

**REPORT NO. 208-MGA-2014-DC015**

**DUMMY PERFORMANCE CALIBRATIONS  
FMVSS 208**

**FORD MOTOR CO.  
2014 FORD ESCAPE MPV  
NHTSA NO.: C20140200**

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



**TEST DATES: JUNE 30, 2014 – AUGUST 25, 2014**

**FINAL REPORT DATE: NOVEMBER 5, 2014**

**FINAL REPORT**

**PREPARED FOR:  
U.S. DEPARTMENT OF TRANSPORTATION  
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION  
OFFICE OF ENFORCEMENT  
OFFICE OF VEHICLE SAFETY COMPLIANCE  
1200 NEW JERSEY AVENUE, S.E., NVS-220  
WASHINGTON, D.C. 20590**

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HYBRID III 50 <sup>th</sup> SN #401, PART 572, SUBPART E EXTERNAL DIMENSIONS				
DIMENSION	DESCRIPTION	DETAILS	ASSEMBLY DIMENSION (inches)	ACTUAL MEASUREMENT
A	TOTAL SITTING HEIGHT	Seat surface to highest point on top of the head.	34.6–35.0	34.7
B	SHOULDER PIVOT HEIGHT	Centerline of shoulder pivot bolt to the seat surface.	19.9-20.5	20.2
C	H-POINT HEIGHT	Reference	3.3-3.5	3.5
D	H-POINT LOCATION FROM BACKLINE	Reference	5.3-5.5	5.4
E	SHOULDER PIVOT FROM BACKLINE	Center of the shoulder clevis to the rear vertical surface of the fixture.	3.3-3.7	3.6
F	THIGH CLEARANCE	Measured at the highest point on the upper femur segment.	5.5-6.1	6.0
G	BACK OF ELBOW TO WRIST PIVOT	Back of the elbow flesh to the wrist pivot in line with the elbow and wrist pivots	11.4-12.0	11.5
H	HEAD BACK TO BACKLINE	Back of skull cap skin to seat rear vertical surface (Reference)	1.6-1.8	1.8
I	SHOULDER TO ELBOW LENGTH	Measure from the highest point on top of the shoulder clevis to the lowest part of the flesh on the elbow in line with the elbow pivot bolt.	13.0-13.6	13.5
J	ELBOW REST HEIGHT	Measure from the flesh below the elbow pivot bolt to the seat surface.	7.5-8.3	7.8
K	BUTTOCK TO KNEE LENGTH	The forward most part of the knee flesh to the rear vertical surface of the fixture.	22.8-23.8	23.1
L	POPLITEAL HEIGHT	Seat surface to the plane of the horizontal plane of the bottom of the feet.	16.9-17.9	17.5
M	KNEE PIVOT HEIGHT	Centerline of knee pivot bolt to the horizontal plane of the bottom of the feet.	19.1-19.7	19.5
N	BUTTOCK POPLITEAL LENGTH	The rearmost surface of the lower leg to the same point on the rear surface of the buttocks used for dim. "K".	17.8-18.8	18.5

HYBRID III 50 <sup>th</sup> SN #401, PART 572, SUBPART E EXTERNAL DIMENSIONS, continued				
DIMENSION	DESCRIPTION	DETAILS		ACTUAL MEASUREMENT
O	CHEST DEPTH WITHOUT JACKET	Measured 16.9-17.1 in. above seat surface	8.4-9.0	8.8
P	FOOT LENGTH	Tip of toe to rear of heel	9.9-10.5	10.2
V	SHOULDER BREADTH	Outside edges of right and left shoulder clevises	16.3-17.2	16.7
W	FOOT BREADTH	The widest part of the foot	3.6-4.2	4.0
Y	CHEST CIRCUMFERENCE (WITH CHEST JACKET)	Measured 16.9-17.1 in. above seat surface	38.2-39.4	38.5
Z	WAIST CIRCUMFERENCE	Measured 8.9-9.1 in. above seat surface	32.9-34.1	33.3
AA	REFERENCE LOCATION FOR MEASUREMENT OF CHEST CIRCUMFERENCE	Reference	16.9-17.1	17.0
BB	REFERENCE LOCATION FOR MEASUREMENT OF WAIST CIRCUMFERENCE	Reference	8.9-9.1	9.0

**DATA SHEET A3**  
HEAD DROP TEST (572.32) (50<sup>th</sup> Male)

Dummy Serial Number: 401

Test Date: 08/01/2014

Technician: David Schoedel

- Pre test calibration  
 Post test calibration verification

Test attempt no. 1 (when successive head drops are necessary)

1. It has been at least 2 hours since the last head drop. (572.32(c)(5))  
 N/A, ONLY one head drop performed
2. The head assembly consists of the complete head (78051-61X), the neck transducer structural replacement (78051-383X), and three (3) accelerometers. (572.32(b))
3. Torque the skull cap screws to 160 lbf-in.
4. Accelerometers and their respective mounts are smooth and clean.
5. The data acquisition system, including transducers, conforms to the requirements of SAE Recommended Practice J2111/1 MAR95. (572.35(i))
6. The head assembly soaked at a temperature between 18.9°C (66°F) and 25.6°C (78°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to a test. (572.132(c)(1))
- |                                 |               |
|---------------------------------|---------------|
| Record the maximum temperature: | <u>21.4°C</u> |
| Record the minimum temperature: | <u>21.2°C</u> |
| Record the maximum humidity:    | <u>51%</u>    |
| Record the minimum humidity:    | <u>43%</u>    |
7. Visually inspect the head skin for cracks, cuts, abrasions, etc. Repair or replace the head skin if the damaged area is more than superficial. Note: If the damage resulted from the vehicle crash test in which the dummy was an occupant, the damaged area is to be documented with photography and the post test calibration verification testing completed before any replacement or repairs are made.
- Record findings and actions: No Damage
8. Clean the impact surface of the skin and the impact surface of the fixture with isopropyl alcohol, trichloroethane or equivalent prior to the test. (572.32(c)(2))

X 9. Suspend and orient the head assembly as shown in Figure 6A. The lowest point on the forehead is 0.5 in. below the lowest point on the dummy's nose when the midsagittal plane is vertical. (572.32(c)(3))

Record the actual distance: 0.5 inches

**NOTE:** The masses of the suspension device and the accelerometer cables are to be kept as lightweight as possible to minimize their effect on the test results.

X 10. The 1.6 mm (0.062 inch) diameter holes located on either side of the dummy's head are equidistance within 2 mm from the impact surface. A typical test setup is shown in Figure 7A.

Record the right side distance: 501 mm

Record the left side distance: 501 mm

X 11. The impact surface is clean and dry and has a micro finish in the range of  $203.2 \times 10^{-6}$  mm (8 micro inches) to  $2032.0 \times 10^{-6}$  mm (80 micro inches) (RMS). (572.32(c)(4))

Record actual micro finish: 24.8 micro inches

X 12. The impact surface is rigidly supported. (572.132(c)(4))

X 13. The impact surface is a flat horizontal steel plate 50.8 mm (2 inches) thick and 610 mm (24 inches) square. (Figure 6A)

Record thickness: 50.9 mm

Record width: 604 mm

Record length: 595 mm

X 14. Drop the head assembly from a height of  $376.0 \pm 1.0$  mm (14.8 inches  $\pm$  0.04 inches) by a means that ensures a smooth, instant release onto the impact surface. (572.32(b) & (572.32(c)(4))

X 15. Complete the following table using channel class 1000 data. (572.36(i)):

Parameter	Specification	Result
Peak resultant acceleration	$225 \text{ g} \leq x \leq 275 \text{ g}$	255 g
Resultant versus time history curve	Unimodal	Yes
Oscillations after the main pulse	Less than 10% of the peak resultant acceleration	Yes
Lateral acceleration	y-axis acceleration $\leq 15 \text{ g}$	-6.6 g

X 16. Plots of the x, y, z, and resultant acceleration data follow this sheet.

David Schoedel

Signature

08/01/2014

Date

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

ATD Serial No: 401

Test ID: D142721

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.2	Pass
Laboratory Relative Humidity	%	10 to 70	45	Pass
Peak Resultant Acceleration	G's	225 to 275	255	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-6.6	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
Overall Test Results				Pass

*David Schoedel*

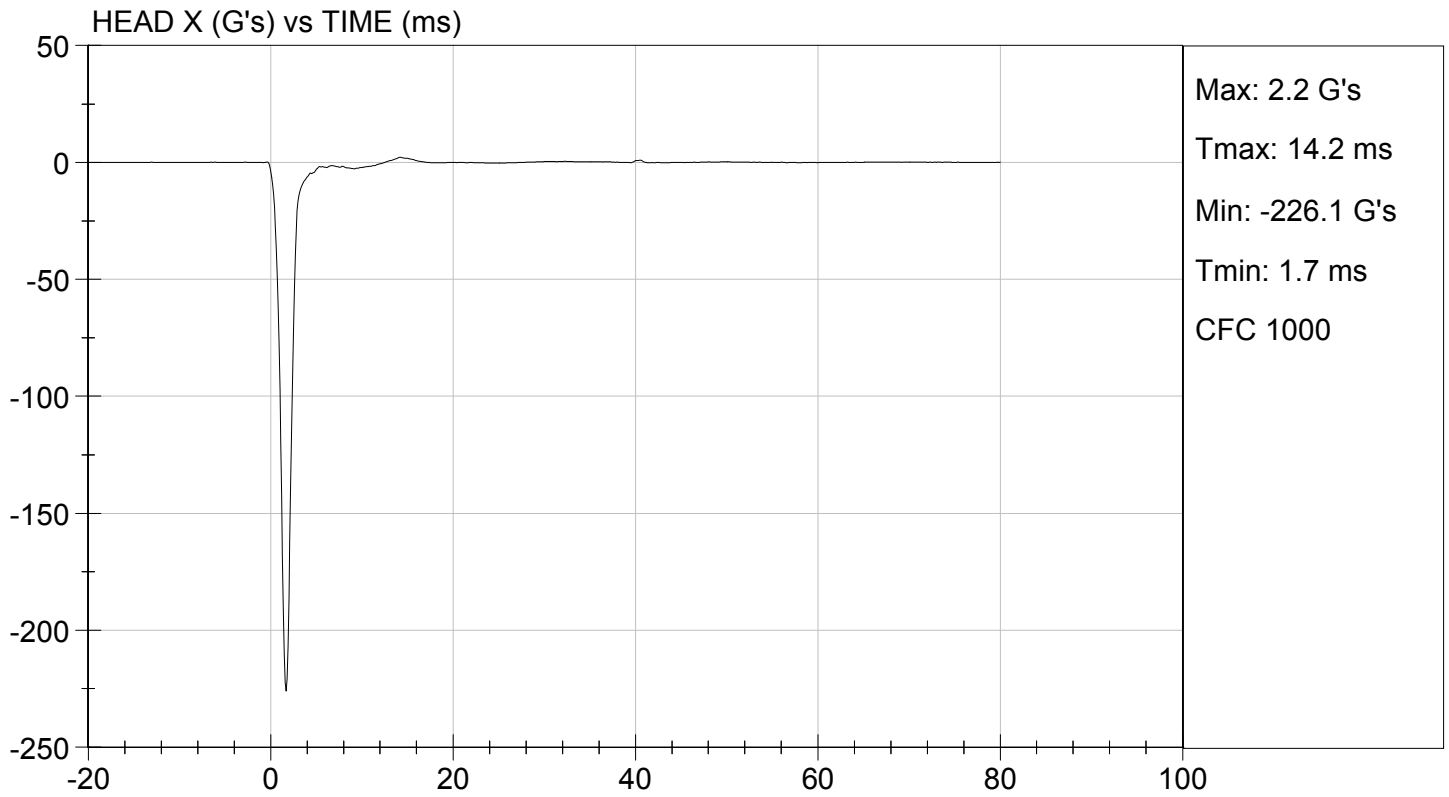
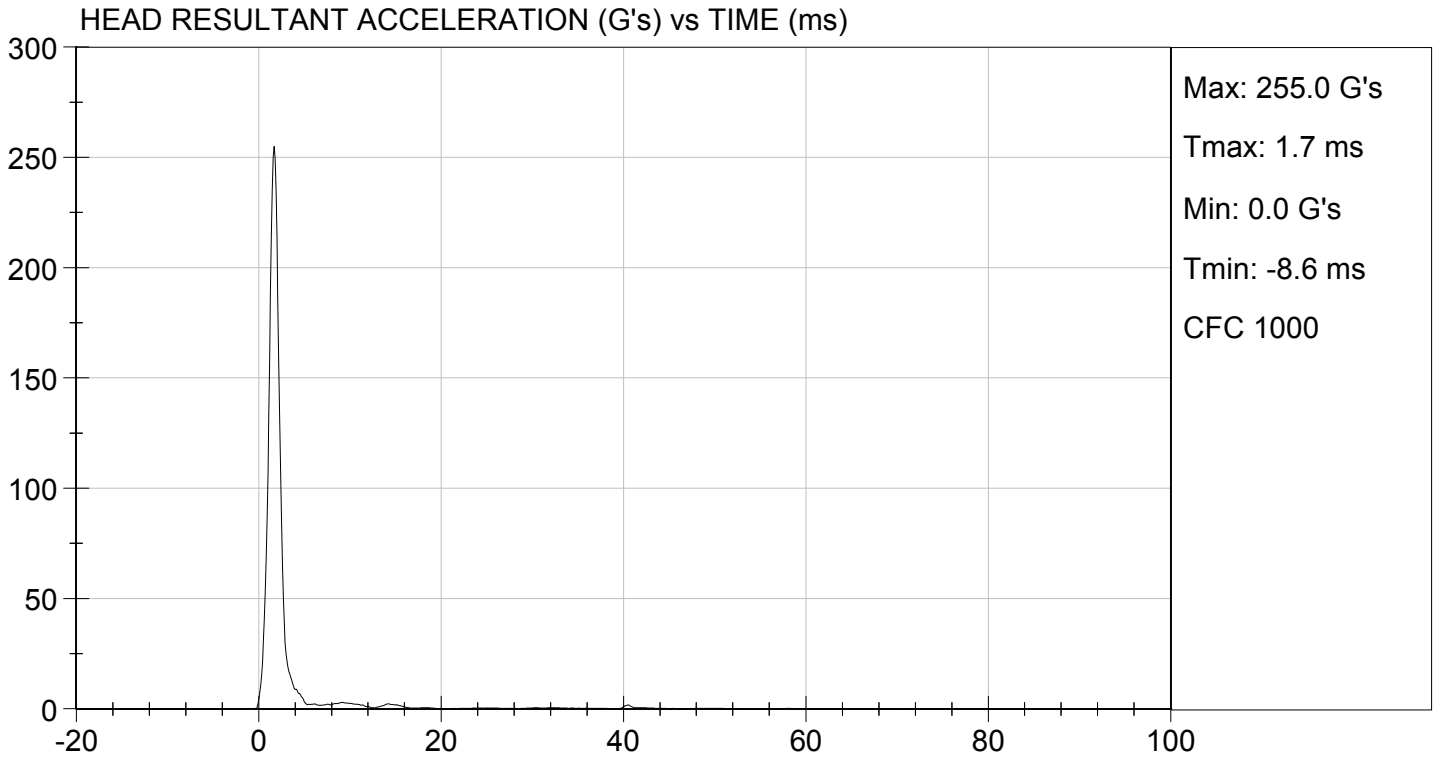
Laboratory Technician

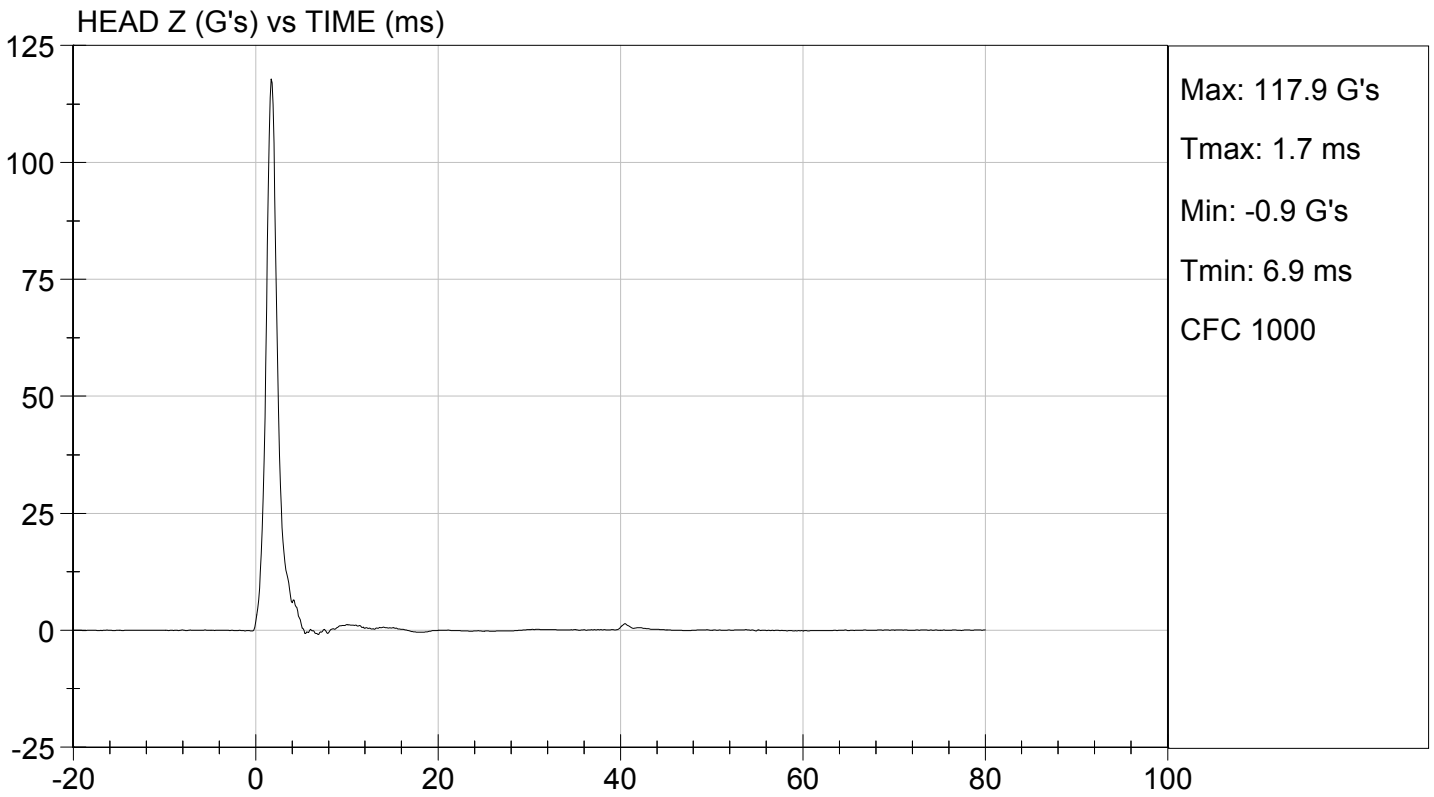
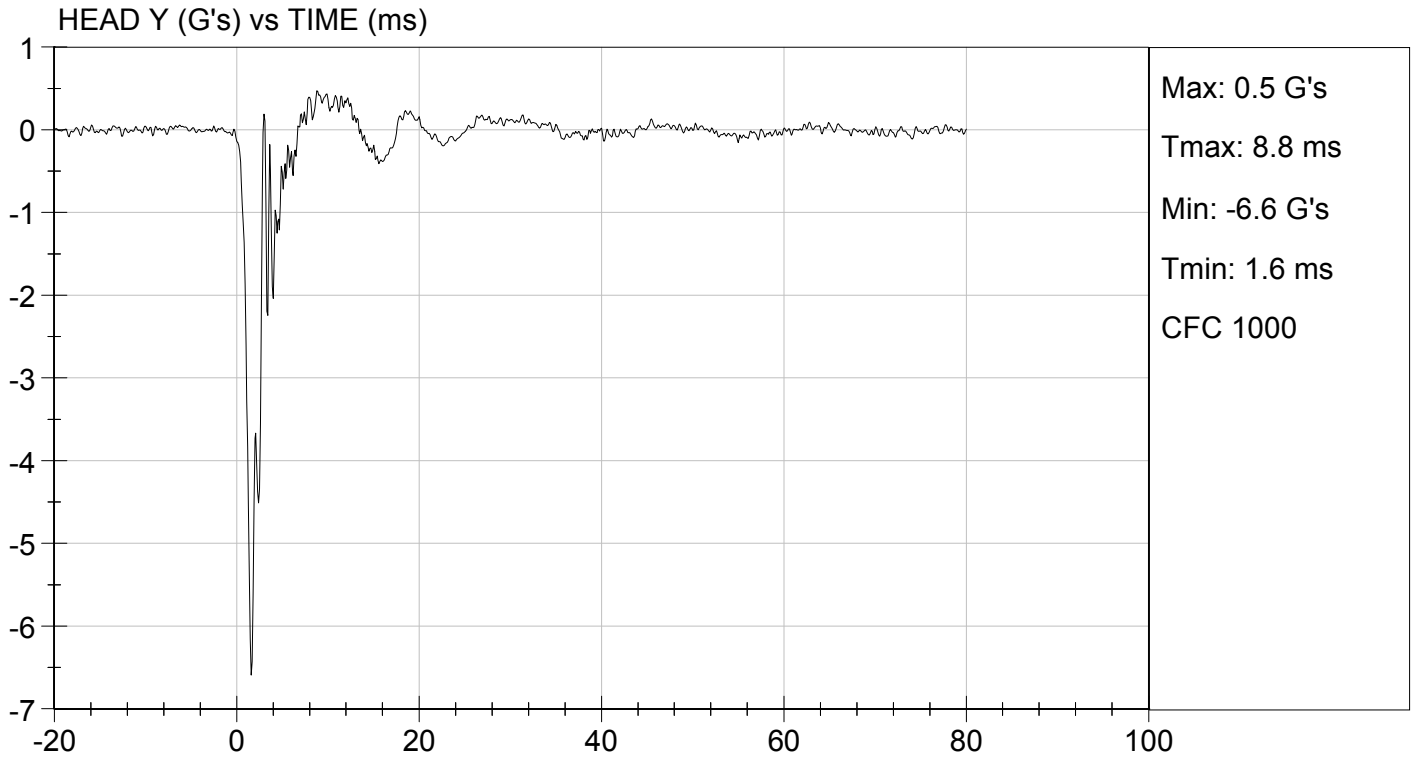
08/01/2014

Test Date

*Jeff Leonard*

Approved By





**DATA SHEET A4**  
NECK FLEXION TEST (572.33) (50<sup>th</sup> Male)

Dummy Serial Number: 401

Test Date: 07/31/2014

Technician: David Schoedel

- Pre test calibration  
 Post test calibration verification

Test attempt no. 1 (when successive flexion tests are necessary)

1. It has been at least 30 minutes since the last flexion test. (572.36(m))  
 N/A, ONLY one neck test performed
2. The components required for the neck tests include the head assembly (78051-61X), neck assembly (78051-90), bib simulator (78051-84), upper neck adjusting bracket (78051-307), lower neck adjusting bracket (78051-303), six axis neck transducer (C-1709) and either three accelerometers or their mass equivalent installed in the head assembly. Data from the accelerometers are not required. (572.33(b))
3. The assembly soaked at a temperature between 20.6°C (69°F) and 22.2°C (72°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to a test. (572.33(c)(1))
- |                                 |               |
|---------------------------------|---------------|
| Record the maximum temperature: | <u>21.4°C</u> |
| Record the minimum temperature: | <u>21.2°C</u> |
| Record the maximum humidity:    | <u>51%</u>    |
| Record the minimum humidity:    | <u>43%</u>    |
4. Visually inspect neck assembly for cracks, cuts and separation of the rubber from the metal segments. Note: If the damage resulted from the vehicle crash test in which the dummy was an occupant, the damaged area is to be documented with photography and the post test calibration verification testing completed before any replacement or repairs are made.
- Record findings and actions: No damage
5. Inspect the nodding blocks (78051-351) for any deterioration, but when replacement is necessary, ONLY replace during pre-test calibration. Using a Shore "A" type Durometer, verify the hardness of the nodding blocks is between 80 and 90. Ensure the nodding blocks are installed correctly. (78051-90).
- Record findings and actions: No Deterioration; Hardness: Front 89; Back 90.
6. Pre-test calibration Neck cable torque: Torque the jam nut (78051-64) on the neck cable (78051-301) to 1.0 ± 0.2 lb-ft by loosening the jam nut and relaxing the neck cable before torquing. (572.33(c)(2))

- X 7. The data acquisition system, including transducers, conforms to the requirements of SAE Recommended Practice J211/1 MAR95. (572.36(i))
- X 8. The test fixture pendulum conforms to the specifications in Figure 8A. (572.33(c)(3))
- X 9. The head-neck assembly is mounted on the pendulum so the midsagittal plane of the head is vertical and coincides with the plane of motion of the pendulum longitudinal centerline as shown in Figure 9A for the flexion test. (572.33(c)(3))
- X 10. Install the transducers or other devices for measuring the "D" plane rotation with respect to the pendulum longitudinal centerline. Note: Plane "D" is the bottom horizontal surface of the skull. These measurement devices should be designed to minimize their influence upon the performance of the head-neck assembly. An example of a measurement device is shown in Figure 11A.
- X 11. With the pendulum resting against the honeycomb material, the neck bracket was adjusted until the longitudinal centerline of the pendulum was perpendicular  $\pm 1$  degree to plane "D" on the dummy's head.
- X 12. Release the pendulum and allow it to fall freely from a height to achieve an impact speed of 22.6 to 23.4 ft/sec as measured at the center of the pendulum accelerometer. (572.33(c)(4))
- X 13. Complete the following table:  

Neck Flexion Test Results (572.33(b)(1) & 572.33(c)(4))

Parameter		Specification	Results
Pendulum impact speed		22.6 ft/s $\leq$ speed $\leq$ 23.4 ft/s	23.15 ft/s
Pendulum Deceleration Versus Time Pulse	@ 10 ms	22.5 $\leq$ g $\leq$ 27.5	25.70 g's
	@ 20 ms	17.6 $\leq$ g $\leq$ 22.6	20.49 g's
	@ 30 ms	12.5 $\leq$ g $\leq$ 18.5	13.83 g's
	Above 30 ms	29 g maximum	13.8 g's
First Pendulum Decay to 5g		34 ms $\leq$ time $\leq$ 42 ms	34.6 ms
Plane D Rotation		64° $\leq$ max. rotation $\leq$ 78°	68.7°
		57 ms $\leq$ time of max. rotation $\leq$ 64 ms	61.4 ms
Time for Plane D Rotation to Cross 0° During First Rebound		113 ms $\leq$ time $\leq$ 128 ms	117.8 ms
Maximum Moment		65 lbf-ft $\leq$ moment $\leq$ 80 lbf-ft	68.2 lbf-ft
		47 ms $\leq$ time of max. moment $\leq$ 58 ms	47.8 ms
Time of first decay to 0 lbf-ft Positive Moment Decay** (Flexion)		97 ms $\leq$ time $\leq$ 107 ms	97.9 ms

\*Moment about the occipital condyle =  $M_y - (0.058 \text{ ft} \times F_x)$ (572.33(b)(1)(ii))

$M_y$  = Moment in lbf-ft measured by the transducer

$F_x$  = Force, in lbf measured by the transducer

\*\*Time zero is defined as the time of initial contact between the pendulum striker plate and the honeycomb material. (572.33(b)(3))

X 14. Plots of pendulum acceleration, y-axis moment, x-axis force, y-axis moment about the occipital condyle, and D plane rotation follows this sheet.

David Schoedel  
Signature

07/31/2014  
Date

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

ATD Serial No: 401

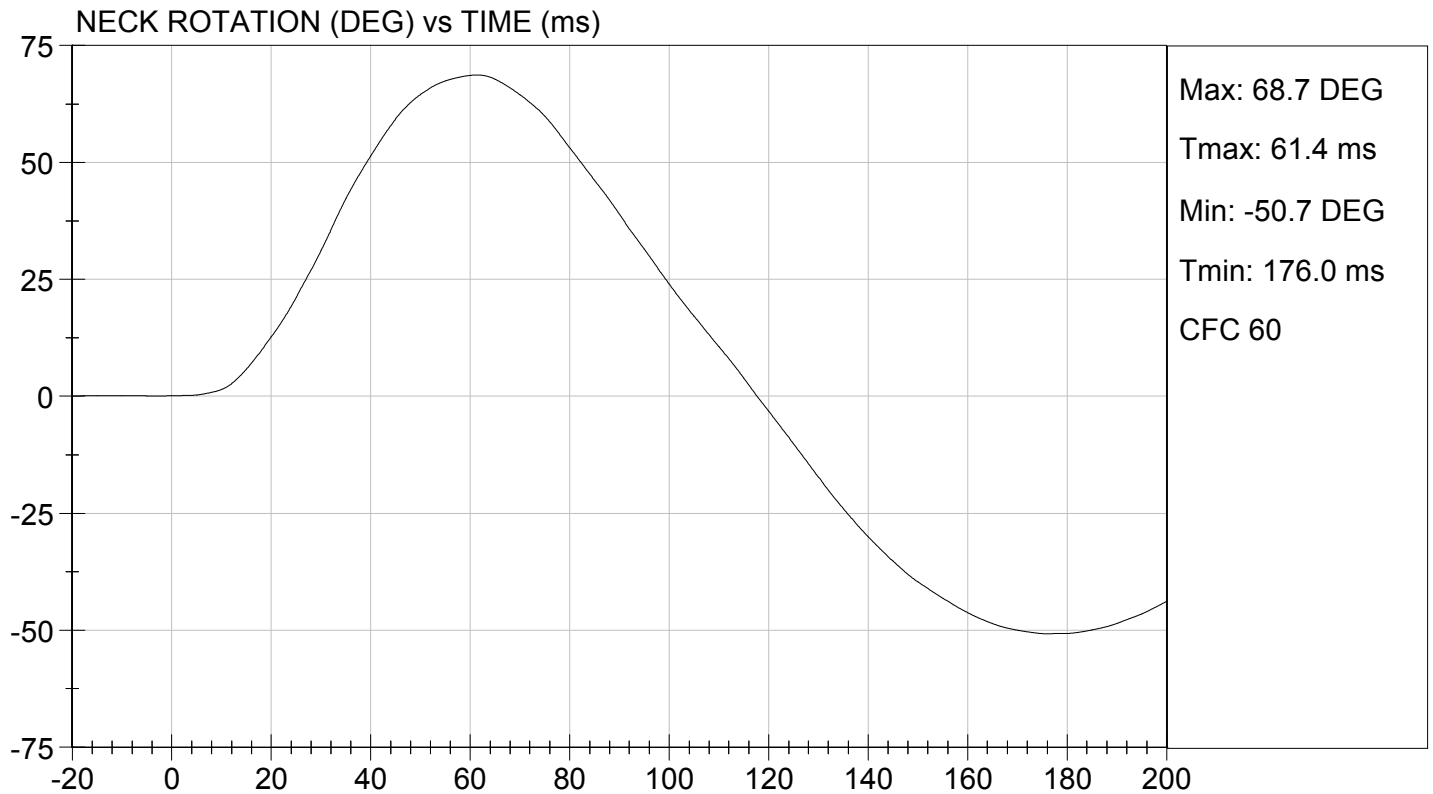
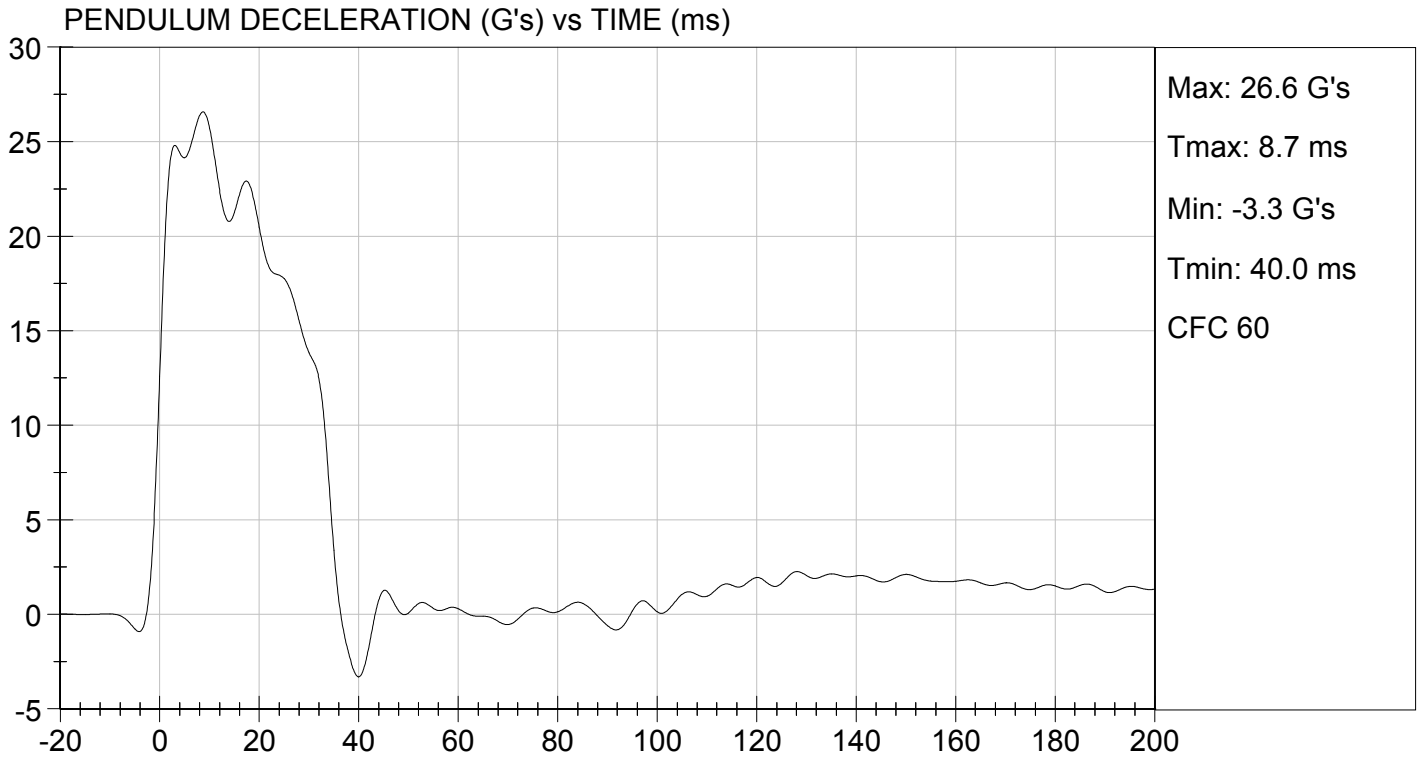
Test I.D.: D142722

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.2	Pass
Laboratory Relative Humidity		%	10 to 70	43	Pass
Pendulum Velocity		m/s	6.89 to 7.13	7.06	Pass
Pendulum Deceleration	10 ms	G's	22.50 to 27.50	25.70	Pass
	20 ms	G's	17.60 to 22.60	20.49	Pass
	30 ms	G's	12.50 to 18.50	13.83	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 29.0	13.8	Pass
Deceleration Decay Time to Cross 5 G's		ms	34.0 to 42.0	34.6	Pass
Maximum "D" Plane Rotation	Maximum	Deg	64.0 to 78.0	68.7	Pass
	Time	ms	57.0 to 64.0	61.4	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	113.0 to 128.0	117.8	Pass
Moment About Occipital Condyle	Maximum	Nm	88.1 to 108.5	92.4	Pass
	Time	ms	47.0 to 58.0	47.8	Pass
Positive Moment Decay Time To Zero Crossing		ms	97.0 to 107.0	97.9	Pass
Overall Test Results					Pass

David Schoedel  
Laboratory Technician

07/31/2014  
Test Date

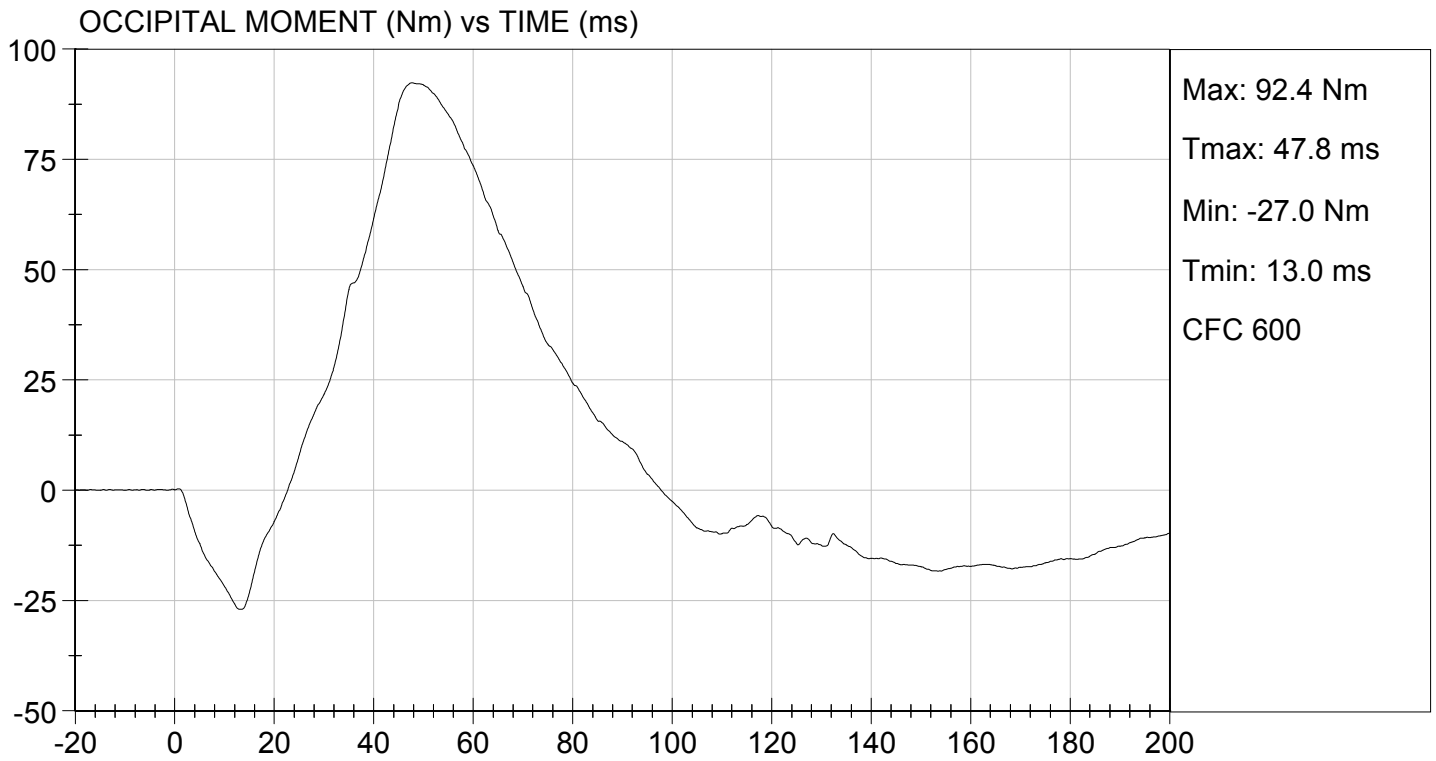
Jeff Leonard  
Approved By





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

TEST DATE: 07/31/2014  
TEST #: D142722



**DATA SHEET A5**  
NECK EXTENSION TEST (572.33) (50<sup>th</sup> Male)

Dummy Serial Number: 401

Test Date: 07/31/2014

Technician: David Schoedel

- Pre test calibration  
 Post test calibration verification

Test attempt no. 1 (when successive extension tests are necessary)

1. It has been at least 30 minutes since the last extension test. (572.36(m))  
 N/A, ONLY one neck test performed
2. The components required for the neck tests include the head assembly (78051-61X), neck assembly (78051-90), bib simulator (78051-84), upper neck adjusting bracket (78051-307), lower neck adjusting bracket (78051-303), six axis neck transducer (C-1709) and either three accelerometers or their mass equivalent installed in the head assembly. Data from the accelerometers are not required. (572.33(b))
3. The assembly soaked at a temperature between 20.6°C (69°F) and 22.2°C (72°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to a test. (572.33(c)(1))
- |                                 |               |
|---------------------------------|---------------|
| Record the maximum temperature: | <u>21.4°C</u> |
| Record the minimum temperature: | <u>21.2°C</u> |
| Record the maximum humidity:    | <u>51%</u>    |
| Record the minimum humidity:    | <u>43%</u>    |
4. Visually inspect neck assembly for cracks, cuts and separation of the rubber from the metal segments. Note: If the damage resulted from the vehicle crash test in which the dummy was an occupant, the damaged area is to be documented with photography and the post test calibration verification testing completed before any replacement or repairs are made.
- Record findings and actions: No damage
5. Inspect the nodding blocks (78051-351) for any deterioration, but when replacement is necessary, ONLY replace during pre-test calibration. Using a Shore "A" type Durometer, verify the hardness of the nodding blocks is between 80 and 90. Ensure the nodding blocks are installed correctly. (78051-90).
- Record findings and actions: No Deterioration; Hardness: Front 89; Back 90.
6. Pre-test calibration Neck cable torque: Torque the jam nut (78051-64) on the neck cable (78051-301) to 1.0 ± 0.2 lb-ft by loosening the jam nut and relaxing the neck cable before torquing. (572.33(c)(2))

- X 7. The data acquisition system, including transducers, conforms to the requirements of SAE Recommended Practice J211/1 MAR95. (572.36(i))
- X 8. The test fixture pendulum conforms to the specifications in Figure 8A. (572.33(c)(3))
- X 9. The head-neck assembly is mounted on the pendulum so the midsagittal plane of the head is vertical and coincides with the plane of motion of the pendulum longitudinal centerline as shown in Figure 10A for the extension test. (572.33(c)(3))
- X 10. Install the transducers or other devices for measuring the "D" plane rotation with respect to the pendulum longitudinal centerline. Note: Plane "D" is the bottom horizontal surface of the skull. These measurement devices should be designed to minimize their influence upon the performance of the head-neck assembly. An example of a measurement device is shown in Figure 11A.
- X 11. With the pendulum resting against the honeycomb material, the neck bracket was adjusted until the longitudinal centerline of the pendulum was perpendicular  $\pm 1$  degree to plane "D" on the dummy's head.
- X 12. Release the pendulum and allow it to fall freely from a height to achieve an impact speed of 19.5 ft/s to 20.3 ft/sec as measured at the center of the pendulum accelerometer. (572.33(c)(4))
- X 13. Complete the following table:  
Neck Extension Test Results (572.33(b)(2) & 572.33(c)(4))

Parameter	Specification	Results
Pendulum impact speed	19.5 ft/s $\leq$ speed $\leq$ 20.3 ft/s	20.30 ft/s
Pendulum Deceleration Versus Time Pulse	@ 10 ms	17.2 $\leq$ g $\leq$ 21.2
	@ 20 ms	14 $\leq$ g $\leq$ 19
	@ 30 ms	11.0 $\leq$ g $\leq$ 16.0
	Above 30 ms	22 g maximum
First Pendulum Decay to 5g	38 ms $\leq$ time $\leq$ 46 ms	40.4 ms
Plane D Rotation	81° $\leq$ max. rotation $\leq$ 106°	99.1°
	72 ms $\leq$ time of max. rotation $\leq$ 82 ms	75.4 ms
Time for Plane D Rotation to Cross 0° During First Rebound	147 ms $\leq$ time $\leq$ 174 ms	155.4 ms
Maximum Moment	-59 lbf-ft $\leq$ moment $\leq$ -39 lbf-ft	-48.8 lbf-ft
	65 ms $\leq$ time of max. moment $\leq$ 79 ms	69.4 ms
Time of first decay to 0 lbf-ft Positive Moment Decay** (Extension)	120 ms $\leq$ time $\leq$ 148 ms	141.5 ms

\*Moment about the occipital condyle =  $M_y - (0.058 \text{ ft} \times F_x)$ (572.33(b)(2)(ii))

$M_y$  = Moment in lbf-ft measured by the transducer

$F_x$  = Force, in lbf measured by the transducer

\*\*Time zero is defined as the time of initial contact between the pendulum striker plate and the honeycomb material. (572.33(b)(3))

- X 14. Plots of pendulum acceleration, y-axis moment, x-axis force, y-axis moment about the occipital condyle, and D plane rotation follows this sheet.

David Schoedel

Signature

07/31/2014

Date

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

ATD Serial No: 401

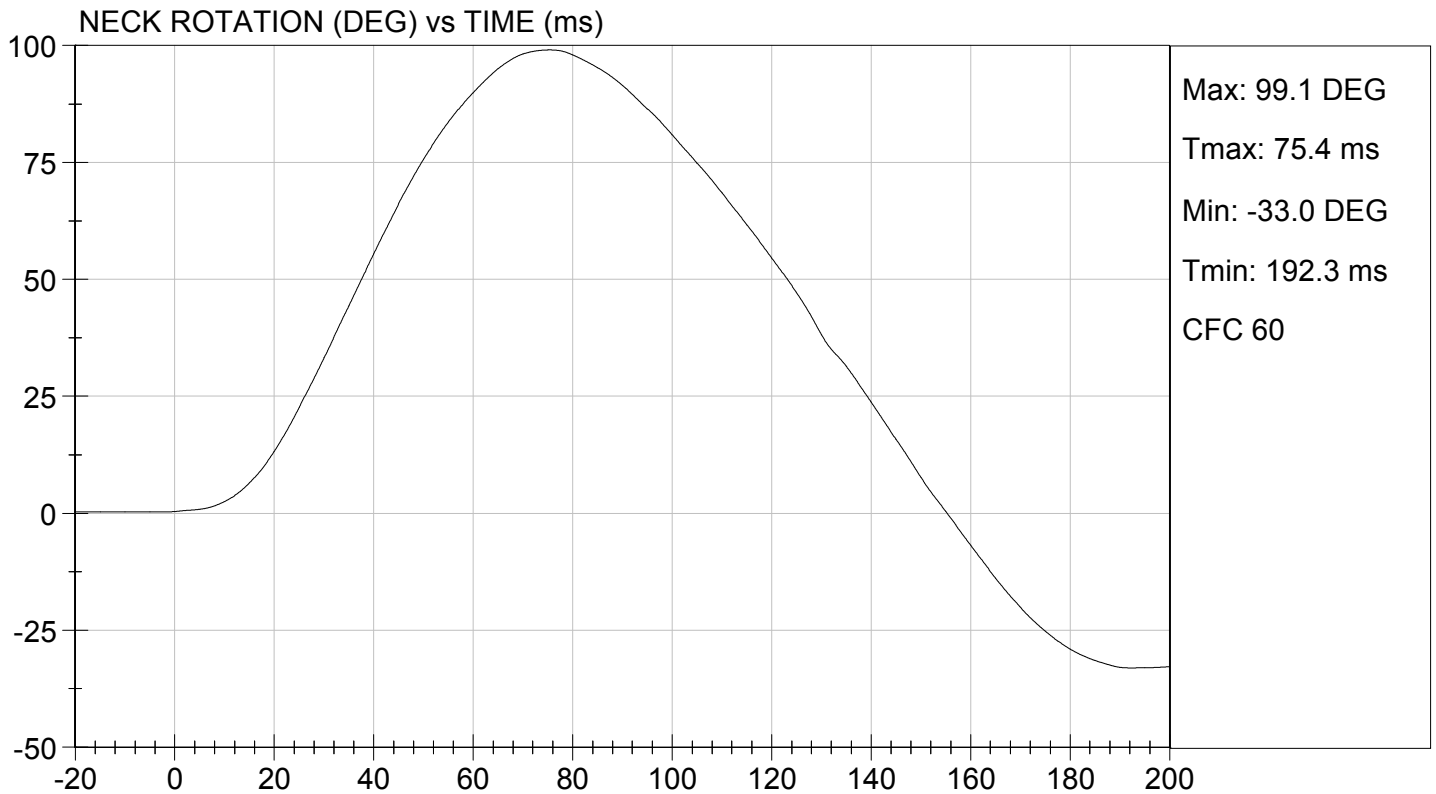
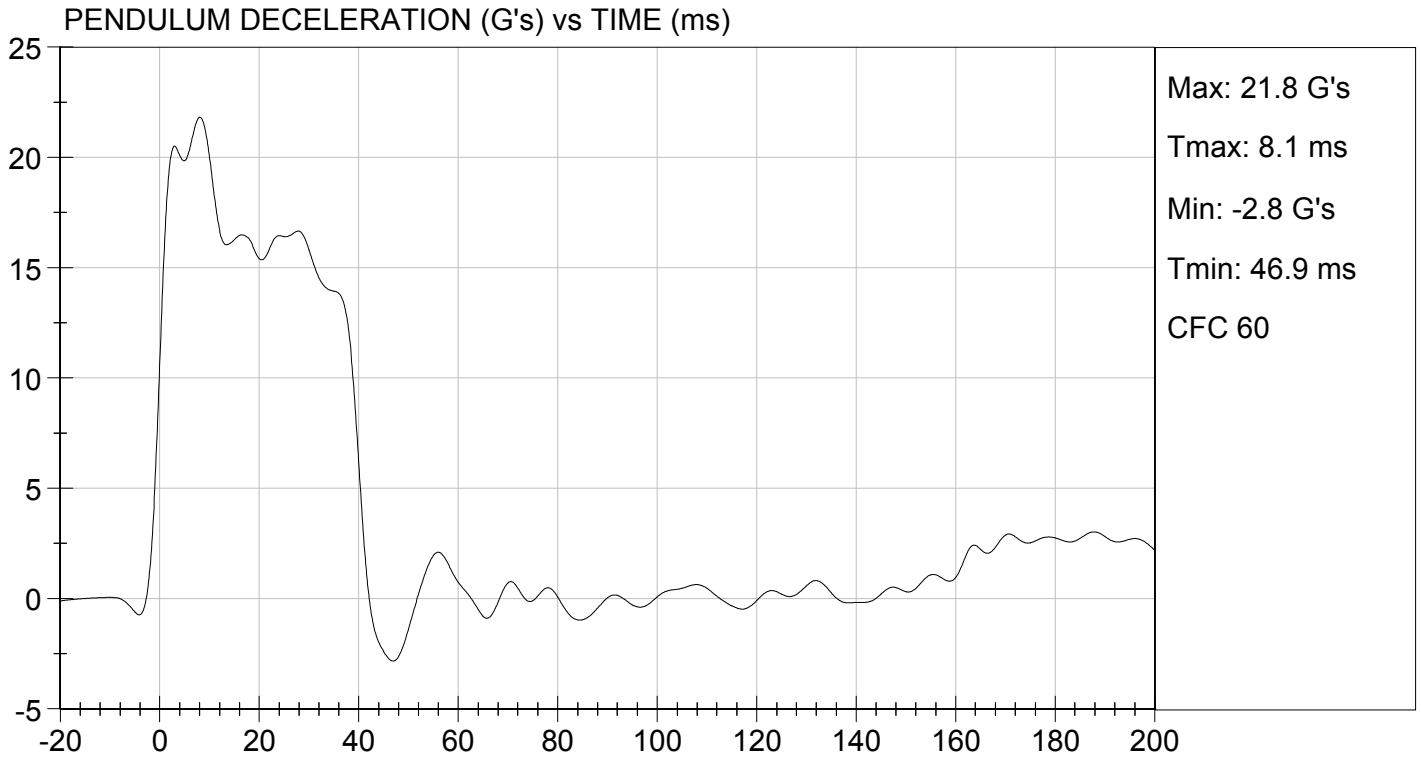
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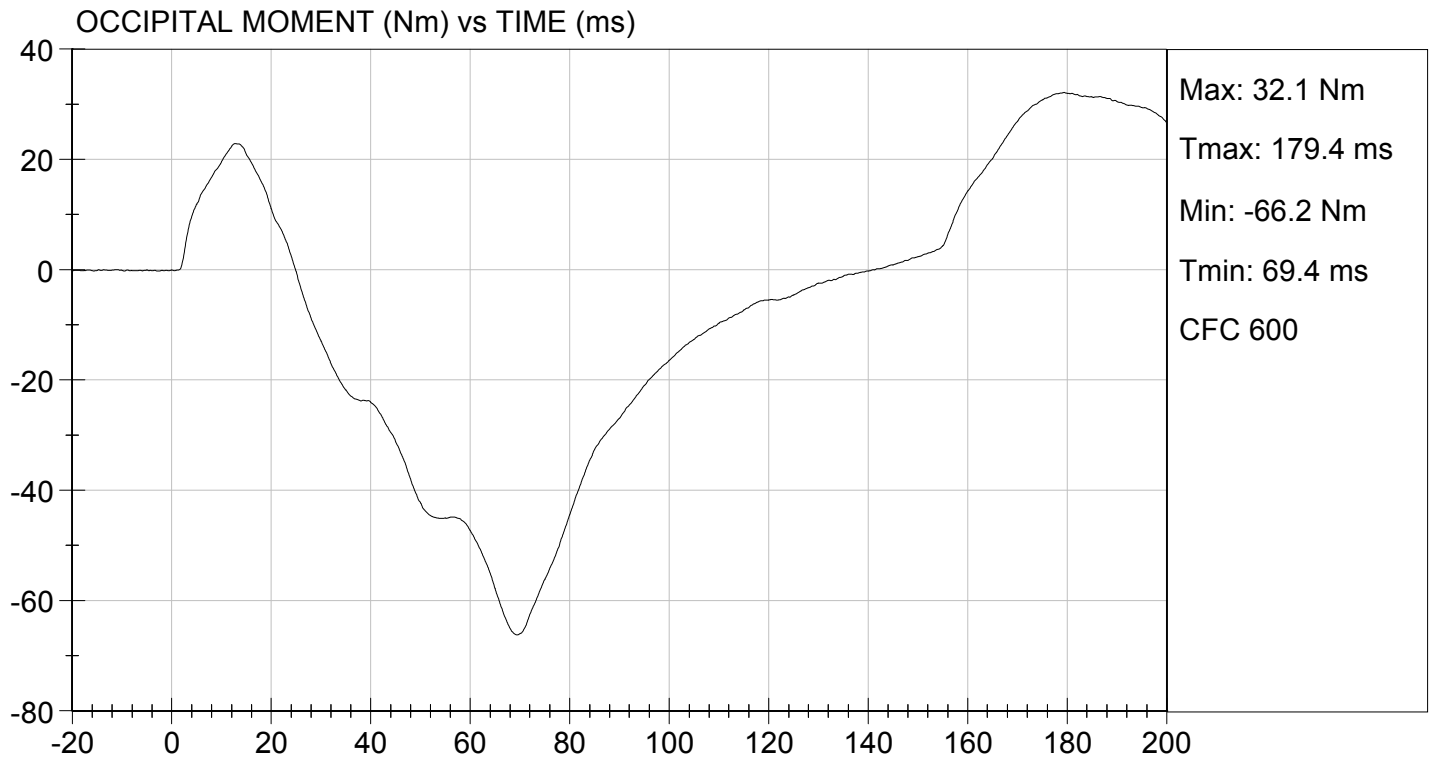
Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.2	Pass
Laboratory Relative Humidity		%	10 to 70	43	Pass
Pendulum Velocity		m/s	5.95 to 6.19	6.18	Pass
Pendulum Deceleration	10 ms	G's	17.20 to 21.20	19.97	Pass
	20 ms	G's	14.00 to 19.00	15.41	Pass
	30 ms	G's	11.00 to 16.00	15.79	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 22.0	15.7	Pass
Deceleration Decay Time to Cross 5 G's		ms	38.0 to 46.0	40.4	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	81.0 to 106.0	99.1	Pass
	Time	ms	72.0 to 82.0	75.4	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	147.0 to 174.0	155.4	Pass
Moment About Occipital Condyle	Maximum	Nm	-52.9 to -79.9	-66.2	Pass
	Time	ms	65.0 to 79.0	69.4	Pass
Negative Moment Decay Time To Zero Crossing		ms	120.0 to 148.0	141.5	Pass
Overall Test Results					Pass

David Schoedel  
Laboratory Technician

07/31/2014  
Test Date

Jeff Levanowski  
Approved By





**DATA SHEET A6**  
THORAX IMPACT TEST (572.34) (50<sup>th</sup> Male)

Dummy Serial Number: 401

Test Date: 08/01/2014

Technician: Jessica Gall

- Pre test calibration  
 Post test calibration verification

Test attempt no. 1 (when successive thorax impact tests are necessary)

1. It has been at least 30 minutes since the last thorax impact test. (572.137(q))  
 N/A, ONLY one thorax impact test performed
2. The test fixture conforms to the specifications in Figure 12A.
3. The complete assembled dummy (78051-218) is used (572.34(b)) and is dressed in a form fitting cotton stretch above-the-elbow sleeved shirt and above-the-knee pants. No shoes are worn. (572.34(b))
4. The dummy assembly soaked at a temperature between 20.6°C (69°F) and 22.2°C (72°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to this test. (572.34(c)(1))

Record the maximum temperature:	<u>21.4°C</u>
Record the minimum temperature:	<u>21.2°C</u>
Record the maximum humidity:	<u>51%</u>
Record the minimum humidity:	<u>43%</u>

5. Remove the chest skin and visually inspect the thorax assembly for cracks, cuts, abrasions, etc. Particular attention should be given to the rib damping material (78051-17 thru 78051-22), chest displacement transducer assembly (78051-317) and the rear rib supports (78051-304). Inspect for rib deformation using the chest depth gage (83-5006-007). If any damage is noted repair and/or replace the damaged components unless the damage resulted from the vehicle crash test in which the dummy was an occupant in which case the damage must be documented and post test calibration verification testing completed before any repairs or replacements are made.

- No Damage

- Damage from crash test, no repairs or replacement because this is a post test calibration verification. Record damage:

- The following repairs or replacement was performed. Record:

---

- X 6. Seat the dummy, (chest skin still removed) without back and arm supports on the test fixture surface as shown in Figure 12A. The surface must be long enough to support the pelvis and outstretched legs. (572.34(c)(2))
- X 7. Level the ribs both longitudinally and laterally  $\pm 0.5^\circ$  and adjust the pelvis angle to  $13^\circ \pm 2^\circ$ . The angle may be measured using the special H-point tool (78051-532) that inserts into the pelvic structure and extends outward beyond the pelvic skin surface or by using the surface of the pelvic adaptor block. (572.34(c)(2))
- X 8. The midsagittal plane of the dummy is vertical within  $\pm 1^\circ$ . (572.134(c)(3))
- X 9. The longitudinal centerline of the test probe is centered within  $\pm 2.5$  mm of the midsagittal plane of the dummy and is  $12.7$  mm  $\pm 1$  mm below the horizontal peripheral centerline of the No. 3 rib and is within  $0.5^\circ$  of a horizontal line in the dummy's midsagittal plane. (572.34(c)(4))
- X 10. Align the adjustable neck bracket index marks to the "zero" position. (Figure 12A)
- X 11. Record locations such as the rear surfaces of the thoracic spine and the lower neck bracket reference with respect to locations such as the rear surfaces of the thoracic spine and the lower neck bracket. These reference measurements are necessary to ensure the dummy is in the same position after the chest skin is installed. The reference locations must be accessible after installation of the chest skin. It may be necessary to leave the chest skin zipper unfastened until the references are checked and fasten it just prior to the test.
- X 12. Install the chest skin and reposition the dummy as described in the preceding paragraph using the reference measurements recorded.
- X 13. Place the arm assemblies horizontal  $\pm 2^\circ$  and parallel to the midsagittal plane. The arms are held in place by tightening the adjustment nut that holds the arm yoke to the clavicle assembly.
- X 14. The data acquisition system, including transducers, must conform to the requirements of SAE Recommended Practice J211/1 MAR95 Class 180.
- X 15. Impact the anterior surface of the thorax with the test probe so the longitudinal centerline of the probe is within  $2^\circ$  of a horizontal line in the dummy's midsagittal plane at the moment of impact. (572.34(c)(5)) The velocity of the test probe at the time of impact is  $22$  f/s  $\pm 0.4$  f/s. (572.34(b)) The probe is guided so there is no significant lateral, vertical or rotational movement during the impact. (572.34(c)(6))

X 16. Complete the following table:

Thorax Impact Results (572.34(b))

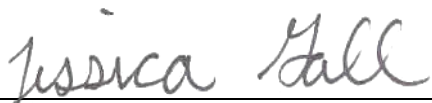
Parameter*	Specification	Result
Test Probe Speed	$21.6 \text{ ft/s} \leq \text{speed} \leq 22.4 \text{ ft/s}$	21.65 ft/s
Chest Compression	$2.5 \text{ in.} \leq \text{compression} \leq 2.86 \text{ in.}$	2.62 in.
Peak resistance force**	$1160 \text{ lb} \leq \text{peak force} \leq 1325 \text{ lb}$	1220 lb
Internal Hysteresis***	$69\% \leq \text{hysteresis} \leq 85\%$	71%

\*Time zero is defined as the time of initial contact between the test probe and the chest skin.

\*\*Force = impactor mass x acceleration (572.34(b))

\*\*\*Area under loading curve minus the area under the unloading curve divided by the area under the loading curve.

X 17. Plots of chest compression, pendulum acceleration, pendulum speed, and force, follow this sheet.

  
Signature

08/01/2014  
Date

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

**ATD Serial No:** 401

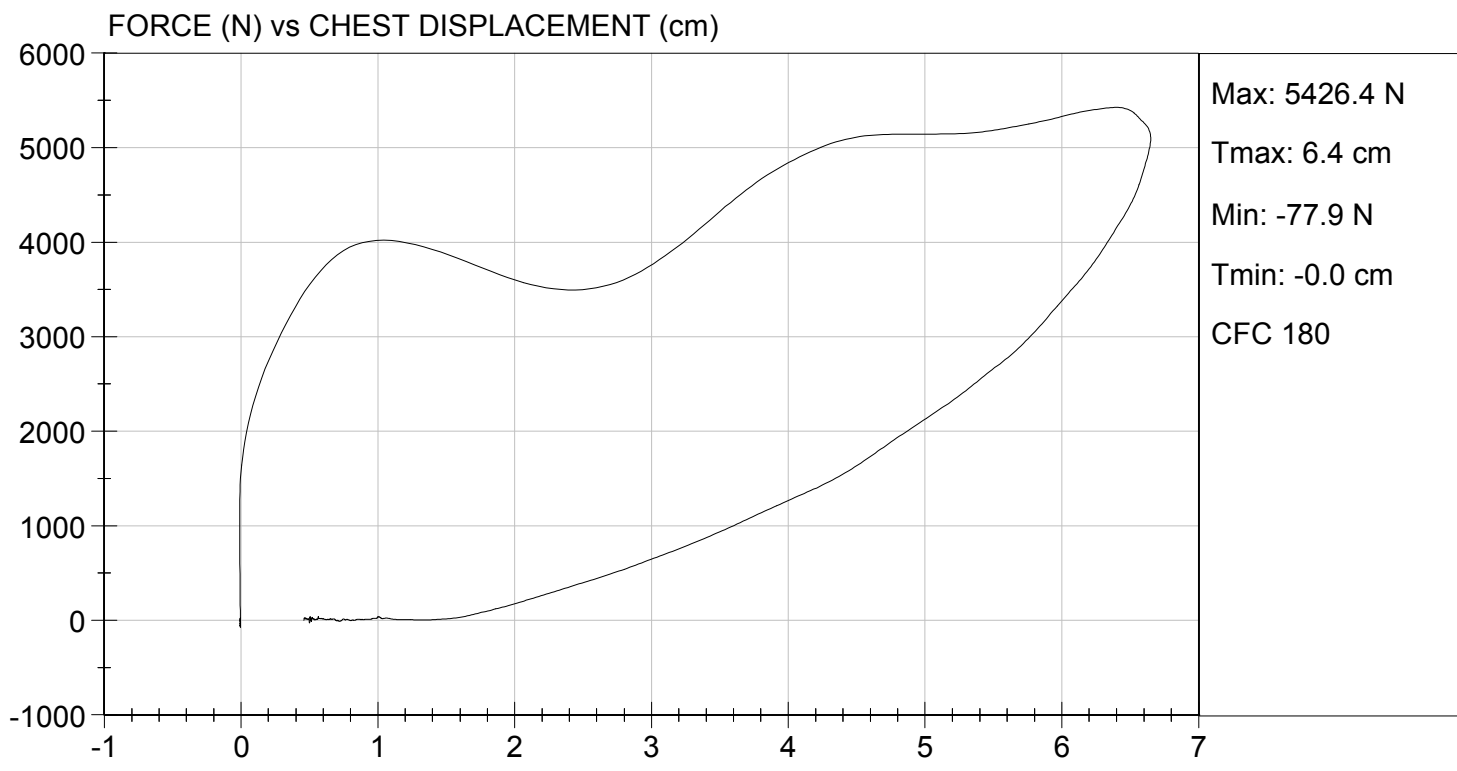
**Test I.D:** D142724

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.4	Pass
Laboratory Relative Humidity	%	10 to 70	51	Pass
Probe Velocity	m/s	6.58 to 6.82	6.60	Pass
Peak Probe Force	N	5159 to 5893	5,426	Pass
Peak Sternum Displacement	cm	6.35 to 7.26	6.65	Pass
Internal Hysteresis	%	69 to 85	71	Pass
<b>Overall Test Results</b>				<b>Pass</b>

*Jessica Hall*  
 \_\_\_\_\_  
 Laboratory Technician

08/01/2014  
 Test Date

*Jeff Leonard-Markus*  
 \_\_\_\_\_  
 Approved By



**DATA SHEET A7**  
LEFT KNEE IMPACT TEST (572.35) (50<sup>th</sup> Male)

Dummy Serial Number: 401

Test Date: 07/31/2014

Technician: David Schoedel

- Pre test calibration  
 Post test calibration verification

Test attempt no. 1 (when successive knee impact tests are necessary)

1. It has been at least 30 minutes since the last knee impact test. (572.36(m))  
 N/A, ONLY one knee impact test performed
2. The test fixture conforms to the specifications in Figure 14A.
3. The leg assembly (86-5001-001) with the upper leg assembly (78051-46) removed, and the load cell simulator (78051-319) is used. (572.35(b)(2))
4. The knee assembly soaked at a temperature between 18.9°C (66°F) and 25.6°C (78°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to this test. (572.35(b)(2)(ii))
- |                                 |               |
|---------------------------------|---------------|
| Record the maximum temperature: | <u>21.4°C</u> |
| Record the minimum temperature: | <u>21.2°C</u> |
| Record the maximum humidity:    | <u>51%</u>    |
| Record the minimum humidity:    | <u>43%</u>    |
5. Mount the test specimen and secure it to the rigid test fixture. (572.35(b)(2)(iii)) (Figure 14A)
6. No parts of the foot or tibia contact any exterior surface. (572.35(b)(2)(iii))
7. Align the test probe so that at contact the longitudinal centerline of the probe is collinear within 2 degrees with the longitudinal centerline of the femur load cell simulator except it is within 0.5 degrees horizontally. (572.35(b)(2)(iv)&(vi))
8. The probe is guided so there is no significant lateral, vertical or rotational movement during the impact with the knee. (572.35(b)(2)(v))
9. The data acquisition system, including transducers, must conform to the requirements of SAE Recommended Practice J2111/1 MAR95 (572.136(m)) Class 600.
10. Contact the knee with the test probe at a speed between 6.8 ft/s and 7.0 ft/s. (572.35(b))

X 11. Complete the following table:

Knee Impact Results (572.35(b)(1))

Parameter	Specification	Result
Probe speed	$6.8 \text{ ft/s} \leq \text{speed} \leq 7.0 \text{ ft/s}$	7.00 ft/s
Peak resistance force*	$1060 \text{ lb} \leq \text{force} \leq 1300 \text{ lb}$	1200 lb

\*Force = impactor mass x deceleration (572.35(b)(1))

X 12. Plots of pendulum acceleration, pendulum speed, and force, follow this sheet. Time zero is defined as the time of contact between the test probe and the knee. (572.3(b)(2)(vii))

David Schoedel  
Signature

07/31/2014  
Date

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

**ATD Serial No:** 401

**Test I.D:** D142726

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.2	Pass
Laboratory Relative Humidity	%	10 to 70	43	Pass
Probe Velocity	m/s	2.07 to 2.13	2.13	Pass
Peak Probe Force	N	4715 to 5782	5,339	Pass
Overall Test Results				Pass

David Schoedel  
Laboratory Technician

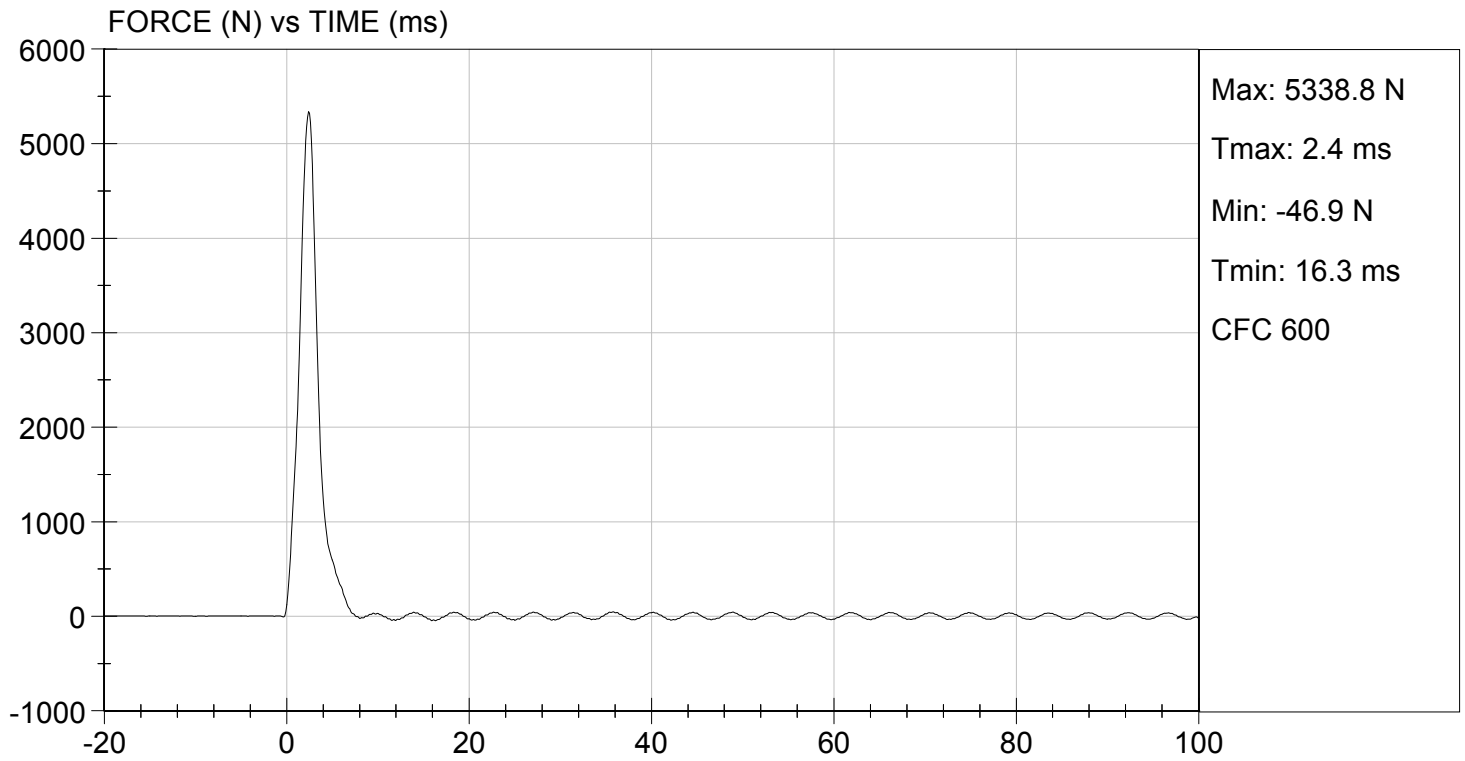
07/31/2014  
Test Date

Jeff Levanowski  
Approved By



TEST DESC: LEFT KNEE  
VELOCITY: 7.00 ft/s, 2.13 m/s

TEST DATE: 07/31/2014  
TEST #: D142726



**DATA SHEET A8**  
RIGHT KNEE IMPACT TEST (572.35) (50<sup>th</sup> Male)

Dummy Serial Number: 401

Test Date: 07/31/2014

Technician: David Schoedel

- Pre test calibration  
 Post test calibration verification

Test attempt no. 1 (when successive knee impact tests are necessary)

1. It has been at least 30 minutes since the last knee impact test. (572.36(m))  
 N/A, ONLY one knee impact test performed
2. The test fixture conforms to the specifications in Figure 14A.
3. The leg assembly (86-5001-002) with the upper leg assembly (78051-47) removed, and the load cell simulator (78051-319) is used. (572.35(b)(2))
4. The knee assembly soaked at a temperature between 18.9°C (66°F) and 25.6°C (78°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to this test. (572.35(b)(2)(ii))
- |                                 |               |
|---------------------------------|---------------|
| Record the maximum temperature: | <u>21.4°C</u> |
| Record the minimum temperature: | <u>21.2°C</u> |
| Record the maximum humidity:    | <u>51%</u>    |
| Record the minimum humidity:    | <u>43%</u>    |
5. Mount the test specimen and secure it to the rigid test fixture. (572.35(b)(2)(iii)) (Figure 14A)
6. No parts of the foot or tibia contact any exterior surface. (572.35(b)(2)(iii))
7. Align the test probe so that at contact the longitudinal centerline of the probe is collinear within 2 degrees with the longitudinal centerline of the femur load cell simulator except it is within 0.5 degrees horizontally. (572.35(b)(2)(iv)&(vi))
8. The probe is guided so there is no significant lateral, vertical or rotational movement during the impact with the knee. (572.35(b)(2)(v))
9. The data acquisition system, including transducers, must conform to the requirements of SAE Recommended Practice J211/1 MAR95 (572.136(m)) Class 600.
10. Contact the knee with the test probe at a speed between 6.8 ft/s and 7.0 ft/s. (572.35(b))

X 11. Complete the following table:

Knee Impact Results (572.35(b)(1))

Parameter	Specification	Result
Probe speed	$6.8 \text{ ft/s} \leq \text{speed} \leq 7.0 \text{ ft/s}$	7.00 ft/s
Peak resistance force*	$1060 \text{ lb} \leq \text{force} \leq 1300 \text{ lb}$	1063 lb

\*Force = impactor mass x deceleration (572.35(b)(1))

X 12. Plots of pendulum acceleration, pendulum speed, and force, follow this sheet. Time zero is defined as the time of contact between the test probe and the knee. (572.3(b)(2)(vii))

David Schoedel  
Signature

07/31/2014  
Date

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

ATD Serial No: 401

Test I.D: D142725

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.2	Pass
Laboratory Relative Humidity	%	10 to 70	43	Pass
Probe Velocity	m/s	2.07 to 2.13	2.13	Pass
Peak Probe Force	N	4715 to 5782	4,729	Pass
Overall Test Results				Pass

David Schoedel  
 Laboratory Technician

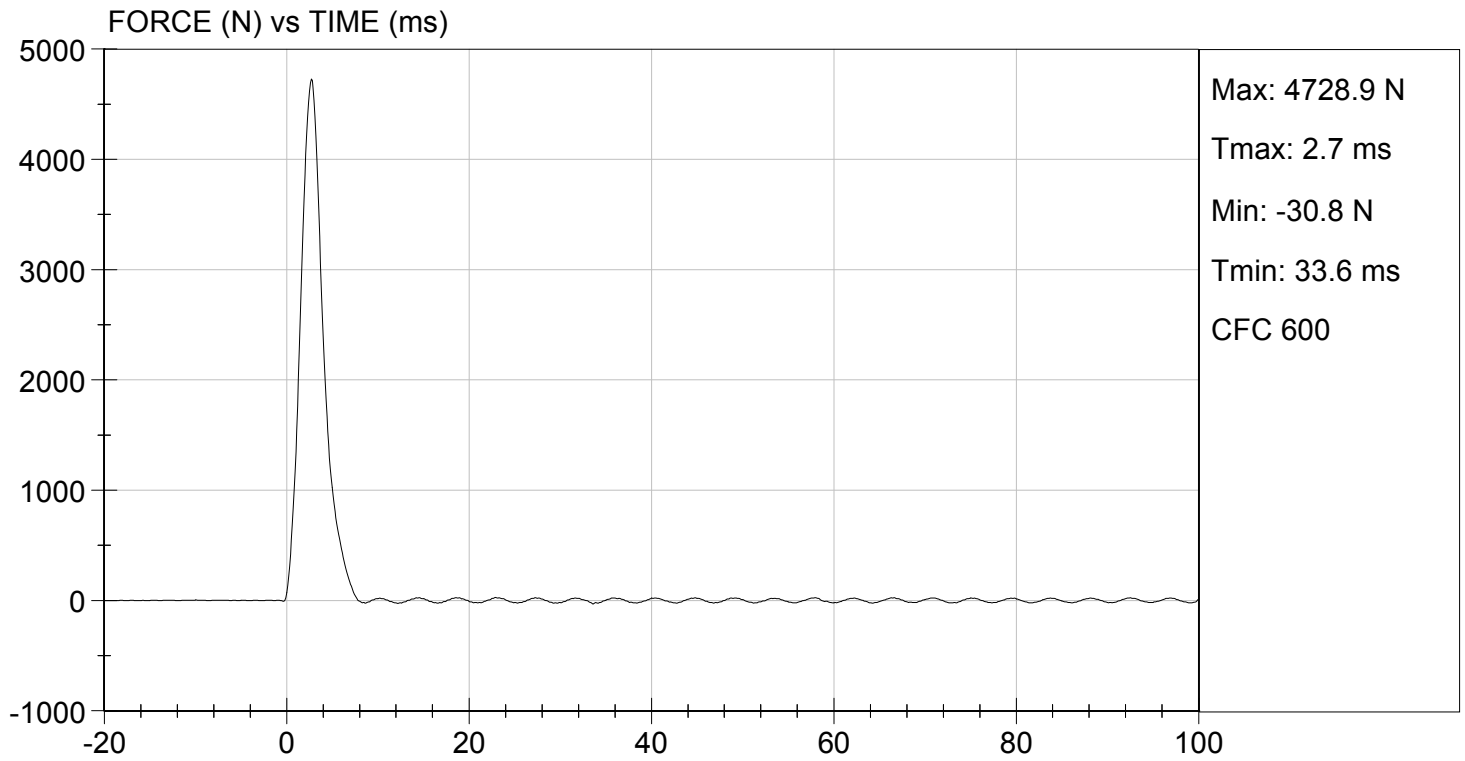
07/31/2014  
 Test Date

Jeff Leonard  
 Approved By



TEST DESC: RIGHT KNEE  
VELOCITY: 7.00 ft/s, 2.13 m/s

TEST DATE: 07/31/2014  
TEST #: D142725



**DATA SHEET A9**  
HIP JOINT-FEMUR FLEXION (572.35(c)) (50<sup>th</sup> Male)

Dummy Serial Number: 401

Test Date: 07/31/2014

Technician: David Schoedel

- Pre test calibration  
 Post test calibration verification

Test attempt no. 1 (when successive hip joint-femur flexion tests are necessary)

1. It has been at least 30 minutes since the last hip joint-femur flexion test. (572.36(m))  
 N/A, ONLY one hip joint-femur flexion test performed
2. The test fixture conforms to the specifications in Figure 17A.
3. Use the assembled dummy (78051-218) except (572.35(c)(2)):  
 3.1 remove the leg assemblies (86-5001-001 & 002) by removing 3/8-16 Socket Head Cap Screw and retaining the structural assembly of the upper legs (78051-43 & 44)  
 3.2 remove the abdominal insert (78051-52)  
 3.3 replace the instrument cover plate (78051-13) in the pelvic bone with a rigid pelvic bone stabilizer insert (Figure 15A) and attach the pelvis upper support device (Figure 16A).
4. The assembly soaked at a temperature between 18.9°C (66°F) and 25.6°C (78°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to this test. (572.35(c)(v))
- |                                 |               |
|---------------------------------|---------------|
| Record the maximum temperature: | <u>21.4°C</u> |
| Record the minimum temperature: | <u>21.2°C</u> |
| Record the maximum humidity:    | <u>51%</u>    |
| Record the minimum humidity:    | <u>43%</u>    |
5. Seat the dummy on the rigid seat fixture. (572.35(c)(2)(ii))
6. Secure the dummy by bolting the stabilizer insert and the pelvis upper support device to the seat back of the test fixture as shown in Figures 17A, 18A, and 19A. (572.35(c)(2)(ii))
7. Adjust the threaded rods until plane B is horizontal.
8. Secure the lever arm into the left femur shaft opening of the upper leg structure assembly (78051-43) and firmly secure it using the 3/8-16 socket head cap screws (Figure 19A). (572.35(c)(2)(iii))

X 9. Lift the lever arm parallel to the midsagittal plane at a rotation rate between 5 and 10 degrees per second while maintaining the ½ in. shoulder bolt longitudinal centerline horizontal throughout the range of motion until the 150 ft-lbf torque level is reached (Figures 18A and 19A). (572.35(c)(2)(iv))

X 10. Complete the following table:  
Left Hip Joint-Femur Flexion Results (572.35(c)(1) & (c)(2)(iv))

Parameter	Specification	Result
Rotation Rate	$5^{\circ}/s \leq \text{rotation rate} \leq 10^{\circ}/s$	6.2°/s
Femur Torque at 30°	Torque $\leq 70$ ft-lbf	67.3 ft-lbf
Rotation at 150 lbf-ft	$40^{\circ} \leq \text{rotation} \leq 50^{\circ}$	40.3°

X 11. Secure the lever arm into the right femur shaft opening of the upper leg structure assembly (78051-44) and firmly secure it using the 3/8-16 socket head cap screws (Figure 19A). (572.35(c)(2)(iii))

X 12. Lift the lever arm parallel to the midsagittal plane at a rotation rate between 5 and 10 degrees per second while maintaining the ½ in. shoulder bolt longitudinal centerline horizontal throughout the range of motion until the 150 ft-lbf torque level is reached (Figures 18A and 19A). (572.35(c)(2)(iv))

X 13. Complete the following table:  
Right Hip Joint-Femur Flexion Results (572.35(c)(1) & (c)(2)(iv))

Parameter	Specification	Result
Rotation Rate	$5^{\circ}/s \leq \text{rotation rate} \leq 10^{\circ}/s$	6.2°/s
Femur Torque at 30°	torque $\leq 70$ ft-lbf	69.0 ft-lbf
Rotation at 150 lbf-ft	$40^{\circ} \leq \text{rotation} \leq 50^{\circ}$	40.5°

David Schoedel  
Signature

07/31/2014  
Date

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

**ATD Serial No:** 401

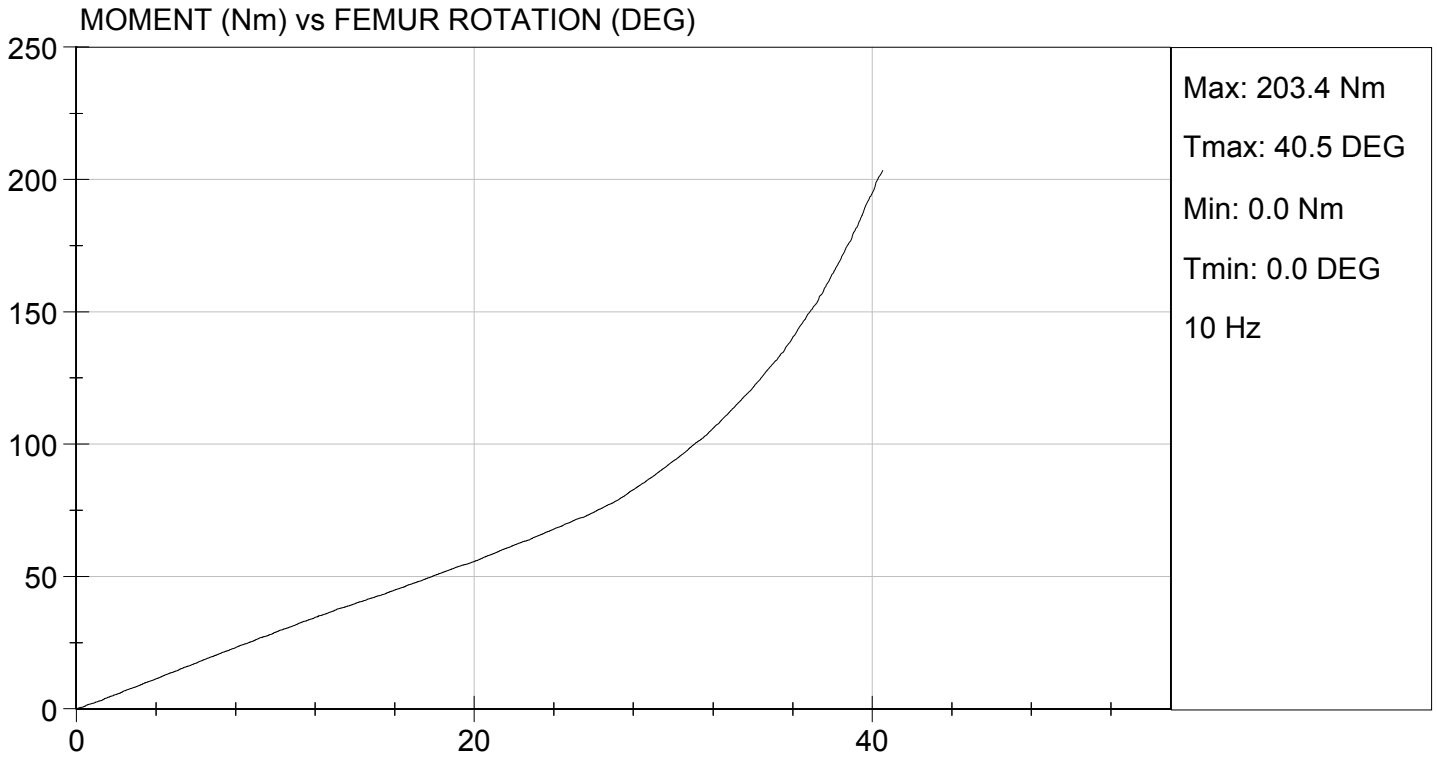
**Test I.D:** D142720

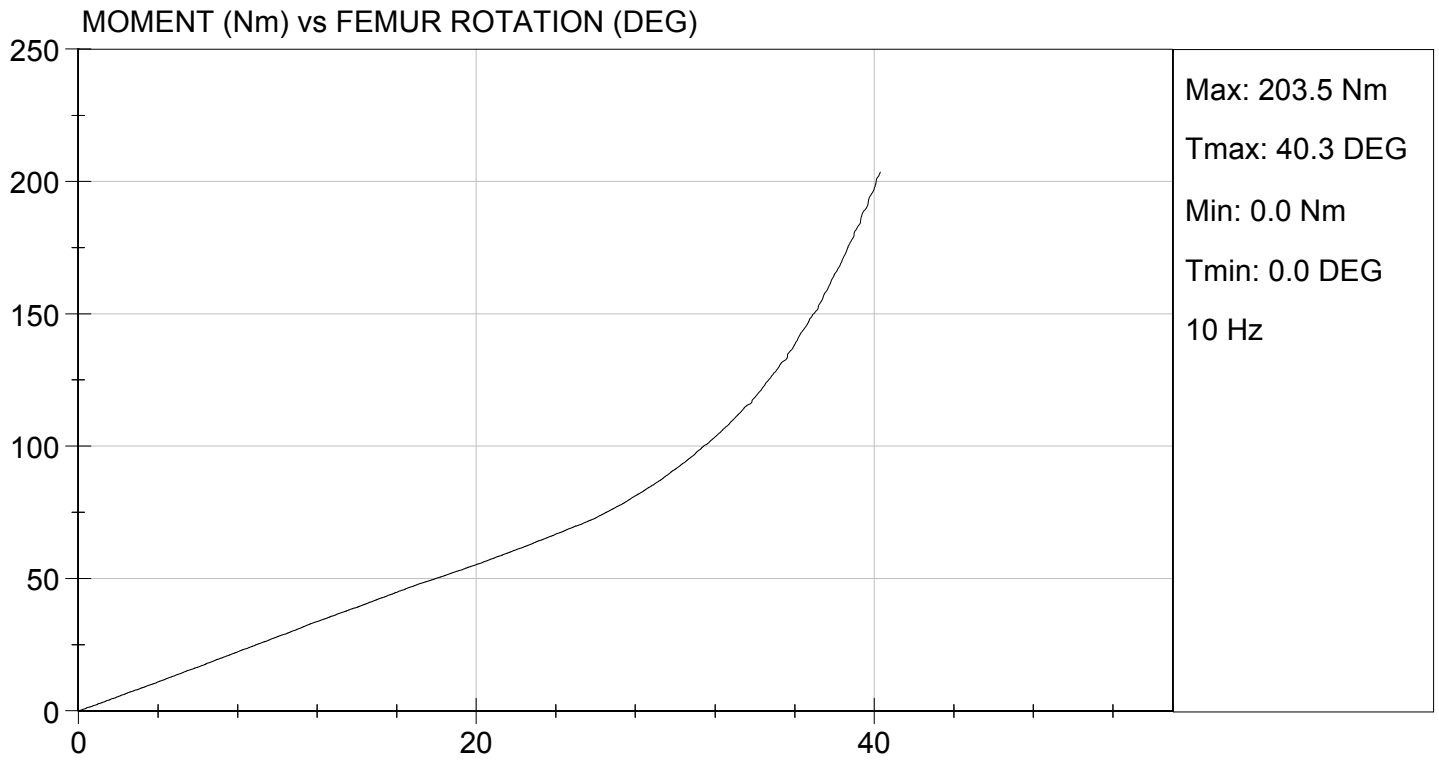
Tested Parameter	Units	Specification	Result		Pass/Fail
			Right	Left	
Laboratory Temperature	deg C	18.9 to 25.6	21.2	21.2	Pass
Laboratory Relative Humidity	%	10 to 70	45	45	Pass
Rotation Rate	deg/s	5.0 to 10.0	6.2	6.2	Pass
30 Degrees	Nm	94.9 Nm Max	93.6	91.3	Pass
150 ft-lbf / 203.4 Nm	Deg	40.0 to 50.0 Degree Max Rotation	40.5	40.3	Pass
Overall Test Results					Pass

David Schoedel  
 Laboratory Technician

07/31/2014  
 Test Date

Jeff Leonard  
 Approved By





### DATA SHEET A10

#### PART 572 INSTRUMENTATION CALIBRATION INFORMATION

I.D. NO.	MANUFACTURER	MODEL NO.	SERIAL NO.	DATE OF LAST CALIBRATION	DATE OF NEXT CALIBRATION
DUMMY INSTRUMENTATION					
HEAD ACCELEROMETERS					
(1) LONGITUDINAL	Endevco	7231C-750	AGH74	04/10/2014	10/10/2014
(2) LATERAL	Endevco	7231C-750	C10686	04/10/2014	10/10/2014
(3) VERTICAL	Endevco	7231C-750	C13046	04/10/2014	10/10/2014
NECK TRANSDUCER	Denton	1716	1562	03/20/2014	09/20/2014
CHEST ACCELEROMETERS					
(1) LONGITUDINAL	Endevco	7231C-750	AH5D9	04/10/2014	10/10/2014
(2) LATERAL	Endevco	7231C-750	AH5L1	04/10/2014	10/10/2014
(3) VERTICAL	Endevco	7231C-750	AH5N9	04/10/2014	10/10/2014
CHEST POTENTIOMETER	Servo	14CBI-2897	401	04/08/2014	10/08/2014
FEMUR LOAD CELLS					
(1) RIGHT FEMUR	Denton	2121	1359	06/20/2014	12/20/2014
(2) LEFT FEMUR	Denton	2121	1360	06/20/2014	12/20/2014
LABORATORY INSTRUMENTATION					
NECK PENDULUM ACCELEROMETER	Endevco	7231C-750	AH467	2/20/2014	8/20/2014
THORAX PENDULUM ACCELEROMETER	Endevco	7264C-2KTZ-2-240	P83176	5/1/2014	11/1/2014
KNEE PENDULUM ACCELEROMETER	Endevco	7264C-2KTZ-2-240	P80111	7/2/2014	1/2/2015
NECK ROTATION TRANSDUCER 1 (OPTIONAL)	Spectrol	132-0-0-102	18	4/15/2014	10/15/2014
NECK ROTATION TRANSDUCER 2 (OPTIONAL)	Spectrol	132-0-0-102	23	4/15/2014	10/15/2014

LABORATORY TECHNICIAN:

*Jessica Hall*

**DATA SHEET A3**  
HEAD DROP TEST (572.32) (50<sup>th</sup> Male)

Dummy Serial Number: 401

Test Date: 08/25/2014

Technician: David Schoedel

- Pre test calibration  
X Post test calibration verification

Test attempt no. 1 (when successive head drops are necessary)

- X 1. It has been at least 2 hours since the last head drop. (572.32(c)(5))  
    X N/A, ONLY one head drop performed
- X 2. The head assembly consists of the complete head (78051-61X), the neck transducer structural replacement (78051-383X), and three (3) accelerometers. (572.32(b))
- X 3. Torque the skull cap screws to 160 lbf-in.
- X 4. Accelerometers and their respective mounts are smooth and clean.
- X 5. The data acquisition system, including transducers, conforms to the requirements of SAE Recommended Practice J2111/1 MAR95. (572.35(i))
- X 6. The head assembly soaked at a temperature between 18.9°C (66°F) and 25.6°C (78°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to a test. (572.132(c)(1))
- |                                 |               |
|---------------------------------|---------------|
| Record the maximum temperature: | <u>21.6°C</u> |
| Record the minimum temperature: | <u>20.8°C</u> |
| Record the maximum humidity:    | <u>58%</u>    |
| Record the minimum humidity:    | <u>52%</u>    |
- X 7. Visually inspect the head skin for cracks, cuts, abrasions, etc. Repair or replace the head skin if the damaged area is more than superficial. Note: If the damage resulted from the vehicle crash test in which the dummy was an occupant, the damaged area is to be documented with photography and the post test calibration verification testing completed before any replacement or repairs are made.
- Record findings and actions:     No Damage
- X 8. Clean the impact surface of the skin and the impact surface of the fixture with isopropyl alcohol, trichloroethane or equivalent prior to the test. (572.32(c)(2))

X 9. Suspend and orient the head assembly as shown in Figure 6A. The lowest point on the forehead is 0.5 in. below the lowest point on the dummy's nose when the midsagittal plane is vertical. (572.32(c)(3))

Record the actual distance: 0.5 inches

**NOTE:** The masses of the suspension device and the accelerometer cables are to be kept as lightweight as possible to minimize their effect on the test results.

X 10. The 1.6 mm (0.062 inch) diameter holes located on either side of the dummy's head are equidistance within 2 mm from the impact surface. A typical test setup is shown in Figure 7A.

Record the right side distance: 501 mm

Record the left side distance: 501 mm

X 11. The impact surface is clean and dry and has a micro finish in the range of  $203.2 \times 10^{-6}$  mm (8 micro inches) to  $2032.0 \times 10^{-6}$  mm (80 micro inches) (RMS). (572.32(c)(4))

Record actual micro finish: 24.8 micro inches

X 12. The impact surface is rigidly supported. (572.132(c)(4))

X 13. The impact surface is a flat horizontal steel plate 50.8 mm (2 inches) thick and 610 mm (24 inches) square. (Figure 6A)

Record thickness: 50.9 mm

Record width: 604 mm

Record length: 595 mm

X 14. Drop the head assembly from a height of  $376.0 \pm 1.0$  mm (14.8 inches  $\pm$  0.04 inches) by a means that ensures a smooth, instant release onto the impact surface. (572.32(b) & (572.32(c)(4))

X 15. Complete the following table using channel class 1000 data. (572.36(i)):

Parameter	Specification	Result
Peak resultant acceleration	$225 \text{ g} \leq x \leq 275 \text{ g}$	236 g
Resultant versus time history curve	Unimodal	Yes
Oscillations after the main pulse	Less than 10% of the peak resultant acceleration	Yes
Lateral acceleration	y-axis acceleration $\leq 15 \text{ g}$	-13.1 g

X 16. Plots of the x, y, z, and resultant acceleration data follow this sheet.

David Schoedel  
Signature

08/25/2014  
Date

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

ATD Serial No: 401

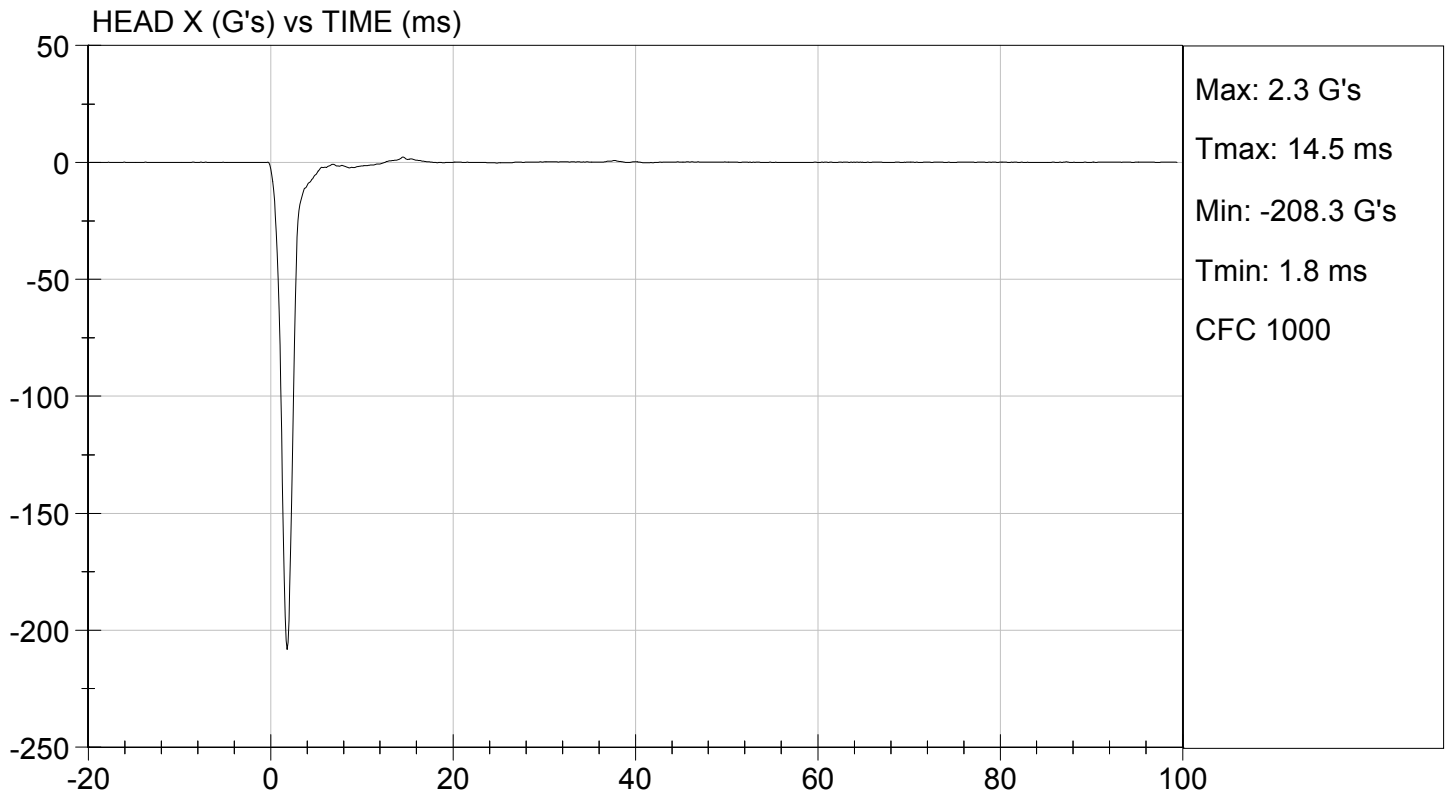
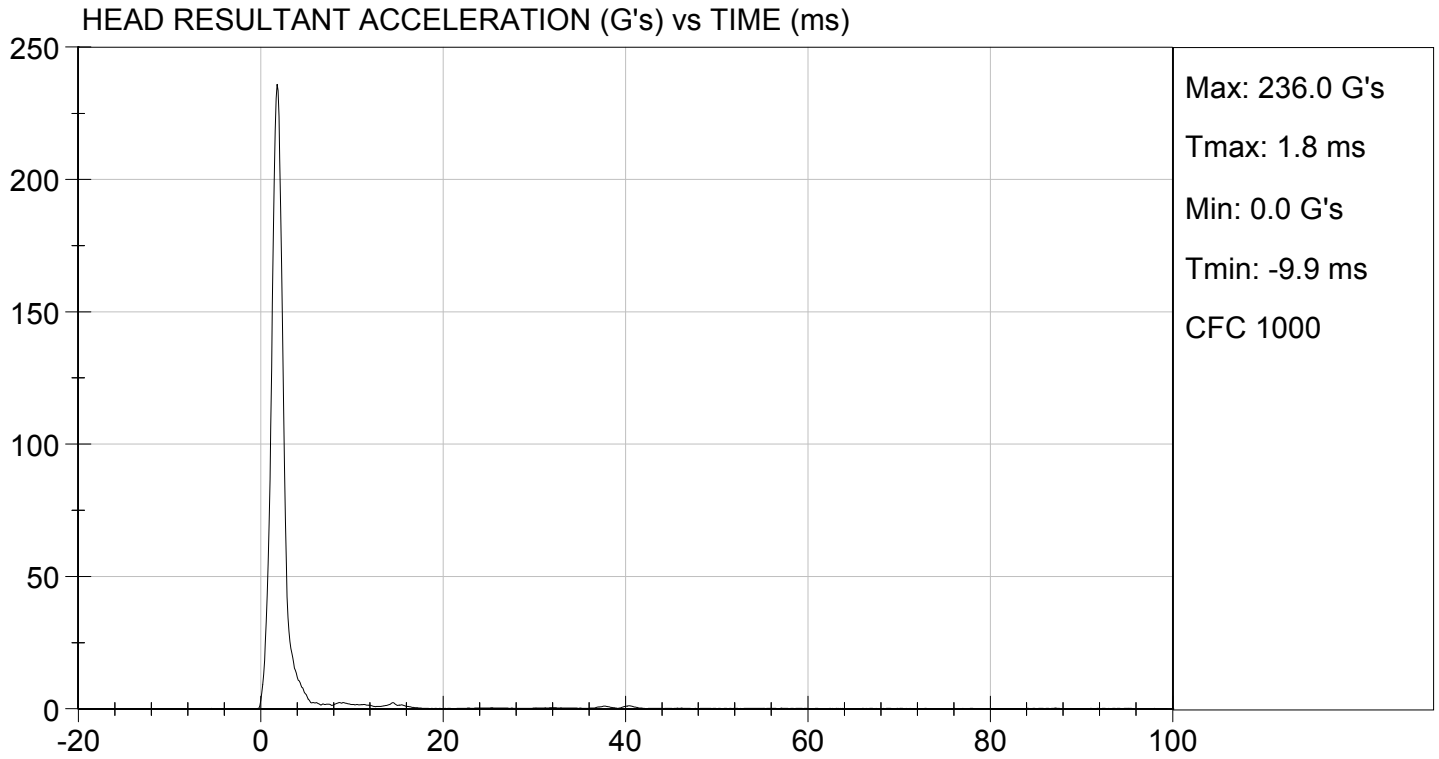
Test ID: D142931

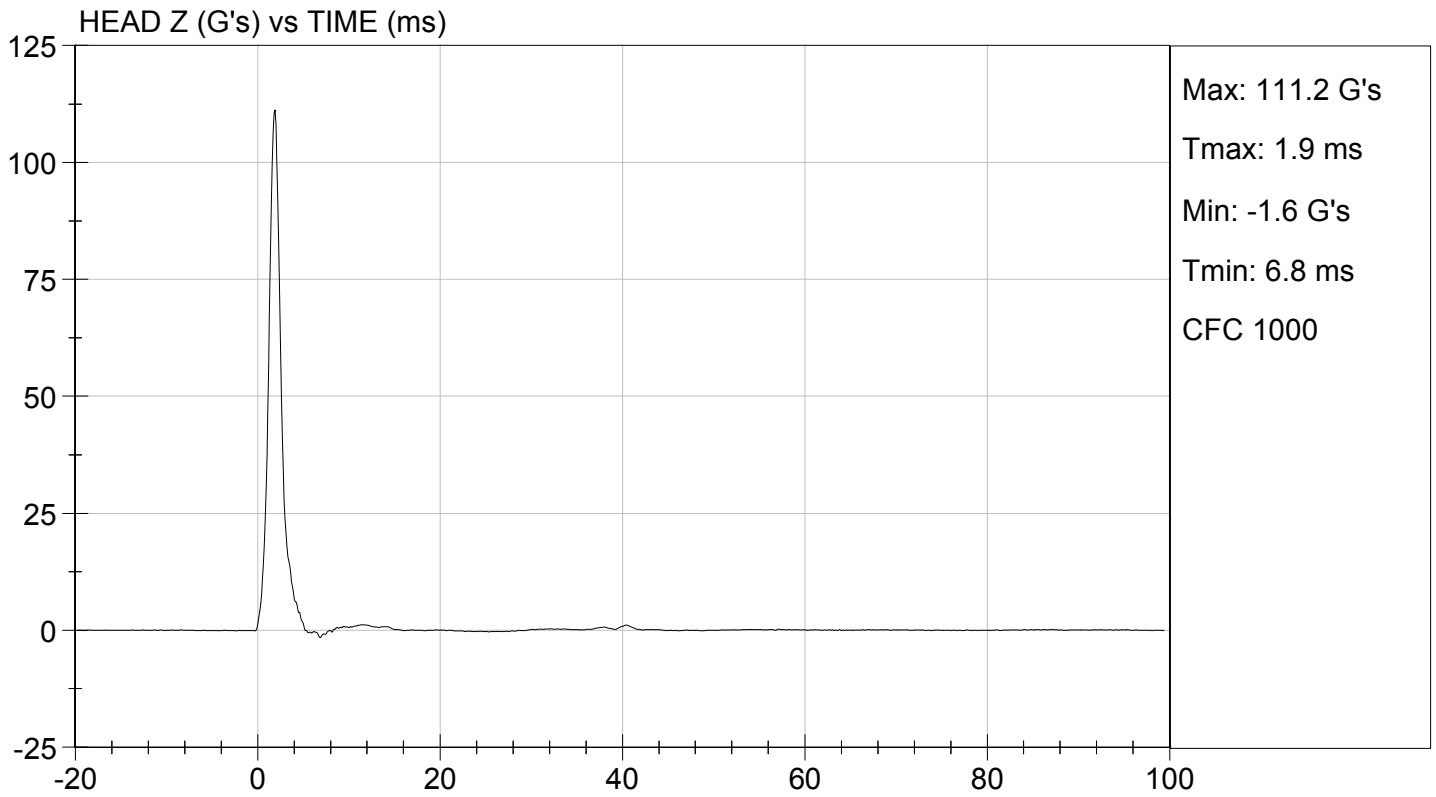
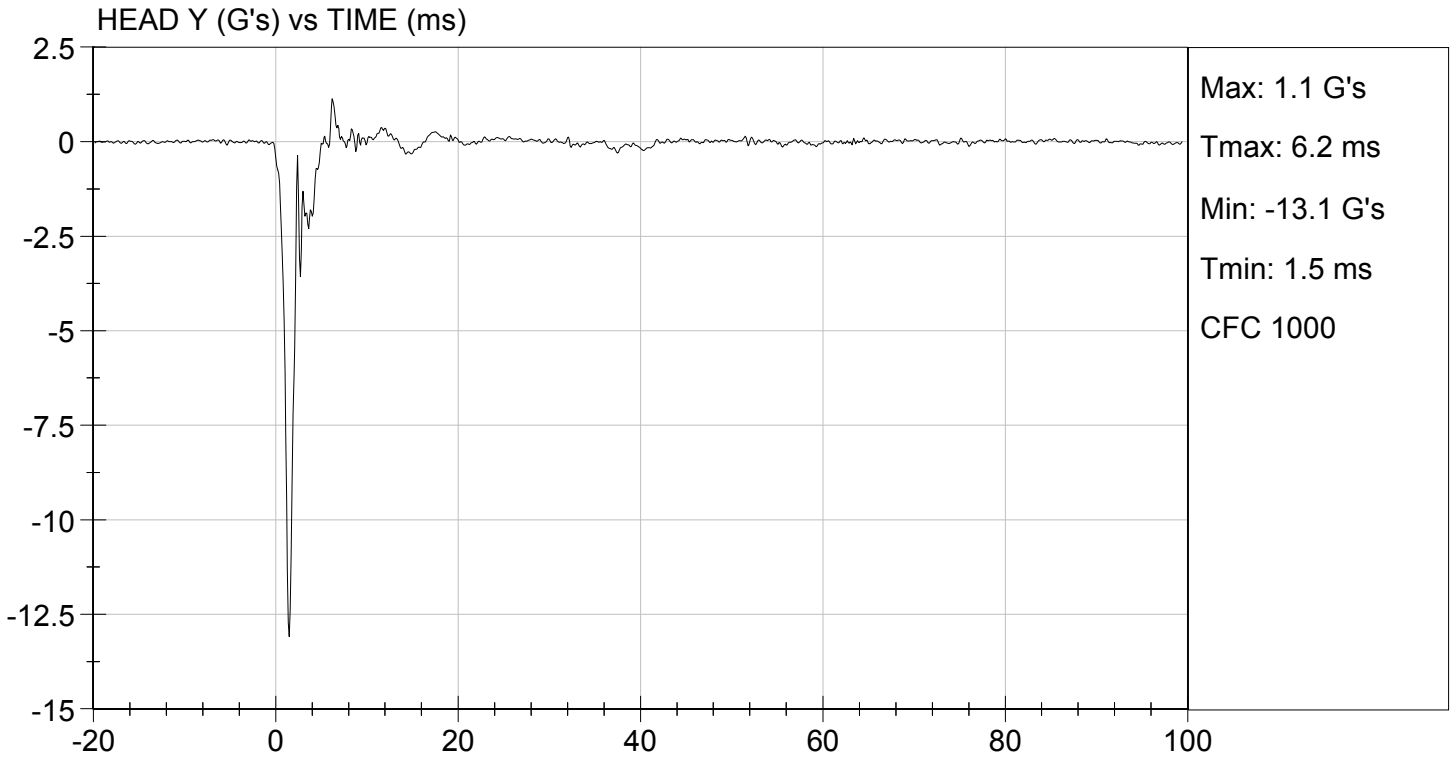
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	20.8	Pass
Laboratory Relative Humidity	%	10 to 70	58	Pass
Peak Resultant Acceleration	G's	225 to 275	236	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-13.1	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
Overall Test Results				Pass

David Schoedel  
Laboratory Technician

08/25/2014  
Test Date

Jeff Leonard  
Approved By





**DATA SHEET A4**  
NECK FLEXION TEST (572.33) (50<sup>th</sup> Male)

Dummy Serial Number: 401

Test Date: 08/26/2014

Technician: David Schoedel

     Pre test calibration  
 X  Post test calibration verification

Test attempt no. 1 (when successive flexion tests are necessary)

X  1. It has been at least 30 minutes since the last flexion test. (572.36(m))  
      X  N/A, ONLY one neck test performed

X  2. The components required for the neck tests include the head assembly (78051-61X), neck assembly (78051-90), bib simulator (78051-84), upper neck adjusting bracket (78051-307), lower neck adjusting bracket (78051-303), six axis neck transducer (C-1709) and either three accelerometers or their mass equivalent installed in the head assembly. Data from the accelerometers are not required. (572.33(b))

X  3. The assembly soaked at a temperature between 20.6°C (69°F) and 22.2°C (72°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to a test. (572.33(c)(1))

Record the maximum temperature: 21.6°C

Record the minimum temperature: 20.8°C

Record the maximum humidity: 58%

Record the minimum humidity: 52%

X  4. Visually inspect neck assembly for cracks, cuts and separation of the rubber from the metal segments. Note: If the damage resulted from the vehicle crash test in which the dummy was an occupant, the damaged area is to be documented with photography and the post test calibration verification testing completed before any replacement or repairs are made.

Record findings and actions: No damage

X  5. Inspect the nodding blocks (78051-351) for any deterioration, but when replacement is necessary, ONLY replace during pre-test calibration. Using a Shore "A" type Durometer, verify the hardness of the nodding blocks is between 80 and 90. Ensure the nodding blocks are installed correctly. (78051-90).

Record findings and actions: No Deterioration; Hardness: Front 89; Back 90.

X  6. Pre-test calibration Neck cable torque: Torque the jam nut (78051-64) on the neck cable (78051-301) to 1.0 ± 0.2 lb-ft by loosening the jam nut and relaxing the neck cable before torquing. (572.33(c)(2))

- X 7. The data acquisition system, including transducers, conforms to the requirements of SAE Recommended Practice J211/1 MAR95. (572.36(i))
- X 8. The test fixture pendulum conforms to the specifications in Figure 8A. (572.33(c)(3))
- X 9. The head-neck assembly is mounted on the pendulum so the midsagittal plane of the head is vertical and coincides with the plane of motion of the pendulum longitudinal centerline as shown in Figure 9A for the flexion test. (572.33(c)(3))
- X 10. Install the transducers or other devices for measuring the "D" plane rotation with respect to the pendulum longitudinal centerline. Note: Plane "D" is the bottom horizontal surface of the skull. These measurement devices should be designed to minimize their influence upon the performance of the head-neck assembly. An example of a measurement device is shown in Figure 11A.
- X 11. With the pendulum resting against the honeycomb material, the neck bracket was adjusted until the longitudinal centerline of the pendulum was perpendicular  $\pm 1$  degree to plane "D" on the dummy's head.
- X 12. Release the pendulum and allow it to fall freely from a height to achieve an impact speed of 22.6 to 23.4 ft/sec as measured at the center of the pendulum accelerometer. (572.33(c)(4))
- X 13. Complete the following table:  
Neck Flexion Test Results (572.33(b)(1) & 572.33(c)(4))

Parameter	Specification	Results
Pendulum impact speed	22.6 ft/s $\leq$ speed $\leq$ 23.4 ft/s	23.40 ft/s
Pendulum Deceleration Versus Time Pulse	@ 10 ms	22.5 $\leq$ g $\leq$ 27.5
	@ 20 ms	17.6 $\leq$ g $\leq$ 22.6
	@ 30 ms	12.5 $\leq$ g $\leq$ 18.5
	Above 30 ms	29 g maximum
First Pendulum Decay to 5g	34 ms $\leq$ time $\leq$ 42 ms	34.0 ms
Plane D Rotation	64° $\leq$ max. rotation $\leq$ 78°	69.2°
	57 ms $\leq$ time of max. rotation $\leq$ 64 ms	61.8 ms
Time for Plane D Rotation to Cross 0° During First Rebound	113 ms $\leq$ time $\leq$ 128 ms	120.7 ms
Maximum Moment	65 lbf-ft $\leq$ moment $\leq$ 80 lbf-ft	71.6 lbf-ft
	47 ms $\leq$ time of max. moment $\leq$ 58 ms	53.2 ms
Time of first decay to 0 lbf-ft Positive Moment Decay** (Flexion)	97 ms $\leq$ time $\leq$ 107 ms	105.4 ms

\*Moment about the occipital condyle =  $M_y - (0.058 \text{ ft} \times F_x)$ (572.33(b)(1)(ii))

$M_y$  = Moment in lbf-ft measured by the transducer

$F_x$  = Force, in lbf measured by the transducer

\*\*Time zero is defined as the time of initial contact between the pendulum striker plate and the honeycomb material. (572.33(b)(3))

- X 14. Plots of pendulum acceleration, y-axis moment, x-axis force, y-axis moment about the occipital condyle, and D plane rotation follows this sheet.

David Schoedel  
Signature

08/26/2014  
Date

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

**ATD Serial No:** 401

**Test I.D.:** D142932

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.2	Pass
Laboratory Relative Humidity		%	10 to 70	52	Pass
Pendulum Velocity		m/s	6.89 to 7.13	7.13	Pass
Pendulum Deceleration	10 ms	G's	22.50 to 27.50	25.23	Pass
	20 ms	G's	17.60 to 22.60	20.93	Pass
	30 ms	G's	12.50 to 18.50	14.12	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 29.0	14.0	Pass
Deceleration Decay Time to Cross 5 G's		ms	34.0 to 42.0	34.0	Pass
Maximum "D" Plane Rotation	Maximum	Deg	64.0 to 78.0	69.2	Pass
	Time	ms	57.0 to 64.0	61.8	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	113.0 to 128.0	120.7	Pass
Moment About Occipital Condyle	Maximum	Nm	88.1 to 108.5	97.1	Pass
	Time	ms	47.0 to 58.0	53.2	Pass
Positive Moment Decay Time To Zero Crossing		ms	97.0 to 107.0	105.4	Pass
<b>Overall Test Results</b>					<b>Pass</b>

*David Schoedel*

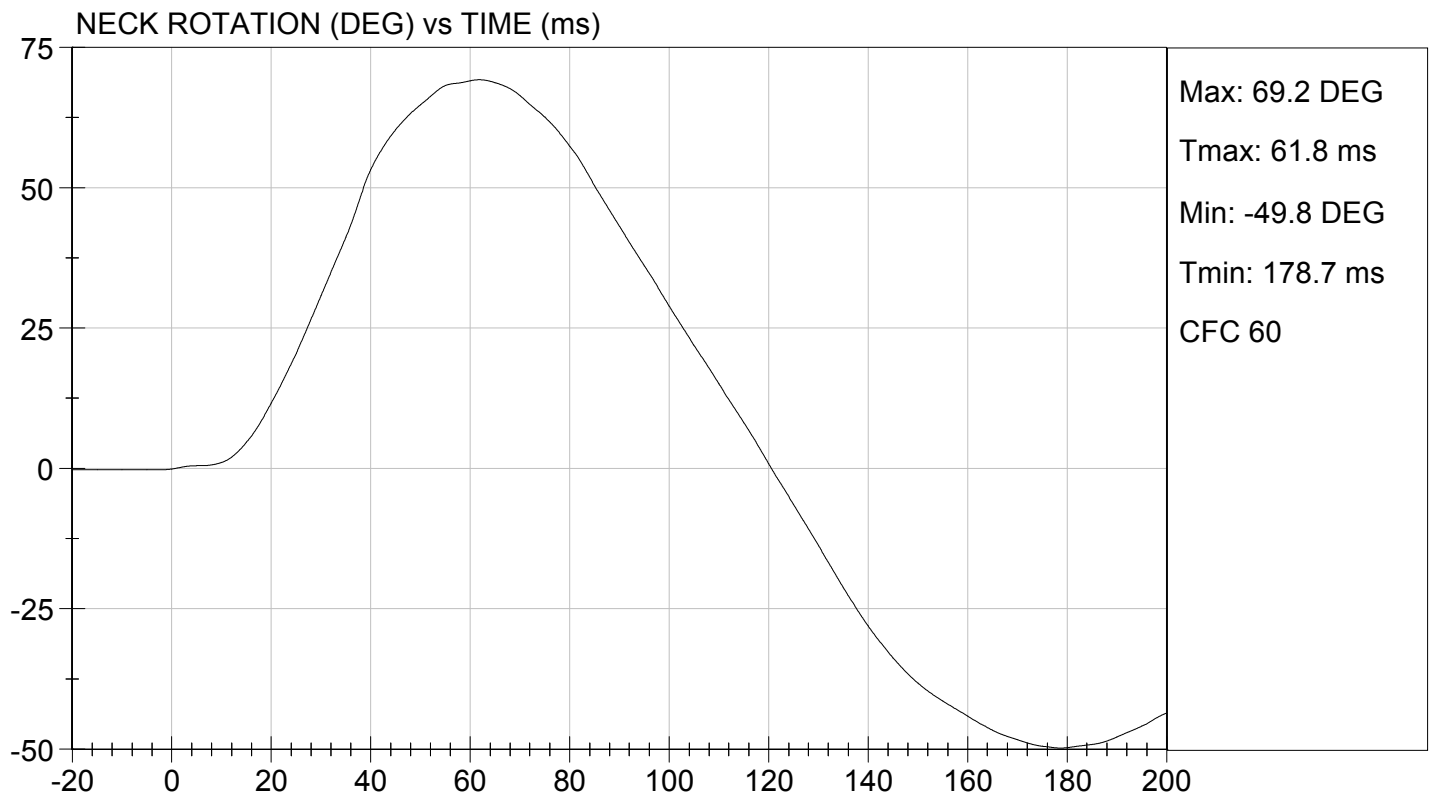
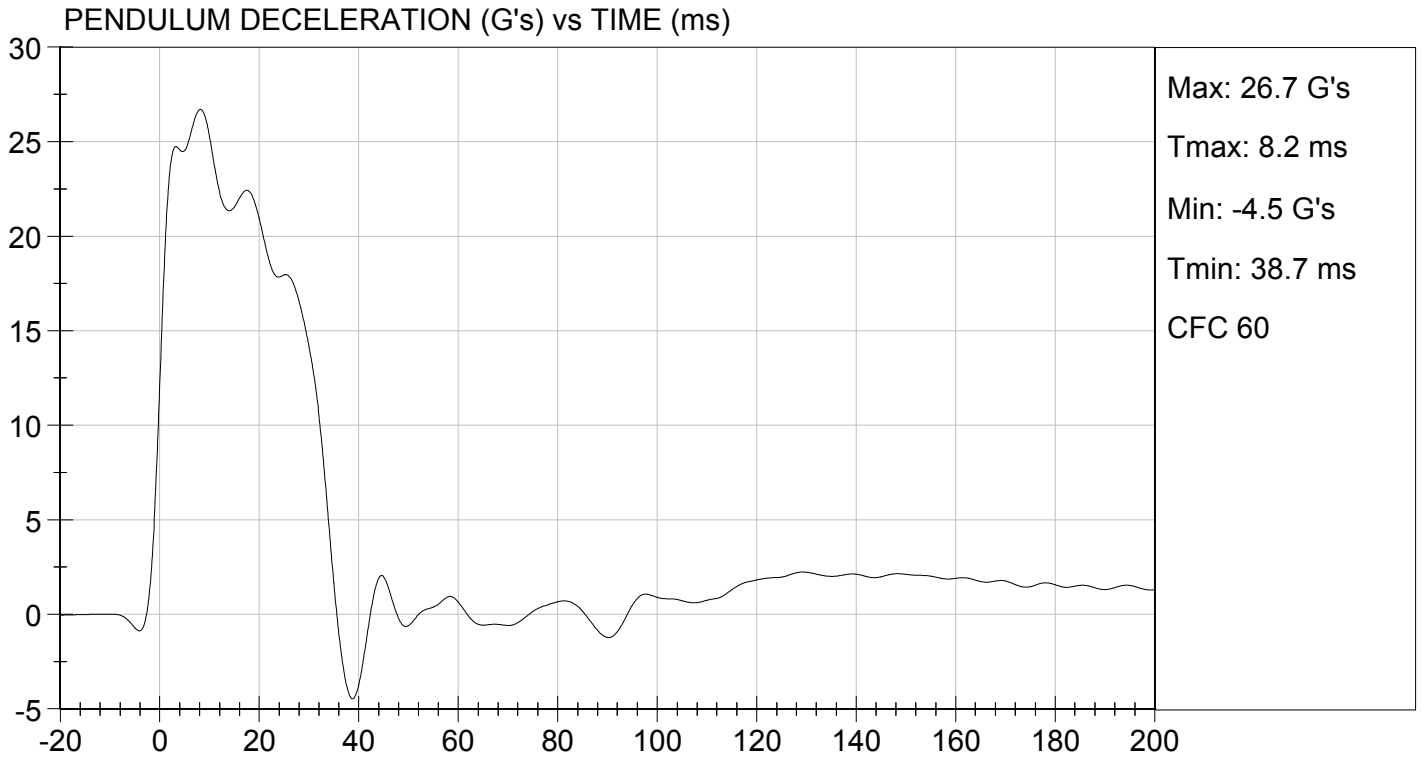
Laboratory Technician

08/26/2014

Test Date

*Jeff Leonard*

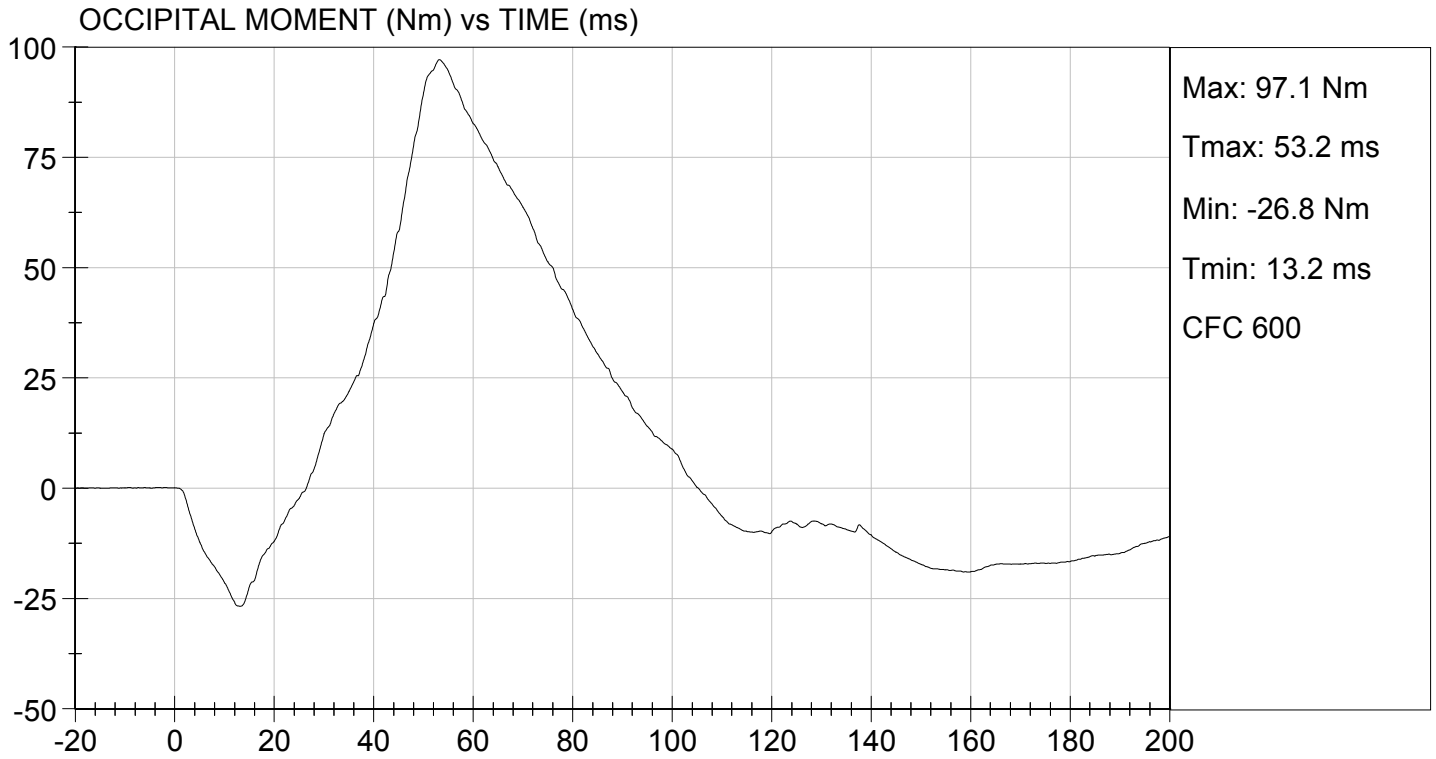
Approved By





TEST DESC: NECK FLEXION  
VELOCITY: 23.40 ft/s, 7.13 m/s

TEST DATE: 08/26/2014  
TEST #: D142932



**DATA SHEET A5**  
NECK EXTENSION TEST (572.33) (50<sup>th</sup> Male)

Dummy Serial Number: 401

Test Date: 08/26/2014

Technician: David Schoedel

- Pre test calibration  
X Post test calibration verification

Test attempt no. 1 (when successive extension tests are necessary)

- X 1. It has been at least 30 minutes since the last extension test. (572.36(m))  
    X N/A, ONLY one neck test performed
- X 2. The components required for the neck tests include the head assembly (78051-61X), neck assembly (78051-90), bib simulator (78051-84), upper neck adjusting bracket (78051-307), lower neck adjusting bracket (78051-303), six axis neck transducer (C-1709) and either three accelerometers or their mass equivalent installed in the head assembly. Data from the accelerometers are not required. (572.33(b))
- X 3. The assembly soaked at a temperature between 20.6°C (69°F) and 22.2°C (72°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to a test. (572.33(c)(1))
- |                                 |               |
|---------------------------------|---------------|
| Record the maximum temperature: | <u>21.6°C</u> |
| Record the minimum temperature: | <u>20.8°C</u> |
| Record the maximum humidity:    | <u>58%</u>    |
| Record the minimum humidity:    | <u>52%</u>    |
- X 4. Visually inspect neck assembly for cracks, cuts and separation of the rubber from the metal segments. Note: If the damage resulted from the vehicle crash test in which the dummy was an occupant, the damaged area is to be documented with photography and the post test calibration verification testing completed before any replacement or repairs are made.
- Record findings and actions: No damage
- X 5. Inspect the nodding blocks (78051-351) for any deterioration, but when replacement is necessary, ONLY replace during pre-test calibration. Using a Shore "A" type Durometer, verify the hardness of the nodding blocks is between 80 and 90. Ensure the nodding blocks are installed correctly. (78051-90).
- Record findings and actions: No Deterioration; Hardness: Front 89; Back 90.
- X 6. Pre-test calibration Neck cable torque: Torque the jam nut (78051-64) on the neck cable (78051-301) to 1.0 ± 0.2 lb-ft by loosening the jam nut and relaxing the neck cable before torquing. (572.33(c)(2))

- X 7. The data acquisition system, including transducers, conforms to the requirements of SAE Recommended Practice J211/1 MAR95. (572.36(i))
- X 8. The test fixture pendulum conforms to the specifications in Figure 8A. (572.33(c)(3))
- X 9. The head-neck assembly is mounted on the pendulum so the midsagittal plane of the head is vertical and coincides with the plane of motion of the pendulum longitudinal centerline as shown in Figure 10A for the extension test. (572.33(c)(3))
- X 10. Install the transducers or other devices for measuring the "D" plane rotation with respect to the pendulum longitudinal centerline. Note: Plane "D" is the bottom horizontal surface of the skull. These measurement devices should be designed to minimize their influence upon the performance of the head-neck assembly. An example of a measurement device is shown in Figure 11A.
- X 11. With the pendulum resting against the honeycomb material, the neck bracket was adjusted until the longitudinal centerline of the pendulum was perpendicular  $\pm 1$  degree to plane "D" on the dummy's head.
- X 12. Release the pendulum and allow it to fall freely from a height to achieve an impact speed of 19.5 ft/s to 20.3 ft/sec as measured at the center of the pendulum accelerometer. (572.33(c)(4))
- X 13. Complete the following table:  
 Neck Extension Test Results (572.33(b)(2) & 572.33(c)(4))

Parameter	Specification	Results
Pendulum impact speed	19.5 ft/s $\leq$ speed $\leq$ 20.3 ft/s	20.30 ft/s
Pendulum Deceleration Versus Time Pulse	@ 10 ms	17.2 $\leq$ g $\leq$ 21.2
	@ 20 ms	14 $\leq$ g $\leq$ 19
	@ 30 ms	11.0 $\leq$ g $\leq$ 16.0
	Above 30 ms	22 g maximum
First Pendulum Decay to 5g	38 ms $\leq$ time $\leq$ 46 ms	41.1 ms
Plane D Rotation	81° $\leq$ max. rotation $\leq$ 106°	95.4°
	72 ms $\leq$ time of max. rotation $\leq$ 82 ms	76.2 ms
Time for Plane D Rotation to Cross 0° During First Rebound	147 ms $\leq$ time $\leq$ 174 ms	155.6 ms
Maximum Moment	-59 lbf-ft $\leq$ moment $\leq$ -39 lbf-ft	-44.3 lbf-ft
	65 ms $\leq$ time of max. moment $\leq$ 79 ms	70.0 ms
Time of first decay to 0 lbf-ft Positive Moment Decay** (Extension)	120 ms $\leq$ time $\leq$ 148 ms	140.0 ms

\*Moment about the occipital condyle =  $M_y - (0.058 \text{ ft} \times F_x)$ (572.33(b)(2)(ii))

$M_y$  = Moment in lbf-ft measured by the transducer

$F_x$  = Force, in lbf measured by the transducer

\*\*Time zero is defined as the time of initial contact between the pendulum striker plate and the honeycomb material. (572.33(b)(3))

- X 14. Plots of pendulum acceleration, y-axis moment, x-axis force, y-axis moment about the occipital condyle, and D plane rotation follows this sheet.

David Schoedel

Signature

08/26/2014

Date

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

ATD Serial No: 401

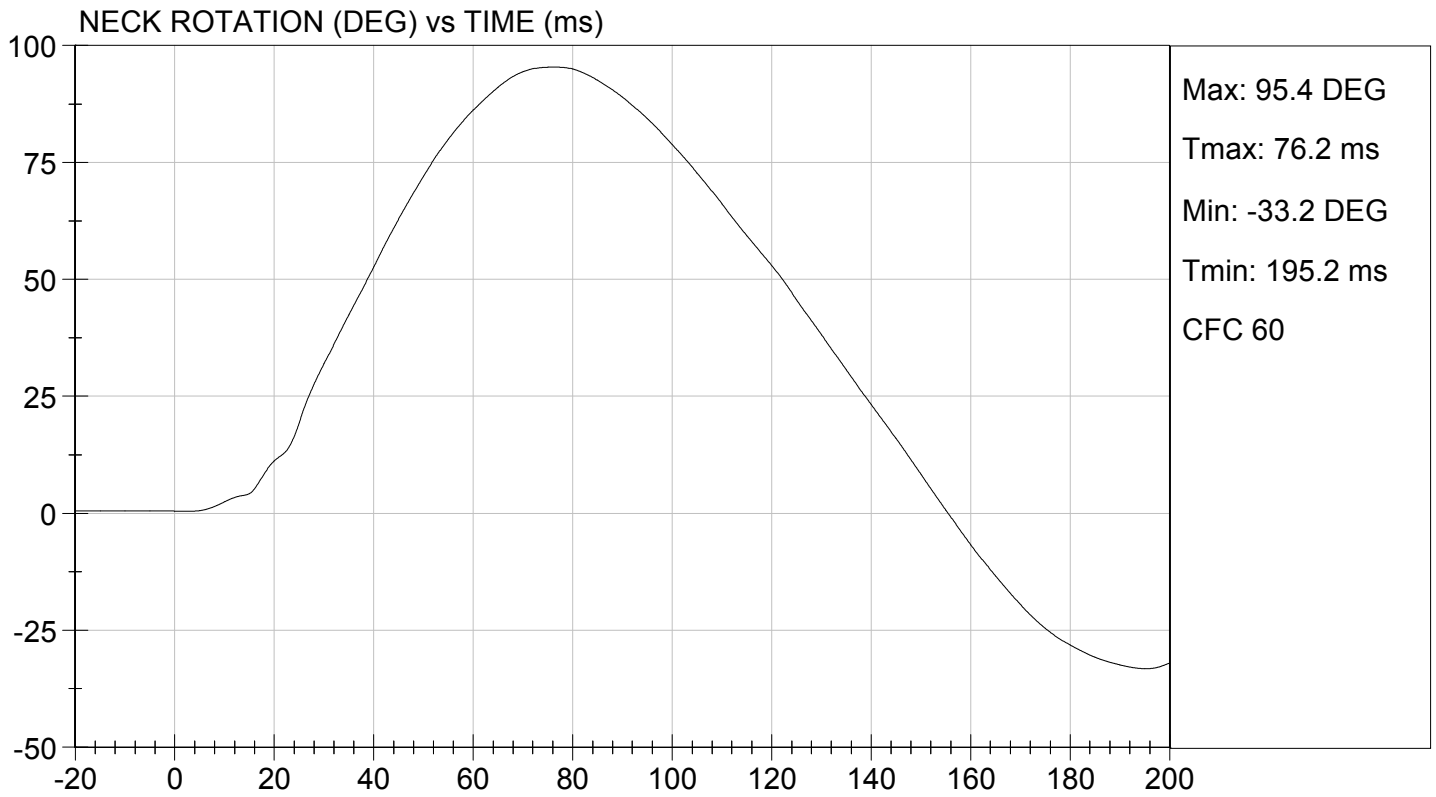
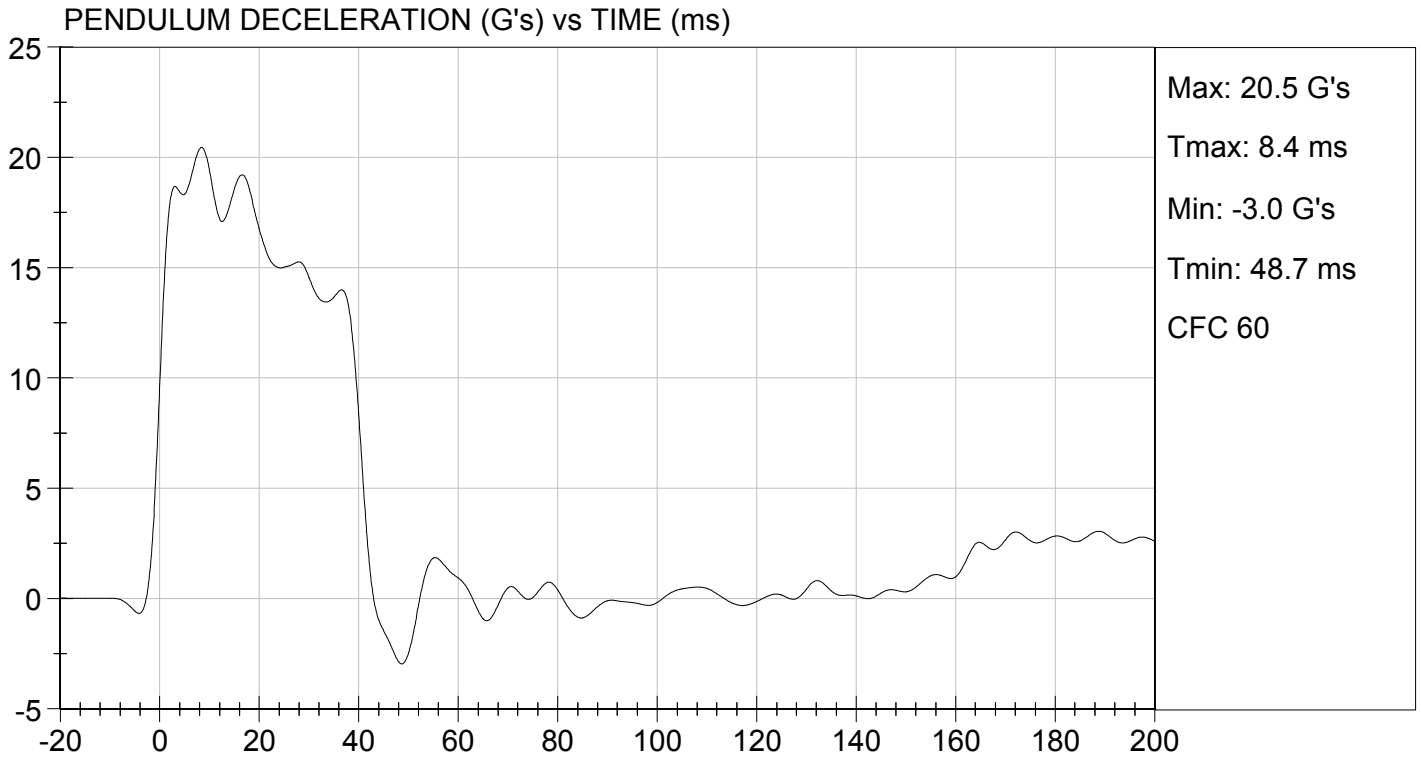
Test I.D.: D142933

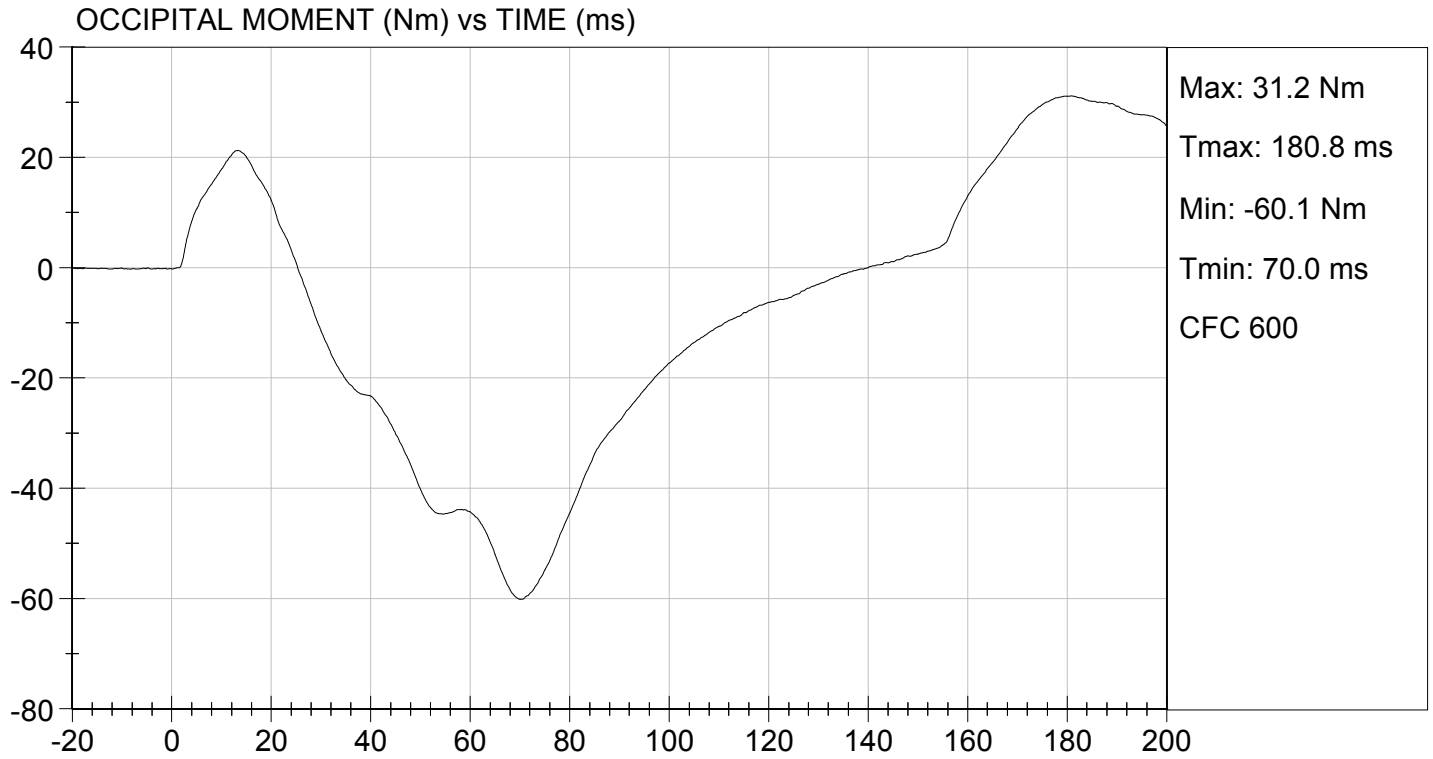
Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.2	Pass
Laboratory Relative Humidity		%	10 to 70	52	Pass
Pendulum Velocity		m/s	5.95 to 6.19	6.19	Pass
Pendulum Deceleration	10 ms	G's	17.20 to 21.20	19.38	Pass
	20 ms	G's	14.00 to 19.00	16.76	Pass
	30 ms	G's	11.00 to 16.00	14.55	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 22.0	14.5	Pass
Deceleration Decay Time to Cross 5 G's		ms	38.0 to 46.0	41.1	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	81.0 to 106.0	95.4	Pass
	Time	ms	72.0 to 82.0	76.2	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	147.0 to 174.0	155.6	Pass
Moment About Occipital Condyle	Maximum	Nm	-52.9 to -79.9	-60.1	Pass
	Time	ms	65.0 to 79.0	70.0	Pass
Negative Moment Decay Time To Zero Crossing		ms	120.0 to 148.0	140.0	Pass
Overall Test Results					Pass

David Schoedel  
Laboratory Technician

08/26/2014  
Test Date

Jeff Levanowski  
Approved By





**DATA SHEET A6**  
THORAX IMPACT TEST (572.34) (50<sup>th</sup> Male)

Dummy Serial Number: 401

Test Date: 08/26/2014

Technician: Jack Coleman

- Pre test calibration  
 Post test calibration verification

Test attempt no. 1 (when successive thorax impact tests are necessary)

1. It has been at least 30 minutes since the last thorax impact test. (572.137(q))  
 N/A, ONLY one thorax impact test performed
2. The test fixture conforms to the specifications in Figure 12A.
3. The complete assembled dummy (78051-218) is used (572.34(b)) and is dressed in a form fitting cotton stretch above-the-elbow sleeved shirt and above-the-knee pants. No shoes are worn. (572.34(b))
4. The dummy assembly soaked at a temperature between 20.6°C (69°F) and 22.2°C (72°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to this test. (572.34(c)(1))

Record the maximum temperature:	<u>21.6°C</u>
Record the minimum temperature:	<u>20.8°C</u>
Record the maximum humidity:	<u>58%</u>
Record the minimum humidity:	<u>52%</u>

5. Remove the chest skin and visually inspect the thorax assembly for cracks, cuts, abrasions, etc. Particular attention should be given to the rib damping material (78051-17 thru 78051-22), chest displacement transducer assembly (78051-317) and the rear rib supports (78051-304). Inspect for rib deformation using the chest depth gage (83-5006-007). If any damage is noted repair and/or replace the damaged components unless the damage resulted from the vehicle crash test in which the dummy was an occupant in which case the damage must be documented and post test calibration verification testing completed before any repairs or replacements are made.

- No Damage

- Damage from crash test, no repairs or replacement because this is a post test calibration verification. Record damage:

- The following repairs or replacement was performed. Record:

---

- X 6. Seat the dummy, (chest skin still removed) without back and arm supports on the test fixture surface as shown in Figure 12A. The surface must be long enough to support the pelvis and outstretched legs. (572.34(c)(2))
- X 7. Level the ribs both longitudinally and laterally  $\pm 0.5^\circ$  and adjust the pelvis angle to  $13^\circ \pm 2^\circ$ . The angle may be measured using the special H-point tool (78051-532) that inserts into the pelvic structure and extends outward beyond the pelvic skin surface or by using the surface of the pelvic adaptor block. (572.34(c)(2))
- X 8. The midsagittal plane of the dummy is vertical within  $\pm 1^\circ$ . (572.134(c)(3))
- X 9. The longitudinal centerline of the test probe is centered within  $\pm 2.5$  mm of the midsagittal plane of the dummy and is  $12.7$  mm  $\pm 1$  mm below the horizontal peripheral centerline of the No. 3 rib and is within  $0.5^\circ$  of a horizontal line in the dummy's midsagittal plane. (572.34(c)(4))
- X 10. Align the adjustable neck bracket index marks to the "zero" position. (Figure 12A)
- X 11. Record locations such as the rear surfaces of the thoracic spine and the lower neck bracket reference with respect to locations such as the rear surfaces of the thoracic spine and the lower neck bracket. These reference measurements are necessary to ensure the dummy is in the same position after the chest skin is installed. The reference locations must be accessible after installation of the chest skin. It may be necessary to leave the chest skin zipper unfastened until the references are checked and fasten it just prior to the test.
- X 12. Install the chest skin and reposition the dummy as described in the preceding paragraph using the reference measurements recorded.
- X 13. Place the arm assemblies horizontal  $\pm 2^\circ$  and parallel to the midsagittal plane. The arms are held in place by tightening the adjustment nut that holds the arm yoke to the clavicle assembly.
- X 14. The data acquisition system, including transducers, must conform to the requirements of SAE Recommended Practice J211/1 MAR95 Class 180.
- X 15. Impact the anterior surface of the thorax with the test probe so the longitudinal centerline of the probe is within  $2^\circ$  of a horizontal line in the dummy's midsagittal plane at the moment of impact. (572.34(c)(5)) The velocity of the test probe at the time of impact is  $22$  f/s  $\pm 0.4$  f/s. (572.34(b)) The probe is guided so there is no significant lateral, vertical or rotational movement during the impact. (572.34(c)(6))

X 16. Complete the following table:

Thorax Impact Results (572.34(b))

Parameter*	Specification	Result
Test Probe Speed	$21.6 \text{ ft/s} \leq \text{speed} \leq 22.4 \text{ ft/s}$	21.60 ft/s
Chest Compression	$2.5 \text{ in.} \leq \text{compression} \leq 2.86 \text{ in.}$	2.65 in.
Peak resistance force**	$1160 \text{ lb} \leq \text{peak force} \leq 1325 \text{ lb}$	1266 lb
Internal Hysteresis***	$69\% \leq \text{hysteresis} \leq 85\%$	69%

\*Time zero is defined as the time of initial contact between the test probe and the chest skin.

\*\*Force = impactor mass x acceleration (572.34(b))

\*\*\*Area under loading curve minus the area under the unloading curve divided by the area under the loading curve.

X 17. Plots of chest compression, pendulum acceleration, pendulum speed, and force, follow this sheet.

Jack Coleman  
Signature

08/26/2014  
Date

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

**ATD Serial No:** 401

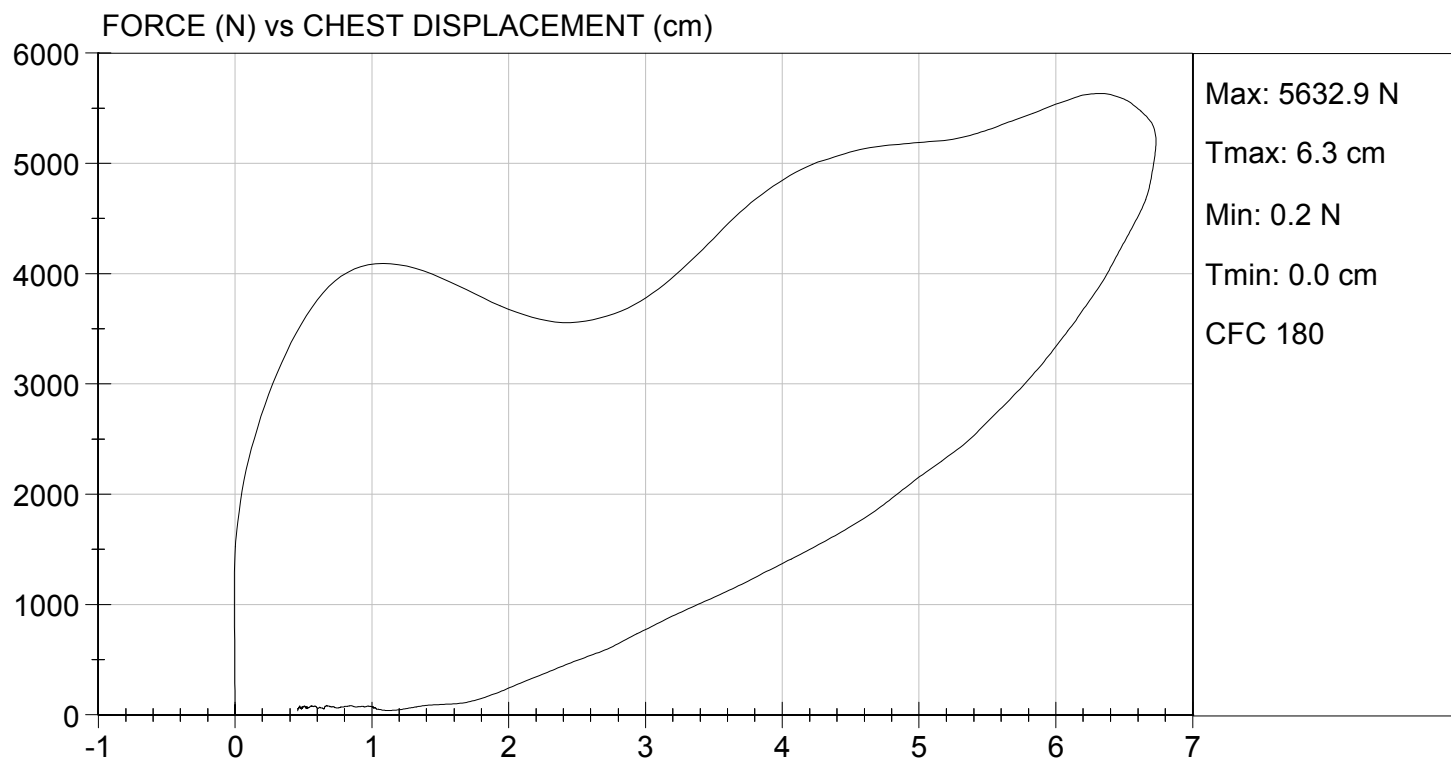
**Test I.D:** D142934

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.6	Pass
Laboratory Relative Humidity	%	10 to 70	53	Pass
Probe Velocity	m/s	6.58 to 6.82	6.58	Pass
Peak Probe Force	N	5159 to 5893	5,633	Pass
Peak Sternum Displacement	cm	6.35 to 7.26	6.73	Pass
Internal Hysteresis	%	69 to 85	69	Pass
<b>Overall Test Results</b>				<b>Pass</b>

*Jack Coleman*  
 \_\_\_\_\_  
 Laboratory Technician

08/26/2014  
 \_\_\_\_\_  
 Test Date

*Jeff Leonard*  
 \_\_\_\_\_  
 Approved By



**DATA SHEET A7**  
LEFT KNEE IMPACT TEST (572.35) (50<sup>th</sup> Male)

Dummy Serial Number: 401

Test Date: 08/26/2014

Technician: David Schoedel

- Pre test calibration  
X Post test calibration verification

Test attempt no. 1 (when successive knee impact tests are necessary)

- X 1. It has been at least 30 minutes since the last knee impact test. (572.36(m))  
     X N/A, ONLY one knee impact test performed
- X 2. The test fixture conforms to the specifications in Figure 14A.
- X 3. The leg assembly (86-5001-001) with the upper leg assembly (78051-46) removed, and the load cell simulator (78051-319) is used. (572.35(b)(2))
- X 4. The knee assembly soaked at a temperature between 18.9°C (66°F) and 25.6°C (78°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to this test. (572.35(b)(2)(ii))
- |                                 |               |
|---------------------------------|---------------|
| Record the maximum temperature: | <u>21.6°C</u> |
| Record the minimum temperature: | <u>20.8°C</u> |
| Record the maximum humidity:    | <u>58%</u>    |
| Record the minimum humidity:    | <u>52%</u>    |
- X 5. Mount the test specimen and secure it to the rigid test fixture. (572.35(b)(2)(iii)) (Figure 14A)
- X 6. No parts of the foot or tibia contact any exterior surface. (572.35(b)(2)(iii))
- X 7. Align the test probe so that at contact the longitudinal centerline of the probe is collinear within 2 degrees with the longitudinal centerline of the femur load cell simulator except it is within 0.5 degrees horizontally. (572.35(b)(2)(iv)&(vi))
- X 8. The probe is guided so there is no significant lateral, vertical or rotational movement during the impact with the knee. (572.35(b)(2)(v))
- X 9. The data acquisition system, including transducers, must conform to the requirements of SAE Recommended Practice J2111/1 MAR95 (572.136(m)) Class 600.
- X 10. Contact the knee with the test probe at a speed between 6.8 ft/s and 7.0 ft/s. (572.35(b))

X 11. Complete the following table:

Knee Impact Results (572.35(b)(1))

Parameter	Specification	Result
Probe speed	$6.8 \text{ ft/s} \leq \text{speed} \leq 7.0 \text{ ft/s}$	7.00 ft/s
Peak resistance force*	$1060 \text{ lb} \leq \text{force} \leq 1300 \text{ lb}$	1100 lb

\*Force = impactor mass x deceleration (572.35(b)(1))

X 12. Plots of pendulum acceleration, pendulum speed, and force, follow this sheet. Time zero is defined as the time of contact between the test probe and the knee. (572.3(b)(2)(vii))

David Schoedel

Signature

08/26/2014

Date

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

**ATD Serial No:** 401

**Test I.D:** D142936

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.3	Pass
Laboratory Relative Humidity	%	10 to 70	58	Pass
Probe Velocity	m/s	2.07 to 2.13	2.13	Pass
Peak Probe Force	N	4715 to 5782	4,895	Pass
Overall Test Results				Pass

David Schoedel  
 Laboratory Technician

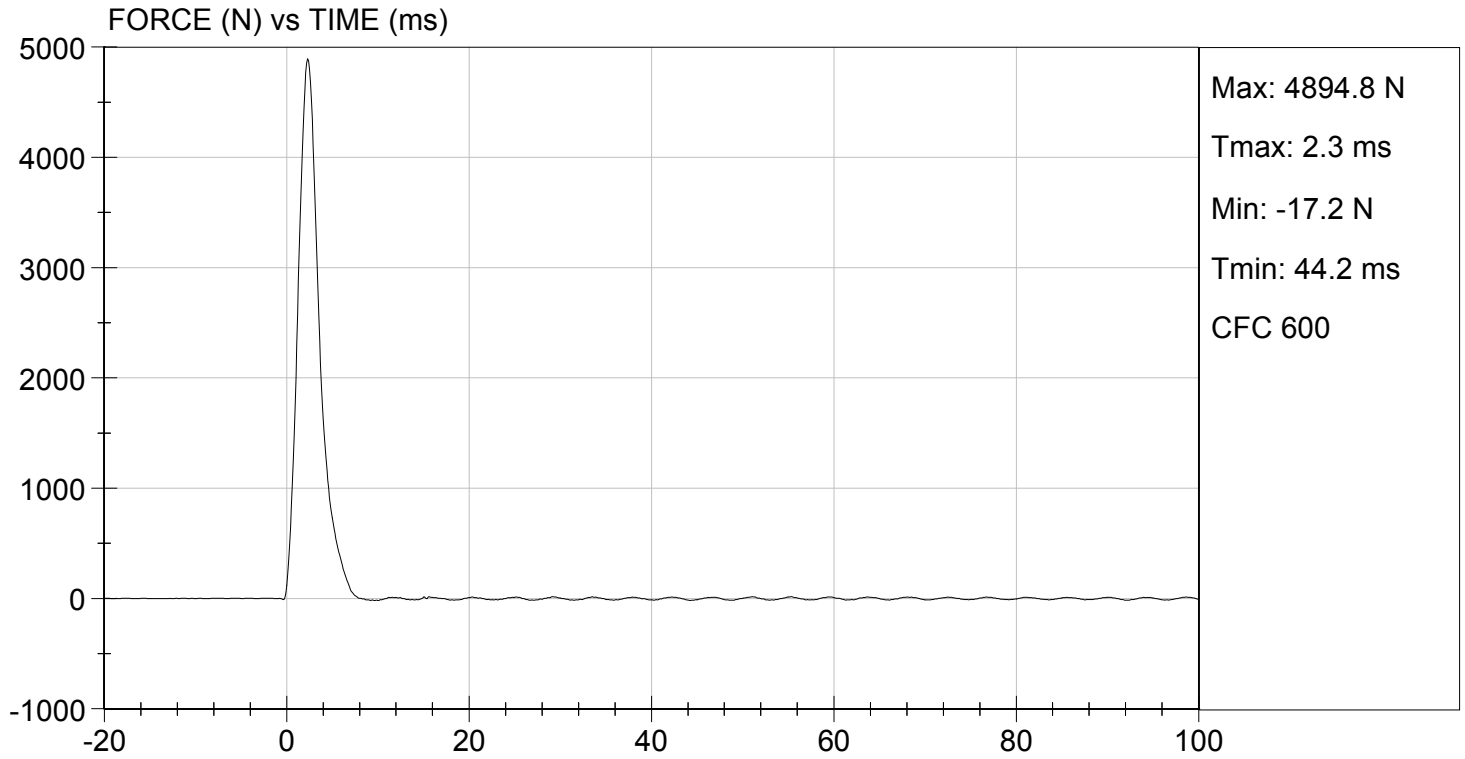
08/26/2014  
 Test Date

Jeff Leonard  
 Approved By



TEST DESC: LEFT KNEE  
VELOCITY: 7.00 ft/s, 2.13 m/s

TEST DATE: 08/26/2014  
TEST #: D142936



**DATA SHEET A8**  
RIGHT KNEE IMPACT TEST (572.35) (50<sup>th</sup> Male)

Dummy Serial Number: 401

Test Date: 08/26/2014

Technician: Jessica Gall

- Pre test calibration  
 Post test calibration verification

Test attempt no. 1 (when successive knee impact tests are necessary)

1. It has been at least 30 minutes since the last knee impact test. (572.36(m))  
 N/A, ONLY one knee impact test performed
2. The test fixture conforms to the specifications in Figure 14A.
3. The leg assembly (86-5001-002) with the upper leg assembly (78051-47) removed, and the load cell simulator (78051-319) is used. (572.35(b)(2))
4. The knee assembly soaked at a temperature between 18.9°C (66°F) and 25.6°C (78°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to this test. (572.35(b)(2)(ii))
- |                                 |               |
|---------------------------------|---------------|
| Record the maximum temperature: | <u>21.6°C</u> |
| Record the minimum temperature: | <u>20.8°C</u> |
| Record the maximum humidity:    | <u>58%</u>    |
| Record the minimum humidity:    | <u>52%</u>    |
5. Mount the test specimen and secure it to the rigid test fixture. (572.35(b)(2)(iii)) (Figure 14A)
6. No parts of the foot or tibia contact any exterior surface. (572.35(b)(2)(iii))
7. Align the test probe so that at contact the longitudinal centerline of the probe is collinear within 2 degrees with the longitudinal centerline of the femur load cell simulator except it is within 0.5 degrees horizontally. (572.35(b)(2)(iv)&(vi))
8. The probe is guided so there is no significant lateral, vertical or rotational movement during the impact with the knee. (572.35(b)(2)(v))
9. The data acquisition system, including transducers, must conform to the requirements of SAE Recommended Practice J211/1 MAR95 (572.136(m)) Class 600.
10. Contact the knee with the test probe at a speed between 6.8 ft/s and 7.0 ft/s. (572.35(b))

X 11. Complete the following table:

Knee Impact Results (572.35(b)(1))

Parameter	Specification	Result
Probe speed	$6.8 \text{ ft/s} \leq \text{speed} \leq 7.0 \text{ ft/s}$	6.97 ft/s
Peak resistance force*	$1060 \text{ lb} \leq \text{force} \leq 1300 \text{ lb}$	1060 lb

\*Force = impactor mass x deceleration (572.35(b)(1))

X 12. Plots of pendulum acceleration, pendulum speed, and force, follow this sheet. Time zero is defined as the time of contact between the test probe and the knee. (572.3(b)(2)(vii))

*Jessica Hall*

Signature

08/26/2014

Date

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

**ATD Serial No:** 401

**Test I.D:** D142935

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.2	Pass
Laboratory Relative Humidity	%	10 to 70	52	Pass
Probe Velocity	m/s	2.07 to 2.13	2.12	Pass
Peak Probe Force	N	4715 to 5782	4,716	Pass
Overall Test Results				Pass

*Jessica Hall*  
 \_\_\_\_\_  
 Laboratory Technician

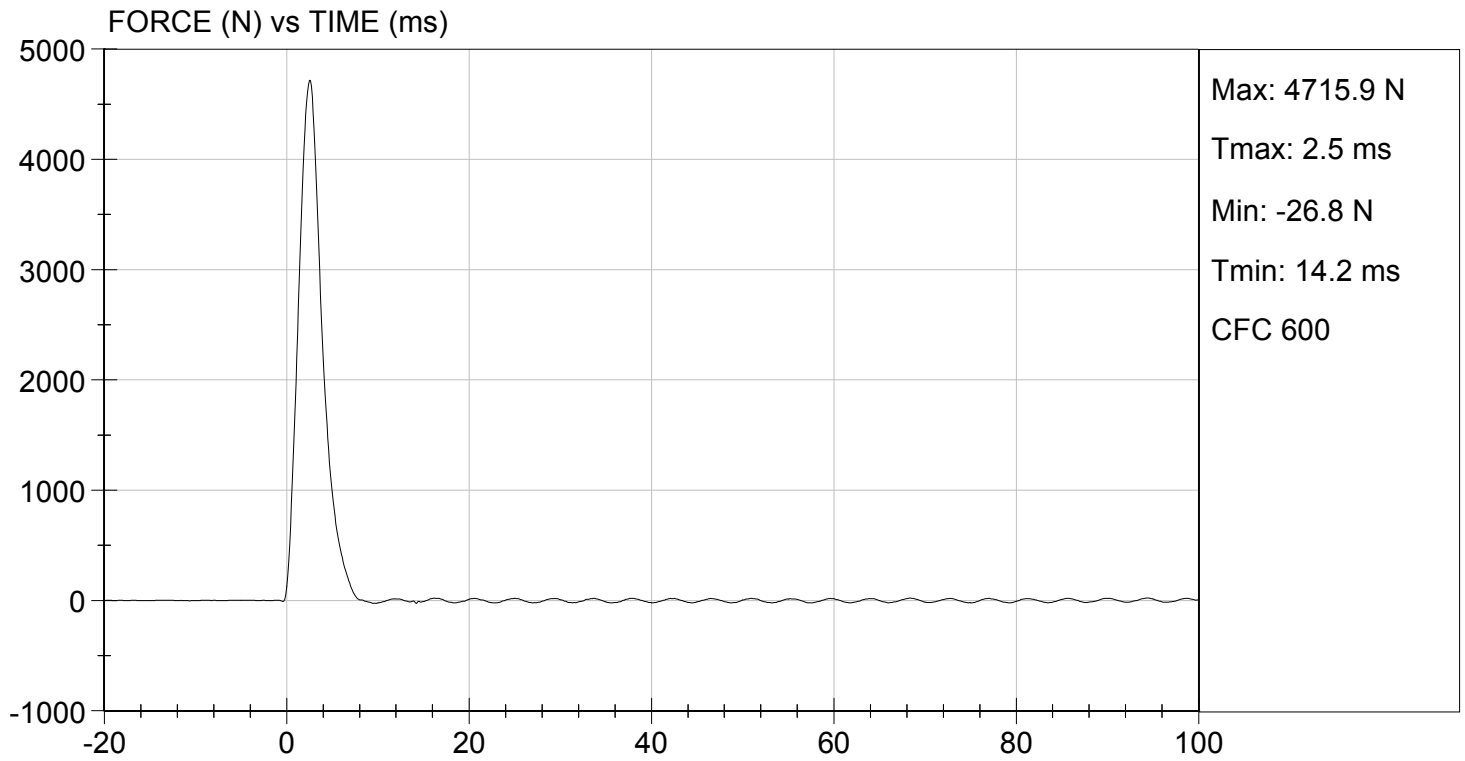
08/26/2014  
 \_\_\_\_\_  
 Test Date

*Jeff Leonard*  
 \_\_\_\_\_  
 Approved By



TEST DESC: RIGHT KNEE  
VELOCITY: 6.97 ft/s, 2.12 m/s

TEST DATE: 08/26/2014  
TEST #: D142935



**DATA SHEET A9**  
HIP JOINT-FEMUR FLEXION (572.35(c)) (50<sup>th</sup> Male)

Dummy Serial Number: 401

Test Date: 08/25/2014

Technician: David Schoedel

- Pre test calibration  
  X   Post test calibration verification

Test attempt no. 1 (when successive hip joint-femur flexion tests are necessary)

- X   1. It has been at least 30 minutes since the last hip joint-femur flexion test. (572.36(m))  
    X   N/A, ONLY one hip joint-femur flexion test performed
- X   2. The test fixture conforms to the specifications in Figure 17A.
- X   3. Use the assembled dummy (78051-218) except (572.35(c)(2)):  
    X   3.1 remove the leg assemblies (86-5001-001 & 002) by removing 3/8-16 Socket Head Cap Screw and retaining the structural assembly of the upper legs (78051-43 & 44)  
    X   3.2 remove the abdominal insert (78051-52)  
    X   3.3 replace the instrument cover plate (78051-13) in the pelvic bone with a rigid pelvic bone stabilizer insert (Figure 15A) and attach the pelvis upper support device (Figure 16A).
- X   4. The assembly soaked at a temperature between 18.9°C (66°F) and 25.6°C (78°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to this test. (572.35(c)(v))
- |                                 |               |
|---------------------------------|---------------|
| Record the maximum temperature: | <u>21.6°C</u> |
| Record the minimum temperature: | <u>20.8°C</u> |
| Record the maximum humidity:    | <u>58%</u>    |
| Record the minimum humidity:    | <u>52%</u>    |
- X   5. Seat the dummy on the rigid seat fixture. (572.35(c)(2)(ii))
- X   6. Secure the dummy by bolting the stabilizer insert and the pelvis upper support device to the seat back of the test fixture as shown in Figures 17A, 18A, and 19A. (572.35(c)(2)(ii))
- X   7. Adjust the threaded rods until plane B is horizontal.
- X   8. Secure the lever arm into the left femur shaft opening of the upper leg structure assembly (78051-43) and firmly secure it using the 3/8-16 socket head cap screws (Figure 19A). (572.35(c)(2)(iii))

X 9. Lift the lever arm parallel to the midsagittal plane at a rotation rate between 5 and 10 degrees per second while maintaining the ½ in. shoulder bolt longitudinal centerline horizontal throughout the range of motion until the 150 ft-lbf torque level is reached (Figures 18A and 19A). (572.35(c)(2)(iv))

X 10. Complete the following table:  
Left Hip Joint-Femur Flexion Results (572.35(c)(1) & (c)(2)(iv))

Parameter	Specification	Result
Rotation Rate	5°/s ≤ rotation rate ≤ 10°/s	6.3°/s
Femur Torque at 30°	Torque ≤ 70 ft-lbf	48.9 ft-lbf
Rotation at 150 lbf-ft	40° ≤ rotation ≤ 50°	45.2°

X 11. Secure the lever arm into the right femur shaft opening of the upper leg structure assembly (78051-44) and firmly secure it using the 3/8-16 socket head cap screws (Figure 19A). (572.35(c)(2)(iii))

X 12. Lift the lever arm parallel to the midsagittal plane at a rotation rate between 5 and 10 degrees per second while maintaining the ½ in. shoulder bolt longitudinal centerline horizontal throughout the range of motion until the 150 ft-lbf torque level is reached (Figures 18A and 19A). (572.35(c)(2)(iv))

X 13. Complete the following table:  
Right Hip Joint-Femur Flexion Results (572.35(c)(1) & (c)(2)(iv))

Parameter	Specification	Result
Rotation Rate	5°/s ≤ rotation rate ≤ 10°/s	6.2°/s
Femur Torque at 30°	torque ≤ 70 ft-lbf	57.5 ft-lbf
Rotation at 150 lbf-ft	40° ≤ rotation ≤ 50°	43.4°

*David Schoedel*

Signature

08/25/2014

Date

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

**ATD Serial No:** 401

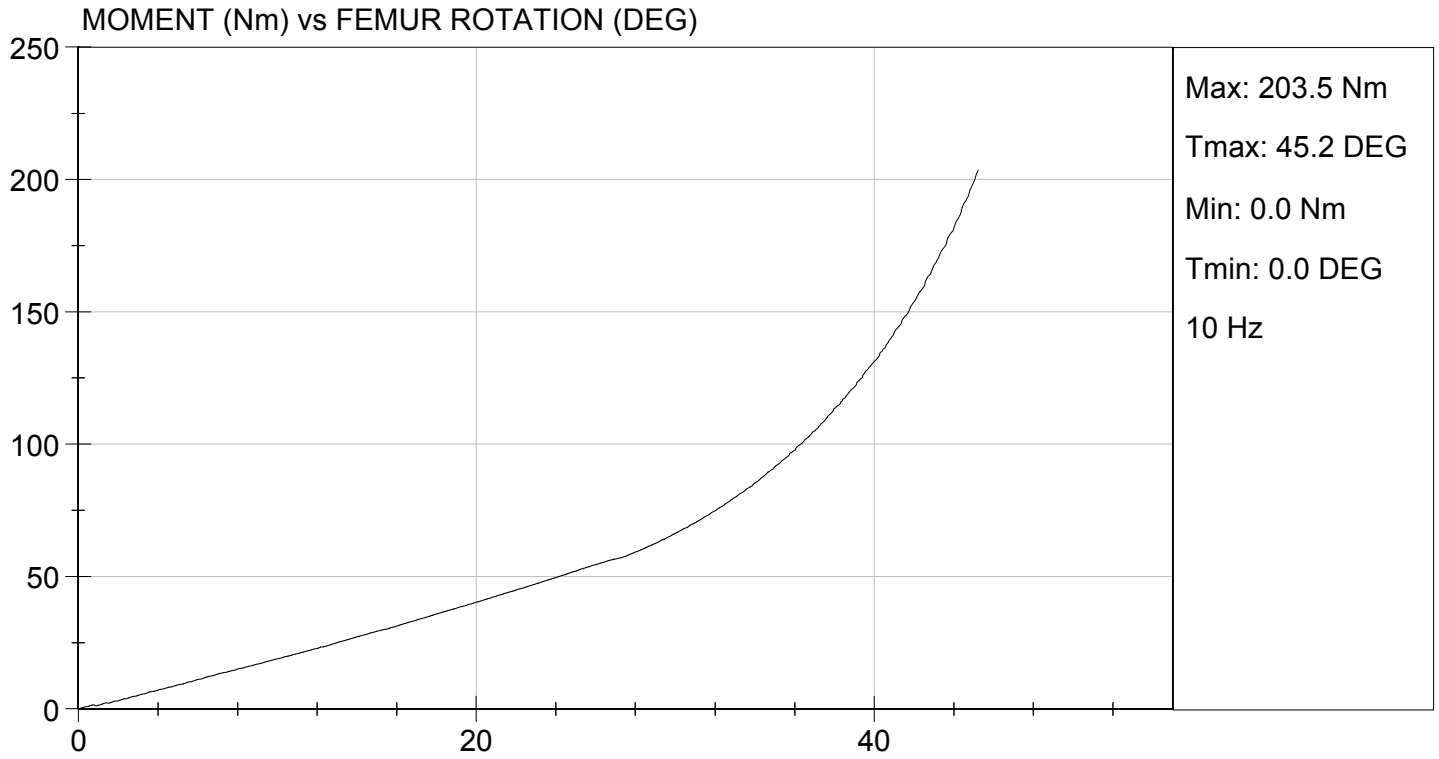
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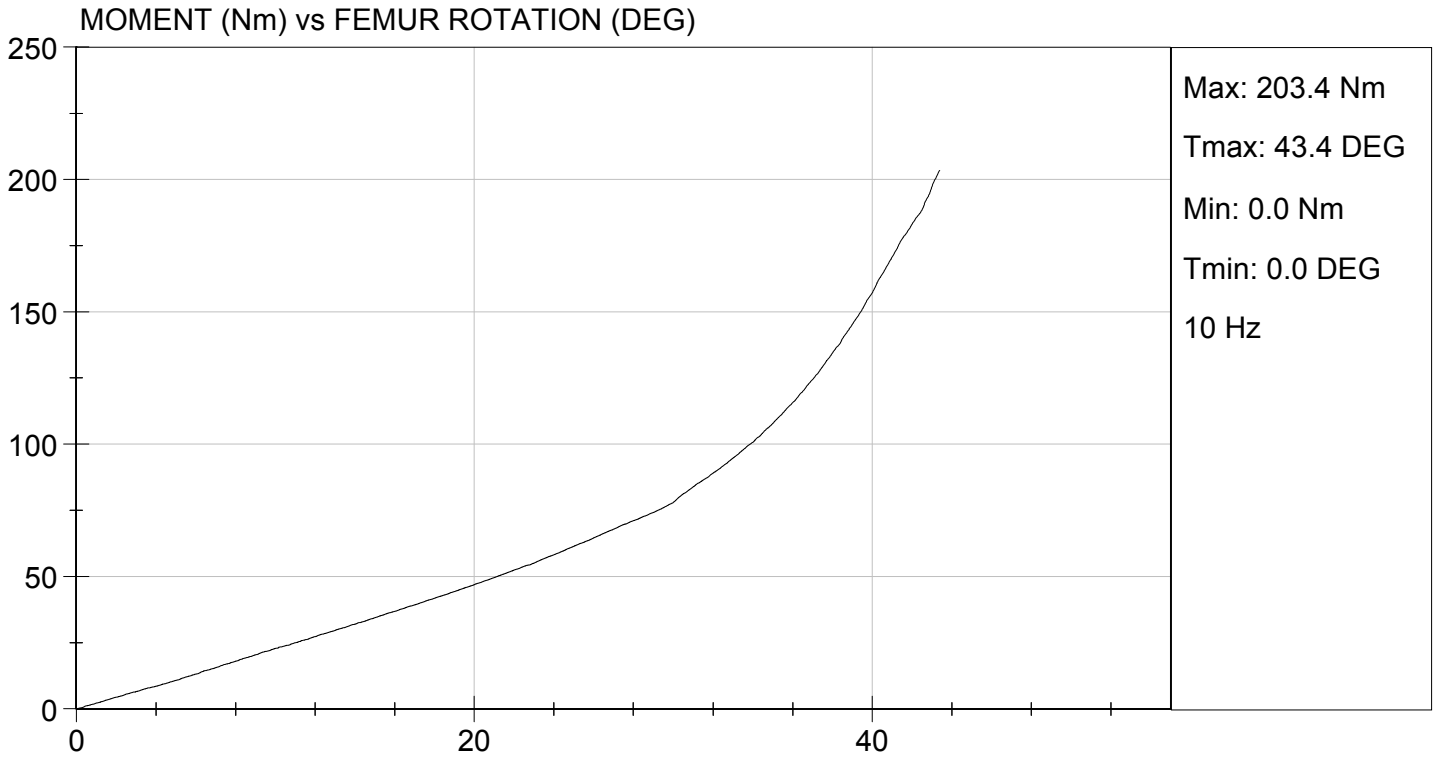
Tested Parameter	Units	Specification	Result		Pass/Fail
			Right	Left	
Laboratory Temperature	deg C	18.9 to 25.6	20.8	20.8	Pass
Laboratory Relative Humidity	%	10 to 70	58	58	Pass
Rotation Rate	deg/s	5.0 to 10.0	6.2	6.3	Pass
30 Degrees	Nm	94.9 Nm Max	78.0	66.3	Pass
150 ft-lbf / 203.4 Nm	Deg	40.0 to 50.0 Degree Max Rotation	43.4	45.2	Pass
Overall Test Results					Pass

David Schoedel  
 Laboratory Technician

08/25/2014  
 Test Date

Jeff Leonard  
 Approved By







**DATA SHEET B1**  
**DUMMY DAMAGE CHECKLIST**

Dummy Serial Number: 401

Test Date: 08/25/2014

Technician: Jessica Gall

This check sheet is completed as part of the post test calibration verification.

Perform general cleaning.

Dummy Item	Inspect for	Comments	Damage	OK
Outer skin	Gashes, rips, cracks			X
Head	Ballast secure			X
	General appearance			X
Neck	Broken or cracked rubber			X
	Upper neck bracket firmly attached to the lower neck bracket			X
	Looseness at the condyle joint			X
	Nodding blocks cracked or out of position			X
Spine	Broken or cracks in rubber			X
Ribs	Broken or bent ribs			X
	Broken or bent rib supports			X
	Damping material separated or cracked			X
	Rubber bumpers in place			X
Chest Displacement Assembly	Bent shaft			X
	Slider arm riding in track			X
Transducer leads	Torn cables			X
Accelerometer Mountings	Head mounting secure			X
	Chest mounting secure			X
Knees	Skin condition			X
	Insert (do not remove)			X
	Casting			X
Limbs	Normal movement and adjustment			X
Knee Sliders	Wires intact			X
	Rubber returned to "at rest" position			X
Pelvis	Broken			X
Other				X

If upon visual examination, damage is apparent in any of these areas, the appropriate engineer or engineering technician is to be consulted for a decision on repair or replacement of parts.

Repair or Replacement approved by:

Jessica Hall  
Signature

08/26/2014  
Date

Describe the repair or replacement of parts:

Checked by:

Jeff Leonard  
Signature

08/26/2014  
Date

HYBRID III 50 <sup>th</sup> SN #403, PART 572, SUBPART E EXTERNAL DIMENSIONS				
DIMENSION	DESCRIPTION	DETAILS	ASSEMBLY DIMENSION (inches)	ACTUAL MEASUREMENT
A	TOTAL SITTING HEIGHT	Seat surface to highest point on top of the head.	34.6–35.0	34.9
B	SHOULDER PIVOT HEIGHT	Centerline of shoulder pivot bolt to the seat surface.	19.9-20.5	20.0
C	H-POINT HEIGHT	Reference	3.3-3.5	3.5
D	H-POINT LOCATION FROM BACKLINE	Reference	5.3-5.5	5.5
E	SHOULDER PIVOT FROM BACKLINE	Center of the shoulder clevis to the rear vertical surface of the fixture.	3.3-3.7	3.6
F	THIGH CLEARANCE	Measured at the highest point on the upper femur segment.	5.5-6.1	5.9
G	BACK OF ELBOW TO WRIST PIVOT	Back of the elbow flesh to the wrist pivot in line with the elbow and wrist pivots	11.4-12.0	11.4
H	HEAD BACK TO BACKLINE	Back of skull cap skin to seat rear vertical surface (Reference)	1.6-1.8	1.6
I	SHOULDER TO ELBOW LENGTH	Measure from the highest point on top of the shoulder clevis to the lowest part of the flesh on the elbow in line with the elbow pivot bolt.	13.0-13.6	13.5
J	ELBOW REST HEIGHT	Measure from the flesh below the elbow pivot bolt to the seat surface.	7.5-8.3	8.3
K	BUTTOCK TO KNEE LENGTH	The forward most part of the knee flesh to the rear vertical surface of the fixture.	22.8-23.8	23.5
L	POPLITEAL HEIGHT	Seat surface to the plane of the horizontal plane of the bottom of the feet.	16.9-17.9	17.5
M	KNEE PIVOT HEIGHT	Centerline of knee pivot bolt to the horizontal plane of the bottom of the feet.	19.1-19.7	19.6
N	BUTTOCK POPLITEAL LENGTH	The rearmost surface of the lower leg to the same point on the rear surface of the buttocks used for dim. "K".	17.8-18.8	18.5

HYBRID III 50 <sup>th</sup> SN #403, PART 572, SUBPART E EXTERNAL DIMENSIONS, continued				
DIMENSION	DESCRIPTION	DETAILS		ACTUAL MEASUREMENT
O	CHEST DEPTH WITHOUT JACKET	Measured 16.9-17.1 in. above seat surface	8.4-9.0	8.8
P	FOOT LENGTH	Tip of toe to rear of heel	9.9-10.5	10.2
V	SHOULDER BREADTH	Outside edges of right and left shoulder clevises	16.3-17.2	16.8
W	FOOT BREADTH	The widest part of the foot	3.6-4.2	3.9
Y	CHEST CIRCUMFERENCE (WITH CHEST JACKET)	Measured 16.9-17.1 in. above seat surface	38.2-39.4	38.8
Z	WAIST CIRCUMFERENCE	Measured 8.9-9.1 in. above seat surface	32.9-34.1	33.2
AA	REFERENCE LOCATION FOR MEASUREMENT OF CHEST CIRCUMFERENCE	Reference	16.9-17.1	17.0
BB	REFERENCE LOCATION FOR MEASUREMENT OF WAIST CIRCUMFERENCE	Reference	8.9-9.1	9.0

**DATA SHEET A3**  
HEAD DROP TEST (572.32) (50<sup>th</sup> Male)

Dummy Serial Number: 403

Test Date: 07/31/2014

Technician: David Schoedel

- Pre test calibration  
 Post test calibration verification

Test attempt no. 1 (when successive head drops are necessary)

1. It has been at least 2 hours since the last head drop. (572.32(c)(5))  
 N/A, ONLY one head drop performed
2. The head assembly consists of the complete head (78051-61X), the neck transducer structural replacement (78051-383X), and three (3) accelerometers. (572.32(b))
3. Torque the skull cap screws to 160 lbf-in.
4. Accelerometers and their respective mounts are smooth and clean.
5. The data acquisition system, including transducers, conforms to the requirements of SAE Recommended Practice J2111/1 MAR95. (572.35(i))
6. The head assembly soaked at a temperature between 18.9°C (66°F) and 25.6°C (78°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to a test. (572.132(c)(1))
- |                                 |               |
|---------------------------------|---------------|
| Record the maximum temperature: | <u>21.5°C</u> |
| Record the minimum temperature: | <u>20.9°C</u> |
| Record the maximum humidity:    | <u>52%</u>    |
| Record the minimum humidity:    | <u>45%</u>    |
7. Visually inspect the head skin for cracks, cuts, abrasions, etc. Repair or replace the head skin if the damaged area is more than superficial. Note: If the damage resulted from the vehicle crash test in which the dummy was an occupant, the damaged area is to be documented with photography and the post test calibration verification testing completed before any replacement or repairs are made.
- Record findings and actions: No Damage
8. Clean the impact surface of the skin and the impact surface of the fixture with isopropyl alcohol, trichloroethane or equivalent prior to the test. (572.32(c)(2))

X 9. Suspend and orient the head assembly as shown in Figure 6A. The lowest point on the forehead is 0.5 in. below the lowest point on the dummy's nose when the midsagittal plane is vertical. (572.32(c)(3))

Record the actual distance: 0.5 inches

**NOTE:** The masses of the suspension device and the accelerometer cables are to be kept as lightweight as possible to minimize their effect on the test results.

X 10. The 1.6 mm (0.062 inch) diameter holes located on either side of the dummy's head are equidistance within 2 mm from the impact surface. A typical test setup is shown in Figure 7A.

Record the right side distance: 501 mm

Record the left side distance: 501 mm

X 11. The impact surface is clean and dry and has a micro finish in the range of  $203.2 \times 10^{-6}$  mm (8 micro inches) to  $2032.0 \times 10^{-6}$  mm (80 micro inches) (RMS). (572.32(c)(4))

Record actual micro finish: 24.8 micro inches

X 12. The impact surface is rigidly supported. (572.132(c)(4))

X 13. The impact surface is a flat horizontal steel plate 50.8 mm (2 inches) thick and 610 mm (24 inches) square. (Figure 6A)

Record thickness: 50.9 mm

Record width: 604 mm

Record length: 595 mm

X 14. Drop the head assembly from a height of  $376.0 \pm 1.0$  mm (14.8 inches  $\pm$  0.04 inches) by a means that ensures a smooth, instant release onto the impact surface. (572.32(b) & (572.32(c)(4))

X 15. Complete the following table using channel class 1000 data. (572.36(i)):

Parameter	Specification	Result
Peak resultant acceleration	$225 \text{ g} \leq x \leq 275 \text{ g}$	255 g
Resultant versus time history curve	Unimodal	Yes
Oscillations after the main pulse	Less than 10% of the peak resultant acceleration	Yes
Lateral acceleration	y-axis acceleration $\leq \pm 15 \text{ g}$	-5.1 g

X 16. Plots of the x, y, z, and resultant acceleration data follow this sheet.

David Schoedel  
Signature

07/31/2014  
Date

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

ATD Serial No: 403

Test ID: D142731

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.2	Pass
Laboratory Relative Humidity	%	10 to 70	45	Pass
Peak Resultant Acceleration	G's	225 to 275	255	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-5.1	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
Overall Test Results				Pass

*David Schoedel*

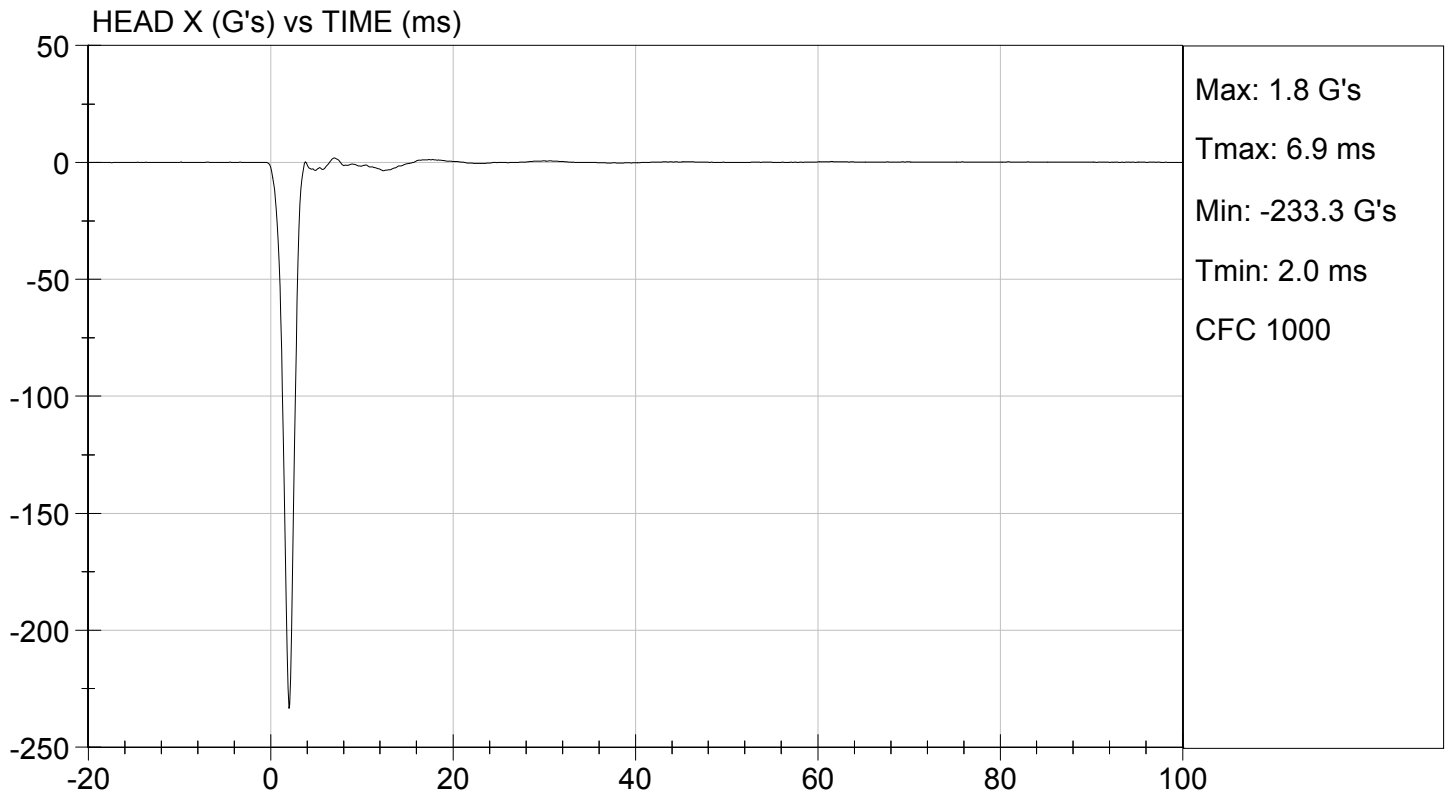
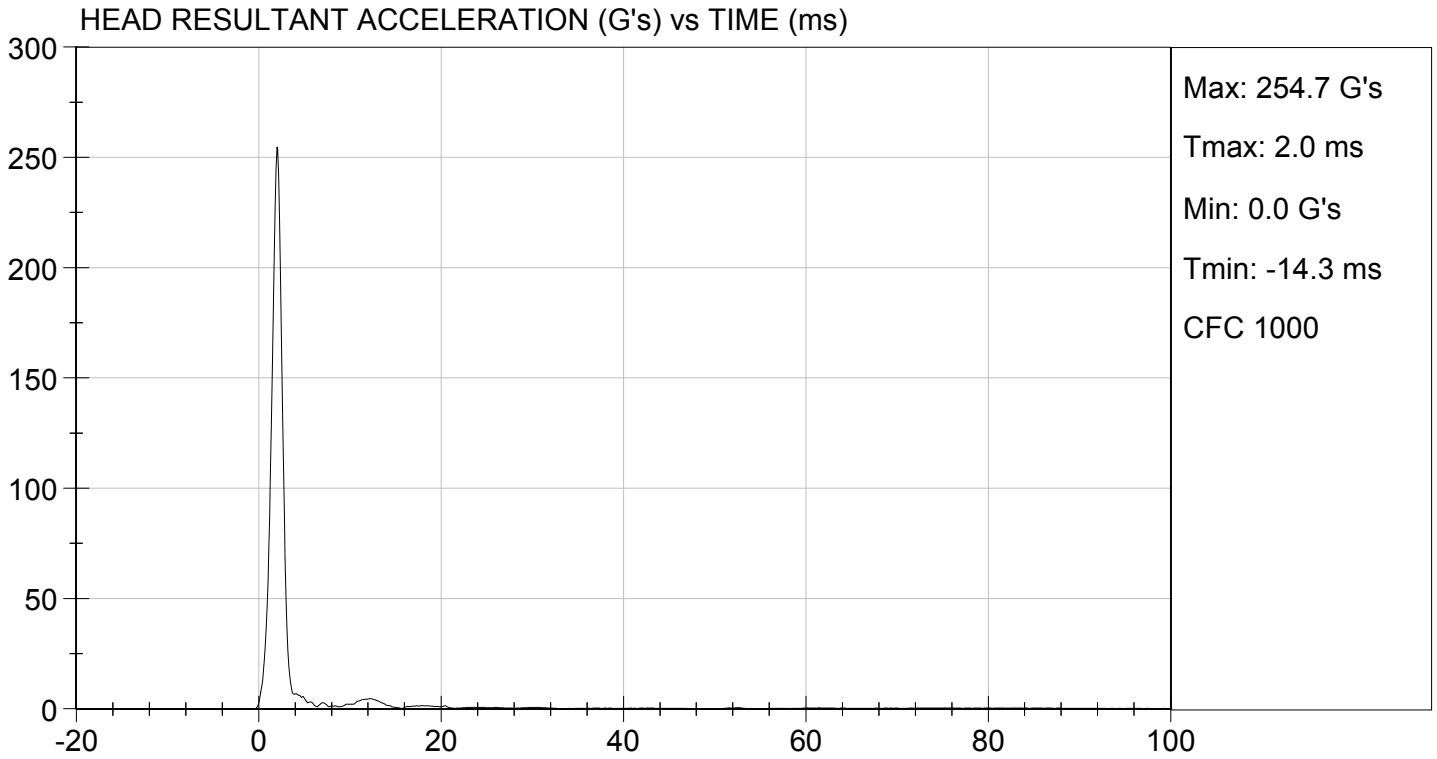
Laboratory Technician

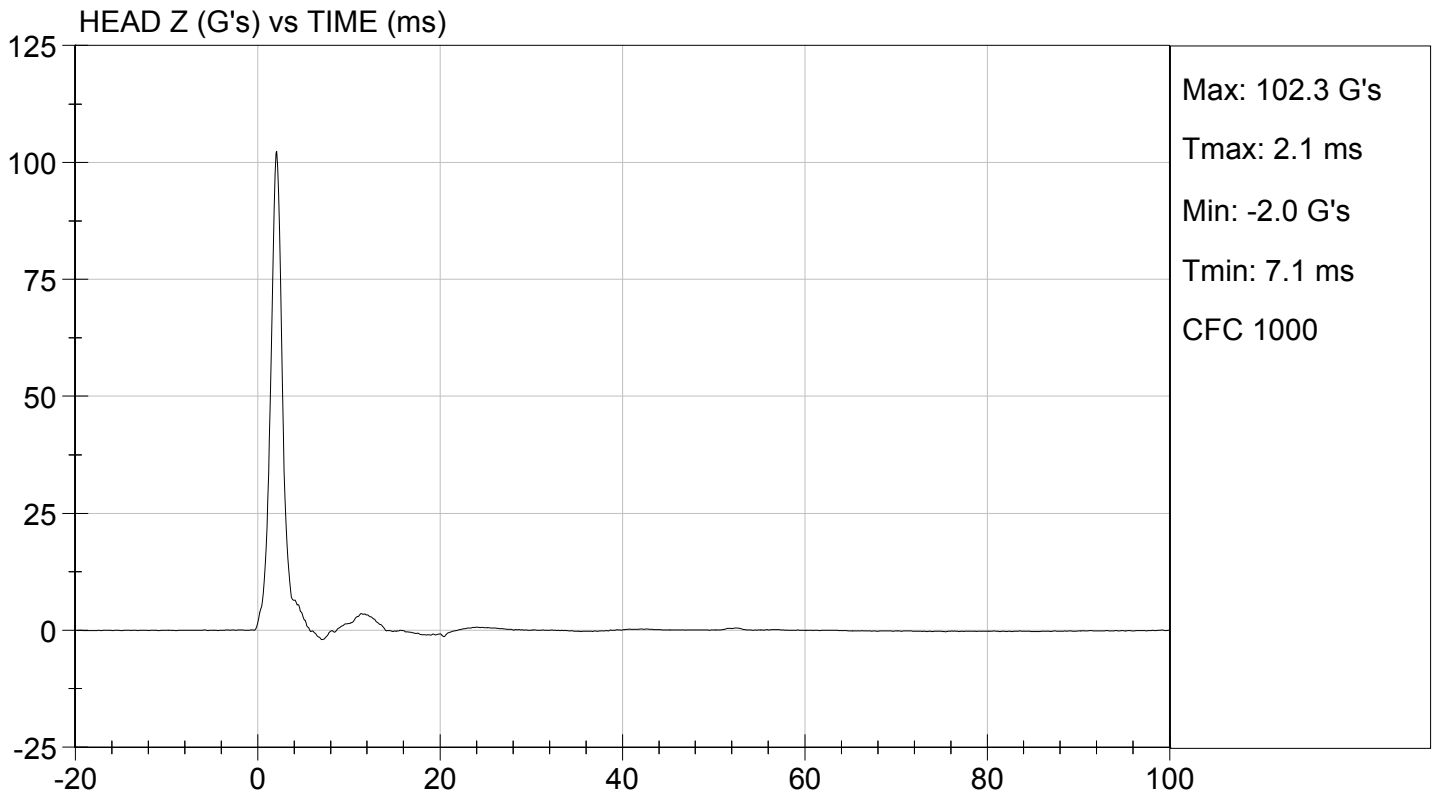
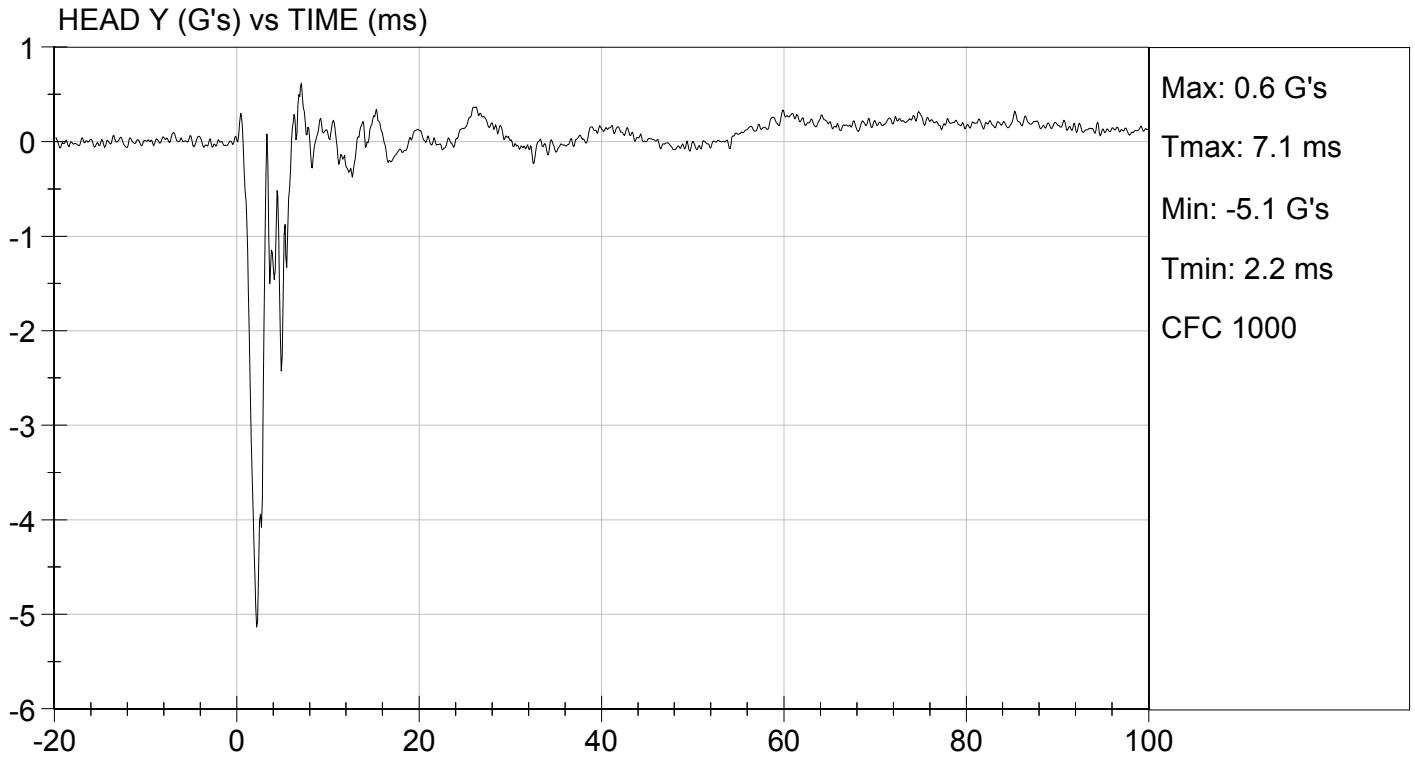
07/31/2014

Test Date

*Jeff Leonard*

Approved By





**DATA SHEET A4**  
NECK FLEXION TEST (572.33) (50<sup>th</sup> Male)

Dummy Serial Number: 403

Test Date: 08/01/2014

Technician: David Schoedel

- Pre test calibration  
 Post test calibration verification

Test attempt no. 1 (when successive flexion tests are necessary)

1. It has been at least 30 minutes since the last flexion test. (572.36(m))  
 N/A, ONLY one neck test performed
2. The components required for the neck tests include the head assembly (78051-61X), neck assembly (78051-90), bib simulator (78051-84), upper neck adjusting bracket (78051-307), lower neck adjusting bracket (78051-303), six axis neck transducer (C-1709) and either three accelerometers or their mass equivalent installed in the head assembly. Data from the accelerometers are not required. (572.33(b))
3. The assembly soaked at a temperature between 20.6°C (69°F) and 22.2°C (72°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to a test. (572.33(c)(1))
- |                                 |               |
|---------------------------------|---------------|
| Record the maximum temperature: | <u>21.5°C</u> |
| Record the minimum temperature: | <u>20.9°C</u> |
| Record the maximum humidity:    | <u>52%</u>    |
| Record the minimum humidity:    | <u>45%</u>    |
4. Visually inspect neck assembly for cracks, cuts and separation of the rubber from the metal segments. Note: If the damage resulted from the vehicle crash test in which the dummy was an occupant, the damaged area is to be documented with photography and the post test calibration verification testing completed before any replacement or repairs are made.
- Record findings and actions: No damage
5. Inspect the nodding blocks (78051-351) for any deterioration, but when replacement is necessary, ONLY replace during pre-test calibration. Using a Shore "A" type Durometer, verify the hardness of the nodding blocks is between 80 and 90. Ensure the nodding blocks are installed correctly. (78051-90).
- Record findings and actions: No Deterioration; Hardness: Front 89; Back 90.
6. Pre-test calibration Neck cable torque: Torque the jam nut (78051-64) on the neck cable (78051-301) to 1.0 ± 0.2 lb-ft by loosening the jam nut and relaxing the neck cable before torquing. (572.33(c)(2))

- X 7. The data acquisition system, including transducers, conforms to the requirements of SAE Recommended Practice J211/1 MAR95. (572.36(i))
- X 8. The test fixture pendulum conforms to the specifications in Figure 8A. (572.33(c)(3))
- X 9. The head-neck assembly is mounted on the pendulum so the midsagittal plane of the head is vertical and coincides with the plane of motion of the pendulum longitudinal centerline as shown in Figure 9A for the flexion test. (572.33(c)(3))
- X 10. Install the transducers or other devices for measuring the "D" plane rotation with respect to the pendulum longitudinal centerline. Note: Plane "D" is the bottom horizontal surface of the skull. These measurement devices should be designed to minimize their influence upon the performance of the head-neck assembly. An example of a measurement device is shown in Figure 11A.
- X 11. With the pendulum resting against the honeycomb material, the neck bracket was adjusted until the longitudinal centerline of the pendulum was perpendicular  $\pm 1$  degree to plane "D" on the dummy's head.
- X 12. Release the pendulum and allow it to fall freely from a height to achieve an impact speed of 22.6 to 23.4 ft/sec as measured at the center of the pendulum accelerometer. (572.33(c)(4))
- X 13. Complete the following table:  
Neck Flexion Test Results (572.33(b)(1) & 572.33(c)(4))

Parameter	Specification	Results
Pendulum impact speed	22.6 ft/s $\leq$ speed $\leq$ 23.4 ft/s	23.15 ft/s
Pendulum Deceleration Versus Time Pulse	@ 10 ms	22.5 $\leq$ g $\leq$ 27.5
	@ 20 ms	17.6 $\leq$ g $\leq$ 22.6
	@ 30 ms	12.5 $\leq$ g $\leq$ 18.5
	Above 30 ms	29 g maximum
First Pendulum Decay to 5g	34 ms $\leq$ time $\leq$ 42 ms	38.8 ms
Plane D Rotation	64° $\leq$ max. rotation $\leq$ 78°	70.5°
	57 ms $\leq$ time of max. rotation $\leq$ 64 ms	57.7 ms
Time for Plane D Rotation to Cross 0° During First Rebound	113 ms $\leq$ time $\leq$ 128 ms	114.5 ms
Maximum Moment	65 lbf-ft $\leq$ moment $\leq$ 80 lbf-ft	68.7 lbf-ft
	47 ms $\leq$ time of max. moment $\leq$ 58 ms	52.4 ms
Time of first decay to 0 lbf-ft Positive Moment Decay** (Flexion)	97 ms $\leq$ time $\leq$ 107 ms	102.4 ms

\*Moment about the occipital condyle =  $M_y - (0.058 \text{ ft} \times F_x)$ (572.33(b)(1)(ii))

$M_y$  = Moment in lbf-ft measured by the transducer

$F_x$  = Force, in lbf measured by the transducer

\*\*Time zero is defined as the time of initial contact between the pendulum striker plate and the honeycomb material. (572.33(b)(3))

X 14. Plots of pendulum acceleration, y-axis moment, x-axis force, y-axis moment about the occipital condyle, and D plane rotation follows this sheet.

*David Schoedel*

Signature

08/01/2014

Date

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

**ATD Serial No:** 403

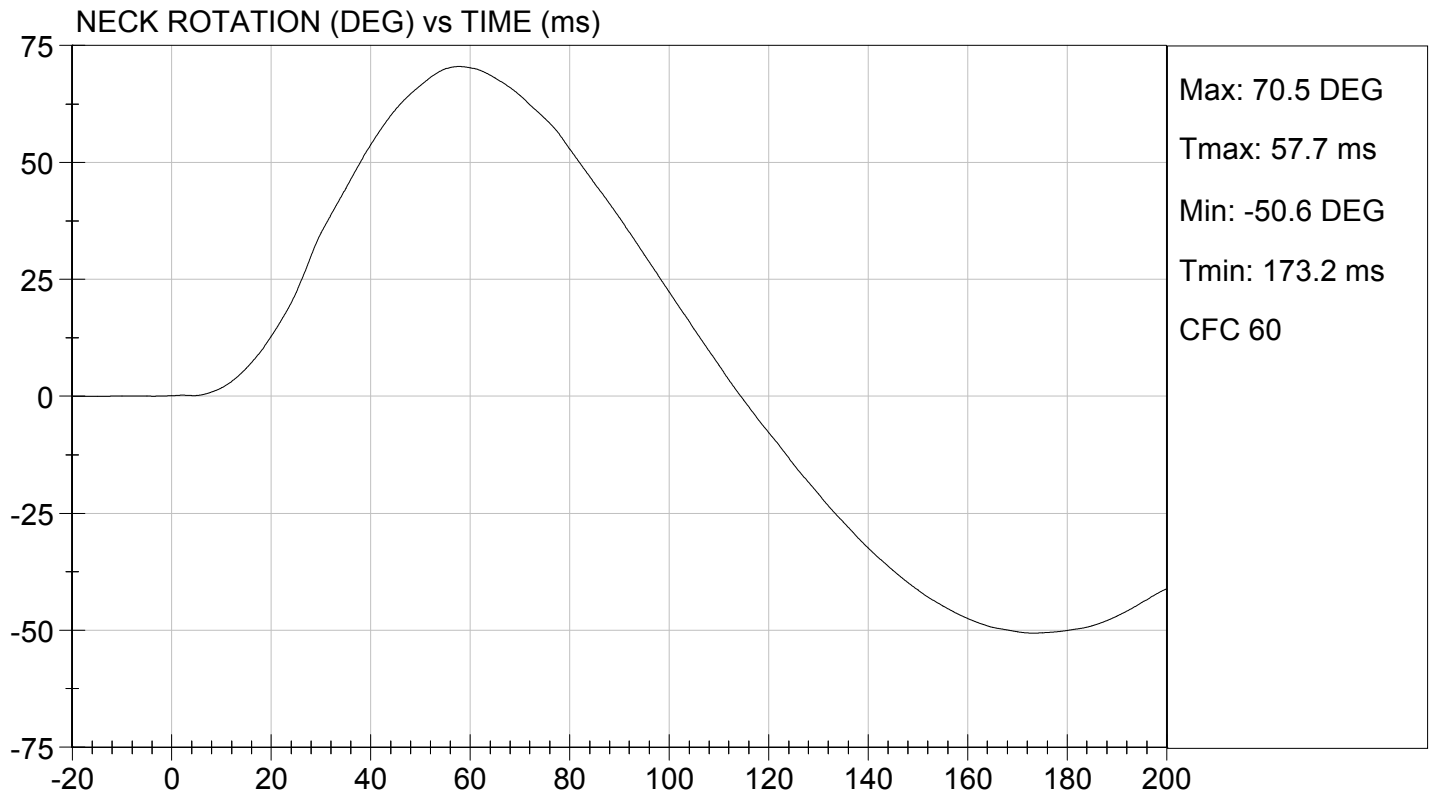
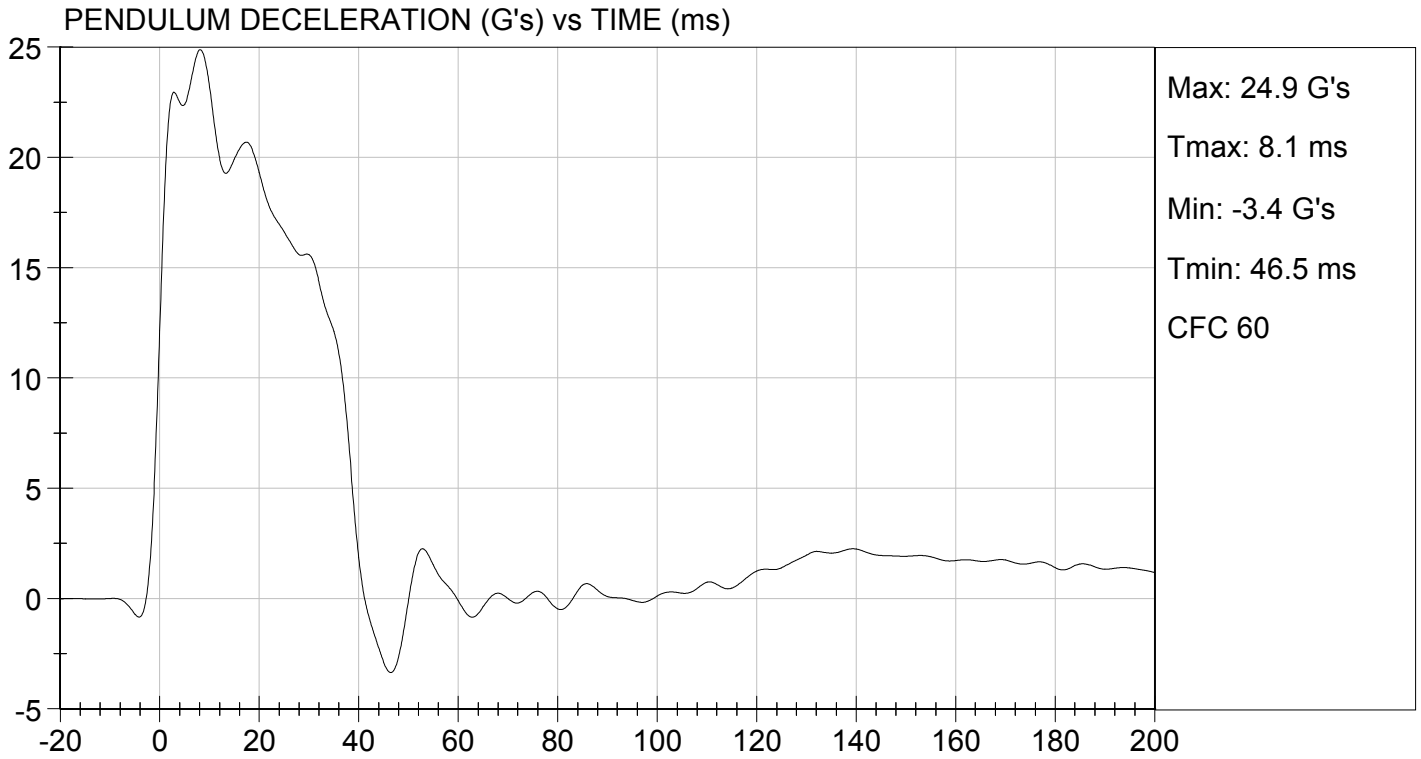
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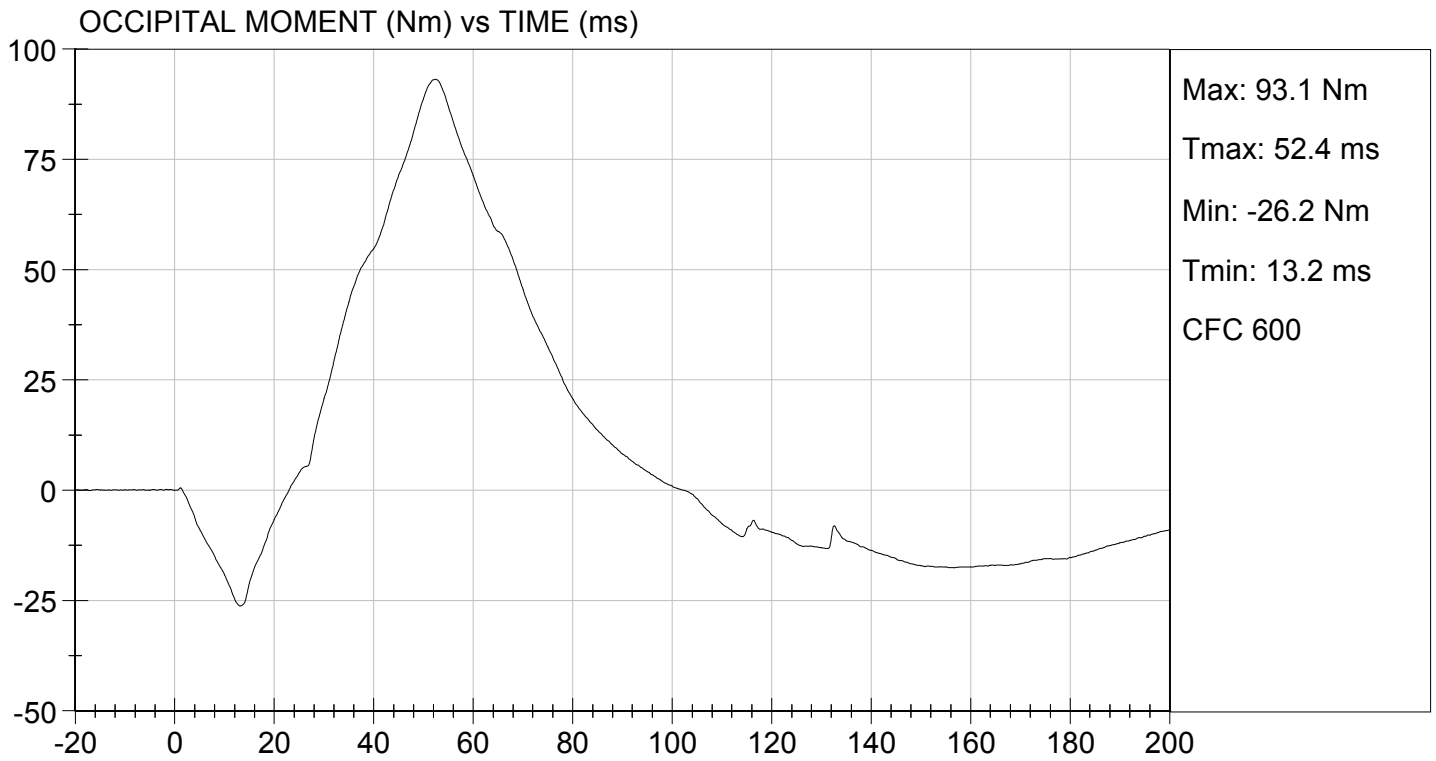
Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	20.9	Pass
Laboratory Relative Humidity		%	10 to 70	52	Pass
Pendulum Velocity		m/s	6.89 to 7.13	7.06	Pass
Pendulum Deceleration	10 ms	G's	22.50 to 27.50	23.18	Pass
	20 ms	G's	17.60 to 22.60	19.31	Pass
	30 ms	G's	12.50 to 18.50	15.59	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 29.0	15.6	Pass
Deceleration Decay Time to Cross 5 G's		ms	34.0 to 42.0	38.8	Pass
Maximum "D" Plane Rotation	Maximum	Deg	64.0 to 78.0	70.5	Pass
	Time	ms	57.0 to 64.0	57.7	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	113.0 to 128.0	114.5	Pass
Moment About Occipital Condyle	Maximum	Nm	88.1 to 108.5	93.1	Pass
	Time	ms	47.0 to 58.0	52.4	Pass
Positive Moment Decay Time To Zero Crossing		ms	97.0 to 107.0	102.4	Pass
<b>Overall Test Results</b>					<b>Pass</b>

David Schoedel  
 Laboratory Technician

08/01/2014  
 Test Date

Jeff Leonard  
 Approved By





**DATA SHEET A5**  
NECK EXTENSION TEST (572.33) (50<sup>th</sup> Male)

Dummy Serial Number: 403

Test Date: 08/01/2014

Technician: David Schoedel

- Pre test calibration  
 Post test calibration verification

Test attempt no. 1 (when successive extension tests are necessary)

1. It has been at least 30 minutes since the last extension test. (572.36(m))  
 N/A, ONLY one neck test performed
2. The components required for the neck tests include the head assembly (78051-61X), neck assembly (78051-90), bib simulator (78051-84), upper neck adjusting bracket (78051-307), lower neck adjusting bracket (78051-303), six axis neck transducer (C-1709) and either three accelerometers or their mass equivalent installed in the head assembly. Data from the accelerometers are not required. (572.33(b))
3. The assembly soaked at a temperature between 20.6°C (69°F) and 22.2°C (72°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to a test. (572.33(c)(1))
- |                                 |               |
|---------------------------------|---------------|
| Record the maximum temperature: | <u>21.5°C</u> |
| Record the minimum temperature: | <u>20.9°C</u> |
| Record the maximum humidity:    | <u>52%</u>    |
| Record the minimum humidity:    | <u>45%</u>    |
4. Visually inspect neck assembly for cracks, cuts and separation of the rubber from the metal segments. Note: If the damage resulted from the vehicle crash test in which the dummy was an occupant, the damaged area is to be documented with photography and the post test calibration verification testing completed before any replacement or repairs are made.
- Record findings and actions: No damage
5. Inspect the nodding blocks (78051-351) for any deterioration, but when replacement is necessary, ONLY replace during pre-test calibration. Using a Shore "A" type Durometer, verify the hardness of the nodding blocks is between 80 and 90. Ensure the nodding blocks are installed correctly. (78051-90).
- Record findings and actions: No Deterioration; Hardness: Front 89; Back 90.
6. Pre-test calibration Neck cable torque: Torque the jam nut (78051-64) on the neck cable (78051-301) to 1.0 ± 0.2 lb-ft by loosening the jam nut and relaxing the neck cable before torquing. (572.33(c)(2))

- X 7. The data acquisition system, including transducers, conforms to the requirements of SAE Recommended Practice J211/1 MAR95. (572.36(i))
- X 8. The test fixture pendulum conforms to the specifications in Figure 8A. (572.33(c)(3))
- X 9. The head-neck assembly is mounted on the pendulum so the midsagittal plane of the head is vertical and coincides with the plane of motion of the pendulum longitudinal centerline as shown in Figure 10A for the extension test. (572.33(c)(3))
- X 10. Install the transducers or other devices for measuring the "D" plane rotation with respect to the pendulum longitudinal centerline. Note: Plane "D" is the bottom horizontal surface of the skull. These measurement devices should be designed to minimize their influence upon the performance of the head-neck assembly. An example of a measurement device is shown in Figure 11A.
- X 11. With the pendulum resting against the honeycomb material, the neck bracket was adjusted until the longitudinal centerline of the pendulum was perpendicular  $\pm 1$  degree to plane "D" on the dummy's head.
- X 12. Release the pendulum and allow it to fall freely from a height to achieve an impact speed of 19.5 ft/s to 20.3 ft/sec as measured at the center of the pendulum accelerometer. (572.33(c)(4))
- X 13. Complete the following table:  
Neck Extension Test Results (572.33(b)(2) & 572.33(c)(4))

Parameter		Specification	Results
Pendulum impact speed		19.5 ft/s $\leq$ speed $\leq$ 20.3 ft/s	20.30 ft/s
Pendulum Deceleration Versus Time Pulse	@ 10 ms	17.2 $\leq$ g $\leq$ 21.2	18.90 g's
	@ 20 ms	14 $\leq$ g $\leq$ 19	16.52 g's
	@ 30 ms	11.0 $\leq$ g $\leq$ 16.0	12.73 g's
	Above 30 ms	22 g maximum	12.8 g's
First Pendulum Decay to 5g		38 ms $\leq$ time $\leq$ 46 ms	43.2 ms
Plane D Rotation		81° $\leq$ max. rotation $\leq$ 106°	96.6°
		72 ms $\leq$ time of max. rotation $\leq$ 82 ms	76.8 ms
Time for Plane D Rotation to Cross 0° During First Rebound		147 ms $\leq$ time $\leq$ 174 ms	159.4 ms
Maximum Moment		-59 lbf-ft $\leq$ moment $\leq$ -39 lbf-ft	-43.1 lbf-ft
		65 ms $\leq$ time of max. moment $\leq$ 79 ms	71.8 ms
Time of first decay to 0 lbf-ft Positive Moment Decay** (Extension)		120 ms $\leq$ time $\leq$ 148 ms	141.6 ms

\*Moment about the occipital condyle =  $M_y - (0.058 \text{ ft} \times F_x)$ (572.33(b)(2)(ii))

$M_y$  = Moment in lbf-ft measured by the transducer

$F_x$  = Force, in lbf measured by the transducer

\*\*Time zero is defined as the time of initial contact between the pendulum striker plate and the honeycomb material. (572.33(b)(3))

- X 14. Plots of pendulum acceleration, y-axis moment, x-axis force, y-axis moment about the occipital condyle, and D plane rotation follows this sheet.

*David Schoedel*

Signature

08/01/2014

Date

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

ATD Serial No: 403

Test I.D.: D142733

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	20.9	Pass
Laboratory Relative Humidity		%	10 to 70	52	Pass
Pendulum Velocity		m/s	5.95 to 6.19	6.18	Pass
Pendulum Deceleration	10 ms	G's	17.20 to 21.20	18.90	Pass
	20 ms	G's	14.00 to 19.00	16.52	Pass
	30 ms	G's	11.00 to 16.00	12.73	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 22.0	12.8	Pass
Deceleration Decay Time to Cross 5 G's		ms	38.0 to 46.0	43.2	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	81.0 to 106.0	96.6	Pass
	Time	ms	72.0 to 82.0	76.8	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	147.0 to 174.0	159.4	Pass
Moment About Occipital Condyle	Maximum	Nm	-52.9 to -79.9	-58.5	Pass
	Time	ms	65.0 to 79.0	71.8	Pass
Negative Moment Decay Time To Zero Crossing		ms	120.0 to 148.0	141.6	Pass
Overall Test Results					Pass

*David Schoedel*

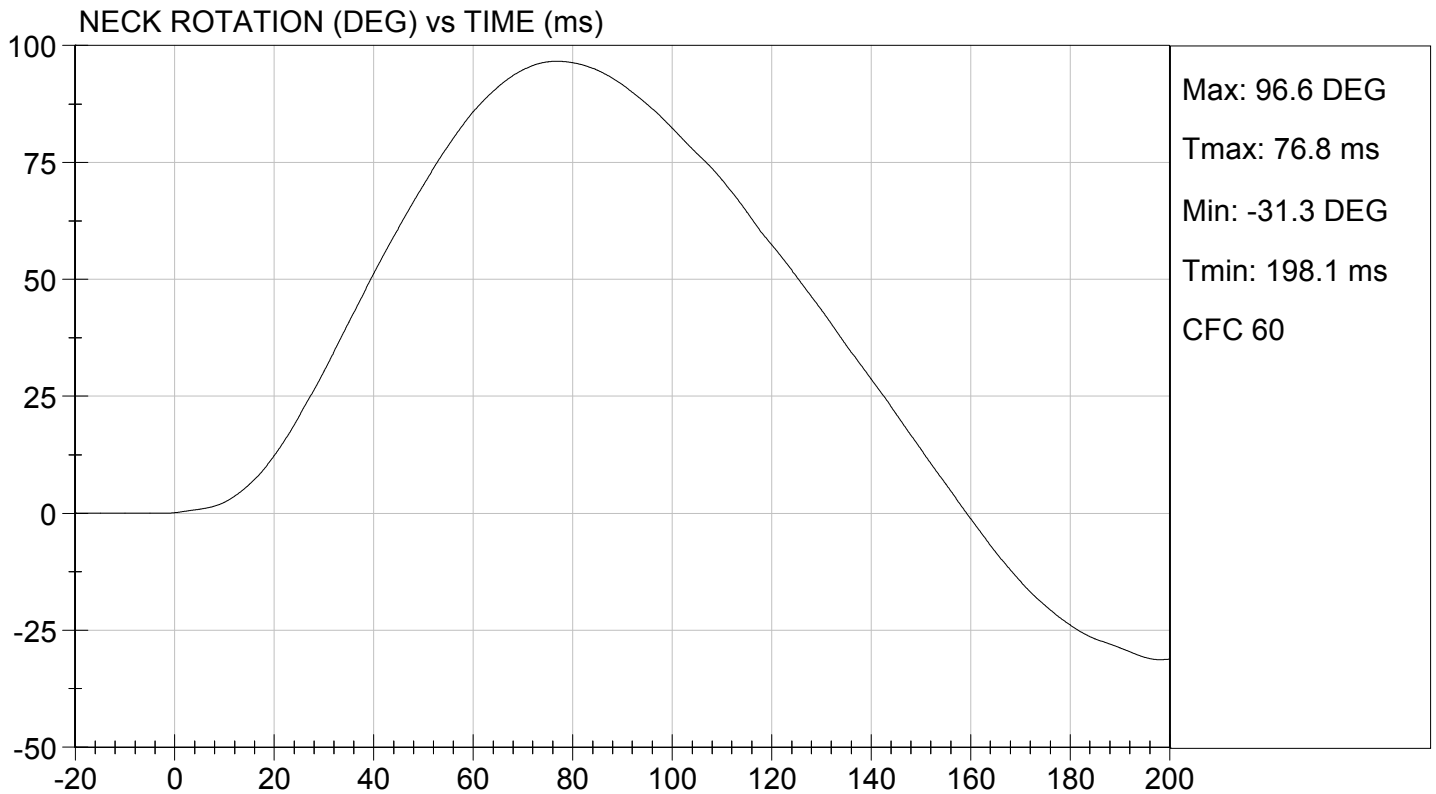
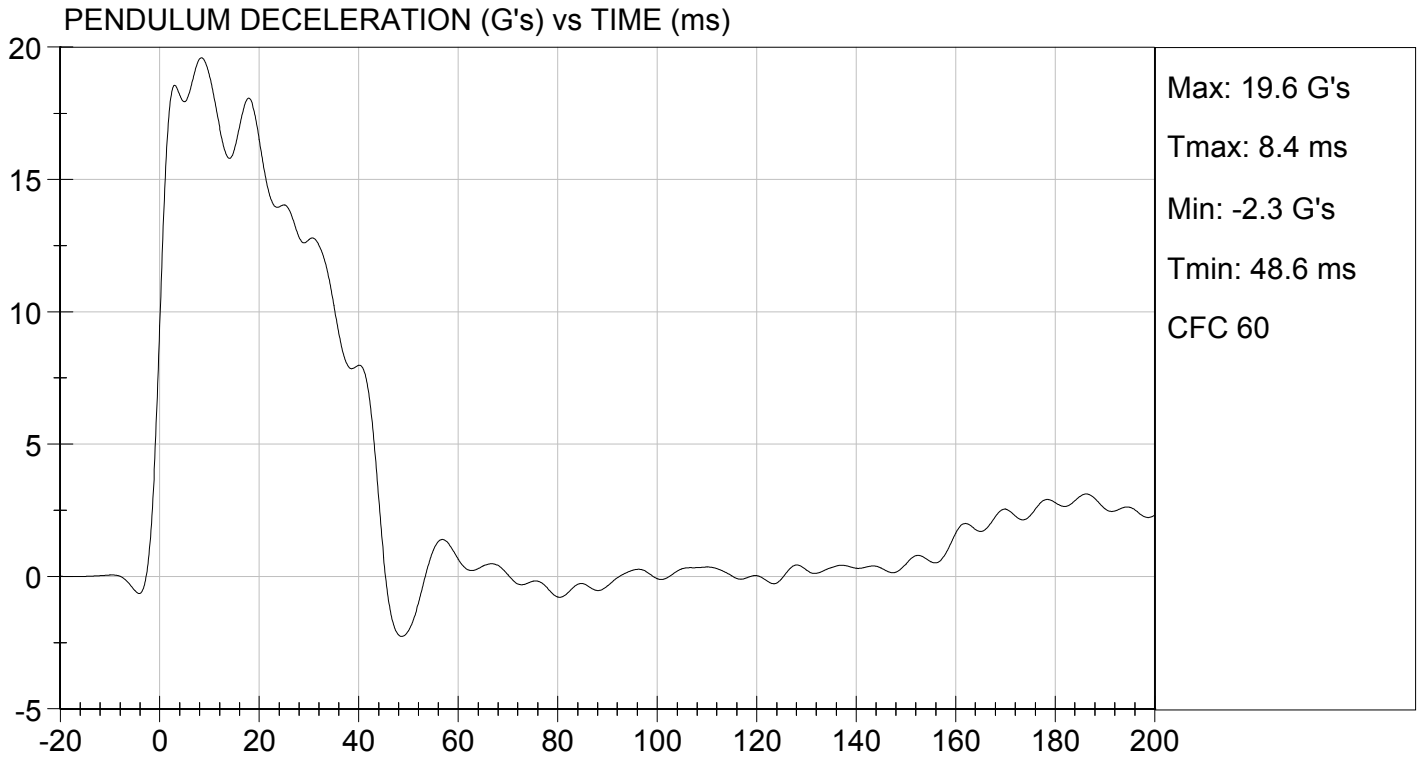
Laboratory Technician

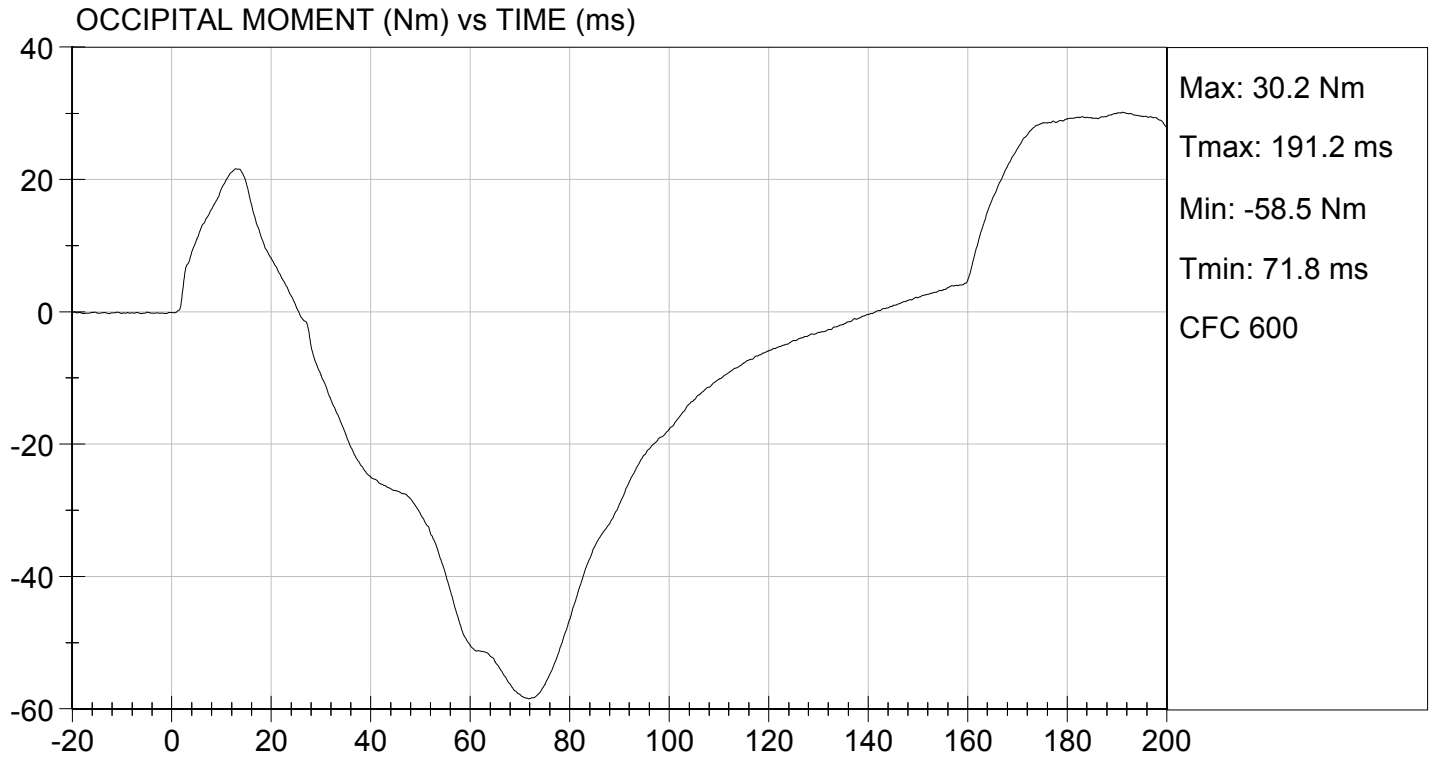
08/01/2014

Test Date

*Jeff Levanowski*

Approved By





**DATA SHEET A6**  
THORAX IMPACT TEST (572.34) (50<sup>th</sup> Male)

Dummy Serial Number: 403

Test Date: 08/01/2014

Technician: Joseph Radke

- Pre test calibration  
 Post test calibration verification

Test attempt no. 1 (when successive thorax impact tests are necessary)

1. It has been at least 30 minutes since the last thorax impact test. (572.137(q))  
 N/A, ONLY one thorax impact test performed
2. The test fixture conforms to the specifications in Figure 12A.
3. The complete assembled dummy (78051-218) is used (572.34(b)) and is dressed in a form fitting cotton stretch above-the-elbow sleeved shirt and above-the-knee pants. No shoes are worn. (572.34(b))
4. The dummy assembly soaked at a temperature between 20.6°C (69°F) and 22.2°C (72°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to this test. (572.34(c)(1))

Record the maximum temperature:	<u>21.5°C</u>
Record the minimum temperature:	<u>20.9°C</u>
Record the maximum humidity:	<u>52%</u>
Record the minimum humidity:	<u>45%</u>

5. Remove the chest skin and visually inspect the thorax assembly for cracks, cuts, abrasions, etc. Particular attention should be given to the rib damping material (78051-17 thru 78051-22), chest displacement transducer assembly (78051-317) and the rear rib supports (78051-304). Inspect for rib deformation using the chest depth gage (83-5006-007). If any damage is noted repair and/or replace the damaged components unless the damage resulted from the vehicle crash test in which the dummy was an occupant in which case the damage must be documented and post test calibration verification testing completed before any repairs or replacements are made.

- No Damage

- Damage from crash test, no repairs or replacement because this is a post test calibration verification. Record damage:

- The following repairs or replacement was performed. Record:

---

- X 6. Seat the dummy, (chest skin still removed) without back and arm supports on the test fixture surface as shown in Figure 12A. The surface must be long enough to support the pelvis and outstretched legs. (572.34(c)(2))
- X 7. Level the ribs both longitudinally and laterally  $\pm 0.5^\circ$  and adjust the pelvis angle to  $13^\circ \pm 2^\circ$ . The angle may be measured using the special H-point tool (78051-532) that inserts into the pelvic structure and extends outward beyond the pelvic skin surface or by using the surface of the pelvic adaptor block. (572.34(c)(2))
- X 8. The midsagittal plane of the dummy is vertical within  $\pm 1^\circ$ . (572.134(c)(3))
- X 9. The longitudinal centerline of the test probe is centered within  $\pm 2.5$  mm of the midsagittal plane of the dummy and is  $12.7$  mm  $\pm 1$  mm below the horizontal peripheral centerline of the No. 3 rib and is within  $0.5^\circ$  of a horizontal line in the dummy's midsagittal plane. (572.34(c)(4))
- X 10. Align the adjustable neck bracket index marks to the "zero" position. (Figure 12A)
- X 11. Record locations such as the rear surfaces of the thoracic spine and the lower neck bracket reference with respect to locations such as the rear surfaces of the thoracic spine and the lower neck bracket. These reference measurements are necessary to ensure the dummy is in the same position after the chest skin is installed. The reference locations must be accessible after installation of the chest skin. It may be necessary to leave the chest skin zipper unfastened until the references are checked and fasten it just prior to the test.
- X 12. Install the chest skin and reposition the dummy as described in the preceding paragraph using the reference measurements recorded.
- X 13. Place the arm assemblies horizontal  $\pm 2^\circ$  and parallel to the midsagittal plane. The arms are held in place by tightening the adjustment nut that holds the arm yoke to the clavicle assembly.
- X 14. The data acquisition system, including transducers, must conform to the requirements of SAE Recommended Practice J211/1 MAR95 Class 180.
- X 15. Impact the anterior surface of the thorax with the test probe so the longitudinal centerline of the probe is within  $2^\circ$  of a horizontal line in the dummy's midsagittal plane at the moment of impact. (572.34(c)(5)) The velocity of the test probe at the time of impact is  $22$  f/s  $\pm 0.4$  f/s. (572.34(b)) The probe is guided so there is no significant lateral, vertical or rotational movement during the impact. (572.34(c)(6))

X 16. Complete the following table:

Thorax Impact Results (572.34(b))

Parameter*	Specification	Result
Test Probe Speed	$21.6 \text{ ft/s} \leq \text{speed} \leq 22.4 \text{ ft/s}$	22.22 ft/s
Chest Compression	$2.5 \text{ in.} \leq \text{compression} \leq 2.86 \text{ in.}$	2.69 in.
Peak resistance force**	$1160 \text{ lb} \leq \text{peak force} \leq 1325 \text{ lb}$	1267 lb
Internal Hysteresis***	$69\% \leq \text{hysteresis} \leq 85\%$	69%

\*Time zero is defined as the time of initial contact between the test probe and the chest skin.

\*\*Force = impactor mass x acceleration (572.34(b))

\*\*\*Area under loading curve minus the area under the unloading curve divided by the area under the loading curve.

X 17. Plots of chest compression, pendulum acceleration, pendulum speed, and force, follow this sheet.

Joseph Radtke  
Signature

08/01/2014  
Date

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

ATD Serial No: 403

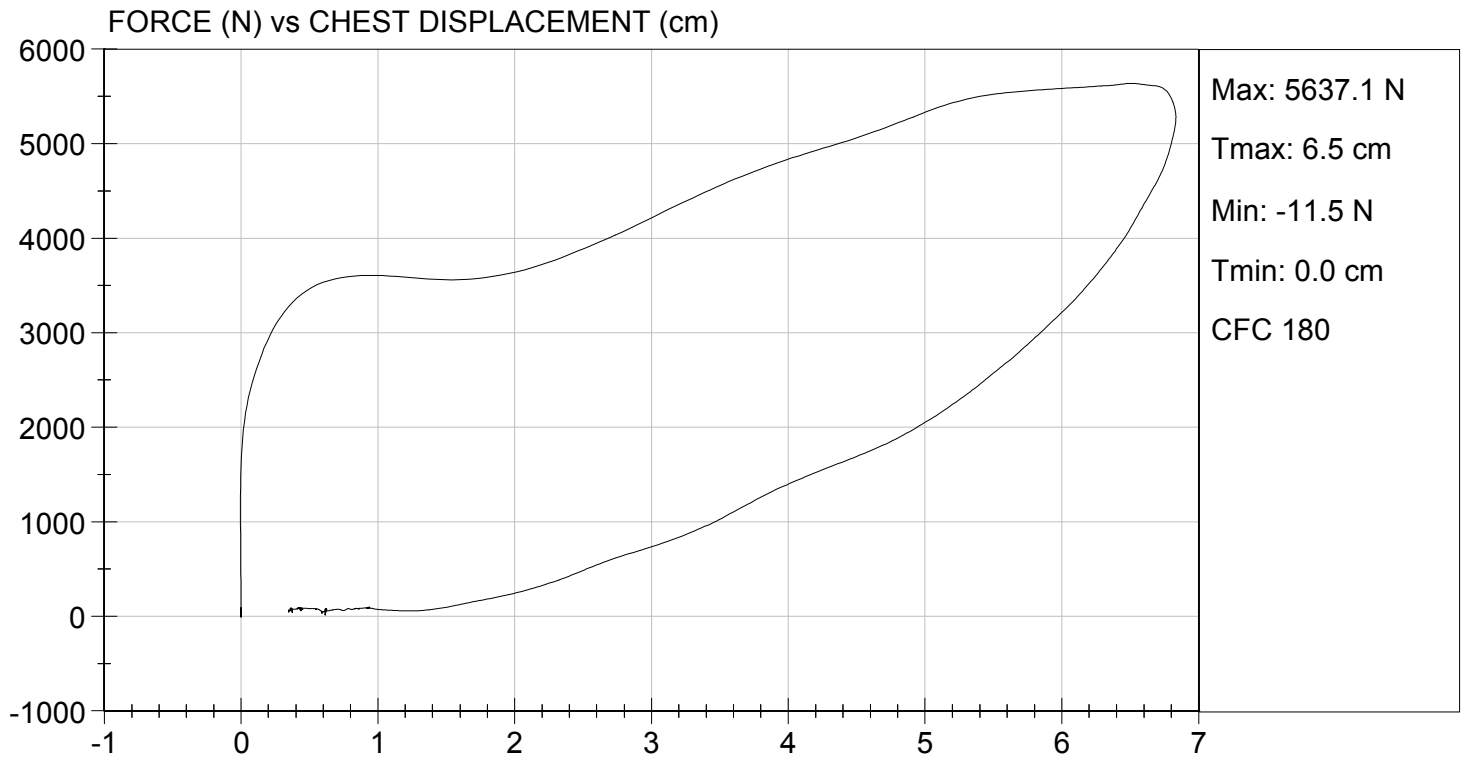
Test I.D: D142734

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.5	Pass
Laboratory Relative Humidity	%	10 to 70	47	Pass
Probe Velocity	m/s	6.58 to 6.82	6.77	Pass
Peak Probe Force	N	5159 to 5893	5,637	Pass
Peak Sternum Displacement	cm	6.35 to 7.26	6.83	Pass
Internal Hysteresis	%	69 to 85	69	Pass
<b>Overall Test Results</b>				<b>Pass</b>

Joseph Radke  
 Laboratory Technician

08/01/2014  
 Test Date

Jeff Leonard  
 Approved By



**DATA SHEET A7**  
LEFT KNEE IMPACT TEST (572.35) (50<sup>th</sup> Male)

Dummy Serial Number: 403

Test Date: 08/01/2014

Technician: Joseph Radke

- Pre test calibration  
 Post test calibration verification

Test attempt no. 1 (when successive knee impact tests are necessary)

1. It has been at least 30 minutes since the last knee impact test. (572.36(m))  
 N/A, ONLY one knee impact test performed
2. The test fixture conforms to the specifications in Figure 14A.
3. The leg assembly (86-5001-001) with the upper leg assembly (78051-46) removed, and the load cell simulator (78051-319) is used. (572.35(b)(2))
4. The knee assembly soaked at a temperature between 18.9°C (66°F) and 25.6°C (78°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to this test. (572.35(b)(2)(ii))
- |                                 |               |
|---------------------------------|---------------|
| Record the maximum temperature: | <u>21.5°C</u> |
| Record the minimum temperature: | <u>20.9°C</u> |
| Record the maximum humidity:    | <u>52%</u>    |
| Record the minimum humidity:    | <u>45%</u>    |
5. Mount the test specimen and secure it to the rigid test fixture. (572.35(b)(2)(iii)) (Figure 14A)
6. No parts of the foot or tibia contact any exterior surface. (572.35(b)(2)(iii))
7. Align the test probe so that at contact the longitudinal centerline of the probe is collinear within 2 degrees with the longitudinal centerline of the femur load cell simulator except it is within 0.5 degrees horizontally. (572.35(b)(2)(iv)&(vi))
8. The probe is guided so there is no significant lateral, vertical or rotational movement during the impact with the knee. (572.35(b)(2)(v))
9. The data acquisition system, including transducers, must conform to the requirements of SAE Recommended Practice J2111/1 MAR95 (572.136(m)) Class 600.
10. Contact the knee with the test probe at a speed between 6.8 ft/s and 7.0 ft/s. (572.35(b))

X 11. Complete the following table:

Knee Impact Results (572.35(b)(1))

Parameter	Specification	Result
Probe speed	$6.8 \text{ ft/s} \leq \text{speed} \leq 7.0 \text{ ft/s}$	6.97 ft/s
Peak resistance force*	$1060 \text{ lb} \leq \text{force} \leq 1300 \text{ lb}$	1117 lb

\*Force = impactor mass x deceleration (572.35(b)(1))

X 12. Plots of pendulum acceleration, pendulum speed, and force, follow this sheet. Time zero is defined as the time of contact between the test probe and the knee. (572.3(b)(2)(vii))

Joseph Radtke  
Signature

08/01/2014  
Date

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

**ATD Serial No:** 403

**Test I.D:** D142736

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.4	Pass
Laboratory Relative Humidity	%	10 to 70	52	Pass
Probe Velocity	m/s	2.07 to 2.13	2.12	Pass
Peak Probe Force	N	4715 to 5782	4,967	Pass
Overall Test Results				Pass

Joseph Radke  
 Laboratory Technician

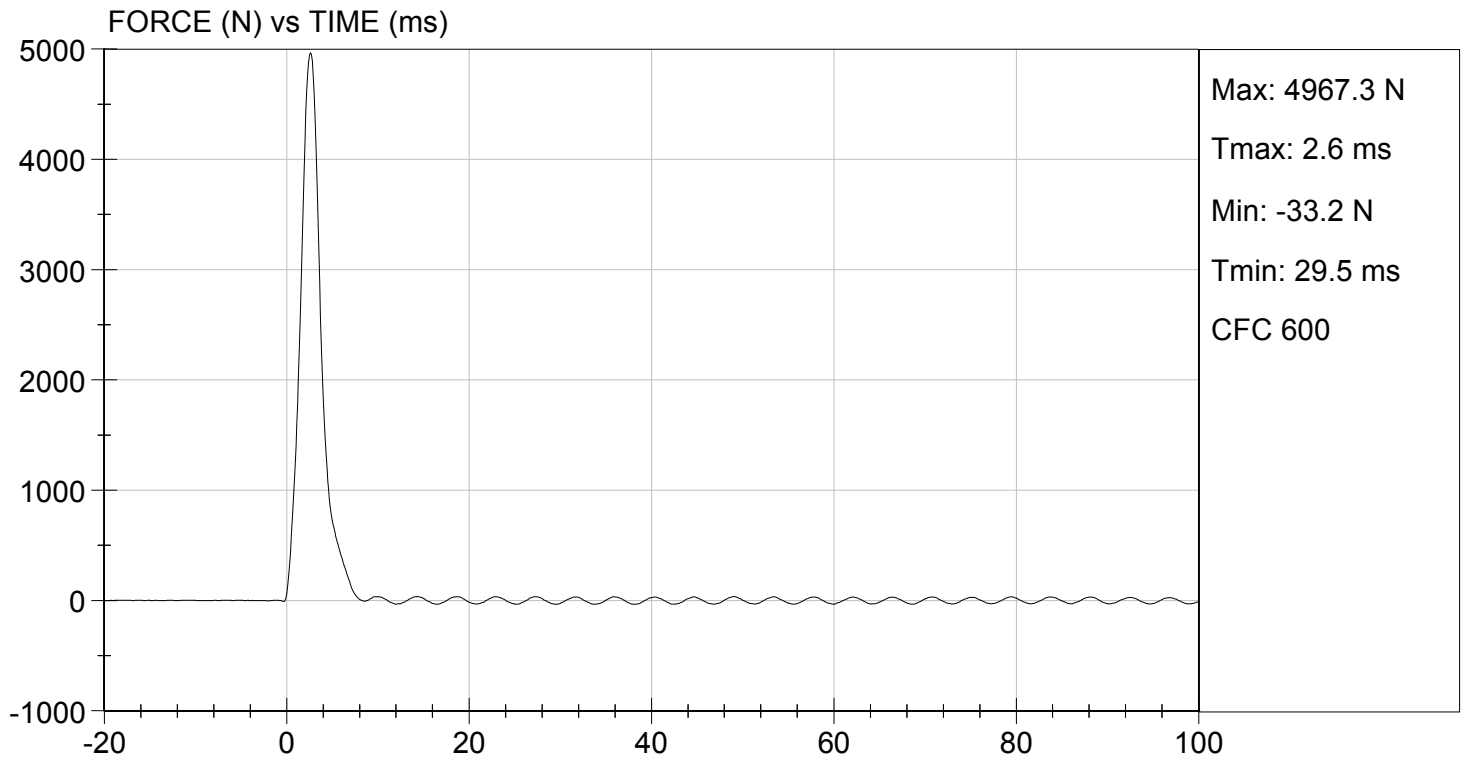
08/01/2014  
 Test Date

Jeff Leonard  
 Approved By



TEST DESC: LEFT KNEE  
VELOCITY: 6.97 ft/s, 2.12 m/s

TEST DATE: 08/01/2014  
TEST #: D142736



**DATA SHEET A8**  
RIGHT KNEE IMPACT TEST (572.35) (50<sup>th</sup> Male)

Dummy Serial Number: 403

Test Date: 08/01/2014

Technician: Joseph Radke

- Pre test calibration  
 Post test calibration verification

Test attempt no. 1 (when successive knee impact tests are necessary)

1. It has been at least 30 minutes since the last knee impact test. (572.36(m))  
 N/A, ONLY one knee impact test performed
2. The test fixture conforms to the specifications in Figure 14A.
3. The leg assembly (86-5001-002) with the upper leg assembly (78051-47) removed, and the load cell simulator (78051-319) is used. (572.35(b)(2))
4. The knee assembly soaked at a temperature between 18.9°C (66°F) and 25.6°C (78°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to this test. (572.35(b)(2)(ii))
- |                                 |               |
|---------------------------------|---------------|
| Record the maximum temperature: | <u>21.5°C</u> |
| Record the minimum temperature: | <u>20.9°C</u> |
| Record the maximum humidity:    | <u>52%</u>    |
| Record the minimum humidity:    | <u>45%</u>    |
5. Mount the test specimen and secure it to the rigid test fixture. (572.35(b)(2)(iii)) (Figure 14A)
6. No parts of the foot or tibia contact any exterior surface. (572.35(b)(2)(iii))
7. Align the test probe so that at contact the longitudinal centerline of the probe is collinear within 2 degrees with the longitudinal centerline of the femur load cell simulator except it is within 0.5 degrees horizontally. (572.35(b)(2)(iv)&(vi))
8. The probe is guided so there is no significant lateral, vertical or rotational movement during the impact with the knee. (572.35(b)(2)(v))
9. The data acquisition system, including transducers, must conform to the requirements of SAE Recommended Practice J211/1 MAR95 (572.136(m)) Class 600.
10. Contact the knee with the test probe at a speed between 6.8 ft/s and 7.0 ft/s. (572.35(b))

X 11. Complete the following table:

Knee Impact Results (572.35(b)(1))

Parameter	Specification	Result
Probe speed	$6.8 \text{ ft/s} \leq \text{speed} \leq 7.0 \text{ ft/s}$	6.97 ft/s
Peak resistance force*	$1060 \text{ lb} \leq \text{force} \leq 1300 \text{ lb}$	1083 lb

\*Force = impactor mass x deceleration (572.35(b)(1))

X 12. Plots of pendulum acceleration, pendulum speed, and force, follow this sheet. Time zero is defined as the time of contact between the test probe and the knee. (572.3(b)(2)(vii))

Joseph Radtke  
Signature

08/01/2014  
Date

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

**ATD Serial No:** 403

**Test I.D:** D142735

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.4	Pass
Laboratory Relative Humidity	%	10 to 70	52	Pass
Probe Velocity	m/s	2.07 to 2.13	2.12	Pass
Peak Probe Force	N	4715 to 5782	4,820	Pass
<b>Overall Test Results</b>				<b>Pass</b>

Joseph Radtke  
 Laboratory Technician

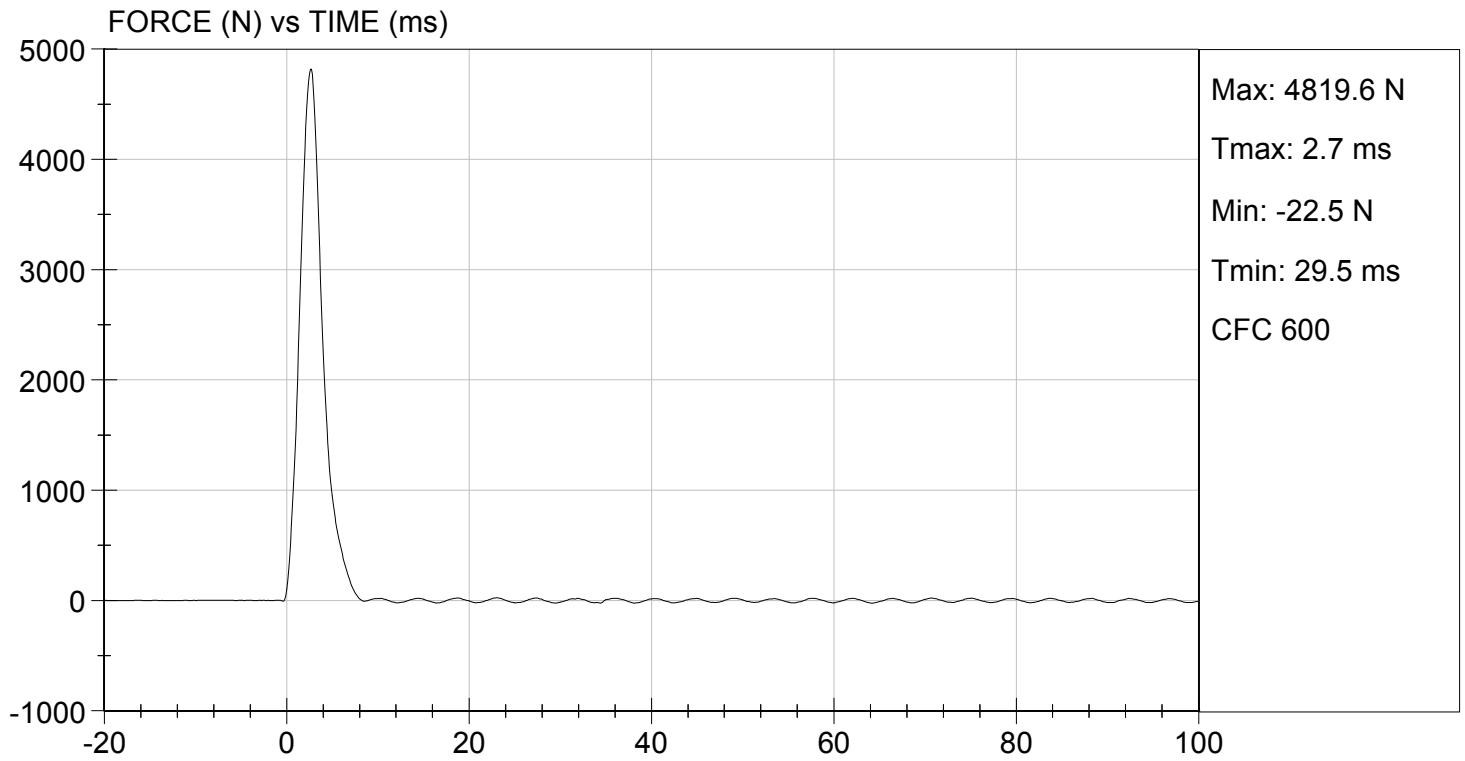
08/01/2014  
 Test Date

Jeff Leonard  
 Approved By



TEST DESC: RIGHT KNEE  
VELOCITY: 6.97 ft/s, 2.12 m/s

TEST DATE: 08/01/2014  
TEST #: D142735



**DATA SHEET A9**  
HIP JOINT-FEMUR FLEXION (572.35(c)) (50<sup>th</sup> Male)

Dummy Serial Number: 403

Test Date: 08/01/2014

Technician: Joseph Radke

- Pre test calibration  
 Post test calibration verification

Test attempt no. 1 (when successive hip joint-femur flexion tests are necessary)

1. It has been at least 30 minutes since the last hip joint-femur flexion test. (572.36(m))  
 N/A, ONLY one hip joint-femur flexion test performed
2. The test fixture conforms to the specifications in Figure 17A.
3. Use the assembled dummy (78051-218) except (572.35(c)(2)):  
 3.1 remove the leg assemblies (86-5001-001 & 002) by removing 3/8-16 Socket Head Cap Screw and retaining the structural assembly of the upper legs (78051-43 & 44)  
 3.2 remove the abdominal insert (78051-52)  
 3.3 replace the instrument cover plate (78051-13) in the pelvic bone with a rigid pelvic bone stabilizer insert (Figure 15A) and attach the pelvis upper support device (Figure 16A).
4. The assembly soaked at a temperature between 18.9°C (66°F) and 25.6°C (78°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to this test. (572.35(c)(v))
- |                                 |               |
|---------------------------------|---------------|
| Record the maximum temperature: | <u>21.5°C</u> |
| Record the minimum temperature: | <u>20.9°C</u> |
| Record the maximum humidity:    | <u>52%</u>    |
| Record the minimum humidity:    | <u>45%</u>    |
5. Seat the dummy on the rigid seat fixture. (572.35(c)(2)(ii))
6. Secure the dummy by bolting the stabilizer insert and the pelvis upper support device to the seat back of the test fixture as shown in Figures 17A, 18A, and 19A. (572.35(c)(2)(ii))
7. Adjust the threaded rods until plane B is horizontal.
8. Secure the lever arm into the left femur shaft opening of the upper leg structure assembly (78051-43) and firmly secure it using the 3/8-16 socket head cap screws (Figure 19A). (572.35(c)(2)(iii))

X 9. Lift the lever arm parallel to the midsagittal plane at a rotation rate between 5 and 10 degrees per second while maintaining the ½ in. shoulder bolt longitudinal centerline horizontal throughout the range of motion until the 150 ft-lbf torque level is reached (Figures 18A and 19A). (572.35(c)(2)(iv))

X 10. Complete the following table:  
Left Hip Joint-Femur Flexion Results (572.35(c)(1) & (c)(2)(iv))

Parameter	Specification	Result
Rotation Rate	5°/s ≤ rotation rate ≤ 10°/s	6.2°/s
Femur Torque at 30°	Torque ≤ 70 ft-lbf	49.8 ft-lbf
Rotation at 150 lbf-ft	40° ≤ rotation ≤ 50°	44.1°

X 11. Secure the lever arm into the right femur shaft opening of the upper leg structure assembly (78051-44) and firmly secure it using the 3/8-16 socket head cap screws (Figure 19A). (572.35(c)(2)(iii))

X 12. Lift the lever arm parallel to the midsagittal plane at a rotation rate between 5 and 10 degrees per second while maintaining the ½ in. shoulder bolt longitudinal centerline horizontal throughout the range of motion until the 150 ft-lbf torque level is reached (Figures 18A and 19A). (572.35(c)(2)(iv))

X 13. Complete the following table:  
Right Hip Joint-Femur Flexion Results (572.35(c)(1) & (c)(2)(iv))

Parameter	Specification	Result
Rotation Rate	5°/s ≤ rotation rate ≤ 10°/s	6.2°/s
Femur Torque at 30°	torque ≤ 70 ft-lbf	58.6 ft-lbf
Rotation at 150 lbf-ft	40° ≤ rotation ≤ 50°	42.9°

Joseph Radtke  
Signature

08/01/2014  
Date

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

**ATD Serial No:** 403

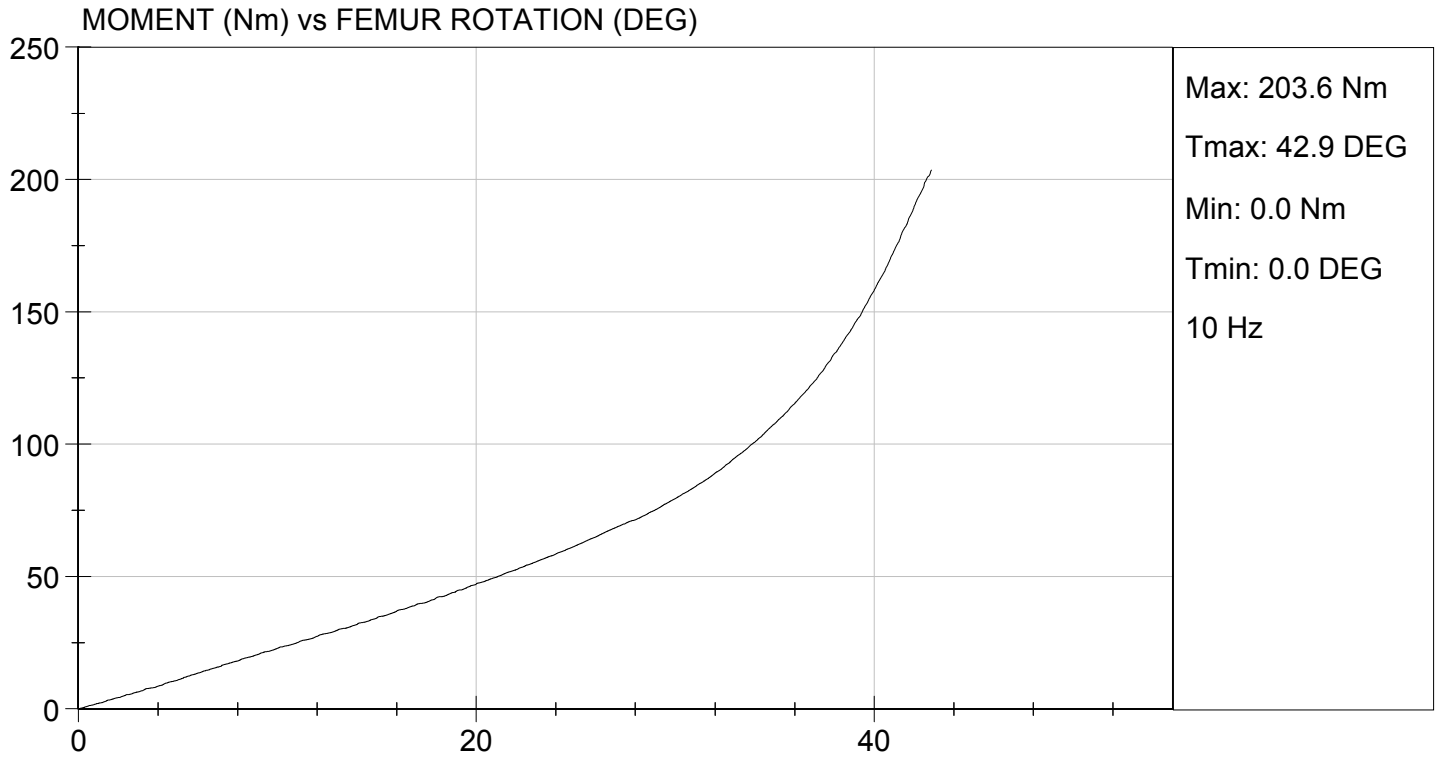
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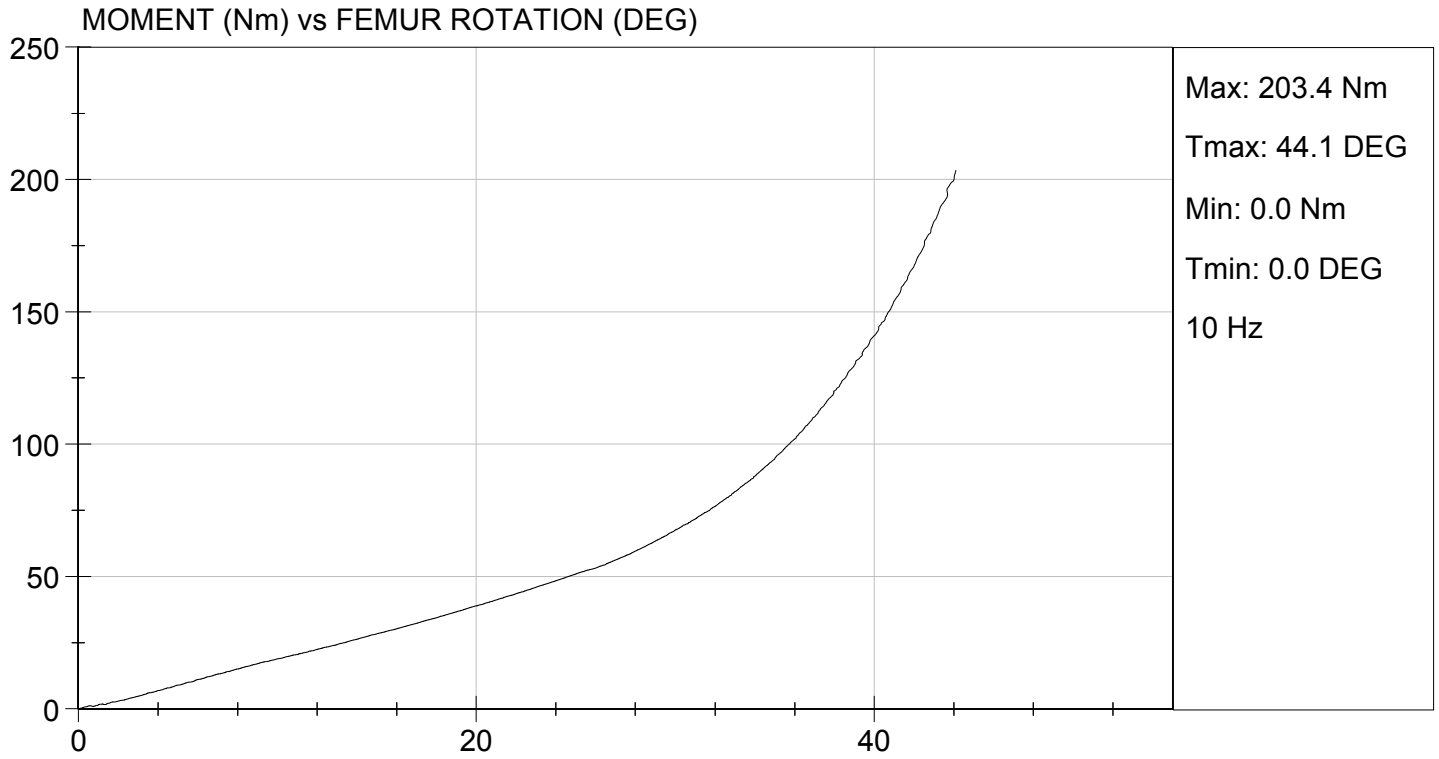
Tested Parameter	Units	Specification	Result		Pass/Fail
			Right	Left	
Laboratory Temperature	deg C	18.9 to 25.6	21.4	21.4	Pass
Laboratory Relative Humidity	%	10 to 70	51	51	Pass
Rotation Rate	deg/s	5.0 to 10.0	6.2	6.2	Pass
30 Degrees	Nm	94.9 Nm Max	79.5	67.5	Pass
150 ft-lbf / 203.4 Nm	Deg	40.0 to 50.0 Degree Max Rotation	42.9	44.1	Pass
Overall Test Results					Pass

Joseph Radke  
 Laboratory Technician

08/01/2014  
 Test Date

Jeff Leonard  
 Approved By





**DATA SHEET A10**

**PART 572 INSTRUMENTATION CALIBRATION INFORMATION**

I.D. NO.	MANUFACTURER	MODEL NO.	SERIAL NO.	DATE OF LAST CALIBRATION	DATE OF NEXT CALIBRATION
DUMMY INSTRUMENTATION					
HEAD ACCELEROMETERS					
(1) LONGITUDINAL	Endevco	7231C-750	AGH70	04/10/2014	10/10/2014
(2) LATERAL	Endevco	7231C-750	AH5E5	04/10/2014	10/10/2014
(3) VERTICAL	Endevco	7231C-750	C10591	04/10/2014	10/10/2014
NECK TRANSDUCER	Denton	1716	1561	03/06/2014	09/06/2014
CHEST ACCELEROMETERS					
(1) LONGITUDINAL	Endevco	7231C-750	AGH55	04/10/2014	10/10/2014
(2) LATERAL	Endevco	7231C-750	AGH79	04/10/2014	10/10/2014
(3) VERTICAL	Endevco	7231C-750	C12863	04/10/2014	10/10/2014
CHEST POTENTIOMETER	Servo	14CBI-2897	403	04/08/2014	10/08/2014
FEMUR LOAD CELLS					
(1) RIGHT FEMUR	Denton	2121	8806	04/14/2014	10/14/2014
(2) LEFT FEMUR	Denton	2121	8807	04/14/2014	10/14/2014
LABORATORY INSTRUMENTATION					
NECK PENDULUM ACCELEROMETER	Endevco	7231C-750	AH467	2/20/2014	8/20/2014
THORAX PENDULUM ACCELEROMETER	Endevco	7264C-2KTZ-2-240	P83176	5/1/2014	11/1/2014
KNEE PENDULUM ACCELEROMETER	Endevco	7264C-2KTZ-2-240	P80111	7/2/2014	1/2/2015
NECK ROTATION TRANSDUCER 1 (OPTIONAL)	Spectrol	132-0-0-102	18	4/15/2014	10/15/2014
NECK ROTATION TRANSDUCER 2 (OPTIONAL)	Spectrol	132-0-0-102	23	4/15/2014	10/15/2014

LABORATORY TECHNICIAN: \_\_\_\_\_

*Jessica Hall*

**DATA SHEET A3**  
HEAD DROP TEST (572.32) (50<sup>th</sup> Male)

Dummy Serial Number: 403

Test Date: 08/25/2014

Technician: David Schoedel

- Pre test calibration  
X Post test calibration verification

Test attempt no. 1 (when successive head drops are necessary)

- X 1. It has been at least 2 hours since the last head drop. (572.32(c)(5))  
    X N/A, ONLY one head drop performed
- X 2. The head assembly consists of the complete head (78051-61X), the neck transducer structural replacement (78051-383X), and three (3) accelerometers. (572.32(b))
- X 3. Torque the skull cap screws to 160 lbf-in.
- X 4. Accelerometers and their respective mounts are smooth and clean.
- X 5. The data acquisition system, including transducers, conforms to the requirements of SAE Recommended Practice J2111/1 MAR95. (572.35(i))
- X 6. The head assembly soaked at a temperature between 18.9°C (66°F) and 25.6°C (78°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to a test. (572.132(c)(1))
- |                                 |               |
|---------------------------------|---------------|
| Record the maximum temperature: | <u>21.6°C</u> |
| Record the minimum temperature: | <u>20.8°C</u> |
| Record the maximum humidity:    | <u>58%</u>    |
| Record the minimum humidity:    | <u>52%</u>    |
- X 7. Visually inspect the head skin for cracks, cuts, abrasions, etc. Repair or replace the head skin if the damaged area is more than superficial. Note: If the damage resulted from the vehicle crash test in which the dummy was an occupant, the damaged area is to be documented with photography and the post test calibration verification testing completed before any replacement or repairs are made.
- Record findings and actions:     No Damage
- X 8. Clean the impact surface of the skin and the impact surface of the fixture with isopropyl alcohol, trichloroethane or equivalent prior to the test. (572.32(c)(2))

X 9. Suspend and orient the head assembly as shown in Figure 6A. The lowest point on the forehead is 0.5 in. below the lowest point on the dummy's nose when the midsagittal plane is vertical. (572.32(c)(3))

Record the actual distance: 0.5 inches

**NOTE:** The masses of the suspension device and the accelerometer cables are to be kept as lightweight as possible to minimize their effect on the test results.

X 10. The 1.6 mm (0.062 inch) diameter holes located on either side of the dummy's head are equidistance within 2 mm from the impact surface. A typical test setup is shown in Figure 7A.

Record the right side distance: 501 mm

Record the left side distance: 501 mm

X 11. The impact surface is clean and dry and has a micro finish in the range of  $203.2 \times 10^{-6}$  mm (8 micro inches) to  $2032.0 \times 10^{-6}$  mm (80 micro inches) (RMS). (572.32(c)(4))

Record actual micro finish: 24.8 micro inches

X 12. The impact surface is rigidly supported. (572.132(c)(4))

X 13. The impact surface is a flat horizontal steel plate 50.8 mm (2 inches) thick and 610 mm (24 inches) square. (Figure 6A)

Record thickness: 50.9 mm

Record width: 604 mm

Record length: 595 mm

X 14. Drop the head assembly from a height of  $376.0 \pm 1.0$  mm (14.8 inches  $\pm$  0.04 inches) by a means that ensures a smooth, instant release onto the impact surface. (572.32(b) & (572.32(c)(4))

X 15. Complete the following table using channel class 1000 data. (572.36(i)):

Parameter	Specification	Result
Peak resultant acceleration	$225 \text{ g} \leq x \leq 275 \text{ g}$	270 g
Resultant versus time history curve	Unimodal	Yes
Oscillations after the main pulse	Less than 10% of the peak resultant acceleration	Yes
Lateral acceleration	y-axis acceleration $\leq \pm 15 \text{ g}$	-12.6 g

X 16. Plots of the x, y, z, and resultant acceleration data follow this sheet.

David Schoedel  
Signature

08/25/2014  
Date

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

ATD Serial No: 403

Test ID: D142941

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	20.8	Pass
Laboratory Relative Humidity	%	10 to 70	58	Pass
Peak Resultant Acceleration	G's	225 to 275	270	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-12.6	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
Overall Test Results				Pass

*David Schoedel*

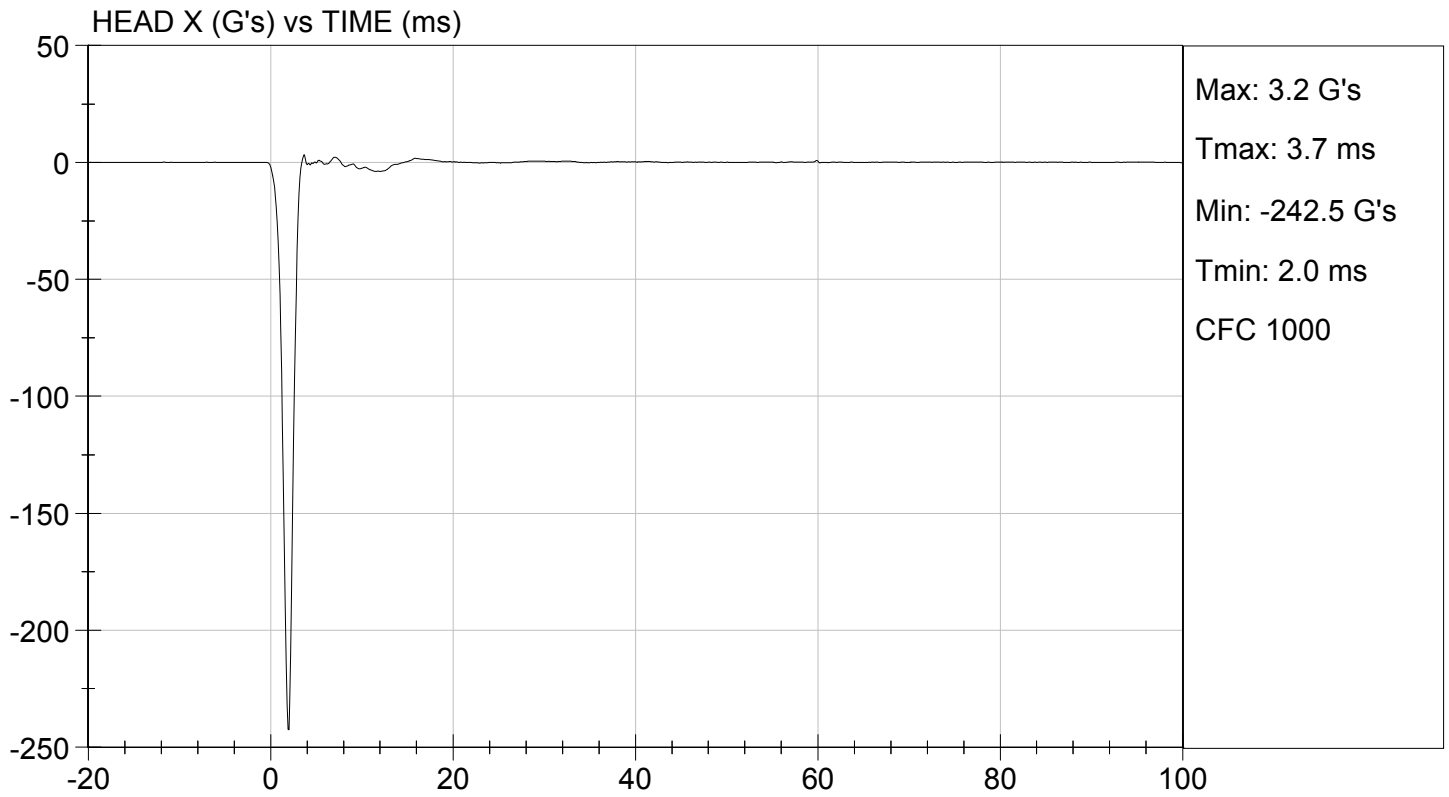
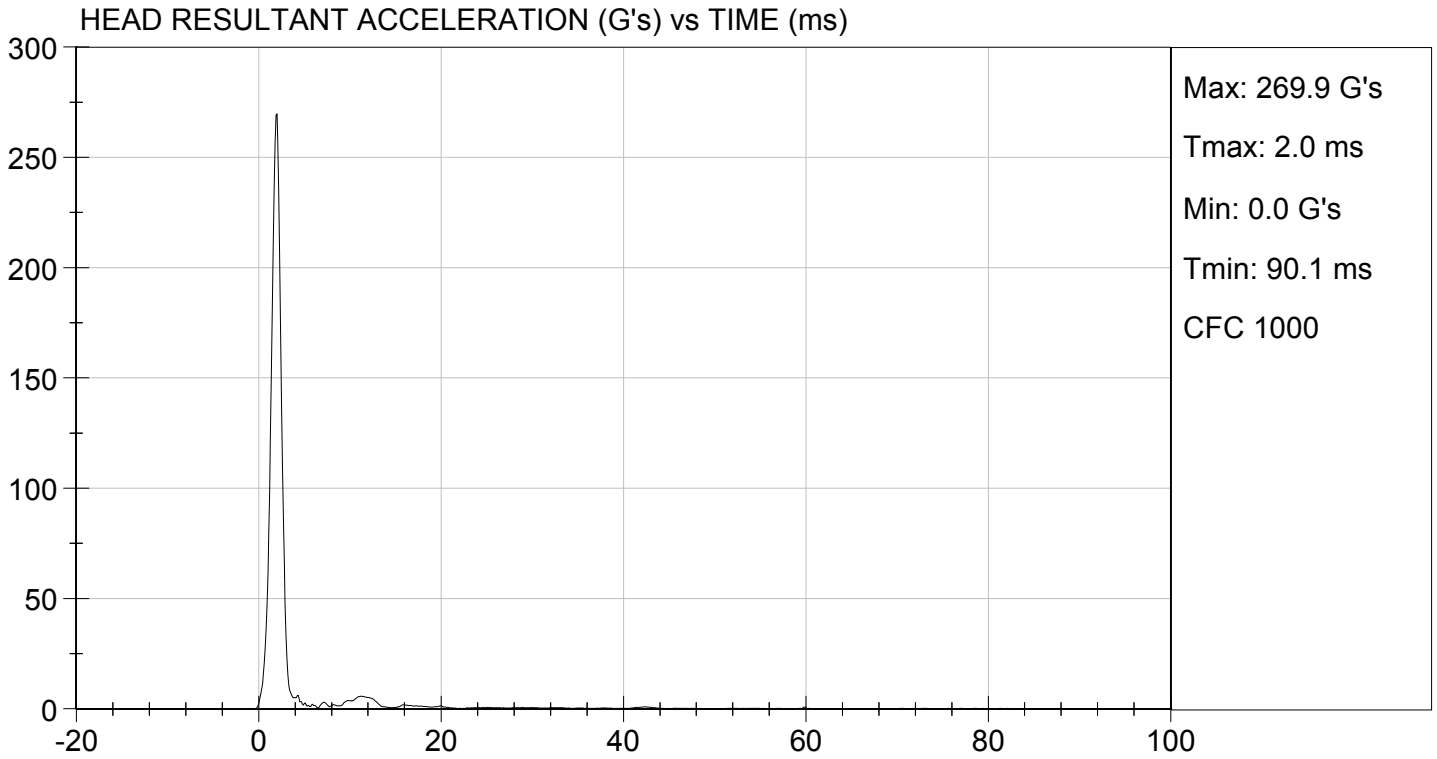
Laboratory Technician

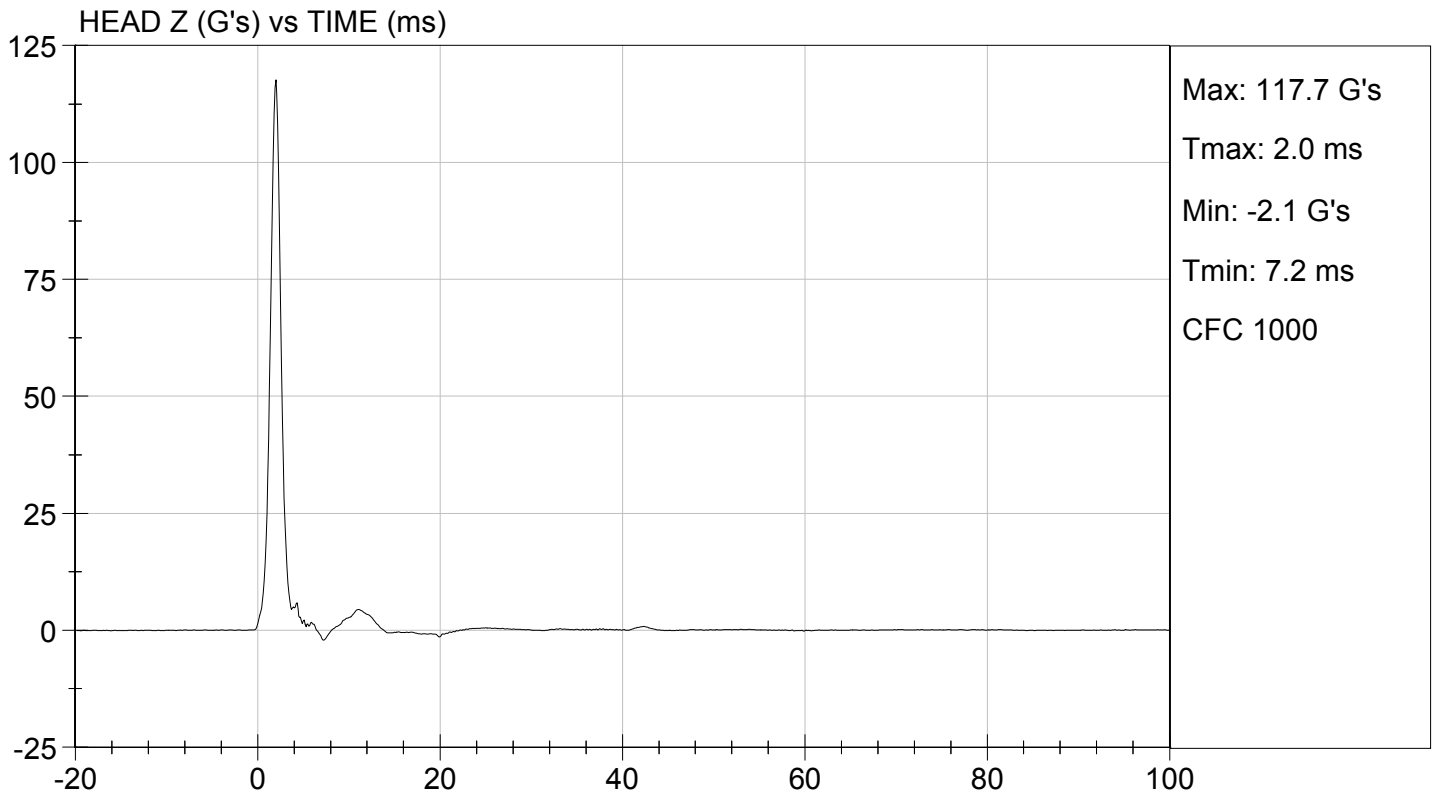
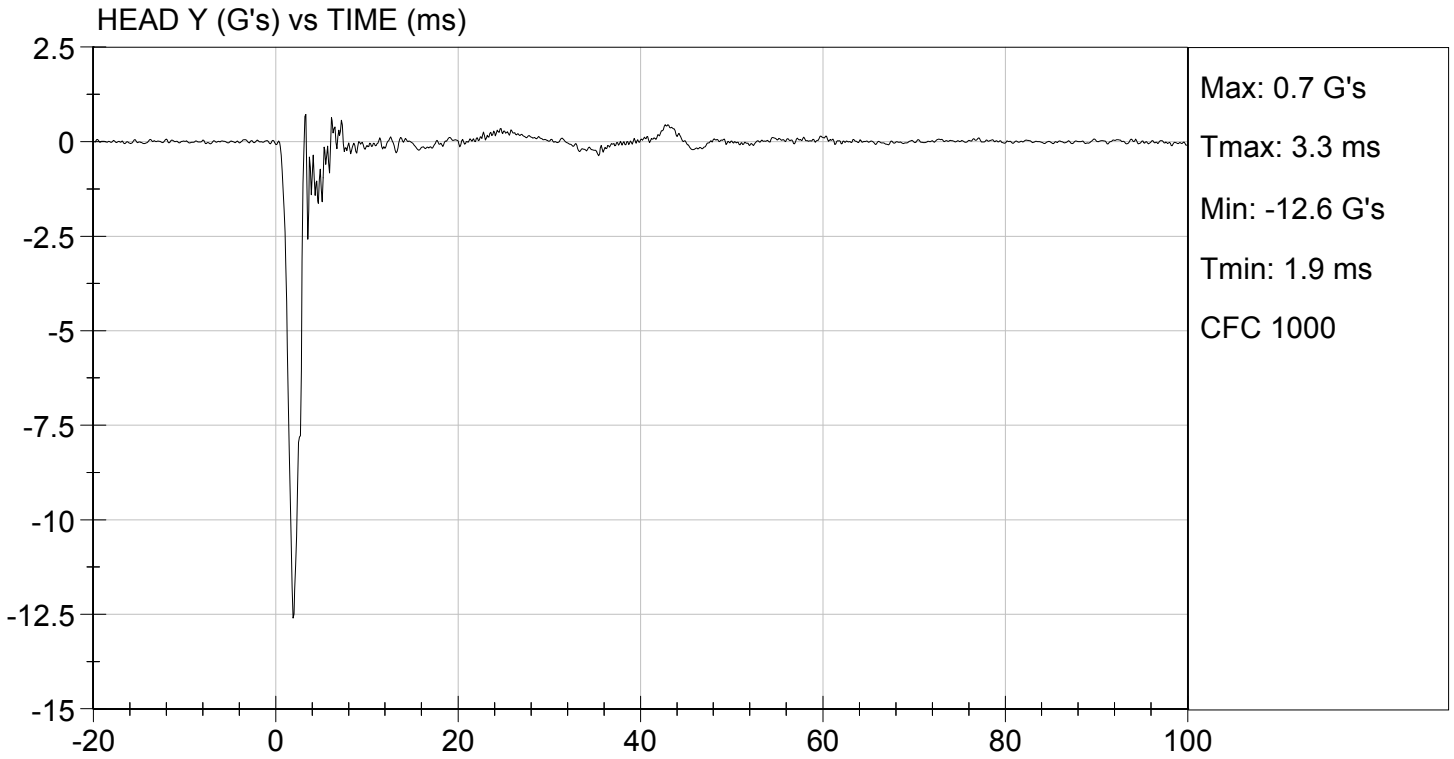
08/25/2014

Test Date

*Jeff Leonard*

Approved By





**DATA SHEET A4**  
NECK FLEXION TEST (572.33) (50<sup>th</sup> Male)

Dummy Serial Number: 403

Test Date: 08/26/2014

Technician: David Schoedel

     Pre test calibration

  X   Post test calibration verification

Test attempt no. 1 (when successive flexion tests are necessary)

  X   1. It has been at least 30 minutes since the last flexion test. (572.36(m))

  X   N/A, ONLY one neck test performed

  X   2. The components required for the neck tests include the head assembly (78051-61X), neck assembly (78051-90), bib simulator (78051-84), upper neck adjusting bracket (78051-307), lower neck adjusting bracket (78051-303), six axis neck transducer (C-1709) and either three accelerometers or their mass equivalent installed in the head assembly. Data from the accelerometers are not required. (572.33(b))

  X   3. The assembly soaked at a temperature between 20.6°C (69°F) and 22.2°C (72°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to a test. (572.33(c)(1))

Record the maximum temperature: 21.6°C

Record the minimum temperature: 20.8°C

Record the maximum humidity: 58%

Record the minimum humidity: 52%

  X   4. Visually inspect neck assembly for cracks, cuts and separation of the rubber from the metal segments. Note: If the damage resulted from the vehicle crash test in which the dummy was an occupant, the damaged area is to be documented with photography and the post test calibration verification testing completed before any replacement or repairs are made.

Record findings and actions: No damage

  X   5. Inspect the nodding blocks (78051-351) for any deterioration, but when replacement is necessary, ONLY replace during pre-test calibration. Using a Shore "A" type Durometer, verify the hardness of the nodding blocks is between 80 and 90. Ensure the nodding blocks are installed correctly. (78051-90).

Record findings and actions: No Deterioration; Hardness: Front 89; Back 90.

  X   6. Pre-test calibration Neck cable torque: Torque the jam nut (78051-64) on the neck cable (78051-301) to 1.0 ± 0.2 lb-ft by loosening the jam nut and relaxing the neck cable before torquing. (572.33(c)(2))

- X 7. The data acquisition system, including transducers, conforms to the requirements of SAE Recommended Practice J211/1 MAR95. (572.36(i))
- X 8. The test fixture pendulum conforms to the specifications in Figure 8A. (572.33(c)(3))
- X 9. The head-neck assembly is mounted on the pendulum so the midsagittal plane of the head is vertical and coincides with the plane of motion of the pendulum longitudinal centerline as shown in Figure 9A for the flexion test. (572.33(c)(3))
- X 10. Install the transducers or other devices for measuring the "D" plane rotation with respect to the pendulum longitudinal centerline. Note: Plane "D" is the bottom horizontal surface of the skull. These measurement devices should be designed to minimize their influence upon the performance of the head-neck assembly. An example of a measurement device is shown in Figure 11A.
- X 11. With the pendulum resting against the honeycomb material, the neck bracket was adjusted until the longitudinal centerline of the pendulum was perpendicular  $\pm 1$  degree to plane "D" on the dummy's head.
- X 12. Release the pendulum and allow it to fall freely from a height to achieve an impact speed of 22.6 to 23.4 ft/sec as measured at the center of the pendulum accelerometer. (572.33(c)(4))
- X 13. Complete the following table:  
Neck Flexion Test Results (572.33(b)(1) & 572.33(c)(4))

Parameter	Specification	Results
Pendulum impact speed	22.6 ft/s $\leq$ speed $\leq$ 23.4 ft/s	23.40 ft/s
Pendulum Deceleration Versus Time Pulse	@ 10 ms	22.5 $\leq$ g $\leq$ 27.5
	@ 20 ms	17.6 $\leq$ g $\leq$ 22.6
	@ 30 ms	12.5 $\leq$ g $\leq$ 18.5
	Above 30 ms	29 g maximum
First Pendulum Decay to 5g	34 ms $\leq$ time $\leq$ 42 ms	36.8 ms
Plane D Rotation	64° $\leq$ max. rotation $\leq$ 78°	68.8°
	57 ms $\leq$ time of max. rotation $\leq$ 64 ms	61.1 ms
Time for Plane D Rotation to Cross 0° During First Rebound	113 ms $\leq$ time $\leq$ 128 ms	119.9 ms
Maximum Moment	65 lbf-ft $\leq$ moment $\leq$ 80 lbf-ft	69.8 lbf-ft
	47 ms $\leq$ time of max. moment $\leq$ 58 ms	47.2 ms
Time of first decay to 0 lbf-ft Positive Moment Decay** (Flexion)	97 ms $\leq$ time $\leq$ 107 ms	101.7 ms

\*Moment about the occipital condyle =  $M_y - (0.058 \text{ ft} \times F_x)$ (572.33(b)(1)(ii))

$M_y$  = Moment in lbf-ft measured by the transducer

$F_x$  = Force, in lbf measured by the transducer

\*\*Time zero is defined as the time of initial contact between the pendulum striker plate and the honeycomb material. (572.33(b)(3))

- X 14. Plots of pendulum acceleration, y-axis moment, x-axis force, y-axis moment about the occipital condyle, and D plane rotation follows this sheet.

David Schoedel  
Signature

08/26/2014  
Date

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

ATD Serial No: 403

Test I.D.: D142942

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.2	Pass
Laboratory Relative Humidity		%	10 to 70	52	Pass
Pendulum Velocity		m/s	6.89 to 7.13	7.13	Pass
Pendulum Deceleration	10 ms	G's	22.50 to 27.50	26.11	Pass
	20 ms	G's	17.60 to 22.60	20.60	Pass
	30 ms	G's	12.50 to 18.50	15.47	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 29.0	15.4	Pass
Deceleration Decay Time to Cross 5 G's		ms	34.0 to 42.0	36.8	Pass
Maximum "D" Plane Rotation	Maximum	Deg	64.0 to 78.0	68.8	Pass
	Time	ms	57.0 to 64.0	61.1	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	113.0 to 128.0	119.9	Pass
Moment About Occipital Condyle	Maximum	Nm	88.1 to 108.5	94.7	Pass
	Time	ms	47.0 to 58.0	47.2	Pass
Positive Moment Decay Time To Zero Crossing		ms	97.0 to 107.0	101.7	Pass
Overall Test Results					Pass

*David Schoedel*

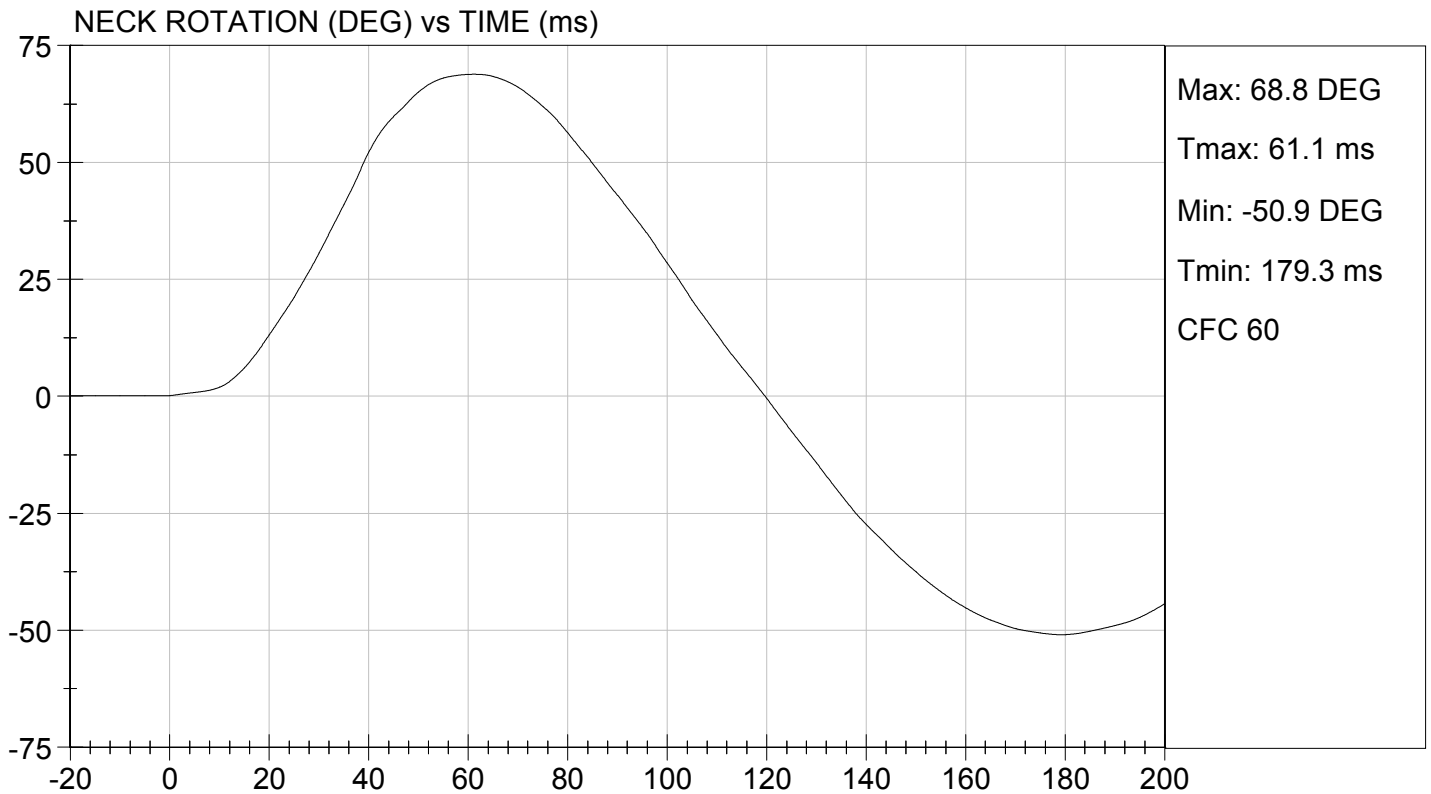
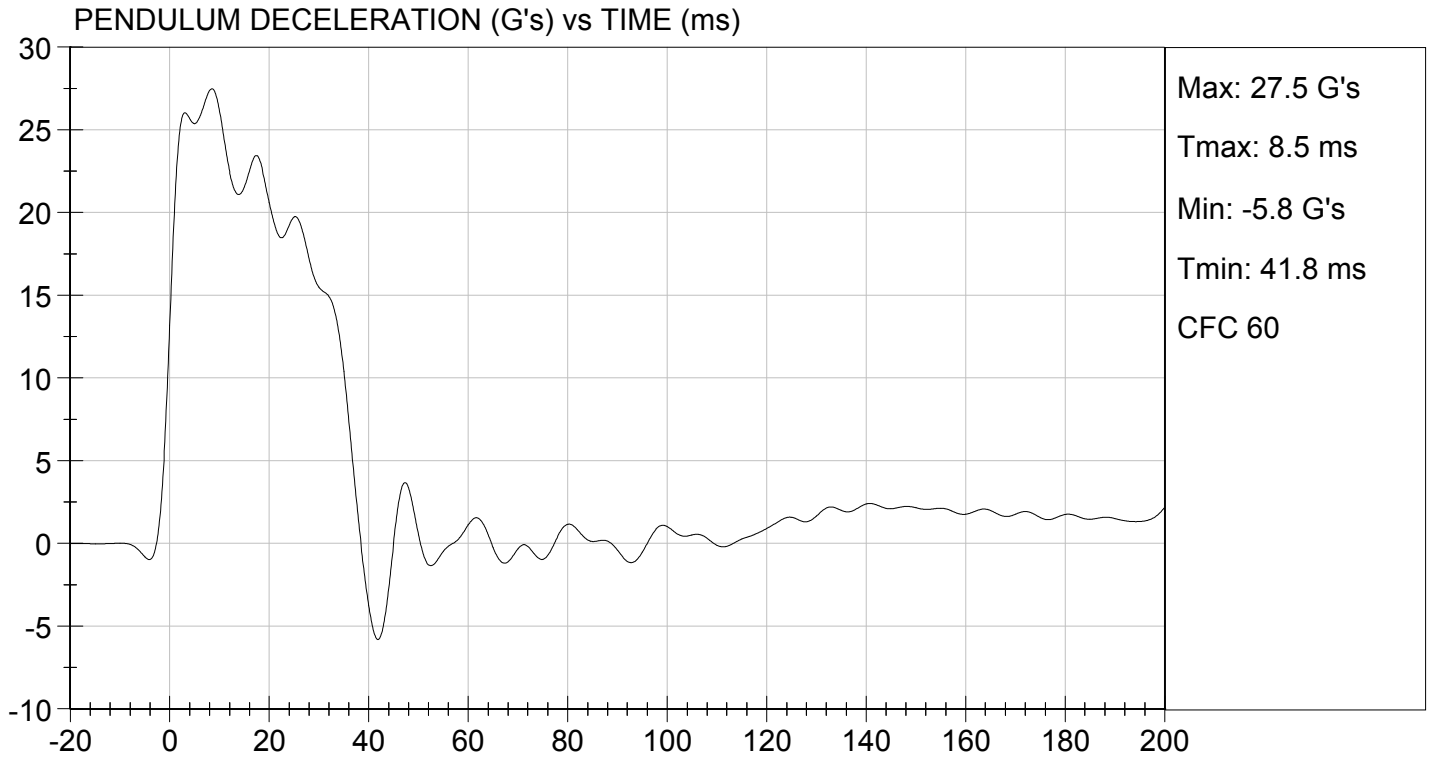
Laboratory Technician

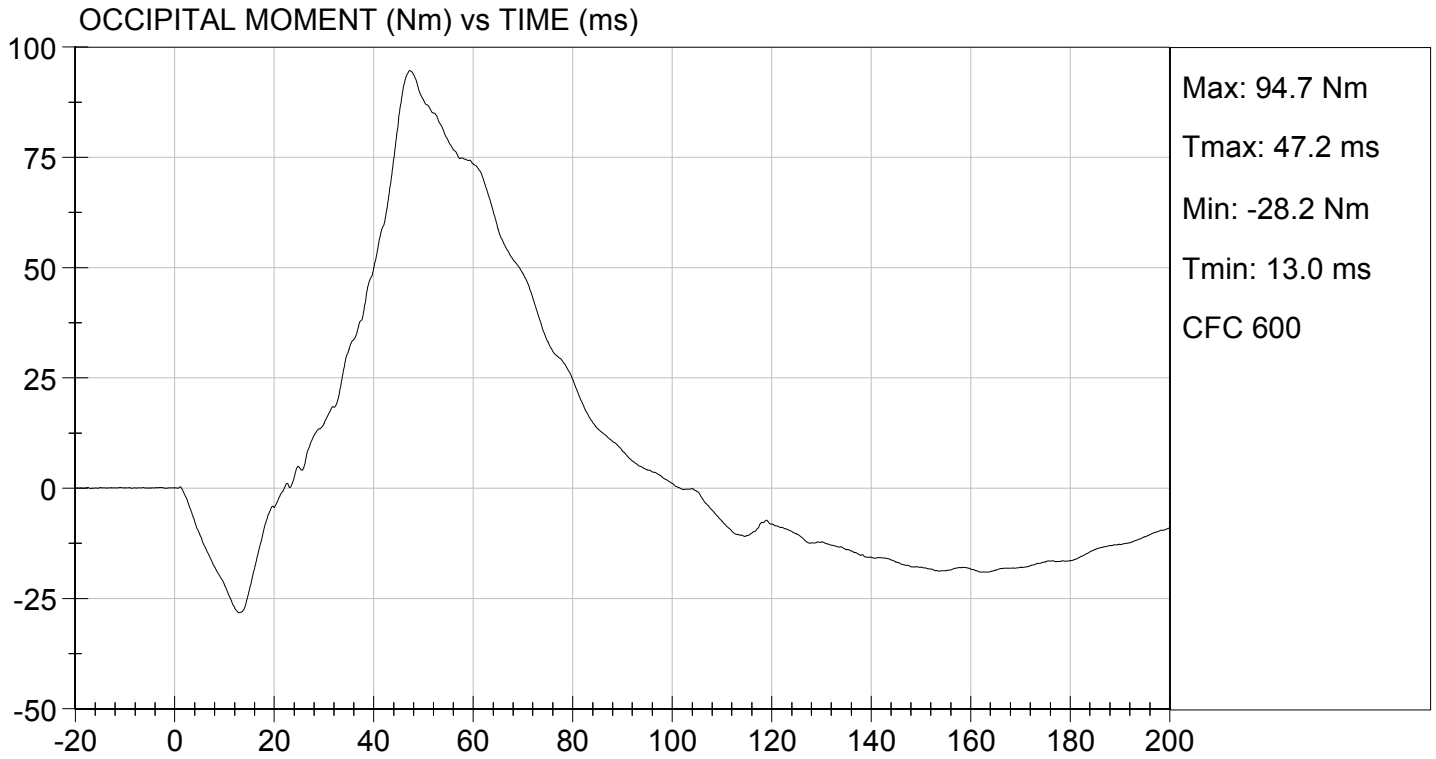
08/26/2014

Test Date

*Jeff Leonard*

Approved By





**DATA SHEET A5**  
NECK EXTENSION TEST (572.33) (50<sup>th</sup> Male)

Dummy Serial Number: 403

Test Date: 08/26/2014

Technician: David Schoedel

     Pre test calibration  
  X   Post test calibration verification

Test attempt no. 1 (when successive extension tests are necessary)

- X   1. It has been at least 30 minutes since the last extension test. (572.36(m))  
       X   N/A, ONLY one neck test performed
- X   2. The components required for the neck tests include the head assembly (78051-61X), neck assembly (78051-90), bib simulator (78051-84), upper neck adjusting bracket (78051-307), lower neck adjusting bracket (78051-303), six axis neck transducer (C-1709) and either three accelerometers or their mass equivalent installed in the head assembly. Data from the accelerometers are not required. (572.33(b))
- X   3. The assembly soaked at a temperature between 20.6°C (69°F) and 22.2°C (72°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to a test. (572.33(c)(1))
- |                                 |               |
|---------------------------------|---------------|
| Record the maximum temperature: | <u>21.6°C</u> |
| Record the minimum temperature: | <u>20.8°C</u> |
| Record the maximum humidity:    | <u>58%</u>    |
| Record the minimum humidity:    | <u>52%</u>    |
- X   4. Visually inspect neck assembly for cracks, cuts and separation of the rubber from the metal segments. Note: If the damage resulted from the vehicle crash test in which the dummy was an occupant, the damaged area is to be documented with photography and the post test calibration verification testing completed before any replacement or repairs are made.
- Record findings and actions: No damage
- X   5. Inspect the nodding blocks (78051-351) for any deterioration, but when replacement is necessary, ONLY replace during pre-test calibration. Using a Shore "A" type Durometer, verify the hardness of the nodding blocks is between 80 and 90. Ensure the nodding blocks are installed correctly. (78051-90).
- Record findings and actions: No Deterioration; Hardness: Front 89; Back 90.
- X   6. Pre-test calibration Neck cable torque: Torque the jam nut (78051-64) on the neck cable (78051-301) to 1.0 ± 0.2 lb-ft by loosening the jam nut and relaxing the neck cable before torquing. (572.33(c)(2))

- X 7. The data acquisition system, including transducers, conforms to the requirements of SAE Recommended Practice J211/1 MAR95. (572.36(i))
- X 8. The test fixture pendulum conforms to the specifications in Figure 8A. (572.33(c)(3))
- X 9. The head-neck assembly is mounted on the pendulum so the midsagittal plane of the head is vertical and coincides with the plane of motion of the pendulum longitudinal centerline as shown in Figure 10A for the extension test. (572.33(c)(3))
- X 10. Install the transducers or other devices for measuring the "D" plane rotation with respect to the pendulum longitudinal centerline. Note: Plane "D" is the bottom horizontal surface of the skull. These measurement devices should be designed to minimize their influence upon the performance of the head-neck assembly. An example of a measurement device is shown in Figure 11A.
- X 11. With the pendulum resting against the honeycomb material, the neck bracket was adjusted until the longitudinal centerline of the pendulum was perpendicular  $\pm 1$  degree to plane "D" on the dummy's head.
- X 12. Release the pendulum and allow it to fall freely from a height to achieve an impact speed of 19.5 ft/s to 20.3 ft/sec as measured at the center of the pendulum accelerometer. (572.33(c)(4))
- X 13. Complete the following table:  

Neck Extension Test Results (572.33(b)(2) & 572.33(c)(4))

Parameter	Specification	Results
Pendulum impact speed	19.5 ft/s $\leq$ speed $\leq$ 20.3 ft/s	20.30 ft/s
Pendulum Deceleration Versus Time Pulse	@ 10 ms	17.2 $\leq$ g $\leq$ 21.2
	@ 20 ms	14 $\leq$ g $\leq$ 19
	@ 30 ms	11.0 $\leq$ g $\leq$ 16.0
	Above 30 ms	22 g maximum
First Pendulum Decay to 5g	38 ms $\leq$ time $\leq$ 46 ms	39.7 ms
Plane D Rotation	81° $\leq$ max. rotation $\leq$ 106°	97.0°
	72 ms $\leq$ time of max. rotation $\leq$ 82 ms	76.2 ms
Time for Plane D Rotation to Cross 0° During First Rebound	147 ms $\leq$ time $\leq$ 174 ms	157.3 ms
Maximum Moment	-59 lbf-ft $\leq$ moment $\leq$ -39 lbf-ft	-44.5 lbf-ft
	65 ms $\leq$ time of max. moment $\leq$ 79 ms	70.4 ms
Time of first decay to 0 lbf-ft Positive Moment Decay** (Extension)	120 ms $\leq$ time $\leq$ 148 ms	140.9 ms

\*Moment about the occipital condyle =  $M_y - (0.058 \text{ ft} \times F_x)$ (572.33(b)(2)(ii))

$M_y$  = Moment in lbf-ft measured by the transducer

$F_x$  = Force, in lbf measured by the transducer

\*\*Time zero is defined as the time of initial contact between the pendulum striker plate and the honeycomb material. (572.33(b)(3))

- X 14. Plots of pendulum acceleration, y-axis moment, x-axis force, y-axis moment about the occipital condyle, and D plane rotation follows this sheet.

*David Schoedel*

Signature

08/26/2014

Date

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

ATD Serial No: 403

Test I.D.: D142943

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.2	Pass
Laboratory Relative Humidity		%	10 to 70	52	Pass
Pendulum Velocity		m/s	5.95 to 6.19	6.19	Pass
Pendulum Deceleration	10 ms	G's	17.20 to 21.20	20.00	Pass
	20 ms	G's	14.00 to 19.00	15.66	Pass
	30 ms	G's	11.00 to 16.00	11.41	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 22.0	13.1	Pass
Deceleration Decay Time to Cross 5 G's		ms	38.0 to 46.0	39.7	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	81.0 to 106.0	97.0	Pass
	Time	ms	72.0 to 82.0	76.2	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	147.0 to 174.0	157.3	Pass
Moment About Occipital Condyle	Maximum	Nm	-52.9 to -79.9	-60.4	Pass
	Time	ms	65.0 to 79.0	70.4	Pass
Negative Moment Decay Time To Zero Crossing		ms	120.0 to 148.0	140.9	Pass
Overall Test Results					Pass

*David Schoedel*

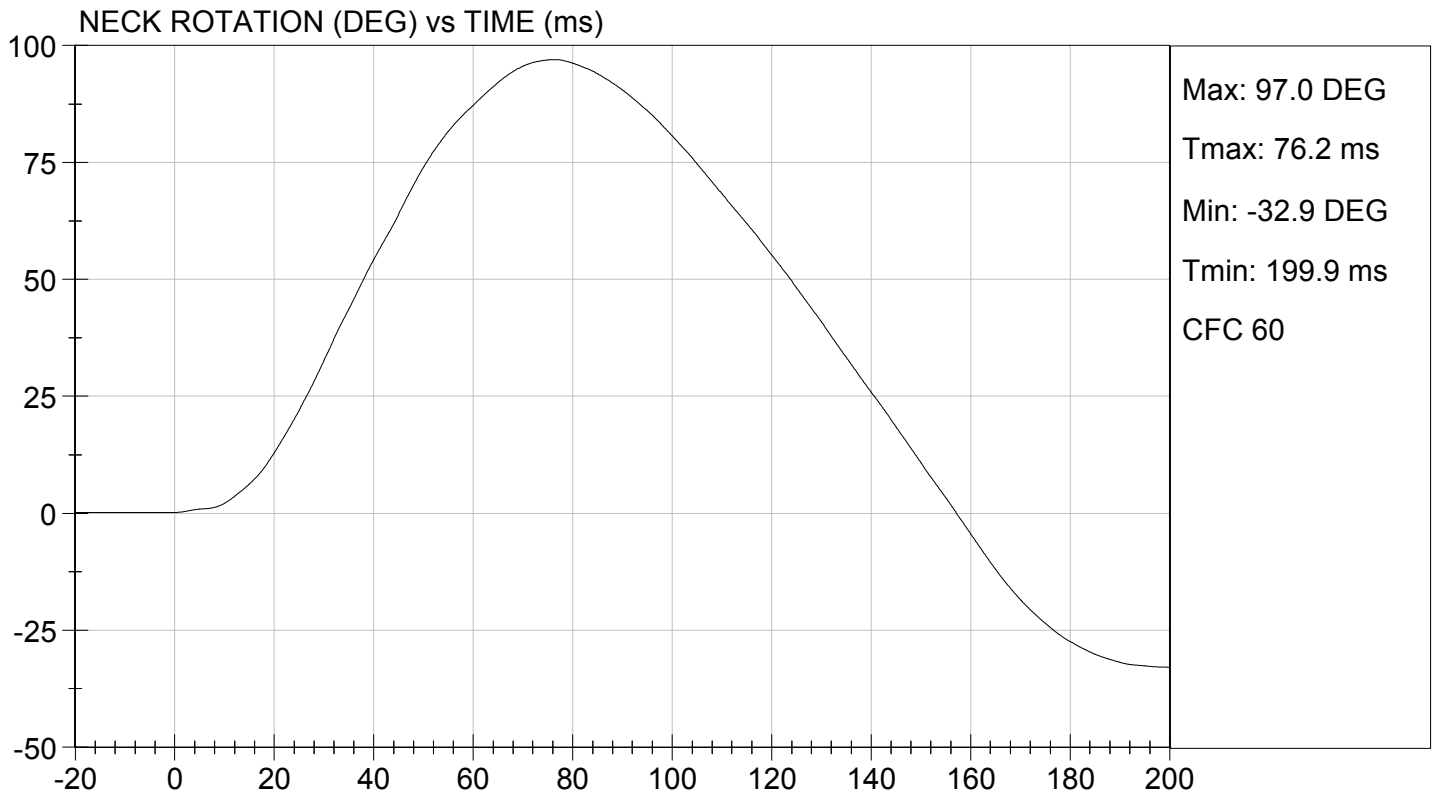
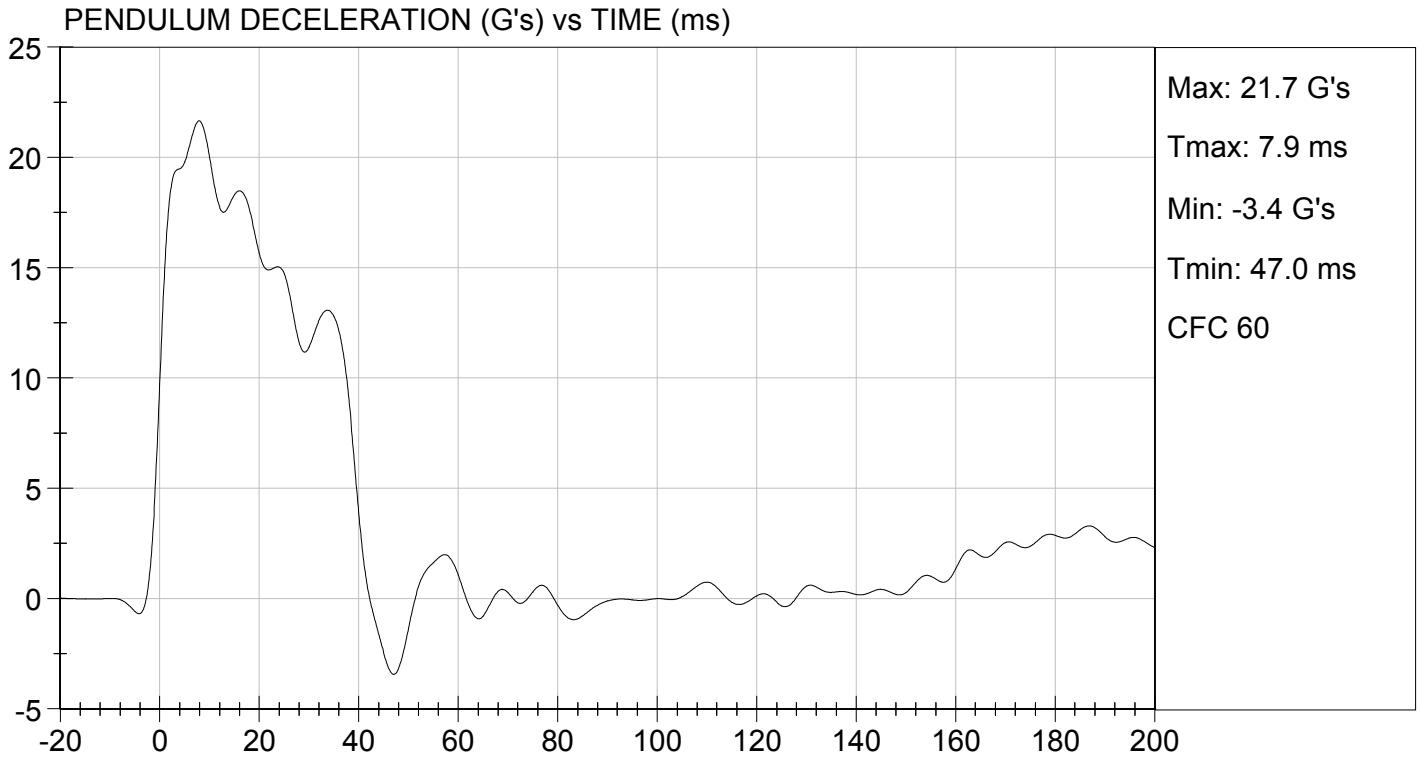
Laboratory Technician

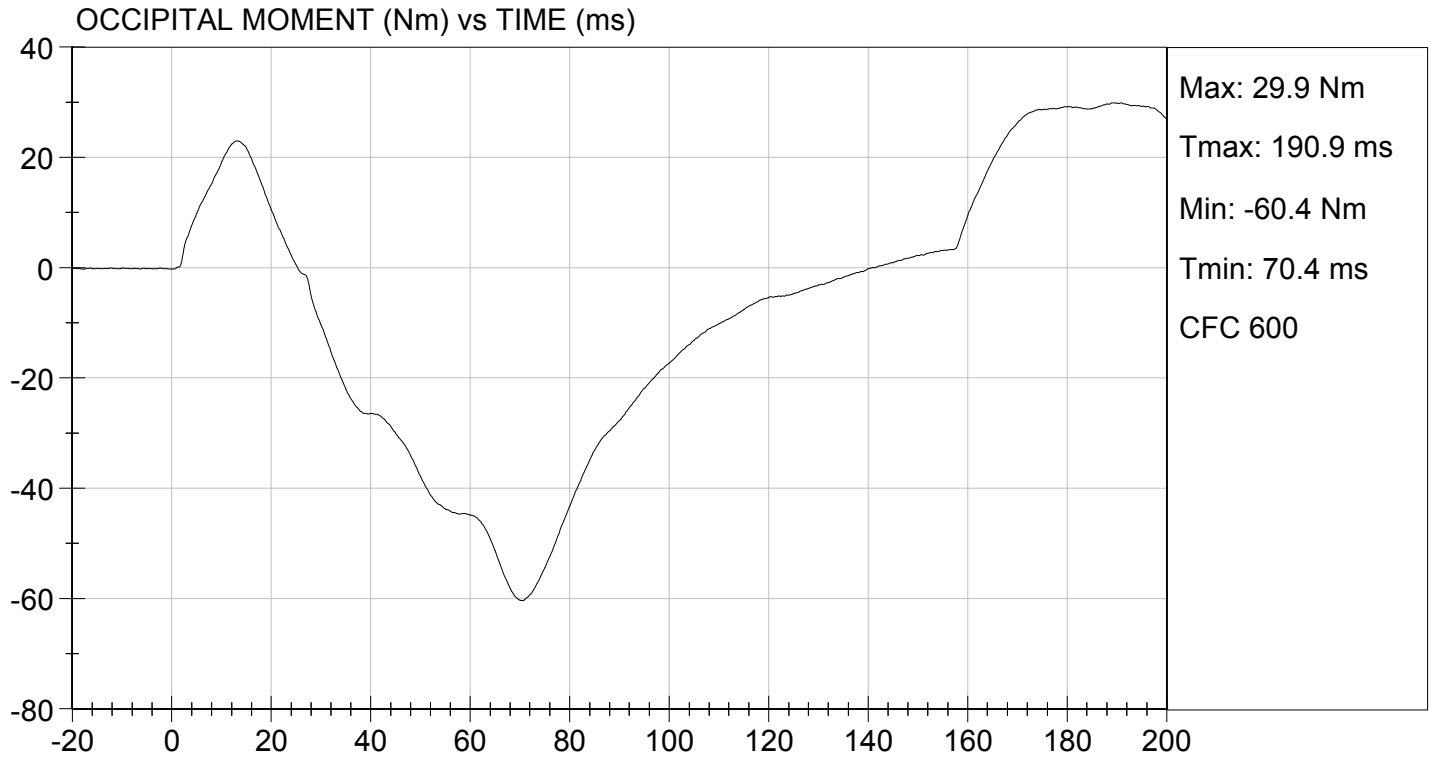
08/26/2014

Test Date

*Jeff Leonard*

Approved By





**DATA SHEET A6**  
THORAX IMPACT TEST (572.34) (50<sup>th</sup> Male)

Dummy Serial Number: 403

Test Date: 08/26/2014

Technician: Jack Coleman

- Pre test calibration  
 Post test calibration verification

Test attempt no. 1 (when successive thorax impact tests are necessary)

1. It has been at least 30 minutes since the last thorax impact test. (572.137(q))  
 N/A, ONLY one thorax impact test performed
2. The test fixture conforms to the specifications in Figure 12A.
3. The complete assembled dummy (78051-218) is used (572.34(b)) and is dressed in a form fitting cotton stretch above-the-elbow sleeved shirt and above-the-knee pants. No shoes are worn. (572.34(b))
4. The dummy assembly soaked at a temperature between 20.6°C (69°F) and 22.2°C (72°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to this test. (572.34(c)(1))

Record the maximum temperature:	<u>21.6°C</u>
Record the minimum temperature:	<u>20.8°C</u>
Record the maximum humidity:	<u>58%</u>
Record the minimum humidity:	<u>52%</u>

5. Remove the chest skin and visually inspect the thorax assembly for cracks, cuts, abrasions, etc. Particular attention should be given to the rib damping material (78051-17 thru 78051-22), chest displacement transducer assembly (78051-317) and the rear rib supports (78051-304). Inspect for rib deformation using the chest depth gage (83-5006-007). If any damage is noted repair and/or replace the damaged components unless the damage resulted from the vehicle crash test in which the dummy was an occupant in which case the damage must be documented and post test calibration verification testing completed before any repairs or replacements are made.

- No Damage

- Damage from crash test, no repairs or replacement because this is a post test calibration verification. Record damage:

- The following repairs or replacement was performed. Record:

- X 6. Seat the dummy, (chest skin still removed) without back and arm supports on the test fixture surface as shown in Figure 12A. The surface must be long enough to support the pelvis and outstretched legs. (572.34(c)(2))
- X 7. Level the ribs both longitudinally and laterally  $\pm 0.5^\circ$  and adjust the pelvis angle to  $13^\circ \pm 2^\circ$ . The angle may be measured using the special H-point tool (78051-532) that inserts into the pelvic structure and extends outward beyond the pelvic skin surface or by using the surface of the pelvic adaptor block. (572.34(c)(2))
- X 8. The midsagittal plane of the dummy is vertical within  $\pm 1^\circ$ . (572.134(c)(3))
- X 9. The longitudinal centerline of the test probe is centered within  $\pm 2.5$  mm of the midsagittal plane of the dummy and is  $12.7$  mm  $\pm 1$  mm below the horizontal peripheral centerline of the No. 3 rib and is within  $0.5^\circ$  of a horizontal line in the dummy's midsagittal plane. (572.34(c)(4))
- X 10. Align the adjustable neck bracket index marks to the "zero" position. (Figure 12A)
- X 11. Record locations such as the rear surfaces of the thoracic spine and the lower neck bracket reference with respect to locations such as the rear surfaces of the thoracic spine and the lower neck bracket. These reference measurements are necessary to ensure the dummy is in the same position after the chest skin is installed. The reference locations must be accessible after installation of the chest skin. It may be necessary to leave the chest skin zipper unfastened until the references are checked and fasten it just prior to the test.
- X 12. Install the chest skin and reposition the dummy as described in the preceding paragraph using the reference measurements recorded.
- X 13. Place the arm assemblies horizontal  $\pm 2^\circ$  and parallel to the midsagittal plane. The arms are held in place by tightening the adjustment nut that holds the arm yoke to the clavicle assembly.
- X 14. The data acquisition system, including transducers, must conform to the requirements of SAE Recommended Practice J211/1 MAR95 Class 180.
- X 15. Impact the anterior surface of the thorax with the test probe so the longitudinal centerline of the probe is within  $2^\circ$  of a horizontal line in the dummy's midsagittal plane at the moment of impact. (572.34(c)(5)) The velocity of the test probe at the time of impact is  $22$  f/s  $\pm 0.4$  f/s. (572.34(b)) The probe is guided so there is no significant lateral, vertical or rotational movement during the impact. (572.34(c)(6))

X 16. Complete the following table:

Thorax Impact Results (572.34(b))

Parameter*	Specification	Result
Test Probe Speed	$21.6 \text{ ft/s} \leq \text{speed} \leq 22.4 \text{ ft/s}$	21.93 ft/s
Chest Compression	$2.5 \text{ in.} \leq \text{compression} \leq 2.86 \text{ in.}$	2.64 in.
Peak resistance force**	$1160 \text{ lb} \leq \text{peak force} \leq 1325 \text{ lb}$	1255 lb
Internal Hysteresis***	$69\% \leq \text{hysteresis} \leq 85\%$	72%

\*Time zero is defined as the time of initial contact between the test probe and the chest skin.

\*\*Force = impactor mass x acceleration (572.34(b))

\*\*\*Area under loading curve minus the area under the unloading curve divided by the area under the loading curve.

X 17. Plots of chest compression, pendulum acceleration, pendulum speed, and force, follow this sheet.

Jack Coleman  
Signature

08/26/2014  
Date

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

**ATD Serial No:** 403

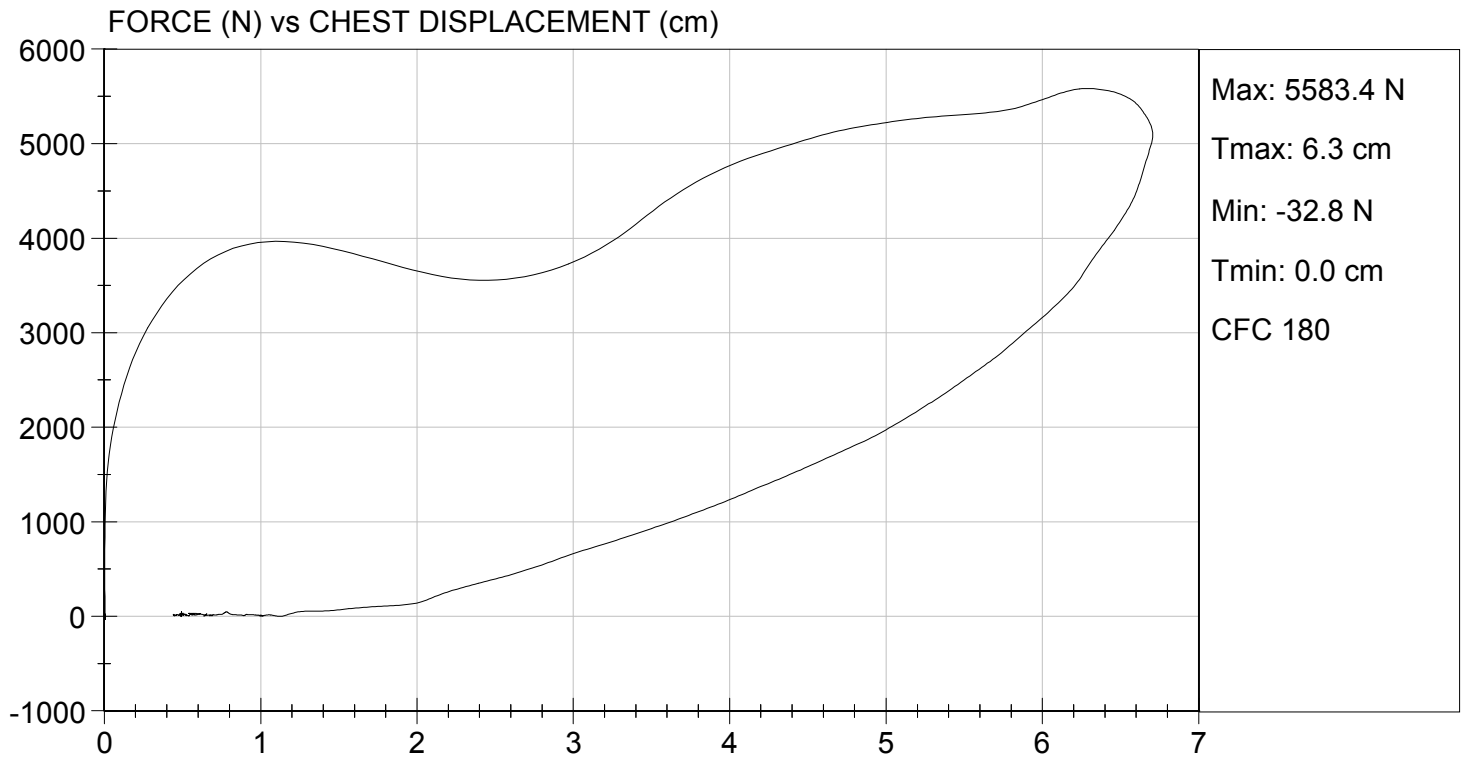
**Test I.D:** D142944

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.6	Pass
Laboratory Relative Humidity	%	10 to 70	53	Pass
Probe Velocity	m/s	6.58 to 6.82	6.68	Pass
Peak Probe Force	N	5159 to 5893	5,583	Pass
Peak Sternum Displacement	cm	6.35 to 7.26	6.71	Pass
Internal Hysteresis	%	69 to 85	72	Pass
<b>Overall Test Results</b>				<b>Pass</b>

*Jack Coleman*  
Laboratory Technician

08/26/2014  
Test Date

*Jeff Leonard*  
Approved By



**DATA SHEET A7**  
LEFT KNEE IMPACT TEST (572.35) (50<sup>th</sup> Male)

Dummy Serial Number: 403

Test Date: 08/26/2014

Technician: David Schoedel

- Pre test calibration  
 Post test calibration verification

Test attempt no. 1 (when successive knee impact tests are necessary)

1. It has been at least 30 minutes since the last knee impact test. (572.36(m))  
 N/A, ONLY one knee impact test performed
2. The test fixture conforms to the specifications in Figure 14A.
3. The leg assembly (86-5001-001) with the upper leg assembly (78051-46) removed, and the load cell simulator (78051-319) is used. (572.35(b)(2))
4. The knee assembly soaked at a temperature between 18.9°C (66°F) and 25.6°C (78°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to this test. (572.35(b)(2)(ii))
- |                                 |               |
|---------------------------------|---------------|
| Record the maximum temperature: | <u>21.6°C</u> |
| Record the minimum temperature: | <u>20.8°C</u> |
| Record the maximum humidity:    | <u>58%</u>    |
| Record the minimum humidity:    | <u>52%</u>    |
5. Mount the test specimen and secure it to the rigid test fixture. (572.35(b)(2)(iii)) (Figure 14A)
6. No parts of the foot or tibia contact any exterior surface. (572.35(b)(2)(iii))
7. Align the test probe so that at contact the longitudinal centerline of the probe is collinear within 2 degrees with the longitudinal centerline of the femur load cell simulator except it is within 0.5 degrees horizontally. (572.35(b)(2)(iv)&(vi))
8. The probe is guided so there is no significant lateral, vertical or rotational movement during the impact with the knee. (572.35(b)(2)(v))
9. The data acquisition system, including transducers, must conform to the requirements of SAE Recommended Practice J2111/1 MAR95 (572.136(m)) Class 600.
10. Contact the knee with the test probe at a speed between 6.8 ft/s and 7.0 ft/s. (572.35(b))

X 11. Complete the following table:

Knee Impact Results (572.35(b)(1))

Parameter	Specification	Result
Probe speed	$6.8 \text{ ft/s} \leq \text{speed} \leq 7.0 \text{ ft/s}$	7.00 ft/s
Peak resistance force*	$1060 \text{ lb} \leq \text{force} \leq 1300 \text{ lb}$	1061 lb

\*Force = impactor mass x deceleration (572.35(b)(1))

X 12. Plots of pendulum acceleration, pendulum speed, and force, follow this sheet. Time zero is defined as the time of contact between the test probe and the knee. (572.3(b)(2)(vii))

David Schoedel  
Signature

08/26/2014  
Date

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

**ATD Serial No:** 403

**Test I.D:** D142946

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.2	Pass
Laboratory Relative Humidity	%	10 to 70	52	Pass
Probe Velocity	m/s	2.07 to 2.13	2.13	Pass
Peak Probe Force	N	4715 to 5782	4,721	Pass
Overall Test Results				Pass

David Schoedel  
 Laboratory Technician

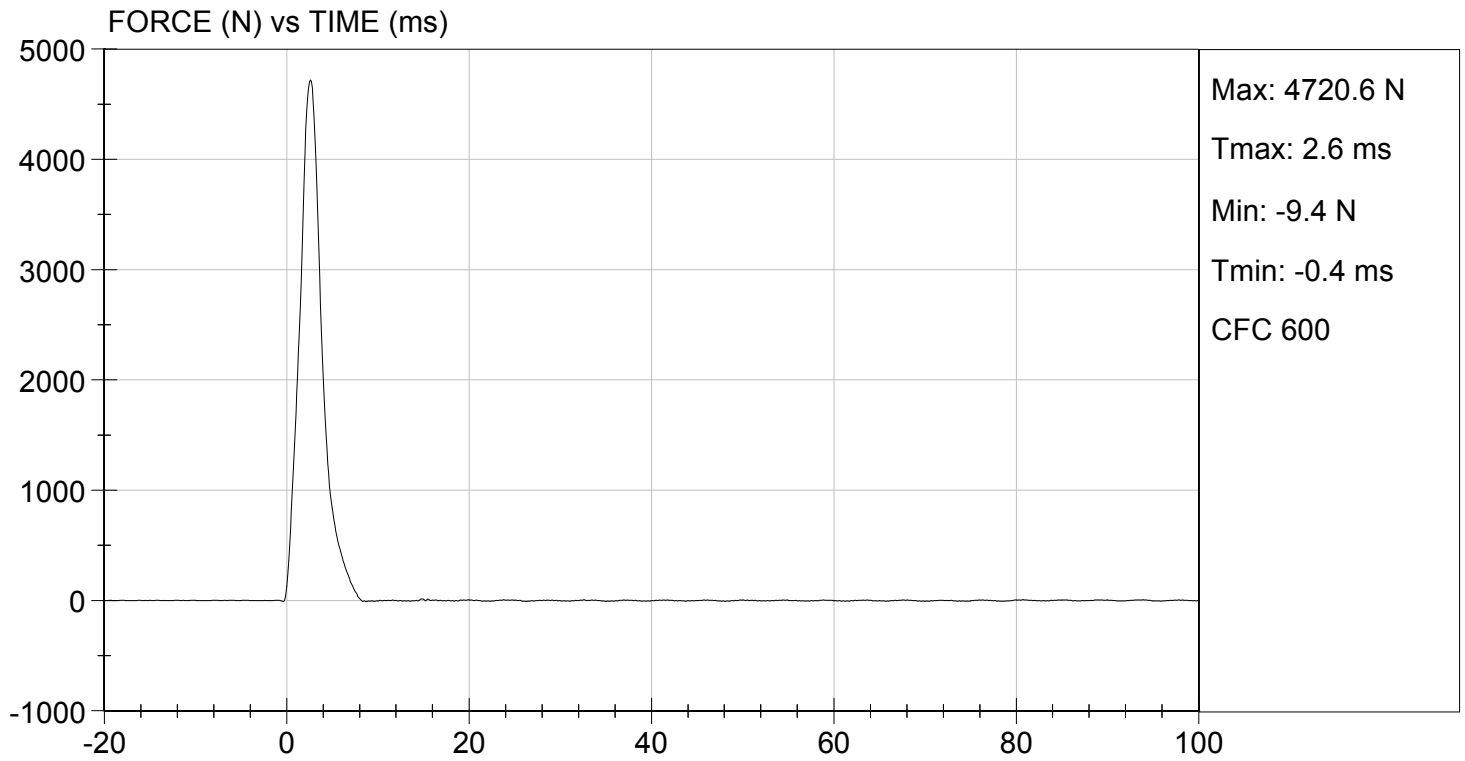
08/26/2014  
 Test Date

Jeff Levanowski  
 Approved By



TEST DESC: LEFT KNEE  
VELOCITY: 7.00 ft/s, 2.13 m/s

TEST DATE: 08/26/2014  
TEST #: D142946



**DATA SHEET A8**  
RIGHT KNEE IMPACT TEST (572.35) (50<sup>th</sup> Male)

Dummy Serial Number: 403

Test Date: 08/26/2014

Technician: David Schoedel

     Pre test calibration  
 X  Post test calibration verification

Test attempt no. 1 (when successive knee impact tests are necessary)

- X  1. It has been at least 30 minutes since the last knee impact test. (572.36(m))  
      X  N/A, ONLY one knee impact test performed
- X  2. The test fixture conforms to the specifications in Figure 14A.
- X  3. The leg assembly (86-5001-002) with the upper leg assembly (78051-47) removed, and the load cell simulator (78051-319) is used. (572.35(b)(2))
- X  4. The knee assembly soaked at a temperature between 18.9°C (66°F) and 25.6°C (78°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to this test. (572.35(b)(2)(ii))
- |                                 |               |
|---------------------------------|---------------|
| Record the maximum temperature: | <u>21.6°C</u> |
| Record the minimum temperature: | <u>20.8°C</u> |
| Record the maximum humidity:    | <u>58%</u>    |
| Record the minimum humidity:    | <u>52%</u>    |
- X  5. Mount the test specimen and secure it to the rigid test fixture. (572.35(b)(2)(iii)) (Figure 14A)
- X  6. No parts of the foot or tibia contact any exterior surface. (572.35(b)(2)(iii))
- X  7. Align the test probe so that at contact the longitudinal centerline of the probe is collinear within 2 degrees with the longitudinal centerline of the femur load cell simulator except it is within 0.5 degrees horizontally. (572.35(b)(2)(iv)&(vi))
- X  8. The probe is guided so there is no significant lateral, vertical or rotational movement during the impact with the knee. (572.35(b)(2)(v))
- X  9. The data acquisition system, including transducers, must conform to the requirements of SAE Recommended Practice J211/1 MAR95 (572.136(m)) Class 600.
- X  10. Contact the knee with the test probe at a speed between 6.8 ft/s and 7.0 ft/s. (572.35(b))

X 11. Complete the following table:

Knee Impact Results (572.35(b)(1))

Parameter	Specification	Result
Probe speed	$6.8 \text{ ft/s} \leq \text{speed} \leq 7.0 \text{ ft/s}$	7.00 ft/s
Peak resistance force*	$1060 \text{ lb} \leq \text{force} \leq 1300 \text{ lb}$	1117 lb

\*Force = impactor mass x deceleration (572.35(b)(1))

X 12. Plots of pendulum acceleration, pendulum speed, and force, follow this sheet. Time zero is defined as the time of contact between the test probe and the knee. (572.3(b)(2)(vii))

*David Schoedel*

Signature

08/26/2014

Date

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

**ATD Serial No:** 403

**Test I.D:** D142945

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.2	Pass
Laboratory Relative Humidity	%	10 to 70	52	Pass
Probe Velocity	m/s	2.07 to 2.13	2.13	Pass
Peak Probe Force	N	4715 to 5782	4,967	Pass
Overall Test Results				Pass

*David Schoedel*  
 Laboratory Technician

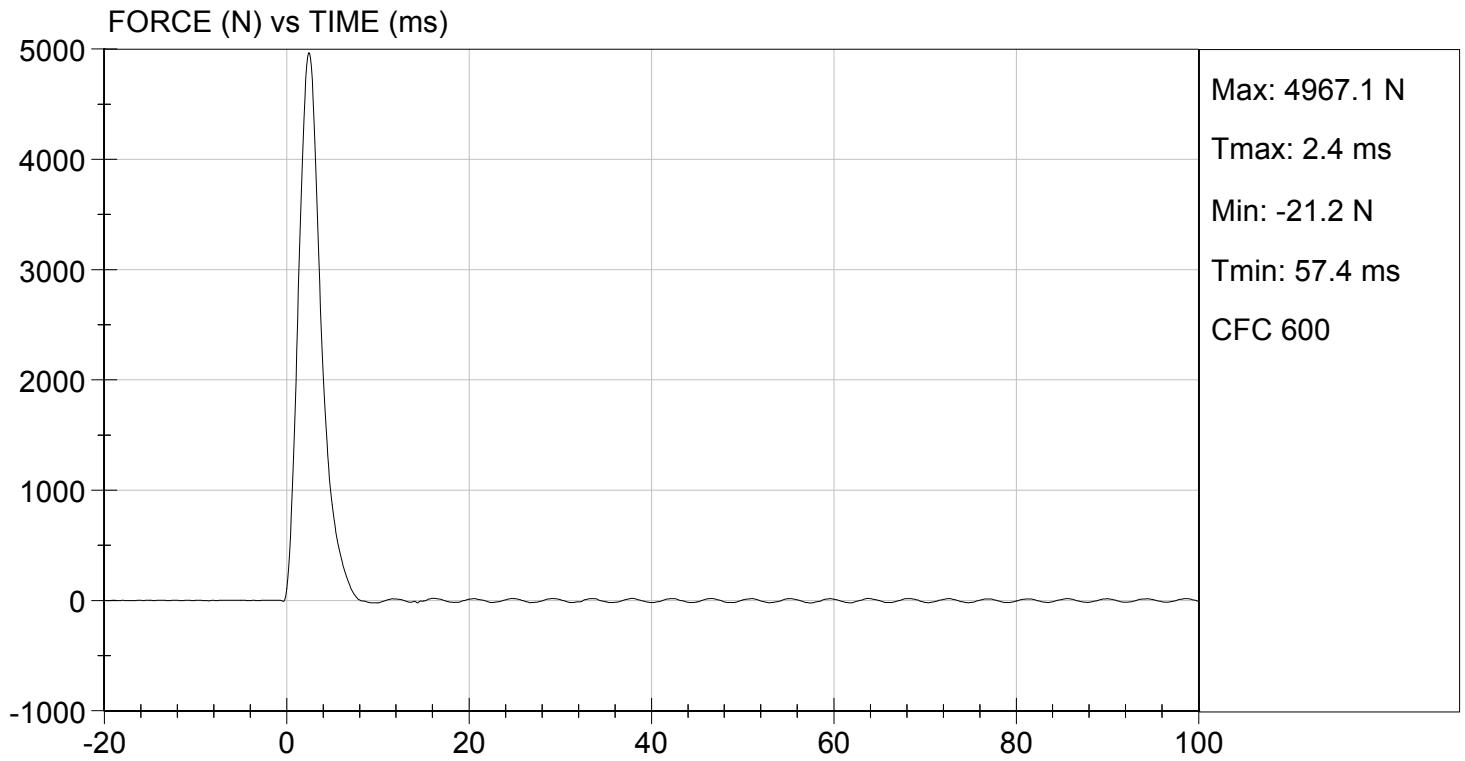
08/26/2014  
 Test Date

*Jeff Leonard*  
 Approved By



TEST DESC: RIGHT KNEE  
VELOCITY: 7.00 ft/s, 2.13 m/s

TEST DATE: 08/26/2014  
TEST #: D142945



**DATA SHEET A9**  
HIP JOINT-FEMUR FLEXION (572.35(c)) (50<sup>th</sup> Male)

Dummy Serial Number: 403

Test Date: 08/25/2014

Technician: Jack Coleman

- Pre test calibration  
  X   Post test calibration verification

Test attempt no. 1 (when successive hip joint-femur flexion tests are necessary)

- X   1. It has been at least 30 minutes since the last hip joint-femur flexion test. (572.36(m))  
      X   N/A, ONLY one hip joint-femur flexion test performed
- X   2. The test fixture conforms to the specifications in Figure 17A.
- X   3. Use the assembled dummy (78051-218) except (572.35(c)(2)):  
      X   3.1 remove the leg assemblies (86-5001-001 & 002) by removing 3/8-16 Socket Head Cap Screw and retaining the structural assembly of the upper legs (78051-43 & 44)  
      X   3.2 remove the abdominal insert (78051-52)  
      X   3.3 replace the instrument cover plate (78051-13) in the pelvic bone with a rigid pelvic bone stabilizer insert (Figure 15A) and attach the pelvis upper support device (Figure 16A).
- X   4. The assembly soaked at a temperature between 18.9°C (66°F) and 25.6°C (78°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to this test. (572.35(c)(v))
- |                                 |               |
|---------------------------------|---------------|
| Record the maximum temperature: | <u>21.6°C</u> |
| Record the minimum temperature: | <u>20.8°C</u> |
| Record the maximum humidity:    | <u>58%</u>    |
| Record the minimum humidity:    | <u>52%</u>    |
- X   5. Seat the dummy on the rigid seat fixture. (572.35(c)(2)(ii))
- X   6. Secure the dummy by bolting the stabilizer insert and the pelvis upper support device to the seat back of the test fixture as shown in Figures 17A, 18A, and 19A. (572.35(c)(2)(ii))
- X   7. Adjust the threaded rods until plane B is horizontal.
- X   8. Secure the lever arm into the left femur shaft opening of the upper leg structure assembly (78051-43) and firmly secure it using the 3/8-16 socket head cap screws (Figure 19A). (572.35(c)(2)(iii))

X 9. Lift the lever arm parallel to the midsagittal plane at a rotation rate between 5 and 10 degrees per second while maintaining the ½ in. shoulder bolt longitudinal centerline horizontal throughout the range of motion until the 150 ft-lbf torque level is reached (Figures 18A and 19A). (572.35(c)(2)(iv))

X 10. Complete the following table:  
Left Hip Joint-Femur Flexion Results (572.35(c)(1) & (c)(2)(iv))

Parameter	Specification	Result
Rotation Rate	5°/s ≤ rotation rate ≤ 10°/s	6.2°/s
Femur Torque at 30°	Torque ≤ 70 ft-lbf	58.0 ft-lbf
Rotation at 150 lbf-ft	40° ≤ rotation ≤ 50°	42.3°

X 11. Secure the lever arm into the right femur shaft opening of the upper leg structure assembly (78051-44) and firmly secure it using the 3/8-16 socket head cap screws (Figure 19A). (572.35(c)(2)(iii))

X 12. Lift the lever arm parallel to the midsagittal plane at a rotation rate between 5 and 10 degrees per second while maintaining the ½ in. shoulder bolt longitudinal centerline horizontal throughout the range of motion until the 150 ft-lbf torque level is reached (Figures 18A and 19A). (572.35(c)(2)(iv))

X 13. Complete the following table:  
Right Hip Joint-Femur Flexion Results (572.35(c)(1) & (c)(2)(iv))

Parameter	Specification	Result
Rotation Rate	5°/s ≤ rotation rate ≤ 10°/s	6.2°/s
Femur Torque at 30°	torque ≤ 70 ft-lbf	66.5 ft-lbf
Rotation at 150 lbf-ft	40° ≤ rotation ≤ 50°	40.9°

Jack Coleman  
Signature

08/25/2014  
Date

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

**ATD Serial No:** 403

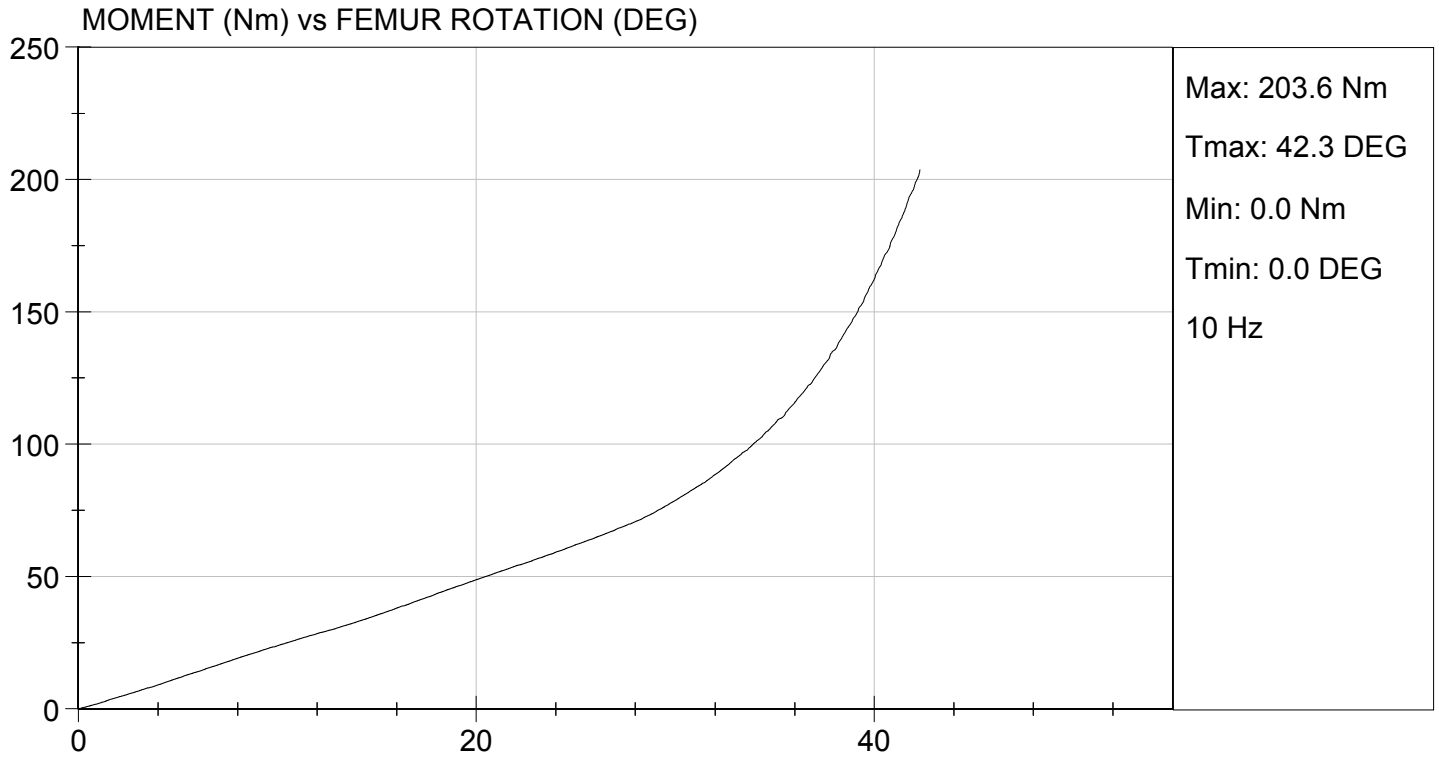
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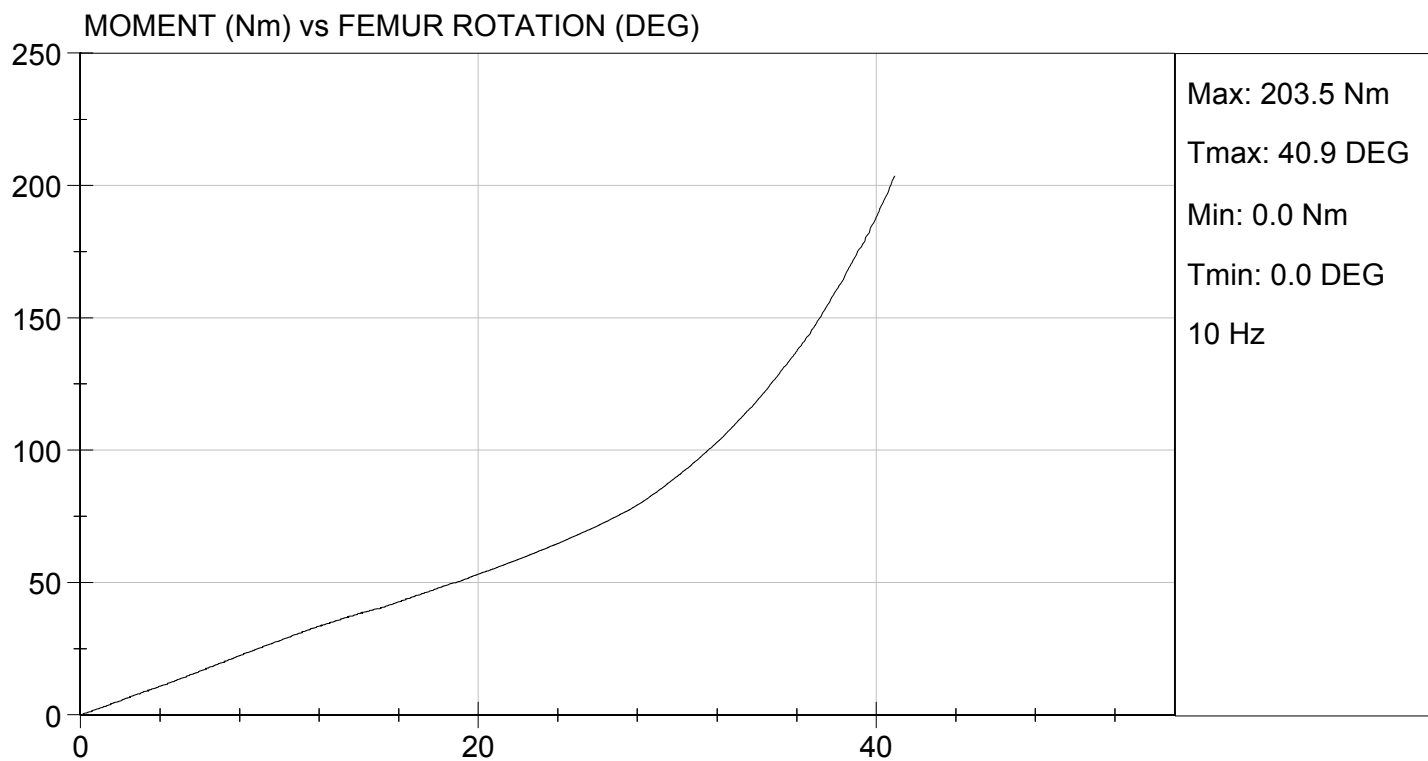
Tested Parameter	Units	Specification	Result		Pass/Fail
			Right	Left	
Laboratory Temperature	deg C	18.9 to 25.6	20.8	20.8	Pass
Laboratory Relative Humidity	%	10 to 70	58	58	Pass
Rotation Rate	deg/s	5.0 to 10.0	6.2	6.2	Pass
30 Degrees	Nm	94.9 Nm Max	90.2	78.7	Pass
150 ft-lbf / 203.4 Nm	Deg	40.0 to 50.0 Degree Max Rotation	40.9	42.3	Pass
Overall Test Results					Pass

*Jack Coleman*  
 Laboratory Technician

08/25/2014  
 Test Date

*Jeff Leonard*  
 Approved By





**DATA SHEET A10**

**PART 572 INSTRUMENTATION CALIBRATION INFORMATION**

I.D. NO.	MANUFACTURER	MODEL NO.	SERIAL NO.	DATE OF LAST CALIBRATION	DATE OF NEXT CALIBRATION
DUMMY INSTRUMENTATION					
HEAD ACCELEROMETERS					
(1) LONGITUDINAL	Endevco	7231C-750	AGH70	04/10/2014	10/10/2014
(2) LATERAL	Endevco	7231C-750	AH5E5	04/10/2014	10/10/2014
(3) VERTICAL	Endevco	7231C-750	C10591	04/10/2014	10/10/2014
NECK TRANSDUCER	Denton	1716	1865	08/04/2014	02/04/2014
CHEST ACCELEROMETERS					
(1) LONGITUDINAL	Endevco	7231C-750	AGH55	04/10/2014	10/10/2014
(2) LATERAL	Endevco	7231C-750	AGH79	04/10/2014	10/10/2014
(3) VERTICAL	Endevco	7231C-750	C12863	04/10/2014	10/10/2014
CHEST POTENTIOMETER	Servo	14CBI-2897	403	04/08/2014	10/08/2014
FEMUR LOAD CELLS					
(1) RIGHT FEMUR	Denton	2121	8804	05/07/2014	11/07/2014
(2) LEFT FEMUR	Denton	2121	8805	05/07/2014	11/07/2014
LABORATORY INSTRUMENTATION					
NECK PENDULUM ACCELEROMETER	Endevco	7231C-750	AGH11	08/11/2014	02/11/2015
THORAX PENDULUM ACCELEROMETER	Endevco	7264C-2KTZ-2-240	P83176	05/1/2014	11/01/2014
KNEE PENDULUM ACCELEROMETER	Endevco	7264C-2KTZ-2-240	P80111	07/02/2014	01/02/2015
NECK ROTATION TRANSDUCER 1 (OPTIONAL)	Spectrol	132-0-0-102	18	04/15/2014	10/15/2014
NECK ROTATION TRANSDUCER 2 (OPTIONAL)	Spectrol	132-0-0-102	23	04/15/2014	10/15/2014

LABORATORY TECHNICIAN: \_\_\_\_\_

*Jessica Hall*

**DATA SHEET B1**  
**DUMMY DAMAGE CHECKLIST**

Dummy Serial Number: 403

Test Date: 08/25/2014

Technician: Jessica Gall

This check sheet is completed as part of the post test calibration verification.

Perform general cleaning.

Dummy Item	Inspect for	Comments	Damage	OK
Outer skin	Gashes, rips, cracks			X
Head	Ballast secure			X
	General appearance			X
Neck	Broken or cracked rubber			X
	Upper neck bracket firmly attached to the lower neck bracket			X
	Looseness at the condyle joint			X
	Nodding blocks cracked or out of position			X
Spine	Broken or cracks in rubber			X
Ribs	Broken or bent ribs			X
	Broken or bent rib supports			X
	Damping material separated or cracked			X
	Rubber bumpers in place			X
Chest Displacement Assembly	Bent shaft			X
	Slider arm riding in track			X
Transducer leads	Torn cables			X
Accelerometer Mountings	Head mounting secure			X
	Chest mounting secure			X
Knees	Skin condition			X
	Insert (do not remove)			X
	Casting			X
Limbs	Normal movement and adjustment			X
Knee Sliders	Wires intact			X
	Rubber returned to "at rest" position			X
Pelvis	Broken			X
Other				X

If upon visual examination, damage is apparent in any of these areas, the appropriate engineer or engineering technician is to be consulted for a decision on repair or replacement of parts.

Repair or Replacement approved by:

Jessica Hall  
Signature

08/26/2014  
Date

Describe the repair or replacement of parts:

Checked by:

Jeff Leonard  
Signature

08/26/2014  
Date

## EXTERNAL DIMENSIONS

HYBRID III 5 <sup>th</sup> SN #124, PART 572, SUBPART O EXTERNAL DIMENSIONS				
DIMENSION	DESCRIPTION	DETAILS	ASSEMBLY DIMENSION (mm)	ACTUAL MEASUREMENT
A	TOTAL SITTING HEIGHT	Seat surface to highest point on top of the head.	774.7-800.1	785.0
B	SHOULDER PIVOT HEIGHT	Centerline of shoulder pivot bolt to the seat surface.	431.8-457.2	455.1
C	H-POINT HEIGHT	Reference	81.3-86.3	85.2
D	H-POINT LOCATION FROM BACKLINE	Reference	144.8-149.8	145.6
E	SHOULDER PIVOT FROM BACKLINE	Center of the shoulder clevis to the rear vertical surface of the fixture.	68.6-83.8	83.0
F	THIGH CLEARANCE	Measured at the highest point on the upper femur segment.	119.4-134.6	125.6
G	BACK OF ELBOW TO WRIST PIVOT	Back of the elbow flesh to the wrist pivot in line with the elbow and wrist pivots	243.9-259.1	245.9
H	HEAD BACK TO BACKLINE	Back of skull cap skin to seat rear vertical surface (Reference)	43.2-48.2	45.0
I	SHOULDER TO ELBOW LENGTH	Measure from the highest point on top of the shoulder clevis to the lowest part of the flesh on the elbow in line with the elbow pivot bolt.	276.8-297.2	296.1
J	ELBOW REST HEIGHT	Measure from the flesh below the elbow pivot bolt to the seat surface.	182.8-203.2	192.3
K	BUTTOCK TO KNEE LENGTH	The forward most part of the knee flesh to the rear vertical surface of the fixture.	520.7-546.1	540.2
L	POPLITEAL HEIGHT	Seat surface to the plane of the horizontal plane of the bottom of the feet.	355.6-376.0	365.6
M	KNEE PIVOT HEIGHT	Centerline of knee pivot bolt to the horizontal plane of the bottom of the feet.	393.7-419.1	395.8
N	BUTTOCK POPLITEAL LENGTH	The rearmost surface of the lower leg to the same point on the rear surface of the buttocks used for dim. "K".	414.0-439.4	434.5

HYBRID III 5 <sup>th</sup> SN #124, PART 572, SUBPART O EXTERNAL DIMENSIONS, continued				
DIMENSION	DESCRIPTION	DETAILS	ASSEMBLY DIMENSION (mm)	ACTUAL MEASUREMENT
O	CHEST DEPTH WITHOUT JACKET	Measured 304.8 ± 5.1 mm above seat surface	175.3-190.5	176.0
P	FOOT LENGTH	Tip of toe to rear of heel	218.5-233.7	219.4
Q	STANDING HEIGHT	(THEORETICAL)	1501.1	N/A
R	BUTTOCK TO KNEE PIVOT LENGTH	The rear surface of the buttocks to the knee pivot bolt	457.2-482.6	481.0
S	HEAD BREADTH	The widest part of the head	137.1-147.3	138.6
T	HEAD DEPTH	Back of the head to the forehead	177.8-188.0	186.2
U	HIP BREADTH	The widest part of the hip	299.7-314.9	310.7
V	SHOULDER BREADTH	Outside edges of right and left shoulder clevises	350.5-365.7	354.9
W	FOOT BREADTH	The widest part of the foot	78.8-94.0	82.0
X	HEAD CIRCUMFERENCE	Measured at the point as in dim. "T"	528.3-548.7	547.1
Y	CHEST CIRCUMFERENCE (WITH CHEST JACKET)	Measured 345.4 ± 12.7 mm above seat surface	850.9-881.3	881.0
Z	WAIST CIRCUMFERENCE	Measured 165.1 ± 5.1 mm above seat surface	759.5-789.9	786.3
AA	REFERENCE LOCATION FOR MEASUREMENT OF CHEST CIRCUMFERENCE	Reference	332.7-358.1	357.4
BB	REFERENCE LOCATION FOR MEASUREMENT OF WAIST CIRCUMFERENCE	Reference	160.1-170.2	169.8

**DATA SHEET B3**  
HEAD DROP TEST (572.132) (5<sup>th</sup> Female)

Dummy Serial Number: 124

Test Date: 07/29/2014

Technician: David Schoedel

- Pre test calibration  
 Post test calibration verification

Test attempt no. 1 (when successive head drops are necessary)

1. It has been at least 2 hours since the last head drop. (572.132(c)(5))  
 N/A, ONLY one head drop performed
2. The head assembly consists of the complete head (880105-100X), the six-axis neck transducer (SA572-S11) or neck transducer structural replacement (78051-383X), and three (3) accelerometers (SA572-S4). (572.132(a))
3. The head accelerometer mounting plate screws (10-24 x 3/8 SHCS) are torqued to 9.0 Nm.
4. Accelerometers and their respective mounts are smooth and clean.
5. Torque the skull cap screws (10-24 x 1/2 SHCS) to 9.0 Nm.
6. The data acquisition system, including transducers, conforms to the requirements of SAE Recommended Practice J211/1 MAR95. (572.136(m))
7. The head assembly soaked at a temperature between 18.9°C (66°F) and 25.6°C (78°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to a test. (572.132(c)(1))
- |                                 |               |
|---------------------------------|---------------|
| Record the maximum temperature: | <u>21.3°C</u> |
| Record the minimum temperature: | <u>21.1°C</u> |
| Record the maximum humidity:    | <u>49%</u>    |
| Record the minimum humidity:    | <u>47%</u>    |
8. Visually inspect the head skin for cracks, cuts, abrasions, etc. Repair or replace the head skin if the damaged area is more than superficial. Note: If the damage resulted from the vehicle crash test in which the dummy was an occupant, the damaged area is to be documented with photography and the post test calibration verification testing completed before any replacement or repairs are made.
- Record findings and actions: No Damage

X 9. Clean the impact surface of the skin and the impact surface of the fixture with isopropyl alcohol, trichloroethane or equivalent prior to the test. (572.132(c)(2))

X 10. Suspend and orient the head assembly as shown in Figure 5B. The lowest point on the forehead is  $376.0 \pm 1.0$  mm ( $14.8 \pm 0.04$  inch) from the impact surface. (572.132(c)(3))  
Record the actual distance: 376 mm

**NOTE:** The masses of the suspension device and the accelerometer cables are to be kept as lightweight as possible to minimize their effect on the test results.

X 11. The 1.57 mm (0.062 inch) diameter holes located on either side of the dummy's head are equidistance within 2 mm from the impact surface. A typical test setup is shown in Figure 6B. (572.132(c)(3))  
Record the right side distance: 501 mm  
Record the left side distance: 501 mm

X 12. The impact surface is clean and dry and has a micro finish in the range of  $203.2 \times 10^{-6}$  mm (8 micro inches) to  $2032.0 \times 10^{-6}$  mm (80 micro inches) (RMS). (572.132(c)(4))  
Record actual micro finish: 24.8 micro inches

X 13. The impact surface is rigidly supported. (572.132(c)(4))

X 14. The impact surface is a flat horizontal steel plate 50.8 mm (2 inches) thick and 610 mm (24 inches) square. (572.132(c)(4))  
Record thickness: 50.9 mm  
Record width: 604 mm  
Record length: 595 mm

X 15. Drop the head assembly from a height of  $376.0 \pm 1.0$  mm (14.8 inches  $\pm$  0.04 inches) by a means that ensures a smooth, instant release onto the impact surface. (572.132(b) & (572.132(c)(4))

X 16. Complete the following table using channel class 1000 data. (572.132(b)):

Parameter	Specification	Result
Peak resultant acceleration	$250 \text{ g} \leq x \leq 300 \text{ g}$	276 g
Resultant versus time history curve	Unimodal	Yes
Oscillations after the main pulse	Less than 10% of the peak resultant acceleration	Yes
Lateral acceleration	y-axis acceleration $\leq 15 \text{ g}$	1.0 g

X 17. Plots of the x, y, z, and resultant acceleration data follow this sheet.

David Schoedel

Signature

07/29/2014

Date

**MGA RESEARCH CORPORATION  
HEAD DROP TEST  
HYBRID III 5TH PERCENTILE**

ATD Serial No: 124

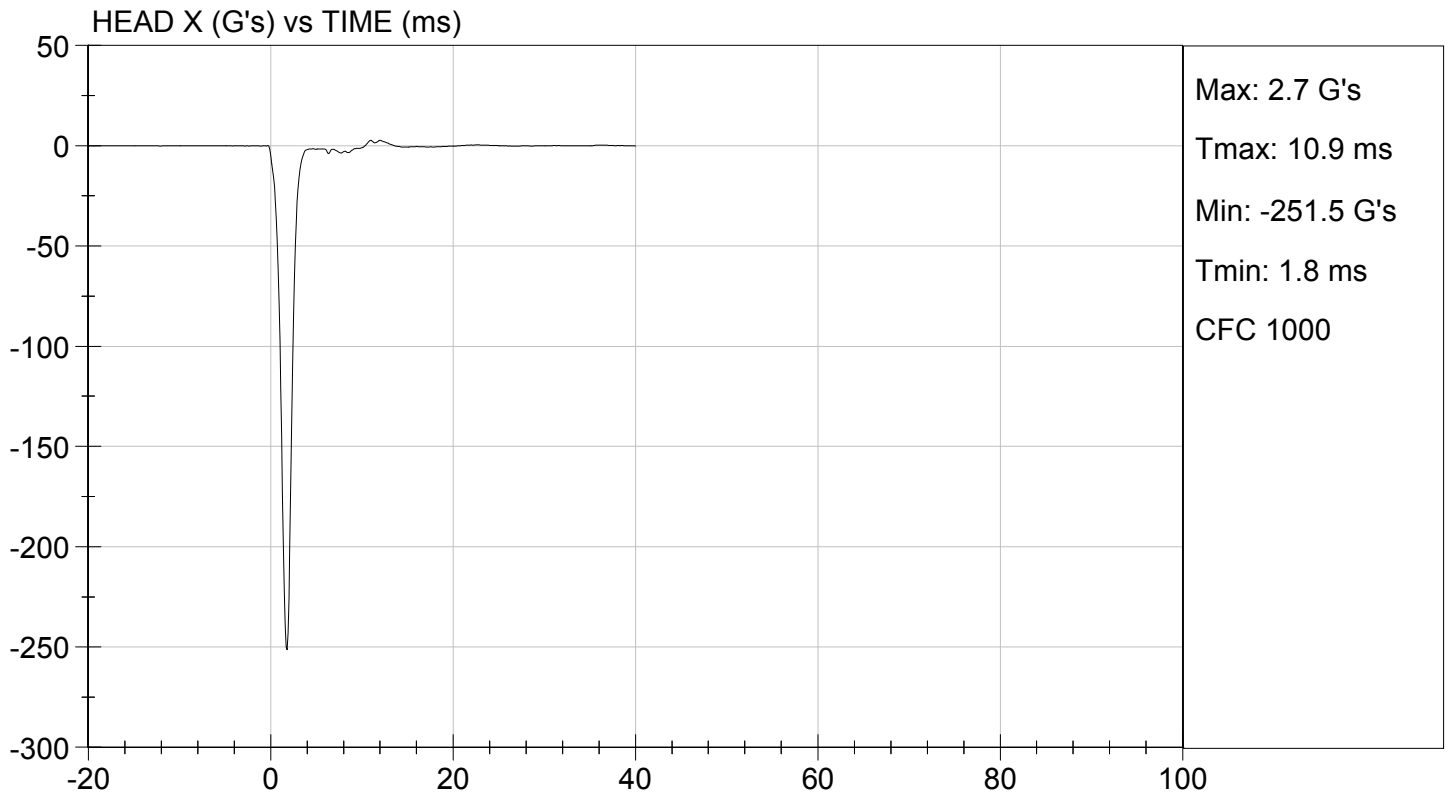
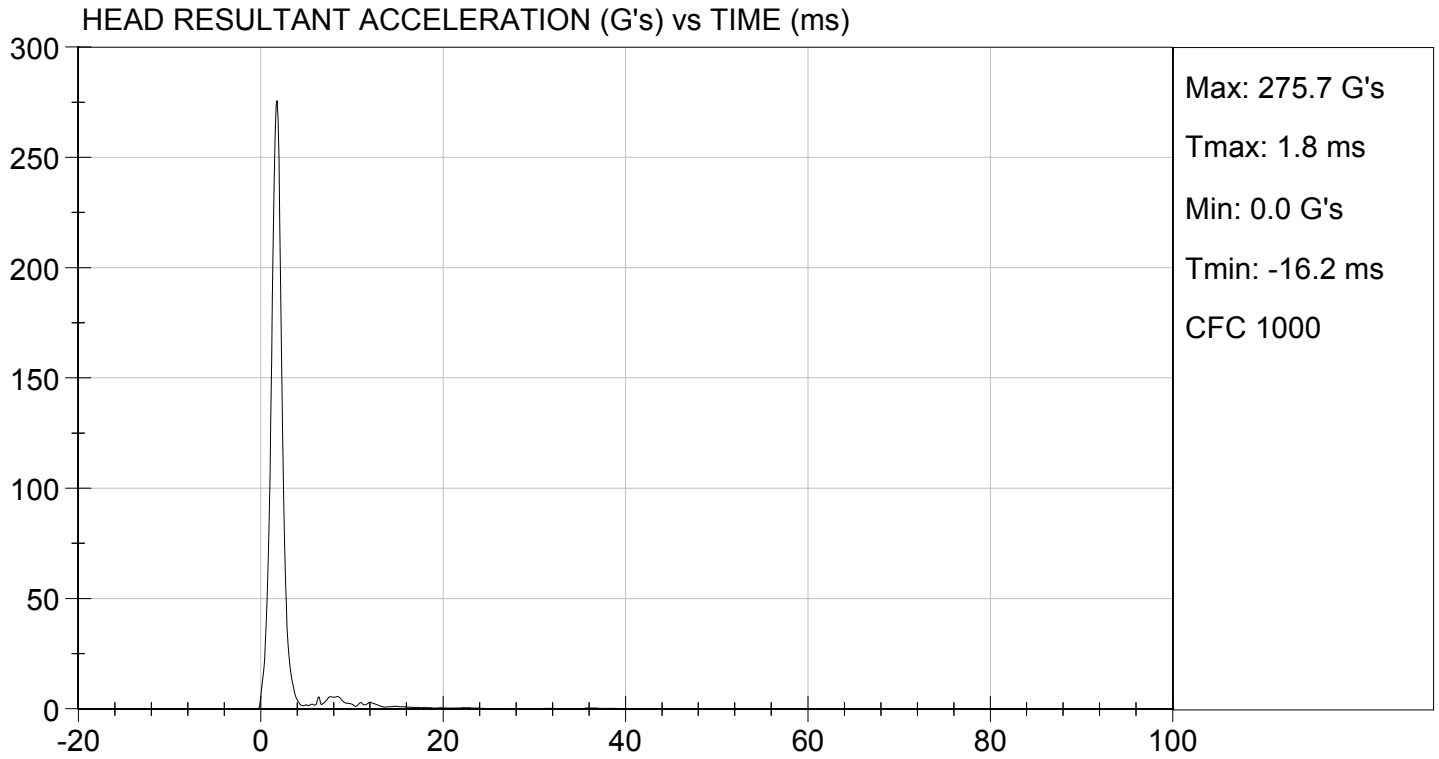
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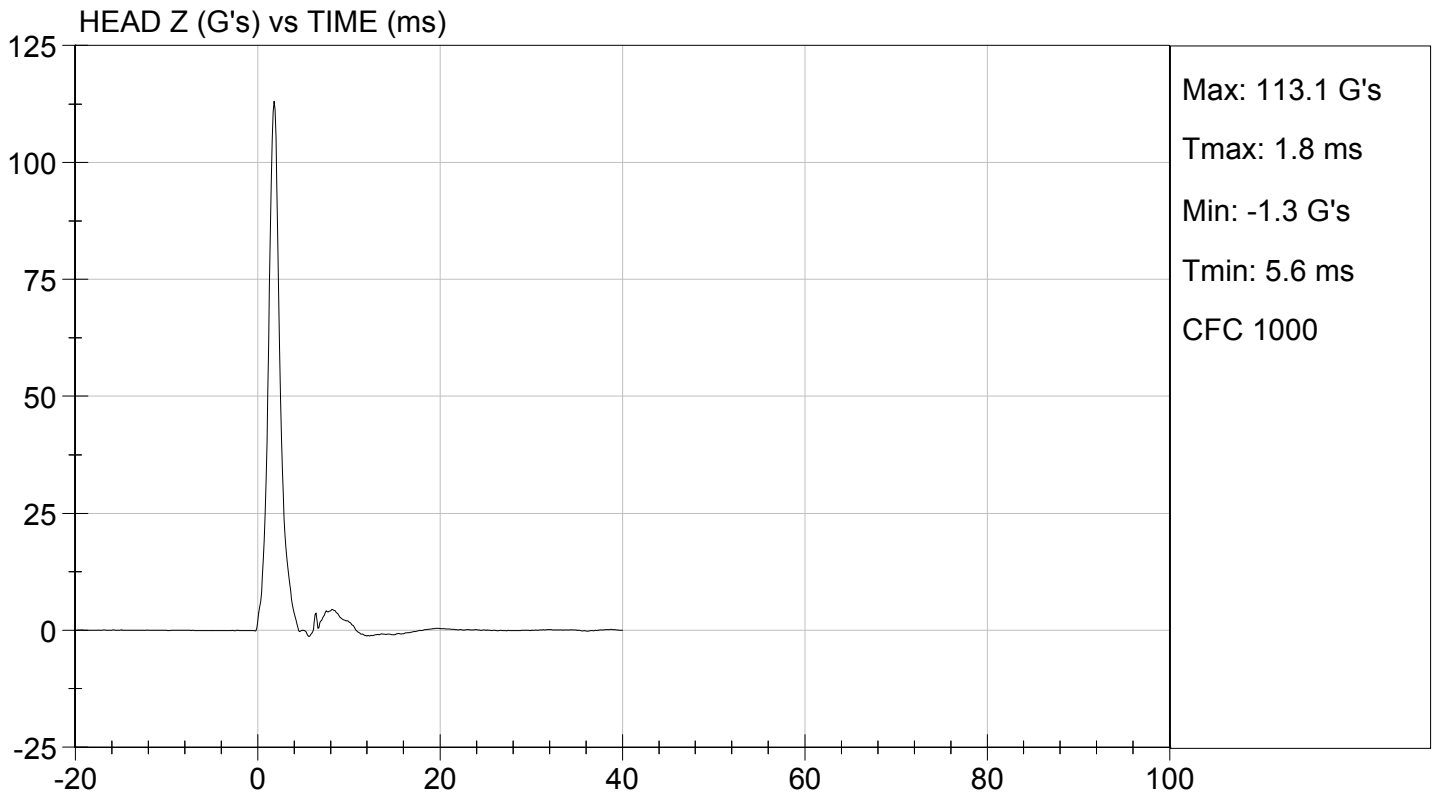
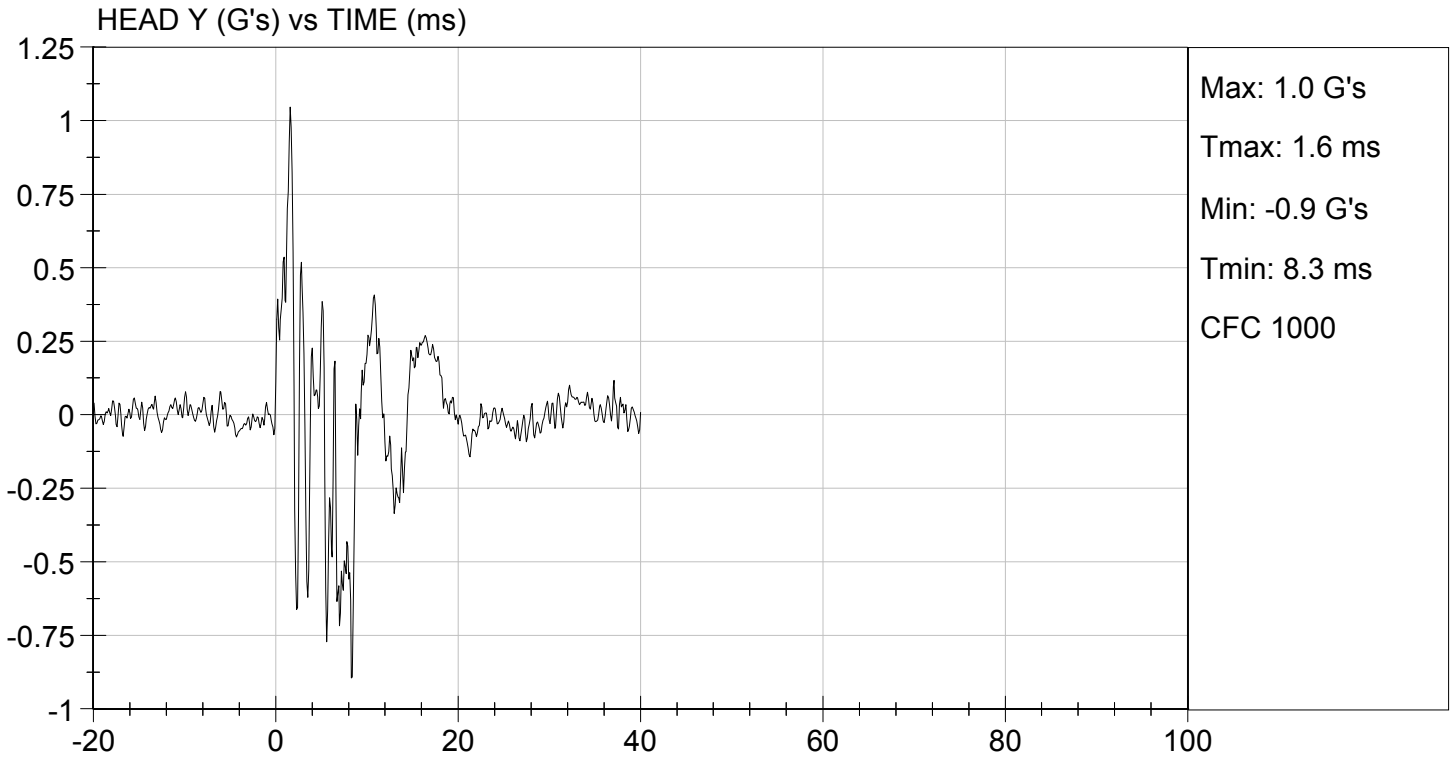
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.1	Pass
Laboratory Relative Humidity	%	10 to 70	49	Pass
Peak Resultant Acceleration	G's	250 to 300	276	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	1.0	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
Overall Test Results				Pass

David Schoedel  
Laboratory Technician

07/29/2014  
Test Date

Jeff Leonard  
Approved By





**DATA SHEET B4**  
NECK FLEXION TEST (572.132) (5<sup>th</sup> Female)

Dummy Serial Number: 124

Test Date: 07/29/2014

Technician: David Schoedel

- Pre test calibration  
 Post test calibration verification

Test attempt no. 1 (when successive flexion tests are necessary)

1. It has been at least 30 minutes since the last flexion test. (572.137(q))  
 N/A, ONLY one neck test performed
2. The components required for the neck tests include the head assembly (880105-100X), neck (880105-250), bib simulator (880105-371), upper neck adjusting bracket (880105-207), lower neck adjusting bracket (880105-208), six axis neck transducer (SA572-S11) and either three accelerometers (SA572-S4) or their mass equivalent installed in the head assembly as specified in drawing 880105-100X. Data from the accelerometers are not required. (572.133(b))
3. The assembly soaked at a temperature between 20.6°C (69°F) and 22.2°C (72°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to a test. (572.133(c)(1))
- |                                 |               |
|---------------------------------|---------------|
| Record the maximum temperature: | <u>21.3°C</u> |
| Record the minimum temperature: | <u>21.1°C</u> |
| Record the maximum humidity:    | <u>49%</u>    |
| Record the minimum humidity:    | <u>47%</u>    |
4. Visually inspect neck assembly for cracks, cuts and separation of the rubber from the metal segments. Note: If the damage resulted from the vehicle crash test in which the dummy was an occupant, the damaged area is to be documented with photography and the post test calibration verification testing completed before any replacement or repairs are made.
- Record findings and actions: No damage
5. Inspect the nodding blocks (78051-351) for any deterioration, but when replacement is necessary, ONLY replace during pre-test calibration. Using a Shore "A" type Durometer, verify the hardness of the nodding blocks is between 80 and 90. Ensure the nodding blocks are installed correctly. (880105-250 and PADI page17).
- Record findings and actions: No Deterioration; Hardness: Front 89; Back 90.
6. Torque the jam nut (9000018) on the neck cable (880105-206) to 1.4 ± 0.2 Nm (12.0 ± 2.0 in-lb). (572.133(c)(2))

- X 7. The data acquisition system, including transducers, conforms to the requirements of SAE Recommended Practice J211/1 MAR95. (572.137(m))
- X 8. The test fixture pendulum conforms to the specifications in Figure 7B. (572.133(c)(3))
- X 9. The head-neck assembly is mounted on the pendulum so the midsagittal plane of the head is vertical and coincides with the plane of motion of the pendulum longitudinal centerline as shown in Figure 8B for the flexion test. (572.133(c)(3))
- X 10. Install the transducers or other devices for measuring the "D" plane rotation with respect to the pendulum longitudinal centerline. Note: Plane "D" is the bottom horizontal surface of the skull. These measurement devices should be designed to minimize their influence upon the performance of the head-neck assembly. An example of a measurement device is shown in Figure 10B.
- X 11. With the pendulum resting against the honeycomb material, the neck bracket was adjusted until the longitudinal centerline of the pendulum was perpendicular  $\pm 1$  degree to plane "D" on the dummy's head.
- X 12. Release the pendulum and allow it to fall freely from a height to achieve an impact speed of 6.89 m/s to 7.13 m/s as measured at the center of the pendulum accelerometer. (572.133(c)(4)(i))
- X 13. Complete the following table:  
Neck Flexion Test Results (572.133(b)(1) & 572.133(c)(4)(i & ii))

Parameter		Specification	Results
Pendulum impact speed		6.89 m/s $\leq$ speed $\leq$ 7.13 m/s	7.13 m/s
Pendulum $\Delta V$ with respect to impact speed	@ 10 ms	2.1 m/s $\leq \Delta V \leq$ 2.5 m/s	2.3 m/s
	@ 20 ms	4.0 m/s $\leq \Delta V \leq$ 5.0 m/s	4.1 m/s
	@ 30 ms	5.8 m/s $\leq \Delta V \leq$ 7.0 m/s	6.0 m/s
Plane D Rotation		Peak moment* 69 Nm $\leq$ moment $\leq$ 83 Nm during the following rotation range 77° $\leq$ angle $\leq$ 91°	78 Nm @ 83 degrees
Positive Moment Decay** (Flexion)		Time to decay to 10 Nm 80 ms $\leq$ time $\leq$ 100 ms	82 ms

\*Moment about the occipital condyle =  $M_y - (0.01778 \text{ m} \times F_x)$ (572.133(b)(1)(ii))

$M_y$  = Moment in Nm measured by the transducer

$F_x$  = Force, in N measured by the transducer

\*\*Time zero is defined as the time of initial contact between the pendulum striker plate and the honeycomb material. (572.133(b)(3))

- X 14. Plots of acceleration, velocity, y-axis moment, and x-axis force and y-axis moment about the occipital condyle follows this sheet.

David Schoedel  
Signature

07/29/2014  
Date

**MGA RESEARCH CORPORATION**

**NECK FLEXION TEST**

**HYBRID III 5TH PERCENTILE**

ATD Serial No: 124

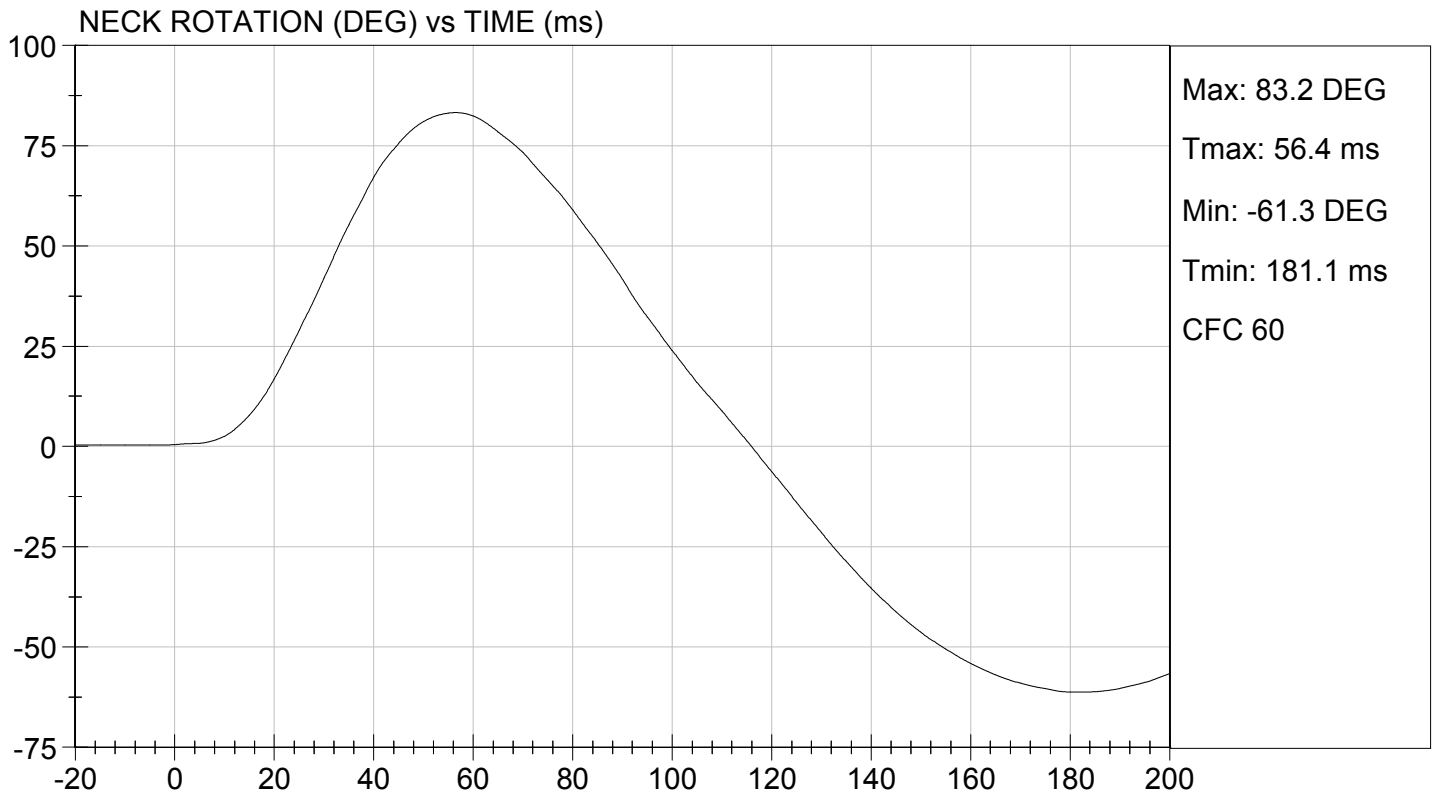
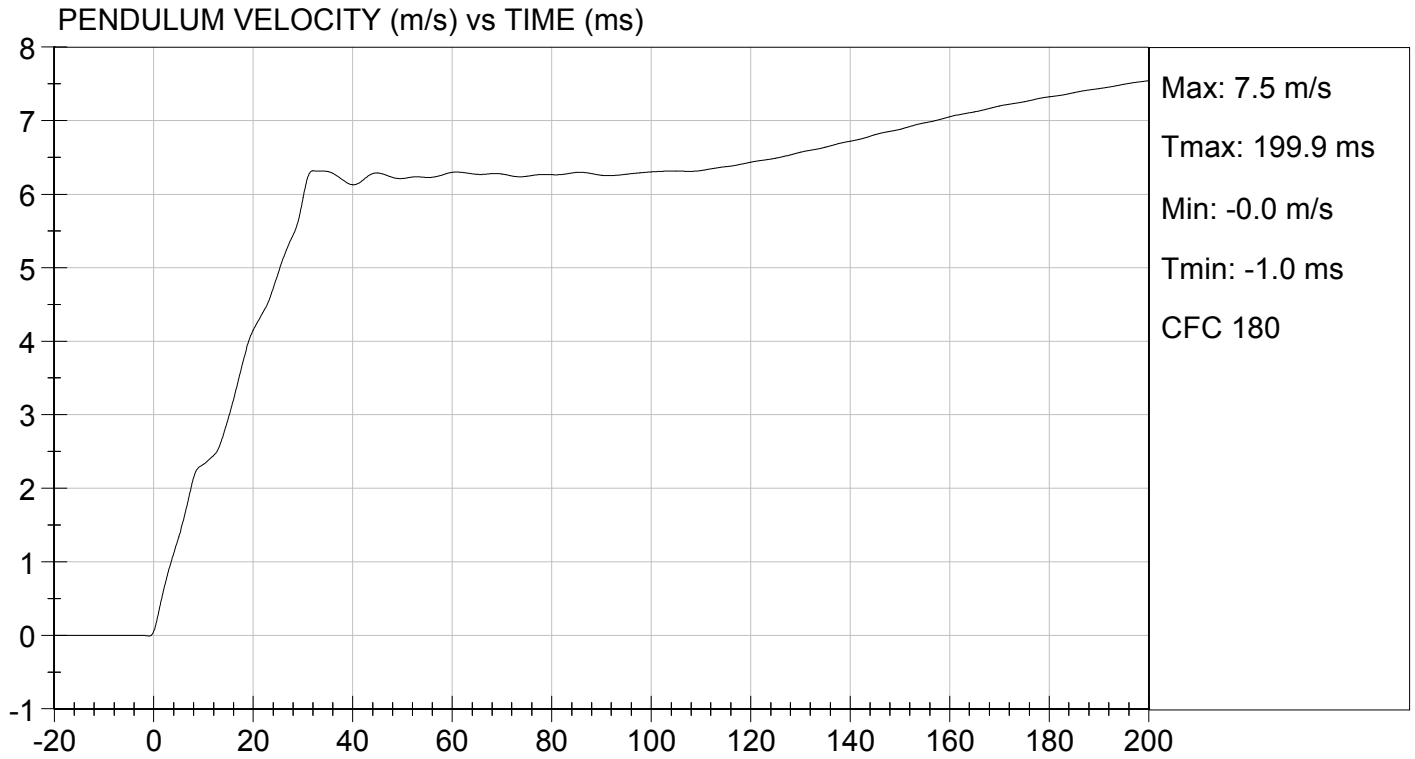
Test I.D.: D142672

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.3	Pass
Laboratory Relative Humidity		%	10 to 70	47	Pass
Pendulum Speed		m/s	6.89 to 7.13	7.13	Pass
Pendulum Velocity	10 ms	m/s	2.1 to 2.5	2.3	Pass
	20 ms	m/s	4.0 to 5.0	4.1	Pass
	30 ms	m/s	5.8 to 7.0	6.0	Pass
D Plane Rotation	Max	deg	77 to 91	83	Pass
Occipital Condyle Moment within Rotation Corridor		Nm	69 to 83	78	Pass
Positive Moment Time Curve Decay to 10 Nm		ms	80 to 100	82	Pass
Overall Results					Pass

David Schoedel  
Laboratory Technician

07/29/2014  
Test Date

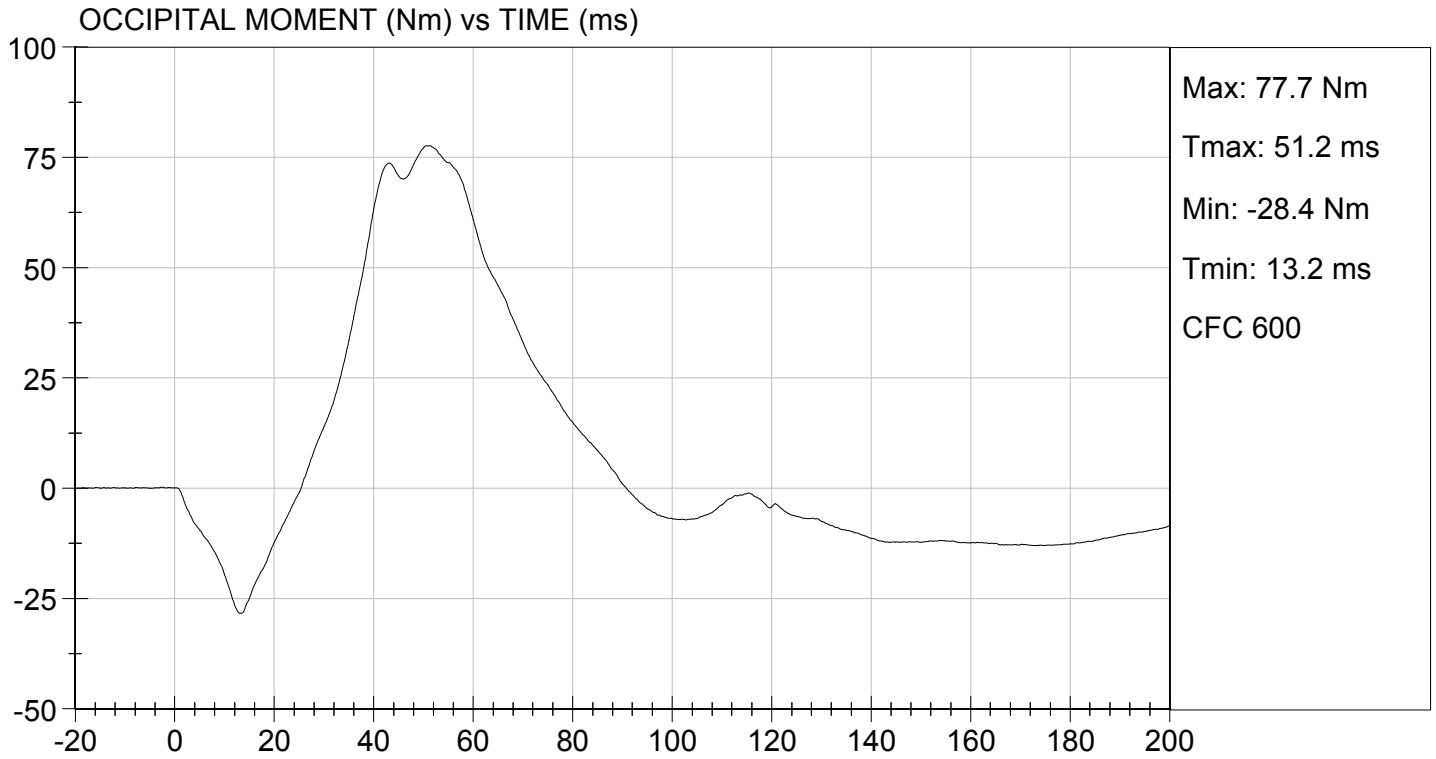
Jeff Leonard  
Approved By





TEST DESC: NECK FLEXION  
VELOCITY: 23.40 ft/s, 7.13 m/s

TEST DATE: 07/29/2014  
TEST #: D142672



**DATA SHEET B5**  
NECK EXTENSION TEST (572.133) (5<sup>th</sup> Female)

Dummy Serial Number: 124

Test Date: 07/29/2014

Technician: David Schoedel

- Pre test calibration  
 Post test calibration verification

Test attempt no. 1 (when successive extension tests are necessary)

1. It has been at least 30 minutes since the last extension test. (572.137(q))  
 N/A, ONLY one neck test performed
2. The components required for the neck tests include the head assembly (880105-100X), neck (880105-250), bib simulator (880105-371), upper neck adjusting bracket (880105-207), lower neck adjusting bracket (880105-208), six axis neck transducer (SA572-S11) and either three accelerometers (SA572-S4) or their mass equivalent installed in the head assembly as specified in drawing 880105-100X. Data from the accelerometers are not required. (572.133(b))
3. The assembly soaked at a temperature between 20.6°C (69°F) and 22.2°C (72°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to a test. (572.133(c)(1))
- |                                 |               |
|---------------------------------|---------------|
| Record the maximum temperature: | <u>21.3°C</u> |
| Record the minimum temperature: | <u>21.1°C</u> |
| Record the maximum humidity:    | <u>49%</u>    |
| Record the minimum humidity:    | <u>47%</u>    |
4. Visually inspect neck assembly for cracks, cuts and separation of the rubber from the metal segments. Note: If the damage resulted from the vehicle crash test in which the dummy was an occupant, the damaged area is to be documented with photography and the post test calibration verification testing completed before any replacement or repairs are made.
- Record findings and actions: No damage
5. Inspect the nodding blocks (78051-351) for any deterioration, but when replacement is necessary, ONLY replace during pre-test calibration. Using a Shore "A" type Durometer, verify the hardness of the nodding blocks is between 80 and 90. Ensure the nodding blocks are installed correctly. (880105-250 and PADI page17).
- Record findings and actions: No Deterioration; Hardness: Front 89; Back 90.
6. Torque the jam nut (9000018) on the neck cable (880105-206) to 1.4 ± 0.2 Nm (12.0 ± 2.0 in-lb). (572.133(c)(2))

- X 7. The data acquisition system, including transducers, conforms to the requirements of SAE Recommended Practice J211/1 MAR95. (572.137(m))
- X 8. The test fixture pendulum conforms to the specifications in Figure 7B. (572.133(c)(3))
- X 9. The head-neck assembly is mounted on the pendulum so the midsagittal plane of the head is vertical and coincides with the plane of motion of the pendulum longitudinal centerline as shown in Figure 9B for the extension test. (572.133(c)(3))
- X 10. Install the transducers or other devices for measuring the "D" plane rotation with respect to the pendulum longitudinal centerline. Note: Plane "D" is the bottom horizontal surface of the skull. These measurement devices should be designed to minimize their influence upon the performance of the head-neck assembly. An example of a measurement device is shown in Figure 10B.
- X 11. With the pendulum resting against the honeycomb material, the neck bracket was adjusted until the longitudinal centerline of the pendulum was perpendicular  $\pm 1$  degree to plane "D" on the dummy's head.
- X 12. Release the pendulum and allow it to fall freely from a height to achieve an impact speed of 5.95 m/s to 6.19 m/s as measured at the center of the pendulum accelerometer. (572.133(c)(4)(i))
- X 13. Complete the following table:  
Neck Extension Test Results (572.133(b)(2) & 572.133(c)(4)(I & ii))

Parameter		Specification	Results
Pendulum impact speed		5.95 m/s $\leq$ speed $\leq$ 6.19 m/s	6.18 m/s
Pendulum $\Delta V$ with respect to impact speed	@ 10 ms	1.5 m/s $\leq \Delta V \leq$ 1.9 m/s	1.7 m/s
	@ 20 ms	3.1 m/s $\leq \Delta V \leq$ 3.9 m/s	3.8 m/s
	@ 30 ms	4.6 m/s $\leq \Delta V \leq$ 5.6 m/s	5.3 m/s
Plane D Rotation		Peak moment* -65 Nm $\leq$ moment $\leq$ -53 Nm during the following rotation range 99° $\leq$ angle $\leq$ 114°	-55 Nm @ 105 degrees
Positive Moment Decay** (Extension)		Time to decay to -10 Nm 94 ms $\leq$ time $\leq$ 114 ms	95 ms

\*Moment about the occipital condyle =  $M_y - (0.01778 \text{ m} \times F_x)$ (572.133(b)(1)(ii))

$M_y$  = Moment in Nm measured by the transducer

$F_x$  = Force, in N measured by the transducer

\*\*Time zero is defined as the time of initial contact between the pendulum striker plate and the honeycomb material. (572.133(b)(3))

- X 14. Plots of acceleration, velocity, y-axis moment, and x-axis force and y-axis moment about the occipital condyle follow this sheet.

David Schoedel  
Signature

07/29/2014  
Date

**MGA RESEARCH CORPORATION**  
**NECK EXTENSION TEST**  
**HYBRID III 5TH PERCENTILE**

ATD Serial No: 124

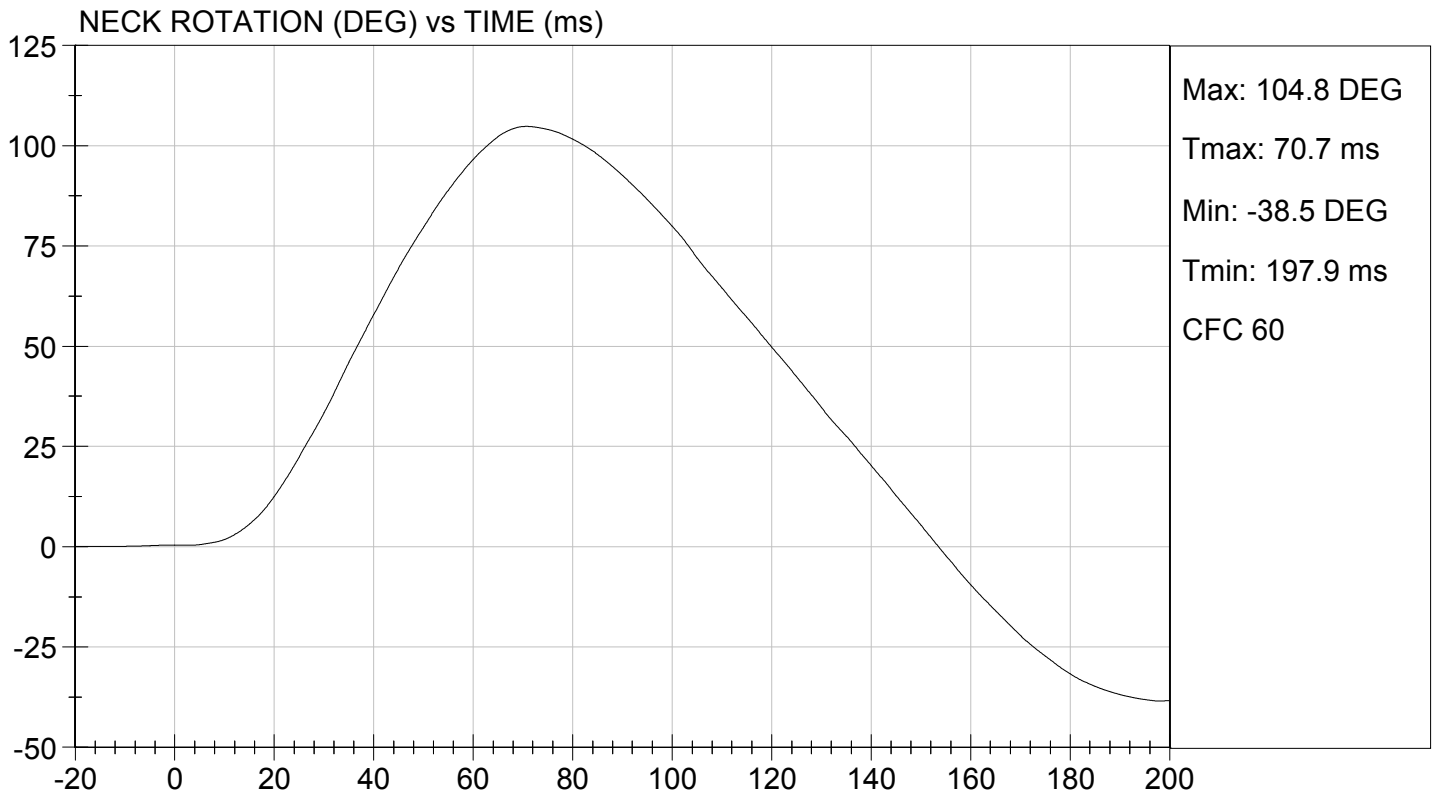
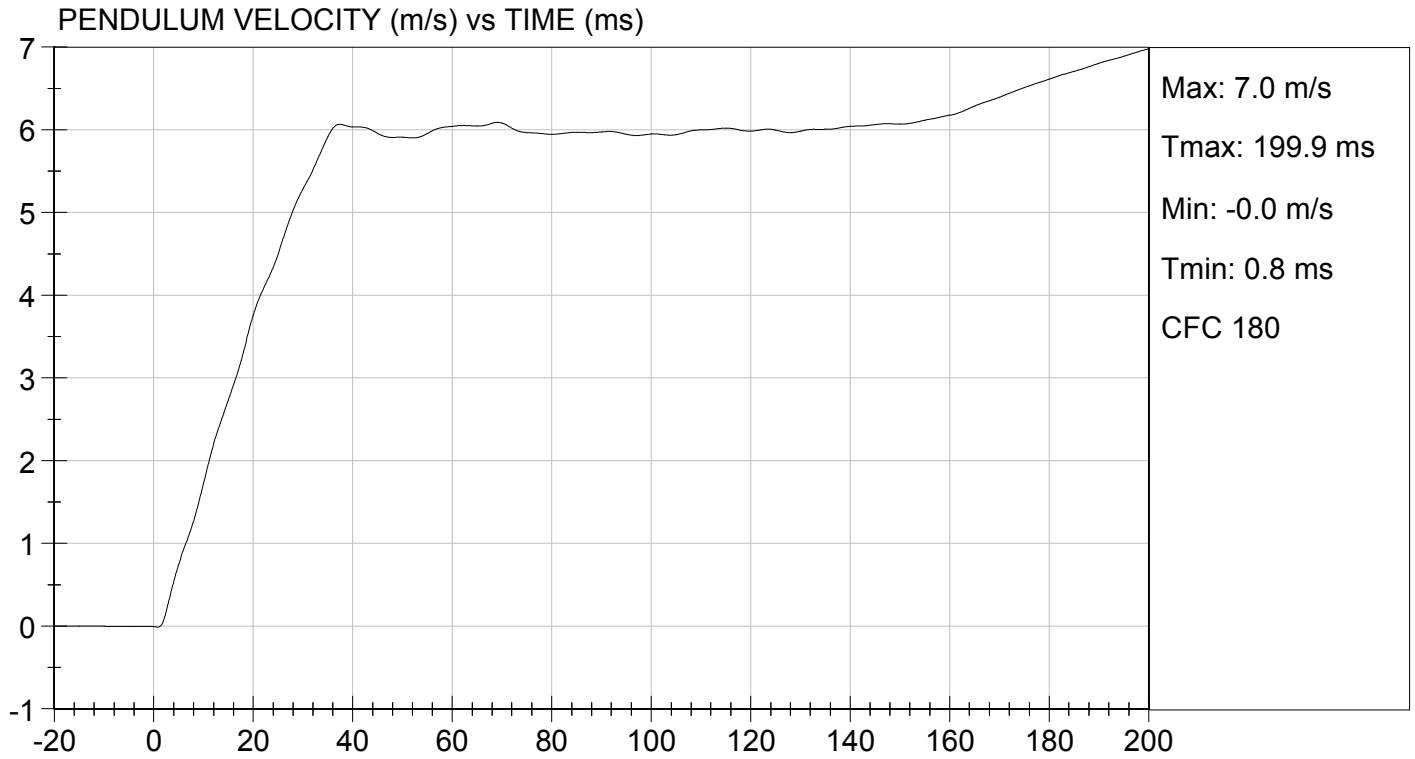
Test I.D: D142673

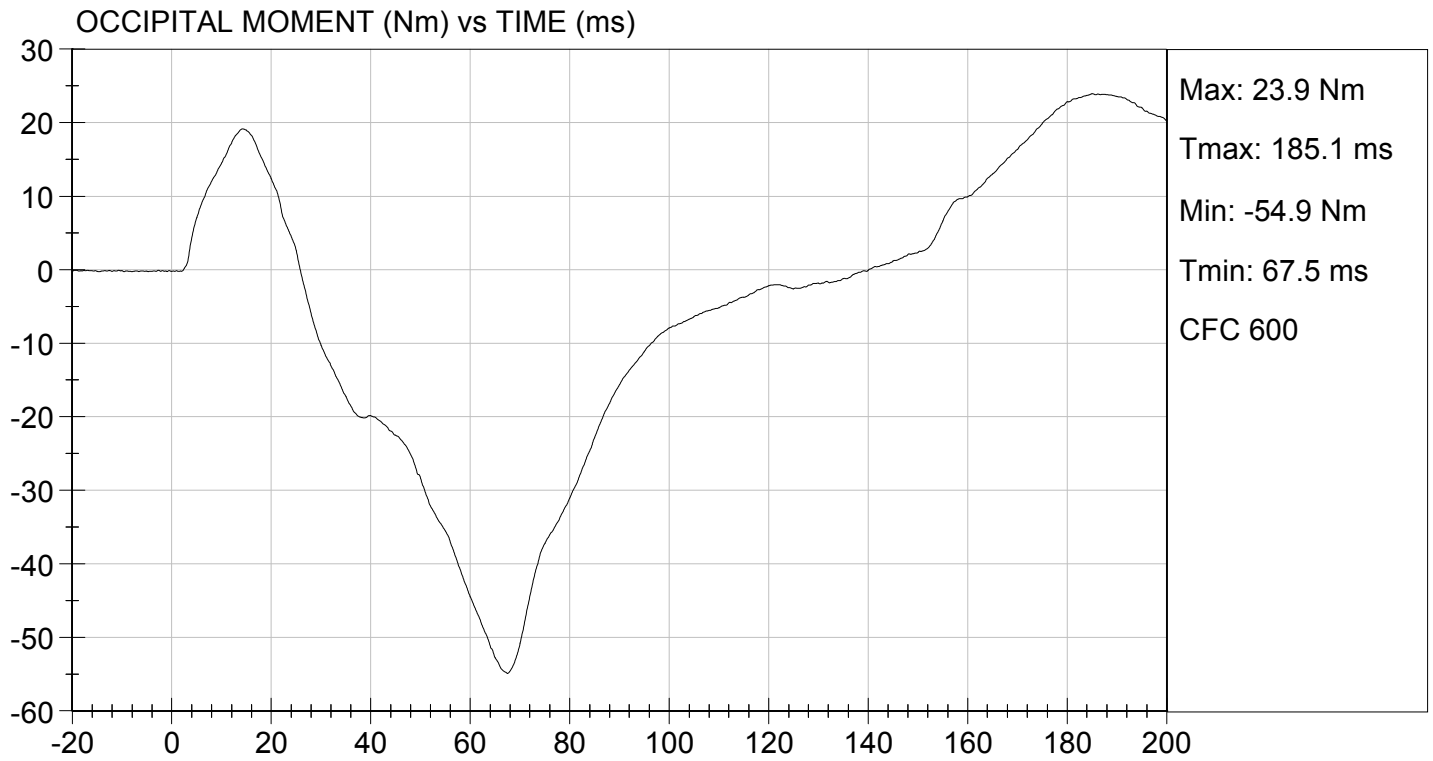
Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.3	Pass
Laboratory Relative Humidity		%	10 to 70	47	Pass
Pendulum Speed		m/s	5.95 to 6.19	6.18	Pass
Pendulum Velocity	10 ms	m/s	1.5 to 1.9	1.7	Pass
	20 ms	m/s	3.1 to 3.9	3.8	Pass
	30 ms	m/s	4.6 to 5.6	5.3	Pass
D Plane Rotation	Max	deg	99 to 114	105	Pass
Occipital Condyle Moment within Rotation Corridor		Nm	-65 to -53	-55	Pass
Negative Moment Time Curve Decay to -10 Nm		ms	94 to 114	95	Pass
<b>Overall Results</b>					<b>Pass</b>

David Schoedel  
Laboratory Technician

07/29/2014  
Test Date

Jeff Leonard  
Approved By





**DATA SHEET B6**  
THORAX IMPACT TEST (572.134) (5<sup>th</sup> Female)

Dummy Serial Number: 124

Test Date: 07/29/2014

Technician: Joseph Radke

- Pre test calibration  
 Post test calibration verification

Test attempt no. 1 (when successive thorax impact tests are necessary)

1. It has been at least 30 minutes since the last thorax impact test. (572.137(q))  
 N/A, ONLY one thorax impact test performed
2. The test fixture conforms to the specifications in Figure 11B.
3. The complete assembled dummy (880105-000) is used (572.134(b)) and is dressed in a form fitting cotton stretch above-the-elbow sleeved shirt and above-the-knee pants. The weight of the shirt and pants shall not exceed 0.14 kg. (572.134(c)(1))
4. The dummy assembly soaked at a temperature between 20.6°C (69°F) and 22.2°C (72°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to this test. (572.134(c)(2))

Record the maximum temperature:	<u>21.3°C</u>
Record the minimum temperature:	<u>21.1°C</u>
Record the maximum humidity:	<u>49%</u>
Record the minimum humidity:	<u>47%</u>

5. Remove the chest skin and visually inspect the thorax assembly for cracks, cuts, abrasions, etc. Particular attention should be given to the rib damping material, chest displacement transducer assembly and the rear rib supports. Inspect for rib deformation using the chest depth gage. If any damage is noted repair and/or replace the damaged components unless the damage resulted from the vehicle crash test in which the dummy was an occupant in which case the damage must be documented and post test calibration verification testing completed before any repairs or replacements are made.

- No Damage  
 - Damage from crash test, no repairs or replacement because this is a post test calibration verification. Record damage:

- The following repairs or replacement was performed. Record:

---

- X 6. Seat the dummy, (chest skin still removed) without back and arm supports on the test fixture surface as shown in Figure 11B. The surface must be long enough to support the pelvis and outstretched legs. (572.134(c)(3))
- X 7. Level the ribs both longitudinally and laterally  $\pm 0.5^\circ$  and adjust the pelvis angle to  $7^\circ \pm 2^\circ$ . The angle may be measured using the special H-point tool (TE-2504) that inserts into the pelvic structure and extends outward beyond the pelvic skin surface or by using the surface of the pelvic adaptor block.
- X 8. The midsagittal plane of the dummy is vertical within  $\pm 1^\circ$ . (572.134(c)(3))
- X 9. The longitudinal centerline of the test probe is centered within  $\pm 2.5$  mm of the midsagittal plane of the dummy and is  $12.7 \text{ mm} \pm 1 \text{ mm}$  below the horizontal peripheral centerline of the No. 3 rib and is within  $0.5^\circ$  of a horizontal line in the dummy's midsagittal plane. (572.134(c)(4))
- X 10. Align the adjustable neck bracket index marks to the "zero" position.
- X 11. Record locations such as the rear surfaces of the thoracic spine and the lower neck bracket reference with respect to the laboratory coordinate system. These reference measurements are necessary to ensure the dummy is in the same position after the chest skin is installed. The reference locations must be accessible after installation of the chest skin. It may be necessary to leave the chest skin zipper unfastened until the references are checked and fasten it just prior to the test.
- X 12. Install the chest skin and reposition the dummy as described in the preceding paragraph using the reference measurements recorded.
- X 13. Place the arm assemblies horizontal  $\pm 2^\circ$  and parallel to the midsagittal plane. The arms are held in place by tightening the adjustment nut that holds the arm yoke to the clavicle assembly.
- X 14. The data acquisition system, including transducers, must conform to the requirements of SAE Recommended Practice J211/1 MAR95 (572.136(m)) Class 180.
- X 15. Impact the anterior surface of the thorax with the test probe so the longitudinal centerline of the probe is within  $2^\circ$  of a horizontal line in the dummy's midsagittal plane at the moment of impact. (572.134(c)(5)) The velocity of the test probe at the time of impact is  $6.71 \text{ m/s} \pm 0.12 \text{ m/s}$ . (572.134(b)) The probe is guided so there is no significant lateral, vertical or rotational movement during the impact. (572.134(c)(6)) Neither the suspension hardware, suspension cables, nor other attachments to the probe, including the velocity vane, make contact with the dummy. (572.134(c)(7))

- X 16. Complete the following table:  
 Thorax Impact Results (572.134(b) and 572.134(b)(1)&(2))

Parameter*	Specification	Result
Test Probe Speed	$6.59 \text{ m/s} \leq \text{speed} \leq 6.83 \text{ m/s}$	6.77 m/s
Chest Compression	$50.0 \text{ mm} \leq \text{compression} \leq 58.0 \text{ mm}$	57 mm
Peak force** between 50.0 and 58.0 mm chest compression	$3900\text{N} \leq \text{peak force} \leq 4400\text{N}$	4259 N
Peak Force** between 18.0 and 50.0 mm chest compression	Peak Force $\leq 4600 \text{ N}$	4148 N
Internal Hysteresis***	$69\% \leq \text{hysteresis} \leq 85\%$	69%

\*Time zero is defined as the time of initial contact between the test probe and the chest skin.

\*\*Force = impactor mass x acceleration (572.134(b)(3))

\*\*\*Area under loading curve minus the area under the unloading curve divided by the area under the loading curve. (Figure 12B)

- X 17. Plots of chest compression, acceleration, force, force versus deflection follow this sheet.

Joseph Radke  
 Signature

07/29/2014  
 Date

**MGA RESEARCH CORPORATION**  
**THORAX IMPACT**  
**HYBRID III 5TH PERCENTILE**

ATD Serial No: 124

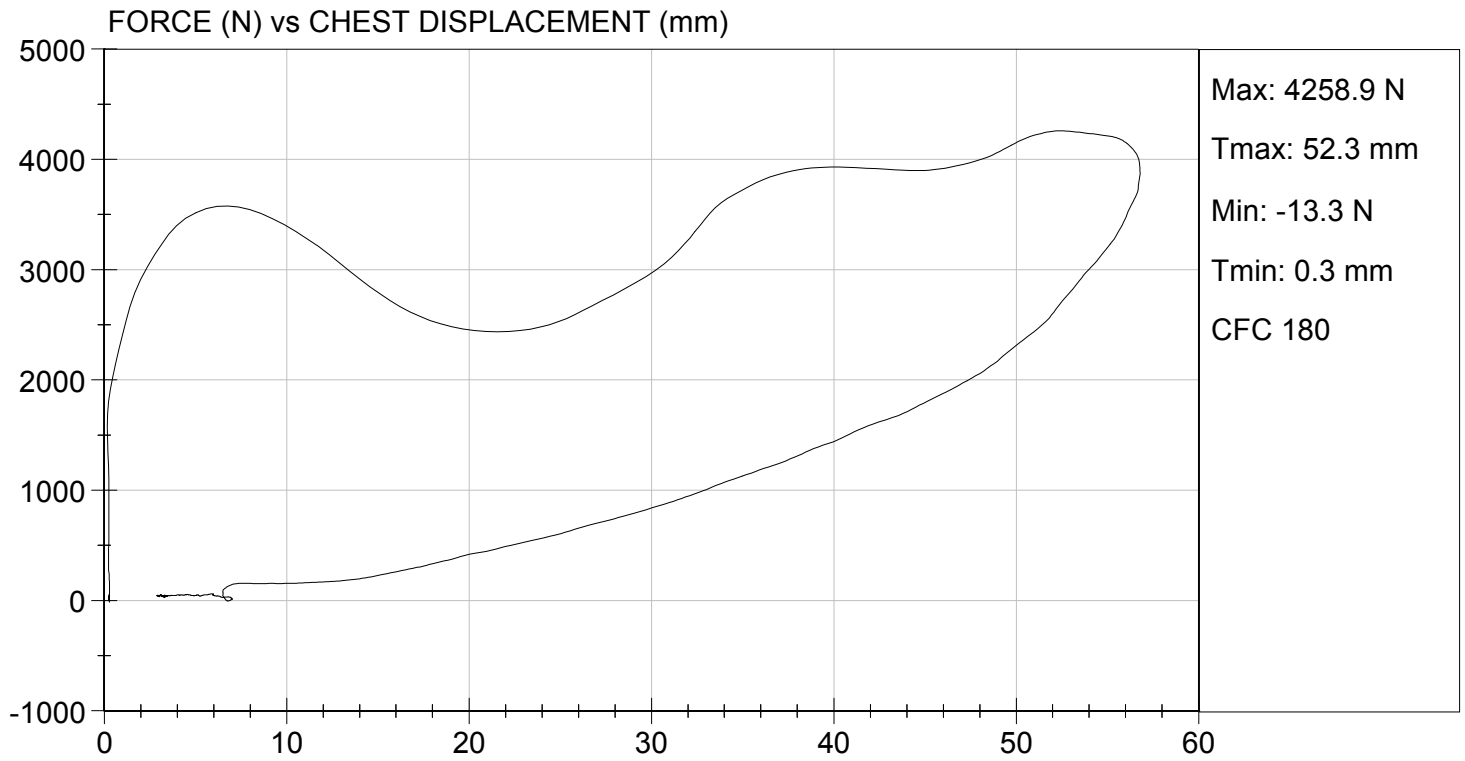
Test I.D: D142674

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.3	Pass
Relative Humidity	%	10 to 70	48	Pass
Probe Speed	m/s	6.59 to 6.83	6.77	Pass
Peak Deflection	mm	50 to 58	57	Pass
Peak Resistive Force w/in Deflection Corridor	N	3900 to 4400	4259	Pass
Internal Hysteresis	%	69 to 85	69	Pass
Peak Force 18 mm - 50 mm	N	<= 4600	4148	Pass
Overall Test Results				Pass

Joseph Radke  
 Laboratory Technician

07/29/2014  
 Test Date

Jeff Leonard  
 Approved By



**DATA SHEET B7**  
TORSO FLEXION TEST (572.135) (5<sup>th</sup> Female)

Dummy Serial Number: 124

Test Date: 07/29/2014

Technician: David Schoedel

- Pre test calibration  
 Post test calibration verification

Test attempt no. 1 (when successive torso flexion tests are necessary)

1. It has been at least 30 minutes since the last torso flexion test. (572.137(q))  
 N/A, ONLY one torso flexion test performed
2. The test fixture conforms to the specifications in Figure 13B.
3. The complete assembled dummy (880105-000) is used (572.135(c)(2)).  
 With legs below femurs.  
 Without legs below femurs.
4. The dummy assembly soaked at a temperature between 18.9°C (66°F) and 25.6°C (78°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to this test. (572.135(c)(1))
- |                                 |               |
|---------------------------------|---------------|
| Record the maximum temperature: | <u>21.3°C</u> |
| Record the minimum temperature: | <u>21.1°C</u> |
| Record the maximum humidity:    | <u>49%</u>    |
| Record the minimum humidity:    | <u>47%</u>    |
5. Secure the pelvis to the fixture at the pelvis instrument cavity rear face by threading four ¼ cap screws into the available threaded attachment holes. Tighten the mountings so that the test material is rigidly affixed to the test fixture and the pelvic lumbar joining surface is horizontal. (572.135(c)(3))
6. Attach the loading adapter bracket to the spine of the dummy as shown in Figure 13B. (572.135(c)(4))
7. Inspect and adjust, if necessary, the seating of the abdominal insert within the pelvis cavity and with respect to the torso flesh, assuring that the torso flesh provides uniform fit and overlap with respect to the outside surface of the pelvis flesh. (572.135(c)(5))
8. Flex the dummy forward and back 3 times such that the angle reference plane moves between 0° and 30° with respect to the vertical transverse plane. (572.135(c)(6))

- X 9. Support the dummy such that the angle reference plane is at or near 0° (vertical with respect to the vertical transverse plane). Wait at least 30 minutes before continuing. (572.135(c)(6))
- X 10. Remove all external support that was implemented in 9 above. (572.135(c)(7))
- X 11. Measure the initial orientation angle of the torso reference plane of the seated, unsupported dummy. (572.135(c)(7))
 

Record reference plane angle (max. allowed 20°):                     See Result Table
- X 12. Attach the pull cable and the load cell. (572.135(c)(8))
- X 13. Apply a tension force in the midsagittal plane to the pull cable at any upper torso deflection rate between 0.5° and 1.5° per second, until the angle reference plane is at 45° ± 0.5° of flexion relative to the vertical transverse plane. (572.135(c)(9))
- X 14. Maintain angle reference plane at 45° ± 0.5° of flexion for 10 seconds. (572.135(c)(10))
- X 15. As quickly as possible release the force applied to the attachment bracket. (572.135(c)(11))
- X 16. 3 minutes after the release of the force, measure the reference plane angle. (572.135(c)(11))
- X 17. Complete the following table:  
Torso Flexion Results (572.135(b), 572.135(c)(7), 572.135(c)(9))

Parameter	Specification	Result
Initial ref. plane angle	Angle ≤ 20°	16 deg
Torso rotation rate	0.5°/s ≤ rate ≤ 1.5°/s	0.9 deg/sec
Force at 45° ± 0.5°	320 N ≤ force ≤ 390 N	358 N
Final ref. plane angle	Initial ref. plane angle ± 8°	18 deg

David Schoedel  
Signature

07/29/2014  
Date

**MGA RESEARCH CORPORATION**  
**TORSO FLEXION TEST**  
**HYBRID III 5TH PERCENTILE**

ATD Serial No: 124

Test I.D: D142677

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.3	Pass
Laboratory Relative Humidity	%	10 to 70	47	Pass
Initial Angle	deg	0 to 20	16	Pass
Return Angle	deg	+/- 8	18	Pass
Force at 45 deg	N	320 to 390	358	Pass
Upper Torso Deflection Rate	deg/s	0.5 to 1.5	0.9	Pass
Overall Result				Pass

*David Schoedel*

Laboratory Technician

07/29/2014

Test Date

*Jeff Leonard*

Approved By

**DATA SHEET B8**  
LEFT KNEE IMPACT TEST (572.136) (5<sup>th</sup> Female)

Dummy Serial Number: 124

Test Date: 07/29/2014

Technician: David Schoedel

- Pre test calibration  
 Post test calibration verification

Test attempt no. 1 (when successive knee impact tests are necessary)

1. It has been at least 30 minutes since the last knee impact test. (572.137(q))  
 N/A, ONLY one knee impact test performed
2. The test fixture conforms to the specifications in Figure 14B.
3. The knee assembly (880105-528L), lower leg structural replacement (880105-603), lower leg flesh (880105-601), ankle assembly (880105-660), foot assembly (880105-650), and femur load transducer (SA572-S14) (may use the load cell structural replacement (78051-319)) were used. (572.136(b)(1))
4. The knee assembly soaked at a temperature between 18.9°C (66°F) and 25.6°C (78°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to this test. (572.136(c)(1))
- |                                 |               |
|---------------------------------|---------------|
| Record the maximum temperature: | <u>21.3°C</u> |
| Record the minimum temperature: | <u>21.1°C</u> |
| Record the maximum humidity:    | <u>49%</u>    |
| Record the minimum humidity:    | <u>47%</u>    |
5. Mount the test specimen and secure it to the rigid test fixture. (572.136(c)(2))
6. No parts of the foot or tibia contact any exterior surface. (572.136(c)(2))
7. Align the test probe so that throughout its stroke and at contact with the knee it is within 2 degrees of horizontal and collinear with the longitudinal centerline of the femur. (572.136(c)(3))
8. The probe is guided so there is no significant lateral, vertical or rotational movement during the impact with the knee. (572.136(c)(4))
9. The data acquisition system, including transducers, must conform to the requirements of SAE Recommended Practice J211/1 MAR95 (572.136(m)) Class 600.

X 10. Contact the knee with the test probe at a speed between 2.07 m/s and 2.13 m/s. (572.136(c)(5)) Neither the suspension hardware, suspension cables, nor other attachments to the probe, including the velocity vane, make contact with the dummy. (572.136(c)(6))

X 11. Complete the following table:  
Knee Impact Results (572.136(b)(1) and 572.136(c)(5))

Parameter	Specification	Result
Probe speed	$2.07 \text{ m/s} \leq \text{speed} \leq 2.13 \text{ m/s}$	2.11 m/s
Peak resistance force*	$3450 \text{ N} \leq \text{force} \leq 4060 \text{ N}$	3554 N

\*Force = impactor mass x deceleration (572.136(b)(2))

X 12. Plots of acceleration versus time and force versus time follow this sheet.

David Schoedel  
Signature

07/29/2014  
Date

MGA RESEARCH CORPORATION

LEFT KNEE IMPACT TEST  
HYBRID III 5TH PERCENTILE

ATD Serial No: 124

Test I.D: D142676

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.3	Pass
Laboratory Relative Humidity	%	10 to 70	47	Pass
Probe Speed	m/s	2.07 to 2.13	2.11	Pass
Maximum Force	N	3450 to 4060	3554	Pass
Overall Test Results				Pass

David Schoedel  
Laboratory Technician

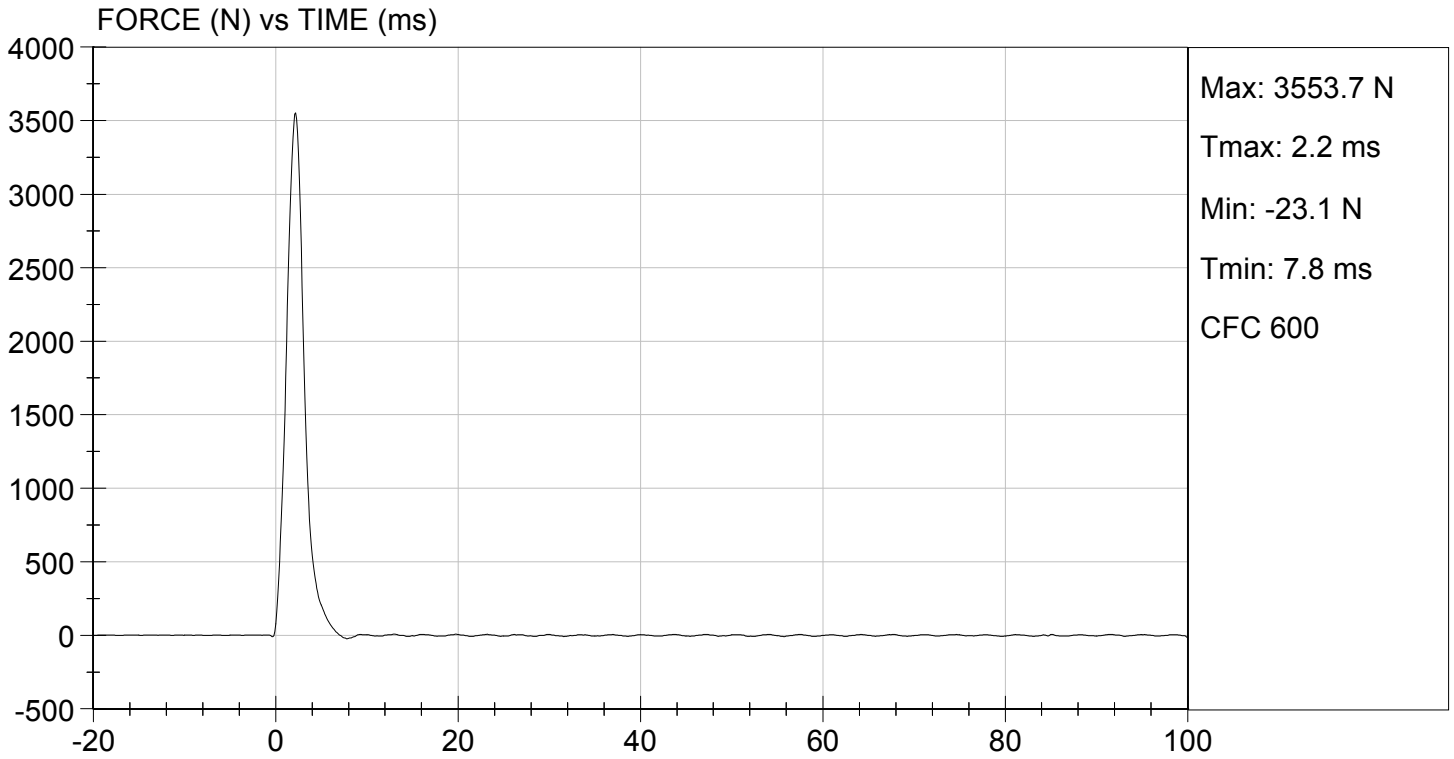
07/29/2014  
Test Date

Jeff Levanowski  
Approved By



TEST DESC: LEFT KNEE  
VELOCITY: 6.92 ft/s, 2.11 m/s

TEST DATE: 07/29/2014  
TEST #: D142676



**DATA SHEET B9**  
RIGHT KNEE IMPACT TEST (572.136) (5<sup>th</sup> Female)

Dummy Serial Number: 124

Test Date: 07/29/2014

Technician: David Schoedel

- Pre test calibration  
 Post test calibration verification

Test attempt no. 1 (when successive knee impact tests are necessary)

1. It has been at least 30 minutes since the last knee impact test. (572.137(q))  
 N/A, ONLY one knee impact test performed
2. The test fixture conforms to the specifications in Figure 14B.
3. The knee assembly (880105-528R), lower leg structural replacement (880105-603), lower leg flesh (880105-601), ankle assembly (880105-660), foot assembly (880105-651), and femur load transducer (SA572-S14) (may use the load cell structural replacement (78051-319)) were used. (572.136(b)(1))
4. The knee assembly soaked at a temperature between 18.9°C (66°F) and 25.6°C (78°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to this test. (572.136(c)(1))

Record the maximum temperature:	<u>21.3°C</u>
Record the minimum temperature:	<u>21.1°C</u>
Record the maximum humidity:	<u>49%</u>
Record the minimum humidity:	<u>47%</u>

5. Mount the test specimen and secure it to the rigid test fixture. (572.136(c)(2))
6. No parts of the foot or tibia contact any exterior surface. (572.136(c)(2))
7. Align the test probe so that throughout its stroke and at contact with the knee it is within 2 degrees of horizontal and collinear with the longitudinal centerline of the femur. (572.136(c)(3))
8. The probe is guided so there is no significant lateral, vertical or rotational movement during the impact with the knee. (572.136(c)(4))
9. The data acquisition system, including transducers, must conform to the requirements of SAE Recommended Practice J2111/1 MAR95 (572.136(m)) Class 600.

X 10. Contact the knee with the test probe at a speed between 2.07 m/s and 2.13 m/s. (572.136(c)(5)) Neither the suspension hardware, suspension cables, nor other attachments to the probe, including the velocity vane, make contact with the dummy. (572.136(c)(6))

X 11. Complete the following table:  
Knee Impact Results (572.136(b)(1) and 572.136(c)(5))

Parameter	Specification	Result
Probe speed	$2.07 \text{ m/s} \leq \text{speed} \leq 2.13 \text{ m/s}$	2.11 m/s
Peak resistance force*	$3450 \text{ N} \leq \text{force} \leq 4060 \text{ N}$	3703 N

\*Force = impactor mass x deceleration (572.136(b)(2))

X 12. Plots of acceleration versus time and force versus time follow this sheet.

David Schoedel  
Signature

07/29/2014  
Date

**MGA RESEARCH CORPORATION**  
**RIGHT KNEE IMPACT TEST**  
**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 124

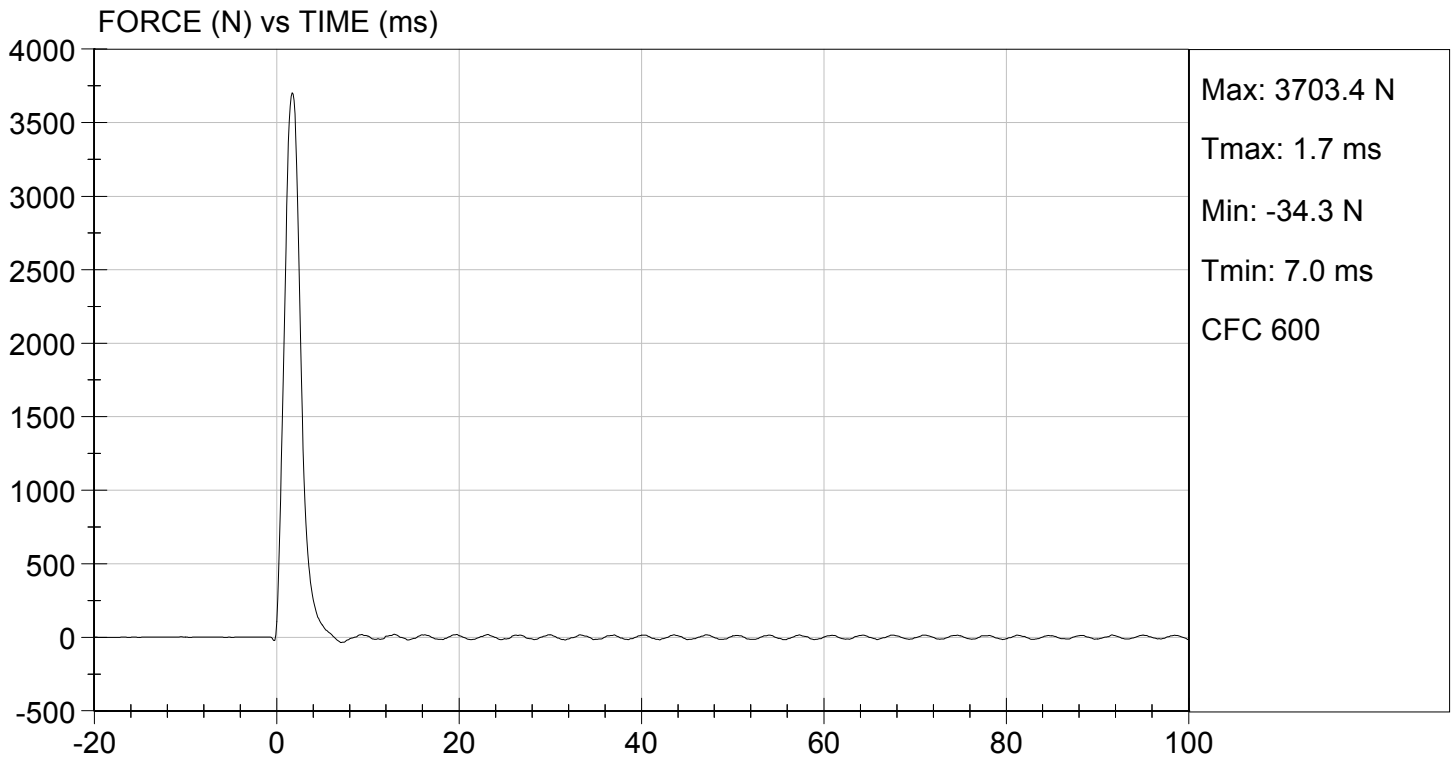
**Test I.D.:** D142675

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.3	Pass
Laboratory Relative Humidity	%	10 to 70	47	Pass
Probe Speed	m/s	2.07 to 2.13	2.11	Pass
Maximum Force	N	3450 to 4060	3703	Pass
Overall Test Results				Pass

David Schoedel  
Laboratory Technician

07/29/2014  
Test Date

Jeff Leonard  
Approved By





**DATA SHEET B3**  
HEAD DROP TEST (572.132) (5<sup>th</sup> Female)

Dummy Serial Number: 124

Test Date: 07/30/2014

Technician: Joseph Radke

- Pre test calibration  
 Post test calibration verification

Test attempt no. 1 (when successive head drops are necessary)

1. It has been at least 2 hours since the last head drop. (572.132(c)(5))  
 N/A, ONLY one head drop performed
2. The head assembly consists of the complete head (880105-100X), the six-axis neck transducer (SA572-S11) or neck transducer structural replacement (78051-383X), and three (3) accelerometers (SA572-S4). (572.132(a))
3. The head accelerometer mounting plate screws (10-24 x 3/8 SHCS) are torqued to 9.0 Nm.
4. Accelerometers and their respective mounts are smooth and clean.
5. Torque the skull cap screws (10-24 x 1/2 SHCS) to 9.0 Nm.
6. The data acquisition system, including transducers, conforms to the requirements of SAE Recommended Practice J211/1 MAR95. (572.136(m))
7. The head assembly soaked at a temperature between 18.9°C (66°F) and 25.6°C (78°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to a test. (572.132(c)(1))
- |                                 |               |
|---------------------------------|---------------|
| Record the maximum temperature: | <u>21.4°C</u> |
| Record the minimum temperature: | <u>21.0°C</u> |
| Record the maximum humidity:    | <u>48%</u>    |
| Record the minimum humidity:    | <u>45%</u>    |
8. Visually inspect the head skin for cracks, cuts, abrasions, etc. Repair or replace the head skin if the damaged area is more than superficial. Note: If the damage resulted from the vehicle crash test in which the dummy was an occupant, the damaged area is to be documented with photography and the post test calibration verification testing completed before any replacement or repairs are made.
- Record findings and actions: No Damage

X 9. Clean the impact surface of the skin and the impact surface of the fixture with isopropyl alcohol, trichloroethane or equivalent prior to the test. (572.132(c)(2))

X 10. Suspend and orient the head assembly as shown in Figure 5B. The lowest point on the forehead is  $376.0 \pm 1.0$  mm ( $14.8 \pm 0.04$  inch) from the impact surface. (572.132(c)(3))  
Record the actual distance: 376 mm

**NOTE:** The masses of the suspension device and the accelerometer cables are to be kept as lightweight as possible to minimize their effect on the test results.

X 11. The 1.57 mm (0.062 inch) diameter holes located on either side of the dummy's head are equidistance within 2 mm from the impact surface. A typical test setup is shown in Figure 6B. (572.132(c)(3))  
Record the right side distance: 501 mm  
Record the left side distance: 501 mm

X 12. The impact surface is clean and dry and has a micro finish in the range of  $203.2 \times 10^{-6}$  mm (8 micro inches) to  $2032.0 \times 10^{-6}$  mm (80 micro inches) (RMS). (572.132(c)(4))  
Record actual micro finish: 24.8 micro inches

X 13. The impact surface is rigidly supported. (572.132(c)(4))

X 14. The impact surface is a flat horizontal steel plate 50.8 mm (2 inches) thick and 610 mm (24 inches) square. (572.132(c)(4))  
Record thickness: 50.9 mm  
Record width: 604 mm  
Record length: 595 mm

X 15. Drop the head assembly from a height of  $376.0 \pm 1.0$  mm (14.8 inches  $\pm$  0.04 inches) by a means that ensures a smooth, instant release onto the impact surface. (572.132(b) & (572.132(c)(4))

X 16. Complete the following table using channel class 1000 data. (572.132(b)):

Parameter	Specification	Result
Peak resultant acceleration	$250 \text{ g} \leq x \leq 300 \text{ g}$	264 g
Resultant versus time history curve	Unimodal	Yes
Oscillations after the main pulse	Less than 10% of the peak resultant acceleration	Yes
Lateral acceleration	y-axis acceleration $\leq 15 \text{ g}$	-7.9 g

X 17. Plots of the x, y, z, and resultant acceleration data follow this sheet.

Joseph Radtke  
Signature

07/30/2014  
Date

**MGA RESEARCH CORPORATION**  
**HEAD DROP TEST**  
**HYBRID III 5TH PERCENTILE**

ATD Serial No: 124

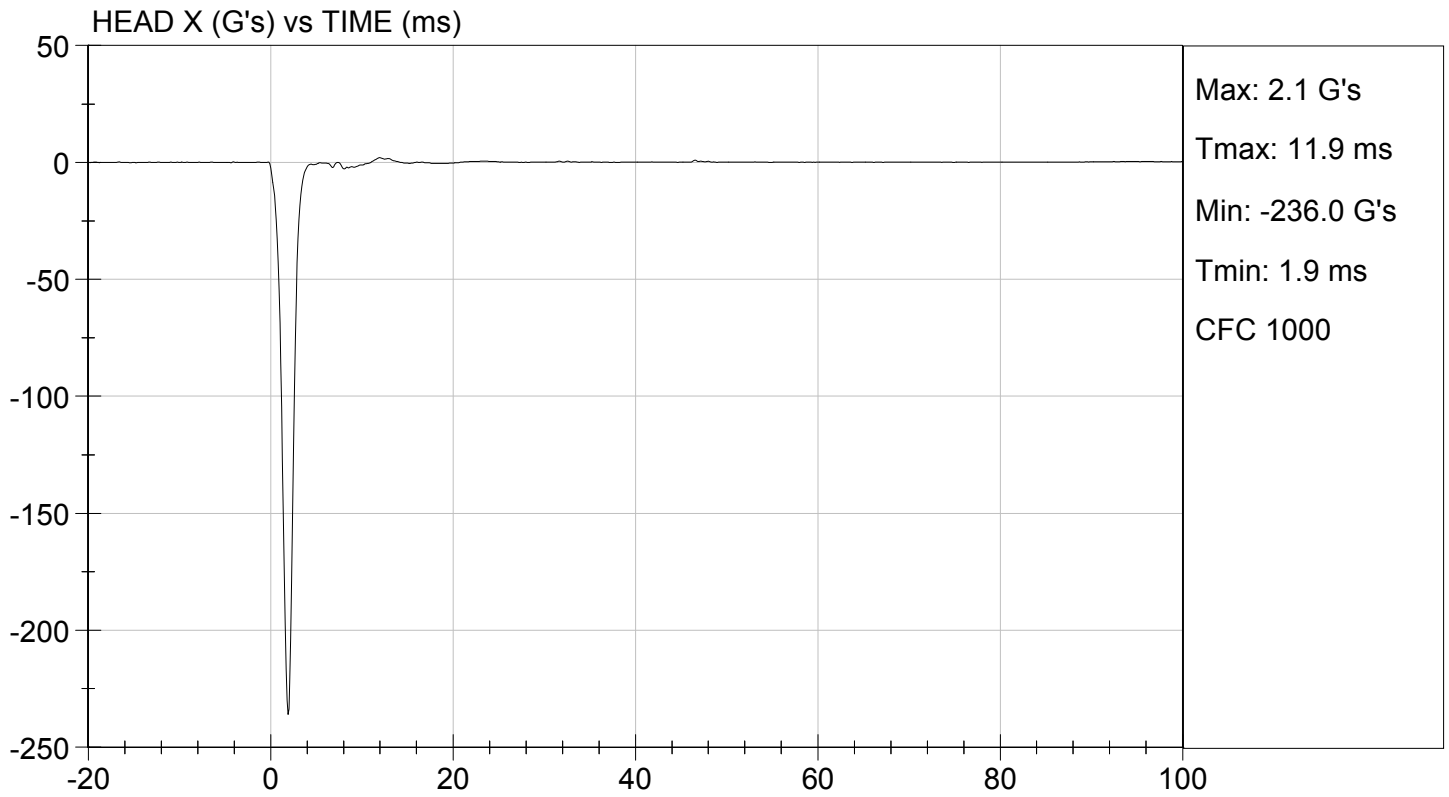
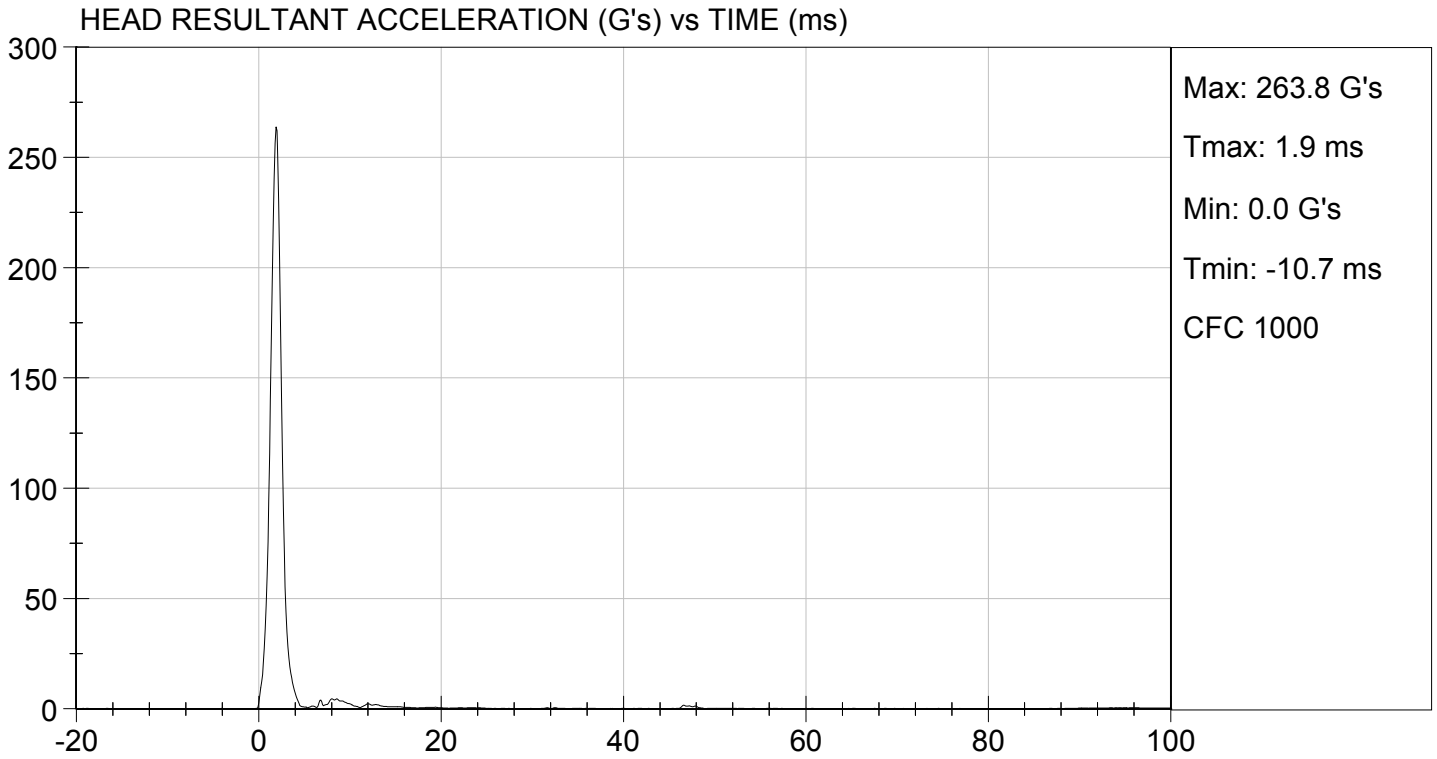
Test ID: D142711

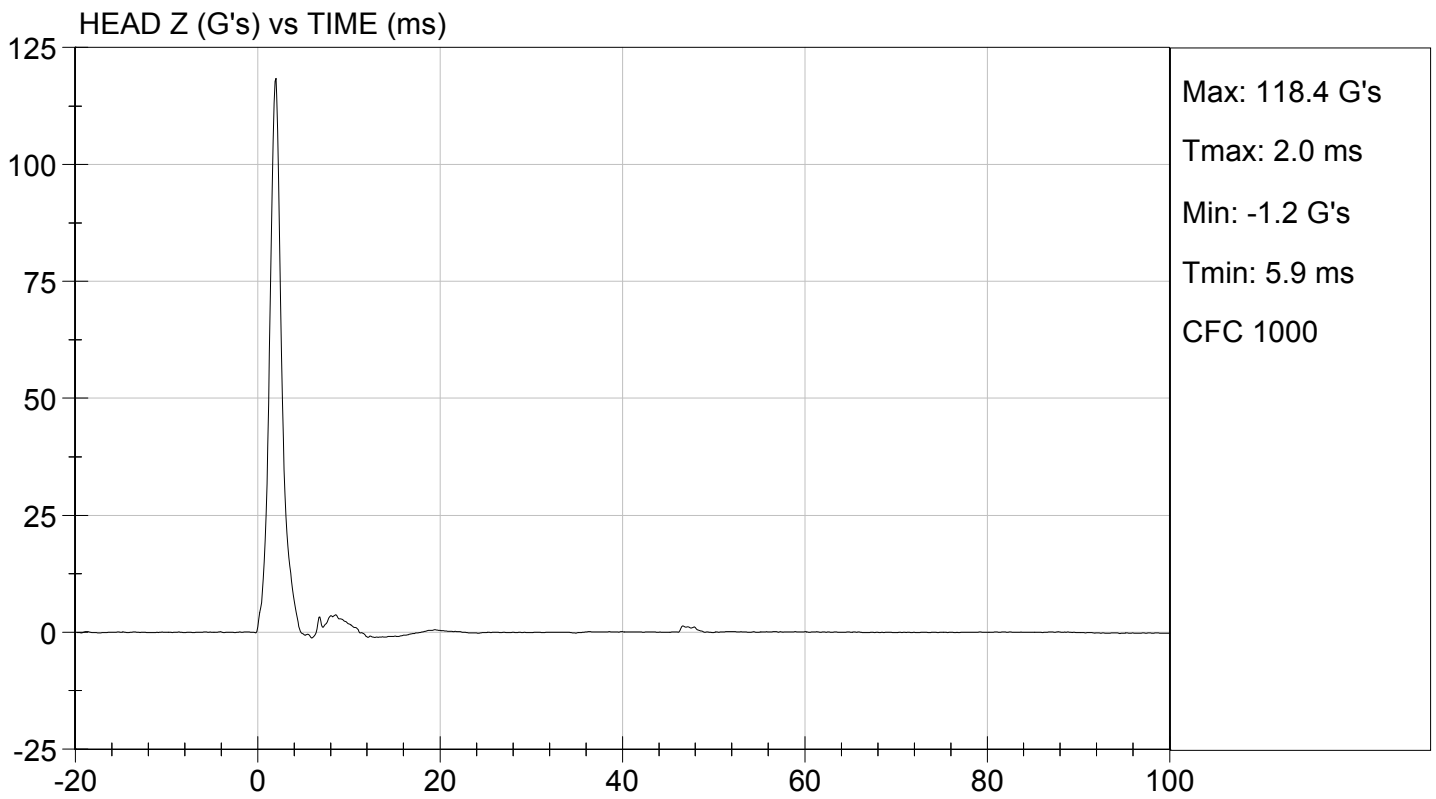
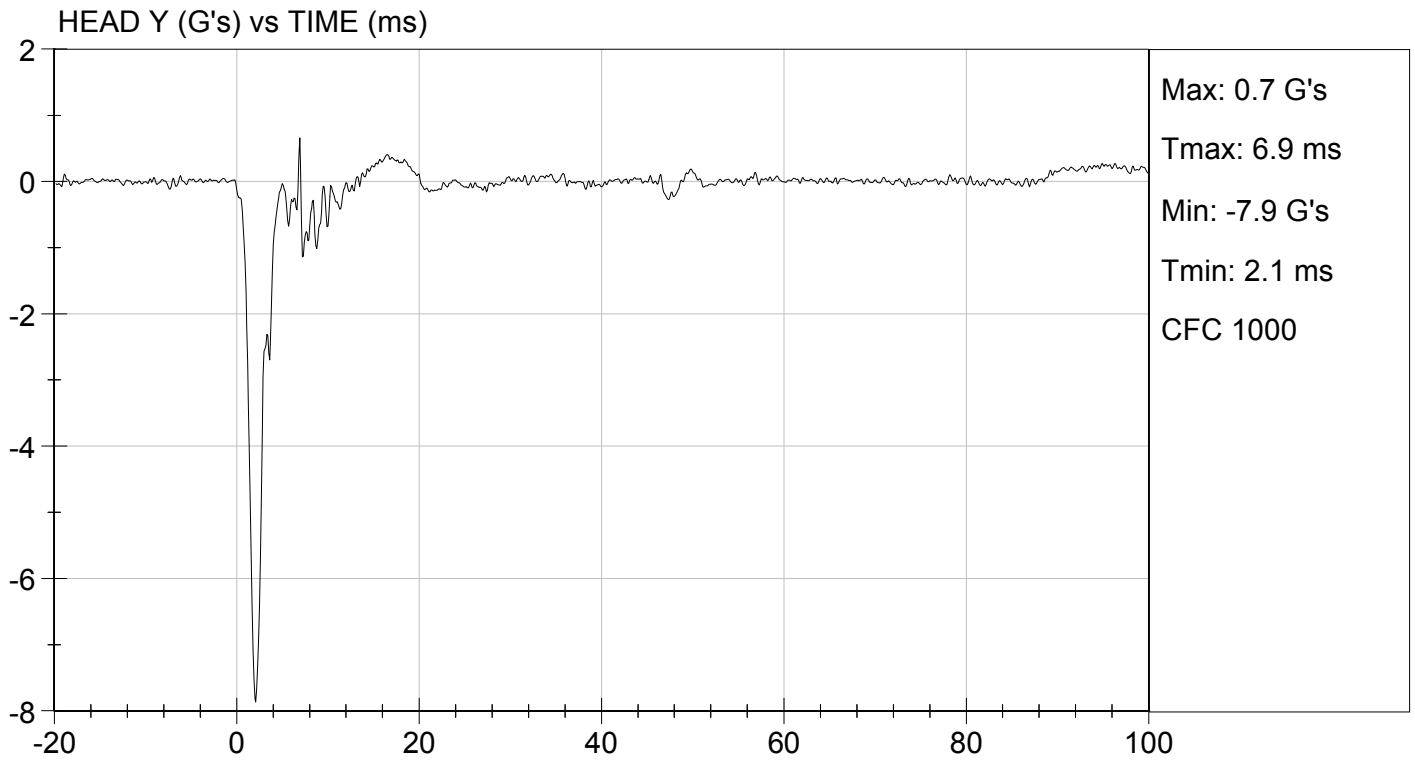
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.3	Pass
Laboratory Relative Humidity	%	10 to 70	48	Pass
Peak Resultant Acceleration	G's	250 to 300	264	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-7.9	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
Overall Test Results				Pass

Joseph Radtke  
 Laboratory Technician

07/30/2014  
 Test Date

Jeff Leonard  
 Approved By





**DATA SHEET B4**  
NECK FLEXION TEST (572.132) (5<sup>th</sup> Female)

Dummy Serial Number: 124

Test Date: 07/30/2014

Technician: David Schoedel

- Pre test calibration  
 Post test calibration verification

Test attempt no. 1 (when successive flexion tests are necessary)

1. It has been at least 30 minutes since the last flexion test. (572.137(q))  
 N/A, ONLY one neck test performed
2. The components required for the neck tests include the head assembly (880105-100X), neck (880105-250), bib simulator (880105-371), upper neck adjusting bracket (880105-207), lower neck adjusting bracket (880105-208), six axis neck transducer (SA572-S11) and either three accelerometers (SA572-S4) or their mass equivalent installed in the head assembly as specified in drawing 880105-100X. Data from the accelerometers are not required. (572.133(b))
3. The assembly soaked at a temperature between 20.6°C (69°F) and 22.2°C (72°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to a test. (572.133(c)(1))
- |                                 |               |
|---------------------------------|---------------|
| Record the maximum temperature: | <u>21.4°C</u> |
| Record the minimum temperature: | <u>21.0°C</u> |
| Record the maximum humidity:    | <u>48%</u>    |
| Record the minimum humidity:    | <u>45%</u>    |
4. Visually inspect neck assembly for cracks, cuts and separation of the rubber from the metal segments. Note: If the damage resulted from the vehicle crash test in which the dummy was an occupant, the damaged area is to be documented with photography and the post test calibration verification testing completed before any replacement or repairs are made.
- Record findings and actions: No damage
5. Inspect the nodding blocks (78051-351) for any deterioration, but when replacement is necessary, ONLY replace during pre-test calibration. Using a Shore "A" type Durometer, verify the hardness of the nodding blocks is between 80 and 90. Ensure the nodding blocks are installed correctly. (880105-250 and PADI page17).
- Record findings and actions: No Deterioration; Hardness: Front 89; Back 90.
6. Torque the jam nut (9000018) on the neck cable (880105-206) to 1.4 ± 0.2 Nm (12.0 ± 2.0 in-lb). (572.133(c)(2))

- X 7. The data acquisition system, including transducers, conforms to the requirements of SAE Recommended Practice J211/1 MAR95. (572.137(m))
- X 8. The test fixture pendulum conforms to the specifications in Figure 7B. (572.133(c)(3))
- X 9. The head-neck assembly is mounted on the pendulum so the midsagittal plane of the head is vertical and coincides with the plane of motion of the pendulum longitudinal centerline as shown in Figure 8B for the flexion test. (572.133(c)(3))
- X 10. Install the transducers or other devices for measuring the "D" plane rotation with respect to the pendulum longitudinal centerline. Note: Plane "D" is the bottom horizontal surface of the skull. These measurement devices should be designed to minimize their influence upon the performance of the head-neck assembly. An example of a measurement device is shown in Figure 10B.
- X 11. With the pendulum resting against the honeycomb material, the neck bracket was adjusted until the longitudinal centerline of the pendulum was perpendicular  $\pm 1$  degree to plane "D" on the dummy's head.
- X 12. Release the pendulum and allow it to fall freely from a height to achieve an impact speed of 6.89 m/s to 7.13 m/s as measured at the center of the pendulum accelerometer. (572.133(c)(4)(i))
- X 13. Complete the following table:  
Neck Flexion Test Results (572.133(b)(1) & 572.133(c)(4)(i & ii))

Parameter		Specification	Results
Pendulum impact speed		6.89 m/s $\leq$ speed $\leq$ 7.13 m/s	7.06 m/s
Pendulum $\Delta V$ with respect to impact speed	@ 10 ms	2.1 m/s $\leq \Delta V \leq$ 2.5 m/s	2.4 m/s
	@ 20 ms	4.0 m/s $\leq \Delta V \leq$ 5.0 m/s	4.5 m/s
	@ 30 ms	5.8 m/s $\leq \Delta V \leq$ 7.0 m/s	6.4 m/s
Plane D Rotation		Peak moment* 69 Nm $\leq$ moment $\leq$ 83 Nm during the following rotation range 77° $\leq$ angle $\leq$ 91°	71 Nm @ 81 degrees
Positive Moment Decay** (Flexion)		Time to decay to 10 Nm 80 ms $\leq$ time $\leq$ 100 ms	84 ms

\*Moment about the occipital condyle =  $M_y - (0.01778 \text{ m} \times F_x)$ (572.133(b)(1)(ii))

$M_y$  = Moment in Nm measured by the transducer

$F_x$  = Force, in N measured by the transducer

\*\*Time zero is defined as the time of initial contact between the pendulum striker plate and the honeycomb material. (572.133(b)(3))

- X 14. Plots of acceleration, velocity, y-axis moment, and x-axis force and y-axis moment about the occipital condyle follows this sheet.

David Schoedel  
Signature

07/30/2014  
Date

**MGA RESEARCH CORPORATION**

**NECK FLEXION TEST**

**HYBRID III 5TH PERCENTILE**

ATD Serial No: 124

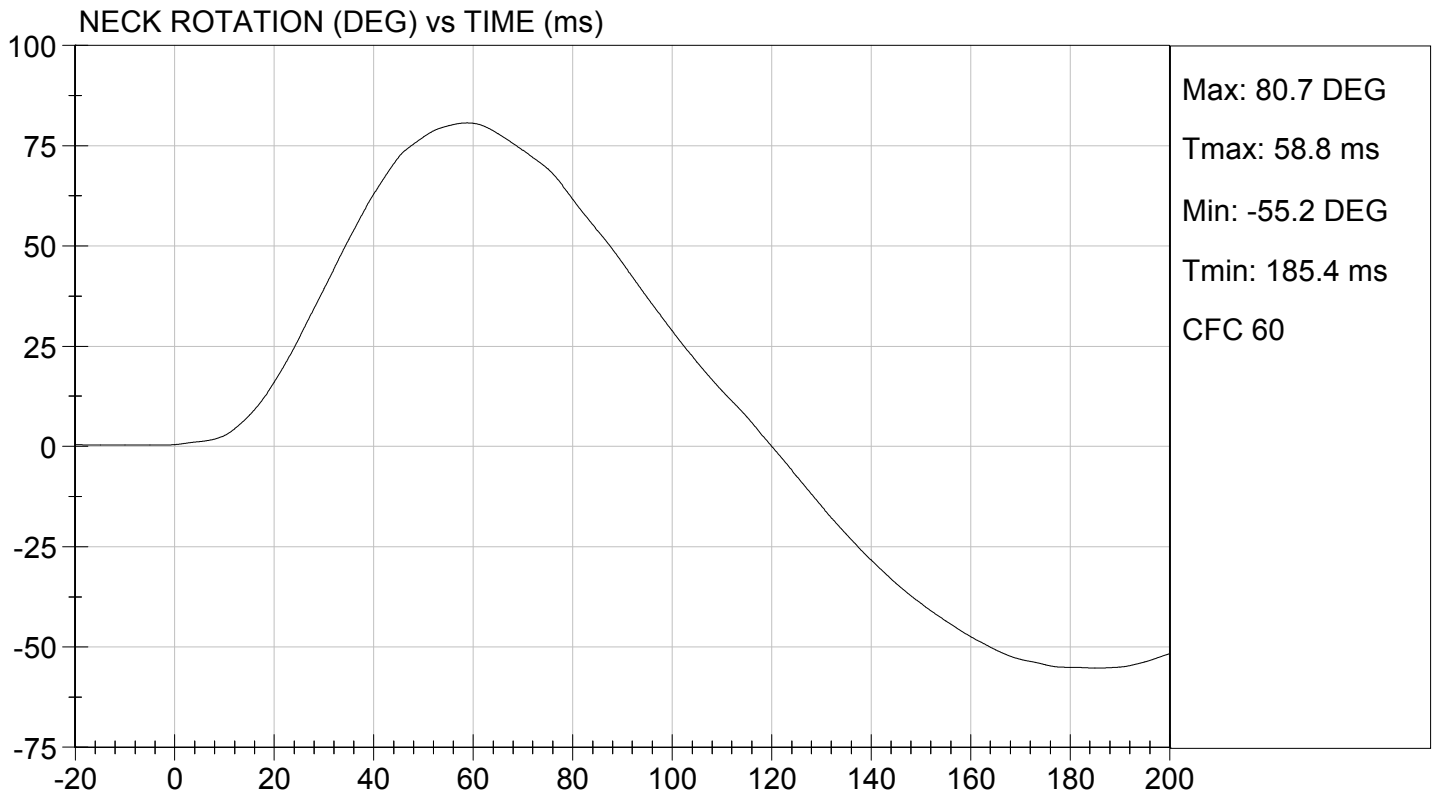
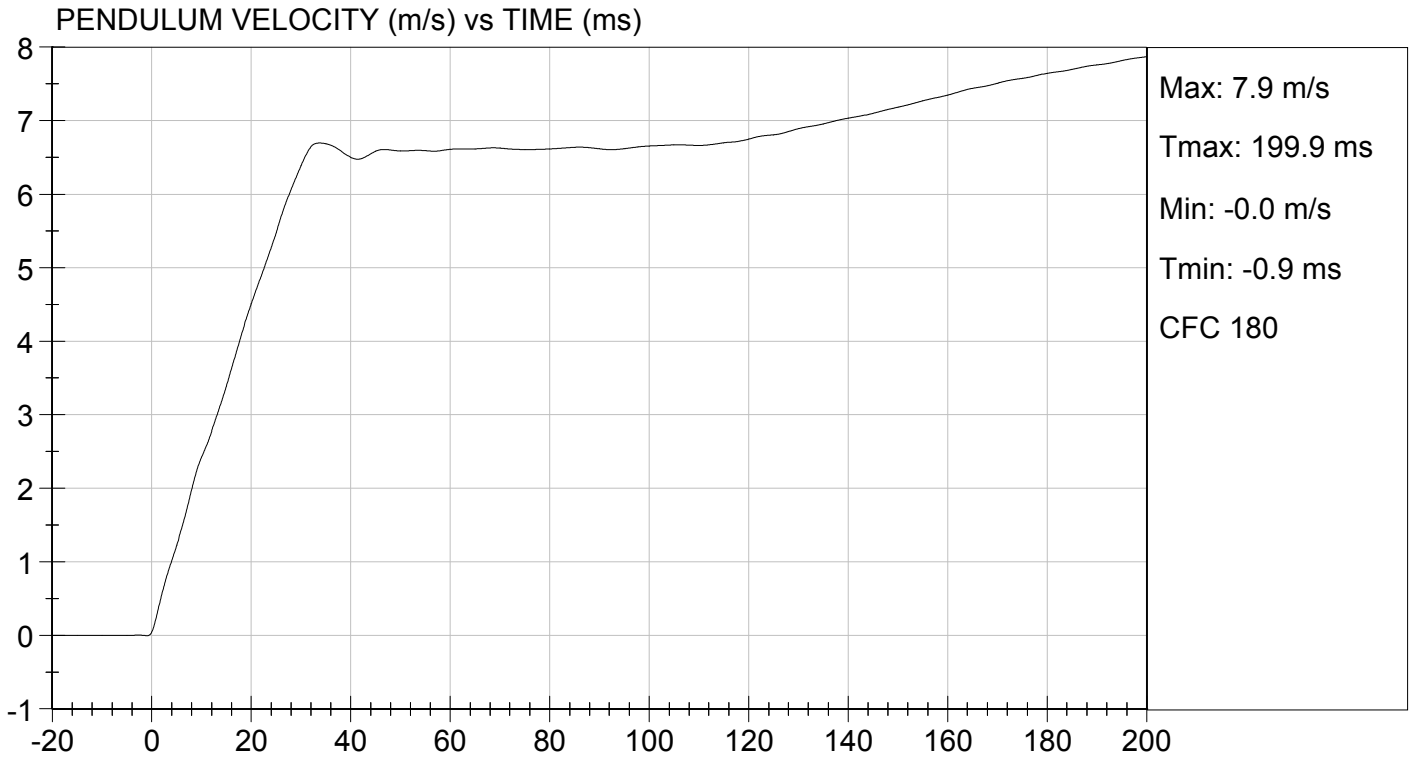
Test I.D.: D142712

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.3	Pass
Laboratory Relative Humidity		%	10 to 70	45	Pass
Pendulum Speed		m/s	6.89 to 7.13	7.06	Pass
Pendulum Velocity	10 ms	m/s	2.1 to 2.5	2.4	Pass
	20 ms	m/s	4.0 to 5.0	4.5	Pass
	30 ms	m/s	5.8 to 7.0	6.4	Pass
D Plane Rotation	Max	deg	77 to 91	81	Pass
Occipital Condyle Moment within Rotation Corridor		Nm	69 to 83	71	Pass
Positive Moment Time Curve Decay to 10 Nm		ms	80 to 100	84	Pass
Overall Results					Pass

David Schoedel  
Laboratory Technician

07/30/2014  
Test Date

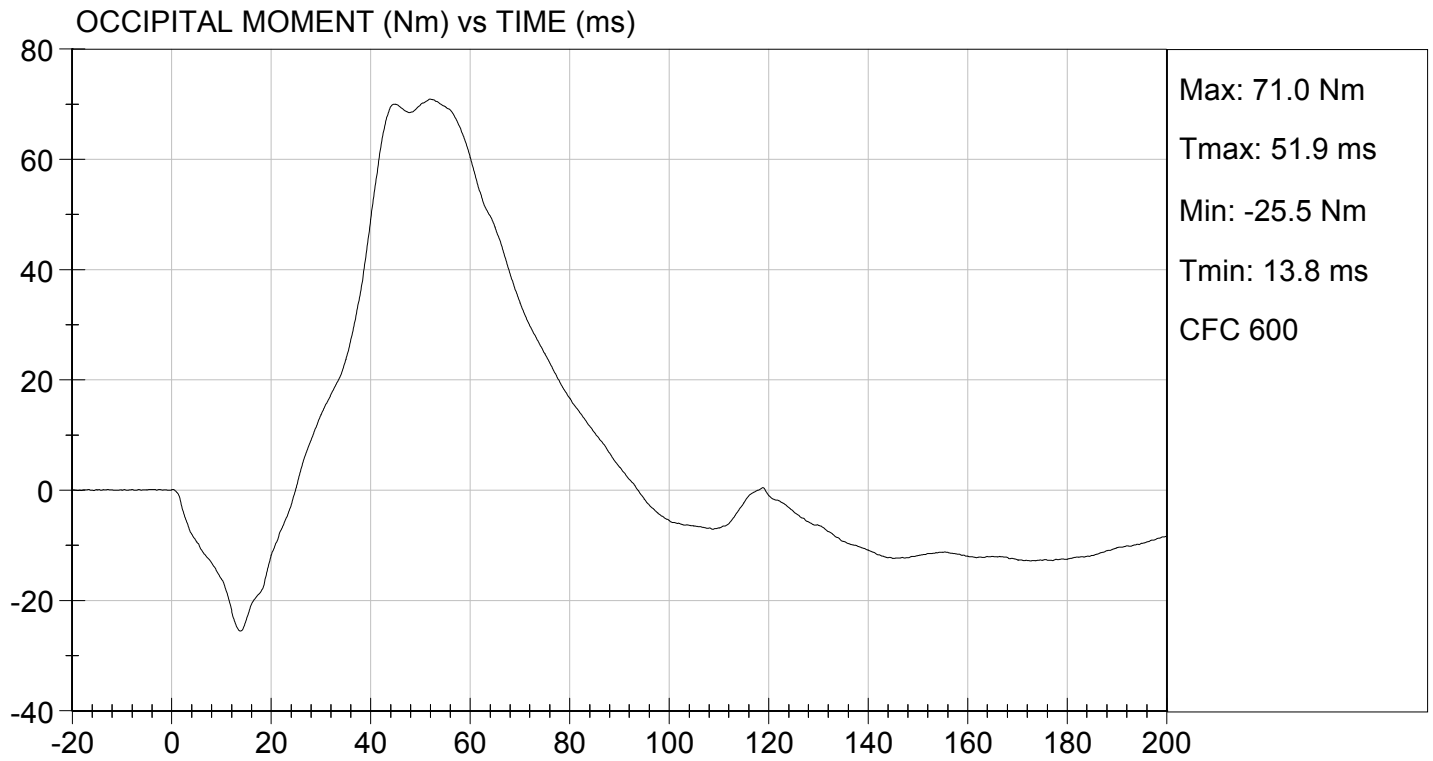
Jeff Levanthasi  
Approved By





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

TEST DATE: 07/30/2014  
TEST #: D142712



**DATA SHEET B5**  
NECK EXTENSION TEST (572.133) (5<sup>th</sup> Female)

Dummy Serial Number: 124

Test Date: 07/30/2014

Technician: David Schoedel

- Pre test calibration  
 Post test calibration verification

Test attempt no. 1 (when successive extension tests are necessary)

1. It has been at least 30 minutes since the last extension test. (572.137(q))  
 N/A, ONLY one neck test performed
2. The components required for the neck tests include the head assembly (880105-100X), neck (880105-250), bib simulator (880105-371), upper neck adjusting bracket (880105-207), lower neck adjusting bracket (880105-208), six axis neck transducer (SA572-S11) and either three accelerometers (SA572-S4) or their mass equivalent installed in the head assembly as specified in drawing 880105-100X. Data from the accelerometers are not required. (572.133(b))
3. The assembly soaked at a temperature between 20.6°C (69°F) and 22.2°C (72°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to a test. (572.133(c)(1))
- |                                 |               |
|---------------------------------|---------------|
| Record the maximum temperature: | <u>21.4°C</u> |
| Record the minimum temperature: | <u>21.0°C</u> |
| Record the maximum humidity:    | <u>48%</u>    |
| Record the minimum humidity:    | <u>45%</u>    |
4. Visually inspect neck assembly for cracks, cuts and separation of the rubber from the metal segments. Note: If the damage resulted from the vehicle crash test in which the dummy was an occupant, the damaged area is to be documented with photography and the post test calibration verification testing completed before any replacement or repairs are made.
- Record findings and actions: No damage
5. Inspect the nodding blocks (78051-351) for any deterioration, but when replacement is necessary, ONLY replace during pre-test calibration. Using a Shore "A" type Durometer, verify the hardness of the nodding blocks is between 80 and 90. Ensure the nodding blocks are installed correctly. (880105-250 and PADI page17).
- Record findings and actions: No Deterioration; Hardness: Front 89; Back 90.
6. Torque the jam nut (9000018) on the neck cable (880105-206) to 1.4 ± 0.2 Nm (12.0 ± 2.0 in-lb). (572.133(c)(2))

- X 7. The data acquisition system, including transducers, conforms to the requirements of SAE Recommended Practice J211/1 MAR95. (572.137(m))
- X 8. The test fixture pendulum conforms to the specifications in Figure 7B. (572.133(c)(3))
- X 9. The head-neck assembly is mounted on the pendulum so the midsagittal plane of the head is vertical and coincides with the plane of motion of the pendulum longitudinal centerline as shown in Figure 9B for the extension test. (572.133(c)(3))
- X 10. Install the transducers or other devices for measuring the "D" plane rotation with respect to the pendulum longitudinal centerline. Note: Plane "D" is the bottom horizontal surface of the skull. These measurement devices should be designed to minimize their influence upon the performance of the head-neck assembly. An example of a measurement device is shown in Figure 10B.
- X 11. With the pendulum resting against the honeycomb material, the neck bracket was adjusted until the longitudinal centerline of the pendulum was perpendicular  $\pm 1$  degree to plane "D" on the dummy's head.
- X 12. Release the pendulum and allow it to fall freely from a height to achieve an impact speed of 5.95 m/s to 6.19 m/s as measured at the center of the pendulum accelerometer. (572.133(c)(4)(i))
- X 13. Complete the following table:  
Neck Extension Test Results (572.133(b)(2) & 572.133(c)(4)(I & ii))

Parameter		Specification	Results
Pendulum impact speed		5.95 m/s $\leq$ speed $\leq$ 6.19 m/s	6.17 m/s
Pendulum $\Delta V$ with respect to impact speed	@ 10 ms	1.5 m/s $\leq \Delta V \leq$ 1.9 m/s	1.7 m/s
	@ 20 ms	3.1 m/s $\leq \Delta V \leq$ 3.9 m/s	3.6 m/s
	@ 30 ms	4.6 m/s $\leq \Delta V \leq$ 5.6 m/s	5.2 m/s
Plane D Rotation		Peak moment* -65 Nm $\leq$ moment $\leq$ -53 Nm during the following rotation range 99° $\leq$ angle $\leq$ 114°	-58 Nm @ 107 degrees
Positive Moment Decay** (Extension)		Time to decay to -10 Nm 94 ms $\leq$ time $\leq$ 114 ms	100 ms

\*Moment about the occipital condyle =  $M_y - (0.01778 \text{ m} \times F_x)$ (572.133(b)(1)(ii))

$M_y$  = Moment in Nm measured by the transducer

$F_x$  = Force, in N measured by the transducer

\*\*Time zero is defined as the time of initial contact between the pendulum striker plate and the honeycomb material. (572.133(b)(3))

- X 14. Plots of acceleration, velocity, y-axis moment, and x-axis force and y-axis moment about the occipital condyle follow this sheet.

David Schoedel  
Signature

07/30/2014  
Date

**MGA RESEARCH CORPORATION**  
**NECK EXTENSION TEST**  
**HYBRID III 5TH PERCENTILE**

ATD Serial No: 124

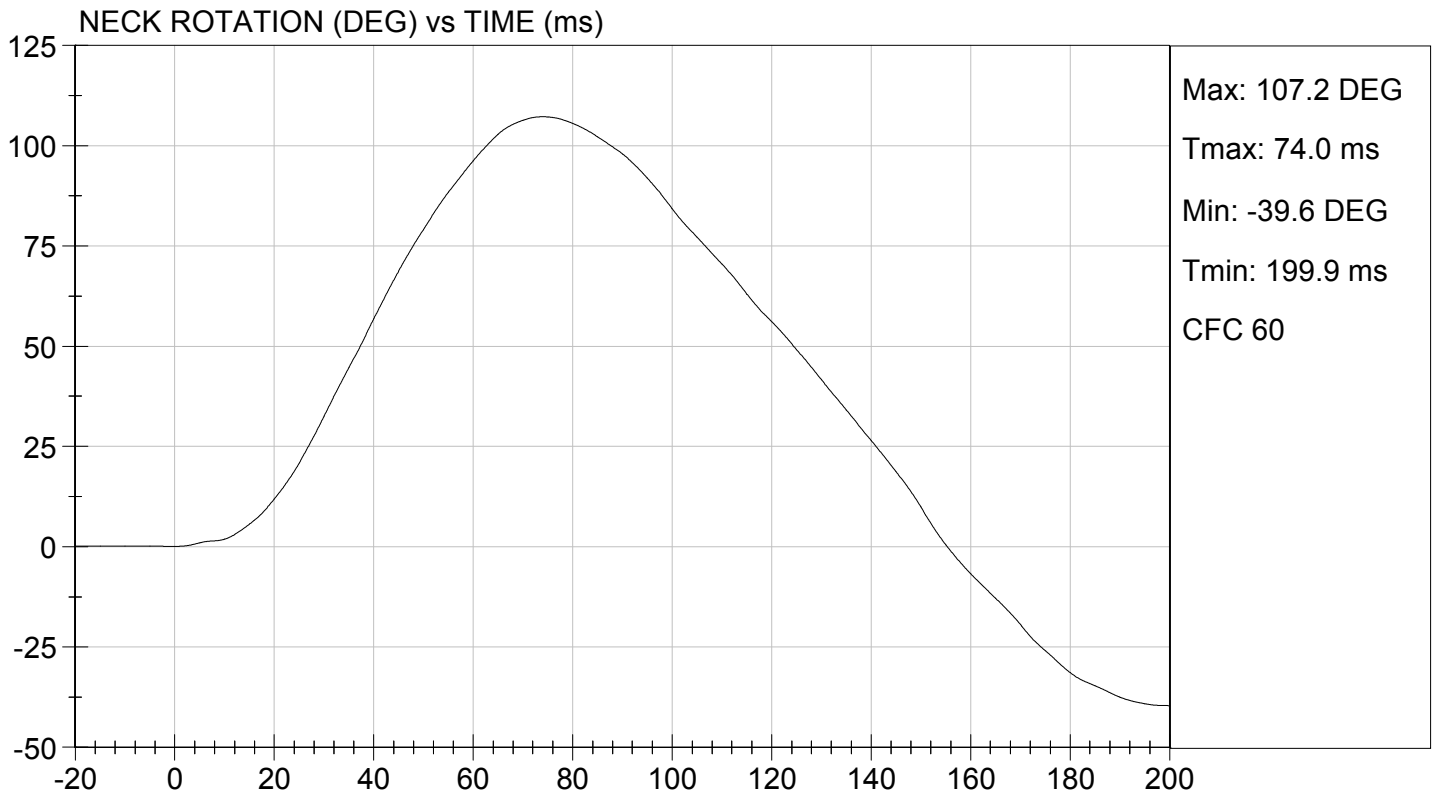
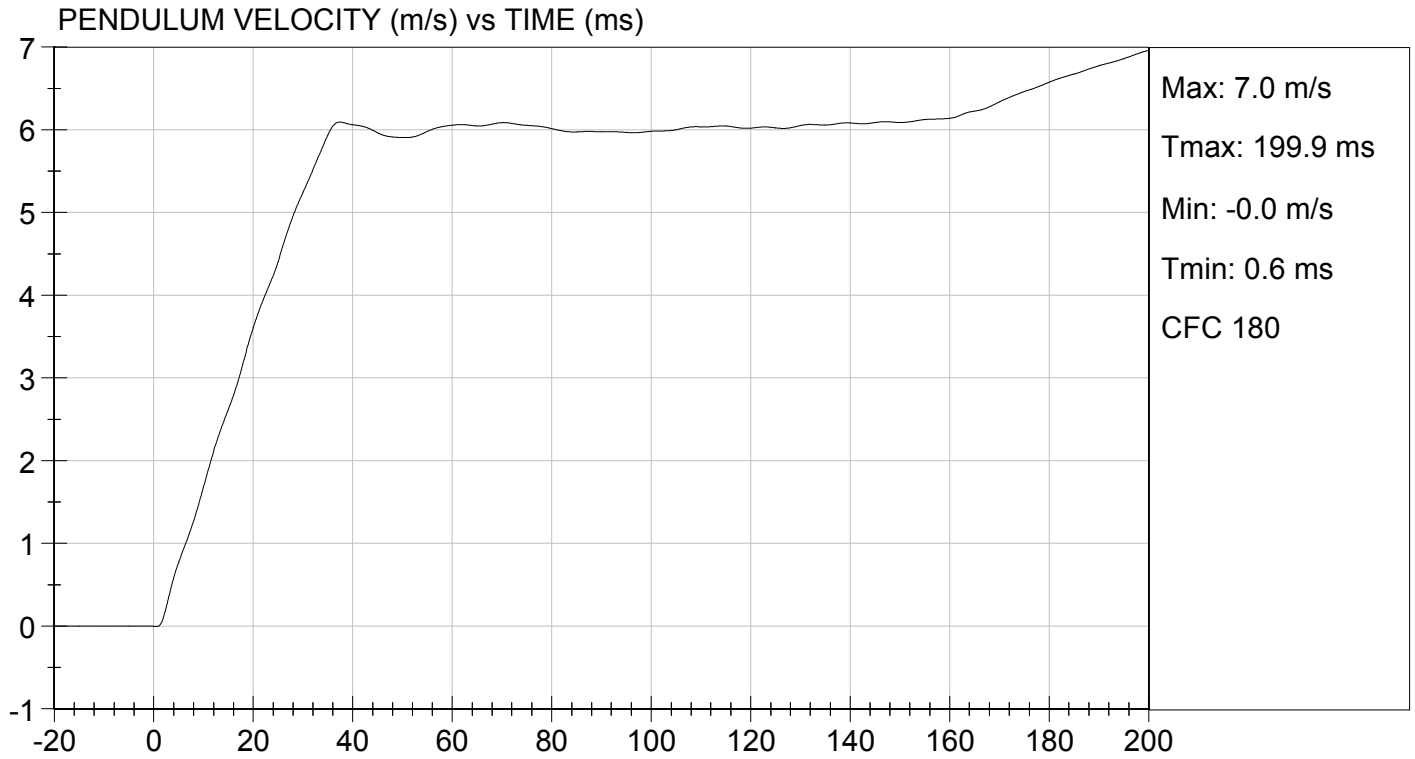
Test I.D: D142713

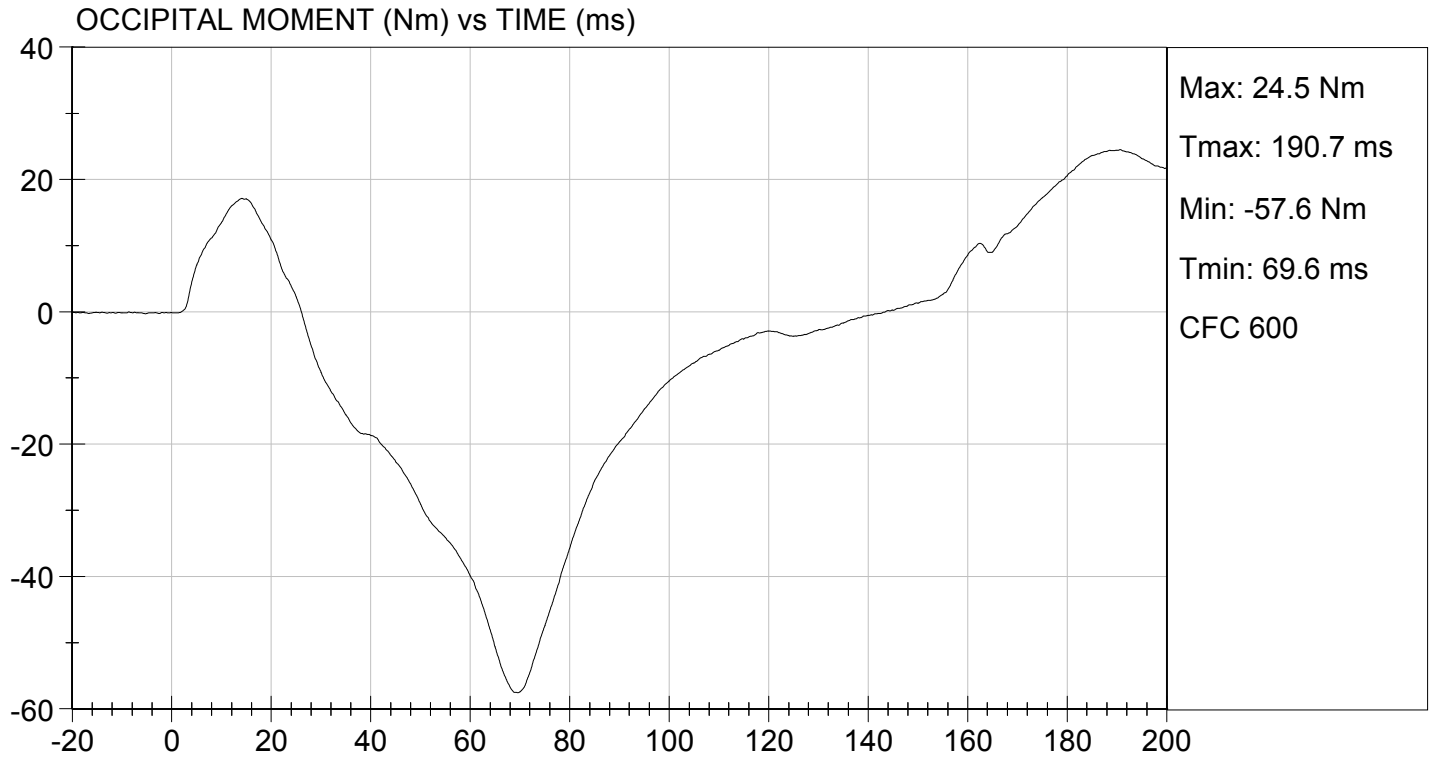
Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.0	Pass
Laboratory Relative Humidity		%	10 to 70	45	Pass
Pendulum Speed		m/s	5.95 to 6.19	6.17	Pass
Pendulum Velocity	10 ms	m/s	1.5 to 1.9	1.7	Pass
	20 ms	m/s	3.1 to 3.9	3.6	Pass
	30 ms	m/s	4.6 to 5.6	5.2	Pass
D Plane Rotation	Max	deg	99 to 114	107	Pass
Occipital Condyle Moment within Rotation Corridor		Nm	-65 to -53	-58	Pass
Negative Moment Time Curve Decay to -10 Nm		ms	94 to 114	100	Pass
Overall Results					Pass

David Schoedel  
Laboratory Technician

07/30/2014  
Test Date

Jeff Leonard  
Approved By





**DATA SHEET B6**  
THORAX IMPACT TEST (572.134) (5<sup>th</sup> Female)

Dummy Serial Number: 124

Test Date: 07/31/2014

Technician: Joseph Radke

- Pre test calibration  
 Post test calibration verification

Test attempt no. 1 (when successive thorax impact tests are necessary)

1. It has been at least 30 minutes since the last thorax impact test. (572.137(q))  
 N/A, ONLY one thorax impact test performed
2. The test fixture conforms to the specifications in Figure 11B.
3. The complete assembled dummy (880105-000) is used (572.134(b)) and is dressed in a form fitting cotton stretch above-the-elbow sleeved shirt and above-the-knee pants. The weight of the shirt and pants shall not exceed 0.14 kg. (572.134(c)(1))
4. The dummy assembly soaked at a temperature between 20.6°C (69°F) and 22.2°C (72°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to this test. (572.134(c)(2))

Record the maximum temperature:	<u>21.4°C</u>
Record the minimum temperature:	<u>21.0°C</u>
Record the maximum humidity:	<u>48%</u>
Record the minimum humidity:	<u>45%</u>

5. Remove the chest skin and visually inspect the thorax assembly for cracks, cuts, abrasions, etc. Particular attention should be given to the rib damping material, chest displacement transducer assembly and the rear rib supports. Inspect for rib deformation using the chest depth gage. If any damage is noted repair and/or replace the damaged components unless the damage resulted from the vehicle crash test in which the dummy was an occupant in which case the damage must be documented and post test calibration verification testing completed before any repairs or replacements are made.

- No Damage

- Damage from crash test, no repairs or replacement because this is a post test calibration verification. Record damage:

- The following repairs or replacement was performed. Record:

---

- X 6. Seat the dummy, (chest skin still removed) without back and arm supports on the test fixture surface as shown in Figure 11B. The surface must be long enough to support the pelvis and outstretched legs. (572.134(c)(3))
- X 7. Level the ribs both longitudinally and laterally  $\pm 0.5^\circ$  and adjust the pelvis angle to  $7^\circ \pm 2^\circ$ . The angle may be measured using the special H-point tool (TE-2504) that inserts into the pelvic structure and extends outward beyond the pelvic skin surface or by using the surface of the pelvic adaptor block.
- X 8. The midsagittal plane of the dummy is vertical within  $\pm 1^\circ$ . (572.134(c)(3))
- X 9. The longitudinal centerline of the test probe is centered within  $\pm 2.5$  mm of the midsagittal plane of the dummy and is  $12.7$  mm  $\pm 1$  mm below the horizontal peripheral centerline of the No. 3 rib and is within  $0.5^\circ$  of a horizontal line in the dummy's midsagittal plane. (572.134(c)(4))
- X 10. Align the adjustable neck bracket index marks to the "zero" position.
- X 11. Record locations such as the rear surfaces of the thoracic spine and the lower neck bracket reference with respect to the laboratory coordinate system. These reference measurements are necessary to ensure the dummy is in the same position after the chest skin is installed. The reference locations must be accessible after installation of the chest skin. It may be necessary to leave the chest skin zipper unfastened until the references are checked and fasten it just prior to the test.
- X 12. Install the chest skin and reposition the dummy as described in the preceding paragraph using the reference measurements recorded.
- X 13. Place the arm assemblies horizontal  $\pm 2^\circ$  and parallel to the midsagittal plane. The arms are held in place by tightening the adjustment nut that holds the arm yoke to the clavicle assembly.
- X 14. The data acquisition system, including transducers, must conform to the requirements of SAE Recommended Practice J211/1 MAR95 (572.136(m)) Class 180.
- X 15. Impact the anterior surface of the thorax with the test probe so the longitudinal centerline of the probe is within  $2^\circ$  of a horizontal line in the dummy's midsagittal plane at the moment of impact. (572.134(c)(5)) The velocity of the test probe at the time of impact is  $6.71$  m/s  $\pm 0.12$  m/s. (572.134(b)) The probe is guided so there is no significant lateral, vertical or rotational movement during the impact. (572.134(c)(6)) Neither the suspension hardware, suspension cables, nor other attachments to the probe, including the velocity vane, make contact with the dummy. (572.134(c)(7))

- X 16. Complete the following table:  
 Thorax Impact Results (572.134(b) and 572.134(b)(1)&(2))

Parameter*	Specification	Result
Test Probe Speed	$6.59 \text{ m/s} \leq \text{speed} \leq 6.83 \text{ m/s}$	6.60 m/s
Chest Compression	$50.0 \text{ mm} \leq \text{compression} \leq 58.0 \text{ mm}$	55 mm
Peak force** between 50.0 and 58.0 mm chest compression	$3900\text{N} \leq \text{peak force} \leq 4400\text{N}$	4269 N
Peak Force** between 18.0 and 50.0 mm chest compression	Peak Force $\leq 4600 \text{ N}$	4178 N
Internal Hysteresis***	$69\% \leq \text{hysteresis} \leq 85\%$	70%

\*Time zero is defined as the time of initial contact between the test probe and the chest skin.

\*\*Force = impactor mass x acceleration (572.134(b)(3))

\*\*\*Area under loading curve minus the area under the unloading curve divided by the area under the loading curve. (Figure 12B)

- X 17. Plots of chest compression, acceleration, force, force versus deflection follow this sheet.

Joseph Radtke  
 Signature

07/31/2014  
 Date

**MGA RESEARCH CORPORATION**  
**THORAX IMPACT**  
**HYBRID III 5TH PERCENTILE**

ATD Serial No: 124

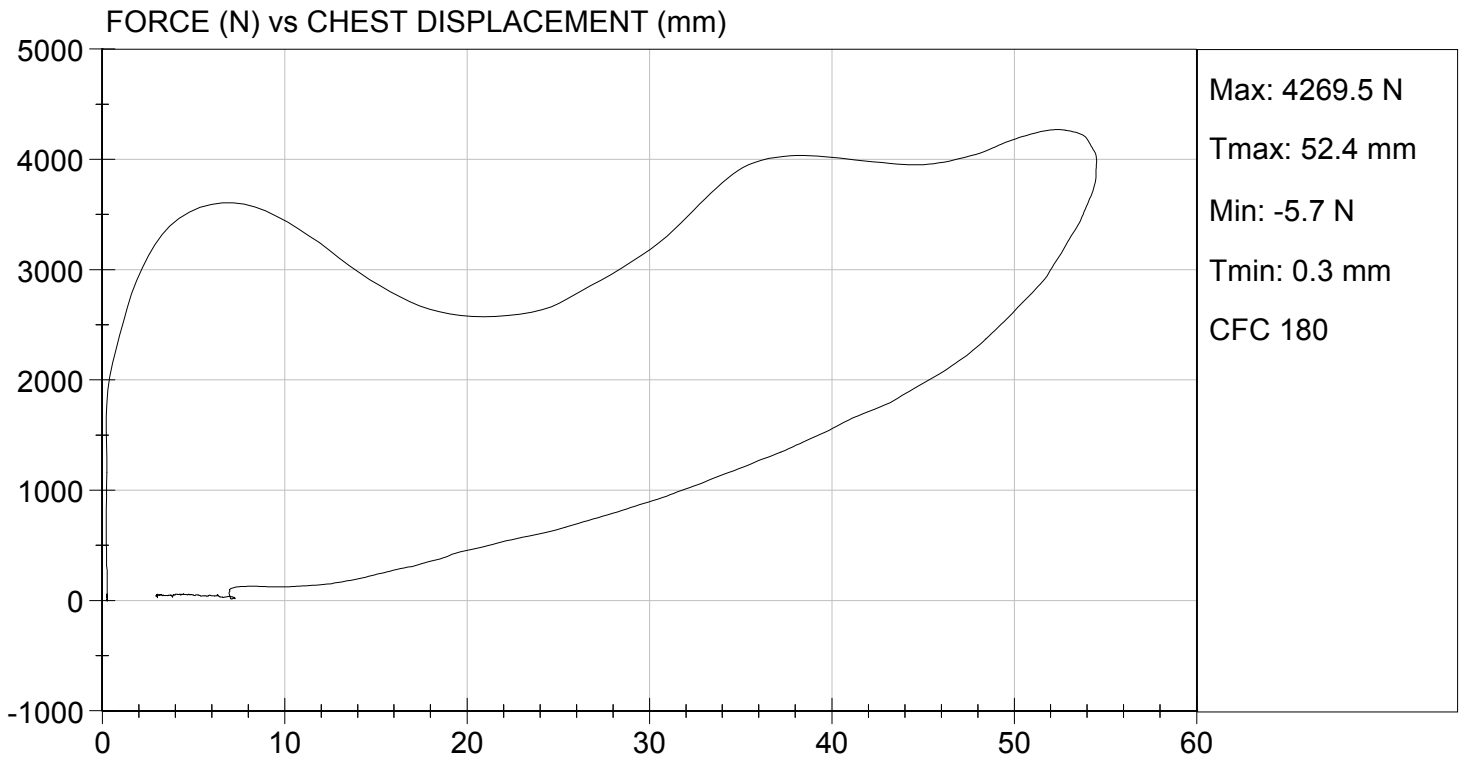
Test I.D: D142714

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.4	Pass
Relative Humidity	%	10 to 70	46	Pass
Probe Speed	m/s	6.59 to 6.83	6.60	Pass
Peak Deflection	mm	50 to 58	55	Pass
Peak Resistive Force w/in Deflection Corridor	N	3900 to 4400	4269	Pass
Internal Hysteresis	%	69 to 85	70	Pass
Peak Force 18 mm - 50 mm	N	<= 4600	4178	Pass
Overall Test Results				Pass

Joseph Radke  
 Laboratory Technician

07/31/2014  
 Test Date

Jeff Leonard  
 Approved By



**DATA SHEET B7**  
TORSO FLEXION TEST (572.135) (5<sup>th</sup> Female)

Dummy Serial Number: 124

Test Date: 07/30/2014

Technician: Joseph Radke

- Pre test calibration  
 Post test calibration verification

Test attempt no. 1 (when successive torso flexion tests are necessary)

1. It has been at least 30 minutes since the last torso flexion test. (572.137(q))  
 N/A, ONLY one torso flexion test performed
2. The test fixture conforms to the specifications in Figure 13B.
3. The complete assembled dummy (880105-000) is used (572.135(c)(2)).  
 With legs below femurs.  
 Without legs below femurs.
4. The dummy assembly soaked at a temperature between 18.9°C (66°F) and 25.6°C (78°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to this test. (572.135(c)(1))
- |                                 |               |
|---------------------------------|---------------|
| Record the maximum temperature: | <u>21.4°C</u> |
| Record the minimum temperature: | <u>21.0°C</u> |
| Record the maximum humidity:    | <u>48%</u>    |
| Record the minimum humidity:    | <u>45%</u>    |
5. Secure the pelvis to the fixture at the pelvis instrument cavity rear face by threading four ¼ cap screws into the available threaded attachment holes. Tighten the mountings so that the test material is rigidly affixed to the test fixture and the pelvic lumbar joining surface is horizontal. (572.135(c)(3))
6. Attach the loading adapter bracket to the spine of the dummy as shown in Figure 13B. (572.135(c)(4))
7. Inspect and adjust, if necessary, the seating of the abdominal insert within the pelvis cavity and with respect to the torso flesh, assuring that the torso flesh provides uniform fit and overlap with respect to the outside surface of the pelvis flesh. (572.135(c)(5))
8. Flex the dummy forward and back 3 times such that the angle reference plane moves between 0° and 30° with respect to the vertical transverse plane. (572.135(c)(6))

- X 9. Support the dummy such that the angle reference plane is at or near 0° (vertical with respect to the vertical transverse plane). Wait at least 30 minutes before continuing. (572.135(c)(6))
- X 10. Remove all external support that was implemented in 9 above. (572.135(c)(7))
- X 11. Measure the initial orientation angle of the torso reference plane of the seated, unsupported dummy. (572.135(c)(7))  
 Record reference plane angle (max. allowed 20°): See Result Table
- X 12. Attach the pull cable and the load cell. (572.135(c)(8))
- X 13. Apply a tension force in the midsagittal plane to the pull cable at any upper torso deflection rate between 0.5° and 1.5° per second, until the angle reference plane is at 45° ± 0.5° of flexion relative to the vertical transverse plane. (572.135(c)(9))
- X 14. Maintain angle reference plane at 45° ± 0.5° of flexion for 10 seconds. (572.135(c)(10))
- X 15. As quickly as possible release the force applied to the attachment bracket. (572.135(c)(11))
- X 16. 3 minutes after the release of the force, measure the reference plane angle. (572.135(c)(11))
- X 17. Complete the following table:  
 Torso Flexion Results (572.135(b), 572.135(c)(7), 572.135(c)(9))

Parameter	Specification	Result
Initial ref. plane angle	Angle ≤ 20°	17 deg
Torso rotation rate	0.5°/s ≤ rate ≤ 1.5°/s	0.9 deg/sec
Force at 45° ± 0.5°	320 N ≤ force ≤ 390 N	350 N
Final ref. plane angle	Initial ref. plane angle ± 8°	18 deg

Joseph Radtke  
 Signature

07/30/2014  
 Date

**MGA RESEARCH CORPORATION**  
**TORSO FLEXION TEST**  
**HYBRID III 5TH PERCENTILE**

ATD Serial No: 124

Test I.D: D142717

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.3	Pass
Laboratory Relative Humidity	%	10 to 70	48	Pass
Initial Angle	deg	0 to 20	17	Pass
Return Angle	deg	+/- 8	18	Pass
Force at 45 deg	N	320 to 390	350	Pass
Upper Torso Deflection Rate	deg/s	0.5 to 1.5	0.9	Pass
Overall Result				Pass

Joseph Radke  
 Laboratory Technician

07/30/2014  
 Test Date

Jeff Leonard  
 Approved By

**DATA SHEET B8**  
LEFT KNEE IMPACT TEST (572.136) (5<sup>th</sup> Female)

Dummy Serial Number:     124    

Test Date:     07/30/2014    

Technician:     David Schoedel    

- Pre test calibration  
  X   Post test calibration verification

Test attempt no.   1   (when successive knee impact tests are necessary)

- X   1. It has been at least 30 minutes since the last knee impact test. (572.137(q))  
       X   N/A, ONLY one knee impact test performed
- X   2. The test fixture conforms to the specifications in Figure 14B.
- X   3. The knee assembly (880105-528L), lower leg structural replacement (880105- 603), lower leg flesh (880105-601), ankle assembly (880105-660), foot assembly (880105-650), and femur load transducer (SA572-S14) (may use the load cell structural replacement (78051-319)) were used. (572.136(b)(1))
- X   4. The knee assembly soaked at a temperature between 18.9°C (66°F) and 25.6°C (78°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to this test. (572.136(c)(1))
- |                                 |                                   |
|---------------------------------|-----------------------------------|
| Record the maximum temperature: | <u>          21.4°C          </u> |
| Record the minimum temperature: | <u>          21.0°C          </u> |
| Record the maximum humidity:    | <u>          48%          </u>    |
| Record the minimum humidity:    | <u>          45%          </u>    |
- X   5. Mount the test specimen and secure it to the rigid test fixture. (572.136(c)(2))
- X   6. No parts of the foot or tibia contact any exterior surface. (572.136(c)(2))
- X   7. Align the test probe so that throughout its stroke and at contact with the knee it is within 2 degrees of horizontal and collinear with the longitudinal centerline of the femur. (572.136(c)(3))
- X   8. The probe is guided so there is no significant lateral, vertical or rotational movement during the impact with the knee. (572.136(c)(4))
- X   9. The data acquisition system, including transducers, must conform to the requirements of SAE Recommended Practice J2111/1 MAR95 (572.136(m)) Class 600.

X 10. Contact the knee with the test probe at a speed between 2.07 m/s and 2.13 m/s. (572.136(c)(5)) Neither the suspension hardware, suspension cables, nor other attachments to the probe, including the velocity vane, make contact with the dummy. (572.136(c)(6))

X 11. Complete the following table:  
Knee Impact Results (572.136(b)(1) and 572.136(c)(5))

Parameter	Specification	Result
Probe speed	$2.07 \text{ m/s} \leq \text{speed} \leq 2.13 \text{ m/s}$	2.13 m/s
Peak resistance force*	$3450 \text{ N} \leq \text{force} \leq 4060 \text{ N}$	3673 N

\*Force = impactor mass x deceleration (572.136(b)(2))

X 12. Plots of acceleration versus time and force versus time follow this sheet.

David Schoedel

Signature

07/30/2014

Date

MGA RESEARCH CORPORATION

LEFT KNEE IMPACT TEST  
HYBRID III 5TH PERCENTILE

ATD Serial No: 124

Test I.D: D142716

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.3	Pass
Laboratory Relative Humidity	%	10 to 70	47	Pass
Probe Speed	m/s	2.07 to 2.13	2.13	Pass
Maximum Force	N	3450 to 4060	3673	Pass
Overall Test Results				Pass

*David Schoedel*

Laboratory Technician

07/30/2014

Test Date

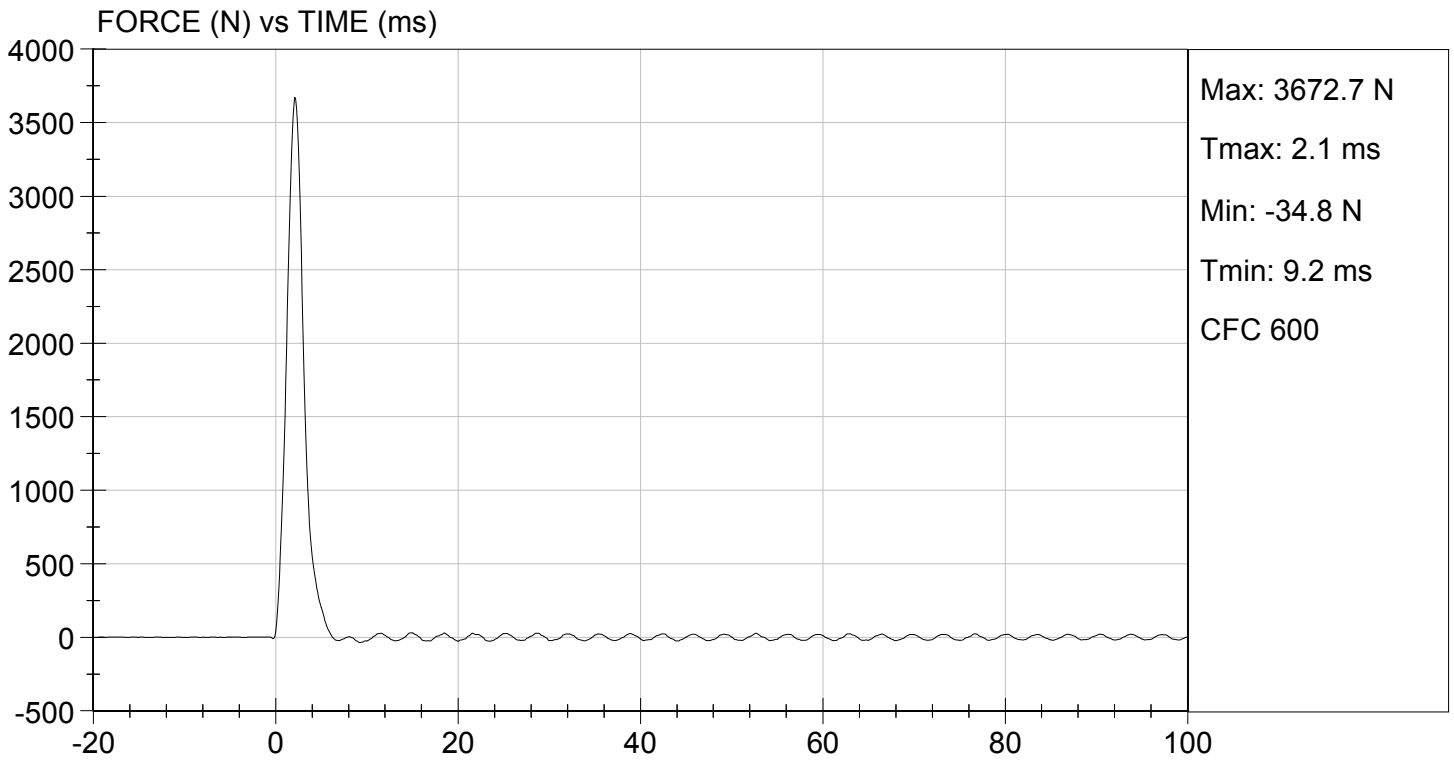
*Jeff Leonard*

Approved By



TEST DESC: LEFT KNEE  
VELOCITY: 7.00 ft/s, 2.13 m/s

TEST DATE: 07/30/2014  
TEST #: D142716



**DATA SHEET B9**  
RIGHT KNEE IMPACT TEST (572.136) (5<sup>th</sup> Female)

Dummy Serial Number: 124

Test Date: 07/30/2014

Technician: David Schoedel

- Pre test calibration  
 Post test calibration verification

Test attempt no. 1 (when successive knee impact tests are necessary)

1. It has been at least 30 minutes since the last knee impact test. (572.137(q))  
 N/A, ONLY one knee impact test performed
2. The test fixture conforms to the specifications in Figure 14B.
3. The knee assembly (880105-528R), lower leg structural replacement (880105-603), lower leg flesh (880105-601), ankle assembly (880105-660), foot assembly (880105-651), and femur load transducer (SA572-S14) (may use the load cell structural replacement (78051-319)) were used. (572.136(b)(1))
4. The knee assembly soaked at a temperature between 18.9°C (66°F) and 25.6°C (78°F) and at a relative humidity from 10% to 70% for a period of at least four (4) hours prior to this test. (572.136(c)(1))

Record the maximum temperature:	<u>21.4°C</u>
Record the minimum temperature:	<u>21.0°C</u>
Record the maximum humidity:	<u>48%</u>
Record the minimum humidity:	<u>45%</u>

5. Mount the test specimen and secure it to the rigid test fixture. (572.136(c)(2))
6. No parts of the foot or tibia contact any exterior surface. (572.136(c)(2))
7. Align the test probe so that throughout its stroke and at contact with the knee it is within 2 degrees of horizontal and collinear with the longitudinal centerline of the femur. (572.136(c)(3))
8. The probe is guided so there is no significant lateral, vertical or rotational movement during the impact with the knee. (572.136(c)(4))
9. The data acquisition system, including transducers, must conform to the requirements of SAE Recommended Practice J2111/1 MAR95 (572.136(m)) Class 600.

X 10. Contact the knee with the test probe at a speed between 2.07 m/s and 2.13 m/s. (572.136(c)(5)) Neither the suspension hardware, suspension cables, nor other attachments to the probe, including the velocity vane, make contact with the dummy. (572.136(c)(6))

X 11. Complete the following table:  
Knee Impact Results (572.136(b)(1) and 572.136(c)(5))

Parameter	Specification	Result
Probe speed	$2.07 \text{ m/s} \leq \text{speed} \leq 2.13 \text{ m/s}$	2.13 m/s
Peak resistance force*	$3450 \text{ N} \leq \text{force} \leq 4060 \text{ N}$	3853 N

\*Force = impactor mass x deceleration (572.136(b)(2))

X 12. Plots of acceleration versus time and force versus time follow this sheet.

David Schoedel  
Signature

07/30/2014  
Date

**MGA RESEARCH CORPORATION**  
**RIGHT KNEE IMPACT TEST**  
**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 124

**Test I.D.:** D142715

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.3	Pass
Laboratory Relative Humidity	%	10 to 70	47	Pass
Probe Speed	m/s	2.07 to 2.13	2.13	Pass
Maximum Force	N	3450 to 4060	3853	Pass
Overall Test Results				Pass

David Schoedel

Laboratory Technician

07/30/2014

Test Date

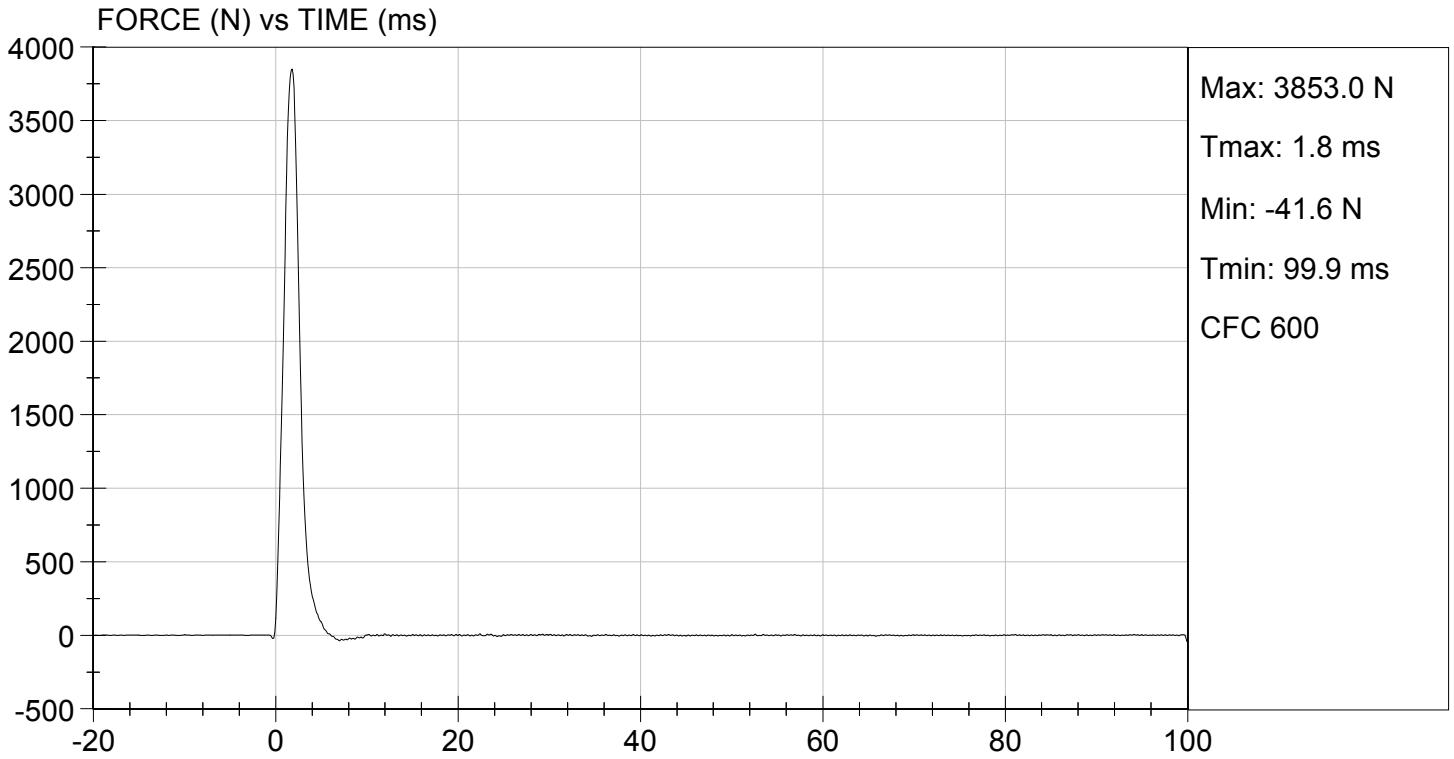
Jeff Leonard

Approved By



TEST DESC: RIGHT KNEE  
VELOCITY: 7.00 ft/s, 2.13 m/s

TEST DATE: 07/30/2014  
TEST #: D142715





**DATA SHEET B1**  
**DUMMY DAMAGE CHECKLIST**

Dummy Serial Number:     124    

Test Date:     07/30/2014    

Technician:     Jessica Gall    

This check sheet is completed as part of the post test calibration verification.

Perform general cleaning.

Dummy Item	Inspect for	Comments	Damage	OK
Outer skin	Gashes, rips, cracks			X
Head	Ballast secure			X
	General appearance			X
Neck	Broken or cracked rubber			X
	Upper neck bracket firmly attached to the lower neck bracket			X
	Looseness at the condyle joint			X
	Nodding blocks cracked or out of position			X
Spine	Broken or cracks in rubber			X
Ribs	Broken or bent ribs			X
	Broken or bent rib supports			X
	Damping material separated or cracked			X
	Rubber bumpers in place			X
Chest Displacement Assembly	Bent shaft			X
	Slider arm riding in track			X
Transducer leads	Torn cables			X
Accelerometer Mountings	Head mounting secure			X
	Chest mounting secure			X
Knees	Skin condition			X
	Insert (do not remove)			X
	Casting			X
Limbs	Normal movement and adjustment			X
Knee Sliders	Wires intact			X
	Rubber returned to "at rest" position			X
Pelvis	Broken			X
Other				X

If upon visual examination, damage is apparent in any of these areas, the appropriate engineer or engineering technician is to be consulted for a decision on repair or replacement of parts.

Repair or Replacement approved by:

Jessica Hall  
Signature

07/31/2014  
Date

Jeff Leonard

\_\_\_\_\_