JRS Dynamic Rollover Test

2011 Kia Soul

Sponsored By:

Automotive Safety Research Institute
Charlottesville, VA.

Vehicle Loaned by:
State Farm Insurance Company
Chicago, IL.

Introduction

The Center for Injury Research conducted a JRS dynamic rollover test consisting of two rolls of a 2011 Kia Soul on June 6h and 7th. This test report is organized in sections containing test information, data tables and photographs as follows:

Section 1 – Test Procedures and Summaries

Section 2 – Test Results, Data Tables and Selected Comparison Photographs for Roll 1.

Section 3 – Test Results, Data Tables and Selected Comparison Photographs for Roll 2.

Section 4 – Data Graphs

Section 5 – All Test Photographs

Enclosed with this report is a DVD of the video of both rolls.

2011 Kia Soul

Executive Summary

The test was a two roll event. The planned difference between the rolls was the contact angle at impact; 145 degrees for Roll 1 and 125 degrees for roll 2, and the position of the Hybrid III dummy. For Roll 1, the dummy was located “out of position;" leaning towards the passenger side approximately 45° in order to simulate approximately 1g of lateral acceleration. For Roll 2, the dummy was left in the resting position from the previous roll. Table 1 describes the impact conditions of each test. Table 2 shows the injury assessment reference values for the low durometer neck that was used.

Table 1 Summary of Test Conditions

Roll	Pitch	Road Speed	Contact Angle	Roll Rate	Yaw	Drop Height
1	10.1 deg	20.4 mph*	139 deg	257 deg/sec	10 deg	4 in.
2	10.3 deg	20.4 mph*	117 deg	266 deg/sec	10 deg	4 in.

***Roll encoder slipped. Estimated from calibration run.

Table 2 Lower Neck IARV's for 10% Probability of an AIS ≥ 3 Injury

Neck Type	My (Nm) Flexion	My (Nm) Extension	Mx (Nm)	Axial Fz (N)
Production	380	−156	268	4000
Low Durometer	90-110	−38-−46	59-90	1640-2000
Human/Cadaver	58			1500

In Roll 1, the peak lower neck compressive load was 479 N and the peak lower neck moment was 60 Nm in flexion and 28 Nm in extension. The peak intrusion speed at the top of the A-Pillar was 6.0 mph with a peak crush of 5.5 inches.

In Roll 2, the peak lower neck compressive load was 1,544 N and the peak lower neck moment was 133 Nm in flexion and 28 Nm in extension. The peak intrusion speed at the top of the A-Pillar was 6.5 mph with a peak crush of 2.8 inches.

1. Test Procedure and Summaries

For each roll of the test, the following steps are performed as necessary:

1. Inspect the test vehicle for prior damage, rust or other factors that might influence the outcome of the test
2. Prepare the test equipment
3. Install and prepare the instrumentation and video cameras
4. Install the test vehicle in test fixture
5. Perform pre-test measurements
6. Photograph the vehicle
7. Conduct the impact test
8. Perform post test measurements
9. Photograph the vehicle following the test

The set up of the test vehicle in the fixture and the instrumentation in the vehicle was the same for Rolls 1 and 2 contact angle. Roll 1 = 145 deg. Roll 2 = 125 deg.

The test weight of the vehicle was 3042 pounds. The initial weight of the vehicle was 2905 pounds. The test roll moment of inertia was approximately 337.03 lb-ft-sec^2 for a referenced value of 355.8 lb-ft-sec^2.

The vehicle was suspended on mounts at the rear and at the front in a manner that allowed it to roll freely and be dropped, passenger side (near side) leading.

Three string potentiometer mounts were placed approximately on the longitudinal roll axis of the vehicle at the cg of the vehicle. The sensors measured the roof dynamics at the top of

the driver's side A-pillar, at the header inboard of the A-pillar and at the top of the passenger's side A-pillar. An instrumented, restrained Hybrid III 50th percentile male test dummy was placed in the driver's seat. The dummy was instrumented with upper and lower neck load cells as well as a triaxial head accelerometer, triaxial chest accelerometer, uniaxial pelvis accelerometer, and a chest deflection transducer. In addition, seat belt load cells were utilized at the lap and shoulder belt.

The Hybrid III dummy was equipped with a more biofidelic (low durometer) neck, located in the driver's seat which was positioned in the mid seat position. The dummy was restrained using the vehicle's standard 3 point harness. The vehicle also had a side curtain airbag and a belt pretensioner which were fired at 30 degrees of roll during the first impact test. The dummy's head was chalked before each roll to locate impact marks during the tests. The lower neck mounting block was replaced with a block that increased the neck angle forward 30 degrees from the nominal position.

For the first roll the dummy was tethered "out of position" with a small cable that electronically disconnected at approximately 30° of roll. The "out of position" location of the dummy was found by rotating the vehicle by 90° toward the passenger side. This orientation simulated the dummy accelerating toward the passenger side door at 1 g. For the second roll the dummy was left in the same position from the end of the first roll, held in place by the belt in tension.

Six vertical and two lateral load cells were placed in the moving roadway to record the impact characteristics of the test.

Two string potentiometers were placed on the fixture support towers to record vehicle vertical motion characteristics during the test. One string potentiometer was located in the front drop tower and the other was located in the rear drop tower. The rear string potentiometer did not register data in this test and the vehicle pitch was calculated using high speed camera data.

A roll encoder was placed on the cable pulley which pulls the moving roadway to record the roadway velocity throughout the test. In addition, a roll rate sensor was placed inside the vehicle. For both rolls, the roll encoder was unable to report sled velocity data. As such the speed was estimated from data provided by the calibration run.

The equipment used in the conduct of this test is listed in Table 3 and the test vehicle identification data is shown in Table 4 below.

Table 3 Equipment and Instrumentation

Item	MFR./Model
String Potentiometer – Driver's Side A-Pillar	Space Age Control – 301432
String Potentiometer – Roof Header	Space Age Control – 301432
String Potentiometer – Passenger's Side A-Pillar	Space Age Control – 301432
String Potentiometer – Front Fixture Support Tower	Space Age Control – 4332-01
String Potentiometer – Rear Fixture Support Tower	Space Age Control – 4332-01
Upper Neck Load Cell	RA Denton 1716A
Lower Neck Load Cell	RA Denton 1794A
Triaxial Head Accelerometer	Endevco, 7264C-2KTZ-2-240
Belt Load Cell - Lap	RADenton 3255
Belt Load Cell - Torso	RADenton 3255
Roll Rate Sensor	DTS ARS
Hybrid III, 50th Percentile Male	Denton 50th Male
Vertical Load Cell 1	Transducer Techniques, SWP-20k – 173372
Vertical Load Cell 2	Transducer Techniques, SWP-20k – 176138
Vertical Load Cell 3	Transducer Techniques, SWP-20k – 176139
Vertical Load Cell 4	Transducer Techniques, SWP-20k – 176140
Vertical Load Cell 5	Transducer Techniques, SWP-20k – 176141
Vertical Load Cell 6	Transducer Techniques, SWP-20k – 176142
Lateral Load Cell 1	Transducer Techniques, DSM-8k – 149806
Lateral Load Cell 2	Transducer Techniques, DSM-8k – 149807
Roadway Velocity Roll Encoder	Contelec – RSC 2201 236 111 106
Vehicle Data Acquisition System	Diversified Technical Systems, TDAS PRO SIM
Roadway Data Acquisition System	Diversified Technical Systems, TDAS PRO SIM
JRS Fixture Acquisition System	Measurement Computing, USB – 1608FS

Table 4 General Test Vehicle Data Test Vehicle: 2011 Kia Soul

Test Vehicle Information:	
Manufacturer: Kia	VIN: KNDJT2A29B7731673
Gross Weight: 3880 lb	Curb Weight: 2810 lb
Sunroof: Yes	2WD/4WD: 2WD
Equivalent Years: 2010- Present	Body Type: 4 Door Wagon

2. Test Results, Data Tables and Selected Comparison Photographs for Roll 1.

The results of the first roll of the JRS Dynamic Rollover Test are presented in this section. In the roll, the vehicle dropped as planned and contacted the vehicle's roof structure.

Roll 1 – 06/06/12

Summary of Results

Instrument	Peak Value	Residual Intrusion (inches)	Peak Velocity (mph)
Sum of Vertical Load Cells (near side contact)	10,869 lb		
Sum of Vertical Load Cells (far side contact)	15,033 lb		
Sum of Lateral Load Cells (near side contact)	552 lb		
Sum of Lateral Load Cells (far side contact)	739 lb		
Driver's Side A-Pillar String Potentiometer	-5.5 in	-3.2 in	-6.0
Roof Header String Potentiometer	-3.3 in	-2.0 in	-4.2
Passenger's Side A-Pillar String Potentiometer	-1.9 in	-1.3 in	-2.0

Instrument	Maximum Value	Minimum Value
Lap Belt Load	265 lbs	-104 lbs
Shoulder Belt Load	378 lbs	-10 lbs
Dummy Head Acceleration Ax	7 G's	-42 G's
Dummy Head Acceleration Ay	4 G's	-18 G's
Dummy Head Acceleration Az	25 G's	-5 G's
Lower Neck Load Cell Fx	159 N	-403 N
Lower Neck Load Cell Fy	429 N	-60 N
Lower Neck Load Cell Fz	260 N	-411 N
Lower Neck Load Cell Mx	6 N-m	-39 N-m
Lower Neck Load Cell My	60 N-m	-28 N-m
Upper Neck Load Cell Fx	6 N	-7 N
Upper Neck Load Cell Fy	36 N	-198 N
Upper Neck Load Cell Fz	254 N	-479 N
Upper Neck Load Cell Mx	10 N-m	-18 N-m
Upper Neck Load Cell My	7 N-m	-28 N-m

Instrument	Maximum Value	Minimum Value
Chest Deflection	5.2 mm	0.0 mm
Chest Acceleration Ax	6.4 G's	-0.9 G's
Chest Acceleration Ay	4.0 G's	-1.7 G's
Chest Acceleration Az	9.0 G's	-0.6 G's
Pelvis Acceleration Az	6.2 G's	-2.8 G's
HIC	80	

The vertical load cells mounted on the roadway platform show the near and far side impacts. For the first roll, the vehicle struck the roadway on the near side at approximately 1.31seconds. The entire roll sequence was completed by approximately 1.65 seconds.

The string potentiometers located on the fixture support towers show the vertical vehicle motion throughout the test. The front of the vehicle dropped 4.18 inches and the rear dropped 3.75 inches prior to initial touchdown. The vehicle was pitched at 10.1 degrees at contact.

The roll encoder slipped on this run and was unable to provide data regarding the roadbed velocity. The firing conditions were identical to the calibration run, so the velocity at impact time was taken from the cal run.

A roll rate sensor in the vehicle was used to determine the roll angle and roll rate at impact. The roll angle of the vehicle was 139 degrees and the roll rate was 194 degrees per second at the roadway impact. At approximately 30 degrees of roll, the pretensioner and side curtain airbag were fired and the dummy tether was released as well.

The majority of the damage was restricted to the far side of the vehicle. The deformation peaked at 5.5 inches at the far A-pillar. The windshield demonstrated some cracking but remained largely intact due to the laminate.

The driver side doors were not opened after the first roll. The passenger side doors opened normally.

The side window-curtain airbag was removed after the first roll.

Roll 1 Comparison Photographs

Figure 1: Vehicle Pre Roll 1

Figure 2: Vehicle Post Roll 1

3. Test Results, Data Tables and Selected Comparison Photographs for Roll 2.

The results of the second roll of the JRS Dynamic Rollover Test are presented in this section. In the roll, the vehicle dropped as planned and contacted the moving roadbed.

Roll 2 – 06/07/12

Summary of Results

Instrument	Peak Value	Residual Intrusion (inches)	Peak Velocity (mph)
Sum of Vertical Load Cells (near side contact)	10,463 lb		
Sum of Vertical Load Cells (far side contact)	8,930 lb		
Sum of Lateral Load Cells (near side contact)	613 lb		
Sum of Lateral Load Cells (far side contact)	1201 lb		
Driver's Side A-Pillar String Potentiometer	-2.8 in	-0.1	-6.5
Roof Header String Potentiometer	-2.6 in	-0.1	-4.2
Passenger's Side A-Pillar String Potentiometer	-5.6 in	-3.0	-11.7

Instrument	Maximum Value	Minimum Value
Lap Belt Load	270 lbs	-35 lbs
Shoulder Belt Load	1179 lbs	-1 lbs
Dummy Head Acceleration Ax	17 G's	-27 G's
Dummy Head Acceleration Ay	15 G's	-20 G's
Dummy Head Acceleration Az	40 G's	-12 G's
Lower Neck Load Cell Fx	1,230 N	-485 N
Lower Neck Load Cell Fy	549 N	-207 N
Lower Neck Load Cell Fz	556 N	-1,544 N
Lower Neck Load Cell Mx	9 N-m	-45 N-m
Lower Neck Load Cell My	133 N-m	-28 N-m
Upper Neck Load Cell Fx	16 N	-10 N
Upper Neck Load Cell Fy	39 N	-619 N
Upper Neck Load Cell Fz	563 N	-2,129 N
Upper Neck Load Cell Mx	62 N-m	-20 N-m
Upper Neck Load Cell My	17 N-m	-54 N-m

Instrument	Maximum Value	Minimum Value
Chest Deflection	0.6 mm	-2.1 mm
Chest Acceleration Ax	9.0 G's	-1.9 G's
Chest Acceleration Ay	6.3 G's	-8.3 G's
Chest Acceleration Az	13.5 G's	-0.5 G's
Pelvis Acceleration Az	6.6 G's	-5.1 G's
HIC	64	

The vertical load cells mounted on the roadway platform show the near and far side impacts. The vehicle struck the roadway on the near side at approximately 1.31 seconds. The entire roll sequence was completed by approximately 1.65 seconds.

The string potentiometers located on the fixture support towers show the vertical vehicle motion throughout the test. The front of the vehicle dropped 4.45 inches and the rear dropped 3.45 inches at impact. The vehicle was pitched at 10.3 degrees at the time of impact.

The roll encoder slipped on this run and was unable to provide data regarding the roadbed velocity. The firing conditions were identical to the calibration run, so the velocity at impact time was taken from the cal run.

A roll rate sensor in the vehicle was used to determine the roll angle and roll rate at impact. The roll angle of the vehicle was 117 degrees and the roll rate was 266 degrees per second at the roadway impact.

During the second roll the roof header buckled and tented upward. The deformation on the near side was similar to the residual crush on the far side, with similar levels of intrusion at both pillars.

A pull test was conducted on the doors after Roll 2. The driver side door and both rear doors opened with less than 20 lbf. The passenger door however, would not open with a force of 56 lbf applied to it. It opened easily after the passenger side rear door was opened first. This was due to the fact that deformation had caused the front door to be wedged behind the rear door.

Roll 2 Comparison Photographs

Figure 3: Vehicle Pre Roll 2

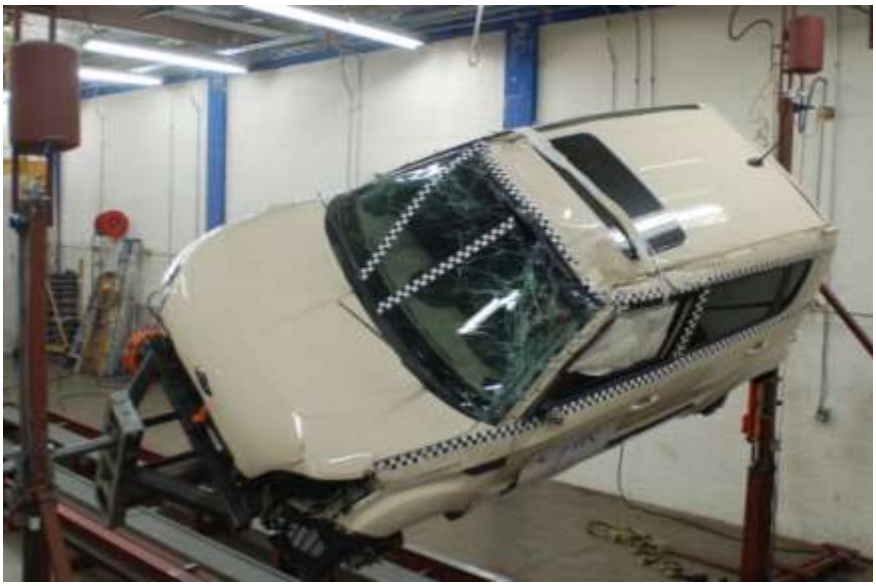
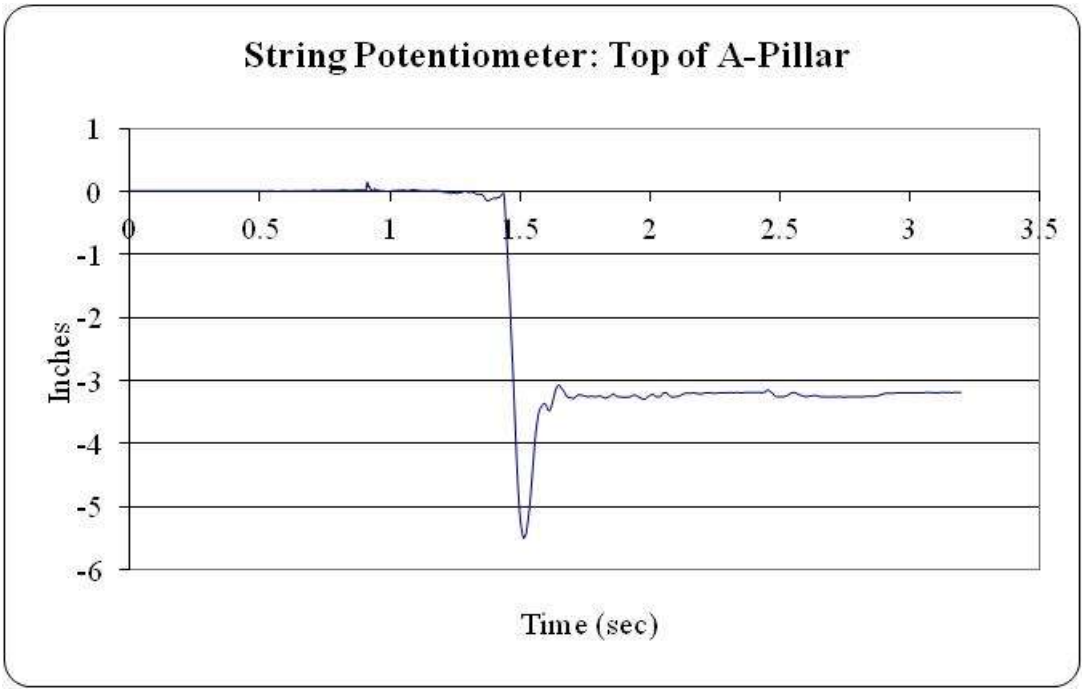


Figure 4: Vehicle Post Roll 2

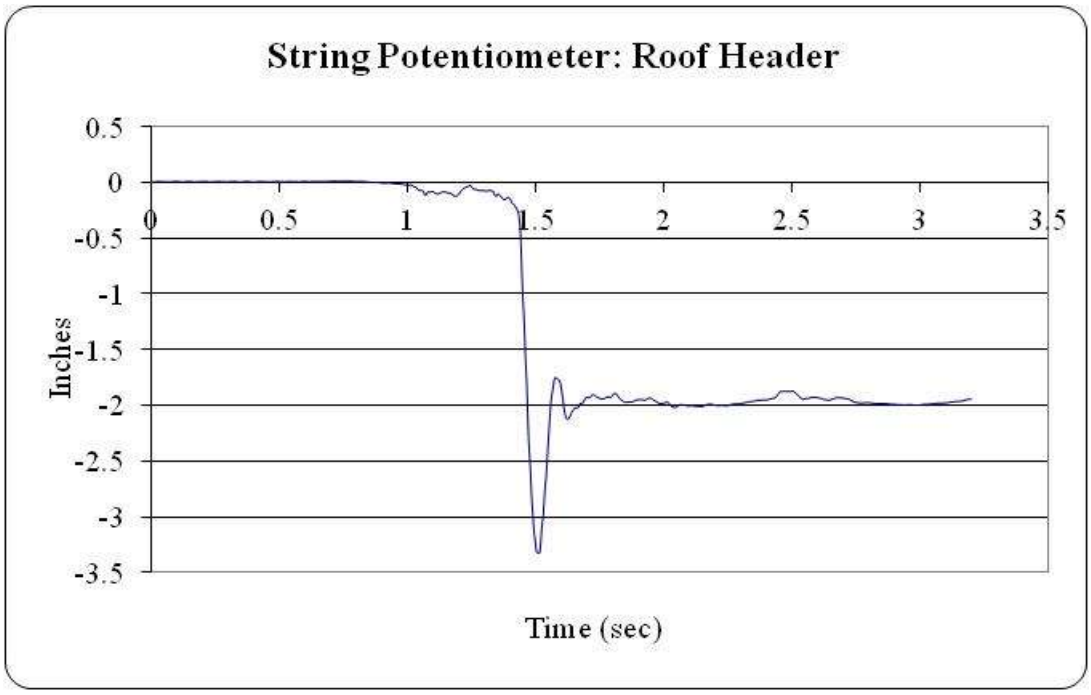
4. Data Graphs

Roll 1 Data Plots – 06/06/12



Plot 1: Top of Driver's Side A-Pillar Displacement v. Time

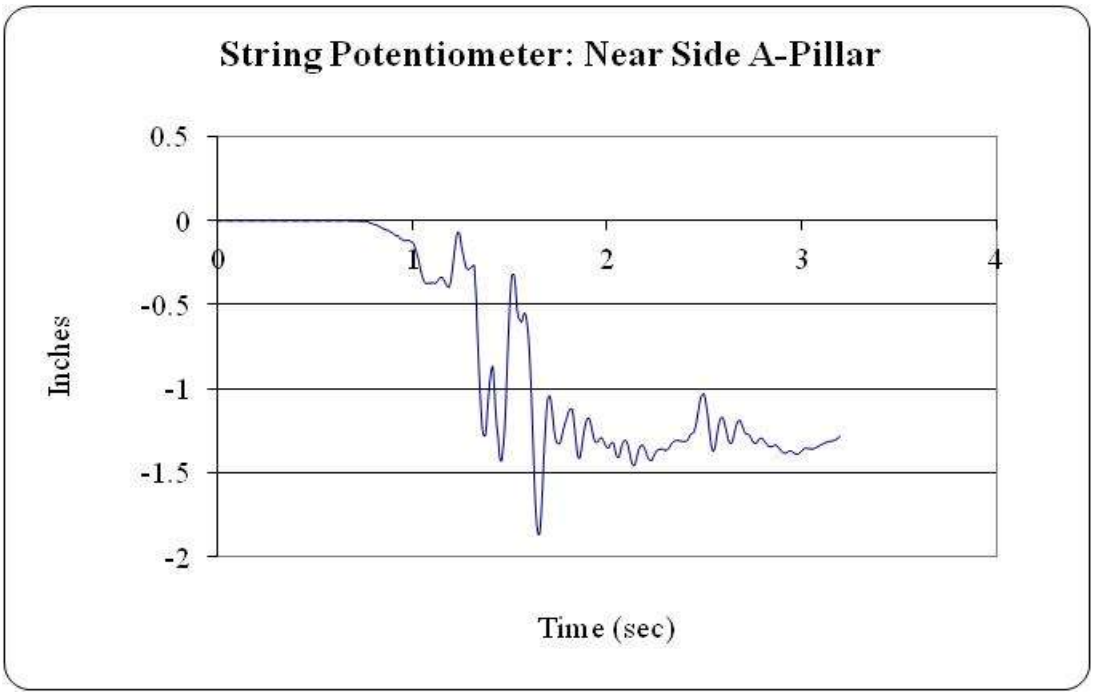
Data Sampling Rate: 10 kHz



Plot 2: String Potentiometer Driver's Side Roof Header Displacement v. Time

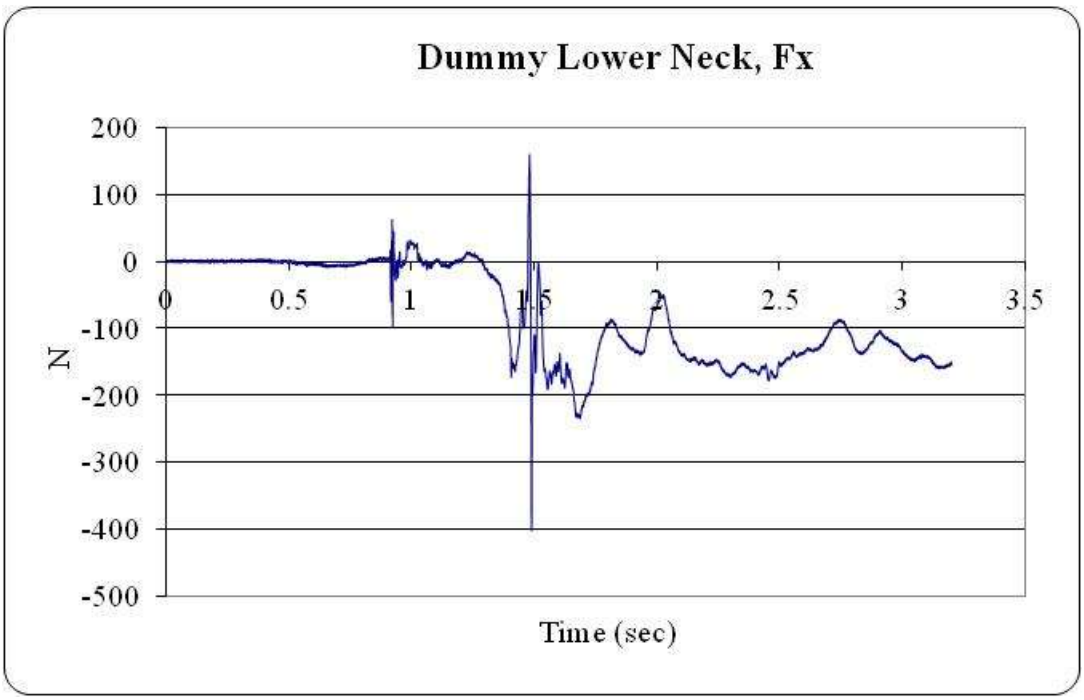
Data Sampling Rate: 10 kHz

Roll 1



Plot 3: String Potentiometer Passenger's Side A-Pillar Displacement v. Time

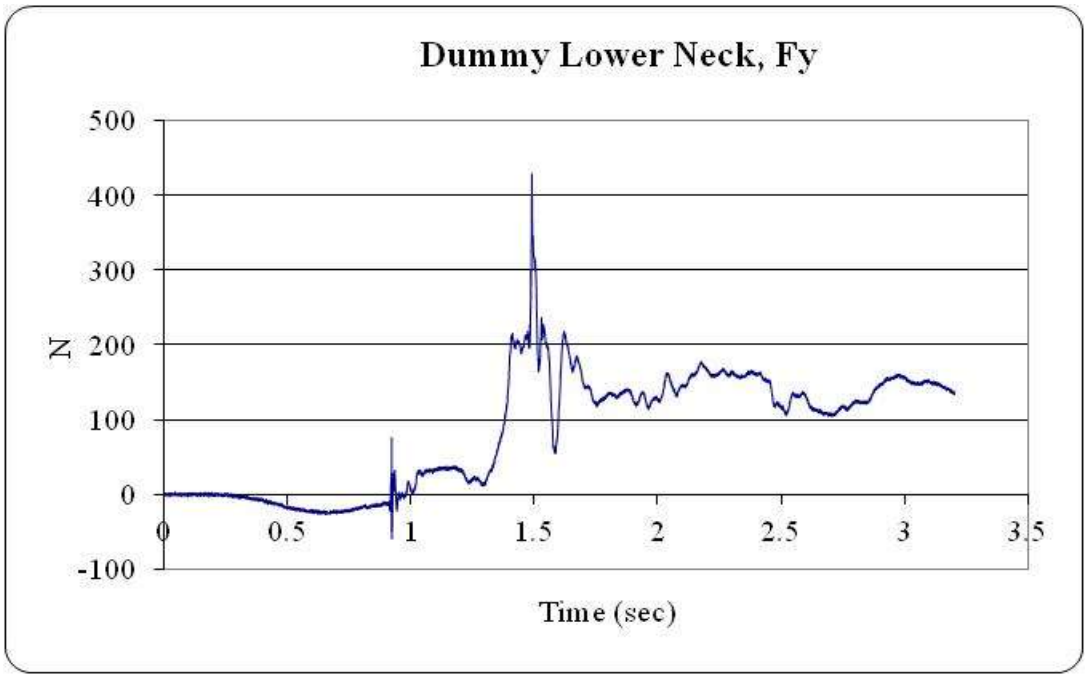
Data Sampling Rate: 10 kHz



Plot 4: Lower Neck Load, Fx, v. Time

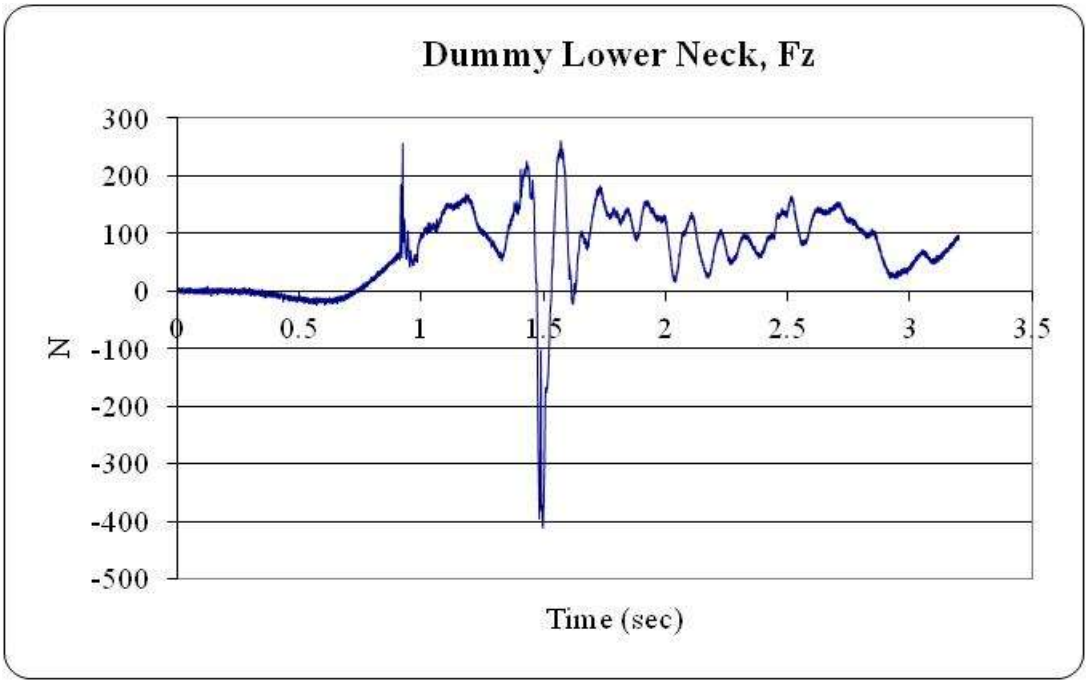
Data Sampling Rate: 10 kHz

Roll 1



Plot 5: Lower Neck Load, Fy, v. Time

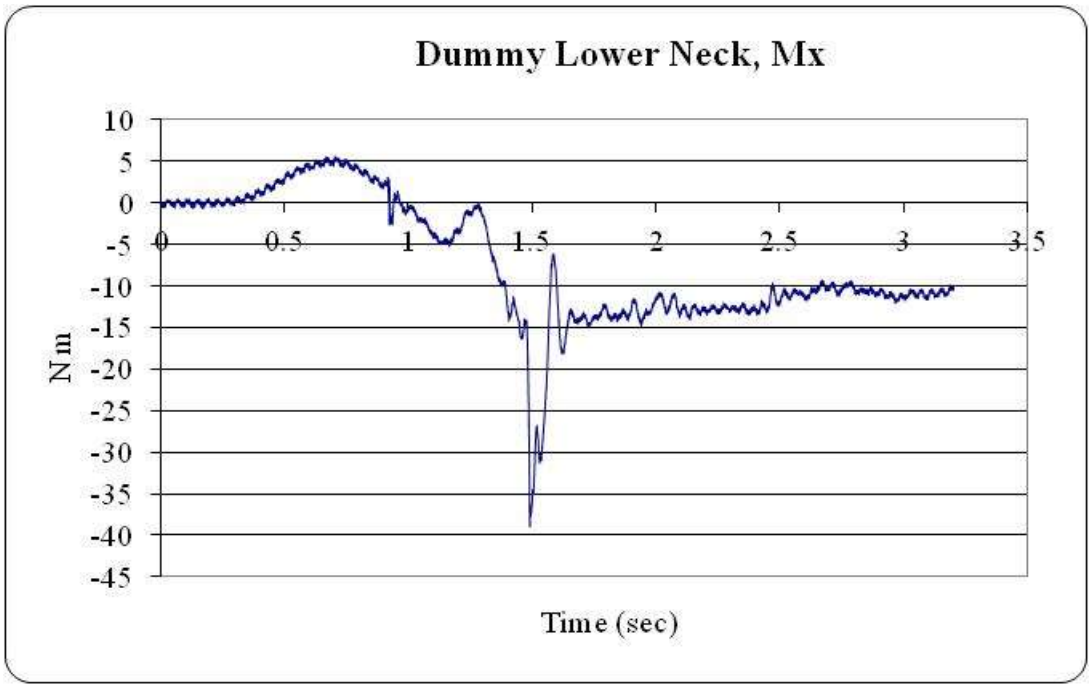
Data Sampling Rate: 10 kHz



Plot 6: Lower Neck Load, Fz, v. Time

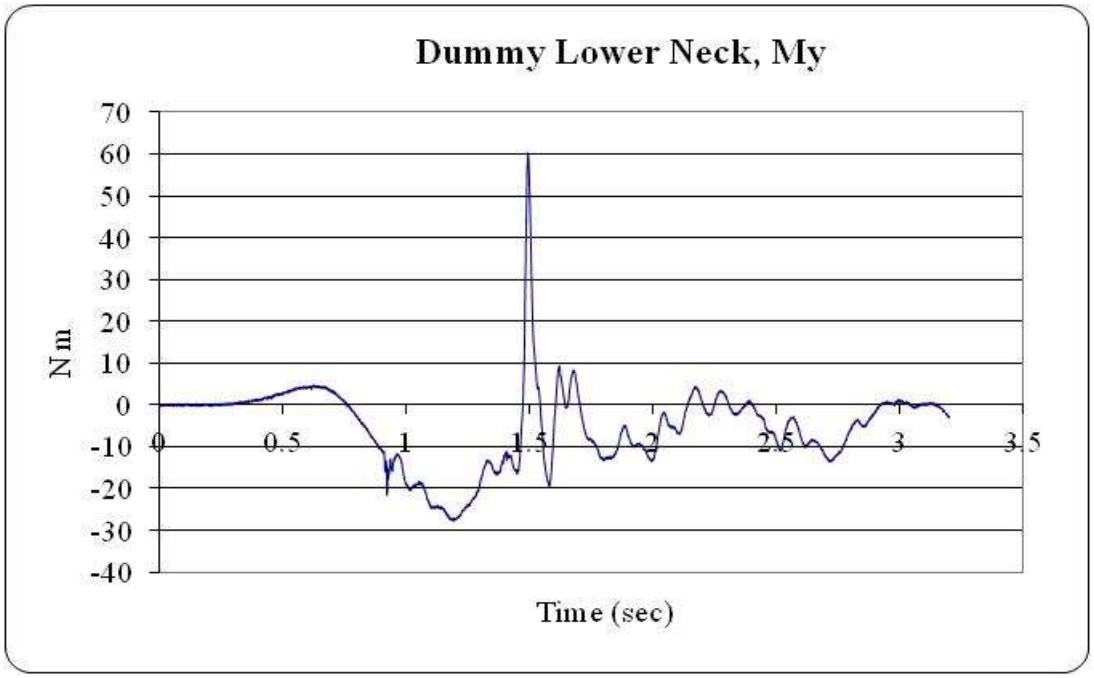
Data Sampling Rate: 10 kHz

Roll 1



Plot 7: Lower Neck Load, Mx, v. Time

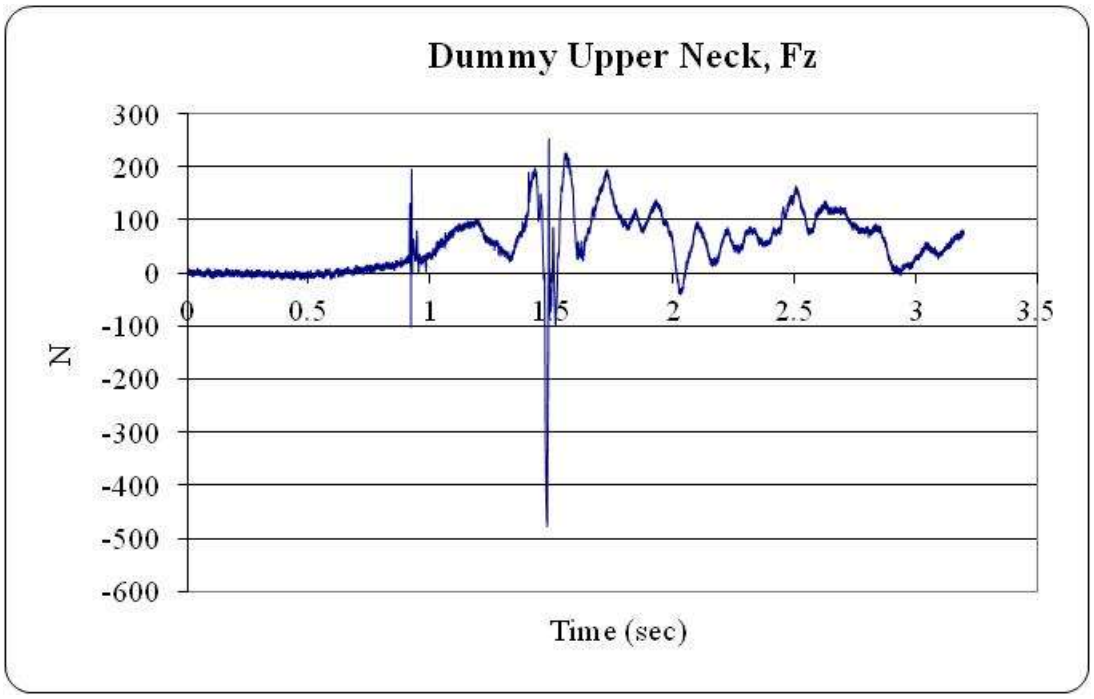
Data Sampling Rate: 10 kHz



Plot 8: Lower Neck Load, My, v. Time

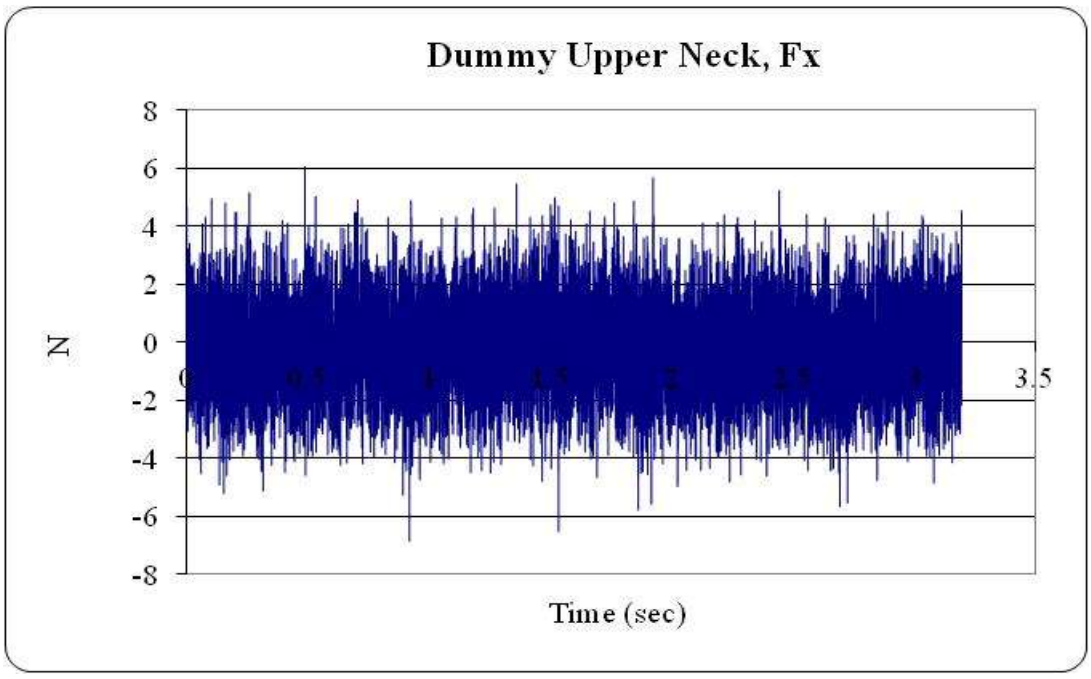
Data Sampling Rate: 10 kHz

Roll 1



Plot 9: Upper Neck Load, Fz, v. Time

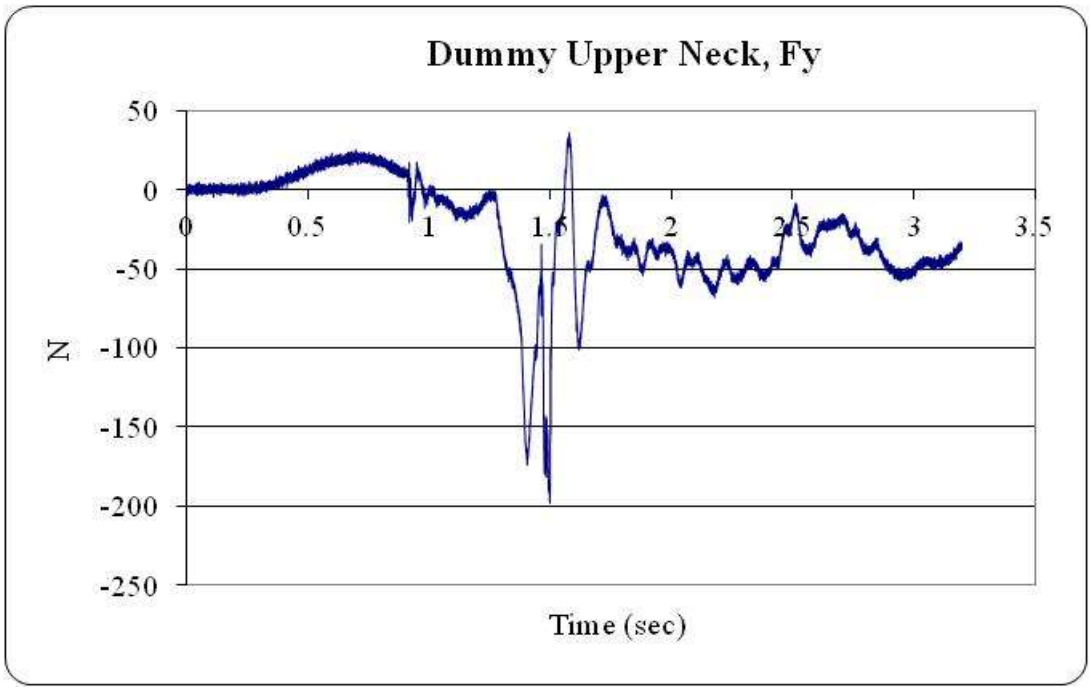
Data Sampling Rate: 10 kHz



Plot 10: Upper Neck Load, Fx, v. Time

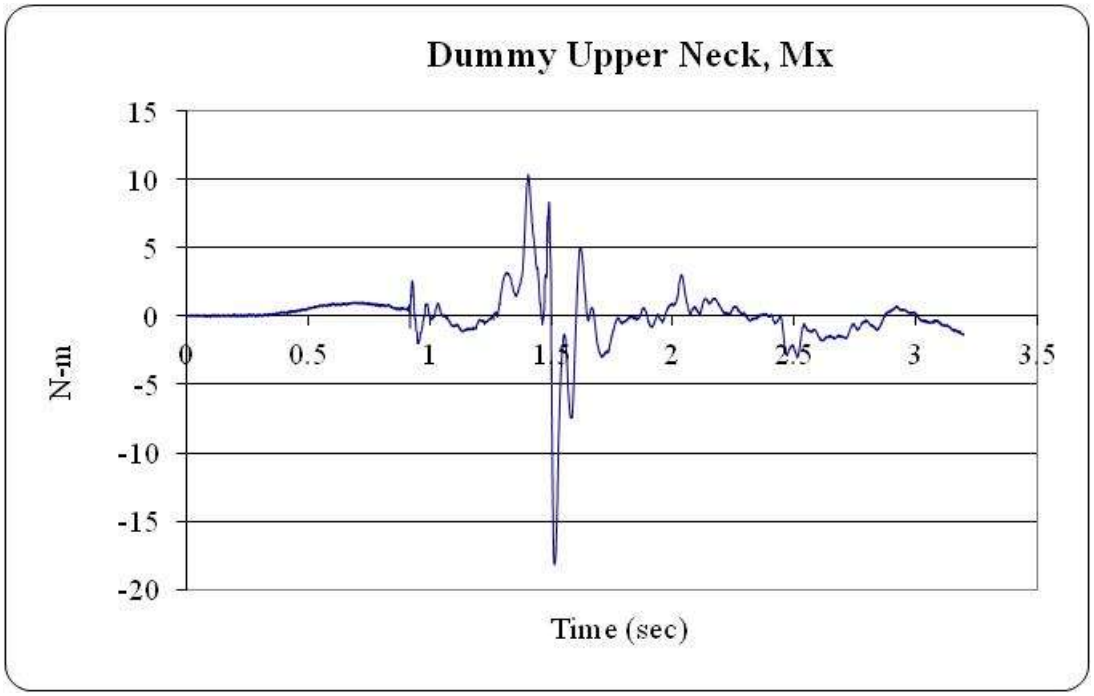
Data Sampling Rate: 10 kHz

Roll 1



Plot 11: Upper Neck Load, Fy, v. Time

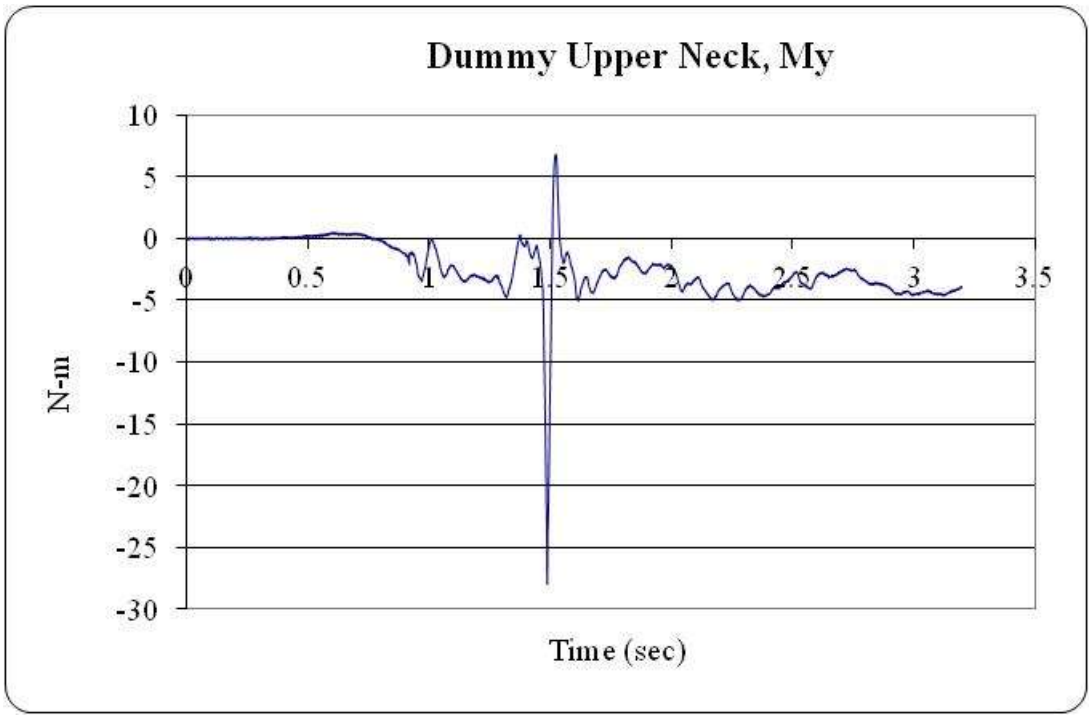
Data Sampling Rate: 10 kHz



Plot 12: Upper Neck Load, Mx, v. Time

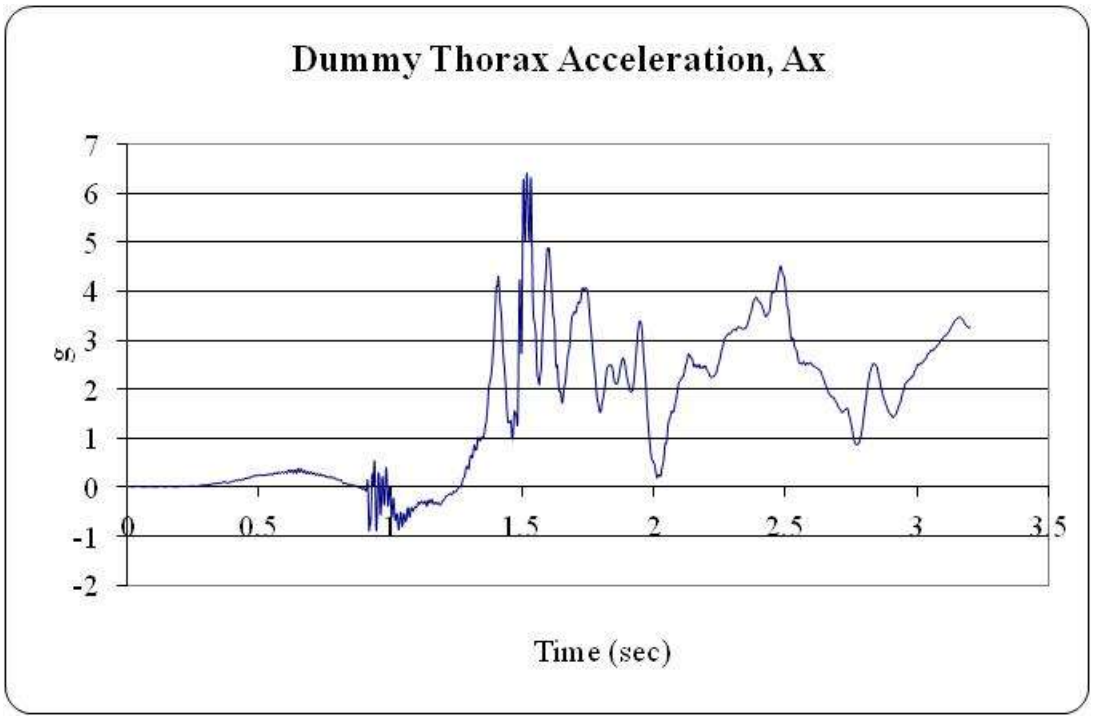
Data Sampling Rate: 10 kHz

Roll 1



Plot 13: Upper Neck Load, My, v. Time

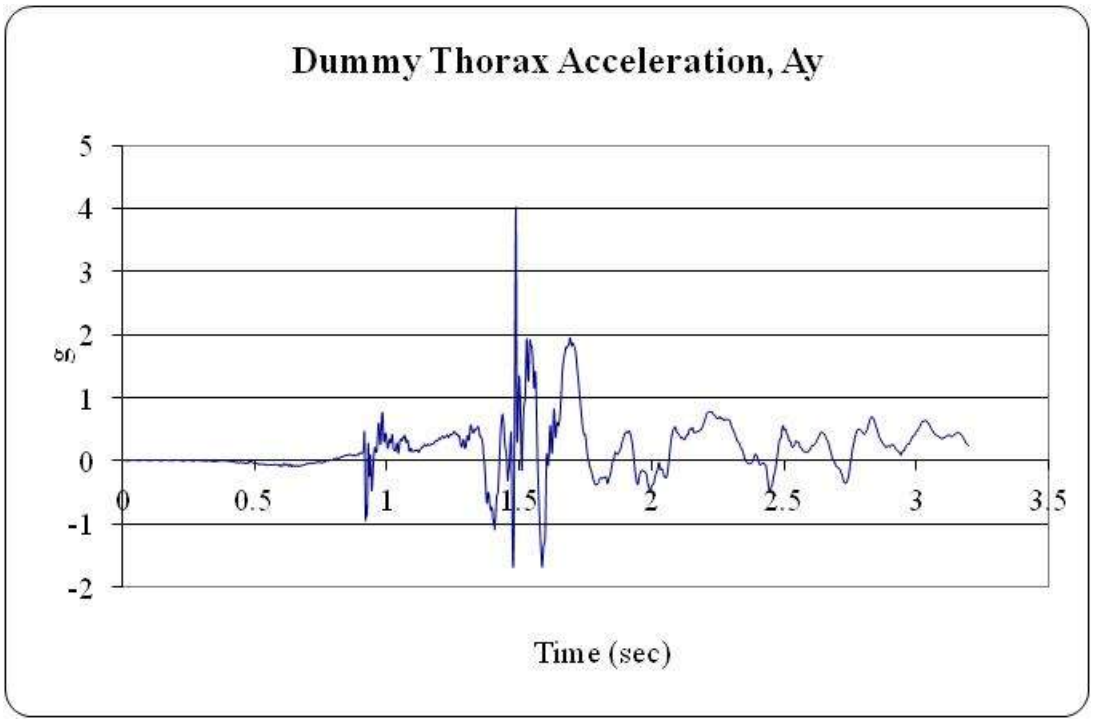
Data Sampling Rate: 10 kHz



Plot 14: Thoracic Acceleration, Ax, v. Time

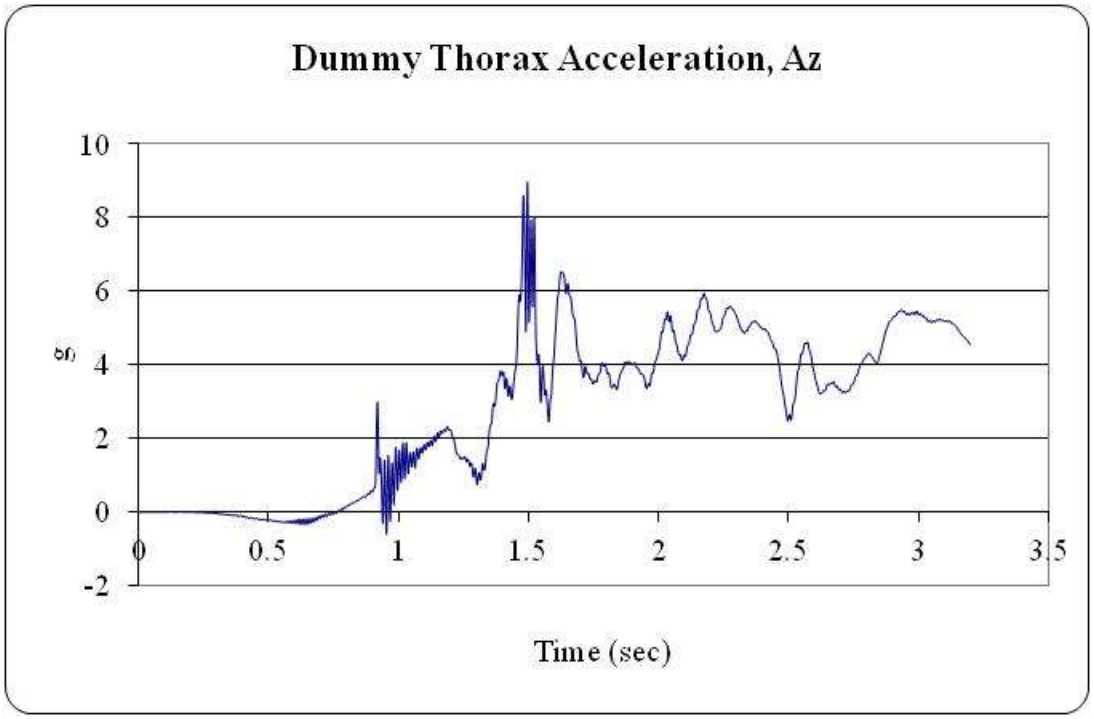
Data Sampling Rate: 10 kHz

Roll 1



Plot 15: Thoracic Acceleration, Ay, v. Time

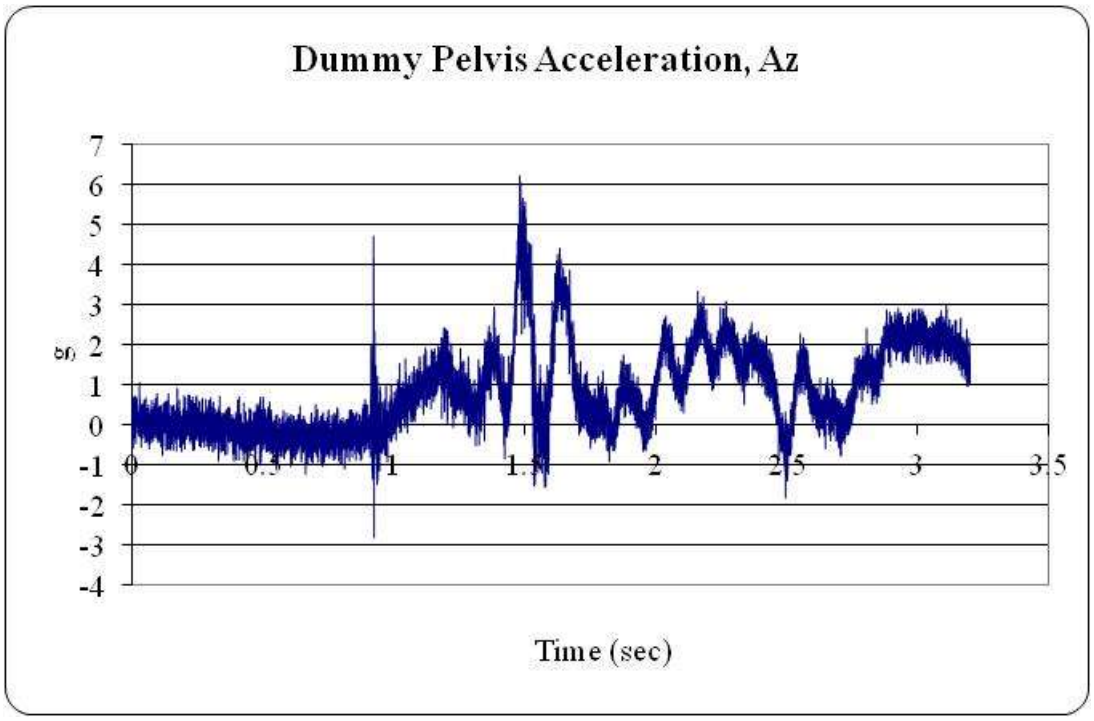
Data Sampling Rate: 10 kHz



Plot 16: Thoracic Acceleration, Az, v. Time

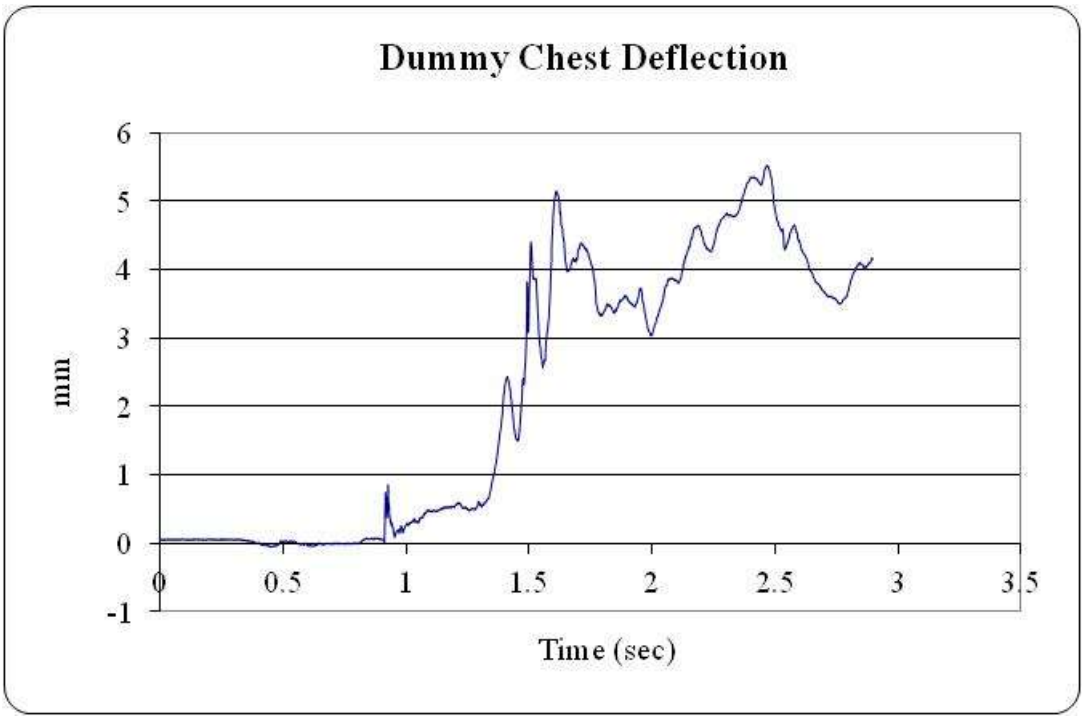
Data Sampling Rate: 10 kHz

Roll 1



Plot 17: Pelvic Acceleration, Az, v. Time

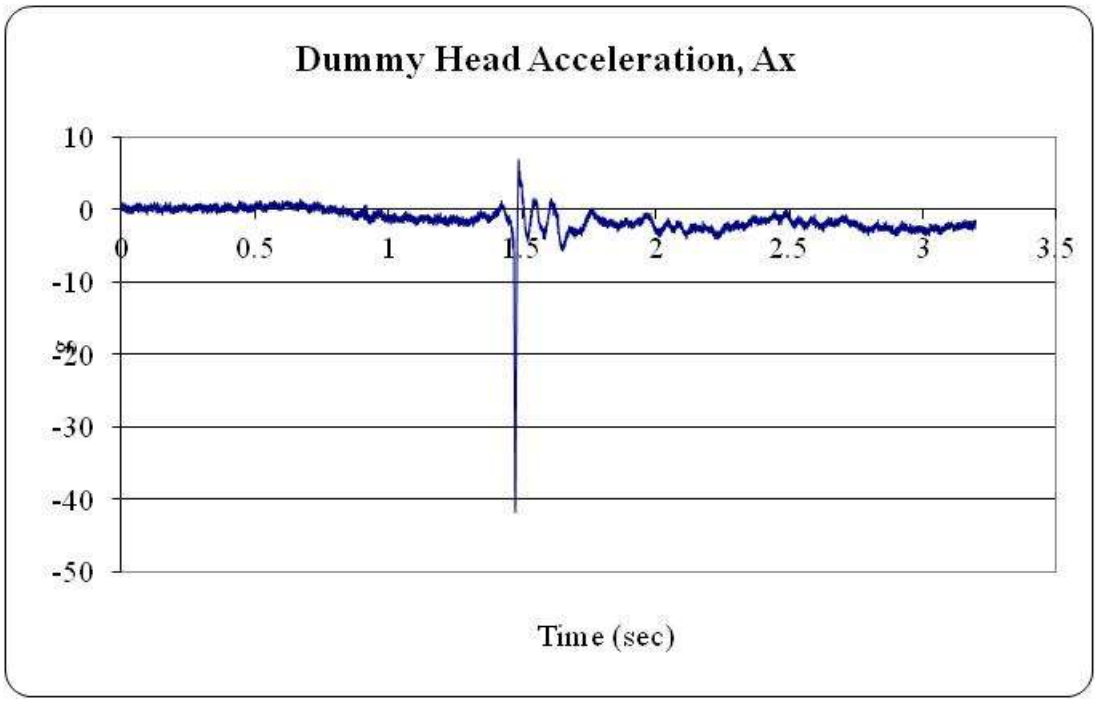
Data Sampling Rate: 10 kHz



Plot 18: Chest Deflection v. Time

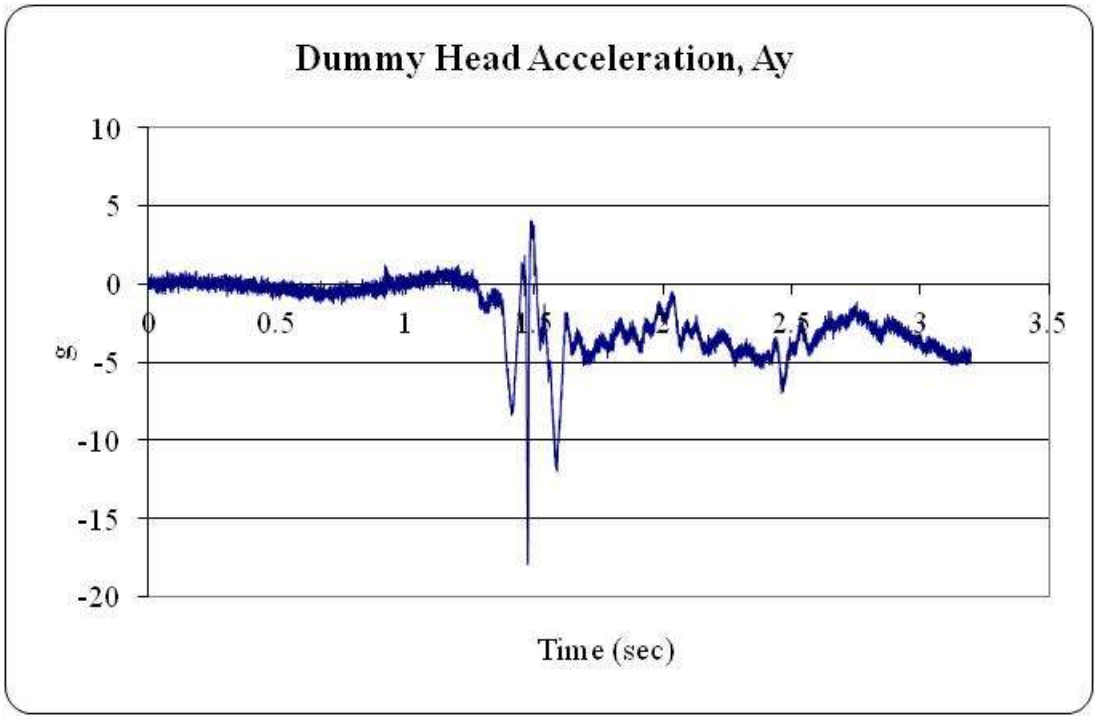
Data Sampling Rate: 10 kHz

Roll 1



Plot 19: Head Acceleration, Ax, vs. Time

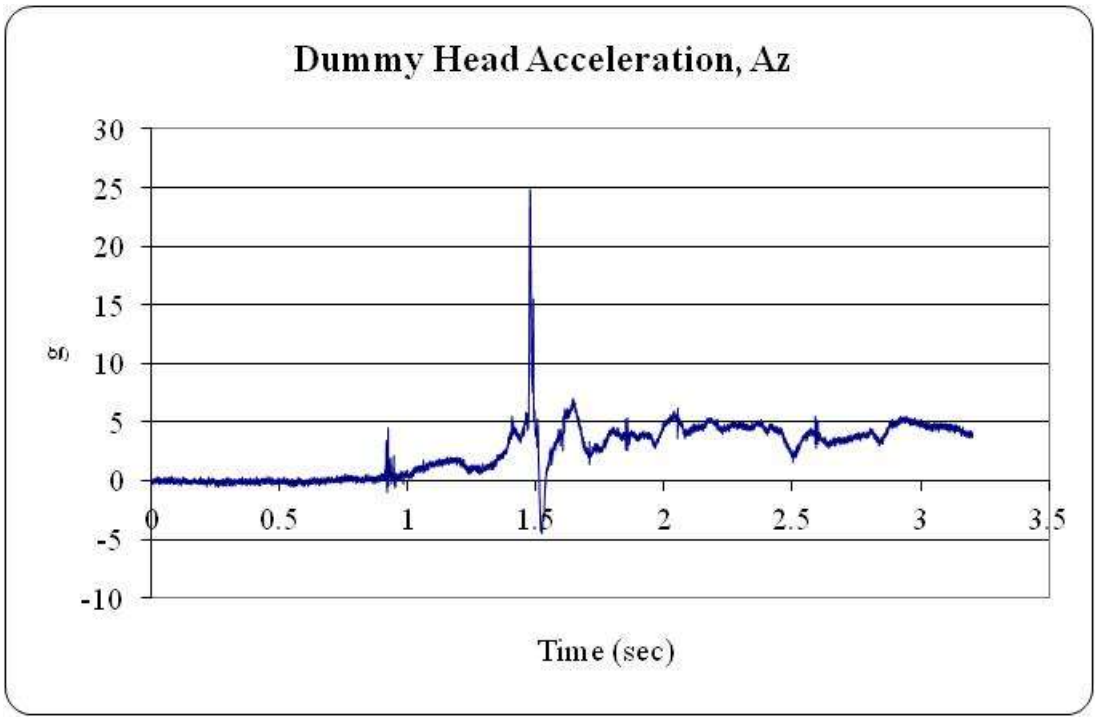
Data Sampling Rate: 10 kHz



Plot 20: Head Acceleration, Ay, vs. Time

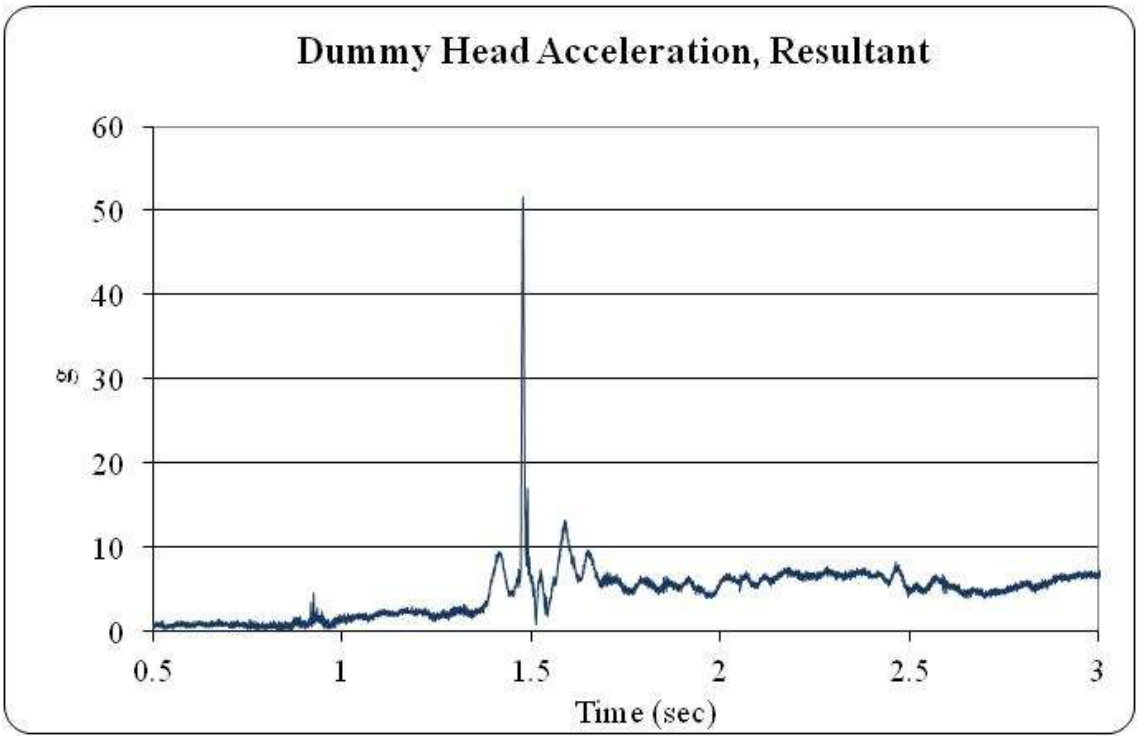
Data Sampling Rate: 10 kHz

Roll 1



Plot 21: Head Acceleration, Az, vs. Time

Data Sampling Rate: 10 kHz

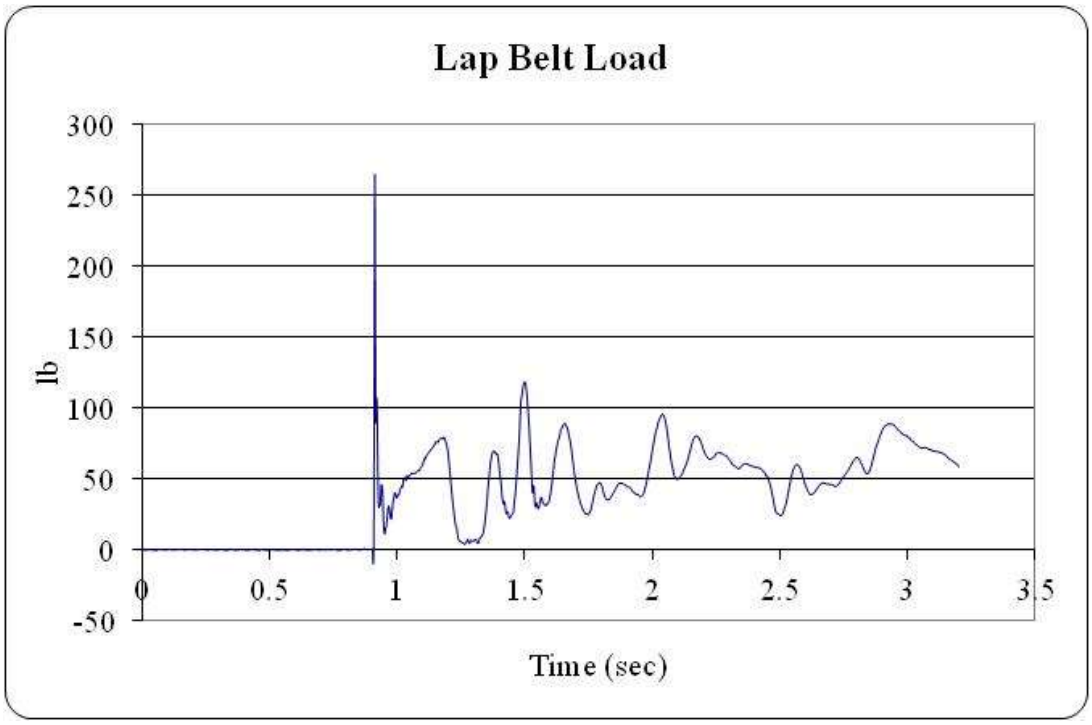


Plot 22: Resultant Head Acceleration vs. Time

HIC = 80

Data Sampling Rate: 10 kHz

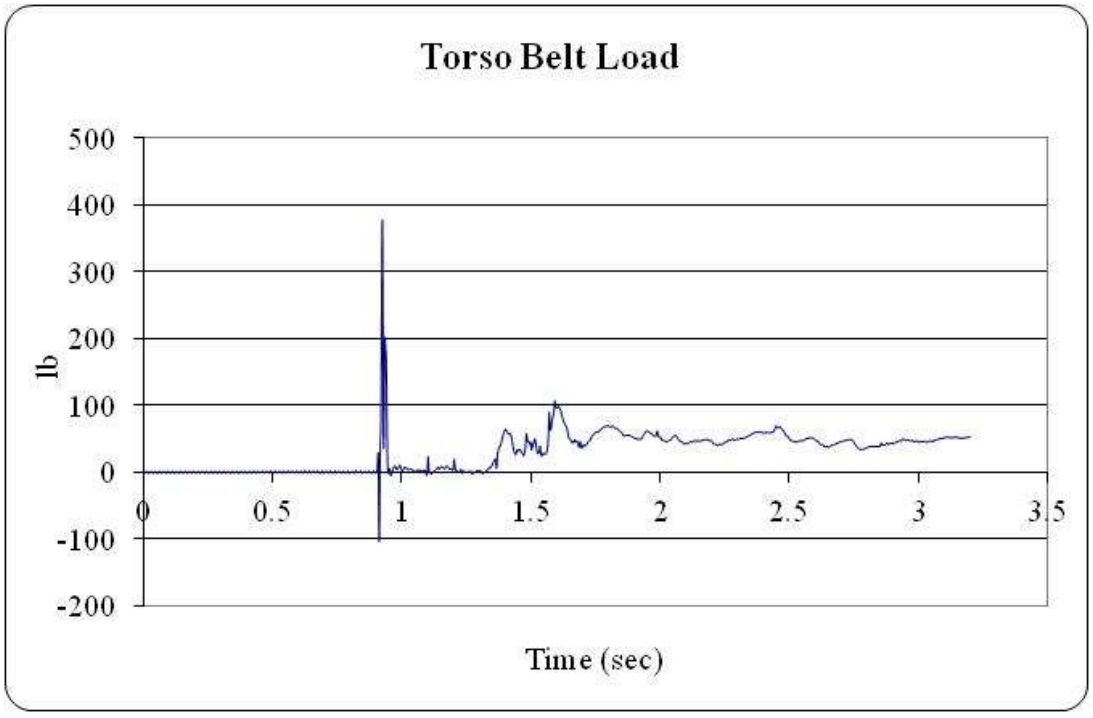
Roll 1



Plot 23: Lap Belt Load* vs. Time

*Measured on one side of the belt

Data Sampling Rate: 10 kHz

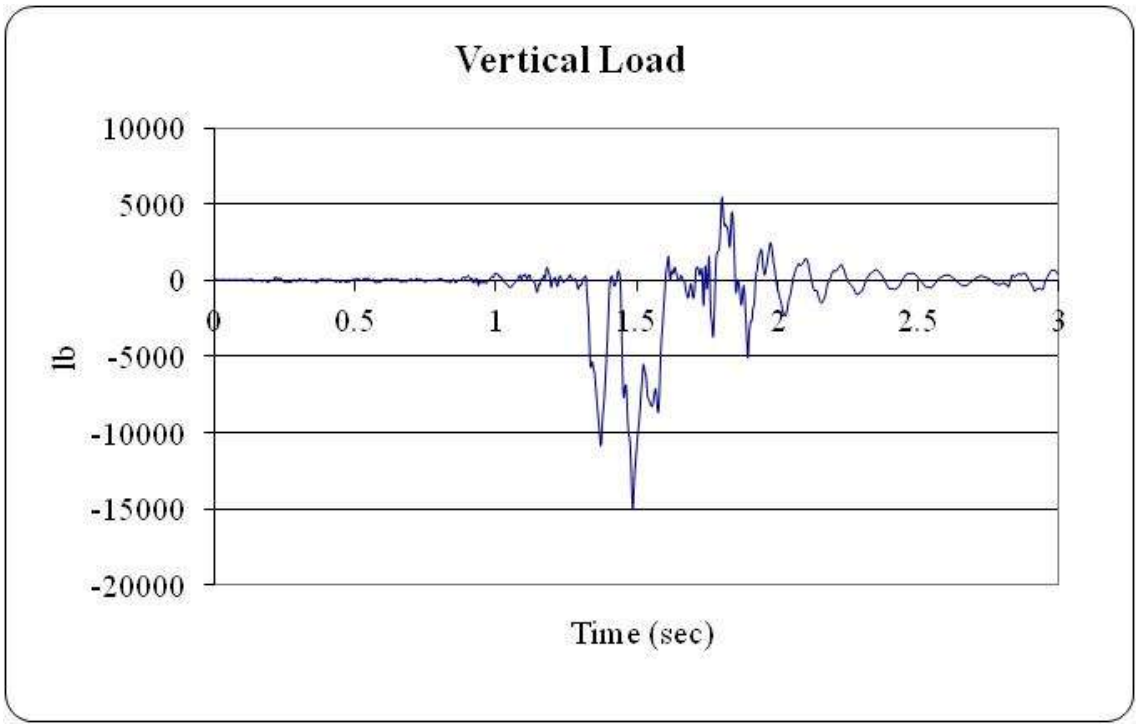


Plot 24: Torso Belt Load* vs. Time

*Measured on one side of the belt

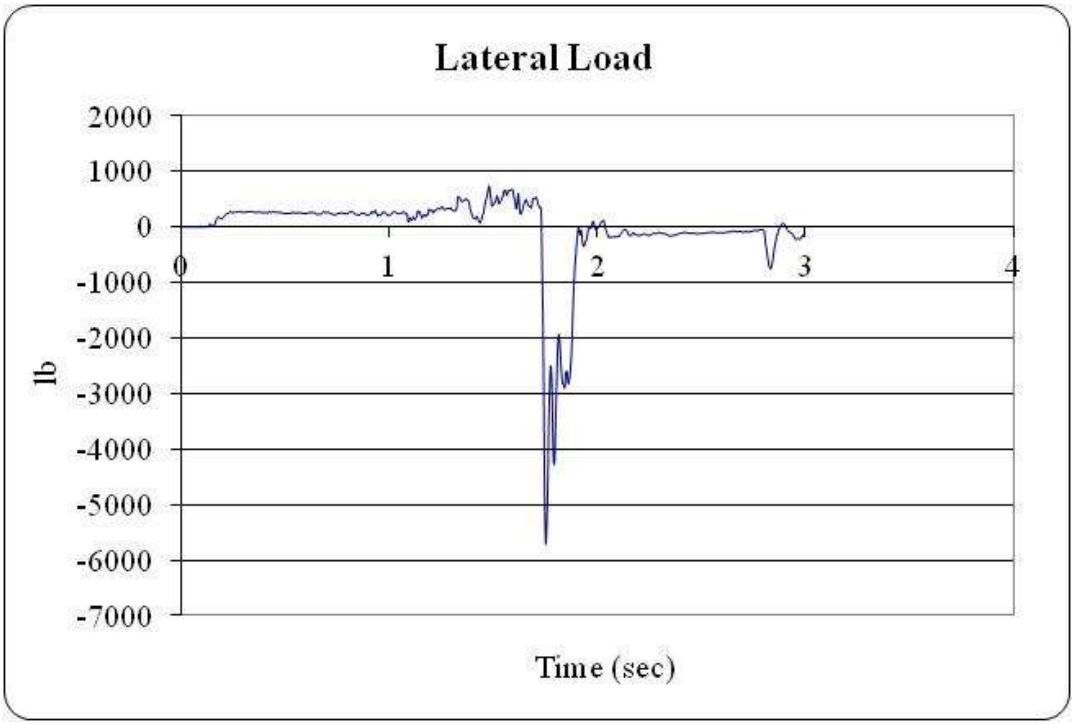
Data Sampling Rate: 10 kHz

Roll 1



Plot 25: Total Vertical Load v. Time

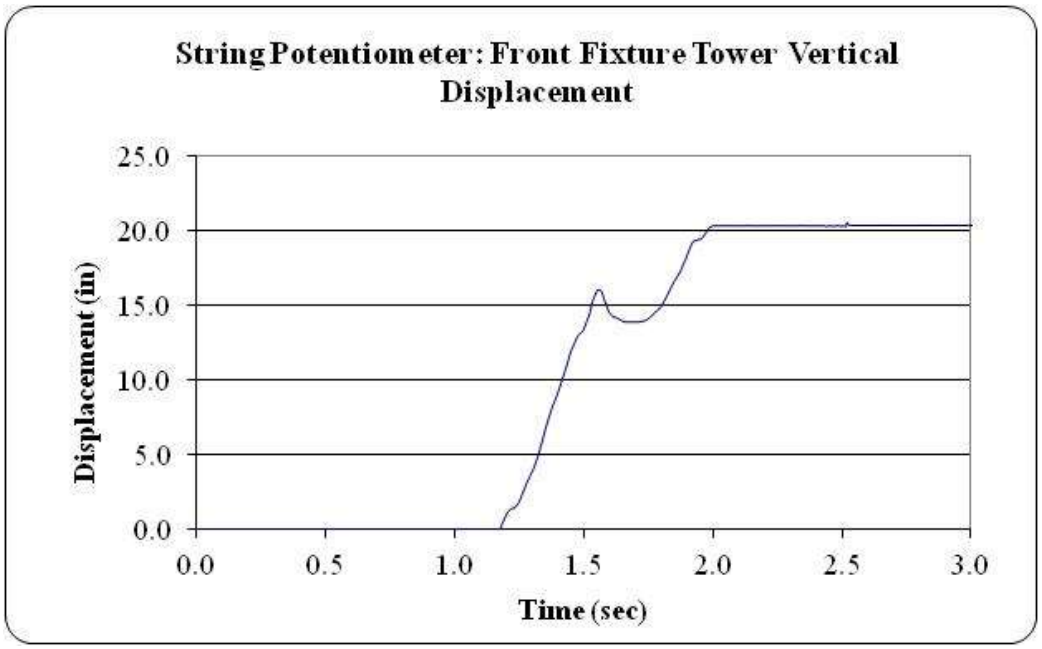
Data Sampling Rate: 10 kHz



Plot 26: Total Lateral Load v. Time

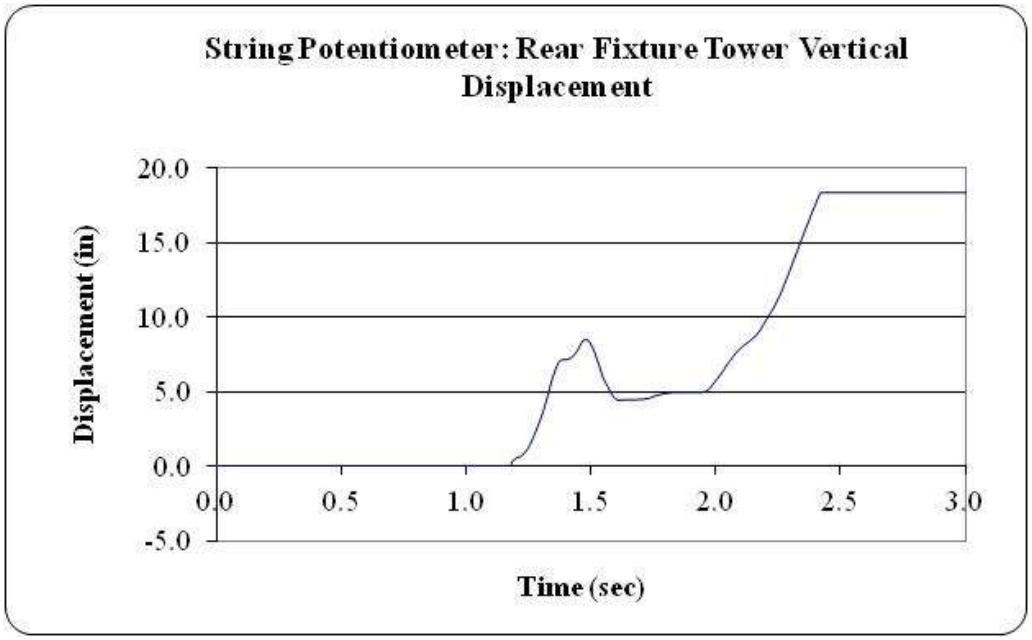
Data Sampling Rate: 10 kHz

Roll 1



Plot 27: String Potentiometer Front Fixture Support Tower Displacement vs. Time

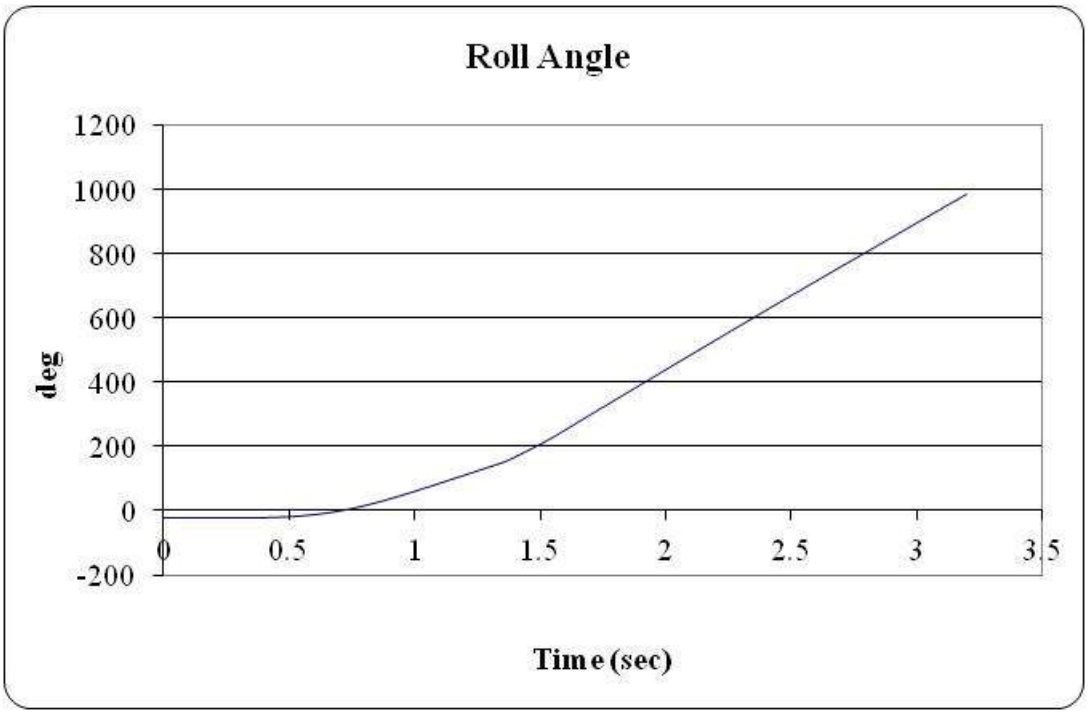
Data Sampling Rate: 1 kHz



Plot 28: String Potentiometer Rear Fixture Support Tower Displacement vs. Time

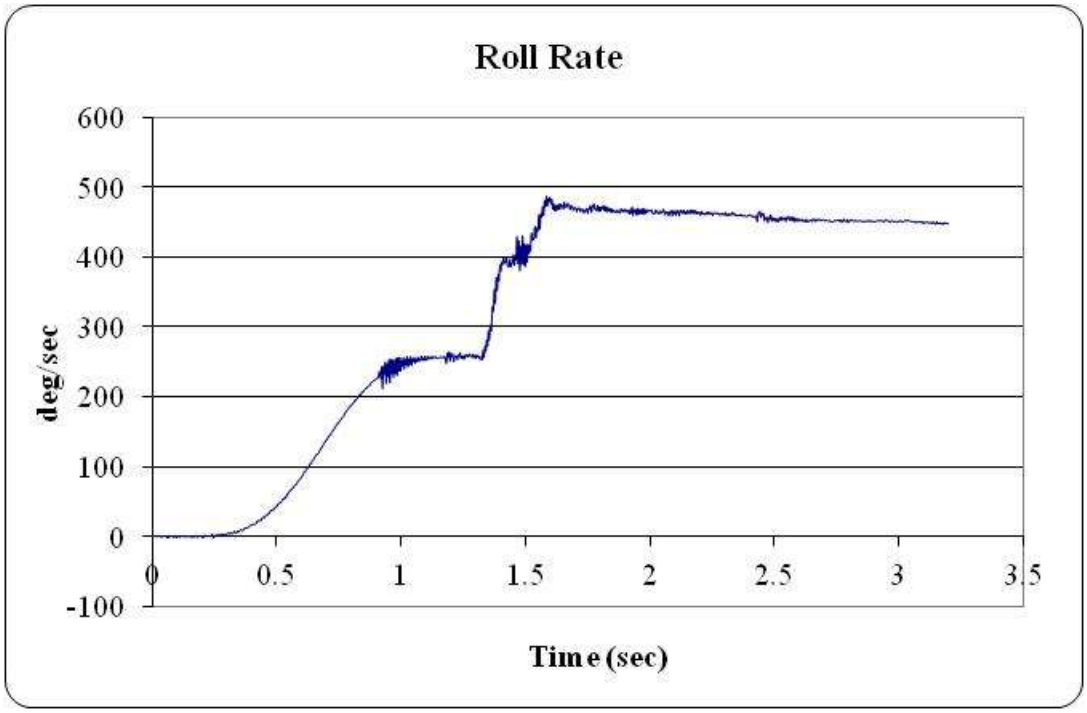
Data Sampling Rate: 1 kHz

Roll 1



Plot 29: Roll Angle vs. Time

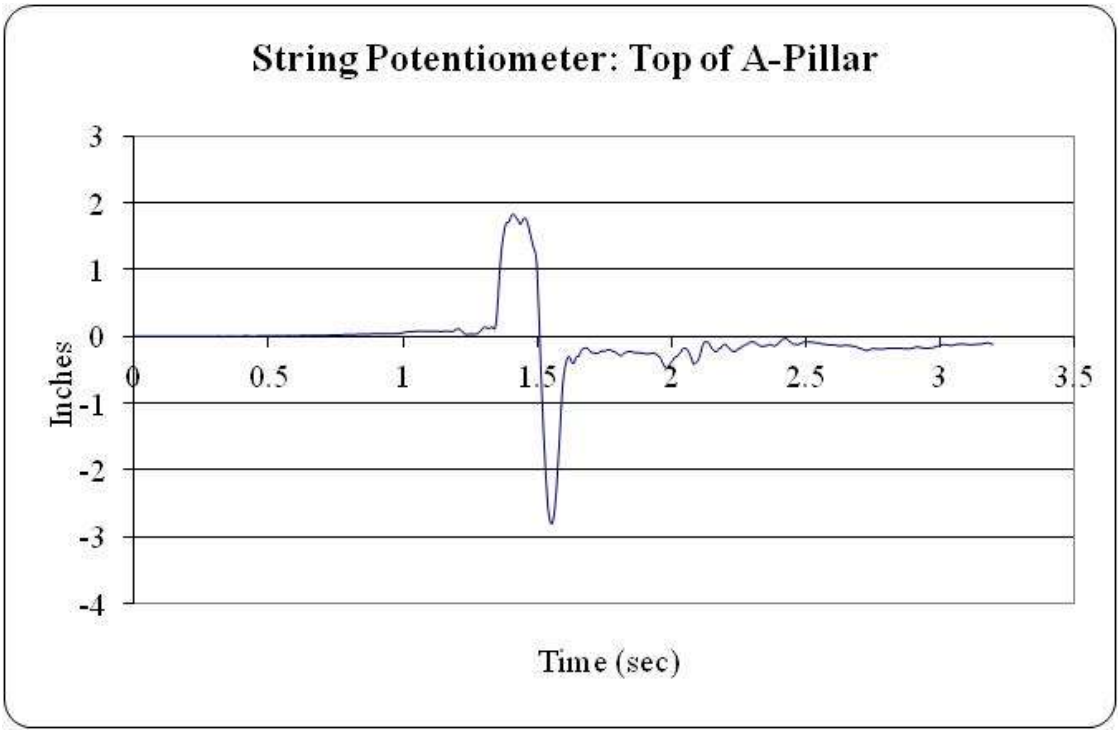
Data Sampling Rate: 10 kHz



Plot 30: Roll Rate vs. Time

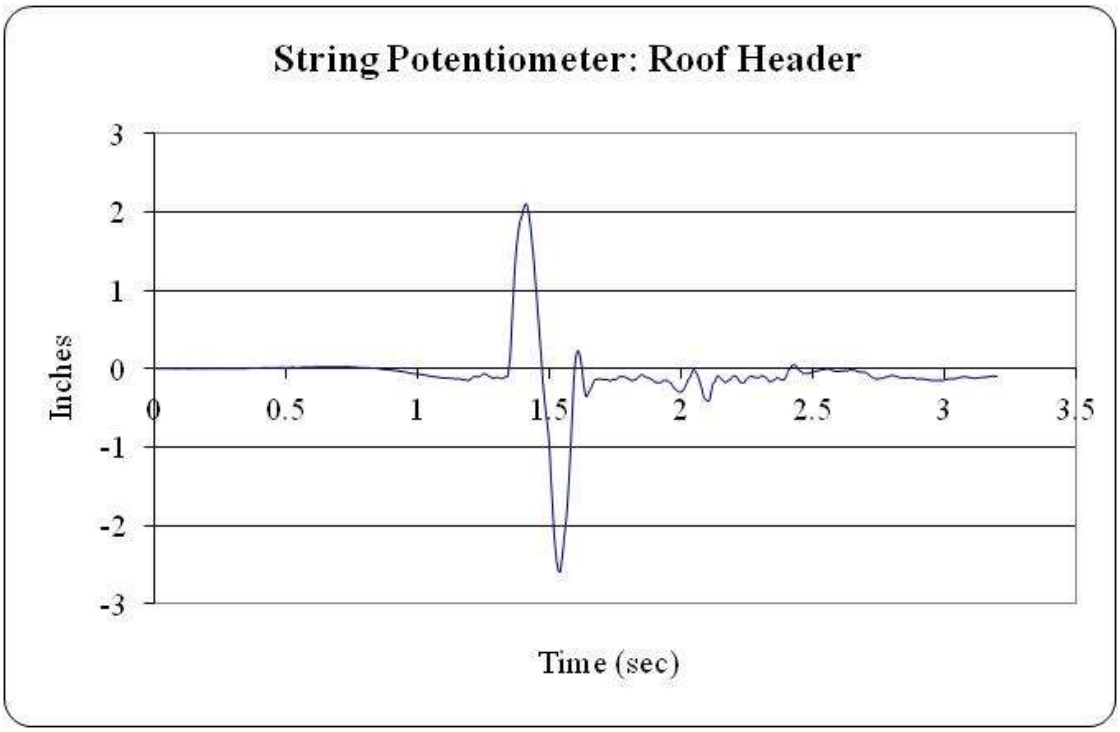
Data Sampling Rate: 10 kHz

Roll 2 Data Plots – 06/07/12



Plot 31: String Potentiometer Driver's Side A-Pillar Displacement v. Time

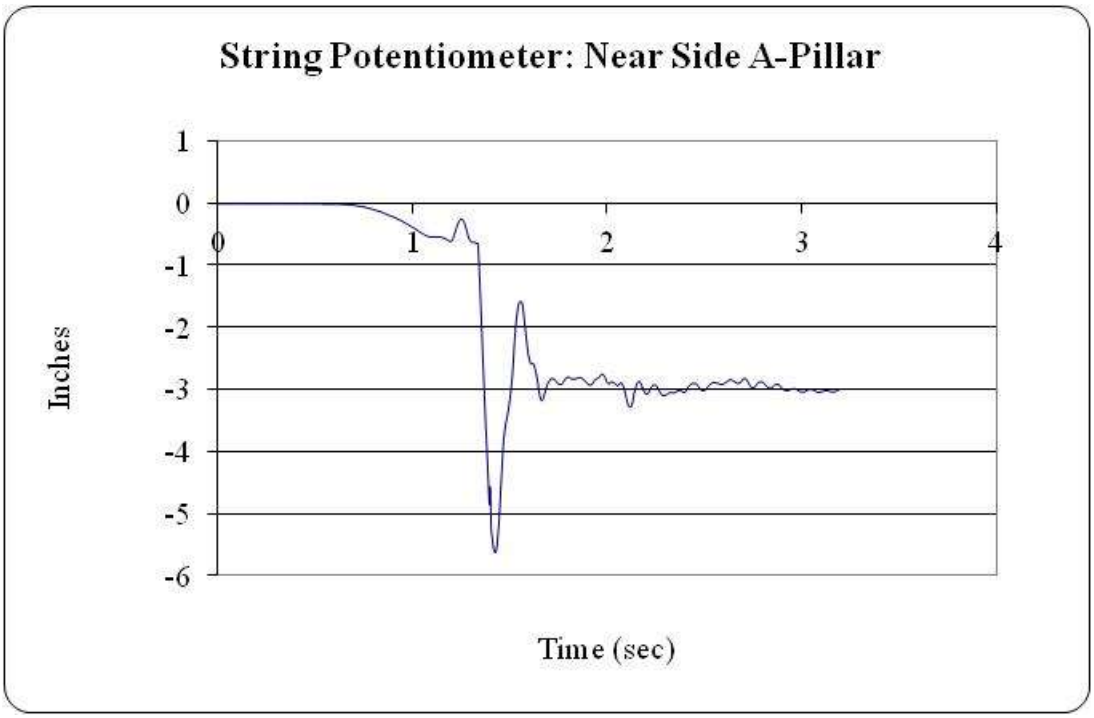
Data Sampling Rate: 10 kHz



Plot 32: String Potentiometer Driver's Side Roof Header Displacement v. Time

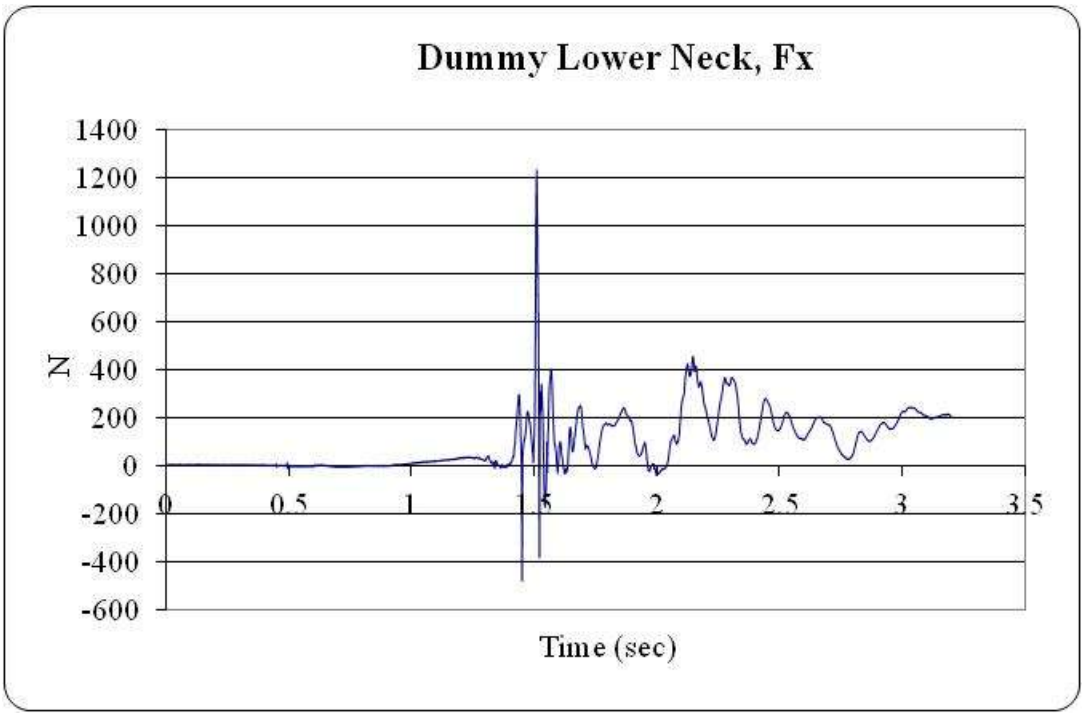
Data Sampling Rate: 10 kHz

Roll 2



Plot 33: String Potentiometer Passenger's Side A-Pillar Displacement v. Time

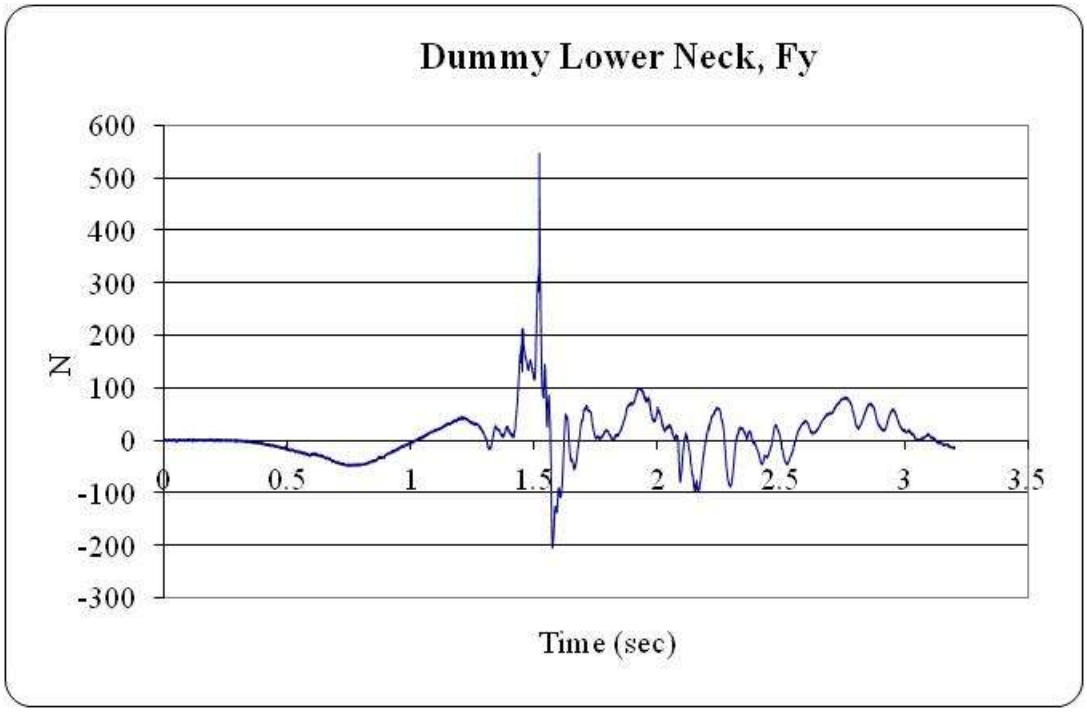
Data Sampling Rate: 10 kHz



Plot 34: Lower Neck Load, Fx, v. Time

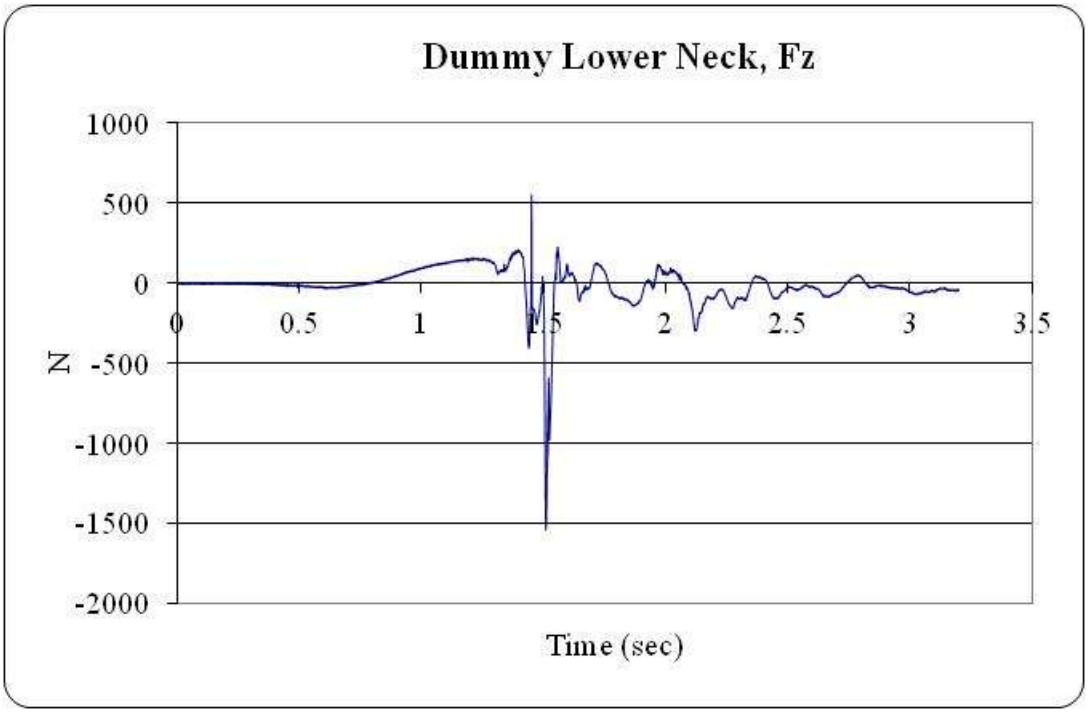
Data Sampling Rate: 10 kHz

Roll 2



Plot 35: Lower Neck Load, Fy, v. Time

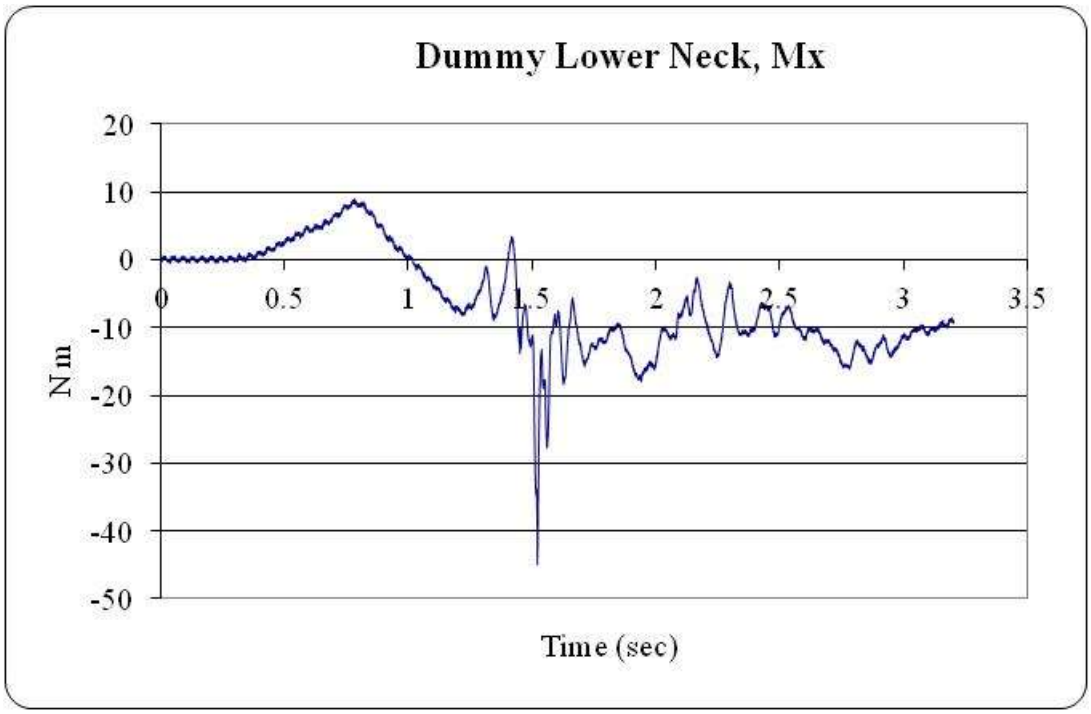
Data Sampling Rate: 10 kHz



Plot 36: Lower Neck Load, Fz, v. Time

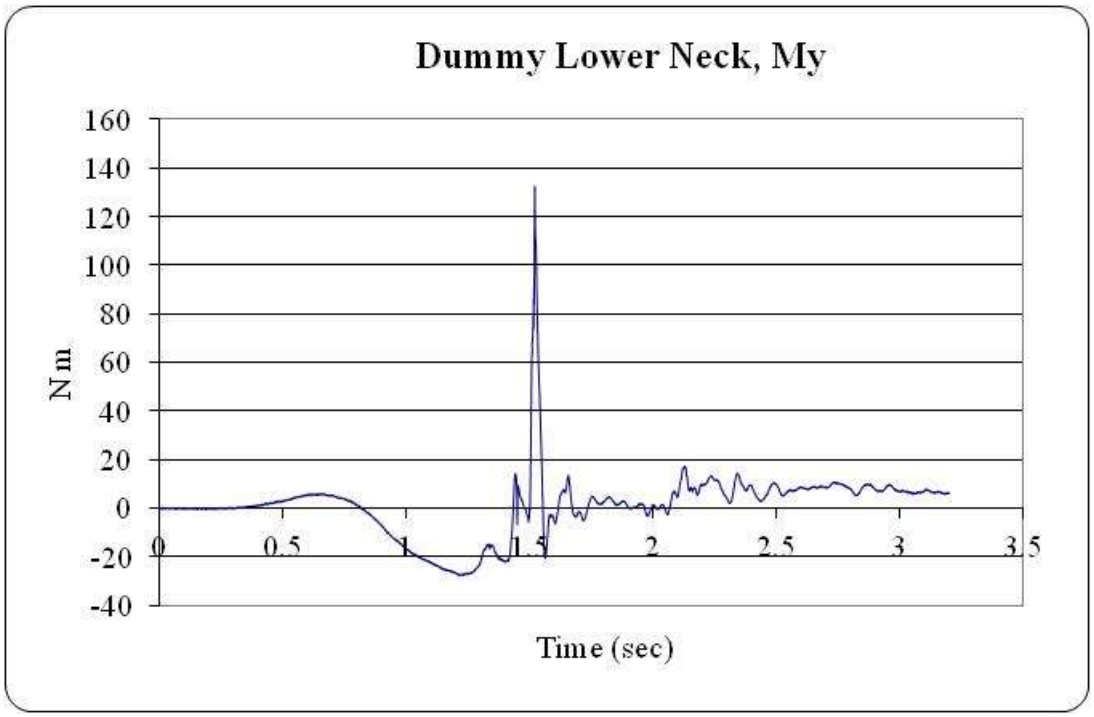
Data Sampling Rate: 10 kHz

Roll 2



Plot 37: Lower Neck Load, Mx, v. Time

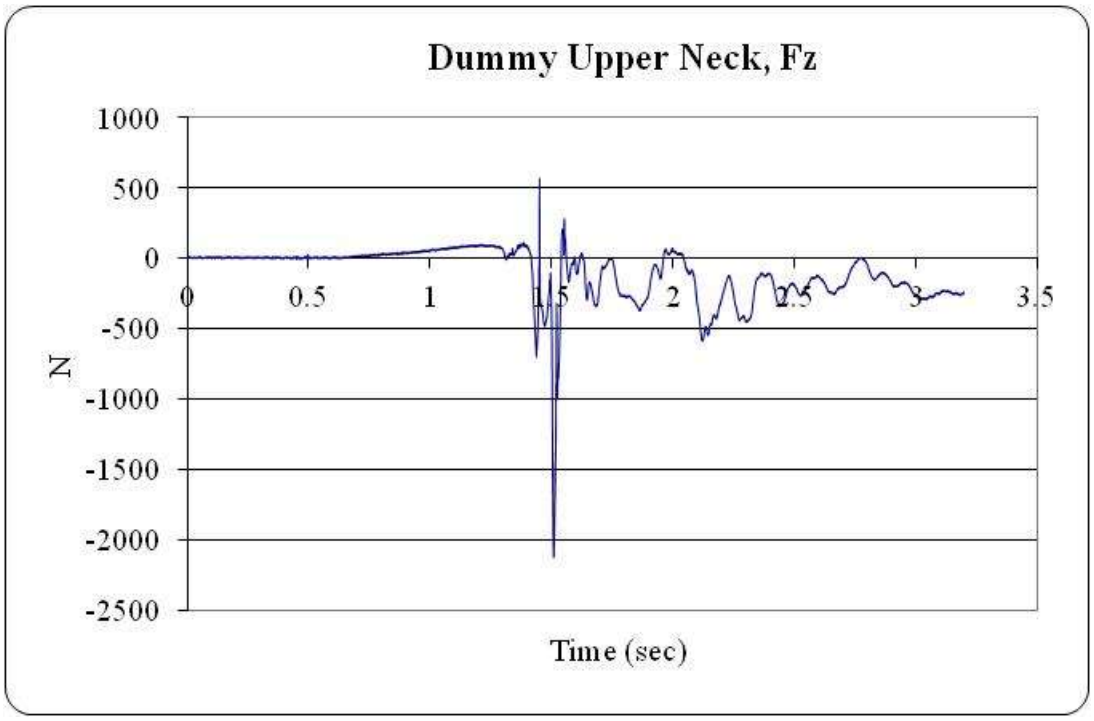
Data Sampling Rate: 10 kHz



Plot 38: Lower Neck Load, My, v. Time

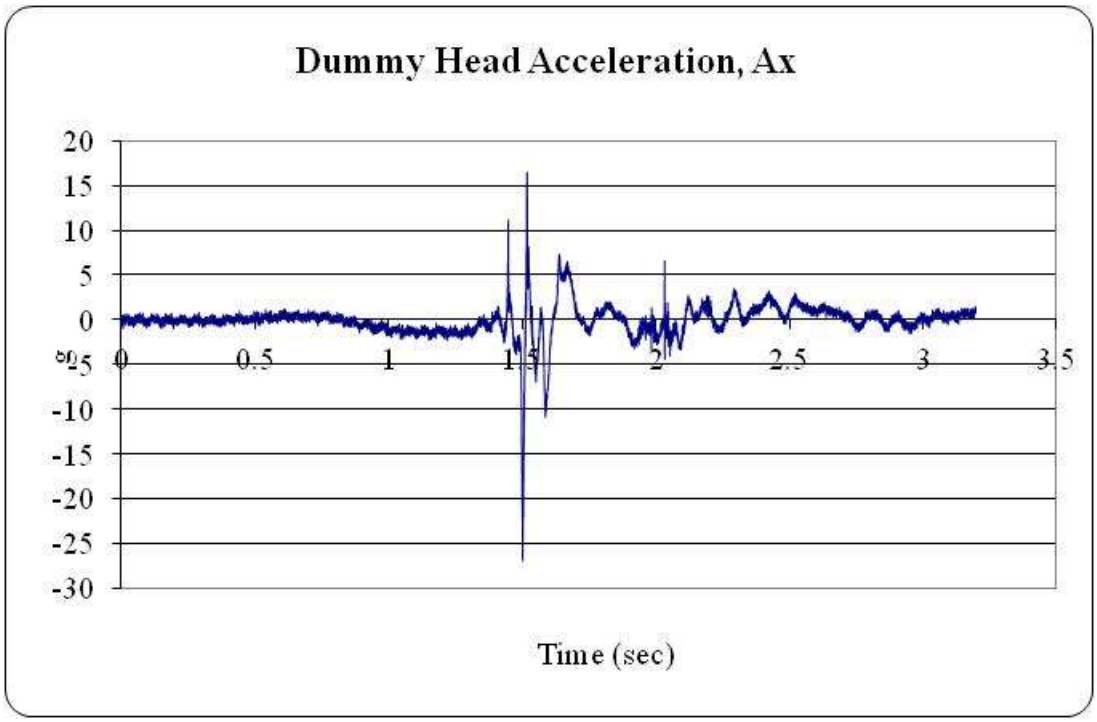
Data Sampling Rate: 10 kHz

Roll 2



Plot 39: Upper Neck Load, Fz, v. Time

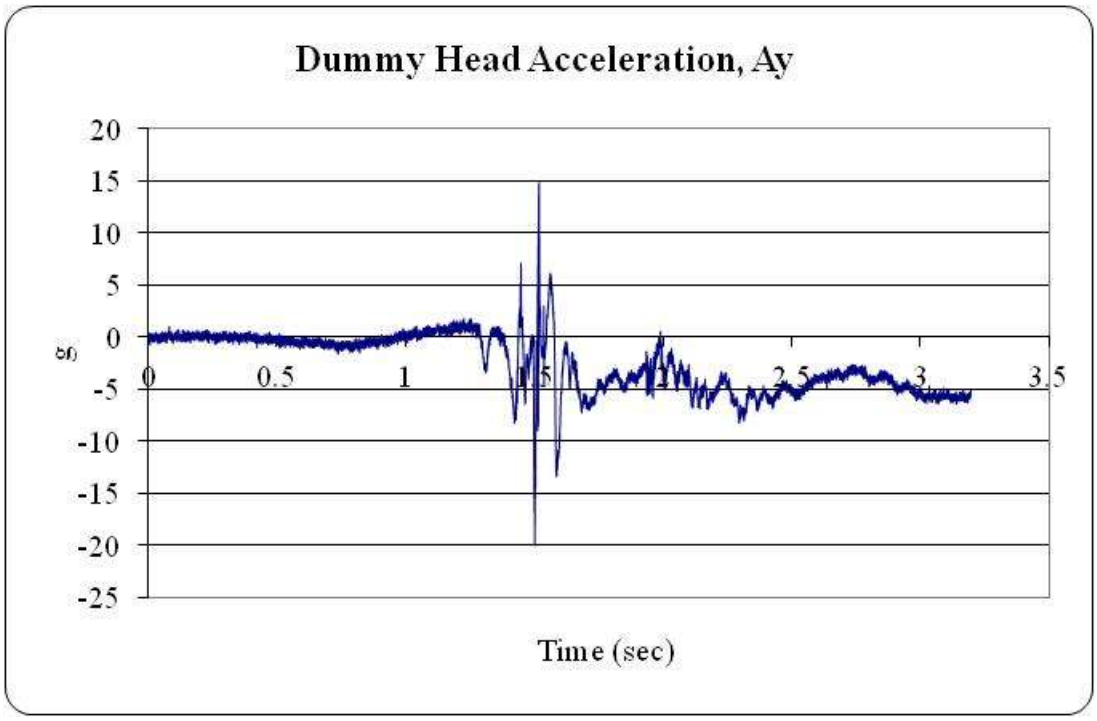
Data Sampling Rate: 10 kHz



Plot 40: Head Acceleration, Ax, vs. Time

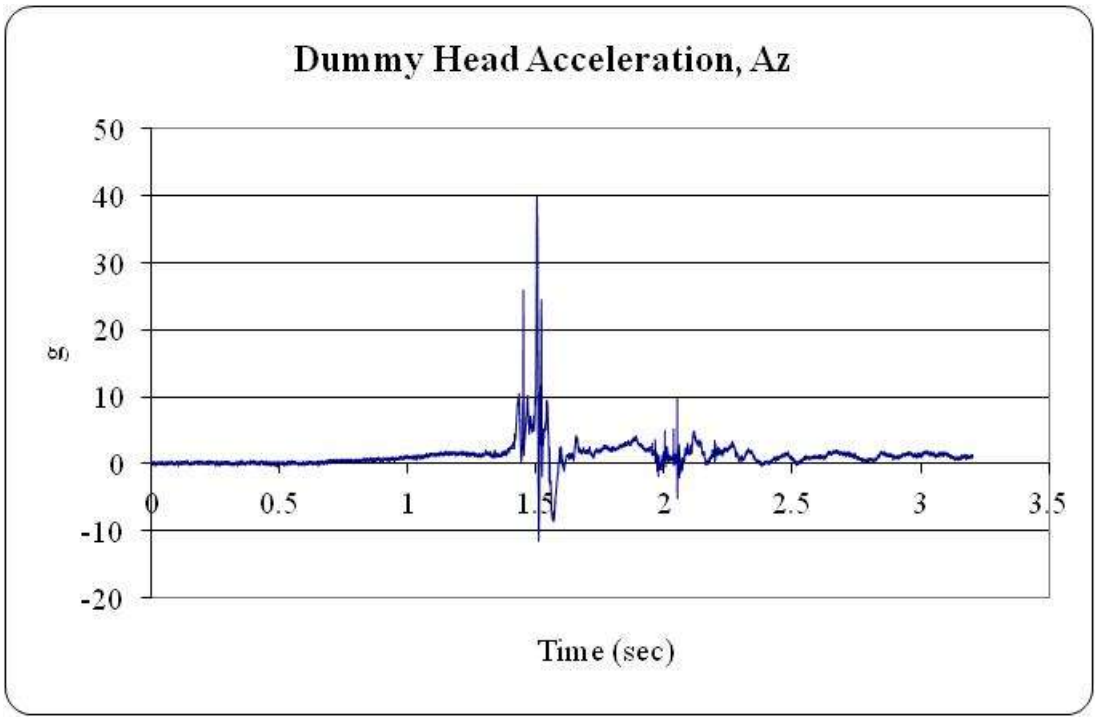
Data Sampling Rate: 10 kHz

Roll 2



Plot 41: Head Acceleration, Ay, vs. Time

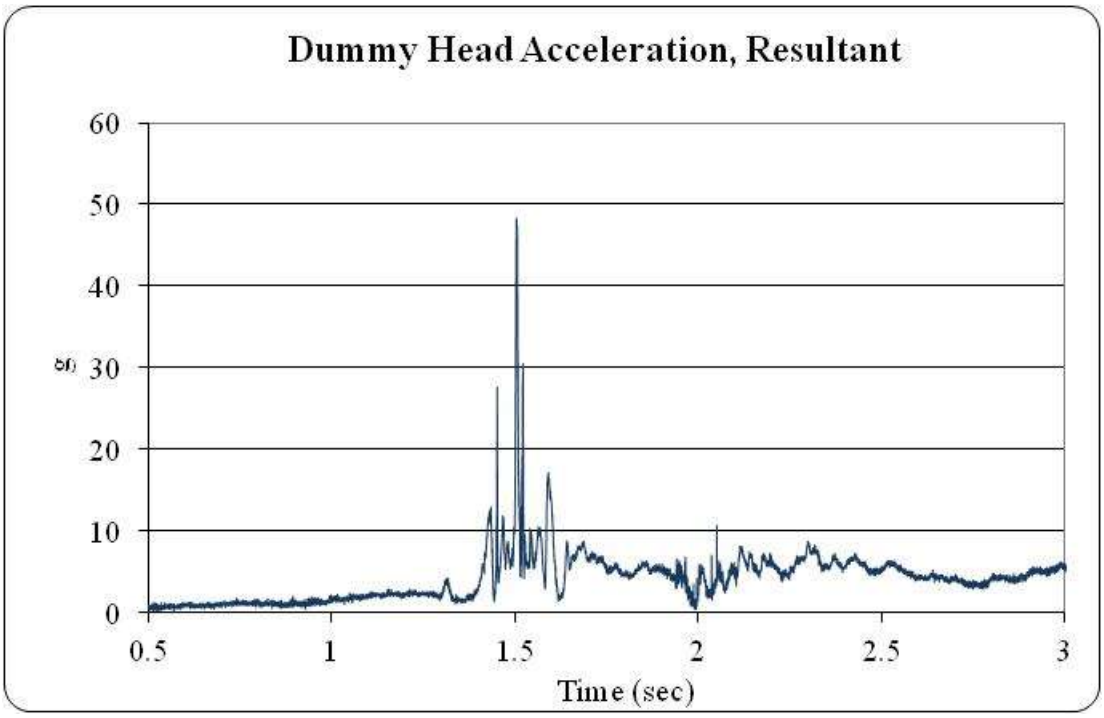
Data Sampling Rate: 10 kHz



Plot 42: Head Acceleration, Az, vs. Time

Data Sampling Rate: 10 kHz

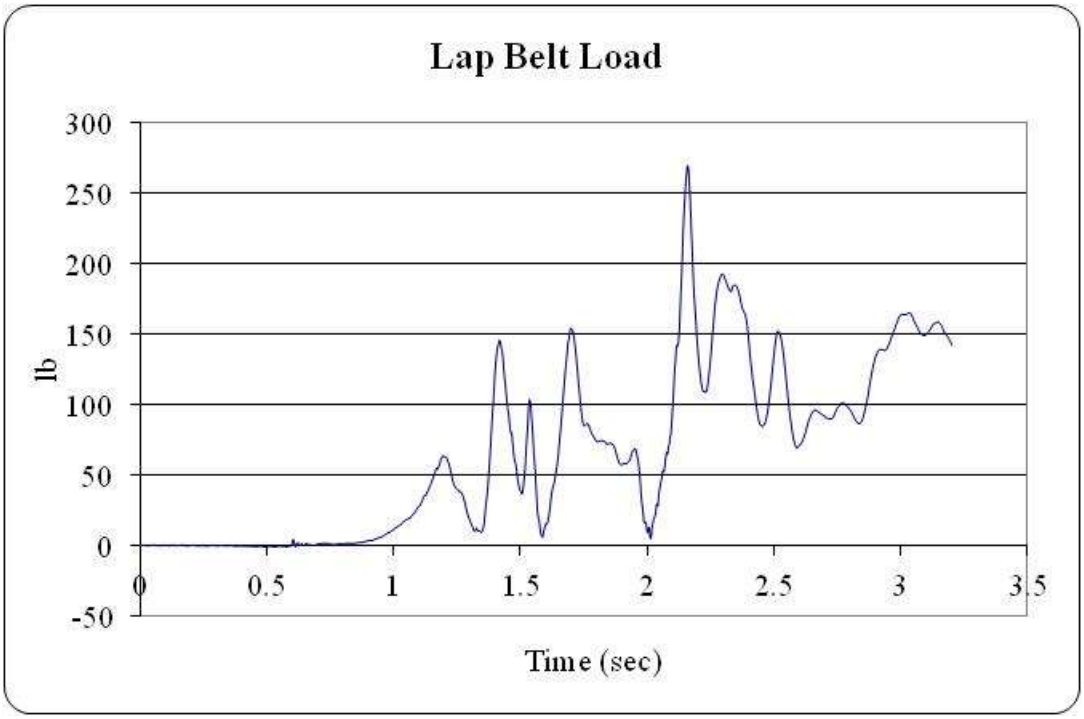
Roll 2



Plot 43: Resultant Head Acceleration vs. Time

HIC = 64

Data Sampling Rate: 10 kHz

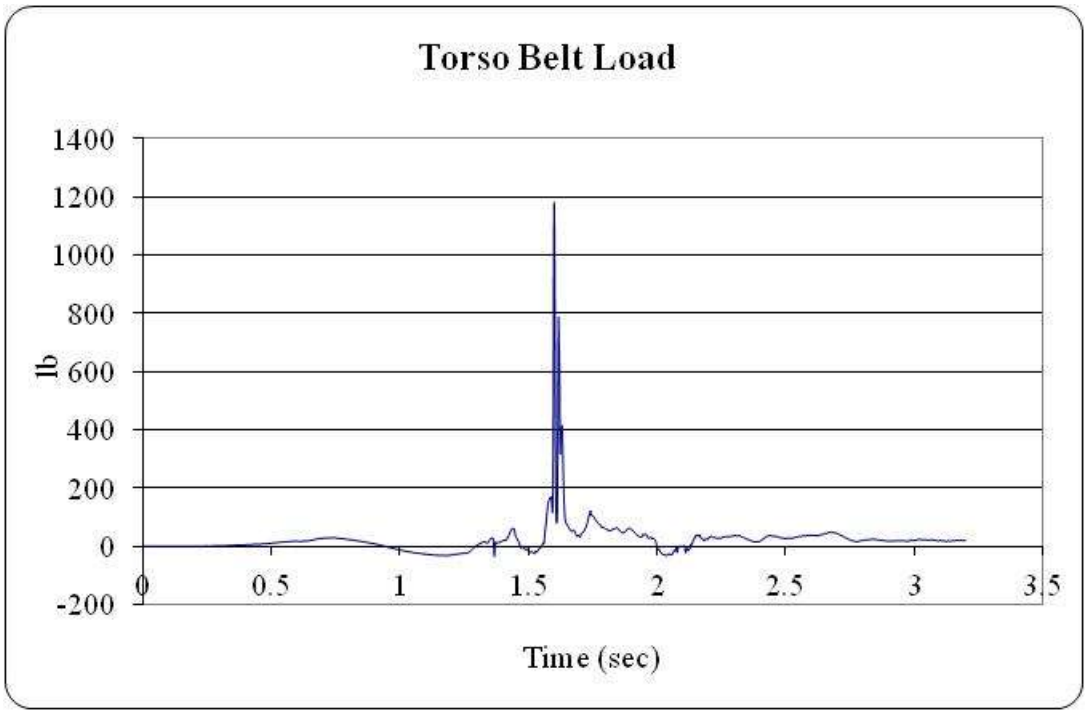


Plot 44: Lap Belt Load* vs. Time

*Measured on one side of the belt

Data Sampling Rate: 10 kHz

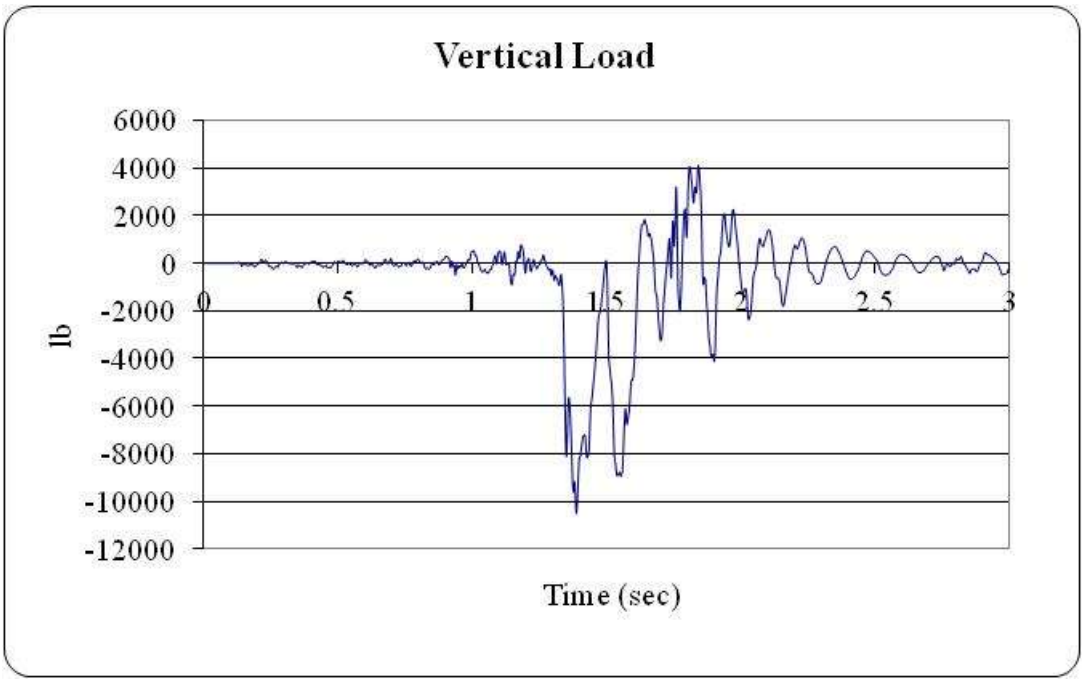
Roll 2



Plot 45: Torso Belt Load* vs. Time

*Measured on one side of the belt

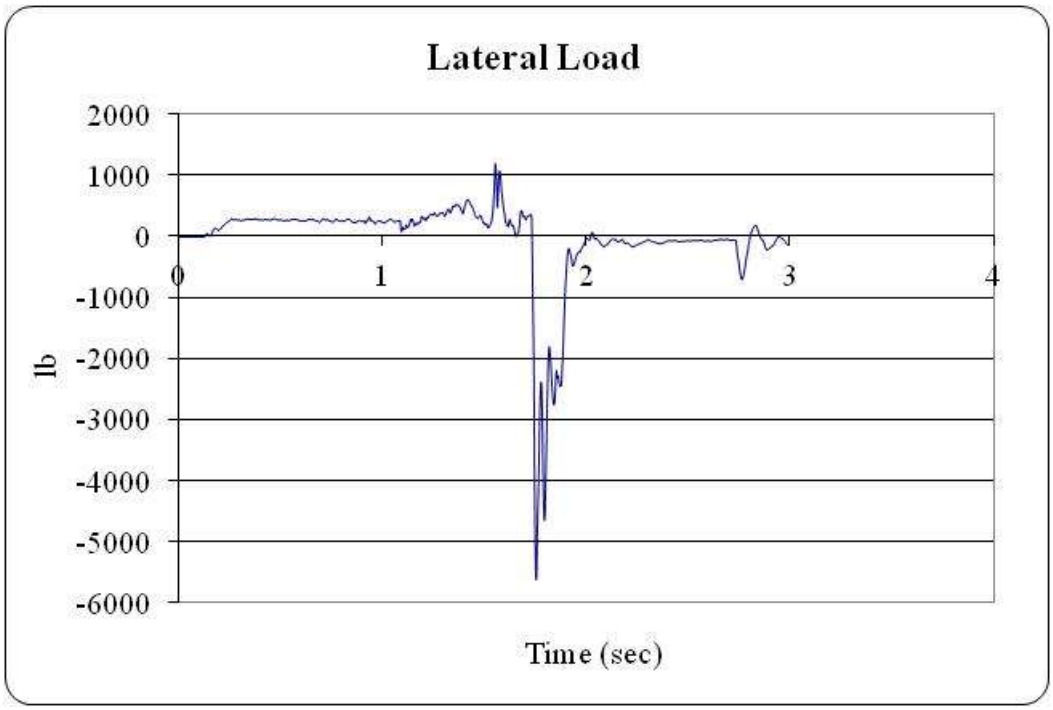
Data Sampling Rate: 10 kHz



Plot 46: Total Vertical Load v. Time

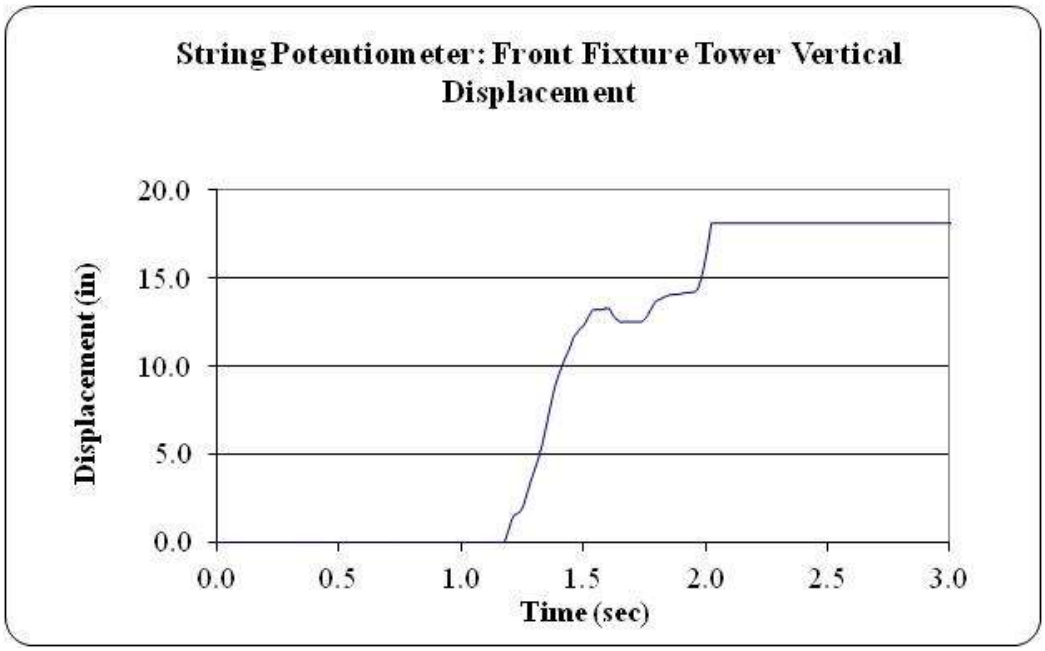
Data Sampling Rate: 10 kHz

Roll 2



Plot 47: Total Lateral Load v. Time

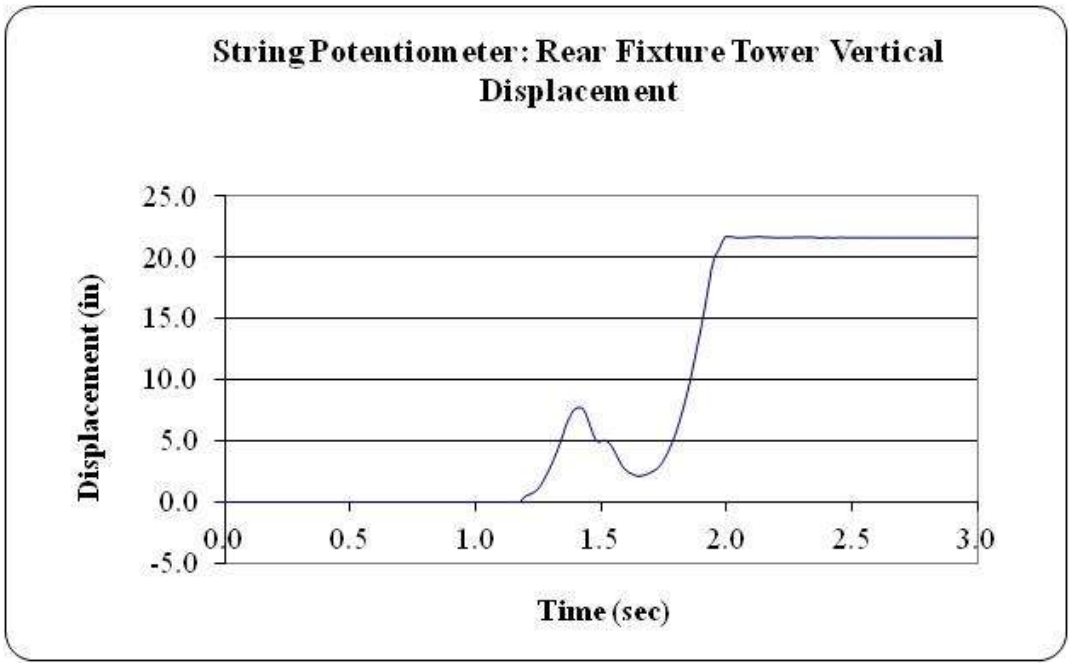
Data Sampling Rate: 10 kHz



Plot 48: String Potentiometer Front Fixture Support Tower Displacement vs. Time

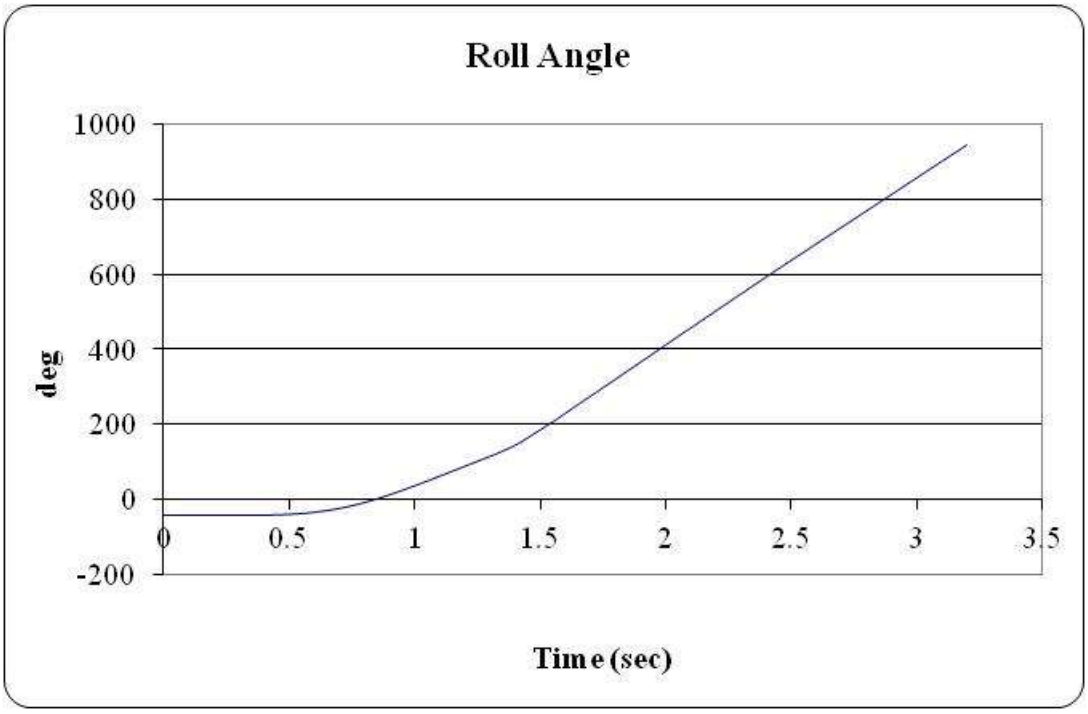
Data Sampling Rate: 1 kHz

Roll 2



Plot 49: String Potentiometer Rear Fixture Support Tower Displacement vs. Time

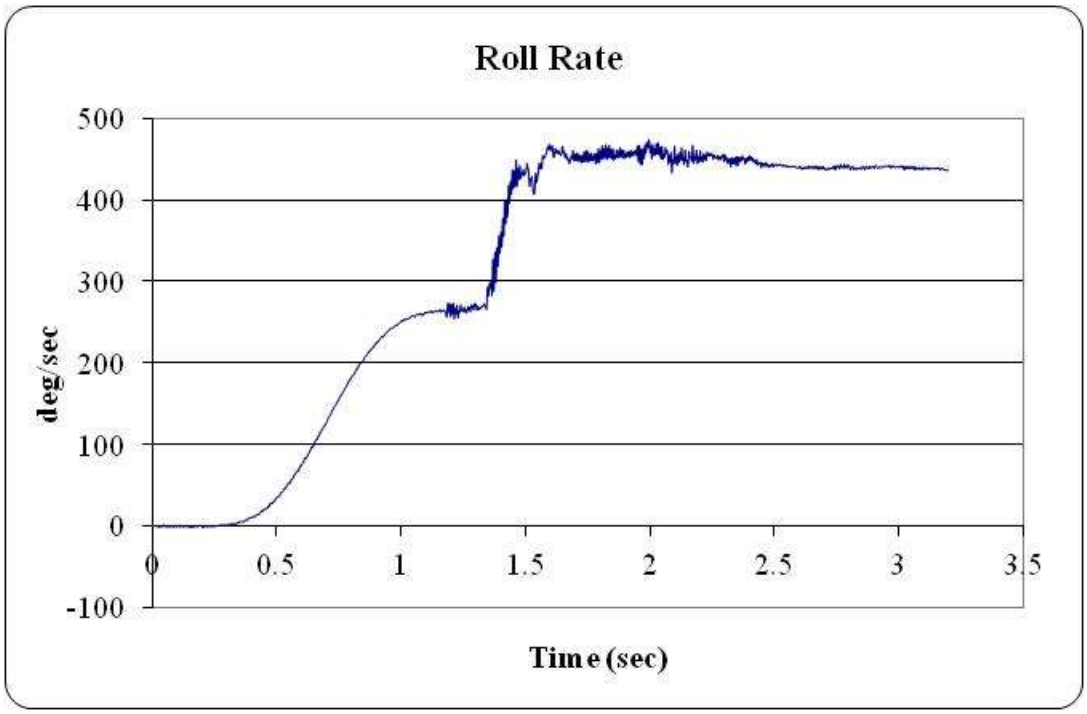
Data Sampling Rate: 1 kHz



Plot 50: Roll Angle vs. Time

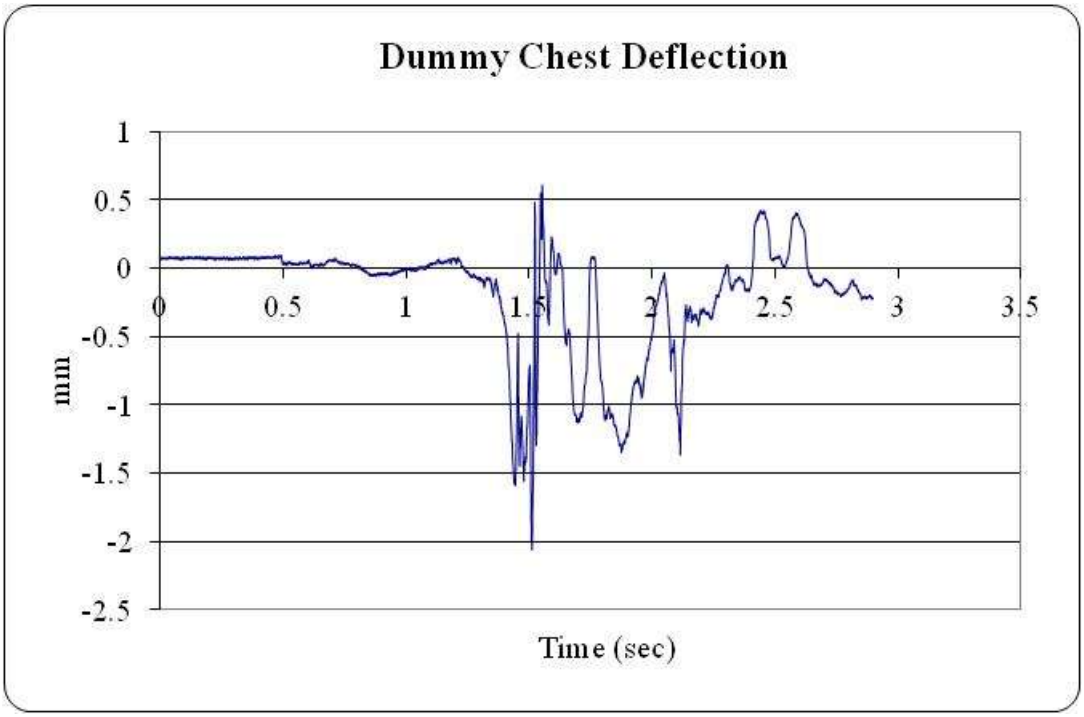
Data Sampling Rate: 10 kHz

Roll 2



Plot 51: Roll Rate vs. Time

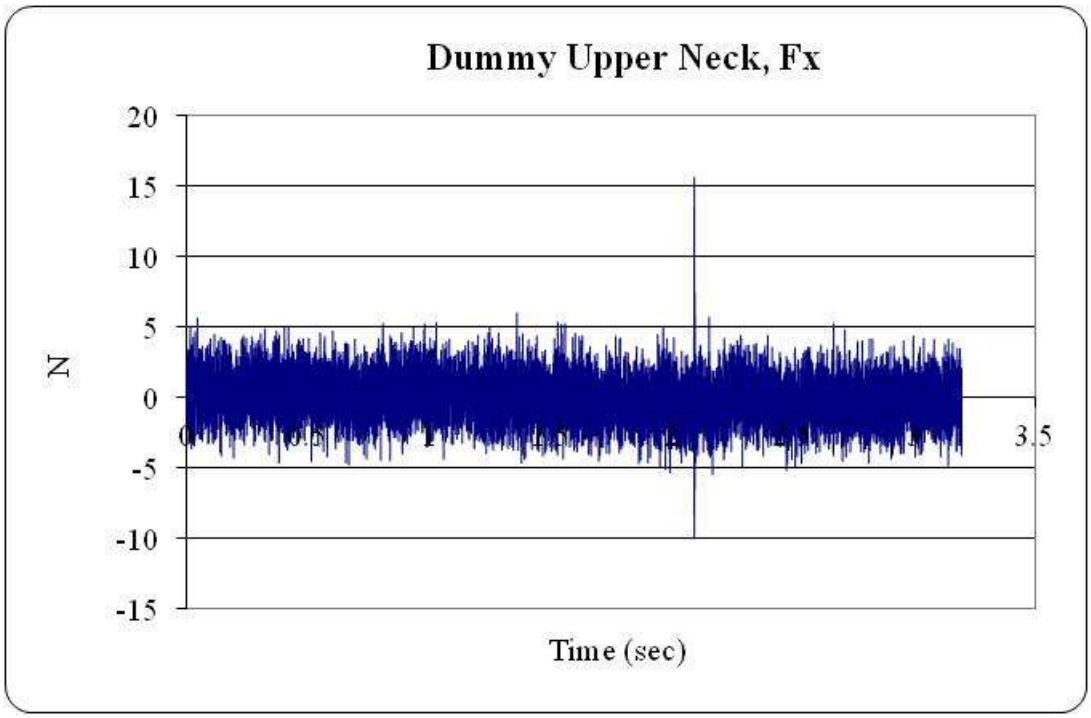
Data Sampling Rate: 10 kHz



Plot 52: Chest Deflection vs. Time

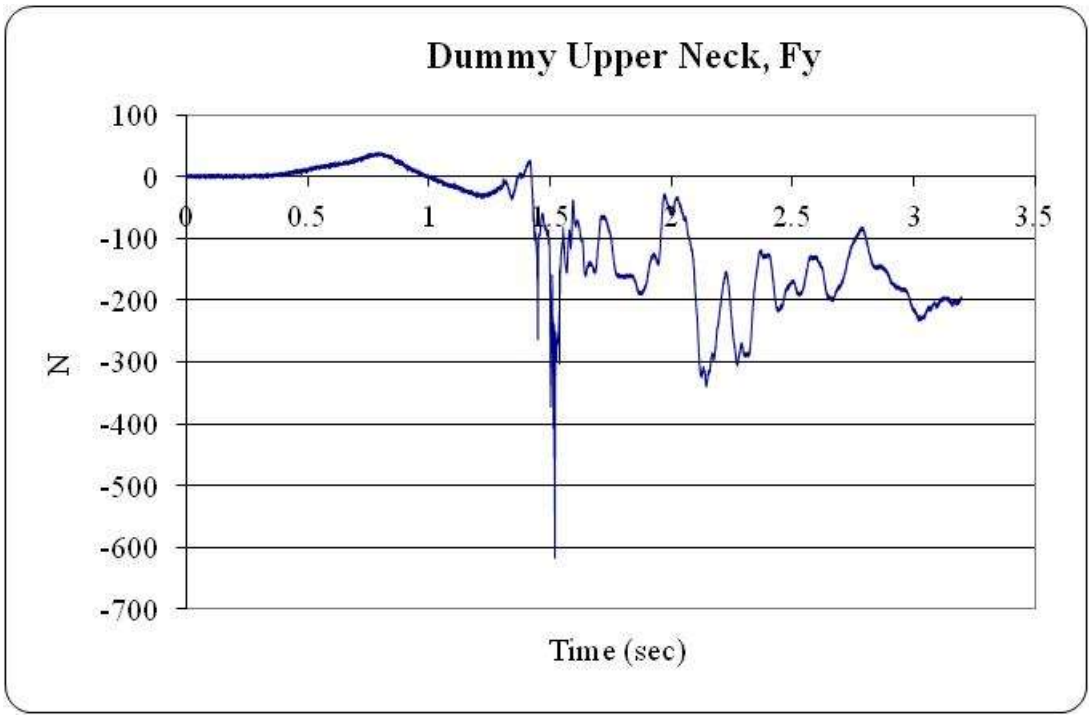
Data Sampling Rate: 10 kHz

Roll 2



Plot 53: Dummy Upper Neck Loading, Fx vs. Time

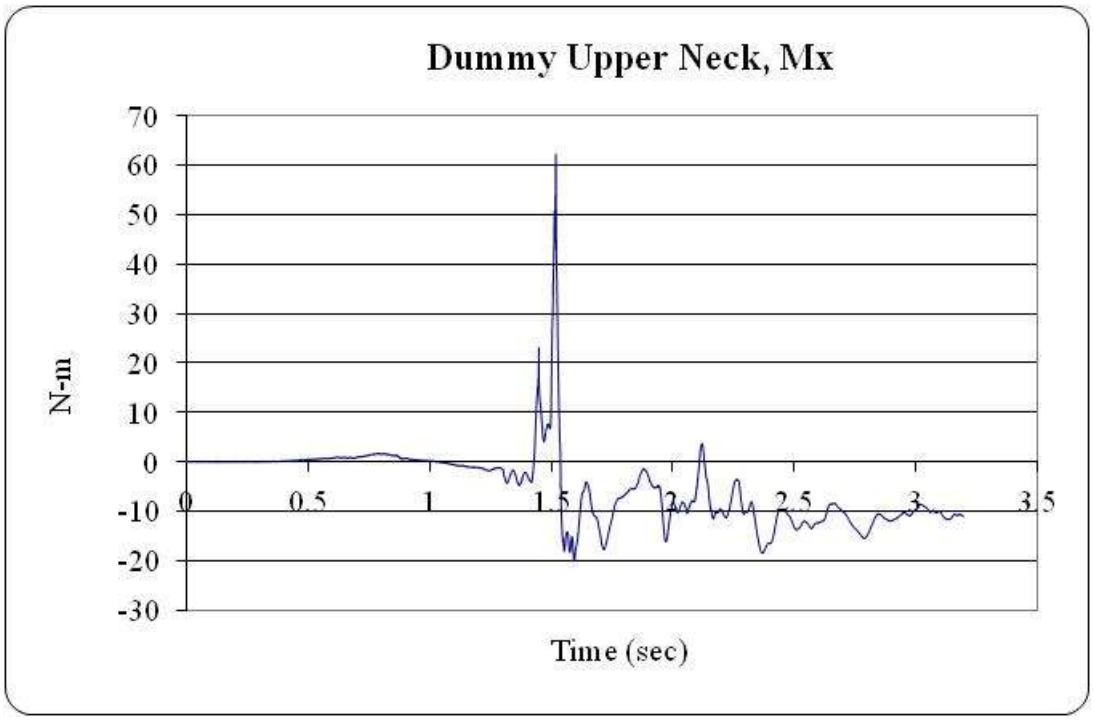
Data Sampling Rate: 10 kHz



Plot 54: Dummy Upper Neck Loading, Fy vs. Time

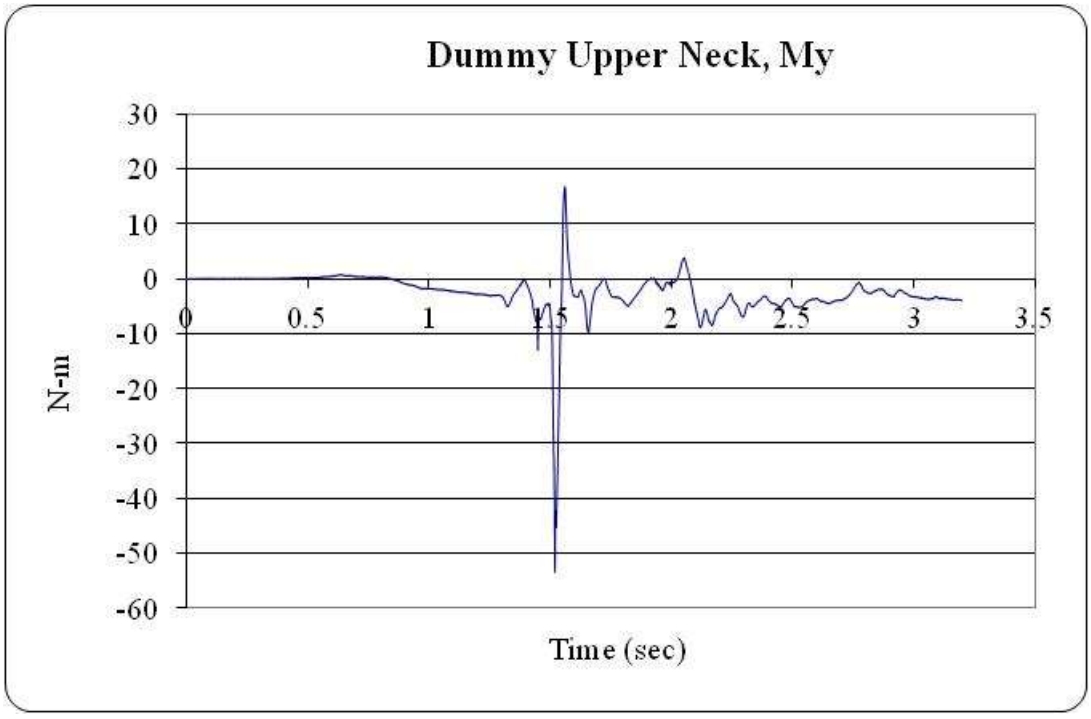
Data Sampling Rate: 10 kHz

Roll 2



Plot 55: Dummy Upper Neck Bending Moment, Mx vs. Time

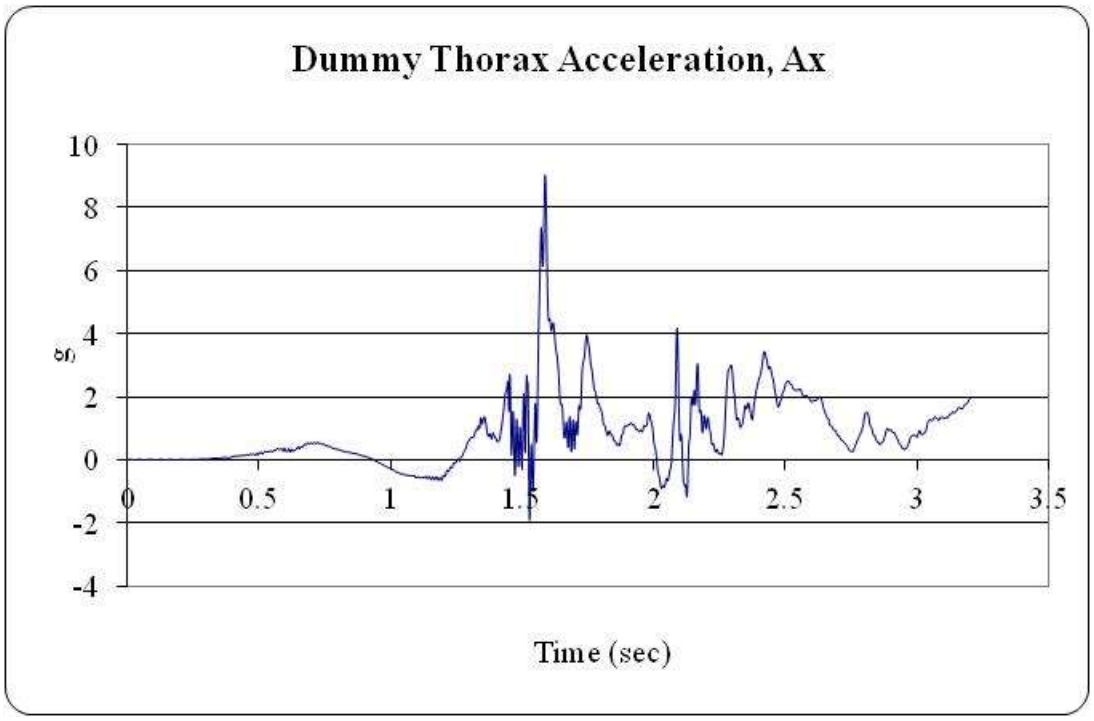
Data Sampling Rate: 10 kHz



Plot 56: Dummy Upper Neck Bending Moment, My vs. Time

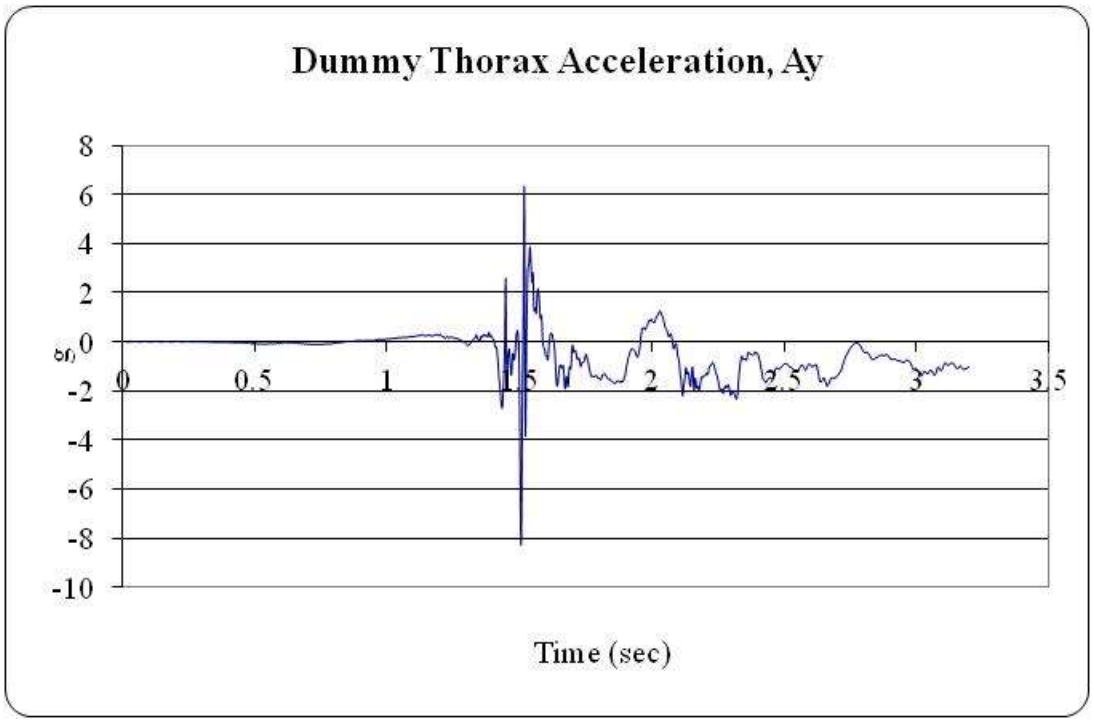
Data Sampling Rate: 10 kHz

Roll 2



Plot 57: Dummy Thorax Acceleration, Ax vs. Time

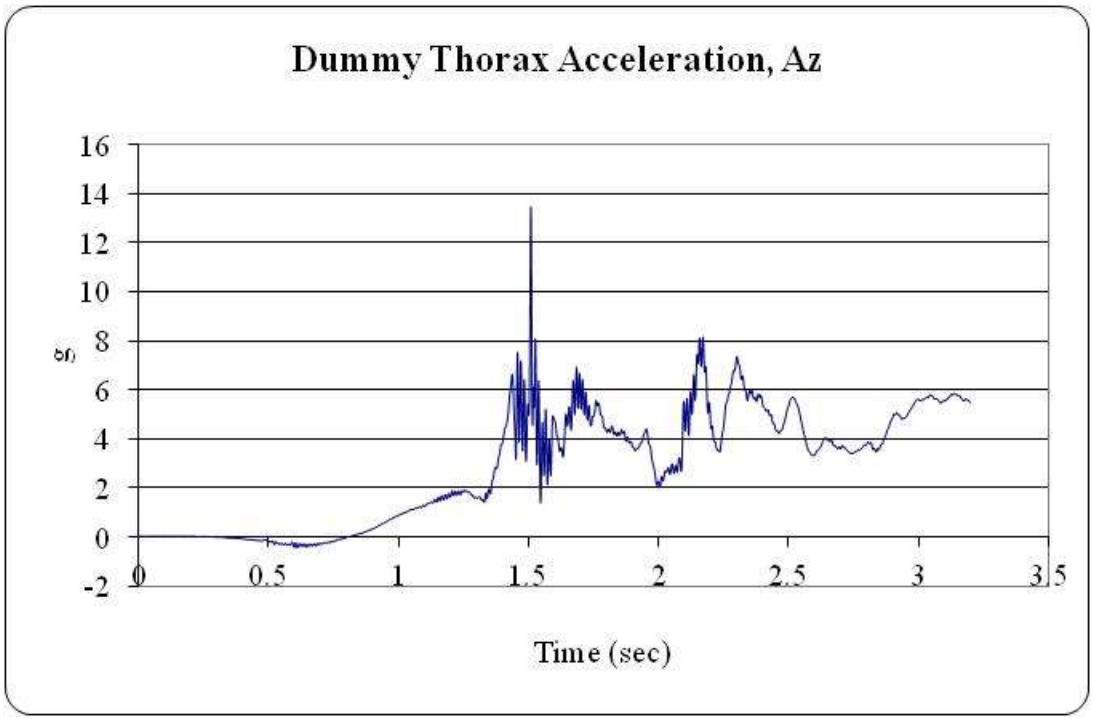
Data Sampling Rate: 10 kHz



Plot 58: Dummy Thorax Acceleration, Ay vs. Time

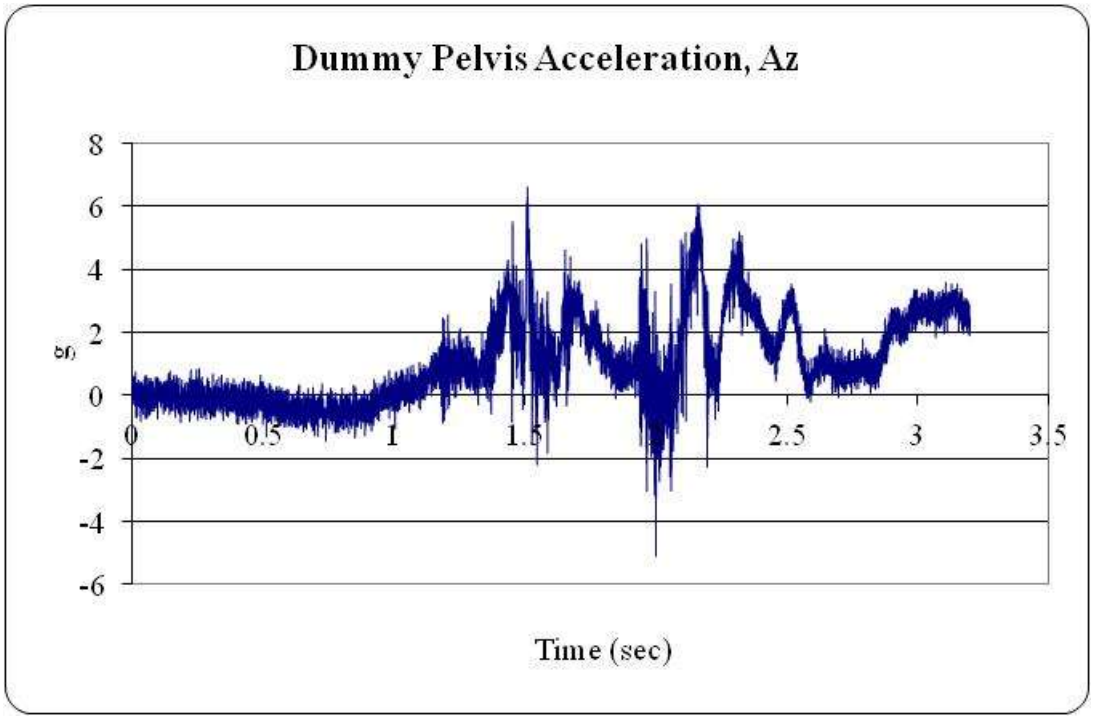
Data Sampling Rate: 10 kHz

Roll 2



Plot 59: Dummy Thorax Acceleration, Az vs. Time

Data Sampling Rate: 10 kHz



Plot 60: Dummy Pelvis Acceleration, Az vs. Time

Data Sampling Rate: 10 kHz

5. All Test Photographs – Test Setup

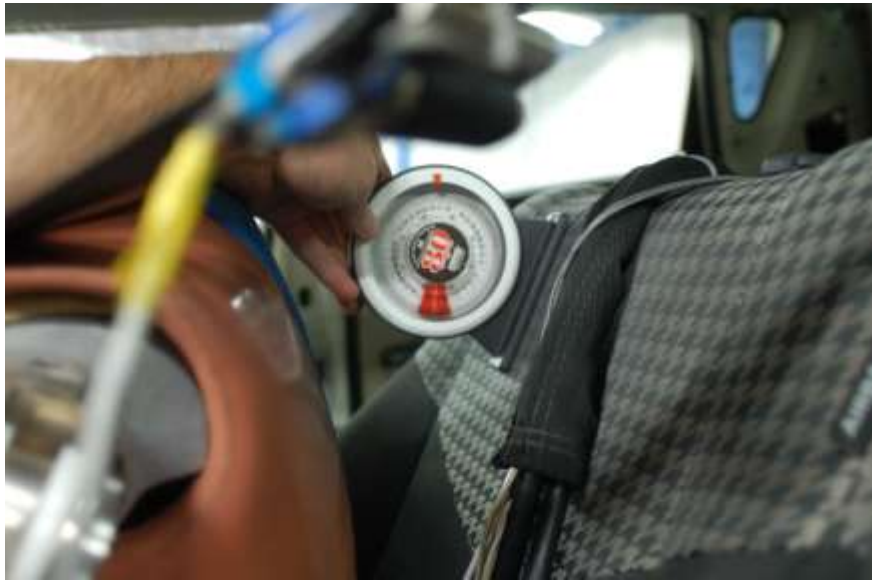
Test Setup

Vehicle Instrumentation



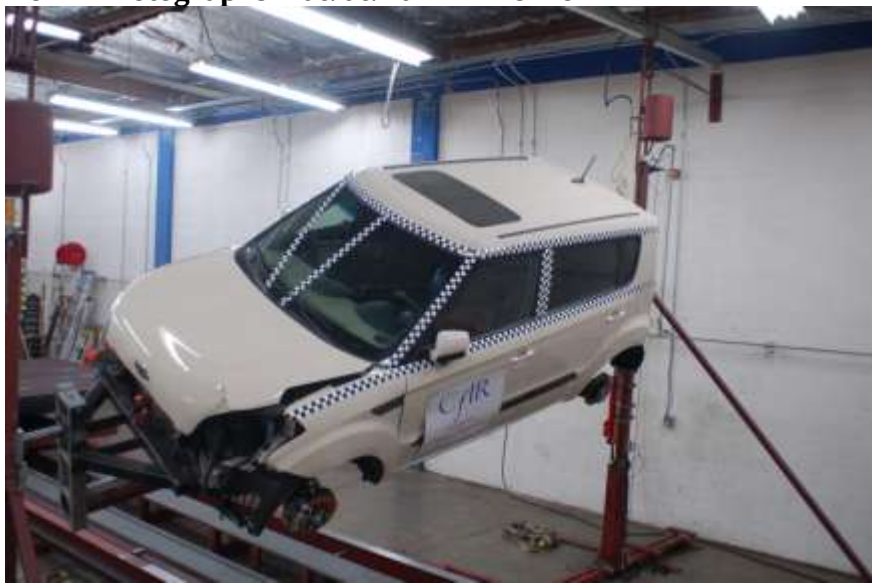

Vehicle Instrumentation

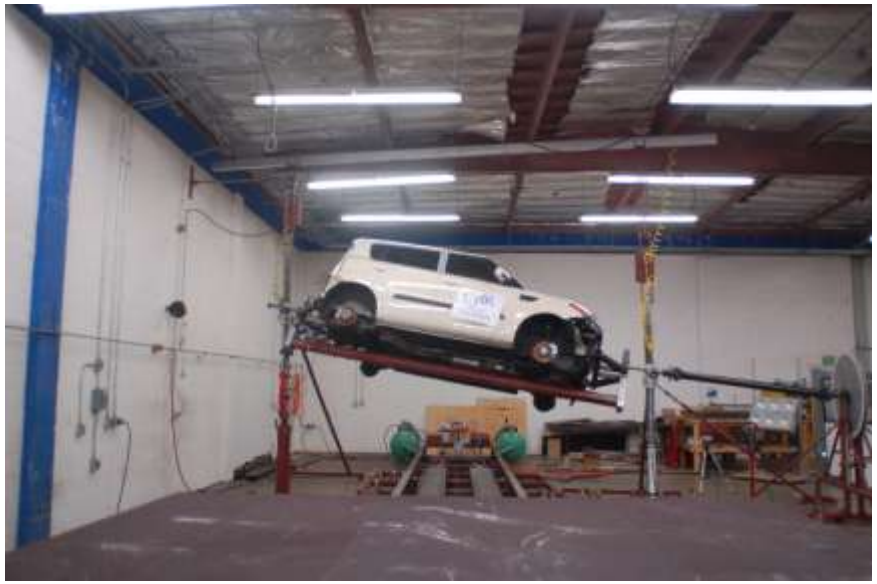
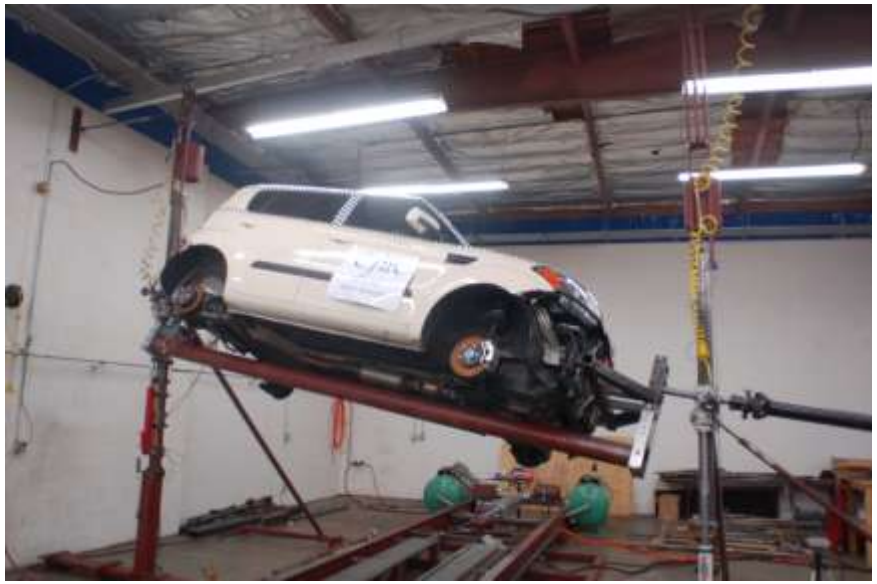
Roll 1 Photographs – 06/06/2012 – Dummy Inspection

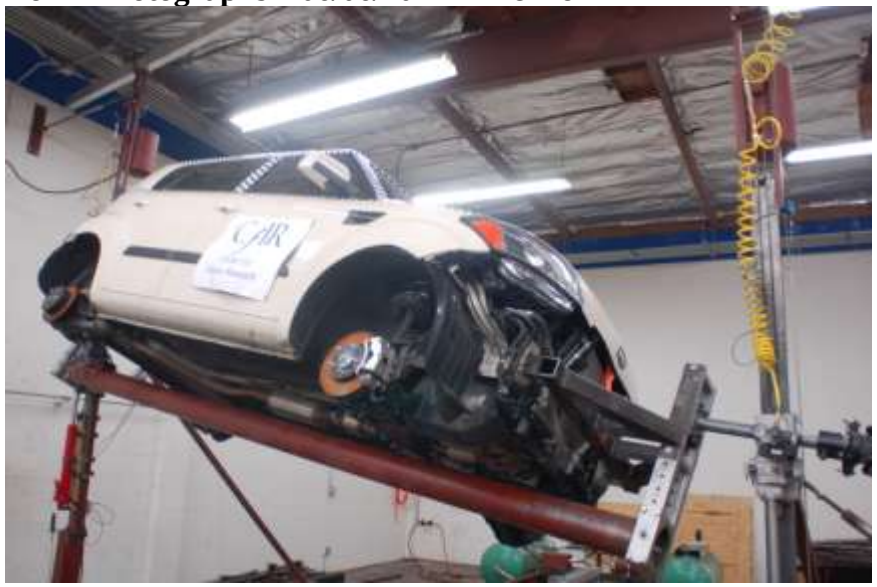
Roll 1 Photographs – 06/06/2012 – Dummy Inspection

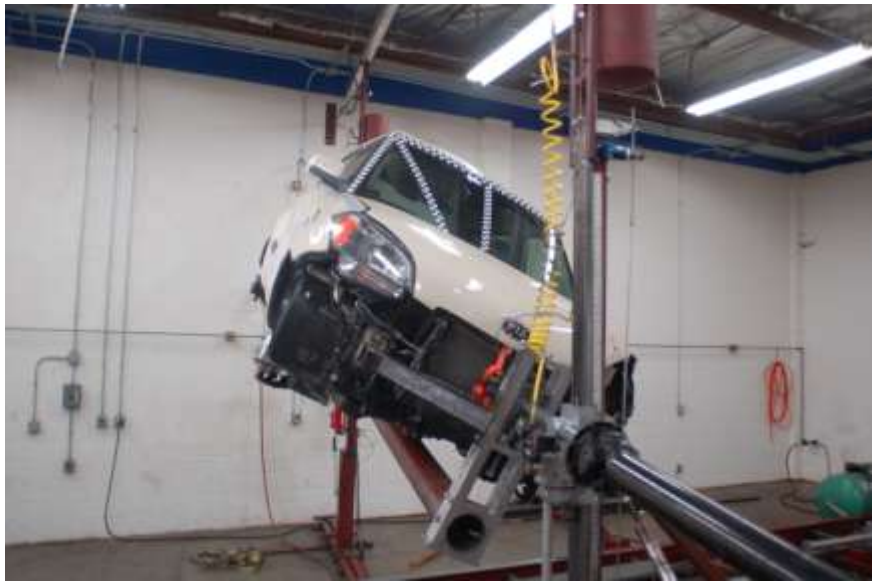
Roll 1 Photographs – 06/06/2012 – Pre-Roll



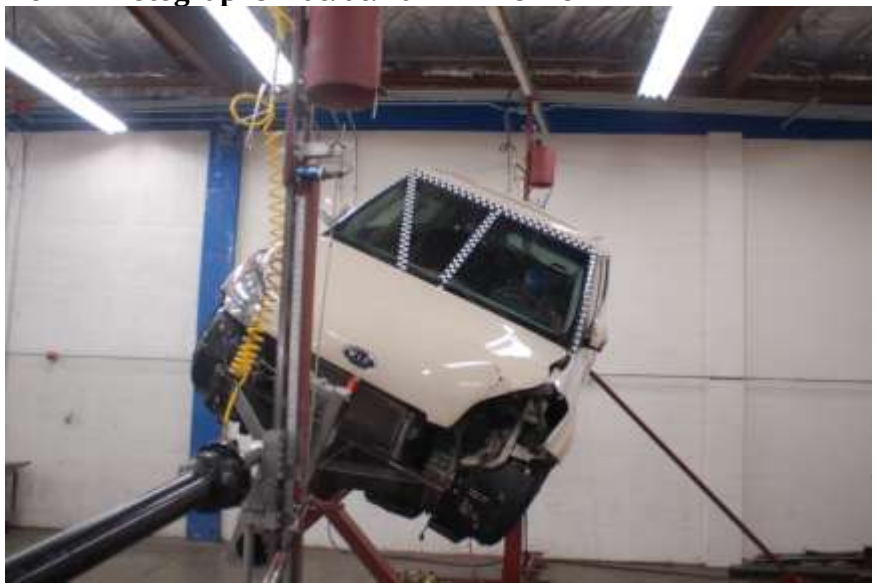
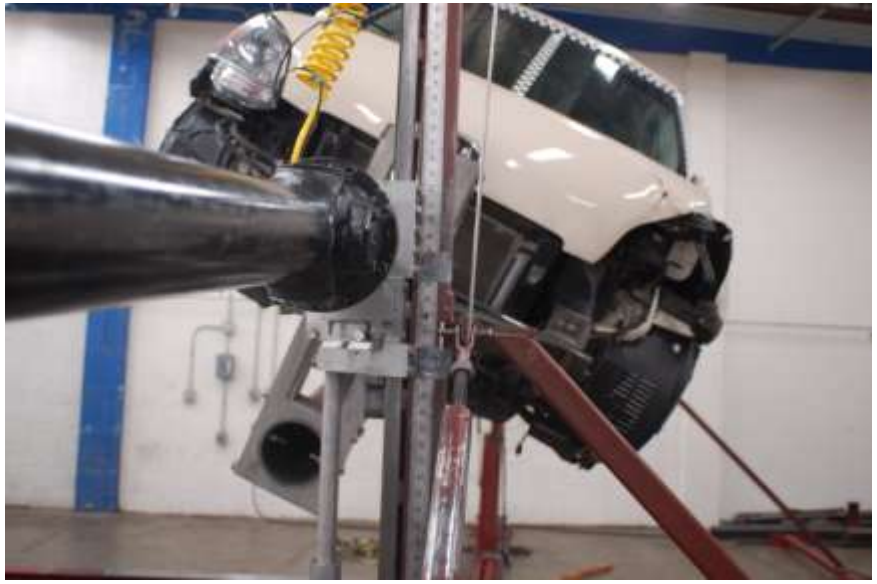



Roll 1 Photographs – 06/06/2012 – Pre-Roll

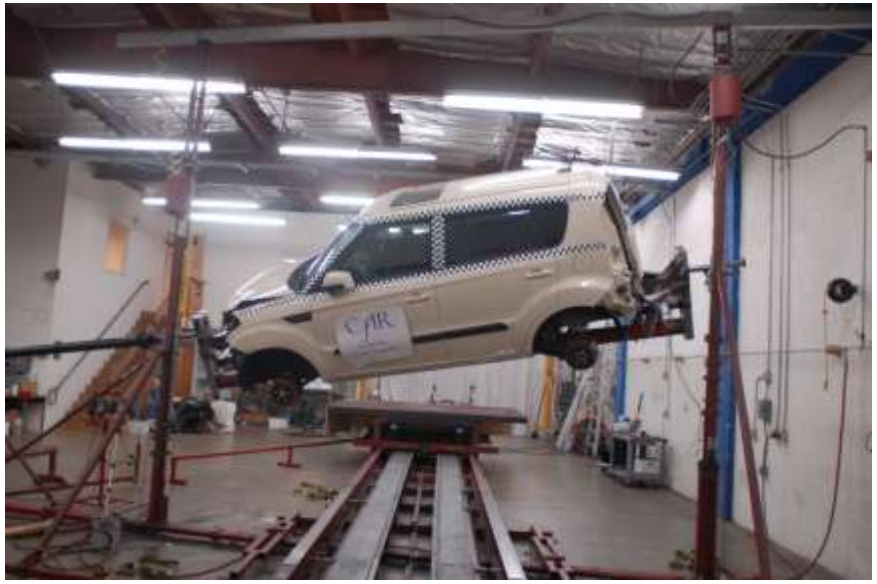




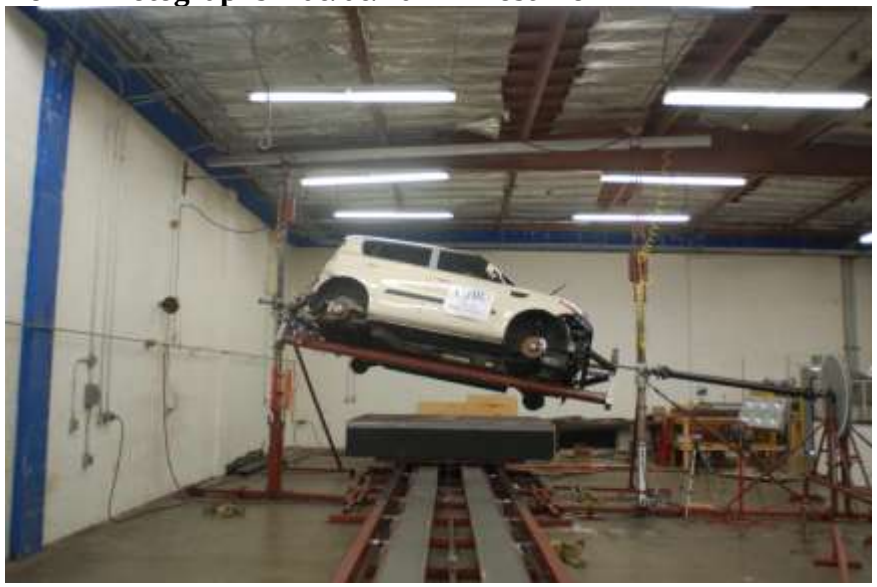
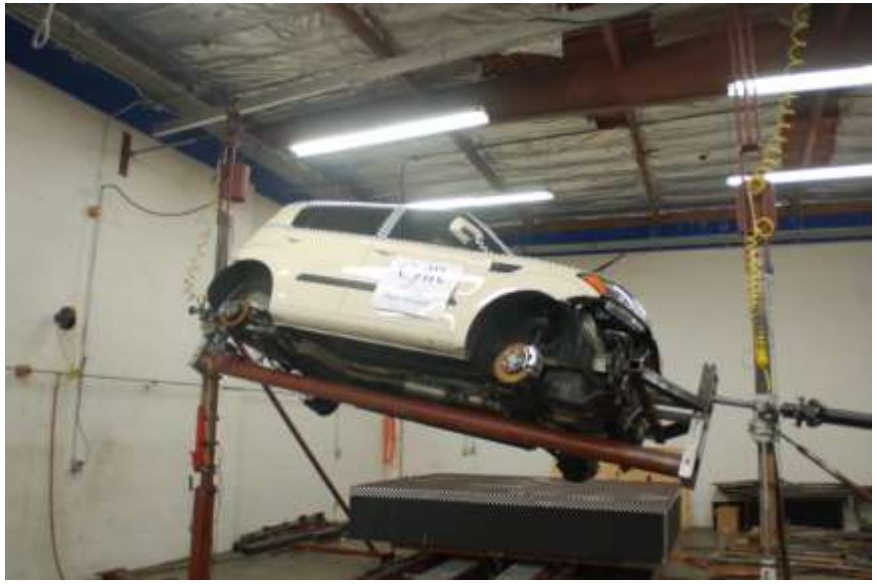

Roll 1 Photographs – 06/06/2012 – Pre-Roll

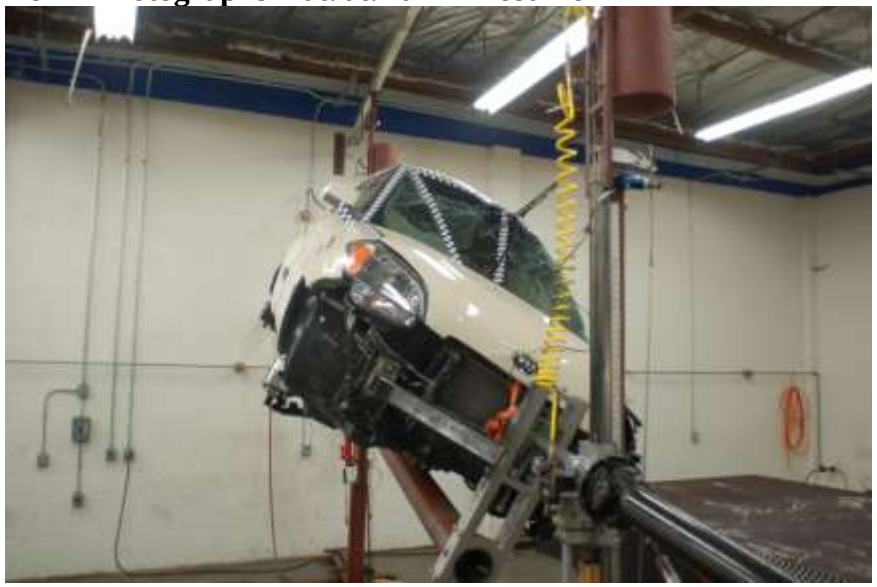
Roll 1 Photographs – 06/06/2012 – Pre-Roll

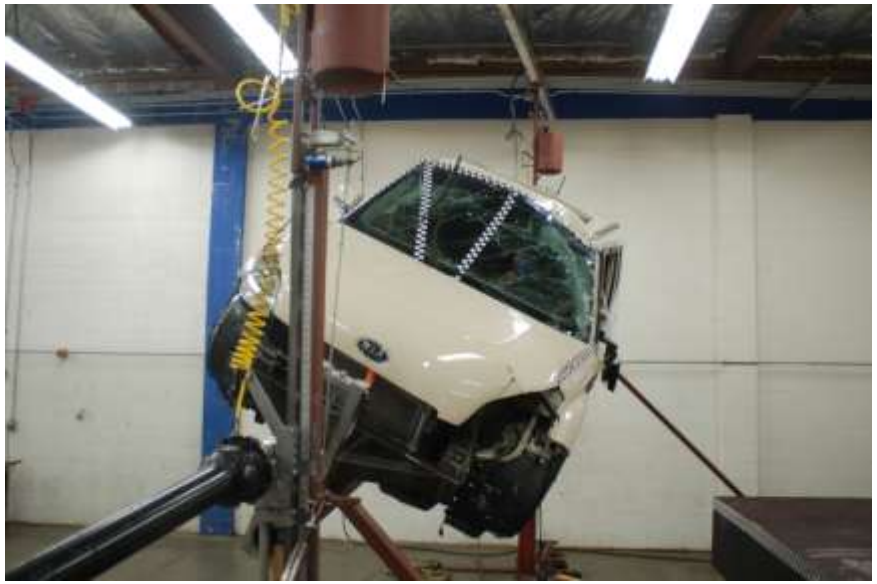


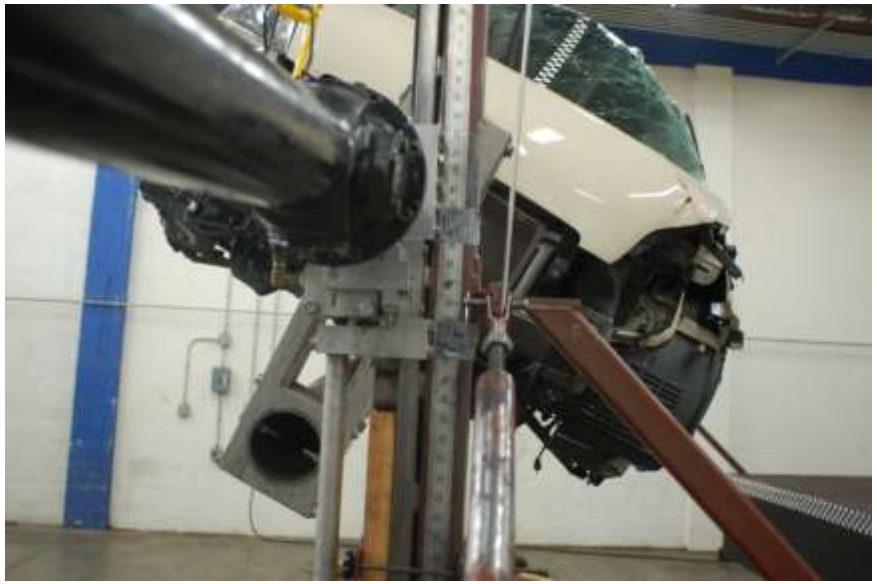
Roll 1 Photographs – 06/06/2012 – Post-Roll

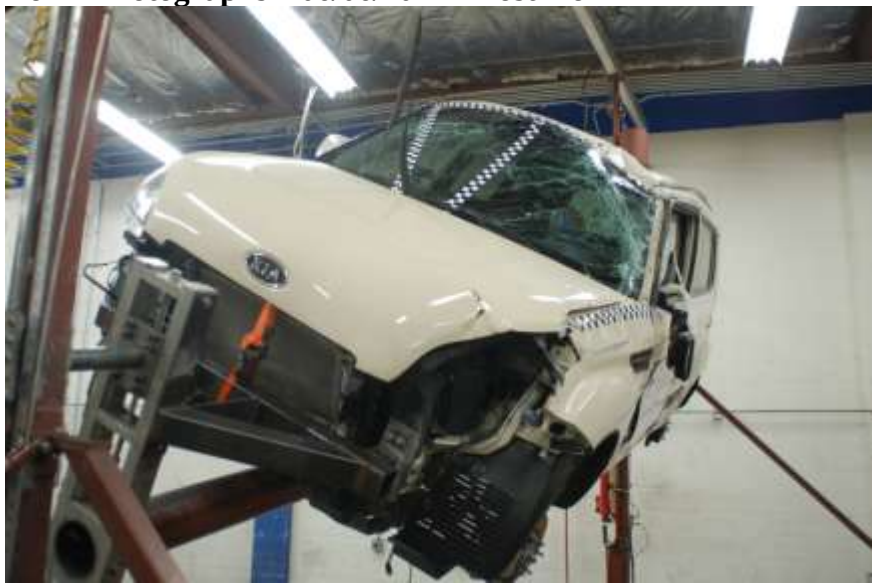
Roll 1 Photographs – 06/06/2012 – Post-Roll

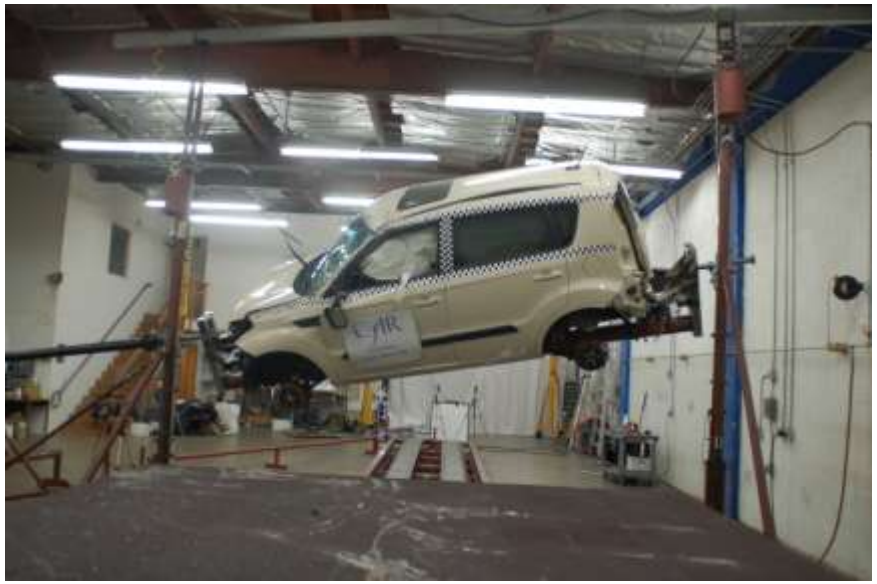




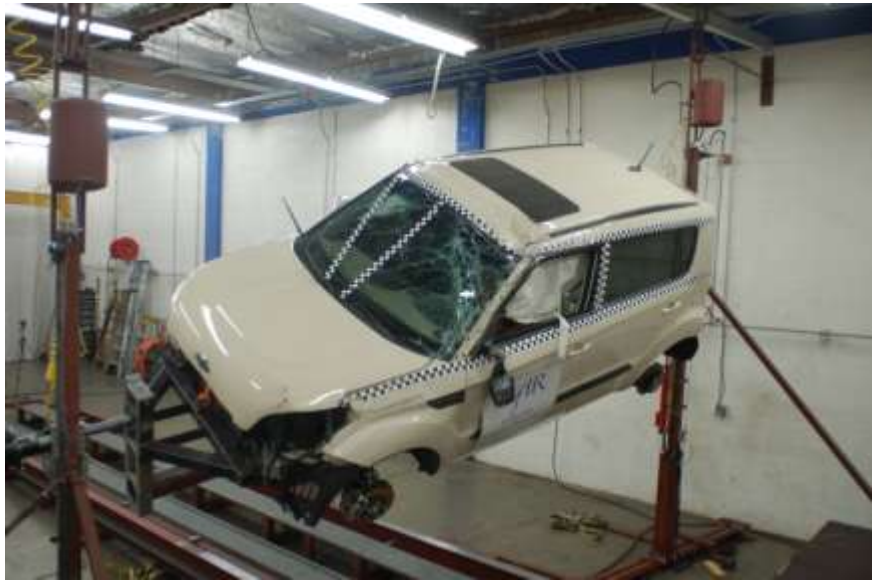


Roll 1 Photographs – 06/06/2012 – Post-Roll



Roll 1 Photographs – 06/06/2012 – Post-Roll

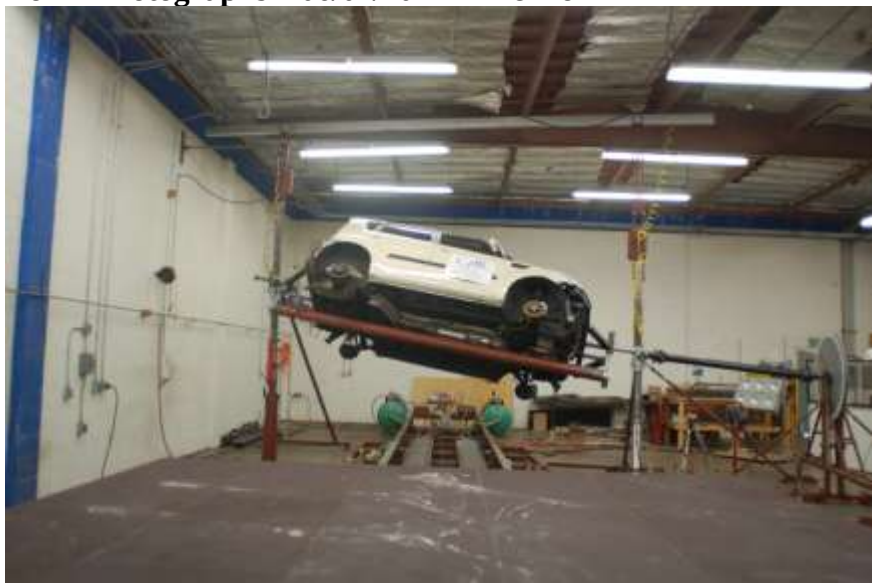
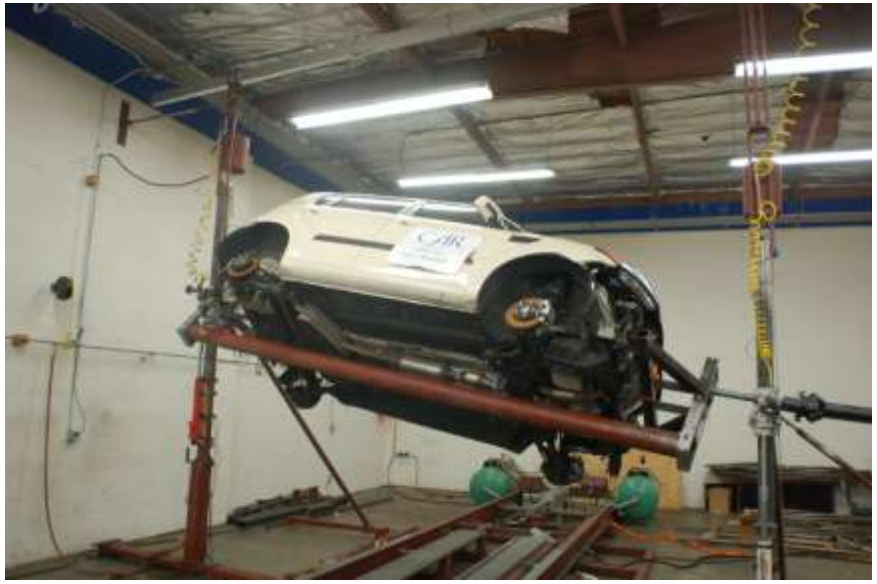
Roll 1 Photographs – 06/06/2012 – Post-Roll

Roll 2 Photographs – 06/07/2012 – Dummy Inspection

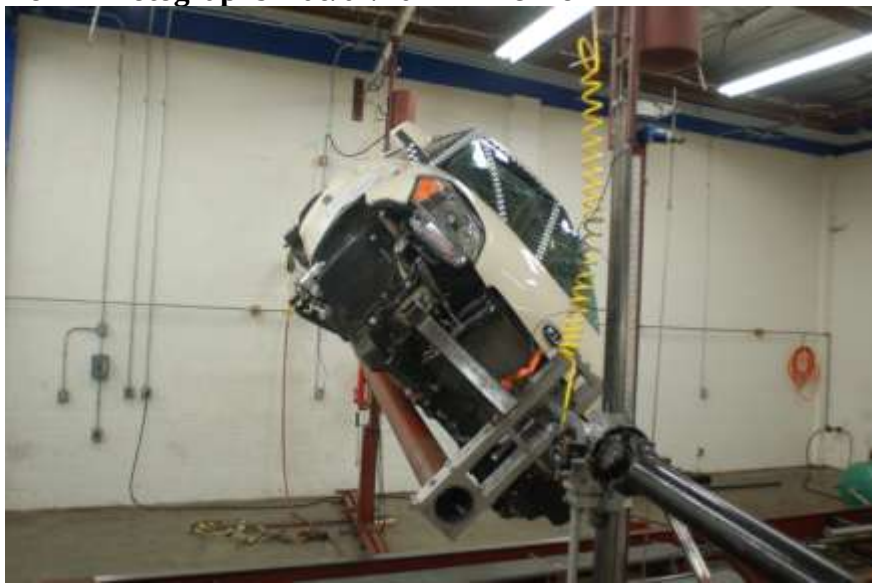


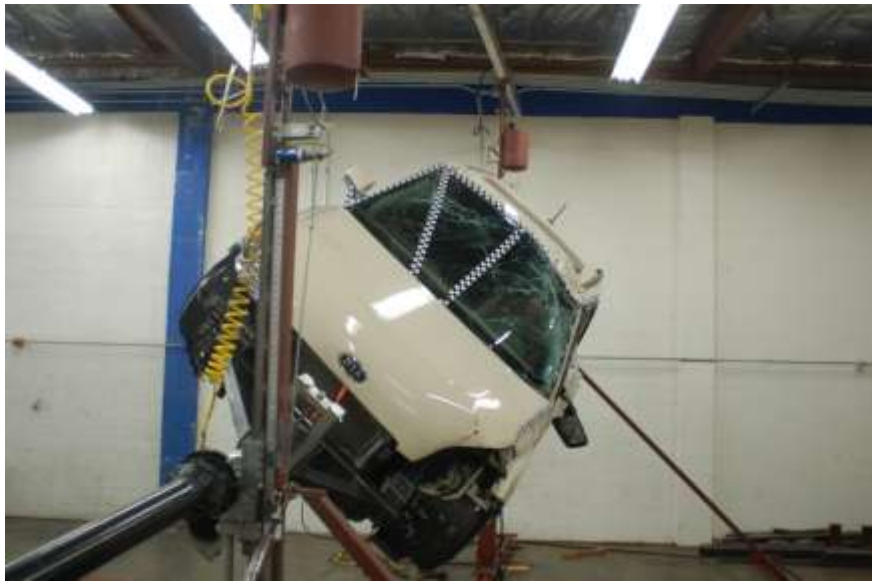

Roll 2 Photographs – 06/07/2012 – Dummy Inspection

Roll 2 Photographs – 06/07/2012 – Pre-Roll

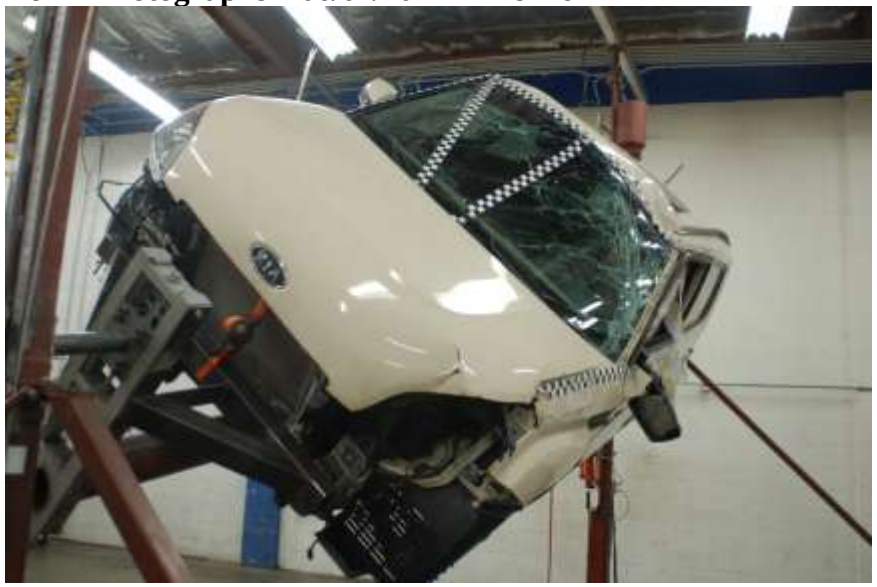



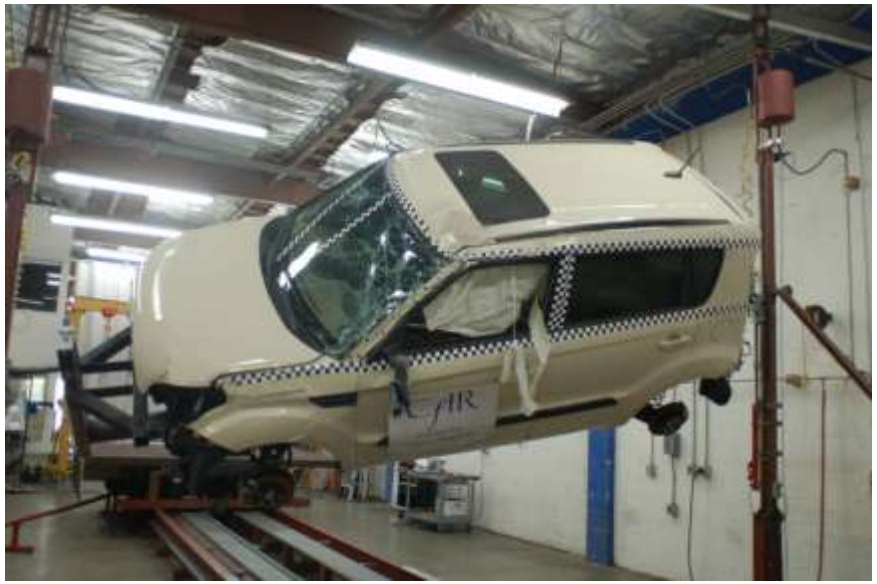
Roll 2 Photographs – 06/07/2012 – Pre-Roll





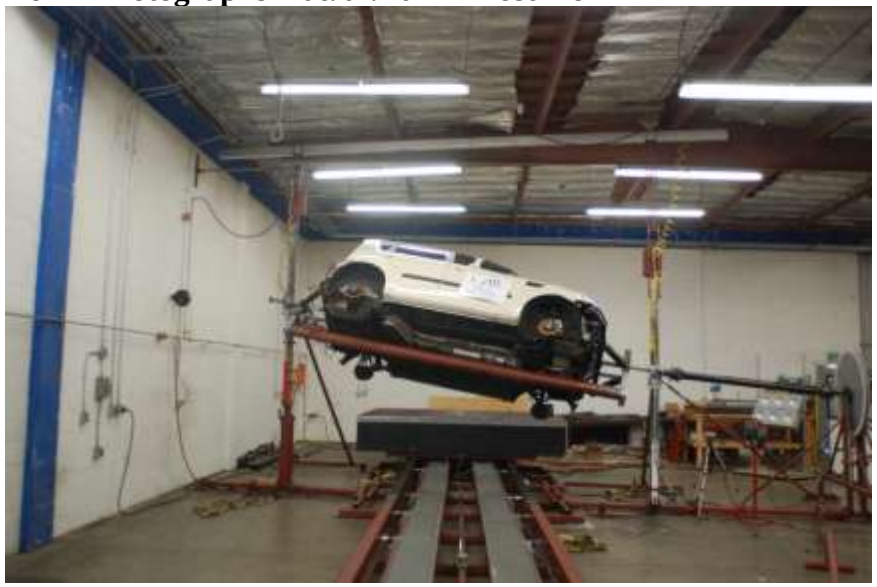
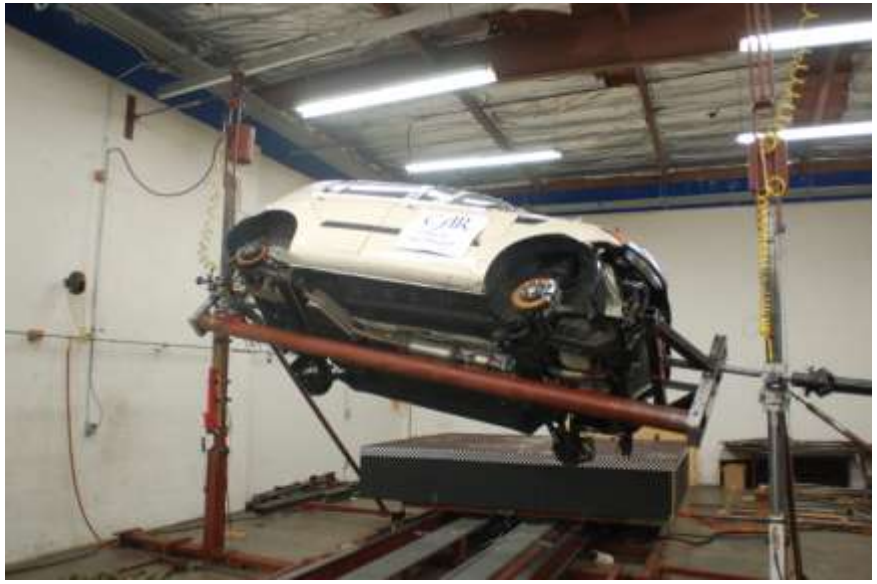
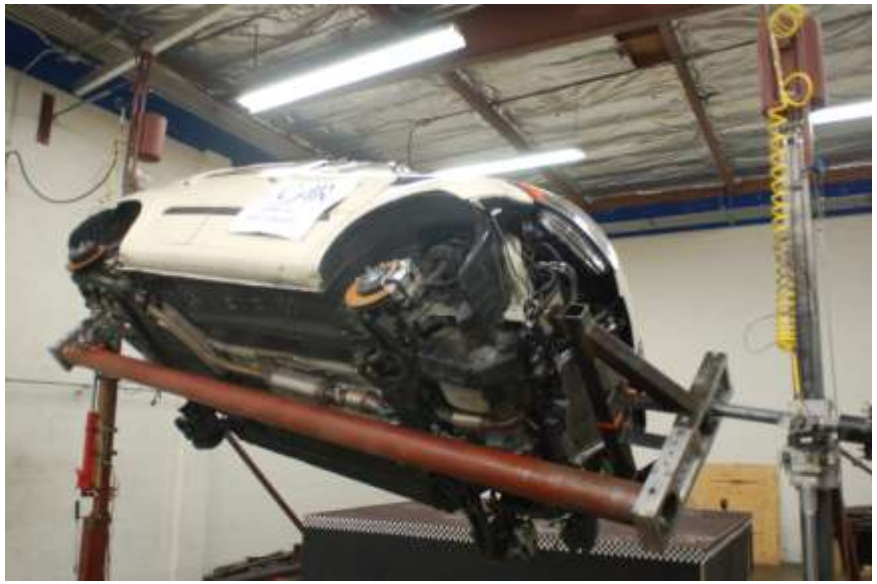
Roll 2 Photographs – 06/07/2012 – Pre-Roll



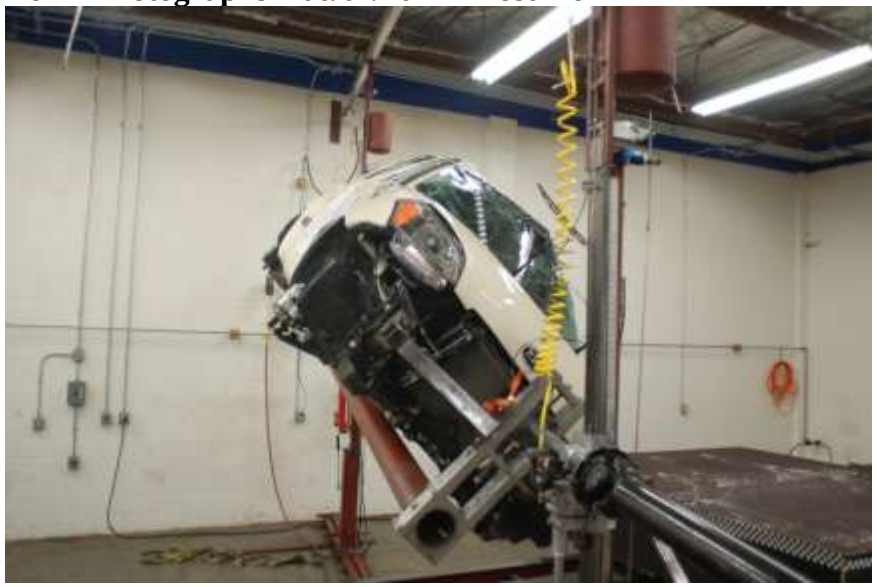


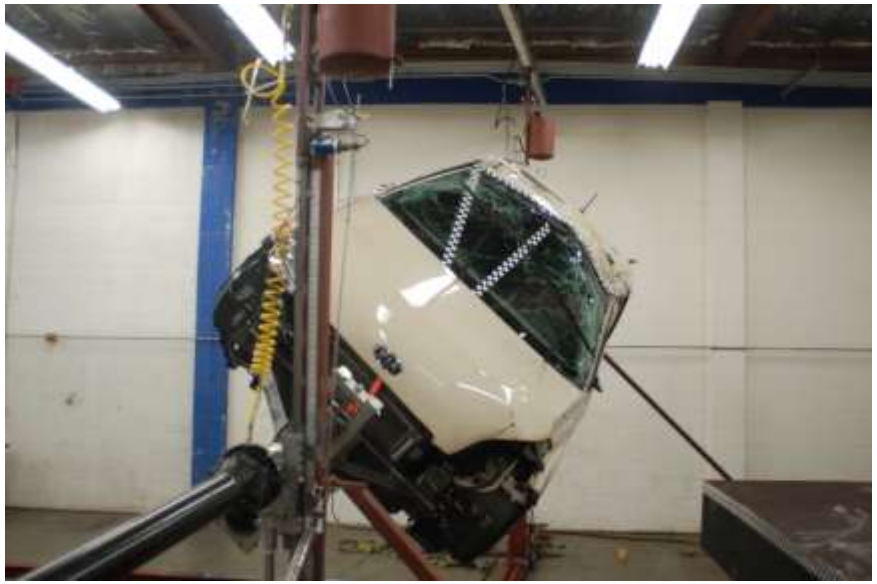

Roll 2 Photographs – 06/07/2012 – Pre-Roll

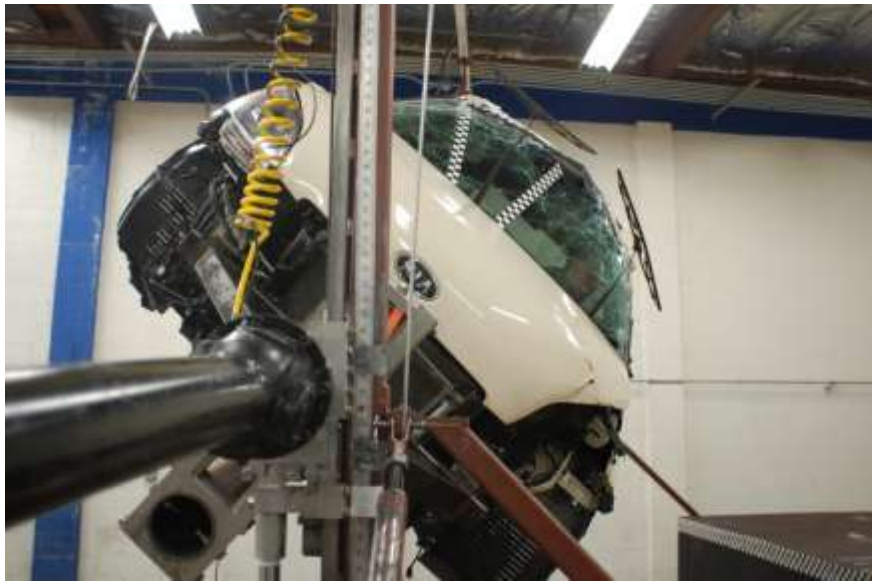
Roll 2 Photographs – 06/07/2012 – Post-Roll

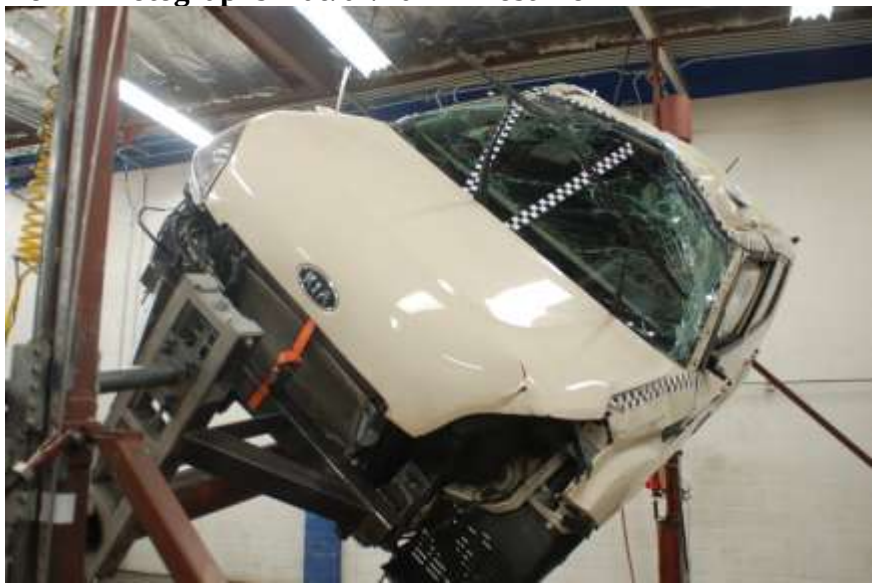

Roll 2 Photographs – 06/07/2012 – Post-Roll

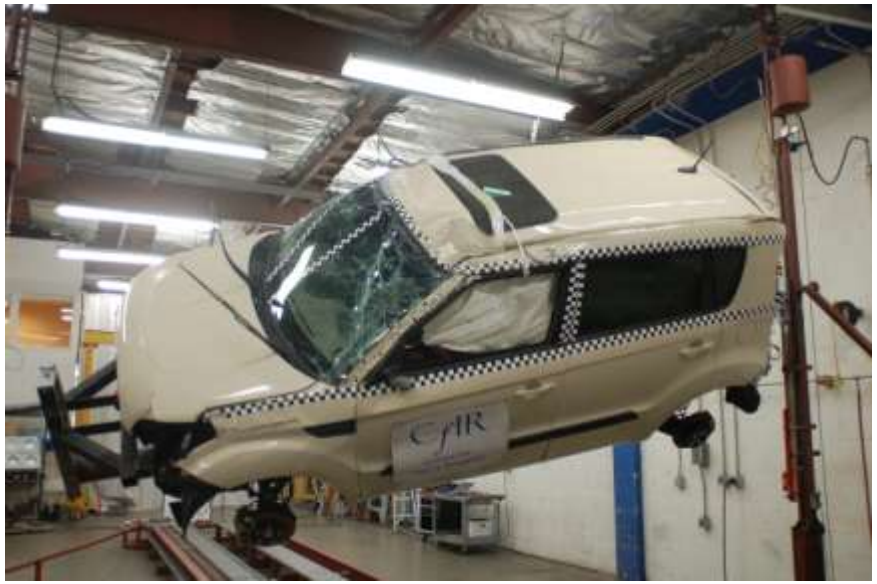
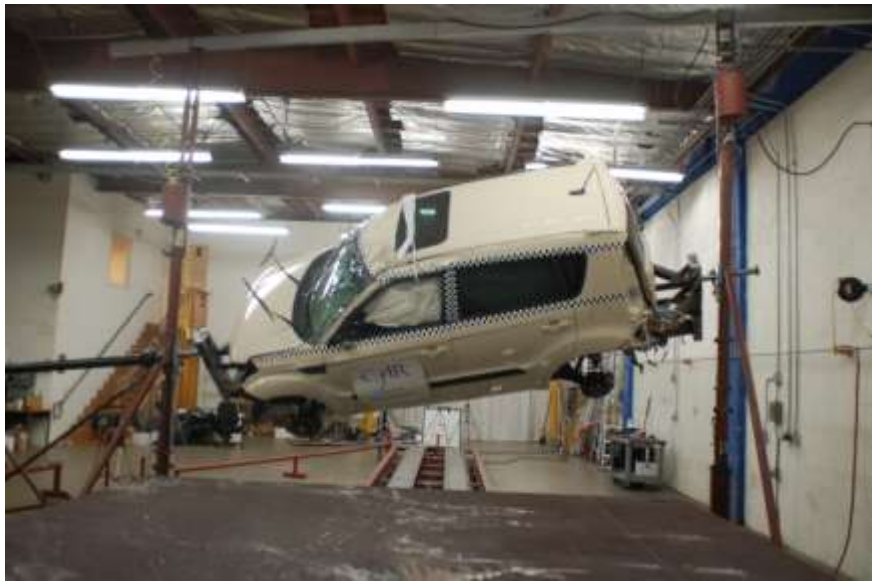




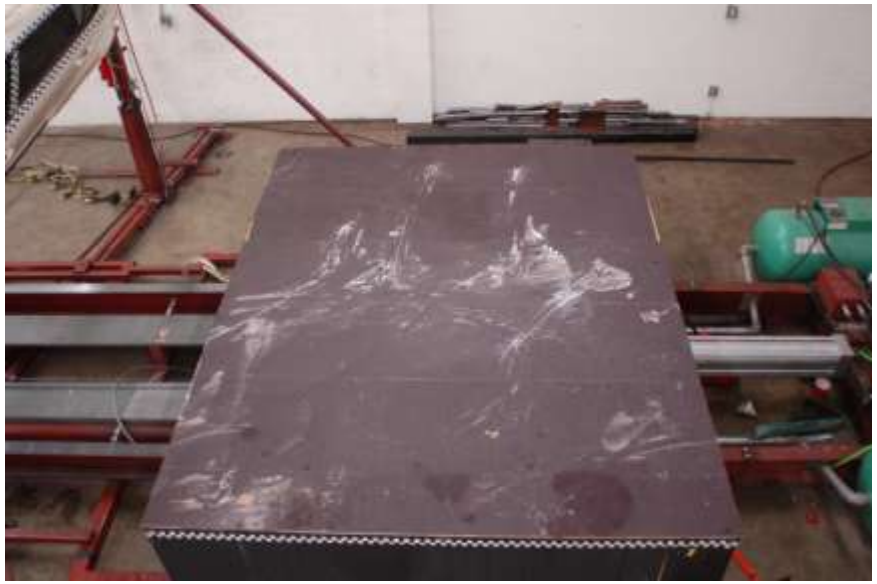


Roll 2 Photographs – 06/07/2012 – Post-Roll



Roll 2 Photographs – 06/07/2012 – Post-Roll



Roll 2 Photographs – 06/07/2012 – Post-Roll

Pre-Test Photos




Pre-Test Photos

Pre-Test Photos

Pre-Test Photos




Pre-Test Photos

Post-Test Photos




Post-Test Photos

Post-Test Photos




Post-Test Photos

Post-Test Photos