**REPORT NUMBER: 201P-MGA-2013-004**

# SAFETY COMPLIANCE TESTING FOR FMVSS 201
# RIGID POLE SIDE IMPACT TEST

**CODA AUTOMOTIVE**
**2012 CODA ALL ELECTRIC 4-DR SEDAN**
**NHTSA NUMBER: CC1005**


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


**TEST DATE: March 7, 2013**

**REPORT DATE: April 2, 2013**

**FINAL REPORT**

**PREPARED FOR:**
**U.S. DEPARTMENT OF TRANSPORTATION**
**NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION**
**OFFICE OF VEHICLE SAFETY COMPLIANCE**
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**WASHINGTON, D.C. 20590**

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FINAL REPORT ACCEPTED BY:

_____
COTR, Side Impact

_____
Date of Acceptance

**Technical Report Documentation Page**

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*16. Abstract*

A rigid pole side impact test was conducted on a 2012 Coda All Electric 4-Dr Sedan in accordance with FMVSS 201, “Occupant Protection in Interior Impact”, S6.2(b)(3) and the Office of Vehicle Safety Compliance Test Procedure No. TP-201P-02 “Rigid Pole Side Impact Test”. The test was conducted at MGA Research Corporation in Burlington, Wisconsin on March 7, 2013.

The impact velocity of the vehicle was 28.1 kph, and the ambient temperature at the struck side (driver’s) of the target vehicle at the time of impact was 21.6$^{o}$C. The post-test maximum crush was 243 mm at level 3. The test vehicle’s occupant performance is as follows:

| | REQUIREMENT | DRIVER |
|---|---|---|
| HIC | $\leq$ 1000 | 81 |

The doors on the struck side of the vehicle did not separate from the body at the hinges or latches and the opposite doors did not open during the side impact event.

| | | | |
|---|---|---|---|
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TABLE OF CONTENTS


| Section | | Page No. |
|---|---|---|
| 1 | Purpose of Compliance Test | 1 |
| 2 | Summary of Rigid Pole Side Impact Test | 2 |
| 3 | Vehicle Test Data | 4 |
| 4 | Occupant and Vehicle Information | 10 |

| Data Sheet No. | | Page No. |
|---|---|---|
| 1 | General Test Vehicle Parameter Data | 5 |
| 2 | Test Vehicle Summary of Results | 8 |
| 3 | Post Test Observations | 9 |
| 4 | SID HIII Instrumentation Data | 11 |
| 5 | Vehicle Pre-Test and Post-Test Measurements | 12 |
| 6 | SID HIII Longitudinal Clearance Dimensions | 13 |
| 7 | SID HIII Lateral Clearance Dimensions | 14 |
| 8 | Vehicle Side Measurements | 15 |
| 9 | Vehicle Exterior Crush Profiles | 16 |
| 10 | Vehicle Damage Profile Distances | 18 |
| 11 | High Speed Camera Locations and Data | 19 |
| 12 | Dummy Damage Checklist – SID HIII | 20 |
| 13 | Test Vehicle Accelerometer Locations and Data Summary | 21 |
| 14 | Vehicle and Dummy Temperature | 24 |

| Appendix | | |
|---|---|---|
| A | Photographs | A |
| B | SID HIII and Vehicle Response Data | B |
| C | SID HIII Configuration and Performance Verification Data | C |
| D | Calibration Information Data | D |

## SECTION 1
## PURPOSE OF COMPLIANCE TEST

This side impact test is conducted as part of the FY 2012 FMVSS 201 “Occupant protection in interior impact” compliance test program sponsored by the National Highway Traffic Safety Administration (NHTSA), under contract No. DTNH22-12-D-00268. The purpose of this test was to evaluate the dynamic head protection system in a 2012 Coda All Electric 4-Dr Sedan. The rigid pole side impact test was conducted in accordance with the Office of Vehicle Safety Compliance’s (OVSC), Laboratory Test Procedure TP-201P-02, dated October 21, 2001.

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

## SECTION 2
## SUMMARY OF RIGID POLE SIDE IMPACT TEST

A rigid pole side impact test was performed on a 2012 Coda All Electric 4-Dr Sedan. The subject vehicle was towed into a rigid pole at a velocity of 28.1 km/h. The test was conducted at MGA Research Corporation in Burlington, Wisconsin, on March 7, 2013. Pretest and post-test photographs of the test vehicle, and the side impact dummy (SID HIII) are included in Appendix A of this report.

One SID HIII was placed in the left front outboard designated seating position according to instructions specified in TP201P-02 dated October 21, 2001. The side impact event was documented by two (2) real-time video cameras and eleven (11) high-speed video cameras. Camera locations and other pertinent camera information are included in this report.

The SID HIII was instrumented with the following accelerometers:

1. Head CG tri-axial accelerometers (X, Y and Z primary)
2. Upper neck 6 channel load cell (X, Y and Z force and moment)
3. Left Upper Rib (LUR) uniaxial accelerometer (Y-axis primary and redundant)
4. Left Lower Rib (LLR) uniaxial accelerometer (Y-axis primary and redundant)
5. Lower Thoracic Spine (T12) uniaxial accelerometer (Y-axis primary and redundant)
6. Pelvic (PEV) section uniaxial accelerometer (Y-axis primary and redundant)

Appendix B contains the vehicle and dummy response data traces. A summary of the side impact dummy (SID HIII) configuration and performance verification test data is shown in Appendix C. Dummy and vehicle calibration data can be found in Appendix D of this report.

The following table summarizes the results of the test.

| Measurements | Units | Driver |
|---|---|---|
| HIC | | 81 |
| TTI* | G's | 43.2 |
| Pelvis* | G's | 52.9 |
| Neck X Force* | N | -368.5 |
| Neck Y Force* | N | 164.3 |
| Neck Z Force* | N | 508.9 |
| Neck  Moment X* | Nm | -52.7 |
| Neck Moment Y* | Nm | -23.2 |
| Neck Moment Z* | Nm | 31.2 |

* For Information Purposes Only

**TEST NOTES**

There was no valid data collected for:
Left Lower A-Post Y after 6ms
Driver Seat Track Y after 11ms

Door Accelerometers (J1, J2, J3) were not installed for this test.

The left side curtain airbag was observed to be twisted.

# SECTION 3
# VEHICLE TEST DATA

**DATA SHEET 1**
**GENERAL TEST VEHICLE PARAMETER DATA**

Test Vehicle: 2012 Coda All Electric 4-Dr Sedan
Test Program: FMVSS 201P
NHTSA No. CC1005
Test Date: March 7, 2013

**TEST VEHICLE INFORMATION**

| | |
|---|---|
| Year | 2012 |
| Make | Coda |
| Model | Coda |
| Body Style | 4-Dr Sedan |
| Color | Black |
| VIN | 53G1U4A43CB000063 |
| NHTSA No. | CC1005 |
| Build Date | 02/12 |
| Engine Data | Electric |
| Engine Placement | Lateral |
| Transmission | Automatic |
| Final Drive | Front |
| Odometer Reading (km) | 57 |

**TEST VEHICLE OPTIONS**

| | |
|---|---|
| Front Airbag | Yes |
| Side Airbags | Yes |
| Power Windows | Yes |
| Power Steering | Yes |
| Power Door Locks | Yes |
| Tilt Wheel | Yes |
| Power Brakes | Yes |

**DATA FROM VEHICLE'S TIRE PLACARD**

| Measured Parameter | Front | Rear |
|---|---|---|
| Tire Pressure at Capacity | 290 | 290 |
| Recommended Tire Size | 205/45R17 | 205/45R17 |
| Tire Size on Vehicle | 205/45R17 | 205/45R17 |
| Tire Manufacturer | Kumho | Kumho |

**VEHICLE CAPACITY DATA**

| Measured Parameter | Front | Rear | Third | Total |
|---|---|---|---|---|
| Designated Seating Capacity (DSC) | 2 | 3 | | 5 |
| Capacity Weight (VCW) (kg) | | | | 375 |
| DSC x 68.04 kg | | | | 340 |
| Rated Cargo and Luggage Weight (RCLW) (kg) | | | | 35 |

**VEHICLE SEAT TYPE**

| Seating Location | Type of Seat Pan | | | Type of Seat Back | | |
|---|---|---|---|---|---|---|
| | Bucket | Bench | Split Bench | Fixed | Adjustable | |
| | | | | | Manual | Power |
| Front Seat | X | | | | w/lever | |
| Rear or Second Row | | X | | X | | |

## DATA SHEET 1 (CONTINUED)
## GENERAL TEST VEHICLE PARAMETER DATA

### TEST VEHICLE WEIGHTS

| | Units | As Delivered (UVW) | | | As Tested (ATW) | | | Fully Loaded | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Front | Rear | Total | Front | Rear | Total | Front | Rear | Total |
| Left | kg | 433.2 | 392.8 | | 469.0 | 443.6 | | 469.5 | 440.4 | |
| Right | kg | 458.1 | 388.8 | | 462.2 | 406.5 | | 460.4 | 417.8 | |
| Ratio | % | 53.3 | 46.7 | | 52.3 | 47.7 | | 52.0 | 48.0 | |
| Totals | kg | 891.3 | 781.6 | 1672.9 | 931.2 | 850.1 | 1781.3 | 929.9 | 858.2 | 1788.1 |

### TARGET TEST WEIGHT CALCULATION

| Measured Parameter | Units | Value |
|---|---|---|
| Total Delivered Weight (UVW) | kg | 1672.9 |
| Weight of SID HIII Side Impact Dummy | kg | 80.7 |
| Rated Cargo/Luggage Weight (RCLW) | kg | 35 |
| Calculated Vehicle Target Weight (TVTW) | kg | 1788.6 |

### TEST VEHICLE ATTITUDES

| | Units | As Delivered | Fully Loaded | Ready For Test |
|---|---|---|---|---|
| Right Front | mm | 666 | 662 | 663 |
| Left Front | mm | 666 | 660 | 662 |
| Right Rear | mm | 674 | 664 | 670 |
| Left Rear | mm | 676 | 661 | 671 |
| Right Door Sill Angle | deg | -1.7 ND | -1.5 ND | -1.6 ND |
| Left Door Sill Angle | deg | -1.6 ND | -1.6 ND | -1.6 ND |
| Front Bumper Angle | deg | 0.6 LU | -0.6 LD | -0.3 LD |
| Rear Bumper Angle | deg | -0.3 LD | -0.6 LD | -0.5 LD |

ND = NOSE DOWN, NU = NOSE UP, BD = BACK DOWN, LD = LEFT DOWN, RD = RIGHT DOWN, RU = RIGHT UP

### GENERAL TEST VEHICLE DATA

| Measurement Description | Units | Value |
|---|---|---|
| Test Vehicle Wheel Base | mm | 2608 |
| CG Rearward of Front Wheel Centerline | mm | 1316 |
| Total Vehicle Length at Left Side | mm | 3774 |
| Total Vehicle Length at Centerline | mm | 4408 |
| Total Vehicle Length at Right Side | mm | 3774 |
| Total Vehicle Width at B-Post | mm | 1709 |
| Weight of Ballast in Cargo Area | kg | 0 |
| Amount of Stoddard Solvent in Fuel Tank | liters | Not Applicable |

## DATA SHEET 1 (CONTINUED)
## GENERAL TEST VEHICLE PARAMETER DATA

### FRONT SEAT FORE/AFT PLACEMENT

Total Length of Adjustment Travel: 256 mm, 22 detents (forwardmost as 0)
Test Position: 136 mm (foremost as 0 mm), 10th detent (forwardmost as 0)

### FRONT SEAT BACK ADJUSTMENT POSITION

Tested Seat Back Angle: 9.8 degrees measured on headrest post

11th detent (1st locking as 0)

### ADJUSTABLE STEERING COLUMN POSITION

| | Degrees | Fore/Aft Position (mm) |
|---|---|---|
| Lowermost, Position 1 | 65.7 | |
| Geometric Center, Position 2 | 64.5 | |
| Uppermost, Position 3 | 63.3 | |
| Telescoping Steering Wheel Travel | | |
| Test Position | 64.5 | |

### WINDOW POSITIONS

| | Front | Rear |
|---|---|---|
| Left Side | Open | Open |
| Right Side | Open | Open |

### FUEL TANK CAPACITY DATA

| Measurement Description | Units | Value |
|---|---|---|
| The “Usable Capacity” of the standard equipment fuel tank | liters | |
| 92-94% of “Usable Capacity” for certification to FMVSS 301 requirements | liters | |
| Actual amount of Stoddard solvent added to vehicle for certification test | liters | |

### TEST VEHICLE VERTICAL IMPACT LINE DATA

| Measurement Description | Units | Value |
|---|---|---|
| Target Impact Point Aft of Front Axle | mm | 1316 |
| Actual Impact Point Aft of Front Axle | mm | 1316 |

**DATA SHEET 2**
**TEST VEHICLE SUMMARY OF RESULTS**

Test Vehicle: 2012 Coda All Electric 4-Dr Sedan NHTSA No. CC1005
Test Program: FMVSS 201P Test Date: March 7, 2013

**TEST VEHICLE WEIGHT**

| | Units | As Tested (ATW) | | |
|---|---|---|---|---|
| | | Front Axle | Rear Axle | Total |
| Left | kg | 469.0 | 443.6 | |
| Right | kg | 462.2 | 406.5 | |
| Weight Ratio | % | 52.3 | 47.7 | |
| Totals | kg | 931.2 | 850.1 | 1781.3 |

**MAXIMUM EXTERIOR STATIC CRUSH**

| Level | Measured Parameter | Units | Maximum Crush | Above Ground |
|---|---|---|---|---|
| Level 1 | Sill Top Height | mm | 203 | 275 |
| Level 2 | Occupant H-Point | mm | 240 | 580 |
| Level 3 | Mid Door | mm | 243 | 650 |
| Level 4 | Window Sill | mm | 206 | 915 |
| Level 5 | Window Top | mm | 27 | 1430 |
| N/A | Maximum Penetration | mm | 243 | 650 |

**INSTRUMENTATION**

| | |
|---|---|
| SID HIII Instrumentation | 17 |
| Vehicle Structure Accelerometers | 18 |
| Total | 35 |

**HIGH SPEED CAMERAS**

| | |
|---|---|
| Onboard Vehicle | 3 |
| Offboard Vehicle | 8 |
| Total | 11 |

**IMPACT POINT DATA**

| Measured Parameter | Units | Requirement | Value |
|---|---|---|---|
| Horizontal Offset | mm | +/- 38 | 0 |

**DATA SHEET 3**
**POST TEST OBSERVATIONS**

Test Vehicle: 2012 Coda All Electric 4-Dr Sedan
Test Program: FMVSS 201P
NHTSA No. CC1005
Test Date: March 7, 2013

**TEST DUMMY INFORMATION AND CONTACT POINTS**

| Description | Left Front Seating Position |
|---|---|
| Dummy Type / Serial No. | SID HIII / 052 |
| Head Contact | Curtain Airbag, Headrest |
| Upper Torso Contact | Side Airbag |
| Lower Torso Contact | None |
| Left Knee Contact | Door Panel |
| Right Knee Contact | Left Knee |

**POST TEST DOOR OPENING AND SEAT TRACK INFORMATION**

| Description | Front | Rear |
|---|---|---|
| Left Side Door Opening | Door remained closed and latched | Door remained closed and latched |
| Right Side Door Opening | Door remained closed and latched | Door remained closed and latched |
| Seat Movement | 0 | 0 |
| Seat Back Failure | None | None |

**POST TEST STRUCTURAL OBSERVATIONS**

| Critical Areas of Performance | Observations and Conclusions |
|---|---|
| Pillar Performance | No Failures |
| Sill Separation | None |
| Windshield Damage | Cracked |
| Window Damage | LF Window |
| Other Notable Effects | None |

**AIRBAG DEPLOYMENT**

| | Driver |
|---|---|
| Front | No |
| Side | Yes |
| Curtain | Yes |

**ARMREST LOCATION AND SEAT CRUSH**

| | Driver |
|---|---|
| Front Armrest (from bottom of window) | 287 |
| Front Seat Back Crush | 33 |
| Front Seat Cushion Crush | 29 |

# SECTION 4
# OCCUPANT AND VEHICLE INFORMATION

**DATA SHEET 4**
**SID HIII INSTRUMENTATION DATA**

Test Vehicle: 2012 Coda All Electric 4-Dr Sedan NHTSA No. CC1005
Test Program: FMVSS 201P Test Date: March 7, 2013

**HEAD CG PEAK ACCELERATIONS (SAE CLASS 1000 Filtered)**

| Location | Axis | Units | Driver | | | |
|---|---|---|---|---|---|---|
| | | | Max | Time | Min | Time |
| Head CG | X | G's | 3.0 | 157.9 | -16.1 | 63.7 |
| Head CG | Y | G's | 24.1 | 60.5 | -5.0 | 19.6 |
| Head CG | Z | G's | 9.2 | 22.3 | -4.1 | 100.7 |
| Head CG Resultant | | G's | 28.6 | 62.0 | | |

**UPPER NECK FORCES AND MOMENTS (SAE CLASS 1000/600 Filtered)**

| Location | Axis | Units | Driver | | | |
|---|---|---|---|---|---|---|
| | | | Max | Time | Min | Time |
| Neck Force | X | N | 78.1 | 149.4 | -368.5 | 64.8 |
| Neck Force | Y | N | 164.3 | 41.7 | -105.8 | 152.6 |
| Neck Force | Z | N | 508.9 | 52.1 | -184.3 | 102.2 |
| Neck Moment | X | Nm | 6.5 | 114.7 | -52.7 | 61.2 |
| Neck Moment | Y | Nm | 20.0 | 95.0 | -23.2 | 61.8 |
| Neck Moment | Z | Nm | 31.2 | 65.5 | -12.5 | 136.2 |

**THORAX AND PELVIS PEAK ACCELERATIONS (FIR 100 Filtered)**

| Location | Axis | Units | Driver | | | |
|---|---|---|---|---|---|---|
| | | | Max | Time | Min | Time |
| Upper Rib (LUR) | Y | G's | 52.9 | 51.4 | -5.1 | 23.2 |
| Upper Rib (LUR) (R) | Y | G's | 52.6 | 51.4 | -6.1 | 23.2 |
| Lower Rib (LLR) | Y | G's | 52.1 | 52.0 | -4.9 | 78.9 |
| Lower Rib (LLR) (R) | Y | G's | 51.7 | 52.0 | -4.8 | 79.4 |
| Lower Spine ($T_{12}$) | Y | G's | 33.5 | 52.6 | -5.1 | 83.9 |
| Lower Spine ($T_{12}$) (R) | Y | G's | 33.3 | 52.6 | -4.8 | 85.1 |
| Pelvis (PEV) | Y | G's | 52.3 | 45.1 | -1.6 | 103.2 |
| Pelvis (PEV) (R) | Y | G's | 52.1 | 45.1 | -1.2 | 212.6 |

**THORACIC TRAUMA INDEX (TTI) AND PELVIC ACCELERATION (FIR 100 Filtered)**

| Location | Driver | | | |
|---|---|---|---|---|
| | LLR | $T_{12}$ | TTI(g) | PEV(g) |
| Rib, Spine, and Pelvis | 52.9 | 33.5 | 43.2 | 52.3 |
| Rib, Spine, and Pelvis (R) | 52.6 | 33.3 | 43.0 | 52.1 |

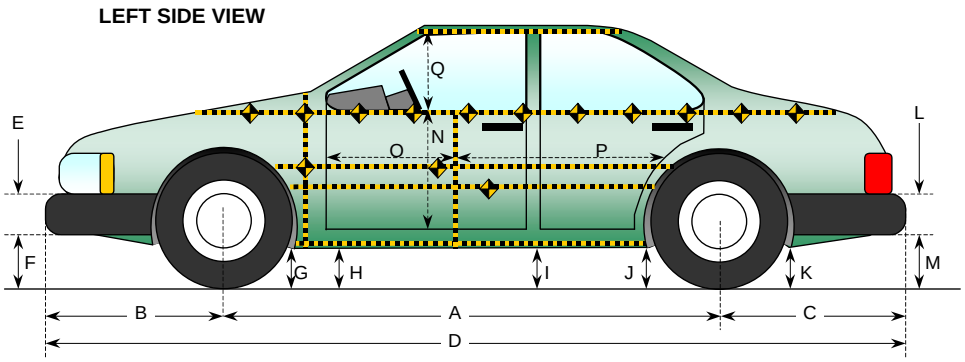
**CRITERIA (SAE CLASS 1000 Filtered)**

| Location | Driver | | |
|---|---|---|---|
| | HIC | T1 | T2 |
| Head CG Resultant | 80.9 | 38.9 | 74.9 |

Positive Acceleration Polarities: Longitudinal (X) = + Forward
(Conforms to SAE J211) Lateral (Y) = + Right
Vertical (Z) = + Down

**DATA SHEET 5**
**VEHICLE PRE-TEST AND POST-TEST MEASUREMENTS**

Test Vehicle: 2012 Coda All Electric 4-Dr Sedan NHTSA No. CC1005
Test Program: FMVSS 201P Test Date: March 7, 2013

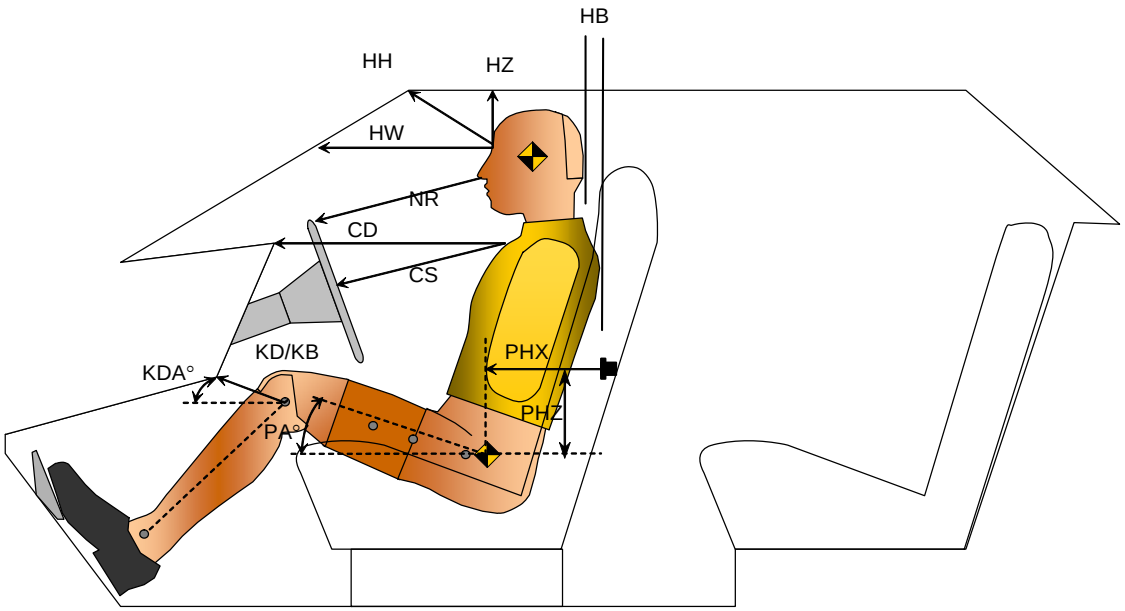



All Measurements in mm

| Code | Measurement Description | Pre-Test | Post-Test | Difference |
|---|---|---|---|---|
| A | Wheelbase | 2608 | 2584 | 24 |
| B | Front Axle to FSOV | 872 | 877 | -5 |
| C | Rear Axle to RSOV | 928 | 914 | 14 |
| D | Total Length at Centerline | 4408 | 4375 | 33 |
| E | Front Bumper Thickness | 111 | 111 | 0 |
| F | Front Bumper Bottom to Ground | 263 | 268 | -5 |
| G | Sill Height at Front Wheel Well | 181 | 185 | -4 |
| H | Sill Height at Front Door Leading Edge | 166 | 160 | 6 |
| I | Sill Height at "B" Pillar | 166 | 165 | 1 |
| J1 | Sill Height at Rear Wheel Well | 188 | 192 | -4 |
| J2 | Pinch Weld Height at Rear Wheel Well | 153 | 156 | -3 |
| K | Sill Height Aft of Rear Wheel Well | 472 | 480 | -8 |
| L | Rear Bumper Thickness | 138 | 138 | 0 |
| M | Rear Bumper Bottom to Ground | 398 | 396 | 2 |
| N | Sill Height to Window Bottom Sill | 705 | 679 | 26 |
| O | Front Door Leading Edge to Impact CL | 855 | 855 | 0 |
| P | Rear Door Trailing Edge to Impact CL | 970 | 1003 | -33 |
| Q | Front Window Opening | 443 | 417 | 26 |
| R | Right Side Length | 3774 | 3781 | -7 |
| S | Left Side Length | 3774 | 3742 | 32 |
| T | Vehicle Width at "B" Post | 1709 | 1609 | 100 |

**DATA SHEET 6**
**SID HIII LONGITUDINAL CLEARANCE DIMENSIONS**

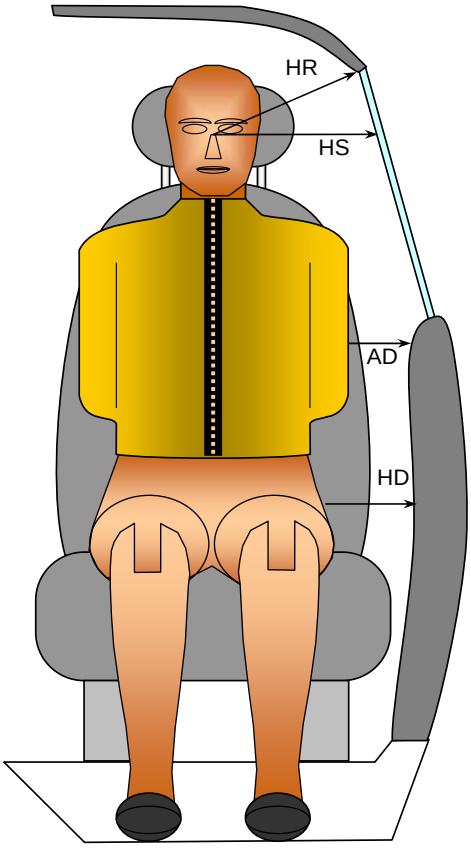
Test Vehicle: 2012 Coda All Electric 4-Dr Sedan NHTSA No. CC1005
Test Program: FMVSS 201P Test Date: March 7, 2013




| Driver Code | Measurement Description | Driver | |
|---|---|---|---|
| | | Length (mm) | Angle (°) |
| HB | Head to Seatback Clearance | 52 | |
| HH | Head to Header | 305 | |
| HW | Head to Windshield | 520 | |
| HZ | Head to Roof | 148 | |
| NR | Nose to Rim | 354 | |
| CD | Chest to Dash | 488 | |
| CS | Chest to Steering Wheel | 279 | |
| KDL | Left Knee to Dash | 143 | 27.0 |
| KDR | Right Knee to Dash | 138 | 29.0 |
| PA | Pelvic Angle | | 23.7 |
| PHX | H-Point to Striker (X-Axis) | 216 | |
| PHZ | H-Point to Striker (Z-Axis) | 159 | |

**DATA SHEET 7**
**SID HIII LATERAL CLEARANCE DIMENSIONS**

Test Vehicle: 2012 Coda All Electric 4-Dr Sedan NHTSA No. CC1005
Test Program: FMVSS 201P Test Date: March 7, 2013



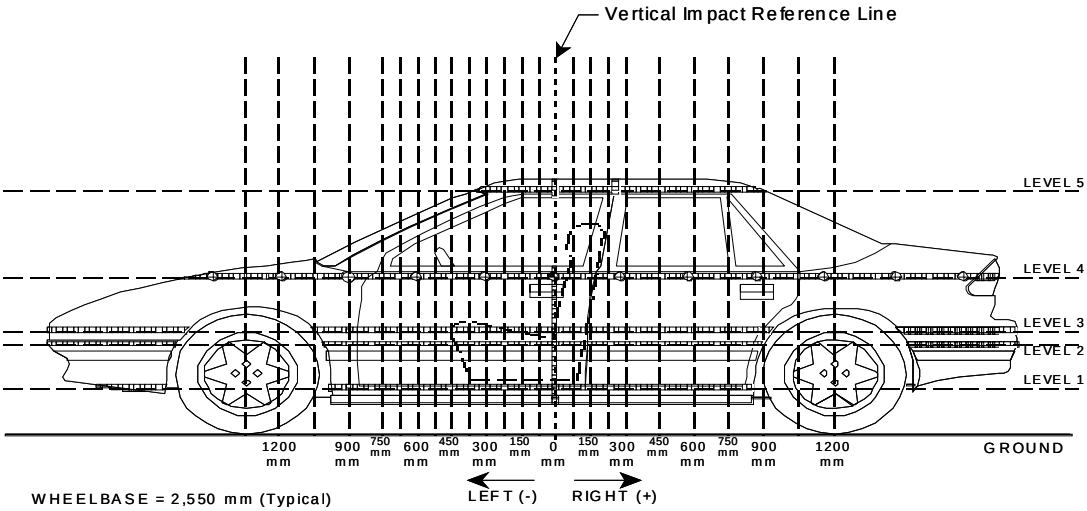

*FRONT VIEW OF DUMMY*

| Code | Measurement Description | Units | Driver |
|---|---|---|---|
| HR | Head to Side Header | mm | 156 |
| HS | Head to Side Window | mm | 281 |
| AD | Arm to Door | mm | 92 |
| HD | H-Point to Door | mm | 159 |

**DATA SHEET 8**
**VEHICLE SIDE MEASUREMENTS**

Test Vehicle: 2012 Coda All Electric 4-Dr Sedan NHTSA No. CC1005
Test Program: FMVSS 201P Test Date: March 7, 2013

PRETEST AND POST TEST EXTERIOR PROFILE MEASUREMENTS




LEFT SIDE VIEW

Measurements are taken with vehicle in the as tested condition.
Measurements along the vertical 0 mm.

| Level | Measurement Description | Units | Height Above Ground |
|---|---|---|---|
| 5 | Window | mm | 1430 |
| 4 | Window Sill | mm | 915 |
| 3 | Mid Door | mm | 650 |
| 2 | Occupant H-Point | mm | 580 |
| 1 | Sill Top | mm | 275 |

**DATA SHEET 9**
**VEHICLE EXTERIOR CRUSH PROFILES**

Test Vehicle: 2012 Coda All Electric 4-Dr Sedan NHTSA No. CC1005
Test Program: FMVSS 201P Test Date: March 7, 2013

| | Pre-Test (mm) | | | | | Post-Test (mm) | | | | | Difference (mm) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| -1800 | | | | 418 | | | | | 423 | | | | | 5 | |
| -1650 | | | | 390 | | | | | 398 | | | | | 8 | |
| -1500 | | | | 368 | | | | | 376 | | | | | 8 | |
| -1350 | | | | 350 | | | | | 362 | | | | | 12 | |
| -1200 | | | 243 | 337 | | | | 258 | 348 | | | | 15 | 11 | |
| -1050 | | 244 | 247 | 324 | | | 262 | 263 | 337 | | | 18 | 16 | 13 | |
| -900 | 286 | 252 | 252 | 314 | | 298 | 267 | 266 | 330 | | 12 | 15 | 14 | 16 | |
| -825 | 286 | 242 | 252 | 311 | | 298 | 256 | 254 | 318 | | 12 | 14 | 2 | 7 | |
| -750 | 287 | 242 | 252 | 307 | | 314 | 255 | 269 | 330 | | 27 | 13 | 17 | 23 | |
| -675 | 287 | 242 | 251 | 304 | | 323 | 268 | 285 | 338 | | 36 | 26 | 34 | 34 | |
| -600 | 287 | 242 | 251 | 300 | | 337 | 283 | 300 | 351 | | 50 | 41 | 49 | 51 | |
| -525 | 287 | 242 | 251 | 298 | | 346 | 298 | 315 | 364 | | 59 | 56 | 64 | 66 | |
| -450 | 287 | 243 | 251 | 295 | | 360 | 317 | 333 | 377 | | 73 | 74 | 82 | 82 | |
| -375 | 288 | 243 | 251 | 293 | | 374 | 338 | 359 | 391 | | 86 | 95 | 108 | 98 | |
| -300 | 289 | 244 | 251 | 292 | | 393 | 367 | 385 | 408 | | 104 | 123 | 134 | 116 | |
| -225 | 290 | 244 | 251 | 289 | | 413 | 396 | 410 | 427 | | 123 | 152 | 159 | 138 | |
| -150 | 290 | 245 | 251 | 287 | 559 | 454 | 426 | 440 | 451 | 583 | 164 | 181 | 189 | 164 | 24 |
| -75 | 291 | 246 | 252 | 285 | 554 | 490 | 460 | 475 | 481 | 577 | 199 | 214 | 223 | 196 | 23 |
| 0 | 293 | 246 | 252 | 284 | 549 | 496 | 486 | 495 | 490 | 576 | 203 | 240 | 243 | 206 | 27 |
| 75 | 295 | 247 | 252 | 282 | 548 | 473 | 450 | 469 | 462 | 572 | 178 | 203 | 217 | 180 | 24 |
| 150 | 294 | 247 | 253 | 281 | 549 | 442 | 399 | 414 | 405 | 570 | 148 | 152 | 161 | 124 | 21 |
| 225 | 296 | 251 | 254 | 282 | 549 | 415 | 351 | 352 | 363 | 568 | 119 | 100 | 98 | 81 | 19 |
| 300 | 298 | 250 | 255 | 282 | 549 | 392 | 336 | 337 | 347 | 563 | 94 | 86 | 82 | 65 | 14 |
| 450 | 300 | 255 | 258 | 282 | 551 | 361 | 313 | 314 | 323 | 563 | 61 | 58 | 56 | 41 | 12 |
| 600 | 304 | 257 | 261 | 282 | 554 | 330 | 288 | 289 | 300 | 562 | 26 | 31 | 28 | 18 | 8 |
| 750 | 308 | 265 | 264 | 282 | 560 | 305 | 266 | 262 | 274 | 561 | -3 | 1 | -2 | -8 | 1 |
| 900 | 314 | 269 | 267 | 265 | 569 | 284 | 272 | 240 | 235 | 572 | -30 | 3 | -27 | -30 | 3 |
| 1050 | | 252 | 256 | 265 | | | 248 | 255 | 211 | | | -4 | -1 | -54 | |
| 1200 | | | | 289 | | | | | 292 | | | | | 3 | |
| 1350 | | | | 294 | | | | | 293 | | | | | -1 | |
| 1500 | | | | 301 | | | | | 298 | | | | | -3 | |
| 1650 | | | | 312 | | | | | 306 | | | | | -6 | |
| 1800 | | | | 327 | | | | | 321 | | | | | -6 | |
| 1950 | | | | 346 | | | | | 340 | | | | | -6 | |

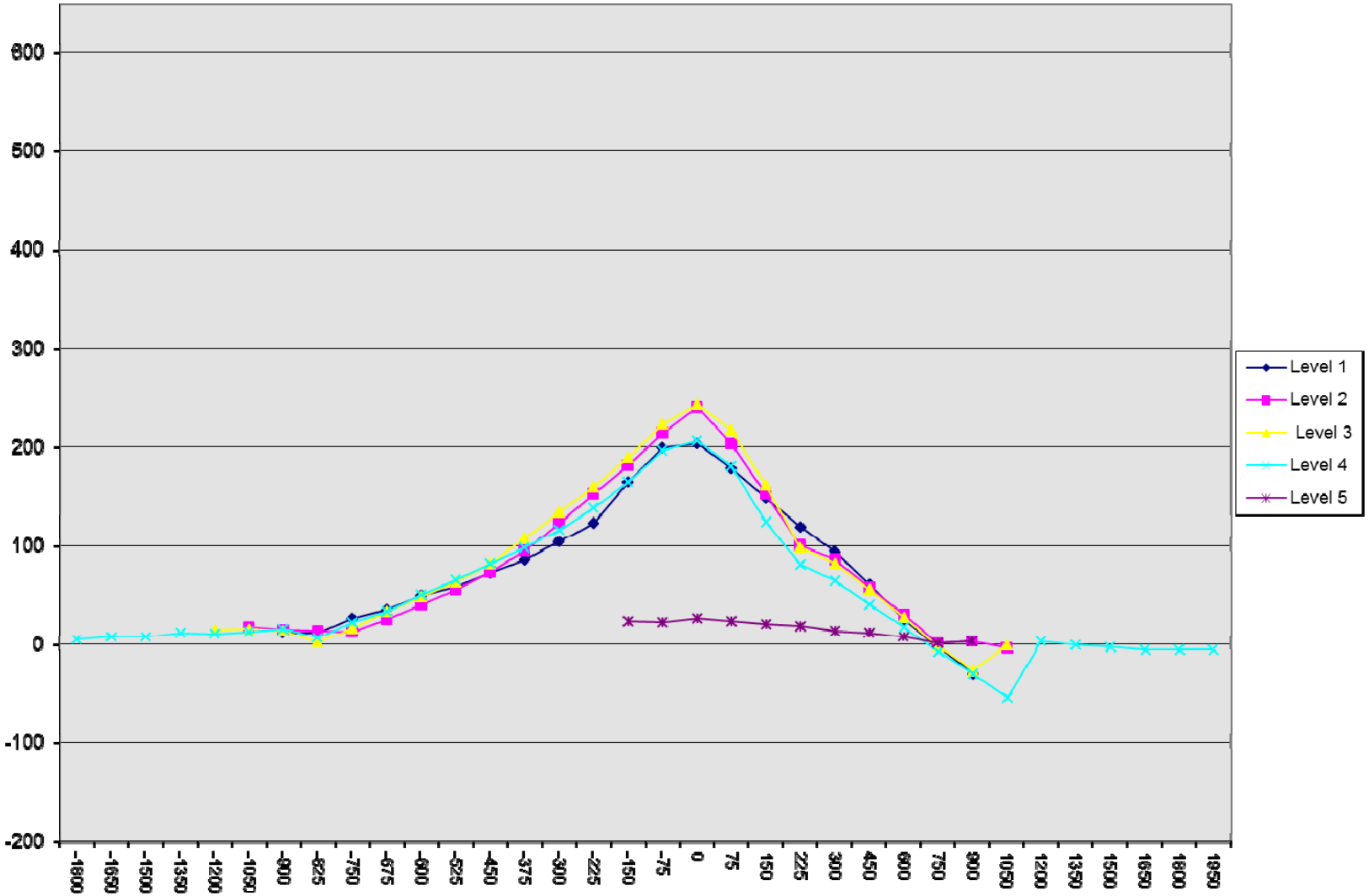
Reference plane is parallel to test vehicle longitudinal centerline

Given dimensions = Reference plane to car body

**DATA SHEET 9**
**VEHICLE EXTERIOR CRUSH PROFILES**

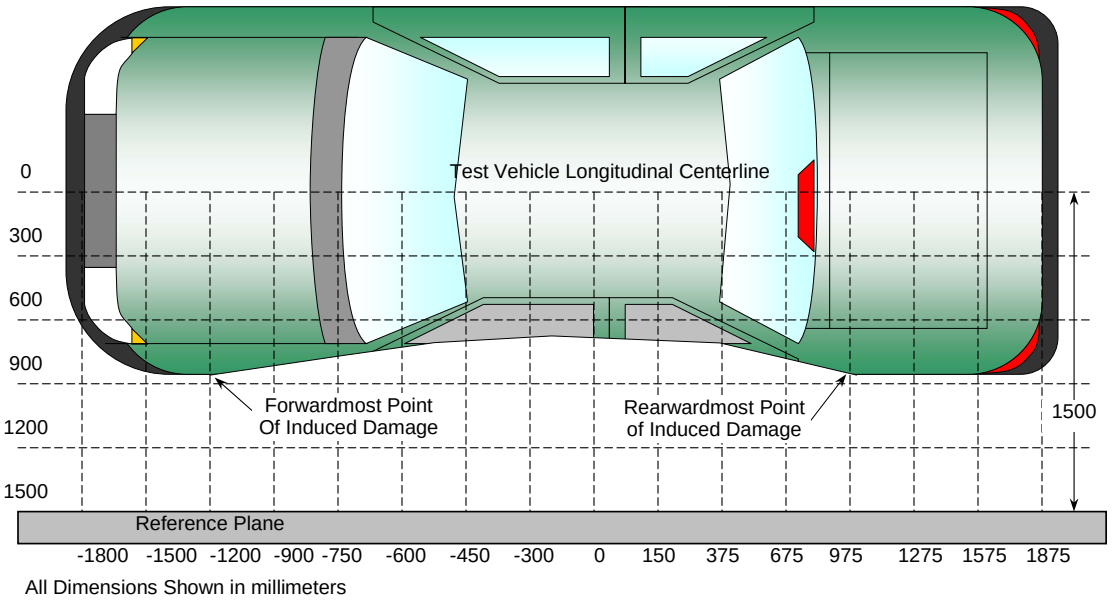
Test Vehicle: 2012 Coda All Electric 4-Dr Sedan
Test Program: FMVSS 201P

NHTSA No. CC1005
Test Date: March 7, 2013



**DATA SHEET 10**
**VEHICLE DAMAGE PROFILE DISTANCES**

Test Vehicle: 2012 Coda All Electric 4-Dr Sedan NHTSA No. CC1005
Test Program: FMVSS 201P Test Date: March 7, 2013




**TOP VIEW**

**Damage Profile Distances**

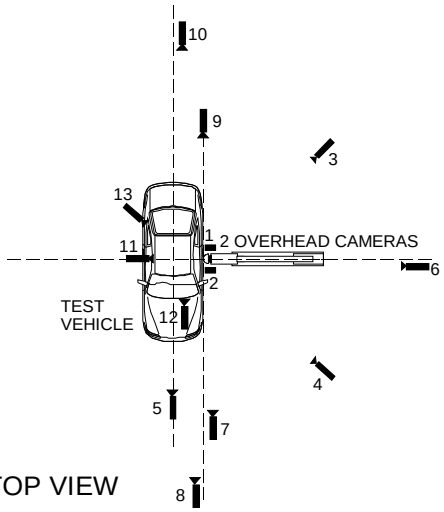
| DPD | Distance from Impact Point in mm | Level | Pre-Test (mm) | Post-Test (mm) | Max Static Crush (mm) |
|---|---|---|---|---|---|
| 1 | 1950 | 4 | 346 | 344 | -2 |
| 2 | 1232 | 4 | 290 | 307 | 17 |
| 3 | 520 | 1 | 302 | 374 | 72 |
| 4 | -315 | 4 | 292 | 437 | 145 |
| 5 | -1050 | 4 | 324 | 346 | 22 |
| 6 | -1800 | 4 | 418 | 424 | 6 |

Reference plane is parallel to test vehicle longitudinal centerline

Given dimensions = Reference plane to car body

**DATA SHEET 11**
**HIGH SPEED CAMERA LOCATIONS AND DATA**

Test Vehicle: 2012 Coda All Electric 4-Dr Sedan NHTSA No. CC1005
Test Program: FMVSS 201P Test Date: March 7, 2013



TOP VIEW

| No. | Camera View | Location (mm) | | | Lens (mm) | Film Speed (fps) |
|---|---|---|---|---|---|---|
| | | X | Y | Z | | |
| 1 | Overhead Overall | 190 | 0 | -4860 | 14 | 1000 |
| 2 | Overhead Close-Up | 20 | -120 | -4430 | 50 | 1000 |
| 3 | Left Side 45° Rearward Pole View | -2690 | 3660 | -2060 | 20 | 1000 |
| 4 | Right Side 45° Forward Pole View | -2970 | -3530 | -1980 | 20 | 1000 |
| 5 | Real Time Pan | | | | 13 | 30 |
| 6* | Left Side Rear Pole View | | | | | |
| 7 | Front Ground Level Vehicle/Pole Impact | 520 | -5670 | -1970 | 50 | 1000 |
| 8 | Front Ground Level Vehicle Roof Targets and Vehicle/Pole Impact | 0 | -5580 | -1990 | 24 | 1000 |
| 9 | Rear Ground Level Vehicle/Pole Impact | 350 | 5480 | -1840 | 50 | 1000 |
| 10 | Rear Ground Level | 0 | 5560 | -1970 | 24 | 1000 |
| 11 | Test Vehicle Onboard Driver Side View | | | | 8 | 1000 |
| 12 | Test Vehicle Onboard Driver Front View | | | | 16 | 1000 |
| 13 | Test Vehicle Onboard Driver ¾ Rear View | | | | 8 | 1000 |

Reference Points X - + Forward of Impact
Y - + Right of Impact
Z - + Ground Plane Down

* Camera 6 was not used for this test.

**DATA SHEET 12**
**DUMMY DAMAGE CHECKLIST – SID HIII**

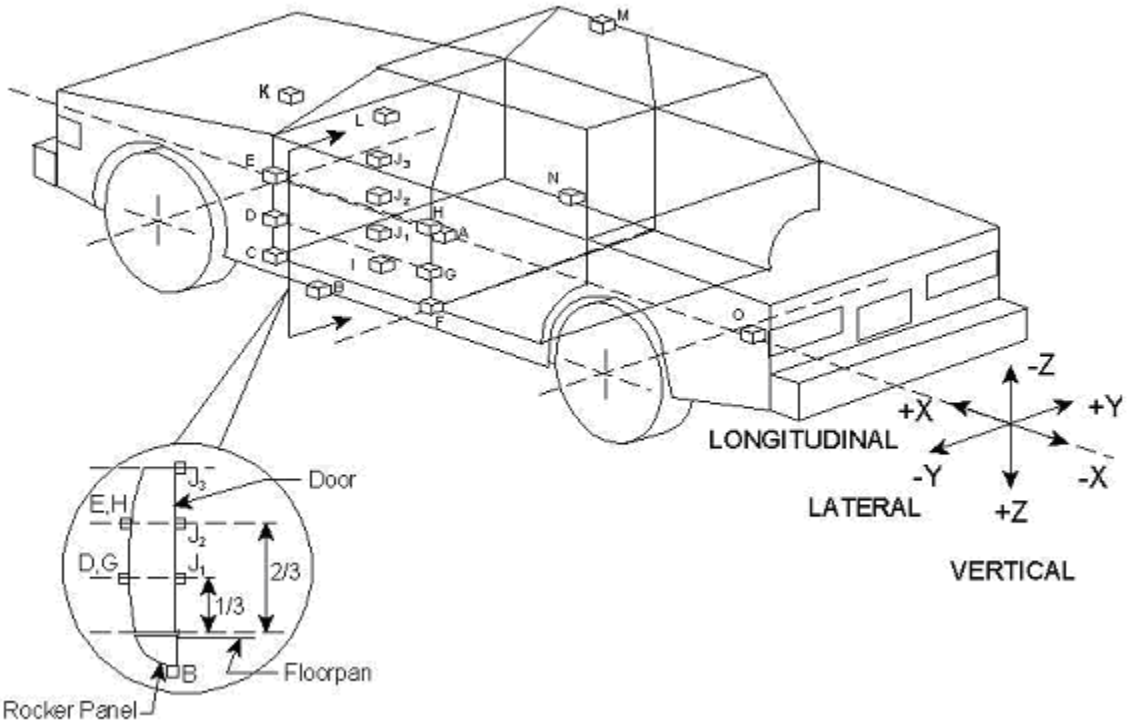
Test Vehicle: 2012 Coda All Electric 4-Dr Sedan NHTSA No. CC1005
Test Program: FMVSS 201P Test Date: March 7, 2013

Dummy Serial Number: 052 Date: February 7, 2013

| OK | Damaged | | |
|---|---|---|---|
| X | | Outer skin on entire dummy (gashes, rips, etc.) | |
| X | | Head | Check that ballast is secure |
| X | | Head | Gashes, rips, general appearances, etc. |
| X | | Neck | Broken or cracks in rubber |
| X | | Neck | Check that upper neck bracket is firmly attached to lower neck |
| X | | Neck | Check for looseness at the condyle joint |
| X | | Neck | Nodding blocks – cracked or out of position |
| X | | Spine | Broken or cracks in rubber |
| X | | Ribs | Check all ribs and rib supports for damage (bent or broken) |
| X | | Ribs | Check damping material for separation or cracks |
| X | | Ribs | Three rubber bumpers in place |
| X | | Lateral shock absorber – bent or broken | |
| X | | Transducer Leads – Torn cables | |
| X | | Accelerometer Mountings – (head, ribs, spine, and pelvis) Check for secure mounting | |
| X | | Knees – Check outer skin, insert and casting (without removing insert) | |
| X | | Limbs – Check for normal movement and adjustment | |
| X | | Head/Neck bracket attachment Check to see if cracked or broken | |

**DATA SHEET 13**
**TEST VEHICLE ACCELEROMETER LOCATIONS AND DATA SUMMARY**

Test Vehicle: 2012 Coda All Electric 4-Dr Sedan NHTSA No. CC1005
Test Program: FMVSS 201P Test Date: March 7, 2013




| No. | Location |
|---|---|
| A | Vehicle CG |
| B | Left Floor Sill |
| C | A Pillar Sill |
| D | A Pillar Low |
| E | A Pillar Mid |
| F | B Pillar Sill |
| G | B Pillar Low |
| H | B Pillar Mid |
| I | Driver Seat |

| No. | Location |
|---|---|
| J1* | Driver Door Lower / Knee |
| J2* | Driver Door Mid / Pelvis |
| J3* | Driver Door Upper / Rib |
| K | Engine |
| L | Firewall |
| M | Right Roof |
| N | Right Floor Sill |
| O | Rear Deck |

*Door Accelerometers (J1, J2, J3) were not installed for this test.

## DATA SHEET 13 (CONTINUED)
## TEST VEHICLE ACCELEROMETER LOCATIONS AND DATA SUMMARY

### VEHICLE ACCELEROMETER PEAK DATA

| Loc. No. | Accelerometer Location | Peak Values (G's) | | | | |
|---|---|---|---|---|---|---|
| | | Axis | Max | Time | Min | Time |
| A | Vehicle CG | X | 1.6 | 90.8 | -4.3 | 25.9 |
| | | Y | 23.0 | 37.7 | -0.8 | 144.0 |
| | | Z | 16.8 | 26.5 | -13.1 | 31.3 |
| | | RES | 24.2 | 26.5 | | |
| B | Left Floor | Y | 28.7 | 27.1 | -39.0 | 32.3 |
| C | A Pillar Sill | Y | 19.3 | 28.3 | -8.0 | 23.9 |
| D | A Pillar Low | Y | (1) | (1) | (1) | (1) |
| E | A Pillar Mid | Y | 25.5 | 19.2 | -1.4 | 4.0 |
| F | B Pillar Sill | Y | 58.4 | 15.5 | -36.7 | 32.7 |
| G | B Pillar Low | Y | 48.7 | 13.9 | -12.9 | 35.9 |
| H | B Pillar Mid | Y | 40.6 | 14.1 | -14.9 | 36.6 |
| I | Driver Seat | Y | (2) | (2) | (2) | (2) |
| J1 | Driver Door Lower / Knee | Y | | | | |
| J2 | Driver Door Mid / Pelvis | Y | | | | |
| J3 | Driver Door Upper / Rib | Y | | | | |
| K | Engine | X | 6.1 | 80.2 | -5.0 | 30.0 |
| | | Y | 20.0 | 64.5 | -3.4 | 105.6 |
| L | Firewall | Y | 18.9 | 55.3 | -1.1 | 5.6 |
| M | Right Roof | Y | 25.1 | 51.6 | -1.9 | 128.3 |
| N | Right Floor Sill | Y | 17.1 | 44.2 | -0.9 | 147.1 |
| O | Rear Deck | X | 3.2 | 40.8 | -3.7 | 52.9 |
| | | Y | 24.6 | 52.5 | -2.3 | 113.3 |

Positive Acceleration Polarities: (Conforms to SAE J211)

| | | |
|---|---|---|
| Longitudinal (X) | = + Forward | |
| Lateral (Y) | = + Right | |
| Vertical (Z) | = + Down | |

(1) No Valid Data Collected for Left Lower A-Post Y after 6ms
(2) No Valid Data Collected for Driver Seat Track Y after 11ms

## DATA SHEET 13 (CONTINUED)
## TEST VEHICLE ACCELEROMETER LOCATIONS AND DATA SUMMARY

### PRE-TEST LOCATIONS

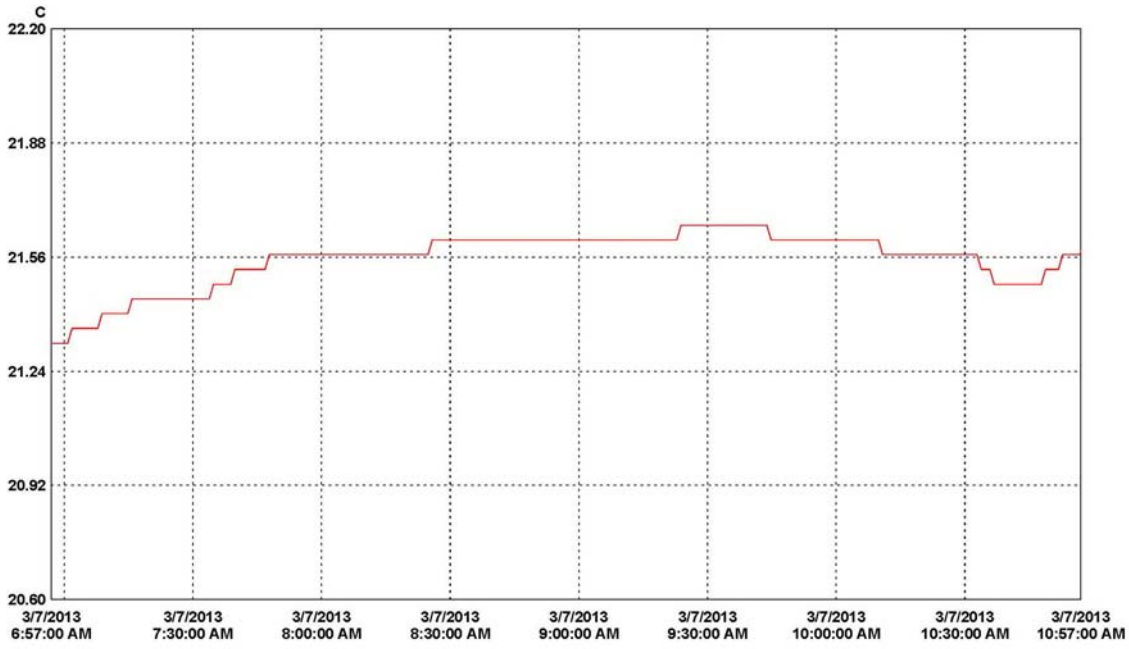
| Loc. No. | Accelerometer Location | Coordinates (mm) | | |
|---|---|---|---|---|
| | | X | Y | Z |
| A | Vehicle CG | 2263 | -7 | -139 |
| B | Left Floor Sill | 2637 | -704 | -194 |
| C | A Pillar Sill | 3113 | -704 | -191 |
| D | A Pillar Low | 3020 | -776 | -500 |
| E | A Pillar Mid | 3023 | -765 | -790 |
| F | B Pillar Sill | 1978 | -704 | -196 |
| G | B Pillar Low | 1993 | -702 | -553 |
| H | B Pillar Mid | 1988 | -693 | -776 |
| I | Driver Seat | 2221 | -308 | -267 |
| K | Engine | 3592 | 0 | -805 |
| L | Firewall | 3480 | 40 | -935 |
| M | Right Roof | 2174 | 479 | -1460 |
| N | Right Floor | 2601 | 704 | -197 |
| O | Rear Deck | 145 | -15 | -422 |

Reference Points:

X-Rear of Vehicle (+ forward)
Y-Vehicle Centerline (+ to right)
Z-Ground Plane (+ down)

**DATA SHEET 14**
**VEHICLE AND DUMMY TEMPERATURE**

| | | | |
|---|---|---|---|
| Test Vehicle: | 2012 Coda All Electric 4-Dr Sedan | NHTSA No. | CC1005 |
| Test Program: | FMVSS 201P | Test Date: | March 7, 2013 |




| LN | Serial # | Description | CH | Value | Maximum | Average | Minimum | Units | CH description | Logger file |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 10102056 | Crash Prep 1 | 1 | | 21.65 | 21.56 | 21.32 | C | Temperature | 10102056_Crash_Prep_1.spl |

# APPENDIX A

# PHOTOGRAPHS

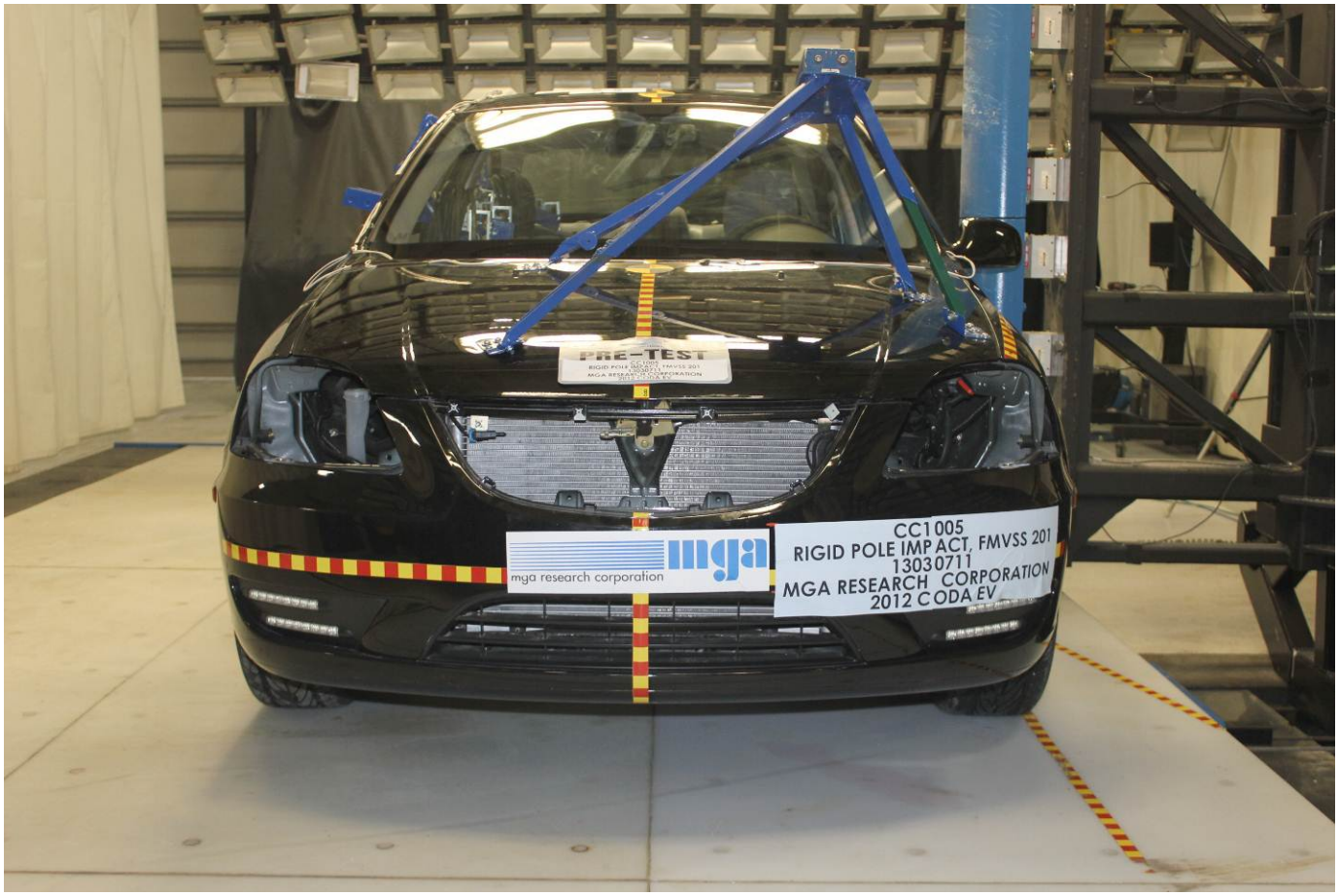
TABLE OF PHOTOGRAPHS


| | | Page No. |
|---|---|---|
| Photo No. 1. | As Delivered Right Front ¾ View of Test Vehicle | A-1 |
| Photo No. 2. | As Delivered Left Rear ¾ View of Test Vehicle | A-1 |
| Photo No. 3. | Pre-Test Front View of Test Vehicle | A-2 |
| Photo No. 4. | Post-Test Front View of Test Vehicle | A-2 |
| Photo No. 5. | Pre-Test Rear View of Test Vehicle | A-3 |
| Photo No. 6. | Post-Test Rear View of Test Vehicle | A-3 |
| Photo No. 7. | Pre-Test Left Side View of Test Vehicle | A-4 |
| Photo No. 8. | Post-Test Left Side View of Test Vehicle | A-4 |
| Photo No. 9. | Pre-Test ¾ Front View of Impact Zone | A-5 |
| Photo No. 10. | Pre-Test ¾ Rear View of Impact Zone | A-5 |
| Photo No. 11. | Pre-Test Overhead View of Test Vehicle | A-6 |
| Photo No. 12. | Post-Test Overhead View of Test Vehicle | A-6 |
| Photo No. 13. | Pre-Test Overhead Close-up View of Test Vehicle | A-7 |
| Photo No. 14. | Post-Test Overhead Close-up View of Test Vehicle | A-7 |
| Photo No. 15. | Pre-Test Driver Dummy Right Side View | A-8 |
| Photo No. 16. | Post-Test Driver Dummy Right Side View | A-8 |
| Photo No. 17. | Pre-Test Driver Dummy Left Side View | A-9 |
| Photo No. 18. | Post-Test Driver Dummy Left Side View | A-9 |
| Photo No. 19. | Pre-Test Driver Dummy Left Side View (Door Open) | A-10 |
| Photo No. 20. | Pre-Test Driver Dummy Shoulder and Door Top View | A-10 |
| Photo No. 21. | Post-Test Driver Dummy Shoulder and Door Top View | A-11 |
| Photo No. 22. | Pre-Test Interior of Front Door | A-11 |
| Photo No. 23. | Post-Test Interior of Front Door Showing Contact Locations | A-12 |
| Photo No. 24. | Post-Test Impact Zone Close-up View | A-12 |
| Photo No. 25. | Post-Test ¾ Front View of Impact Zone | A-13 |
| Photo No. 26. | Post-Test ¾ Rear View of Impact Zone | A-13 |

| | | Page No. |
|---|---|---|
| Photo No. 27. | Post-Test Close-up View of Impact Point Target | A-14 |
| Photo No. 28. | Close-up View of Vehicle's Certification Label | A-14 |
| Photo No. 29. | Close-up View of Vehicle's Tire Placard Label | A-15 |
| Photo No. 30. | Monroney Label | A-15 |
| Photo No. 31. | Vehicle Impact | A-16 |

As Delivered Right Front ¾ View of Test Vehicle

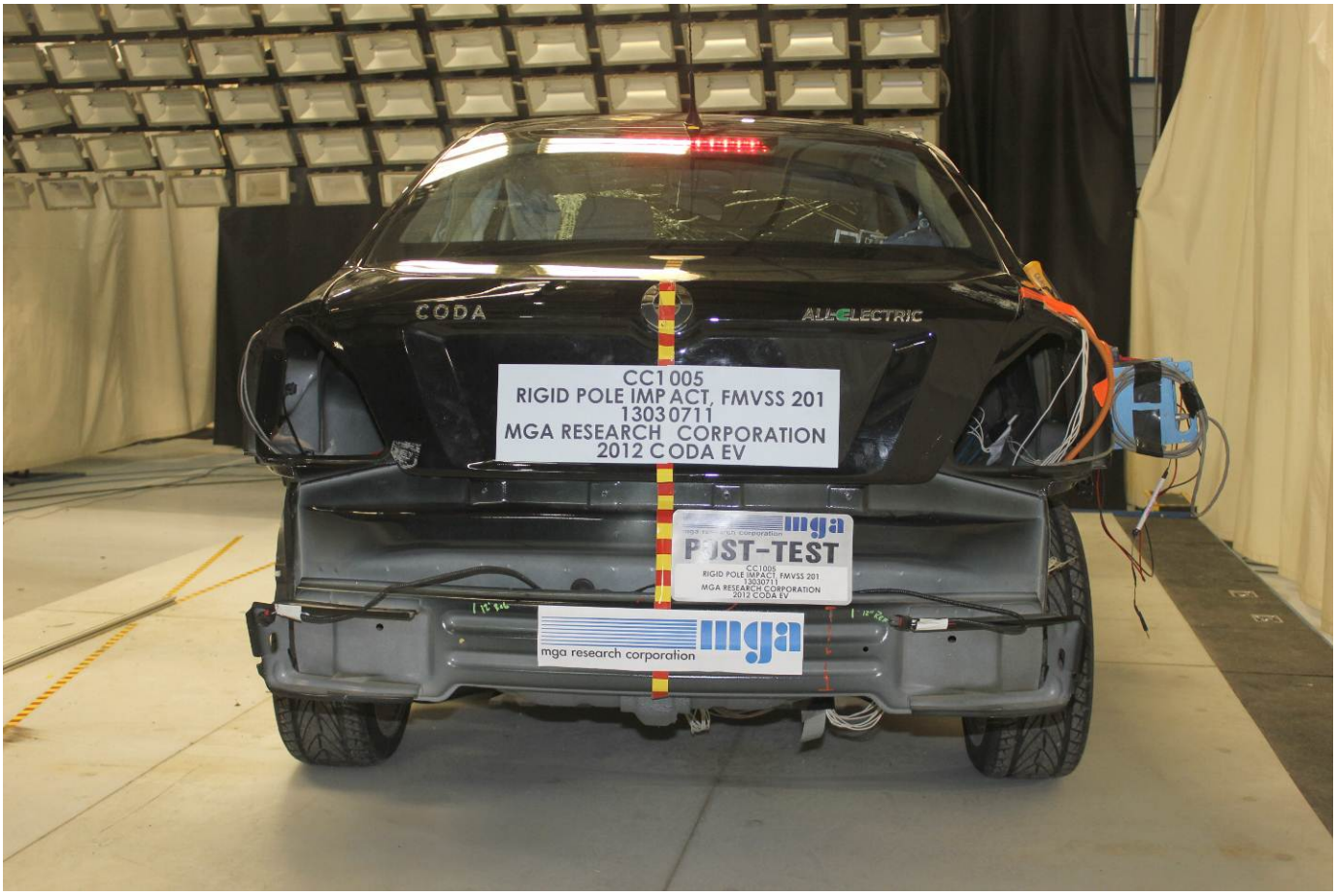
As Delivered Left Rear ¾ View of Test Vehicle




Pre-Test Front View of Test Vehicle

Post-Test Front View of Test Vehicle

Pre-Test Rear View of Test Vehicle

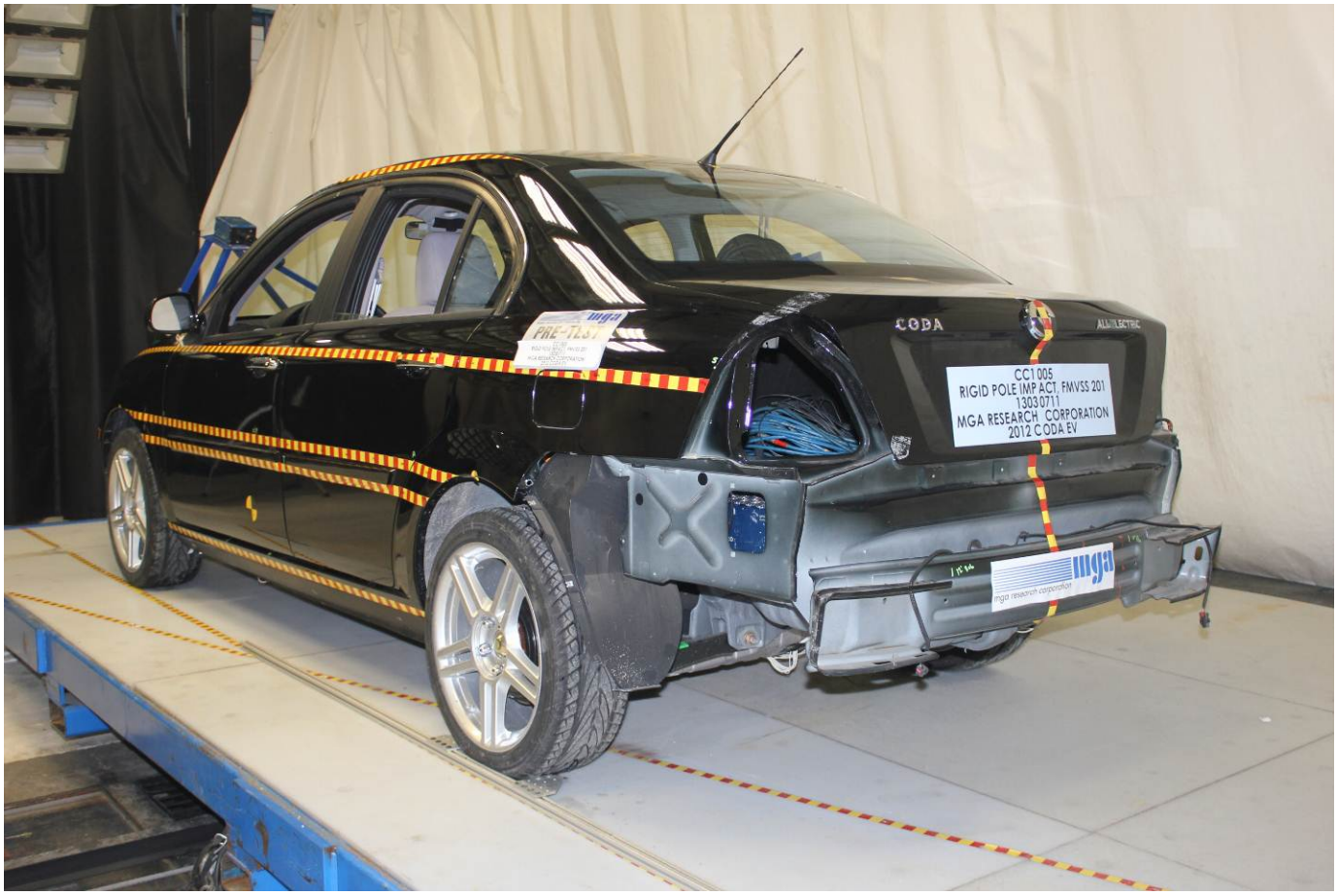



Post-Test Rear View of Test Vehicle

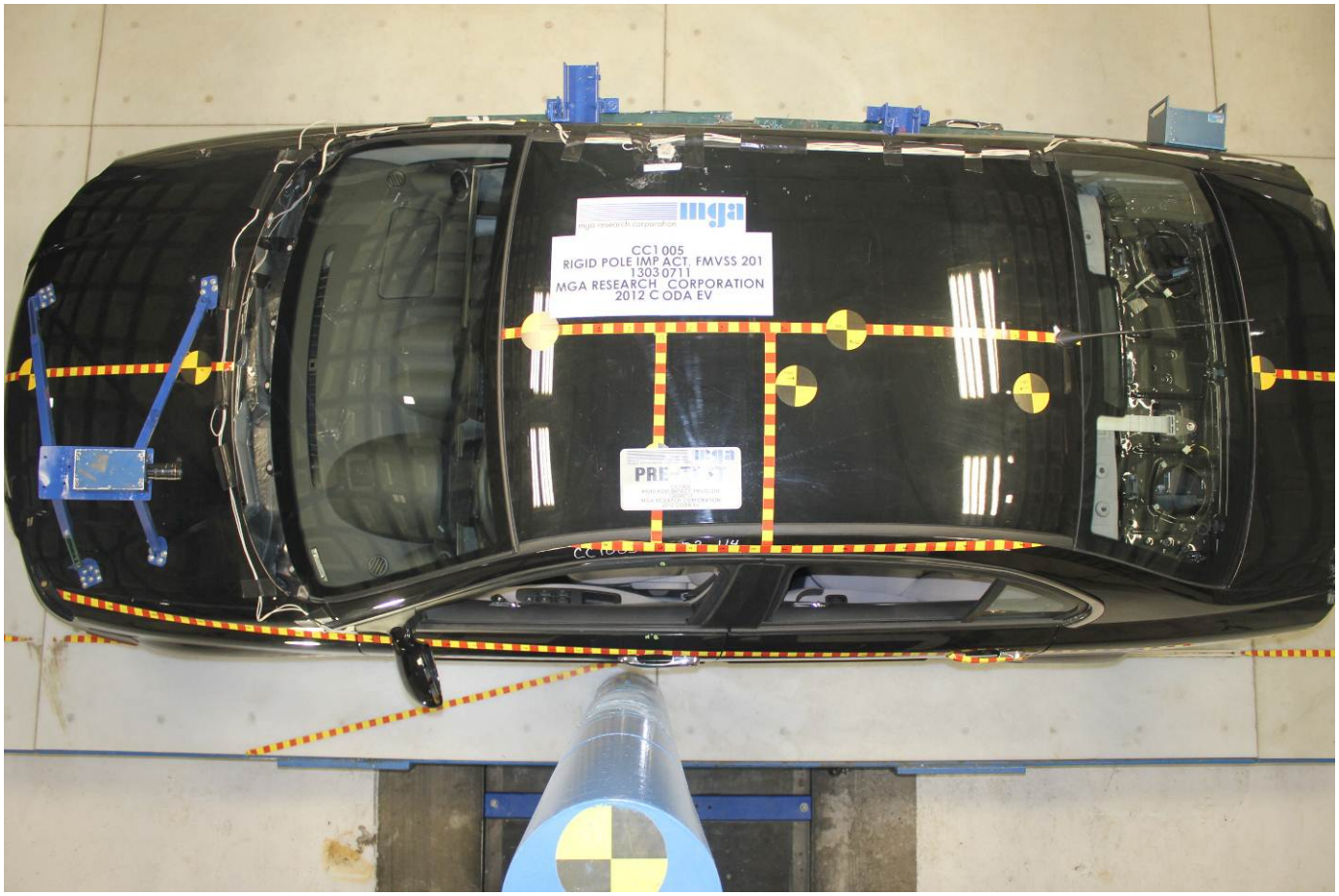
Pre-Test Left Side View of Test Vehicle

Post-Test Left Side View of Test Vehicle

Pre-Test ¾ Front View of Impact Zone




Pre-Test ¾ Rear View of Impact Zone




Pre-Test Overhead View of Test Vehicle

Post-Test Overhead View of Test Vehicle

Pre-Test Overhead Close-up View of Test Vehicle

Post-Test Overhead Close-up View of Test Vehicle

Pre-Test Driver Dummy Right Side View

Post-Test Driver Dummy Right Side View

Pre-Test Driver Dummy Left Side View

Post-Test Driver Dummy Left Side View

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

Pre-Test Driver Dummy Shoulder and Door Top View

Post-Test Driver Dummy Shoulder and Door Top View

Pre-Test Interior of Front Door

Post-Test Interior of Front Door Showing Contact Locations

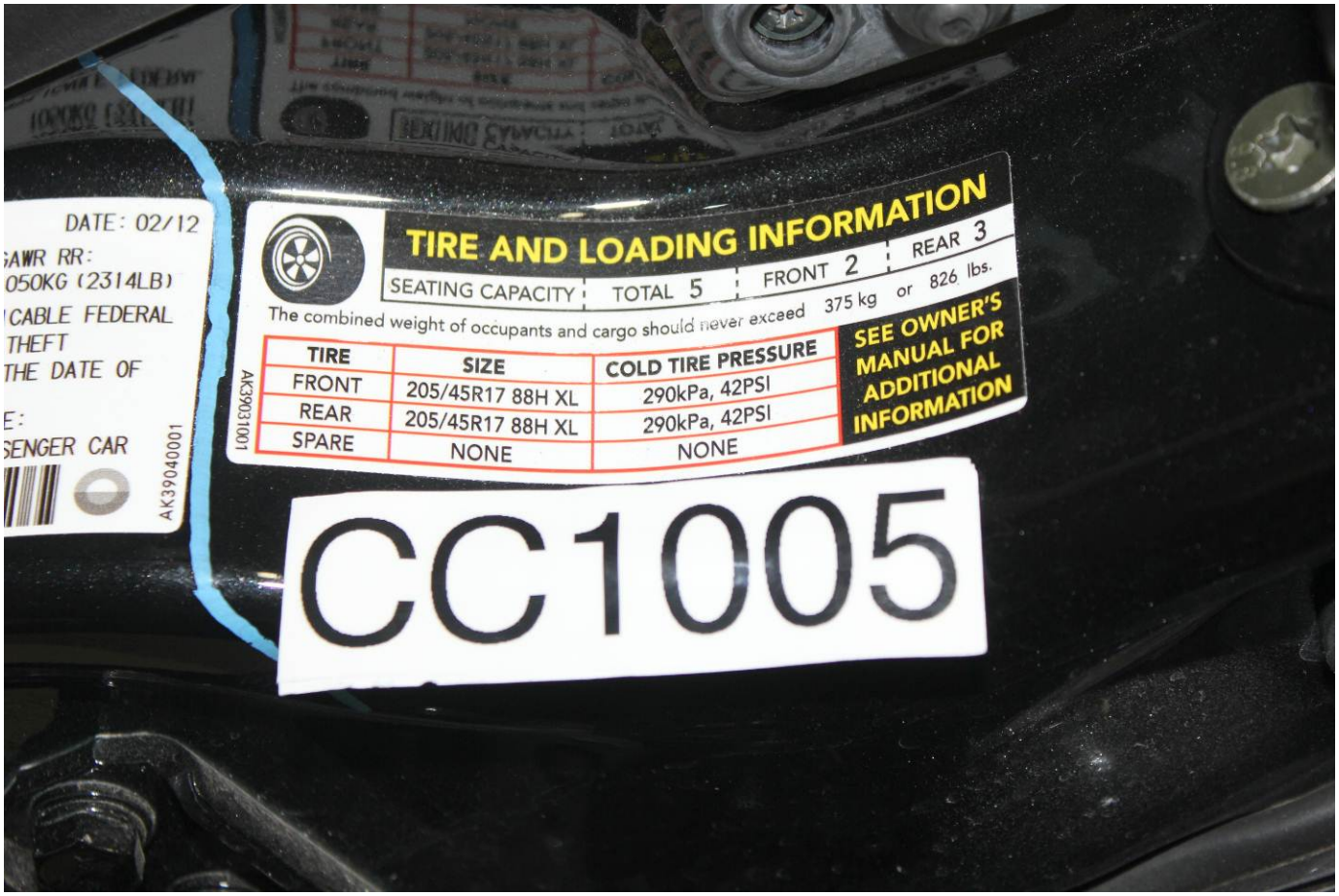
Post-Test Impact Zone Close-up View

Post-Test ¾ Front View of Impact Zone

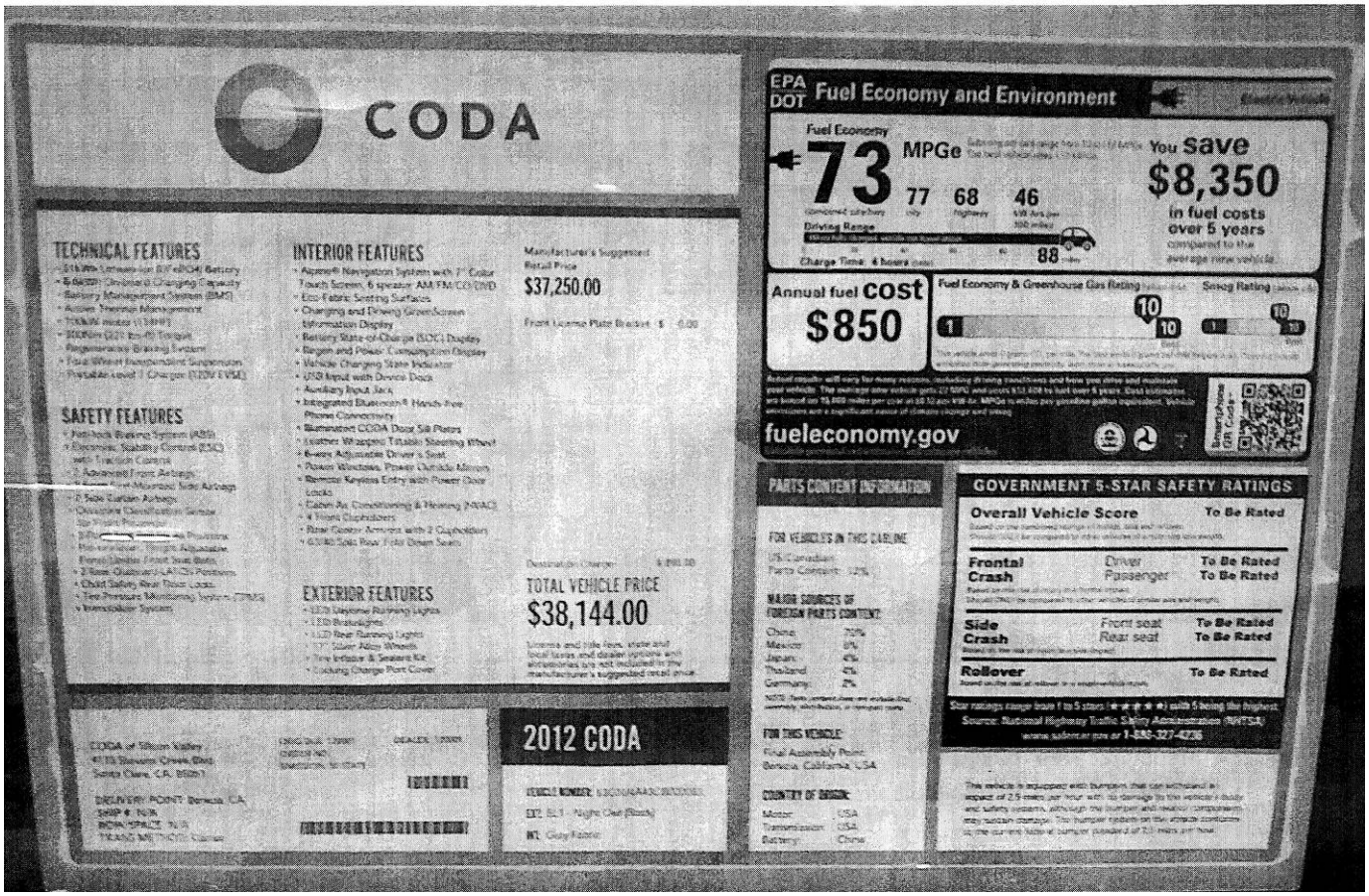
Post-Test ¾ Rear View of Impact Zone

Post-Test Close-up View of Impact Point Target

Close-up View of Vehicle's Certification Label




Close-up View of Vehicle's Tire Placard Label




Monroney Label

Vehicle Impact

# APPENDIX B

# SID/HIII AND VEHICLE RESPONSE DATA

## TABLE OF DATA PLOTS


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

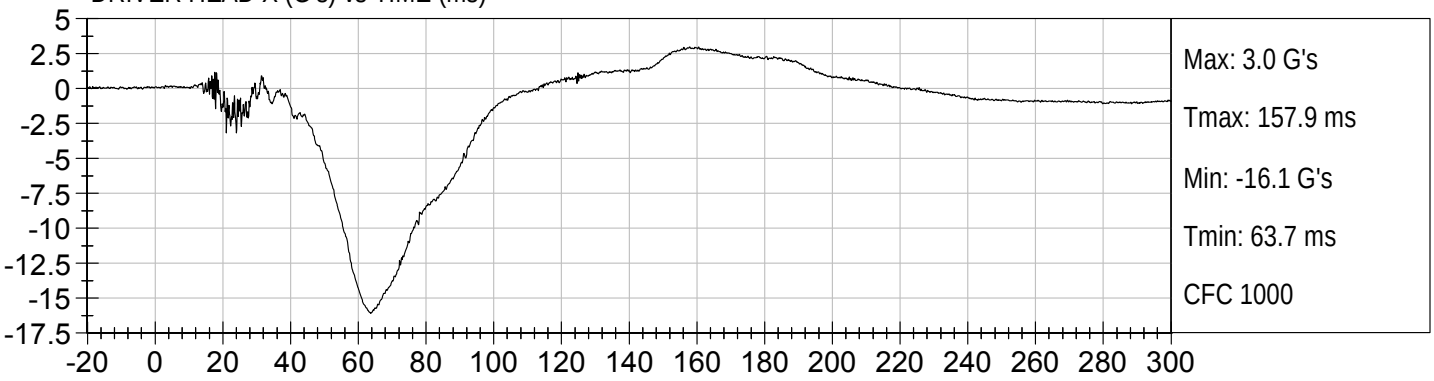
| | | Page No. |
|---|---|---|
| Figure No. 30. | Driver Pelvis Y Redundant Acceleration vs. Time | B-8 |
| Figure No. 31. | Driver Pelvis Y Redundant Velocity vs. Time | B-8 |
| Figure No. 32. | Vehicle CG X Acceleration vs. Time | B-9 |
| Figure No. 33. | Vehicle CG Y Acceleration vs. Time | B-9 |
| Figure No. 34. | Vehicle CG Z Acceleration vs. Time | B-9 |
| Figure No. 35. | Vehicle CG Resultant Acceleration vs. Time | B-9 |
| Figure No. 36. | Vehicle CG X Velocity vs. Time | B-10 |
| Figure No. 37. | Vehicle CG Y Velocity vs. Time | B-10 |
| Figure No. 38. | Vehicle CG Z Velocity vs. Time | B-10 |
| Figure No. 39. | Left Floor Y Acceleration vs. Time | B-11 |
| Figure No. 40. | Left Floor Y Velocity vs. Time | B-11 |
| Figure No. 41. | Left A-Post at Sill Y Acceleration vs. Time | B-11 |
| Figure No. 42. | Left A-Post at Sill Y Velocity vs. Time | B-11 |
| Figure No. 43. | Left Lower A-Post Y Acceleration vs. Time | B-12 |
| Figure No. 44. | Left Lower A-Post Y Velocity vs. Time | B-12 |
| Figure No. 45. | Left Mid A-Post Y Acceleration vs. Time | B-12 |
| Figure No. 46. | Left Mid A-Post Y Velocity vs. Time | B-12 |
| Figure No. 47. | Left B-Post at Sill Y Acceleration vs. Time | B-13 |
| Figure No. 48. | Left B-Post at Sill Y Velocity vs. Time | B-13 |
| Figure No. 49. | Left Lower B-Post Y Acceleration vs. Time | B-13 |
| Figure No. 50. | Left Lower B-Post Y Velocity vs. Time | B-13 |
| Figure No. 51. | Left Mid B-Post Y Acceleration vs. Time | B-14 |
| Figure No. 52. | Left Mid B-Post Y Velocity vs. Time | B-14 |
| Figure No. 53. | Driver Seat Track Y Acceleration vs. Time | B-14 |
| Figure No. 54. | Driver Seat Track Y Velocity vs. Time | B-14 |
| Figure No. 55. | Upper Engine X Acceleration vs. Time | B-15 |
| Figure No. 56. | Upper Engine Y Acceleration vs. Time | B-15 |
| Figure No. 57. | Upper Engine X Velocity vs. Time | B-15 |
| Figure No. 58. | Upper Engine Y Velocity vs. Time | B-15 |
| Figure No. 59. | Firewall Y Acceleration vs. Time | B-16 |

| | | Page No. |
|---|---|---|
| Figure No. 60. | Firewall Y Velocity vs. Time | B-16 |
| Figure No. 61. | Right Front Roof Y Acceleration vs. Time | B-16 |
| Figure No. 62. | Right Front Roof Y Velocity vs. Time | B-16 |
| Figure No. 63. | Right Floor Y Acceleration vs. Time | B-17 |
| Figure No. 64. | Right Floor Y Velocity vs. Time | B-17 |
| Figure No. 65. | Rear Deck X Acceleration vs. Time | B-18 |
| Figure No. 66. | Rear Deck Y Acceleration vs. Time | B-18 |
| Figure No. 67. | Rear Deck X Velocity vs. Time | B-18 |
| Figure No. 68. | Rear Deck Y Velocity vs. Time | B-18 |
| Figure No. 69. | Driver Upper Rib Y Acceleration vs. Time | B-19 |
| Figure No. 70. | Driver Upper Rib Y Velocity vs. Time | B-19 |
| Figure No. 71. | Driver Lower Rib Y Acceleration vs. Time | B-19 |
| Figure No. 72. | Driver Lower Rib Y Velocity vs. Time | B-19 |
| Figure No. 73. | Driver Lower Spine Y Acceleration vs. Time | B-20 |
| Figure No. 74. | Driver Lower Spine Y Velocity vs. Time | B-20 |
| Figure No. 75. | Driver Pelvis Y Acceleration vs. Time | B-20 |
| Figure No. 76. | Driver Pelvis Y Velocity vs. Time | B-20 |
| Figure No. 77. | Driver Upper Rib Y Redundant Acceleration vs. Time | B-21 |
| Figure No. 78. | Driver Upper Rib Y Redundant Velocity vs. Time | B-21 |
| Figure No. 79. | Driver Lower Rib Y Redundant Acceleration vs. Time | B-21 |
| Figure No. 80. | Driver Lower Rib Y Redundant Velocity vs. Time | B-21 |
| Figure No. 81. | Driver Lower Spine Y Redundant Acceleration vs. Time | B-22 |
| Figure No. 82. | Driver Lower Spine Y Redundant Velocity vs. Time | B-22 |
| Figure No. 83. | Driver Pelvis Y Redundant Acceleration vs. Time | B-22 |
| Figure No. 84. | Driver Pelvis Y Redundant Velocity vs. Time | B-22 |

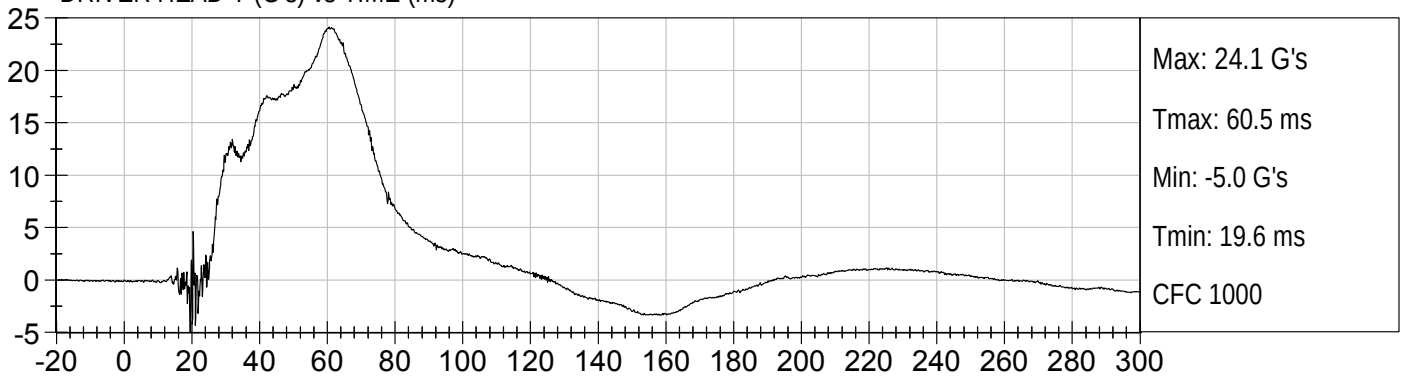
Rigid Pole Side Impact FMVSS 201
2012 Coda All Electric - CC1005

Test Date: 03/07/2013
Speed: 17.5 mph (28.1 km/h)

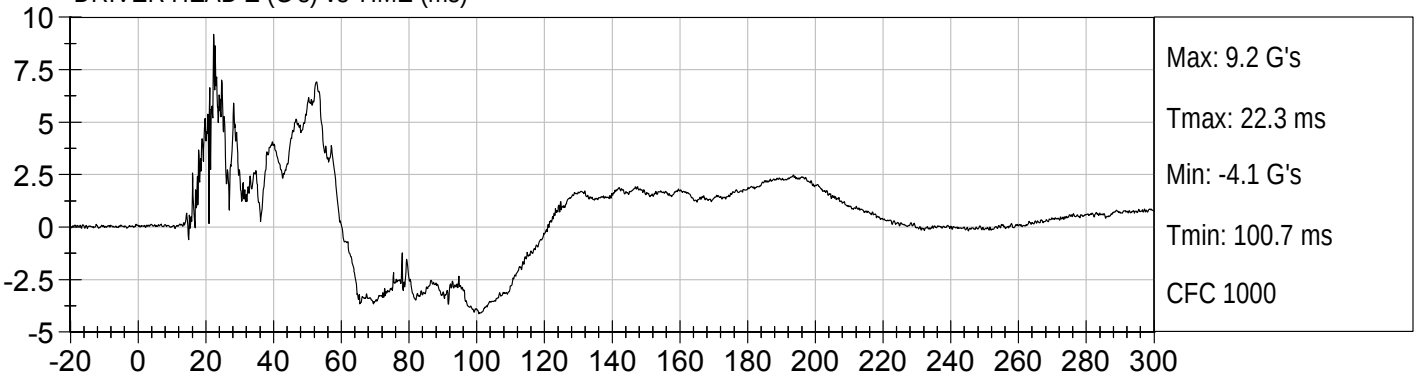
DRIVER HEAD X (G's) vs TIME (ms)



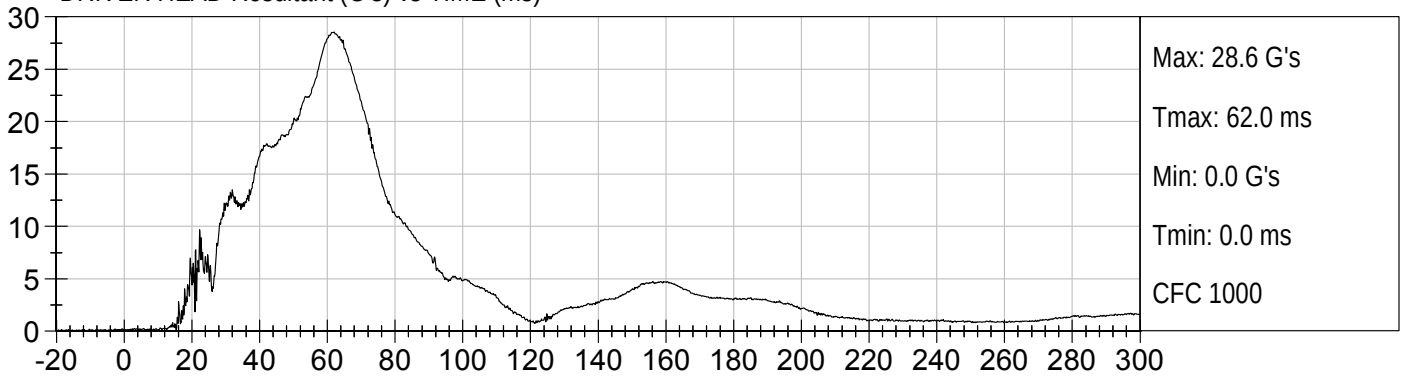

DRIVER HEAD Y (G's) vs TIME (ms)




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

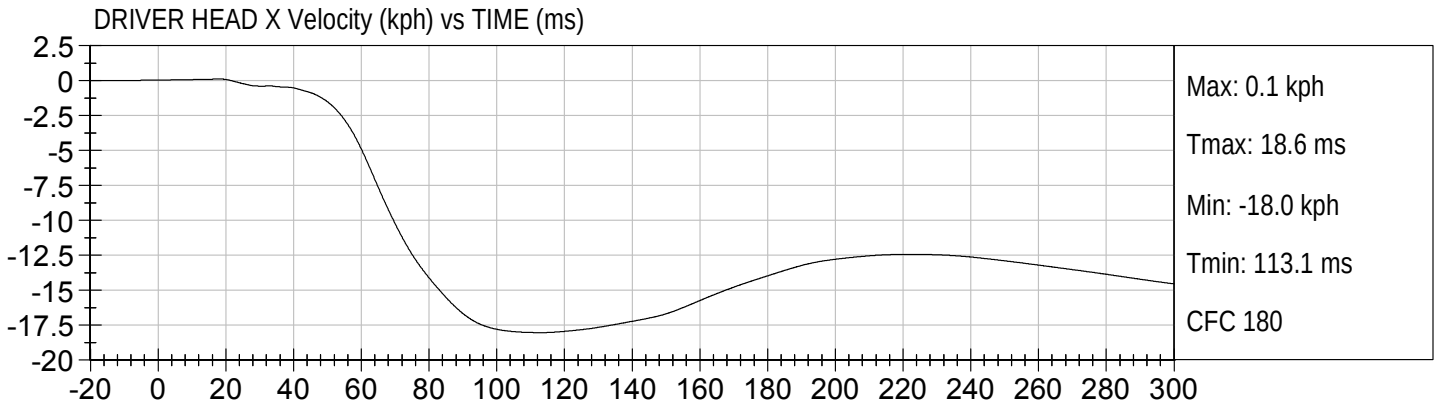


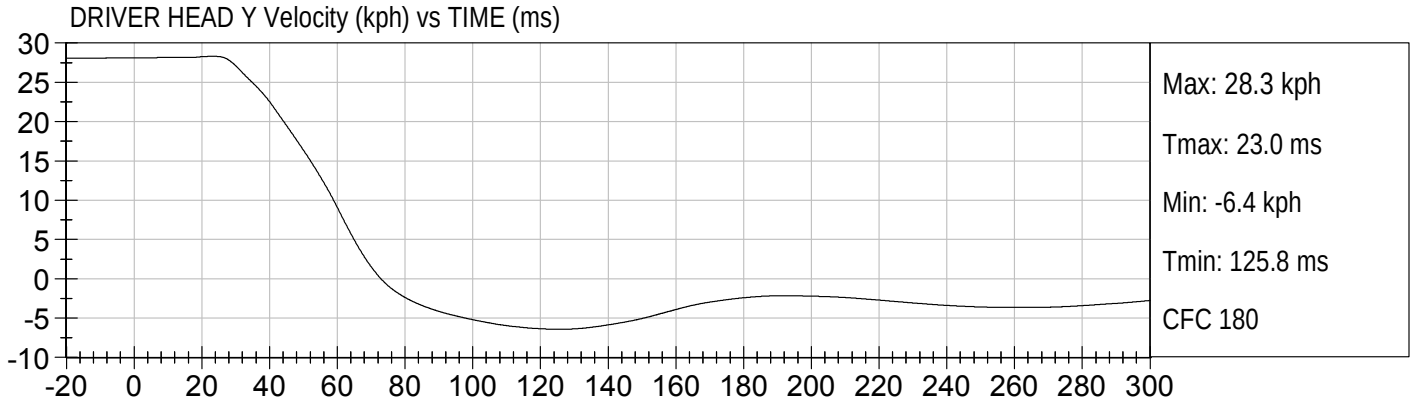

DRIVER HEAD Resultant (G's) vs TIME (ms)

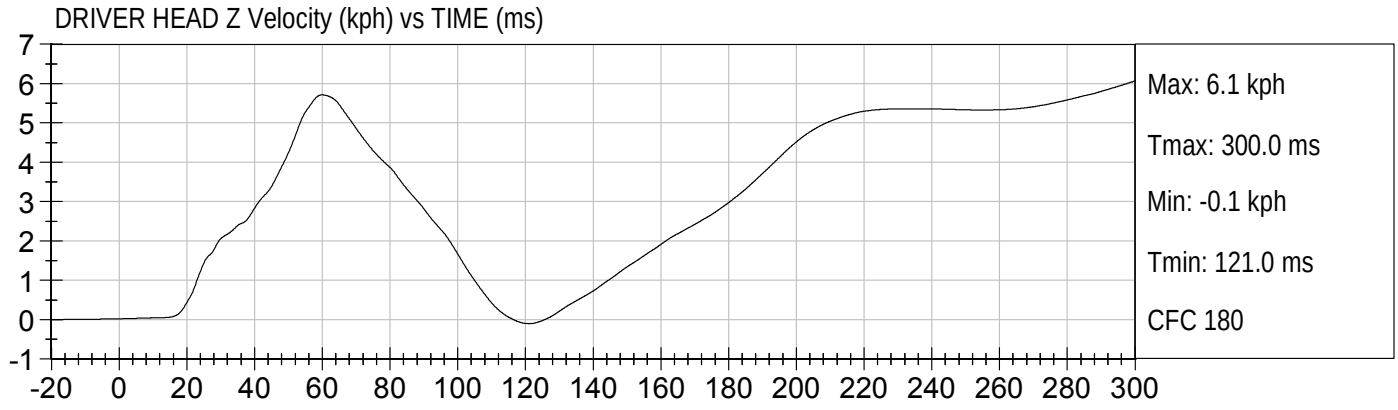


Rigid Pole Side Impact FMVSS 201
2012 Coda All Electric - CC1005

Test Date: 03/07/2013
Speed: 17.5 mph (28.1 km/h)

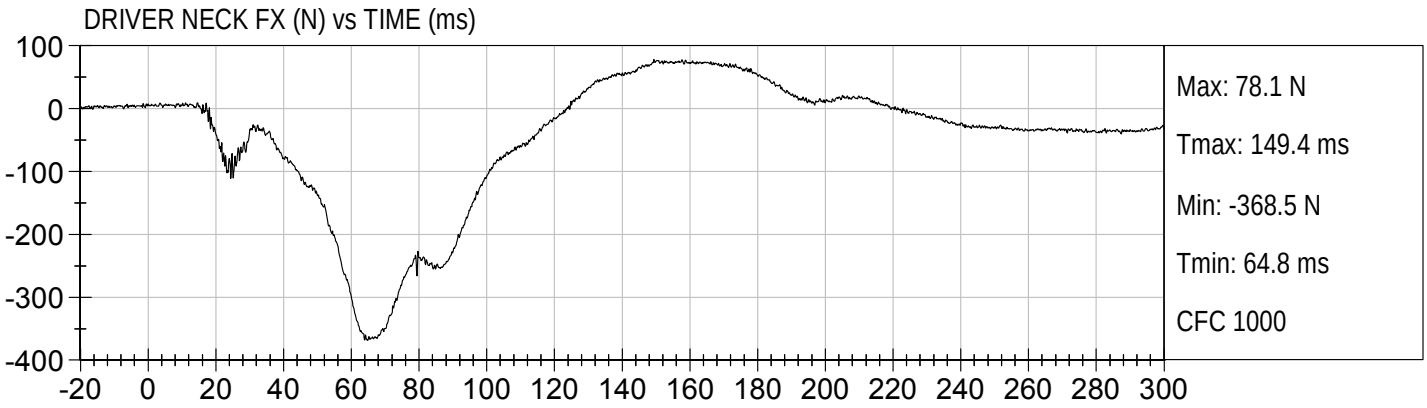


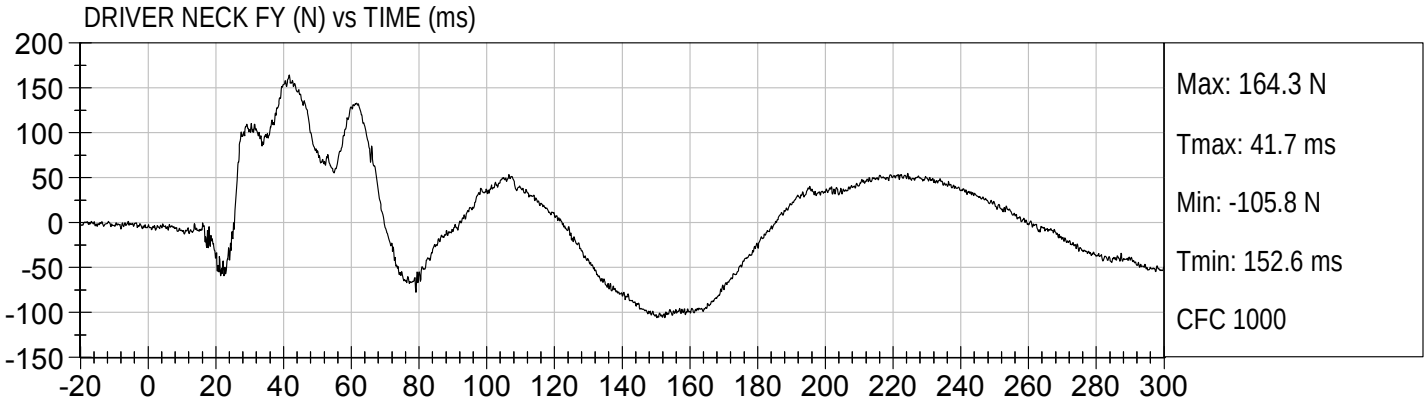



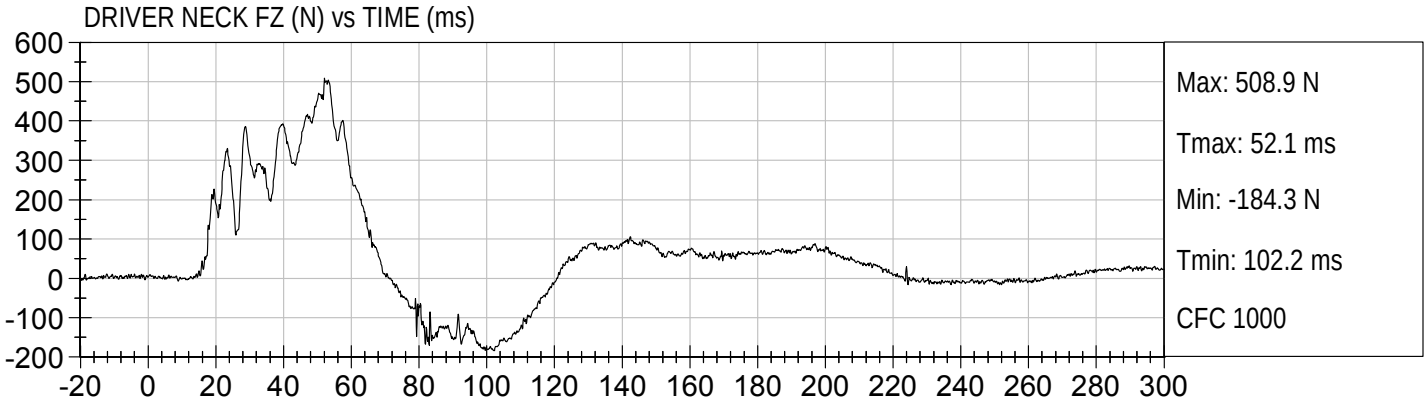



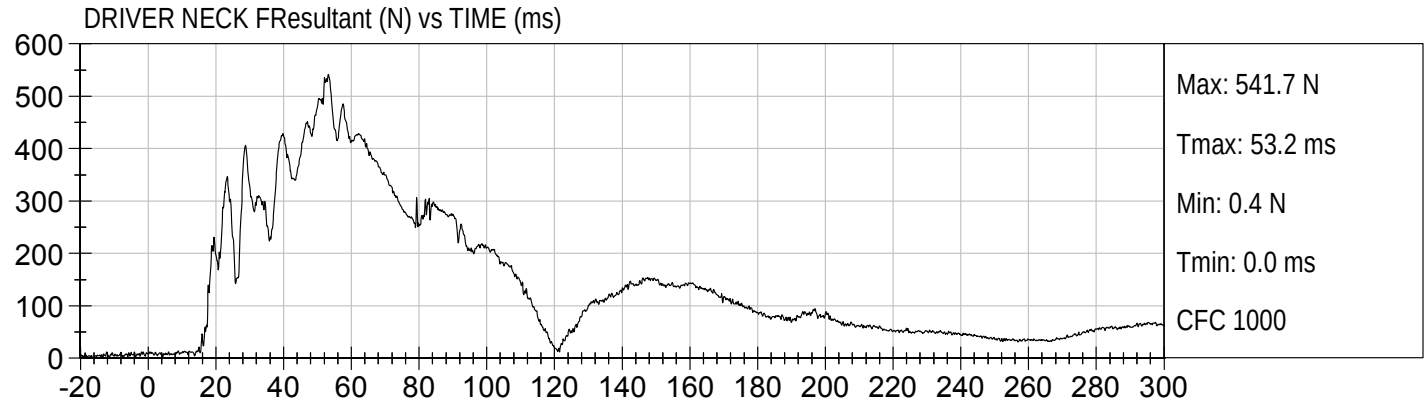
Rigid Pole Side Impact FMVSS 201
2012 Coda All Electric - CC1005

Test Date: 03/07/2013
Speed: 17.5 mph (28.1 km/h)



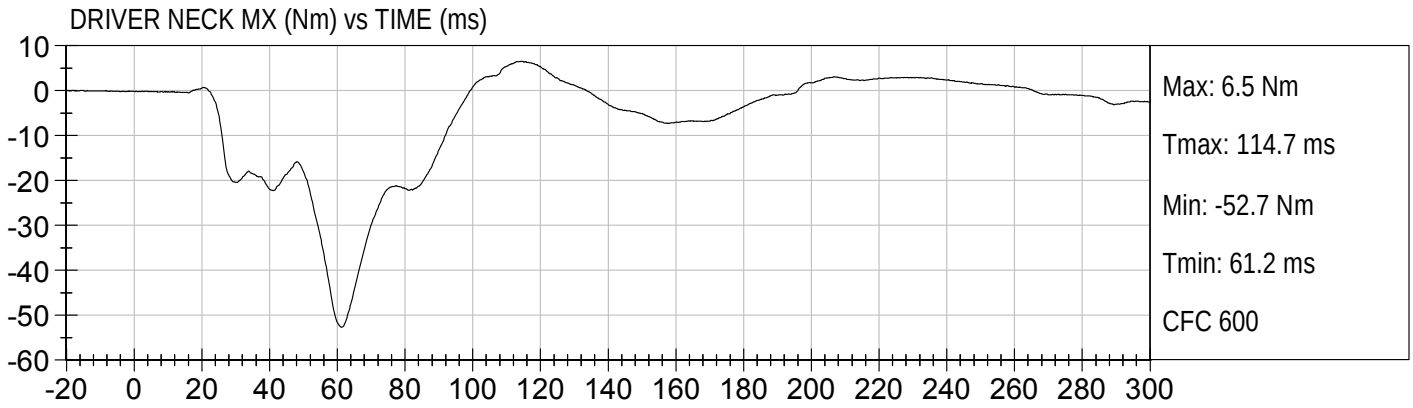



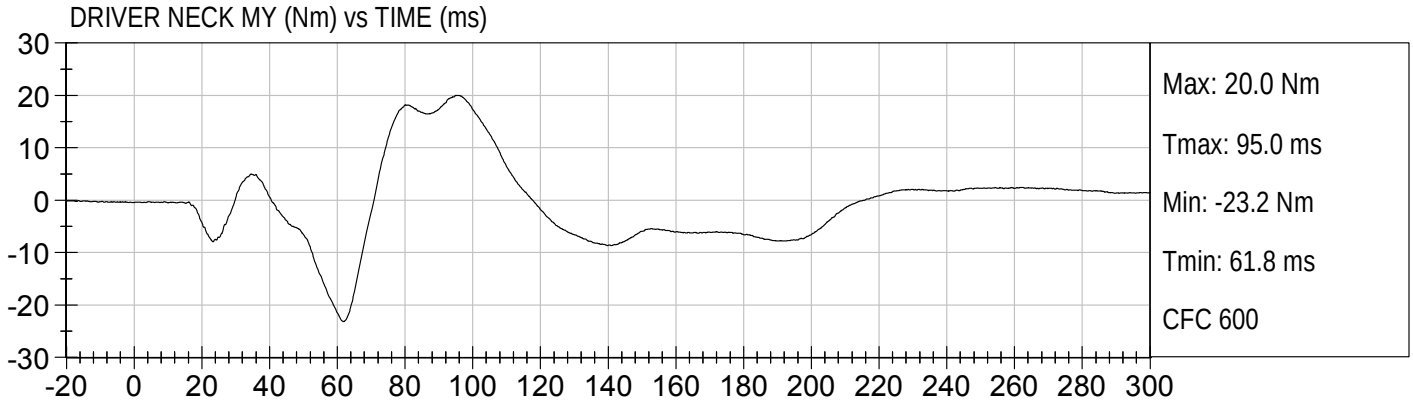



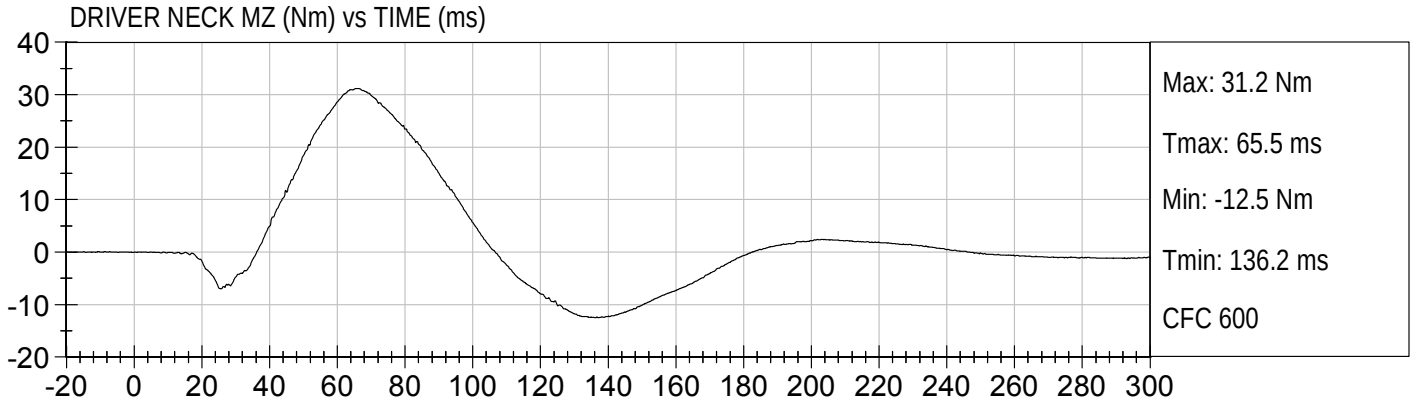



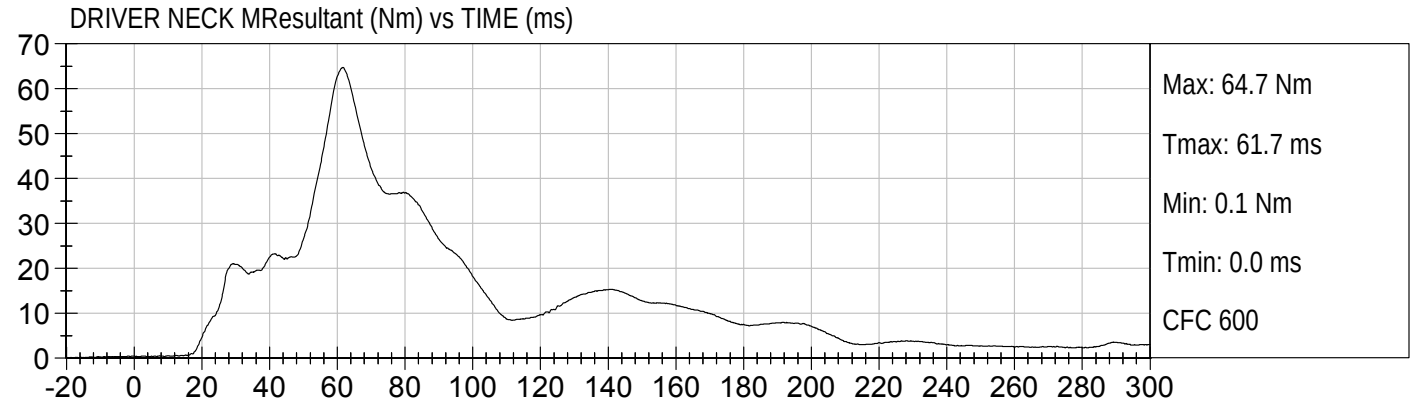
Rigid Pole Side Impact FMVSS 201
2012 Coda All Electric - CC1005

Test Date: 03/07/2013
Speed: 17.5 mph (28.1 km/h)



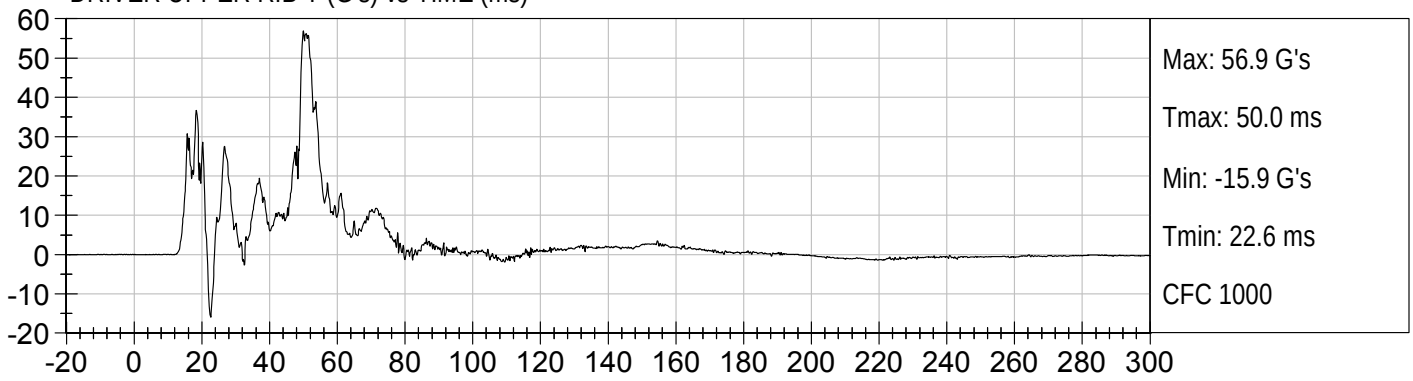



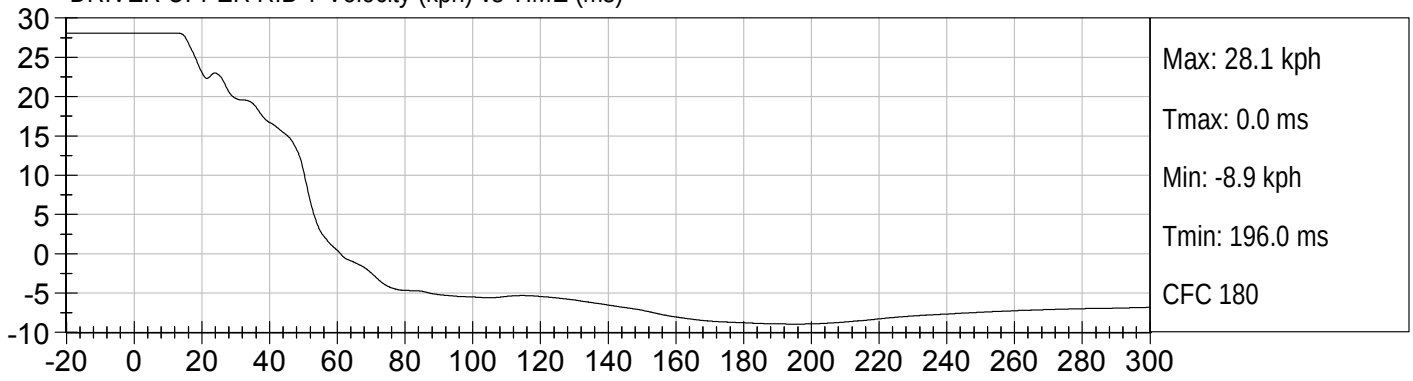
Rigid Pole Side Impact FMVSS 201
2012 Coda All Electric - CC1005

Test Date: 03/07/2013
Speed: 17.5 mph (28.1 km/h)

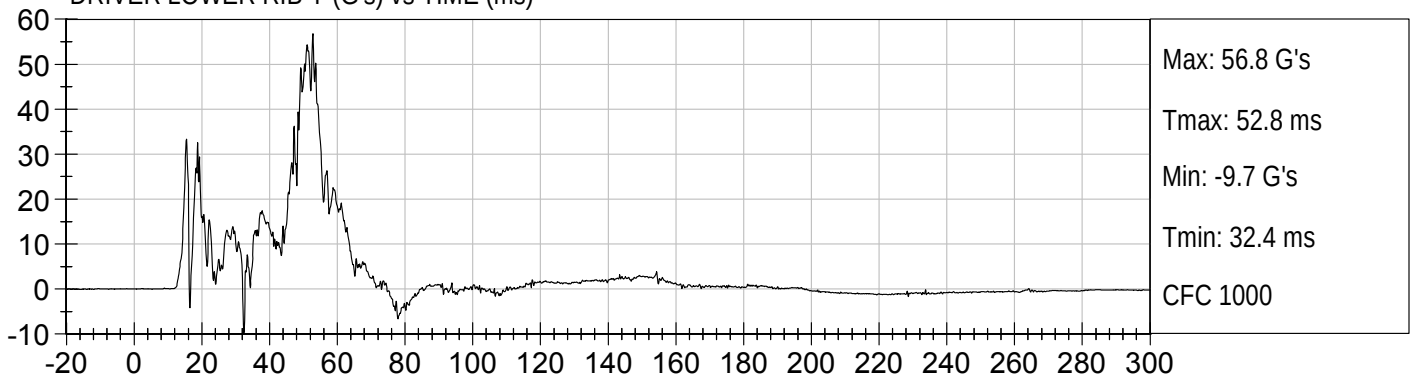
DRIVER UPPER RIB Y (G's) vs TIME (ms)



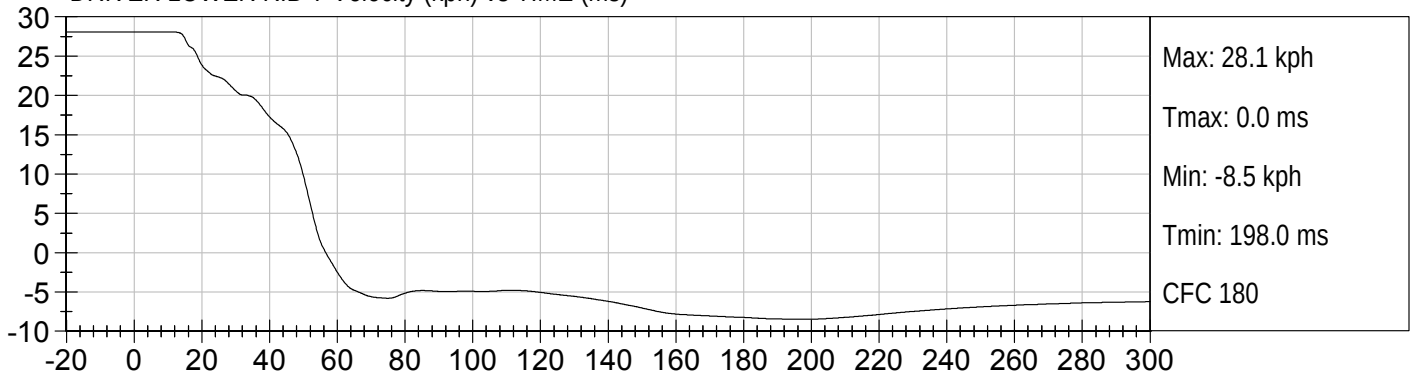

DRIVER UPPER RIB Y Velocity (kph) vs TIME (ms)




DRIVER LOWER RIB Y (G's) vs TIME (ms)



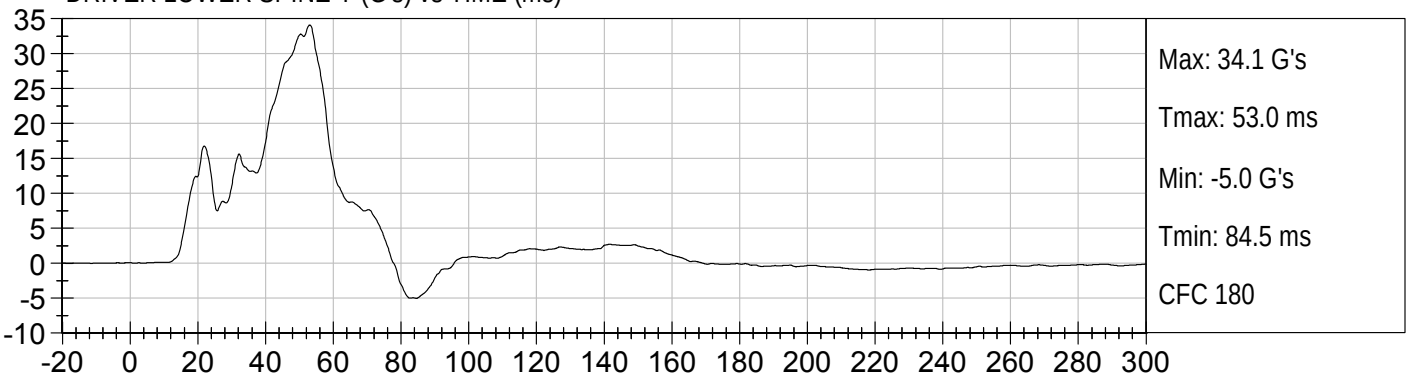

DRIVER LOWER RIB Y Velocity (kph) vs TIME (ms)



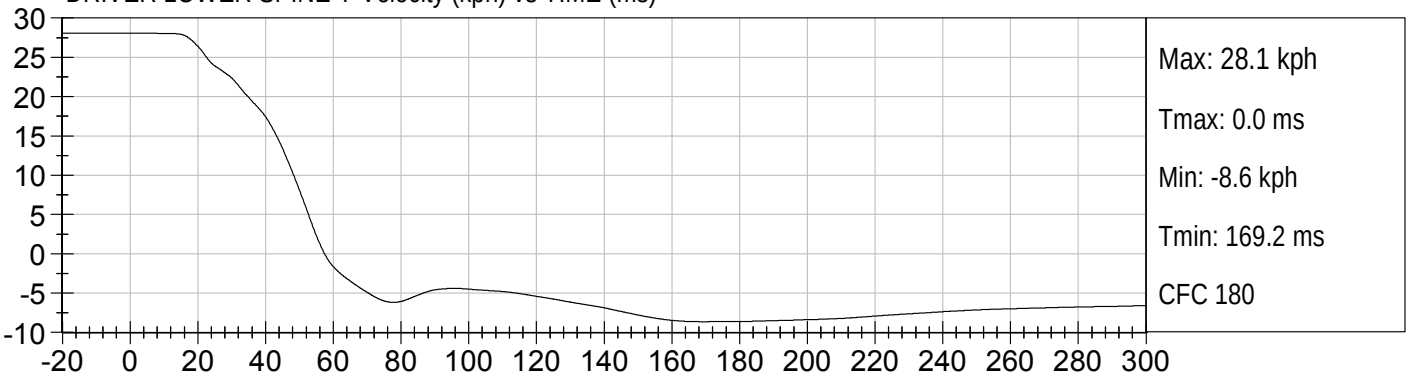
Rigid Pole Side Impact FMVSS 201
2012 Coda All Electric - CC1005

Test Date: 03/07/2013
Speed: 17.5 mph (28.1 km/h)

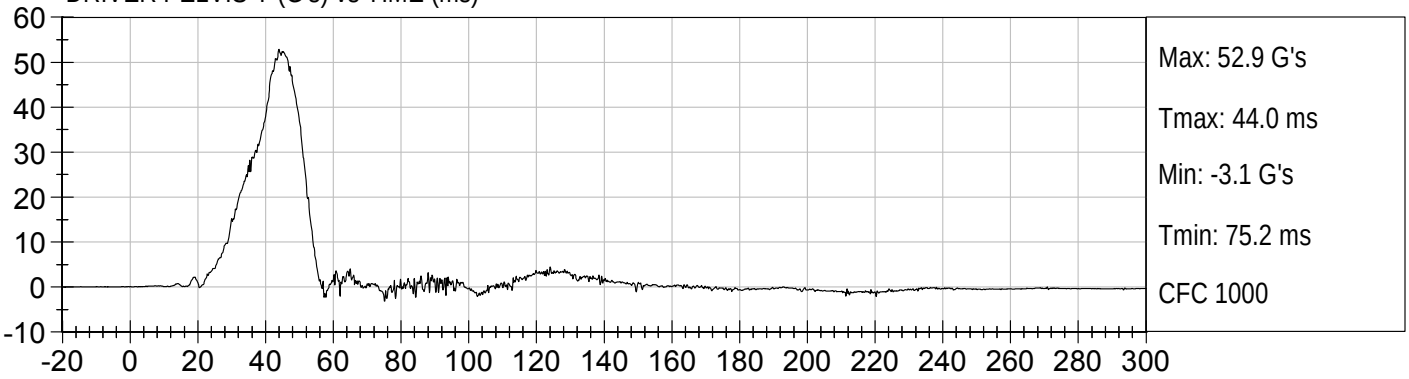
DRIVER LOWER SPINE Y (G's) vs TIME (ms)



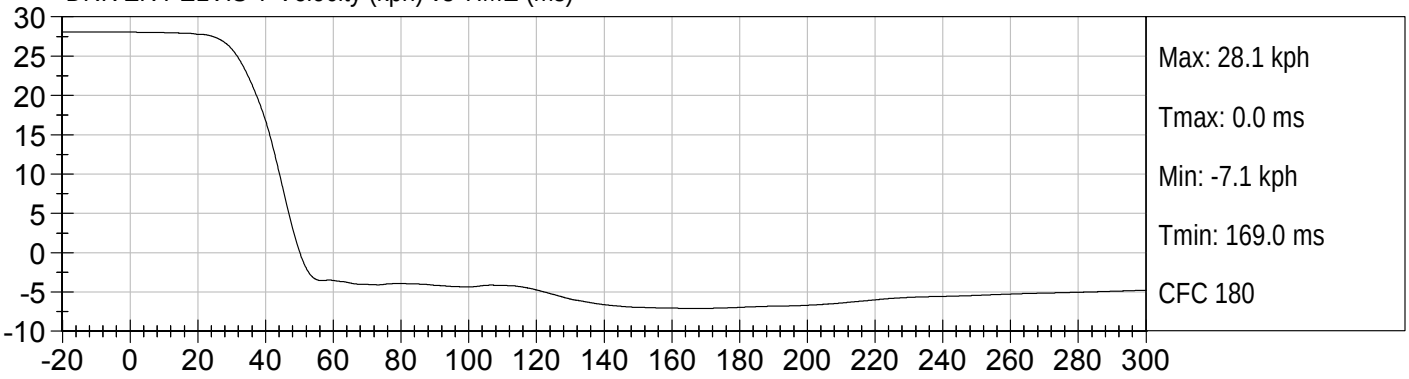

DRIVER LOWER SPINE Y Velocity (kph) vs TIME (ms)




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



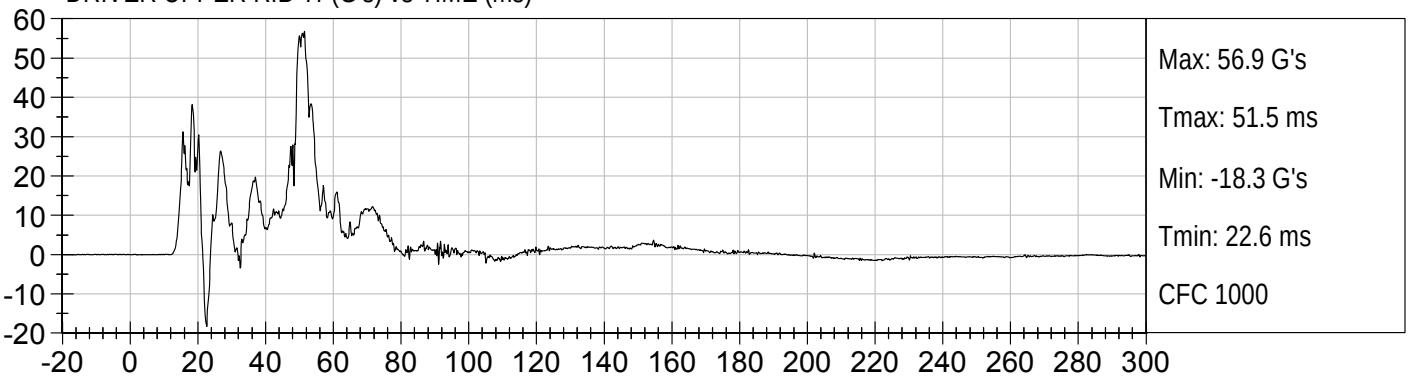

DRIVER PELVIS Y Velocity (kph) vs TIME (ms)



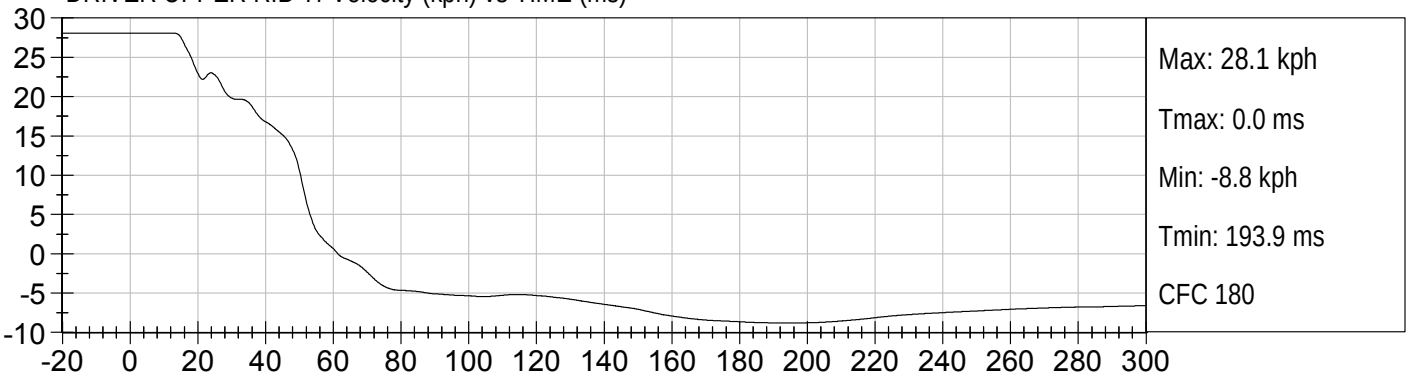
Rigid Pole Side Impact FMVSS 201
2012 Coda All Electric - CC1005

Test Date: 03/07/2013
Speed: 17.5 mph (28.1 km/h)

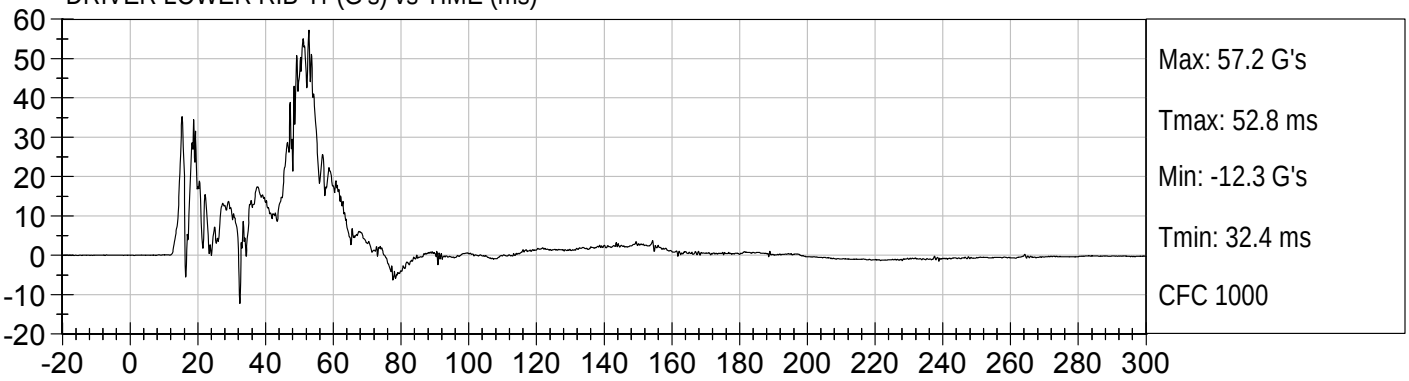
DRIVER UPPER RIB Yr (G's) vs TIME (ms)



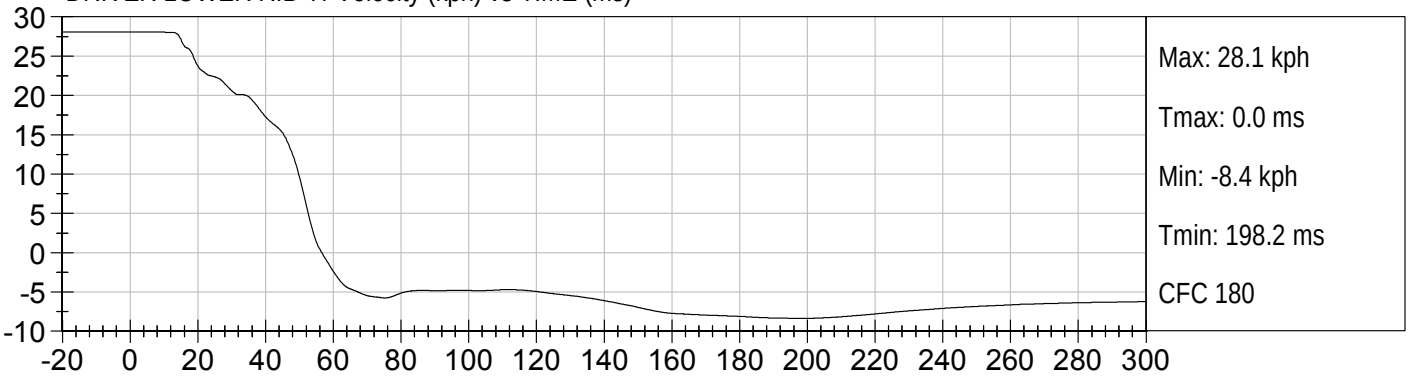

DRIVER UPPER RIB Yr Velocity (kph) vs TIME (ms)




DRIVER LOWER RIB Yr (G's) vs TIME (ms)



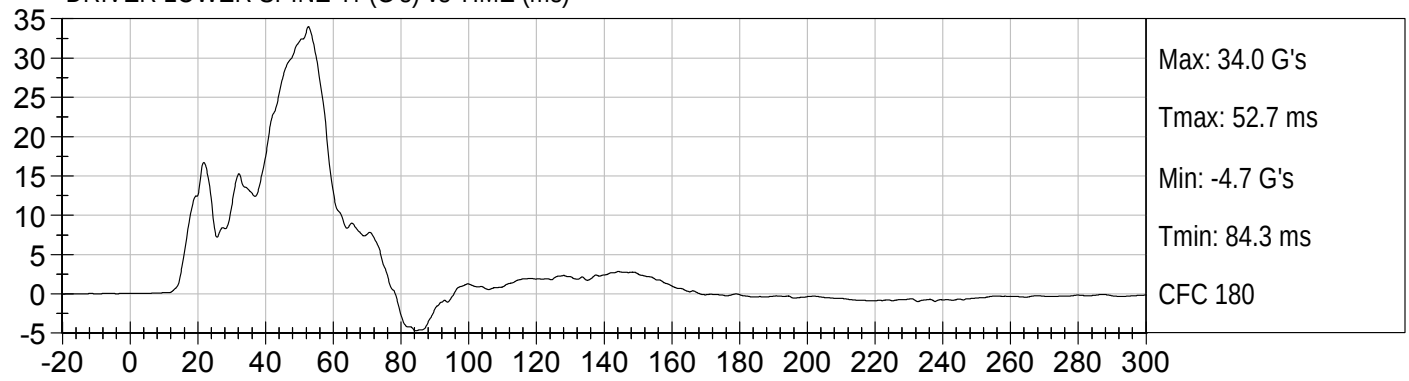

DRIVER LOWER RIB Yr Velocity (kph) vs TIME (ms)



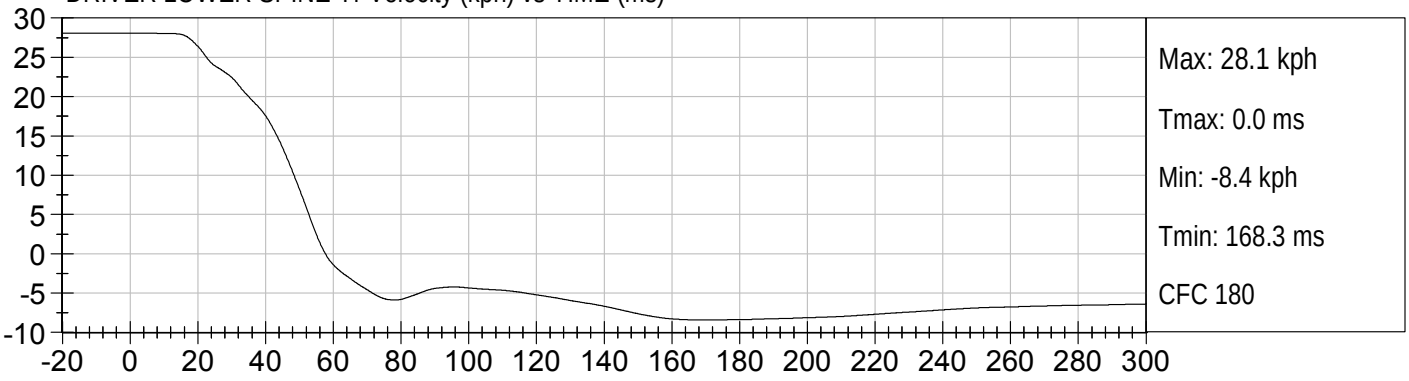
Rigid Pole Side Impact FMVSS 201
2012 Coda All Electric - CC1005

Test Date: 03/07/2013
Speed: 17.5 mph (28.1 km/h)

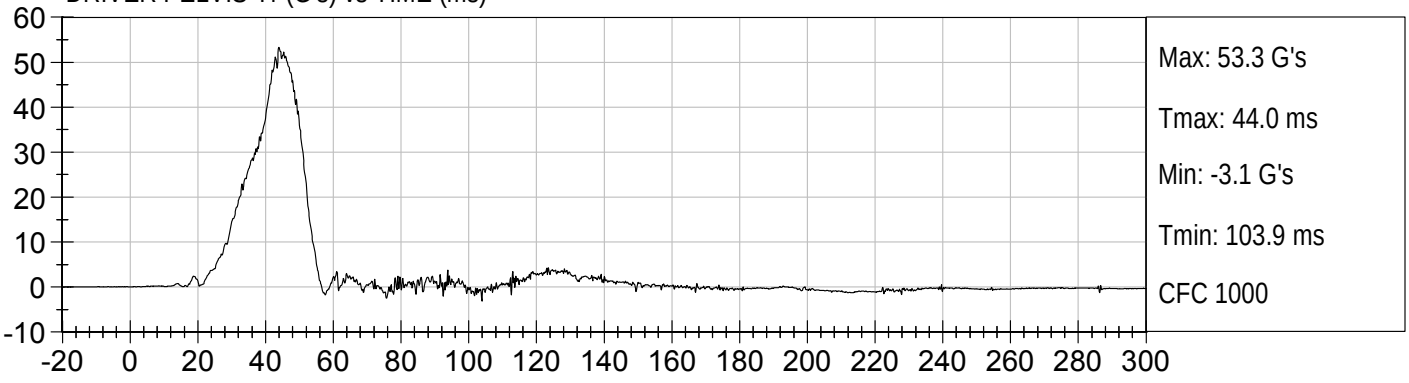
DRIVER LOWER SPINE Yr (G's) vs TIME (ms)



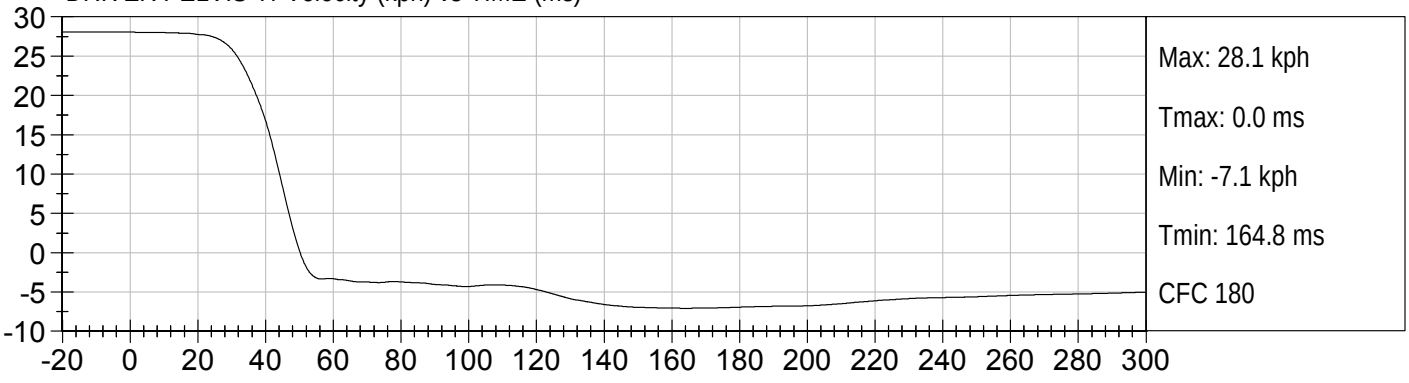

DRIVER LOWER SPINE Yr Velocity (kph) vs TIME (ms)




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



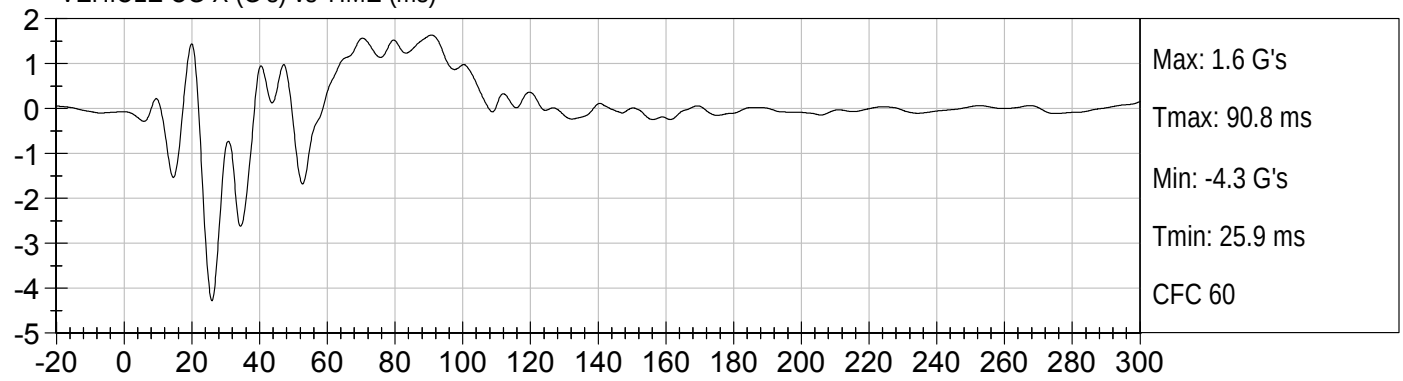

DRIVER PELVIS Yr Velocity (kph) vs TIME (ms)



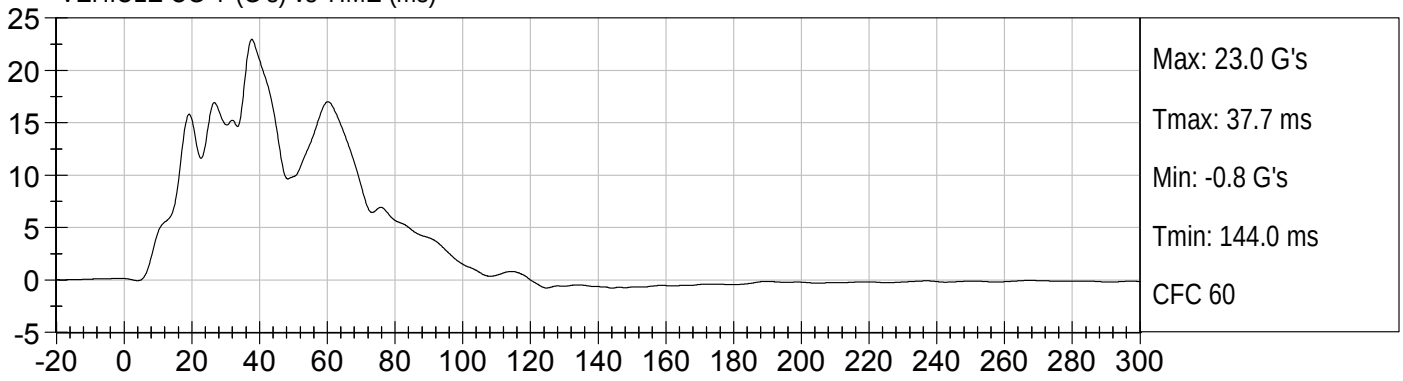
Rigid Pole Side Impact FMVSS 201
2012 Coda All Electric - CC1005

Test Date: 03/07/2013
Speed: 17.5 mph (28.1 km/h)

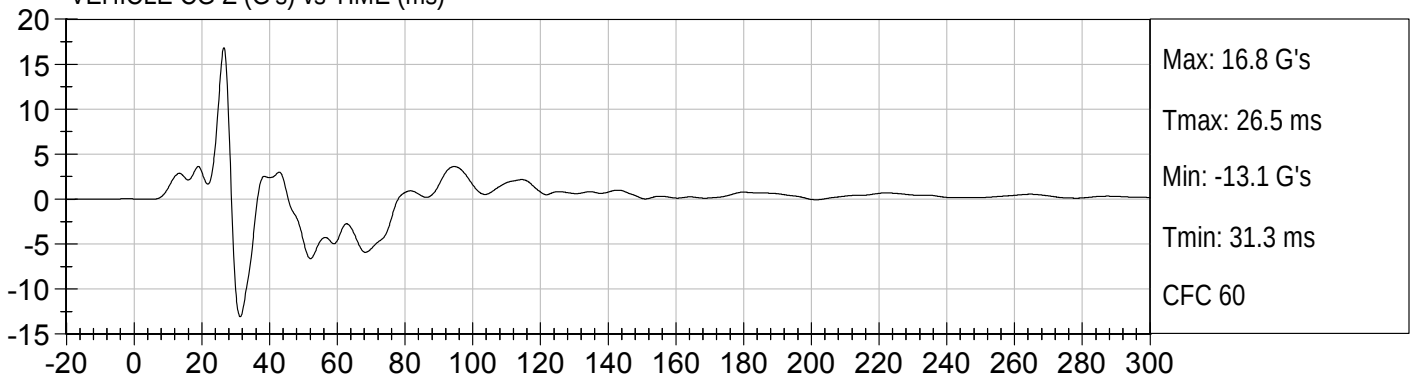
VEHICLE CG X (G's) vs TIME (ms)



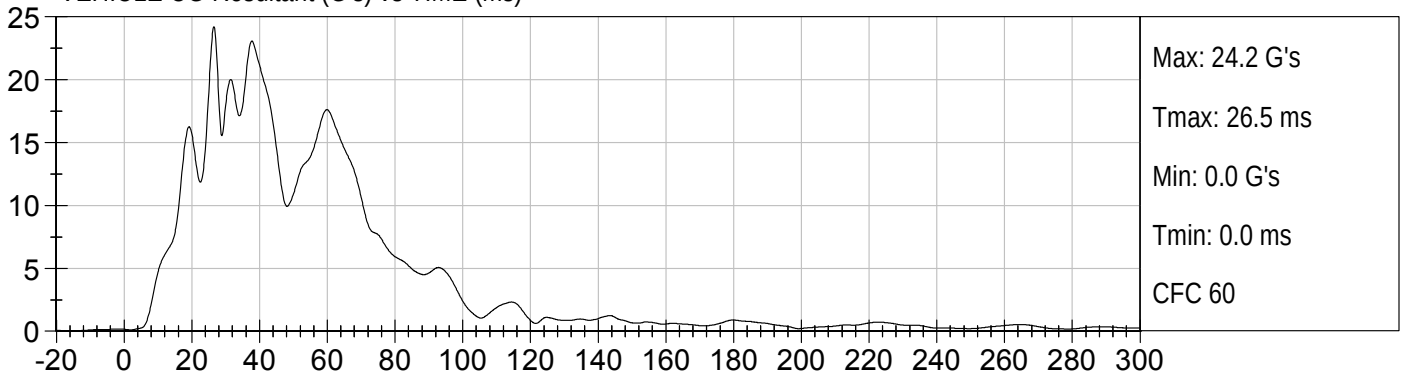

VEHICLE CG Y (G's) vs TIME (ms)




VEHICLE CG Z (G's) vs TIME (ms)

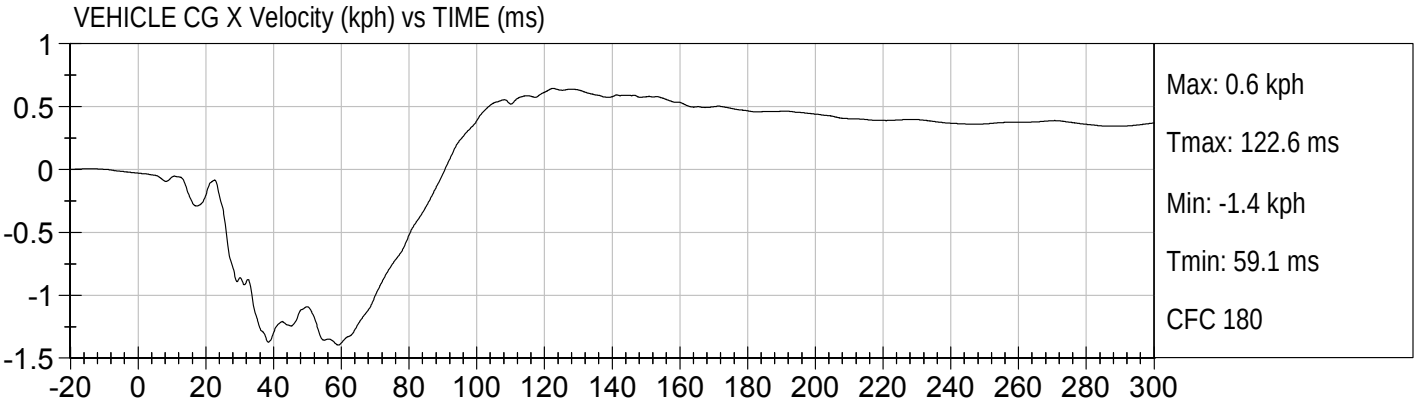


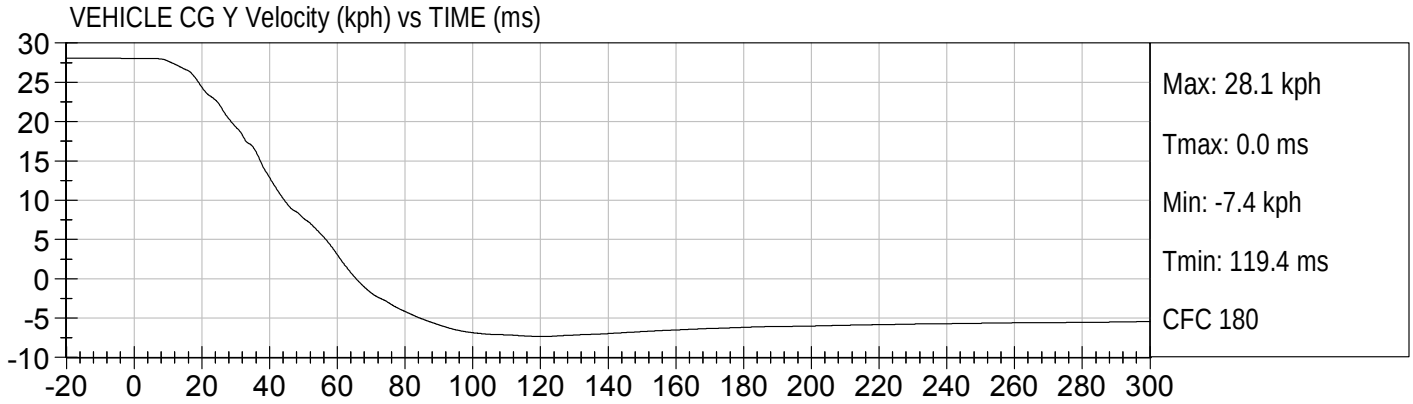

VEHICLE CG Resultant (G's) vs TIME (ms)

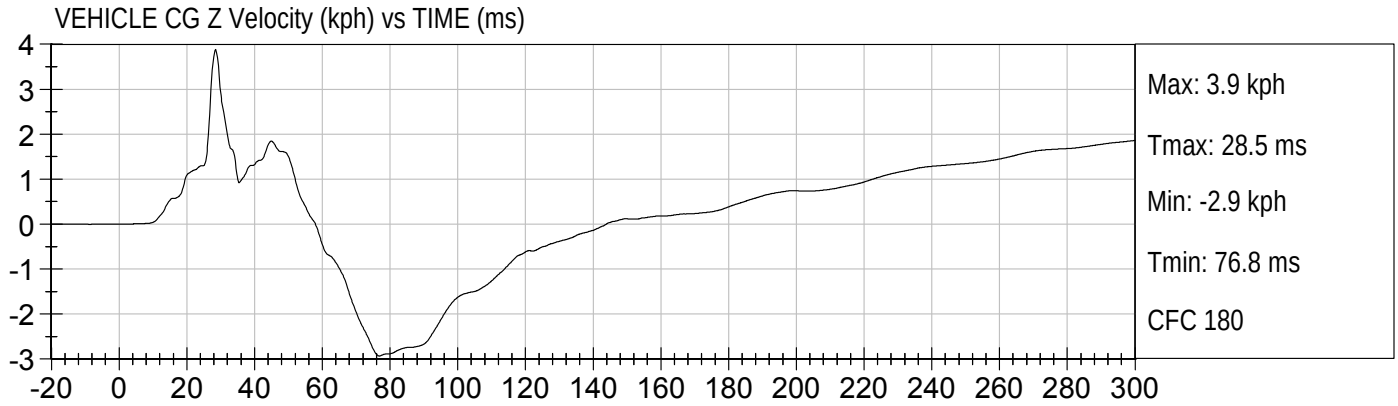


Rigid Pole Side Impact FMVSS 201
2012 Coda All Electric - CC1005

Test Date: 03/07/2013
Speed: 17.5 mph (28.1 km/h)



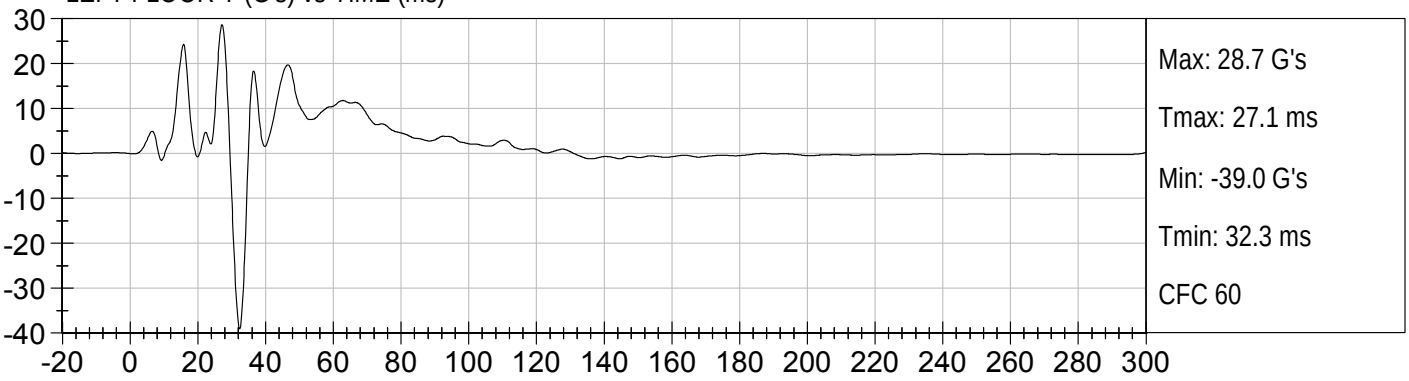



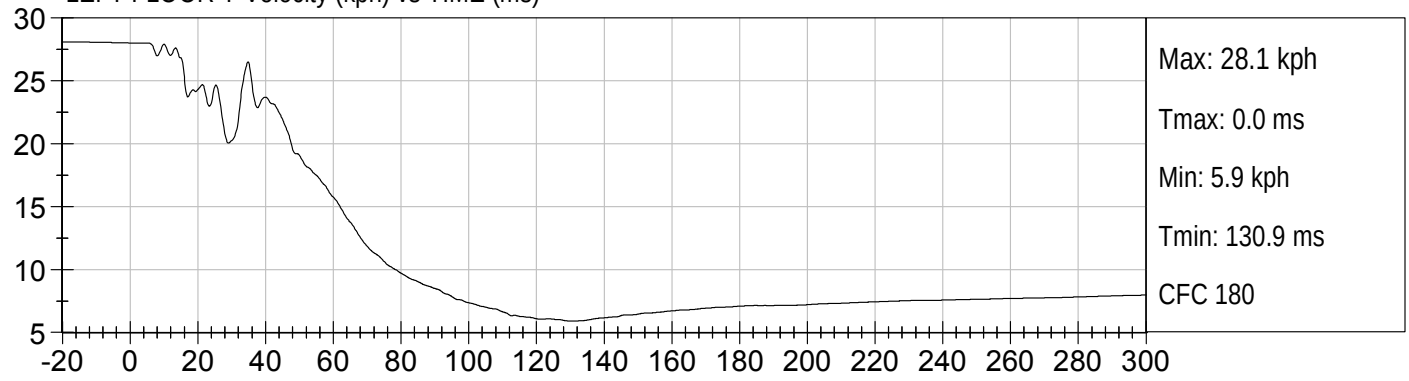
Rigid Pole Side Impact FMVSS 201
2012 Coda All Electric - CC1005

Test Date: 03/07/2013
Speed: 17.5 mph (28.1 km/h)

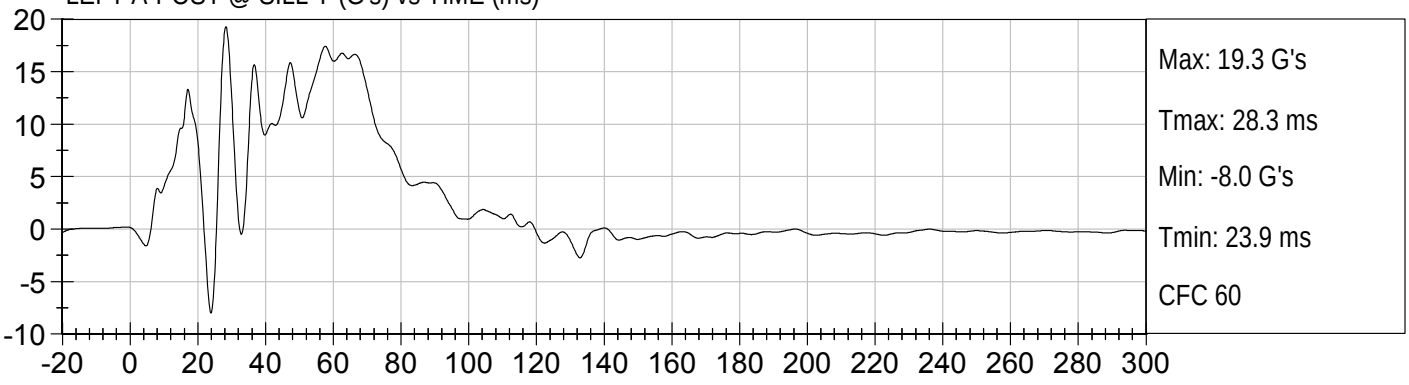
LEFT FLOOR Y (G's) vs TIME (ms)



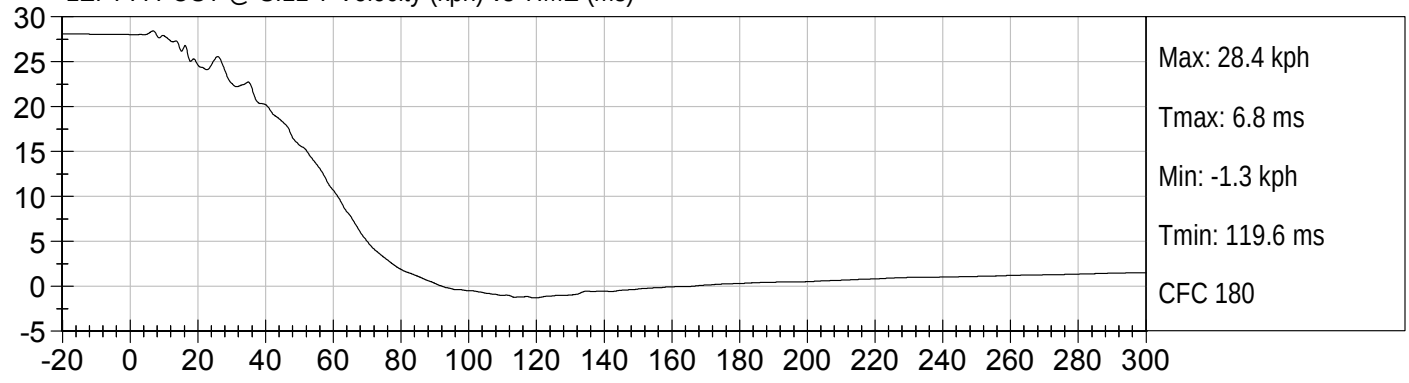

LEFT FLOOR Y Velocity (kph) vs TIME (ms)




LEFT A-POST @ SILL Y (G's) vs TIME (ms)



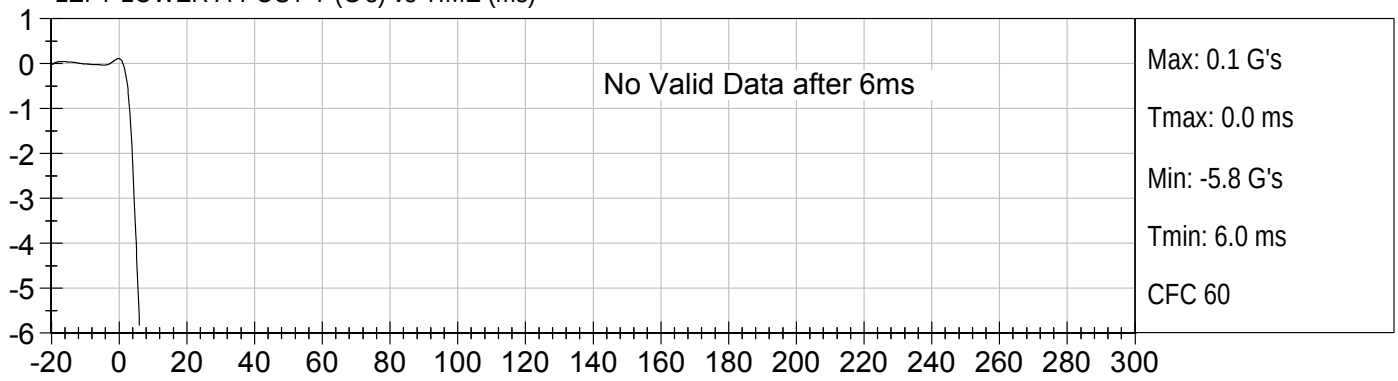

LEFT A-POST @ SILL Y Velocity (kph) vs TIME (ms)



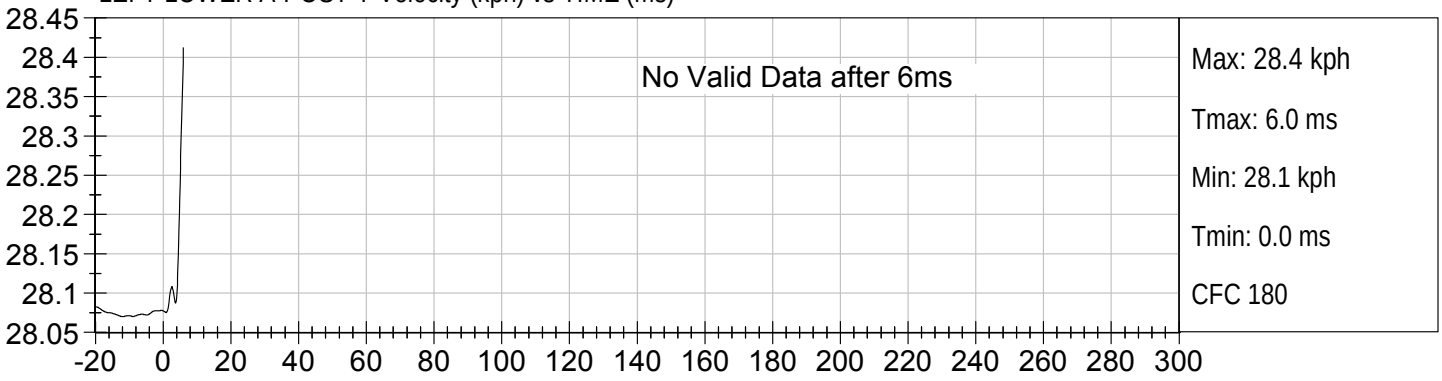
Rigid Pole Side Impact FMVSS 201
2012 Coda All Electric - CC1005

Test Date: 03/07/2013
Speed: 17.5 mph (28.1 km/h)

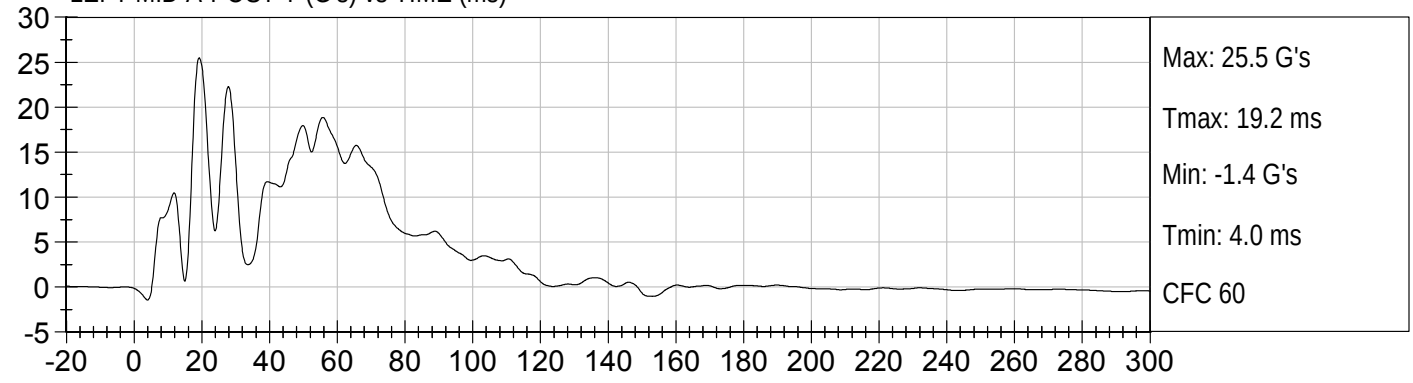
LEFT LOWER A-POST Y (G's) vs TIME (ms)



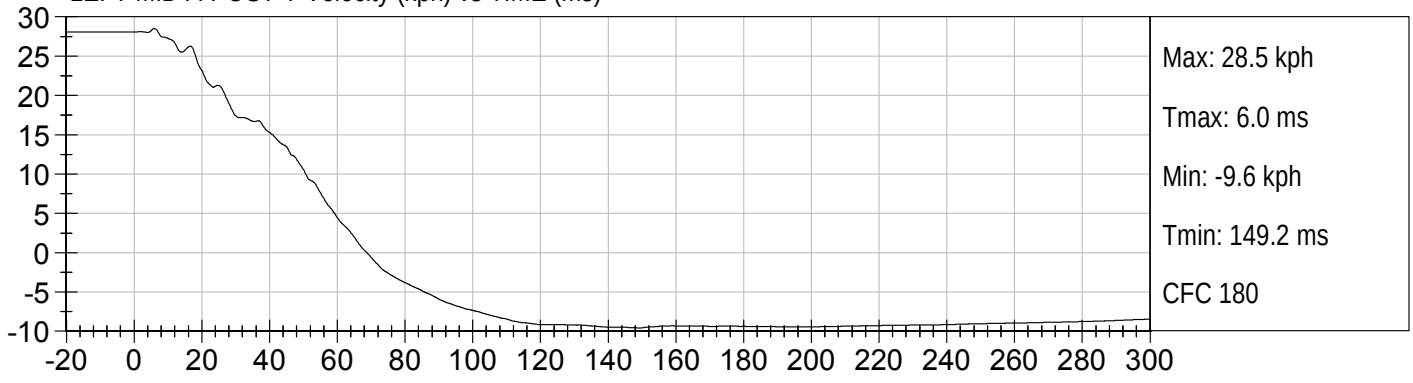

LEFT LOWER A-POST Y Velocity (kph) vs TIME (ms)




LEFT MID A-POST Y (G's) vs TIME (ms)



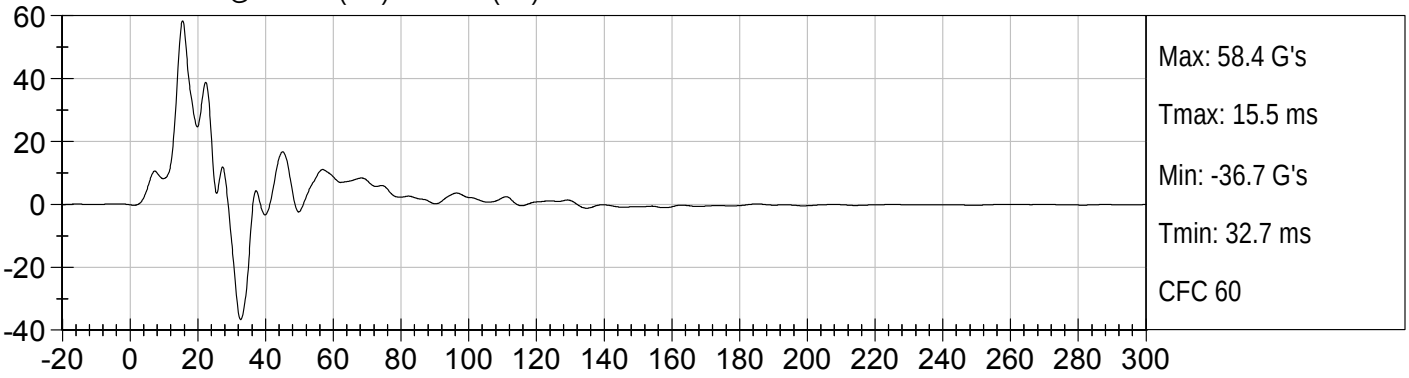

LEFT MID A-POST Y Velocity (kph) vs TIME (ms)



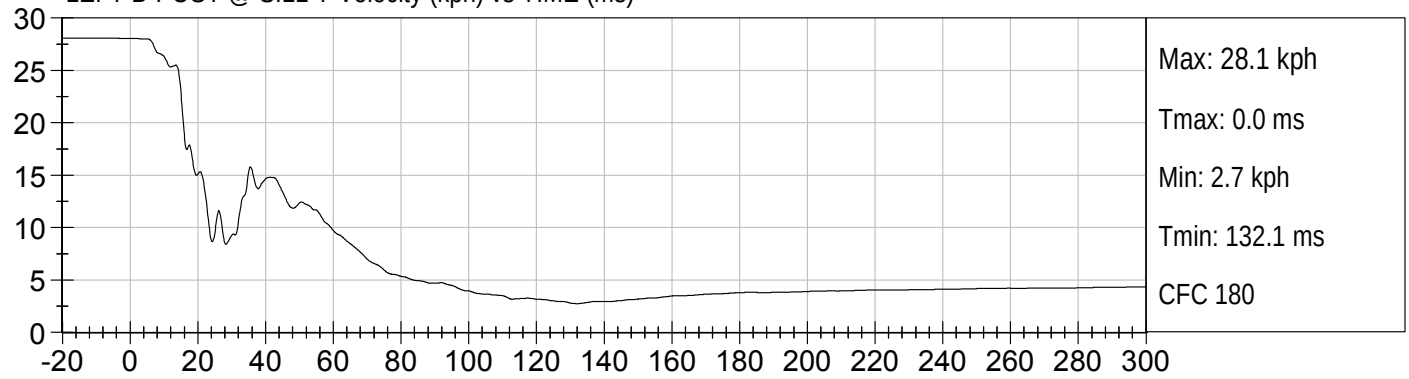
Rigid Pole Side Impact FMVSS 201
2012 Coda All Electric - CC1005

Test Date: 03/07/2013
Speed: 17.5 mph (28.1 km/h)

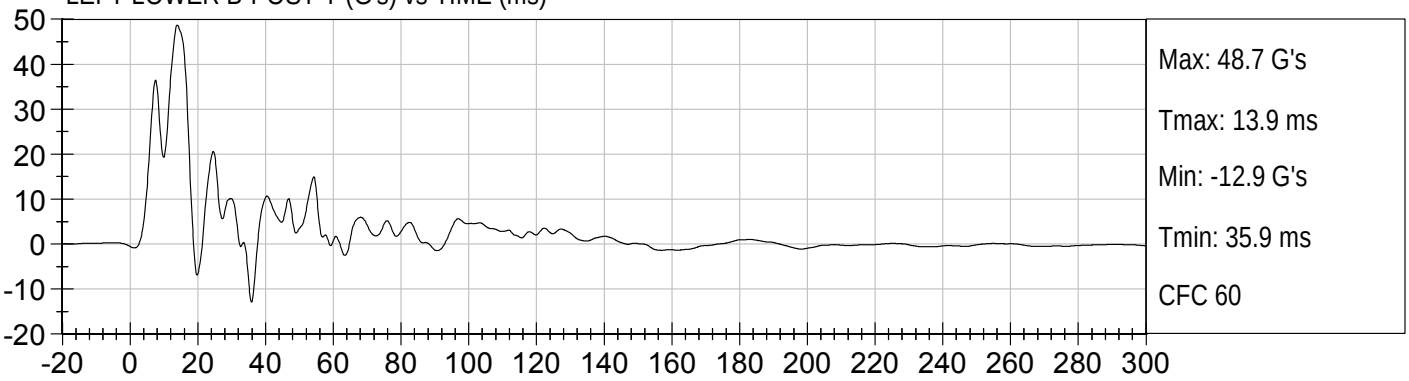
LEFT B-POST @ SILL Y (G's) vs TIME (ms)



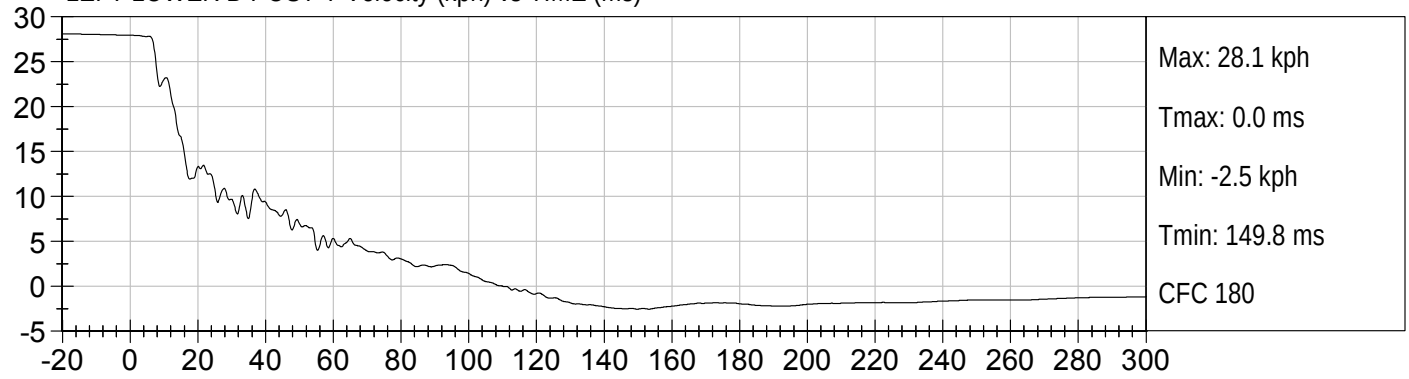

LEFT B-POST @ SILL Y Velocity (kph) vs TIME (ms)




LEFT LOWER B-POST Y (G's) vs TIME (ms)



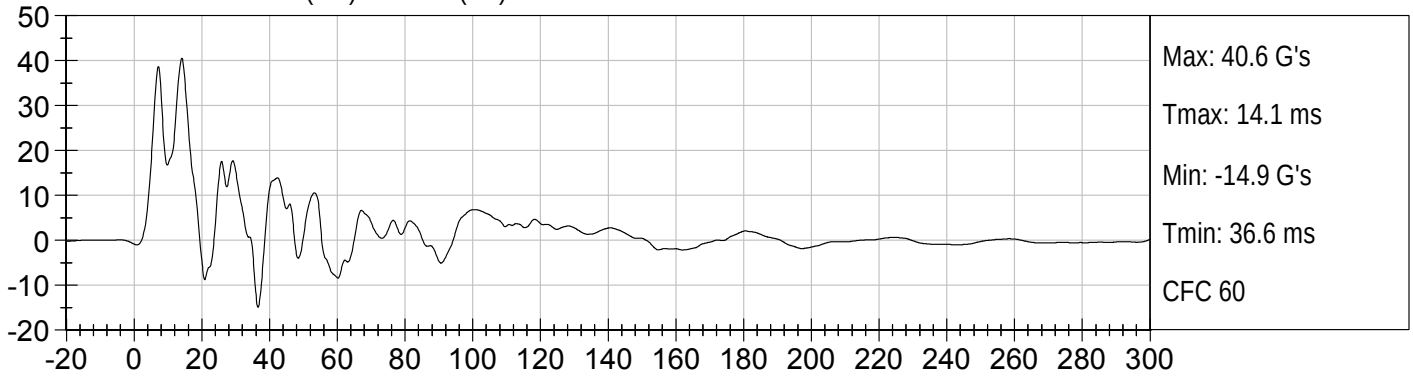

LEFT LOWER B-POST Y Velocity (kph) vs TIME (ms)



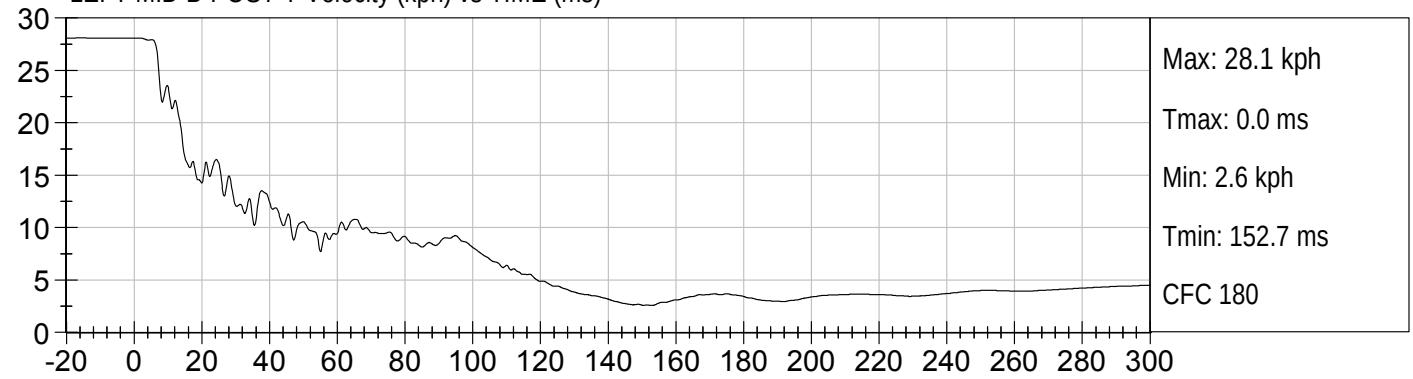
Rigid Pole Side Impact FMVSS 201
2012 Coda All Electric - CC1005

Test Date: 03/07/2013
Speed: 17.5 mph (28.1 km/h)

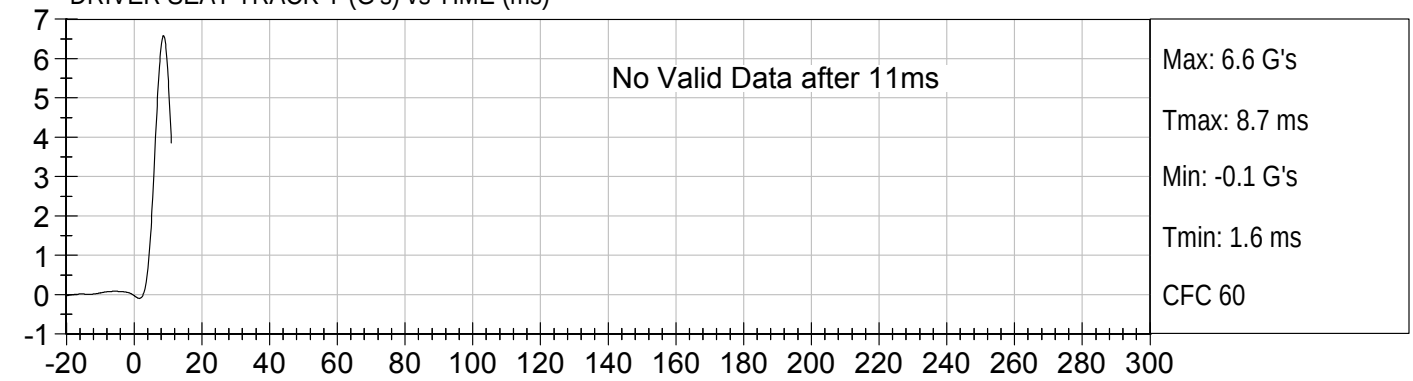
LEFT MID B-POST Y (G's) vs TIME (ms)



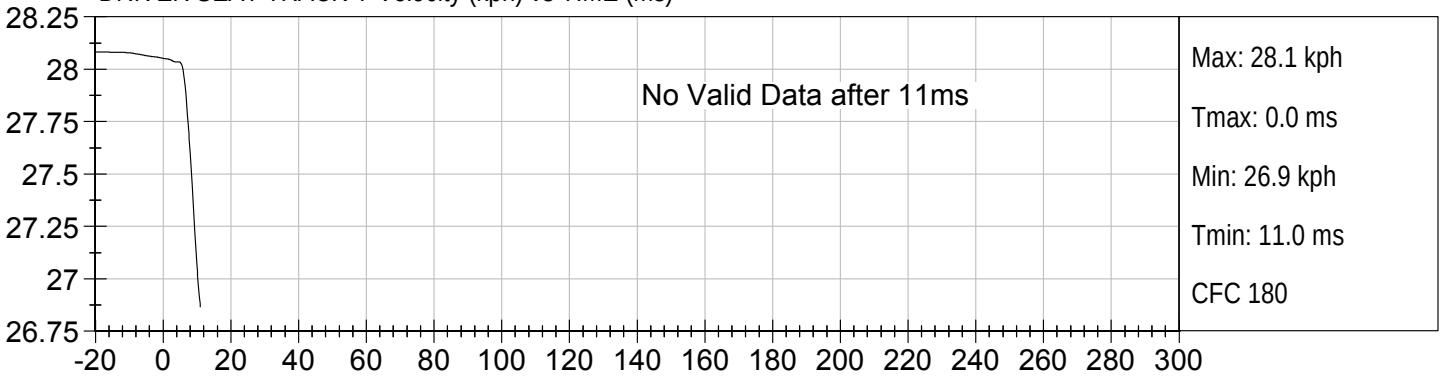

LEFT MID B-POST Y Velocity (kph) vs TIME (ms)




DRIVER SEAT TRACK Y (G's) vs TIME (ms)



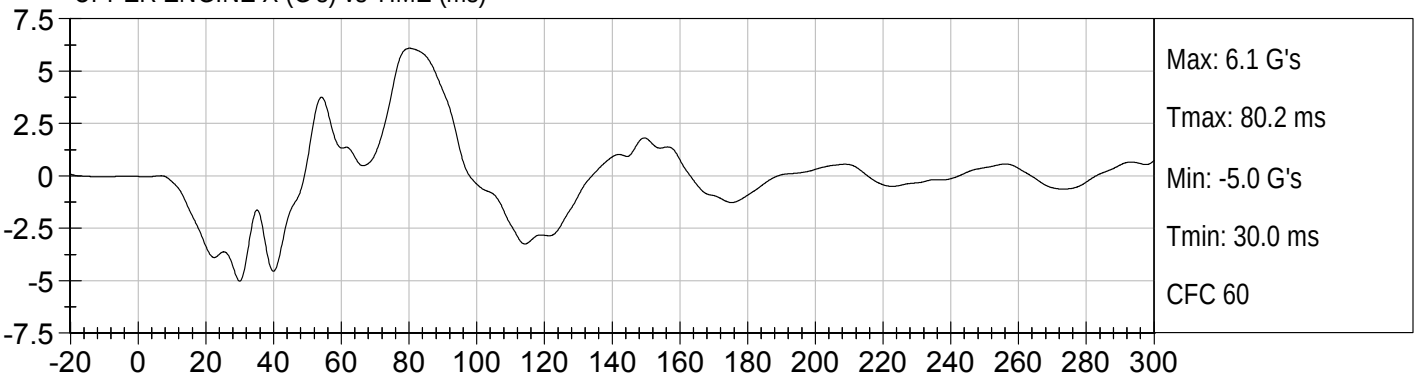

DRIVER SEAT TRACK Y Velocity (kph) vs TIME (ms)



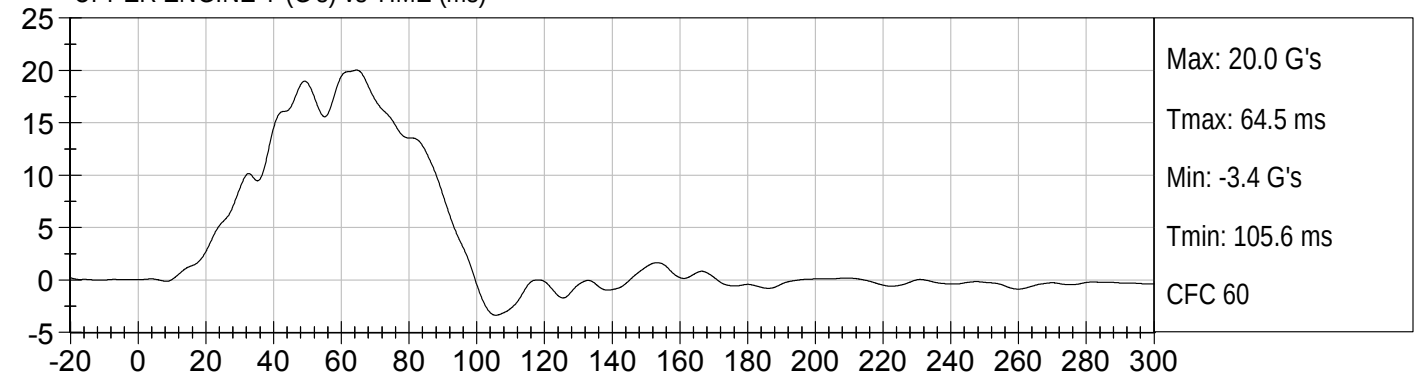
Rigid Pole Side Impact FMVSS 201
2012 Coda All Electric - CC1005

Test Date: 03/07/2013
Speed: 17.5 mph (28.1 km/h)

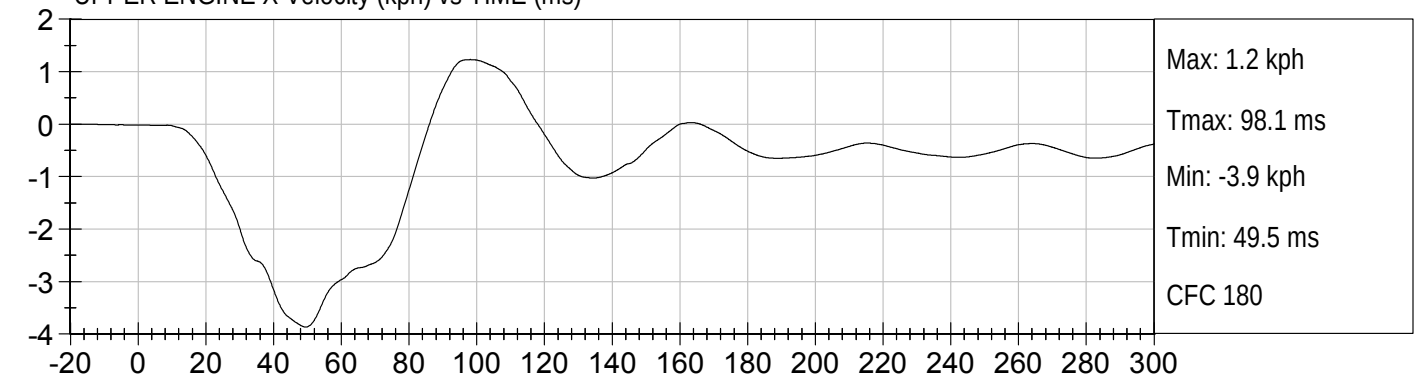
UPPER ENGINE X (G's) vs TIME (ms)



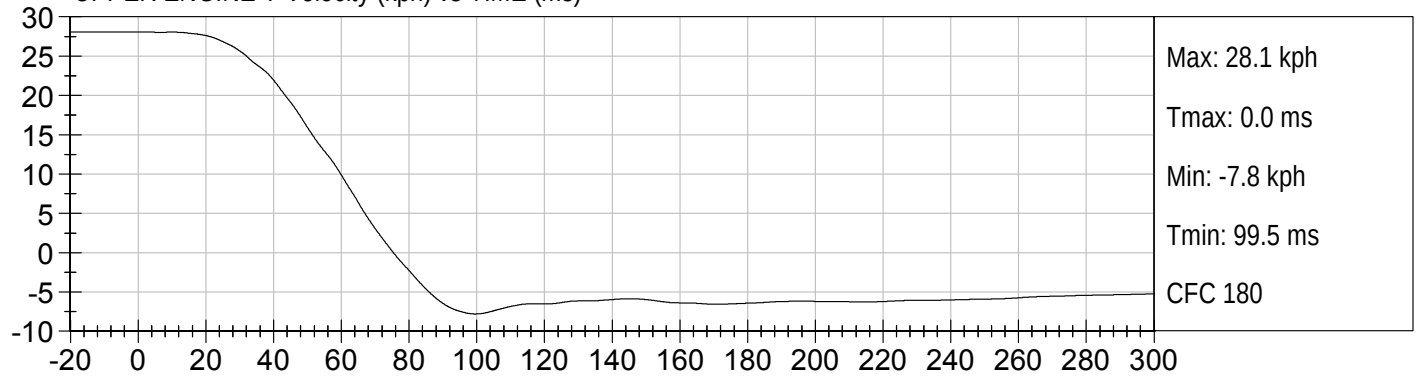

UPPER ENGINE Y (G's) vs TIME (ms)




UPPER ENGINE X Velocity (kph) vs TIME (ms)



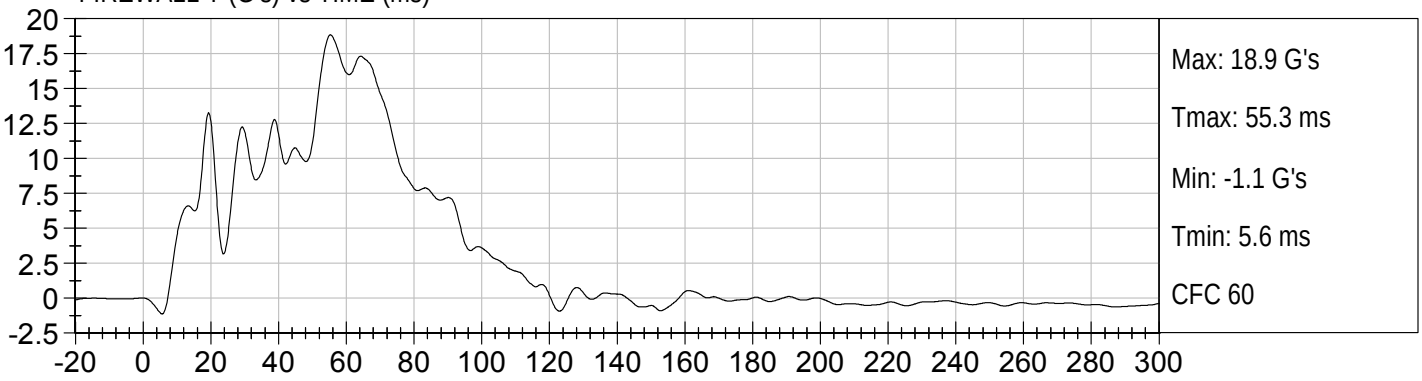

UPPER ENGINE Y Velocity (kph) vs TIME (ms)



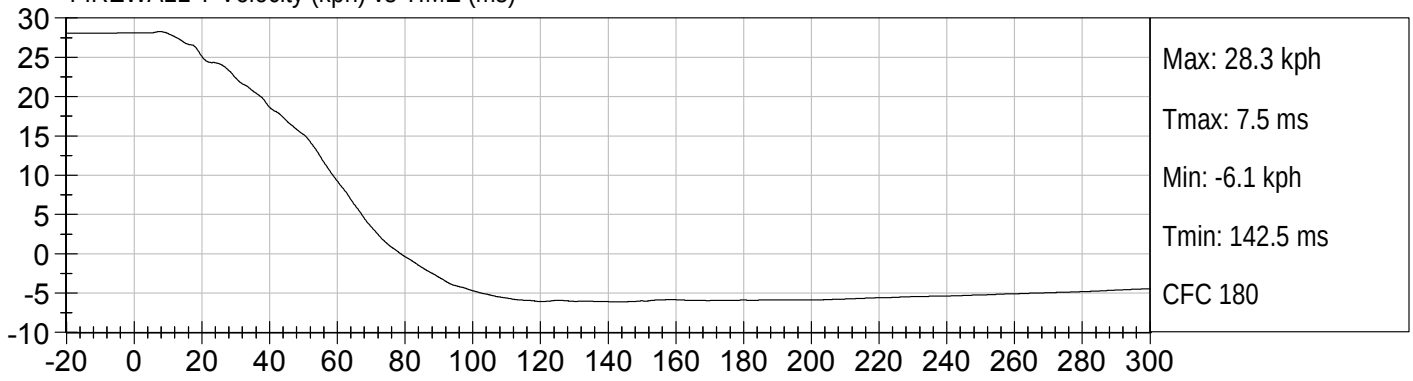
Rigid Pole Side Impact FMVSS 201
2012 Coda All Electric - CC1005

Test Date: 03/07/2013
Speed: 17.5 mph (28.1 km/h)

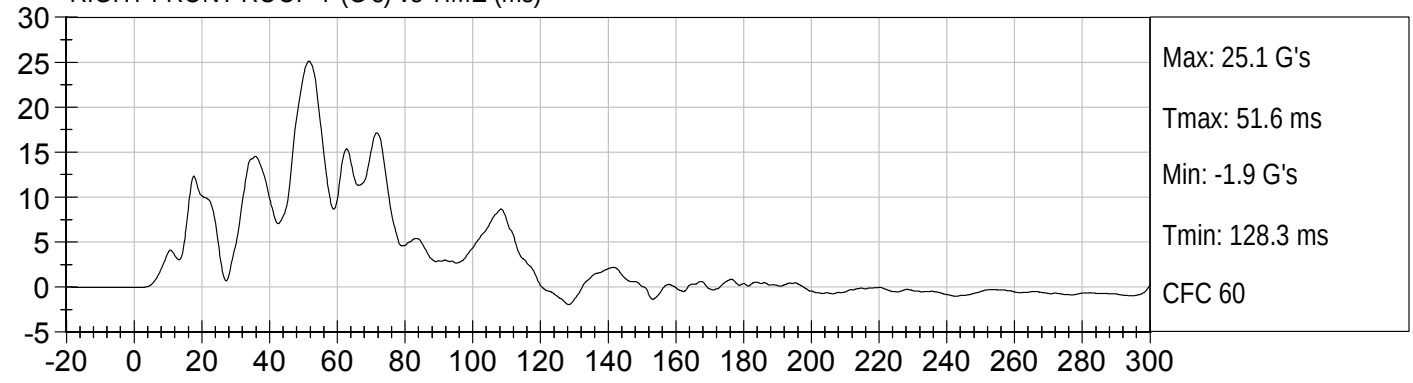
FIREWALL Y (G's) vs TIME (ms)



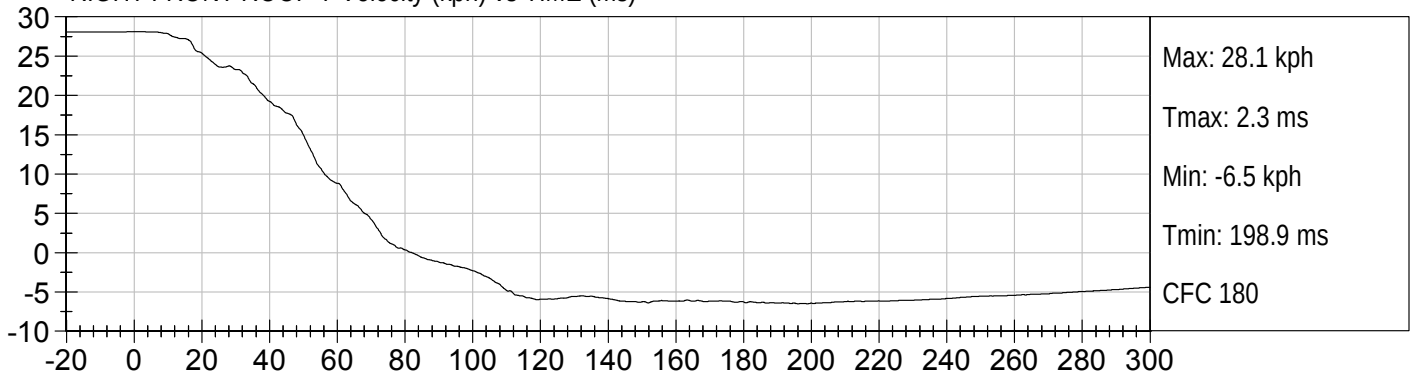

FIREWALL Y Velocity (kph) vs TIME (ms)




RIGHT FRONT ROOF Y (G's) vs TIME (ms)

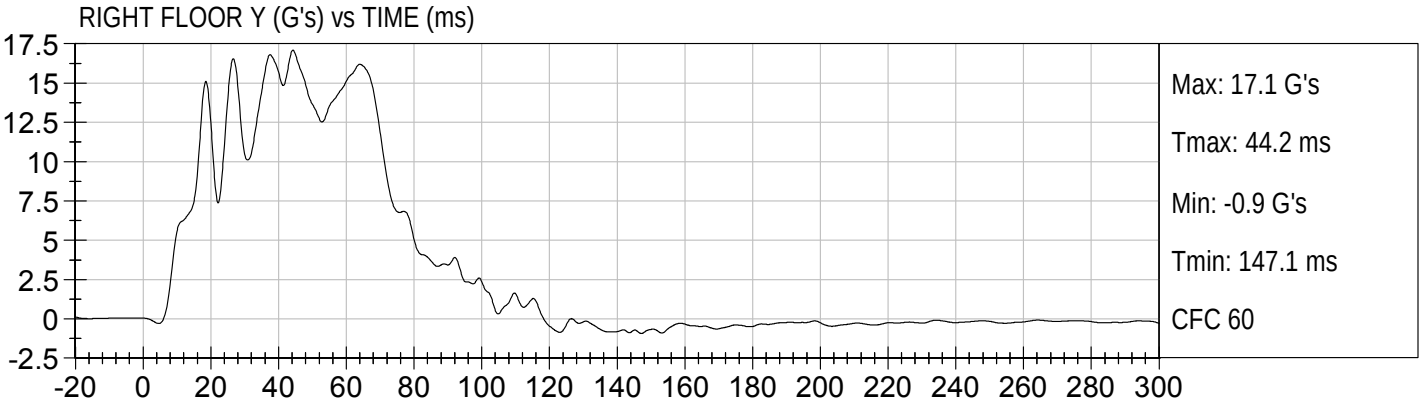


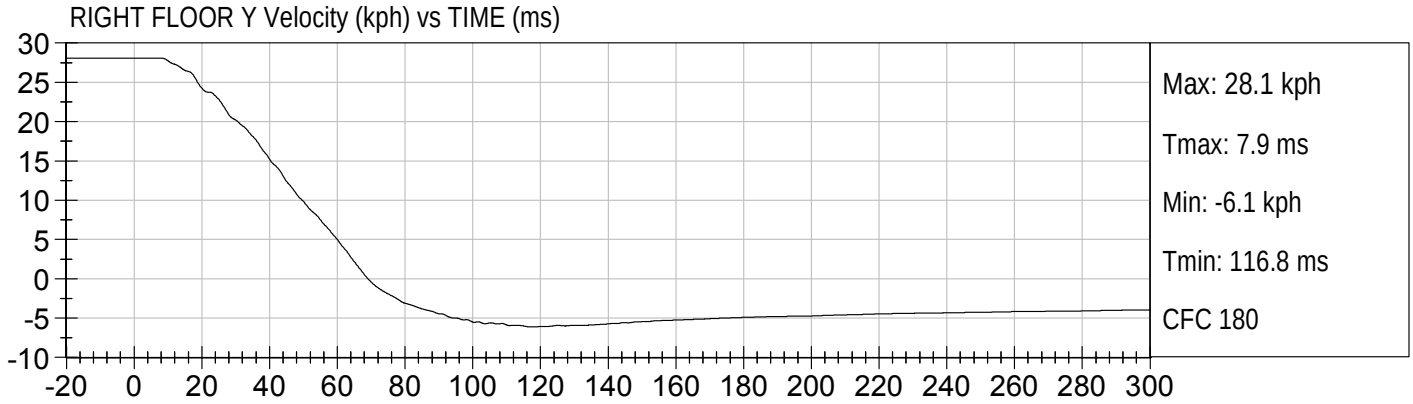

RIGHT FRONT ROOF Y Velocity (kph) vs TIME (ms)



Rigid Pole Side Impact FMVSS 201
2012 Coda All Electric - CC1005

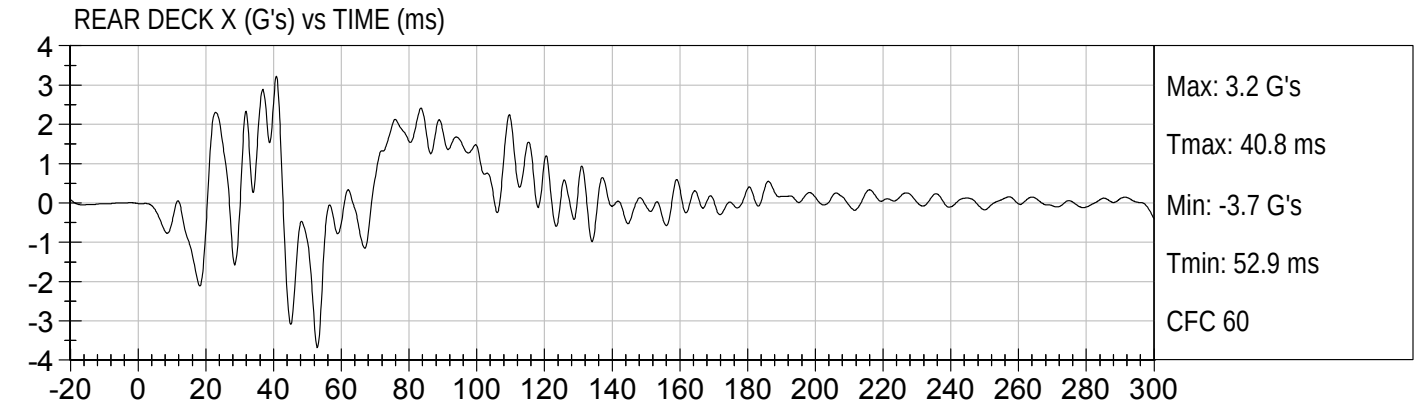
Test Date: 03/07/2013
Speed: 17.5 mph (28.1 km/h)

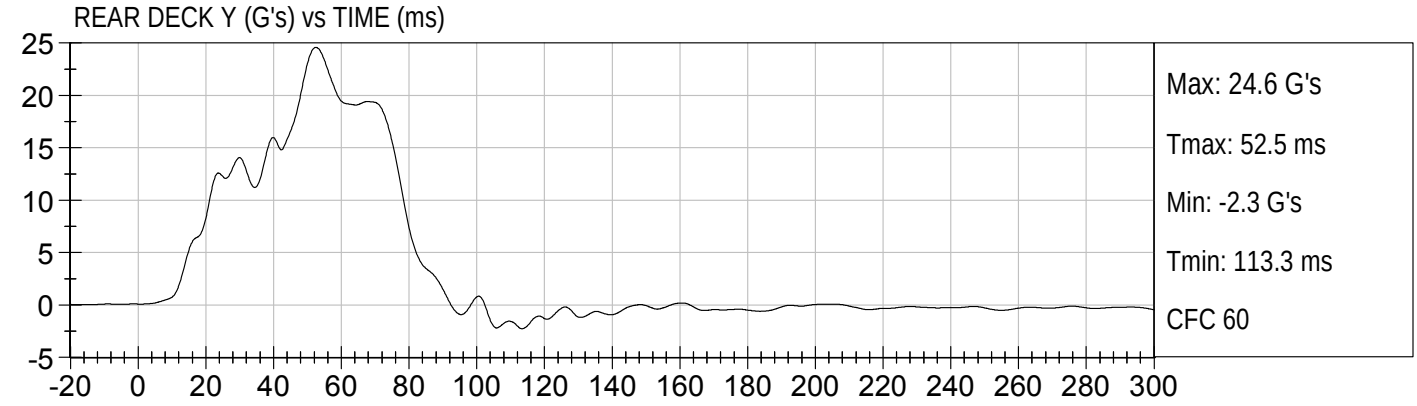


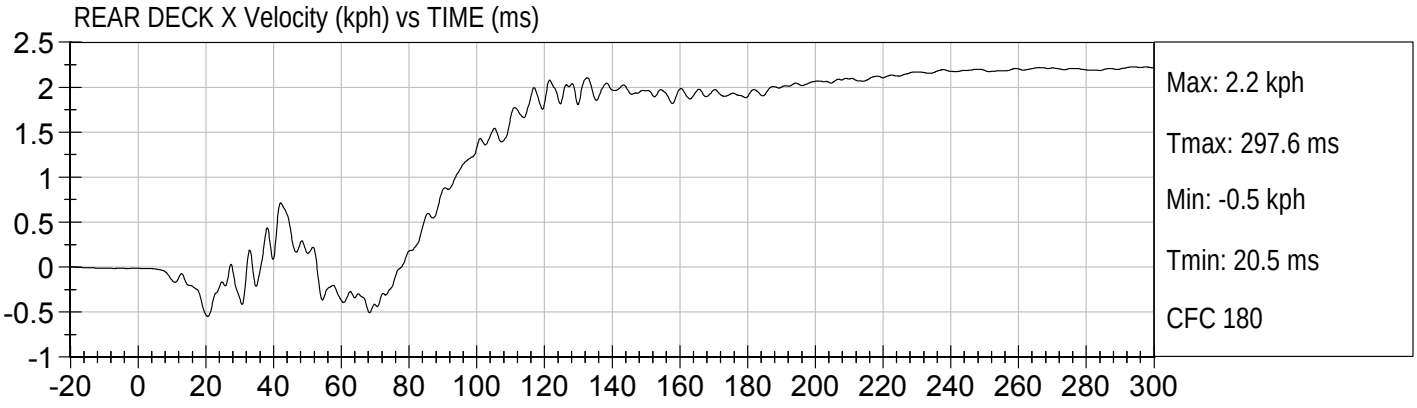



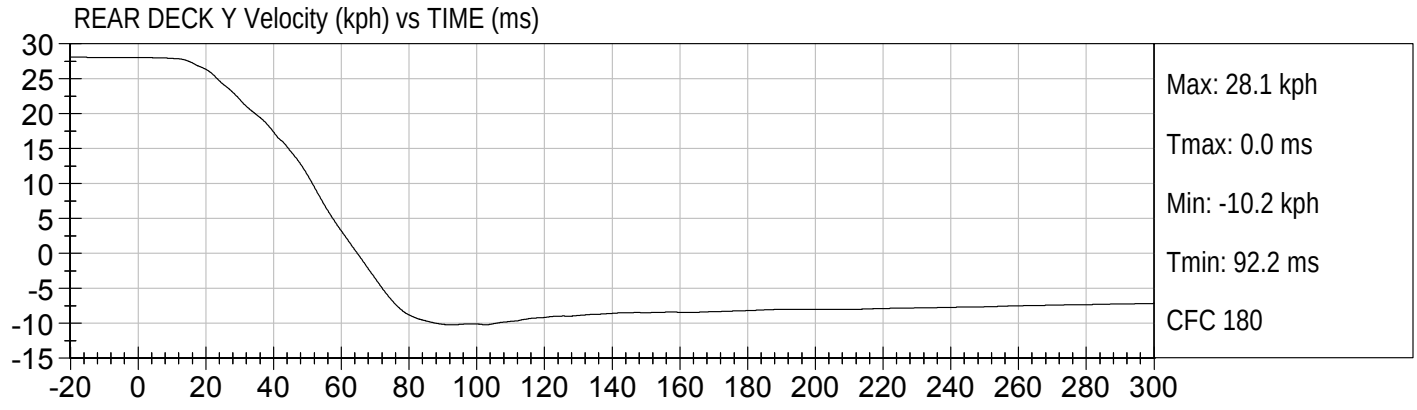
Rigid Pole Side Impact FMVSS 201
2012 Coda All Electric - CC1005

Test Date: 03/07/2013
Speed: 17.5 mph (28.1 km/h)



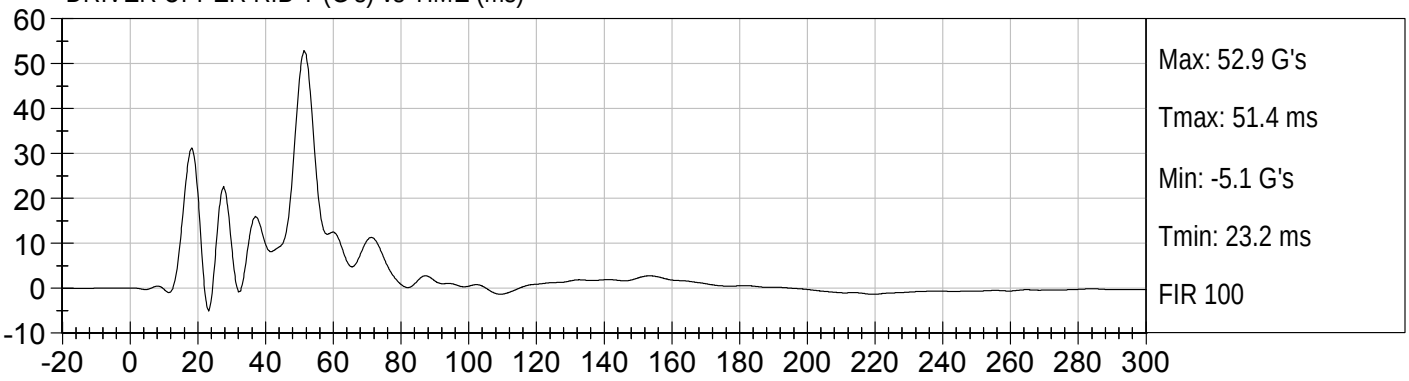



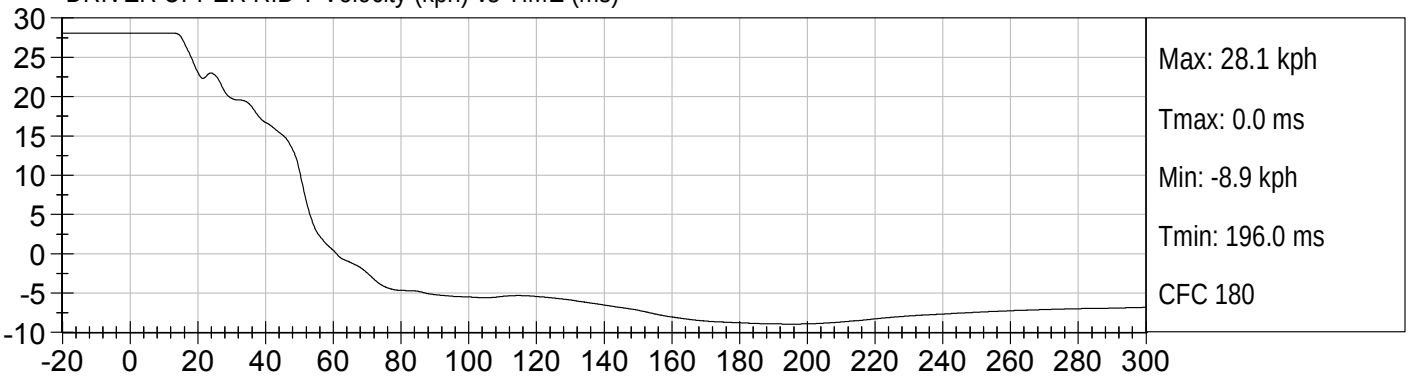
Rigid Pole Side Impact FMVSS 201
2012 Coda All Electric - CC1005

Test Date: 03/07/2013
Speed: 17.5 mph (28.1 km/h)

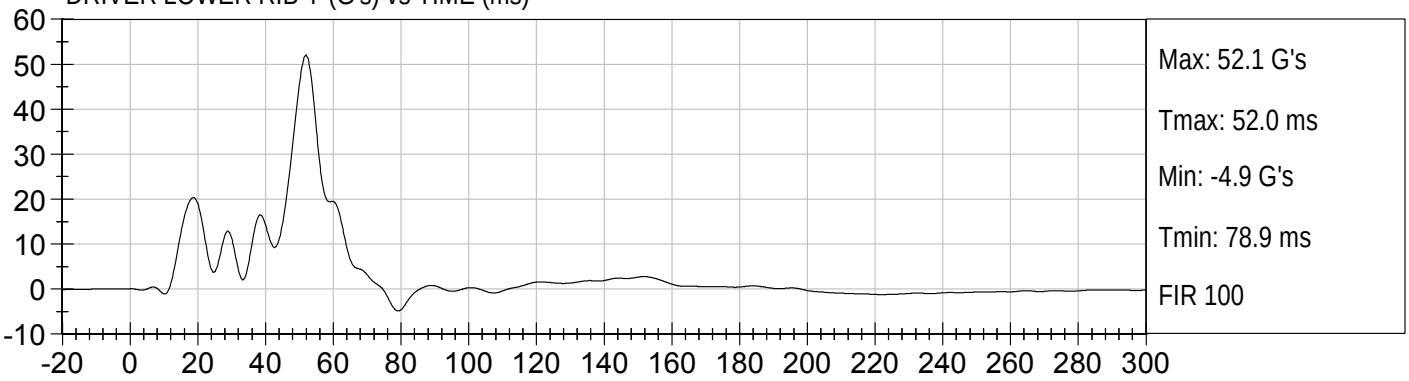
DRIVER UPPER RIB Y (G's) vs TIME (ms)



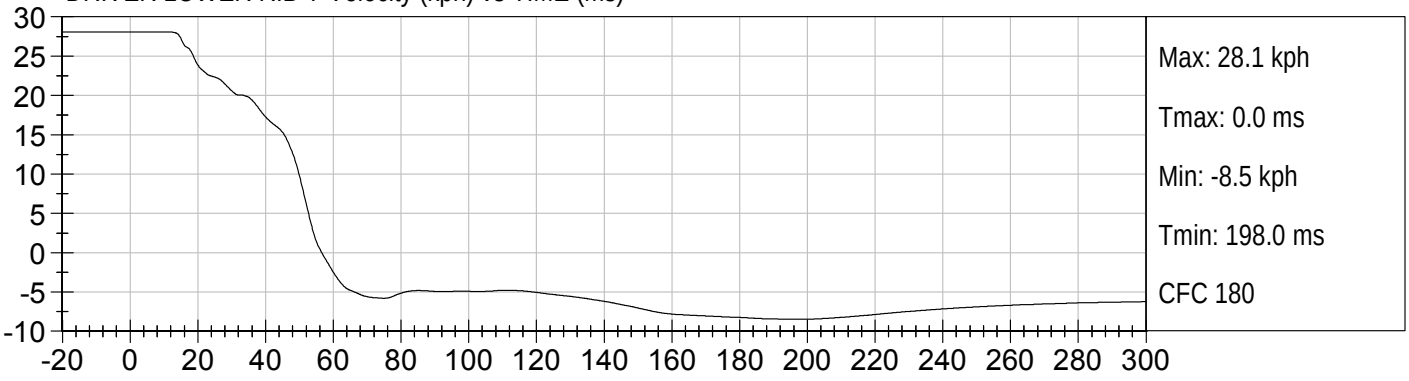

DRIVER UPPER RIB Y Velocity (kph) vs TIME (ms)




DRIVER LOWER RIB Y (G's) vs TIME (ms)



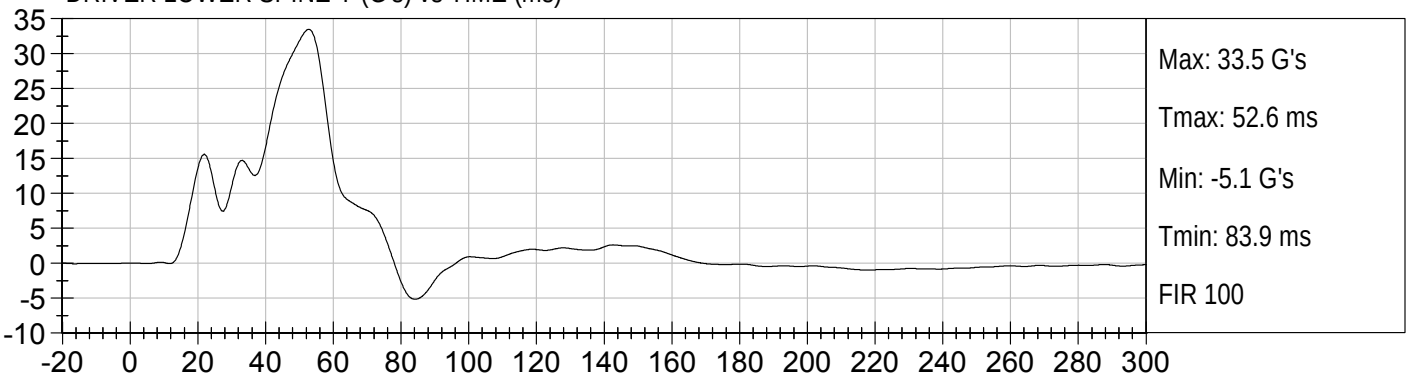

DRIVER LOWER RIB Y Velocity (kph) vs TIME (ms)



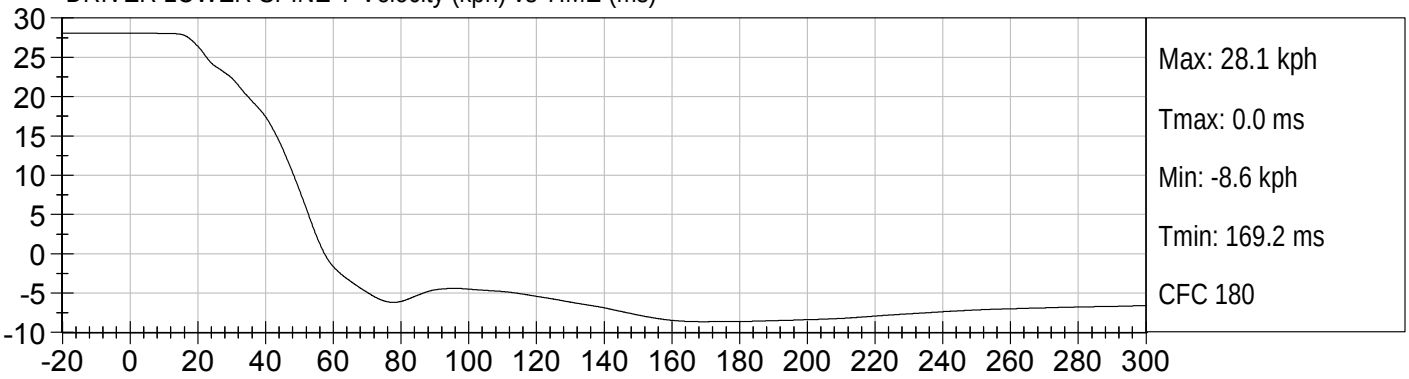
Rigid Pole Side Impact FMVSS 201
2012 Coda All Electric - CC1005

Test Date: 03/07/2013
Speed: 17.5 mph (28.1 km/h)

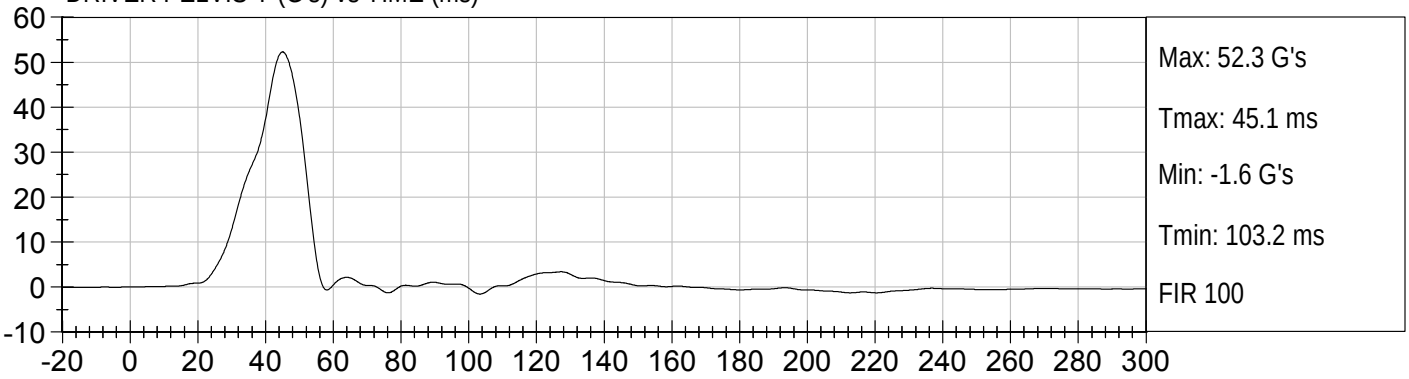
DRIVER LOWER SPINE Y (G's) vs TIME (ms)



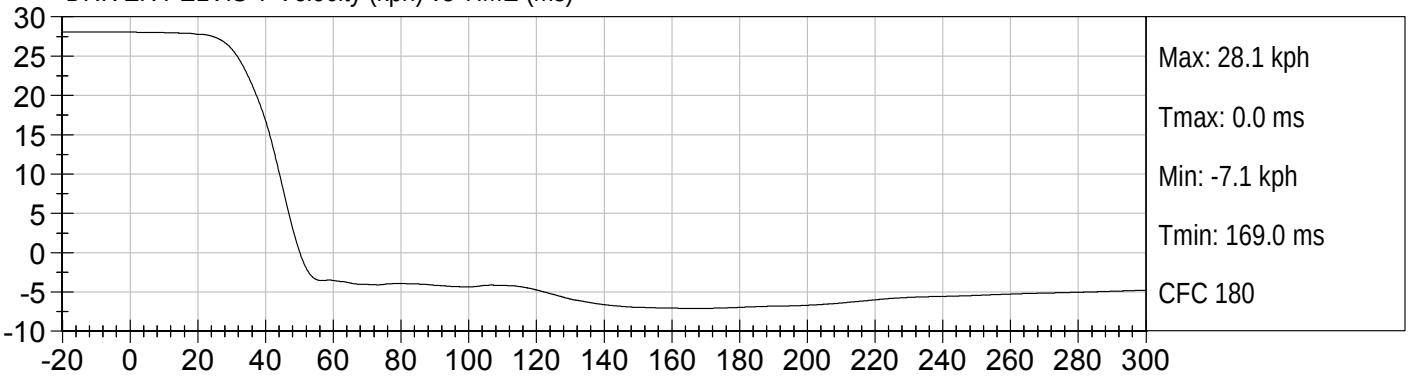

DRIVER LOWER SPINE Y Velocity (kph) vs TIME (ms)




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



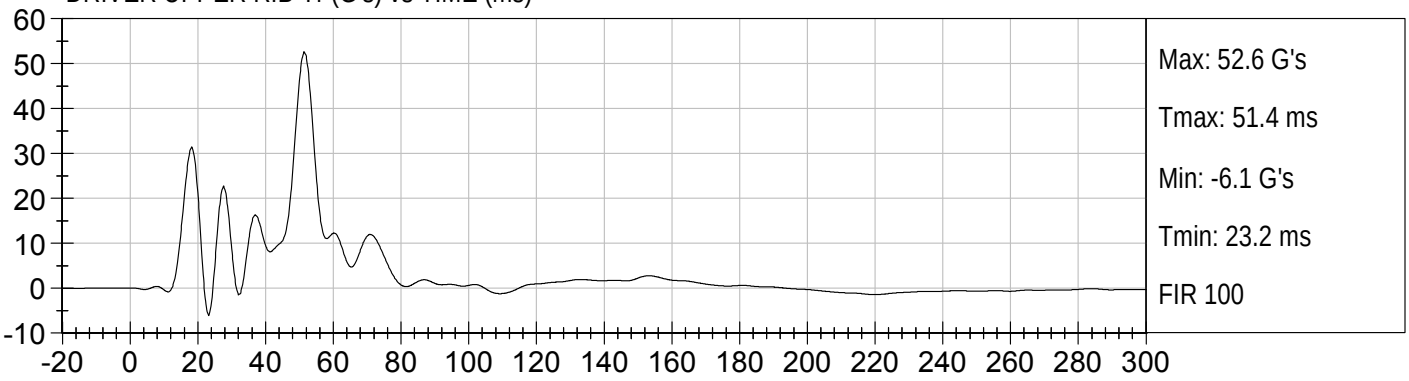

DRIVER PELVIS Y Velocity (kph) vs TIME (ms)



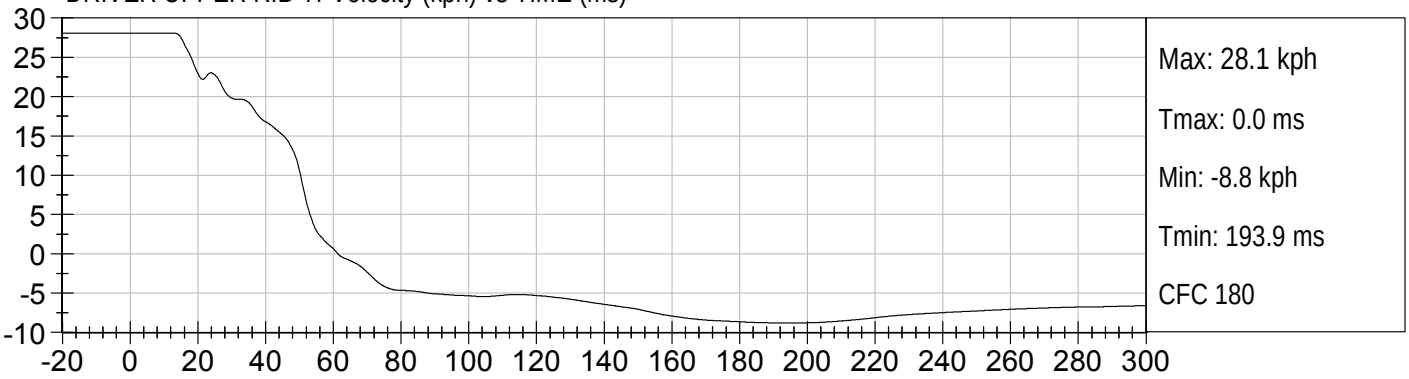
Rigid Pole Side Impact FMVSS 201
2012 Coda All Electric - CC1005

Test Date: 03/07/2013
Speed: 17.5 mph (28.1 km/h)

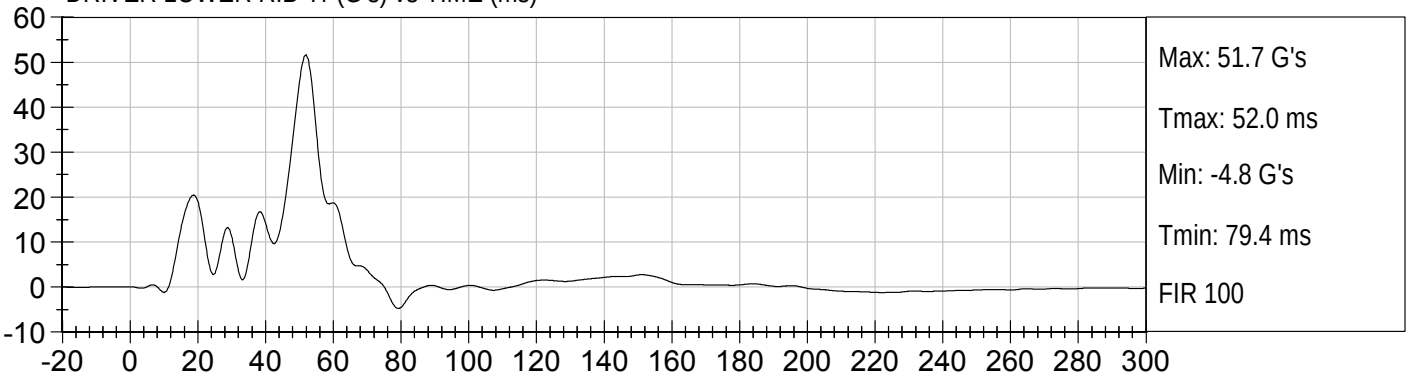
DRIVER UPPER RIB Yr (G's) vs TIME (ms)



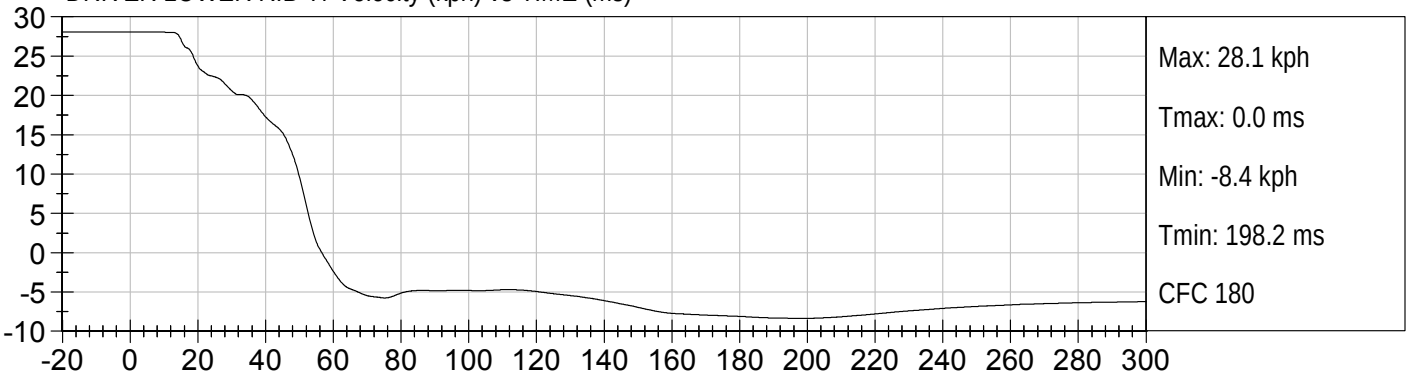

DRIVER UPPER RIB Yr Velocity (kph) vs TIME (ms)




DRIVER LOWER RIB Yr (G's) vs TIME (ms)



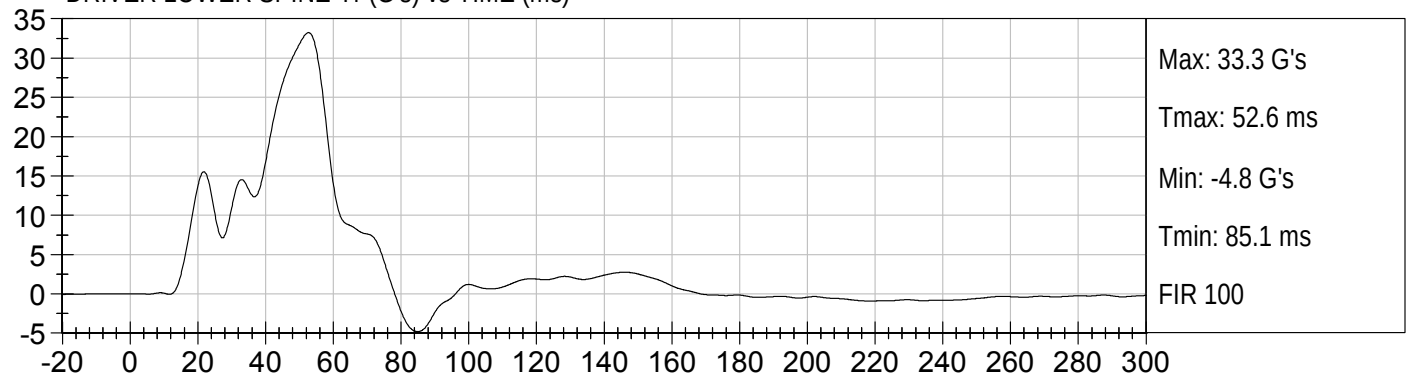

DRIVER LOWER RIB Yr Velocity (kph) vs TIME (ms)



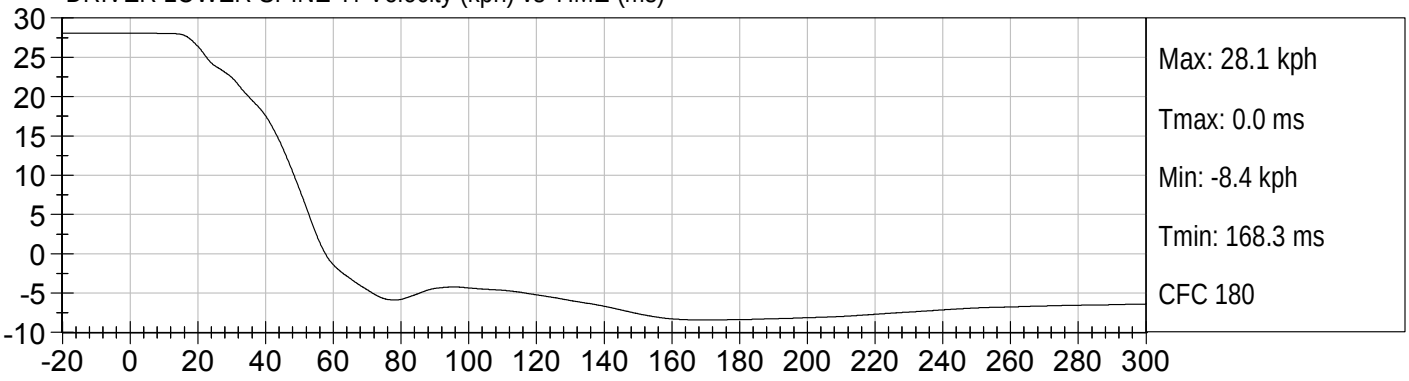
Rigid Pole Side Impact FMVSS 201
2012 Coda All Electric - CC1005

Test Date: 03/07/2013
Speed: 17.5 mph (28.1 km/h)

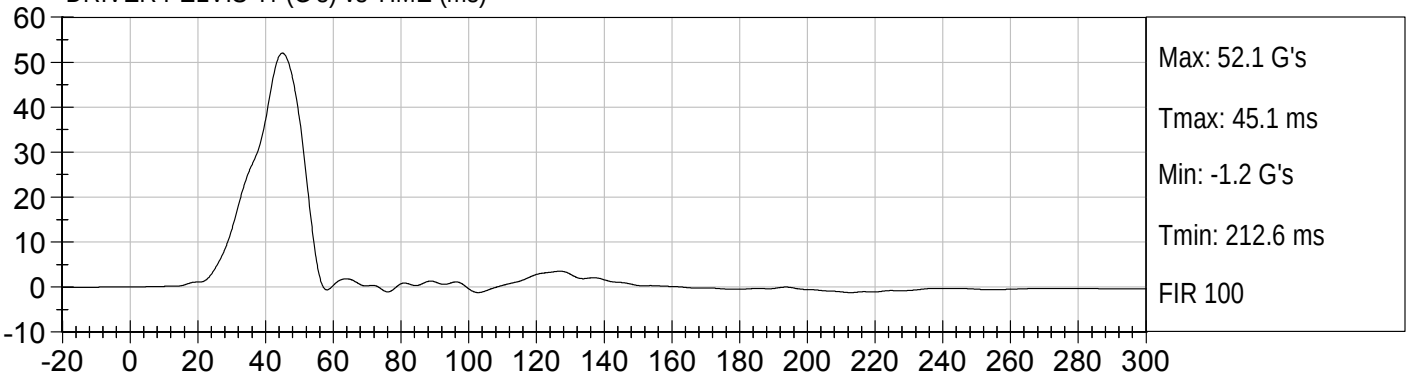
DRIVER LOWER SPINE Yr (G's) vs TIME (ms)



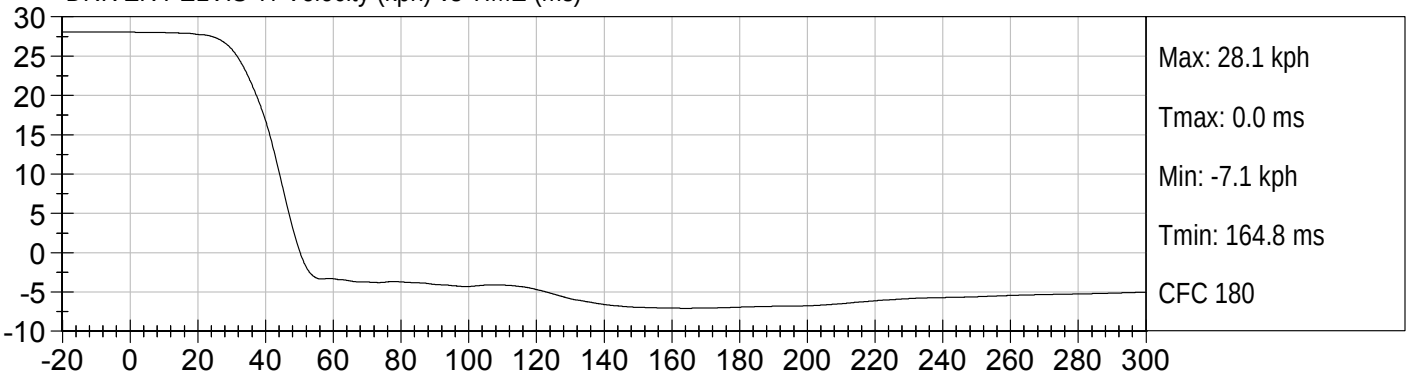

DRIVER LOWER SPINE Yr Velocity (kph) vs TIME (ms)




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




DRIVER PELVIS Yr Velocity (kph) vs TIME (ms)



# APPENDIX C

# SID/HIII CONFIGURATION AND PERFORMANCE VERIFICATION DATA

**MGA RESEARCH CORPORATION**

**EXTERNAL MEASUREMENTS**

**HYBRID III SIDE IMPACT DUMY**

**ATD Serial No:** 052 **Test I.D:** D12448

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| SH - Seated Height | mm | 889 - 909 | 900 | Pass |
| RH - Rib Height | mm | 501 - 521 | 507 | Pass |
| HP - Hip Pivot Height | mm | 99 ref. | 99 | Pass |
| RD - Rib from Back Line | mm | 229 - 241 | 238 | Pass |
| KV - Knee Pivot to Back Line | mm | 511 - 526 | 525 | Pass |
| SW - Knee Pivot to Floor | mm | 490 - 505 | 492 | Pass |
| HW - Hip Width | mm | 356 - 391 | 377 | Pass |
| | | Overall Test Results | | Pass |

Jessica Gall
Laboratory Technician

11/21/2012
Test Date

David Winkelbauer
Approved By

**MGA RESEARCH CORPORATION**

**HEAD DROP TEST**

**HYBRID III SIDE IMPACT DUMMY**

**ATD Serial No:** 052 **Test ID:** D13321

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 - 25.5 | 20.8 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 28 | Pass |
| Peak Resultant Acceleration | G's | 120 to 150 | 137 | Pass |
| Peak Lateral Acceleration | G's | +/- 15.0 | 7.0 | Pass |
| Unimodal | N/A | Yes | Yes | Pass |
| Oscillations | N/A | < 15% of peak | Yes | Pass |
| | | Overall Test Results | | Pass |

Jessica Gall
Laboratory Technician

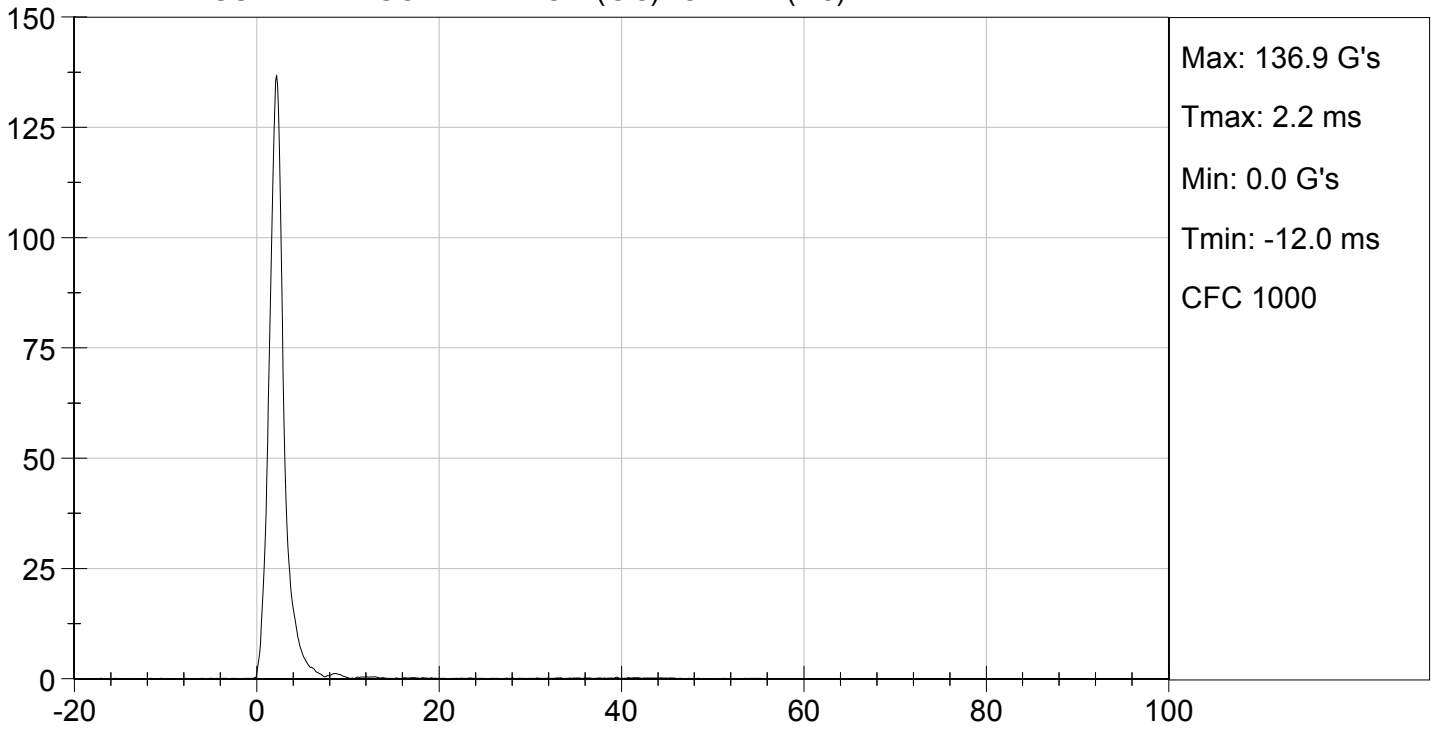
02/07/2013
Test Date

David Winkelbauer
Approved By

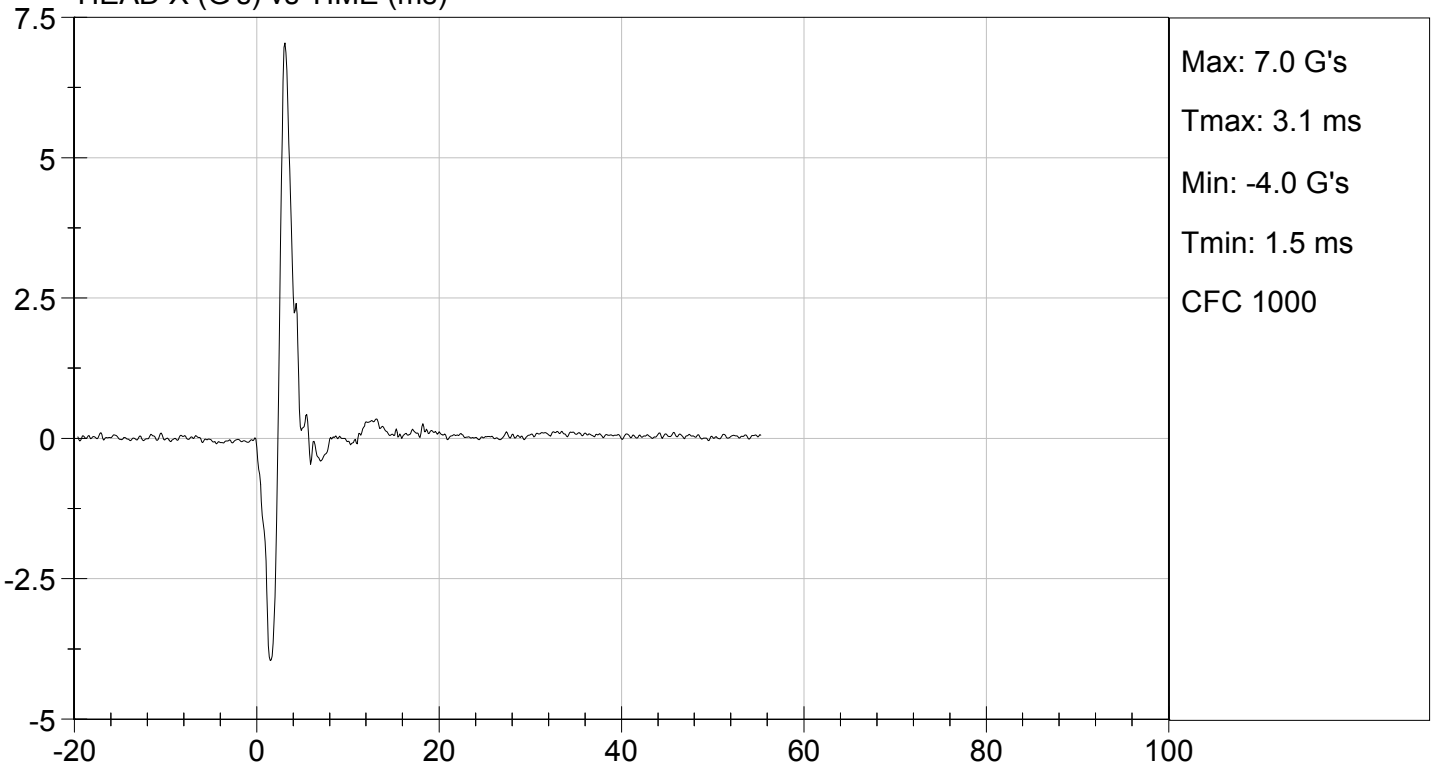
TEST DESC: HEAD DROP

TEST DATE: 02/07/2013
TEST #: D13321

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

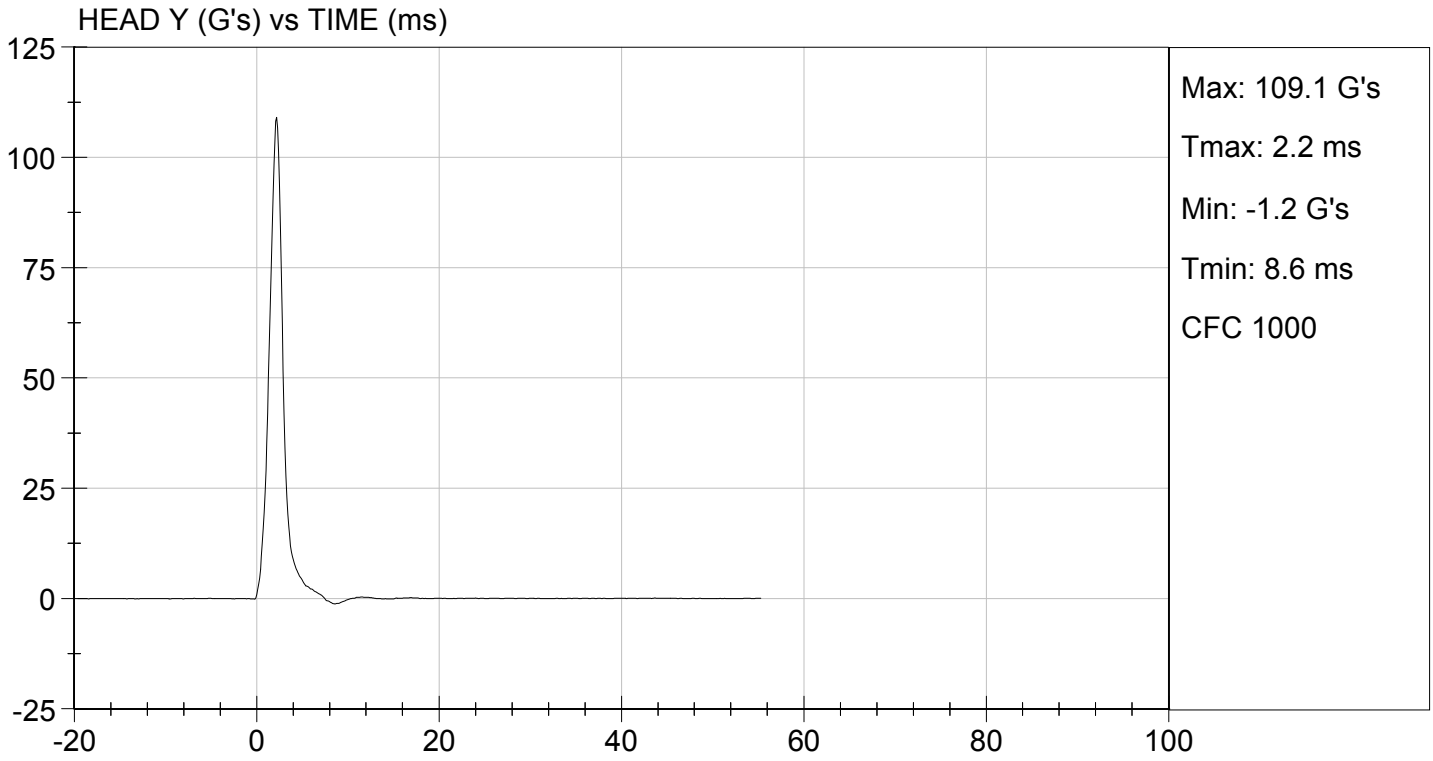


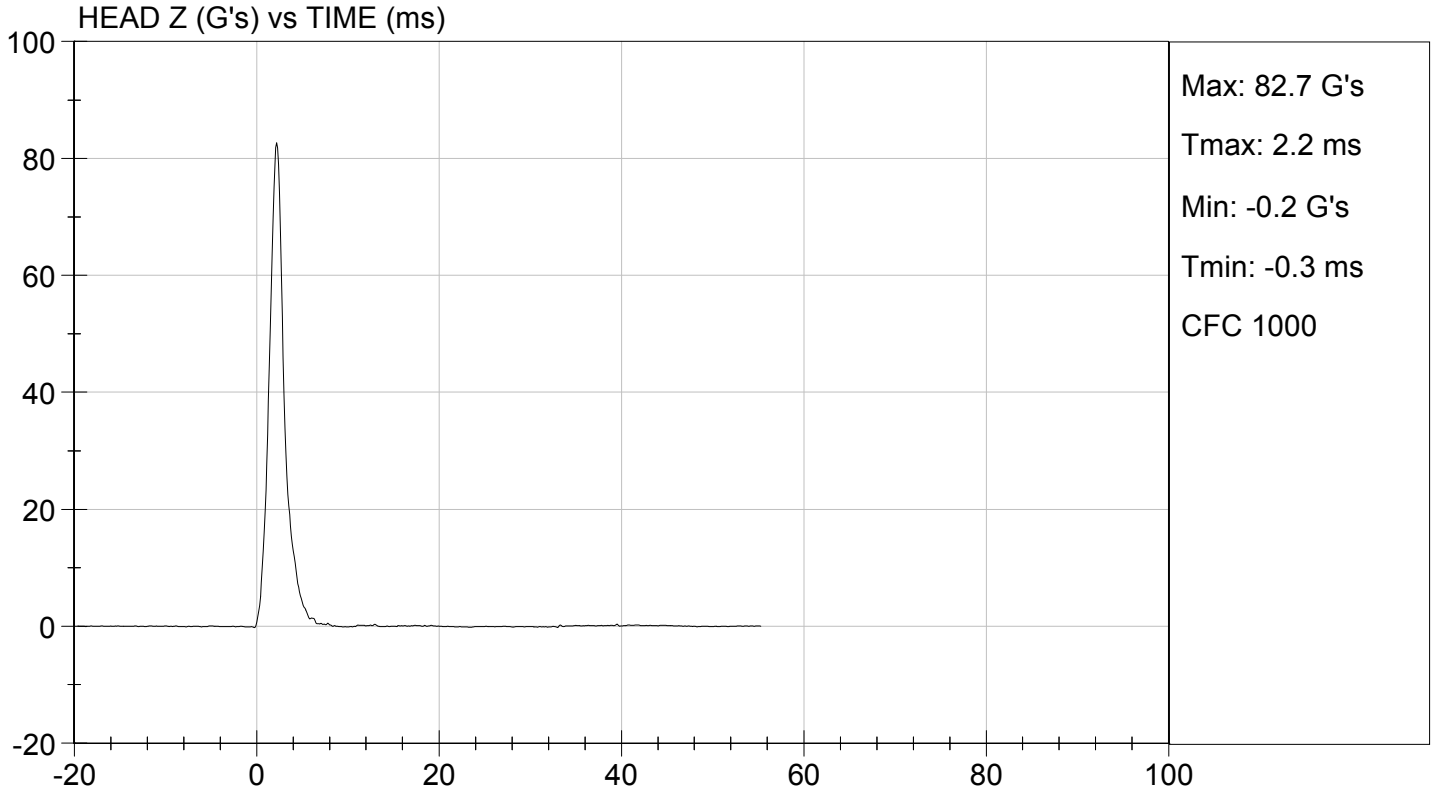

HEAD X (G's) vs TIME (ms)



TEST DESC: HEAD DROP

TEST DATE: 02/07/2013
TEST #: D13321



**MGA RESEARCH CORPORATION**

**THORAX IMPACT TEST**

**HYBRID III SIDE IMPACT DUMMY**

**ATD Serial No:** 052 **Test I.D:** D13322

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 - 25.5 | 21.0 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 27 | Pass |
| Probe Velocity | m/s | 4.27 - 4.33 | 4.30 | Pass |
| Upper Rib | G's | 37 - 46 | 41 | Pass |
| Lower Rib | G's | 37 - 46 | 39 | Pass |
| Lower Spine | G's | 15 - 22 | 20 | Pass |
| | | Overall Test Results | | Pass |

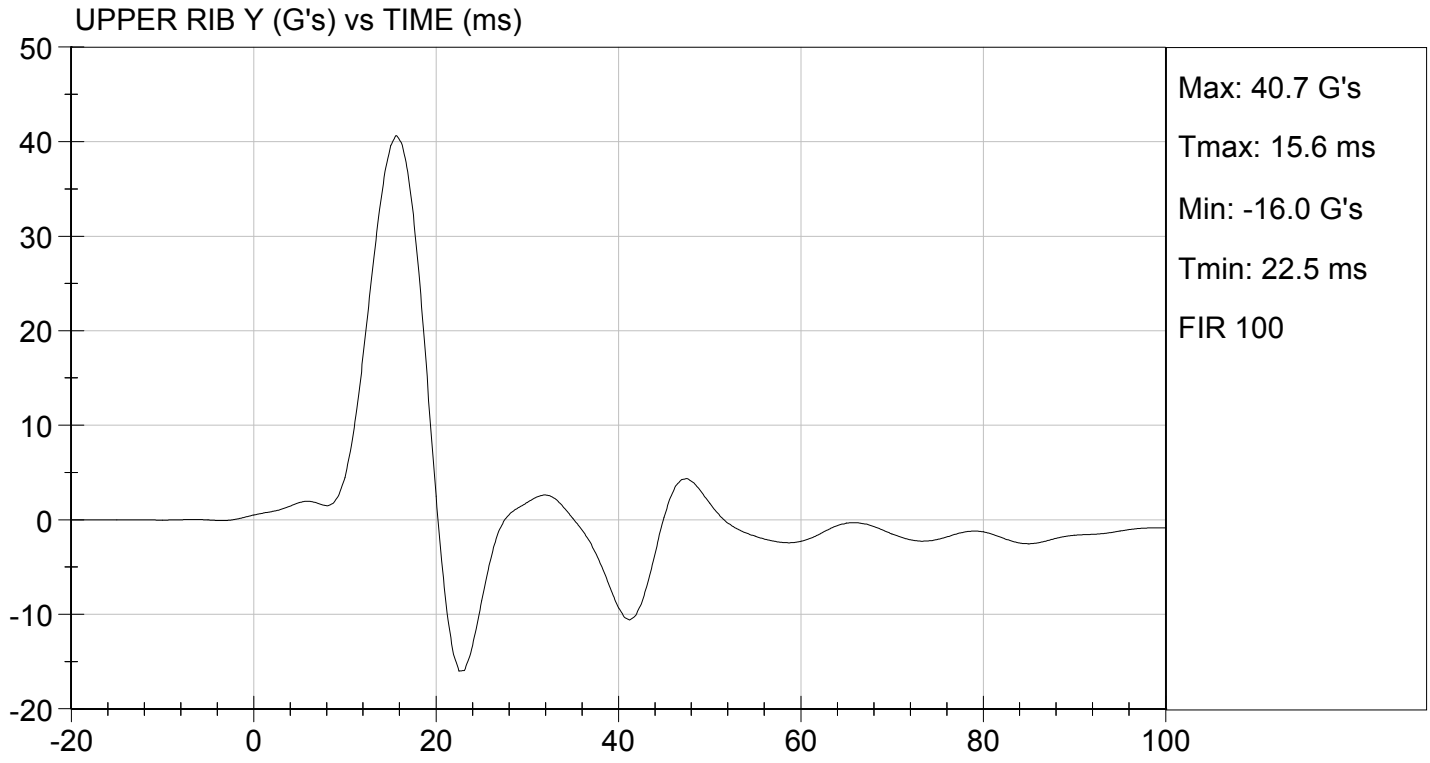
Jessica Gall
Laboratory Technician

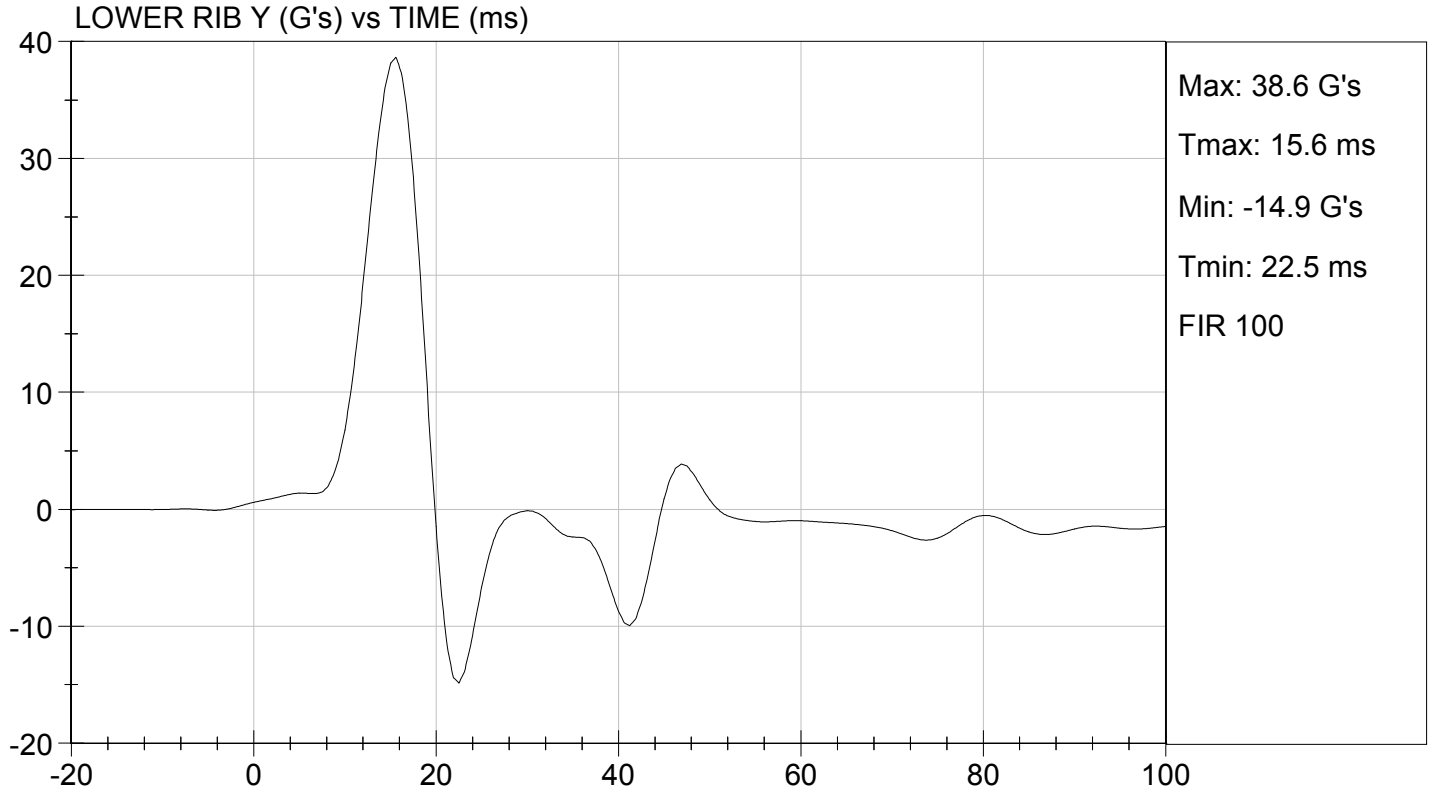
02/07/2013
Test Date

David Winkelbauer
Approved By

TEST DESC: THORAX IMPACT
VELOCITY: 14.12 ft/s, 4.30 m/s

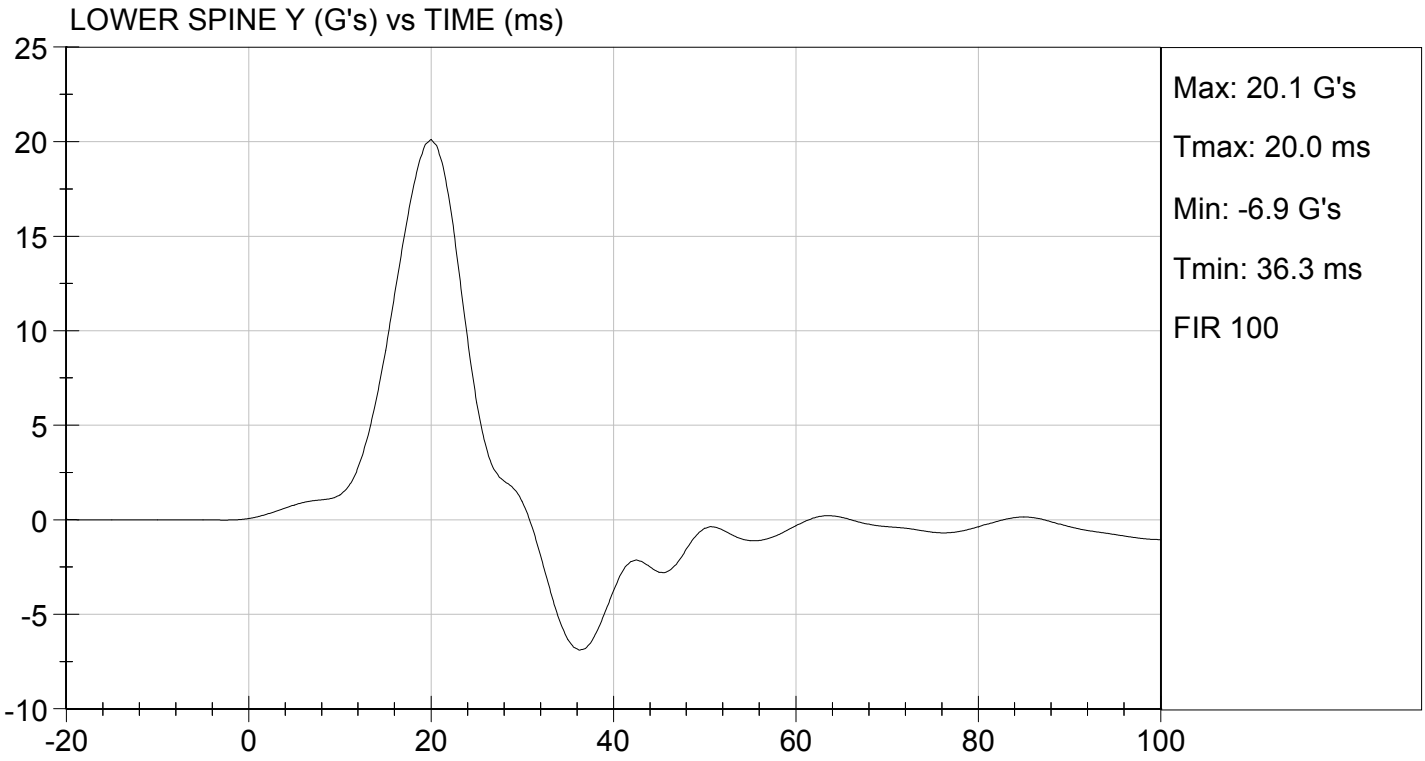
TEST DATE: 02/07/2013
TEST #: D13322



TEST DESC: THORAX IMPACT
VELOCITY: 14.12 ft/s, 4.30 m/s

TEST DATE: 02/07/2013
TEST #: D13322



**MGA RESEARCH CORPORATION**

**PELVIS IMPACT TEST**

**HYBRID III SIDE IMPACT DUMMY**

**ATD Serial No:** 052 **Test I.D:** D13323

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 to 25.5 | 21.0 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 27 | Pass |
| Probe Velocity | m/s | 4.27 - 4.33 | 4.30 | Pass |
| Pelvis Y Acceleration | G's | 40 - 60 | 41 | Pass |
| | | Overall Test Results | | Pass |

Jessica Gall

Laboratory Technician

02/07/2013

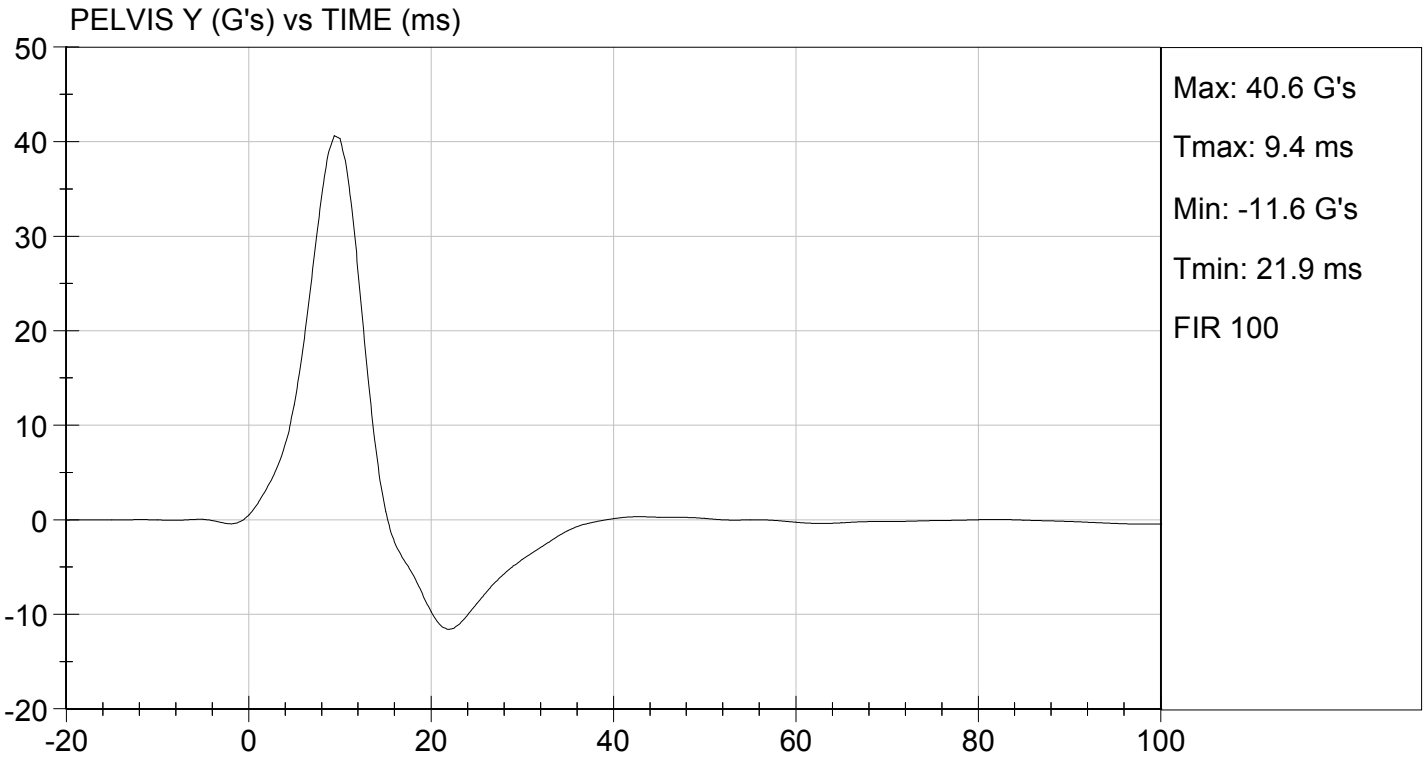
Test Date

David Winkelbauer

Approved By

TEST DESC: PELVIS IMPACT
VELOCITY: 14.12 ft/s, 4.30 m/s

TEST DATE: 02/07/2013
TEST #: D13323



**MGA RESEARCH CORPORATION**

**ABDOMEN COMPRESSION TEST**

**HYBRID III SIDE IMPACT DUMMY**

**ATD Serial No:** 052 **Test I.D:** D13324

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 to 25.5 | 20.9 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 27 | Pass |
| Force At 12.7 mm | N | 104 to 162 | 130 | Pass |
| Force At 19 mm | N | 163 to 221 | 185 | Pass |
| Force At 25.4 mm | N | 222 to 280 | 254 | Pass |
| Force At 33 mm | N | 325 to 391 | 360 | Pass |
| | | Overall Test Results | | Pass |

Jessica Gall
Laboratory Technician

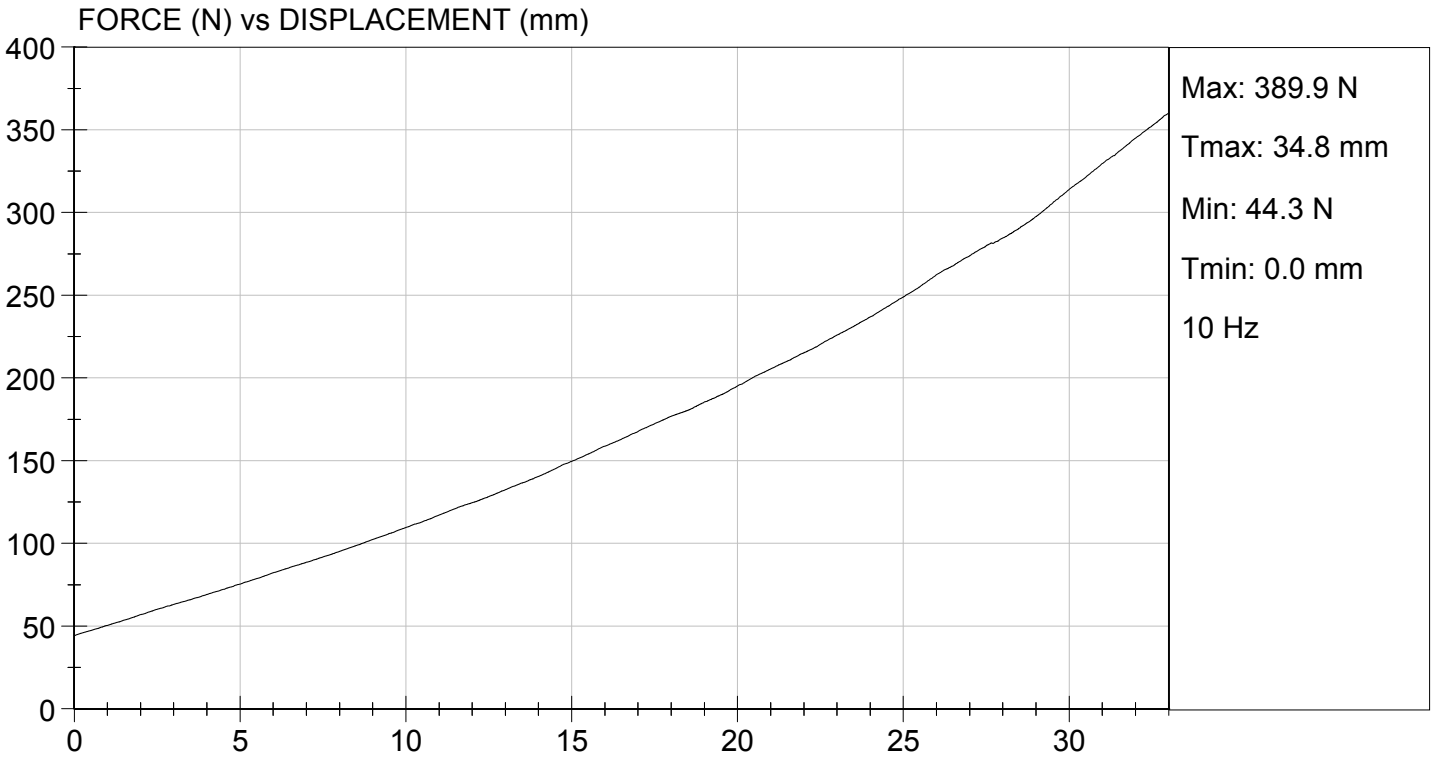
02/07/2013
Test Date

David Winkelbauer
Approved By

TEST DESC: ABDOMEN COMPRESSION

TEST DATE: 02/07/2013

TEST #: D13324



**MGA RESEARCH CORPORATION**

**LUMBAR FLEXION TEST**

**HYBRID III SIDE IMPACT DUMMY**

**ATD Serial No:** 052 **Test I.D:** D13325

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 to 25.5 | 20.9 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 27 | Pass |
| Force At 0 deg | N | 0 to 26.7 | 21.8 | Pass |
| Force At 20 deg | N | 97.8 to 151.2 | 107.3 | Pass |
| Force At 30 deg | N | 151.2 to 204.6 | 153.8 | Pass |
| Force At 40 deg | N | 204.6 to 258.0 | 216.6 | Pass |
| Return Angle | Deg | 12 Maximum | 6 | Pass |
| | | Overall Test Results | | Pass |

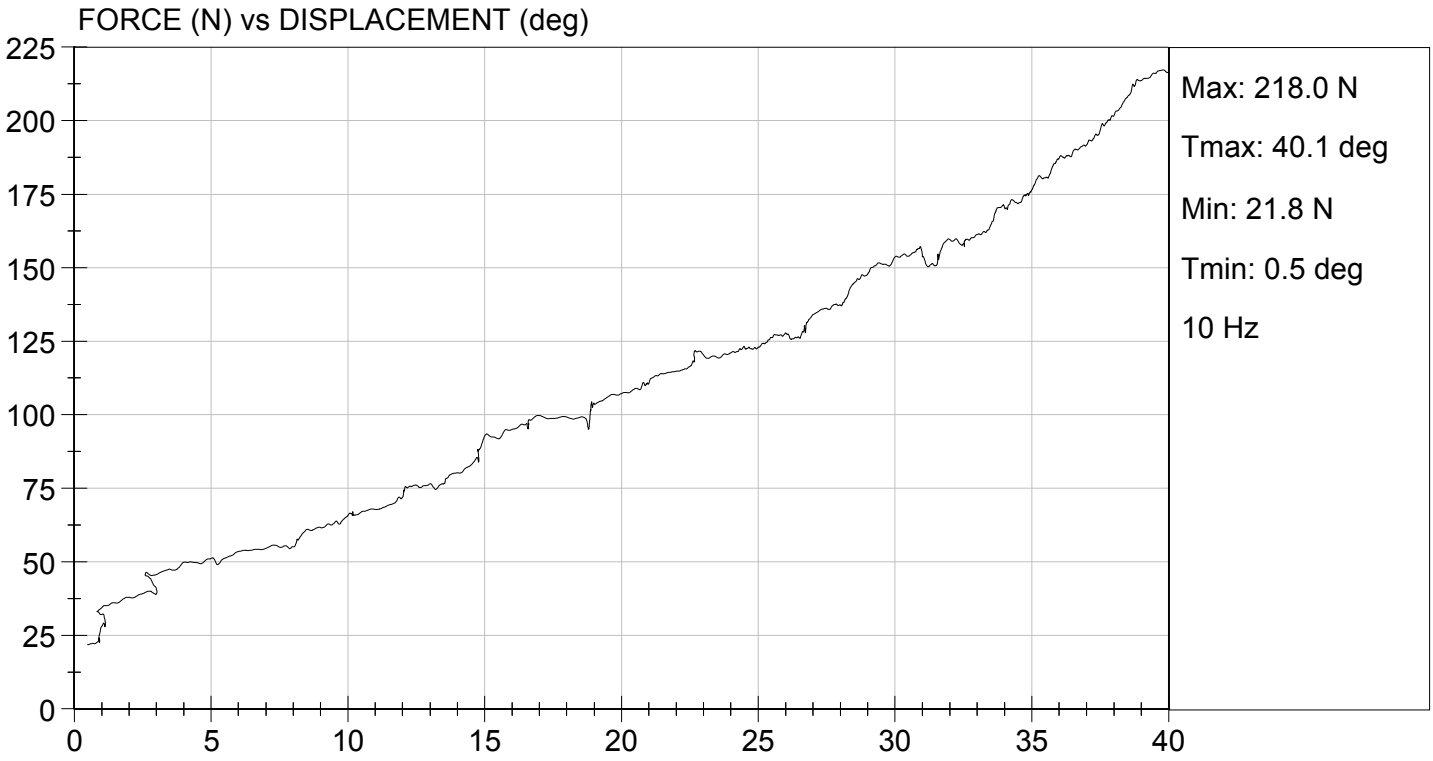
Jessica Gall
Laboratory Technician

02/07/2013
Test Date

David Winkelbauer
Approved By

TEST DESC: LUMBAR FLEXION

TEST DATE: 02/07/2013
TEST #: D13325



**MGA RESEARCH CORPORATION**

**NECK BENDING TEST**

**HYBRID III SIDE IMPACT DUMMY**

**ATD Serial No:** 052 **Test I.D:** D13329

| Tested Parameter | | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|---|
| Laboratory Temperature | | deg C | 20.6 to 22.2 | 20.8 | Pass |
| Laboratory Relative Humidity | | % | 10 to 70 | 28 | Pass |
| Pendulum Velocity | | m/s | 6.89 to 7.13 | 7.06 | Pass |
| Pendulum Velocity | 10 ms | m/s | 1.96 to 2.55 | 2.51 | Pass |
| | 20 ms | m/s | 4.12 to 5.10 | 4.93 | Pass |
| | 30 ms | m/s | 5.73 to 7.01 | 6.7 | Pass |
| | 40 to 70 ms | m/s | 6.27 to 7.64 | 6.71 | Pass |
| Midsaggital Plane Max Rotation | | deg | 66 to 82 | 70 | Pass |
| Head Rotation Peak to Zero Decay Time | | ms | 58 to 67 | 62 | Pass |
| Maximum Mx at Occipital Condyles | | Nm | 73 to 88 | 80 | Pass |
| Mx Peak to Zero Decay Time | | ms | 49 to 64 | 50 | Pass |
| Mx Peak to Maximum Head Rotation | | ms | 2 to 16 | 4.20 | Pass |
| | | | Overall Test Results | | Pass |

Jessica Hall
Laboratory Technician

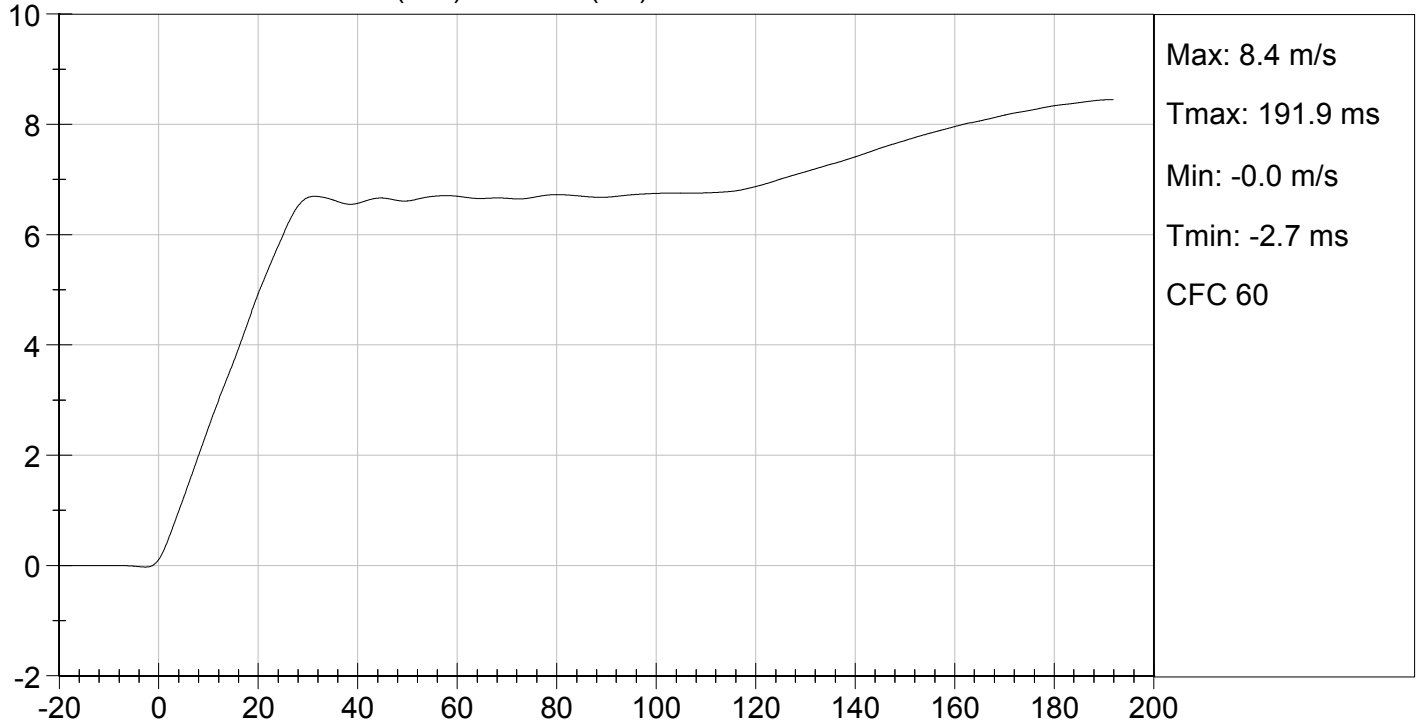
02/07/2013
Test Date

David Winkelbauer
Approved By

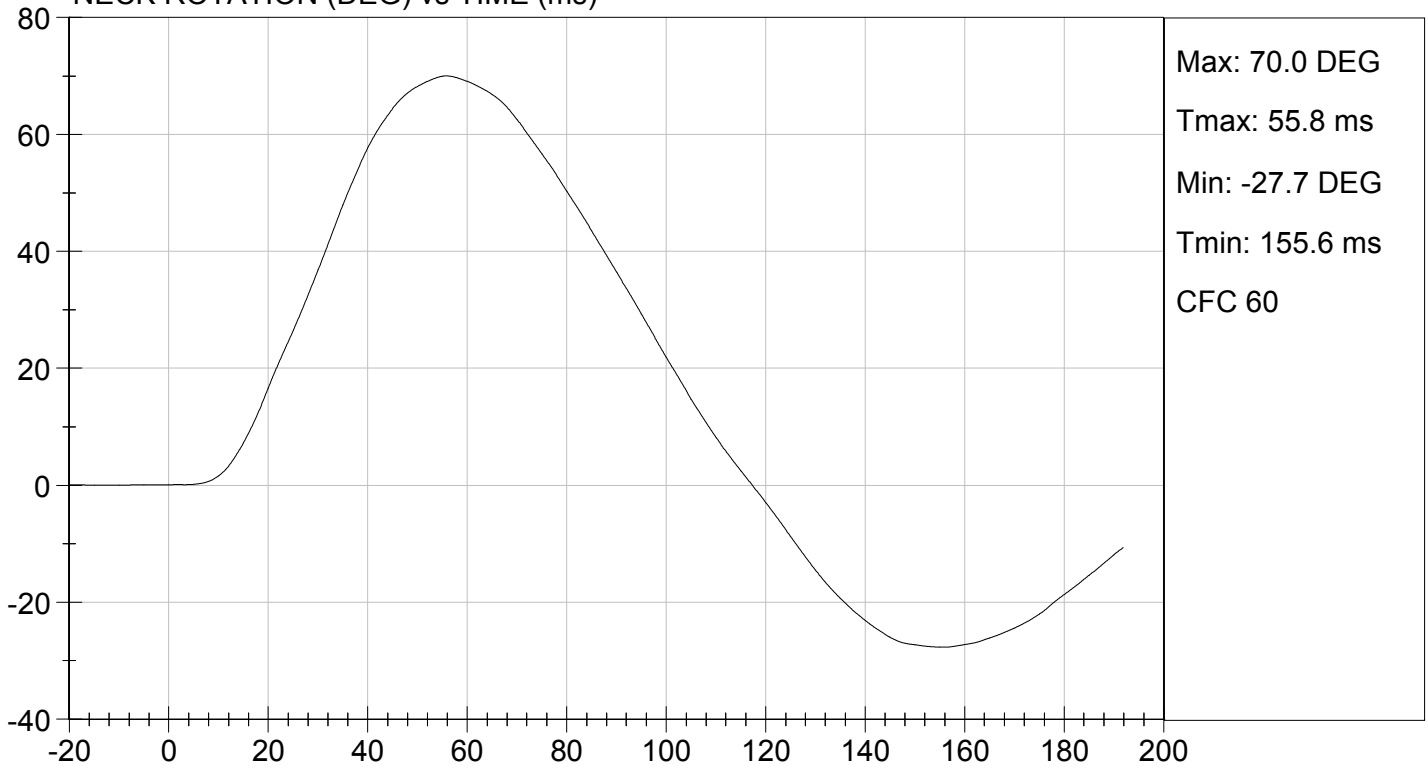
TEST DESC: NECK BENDING
VELOCITY: 23.15 ft/s, 7.06 m/s

TEST DATE: 02/07/2013
TEST #: D13329

PENDULUM VELOCITY (m/s) vs TIME (ms)

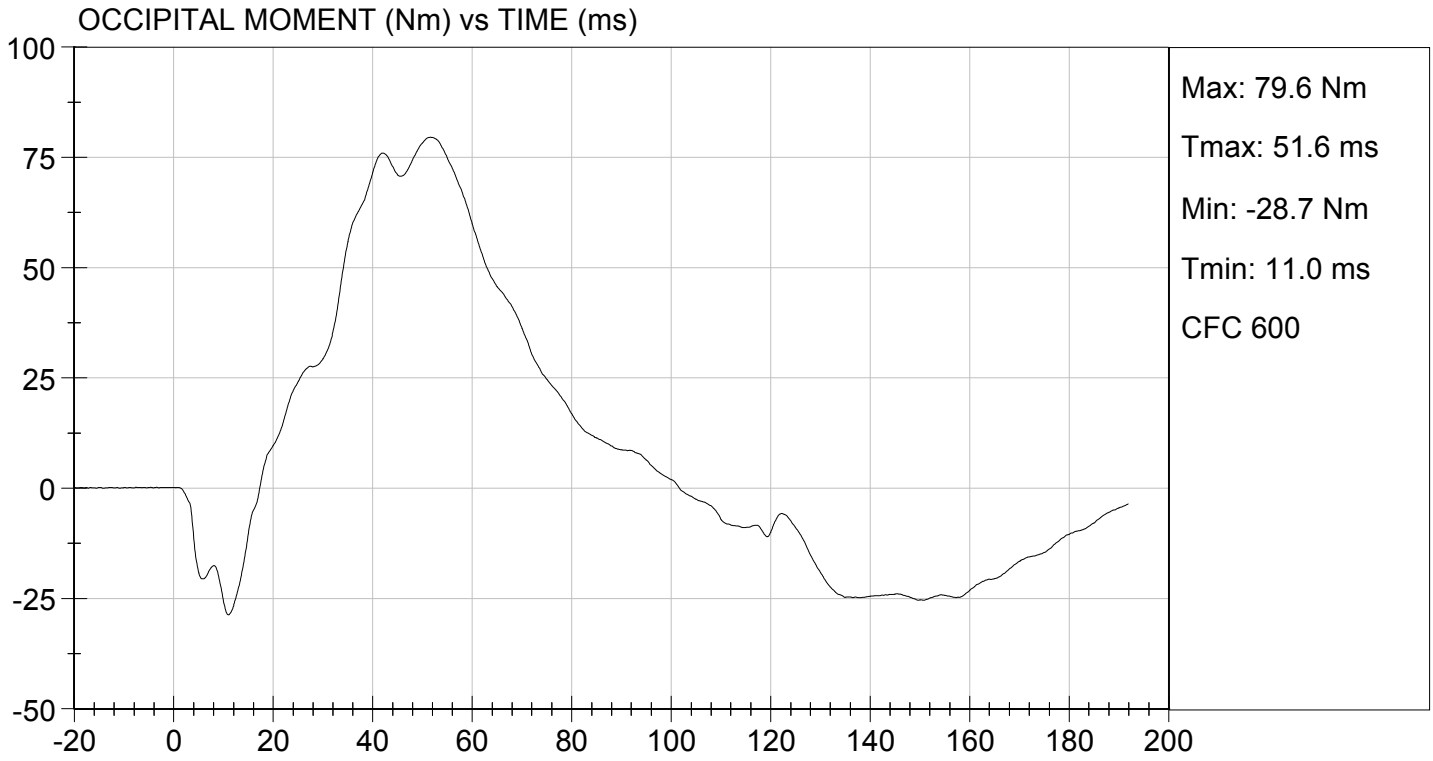



NECK ROTATION (DEG) vs TIME (ms)



TEST DESC: NECK BENDING
VELOCITY: 23.15 ft/s, 7.06 m/s

TEST DATE: 02/07/2013
TEST #: D13329



**SID Calibration Data Sheet**

**Side Impact Dummy**

**Thoracic Shock Absorber Calibration**

**ATD Serial No:** 052 **Test I.D:** D124788

| Tested Parameter | | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|---|
| Laboratory Temperature | | deg C | 18.9 to 25.5 | 21.9 | Pass |
| Laboratory Relative Humidity | | % | 10 to 70 | 27 | Pass |
| Velocity 3.05 m/s | Force | N | 836 - 1125 | 864 | Pass |
| | Displacement | mm | 30 - 35 | 34 | Pass |
| Velocity 4.27 m/s | Force | N | 1730 - 2099 | 1,816 | Pass |
| | Displacement | mm | 32 - 37 | 37 | Pass |
| Velocity 6.1 m/s | Force | N | 3741 - 4448 | 3,829 | Pass |
| | Displacement | mm | 33 - 40 | 39 | Pass |
| | | | Overall Test Results | | Pass |

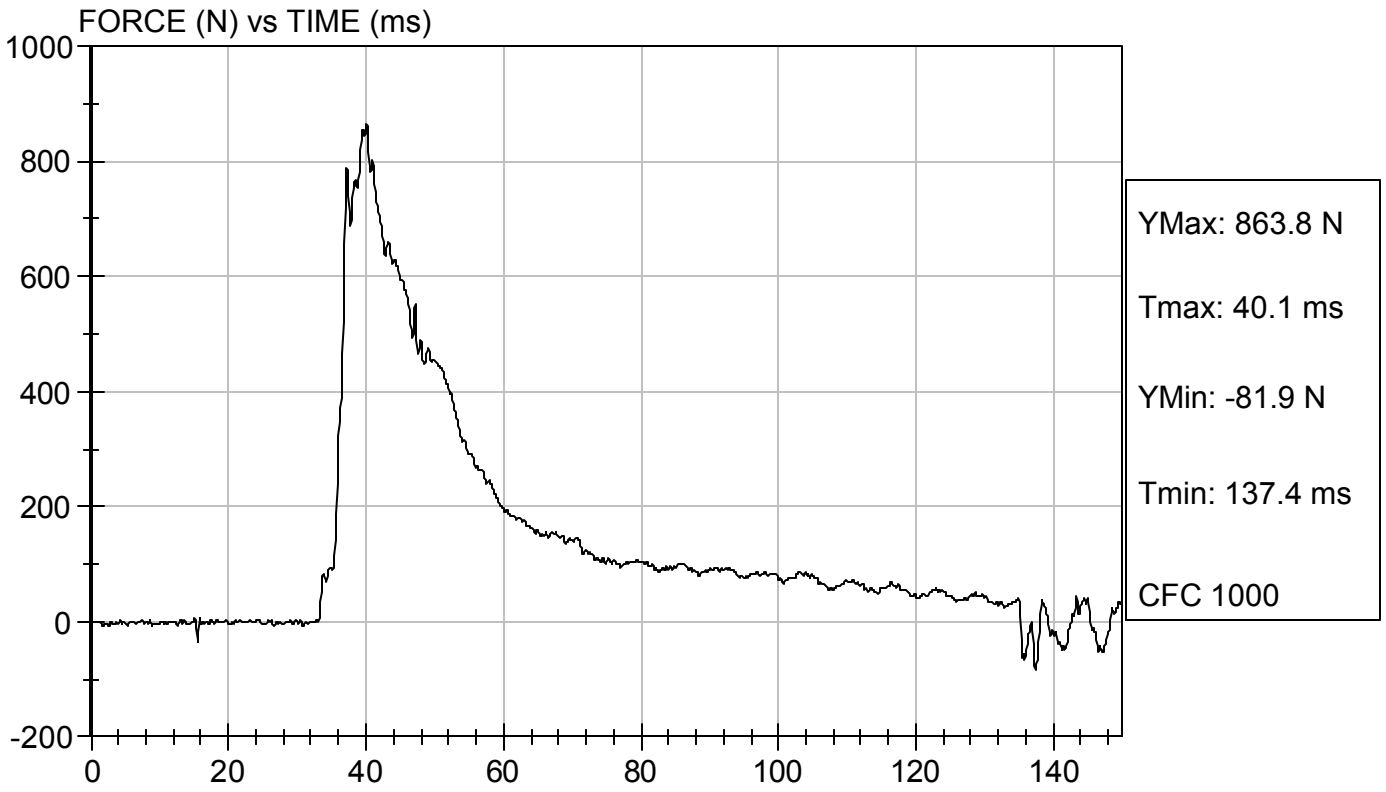
Jessica Gall
Laboratory Technician

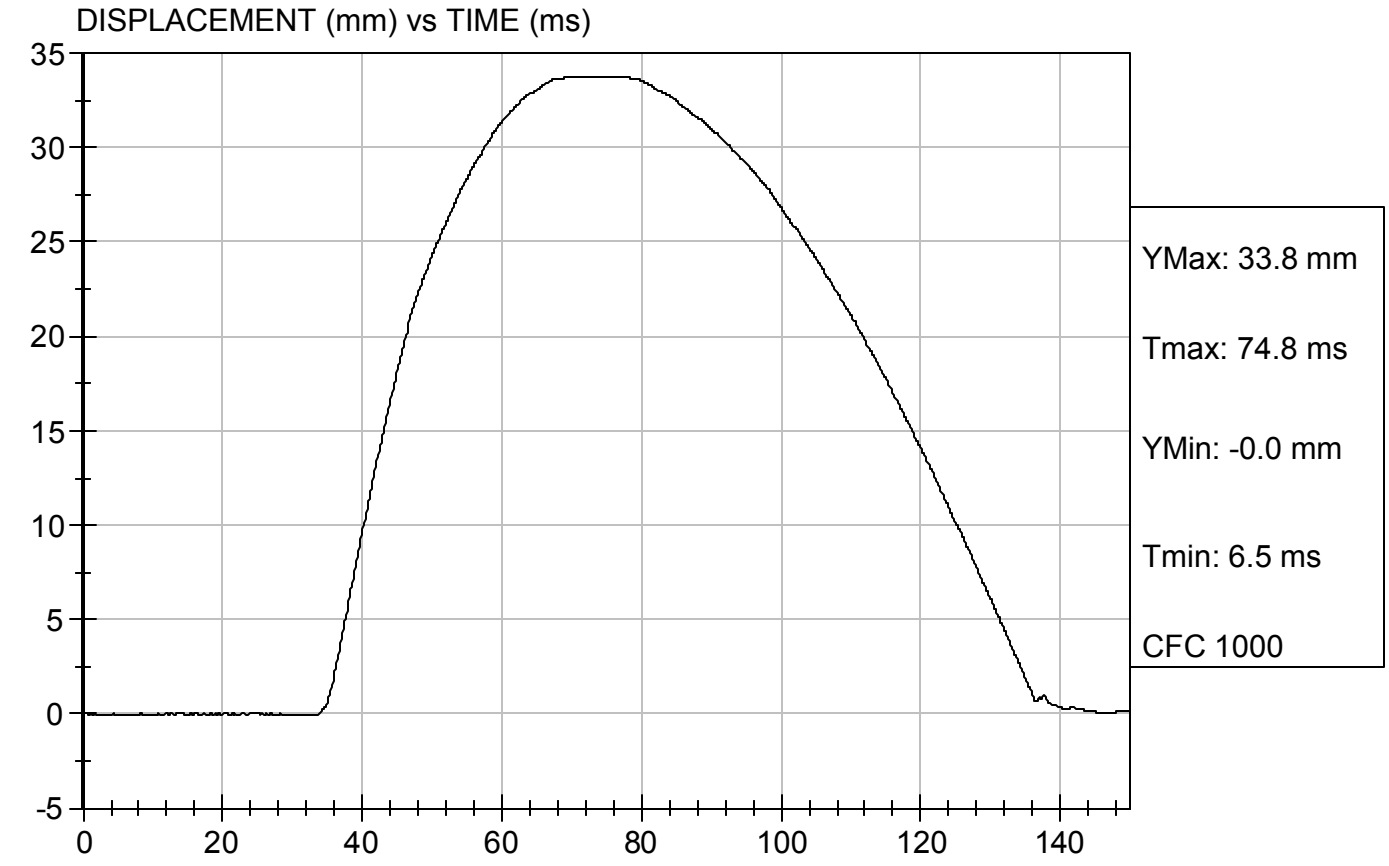
12/19/12
Test Date

David Winkelbauer
Approved By

Test Desc: Thoracic Shock Absorber
Component ID: D124786

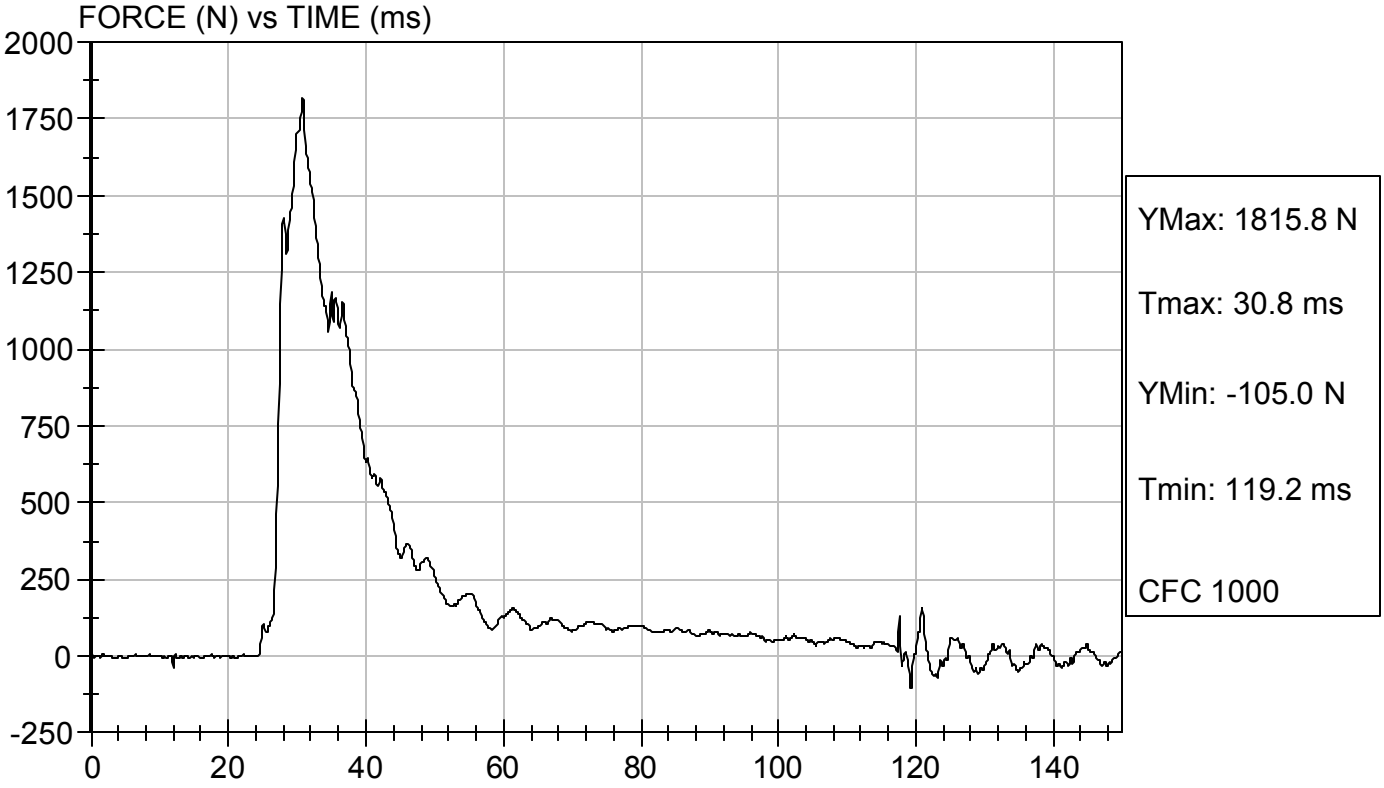
Test Date: 12/19/12
Speed: 10 ft/s, 3.05 m/s

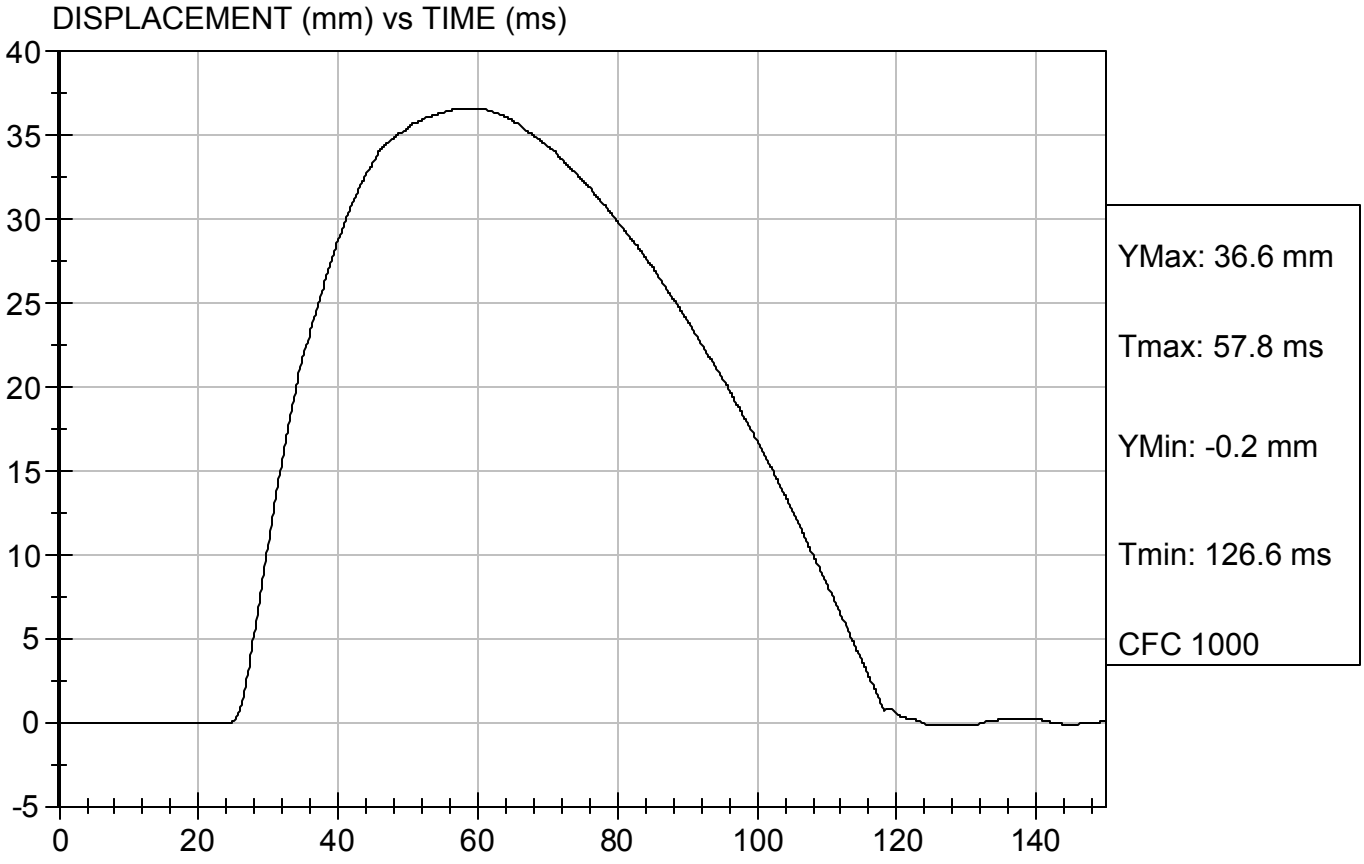


Test Desc: Thoracic Shock Absorber
Component ID: D124787

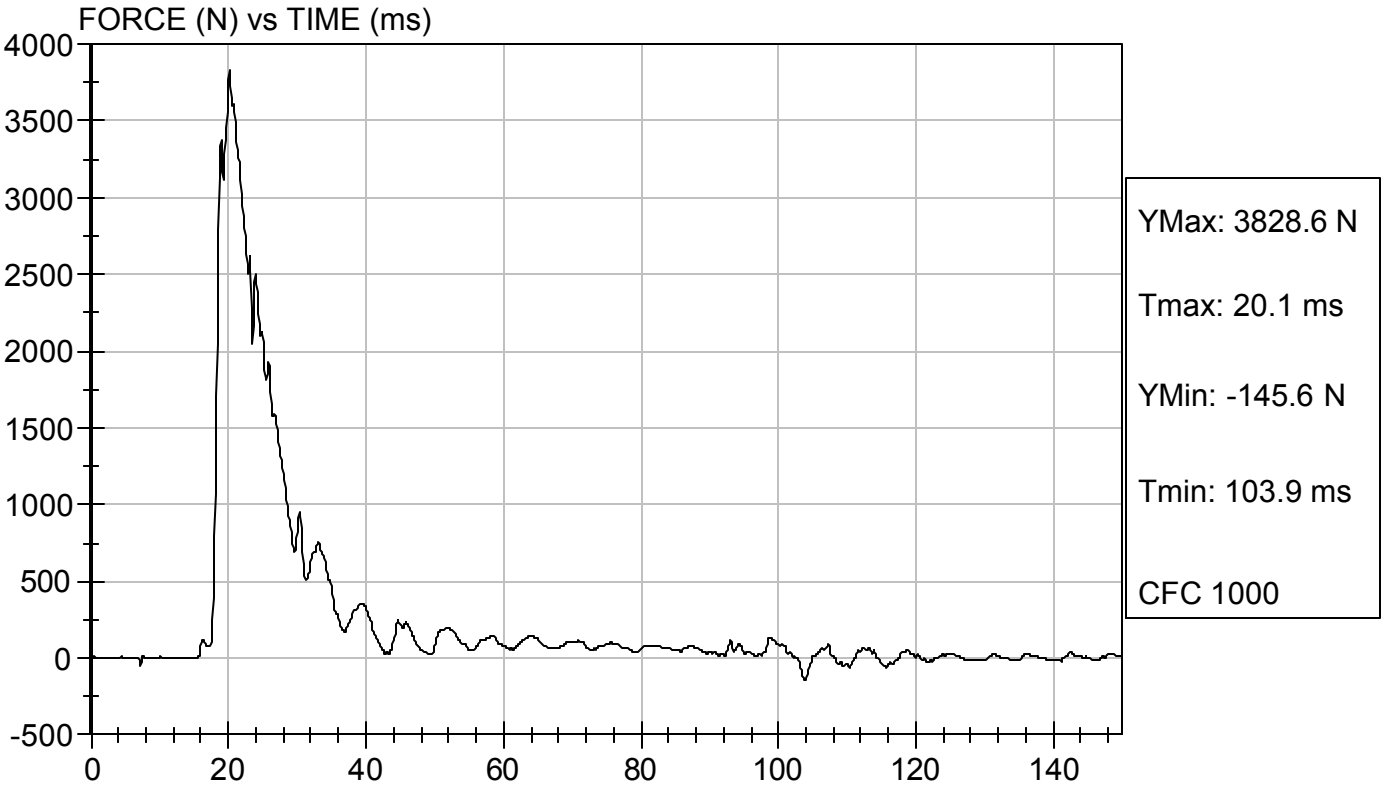
Test Date: 12/19/12
Speed: 14 ft/s, 4.27 m/s

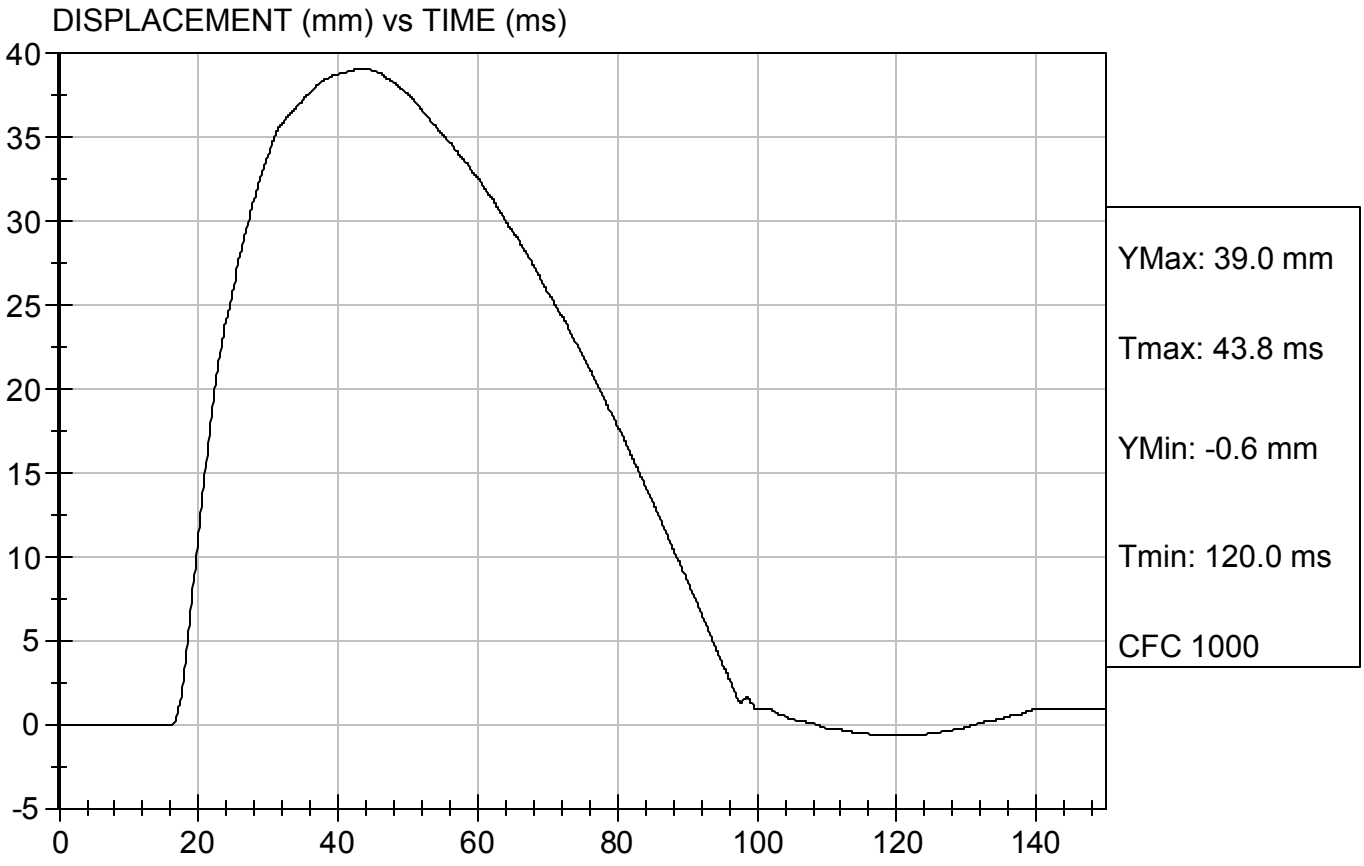


Test Desc: Thoracic Shock Absorber
Component ID: D124788

Test Date: 12/19/12
Speed: 20 ft/s, 6.10 m/s



**MGA RESEARCH CORPORATION**

**HEAD DROP TEST**

**HYBRID III SIDE IMPACT DUMMY**

**ATD Serial No:** 052 **Test ID:** D13761

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 - 25.5 | 21.6 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 24 | Pass |
| Peak Resultant Acceleration | G's | 120 to 150 | 147 | Pass |
| Peak Lateral Acceleration | G's | +/- 15.0 | 6.7 | Pass |
| Unimodal | N/A | Yes | Yes | Pass |
| Oscillations | N/A | < 15% of peak | Yes | Pass |
| | | Overall Test Results | | Pass |

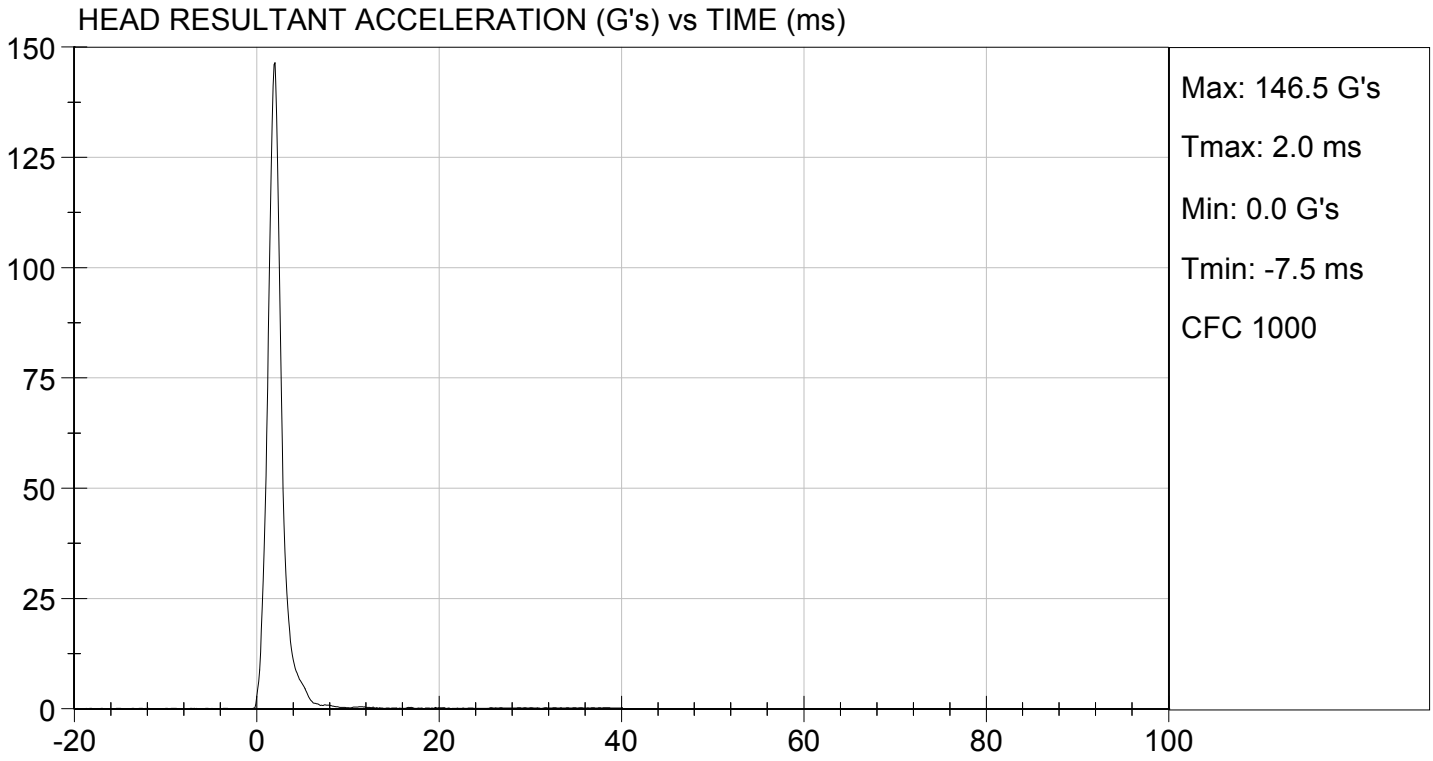
Jessica Gall
Laboratory Technician

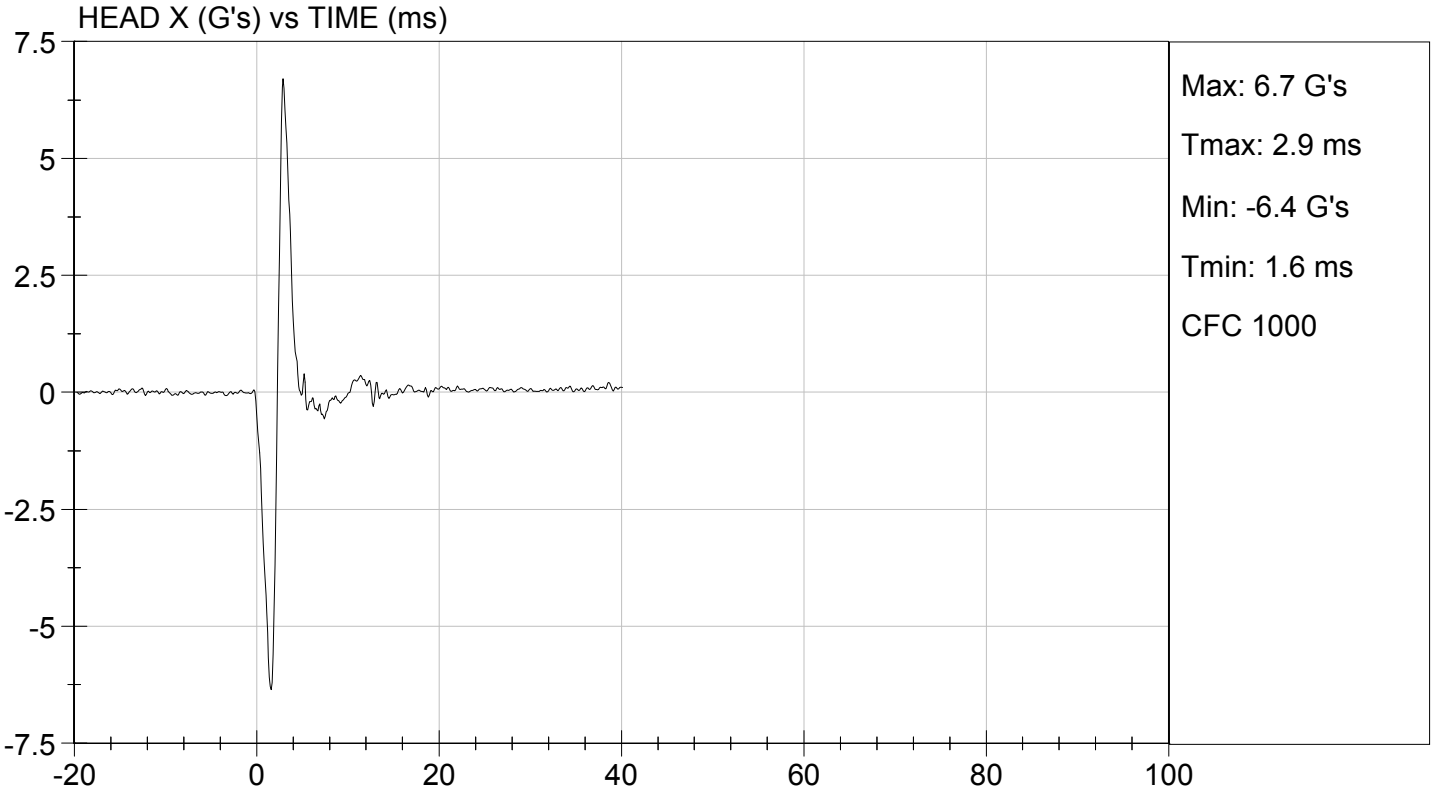
03/08/2013
Test Date

David Winkelbauer
Approved By

TEST DESC: HEAD DROP

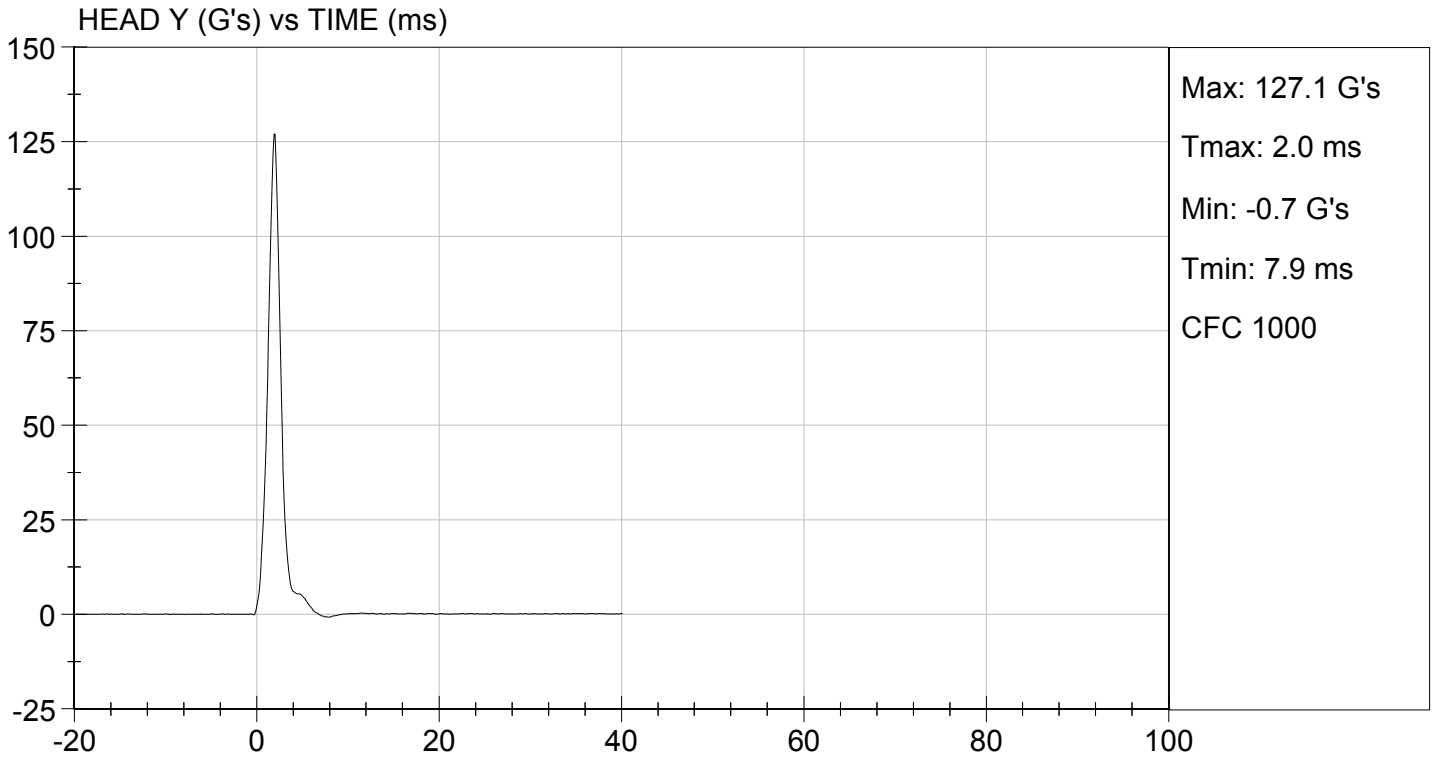
TEST DATE: 03/08/2013
TEST #: D13761

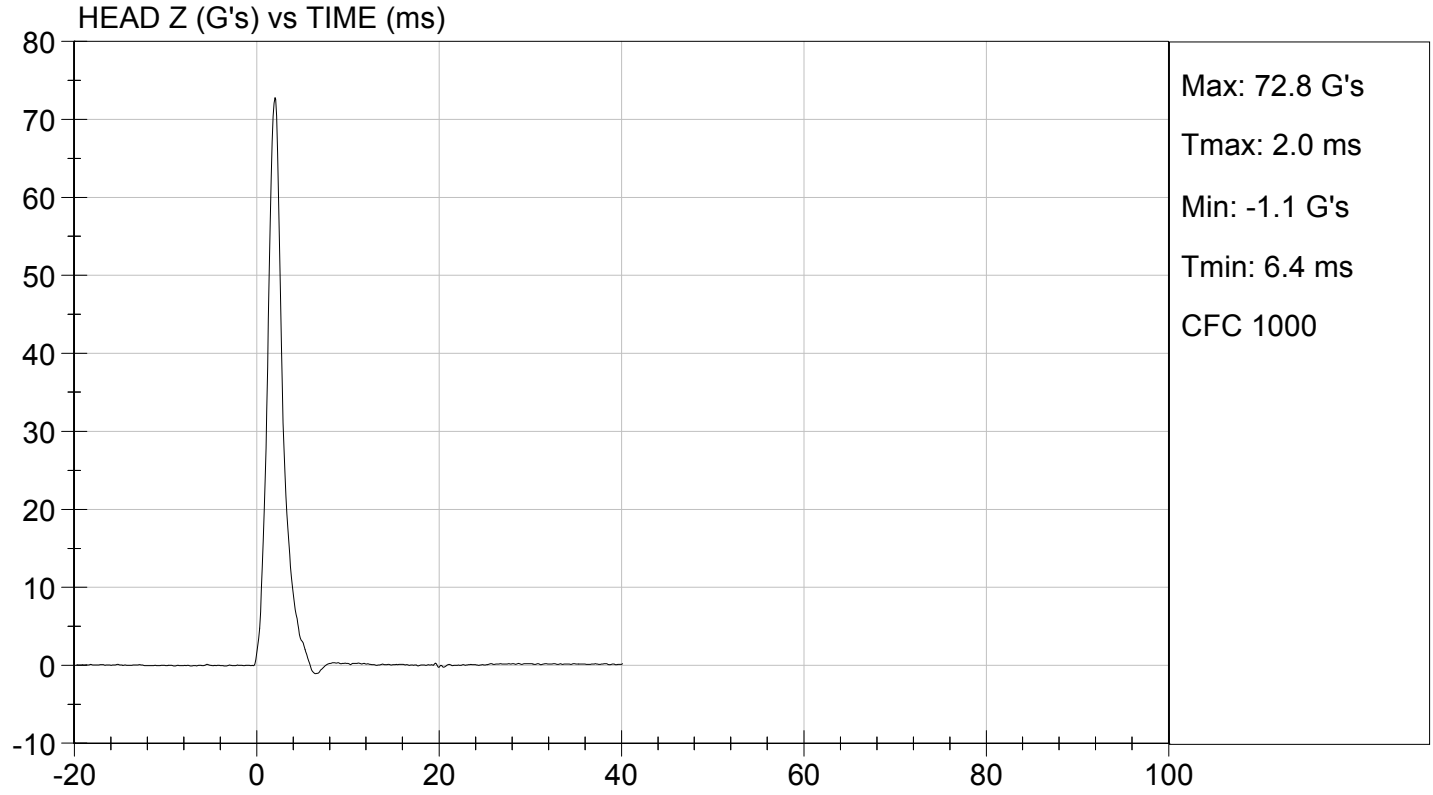


TEST DESC: HEAD DROP

TEST DATE: 03/08/2013
TEST #: D13761



**MGA RESEARCH CORPORATION**

**THORAX IMPACT TEST**

**HYBRID III SIDE IMPACT DUMMY**

**ATD Serial No:** 052 **Test I.D:** D13762

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 - 25.5 | 21.5 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 25 | Pass |
| Probe Velocity | m/s | 4.27 - 4.33 | 4.30 | Pass |
| Upper Rib | G's | 37 - 46 | 40 | Pass |
| Lower Rib | G's | 37 - 46 | 38 | Pass |
| Lower Spine | G's | 15 - 22 | 21 | Pass |
| | | Overall Test Results | | Pass |

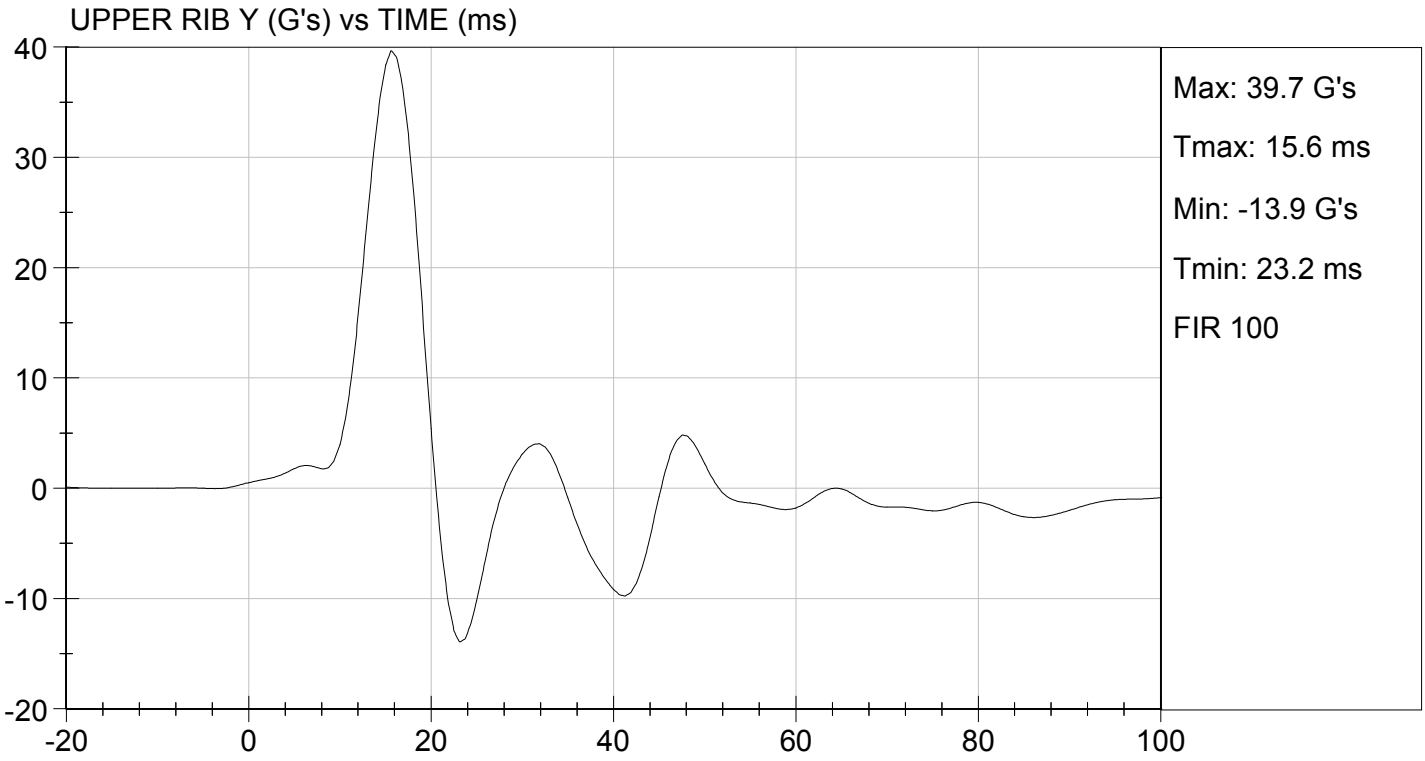
Jessica Gall
Laboratory Technician

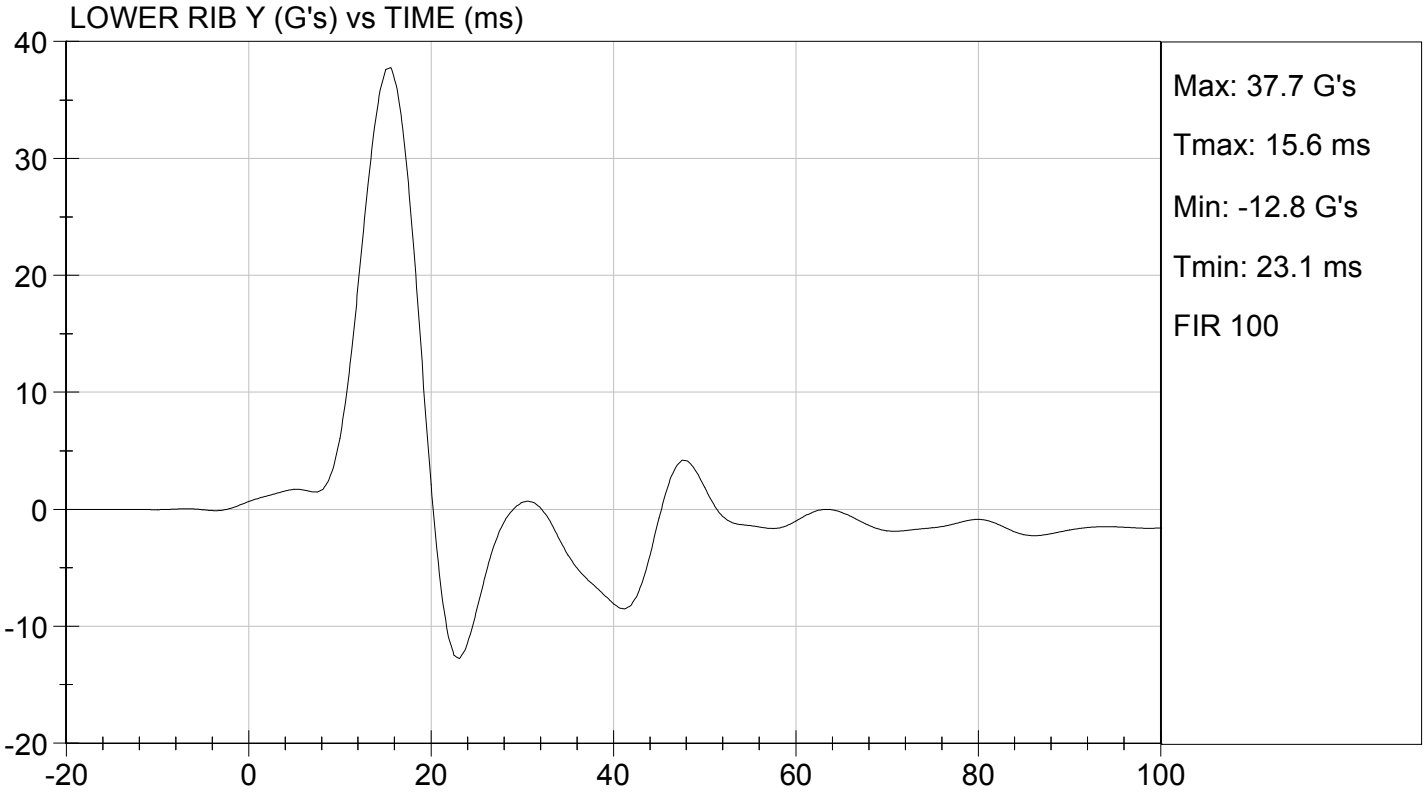
03/08/2013
Test Date

David Winkelbauer
Approved By

TEST DESC: THORAX IMPACT
VELOCITY: 14.12 ft/s, 4.30 m/s

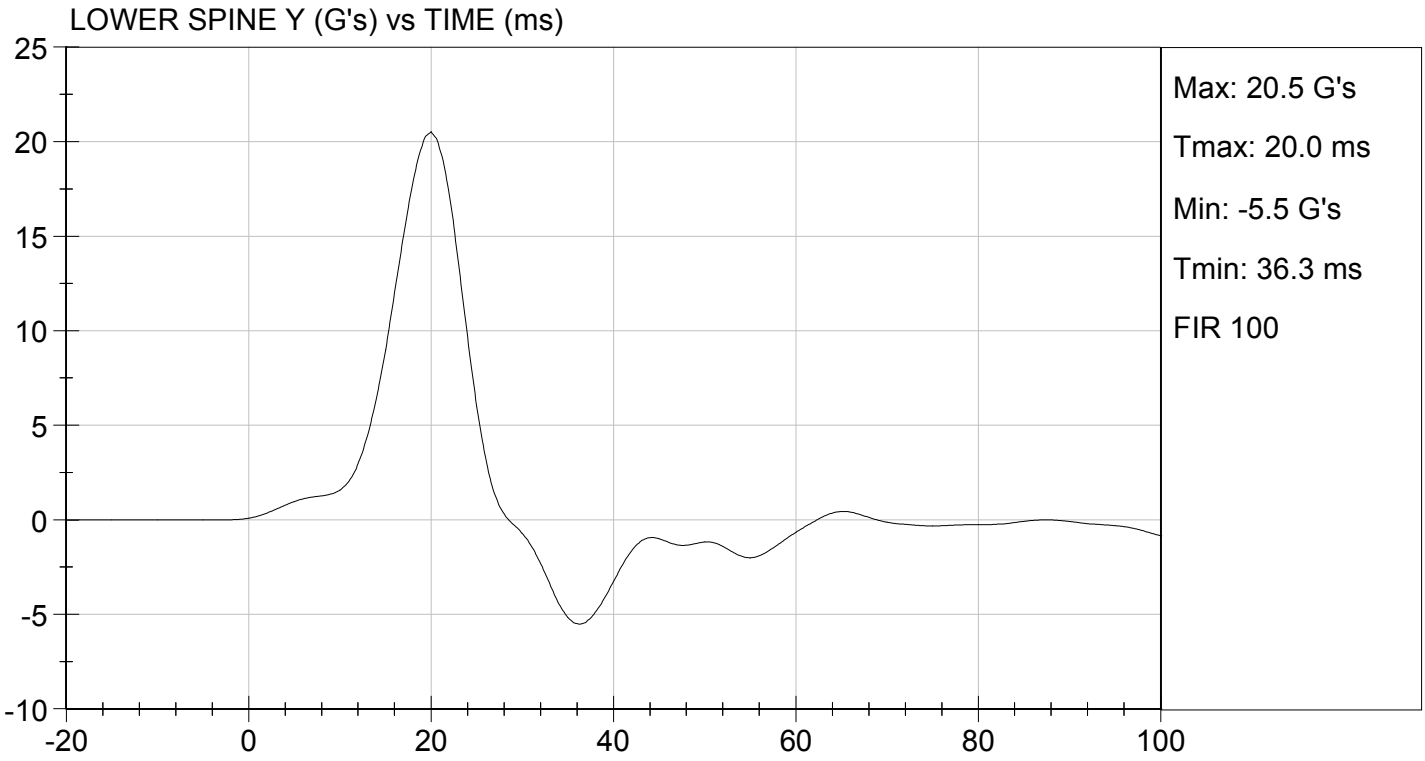
TEST DATE: 03/08/2013
TEST #: D13762



TEST DESC: THORAX IMPACT
VELOCITY: 14.12 ft/s, 4.30 m/s

TEST DATE: 03/08/2013
TEST #: D13762



**MGA RESEARCH CORPORATION**

**PELVIS IMPACT TEST**

**HYBRID III SIDE IMPACT DUMMY**

**ATD Serial No:** 052 **Test I.D:** D13763

| 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 | 25 | Pass |
| Probe Velocity | m/s | 4.27 - 4.33 | 4.30 | Pass |
| Pelvis Y Acceleration | G's | 40 - 60 | 43 | Pass |
| | | Overall Test Results | | Pass |

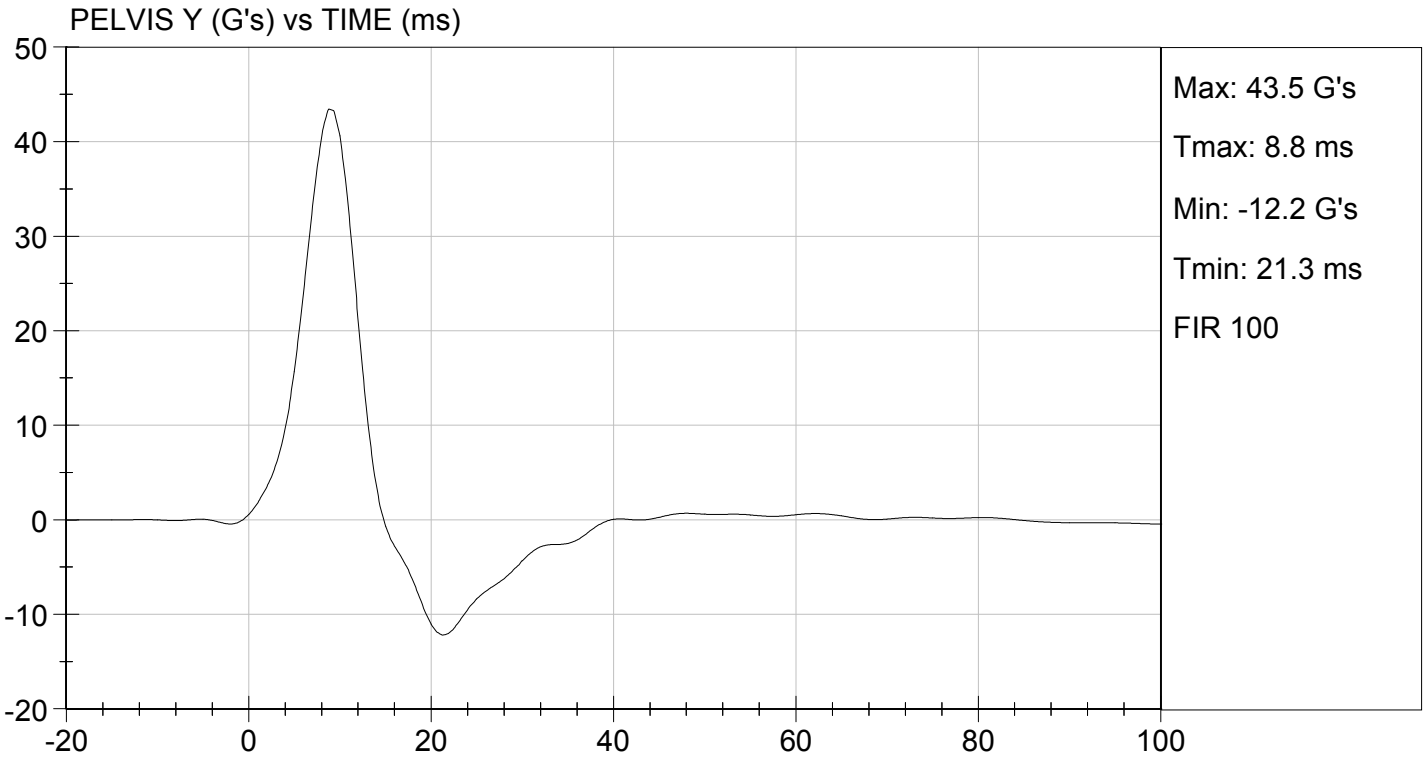
Jessica Hall
Laboratory Technician

03/08/2013
Test Date

David Winkelbauer
Approved By

TEST DESC: PELVIS IMPACT
VELOCITY: 14.12 ft/s, 4.30 m/s

TEST DATE: 03/08/2013
TEST #: D13763



**MGA RESEARCH CORPORATION**

**ABDOMEN COMPRESSION TEST**

**HYBRID III SIDE IMPACT DUMMY**

**ATD Serial No:** 052 **Test I.D:** D13764

| 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 | 25 | Pass |
| Force At 12.7 mm | N | 104 to 162 | 136 | Pass |
| Force At 19 mm | N | 163 to 221 | 192 | Pass |
| Force At 25.4 mm | N | 222 to 280 | 259 | Pass |
| Force At 33 mm | N | 325 to 391 | 357 | Pass |
| | | Overall Test Results | | Pass |

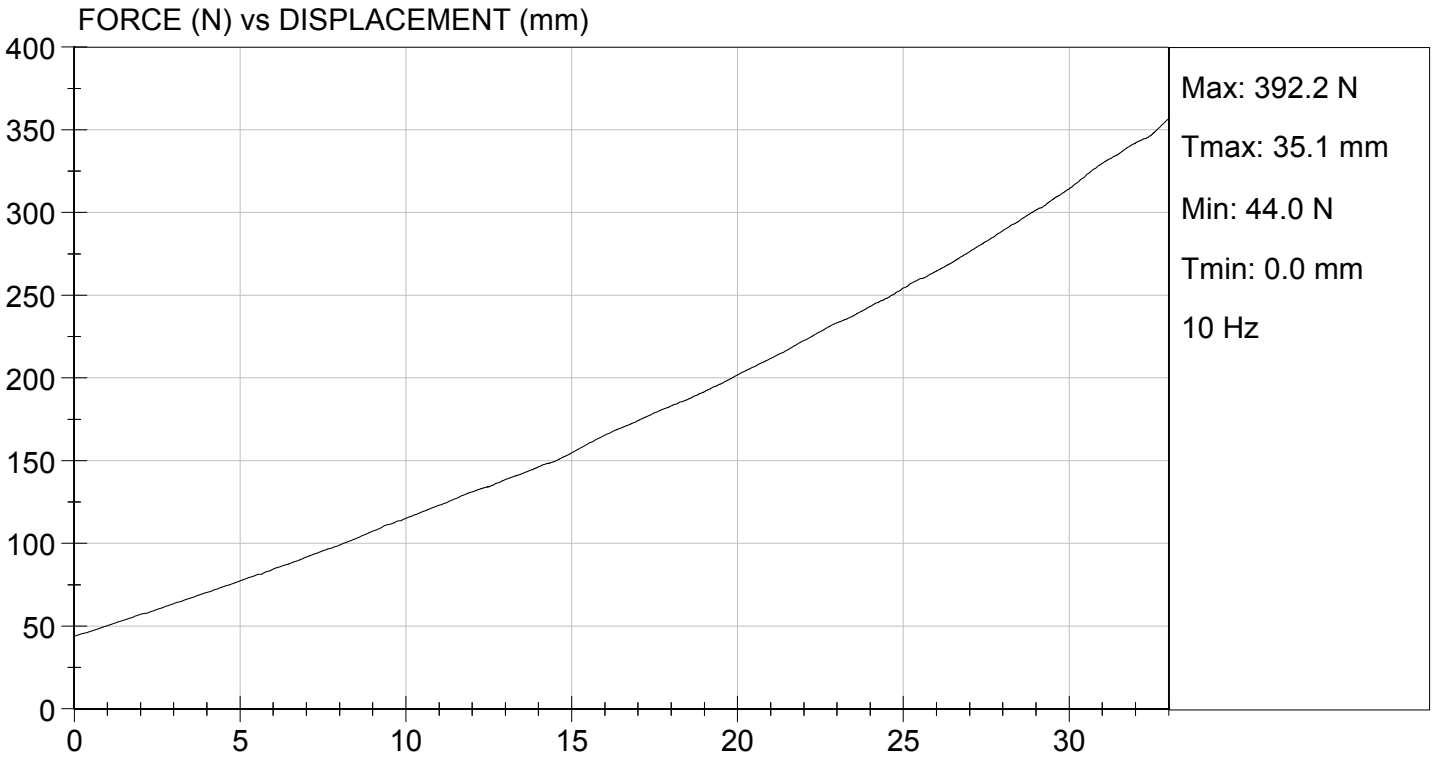
Jessica Gall
Laboratory Technician

03/08/2013
Test Date

David Winkelbauer
Approved By

TEST DESC: ABDOMEN COMPRESSION

TEST DATE: 03/08/2013
TEST #: D13764



**MGA RESEARCH CORPORATION**

**LUMBAR FLEXION TEST**

**HYBRID III SIDE IMPACT DUMMY**

**ATD Serial No:** 052 **Test I.D:** D13765

| 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 | 25 | Pass |
| Force At 0 deg | N | 0 to 26.7 | 25.6 | Pass |
| Force At 20 deg | N | 97.8 to 151.2 | 110.6 | Pass |
| Force At 30 deg | N | 151.2 to 204.6 | 158.0 | Pass |
| Force At 40 deg | N | 204.6 to 258.0 | 224.9 | Pass |
| Return Angle | Deg | 12 Maximum | 8 | Pass |
| | | Overall Test Results | | Pass |

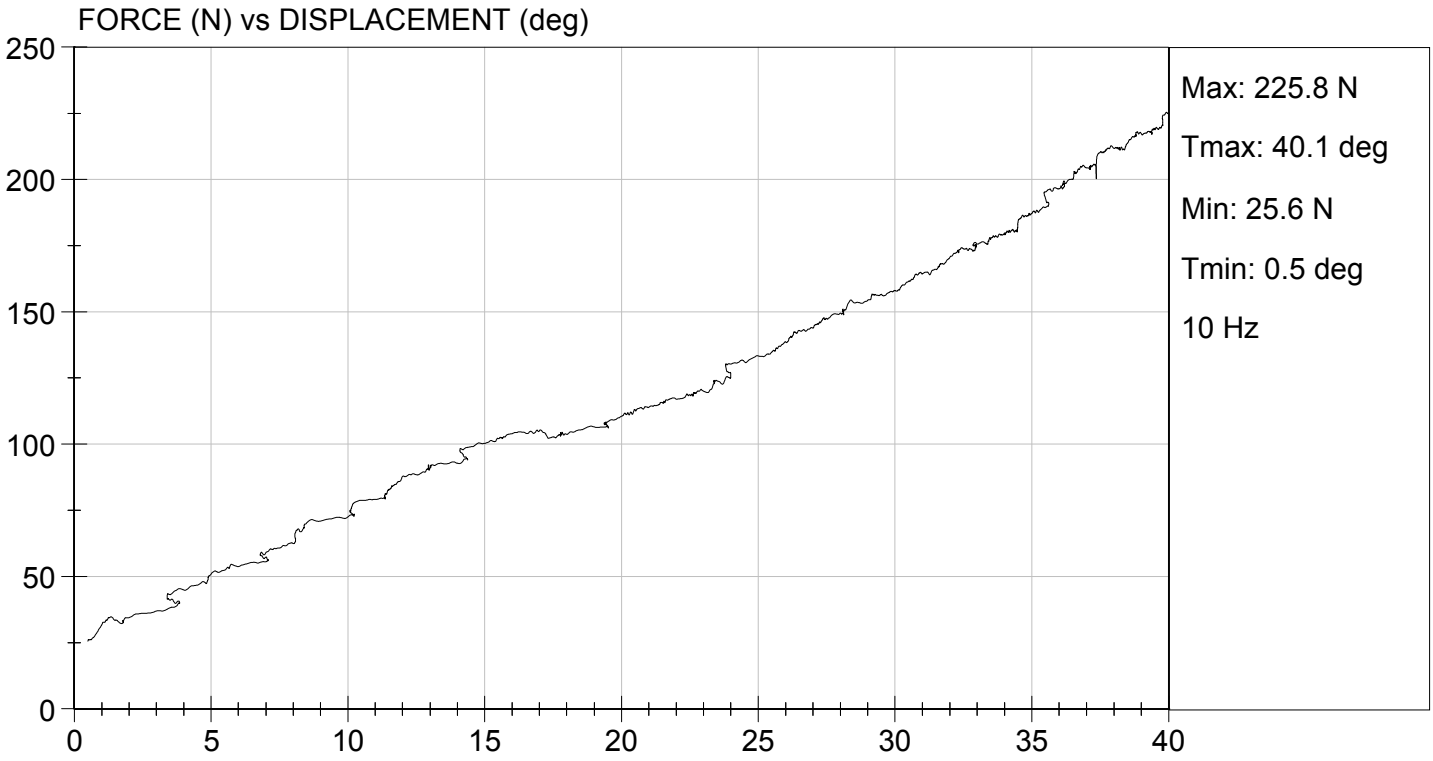
Jessica Hall
Laboratory Technician

03/08/2013
Test Date

David Winkelbauer
Approved By

TEST DESC: LUMBAR FLEXION

TEST DATE: 03/08/2013
TEST #: D13765



**MGA RESEARCH CORPORATION**

**NECK BENDING TEST**

**HYBRID III SIDE IMPACT DUMMY**

**ATD Serial No:** 052 **Test I.D:** D13769

| Tested Parameter | | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|---|
| Laboratory Temperature | | deg C | 20.6 to 22.2 | 21.5 | Pass |
| Laboratory Relative Humidity | | % | 10 to 70 | 25 | Pass |
| Pendulum Velocity | | m/s | 6.89 to 7.13 | 7.06 | Pass |
| Pendulum Velocity | 10 ms | m/s | 1.96 to 2.55 | 2.28 | Pass |
| | 20 ms | m/s | 4.12 to 5.10 | 4.42 | Pass |
| | 30 ms | m/s | 5.73 to 7.01 | 6.14 | Pass |
| | 40 to 70 ms | m/s | 6.27 to 7.64 | 6.76 | Pass |
| Midsaggital Plane Max Rotation | | deg | 66 to 82 | 68 | Pass |
| Head Rotation Peak to Zero Decay Time | | ms | 58 to 67 | 62 | Pass |
| Maximum Mx at Occipital Condyles | | Nm | 73 to 88 | 79 | Pass |
| Mx Peak to Zero Decay Time | | ms | 49 to 64 | 55 | Pass |
| Mx Peak to Maximum Head Rotation | | ms | 2 to 16 | 8.90 | Pass |
| | | | Overall Test Results | | Pass |

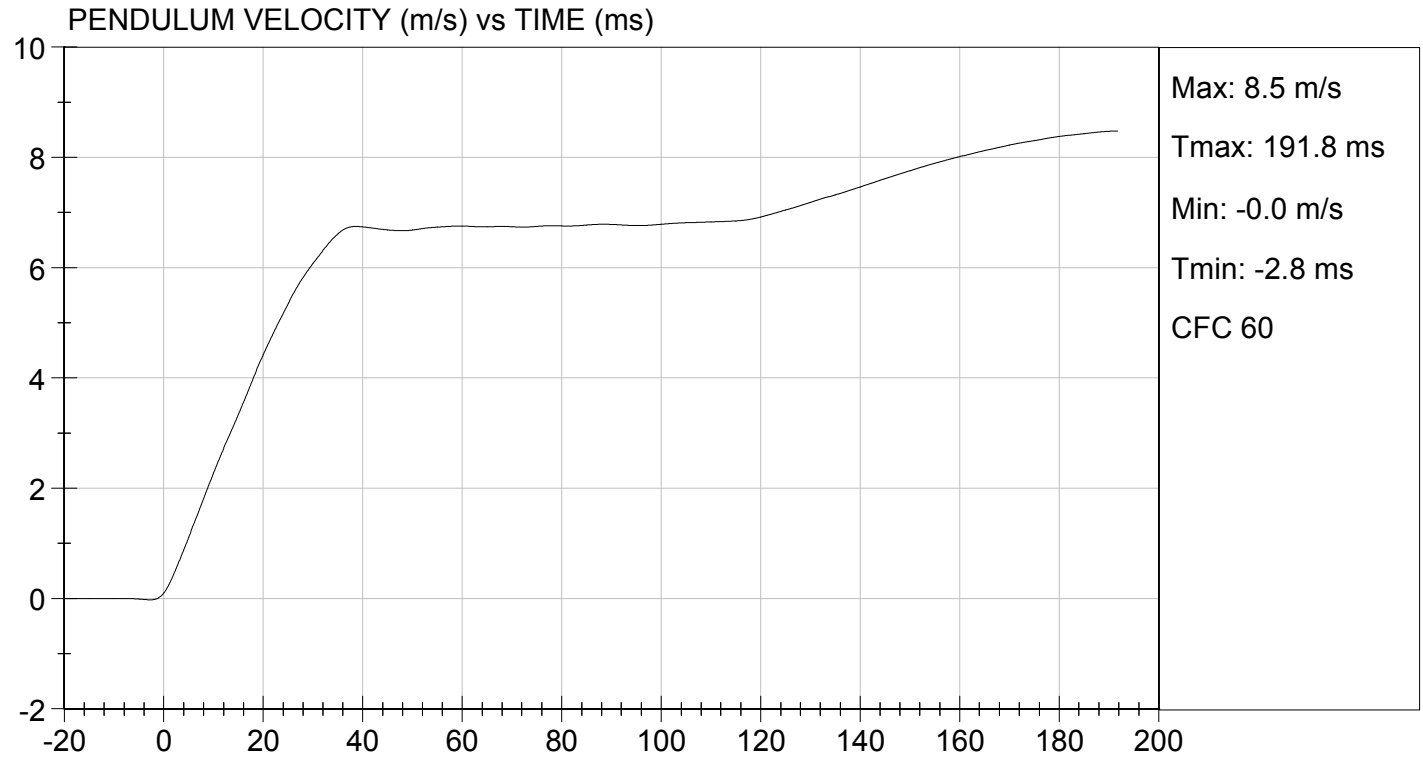
Jessica Gall
Laboratory Technician

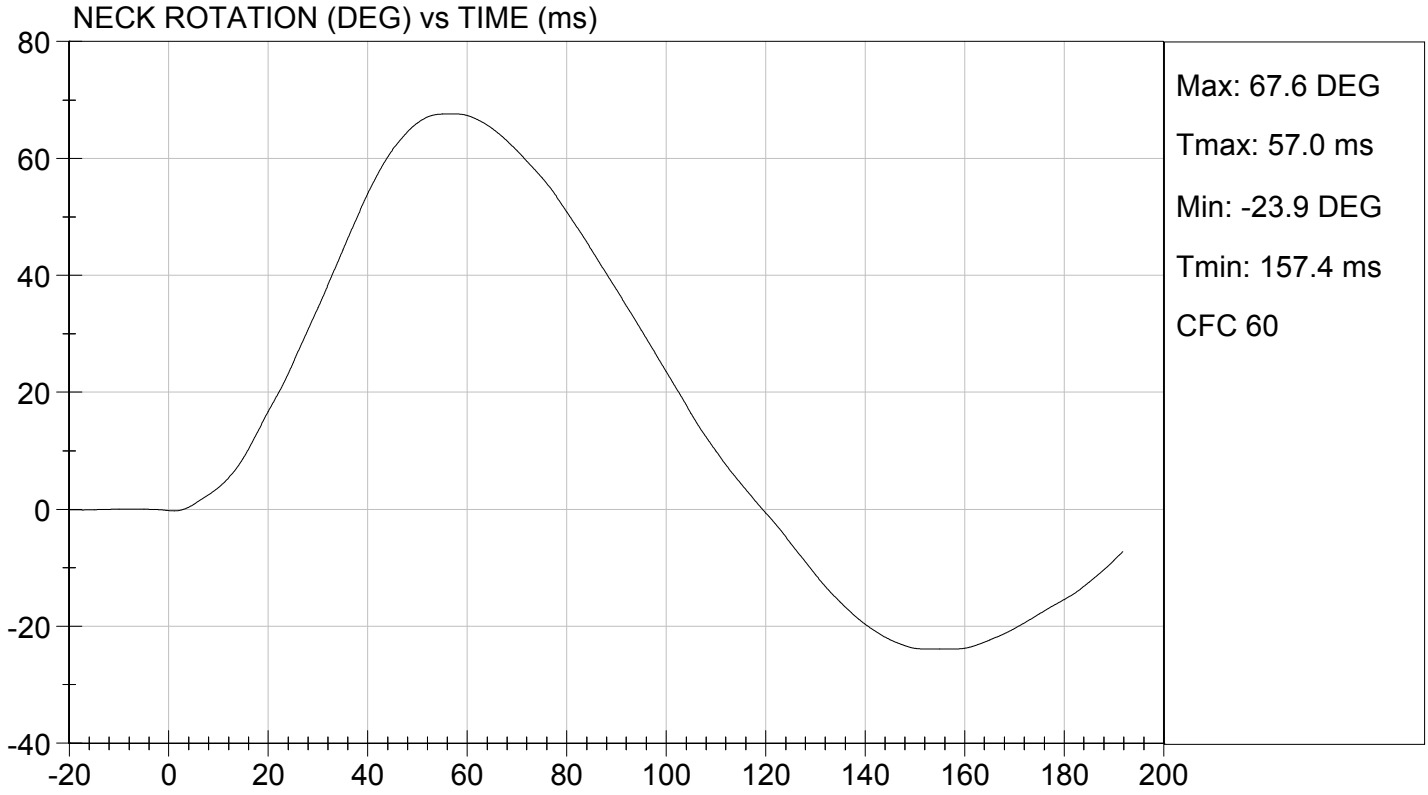
03/08/2013
Test Date

David Winkelbauer
Approved By

TEST DESC: NECK BENDING
VELOCITY: 23.15 ft/s, 7.06 m/s

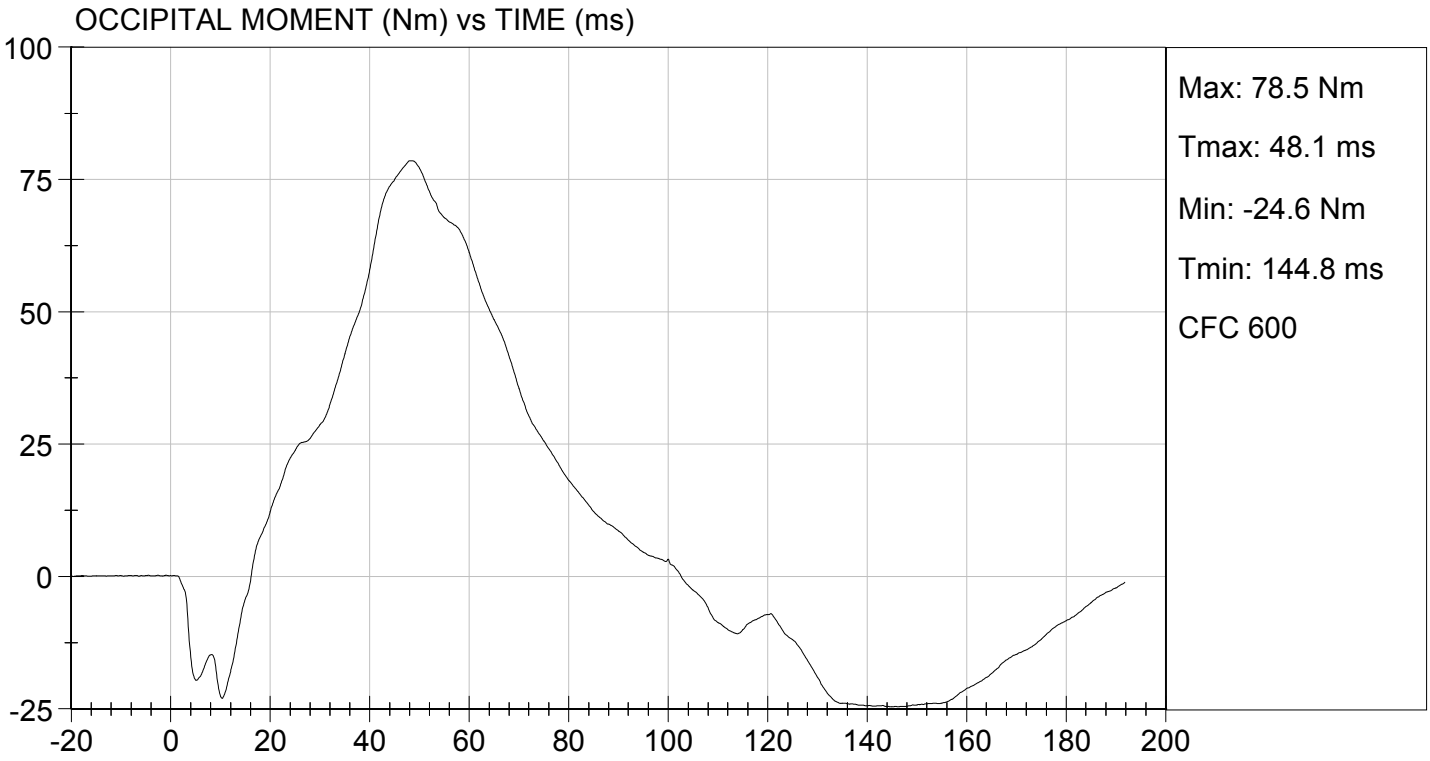
TEST DATE: 03/08/2013
TEST #: D13769



TEST DESC: NECK BENDING
VELOCITY: 23.15 ft/s, 7.06 m/s

TEST DATE: 03/08/2013
TEST #: D13769



**SID Calibration Data Sheet**

**Side Impact Dummy**

**Thoracic Shock Absorber Calibration**

**ATD Serial No:** 052 **Test I.D:** D124788

| Tested Parameter | | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|---|
| Laboratory Temperature | | deg C | 18.9 to 25.5 | 21.9 | Pass |
| Laboratory Relative Humidity | | % | 10 to 70 | 27 | Pass |
| Velocity 3.05 m/s | Force | N | 836 - 1125 | 864 | Pass |
| | Displacement | mm | 30 - 35 | 34 | Pass |
| Velocity 4.27 m/s | Force | N | 1730 - 2099 | 1,816 | Pass |
| | Displacement | mm | 32 - 37 | 37 | Pass |
| Velocity 6.1 m/s | Force | N | 3741 - 4448 | 3,829 | Pass |
| | Displacement | mm | 33 - 40 | 39 | Pass |
| | | | Overall Test Results | | Pass |

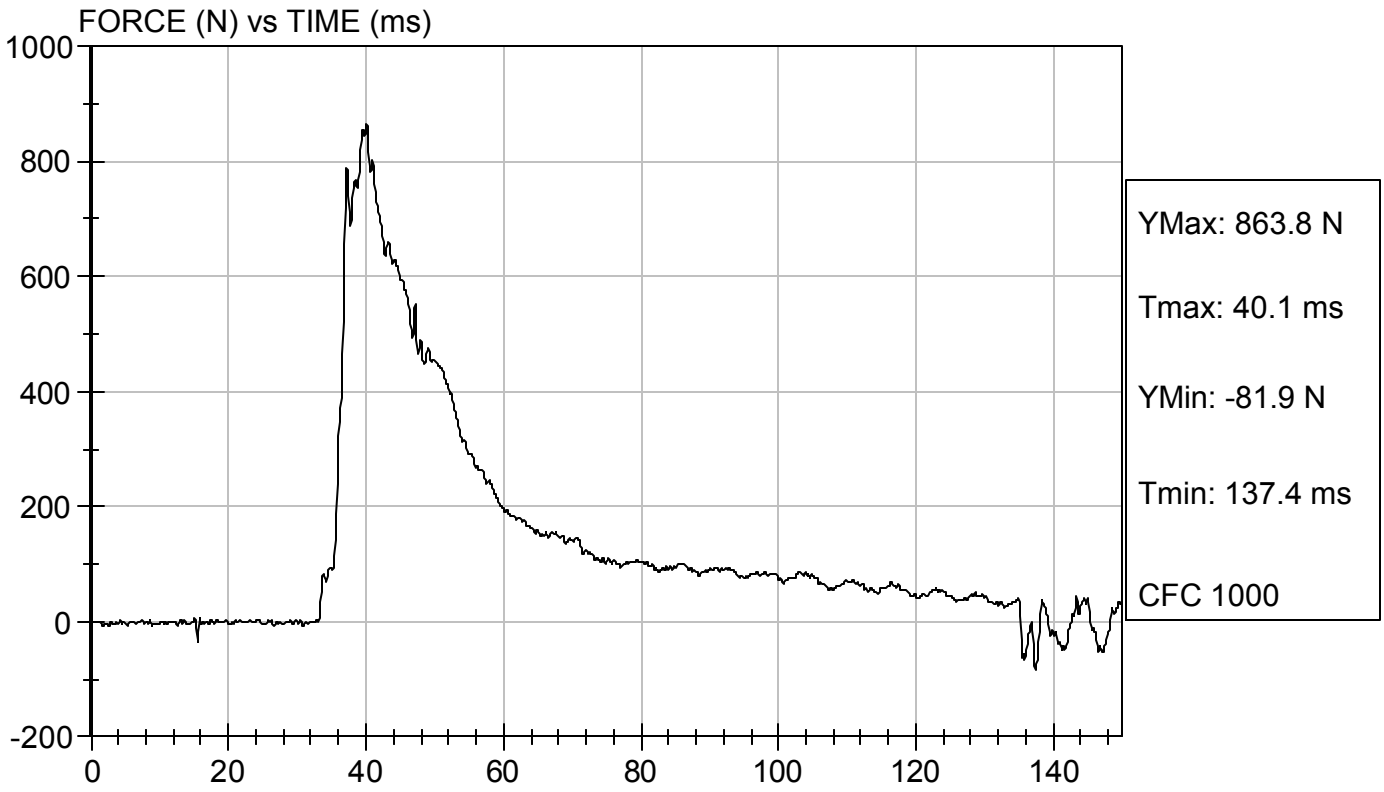
Jessica Gall
Laboratory Technician

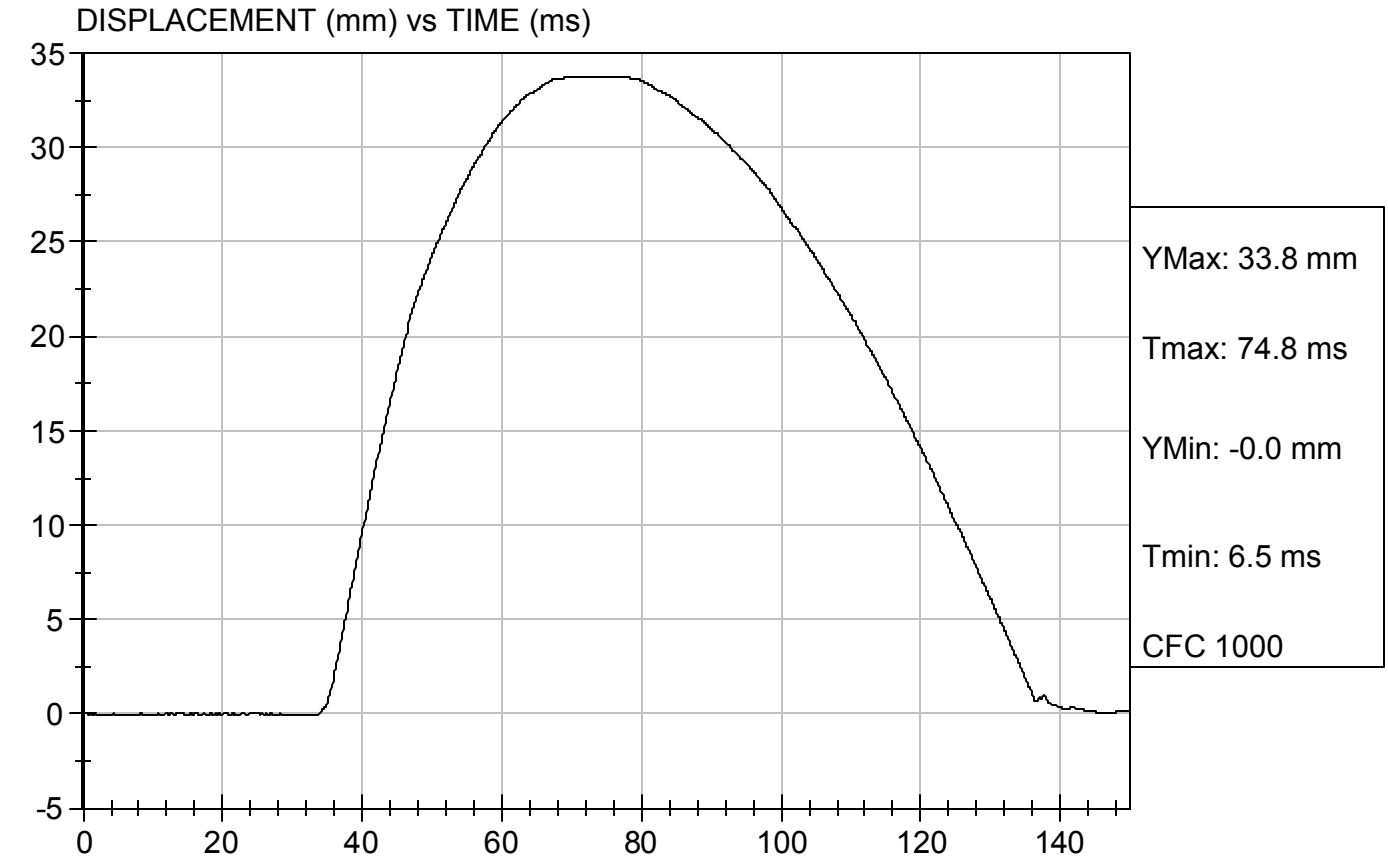
12/19/12
Test Date

David Winkelbauer
Approved By

Test Desc: Thoracic Shock Absorber
Component ID: D124786

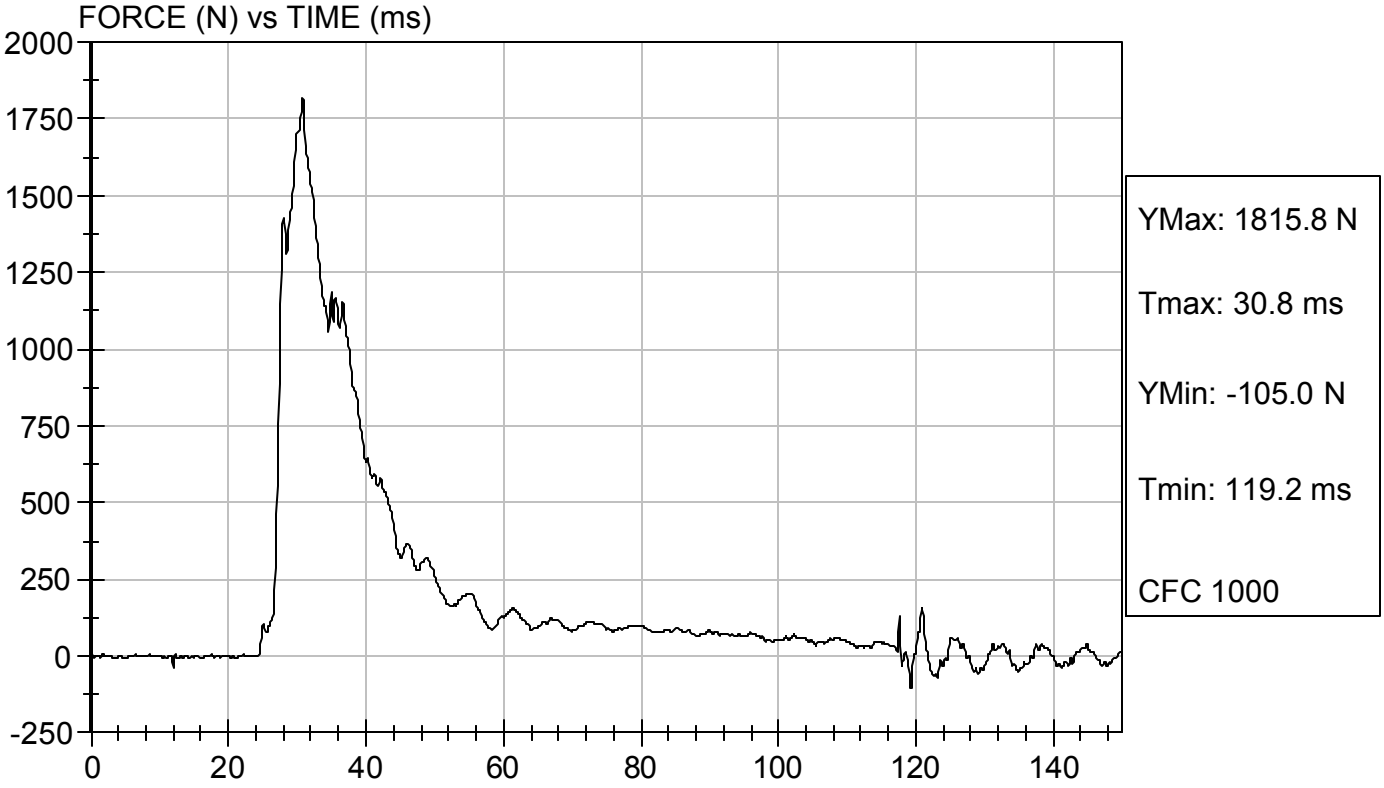
Test Date: 12/19/12
Speed: 10 ft/s, 3.05 m/s

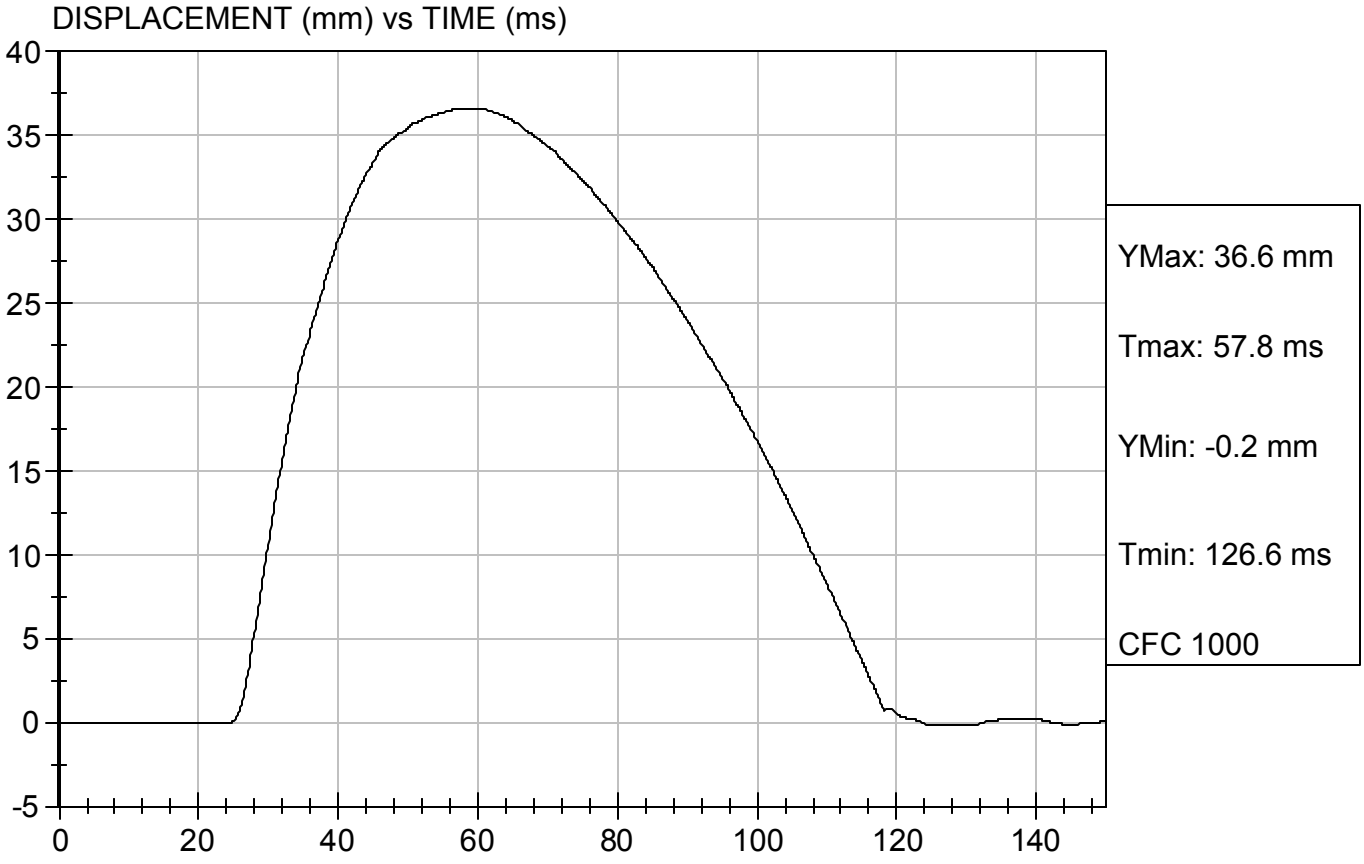


Test Desc: Thoracic Shock Absorber
Component ID: D124787

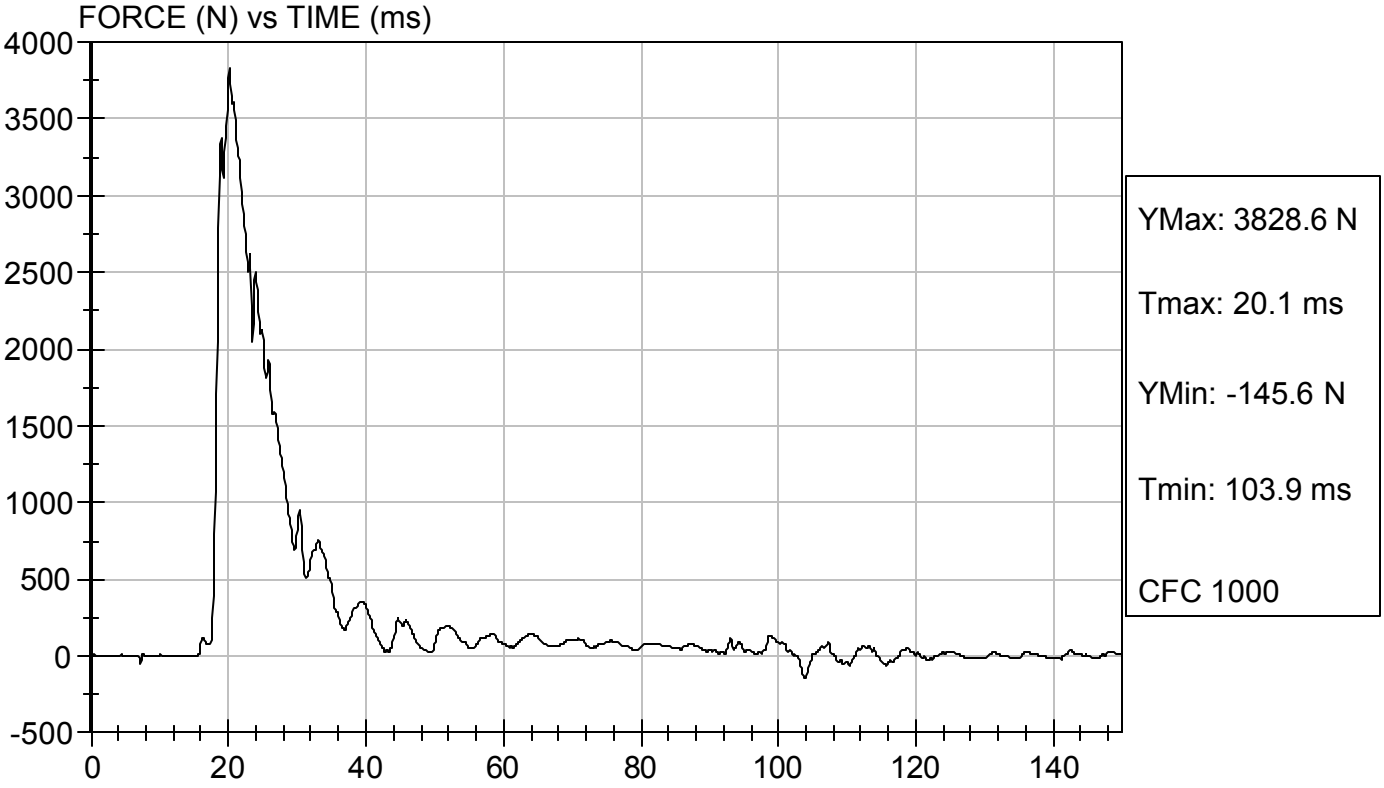
Test Date: 12/19/12
Speed: 14 ft/s, 4.27 m/s

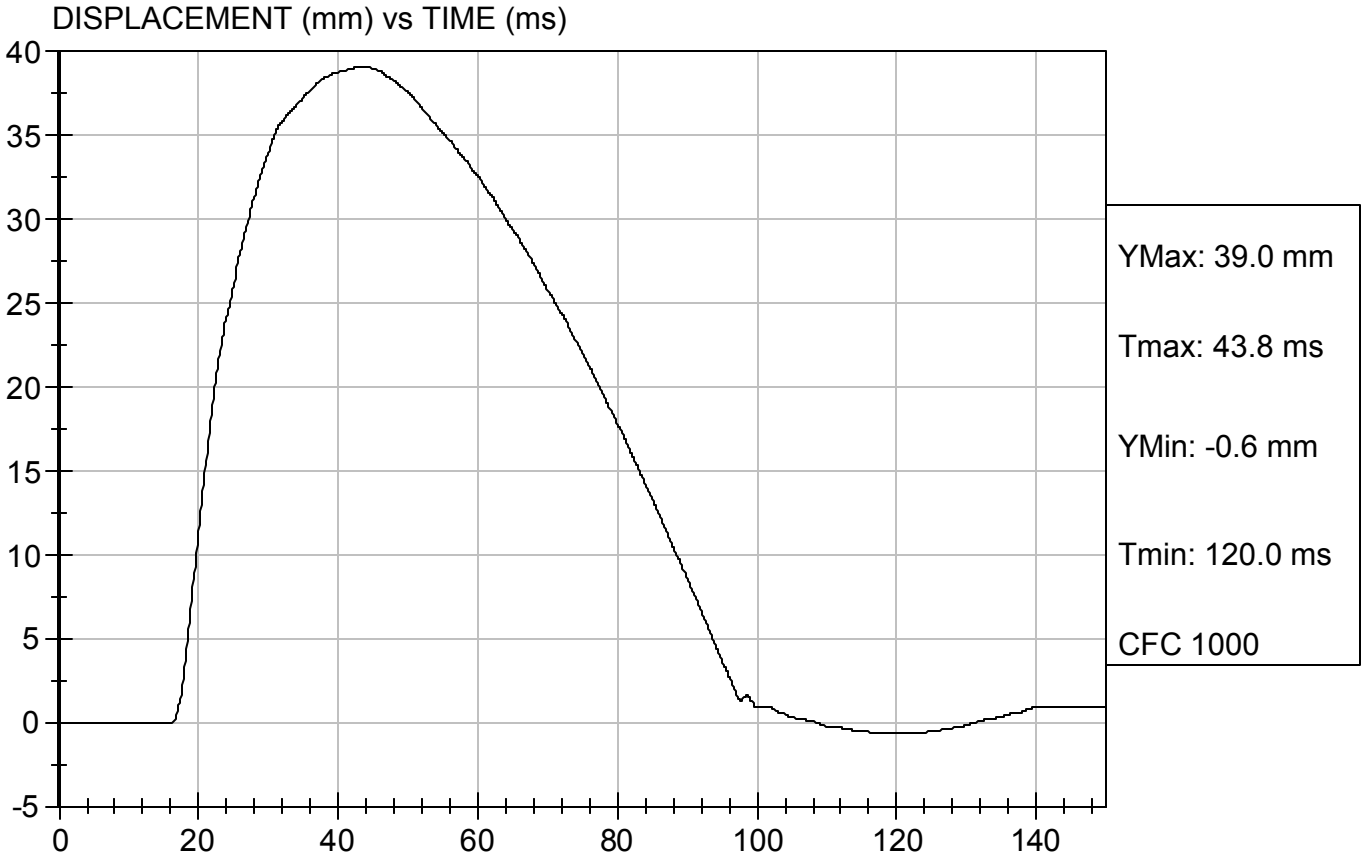


Test Desc: Thoracic Shock Absorber
Component ID: D124788

Test Date: 12/19/12
Speed: 20 ft/s, 6.10 m/s



# APPENDIX D

# CALIBRATION INFORMATION DATA

DUMMY AND VEHICLE CALIBRATION DATA

| | INSTRUMENTS FOR DRIVER S/N 052 | | |
|---|---|---|---|
| | SERIAL NO. | MANUFACTURER | CALIBRATION DATE |
| Head CG X | C13801 | Endevco | 09/27/12 |
| Head CG Y | AL6Y2 | Endevco | 09/27/12 |
| Head CG Z | AGH11 | Endevco | 09/27/12 |
| Neck Load Cell | 1175 | Denton | 02/21/13 |
| Upper Rib Y | P67884 | Endevco | 11/19/12 |
| Lower Rib Y | P67887 | Endevco | 11/19/12 |
| Lower Spine Y | P67889 | Endevco | 11/19/12 |
| Pelvis Y | P67513 | Endevco | 11/19/12 |
| Upper Rib Redundant Y | P67886 | Endevco | 11/19/12 |
| Lower Rib Redundant Y | P67888 | Endevco | 11/19/12 |
| Lower Spine Redundant Y | P67890 | Endevco | 11/19/12 |
| Pelvis Redundant Y | P67515 | Endevco | 11/19/12 |

VEHICLE INSTRUMENT CALIBRATION

| | VEHICLE ACCELEROMETERS | | |
|---|---|---|---|
| | SERIAL NO. | MANUFACTURER | CALIBRATION DATE |
| Vehicle CG X | P66679 | Endevco | 12/27/12 |
| Vehicle CG Y | P66678 | Endevco | 12/27/12 |
| Vehicle CG Z | P66680 | Endevco | 12/27/12 |
| Left Floor Y | P59405 | Endevco | 01/04/13 |
| Left A-Post @ Sill Y | P47853 | Endevco | 12/26/12 |
| Left Lower A-Post Y | P78749 | Endevco | 10/23/12 |
| Left Mid A-Post Y | P78750 | Endevco | 10/23/12 |
| Left B-Post @ Sill Y | P77756 | Endevco | 01/04/13 |
| Left Lower B-Post Y | P59330 | Endevco | 11/03/12 |
| Left Mid B-Post Y | P59331 | Endevco | 11/03/12 |
| Driver Seat Track Y | P63351 | Endevco | 11/01/12 |
| Upper Engine X | P59299 | Endevco | 12/26/12 |
| Upper Engine Y | P59298 | Endevco | 12/26/12 |
| Firewall Y | P63505 | Endevco | 10/31/12 |
| Right Front Roof Y | P78881 | Endevco | 11/03/12 |
| Right Floor Y | P67447 | Endevco | 10/30/12 |
| Rear Deck X | P63892 | Endevco | 10/18/12 |
| Rear Deck Y | P63891 | Endevco | 10/18/12 |