REPORT NUMBER: NCAP-MGA-2005-013

NEW CAR ASSESSMENT PROGRAM
FRONTAL BARRIER IMPACT TEST

HYUNDAI MOTOR COMPANY
2005 HYUNDAI SANTA FE
NHTSA NUMBER: M50500

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

Test Date: February 17, 2005

Final Report Date: April 7, 2005

FINAL REPORT

PREPARED FOR:
U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
RULEMAKING
OFFICE OF CRASHWORTHINESS STANDARDS
400 SEVENTH STREET, SW, ROOM 5311
WASHINGTON, D.C. 20590

This final test report was prepared for the U.S. Department of Transportation, National Highway Traffic Safety Administration, in response to Contract Number DTNH22-01-D-12005.

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Shefalika Naik, Project Engineer Date: 4/07/05

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David Winkelbauer, Facility Director Date: 4/07/05

FINAL REPORT ACCEPTED BY:

_____
Manager, New Car Assessment Program

_____
Date of Acceptance

_____
COTR, NCAP Frontal Impact Program

_____
Date of Acceptance

Technical Report Documentation Page

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16. Abstract

A 35.2 mph (56.6 km/h) frontal barrier impact was conducted on a 2005 Hyundai Santa Fe at MGA Research Corporation on February 17, 2005. This test was conducted to obtain data indicant of FMVSS 208, 212, 219 (partial), 301, and foot well intrusion performance. The impact velocity was 56.6 km/h. The ambient temperature at the barrier face at the time of impact was 21 degrees Celsius. The vehicle's maximum post test static crush is 583 mm located at the centerline of the vehicle. The test vehicle is equipped with a 3-point continuous belt system and an airbag in both front outboard seating positions. With respect to FMVSS 208 "Occupant Crash Protection", the occupant injury criteria summary is as follows:

Measurement Description	Units	Threshold	Driver ATD	Pass. ATD
Head Injury Criteria (HIC)	N/A	1000	449	487
Max. Thorax Accel. (3ms Clip)	G's	60	50	43
Left Femur Force	Newton	10009	-4458	-6543
Right Femur Force	Newton	10009	-6482	-3511

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SECTION 1

PURPOSE AND SUMMARY OF TEST

PURPOSE

This 56.6 km/h frontal barrier impact test is part of the Vehicle Barrier Impact Testing Program sponsored by the National Highway Traffic Safety Administration (NHTSA) under contract number DTNH22-01-D-12005. The purpose of this test was to obtain vehicle crashworthiness and occupant restraint system performance data for an impact in excess of the current 48.3 kph requirements.

SUMMARY

A load cell barrier consisting of 30 load cells was impacted by a 2005 Hyundai Santa Fe at a velocity of 56.6 kph. The test was performed at MGA Research Corporation on February 17, 2005. Pre-and post-test photographs of the vehicle and dummies can be found in Appendix A.

One real-time camera and sixteen high-speed cameras were used to document the frontal barrier impact event. Camera locations and other pertinent camera information can be found in this report.

Two Part 572E, 50th percentile male anthropomorphic test devices (ATDs), were placed in the driver and right-front passenger seating positions according to dummy placement instructions specified in the Laboratory Indicant Test Procedure.

Both ATDs were fully instrumented with head, chest and pelvis tri-axial accelerometers, chest displacement potentiometer, upper neck transducers, right/left femur load cells, and lower leg instrumentation. The driver (position 1) ATD (Serial No. 065) and right-front passenger (position 2) ATD (Serial No. 066) were calibrated previous to this test. Certification details, along with instrumentation calibration data, are found in Appendix C.

The 155 channels of data were recorded on an on-board data acquisition system. Appendix B contains the vehicle and dummy response data traces.

There was 100 percent windshield retention and no intrusion into the protected zone of the windshield during the event. There was no Stoddard Solvent leakage after the event or during any phase of the static rollover.

The maximum static crush of the vehicle was 583mm and both the driver and passenger side doors remained closed and latched during the impact event and were operable after the impact.

The driver’s head, chest, and abdomen contacted the airbag. The driver’s head also contacted the headrest and headliner. The driver’s knees contacted the bolster. The passenger’s head and chest contacted the airbag. The passenger's head also contacted the headrest and visor. The passenger’s knees contacted the glove box.

The occupant data is summarized below:

ATD position	HIC	Clip (g)	Chest Disp. (mm)	Left Femur (N)	Right Femur (N)
Driver	448.8	49.7	-28.7	-4458	-6482
Passenger	486.9	43.2	-25.6	-6543	-3511

TEST NOTES

No valid data was collected for the following:

Barrier 9-4

SECTION 2

OCCUPANT AND VEHICLE INFORMATION / DATA SHEETS

Test Vehicle: 2005 Hyundai Santa Fe
Test Program: 35mph Frontal Impact

NHTSA No.: M50500
Test Date: 02/17/2005

CONVERSION FACTORS USED IN THIS REPORT*

Quantity	Typical Application	English Units	Metric Unit	Multiply By
Mass	Vehicle Weight	lb	kg	0.4536
Linear Velocity	Impact Velocity	mile/h	km/h	1.609
Length or Distance	Measurements	in	mm	25.4
Volume	Fuel Systems	gal	liter	3.785
Volume	Small Fluids	oz	mL	29.573
Pressure	Tire Pressure	lbf/in^2	kPa	7.0
Volume	Liquid	gal	liter	3.785
Temperature	General Use	°F	°C	=(tf -32)/1.8
Force	Dynamic Forces	lbf	N	4.448
Moment	Torque	lbf/ft	Nm	1.355

*Based on the Recommended Practice in SAE J916, May 85

DATA SHEET NO. 1
CRASH TEST SUMMARY

Test Vehicle: 2005 Hyundai Santa Fe
Test Program: 35mph Frontal Impact
NHTSA No.: M50500
Test Date: 02/17/2005

PRIMARY IMPACT DATA

Measured Parameter	Units	Value
Velocity at Impact	km/hr	56.6
Test Weight	kg	2013.5
Average Rebound	mm	601
Maximum Static Crush	mm	583
Impact Angle	degrees	0.0

DOOR OPENING AND SEAT TRACK INFORMATION

Description	Driver	Passenger
Locked/Unlocked Doors	Doors were unlocked	Doors were unlocked
Front Door Opening	Door remained closed and latched; Door opened without tools	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
Seat Track Shift (mm)	0	0
Seat Back Failure	None	None
Glazing Damage	The windshield cracked	

TEST DUMMY INFORMATION

Description	Driver	Passenger
Dummy Type / Serial No.	HIII 50th / 065	HIII 50th / 066
Head Contact	Airbag, Headrest, Headliner	Airbag, Headrest, Visor
Chest Contact	Airbag	Airbag
Abdomen Contact	Airbag	None
Left Knee Contact	Knee Bolster	Glove Box
Right Knee Contact	Knee Bolster	Glove Box

16mm MOVIE COVERAGE

High Speed	16
Real Time	1
Total	17

Driver ATD Sensors	52
Passenger ATD Sensors	48
Belt Assessment Sensors	4
Vehicle Structure Accelerometers	9
Total	113

DATA SHEET NO. 2

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2005 Hyundai Santa Fe NHTSA No: M50500
Test Program: 35mph Frontal Impact Test Date: 02/17/2005

TEST VEHICLE INFORMATION

Manufacturer	Hyundai Motor Company
Model	Santa Fe
Body Style	MPV
NHTSA No.	M50500
VIN	KM8SC73D35U881358
Color	Merlot
Delivery Date	2/4/05
Odometer Reading (mile)	86
Dealer	Arrow Hyundai
Transmission	Automatic
Final Drive	4 Wheel
Number of Cylinders	6
Engine Displacement (L)	2.7
Engine Placement	Lateral
Automatic Door Lock (ADL)	No
Owners Manual Details Instructions on Disabling ADLs	NA

TEST VEHICLE OPTIONS

Driver Airbag	Yes
Passenger Airbag	Yes
Force Limiter	Yes
Pretensioner	Yes
Power Windows	Yes
Power Steering	Yes
Power Door Locks	Yes
Tilt Wheel	Yes
Air Conditioning	Yes
Power Brakes	Yes
Disc Brakes, Front	Yes
Disc Brakes, Rear	Yes
Anti-lock Brakes	Yes
AM/FM/CD	Yes
Anti-theft System	Yes
Cruise Control	Yes

DATA FROM CERTIFICATION LABEL

Manufactured By	Hyundai Motor Company
Date of Manufacture	09/15/04

GVWR (kg)	2377
GAWR Front (kg)	1200
GAWR Rear (kg)	1370

DATA FROM TIRE PLACARD

Measured Parameter	Front	Rear
Maximum Tire Pressure (kPa)	385	385
Cold Pressure (2 persons)	210	210
Cold Pressure (max)	200	220
Recommended Tire Size	P225/70R16	P225/70R16
Tire size on Vehicle	P225/70R16	P225/70R16
Tire Manufacturer	BF Goodrich	BF Goodrich

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Split Bench		
Number of Occupants	2	3		5
Capacity Wt. (VCW) (kg)				400
Cargo Wt. (RCLW) (kg)				59.0

DATA SHEET NO. 2... (continued)

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2005 Hyundai Santa Fe NHTSA No.: M50500
Test Program: 35mph Frontal Impact Test Date: 02/17/2005

TEST VEHICLE WEIGHTS

	Units	As Delivered (UVW) (Axle)			As Tested (ATW) (Axle)		
		Front	Rear	Total	Front	Rear	Total
Left	kg	532.5	379.7		578.3	449.5	
Right	kg	512.6	381.9		537.1	448.6	
Ratio	%	57.8	42.2		55.4	44.6	
Totals	kg	1045.1	761.6	1806.7	1115.4	898.1	2013.5

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value
Total Delivered Weight (UVW)	kg	1806.7
Weight of 2 P572E ATDs	kg	156.0
Rated Cargo/Luggage Weight (RCLW)	kg	59.0
Calculated Vehicle Target Weight (TVTW)	kg	2021.7

TEST VEHICLE ATTITUDES AND CG

	Units	LF	RF	LR	RR	CG(aft of front axle)
As Delivered	mm	793	800	808	814	1113
As Tested	mm	785	795	782	789	1178
Post Test	mm	768	762	775	760	

Vehicle Wheelbase (mm): 2640

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

Vehicle Components Removed: None

Ballast weight does not include instrumentation and data acquisition system.

FUEL SYSTEM DATA

Fuel System Capacity From Owner's Manual (L): 71.9

Usable Capacity Figure Furnished by COTR (L): 71.9

Actual Test Volume (L): 49.2

Test Fluid Type: Stoddard Solvent; Specific Gravity: 0.77

Is Vehicle Fuel Pump Electric or Mechanical? Electric

If electric, does pump operate with ignition switch "ON" & engine "OFF"? Yes

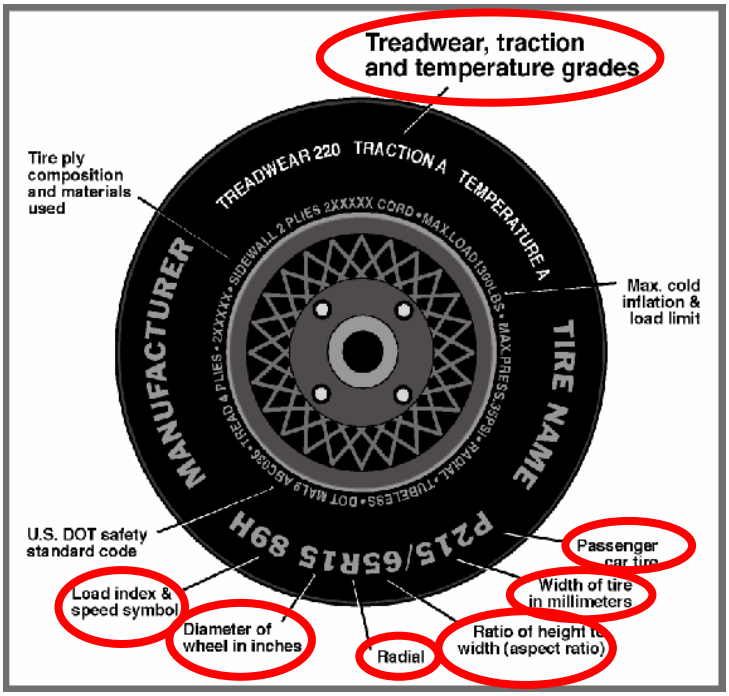
DATA SHEET NO. 3

TEST VEHICLE TIRE INFORMATION

Test Vehicle: 2005 Hyundai Santa Fe
Test Program: 35mph Frontal Impact

NHTSA No.: M50500
Test Date: 02/17/2005

Vehicle Year	2005	Vehicle Make	Hyundai
VIN	KM8SC73D35U881358	Vehicle Model	Santa Fe



	Front	Rear
Tire Manufacturer	BF Goodrich	BF Goodrich
Tire Name	Radial Longtrail T/A	Radial Longtrail T/A
Tire Type	M+S	M+S
Tire Width (mm)	225	225
Ratio of Height to Width (aspect ratio)	70	70
Radial	R	R
Wheel Diameter	16	16
Load Index & Speed Symbol	101T	101T
Treadwear	440	440
Traction Grade	A	A
Temperature Grade	B	B

DATA SHEET NO. 4

POST IMPACT DATA

Test Vehicle: 2005 Hyundai Santa Fe
Test Program: 35mph Frontal Impact

NHTSA No.: M50500
Test Date: 02/17/2005

Measured Parameter	Units	Requirement	Value
Trap No. 1 Velocity (Primary)	km/h	55.5 – 57.1	56.6
Trap No. 1 Entry Distance	mm	<1524	1300
Trap No. 1 Exit Distance	mm	<1524	300
Trap No. 2 Velocity (Redundant)	km/h	55.5 – 57.1	56.6
Trap No. 2 Entry Distance	mm	<1524	1425
Trap No. 2 Exit Distance	mm	<1524	425

VEHICLE STATIC CRUSH

Measured Parameter	Units	Pre-Test	Post-Test	Difference
Left Side	mm	3490	3313	177
Center	mm	4555	3972	583
Right Side	mm	3407	3302	105

VEHICLE REBOUND FROM BARRIER

Measured Parameter	Units	Value
Left Side	mm	563
Center	mm	577
Right Side	mm	644
Average	mm	601

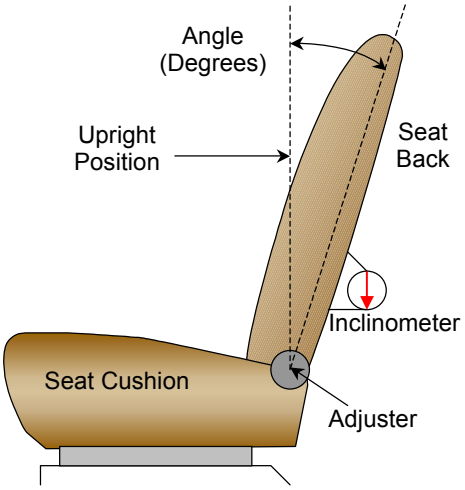
DATA SHEET NO. 5

TEST VEHICLE INFORMATION

Test Vehicle: 2005 Hyundai Santa Fe NHTSA No.: M50500
Test Program: 35mph Frontal Impact Test Date: 02/17/2005

NORMAL DESIGN RIDING POSITION

The driver and passenger seat back is positioned to the manufacturer's designated angle. The procedure is as follows:



FRONT SEAT ASSEMBLY

Driver:
Total Number of detents: 47
Test detent (with the forward most detent defined as 0): 14th

Passenger:
Total Number of detents: 47
Test detent (with the forward-most detent defined as 0): 14th

Driver seat back angle: notch 14 from upright notch as 0
Passenger seat back angle: notch 14 from upright notch as 0

SEAT FORE/AFT POSITIONS

The driver was power operated and the passenger seat was manually operated.

Driver seat fore/aft total travel:	23 notches
Driver seat fore/aft position:	12 of 23 notches (with the forward-most detent defined as 0)
Passenger seat fore/aft total travel:	23 notches
Passenger seat fore/aft position:	12 of 23 notches (with the forward-most detent defined as 0)

DATA SHEET NO. 5... (continued)

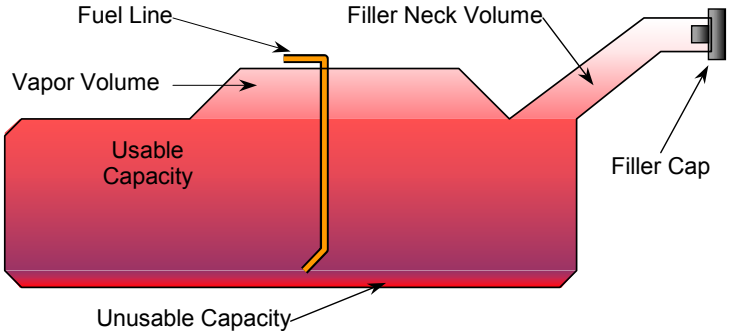
TEST VEHICLE INFORMATION

Test Vehicle:	2005 Hyundai Santa Fe	NHTSA No.:	M50500
Test Program:	35mph Frontal Impact	Test Date:	02/17/2005

FUEL TANK CAPACITY DATA

The "Usable Capacity" of the standard equipment fuel tank is:	71.9 liters
The "Usable Capacity" of any optional equipment fuel tank is:	N/A liters
The "Usable Capacity" used for certification to FMVSS 301 requirements:	71.9 liters
Actual amount of Stoddard solvent added to vehicle for certification test:	49.2 liters

The fuel door is located on the left (driver's) side of the vehicle.

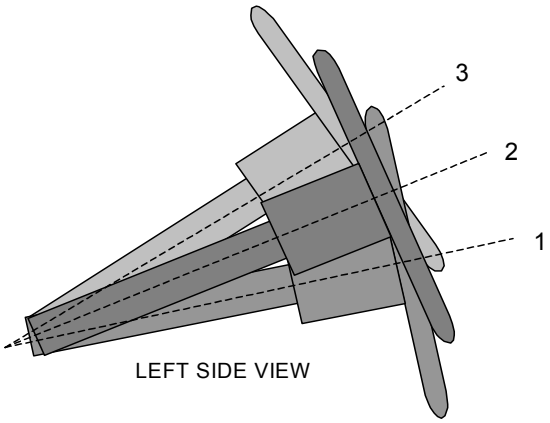


VEHICLE FUEL TANK ASSEMBLY

STEERING COLUMN ADJUSTMENT

Adjustable steering controls are made so that the steering wheel hub is at the geometric center of the locus it describes when it is moved through its full range of driving positions.

Lowermost, Position 1: 22.0°
Geometric Center, Position 2: 29.1°
Uppermost, Position 3: 36.3°



STEERING COLUMN ASSEMBLY

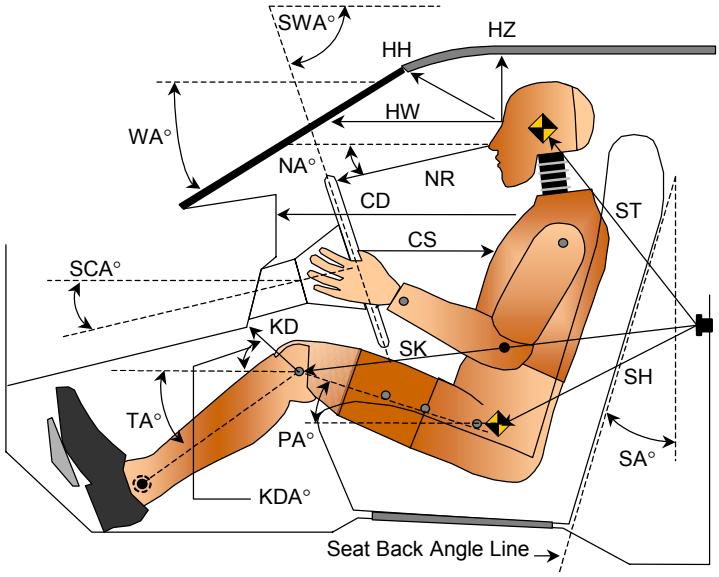
DATA SHEET NO. 6

DUMMY POSITIONING IN VEHICLE

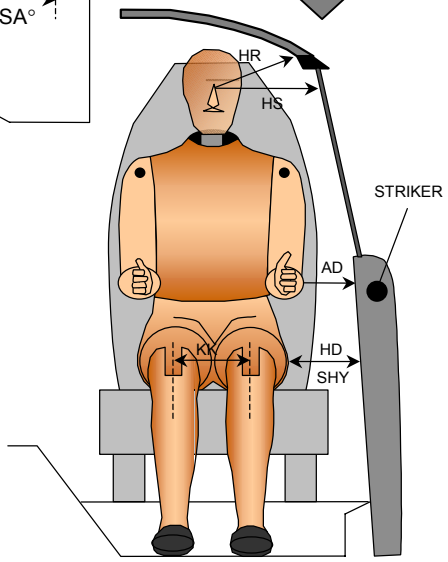
Test Vehicle: 2005 Hyundai Santa Fe
Test Program: 35mph Frontal Impact

NHTSA No.: M50500
Test Date: 02/17/2005

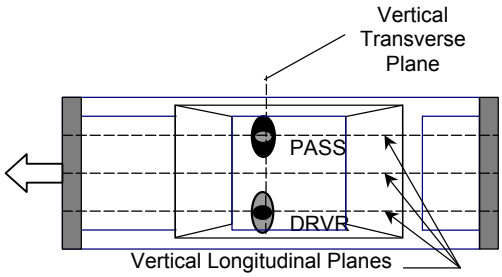
DUMMY MEASUREMENTS FOR FRONT SEAT OCCUPANTS



AD	Arm to Door
HD	H-Point to Door
HR	Head to Side Header
HS	Head to Side Window
KK	Knee to Knee
SHY	Striker to H-Point (Y Axis)



CD	Chest to Dash
CS	Chest to Steering Wheel Hub
HH	Head to Header
HW	Head to Windshield
HZ	Head to Roof
KDA	Knee to Dash Angle
KDL	Left Knee to Dash
KDR	Right Knee to Dash
NA	Nose to Rim Angle
NR	Nose to Rim
PA	Pelvic Angle
RA	Rim to Abdomen
SA	Seat Back Angle
SCA	Steering Column Angle
SH	Striker to H-Point
SK	Striker to Knee
ST	Striker to Head
SWA	Steering Wheel Angle
TA	Tibial Angle
WA	Windshield Angle



DATA SHEET NO. 6... (continued)

DUMMY POSITIONING IN VEHICLE

Test Vehicle: 2005 Hyundai Santa Fe NHTSA No.: M50500
Test Program: 35mph Frontal Impact Test Date: 02/17/2005

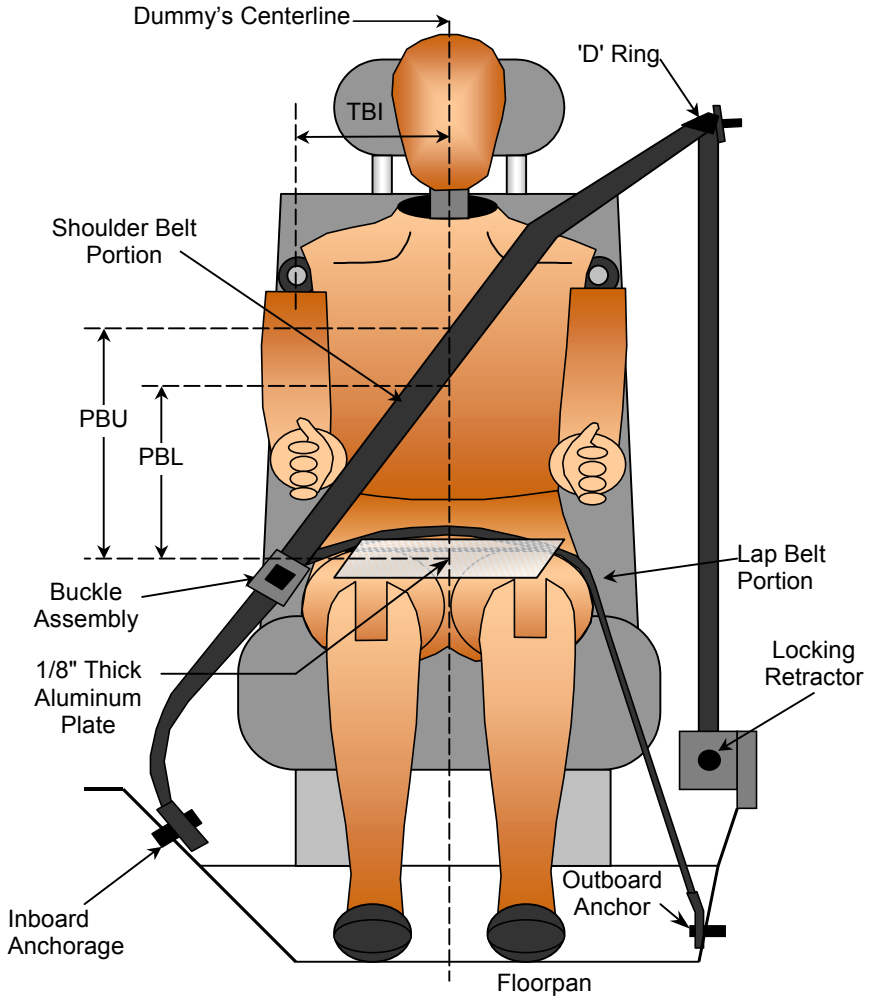
TEST DUMMY POSITION MEASUREMENTS

Code	Measurement Description	Driver		Passenger	
		Length (mm)	Angle (°)	Length (mm)	Angle (°)
WA	Windshield Angle		29.9		
SWA	Steering Wheel Angle		60.9		
SCA	Steering Column Angle		30.1		
SA	Seat Back Angle (headrest post)		10.9		11.5
HZ	Head to Roof (Z)	158	90.0	155	90.0
HH	Head to Header	329	18.6	341	20.2
HW	Head to Windshield	543	0.0	537	0.0
HR	Head to Side Header (Y)	197		192	
NR	Nose to Rim	429	15.5		
CD	Chest to Dash	526		535	
CS	Chest to Steering Hub	329	16.4		
RA	Rim to Abdomen	164	0.0		
KDL	Left Knee to Dash	124	9.3	128	
KDR	Right Knee to Dash	129		136	19.9
PA	Pelvic Angle		24.6		23.8
TA	Tibia Angle		58.2		47.8
KK	Knee to Knee (Y)	311		271	
SK	Striker to Knee	604	86.8	618	87.3
ST	Striker to Head	585	8.1	597	8.3
SH	Striker to H-Point	224	108.5	236	107.1
SHY	Striker to H-Point (Y)	252		238	
HS	Head to Side Window	289		289	
HD	H-Point to Door (Y)	169		135	
AD	Arm to Door (Y)	109		101	
AA	Ankle to Ankle	343		223	

DATA SHEET NO. 7

SEAT BELT POSITIONING DATA

Test Vehicle: 2005 Hyundai Santa Fe NHTSA No.: M50500
Test Program: 35mph Frontal Impact Test Date: 02/17/2005



SEAT BELT POSITIONING MEASUREMENTS

Measurement Description	Units	Driver	Passenger
TBI - Dummy centerline to shoulder bolt	mm	170	170
PBU - Top surface of reference to belt upper edge	mm	311	336
PBL - To surface of reference to belt lower edge	mm	221	295

DATA SHEET NO. 8

VEHICLE ACCELEROMETER LOCATION AND DATA SUMMARY

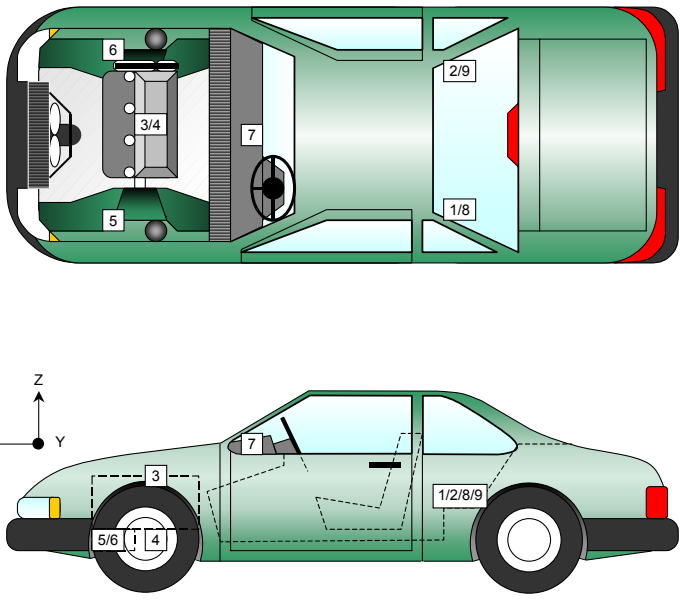
Test Vehicle: 2005 Hyundai Santa Fe
Test Program: 35mph Frontal Impact

NHTSA No.: M50500
Test Date: 02/17/2005

VEHICLE ACCELEROMETER PEAK DATA AND PRE-TEST LOCATIONS

No.	Accelerometer Location	Measurements (mm)			Peak Values				
		X	Y	Z	Units	Max	Time	Min	Time
1	Left Rear X-Member X	1710	-310	560	G's	2.9	124	-44.2	35
2	Right Rear X-Member X	1710	310	560	G's	2.7	125	-41.7	35
3	Engine Top X	3586	-20	905	G's	39.6	35	-174.3	26
4	Engine Bottom X	3775	-15	265	G's	46.9	38	-148.0	27
5	Left Brake Caliper X	3685	-684	265	G's	29.1	64	-73.9	46
6	Right Brake Caliper X	3685	684	265	G's	49.6	62	-87.3	45
7	Instrument Panel X	2935	0	1200	G's	37.2	81	-71.5	33
8	Left Rear X-Member Z	1710	-310	560	G's	11.2	65	-14.2	43
9	Right Rear X-Member Z	1710	310	560	G's	8.9	36	-9.8	47

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



DATA SHEET NO. 9

HYBRID III ATD INJURY CRITERIA AND SENSOR DATA

Test Vehicle: 2005 Hyundai Santa Fe
Test Program: 35mph Frontal Impact
NHTSA No.: M50500
Test Date: 02/17/2005

HEAD PRIMARY PEAK ACCELERATIONS

Location	Axis	Units	Driver				Passenger			
			Max	Time	Min	Time	Max	Time	Min	Time
Head CG	X	G's	8.5	239	-49.9	75	7.4	251	-51.2	77
Head CG	Y	G's	2.1	197	-19.9	83	3.2	25	-29.7	84
Head CG	Z	G's	22.7	68	-2.9	113	29.7	90	-2.2	88
Head CG Resultant	N/A	G's	55.0	72			57.5	77		

CHEST PRIMARY PEAK ACCELERATIONS

Location	Axis	Units	Driver				Passenger			
			Max	Time	Min	Time	Max	Time	Min	Time
Chest CG	X	G's	2.5	140	-51.2	80	2.5	159	-42.6	76
Chest CG	Y	G's	5.6	97	-7.6	45	3.7	50	-6.4	70
Chest CG	Z	G's	9.9	70	-7.6	106	12.3	88	-11.0	106
Chest CG Resultant	N/A	G's	51.3	80			44.2	76		

FEMUR PEAK FORCES

Location	Axis	Units	Driver				Passenger			
			Max	Time	Min	Time	Max	Time	Min	Time
Left Femur	Z	Newtons	443	34	-4458	51	436	37	-6543	50
Right Femur	Z	Newtons	418	25	-6482	52	657	31	-3511	58

SEAT BELT SENSOR PEAK VALUES

Location	Axis	Units	Driver				Passenger			
			Max	Time	Min	Time	Max	Time	Min	Time
Lap Belt Force	N/A	Newtons	6026	50			6218	53		
Shoulder Belt Force	N/A	Newtons	4178	67			4993	45		

HEAD INJURY CRITERIA (HIC)

Location	Driver				Passenger			
	HIC	Avg. G's	T^1	T^2	HIC	Avg. G's	T^1	T^2
Head CG Primary	448.8	44.0	58.4	93.3	486.9	44.9	60.7	96.7

CHEST CLIP (3MSEC)

Location	Driver			Passenger		
	CLIP	T^1	T^2	CLIP	T^1	T^2
Chest CG Primary	49.7	78.0	81.0	43.2	74.5	77.5

DATA SHEET NO. 9... (continued)

HYBRID III ATD INJURY CRITERIA AND SENSOR DATA

Test Vehicle: 2005 Hyundai Santa Fe
Test Program: 35mph Frontal Impact

NHTSA No.: M50500
Test Date: 02/17/2005

PELVIC PEAK ACCELERATIONS

Location	Axis	Units	Driver				Passenger			
			Max	Time	Min	Time	Max	Time	Min	Time
Pelvis	X	G's	2.5	140	-70.5	52	3.5	118	-65.1	50
Pelvis	Y	G's	13.0	85	-11.4	56	6.9	47	-6.1	94
Pelvis	Z	G's	2.1	285	-21.0	57	1.8	290	-23.2	66

UPPER NECK PEAK FORCES AND MOMENTS

Location	Axis	Units	Driver				Passenger			
			Max	Time	Min	Time	Max	Time	Min	Time
Neck Force	X	Newtons	492	76	-434	123	363	82	-451	135
Neck Force	Y	Newtons	261	75	-225	106	235	77	-374	125
Neck Force	Z	Newtons	1945	70	-108	126	1411	90	-133	143
Neck Moment	X	N•m	5.5	151	-27.4	76	7.3	95	-27.2	129
Neck Moment	Y	N•m	38.3	136	-12.5	226	39.0	144	-26.2	277
Neck Moment	Z	N•m	21.7	89	-13.2	147	31.6	95	-17.6	150

FOOT PEAK ACCELERATIONS

Location	Axis	Units	Driver				Passenger			
			Max	Time	Min	Time	Max	Time	Min	Time
Left Foot Aft	X	G's	9.3	83	-41.3	51	19.2	46	-137.6	36
Left Foot Aft	Z	G's	5.1	178	-42.0	43	17.4	173	-63.2	52
Left Foot Fore	Z	G's	5.6	195	-61.4	26	28.2	36	-84.4	31
Right Foot Aft	X	G's	43.3	58	-171.6	43	18.5	85	-84.8	37
Right Foot Aft	Z	G's	28.0	51	-148.7	44	5.7	50	-87.7	38
Right Foot Fore	Z	G's	112.9	50	-228.3	40	33.5	36	-84.9	31

UPPER AND LOWER TIBIA PEAK FORCES AND MOMENTS

Location	Axis	Units	Driver				Passenger			
			Max	Time	Min	Time	Max	Time	Min	Time
Left Lower Moment	X	N•m	24.1	61	-7.9	186	47.9	60	-11.3	37
Left Lower Moment	Y	N•m	31.5	51	-57.3	27	56.4	36	-167.6	65
Left Lower Force	Z	Newtons	188	125	-979	25	116	148	-1909	85
Left Upper Moment	X	N•m	34.7	72	-11.1	27	6.3	90	-43.1	59
Left Upper Moment	Y	N•m	22.6	27	-32.6	83	290.4	53	-80.4	36
Left Upper Force	Z	Newtons	101	127	-1218	25	141	132	-2895	52
Right Lower Moment	X	N•m	95.5	68	-49.3	45	54.5	60	-24.4	39
Right Lower Moment	Y	N•m	81.6	44	-168.9	56	35.8	31	-220.1	63
Right Lower Force	Z	Newtons	395	137	-3180	43	42	133	-2919	41
Right Upper Moment	X	N•m	85.7	45	-39.5	58	37.4	39	-50.7	60
Right Upper Moment	Y	N•m	28.2	110	-95.6	45	35.6	81	-68.8	38
Right Upper Force	Z	Newtons	1140	111	-3451	45	69	119	-3500	61

DATA SHEET NO. 9... (continued)

HYBRID III ATD INJURY CRITERIA AND SENSOR DATA

Test Vehicle: 2005 Hyundai Santa Fe NHTSA No.: M50500
Test Program: 35mph Frontal Impact Test Date: 02/17/2005

CHEST PEAK DISPLACEMENTS

Location	Axis	Units	Driver				Passenger			
			Max	Time	Min	Time	Max	Time	Min	Time
Chest	X	mm			-28.7	81			-25.6	76

HEAD REDUNDANT PEAK ACCELERATIONS

Location	Axis	Units	Driver				Passenger			
			Max	Time	Min	Time	Max	Time	Min	Time
Head CG	X	G's	8.8	240	-50.2	75	7.5	250	-48.3	77
Head CG	Y	G's	1.9	197	-18.9	83	3.2	44	-31.9	84
Head CG	Z	G's	25.1	70	-2.7	129	28.5	90	-3.2	88
Head CG Resultant	N/A	G's	55.2	72			55.2	77		

* No valid data collected

CHEST REDUNDANT PEAK ACCELERATIONS

Location	Axis	Units	Driver				Passenger			
			Max	Time	Min	Time	Max	Time	Min	Time
Chest CG	X	G's	2.6	124	-52.3	80	2.2	149	-42.3	76
Chest CG	Y	G's	6.0	99	-8.0	45	3.6	50	-6.1	70
Chest CG	Z	G's	10.1	70	-7.2	96	13.2	88	-10.9	106
Chest CG Resultant	N/A	G's	52.5	80			44.2	76		

REDUNDANT HEAD INJURY CRITERIA (HIC)

Location	Driver				Passenger			
	HIC	Avg.	T^1	T^2	HIC	Avg.	T^1	T^2
Head CG Primary Redundant	452.1	44.4	58.4	92.9	457.5	43.8	61.3	97.3

REDUNDANT CHEST CLIP (3MSEC)

Location	Driver			Passenger		
	CLIP	T^1	T^2	CLIP	T^1	T^2
Chest CG Primary Redundant	48.6	76.9	81.3	42.9	74.5	77.5

DATA SHEET NO. 10

SEAT BELT PERFORMANCE ASSESSMENT TEST DATA

Test Vehicle: 2005 Hyundai Santa Fe
Test Program: 35mph Frontal Impact

NHTSA No.: M50500
Test Date: 02/17/2005

SEAT BELT PLACEMENT MEASUREMENTS

Measurement Description	Units	Driver	Passenger
TBI - Dummy centerline to shoulder bolt	mm	170	170
PBU - Top surface of reference to belt upper edge	mm	311	336
PBL - Top surface of reference to belt lower edge	mm	221	295

BELT LENGTH DATA

Measurement Description	Units	Driver	Passenger
Shoulder belt length as measured on ATD	mm	814	827
Lap belt length as measured on ATD	mm	776	784
Remainder of belt on reel	mm	816	816
Total belt length for continuous webbing systems	mm	2406	2427

SHOULDER BELT SPOOL-OUT DATA

Measurement Description	Units	Driver	Passenger
As determined mechanically	mm	Not recorded	
As determined electronically	mm	Not recorded	

DATA SHEET NO. 11

SUMMARY OF FMVSS 212 DATA

Test Vehicle: 2005 Hyundai Santa Fe
Test Program: 35mph Frontal Impact

NHTSA No.: M50500
Test Date: 02/17/2005

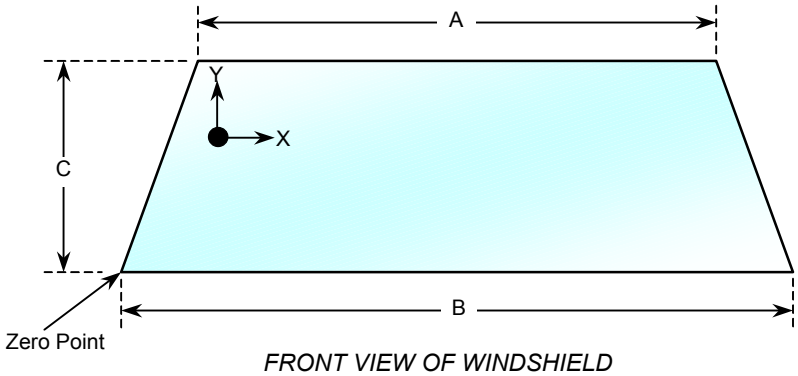
Windshield Mounting Details:
Windshield glass is secured to the vehicle frame with a rubber trim and glue.

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	2103	2103	100
Right Side	2103	2103	100
Total	4206	4206	100



FRONT VIEW OF WINDSHIELD

WINDSHIELD DIMENSIONS

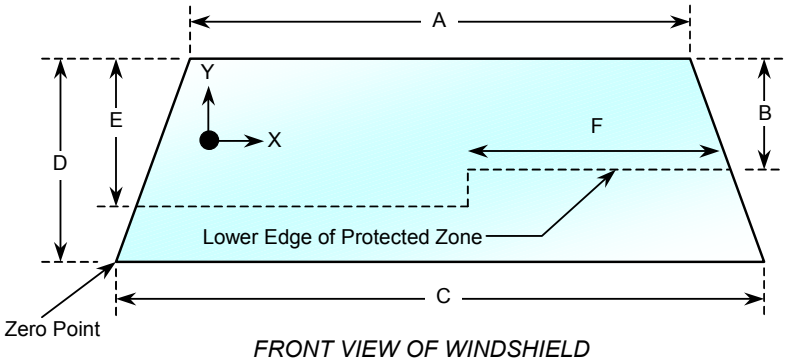
Item	Units	Segment Length	Molding Width
A	mm	1136	17
B	mm	1562	N/A
C	mm	754	17

DATA SHEET NO. 12

WINDSHIELD ZONE INTRUSION FMVSS 219 (Partial) DATA

Test Vehicle: 2005 Hyundai Santa Fe
Test Program: 35mph Frontal Impact

NHTSA No.: M50500
Test Date: 02/17/2005



FRONT VIEW OF WINDSHIELD

Item	Units	Value
A	mm	1136
B	mm	412
C	mm	1562
D	mm	754
E	mm	412
F	mm	520

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 NO. 13

FMVSS 301 FUEL SYSTEM INTEGRITY POST IMPACT DATA

Test Vehicle: 2005 Hyundai Santa Fe NHTSA No.: M50500
Test Program: 35mph Frontal Impact Test Date: 02/17/2005

Temperature at Time of Impact: 21° C Test Time: 11:13 am

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)

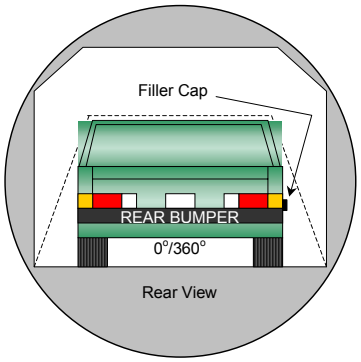
D. Spillage: None

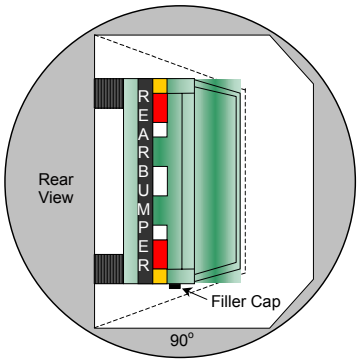
DATA SHEET NO. 14

FMVSS 301 STATIC ROLLOVER DATA

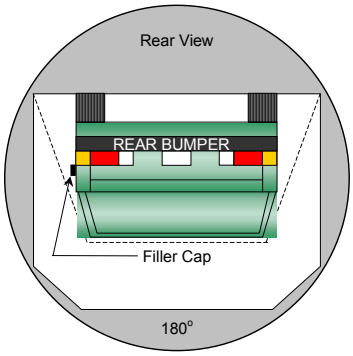
Test Vehicle: 2005 Hyundai Santa Fe NHTSA No.: M50500
Test Program: 35mph Frontal Impact Test Date: 02/17/2005

Test Time: 11:13 am

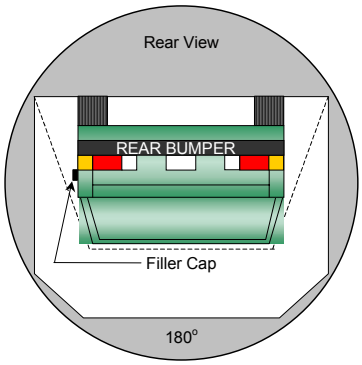




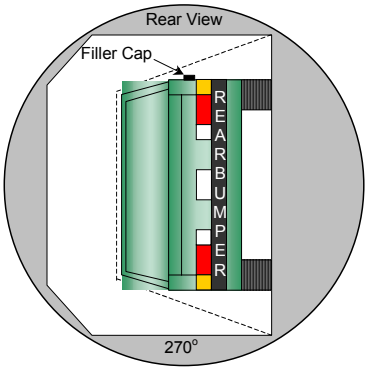
0° to 90°

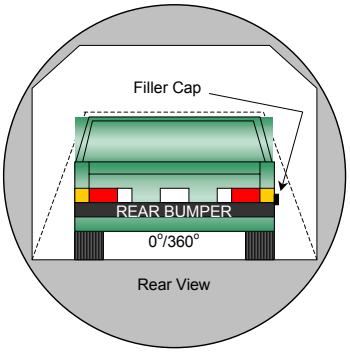


90° to 180°



180° to 270°





270° to 360°

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: None

Test Phase	Rotation Time (sec.)	Hold Time (sec.)	Spillage (oz.)
0° to 90°	166	300	0
90° to 180°	148	300	0
180° to 270°	148	300	0
270° to 360°	168	300	0

DATA SHEET NO. 15

VEHICLE MEASUREMENTS

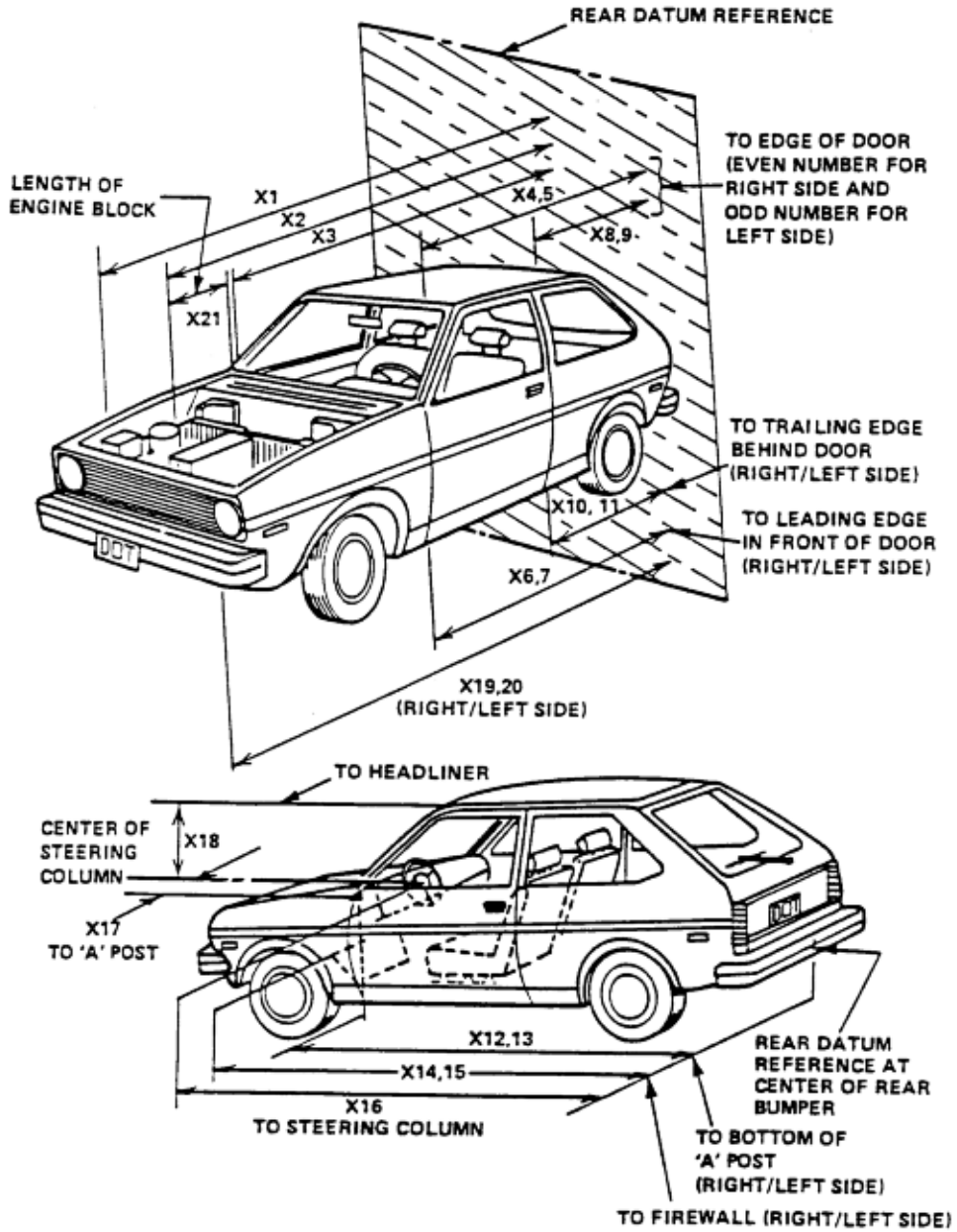
Test Vehicle: 2005 Hyundai Santa Fe
Test Program: 35mph Frontal Impact
NHTSA No.: M50500
Test Date: 02/17/2005

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
1	Total length of vehicle at centerline	mm	4555	3972	583
2	RSOV to front of engine	mm	4143	3758	385
3	RSOV to firewall centerline	mm	3558	3326	232
4	RSOV to leading edge of right door	mm	3033	2996	37
5	RSOV to leading edge of left door	mm	3022	2990	32
6	RSOV to lower leading edge of right door	mm	3022	3003	19
7	RSOV to lower leading edge of left door	mm	3013	3000	13
8	RSOV to upper leading edge of right door	mm	2020	1980	40
9	RSOV to upper leading edge of left door	mm	2003	1976	27
10	RSOV to lower trailing edge of right door	mm	2021	2002	19
11	RSOV to lower trailing edge of left door	mm	2022	2005	17
12	RSOV to bottom of right 'A' pillar	mm	2958	2943	15
13	RSOV to bottom of left 'A' pillar	mm	2954	2941	13
14	RSOV to firewall on right side	mm	3407	3302	105
15	RSOV to firewall on left side	mm	3490	3313	177
16	RSOV to steering column	mm	2589	2711	-122
17	Center of steering column to left 'A' pillar	mm	383	390	-7
18	Center of steering column to headlining	mm	440	462	-22
19	RSOV to right side of front bumper	mm	4351	3924	427
20	RSOV to left side of front bumper	mm	4336	3925	411
21	Length of engine block	mm	425	425	0
RD	RSOV to right side of dash panel	mm	2842	2805	37
CD	RSOV to center of dash panel	mm	2900	2807	93
LD	RSOV to left side of dash panel	mm	2840	2798	42

DATA SHEET NO. 15... (continued)

VEHICLE MEASUREMENTS

Test Vehicle: 2005 Hyundai Santa Fe NHTSA No.: M50500
Test Program: 35mph Frontal Impact Test Date: 02/17/2005



DATA SHEET NO. 15... (continued)

VEHICLE MEASUREMENTS

Test Vehicle: 2005 Hyundai Santa Fe NHTSA No.: M50500
Test Program: 35mph Frontal Impact Test Date: 02/17/2005

Target Vehicle Structural Measurement

	Elements	Pre-Test (mm)
1	Total Length	4555
2	Total Width	1805
3	Bumper Top Height	733
4	Bumper Bottom Height	490
5	Longitudinal Member Top Height	300
6	Distance between Longitudinal Members	740
7	Longitudinal Member Width	85
8	Engine Top Height	886
9	Engine Bottom Height	233
10	Engine and gearbox width	845
11	Front bumper-engine distance	370
12	Front shock absorber fixing height	990
13	Bonnet leading edge height	785
14	Front shock absorber fixing width	1110
15	Front bumper – front axle distance	915
16	Front axle – a pillar distance	521
17	A-pillar – B-pillar distance	1012
18	B-Pillar – rear axle distance	1070
19	B-pillar – C-pillar distance	630
20	Roof sill bottom height	1600
21	Roof sill top height	1635
22	Floor sill bottom height	310
23	Floor sill top height	404

DATA SHEET NO. 16

CAMERA LOCATIONS

Test Vehicle: 2005 Hyundai Santa Fe
Test Program: 35mph Frontal Impact
NHTSA No.: M50500
Test Date: 02/17/2005

No.	Camera View	Location (mm) *			Lens (mm)	Speed (fps)
		X	Y	Z		
1	Real-Time Left Side View				13	24
2	Left Front View	885	-9470	1350	24	1000
3	Steering Column Top	2095	-7610	1565	19	1000
4	Steering Column Bottom	2075	-7600	1040	24	1000
5	Driver Close-up	1425	-9550	1550	50	1000
6	Driver Angle	6705	-4090	2040	50	1000
7	On board Driver Side				8	500
8	On board Passenger Side				8	500
9	Right Overall	2345	6740	1260	19	1000
10	Right Passenger Half	475	9315	1375	25	1000
11	Right Close-up	1905	8635	1480	50	1000
12	Right Angle	6645	5205	2080	50	1000
13	Windshield	-675	0	2820	14	1000
14	Top Driver	-10	-605	2035	13	1000
15	Top Passenger	0	600	2040	13	1000
16	Pit Front	930	0	-3150	19	1000
17	Pit Rear	2680	0	-3150	19	1000

*COORDINATES:

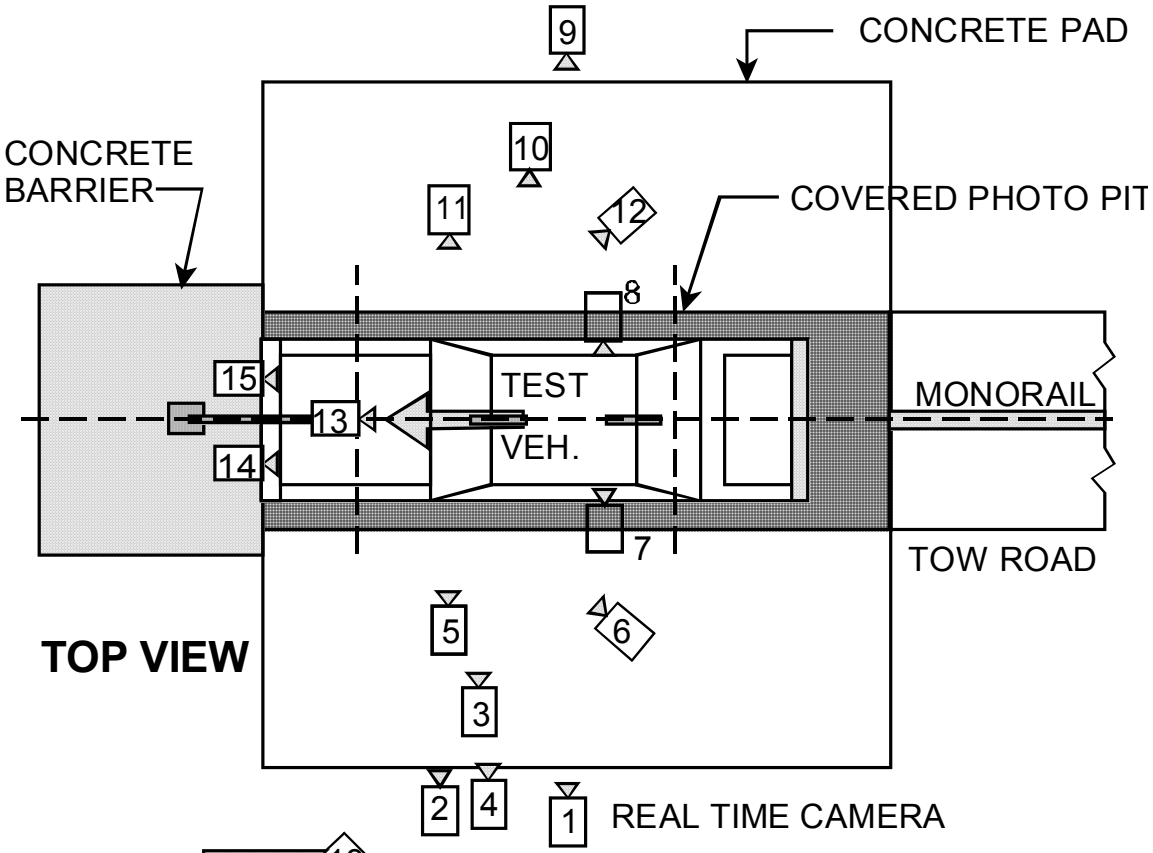
+X = forward of impact plane
+Y = right of monorail centerline
+Z = above ground level

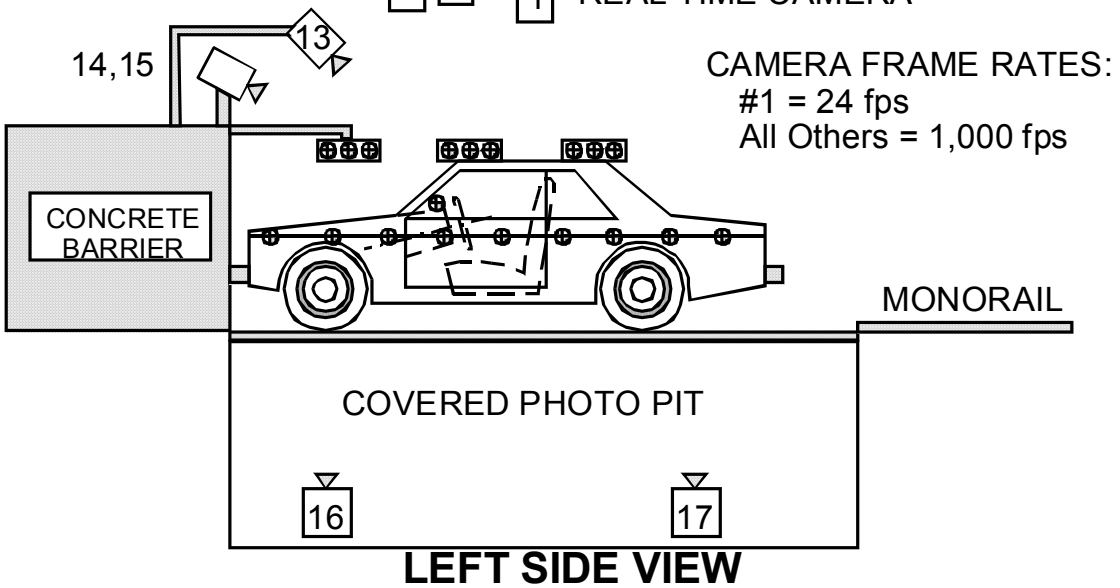
DATA SHEET NO. 16... (continued)

CAMERA LOCATIONS

Test Vehicle: 2005 Hyundai Santa Fe NHTSA No.: M50500
Test Program: 35mph Frontal Impact Test Date: 02/17/2005

CAMERA POSITIONS FOR FRONTAL IMPACTS





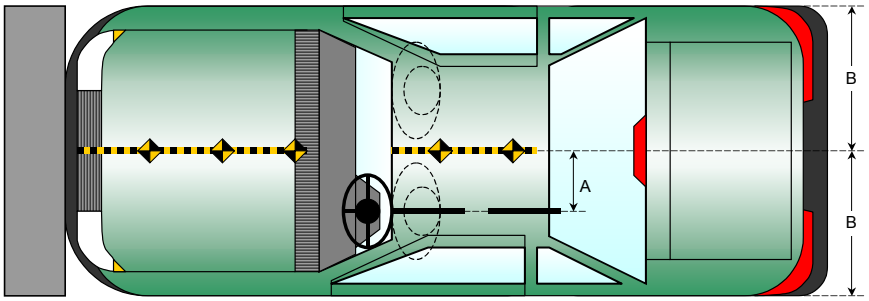
DATA SHEET NO. 17

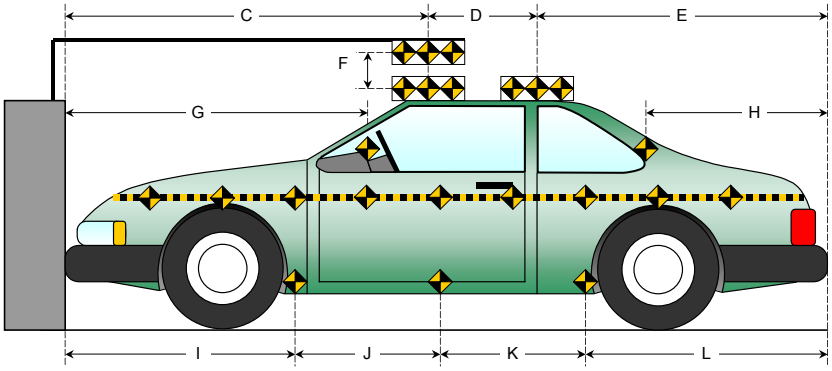
PHOTOGRAPHIC REFERENCE TARGET LOCATIONS

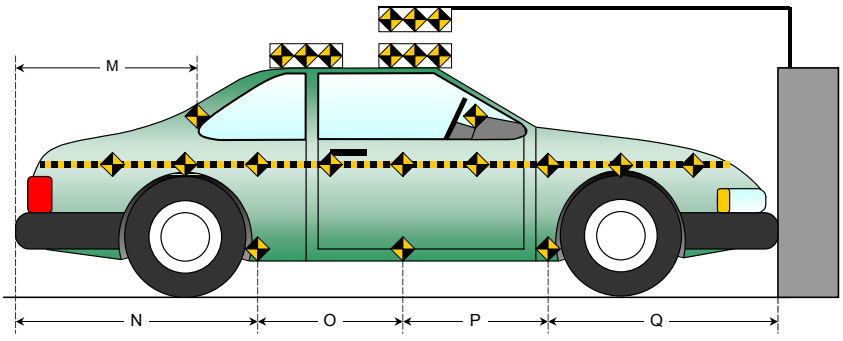
Test Vehicle: 2005 Hyundai Santa Fe
Test Program: 35mph Frontal Impact

NHTSA No.: M50500
Test Date: 02/17/2005

Item	Value
A	348
B	902
C	2302
D	609
E	1644
F	1646
G	
H	1233
I	1466
J	842
K	832
L	1415
M	1230
N	1414
O	837
P	835
Q	1469







DATA SHEET NO. 18

VEHICLE INTRUSION MEASUREMENTS

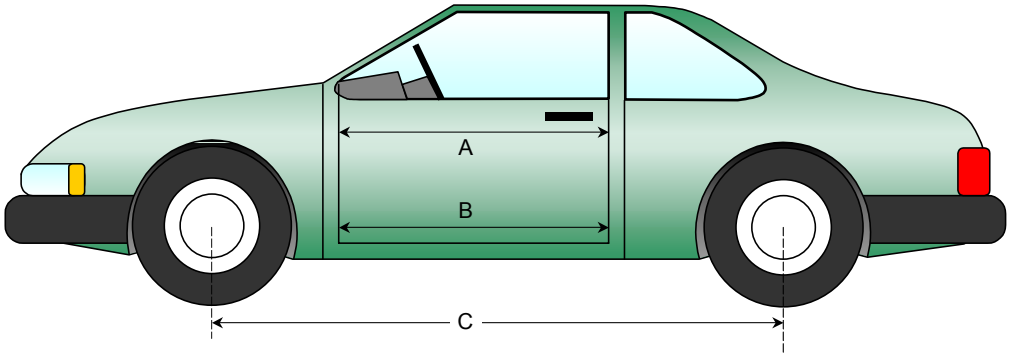
Test Vehicle: 2005 Hyundai Santa Fe
Test Program: 35mph Frontal Impact
NHTSA No.: M50500
Test Date: 02/17/2005

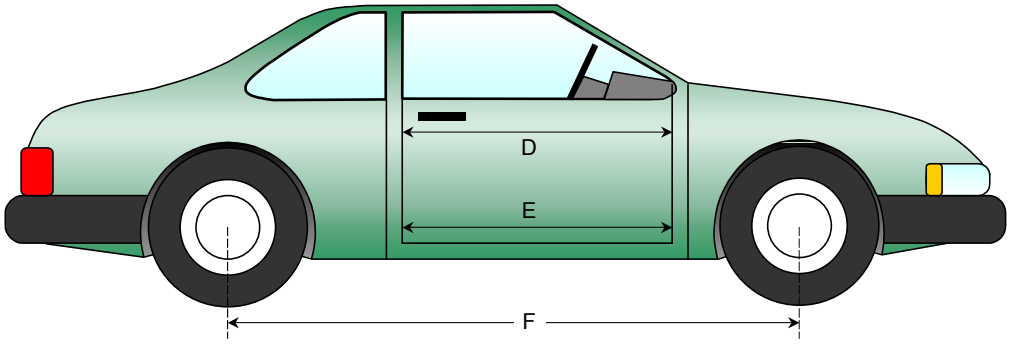
DOOR OPENING WIDTH

Item	Description	Units	Pre-Test	Post-Test	Difference
A	Left Side Upper	mm	955	942	13
B	Left Side Lower	mm	840	841	-1
D	Right Side Upper	mm	915	907	8
E	Right Side Lower	mm	825	826	-1

WHEELBASE MEASUREMENTS

Item	Description	Units	Pre-Test	Post-Test	Difference
C	Left Side Wheelbase	mm	2625	2572	53
F	Right Side Wheelbase	mm	2625	2570	55





DATA SHEET NO. 18... (continued)

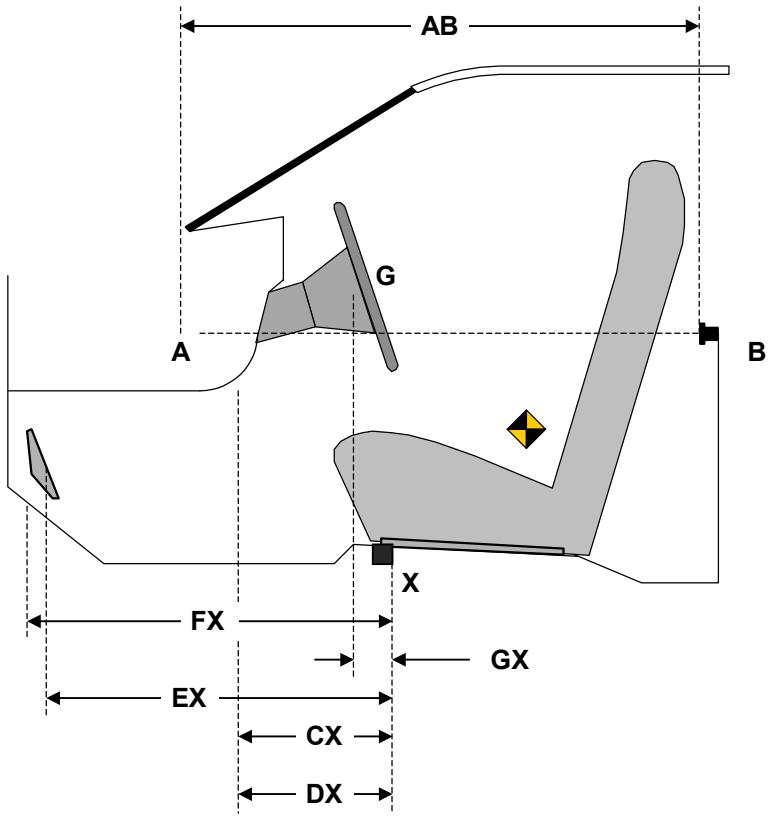
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2005 Hyundai Santa Fe NHTSA No.: M50500
Test Program: 35mph Frontal Impact Test Date: 02/17/2005

DRIVER COMPARTMENT INTRUSION

Item	Description	Units	Pre-Test	Post-Test	Difference
AB	Door Opening (Inside window jam)	mm	705	705	0
CX	Left Knee Bolster to X	mm	328	390	-62
DX	Right Knee Bolster to X	mm	344	386	-42
EX	Brake Pedal to X	mm	517	534	-17
FX	Foot Rest to X	mm	522	577	-55
GX	Center of Steering Column Wheel Hub to X	mm	54	171	-117

X = Front of Seat Track (stationary)



DRIVER COMPARTMENT

DATA SHEET NO. 18... (continued)

VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2005 Hyundai Santa Fe
Test Program: 35mph Frontal Impact

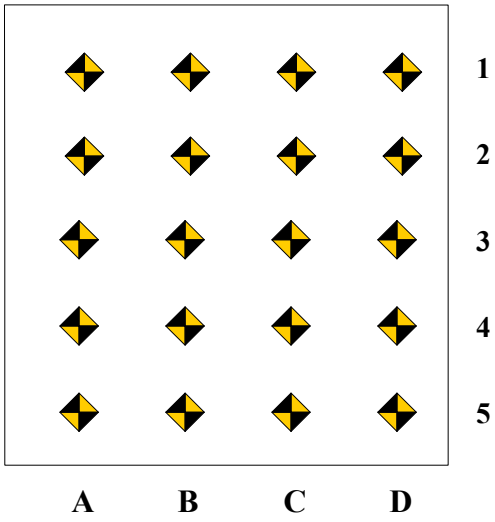
NHTSA No.: M50500
Test Date: 02/17/2005

Measurement reference point for X and Z axis is the forward outboard seat mounting bolt.

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 FLOOR PAN X-AXIS

	Pre-Test				Post-Test				Difference			
	A	B	C	D	A	B	C	D	A	B	C	D
1		771	769	780		671	666	641		100	103	139
2		698	693	704		623	624	609		75	69	95
3		619	621	626		597	587	576		22	34	50
4	495	492	497	500	488	471	465	464	7	21	32	36
5	361	365	370	375	355	343	323	340	6	22	47	35

DRIVER FLOOR PAN Z-AXIS

	Pre-Test				Post-Test				Difference			
	A	B	C	D	A	B	C	D	A	B	C	D
1		-16	-17	-11		29	23	38		-45	-40	-49
2		-83	-82	-78		-57	-68	-55		-26	-14	-23
3		-146	-152	-139		-148	-157	-140		2	5	1
4	-157	-148	-156	-154	-162	-143	-155	-154	5	-5	-1	0
5	-155	-153	-153	-153	-156	-152	-159	-157	1	-1	6	4

DATA SHEET NO. 18... (continued)

VEHICLE INTRUSION MEASUREMENTS

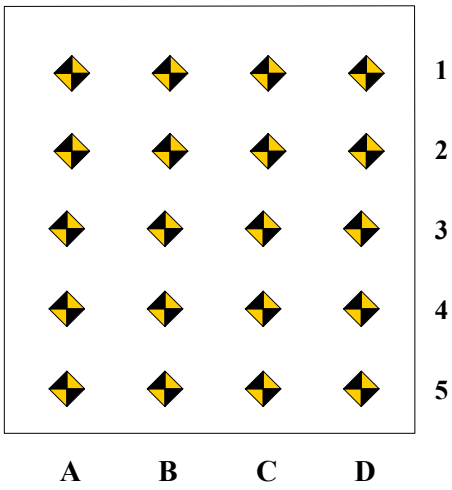
Test Vehicle: 2005 Hyundai Santa Fe
Test Program: 35mph Frontal Impact
NHTSA No.: M50500
Test Date: 02/17/2005

Measurement reference point for X and Z axis is the forward outboard seat mounting bolt.

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 FLOOR PAN X-AXIS

	Pre-Test				Post-Test				Difference			
	A	B	C	D	A	B	C	D	A	B	C	D
1	727	730	745		608	618	630		119	112	115	
2	662	661	668		593	587	591		69	74	77	
3	583	590	594		542	558	564		41	32	30	
4	457	464	467	469	418	439	452	463	39	25	15	6
5	327	337	342	346	299	309	328	337	28	28	14	9

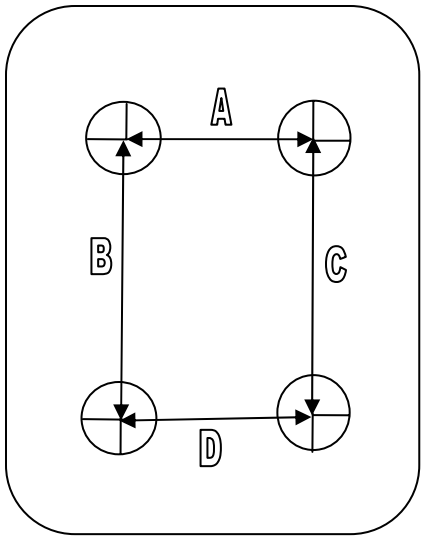
PASSENGER FLOOR PAN Z-AXIS

	Pre-Test				Post-Test				Difference			
	A	B	C	D	A	B	C	D	A	B	C	D
1	30	32	25		75	77	83		-45	-45	-58	
2	-47	-41	-40		-25	-18	-7		-22	-23	-33	
3	-111	-109	-106		-106	-111	-100		-5	2	-6	
4	-115	-122	-120	-119	-110	-123	-125	-122	-5	1	5	3
5	-114	-122	-117	-116	-118	-112	-118	-123	4	-10	1	7

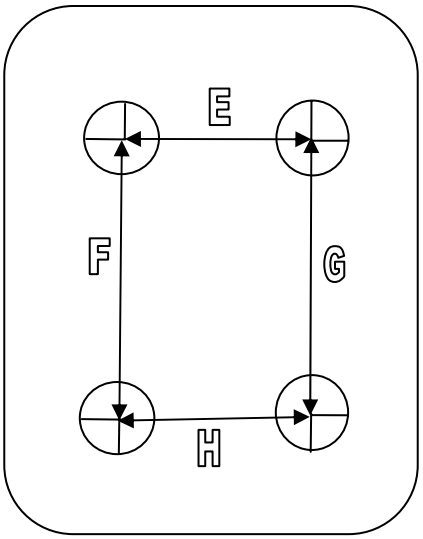
DATA SHEET NO. 18... (continued)

VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2005 Hyundai Santa Fe NHTSA No.: M50500
Test Program: 35mph Frontal Impact Test Date: 02/17/2005



Driver



Passenger

UNDERBODY FLOORBOARD DEFORMATION

Measurement	Pre-Test	Post-Test	Difference
A	272	261	11
B	218	219	-1
C	212	196	16
D	283	277	6
E	267	264	3
F	214	208	6
G	220	220	0
H	280	282	-2

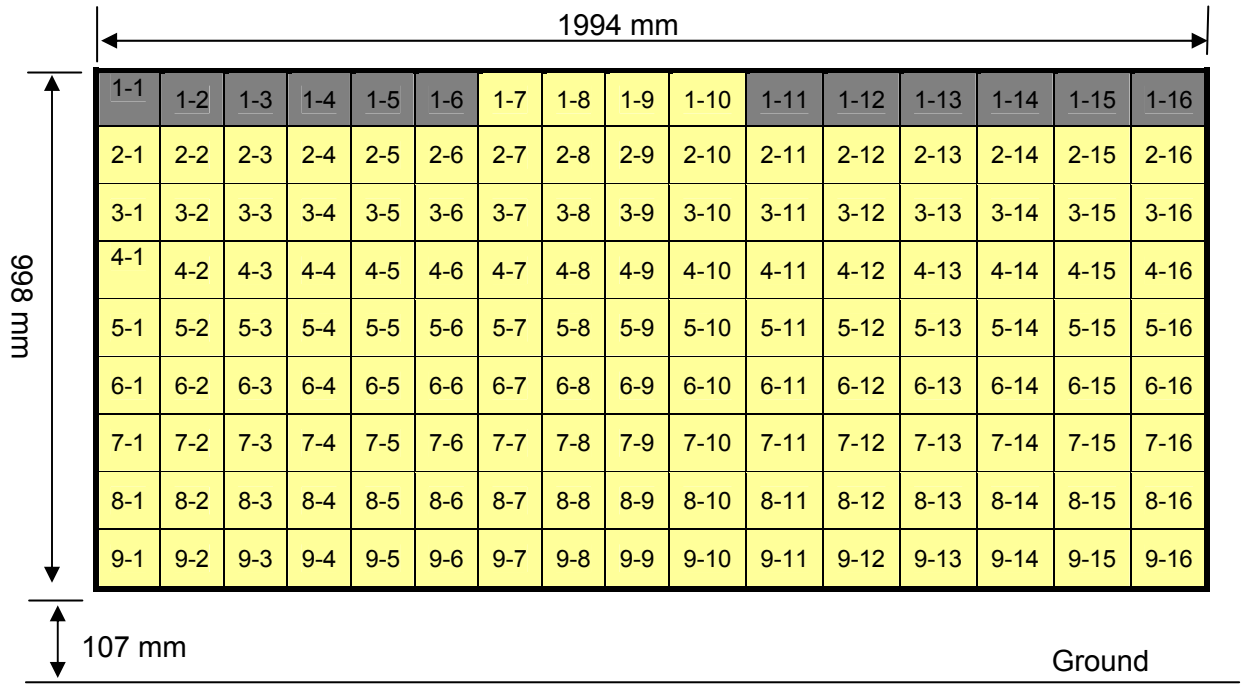
DATA SHEET NO. 19

LOAD CELL LOCATIONS ON FIXED BARRIER

Test Vehicle: 2005 Hyundai Santa Fe
Test Program: 35mph Frontal Impact

NHTSA No.: M50500
Test Date: 02/17/2005

144 Load Cell Rigid Barrier
Load Cell Locations on Fixed Barrier



1-1	1-2	1-3	1-4	1-5	1-6	1-7	1-8	1-9	1-10	1-11	1-12	1-13	1-14	1-15	1-16
2-1	2-2	2-3	2-4	2-5	2-6	2-7	2-8	2-9	2-10	2-11	2-12	2-13	2-14	2-15	2-16
3-1	3-2	3-3	3-4	3-5	3-6	3-7	3-8	3-9	3-10	3-11	3-12	3-13	3-14	3-15	3-16
4-1	4-2	4-3	4-4	4-5	4-6	4-7	4-8	4-9	4-10	4-11	4-12	4-13	4-14	4-15	4-16
5-1	5-2	5-3	5-4	5-5	5-6	5-7	5-8	5-9	5-10	5-11	5-12	5-13	5-14	5-15	5-16
6-1	6-2	6-3	6-4	6-5	6-6	6-7	6-8	6-9	6-10	6-11	6-12	6-13	6-14	6-15	6-16
7-1	7-2	7-3	7-4	7-5	7-6	7-7	7-8	7-9	7-10	7-11	7-12	7-13	7-14	7-15	7-16
8-1	8-2	8-3	8-4	8-5	8-6	8-7	8-8	8-9	8-10	8-11	8-12	8-13	8-14	8-15	8-16
9-1	9-2	9-3	9-4	9-5	9-6	9-7	9-8	9-9	9-10	9-11	9-12	9-13	9-14	9-15	9-16

Load Cells are 121 mm x 121 mm with a 7 mm gap in between each load cell.

Note: 9-4 did not collect any valid data.

The data is presented in Appendix B with the following requirements:

1. Overlay plot of summed force from each row.
2. Total force of all 9 rows (144 individual load cells).

Note: Data tape includes all individual load cell data.

DATA SHEET NO. 20

ACCIDENT INVESTIGATION DIVISION DATA

Test Vehicle: 2005 Hyundai Santa Fe NHTSA No.: M50500
Test Program: 35mph Frontal Impact Test Date: 02/17/2005

VEHICLE INFORMATION

VIN: KM8SC73D35U881358 Wheelbase (mm) : 2640
Vehicle Size Category: MPV Test Weight (kg) : 2013.5

ACCELEROMETER DATA

Accelerometer Locations: As per measurements on Page 14
Cal. Procedure/Interval: MGA procedure / 6 month
Integration Algorithm: Trapezoidal Linearity: > 99%
Impact Velocity (km/h): 56.6
Velocity Change (km/h): 62.7 Time of Separation (msec): 97

CRUSH PROFILE

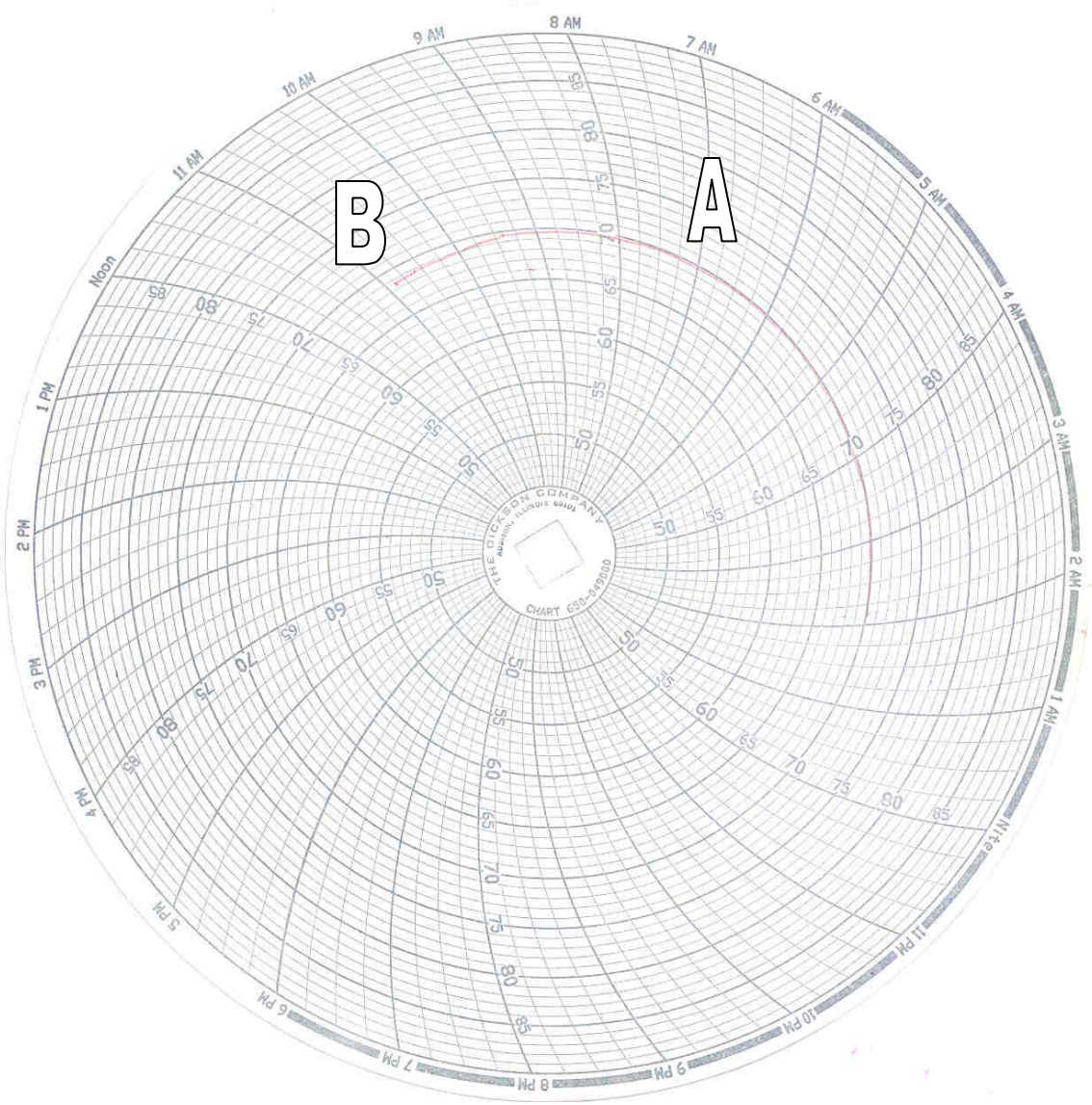
Collision Deformation Classification: Frontal Midpoint of Damage: Centerline
Damage Region Length (mm): 1520 Impact Mode: Frontal

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
C1	Crush zone 1 at left side	mm	4336	3925	411
C2	Crush zone 2 at left side	mm	4420	3888	532
C3	Crush zone 3 at left side	mm	4451	3951	500
C4	Crush zone 4 at right side	mm	4460	3990	470
C5	Crush zone 5 at right side	mm	4440	3978	462
C6	Crush zone 6 at right side	mm	4351	3924	427
L	C1 TO C6	mm	1532	1493	39

DATA SHEET NO. 21

DUMMY / VEHICLE TEMPERATURE STABILIZATION CHART

Test Vehicle: 2005 Hyundai Santa Fe NHTSA No.: M50500
Test Program: 35mph Frontal Impact Test Date: 02/17/2005



A = Dummies installed in vehicle at 7:00 am

B = Test conducted at 11:13 am

APPENDIX A

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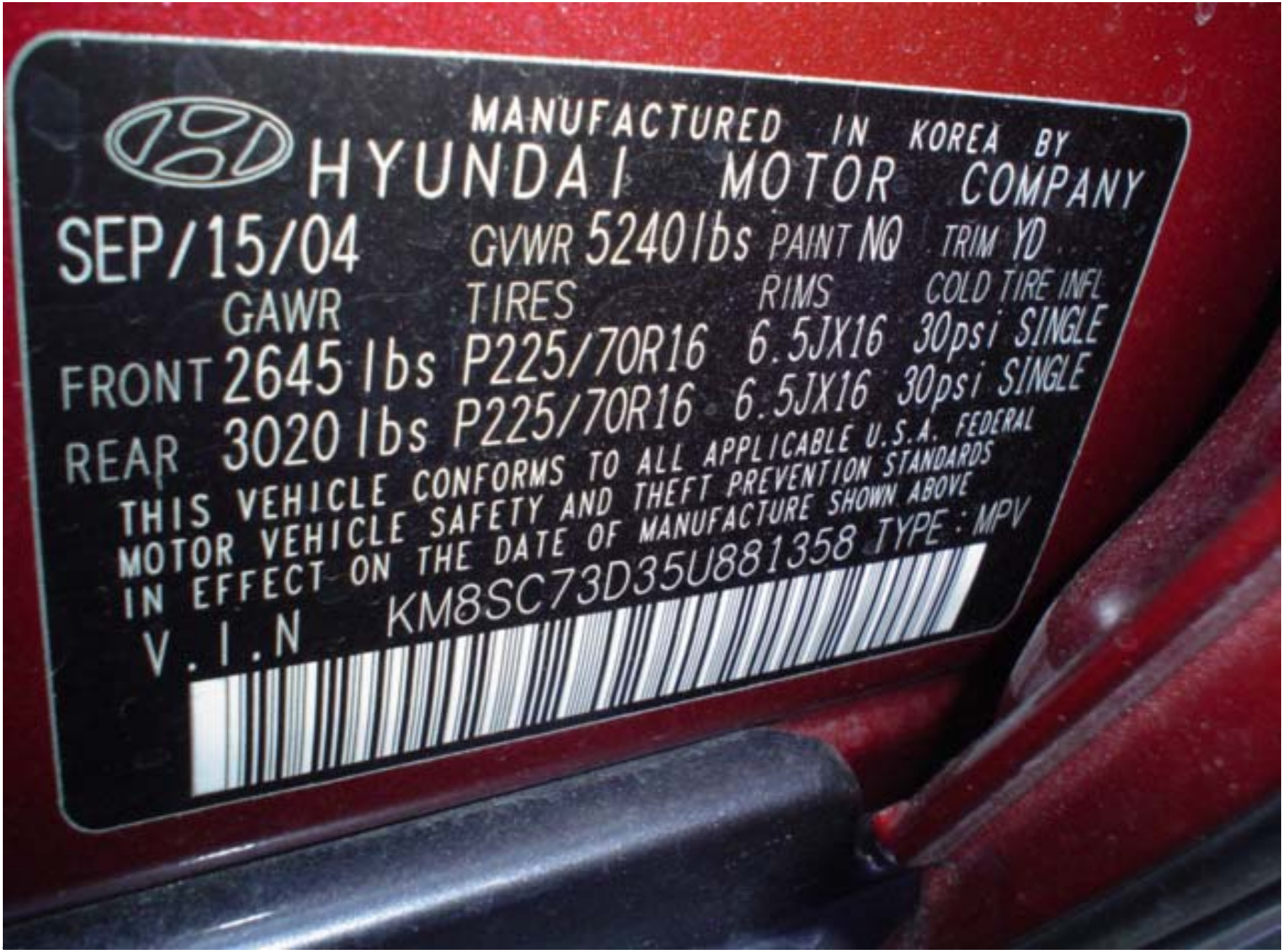
Load Cell Location



A-2.

Vehicle Certification Label

Tire Placard

Right Front View of Test Vehicle, as received

Left Rear View of Test Vehicle, as received

Pre-Test Front View of Test Vehicle

Post-Test Front View of Test Vehicle

Pre-Test Left Side View of Test Vehicle

Post-Test Left Side View of Test Vehicle

Pre-Test Right Side View of Test Vehicle

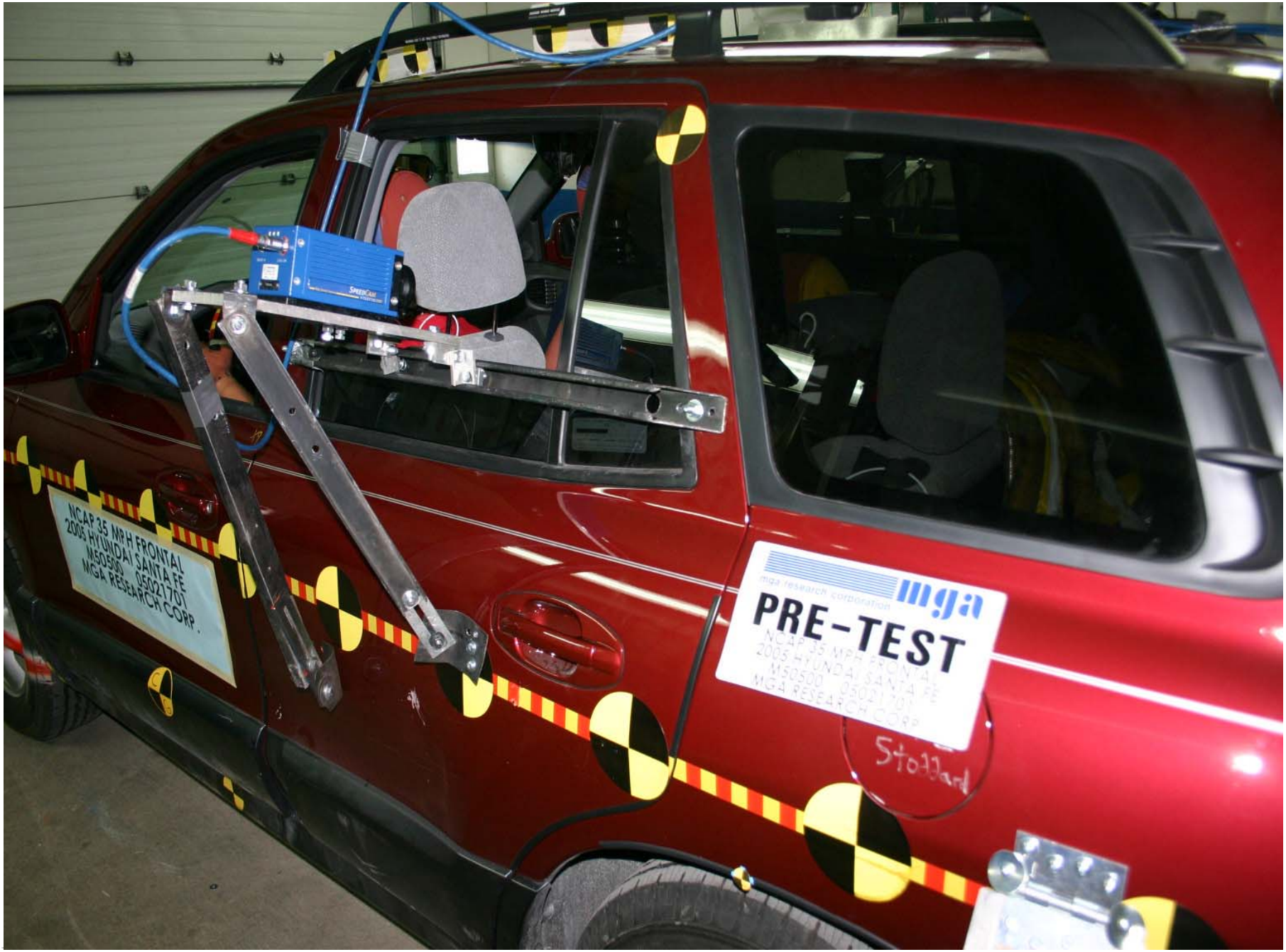
Post-Test Right Side View of Test Vehicle

Pre-Test Right Front Three-Quarter View of Test Vehicle

Post-Test Right Front Three-Quarter View of Test Vehicle

Pre-Test Left Rear Three-Quarter View of Test Vehicle

Post-Test Left Rear Three-Quarter View of Test Vehicle

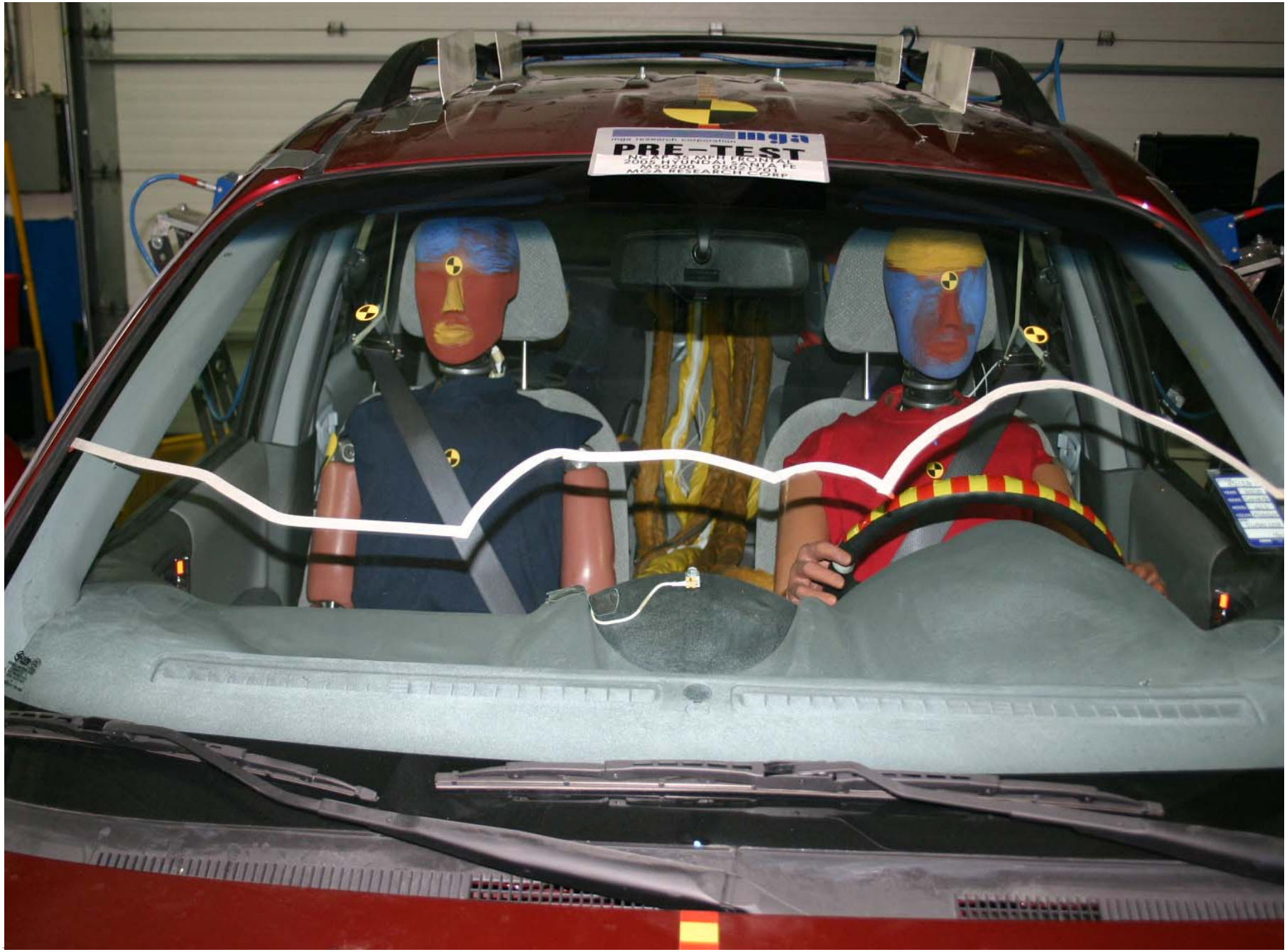


Pre-Test Left Rear Three-Quarter View of Doors

Post-Test Left Rear Three-Quarter View of Doors

Pre-Test Right Rear Three-Quarter View of Doors

Post-Test Right Rear Three-Quarter View of Doors



Pre-Test Windshield View

Post-Test Windshield View

Pre-Test Engine Compartment View

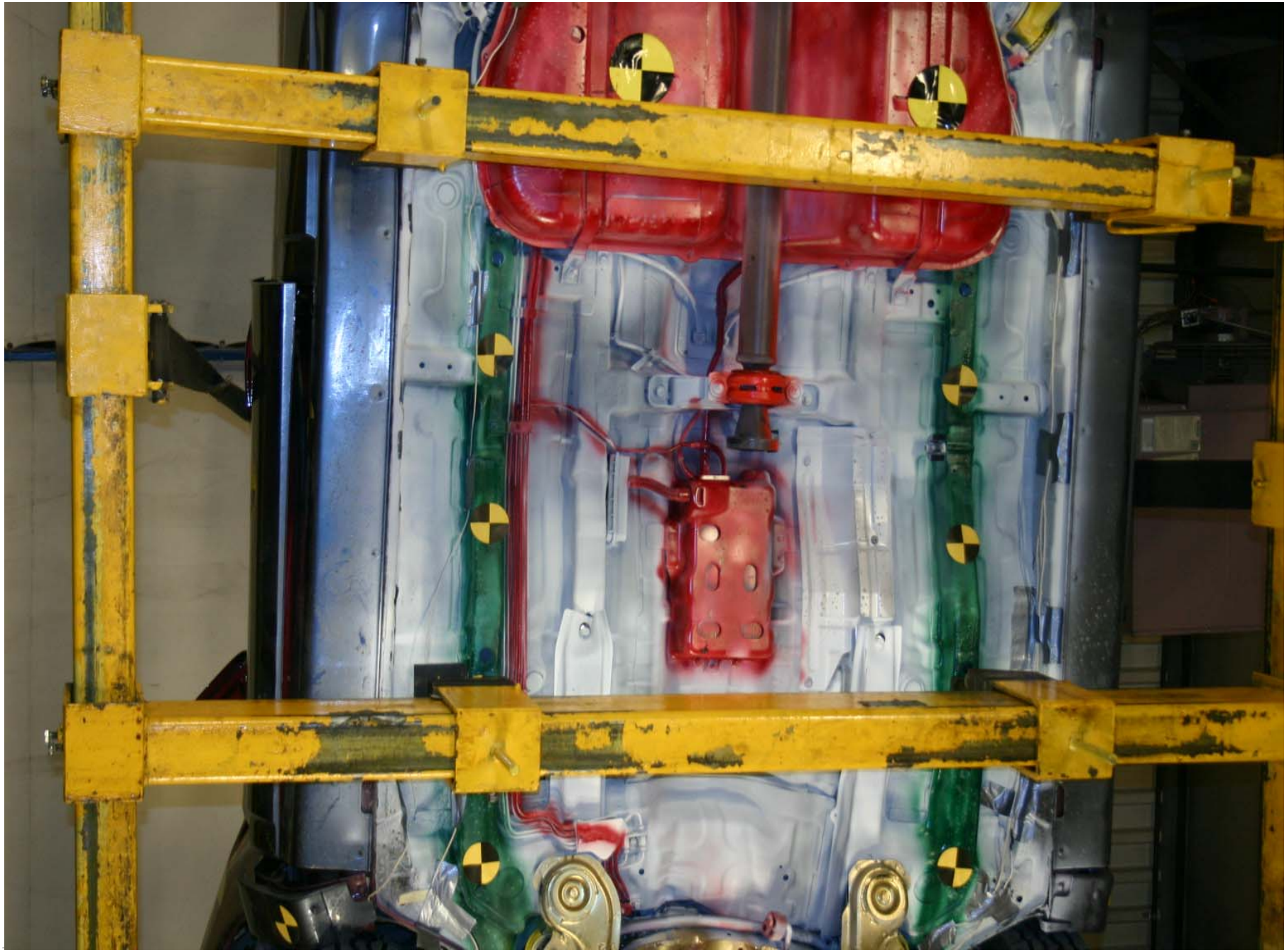
Pre-Test Fuel Filler Cap View

Post-Test Fuel Filler Cap View

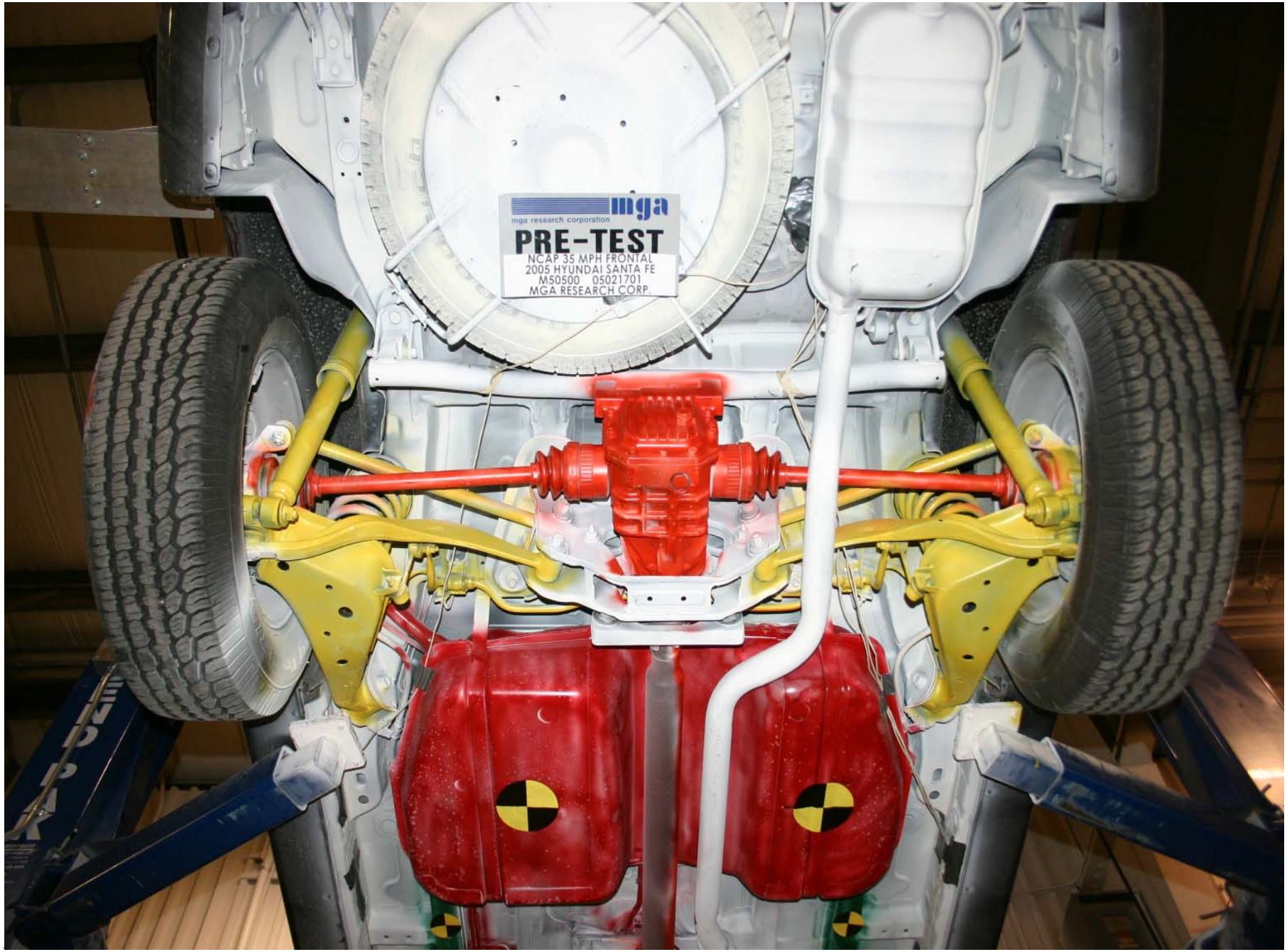
Pre-Test Front Underbody View

Post-Test Front Underbody View

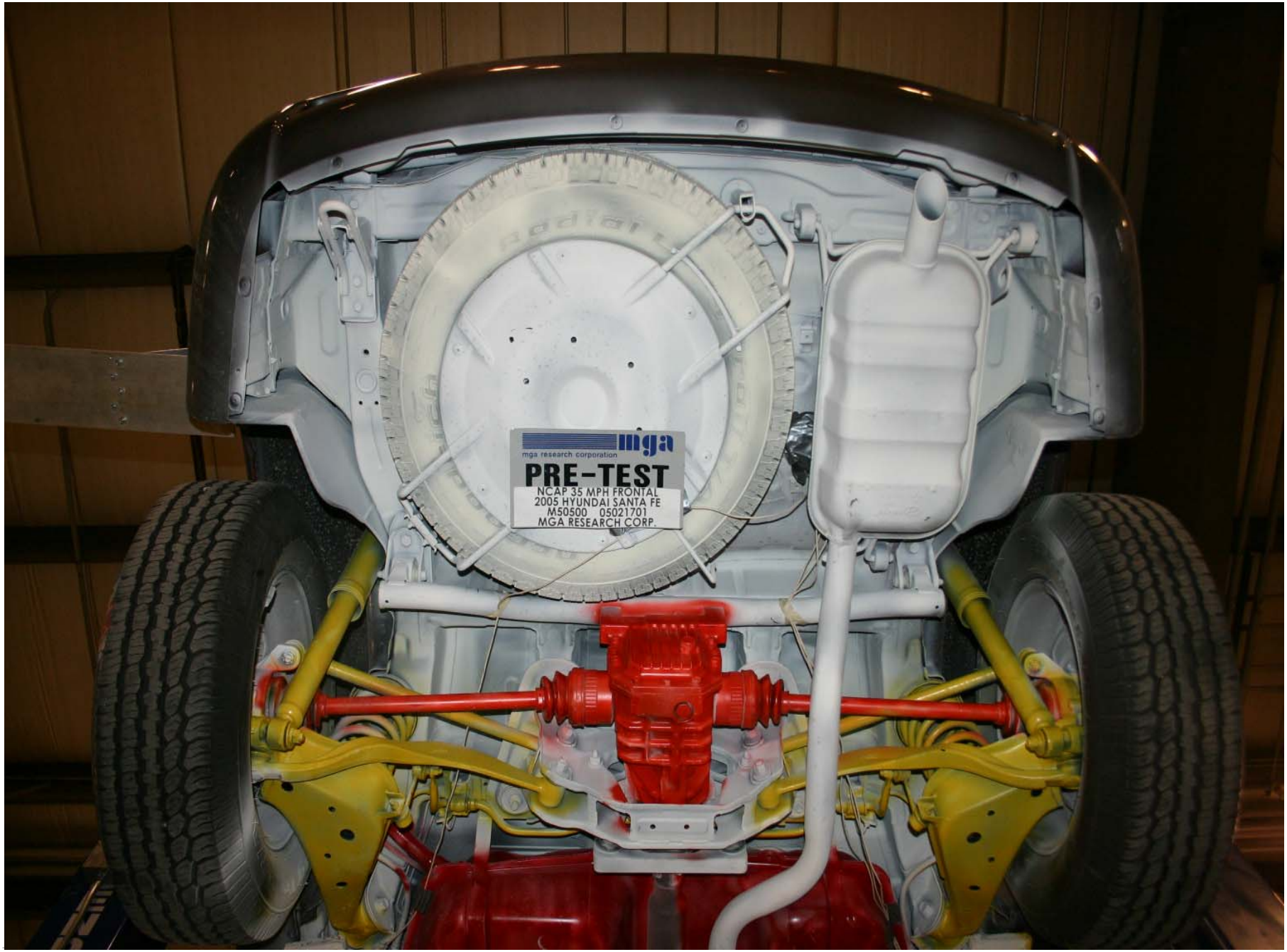
Pre-Test Front Mid Underbody View



Pre-Test Rear Mid Underbody View

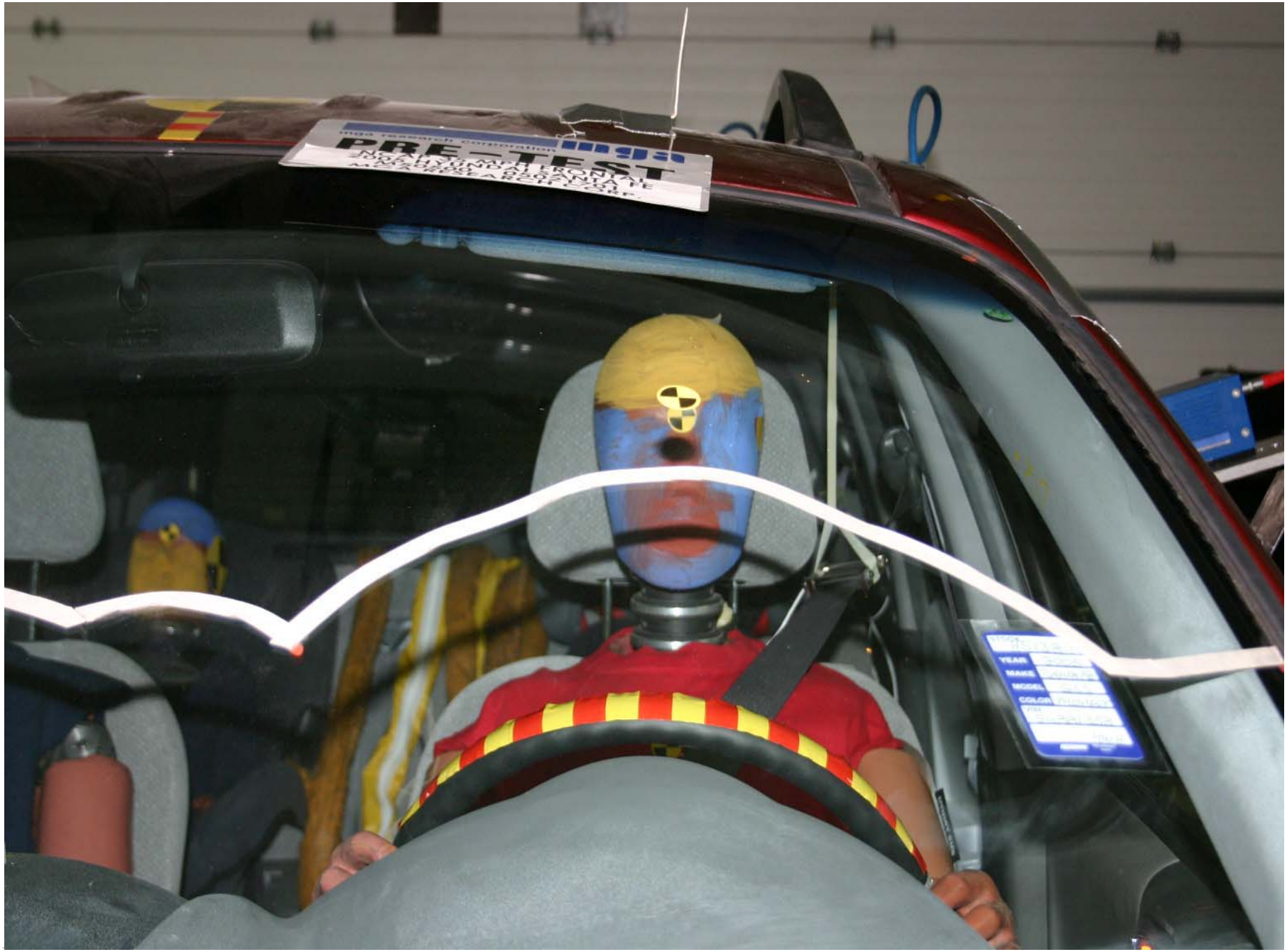


Post-Test Mid Underbody View



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 Position Left Side View

Post-Test Driver Dummy Position Left Side View

Pre-Test Driver Dummy Position Left Side View (Door Open)

Post-Test Driver Dummy Position Left Side View (Door Open)

Pre-Test Driver Dummy Seat Position

Post-Test Driver Dummy Seat Position

Pre-Test Driver Dummy Feet Position

Post-Test Driver Dummy Feet Position

Pre-Test Driver Side Knee Bolster View

Post-Test Driver Side Knee Bolster View

Pre-Test Driver Side Floor Pan View

Post-Test Driver Side Floor Pan View

Post-Test Driver Dummy Head Contact

Post-Test Driver Dummy Knee Contact

Post-Test Driver Dummy Airbag Contact

Pre-Test Passenger Dummy Front View (head position)

Post-Test Passenger Dummy Front View (head position)

Pre-Test Passenger Dummy Position Right Side View

Post-Test Passenger Dummy Position Right Side View

Pre-Test Passenger Dummy Position Right Side View (Door Open)

Post-Test Passenger Dummy Position Right Side View (Door Open)

Pre-Test Passenger Dummy Seat Position

Post-Test Passenger Dummy Seat Position

Pre-Test Passenger Dummy Feet Position

Post-Test Passenger Dummy Feet Position

Pre-Test Passenger Side Knee Bolster View

Post-Test Passenger Side Knee Bolster View

Pre-Test Passenger Side Floor Pan View

Post-Test Passenger Side Floor Pan View

Post-Test Passenger Dummy Head Contact

Post-Test Passenger Dummy Knee Contact

Post-Test Passenger Dummy Airbag Contact

Rollover 90 Degrees

Rollover 180 Degrees

Rollover 270 Degrees

Rollover 360 Degrees

Vehicle Impact

APPENDIX B

DUMMY AND VEHICLE RESPONSE DATA TRACES

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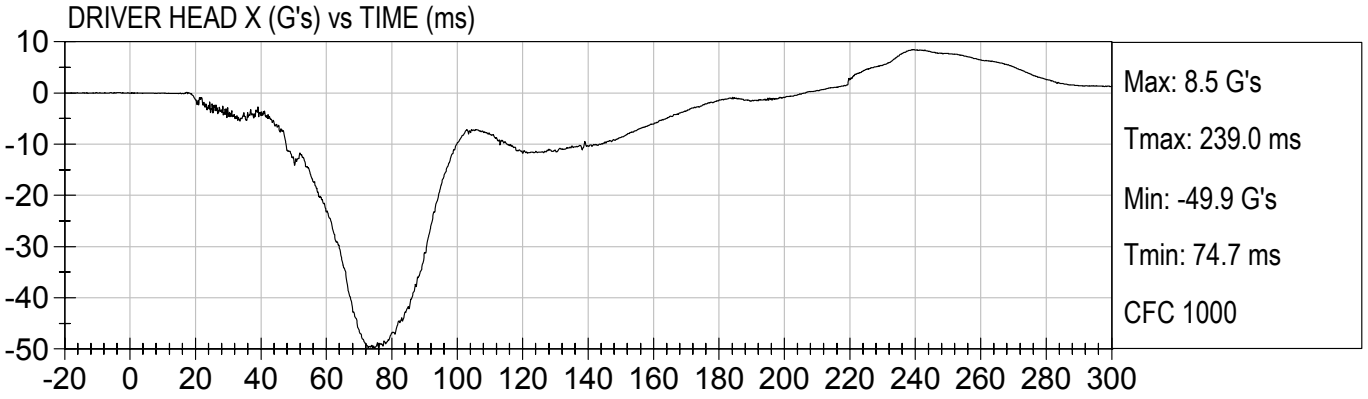
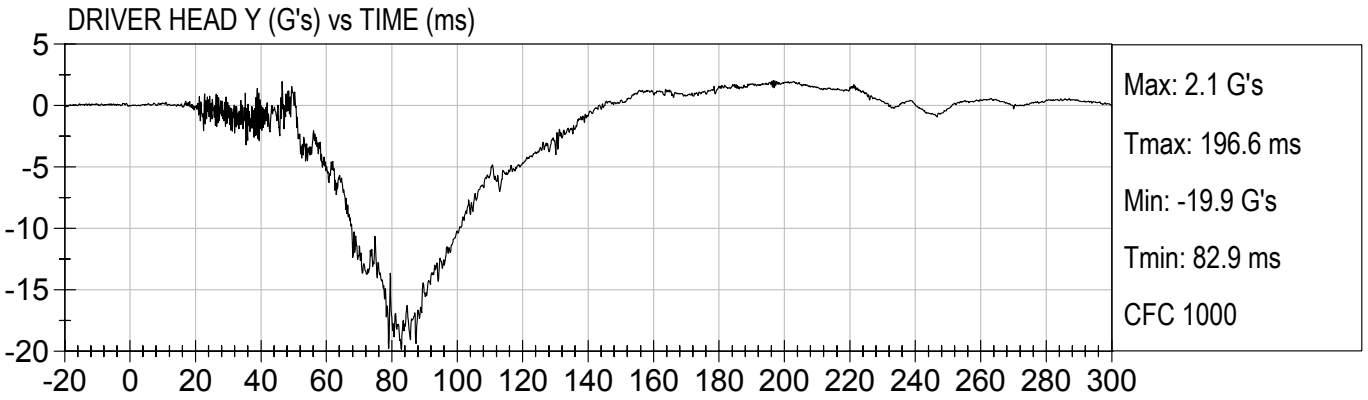
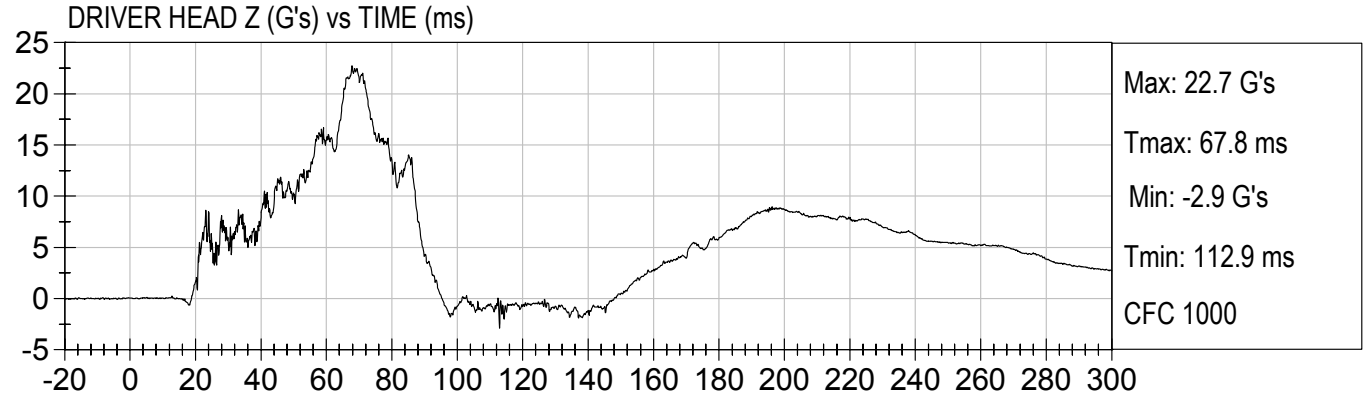
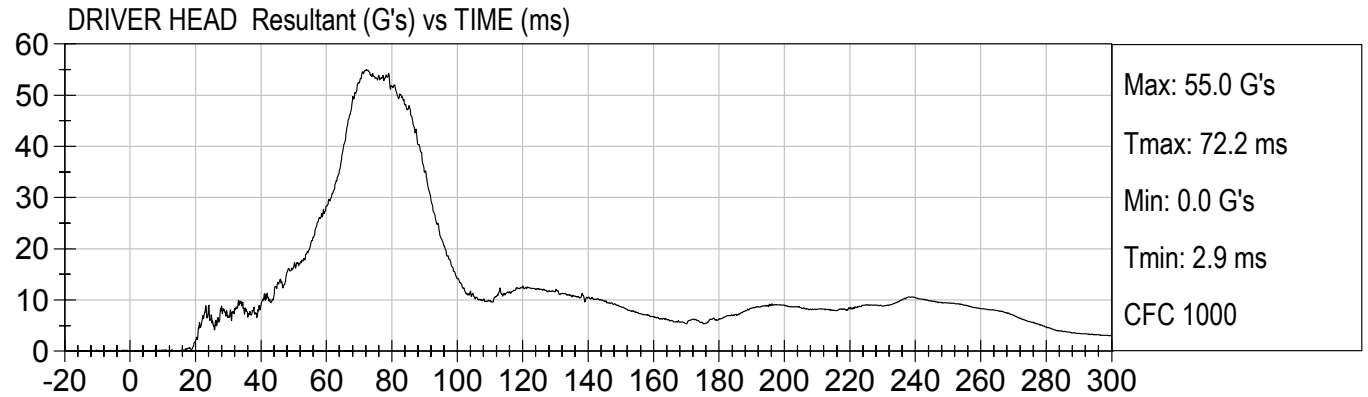
NCAP 35MPH FRONTAL IMPACT
2005 HYUNDAI SANTA FE (M50500)

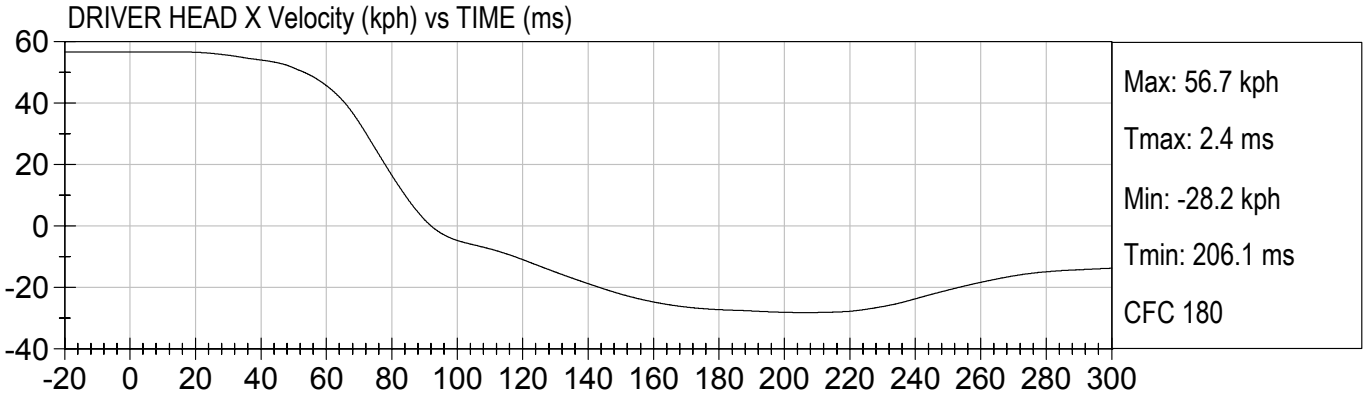
Test Date: 02/17/05
Speed: 35.2 mph (56.6 km/h)

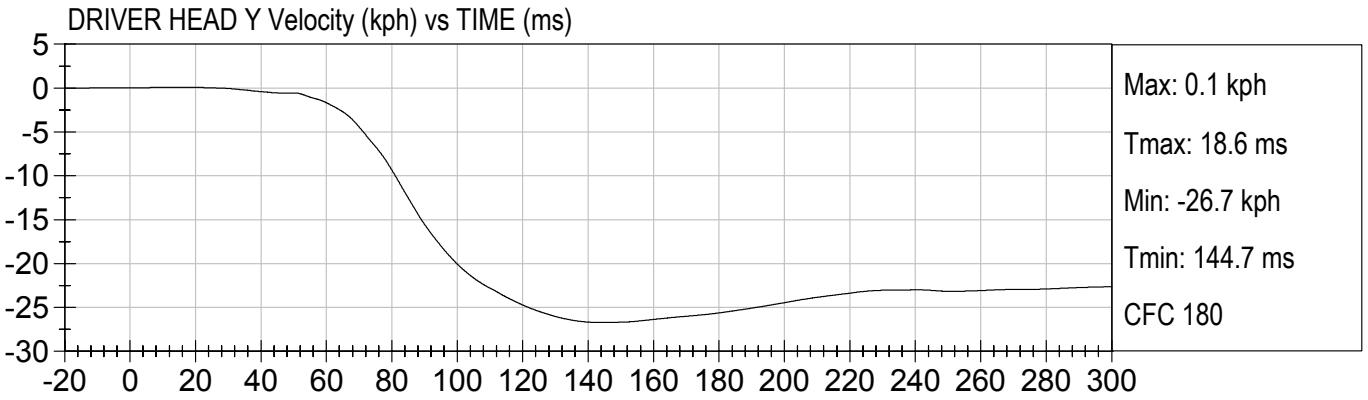


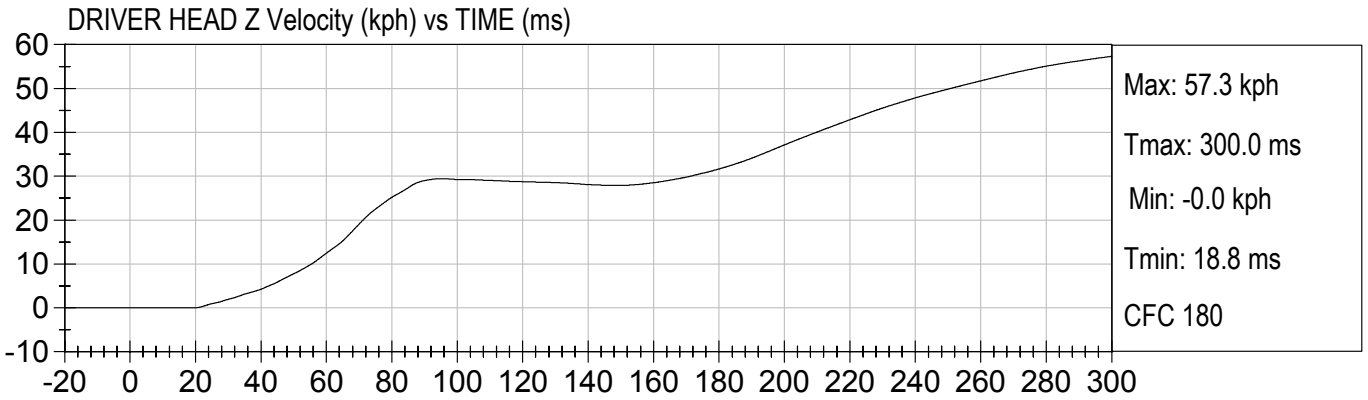







DRIVER HEAD X Velocity (kph) vs TIME (ms)
60
40
20
0
-20
-40
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 56.7 kph
Tmax: 2.4 ms
Min: -28.2 kph
Tmin: 206.1 ms
CFC 180

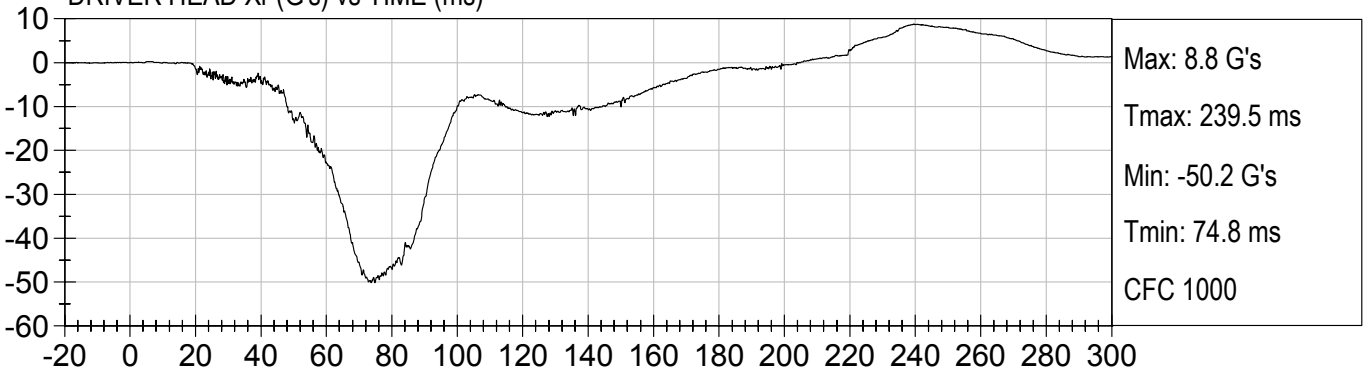

DRIVER HEAD Y Velocity (kph) vs TIME (ms)
5
0
-5
-10
-15
-20
-25
-30
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 0.1 kph
Tmax: 18.6 ms
Min: -26.7 kph
Tmin: 144.7 ms
CFC 180


DRIVER HEAD Z Velocity (kph) vs TIME (ms)
60
50
40
30
20
10
0
-10
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 57.3 kph
Tmax: 300.0 ms
Min: -0.0 kph
Tmin: 18.8 ms
CFC 180

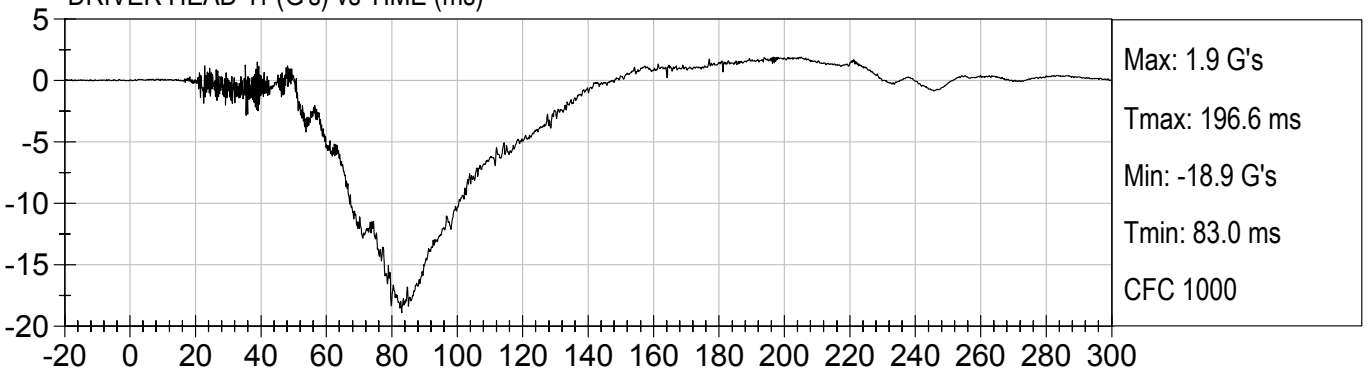
NCAP 35MPH FRONTAL IMPACT
2005 HYUNDAI SANTA FE (M50500)

Test Date: 02/17/05
Speed: 35.2 mph (56.6 km/h)

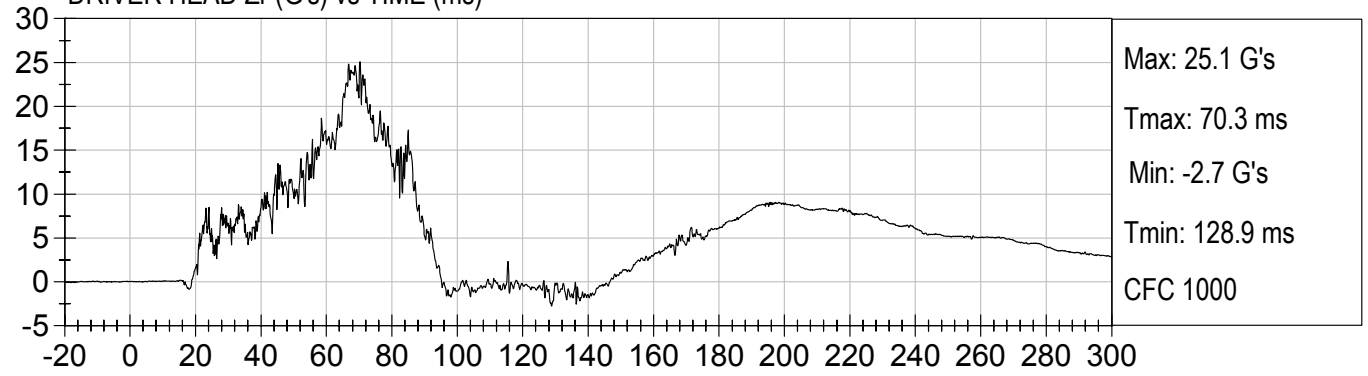
DRIVER HEAD Xr (G's) vs TIME (ms)



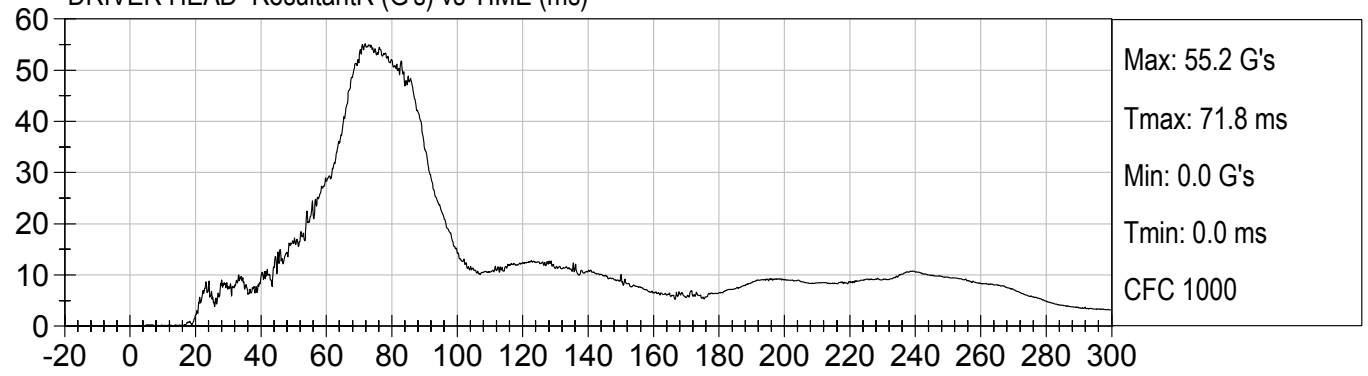
DRIVER HEAD Yr (G's) vs TIME (ms)

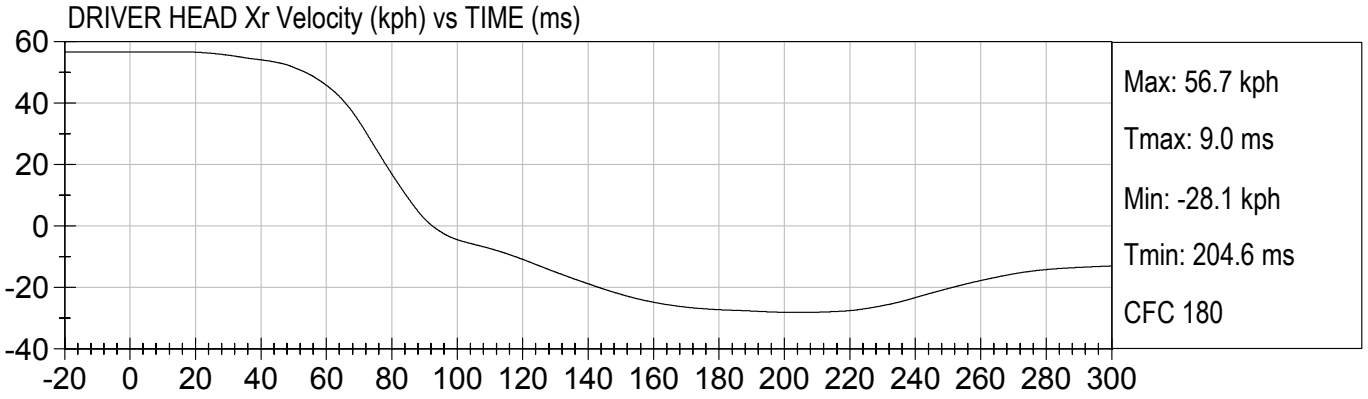


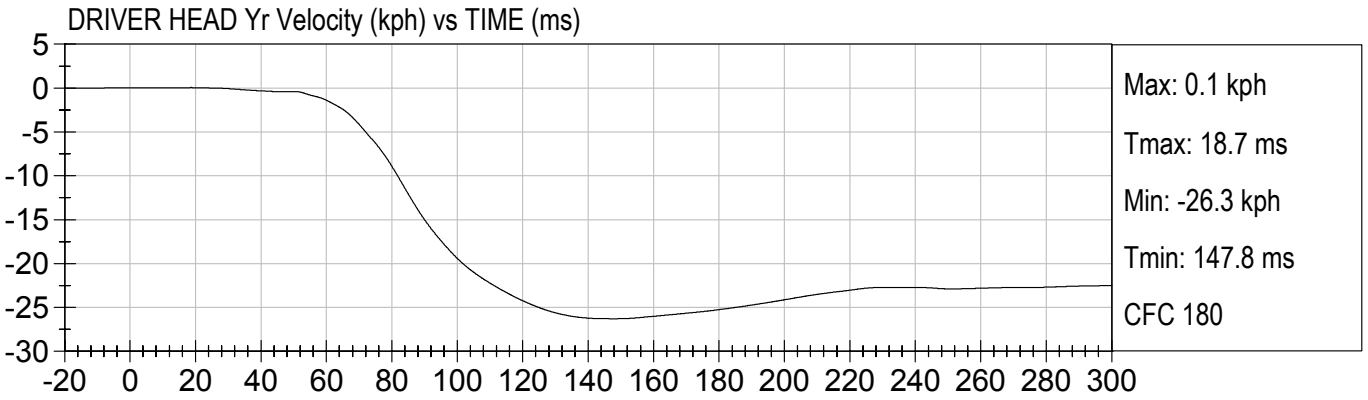
DRIVER HEAD Zr (G's) vs TIME (ms)

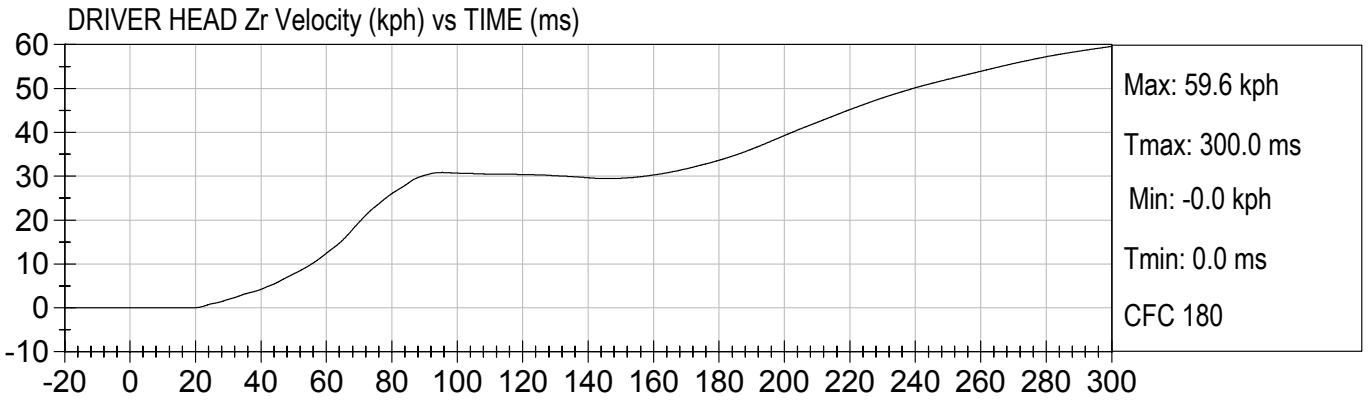


DRIVER HEAD ResultantR (G's) vs TIME (ms)




DRIVER HEAD Xr Velocity (kph) vs TIME (ms)
60
40
20
0
-20
-40
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 56.7 kph
Tmax: 9.0 ms
Min: -28.1 kph
Tmin: 204.6 ms
CFC 180

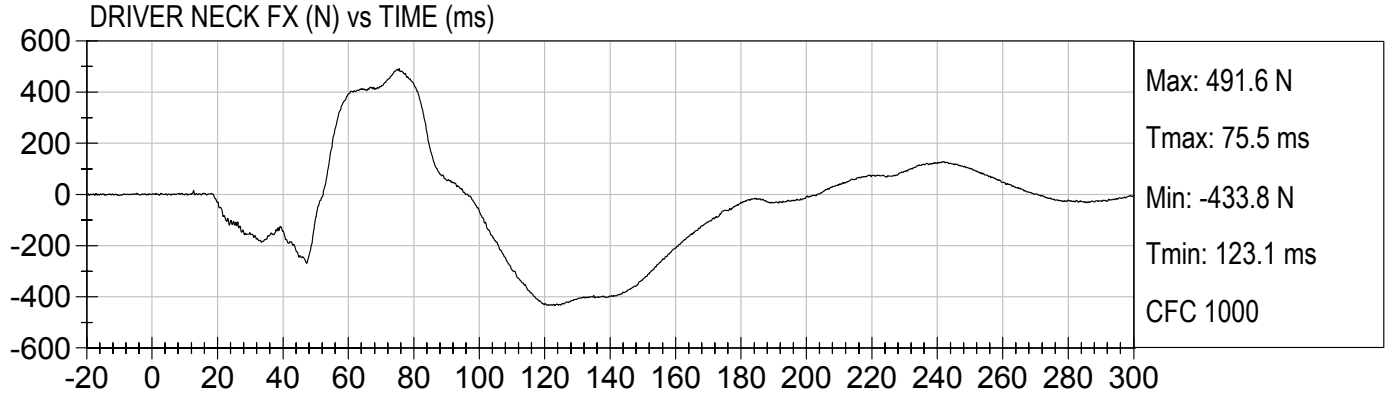

DRIVER HEAD Yr Velocity (kph) vs TIME (ms)
5
0
-5
-10
-15
-20
-25
-30
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 0.1 kph
Tmax: 18.7 ms
Min: -26.3 kph
Tmin: 147.8 ms
CFC 180


DRIVER HEAD Zr Velocity (kph) vs TIME (ms)
60
50
40
30
20
10
0
-10
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 59.6 kph
Tmax: 300.0 ms
Min: -0.0 kph
Tmin: 0.0 ms
CFC 180

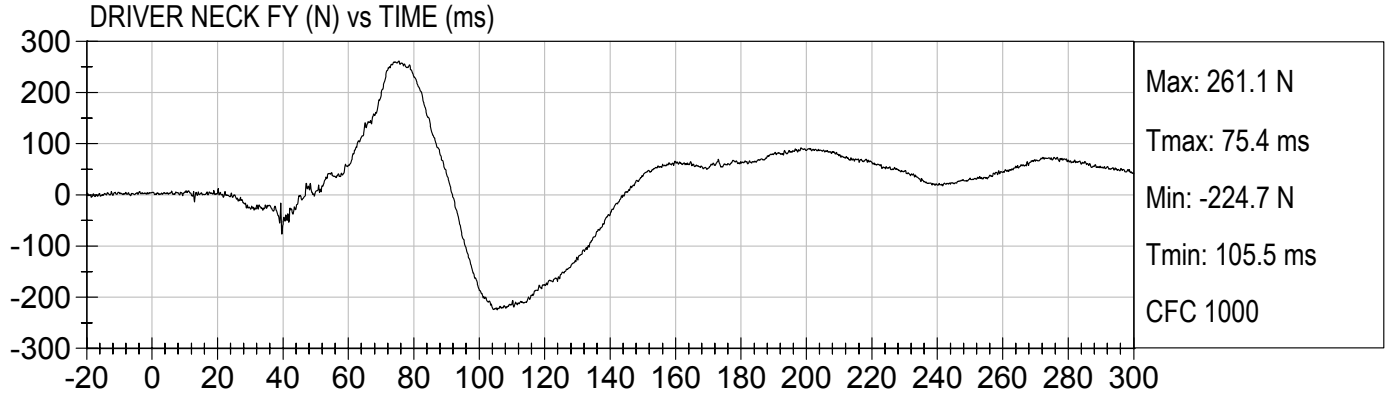
NCAP 35MPH FRONTAL IMPACT
2005 HYUNDAI SANTA FE (M50500)

Test Date: 02/17/05
Speed: 35.2 mph (56.6 km/h)

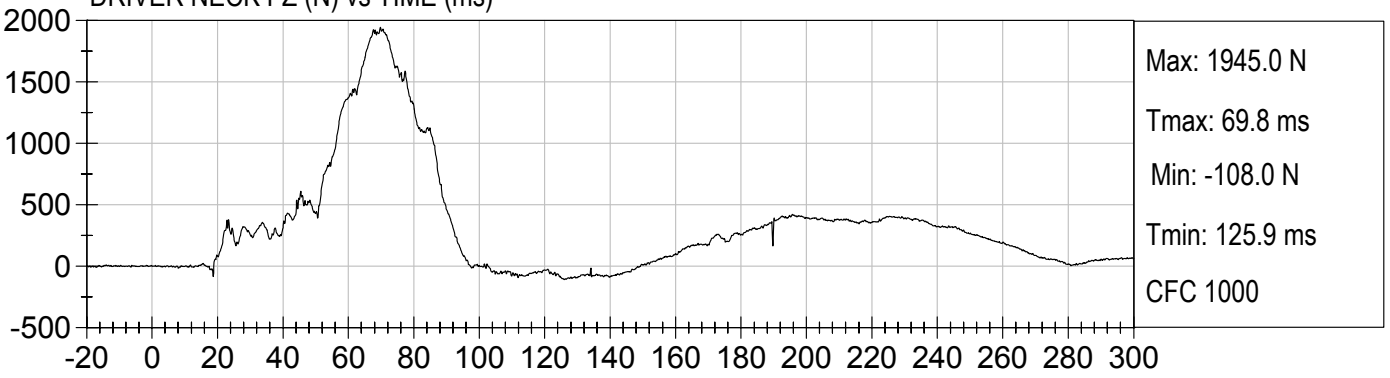
DRIVER NECK FX (N) vs TIME (ms)



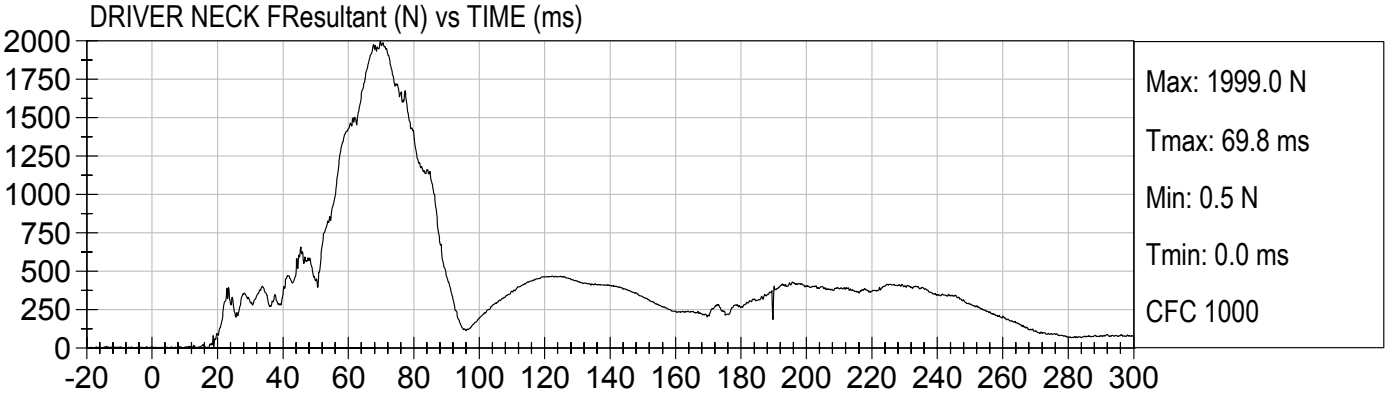
DRIVER NECK FY (N) vs TIME (ms)



DRIVER NECK FZ (N) vs TIME (ms)



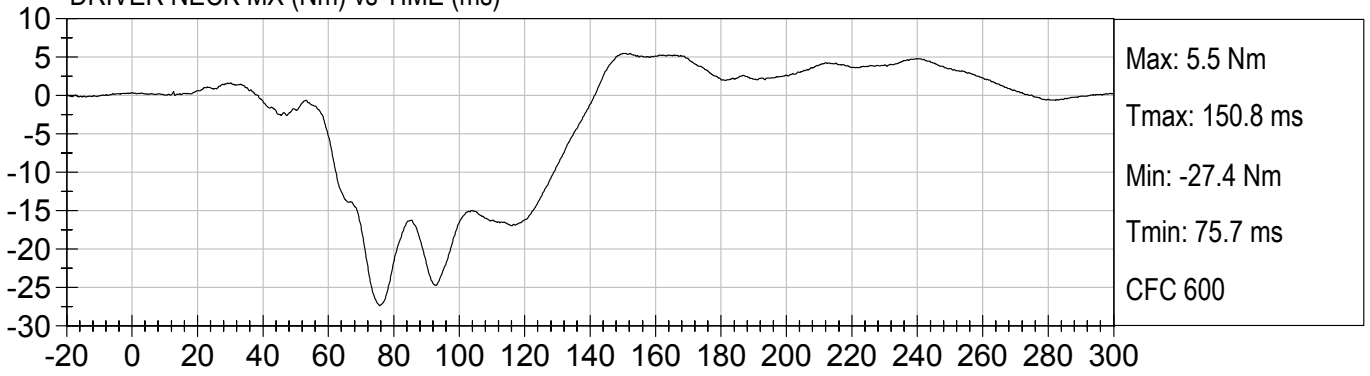
DRIVER NECK FResultant (N) vs TIME (ms)



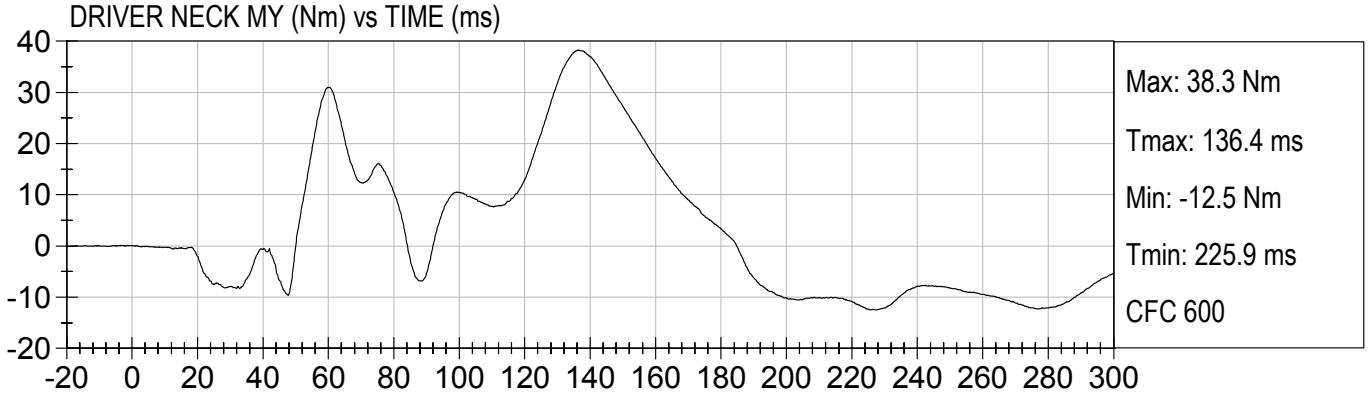
NCAP 35MPH FRONTAL IMPACT
2005 HYUNDAI SANTA FE (M50500)

Test Date: 02/17/05
Speed: 35.2 mph (56.6 km/h)

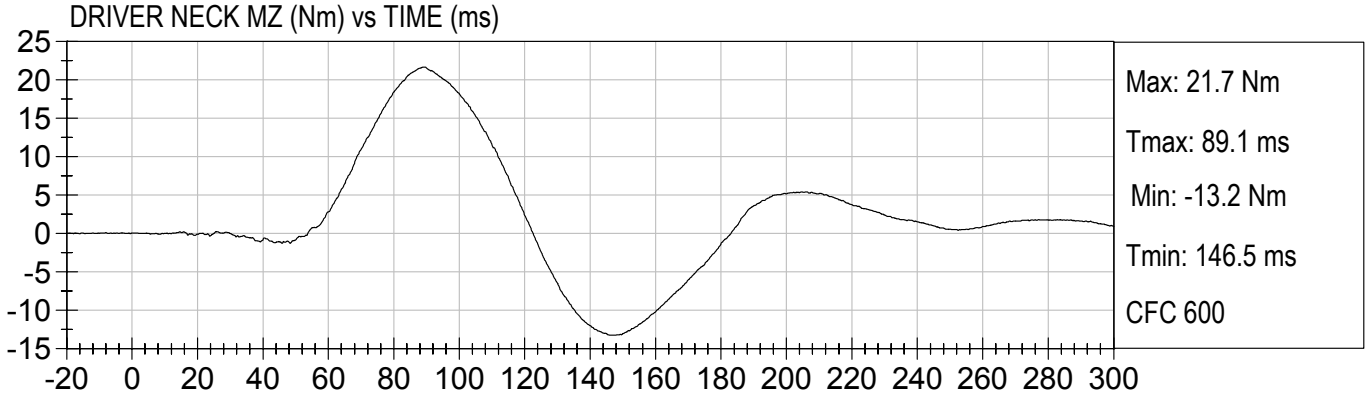
DRIVER NECK MX (Nm) vs TIME (ms)



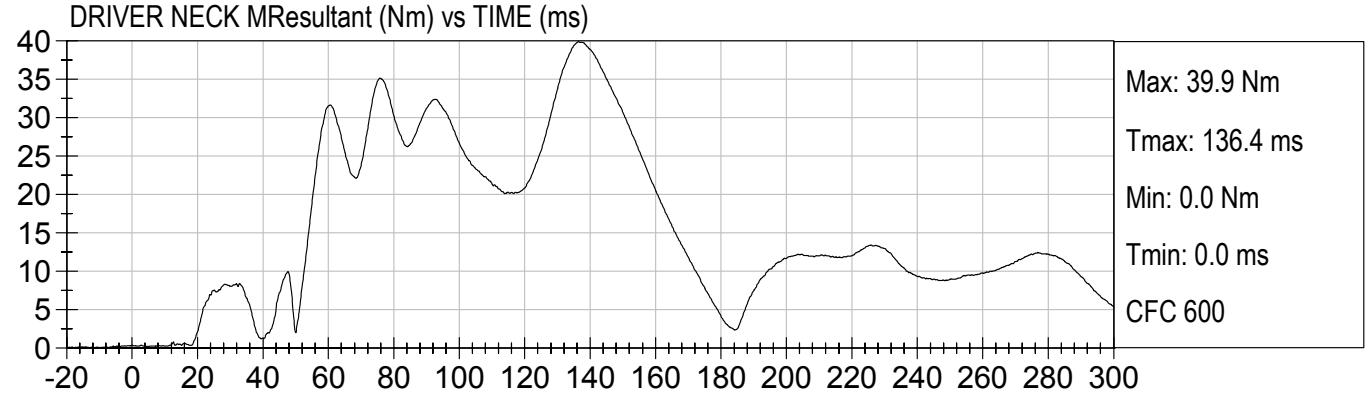
DRIVER NECK MY (Nm) vs TIME (ms)



DRIVER NECK MZ (Nm) vs TIME (ms)



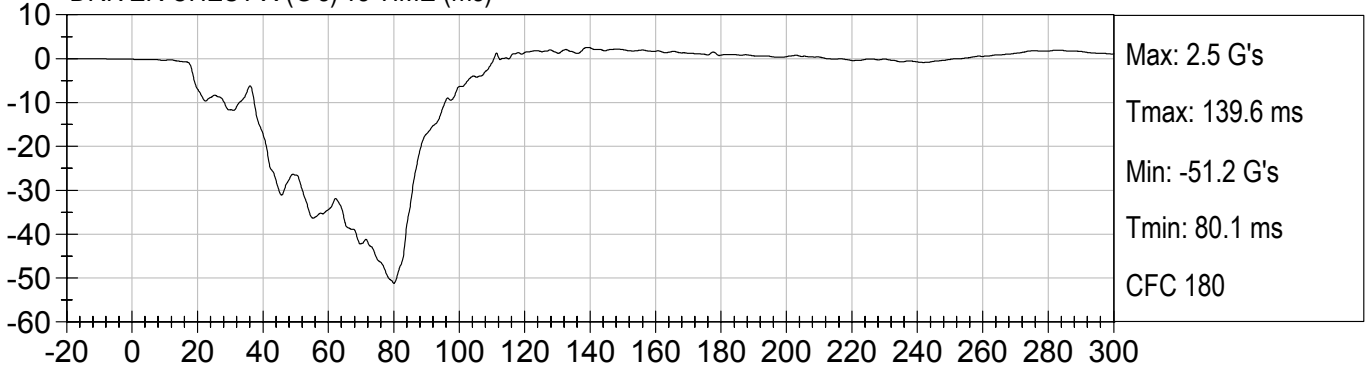
DRIVER NECK MResultant (Nm) vs TIME (ms)



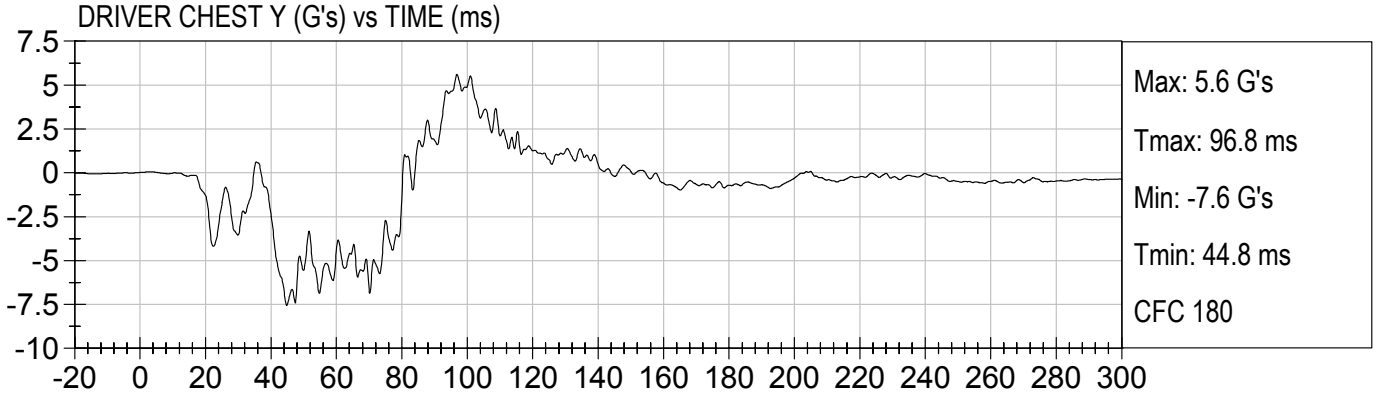
NCAP 35MPH FRONTAL IMPACT
2005 HYUNDAI SANTA FE (M50500)

Test Date: 02/17/05
Speed: 35.2 mph (56.6 km/h)

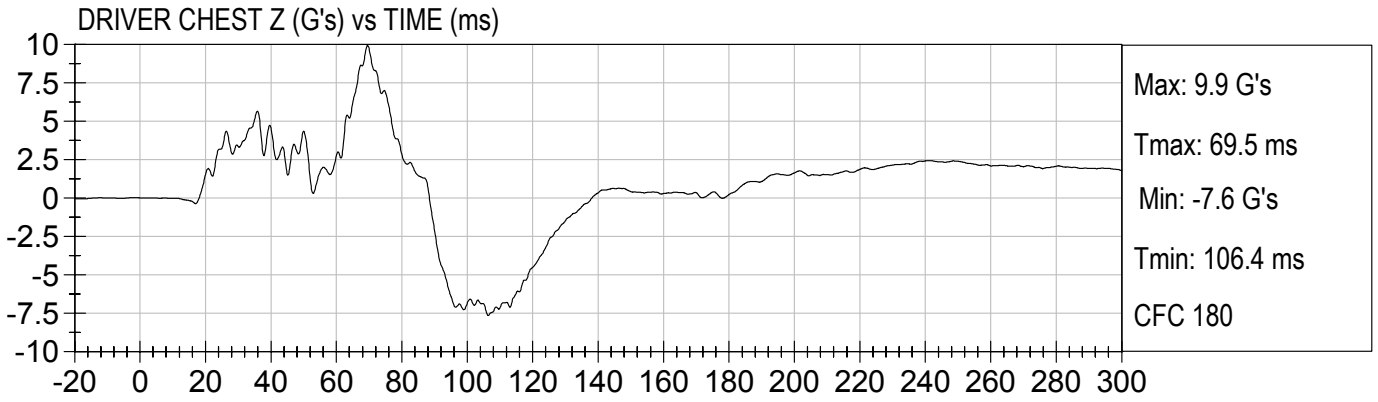
DRIVER CHEST X (G's) vs TIME (ms)



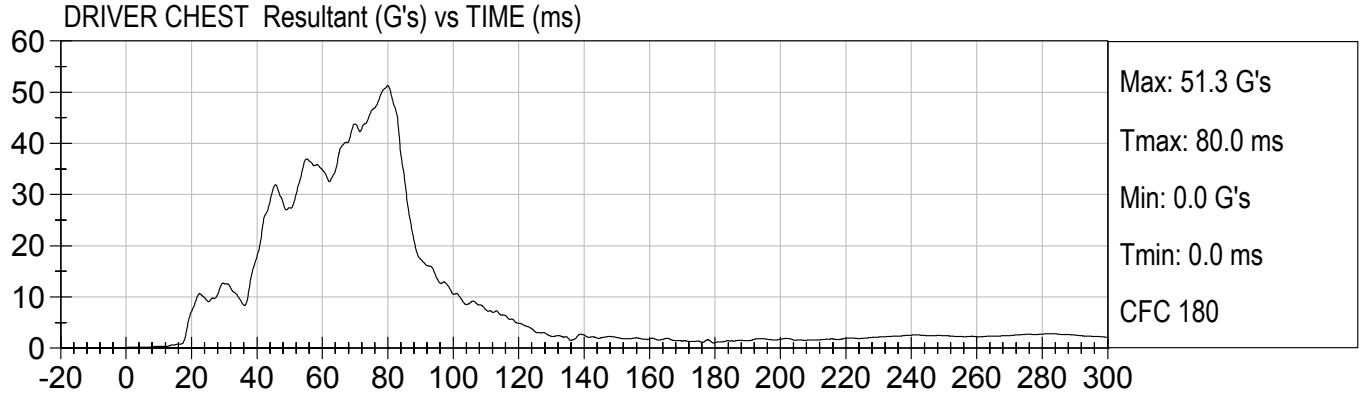
DRIVER CHEST Y (G's) vs TIME (ms)



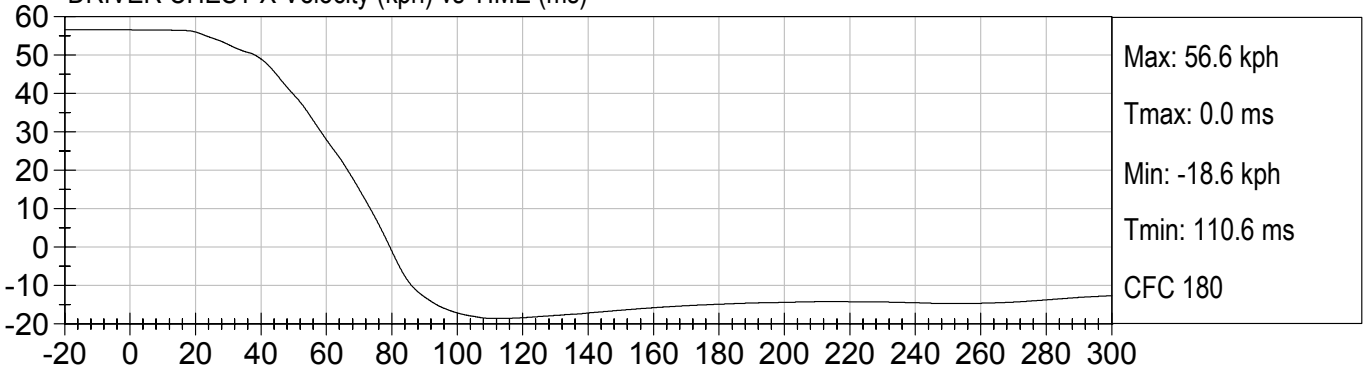
DRIVER CHEST Z (G's) vs TIME (ms)



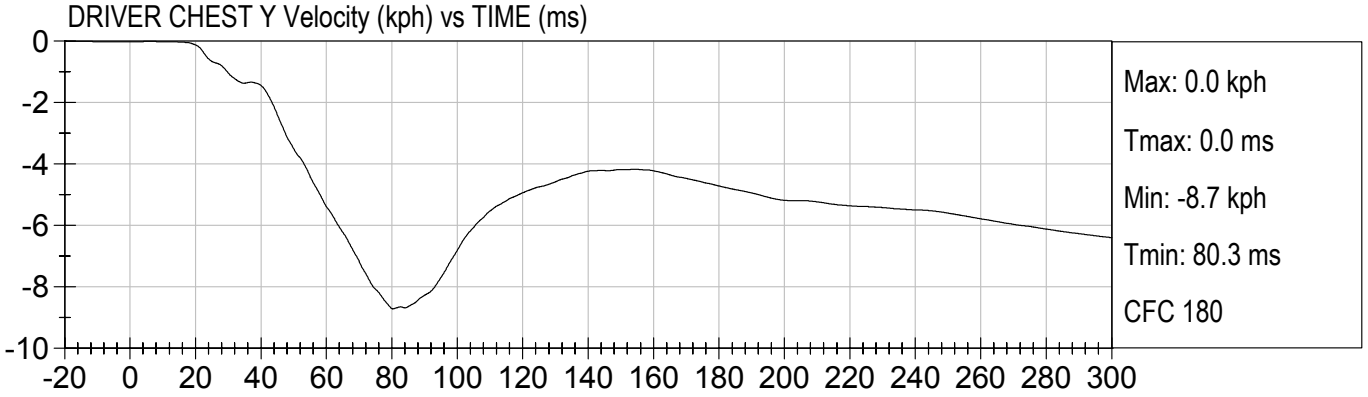
DRIVER CHEST Resultant (G's) vs TIME (ms)



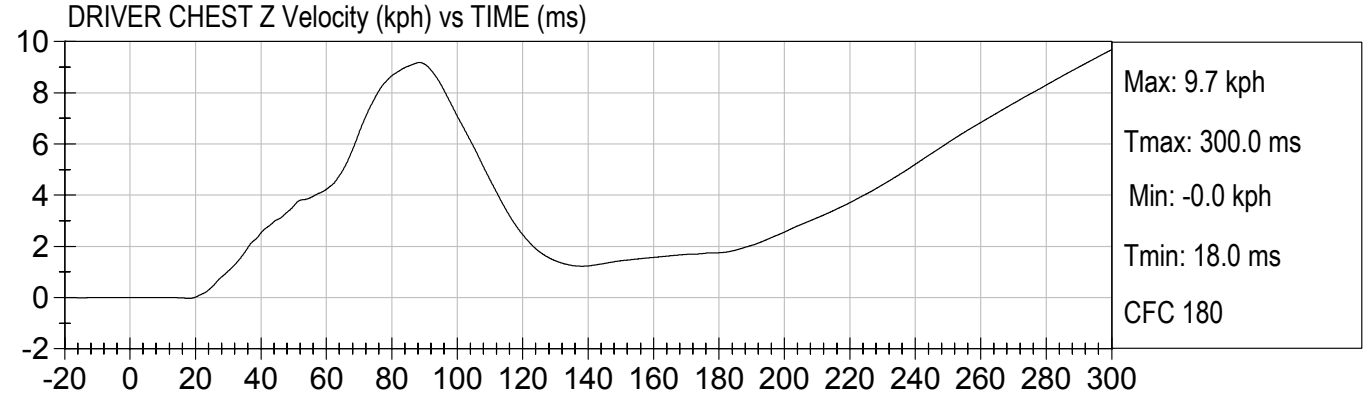
DRIVER CHEST X Velocity (kph) vs TIME (ms)



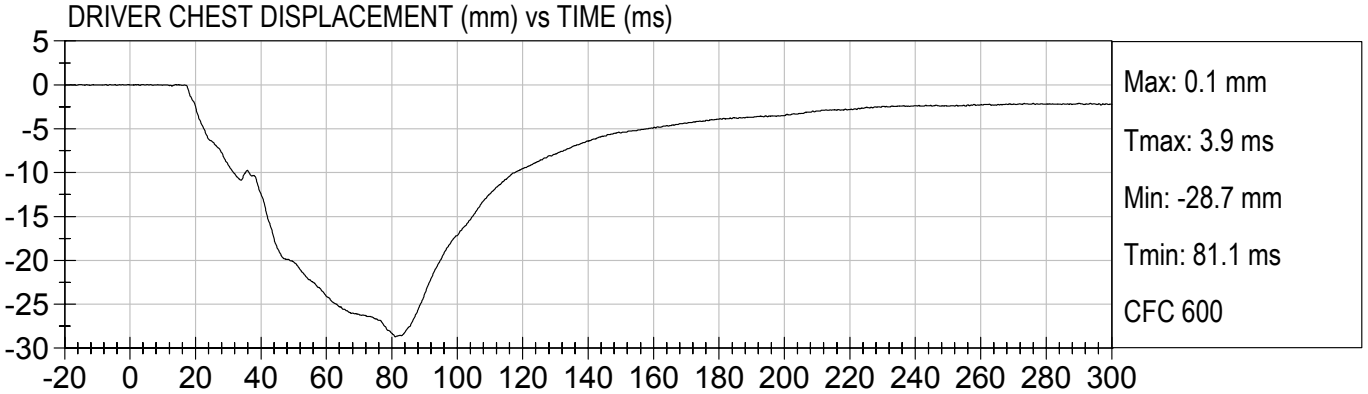
DRIVER CHEST Y Velocity (kph) vs TIME (ms)



DRIVER CHEST Z Velocity (kph) vs TIME (ms)

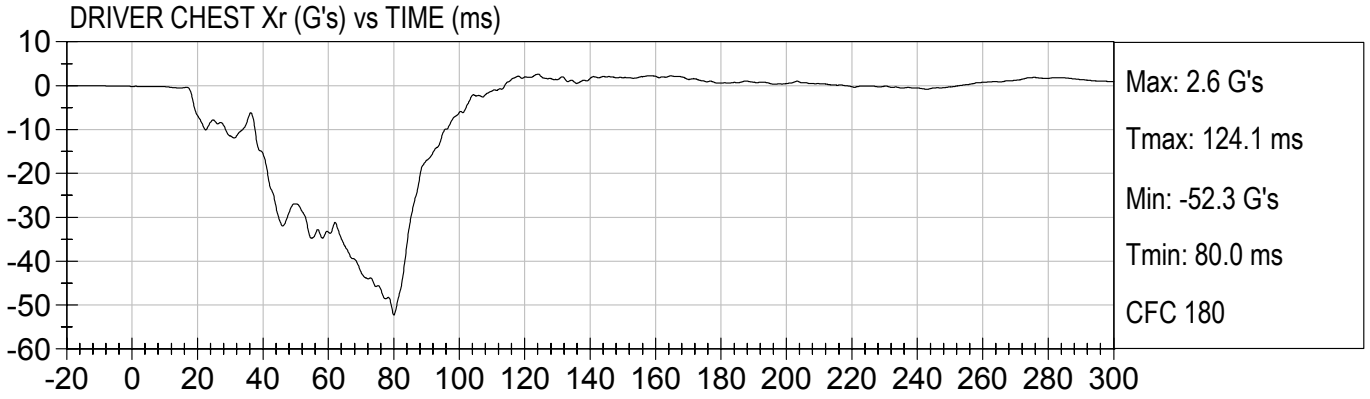


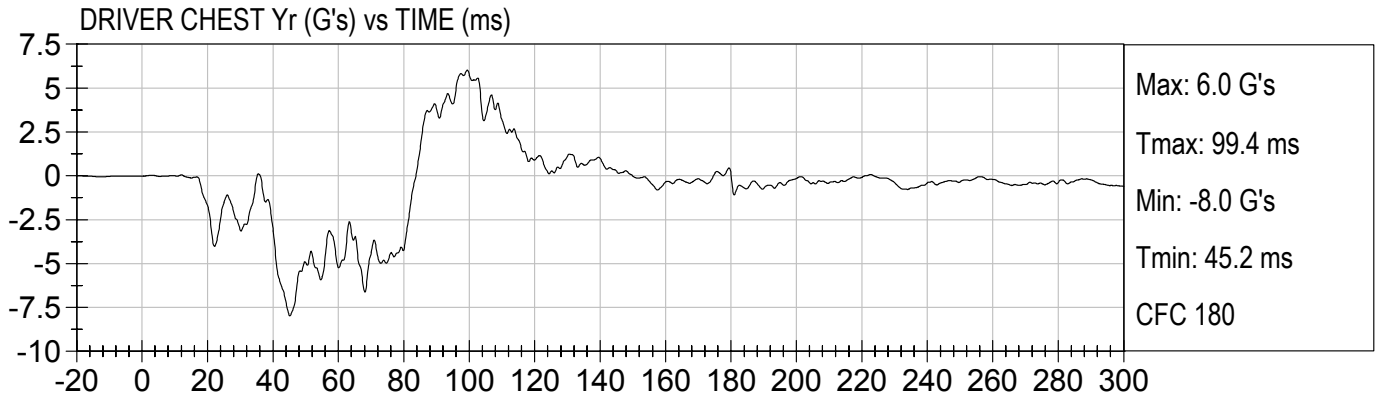
DRIVER CHEST DISPLACEMENT (mm) vs TIME (ms)

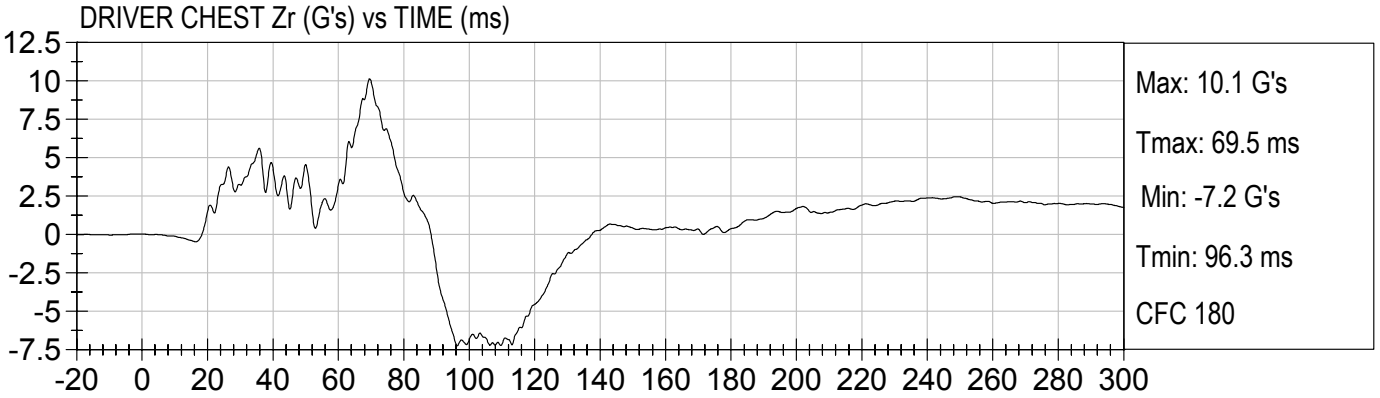


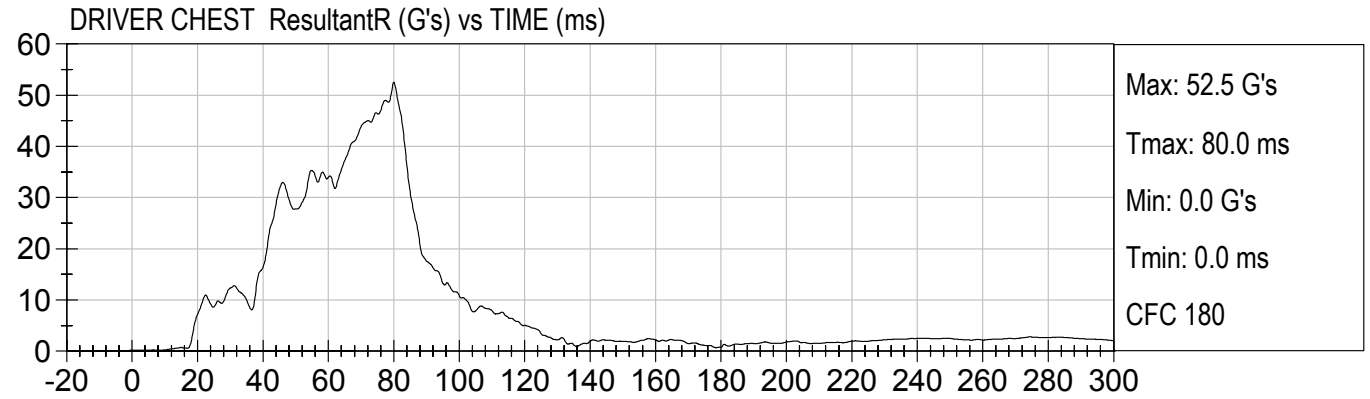
NCAP 35MPH FRONTAL IMPACT
2005 HYUNDAI SANTA FE (M50500)

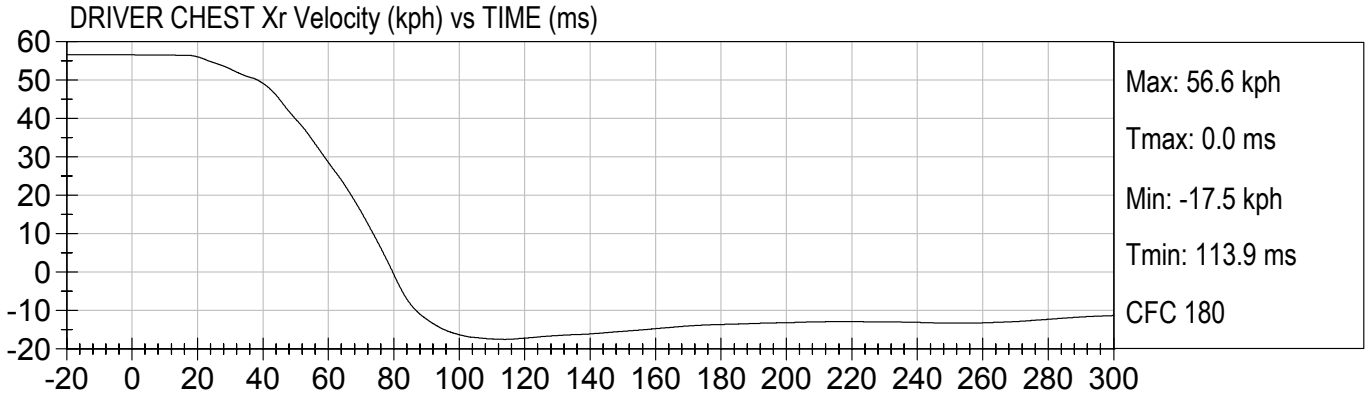
Test Date: 02/17/05
Speed: 35.2 mph (56.6 km/h)

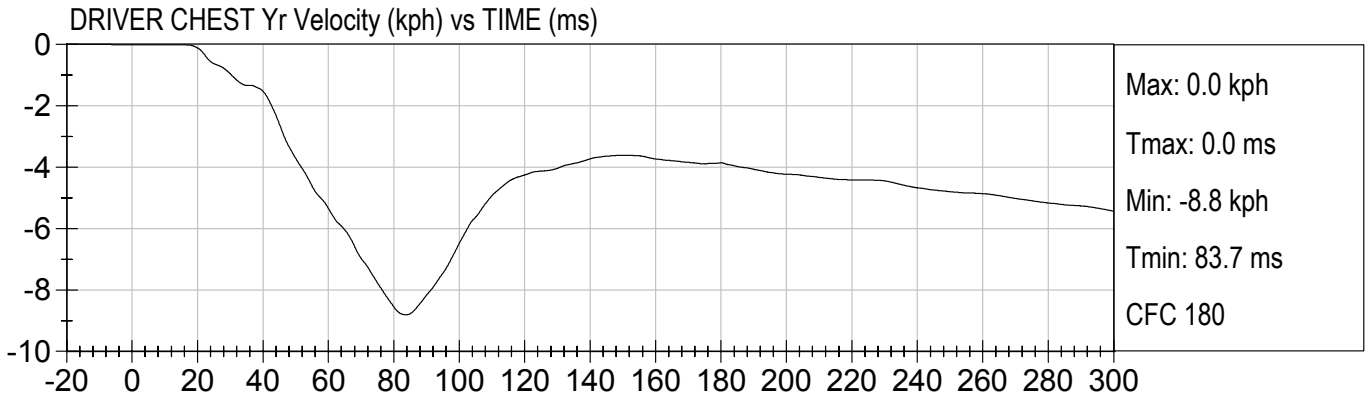


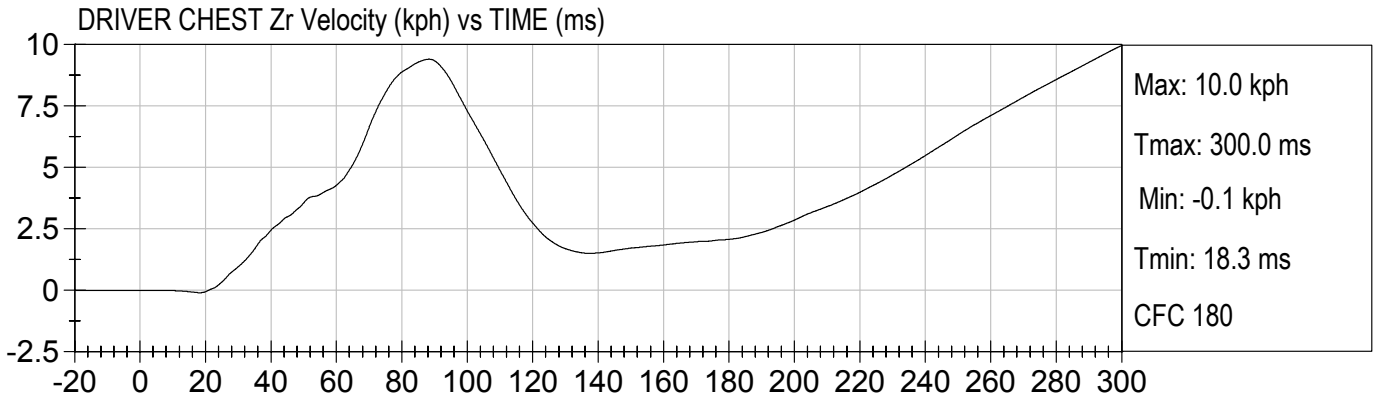







DRIVER CHEST Xr Velocity (kph) vs TIME (ms)
60
50
40
30
20
10
0
-10
-20
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 56.6 kph
Tmax: 0.0 ms
Min: -17.5 kph
Tmin: 113.9 ms
CFC 180

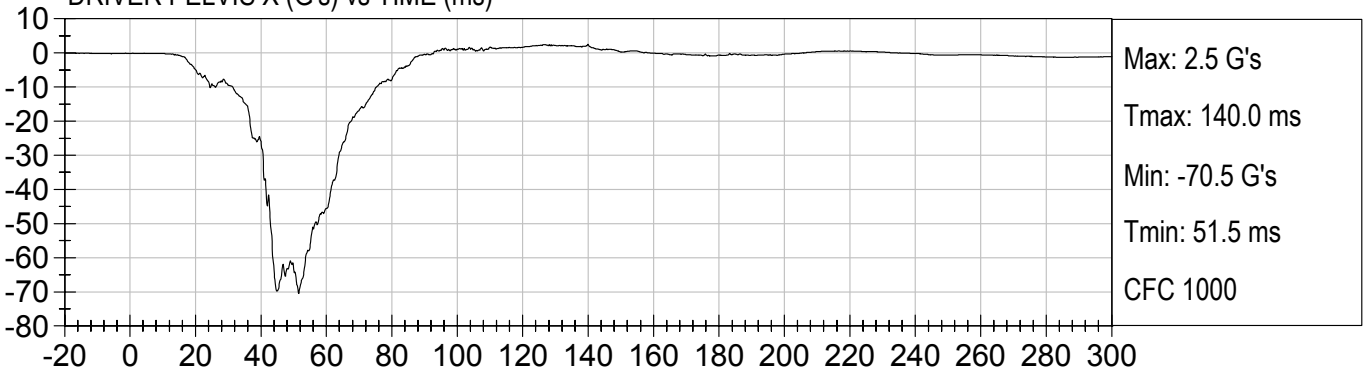

DRIVER CHEST Yr Velocity (kph) vs TIME (ms)
0
-2
-4
-6
-8
-10
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 0.0 kph
Tmax: 0.0 ms
Min: -8.8 kph
Tmin: 83.7 ms
CFC 180


DRIVER CHEST Zr Velocity (kph) vs TIME (ms)
10
7.5
5
2.5
0
-2.5
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 10.0 kph
Tmax: 300.0 ms
Min: -0.1 kph
Tmin: 18.3 ms
CFC 180

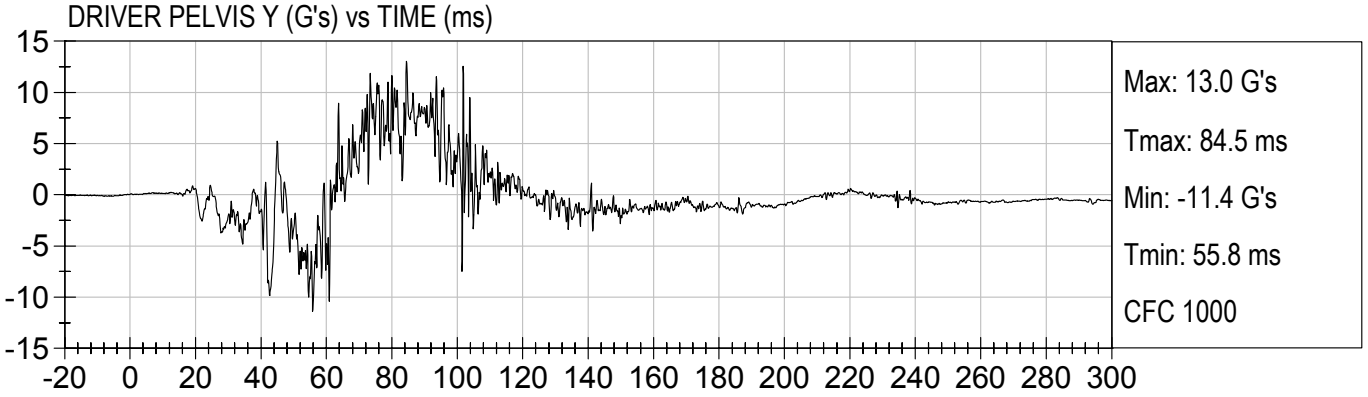
NCAP 35MPH FRONTAL IMPACT
2005 HYUNDAI SANTA FE (M50500)

Test Date: 02/17/05
Speed: 35.2 mph (56.6 km/h)

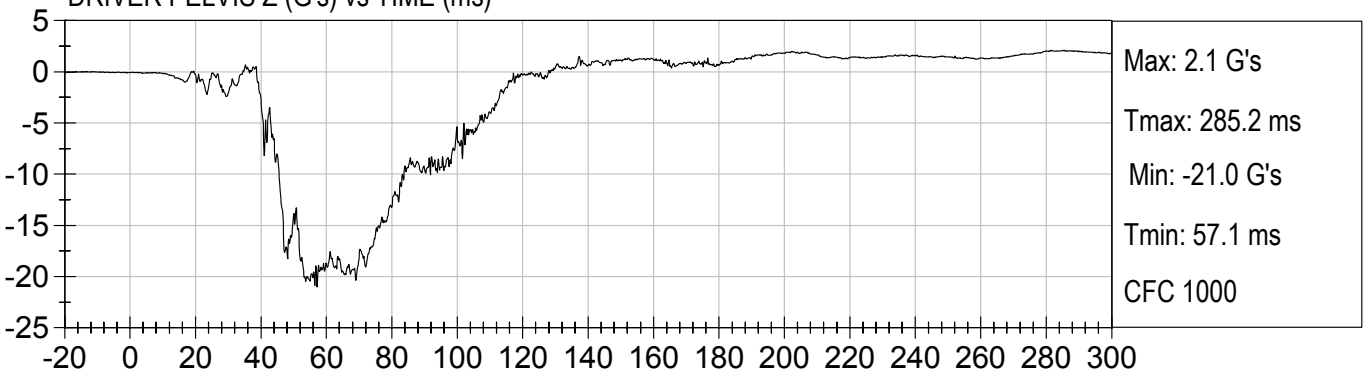
DRIVER PELVIS X (G's) vs TIME (ms)



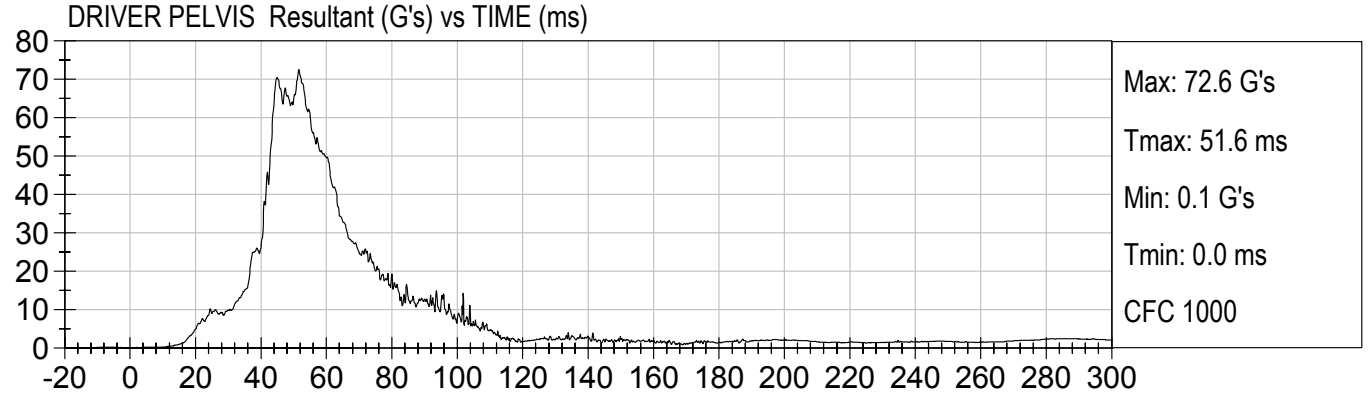
DRIVER PELVIS Y (G's) vs TIME (ms)

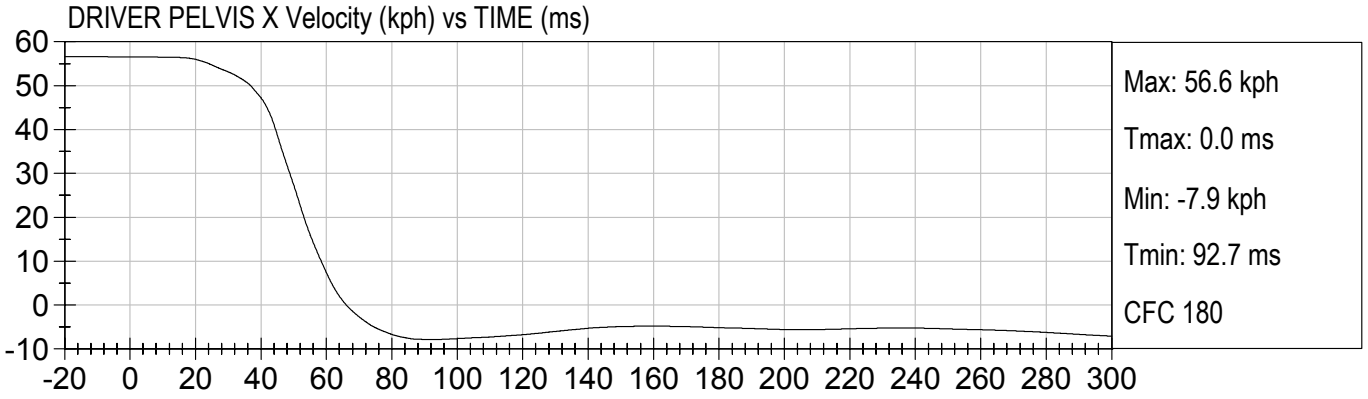


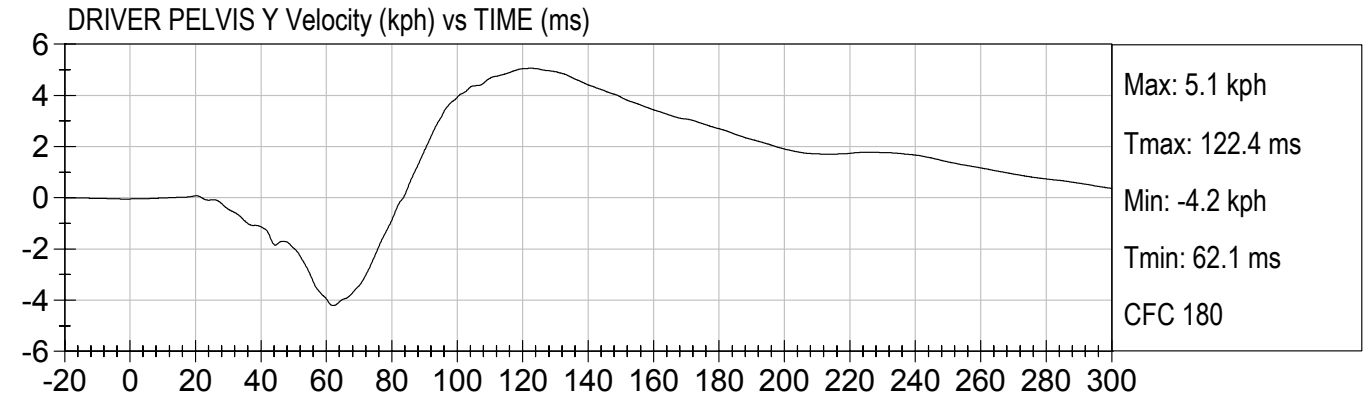
DRIVER PELVIS Z (G's) vs TIME (ms)

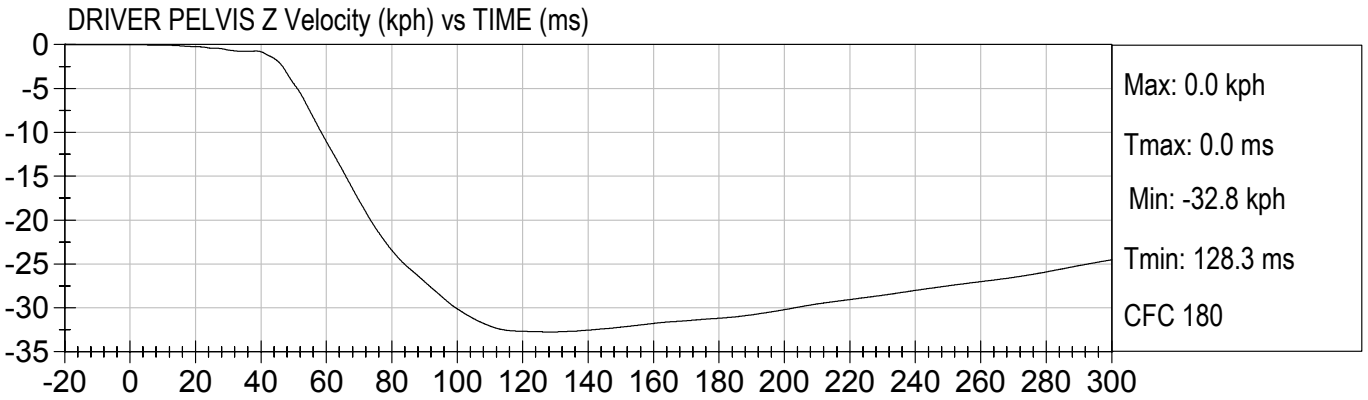


DRIVER PELVIS Resultant (G's) vs TIME (ms)




DRIVER PELVIS X Velocity (kph) vs TIME (ms)
60
50
40
30
20
10
0
-10
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 56.6 kph
Tmax: 0.0 ms
Min: -7.9 kph
Tmin: 92.7 ms
CFC 180

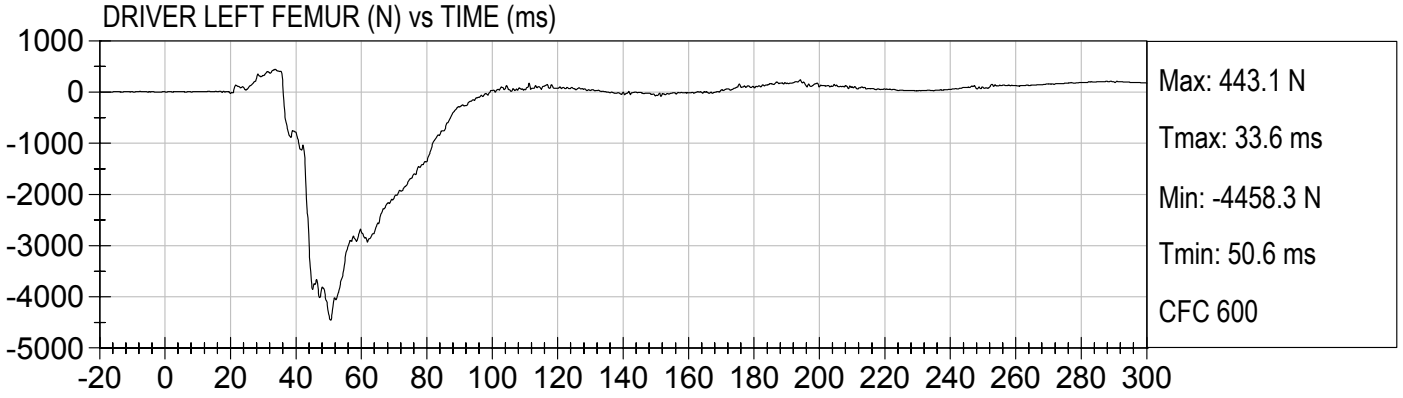

DRIVER PELVIS Y Velocity (kph) vs TIME (ms)
6
4
2
0
-2
-4
-6
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 5.1 kph
Tmax: 122.4 ms
Min: -4.2 kph
Tmin: 62.1 ms
CFC 180


DRIVER PELVIS Z Velocity (kph) vs TIME (ms)
0
-5
-10
-15
-20
-25
-30
-35
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 0.0 kph
Tmax: 0.0 ms
Min: -32.8 kph
Tmin: 128.3 ms
CFC 180

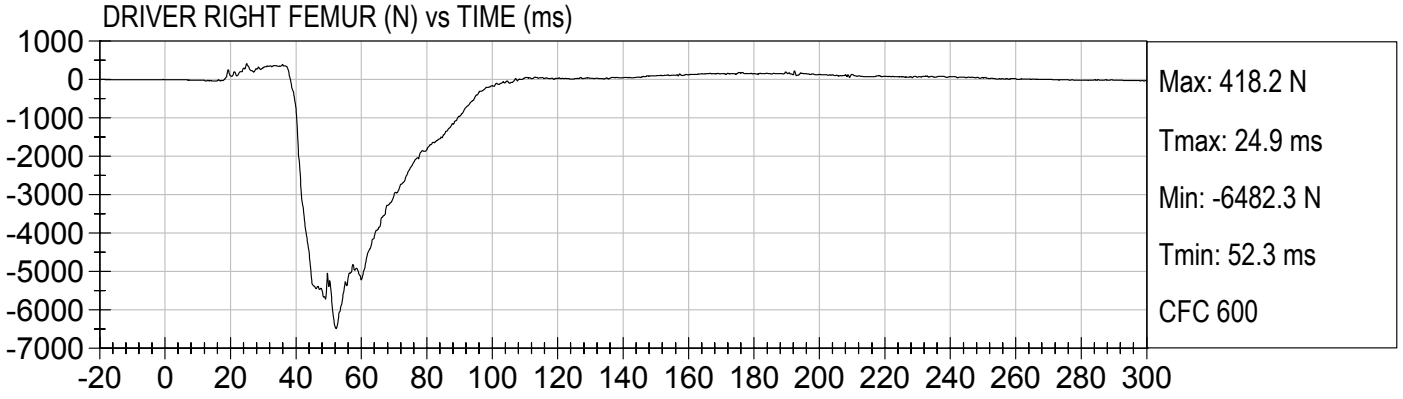
NCAP 35MPH FRONTAL IMPACT
2005 HYUNDAI SANTA FE (M50500)

Test Date: 02/17/05
Speed: 35.2 mph (56.6 km/h)

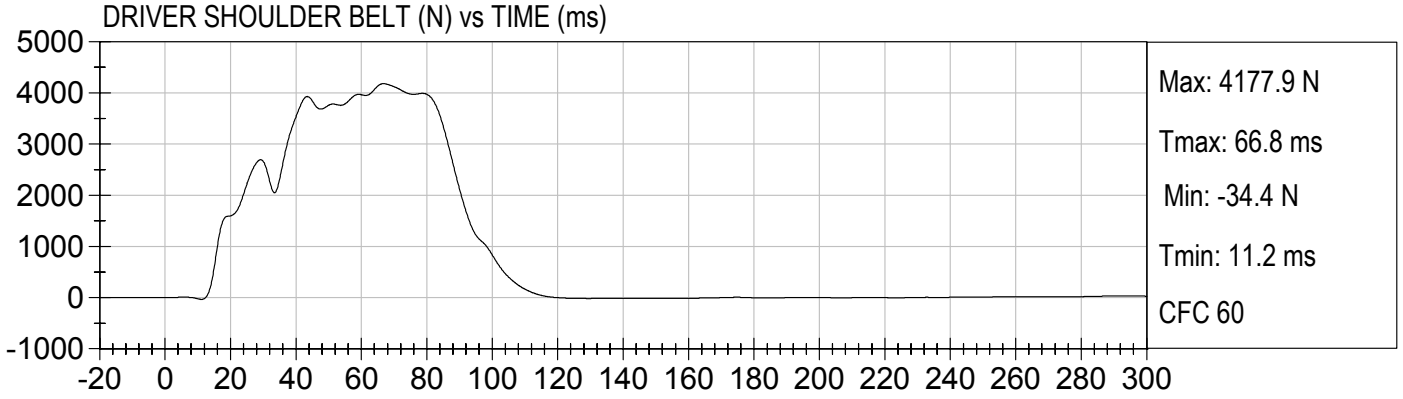
DRIVER LEFT FEMUR (N) vs TIME (ms)



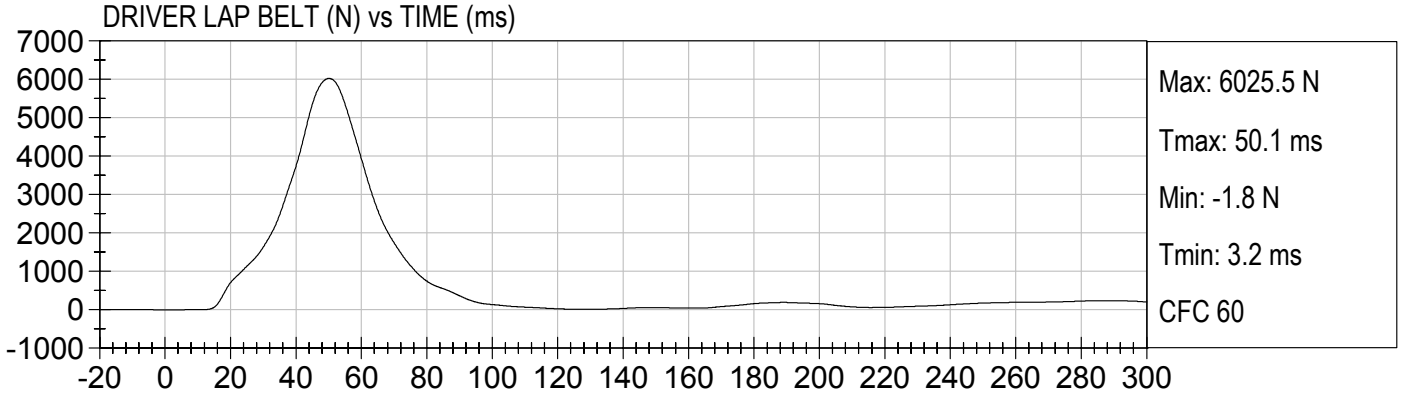
DRIVER RIGHT FEMUR (N) vs TIME (ms)



DRIVER SHOULDER BELT (N) vs TIME (ms)



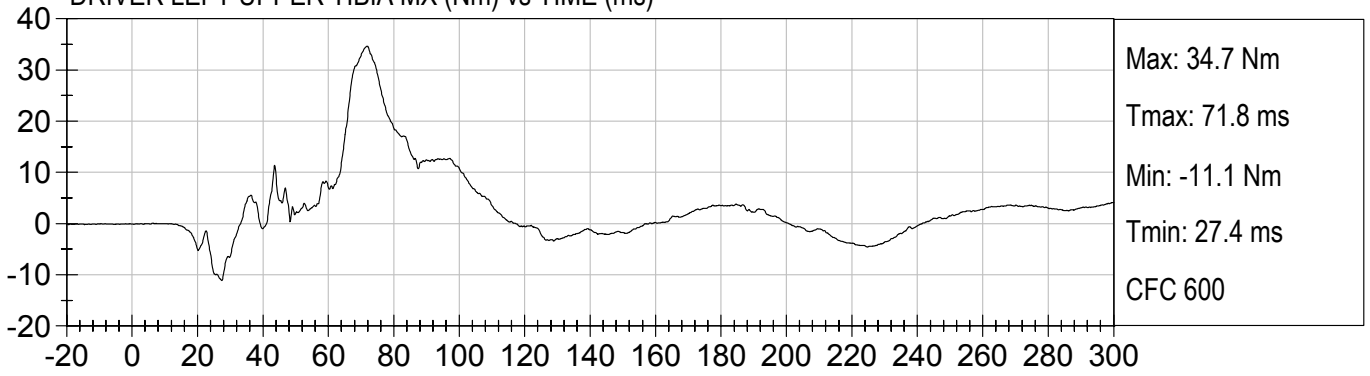
DRIVER LAP BELT (N) vs TIME (ms)



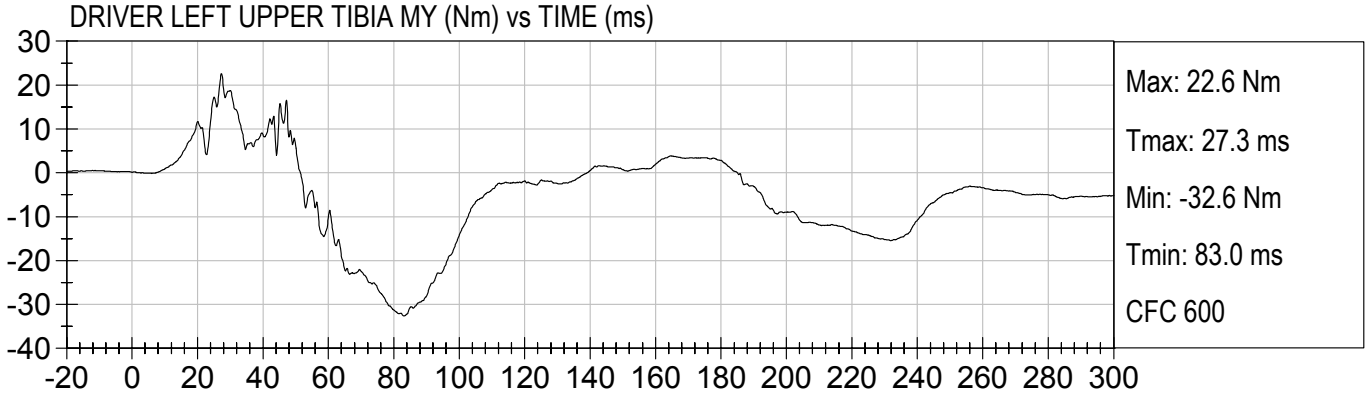
NCAP 35MPH FRONTAL IMPACT
2005 HYUNDAI SANTA FE (M50500)

Test Date: 02/17/05
Speed: 35.2 mph (56.6 km/h)

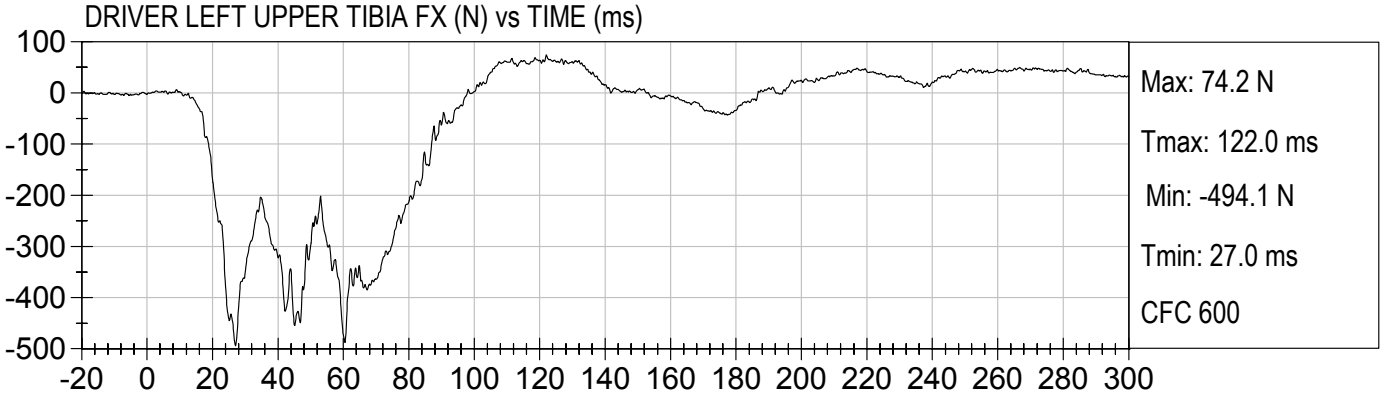
DRIVER LEFT UPPER TIBIA MX (Nm) vs TIME (ms)



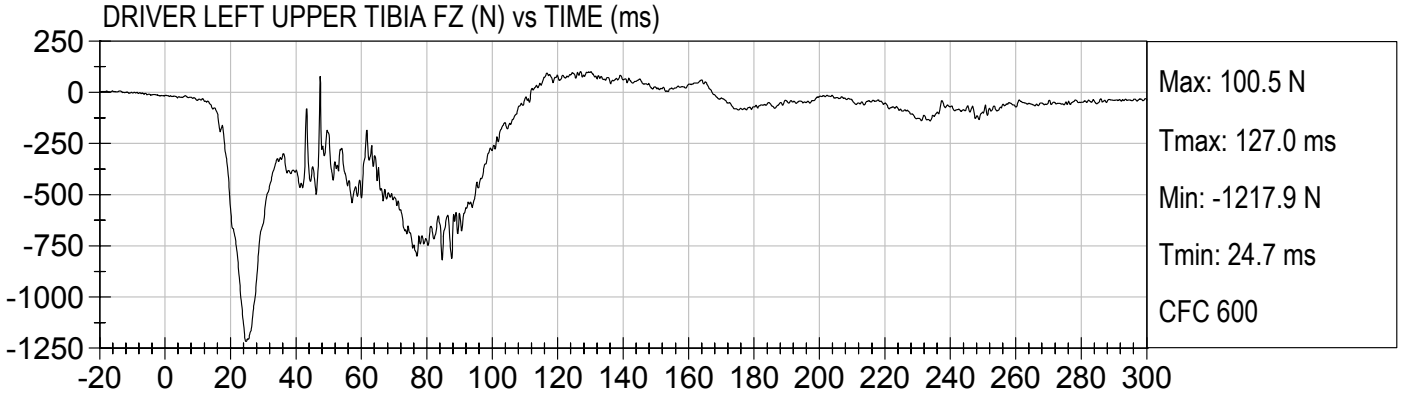
DRIVER LEFT UPPER TIBIA MY (Nm) vs TIME (ms)



DRIVER LEFT UPPER TIBIA FX (N) vs TIME (ms)



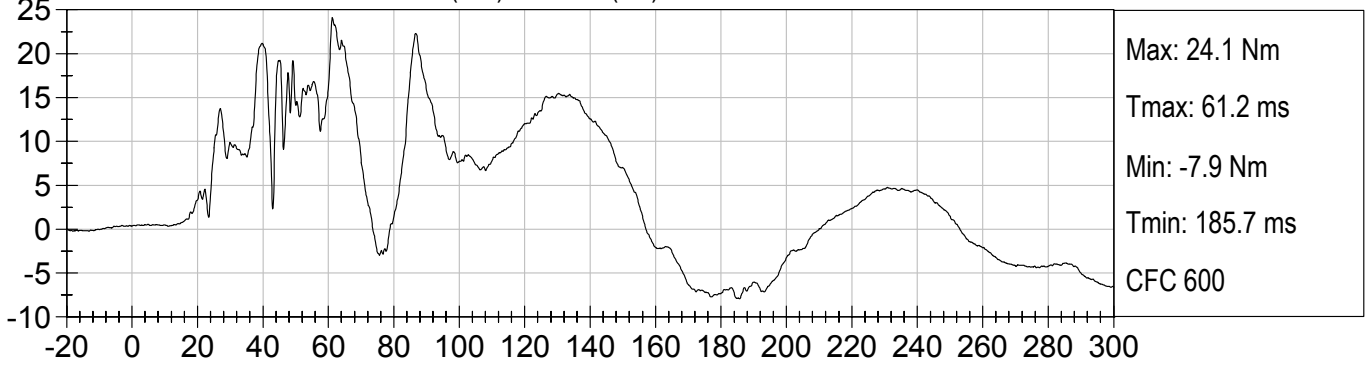
DRIVER LEFT UPPER TIBIA FZ (N) vs TIME (ms)



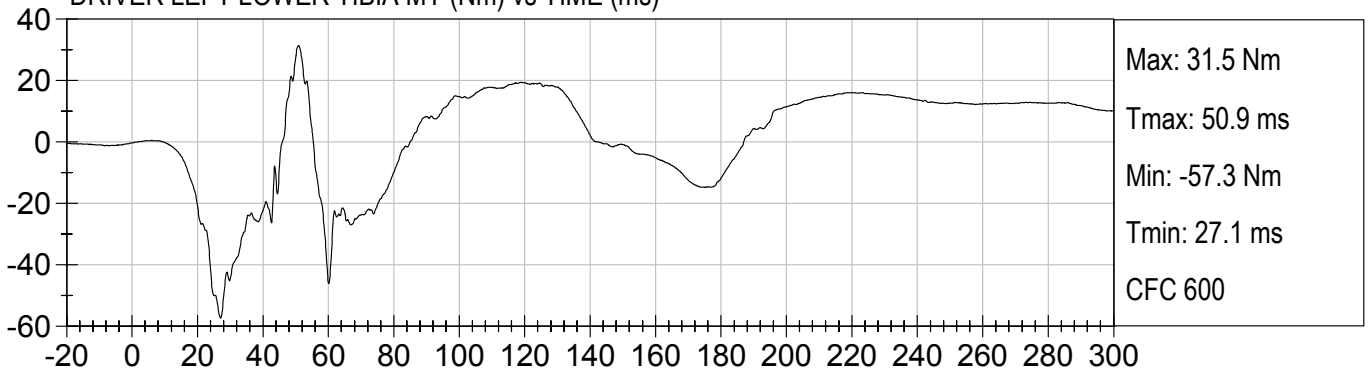
NCAP 35MPH FRONTAL IMPACT
2005 HYUNDAI SANTA FE (M50500)

Test Date: 02/17/05
Speed: 35.2 mph (56.6 km/h)

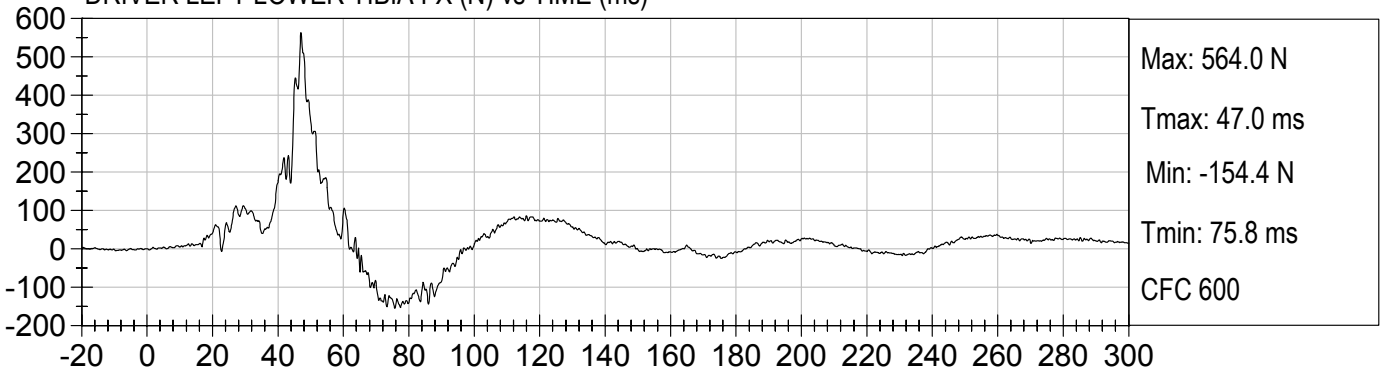
DRIVER LEFT LOWER TIBIA MX (Nm) vs TIME (ms)



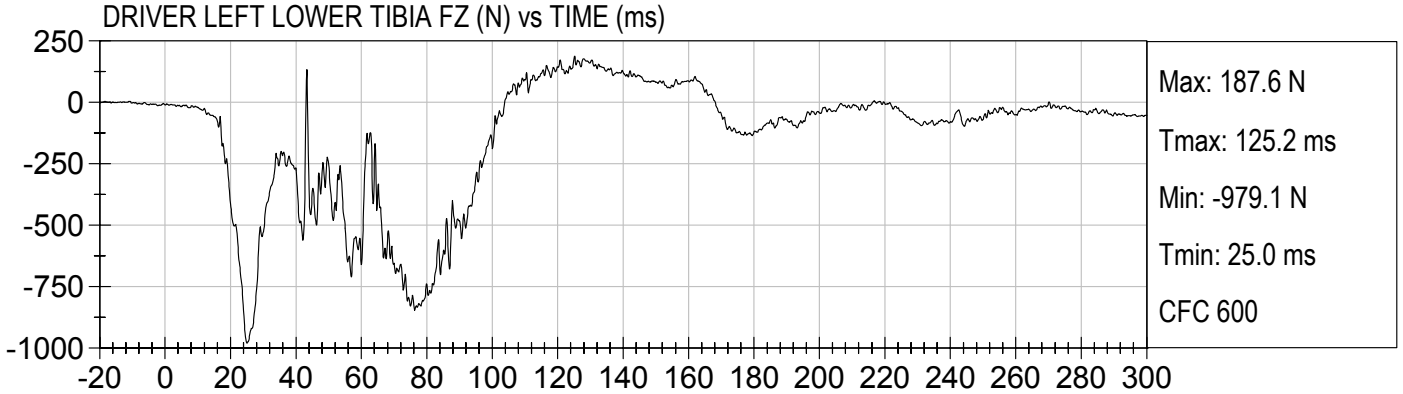
DRIVER LEFT LOWER TIBIA MY (Nm) vs TIME (ms)



DRIVER LEFT LOWER TIBIA FX (N) vs TIME (ms)



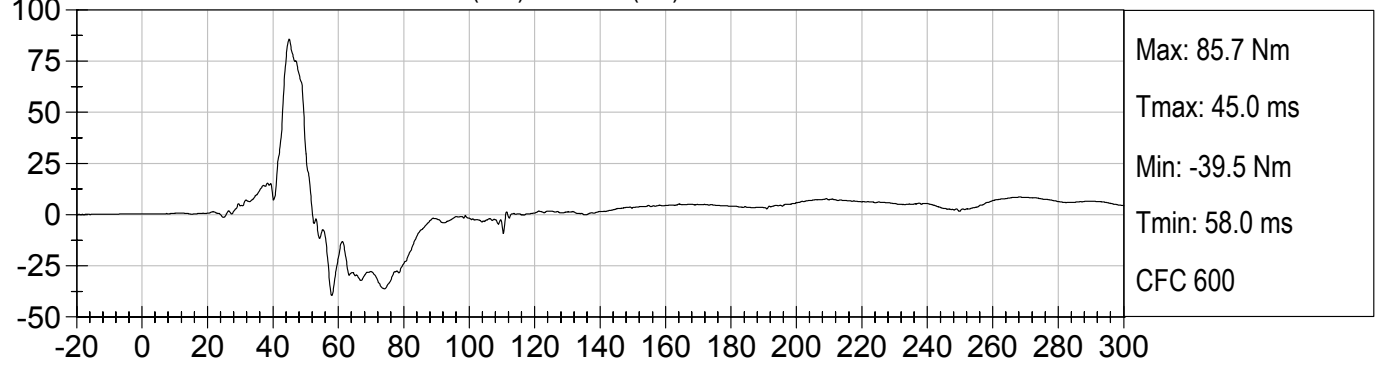
DRIVER LEFT LOWER TIBIA FZ (N) vs TIME (ms)



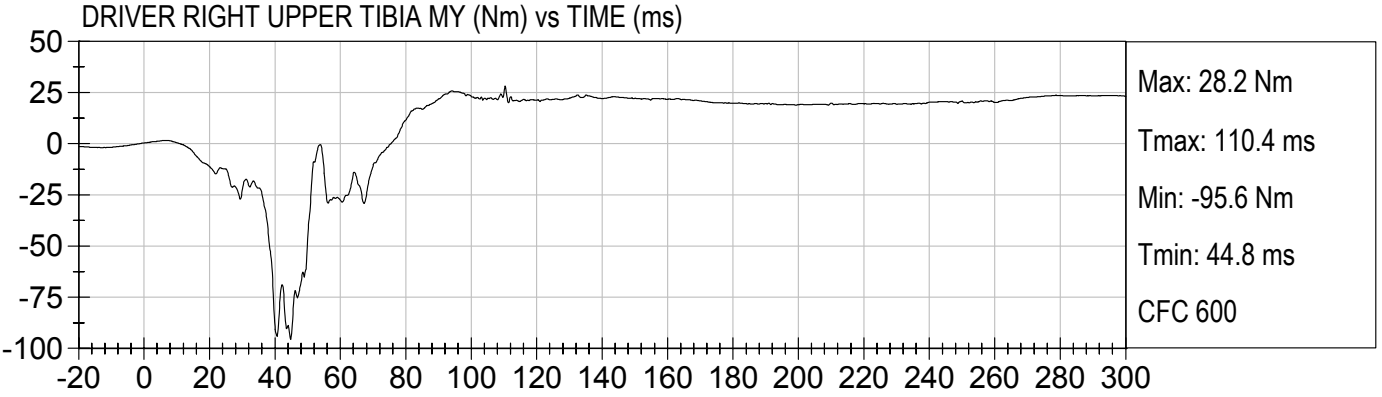
NCAP 35MPH FRONTAL IMPACT
2005 HYUNDAI SANTA FE (M50500)

Test Date: 02/17/05
Speed: 35.2 mph (56.6 km/h)

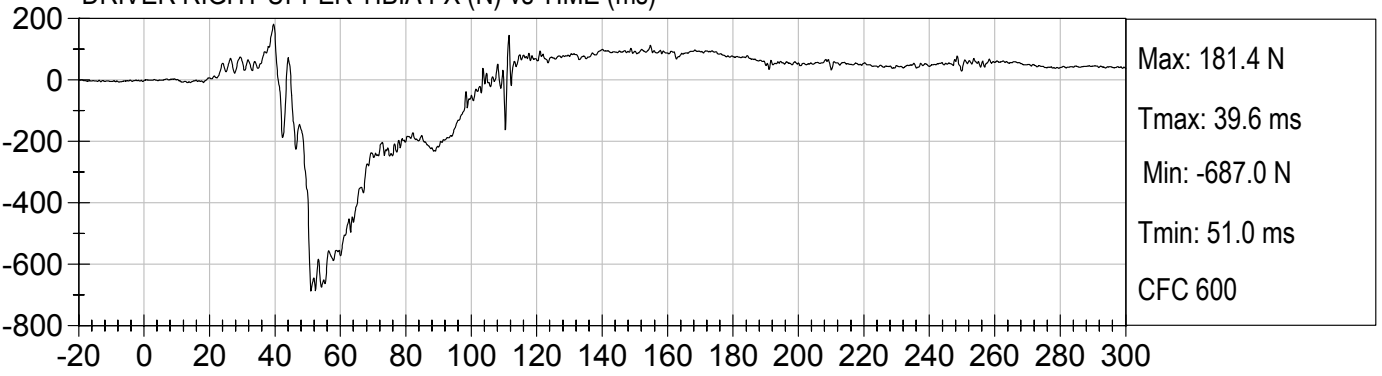
DRIVER RIGHT UPPER TIBIA MX (Nm) vs TIME (ms)



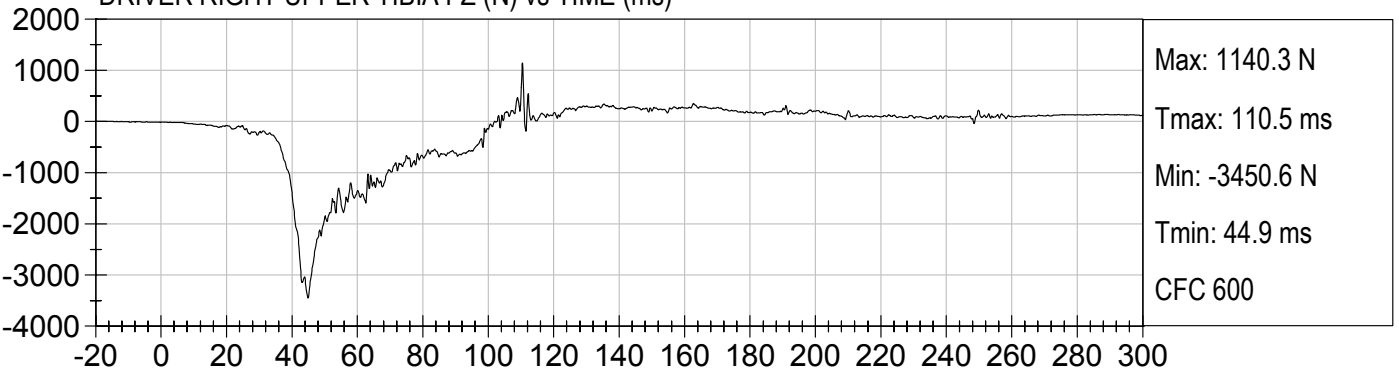
DRIVER RIGHT UPPER TIBIA MY (Nm) vs TIME (ms)



DRIVER RIGHT UPPER TIBIA FX (N) vs TIME (ms)



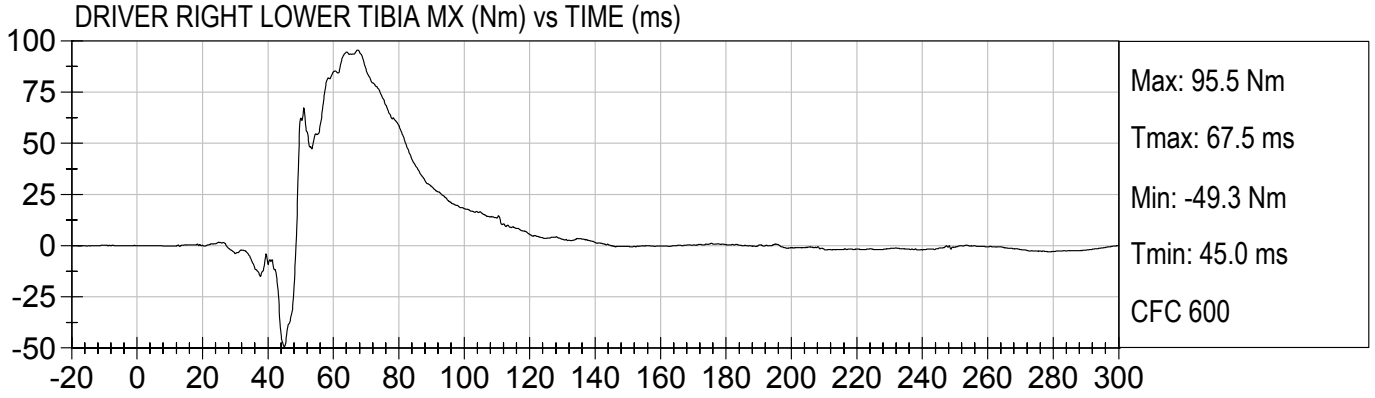
DRIVER RIGHT UPPER TIBIA FZ (N) vs TIME (ms)



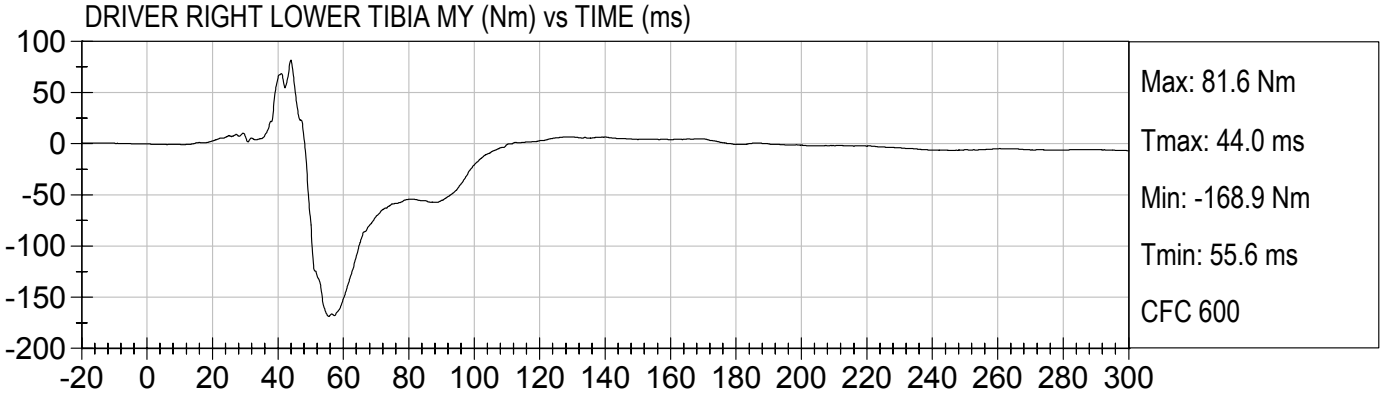
NCAP 35MPH FRONTAL IMPACT
2005 HYUNDAI SANTA FE (M50500)

Test Date: 02/17/05
Speed: 35.2 mph (56.6 km/h)

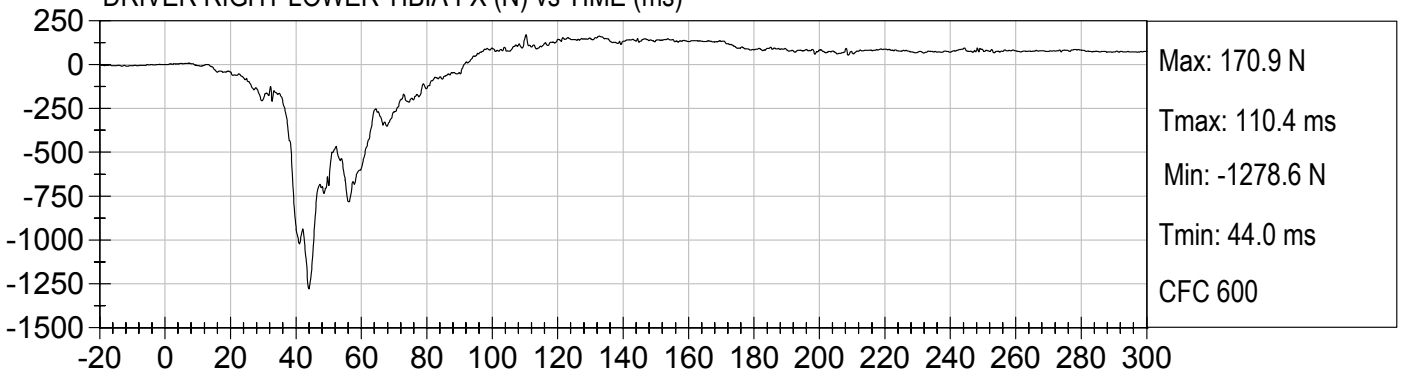
DRIVER RIGHT LOWER TIBIA MX (Nm) vs TIME (ms)



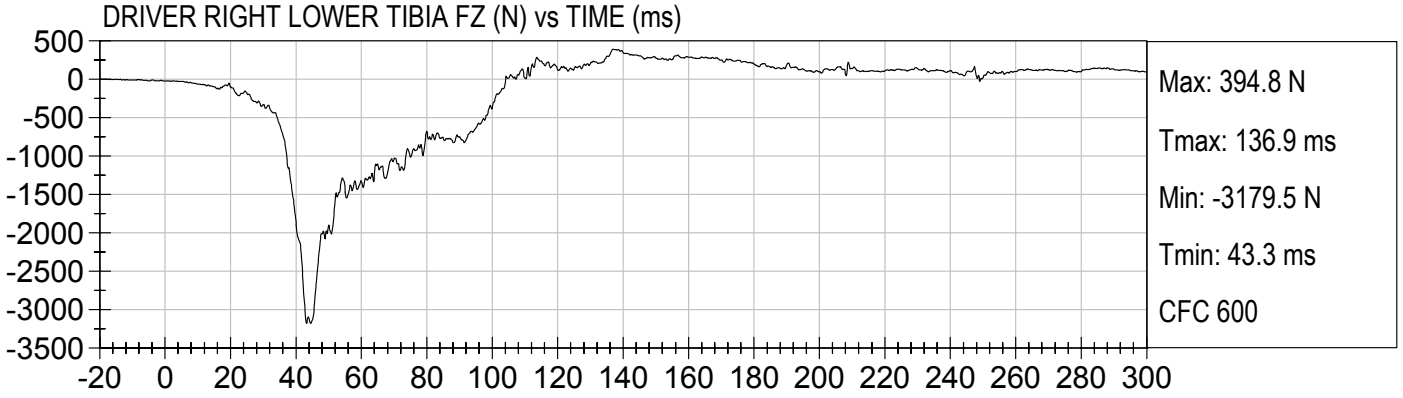
DRIVER RIGHT LOWER TIBIA MY (Nm) vs TIME (ms)

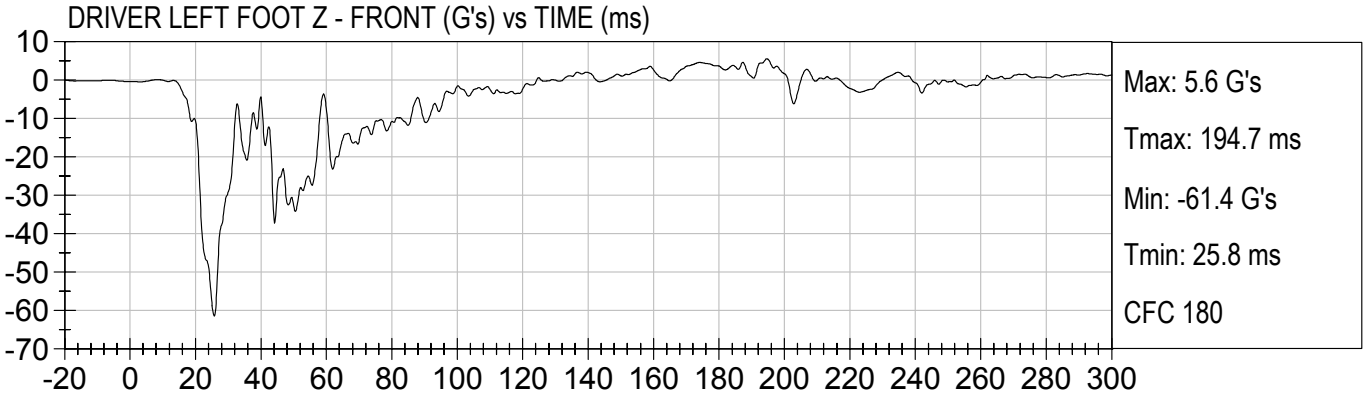


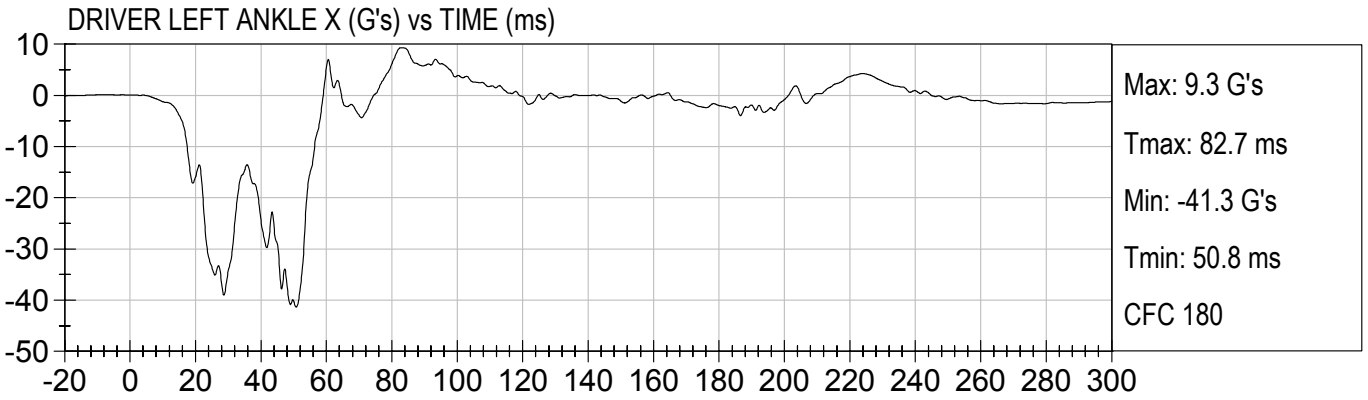
DRIVER RIGHT LOWER TIBIA FX (N) vs TIME (ms)

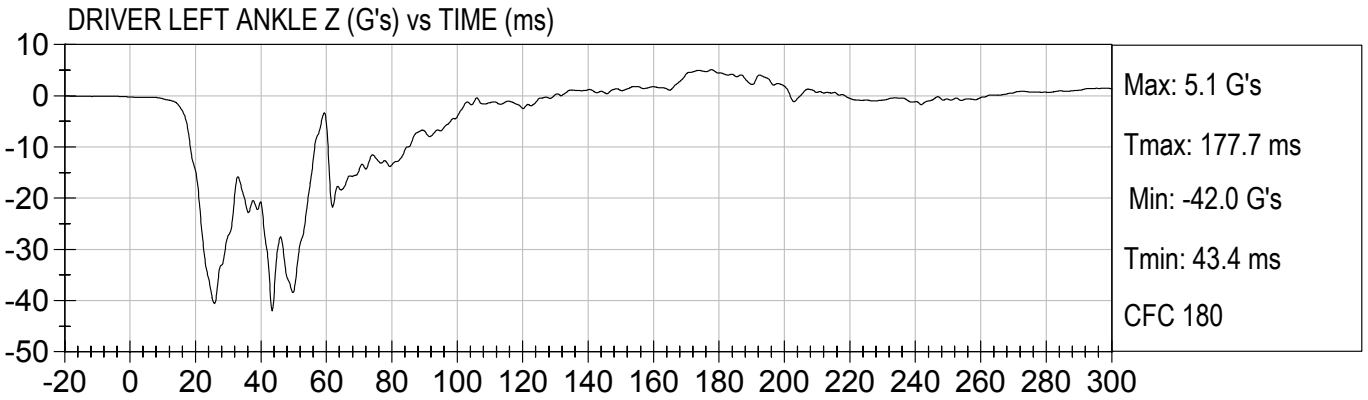


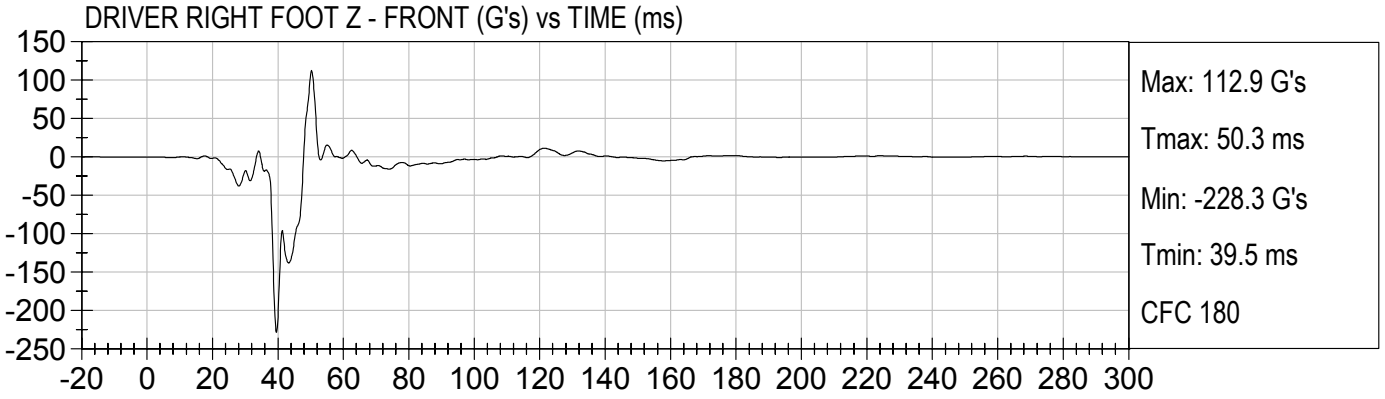
DRIVER RIGHT LOWER TIBIA FZ (N) vs TIME (ms)

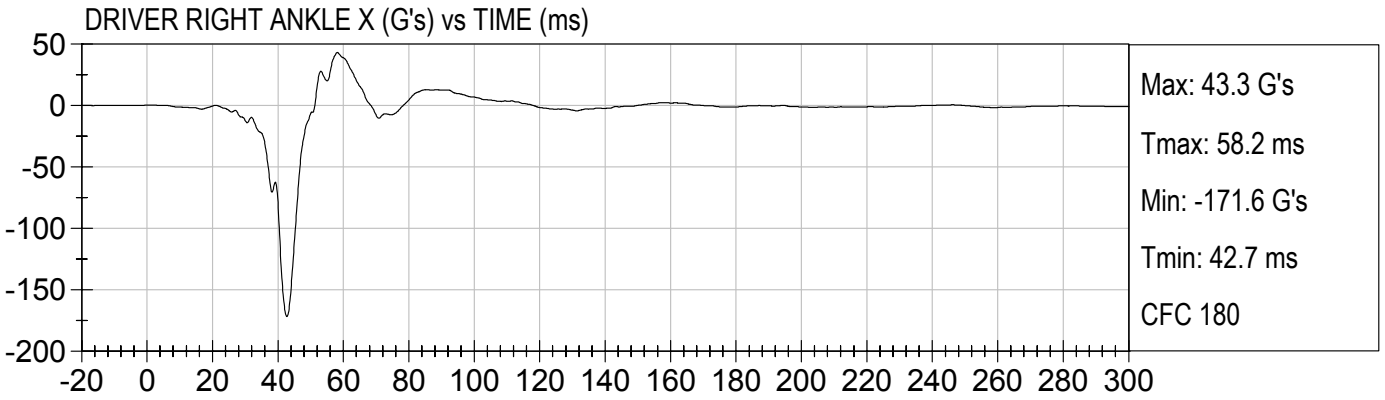


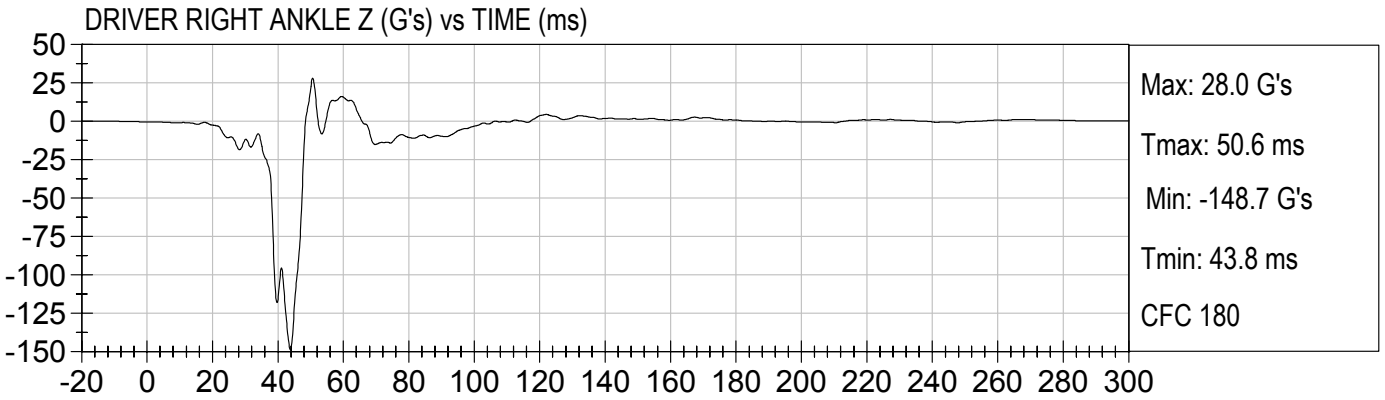

DRIVER LEFT FOOT Z - FRONT (G's) vs TIME (ms)
10
0
-10
-20
-30
-40
-50
-60
-70
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 5.6 G's
Tmax: 194.7 ms
Min: -61.4 G's
Tmin: 25.8 ms
CFC 180


DRIVER LEFT ANKLE X (G's) vs TIME (ms)
10
0
-10
-20
-30
-40
-50
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 9.3 G's
Tmax: 82.7 ms
Min: -41.3 G's
Tmin: 50.8 ms
CFC 180


DRIVER LEFT ANKLE Z (G's) vs TIME (ms)
10
0
-10
-20
-30
-40
-50
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 5.1 G's
Tmax: 177.7 ms
Min: -42.0 G's
Tmin: 43.4 ms
CFC 180


DRIVER RIGHT FOOT Z - FRONT (G's) vs TIME (ms)
150
100
50
0
-50
-100
-150
-200
-250
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 112.9 G's
Tmax: 50.3 ms
Min: -228.3 G's
Tmin: 39.5 ms
CFC 180

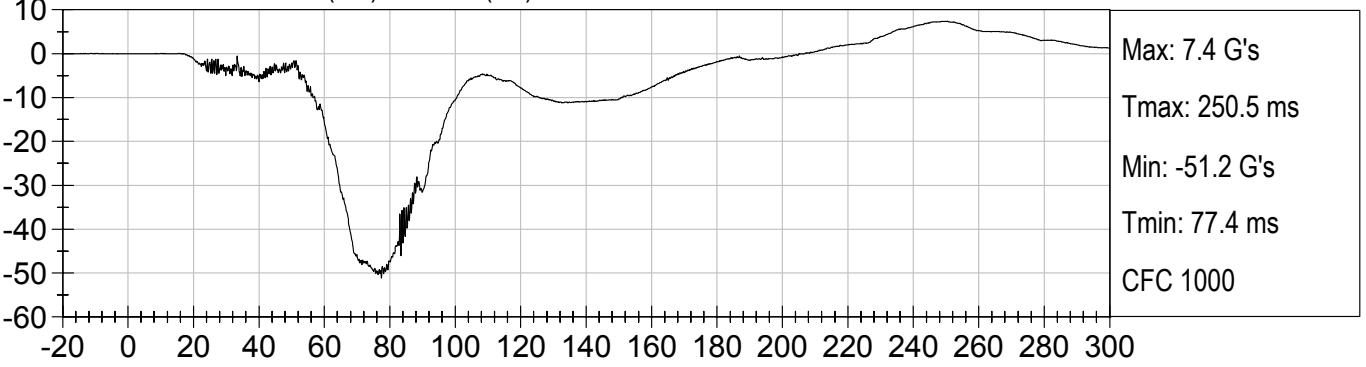

DRIVER RIGHT ANKLE X (G's) vs TIME (ms)
50
0
-50
-100
-150
-200
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 43.3 G's
Tmax: 58.2 ms
Min: -171.6 G's
Tmin: 42.7 ms
CFC 180


DRIVER RIGHT ANKLE Z (G's) vs TIME (ms)
50
25
0
-25
-50
-75
-100
-125
-150
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 28.0 G's
Tmax: 50.6 ms
Min: -148.7 G's
Tmin: 43.8 ms
CFC 180

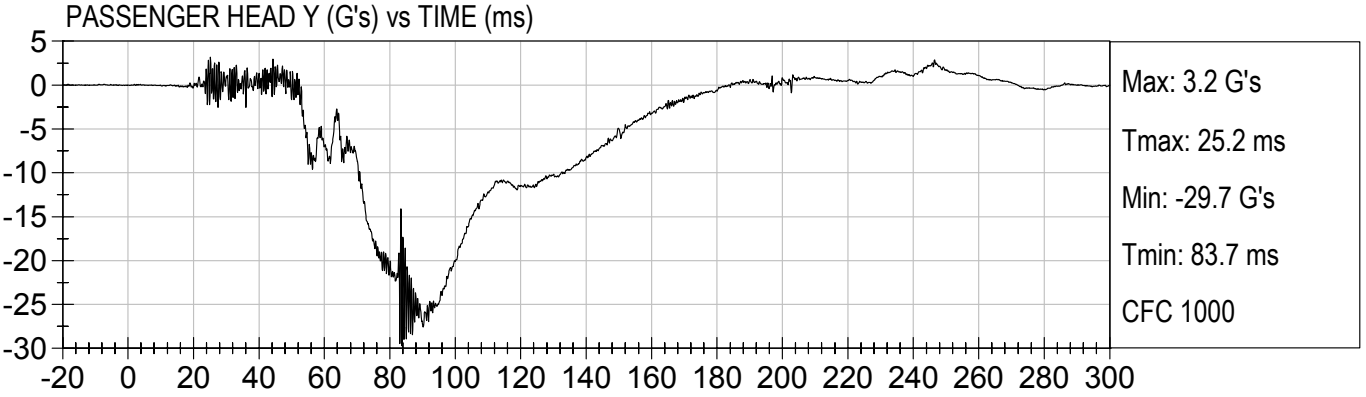
NCAP 35MPH FRONTAL IMPACT
2005 HYUNDAI SANTA FE (M50500)

Test Date: 02/17/05
Speed: 35.2 mph (56.6 km/h)

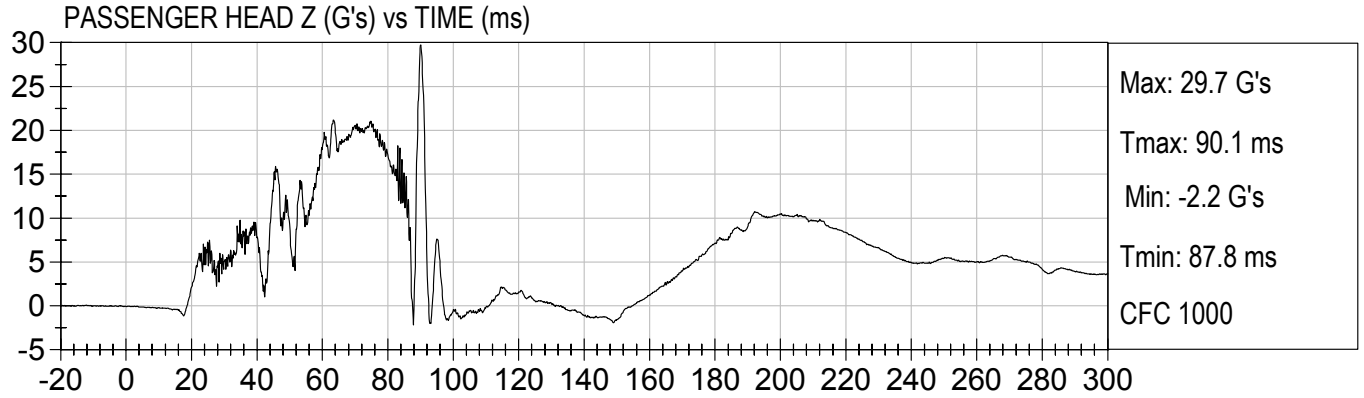
PASSENGER HEAD X (G's) vs TIME (ms)



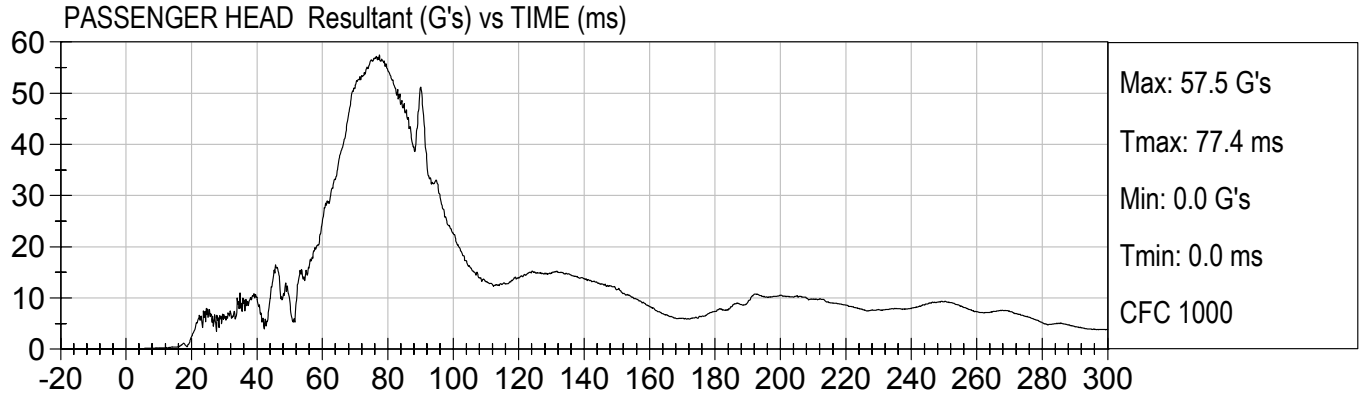
PASSENGER HEAD Y (G's) vs TIME (ms)

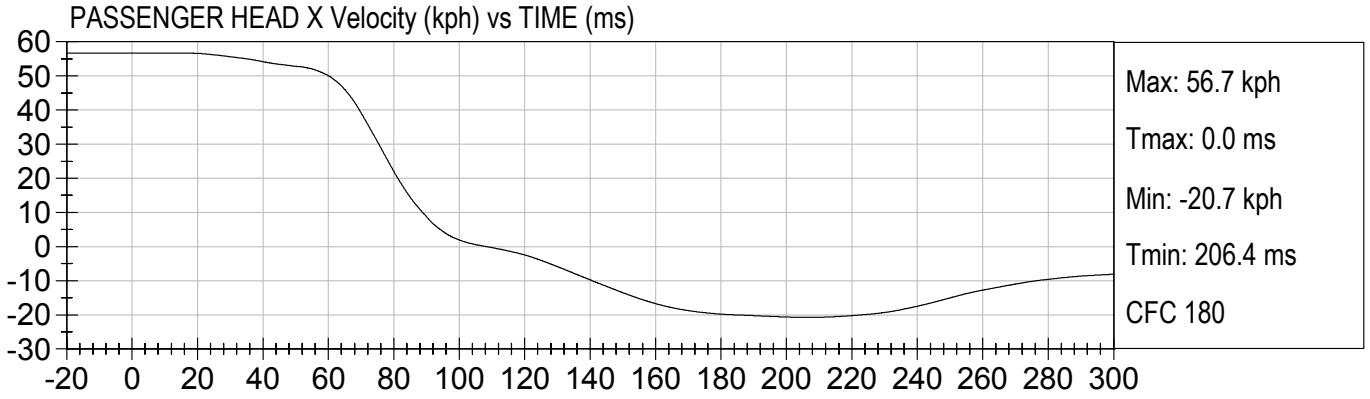


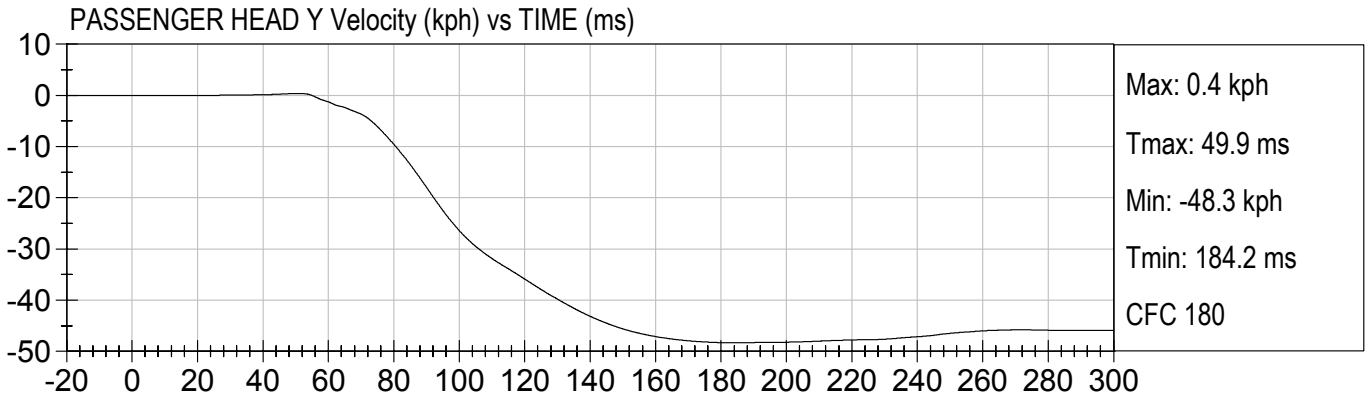
PASSENGER HEAD Z (G's) vs TIME (ms)

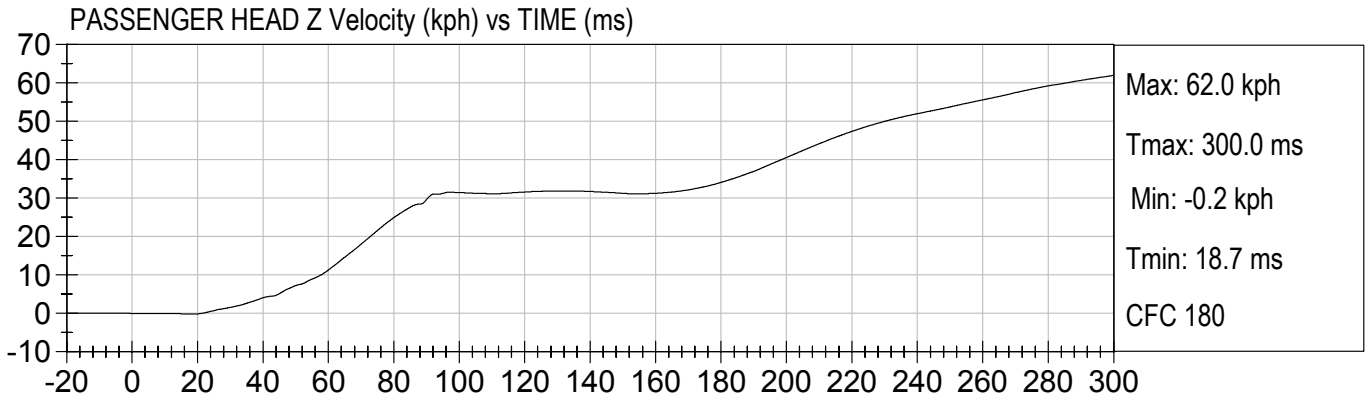


PASSENGER HEAD Resultant (G's) vs TIME (ms)




PASSENGER HEAD X Velocity (kph) vs TIME (ms)
60
50
40
30
20
10
0
-10
-20
-30
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 56.7 kph
Tmax: 0.0 ms
Min: -20.7 kph
Tmin: 206.4 ms
CFC 180

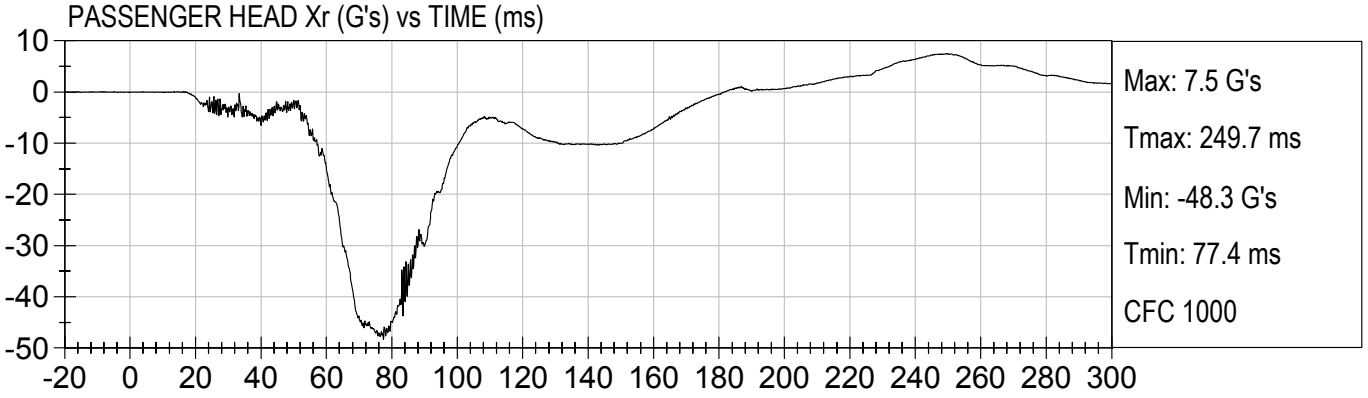

PASSENGER HEAD Y Velocity (kph) vs TIME (ms)
10
0
-10
-20
-30
-40
-50
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 0.4 kph
Tmax: 49.9 ms
Min: -48.3 kph
Tmin: 184.2 ms
CFC 180


PASSENGER HEAD Z Velocity (kph) vs TIME (ms)
70
60
50
40
30
20
10
0
-10
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 62.0 kph
Tmax: 300.0 ms
Min: -0.2 kph
Tmin: 18.7 ms
CFC 180

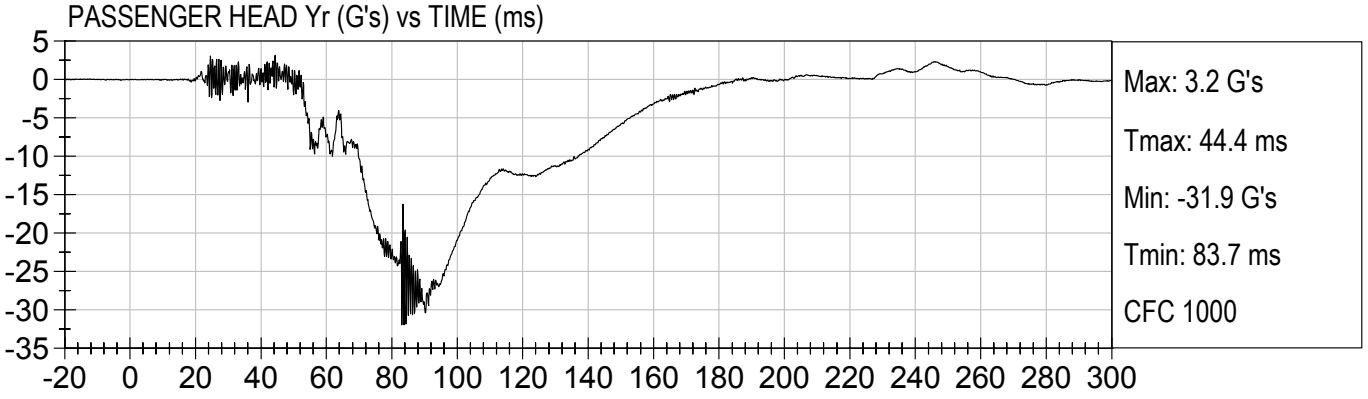
NCAP 35MPH FRONTAL IMPACT
2005 HYUNDAI SANTA FE (M50500)

Test Date: 02/17/05
Speed: 35.2 mph (56.6 km/h)

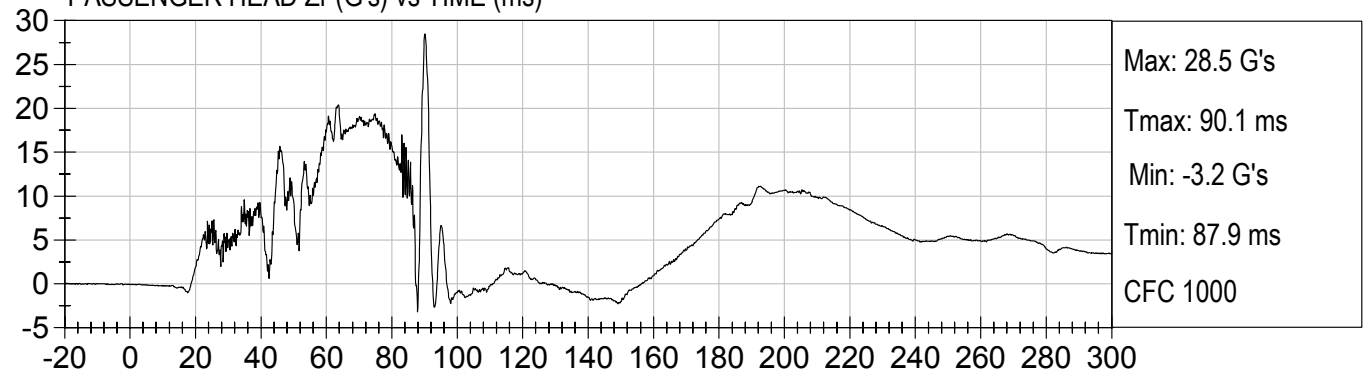
PASSENGER HEAD Xr (G's) vs TIME (ms)



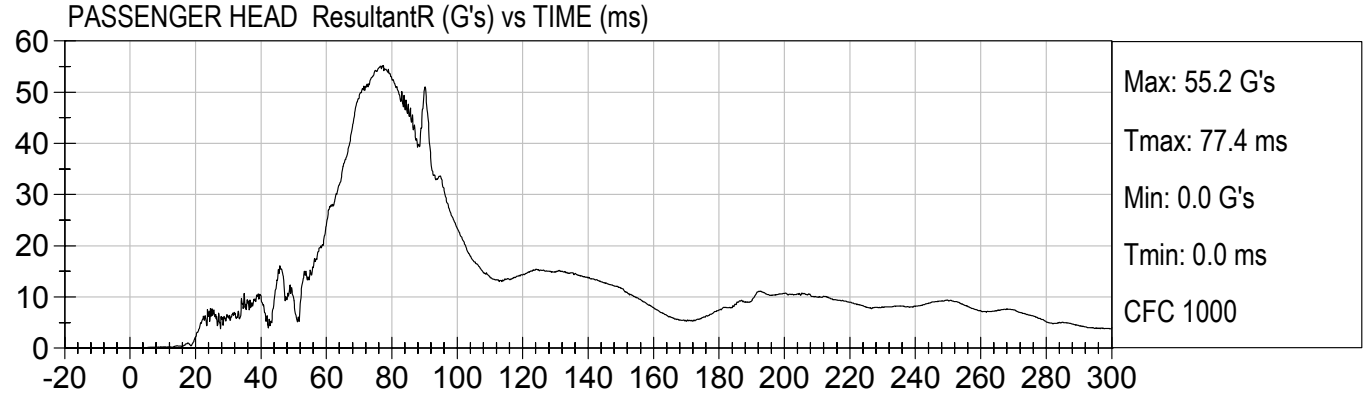
PASSENGER HEAD Yr (G's) vs TIME (ms)

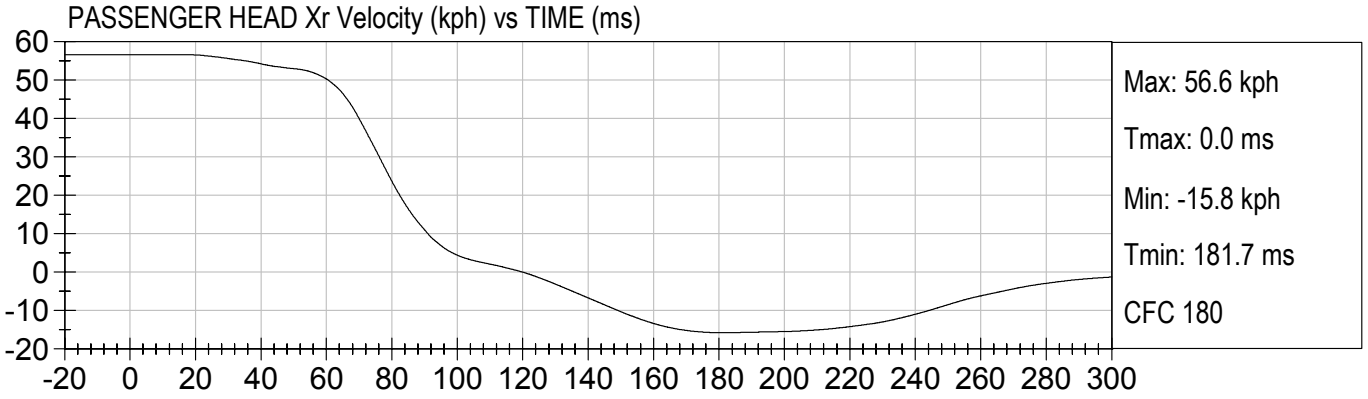


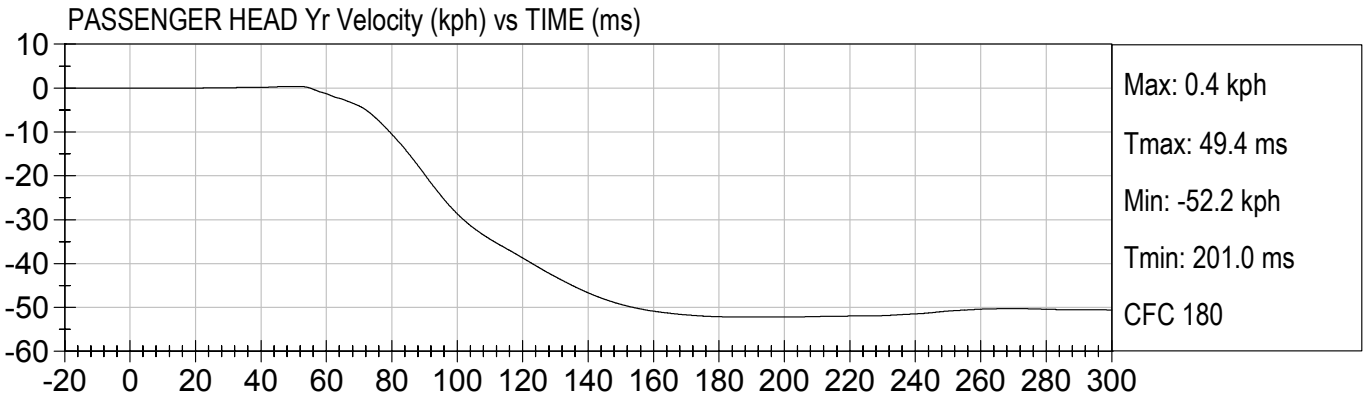
PASSENGER HEAD Zr (G's) vs TIME (ms)

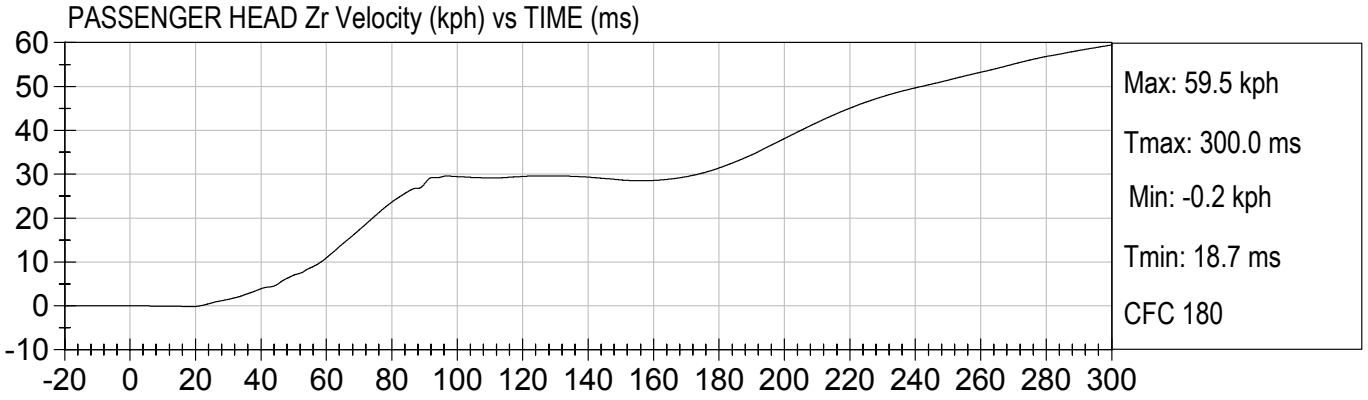


PASSENGER HEAD ResultantR (G's) vs TIME (ms)




PASSENGER HEAD Xr Velocity (kph) vs TIME (ms)
60
50
40
30
20
10
0
-10
-20
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 56.6 kph
Tmax: 0.0 ms
Min: -15.8 kph
Tmin: 181.7 ms
CFC 180

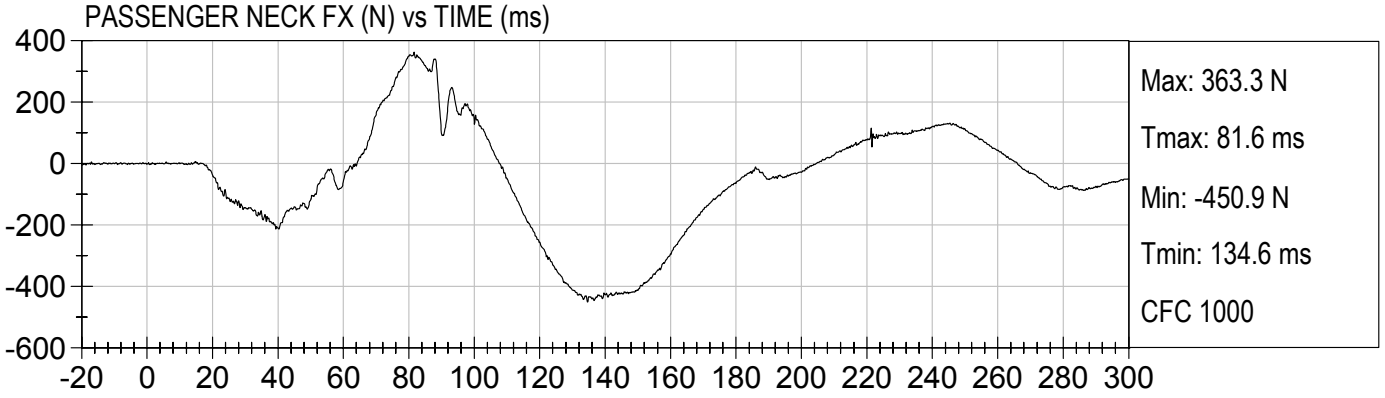

PASSENGER HEAD Yr Velocity (kph) vs TIME (ms)
10
0
-10
-20
-30
-40
-50
-60
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 0.4 kph
Tmax: 49.4 ms
Min: -52.2 kph
Tmin: 201.0 ms
CFC 180


PASSENGER HEAD Zr Velocity (kph) vs TIME (ms)
60
50
40
30
20
10
0
-10
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 59.5 kph
Tmax: 300.0 ms
Min: -0.2 kph
Tmin: 18.7 ms
CFC 180

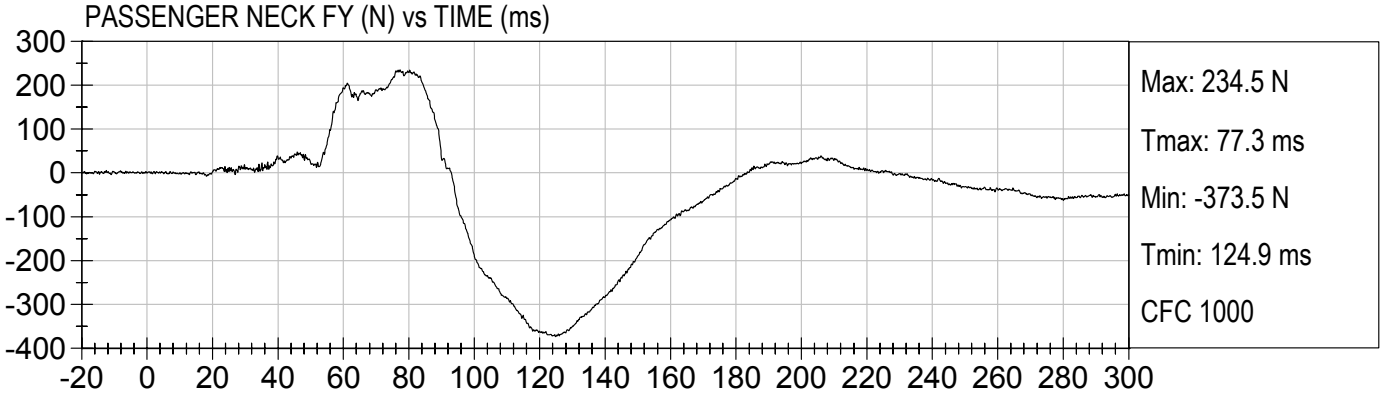
NCAP 35MPH FRONTAL IMPACT
2005 HYUNDAI SANTA FE (M50500)

Test Date: 02/17/05
Speed: 35.2 mph (56.6 km/h)

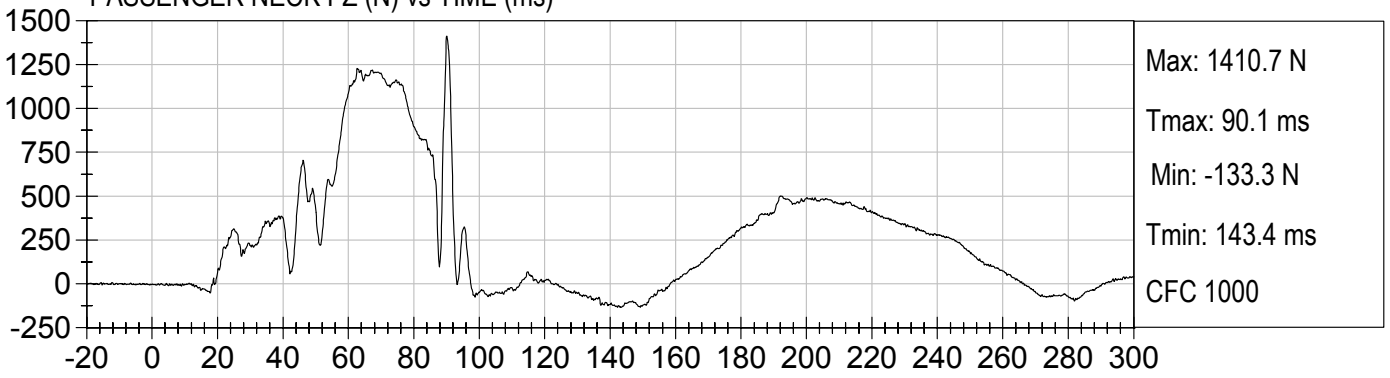
PASSENGER NECK FX (N) vs TIME (ms)



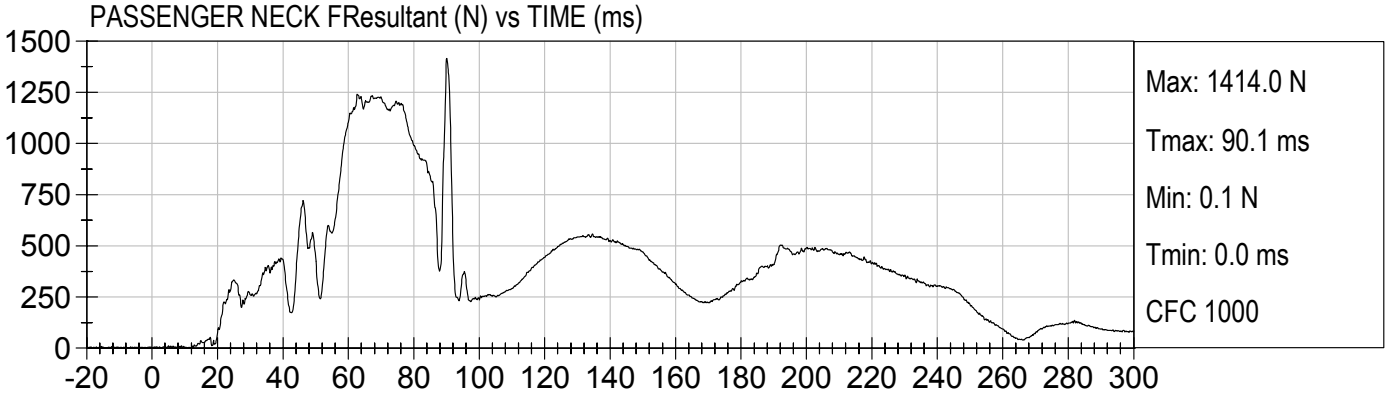
PASSENGER NECK FY (N) vs TIME (ms)



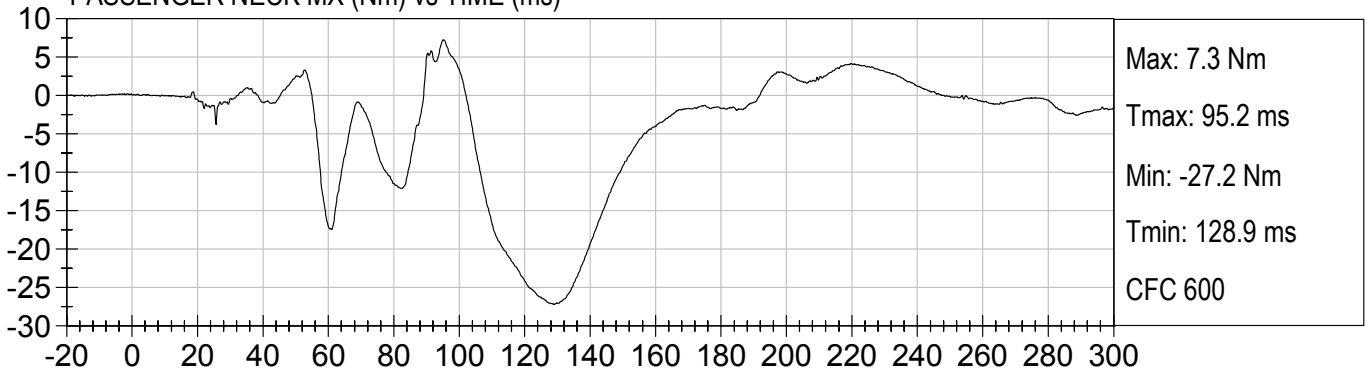
PASSENGER NECK FZ (N) vs TIME (ms)



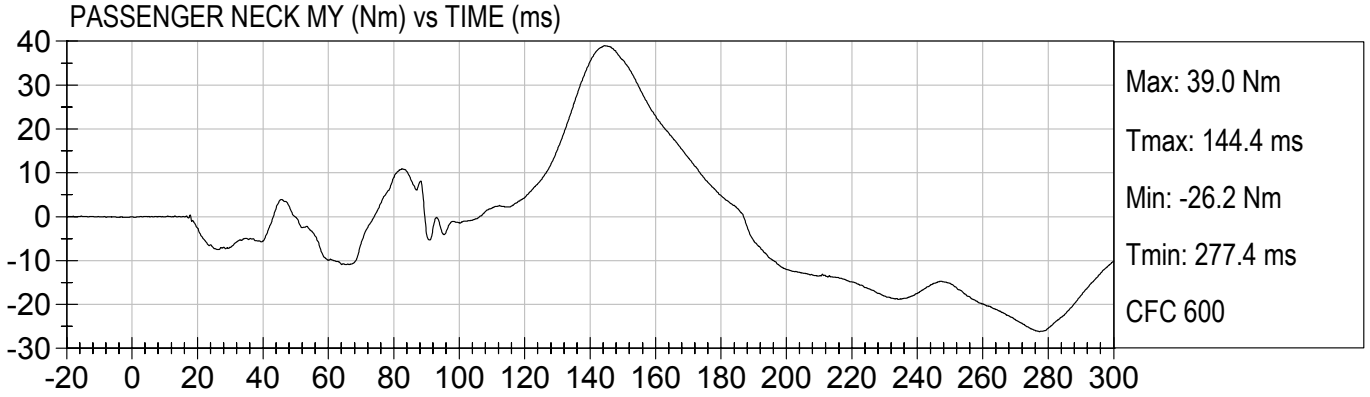
PASSENGER NECK FResultant (N) vs TIME (ms)



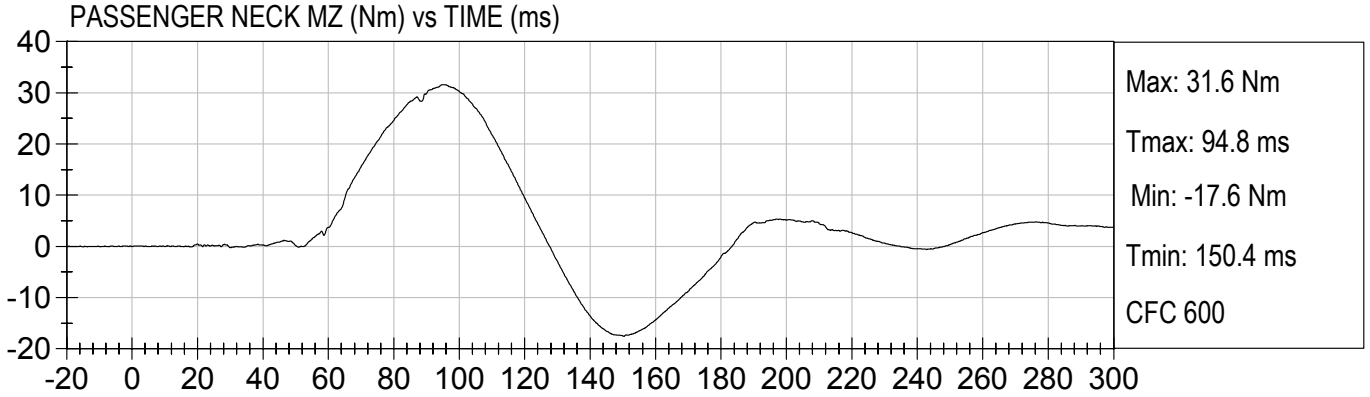
PASSENGER NECK MX (Nm) vs TIME (ms)



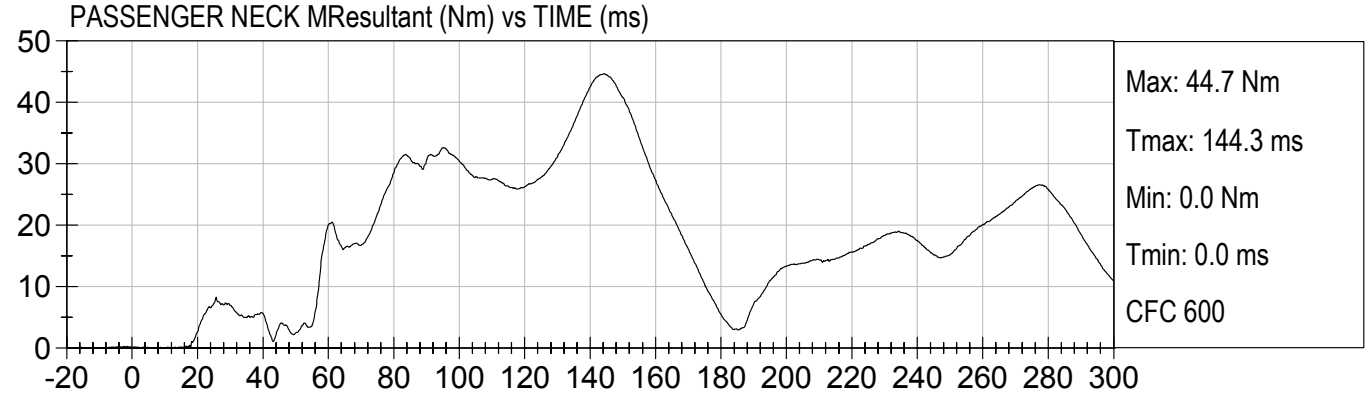
PASSENGER NECK MY (Nm) vs TIME (ms)

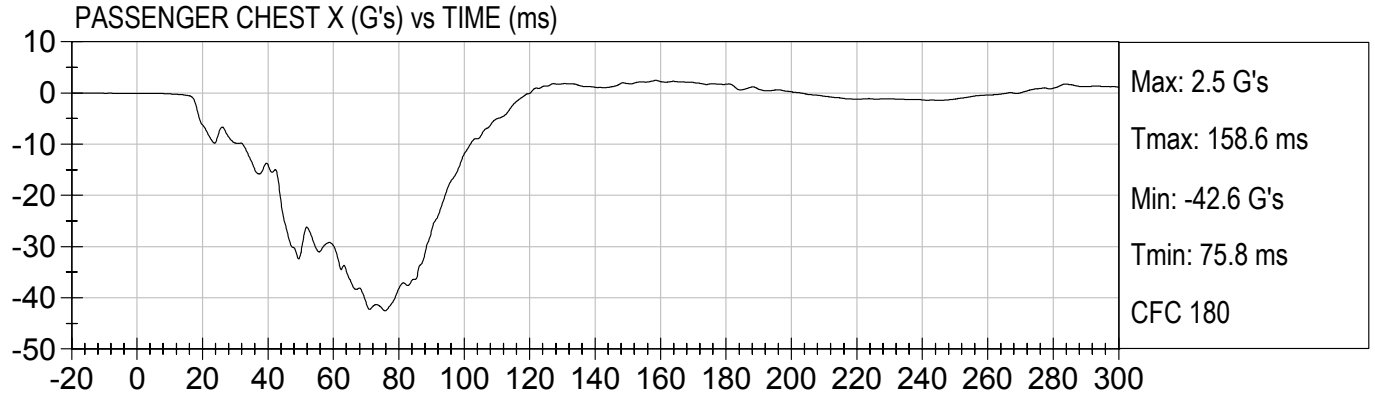


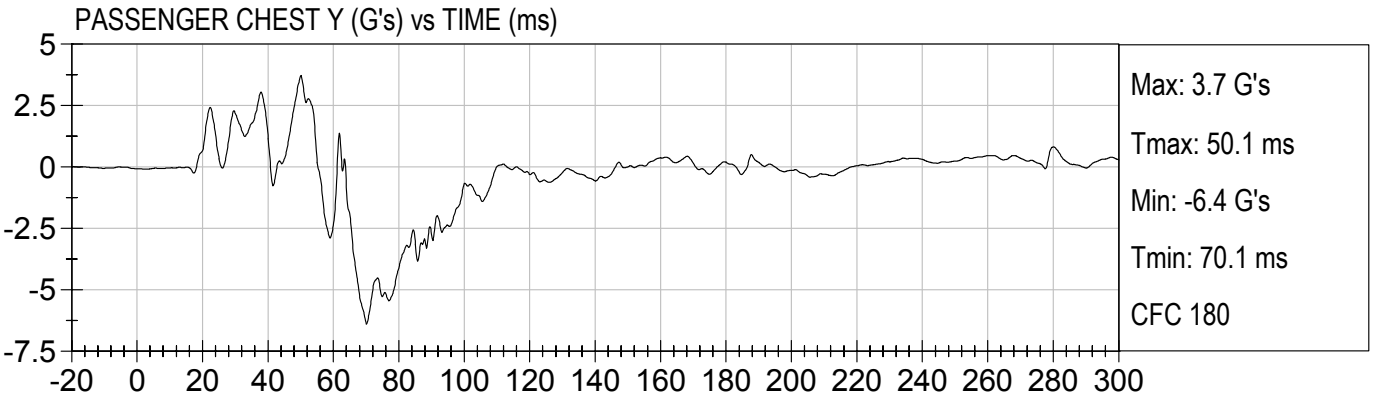
PASSENGER NECK MZ (Nm) vs TIME (ms)

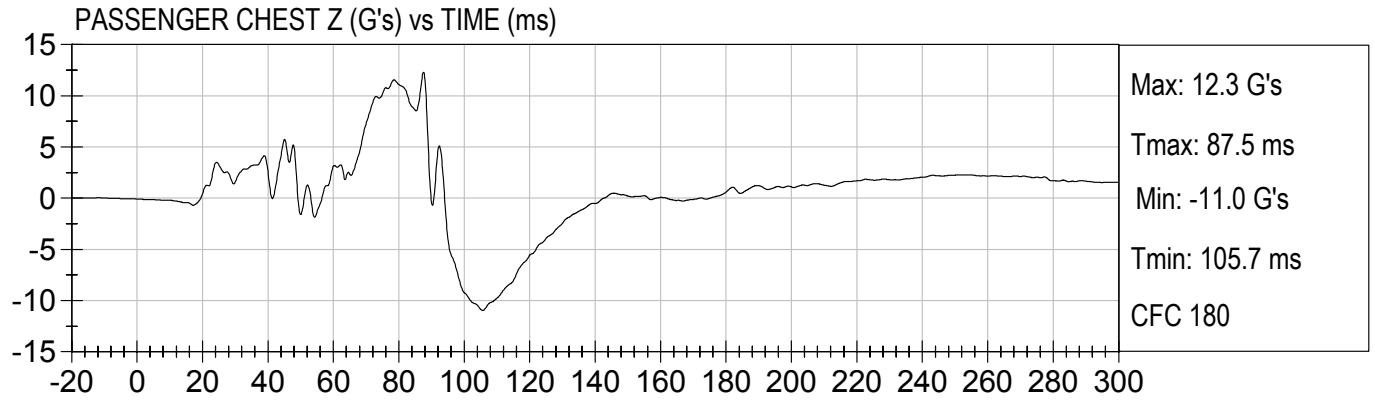


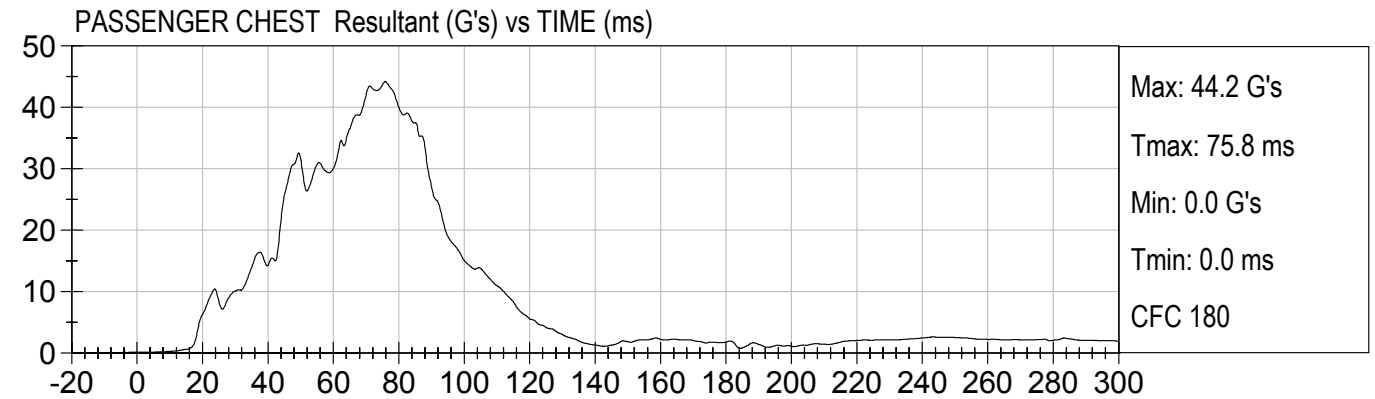
PASSENGER NECK MResultant (Nm) vs TIME (ms)




PASSENGER CHEST X (G's) vs TIME (ms)
10
0
-10
-20
-30
-40
-50
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 2.5 G's
Tmax: 158.6 ms
Min: -42.6 G's
Tmin: 75.8 ms
CFC 180


PASSENGER CHEST Y (G's) vs TIME (ms)
5
2.5
0
-2.5
-5
-7.5
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 3.7 G's
Tmax: 50.1 ms
Min: -6.4 G's
Tmin: 70.1 ms
CFC 180

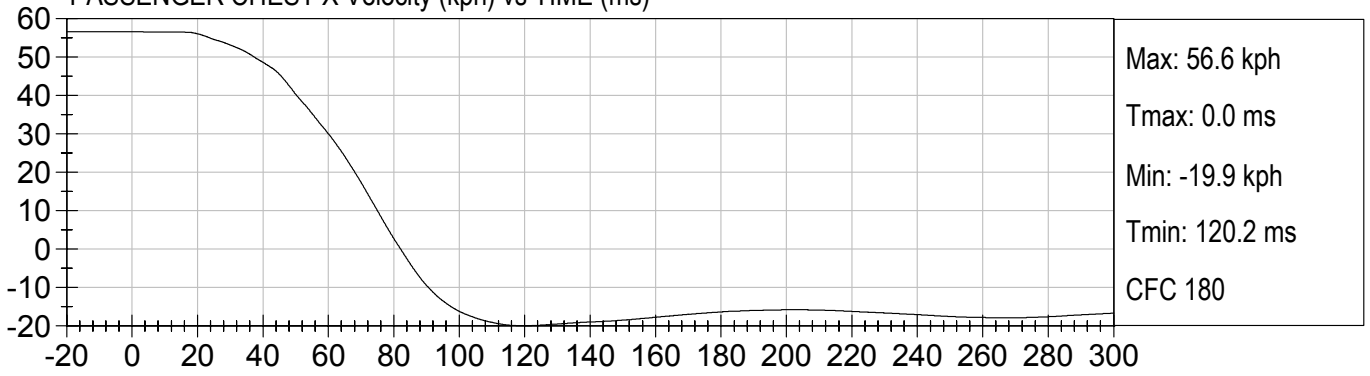

PASSENGER CHEST Z (G's) vs TIME (ms)
15
10
5
0
-5
-10
-15
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 12.3 G's
Tmax: 87.5 ms
Min: -11.0 G's
Tmin: 105.7 ms
CFC 180


PASSENGER CHEST Resultant (G's) vs TIME (ms)
50
40
30
20
10
0
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 44.2 G's
Tmax: 75.8 ms
Min: 0.0 G's
Tmin: 0.0 ms
CFC 180

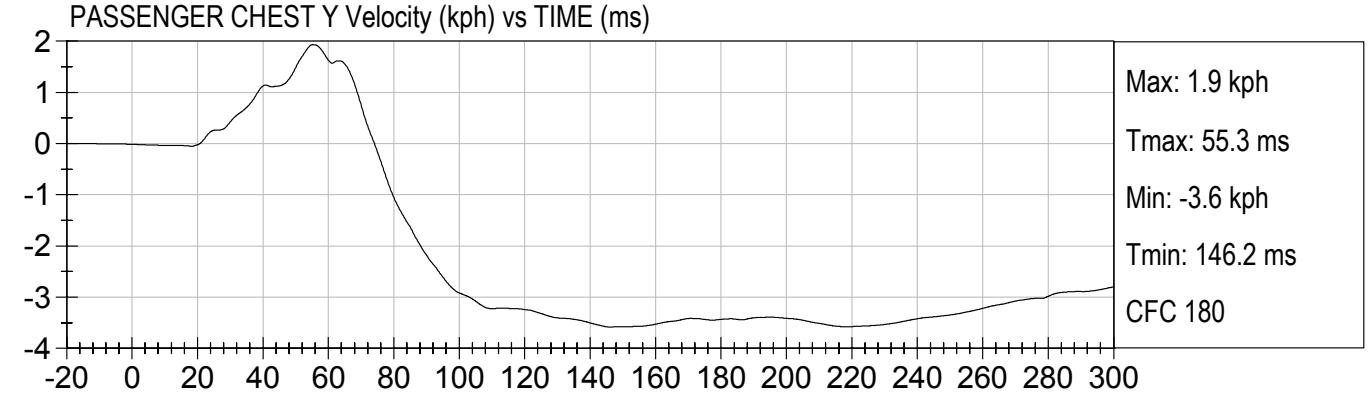
NCAP 35MPH FRONTAL IMPACT
2005 HYUNDAI SANTA FE (M50500)

Test Date: 02/17/05
Speed: 35.2 mph (56.6 km/h)

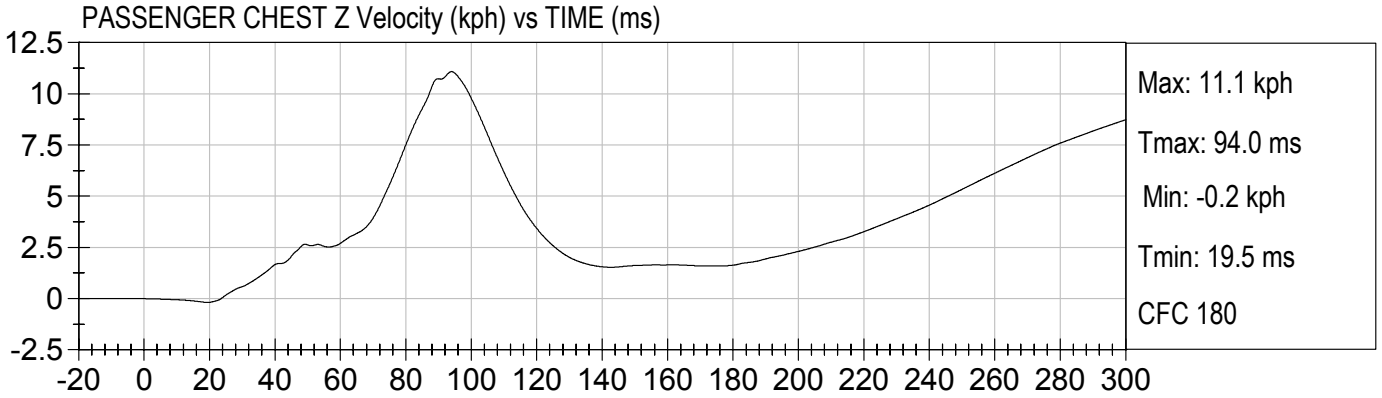
PASSENGER CHEST X Velocity (kph) vs TIME (ms)



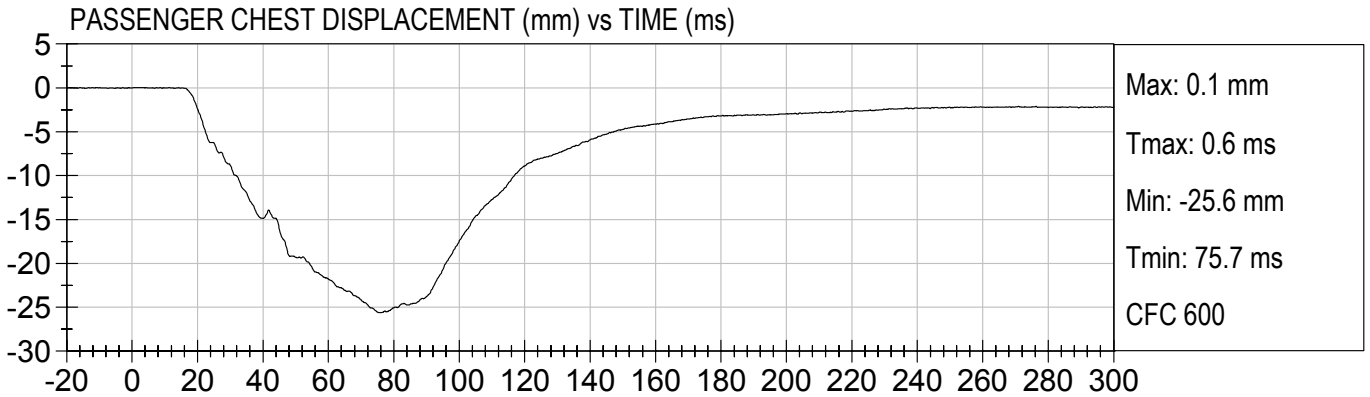
PASSENGER CHEST Y Velocity (kph) vs TIME (ms)



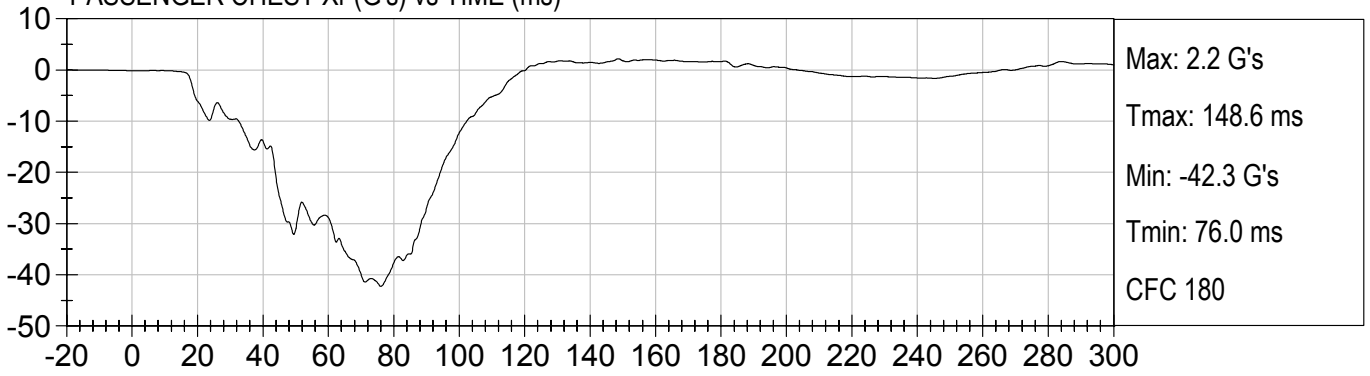
PASSENGER CHEST Z Velocity (kph) vs TIME (ms)



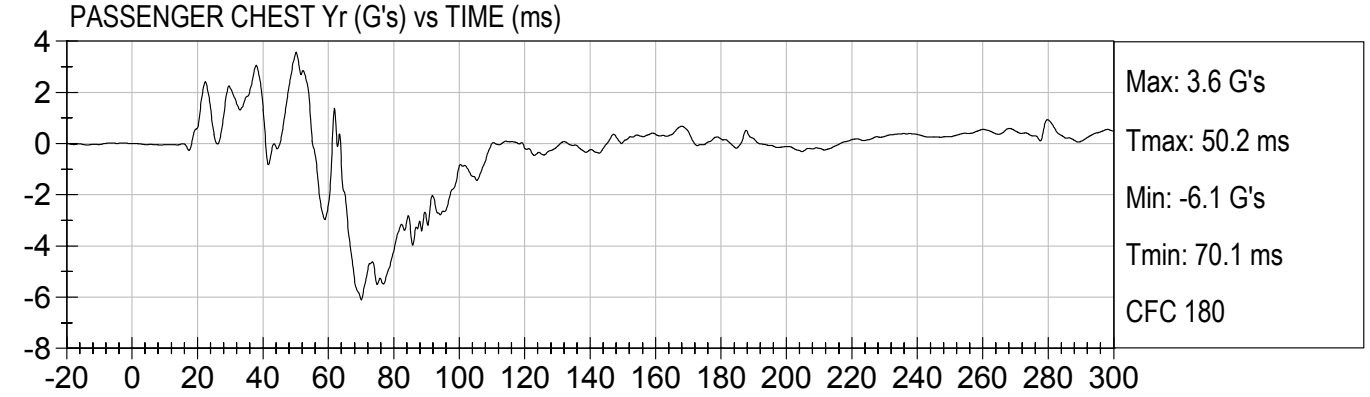
PASSENGER CHEST DISPLACEMENT (mm) vs TIME (ms)



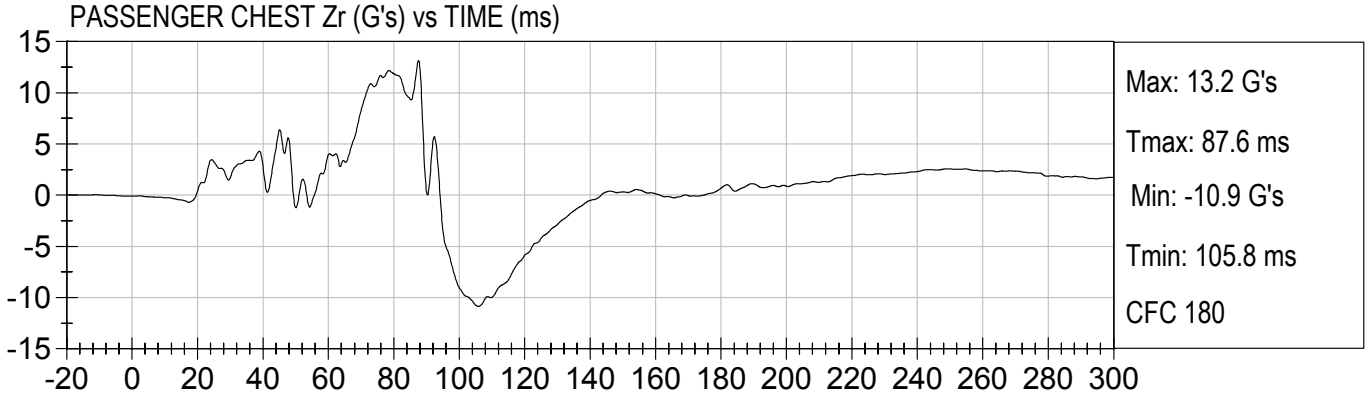
PASSENGER CHEST Xr (G's) vs TIME (ms)



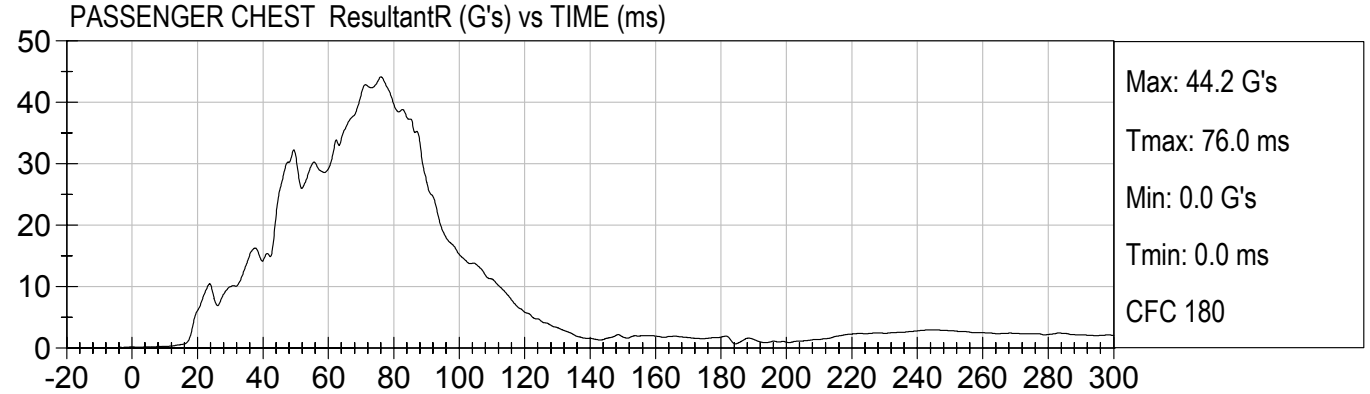
PASSENGER CHEST Yr (G's) vs TIME (ms)

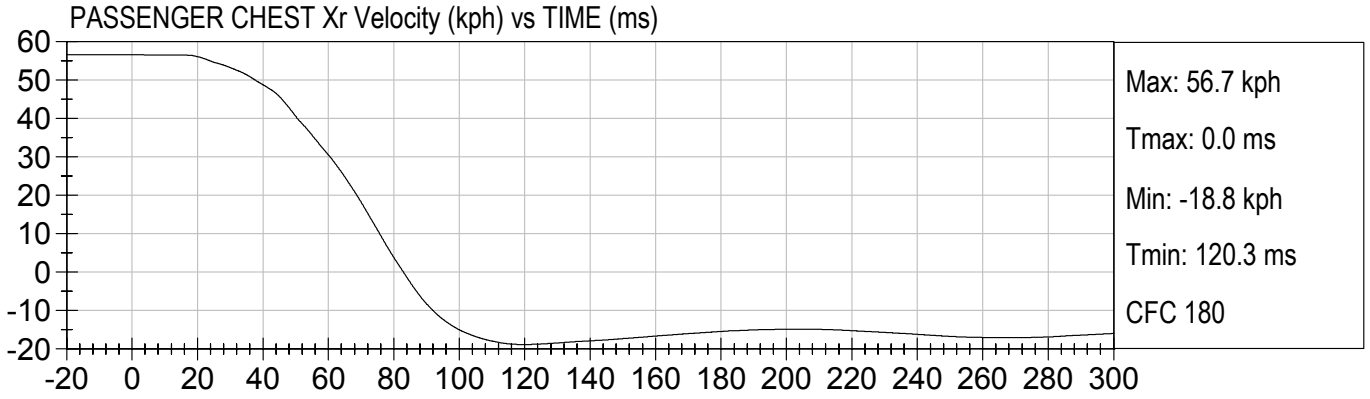


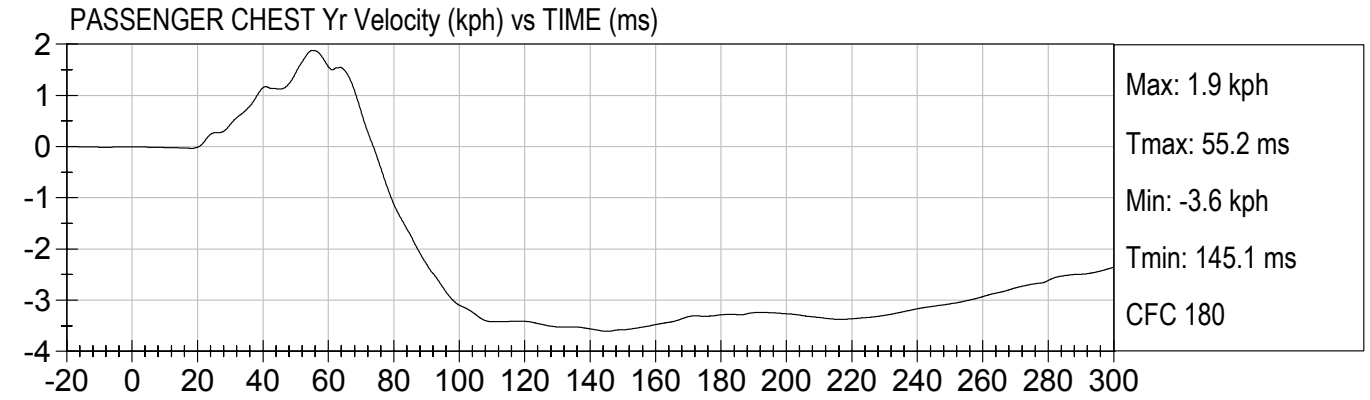
PASSENGER CHEST Zr (G's) vs TIME (ms)

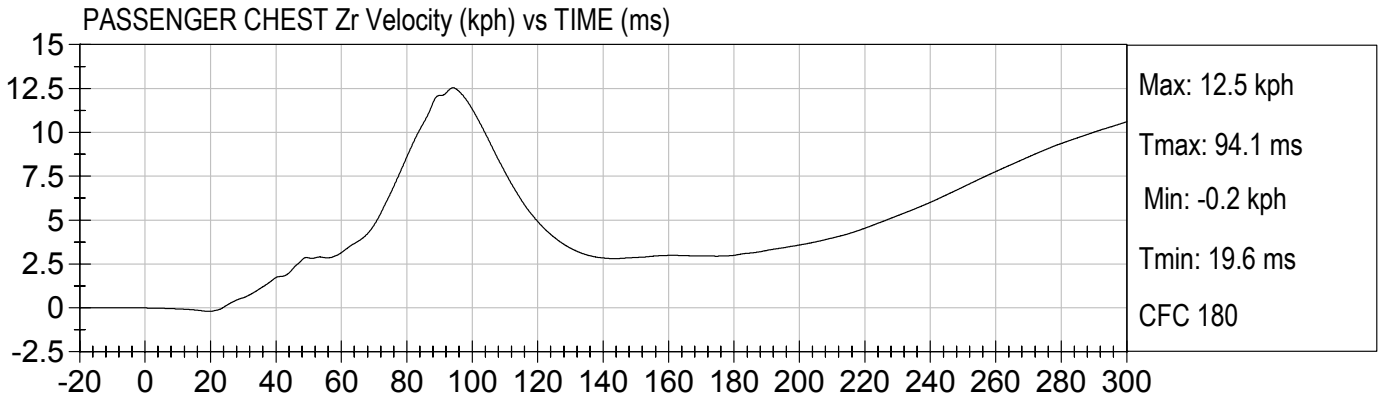


PASSENGER CHEST ResultantR (G's) vs TIME (ms)




PASSENGER CHEST Xr Velocity (kph) vs TIME (ms)
60
50
40
30
20
10
0
-10
-20
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 56.7 kph
Tmax: 0.0 ms
Min: -18.8 kph
Tmin: 120.3 ms
CFC 180

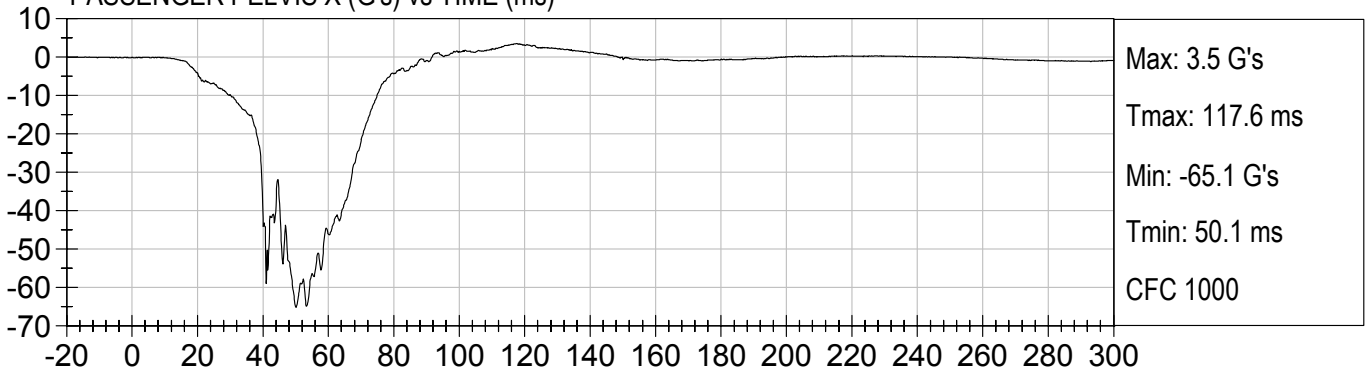

PASSENGER CHEST Yr Velocity (kph) vs TIME (ms)
2
1
0
-1
-2
-3
-4
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 1.9 kph
Tmax: 55.2 ms
Min: -3.6 kph
Tmin: 145.1 ms
CFC 180


PASSENGER CHEST Zr Velocity (kph) vs TIME (ms)
15
12.5
10
7.5
5
2.5
0
-2.5
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 12.5 kph
Tmax: 94.1 ms
Min: -0.2 kph
Tmin: 19.6 ms
CFC 180

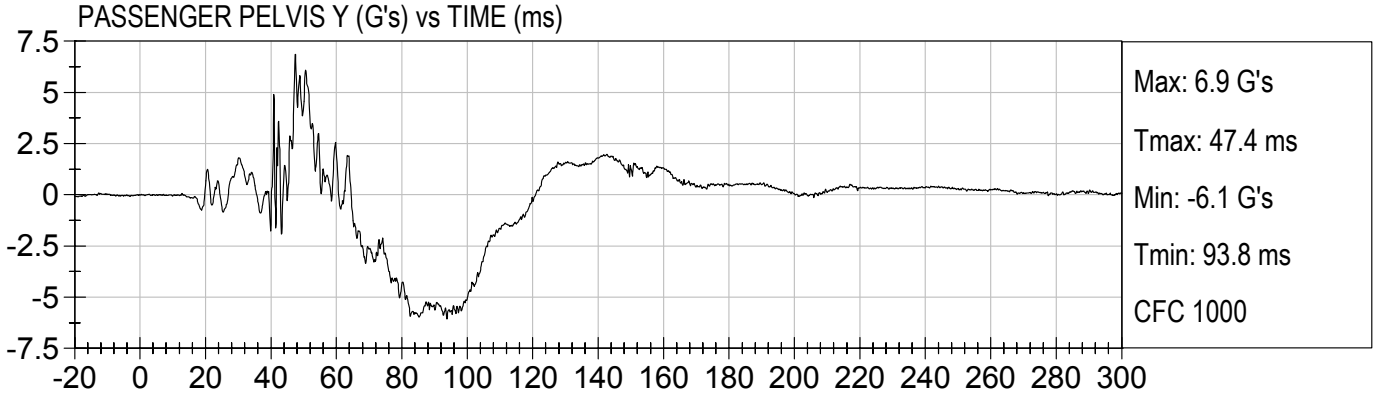
NCAP 35MPH FRONTAL IMPACT
2005 HYUNDAI SANTA FE (M50500)

Test Date: 02/17/05
Speed: 35.2 mph (56.6 km/h)

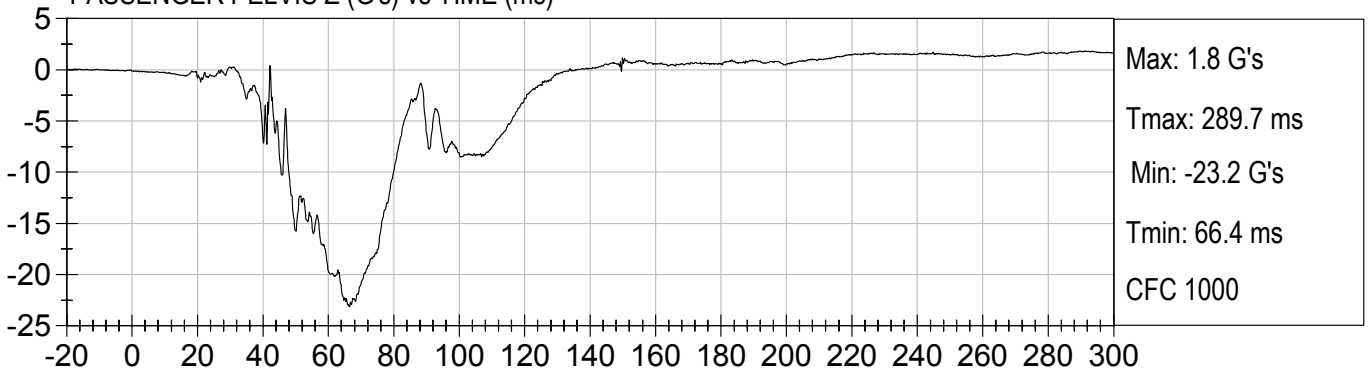
PASSENGER PELVIS X (G's) vs TIME (ms)



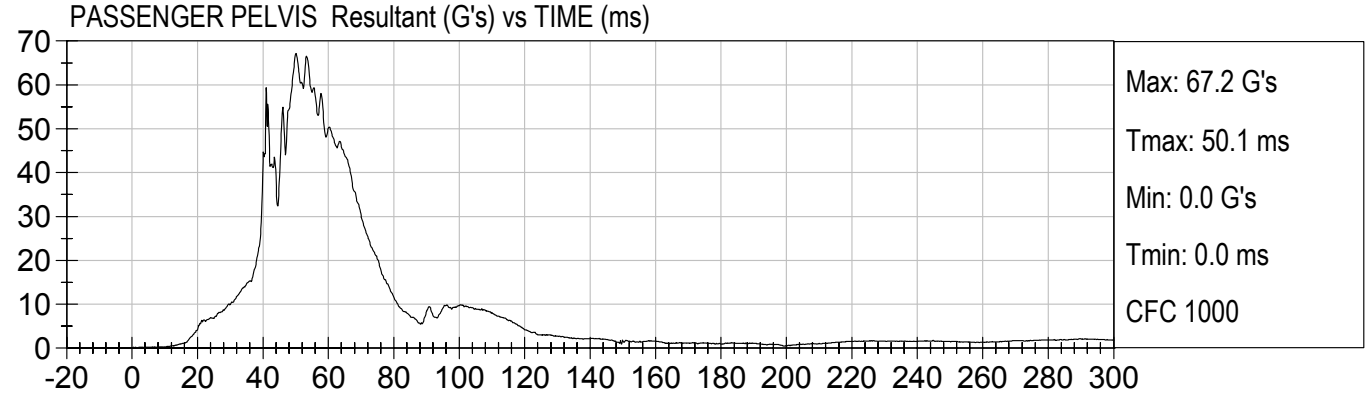
PASSENGER PELVIS Y (G's) vs TIME (ms)

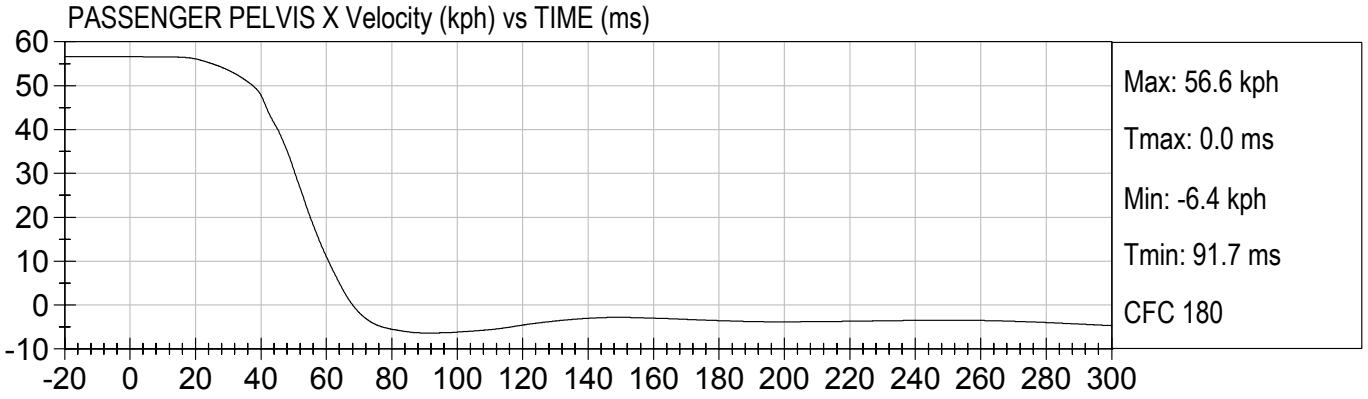


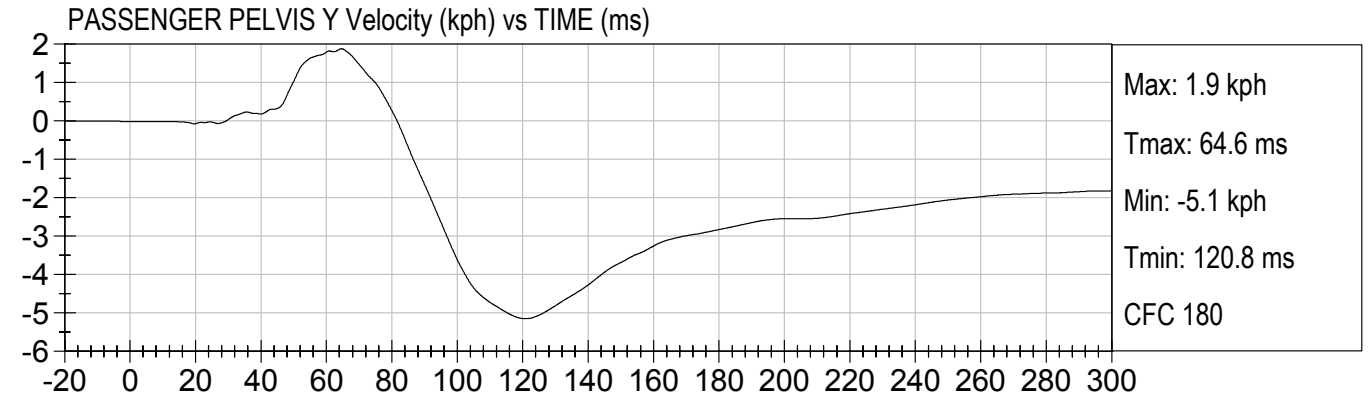
PASSENGER PELVIS Z (G's) vs TIME (ms)

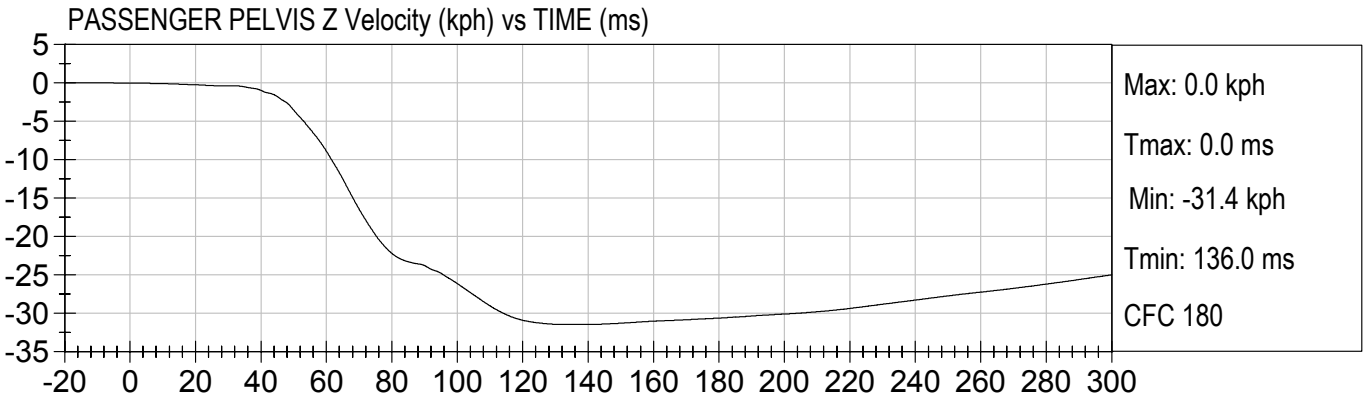


PASSENGER PELVIS Resultant (G's) vs TIME (ms)




PASSENGER PELVIS X Velocity (kph) vs TIME (ms)
60
50
40
30
20
10
0
-10
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 56.6 kph
Tmax: 0.0 ms
Min: -6.4 kph
Tmin: 91.7 ms
CFC 180

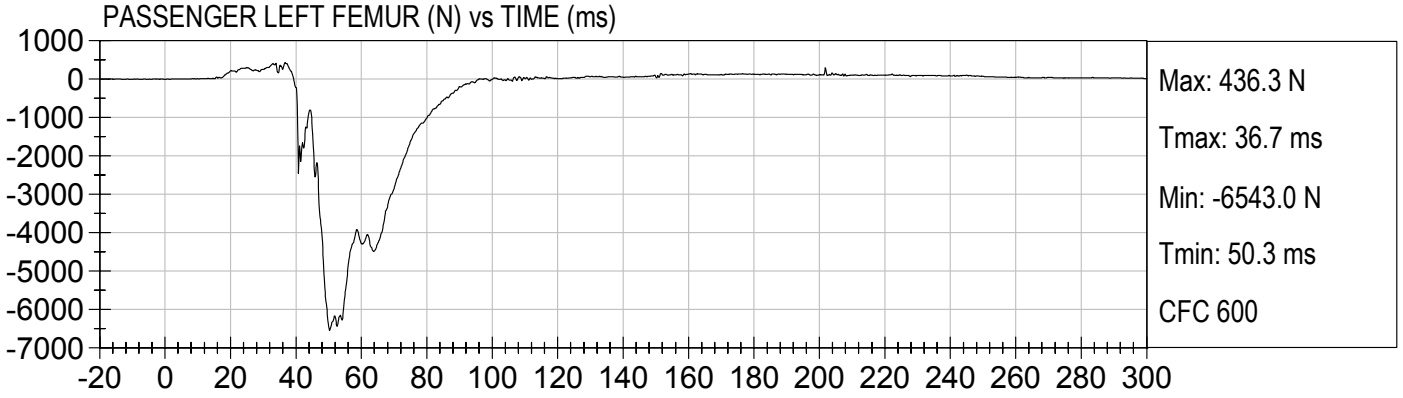

PASSENGER PELVIS Y Velocity (kph) vs TIME (ms)
2
1
0
-1
-2
-3
-4
-5
-6
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 1.9 kph
Tmax: 64.6 ms
Min: -5.1 kph
Tmin: 120.8 ms
CFC 180


PASSENGER PELVIS Z Velocity (kph) vs TIME (ms)
5
0
-5
-10
-15
-20
-25
-30
-35
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 0.0 kph
Tmax: 0.0 ms
Min: -31.4 kph
Tmin: 136.0 ms
CFC 180

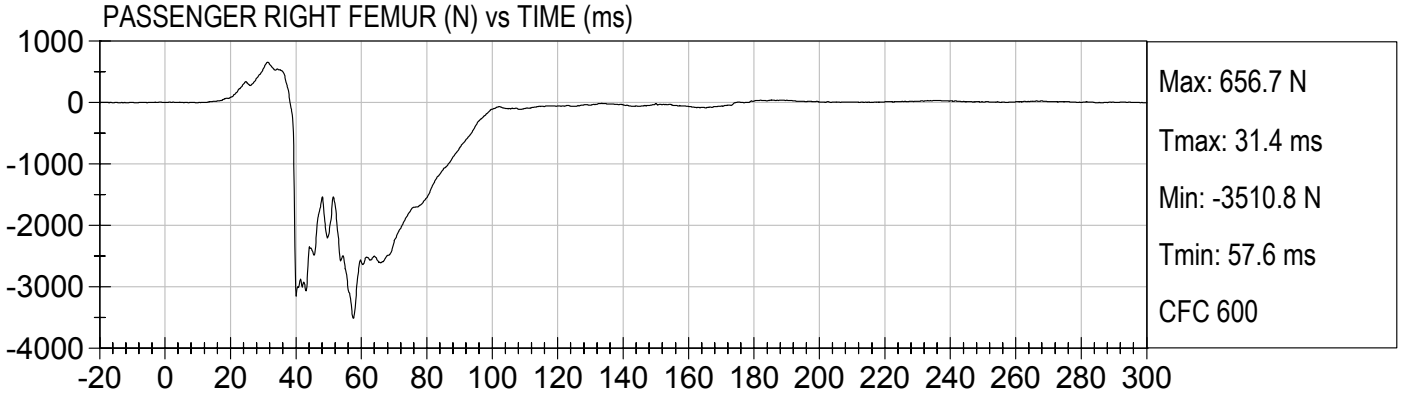
NCAP 35MPH FRONTAL IMPACT
2005 HYUNDAI SANTA FE (M50500)

Test Date: 02/17/05
Speed: 35.2 mph (56.6 km/h)

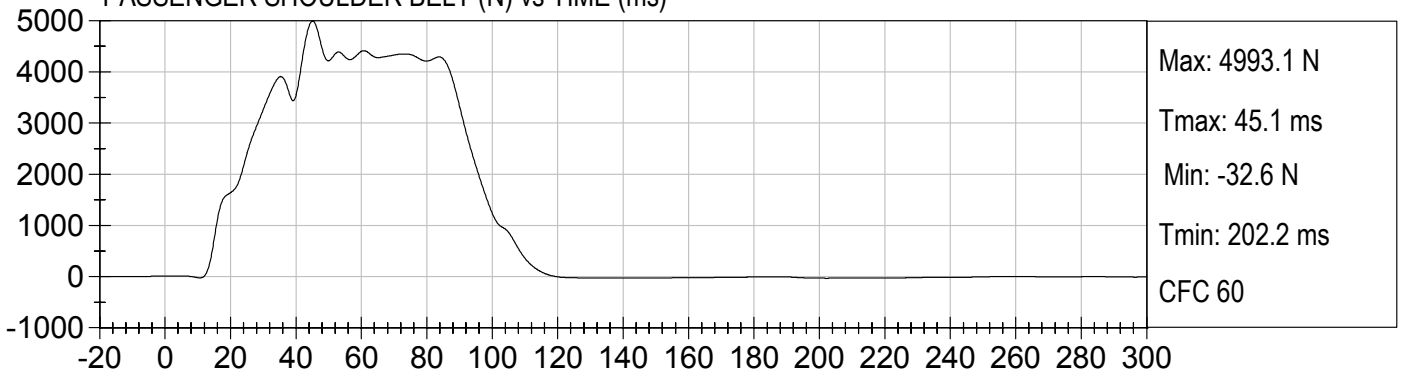
PASSENGER LEFT FEMUR (N) vs TIME (ms)



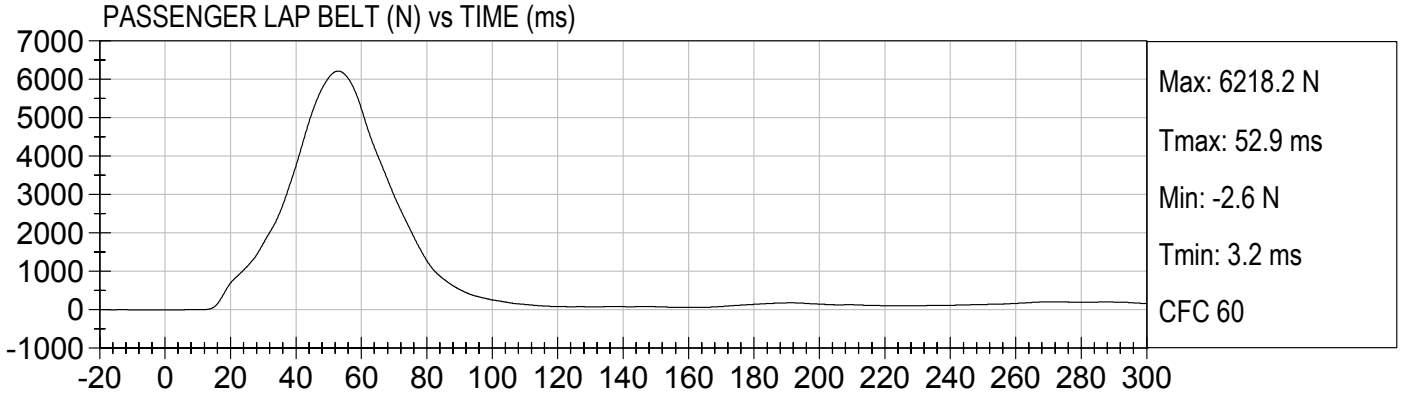
PASSENGER RIGHT FEMUR (N) vs TIME (ms)



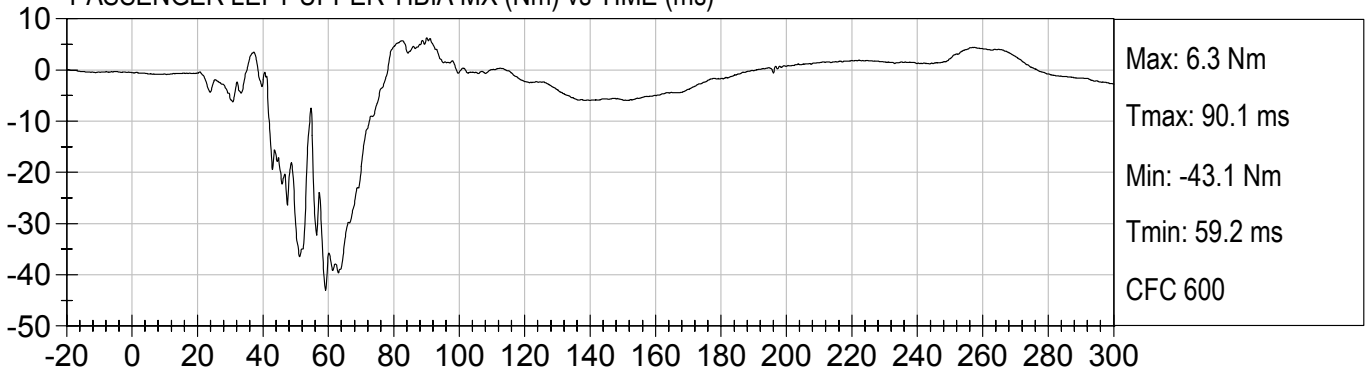
PASSENGER SHOULDER BELT (N) vs TIME (ms)



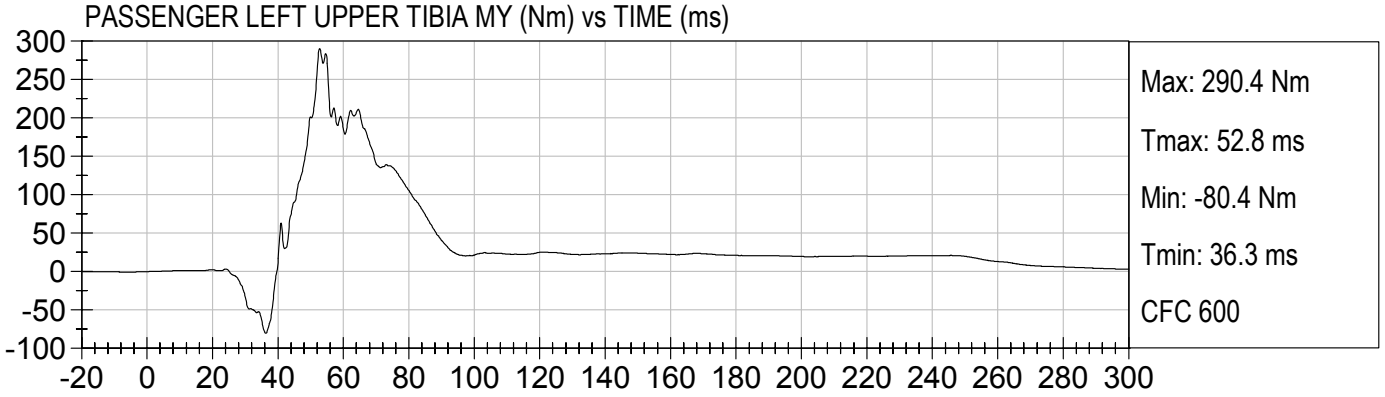
PASSENGER LAP BELT (N) vs TIME (ms)



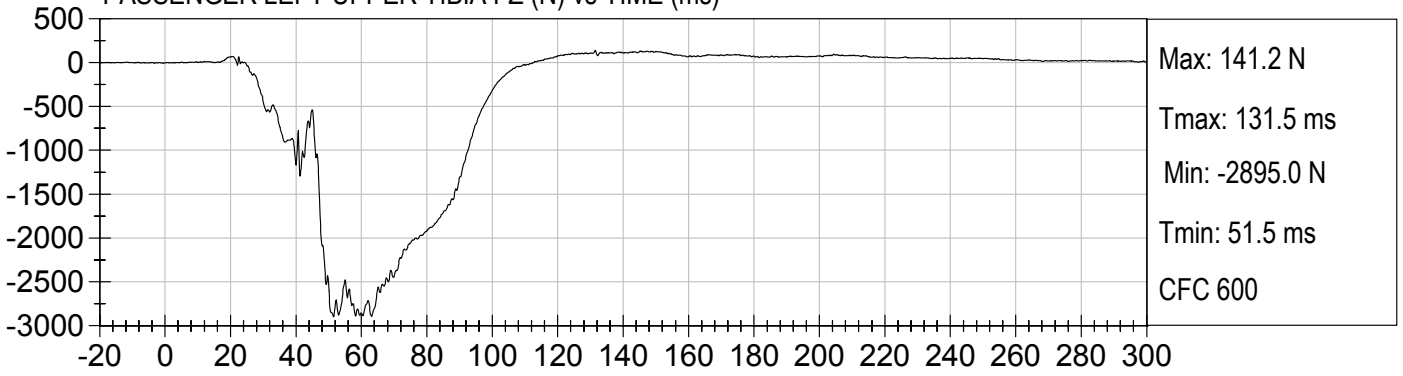
PASSENGER LEFT UPPER TIBIA MX (Nm) vs TIME (ms)

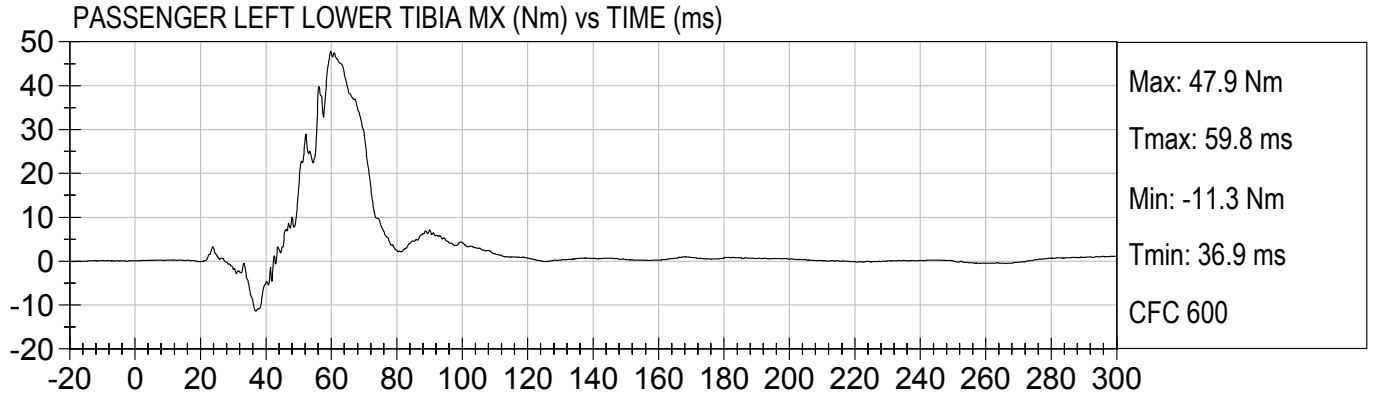


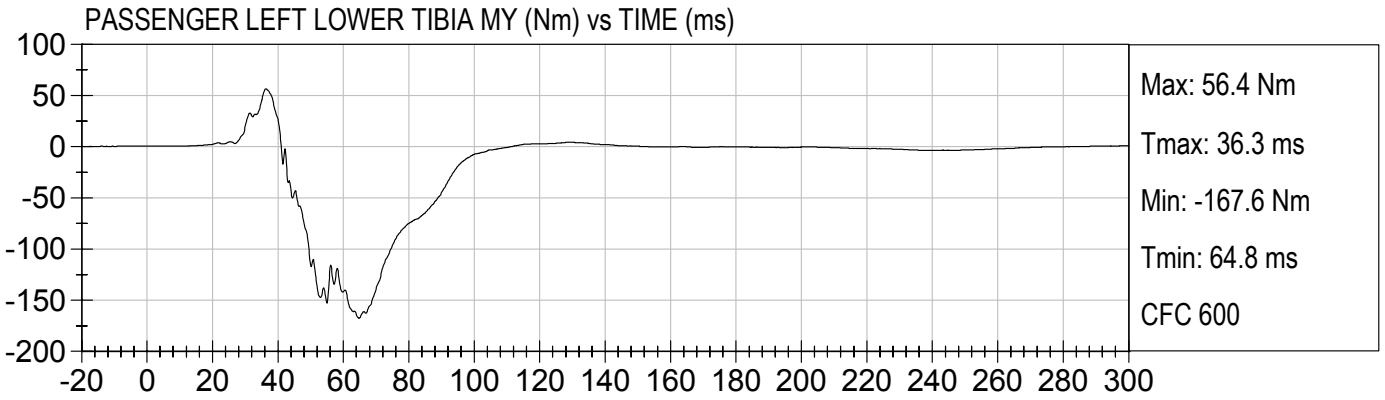
PASSENGER LEFT UPPER TIBIA MY (Nm) vs TIME (ms)

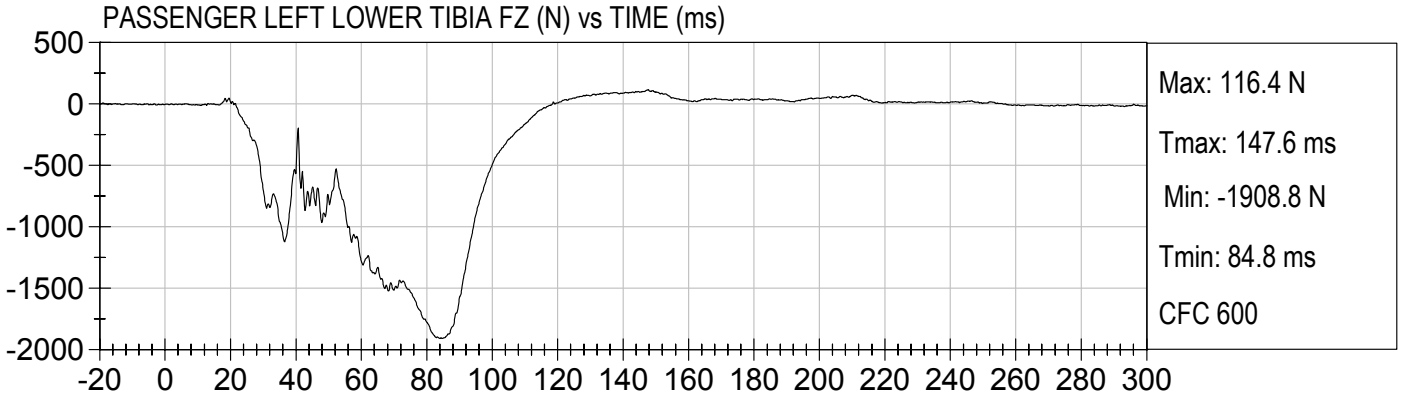


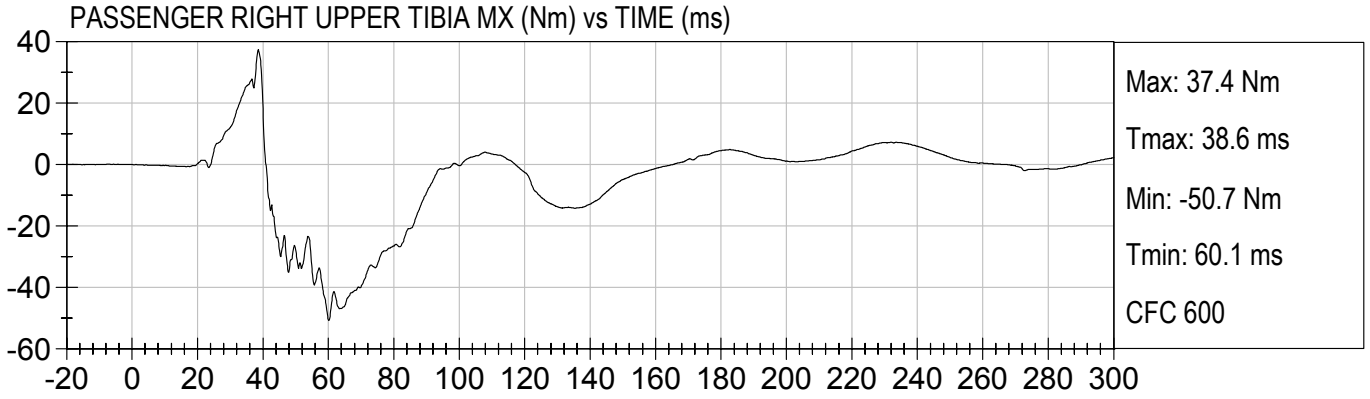
PASSENGER LEFT UPPER TIBIA FZ (N) vs TIME (ms)

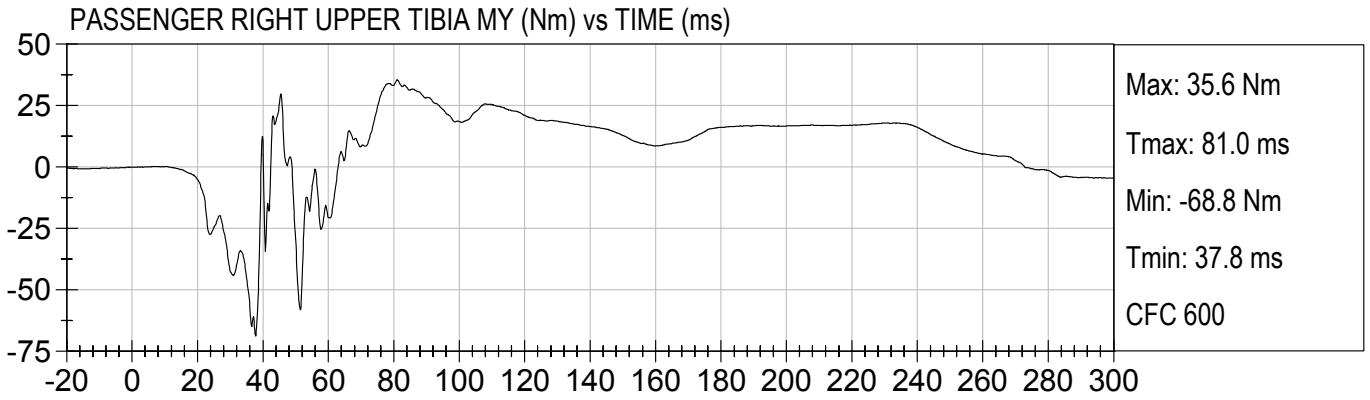


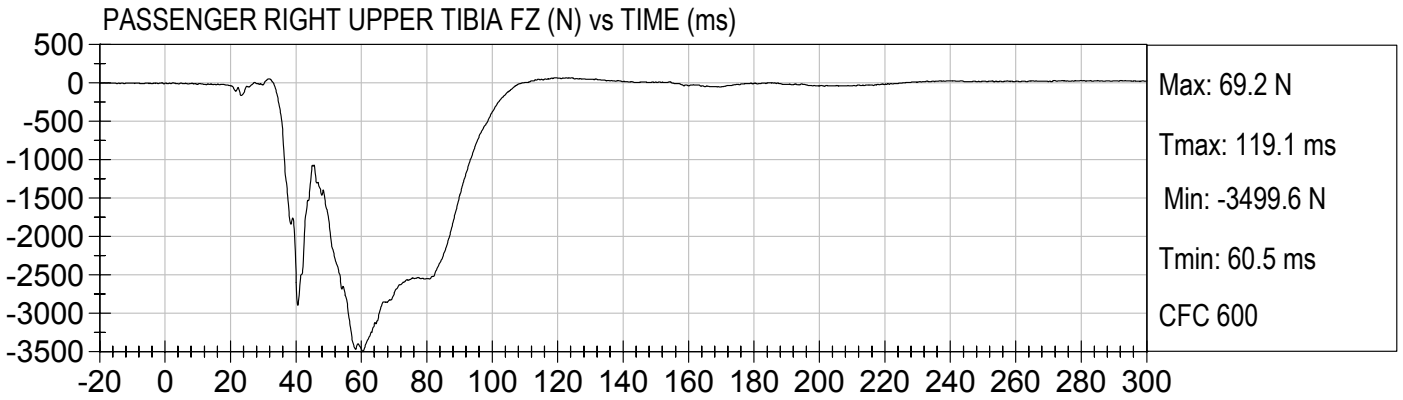

PASSENGER LEFT LOWER TIBIA MX (Nm) vs TIME (ms)
50
40
30
20
10
0
-10
-20
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 47.9 Nm
Tmax: 59.8 ms
Min: -11.3 Nm
Tmin: 36.9 ms
CFC 600

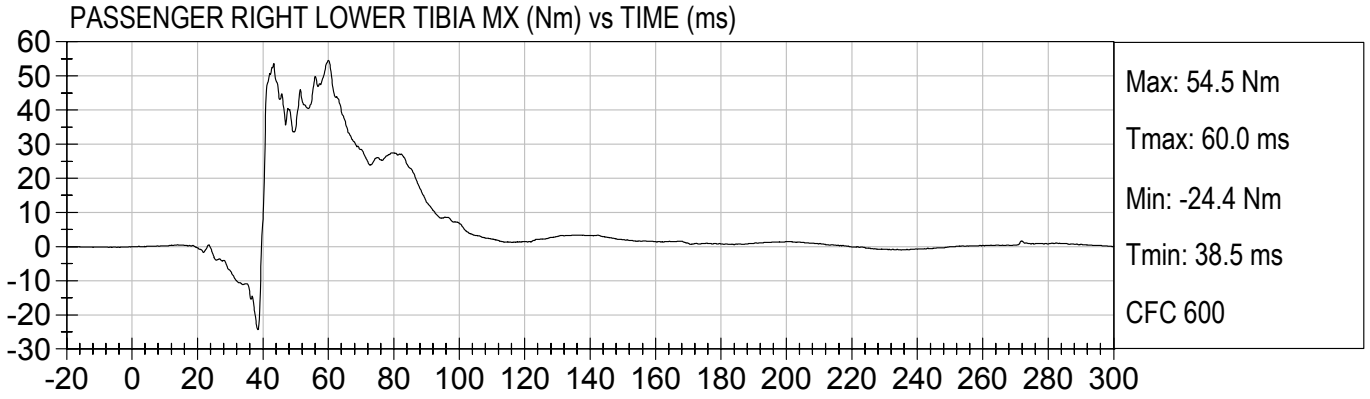

PASSENGER LEFT LOWER TIBIA MY (Nm) vs TIME (ms)
100
50
0
-50
-100
-150
-200
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 56.4 Nm
Tmax: 36.3 ms
Min: -167.6 Nm
Tmin: 64.8 ms
CFC 600

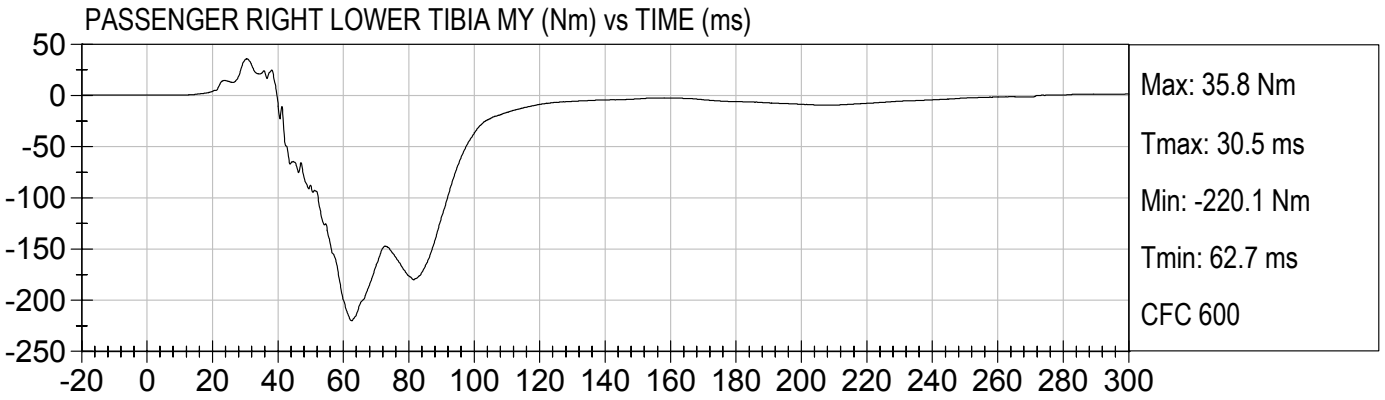

PASSENGER LEFT LOWER TIBIA FZ (N) vs TIME (ms)
500
0
-500
-1000
-1500
-2000
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 116.4 N
Tmax: 147.6 ms
Min: -1908.8 N
Tmin: 84.8 ms
CFC 600

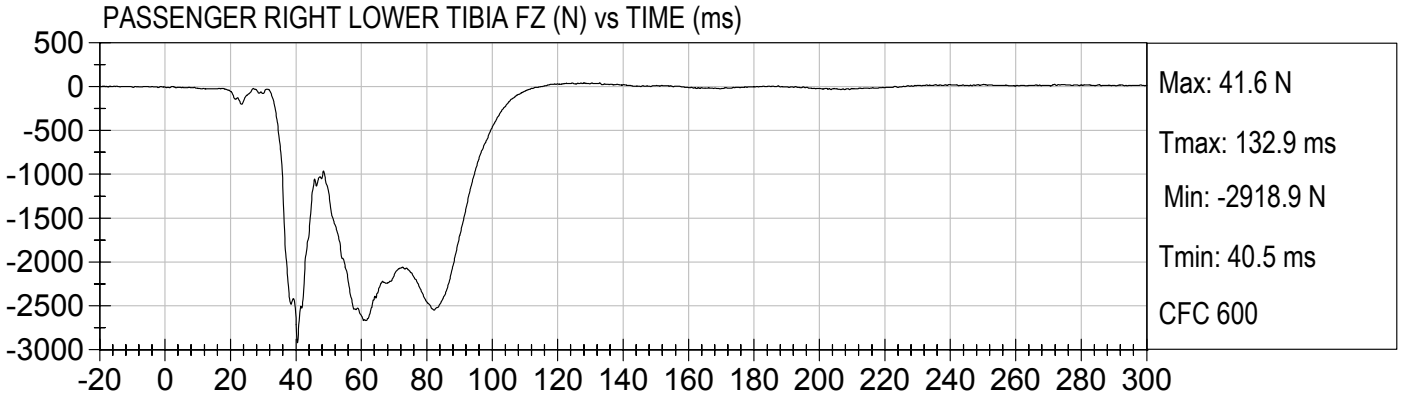

PASSENGER RIGHT UPPER TIBIA MX (Nm) vs TIME (ms)
40
20
0
-20
-40
-60
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 37.4 Nm
Tmax: 38.6 ms
Min: -50.7 Nm
Tmin: 60.1 ms
CFC 600

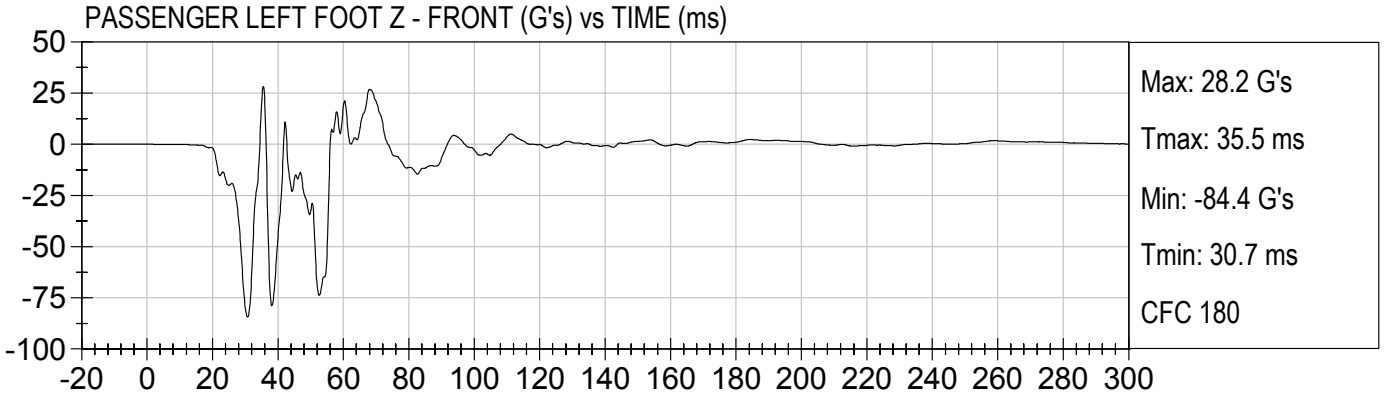

PASSENGER RIGHT UPPER TIBIA MY (Nm) vs TIME (ms)
50
25
0
-25
-50
-75
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 35.6 Nm
Tmax: 81.0 ms
Min: -68.8 Nm
Tmin: 37.8 ms
CFC 600

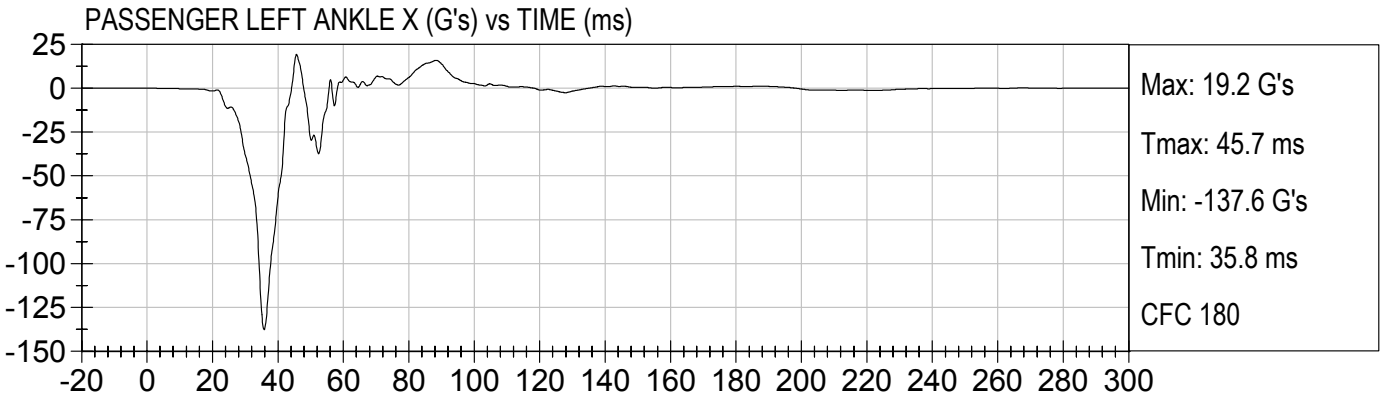

PASSENGER RIGHT UPPER TIBIA FZ (N) vs TIME (ms)
500
0
-500
-1000
-1500
-2000
-2500
-3000
-3500
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 69.2 N
Tmax: 119.1 ms
Min: -3499.6 N
Tmin: 60.5 ms
CFC 600

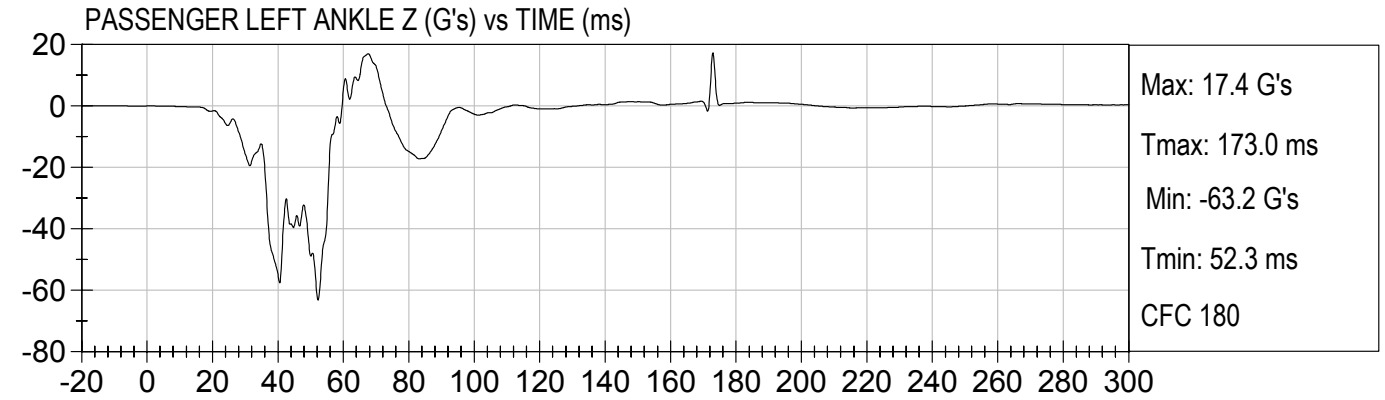

PASSENGER RIGHT LOWER TIBIA MX (Nm) vs TIME (ms)
60
50
40
30
20
10
0
-10
-20
-30
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 54.5 Nm
Tmax: 60.0 ms
Min: -24.4 Nm
Tmin: 38.5 ms
CFC 600

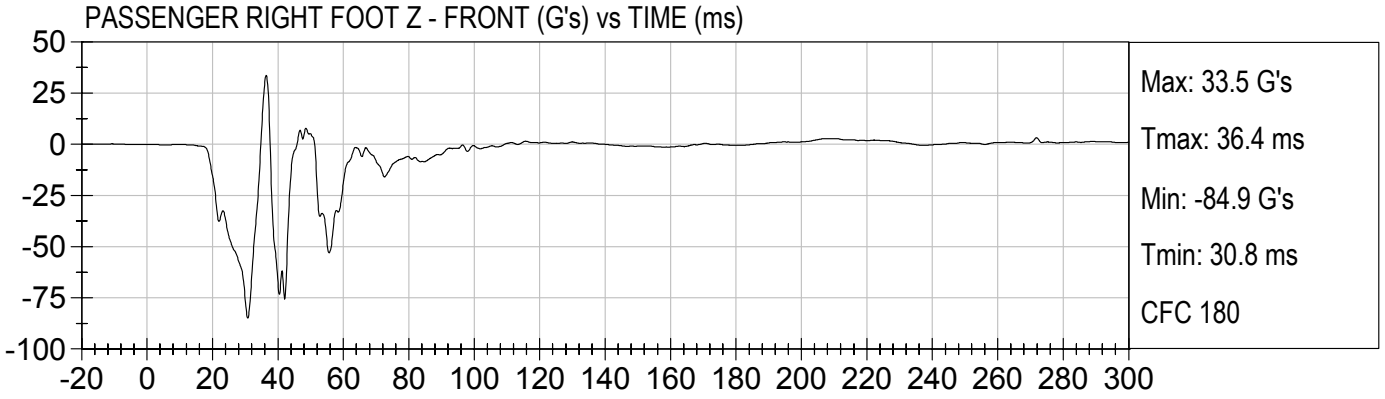

PASSENGER RIGHT LOWER TIBIA MY (Nm) vs TIME (ms)
50
0
-50
-100
-150
-200
-250
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 35.8 Nm
Tmax: 30.5 ms
Min: -220.1 Nm
Tmin: 62.7 ms
CFC 600

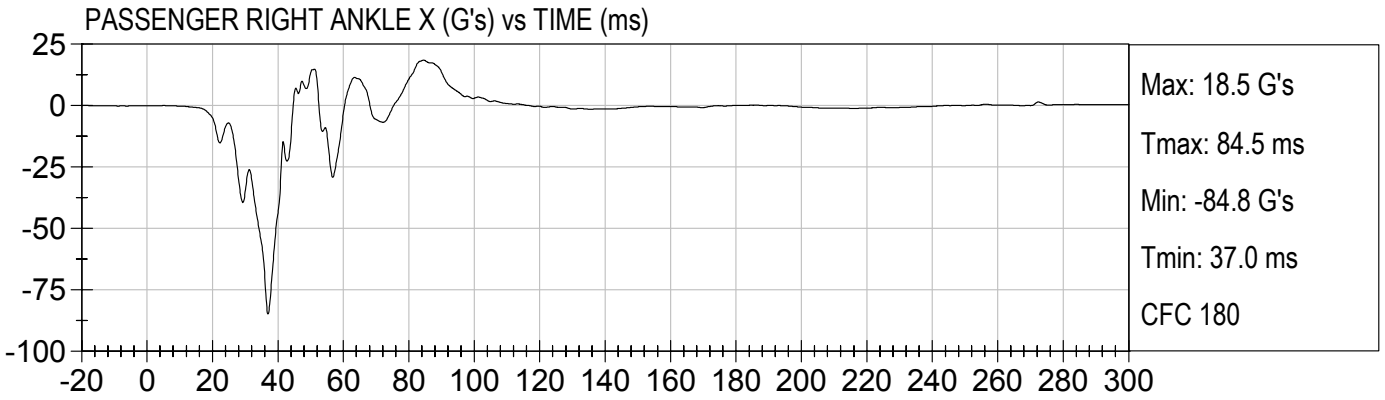

PASSENGER RIGHT LOWER TIBIA FZ (N) vs TIME (ms)
500
0
-500
-1000
-1500
-2000
-2500
-3000
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 41.6 N
Tmax: 132.9 ms
Min: -2918.9 N
Tmin: 40.5 ms
CFC 600

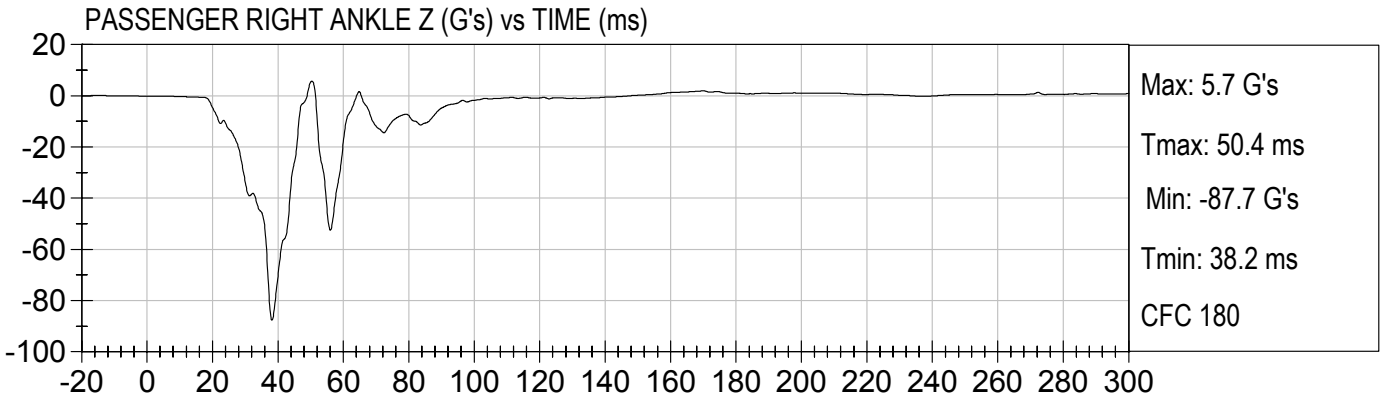

PASSENGER LEFT FOOT Z - FRONT (G's) vs TIME (ms)
50
25
0
-25
-50
-75
-100
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 28.2 G's
Tmax: 35.5 ms
Min: -84.4 G's
Tmin: 30.7 ms
CFC 180

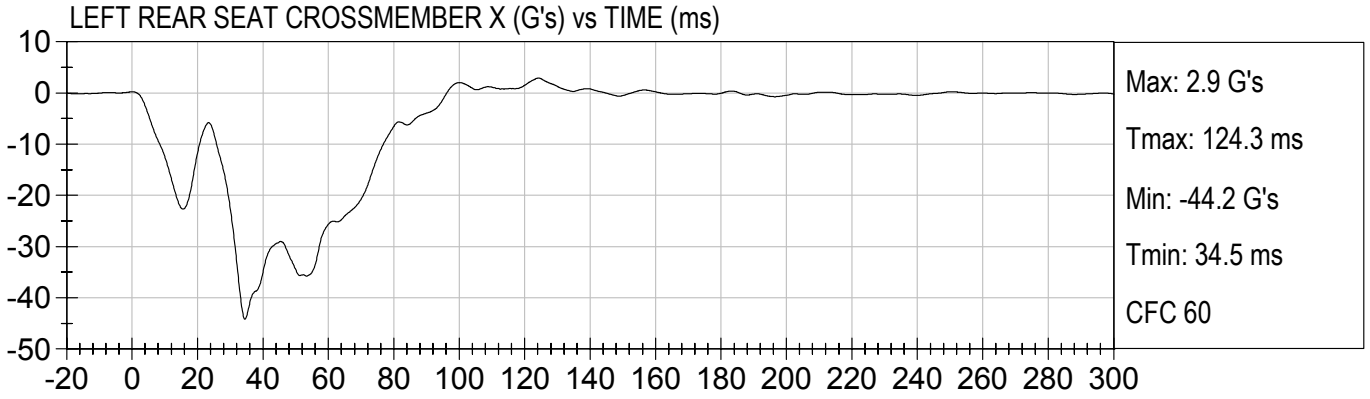

PASSENGER LEFT ANKLE X (G's) vs TIME (ms)
25
0
-25
-50
-75
-100
-125
-150
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 19.2 G's
Tmax: 45.7 ms
Min: -137.6 G's
Tmin: 35.8 ms
CFC 180

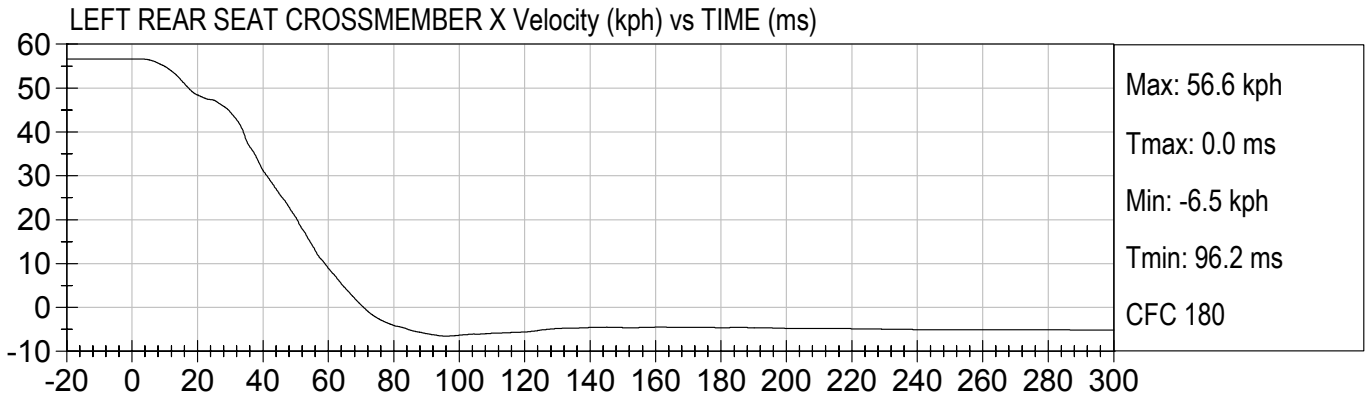

PASSENGER LEFT ANKLE Z (G's) vs TIME (ms)
20
0
-20
-40
-60
-80
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 17.4 G's
Tmax: 173.0 ms
Min: -63.2 G's
Tmin: 52.3 ms
CFC 180

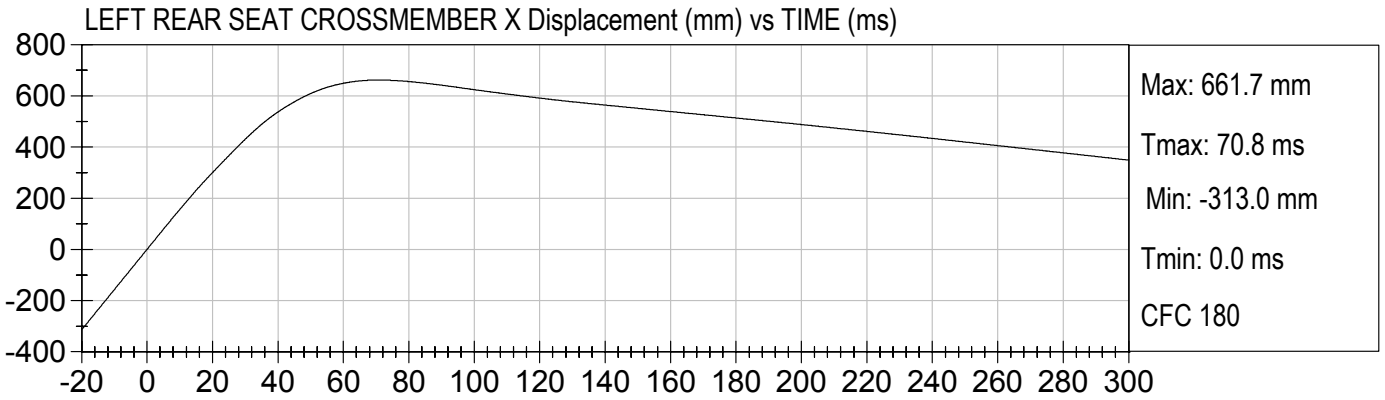

PASSENGER RIGHT FOOT Z - FRONT (G's) vs TIME (ms)
50
25
0
-25
-50
-75
-100
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 33.5 G's
Tmax: 36.4 ms
Min: -84.9 G's
Tmin: 30.8 ms
CFC 180


PASSENGER RIGHT ANKLE X (G's) vs TIME (ms)
25
0
-25
-50
-75
-100
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 18.5 G's
Tmax: 84.5 ms
Min: -84.8 G's
Tmin: 37.0 ms
CFC 180


PASSENGER RIGHT ANKLE Z (G's) vs TIME (ms)
20
0
-20
-40
-60
-80
-100
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 5.7 G's
Tmax: 50.4 ms
Min: -87.7 G's
Tmin: 38.2 ms
CFC 180

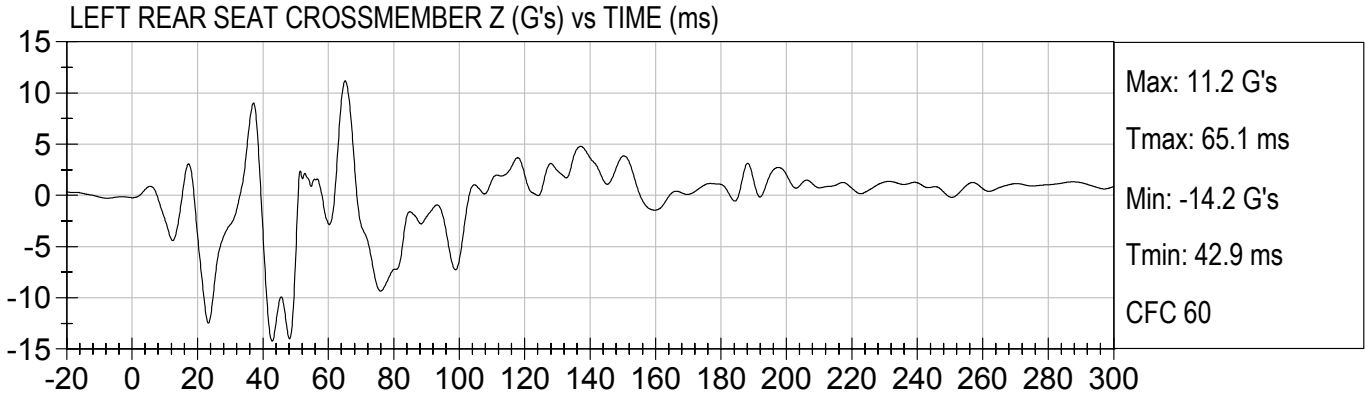

LEFT REAR SEAT CROSSMEMBER X (G's) vs TIME (ms)
10
0
-10
-20
-30
-40
-50
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 2.9 G's
Tmax: 124.3 ms
Min: -44.2 G's
Tmin: 34.5 ms
CFC 60

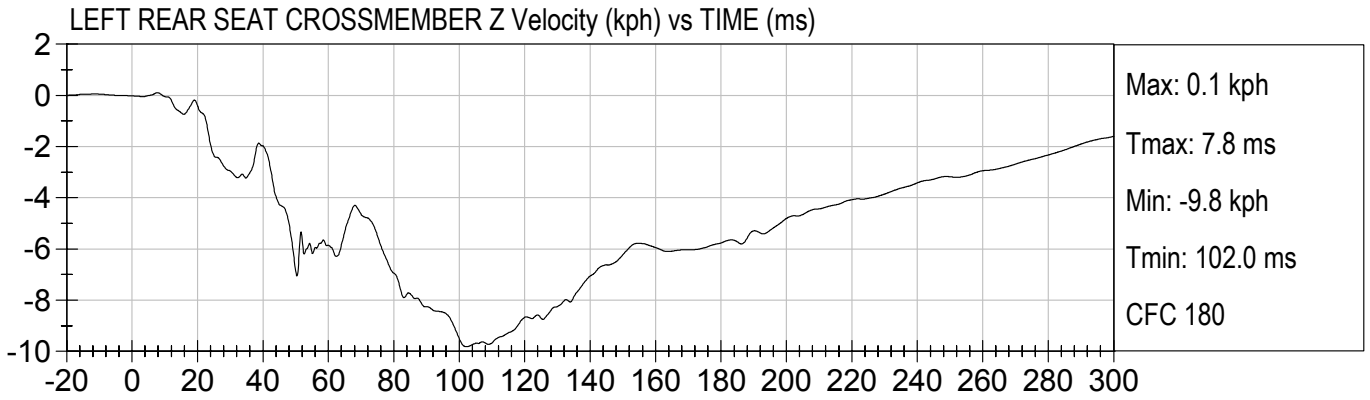

LEFT REAR SEAT CROSSMEMBER X Velocity (kph) vs TIME (ms)
60
50
40
30
20
10
0
-10
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 56.6 kph
Tmax: 0.0 ms
Min: -6.5 kph
Tmin: 96.2 ms
CFC 180

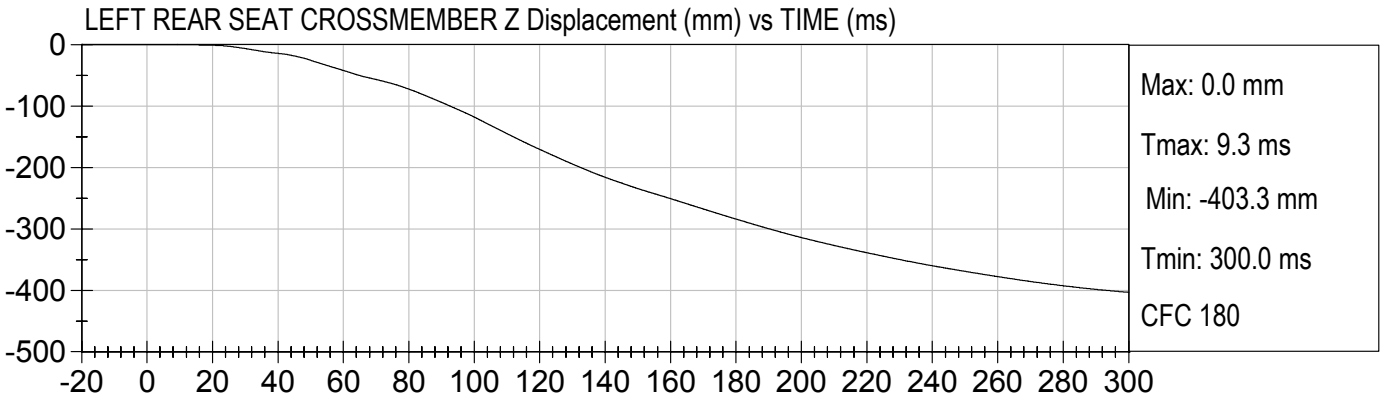

LEFT REAR SEAT CROSSMEMBER X Displacement (mm) vs TIME (ms)
800
600
400
200
0
-200
-400
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 661.7 mm
Tmax: 70.8 ms
Min: -313.0 mm
Tmin: 0.0 ms
CFC 180

NCAP 35MPH FRONTAL IMPACT
2005 HYUNDAI SANTA FE (M50500)

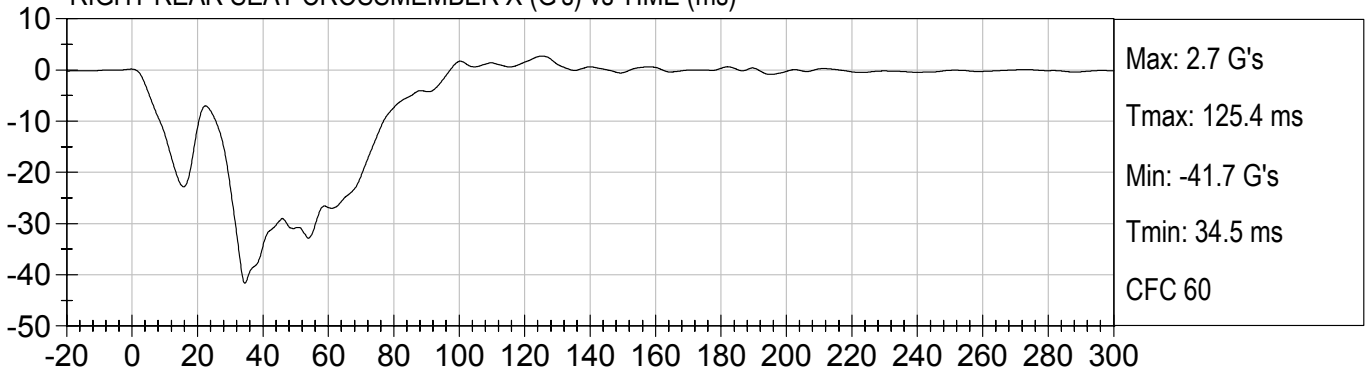
Test Date: 02/17/05
Speed: 35.2 mph (56.6 km/h)



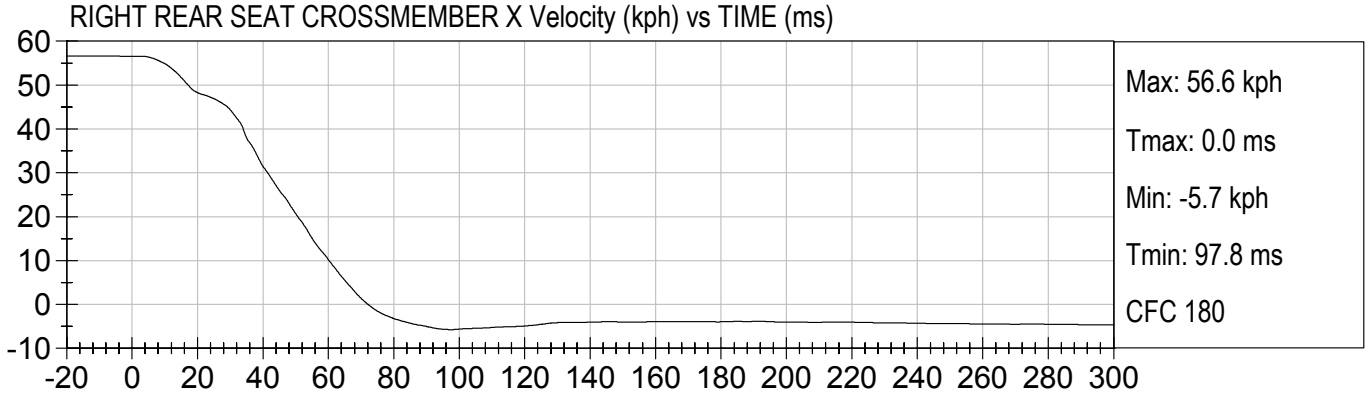




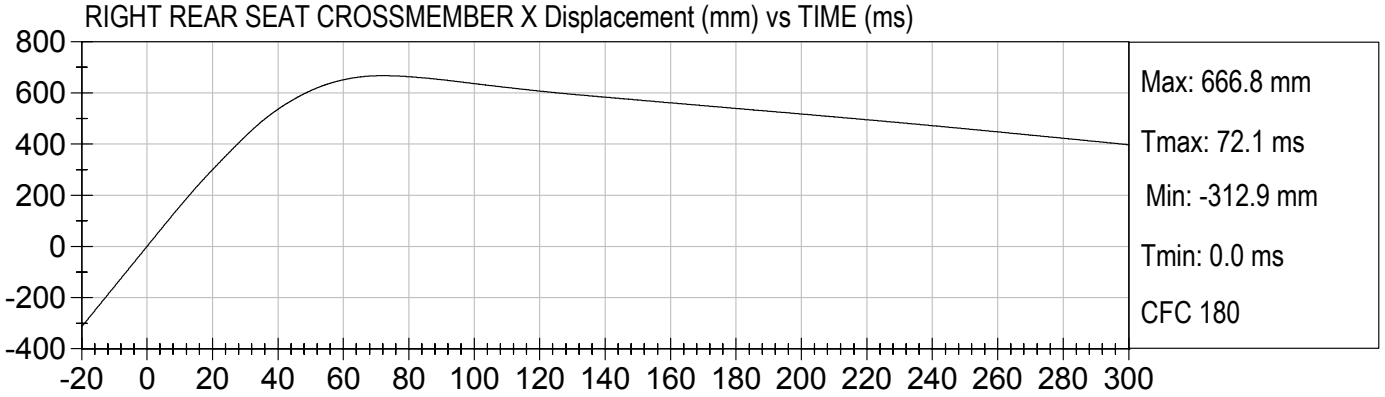
RIGHT REAR SEAT CROSSMEMBER X (G's) vs TIME (ms)

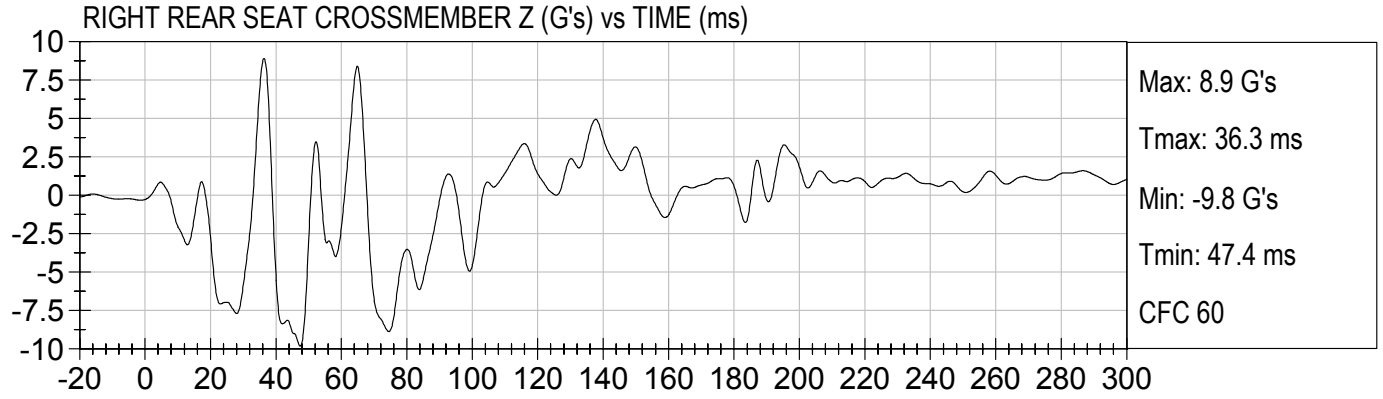


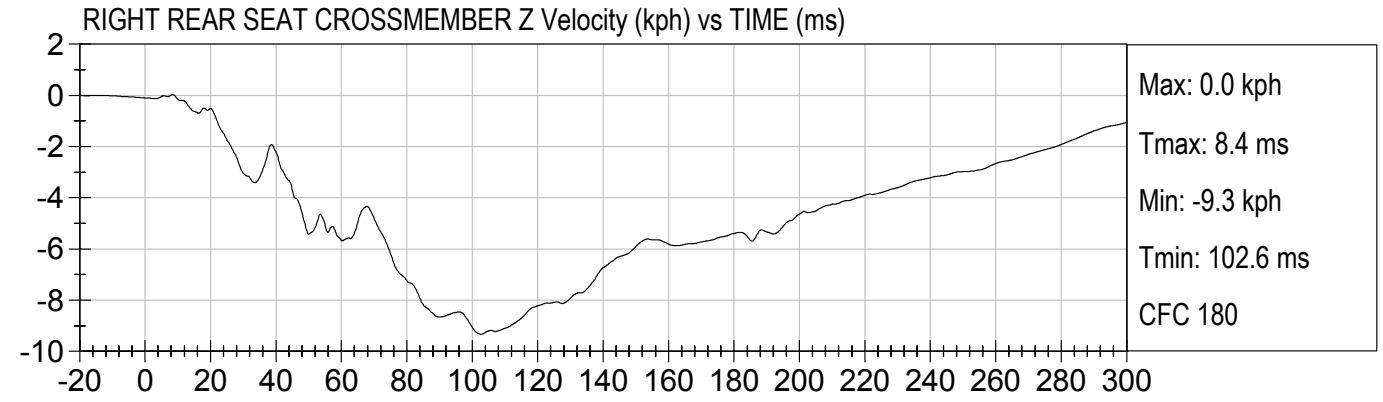
RIGHT REAR SEAT CROSSMEMBER X Velocity (kph) vs TIME (ms)

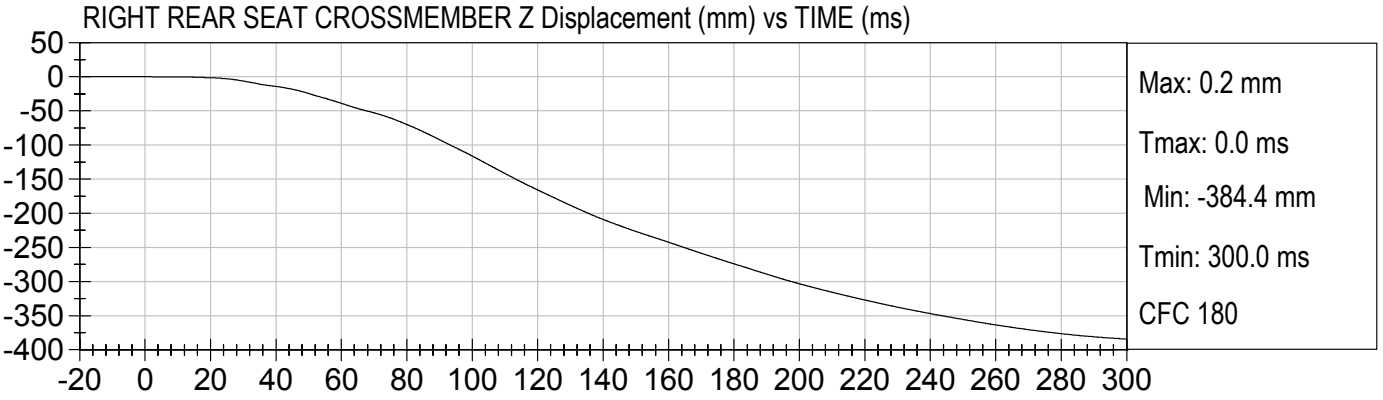


RIGHT REAR SEAT CROSSMEMBER X Displacement (mm) vs TIME (ms)



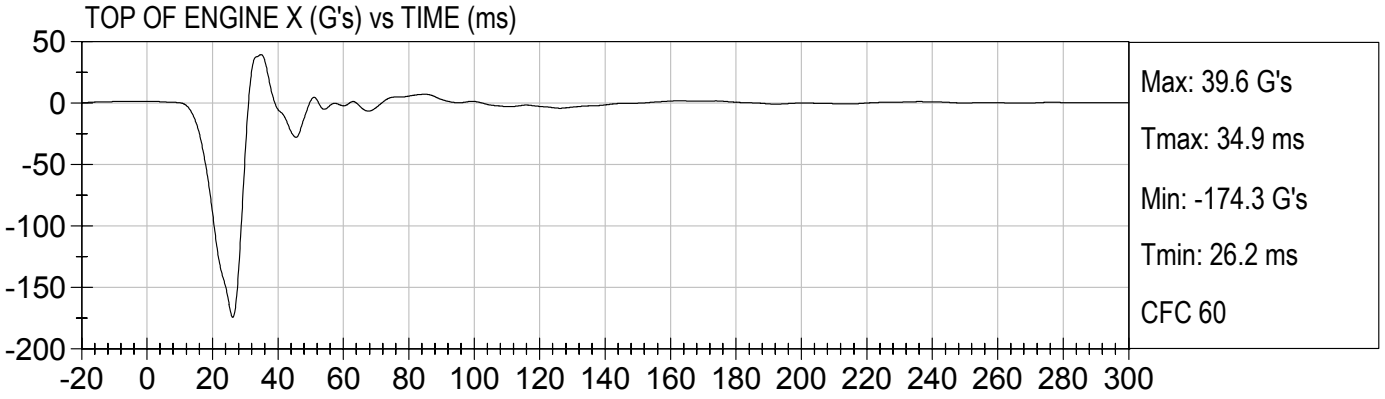

RIGHT REAR SEAT CROSSMEMBER Z (G's) vs TIME (ms)
10
7.5
5
2.5
0
-2.5
-5
-7.5
-10
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 8.9 G's
Tmax: 36.3 ms
Min: -9.8 G's
Tmin: 47.4 ms
CFC 60

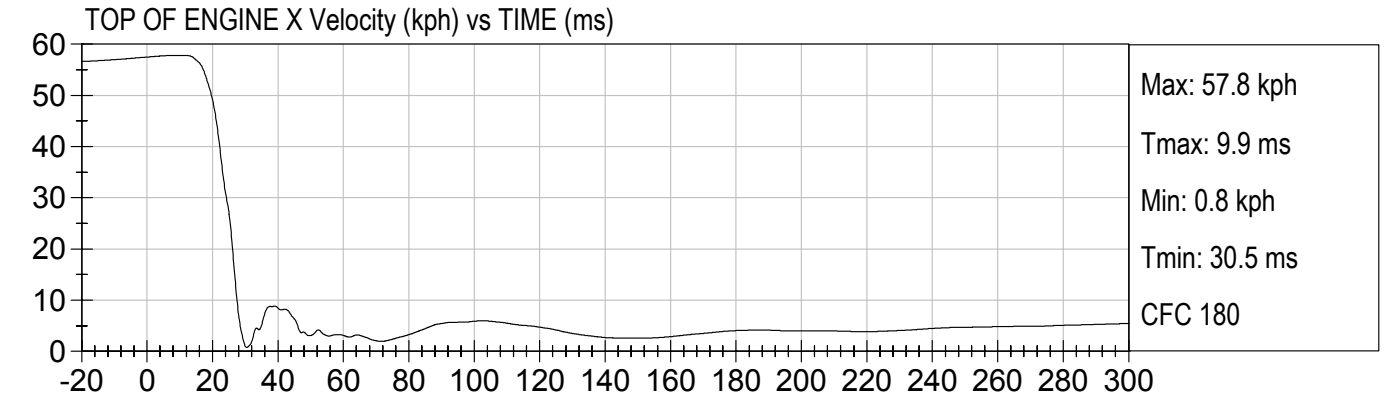

RIGHT REAR SEAT CROSSMEMBER Z Velocity (kph) vs TIME (ms)
2
0
-2
-4
-6
-8
-10
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 0.0 kph
Tmax: 8.4 ms
Min: -9.3 kph
Tmin: 102.6 ms
CFC 180

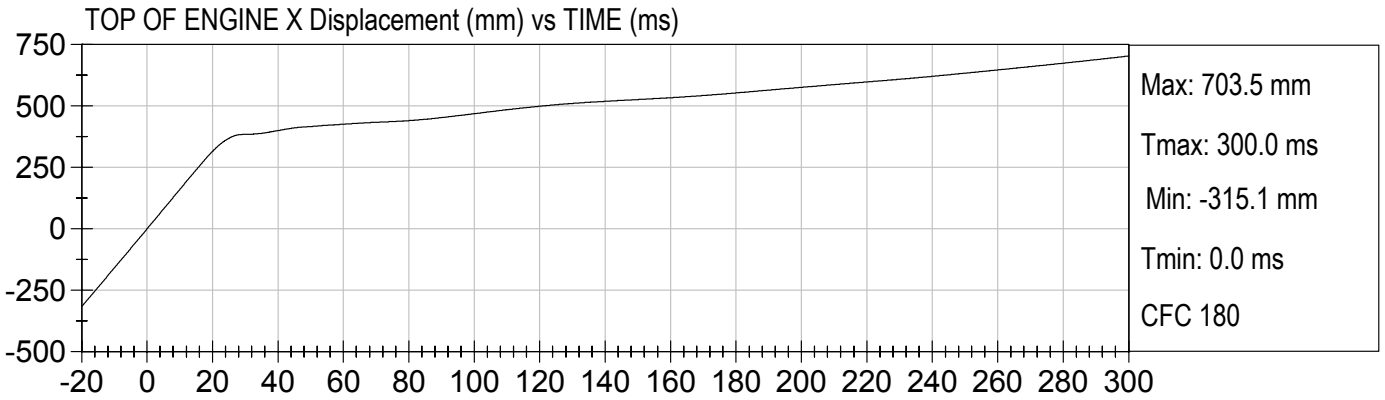

RIGHT REAR SEAT CROSSMEMBER Z Displacement (mm) vs TIME (ms)
50
0
-50
-100
-150
-200
-250
-300
-350
-400
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 0.2 mm
Tmax: 0.0 ms
Min: -384.4 mm
Tmin: 300.0 ms
CFC 180

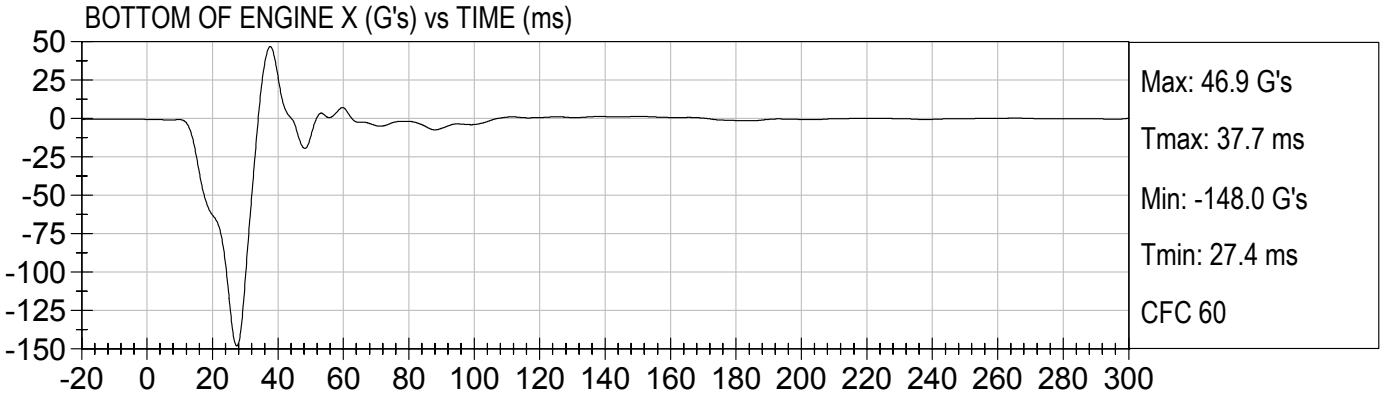
NCAP 35MPH FRONTAL IMPACT
2005 HYUNDAI SANTA FE (M50500)

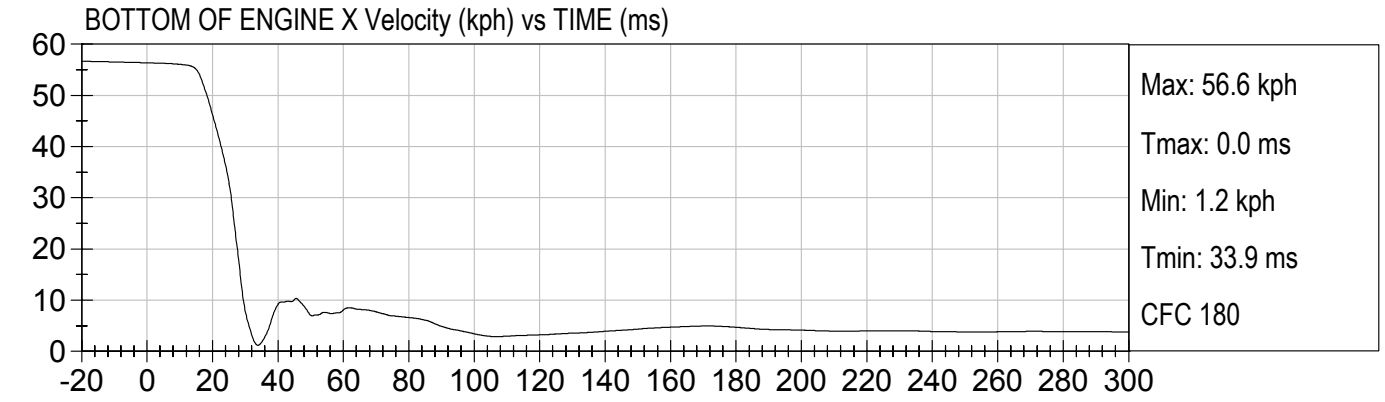
Test Date: 02/17/05
Speed: 35.2 mph (56.6 km/h)

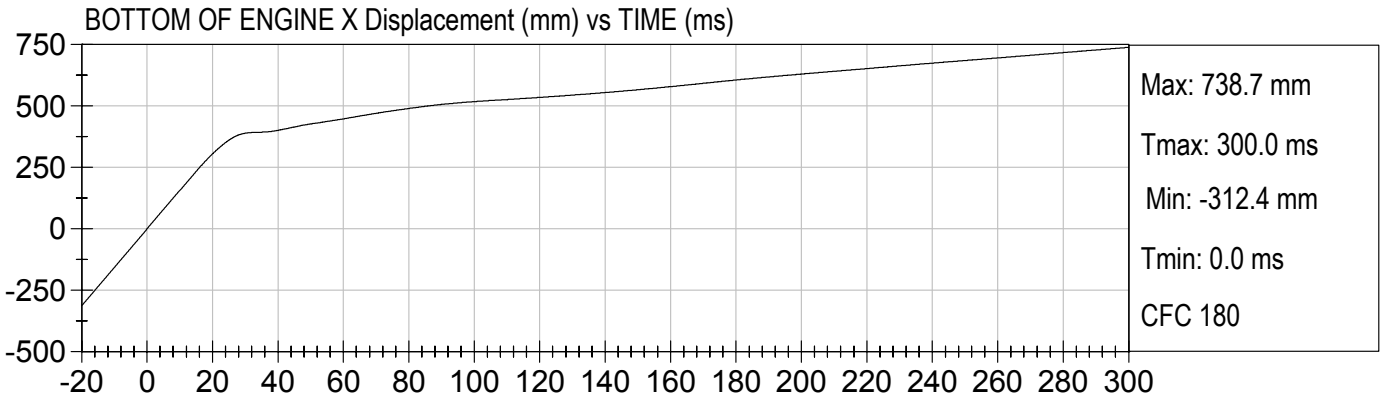


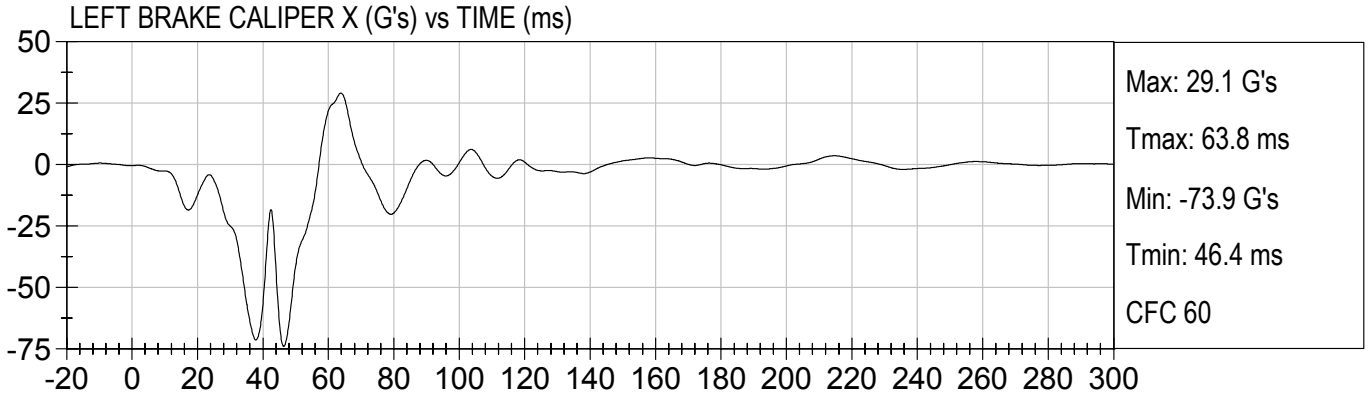


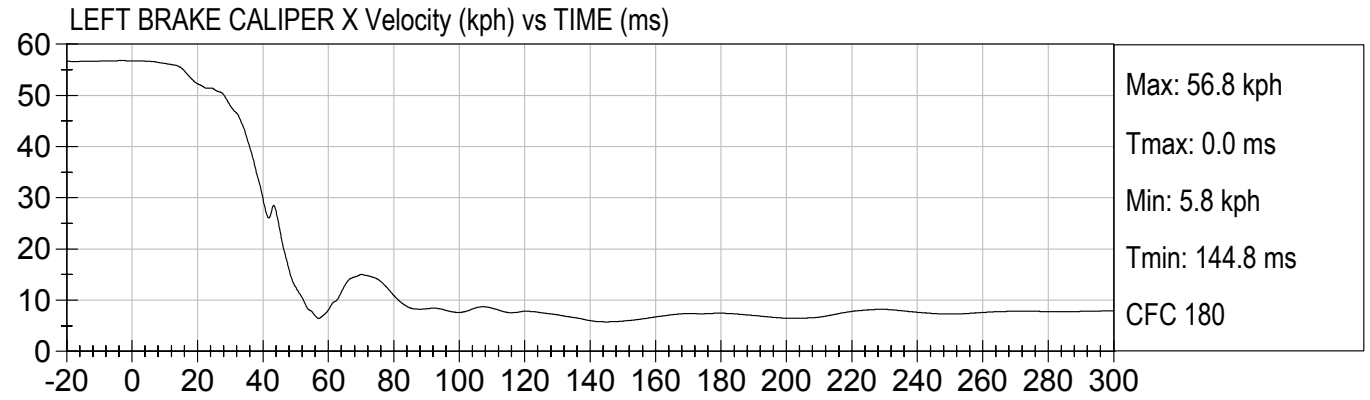


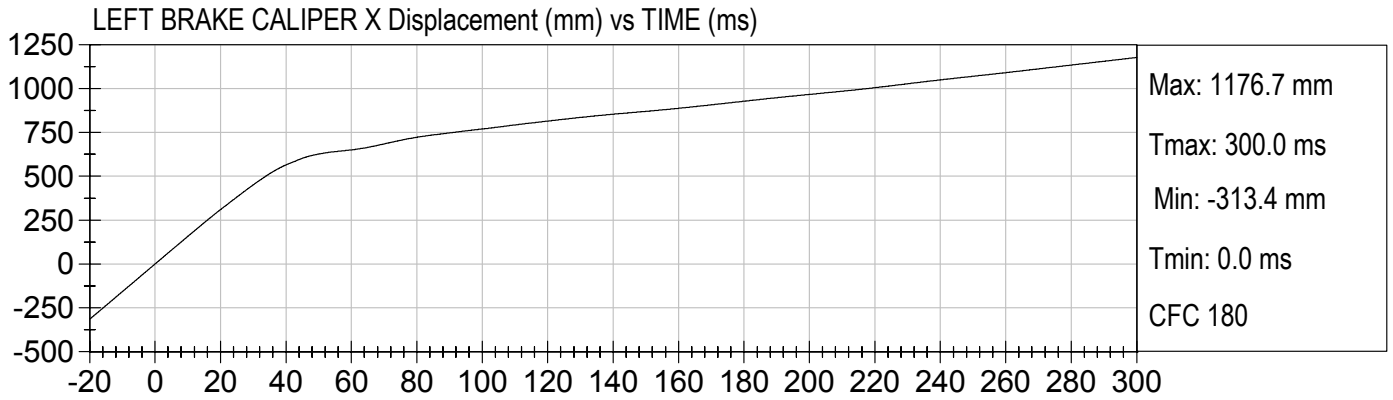

BOTTOM OF ENGINE X (G's) vs TIME (ms)
50
25
0
-25
-50
-75
-100
-125
-150
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 46.9 G's
Tmax: 37.7 ms
Min: -148.0 G's
Tmin: 27.4 ms
CFC 60

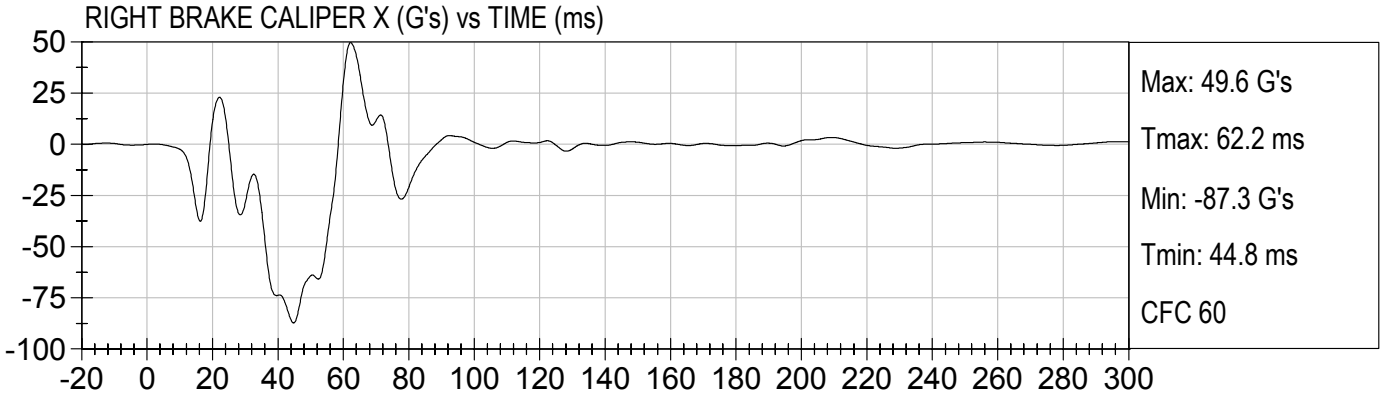

BOTTOM OF ENGINE X Velocity (kph) vs TIME (ms)
60
50
40
30
20
10
0
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 56.6 kph
Tmax: 0.0 ms
Min: 1.2 kph
Tmin: 33.9 ms
CFC 180

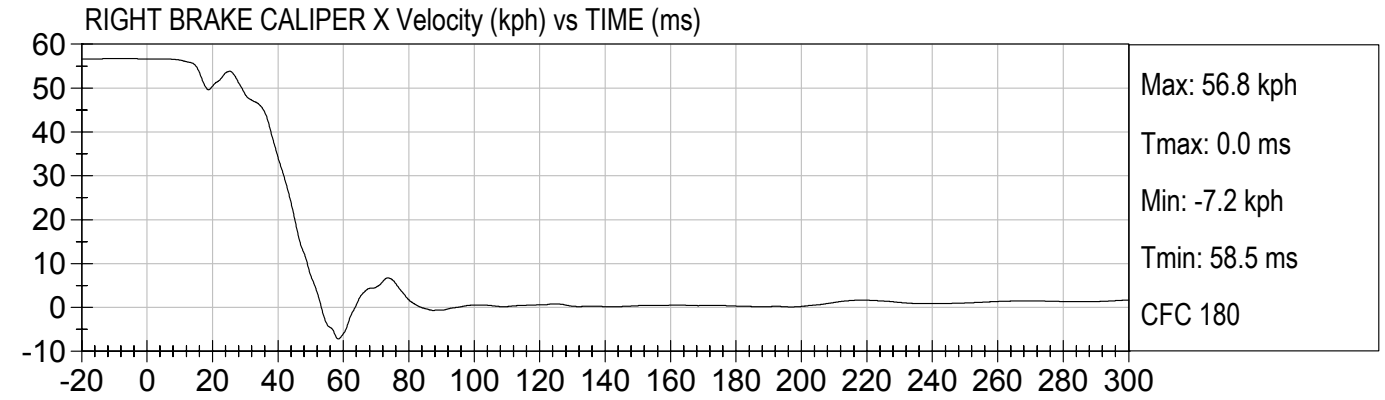

BOTTOM OF ENGINE X Displacement (mm) vs TIME (ms)
750
500
250
0
-250
-500
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 738.7 mm
Tmax: 300.0 ms
Min: -312.4 mm
Tmin: 0.0 ms
CFC 180

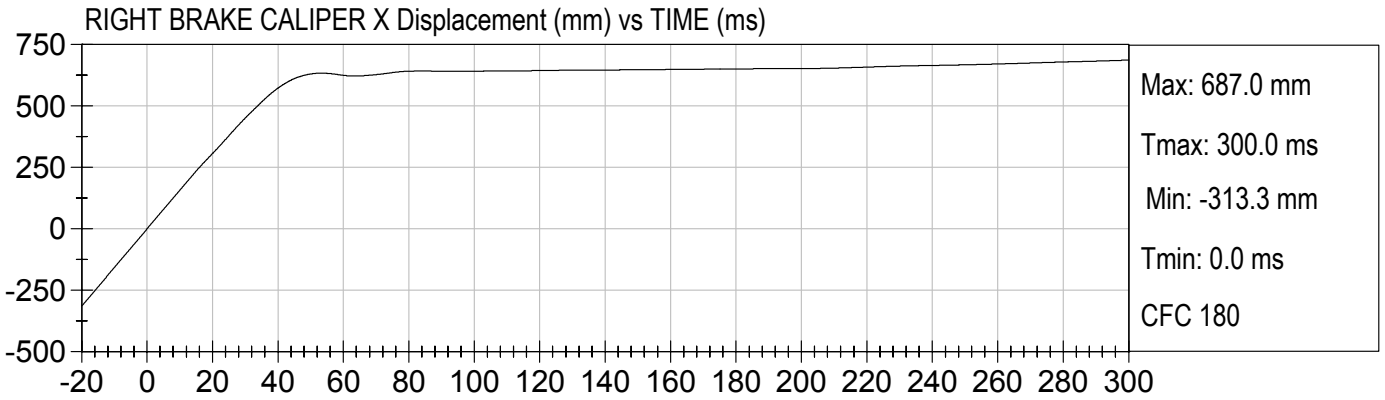

LEFT BRAKE CALIPER X (G's) vs TIME (ms)
50
25
0
-25
-50
-75
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 29.1 G's
Tmax: 63.8 ms
Min: -73.9 G's
Tmin: 46.4 ms
CFC 60

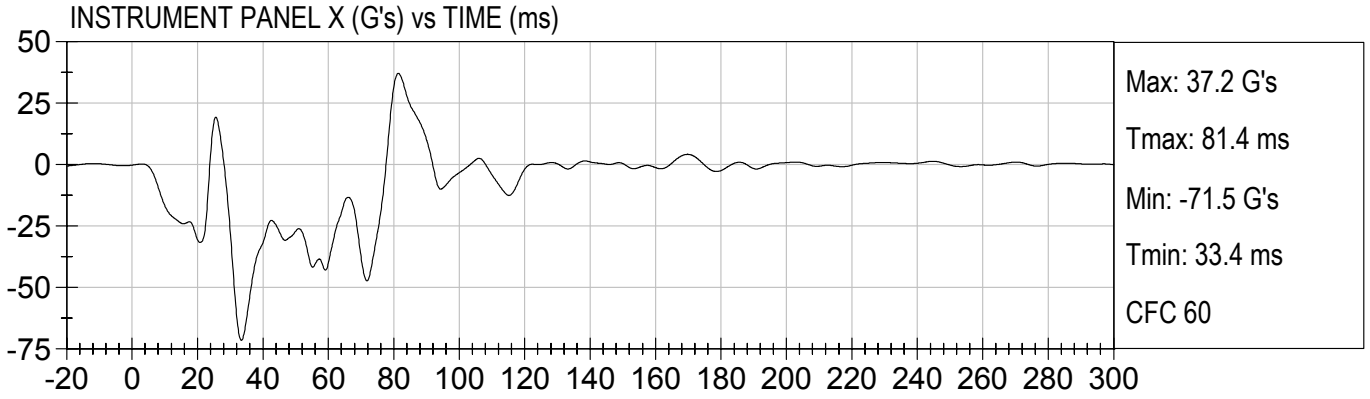

LEFT BRAKE CALIPER X Velocity (kph) vs TIME (ms)
60
50
40
30
20
10
0
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 56.8 kph
Tmax: 0.0 ms
Min: 5.8 kph
Tmin: 144.8 ms
CFC 180

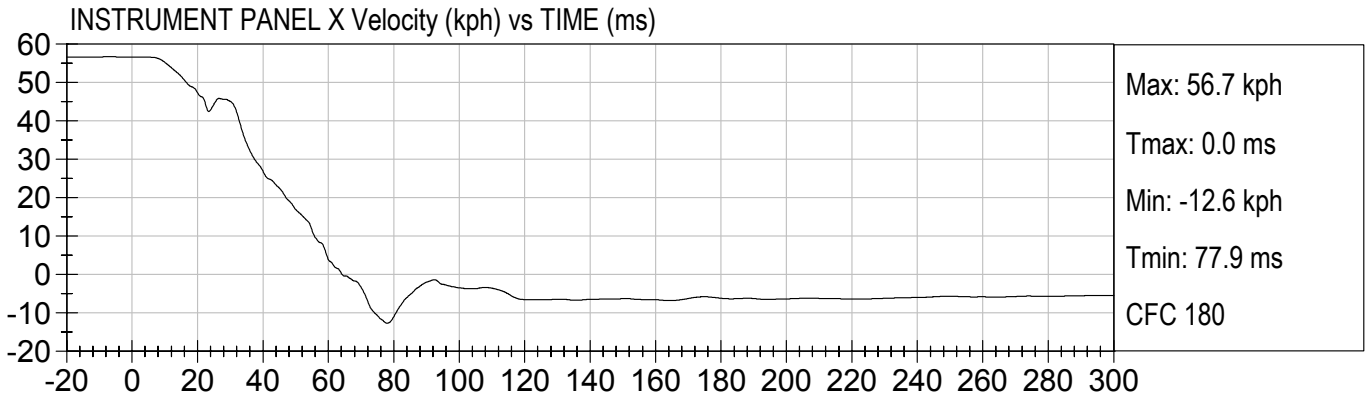

LEFT BRAKE CALIPER X Displacement (mm) vs TIME (ms)
1250
1000
750
500
250
0
-250
-500
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 1176.7 mm
Tmax: 300.0 ms
Min: -313.4 mm
Tmin: 0.0 ms
CFC 180

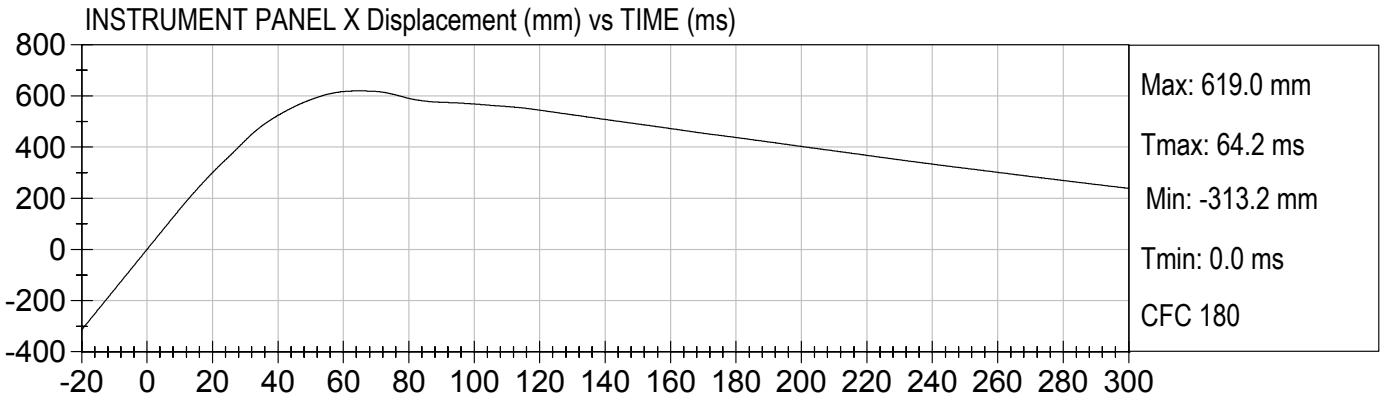

RIGHT BRAKE CALIPER X (G's) vs TIME (ms)
50
25
0
-25
-50
-75
-100
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 49.6 G's
Tmax: 62.2 ms
Min: -87.3 G's
Tmin: 44.8 ms
CFC 60


RIGHT BRAKE CALIPER X Velocity (kph) vs TIME (ms)
60
50
40
30
20
10
0
-10
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 56.8 kph
Tmax: 0.0 ms
Min: -7.2 kph
Tmin: 58.5 ms
CFC 180


RIGHT BRAKE CALIPER X Displacement (mm) vs TIME (ms)
750
500
250
0
-250
-500
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 687.0 mm
Tmax: 300.0 ms
Min: -313.3 mm
Tmin: 0.0 ms
CFC 180

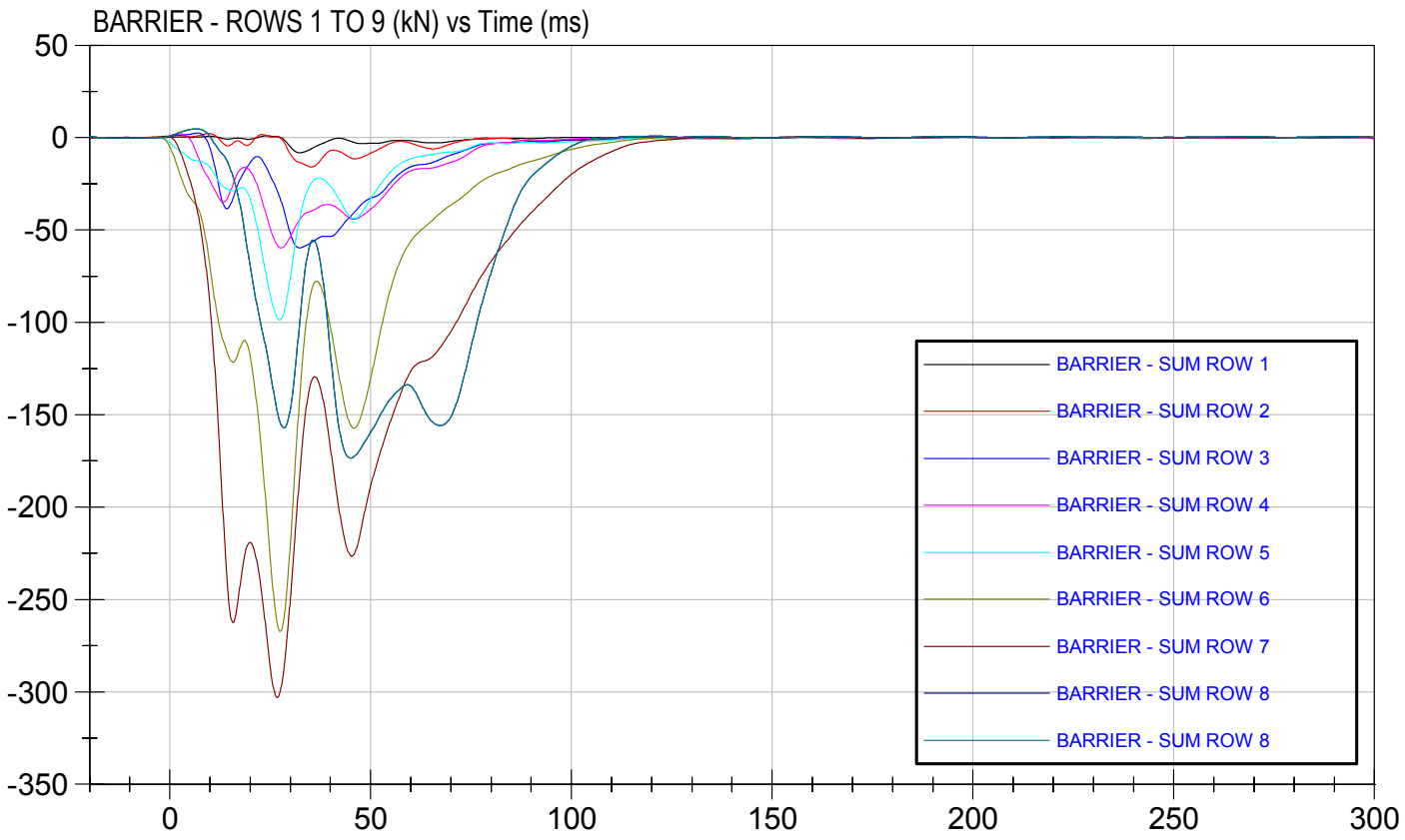

INSTRUMENT PANEL X (G's) vs TIME (ms)
50
25
0
-25
-50
-75
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 37.2 G's
Tmax: 81.4 ms
Min: -71.5 G's
Tmin: 33.4 ms
CFC 60

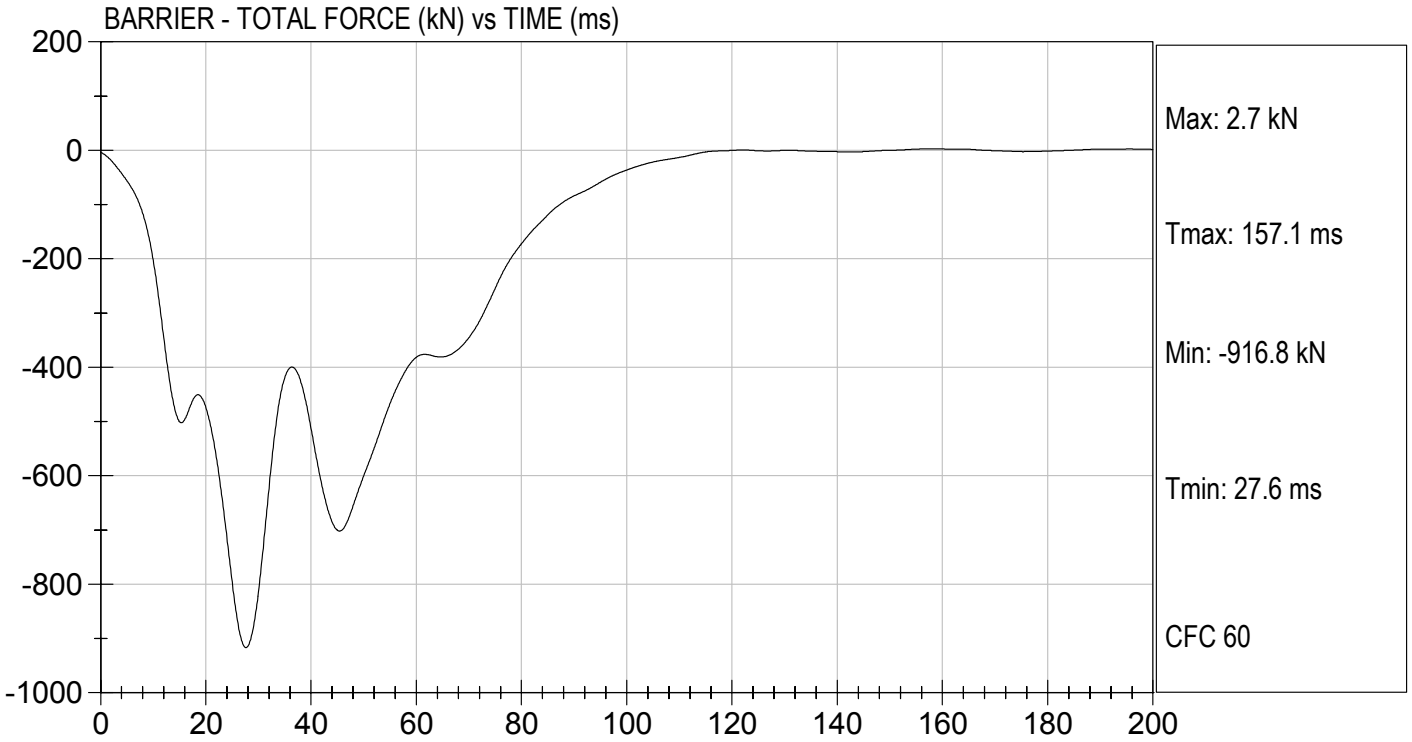

INSTRUMENT PANEL X Velocity (kph) vs TIME (ms)
60
50
40
30
20
10
0
-10
-20
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 56.7 kph
Tmax: 0.0 ms
Min: -12.6 kph
Tmin: 77.9 ms
CFC 180


INSTRUMENT PANEL X Displacement (mm) vs TIME (ms)
800
600
400
200
0
-200
-400
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 619.0 mm
Tmax: 64.2 ms
Min: -313.2 mm
Tmin: 0.0 ms
CFC 180

NCAP 35MPH FRONTAL IMPACT
2005 HYUNDAI SANTA FE (M50500)

Test Date: 02/17/05
Speed: 35.2 mph (0.0 km/h)





APPENDIX C

DUMMY CALIBRATION DATA TRACES AND TABLES

MGA RESEARCH CORPORATION

HEAD DROP TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 065 **Test ID:** D05141

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 - 25.6	21.0	Pass
Laboratory Relative Humidity	%	10 to 70	23	Pass
Peak Resultant Acceleration	G's	225 - 275	240	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	14.2	Pass
Unimodal	Yes/No	NA	Yes	Pass
Oscillations	Yes/No	within 10% of peak	Yes	Pass
		Overall Test Results		Pass

Joe Fleck

Laboratory Technician

01/20/2005

Test Date

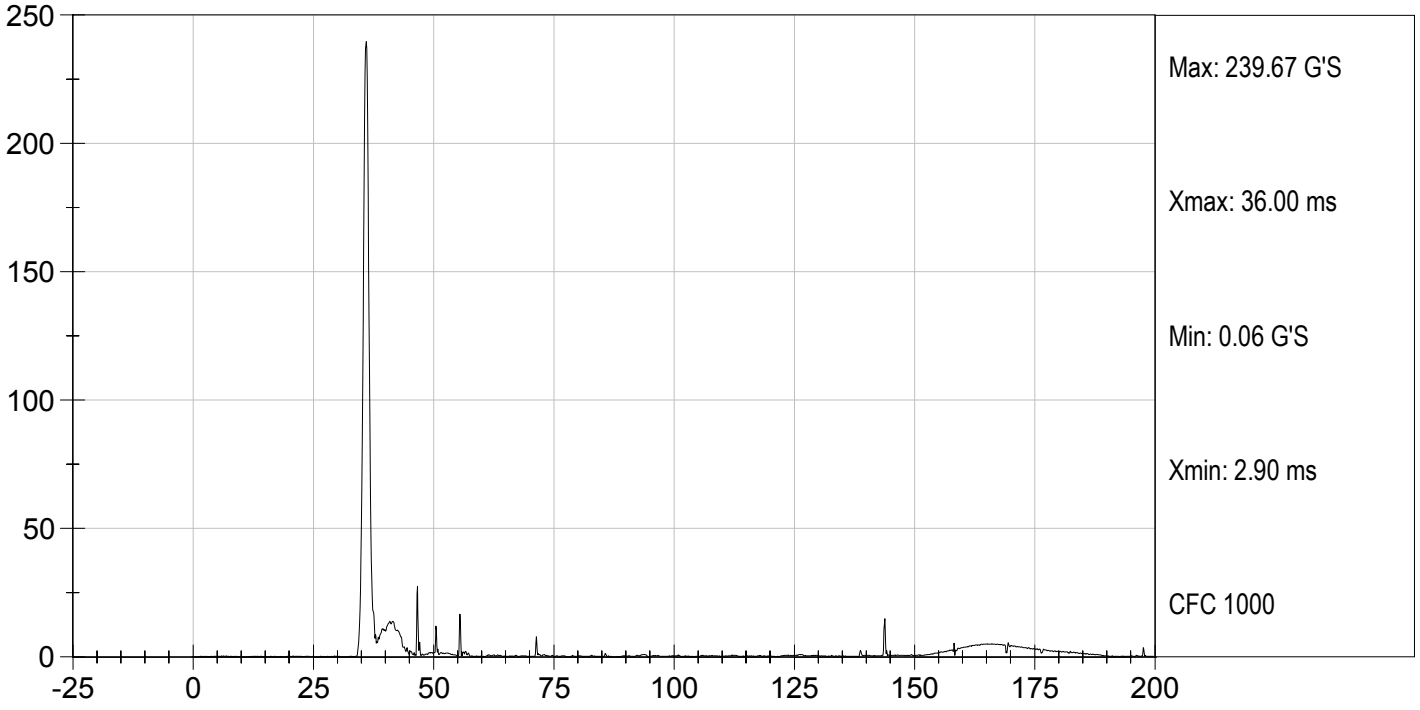
David Winkelbauer

Approved By

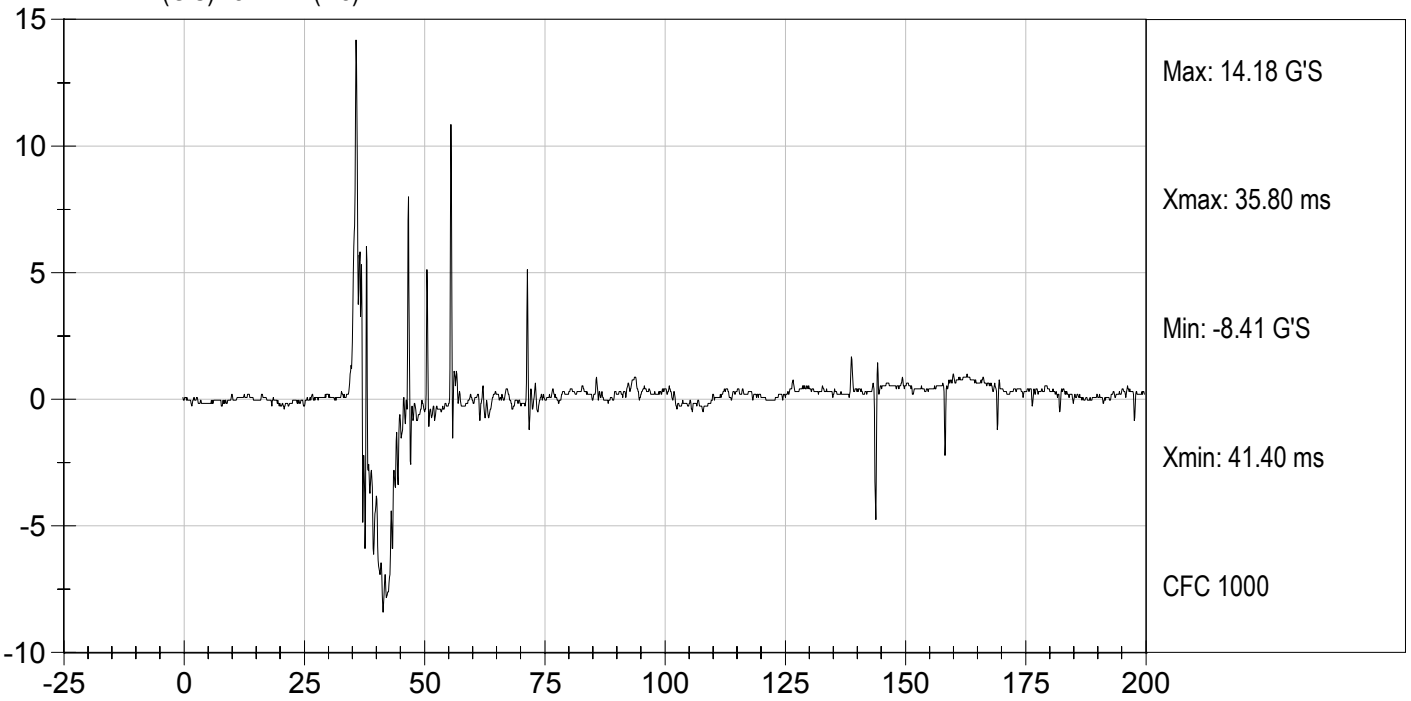
Test Desc: Head Drop
Componet ID: D05141

Test Date: 01/20/2005
Velocity: 0 ft/s, 0.00 m/s

HEAD RESULTANT ACCELERATION (G'S) vs TIME (ms)



HEAD Y (G'S) vs TIME (ms)



MGA RESEARCH CORPORATION

NECK FLEXION TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 065 **Test I.D:** D05142

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	20.9	Pass
Laboratory Relative Humidity		%	10 to 70	22	Pass
Pendulum Velocity		m/s	6.89 to 7.13	6.96	Pass
Pendulum Deceleration	10 msec	G's	22.50 to 27.50	25.11	Pass
	20 msec	G's	17.60 to 22.60	20.49	Pass
	30 msec	G's	12.50 to 18.50	15.90	Pass
Peak Pendulum Deceleration After 30 msec		G's	<= 29.0	15.87	Pass
Deceleration Decay Time to Cross 5 G's		msec	34.0 to 42.0	36.7	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	64.0 to 78.0	73.0	Pass
	Time	msec	57.0 to 64.0	58.5	Pass
"D" Plane Rotation Decay Time To Zero Crossing		msec	113.0 to 128.0	114.4	Pass
Moment About Occipital Condyle	Maximum	N m	88.1 to 108.5	98.1	Pass
	Time	msec	47.0 to 58.0	49.4	Pass
Positive Moment Decay Time To Zero Crossing		msec	97.0 to 107.0	104.4	Pass
			Overall Test Results		Pass

Joe Fleck

Laboratory Technician

01/20/2005

Test Date

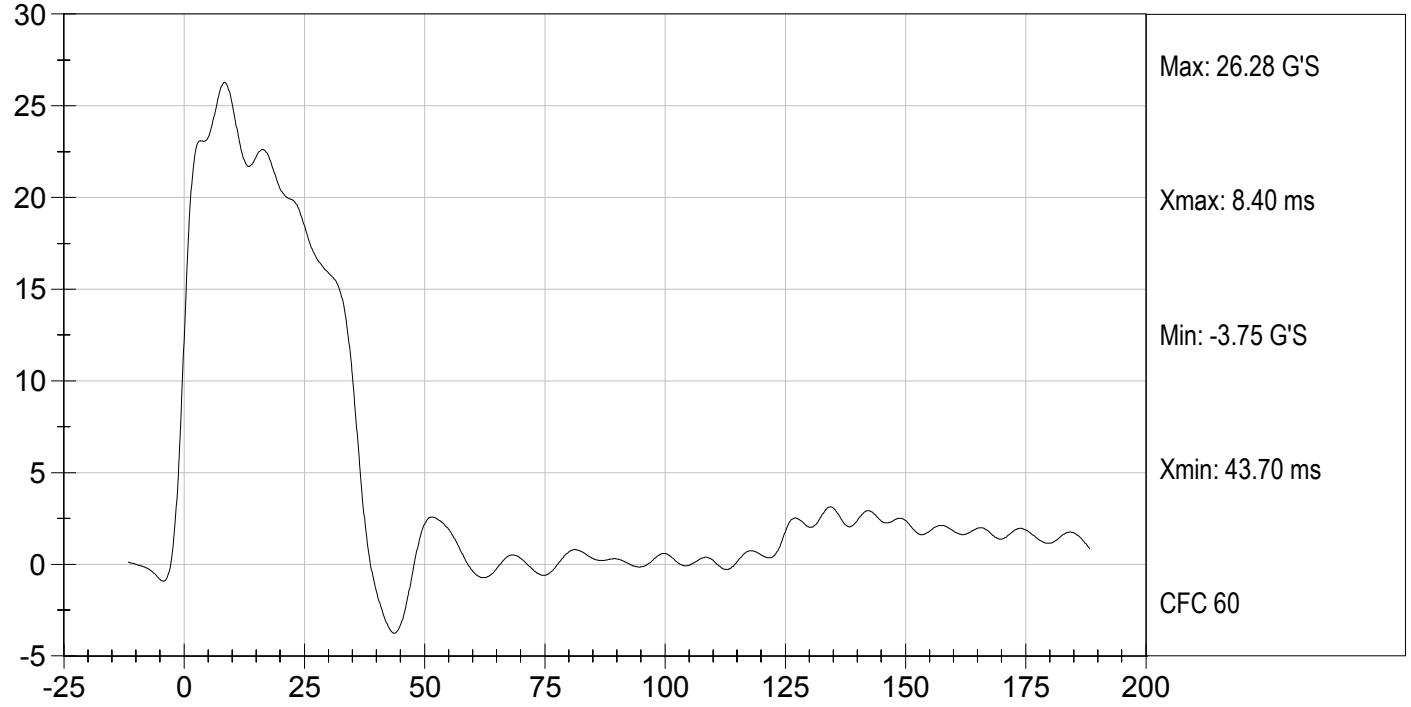
David Winkelbauer

Approved By

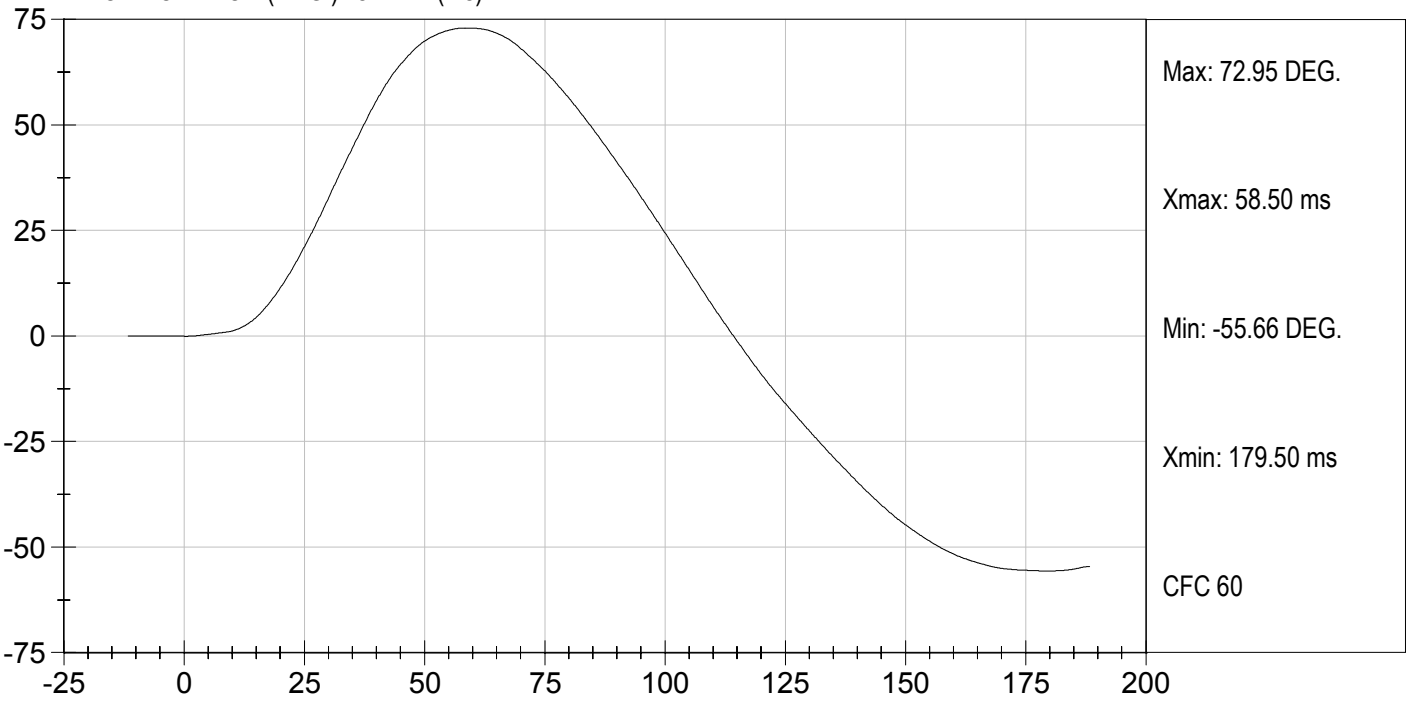
Test Desc: Neck Flexion
Componet ID: D05142

Test Date: 01/20/2005
Velocity: 22.82 ft/s, 6.96 m/s

PENDULUM DECELERATION (G'S) vs TIME (ms)

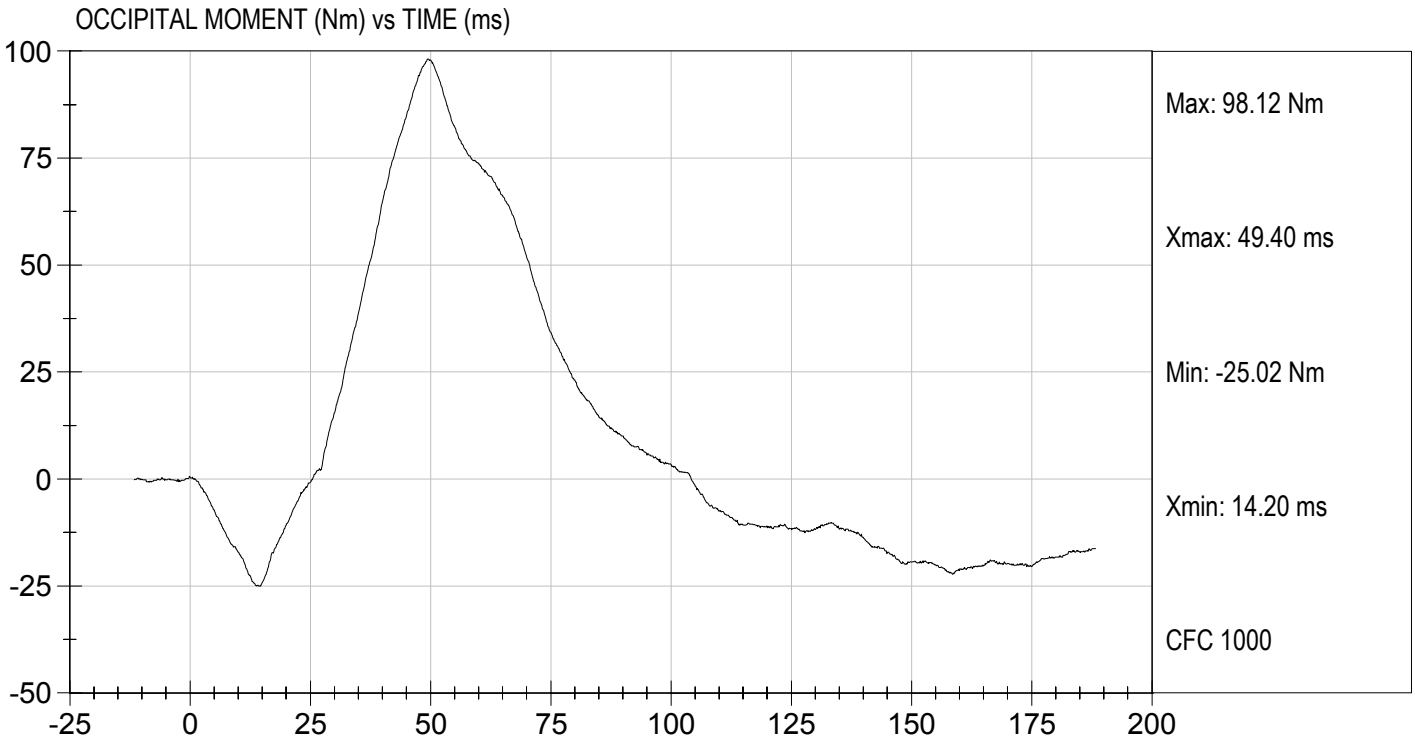


NECK ROTATION (DEG.) vs TIME (ms)



Test Desc: Neck Flexion
Componet ID: D05142

Test Date: 01/20/2005
Velocity: 22.82 ft/s, 6.96 m/s



MGA RESEARCH CORPORATION

NECK EXTENSION TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 065 **Test I.D:** D05143

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	20.9	Pass
Laboratory Relative Humidity		%	10 to 70	22	Pass
Pendulum Velocity		m/s	5.95 to 6.19	5.96	Pass
Pendulum Deceleration	10 msec	G's	17.20 to 21.20	19.56	Pass
	20 msec	G's	14.00 to 19.00	16.54	Pass
	30 msec	G's	11.00 to 16.00	12.37	Pass
Peak Pendulum Deceleration After 30 msec		G's	<= 22.0	13.18	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	99.6	Pass
	Time	msec	72.0 to 82.0	78.1	Pass
"D" Plane Rotation Decay Time To Zero Crossing		msec	147.0 to 174.0	158.2	Pass
Moment About Occipital Condyle	Maximum	N m	-52.9 to -79.9	-67.2	Pass
	Time	msec	65.0 to 79.0	73.0	Pass
Negative Moment Decay Time To Zero Crossing		msec	120.0 to 148.0	145.5	Pass
			Overall Test Results		Pass

Joe Fleck

Laboratory Technician

01/20/2005

Test Date

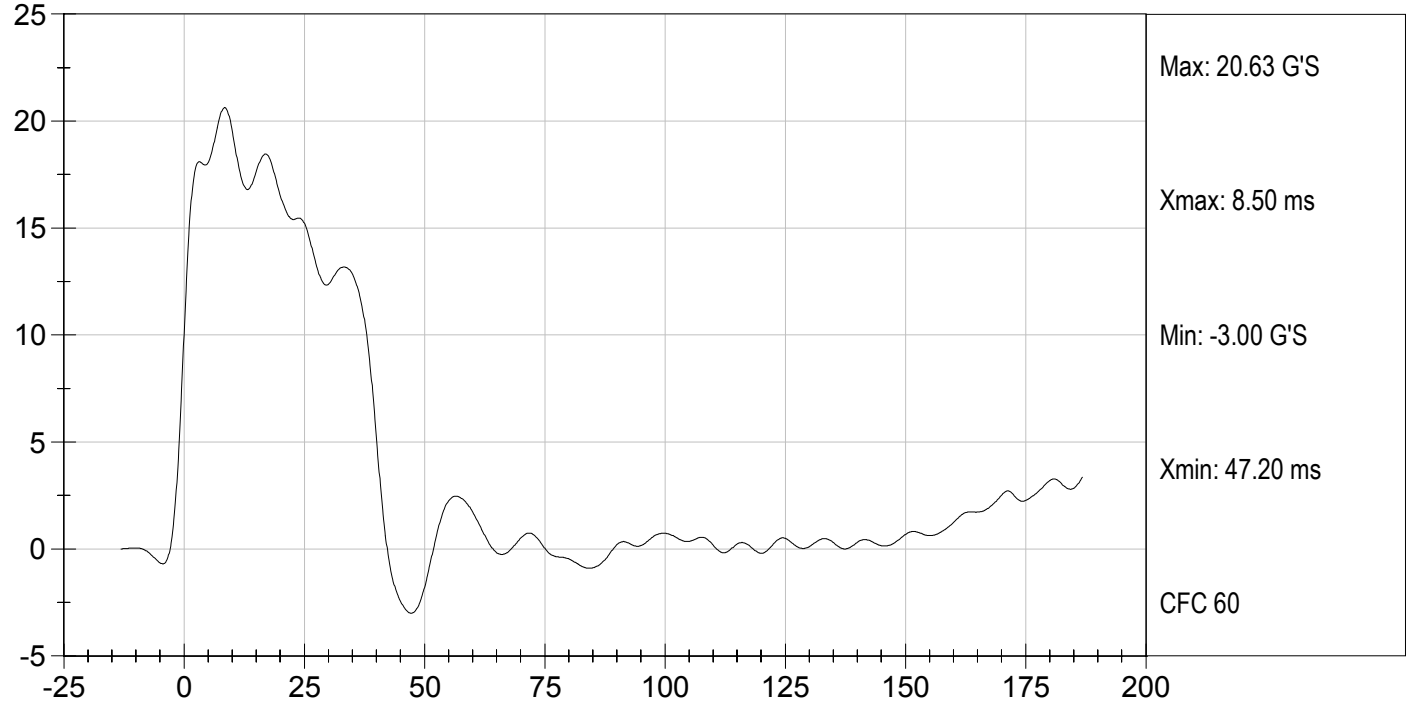
David Winkelbauer

Approved By

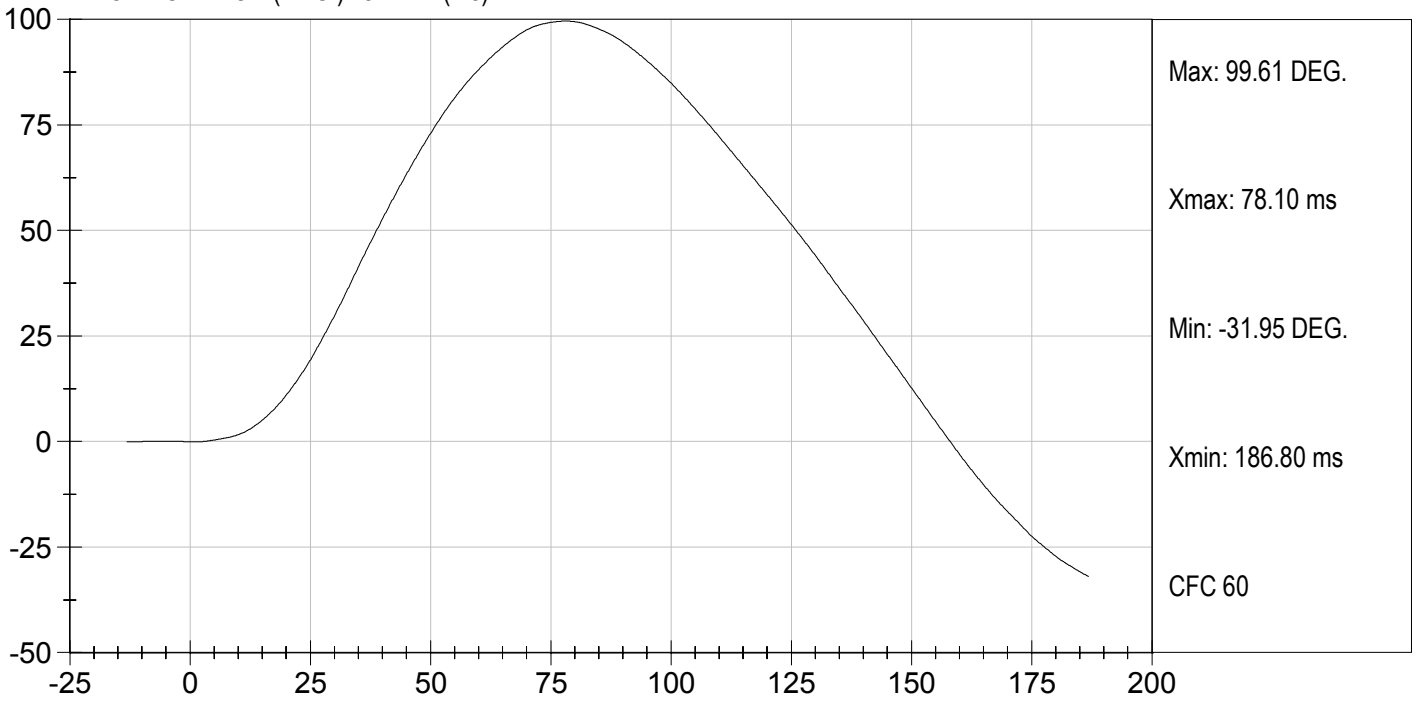
Test Desc: Neck Extension
Componet ID: D05143

Test Date: 01/20/2005
Velocity: 19.56 ft/s, 5.96 m/s

PENDULUM DECELERATION (G'S) vs TIME (ms)

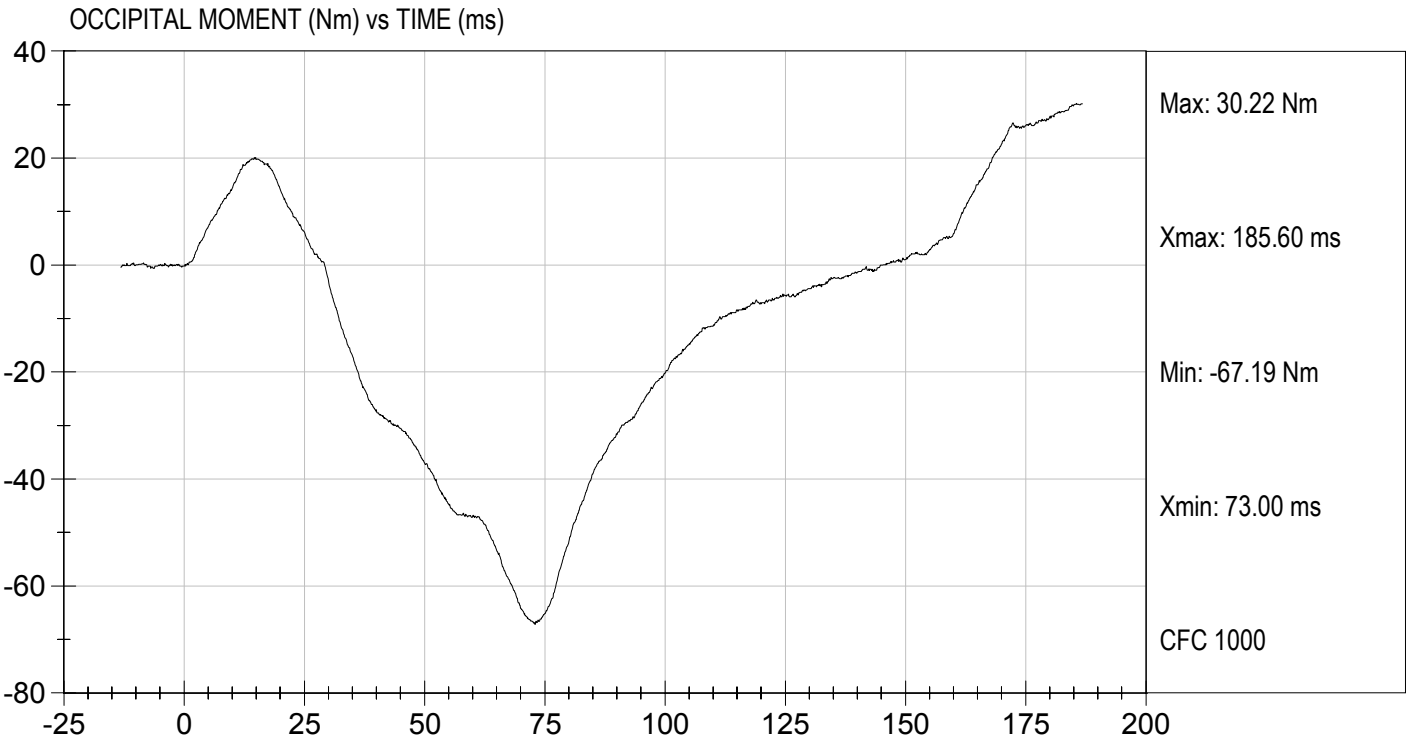


NECK ROTATION (DEG.) vs TIME (ms)



Test Desc: Neck Extension
Componet ID: D05143

Test Date: 01/20/2005
Velocity: 19.56 ft/s, 5.96 m/s



MGA RESEARCH CORPORATION

THORAX IMPACT

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 065 **Test I.D:** D05144

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.2	Pass
Laboratory Relative Humidity	%	10 to 70	18	Pass
Probe Velocity	m/s	6.58 to 6.82	6.72	Pass
Peak Probe Force	N	5159 to 5893	5,625	Pass
Peak Sternum Displacement	cm	6.35 to 7.26	6.63	Pass
Internal Hysteresis	%	69 to 85	72	Pass
		Overall Test Results		Pass

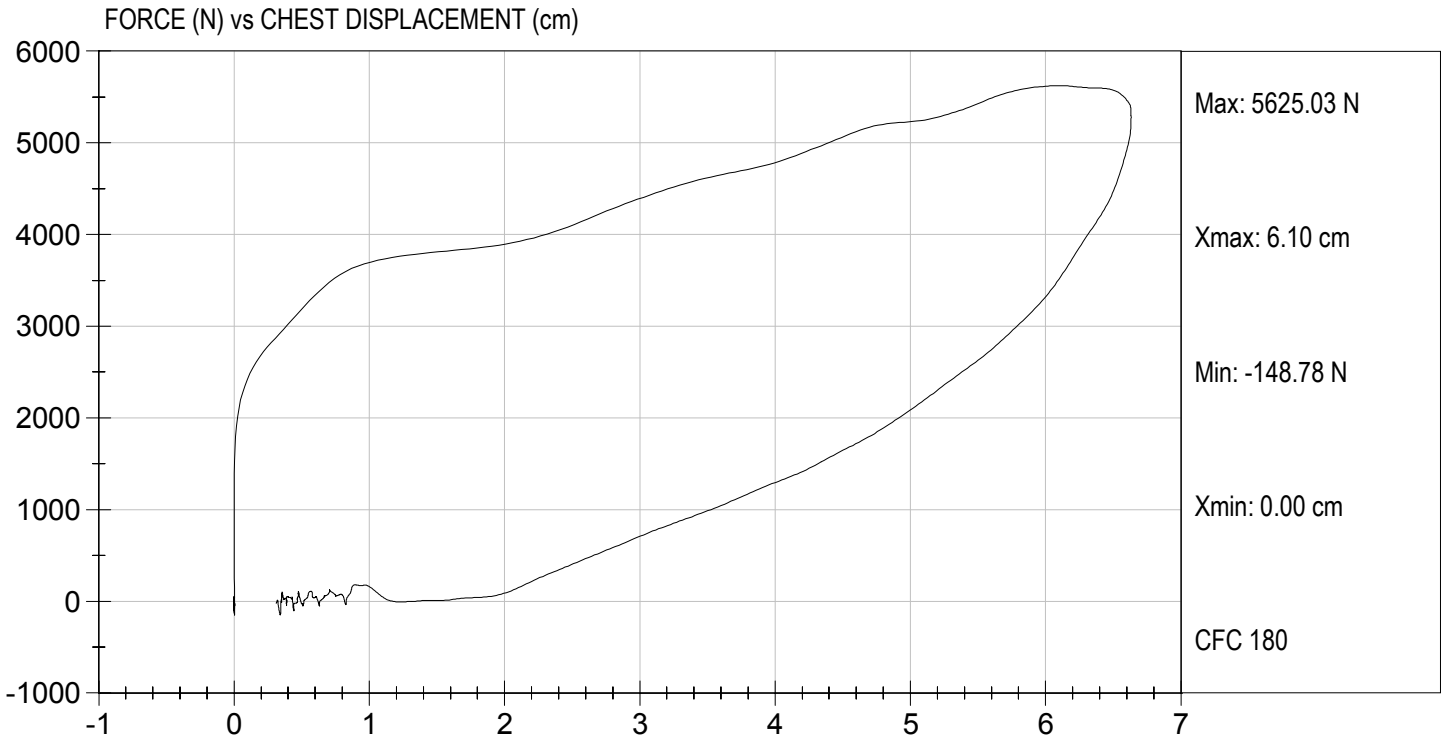
Joe Fleck
Laboratory Technician

01/21/2005
Test Date

David Winkelbauer
Approved By

Test Desc: Thorax Impact
Componet ID: D05144

Test Date: 01/21/2005
Velocity: 22.05 ft/s, 6.72 m/s



MGA RESEARCH CORPORATION

RIGHT KNEE IMPACT TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 065 **Test I.D:** D05145

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	21.5	Pass
Laboratory Relative Humidity	%	10 to 70	18	Pass
Probe Velocity	m/sec	2.07 to 2.13	2.08	Pass
Peak Probe Force	Newtons	4715 to 5782	5,073	Pass
		Overall Test Results		Pass

Joe Fleck

Laboratory Technician

01/21/2005

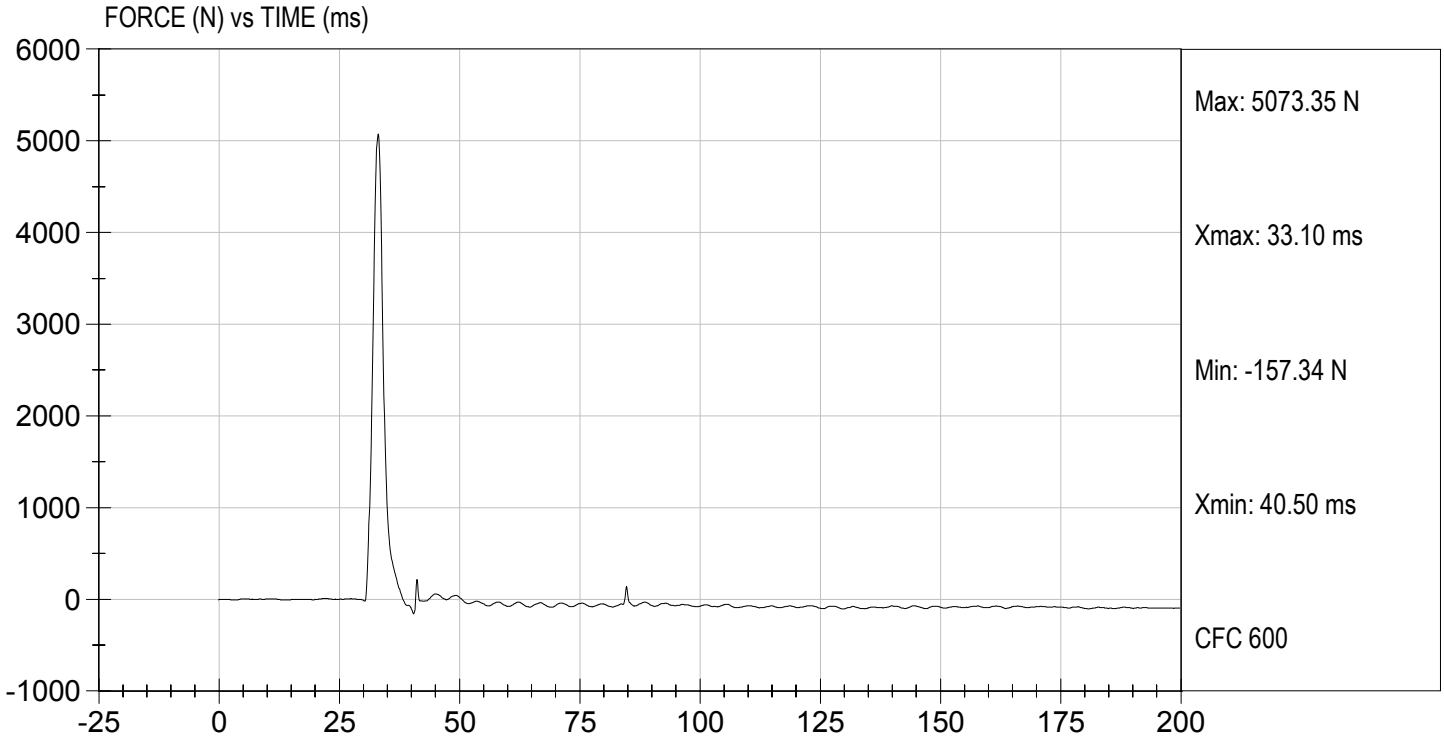
Test Date

David Winkelbauer

Approved By

Test Desc: Right Knee
Componet ID: D05145

Test Date: 01/21/2005
Velocity: 6.83 ft/s, 2.08 m/s



MGA RESEARCH CORPORATION

LEFT KNEE IMPACT TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 065 **Test I.D:** D05146

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	21.5	Pass
Laboratory Relative Humidity	%	10 to 70	18	Pass
Probe Velocity	m/sec	2.07 to 2.13	2.08	Pass
Peak Probe Force	Newtons	4715 to 5782	5,403	Pass
		Overall Test Results		Pass

Joe Fleck

Laboratory Technician

01/21/2005

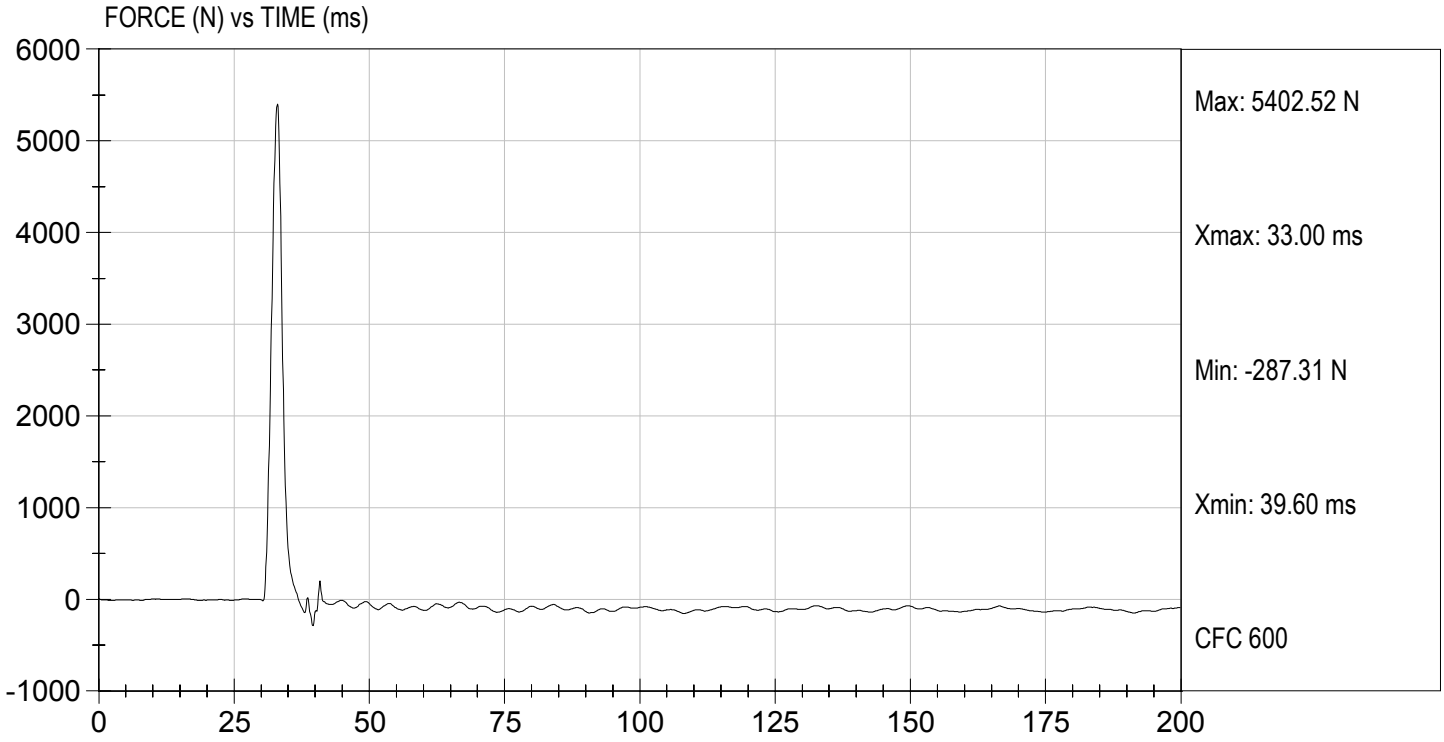
Test Date

David Winkelbauer

Approved By

Test Desc: Left Knee
Componet ID: D05146

Test Date: 01/21/2005
Velocity: 6.82 ft/s, 2.08 m/s



MGA RESEARCH CORPORATION

HIP-FEMUR FLEXION TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 065 **Test I.D:** D05140

Tested Parameter	Units	Specification	Result		Pass/Fail
			Right	Left	
Laboratory Temperature	deg C	18.9 to 25.6	21.8	21.8	Pass
Laboratory Relative Humidity	%	10 to 70	18	18	Pass
Rotation Rate	deg/sec	5 -10	8	8	Pass
30 Degrees	Nm	94.9 Nm Max	73.9	76.7	Pass
150 ft-lbf / 203.4 Nm	Deg	40- 50 Degree Max Rotation	43	42	Pass
		Overall Test Results			Pass

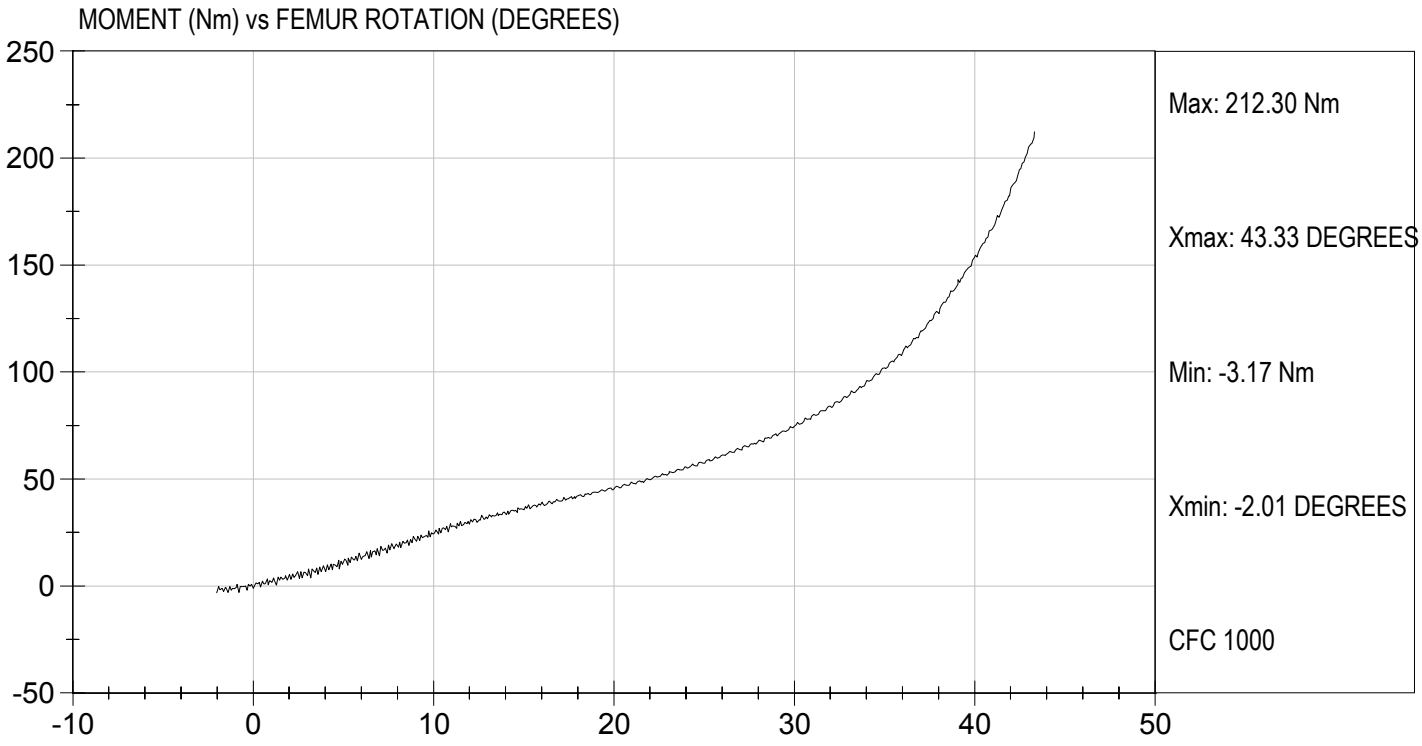
Laboratory Technician

01/21/2005
Test Date

Approved By

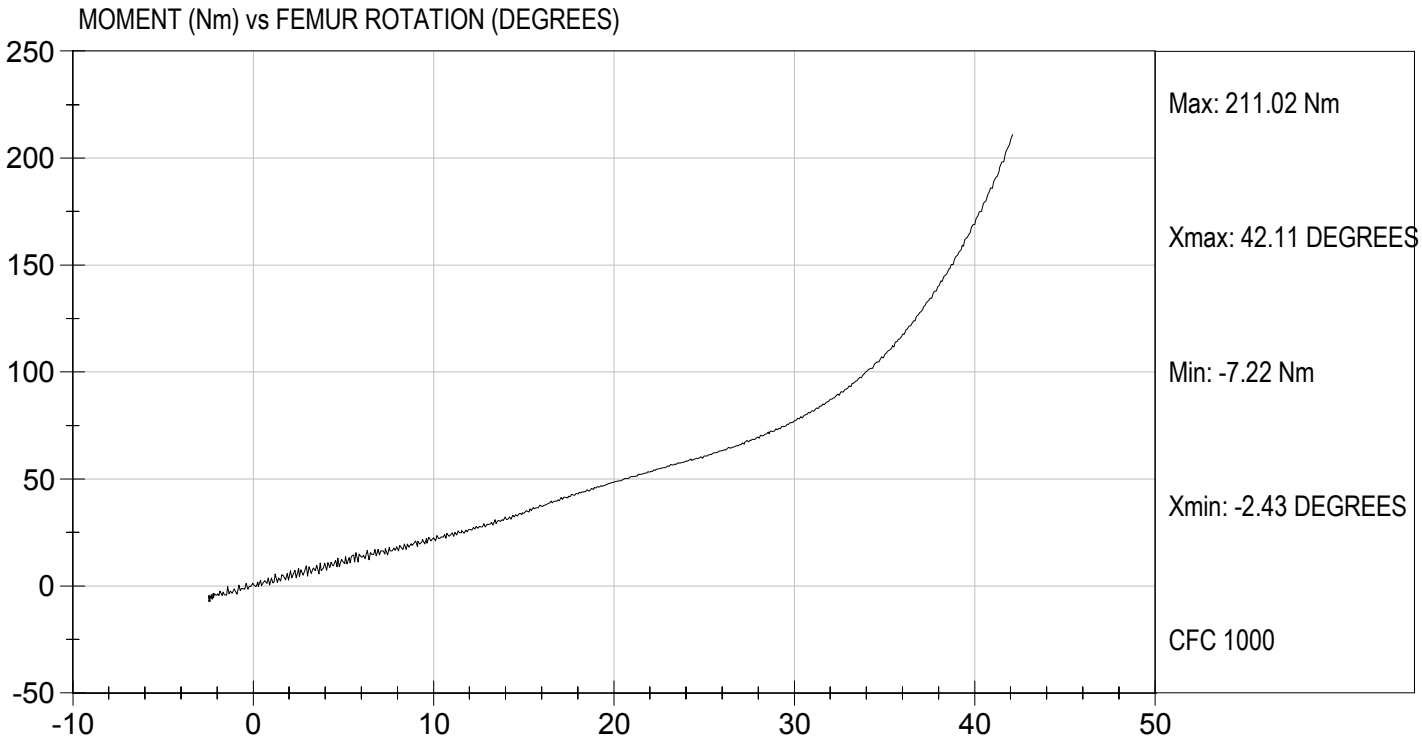
Test Desc: Hip Femur Flexion
Componet ID: D05149

Test Date: 01/21/2005
Velocity: 0 ft/s, 0.00 m/s



Test Desc: Hip Femur Flexion
Componet ID: D05140

Test Date: 01/21/2005
Velocity: 0 ft/s, 0.00 m/s



MGA RESEARCH CORPORATION

HEAD DROP TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 066 **Test ID:** D05151

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 - 25.6	21.0	Pass
Laboratory Relative Humidity	%	10 to 70	21	Pass
Peak Resultant Acceleration	G's	225 - 275	251	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-11.0	Pass
Unimodal	Yes/No	NA	Yes	Pass
Oscillations	Yes/No	within 10% of peak	Yes	Pass
		Overall Test Results		Pass

Joe Fleck

Laboratory Technician

01/20/2005

Test Date

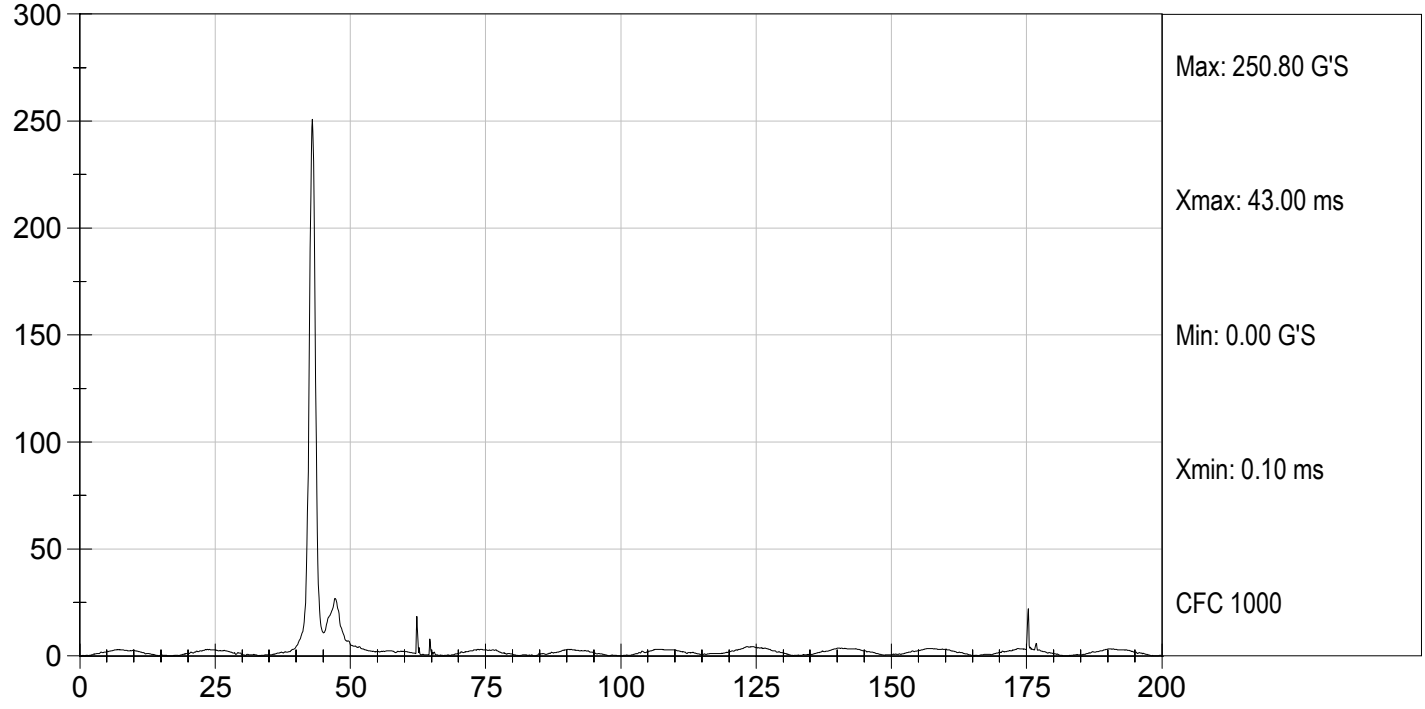
David Winkelbauer

Approved By

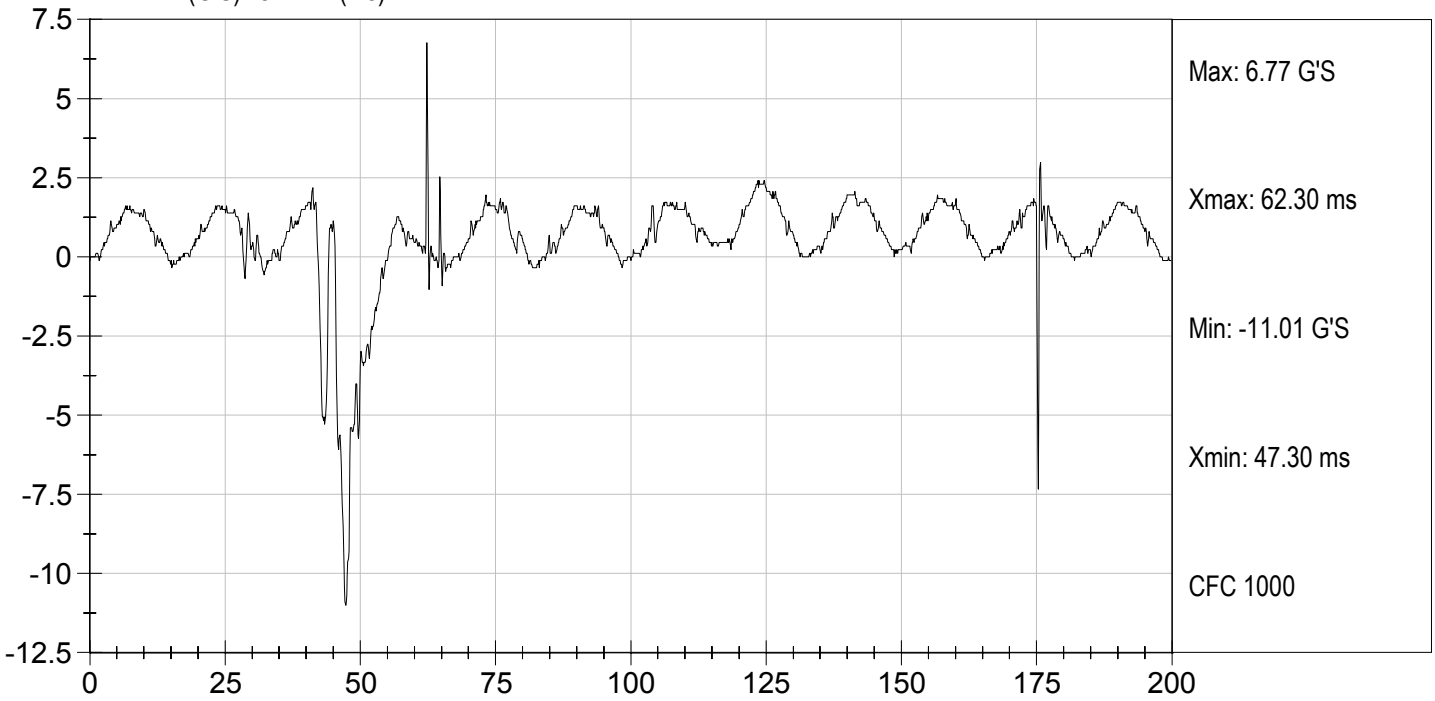
Test Desc: Head Drop
Componet ID: D05151

Test Date: 01/20/2005
Velocity: 0 ft/s, 0.00 m/s

HEAD RESULTANT ACCELERATION (G'S) vs TIME (ms)



HEAD Y (G'S) vs TIME (ms)



MGA RESEARCH CORPORATION

NECK FLEXION TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 066 **Test I.D:** D05152

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.1	Pass
Laboratory Relative Humidity		%	10 to 70	21	Pass
Pendulum Velocity		m/s	6.89 to 7.13	6.93	Pass
Pendulum Deceleration	10 msec	G's	22.50 to 27.50	23.32	Pass
	20 msec	G's	17.60 to 22.60	19.69	Pass
	30 msec	G's	12.50 to 18.50	15.18	Pass
Peak Pendulum Deceleration After 30 msec		G's	<= 29.0	15.12	Pass
Deceleration Decay Time to Cross 5 G's		msec	34.0 to 42.0	39.5	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	64.0 to 78.0	73.2	Pass
	Time	msec	57.0 to 64.0	60.9	Pass
"D" Plane Rotation Decay Time To Zero Crossing		msec	113.0 to 128.0	115.5	Pass
Moment About Occipital Condyle	Maximum	N m	88.1 to 108.5	97.1	Pass
	Time	msec	47.0 to 58.0	52.7	Pass
Positive Moment Decay Time To Zero Crossing		msec	97.0 to 107.0	102.7	Pass
			Overall Test Results		Pass

Joe Fleck

Laboratory Technician

01/20/2005

Test Date

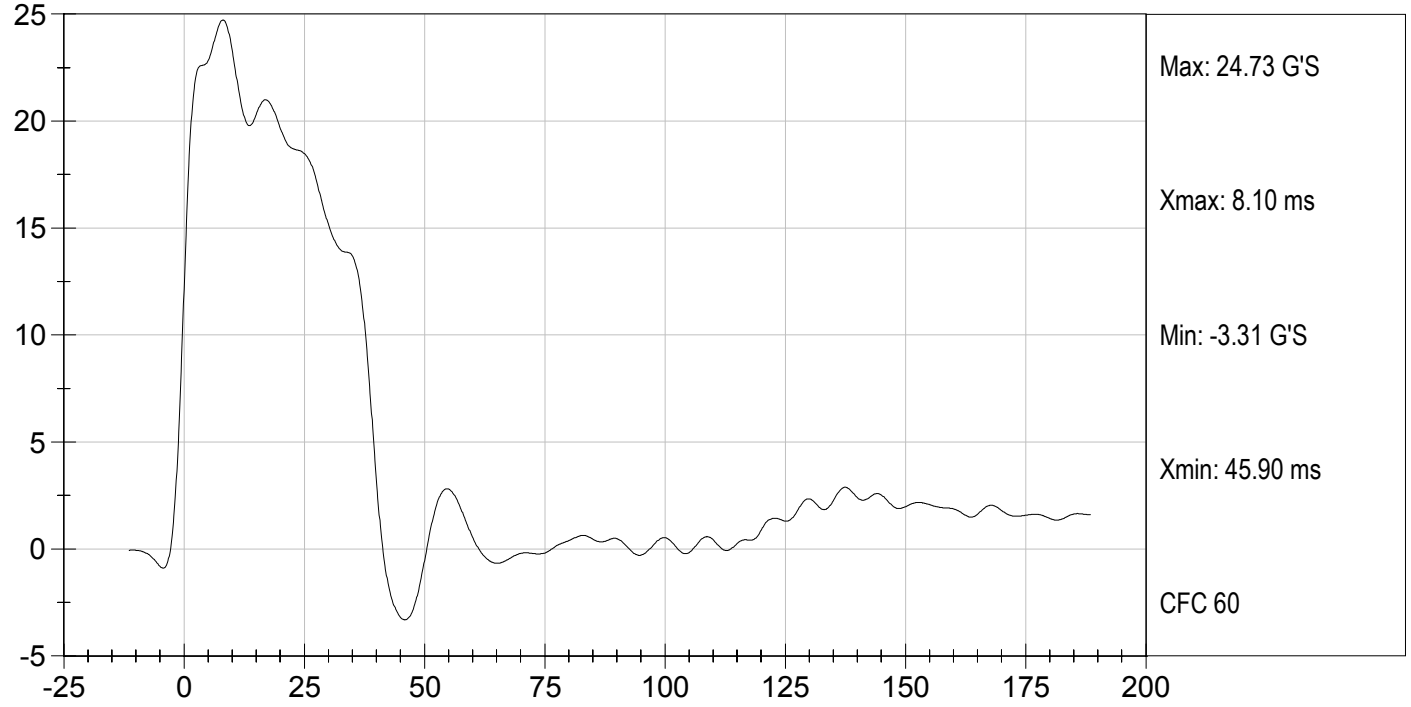
David Winkelbauer

Approved By

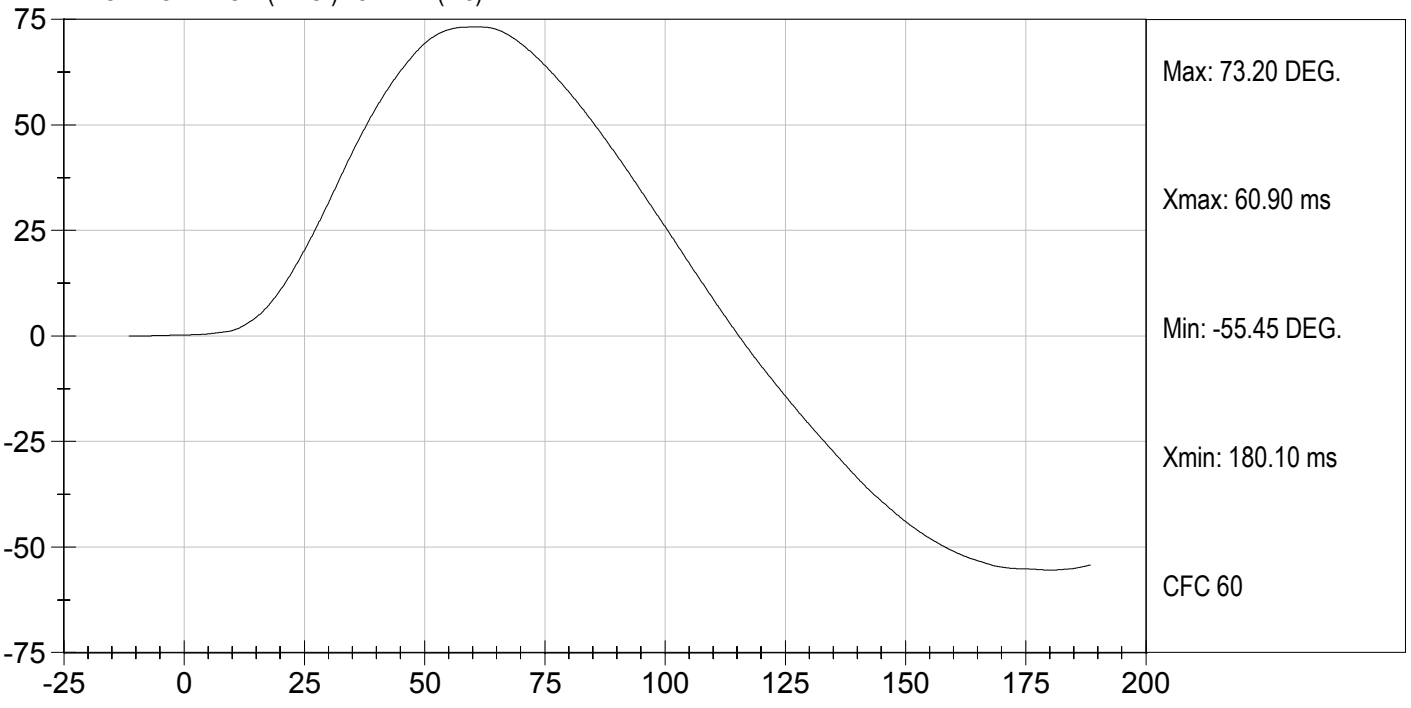
Test Desc: Neck Flexion
Componet ID: D05152

Test Date: 01/20/2005
Velocity: 22.73 ft/s, 6.93 m/s

PENDULUM DECELERATION (G'S) vs TIME (ms)



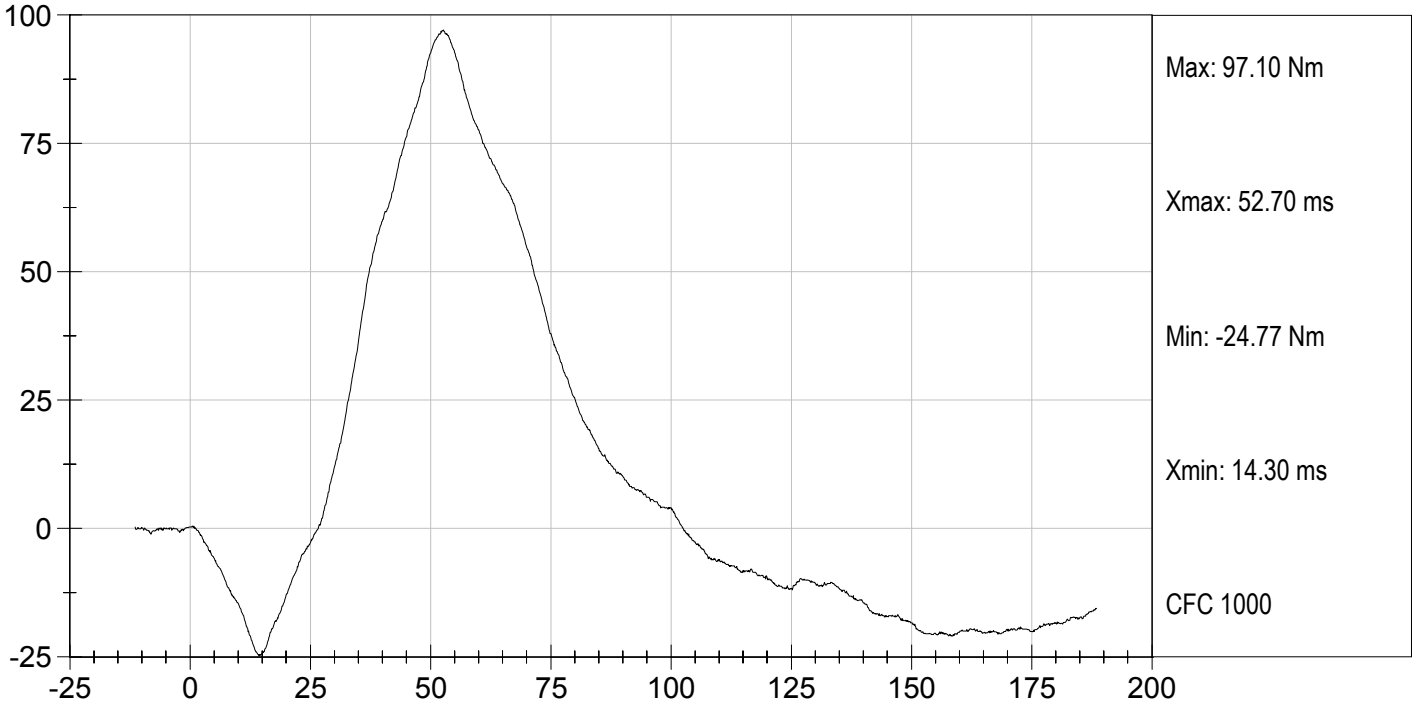
NECK ROTATION (DEG.) vs TIME (ms)



Test Desc: Neck Flexion
Componet ID: D05152

Test Date: 01/20/2005
Velocity: 22.73 ft/s, 6.93 m/s

OCCIPITAL MOMENT (Nm) vs TIME (ms)



MGA RESEARCH CORPORATION

NECK EXTENSION TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 066 **Test I.D:** D05153

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.0	Pass
Laboratory Relative Humidity		%	10 to 70	21	Pass
Pendulum Velocity		m/s	5.95 to 6.19	5.99	Pass
Pendulum Deceleration	10 msec	G's	17.20 to 21.20	19.62	Pass
	20 msec	G's	14.00 to 19.00	16.20	Pass
	30 msec	G's	11.00 to 16.00	14.10	Pass
Peak Pendulum Deceleration After 30 msec		G's	<= 22.0	14.04	Pass
Deceleration Decay Time to Cross 5 G's		msec	38.0 to 46.0	39.1	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	81.0 to 106.0	101.0	Pass
	Time	msec	72.0 to 82.0	78.2	Pass
"D" Plane Rotation Decay Time To Zero Crossing		msec	147.0 to 174.0	157.5	Pass
Moment About Occipital Condyle	Maximum	N m	-52.9 to -79.9	-69.5	Pass
	Time	msec	65.0 to 79.0	72.4	Pass
Negative Moment Decay Time To Zero Crossing		msec	120.0 to 148.0	147.2	Pass
			Overall Test Results		Pass

Joe Fleck

Laboratory Technician

01/20/2005

Test Date

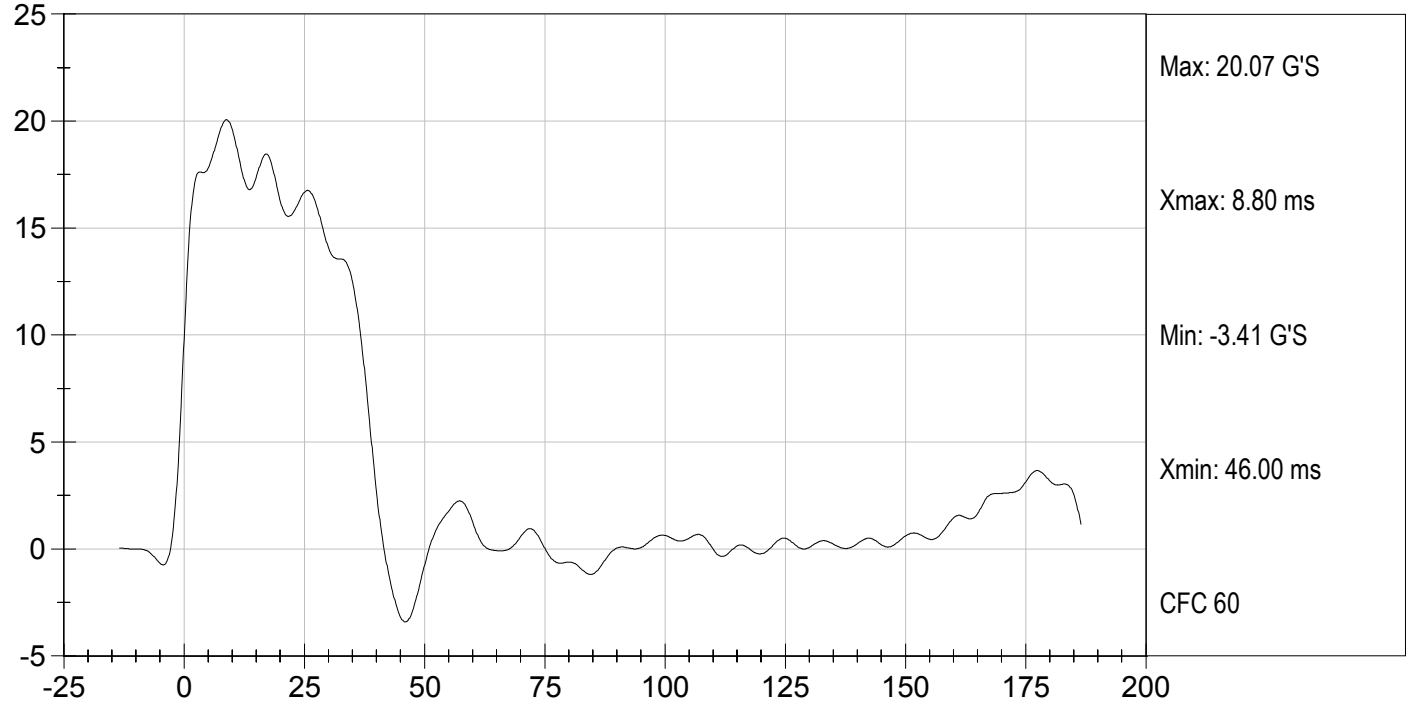
David Winkelbauer

Approved By

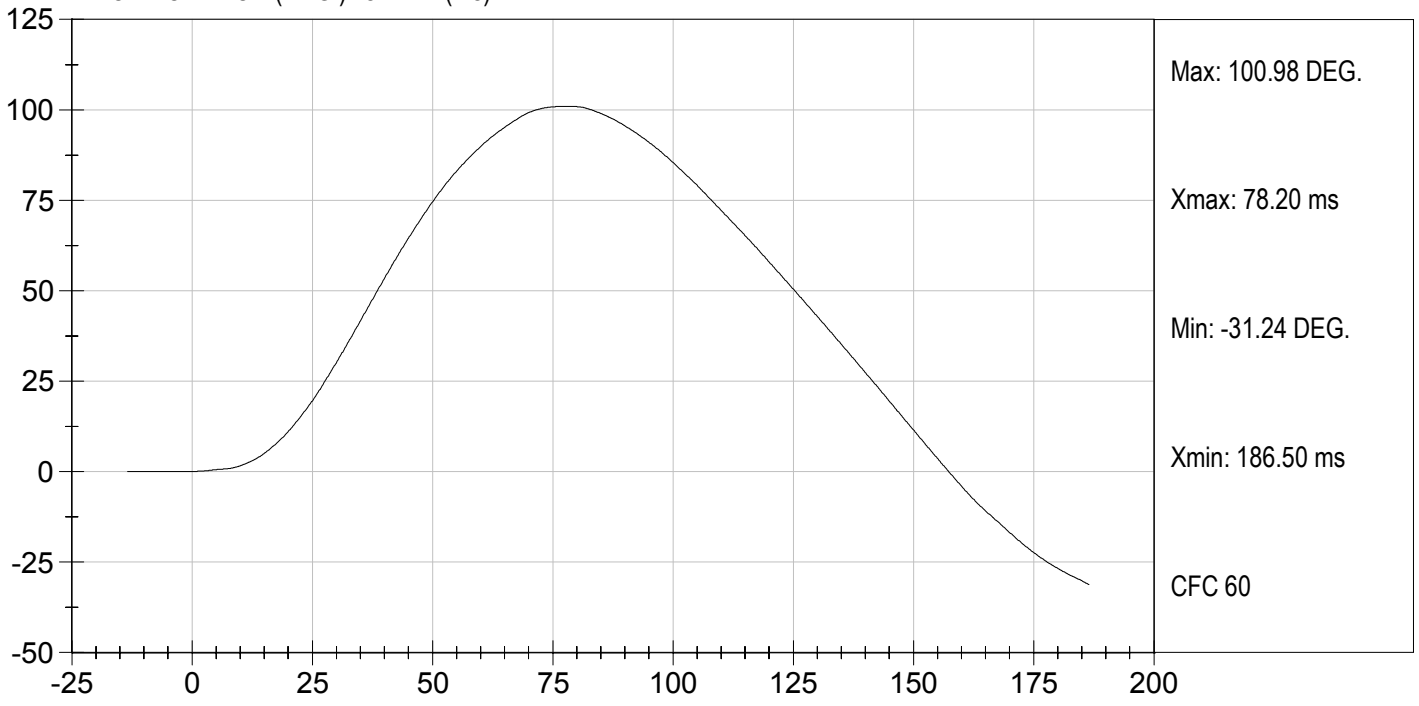
Test Desc: Neck Extension
Componet ID: D05153

Test Date: 01/20/2005
Velocity: 19.64 ft/s, 5.99 m/s

PENDULUM DECELERATION (G'S) vs TIME (ms)

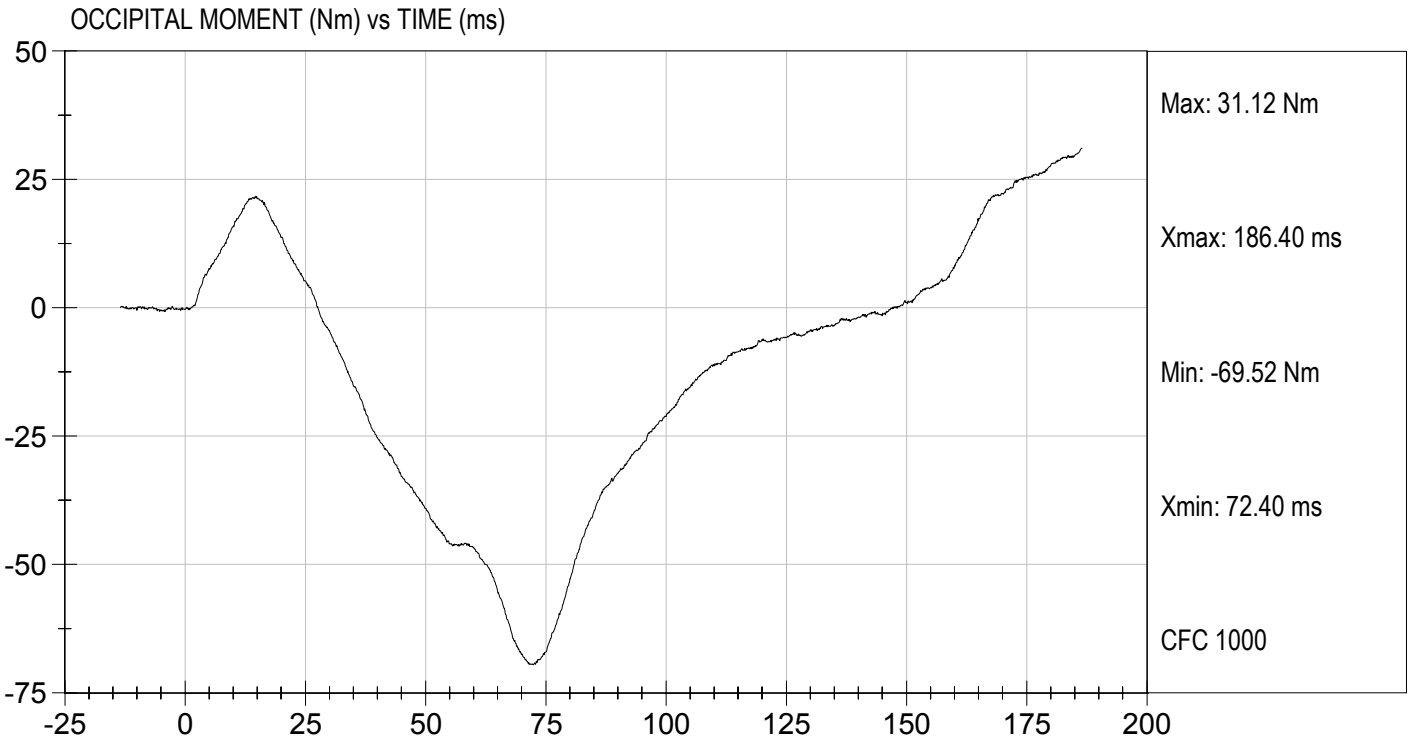


NECK ROTATION (DEG.) vs TIME (ms)



Test Desc: Neck Extension
Componet ID: D05153

Test Date: 01/20/2005
Velocity: 19.64 ft/s, 5.99 m/s



MGA RESEARCH CORPORATION

THORAX IMPACT

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 066 **Test I.D:** D05154

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.2	Pass
Laboratory Relative Humidity	%	10 to 70	18	Pass
Probe Velocity	m/s	6.58 to 6.82	6.73	Pass
Peak Probe Force	N	5159 to 5893	5,800	Pass
Peak Sternum Displacement	cm	6.35 to 7.26	6.82	Pass
Internal Hysteresis	%	69 to 85	71	Pass
		Overall Test Results		Pass

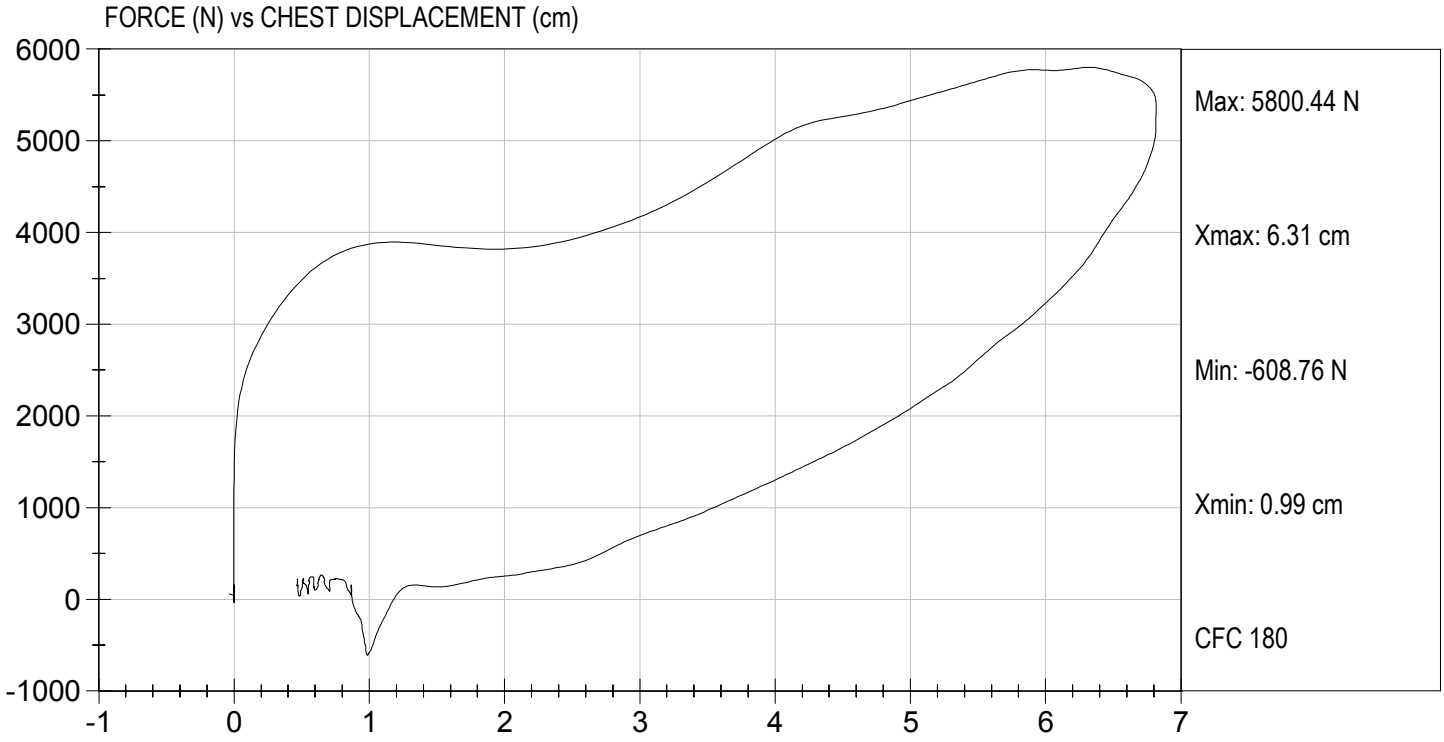
Joe Fleck
Laboratory Technician

01/21/2005
Test Date

David Winkelbauer
Approved By

Test Desc: Thorax Impact
Componet ID: D05154

Test Date: 01/21/2005
Velocity: 22.07 ft/s, 6.73 m/s



MGA RESEARCH CORPORATION

RIGHT KNEE IMPACT TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 066 **Test I.D:** D05155

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	21.4	Pass
Laboratory Relative Humidity	%	10 to 70	19	Pass
Probe Velocity	m/sec	2.07 to 2.13	2.11	Pass
Peak Probe Force	Newtons	4715 to 5782	5,538	Pass
		Overall Test Results		Pass

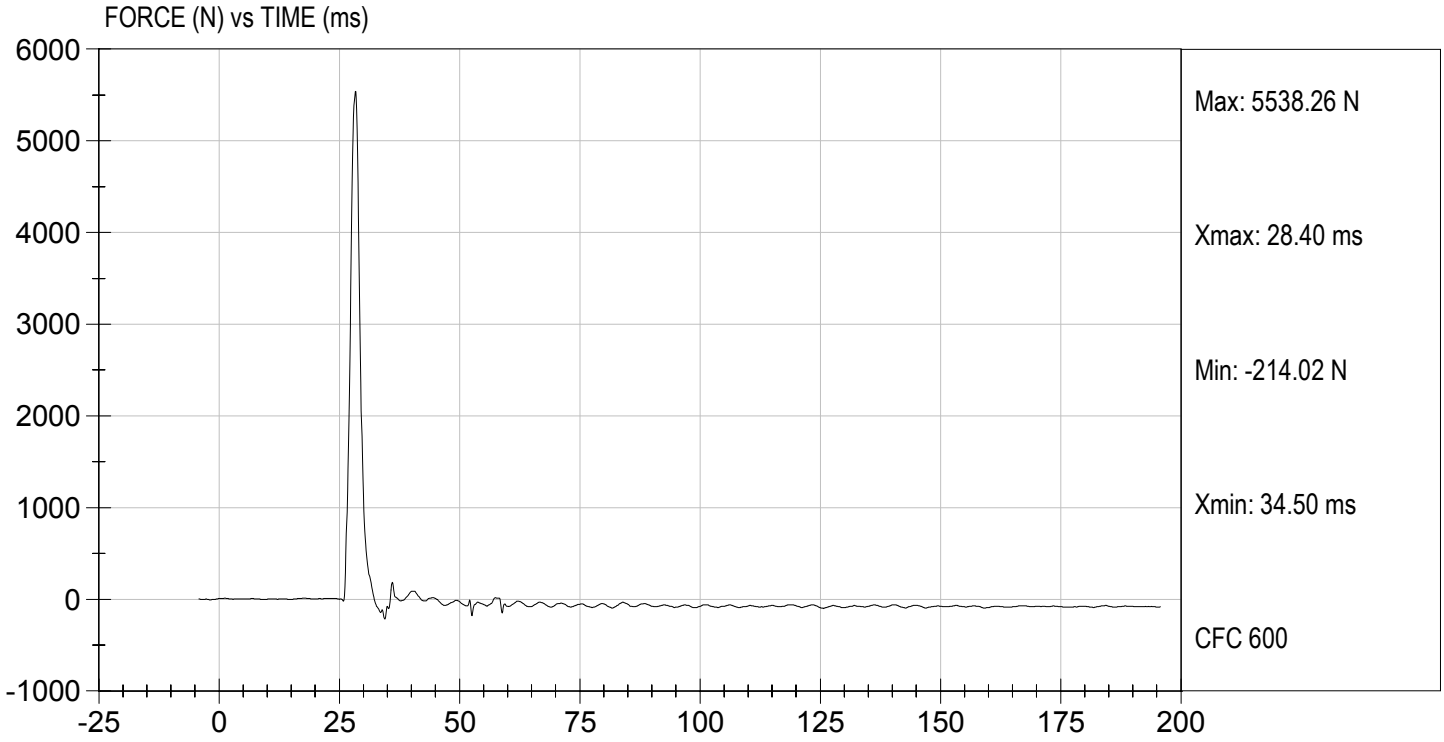
Joe Fleck
Laboratory Technician

01/21/2005
Test Date

David Winkelbauer
Approved By

Test Desc: Right Knee
Componet ID: D05155

Test Date: 01/21/2005
Velocity: 6.91 ft/s, 2.11 m/s



MGA RESEARCH CORPORATION

LEFT KNEE IMPACT TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 066 **Test I.D:** D05156

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	21.4	Pass
Laboratory Relative Humidity	%	10 to 70	18	Pass
Probe Velocity	m/sec	2.07 to 2.13	2.11	Pass
Peak Probe Force	Newtons	4715 to 5782	4,905	Pass
		Overall Test Results		Pass

Joe Fleck

Laboratory Technician

01/21/2005

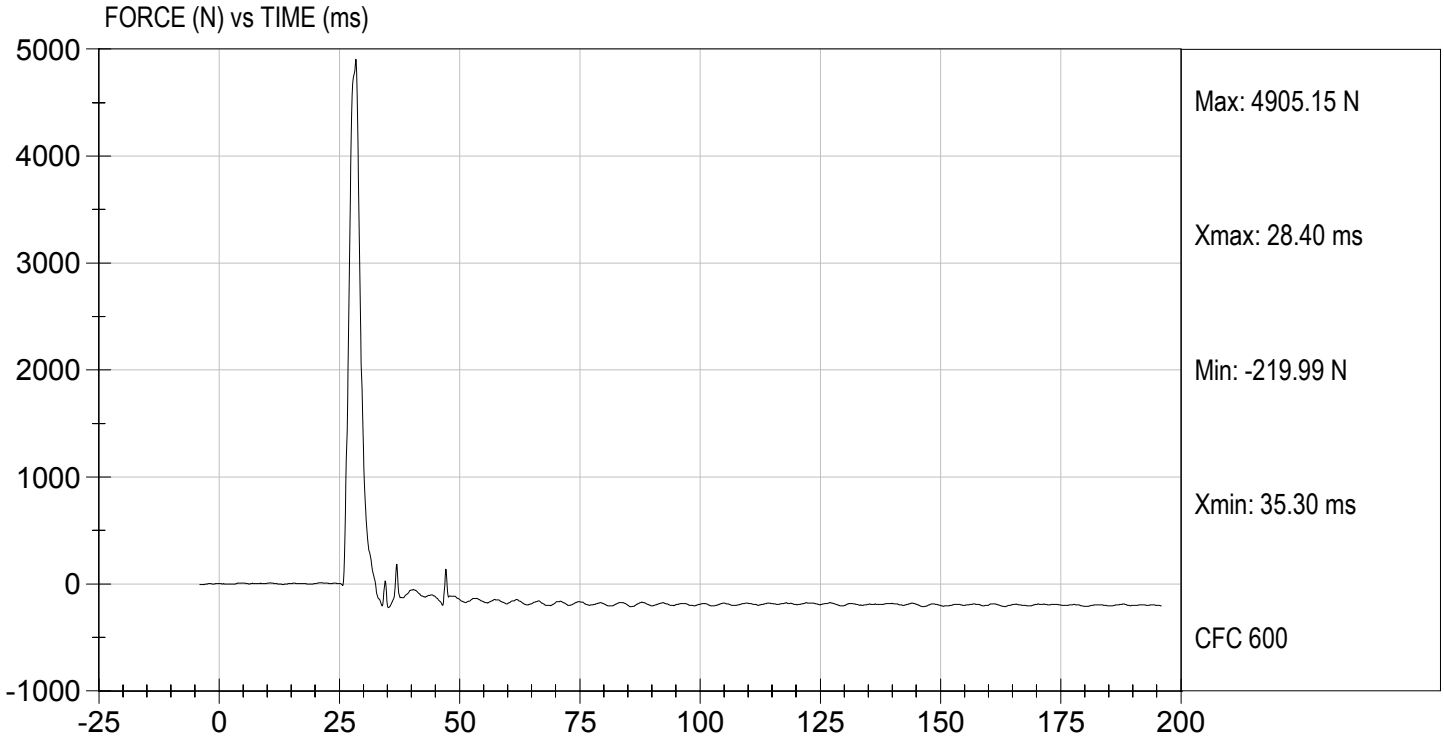
Test Date

David Winkelbauer

Approved By

Test Desc: Left Knee
Componet ID: D05156

Test Date: 01/21/2005
Velocity: 6.93 ft/s, 2.11 m/s



MGA RESEARCH CORPORATION

HIP-FEMUR FLEXION TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 066 **Test I.D:** D05150

Tested Parameter	Units	Specification	Result		Pass/Fail
			Right	Left	
Laboratory Temperature	deg C	18.9 to 25.6	21.5	21.5	Pass
Laboratory Relative Humidity	%	10 to 70	18	18	Pass
Rotation Rate	deg/sec	5 -10	8	8	Pass
30 Degrees	Nm	94.9 Nm Max	84.2	76.6	Pass
150 ft-lbf / 203.4 Nm	Deg	40- 50 Degree Max Rotation	43	40	Pass
		Overall Test Results			Pass

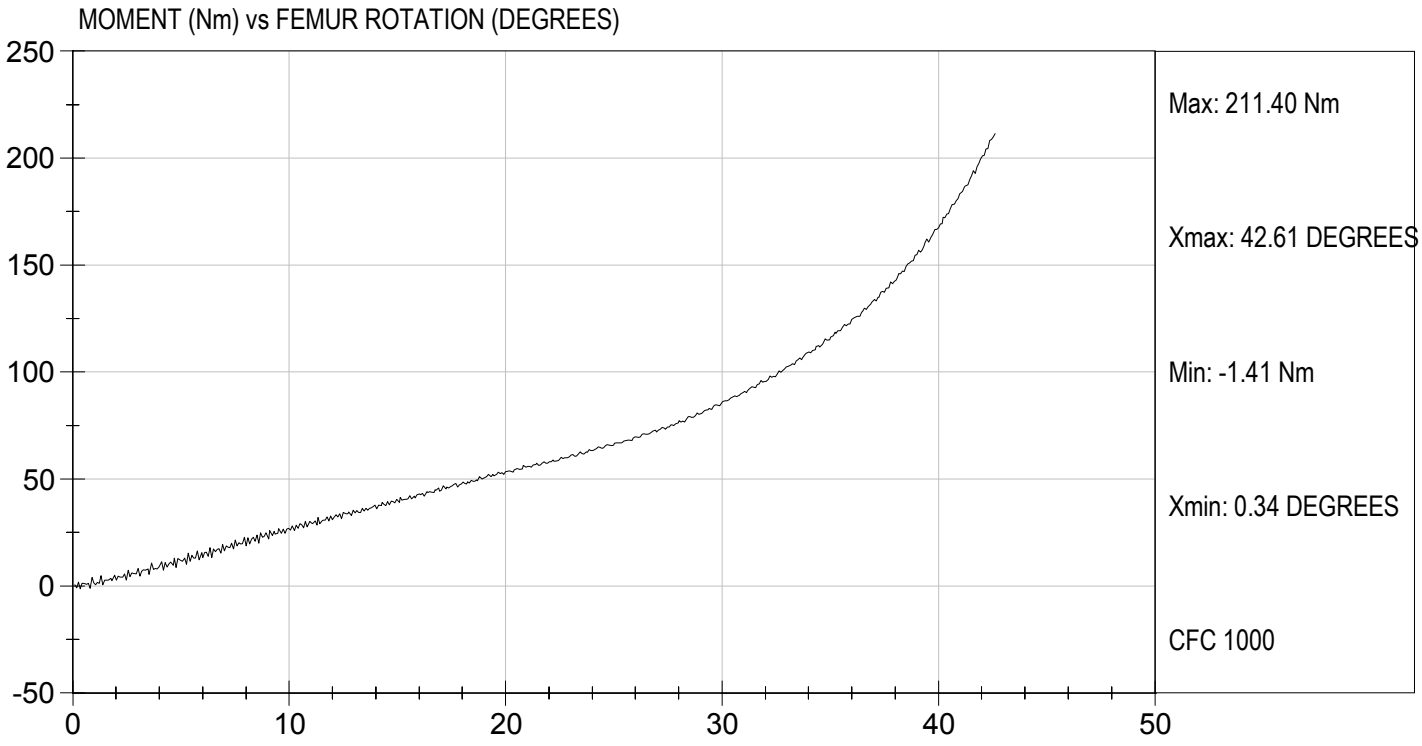
Laboratory Technician

01/21/2005
Test Date

Approved By

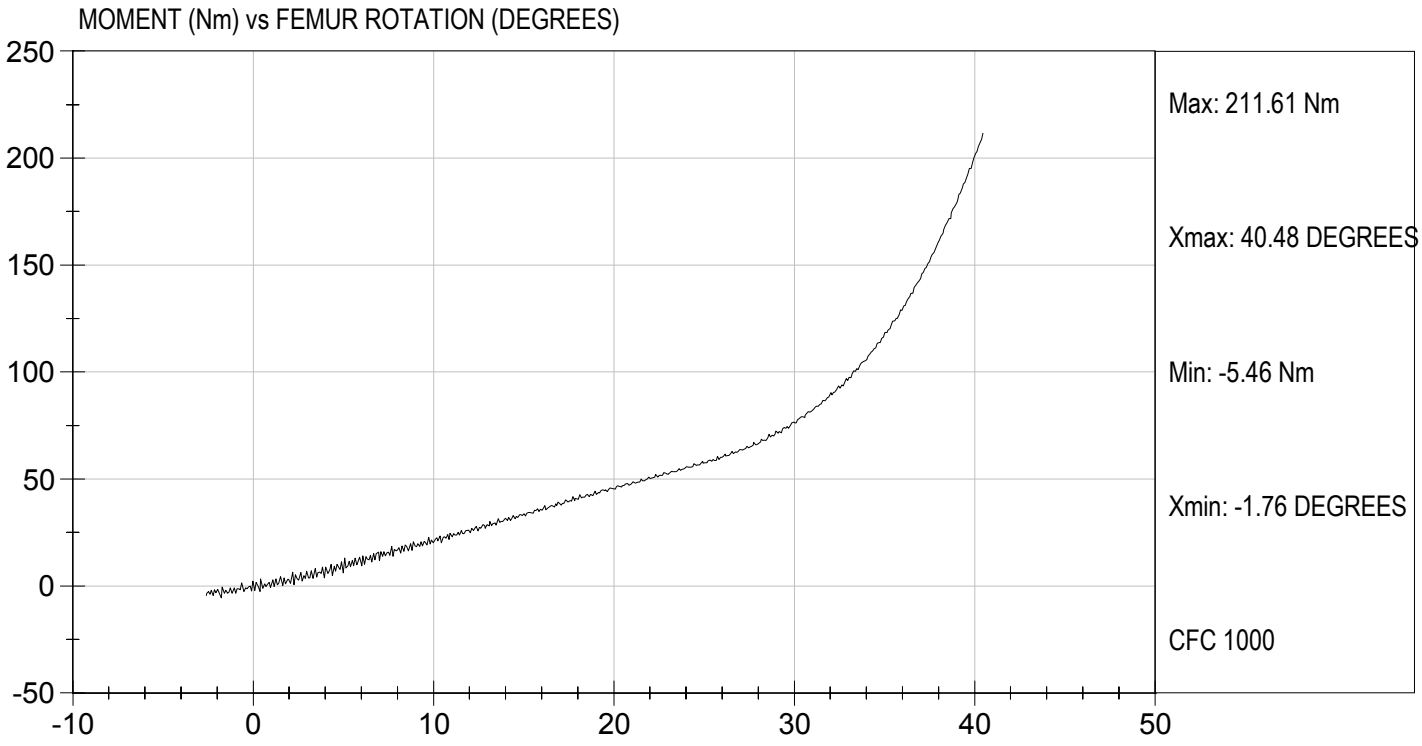
Test Desc: Hip Femur Flexion
Componet ID: D05159

Test Date: 01/21/2005
Velocity: 0 ft/s, 0.00 m/s



Test Desc: Hip Femur Flexion
Componet ID: D05150

Test Date: 01/21/2005
Velocity: 0 ft/s, 0.00 m/s



APPENDIX D

TEST EQUIPMENT AND INSTRUMENTATION CALIBRATION

INSTRUMENTS FOR DRIVER DUMMY NO. 065

	SERIAL NO.	MANUFACTURER	CALIBRATION DATE
Head X	P27020	Endevco	02/02/05
Head Y	P26986	Endevco	02/02/05
Head Z	P22692	Endevco	02/02/05
Head X Redundant	J10431	Endevco	02/02/05
Head Y Redundant	P27025	Endevco	02/02/05
Head Z Redundant	AN9E3	Endevco	02/02/05
Neck Load Cell	443	Denton	07/20/04
Chest X	AMT78	Endevco	02/02/05
Chest Y	AP1Y8	Endevco	02/02/05
Chest Z	J11361	Endevco	02/02/05
Chest Deflection Gauge	065	Servo	02/01/05
Chest X Redundant	ALFP5	Endevco	02/02/05
Chest Y Redundant	AP138	Endevco	02/02/05
Chest Z Redundant	AJ9Y3	Endevco	02/02/05
Pelvis X	AJ9D8	Endevco	11/12/04
Pelvis Y	AJ4J3	Endevco	11/12/04
Pelvis Z	AF0M3	Endevco	11/12/04
Left Femur Load Cell	262	Denton	07/20/04
Right Femur Load Cell	261	Denton	07/20/04
Left Upper Tibia Load Cell	266	Denton	07/22/04
Left Lower Tibia Load Cell	179	Denton	07/22/04
Right Upper Tibia Load Cell	263	Denton	07/22/04
Right Lower Tibia Load Cell	174	Denton	07/22/04
Left Foot Z – Front	AMTL6	Endevco	09/17/04
Left Ankle X	AMTG3	Endevco	09/17/04
Left Ankle Z	ALC37	Endevco	09/17/04
Right Foot Z – Front	J21970	Endevco	09/17/04
Right Ankle X	J22033	Endevco	09/17/04
Right Ankle Z	J21691	Endevco	09/17/04
Shoulder Belt Load Cell	158	Denton	12/07/04
Lap Belt Load Cell	166	Denton	12/07/04

INSTRUMENTS FOR PASSENGER DUMMY NO. 066

	SERIAL NO.	MANUFACTURER	CALIBRATION DATE
Head X	A28-H01	Entran	09/17/04
Head Y	J13535	Endevco	10/25/04
Head Z	A28-H02	Entran	09/17/04
Head X Redundant	A27-Z12	Entran	09/17/04
Head Y Redundant	AH097	Endevco	10/25/04
Head Z Redundant	L17-Z14	Entran	09/17/04
Neck Load Cell	442	Denton	07/20/04
Chest X	J26-H10	Entran	02/01/05
Chest Y	J26-H04	Entran	02/01/05
Chest Z	J26-H09	Entran	02/01/05
Chest Deflection Gauge	066	Servo	02/01/05
Chest X Redundant	J25-R13	Entran	02/01/05
Chest Y Redundant	J26-H01	Entran	02/01/05
Chest Z Redundant	J25-R15	Entran	02/01/05
Pelvis X	J07-H14	Entran	02/01/05
Pelvis Y	J07-H23	Entran	02/01/05
Pelvis Z	I20-J10	Entran	02/01/05
Left Femur Load Cell	259	Denton	07/20/04
Right Femur Load Cell	256	Denton	07/20/04
Left Upper Tibia Load Cell	107	Denton	07/22/04
Left Lower Tibia Load Cell	136	Denton	07/22/04
Right Upper Tibia Load Cell	103	Denton	07/22/04
Right Lower Tibia Load Cell	133	Denton	07/22/04
Left Foot Z – Front	J13-A23	Entran	02/01/05
Left Ankle X	J21-Z03	Entran	02/01/05
Left Ankle Z	J14-J07	Entran	02/01/05
Right Foot Z – Front	J26-H11	Entran	02/01/05
Right Ankle X	J26-H15	Entran	02/01/05
Right Ankle Z	J26-H12	Entran	02/01/05
Shoulder Belt Load Cell	157	Denton	08/18/04
Lap Belt Load Cell	194	Denton	12/07/04

INSTRUMENTS FOR VEHICLE

	SERIAL NO.	MANUFACTURER	CALIBRATION DATE
Left Rear Seat Crossmember X	I16-B11	Entran	10/27/04
Left Rear Seat Crossmember Z	A08-M06	Entran	09/13/04
Right Rear Seat Crossmember X	L17-D34	Entran	09/24/04
Right Rear Seat Crossmember Z	C12-R25	Entran	10/27/04
Top of Engine X	J07-M18	Entran	10/29/04
Bottom of Engine X	L13-R28	Entran	09/13/04
Left Brake Caliper X	J25-R17	Entran	12/01/04
Right Brake Caliper X	A08-M02	Entran	09/13/04
Instrument Panel X	F16-J19	Entran	12/02/04