**REPORT NUMBER: SPNCAP-CAL-20-006**

# NEW CAR ASSESSMENT PROGRAM (NCAP)
# SIDE IMPACT POLE TEST

**Volvo Car Corporation**
**2020 Volvo S60**
**Four Door Sedan**

**NHTSA No: M20205901**

**PREPARED BY:**
**CALSPAN CORPORATION**
**P.O. BOX 400**
**BUFFALO, NEW YORK 14225**

**May 20, 2020**

**FINAL REPORT**

**PREPARED FOR:**
**U.S. DEPARTMENT OF TRANSPORTATION**
**NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION**
**OFFICE OF CRASHWORTHINESS STANDARDS**
**MAIL CODE: NRM-110**
**1200 NEW JERSEY AVE SE, ROOM W43-410**
**WASHINGTON, D.C. 20590**

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Prepared by: Matthew Pronko Date: May 20, 2020
Matthew Pronko, Test Engineer

Approved by: Vanessa Hansen Date: May 20, 2020
Vanessa Hansen, Operations Manager

**FINAL REPORT ACCEPTANCE BY OCWS:**

_____
Division Chief, New Car Assessment Program
NHTSA, Office of Crashworthiness Standards

Date: _____

_____
COTR, New Car Assessment Program
NHTSA, Office of Crashworthiness Standards

Date: _____

## TECHNICAL REPORT DOCUMENTATION PAGE

| | | |
|---|---|---|
| ***1. Report No.***<br>SPNCAP-CAL-20-006 | ***2. Government Accession No.*** | ***3. Recipient's Catalog No.*** |
| ***4. Title and Subtitle***<br>Final Report of New Car Assessment Program<br>Side Impact Pole Testing of a<br>2020 Volvo S60 four door sedan<br>NHTSA No.: M20205901 | | ***5. Report Date***<br>May 20, 2020<br>***6. Performing Organization Code***<br>CAL |
| ***7. Author(s)***<br>Matthew Pronko, Test Engineer<br>Vanessa Hansen, Operations Manager | | ***8. Performing Organization Report No.***<br>CAL-DOT-2020-006 |
| ***9. Performing Organization Name and Address***<br>Calspan Corporation<br>Transportation Test Operation<br>P.O. Box 400<br>Buffalo, New York 14225 | | ***10. Work Unit No.***<br><br>***11. Contract or Grant No.***<br>DTNH22-14-D-00352 |
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| **15. *Supplementary Notes*** | | |

***16. Abstract***

A 32.20 km/h (20 mph), 75° oblique impact Side NCAP Test was conducted on the subject 2020 Volvo S60 four door sedan in accordance with the specifications of the Office of Crashworthiness Standards Side NCAP Pole Laboratory Test Procedure for the generation of consumer information on vehicle side pole crash protection. This test was conducted at Calspan Corporation's Transportation Test Operations facility in Buffalo, New York on March 10, 2020.

The impact velocity of the vehicle was 32.21 km/h, and the ambient temperature at the struck (driver's) side of the target vehicle was 21°C. The target vehicle's maximum post-test static crush was 318 mm located at level 3. The test vehicle's occupant performance data is as follows:

| Measurement Description | Driver ATD (SID-IIs) (Serial No. DG8012) | | |
|---|---|---|---|
| | Units | Threshold | Result |
| Head Injury Criteria ($HIC_{36}$) | | 1000 | 319.052 |
| Resultant Lower Spine Acceleration | G | 82 | 28.912 |
| Total Pelvic Force (sum of acetabular and iliac forces) | N | 5525 | 2181.066 |
| Maximum Thoracic Rib Deflection | mm | 38 | 22.659 |
| Maximum Abdomen Rib Deflection | mm | 45 | 30.515 |

The two 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.

| | |
|---|---|
| ***17. Key Words***<br>New Car Assessment Program (NCAP)<br>Side Impact<br>Pole<br>Part 572V<br>SID-IIs | ***18. Distribution Statement***<br>Copies of this report are available from:<br>National Highway Traffic Safety Administration<br>Technical Information Services Division,<br>1200 New Jersey Ave. SE<br>Washington, D.C. 20590 |

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|---|---|---|---|
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Form DOT F1700.7 (8-72)

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## SECTION 1

## TEST PURPOSE AND PROCEDURE

This side impact test was conducted as part of the MY 2020 New Car Assessment Program Side Impact Test Program, sponsored by the National Highway Traffic Safety Administration (NHTSA), under Contract No. DTNH22-14-D-00352. The purpose of this test is to generate comparative side impact performance in a 2020 Volvo S60 four door sedan. The side impact test was conducted in accordance with the Office of Crashworthiness Standard's Side NCAP Pole Laboratory Test Procedure, dated October 2015.

## SECTION 2

## SUMMARY OF TEST RESULTS

A rigid pole side impact test was conducted on a 2020 Volvo S60 four door sedan. The subject vehicle was towed into the rigid pole at an angle of 75° and a velocity of 32.21 km/h. The test was conducted by Calspan Corporation's Transportation Test Operations facility in Buffalo, New York on March 10, 2020. Pre-test and post-test photographs of the test vehicle and side impact dummy (SID-IIs) are included in Appendix A of this report.

One Part 572V (SID-IIs) dummy was placed in the driver designated seating position according to instructions specified in the OCWS Side NCAP Pole Laboratory Test Procedure, dated October 2015. Camera locations and other pertinent camera information are included on page 3-11 in this report.

The Part 572V (SID-IIs) dummy was instrumented accordingly:

Head CG tri-axial accelerometers
Thorax upper, middle, and lower rib displacement potentiometers
Abdomen upper and lower rib displacement potentiometers
Lower spine tri-axial accelerometers
Iliac load cell
Acetabulum load cell

Appendix B contains the dummy response data. Dummy configuration and performance verification data can be found in Appendix C of this report. Appendix D identifies all serial numbers, manufacturers, and calibration dates for test equipment, dummy sensors, potentiometers, and load cells used to collect data during the test.

Injury readings for the SID-IIs dummy were recorded as follows:

**INJURY READINGS**

| Measurement Description | Driver ATD (SID-IIs) | | |
|---|---|---|---|
| | Units | IARV | Result |
| Head Injury Criteria ($HIC_{36}$) | | 1000 | 319.052 |
| Resultant Lower Spine Acceleration | g | 82 | 28.912 |
| Total Pelvic Force (sum of acetabular and iliac forces) | N | 5525 | 2181.066 |
| Maximum Thoracic Rib Deflection | mm | 38* | 22.659 |
| Maximum Abdominal Rib Deflection | mm | 45* | 30.515 |

*****Proposed IARV

Supplemental restraint information was recorded as follows:

**SUPPLEMENTAL RESTRAINT INFORMATION**

| Restraint Type | Left Front (Driver) Occupant Location 1 | | Left Rear (Passenger) Occupant Location 4 | |
|---|---|---|---|---|
| | Mounted | Deployed | Mounted | Deployed |
| Frontal Airbag | Yes | No | | |
| Knee Airbag | Yes | No | | |
| Side Airbag 1 - Curtain | Yes | Yes | Yes | Yes |
| Side Airbag 2 – Torso/Pelvis | Yes | Yes | No | N/A |
| Seat Belt Pretensioner | Yes | Yes | Yes | Yes |
| Seat Belt Load Limiter | Yes | Yes | Yes | Yes |
| Other | | | | |

**GENERAL COMMENTS:**

1. P1 serial number – DG8012

**Data Anomalies:**

- Left Middle A-Pillar Y Acceleration, Exceeded calibration range at 27.9 ms
- Driver Seat Track Acceleration Y, Spike at 52 ms
- Firewall Acceleration Y, Questionable data from 42 to 46 ms

## SECTION 3

## OCCUPANT AND VEHICLE INFORMATION

This section contains information reporting for the following Data Sheets:

Data Sheet No. 1 – General Test and Vehicle Parameter Data

Data Sheet No. 2 – Seat, Seat Belt, Steering Wheel Adjustment and Fuel Systems Data

Data Sheet No. 3 – Dummy Longitudinal Clearance Dimensions

Data Sheet No. 4 – Dummy Lateral Clearance Dimensions

Data Sheet No. 5 – Camera and instrumentation Data

Data Sheet No. 6 – Vehicle Accelerometer Data

Data Sheet No. 7 – Rigid Pole Load Cell Data

Data Sheet No. 8 – Post-Test Observations

Data Sheet No. 9 – Test Vehicle Profile Measurements

Data Sheet No. 10 – Test Vehicle Exterior Crush Measurements

Data Sheet No. 11 – Vehicle Damage Profile Distances

Data Sheet No. 12 – FMVSS No. 301 Static Rollover Results

Data Sheet No. 13 – Dummy / Vehicle Temperature and Humidity Stabilization Data

## DATA SHEET NO. 1
## GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2020 Volvo S60 four door sedan
NHTSA No.: M20205901
Test Program: NCAP Side Pole Impact Test
Test Date: 3/10/2020

### TEST VEHICLE INFORMATION AND OPTIONS

| | |
|---|---|
| NHTSA No. | M20205901 |
| Model Year | 2020 |
| Make | Volvo |
| Model | S60 |
| Body Style | Four Door Sedan |
| VIN | 7JR102FK1LG048418 |
| Body Color | Red |
| Odometer Reading (km/mi) | 4 Miles |
| Engine Displacement (L) | 2.0 |
| Type / No. Cylinders | I4 |
| Engine Placement | Transverse |
| Transmission Type | Automatic |
| Transmission Speeds | 8-Speed |
| Overdrive | Yes |
| Final Drive | Front Wheel Drive |
| Roof Rack | No |
| Sunroof / T-Top | Yes |
| Running Boards | No |
| Tilt Steering Wheel | Yes |
| Power Seats | Yes |
| Anti-Lock Brakes (ABS) | Yes |

| | |
|---|---|
| Traction Control System (TCS) | Yes |
| Auto-Leveling System | No |
| Automatic Door Locks (ADL) | Yes |
| Power Window Auto-Reverse | No |
| Other Optional Feature | - |
| Driver Front Airbag | Yes |
| Driver Curtain Airbag | Yes |
| Driver Head/Torso Airbag | No |
| Driver Torso Airbag | No |
| Driver Torso / Pelvis Airbag | Yes |
| Driver Pelvis Airbag | No |
| Driver Knee Airbag | Yes |
| Rear Pass. Curtain Airbag | Yes |
| Rear Pass. Head / Torso Airbag | No |
| Rear Pass. Torso Airbag | No |
| Rear Pass. Torso / Pelvis Airbag | No |
| Rear Pass. Pelvis Airbag | No |
| Driver Seat Belt Pretensioner | Yes |
| Rear Pass. Seat Belt Pretensioner | Yes |
| Driver Load Limiter | Yes |
| Rear Pass. Load Limiter | Yes |
| Other Safety Restraint | No |

Does owner's manual provide instructions to turn off automatic door locks? No

### DATA FROM CERTIFICATION LABEL

| | |
|---|---|
| Manufactured By | Volvo Car Corporation |
| Date of Manufacture | 10/19 |
| Vehicle Type | Passenger Car |

| | |
|---|---|
| GVWR (kg) | 2189 |
| GAWR Front (kg) | 1109 |
| GAWR Rear (kg) | 1109 |

### VEHICLE SEATING AND WEIGHT CAPACITY DATA

| Measured Parameter | Front | Rear | Third | Total | |
|---|---|---|---|---|---|
| Designated Seating Capacity (DSC) | 2 | 3 | - | 5 | |
| Capacity Weight (VCW) (kg) | | | | 405 | (A) |
| DSC X 68.04 kg | | | | 340.2 | (B) |
| Cargo Weight (RCLW) (kg) | | | | 64.8 | (A-B) |

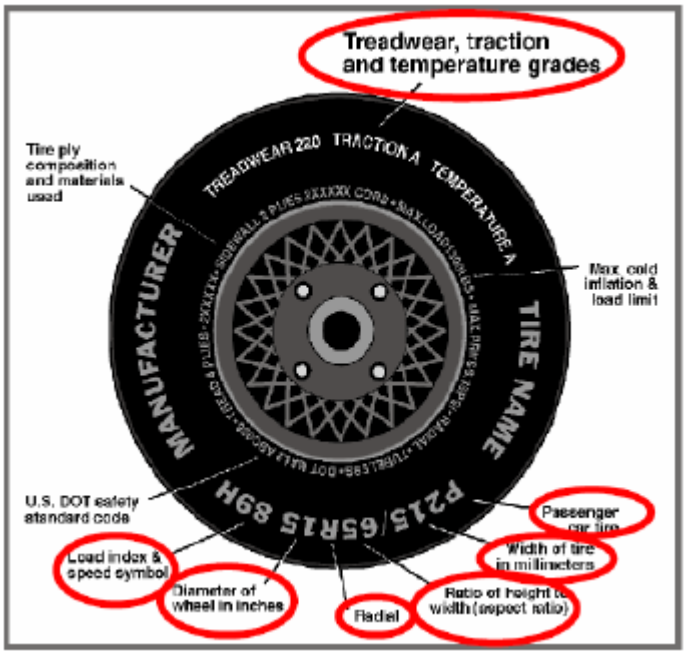
### VEHICLE SEAT TYPE

| Seating Location | Type of Seat Pan | | | | Type of Seat Back | | |
|---|---|---|---|---|---|---|---|
| | Bucket | Bench | Split Bench | Contoured | Fixed | Adjustable | |
| | | | | | | W/ Lever | W/ Knob |
| Front Seat | X | | | | | | X |
| Rear or Second Row Seat | | | X | | X | | |
| Third Row seat | | | | | | | |

**DATA SHEET NO. 1 … (CONTINUED)**
**GENERAL TEST AND VEHICLE PARAMETER DATA**

| | | | |
|---|---|---|---|
| Test Vehicle: | 2020 Volvo S60 four door sedan | NHTSA No.: | M20205901 |
| Test Program: | NCAP Side Pole Impact Test | Test Date: | 3/10/2020 |

*Collected for year, make, model, & VIN, all items circled in red, tire manufacturer and tire name.*




**VEHICLE TIRE INFORMATION**

| Measured Parameter | Front | Rear |
|---|---|---|
| Maximum Tire Pressure (kPa) | 350 | 350 |
| Cold Pressure (kPa) | 250 | 250 |
| Recommended Tire Size | 235/45R18 | 235/45R18 |
| Tire Size on Vehicle | 235/45R18 | 235/45R18 |
| Tire Manufacturer | Continental | Continental |
| Tire Model | ProContact | ProContact |
| Treadwear | 500 | 500 |
| Traction | A | A |
| Temperature Grades | A | A |
| Tire Plies Sidewall | 2 Polyester | 2 Polyester |
| Tire Plies Body | 1 Polyester, 2 Steel, 1 Polyamide | 1 Polyester, 2 Steel, 1 Polyamide |
| Load Index/Speed Symbol | 98H | 98H |
| Tire Material | Rubber | Rubber |
| DOT Safety Code Left | VYFUWCC03519 | VYFUWCC03519 |
| DOT Safety Code Right | VYFUWCC03519 | VYFUWCC03519 |

## DATA SHEET NO. 1 … (CONTINUED)
## GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2020 Volvo S60 four door sedan NHTSA No.: M20205901
Test Program: NCAP Side Pole Impact Test Test Date: 3/10/2020

### TIRE PRESSURES

| | Units | LF | RF | LR | RR |
|---|---|---|---|---|---|
| As Delivered | kPa | 290 | 290 | 290 | 290 |
| Tire Placard | kPa | 250 | 250 | 250 | 250 |
| Owner's Manual | kPa | 250 | 250 | 250 | 250 |
| As Tested | kPa | 250 | 250 | 250 | 250 |

### TEST VEHICLE AXLE WEIGHTS

| | Units | As Delivered (UVW) | | | As Tested (ATW) | | | Fully Loaded | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Front | Rear | Total | Front | Rear | Total | Front | Rear | Total |
| Left | kg | 490 | 368 | | 506 | 407 | | 505 | 425 | |
| Right | kg | 478 | 354 | | 481 | 404 | | 479 | 398 | |
| Ratio | % | 57.3 | 42.7 | | 54.9 | 45.1 | | 54.5 | 45.5 | |
| Totals | kg | 968 | 722 | 1690 | 987 | 811 | 1798 | 984 | 823 | 1807 |

### TARGET TEST WEIGHT CALCULATION

| Measured Parameter | Units | Value | |
|---|---|---|---|
| Total As Delivered Weight (UVW) | kg | 1690 | (A) |
| Actual Weight of 1 P572V (SID-IIs) ATD Used | kg | 50 | (B) |
| Rated Cargo / Luggage Weight (RCLW) | kg | 64.8 | (C) |
| Calculated Vehicle Target Weight (TVTW) | kg | 1804.8 | (A+B+C) |

**Does the measured As Test Vehicle Weight lie within the required weight range (i.e. Calculated Test Vehicle Target Weight – 4.5 kg to – 9 kg)?** [X] **Yes** [ ] **No**

### TEST VEHICLE ATTITUDES AND CG

| Measurement Description | Units | As Delivered | As Tested | Fully Loaded | Meets Rqmt*** |
|---|---|---|---|---|---|
| Driver Door Sill Angle (front-to-rear)* | Deg | -0.9 | -0.7 | -0.7 | Yes |
| Front Passenger Sill Angle (front-to-rear)* | Deg | -0.95 | -0.75 | -0.6 | Yes |
| Front Bumper-Line Angle (left-to-right)** | Deg | +0.1 | +0.1 | +0.05 | Yes |
| Rear Bumper-Line Angle (left-to-right)** | Deg | -0.25 | 0.0 | +0.05 | Yes |
| Vehicle CG (Aft of Front Axle) | mm | 1228 | 1297 | 1309 | |
| Vehicle CG (Left (+) / Right (-) from Longitudinal Centerline) | mm | 13 | 13 | 24 | |

* ND = Nose Down (-), NU = Nose Up (+)
** LD = Left Down (-), LU = Left Up (+)
*** The "As Tested" vehicle attitude measurements must be equal to or between the "As Delivered" and "Fully Loaded" vehicle attitude measurements. Indicate "Yes" or "No" for Meets Requirement"

**DATA SHEET NO. 1 … (CONTINUED)**
**GENERAL TEST AND VEHICLE PARAMETER DATA**

| | | | |
|---|---|---|---|
| Test Vehicle: | 2020 Volvo S60 four door sedan | NHTSA No.: | M20205901 |
| Test Program: | NCAP Side Pole Impact Test | Test Date: | 3/10/2020 |

**WEIGHT OF BALLAST AND VEHICLE COMPONENTS REMOVED TO MEET TVTW**

| Component Description | Weight (kg) |
|---|---|
| Trunk Carpeting | 9 |
| Spare Tire | 14 |
| Jack | 3 |
| | |
| Ballast / Equipment Added | 49 |

| | |
|---|---|
| Test Height – Adjustable Suspension Setting, if Applicable | N/A |

**DATA SHEET NO. 2**
**SEAT, SEAT BELT, STEERING WHEEL ADJUSTMENT AND FUEL SYSTEMS DATA**

| | | | |
|---|---|---|---|
| Test Vehicle: | 2020 Volvo S60 four door sedan | NHTSA No.: | M20205901 |
| Test Program: | NCAP Side Pole Impact Test | Test Date: | 3/10/2020 |

**SEAT POSITIONING**

*The driver's seat, front center seat (if applicable), and right front passenger's seat should be set to the forward-most, mid-height, mid-angle position. The struck-side rear passenger's seat, rear center seat, and non-struck side rear passenger's seats should be set to the rear-most, lowest, mid-angle position.*

**SCRL ANGLE RANGE**

| Seat | SCRL (º) | | |
|---|---|---|---|
| | Max | Min | Mid |
| Driver Seat | 25.1 | 13.1 | 19.1 |
| Front Passenger Seat | 24.9 | 13.1 | 19 |
| Front Center Seat | N/A | N/A | N/A |
| Struck Side Rear Seat | Fixed | Fixed | Fixed |
| Non-Struck Side Rear Seat | Fixed | Fixed | Fixed |
| Rear Center Seat | Fixed | Fixed | Fixed |

**SEAT HEIGHT AND ANGLE**

| Seat | As Tested SCRL Angle (Mid) (º) | As Tested SCRP Height (mm) | SCRP Height Position | SCRP Height (mm) | | |
|---|---|---|---|---|---|---|
| | | | | Rearmost | Mid-Fore / Aft | Forward-Most |
| Driver Seat | 19.1 | 57 | Max | 60 | 73 | 87 |
| | | | Mid | 30 | 43 | 57 |
| | | | Min | 0 | 13 | 27 |
| Front Passenger Seat | 19.0 | 57 | Max | 60 | 75 | 88 |
| | | | Mid | 30 | 43 | 57 |
| | | | Min | 0 | 13 | 28 |
| Front Center Seat | N/A | N/A | Max | - | - | - |
| | | | Mid | - | - | - |
| | | | Min | - | - | - |
| Struck Side Rear Seat | Fixed | Fixed | Max | - | - | - |
| | | | Mid | - | - | - |
| | | | Min | - | - | - |
| Non-Struck Side Rear Seat | Fixed | Fixed | Max | - | - | - |
| | | | Mid | - | - | - |
| | | | Min | - | - | - |
| Rear Center Seat | Fixed | Fixed | Max | - | - | - |
| | | | Mid | - | - | - |
| | | | Min | - | - | - |

**DATA SHEET NO. 2 … (CONTINUED)**
**SEAT, SEAT BELT, STEERING WHEEL ADJUSTMENT AND FUEL SYSTEMS DATA**

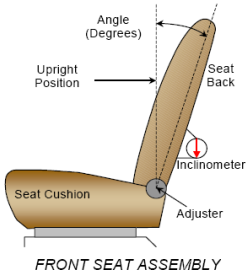
Test Vehicle: 2020 Volvo S60 four door sedan NHTSA No.: M20205901
Test Program: NCAP Side Pole Impact Test Test Date: 3/10/2020

## SEAT FORE / AFT POSITION

| Seat | Total Fore / Aft Travel | | Test Position from Forward most Position | |
|---|---|---|---|---|
| | mm | Detents* | mm | Detents* |
| Driver Seat | 265 | N/A | 0 | N/A |
| Front Passenger Seat | 265 | N/A | 0 | N/A |
| Front Center Seat | N/A | N/A | N/A | N/A |
| Struck Side Rear Seat | FIXED | FIXED | FIXED | FIXED |
| Non-Struck Side Rear Seat | FIXED | FIXED | FIXED | FIXED |
| Rear Center Seat | FIXED | FIXED | FIXED | FIXED |

## SEAT BACK ANGLE ADJUSTMENT

*The driver's seat back is positioned such that the dummy's head is level. The front center and front passenger's seat backs are positioned in a similar manner as the driver's seat back. The struck-side rear passenger seat back is positioned in accordance with the information provided by the manufacturer on Form No. 1 for the 5th percentile female dummy in a Side NCAP MDB test. The rear center and non-struck side rear passenger's seat back are set to match the struck-side rear seat back.*



FRONT SEAT ASSEMBLY

| Seat | Total Seat Back Angle Range | | Test Position from Most Upright | |
|---|---|---|---|---|
| | Degrees | Detents* | Degrees | Detents* |
| Driver Seat w/Seated Dummy | 77 | N/A | 12.2 | N/A |
| Front Passenger Seat | 78 | N/A | 12.2 | N/A |
| Front Center Seat | N/A | N/A | N/A | N/A |
| Struck Side Rear Seat | FIXED | FIXED | FIXED | FIXED |
| Non-Struck Side Rear Seat | FIXED | FIXED | FIXED | FIXED |
| Rear Center Seat | FIXED | FIXED | FIXED | FIXED |

## SEAT BELT ANCHORAGE ADJUSTMENT

*Seat belt anchorages are adjusted in accordance with the information provided by the manufacturer on Form No. 1. Zero is defined as the uppermost detent*

| Seat | Total # of Positions | Placed in Position # |
|---|---|---|
| Driver Seat | 4 (0-3) | 0 |

## HEAD RESTRAINT ADJUSTMENT

*The driver's head restraint is adjusted to the lowest and most full forward in-use position.*

| Seat | Total # of Positions | Placed in Position # |
|---|---|---|
| Driver Seat | Fixed | Fixed |

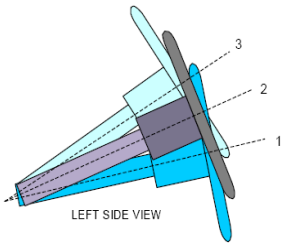
## DATA SHEET NO. 2 … (CONTINUED)
## SEAT, SEAT BELT, STEERING WHEEL ADJUSTMENT AND FUEL SYSTEMS DATA

| | | | |
|---|---|---|---|
| Test Vehicle: | 2020 Volvo S60 four door sedan | NHTSA No.: | M20205901 |
| Test Program: | NCAP Side Pole Impact Test | Test Date: | 3/10/2020 |

### STEERING COLUMN ADJUSTMENT

*Steering wheel and column adjustments are made so that the steering wheel hub is at the center of its geometric locus it describes when it moves through its full range of motion.*

| | Degrees | Fore / Aft Position (mm) |
|---|---|---|
| Lowermost – Position 1 | 16.2 | |
| Geometric Center – Position 2 | 19.2 | |
| Uppermost – Position 3 | 22.2 | |
| Telescoping Steering Wheel Travel | | 55 |
| Test Position | 19.2 | 22.5 |

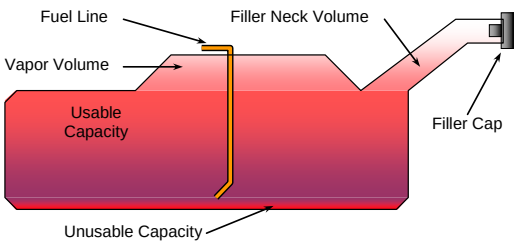


*STEERING COLUMN ASSEMBLY*

### FUEL PUMP

*Describe the fuel pump type, details about how it operates, and the location of the fuel filler neck.*

The vehicle is equipped with an electric fuel pump. The fuel filler neck is on the right side of the vehicle. The pump creates positive pressure in the fuel lines, pushing the gasoline to the engine. See form 1 for more information.



*VEHICLE FUEL TANK ASSEMBLY*

### FUEL TANK CAPACITY DATA

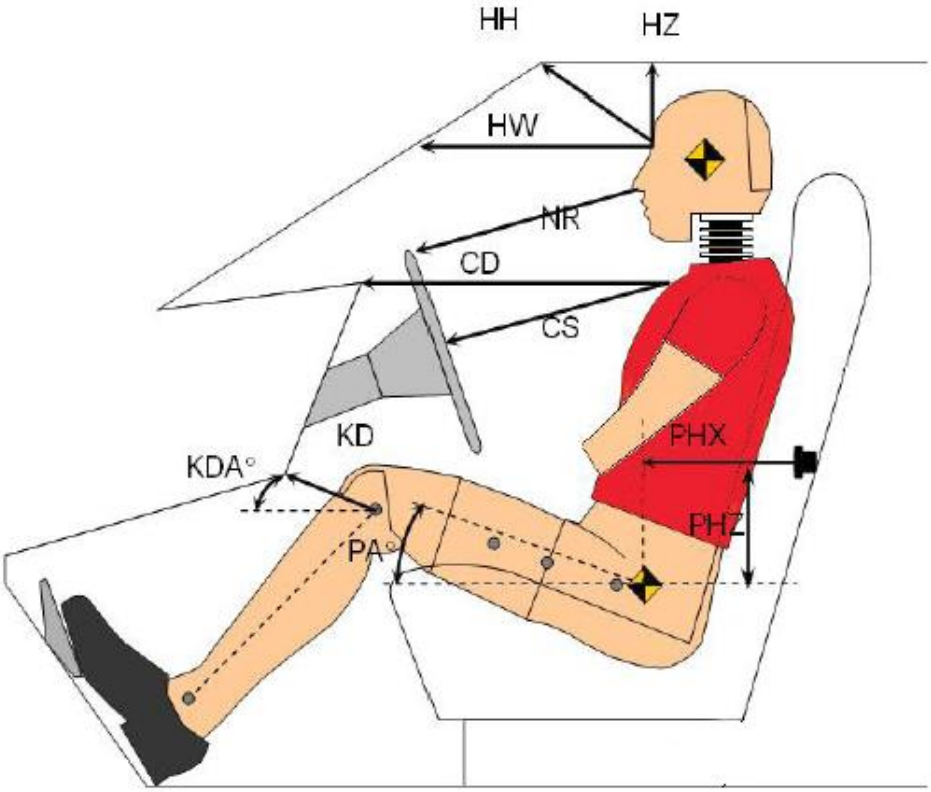
| Description | | | Liters |
|---|---|---|---|
| Usable Capacity of “Standard Tank” | - | see Form No. 1 | 60 |
| Usable Capacity of “Optional Tank” | - | see Form No. 1 | N/A |
| Usable Capacity of “Standard Tank” | - | see Owner’s Manual | 60 |
| Usable Capacity of “Optional Tank” | - | see Owner’s Manual | N/A |
| 93% of Usable Capacity | | | 55.8 |
| Actual Amount of Solvent Used in Test | | | 55.8 |
| 1/3 of Usable Capacity | | | 20 |

Is the Actual Amount of Solvent Used in the test equal to 93% ±1% of the Usable Capacity stated in Form No. 1?

[X] Yes [ ] No

**DATA SHEET NO. 3**
**DUMMY LONGITUDINAL CLEARANCE DIMENSIONS**

| | | | |
|---|---|---|---|
| Test Vehicle: | 2020 Volvo S60 four door sedan | NHTSA No.: | M20205901 |
| Test Program: | NCAP Side Pole Impact Test | Test Date: | 3/10/2020 |



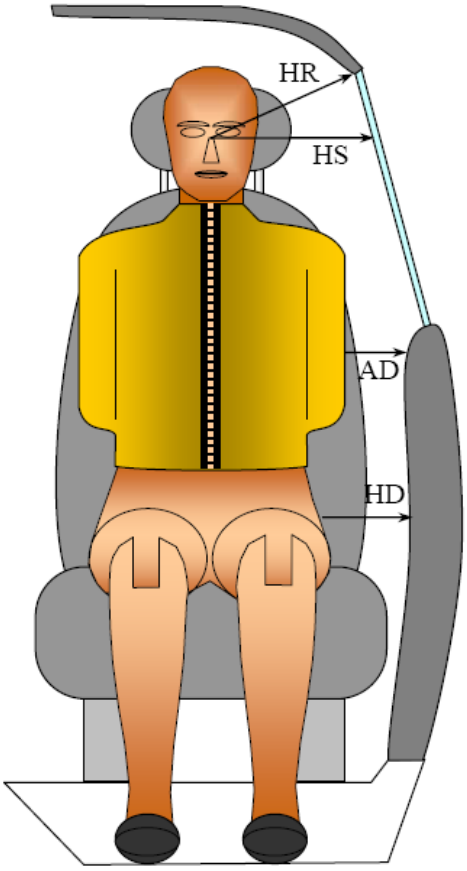

**Left Side View**

**DUMMY LONGITUDINAL CLEARANCE DIMENSION INFORMATION**

| Driver Code | Description | Driver (Serial No. DG8012) | |
|---|---|---|---|
| | | Length (mm) | Angle (◦) |
| HH | Head to Header | 252 | |
| HW | Head to Windshield | 578 | |
| HZ | Head to Roof Liner | 170 | |
| NR | Nose to Rim | 208 | |
| CD | Chest to Dash | 380 | |
| CS | Chest to Steering Wheel | 173 | |
| KD(L) / KDA(L)◦ | Left Knee to Dash | 162 | 23.9 |
| KD(R) / KDA(R)◦ | Right Knee to Dash | 170 | 14.0 |
| PAX◦ | Pelvic Tilt Angle (X-Axis) | | 20.2 |
| PAY◦ | Pelvic Tilt Angle (Y-Axis) | | 0.3 |
| PHX | Hip Point to Striker (X-Axis) | 302 | |
| PHZ | Hip Point to Striker (Z-Axis) | 179 | |

**DATA SHEET NO. 4**
**DUMMY LATERAL CLEARANCE DIMENSIONS**

| | | | |
|---|---|---|---|
| Test Vehicle: | 2020 Volvo S60 four door sedan | NHTSA No.: | M20205901 |
| Test Program: | NCAP Side Pole Impact Test | Test Date: | 3/10/2020 |



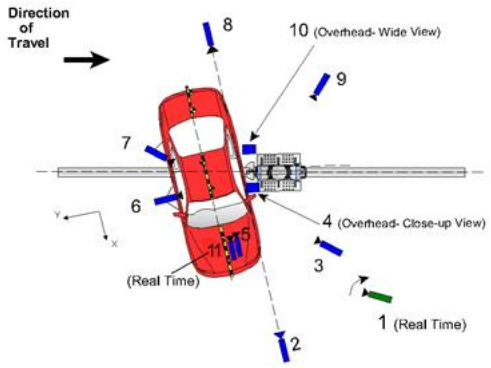

*FRONT VIEW OF DUMMY*

**DUMMY LATERAL CLEARANCE DIMENSION INFORMATION**

| Code | Measurement Description | Units | Driver - Length (Serial No. DG8012) |
|---|---|---|---|
| HR | Head To Side Header | mm | 210 |
| HS | Head to Side Window | mm | 355 |
| AD | Arm to Door | mm | 156 |
| HD | Hip Point to Door | mm | 165 |

**DATA SHEET NO. 5**
**CAMERA AND INSTRUMENTATION DATA**

Test Vehicle: 2020 Volvo S60 four door sedan NHTSA No.: M20205901
Test Program: NCAP Side Pole Impact Test Test Date: 3/10/2020




**CAMERA LOCATIONS AND DATA**

| No. | Camera View | Coordinates (mm) | | | Lens Length (mm) | Operating Frame Rate (fps) |
|---|---|---|---|---|---|---|
| | | X | Y | Z | | |
| 1 | Real-time (24 - 30 fps) pan view of impact | | | | Zoom | 60 |
| 2 | Front ground level - impact view | 7940 | 0 | -1447 | 28 | 1000 |
| 3 | Impact side 45º - forward pole view | 5026 | -1194 | -1264 | 24 | 1000 |
| 4 | Overhead Close-up view of impact | 0 | 0 | -9375 | 28 | 1000 |
| 5 | Onboard - dummy front view | | | | 25 | 1000 |
| 6 | Onboard - dummy side view | | | | 12.5 | 1000 |
| 7 | Onboard - dummy rear oblique view | | | | 12.5 | 1000 |
| 8 | Rear ground level - impact view | -8715 | 0 | -1265 | 28 | 1000 |
| 9 | Impact side 45º - rearward pole view | -3824 | -4220 | -1294 | 24 | 1000 |
| 10 | Overhead wide - view of impact | 0 | 0 | -9375 | 12.5 | 1000 |
| 11 | Real-time (24 - 30 fps) - dummy front view | | | | Zoom | 60 |

*Notes:* *Reference - From Point of Impact for X and Y; from Ground for Z*
*+X = Forward of vehicle, +Y = Right of vehicle, +Z = Down*
** All measurements accurate to ± 6 mm.* *Vehicle is at a 75º angle to the rigid pole.*

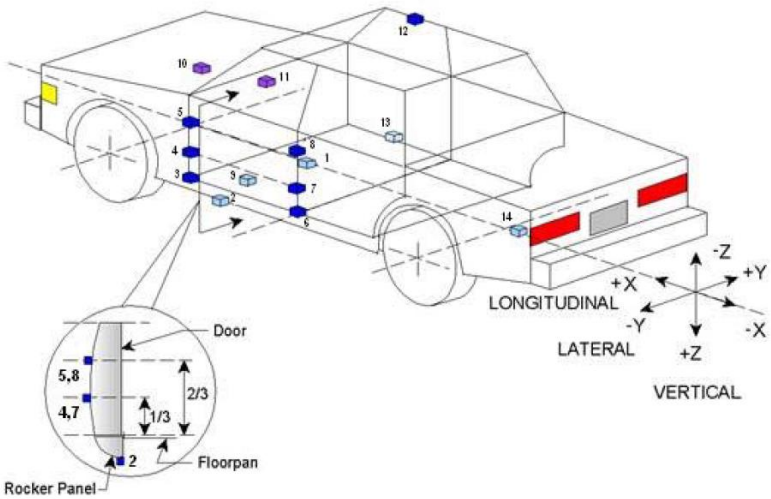
*Comments:* All cameras operated as intended.

**INSTRUMENTATION**

| Description | Number of Channels |
|---|---|
| Driver Dummy Channels | 16 |
| Vehicle Structure Accelerometers | 18 |
| Pole Load Cells | 8 |
| Total | 42 |

**DATA SHEET NO. 6**
**VEHICLE ACCELEROMETER DATA**

| | | | |
|---|---|---|---|
| Test Vehicle: | 2020 Volvo S60 four door sedan | NHTSA No.: | M20205901 |
| Test Program: | NCAP Side Pole Impact Test | Test Date: | 3/10/2020 |




**TEST VEHICLE ACCELEROMETER LOCATIONS**

| No. | Accelerometer Location | Coordinates (mm) | | |
|---|---|---|---|---|
| | | X | Y | Z |
| 1 | Vehicle CG | 2476 | -25 | -239 |
| 2 | Left Floor Sill | 2923 | -686 | 119 |
| 3 | A-Pillar Sill | 3085 | -652 | -579 |
| 4 | A-Pillar Low | 3178 | -670 | 103 |
| 5 | A-Pillar Mid | 3192 | -672 | -138 |
| 6 | B-Pillar Sill | 2095 | -637 | -531 |
| 7 | B-Pillar Low | 2193 | -688 | 138 |
| 8 | B-Pillar Mid | 2203 | -704 | -195 |
| 9 | Driver Seat Track | 2395 | -566 | 151 |
| 10 | Engine Top | 4135 | 283 | -357 |
| 11 | Firewall | 3656 | 210 | -245 |
| 12 | Right Roof | 2217 | 582 | -973 |
| 13 | Right Floor Sill | 2912 | 680 | 138 |
| 14 | Rear Floorpan | 922 | -2 | -68 |

*Reference:* *X – Rear surface of vehicle (+ forward)*
*Y – Vehicle centerline (+ to right)*
*Z – Ground plane (+ down)*

**DATA SHEET NO. 7**
**RIGID POLE LOAD CELL DATA**

| | | | |
|---|---|---|---|
| Test Vehicle: | 2020 Volvo S60 four door sedan | NHTSA No.: | M20205901 |
| Test Program: | NCAP Side Pole Impact Test | Test Date: | 3/10/2020 |

**POLE BARRIER**

**RIGID POLE LOAD CELL LOCATIONS**

| ID | Units | Height From Ground |
|---|---|---|
| 1 | mm | 200 |
| 2 | mm | 590 |
| 3 | mm | 750 |
| 4 | mm | 1075 |
| 5 | mm | 1260 |
| 6 | mm | 1740 |
| 7 | mm | 1920 |
| 8 | mm | 2300 |

**DATA SHEET NO. 8**
**POST-TEST OBSERVATIONS**

Test Vehicle: 2020 Volvo S60 four door sedan NHTSA No.: M20205901
Test Program: NCAP Side Pole Impact Test Test Date: 3/10/2020

## TEST DUMMY INFORMATION AND CONTACT POINTS

| Dummy Body Part | Driver Seat Dummy (SID-IIs) |
|---|---|
| Face | None |
| Top of Head | Curtain Airbag |
| Left Side of Head | Curtain Airbag |
| Back of Head | Curtain Airbag & Head Rest |
| Left Shoulder | Torso/Pelvis Airbag & Seatback |
| Upper Torso | Torso/Pelvis Airbag & Seatback |
| Lower Torso | Seatback |
| Left Hip | Torso/Pelvis Airbag, Seatback & Seat Pan |
| Left Knee | Driver Door |

## POST-TEST DOOR PERFORMANCE

| Description | Struck Side | | Non-Struck Side | | Rear Hatch/ Other |
|---|---|---|---|---|---|
| | Front | Rear | Front | Rear | |
| Remained Closed and Operational | No | No | Yes | Yes | Yes |
| Total Separation from Vehicle at Hinges or Latches | No | No | No | No | No |
| Latch or Hinge Systems Pulled Out of Their Anchorages | No | No | No | No | No |
| Disengaged from Latched Position | No | No | No | No | No |
| Latch Separated from Striker | No | No | No | No | No |
| Jammed Shut | Yes | Yes | No | No | No |
| If Door Opened at Striker, Width of Opening at Striker (mm) | 0 | 0 | 0 | 0 | 0 |

## POST-TEST SEAT PERFORMANCE

| Description | Struck Side | | Non-Struck Side | |
|---|---|---|---|---|
| | Front | Rear | Front | Rear |
| Seat Movement Along Seat Track | No | No | No | No |
| Seat Disengagement from Floor Pan | No | No | No | No |
| Seat Back Movement from Initial Position | No | No | No | No |
| Seat Back Collapse | No | No | No | No |

**DATA SHEET NO. 8 … (CONTINUED)**
**POST-TEST OBSERVATIONS**

Test Vehicle: 2020 Volvo S60 four door sedan NHTSA No.: M20205901
Test Program: NCAP Side Pole Impact Test Test Date: 3/10/2020

## POST-TEST STRUCTURAL OBSERVATIONS

| Critical Areas of Performance | Observations and Conclusions |
|---|---|
| Pillar Performance | A-Pillar & C-Pillar Buckled |
| Sill Separation | None |
| Windshield Damage | Cracks throughout with separation along driver A-Pillar |
| Side Window Damage | Driver window shattered |
| Other Notable Effects | None |

## SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

| Restraint Type | Struck Side Driver | | Struck Side Rear Passenger | |
|---|---|---|---|---|
| | Mounted | Deployed | Mounted | Deployed |
| Frontal Airbag | Yes | No | | |
| Knee Airbag | Yes | No | | |
| Side Airbag 1 - Curtain | Yes | Yes | Yes | Yes |
| Side Airbag 2 – Torso/Pelvis | Yes | Yes | No | N/A |
| Seat Belt Pretensioner | Yes | Yes | Yes | Yes |
| Seat Belt Load Limiter | Yes | Yes | Yes | Yes |
| Other | | | | |

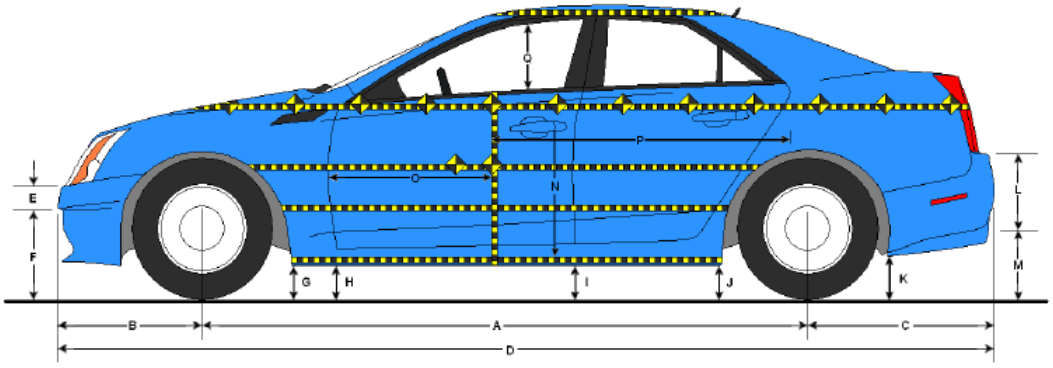
## VEHICLE SPEED, VEHICLE ANGLE AT IMPACT AND IMPACT POINT LOCATION DATA

| Measured Parameter | | Units | Tolerance | Value |
|---|---|---|---|---|
| Vertical Impact Ref Line | - Aft of Front Axle, Intended Impact Pt | mm | | 1282 |
| Actual Impact Point | - Aft of Front Axle | mm | | 1289 |
| Horizontal Offset (+ forward / - rearward) | | mm | +/- 38 * | -7 |
| Angle Between Vehicle's Longitudinal Centerline and Line of Forward Motion | | deg | 75 +/- 3 | 75.0 |
| Trap No. 1 Velocity | - Primary | kph | 31.4 to 33.0 | 32.21 |
| Trap No. 2 Velocity | - Redundant | kph | 31.4 to 33.0 | 32.23 |

* Of Intended Impact Point

**DATA SHEET NO. 9**
**TEST VEHICLE PROFILE MEASUREMENTS**

| | | | |
|---|---|---|---|
| Test Vehicle: | 2020 Volvo S60 four door sedan | NHTSA No.: | M20205901 |
| Test Program: | NCAP Side Pole Impact Test | Test Date: | 3/10/2020 |




LEFT SIDE VIEW

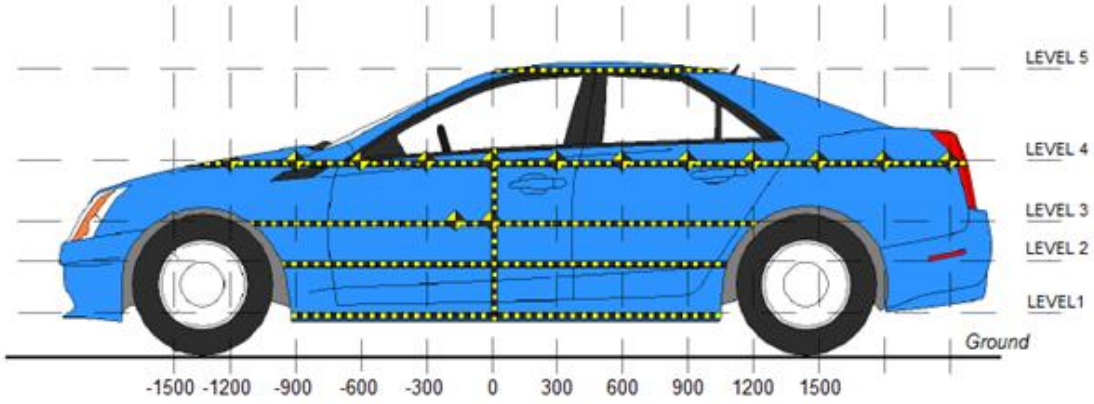
**VEHICLE PRE- AND POST-TEST MEASUREMENT INFORMATION**

| Code | Description | Pre-Test | Post-Test | Difference |
|---|---|---|---|---|
| A | Vehicle Wheelbase | 2875 | 2810 | 65 |
| B | Front Axle to FSOV | 848 | 888 | -40 |
| C | Rear Axle to RSOV | 1041 | 1042 | -1 |
| D | Total Length at Centerline | 4764 | 4740 | 24 |
| E | Front Bumper Thickness | 258 | 258 | 0 |
| F | Front Bumper Bottom to Ground | 218 | 236 | -18 |
| G | Sill Height at Front Wheel Well | 156 | 160 | -4 |
| H | Sill Height at Front Door Leading Edge | 164 | 155 | 9 |
| I | Sill Height at B-Pillar | 177 | 177 | 0 |
| J1 | Sill Height at Rear Wheel Well | 176 | 188 | -12 |
| J2 | Pinch Weld Height at Rear Wheel Well | 168 | 173 | -5 |
| K | Sill Height Aft of Rear Wheel Well | 220 | 220 | 0 |
| L | Rear Bumper Thickness | 155 | 155 | 0 |
| M | Rear Bumper Bottom to Ground | 320 | 313 | 7 |
| N | Sill Height to Bottom of Front Window Sill | 709 | 713 | -4 |
| O | Front Door Leading Edge to Impact CL | 621 | 557 | 64 |
| P | Rear Door Trailing Edge to Impact CL | 1421 | 1351 | 70 |
| Q | Front Window Opening | 363 | 367 | -4 |
| R | Right Side Length | 4682 | 4682 | 0 |
| S | Left Side Length | 4678 | 4634 | 44 |
| T | Vehicle Width at B-Pillars | 1852 | 1743 | 109 |

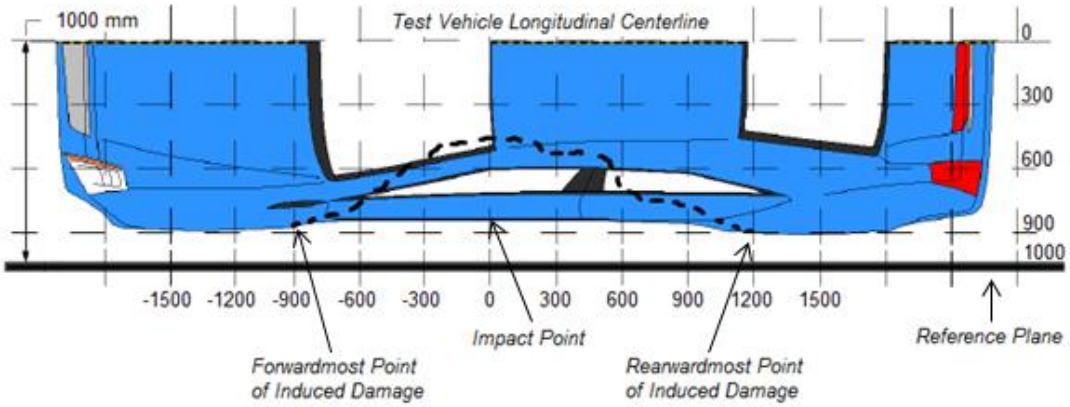
* All measurements in mm with tolerance of ± 3mm

**DATA SHEET NO. 10**
**TEST VEHICLE EXTERIOR CRUSH MEASUREMENTS**

| | | | |
|---|---|---|---|
| Test Vehicle: | 2020 Volvo S60 four door sedan | NHTSA No.: | M20205901 |
| Test Program: | NCAP Side Pole Impact Test | Test Date: | 3/10/2020 |




***Left Side View***




***Overhead View***

**MAXIMUM EXTERIOR CRUSH MEASUREMENTS**

| Level | Measurement Description | Units | Height Above Ground | Maximum Exterior Static Crush | Distance from Impact |
|---|---|---|---|---|---|
| 1 | Sill Top | mm | 280 | 294 | 0 |
| 2 | Occupant Hip Point | mm | 523 | 305 | 0 |
| 3 | Mid - Door | mm | 626 | 318 | 0 |
| 4 | Window Sill | mm | 915 | 269 | 0 |
| 5 | Window Top | mm | 1369 | 95 | 150 |

***NOTE:*** *The above measurements should be taken along the vertical impact reference line. Vehicle measurements forward of the vertical impact reference line are negative.*

## DATA SHEET NO. 10 … (CONTINUED)
## TEST VEHICLE EXTERIOR CRUSH MEASUREMENTS

Test Vehicle: 2020 Volvo S60 four door sedan NHTSA No.: M20205901
Test Program: NCAP Side Pole Impact Test Test Date: 3/10/2020

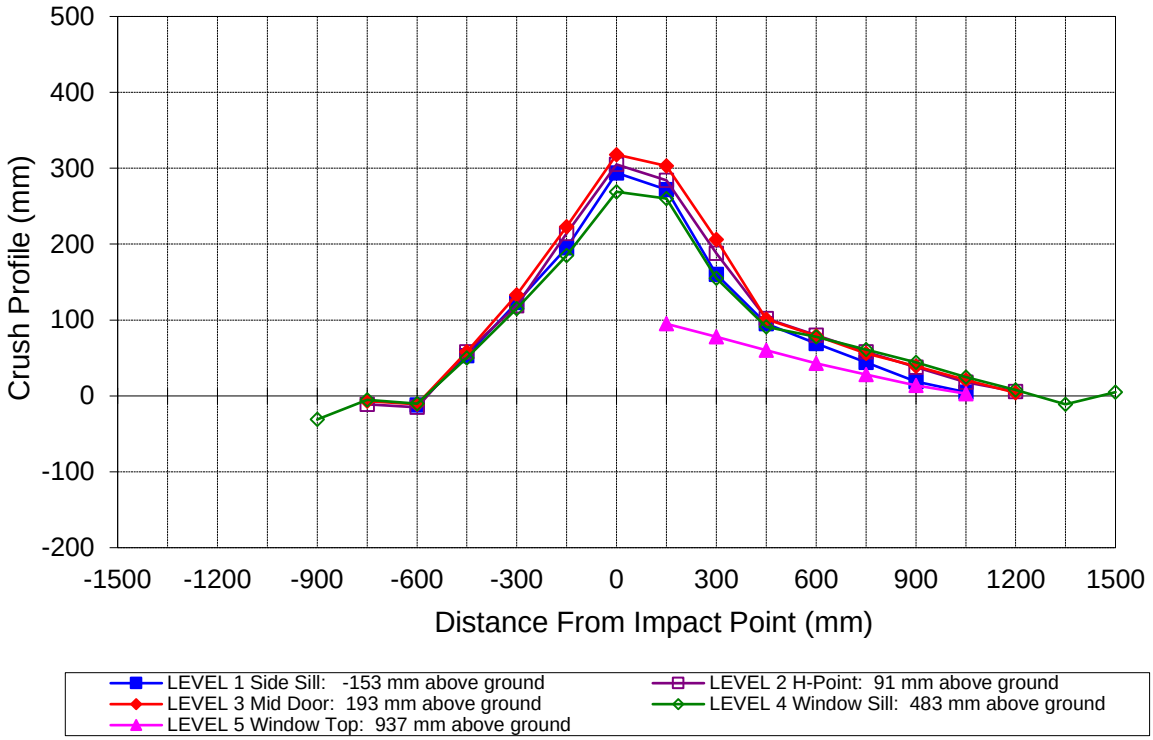
### EXTERIOR CRUSH MEASUREMENTS AT EACH LEVEL

| | Pre-Test | | | | | Post-Test | | | | | Difference | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 | 1 | 2 | 3 | 4 | 5 |
| **-1500** | | | | | | | | | | | | | | | |
| **-1350** | | | | | | | | | | | | | | | |
| **-1200** | | | | | | | | | | | | | | | |
| **-1050** | | | | | | | | | | | | | | | |
| **-900** | | | | 766 | | | | | 797 | | | | | -31 | |
| **-750** | | 905 | 907 | 804 | | | 916 | 914 | 809 | | | -11 | -7 | -5 | |
| **-600** | 899 | 900 | 907 | 821 | | 911 | 915 | 918 | 831 | | -12 | -15 | -11 | -10 | |
| **-450** | 900 | 899 | 909 | 829 | | 847 | 841 | 851 | 779 | | 53 | 58 | 58 | 50 | |
| **-300** | 901 | 899 | 911 | 834 | | 778 | 780 | 778 | 719 | | 123 | 119 | 133 | 115 | |
| **-150** | 900 | 899 | 911 | 839 | | 705 | 685 | 688 | 654 | | 195 | 214 | 223 | 185 | |
| **0** | 900 | 899 | 911 | 845 | | 606 | 594 | 593 | 576 | | 294 | 305 | 318 | 269 | |
| **150** | 899 | 897 | 911 | 850 | 593 | 627 | 613 | 608 | 590 | 498 | 272 | 284 | 303 | 260 | 95 |
| **300** | 896 | 897 | 909 | 853 | 604 | 736 | 709 | 703 | 698 | 526 | 160 | 188 | 206 | 155 | 78 |
| **450** | 893 | 895 | 907 | 855 | 604 | 798 | 793 | 806 | 764 | 544 | 95 | 102 | 101 | 91 | 60 |
| **600** | 889 | 894 | 904 | 857 | 602 | 820 | 814 | 825 | 779 | 559 | 69 | 80 | 79 | 78 | 43 |
| **750** | 885 | 893 | 901 | 857 | 600 | 841 | 835 | 845 | 796 | 572 | 44 | 58 | 56 | 61 | 28 |
| **900** | 877 | 894 | 899 | 856 | 596 | 858 | 856 | 860 | 812 | 582 | 19 | 38 | 39 | 44 | 14 |
| **1050** | 884 | 900 | 903 | 855 | 579 | 879 | 882 | 882 | 830 | 576 | 5 | 18 | 21 | 25 | 3 |
| **1200** | | 915 | 913 | 852 | | | 909 | 909 | 844 | | | 6 | 4 | 8 | |
| **1350** | | | | 850 | | | | | 861 | | | | | -11 | |
| **1500** | | | | 842 | | | | | 837 | | | | | 5 | |

***NOTE:*** *Pre-test measurements are taken when the vehicle is in the "As Tested" weight condition. Vehicle measurements forward of the vertical impact reference line are negative. The crush profile grid is established prior to the test based on an estimated impact point. The final distance from impact is determined after the final dummy positioning and the pole is aligned with the center of gravity of the dummy's head.*

**DATA SHEET NO. 10 … (CONTINUED)**
**TEST VEHICLE EXTERIOR CRUSH MEASUREMENTS**

| | | | |
|---|---|---|---|
| Test Vehicle: | 2020 Volvo S60 four door sedan | NHTSA No.: | M20205901 |
| Test Program: | NCAP Side Pole Impact Test | Test Date: | 3/10/2020 |

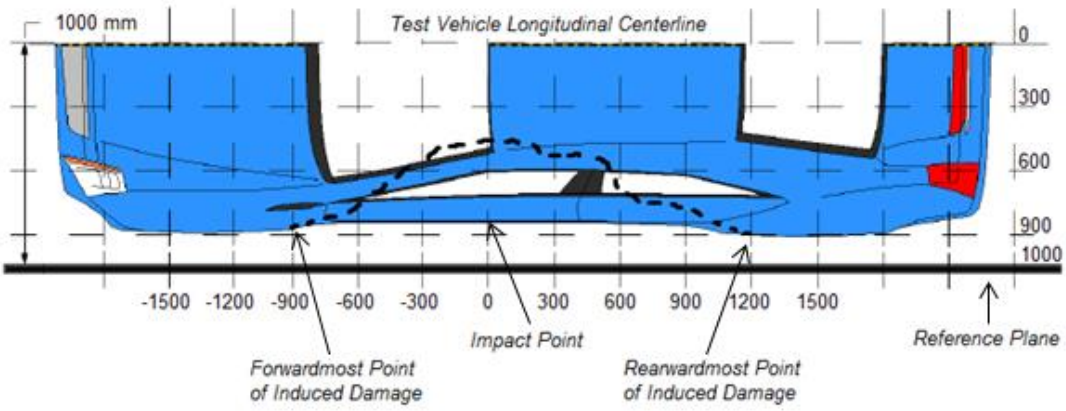



***Vehicle Exterior Crush Measurements - Visual Representation***

**DATA SHEET NO. 11**
**VEHICLE DAMAGE PROFILE DISTANCES**

| | | | |
|---|---|---|---|
| Test Vehicle: | 2020 Volvo S60 four door sedan | NHTSA No.: | M20205901 |
| Test Program: | NCAP Side Pole Impact Test | Test Date: | 3/10/2020 |

For guidance regarding damage profile distance measurements, please refer to the latest version of the *NHTSA Test Reference Guide, Volume 1: Vehicle Tests.*




***Overhead View***

**VEHICLE DAMAGE PROFILE DISTANCES**

| DPD | Distance From Impact Point (mm) | Level | Post-Test (mm) | Pre-Test (mm) | Crush (mm) |
|---|---|---|---|---|---|
| 1 | -750 | 3 | 86 | 93 | -7 |
| 2 | -360 | 3 | 193 | 90 | 103 |
| 3 | 30 | 3 | 404 | 89 | 315 |
| 4 | 420 | 3 | 215 | 93 | 122 |
| 5 | 810 | 3 | 149 | 100 | 49 |
| 6 | 1200 | 3 | 91 | 87 | 4 |

**DATA SHEET NO. 12**
**FMVSS NO. 301 STATIC ROLLOVER RESULTS**

| | | | |
|---|---|---|---|
| Test Vehicle: | 2020 Volvo S60 four door sedan | NHTSA No.: | M20205901 |
| Test Program: | NCAP Side MDB Impact Test | Test Date: | 3/10/2020 |
| Test Time: | 8:24 AM | Temperature: | 21º C |

A. From impact until vehicle motion ceases: (Maximum allowable is 1 oz.) — 0 oz.

B. For the 5-minute period after motion ceases: (Maximum allowable is 5 oz.) — 0 oz.

C. For the following 25 minutes: (Maximum allowable is 1 oz./minute) — 0 oz.

D. Spillage Details: — No Spillage Occurred

**FMVSS NO. 301 STATIC ROLLOVER DATA**


**ROLLOVER SOLVENT COLLECTION TIME TABLE IN SECONDS**

| Test Phase | Rotation Time | Hold Time | Total Time |
|---|---|---|---|
| 0° to 90° | 70 | 300 | 370 |
| 90° to 180° | 69 | 300 | 369 |
| 180° to 270° | 70 | 300 | 370 |
| 270° to 360° | 69 | 300 | 369 |

**FMVSS NO. 301 ROLLOVER SPILLAGE TABLE**

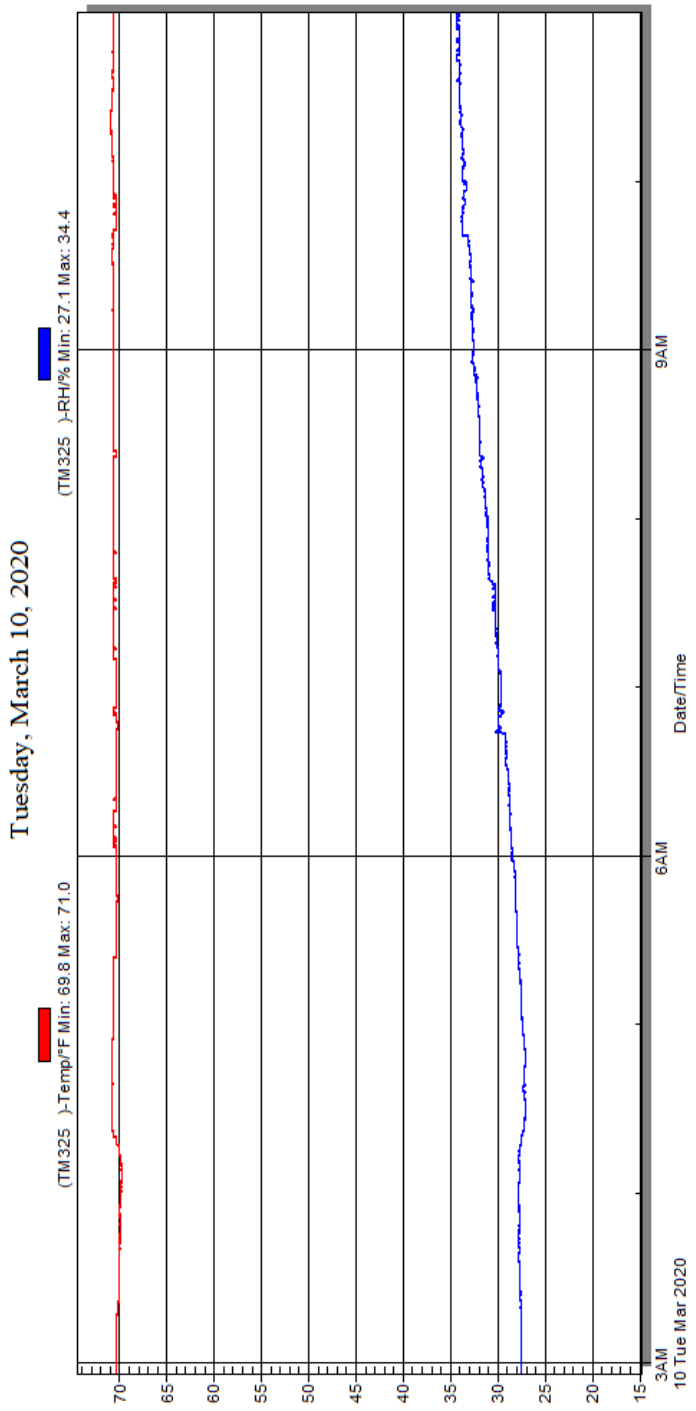
| Test Phase | First 5 Minutes | Sixth Minute | Seventh Minute | Eighth Minute |
|---|---|---|---|---|
| 0° to 90° | 0 | 0 | 0 | 0 |
| 90° to 180° | 0 | 0 | 0 | 0 |
| 180° to 270° | 0 | 0 | 0 | 0 |
| 270° to 360° | 0 | 0 | 0 | 0 |

**ROLLOVER SOLVENT SPILLAGE LOCATION TABLE**

| Test Phase | Spillage Location |
|---|---|
| 0° to 90° | No Spillage Occurred |
| 90° to 180° | No Spillage Occurred |
| 180° to 270° | No Spillage Occurred |
| 270° to 360° | No Spillage Occurred |

**DATA SHEET NO. 13**
**DUMMY / VEHICLE TEMPERATURE AND HUMIDITY STABILIZATION DATA**

| | | | |
|---|---|---|---|
| Test Vehicle: | 2020 Volvo S60 four door sedan | NHTSA No.: | M20205901 |
| Test Program: | NCAP Side Pole Impact Test | Test Date: | 3/10/2020 |




***Temperature and Humidity Stabilization Chart / Data for Dummies and Test Vehicle***

# APPENDIX A

# PHOTOGRAPHS

## TABLE OF PHOTOGRAPHS


**Figure A-1: As Delivered Right Front ¾ View of Test Vehicle**


**Figure A-2: As Delivered Left Rear ¾ View of Test Vehicle**


**Figure A-3: Pre-Test Frontal View of Test Vehicle**


**Figure A-4: Post-Test Frontal View of Test Vehicle**


**Figure A-5: Pre-Test Left Front ¾ View of Test Vehicle**


**Figure A-6: Post-Test Left Front ¾ View of Test Vehicle**


**Figure A-7: Pre-Test Left Side View of Test Vehicle**


**Figure A-8: Post-Test Left Side View of Test Vehicle**


**Figure A-9: Pre-Test Left Rear ¾ View of Test Vehicle**


**Figure A-10: Post-Test Left Rear ¾ View of Test Vehicle**


**Figure A-11: Pre-Test Rear View of Test Vehicle**


**Figure A-12: Post-Test Rear View of Test Vehicle**


**Figure A-13: Pre-Test Right Side View of Test Vehicle**


**Figure A-14: Post-Test Right Side View of Test Vehicle**


**Figure A-15: Pre-Test Overhead View of Test Area**

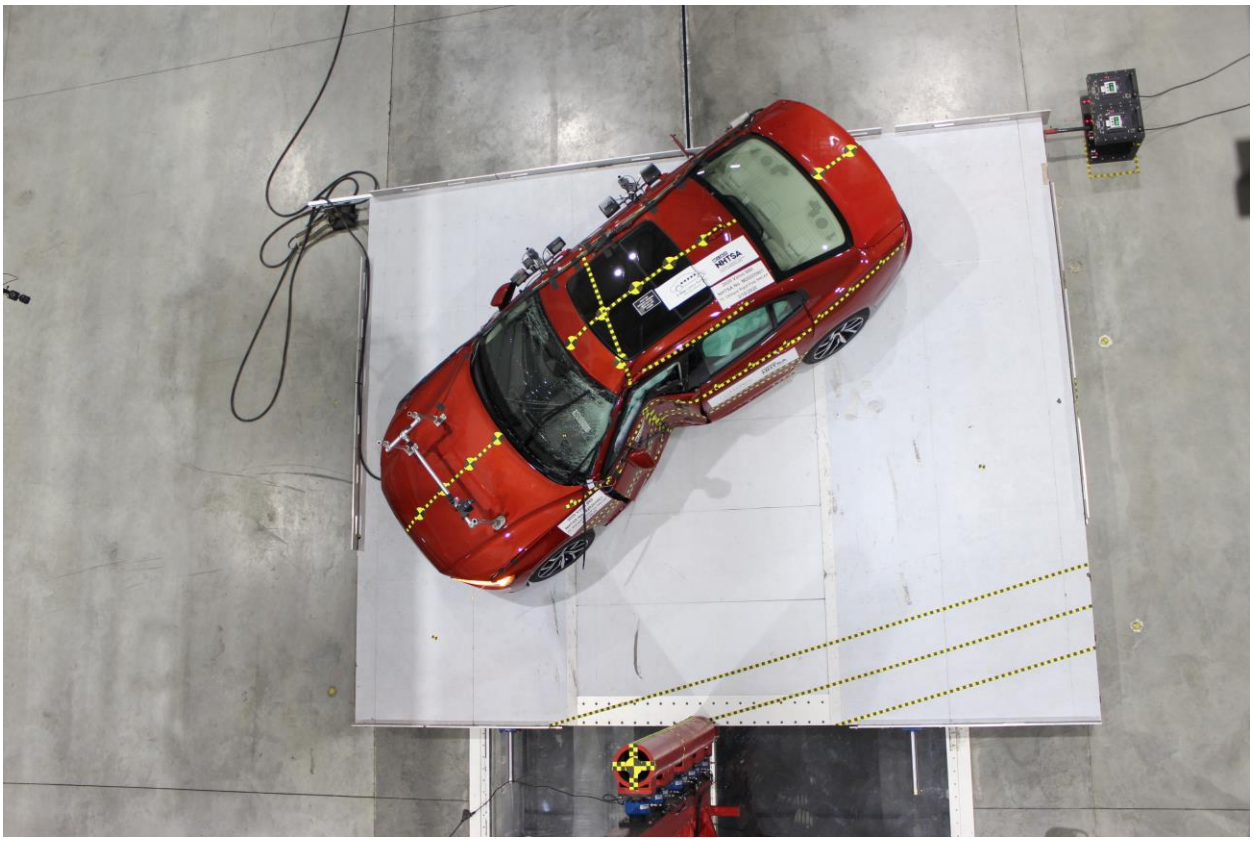



**Figure A-16: Post-Test Overhead View of Test Area**


**Figure A-17: Pre-Test Left Side View of Pole Positioned Against Side of Vehicle**


**Figure A-18: Pre-Test Right Side View of Pole Positioned Against Side of Vehicle**

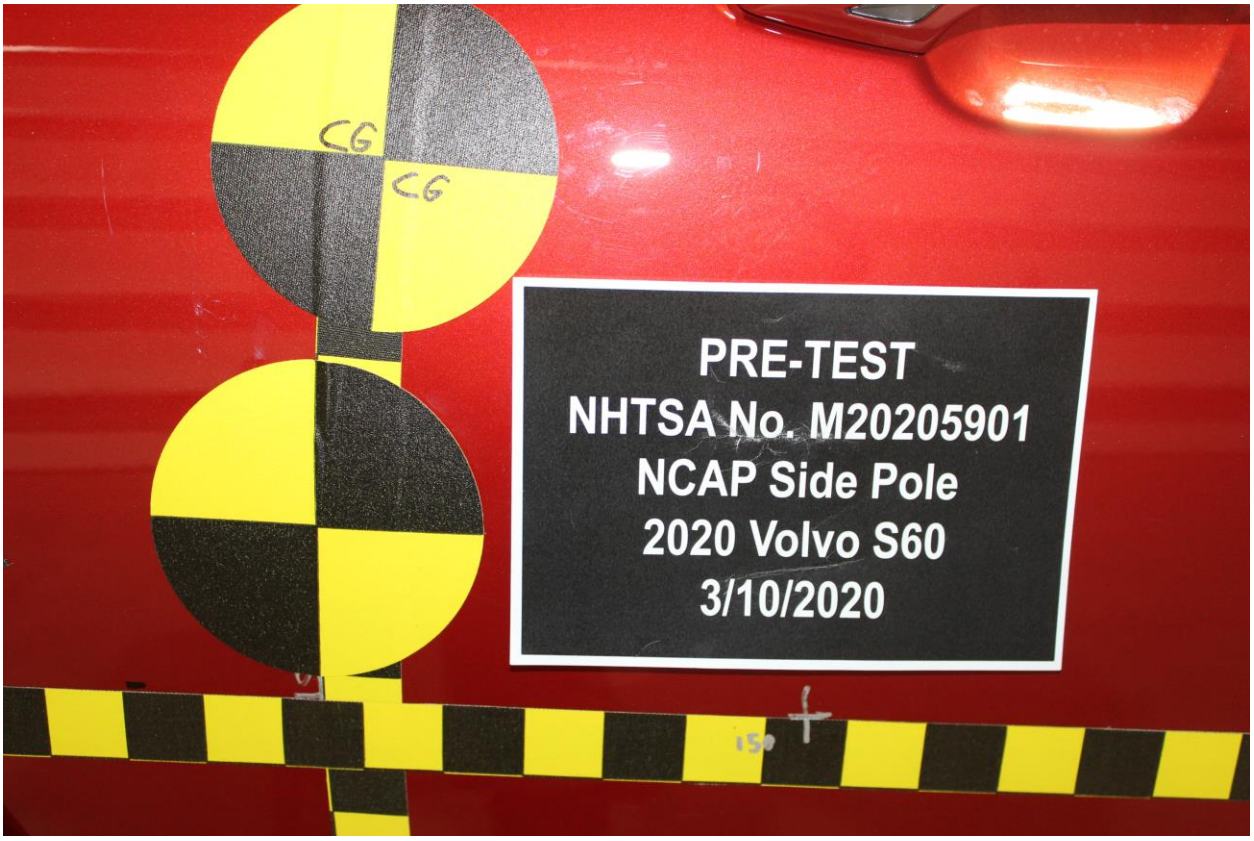



**Figure A-19: Pre-Test Close-Up View of Impact Point Target**


**Figure A-20: Post-Test Close-Up View of Impact Point Target Showing Impact Location**


**Figure A-21: Pre-Test Front Close-Up View of Dummy Head and Chest**


**Figure A-22: Post-Test Front Close-Up View of Dummy**


**Figure A-23: Pre-Test Left Side View of Dummy Showing Belt and Chalking**


**Figure A-24: Pre-Test Left Side View of Dummy Shoulder and Door Top View**


**Figure A-25: Post-Test Left Side View of Dummy Shoulder and Door Top View**


**Figure A-26: Pre-Test Frontal View of Seat Back Prior to Dummy Positioning**


**Figure A-27: Pre-Test Frontal Close-Up View of Dummy Head / Shoulders in Relation to Head Restraint**


**Figure A-28: Pre-Test Frontal View of Seat Pan Prior to Dummy Positioning**


**Figure A-29: Pre-Test Overhead View of Dummy Thighs on Seat Pan**


**Figure A-30: Pre-Test Left Side View of Dummy's Neck Showing Position of Adjustable Neck Bracket**


**Figure A-31: Pre-Test Left Side View of Dummy's Head Showing Dummy's Head is Level**

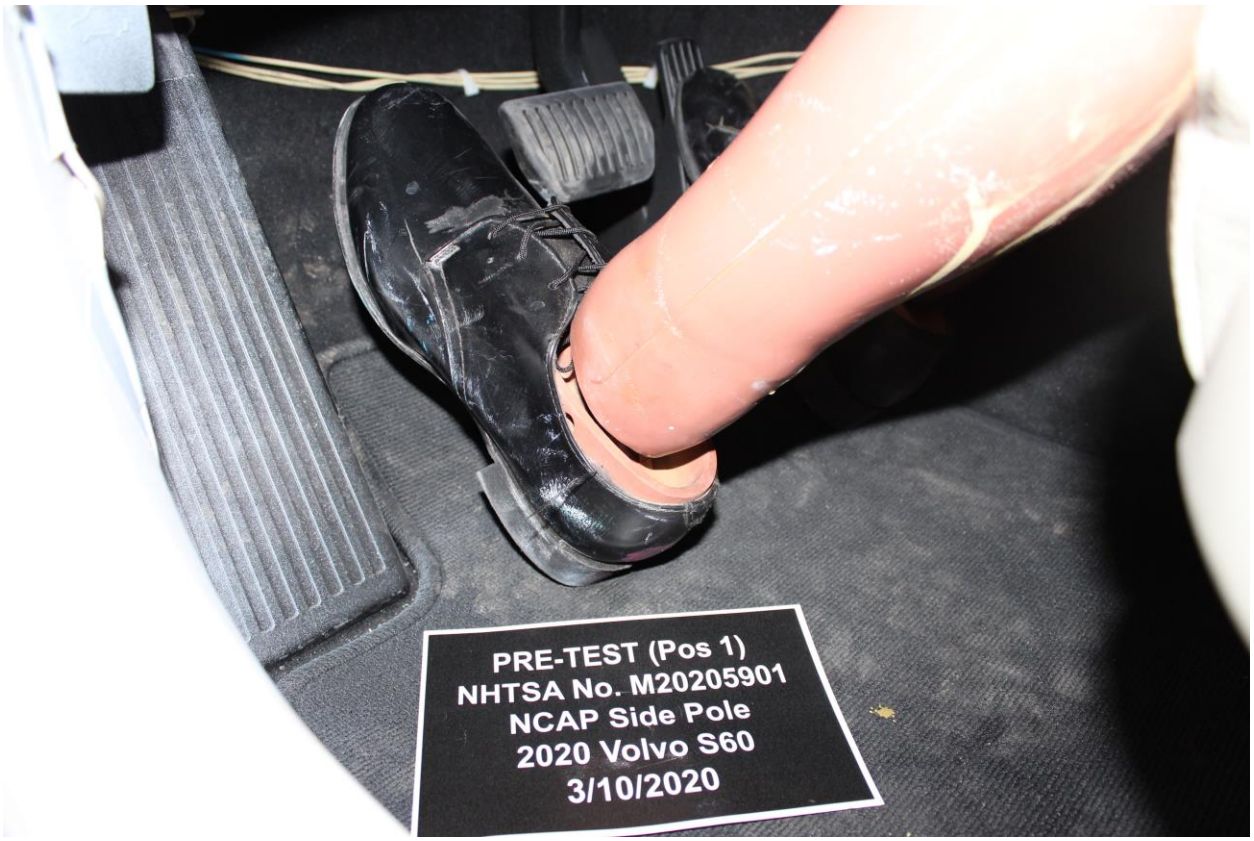



**Figure A-32: Pre-Test Placement of Dummy's Feet**


**Figure A-33: Pre-Test View of Belt Anchorage for Dummy**


**Figure A-34: Pre-Test Left Side View of Steering Wheel**


**Figure A-35: Pre-Test View of Disengaged Parking Brake**


**Figure A-36: Pre-Test View of Parking Brake**


**Figure A-37: Pre-Test Close-Up Left Side View of Driver Seat Track**


**Figure A-38: Pre-Test Close-Up Left Side View of Driver Seat Back**


**Figure A-39: Pre-Test Close-Up View of Driver Seat Back or Head Restraint**


**Figure A-40: Pre-Test Dummy and Door Clearance View**


**Figure A-41: Post-Test Dummy and Door Clearance View**


**Figure A-42: Pre-Test Right Side View of Dummy and Front Seat of Occupant Compartment**


**Figure A-43: Post-Test Right Side View of Dummy and Front Seat of Occupant Compartment**


**Figure A-44: Pre-Test Inner Door Panel View**

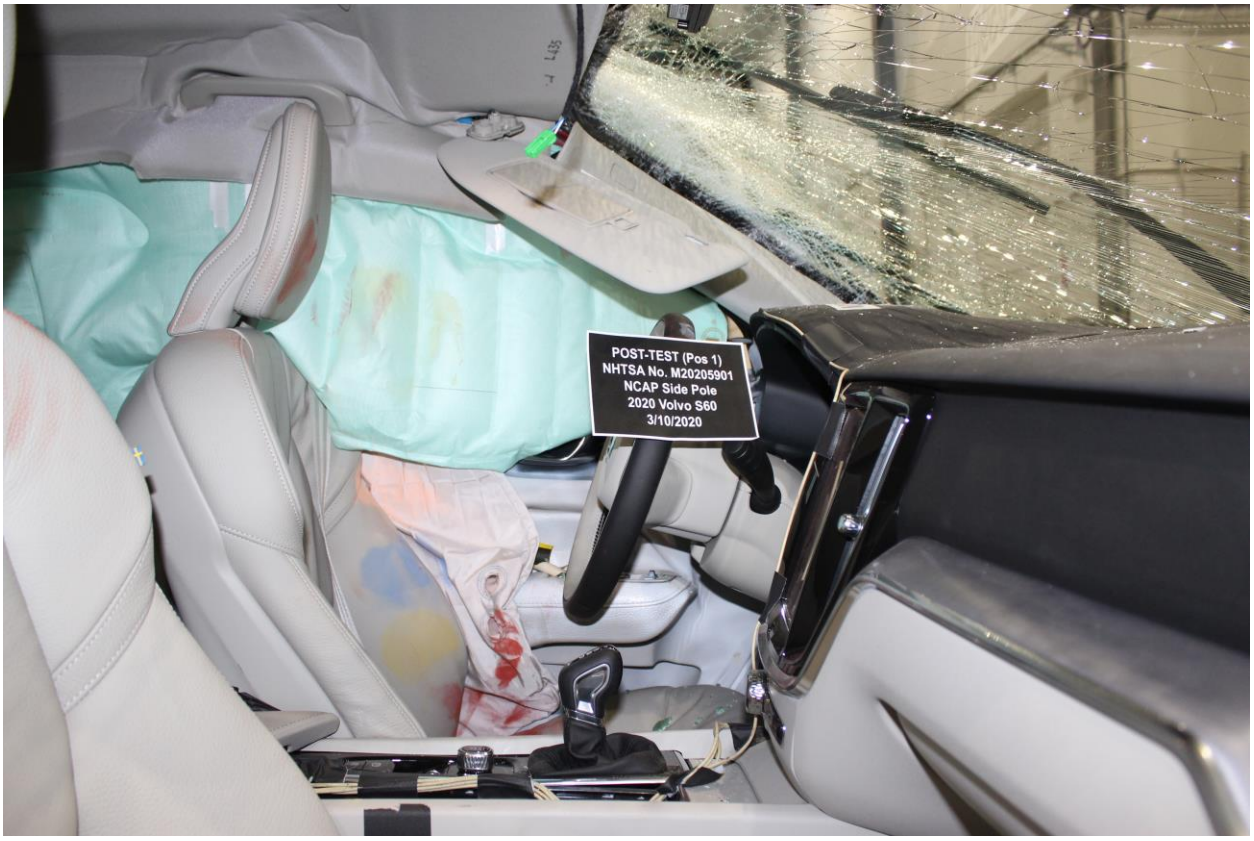



**Figure A-45: Post-Test Inner Door Panel View Showing Dummy Contact Location**


**Figure A-46: Post-Test Dummy Close-Up Head Contact with Vehicle Interior View**


**Figure A-47: Post-Test Dummy Close-Up Head Contact with Side Airbag View**

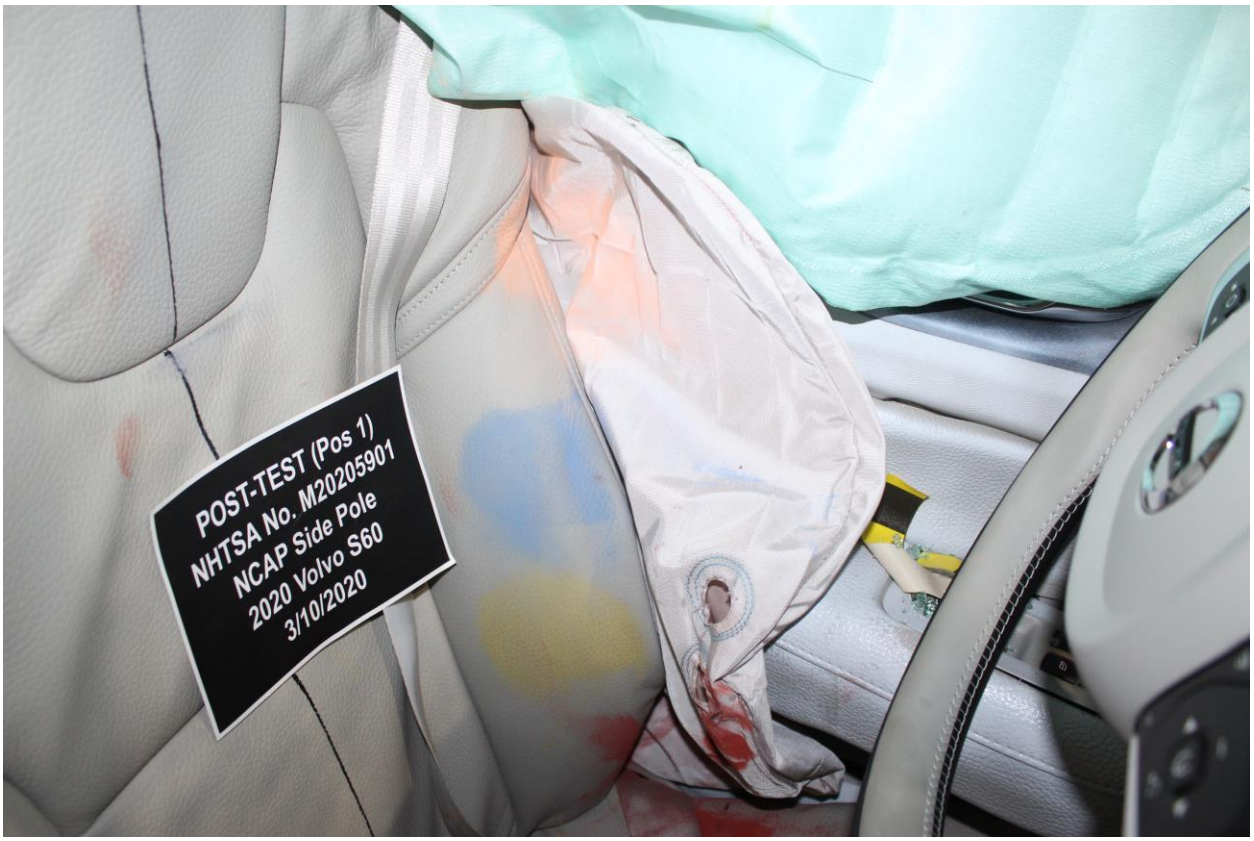



**Figure A-48: Post-Test Dummy Close-Up Torso Contact with Vehicle Interior View**


**Figure A-49: Post-Test Dummy Close-Up Torso Contact with Side Airbag View**


**Figure A-50: Post-Test Dummy Close-Up Pelvis Contact with Vehicle Interior View**


**Figure A-51: Post-Test Dummy Close-Up Pelvis Contact with Side Airbag View**


**Figure A-52: Post-Test Dummy Close-Up Knee Contact with Vehicle Interior View**


**Figure A-53: Pre-Test View of Fuel Filler Cap or Fuel Filler Neck**


**Figure A-54: Post-Test View of Fuel Filler Cap or Fuel Filler Neck**


**Figure A-55: Close-Up View of Vehicle's Certification Label**

# Photo Not Applicable

**Figure A-55a: Close-Up View of Reduced Load Capacity Label**


**Figure A-56: Close-Up View of Vehicle's Tire Information Placard or Label**

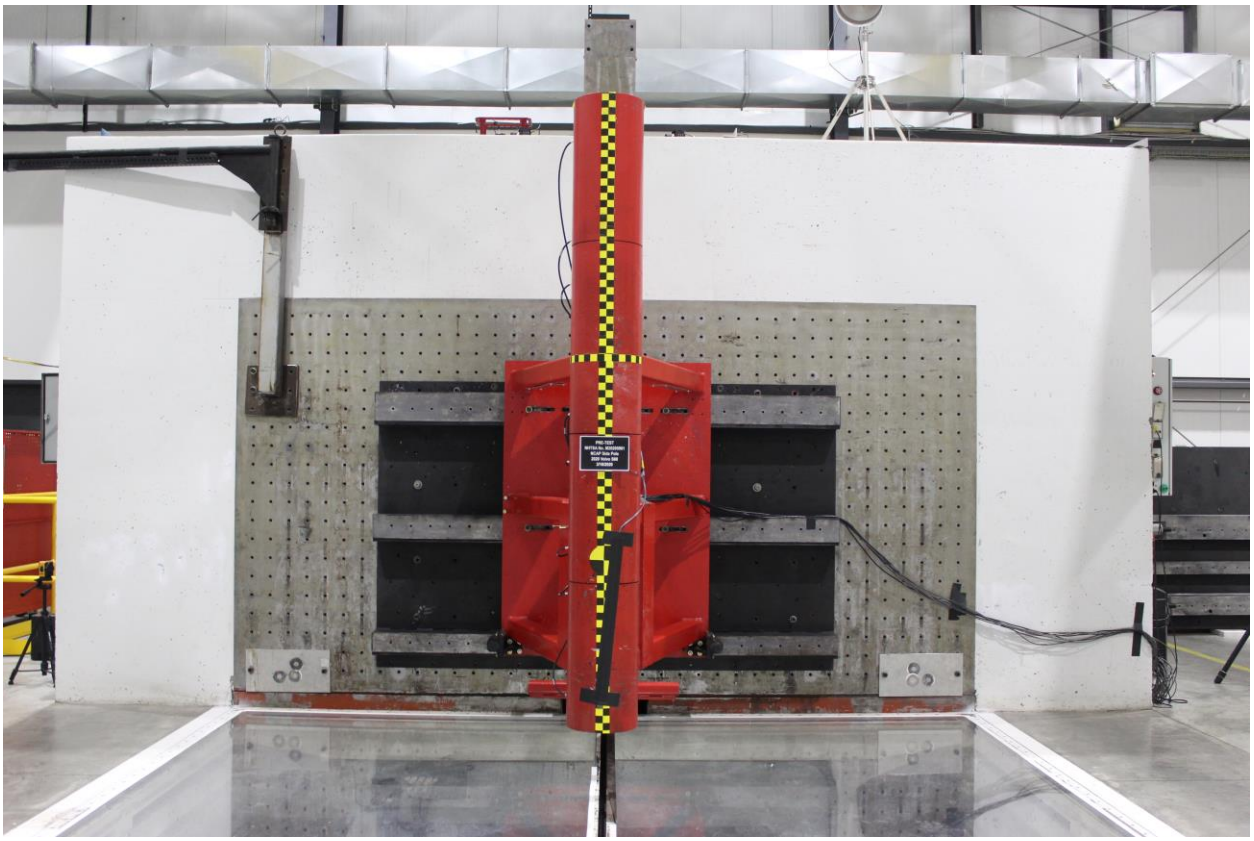


**Figure A-57: Pre-Test Pole Barrier Front View**

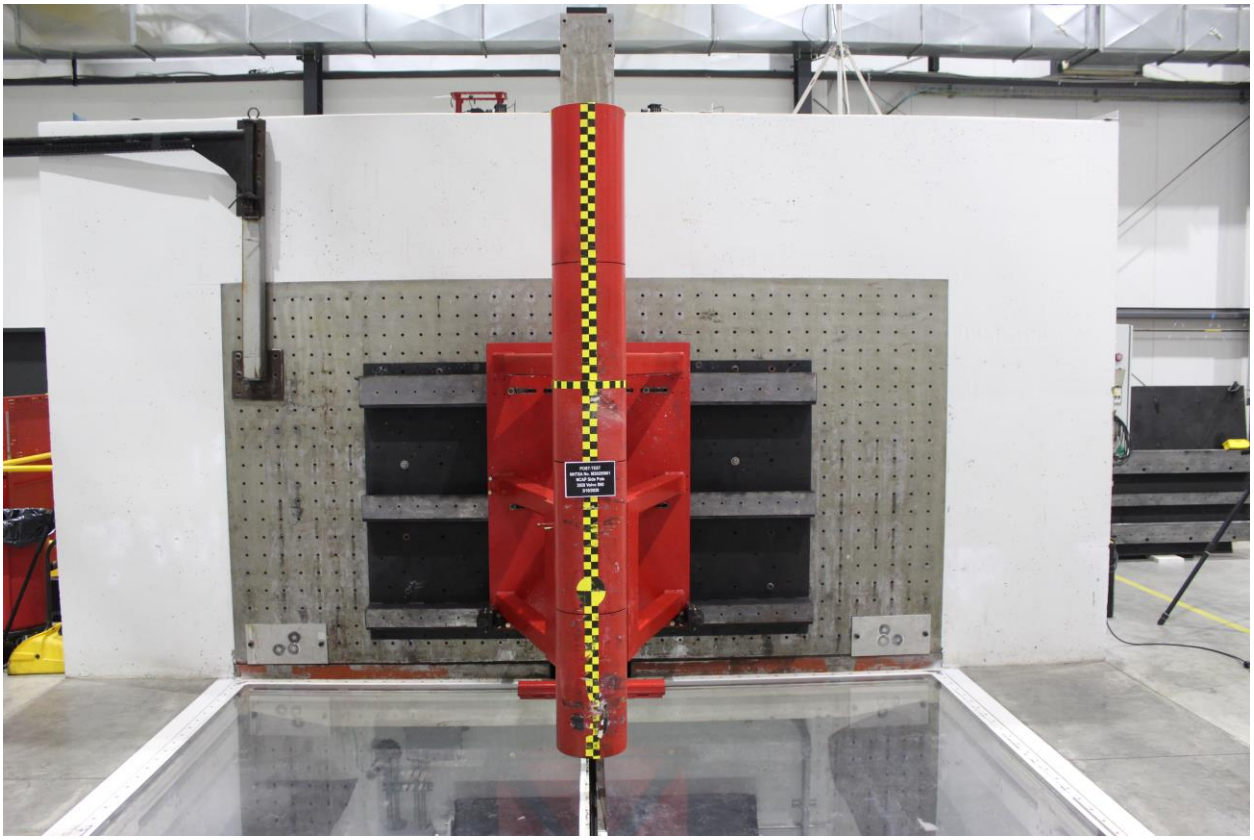


**Figure A-58: Post-Test Pole Barrier Front View**

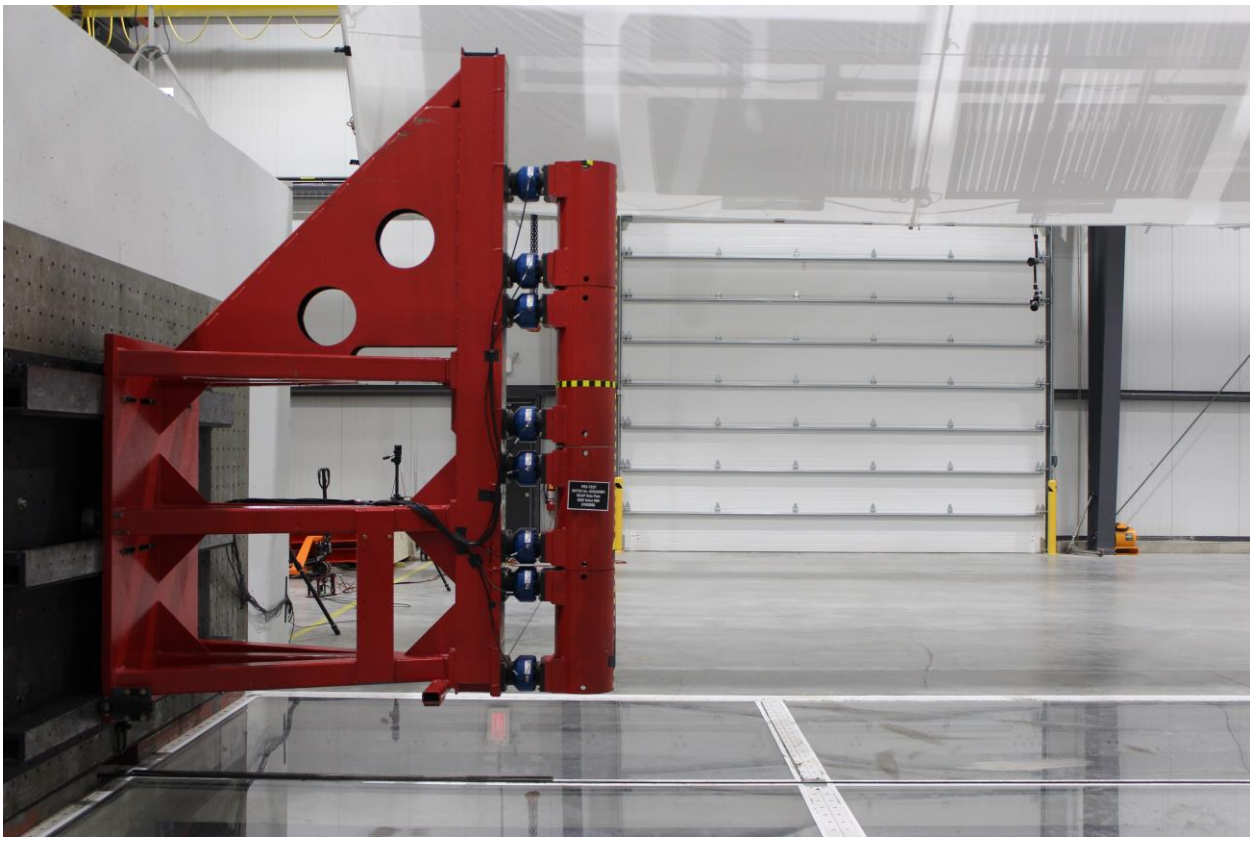


**Figure A-59: Pre-Test Pole Barrier Side View**

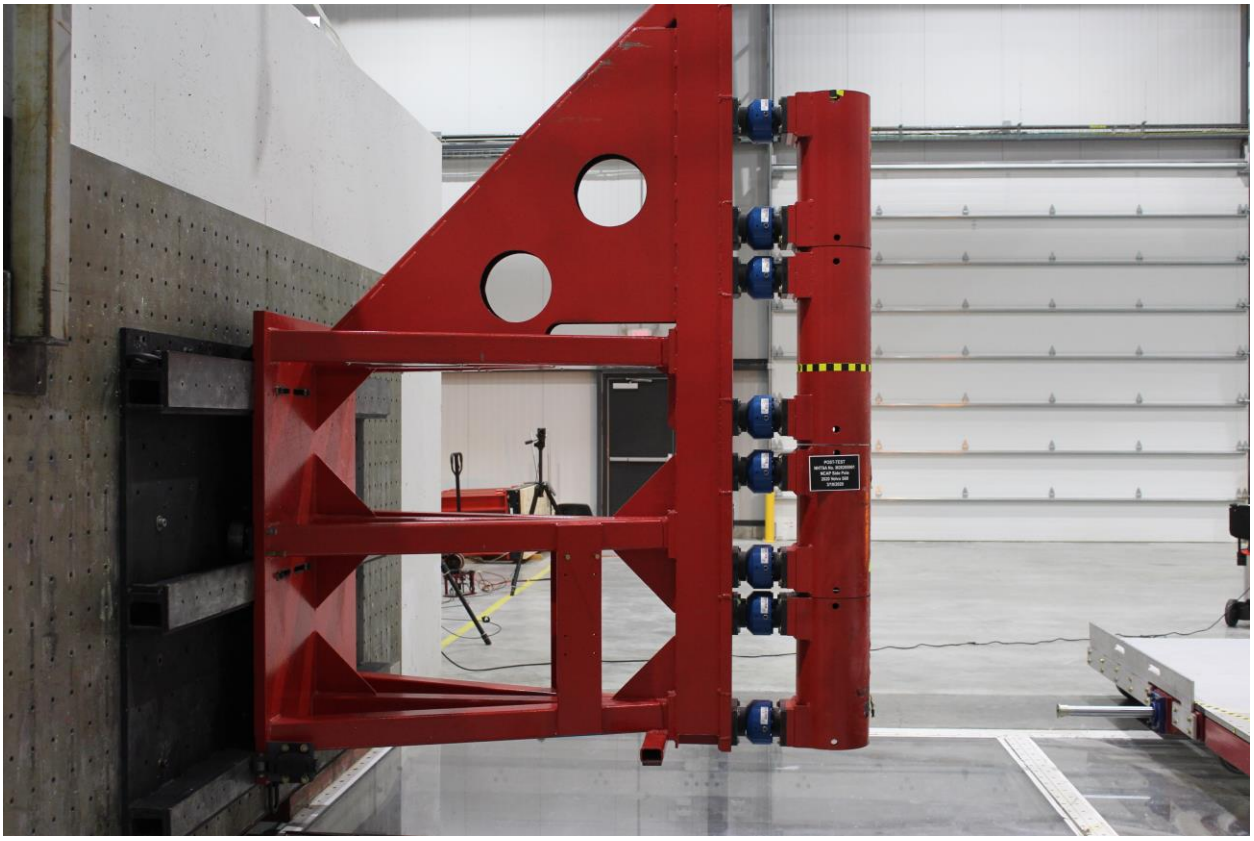


**Figure A-60: Post-Test Pole Barrier Side View**


**Figure A-61: Pre-Test Ballast View**


**Figure A-62: Post-Test Primary and Redundant Speed Trap Read-Out**

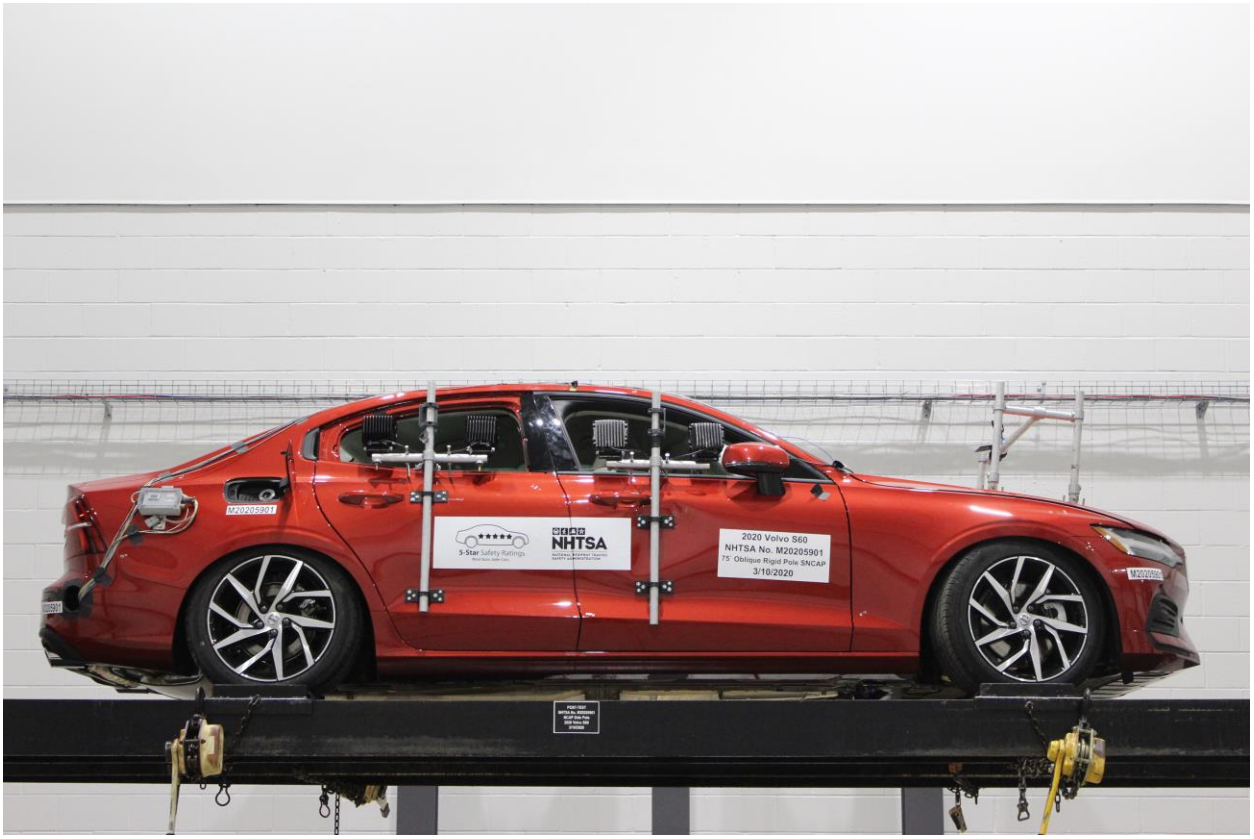



**Figure A-63: FMVSS No. 301 Static Rollover 0 Degrees**


**Figure A-64: FMVSS No. 301 Static Rollover 90 Degrees**


**Figure A-65: FMVSS No. 301 Static Rollover 180 Degrees**

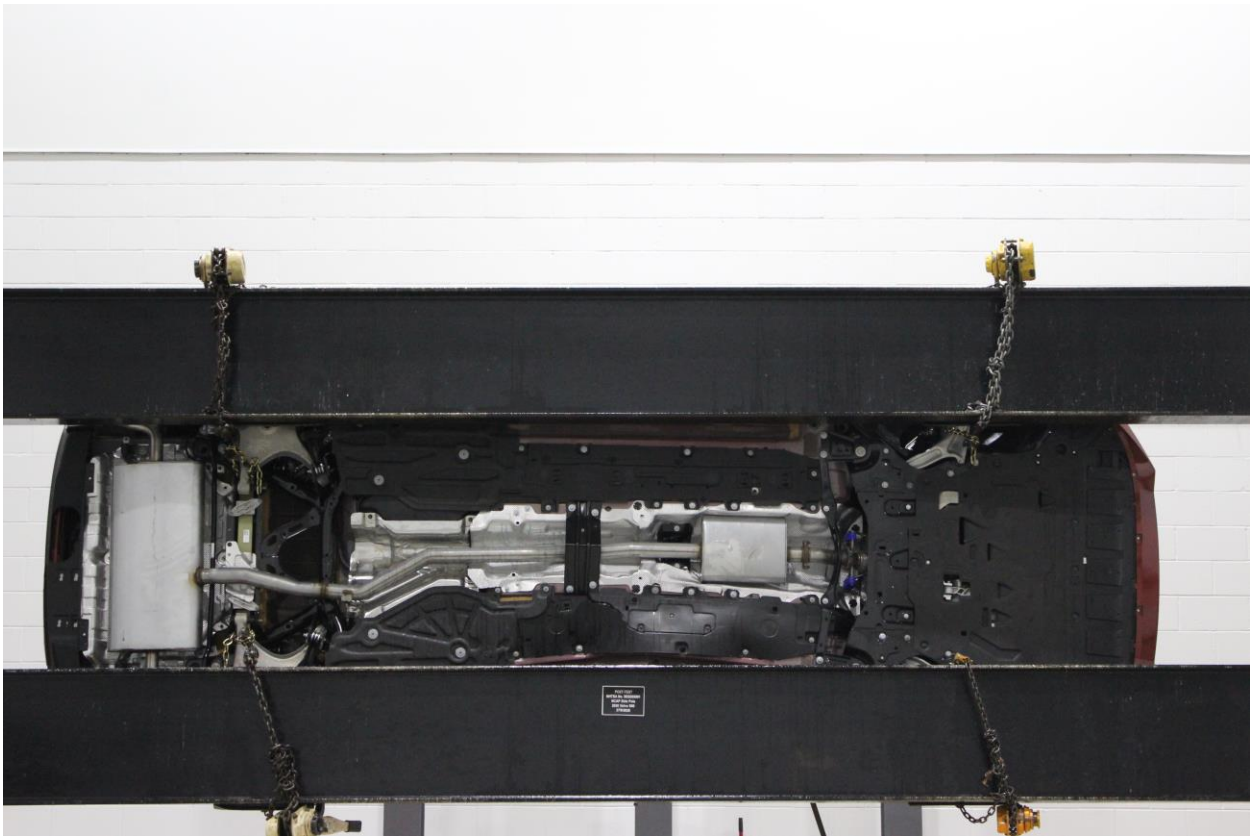


**Figure A-66: FMVSS No. 301 Static Rollover 270 Degrees**


**Figure A-67: FMVSS No. 301 Static Rollover 360 Degrees**


**Figure A-68: Impact Event**

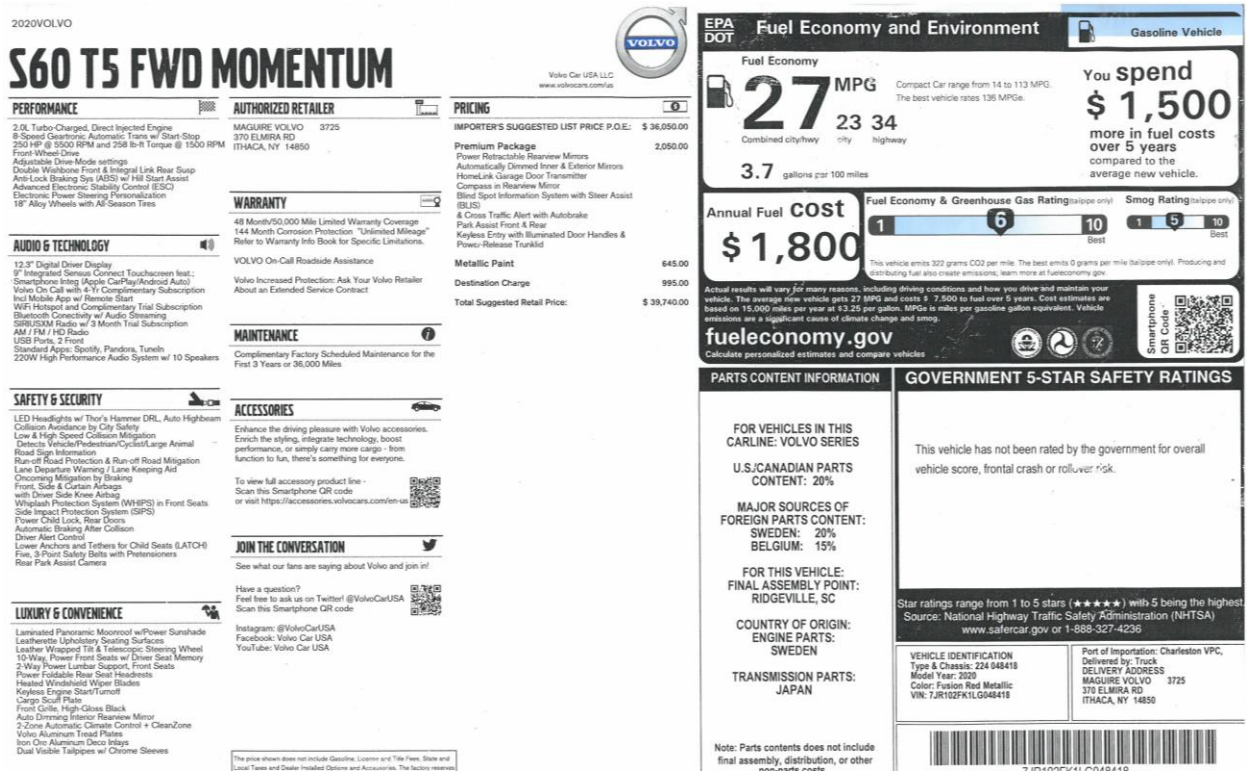



**Figure A-69: Monroney Label**

# Photo Not Applicable

**Figure A-70: Head Restraint Use and Adjustment Information from Vehicle Owner's Manual**

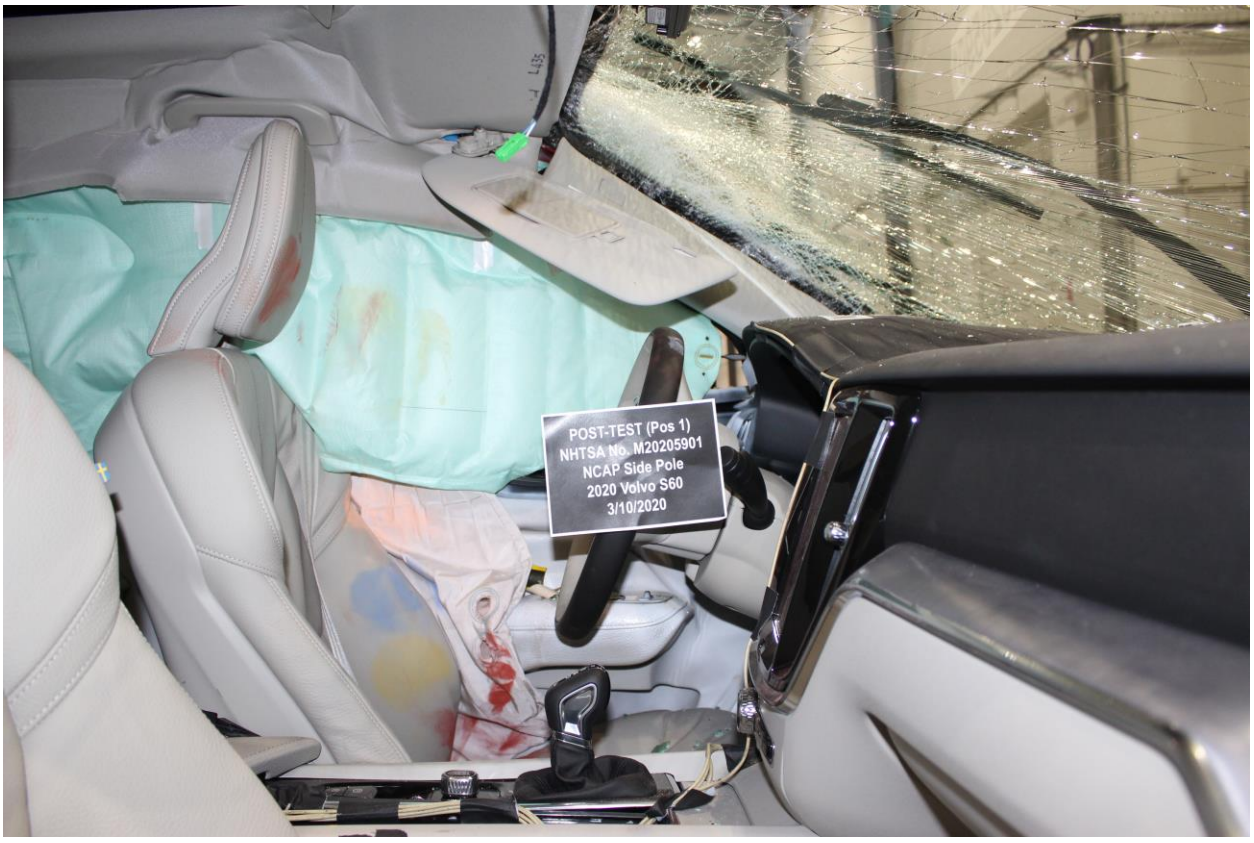



**Figure A-71: Post-Test View of Shattered Vehicle Inner Door Panel (if applicable)**

# APPENDIX B

# VEHICLE AND DUMMY RESPONSE DATA PLOTS

## TABLE OF DATA PLOTS

### Driver Dummy Instrumentation Plots

**The following additional data for this test can be obtained from the Research and Development section of the NHTSA website. The website can be found at www.NHTSA.gov.**

## Additional Driver Dummy Instrumentation Data

Driver Head Acceleration Redundant (X)
Driver Head Acceleration Redundant (Y)
Driver Head Acceleration Redundant (Z)
Driver Upper Thorax Rib Deflection (Y)
Driver Middle Thorax Rib Deflection (Y)
Driver Lower Thorax Rib Deflection (Y)
Driver Upper Abdomen Rib Deflection (Y)
Driver Lower Abdomen Rib Deflection (Y)

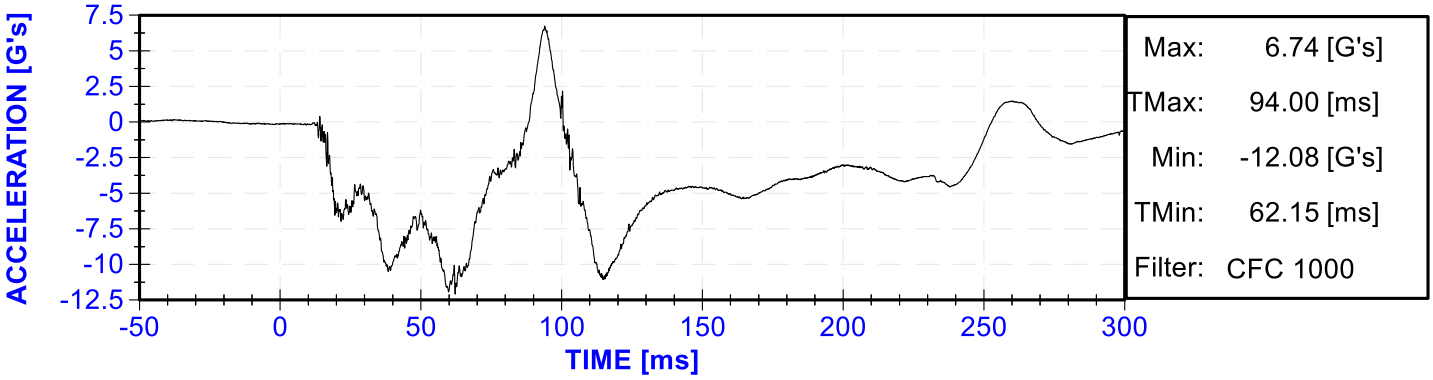
## Vehicle Instrumentation Data

Vehicle Center of Gravity Acceleration (X)
Vehicle Center of Gravity Acceleration (Y)
Vehicle Center of Gravity Acceleration (Z)
Left Floor Sill Acceleration (Y)
Left A-Pillar Sill Acceleration (Y)
Left Lower A-Pillar Acceleration (Y)
Left Mid A-Pillar Acceleration (Y)
Left B-Pillar Sill Acceleration (Y)
Left Lower B-Pillar Acceleration (Y)
Left Mid B-Pillar Acceleration (Y)
Driver Seat Track at Dummy Hip Point Acceleration (Y)
Engine Top Acceleration (X)
Engine Top Acceleration (Y)
Firewall Center Acceleration (Y)
Right Roof at Vertical Impact Reference Line Acceleration (Y)
Right Sill at Vertical Impact Reference Line Acceleration (Y)
Rear Floorpan Behind Rear Axle at Centerline Acceleration (X)
Rear Floorpan Behind Rear Axle at Centerline Acceleration (Y)

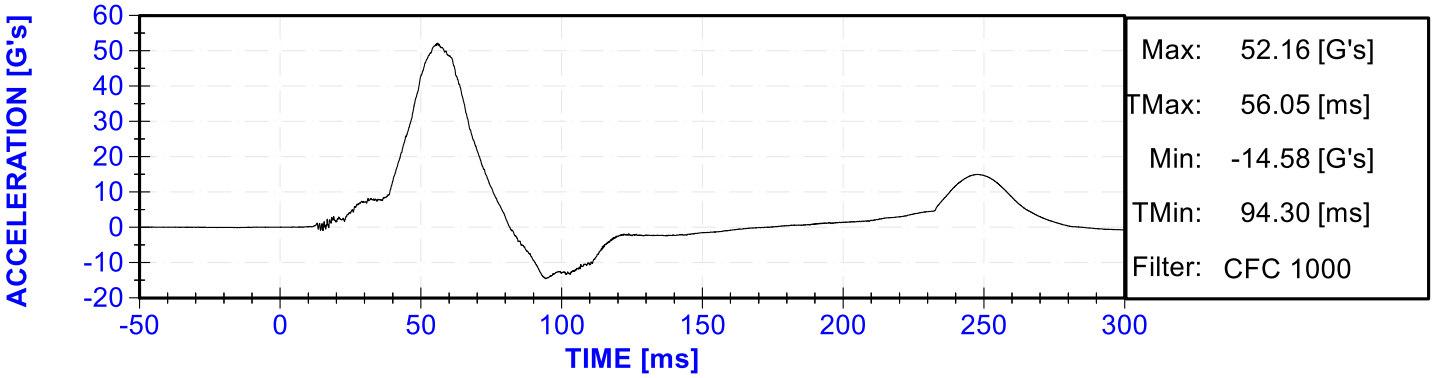
## Pole Instrumentation Data

Load Cell Pole Barrier #1 Force (Y)
Load Cell Pole Barrier #2 Force (Y)
Load Cell Pole Barrier #3 Force (Y)
Load Cell Pole Barrier #4 Force (Y)
Load Cell Pole Barrier #5 Force (Y)
Load Cell Pole Barrier #6 Force (Y)
Load Cell Pole Barrier #7 Force (Y)
Load Cell Pole Barrier #8 Force (Y)

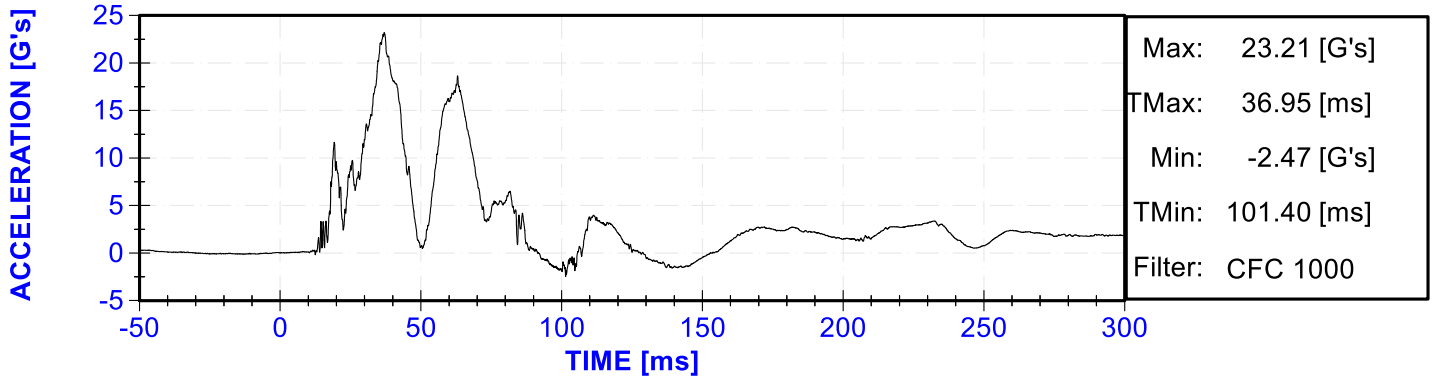
Driver Head Acceleration (X) Primary vs. Time



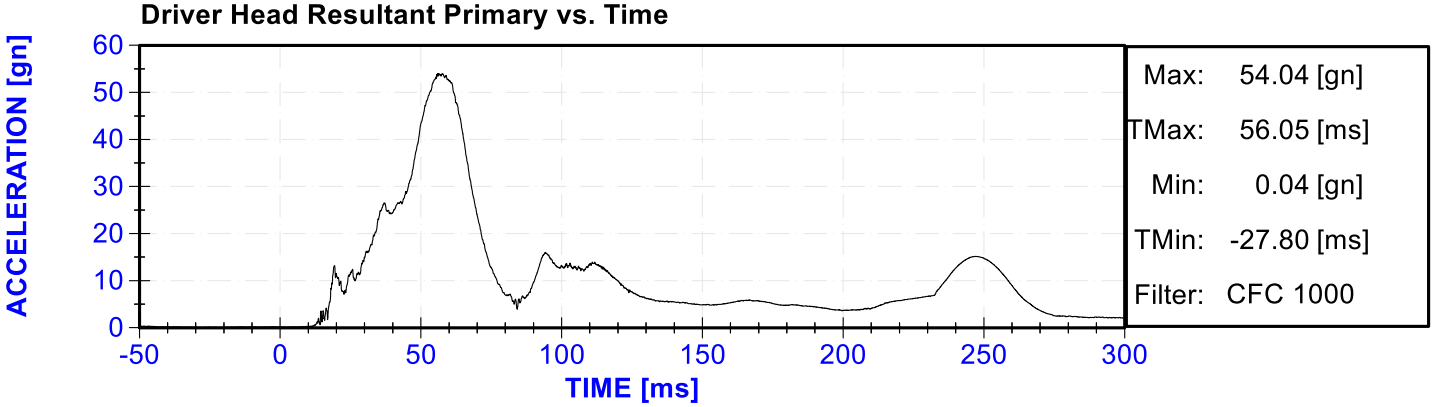

Driver Head Acceleration (Y) Primary vs. Time



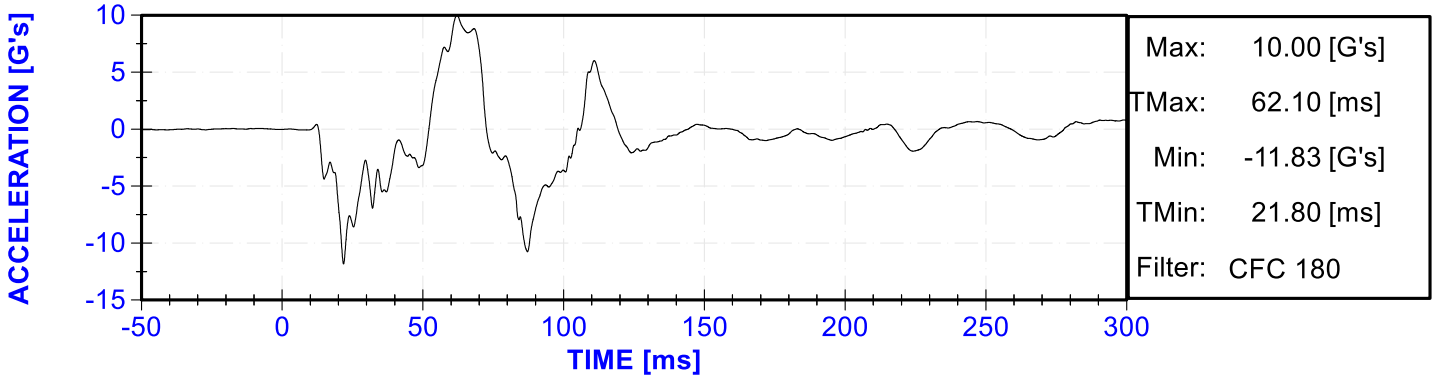

Driver Head Acceleration (Z) Primary vs. Time



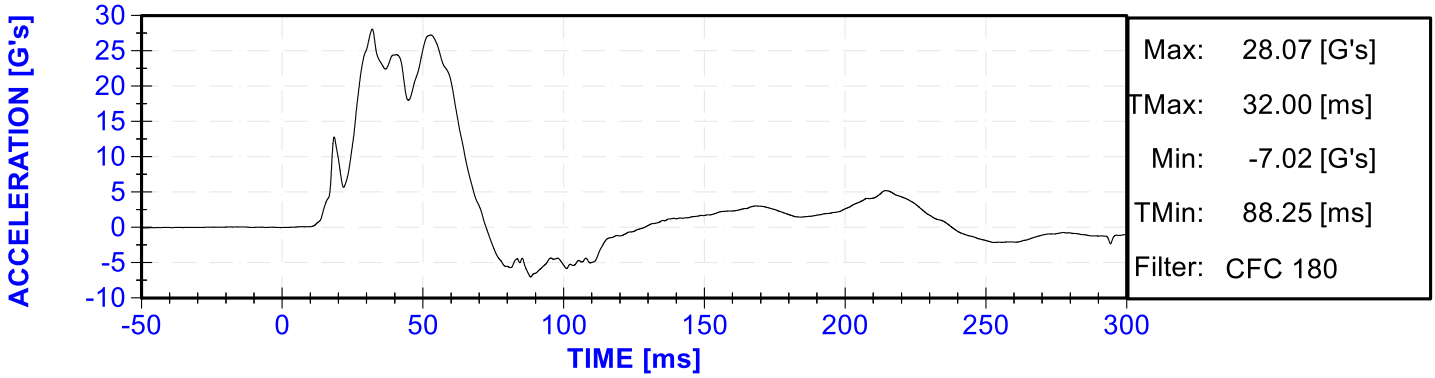

Driver Head Resultant Primary vs. Time



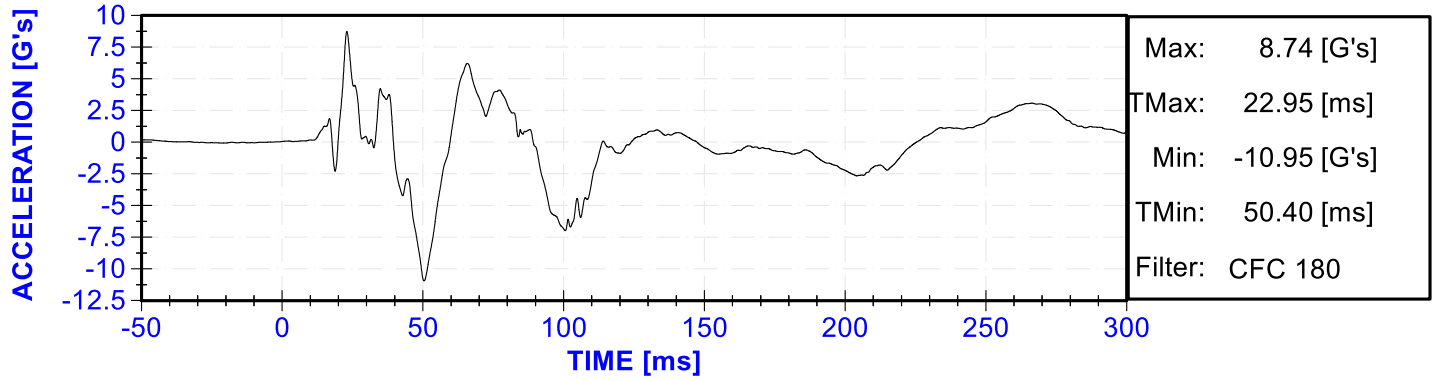
Driver Lower Spine T12 Acceleration (X) vs. Time



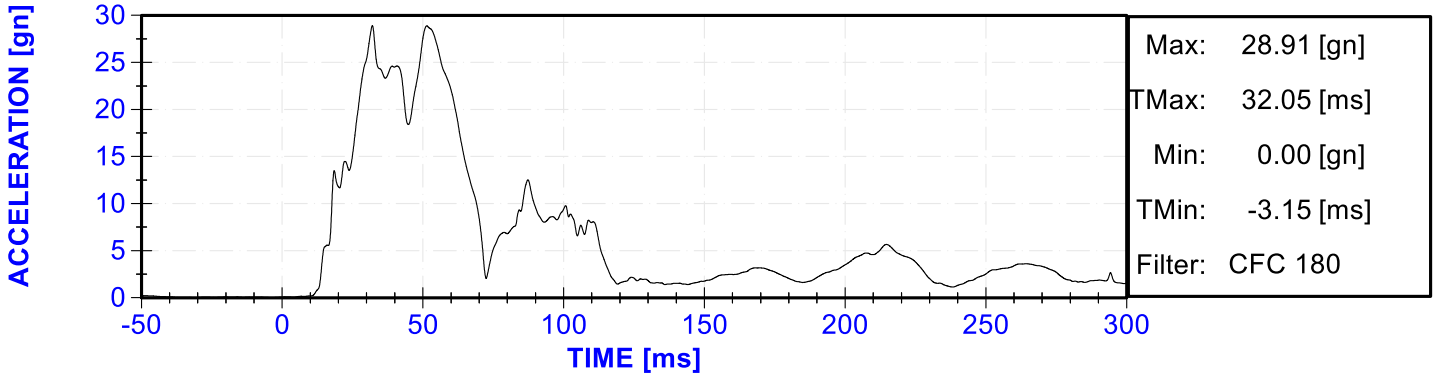

Driver Lower Spine T12 Acceleration (Y) vs. Time



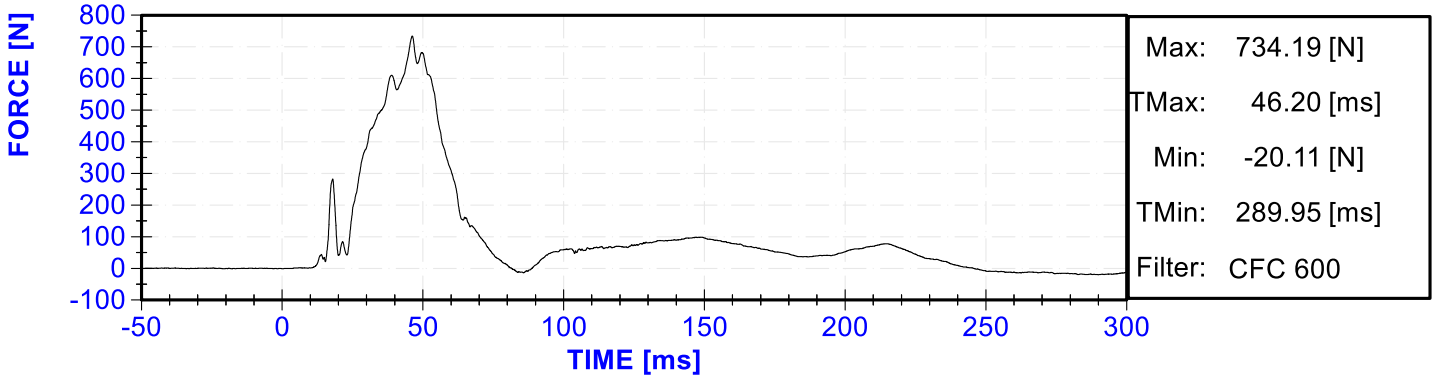

Driver Lower Spine T12 Acceleration (Z) vs. Time



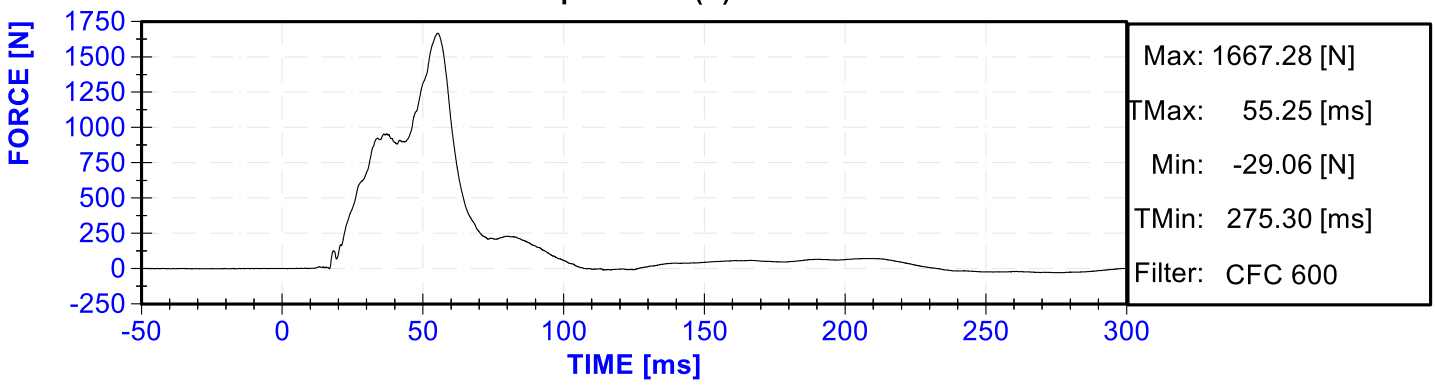

Driver Lower Spine T12 Resultant Acceleration vs. Time



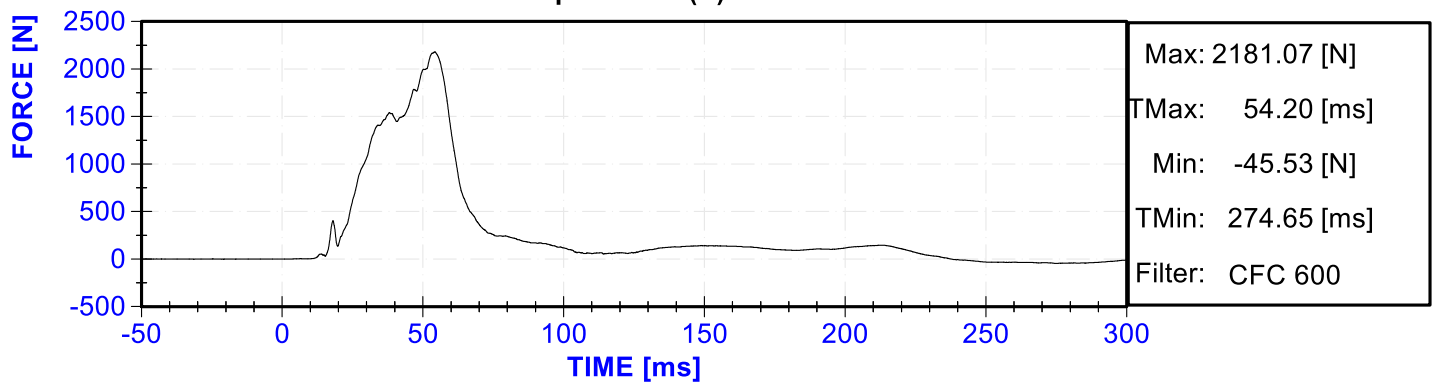
Driver Iliac Wing Force on Impact Side (Y) vs. Time




Driver Acetabulum Force on Impact Side (Y) vs. Time




Driver Total Pelvis Force on Impact Side (Y) vs. Time



**APPENDIX C**

**DUMMY CONFIGURATION AND PERFORMANCE VERIFICATION DATA**

**CALIBRATION TEST RESULTS**

**PRE-TEST**

**SID-IIS 5TH PERCENTILE FEMALE - DRIVER ATD**

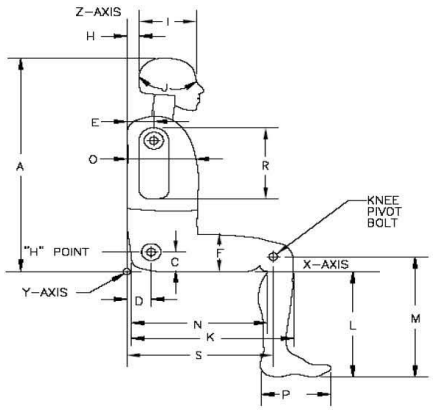
**SERIAL NO: DG8012**

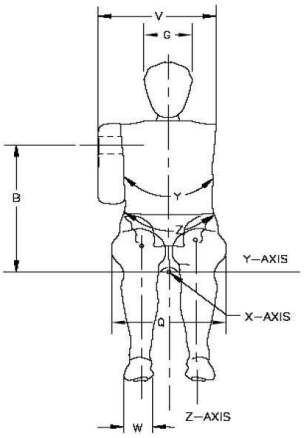
**(CONFIGURED FOR LEFT SIDE IMPACT)**

External Measurements - SID-IIs

Technician: K. Dutton  Date: 03/03/2020

Dummy Serial Number: DG8012




| Symbol | Description | Specification (mm) | | Result (mm) | Pass/Fail |
|---|---|---|---|---|---|
| A | Sitting Height | 772 | 788 | 779 | Pass |
| B | Shoulder Pivot Height | 437 | 453 | 446 | Pass |
| C | H-point Height | 79 | 89 | 85 | Pass |
| D | H-point from seatback | 141 | 151 | 146 | Pass |
| E | Shoulder Pivot from Backline | 97 | 107 | 102 | Pass |
| F | Thigh Clearance | 119 | 135 | 126 | Pass |
| G | Head Breadth | 140 | 148 | 144 | Pass |
| H | Head Back from Backline | 40 | 46 | 44 | Pass |
| I | Head Depth | 178 | 188 | 185 | Pass |
| J | Head Circumference | 541 | 551 | 547 | Pass |
| K | Buttock to Knee Length | 514 | 540 | 532 | Pass |
| L | Popliteal Height | 343 | 369 | 357 | Pass |
| M | Knee Pivot to floor height | 392 | 409 | 403 | Pass |
| N | Buttock Popliteal Length | 416 | 442 | 433 | Pass |
| O | Chest Depth w/o jacket | 195 | 211 | 205 | Pass |
| P | Foot Length | 216 | 232 | 224 | Pass |
| Q | Hip Breadth (w/pelvic plugs) | 313 | 323 | 318 | Pass |
| R | Arm Length | 249 | 259 | 255 | Pass |
| S | Knee Joint to seatback | 477 | 493 | 486 | Pass |
| V | Shoulder Width | 341 | 357 | 345 | Pass |
| W | Foot Width | 78 | 94 | 85 | Pass |
| Y | Chest Circumference w/jacket | 851 | 881 | 867 | Pass |
| Z | Waist Circumference | 761 | 791 | 781 | Pass |

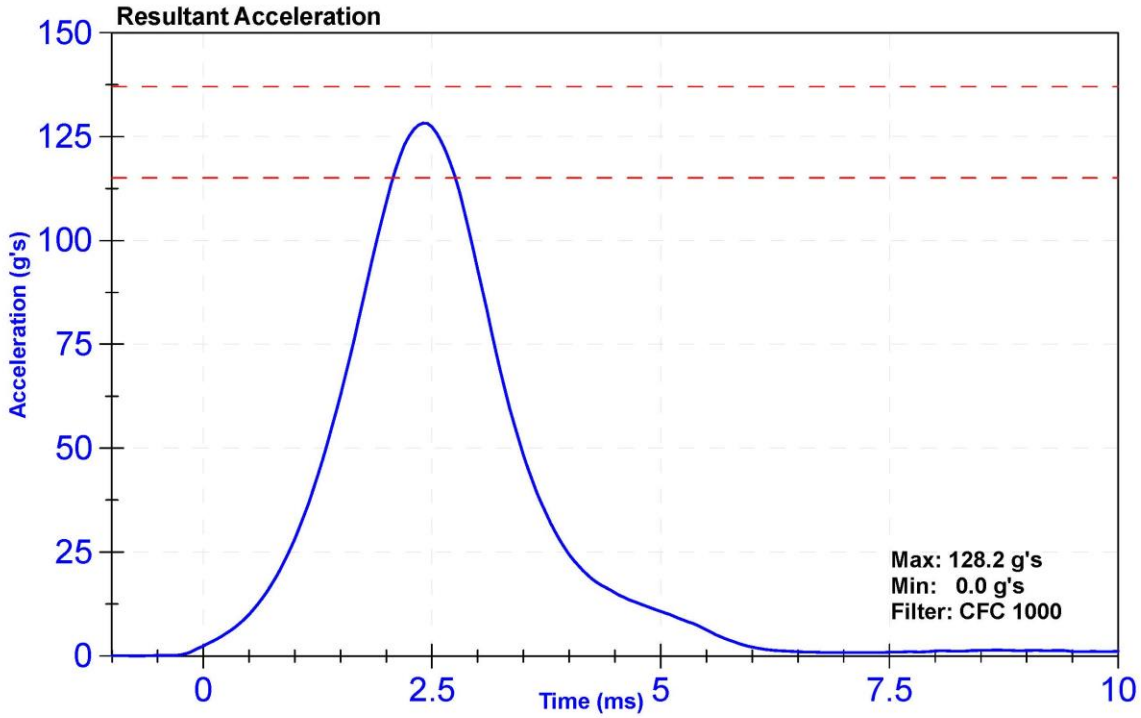
| | | | |
|---|---|---|---|
| ATD Manufacturer | FTSS | Test Technician | M. Dudek |
| ATD Serial Number | DG8012 | Laboratory Supervisor | K. Brogan |

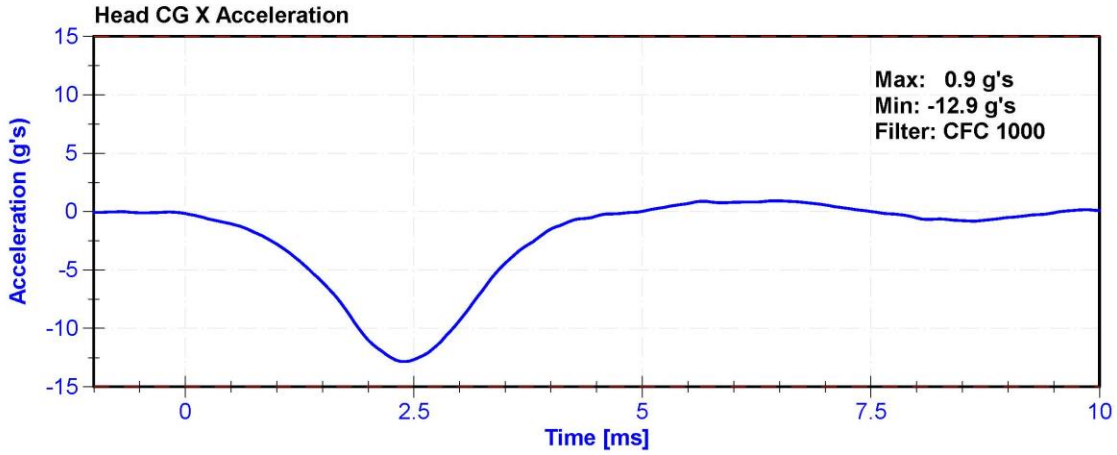
**Results**

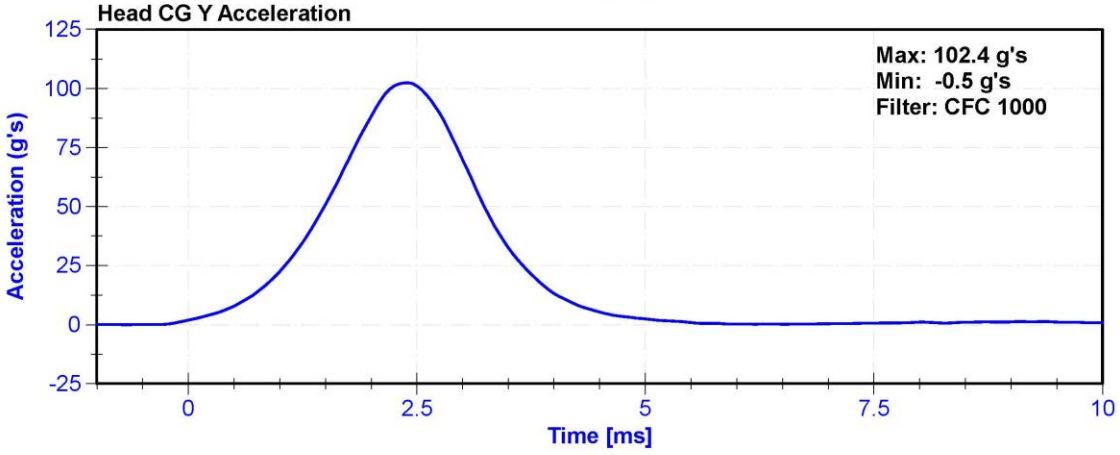
| Test Parameter | Minimum Specification | Maximum Specification | Unit | Result | Pass/Fail |
|---|---|---|---|---|---|
| Temperature | 20.6 | 22.2 | ºC | 21.2 | Pass |
| Humidity | 10 | 70 | % | 30.4 | Pass |
| Resultant Acceleration | 115 | 137 | g's | 128.2 | Pass |
| Oscillation | 0 | 15 | % | 1.1 | Pass |
| Fore-Aft Acceleration | -15 | 15 | g's | -12.9 | Pass |

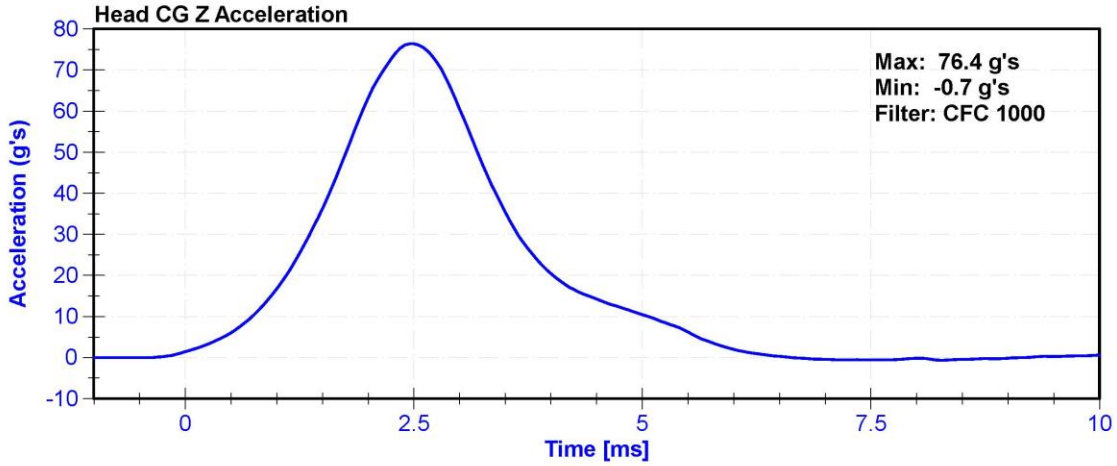
**Transducer Calibrations**

| Channel | Manufacturer | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|
| X Accelerometer | ENDEVCO 7264 | AC-P74788 | 10/28/2019 | 4/27/2020 |
| Y Accelerometer | ENDEVCO 7264CT | AC-P83432 | 10/28/2019 | 4/27/2020 |
| Z Accelerometer | ENDEVCO 7264 | AC-P83319 | 10/28/2019 | 4/27/2020 |




Head CG X Acceleration
Max: 0.9 g's
Min: -12.9 g's
Filter: CFC 1000
Acceleration (g's)
15
10
5
0
-5
-10
-15
0
2.5
5
7.5
10
Time [ms]


Head CG Y Acceleration
Max: 102.4 g's
Min: -0.5 g's
Filter: CFC 1000
Acceleration (g's)
125
100
75
50
25
0
-25
0
2.5
5
7.5
10
Time [ms]


Head CG Z Acceleration
Max: 76.4 g's
Min: -0.7 g's
Filter: CFC 1000
Acceleration (g's)
80
70
60
50
40
30
20
10
0
-10
0
2.5
5
7.5
10
Time [ms]

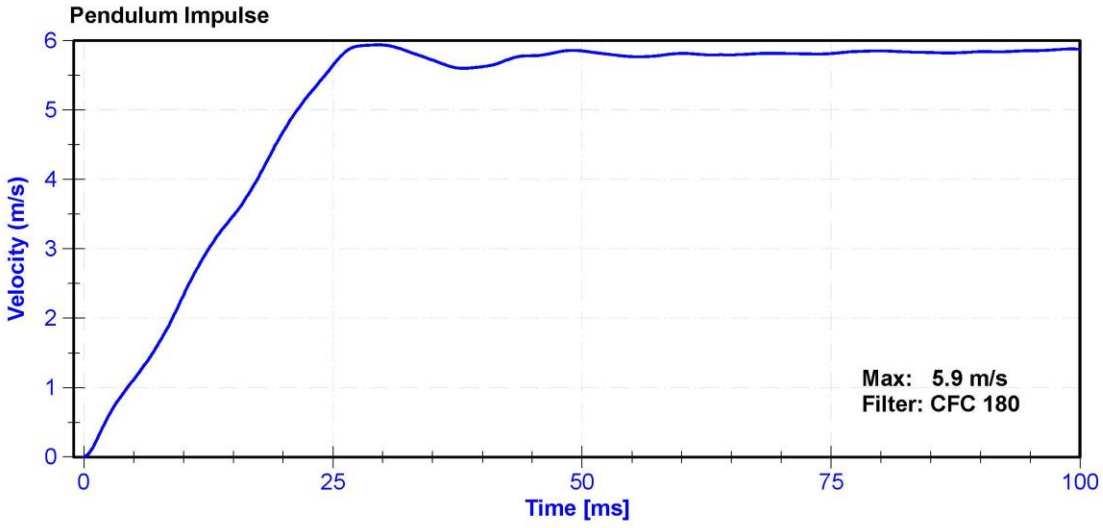
| | | | |
|---|---|---|---|
| ATD Manufacturer | FTSS | Test Technician | C. Mantell |
| ATD Serial Number | DG8012 | Laboratory Supervisor | K. Brogan |

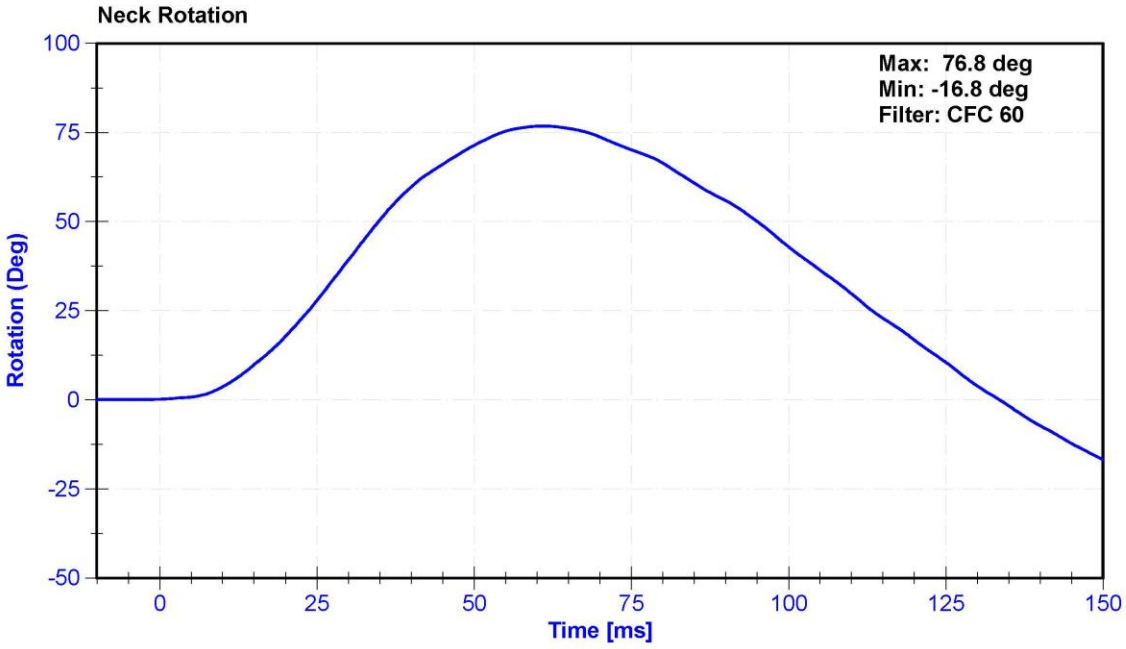
**Results**

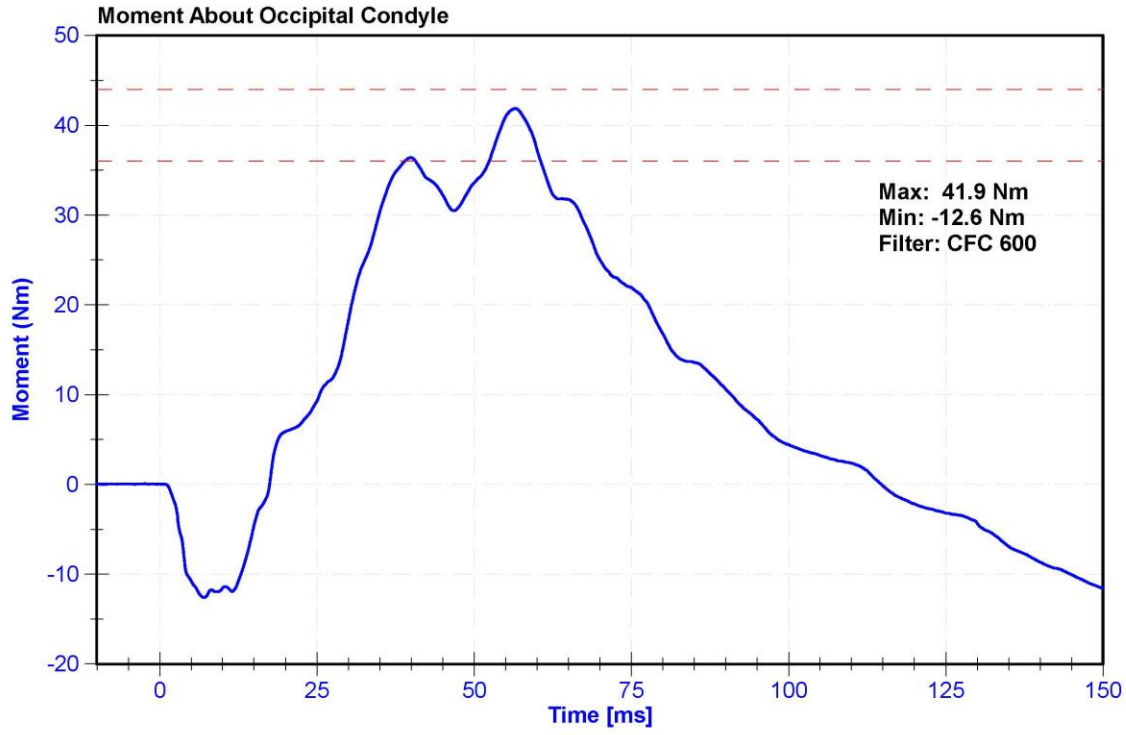
| Test Parameter | Minimum Specification | Maximum Specification | Unit | Result | Pass/Fail |
|---|---|---|---|---|---|
| Temperature | 20.6 | 22.2 | ºC | 21.2 | Pass |
| Humidity | 10 | 70 | % | 30 | Pass |
| Velocity | 5.51 | 5.63 | m/s | 5.514 | Pass |
| Pendulum Impulse at 10ms | 2.2 | 2.8 | m/s | 2.33 | Pass |
| Pendulum Impulse at 15ms | 3.3 | 4.1 | m/s | 3.47 | Pass |
| Pendulum Impulse at 20ms | 4.4 | 5.4 | m/s | 4.68 | Pass |
| Pendulum Impulse at 25ms | 5.4 | 6.1 | m/s | 5.64 | Pass |
| Pendulum Impulse from 25 to 100ms | 5.5 | 6.2 | m/s | 5.94 | Pass |
| Neck Rotation | 71 | 81 | deg | 76.8 | Pass |
| Time at Maximum Rotation | 50 | 70 | ms | 60.9 | Pass |
| Moment about the OC | 36 | 44 | Nm | 41.9 | Pass |
| Moment Decay to 0 Nm | 102 | 126 | ms | 114.8 | Pass |

**Transducer Calibrations**

| Channel | Manufacturer | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|
| Pendulum Accelerometer | ENDEVCO 7231CT | AC-AH5M9 Pend | 1/30/2020 | 1/29/2021 |
| Pendulum Potentiometer | Denton 78051-342 | DS-184Pend | 11/4/2019 | 11/3/2020 |
| Condyle Potentiometer | Denton 78051-342 | DS-185Pend | 11/4/2019 | 11/3/2020 |
| Upper Neck Load Cell | Denton 1716A | LC-2192Fy | 6/20/2019 | 6/19/2020 |




Neck Rotation
Max: 76.8 deg
Min: -16.8 deg
Filter: CFC 60
Rotation (Deg)
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]


Moment About Occipital Condyle
Max: 41.9 Nm
Min: -12.6 Nm
Filter: CFC 600
Moment (Nm)
50
40
30
20
10
0
-10
-20
0
25
50
75
100
125
150
Time [ms]

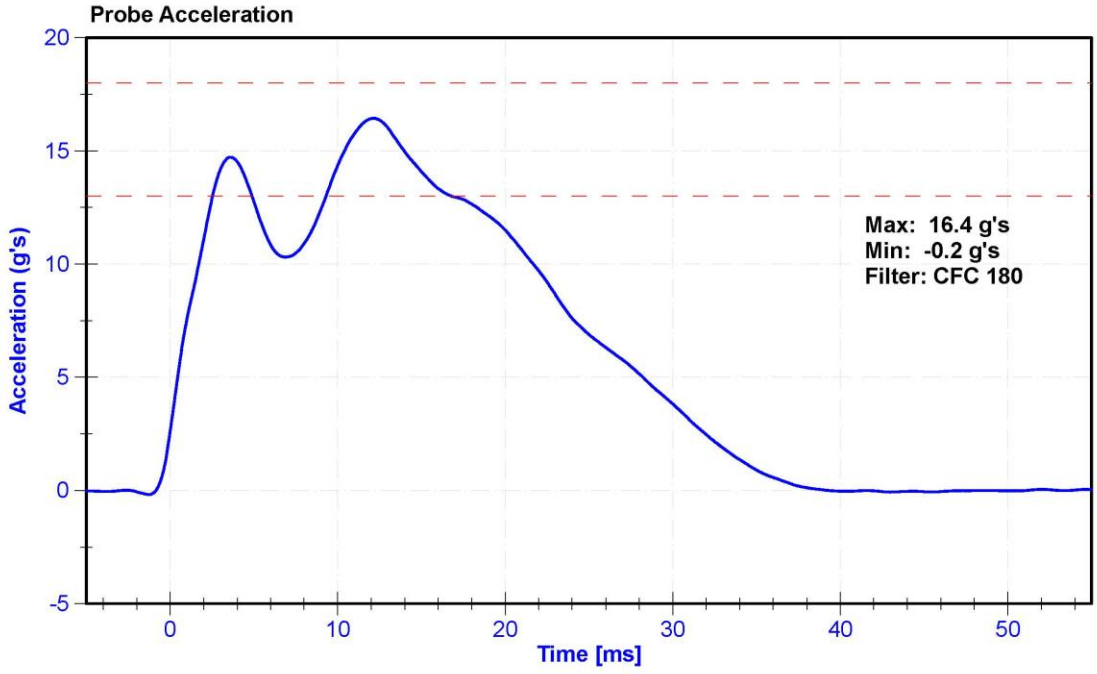
| | | | |
|---|---|---|---|
| ATD Manufacturer | FTSS | Test Technician | D.Reinhard |
| ATD Serial Number | DG8012 | Laboratory Supervisor | K. Brogan |

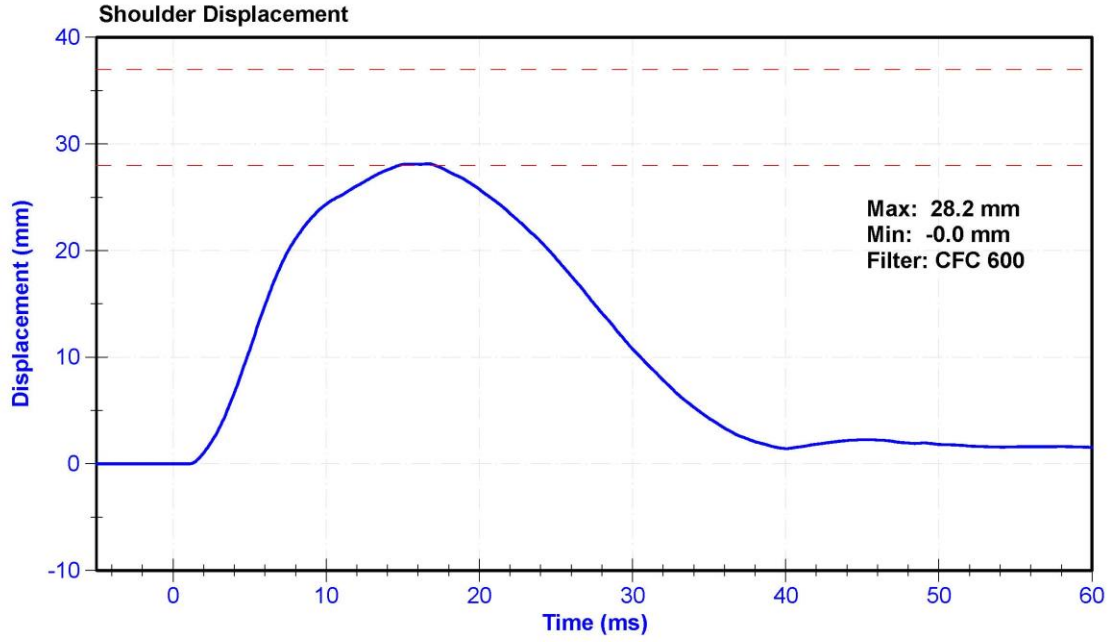
**Results**

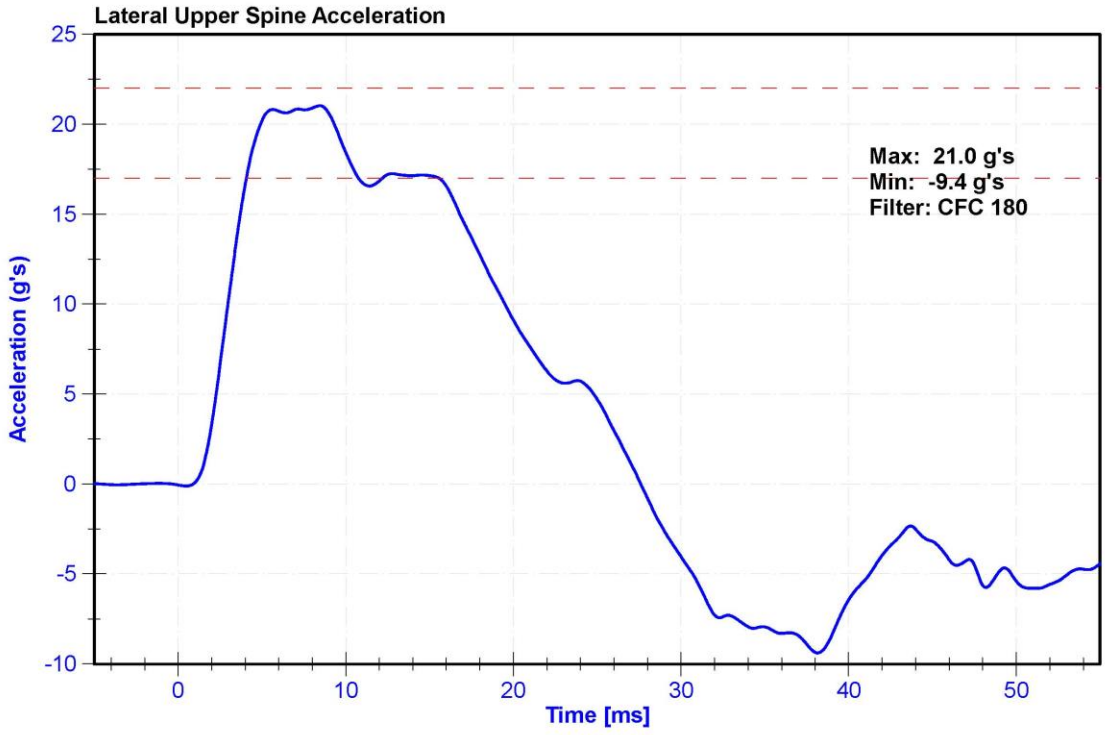
| Test Parameter | Minimum Specification | Maximum Specification | Unit | Result | Pass/Fail |
|---|---|---|---|---|---|
| Temperature | 20.6 | 22.2 | ºC | 20.8 | Pass |
| Humidity | 10 | 70 | % | 39 | Pass |
| Velocity | 4.2 | 4.4 | m/s | 4.40 | Pass |
| Probe Acceleration | 13 | 18 | g's | 16.4 | Pass |
| Shoulder Deflection | 28 | 37 | mm | 28.2 | Pass |
| Lateral Upper Spine Acceleration | 17 | 22 | g's | 21.0 | Pass |

**Transducer Calibrations**

| Channel | Manufacturer | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|
| Pendulum Accelerometer | MSI 64C-2000 | A286228 | 1/29/2020 | 7/29/2020 |
| Shoulder Potentiometer | Servo 08TC1-3745 | DS-1845GFE | 10/28/2019 | 4/27/2020 |
| Upper Spine Y Accelerometer | ENDEVCO 7264CT | AC-P64148 | 10/28/2019 | 4/27/2020 |




Shoulder Displacement
Displacement (mm)
Time (ms)
Max: 28.2 mm
Min: -0.0 mm
Filter: CFC 600
40
30
20
10
0
-10
0
10
20
30
40
50
60


Lateral Upper Spine Acceleration
Acceleration (g's)
Time [ms]
Max: 21.0 g's
Min: -9.4 g's
Filter: CFC 180
25
20
15
10
5
0
-5
-10
0
10
20
30
40
50

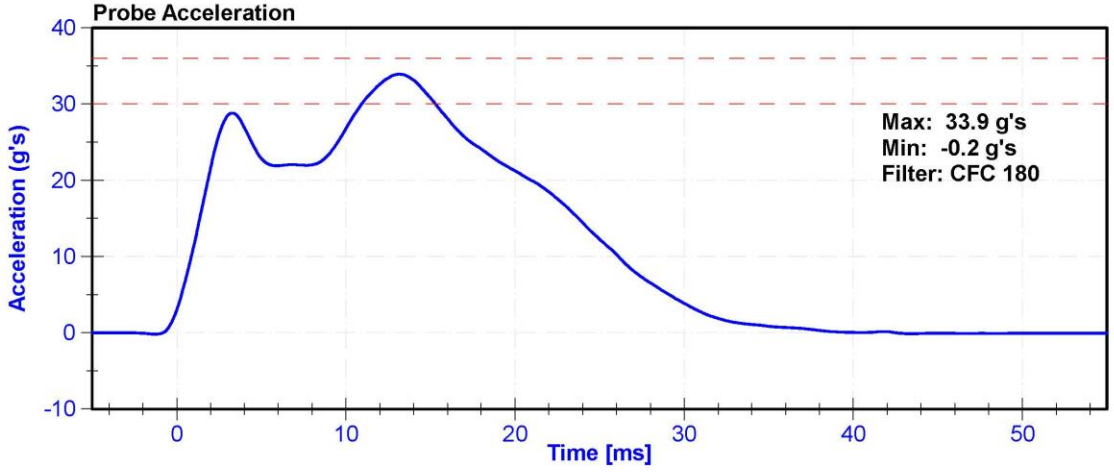
| | | | |
|---|---|---|---|
| ATD Manufacturer | FTSS | Test Technician | D.Reinhard |
| ATD Serial Number | DG8012 | Laboratory Supervisor | K. Brogan |

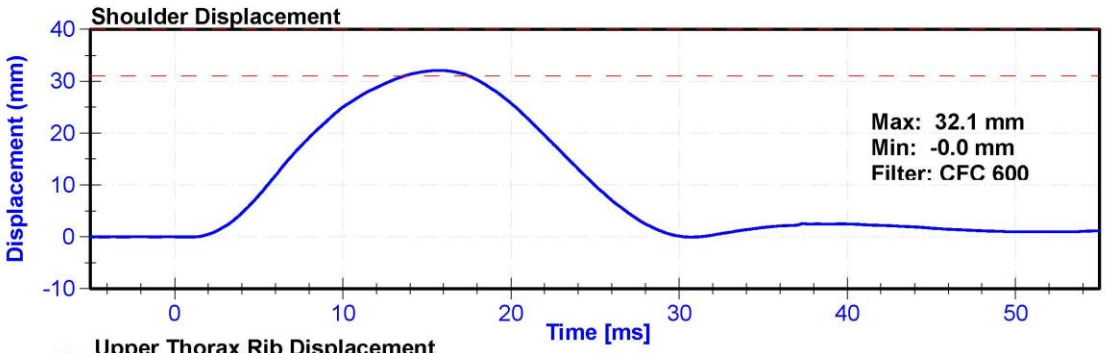
**Results**

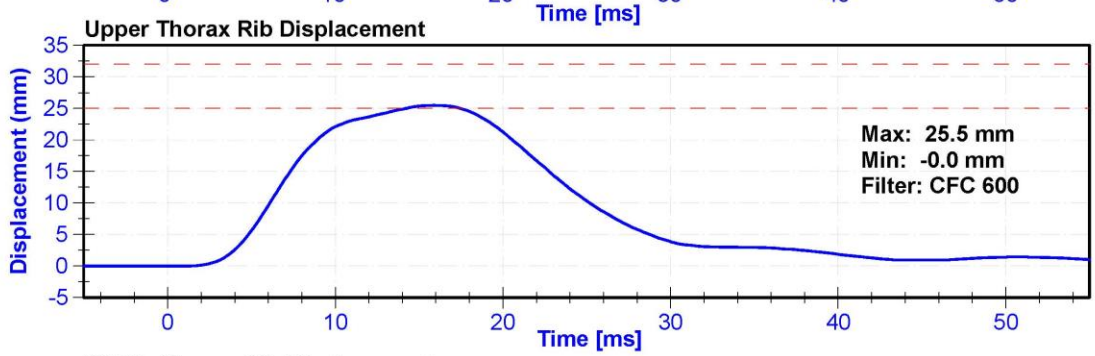
| Test Parameter | Minimum Specification | Maximum Specification | Unit | Result | Pass/Fail |
|---|---|---|---|---|---|
| Temperature | 20.6 | 22.2 | ºC | 20.7 | Pass |
| Humidity | 10 | 70 | % | 30.0 | Pass |
| Velocity | 6.6 | 6.8 | m/s | 6.70 | Pass |
| Probe Acceleration after 5 ms | 30 | 36 | g's | 33.9 | Pass |
| Lateral Upper Spine Acceleration | 34 | 43 | g's | 38.6 | Pass |
| Lateral Lower Spine Acceleration | 29 | 37 | g's | 31.6 | Pass |
| Shoulder Deflection | 31 | 40 | mm | 32.1 | Pass |
| Upper Thorax Rib Deflection | 25 | 32 | mm | 25.5 | Pass |
| Mid Thorax Rib Deflection | 30 | 36 | mm | 31.1 | Pass |
| Lower Thorax Rib Deflection | 32 | 38 | mm | 36.2 | Pass |

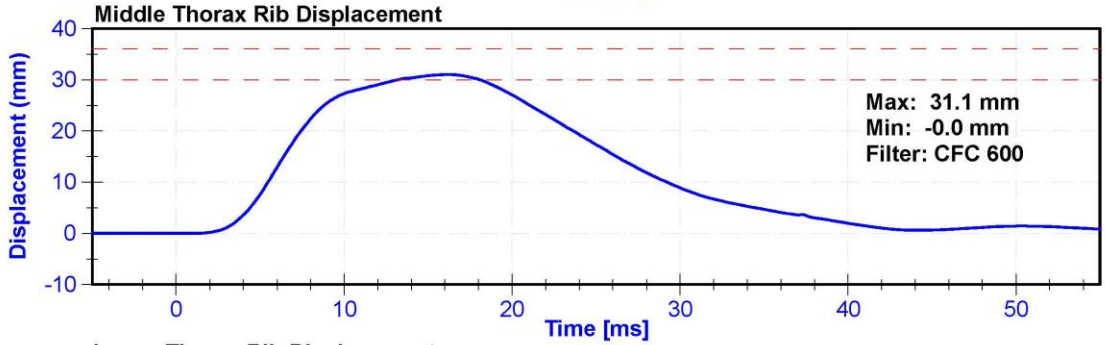
**Transducer Calibrations**

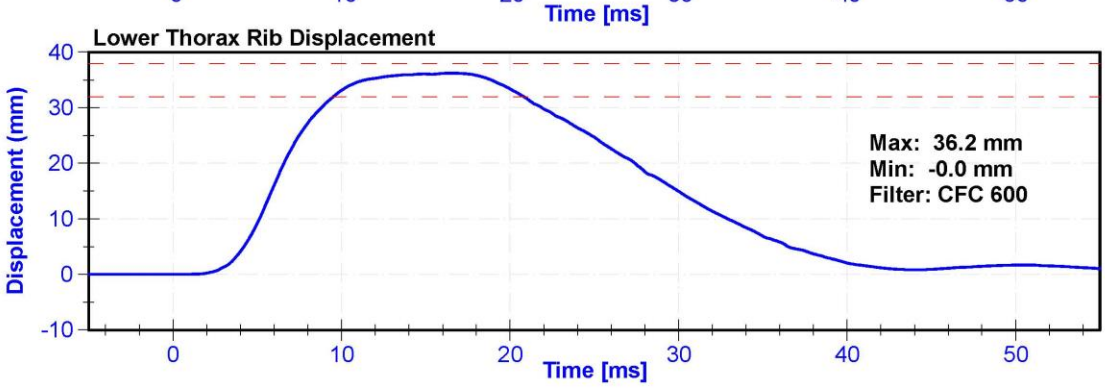
| Channel | Manufacturer | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|
| Pendulum Accelerometer | MSI 64C-2000 | A286228 | 1/29/2020 | 7/29/2020 |
| Upper Spine T1 Y Accelerometer | ENDEVCO 7264CT | AC-P64148 | 10/28/2019 | 4/27/2020 |
| Upper Spine T12 Y Accelerometer | ENDEVCO 7264CT | AC-P51327 | 9/30/2019 | 3/31/2020 |
| Shoulder Potentiometer | Servo 08TC1-3745 | DS-1845GFE | 10/28/2019 | 4/27/2020 |
| Upper Thorax Rib Potentiometer | Servo 1246 | DS-2165GFE | 10/28/2019 | 4/27/2020 |
| Middle Thorax Rib Potentiometer | Servo 08TC1-3621 | DS-45 GFE | 10/28/2019 | 4/27/2020 |
| Lower Thorax Rib Potentiometer | Servo 08TC1-3787 | DS-011GFE | 10/28/2019 | 4/27/2020 |

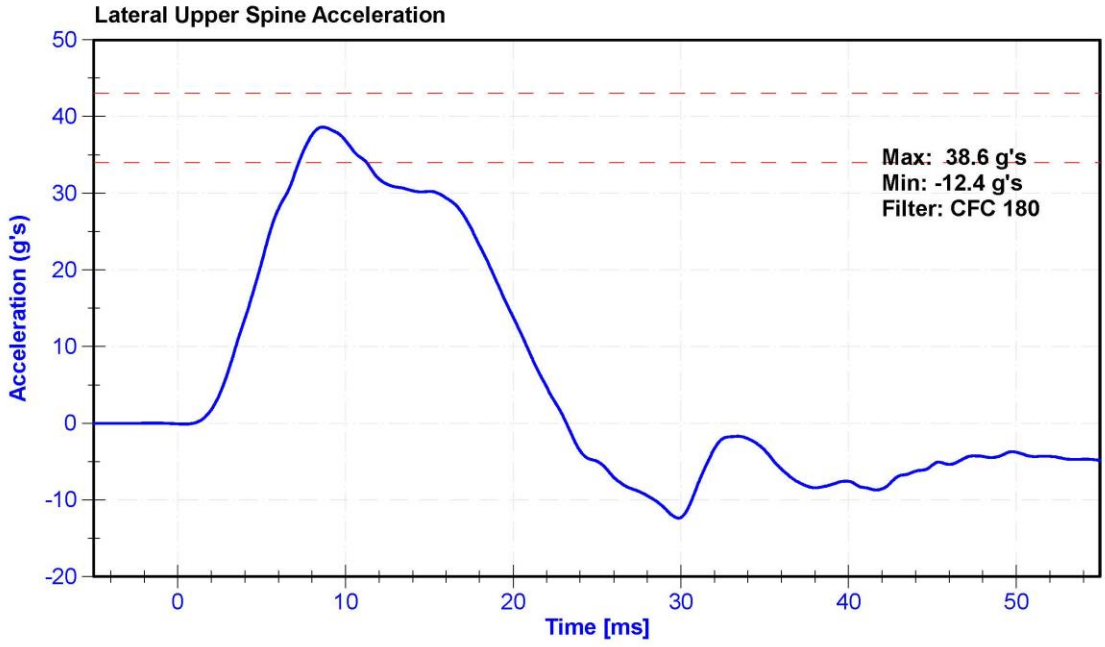


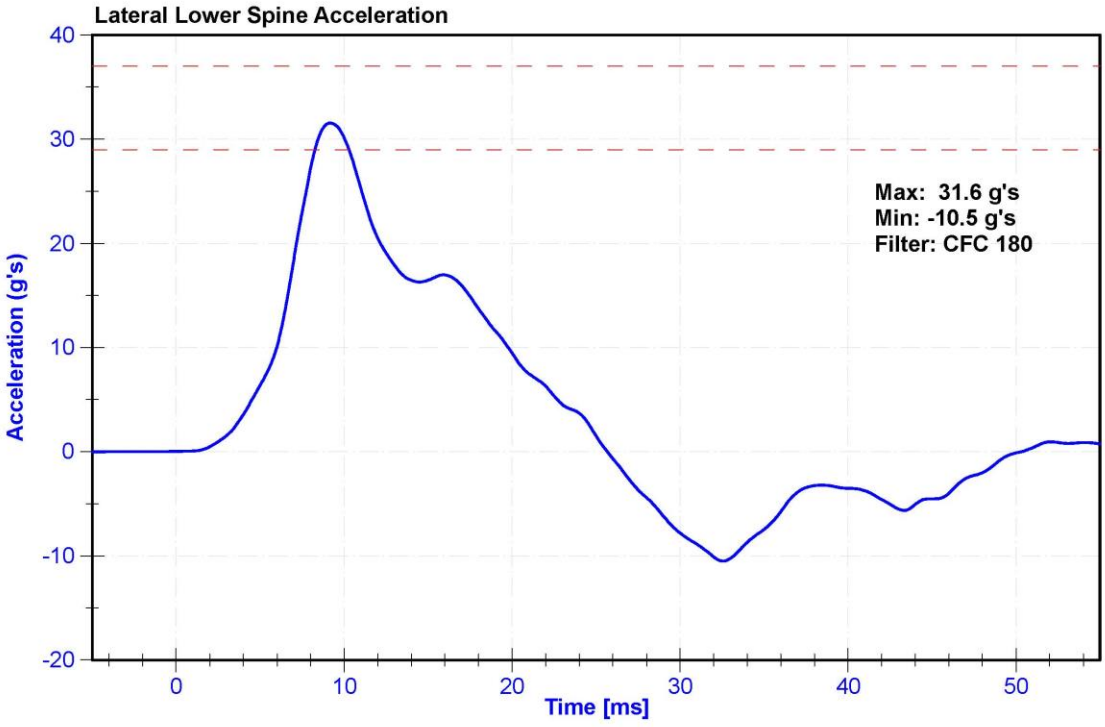

Shoulder Displacement
Displacement (mm)
Time [ms]
Max: 32.1 mm
Min: -0.0 mm
Filter: CFC 600


Upper Thorax Rib Displacement
Displacement (mm)
Time [ms]
Max: 25.5 mm
Min: -0.0 mm
Filter: CFC 600


Middle Thorax Rib Displacement
Displacement (mm)
Time [ms]
Max: 31.1 mm
Min: -0.0 mm
Filter: CFC 600


Lower Thorax Rib Displacement
Displacement (mm)
Time [ms]
Max: 36.2 mm
Min: -0.0 mm
Filter: CFC 600


Lateral Upper Spine Acceleration
Max: 38.6 g's
Min: -12.4 g's
Filter: CFC 180
Acceleration (g's)
Time [ms]
50
40
30
20
10
0
-10
-20
0
10
20
30
40
50


Lateral Lower Spine Acceleration
Max: 31.6 g's
Min: -10.5 g's
Filter: CFC 180
Acceleration (g's)
Time [ms]
40
30
20
10
0
-10
-20
0
10
20
30
40
50

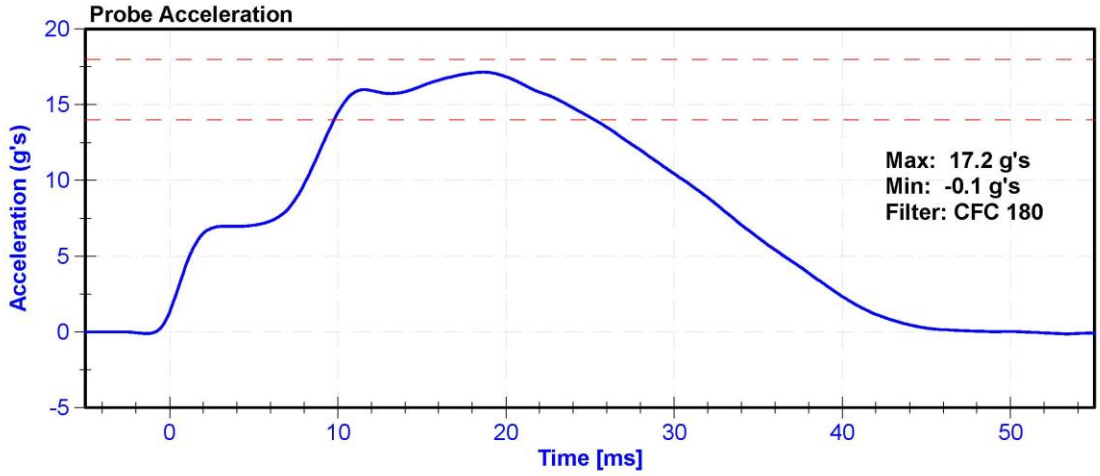
| | | | |
|---|---|---|---|
| ATD Manufacturer | FTSS | Test Technician | D.Reinhard |
| ATD Serial Number | DG8012 | Laboratory Supervisor | K. Brogan |

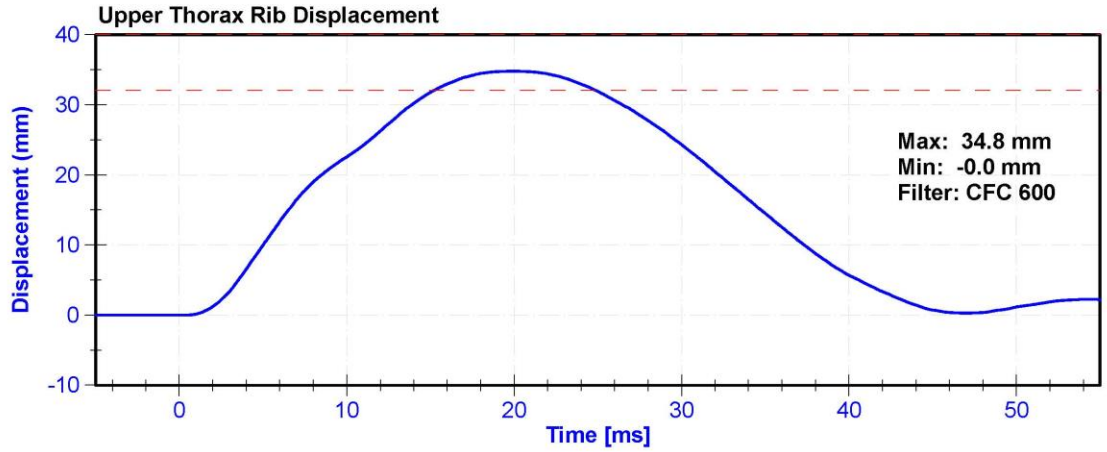
**Results**

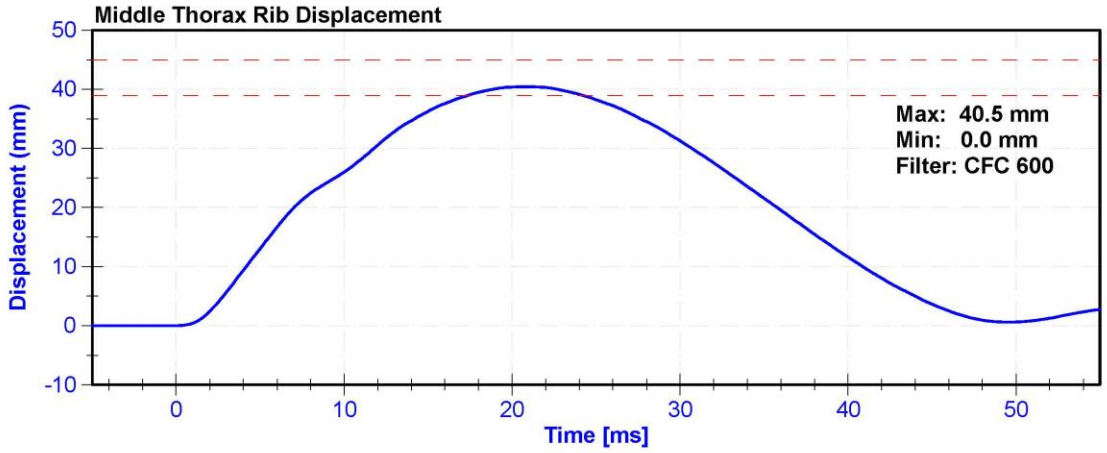
| Test Parameter | Minimum Specification | Maximum Specification | Unit | Result | Pass/Fail |
|---|---|---|---|---|---|
| Temperature | 20.6 | 22.2 | ºC | 20.8 | Pass |
| Humidity | 10 | 70 | % | 30 | Pass |
| Velocity | 4.2 | 4.4 | m/s | 4.37 | Pass |
| Probe Acceleration | 14 | 18 | g's | 17.2 | Pass |
| Lateral Upper Spine Acceleration | 13 | 17 | g's | 14.7 | Pass |
| Lateral Lower Spine Acceleration | 7 | 11 | g's | 10.0 | Pass |
| Upper Thorax Rib Deflection | 32 | 40 | mm | 34.8 | Pass |
| Middle Thorax Rib Deflection | 39 | 45 | mm | 40.5 | Pass |
| Lower Thorax Rib Deflection | 35 | 43 | mm | 39.3 | Pass |

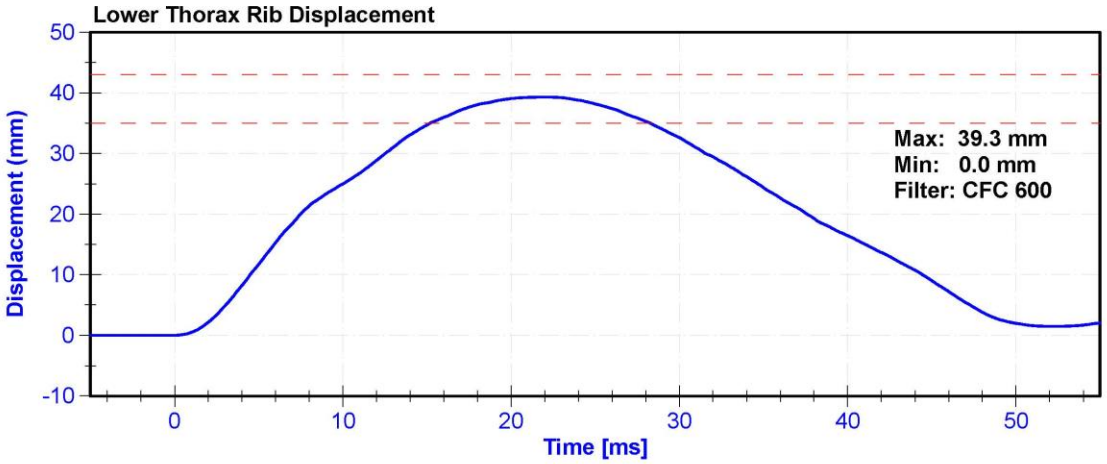
**Transducer Calibrations**

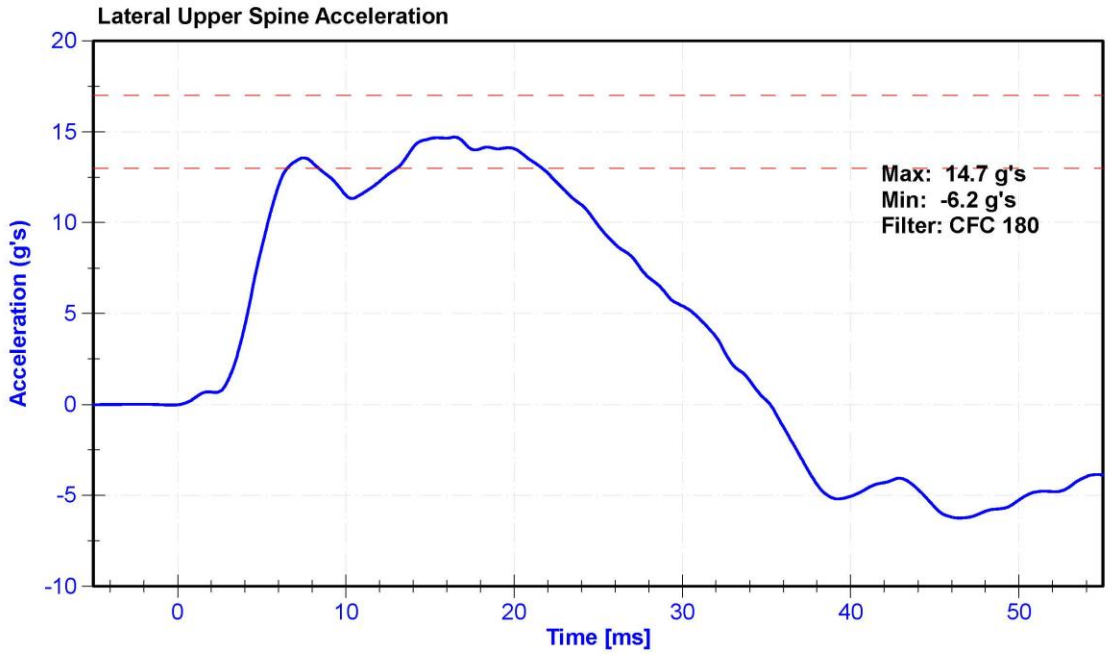
| Channel | Manufacturer | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|
| Pendulum Accelerometer | MSI 64C-2000 | A286228 | 1/29/2020 | 7/29/2020 |
| Upper Spine Y Accelerometer | ENDEVCO 7264CT | AC-P64148 | 10/28/2019 | 4/27/2020 |
| Lower Spine Y Accelerometer | ENDEVCO 7264CT | AC-P51327 | 9/30/2019 | 3/31/2020 |
| Upper Thorax Rib Potentiometer | Servo 1246 | DS-2165GFE | 10/28/2019 | 4/27/2020 |
| Middle Thorax Rib Potentiometer | Servo 08TC1-3621 | DS-45 GFE | 10/28/2019 | 4/27/2020 |
| Lower Thorax Rib Potentiometer | Servo 08TC1-3787 | DS-011GFE | 10/28/2019 | 4/27/2020 |

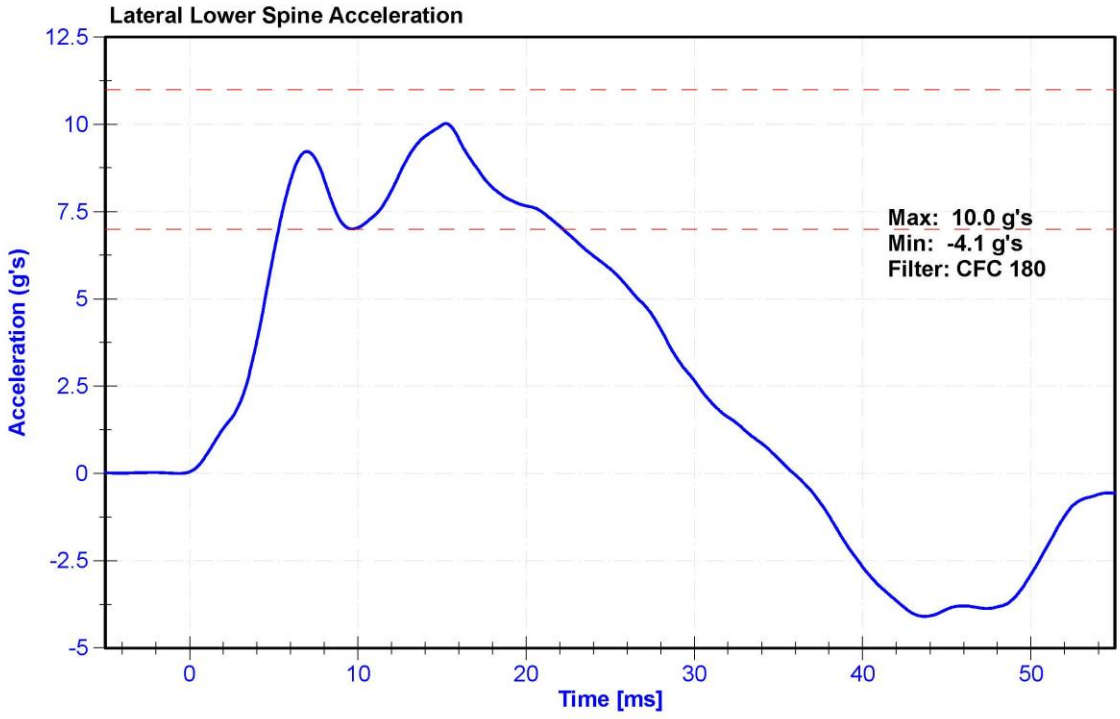



Upper Thorax Rib Displacement
Displacement (mm)
Time [ms]
Max: 34.8 mm
Min: -0.0 mm
Filter: CFC 600


Middle Thorax Rib Displacement
Displacement (mm)
Time [ms]
Max: 40.5 mm
Min: 0.0 mm
Filter: CFC 600


Lower Thorax Rib Displacement
Displacement (mm)
Time [ms]
Max: 39.3 mm
Min: 0.0 mm
Filter: CFC 600


Lateral Upper Spine Acceleration
Acceleration (g's)
Time [ms]
Max: 14.7 g's
Min: -6.2 g's
Filter: CFC 180


Lateral Lower Spine Acceleration
Acceleration (g's)
Time [ms]
Max: 10.0 g's
Min: -4.1 g's
Filter: CFC 180

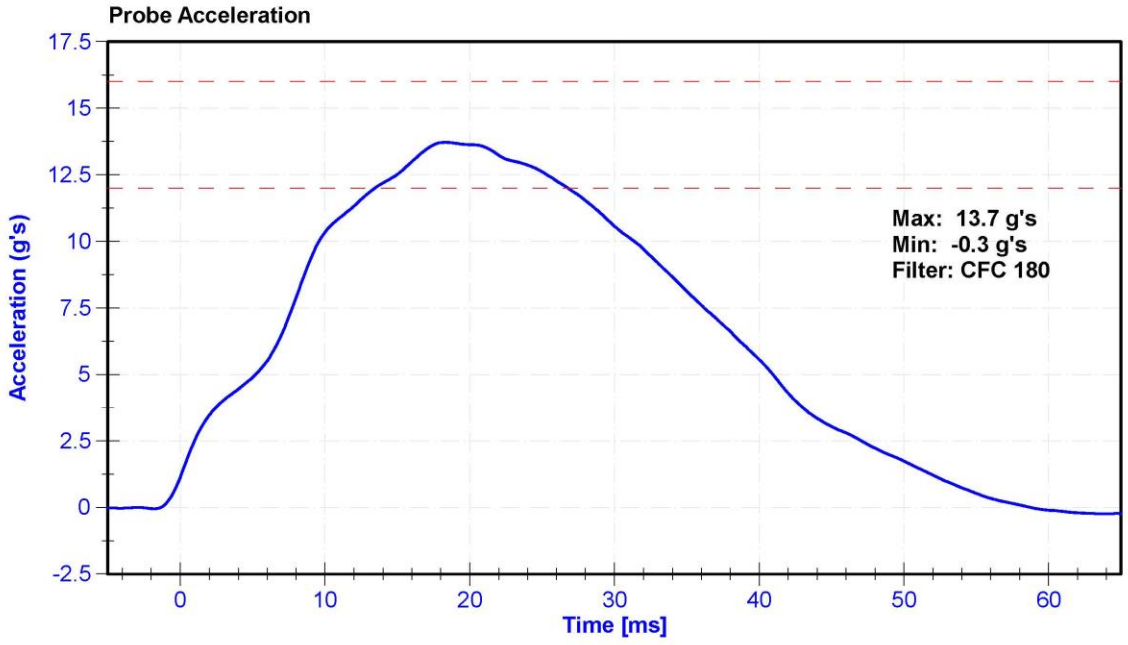
| | | | |
|---|---|---|---|
| ATD Manufacturer | FTSS | Test Technician | D.Reinhard |
| ATD Serial Number | DG8012 | Laboratory Supervisor | K. Brogan |

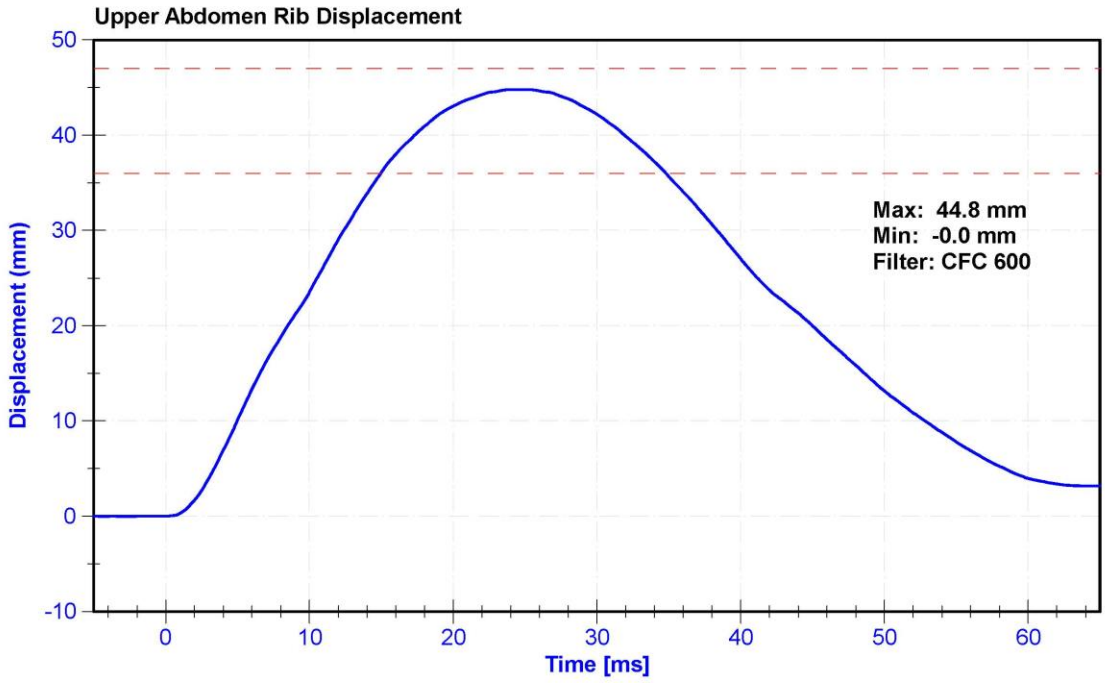
**Results**

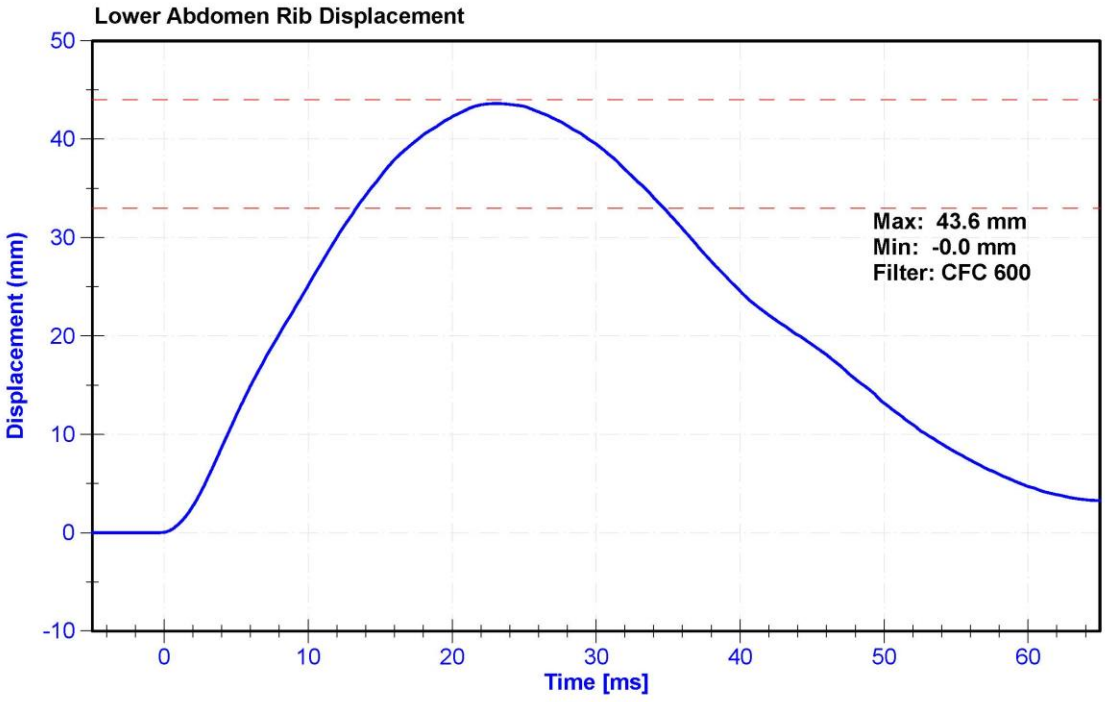
| Test Parameter | Minimum Specification | Maximum Specification | Unit | Result | Pass/Fail |
|---|---|---|---|---|---|
| Temperature | 20.6 | 22.2 | ºC | 20.7 | Pass |
| Humidity | 10 | 70 | % | 30.0 | Pass |
| Velocity | 4.2 | 4.4 | m/s | 4.22 | Pass |
| Probe Acceleration | 12 | 16 | g's | 13.7 | Pass |
| Lateral Lower Spine Acceleration | 9 | 14 | g's | 9.2 | Pass |
| Upper Abdomen Rib Deflection | 36 | 47 | mm | 44.8 | Pass |
| Lower Abdomen Rib Deflection | 33 | 44 | mm | 43.6 | Pass |

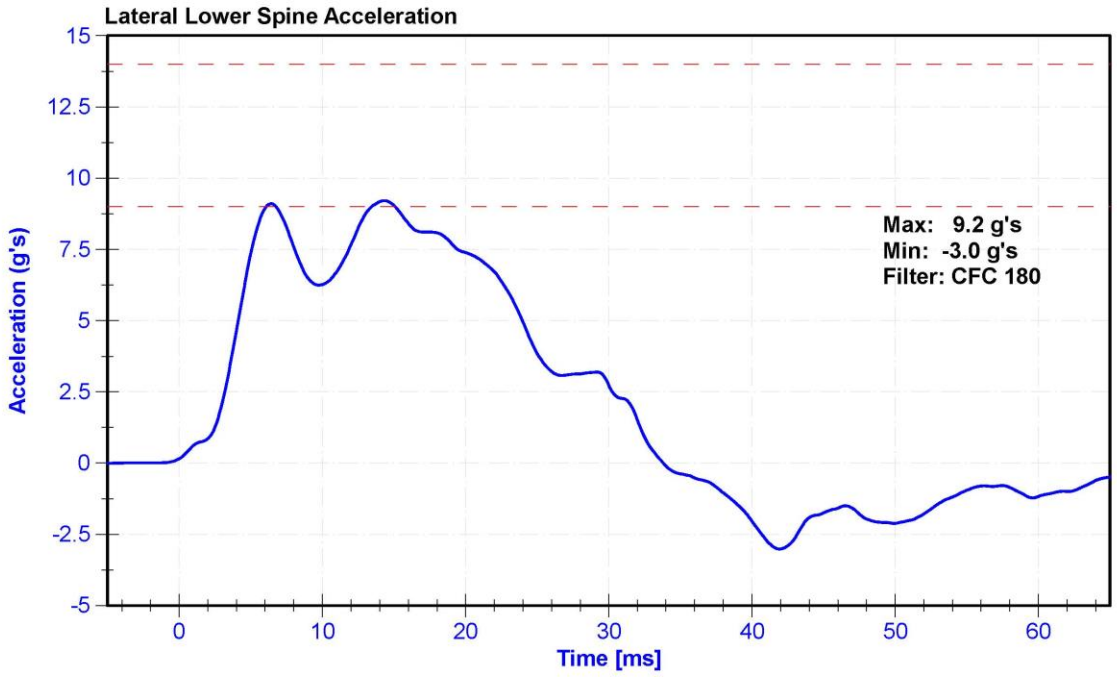
**Transducer Calibrations**

| Channel | Manufacturer | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|
| Probe Accelerometer | MSI 64C-2000 | A286228 | 1/29/2020 | 7/29/2020 |
| Lower Spine Y Accelerometer | ENDEVCO 7264CT | AC-P51327 | 9/30/2019 | 3/31/2020 |
| Upper Abdomen Rib Potentiometer | Servo 08TC1-3725 | DS-008GFE | 10/28/2019 | 4/27/2020 |
| Lower Abdomen Rib Potentiometer | Servo 08TC1-3745 | DS-1774GFE | 10/28/2019 | 4/27/2020 |




Upper Abdomen Rib Displacement
Displacement (mm)
Time [ms]
Max: 44.8 mm
Min: -0.0 mm
Filter: CFC 600


Lower Abdomen Rib Displacement
Displacement (mm)
Time [ms]
Max: 43.6 mm
Min: -0.0 mm
Filter: CFC 600


Lateral Lower Spine Acceleration
Acceleration (g's)
15
12.5
10
7.5
5
2.5
0
-2.5
-5
0
10
20
30
40
50
60
Time [ms]
Max: 9.2 g's
Min: -3.0 g's
Filter: CFC 180

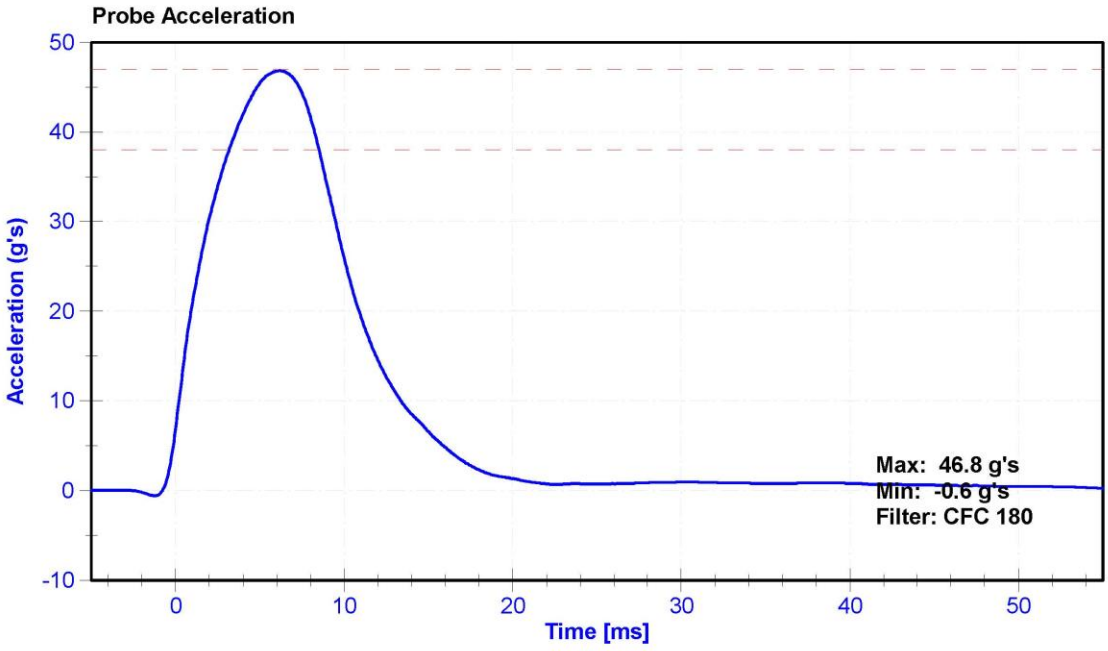
| | | | |
|---|---|---|---|
| ATD Manufacturer | FTSS | Test Technician | D.Reinhard |
| ATD Serial Number | DG8012 | Laboratory Supervisor | K. Brogan |

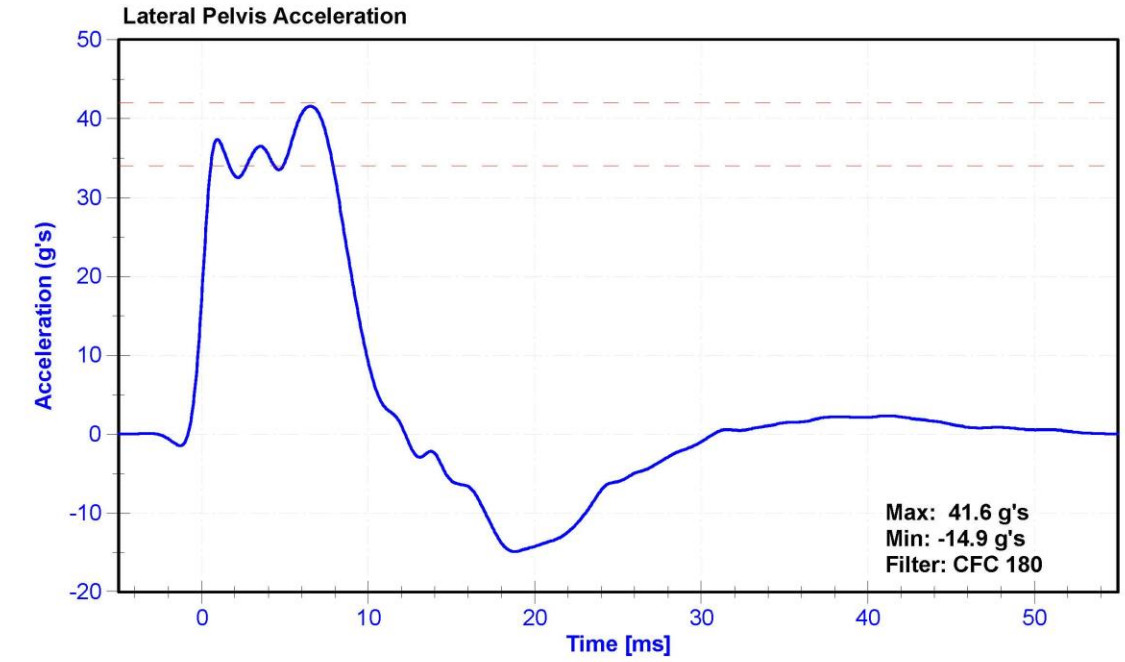
**Results**

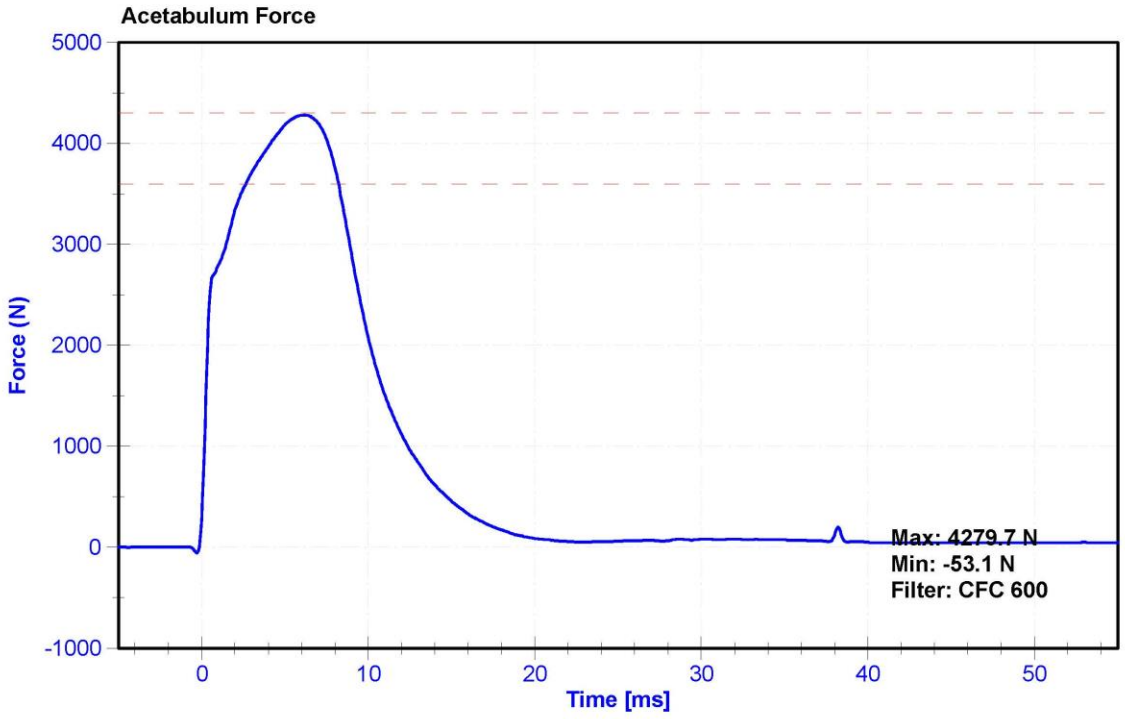
| Test Parameter | Minimum Specification | Maximum Specification | Unit | Result | Pass/Fail |
|---|---|---|---|---|---|
| Temperature | 20.6 | 22.2 | ºC | 20.7 | Pass |
| Humidity | 10 | 70 | % | 29 | Pass |
| Velocity | 6.6 | 6.8 | m/s | 6.61 | Pass |
| Probe Acceleration | 38 | 47 | g's | 46.8 | Pass |
| Lateral Pelvis Acceleration after 6ms | 34 | 42 | g's | 41.6 | Pass |
| Acetabulum Force | 3600 | 4300 | N | 4279.7 | Pass |

**Transducer Calibrations**

| Channel | Manufacturer | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|
| Pendulum Accelerometer | MSI 64C-2000 | A286228 | 1/29/2020 | 7/29/2020 |
| Pelvis Y Accelerometer | ENDEVCO 7264CT | AC-P51875 | 10/28/2019 | 4/27/2020 |
| Acetabulum Load Cell | Denton 3249J | LC-4986Fy | 6/14/2019 | 6/13/2020 |
| Certification Plug | SACO | 12586 | 10-3-2018 | N/A |
| Crash Test Plug | SACO | 12789 | 1-17-2019 | N/A |




Lateral Pelvis Acceleration
Acceleration (g's)
50
40
30
20
10
0
-10
-20
0
10
20
30
40
50
Time [ms]
Max: 41.6 g's
Min: -14.9 g's
Filter: CFC 180


Acetabulum Force
Force (N)
5000
4000
3000
2000
1000
0
-1000
0
10
20
30
40
50
Time [ms]
Max: 4279.7 N
Min: -53.1 N
Filter: CFC 600

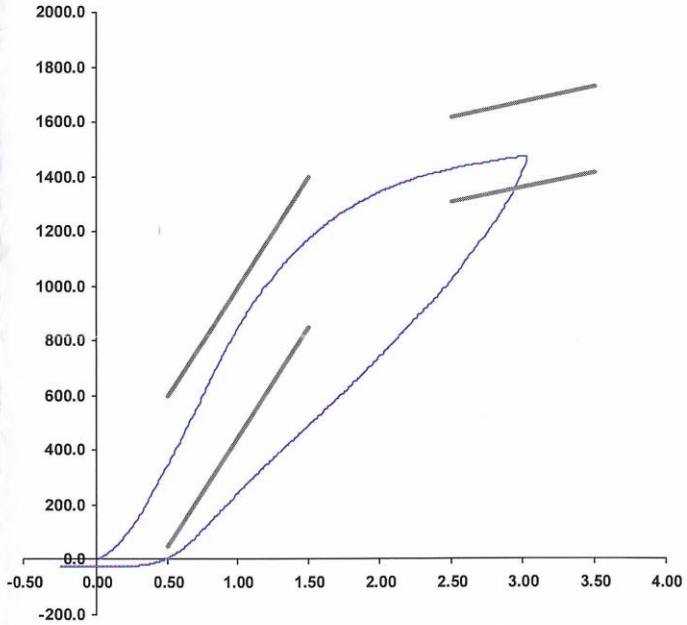
Cert 1
DG 5012

## SID-IIs Pelvis Plug Certification Test

Plug S/N 12586
Test Number 7516
Report Number 7531
Test Date 10/3/2018 10:22:22 AM

| | Test Results | Spec Min | Spec Max |
|---|---|---|---|
| Force @ 0.5 mm (N) | 342.04 | 50.00 | 600.00 |
| Force @ 1.5 mm (N) | 1,174.68 | 850.00 | 1,400.00 |
| Force @ 2.5 mm (N) | 1,427.96 | 1,306.00 | 1,618.00 |
| Force @ 3.0 mm (N) | 1,474.13 | 1,361.00 | 1,673.00 |

Force (-N) vs Extension (-mm)




**Testing Machine STM-20 5965542**
**Load Cell S/N (FI360947), Units (LBS )** 1000

**Crosshead Speed ( mm / min ) or Rate** 12.7
**Extension or Position Measured by** XHD_100 ( XHD100 )

Notes:

**Operator**

**Part Number** 180-4450

**Template No 107** **03-Oct-18**
SACO Research

By : DC Date : 10/3/18

SACO Research 41735 Elm St, #401 Murrieta, CA 92562 Tel 310-694-2082 FAX

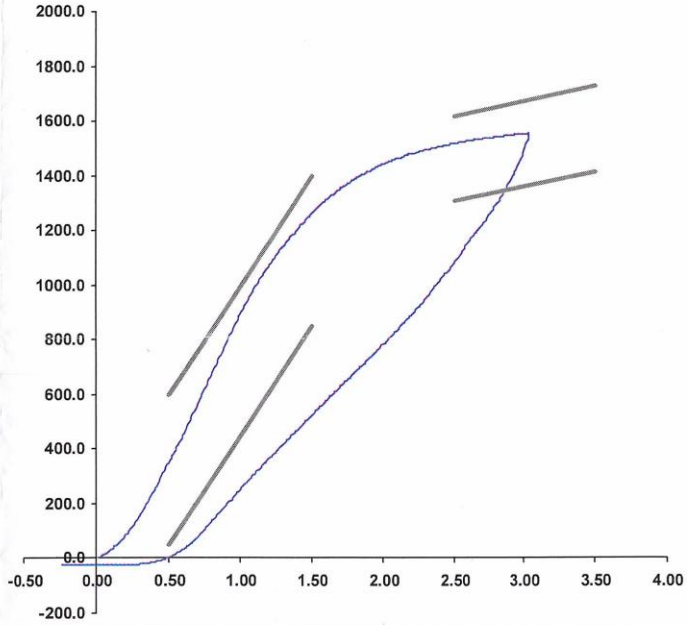
Crash D68012

## SID-IIs Pelvis Plug Certification Test

Plug S/N 12789
Test Number 8121
Report Number 8151
Test Date 1/17/2019 12:42:15 PM

| | Test Results | Spec Min | Spec Max |
|---|---|---|---|
| Force @ 0.5 mm (N) | 350.90 | 50.00 | 600.00 |
| Force @ 1.5 mm (N) | 1,260.52 | 850.00 | 1,400.00 |
| Force @ 2.5 mm (N) | 1,516.60 | 1,306.00 | 1,618.00 |
| Force @ 3.0 mm (N) | 1,554.56 | 1,361.00 | 1,673.00 |

Force (-N) vs Extension (-mm)




**Testing Machine** STM-20 5965542
**Load Cell S/N (FI360947), Units (LBS )** 1000
**Preload Value ( -N )** 22.24
**Crosshead Speed ( mm / min ) or Rate** 12.7
**Extension or Position Measured by** XHD_100 ( XHD100 )

Notes:

**Operator**

**Part Number** 180-4450

**Template No 107** **17-Jan-19**
SACO Research

By : DC Date : 1/17/2019

SACO Research 41735 Elm St, #401 Murrieta, CA 92562 Tel 310-694-2082 FAX

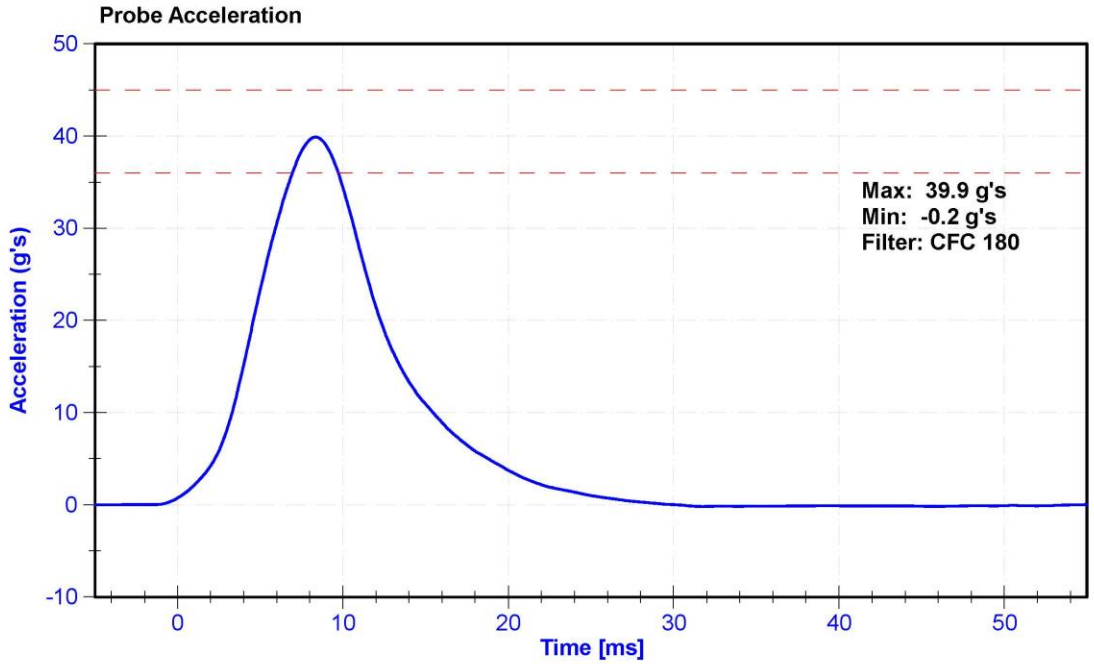
| | | | |
|---|---|---|---|
| ATD Manufacturer | FTSS | Test Technician | D.Reinhard |
| ATD Serial Number | DG8012 | Laboratory Supervisor | K. Brogan |

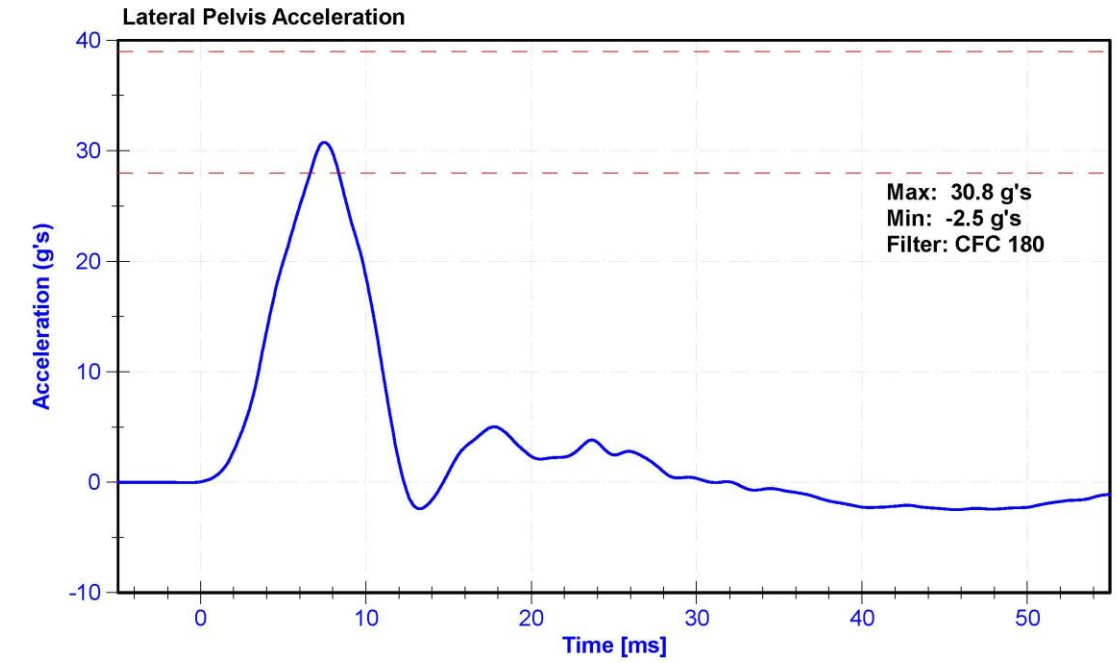
**Results**

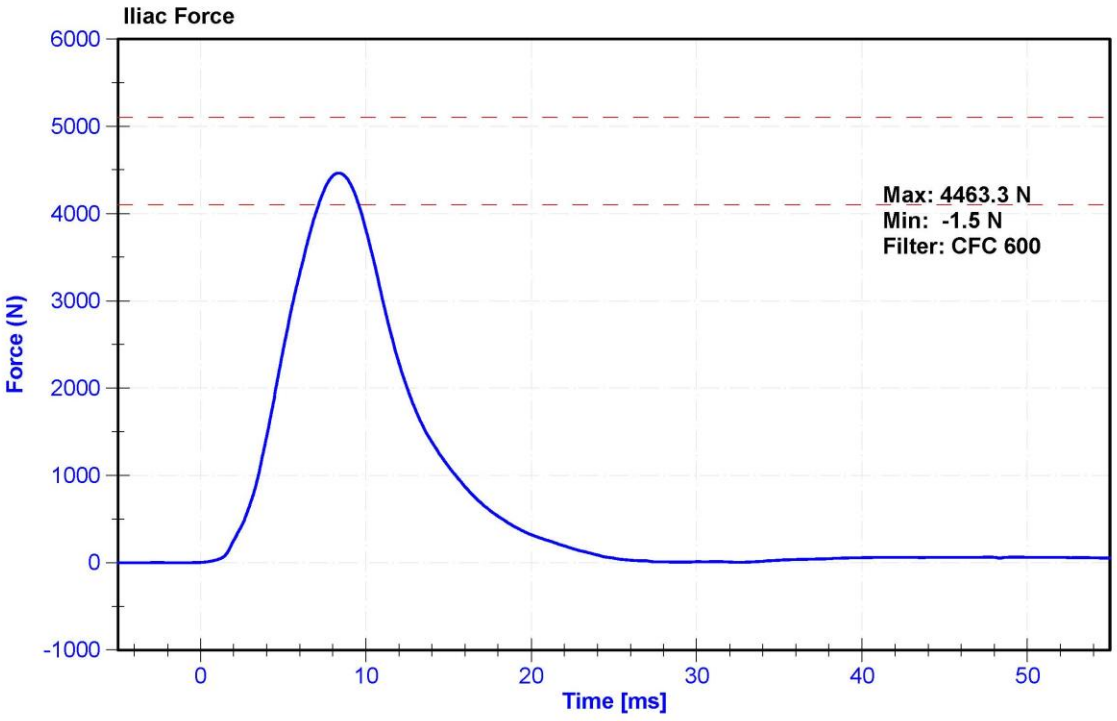
| Test Parameter | Minimum Specification | Maximum Specification | Unit | Result | Pass/Fail |
|---|---|---|---|---|---|
| Temperature | 20.6 | 22.2 | ºC | 20.8 | Pass |
| Humidity | 10 | 70 | % | 33.0 | Pass |
| Velocity | 4.2 | 4.4 | m/s | 4.37 | Pass |
| Probe Acceleration | 36 | 45 | g's | 39.9 | Pass |
| Lateral Pelvis Acceleration | 28 | 39 | g's | 30.8 | Pass |
| Iliac Force | 4100 | 5100 | N | 4463.3 | Pass |

**Transducer Calibrations**

| Channel | Manufacturer | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|
| Pendulum Accelerometer | MSI 64C-2000 | A286228 | 1/29/2020 | 7/29/2020 |
| Pelvis Y Accelerometer | ENDEVCO 7264CT | AC-P51875 | 10/28/2019 | 4/27/2020 |
| Iliac Load Cell | DENTON 3228J | LC-290Fy | 9/25/2019 | 9/24/2020 |




Lateral Pelvis Acceleration
Acceleration (g's)
Time [ms]
Max: 30.8 g's
Min: -2.5 g's
Filter: CFC 180


Iliac Force
Force (N)
Time [ms]
Max: 4463.3 N
Min: -1.5 N
Filter: CFC 600

**CALIBRATION TEST RESULTS**

**POST-TEST**

**SID-IIS 5TH PERCENTILE FEMALE - DRIVER ATD**

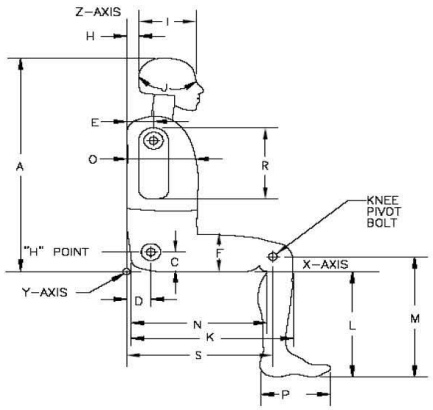
**SERIAL NO: DG8012**

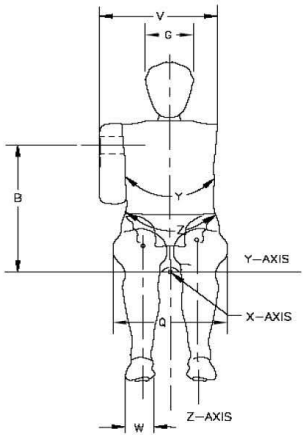
**(CONFIGURED FOR LEFT SIDE IMPACT)**

External Measurements - SID-IIs

Technician: K. Dutton  Date: 03/10/2020

Dummy Serial Number: DG8012




| Symbol | Description | Specification (mm) | | Result (mm) | Pass/Fail |
|---|---|---|---|---|---|
| A | Sitting Height | 772 | 788 | 779 | Pass |
| B | Shoulder Pivot Height | 437 | 453 | 446 | Pass |
| C | H-point Height | 79 | 89 | 85 | Pass |
| D | H-point from seatback | 141 | 151 | 146 | Pass |
| E | Shoulder Pivot from Backline | 97 | 107 | 103 | Pass |
| F | Thigh Clearance | 119 | 135 | 126 | Pass |
| G | Head Breadth | 140 | 148 | 144 | Pass |
| H | Head Back from Backline | 40 | 46 | 44 | Pass |
| I | Head Depth | 178 | 188 | 185 | Pass |
| J | Head Circumference | 541 | 551 | 547 | Pass |
| K | Buttock to Knee Length | 514 | 540 | 532 | Pass |
| L | Popliteal Height | 343 | 369 | 357 | Pass |
| M | Knee Pivot to floor height | 392 | 409 | 404 | Pass |
| N | Buttock Popliteal Length | 416 | 442 | 433 | Pass |
| O | Chest Depth w/o jacket | 195 | 211 | 205 | Pass |
| P | Foot Length | 216 | 232 | 224 | Pass |
| Q | Hip Breadth (w/pelvic plugs) | 313 | 323 | 318 | Pass |
| R | Arm Length | 249 | 259 | 255 | Pass |
| S | Knee Joint to seatback | 477 | 493 | 486 | Pass |
| V | Shoulder Width | 341 | 357 | 345 | Pass |
| W | Foot Width | 78 | 94 | 85 | Pass |
| Y | Chest Circumference w/jacket | 851 | 881 | 867 | Pass |
| Z | Waist Circumference | 761 | 791 | 781 | Pass |

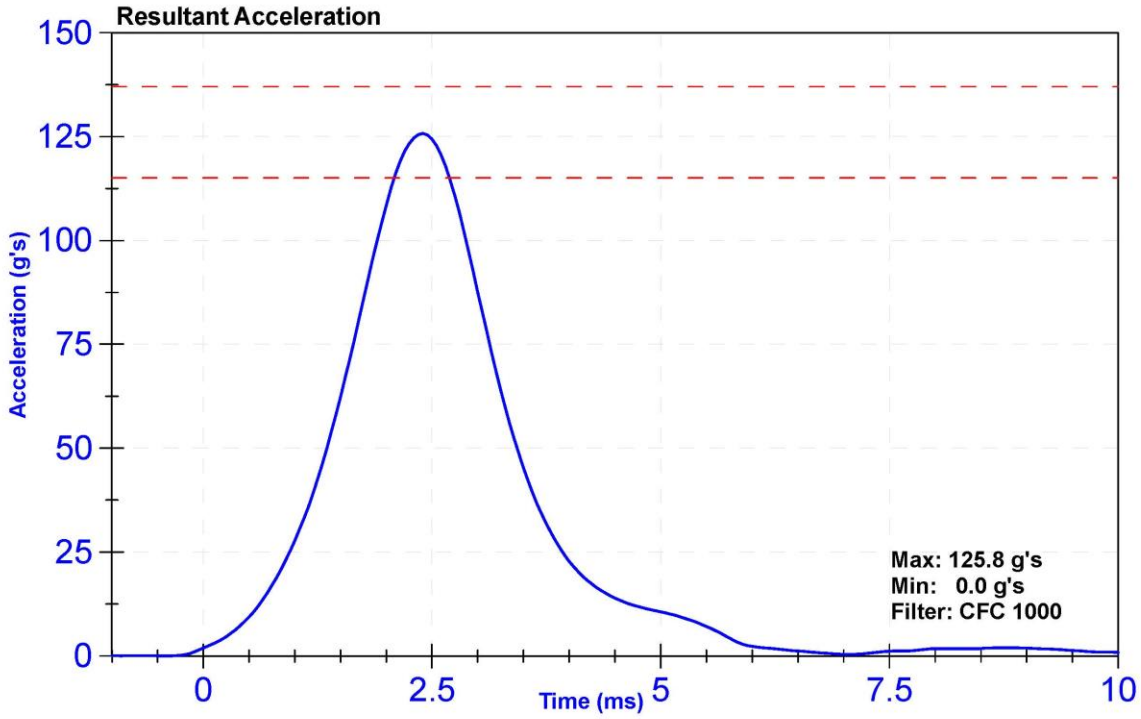
| | | | |
|---|---|---|---|
| ATD Manufacturer | FTSS | Test Technician | M. Dudek |
| ATD Serial Number | DG8012 | Laboratory Supervisor | K. Brogan |

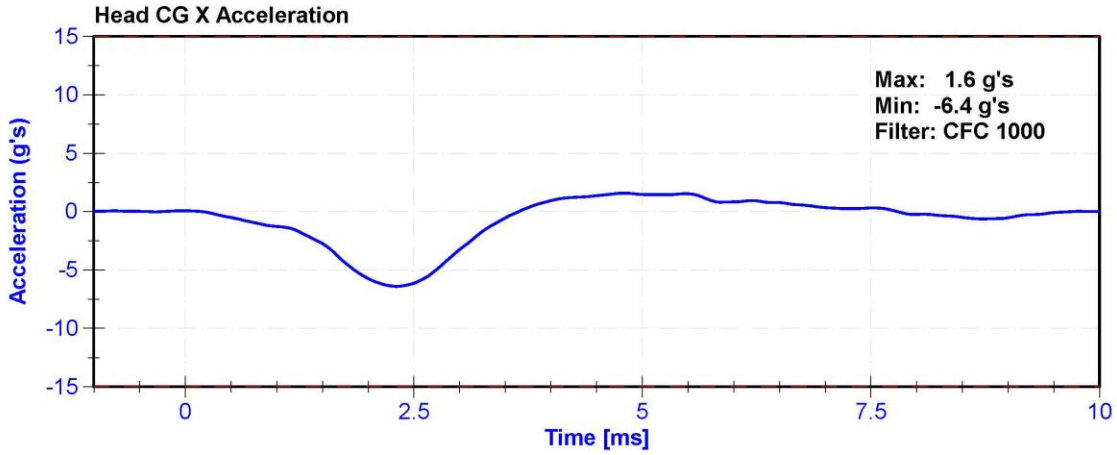
**Results**

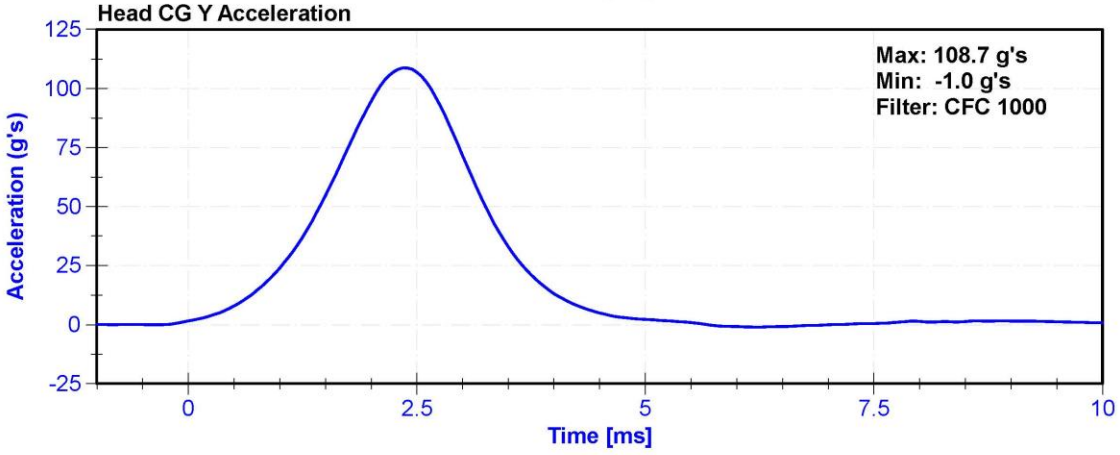
| Test Parameter | Minimum Specification | Maximum Specification | Unit | Result | Pass/Fail |
|---|---|---|---|---|---|
| Temperature | 20.6 | 22.2 | ºC | 21 | Pass |
| Humidity | 10 | 70 | % | 27.1 | Pass |
| Resultant Acceleration | 115 | 137 | g's | 125.8 | Pass |
| Oscillation | 0 | 15 | % | 1.6 | Pass |
| Fore-Aft Acceleration | -15 | 15 | g's | -6.4 | Pass |

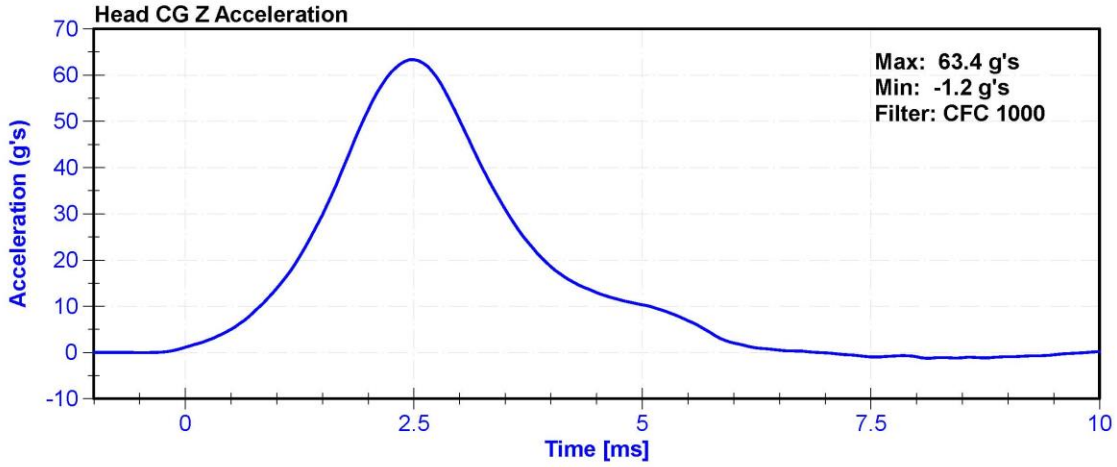
**Transducer Calibrations**

| Channel | Manufacturer | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|
| X Accelerometer | ENDEVCO 7264 | AC-P74788 | 10/28/2019 | 4/27/2020 |
| Y Accelerometer | ENDEVCO 7264CT | AC-P83432 | 10/28/2019 | 4/27/2020 |
| Z Accelerometer | ENDEVCO 7264 | AC-P83319 | 10/28/2019 | 4/27/2020 |




Head CG X Acceleration
Max: 1.6 g's
Min: -6.4 g's
Filter: CFC 1000
Acceleration (g's)
15
10
5
0
-5
-10
-15
0
2.5
5
7.5
10
Time [ms]


Head CG Y Acceleration
Max: 108.7 g's
Min: -1.0 g's
Filter: CFC 1000
Acceleration (g's)
125
100
75
50
25
0
-25
0
2.5
5
7.5
10
Time [ms]


Head CG Z Acceleration
Max: 63.4 g's
Min: -1.2 g's
Filter: CFC 1000
Acceleration (g's)
70
60
50
40
30
20
10
0
-10
0
2.5
5
7.5
10
Time [ms]

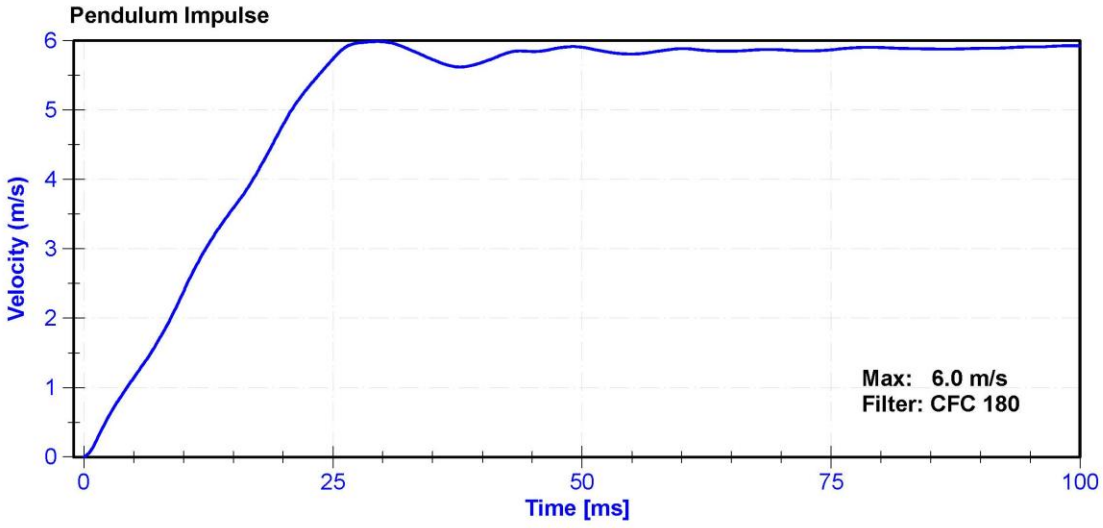
| | | | |
|---|---|---|---|
| ATD Manufacturer | FTSS | Test Technician | C. Mantell |
| ATD Serial Number | DG8012 | Laboratory Supervisor | K. Brogan |

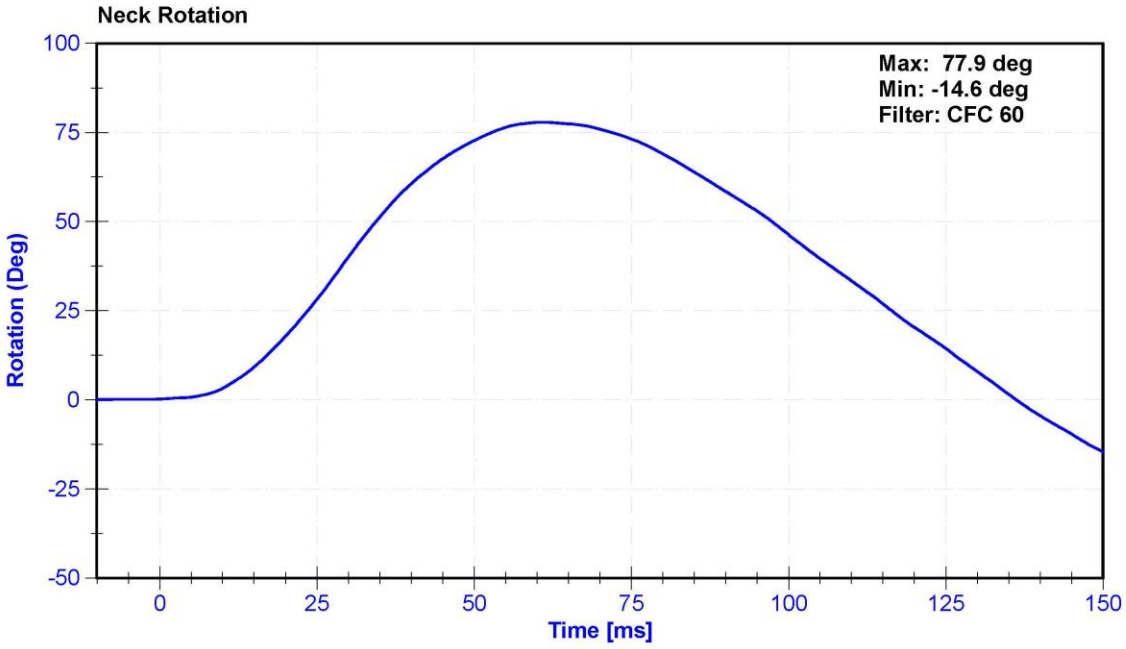
**Results**

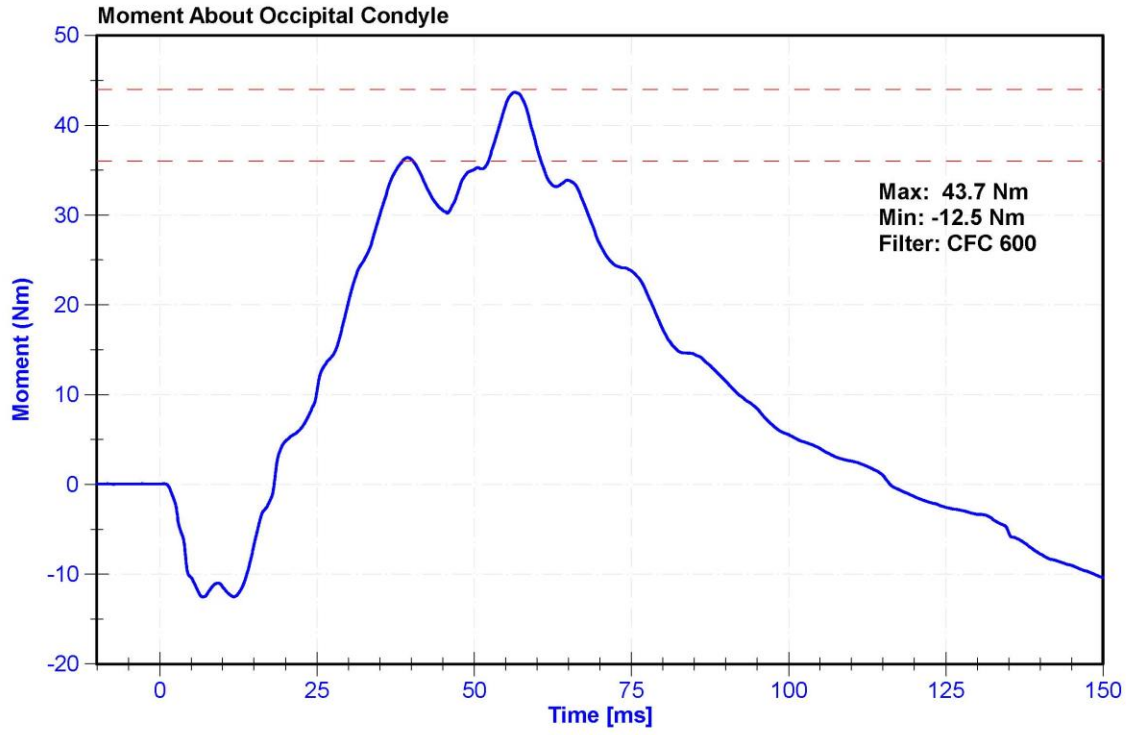
| Test Parameter | Minimum Specification | Maximum Specification | Unit | Result | Pass/Fail |
|---|---|---|---|---|---|
| Temperature | 20.6 | 22.2 | ºC | 21.8 | Pass |
| Humidity | 10 | 70 | % | 31.4 | Pass |
| Velocity | 5.51 | 5.63 | m/s | 5.549 | Pass |
| Pendulum Impulse at 10ms | 2.2 | 2.8 | m/s | 2.38 | Pass |
| Pendulum Impulse at 15ms | 3.3 | 4.1 | m/s | 3.59 | Pass |
| Pendulum Impulse at 20ms | 4.4 | 5.4 | m/s | 4.79 | Pass |
| Pendulum Impulse at 25ms | 5.4 | 6.1 | m/s | 5.73 | Pass |
| Pendulum Impulse from 25 to 100ms | 5.5 | 6.2 | m/s | 5.99 | Pass |
| Neck Rotation | 71 | 81 | deg | 77.9 | Pass |
| Time at Maximum Rotation | 50 | 70 | ms | 60.8 | Pass |
| Moment about the OC | 36 | 44 | Nm | 43.7 | Pass |
| Moment Decay to 0 Nm | 102 | 126 | ms | 116.2 | Pass |

**Transducer Calibrations**

| Channel | Manufacturer | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|
| Pendulum Accelerometer | ENDEVCO 7231CT | AC-AH5M9 Pend | 1/30/2020 | 1/29/2021 |
| Pendulum Potentiometer | Denton 78051-342 | DS-184Pend | 11/4/2019 | 11/3/2020 |
| Condyle Potentiometer | Denton 78051-342 | DS-185Pend | 11/4/2019 | 11/3/2020 |
| Upper Neck Load Cell | Denton 1716A | LC-2192Fy | 6/20/2019 | 6/19/2020 |




Neck Rotation
Max: 77.9 deg
Min: -14.6 deg
Filter: CFC 60
Rotation (Deg)
100
75
50
25
0
-25
-50
0
25
50
75
100
125
150
Time [ms]


Moment About Occipital Condyle
Max: 43.7 Nm
Min: -12.5 Nm
Filter: CFC 600
Moment (Nm)
50
40
30
20
10
0
-10
-20
0
25
50
75
100
125
150
Time [ms]

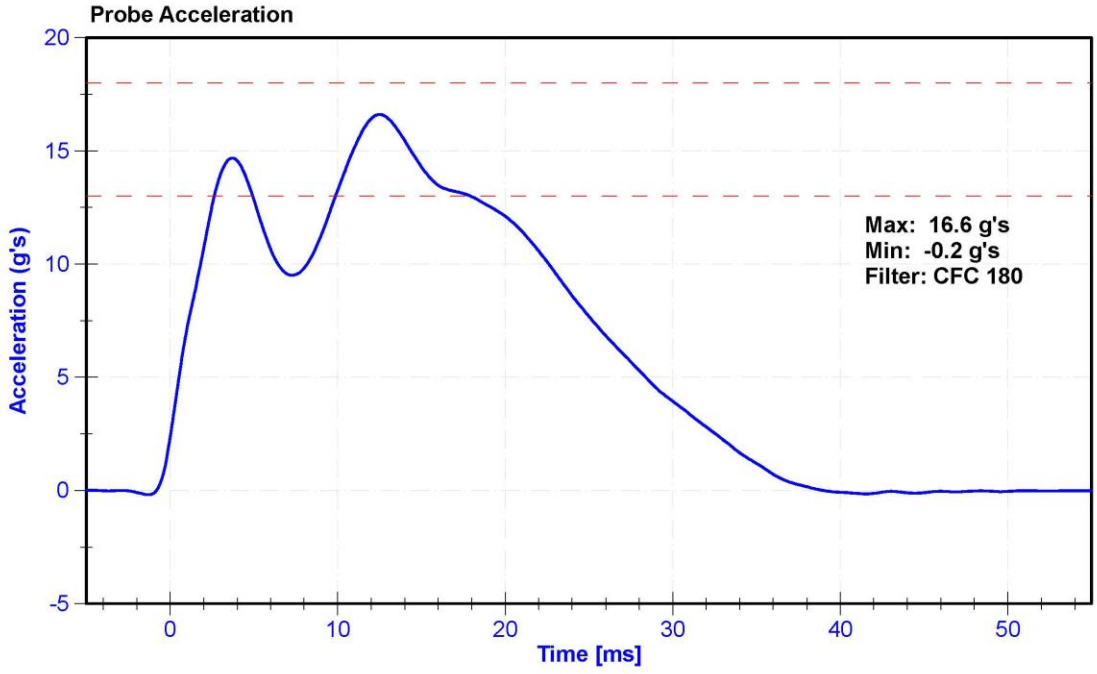
| | | | |
|---|---|---|---|
| ATD Manufacturer | FTSS | Test Technician | D.Reinhard |
| ATD Serial Number | DG8012 | Laboratory Supervisor | K. Brogan |

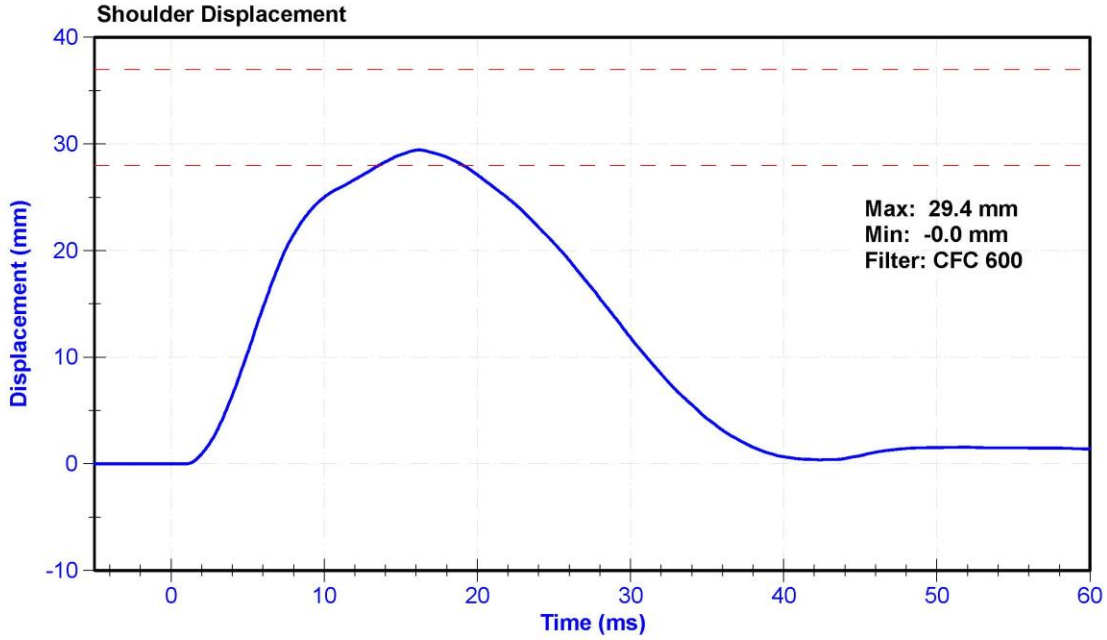
**Results**

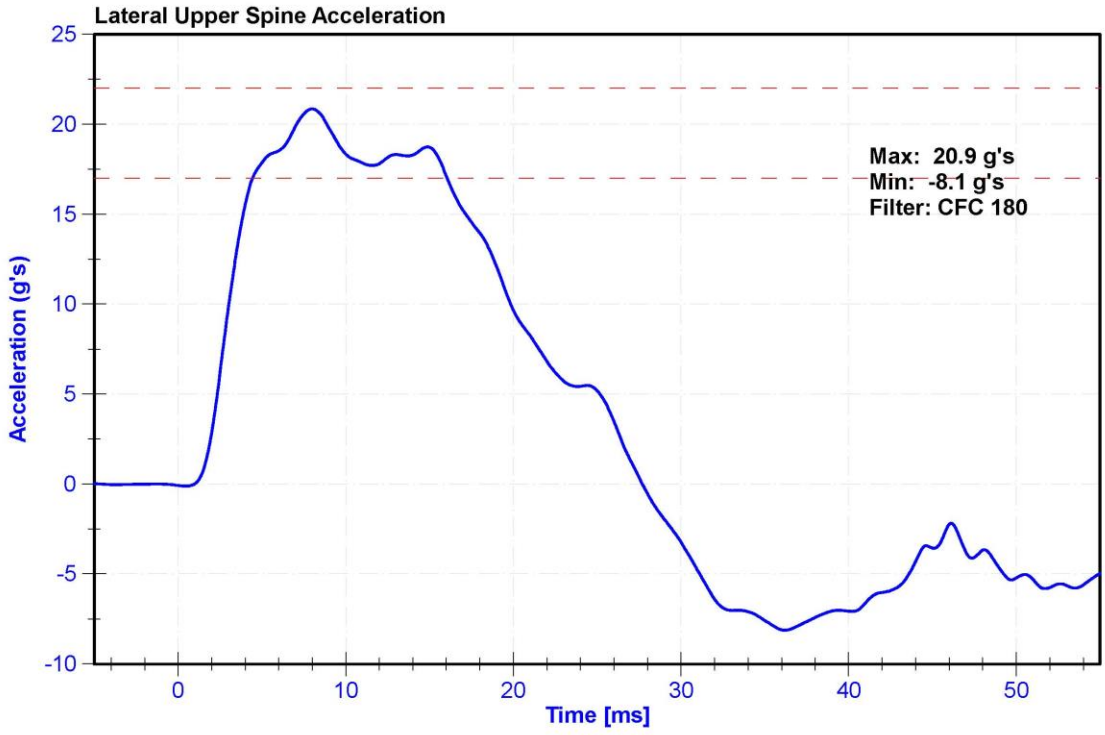
| Test Parameter | Minimum Specification | Maximum Specification | Unit | Result | Pass/Fail |
|---|---|---|---|---|---|
| Temperature | 20.6 | 22.2 | ºC | 20.7 | Pass |
| Humidity | 10 | 70 | % | 29 | Pass |
| Velocity | 4.2 | 4.4 | m/s | 4.39 | Pass |
| Probe Acceleration | 13 | 18 | g's | 16.6 | Pass |
| Shoulder Deflection | 28 | 37 | mm | 29.4 | Pass |
| Lateral Upper Spine Acceleration | 17 | 22 | g's | 20.9 | Pass |

**Transducer Calibrations**

| Channel | Manufacturer | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|
| Pendulum Accelerometer | MSI 64C-2000 | A286228 | 1/29/2020 | 7/29/2020 |
| Shoulder Potentiometer | Servo 08TC1-3745 | DS-1845GFE | 10/28/2019 | 4/27/2020 |
| Upper Spine Y Accelerometer | ENDEVCO 7264CT | AC-P64148 | 10/28/2019 | 4/27/2020 |




Shoulder Displacement
Displacement (mm)
Time (ms)
Max: 29.4 mm
Min: -0.0 mm
Filter: CFC 600


Lateral Upper Spine Acceleration
Acceleration (g's)
Time [ms]
Max: 20.9 g's
Min: -8.1 g's
Filter: CFC 180

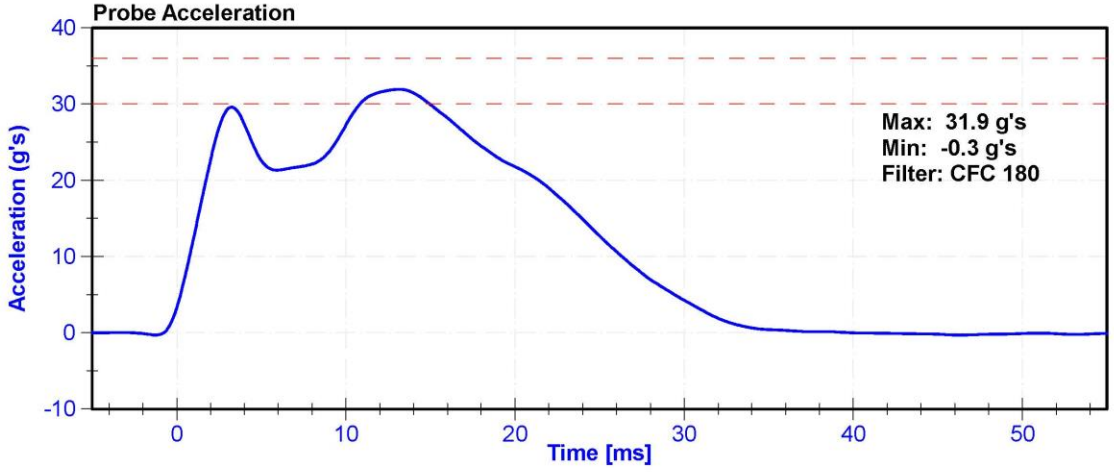
| | | | |
|---|---|---|---|
| ATD Manufacturer | FTSS | Test Technician | D.Reinhard |
| ATD Serial Number | DG8012 | Laboratory Supervisor | K. Brogan |

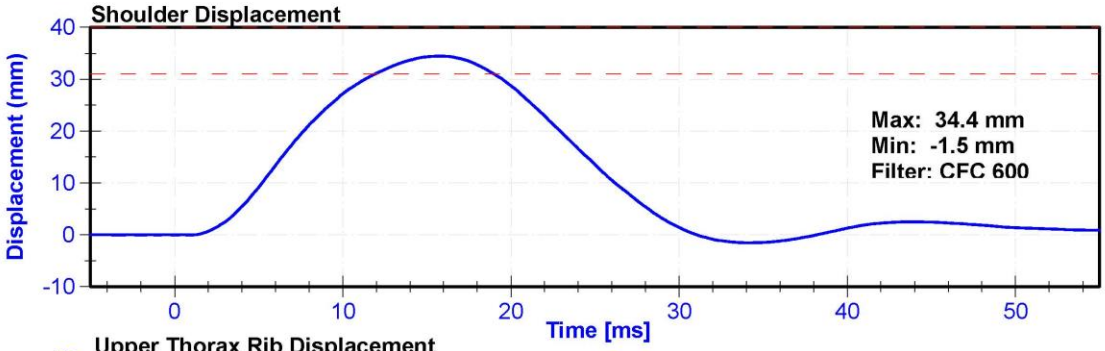
**Results**

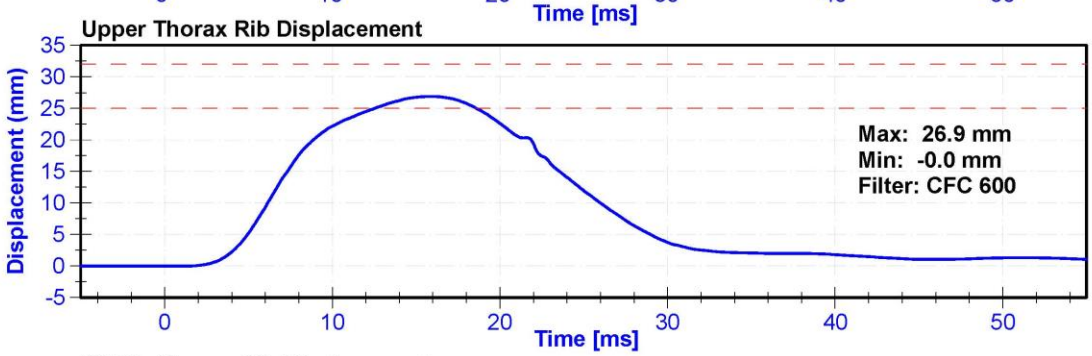
| Test Parameter | Minimum Specification | Maximum Specification | Unit | Result | Pass/Fail |
|---|---|---|---|---|---|
| Temperature | 20.6 | 22.2 | ºC | 20.7 | Pass |
| Humidity | 10 | 70 | % | 27.0 | Pass |
| Velocity | 6.6 | 6.8 | m/s | 6.80 | Pass |
| Probe Acceleration after 5 ms | 30 | 36 | g's | 31.9 | Pass |
| Lateral Upper Spine Acceleration | 34 | 43 | g's | 36.8 | Pass |
| Lateral Lower Spine Acceleration | 29 | 37 | g's | 29.8 | Pass |
| Shoulder Deflection | 31 | 40 | mm | 34.4 | Pass |
| Upper Thorax Rib Deflection | 25 | 32 | mm | 26.9 | Pass |
| Mid Thorax Rib Deflection | 30 | 36 | mm | 32.6 | Pass |
| Lower Thorax Rib Deflection | 32 | 38 | mm | 36.9 | Pass |

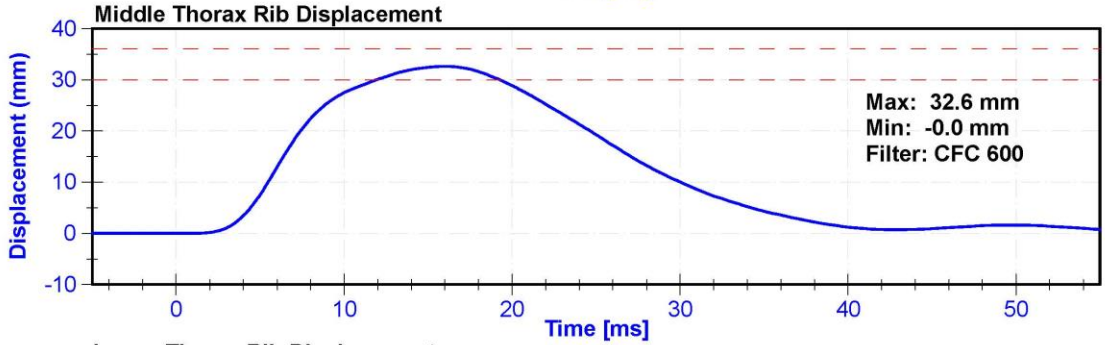
**Transducer Calibrations**

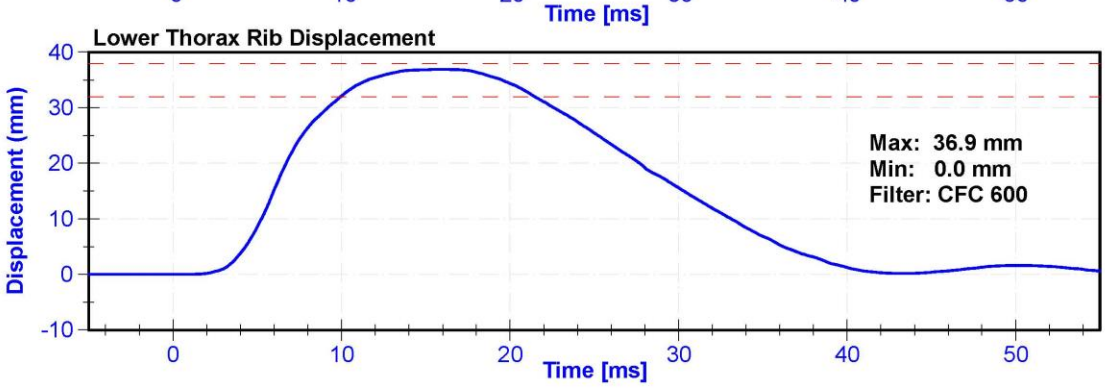
| Channel | Manufacturer | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|
| Pendulum Accelerometer | MSI 64C-2000 | A286228 | 1/29/2020 | 7/29/2020 |
| Upper Spine T1 Y Accelerometer | ENDEVCO 7264CT | AC-P64148 | 10/28/2019 | 4/27/2020 |
| Upper Spine T12 Y Accelerometer | ENDEVCO 7264CT | AC-P51327 | 9/30/2019 | 3/31/2020 |
| Shoulder Potentiometer | Servo 08TC1-3745 | DS-1845GFE | 10/28/2019 | 4/27/2020 |
| Upper Thorax Rib Potentiometer | Servo 1246 | DS-2165GFE | 10/28/2019 | 4/27/2020 |
| Middle Thorax Rib Potentiometer | Servo 08TC1-3621 | DS-45 GFE | 10/28/2019 | 4/27/2020 |
| Lower Thorax Rib Potentiometer | Servo 08TC1-3787 | DS-011GFE | 10/28/2019 | 4/27/2020 |

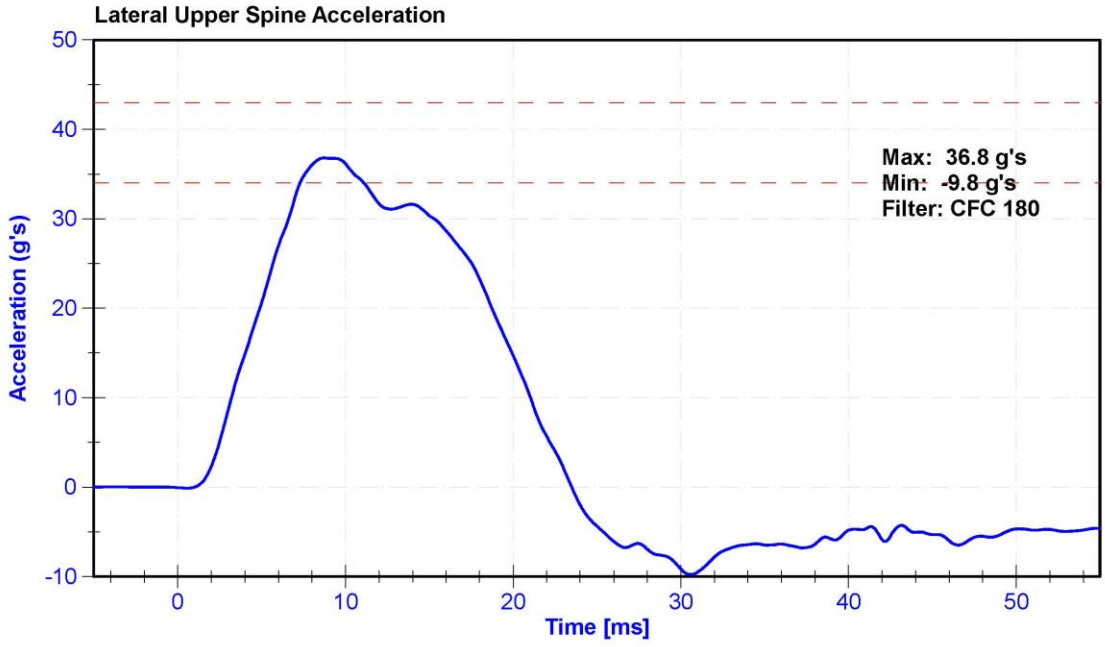


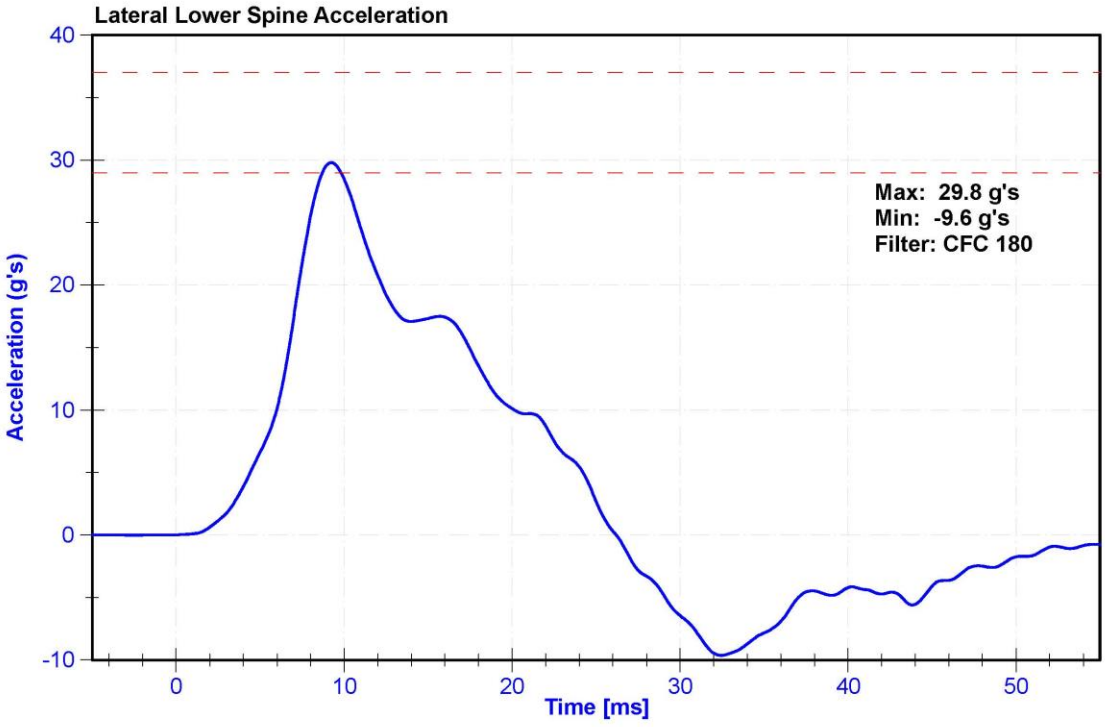

Shoulder Displacement
Displacement (mm)
Time [ms]
Max: 34.4 mm
Min: -1.5 mm
Filter: CFC 600


Upper Thorax Rib Displacement
Displacement (mm)
Time [ms]
Max: 26.9 mm
Min: -0.0 mm
Filter: CFC 600


Middle Thorax Rib Displacement
Displacement (mm)
Time [ms]
Max: 32.6 mm
Min: -0.0 mm
Filter: CFC 600


Lower Thorax Rib Displacement
Displacement (mm)
Time [ms]
Max: 36.9 mm
Min: 0.0 mm
Filter: CFC 600


Lateral Upper Spine Acceleration
Max: 36.8 g's
Min: -9.8 g's
Filter: CFC 180
Acceleration (g's)
Time [ms]
50
40
30
20
10
0
-10
0
10
20
30
40
50


Lateral Lower Spine Acceleration
Max: 29.8 g's
Min: -9.6 g's
Filter: CFC 180
Acceleration (g's)
Time [ms]
40
30
20
10
0
-10
0
10
20
30
40
50

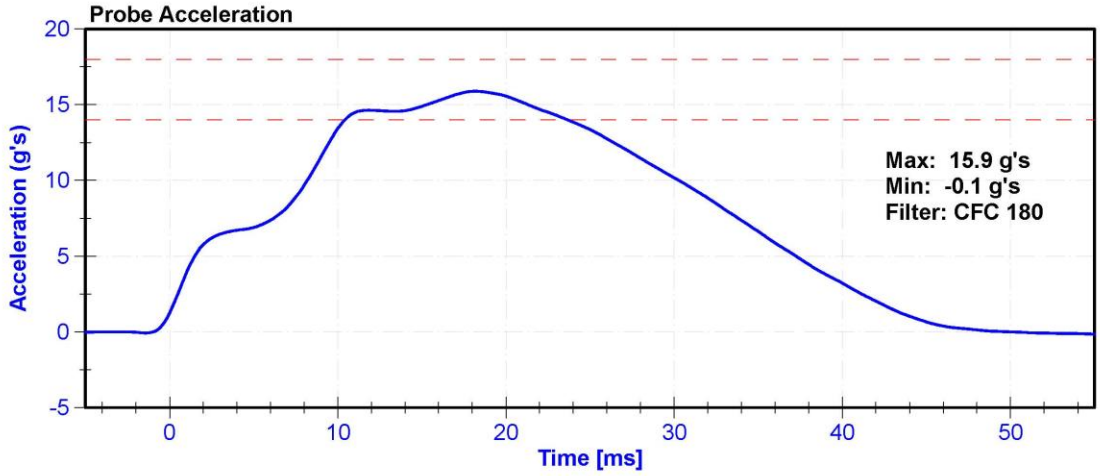
| | | | |
|---|---|---|---|
| ATD Manufacturer | FTSS | Test Technician | D.Reinhard |
| ATD Serial Number | DG8012 | Laboratory Supervisor | K. Brogan |

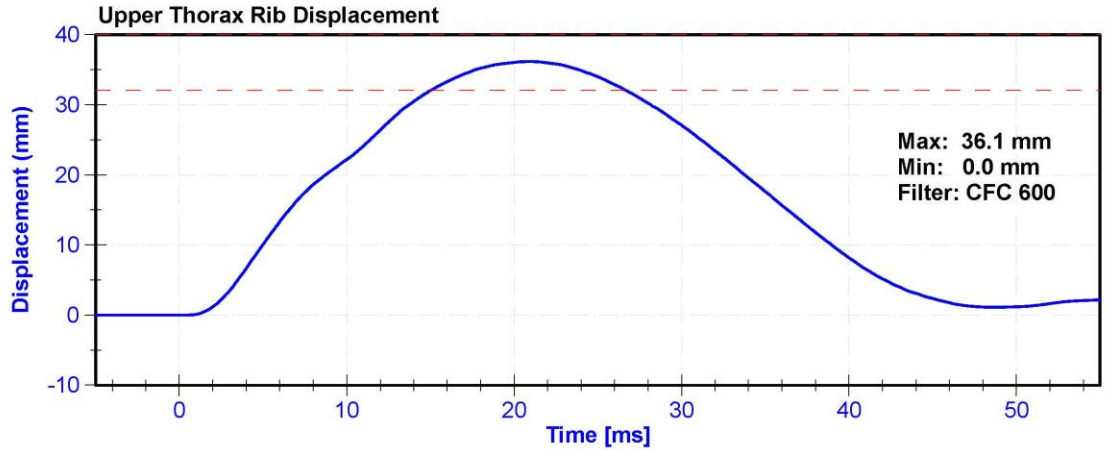
**Results**

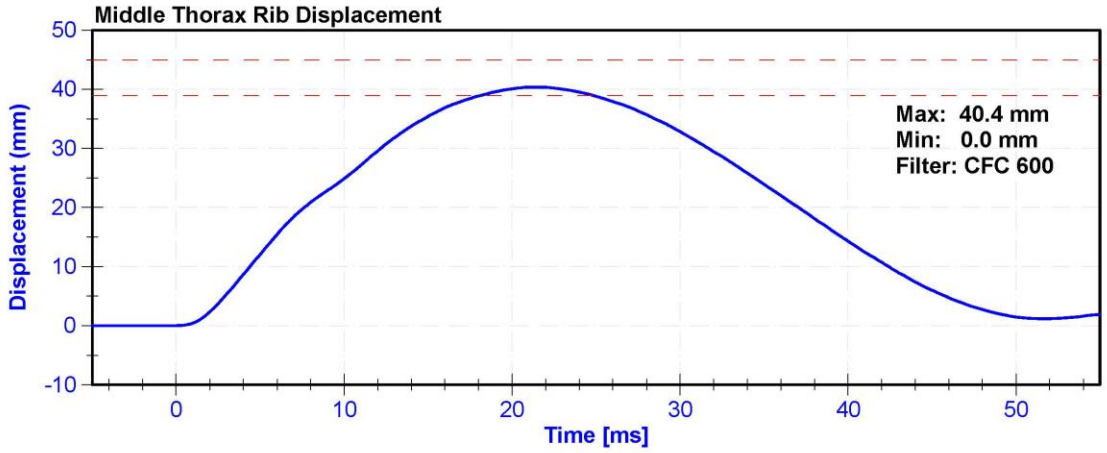
| Test Parameter | Minimum Specification | Maximum Specification | Unit | Result | Pass/Fail |
|---|---|---|---|---|---|
| Temperature | 20.6 | 22.2 | ºC | 20.8 | Pass |
| Humidity | 10 | 70 | % | 30 | Pass |
| Velocity | 4.2 | 4.4 | m/s | 4.22 | Pass |
| Probe Acceleration | 14 | 18 | g's | 15.9 | Pass |
| Lateral Upper Spine Acceleration | 13 | 17 | g's | 14.5 | Pass |
| Lateral Lower Spine Acceleration | 7 | 11 | g's | 8.9 | Pass |
| Upper Thorax Rib Deflection | 32 | 40 | mm | 36.1 | Pass |
| Middle Thorax Rib Deflection | 39 | 45 | mm | 40.4 | Pass |
| Lower Thorax Rib Deflection | 35 | 43 | mm | 37.4 | Pass |

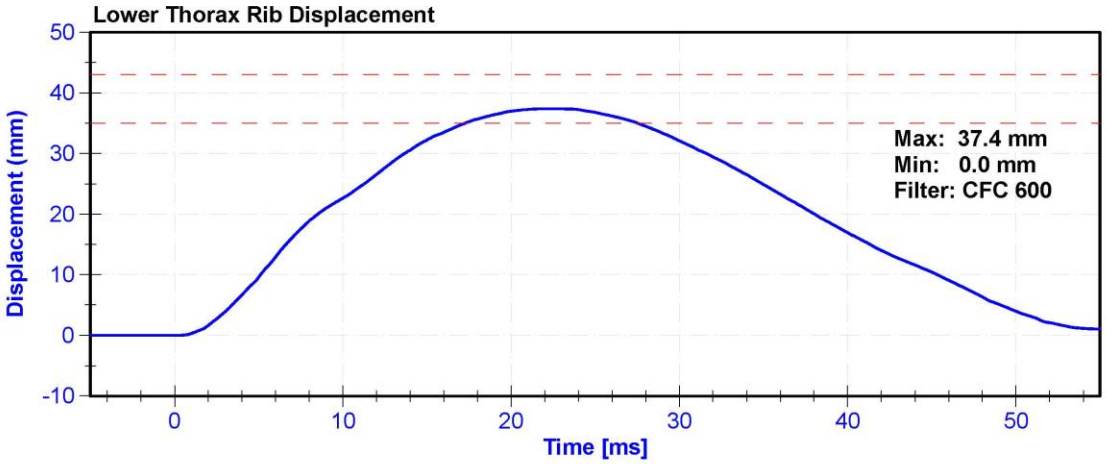
**Transducer Calibrations**

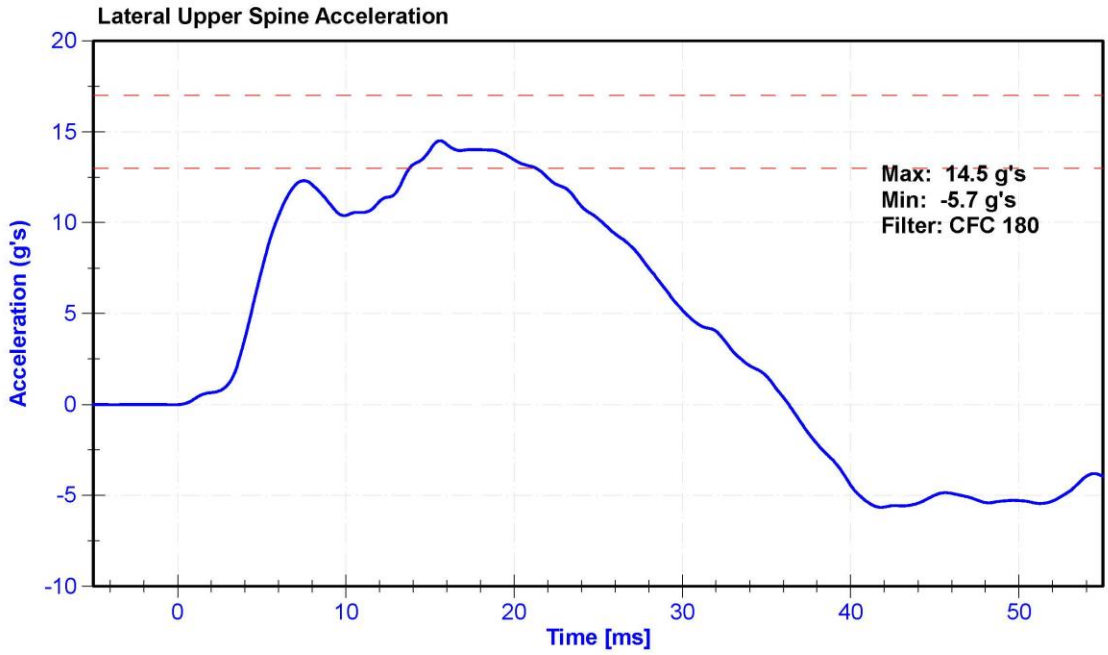
| Channel | Manufacturer | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|
| Pendulum Accelerometer | MSI 64C-2000 | A286228 | 1/29/2020 | 7/29/2020 |
| Upper Spine Y Accelerometer | ENDEVCO 7264CT | AC-P64148 | 10/28/2019 | 4/27/2020 |
| Lower Spine Y Accelerometer | ENDEVCO 7264CT | AC-P51327 | 9/30/2019 | 3/31/2020 |
| Upper Thorax Rib Potentiometer | Servo 1246 | DS-2165GFE | 10/28/2019 | 4/27/2020 |
| Middle Thorax Rib Potentiometer | Servo 08TC1-3621 | DS-45 GFE | 10/28/2019 | 4/27/2020 |
| Lower Thorax Rib Potentiometer | Servo 08TC1-3787 | DS-011GFE | 10/28/2019 | 4/27/2020 |

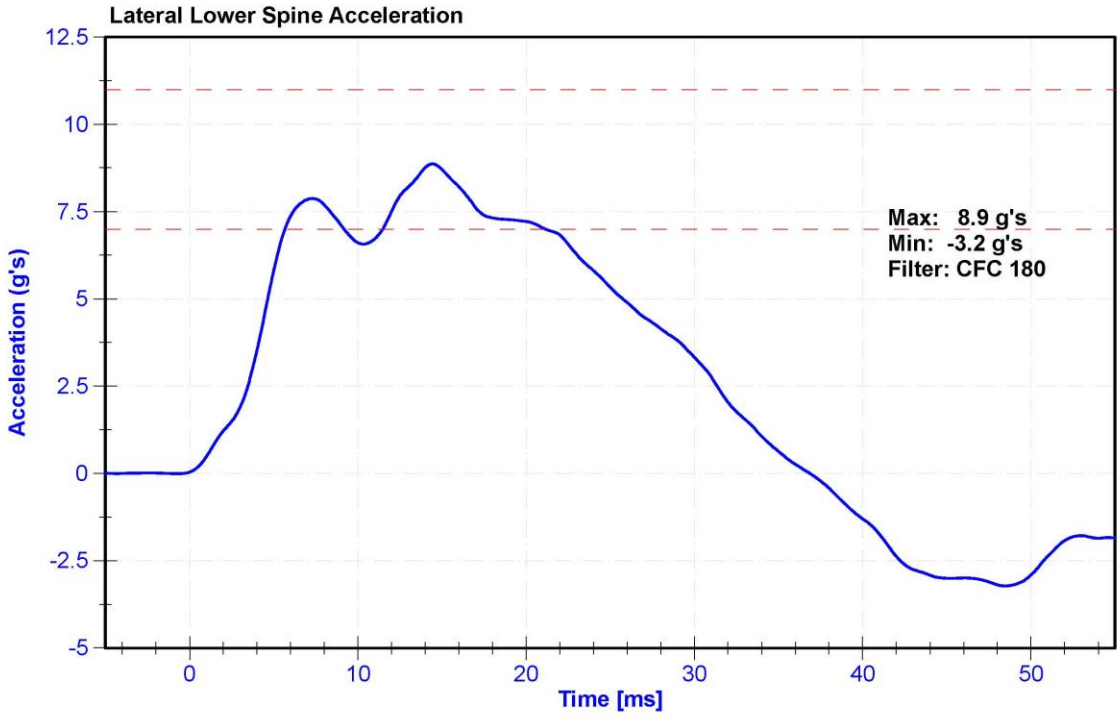



Upper Thorax Rib Displacement
Displacement (mm)
Time [ms]
Max: 36.1 mm
Min: 0.0 mm
Filter: CFC 600


Middle Thorax Rib Displacement
Displacement (mm)
Time [ms]
Max: 40.4 mm
Min: 0.0 mm
Filter: CFC 600


Lower Thorax Rib Displacement
Displacement (mm)
Time [ms]
Max: 37.4 mm
Min: 0.0 mm
Filter: CFC 600


Lateral Upper Spine Acceleration
Max: 14.5 g's
Min: -5.7 g's
Filter: CFC 180
Acceleration (g's)
Time [ms]
20
15
10
5
0
-5
-10
0
10
20
30
40
50


Lateral Lower Spine Acceleration
Max: 8.9 g's
Min: -3.2 g's
Filter: CFC 180
Acceleration (g's)
Time [ms]
12.5
10
7.5
5
2.5
0
-2.5
-5
0
10
20
30
40
50

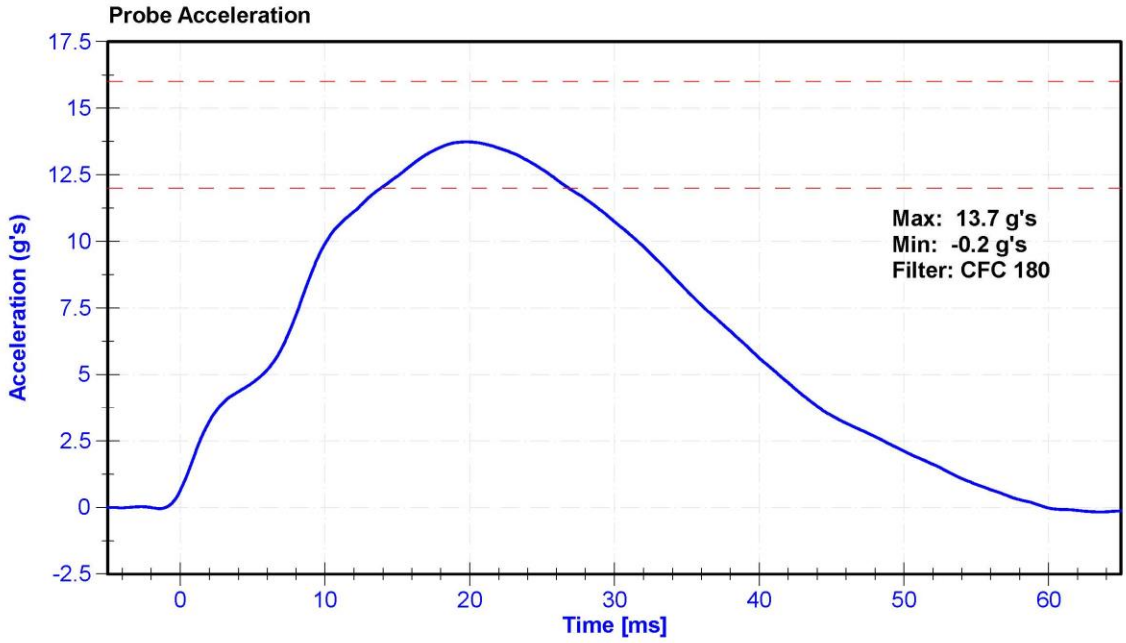
| | | | |
|---|---|---|---|
| ATD Manufacturer | FTSS | Test Technician | D.Reinhard |
| ATD Serial Number | DG8012 | Laboratory Supervisor | K. Brogan |

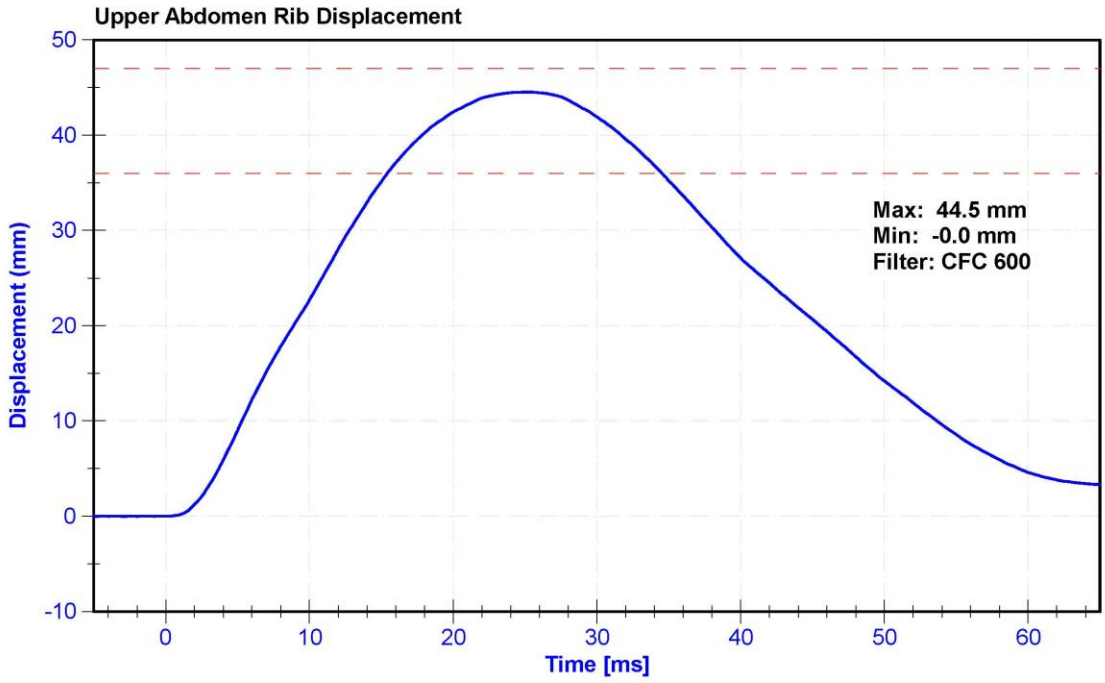
**Results**

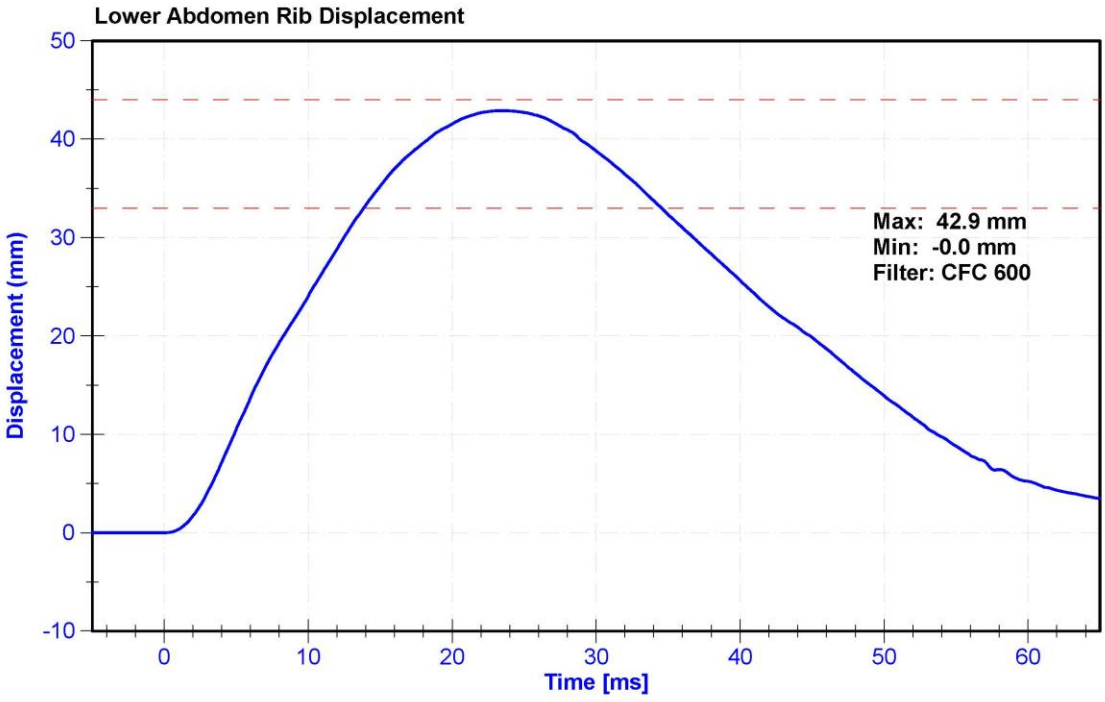
| Test Parameter | Minimum Specification | Maximum Specification | Unit | Result | Pass/Fail |
|---|---|---|---|---|---|
| Temperature | 20.6 | 22.2 | ºC | 20.8 | Pass |
| Humidity | 10 | 70 | % | 22.0 | Pass |
| Velocity | 4.2 | 4.4 | m/s | 4.22 | Pass |
| Probe Acceleration | 12 | 16 | g's | 13.7 | Pass |
| Lateral Lower Spine Acceleration | 9 | 14 | g's | 9.4 | Pass |
| Upper Abdomen Rib Deflection | 36 | 47 | mm | 44.5 | Pass |
| Lower Abdomen Rib Deflection | 33 | 44 | mm | 42.9 | Pass |

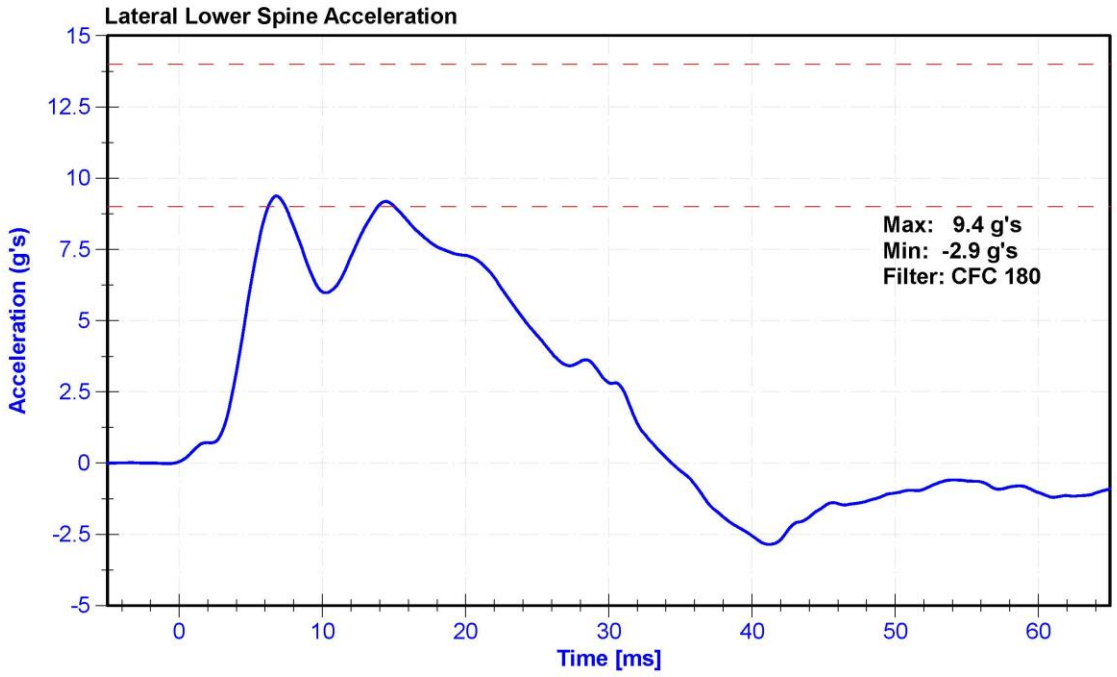
**Transducer Calibrations**

| Channel | Manufacturer | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|
| Probe Accelerometer | MSI 64C-2000 | A286228 | 1/29/2020 | 7/29/2020 |
| Lower Spine Y Accelerometer | ENDEVCO 7264CT | AC-P51327 | 9/30/2019 | 3/31/2020 |
| Upper Abdomen Rib Potentiometer | Servo 08TC1-3725 | DS-008GFE | 10/28/2019 | 4/27/2020 |
| Lower Abdomen Rib Potentiometer | Servo 08TC1-3745 | DS-1774GFE | 10/28/2019 | 4/27/2020 |




Upper Abdomen Rib Displacement
Displacement (mm)
Time [ms]
Max: 44.5 mm
Min: -0.0 mm
Filter: CFC 600


Lower Abdomen Rib Displacement
Displacement (mm)
Time [ms]
Max: 42.9 mm
Min: -0.0 mm
Filter: CFC 600


Lateral Lower Spine Acceleration
Acceleration (g's)
15
12.5
10
7.5
5
2.5
0
-2.5
-5
0
10
20
30
40
50
60
Time [ms]
Max: 9.4 g's
Min: -2.9 g's
Filter: CFC 180

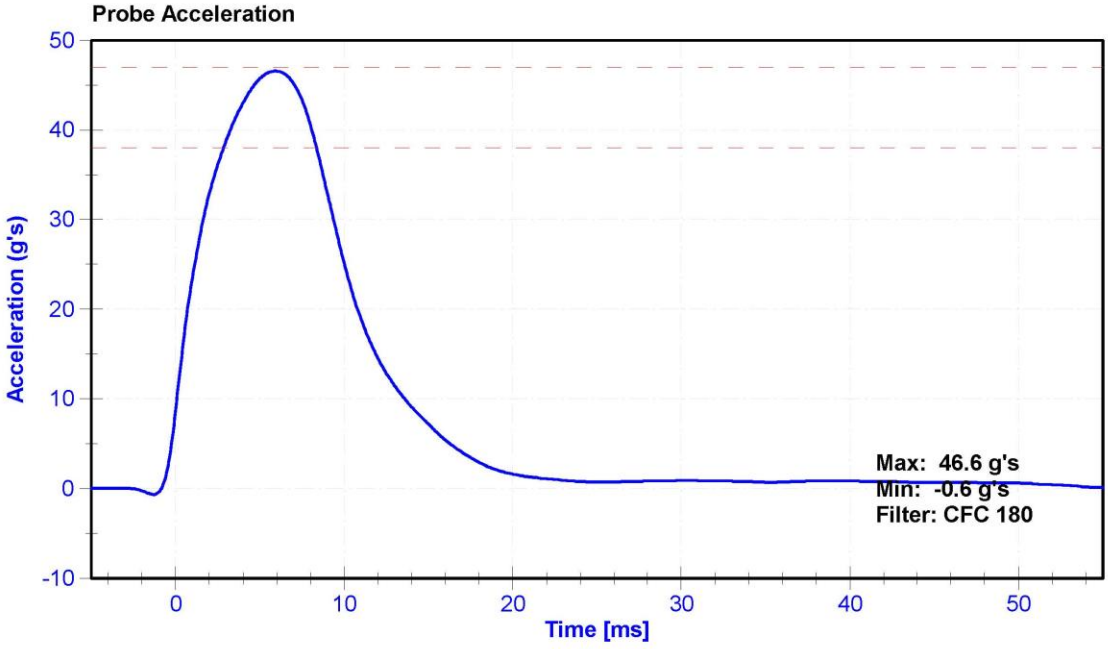
| | | | |
|---|---|---|---|
| ATD Manufacturer | FTSS | Test Technician | D.Reinhard |
| ATD Serial Number | DG8012 | Laboratory Supervisor | K. Brogan |

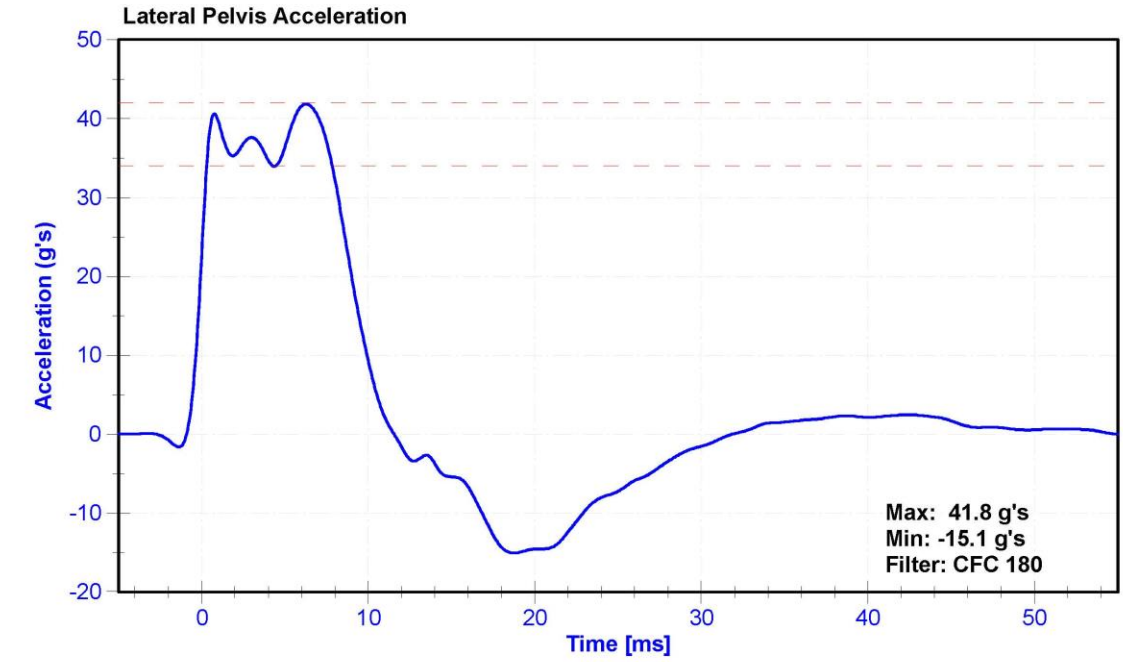
**Results**

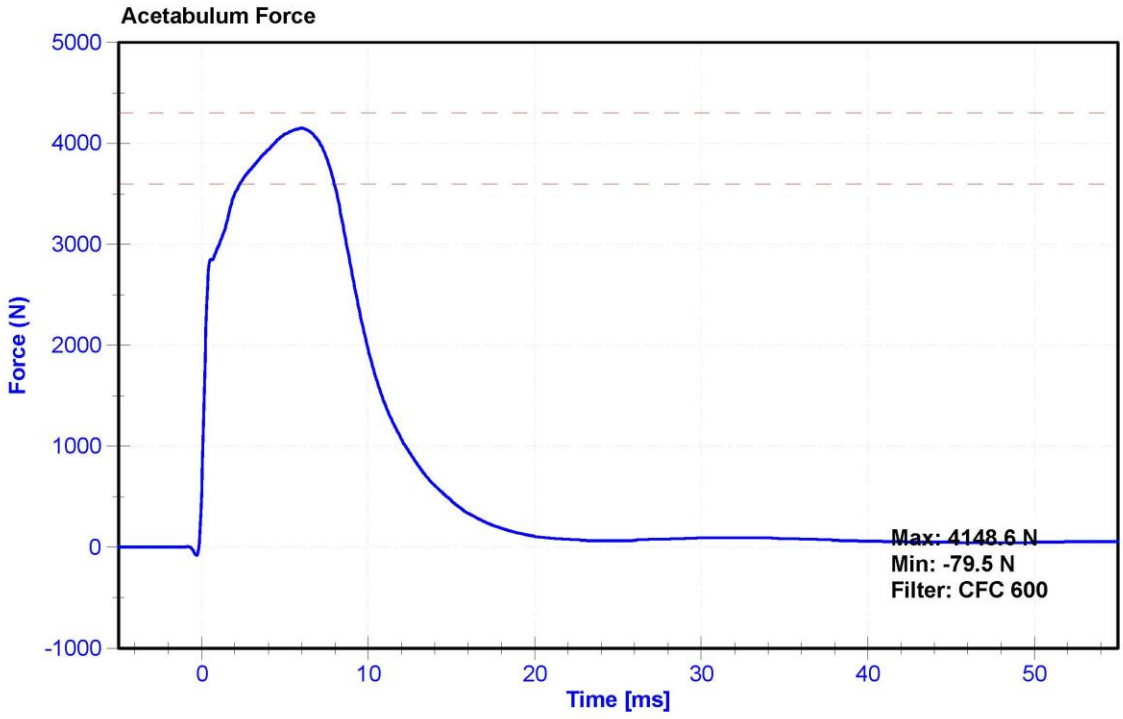
| Test Parameter | Minimum Specification | Maximum Specification | Unit | Result | Pass/Fail |
|---|---|---|---|---|---|
| Temperature | 20.6 | 22.2 | ºC | 20.7 | Pass |
| Humidity | 10 | 70 | % | 29 | Pass |
| Velocity | 6.6 | 6.8 | m/s | 6.61 | Pass |
| Probe Acceleration | 38 | 47 | g's | 46.6 | Pass |
| Lateral Pelvis Acceleration after 6ms | 34 | 42 | g's | 41.8 | Pass |
| Acetabulum Force | 3600 | 4300 | N | 4148.6 | Pass |

**Transducer Calibrations**

| Channel | Manufacturer | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|
| Pendulum Accelerometer | MSI 64C-2000 | A286228 | 1/29/2020 | 7/29/2020 |
| Pelvis Y Accelerometer | ENDEVCO 7264CT | AC-P51875 | 10/28/2019 | 4/27/2020 |
| Acetabulum Load Cell | Denton 3249J | LC-4986Fy | 6/14/2019 | 6/13/2020 |
| Certification Plug | SACO | 12769 | 01/17/2019 | N/A |
| Crash Test Plug | SACO | 12658 | 11/21/2018 | N/A |




Lateral Pelvis Acceleration
Acceleration (g's)
50
40
30
20
10
0
-10
-20
0
10
20
30
40
50
Time [ms]
Max: 41.8 g's
Min: -15.1 g's
Filter: CFC 180


Acetabulum Force
Force (N)
5000
4000
3000
2000
1000
0
-1000
0
10
20
30
40
50
Time [ms]
Max: 4148.6 N
Min: -79.5 N
Filter: CFC 600

DG 8012 3/11/2020
Certy

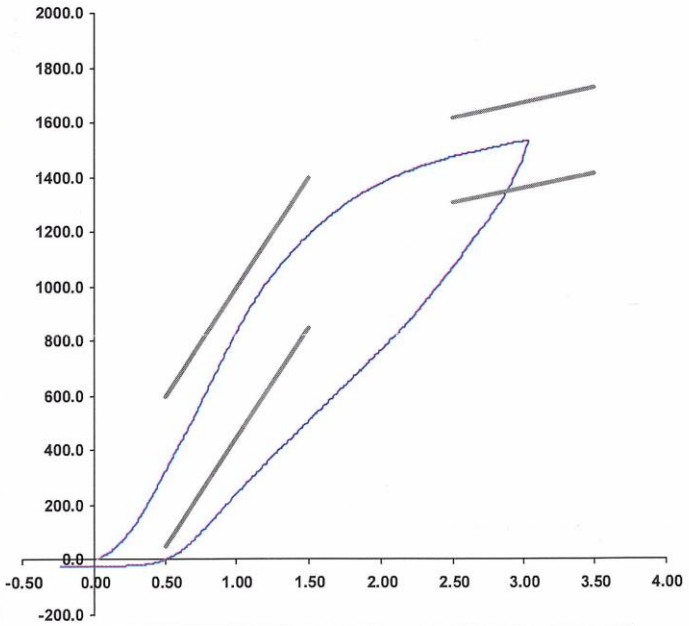
SACO RESEARCH

## SID-IIs Pelvis Plug Certification Test

Plug S/N 12769
Test Number 8101
Report Number 8131
Test Date 1/17/2019 9:28:20 AM

| | Test Results | Spec Min | Spec Max |
|---|---|---|---|
| Force @ 0.5 mm (N) | 328.07 | 50.00 | 600.00 |
| Force @ 1.5 mm (N) | 1,191.01 | 850.00 | 1,400.00 |
| Force @ 2.5 mm (N) | 1,473.24 | 1,306.00 | 1,618.00 |
| Force @ 3.0 mm (N) | 1,530.07 | 1,361.00 | 1,673.00 |

Force (-N) vs Extension (-mm)




**Testing Machine STM-20 5965542**
**Load Cell S/N (FI360947), Units (LBS )** 1000
**Preload Value ( -N )** 22.24
**Crosshead Speed ( mm / min ) or Rate** 12.7
**Extension or Position Measured by** XHD_100 ( XHD100 )

Notes:

**Operator**

**Part Number** 180-4450

**Template No 107** **17-Jan-19**
SACO Research

By : DC Date : 1/17/2019

SACO Research 41735 Elm St, #401 Murrieta, CA 92562 Tel 310-694-2082 FAX

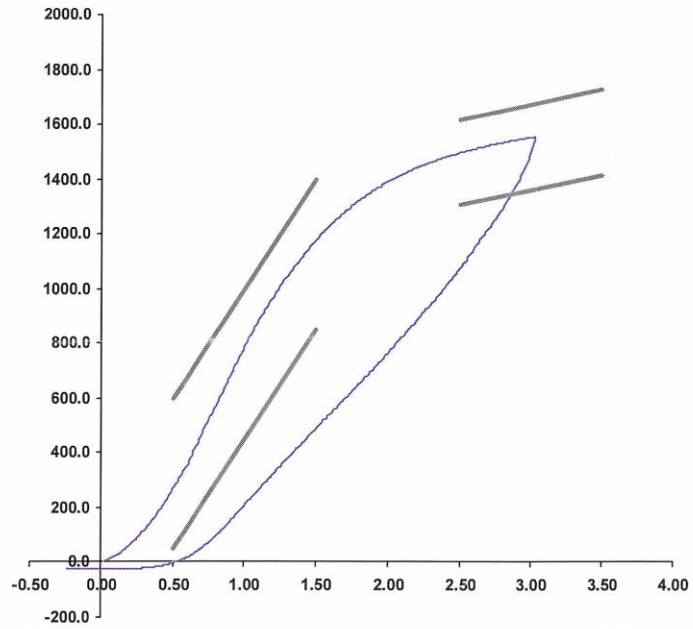
3/11/20 Crash Plug
DG8012

## SID-IIs Pelvis Plug Certification Test

Plug S/N 12658
Test Number 7659
Report Number 7688
Test Date 11/21/2018 9:48:01 AM

| | Test Results | Spec Min | Spec Max |
|---|---|---|---|
| Force @ 0.5 mm (N) | 275.28 | 50.00 | 600.00 |
| Force @ 1.5 mm (N) | 1,176.70 | 850.00 | 1,400.00 |
| Force @ 2.5 mm (N) | 1,496.71 | 1,306.00 | 1,618.00 |
| Force @ 3.0 mm (N) | 1,553.74 | 1,361.00 | 1,673.00 |

Force (-N) vs Extension (-mm)




**Testing Machine STM-20 5965542**
**Load Cell S/N (FI360947), Units (LBS )** 1000
**Preload Value ( -N )** 22.24
**Crosshead Speed ( mm / min ) or Rate** 12.7
**Extension or Position Measured by** XHD_100 ( XHD100 )

Notes:

**Operator**

**Part Number** 180-4450

**Template No 107** **21-Nov-18**
SACO Research

By : DC Date : 11/21/2018

SACO Research 41735 Elm St, #401 Murrieta, CA 92562 Tel 310-694-2082 FAX

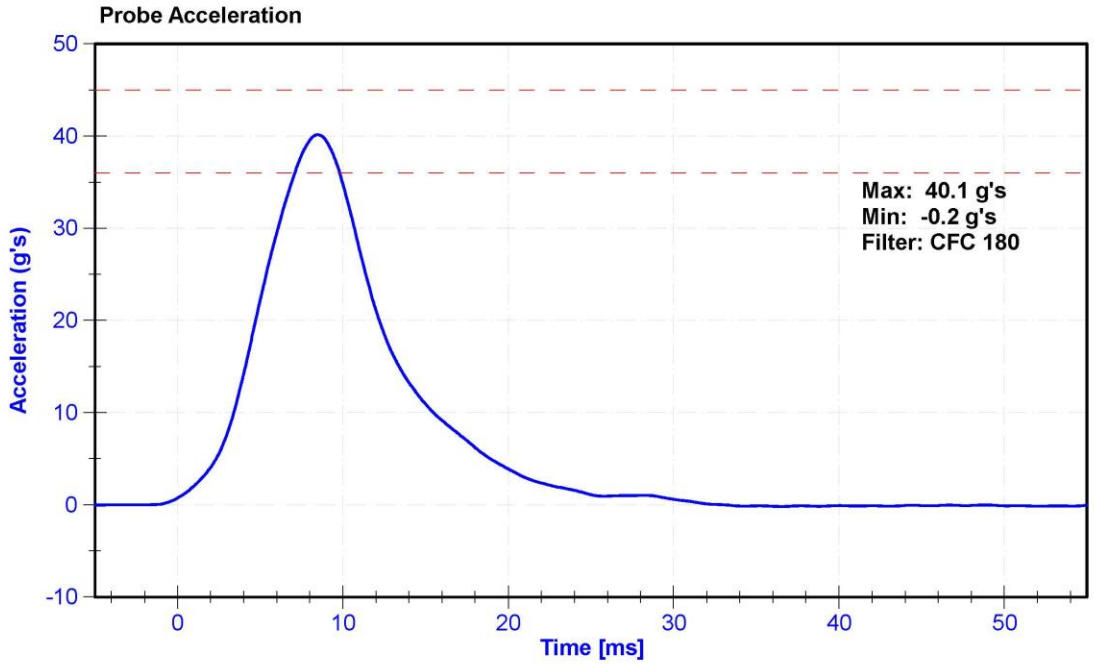
| | | | |
|---|---|---|---|
| ATD Manufacturer | FTSS | Test Technician | D.Reinhard |
| ATD Serial Number | DG8012 | Laboratory Supervisor | K. Brogan |

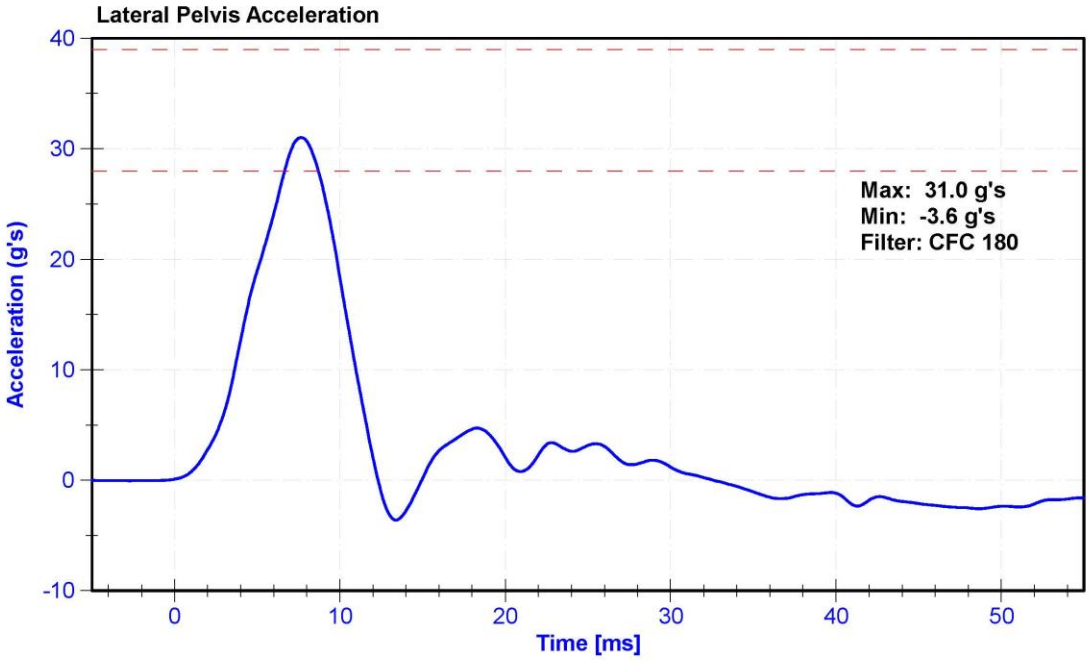
**Results**

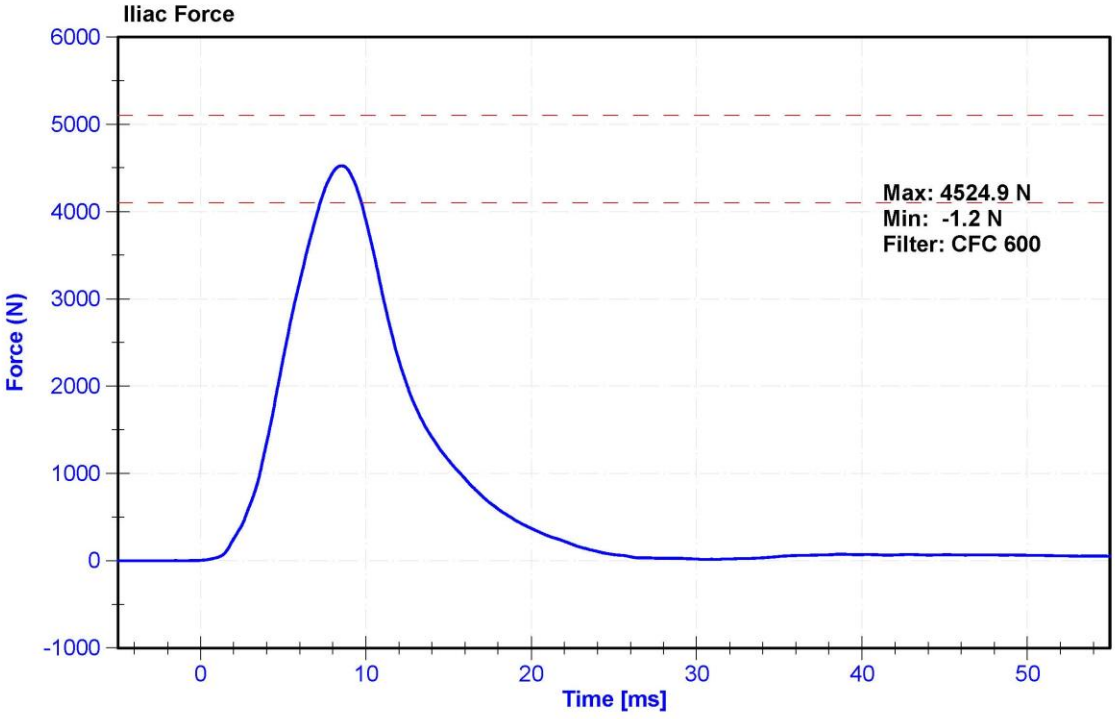
| Test Parameter | Minimum Specification | Maximum Specification | Unit | Result | Pass/Fail |
|---|---|---|---|---|---|
| Temperature | 20.6 | 22.2 | ºC | 21.0 | Pass |
| Humidity | 10 | 70 | % | 43.0 | Pass |
| Velocity | 4.2 | 4.4 | m/s | 4.36 | Pass |
| Probe Acceleration | 36 | 45 | g's | 40.1 | Pass |
| Lateral Pelvis Acceleration | 28 | 39 | g's | 31.0 | Pass |
| Iliac Force | 4100 | 5100 | N | 4524.9 | Pass |

**Transducer Calibrations**

| Channel | Manufacturer | Serial Number | Calibration Date | Calibration Due Date |
|---|---|---|---|---|
| Pendulum Accelerometer | MSI 64C-2000 | A286228 | 1/29/2020 | 7/29/2020 |
| Pelvis Y Accelerometer | ENDEVCO 7264CT | AC-P51875 | 10/28/2019 | 4/27/2020 |
| Iliac Load Cell | DENTON 3228J | LC-290Fy | 9/25/2019 | 9/24/2020 |




Lateral Pelvis Acceleration
Acceleration (g's)
Time [ms]
Max: 31.0 g's
Min: -3.6 g's
Filter: CFC 180


Iliac Force
Force (N)
Time [ms]
Max: 4524.9 N
Min: -1.2 N
Filter: CFC 600

# APPENDIX D

# TEST EQUIPMENT AND INSTRUMENTATION CALIBRATION DATA

**Table 1 – Dummy Instrumentation (SID-IIs)**

| | | | | SID-IIs S/N: DG8012 | | |
|---|---|---|---|---|---|---|
| | | | | Serial Number | Manufacturer | Calibration Date |
| Head Accelerometers | | | X | AC-P74788 | ENDEVCO | 10/28/2019 |
| | | | Y | AC-P83432 | ENDEVCO | 10/28/2019 |
| | | | Z | AC-P83319 | ENDEVCO | 10/28/2019 |
| Head Accelerometers - Redundant | | | X | AC-P80334 | ENDEVCO | 10/28/2019 |
| | | | Y | AC-P63841 | ENDEVCO | 10/28/2019 |
| | | | Z | AC-P83322 | ENDEVCO | 10/28/2019 |
| Displacement Potentiometer | Shoulder | | Y | | | |
| | Thoracic Rib | Upper | Y | DS-2165GFE | Servo | 10/28/2019 |
| | | Middle | Y | DS-45 GFE | Servo | 10/28/2019 |
| | | Lower | Y | DS-011GFE | Servo | 10/28/2019 |
| | Abdominal Rib | Upper | Y | DS-008GFE | Servo | 10/28/2019 |
| | | Lower | Y | DS-1774GFE | Servo | 10/28/2019 |
| Lower Spine Accelerometers (T12) | | | X | AC-P52040 | ENDEVCO | 9/30/2019 |
| | | | Y | AC-P51327 | ENDEVCO | 9/30/2019 |
| | | | Z | AC-P52067 | ENDEVCO | 9/30/2019 |
| Acetabulum Load Cell | | | Y | LC-4986Fy | Denton | 6/14/2019 |
| Lilac Wing Load Cell | | | Y | LC-290Fy | Denton | 9/25/2019 |
| Pelvis Plug (Struck Side) | | | | 12789 | SACO | 1/17/2019 |
| Pelvis Plug (Non-Struck Side) | | | | | | |

**Table 2 – Vehicle Instrumentation**

| Vehicle Instrumentation | | Serial Number | Manufacturer | Calibration Date |
|---|---|---|---|---|
| Vehicle Center of Gravity | X | AC-A280004 | MSI 1201-1000 | 11/12/2019 |
| Vehicle Center of Gravity | Y | AC-A280190 | MSI 1201-1000 | 12/17/2019 |
| Vehicle Center of Gravity | Z | A283598 | MSI 1201-1000 | 1/24/2020 |
| Left Floor Sill | Y | AC-A280362 | MSI 1201-1000 | 1/3/2020 |
| A-Pillar Sill | Y | AC-A255984 | MSI 1201-1000 | 10/1/2019 |
| A-Pillar Low | Y | AC-A280003 | MSI 1201-1000 | 1/10/2020 |
| A-Pillar Mid | Y | AC-A280024 | MSI 1201-1000 | 9/12/2019 |
| B-Pillar Sill | Y | AC-A280192 | MSI 1201-1000 | 10/15/2019 |
| B-Pillar Low | Y | AC-A281011 | MSI 1201-1000 | 1/9/2020 |
| B-Pillar Mid | Y | A284324 | MSI 1201-1000 | 1/9/2020 |
| Driver Seat | Y | AC-A280841 | MSI 1201-1000 | 11/14/2019 |
| Engine Top | X | AC-A255880 | MSI 1201-1000 | 1/3/2020 |
| Engine Top | Y | AC-A280401 | MSI 1201-1000 | 12/23/2019 |
| Firewall | Y | AC-A254660 | MSI 1201-1000 | 1/13/2020 |
| Right Roof | Y | AC-A262043 | MSI 1201-1000 | 3/7/2020 |
| Right Floor Sill | Y | AC-A280001 | MSI 1201-1000 | 10/9/2019 |
| Rear Floorpan | X | AC-A281006 | MSI 1201-1000 | 11/25/2019 |
| Rear Floorpan | Y | AC-A281042 | MSI 1201-1000 | 11/25/2019 |

**Table 3 – Pole Instrumentation**

| Pole Instrumentation | Serial Number | Manufacturer | Calibration Date |
|---|---|---|---|
| Load Cell 1 | LC_1117012 | Interface | 10/16/2019 |
| Load Cell 2 | LC_1117020 | Interface | 10/25/2019 |
| Load Cell 3 | LC_1117025 | Interface | 10/25/2019 |
| Load Cell 4 | LC_1117019 | Interface | 10/25/2019 |
| Load Cell 5 | LC_1117011 | Interface | 10/25/2019 |
| Load Cell 6 | LC_1117017 | Interface | 10/25/2019 |
| Load Cell 7 | LC_1117035 | Interface | 10/25/2019 |
| Load Cell 8 | LC_1117006 | Interface | 10/7/2019 |