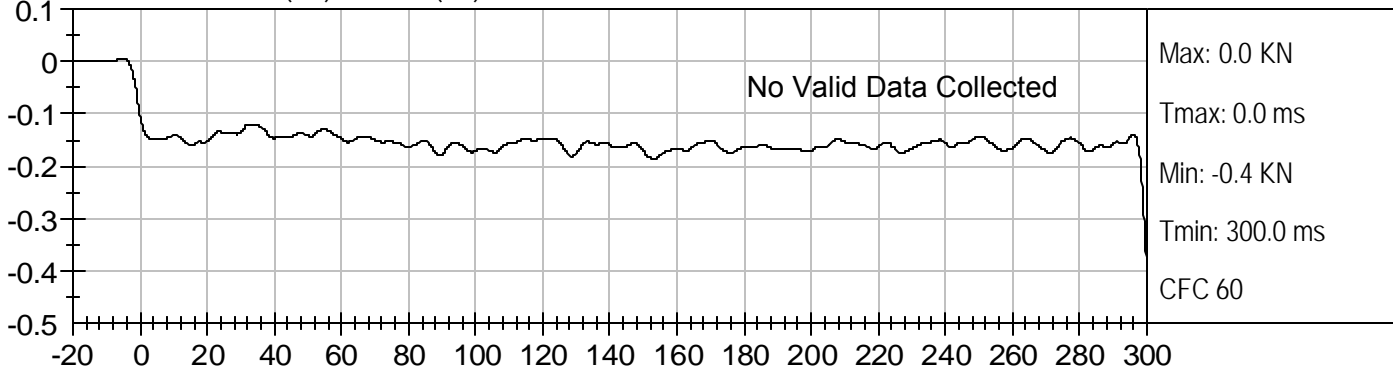




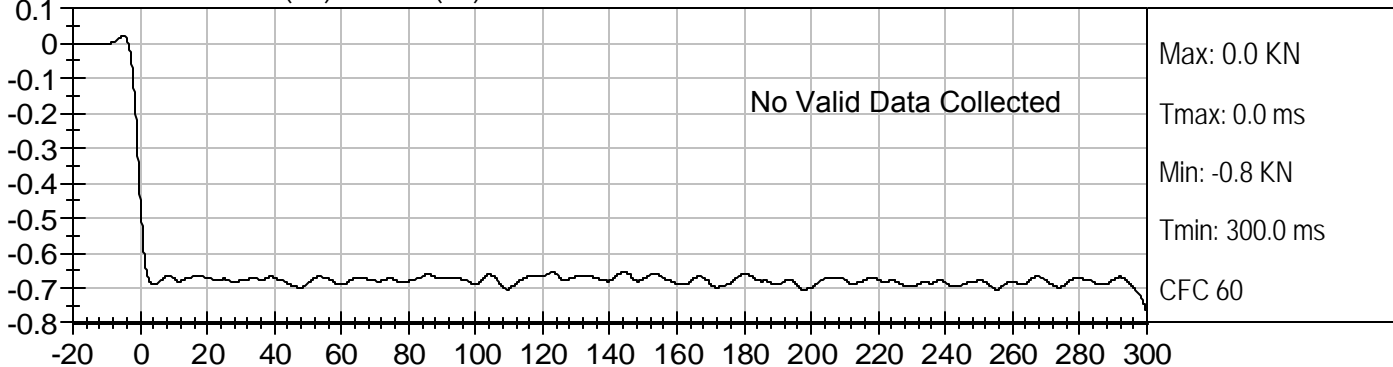




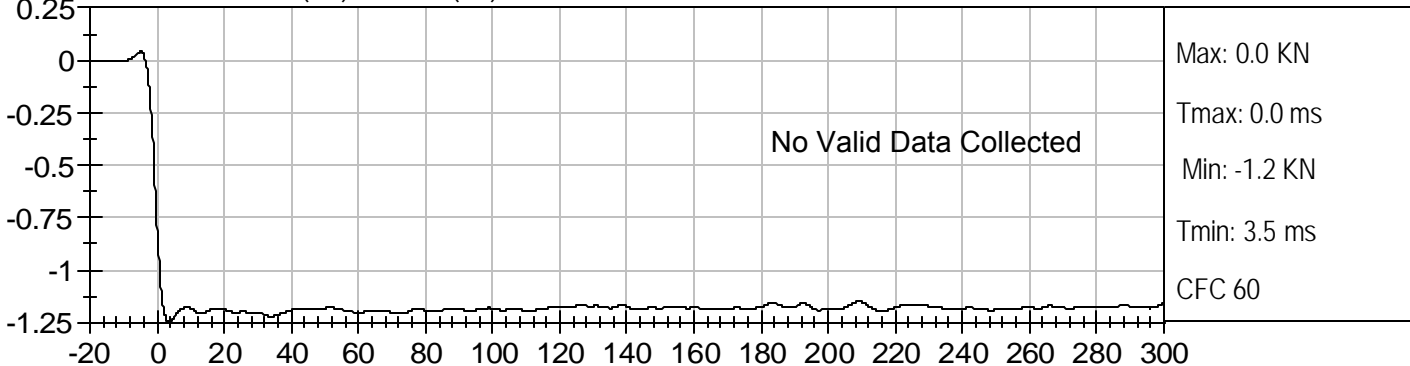
ODB BARRIER 53 (KN) vs TIME (ms)



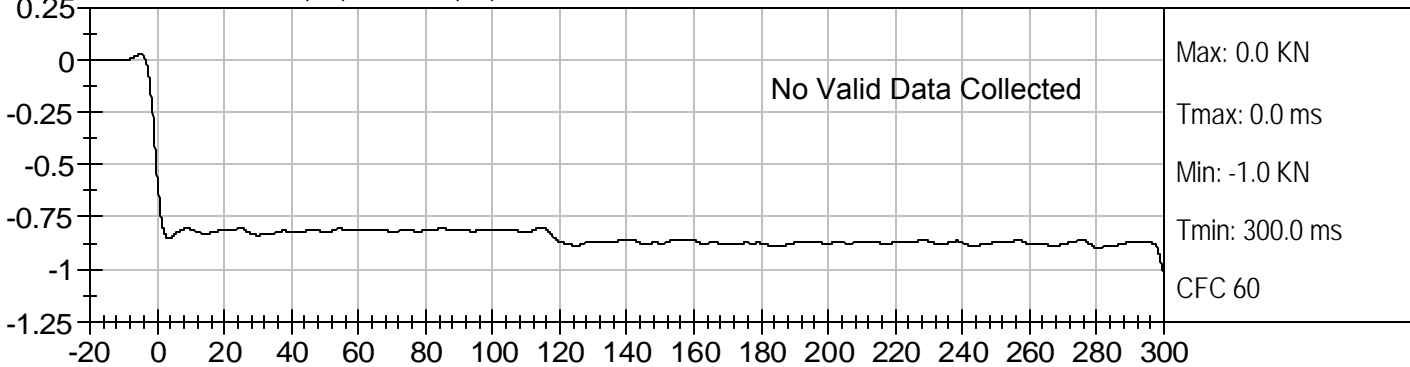
ODB BARRIER 54 (KN) vs TIME (ms)



ODB BARRIER 55 (KN) vs TIME (ms)

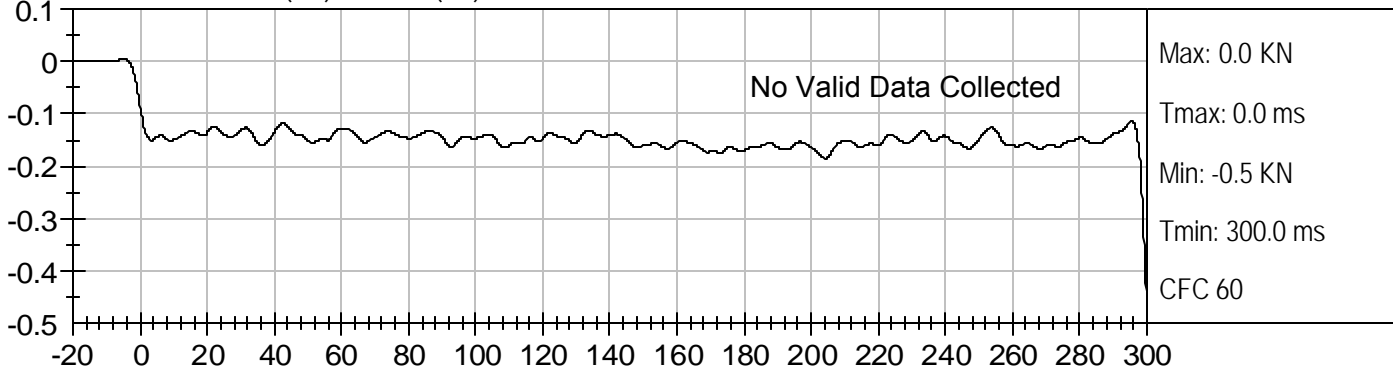


ODB BARRIER 56 (KN) vs TIME (ms)

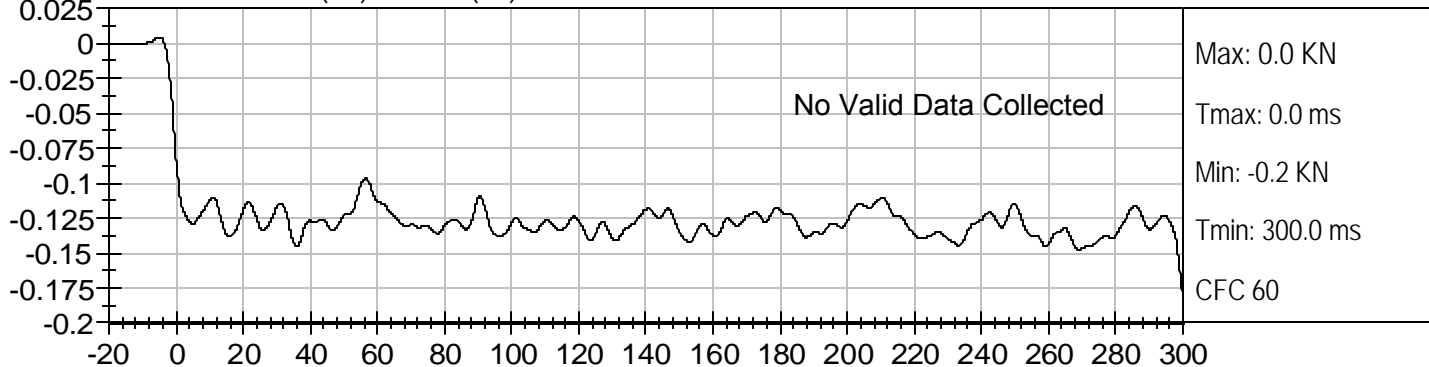




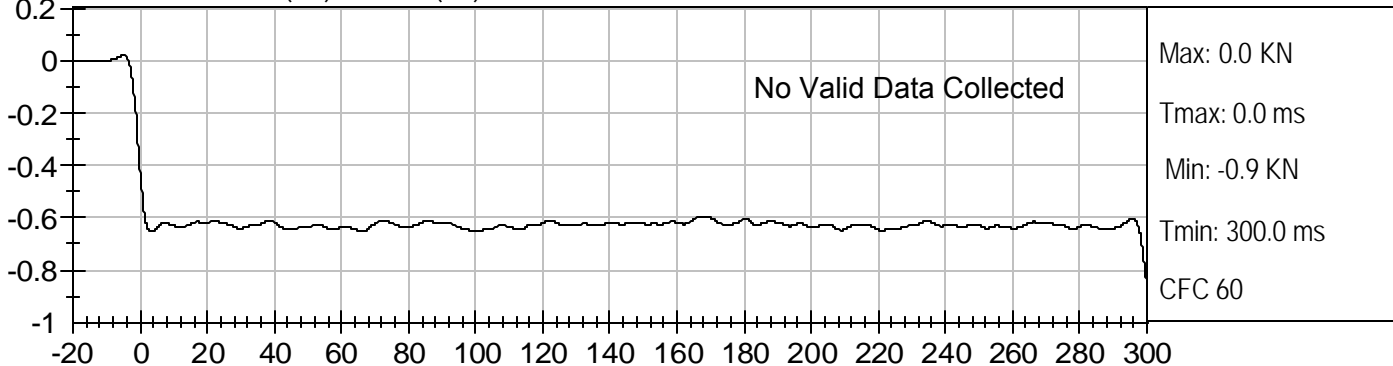
ODB BARRIER 57 (KN) vs TIME (ms)



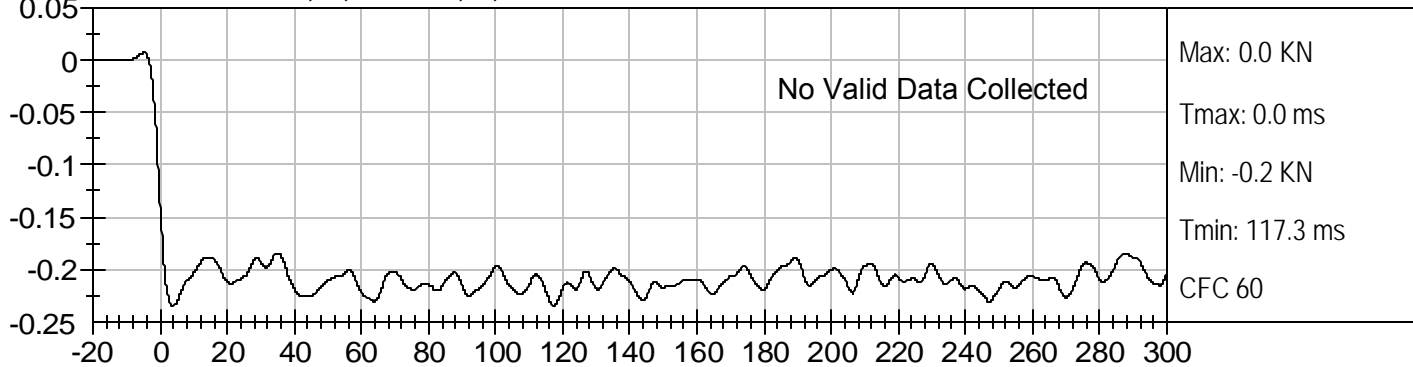
ODB BARRIER 58 (KN) vs TIME (ms)



ODB BARRIER 59 (KN) vs TIME (ms)

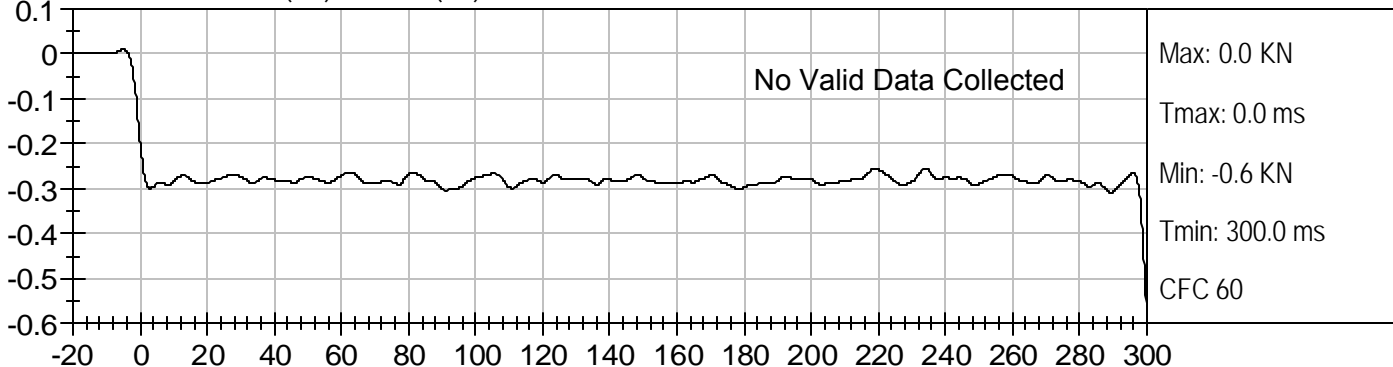


ODB BARRIER 60 (KN) vs TIME (ms)

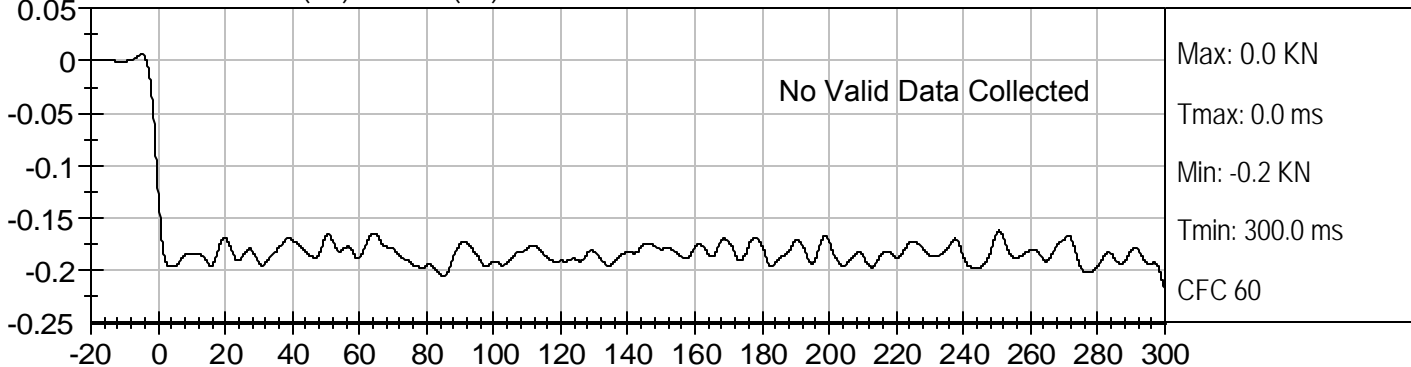




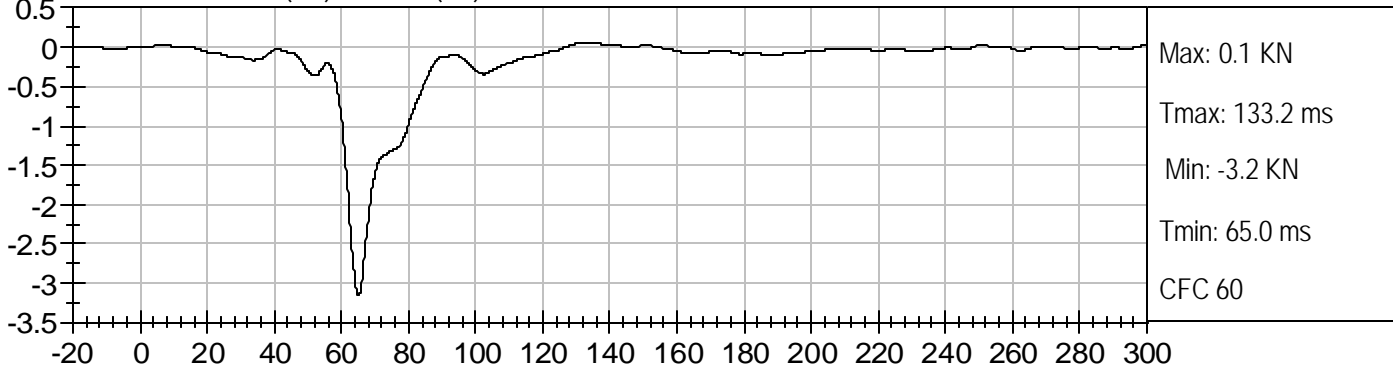
ODB BARRIER 61 (KN) vs TIME (ms)



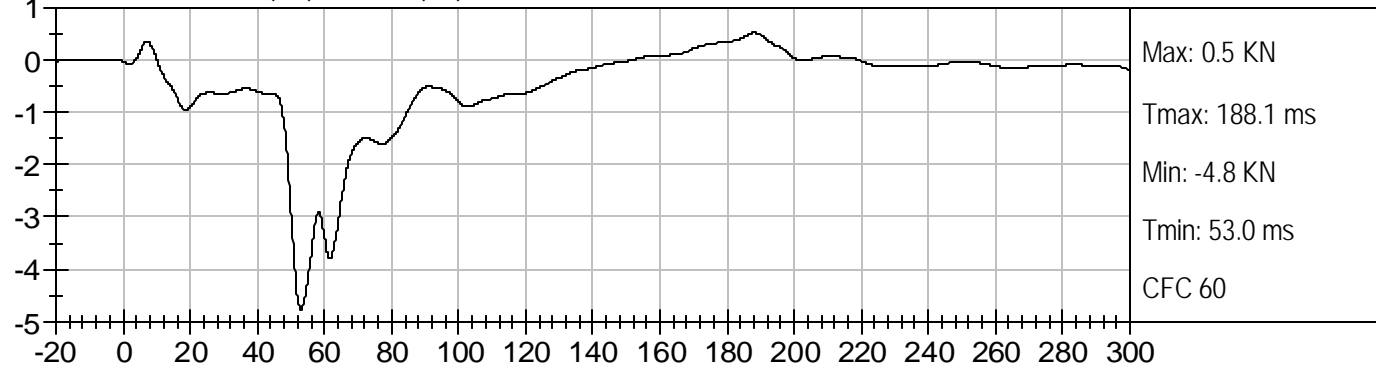
ODB BARRIER 62 (KN) vs TIME (ms)

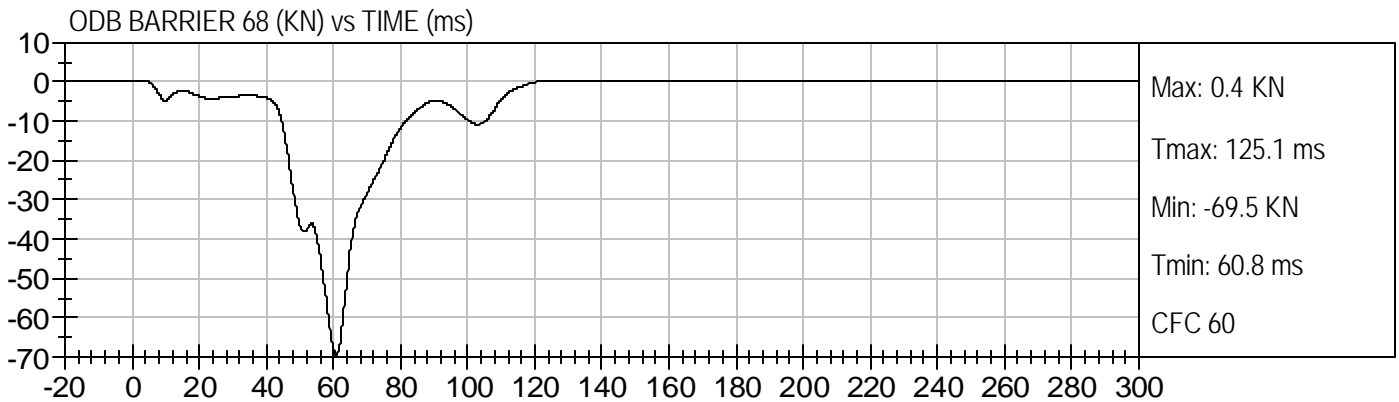
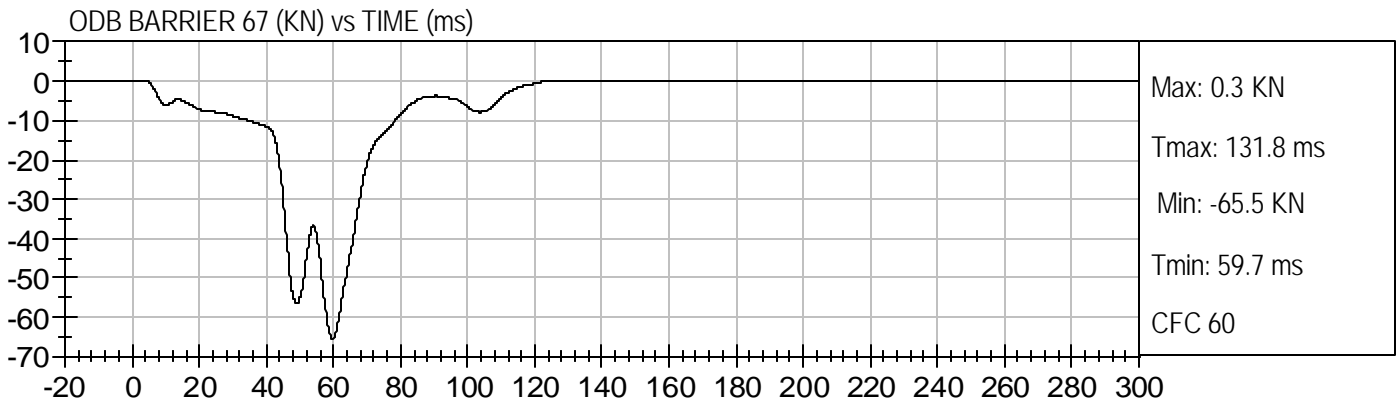
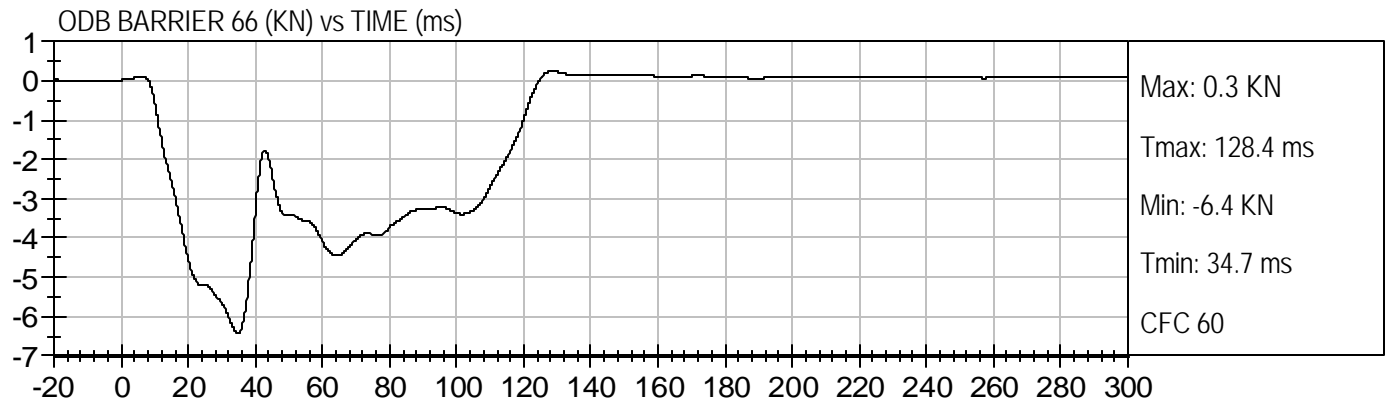
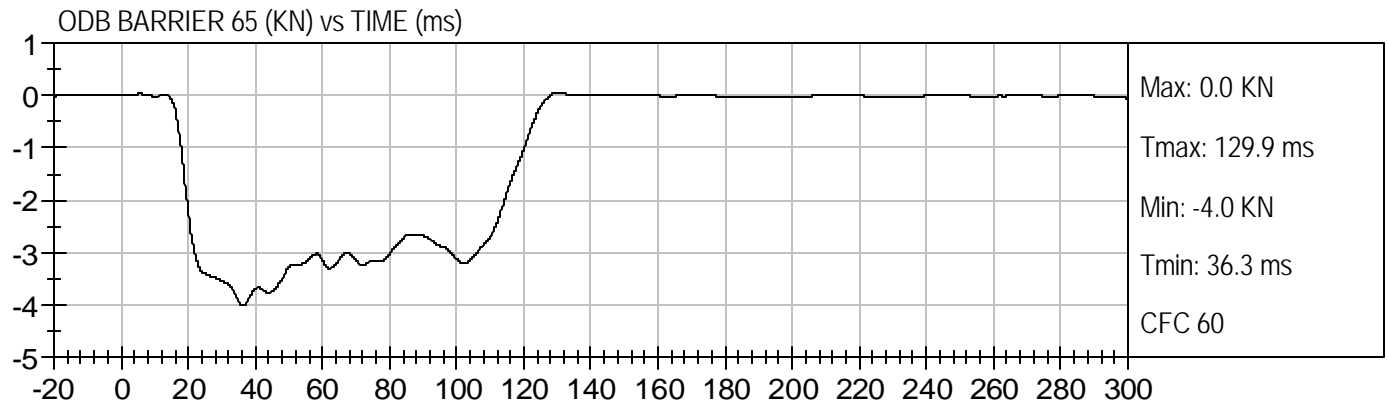


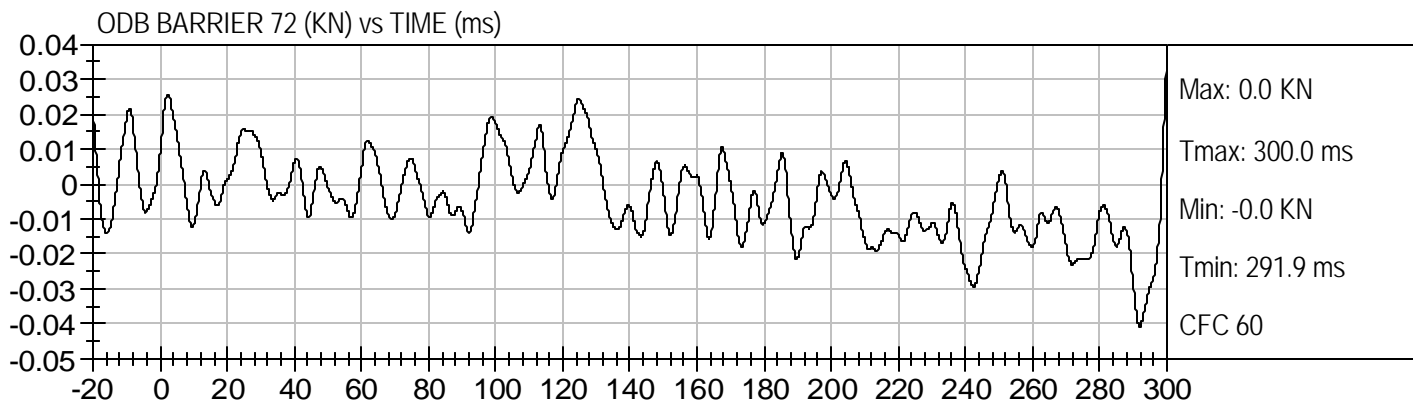
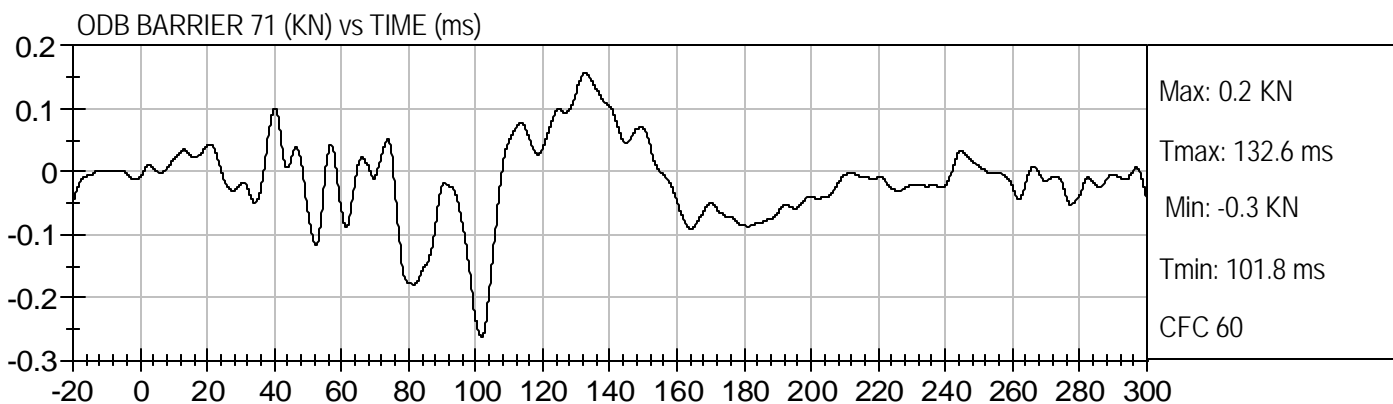
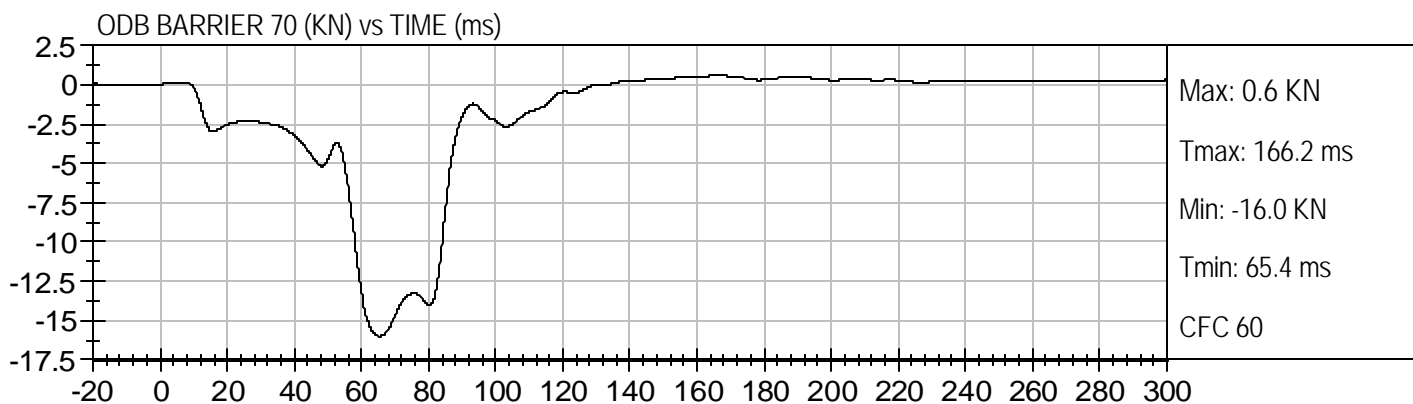
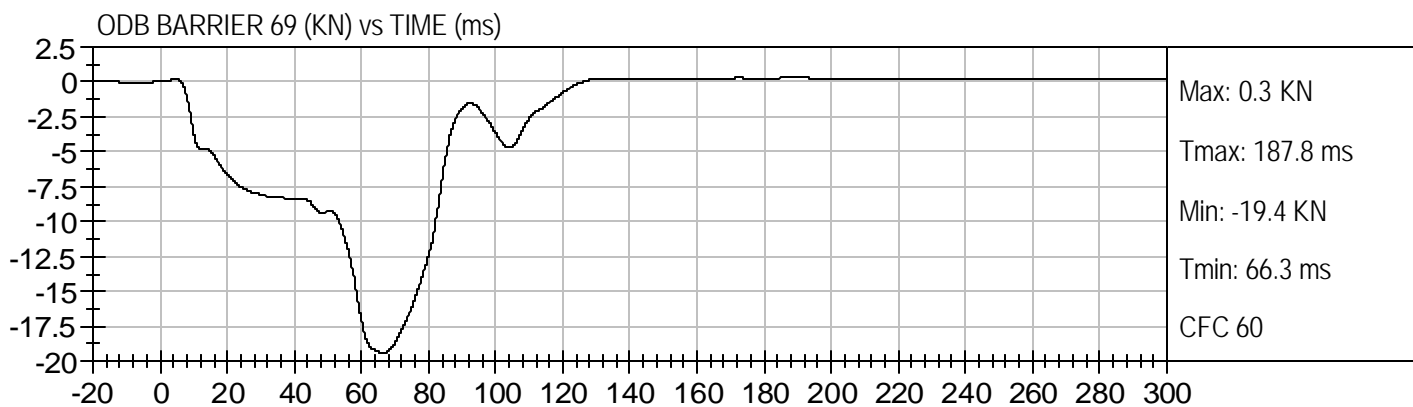
ODB BARRIER 63 (KN) vs TIME (ms)

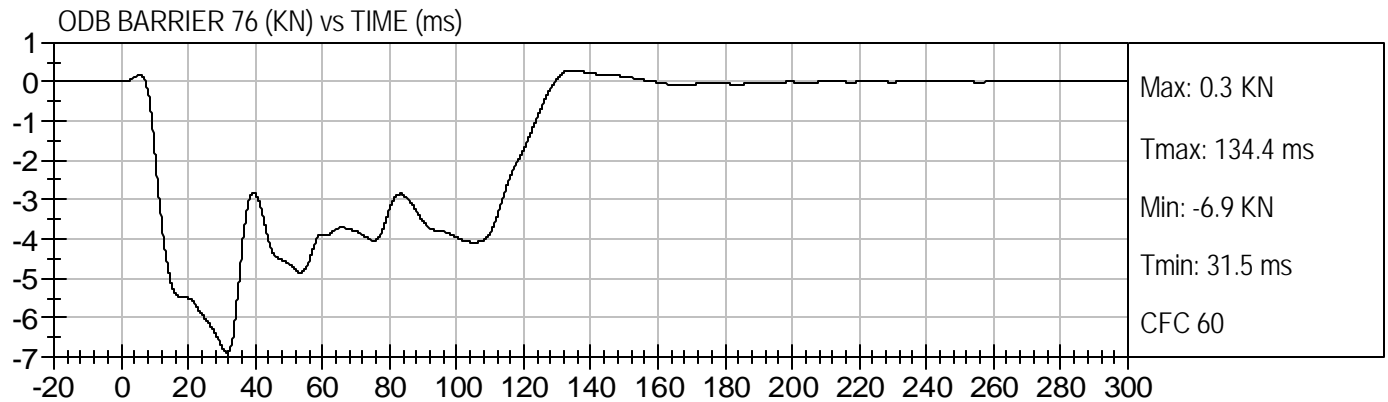
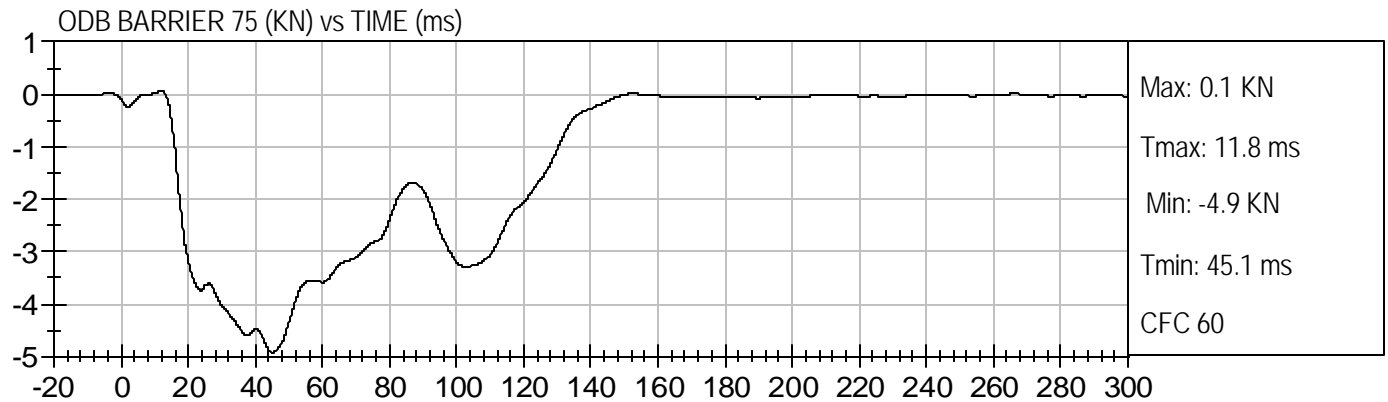
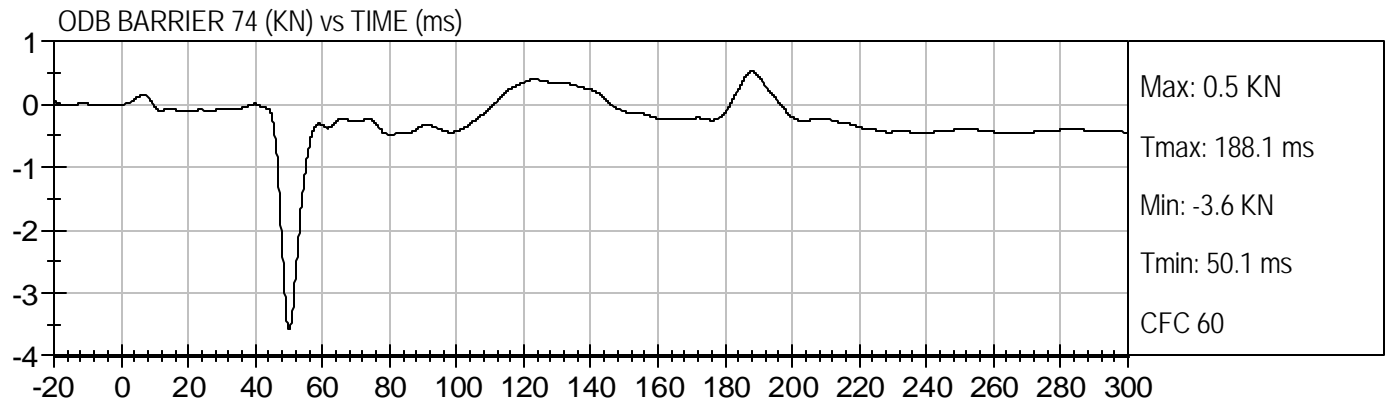
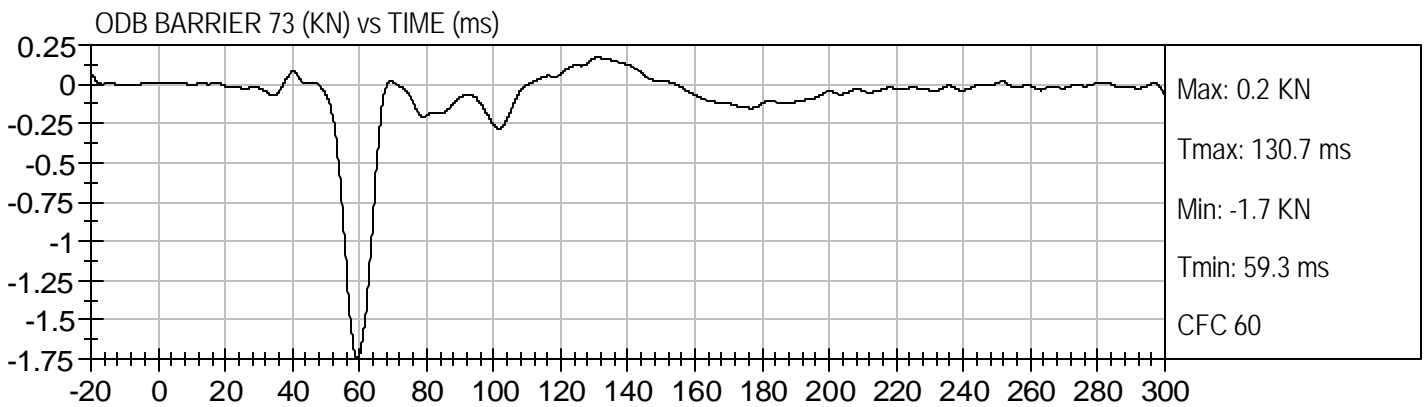


ODB BARRIER 64 (KN) vs TIME (ms)



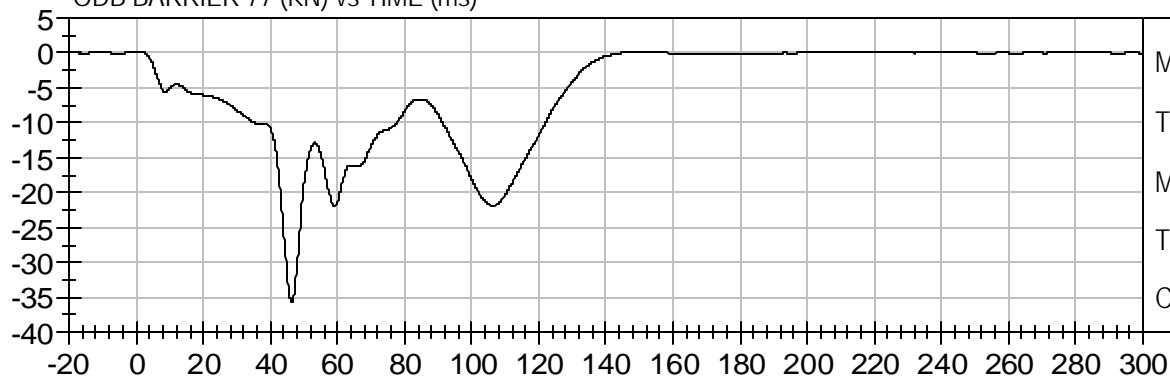






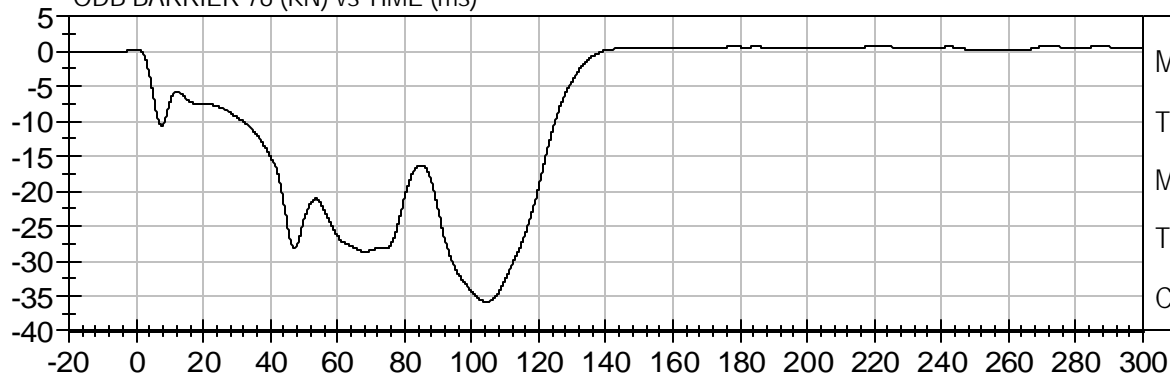


ODB BARRIER 77 (KN) vs TIME (ms)



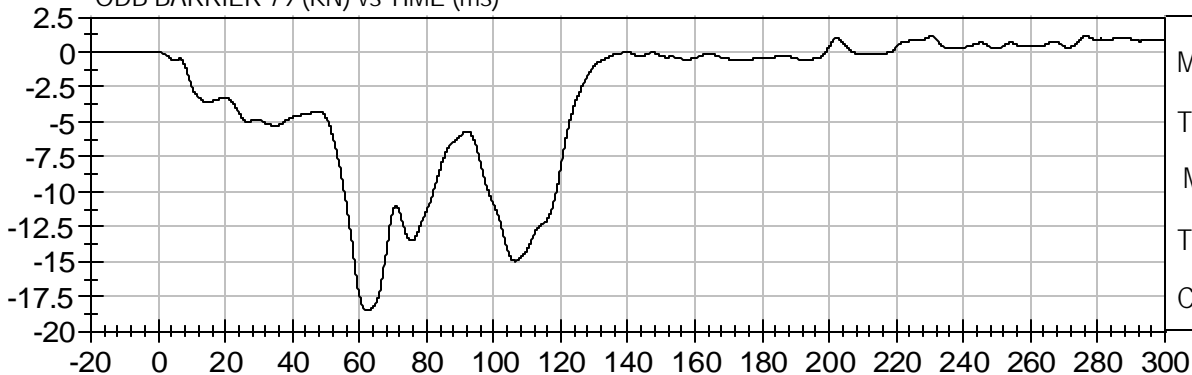
Max: 0.1 KN
Tmax: 0.9 ms
Min: -35.7 KN
Tmin: 46.4 ms
CFC 60

ODB BARRIER 78 (KN) vs TIME (ms)



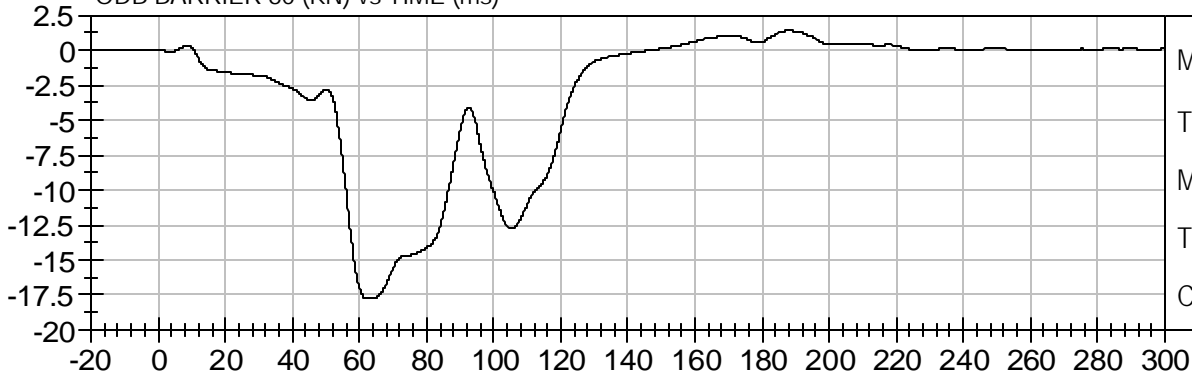
Max: 0.7 KN
Tmax: 272.4 ms
Min: -35.9 KN
Tmin: 104.3 ms
CFC 60

ODB BARRIER 79 (KN) vs TIME (ms)

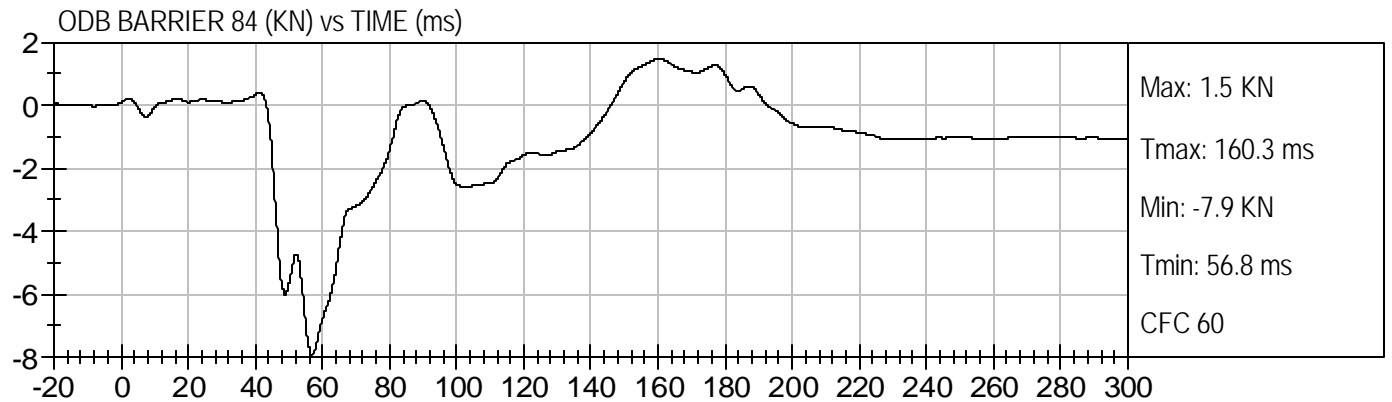
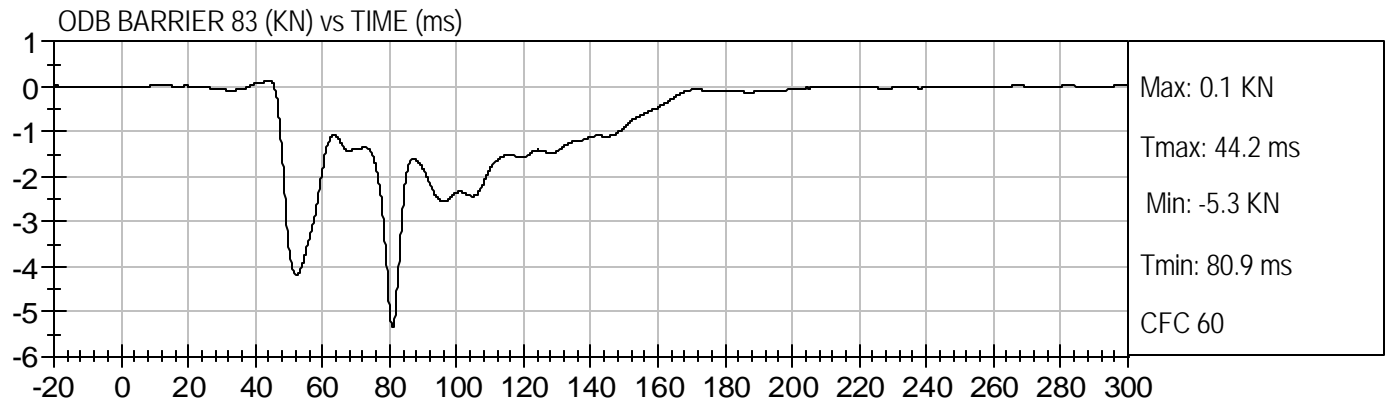
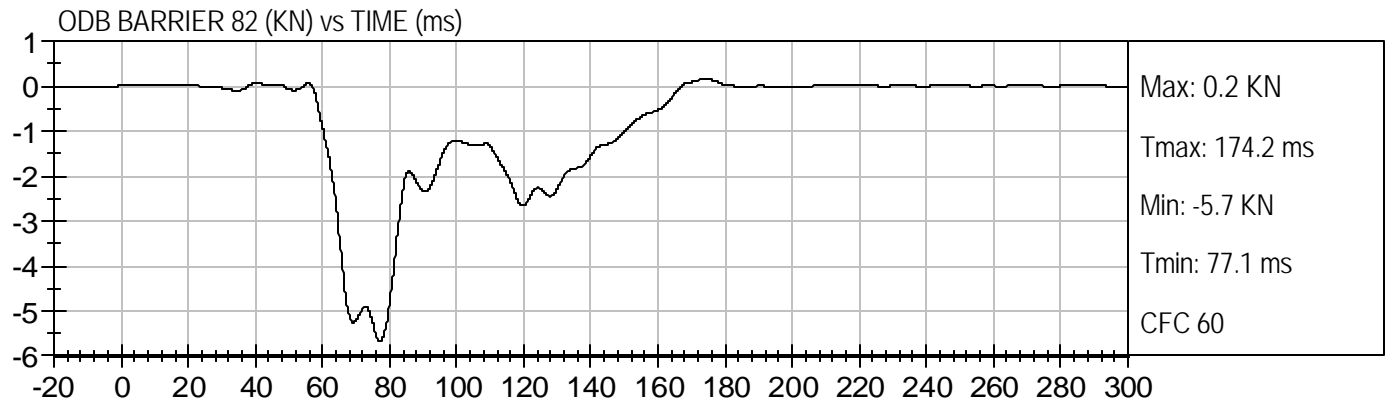
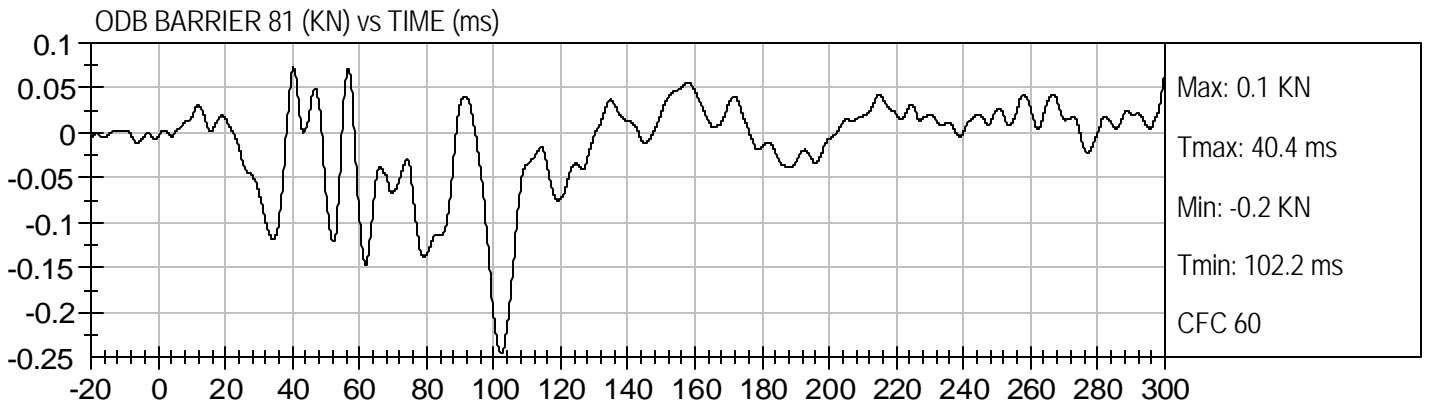


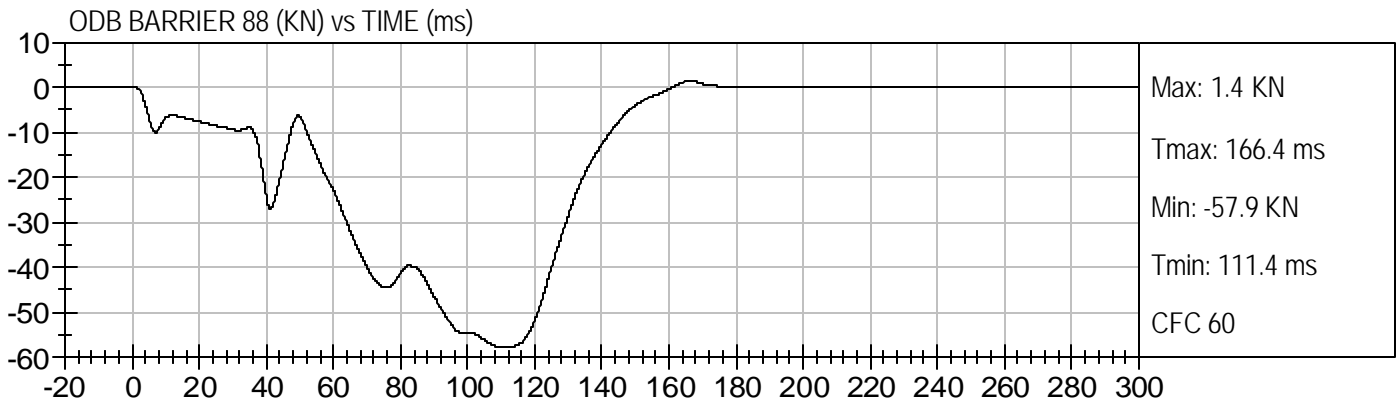
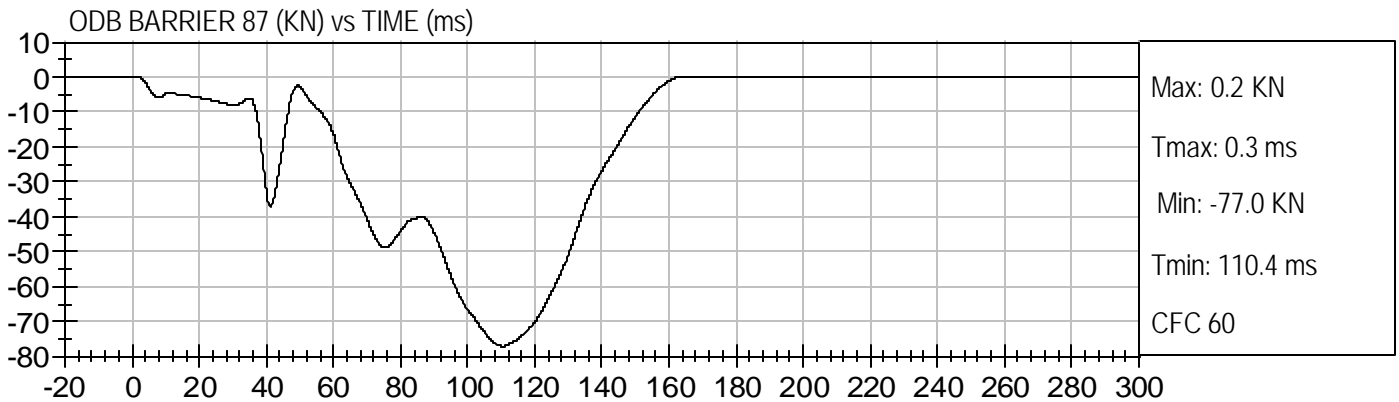
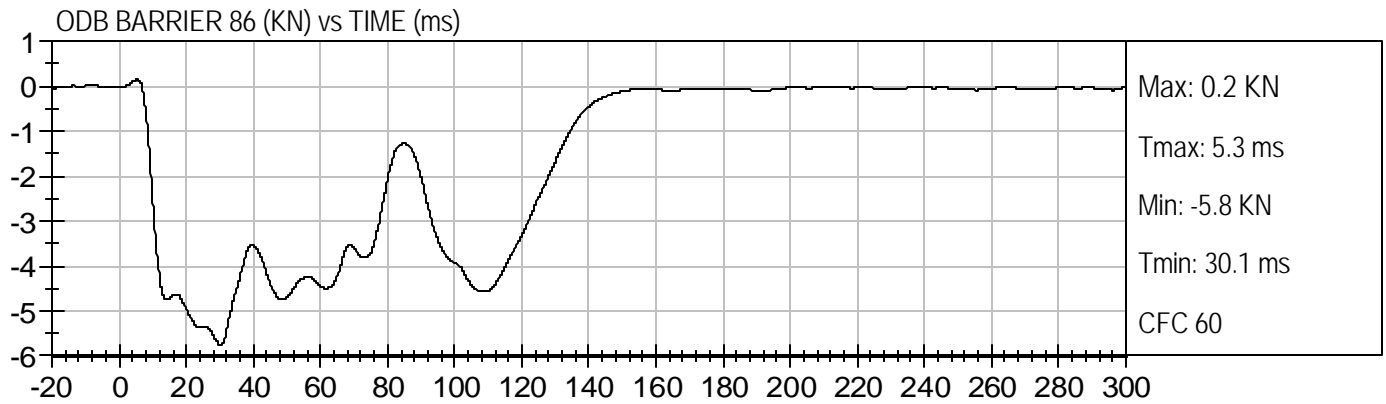
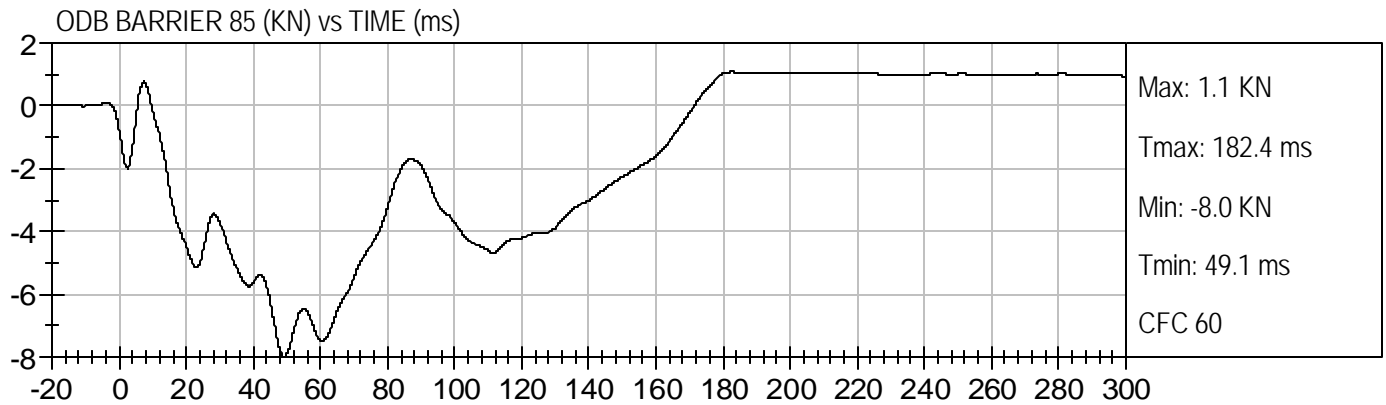
Max: 1.1 KN
Tmax: 276.6 ms
Min: -18.5 KN
Tmin: 62.2 ms
CFC 60

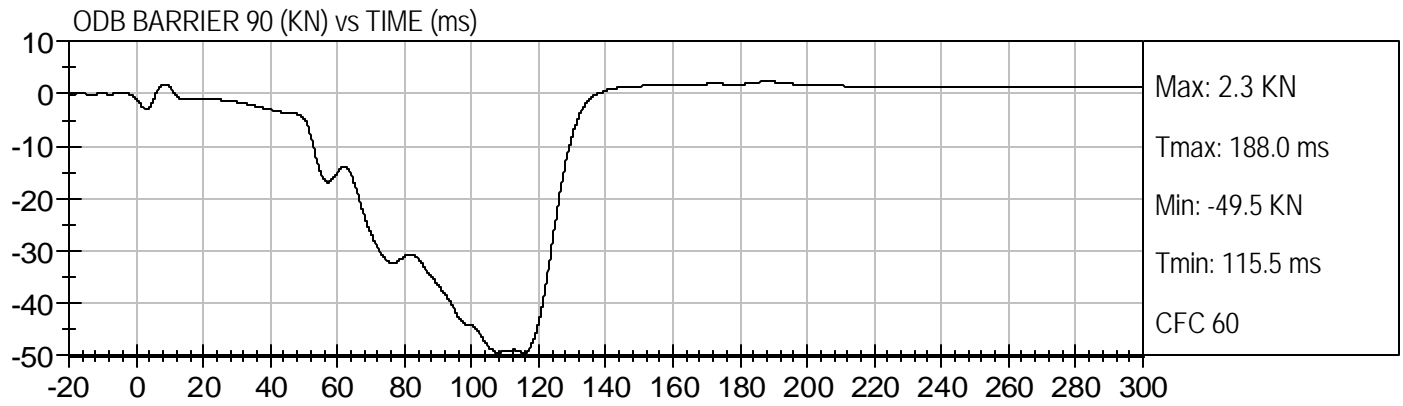
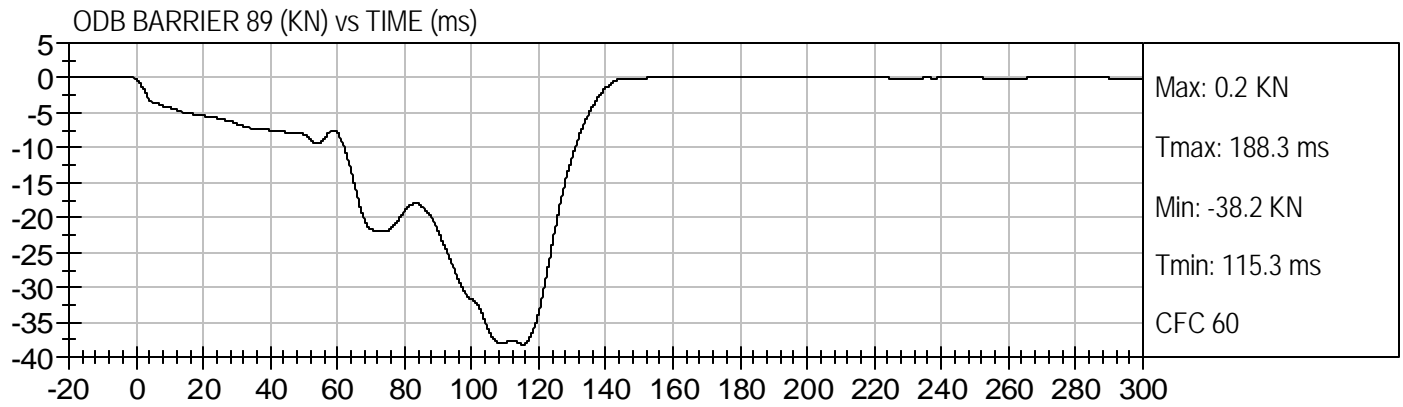
ODB BARRIER 80 (KN) vs TIME (ms)



Max: 1.4 KN
Tmax: 187.7 ms
Min: -17.8 KN
Tmin: 62.8 ms
CFC 60







APPENDIX C

DUMMY CONFIGURATION AND PERFORMANCE VERIFICATION DATA

MGA RESEARCH CORPORATION
HEAD DROP TEST
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 202

Test ID: D08481

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 - 25.6	21.1	Pass
Laboratory Relative Humidity	%	10 to 70	17	Pass
Peak Resultant Acceleration	G's	225 - 275	256	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	2.8	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
Overall Test Results				Pass

Jessica Gall
Laboratory Technician

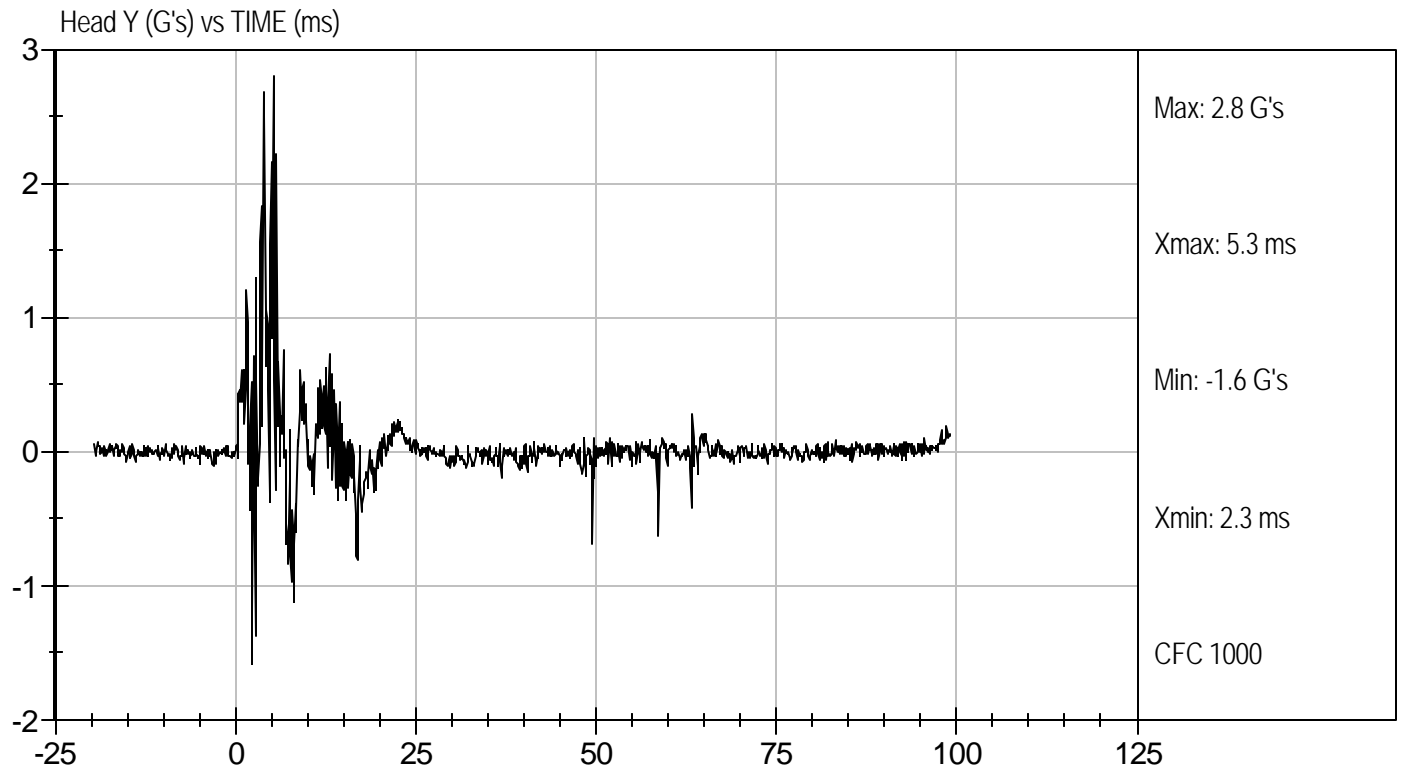
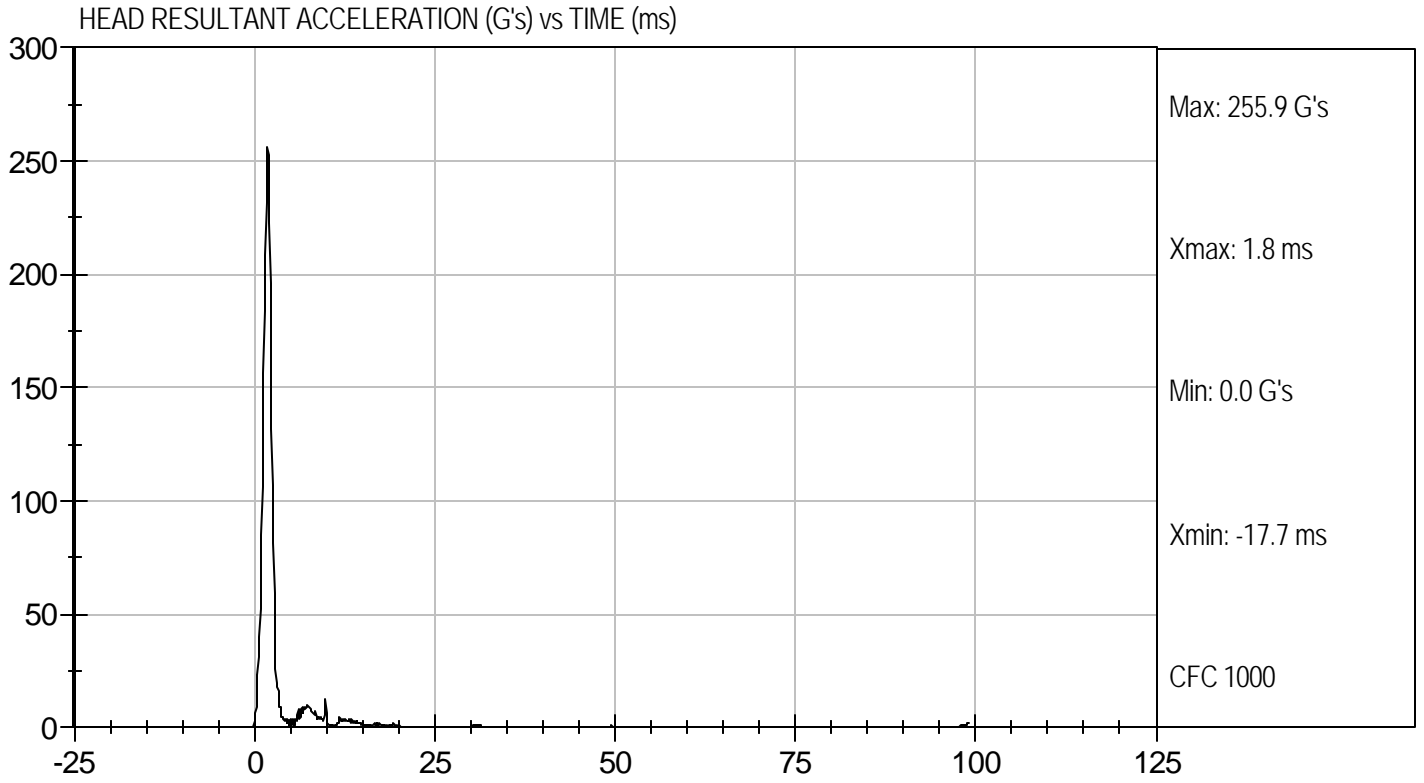
2/27/08
Test Date

David Winkelbauer
Approved By



Test Desc: Head Drop
Component ID: D08481

Test Date: 2/27/08
Velocity: 0 ft/s, 0.00 m/s



MGA RESEARCH CORPORATION
NECK FLEXION TEST
HYBRID III 50TH PERCENTILE MALE


ATD Serial No: 202

Test I.D.: D08482

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	20.6	Pass
Laboratory Relative Humidity		%	10 to 70	13	Pass
Pendulum Velocity		m/s	6.89 to 7.13	7.05	Pass
Pendulum Deceleration	10 msec	G's	22.50 to 27.50	26.22	Pass
	20 msec	G's	17.60 to 22.60	20.16	Pass
	30 msec	G's	12.50 to 18.50	13.66	Pass
Peak Pendulum Deceleration After 30 msec		G's	<= 29.0	14.11	Pass
Deceleration Decay Time to Cross 5 G's		msec	34.0 to 42.0	37.0	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	64.0 to 78.0	72.4	Pass
	Time	msec	57.0 to 64.0	57.6	Pass
"D" Plane Rotation Decay Time To Zero Crossing		msec	113.0 to 128.0	114.8	Pass
Moment About Occipital Condyle	Maximum	N m	88.1 to 108.5	96.0	Pass
	Time	msec	47.0 to 58.0	50.4	Pass
Positive Moment Decay Time To Zero Crossing		msec	97.0 to 107.0	97.6	Pass
Overall Test Results					Pass


 Laboratory Technician

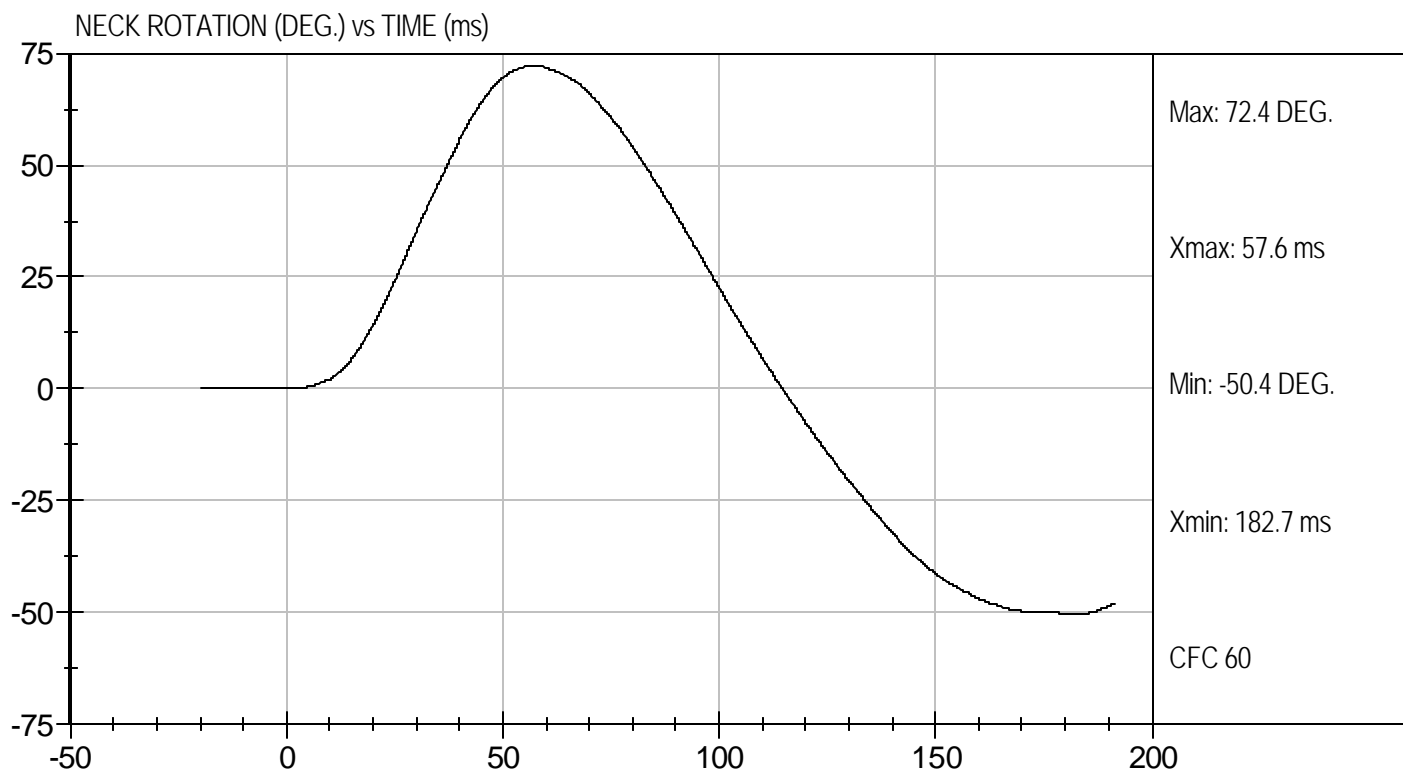
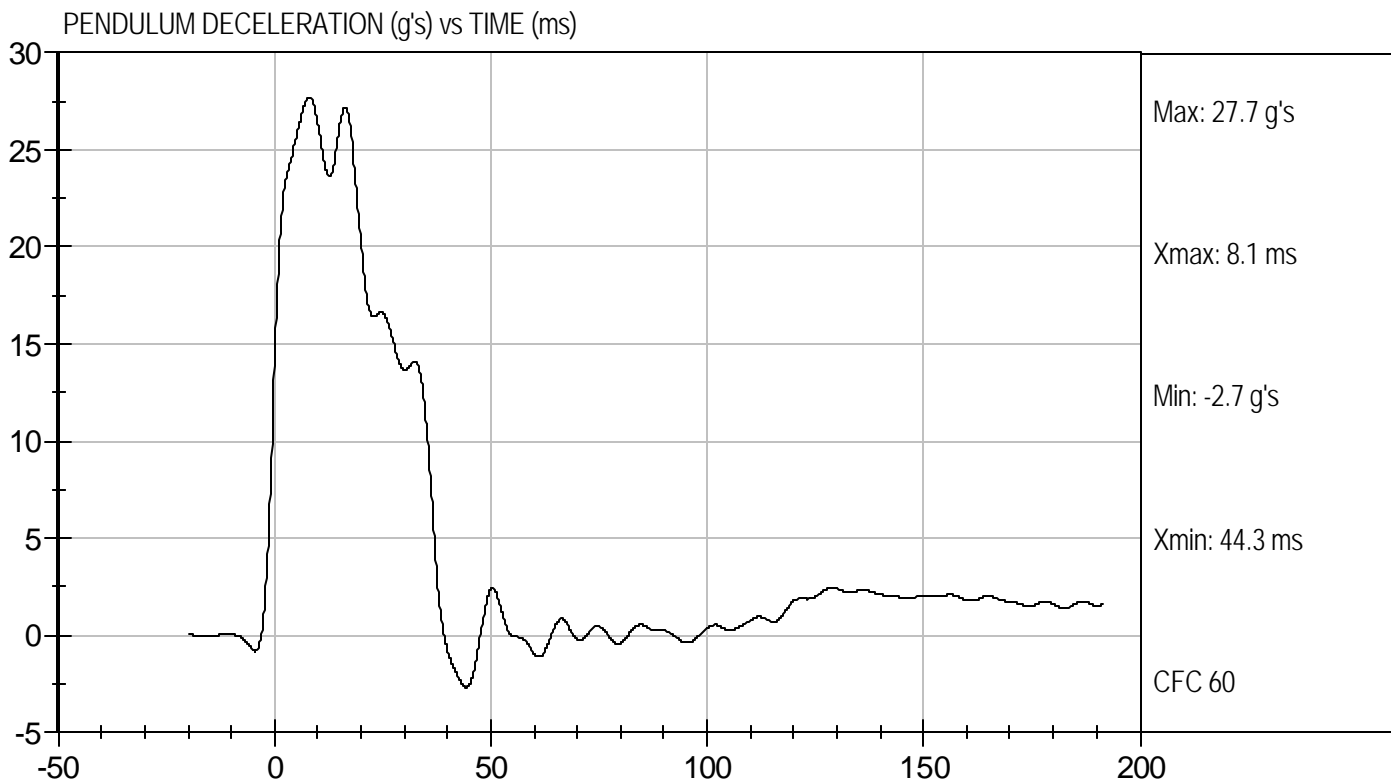
2/28/08
 Test Date


 Approved By



Test Desc: Neck Flexion
Component ID: D08482

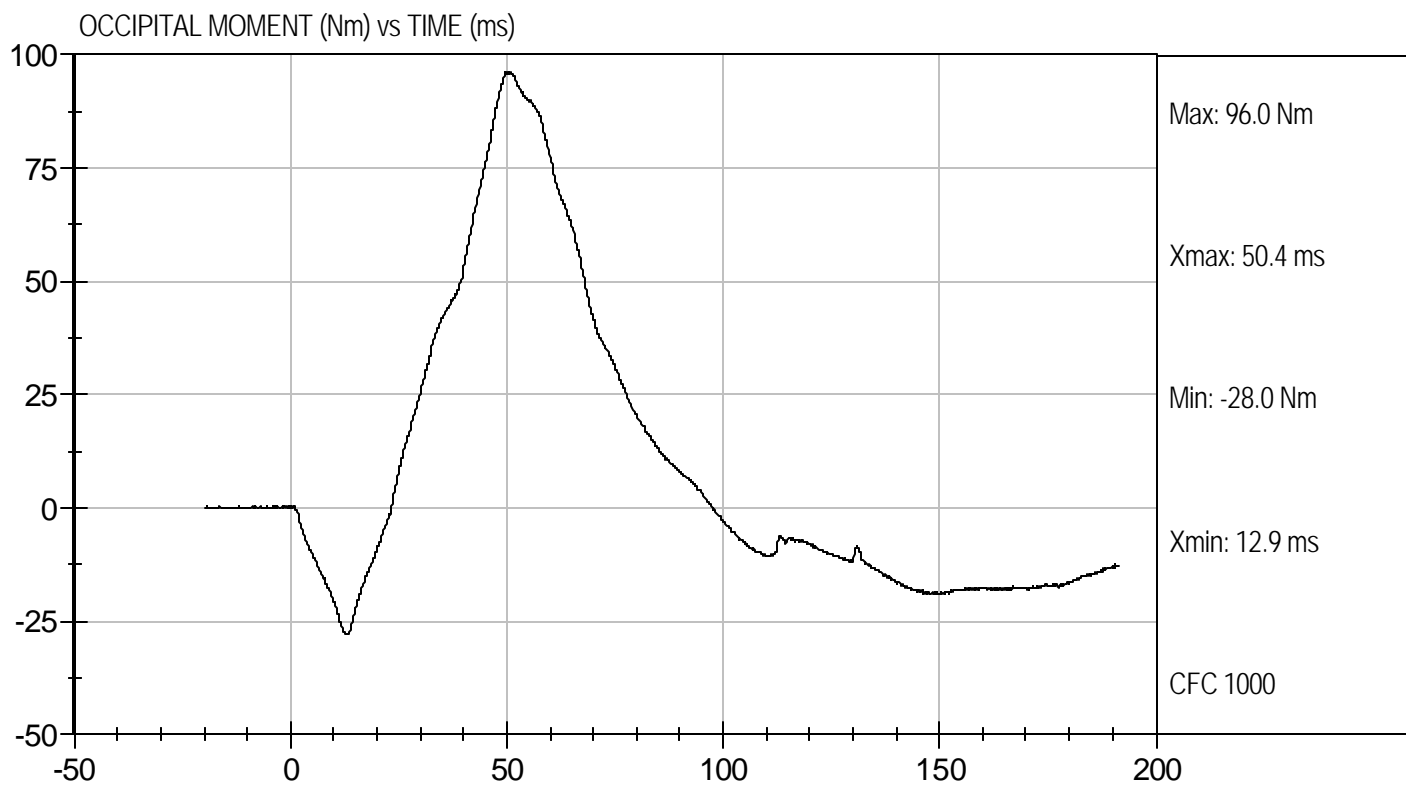
Test Date: 2/28/08
Velocity: 23.14 ft/s, 7.05 m/s





Test Desc: Neck Flexion
Component ID: D08482

Test Date: 2/28/08
Velocity: 23.14 ft/s, 7.05 m/s



**MGA RESEARCH CORPORATION
NECK EXTENSION TEST
HYBRID III 50TH PERCENTILE MALE**


ATD Serial No: 202

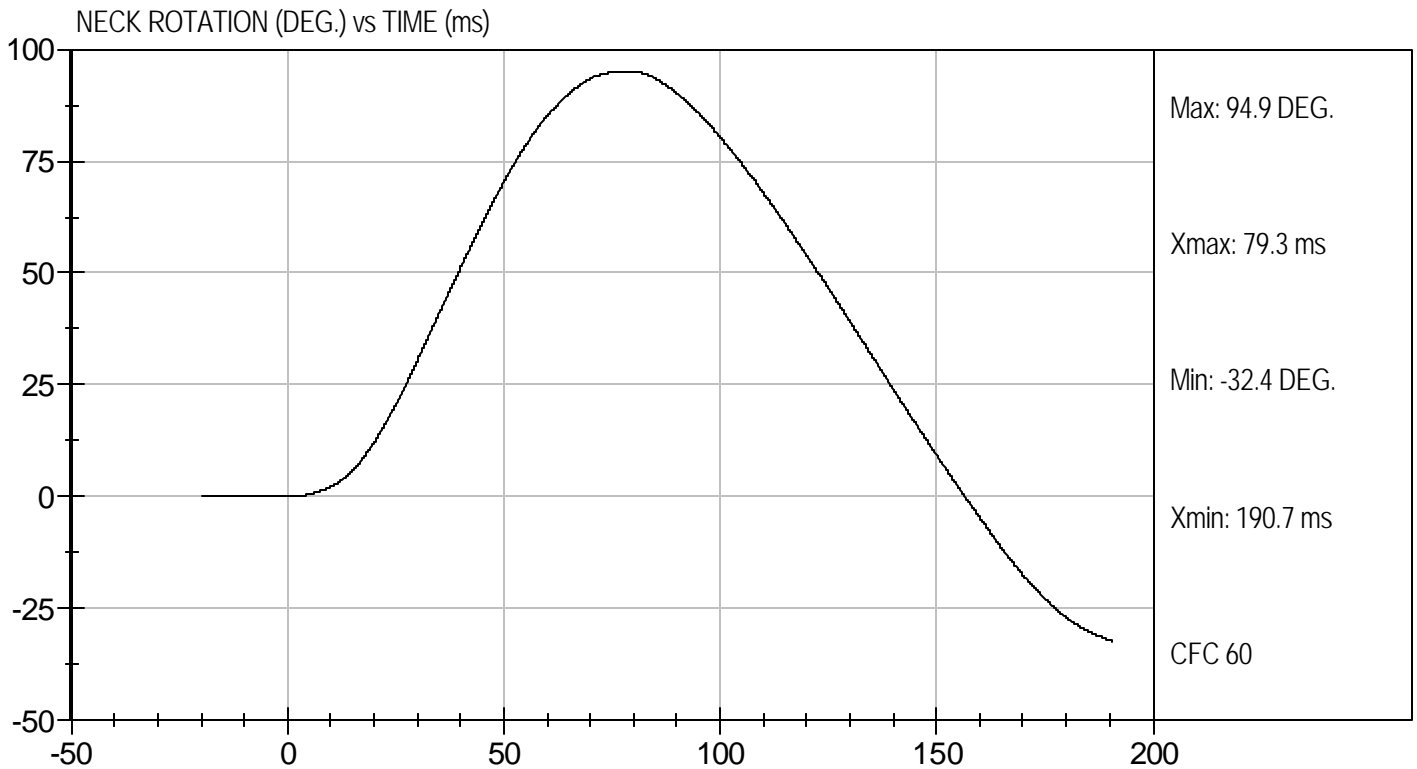
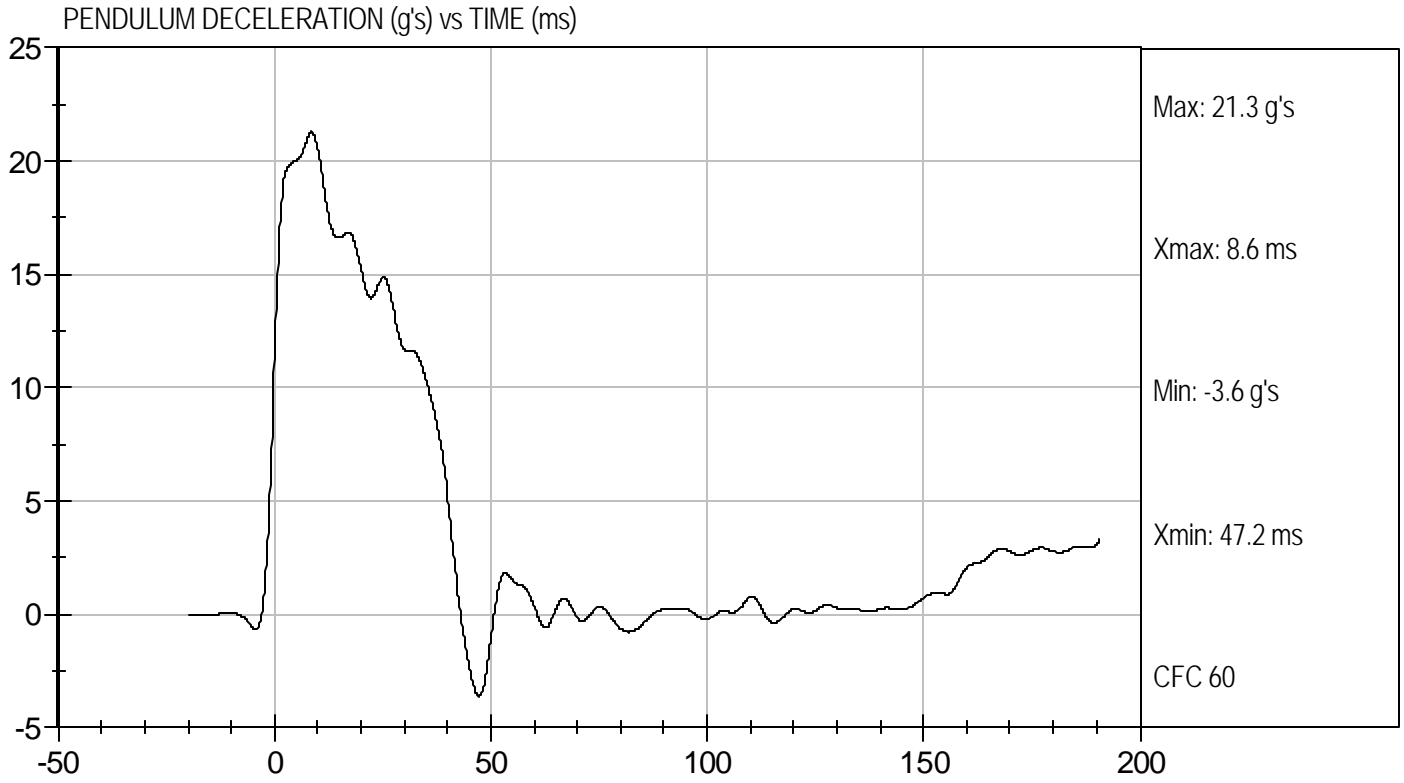
Test I.D.: D08483

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	20.6	Pass
Laboratory Relative Humidity		%	10 to 70	14	Pass
Pendulum Velocity		m/s	5.95 to 6.19	6.12	Pass
Pendulum Deceleration	10 msec	G's	17.20 to 21.20	20.43	Pass
	20 msec	G's	14.00 to 19.00	15.21	Pass
	30 msec	G's	11.00 to 16.00	11.67	Pass
Peak Pendulum Deceleration After 30 msec		G's	<= 22.0	11.65	Pass
Deceleration Decay Time to Cross 5 G's		msec	38.0 to 46.0	40.2	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	81.0 to 106.0	94.9	Pass
	Time	msec	72.0 to 82.0	79.3	Pass
"D" Plane Rotation Decay Time To Zero Crossing		msec	147.0 to 174.0	156.7	Pass
Moment About Occipital Condyle	Maximum	N m	-52.9 to -79.9	-63.0	Pass
	Time	msec	65.0 to 79.0	71.2	Pass
Negative Moment Decay Time To Zero Crossing		msec	120.0 to 148.0	140.7	Pass
Overall Test Results					Pass


Laboratory Technician

2/28/08
Test Date

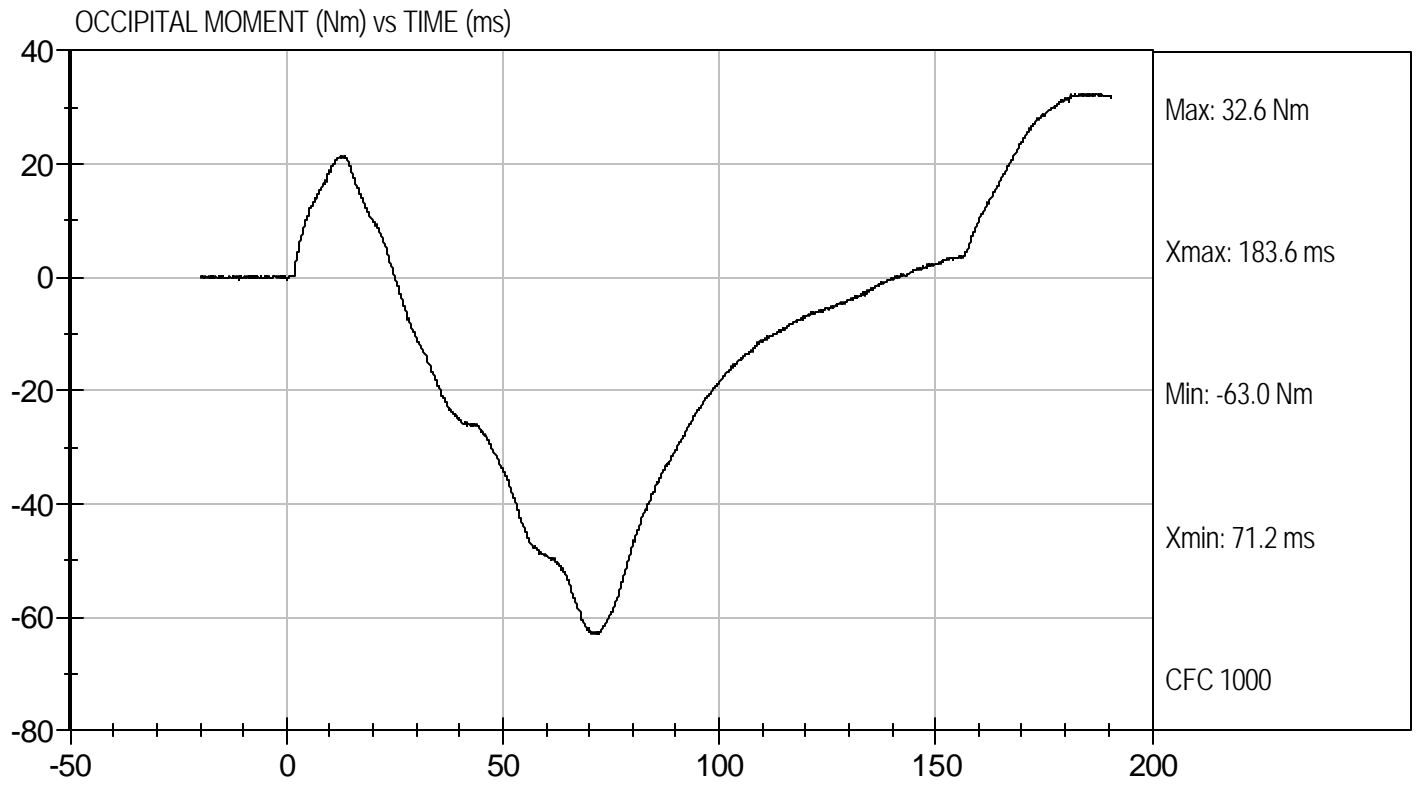

Approved By





Test Desc: Neck Extension
Component ID: D08483

Test Date: 2/28/08
Velocity: 20.08 ft/s, 6.12 m/s



**MGA RESEARCH CORPORATION
THORAX IMPACT
HYBRID III 50TH PERCENTILE MALE**

ATD Serial No: 202

Test I.D: D08484

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	20.7	Pass
Laboratory Relative Humidity	%	10 to 70	17	Pass
Probe Velocity	m/s	6.58 to 6.82	6.77	Pass
Peak Probe Force	N	5159 to 5893	5,715	Pass
Peak Sternum Displacement	cm	6.35 to 7.26	6.48	Pass
Internal Hysteresis	%	69 to 85	71	Pass
Overall Test Results				Pass

Jessica Hall
Laboratory Technician

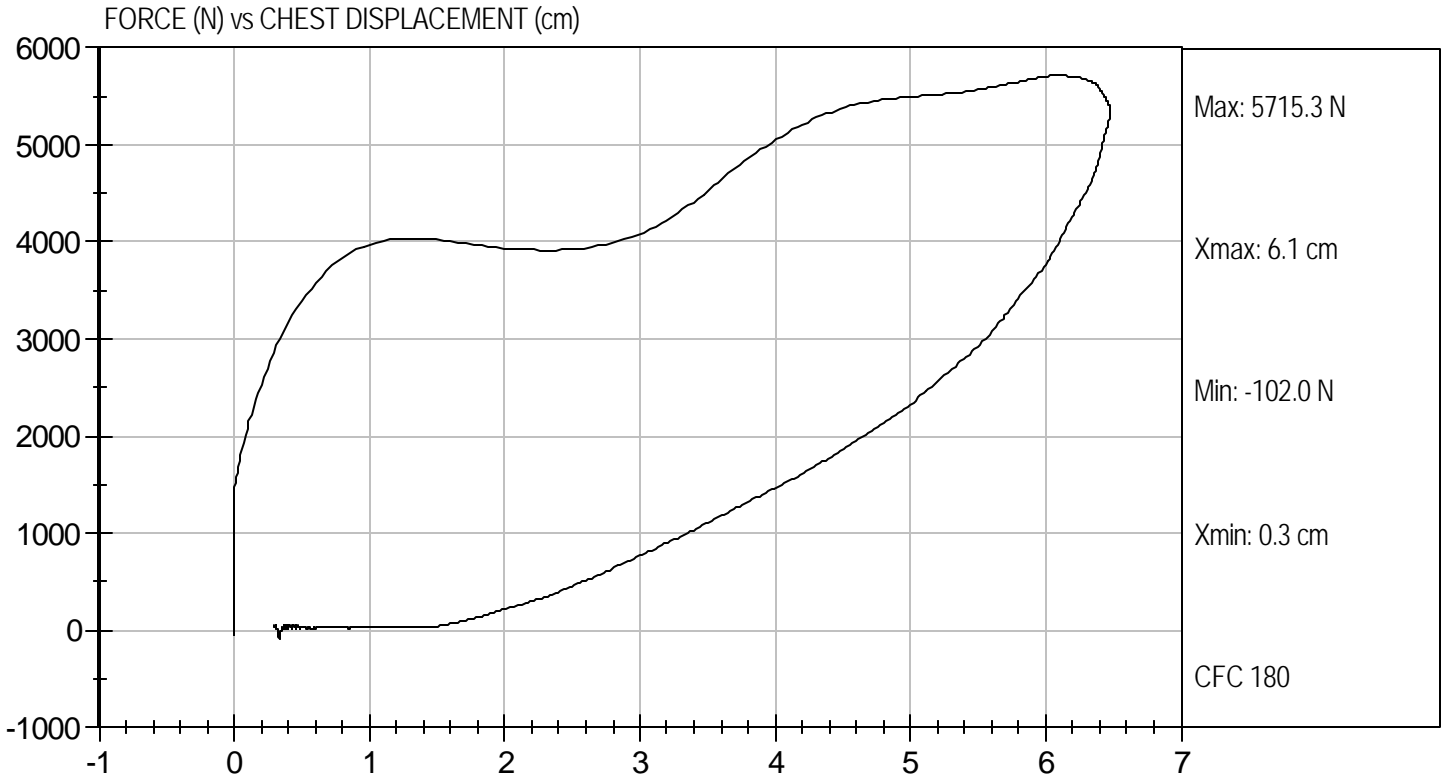
2/27/08
Test Date

David Winkelbauer
Approved By



Test Desc: Thorax Impact
Component ID: D08484

Test Date: 2/27/08
Velocity: 22.22 ft/s, 6.77 m/s



**MGA RESEARCH CORPORATION
RIGHT KNEE IMPACT TEST
HYBRID III 50TH PERCENTILE MALE**

ATD Serial No: 202

Test I.D: D08485

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	20.1	Pass
Laboratory Relative Humidity	%	10 to 70	20	Pass
Probe Velocity	m/sec	2.07 to 2.13	2.10	Pass
Peak Probe Force	Newtons	4715 to 5782	5,346	Pass
Overall Test Results				Pass



Laboratory Technician

3/4/08

Test Date

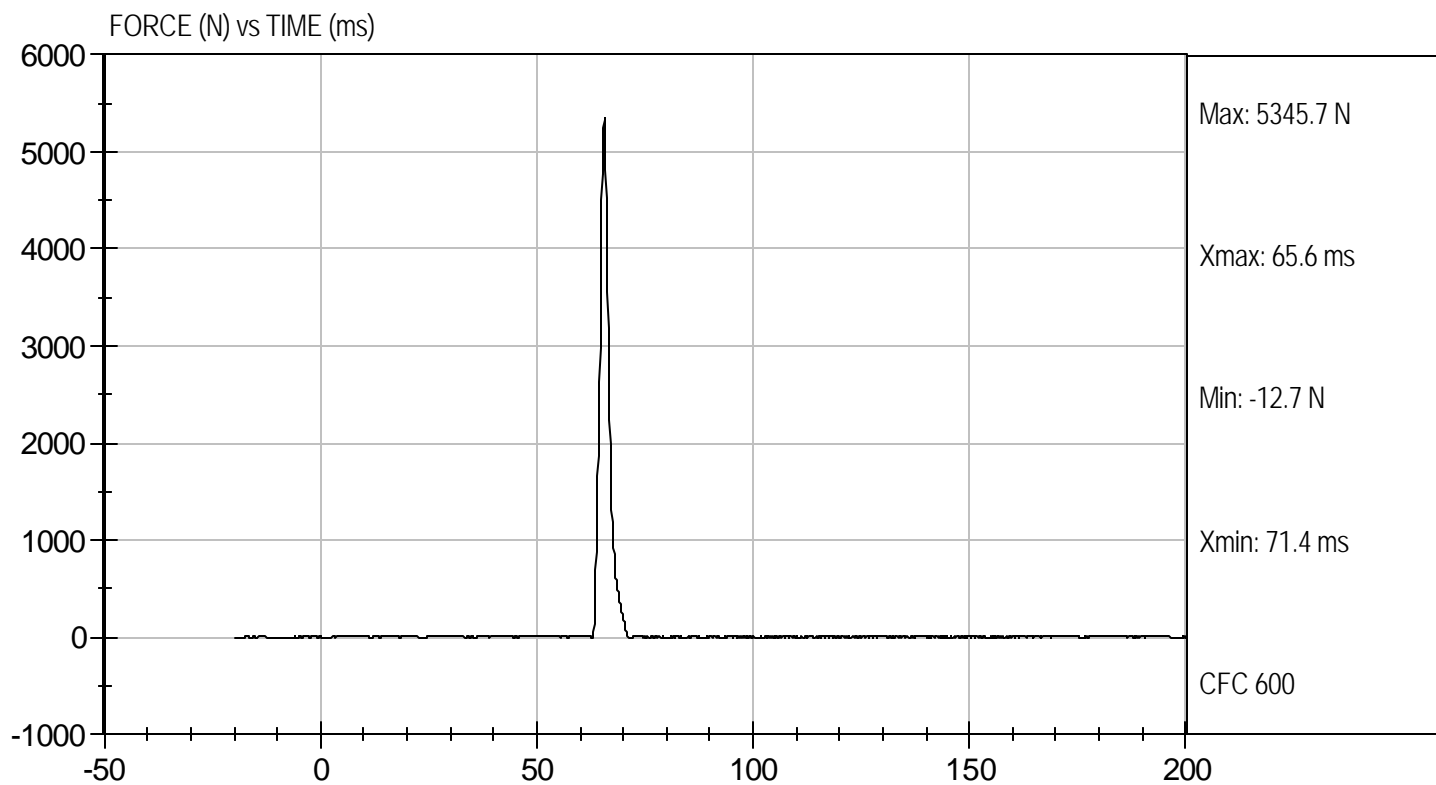


Approved By



Test Desc: Right Knee
Component ID: D08485

Test Date: 3/4/08
Velocity: 6.89 ft/s, 2.10 m/s



MGA RESEARCH CORPORATION
LEFT KNEE IMPACT TEST
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 202

Test I.D: D08486

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	20.1	Pass
Laboratory Relative Humidity	%	10 to 70	20	Pass
Probe Velocity	m/sec	2.07 to 2.13	2.10	Pass
Peak Probe Force	Newtons	4715 to 5782	5,223	Pass
Overall Test Results				Pass



Laboratory Technician

3/4/08

Test Date

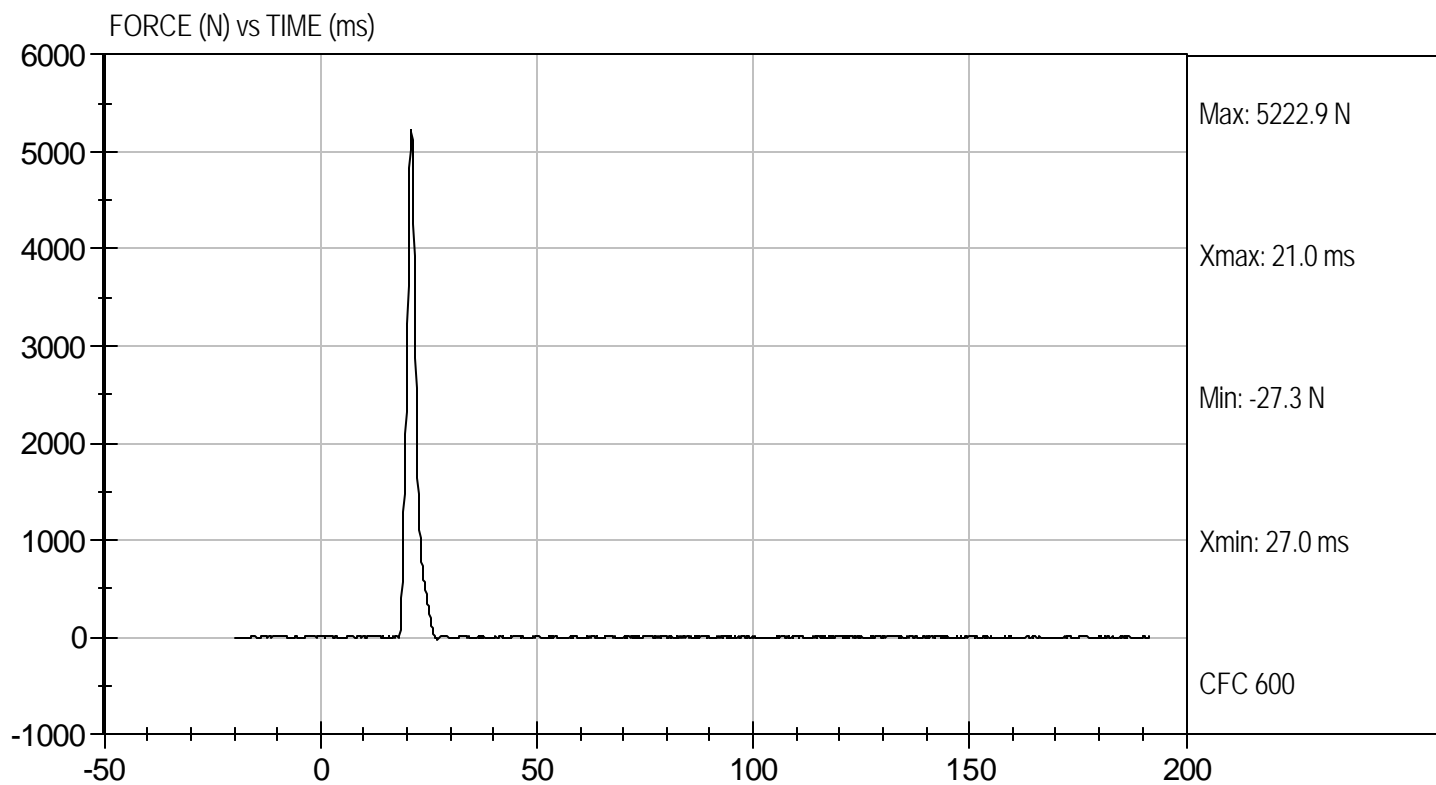


Approved By



Test Desc: Left Knee
Component ID: D08486

Test Date: 3/4/08
Velocity: 6.89 ft/s, 2.10 m/s



MGA RESEARCH CORPORATION
HIP-FEMUR FLEXION TEST
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 202

Test I.D: D08480

Tested Parameter	Units	Specification	Result		Pass/Fail
			Right	Left	
Laboratory Temperature	deg C	18.9 to 25.6	21.3	21.3	Pass
Laboratory Relative Humidity	%	10 to 70	17	17	Pass
Rotation Rate	deg/sec	5 -10	8	8	Pass
30 Degrees	Nm	94.9 Nm Max	86.5	83.6	Pass
150 ft-lbf / 203.4 Nm	Deg	40- 50 Degree Max Rotation	41	43	Pass
Overall Test Results					Pass



Laboratory Technician

2/27/08

Test Date

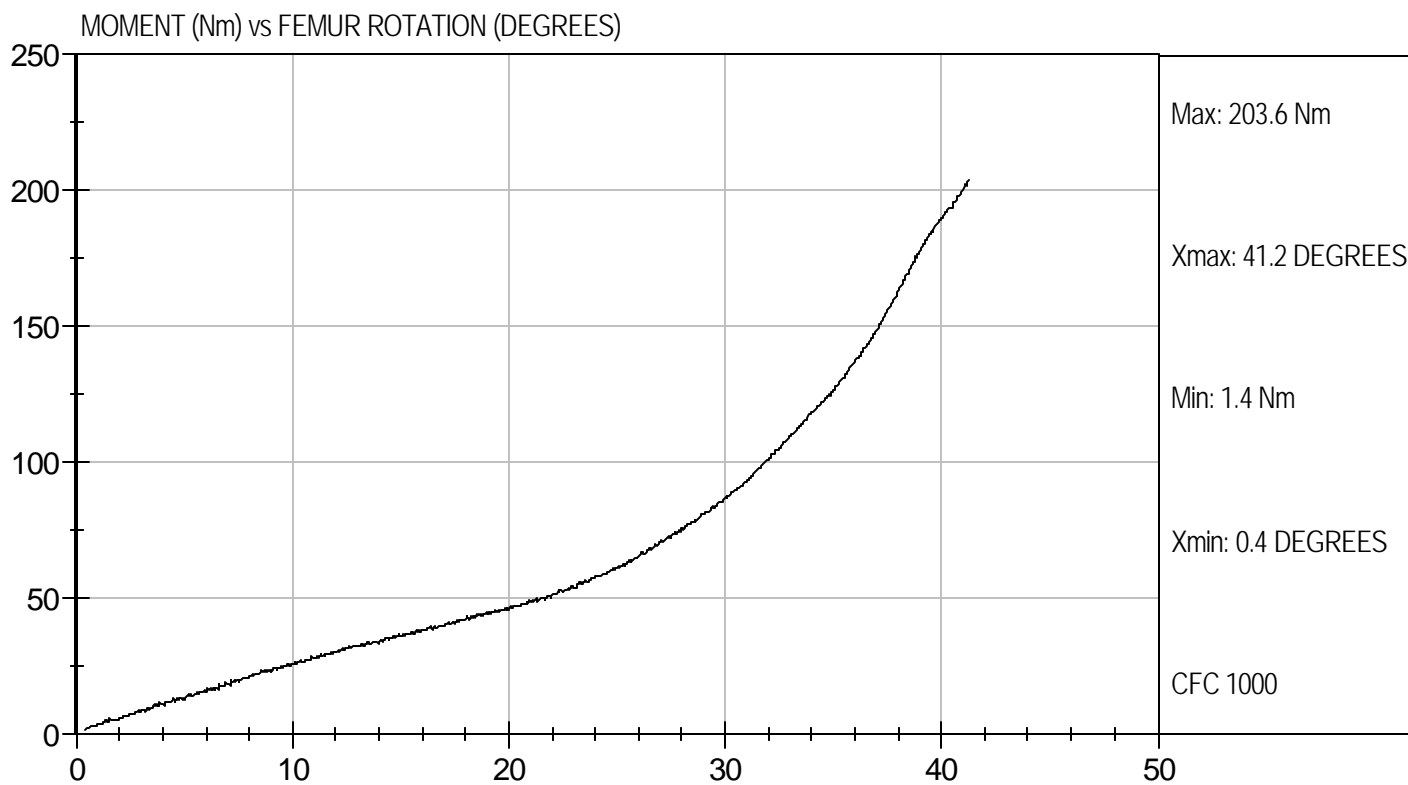


Approved By



Test Desc: Hip Femur Flexion
Component ID: D08489

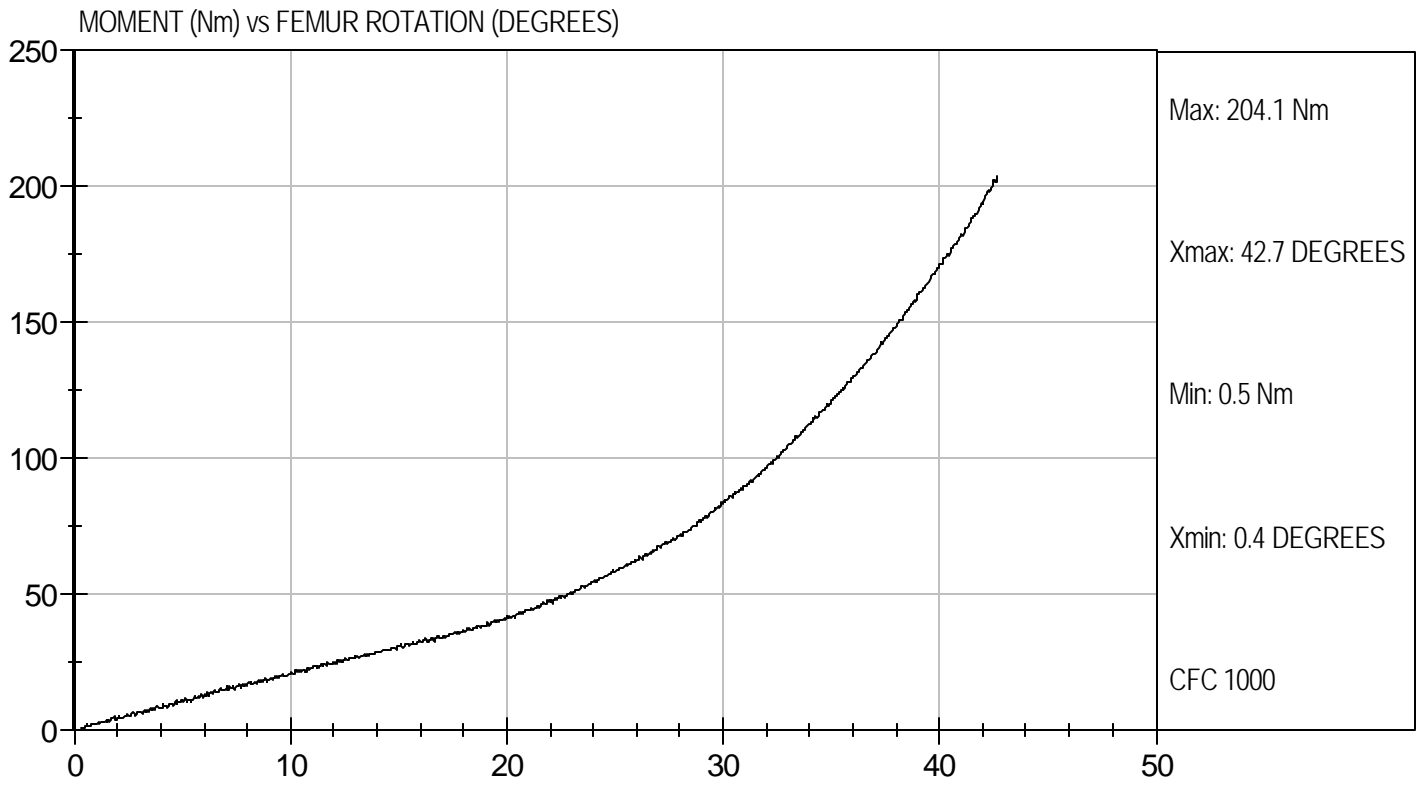
Test Date: 2/27/08
Velocity: 0 ft/s, 0.00 m/s





Test Desc: Hip Femur Flexion
Component ID: D08480

Test Date: 2/27/08
Velocity: 0 ft/s, 0.00 m/s



CERTIFICATION DATA

THOR Lx Legs #036 & #037

Installed in Hybrid III 50th Percentile Male Dummy #202

GESAC, INC

DESIGN | MANUFACTURE | TEST | SOFTWARE DEVELOPMENT | ERGONOMICS
 125 Orchard Drive, Boonsboro, MD 21713
 Tel (301) 432-5885 Fax (301) 432-6199

Thor-LX Test Report

Dynamic Ball of Foot Impact Test (page 1)

Engineer	S.Kamalakkannan	Test Date	February 27, 2008
Customer	MGA	Temp (C)/Hum.(%)	21.7/23
Description	Right Lower Extremities	Serial No.	LX037

Testing Summary

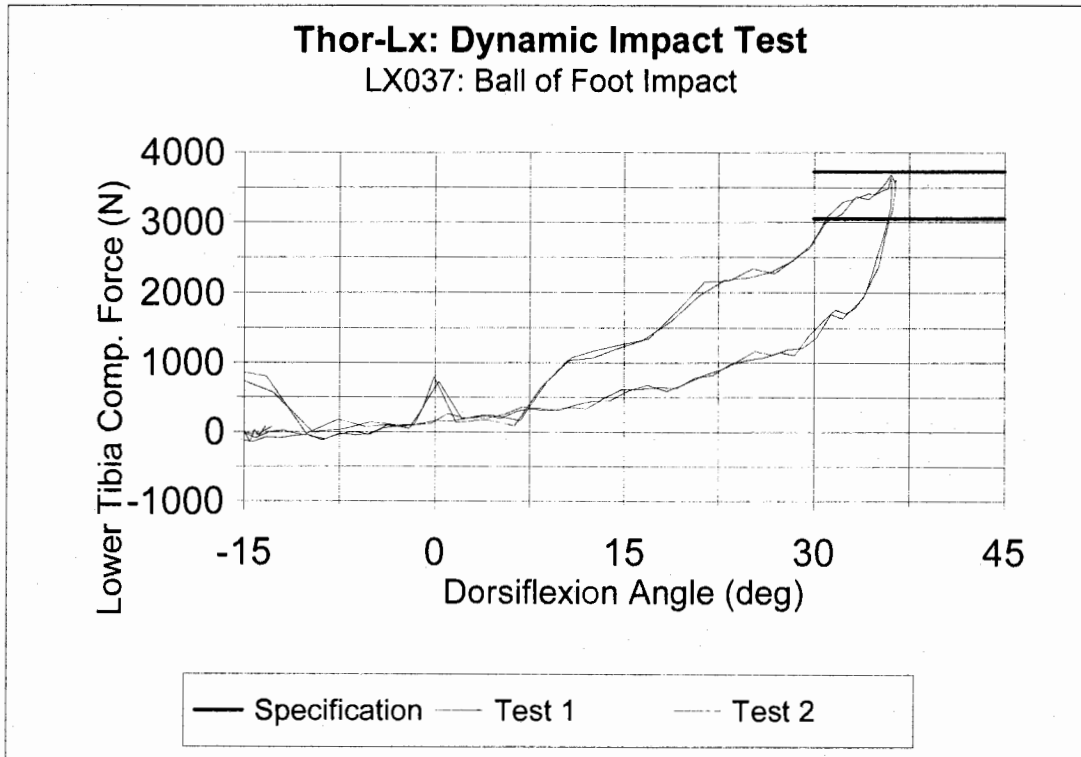
Impact Speed	5.0 m/s	Scan Rate	10000 scans/sec
Impact Effective Mass	5.0 kg	Filter	CFC 600
Impactor	NHTSA Dynamic Impactor (TLX-9000-013)		

Response

Peak Lower Tibia Compressive Force* (N)	Specification (N)	Within Reference
3667	3058 - 3738	Yes

*Average Value

Test Plot



Tested by: <u>K. Sulh B.L.</u>	Date: <u>2/27/08</u>
Analyzed by: <u>K. Sulh B.L.</u>	Date: <u>2/27/08</u>

GESAC, INC

DESIGN | MANUFACTURE | TEST | SOFTWARE DEVELOPMENT | ERGONOMICS

125 Orchard Drive, Boonsboro, MD 21713

Tel (301) 432-5885

Fax (301) 432-6199

Thor-LX Test Report

Dynamic Ball of Foot Impact Test (page 2)

Engineer S.Kamalakkannan
Customer MGA
Description Right Lower Extremities

Test Date February 27, 2008
Temp (C)/Hum.(%) 21.7/23
Serial No. LX037

Testing Summary

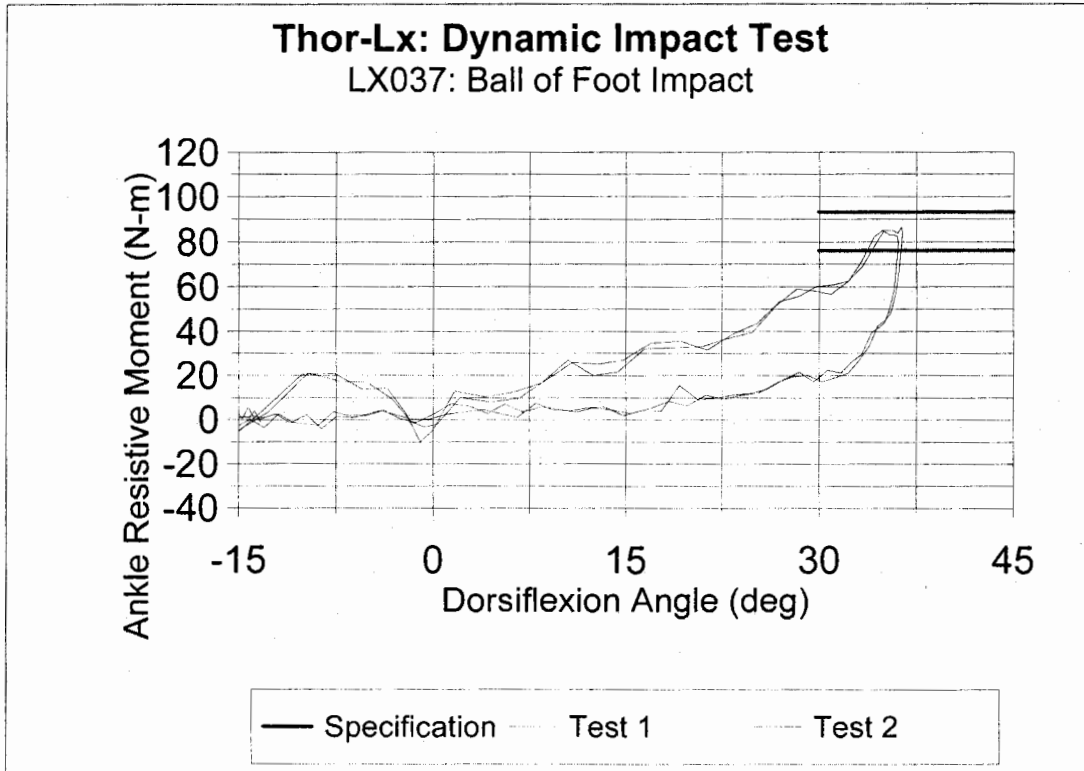
Impact Speed	5.0 m/s	Scan Rate	10000 scans/sec
Impact Effective Mass	5.0 kg	Filter	CFC 600
Impactor	NHTSA Dynamic Impactor (TLX-9000-013)		

Response

Peak Ankle Resistive Moment* (N-m)	Specification (N-m)	Within Reference
85.8	76.2 - 93.2	Yes

*Average Value

Test Plot



Tested by: K. Sults Bil.

Date: 2/27/08

Analyzed by: K. Sults Bil.

Date: 2/27/08

GESAC, INC

DESIGN | MANUFACTURE | TEST | SOFTWARE DEVELOPMENT | ERGONOMICS

125 Orchard Drive, Boonsboro, MD 21713
 Tel (301) 432-5885 Fax (301) 432-6199

Thor-LX Test Report

Dynamic Heel of Foot Impact Test

Engineer S.Kamalakkannan
Customer MGA
Description Right Lower Extremities

Test Date February 27, 2008
Temp (C)/Hum.(%) 20.7/23
Serial No. LX037

Testing Summary

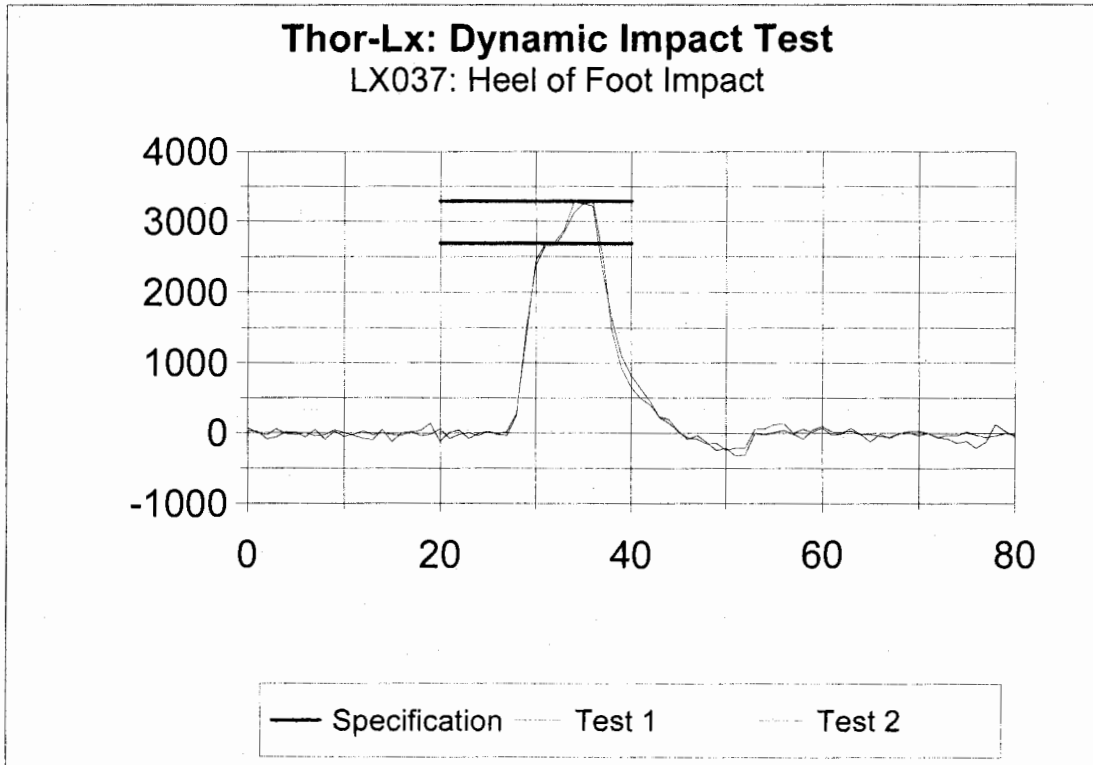
Impact Speed	4.0 m/s	Scan Rate	10000 scans/sec
Impact Effective Mass	5.0 kg	Filter	CFC 600
Impactor	NHTSA Dynamic Impactor (TLX-9000-013)		

Response

Peak Lower Tibia Compressive Force* (N)	Specification (N)	Within Reference
3272	2694 - 3292	Yes

*Average Value

Test Plot



Tested by: K. Sulh Bil Date: 2/27/08
 Analyzed by: K. Sulh Bil Date: 2/27/08

GESAC, INC

DESIGN | MANUFACTURE | TEST | SOFTWARE DEVELOPMENT | ERGONOMICS

125 Orchard Drive, Boonsboro, MD 21713

Tel (301) 432-5885 Fax (301) 432-6199

Thor-Lx Test Report

Inversion Quasi-Static Test

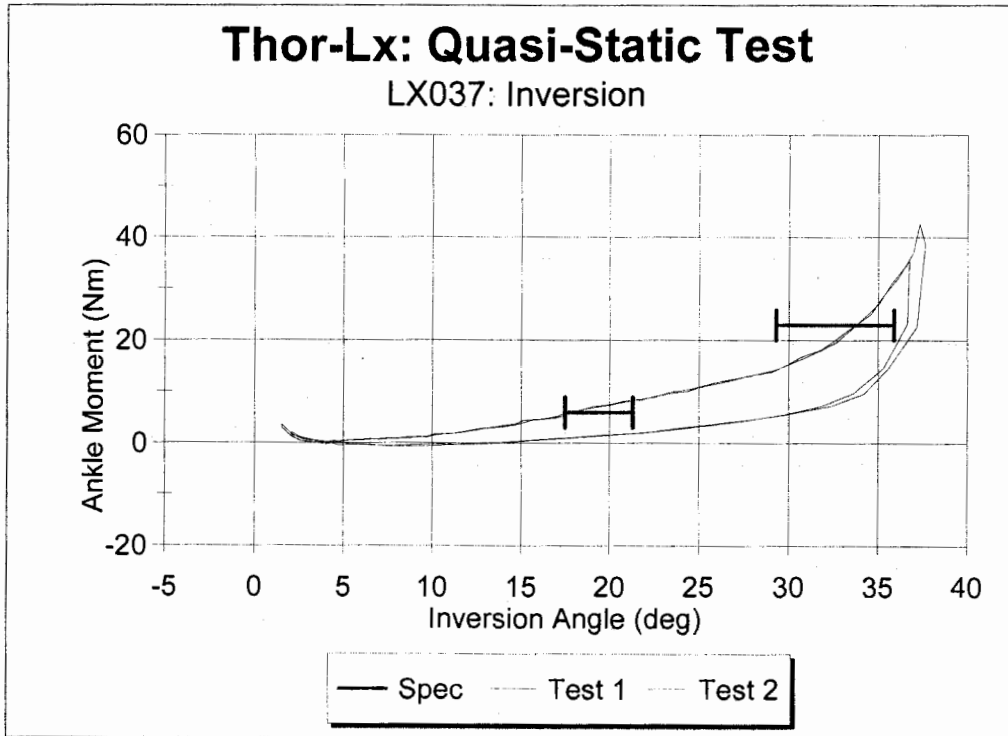
Engineer	S.Kamalakkannan	Test Date	February 28, 2008
Customer	MGA	Temp. (C)/Hum.(%)	20.7/20
Description	Right Lower Extremity	Serial No.	LX037

Testing Summary (Design Reference)

Ankle Moment (Nm)	Inversion Angle (Degree)	Reference Specification (Degree)	Within Reference?
6	17.8	17.5 - 21.3	Yes
23	33.8	29.3 - 35.9	Yes

*Average Value

Result Plot



Tested by: K. Sulh Bel
 Analyzed by: K. Sulh Bel

Date: 2/28/08
 Date: 2/28/08

GESAC, INC

DESIGN | MANUFACTURE | TEST | SOFTWARE DEVELOPMENT | ERGONOMICS

125 Orchard Drive, Boonsboro, MD 21713

Tel (301) 432-5885 Fax (301) 432-6199

Thor-Lx Test Report

Eversion Quasi-Static Test

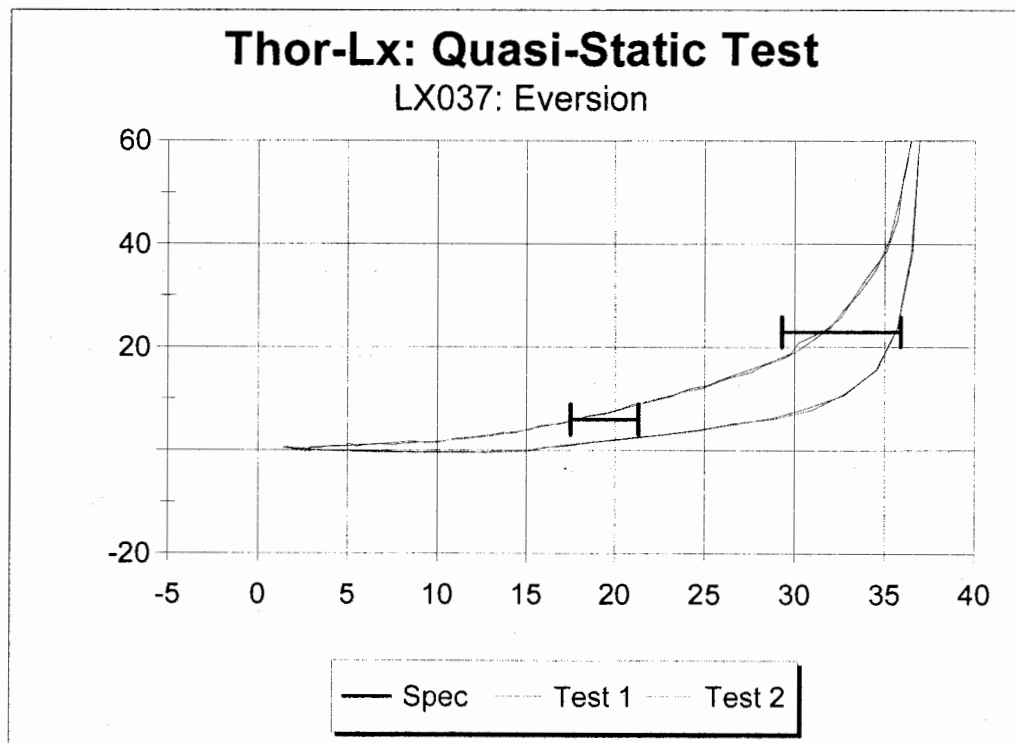
Engineer	S.Kamalakkannan	Test Date	February 28, 2008
Customer	MGA	Temp. (C)/Hum.(%)	20.7/23
Description	Right Lower Extremity	Serial No.	LX037

Testing Summary (Design Reference)

Ankle Moment (Nm)	Eversion Angle (Degree)	Reference Specification (Degree)	Within Reference?
6	17.8	17.5 - 21.3	Yes
23	31.6	29.3 - 35.9	Yes

*Average Value

Result Plot



Tested by: K. Sathya B.

Date: 2/28/08

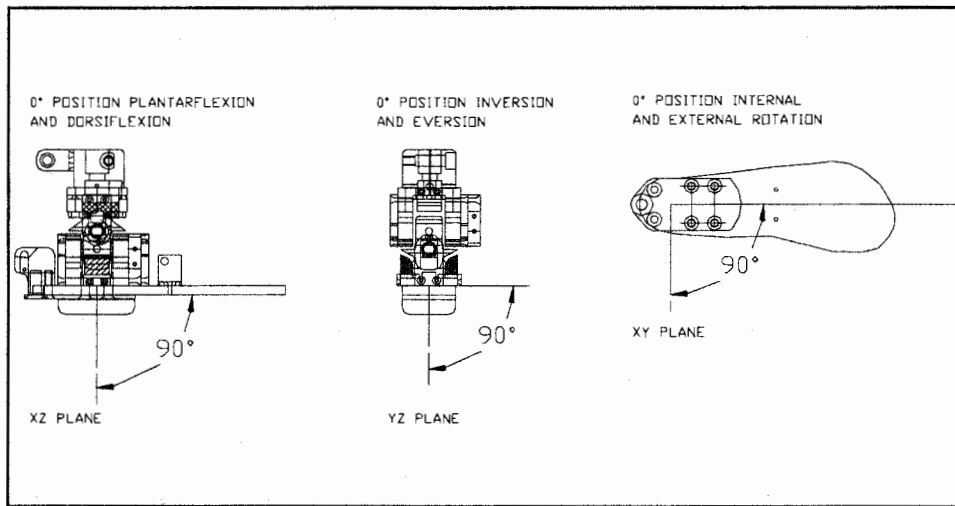
Analyzed by: K. Sathya B.

Date: 2/28/08

THOR - LX Rotary Potentiometer Calibration

The figure below shows the three primary calibration positions for the THOR-LX Rotary Potentiometer Units.

The following table provides the expected potentiometer outputs at 10V excitation for each of the positions shown in the Figure below. The X potentiometer measures inversion / eversion rotation; the Y potentiometer measures dorsiflexion / plantarflexion rotation, and the Z potentiometer measures internal and external rotation. The voltage for each potentiometer should be verified at the zero position prior to testing.



Rotary Potentiometer Calibrations for Right Leg - Serial # LX-037

Pot	Rotary Pot Serial #	Sensitivity at 10 V Excitation	Units	Volts @ 0 Position	Units
X	PD210-4B 7921-0368	31.71	Volts/Degree	5.01	Volts
Y	PD210-4B 7921-0369	32.10	Volts/Degree	4.92	Volts
Z	PD210-4B 7921-0370	31.88	Volts/Degree	4.90	Volts

GESAC, INC

DESIGN | MANUFACTURE | TEST | SOFTWARE DEVELOPMENT | ERGONOMICS
 125 Orchard Drive, Boonsboro, MD 21713
 Tel (301) 432-5885 Fax (301) 432-6199

Thor-LX Test Report

Dynamic Ball of Foot Impact Test (page 1)

Engineer	S.Kamalakkannan	Test Date	February 26, 2008
Customer	MGA	Temp (C)/Hum.(%)	21.7/21
Description	Left Lower Extremities	Serial No.	LX036

Testing Summary

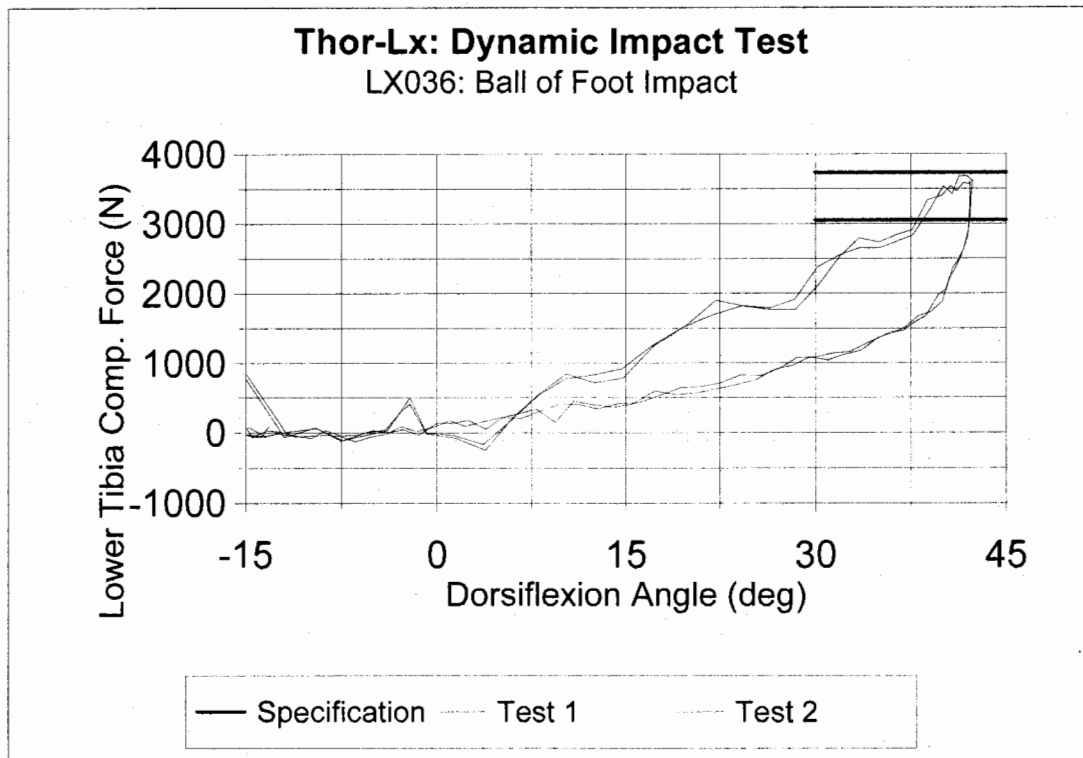
Impact Speed	5.0 m/s	Scan Rate	10000 scans/sec
Impact Effective Mass	5.0 kg	Filter	CFC 600
Impactor	NHTSA Dynamic Impactor (TLX-9000-013)		

Response

Peak Lower Tibia Compressive Force* (N)	Specification (N)	Within Reference
3645	3058 - 3738	Yes

*Average Value

Test Plot



Tested by: H. Subh B.L.

Date: 2/26/08

Analyzed by: H. Subh B.L.

Date: 2/26/08

GESAC, INC

DESIGN | MANUFACTURE | TEST | SOFTWARE DEVELOPMENT | ERGONOMICS

125 Orchard Drive, Boonsboro, MD 21713

Tel (301) 432-5885

Fax (301) 432-6199

Thor-LX Test Report

Dynamic Ball of Foot Impact Test (page 2)

Engineer S.Kamalakkannan
Customer MGA
Description Left Lower Extremities

Test Date February 26, 2008
Temp (C)/Hum.(%) 21.7/21
Serial No. LX036

Testing Summary

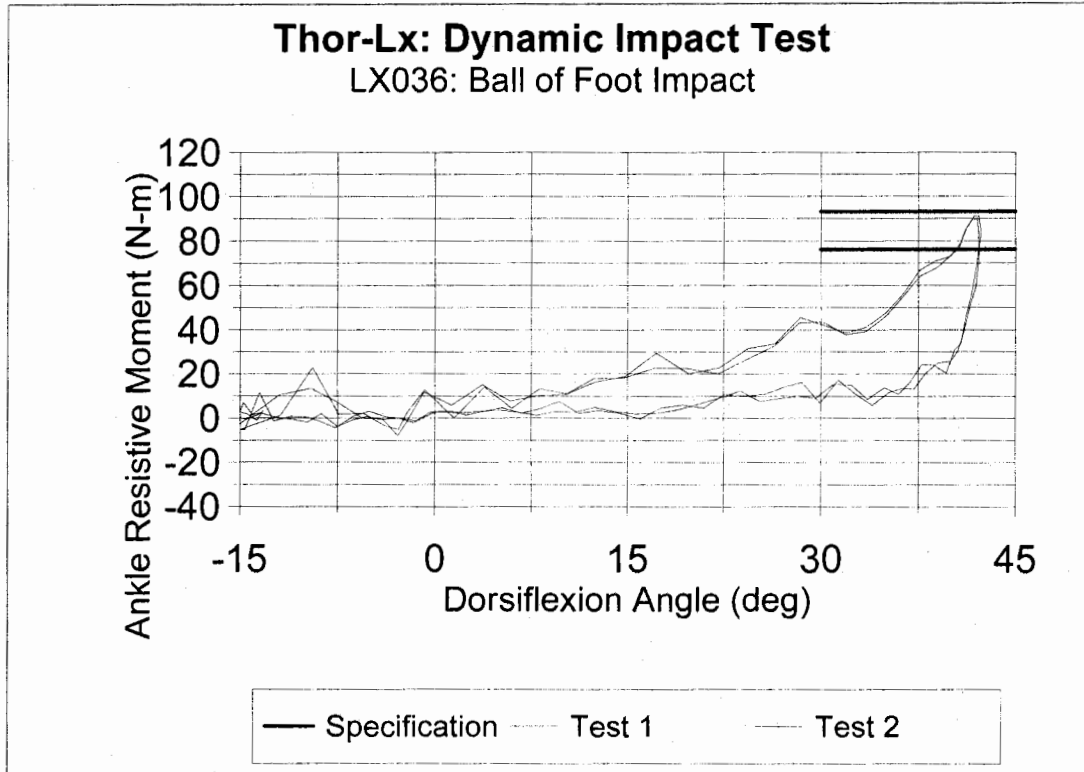
Impact Speed	5.0 m/s	Scan Rate	10000 scans/sec
Impact Effective Mass	5.0 kg	Filter	CFC 600
Impactor	NHTSA Dynamic Impactor (TLX-9000-013)		

Response

Peak Ankle Resistive Moment* (N-m)	Specification (N-m)	Within Reference
90.8	76.2 - 93.2	Yes

*Average Value

Test Plot



Tested by: H. Sulh B.L.
 Analyzed by: H. Sulh B.L.

Date: 2/26/08
 Date: 2/26/08

GESAC, INC

DESIGN | MANUFACTURE | TEST | SOFTWARE DEVELOPMENT | ERGONOMICS
 125 Orchard Drive, Boonsboro, MD 21713
 Tel (301) 432-5885 Fax (301) 432-6199

Thor-LX Test Report

Dynamic Heel of Foot Impact Test

Engineer	S.Kamalakkannan	Test Date	February 22, 2008
Customer	MGA	Temp (C)/Hum.(%)	20.7/20
Description	Left Lower Extremities	Serial No.	LX036

Testing Summary

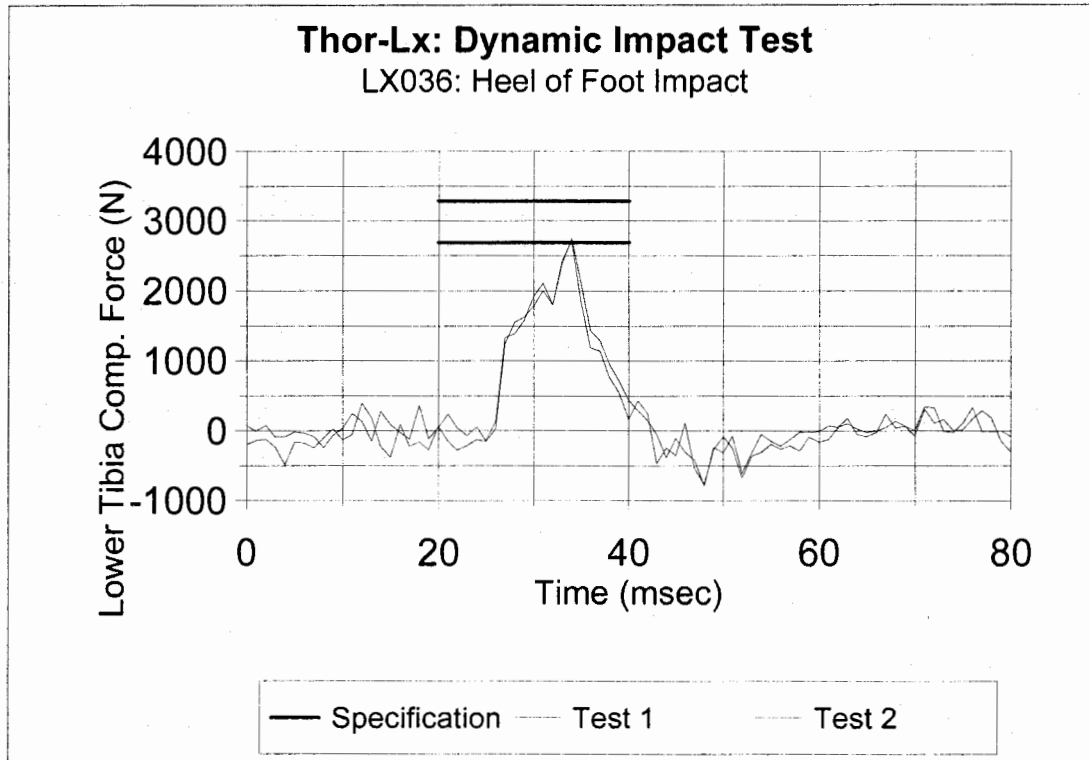
Impact Speed	4.0 m/s	Scan Rate	10000 scans/sec
Impact Effective Mass	5.0 kg	Filter	CFC 600
Impactor	NHTSA Dynamic Impactor (TLX-9000-013)		

Response

Peak Lower Tibia Compressive Force* (N)	Specification (N)	Within Reference
2740	2694 - 3292	Yes

*Average Value

Test Plot



Tested by: <u>K. Sulh B.l</u>	Date: <u>2/22/08</u>
Analyzed by: <u>K. Sulh B.l</u>	Date: <u>2/22/08</u>

GESAC, INC

DESIGN | MANUFACTURE | TEST | SOFTWARE DEVELOPMENT | ERGONOMICS

125 Orchard Drive, Boonsboro, MD 21713

Tel (301) 432-5885 Fax (301) 432-6199

Thor-Lx Test Report

Inversion Quasi-Static Test

Engineer S.Kamalakkannan

Test Date

February 26, 2008

Customer
Description

MGA
Left Lower Extremity

Temp. (C)/Hum.(%)
Serial No.

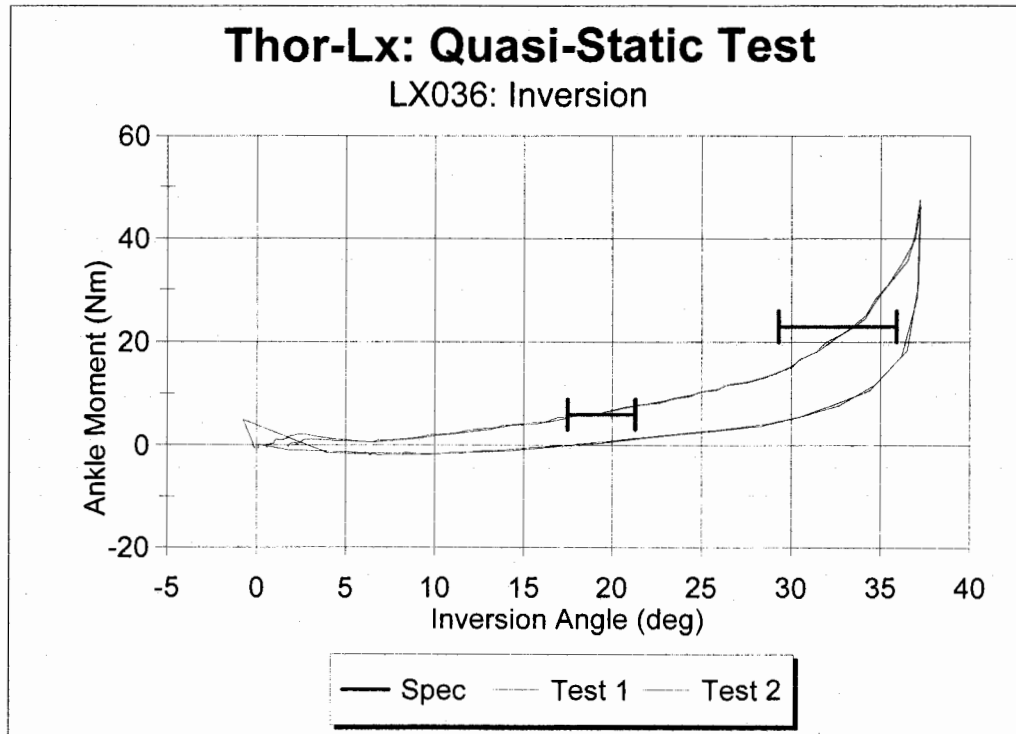
20.7/20
LX036

Testing Summary (Design Reference)

Ankle Moment (Nm)	Inversion Angle (Degree)	Reference Specification (Degree)		Within Reference?
		Min	Max	
6	18.5	17.5	21.3	Yes
23	33.5	29.3	35.9	Yes

*Average Value

Result Plot



Tested by: K. Sulli B.J.

Date: 2/26/08

Analyzed by: K. Sulli B.J.

Date: 2/26/08

GESAC, INC

DESIGN | MANUFACTURE | TEST | SOFTWARE DEVELOPMENT | ERGONOMICS

125 Orchard Drive, Boonsboro, MD 21713

Tel (301) 432-5885 Fax (301) 432-6199

Thor-Lx Test Report

Eversion Quasi-Static Test

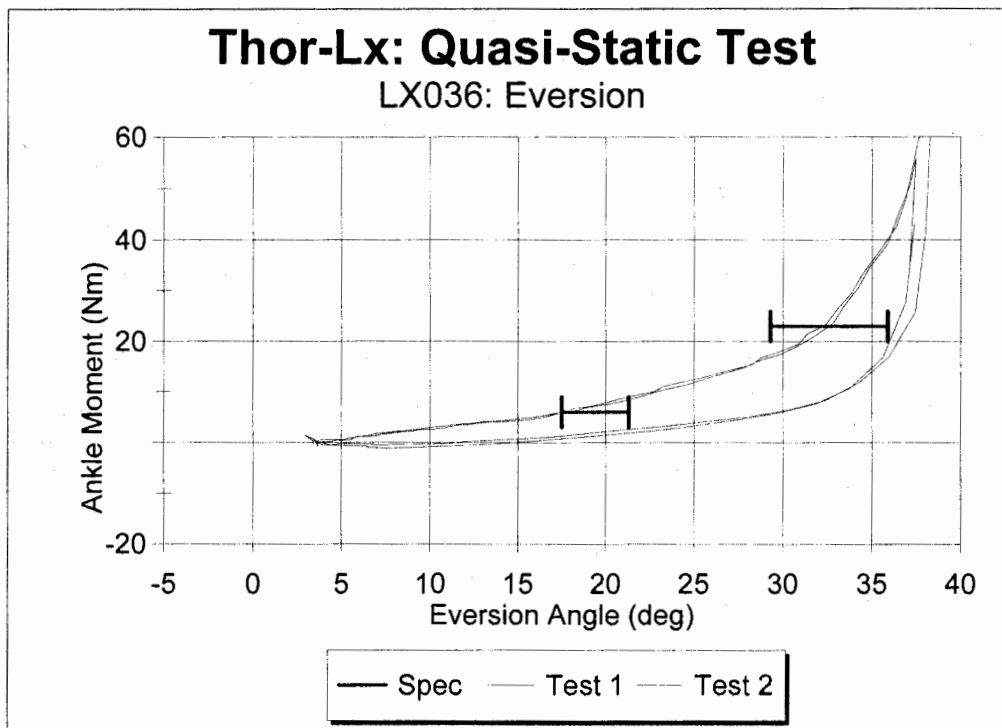
Engineer	S.Kamalakkannan	Test Date	February 27, 2008
Customer	MGA	Temp. (C)/Hum.(%)	20.7/23
Description	Left Lower Extremity	Serial No.	LX036

Testing Summary (Design Reference)

Ankle Moment (Nm)	Eversion Angle (Degree)	Reference Specification (Degree)	Within Reference?
6	17.6	17.5 - 21.3	Yes
23	32.4	29.3 - 35.9	Yes

*Average Value

Result Plot



Tested by: K. Selh Bl.

Date: 2/27/08

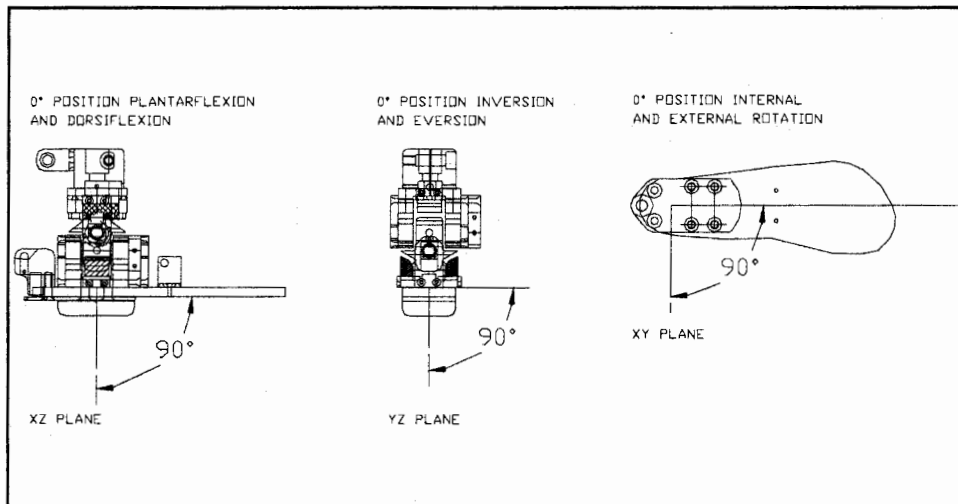
Analyzed by: K. Selh Bl.

Date: 2/27/08

THOR - LX Rotary Potentiometer Calibration

The figure below shows the three primary calibration positions for the THOR-LX Rotary Potentiometer Units.

The following table provides the expected potentiometer outputs at 10V excitation for each of the positions shown in the Figure below. The X potentiometer measures inversion / eversion rotation; the Y potentiometer measures dorsiflexion / plantarflexion rotation, and the Z potentiometer measures internal and external rotation. The voltage for each potentiometer should be verified at the zero position prior to testing.



Rotary Potentiometer Calibrations for Left Leg - Serial # LX -036

Pot	Rotary Pot Serial #	Sensitivity at 10 V Excitation	Units	Volts @ 0 Position	Units
X	PD210-4B 7921-0371	32.06	Volts/Degree	4.97	Volts
Y	PD210-4B 7921-0367	31.74	Volts/Degree	5.43	Volts
Z	PD210-4B 7921-0365	31.78	Volts/Degree	3.50	Volts

Transportation Research Center Inc.

Front Head Drop

HIII 10YO Serial No. D001 Certification No. 14-1

Test Date: 6/12/2007

Test Parameter	Specification	Test Results	Pass
Temperature	18.9 - 25.6 °C	21.2 °C	Yes
Relative Humidity	10 - 70 %	53 %	Yes
Peak Head Resultant Acceleration	250 - 300 g	270.3 g	Yes
Peak Head Lateral Acceleration	(-15) - 15 g	9.1 g	Yes
Is Acceleration Curve Unimodal	Yes	Yes	Yes

Test meets specifications.

Comments:

Technician

Approved

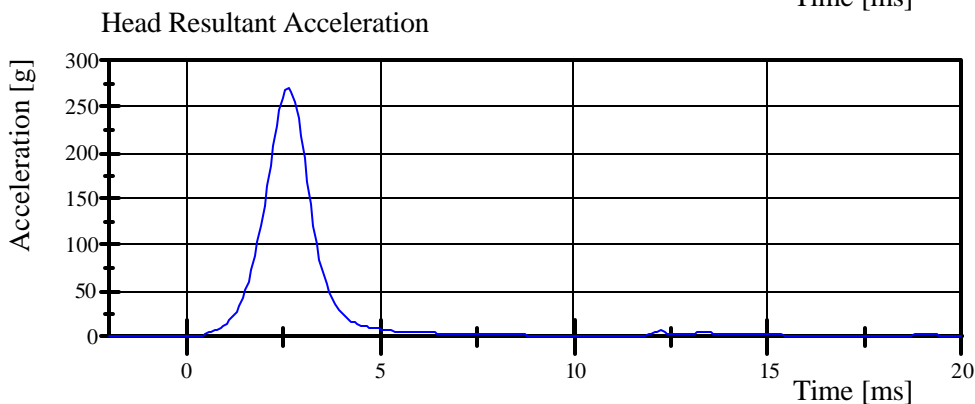
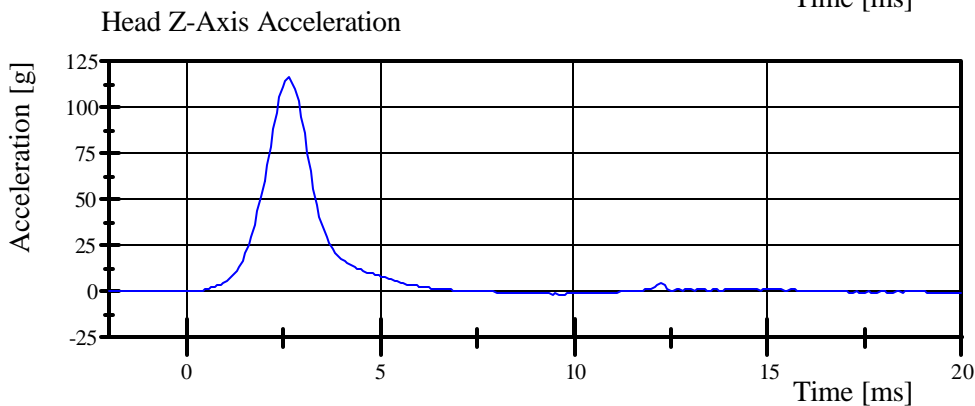
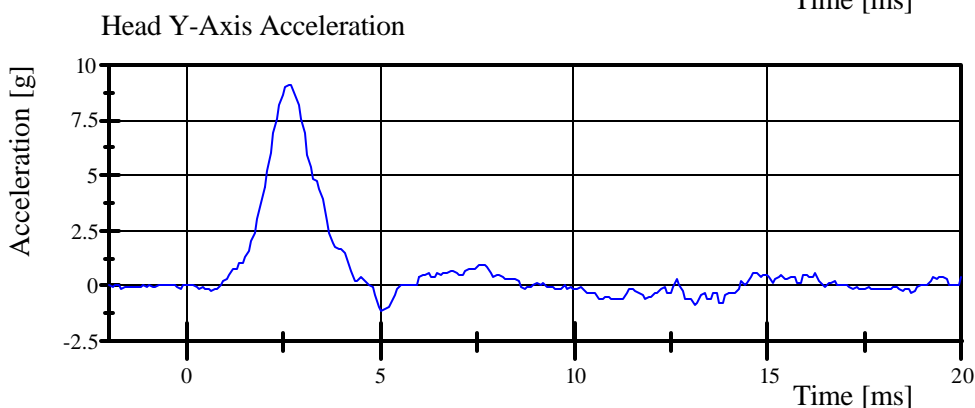
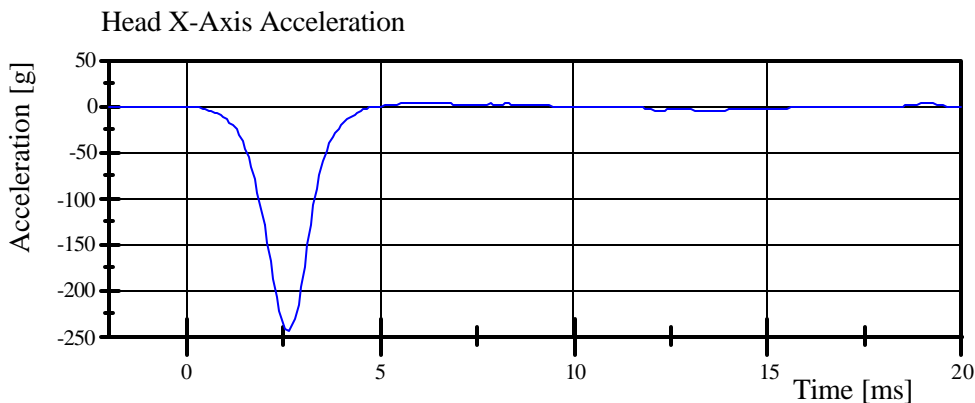


Transportation Research Center Inc.

Front Head Drop

HIII 10YO Serial No. D001 Certification No. 14-1

Test Date: 6/12/2007



Transportation Research Center Inc.

Neck Flexion

HIII 10YO Serial No. D001 Certification No. 14-2

Test Date: 6/13/2007

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	21.1 °C	Yes
Relative Humidity	10 - 70 %	52 %	Yes
Pendulum Impact Velocity	5.98 - 6.22 m/s	6.073 m/s	Yes
Pendulum Integrated Velocity at 10ms	(-1.64) - (-2.04) m/s	-1.648 m/s	Yes
Pendulum Integrated Velocity at 20ms	(-3.04) - (-4.04) m/s	-3.189 m/s	Yes
Pendulum Integrated Velocity at 30ms	(-4.45) - (-5.65) m/s	-4.692 m/s	Yes
Total Head D-Plane Rotation	(-76.0) - (-90.0) °	-82.31 °	Yes
Total Neck Occipital Condyles Moment Between -74° and -88° Rotation	50.0 - 62.0 Nm	52.09 Nm	Yes
Neck Occipital Condyles Moment Decay to 10 Nm	86.0 - 105.0 ms	100.64 ms	Yes

Test meets specifications.

Comments:

Technician

Approved

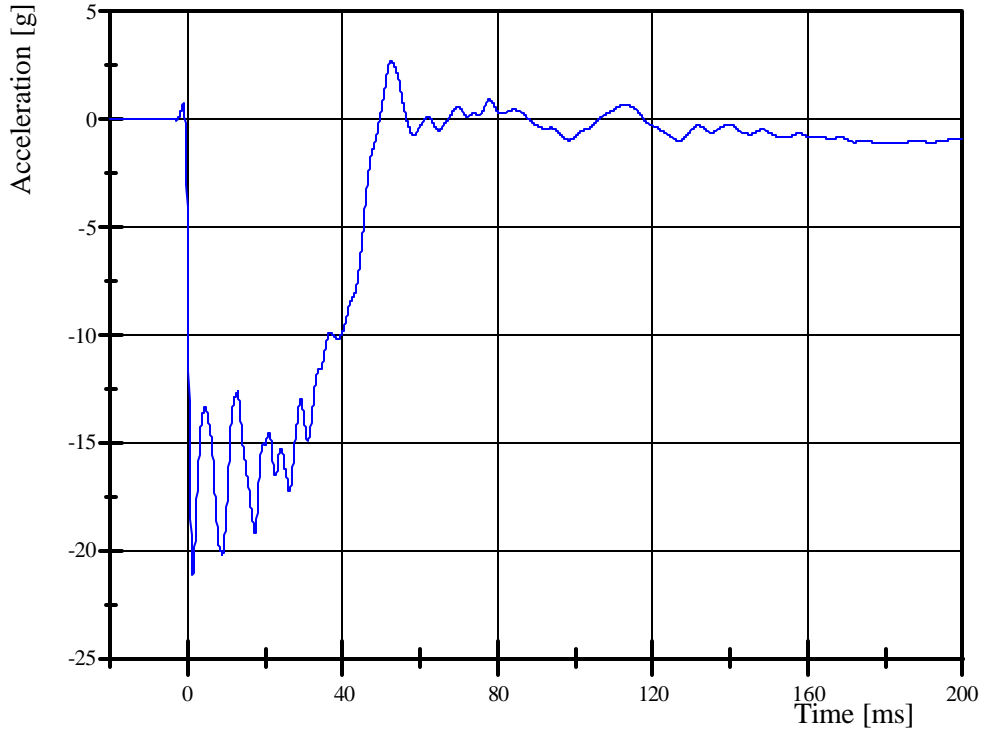
Transportation Research Center Inc.

Neck Flexion

HIII 10YO Serial No. D001 Certification No. 14-2

Test Date: 6/13/2007

Pendulum Acceleration

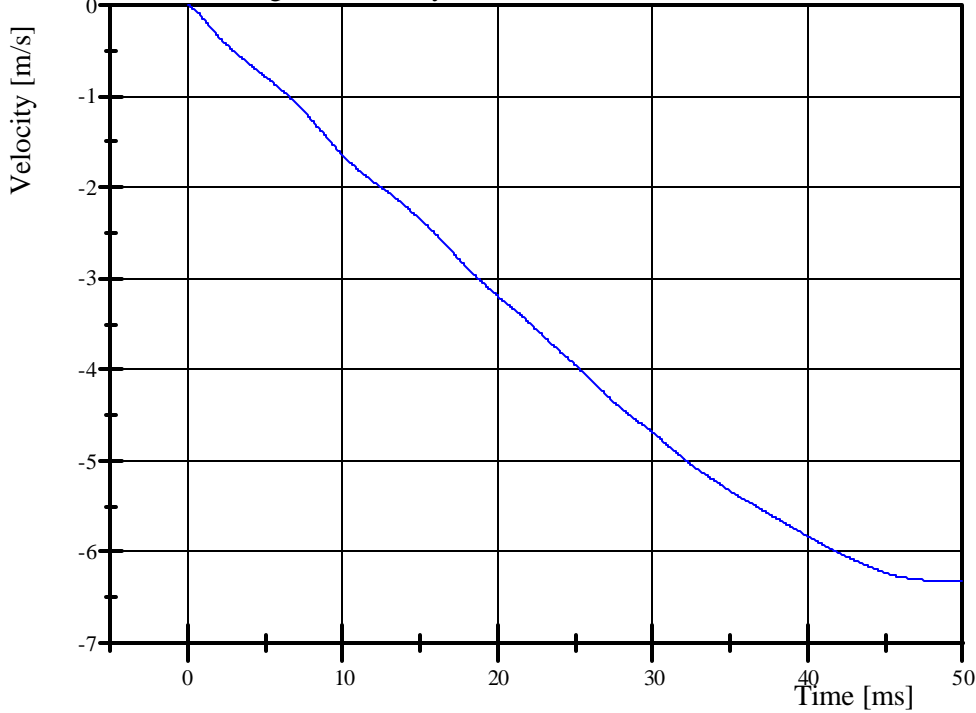


Filter Class: CFC_180

Max: 2.7 g at 52.6 ms

Min: -21.2 g at 1.3 ms

Pendulum Integrated Velocity



Filter Class: CFC_180

Max: 0.0 m/s at 0.0 ms

Min: -6.3 m/s at 49.5 ms

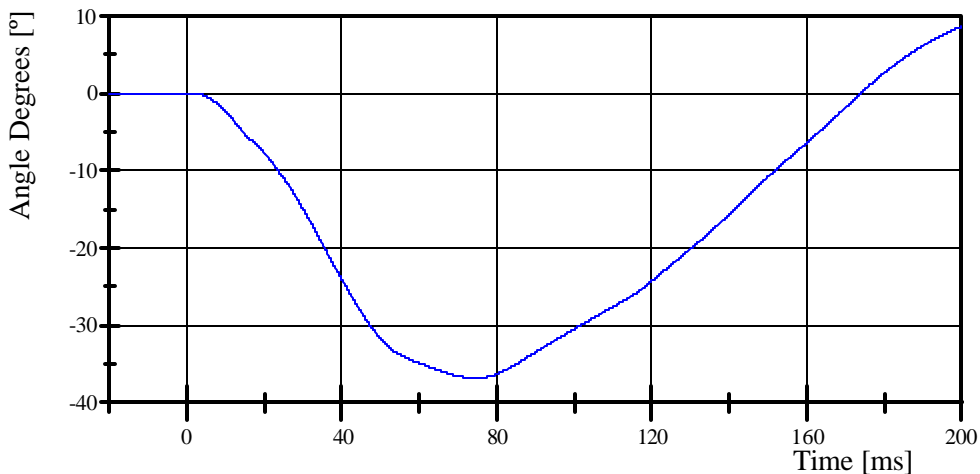
Transportation Research Center Inc.

Neck Flexion

HIII 10YO Serial No. D001 Certification No. 14-2

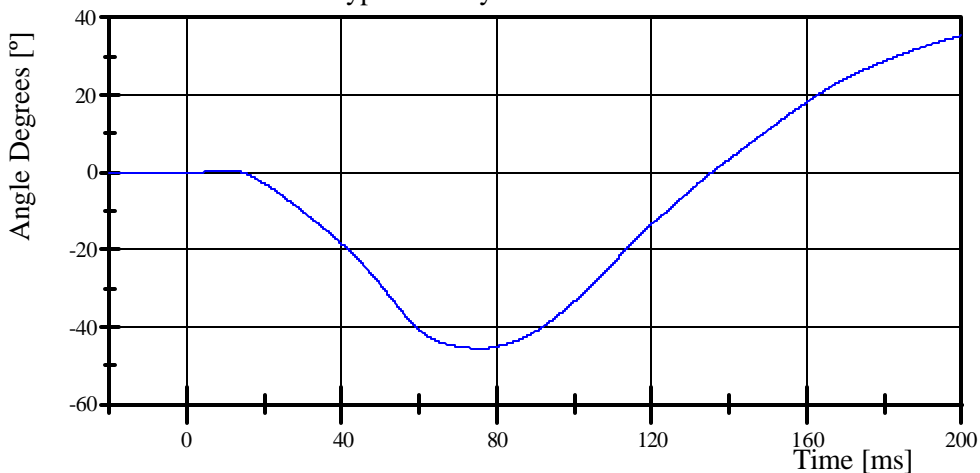
Test Date: 6/13/2007

Pot Rotation at the Base of Neck



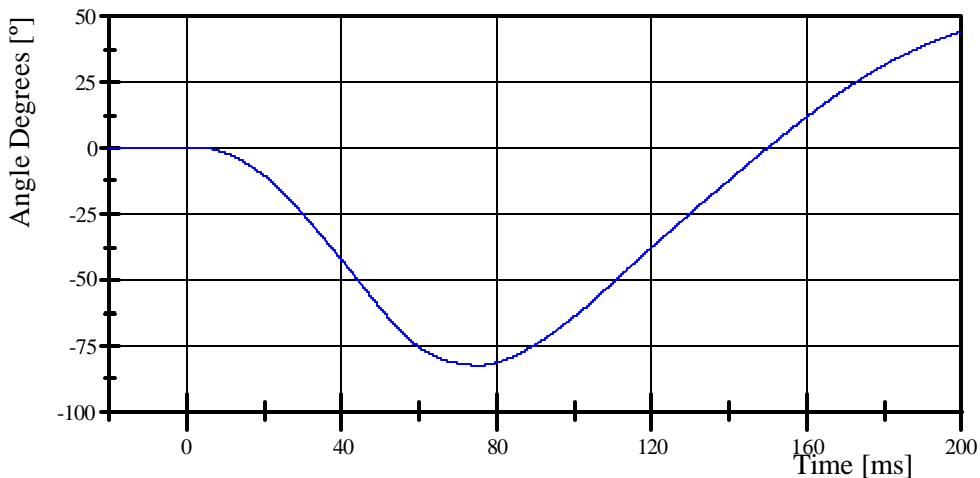
Filter Class: CFC_60
Max: 8.7 ° at 200.0 ms
Min: -36.8 ° at 74.3 ms

Head Rotation at Occypital Condyles



Filter Class: CFC_60
Max: 35.4 ° at 200.0 ms
Min: -45.6 ° at 75.7 ms

Total Head D-Plane Rotation



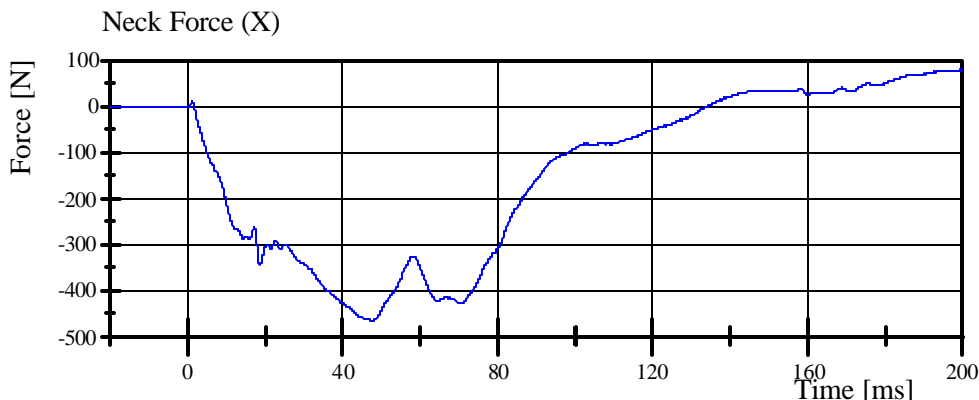
Filter Class: CFC_60
Max: 44.1 ° at 200.0 ms
Min: -82.3 ° at 75.3 ms

Transportation Research Center Inc.

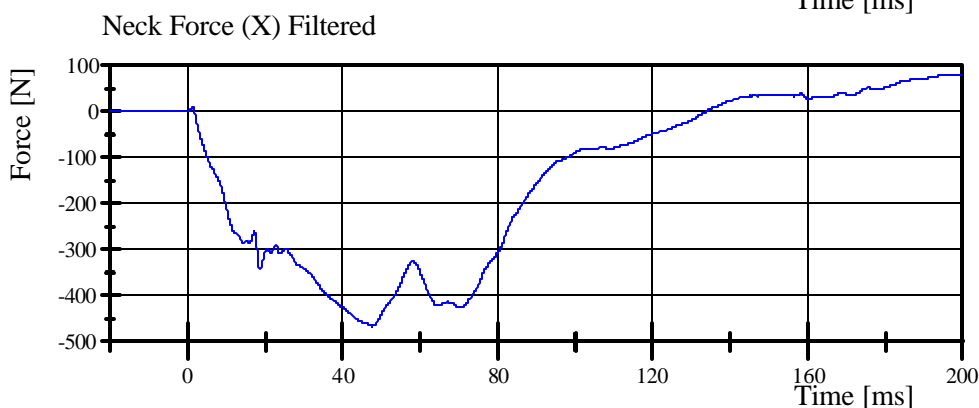
Neck Flexion

HIII 10YO Serial No. D001 Certification No. 14-2

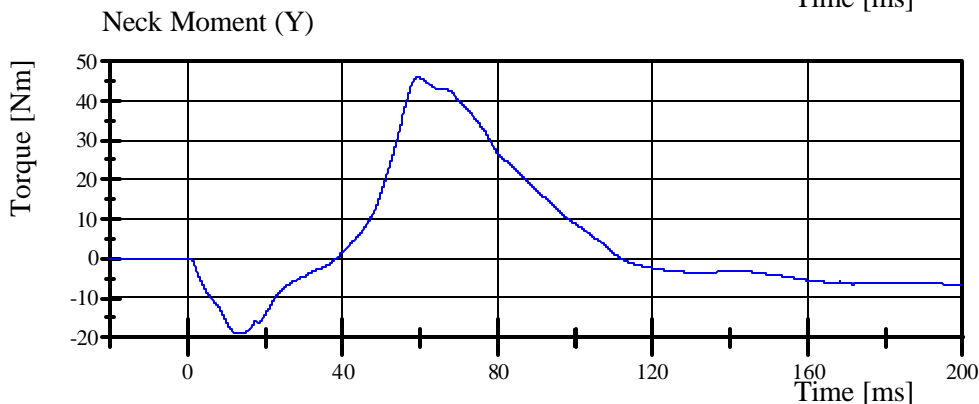
Test Date: 6/13/2007



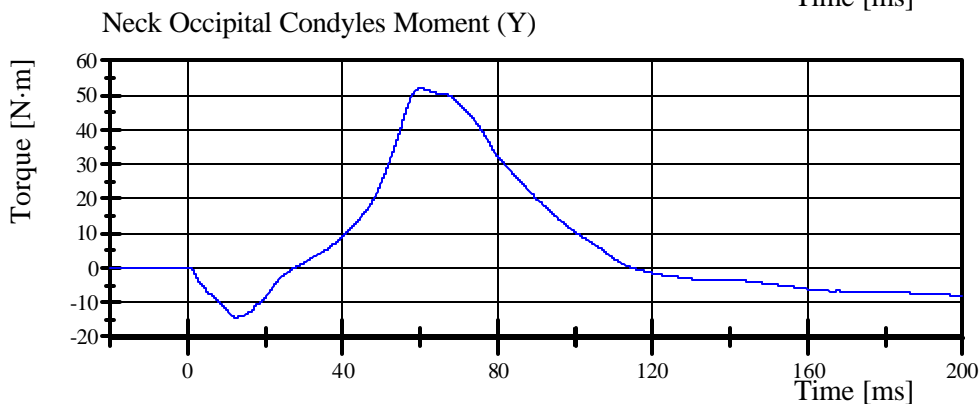
Filter Class: CFC_1000
Max: 80.1 N at 199.8 ms
Min: -467.0 N at 47.6 ms



Filter Class: CFC_600
Max: 79.9 N at 200.0 ms
Min: -466.7 N at 47.5 ms



Filter Class: CFC_600
Max: 45.9 Nm at 59.6 ms
Min: -19.1 Nm at 14.1 ms



Filter Class: CFC_600
Max: 52.1 N·m at 60.2 ms
Min: -14.3 N·m at 12.8 ms

Transportation Research Center Inc.

Neck Extension

HIII 10YO Serial No. D001 Certification No. 14-1

Test Date: 6/13/2007

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	21.3 °C	Yes
Relative Humidity	10 - 70 %	53 %	Yes
Pendulum Impact Velocity	4.91 - 5.15 m/s	5.018 m/s	Yes
Pendulum Integrated Velocity at 10ms	1.49 - 1.89 m/s	1.789 m/s	Yes
Pendulum Integrated Velocity at 20ms	2.88 - 3.68 m/s	3.403 m/s	Yes
Pendulum Integrated Velocity at 30ms	4.20 - 5.20 m/s	4.899 m/s	Yes
Total Head D-Plane Rotation	96.0 - 115.0 °	103.19 °	Yes
Total Neck Occipital Condyles Moment Between 99° and 114° Rotation	(-37.0) - (-46.0) Nm	-43.33 Nm	Yes
Neck Occipital Condyles Moment Decay to -10 Nm	100.0 - 116.0 ms	107.36 ms	Yes

Test meets specifications.

Comments:

Technician

Approved

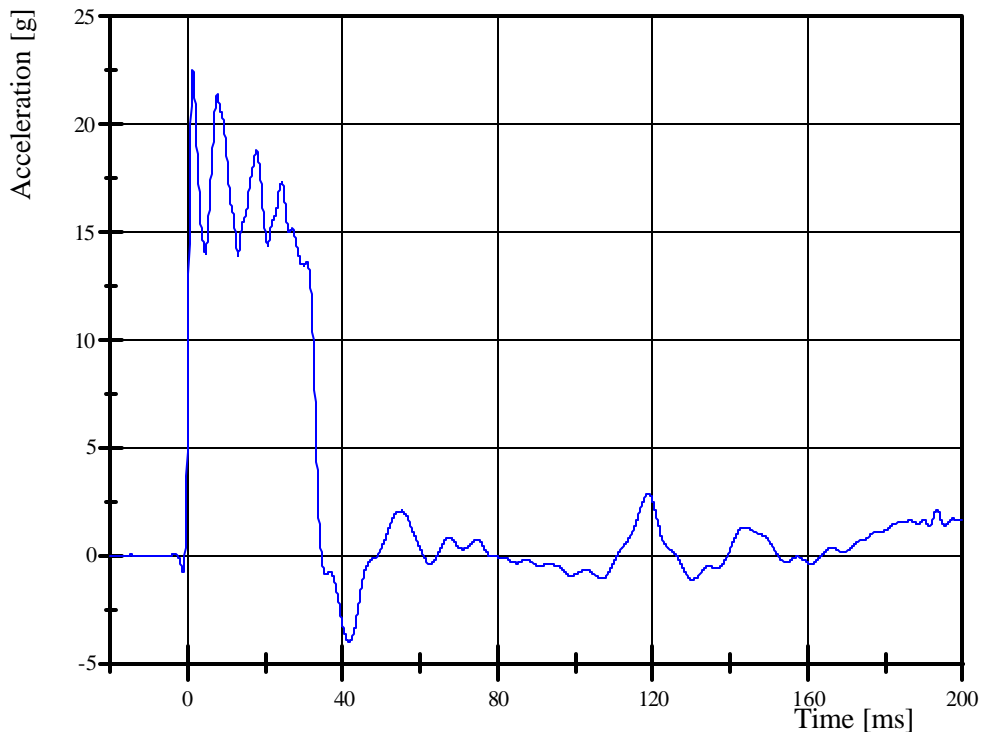
Transportation Research Center Inc.

Neck Extension

HIII 10YO Serial No. D001 Certification No. 14-1

Test Date: 6/13/2007

Pendulum Acceleration

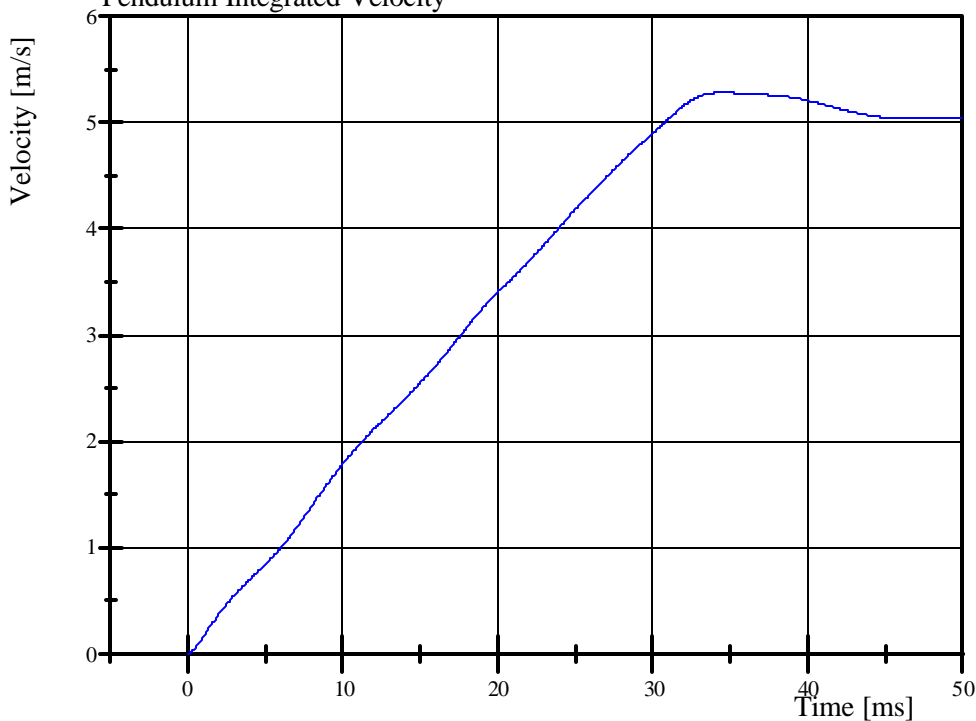


Filter Class: CFC_180

Max: 22.5 g at 1.2 ms

Min: -4.0 g at 41.5 ms

Pendulum Integrated Velocity



Filter Class: CFC_180

Max: 5.3 m/s at 34.5 ms

Min: 0.0 m/s at 0.0 ms

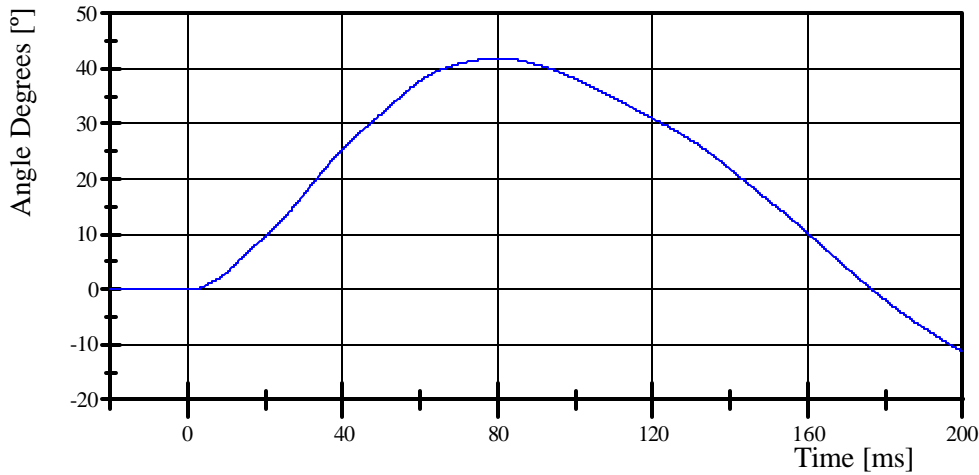
Transportation Research Center Inc.

Neck Extension

HIII 10YO Serial No. D001 Certification No. 14-1

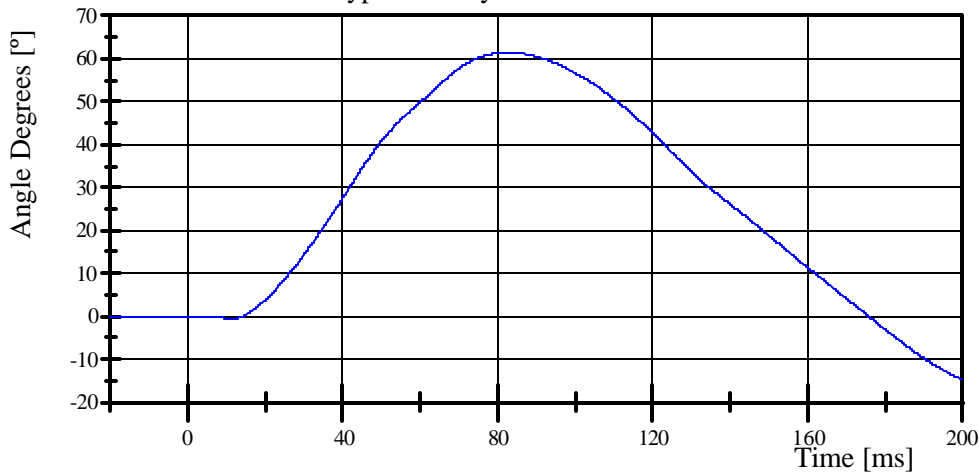
Test Date: 6/13/2007

Pot Rotation at the Base of Neck



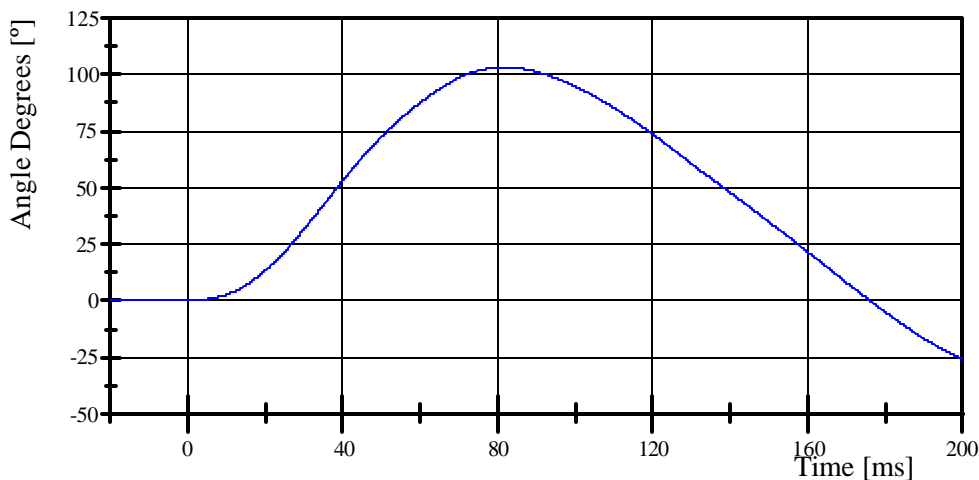
Filter Class: CFC_60
Max: 41.8 ° at 80.1 ms
Min: -11.2 ° at 200.0 ms

Head Rotation at Occypital Condyles



Filter Class: CFC_60
Max: 61.4 ° at 83.0 ms
Min: -14.7 ° at 200.0 ms

Total Head D-Plane Rotation



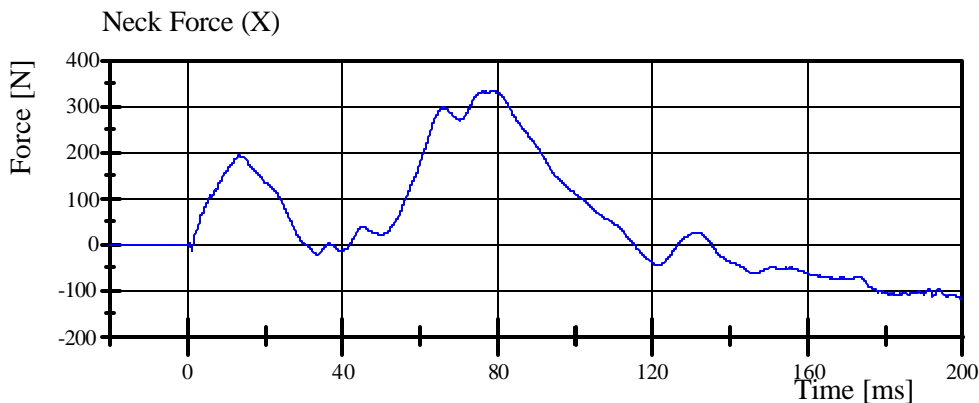
Filter Class: CFC_60
Max: 103.2 ° at 81.8 ms
Min: -25.9 ° at 200.0 ms

Transportation Research Center Inc.

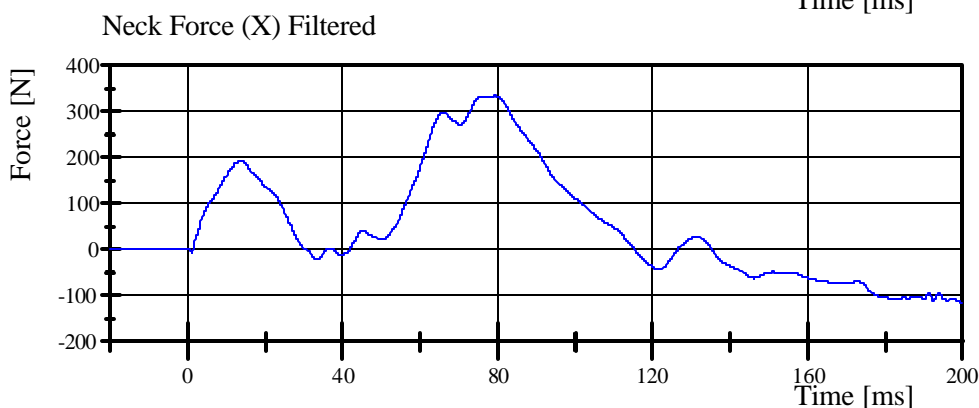
Neck Extension

HIII 10YO Serial No. D001 Certification No. 14-1

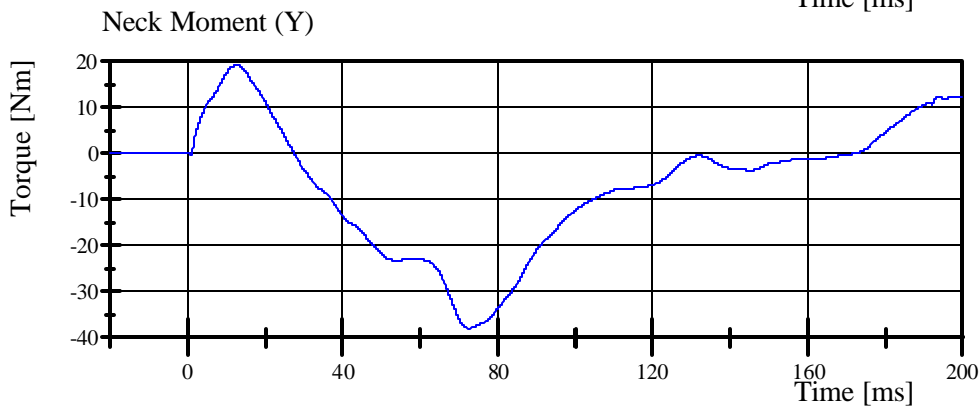
Test Date: 6/13/2007



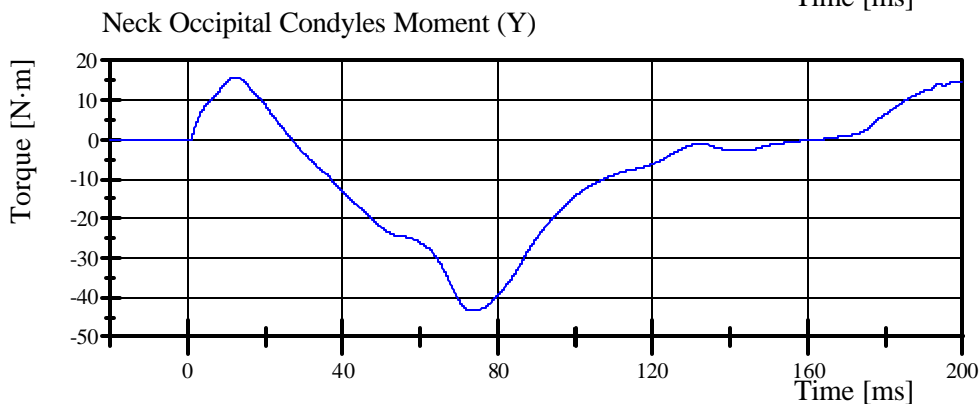
Filter Class: CFC_1000
Max: 333.9 N at 79.3 ms
Min: -118.3 N at 200.0 ms



Filter Class: CFC_600
Max: 333.5 N at 79.3 ms
Min: -118.2 N at 200.0 ms



Filter Class: CFC_600
Max: 19.3 Nm at 13.0 ms
Min: -38.0 Nm at 72.6 ms



Filter Class: CFC_600
Max: 15.9 N·m at 12.3 ms
Min: -43.3 N·m at 73.4 ms

Transportation Research Center Inc.

Front Thorax

HIII 10YO Serial No. D001 Certification No. 14-2

Test Date: 6/13/2007

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	21.0 °C	Yes
Relative Humidity	10 - 70 %	55 %	Yes
Probe Velocity	5.88 - 6.12 m/s	5.946 m/s	Yes
Probe Force Peak Between 37.0 mm and 46.0 mm Chest Deflection	(-2,000) - (-2,450) N	-2,255.5 N	Yes
Probe Force Peak Between 20.0 mm and 40.5 mm Chest Deflection	\geq (-2,450) N	-2,218.4 N	Yes
Maximum Chest Compression	(-37) - (-46) mm	-45.6 mm	Yes
Internal Hysteresis	69 - 85 %	79.2 %	Yes

Test meets specifications.

Comments:

Technician

Approved

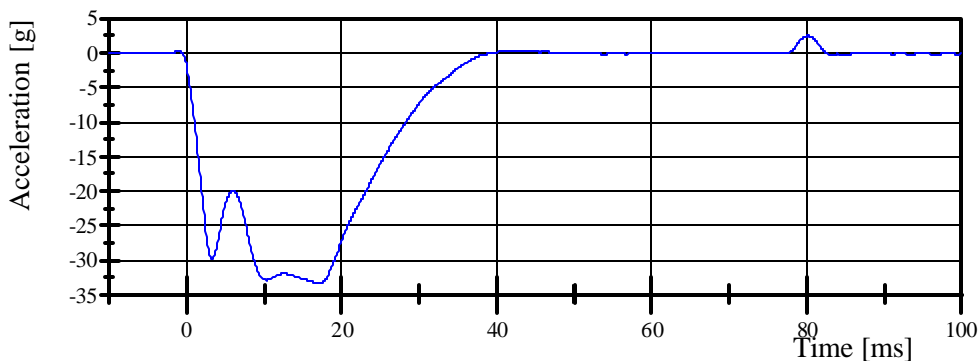
Transportation Research Center Inc.

Front Thorax

HIII 10YO Serial No. D001 Certification No. 14-2

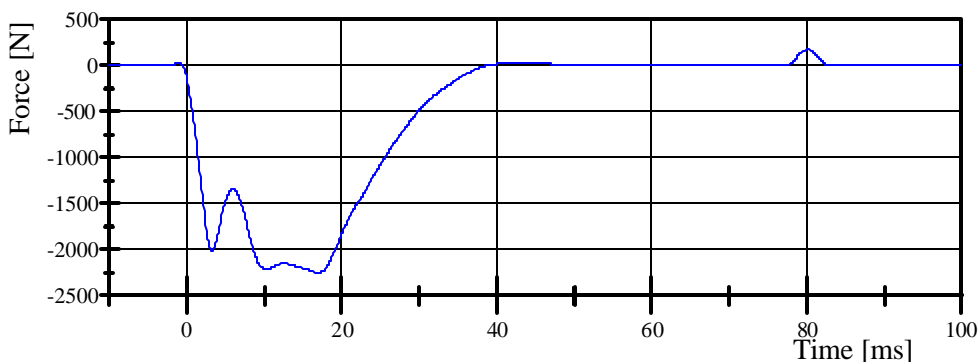
Test Date: 6/13/2007

Pendulum Acceleration



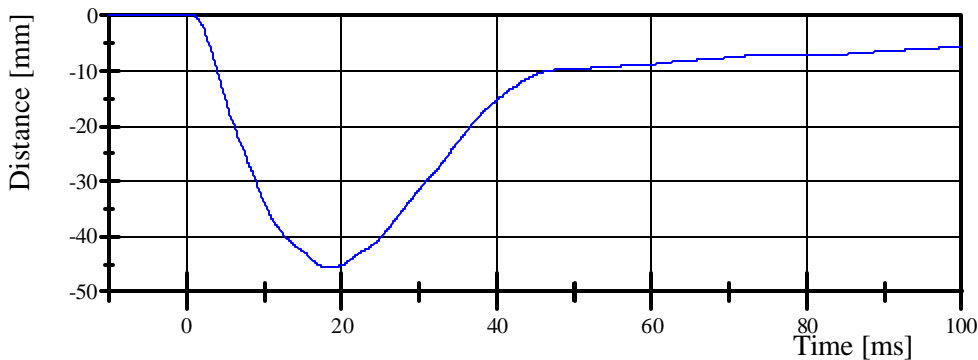
Filter Class: CFC_180
Max: 2.5 g at 80.2 ms
Min: -33.4 g at 17.0 ms

Pendulum Force



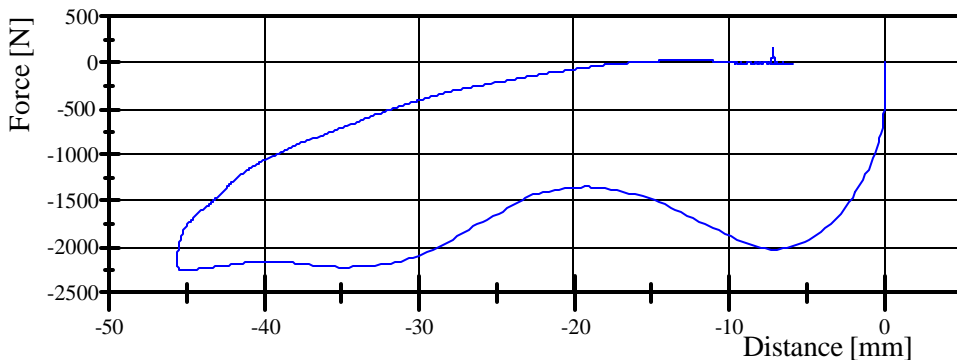
Filter Class: CFC_180
Max: 169.5 N at 80.2 ms
Min: -2,255.5 N at 17.0 ms

Thorax Displacement X-Axis



Filter Class: CFC_600
Max: 0.0 mm at -5.9 ms
Min: -45.6 mm at 18.5 ms

Pendulum Force vs. Thorax Displacement X-Axis



Filter Class: CFC_180
Max: 169.5 N at -7.2 mm
Min: -2,255.5 N at -45.1 mm

POST-TEST DUMMY INSPECTION

Position:	Driver
Dummy:	Hybrid III 50 th Percentile Male with Thor-Lx Legs
Serial Number:	#202 (Right Leg #037; Left Leg #036)
Inspected By:	Jessica Gall
Date:	March 13, 2008
Comments:	No Damage.

Position:	Left Rear Passenger
Dummy:	Hybrid III 10 year old
Serial Number:	#D001
Inspected By:	Jessica Gall
Date:	March 13, 2008
Comments:	No Damage.

APPENDIX D

CUSTOMER PROVIDED SEATING PROCEDURE

CONTROL LOG

50th Percentile Male Dummy - Driver side

Rev. No.	Date	Description
00	1/16/2008	Original release by VRTC
01	1/22/2008	Modified left foot placement to avoid pedals (modified step 30 and 35)

A.2 50th Percentile Male Dummy - Driver side

1. Position the seat's adjustable lumbar supports so that the lumbar supports are in the lowest, retracted or deflated adjustment positions.
 N/A – No lumbar adjustment
2. Position any adjustable parts of the seat that provide additional support so that they are in the lowest or most open adjustment position.
 N/A – No additional support adjustment
3. Position an adjustable leg support system in its rearmost position
 N/A – No adjustable leg support system
4. Mark a point (seat cushion reference point) on the side of the seat cushion that is between 150 mm and 250 mm from the front edge of the seat cushion.
5. Draw a line (seat cushion reference line) through the seat cushion reference point.
6. Use only the controls that primarily move the seat in the fore-aft direction to move the seat cushion reference point to the rearmost position.
7. If the seat cushion adjusts fore-aft, independent of the seat back, use only the controls that primarily move the seat cushion in the fore-aft direction to move the seat cushion reference point to the rearmost position.
 N/A – No independent fore-aft seat cushion adjustment
8. Use any part of any control, other than the parts just used for fore-aft positioning, to determine the range of angles of the seat cushion reference line and to set the seat cushion reference line at the mid-angle.
Maximum angle _____
Minimum angle _____
Mid-angle _____
9. If the seat and/or seat cushion height is adjustable, use any part of any control other than the parts which primarily move the seat or seat cushion fore-aft, to put the seat cushion reference point in its lowest position with the seat cushion reference line angle at the mid-angle found in 8.
 N/A – No seat height adjustment
10. Use only the controls that primarily move the seat in the fore-aft direction to verify the seat is in the rearmost position.
11. Place seat back at angle specified by the manufacturer. If angle is not provided, place seat back at 25 degrees from vertical.
 N/A – No seat back angle adjustment
Manufacturer's design seat back angle _____
12. Is the seat a bucket seat?
 Yes, go to 13 and skip 14
 No, go to 14 and skip 13
13. Bucket seats:
Locate and mark for future reference the longitudinal centerline of the seat cushion. The intersection of the vertical longitudinal plane that passes through the SgRP and the seat cushion upper surface determines the longitudinal centerline of a bucket seat cushion.
14. Bench seats
Locate and mark for future reference the longitudinal line on the seat cushion that marks the intersection of the vertical longitudinal plane through the centerline of the steering wheel and the seat cushion upper surface.
15. Head Restraint Position
 N/A Vehicle contains automatic head restraints.
 N/A, there is no head restraint adjustment
 Adjust the head restraint to its highest position.
16. Place any adjustable seat belt anchorages at the vehicle manufacturer's nominal design position for a 50th percentile adult male occupant
 N/A – No adjustable upper seat belt anchorage
Manufacturer's specified anchorage position. _____
Tested anchorage position _____

- ___17. Place adjustable pedals in the full forward position (towards the front of the vehicle.)
___N/A – the pedals are not adjustable.
- ___18. Locate and mark the right heel point (RHP) on the carpet.
Flat accelerator pedals: Extend a line through the axis of symmetry (that is closest to the vertical plane) of the accelerator pedal. The RHP is the intersection of that line with the floorpan.
Curved accelerator pedals: Construct a line in the side view tangent to the accelerator pedal such that the distance from the contact point on the pedal to the floorpan, along the tangent line, is 200 mm. The RHP is at the intersection of this tangent line and the floorpan
- ___19. Locate a longitudinal line L1 and a transverse line T1 on the floorpan through the RHP. Locate a Left Heel Point (LHP) point on the line T1 that is to the left of the seat centerline at the same distance from the seat centerline as the RHP. Locate a longitudinal line L2 through the LHP.
- ___20. Set the steering wheel hub at the geometric center of the full range of driving positions including any telescoping positions as determined in data sheet 14.3.
- ___21. Verify that the seat is in the rearmost seat track position and full down height adjustment with the seat cushion at the mid-angle with the seat back at the manufacturer's nominal seat back angle or as determined in step 11
- ___22. With the seat in the rearmost, full down, mid-angle position, determine the H-point using SAE J826 and the FMVSS 208 leg and thigh dimensions. Record the measurements.
- ___23. Place the dummy in the seat such that the midsagittal plane is coincident with the longitudinal seat cushion markings and the upper torso resting against the seat back.
- ___24. Rest the thighs on the seat cushion.
- ___25. Set the distance between the outboard knee clevis flange surfaces at 10.6 inches.
___measured distance (10.6 inches)
- ___26. Set the heels of the feet on the floor pan.
- ___27. Position the H-point of the dummy within 0.5 inch of the vertical dimension and 0.5 inch of the horizontal dimension of a point 0.25 inch below the H-point determined in step 22
Measure the pelvic angle with respect to the horizontal using the pelvic angle gage.
Adjust the dummy position until these three measurements are within the specifications.
___horizontal inches from the point 0.25 below the determined H-point (0.5 inch max.)
___vertical inches from the point 0.25 below the determined H-point (0.5 inch max.)
___pelvic angle (20° to 25°)
The H-point and pelvic angle are not adjusted after this step.
- ___28. Set the left and right feet in the neutral position (longitudinal centerline of foot in the same plane as the lower leg/thigh, foot Y angle at -15 degrees +/- 2 degrees to lower leg), as determined by the output of the potentiometers at the ankle.
- ___29. Without moving the seat, and while keeping the right thigh and leg in the same vertical plane, set the right foot heel on Line L1. If the vehicle interior prevents the heel from reaching L1, place the heel as close to L1 as possible, while maintaining a clearance of 0.25" from the vehicle interior.
- ___30. Without moving the seat, and while keeping the left thigh and leg in the same vertical plane, move the left foot laterally to the left **until any of the following occurs first:**
- The right edge of the foot is clear of the brake or clutch pedal by 0.25" laterally or
- The left edge of the shoe contacts the vehicle interior
- ___31. Place a 100 N +0, -5N weight (e.g. 100 N shot bag), no larger than 4" x 4", on each knee-thigh area. The weight should be centered on the assembly-hole on the top of the knee.
- ___32. Raise the heels off the floor pan so that the seat can be moved forward.
- ___33. Using only the control that primarily moves the seat in the fore-aft direction, move the seat forward and rest the rearmost point of the right foot heel on the floor pan such that:
- the heel is on the line L1
- the foot is in the same plane as the lower leg/thigh, foot at -15 degrees +/- 2 degrees (about the Y- axis) to lower leg,

- foot is contacting the accelerator pedal
 - the thighs are resting on the seat cushion
 - the thigh, leg and foot are in the same vertical plane
- ___33.1 If the heel is unable to reach line L1 because the foot contacts the vehicle interior, place the foot as close to the line L1 as possible while maintaining a gap of no more than 5 mm between the shoe and the vehicle interior.
- ___33.2 If the left foot contacts the brake or clutch pedals or the vehicle interior, then stop the forward movement of the left foot, raising the left knee off the seat cushion if needed. The pedals should not be depressed.
- ___34. If the right foot does not reach the accelerator pedal, move the adjustable pedal until it contacts the foot. Locate a new heel point. Repeat steps 18 – 33 to re-position the seat. If the pedals are not adjustable, place the heel at the point closest to the pedal, in the same longitudinal vertical plane as the line L1.
___N/A – the accelerator pedal is not adjustable
___N/A – the accelerator pedal did not need to be moved.
- ___35. Verify that the left thigh and leg are in a vertical longitudinal plane, the foot in the neutral position (longitudinal centerline of foot in the same plane as the lower leg/thigh, foot at - 15 degrees +/- 2 degrees (Y-axis) to lower leg), the heel on the floor pan. Place the heel on the line L2, unless the left edge of the shoe contacts the vehicle, preventing the heel from reaching Line L2. If there is overlap with the pedal, move the leg to the left until a lateral clearance of 0.25" from the pedal is attained, unless the left edge of the shoe contacts the vehicle. If the left edge of the shoe contacts the vehicle interior, maintain a clearance of 0.25" from the vehicle interior.
- ___36. Remove the leg weights.
- ___37. Verify that the right foot is in the neutral position, at the lateral location determined in step 30, and is contacting the accelerator pedal. If the foot is not contacting the accelerator pedal, move the seat forward to rest the right foot on the accelerator pedal, keeping the foot in the neutral position
- ___38. While holding the thighs in place, push with a 50 lb force on a 3 inch diameter area of the chest that is centered 5" (127mm) vertically below the chin on the midsagittal plane of the dummy.
- ___39.1 Fasten the seat belt around the dummy.
- ___39.2 Remove all slack from the lap belt portion.
- ___39.3 Pull the upper torso webbing out of the retractor and allow it to retract; repeat this four times.
- ___39.4 Apply a 2 to 4 pound tension load to the lap belt.
___pound load applied
- ___39.5 Is the belt system equipped with a tension-relieving device?
___Yes, continue
___No, go to 40
- ___39.6 Introduce the maximum amount of slack into the upper torso belt that is recommended by the vehicle manufacturer in the vehicle owner's manual..
- ___40. Place the upper arms adjacent to the torso with the centerline as close to a vertical plane as possible.
- ___41. Adjust the head level within ± 0.5 degrees using the seat back adjustment. Check the head angle after pushing on the chest with a 50 lb force on a 3 inch diameter area of the chest that is centered 5" (127mm) vertically below the chin on the midsagittal plane of the dummy, while holding the thighs in place, and releasing.
- ___42. No seat back adjustment. Adjust the neck bracket to achieve head level within ± 0.5 degrees Record neck bracket setting. _____
- ___43. Maintaining the head alignment as determined above, place the right hand with the palm in contact with the steering wheel at the rim's horizontal centerline and with the thumb over the steering wheel.
- ___44. Maintaining the head alignment as determined above place the left hand with the palm in contact with the steering wheel at the rim's horizontal centerline and with the thumb over the steering wheel.

- ___45. If the hands don't reach the steering wheel at the horizontal centerline, maintaining the head alignment place them at symmetric location on the wheel, below the horizontal centerline.
- ___46. Tape the thumb of each hand to the steering wheel by using masking tape with a width of 0.25 inch. The length of the tape shall only be enough to go around the thumb and steering wheel one time.
- ___47. Verify that the feet are in the neutral position (± 2 deg), and at lateral locations determined in step 30 (right foot) and step 35 (left foot), and the head is level (± 0.5 deg). Adjust and repeat until the feet position and angles and head angles are within their ranges.



U.S. Department
of Transportation

National Highway
Traffic Safety
Administration

Memorandum

Vehicle Research and Test Center P.O. Box B37
East Liberty, Ohio 43319
(937) 666-4511

Subject: VRTC Seating Procedure for FMVSS 213-Type Booster Seat
Testing with the Hybrid III 6 Year Old & 10 Year Old Child
Dummies

OCT 24 2007

From: *Joseph M. Kaniyantra*
Joseph M. Kaniyantra, Ph.D.
Associate Administrator for
Vehicle Safety Research

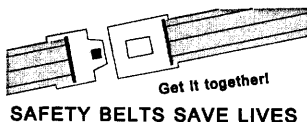
To: Docket NHTSA-2005-21245

Thru: *Anthony M. Cooke*
Anthony M. Cooke
Chief Counsel

VRTC Seating Procedure for Hybrid III 6 Year Old Child Dummy for Testing Belt Positioning
Booster Seats

VRTC
Use the following procedure to position the dummy in the belt positioning booster seat:

- DA*
11/24/07
- a) Place the booster seat on the FMVSS 213 bench seat such that it is centered between the lap belt anchor positions and the booster is pushed rearward until the intersection of the booster's back and bottom contacts the intersection of the FMVSS 213 bench seat's back and base cushions.
 - b) Place the dummy in the booster seat so that the mid-sagittal line of the dummy is coincident with the centerline of the booster.
 - c) Measure the X and Z locations of the left and right shoulder pivots. Position the dummy so that the difference between the X and Z values for these two points is less than or equal to 1 cm (see Figure 1).
 - d) As illustrated in Figure 2 of this section, calculate the H-point location of the dummy relative to the FMVSS 213 seat Z point (see Figure 1B in FMVSS 213) by
 - a. Measuring the X and Z coordinates of the knee pivot (X_{KP} and Z_{KP}) and head center of gravity (X_{CG} and Z_{CG}).
 - b. Mathematically locating the intersection point of two circles using the knee pivot and head center of gravity as the centers and the known dummy anthropometric lengths as radii. The equations for calculating the H-point are as follows:



AUTO SAFETY HOTLINE
(800) 424-9393
Wash. D.C. Area 366-0123

$$X_{HP} = X_{CG} + \frac{A(X_{KP} - X_{CG})}{B} + \frac{\sqrt{473^2 - A^2}(Z_{KP} - Z_{CG})}{B}$$

$$Z_{HP} = Z_{CG} + \frac{A(Z_{KP} - Z_{CG})}{B} - \frac{\sqrt{473^2 - A^2}(X_{KP} - X_{CG})}{B}$$

Where:

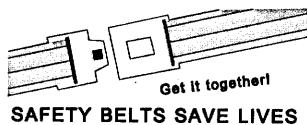
$$A = \frac{(473^2 - 238^2 + B^2)}{2B}$$

$$B = \sqrt{(X_{KP} - X_{CG})^2 + (Z_{KP} - Z_{CG})^2}$$

- e) Use the H-point location and head center of gravity location to determine the torso angle relative to vertical. This angle is calculated using

$$\text{Torso Angle} = \arctan\left(\frac{X_{HP} - X_{CG}}{Z_{CG} - Z_{HP}}\right)\left(\frac{180}{\pi}\right)$$

- f) Adjust the dummy until the torso angle is 14 ± 0.5 degrees from vertical.
- g) Secure the dummy and booster with belt restraint, following booster manufacturer's instructions for routing the shoulder and lap belts. Apply standard FMVSS 213 belt tensions.
- h) Locate the shoulder belt such that its outboard edge is inside of the outer edge of the chest jacket (see Figure 3). If it is not feasible to get the outboard edge of the belt inside the outer edge of the chest jacket, document the closest distance from the belt to the chest jacket that is obtainable.
- i) The straight line distance from the bottom of the dummy's chin to the center of the shoulder belt/middle of the sternum along the dummy's mid-sagittal line should be 15.5 ± 0.5 cm (see Figure 4). Measure and document the intersection of the dummy's mid-sagittal line and vertical center of shoulder belt's width.
- j) Measure and document the angle of the shoulder belt relative to horizontal. The shoulder belt angle should be $50^\circ \pm 10^\circ$. If it is not feasible to achieve the specified shoulder belt angle while following the manufacturer's instructions for belt routing, document angle that is obtainable.
- k) Locate the lap belt such that the top of the belt is 2.54 cm or more below the top rim of the pelvis molded skin at the dummy's mid-sagittal line (Figure 4). If it is not feasible to locate the lap belt at least 2.54 cm below the top of the pelvis while following the manufacturer's instructions for belt routing, position belt as low as possible on pelvis.
- l) Measure and document the intersection of the dummy's mid-sagittal line and center of lap belt width.
- m) Put upper arms as close as possible to, and in alignment with, the upper torso on sides and bend at elbows such that the hands are resting on the booster seat cushion if possible; otherwise bend lower arm perpendicular to upper arm and have hands pointed forward.



AUTO SAFETY HOTLINE
(800) 424-9393
Wash. D.C. Area 366-0123

- n) Level the top of the dummy's head $\pm 1^\circ$ off of horizontal.
- o) Document final H-point, Head CG, and Knee Pivot coordinates in addition to the torso angle.

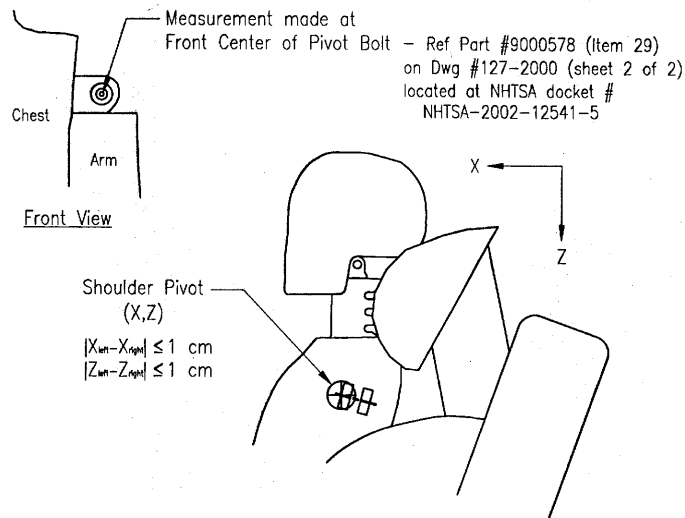


Figure 1. Shoulder Pivot Bolt Alignment

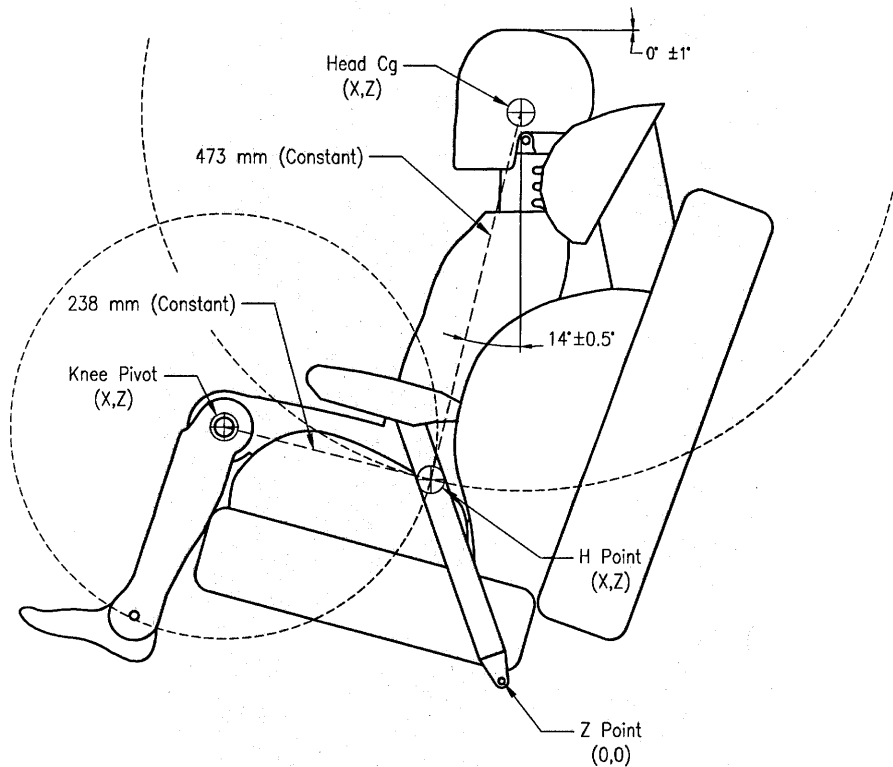
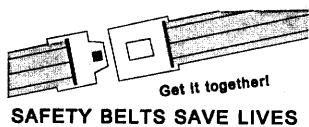


Figure 2. Locating the H-Point so that HIII-6C Torso Angle is 14 ± 0.5 Degrees from Vertical



AUTO SAFETY HOTLINE
 (800) 424-9393
 Wash. D.C. Area 366-0123

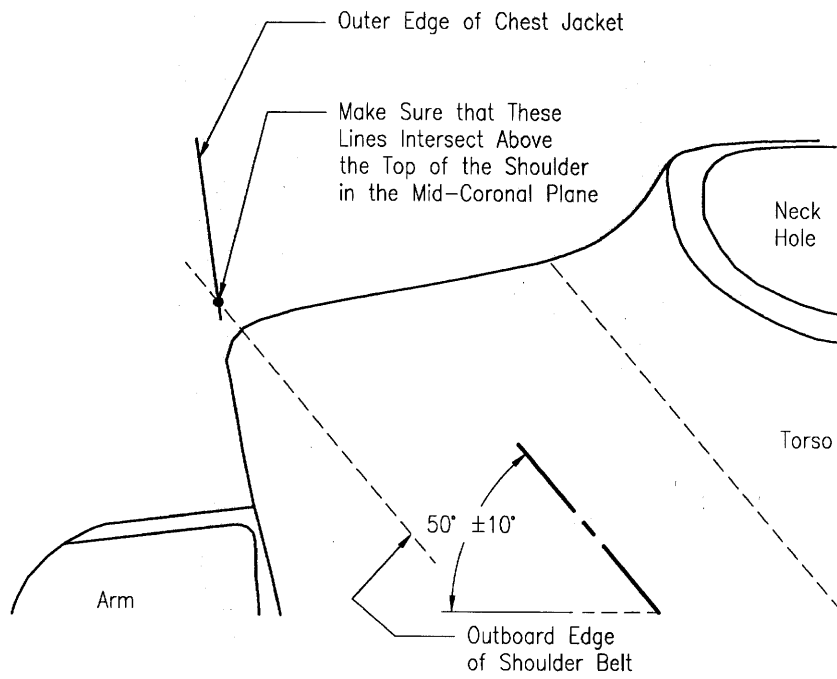
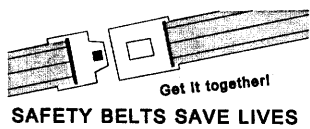


Figure 3. Shoulder Belt Placement



AUTO SAFETY HOTLINE
(800) 424-9393
Wash. D.C. Area 366-0123

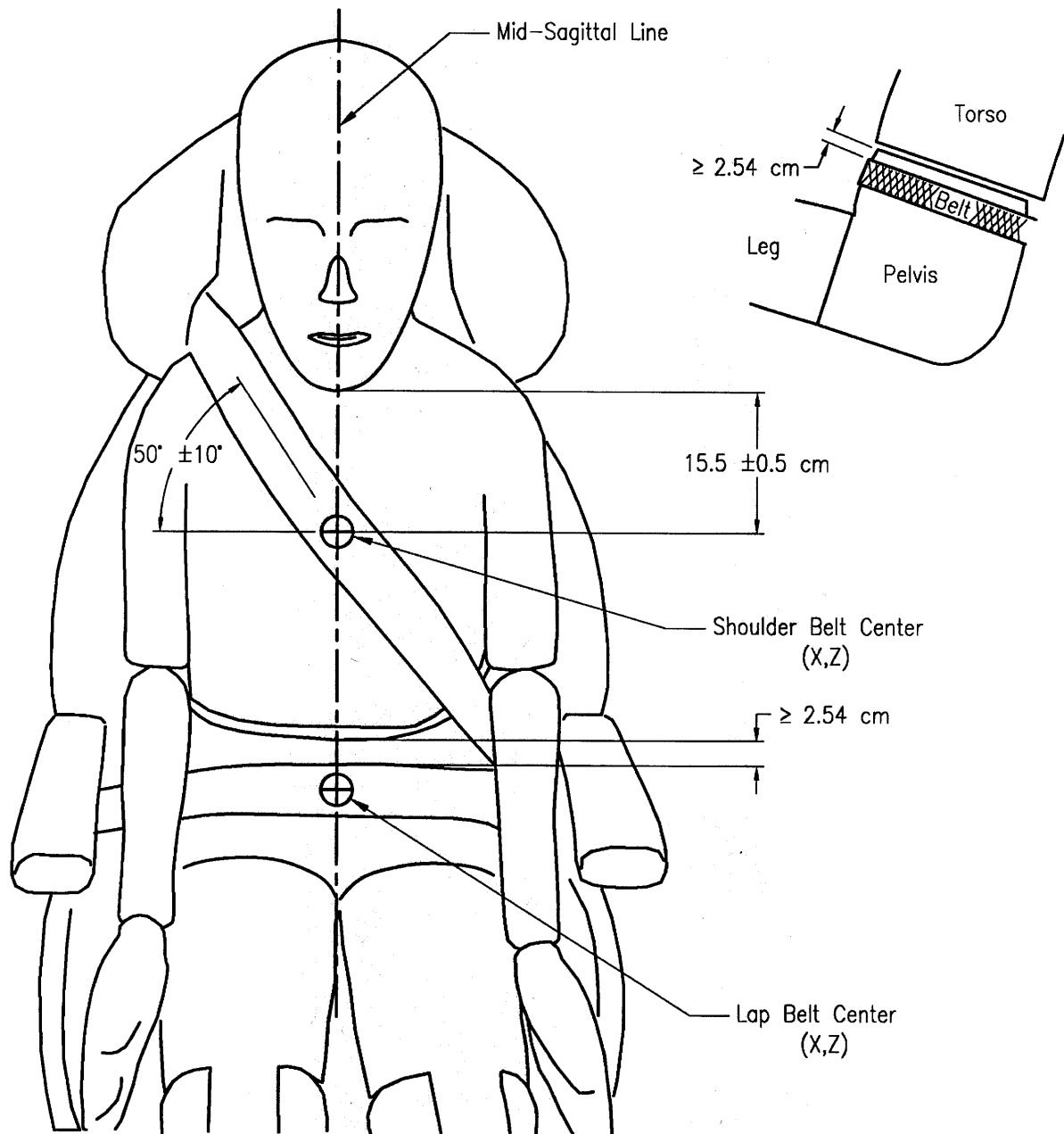
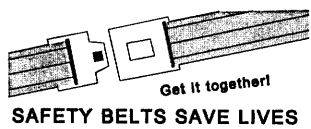


Figure 4. Overall Belt Placement for HIII-6C Dummy



AUTO SAFETY HOTLINE
(800) 424-9393
Wash. D.C. Area 366-0123

VRTC Seating Procedure for Hybrid III 10 Year Old Child Dummy for Testing Belt Positioning Booster Seats

Use the following procedure to position the dummy in the belt positioning booster seat:

- a) Set the dummy's neck angle at the SP-16 setting (Figure 5a). See also Figure 20 of PADI (NHTSA-2005-21247-8) for more detail.
- b) Set the dummy's lumbar angle at the SP-12 setting ("SP" means standard posture), see Figure 5b. This is done by aligning the notch on the lumbar adjustment bracket with the SP-12 notch on the lumbar attachment. See also Figure 45 of PADI for more detail.
- c) Place the booster seat on the FMVSS 213 bench seat such that it is centered between the lap belt anchor positions and the booster is pushed rearward until the intersection of the booster's back and bottom contacts the intersection of the FMVSS 213 bench seat's back and base cushions.
- d) Place the dummy in the booster seat so that the mid-sagittal line of the dummy is coincident with the centerline of the booster.
- e) Measure the X and Z locations of the left and right shoulder pivots. Position the dummy so that the difference between the X and Z values for these two points is less than or equal to 1 cm (see Figure 6).
- f) As illustrated in Figure 7 of this section, calculate the H-point location of the dummy relative to the FMVSS 213 seat Z point (see Figure 1B in FMVSS 213) by
 1. Measuring the X and Z coordinates of the knee pivot (X_{KP} and Z_{KP}) and head center of gravity (X_{CG} and Z_{CG}).
 2. Mathematically locating the intersection point of two circles using the knee pivot and head center of gravity as the centers and the known dummy anthropometric lengths as radii. The equations for calculating the H-point are as follows:

$$X_{HP} = X_{CG} + \frac{A(X_{KP} - X_{CG})}{B} + \frac{\sqrt{527^2 - A^2}(Z_{KP} - Z_{CG})}{B}$$

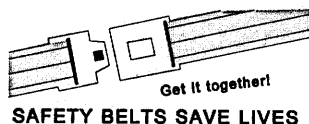
$$Z_{HP} = Z_{CG} + \frac{A(Z_{KP} - Z_{CG})}{B} - \frac{\sqrt{527^2 - A^2}(X_{KP} - X_{CG})}{B}$$

Where:

$$A = \frac{(527^2 - 288^2 + B^2)}{2B}$$

$$B = \sqrt{(X_{KP} - X_{CG})^2 + (Z_{KP} - Z_{CG})^2}$$

- g) Use the H-point location and head center of gravity location to determine the torso angle relative to vertical. This angle is calculated using



AUTO SAFETY HOTLINE
(800) 424-9393
Wash. D.C. Area 366-0123

$$\text{Torso Angle} = \arctan\left(\frac{X_{HP} - X_{CG}}{Z_{CG} - Z_{HP}}\right)\left(\frac{180}{\pi}\right)$$

- h) Adjust the dummy until the torso angle is 14 ± 0.5 degrees from vertical.
- i) Secure the dummy and booster with belt restraint, following booster manufacturer's instructions for routing the shoulder and lap belts. Apply standard FMVSS 213 belt tensions.
- j) Locate the shoulder belt such that its outboard edge is inside of the outer edge of the chest jacket (see Figure 8). If it is not feasible to get the outboard edge of the belt inside the outer edge of the chest jacket, document the closest distance from the belt to the chest jacket that is obtainable.
- k) The straight line distance from the bottom of the dummy's chin to the center of the shoulder belt/middle of the sternum along the dummy's mid-sagittal line should be 16 ± 0.5 cm (see Figure 9). Measure and document the intersection of the dummy's mid-sagittal line and vertical center of shoulder belt's width.
- l) Measure and document the angle of the shoulder belt relative to horizontal. The shoulder belt angle should be $50^\circ \pm 10^\circ$. If it is not feasible to achieve the specified shoulder belt angle while following the manufacturer's instructions for belt routing, document angle that is obtainable.
- m) Locate the lap belt such that the top of the belt is 2.54 cm or more below the top rim of the pelvis molded skin at the dummy's mid-sagittal line (Figure 9). If it is not feasible to locate the lap belt at least 2.54 cm below the top of the pelvis while following the manufacturer's instructions for belt routing, position belt as low as possible on pelvis.
- n) Measure and document the intersection of the dummy's mid-sagittal line and center of lap belt width.
- o) Put upper arms as close as possible to, and in alignment with, the upper torso on sides and bend at elbows such that the hands are resting on the booster seat cushion if possible; otherwise bend lower arm perpendicular to upper arm and have hands pointed forward.
- p) Level dummy's head $\pm 1^\circ$ off of horizontal.
- q) Document final H-point, Head CG, and Knee Pivot coordinates in addition to the torso angle.

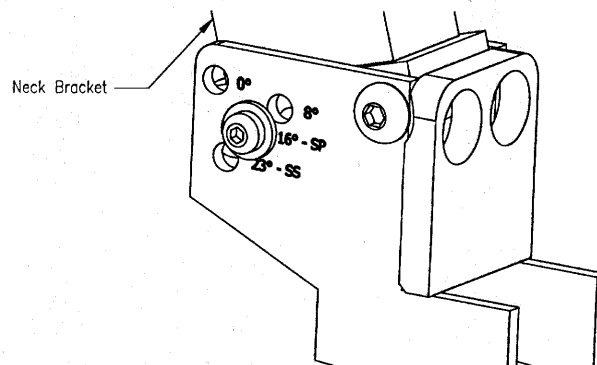
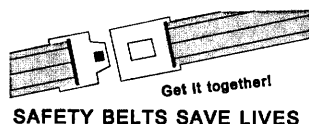


Figure 5a. Neck Angle Setting is SP-16 Degrees



AUTO SAFETY HOTLINE
(800) 424-9393
Wash. D.C. Area 366-0123

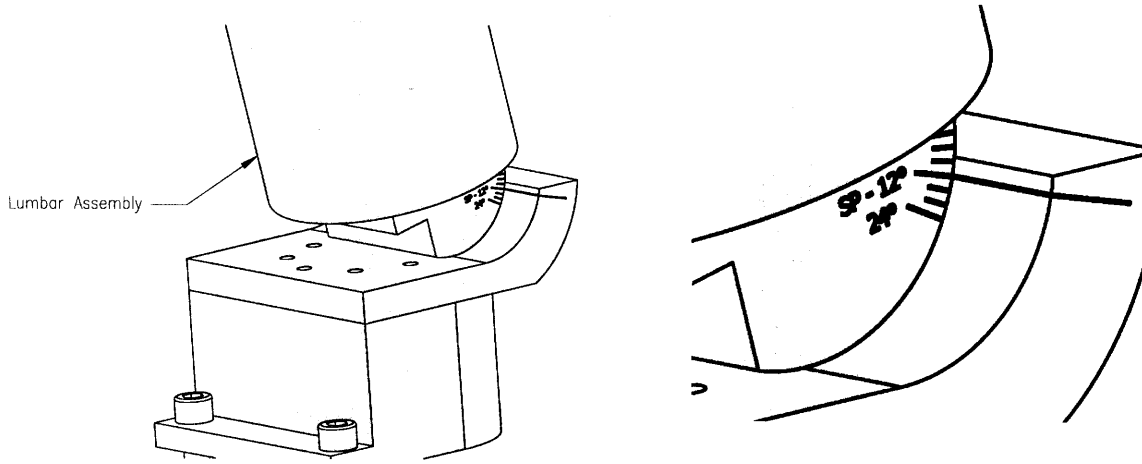


Figure 5b. Lumbar Angle Setting is SP-12 Degrees

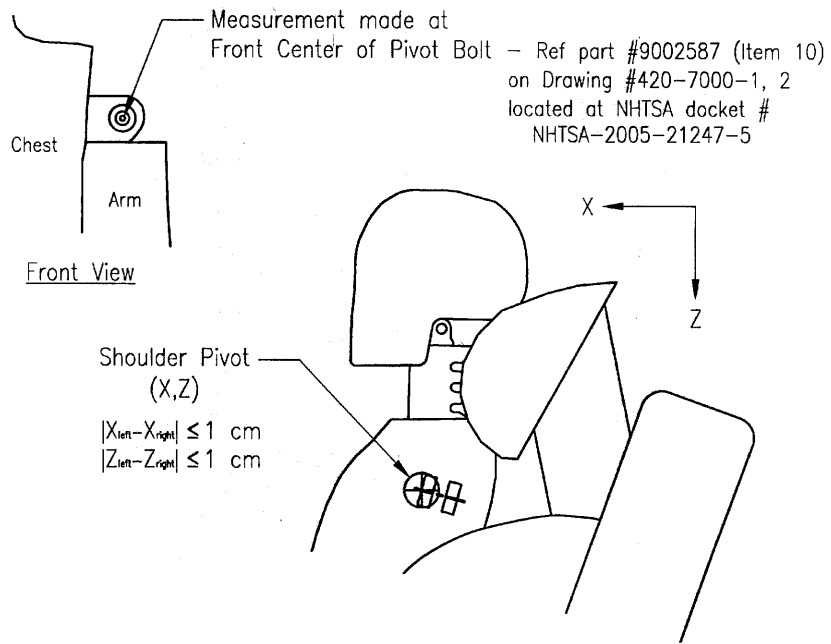
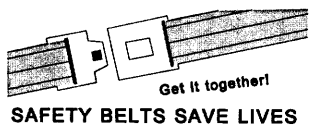


Figure 6. Shoulder Pivot Bolt Alignment



AUTO SAFETY HOTLINE
 (800) 424-9393
 Wash. D.C. Area 366-0123

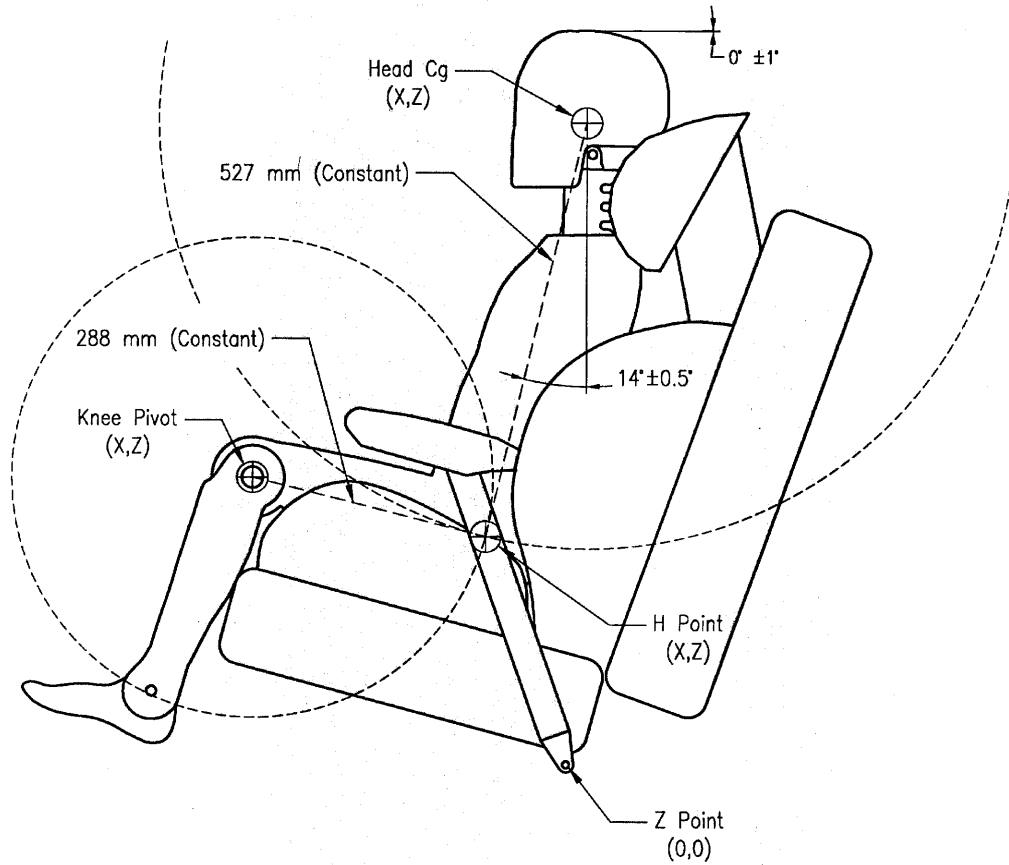


Figure 7. Locating the H-Point so that HIII-10C Torso Angle is 14 ± 0.5 Degrees from Vertical

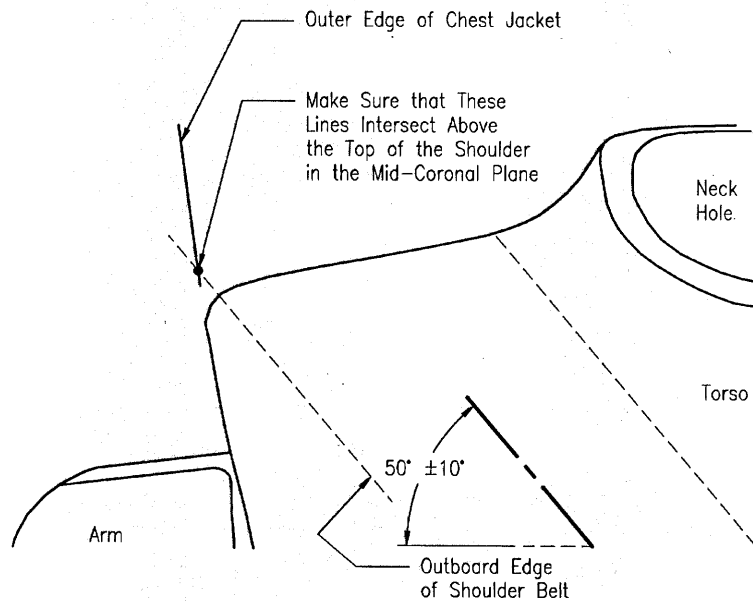
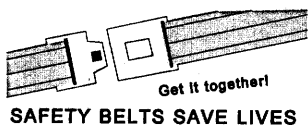


Figure 8. Shoulder Belt Placement



AUTO SAFETY HOTLINE
(800) 424-9393
Wash. D.C. Area 366-0123

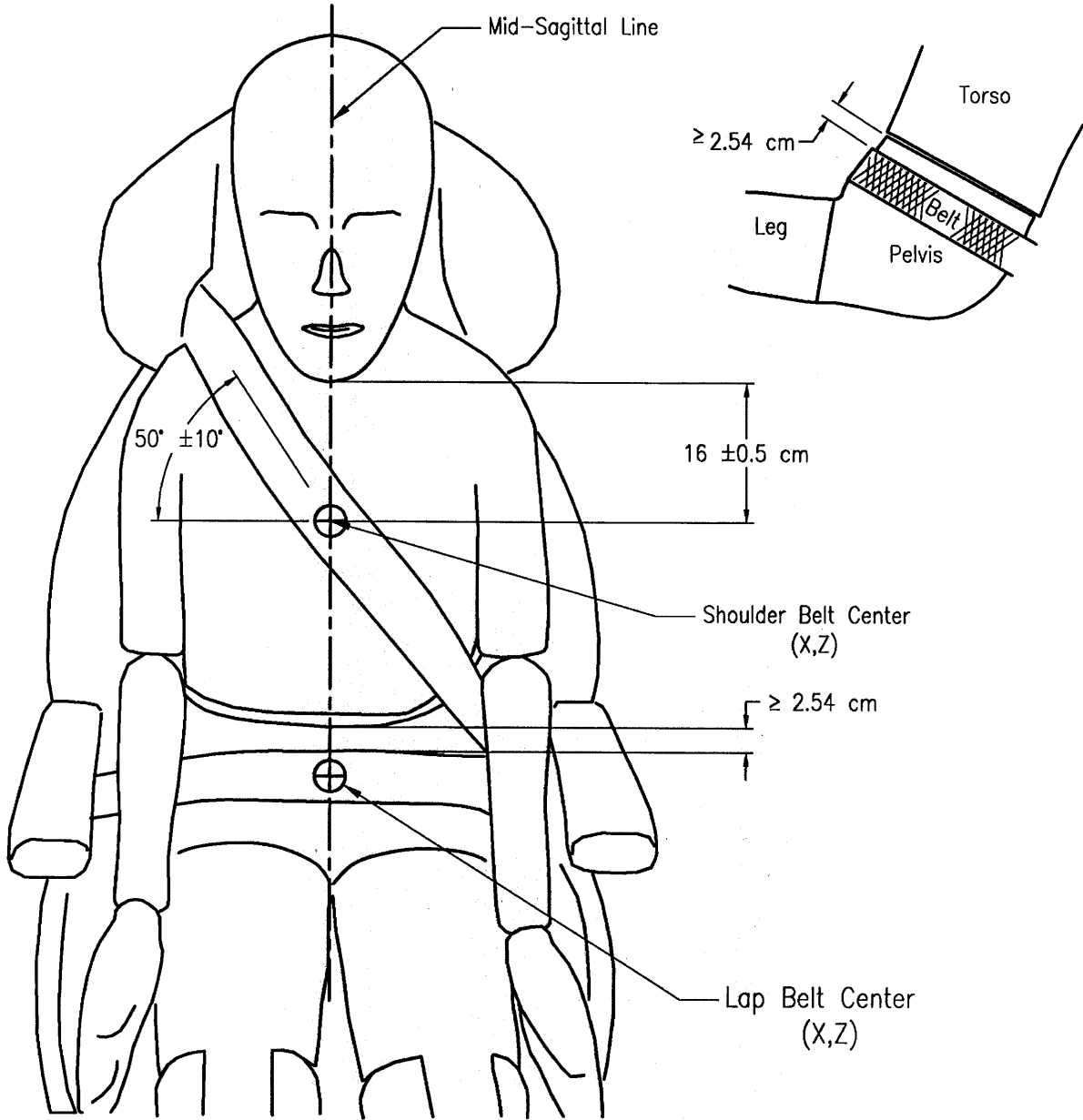
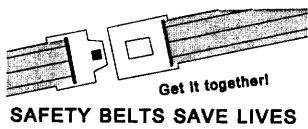


Figure 9. Overall Belt Placement for HIII-10C Dummy



AUTO SAFETY HOTLINE
(800) 424-9393
Wash. D.C. Area 366-0123

VRTC DUMMY SETUP SHEET

Dummy S/N _____ Test Date _____ Test No. _____

DUMMY CONFIGURATION

Lumbar Angle Setting (10YO only) _____ Neck Angle Setting (10YO only) _____

DUMMY ALIGNMENT

Dummy/Booster Centerline Coincident (check when confirmed)

Left Shoulder Pivot Bolt: X _____ Z _____
 Right Shoulder Pivot Bolt: X _____ Z _____

BELT PLACEMENT

Belt routed per manufacturer instructions (check when confirmed)

Shoulder Belt Tension _____ lbs
 Lap Belt Tension _____ lbs

Outside edge of shoulder belt inside outer edge of chest jacket (circle one)? Yes / No
 If "No", what is distance from outside edge of belt to outer edge of chest jacket (along top of shoulder)? _____ mm

Intersection of mid-sagittal plane and center of shoulder belt: X _____ Y _____ Z _____
 Shoulder belt angle relative to horizontal (50 ± 10 degrees): _____ deg

Top edge of lap belt ≥ 2.54 cm from pelvis rim (circle one)? Yes / No
 If "No", is belt positioned as low as possible (check when confirmed)

Intersection of mid-sagittal plane and center of lap belt: X _____ Y _____ Z _____

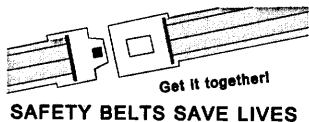
DUMMY POSTURE

Arms positioned correctly (check when confirmed)

Head is level (0 ± 1 degree): _____ deg

Head Center of Gravity (outboard side): X _____ Y _____ Z _____
 H-Point (outboard side): X _____ Y _____ Z _____
 Knee Pivot (outboard side): X _____ Y _____ Z _____

Torso Angle (14 ± 0.5 degrees): _____ deg



AUTO SAFETY HOTLINE
 (800) 424-9393
 Wash. D.C. Area 366-0123

APPENDIX E
BARRIER CERTIFICATION



CERTIFICATE OF CONFORMITY

Certificate No. **28638**
Serial No. **GH117**

Cellbond Composites Ltd
5 Stukeley Business Centre
Blackstone Road
Huntingdon
Cambridgeshire
PE29 6EF
United Kingdom

Product Description	Frontal ODB painted grey
Cellbond Part No.	70EEVCFIUS

telephone
+44 (0) 1480 435302
telefax
+44 (0) 1480 450181
email
sales@cellbond.com
website
www.cellbond.com

	Test Results	GR No.	Blk No.
1	16159-8	CHC0303188GG	N/A
2	16746-8	CHC0511040GF	N/A

Declaration.

The above moving deformable barrier has been manufactured in accordance with the provisions of the European Parliament and Council No 96/79/EC Directive (Regulation ECE R94)

Additional Information...

company registration
England 1944904

registered office
5 Stukeley Business Centre
Blackstone Road
Huntingdon
Cambridgeshire
PE29 6EF

Cellbond Offices
United Kingdom
United States of America



FM 78320
FM 31401





EEVC DEFORMABLE FRONTAL BARRIER
ALUMINIUM HONEYCOMB CERTIFICATION
STATIC TEST RESULTS

MAIN BLOCK
Core: 1.8 3/4 3003

Required Crush Strength
0.308 MPa to 0.342 MPa

Test No: 16159-8

GR No : CHC0303188GG

Block No: N/A

	Crush Strength (MPa)			RESULT
	6.4 to 9.7 mm	9.7 to 13.2 mm	13.2 to 16.5 mm	
Sample* 1	0.3146	0.3180	0.3300	PASS
Sample 2	0.3165	0.3205	0.3192	PASS
Sample 3	0.3182	0.3260	0.3174	PASS
Sample 4	0.3146	0.3212	0.3183	PASS
Sample 5	0.3220	0.3185	0.3248	PASS
Sample 6	0.3174	0.3261	0.3253	PASS
Sample 7	0.3150	0.3171	0.3232	PASS
Sample 8	0.3121	0.3036	0.3181	FAIL

Seven out of the eight samples must fulfil the crush strength requirement in order to pass the block certification

*Sample size and location as per R94.

RESULT: PASSED

**EEVC DEFORMABLE FRONTAL BARRIER
MAIN BLOCK**

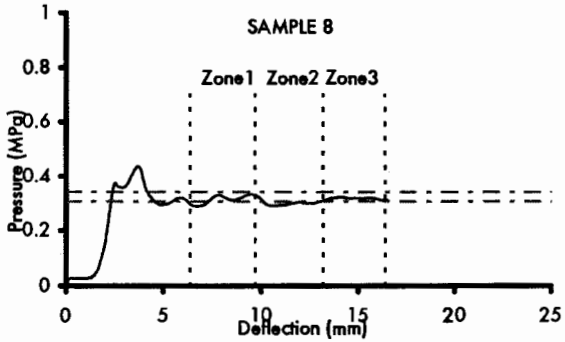
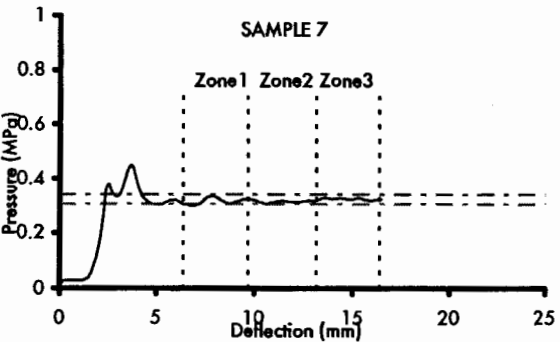
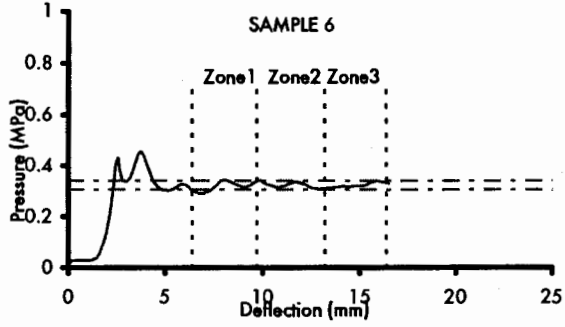
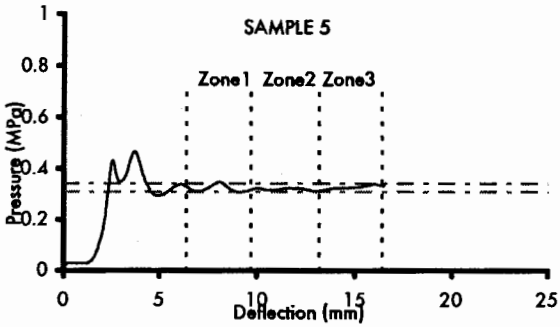
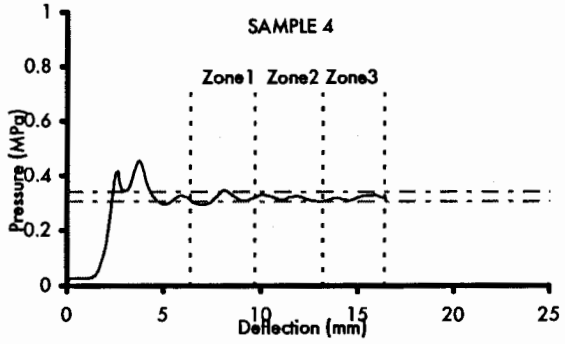
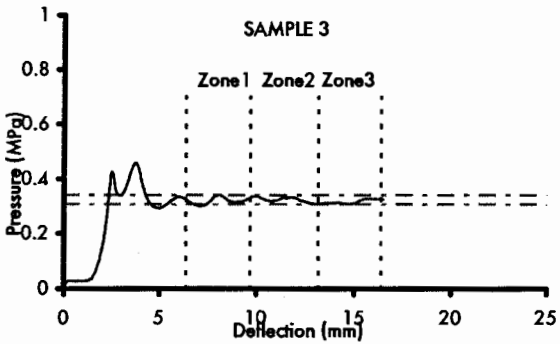
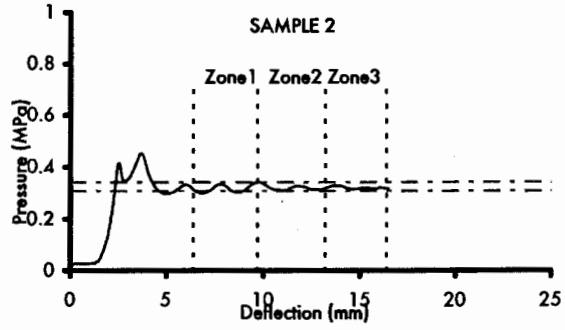
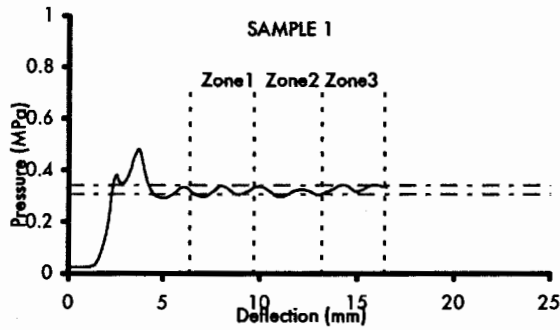
Honeycomb Type: 1.8 3/4 3003
 Higher Acceptable Crush Strength Limit: 0.342 MPa
 Lower Acceptable Crush Strength Limit: 0.308 MPa

Section 1: 6.4 - 9.7mm
 Section 2: 9.7 - 13.2mm
 Section 3: 13.2 - 16.5mm
 Speed: 6.35 mm/min

Test No: 16159-8

GR No: CHC0303188GG

Block No: N/A





**EEVC DEFORMABLE FRONTAL BARRIER
ALUMINIUM HONEYCOMB CERTIFICATION
STATIC TEST RESULTS**

**BUMPER
Core: 5.2 1/4 3003**

**Required Crush Strength
1.540 MPa to 1.711 MPa**

Test No: 16746-8

GR No: CHC0511040GF

Block No: N/A

	Crush Strength (MPa)			RESULT
	6.4 to 9.7 mm	9.7 to 13.2 mm	13.2 to 16.5 mm	
Sample* 1	1.653	1.646	1.629	PASS
Sample 2	1.625	1.604	1.593	PASS
Sample 3	1.661	1.644	1.628	PASS
Sample 4	1.621	1.615	1.606	PASS
Sample 5	1.583	1.608	1.610	PASS
Sample 6	1.646	1.612	1.603	PASS
Sample 7	1.598	1.606	1.615	PASS
Sample 8	1.619	1.591	1.587	PASS

Seven out of the eight samples must fulfil the crush strength requirement in order to pass the block certification

*Sample size and location as per R94.

RESULT: PASSED

EEVC DEFORMABLE FRONTAL BARRIER BUMPER

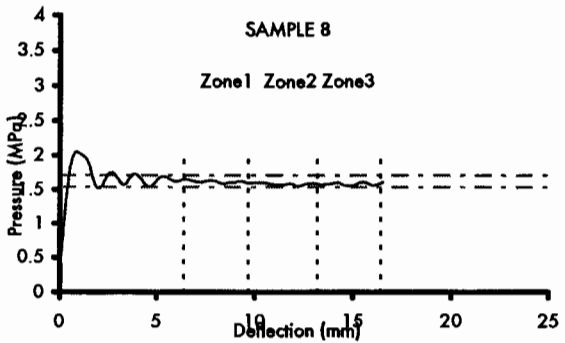
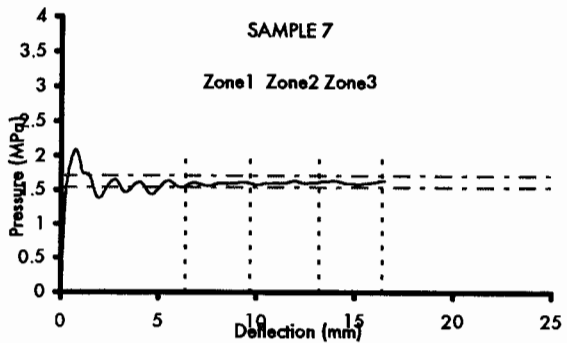
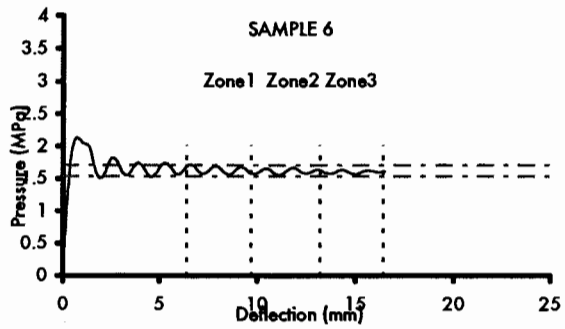
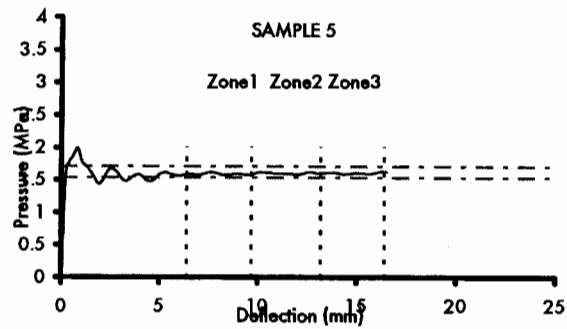
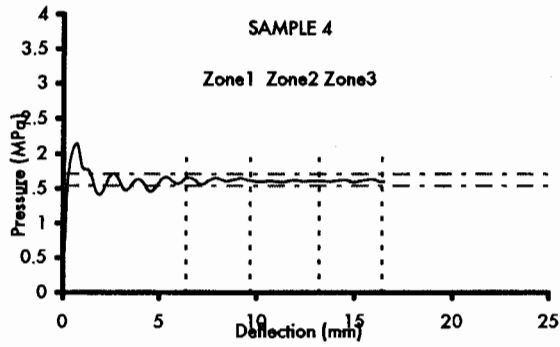
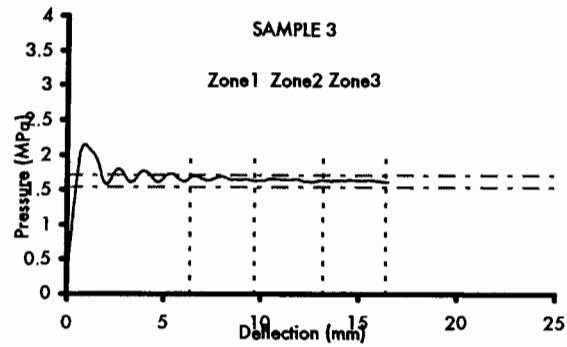
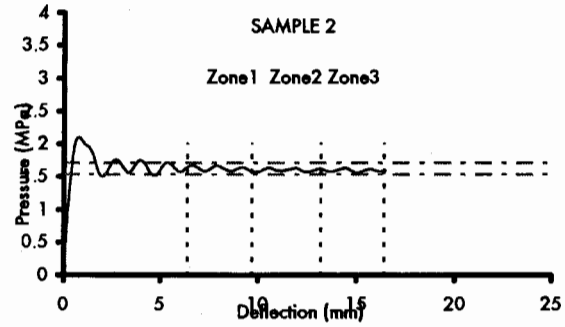
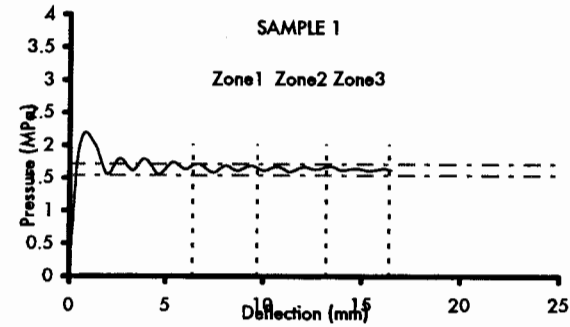
Honeycomb Type: 5.2 1/4 3003
Higher Acceptable Crush Strength Limit: 1.711 MPa
Lower Acceptable Crush Strength Limit: 1.540 MPa

Section 1: 6.4 - 9.7mm
Section 2: 9.7 - 13.2mm
Section 3: 13.2 - 16.5mm
Speed: 6.35 mm/min

Test No: 16746-8

GR No: CHC0511040GF

Block No: N/A



APPENDIX F

INSIA REPORT ON STRUCTURAL MEASUREMENTS

STRUCTURAL SURVEY OF CARS. MEASUREMENT METHODOLOGY OF THE MAIN RESISTANT ELEMENTS IN THE CAR BODY

**APARICIO IZQUIERDO, FRANCISCO
PÁEZ AYUSO, FRANCISCO JAVIER**

**INSIA
Carretera de Valencia, km. 7
Campus Sur de la Universidad Politécnica de Madrid
28031 – MADRID – (SPAIN)**

March, 1999

REPORT DOCUMENTATION PAGE
Title:

STRUCTURAL SURVEY OF CARS. MEASUREMENT METHODOLOGY OF THE MAIN RESISTANT ELEMENTS IN THE CAR BODY

Author(s):

Aparicio Izquierdo, Francisco
 Páez Ayuso, Francisco Javier

Performing Organisation name and address:

INSIA – University Institute for Automobile Research
 Carretera de Valencia, Km. 7 – Campus Sur de la Universidad Politécnica de Madrid
 28031 – Madrid – Spain

Supplementary notes:

Under contract to:

THE EUROPEAN COMMUNITY

Project: “Improvement of Crash Compatibility between Cars”
 Contract N°: RO – 97 – SC.1064

Abstract:

The main aim of this working package -*Structural Survey of Cars*- is the reduction of incompatibilities, both structural and geometric, between passenger vehicles and their potential collision partners. The understanding of these incompatibilities needs a previous step for the knowledge of the existing car fleet.

Firstly, it is necessary to select the main resistant elements in the car body. These elements have to be chosen from the point of view of the sort of collision that we want to study, that is to say, frontal and side impacts.

Detailed measurements have been taken from exterior and interior elements, spread to a total number of 74 models selected from the main vehicle manufacturers at Spain. All of them are being sold this year. Using the information available from the previous measurements in vehicles, the geometric characteristics of the main resistant elements involved in the geometric compatibility between cars will be defined.

This report shows the methodology followed to get these measurements.

Subject terms:

Crash compatibility, geometric compatibility, resistant elements, measure methodology

Date:

March, 1999

1.- METHODOLOGY.

Detailed measurements have been taken from exterior and interior elements. Using the information available from the previous measurements in vehicles, the geometric characteristics of the main resistant elements involved in the geometric compatibility between cars have been defined. These elements are presented in the following figures, and have been divided in two main groups according to the vehicle zones studied in this project.

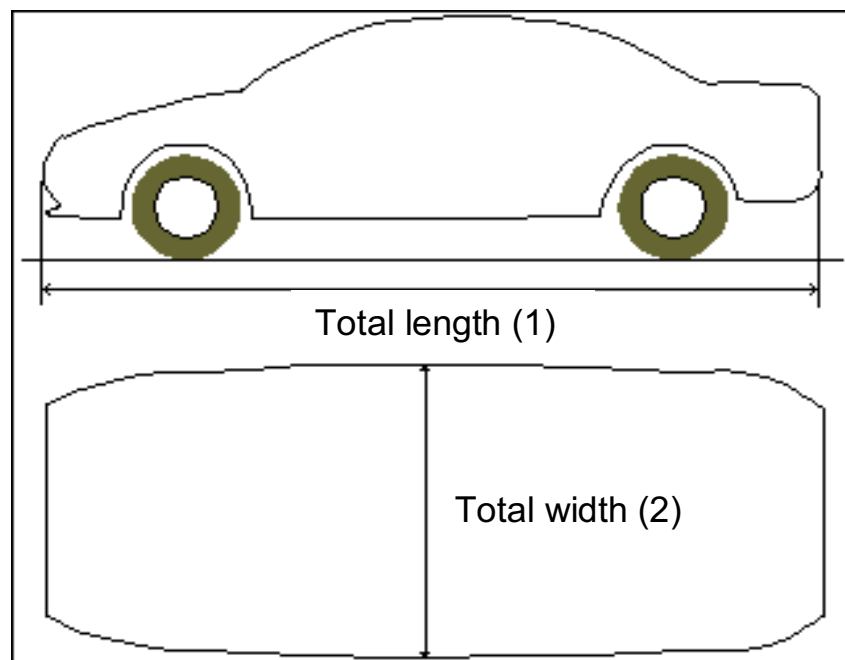


Figure 1.- Definition of the main resistant elements. General dimensions.

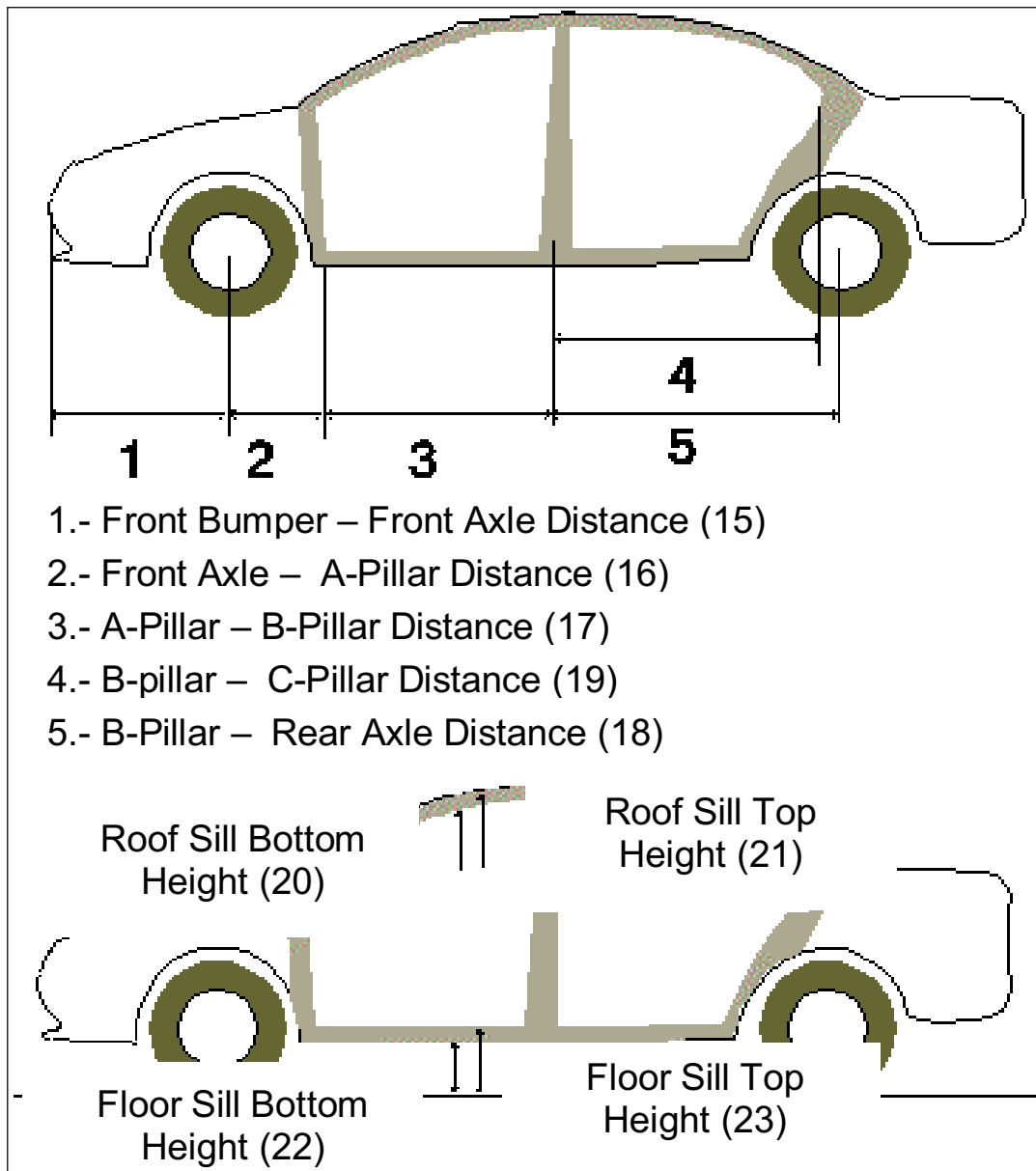


Figure 2.- Definition of the main resistant elements. Side elements.

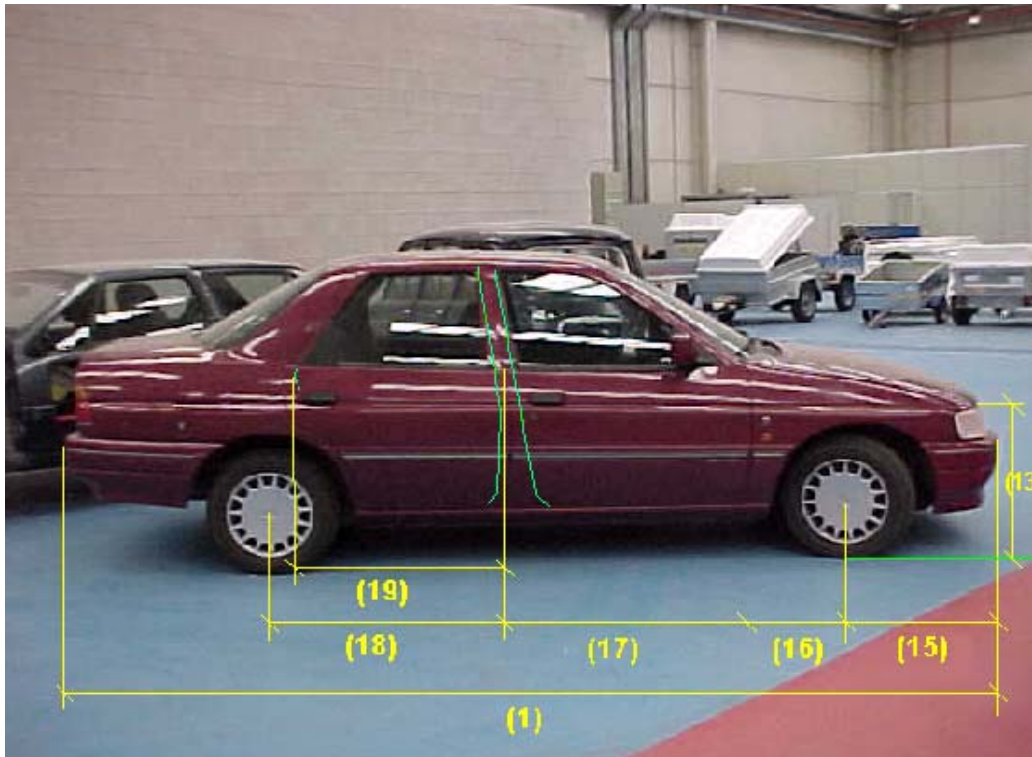


Figure 3.-
Measurements of
the side resistant
elements (outer).

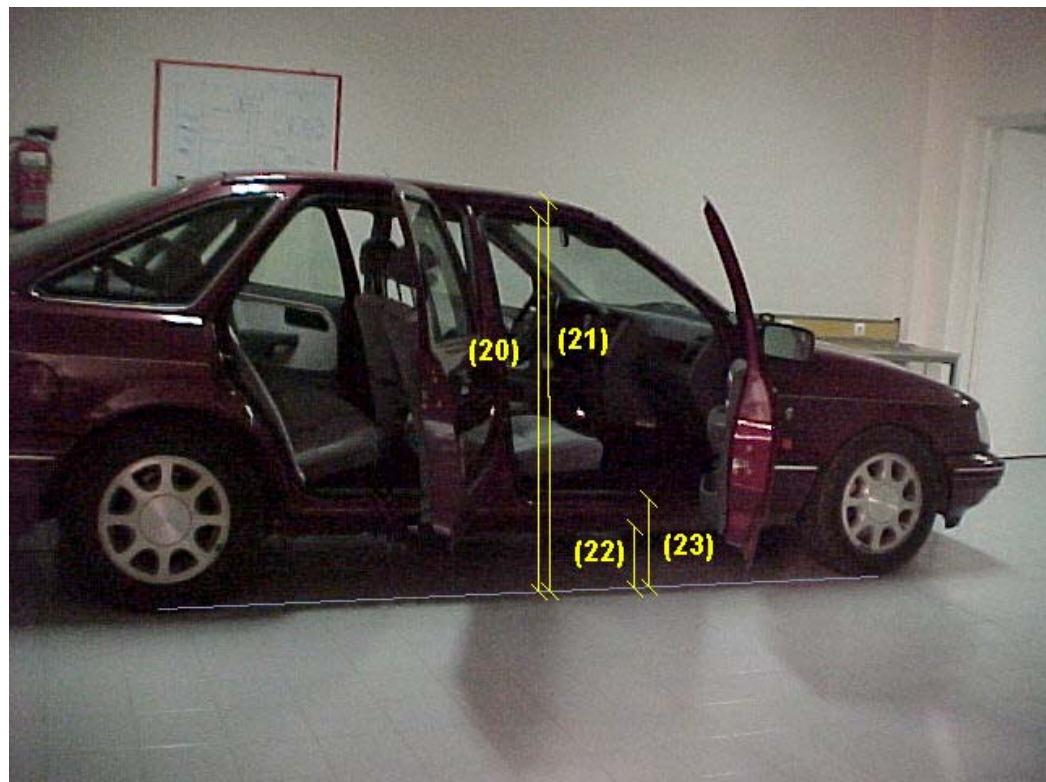


Figure 4.- Measurements
of the side resistant
elements (inner).

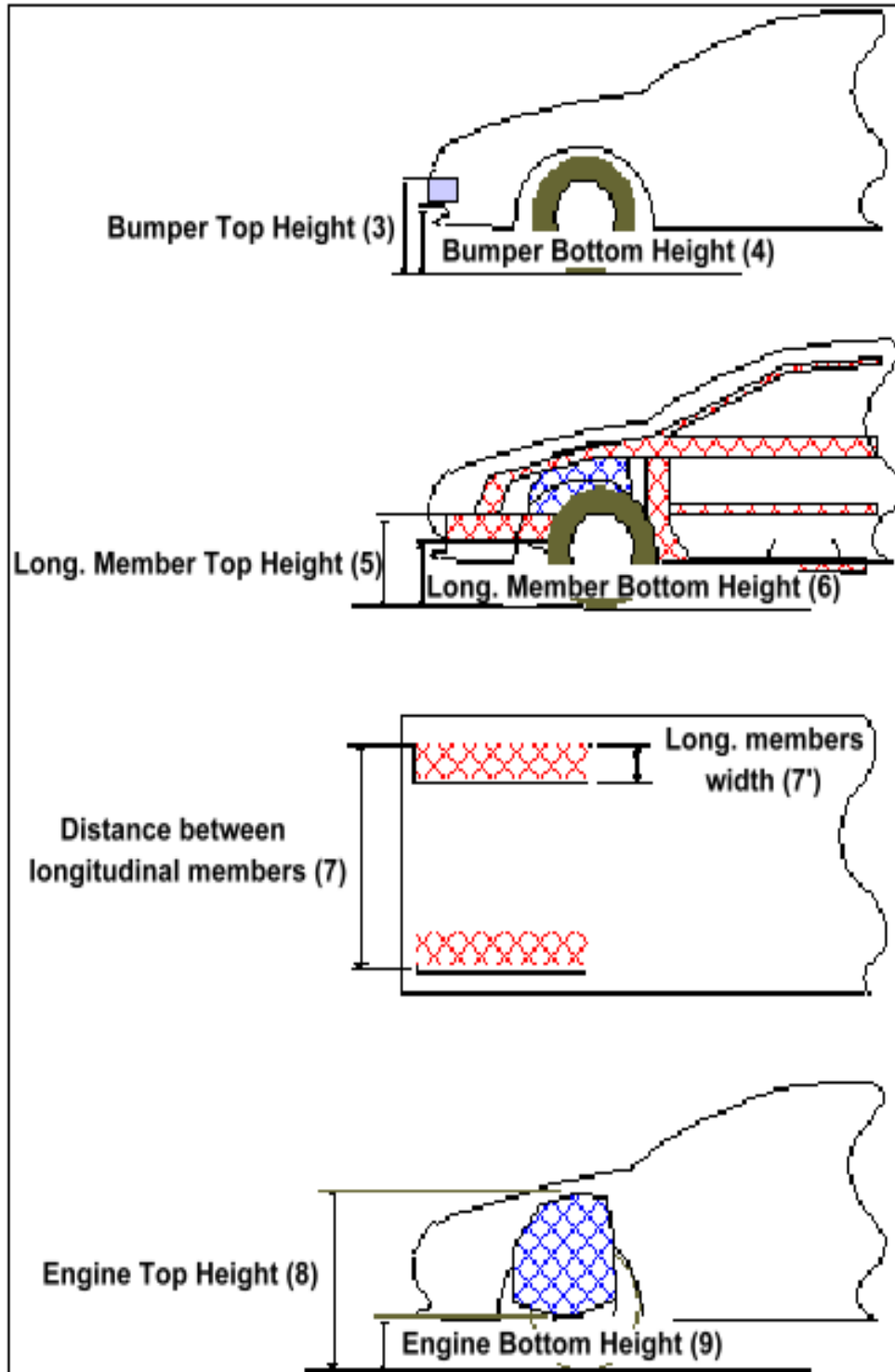


Figure 5.- Definition of the main resistant elements. Front elements.

Figure 6.-
Measurements of the
main resistant elements.
Front elements 1.

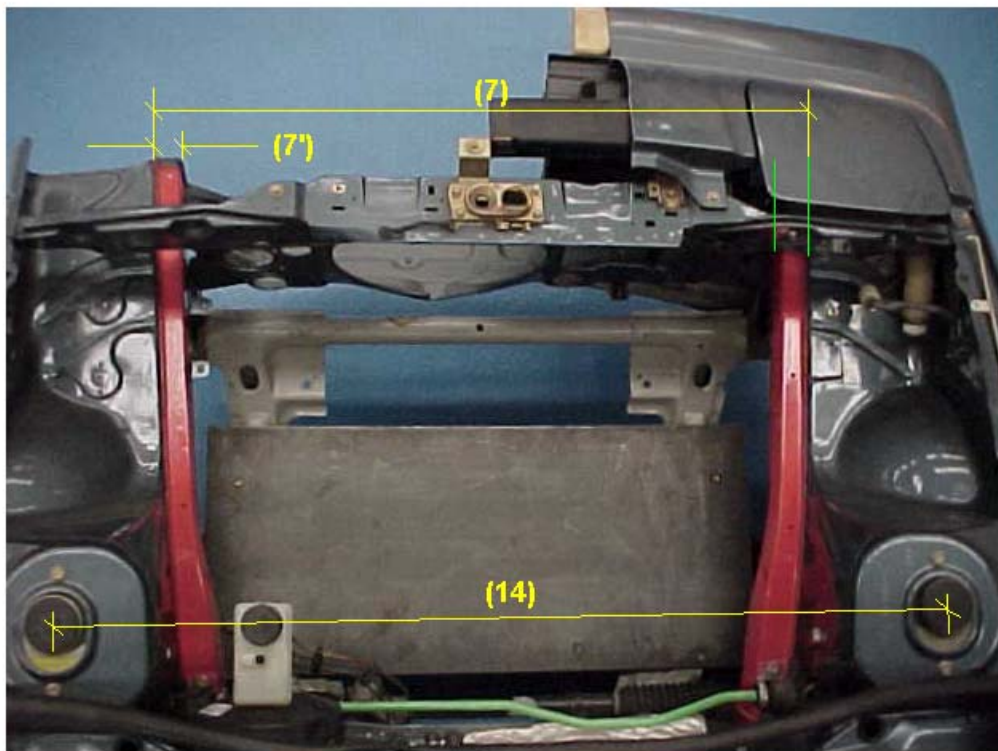
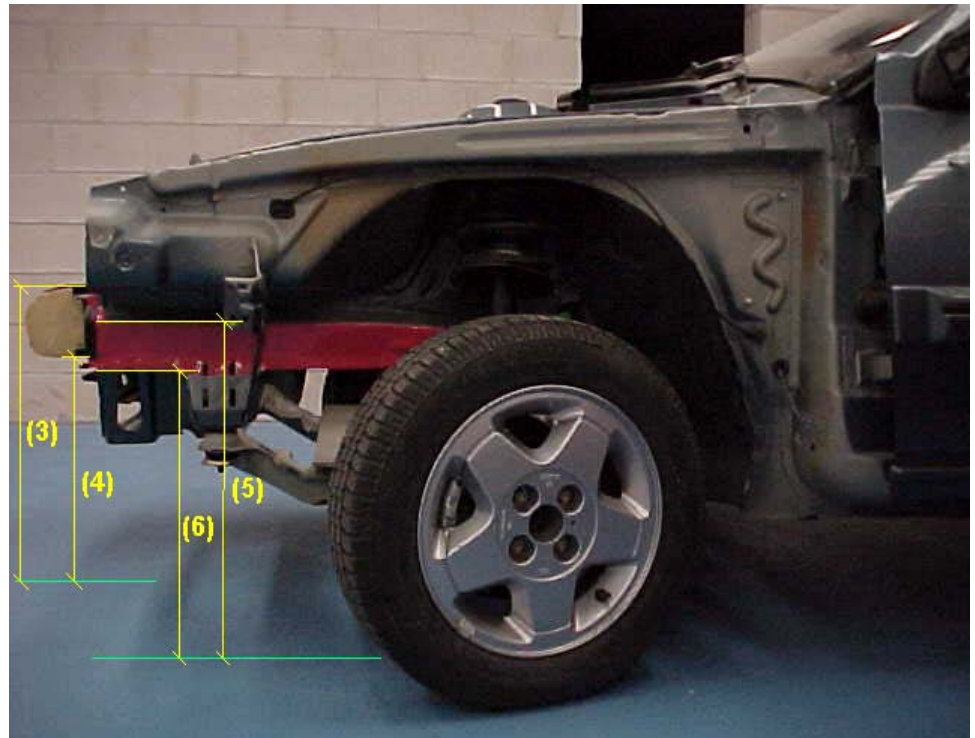


Figure 7.-
Measurements
of the main
resistant
elements. Front
elements 2.

Figure 8.-
Measurements of
the main resistant
elements. Front
elements 3.

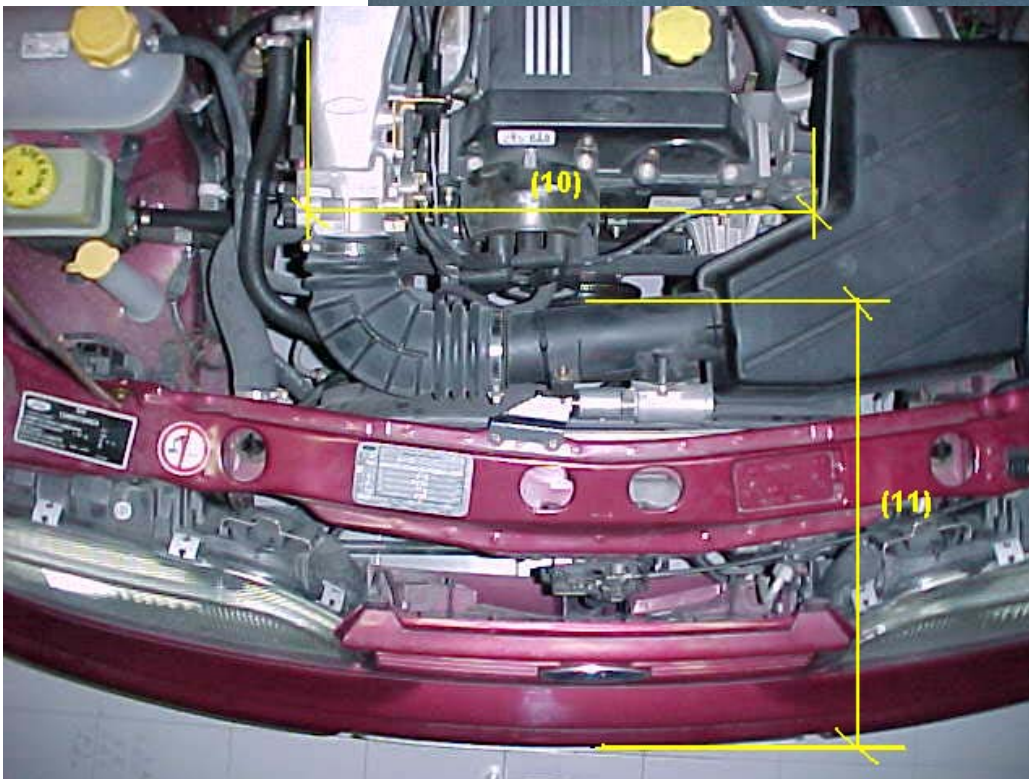
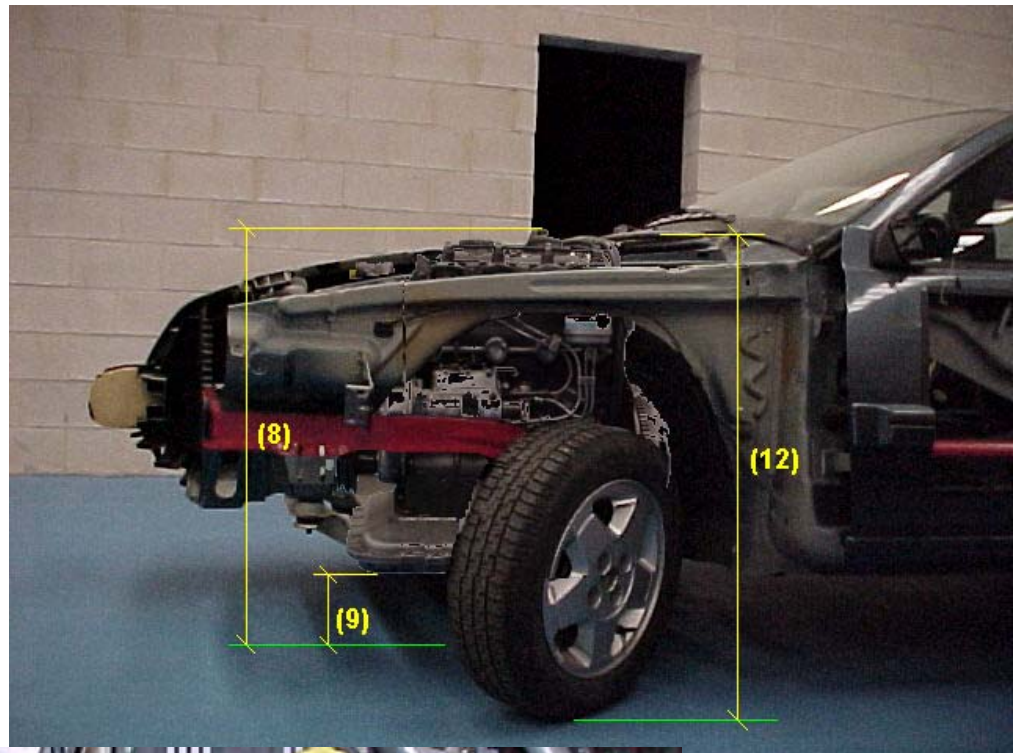


Figure 9.-
Definition of
the main
resistant
elements. Front
elements
(Longitudinal
engine).

The procedure considered to measure these elements is described as follows, where it is indicated the location of these ones in the Excel Sheet (SURVEY.XLS) into brackets:

FRONT ELEMENTS

- **Total Length –(1)- (Side & Front Sheets - C column):** distance between the point in the front bumper further on and the point in the rear bumper further back.
- **Weight (Side & Front Sheets - D column):** mass, including an average driver weight (70 kg), and the fuel tank mass (at half-capacity).
- **Total Width –(2)- (Side & Front Sheets - E column):** distance between the outer side points in a transverse plane of the vehicle (middle plane between the front and rear axles).
- **Bumper bottom height –(4)- (Front Sheet G column):** distance between the ground and the lowest point on the front bumper, being a resistant member (aerodynamic elements under the front bumper are not considered).
- **Bumper top height –(3)- (Front Sheet H column):** distance between the ground and the highest point on the front bumper, being a resistant member (aerodynamic elements are not considered).
- **Longitudinal member top height –(5)- (Front Sheet I column):** distance between the ground and the highest point on the longitudinal members, measured approximately in the front bumper-longitudinal member joint (when accessible).
- **Longitudinal member bottom height –(6)- (Front Sheet J column):** distance between the ground and the lowest point on the longitudinal members, measured approximately in the front bumper-longitudinal member joint.
- **Distance between longitudinal members (Front Sheet K column):** transverse distance between extreme points in longitudinal members, measured approximately in the front bumper-longitudinal member joint.

Depending on the accessibility of these members, the extreme points are the inner points (I) or the outer points (O).

- **Longitudinal member width -7'- (Front Sheet L column):** width of one of the longitudinal members, measured approximately in the front bumper-longitudinal member joint.

-
- **Engine top height (8) (Front Sheet N column):** distance between the ground and the highest point on the engine that can be a resistant member in case of accident (usually, the highest point on the head, or the highest point of the inlet or exhaust manifolds).
 - **Engine bottom height (9) (Front Sheet M column):** distance between the ground and the lowest point on the engine (usually, the lowest point on the crankcase).
 - **Engine and Gearbox width (10) (Front Sheet O & P columns):**
 - *Transverse configuration engine:* distance between extreme points in the gearbox-cylinder block unit or others resistant members attached to the cylinder block unit, i.e. fan belts (from a front point of view).
 - *Longitudinal configuration engine:* distance between extreme points in the cylinder block unit (from a front point of view).
 - **Front bumper - Engine distance (11) (Front Sheet Q column):** distance between the point in the front bumper further on and the point in the engine further on that is a resistant element, i.e. the further on point of the exhaust manifold placed in the front of the engine.
 - **Front shock absorber fixing width (14) (Front Sheet R column):** transverse distance between the front shock absorber - body car joints.
 - **Front shock absorber fixing height (12) (Front Sheet S column):** distance between the ground and the front shock absorber-body car joint.
 - **Bonnet leading edge height (Front Sheet T column):** distance between the ground and the bonnet edge further on.

SIDE ELEMENTS

- **Front bumper - Front axle distance (15) (Side Sheet G column):** distance between the point in the front bumper further on and the middle point in the front tyre-road contact patch.
- **Front axle - A Pillar distance (16) (Side Sheet H column):** distance between the middle point in the front tyre-road contact patch and the point in the A-pillar further back.
- **A Pillar - B Pillar distance (17) (Side Sheet I column):** distance between the point in the A-pillar further back and the middle point in the B-pillar.
- **B Pillar - C Pillar distance (19) (Side Sheet J column):** distance between the middle point in the B-pillar and the point in the C-pillar further back (only 4/5-door vehicles).
- **B Pillar - Rear axle distance (18) (Side Sheet K column):** distance between the middle point in the B-pillar and the middle point in the rear tyre-road contact patch.
- **Roof sill bottom height (20) (Side Sheet L column):** distance between the ground and the lowest point on the roof sill, measured in the front door middle point.
- **Roof sill top height (21) (Side Sheet M column):** distance between the ground and the highest point on the roof sill (usually located in the sill-roof joint), measured in the front door middle point.
- **Floor sill bottom height (22) (Side Sheet N column):** distance between the ground and the lowest point on the floor sill, measured in the front door middle point.
- **Floor sill top height (23) (Side Sheet O column):** distance between the ground and the highest point on the floor sill, measured in the front door middle point.

NOTE

- N/A: dimension not available.