**REPORT NO. 208-MGA-2004-DC012**

# DUMMY PERFORMANCE CALIBRATIONS
# FMVSS 208

**Hyundai Motor Company**
**2004 Hyundai Elantra 4 Door**
**NHTSA No.: C40510**

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

**Test Dates: August 27, 2004**

**Final Report Date: October 1, 2004**

**FINAL REPORT**

**PREPARED FOR:**
**U.S. DEPARTMENT OF TRANSPORTATION**
**NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION**
**OFFICE OF ENFORCEMENT**
**OFFICE OF VEHICLE SAFETY COMPLIANCE**
**MAIL CODE: NVS-220**
**400 SEVENTH STREET, S.W., ROOM 6115**
**WASHINGTON, D.C. 20590**

## TABLE OF CONTENTS


| | | | Page No. |
|---|---|---|---|
| DUMMY S/N: | 505 | PRE-TEST CERTIFICATION DATA | 1-1 |
| | | PASSED ALL CALIBRATION CHECKS | |
| DUMMY S/N: | 505 | POST-TEST CERTIFICATION DATA | 2-1 |
| | | PASSED ALL CALIBRATION CHECKS | |
| DUMMY S/N: | 506 | PRE-TEST CERTIFICATION DATA | 3-1 |
| | | PASSED ALL CALIBRATION CHECKS | |
| DUMMY S/N: | 506 | POST-TEST CERTIFICATION DATA | 4-1 |
| | | PASSED ALL CALIBRATION CHECKS | |
| DUMMY S/N: | 516 | PRE-TEST CERTIFICATION DATA | 5-1 |
| | | PASSED ALL CALIBRATION CHECKS | |
| DUMMY S/N: | 506 | PRE-TEST CERTIFICATION DATA | 6-1 |
| | | PASSED ALL CALIBRATION CHECKS | |
| DUMMY S/N: | 506 | POST-TEST CERTIFICATION DATA | 7-1 |
| | | PASSED ALL CALIBRATION CHECKS | |
| DUMMY S/N: | 505 | PRE-TEST CERTIFICATION DATA | 8-1 |
| | | PASSED ALL CALIBRATION CHECKS | |
| DUMMY S/N: | 505 | POST-TEST CERTIFICATION DATA | 9-1 |
| | | PASSED ALL CALIBRATION CHECKS | |

## EXTERNAL DIMENSIONS

| SN505, HYBRID III, 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 | 783.4 |
| B | SHOULDER PIVOT HEIGHT | Centerline of shoulder pivot bolt to the seat surface. | 431.8-457.2 | 438.0 |
| C | H-POINT HEIGHT | Reference | 81.3-86.3 | 84.2 |
| D | H-POINT LOCATION FROM BACKLINE | Reference | 144.8-149.8 | 147.3 |
| E | SHOULDER PIVOT FROM BACKLINE | Center of the shoulder clevis to the rear vertical surface of the fixture. | 68.6-83.8 | 76.4 |
| F | THIGH CLEARANCE | Measured at the highest point on the upper femur segment. | 119.4-134.6 | 124.3 |
| 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 | 250.3 |
| H | HEAD BACK TO BACKLINE | Back of skull cap skin to seat rear vertical surface (Reference) | 43.2-48.2 | 46.7 |
| 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 | 283.4 |
| J | ELBOW REST HEIGHT | Measure from the flesh below the elbow pivot bolt to the seat surface. | 182.8-203.2 | 187.3 |
| 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 | 532.4 |
| L | POPLITEAL HEIGHT | Seat surface to the plane of the horizontal plane of the bottom of the feet. | 355.6-376.0 | 362.3 |
| M | KNEE PIVOT HEIGHT | Centerline of knee pivot bolt to the horizontal plane of the bottom of the feet. | 393.7-419.1 | 405.2 |
| 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”. | 414-439.4 | 421.6 |

| SN505, HYBRID III, 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 | 182.4 |
| P | FOOT LENGTH | Tip of toe to rear of heal | 218.5-233.7 | 224.7 |
| 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 | 473.7 |
| S | HEAD BREADTH | The widest part of the head | 137.1-147.3 | 144.6 |
| T | HEAD DEPTH | Back of the head to the forehead | 177.8-188.0 | 179.2 |
| U | HIP BREADTH | The widest part of the hip | 299.7-314.9 | 305.7 |
| V | SHOULDER BREADTH | Outside edges of right and left shoulder clevises | 350.5-365.7 | 362.4 |
| W | FOOT BREADTH | The widest part of the foot | 78.8-94.0 | 84.3 |
| X | HEAD CIRCUMFERENCE | Measured at the point as in dim. “T” | 528.3-548.7 | 533.7 |
| Y | CHEST CIRCUMFERENCE (WITH CHEST JACKET) | Measured 345.4 ± 12.7 mm above seat surface | 850.9-881.3 | 863.7 |
| Z | WAIST CIRCUMFERENCE | Measured 165.1 ± 5.1 mm above seat surface | 759.5-789.9 | 773.6 |
| AA | REFERENCE LOCATION FOR MEASUREMENT OF CHEST CIRCUMFERENCE | Reference | 332.7-358.1 | 345.0 |
| BB | REFERENCE LOCATION FOR MEASUREMENT OF WAIST CIRCUMFERENCE | Reference | 160.1-170.2 | 165.0 |

DATA SHEET B3
HEAD DROP TEST (572.132)

Dummy Serial Number 505 Test Date 8/23/04

Technician Joe Fleck

_X_Pretest 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))
_X_ N/A, ONLY one head drop performed

_X_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))

_X_3. The head accelerometer mounting plate screws ((10-24 x 3/8 SHCS) are torqued to 9.0 Nm.

_X_4. Accelerometers and their respective mounts are smooth and clean.

_X_5. Torque the skull cap screws (10-24 x 1/2 SHCS) to 9.0 Nm.

_X_6. The data acquisition system, including transducers, conforms to the requirements of SAE Recommended Practice J211/1 MAR95. (572.136(m))

_X_7. The head assembly soaked at a temperature between 18.9°C (66ºF) and 25.6°C (78ºF) 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 21.8
Record the minimum temperature 21.2
Record the maximum humidity 56%
Record the minimum humidity 48%

_X_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 ± 1.0 mm (14.8±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 __500mm____
Record the left side distance __500mm____

_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 __$656 \times 10^{-6}$mm_____

_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 ± 1.0 mm (14.8 inches ± 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 g ≤ x ≤ 300 g | 272 |
| 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 ≤ 15 g | 12 |

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

Joe Fleck
Signature

8/23/04
Date

**MGA RESEARCH CORPORATION**

**HEAD DROP TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 505 **Test ID:** D041991

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 - 25.6 | 21.7 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 54 | Pass |
| Peak Resultant Acceleration | G's | 250 - 300 | 272 | Pass |
| Peak Lateral Acceleration | G's | +/- 15 | 11.7 | Pass |
| Unimodal | Yes/No | NA | Yes | Pass |
| Oscillations | Yes/No | within 10% of peak | Yes | Pass |
| | | Overall Test Results | | Pass |

Laboratory Technician

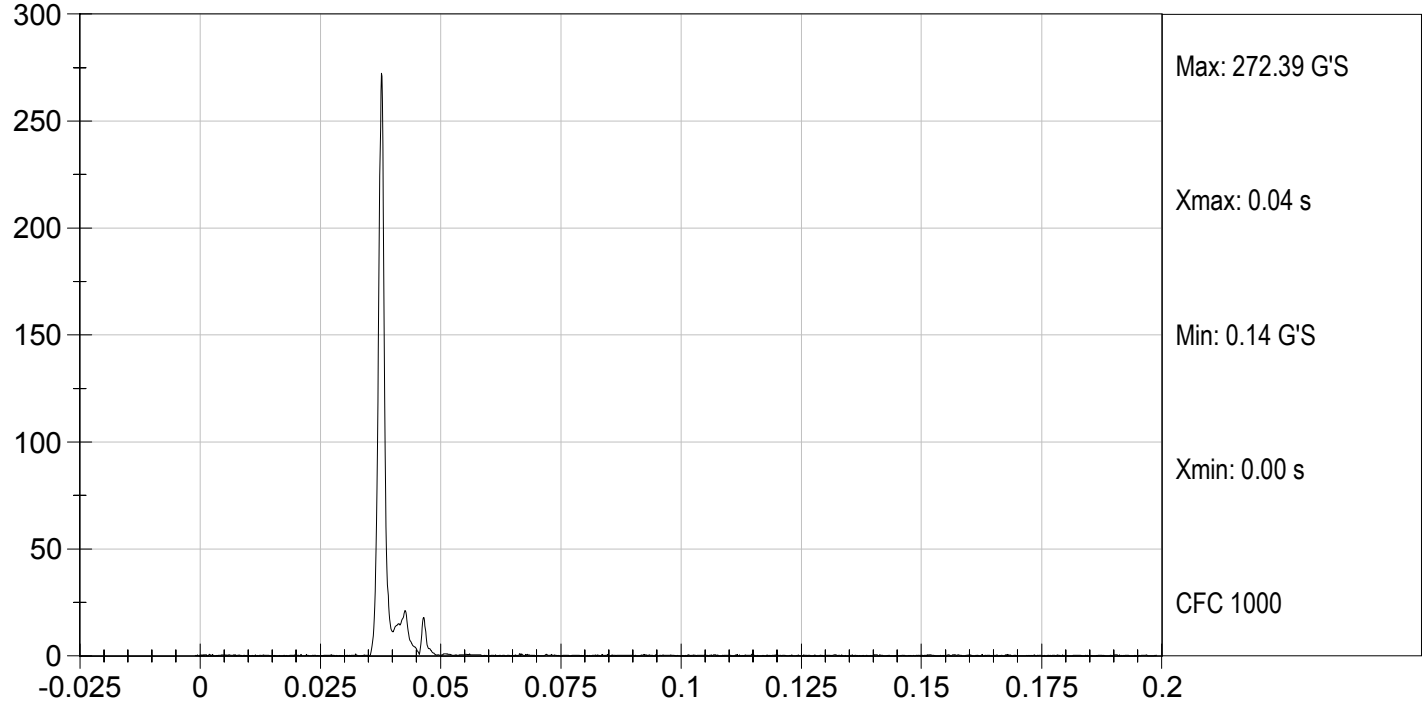
08/23/2004
Test Date

Approved By

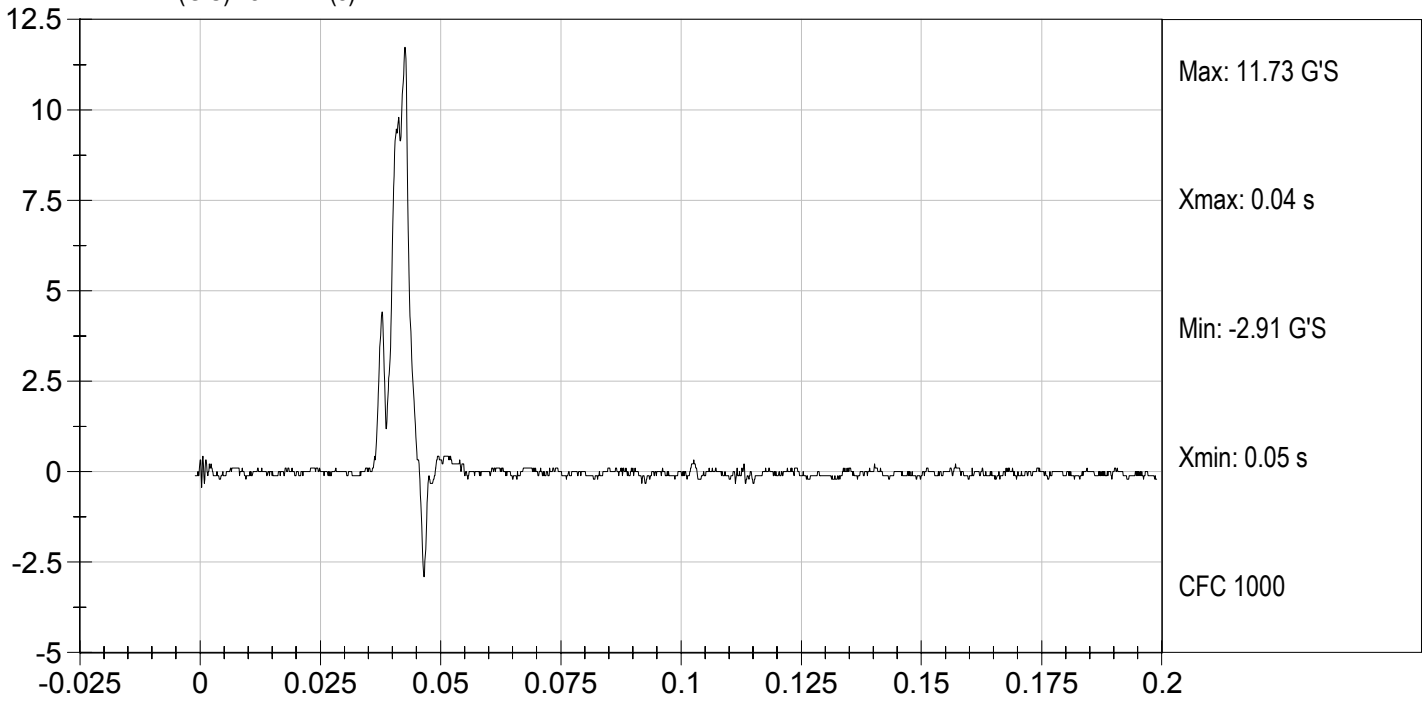
Test Desc: Head Drop
Componet ID: D041991

Test Date: 08/23/2004
Velocity: 0 ft/s, 0 m/s

PEAK RESULTANT ACCELERATION (G'S) vs TIME (s)




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



DATA SHEET B4
NECK FLEXION TEST (572.133)

Dummy Serial Number ___505___ Test Date ___8/23/04___

Technician ___Joe Fleck___

_X_Pretest 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))
_X_ N/A, ONLY one flexion test performed

_X_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))

_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. (572.133(c)(1))
Record the maximum temperature __21.8__
Record the minimum temperature __21.2__
Record the maximum humidity __56%__
Record the minimum humidity __48%__

_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. (880105-250 and PADI page17).
Record findings and actions: __No Deterioration. Hardness Front 85; Back 88.

_X_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 ± 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 | Result |
|---|---|---|---|
| Pendulum impact speed | | 6.89 m/s ≤ speed ≤ 7.13 m/s | 7.07 m/s |
| Pendulum ΔV with respect to impact speed | @ 10ms | 2.1 m/s ≤ ΔV ≤ 2.5 m/s | 2.5 m/s |
| | @ 20 ms | 4.0 m/s ≤ ΔV ≤ 5.0 m/s | 4.9 m/s |
| | @30ms | 5.8 m/s ≤ ΔV ≤ 7.0 m/s | 6.8 m/s |
| Plane D Rotation | | Peak moment*<br>69 Nm ≤ moment ≤ 83 Nm during the following rotation range $77^o$ ≤ angle ≤ $91^o$ | __78__ Nm @ __79__ degrees |
| Positive Moment Decay** (Flexion) | | Time to decay to 10 Nm<br>80 ms ≤ time ≤ 100ms | 86 ms |

*Moment about the occipital condyle = $M_y$ – (0.01778 m x $F_x$) (572.133(b)(1)(ii))

My = Moment in Nm measured by the transducer

Fx = 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.

Joe Flees
Signature

8/23/04
Date

**MGA RESEARCH CORPORATION**

**NECK FLEXION TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 505 **Test I.D:** D041992

| 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 | 52 | Pass |
| Pendulum Speed | | m/sec | 6.89 to 7.13 | 7.07 | Pass |
| Pendulum Deceleration | 10 msec | m/sec | 2.1 to 2.5 | 2.5 | Pass |
| | 20 msec | m/sec | 4.0 to 5.0 | 4.9 | Pass |
| | 30 msec | m/sec | 5.8 to 7.0 | 6.8 | Pass |
| D Plane Rotation | Max | deg | 77 to 91 | 79 | Pass |
| Occipital Condyle Moment within Deflection Corridor | | Nm | 69 to 83 | 78 | Pass |
| Positive Moment Time Curve Decay to 10 Nm | | msec | 80 to 100 | 86 | Pass |
| | | | Overall Results | | Pass |

Laboratory Technician

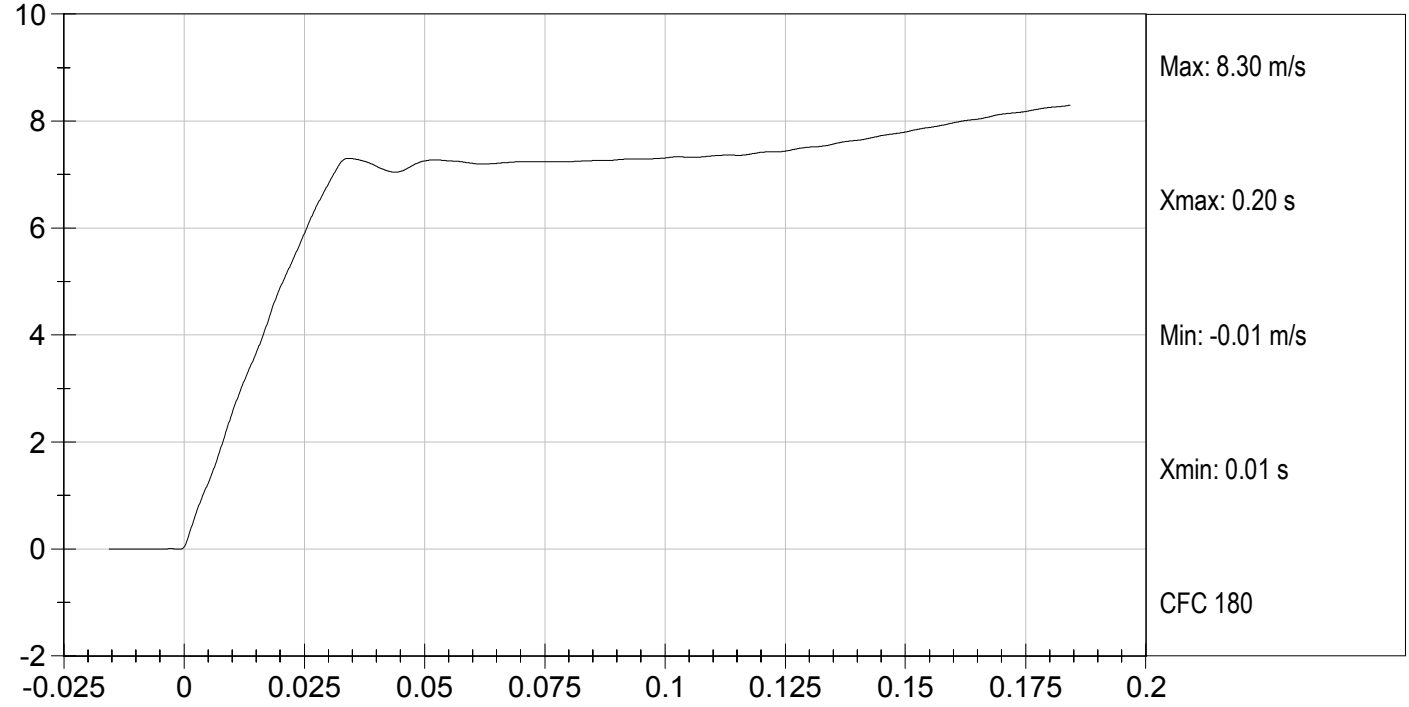
08/23/2004
Test Date

Approved By

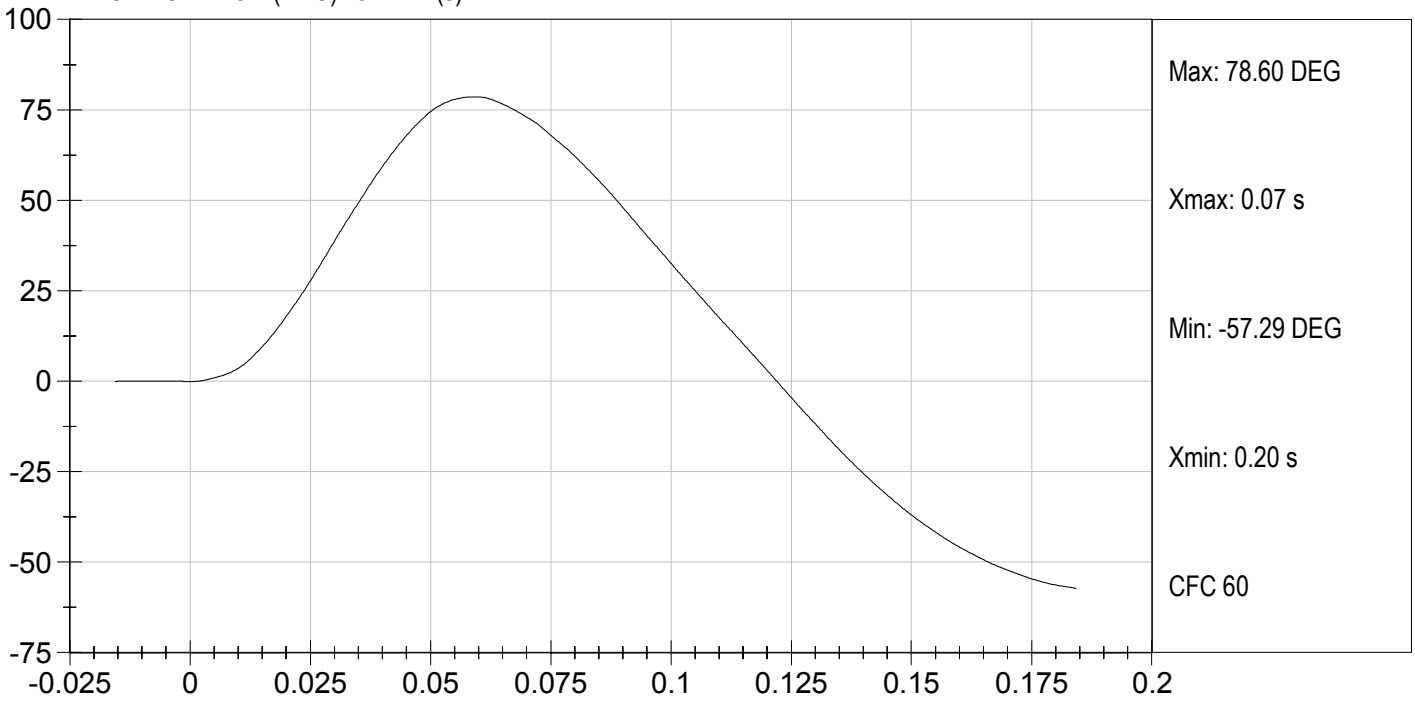
Test Desc: Neck Flexion
Componet ID: D041992

Test Date: 08/23/2004
Velocity: 23.18 ft/s, 7.07 m/s

PENDULUM DECELERATION (m/s) vs TIME (s)

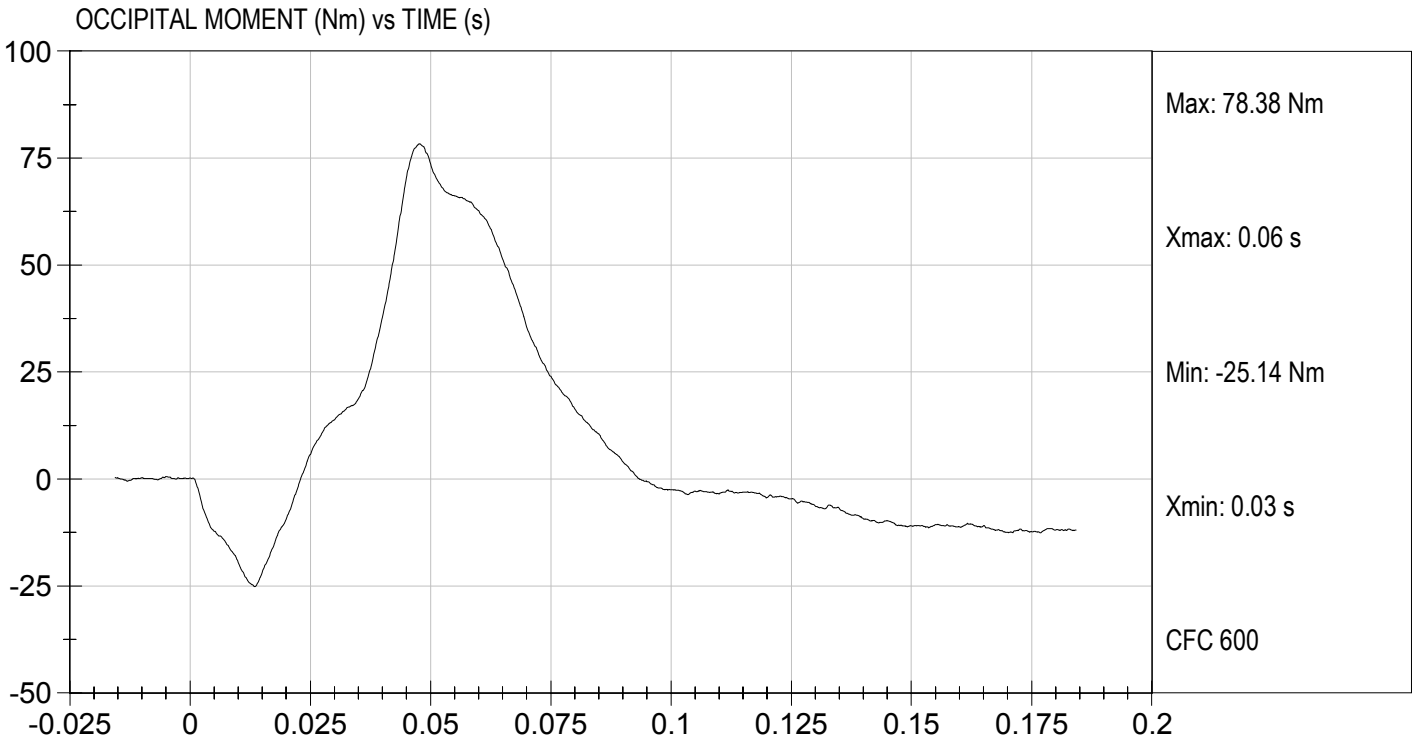



NECK ROTATION (DEG) vs TIME (s)



Test Desc: Neck Flexion
Componet ID: D041992

Test Date: 08/23/2004
Velocity: 23.18 ft/s, 7.07 m/s



DATA SHEET B5
NECK EXTENSION TEST (572.133)

Dummy Serial Number ____505_____ Test Date ___8/23/04_____

Technician _____Joe Fleck_____

_X_Pretest 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))
_X_ N/A, ONLY one extension test performed

_X_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))

_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. (572.133(c)(1))
Record the maximum temperature __21.8___
Record the minimum temperature __21.2___
Record the maximum humidity __56%__
Record the minimum humidity __48%__

_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. (880105-250 and PADI page17).
Record findings and actions: __No Deterioration. Hardness Front 85; Back 88.

_X_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 ± 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 | Result |
|---|---|---|---|
| Pendulum impact speed | | 5.95 m/s ≤ speed ≤ 6.19 m/s | 6.11 m/s |
| Pendulum ΔV with respect to impact speed | @ 10ms | 1.5 m/s ≤ ΔV ≤ 1.9 m/s | 1.9 m/s |
| | @ 20 ms | 3.1 m/s ≤ ΔV ≤ 3.9 m/s | 3.7 m/s |
| | @30ms | 4.6 m/s ≤ ΔV ≤ 5.6 m/s | 5.2 m/s |
| Plane D Rotation | | Peak moment*<br>-65 Nm ≤ moment ≤ -53 Nm during the following rotation range 99° ≤ angle ≤ 114° | _-55_ Nm @ _105_ degrees |
| Negative Moment Decay** (Extension) | | Time to decay to -10 Nm<br>94 ms ≤ time ≤ 114 ms | 101 ms |

*Moment about the occipital condyle = $M_y$ – (0.01778 m x $F_x$) (572.133(b)(1)(ii)

My = Moment in Nm measured by the transducer

Fx = 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.

Joe Fleck _____ 8/23/04

Signature Date

**MGA RESEARCH CORPORATION**

**NECK EXTENSION TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 505 **Test I.D:** D041993

| 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 Speed | | m/sec | 5.95 to 6.19 | 6.11 | Pass |
| Pendulum Deceleration | 10 msec | m/sec | 1.5 to 1.9 | 1.9 | Pass |
| | 20 msec | m/sec | 3.1 to 3.9 | 3.7 | Pass |
| | 30 msec | m/sec | 4.6 to 5.6 | 5.2 | Pass |
| D Plane Rotation | Max | deg | 99 to 114 | 105 | Pass |
| Occipital Condyle Moment within Deflection Corridor | | Nm | -65 to -53 | -55 | Pass |
| Negative Moment Time Curve Decay to -10 Nm | | msec | 94 to 114 | 101 | Pass |
| | | | Overall Results | | Pass |

Laboratory Technician

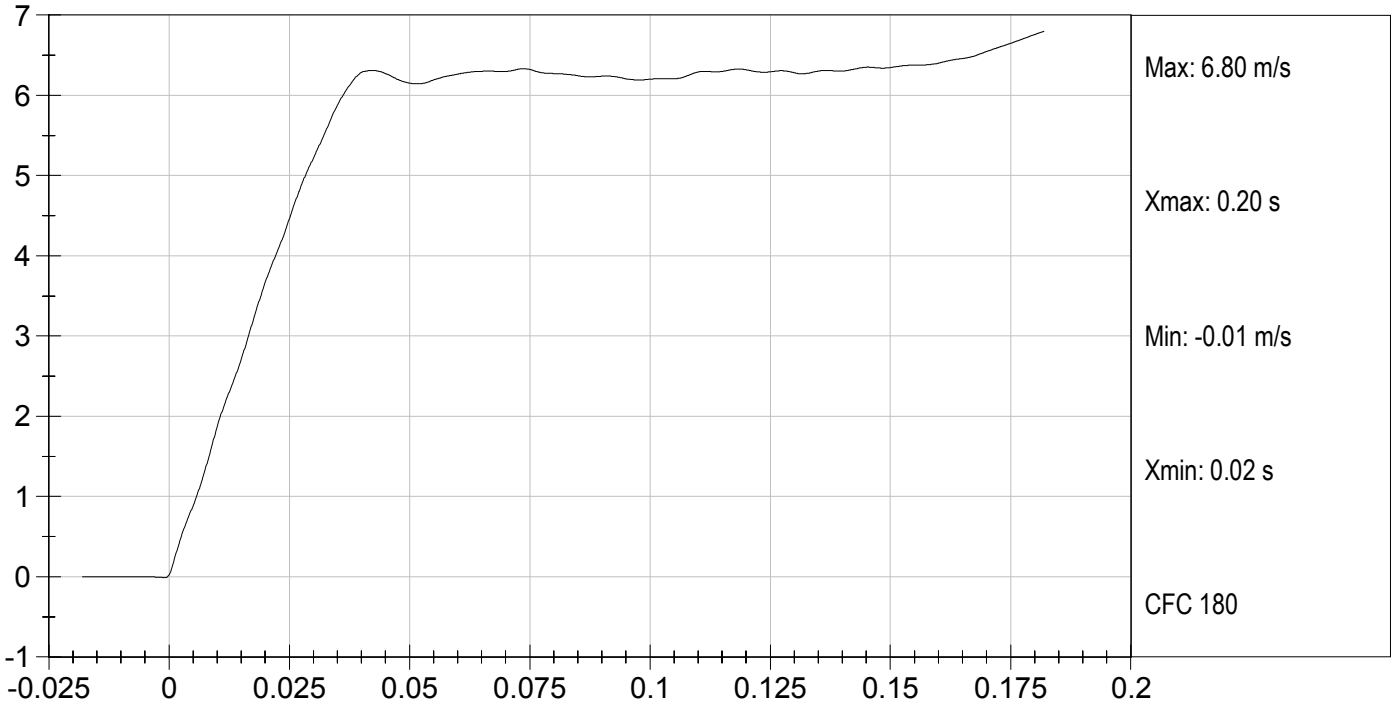
08/23/2004
Test Date

Approved By

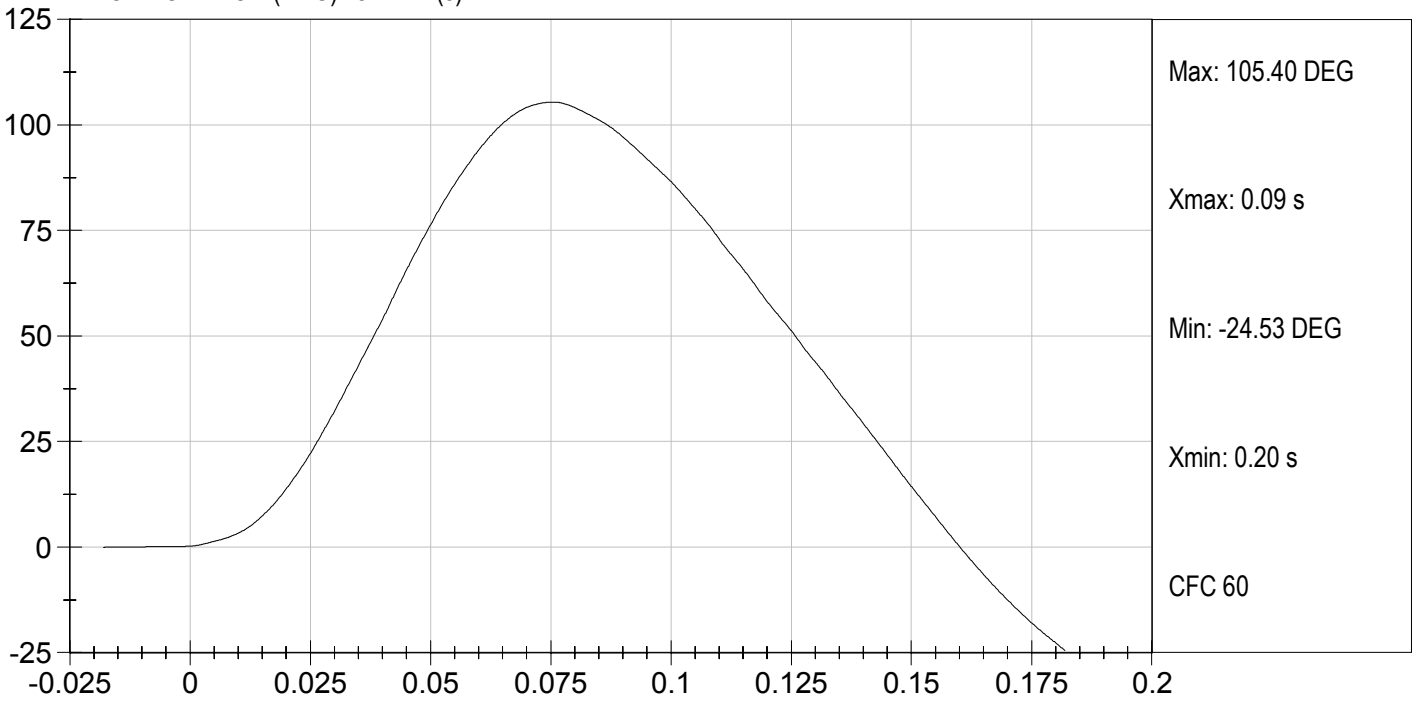
Test Desc: Neck Extension
Componet ID: D041993

Test Date: 08/23/2004
Velocity: 20.05 ft/s, 6.11 m/s

PENDULUM DECELERATION (m/s) vs TIME (s)

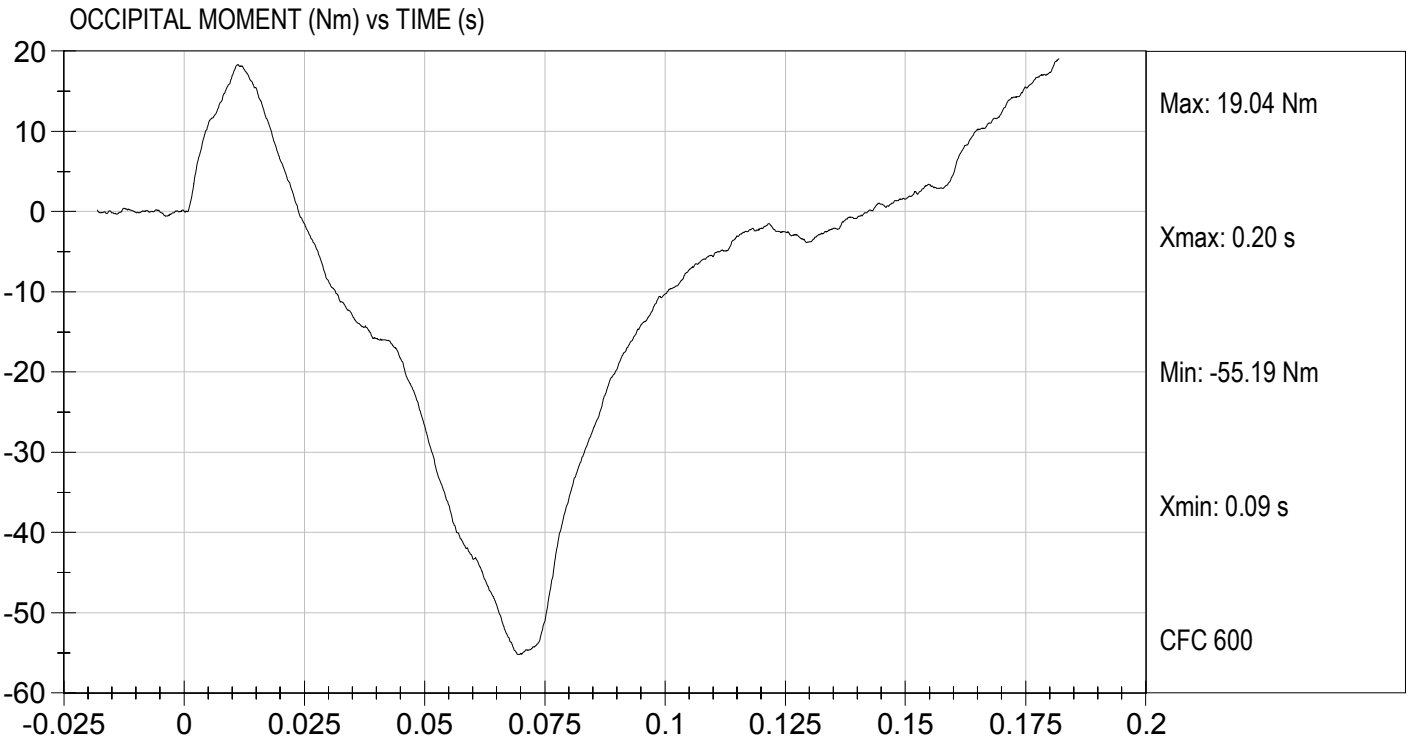



NECK ROTATION (DEG) vs TIME (s)



Test Desc: Neck Extension
Componet ID: D041993

Test Date: 08/23/2004
Velocity: 20.05 ft/s, 6.11 m/s



DATA SHEET B6
THORAX IMPACT TEST (572.134)

Dummy Serial Number __505_____ Test Date __8/23/04_____

Technician ____Joe Fleck_____

_X_Pretest 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))
_X_ N/A, ONLY one thorax impact test performed
_X_2. The test fixture conforms to the specifications in Figure 11B.
_X_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))
_X_4. The dummy assembly soaked at a temperature between 20.6°C (69ºF) and 22.2°C (72ºF) 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 _22.0_
Record the minimum temperature _21.2_
Record the maximum humidity _60%_
Record the minimum humidity _51%_
_X_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.
_X_ - 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 ± 0.5º and adjust the pelvis angle to 7º ± 2º. 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 ± 1º. (572.134(c)(3))

_X_ 9. The longitudinal centerline of the test probe is centered within ±2.5 mm of the midsagittal plane of the dummy and is 12.7 mm ± 1mm below the horizontal peripheral centerline of the No. 3 rib and is within 0.5º 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 ± 2º 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 2º 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 ± 0.12m/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 m/s ≤ speed ≤ 6.83 m/s | 6.65 m/s |
| Chest Compression | 50.0 mm ≤ compression ≤ 58.0 mm | 53 mm |
| Peak force** between 50.0 and 58.0 mm chest compression | 3900N ≤ peak force ≤ 4400N | 4260 N |
| Peak force** between 18.0 and 50.0 mm chest compression | peak force ≤ 4600 N | 4256 N |
| Internal Hysteresis*** | 69% ≤ hysteresis ≤ 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.

Joe Fleck _____ 8/24/04

Signature Date

**MGA RESEARCH CORPORATION**

**THORAX IMPACT**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 505 **Test I.D:** D041994

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Temperature | deg C | 20.6 to 22.2 | 21.2 | Pass |
| Relative Humidity | % | 10 to 70 | 55 | Pass |
| Probe Speed | m/s | 6.59 to 6.83 | 6.65 | Pass |
| Peak Deflection | mm | 50 to 58 | 52.5 | Pass |
| Peak Resistive Force w/in Deflection Corridor | kN | 3.9 to 4.4 | 4.3 | Pass |
| Internal Hysteresis | % | 69 to 85 | 69 | Pass |
| Peak Force 18 mm - 50 mm | N | < 4600 N | 4,256 | Pass |
| | | Overall Test Results | | Pass |

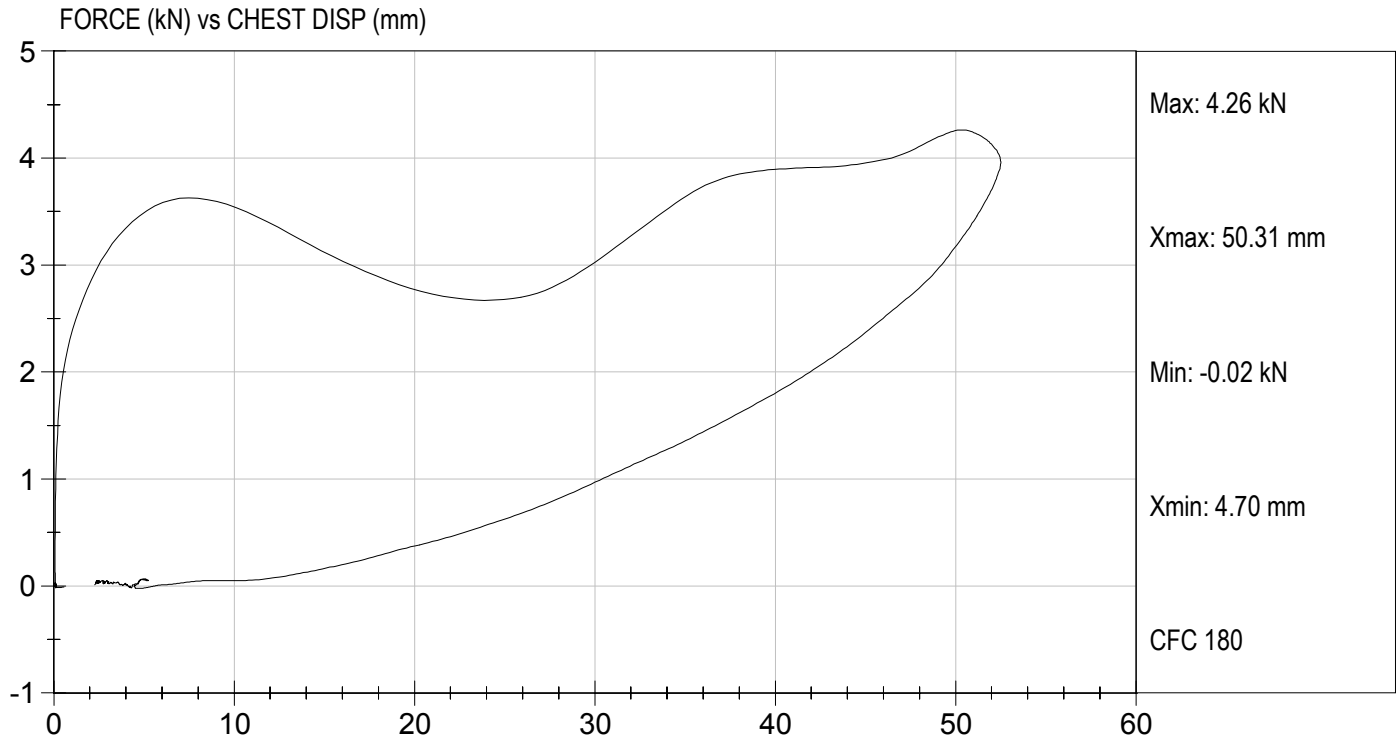
Laboratory Technician

08/24/2004
Test Date

Approved By

Test Desc: Thorax Impact
Componet ID: D041994

Test Date: 08/24/2004
Velocity: 21.81 ft/s, 6.65 m/s



DATA SHEET B7
TORSO FLEXION TEST (572.135)

Dummy Serial Number __505_____ Test Date __8/23/04_____

Technician _____Joe Fleck_____

_X_Pretest 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))
_X_ N/A, ONLY one thorax impact test performed
_X_2. The test fixture conforms to the specifications in Figure 13B.
_X_3. The complete assembled dummy (880105-000) is used (572.135(c)(2)).
__ with legs below the femurs.
_X_ without legs below the femurs.
_X_4. The dummy assembly soaked at a temperature between 18.9°C (66ºF) and 25.6°C (78ºF) 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 __21.8__
Record the minimum temperature __20.2__
Record the maximum humidity __56%__
Record the minimum humidity __49%__
_X_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))
_X_6. Attach the loading adapter bracket to the spine of the dummy as shown in Figure 13B**.** (572.135(c)(4))
_X_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))
_X_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°)___19°___
_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° | 19° |
| Torso rotation rate | 0.5°/s ≤ rate ≤ 1.5°/s | 1.0 |
| Force at 45° ±0.5° | 320 N ≤ force ≤ 390 N | 352 N |
| Final ref. plane angle | Initial ref. plane angle ±8° | 20° |

Joe Fleck
Signature

8/23/04
Date

**MGA RESEARCH CORPORATION**

**TORSO FLEXION TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 505 **Test I.D:** D041997

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 - 25.6 | 21.2 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 50 | Pass |
| Initial Angle | deg | 0 to 20 | 19 | Pass |
| Return Angle | deg | +/- 8 | 23 | Pass |
| Force at 45 deg | N | 320 to 390 | 352 | Pass |
| Upper Torso Deflection Rate | Deg/sec | 0.5 - 1.5 | 1.0 | Pass |
| | | Overall Result | | Pass |

Laboratory Technician

08/23/2004
Test Date

Approved By

DATA SHEET B8
LEFT KNEE IMPACT TEST (572.136)

Dummy Serial Number __505_____ Test Date __8/23/04_____

Technician ____Joe Fleck_____

_X_Pretest 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))
_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 (66ºF) and 25.6°C (78ºF) 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 _21.8__
Record the minimum temperature _21.2__
Record the maximum humidity _56%__
Record the minimum humidity _48%__
_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 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 m/s ≤ speed ≤ 2.13 m/s | 2.12 m/s |
| Peak resistance force* | 3450 N ≤ force ≤ 4060 N | 3770 N |

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

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

Joe Fleck
Signature

8/23/04
Date

**MGA RESEARCH CORPORATION**

**LEFT KNEE IMPACT TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 505 **Test I.D:** D041996

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 to 25.5 | 21.4 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 52 | Pass |
| Probe Speed | m/sec | 2.07 to 2.13 | 2.12 | Pass |
| Maximum Force | kN | 3.45 to 4.06 | 3.77 | Pass |
| | | Overall Test Results | | Pass |

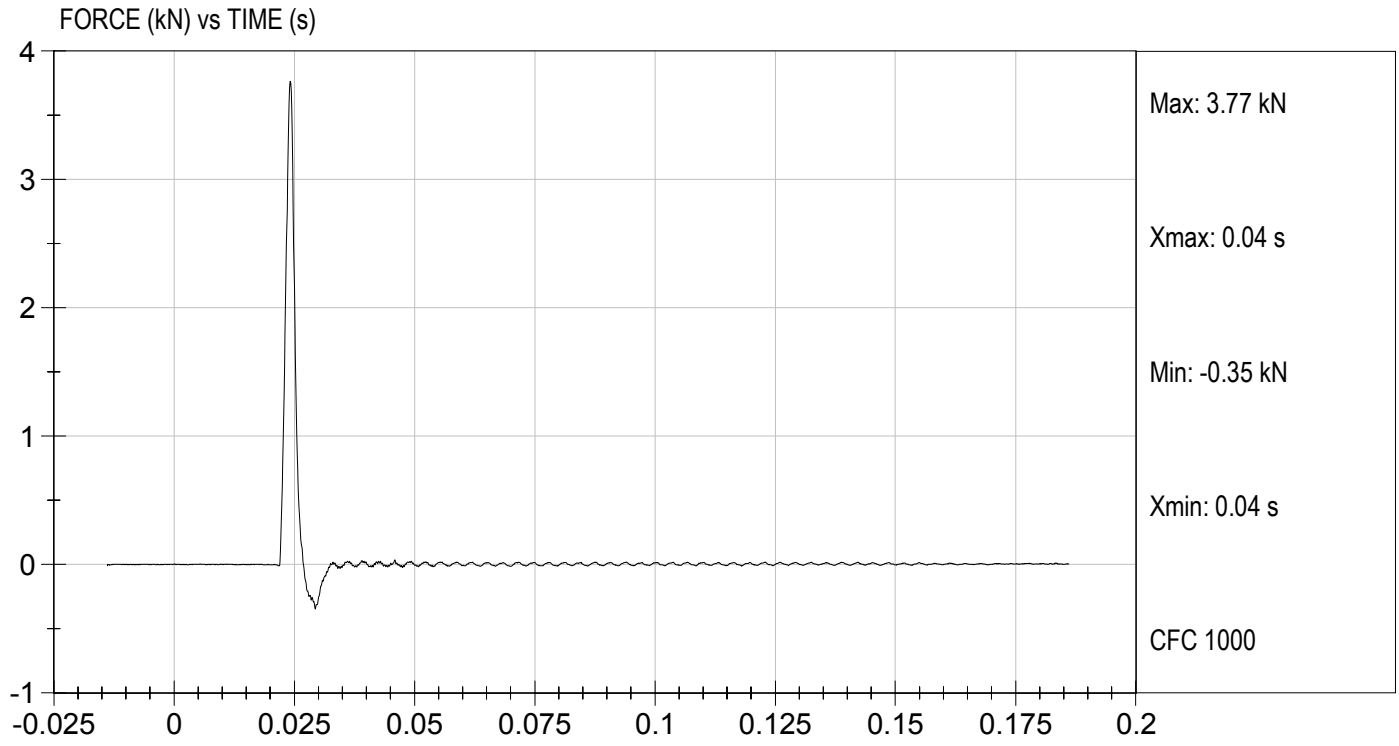
Laboratory Technician

08/23/2004
Test Date

Approved By

Test Desc: Left Knee
Componet ID: D041996

Test Date: 08/23/2004
Velocity: 6.94 ft/s, 2.12 m/s



DATA SHEET B9
RIGHT KNEE IMPACT TEST (572.136)

Dummy Serial Number ___505_____ Test Date __8/23/04_____

Technician ___Joe Fleck_____

_X_Pretest calibration
__Post test calibration verification

Test attempt no. _2__ (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))
__ 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 (880105-528R), 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))
_X_4. The knee assembly soaked at a temperature between 18.9°C (66ºF) and 25.6°C (78ºF) 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 _21.8___
Record the minimum temperature _21.2___
Record the maximum humidity _56 %___
Record the minimum humidity _48 %___
_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 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))
_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 m/s ≤ speed ≤ 2.13 m/s | 2.11 m/s |
| Peak resistance force* | 3450 N ≤ force ≤ 4060 N | 3620 N |

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

_X_12. Plots of acceleration versus time and force versus time follow this sheet.

Signature

8/23/04
Date

**MGA RESEARCH CORPORATION**

**RIGHT KNEE IMPACT TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 505 **Test I.D:** D041995

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 to 25.5 | 21.4 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 52 | Pass |
| Probe Speed | m/sec | 2.07 to 2.13 | 2.11 | Pass |
| Maximum Force | kN | 3.45 to 4.06 | 3.62 | Pass |
| | | Overall Test Results | | Pass |

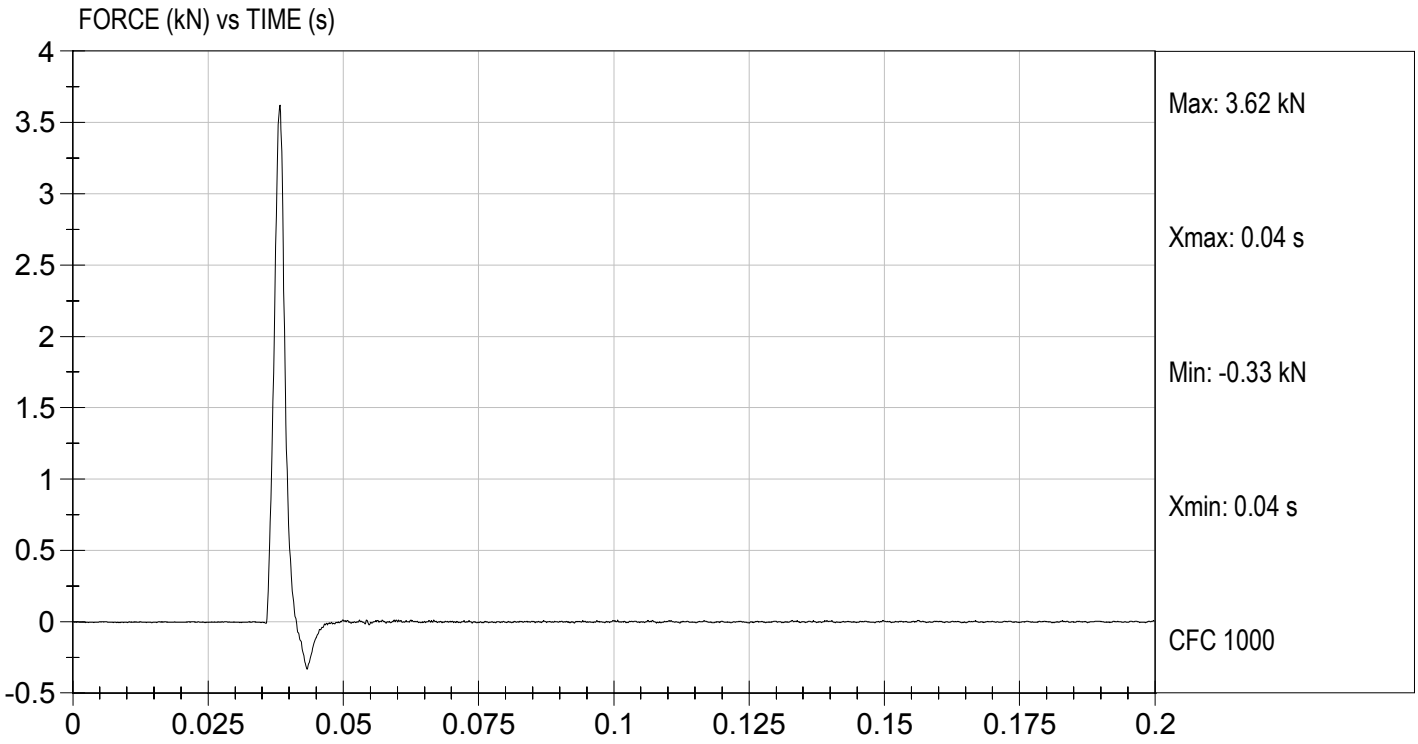
Laboratory Technician

08/23/2004
Test Date

Approved By

Test Desc: Right Knee
Componet ID: D041995

Test Date: 08/23/2004
Velocity: 6.91 ft/s, 2.11 m/s



DATA SHEET B3
HEAD DROP TEST (572.132)

Dummy Serial Number 505 Test Date 8/30/04

Technician Joe Fleck

__Pretest calibration
_X_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))
_X_ N/A, ONLY one head drop performed
_X_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))
_X_3. The head accelerometer mounting plate screws ((10-24 x 3/8 SHCS) are torqued to 9.0 Nm.
_X_4. Accelerometers and their respective mounts are smooth and clean.
_X_5. Torque the skull cap screws (10-24 x 1/2 SHCS) to 9.0 Nm.
_X_6. The data acquisition system, including transducers, conforms to the requirements of SAE Recommended Practice J211/1 MAR95. (572.136(m))
_X_7. The head assembly soaked at a temperature between 18.9°C (66ºF) and 25.6°C (78ºF) 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 21.9
Record the minimum temperature 20.9
Record the maximum humidity 52%
Record the minimum humidity 42%
_X_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 ± 1.0 mm (14.8±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 __500mm____
Record the left side distance __500mm____

_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 __$656 \times 10^{-6}$mm_____

_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 ± 1.0 mm (14.8 inches ± 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 g ≤ x ≤ 300 g | 266 |
| 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 ≤ 15 g | 9.7 |

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

Joe Fleck
Signature

8/30/04
Date

**MGA RESEARCH CORPORATION**

**HEAD DROP TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 505 **Test ID:** D042031

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 - 25.6 | 21.7 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 48 | Pass |
| Peak Resultant Acceleration | G's | 250 - 300 | 266 | Pass |
| Peak Lateral Acceleration | G's | +/- 15 | 9.7 | Pass |
| Unimodal | Yes/No | NA | Yes | Pass |
| Oscillations | Yes/No | within 10% of peak | Yes | Pass |
| | | Overall Test Results | | Pass |

Laboratory Technician

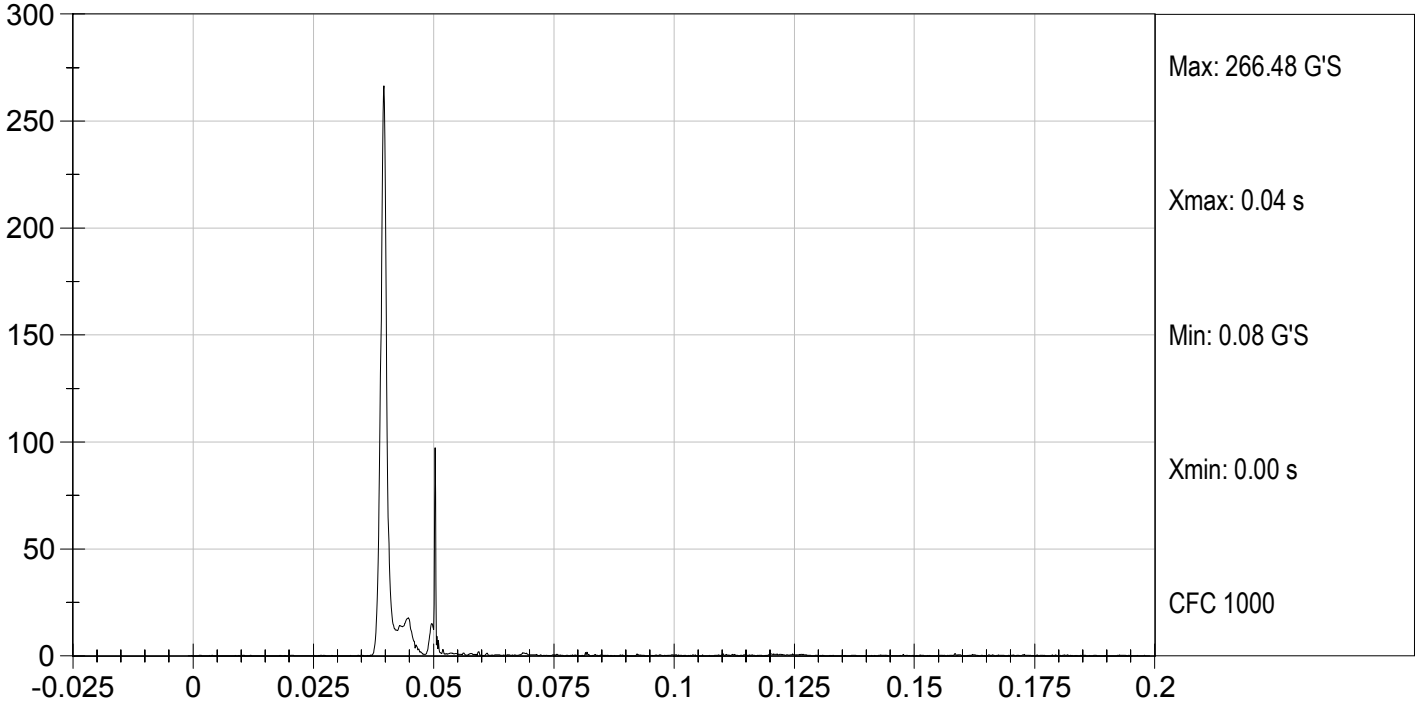
08/30/2004
Test Date

Approved By

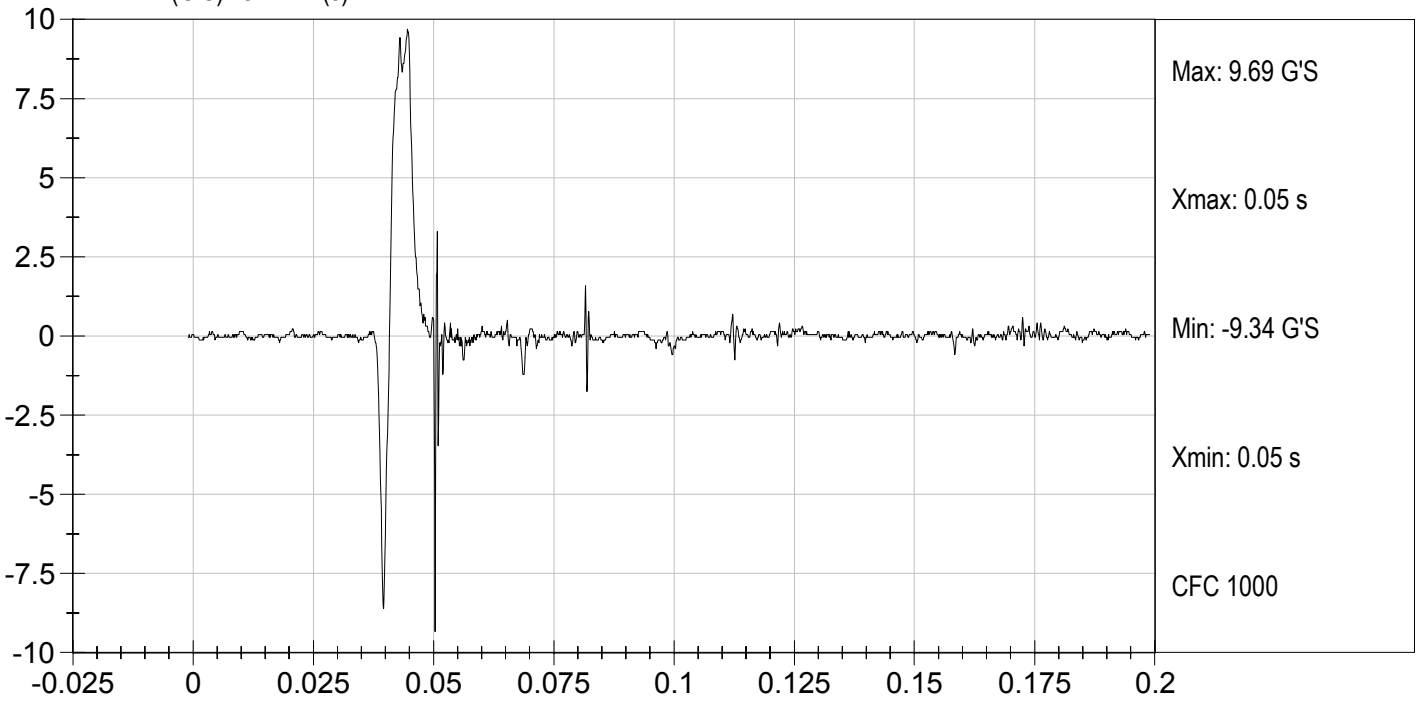
Test Desc: Head Drop
Componet ID: D042031

Test Date: 08/30/2004
Velocity: 0 ft/s, 0 m/s

PEAK RESULTANT ACCELERATION (G'S) vs TIME (s)




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



DATA SHEET B4
NECK FLEXION TEST (572.133)

Dummy Serial Number ____505_____ Test Date ____8/30/04_____

Technician _____Joe Fleck_____

__Pretest calibration
_X_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))
_X_ N/A, ONLY one flexion test performed

_X_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))

_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. (572.133(c)(1))
Record the maximum temperature __21.9__
Record the minimum temperature __20.9__
Record the maximum humidity __52%__
Record the minimum humidity __42%__

_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. (880105-250 and PADI page17).
Record findings and actions: __No Deterioration. Hardness Front 85; Back 88.

_X_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 ± 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 | Result |
|---|---|---|---|
| Pendulum impact speed | | 6.89 m/s ≤ speed ≤ 7.13 m/s | 6.91 m/s |
| Pendulum ΔV with respect to impact speed | @ 10ms | 2.1 m/s ≤ ΔV ≤ 2.5 m/s | 2.5 m/s |
| | @ 20 ms | 4.0 m/s ≤ ΔV ≤ 5.0 m/s | 4.8 m/s |
| | @30ms | 5.8 m/s ≤ ΔV ≤ 7.0 m/s | 6.7 m/s |
| Plane D Rotation | | Peak moment*<br>69 Nm ≤ moment ≤ 83 Nm during the following rotation range 77° ≤ angle ≤ 91° | __79__ Nm @ _71__ degrees |
| Positive Moment Decay** (Flexion) | | Time to decay to 10 Nm<br>80 ms ≤ time ≤ 100ms | 87 ms |

*Moment about the occipital condyle = $M_y$ – (0.01778 m x $F_x$) (572.133(b)(1)(ii))

My = Moment in Nm measured by the transducer

Fx = 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.

Joe Fleck
Signature

8/30/04
Date

**MGA RESEARCH CORPORATION**

**NECK FLEXION TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 505 **Test I.D:** D042032

| Tested Parameter | | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|---|
| Laboratory Temperature | | deg C | 20.6 to 22.2 | 21.9 | Pass |
| Laboratory Relative Humidity | | % | 10 to 70 | 46 | Pass |
| Pendulum Speed | | m/sec | 6.89 to 7.13 | 6.91 | Pass |
| Pendulum Deceleration | 10 msec | m/sec | 2.1 to 2.5 | 2.5 | Pass |
| | 20 msec | m/sec | 4.0 to 5.0 | 4.8 | Pass |
| | 30 msec | m/sec | 5.8 to 7.0 | 6.7 | Pass |
| D Plane Rotation | Max | deg | 77 to 91 | 79 | Pass |
| Occipital Condyle Moment within Deflection Corridor | | Nm | 69 to 83 | 71 | Pass |
| Positive Moment Time Curve Decay to 10 Nm | | msec | 80 to 100 | 87 | Pass |
| | | | Overall Results | | Pass |

Laboratory Technician

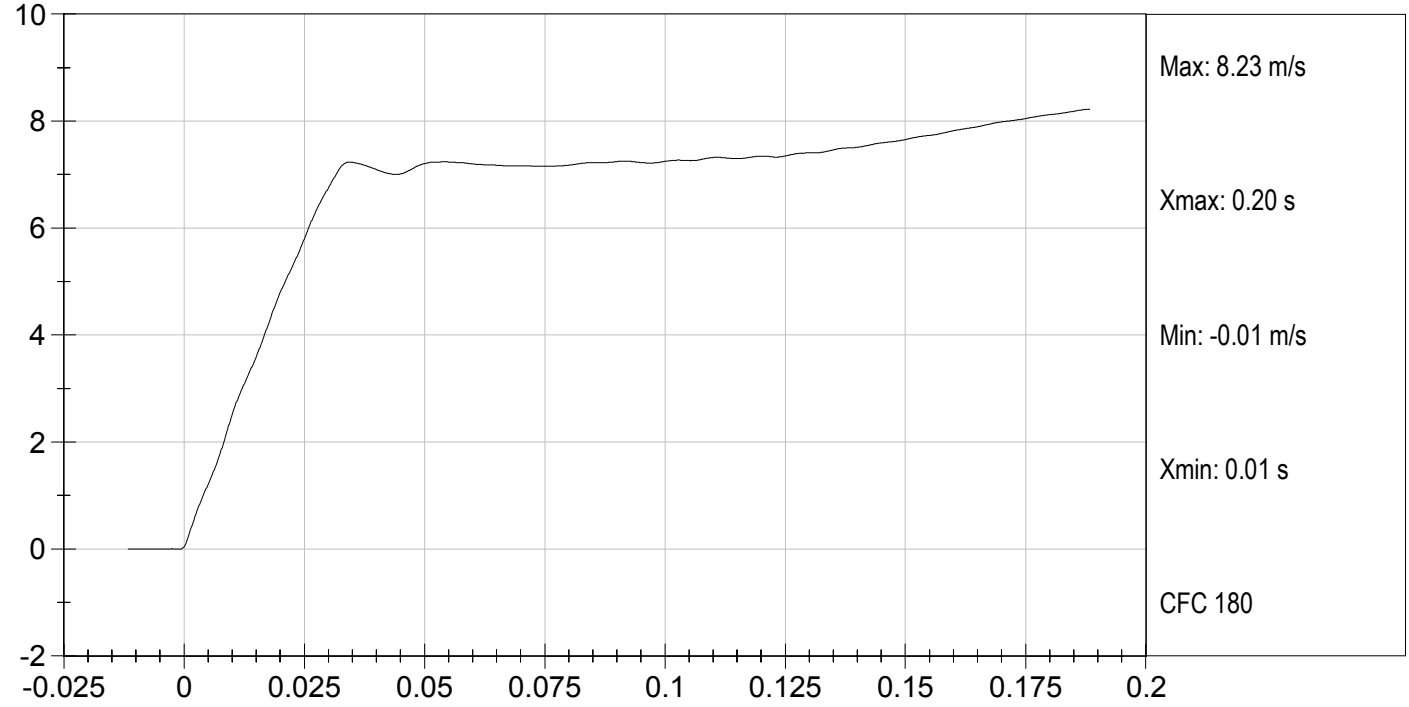
08/30/2004
Test Date

Approved By

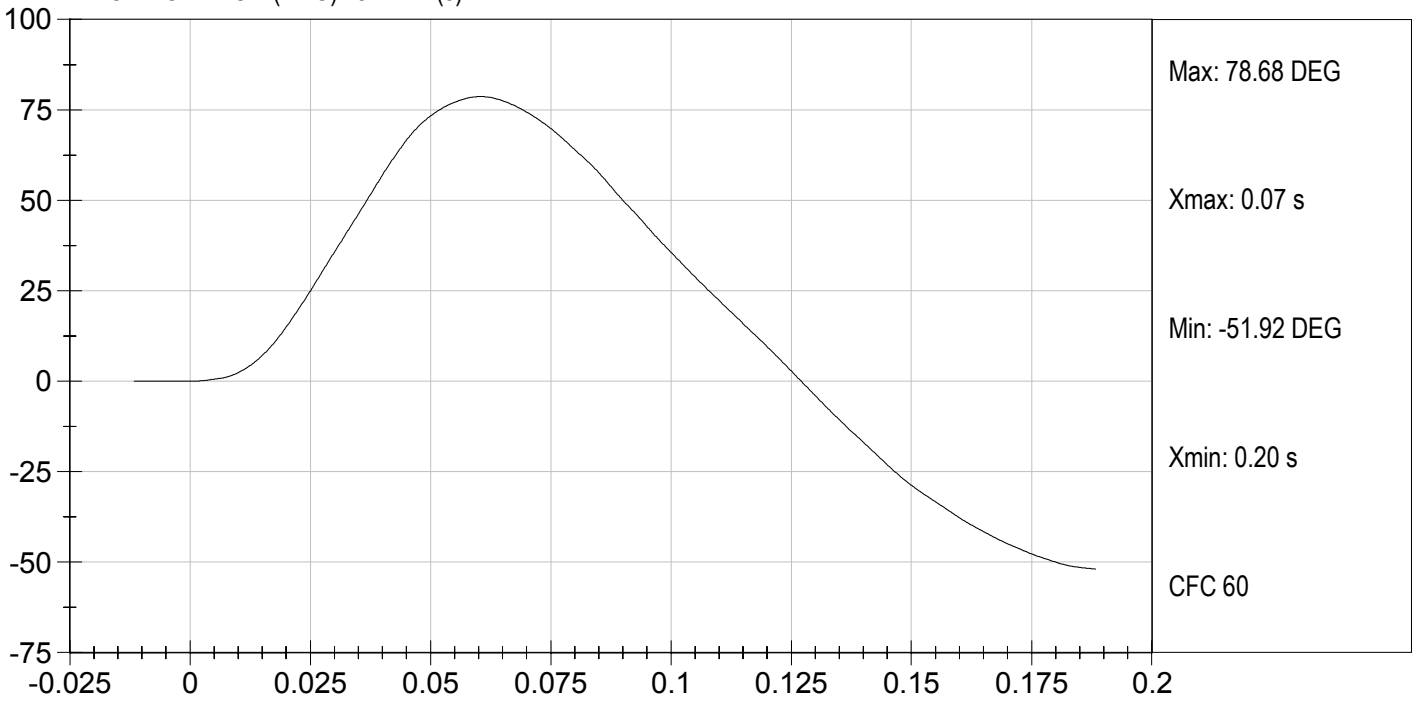
Test Desc: Neck Flexion
Componet ID: D042032

Test Date: 08/30/2004
Velocity: 22.66 ft/s, 6.91 m/s

PENDULUM DECELERATION (m/s) vs TIME (s)

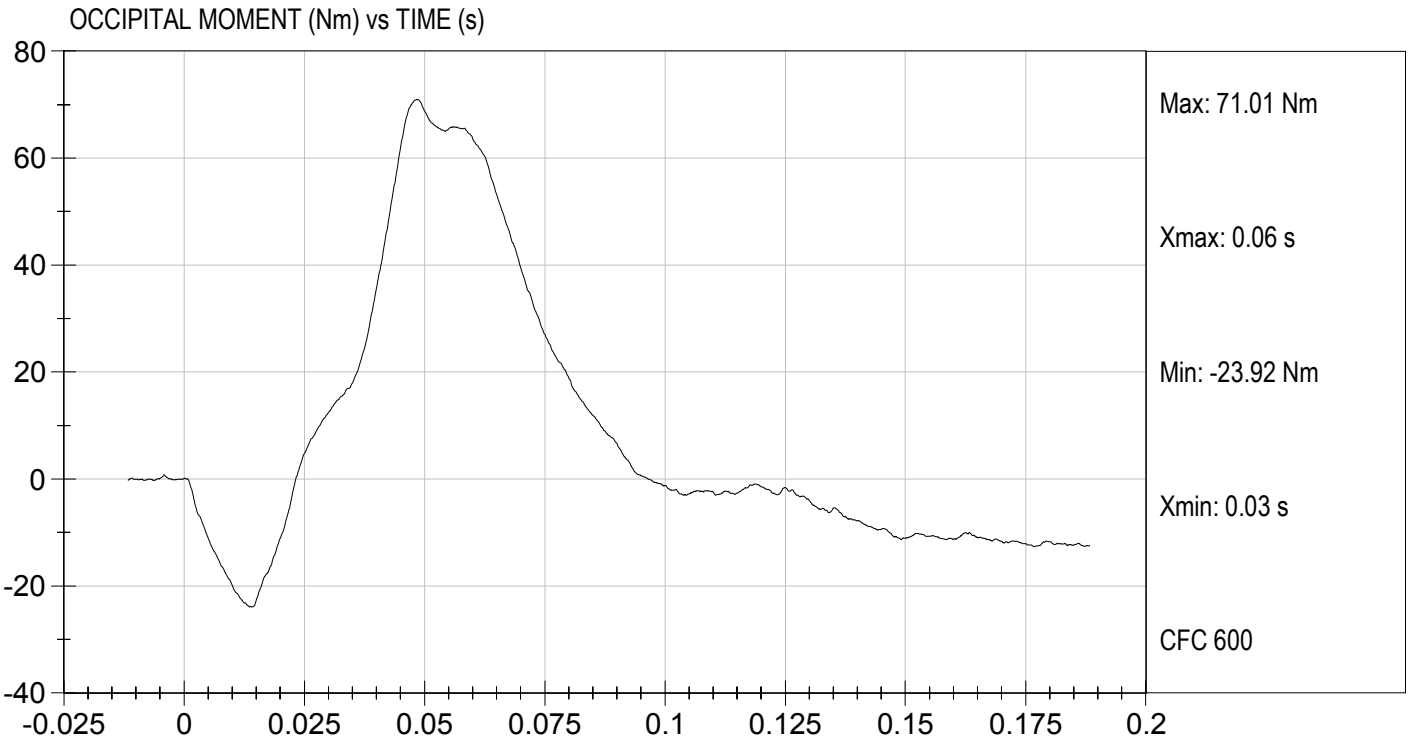



NECK ROTATION (DEG) vs TIME (s)



Test Desc: Neck Flexion
Componet ID: D042032

Test Date: 08/30/2004
Velocity: 22.66 ft/s, 6.91 m/s



DATA SHEET B5
NECK EXTENSION TEST (572.133)

Dummy Serial Number ____505_____ Test Date ___8/30/04_____

Technician _____Joe Fleck_____

__Pretest calibration
_X_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))
_X_ N/A, ONLY one extension test performed

_X_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))

_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. (572.133(c)(1))
Record the maximum temperature __21.9___
Record the minimum temperature __20.9___
Record the maximum humidity __52%__
Record the minimum humidity __42%__

_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. (880105-250 and PADI page17).
Record findings and actions: __No Deterioration. Hardness Front 85; Back 88.

_X_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 ± 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 | Result |
|---|---|---|---|
| Pendulum impact speed | | 5.95 m/s ≤ speed ≤ 6.19 m/s | 6.05 m/s |
| Pendulum ΔV with respect to impact speed | @ 10ms | 1.5 m/s ≤ ΔV ≤ 1.9 m/s | 1.9 m/s |
| | @ 20 ms | 3.1 m/s ≤ ΔV ≤ 3.9 m/s | 3.8 m/s |
| | @30ms | 4.6 m/s ≤ ΔV ≤ 5.6 m/s | 5.5 m/s |
| Plane D Rotation | | Peak moment*<br>-65 Nm ≤ moment ≤ -53 Nm during the following rotation range 99° ≤ angle ≤ 114° | _-61_ Nm @ _100_ degrees |
| Negative Moment Decay** (Extension) | | Time to decay to -10 Nm<br>94 ms ≤ time ≤ 114 ms | 96 ms |

*Moment about the occipital condyle = $M_y$ – (0.01778 m x $F_x$) (572.133(b)(1)(ii)

My = Moment in Nm measured by the transducer

Fx = 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.

Joe Fleck — 8/30/04

Signature Date

**MGA RESEARCH CORPORATION**

**NECK EXTENSION TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 505 **Test I.D:** D042033

| 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/sec | 5.95 to 6.19 | 6.05 | Pass |
| Pendulum Deceleration | 10 msec | m/sec | 1.5 to 1.9 | 1.9 | Pass |
| | 20 msec | m/sec | 3.1 to 3.9 | 3.8 | Pass |
| | 30 msec | m/sec | 4.6 to 5.6 | 5.5 | Pass |
| D Plane Rotation | Max | deg | 99 to 114 | 100 | Pass |
| Occipital Condyle Moment within Deflection Corridor | | Nm | -65 to -53 | -61 | Pass |
| Negative Moment Time Curve Decay to -10 Nm | | msec | 94 to 114 | 96 | Pass |
| | | | Overall Results | | Pass |

Laboratory Technician

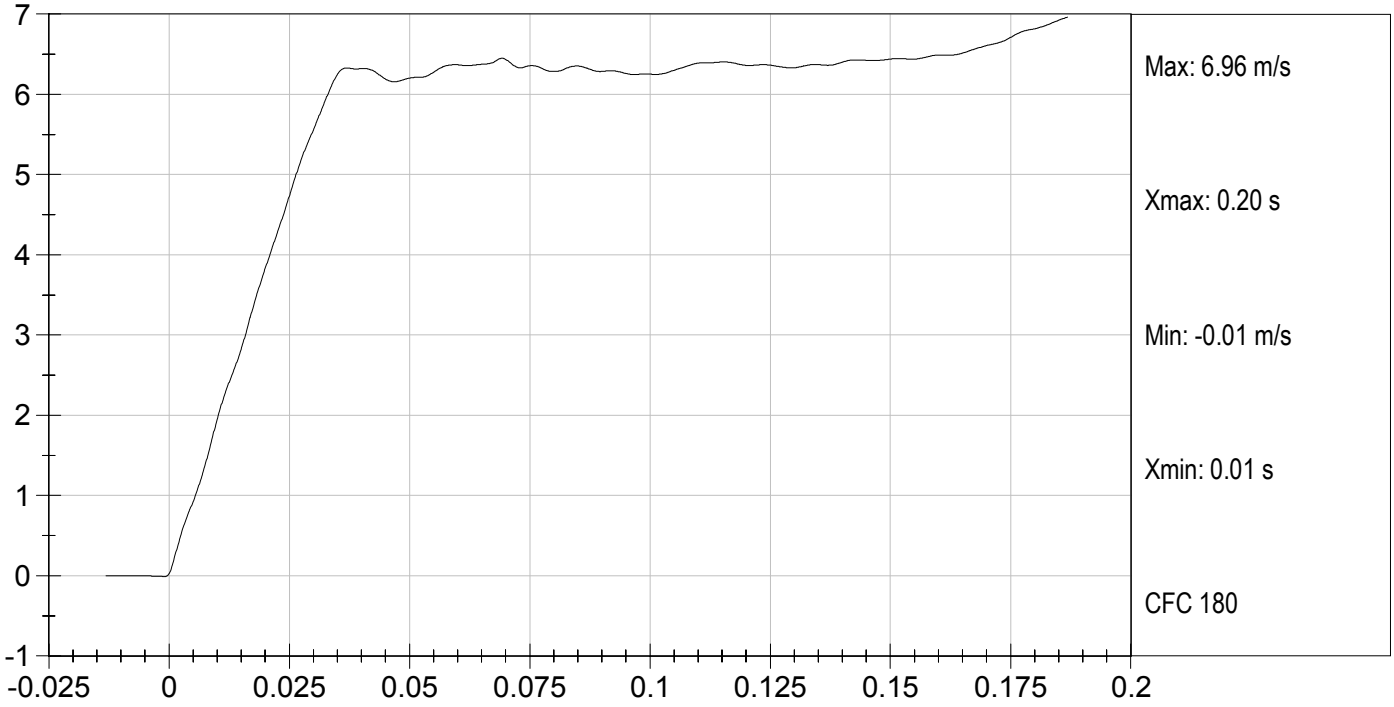
08/30/2004
Test Date

Approved By

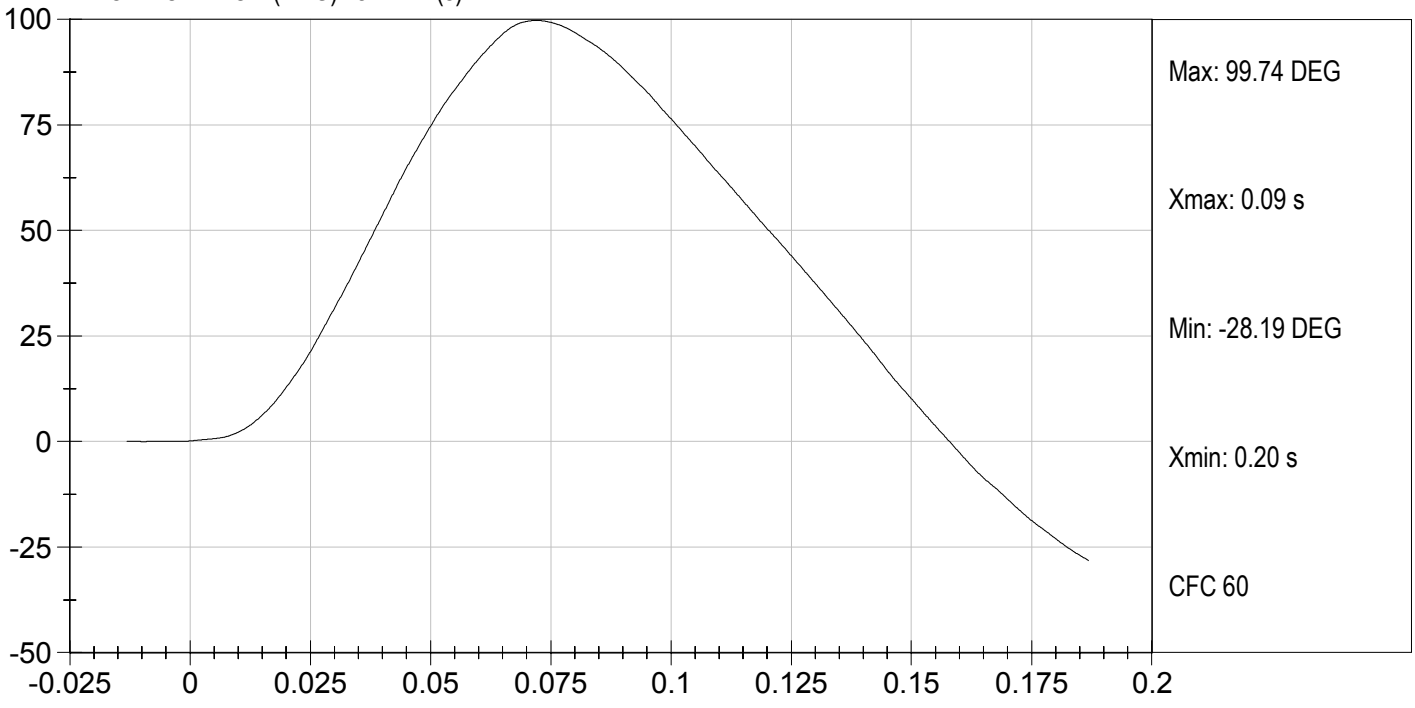
Test Desc: Neck Extension
Componet ID: D042033

Test Date: 08/30/2004
Velocity: 19.85 ft/s, 6.05 m/s

PENDULUM DECELERATION (m/s) vs TIME (s)

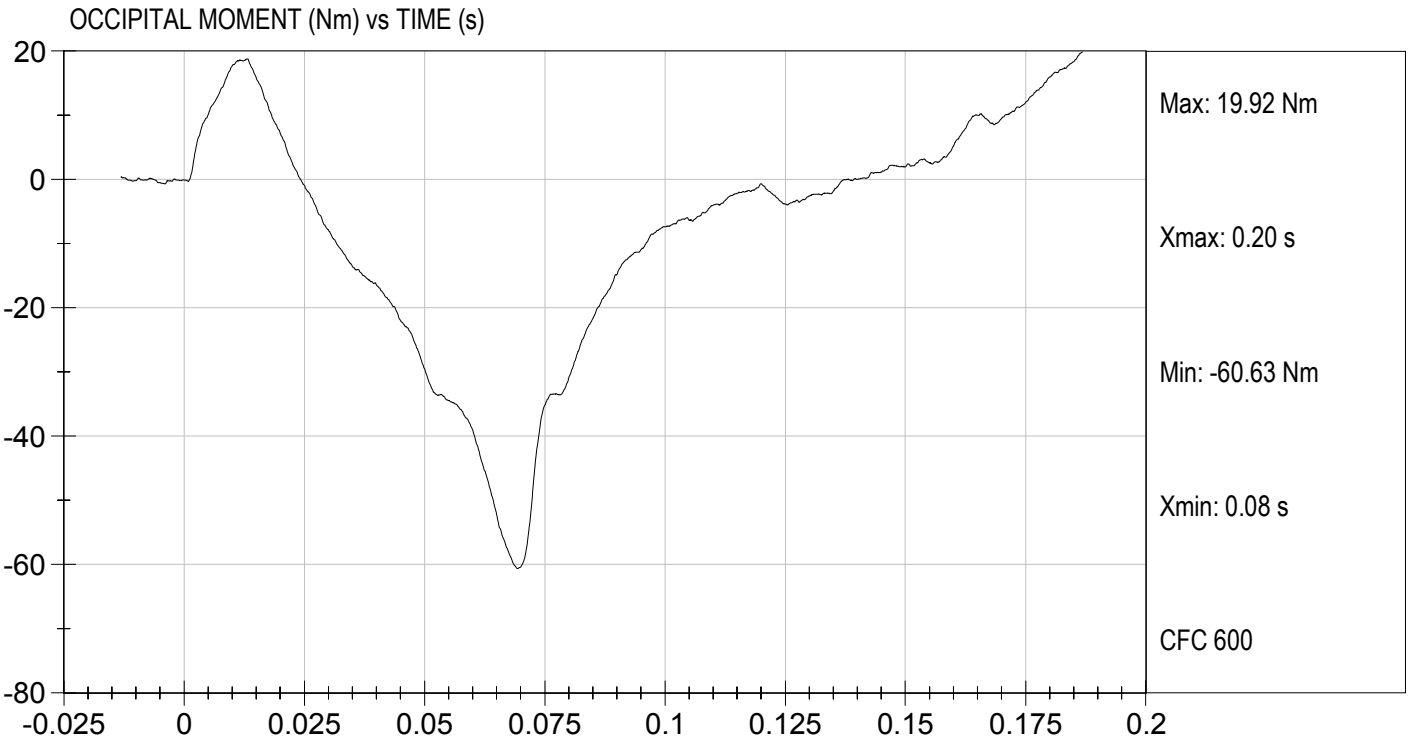



NECK ROTATION (DEG) vs TIME (s)



Test Desc: Neck Extension
Componet ID: D042033

Test Date: 08/30/2004
Velocity: 19.85 ft/s, 6.05 m/s



DATA SHEET B6
THORAX IMPACT TEST (572.134)

Dummy Serial Number __505_____ Test Date __8/31/04_____

Technician ____Joe Fleck_____

__Pretest calibration
_X_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))
_X_ N/A, ONLY one thorax impact test performed
_X_2. The test fixture conforms to the specifications in Figure 11B.
_X_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))
_X_4. The dummy assembly soaked at a temperature between 20.6°C (69ºF) and 22.2°C (72ºF) 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 _21.7_
Record the minimum temperature _20.8_
Record the maximum humidity _56%_
Record the minimum humidity _42%_
_X_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.
_X_ - 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 ± 0.5º and adjust the pelvis angle to 7º ± 2º. 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 ± 1º. (572.134(c)(3))

_X_ 9. The longitudinal centerline of the test probe is centered within ±2.5 mm of the midsagittal plane of the dummy and is 12.7 mm ± 1mm below the horizontal peripheral centerline of the No. 3 rib and is within 0.5º 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 ± 2º 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 2º 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 ± 0.12m/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 m/s ≤ speed ≤ 6.83 m/s | 6.78 m/s |
| Chest Compression | 50.0 mm ≤ compression ≤ 58.0 mm | 54.8 mm |
| Peak force** between 50.0 and 58.0 mm chest compression | 3900N ≤ peak force ≤ 4400N | 4287 N |
| Peak force** between 18.0 and 50.0 mm chest compression | peak force ≤ 4600 N | Yes |
| Internal Hysteresis*** | 69% ≤ hysteresis ≤ 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.

Signature _____ Date 8/31/04

**MGA RESEARCH CORPORATION**

**THORAX IMPACT**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 505 **Test I.D:** D042034

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Temperature | deg C | 20.6 to 22.2 | 21.4 | Pass |
| Relative Humidity | % | 10 to 70 | 49 | Pass |
| Probe Speed | m/s | 6.59 to 6.83 | 6.78 | Pass |
| Peak Deflection | mm | 50 to 58 | 54.8 | Pass |
| Peak Resistive Force w/in Deflection Corridor | kN | 3.9 to 4.4 | 4.3 | Pass |
| Internal Hysteresis | % | 69 to 85 | 70 | Pass |
| Peak Force 18 mm - 50 mm | N | < 4600 N | 4,287 | Pass |
| | | Overall Test Results | | Pass |

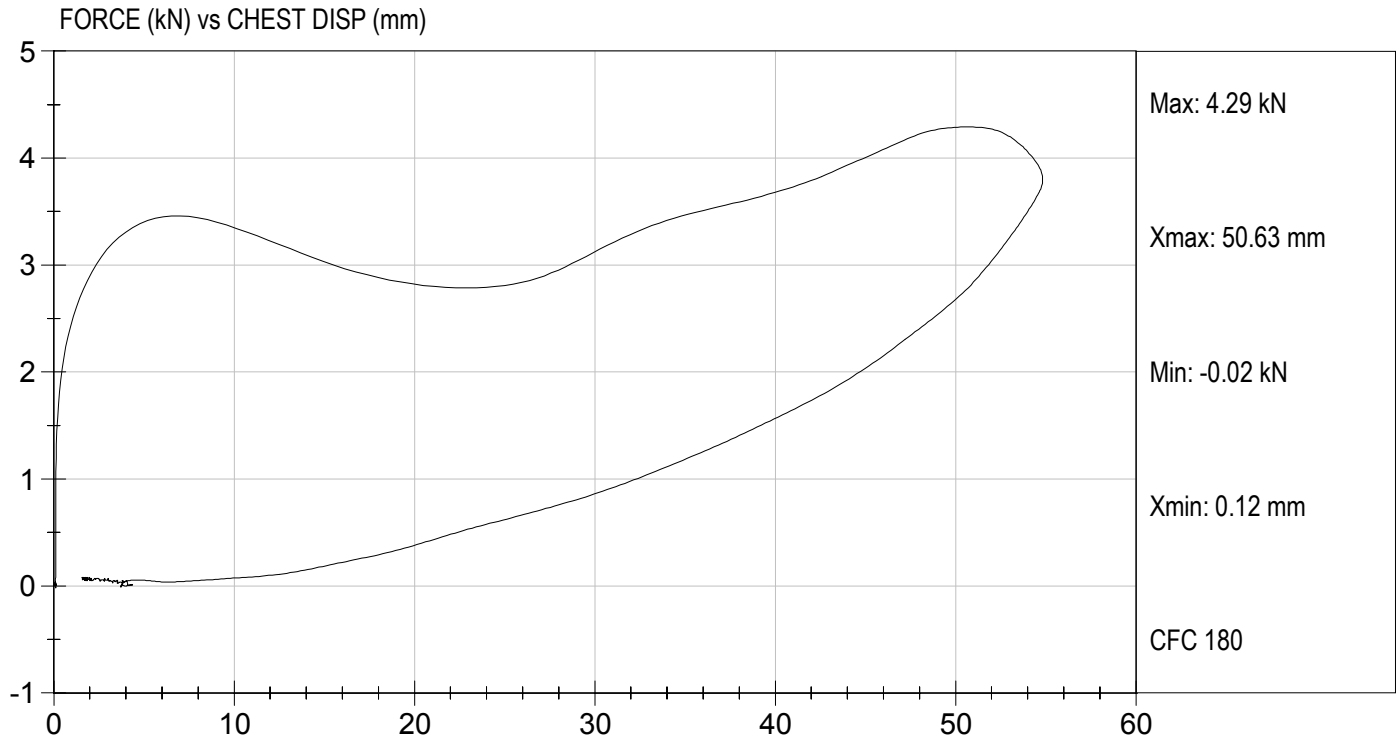
James Carney
Laboratory Technician

08/31/2004
Test Date

Jeff Leonardelli
Approved By

Test Desc: Thorax Impact
Componet ID: D042034

Test Date: 08/31/2004
Velocity: 22.26 ft/s, 6.78 m/s



DATA SHEET B7
TORSO FLEXION TEST (572.135)

Dummy Serial Number __505_____ Test Date __8/30/04_____

Technician _____Joe Fleck_____

__Pretest calibration
_X_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))
_X_ N/A, ONLY one thorax impact test performed
_X_2. The test fixture conforms to the specifications in Figure 13B.
_X_3. The complete assembled dummy (880105-000) is used (572.135(c)(2)).
__ with legs below the femurs.
_X_ without legs below the femurs.
_X_4. The dummy assembly soaked at a temperature between 18.9°C (66ºF) and 25.6°C (78ºF) 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 __21.9__
Record the minimum temperature __20.9__
Record the maximum humidity __52%__
Record the minimum humidity __42%__
_X_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))
_X_6. Attach the loading adapter bracket to the spine of the dummy as shown in Figure 13B**.** (572.135(c)(4))
_X_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))
_X_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°)___$15^0$___
_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° | 15° |
| Torso rotation rate | 0.5°/s ≤ rate ≤ 1.5°/s | 1.0 |
| Force at 45° ±0.5° | 320 N ≤ force ≤ 390 N | 387 N |
| Final ref. plane angle | Initial ref. plane angle ±8° | 17° |

Joe Fleck
Signature

8/30/04
Date

**MGA RESEARCH CORPORATION**

**TORSO FLEXION TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 505 **Test I.D:** D042037

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 - 25.6 | 21.7 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 46 | Pass |
| Initial Angle | deg | 0 to 20 | 15 | Pass |
| Return Angle | deg | +/- 8 | 17 | Pass |
| Force at 45 deg | N | 320 to 390 | 387 | Pass |
| Upper Torso Deflection Rate | Deg/sec | 0.5 - 1.5 | 1.0 | Pass |
| | | Overall Result | | Pass |

Joe Fleck
Laboratory Technician

08/30/2004
Test Date

Jeff Levandowski
Approved By

DATA SHEET B8
LEFT KNEE IMPACT TEST (572.136)

Dummy Serial Number __505_____ Test Date __8/30/04_____

Technician ____Joe Fleck_____

__Pretest calibration
_X_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))
_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 (66ºF) and 25.6°C (78ºF) 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 _21.9__
Record the minimum temperature _20.9__
Record the maximum humidity _52%__
Record the minimum humidity _42%__
_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 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 m/s ≤ speed ≤ 2.13 m/s | 2.12 m/s |
| Peak resistance force* | 3450 N ≤ force ≤ 4060 N | 3860 N |

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

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

Joe Fleck
Signature

8/30/04
Date

**MGA RESEARCH CORPORATION**

**LEFT KNEE IMPACT TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 505 **Test I.D:** D042036

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 to 25.5 | 21.8 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 47 | Pass |
| Probe Speed | m/sec | 2.07 to 2.13 | 2.12 | Pass |
| Maximum Force | kN | 3.45 to 4.06 | 3.86 | Pass |
| | | Overall Test Results | | Pass |

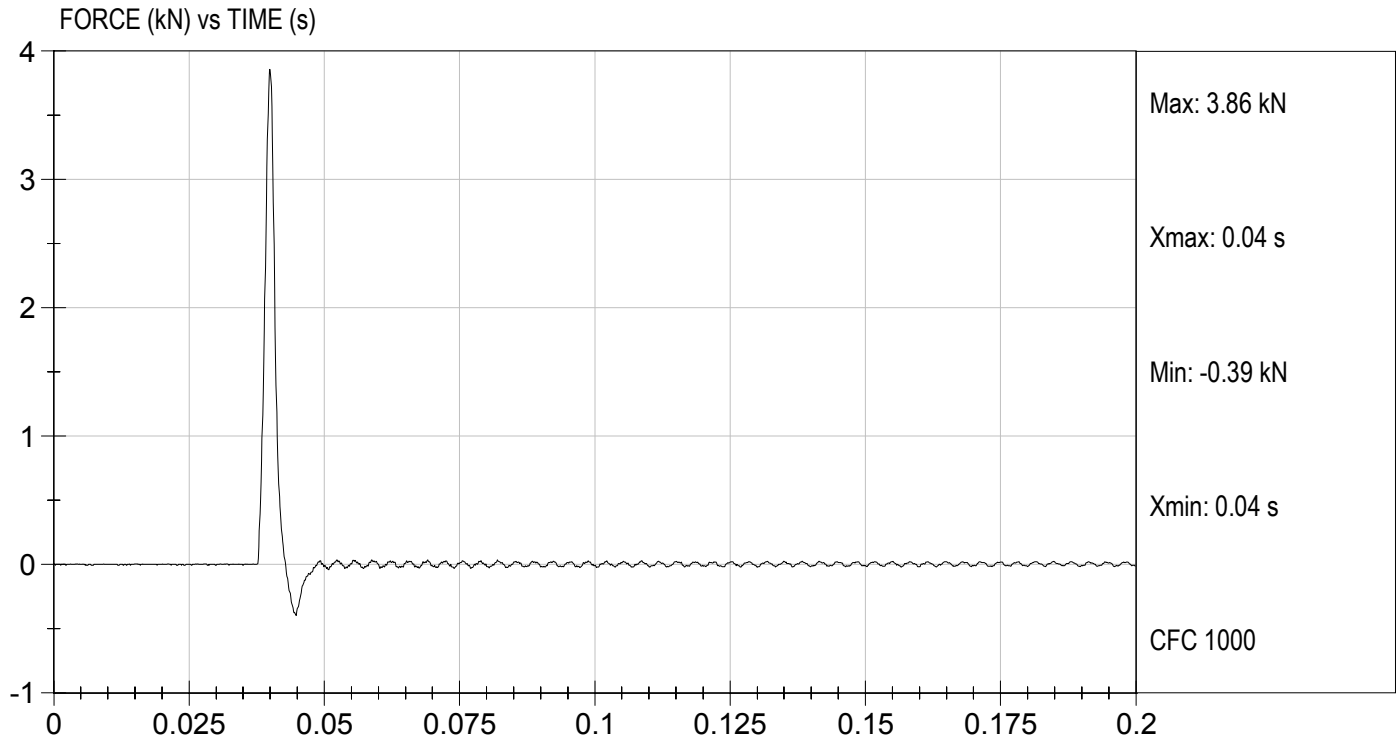
Joe Fleck
Laboratory Technician

08/30/2004
Test Date

Jeff Levandoski
Approved By

Test Desc: Left Knee
Componet ID: D042036

Test Date: 08/30/2004
Velocity: 6.96 ft/s, 2.12 m/s



DATA SHEET B9
RIGHT KNEE IMPACT TEST (572.136)

Dummy Serial Number ___505_____ Test Date __8/30/04_____

Technician ___Joe Fleck_____

__Pretest calibration
_X_Post test calibration verification

Test attempt no. _2__ (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))
__ 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 (880105-528R), 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))
_X_4. The knee assembly soaked at a temperature between 18.9°C (66ºF) and 25.6°C (78ºF) 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 _21.9___
Record the minimum temperature _20.9___
Record the maximum humidity _52 %___
Record the minimum humidity _42 %___
_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 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))
_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 m/s ≤ speed ≤ 2.13 m/s | 2.10 m/s |
| Peak resistance force* | 3450 N ≤ force ≤ 4060 N | 3650 N |

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

_X_12. Plots of acceleration versus time and force versus time follow this sheet.

Signature

8/30/04
Date

**MGA RESEARCH CORPORATION**

**RIGHT KNEE IMPACT TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 505 **Test I.D:** D042035

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 to 25.5 | 21.8 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 47 | Pass |
| Probe Speed | m/sec | 2.07 to 2.13 | 2.10 | Pass |
| Maximum Force | kN | 3.45 to 4.06 | 3.65 | Pass |
| | | Overall Test Results | | Pass |

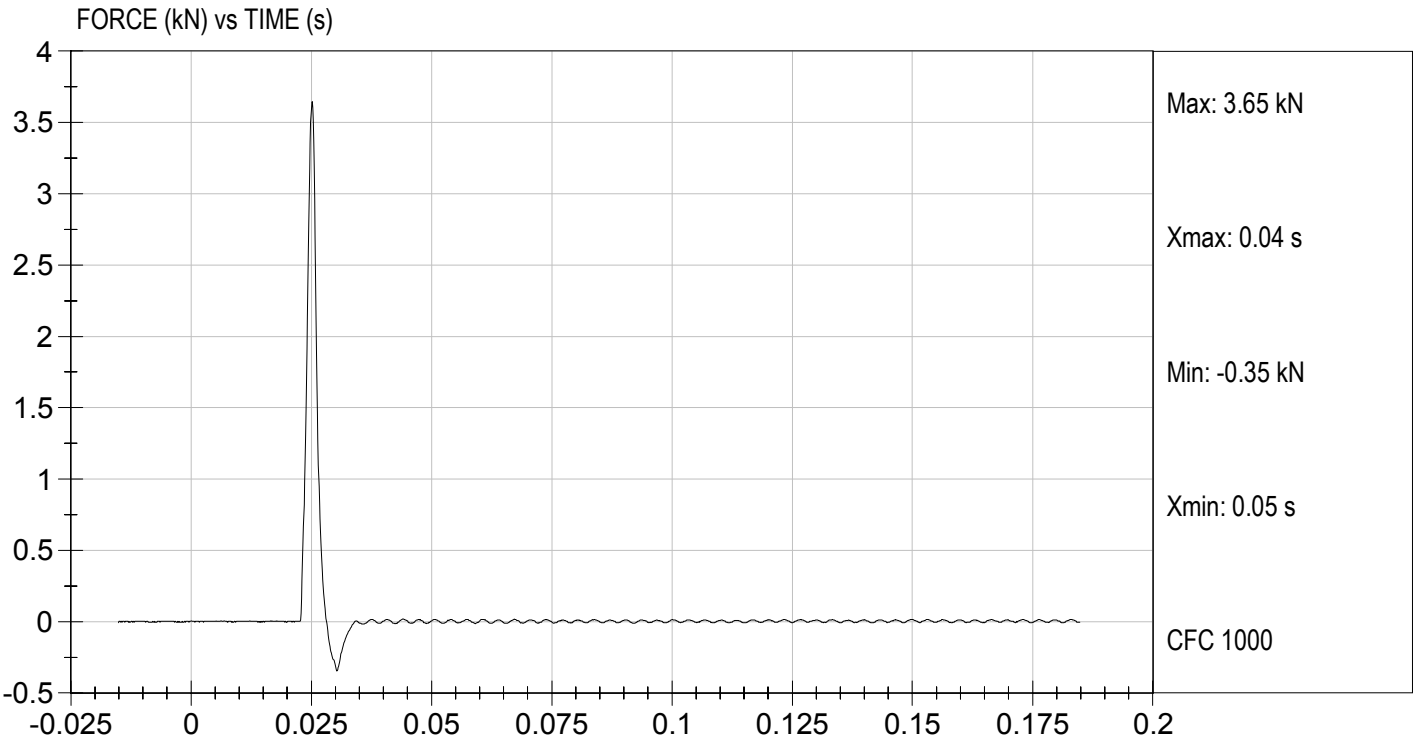
Laboratory Technician

08/30/2004
Test Date

Approved By

Test Desc: Right Knee
Componet ID: D042035

Test Date: 08/30/2004
Velocity: 6.9 ft/s, 2.10 m/s



DATA SHEET B1
DUMMY DAMAGE CHECKLIST

Dummy Serial Number ____505_____ Test Date ___8/27/04_____

Technician _____Jessica Gall_____

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

_X_ Perform general cleaning.

| Dummy Item | Inspect for | Comments | Damaged | 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 |

| Dummy Item | Inspect for | Comments | Damaged | OK |
|---|---|---|---|---|
| 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 _____ 8/30/04_____
Signature Date

Describe the repair or replacement of parts:

Checked by

Jeff Leonardelli _____ 8/30/04_____
Signature Date

## EXTERNAL DIMENSIONS

| SN505, HYBRID III, 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 | 783.4 |
| B | SHOULDER PIVOT HEIGHT | Centerline of shoulder pivot bolt to the seat surface. | 431.8-457.2 | 438.0 |
| C | H-POINT HEIGHT | Reference | 81.3-86.3 | 84.2 |
| D | H-POINT LOCATION FROM BACKLINE | Reference | 144.8-149.8 | 147.3 |
| E | SHOULDER PIVOT FROM BACKLINE | Center of the shoulder clevis to the rear vertical surface of the fixture. | 68.6-83.8 | 76.4 |
| F | THIGH CLEARANCE | Measured at the highest point on the upper femur segment. | 119.4-134.6 | 124.3 |
| 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 | 250.3 |
| H | HEAD BACK TO BACKLINE | Back of skull cap skin to seat rear vertical surface (Reference) | 43.2-48.2 | 46.7 |
| 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 | 283.4 |
| J | ELBOW REST HEIGHT | Measure from the flesh below the elbow pivot bolt to the seat surface. | 182.8-203.2 | 187.3 |
| 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 | 532.4 |
| L | POPLITEAL HEIGHT | Seat surface to the plane of the horizontal plane of the bottom of the feet. | 355.6-376.0 | 362.3 |
| M | KNEE PIVOT HEIGHT | Centerline of knee pivot bolt to the horizontal plane of the bottom of the feet. | 393.7-419.1 | 405.2 |
| 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”. | 414-439.4 | 421.6 |

| SN505, HYBRID III, 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 | 182.4 |
| P | FOOT LENGTH | Tip of toe to rear of heal | 218.5-233.7 | 224.7 |
| 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 | 473.7 |
| S | HEAD BREADTH | The widest part of the head | 137.1-147.3 | 144.6 |
| T | HEAD DEPTH | Back of the head to the forehead | 177.8-188.0 | 179.2 |
| U | HIP BREADTH | The widest part of the hip | 299.7-314.9 | 305.7 |
| V | SHOULDER BREADTH | Outside edges of right and left shoulder clevises | 350.5-365.7 | 362.4 |
| W | FOOT BREADTH | The widest part of the foot | 78.8-94.0 | 84.3 |
| X | HEAD CIRCUMFERENCE | Measured at the point as in dim. “T” | 528.3-548.7 | 533.7 |
| Y | CHEST CIRCUMFERENCE (WITH CHEST JACKET) | Measured 345.4 ± 12.7 mm above seat surface | 850.9-881.3 | 863.7 |
| Z | WAIST CIRCUMFERENCE | Measured 165.1 ± 5.1 mm above seat surface | 759.5-789.9 | 773.6 |
| AA | REFERENCE LOCATION FOR MEASUREMENT OF CHEST CIRCUMFERENCE | Reference | 332.7-358.1 | 345.0 |
| BB | REFERENCE LOCATION FOR MEASUREMENT OF WAIST CIRCUMFERENCE | Reference | 160.1-170.2 | 165.0 |

## EXTERNAL DIMENSIONS

| SN506, HYBRID III, 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 | 780.2 |
| B | SHOULDER PIVOT HEIGHT | Centerline of shoulder pivot bolt to the seat surface. | 431.8-457.2 | 443.0 |
| C | H-POINT HEIGHT | Reference | 81.3-86.3 | 85.1 |
| D | H-POINT LOCATION FROM BACKLINE | Reference | 144.8-149.8 | 145.0 |
| E | SHOULDER PIVOT FROM BACKLINE | Center of the shoulder clevis to the rear vertical surface of the fixture. | 68.6-83.8 | 76.4 |
| F | THIGH CLEARANCE | Measured at the highest point on the upper femur segment. | 119.4-134.6 | 128.0 |
| G | BACK OF ELBOW TO WRIST PIVOT | Back of the elbow flesh to the wrist pivot in line with the elbow and wrist pivots | 243.9-259.1 | 255.8 |
| 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 | 280.2 |
| J | ELBOW REST HEIGHT | Measure from the flesh below the elbow pivot bolt to the seat surface. | 182.8-203.2 | 193.0 |
| 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 | 545.0 |
| L | POPLITEAL HEIGHT | Seat surface to the plane of the horizontal plane of the bottom of the feet. | 355.6-376.0 | 365.2 |
| M | KNEE PIVOT HEIGHT | Centerline of knee pivot bolt to the horizontal plane of the bottom of the feet. | 393.7-419.1 | 400.5 |
| 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”. | 414-439.4 | 438.0 |

| SN506, HYBRID III, 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 | 183.0 |
| P | FOOT LENGTH | Tip of toe to rear of heal | 218.5-233.7 | 226.2 |
| 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 | 475.8 |
| S | HEAD BREADTH | The widest part of the head | 137.1-147.3 | 142.0 |
| T | HEAD DEPTH | Back of the head to the forehead | 177.8-188.0 | 180.5 |
| U | HIP BREADTH | The widest part of the hip | 299.7-314.9 | 305.1 |
| V | SHOULDER BREADTH | Outside edges of right and left shoulder clevises | 350.5-365.7 | 359.0 |
| W | FOOT BREADTH | The widest part of the foot | 78.8-94.0 | 85.5 |
| X | HEAD CIRCUMFERENCE | Measured at the point as in dim. “T” | 528.3-548.7 | 538.0 |
| Y | CHEST CIRCUMFERENCE (WITH CHEST JACKET) | Measured 345.4 ± 12.7 mm above seat surface | 850.9-881.3 | 857.6 |
| Z | WAIST CIRCUMFERENCE | Measured 165.1 ± 5.1 mm above seat surface | 759.5-789.9 | 789.0 |
| AA | REFERENCE LOCATION FOR MEASUREMENT OF CHEST CIRCUMFERENCE | Reference | 332.7-358.1 | 345.0 |
| BB | REFERENCE LOCATION FOR MEASUREMENT OF WAIST CIRCUMFERENCE | Reference | 160.1-170.2 | 165.0 |

DATA SHEET B3
HEAD DROP TEST (572.132)

Dummy Serial Number 506 Test Date 8/20/04

Technician Joe Fleck

_X_Pretest 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))
__X_ N/A, ONLY one head drop performed
_X_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))
_X_3. The head accelerometer mounting plate screws ((10-24 x 3/8 SHCS) are torqued to 9.0 Nm.
_X_4. Accelerometers and their respective mounts are smooth and clean.
_X_5. Torque the skull cap screws (10-24 x 1/2 SHCS) to 9.0 Nm.
_X_6. The data acquisition system, including transducers, conforms to the requirements of SAE Recommended Practice J211/1 MAR95. (572.136(m))
_X_7. The head assembly soaked at a temperature between 18.9°C (66ºF) and 25.6°C (78ºF) 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 22.1
Record the minimum temperature 21.4
Record the maximum humidity 44%
Record the minimum humidity 42%
_X_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 ± 1.0 mm (14.8±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 __502mm_____
Record the left side distance __501mm_____

_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 __$656 \times 10^{-6}$mm_____

_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 ± 1.0 mm (14.8 inches ± 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 g ≤ x ≤ 300 g | 263 |
| 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 ≤ 15 g | 11 |

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

Ian Fleck
Signature

8/20/04
Date

**MGA RESEARCH CORPORATION**

**HEAD DROP TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 506 **Test ID:** D041971

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 - 25.6 | 22.1 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 43 | Pass |
| Peak Resultant Acceleration | G's | 250 - 300 | 263 | Pass |
| Peak Lateral Acceleration | G's | +/- 15 | 11.5 | Pass |
| Unimodal | Yes/No | NA | Yes | Pass |
| Oscillations | Yes/No | within 10% of peak | Yes | Pass |
| | | Overall Test Results | | Pass |

Laboratory Technician

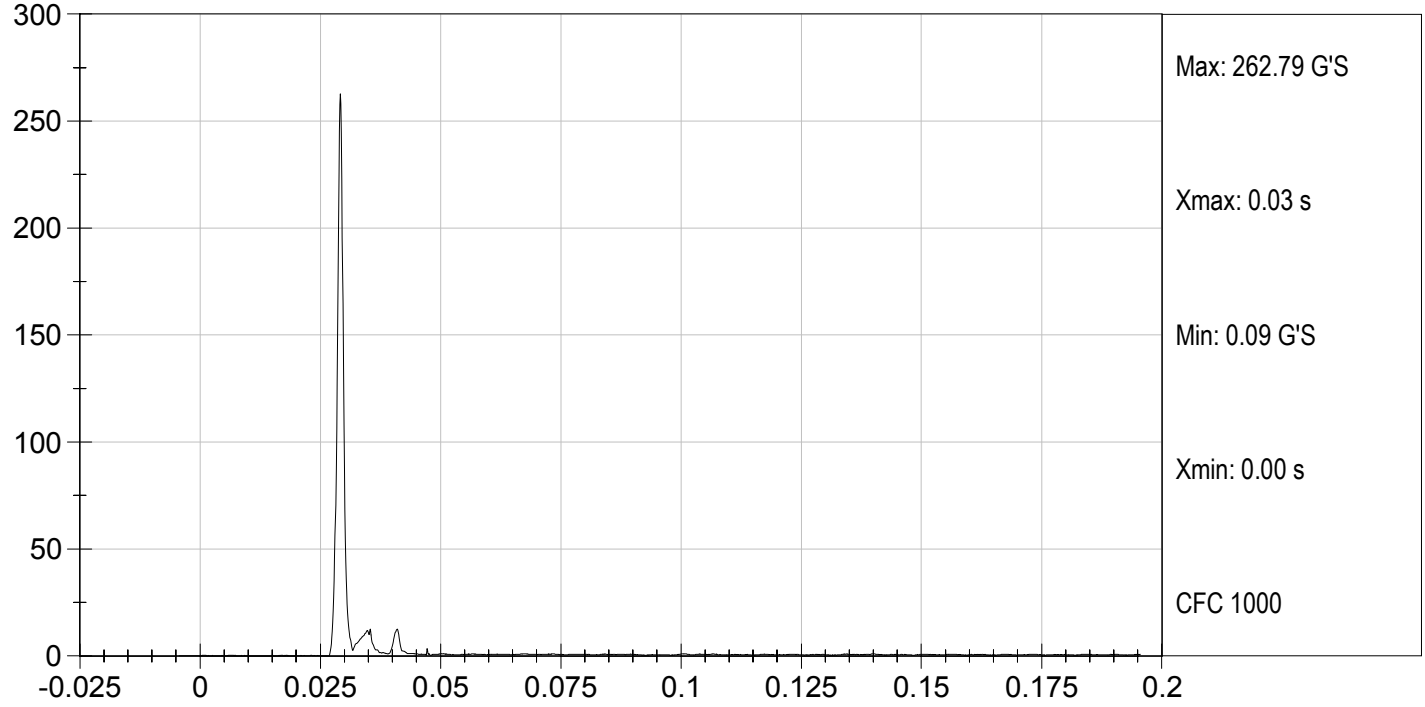
08/20/2004
Test Date

Approved By

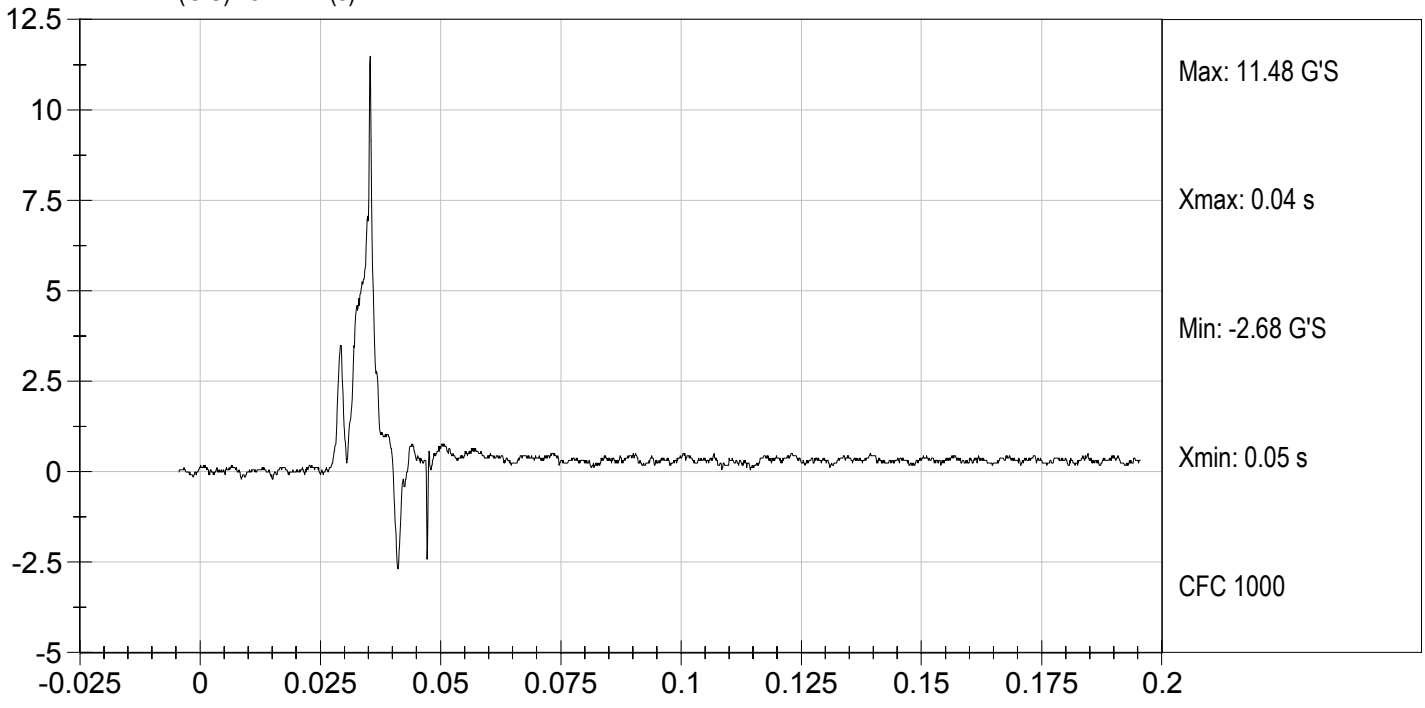
Test Desc: Head Drop
Componet ID: D041971

Test Date: 08/20/2004
Velocity: 0 ft/s, 6.73 m/s

PEAK RESULTANT ACCELERATION (G'S) vs TIME (s)




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



DATA SHEET B4
NECK FLEXION TEST (572.133)

Dummy Serial Number ____506_____ Test Date ____8/20/04_____

Technician ____Joe Fleck_____

_X_Pretest 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))
_X_ N/A, ONLY one flexion test performed

_X_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))

_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. (572.133(c)(1))
Record the maximum temperature __22.1__
Record the minimum temperature __21.4__
Record the maximum humidity __44%__
Record the minimum humidity __42%__

_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. (880105-250 and PADI page17).
Record findings and actions: __No Deterioration. Hardness Front 89; Back 90.

_X_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 ± 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 | Result |
|---|---|---|---|
| Pendulum impact speed | | 6.89 m/s ≤ speed ≤ 7.13 m/s | 6.99 m/s |
| Pendulum ΔV with respect to impact speed | @ 10ms | 2.1 m/s ≤ ΔV ≤ 2.5 m/s | 2.2 m/s |
| | @ 20 ms | 4.0 m/s ≤ ΔV ≤ 5.0 m/s | 4.3 m/s |
| | @30ms | 5.8 m/s ≤ ΔV ≤ 7.0 m/s | 6.1 m/s |
| Plane D Rotation | | Peak moment*<br>69 Nm ≤ moment ≤ 83 Nm during the following rotation range 77° ≤ angle ≤ 91° | __77__ Nm @ __80__ degrees |
| Positive Moment Decay** (Flexion) | | Time to decay to 10 Nm<br>80 ms ≤ time ≤ 100ms | 88 ms |

*Moment about the occipital condyle = $M_y$ – (0.01778 m x $F_x$) (572.133(b)(1)(ii))

My = Moment in Nm measured by the transducer

Fx = 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.

Joe Fleck
Signature

8/20/04
Date

**MGA RESEARCH CORPORATION**

**NECK FLEXION TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 506 **Test I.D:** D041972

| 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 | 42 | Pass |
| Pendulum Speed | | m/sec | 6.89 to 7.13 | 6.99 | Pass |
| Pendulum Deceleration | 10 msec | m/sec | 2.1 to 2.5 | 2.2 | Pass |
| | 20 msec | m/sec | 4.0 to 5.0 | 4.3 | Pass |
| | 30 msec | m/sec | 5.8 to 7.0 | 6.1 | Pass |
| D Plane Rotation | Max | deg | 77 to 91 | 80 | Pass |
| Occipital Condyle Moment within Deflection Corridor | | Nm | 69 to 83 | 77 | Pass |
| Positive Moment Time Curve Decay to 10 Nm | | msec | 80 to 100 | 88 | Pass |
| | | | Overall Results | | Pass |

Laboratory Technician

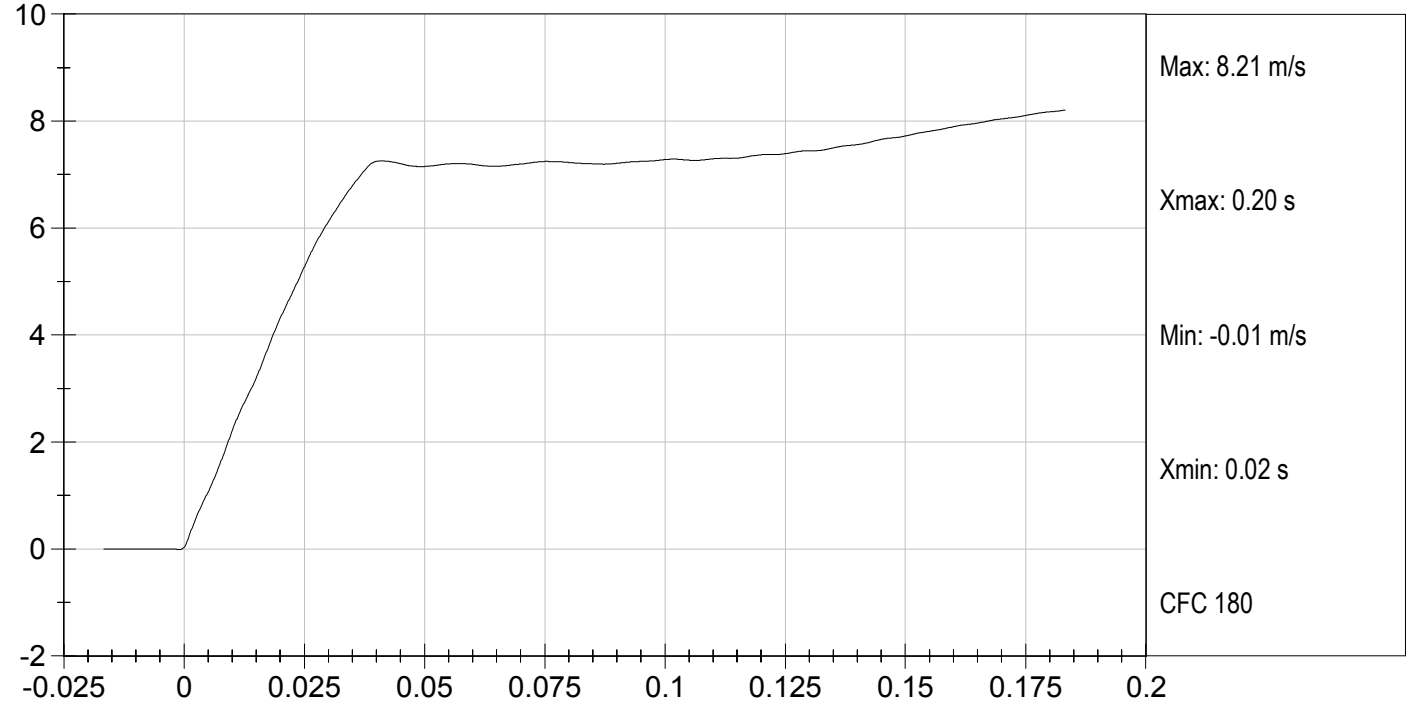
08/20/2004
Test Date

Approved By

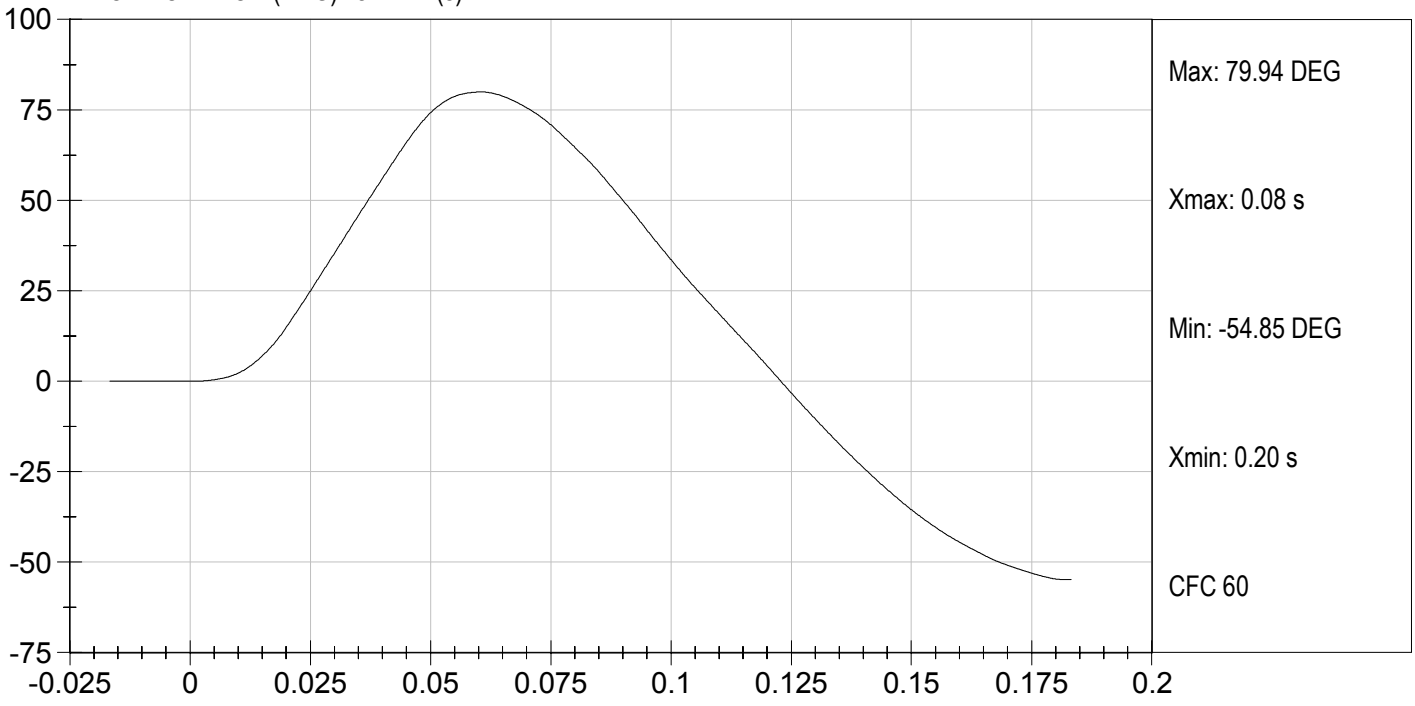
Test Desc: Neck Flexion
Componet ID: D041972

Test Date: 08/20/2004
Velocity: 22.92 ft/s, 6.99 m/s

PENDULUM DECELERATION (m/s) vs TIME (s)

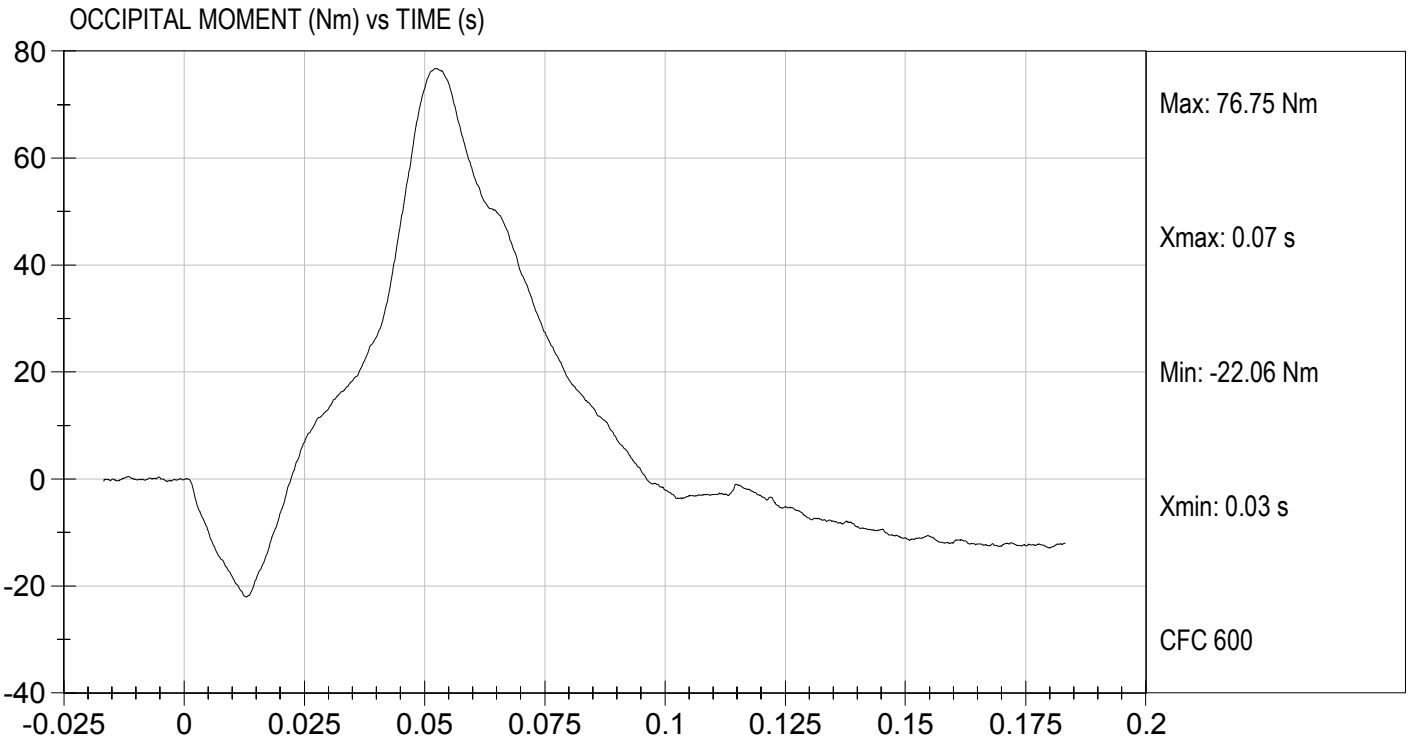



NECK ROTATION (DEG) vs TIME (s)



Test Desc: Neck Flexion
Componet ID: D041972

Test Date: 08/20/2004
Velocity: 22.92 ft/s, 6.99 m/s



DATA SHEET B5
NECK EXTENSION TEST (572.133)

Dummy Serial Number ____506_____ Test Date ___8/20/04_____

Technician _____Joe Fleck_____

_X_Pretest 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))
_X_ N/A, ONLY one extension test performed

_X_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))

_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. (572.133(c)(1))
Record the maximum temperature __22.1___
Record the minimum temperature __21.4___
Record the maximum humidity __44%__
Record the minimum humidity __42%__

_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. (880105-250 and PADI page17).
Record findings and actions: __No Deterioration. Hardness Front 89; Back 90.

_X_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 ± 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 | Result |
|---|---|---|---|
| Pendulum impact speed | | 5.95 m/s ≤ speed ≤ 6.19 m/s | 6.04 m/s |
| Pendulum ΔV with respect to impact speed | @ 10ms | 1.5 m/s ≤ ΔV ≤ 1.9 m/s | 1.8 m/s |
| | @ 20 ms | 3.1 m/s ≤ ΔV ≤ 3.9 m/s | 3.7 m/s |
| | @30ms | 4.6 m/s ≤ ΔV ≤ 5.6 m/s | 5.3 m/s |
| Plane D Rotation | | Peak moment*<br>-65 Nm ≤ moment ≤ -53 Nm during the following rotation range $99^o$ ≤ angle ≤ $114^o$ | _-55_ Nm @ _109_ degrees |
| Negative Moment Decay** (Extension) | | Time to decay to -10 Nm<br>94 ms ≤ time ≤ 114 ms | 99 ms |

*Moment about the occipital condyle = $M_y$ – (0.01778 m x $F_x$) (572.133(b)(1)(ii)

My = Moment in Nm measured by the transducer

Fx = 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.

Joe Fleck _____ 8/20/04

Signature Date

**MGA RESEARCH CORPORATION**

**NECK EXTENSION TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 506 **Test I.D:** D041973

| 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 | 43 | Pass |
| Pendulum Speed | | m/sec | 5.95 to 6.19 | 6.04 | Pass |
| Pendulum Deceleration | 10 msec | m/sec | 1.5 to 1.9 | 1.8 | Pass |
| | 20 msec | m/sec | 3.1 to 3.9 | 3.7 | Pass |
| | 30 msec | m/sec | 4.6 to 5.6 | 5.3 | Pass |
| D Plane Rotation | Max | deg | 99 to 114 | 109 | Pass |
| Occipital Condyle Moment within Deflection Corridor | | Nm | -65 to -53 | -55 | Pass |
| Negative Moment Time Curve Decay to -10 Nm | | msec | 94 to 114 | 99 | Pass |
| | | | Overall Results | | Pass |

Laboratory Technician

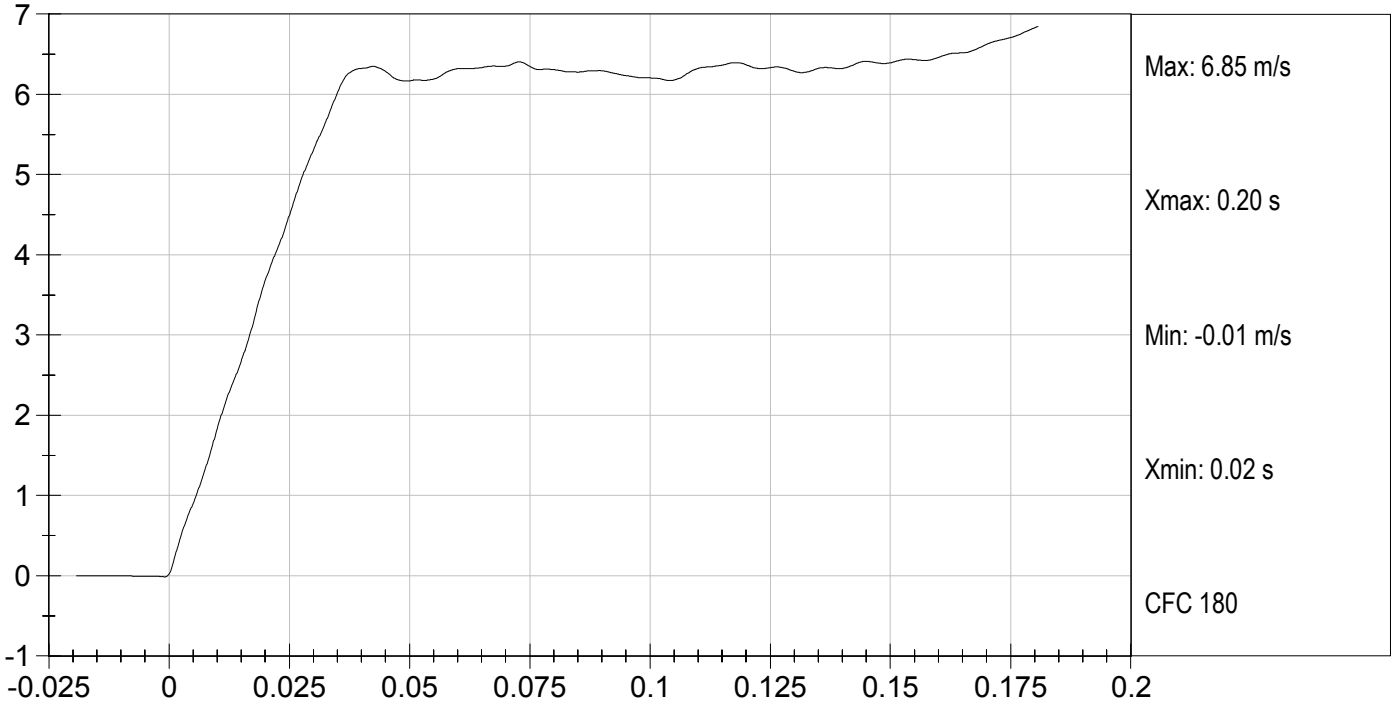
08/20/2004
Test Date

Approved By

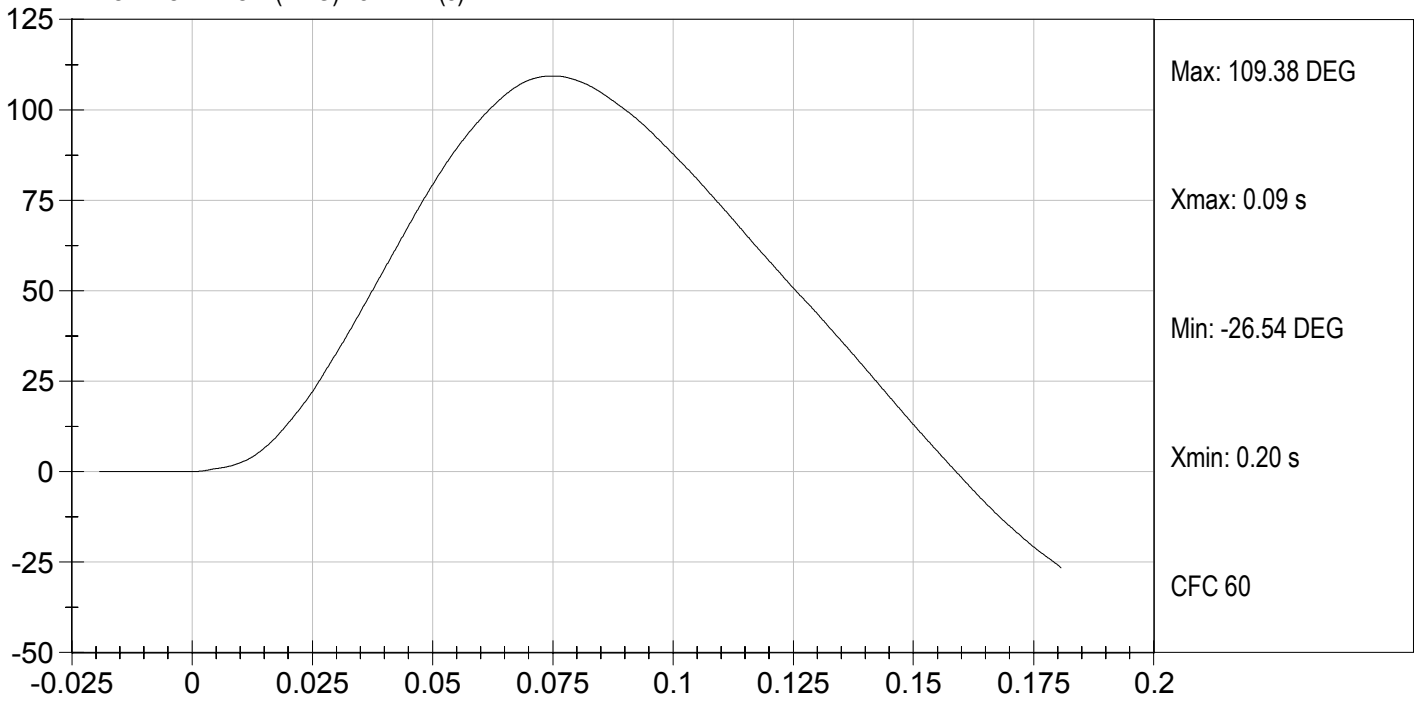
Test Desc: Neck Extension
Componet ID: D041973

Test Date: 08/20/2004
Velocity: 19.8 ft/s, 6.04 m/s

PENDULUM DECELERATION (m/s) vs TIME (s)

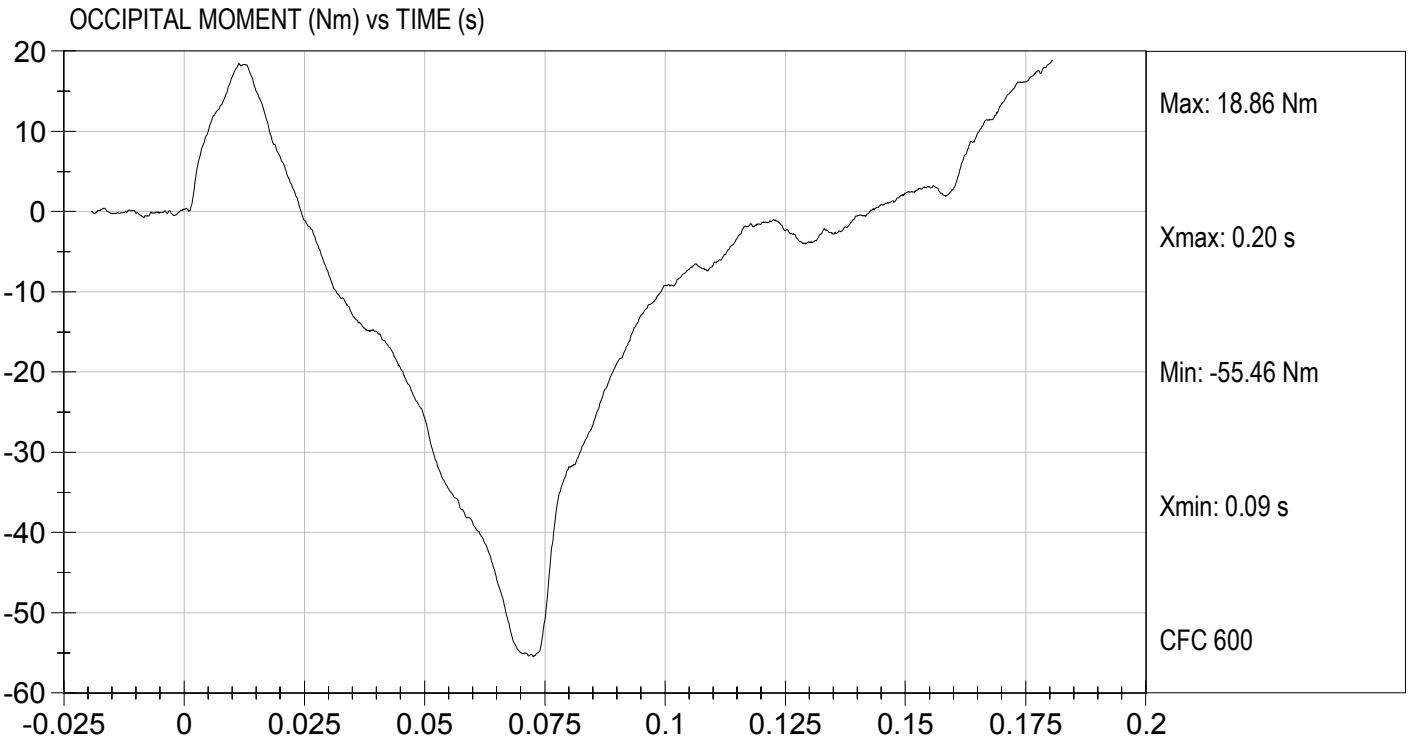



NECK ROTATION (DEG) vs TIME (s)



Test Desc: Neck Extension
Componet ID: D041973

Test Date: 08/20/2004
Velocity: 19.8 ft/s, 6.04 m/s



DATA SHEET B6
THORAX IMPACT TEST (572.134)

Dummy Serial Number __506_____ Test Date __8/20/04_____

Technician ____Joe Fleck_____

_X_Pretest 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))
_X_ N/A, ONLY one thorax impact test performed
_X_2. The test fixture conforms to the specifications in Figure 11B.
_X_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))
_X_4. The dummy assembly soaked at a temperature between 20.6°C (69ºF) and 22.2°C (72ºF) 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 _22.1_
Record the minimum temperature _21.4_
Record the maximum humidity _44%_
Record the minimum humidity _42%_
_X_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.
_X_ - 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 ± 0.5º and adjust the pelvis angle to 7º ± 2º. 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 ± 1º. (572.134(c)(3))

_X_ 9. The longitudinal centerline of the test probe is centered within ±2.5 mm of the midsagittal plane of the dummy and is 12.7 mm ± 1mm below the horizontal peripheral centerline of the No. 3 rib and is within 0.5º 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 ± 2º 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 2º 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 ± 0.12m/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 m/s ≤ speed ≤ 6.83 m/s | 6.61 m/s |
| Chest Compression | 50.0 mm ≤ compression ≤ 58.0 mm | 54 mm |
| Peak force** between 50.0 and 58.0 mm chest compression | 3900N ≤ peak force ≤ 4400N | 4120 N |
| Peak force** between 18.0 and 50.0 mm chest compression | peak force ≤ 4600 N | 4045 N |
| Internal Hysteresis*** | 69% ≤ hysteresis ≤ 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.

Joe Fleck
Signature

8/20/04
Date

**MGA RESEARCH CORPORATION**

**THORAX IMPACT**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 506 **Test I.D:** D041974

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Temperature | deg C | 20.6 to 22.2 | 21.4 | Pass |
| Relative Humidity | % | 10 to 70 | 43 | Pass |
| Probe Speed | m/s | 6.59 to 6.83 | 6.61 | Pass |
| Peak Deflection | mm | 50 to 58 | 54.1 | Pass |
| Peak Resistive Force w/in Deflection Corridor | kN | 3.9 to 4.4 | 4.1 | Pass |
| Internal Hysteresis | % | 69 to 85 | 69 | Pass |
| Peak Force 18 mm - 50 mm | N | < 4600 N | 4,045 | Pass |
| | | Overall Test Results | | Pass |

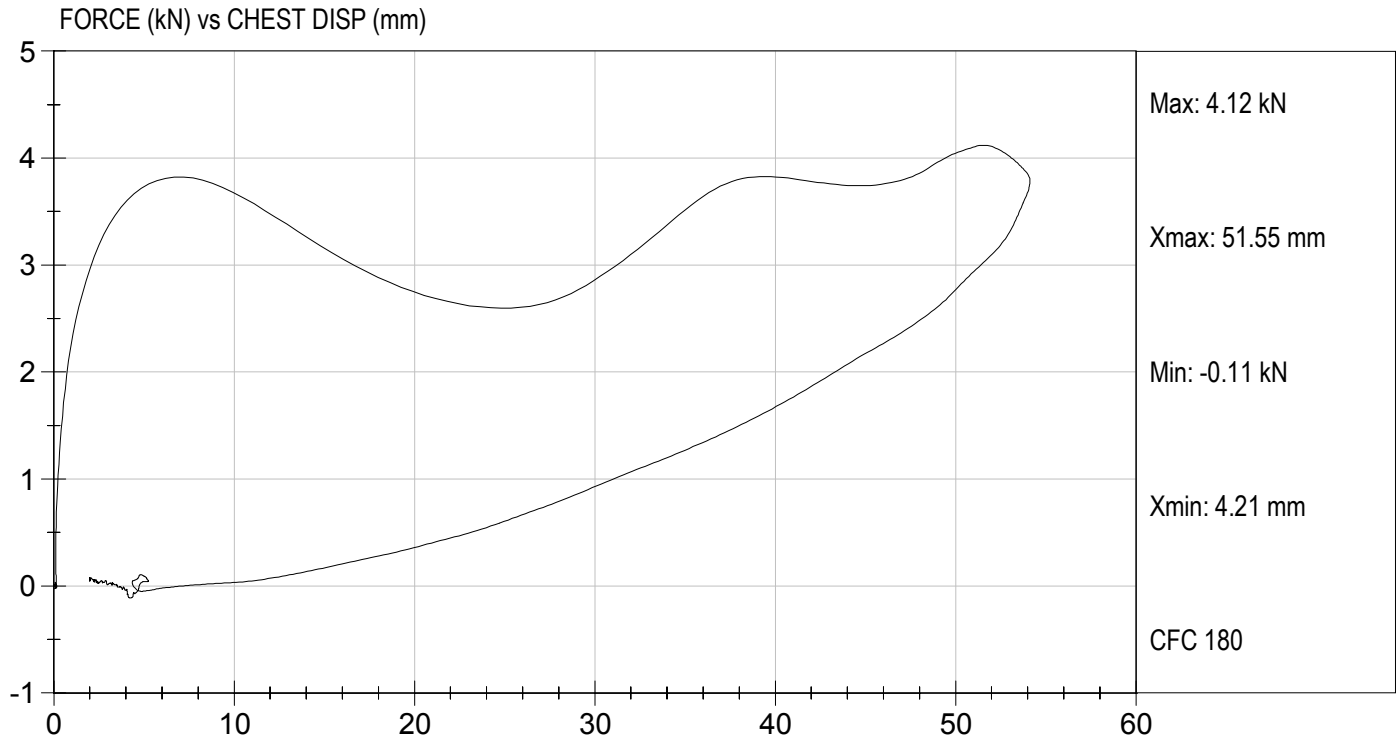
Laboratory Technician

08/20/2004
Test Date

Approved By

Test Desc: Thorax Impact
Componet ID: D041974

Test Date: 08/20/2004
Velocity: 21.69 ft/s, 6.61 m/s



DATA SHEET B7
TORSO FLEXION TEST (572.135)

Dummy Serial Number __506_____ Test Date __8/20/04_____

Technician _____Joe Fleck_____

_X_Pretest calibration
__Post test calibration verification

Test attempt no. __2__ (when successive torso flexion tests are necessary)

_X_1. It has been at least 30 minutes since the last torso flexion test. (572.137(q))
__ N/A, ONLY one thorax impact test performed
_X_2. The test fixture conforms to the specifications in Figure 13B.
_X_3. The complete assembled dummy (880105-000) is used (572.135(c)(2)).
__ with legs below the femurs.
_X_ without legs below the femurs.
_X_4. The dummy assembly soaked at a temperature between 18.9°C (66ºF) and 25.6°C (78ºF) 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 __22.1__
Record the minimum temperature __21.4__
Record the maximum humidity __44%__
Record the minimum humidity __42%__
_X_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))
_X_6. Attach the loading adapter bracket to the spine of the dummy as shown in Figure 13B**.** (572.135(c)(4))
_X_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))
_X_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°)__16°__
_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° |
| Torso rotation rate | 0.5°/s ≤ rate ≤ 1.5°/s | 1.0 |
| Force at 45° ±0.5° | 320 N ≤ force ≤ 390 N | 324 N |
| Final ref. plane angle | Initial ref. plane angle ±8° | 20° |

Joe Fleck
Signature

8/20/04
Date

**MGA RESEARCH CORPORATION**

**TORSO FLEXION TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 506 **Test I.D:** D041977

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 - 25.6 | 21.4 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 44 | Pass |
| Initial Angle | deg | 0 to 20 | 16 | Pass |
| Return Angle | deg | +/- 8 | 20 | Pass |
| Force at 45 deg | N | 320 to 390 | 324 | Pass |
| Upper Torso Deflection Rate | Deg/sec | 0.5 - 1.5 | 1.0 | Pass |
| | | Overall Result | | Pass |

Laboratory Technician

08/20/2004
Test Date

Approved By

DATA SHEET B8
LEFT KNEE IMPACT TEST (572.136)

Dummy Serial Number __506_____ Test Date __8/20/04_____

Technician ____Joe Fleck_____

_X_Pretest 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))
_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 (66ºF) and 25.6°C (78ºF) 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 __22.1__
Record the minimum temperature __21.4__
Record the maximum humidity __44%__
Record the minimum humidity __42%__
_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 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 m/s ≤ speed ≤ 2.13 m/s | 2.12 m/s |
| Peak resistance force* | 3450 N ≤ force ≤ 4060 N | 3610 N |

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

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

Joe Fleck
Signature

8/20/04
Date

**MGA RESEARCH CORPORATION**

**LEFT KNEE IMPACT TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 506 **Test I.D:** D041976

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 to 25.5 | 21.7 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 42 | Pass |
| Probe Speed | m/sec | 2.07 to 2.13 | 2.12 | Pass |
| Maximum Force | kN | 3.45 to 4.06 | 3.61 | Pass |
| | | Overall Test Results | | Pass |

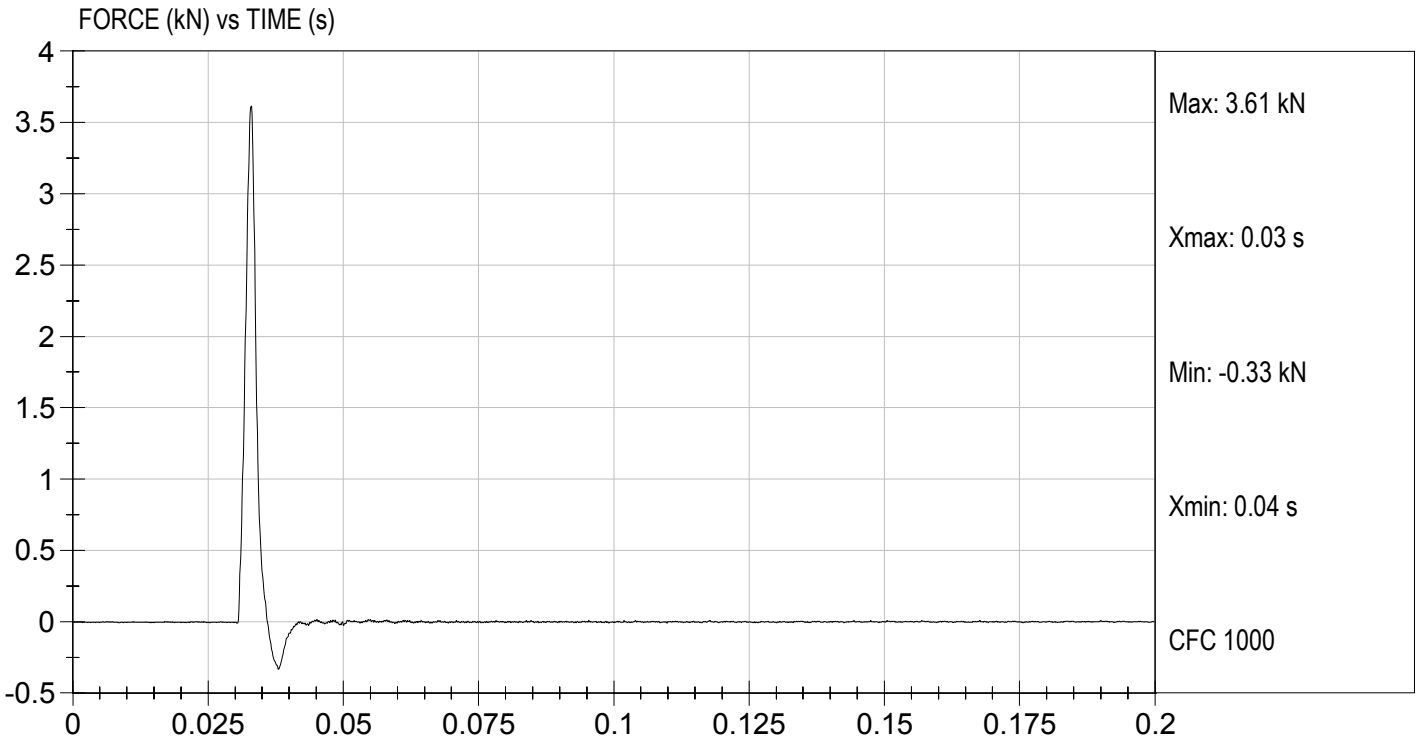
Joe Fleck
Laboratory Technician

08/20/2004
Test Date

Jeff Levandoski
Approved By

Test Desc: Left Knee
Componet ID: D041976

Test Date: 08/20/2004
Velocity: 6.94 ft/s, 2.12 m/s



DATA SHEET B9
RIGHT KNEE IMPACT TEST (572.136)

Dummy Serial Number ___506_____ Test Date __8/20/04_____

Technician ___Joe Fleck_____

_X_Pretest 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))
_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 (880105-528R), 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))
_X_4. The knee assembly soaked at a temperature between 18.9°C (66ºF) and 25.6°C (78ºF) 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 _22.1___
Record the minimum temperature _21.4___
Record the maximum humidity _44 %___
Record the minimum humidity _42 %___
_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 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))
_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 m/s ≤ speed ≤ 2.13 m/s | 2.11 m/s |
| Peak resistance force* | 3450 N ≤ force ≤ 4060 N | 3470 N |

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

_X_12. Plots of acceleration versus time and force versus time follow this sheet.

Signature

8/20/04
Date

**MGA RESEARCH CORPORATION**

**RIGHT KNEE IMPACT TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 506 **Test I.D:** D041975

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 to 25.5 | 21.9 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 42 | Pass |
| Probe Speed | m/sec | 2.07 to 2.13 | 2.11 | Pass |
| Maximum Force | kN | 3.45 to 4.06 | 3.47 | Pass |
| | | Overall Test Results | | Pass |

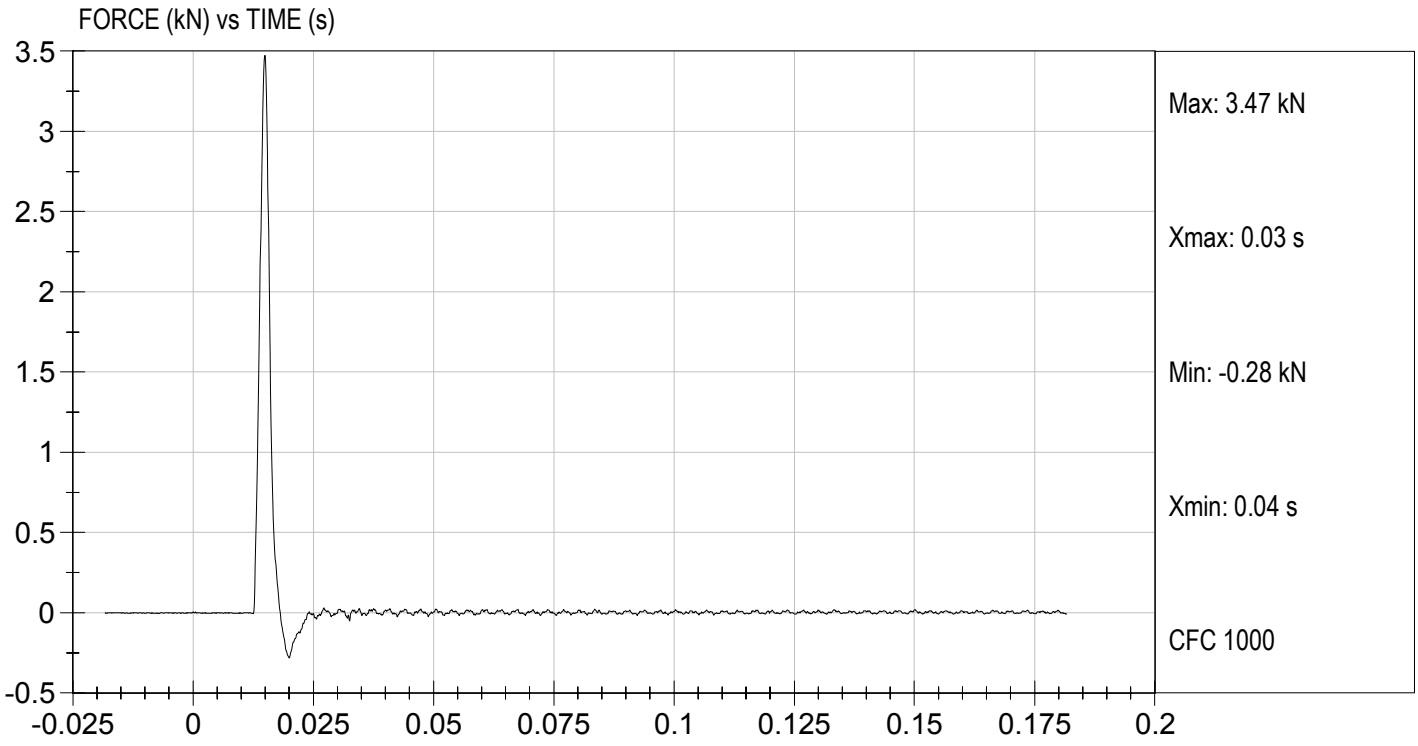
Joe Fleck
Laboratory Technician

08/20/2004
Test Date

Jeff Levandoski
Approved By

Test Desc: Right Knee
Componet ID: D041975

Test Date: 08/20/2004
Velocity: 6.92 ft/s, 2.11 m/s



DATA SHEET B3
HEAD DROP TEST (572.132)

Dummy Serial Number 506 Test Date 8/30/04

Technician Joe Fleck

__Pretest calibration
_X_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))
__X_ N/A, ONLY one head drop performed
_X_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))
_X_3. The head accelerometer mounting plate screws ((10-24 x 3/8 SHCS) are torqued to 9.0 Nm.
_X_4. Accelerometers and their respective mounts are smooth and clean.
_X_5. Torque the skull cap screws (10-24 x 1/2 SHCS) to 9.0 Nm.
_X_6. The data acquisition system, including transducers, conforms to the requirements of SAE Recommended Practice J211/1 MAR95. (572.136(m))
_X_7. The head assembly soaked at a temperature between 18.9°C (66ºF) and 25.6°C (78ºF) 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 21.9
Record the minimum temperature 20.9
Record the maximum humidity 52%
Record the minimum humidity 42%
_X_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 ± 1.0 mm (14.8±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 __502mm_____
Record the left side distance __501mm_____

_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 __$656 \times 10^{-6}$mm_____

_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 ± 1.0 mm (14.8 inches ± 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 g ≤ x ≤ 300 g | 277 |
| 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 ≤ 15 g | 14.1 |

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

Joe Fleck
Signature

8/30/04
Date

**MGA RESEARCH CORPORATION**

**HEAD DROP TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 506 **Test ID:** D042041

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 - 25.6 | 21.9 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 48 | Pass |
| Peak Resultant Acceleration | G's | 250 - 300 | 277 | Pass |
| Peak Lateral Acceleration | G's | +/- 15 | 14.1 | Pass |
| Unimodal | Yes/No | NA | Yes | Pass |
| Oscillations | Yes/No | within 10% of peak | Yes | Pass |
| | | Overall Test Results | | Pass |

Laboratory Technician

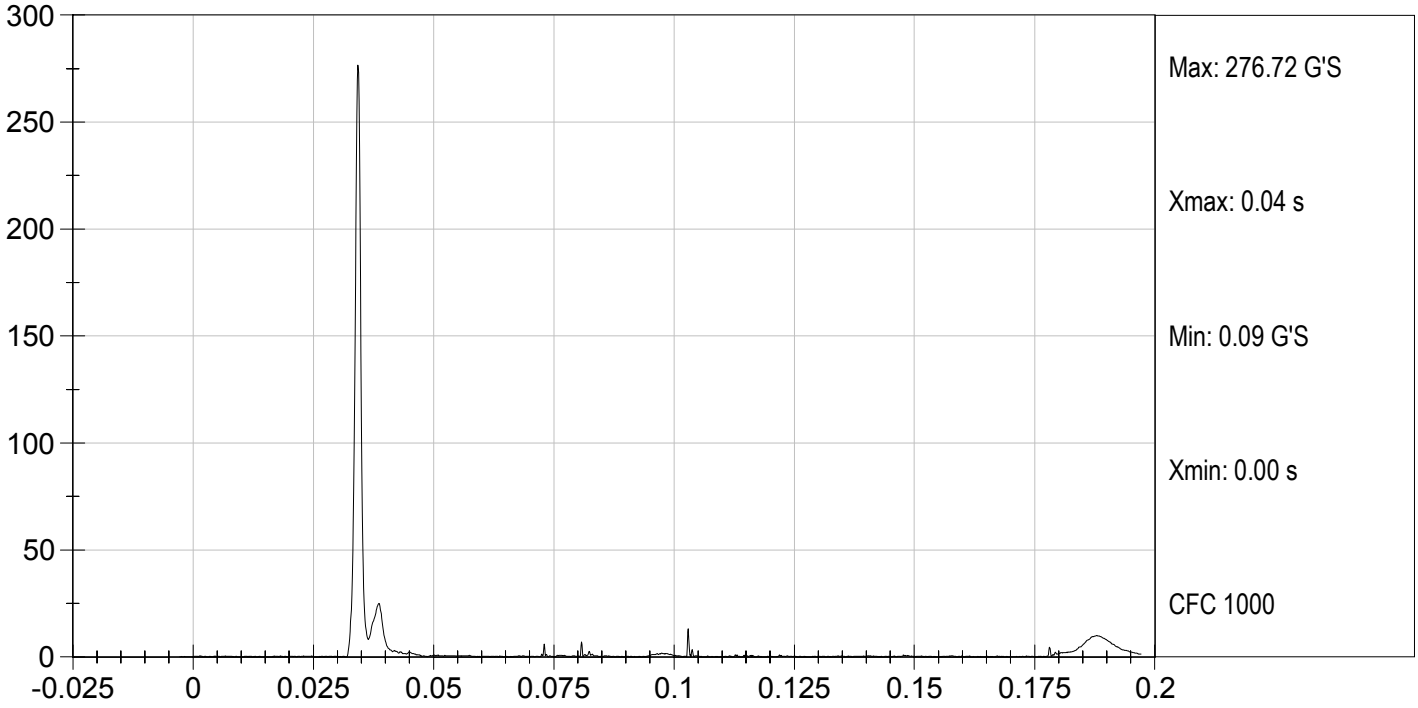
08/30/2004
Test Date

Approved By

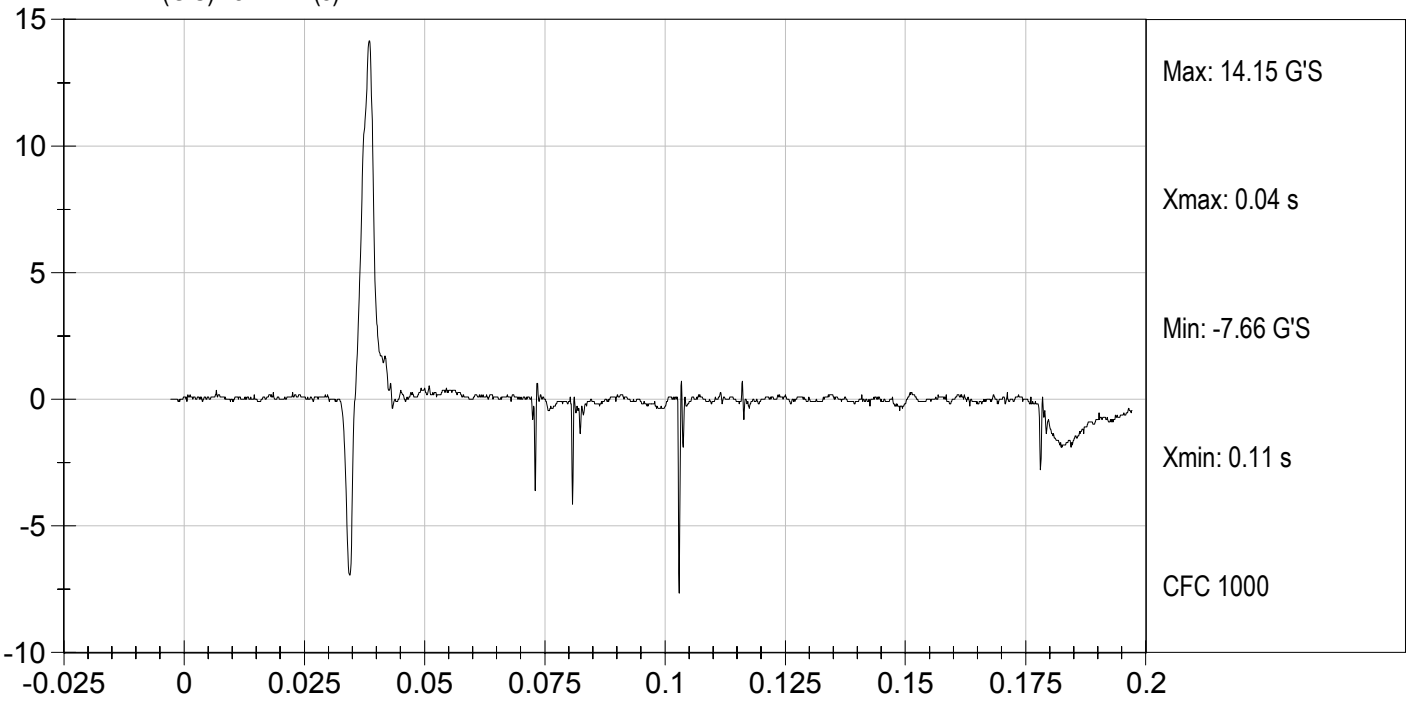
Test Desc: Head Drop
Componet ID: D042041

Test Date: 08/30/2004
Velocity: 0 ft/s, 0 m/s

PEAK RESULTANT ACCELERATION (G'S) vs TIME (s)




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



DATA SHEET B4
NECK FLEXION TEST (572.133)

Dummy Serial Number ____506_____ Test Date ____8/30/04_____

Technician ____Joe Fleck_____

__Pretest calibration
_X_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))
_X_ N/A, ONLY one flexion test performed

_X_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))

_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. (572.133(c)(1))
Record the maximum temperature __21.9__
Record the minimum temperature __20.9__
Record the maximum humidity __52%__
Record the minimum humidity __42%__

_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. (880105-250 and PADI page17).
Record findings and actions: __No Deterioration. Hardness Front 89; Back 90.

_X_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 ± 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 | Result |
|---|---|---|---|
| Pendulum impact speed | | 6.89 m/s ≤ speed ≤ 7.13 m/s | 7.02 m/s |
| Pendulum ΔV with respect to impact speed | @ 10ms | 2.1 m/s ≤ ΔV ≤ 2.5 m/s | 2.3 m/s |
| | @ 20 ms | 4.0 m/s ≤ ΔV ≤ 5.0 m/s | 4.6 m/s |
| | @30ms | 5.8 m/s ≤ ΔV ≤ 7.0 m/s | 6.7 m/s |
| Plane D Rotation | | Peak moment*<br>69 Nm ≤ moment ≤ 83 Nm during the following rotation range 77° ≤ angle ≤ 91° | __76__ Nm @ __78__ degrees |
| Positive Moment Decay** (Flexion) | | Time to decay to 10 Nm<br>80 ms ≤ time ≤ 100ms | 86 ms |

*Moment about the occipital condyle = $M_y$ – (0.01778 m x $F_x$) (572.133(b)(1)(ii))

My = Moment in Nm measured by the transducer

Fx = 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.

Signature _____ Date 8/30/04

**MGA RESEARCH CORPORATION**

**NECK FLEXION TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 506 **Test I.D:** D042042

| 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 | 46 | Pass |
| Pendulum Speed | | m/sec | 6.89 to 7.13 | 7.02 | Pass |
| Pendulum Deceleration | 10 msec | m/sec | 2.1 to 2.5 | 2.3 | Pass |
| | 20 msec | m/sec | 4.0 to 5.0 | 4.6 | Pass |
| | 30 msec | m/sec | 5.8 to 7.0 | 6.7 | Pass |
| D Plane Rotation | Max | deg | 77 to 91 | 78 | Pass |
| Occipital Condyle Moment within Deflection Corridor | | Nm | 69 to 83 | 76 | Pass |
| Positive Moment Time Curve Decay to 10 Nm | | msec | 80 to 100 | 86 | Pass |
| | | | Overall Results | | Pass |

James Carney
Laboratory Technician

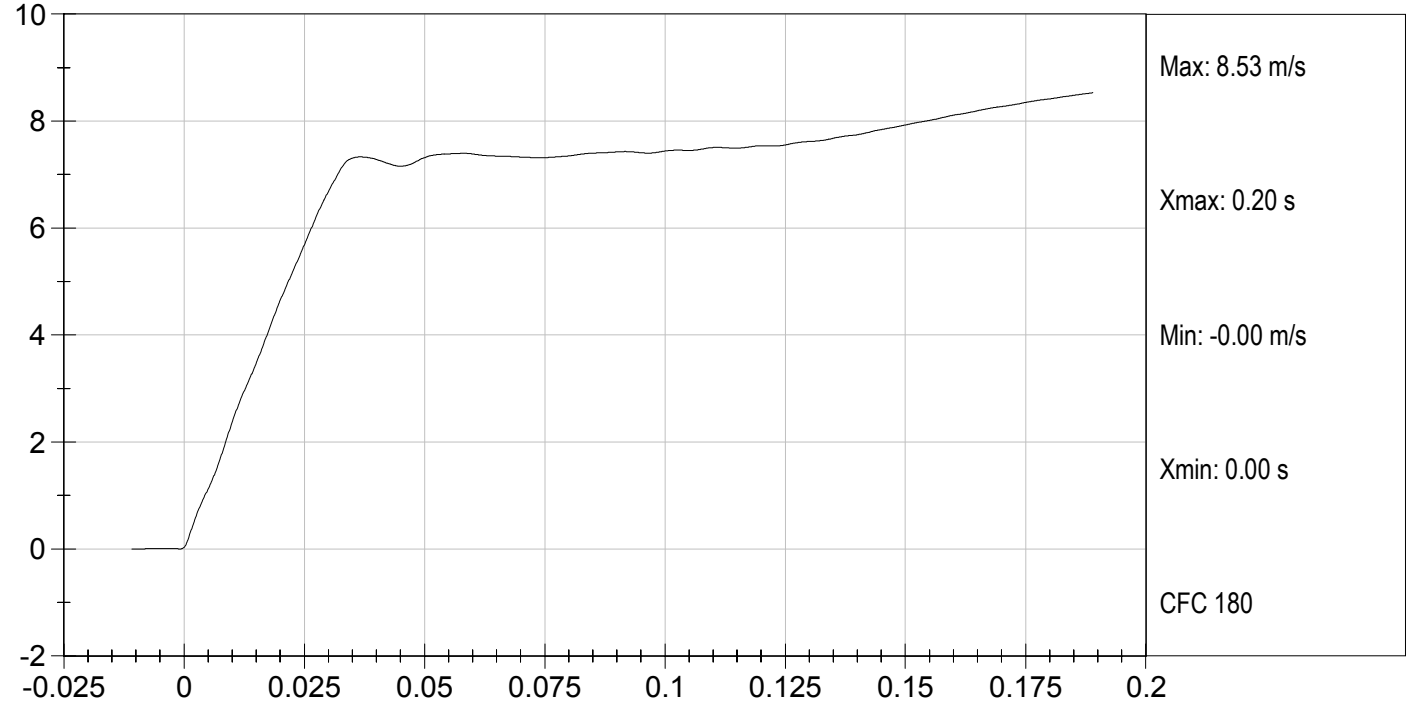
08/30/2004
Test Date

Jeff Levandoski
Approved By

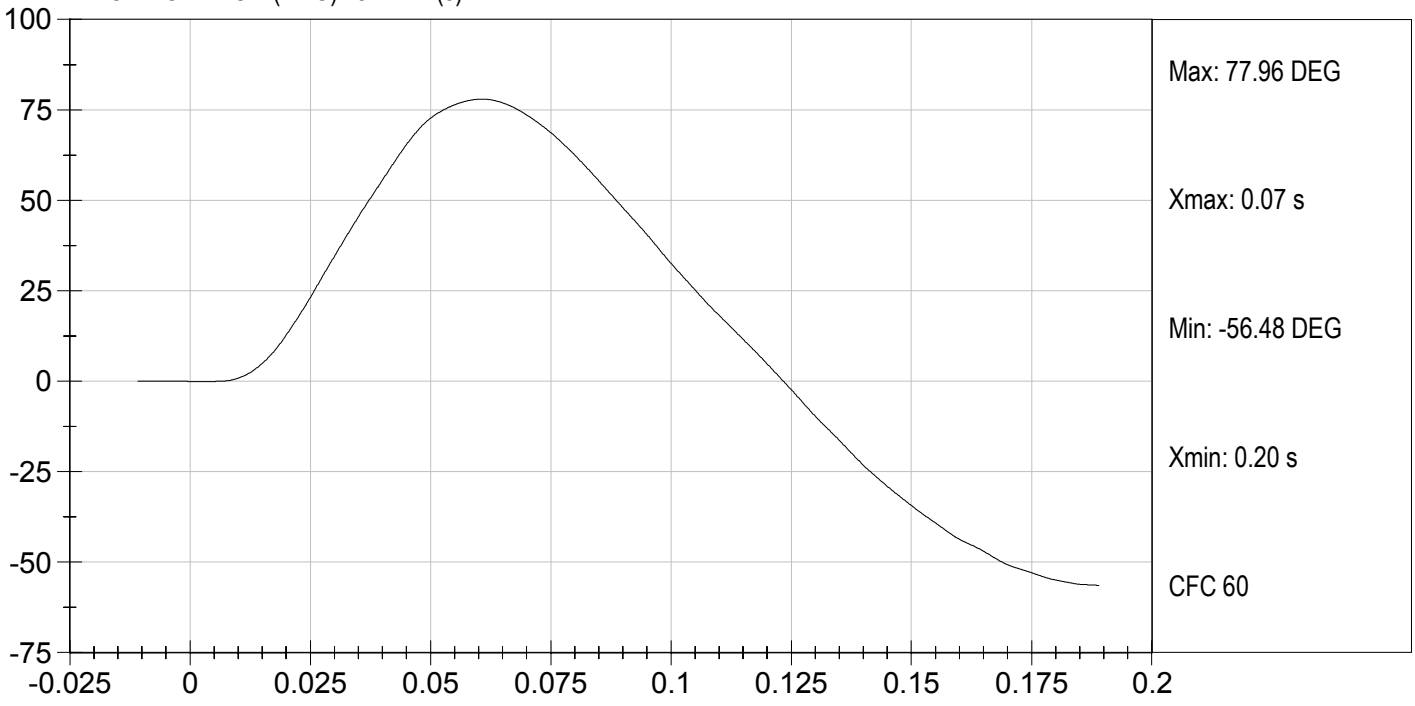
Test Desc: Neck Flexion
Componet ID: D042042

Test Date: 08/30/2004
Velocity: 23.02 ft/s, 7.02 m/s

PENDULUM DECELERATION (m/s) vs TIME (s)

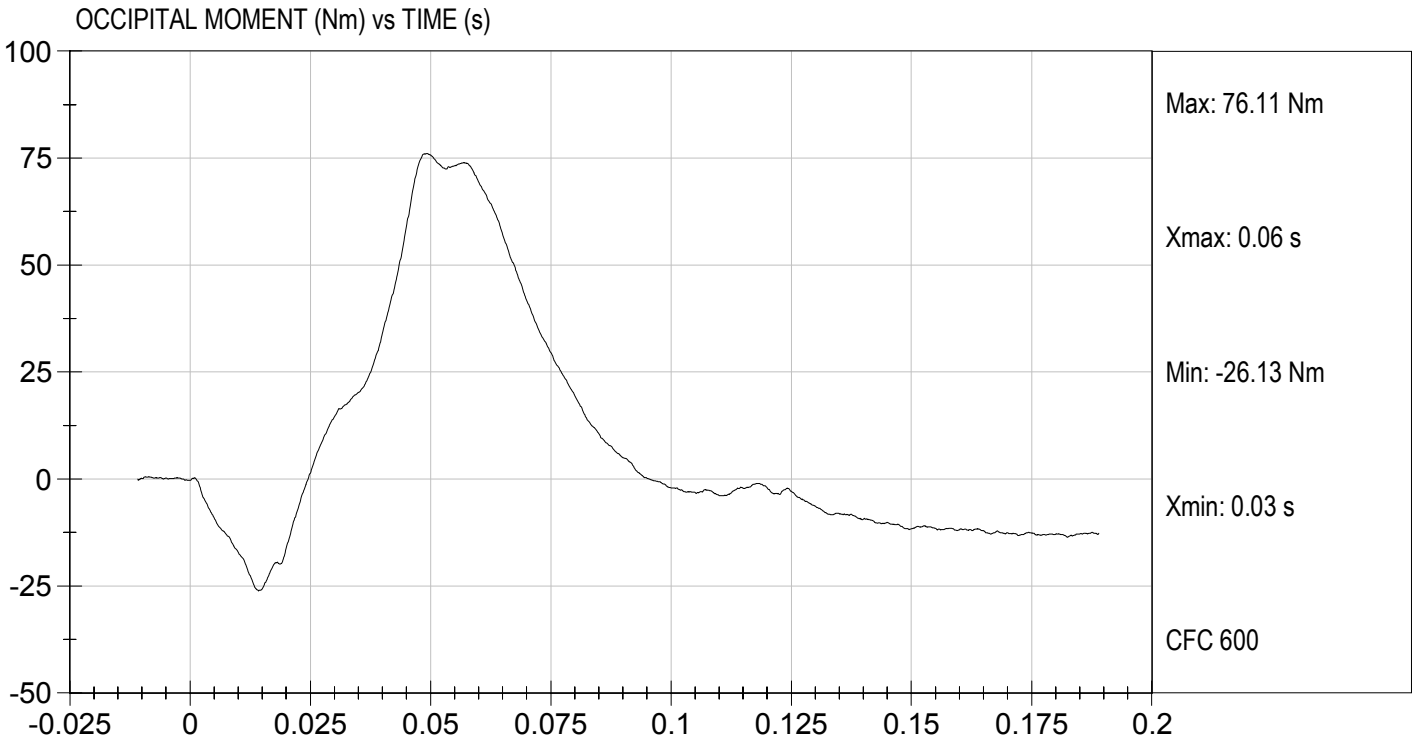



NECK ROTATION (DEG) vs TIME (s)



Test Desc: Neck Flexion
Componet ID: D042042

Test Date: 08/30/2004
Velocity: 23.02 ft/s, 7.02 m/s



DATA SHEET B5
NECK EXTENSION TEST (572.133)

Dummy Serial Number ____506_____ Test Date ___8/30/04_____

Technician _____Joe Fleck_____

__Pretest calibration
_X_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))
_X_ N/A, ONLY one extension test performed

_X_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))

_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. (572.133(c)(1))
Record the maximum temperature __21.9___
Record the minimum temperature __20.9___
Record the maximum humidity __52%__
Record the minimum humidity __42%__

_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. (880105-250 and PADI page17).
Record findings and actions: __No Deterioration. Hardness Front 89; Back 90.

_X_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 ± 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 | Result |
|---|---|---|---|
| Pendulum impact speed | | 5.95 m/s ≤ speed ≤ 6.19 m/s | 6.09 m/s |
| Pendulum ΔV with respect to impact speed | @ 10ms | 1.5 m/s ≤ ΔV ≤ 1.9 m/s | 1.8 m/s |
| | @ 20 ms | 3.1 m/s ≤ ΔV ≤ 3.9 m/s | 3.5 m/s |
| | @30ms | 4.6 m/s ≤ ΔV ≤ 5.6 m/s | 5.1 m/s |
| Plane D Rotation | | Peak moment*<br>-65 Nm ≤ moment ≤ -53 Nm during the following rotation range 99° ≤ angle ≤ 114° | _-59_ Nm @ _100_ degrees |
| Negative Moment Decay** (Extension) | | Time to decay to -10 Nm<br>94 ms ≤ time ≤ 114 ms | 99 ms |

*Moment about the occipital condyle = $M_y$ – (0.01778 m x $F_x$) (572.133(b)(1)(ii)

My = Moment in Nm measured by the transducer

Fx = 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.

Joe Fleck — 8/30/04

Signature Date

**MGA RESEARCH CORPORATION**

**NECK EXTENSION TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 506 **Test I.D:** D042043

| 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 | 46 | Pass |
| Pendulum Speed | | m/sec | 5.95 to 6.19 | 6.09 | Pass |
| Pendulum Deceleration | 10 msec | m/sec | 1.5 to 1.9 | 1.8 | Pass |
| | 20 msec | m/sec | 3.1 to 3.9 | 3.5 | Pass |
| | 30 msec | m/sec | 4.6 to 5.6 | 5.1 | Pass |
| D Plane Rotation | Max | deg | 99 to 114 | 100 | Pass |
| Occipital Condyle Moment within Deflection Corridor | | Nm | -65 to -53 | -59 | Pass |
| Negative Moment Time Curve Decay to -10 Nm | | msec | 94 to 114 | 99 | Pass |
| | | | Overall Results | | Pass |

James Carney

Laboratory Technician

08/30/2004

Test Date

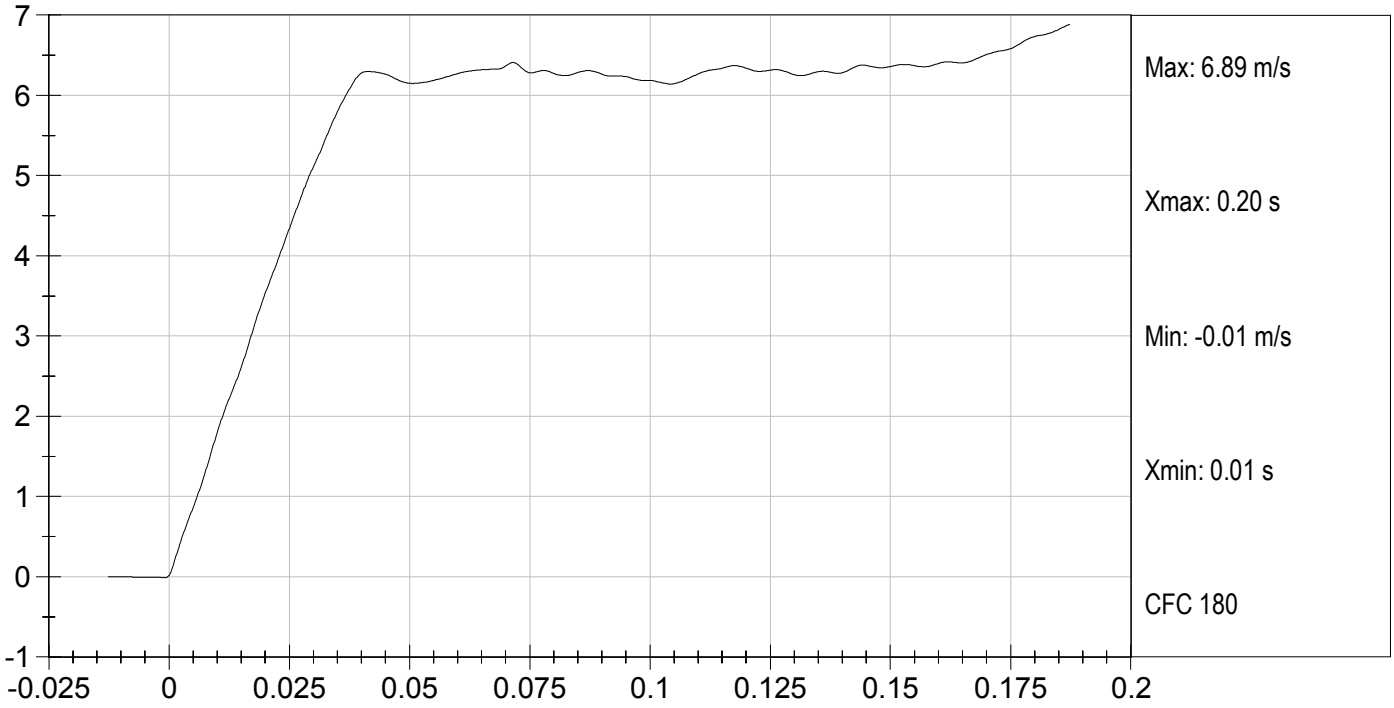
Jeff Leonardelli

Approved By

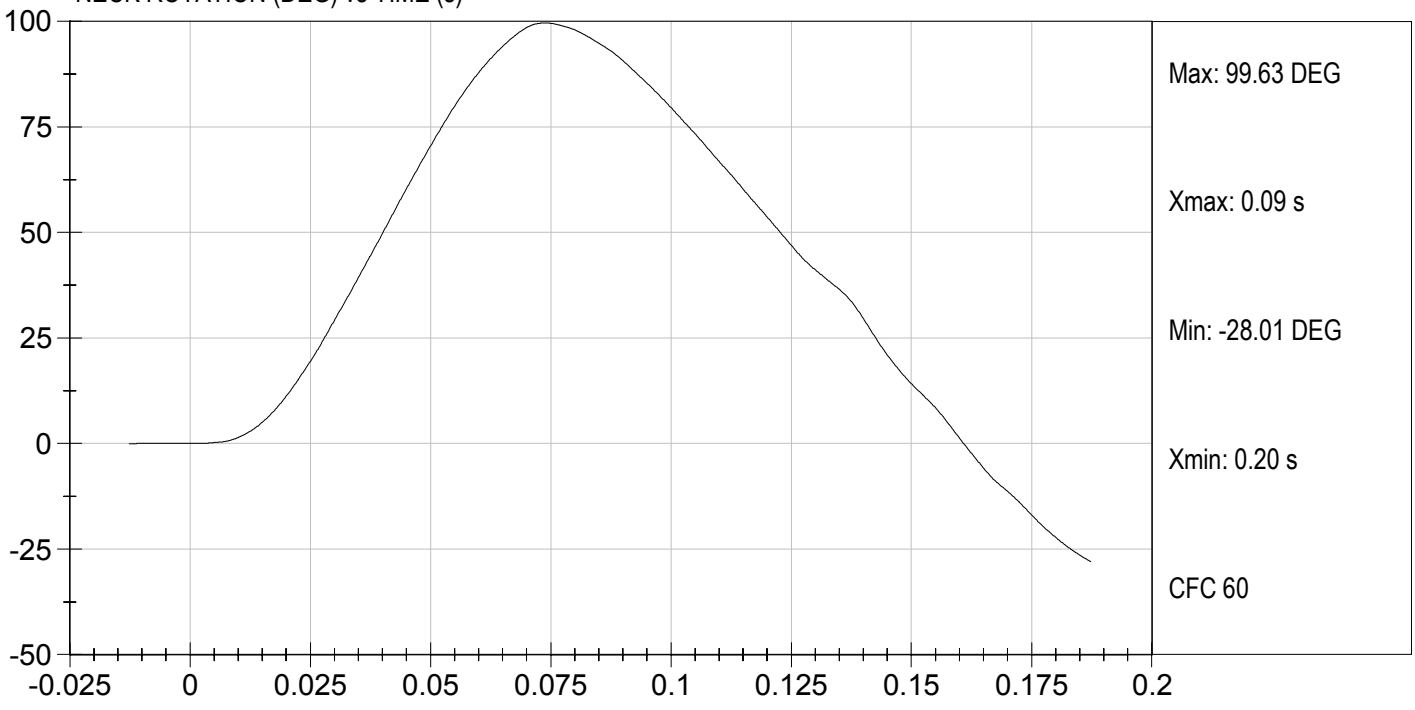
Test Desc: Neck Extension
Componet ID: D042043

Test Date: 08/30/2004
Velocity: 19.97 ft/s, 6.09 m/s

PENDULUM DECELERATION (m/s) vs TIME (s)

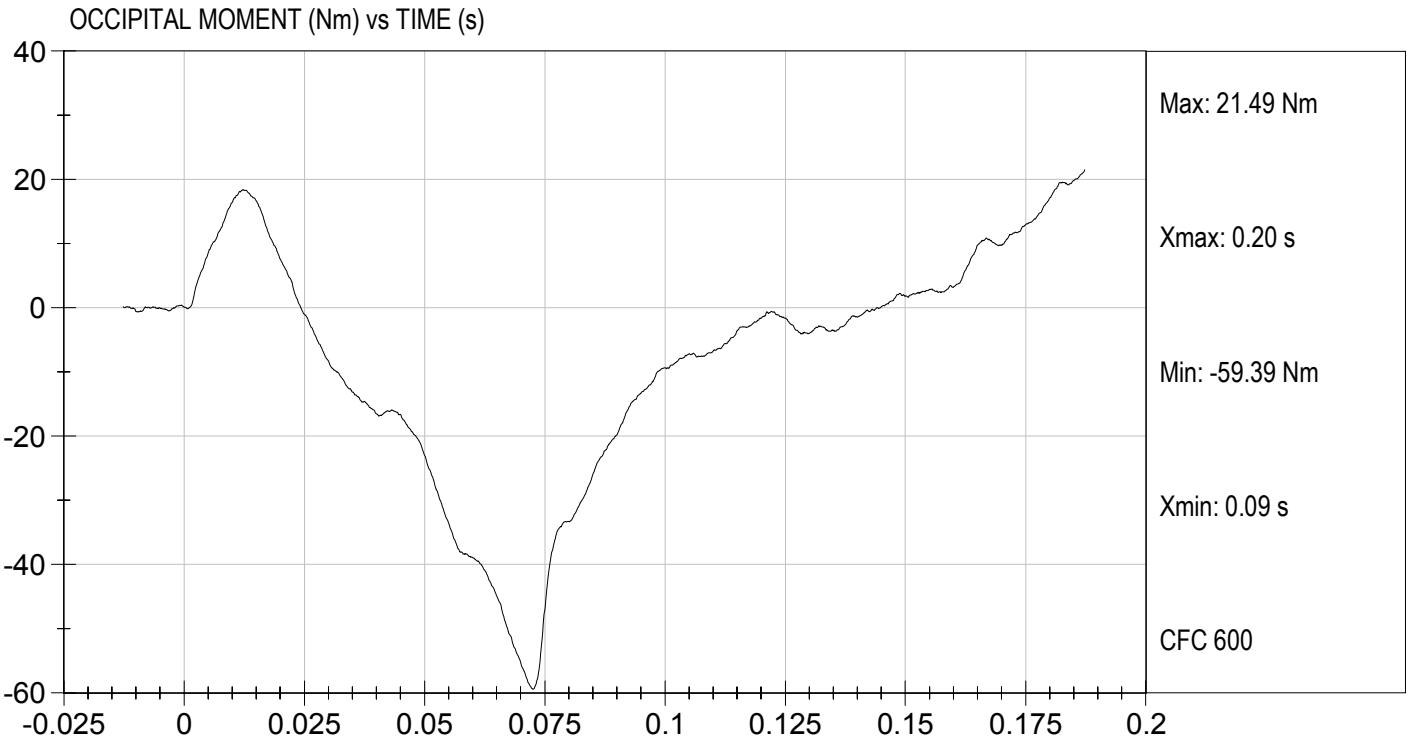



NECK ROTATION (DEG) vs TIME (s)



Test Desc: Neck Extension
Componet ID: D042043

Test Date: 08/30/2004
Velocity: 19.97 ft/s, 6.09 m/s



DATA SHEET B6
THORAX IMPACT TEST (572.134)

Dummy Serial Number __506_____ Test Date __8/31/04_____

Technician _____Joe Fleck_____

__Pretest calibration
_X_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))
_X_ N/A, ONLY one thorax impact test performed
_X_2. The test fixture conforms to the specifications in Figure 11B.
_X_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))
_X_4. The dummy assembly soaked at a temperature between 20.6°C (69ºF) and 22.2°C (72ºF) 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 _21.7_
Record the minimum temperature _20.8_
Record the maximum humidity _56%_
Record the minimum humidity _42%_
_X_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.
_X_ - 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 ± 0.5º and adjust the pelvis angle to 7º ± 2º. 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 ± 1º. (572.134(c)(3))

_X_ 9. The longitudinal centerline of the test probe is centered within ±2.5 mm of the midsagittal plane of the dummy and is 12.7 mm ± 1mm below the horizontal peripheral centerline of the No. 3 rib and is within 0.5º 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 ± 2º 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 2º 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 ± 0.12m/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 m/s ≤ speed ≤ 6.83 m/s | 6.80 m/s |
| Chest Compression | 50.0 mm ≤ compression ≤ 58.0 mm | 54.9 mm |
| Peak force** between 50.0 and 58.0 mm chest compression | 3900N ≤ peak force ≤ 4400N | 4100 N |
| Peak force** between 18.0 and 50.0 mm chest compression | peak force ≤ 4600 N | 3967 N |
| Internal Hysteresis*** | 69% ≤ hysteresis ≤ 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.

Signature 8/31/04
Date

**MGA RESEARCH CORPORATION**

**THORAX IMPACT**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 506 **Test I.D:** D042044

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Temperature | deg C | 20.6 to 22.2 | 21.4 | Pass |
| Relative Humidity | % | 10 to 70 | 45 | Pass |
| Probe Speed | m/s | 6.59 to 6.83 | 6.80 | Pass |
| Peak Deflection | mm | 50 to 58 | 54.9 | Pass |
| Peak Resistive Force w/in Deflection Corridor | kN | 3.9 to 4.4 | 4.1 | Pass |
| Internal Hysteresis | % | 69 to 85 | 69 | Pass |
| Peak Force 18 mm - 50 mm | N | < 4600 N | 3,967 | Pass |
| | | Overall Test Results | | Pass |

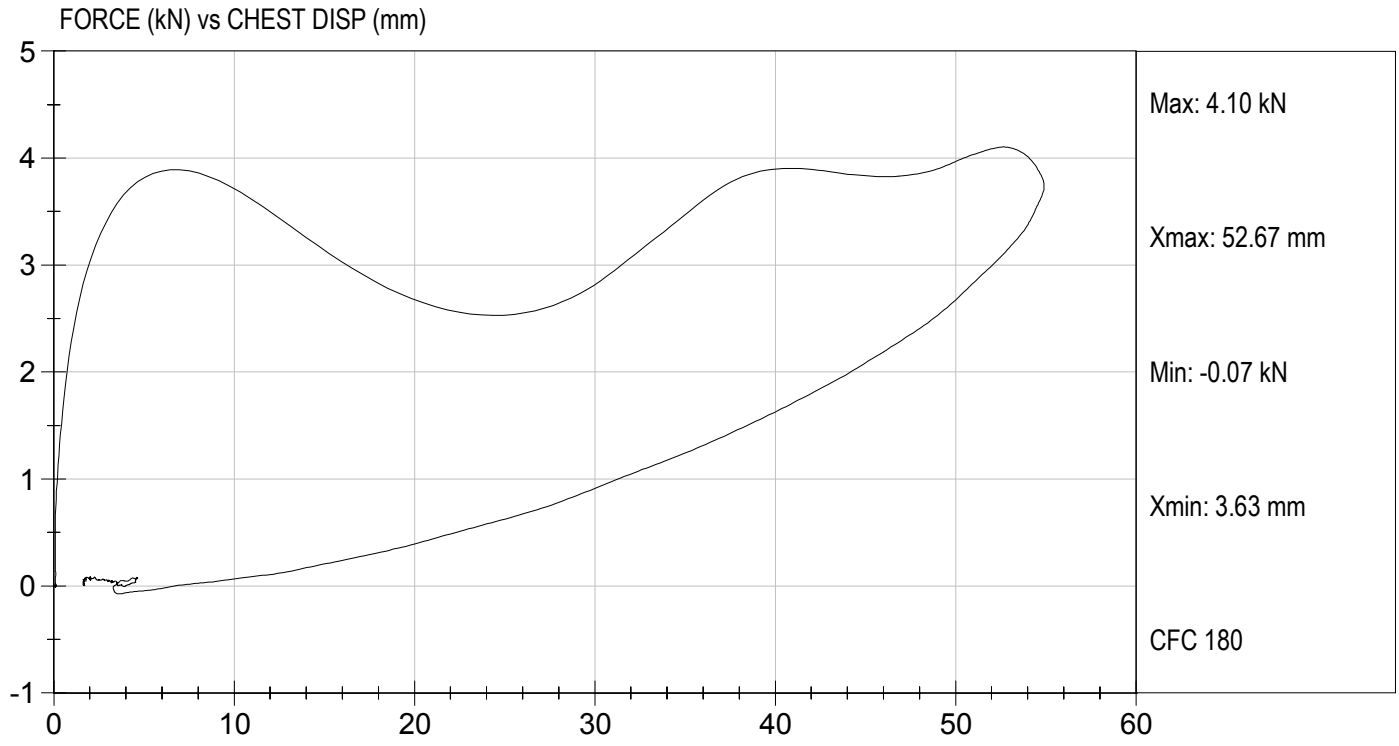
James Carney
Laboratory Technician

08/31/2004
Test Date

Jeff Levandoski
Approved By

Test Desc: Thorax Impact
Componet ID: D042044

Test Date: 08/31/2004
Velocity: 22.3 ft/s, 6.80 m/s



DATA SHEET B7
TORSO FLEXION TEST (572.135)

Dummy Serial Number __506_____ Test Date __8/30/04_____

Technician _____Joe Fleck_____

__Pretest calibration
_X_Post test calibration verification

Test attempt no. __2__ (when successive torso flexion tests are necessary)

_X_1. It has been at least 30 minutes since the last torso flexion test. (572.137(q))
__ N/A, ONLY one thorax impact test performed
_X_2. The test fixture conforms to the specifications in Figure 13B.
_X_3. The complete assembled dummy (880105-000) is used (572.135(c)(2)).
__ with legs below the femurs.
_X_ without legs below the femurs.
_X_4. The dummy assembly soaked at a temperature between 18.9°C (66ºF) and 25.6°C (78ºF) 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 __21.9__
Record the minimum temperature __20.9__
Record the maximum humidity __52%__
Record the minimum humidity __42%__
_X_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))
_X_6. Attach the loading adapter bracket to the spine of the dummy as shown in Figure 13B**.** (572.135(c)(4))
_X_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))
_X_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°)___$15^0$___
_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° | 15° |
| Torso rotation rate | 0.5°/s ≤ rate ≤ 1.5°/s | 1.0 |
| Force at 45° ±0.5° | 320 N ≤ force ≤ 390 N | 340 N |
| Final ref. plane angle | Initial ref. plane angle ±8° | 16° |

Signature

8/30/04
Date

**MGA RESEARCH CORPORATION**

**TORSO FLEXION TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 506 **Test I.D:** D042047

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 - 25.6 | 21.5 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 47 | Pass |
| Initial Angle | deg | 0 to 20 | 15 | Pass |
| Return Angle | deg | +/- 8 | 16 | Pass |
| Force at 45 deg | N | 320 to 390 | 340 | Pass |
| Upper Torso Deflection Rate | Deg/sec | 0.5 - 1.5 | 1.0 | Pass |
| | | Overall Result | | Pass |

Joe Fleck
Laboratory Technician

08/30/2004
Test Date

Jeff Leonardelli
Approved By

DATA SHEET B8
LEFT KNEE IMPACT TEST (572.136)

Dummy Serial Number __506_____ Test Date __8/30/04_____

Technician ____Joe Fleck_____

__Pretest calibration
_X_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))
_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 (66ºF) and 25.6°C (78ºF) 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 _21.9__
Record the minimum temperature _20.9__
Record the maximum humidity _52%__
Record the minimum humidity _42%__
_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 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 m/s ≤ speed ≤ 2.13 m/s | 2.12 m/s |
| Peak resistance force* | 3450 N ≤ force ≤ 4060 N | 3570 N |

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

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

Joe Fleck
Signature

8/30/04
Date

**MGA RESEARCH CORPORATION**

**LEFT KNEE IMPACT TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 506 **Test I.D:** D042046

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 to 25.5 | 21.8 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 46 | Pass |
| Probe Speed | m/sec | 2.07 to 2.13 | 2.12 | Pass |
| Maximum Force | kN | 3.45 to 4.06 | 3.57 | Pass |
| | | Overall Test Results | | Pass |

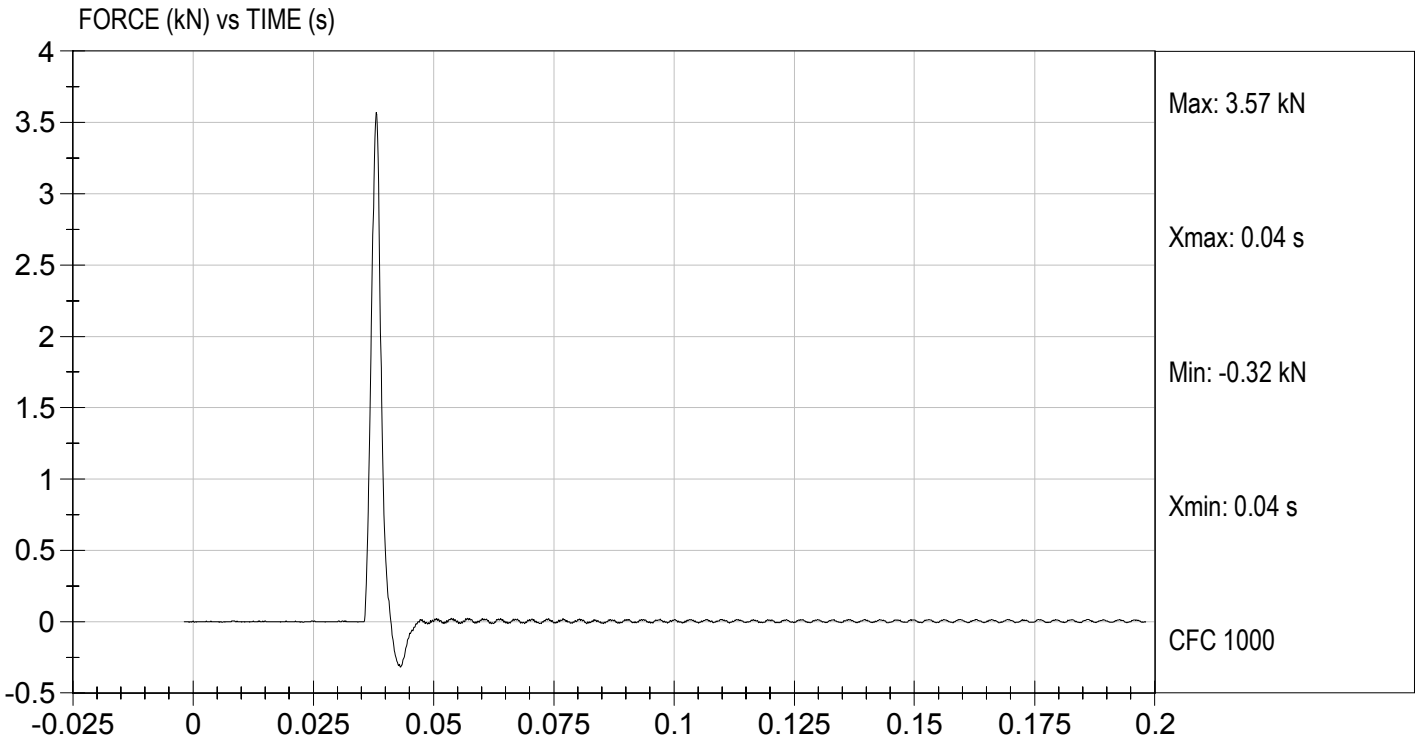
Laboratory Technician

08/30/2004
Test Date

Approved By

Test Desc: Left Knee
Componet ID: D042046

Test Date: 08/30/2004
Velocity: 6.95 ft/s, 2.12 m/s



DATA SHEET B9
RIGHT KNEE IMPACT TEST (572.136)

Dummy Serial Number ___506_____ Test Date __8/30/04_____

Technician ___Joe Fleck_____

__Pretest calibration
_X_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))
_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 (880105-528R), 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))
_X_4. The knee assembly soaked at a temperature between 18.9°C (66ºF) and 25.6°C (78ºF) 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 _21.9___
Record the minimum temperature _20.9___
Record the maximum humidity _52 %___
Record the minimum humidity _42 %___
_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 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))
_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 m/s ≤ speed ≤ 2.13 m/s | 2.12 m/s |
| Peak resistance force* | 3450 N ≤ force ≤ 4060 N | 3640 N |

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

_X_12. Plots of acceleration versus time and force versus time follow this sheet.

Signature

8/30/04
Date

**MGA RESEARCH CORPORATION**

**RIGHT KNEE IMPACT TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 506 **Test I.D:** D042045

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 to 25.5 | 21.9 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 47 | Pass |
| Probe Speed | m/sec | 2.07 to 2.13 | 2.12 | Pass |
| Maximum Force | kN | 3.45 to 4.06 | 3.64 | Pass |
| | | Overall Test Results | | Pass |

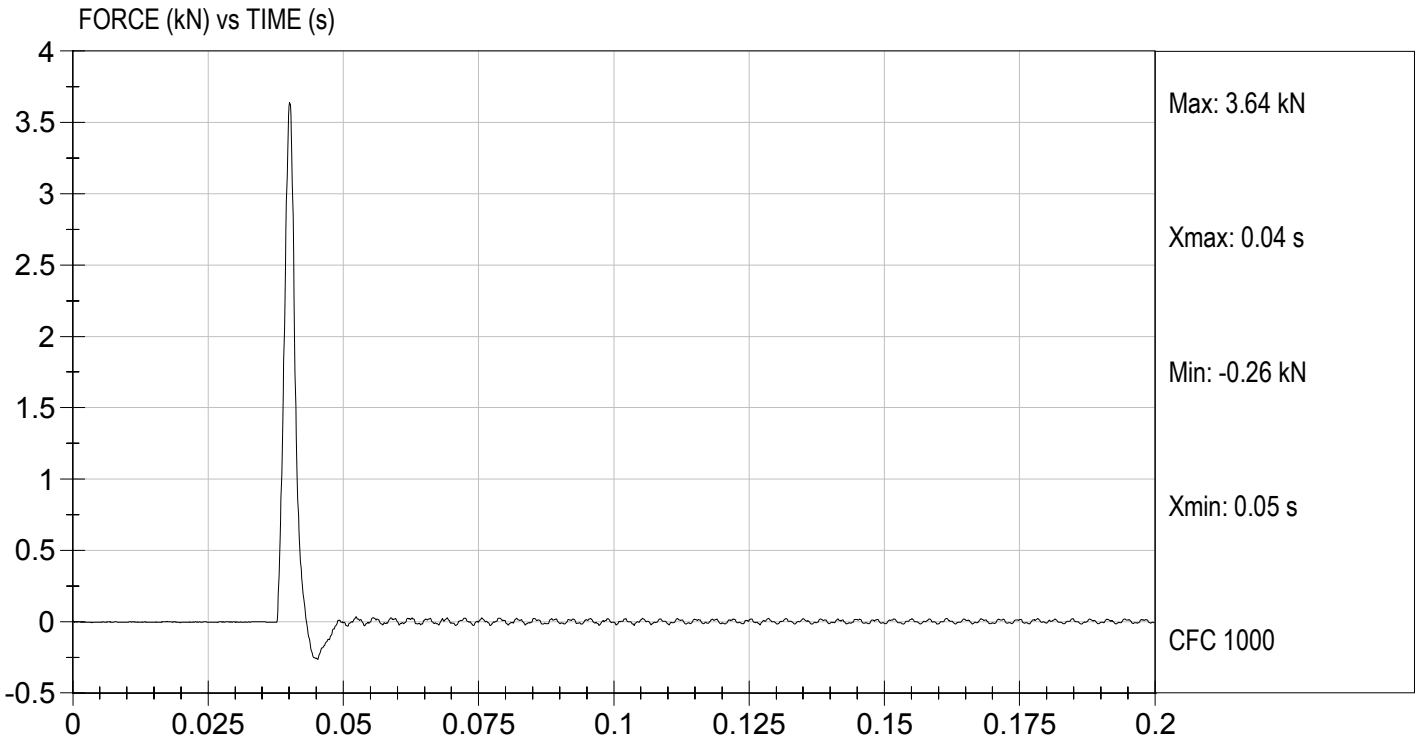
Laboratory Technician

08/30/2004
Test Date

Approved By

Test Desc: Right Knee
Componet ID: D042045

Test Date: 08/30/2004
Velocity: 6.94 ft/s, 2.12 m/s



DATA SHEET B1
DUMMY DAMAGE CHECKLIST

Dummy Serial Number ____506_____ Test Date ___8/27/04_____

Technician _____Jessica Gall_____

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

_X_ Perform general cleaning.

| Dummy Item | Inspect for | Comments | Damaged | 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 |

| Dummy Item | Inspect for | Comments | Damaged | OK |
|---|---|---|---|---|
| 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 _____ 8/30/04_____
Signature Date

Describe the repair or replacement of parts:

Checked by

Jeff Leonardi _____ 8/30/04_____
Signature Date

## EXTERNAL DIMENSIONS

| SN506, HYBRID III, 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 | 780.2 |
| B | SHOULDER PIVOT HEIGHT | Centerline of shoulder pivot bolt to the seat surface. | 431.8-457.2 | 443.0 |
| C | H-POINT HEIGHT | Reference | 81.3-86.3 | 85.1 |
| D | H-POINT LOCATION FROM BACKLINE | Reference | 144.8-149.8 | 145.0 |
| E | SHOULDER PIVOT FROM BACKLINE | Center of the shoulder clevis to the rear vertical surface of the fixture. | 68.6-83.8 | 76.4 |
| F | THIGH CLEARANCE | Measured at the highest point on the upper femur segment. | 119.4-134.6 | 128.0 |
| G | BACK OF ELBOW TO WRIST PIVOT | Back of the elbow flesh to the wrist pivot in line with the elbow and wrist pivots | 243.9-259.1 | 255.8 |
| 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 | 280.2 |
| J | ELBOW REST HEIGHT | Measure from the flesh below the elbow pivot bolt to the seat surface. | 182.8-203.2 | 193.0 |
| 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 | 545.0 |
| L | POPLITEAL HEIGHT | Seat surface to the plane of the horizontal plane of the bottom of the feet. | 355.6-376.0 | 365.2 |
| M | KNEE PIVOT HEIGHT | Centerline of knee pivot bolt to the horizontal plane of the bottom of the feet. | 393.7-419.1 | 400.5 |
| 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”. | 414-439.4 | 438.0 |

| SN506, HYBRID III, 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 | 183.0 |
| P | FOOT LENGTH | Tip of toe to rear of heal | 218.5-233.7 | 226.2 |
| 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 | 475.8 |
| S | HEAD BREADTH | The widest part of the head | 137.1-147.3 | 142.0 |
| T | HEAD DEPTH | Back of the head to the forehead | 177.8-188.0 | 180.5 |
| U | HIP BREADTH | The widest part of the hip | 299.7-314.9 | 305.1 |
| V | SHOULDER BREADTH | Outside edges of right and left shoulder clevises | 350.5-365.7 | 359.0 |
| W | FOOT BREADTH | The widest part of the foot | 78.8-94.0 | 85.5 |
| X | HEAD CIRCUMFERENCE | Measured at the point as in dim. “T” | 528.3-548.7 | 538.0 |
| Y | CHEST CIRCUMFERENCE (WITH CHEST JACKET) | Measured 345.4 ± 12.7 mm above seat surface | 850.9-881.3 | 857.6 |
| Z | WAIST CIRCUMFERENCE | Measured 165.1 ± 5.1 mm above seat surface | 759.5-789.9 | 789.0 |
| AA | REFERENCE LOCATION FOR MEASUREMENT OF CHEST CIRCUMFERENCE | Reference | 332.7-358.1 | 345.0 |
| BB | REFERENCE LOCATION FOR MEASUREMENT OF WAIST CIRCUMFERENCE | Reference | 160.1-170.2 | 165.0 |

## EXTERNAL DIMENSIONS

| SN516, HYBRID III, 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 | 785.2 |
| B | SHOULDER PIVOT HEIGHT | Centerline of shoulder pivot bolt to the seat surface. | 431.8-457.2 | 454.9 |
| C | H-POINT HEIGHT | Reference | 81.3-86.3 | 83.5 |
| D | H-POINT LOCATION FROM BACKLINE | Reference | 144.8-149.8 | 146.2 |
| E | SHOULDER PIVOT FROM BACKLINE | Center of the shoulder clevis to the rear vertical surface of the fixture. | 68.6-83.8 | 81.5 |
| F | THIGH CLEARANCE | Measured at the highest point on the upper femur segment. | 119.4-134.6 | 130.0 |
| G | BACK OF ELBOW TO WRIST PIVOT | Back of the elbow flesh to the wrist pivot in line with the elbow and wrist pivots | 243.9-259.1 | 252.0 |
| H | HEAD BACK TO BACKLINE | Back of skull cap skin to seat rear vertical surface (Reference) | 43.2-48.2 | 44.5 |
| 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 | 282.3 |
| J | ELBOW REST HEIGHT | Measure from the flesh below the elbow pivot bolt to the seat surface. | 182.8-203.2 | 187.1 |
| 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 | 525.9 |
| L | POPLITEAL HEIGHT | Seat surface to the plane of the horizontal plane of the bottom of the feet. | 355.6-376.0 | 357.7 |
| M | KNEE PIVOT HEIGHT | Centerline of knee pivot bolt to the horizontal plane of the bottom of the feet. | 393.7-419.1 | 396.0 |
| 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”. | 414-439.4 | 421.2 |

| SN516, HYBRID III, 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 | 176.8 |
| P | FOOT LENGTH | Tip of toe to rear of heal | 218.5-233.7 | 223.0 |
| 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 | 472.1 |
| S | HEAD BREADTH | The widest part of the head | 137.1-147.3 | 141.7 |
| T | HEAD DEPTH | Back of the head to the forehead | 177.8-188.0 | 180.1 |
| U | HIP BREADTH | The widest part of the hip | 299.7-314.9 | 310.0 |
| V | SHOULDER BREADTH | Outside edges of right and left shoulder clevises | 350.5-365.7 | 357.1 |
| W | FOOT BREADTH | The widest part of the foot | 78.8-94.0 | 82.5 |
| X | HEAD CIRCUMFERENCE | Measured at the point as in dim. “T” | 528.3-548.7 | 539.6 |
| Y | CHEST CIRCUMFERENCE (WITH CHEST JACKET) | Measured 345.4 ± 12.7 mm above seat surface | 850.9-881.3 | 863.2 |
| Z | WAIST CIRCUMFERENCE | Measured 165.1 ± 5.1 mm above seat surface | 759.5-789.9 | 784.4 |
| AA | REFERENCE LOCATION FOR MEASUREMENT OF CHEST CIRCUMFERENCE | Reference | 332.7-358.1 | 342.0 |
| BB | REFERENCE LOCATION FOR MEASUREMENT OF WAIST CIRCUMFERENCE | Reference | 160.1-170.2 | 163.0 |

DATA SHEET B3
HEAD DROP TEST (572.132)

Dummy Serial Number 516 Test Date 8/23/04

Technician Joe Fleck

_X_Pretest 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))
_X_ N/A, ONLY one head drop performed

_X_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))

_X_3. The head accelerometer mounting plate screws ((10-24 x 3/8 SHCS) are torqued to 9.0 Nm.

_X_4. Accelerometers and their respective mounts are smooth and clean.

_X_5. Torque the skull cap screws (10-24 x 1/2 SHCS) to 9.0 Nm.

_X_6. The data acquisition system, including transducers, conforms to the requirements of SAE Recommended Practice J211/1 MAR95. (572.136(m))

_X_7. The head assembly soaked at a temperature between 18.9°C (66ºF) and 25.6°C (78ºF) 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 21.8
Record the minimum temperature 21.2
Record the maximum humidity 54%
Record the minimum humidity 50%

_X_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 ± 1.0 mm (14.8±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 __500mm____
Record the left side distance __501mm____

_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 __$656 \times 10^{-6}$mm_____

_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 ± 1.0 mm (14.8 inches ± 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 g ≤ x ≤ 300 g | 281 |
| 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 ≤ 15 g | 11 |

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

_____ __8/23/04_____
Signature Date

**MGA RESEARCH CORPORATION**

**HEAD DROP TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 516 **Test ID:** D042001

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 - 25.6 | 21.3 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 51 | Pass |
| Peak Resultant Acceleration | G's | 250 - 300 | 281 | Pass |
| Peak Lateral Acceleration | G's | +/- 15 | 11.1 | Pass |
| Unimodal | Yes/No | NA | Yes | Pass |
| Oscillations | Yes/No | within 10% of peak | Yes | Pass |
| | | Overall Test Results | | Pass |

Laboratory Technician

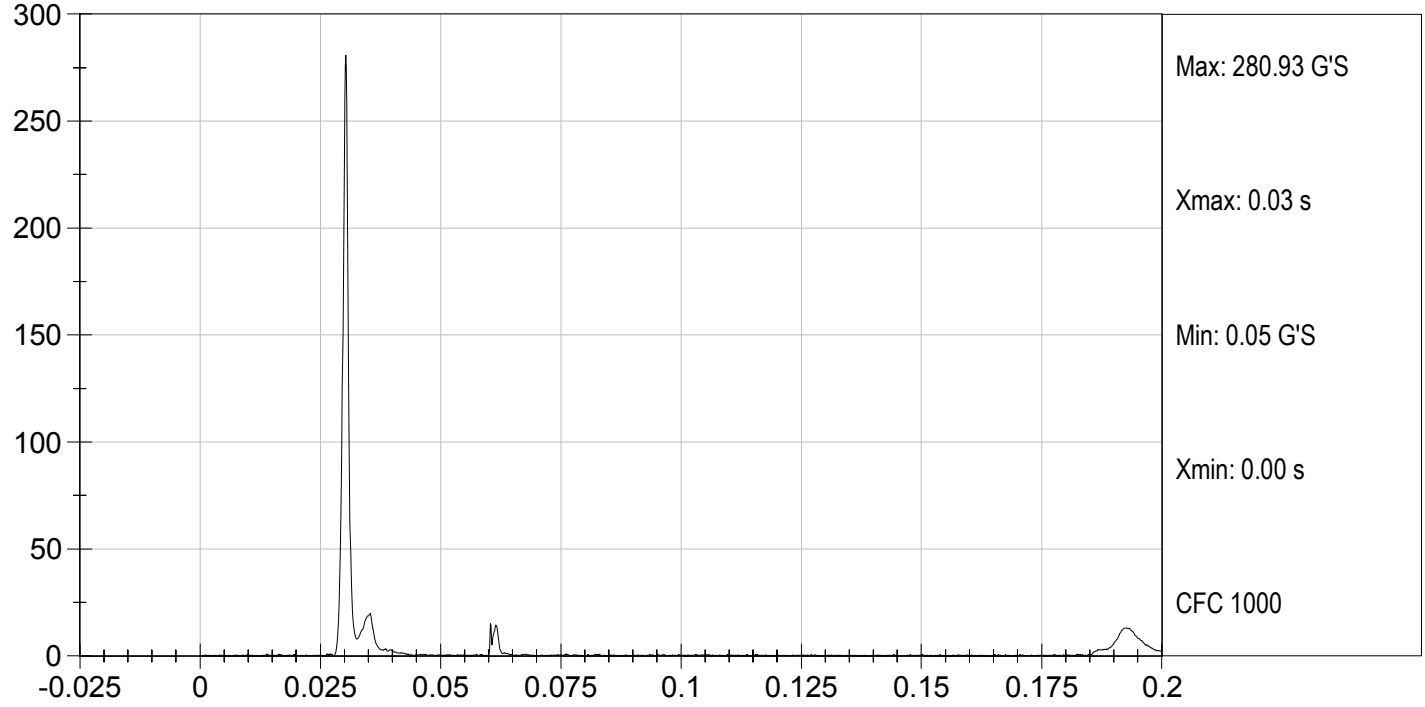
08/23/2004
Test Date

Approved By

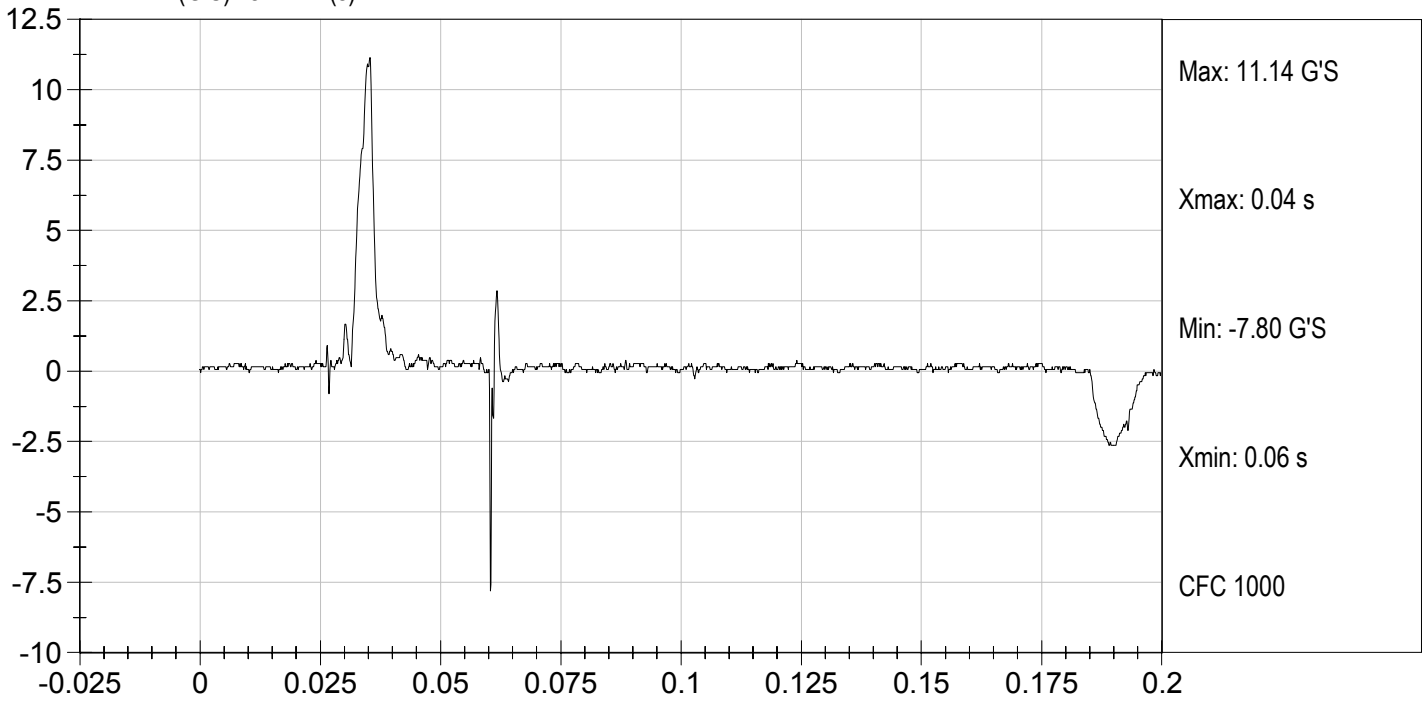
Test Desc: Head Drop
Componet ID: D042001

Test Date: 08/23/2004
Velocity: 0 ft/s, 0 m/s

PEAK RESULTANT ACCELERATION (G'S) vs TIME (s)




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



DATA SHEET B4
NECK FLEXION TEST (572.133)

Dummy Serial Number ___516___ Test Date ___8/23/04___

Technician ___Joe Fleck___

_X_Pretest 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))
_X_ N/A, ONLY one flexion test performed

_X_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))

_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. (572.133(c)(1))
Record the maximum temperature __21.8__
Record the minimum temperature __21.2__
Record the maximum humidity __54%__
Record the minimum humidity __50%__

_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. (880105-250 and PADI page17).
Record findings and actions: __No Deterioration. Hardness Front 89; Back 89.

_X_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 ± 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 | Result |
|---|---|---|---|
| Pendulum impact speed | | 6.89 m/s ≤ speed ≤ 7.13 m/s | 7.12 m/s |
| Pendulum ΔV with respect to impact speed | @ 10ms | 2.1 m/s ≤ ΔV ≤ 2.5 m/s | 2.5 m/s |
| | @ 20 ms | 4.0 m/s ≤ ΔV ≤ 5.0 m/s | 4.8 m/s |
| | @30ms | 5.8 m/s ≤ ΔV ≤ 7.0 m/s | 6.8 m/s |
| Plane D Rotation | | Peak moment*<br>69 Nm ≤ moment ≤ 83 Nm during the following rotation range 77° ≤ angle ≤ 91° | __78__ Nm @ __78__ degrees |
| Positive Moment Decay** (Flexion) | | Time to decay to 10 Nm<br>80 ms ≤ time ≤ 100ms | 84 ms |

*Moment about the occipital condyle = $M_y$ – (0.01778 m x $F_x$) (572.133(b)(1)(ii))

My = Moment in Nm measured by the transducer

Fx = 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.

Signature _____ Date 8/23/04

**MGA RESEARCH CORPORATION**

**NECK FLEXION TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 516 **Test I.D:** D042002

| 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 |
| Pendulum Speed | | m/sec | 6.89 to 7.13 | 7.12 | Pass |
| Pendulum Deceleration | 10 msec | m/sec | 2.1 to 2.5 | 2.5 | Pass |
| | 20 msec | m/sec | 4.0 to 5.0 | 4.8 | Pass |
| | 30 msec | m/sec | 5.8 to 7.0 | 6.8 | Pass |
| D Plane Rotation | Max | deg | 77 to 91 | 78 | Pass |
| Occipital Condyle Moment within Deflection Corridor | | Nm | 69 to 83 | 78 | Pass |
| Positive Moment Time Curve Decay to 10 Nm | | msec | 80 to 100 | 84 | Pass |
| | | | Overall Results | | Pass |

Laboratory Technician

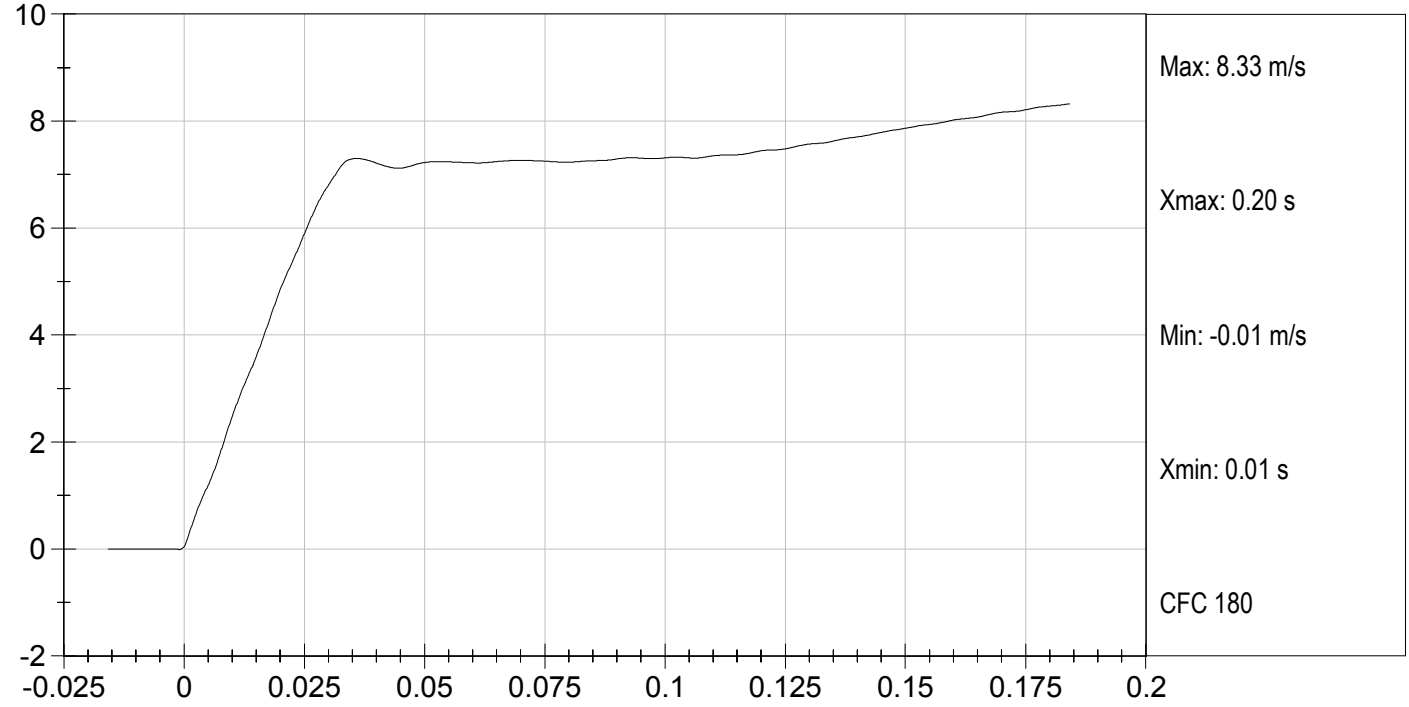
08/23/2004
Test Date

Approved By

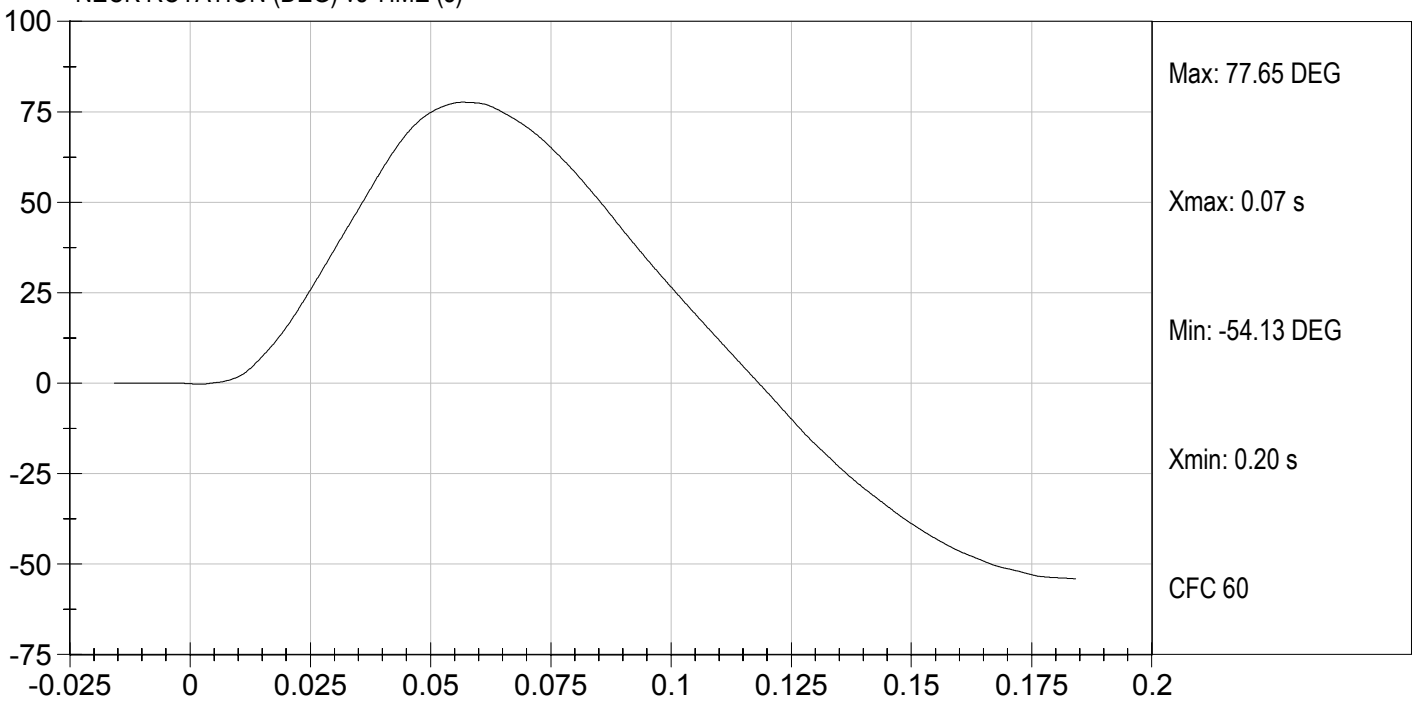
Test Desc: Neck Flexion
Componet ID: D042002

Test Date: 08/23/2004
Velocity: 23.35 ft/s, 7.12 m/s

PENDULUM DECELERATION (m/s) vs TIME (s)

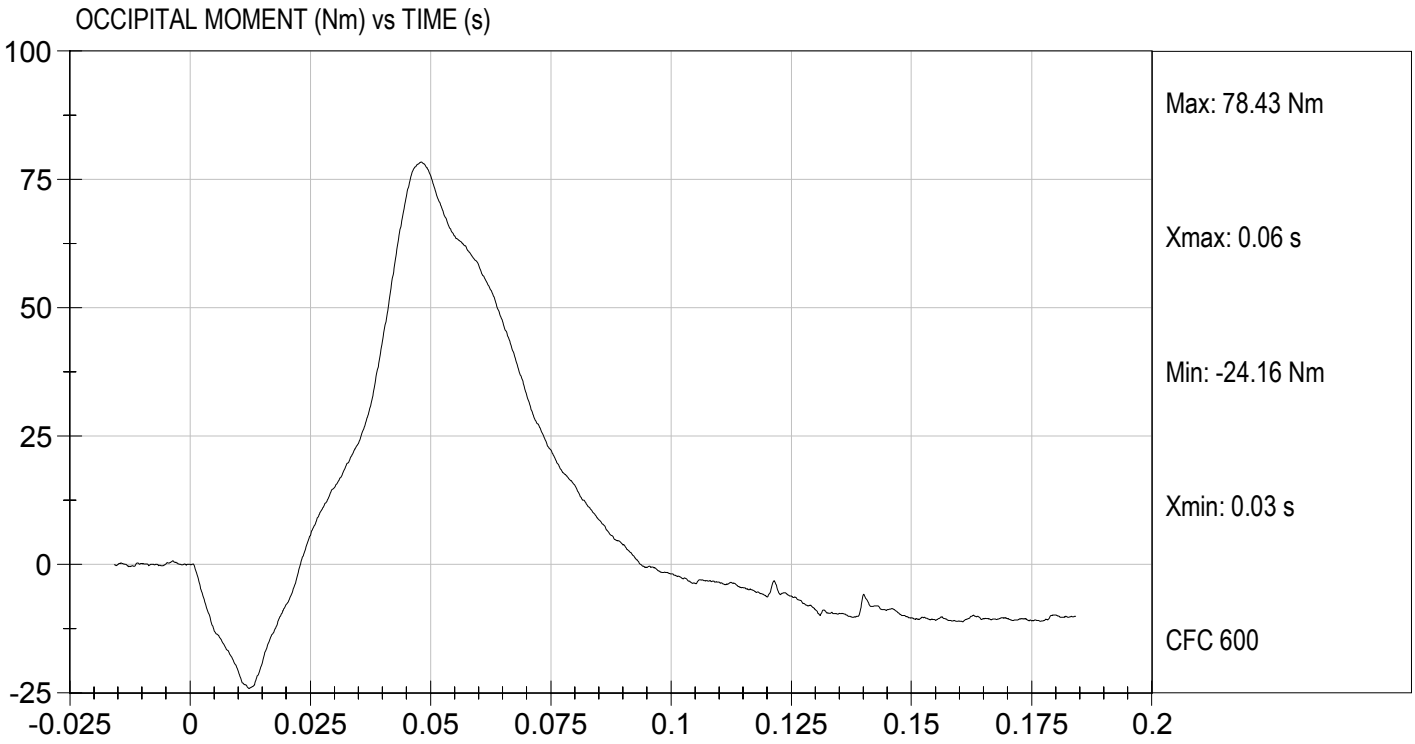



NECK ROTATION (DEG) vs TIME (s)



Test Desc: Neck Flexion
Componet ID: D042002

Test Date: 08/23/2004
Velocity: 23.35 ft/s, 7.12 m/s



DATA SHEET B5
NECK EXTENSION TEST (572.133)

Dummy Serial Number ___516_____ Test Date ___8/23/04_____

Technician _____Joe Fleck_____

_X_Pretest 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))
_X_ N/A, ONLY one extension test performed

_X_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))

_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. (572.133(c)(1))
Record the maximum temperature __21.8___
Record the minimum temperature __21.2___
Record the maximum humidity __54%__
Record the minimum humidity __50%__

_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. (880105-250 and PADI page17).
Record findings and actions: __No Deterioration. Hardness Front 89; Back 89.

_X_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 ± 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 | Result |
|---|---|---|---|
| Pendulum impact speed | | 5.95 m/s ≤ speed ≤ 6.19 m/s | 6.13 m/s |
| Pendulum ΔV with respect to impact speed | @ 10ms | 1.5 m/s ≤ ΔV ≤ 1.9 m/s | 1.8 m/s |
| | @ 20 ms | 3.1 m/s ≤ ΔV ≤ 3.9 m/s | 3.6 m/s |
| | @30ms | 4.6 m/s ≤ ΔV ≤ 5.6 m/s | 5.2 m/s |
| Plane D Rotation | | Peak moment*<br>-65 Nm ≤ moment ≤ -53 Nm during the following rotation range 99° ≤ angle ≤ 114° | _-54_ Nm @ _109_ degrees |
| Negative Moment Decay** (Extension) | | Time to decay to -10 Nm<br>94 ms ≤ time ≤ 114 ms | 101 ms |

*Moment about the occipital condyle = $M_y$ – (0.01778 m x $F_x$) (572.133(b)(1)(ii)

My = Moment in Nm measured by the transducer

Fx = 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.

Joe Fleck _____ 8/23/04

Signature Date

**MGA RESEARCH CORPORATION**

**NECK EXTENSION TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 516 **Test I.D:** D042003

| 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 | 53 | Pass |
| Pendulum Speed | | m/sec | 5.95 to 6.19 | 6.13 | Pass |
| Pendulum Deceleration | 10 msec | m/sec | 1.5 to 1.9 | 1.8 | Pass |
| | 20 msec | m/sec | 3.1 to 3.9 | 3.6 | Pass |
| | 30 msec | m/sec | 4.6 to 5.6 | 5.2 | Pass |
| D Plane Rotation | Max | deg | 99 to 114 | 109 | Pass |
| Occipital Condyle Moment within Deflection Corridor | | Nm | -65 to -53 | -54 | Pass |
| Negative Moment Time Curve Decay to -10 Nm | | msec | 94 to 114 | 101 | Pass |
| | | | Overall Results | | Pass |

Laboratory Technician

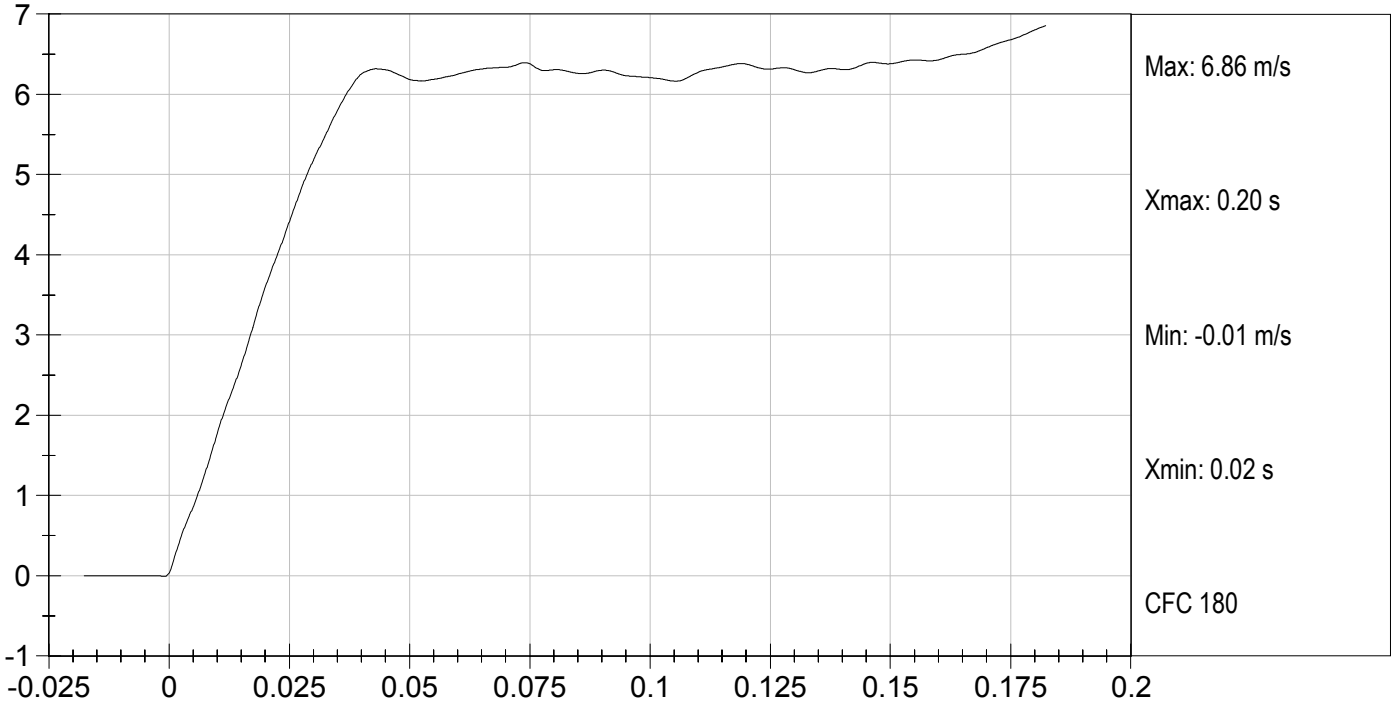
08/23/2004
Test Date

Approved By

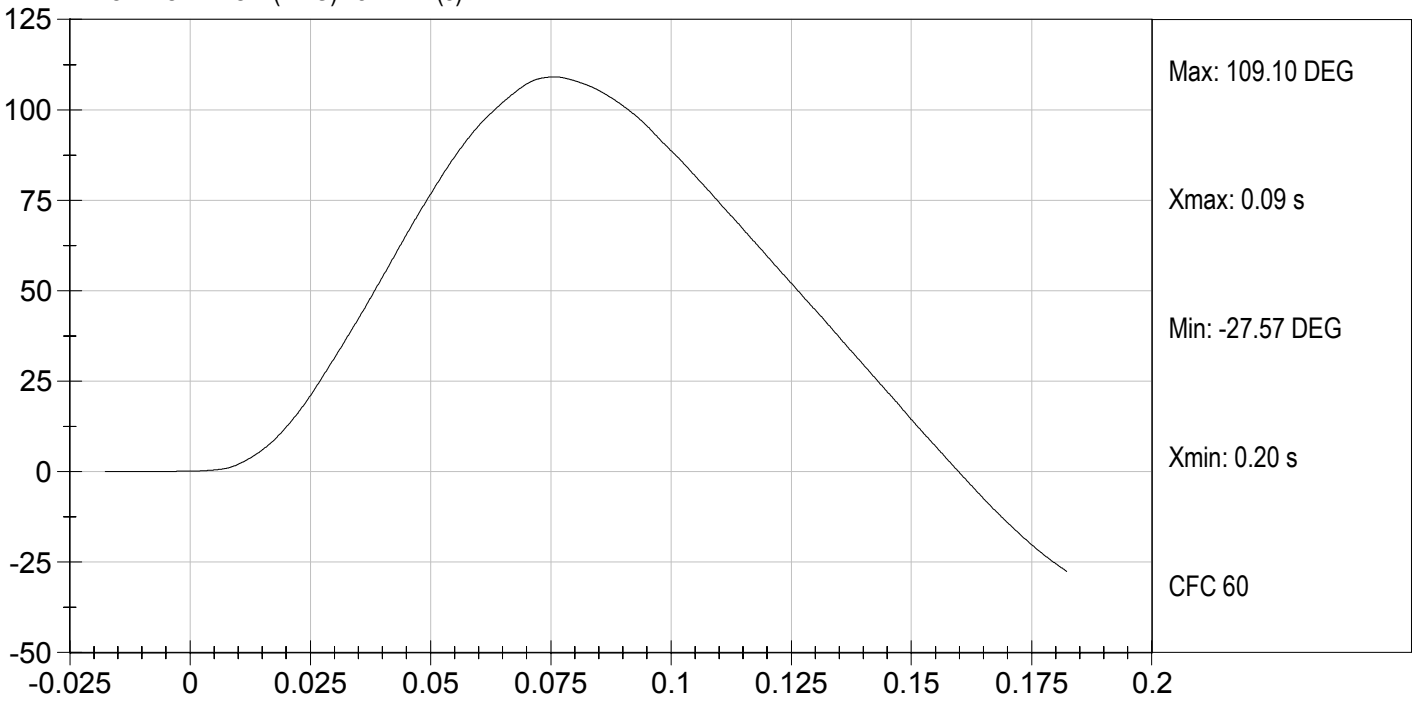
Test Desc: Neck Extension
Componet ID: D042003

Test Date: 08/23/2004
Velocity: 20.12 ft/s, 6.13 m/s

PENDULUM DECELERATION (m/s) vs TIME (s)

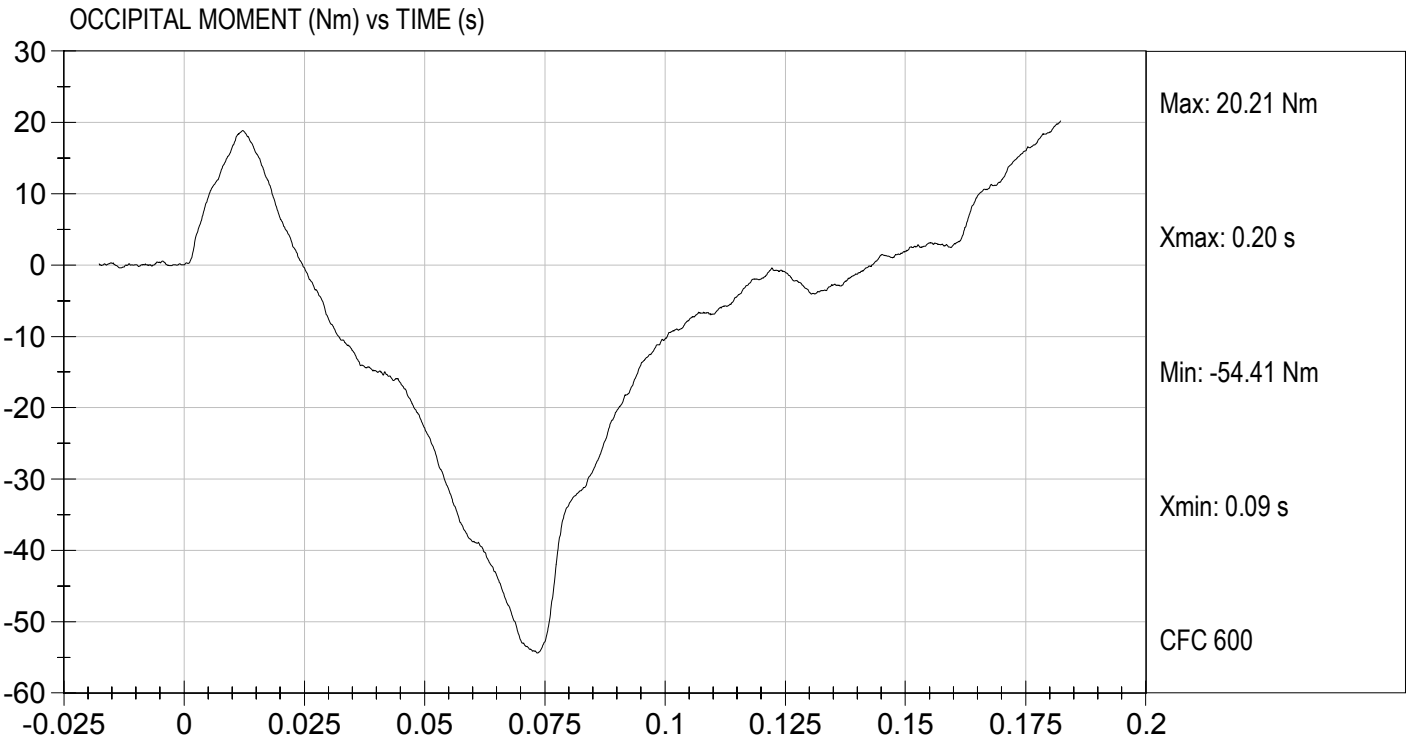



NECK ROTATION (DEG) vs TIME (s)



Test Desc: Neck Extension
Componet ID: D042003

Test Date: 08/23/2004
Velocity: 20.12 ft/s, 6.13 m/s



DATA SHEET B6
THORAX IMPACT TEST (572.134)

Dummy Serial Number __516_____ Test Date __8/24/04_____

Technician ____Joe Fleck_____

_X_Pretest 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))
_X_ N/A, ONLY one thorax impact test performed
_X_2. The test fixture conforms to the specifications in Figure 11B.
_X_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))
_X_4. The dummy assembly soaked at a temperature between 20.6°C (69ºF) and 22.2°C (72ºF) 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 _21.7_
Record the minimum temperature _20.7_
Record the maximum humidity _54%_
Record the minimum humidity _49%_
_X_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.
_X_ - 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 ± 0.5º and adjust the pelvis angle to 7º ± 2º. 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 ± 1º. (572.134(c)(3))

_X_ 9. The longitudinal centerline of the test probe is centered within ±2.5 mm of the midsagittal plane of the dummy and is 12.7 mm ± 1mm below the horizontal peripheral centerline of the No. 3 rib and is within 0.5º 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 ± 2º 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 2º 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 ± 0.12m/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 m/s ≤ speed ≤ 6.83 m/s | 6.75 m/s |
| Chest Compression | 50.0 mm ≤ compression ≤ 58.0 mm | 52 mm |
| Peak force** between 50.0 and 58.0 mm chest compression | 3900N ≤ peak force ≤ 4400N | 4200 N |
| Peak force** between 18.0 and 50.0 mm chest compression | peak force ≤ 4600 N | 4190 N |
| Internal Hysteresis*** | 69% ≤ hysteresis ≤ 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.

Jan Fleck 8/24/04

Signature Date

**MGA RESEARCH CORPORATION**

**THORAX IMPACT**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 516 **Test I.D:** D042004

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Temperature | deg C | 20.6 to 22.2 | 21.2 | Pass |
| Relative Humidity | % | 10 to 70 | 52 | Pass |
| Probe Speed | m/s | 6.59 to 6.83 | 6.75 | Pass |
| Peak Deflection | mm | 50 to 58 | 52.4 | Pass |
| Peak Resistive Force w/in Deflection Corridor | kN | 3.9 to 4.4 | 4.2 | Pass |
| Internal Hysteresis | % | 69 to 85 | 70 | Pass |
| Peak Force 18 mm - 50 mm | N | < 4600 N | 4,190 | Pass |
| | | Overall Test Results | | Pass |

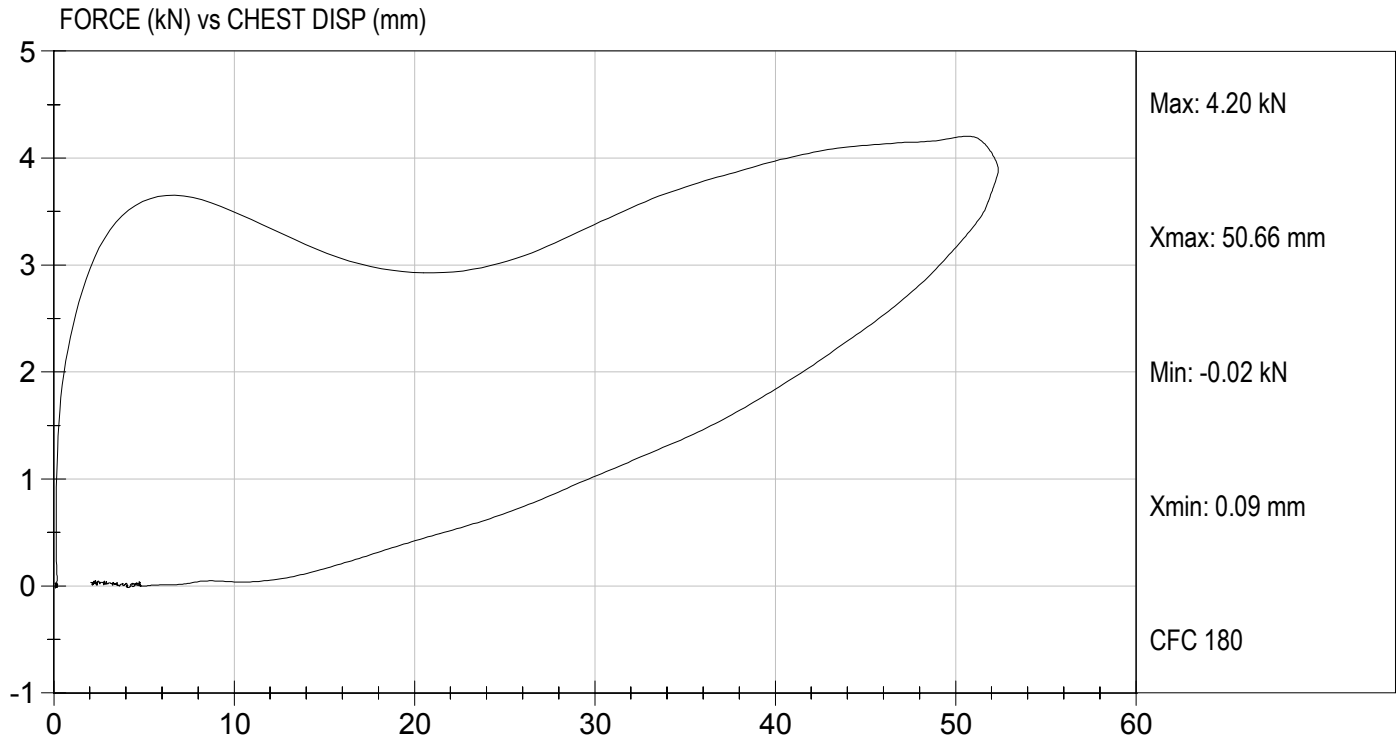
Laboratory Technician

08/24/2004
Test Date

Approved By

Test Desc: Thorax Impact
Componet ID: D042004

Test Date: 08/24/2004
Velocity: 22.14 ft/s, 6.75 m/s



DATA SHEET B7
TORSO FLEXION TEST (572.135)

Dummy Serial Number __516_____ Test Date __8/23/04_____

Technician _____Joe Fleck_____

_X_Pretest 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))
_X_ N/A, ONLY one thorax impact test performed
_X_2. The test fixture conforms to the specifications in Figure 13B.
_X_3. The complete assembled dummy (880105-000) is used (572.135(c)(2)).
__ with legs below the femurs.
_X_ without legs below the femurs.
_X_4. The dummy assembly soaked at a temperature between 18.9°C (66ºF) and 25.6°C (78ºF) 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 __21.8__
Record the minimum temperature __21.2__
Record the maximum humidity __54%__
Record the minimum humidity __50%__
_X_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))
_X_6. Attach the loading adapter bracket to the spine of the dummy as shown in Figure 13B**.** (572.135(c)(4))
_X_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))
_X_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°)___18°___
_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° | 18° |
| Torso rotation rate | 0.5°/s ≤ rate ≤ 1.5°/s | 1.0 |
| Force at 45° ±0.5° | 320 N ≤ force ≤ 390 N | 336 N |
| Final ref. plane angle | Initial ref. plane angle ±8° | 19° |

Signature 8/23/04 Date

**MGA RESEARCH CORPORATION**

**TORSO FLEXION TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 516 **Test I.D:** D042007

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 - 25.6 | 21.2 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 50 | Pass |
| Initial Angle | deg | 0 to 20 | 17.5 | Pass |
| Return Angle | deg | +/- 8 | 22 | Pass |
| Force at 45 deg | N | 320 to 390 | 357 | Pass |
| Upper Torso Deflection Rate | Deg/sec | 0.5 - 1.5 | 1.0 | Pass |
| | | Overall Result | | Pass |

Joe Fleck
Laboratory Technician

08/23/2004
Test Date

Jeff Leonardelli
Approved By

DATA SHEET B8
LEFT KNEE IMPACT TEST (572.136)

Dummy Serial Number __516_____ Test Date __8/23/04_____

Technician ____Joe Fleck_____

_X_Pretest 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))
_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 (66ºF) and 25.6°C (78ºF) 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 _21.8__
Record the minimum temperature _21.2__
Record the maximum humidity _54%__
Record the minimum humidity _50%__
_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 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 m/s ≤ speed ≤ 2.13 m/s | 2.11 m/s |
| Peak resistance force* | 3450 N ≤ force ≤ 4060 N | 3800 N |

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

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

Joe Fleck
Signature

8/23/04
Date

**MGA RESEARCH CORPORATION**

**LEFT KNEE IMPACT TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 516 **Test I.D:** D042006

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 to 25.5 | 21.4 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 53 | Pass |
| Probe Speed | m/sec | 2.07 to 2.13 | 2.11 | Pass |
| Maximum Force | kN | 3.45 to 4.06 | 3.8 | Pass |
| | | Overall Test Results | | Pass |

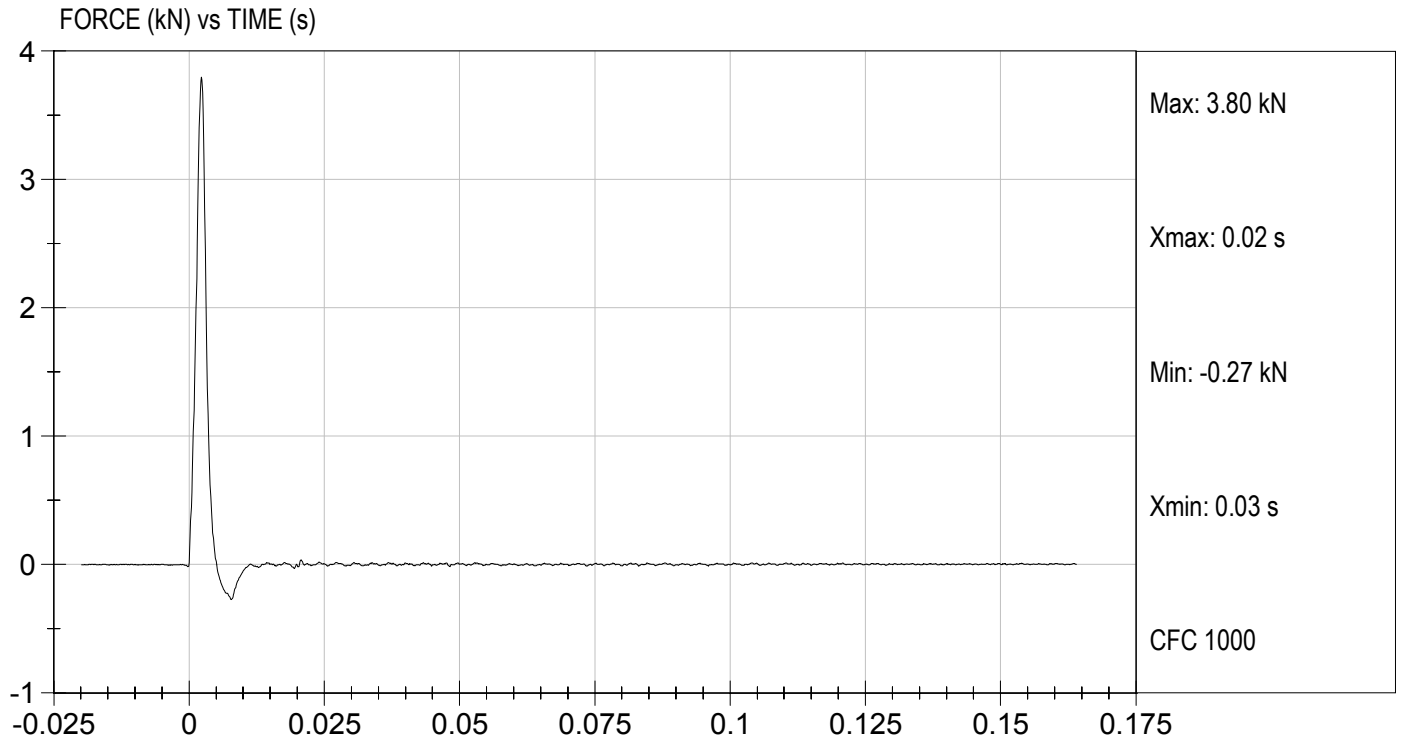
Laboratory Technician

08/23/2004
Test Date

Approved By

Test Desc: Left Knee
Componet ID: D042006

Test Date: 08/23/2004
Velocity: 6.91 ft/s, 2.11 m/s



DATA SHEET B9
RIGHT KNEE IMPACT TEST (572.136)

Dummy Serial Number ___516_____ Test Date __8/23/04_____

Technician ___Joe Fleck_____

_X_Pretest calibration
__Post test calibration verification

Test attempt no. _2__ (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))
__ 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 (880105-528R), 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))
_X_4. The knee assembly soaked at a temperature between 18.9°C (66ºF) and 25.6°C (78ºF) 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 _21.8___
Record the minimum temperature _21.1___
Record the maximum humidity _54 %___
Record the minimum humidity _50 %___
_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 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))
_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 m/s ≤ speed ≤ 2.13 m/s | 2.11 m/s |
| Peak resistance force* | 3450 N ≤ force ≤ 4060 N | 3790 N |

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

_X_12. Plots of acceleration versus time and force versus time follow this sheet.

Signature

8/23/04
Date

**MGA RESEARCH CORPORATION**

**RIGHT KNEE IMPACT TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 516 **Test I.D:** D042005

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 to 25.5 | 21.3 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 53 | Pass |
| Probe Speed | m/sec | 2.07 to 2.13 | 2.11 | Pass |
| Maximum Force | kN | 3.45 to 4.06 | 3.79 | Pass |
| | | Overall Test Results | | Pass |

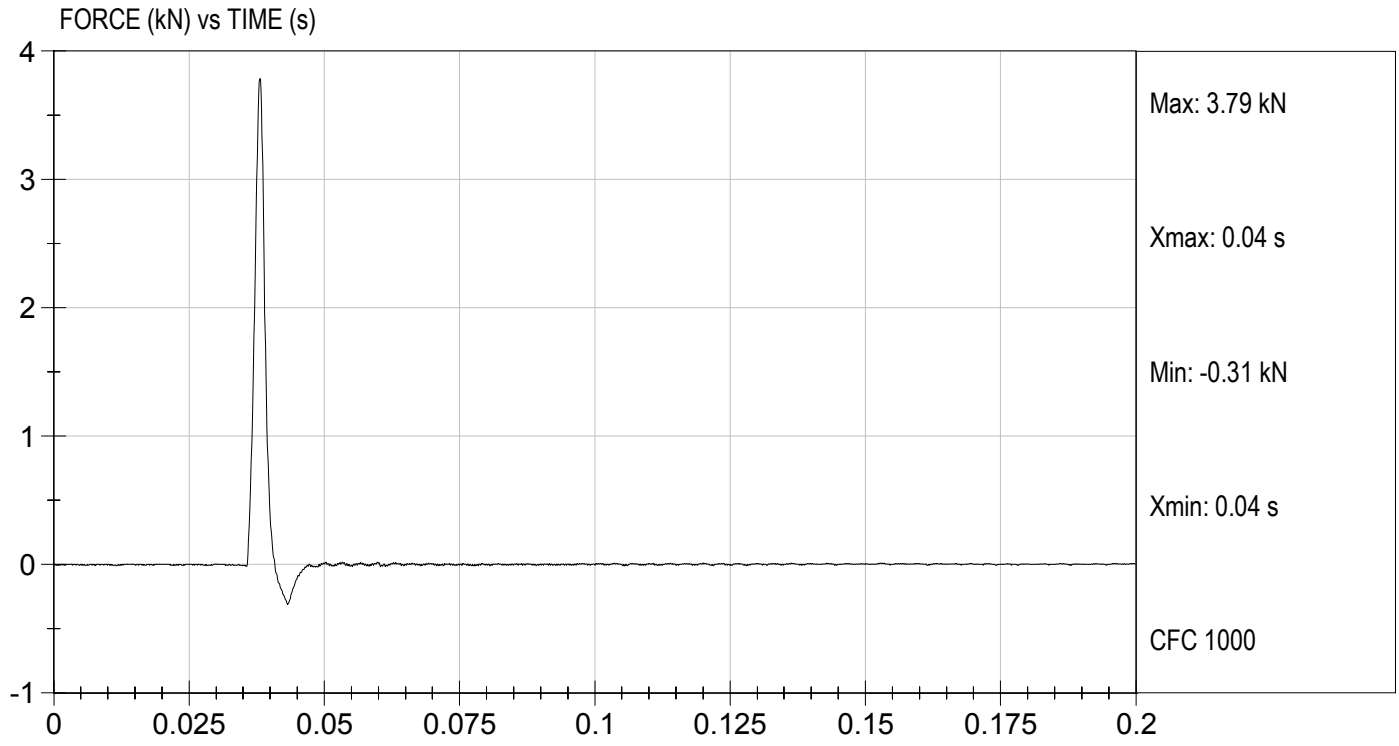
Joe Fleck
Laboratory Technician

08/23/2004
Test Date

Jeff Levandoski
Approved By

Test Desc: Right Knee
Componet ID: D042005

Test Date: 08/23/2004
Velocity: 6.92 ft/s, 2.11 m/s



DATA SHEET B1
DUMMY DAMAGE CHECKLIST

Dummy Serial Number _____516_____ Test Date __8/27/04___

Technician _____Jessica Gall_____

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

_X_ Perform general cleaning.

| Dummy Item | Inspect for | Comments | Damaged | 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** |

| Dummy Item | Inspect for | Comments | Damaged | OK |
|---|---|---|---|---|
| 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 _____ 8/30/04_____
Signature Date

Describe the repair or replacement of parts:

Checked by

Jeff Leonardelli _____ 8/30/04_____
Signature Date

## EXTERNAL DIMENSIONS

| SN516, HYBRID III, 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 | 785.2 |
| B | SHOULDER PIVOT HEIGHT | Centerline of shoulder pivot bolt to the seat surface. | 431.8-457.2 | 454.9 |
| C | H-POINT HEIGHT | Reference | 81.3-86.3 | 83.5 |
| D | H-POINT LOCATION FROM BACKLINE | Reference | 144.8-149.8 | 146.2 |
| E | SHOULDER PIVOT FROM BACKLINE | Center of the shoulder clevis to the rear vertical surface of the fixture. | 68.6-83.8 | 81.5 |
| F | THIGH CLEARANCE | Measured at the highest point on the upper femur segment. | 119.4-134.6 | 130.0 |
| G | BACK OF ELBOW TO WRIST PIVOT | Back of the elbow flesh to the wrist pivot in line with the elbow and wrist pivots | 243.9-259.1 | 252.0 |
| H | HEAD BACK TO BACKLINE | Back of skull cap skin to seat rear vertical surface (Reference) | 43.2-48.2 | 44.5 |
| 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 | 282.3 |
| J | ELBOW REST HEIGHT | Measure from the flesh below the elbow pivot bolt to the seat surface. | 182.8-203.2 | 187.1 |
| 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 | 525.9 |
| L | POPLITEAL HEIGHT | Seat surface to the plane of the horizontal plane of the bottom of the feet. | 355.6-376.0 | 357.7 |
| M | KNEE PIVOT HEIGHT | Centerline of knee pivot bolt to the horizontal plane of the bottom of the feet. | 393.7-419.1 | 396.0 |
| 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”. | 414-439.4 | 421.2 |

| SN516, HYBRID III, 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 | 176.8 |
| P | FOOT LENGTH | Tip of toe to rear of heal | 218.5-233.7 | 223.0 |
| 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 | 472.1 |
| S | HEAD BREADTH | The widest part of the head | 137.1-147.3 | 141.7 |
| T | HEAD DEPTH | Back of the head to the forehead | 177.8-188.0 | 180.1 |
| U | HIP BREADTH | The widest part of the hip | 299.7-314.9 | 310.0 |
| V | SHOULDER BREADTH | Outside edges of right and left shoulder clevises | 350.5-365.7 | 357.1 |
| W | FOOT BREADTH | The widest part of the foot | 78.8-94.0 | 82.5 |
| X | HEAD CIRCUMFERENCE | Measured at the point as in dim. “T” | 528.3-548.7 | 539.6 |
| Y | CHEST CIRCUMFERENCE (WITH CHEST JACKET) | Measured 345.4 ± 12.7 mm above seat surface | 850.9-881.3 | 863.2 |
| Z | WAIST CIRCUMFERENCE | Measured 165.1 ± 5.1 mm above seat surface | 759.5-789.9 | 784.4 |
| AA | REFERENCE LOCATION FOR MEASUREMENT OF CHEST CIRCUMFERENCE | Reference | 332.7-358.1 | 342.0 |
| BB | REFERENCE LOCATION FOR MEASUREMENT OF WAIST CIRCUMFERENCE | Reference | 160.1-170.2 | 163.0 |

## EXTERNAL DIMENSIONS

| SN506, HYBRID III, 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 | 780.2 |
| B | SHOULDER PIVOT HEIGHT | Centerline of shoulder pivot bolt to the seat surface. | 431.8-457.2 | 443.0 |
| C | H-POINT HEIGHT | Reference | 81.3-86.3 | 85.1 |
| D | H-POINT LOCATION FROM BACKLINE | Reference | 144.8-149.8 | 145.0 |
| E | SHOULDER PIVOT FROM BACKLINE | Center of the shoulder clevis to the rear vertical surface of the fixture. | 68.6-83.8 | 76.4 |
| F | THIGH CLEARANCE | Measured at the highest point on the upper femur segment. | 119.4-134.6 | 128.0 |
| G | BACK OF ELBOW TO WRIST PIVOT | Back of the elbow flesh to the wrist pivot in line with the elbow and wrist pivots | 243.9-259.1 | 255.8 |
| 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 | 280.2 |
| J | ELBOW REST HEIGHT | Measure from the flesh below the elbow pivot bolt to the seat surface. | 182.8-203.2 | 193.0 |
| 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 | 545.0 |
| L | POPLITEAL HEIGHT | Seat surface to the plane of the horizontal plane of the bottom of the feet. | 355.6-376.0 | 365.2 |
| M | KNEE PIVOT HEIGHT | Centerline of knee pivot bolt to the horizontal plane of the bottom of the feet. | 393.7-419.1 | 400.5 |
| 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”. | 414-439.4 | 438.0 |

| SN506, HYBRID III, 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 | 183.0 |
| P | FOOT LENGTH | Tip of toe to rear of heal | 218.5-233.7 | 226.2 |
| 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 | 475.8 |
| S | HEAD BREADTH | The widest part of the head | 137.1-147.3 | 142.0 |
| T | HEAD DEPTH | Back of the head to the forehead | 177.8-188.0 | 180.5 |
| U | HIP BREADTH | The widest part of the hip | 299.7-314.9 | 305.1 |
| V | SHOULDER BREADTH | Outside edges of right and left shoulder clevises | 350.5-365.7 | 359.0 |
| W | FOOT BREADTH | The widest part of the foot | 78.8-94.0 | 85.5 |
| X | HEAD CIRCUMFERENCE | Measured at the point as in dim. “T” | 528.3-548.7 | 538.0 |
| Y | CHEST CIRCUMFERENCE (WITH CHEST JACKET) | Measured 345.4 ± 12.7 mm above seat surface | 850.9-881.3 | 857.6 |
| Z | WAIST CIRCUMFERENCE | Measured 165.1 ± 5.1 mm above seat surface | 759.5-789.9 | 789.0 |
| AA | REFERENCE LOCATION FOR MEASUREMENT OF CHEST CIRCUMFERENCE | Reference | 332.7-358.1 | 345.0 |
| BB | REFERENCE LOCATION FOR MEASUREMENT OF WAIST CIRCUMFERENCE | Reference | 160.1-170.2 | 165.0 |

DATA SHEET B3
HEAD DROP TEST (572.132)

Dummy Serial Number 506 Test Date 7/12/04

Technician Joe Fleck

_X_Pretest 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))
__X_ N/A, ONLY one head drop performed
_X_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))
_X_3. The head accelerometer mounting plate screws ((10-24 x 3/8 SHCS) are torqued to 9.0 Nm.
_X_4. Accelerometers and their respective mounts are smooth and clean.
_X_5. Torque the skull cap screws (10-24 x 1/2 SHCS) to 9.0 Nm.
_X_6. The data acquisition system, including transducers, conforms to the requirements of SAE Recommended Practice J211/1 MAR95. (572.136(m))
_X_7. The head assembly soaked at a temperature between 18.9°C (66ºF) and 25.6°C (78ºF) 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 21.2
Record the minimum temperature 20.6
Record the maximum humidity 54%
Record the minimum humidity 50%
_X_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 ± 1.0 mm (14.8±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 _501mm_____
Record the left side distance _501mm_____

_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 _$656 \times 10^{-6}$mm_____

_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 ± 1.0 mm (14.8 inches ± 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 g ≤ x ≤ 300 g | 266 |
| 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 ≤ 15 g | 14 |

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

Joe Fleck
Signature

7/12/04
Date

**MGA RESEARCH CORPORATION**

**HEAD DROP TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 506 **Test ID:** D041561

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 - 25.6 | 21.0 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 52 | Pass |
| Peak Resultant Acceleration | G's | 250 - 300 | 266 | Pass |
| Peak Lateral Acceleration | G's | +/- 15 | 14.5 | Pass |
| Unimodal | Yes/No | NA | Yes | Pass |
| Oscillations | Yes/No | within 10% of peak | Yes | Pass |
| | | Overall Test Results | | Pass |

Laboratory Technician

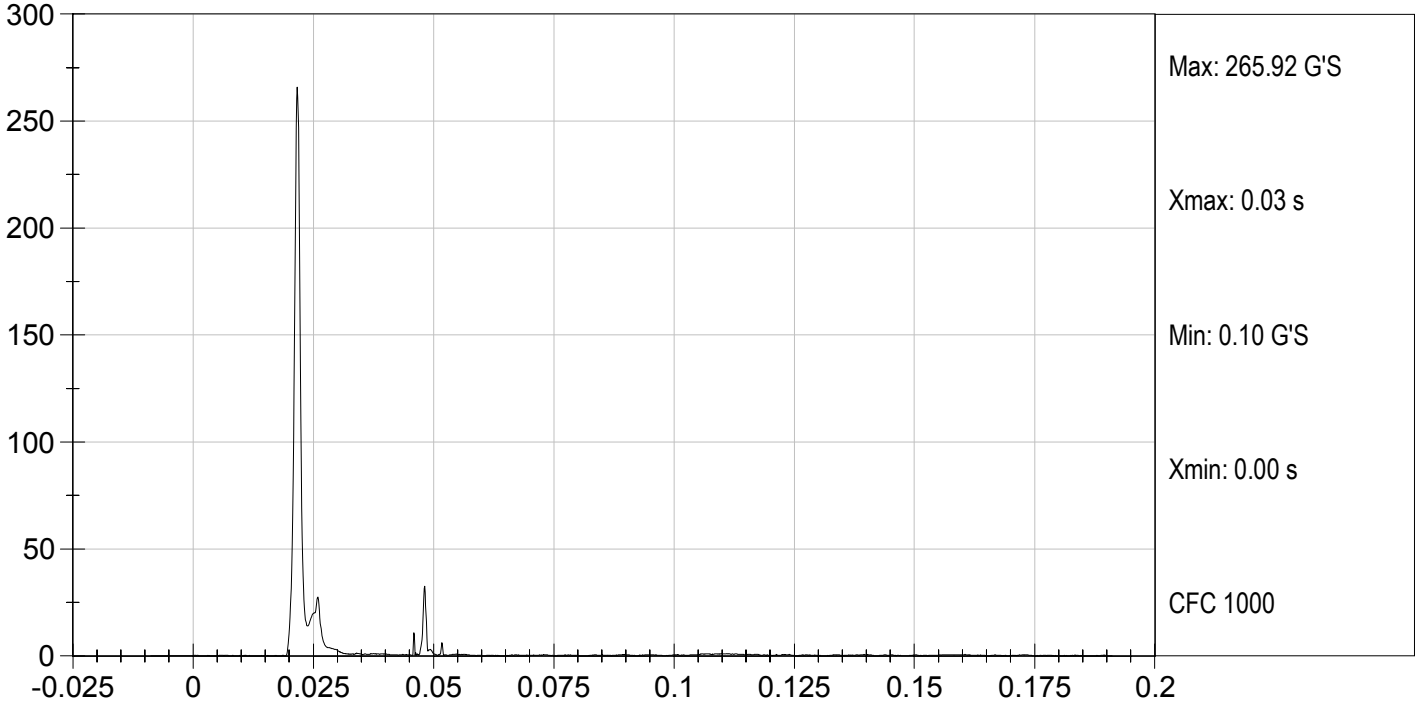
07/12/2004
Test Date

Approved By

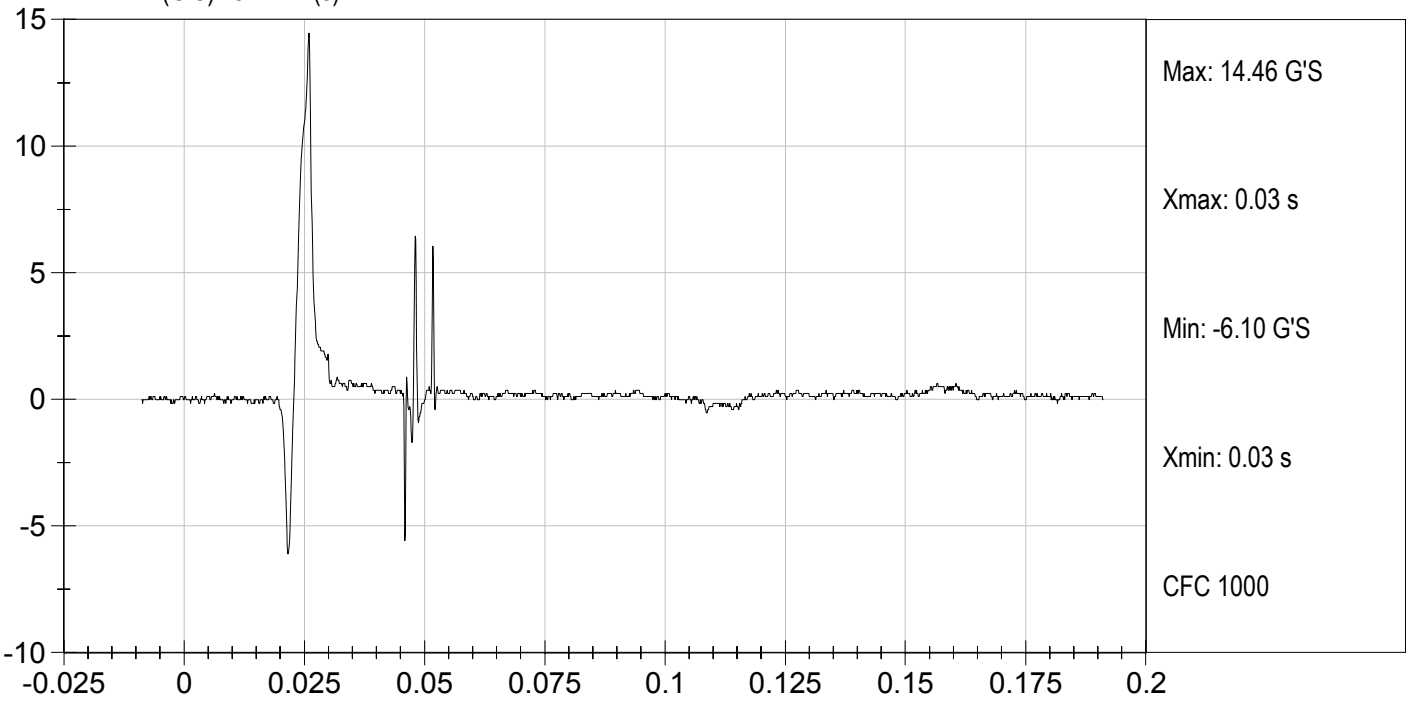
Test Desc: Head Drop
Componet ID: D041561

Test Date: 07/12/2004
Velocity: 0 ft/s, 0 m/s

PEAK RESULTANT ACCELERATION (G'S) vs TIME (s)




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



DATA SHEET B4
NECK FLEXION TEST (572.133)

Dummy Serial Number ___506___ Test Date ___7/12/04___

Technician ___Joe Fleck___

_X_Pretest 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))
_X_ N/A, ONLY one flexion test performed

_X_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))

_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. (572.133(c)(1))
Record the maximum temperature __21.2__
Record the minimum temperature __20.6__
Record the maximum humidity __54%__
Record the minimum humidity __50%__

_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. (880105-250 and PADI page17).
Record findings and actions: __No Deterioration. Hardness Front 89; Back 90.

_X_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 ± 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 | Result |
|---|---|---|---|
| Pendulum impact speed | | 6.89 m/s ≤ speed ≤ 7.13 m/s | 7.02 m/s |
| Pendulum ΔV with respect to impact speed | @ 10ms | 2.1 m/s ≤ ΔV ≤ 2.5 m/s | 2.4 m/s |
| | @ 20 ms | 4.0 m/s ≤ ΔV ≤ 5.0 m/s | 4.8 m/s |
| | @30ms | 5.8 m/s ≤ ΔV ≤ 7.0 m/s | 6.6 m/s |
| Plane D Rotation | | Peak moment*<br>69 Nm ≤ moment ≤ 83 Nm during the following rotation range 77° ≤ angle ≤ 91° | __83__Nm @ _81__degrees |
| Positive Moment Decay** (Flexion) | | Time to decay to 10 Nm<br>80 ms ≤ time ≤ 100ms | 85 ms |

*Moment about the occipital condyle = $M_y$ – (0.01778 m x $F_x$) (572.133(b)(1)(ii))

My = Moment in Nm measured by the transducer

Fx = 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.

Joe Fleck _____ 7/12/04

Signature Date

**MGA RESEARCH CORPORATION**

**NECK FLEXION TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 506 **Test I.D:** D041562

| 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 | 50 | Pass |
| Pendulum Speed | | m/sec | 6.89 to 7.13 | 7.02 | Pass |
| Pendulum Deceleration | 10 msec | m/sec | 2.1 to 2.5 | 2.4 | Pass |
| | 20 msec | m/sec | 4.0 to 5.0 | 4.8 | Pass |
| | 30 msec | m/sec | 5.8 to 7.0 | 6.6 | Pass |
| D Plane Rotation | Max | deg | 77 to 91 | 81 | Pass |
| Occipital Condyle Moment within Deflection Corridor | | Nm | 69 to 83 | 83 | Pass |
| Positive Moment Time Curve Decay to 10 Nm | | msec | 80 to 100 | 85 | Pass |
| | | | Overall Results | | Pass |

Laboratory Technician

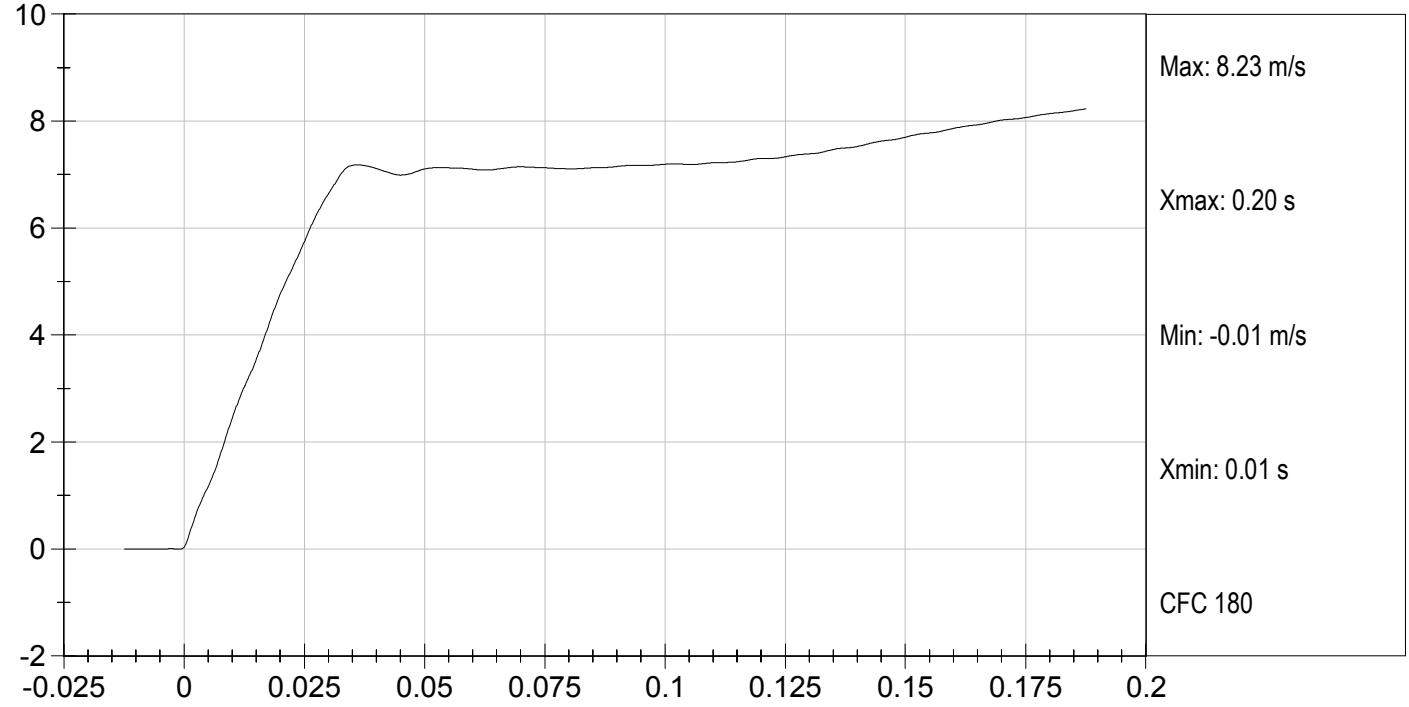
07/12/2004
Test Date

Approved By

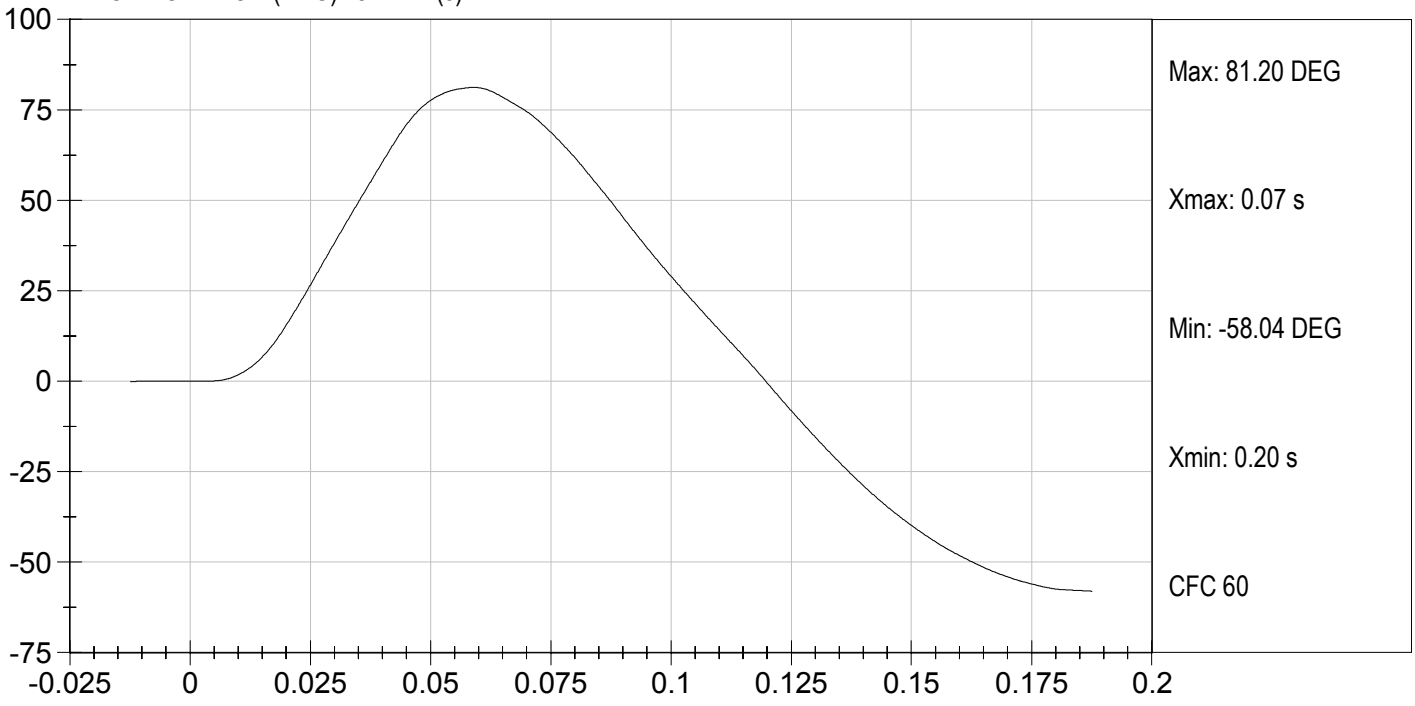
Test Desc: Neck Flexion
Componet ID: D041562

Test Date: 07/12/2004
Velocity: 23.03 ft/s, 7.02 m/s

PENDULUM DECELERATION (m/s) vs TIME (s)



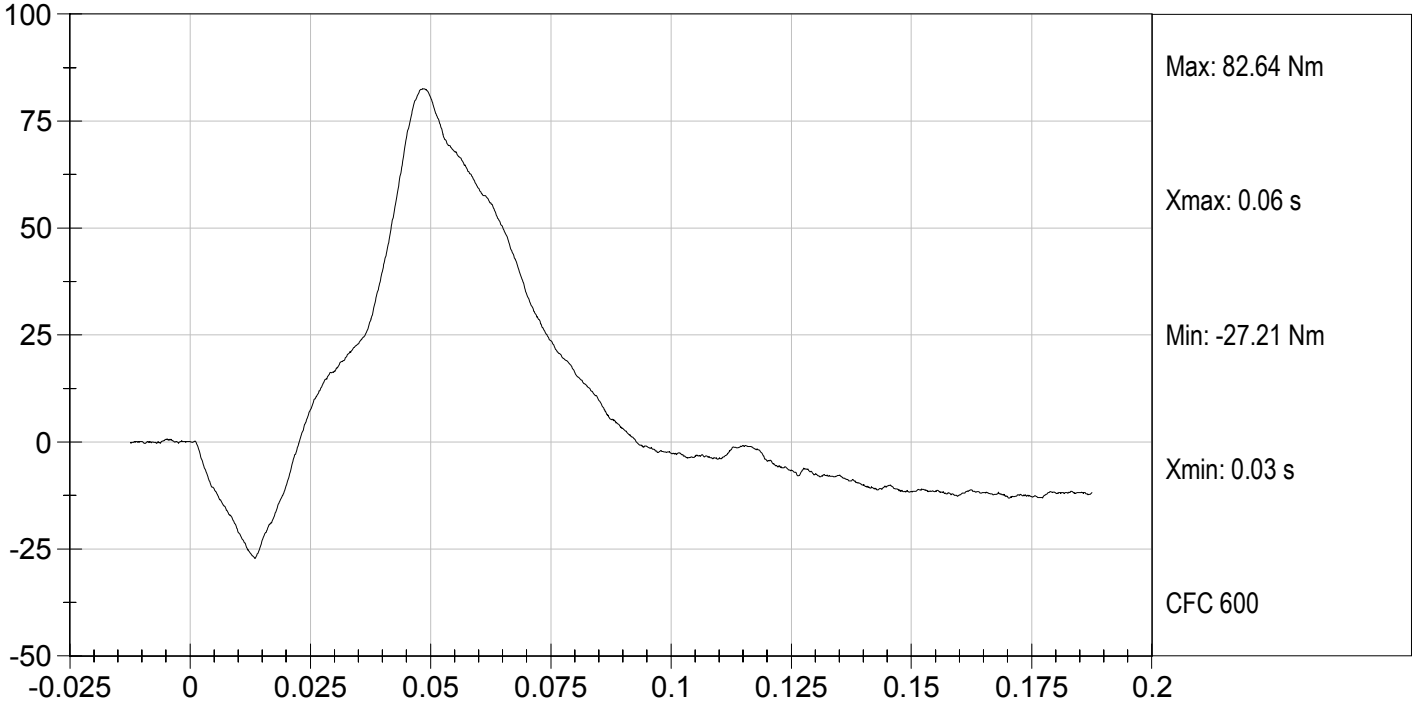

NECK ROTATION (DEG) vs TIME (s)



Test Desc: Neck Flexion
Componet ID: D041562

Test Date: 07/12/2004
Velocity: 23.03 ft/s, 7.02 m/s

OCCIPITAL MOMENT (Nm) vs TIME (s)



DATA SHEET B5
NECK EXTENSION TEST (572.133)

Dummy Serial Number ___506_____ Test Date ___7/12/04_____

Technician _____Joe Fleck_____

_X_Pretest 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))
_X_ N/A, ONLY one extension test performed

_X_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))

_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. (572.133(c)(1))
Record the maximum temperature __21.2___
Record the minimum temperature __20.6___
Record the maximum humidity __54%__
Record the minimum humidity __50%__

_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. (880105-250 and PADI page17).
Record findings and actions: __No Deterioration. Hardness Front 89; Back 90.

_X_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 ± 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 | Result |
|---|---|---|---|
| Pendulum impact speed | | 5.95 m/s ≤ speed ≤ 6.19 m/s | 6.07 m/s |
| Pendulum ΔV with respect to impact speed | @ 10ms | 1.5 m/s ≤ ΔV ≤ 1.9 m/s | 1.9 m/s |
| | @ 20 ms | 3.1 m/s ≤ ΔV ≤ 3.9 m/s | 3.8 m/s |
| | @30ms | 4.6 m/s ≤ ΔV ≤ 5.6 m/s | 5.6 m/s |
| Plane D Rotation | | Peak moment*<br>-65 Nm ≤ moment ≤ -53 Nm during the following rotation range 99° ≤ angle ≤ 114° | _-61_ Nm @ _110_ degrees |
| Negative Moment Decay** (Extension) | | Time to decay to -10 Nm<br>94 ms ≤ time ≤ 114 ms | 97 ms |

*Moment about the occipital condyle = $M_y$ – (0.01778 m x $F_x$) (572.133(b)(1)(ii)

My = Moment in Nm measured by the transducer

Fx = 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.

Joe Fleck

Signature

7/12/04

Date

**MGA RESEARCH CORPORATION**

**NECK EXTENSION TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 506 **Test I.D:** D041563

| 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 | 50 | Pass |
| Pendulum Speed | | m/sec | 5.95 to 6.19 | 6.07 | Pass |
| Pendulum Deceleration | 10 msec | m/sec | 1.5 to 1.9 | 1.9 | Pass |
| | 20 msec | m/sec | 3.1 to 3.9 | 3.8 | Pass |
| | 30 msec | m/sec | 4.6 to 5.6 | 5.6 | Pass |
| D Plane Rotation | Max | deg | 99 to 114 | 110 | Pass |
| Occipital Condyle Moment within Deflection Corridor | | Nm | -65 to -53 | -61 | Pass |
| Negative Moment Time Curve Decay to -10 Nm | | msec | 94 to 114 | 97 | Pass |
| | | | Overall Results | | Pass |

Laboratory Technician

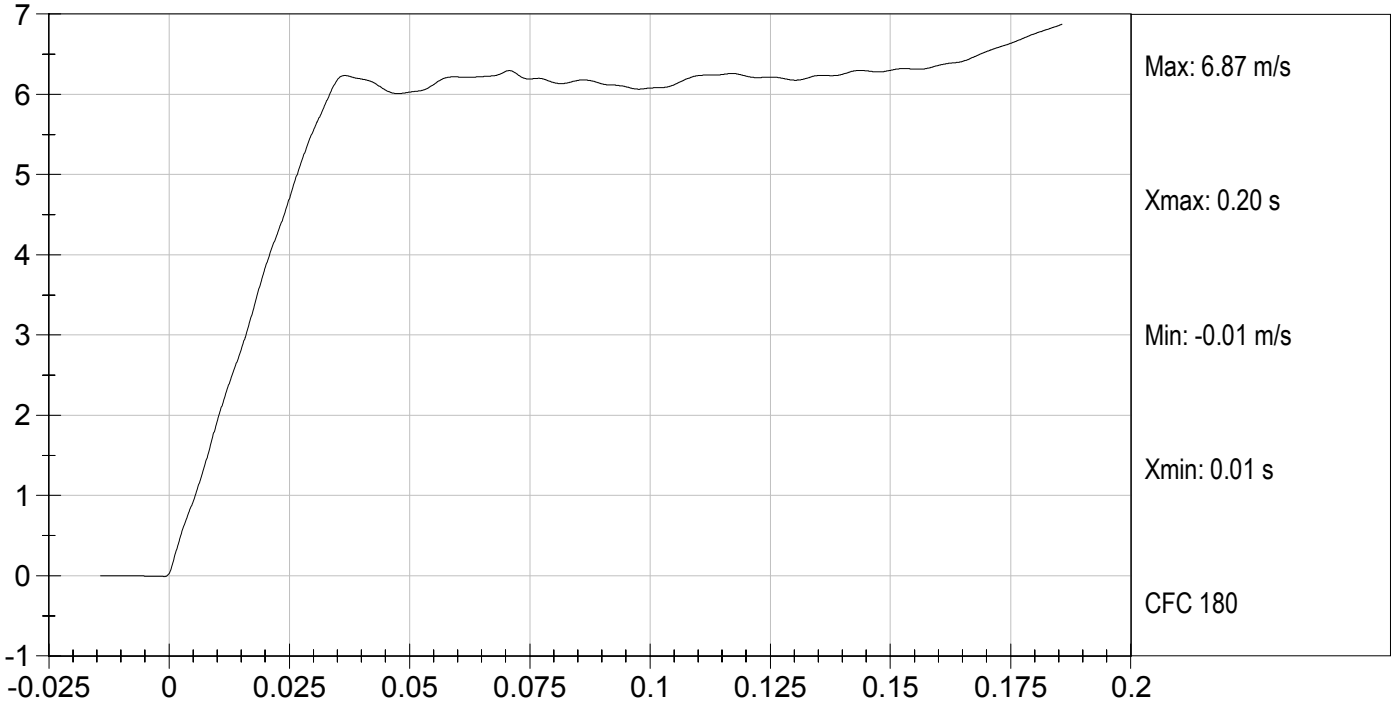
07/12/2004
Test Date

Approved By

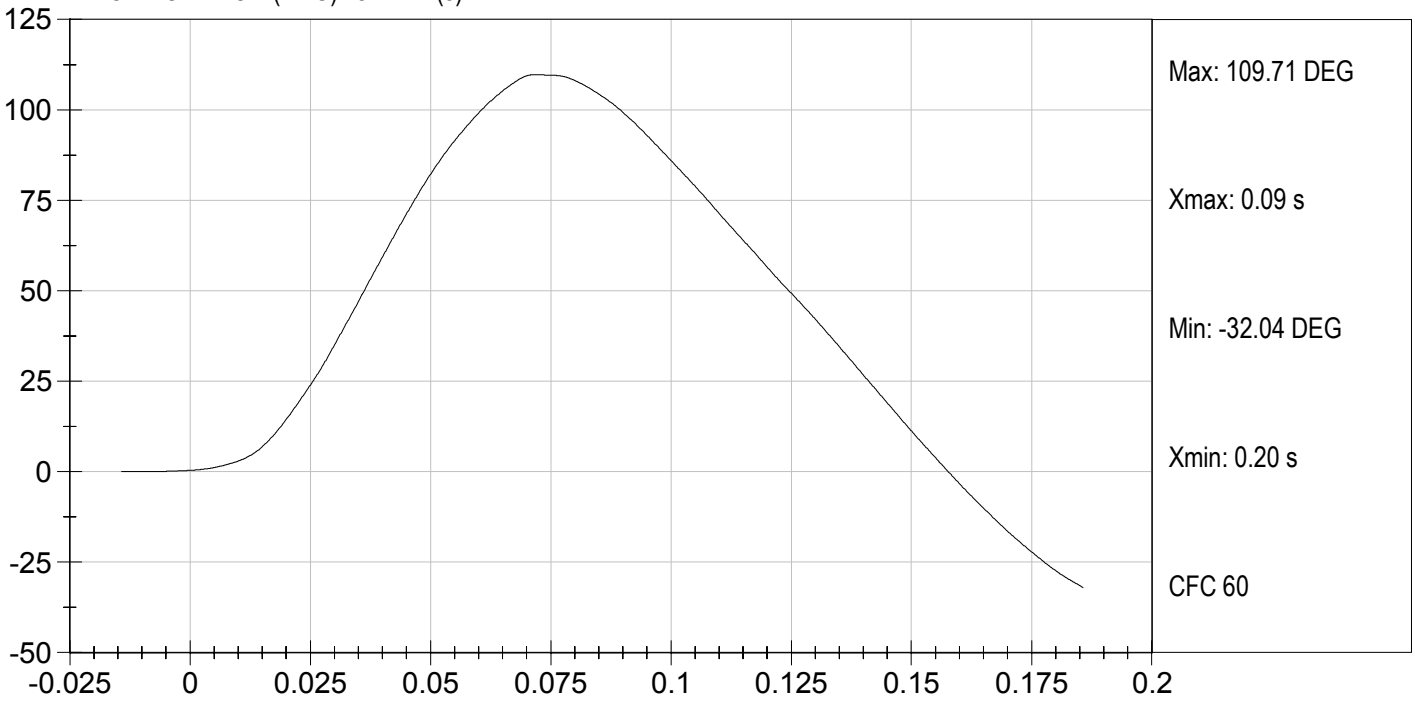
Test Desc: Neck Extension
Componet ID: D041563

Test Date: 07/12/2004
Velocity: 19.91 ft/s, 6.07 m/s

PENDULUM DECELERATION (m/s) vs TIME (s)

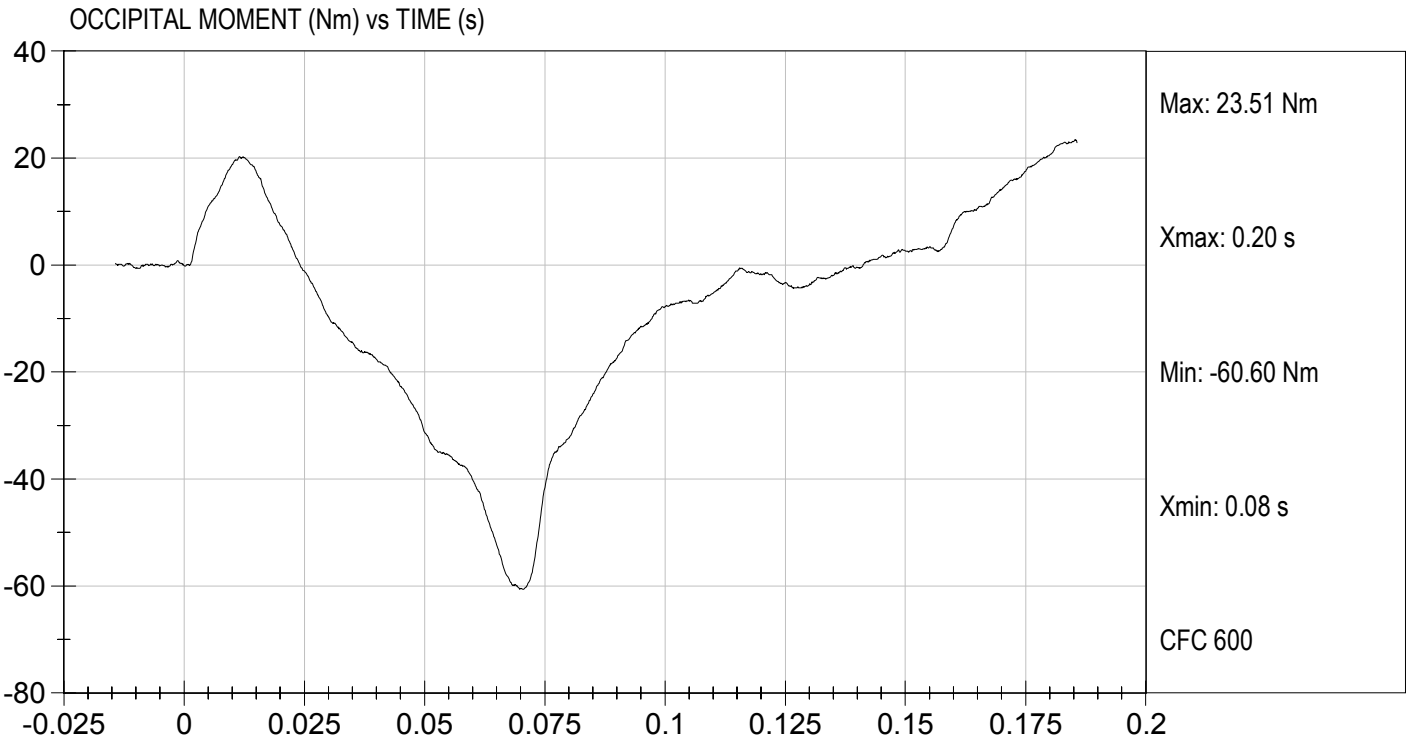



NECK ROTATION (DEG) vs TIME (s)



Test Desc: Neck Extension
Componet ID: D041563

Test Date: 07/12/2004
Velocity: 19.91 ft/s, 6.07 m/s



DATA SHEET B6
THORAX IMPACT TEST (572.134)

Dummy Serial Number __506_____ Test Date __7/13/04_____

Technician ____Joe Fleck_____

_X_Pretest 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))
_X_ N/A, ONLY one thorax impact test performed
_X_2. The test fixture conforms to the specifications in Figure 11B.
_X_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))
_X_4. The dummy assembly soaked at a temperature between 20.6°C (69ºF) and 22.2°C (72ºF) 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 _21.2_
Record the minimum temperature _20.6_
Record the maximum humidity _54%_
Record the minimum humidity _50%_
_X_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.
_X_ - 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 ± 0.5º and adjust the pelvis angle to 7º ± 2º. 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 ± 1º. (572.134(c)(3))

_X_ 9. The longitudinal centerline of the test probe is centered within ±2.5 mm of the midsagittal plane of the dummy and is 12.7 mm ± 1mm below the horizontal peripheral centerline of the No. 3 rib and is within 0.5º 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 ± 2º 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 2º 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 ± 0.12m/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 m/s ≤ speed ≤ 6.83 m/s | 6.69 m/s |
| Chest Compression | 50.0 mm ≤ compression ≤ 58.0 mm | 53 mm |
| Peak force** between 50.0 and 58.0 mm chest compression | 3900N ≤ peak force ≤ 4400N | 4930 N |
| Peak force** between 18.0 and 50.0 mm chest compression | peak force ≤ 4600 N | 3886 N |
| Internal Hysteresis*** | 69% ≤ hysteresis ≤ 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.

Signature 7/13/04
Date

**MGA RESEARCH CORPORATION**

**THORAX IMPACT**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 506 **Test I.D:** D041564

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Temperature | deg C | 20.6 to 22.2 | 21.2 | Pass |
| Relative Humidity | % | 10 to 70 | 53 | Pass |
| Probe Speed | m/s | 6.59 to 6.83 | 6.69 | Pass |
| Peak Deflection | mm | 50 to 58 | 53.3 | Pass |
| Peak Resistive Force w/in Deflection Corridor | kN | 3.9 to 4.4 | 3.9 | Pass |
| Internal Hysteresis | % | 69 to 85 | 69 | Pass |
| Peak Force 18 mm - 50 mm | N | < 4600 N | 3,886 | Pass |
| | | Overall Test Results | | Pass |

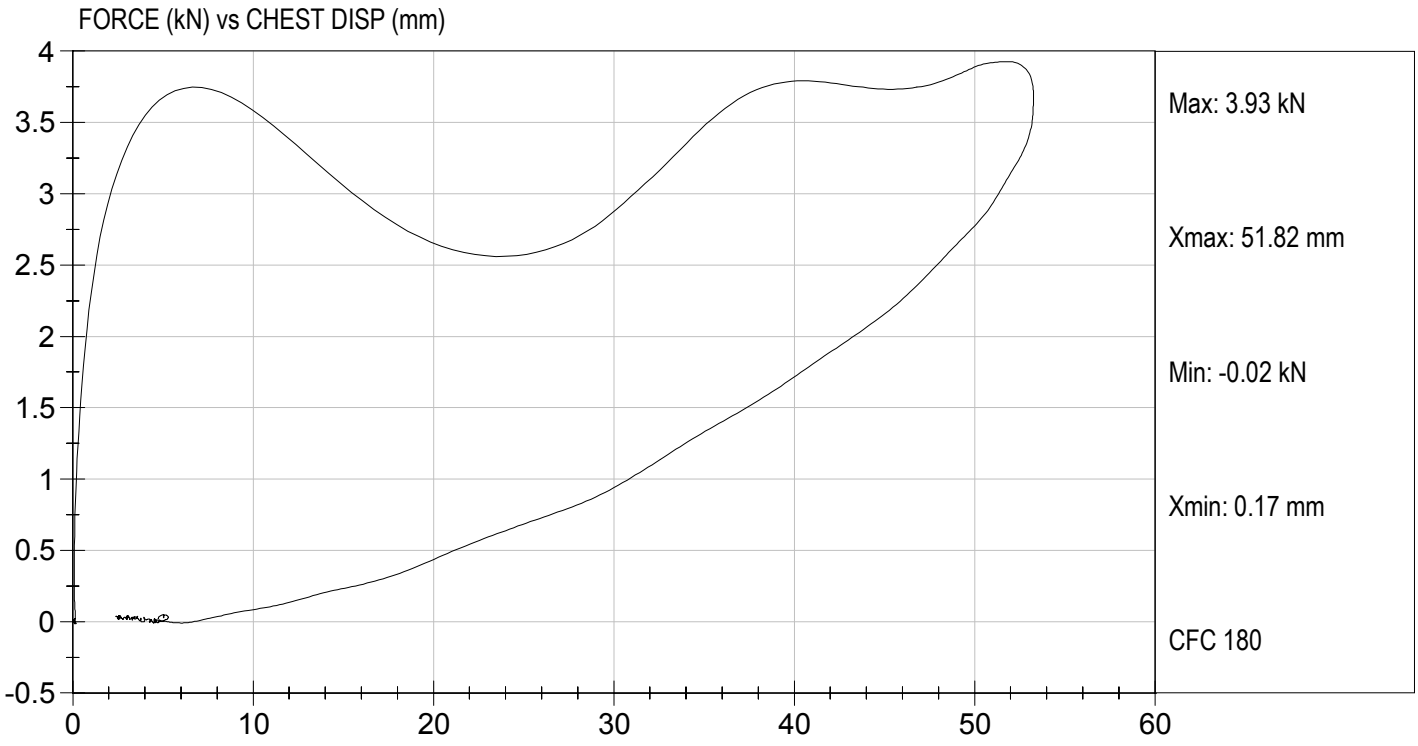
Laboratory Technician

07/13/2004
Test Date

Approved By

Test Desc: Thorax Impact
Componet ID: D041564

Test Date: 07/13/2004
Velocity: 21.94 ft/s, 6.69 m/s



DATA SHEET B7
TORSO FLEXION TEST (572.135)

Dummy Serial Number __506_____ Test Date __7/12/04_____

Technician _____Joe Fleck_____

_X_Pretest 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))
_X_ N/A, ONLY one thorax impact test performed
_X_2. The test fixture conforms to the specifications in Figure 13B.
_X_3. The complete assembled dummy (880105-000) is used (572.135(c)(2)).
__ with legs below the femurs.
_X_ without legs below the femurs.
_X_4. The dummy assembly soaked at a temperature between 18.9°C (66ºF) and 25.6°C (78ºF) 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 __21.2__
Record the minimum temperature __20.6__
Record the maximum humidity __54%__
Record the minimum humidity __50%__
_X_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))
_X_6. Attach the loading adapter bracket to the spine of the dummy as shown in Figure 13B**.** (572.135(c)(4))
_X_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))
_X_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°)___$15^0$___
_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° | 15° |
| Torso rotation rate | 0.5°/s ≤ rate ≤ 1.5°/s | 1.0 |
| Force at 45° ±0.5° | 320 N ≤ force ≤ 390 N | 362 N |
| Final ref. plane angle | Initial ref. plane angle ±8° | 19° |

Signature

7/12/04
Date

**MGA RESEARCH CORPORATION**

**TORSO FLEXION TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 506 **Test I.D:** D041567

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 - 25.6 | 20.6 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 53 | Pass |
| Initial Angle | deg | 0 to 20 | 15 | Pass |
| Return Angle | deg | +/- 8 | 19 | Pass |
| Force at 45 deg | N | 320 to 390 | 362 | Pass |
| Upper Torso Deflection Rate | Deg/sec | 0.5 - 1.5 | 1.0 | Pass |
| | | Overall Result | | Pass |

Laboratory Technician

07/12/2004
Test Date

Approved By

DATA SHEET B8
LEFT KNEE IMPACT TEST (572.136)

Dummy Serial Number __506_____ Test Date __7/12/04_____

Technician ____Joe Fleck_____

_X_Pretest 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))
_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 (66ºF) and 25.6°C (78ºF) 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 _21.2__
Record the minimum temperature _20.6__
Record the maximum humidity _54%__
Record the minimum humidity _50%__
_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 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 m/s ≤ speed ≤ 2.13 m/s | 2.09 m/s |
| Peak resistance force* | 3450 N ≤ force ≤ 4060 N | 3490 N |

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

_X_12. Plots of acceleration versus time and force versus time follow this sheet.

Joe Fleck _____ 7/12/04_____

Signature Date

**MGA RESEARCH CORPORATION**

**LEFT KNEE IMPACT TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 506 **Test I.D:** D041566

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 to 25.5 | 21.1 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 54 | Pass |
| Probe Speed | m/sec | 2.07 to 2.13 | 2.09 | Pass |
| Maximum Force | kN | 3.45 to 4.06 | 3.49 | Pass |
| | | Overall Test Results | | Pass |

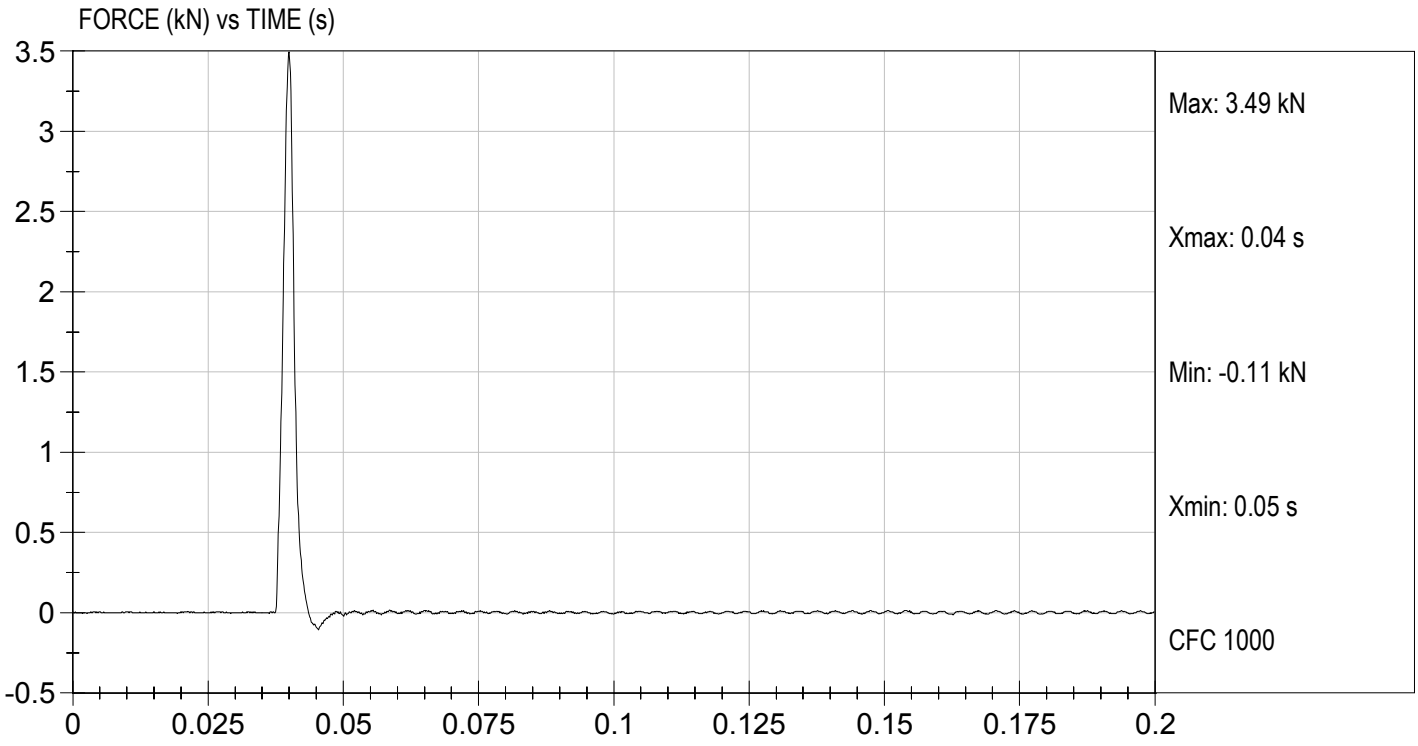
Joe Fleck
Laboratory Technician

07/12/2004
Test Date

Jeff Leonardelli
Approved By

Test Desc: Left Knee
Componet ID: D041566

Test Date: 07/12/2004
Velocity: 6.87 ft/s, 2.09 m/s



DATA SHEET B9
RIGHT KNEE IMPACT TEST (572.136)

Dummy Serial Number ___506_____ Test Date __7/12/04_____

Technician ___Joe Fleck_____

_X_Pretest 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))
_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 (880105-528R), 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))
_X_4. The knee assembly soaked at a temperature between 18.9°C (66ºF) and 25.6°C (78ºF) 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 _21.2___
Record the minimum temperature _20.6___
Record the maximum humidity _54 %___
Record the minimum humidity _50 %___
_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 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))
_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 m/s ≤ speed ≤ 2.13 m/s | 2.10 m/s |
| Peak resistance force* | 3450 N ≤ force ≤ 4060 N | 3580 N |

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

_X_12. Plots of acceleration versus time and force versus time follow this sheet.

Signature

7/12/04
Date

**MGA RESEARCH CORPORATION**

**RIGHT KNEE IMPACT TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 506 **Test I.D:** D041565

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 to 25.5 | 21.2 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 54 | Pass |
| Probe Speed | m/sec | 2.07 to 2.13 | 2.10 | Pass |
| Maximum Force | kN | 3.45 to 4.06 | 3.58 | Pass |
| | | Overall Test Results | | Pass |

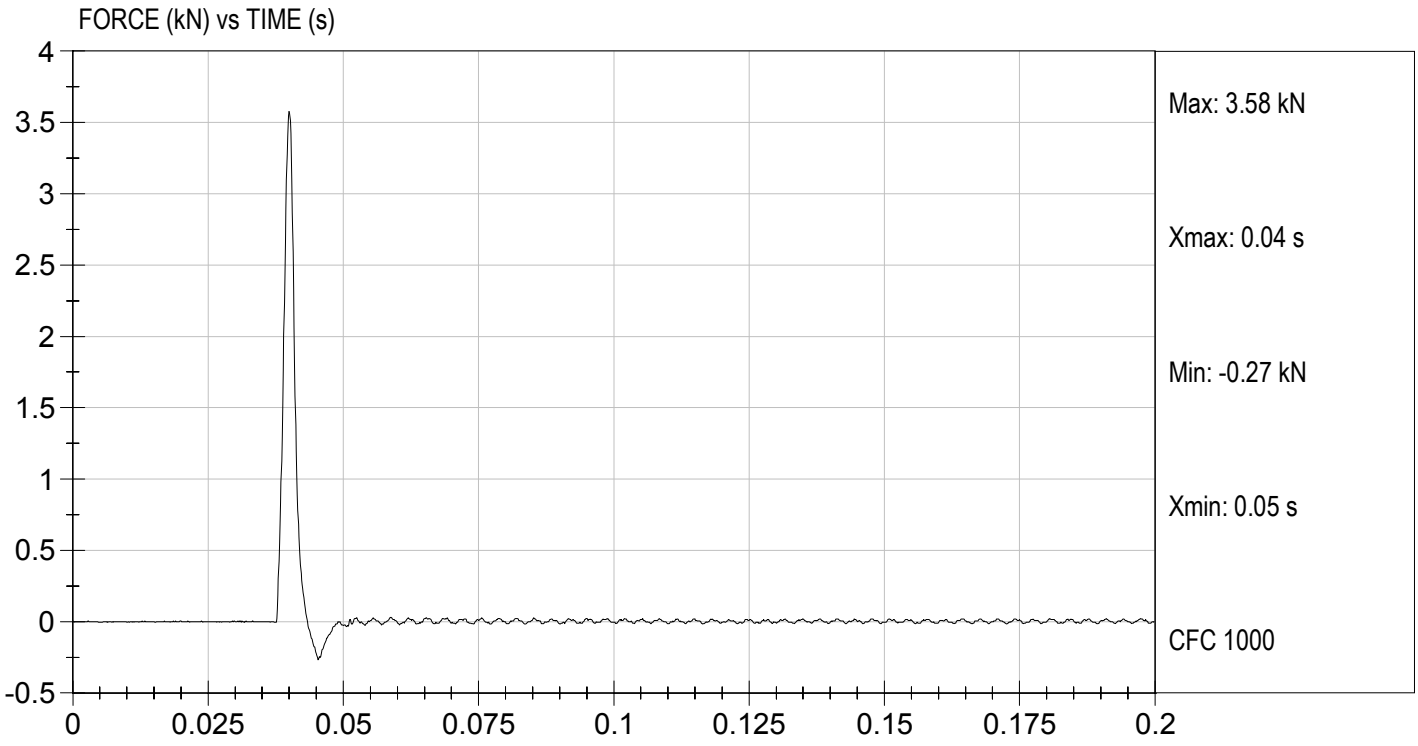
Laboratory Technician

07/12/2004
Test Date

Approved By

Test Desc: Right Knee
Componet ID: D041565

Test Date: 07/12/2004
Velocity: 6.89 ft/s, 2.10 m/s



DATA SHEET B3
HEAD DROP TEST (572.132)

Dummy Serial Number 506 Test Date 7/19/04

Technician Dave Wilcox

__Pretest calibration
_X_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))
__X_ N/A, ONLY one head drop performed
_X_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))
_X_3. The head accelerometer mounting plate screws ((10-24 x 3/8 SHCS) are torqued to 9.0 Nm.
_X_4. Accelerometers and their respective mounts are smooth and clean.
_X_5. Torque the skull cap screws (10-24 x 1/2 SHCS) to 9.0 Nm.
_X_6. The data acquisition system, including transducers, conforms to the requirements of SAE Recommended Practice J211/1 MAR95. (572.136(m))
_X_7. The head assembly soaked at a temperature between 18.9°C (66ºF) and 25.6°C (78ºF) 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 21.0
Record the minimum temperature 20.7
Record the maximum humidity 50%
Record the minimum humidity 48%
_X_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 ± 1.0 mm (14.8±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 _501mm_____
Record the left side distance _501mm_____

_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 _$656 \times 10^{-6}$mm_____

_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 ± 1.0 mm (14.8 inches ± 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 g ≤ x ≤ 300 g | 266 |
| 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 ≤ 15 g | 13 |

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

Signature

7/19/04
Date

**MGA RESEARCH CORPORATION**

**HEAD DROP TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 506 **Test ID:** D041601

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 - 25.6 | 20.7 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 49 | Pass |
| Peak Resultant Acceleration | G's | 250 - 300 | 266 | Pass |
| Peak Lateral Acceleration | G's | +/- 15 | 12.6 | Pass |
| Unimodal | Yes/No | NA | Yes | Pass |
| Oscillations | Yes/No | within 10% of peak | Yes | Pass |
| | | Overall Test Results | | Pass |

Laboratory Technician

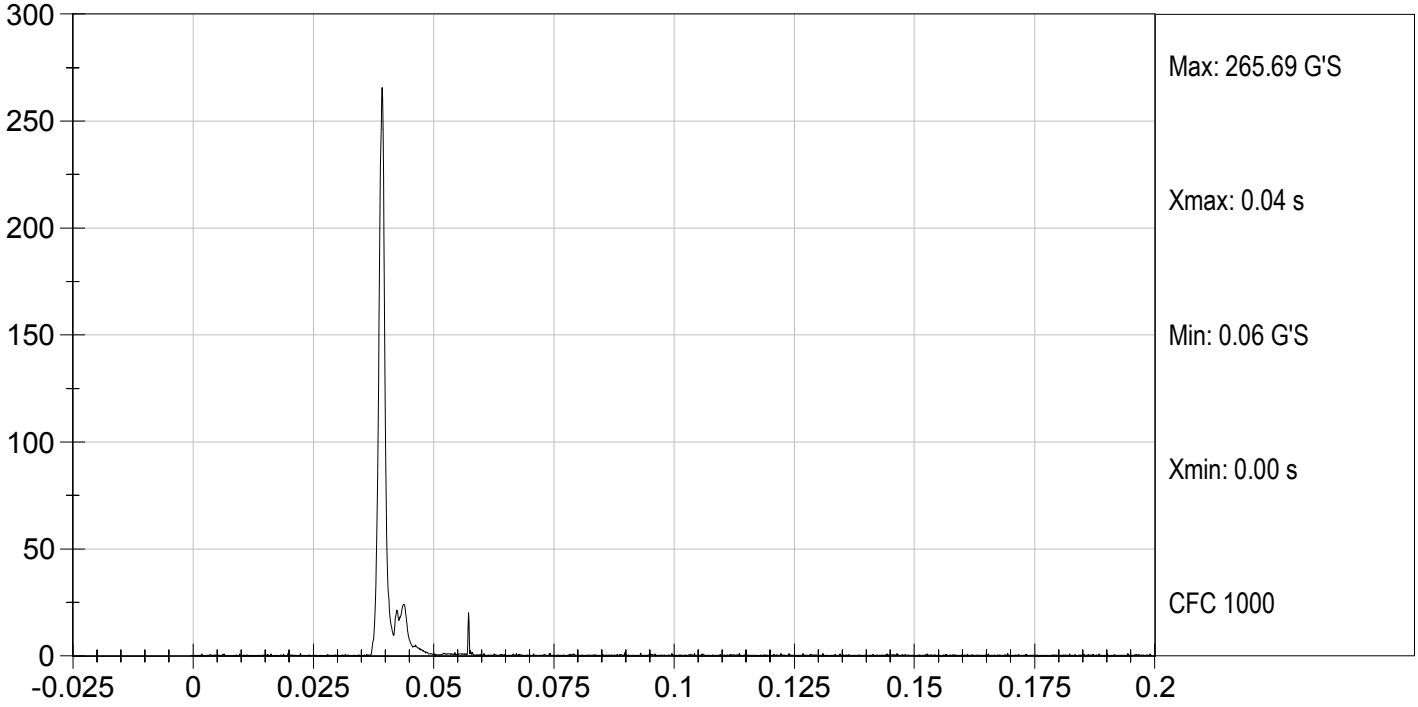
07/19/2004
Test Date

Approved By

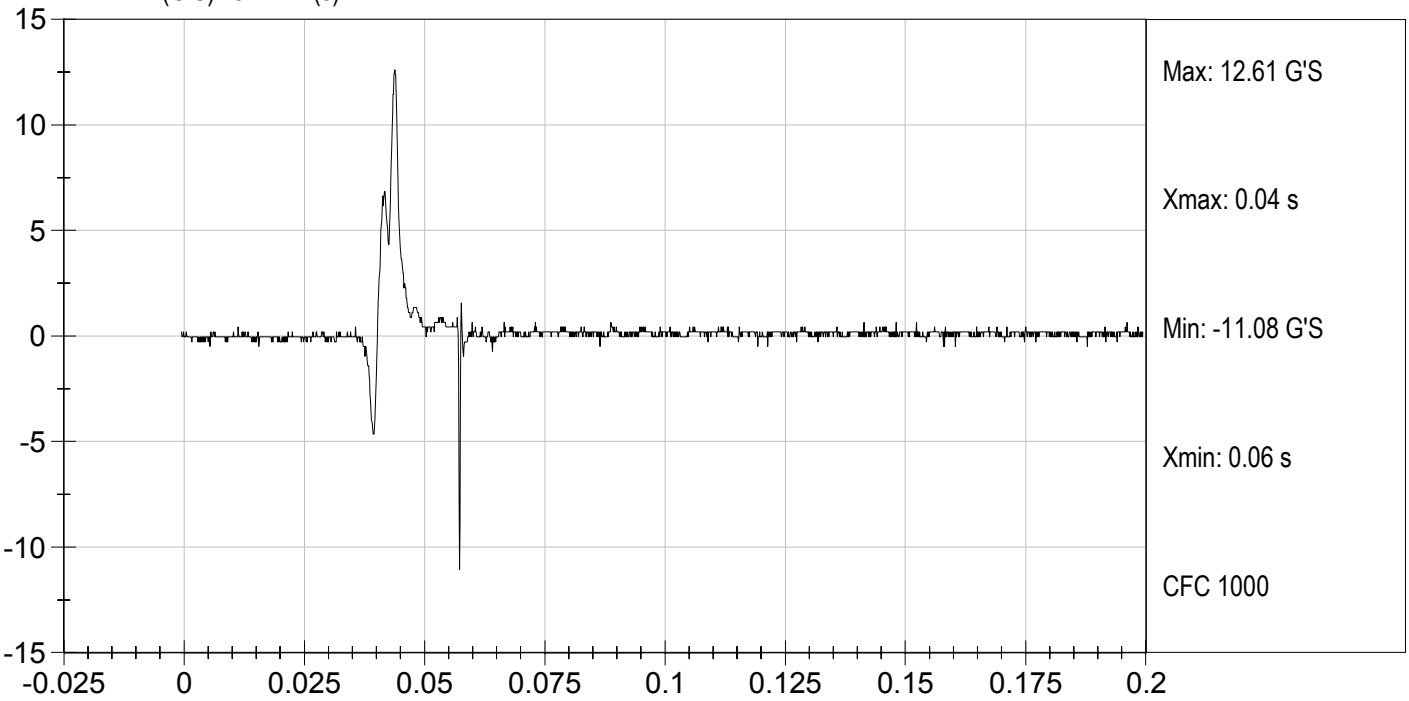
Test Desc: Head Drop
Componet ID: D041601

Test Date: 07/19/2004
Velocity: 0 ft/s, 0 m/s

PEAK RESULTANT ACCELERATION (G'S) vs TIME (s)




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



DATA SHEET B4
NECK FLEXION TEST (572.133)

Dummy Serial Number ____506_____ Test Date ____7/19/04_____

Technician ____Dave Wilcox_____

__Pretest calibration
_X_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))
_X_ N/A, ONLY one flexion test performed

_X_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))

_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. (572.133(c)(1))
Record the maximum temperature __21.0__
Record the minimum temperature __20.7__
Record the maximum humidity __50%__
Record the minimum humidity __48%__

_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. (880105-250 and PADI page17).
Record findings and actions: __No Deterioration. Hardness Front 89; Back 90.

_X_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 ± 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 | Result |
|---|---|---|---|
| Pendulum impact speed | | 6.89 m/s ≤ speed ≤ 7.13 m/s | 7.11 m/s |
| Pendulum ΔV with respect to impact speed | @ 10ms | 2.1 m/s ≤ ΔV ≤ 2.5 m/s | 2.3 m/s |
| | @ 20 ms | 4.0 m/s ≤ ΔV ≤ 5.0 m/s | 4.5 m/s |
| | @30ms | 5.8 m/s ≤ ΔV ≤ 7.0 m/s | 6.7 m/s |
| Plane D Rotation | | Peak moment*<br>69 Nm ≤ moment ≤ 83 Nm during the following rotation range $77^o$ ≤ angle ≤ $91^o$ | __80__ Nm @ __82__ degrees |
| Positive Moment Decay** (Flexion) | | Time to decay to 10 Nm<br>80 ms ≤ time ≤ 100ms | 86 ms |

*Moment about the occipital condyle = $M_y$ – (0.01778 m x $F_x$) (572.133(b)(1)(ii))

My = Moment in Nm measured by the transducer

Fx = 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.

Signature

7/19/04

Date

**MGA RESEARCH CORPORATION**

**NECK FLEXION TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 506 **Test I.D:** D041602

| 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 | 48 | Pass |
| Pendulum Speed | | m/sec | 6.89 to 7.13 | 7.11 | Pass |
| Pendulum Deceleration | 10 msec | m/sec | 2.1 to 2.5 | 2.3 | Pass |
| | 20 msec | m/sec | 4.0 to 5.0 | 4.5 | Pass |
| | 30 msec | m/sec | 5.8 to 7.0 | 6.7 | Pass |
| D Plane Rotation | Max | deg | 77 to 91 | 82 | Pass |
| Occipital Condyle Moment within Deflection Corridor | | Nm | 69 to 83 | 80 | Pass |
| Positive Moment Time Curve Decay to 10 Nm | | msec | 80 to 100 | 86 | Pass |
| | | | Overall Results | | Pass |

Laboratory Technician

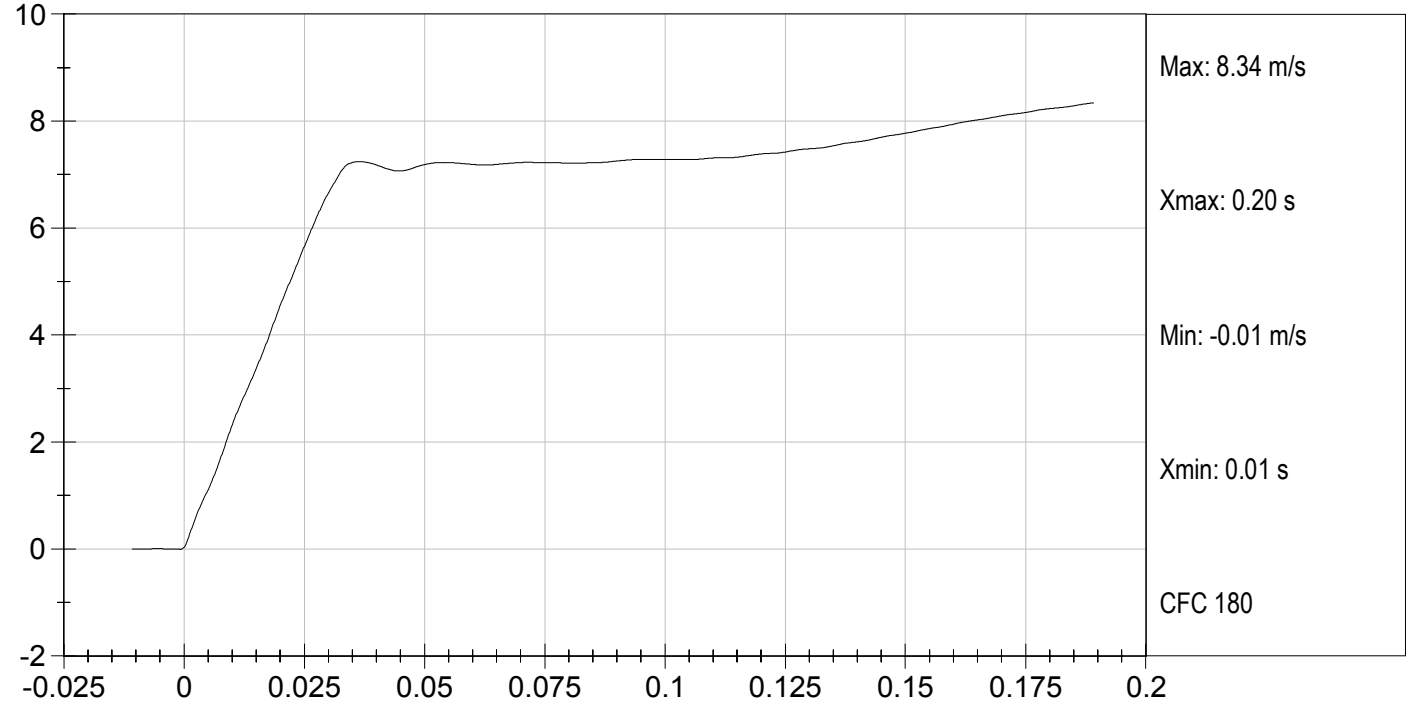
07/19/2004
Test Date

Jeff Leonardelli
Approved By

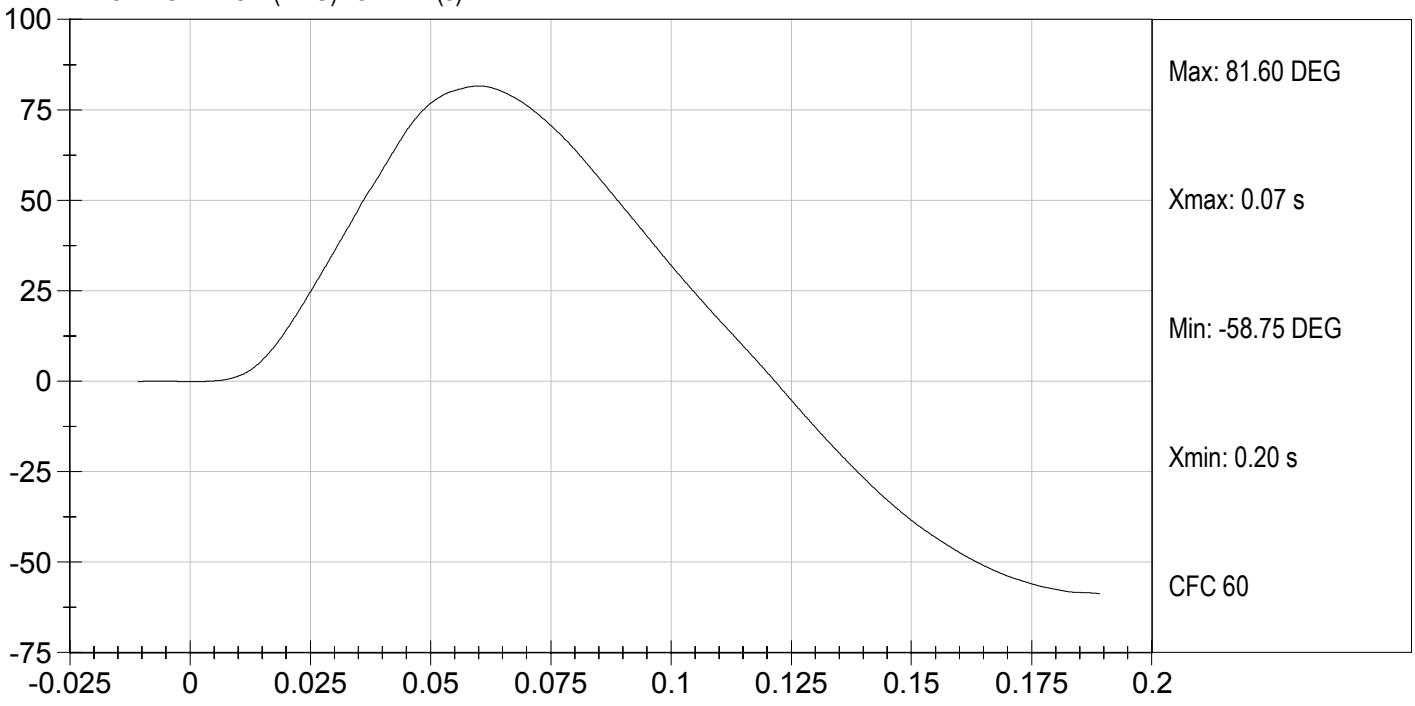
Test Desc: Neck Flexion
Componet ID: D041602

Test Date: 07/19/2004
Velocity: 23.33 ft/s, 7.11 m/s

PENDULUM DECELERATION (m/s) vs TIME (s)

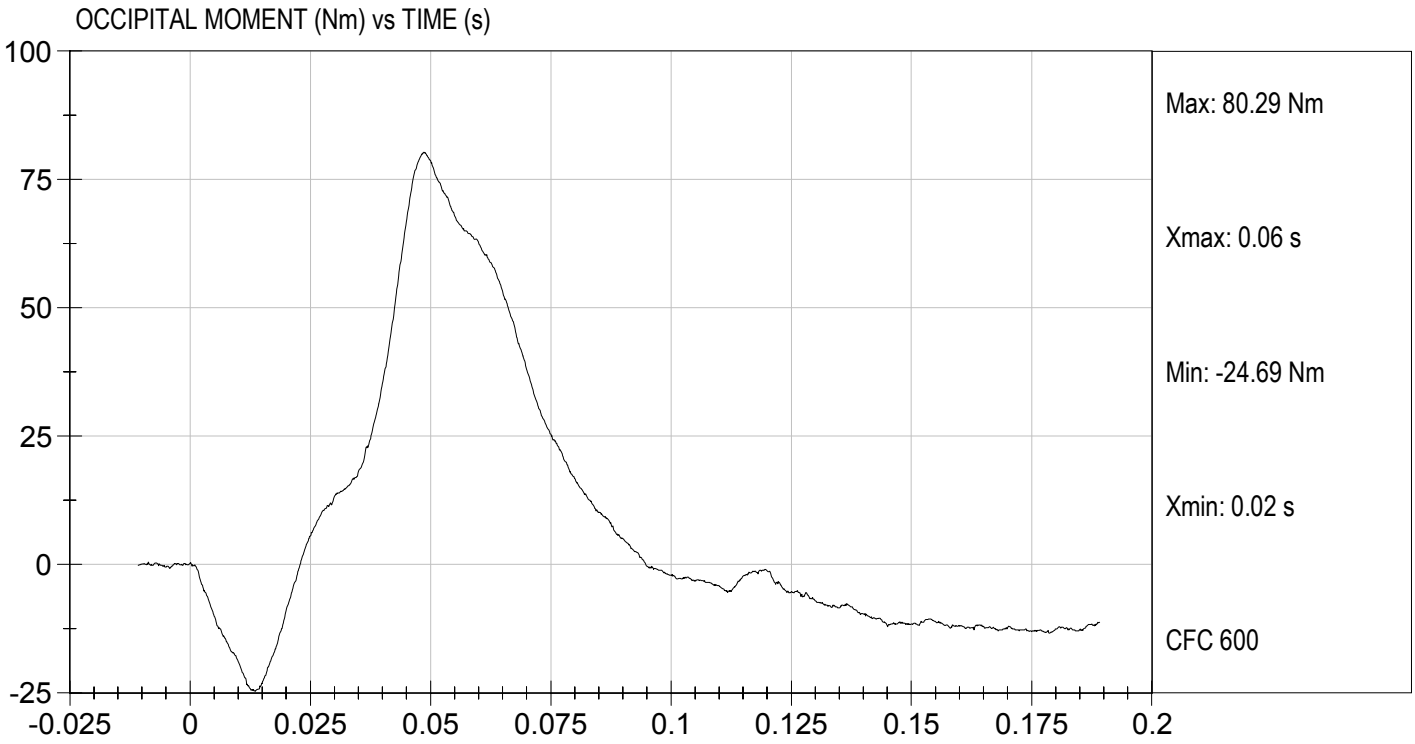



NECK ROTATION (DEG) vs TIME (s)



Test Desc: Neck Flexion
Componet ID: D041602

Test Date: 07/19/2004
Velocity: 23.33 ft/s, 7.11 m/s



DATA SHEET B5
NECK EXTENSION TEST (572.133)

Dummy Serial Number ___506_____ Test Date ___7/19/04_____

Technician _____Jim Carney_____

__Pretest calibration
_X_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))
_X_ N/A, ONLY one extension test performed

_X_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))

_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. (572.133(c)(1))
Record the maximum temperature __21.0___
Record the minimum temperature __20.7___
Record the maximum humidity __50%__
Record the minimum humidity __48%__

_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. (880105-250 and PADI page17).
Record findings and actions: __No Deterioration. Hardness Front 89; Back 90.

_X_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 ± 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 | Result |
|---|---|---|---|
| Pendulum impact speed | | 5.95 m/s ≤ speed ≤ 6.19 m/s | 6.18 m/s |
| Pendulum ΔV with respect to impact speed | @ 10ms | 1.5 m/s ≤ ΔV ≤ 1.9 m/s | 1.8 m/s |
| | @ 20 ms | 3.1 m/s ≤ ΔV ≤ 3.9 m/s | 3.6 m/s |
| | @30ms | 4.6 m/s ≤ ΔV ≤ 5.6 m/s | 5.2 m/s |
| Plane D Rotation | | Peak moment*<br>-65 Nm ≤ moment ≤ -53 Nm during the following rotation range $99^o$ ≤ angle ≤ $114^o$ | _-60_ Nm @ _109_ degrees |
| Negative Moment Decay** (Extension) | | Time to decay to -10 Nm<br>94 ms ≤ time ≤ 114 ms | 98 ms |

*Moment about the occipital condyle = $M_y$ – (0.01778 m x $F_x$) (572.133(b)(1)(ii)

My = Moment in Nm measured by the transducer

Fx = 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.

James Cumby

Signature

7/19/04

Date

**MGA RESEARCH CORPORATION**

**NECK EXTENSION TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 506 **Test I.D:** D041603

| 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 | 48 | Pass |
| Pendulum Speed | | m/sec | 5.95 to 6.19 | 6.18 | Pass |
| Pendulum Deceleration | 10 msec | m/sec | 1.5 to 1.9 | 1.8 | Pass |
| | 20 msec | m/sec | 3.1 to 3.9 | 3.6 | Pass |
| | 30 msec | m/sec | 4.6 to 5.6 | 5.2 | Pass |
| D Plane Rotation | Max | deg | 99 to 114 | 109 | Pass |
| Occipital Condyle Moment within Deflection Corridor | | Nm | -65 to -53 | -60 | Pass |
| Negative Moment Time Curve Decay to -10 Nm | | msec | 94 to 114 | 98 | Pass |
| | | | Overall Results | | Pass |

James Carney

Laboratory Technician

07/19/2004

Test Date

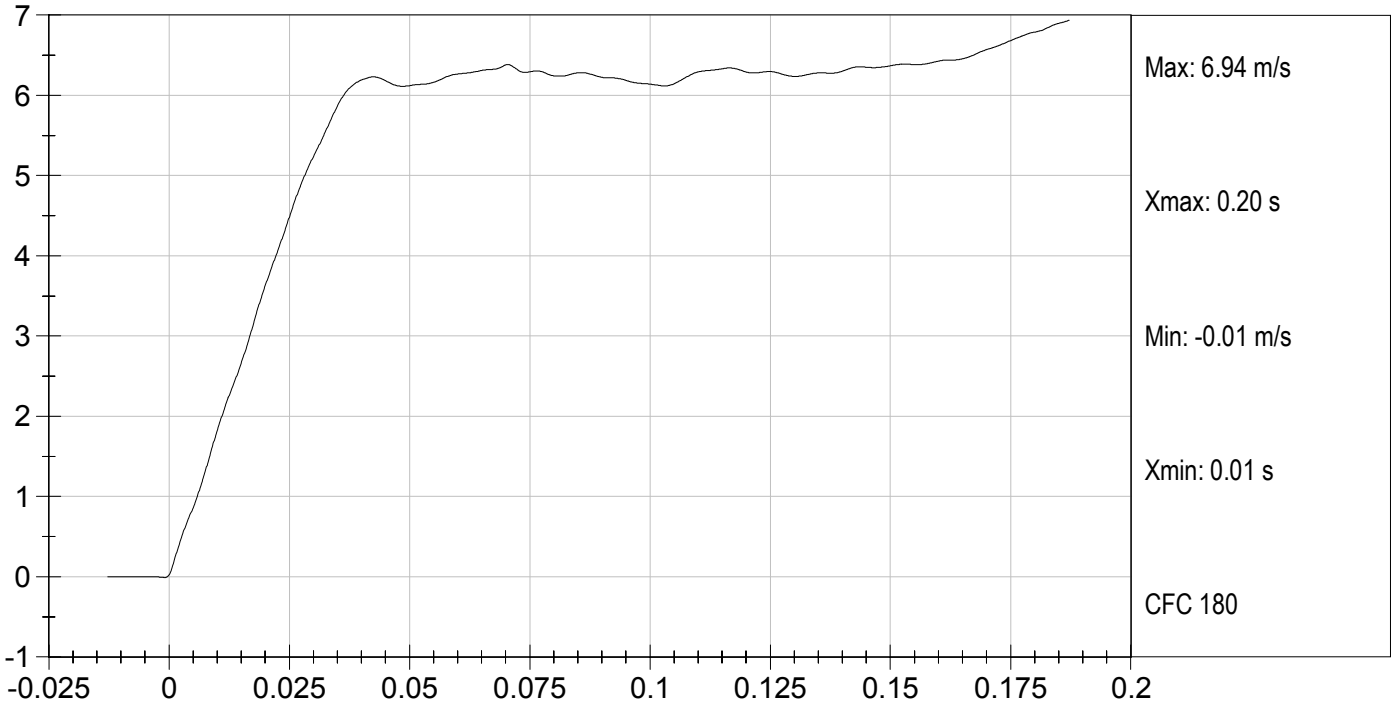
Jeff Leonardelli

Approved By

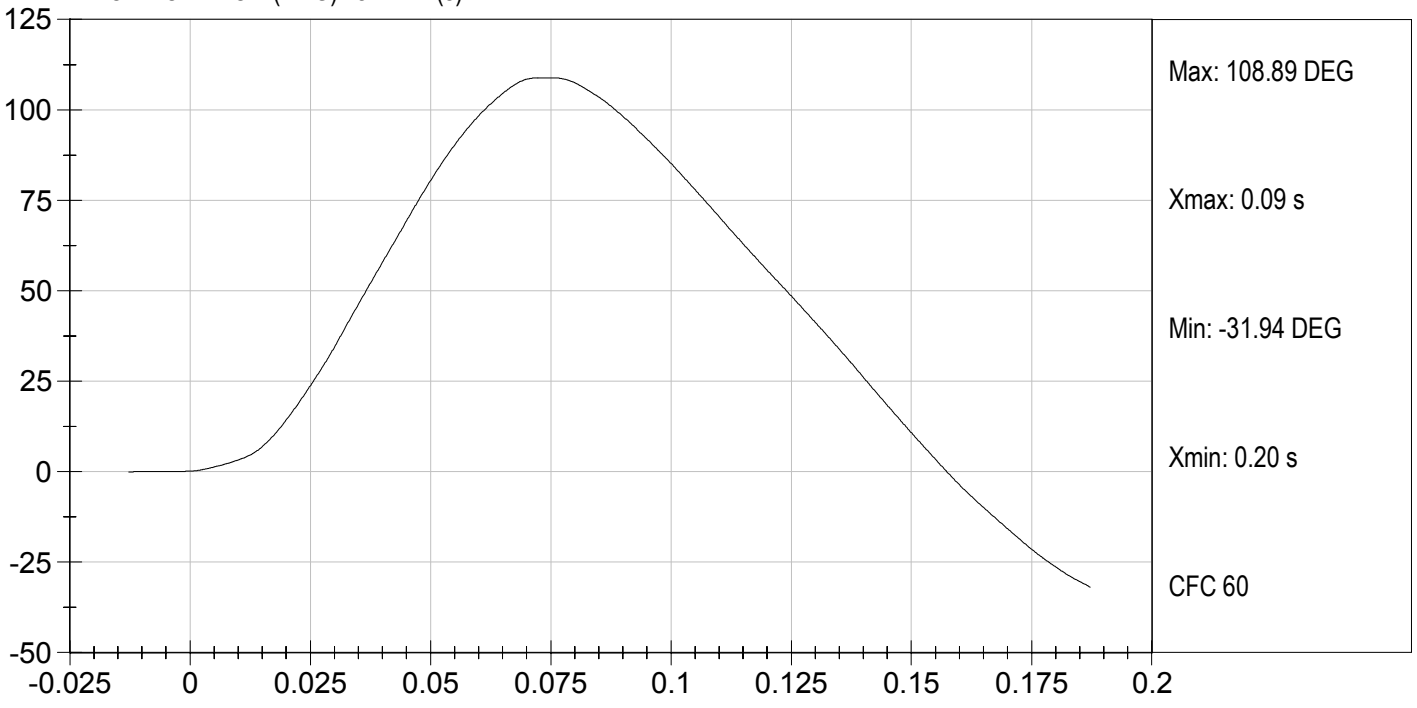
Test Desc: Neck Extension
Componet ID: D041603

Test Date: 07/19/2004
Velocity: 20.29 ft/s, 6.18 m/s

PENDULUM DECELERATION (m/s) vs TIME (s)

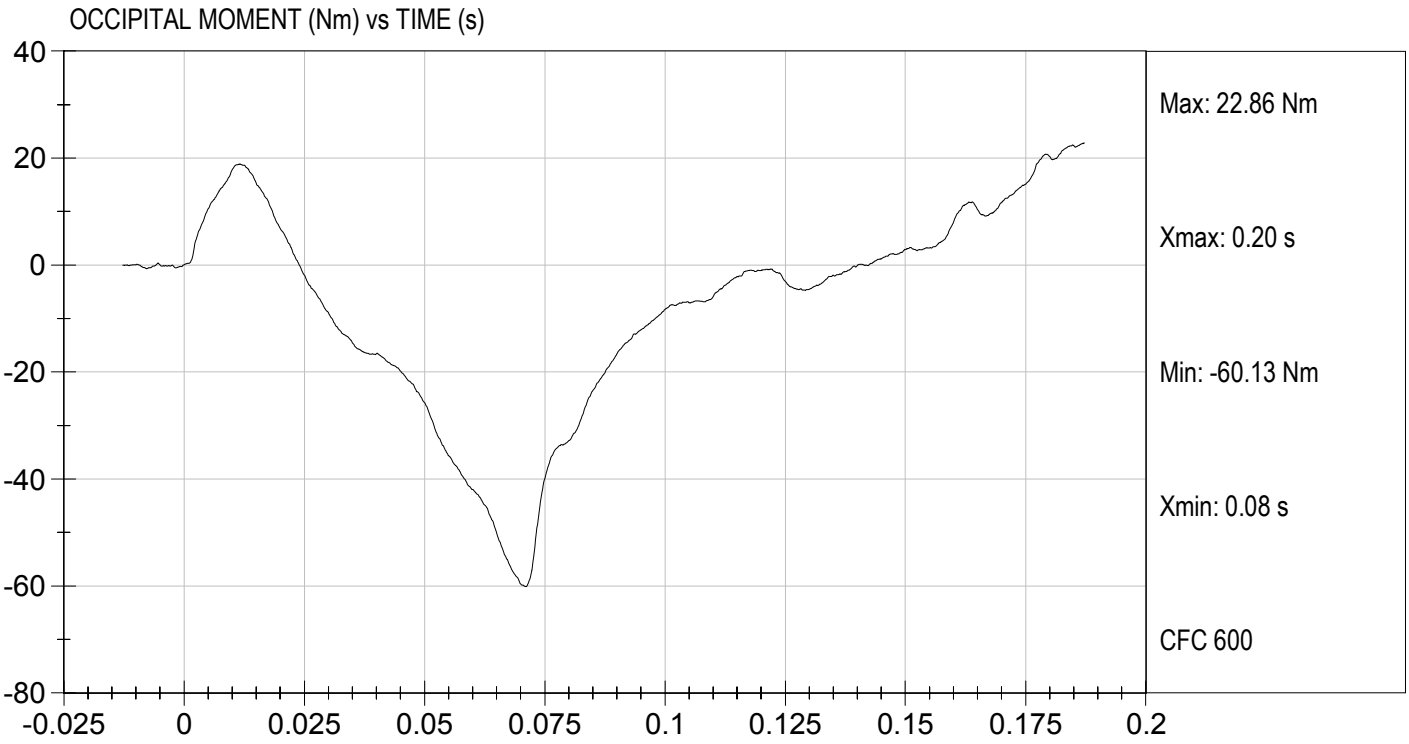



NECK ROTATION (DEG) vs TIME (s)



Test Desc: Neck Extension
Componet ID: D041603

Test Date: 07/19/2004
Velocity: 20.29 ft/s, 6.18 m/s



DATA SHEET B6
THORAX IMPACT TEST (572.134)

Dummy Serial Number __506_____ Test Date __7/20/04_____

Technician ____Jessica Gall_____

__Pretest calibration
_X_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))
_X_ N/A, ONLY one thorax impact test performed
_X_2. The test fixture conforms to the specifications in Figure 11B.
_X_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))
_X_4. The dummy assembly soaked at a temperature between 20.6°C (69ºF) and 22.2°C (72ºF) 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 _21.8_
Record the minimum temperature _21.0_
Record the maximum humidity _51%_
Record the minimum humidity _48%_
_X_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.
_X_ - 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 ± 0.5º and adjust the pelvis angle to 7º ± 2º. 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 ± 1º. (572.134(c)(3))

_X_ 9. The longitudinal centerline of the test probe is centered within ±2.5 mm of the midsagittal plane of the dummy and is 12.7 mm ± 1mm below the horizontal peripheral centerline of the No. 3 rib and is within 0.5º 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 ± 2º 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 2º 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 ± 0.12m/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 m/s ≤ speed ≤ 6.83 m/s | 6.65 m/s |
| Chest Compression | 50.0 mm ≤ compression ≤ 58.0 mm | 56 mm |
| Peak force** between 50.0 and 58.0 mm chest compression | 3900N ≤ peak force ≤ 4400N | 4930 N |
| Peak force** between 18.0 and 50.0 mm chest compression | peak force ≤ 4600 N | 3767 N |
| Internal Hysteresis*** | 69% ≤ hysteresis ≤ 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.

Jessica Hall
Signature

7/20/04
Date

**MGA RESEARCH CORPORATION**

**THORAX IMPACT**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 506 **Test I.D:** D041604

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Temperature | deg C | 20.6 to 22.2 | 21.0 | Pass |
| Relative Humidity | % | 10 to 70 | 51 | Pass |
| Probe Speed | m/s | 6.59 to 6.83 | 6.65 | Pass |
| Peak Deflection | mm | 50 to 58 | 56.3 | Pass |
| Peak Resistive Force w/in Deflection Corridor | kN | 3.9 to 4.4 | 3.9 | Pass |
| Internal Hysteresis | % | 69 to 85 | 70 | Pass |
| Peak Force 18 mm - 50 mm | N | < 4600 N | 3,767 | Pass |
| | | Overall Test Results | | Pass |

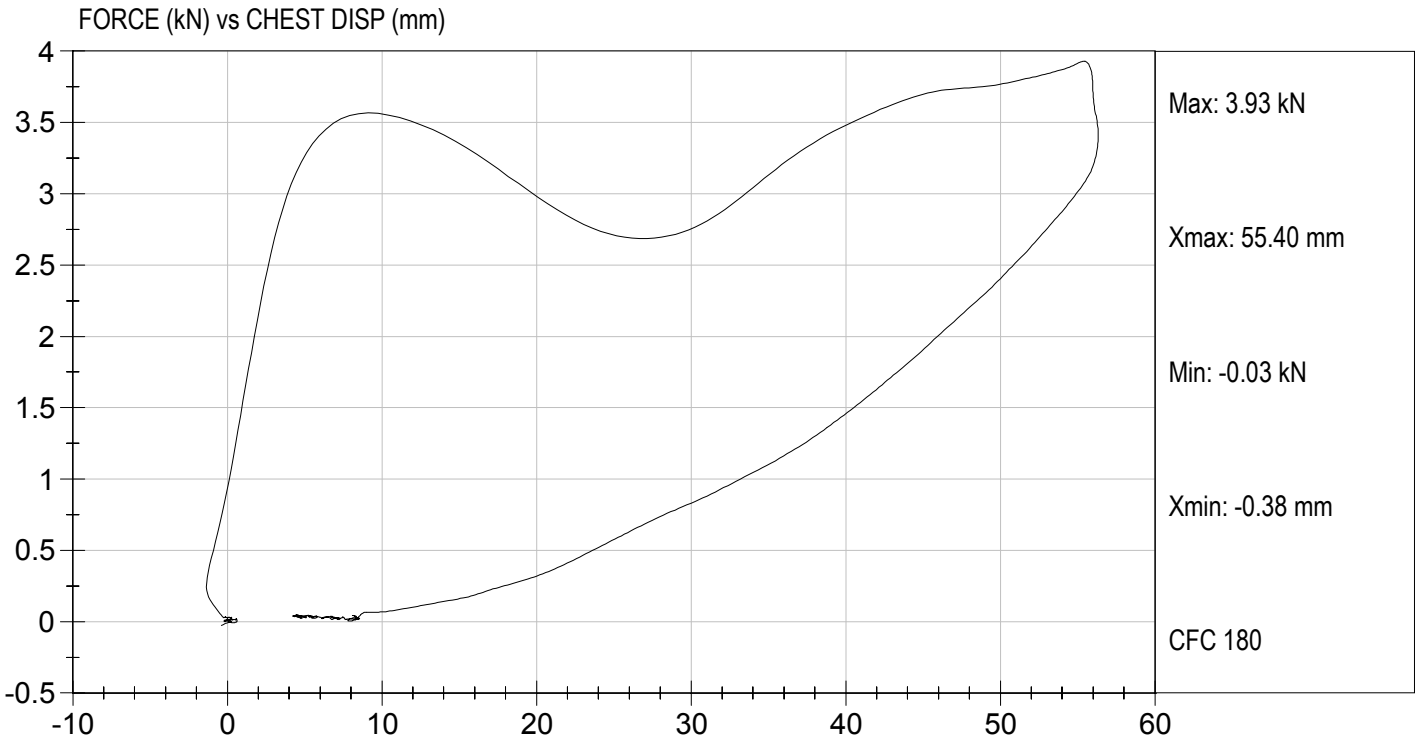
Jessica Hall
Laboratory Technician

07/20/2004
Test Date

Jeff Levandoski
Approved By

Test Desc: Thorax Impact
Componet ID: D041604

Test Date: 07/20/2004
Velocity: 21.81 ft/s, 6.65 m/s



DATA SHEET B7
TORSO FLEXION TEST (572.135)

Dummy Serial Number __506_____ Test Date __7/20/04_____

Technician _____Joe Fleck_____

__Pretest calibration
_X_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))
_X_ N/A, ONLY one thorax impact test performed
_X_2. The test fixture conforms to the specifications in Figure 13B.
_X_3. The complete assembled dummy (880105-000) is used (572.135(c)(2)).
__ with legs below the femurs.
_X_ without legs below the femurs.
_X_4. The dummy assembly soaked at a temperature between 18.9°C (66ºF) and 25.6°C (78ºF) 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 __21.8__
Record the minimum temperature __20.8__
Record the maximum humidity __51%__
Record the minimum humidity __48%__
_X_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))
_X_6. Attach the loading adapter bracket to the spine of the dummy as shown in Figure 13B**.** (572.135(c)(4))
_X_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))
_X_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°)___$15^0$___
_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° | 15° |
| Torso rotation rate | 0.5°/s ≤ rate ≤ 1.5°/s | 1.0 |
| Force at 45° ±0.5° | 320 N ≤ force ≤ 390 N | 347 N |
| Final ref. plane angle | Initial ref. plane angle ±8° | 19° |

Signature

7/20/04
Date

**MGA RESEARCH CORPORATION**

**LEFT KNEE IMPACT TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 506 **Test I.D:** D041606

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 to 25.5 | 21.0 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 48 | Pass |
| Probe Speed | m/sec | 2.07 to 2.13 | 2.12 | Pass |
| Maximum Force | kN | 3.45 to 4.06 | 3.52 | Pass |
| | | Overall Test Results | | Pass |

James Carney
Laboratory Technician

07/20/2004
Test Date

Jeff Levandoski
Approved By

DATA SHEET B8
LEFT KNEE IMPACT TEST (572.136)

Dummy Serial Number __506_____ Test Date __7/20/04_____

Technician ____Jim Carney_____

__Pretest calibration
_X_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))
_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 (66ºF) and 25.6°C (78ºF) 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 _21.9__
Record the minimum temperature _20.8__
Record the maximum humidity _51%__
Record the minimum humidity _48%__
_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 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 m/s ≤ speed ≤ 2.13 m/s | 2.12 m/s |
| Peak resistance force* | 3450 N ≤ force ≤ 4060 N | 3520 N |

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

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

James Carney
Signature

7/20/04
Date

**MGA RESEARCH CORPORATION**

**TORSO FLEXION TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 506 **Test I.D:** D041607

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 - 25.6 | 21.0 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 48 | Pass |
| Initial Angle | deg | 0 to 20 | 15 | Pass |
| Return Angle | deg | +/- 8 | 19 | Pass |
| Force at 45 deg | N | 320 to 390 | 347 | Pass |
| Upper Torso Deflection Rate | Deg/sec | 0.5 - 1.5 | 1.0 | Pass |
| | | Overall Result | | Pass |

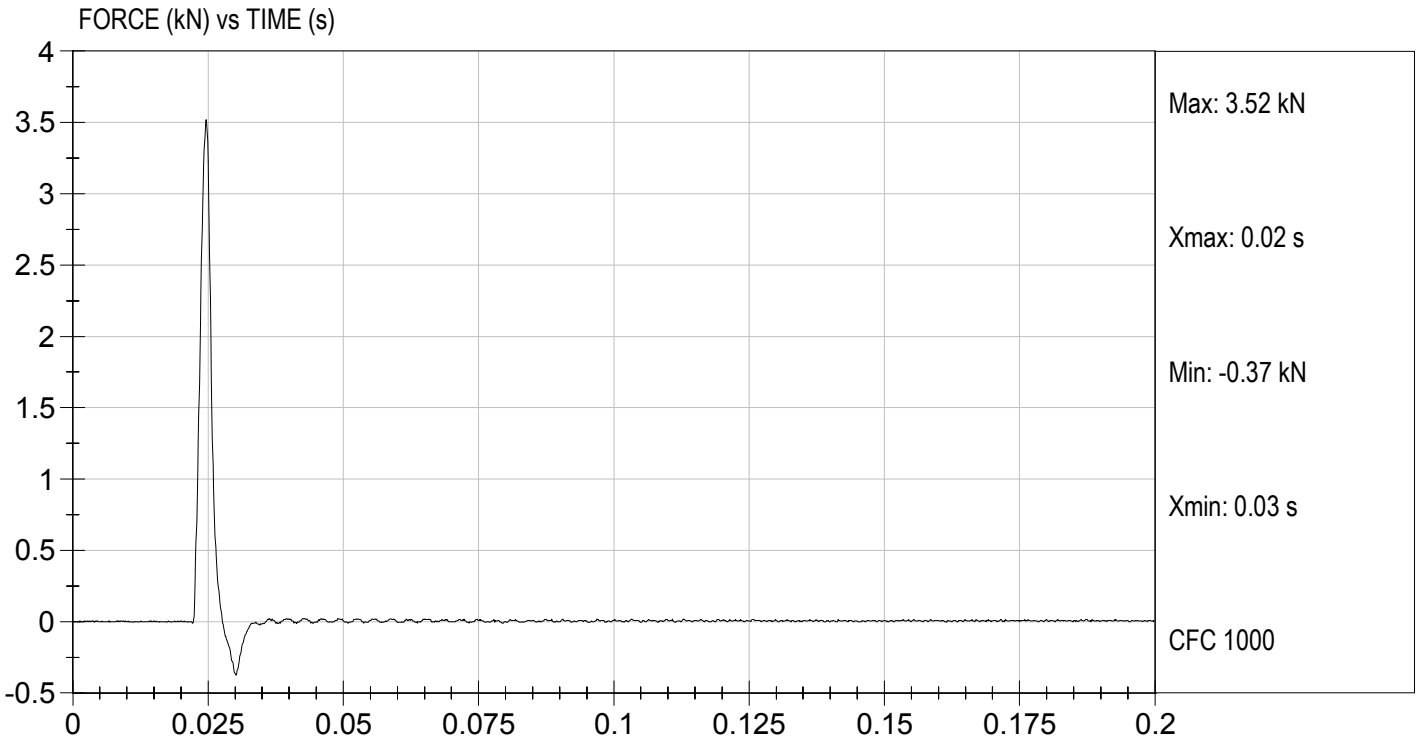
Joe Fleck
Laboratory Technician

07/20/2004
Test Date

Jeff Leonardelli
Approved By

Test Desc: Left Knee
Componet ID: D041606

Test Date: 07/20/2004
Velocity: 6.94 ft/s, 2.12 m/s



DATA SHEET B9
RIGHT KNEE IMPACT TEST (572.136)

Dummy Serial Number ___506_____ Test Date __7/20/04_____

Technician ___Jim Carney_____

__Pretest calibration
_X_Post test calibration verification

Test attempt no. _1__ (when successive knee impact tests are necessary)

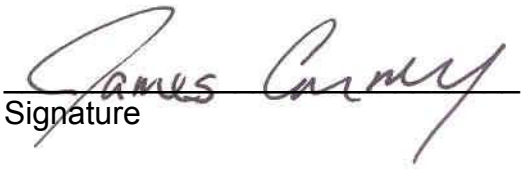
__1. It has been at least 30 minutes since the last knee impact test. (572.137(q))
_X_ N/A, ONLY one knee impact test performed
_X_2. The test fixture conforms to the specifications in Figure 14B.
_X_3. The knee assembly (880105-528R), lower leg structural replacement (880105-603), lower leg flesh (880105-601), 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))
_X_4. The knee assembly soaked at a temperature between 18.9°C (66ºF) and 25.6°C (78ºF) 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 _21.9___
Record the minimum temperature _20.8___
Record the maximum humidity _51 %___
Record the minimum humidity _48 %___
_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 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))
_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 m/s ≤ speed ≤ 2.13 m/s | 2.07 m/s |
| Peak resistance force* | 3450 N ≤ force ≤ 4060 N | 3550 N |

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

_X_12. Plots of acceleration versus time and force versus time follow this sheet.



Signature

7/20/04
Date

**MGA RESEARCH CORPORATION**

**RIGHT KNEE IMPACT TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 506 **Test I.D:** D041605

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 to 25.5 | 21.0 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 48 | Pass |
| Probe Speed | m/sec | 2.07 to 2.13 | 2.07 | Pass |
| Maximum Force | kN | 3.45 to 4.06 | 3.55 | Pass |
| | | Overall Test Results | | Pass |

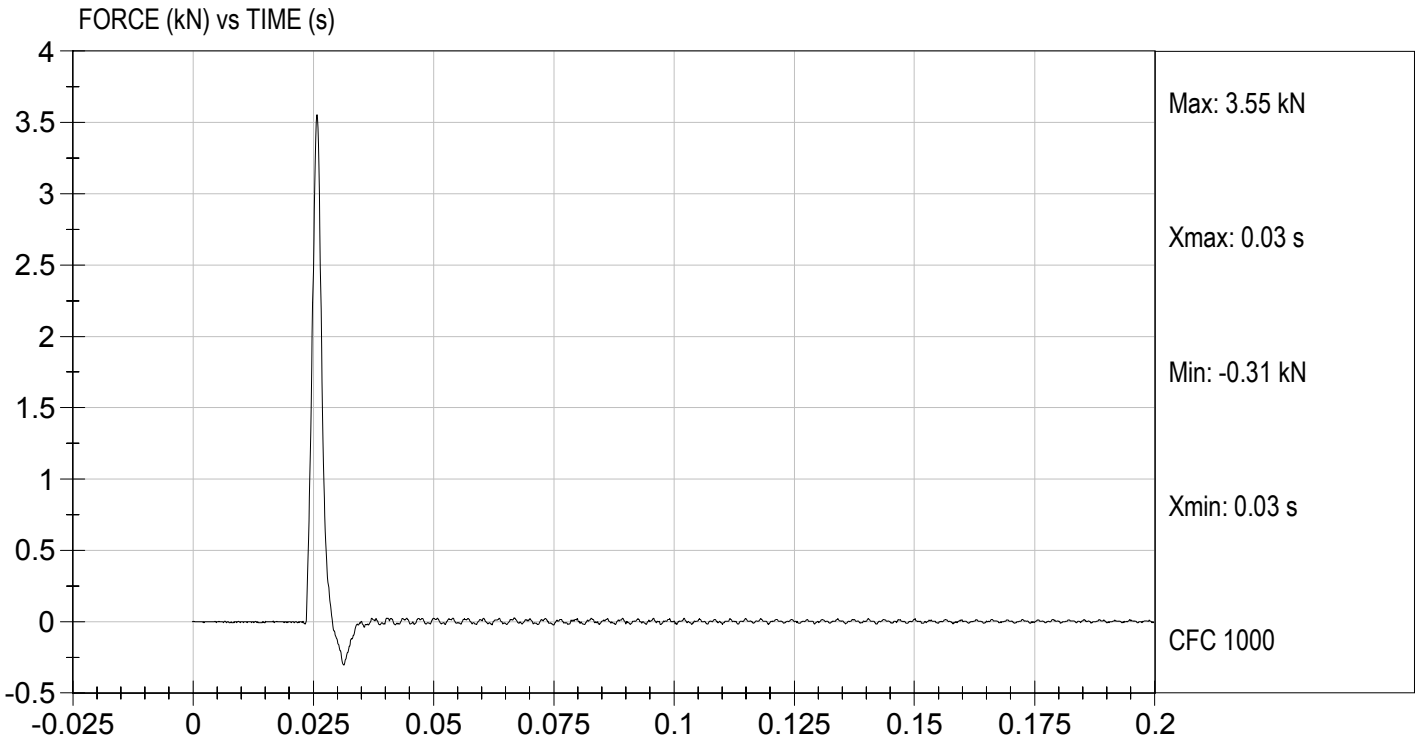
James Carney
Laboratory Technician

07/20/2004
Test Date

Jeff Leonardelli
Approved By

Test Desc: Right Knee
Componet ID: D041605

Test Date: 07/20/2004
Velocity: 6.8 ft/s, 2.07 m/s



DATA SHEET B1
DUMMY DAMAGE CHECKLIST

Dummy Serial Number ____506_____ Test Date ___7/15/04_____

Technician _____Jessica Gall_____

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

_X_ Perform general cleaning.

| Dummy Item | Inspect for | Comments | Damaged | 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 |

| Dummy Item | Inspect for | Comments | Damaged | OK |
|---|---|---|---|---|
| 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 _____ 7/16/04_____
Signature Date

Describe the repair or replacement of parts:

Checked by

Jeff Leonardski _____ 7/16/04_____
Signature Date

## EXTERNAL DIMENSIONS

| SN506, HYBRID III, 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 | 780.2 |
| B | SHOULDER PIVOT HEIGHT | Centerline of shoulder pivot bolt to the seat surface. | 431.8-457.2 | 443.0 |
| C | H-POINT HEIGHT | Reference | 81.3-86.3 | 85.1 |
| D | H-POINT LOCATION FROM BACKLINE | Reference | 144.8-149.8 | 145.0 |
| E | SHOULDER PIVOT FROM BACKLINE | Center of the shoulder clevis to the rear vertical surface of the fixture. | 68.6-83.8 | 76.4 |
| F | THIGH CLEARANCE | Measured at the highest point on the upper femur segment. | 119.4-134.6 | 128.0 |
| G | BACK OF ELBOW TO WRIST PIVOT | Back of the elbow flesh to the wrist pivot in line with the elbow and wrist pivots | 243.9-259.1 | 255.8 |
| 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 | 280.2 |
| J | ELBOW REST HEIGHT | Measure from the flesh below the elbow pivot bolt to the seat surface. | 182.8-203.2 | 193.0 |
| 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 | 545.0 |
| L | POPLITEAL HEIGHT | Seat surface to the plane of the horizontal plane of the bottom of the feet. | 355.6-376.0 | 365.2 |
| M | KNEE PIVOT HEIGHT | Centerline of knee pivot bolt to the horizontal plane of the bottom of the feet. | 393.7-419.1 | 400.5 |
| 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”. | 414-439.4 | 438.0 |

| SN506, HYBRID III, 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 | 183.0 |
| P | FOOT LENGTH | Tip of toe to rear of heal | 218.5-233.7 | 226.2 |
| 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 | 475.8 |
| S | HEAD BREADTH | The widest part of the head | 137.1-147.3 | 142.0 |
| T | HEAD DEPTH | Back of the head to the forehead | 177.8-188.0 | 180.5 |
| U | HIP BREADTH | The widest part of the hip | 299.7-314.9 | 305.1 |
| V | SHOULDER BREADTH | Outside edges of right and left shoulder clevises | 350.5-365.7 | 359.0 |
| W | FOOT BREADTH | The widest part of the foot | 78.8-94.0 | 85.5 |
| X | HEAD CIRCUMFERENCE | Measured at the point as in dim. “T” | 528.3-548.7 | 538.0 |
| Y | CHEST CIRCUMFERENCE (WITH CHEST JACKET) | Measured 345.4 ± 12.7 mm above seat surface | 850.9-881.3 | 857.6 |
| Z | WAIST CIRCUMFERENCE | Measured 165.1 ± 5.1 mm above seat surface | 759.5-789.9 | 789.0 |
| AA | REFERENCE LOCATION FOR MEASUREMENT OF CHEST CIRCUMFERENCE | Reference | 332.7-358.1 | 345.0 |
| BB | REFERENCE LOCATION FOR MEASUREMENT OF WAIST CIRCUMFERENCE | Reference | 160.1-170.2 | 165.0 |

## EXTERNAL DIMENSIONS

| SN505, HYBRID III, 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 | 783.4 |
| B | SHOULDER PIVOT HEIGHT | Centerline of shoulder pivot bolt to the seat surface. | 431.8-457.2 | 438.0 |
| C | H-POINT HEIGHT | Reference | 81.3-86.3 | 84.2 |
| D | H-POINT LOCATION FROM BACKLINE | Reference | 144.8-149.8 | 147.3 |
| E | SHOULDER PIVOT FROM BACKLINE | Center of the shoulder clevis to the rear vertical surface of the fixture. | 68.6-83.8 | 76.4 |
| F | THIGH CLEARANCE | Measured at the highest point on the upper femur segment. | 119.4-134.6 | 124.3 |
| 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 | 250.3 |
| H | HEAD BACK TO BACKLINE | Back of skull cap skin to seat rear vertical surface (Reference) | 43.2-48.2 | 46.7 |
| 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 | 283.4 |
| J | ELBOW REST HEIGHT | Measure from the flesh below the elbow pivot bolt to the seat surface. | 182.8-203.2 | 187.3 |
| 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 | 532.4 |
| L | POPLITEAL HEIGHT | Seat surface to the plane of the horizontal plane of the bottom of the feet. | 355.6-376.0 | 362.3 |
| M | KNEE PIVOT HEIGHT | Centerline of knee pivot bolt to the horizontal plane of the bottom of the feet. | 393.7-419.1 | 405.2 |
| 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”. | 414-439.4 | 421.6 |

| SN505, HYBRID III, 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 | 182.4 |
| P | FOOT LENGTH | Tip of toe to rear of heal | 218.5-233.7 | 224.7 |
| 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 | 473.7 |
| S | HEAD BREADTH | The widest part of the head | 137.1-147.3 | 144.6 |
| T | HEAD DEPTH | Back of the head to the forehead | 177.8-188.0 | 179.2 |
| U | HIP BREADTH | The widest part of the hip | 299.7-314.9 | 305.7 |
| V | SHOULDER BREADTH | Outside edges of right and left shoulder clevises | 350.5-365.7 | 362.4 |
| W | FOOT BREADTH | The widest part of the foot | 78.8-94.0 | 84.3 |
| X | HEAD CIRCUMFERENCE | Measured at the point as in dim. “T” | 528.3-548.7 | 533.7 |
| Y | CHEST CIRCUMFERENCE (WITH CHEST JACKET) | Measured 345.4 ± 12.7 mm above seat surface | 850.9-881.3 | 863.7 |
| Z | WAIST CIRCUMFERENCE | Measured 165.1 ± 5.1 mm above seat surface | 759.5-789.9 | 773.6 |
| AA | REFERENCE LOCATION FOR MEASUREMENT OF CHEST CIRCUMFERENCE | Reference | 332.7-358.1 | 345.0 |
| BB | REFERENCE LOCATION FOR MEASUREMENT OF WAIST CIRCUMFERENCE | Reference | 160.1-170.2 | 165.0 |

DATA SHEET B3
HEAD DROP TEST (572.132)

Dummy Serial Number 505 Test Date 7/26/04

Technician Jessica Gall

_X_Pretest 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))
__X_ N/A, ONLY one head drop performed

_X_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))

_X_3. The head accelerometer mounting plate screws ((10-24 x 3/8 SHCS) are torqued to 9.0 Nm.

_X_4. Accelerometers and their respective mounts are smooth and clean.

_X_5. Torque the skull cap screws (10-24 x 1/2 SHCS) to 9.0 Nm.

_X_6. The data acquisition system, including transducers, conforms to the requirements of SAE Recommended Practice J211/1 MAR95. (572.136(m))

_X_7. The head assembly soaked at a temperature between 18.9°C (66ºF) and 25.6°C (78ºF) 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 21.9
Record the minimum temperature 20.8
Record the maximum humidity 43%
Record the minimum humidity 41%

_X_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 ± 1.0 mm (14.8±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 __503mm_____
Record the left side distance __503mm_____

_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 __$656 \times 10^{-6}$mm_____

_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 ± 1.0 mm (14.8 inches ± 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 g ≤ x ≤ 300 g | 271 |
| 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 ≤ 15 g | 15 |

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

Jessica Hall
Signature

7/26/04
Date

**MGA RESEARCH CORPORATION**

**HEAD DROP TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 505 **Test ID:** D041661

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 - 25.6 | 21.9 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 43 | Pass |
| Peak Resultant Acceleration | G's | 250 - 300 | 271 | Pass |
| Peak Lateral Acceleration | G's | +/- 15 | 14.6 | Pass |
| Unimodal | Yes/No | NA | Yes | Pass |
| Oscillations | Yes/No | within 10% of peak | Yes | Pass |
| | | Overall Test Results | | Pass |

Jessica Hall
Laboratory Technician

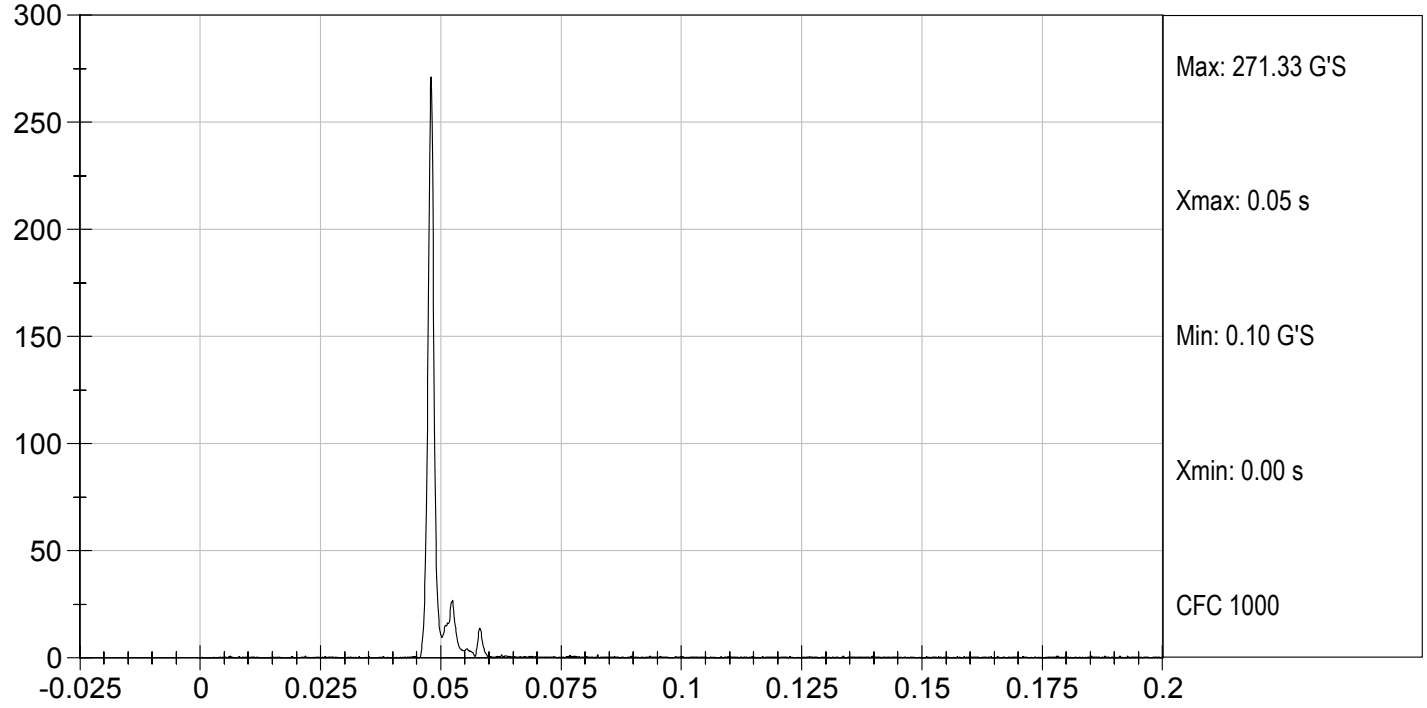
07/26/2004
Test Date

Jeff Levandoski
Approved By

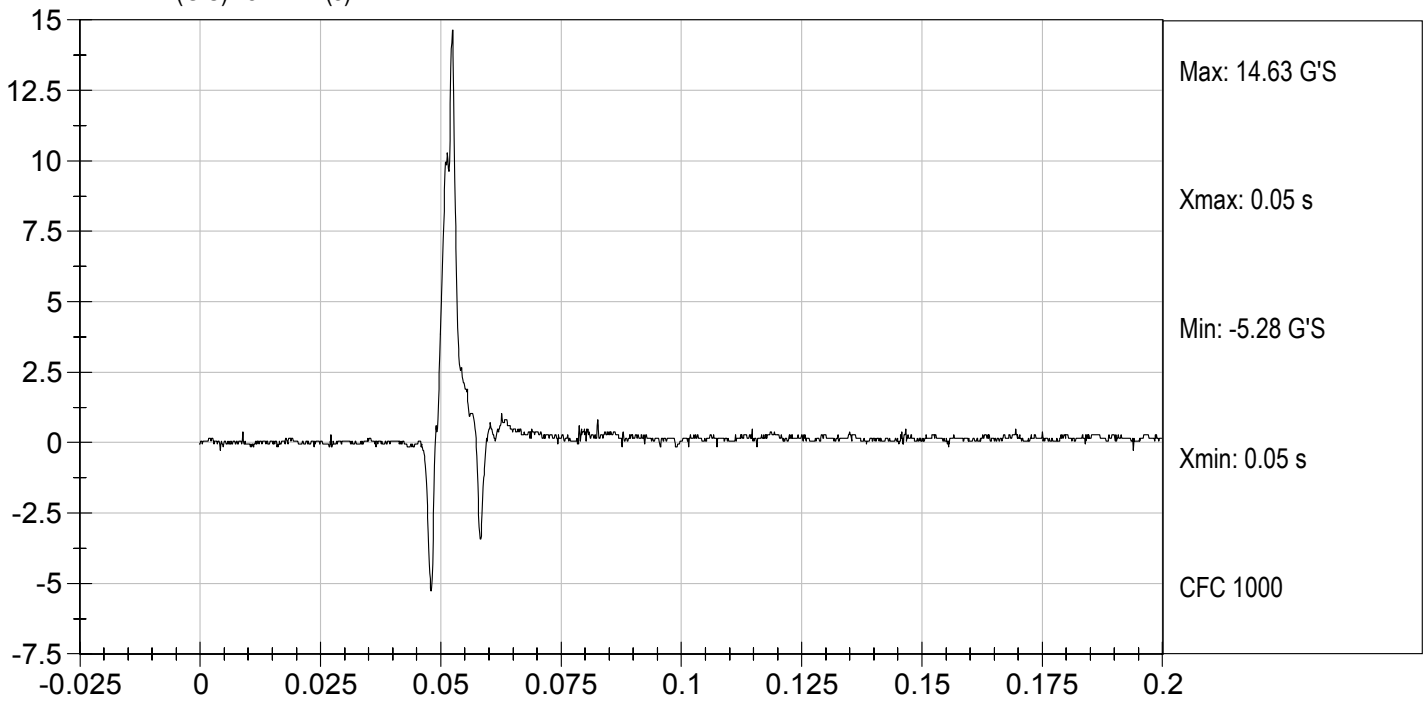
Test Desc: Head Drop
Componet ID: D041661

Test Date: 07/26/2004
Velocity: 0 ft/s, 0 m/s

PEAK RESULTANT ACCELERATION (G'S) vs TIME (s)




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



DATA SHEET B4
NECK FLEXION TEST (572.133)

Dummy Serial Number ____505_____ Test Date ____7/26/04_____

Technician ____Jessica Gall_____

_X_Pretest 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))
_X_ N/A, ONLY one flexion test performed

_X_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))

_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. (572.133(c)(1))
Record the maximum temperature __21.9__
Record the minimum temperature __20.8__
Record the maximum humidity __43%__
Record the minimum humidity __41%__

_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. (880105-250 and PADI page17).
Record findings and actions: __No Deterioration. Hardness Front 85; Back 88.

_X_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 ± 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 | Result |
|---|---|---|---|
| Pendulum impact speed | | 6.89 m/s ≤ speed ≤ 7.13 m/s | 7.10 m/s |
| Pendulum ΔV with respect to impact speed | @ 10ms | 2.1 m/s ≤ ΔV ≤ 2.5 m/s | 2.5 m/s |
| | @ 20 ms | 4.0 m/s ≤ ΔV ≤ 5.0 m/s | 4.8 m/s |
| | @30ms | 5.8 m/s ≤ ΔV ≤ 7.0 m/s | 6.8 m/s |
| Plane D Rotation | | Peak moment*<br>69 Nm ≤ moment ≤ 83 Nm during the following rotation range $77^o$ ≤ angle ≤ $91^o$ | __76__ Nm @ __85__ degrees |
| Positive Moment Decay** (Flexion) | | Time to decay to 10 Nm<br>80 ms ≤ time ≤ 100ms | 84 ms |

*Moment about the occipital condyle = $M_y$ – (0.01778 m x $F_x$) (572.133(b)(1)(ii))

My = Moment in Nm measured by the transducer

Fx = 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.

Jessica Gall
Signature

7/26/04
Date

**MGA RESEARCH CORPORATION**

**NECK FLEXION TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 505 **Test I.D:** D041662

| 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 | 42 | Pass |
| Pendulum Speed | | m/sec | 6.89 to 7.13 | 7.10 | Pass |
| Pendulum Deceleration | 10 msec | m/sec | 2.1 to 2.5 | 2.5 | Pass |
| | 20 msec | m/sec | 4.0 to 5.0 | 4.8 | Pass |
| | 30 msec | m/sec | 5.8 to 7.0 | 6.8 | Pass |
| D Plane Rotation | Max | deg | 77 to 91 | 85 | Pass |
| Occipital Condyle Moment within Deflection Corridor | | Nm | 69 to 83 | 76 | Pass |
| Positive Moment Time Curve Decay to 10 Nm | | msec | 80 to 100 | 84 | Pass |
| | | | Overall Results | | Pass |

Jessica Gall
Laboratory Technician

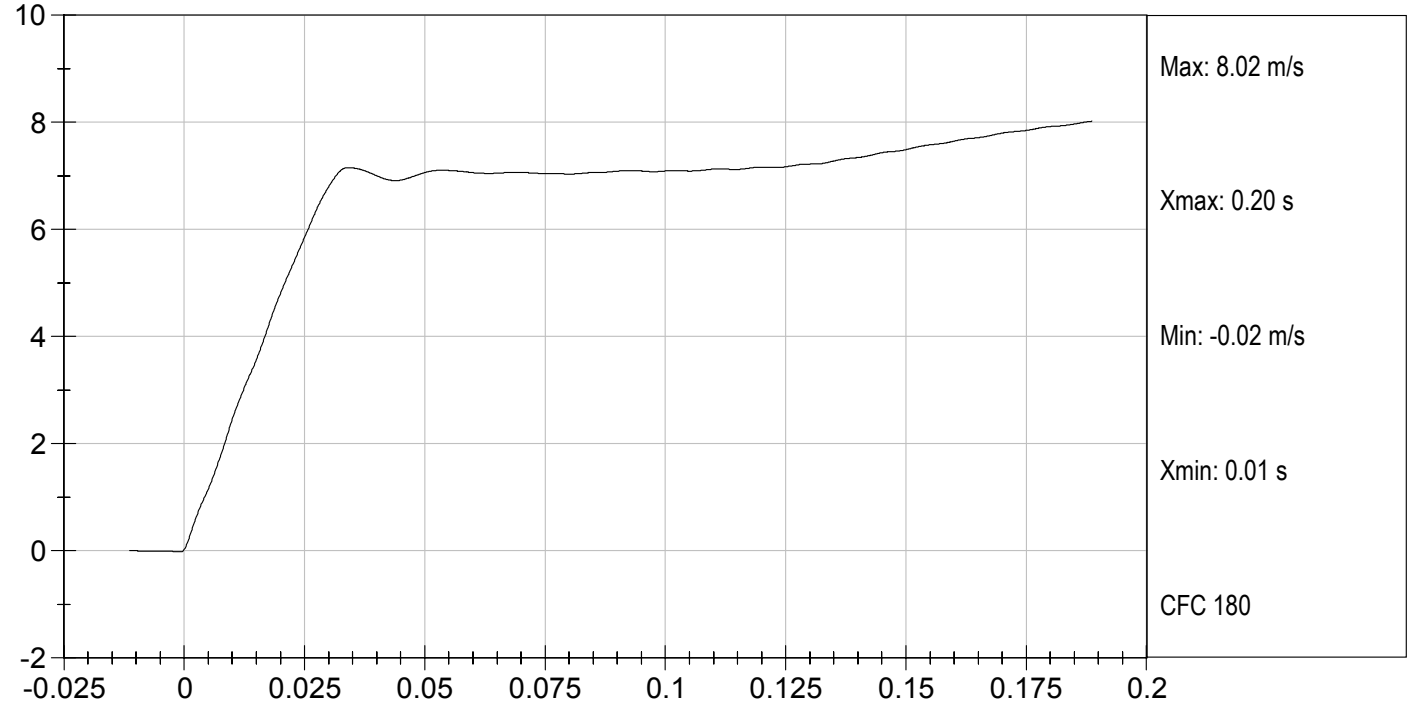
07/26/2004
Test Date

Jeff Leonardelli
Approved By

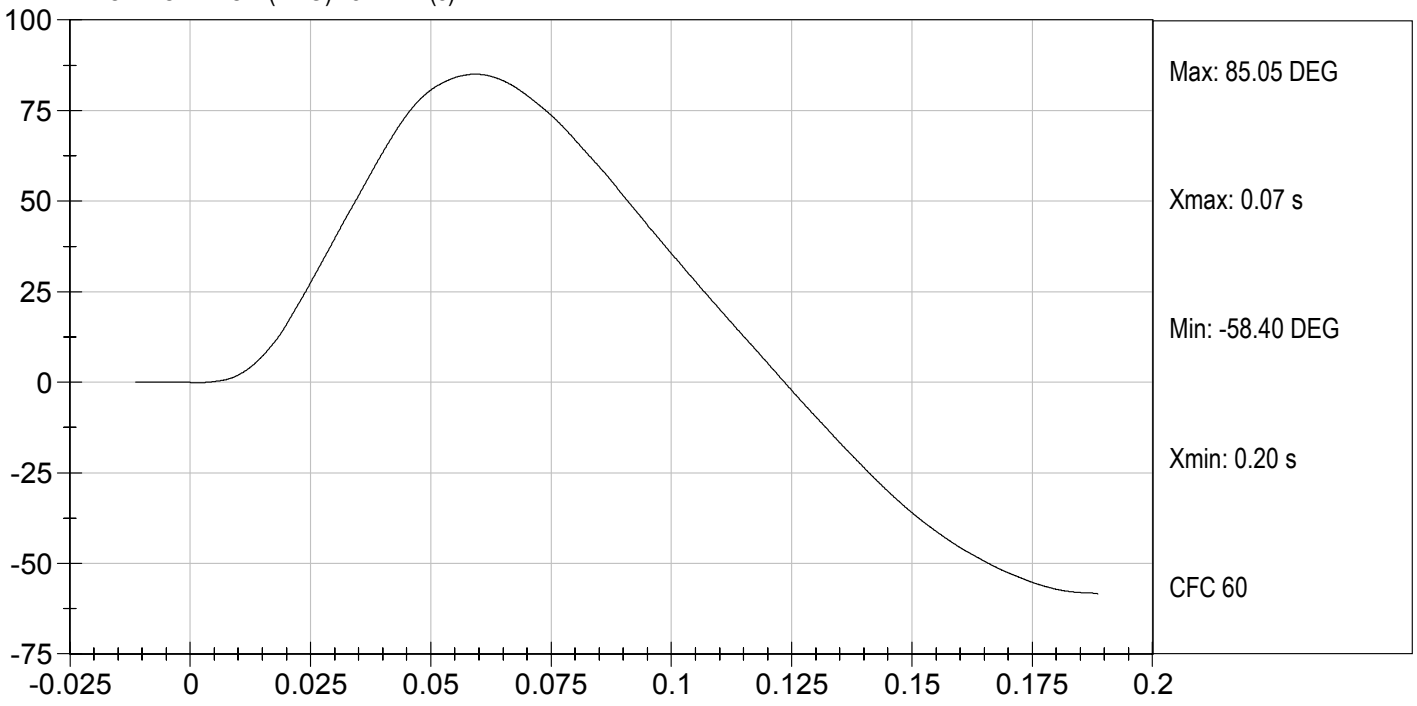
Test Desc: Neck Flexion
Componet ID: D041662

Test Date: 07/26/2004
Velocity: 23.31 ft/s, 7.10 m/s

PENDULUM DECELERATION (m/s) vs TIME (s)

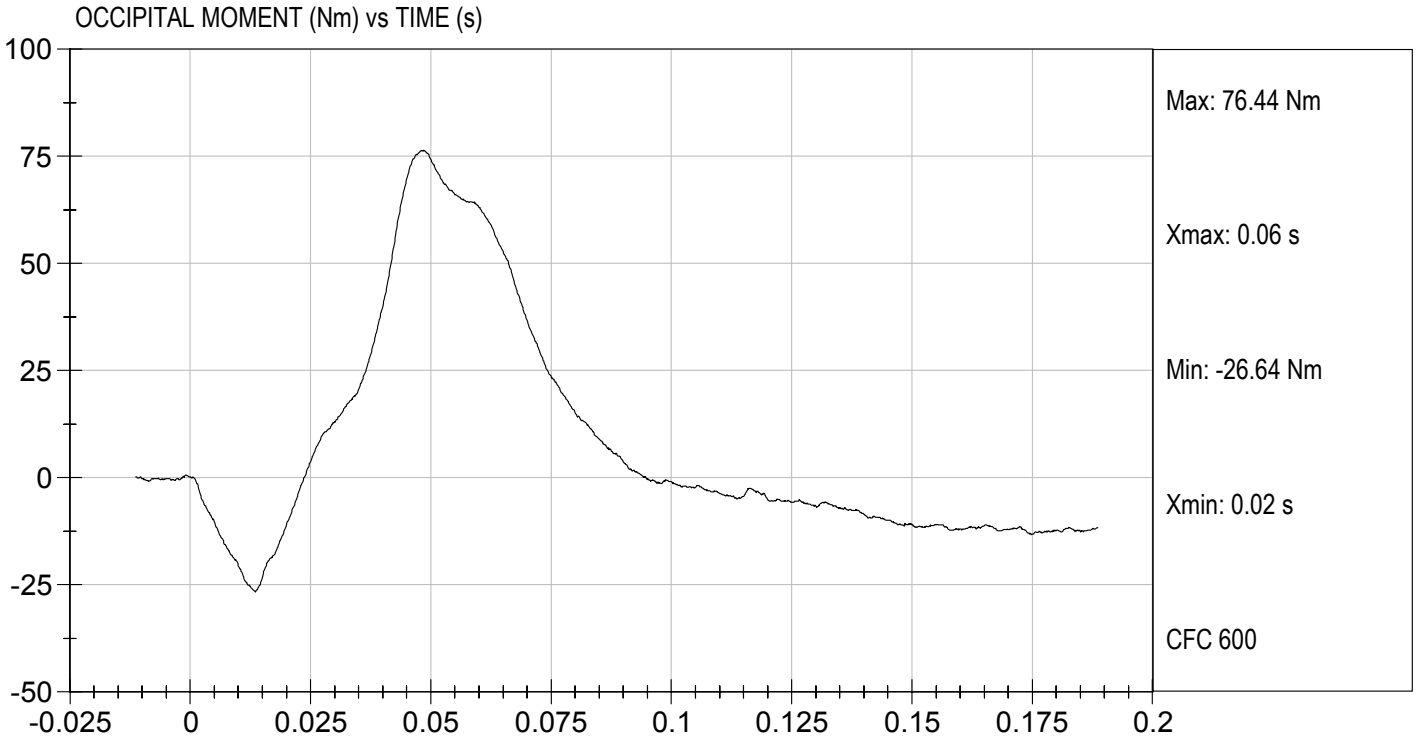



NECK ROTATION (DEG) vs TIME (s)



Test Desc: Neck Flexion
Componet ID: D041662

Test Date: 07/26/2004
Velocity: 23.31 ft/s, 7.10 m/s



DATA SHEET B5
NECK EXTENSION TEST (572.133)

Dummy Serial Number ___505_____ Test Date ___7/26/04_____

Technician _____Joe Fleck_____

_X_Pretest 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))
_X_ N/A, ONLY one extension test performed

_X_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))

_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. (572.133(c)(1))
Record the maximum temperature __21.9___
Record the minimum temperature __20.8___
Record the maximum humidity __43%__
Record the minimum humidity __41%__

_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. (880105-250 and PADI page17).
Record findings and actions: __No Deterioration. Hardness Front 85; Back 88.

_X_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 ± 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 | Result |
|---|---|---|---|
| Pendulum impact speed | | 5.95 m/s ≤ speed ≤ 6.19 m/s | 6.15 m/s |
| Pendulum ΔV with respect to impact speed | @ 10ms | 1.5 m/s ≤ ΔV ≤ 1.9 m/s | 1.9 m/s |
| | @ 20 ms | 3.1 m/s ≤ ΔV ≤ 3.9 m/s | 3.7 m/s |
| | @30ms | 4.6 m/s ≤ ΔV ≤ 5.6 m/s | 5.3 m/s |
| Plane D Rotation | | Peak moment*<br>-65 Nm ≤ moment ≤ -53 Nm during the following rotation range $99^o$ ≤ angle ≤ $114^o$ | _-61_ Nm @ _109_ degrees |
| Negative Moment Decay** (Extension) | | Time to decay to -10 Nm<br>94 ms ≤ time ≤ 114 ms | 96 ms |

*Moment about the occipital condyle = $M_y$ – (0.01778 m x $F_x$) (572.133(b)(1)(ii)

My = Moment in Nm measured by the transducer

Fx = 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.

Joe Fleck _____ 7/26/04

Signature Date

**MGA RESEARCH CORPORATION**

**NECK EXTENSION TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 505 **Test I.D:** D041663

| Tested Parameter | | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|---|
| Laboratory Temperature | | deg C | 20.6 to 22.2 | 20.8 | Pass |
| Laboratory Relative Humidity | | % | 10 to 70 | 41 | Pass |
| Pendulum Speed | | m/sec | 5.95 to 6.19 | 6.15 | Pass |
| Pendulum Deceleration | 10 msec | m/sec | 1.5 to 1.9 | 1.9 | Pass |
| | 20 msec | m/sec | 3.1 to 3.9 | 3.7 | Pass |
| | 30 msec | m/sec | 4.6 to 5.6 | 5.3 | Pass |
| D Plane Rotation | Max | deg | 99 to 114 | 109 | Pass |
| Occipital Condyle Moment within Deflection Corridor | | Nm | -65 to -53 | -61 | Pass |
| Negative Moment Time Curve Decay to -10 Nm | | msec | 94 to 114 | 96 | Pass |
| | | | Overall Results | | Pass |

Laboratory Technician

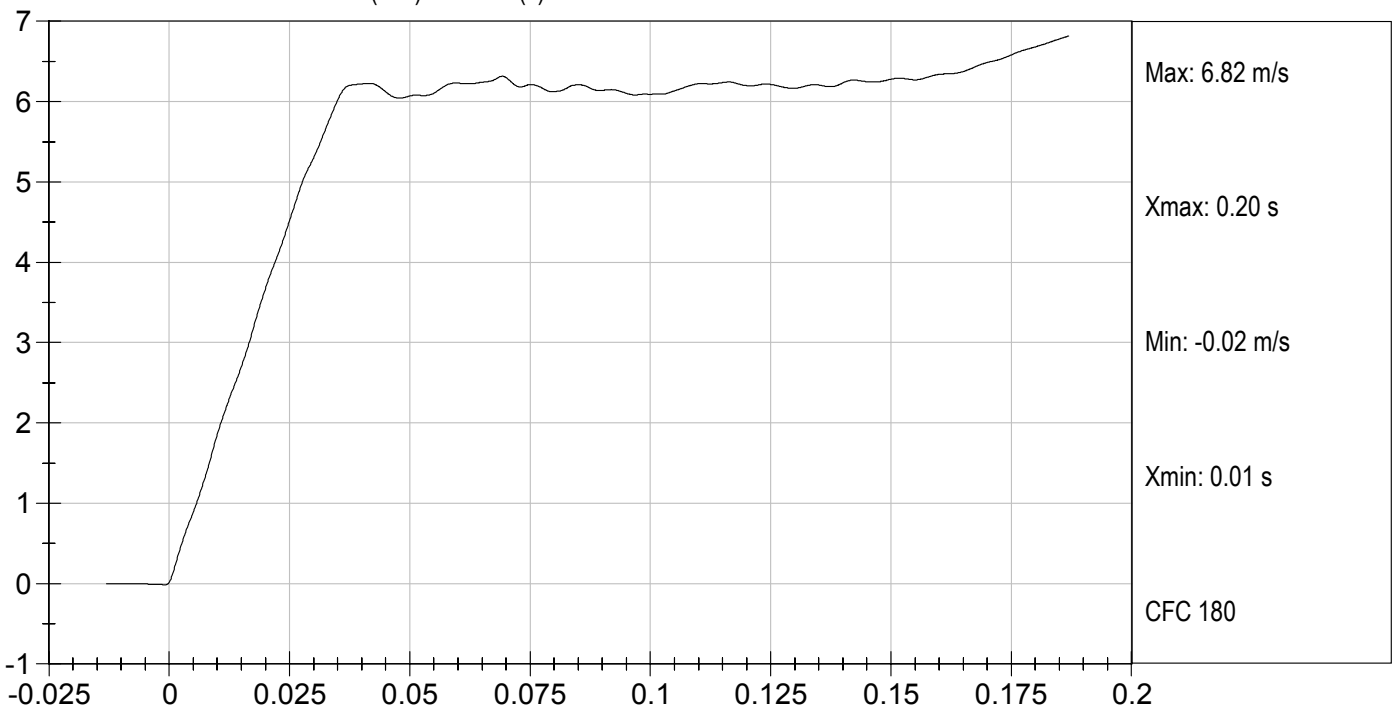
07/26/2004
Test Date

Approved By

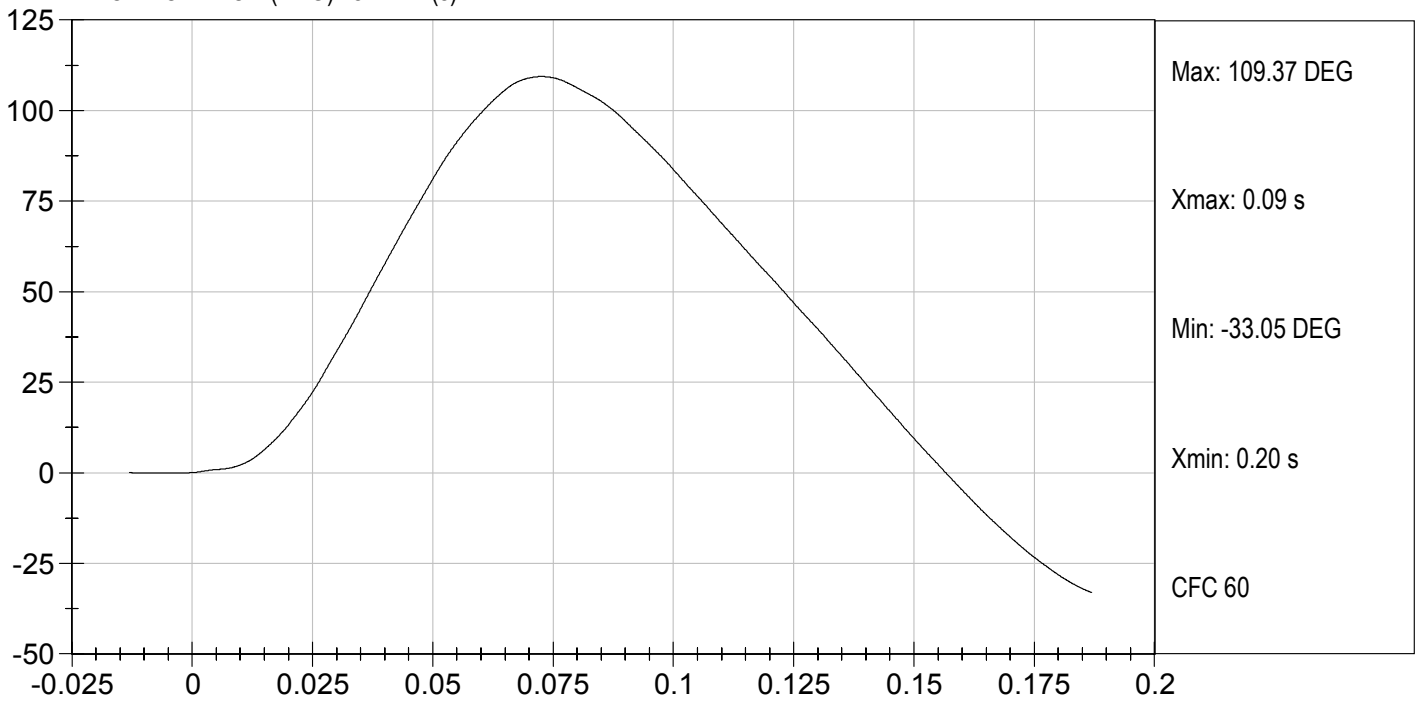
Test Desc: Neck Extension
Componet ID: D041663

Test Date: 07/26/2004
Velocity: 20.18 ft/s, 6.15 m/s

PENDULUM DECELERATION (m/s) vs TIME (s)

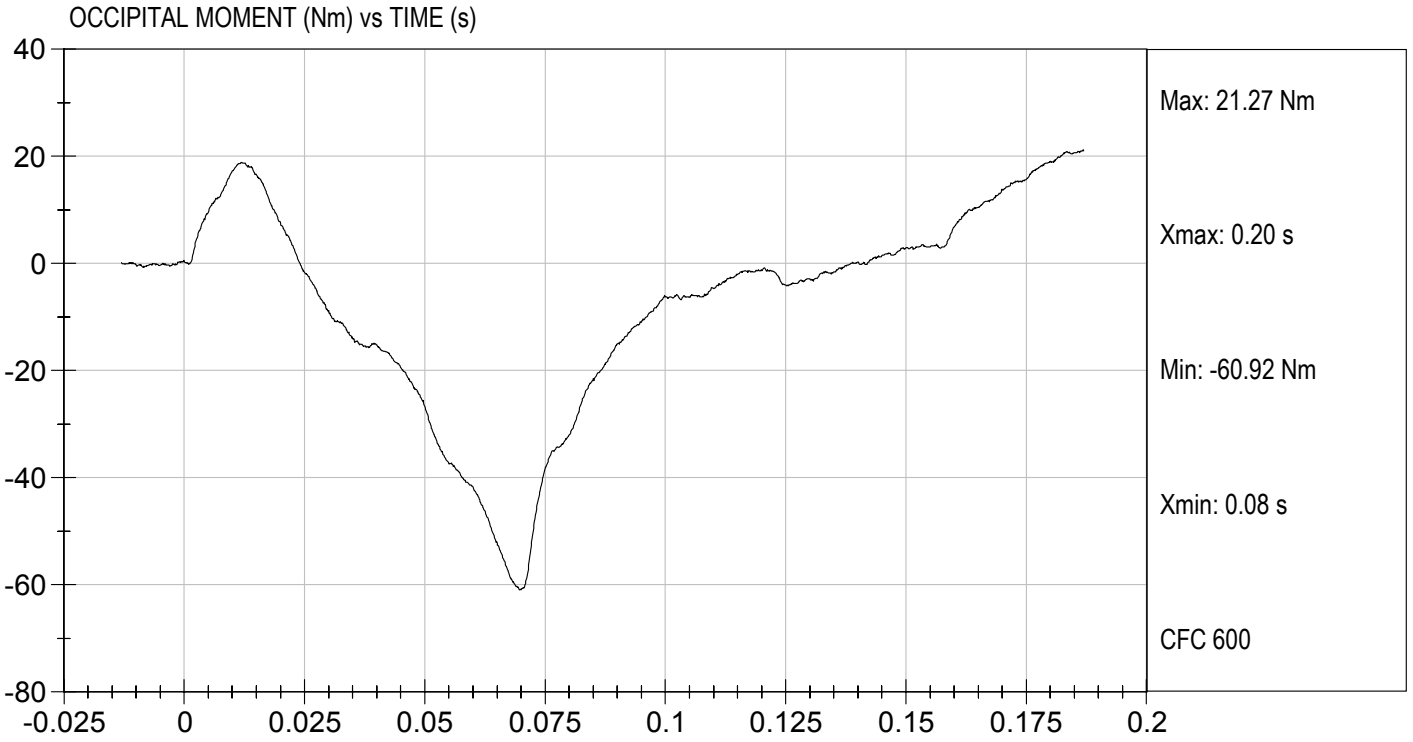



NECK ROTATION (DEG) vs TIME (s)



Test Desc: Neck Extension
Componet ID: D041663

Test Date: 07/26/2004
Velocity: 20.18 ft/s, 6.15 m/s



DATA SHEET B6
THORAX IMPACT TEST (572.134)

Dummy Serial Number __505_____ Test Date __7/27/04_____

Technician ____Joe Fleck_____

_X_Pretest 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))
_X_ N/A, ONLY one thorax impact test performed
_X_2. The test fixture conforms to the specifications in Figure 11B.
_X_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))
_X_4. The dummy assembly soaked at a temperature between 20.6°C (69ºF) and 22.2°C (72ºF) 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 _21.5_
Record the minimum temperature _20.7_
Record the maximum humidity _48%_
Record the minimum humidity _45%_
_X_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.
_X_ - 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 ± 0.5º and adjust the pelvis angle to 7º ± 2º. 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 ± 1º. (572.134(c)(3))

_X_ 9. The longitudinal centerline of the test probe is centered within ±2.5 mm of the midsagittal plane of the dummy and is 12.7 mm ± 1mm below the horizontal peripheral centerline of the No. 3 rib and is within 0.5º 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 ± 2º 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 2º 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 ± 0.12m/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 m/s ≤ speed ≤ 6.83 m/s | 6.64 m/s |
| Chest Compression | 50.0 mm ≤ compression ≤ 58.0 mm | 54 mm |
| Peak force** between 50.0 and 58.0 mm chest compression | 3900N ≤ peak force ≤ 4400N | 4190 N |
| Peak force** between 18.0 and 50.0 mm chest compression | peak force ≤ 4600 N | 4138 N |
| Internal Hysteresis*** | 69% ≤ hysteresis ≤ 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.

Signature

7/27/04
Date

**MGA RESEARCH CORPORATION**

**THORAX IMPACT**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 505 **Test I.D:** D041664

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Temperature | deg C | 20.6 to 22.2 | 20.7 | Pass |
| Relative Humidity | % | 10 to 70 | 45 | Pass |
| Probe Speed | m/s | 6.59 to 6.83 | 6.64 | Pass |
| Peak Deflection | mm | 50 to 58 | 53.5 | Pass |
| Peak Resistive Force w/in Deflection Corridor | kN | 3.9 to 4.4 | 4.2 | Pass |
| Internal Hysteresis | % | 69 to 85 | 70 | Pass |
| Peak Force 18 mm - 50 mm | N | < 4600 N | 4,138 | Pass |
| | | Overall Test Results | | Pass |

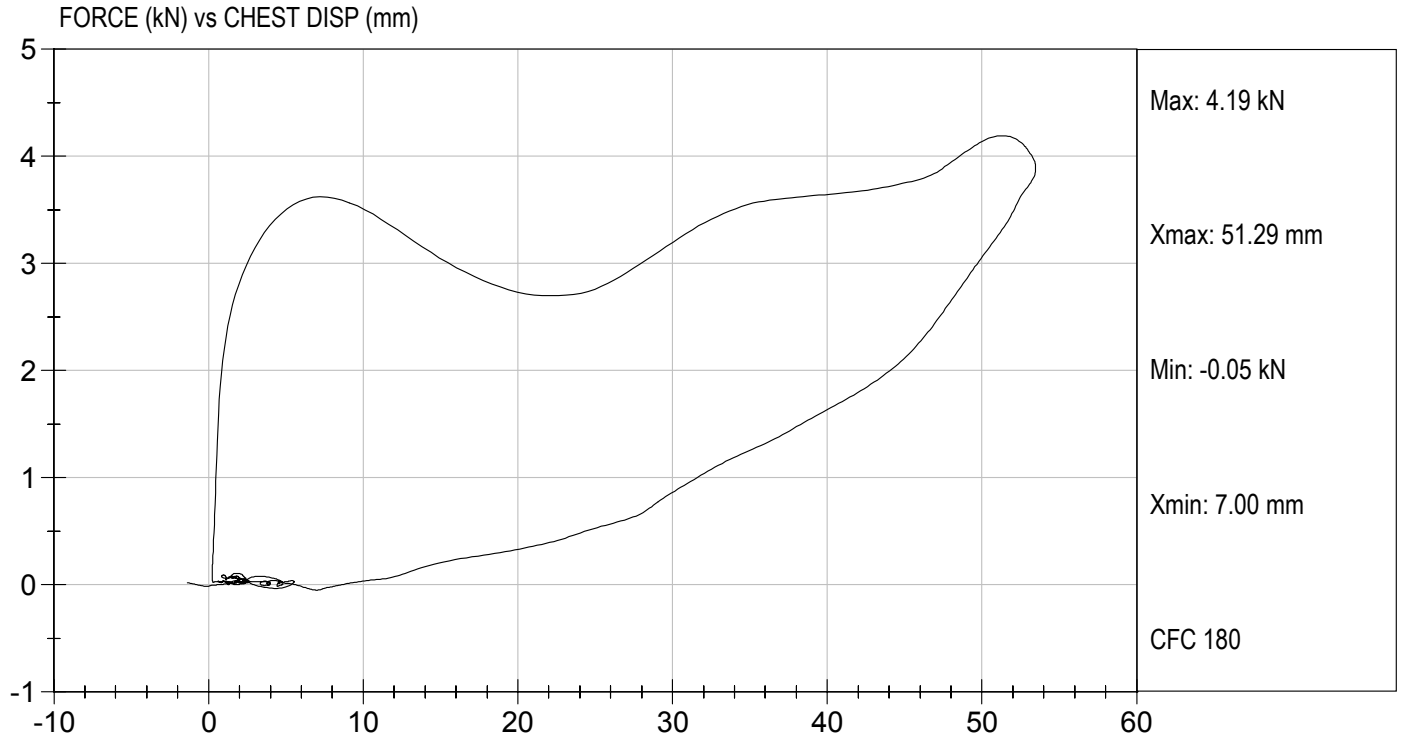
Laboratory Technician

07/27/2004
Test Date

Approved By

Test Desc: Thorax Impact
Componet ID: D041664

Test Date: 07/27/2004
Velocity: 21.77 ft/s, 6.64 m/s



DATA SHEET B7
TORSO FLEXION TEST (572.135)

Dummy Serial Number __505_____ Test Date __7/26/04_____

Technician _____Joe Fleck_____

_X_Pretest 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))
_X_ N/A, ONLY one thorax impact test performed
_X_2. The test fixture conforms to the specifications in Figure 13B.
_X_3. The complete assembled dummy (880105-000) is used (572.135(c)(2)).
__ with legs below the femurs.
_X_ without legs below the femurs.
_X_4. The dummy assembly soaked at a temperature between 18.9°C (66ºF) and 25.6°C (78ºF) 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 __21.9__
Record the minimum temperature __20.8__
Record the maximum humidity __43%__
Record the minimum humidity __41%__
_X_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))
_X_6. Attach the loading adapter bracket to the spine of the dummy as shown in Figure 13B**.** (572.135(c)(4))
_X_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))
_X_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°)___18°___
_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° | 18° |
| Torso rotation rate | 0.5°/s ≤ rate ≤ 1.5°/s | 1.0 |
| Force at 45° ±0.5° | 320 N ≤ force ≤ 390 N | 370 N |
| Final ref. plane angle | Initial ref. plane angle ±8° | 20° |

Signature 7/26/04 Date

**MGA RESEARCH CORPORATION**

**TORSO FLEXION TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 505 **Test I.D:** D041667

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 - 25.6 | 21.0 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 41 | Pass |
| Initial Angle | deg | 0 to 20 | 18 | Pass |
| Return Angle | deg | +/- 8 | 20 | Pass |
| Force at 45 deg | N | 320 to 390 | 370 | Pass |
| Upper Torso Deflection Rate | Deg/sec | 0.5 - 1.5 | 1.0 | Pass |
| | | Overall Result | | Pass |

Joe Fleck
Laboratory Technician

07/26/2004
Test Date

Jeff Leonardelli
Approved By

DATA SHEET B8
LEFT KNEE IMPACT TEST (572.136)

Dummy Serial Number __505_____ Test Date __7/26/04_____

Technician ____Joe Fleck_____

_X_Pretest 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))
_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 (66ºF) and 25.6°C (78ºF) 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 _21.9__
Record the minimum temperature _20.8__
Record the maximum humidity _43%__
Record the minimum humidity _41%__
_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 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 m/s ≤ speed ≤ 2.13 m/s | 2.12 m/s |
| Peak resistance force* | 3450 N ≤ force ≤ 4060 N | 3830 N |

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

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

Jan Fleck _____ 7/26/04

Signature Date

**MGA RESEARCH CORPORATION**

**LEFT KNEE IMPACT TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 505 **Test I.D:** D041666

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 to 25.5 | 21.7 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 43 | Pass |
| Probe Speed | m/sec | 2.07 to 2.13 | 2.12 | Pass |
| Maximum Force | kN | 3.45 to 4.06 | 3.83 | Pass |
| | | Overall Test Results | | Pass |

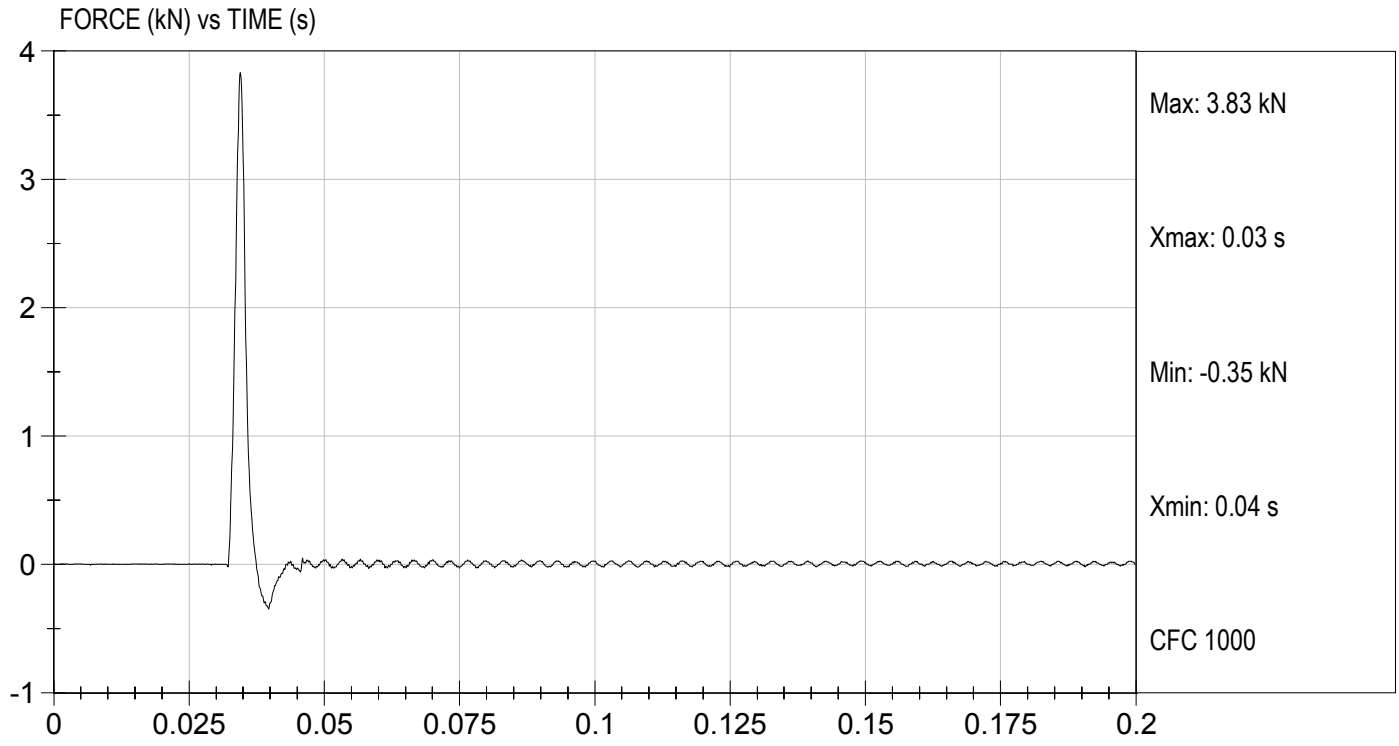
Joe Fleck
Laboratory Technician

07/26/2004
Test Date

Jeff Levandoski
Approved By

Test Desc: Left Knee
Componet ID: D041666

Test Date: 07/26/2004
Velocity: 6.95 ft/s, 2.12 m/s



DATA SHEET B9
RIGHT KNEE IMPACT TEST (572.136)

Dummy Serial Number ___505_____ Test Date __7/26/04_____

Technician ___Joe Fleck_____

_X_Pretest 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))
_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 (880105-528R), 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))
_X_4. The knee assembly soaked at a temperature between 18.9°C (66ºF) and 25.6°C (78ºF) 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 _21.9___
Record the minimum temperature _20.8___
Record the maximum humidity _43 %___
Record the minimum humidity _41 %___
_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 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))
_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 m/s ≤ speed ≤ 2.13 m/s | 2.12 m/s |
| Peak resistance force* | 3450 N ≤ force ≤ 4060 N | 3770 N |

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

_X_12. Plots of acceleration versus time and force versus time follow this sheet.

Signature

7/26/04
Date

**MGA RESEARCH CORPORATION**

**RIGHT KNEE IMPACT TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 505 **Test I.D:** D041665

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 to 25.5 | 21.7 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 43 | Pass |
| Probe Speed | m/sec | 2.07 to 2.13 | 2.12 | Pass |
| Maximum Force | kN | 3.45 to 4.06 | 3.77 | Pass |
| | | Overall Test Results | | Pass |

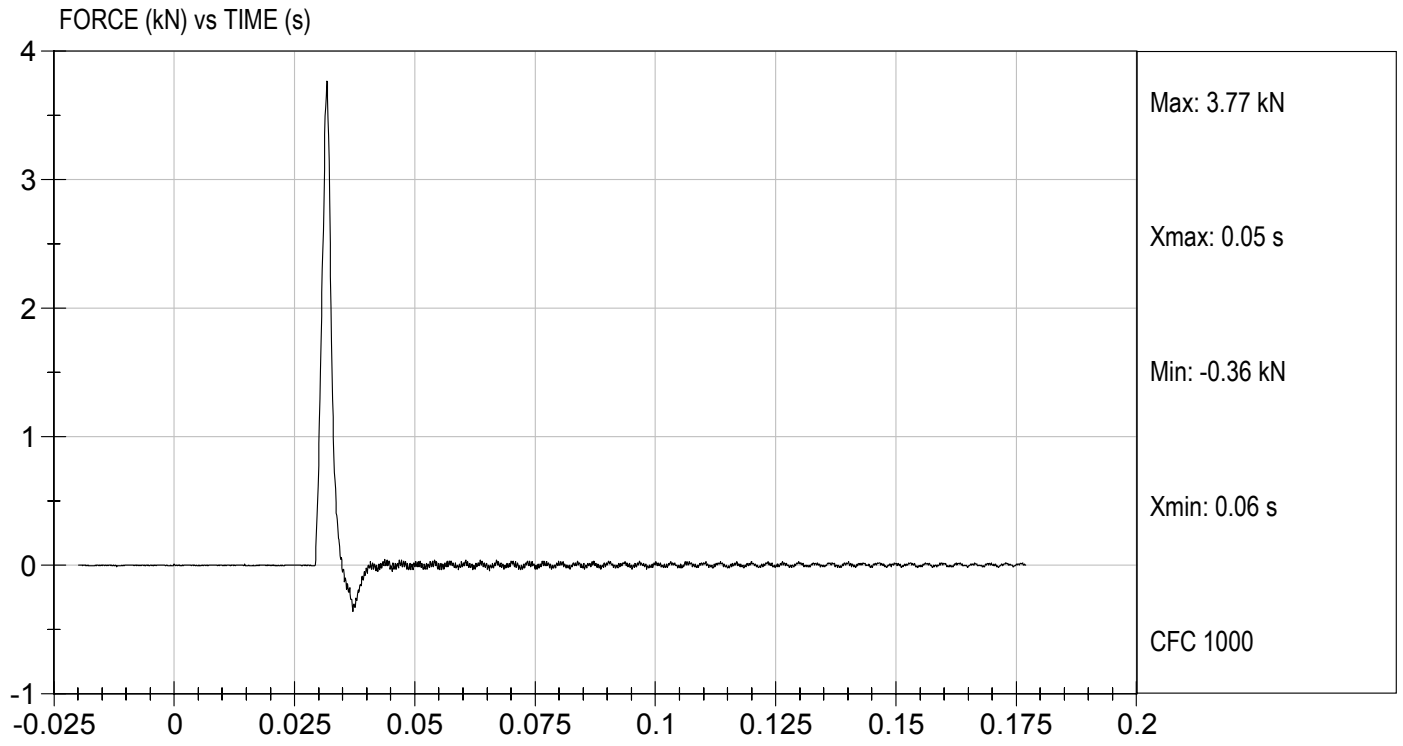
Joe Fleck
Laboratory Technician

07/26/2004
Test Date

Jeff Levandoski
Approved By

Test Desc: Right Knee
Componet ID: D041665

Test Date: 07/26/2004
Velocity: 6.95 ft/s, 2.12 m/s



DATA SHEET B3
HEAD DROP TEST (572.132)

Dummy Serial Number 505 Test Date 8/02/04

Technician Joe Fleck

__Pretest calibration
_X_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))
__X_ N/A, ONLY one head drop performed
_X_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))
_X_3. The head accelerometer mounting plate screws ((10-24 x 3/8 SHCS) are torqued to 9.0 Nm.
_X_4. Accelerometers and their respective mounts are smooth and clean.
_X_5. Torque the skull cap screws (10-24 x 1/2 SHCS) to 9.0 Nm.
_X_6. The data acquisition system, including transducers, conforms to the requirements of SAE Recommended Practice J211/1 MAR95. (572.136(m))
_X_7. The head assembly soaked at a temperature between 18.9°C (66ºF) and 25.6°C (78ºF) 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 21.7
Record the minimum temperature 20.7
Record the maximum humidity 52%
Record the minimum humidity 46%
_X_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 ± 1.0 mm (14.8±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 __503mm_____
Record the left side distance __503mm_____

_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 __$656 \times 10^{-6}$mm_____

_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 ± 1.0 mm (14.8 inches ± 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 g ≤ x ≤ 300 g | 260 |
| 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 ≤ 15 g | 9.2 |

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

Joe Fleck
Signature

8/02/04
Date

**MGA RESEARCH CORPORATION**

**HEAD DROP TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 505 **Test ID:** D041751

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 - 25.6 | 20.8 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 50 | Pass |
| Peak Resultant Acceleration | G's | 250 - 300 | 260 | Pass |
| Peak Lateral Acceleration | G's | +/- 15 | -9.2 | Pass |
| Unimodal | Yes/No | NA | Yes | Pass |
| Oscillations | Yes/No | within 10% of peak | Yes | Pass |
| | | Overall Test Results | | Pass |

Laboratory Technician

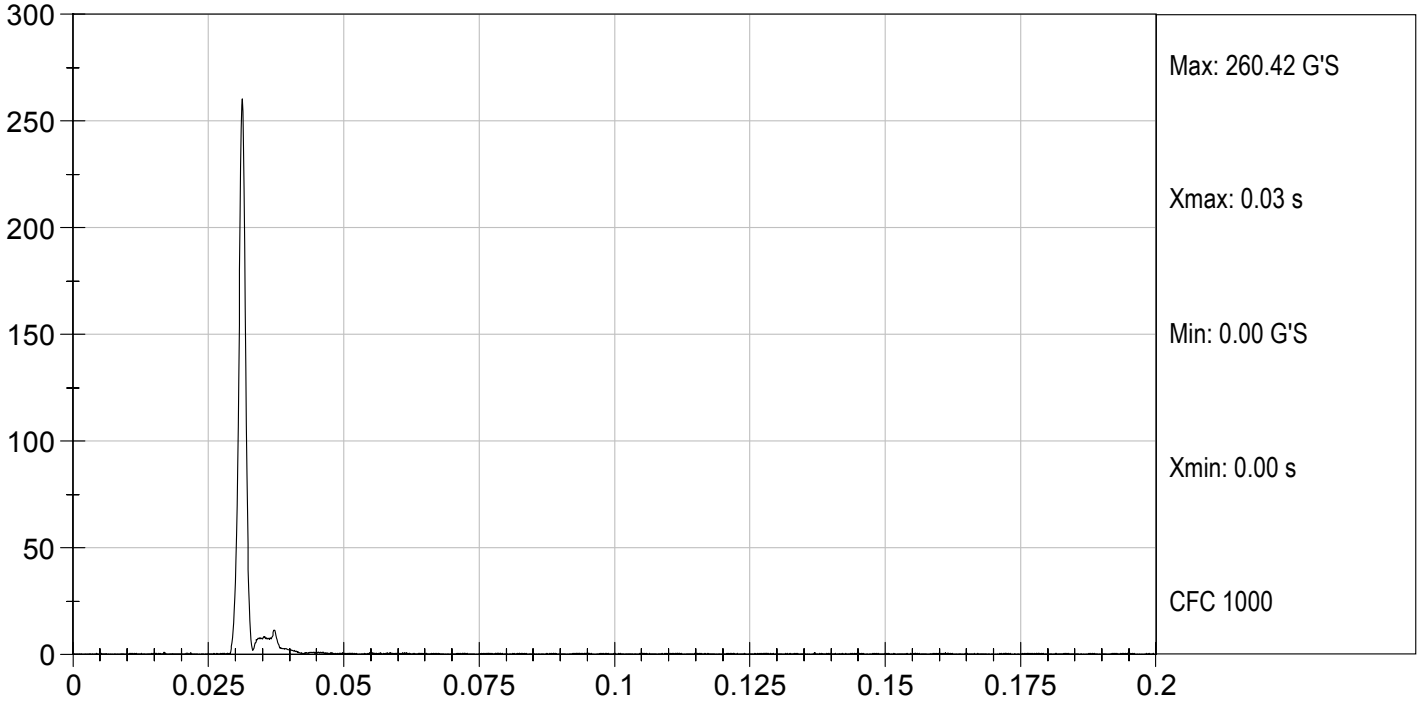
08/02/2004
Test Date

Approved By

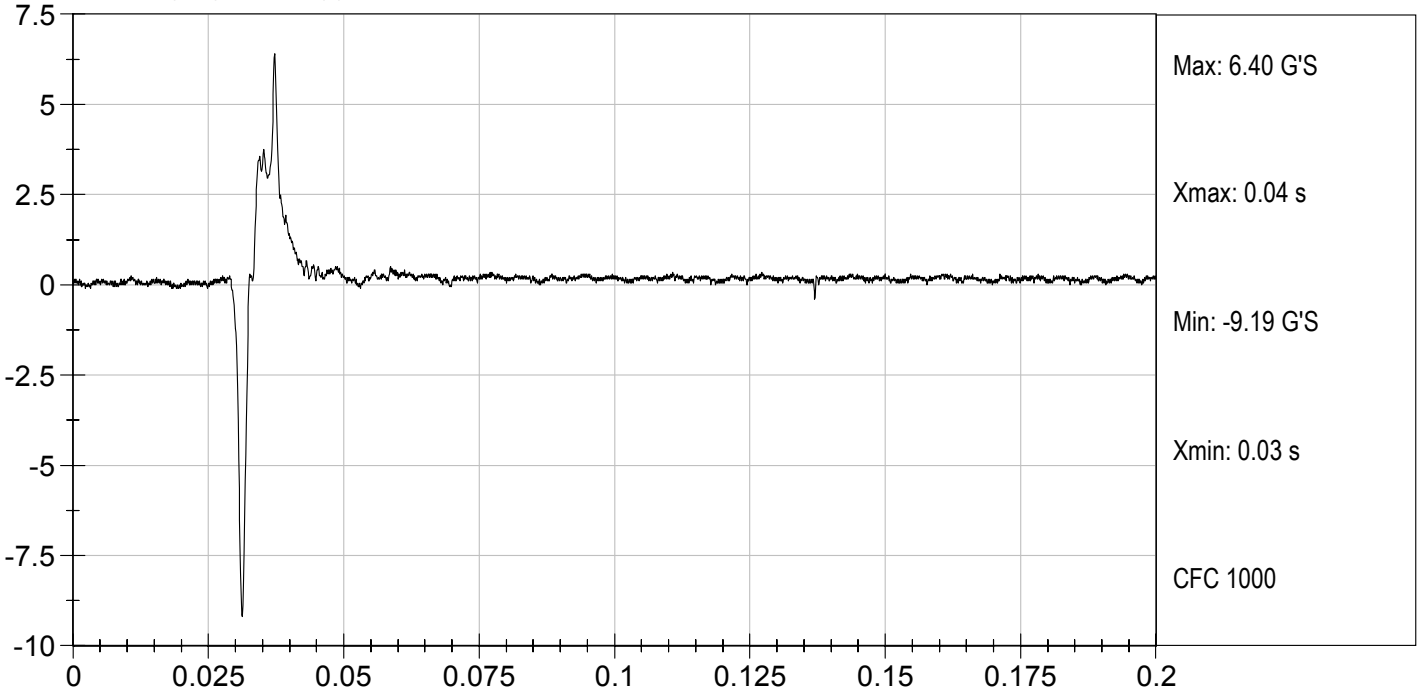
Test Desc: Head Drop
Componet ID: D041751

Test Date: 08/02/2004
Velocity: 0 ft/s, 0 m/s

PEAK RESULTANT ACCELERATION (G'S) vs TIME (s)




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



DATA SHEET B4
NECK FLEXION TEST (572.133)

Dummy Serial Number ____505_____ Test Date ____8/02/04_____

Technician ____Joe Fleck_____

__Pretest calibration
_X_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))
_X_ N/A, ONLY one flexion test performed

_X_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))

_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. (572.133(c)(1))
Record the maximum temperature __21.7__
Record the minimum temperature __20.7__
Record the maximum humidity __52%__
Record the minimum humidity __46%__

_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. (880105-250 and PADI page17).
Record findings and actions: __No Deterioration. Hardness Front 85; Back 88.

_X_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 ± 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 | Result |
|---|---|---|---|
| Pendulum impact speed | | 6.89 m/s ≤ speed ≤ 7.13 m/s | 7.09 m/s |
| Pendulum ΔV with respect to impact speed | @ 10ms | 2.1 m/s ≤ ΔV ≤ 2.5 m/s | 2.4 m/s |
| | @ 20 ms | 4.0 m/s ≤ ΔV ≤ 5.0 m/s | 4.6 m/s |
| | @30ms | 5.8 m/s ≤ ΔV ≤ 7.0 m/s | 6.6 m/s |
| Plane D Rotation | | Peak moment*<br>69 Nm ≤ moment ≤ 83 Nm during the following rotation range $77^o$ ≤ angle ≤ $91^o$ | __76__ Nm @ __83__ degrees |
| Positive Moment Decay** (Flexion) | | Time to decay to 10 Nm<br>80 ms ≤ time ≤ 100ms | 86 ms |

*Moment about the occipital condyle = $M_y$ – (0.01778 m x $F_x$) (572.133(b)(1)(ii))

My = Moment in Nm measured by the transducer

Fx = 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.

Signature _____ Date 8/02/04

**MGA RESEARCH CORPORATION**

**NECK FLEXION TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 505 **Test I.D:** D041752

| 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 | 50 | Pass |
| Pendulum Speed | | m/sec | 6.89 to 7.13 | 7.09 | Pass |
| Pendulum Deceleration | 10 msec | m/sec | 2.1 to 2.5 | 2.4 | Pass |
| | 20 msec | m/sec | 4.0 to 5.0 | 4.6 | Pass |
| | 30 msec | m/sec | 5.8 to 7.0 | 6.6 | Pass |
| D Plane Rotation | Max | deg | 77 to 91 | 83 | Pass |
| Occipital Condyle Moment within Deflection Corridor | | Nm | 69 to 83 | 76 | Pass |
| Positive Moment Time Curve Decay to 10 Nm | | msec | 80 to 100 | 86 | Pass |
| | | | Overall Results | | Pass |

Laboratory Technician

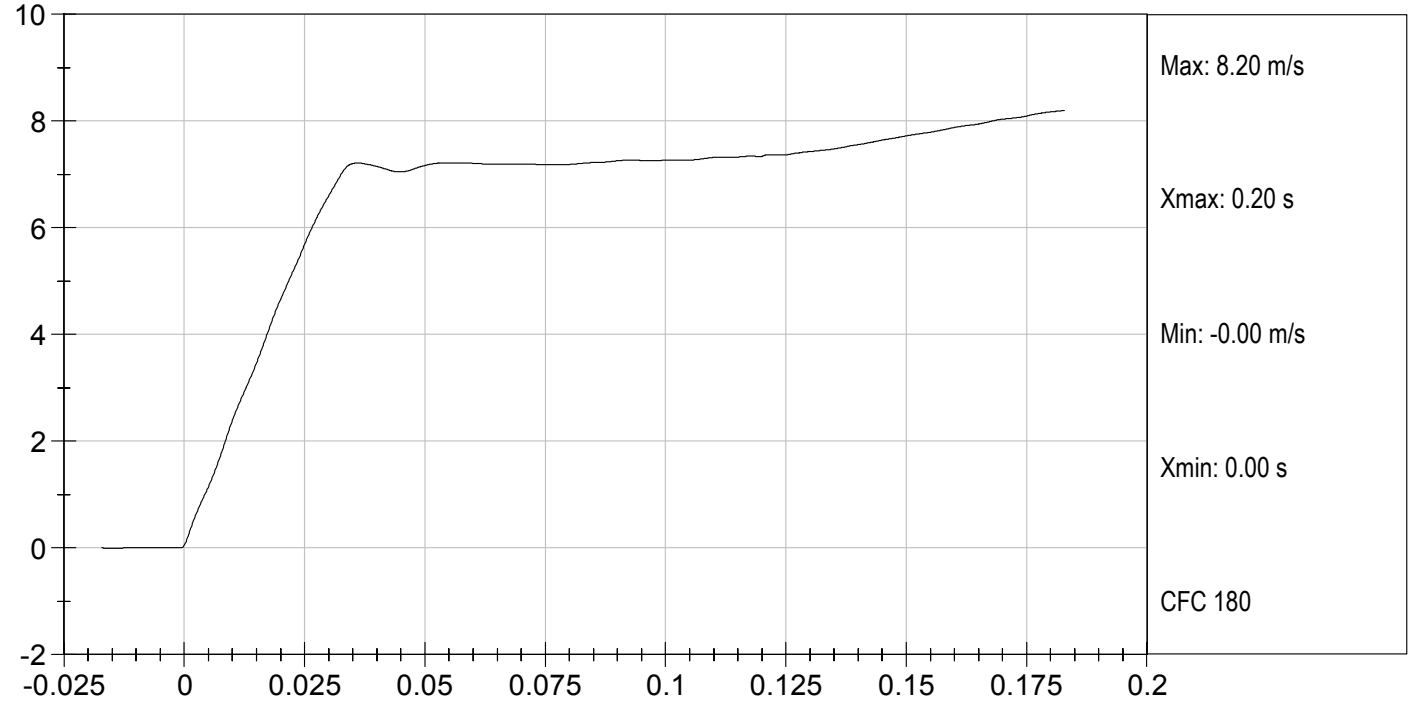
08/02/2004
Test Date

Approved By

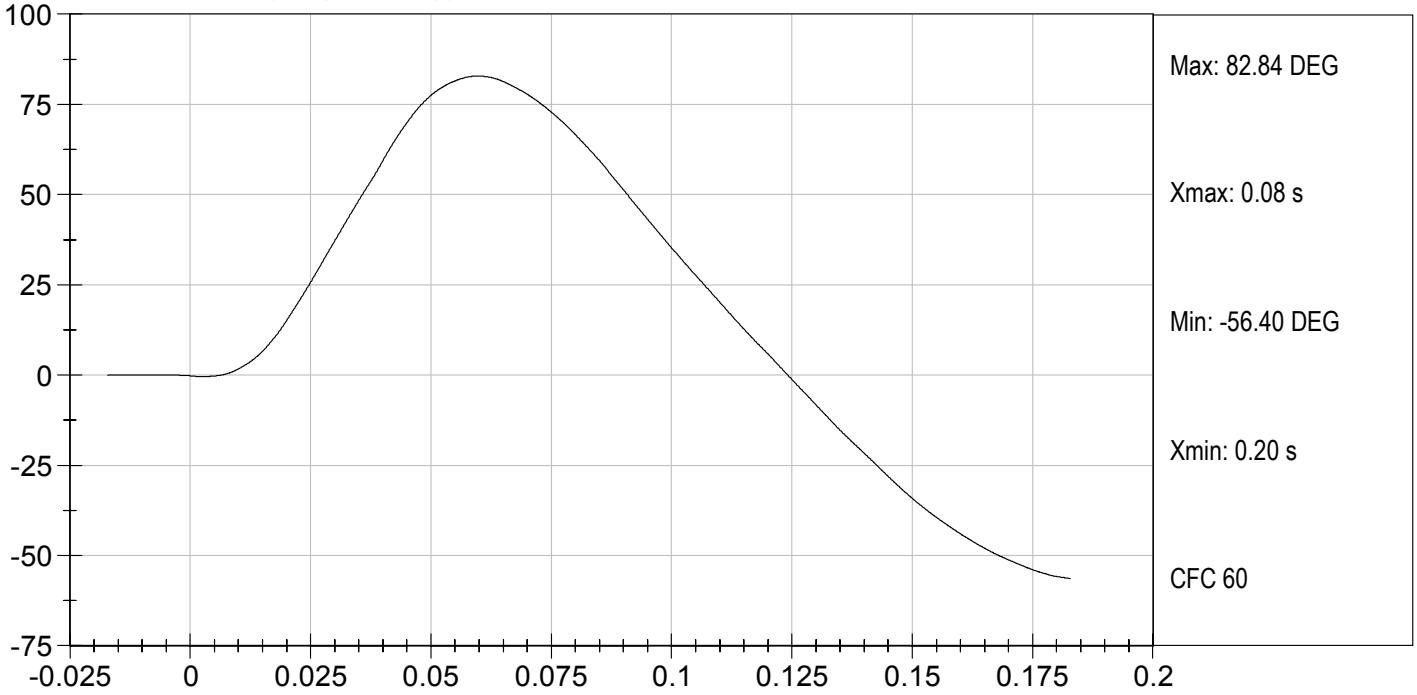
Test Desc: Neck Flexion
Componet ID: D041752

Test Date: 08/02/2004
Velocity: 23.2579 ft/s, 7.09 m/s

PENDULUM DECELERATION (m/s) vs TIME (s)

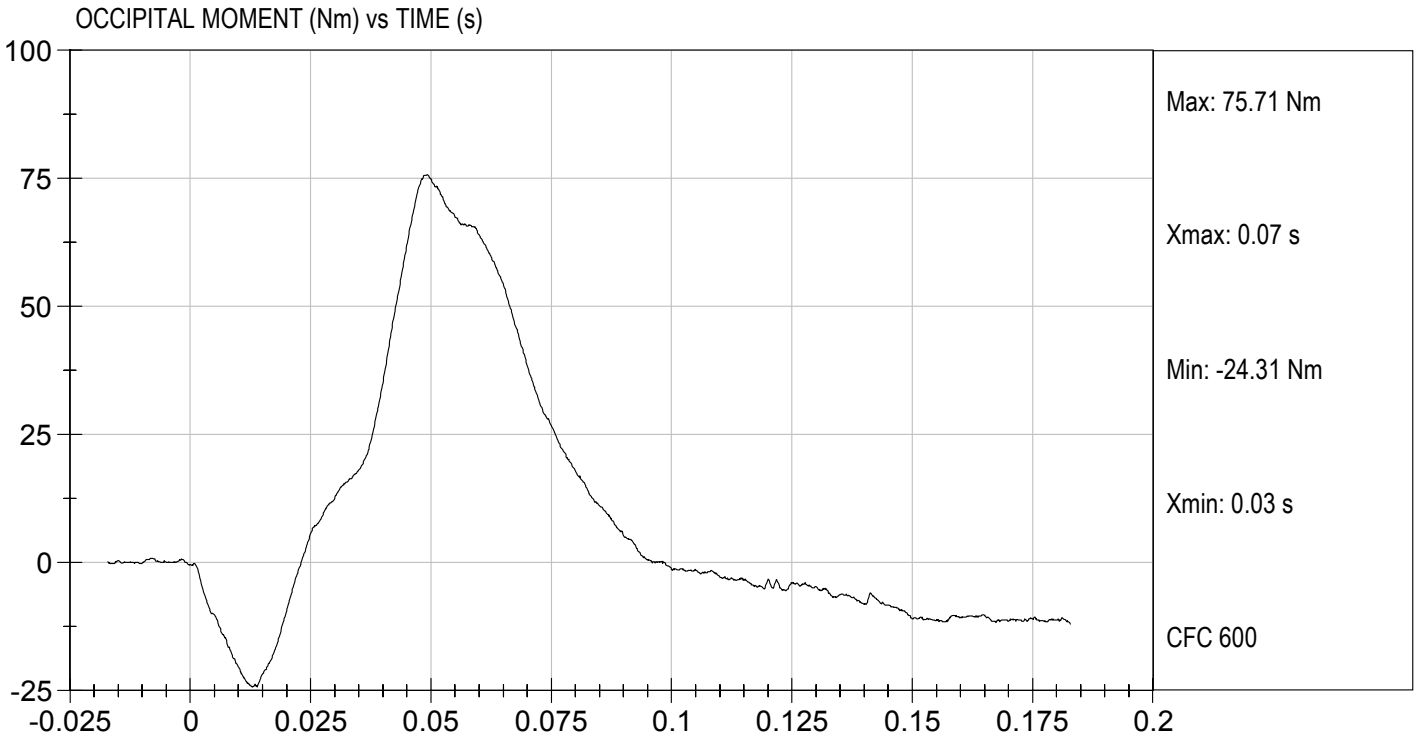



NECK ROTATION (DEG) vs TIME (s)



Test Desc: Neck Flexion
Componet ID: D041752

Test Date: 08/02/2004
Velocity: 23.2579 ft/s, 7.09 m/s



DATA SHEET B5
NECK EXTENSION TEST (572.133)

Dummy Serial Number ___505_____ Test Date ___8/02/04_____

Technician _____Joe Fleck_____

__Pretest calibration
_X_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))
_X_ N/A, ONLY one extension test performed

_X_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))

_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. (572.133(c)(1))
Record the maximum temperature __21.7___
Record the minimum temperature __20.7___
Record the maximum humidity __52%__
Record the minimum humidity __46%__

_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. (880105-250 and PADI page17).
Record findings and actions: __No Deterioration. Hardness Front 85; Back 88.

_X_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 ± 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 | Result |
|---|---|---|---|
| Pendulum impact speed | | 5.95 m/s ≤ speed ≤ 6.19 m/s | 6.10 m/s |
| Pendulum ΔV with respect to impact speed | @ 10ms | 1.5 m/s ≤ ΔV ≤ 1.9 m/s | 1.9 m/s |
| | @ 20 ms | 3.1 m/s ≤ ΔV ≤ 3.9 m/s | 3.7 m/s |
| | @30ms | 4.6 m/s ≤ ΔV ≤ 5.6 m/s | 5.3 m/s |
| Plane D Rotation | | Peak moment*<br>-65 Nm ≤ moment ≤ -53 Nm during the following rotation range $99^o$ ≤ angle ≤ $114^o$ | _-61_ Nm @ _110_ degrees |
| Negative Moment Decay** (Extension) | | Time to decay to -10 Nm<br>94 ms ≤ time ≤ 114 ms | 95 ms |

*Moment about the occipital condyle = $M_y$ – (0.01778 m x $F_x$) (572.133(b)(1)(ii)

My = Moment in Nm measured by the transducer

Fx = 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.

Joe Fleck _____ 8/02/04

Signature Date

**MGA RESEARCH CORPORATION**

**NECK EXTENSION TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 505 **Test I.D:** D041753

| Tested Parameter | | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|---|
| Laboratory Temperature | | deg C | 20.6 to 22.2 | 21.1 | Pass |
| Laboratory Relative Humidity | | % | 10 to 70 | 50 | Pass |
| Pendulum Speed | | m/sec | 5.95 to 6.19 | 6.10 | Pass |
| Pendulum Deceleration | 10 msec | m/sec | 1.5 to 1.9 | 1.9 | Pass |
| | 20 msec | m/sec | 3.1 to 3.9 | 3.7 | Pass |
| | 30 msec | m/sec | 4.6 to 5.6 | 5.3 | Pass |
| D Plane Rotation | Max | deg | 99 to 114 | 110 | Pass |
| Occipital Condyle Moment within Deflection Corridor | | Nm | -65 to -53 | -61 | Pass |
| Negative Moment Time Curve Decay to -10 Nm | | msec | 94 to 114 | 95 | Pass |
| | | | Overall Results | | Pass |

Laboratory Technician

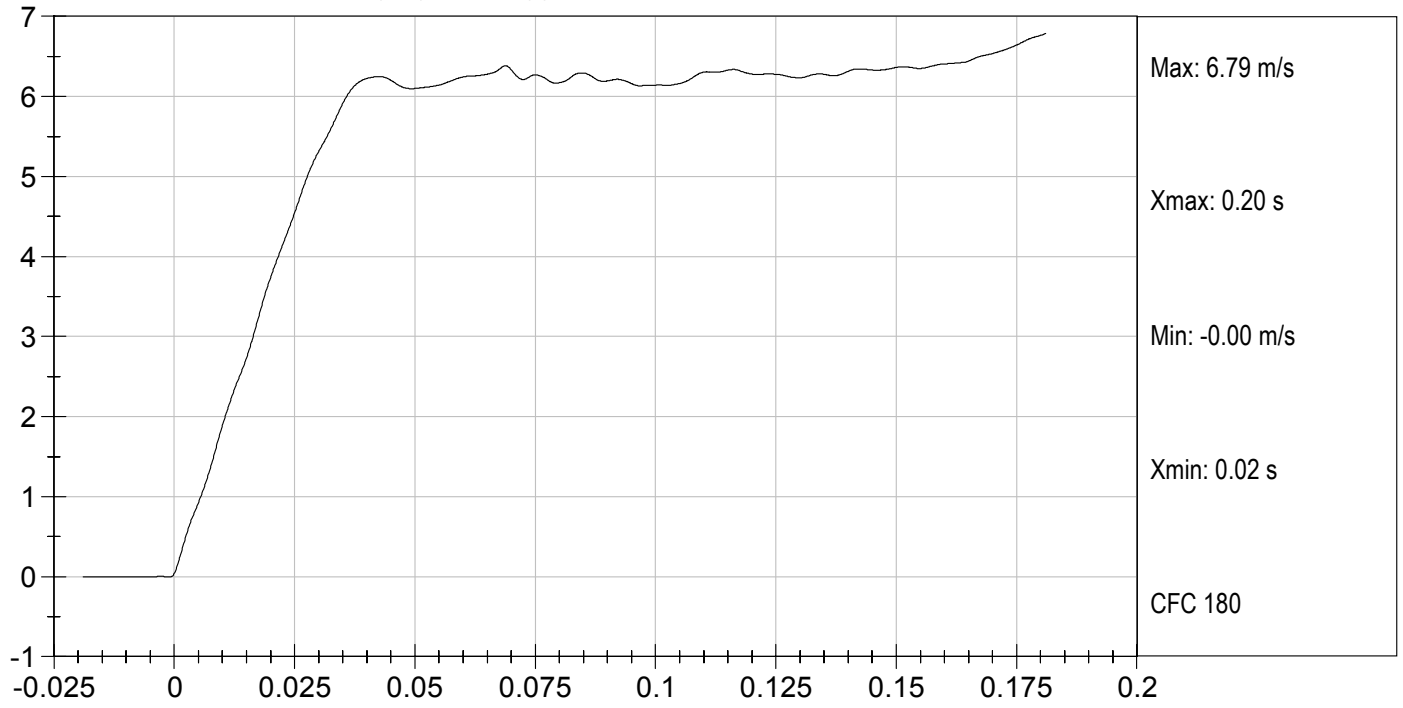
08/02/2004
Test Date

Approved By

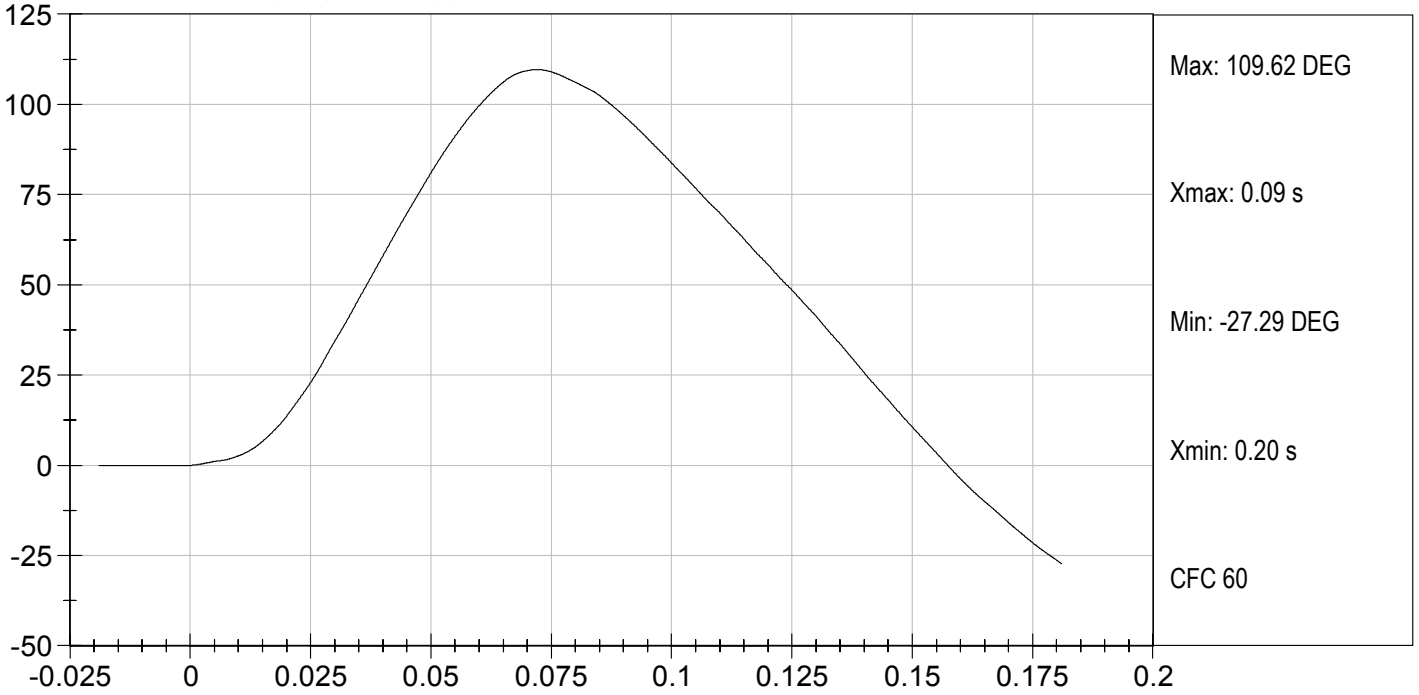
Test Desc: Neck Extension
Componet ID: D041753

Test Date: 08/02/2004
Velocity: 20.01 ft/s, 6.10 m/s

PENDULUM DECELERATION (m/s) vs TIME (s)

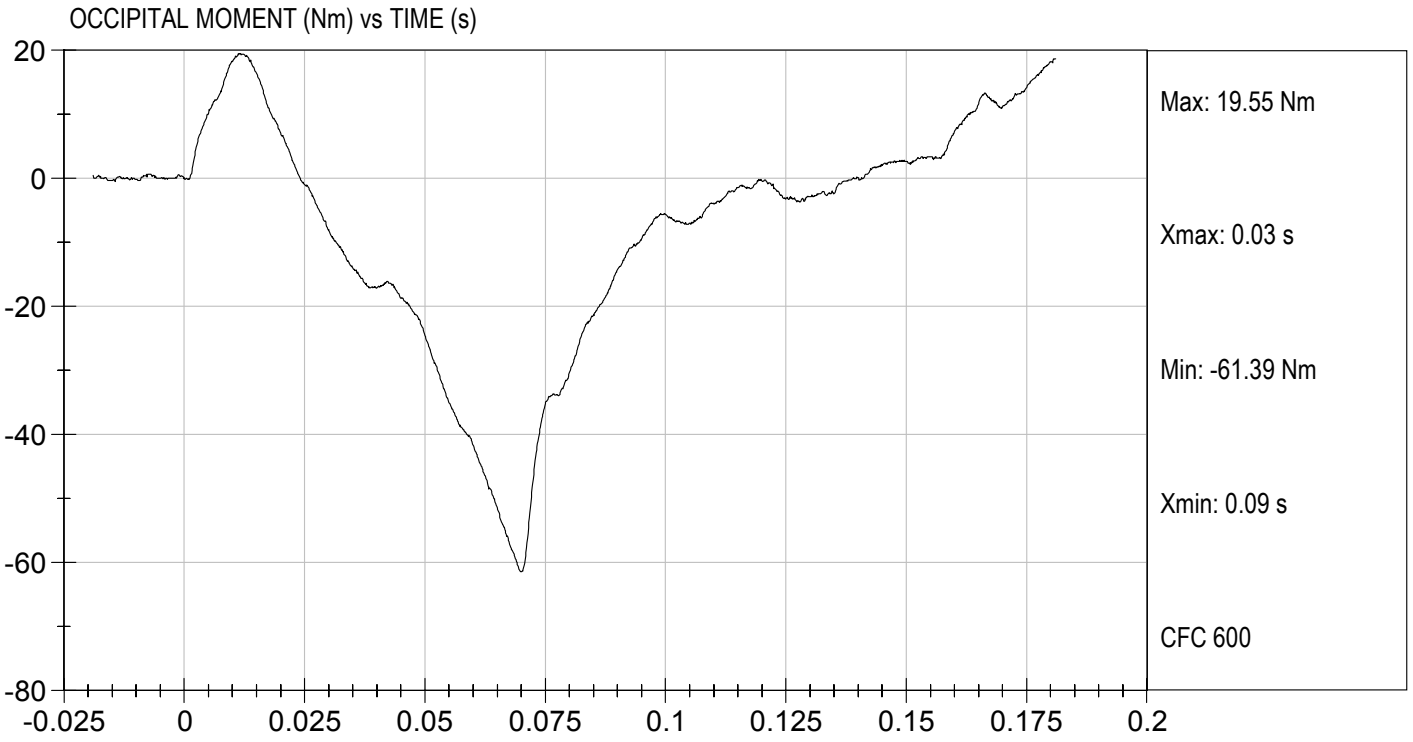



NECK ROTATION (DEG) vs TIME (s)



Test Desc: Neck Extension
Componet ID: D041753

Test Date: 08/02/2004
Velocity: 20.01 ft/s, 6.10 m/s



DATA SHEET B6
THORAX IMPACT TEST (572.134)

Dummy Serial Number __505_____ Test Date __8/02/04_____

Technician _____Joe Fleck_____

__Pretest calibration
_X_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))
_X_ N/A, ONLY one thorax impact test performed
_X_2. The test fixture conforms to the specifications in Figure 11B.
_X_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))
_X_4. The dummy assembly soaked at a temperature between 20.6°C (69ºF) and 22.2°C (72ºF) 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 _21.7_
Record the minimum temperature _20.7_
Record the maximum humidity _52%_
Record the minimum humidity _46%_
_X_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.
_X_ - 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 ± 0.5º and adjust the pelvis angle to 7º ± 2º. 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 ± 1º. (572.134(c)(3))

_X_ 9. The longitudinal centerline of the test probe is centered within ±2.5 mm of the midsagittal plane of the dummy and is 12.7 mm ± 1mm below the horizontal peripheral centerline of the No. 3 rib and is within 0.5º 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 ± 2º 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 2º 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 ± 0.12m/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 m/s ≤ speed ≤ 6.83 m/s | 6.63 m/s |
| Chest Compression | 50.0 mm ≤ compression ≤ 58.0 mm | 55.9 mm |
| Peak force** between 50.0 and 58.0 mm chest compression | 3900N ≤ peak force ≤ 4400N | 4020 N |
| Peak force** between 18.0 and 50.0 mm chest compression | peak force ≤ 4600 N | 3791 N |
| Internal Hysteresis*** | 69% ≤ hysteresis ≤ 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.

Signature 8/02/04
Date

**MGA RESEARCH CORPORATION**

**THORAX IMPACT**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 505 **Test I.D:** D041754

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Temperature | deg C | 20.6 to 22.2 | 20.7 | Pass |
| Relative Humidity | % | 10 to 70 | 48 | Pass |
| Probe Speed | m/s | 6.59 to 6.83 | 6.63 | Pass |
| Peak Deflection | mm | 50 to 58 | 55.9 | Pass |
| Peak Resistive Force w/in Deflection Corridor | kN | 3.9 to 4.4 | 4.0 | Pass |
| Internal Hysteresis | % | 69 to 85 | 69 | Pass |
| Peak Force 18 mm - 50 mm | N | < 4600 N | 3,791 | Pass |
| | | Overall Test Results | | Pass |

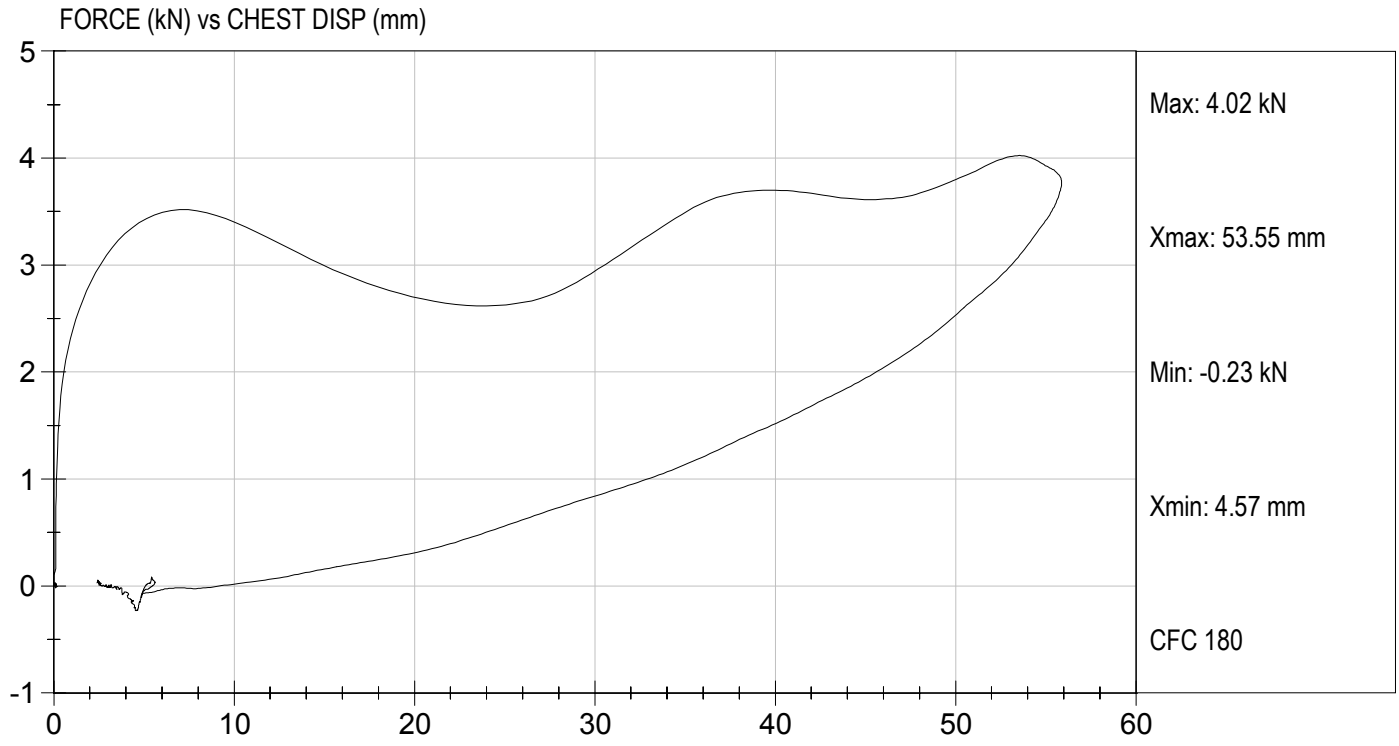
Laboratory Technician

08/02/2004
Test Date

Approved By

Test Desc: Thorax Impact
Componet ID: D041754

Test Date: 08/02/2004
Velocity: 21.74 ft/s, 6.63 m/s



DATA SHEET B7
TORSO FLEXION TEST (572.135)

Dummy Serial Number __505_____ Test Date __8/02/04_____

Technician _____Joe Fleck_____

__Pretest calibration
_X_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))
_X_ N/A, ONLY one thorax impact test performed
_X_2. The test fixture conforms to the specifications in Figure 13B.
_X_3. The complete assembled dummy (880105-000) is used (572.135(c)(2)).
__ with legs below the femurs.
_X_ without legs below the femurs.
_X_4. The dummy assembly soaked at a temperature between 18.9°C (66ºF) and 25.6°C (78ºF) 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 __21.7__
Record the minimum temperature __20.7__
Record the maximum humidity __52%__
Record the minimum humidity __46%__
_X_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))
_X_6. Attach the loading adapter bracket to the spine of the dummy as shown in Figure 13B**.** (572.135(c)(4))
_X_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))
_X_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°)___$16^0$___
_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° |
| Torso rotation rate | 0.5°/s ≤ rate ≤ 1.5°/s | 1.0 |
| Force at 45° ±0.5° | 320 N ≤ force ≤ 390 N | 381 N |
| Final ref. plane angle | Initial ref. plane angle ±8° | 17° |

Signature

8/02/04
Date

**MGA RESEARCH CORPORATION**

**TORSO FLEXION TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 505 **Test I.D:** D041757

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 - 25.6 | 21.3 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 50 | Pass |
| Initial Angle | deg | 0 to 20 | 16 | Pass |
| Return Angle | deg | +/- 8 | 17 | Pass |
| Force at 45 deg | N | 320 to 390 | 381 | Pass |
| Upper Torso Deflection Rate | Deg/sec | 0.5 - 1.5 | 1.0 | Pass |
| | | Overall Result | | Pass |

Laboratory Technician

08/02/2004
Test Date

Approved By

DATA SHEET B8
LEFT KNEE IMPACT TEST (572.136)

Dummy Serial Number __505_____ Test Date __8/02/04_____

Technician ____Joe Fleck_____

__Pretest calibration
_X_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))
_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 (66ºF) and 25.6°C (78ºF) 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 _21.7__
Record the minimum temperature _20.7__
Record the maximum humidity _52%__
Record the minimum humidity _46%__
_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 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 m/s ≤ speed ≤ 2.13 m/s | 2.12 m/s |
| Peak resistance force* | 3450 N ≤ force ≤ 4060 N | 3850 N |

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

_X_12. Plots of acceleration versus time and force versus time follow this sheet.

Signature _____ Date 8/02/04

**MGA RESEARCH CORPORATION**

**LEFT KNEE IMPACT TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 505 **Test I.D:** D041756

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 to 25.5 | 21.0 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 49 | Pass |
| Probe Speed | m/sec | 2.07 to 2.13 | 2.12 | Pass |
| Maximum Force | kN | 3.45 to 4.06 | 3.85 | Pass |
| | | Overall Test Results | | Pass |

Joe Fleck

Laboratory Technician

08/02/2004

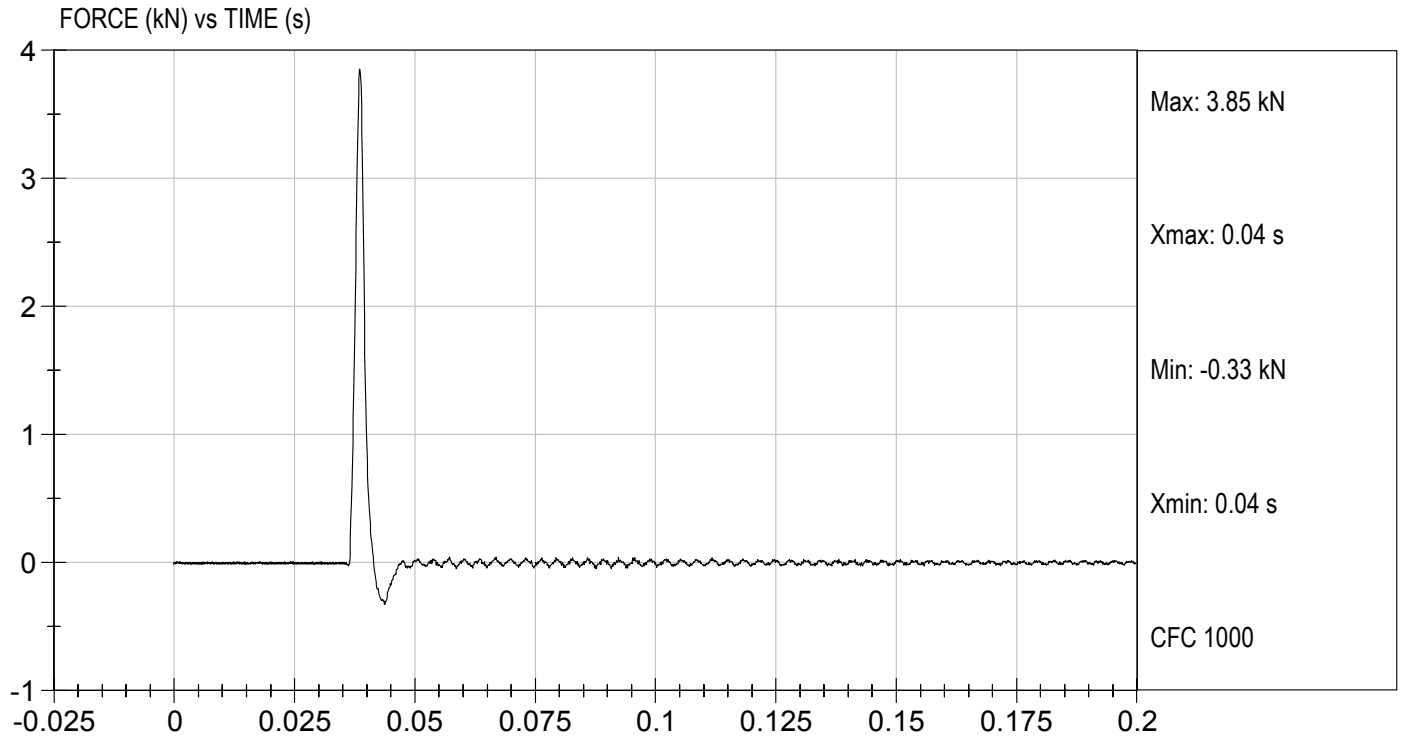
Test Date

Jeff Leuenhagen

Approved By

Test Desc: Left Knee
Componet ID: D041756

Test Date: 08/02/2004
Velocity: 6.95 ft/s, 2.12 m/s



DATA SHEET B9
RIGHT KNEE IMPACT TEST (572.136)

Dummy Serial Number ___505_____ Test Date __8/02/04_____

Technician ___Joe Fleck_____

__Pretest calibration
_X_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))
_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 (880105-528R), 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))
_X_4. The knee assembly soaked at a temperature between 18.9°C (66ºF) and 25.6°C (78ºF) 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 _21.7___
Record the minimum temperature _20.7___
Record the maximum humidity _52 %___
Record the minimum humidity _46 %___
_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 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))
_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 m/s ≤ speed ≤ 2.13 m/s | 2.11 m/s |
| Peak resistance force* | 3450 N ≤ force ≤ 4060 N | 3560 N |

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

_X_12. Plots of acceleration versus time and force versus time follow this sheet.

Signature

8/02/04
Date

**MGA RESEARCH CORPORATION**

**RIGHT KNEE IMPACT TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 505 **Test I.D:** D041755

| Tested Parameter | Units | Specification | Result | Pass/Fail |
|---|---|---|---|---|
| Laboratory Temperature | deg C | 18.9 to 25.5 | 21.0 | Pass |
| Laboratory Relative Humidity | % | 10 to 70 | 50 | Pass |
| Probe Speed | m/sec | 2.07 to 2.13 | 2.11 | Pass |
| Maximum Force | kN | 3.45 to 4.06 | 3.56 | Pass |
| | | Overall Test Results | | Pass |

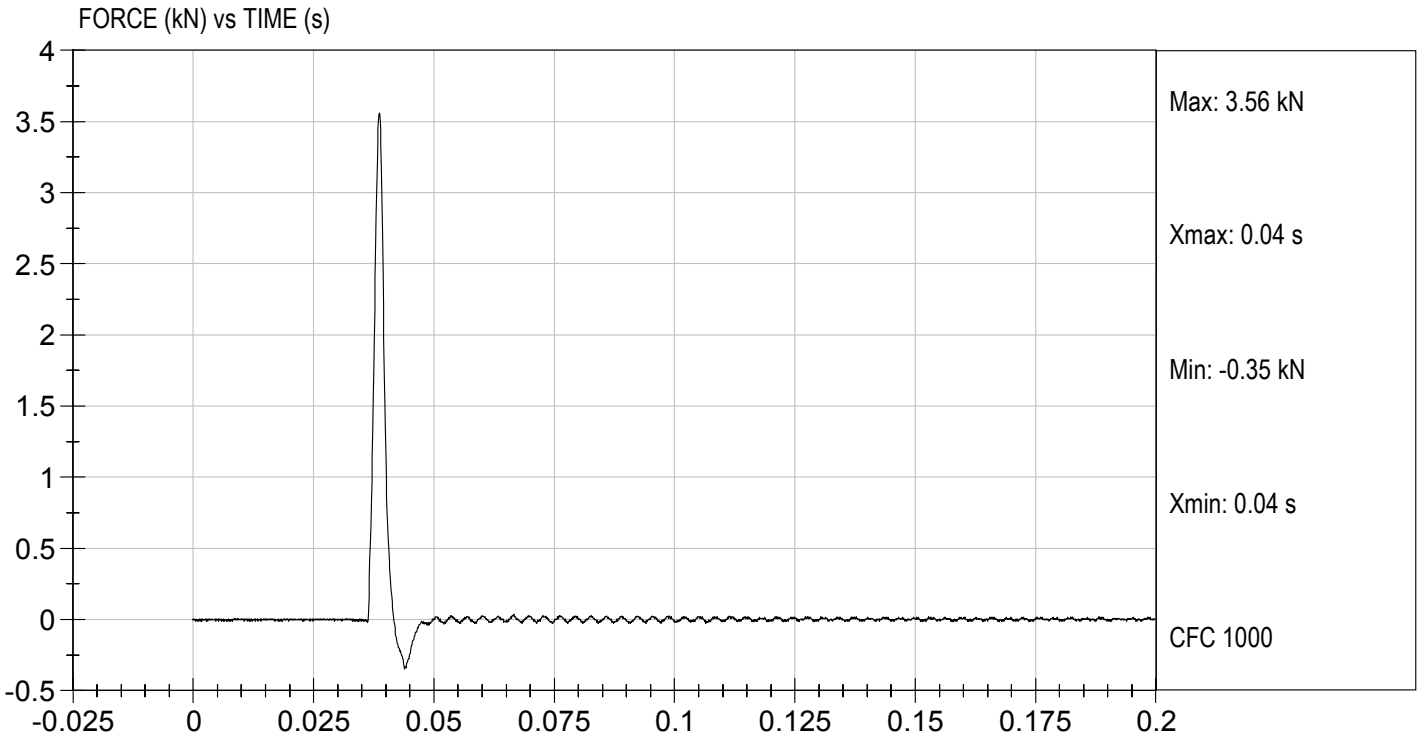
Joe Fleck
Laboratory Technician

08/02/2004
Test Date

Jeff Leuenberger
Approved By

Test Desc: Right Knee
Componet ID: D041755

Test Date: 08/02/2004
Velocity: 6.93 ft/s, 2.11 m/s



DATA SHEET B1
DUMMY DAMAGE CHECKLIST

Dummy Serial Number ____505_____ Test Date ___7/30/04_____

Technician _____Jessica Gall_____

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

_X_ Perform general cleaning.

| Dummy Item | Inspect for | Comments | Damaged | 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 |

| Dummy Item | Inspect for | Comments | Damaged | OK |
|---|---|---|---|---|
| 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 _____ 8/02/04_____
Signature Date

Describe the repair or replacement of parts:

Checked by

Jeff Levandoski _____ 8/02/04_____
Signature Date

## EXTERNAL DIMENSIONS

| SN505, HYBRID III, 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 | 783.4 |
| B | SHOULDER PIVOT HEIGHT | Centerline of shoulder pivot bolt to the seat surface. | 431.8-457.2 | 438.0 |
| C | H-POINT HEIGHT | Reference | 81.3-86.3 | 84.2 |
| D | H-POINT LOCATION FROM BACKLINE | Reference | 144.8-149.8 | 147.3 |
| E | SHOULDER PIVOT FROM BACKLINE | Center of the shoulder clevis to the rear vertical surface of the fixture. | 68.6-83.8 | 76.4 |
| F | THIGH CLEARANCE | Measured at the highest point on the upper femur segment. | 119.4-134.6 | 124.3 |
| 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 | 250.3 |
| H | HEAD BACK TO BACKLINE | Back of skull cap skin to seat rear vertical surface (Reference) | 43.2-48.2 | 46.7 |
| 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 | 283.4 |
| J | ELBOW REST HEIGHT | Measure from the flesh below the elbow pivot bolt to the seat surface. | 182.8-203.2 | 187.3 |
| 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 | 532.4 |
| L | POPLITEAL HEIGHT | Seat surface to the plane of the horizontal plane of the bottom of the feet. | 355.6-376.0 | 362.3 |
| M | KNEE PIVOT HEIGHT | Centerline of knee pivot bolt to the horizontal plane of the bottom of the feet. | 393.7-419.1 | 405.2 |
| 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”. | 414-439.4 | 421.6 |

| SN505, HYBRID III, 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 | 182.4 |
| P | FOOT LENGTH | Tip of toe to rear of heal | 218.5-233.7 | 224.7 |
| 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 | 473.7 |
| S | HEAD BREADTH | The widest part of the head | 137.1-147.3 | 144.6 |
| T | HEAD DEPTH | Back of the head to the forehead | 177.8-188.0 | 179.2 |
| U | HIP BREADTH | The widest part of the hip | 299.7-314.9 | 305.7 |
| V | SHOULDER BREADTH | Outside edges of right and left shoulder clevises | 350.5-365.7 | 362.4 |
| W | FOOT BREADTH | The widest part of the foot | 78.8-94.0 | 84.3 |
| X | HEAD CIRCUMFERENCE | Measured at the point as in dim. “T” | 528.3-548.7 | 533.7 |
| Y | CHEST CIRCUMFERENCE (WITH CHEST JACKET) | Measured 345.4 ± 12.7 mm above seat surface | 850.9-881.3 | 863.7 |
| Z | WAIST CIRCUMFERENCE | Measured 165.1 ± 5.1 mm above seat surface | 759.5-789.9 | 773.6 |
| AA | REFERENCE LOCATION FOR MEASUREMENT OF CHEST CIRCUMFERENCE | Reference | 332.7-358.1 | 345.0 |
| BB | REFERENCE LOCATION FOR MEASUREMENT OF WAIST CIRCUMFERENCE | Reference | 160.1-170.2 | 165.0 |