1997 Thomas Built Bus
into a Flat Frontal Barrier
TRC Test Number: 990421-1

Prepared by:
Transportation Research Center Inc.
10820 State Route 347
East Liberty, OH 43319

Final Report
April - June 1999

Prepared For:
Vehicle Research and Test Center
P. O. Box 37
East Liberty, OH 43319
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Section 1.0

Purpose and Test Procedure
Purpose and Test Summary

The overall objective of this test program is the evaluation and/or development of school bus safety systems. This 30 mph flat barrier impact test was conducted to generate both vehicle and occupant dynamics in order to develop a frontal crash profile for subsequent HYGE sled testing.

The test was conducted with a 1997 Thomas Built Bus obtained from General Testing Laboratories (GTL). The vehicle had previously been used as a FMVSS 301 test vehicle. The test vehicle contained two instrumented Hybrid III 50th percentile adult male dummies; two instrumented Hybrid III 5th percentile adult female dummies; two instrumented 6 year old child dummies; and two uninstrumented 50th percentile adult male ballast dummies.
Section 2.0

Frontal Barrier Impact Test Summary
Test Procedure

This test was conducted per VRTC personnel's instructions. Data was obtained relative to FMVSS 208, "Occupant Crash Protection," performance.

The test vehicle was instrumented with twelve (12) accelerometers to measure longitudinal, lateral, and vertical axis accelerations. The vehicle's specified impact velocity range was 29.5 to 30.5 mph. The vehicle impacted a flat frontal barrier.

The test vehicle contained six (6) instrumented anthropomorphic test devices (dummies) and four (4) uninstrumented anthropomorphic test devices (dummies). The dummies were positioned according to Figure 1.

The dummies were instrumented with head, chest, and pelvis accelerometers to measure longitudinal, lateral, and vertical accelerations; chest deflection potentiometers; left and right femur load cells to measure axial forces; and upper neck load cells to measure forces and moments.

The one hundred-twenty (120) data channels were digitally sampled at 12,500 samples per second and processed per Sections 11.13 through 11.15 of the Laboratory Test Procedure.

The crash event was recorded by one (1) real-time panning motion picture camera and fourteen (14) high-speed motion picture cameras. The pre-test and post-test conditions were recorded by one (1) real-time motion picture camera.

The vehicle and occupant data are summarized in Section 2.0. The FMVSS 208 data are presented in Section 3.0. The vehicle, occupant, and camera measurements are presented in Section 4.0. Appendix A contains the still photographic prints. Appendix B contains the dummy and vehicle data plots. Appendix C contains the dummy calibration information.
Figure 1 Dummy Positioning Data
Test Results Summary

This flat frontal barrier test was conducted at TRC on April 21, 1999.

The test vehicle was a 1997 Thomas Built Bus. The vehicle's test weight was 17,760 pounds. The vehicle's impact speed was 30.0 mph. The vehicle's maximum static crush was 206 millimeters.

The Position #1 dummy’s 36 milliseconds Head Injury Criteria (HIC) was 244. The Position #1 dummy’s chest maximum resultant acceleration with three (3) milliseconds minimum duration was 26.0 g. The Position #1 dummy’s chest deflection was 4 mm. The Position #1 dummy’s left and right femur maximum compressive forces were 2704 N and 2708 N, respectively.

The Position #2 dummy’s 36 milliseconds HIC was 175. The Position #2 dummy’s chest maximum resultant acceleration with three (3) milliseconds minimum duration was 30.8 g. The Position #2 dummy’s chest deflection was 4 mm. The Position #2 dummy’s left and right femur maximum compressive forces were 1270 N and 9028 N, respectively.

The Position #3 dummy’s 36 milliseconds HIC was 280. The Position #3 dummy’s chest maximum resultant acceleration with three (3) milliseconds minimum duration was 33.1 g. The Position #3 dummy’s chest deflection was 4 mm. The Position #3 dummy’s left and right femur maximum compressive forces were 1150 N and 1855 N, respectively.

The Position #4 dummy’s 36 milliseconds HIC was 112. The Position #4 dummy’s chest maximum resultant acceleration with three (3) milliseconds minimum duration was 23.2 g. The Position #4 dummy’s chest deflection was 4 mm. The Position #4 dummy’s left and right femur maximum compressive forces were 2996 N and 2769 N, respectively.

The Position #5 dummy’s 36 milliseconds HIC was 330. The Position #5 dummy’s chest maximum resultant acceleration with three (3) milliseconds minimum duration was 22.6 g. The Position #5 dummy’s chest deflection was 5 mm. The Position #5 dummy’s left and right femur maximum compressive forces were 3287 N and 2274 N, respectively.
The Position #6 dummy’s 36 milliseconds HIC was 153. The Position #6 dummy’s chest maximum resultant acceleration with three (3) milliseconds minimum duration was 22.3 g. The Position #6 dummy’s chest deflection was 4 mm. The Position #6 dummy’s left and right femur maximum compressive forces were 4271 N and 2956 N, respectively.

1 See Data Acquisition Explanations
Data Acquisition Explanations

The Position #1 dummy's neck moment about Y-axis data channel, NEKYM1, exceeded its data channel's full scale input between approximately 130 and 140 milliseconds. This affected the calculation for the moment about the occipital condyle for the Position #1 dummy.

The Position #1 dummy’s pelvis X-axis acceleration data channel, PEVXG1, recorded questionable data throughout the event. This affected the resultant calculation for the Position #1 dummy’s pelvis.

The Position #2 dummy’s right femur force data channel, RFMF2, recorded questionable data spikes at approximately 25, 128, and 154 milliseconds.

The Position #4 dummy’s chest X-axis acceleration data channel, CSTXG4, recorded questionable data throughout the event. This affected the resultant calculation for the Position #4 dummy’s chest.

The Position #4 dummy’s pelvis X-axis acceleration data channel, PEVXG4, recorded questionable data spikes at approximately 57 and 100 milliseconds. This affected the resultant calculation for the Position #4 dummy’s pelvis.

The Position #4 dummy’s pelvis Y-axis acceleration data channel, PEVYG4, recorded questionable data throughout the event. This affected the resultant calculation for the Position #4 dummy’s pelvis.
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</tr>
<tr>
<td>Test date:</td>
</tr>
<tr>
<td>Test time:</td>
</tr>
<tr>
<td>Ambient temperature at impact area:</td>
</tr>
<tr>
<td>Vehicle year/make/model/body style:</td>
</tr>
<tr>
<td>Vehicle test weight:</td>
</tr>
<tr>
<td>Impact angle¹:</td>
</tr>
<tr>
<td>Impact velocity²:</td>
</tr>
<tr>
<td>Primary:</td>
</tr>
<tr>
<td>Secondary:</td>
</tr>
<tr>
<td>Maximum static crush:</td>
</tr>
<tr>
<td>Average rebound:</td>
</tr>
<tr>
<td>Number of cameras:</td>
</tr>
<tr>
<td>Real-time:</td>
</tr>
<tr>
<td>High-speed:</td>
</tr>
<tr>
<td>Door opening data:</td>
</tr>
<tr>
<td>Left-front:</td>
</tr>
<tr>
<td>Right-front:</td>
</tr>
</tbody>
</table>

¹ With respect to tow track centerline.
² Speed trap measurement (± .08 km/h accuracy)
**Table 2 Test Vehicle Information**

Vehicle year/make/model/body style: 1997/Thomas Built/Bus

Color: Yellow

VIN: 4UZ3CFBA5VC749501

Engine data:
- Placement: Longitudinal
- Cylinders: 6
- Displacement: 5.9 liters

Transmission data:
- 4-speed, ___ manual, X automatic, ___ overdrive

Final drive:
- ___ fwd, X rwd, ___ 4wd

Date vehicle received: N/A

Odometer reading: N/A

Dealer's name and address: N/A

**Accessories:**

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<th>Feature</th>
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<th>Automatic transmission</th>
<th>Yes</th>
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<td>Power steering</td>
<td>Yes</td>
<td>Automatic speed control</td>
<td>No</td>
</tr>
<tr>
<td>Power brakes</td>
<td>Yes</td>
<td>Tilting steering wheel</td>
<td>No</td>
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<tr>
<td>Power seats</td>
<td>No</td>
<td>Telescoping steering wheel</td>
<td>No</td>
</tr>
<tr>
<td>Power windows</td>
<td>No</td>
<td>Air conditioning</td>
<td>No</td>
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<tr>
<td>Tinted glass</td>
<td>No</td>
<td>Anti-skid brake</td>
<td>No</td>
</tr>
<tr>
<td>Radio</td>
<td>No</td>
<td>Rear window defroster</td>
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</tr>
<tr>
<td>Clock</td>
<td>No</td>
<td>Other:</td>
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<tr>
<td>Power door locks</td>
<td>No</td>
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**Certification data from vehicle's label:**

Vehicle manufactured by: Thomas Built

Date of manufacture: 11/96

VIN: 4UZ3CFBA5VC749501

GVWR: 29,000 lbs

GAWR: Front: 10,000 lbs
        Rear: 19,000 lbs
Table 2  Test Vehicle Information, Cont'd.

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<th>Description</th>
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<td>Size of tires on vehicle:</td>
<td>11R x 22.5</td>
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<tr>
<td>Spare tire:</td>
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<tr>
<td>Type of front seats:</td>
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</table>

**Tire & capacity data from vehicle's label:**

- **Recommended tire size:** 22.5 x 8.25
- **Recommended cold tire pressure:**
  - Front: 100 psi
  - Rear: 100 psi
- **Designated Seating Capacity:**
  - Front: N/A
  - Rear: N/A
  - Total: N/A
  - Vehicle Cargo Weight: N/A
Table 2  Test Vehicle Information, Cont’d.

Weight of test vehicle as received (with maximum fluids):

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<th>Right front</th>
<th>Right rear</th>
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<td>Left front</td>
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<td>Left rear</td>
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<td>Total front weight</td>
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<td>(N/A% of total vehicle weight)</td>
</tr>
<tr>
<td>Total rear weight</td>
<td>N/A</td>
<td>(N/A% of total vehicle weight)</td>
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<tr>
<td>Total delivered weight</td>
<td>N/A</td>
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Calculation of test vehicle’s target test weight:

RCLW = Rated Cargo and Luggage Weight
UDW = Unloaded Delivered Weight
DSC\(^1\) = Designated Seating Capacity
RCLW\(^2\) = N/A

Target test weight = UDW + RCLW + (number of Hybrid III Dummies x 75.7 kg per dummy)
Target test weight\(^3\) = N/A

Weight of test vehicle with required dummies:

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<tr>
<td>Front</td>
<td>10,380 lbs</td>
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<tr>
<td>Rear</td>
<td>7,380 lbs</td>
</tr>
<tr>
<td>Total</td>
<td>17,760 lbs</td>
</tr>
</tbody>
</table>

Weight of ballast secured in vehicle: None
Components removed to meet target test weight: None
CG rearward of front wheel centerline: 114 in
Vehicle Wheelbase: 274.2 in

\(^1\) The designated seating capacity is determined by counting the number of seat belts installed in the vehicle.
\(^2\) From vehicle’s tire label.
\(^3\) There was no target test weight provided.
Table 3  Post-Impact Data

Test number: 990421-1
Test date: 04/21/99
Test time: 1822
Test type: Frontal barrier impact
Impact angle: 0°
Ambient temperature at impact area: 21° C
Temperature in occupant compartment: 18° C

Impact velocity:
  Cable speed: 30.0 mph
  Specified range: 29.5 to 30.5 mph

Test vehicle static crush:
Overall length of test vehicle:
  Pre-test: L: 428.4 in  C: 442.9 in  R: 430.1 in
  Post-test: L: 427.6 in  C: 435.1 in  R: 425.3 in
  Total crush: L: 0.8 in  C: 7.8 in  R: 4.8 in
  Average crush: 4.5 in

Test vehicle rebound from flat barrier:
Distance from test vehicle to barrier:
  Post-test: L: N/A  C: 8.9 in  R: N/A
  Average rebound: 8.9 in
Figure 2  Vehicle Accelerometer Placement

Side View

Bottom View
<table>
<thead>
<tr>
<th>TEST NUMBER: 990421-1</th>
<th>X</th>
<th>Y</th>
<th>Z</th>
<th>POSITIVE DIRECTION</th>
<th>NEGATIVE DIRECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. LOCATION</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 FLOOR TUNNEL #1</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LONGITUDINAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LATERAL</td>
<td>1.1 g</td>
<td>@ 257.3 ms</td>
<td>23.6 g</td>
<td>@ 76.3 ms</td>
<td></td>
</tr>
<tr>
<td>VERTICAL</td>
<td>4.7 g</td>
<td>@ 187.6 ms</td>
<td>12.5 g</td>
<td>@ 63.2 ms</td>
<td></td>
</tr>
<tr>
<td>RESULTANT</td>
<td>25.4 g</td>
<td>@ 72.9 ms</td>
<td>39.9 g</td>
<td>@ 76.6 ms</td>
<td></td>
</tr>
<tr>
<td></td>
<td>46.7 g</td>
<td>@ 76.5 ms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 FLOOR TUNNEL #2</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LONGITUDINAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LATERAL</td>
<td>5.8 g</td>
<td>@ 15.4 ms</td>
<td>21.4 g</td>
<td>@ 51.1 ms</td>
<td></td>
</tr>
<tr>
<td>VERTICAL</td>
<td>4.4 g</td>
<td>@ 98.6 ms</td>
<td>10.9 g</td>
<td>@ 67.5 ms</td>
<td></td>
</tr>
<tr>
<td>RESULTANT</td>
<td>37.2 g</td>
<td>@ 24.5 ms</td>
<td>34.5 g</td>
<td>@ 50.3 ms</td>
<td></td>
</tr>
<tr>
<td></td>
<td>39.2 g</td>
<td>@ 50.5 ms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 FLOOR TUNNEL #3</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LONGITUDINAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LATERAL</td>
<td>2.1 g</td>
<td>@ 218.2 ms</td>
<td>17.3 g</td>
<td>@ 135.0 ms</td>
<td></td>
</tr>
<tr>
<td>VERTICAL</td>
<td>5.8 g</td>
<td>@ 105.6 ms</td>
<td>6.3 g</td>
<td>@ 26.6 ms</td>
<td></td>
</tr>
<tr>
<td>RESULTANT</td>
<td>44.9 g</td>
<td>@ 86.6 ms</td>
<td>38.9 g</td>
<td>@ 91.4 ms</td>
<td></td>
</tr>
<tr>
<td></td>
<td>45.3 g</td>
<td>@ 86.6 ms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 VEHICLE CENTER</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OF GRAVITY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LONGITUDINAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LATERAL</td>
<td>4.5 g</td>
<td>@ 68.4 ms</td>
<td>16.2 g</td>
<td>@ 136.5 ms</td>
<td></td>
</tr>
<tr>
<td>VERTICAL</td>
<td>4.4 g</td>
<td>@ 159.1 ms</td>
<td>11.9 g</td>
<td>@ 64.1 ms</td>
<td></td>
</tr>
<tr>
<td>RESULTANT</td>
<td>50.9 g</td>
<td>@ 63.9 ms</td>
<td>51.4 g</td>
<td>@ 69.3 ms</td>
<td></td>
</tr>
<tr>
<td></td>
<td>53.4 g</td>
<td>@ 63.9 ms</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REFERENCE: X: + FORWARD FROM REAR BUMPER
Y: + LEFTWARD FROM VEHICLE CENTERLINE
Z: + UPWARD FROM GROUND LEVEL
Section 3.0

FMVSS 208 Data
### Table 5  Dummy Injury Criteria

**Maximum Acceleration**

<table>
<thead>
<tr>
<th>Position #1</th>
<th>Head</th>
<th>Chest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dummy</td>
<td>X: -79.0 g, Y: -6.9 g, Z: 20.2 g, R: 79.4 g, X: -26.2 g, Y: 3.4 g, Z: 11.7 g</td>
<td></td>
</tr>
</tbody>
</table>

**Maximum Femur Compressive Force**

<table>
<thead>
<tr>
<th>Position #1 Dummy</th>
<th>Left Femur</th>
<th>Right Femur</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2704 N</td>
<td>2708 N</td>
</tr>
</tbody>
</table>

**36 millisecond Head Injury Criteria**

| Position #1 Dummy | HIC: 244 | Time $t_1$: 120.3 ms | Time $t_2$: 130.9 ms |

**Chest Maximum Resultant Acceleration**

| Acceleration: 26.0 g | Time $t_1$: 135.9 ms | Time $t_2$: 139.0 ms |

**Maximum Chest Deflection**

| Position #1 Dummy   | 4 mm |

---

1. As defined in FMVSS No. 208
2. Defined as equal to or exceeding 0.003 sec. duration
### Table 5  Dummy Injury Criteria, Cont’d.

#### Maximum Acceleration

<table>
<thead>
<tr>
<th></th>
<th>X</th>
<th>Y</th>
<th>Z</th>
<th>R</th>
<th>Chest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dummy</td>
<td>-50.3</td>
<td>-8.6</td>
<td>25.7</td>
<td>54.9</td>
<td>-27.1</td>
</tr>
<tr>
<td>Position #2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>18.4</td>
</tr>
</tbody>
</table>

#### Maximum Femur Compressive Force

<table>
<thead>
<tr>
<th></th>
<th>Left Femur</th>
<th>Right Femur³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dummy</td>
<td>1270 N</td>
<td>9028 N</td>
</tr>
<tr>
<td>Position #2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### 36 millisecond Head Injury Criteria

<table>
<thead>
<tr>
<th></th>
<th>HIC</th>
<th>Time t₁</th>
<th>Time t₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dummy</td>
<td>175</td>
<td>141.4 ms</td>
<td>177.4 ms</td>
</tr>
<tr>
<td>Position #2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Chest Maximum Resultant Acceleration²

<table>
<thead>
<tr>
<th></th>
<th>Acceleration</th>
<th>Time t₁</th>
<th>Time t₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dummy</td>
<td>30.8 g</td>
<td>156.3 ms</td>
<td>159.4 ms</td>
</tr>
<tr>
<td>Position #2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Maximum Chest Deflection

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dummy</td>
<td>4 mm</td>
</tr>
<tr>
<td>Position #2</td>
<td></td>
</tr>
</tbody>
</table>

---

¹ As defined in FMVSS No. 208
² Defined as equal to or exceeding 0.003 sec. Duration
³ See Data Acquisition Explanations
Table 5  Dummy Injury Criteria, Cont’d.

Maximum Acceleration

<table>
<thead>
<tr>
<th>Head</th>
<th>Chest</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>Y</td>
</tr>
<tr>
<td>-77.6 g</td>
<td>-11.8 g</td>
</tr>
</tbody>
</table>

Position #3 Dummy

Maximum Femur Compressive Force

<table>
<thead>
<tr>
<th>Left Femur</th>
<th>Right Femur</th>
</tr>
</thead>
<tbody>
<tr>
<td>1150 N</td>
<td>1855 N</td>
</tr>
</tbody>
</table>

36 millisecond Head Injury Criteria

<table>
<thead>
<tr>
<th>HIC</th>
<th>Time $t_1$</th>
<th>Time $t_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>280</td>
<td>141.0 ms</td>
<td>176.9 ms</td>
</tr>
</tbody>
</table>

Position #3 Dummy

Chest Maximum Resultant Acceleration$^2$

<table>
<thead>
<tr>
<th>Acceleration</th>
<th>Time $t_1$</th>
<th>Time $t_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>33.1 g</td>
<td>173.0 ms</td>
<td>176.1 ms</td>
</tr>
</tbody>
</table>

Position #3 Dummy

Maximum Chest Deflection

Position #3 Dummy 4 mm

---

1  As defined in FMVSS No. 208
2  Defined as equal to or exceeding 0.003 sec. duration

3-4
Table 5  Dummy Injury Criteria, Cont’d.

**Maximum Acceleration**

<table>
<thead>
<tr>
<th></th>
<th>Head</th>
<th></th>
<th></th>
<th>Chest</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X</td>
<td>Y</td>
<td>Z</td>
<td>X</td>
</tr>
<tr>
<td>Position #4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dummy</td>
<td>-42.9 g</td>
<td>76.4 g</td>
<td>36.0 g</td>
<td>89.5 g</td>
</tr>
</tbody>
</table>

**Maximum Femur Compressive Force**

<table>
<thead>
<tr>
<th></th>
<th>Left Femur</th>
<th>Right Femur</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position #4 Dummy</td>
<td>2996 N</td>
<td>2769 N</td>
</tr>
</tbody>
</table>

**36 millisecond Head Injury Criteria**

<table>
<thead>
<tr>
<th></th>
<th>HIC</th>
<th>Time t(_1)</th>
<th>Time t(_2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position #4 Dummy</td>
<td>112</td>
<td>113.8 ms</td>
<td>133.7 ms</td>
</tr>
</tbody>
</table>

**Chest Maximum Resultant Acceleration\(^2\)**

<table>
<thead>
<tr>
<th></th>
<th>Acceleration</th>
<th>Time t(_1)</th>
<th>Time t(_2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position #4 Dummy</td>
<td>23.2 g</td>
<td>145.0 ms</td>
<td>148.1 ms</td>
</tr>
</tbody>
</table>

**Maximum Chest Deflection**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Position #4 Dummy</td>
<td>4 mm</td>
</tr>
</tbody>
</table>

\(^1\) As defined in FMVSS No. 208  
\(^2\) Defined as equal to or exceeding 0.003 sec. duration  
\(^3\) See Data Acquisition Explanations
Table 5  Dummy Injury Criteria, Cont’d.

Maximum Acceleration

<table>
<thead>
<tr>
<th></th>
<th>Head</th>
<th></th>
<th></th>
<th></th>
<th>Chest</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X g</td>
<td>Y g</td>
<td>Z g</td>
<td>R g</td>
<td>X g</td>
<td>Y g</td>
<td>Z g</td>
</tr>
<tr>
<td>Position #5 Dummy</td>
<td>-91.9</td>
<td>5.8</td>
<td>-20.4</td>
<td>93.7</td>
<td>-18.3</td>
<td>5.4</td>
<td>14.4</td>
</tr>
</tbody>
</table>

Maximum Femur Compressive Force

<table>
<thead>
<tr>
<th></th>
<th>Left Femur</th>
<th>Right Femur</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position #5 Dummy</td>
<td>3287 N</td>
<td>2274 N</td>
</tr>
</tbody>
</table>

36 millisecond Head Injury Criteria

<table>
<thead>
<tr>
<th></th>
<th>HIC</th>
<th>Time t₁</th>
<th>Time t₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position #5 Dummy</td>
<td>330</td>
<td>120.6 ms</td>
<td>128.6 ms</td>
</tr>
</tbody>
</table>

Chest Maximum Resultant Acceleration¹

<table>
<thead>
<tr>
<th></th>
<th>Acceleration</th>
<th>Time t₁</th>
<th>Time t₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>Position #5 Dummy</td>
<td>22.6 g</td>
<td>149.3 ms</td>
<td>152.3 ms</td>
</tr>
</tbody>
</table>

Maximum Chest Deflection

<table>
<thead>
<tr>
<th></th>
<th>Position #5 Dummy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5 mm</td>
</tr>
</tbody>
</table>

¹ As defined in FMVSS No. 208
² Defined as equal to or exceeding 0.003 sec. duration
Table 5  Dummy Injury Criteria, Cont’d.

Maximum Acceleration

<table>
<thead>
<tr>
<th></th>
<th>X</th>
<th>Y</th>
<th>Z</th>
<th>R</th>
<th>X</th>
<th>Y</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dummy</td>
<td>47.7 g</td>
<td>8.4 g</td>
<td>16.3 g</td>
<td>48.1 g</td>
<td>-20.9 g</td>
<td>-1.8 g</td>
<td>9.7 g</td>
</tr>
</tbody>
</table>

Position #6 Dummy

Maximum Femur Compressive Force

<table>
<thead>
<tr>
<th></th>
<th>Left Femur</th>
<th>Right Femur</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dummy</td>
<td>4271 N</td>
<td>2956 N</td>
</tr>
</tbody>
</table>

36 millisecond Head Injury Criteria

<table>
<thead>
<tr>
<th></th>
<th>HIC</th>
<th>Time $t_1$</th>
<th>Time $t_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dummy</td>
<td>153</td>
<td>124.6 ms</td>
<td>142.6 ms</td>
</tr>
</tbody>
</table>

Chest Maximum Resultant Acceleration

<table>
<thead>
<tr>
<th></th>
<th>Acceleration</th>
<th>Time $t_1$</th>
<th>Time $t_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dummy</td>
<td>22.3 g</td>
<td>140.6 ms</td>
<td>143.6 ms</td>
</tr>
</tbody>
</table>

Maximum Chest Deflection

Position #6 Dummy          4 mm

---

1 As defined in FMVSS No. 208
2 Defined as equal to or exceeding 0.003 sec. duration
Section 4.0

Vehicle, Occupant, and Camera Measurements
Figure 3 Pre-test and Post-test Measurement Points

- Ctr. of strg. column
- X17
- To 'A' Post
- X1
- X2
- X3
- X4,5
- X8,9
- Rear Datum Reference
- To edge of door (even number for right side and odd numbers for left side)
- X6,7
- To trailing edge behind door (right / left side)
- X10,11
- To leading edge in front of door (right / left side)
- X19,20 (right / left side)
- To Headliner
- Ctr. Strg. Column
- X18
- Rear Datum Reference at center of rear bumper
- X16
- To strg. Column
- X12,13
- X14,15
- To bottom of 'A' post (right / left side)
- To firewall (right / left side)
Table 6  Impacted Vehicle Measurements

Vehicle year/make/model/body style: 1997/Thomas Built/Bus

Test Number: 990421-1

<table>
<thead>
<tr>
<th>No.</th>
<th>Type of measurement</th>
<th>Pre-Test</th>
<th>Post-Test</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>X1</td>
<td>Total Length of Veh. at Centerline</td>
<td>442.9</td>
<td>435.1</td>
<td>7.8</td>
</tr>
<tr>
<td>X2</td>
<td>Rear Surface of Veh. to Front of Engine Block</td>
<td>422.5</td>
<td>428.5</td>
<td>-6.0</td>
</tr>
<tr>
<td>X3</td>
<td>Rear Surface of Veh. to Firewall</td>
<td>394.0</td>
<td>419.5</td>
<td>-25.5</td>
</tr>
<tr>
<td>X4</td>
<td>Rear Surface of Veh. to Upper Leading Edge of Right Door</td>
<td>374.0</td>
<td>390.6</td>
<td>-16.6</td>
</tr>
<tr>
<td>X5</td>
<td>Rear Surface of Veh. to Upper Leading Edge of Left Door</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>X6</td>
<td>Rear Surface of Veh. to Lower Leading Edge of Right Door</td>
<td>373.5</td>
<td>387.7</td>
<td>-14.2</td>
</tr>
<tr>
<td>X7</td>
<td>Rear Surface of Veh. to Lower Leading Edge of Left Door</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>X8</td>
<td>Rear Surface of Veh. to Upper Trailing Edge of Right Door</td>
<td>337.9</td>
<td>382.0</td>
<td>-44.1</td>
</tr>
<tr>
<td>X9</td>
<td>Rear Surface of Veh. to Upper Trailing Edge of Left Door</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>X10</td>
<td>Rear Surface of Veh. to Lower Trailing Edge of Right Door</td>
<td>337.8</td>
<td>369.7</td>
<td>-31.9</td>
</tr>
<tr>
<td>X11</td>
<td>Rear Surface of Veh. to Lower Trailing Edge of Left Door</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>X12</td>
<td>Rear Surface of Veh. to Bottom of &quot; A &quot; Post on Right Side</td>
<td>372.8</td>
<td>390.4</td>
<td>-17.6</td>
</tr>
<tr>
<td>X13</td>
<td>Rear Surface of Veh. to Bottom of &quot; A &quot; Post on Left Side</td>
<td>372.8</td>
<td>417.5</td>
<td>-44.7</td>
</tr>
<tr>
<td>X14</td>
<td>Rear Surface of Veh. to Firewall --Right Side</td>
<td>389.7</td>
<td>416.2</td>
<td>-26.5</td>
</tr>
<tr>
<td>X15</td>
<td>Rear Surface of Vehicle to Firewall --Left Side</td>
<td>390.2</td>
<td>426.4</td>
<td>-36.2</td>
</tr>
<tr>
<td>X16</td>
<td>Rear Surface of Veh. to Steering Wheel Center</td>
<td>365.3</td>
<td>391.0</td>
<td>-25.7</td>
</tr>
<tr>
<td>X17</td>
<td>Center of Steering Column to &quot; A &quot; Post</td>
<td>29.0</td>
<td>28.0</td>
<td>1.0</td>
</tr>
<tr>
<td>X18</td>
<td>Center of Steering Column to Headliner</td>
<td>29.6</td>
<td>36.8</td>
<td>-7.2</td>
</tr>
<tr>
<td>X19</td>
<td>Rear Surface of Veh. to Right Side of Front Bumper</td>
<td>430.1</td>
<td>425.3</td>
<td>4.8</td>
</tr>
<tr>
<td>X20</td>
<td>Rear Surface of Veh. to Left Side of Front Bumper</td>
<td>428.4</td>
<td>427.6</td>
<td>0.8</td>
</tr>
<tr>
<td>X21</td>
<td>Length of Engine Block</td>
<td>29.0</td>
<td>29.0</td>
<td>0</td>
</tr>
</tbody>
</table>
Figure 4 Vehicle Target Locations
Table 7 Dummy Measurement Data For Bus Seat Occupants

All measurements are referenced to the front outboard seat mounting belt.

**Placement of Left Side, Instrumented 6-Yr.-Old Dummy:**

<table>
<thead>
<tr>
<th>Bus seat #4</th>
<th>x:</th>
<th>y:</th>
<th>z:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance from bus seat back hinge to head CG</td>
<td>-344</td>
<td>345</td>
<td>879</td>
</tr>
<tr>
<td>Distance from bus seat back hinge to H-point</td>
<td>-315</td>
<td>325</td>
<td>442</td>
</tr>
<tr>
<td>Distance from bus seat back hinge to knee pivot</td>
<td>-47</td>
<td>325</td>
<td>489</td>
</tr>
</tbody>
</table>

**Placement of Left Side, Instrumented HIII 5th Female Dummy:**

<table>
<thead>
<tr>
<th>Bus seat #9</th>
<th>x:</th>
<th>y:</th>
<th>z:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance from seat back hinge to head CG</td>
<td>-307</td>
<td>110</td>
<td>1025</td>
</tr>
<tr>
<td>Distance from seat back hinge to H-point</td>
<td>-195</td>
<td>30</td>
<td>445</td>
</tr>
<tr>
<td>Distance from seat back hinge to knee pivot</td>
<td>110</td>
<td>30</td>
<td>423</td>
</tr>
</tbody>
</table>

**Placement of Right Side, Instrumented 6-Yr.-Old Dummy:**

<table>
<thead>
<tr>
<th>Bus seat #19</th>
<th>x:</th>
<th>y:</th>
<th>z:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance from seat back hinge to head CG</td>
<td>-360</td>
<td>-120</td>
<td>887</td>
</tr>
<tr>
<td>Distance from seat back hinge to H-point</td>
<td>-290</td>
<td>-75</td>
<td>422</td>
</tr>
<tr>
<td>Distance from seat back hinge to knee pivot</td>
<td>-25</td>
<td>-75</td>
<td>460</td>
</tr>
</tbody>
</table>

**Placement of Right Side, Instrumented HIII 5th Female Dummy:**

<table>
<thead>
<tr>
<th>Bus seat #19</th>
<th>x:</th>
<th>y:</th>
<th>z:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance from seat back hinge to head CG</td>
<td>-210</td>
<td>-620</td>
<td>1035</td>
</tr>
<tr>
<td>Distance from seat back hinge to H-point</td>
<td>-265</td>
<td>-450</td>
<td>460</td>
</tr>
<tr>
<td>Distance from seat back hinge to knee pivot</td>
<td>70</td>
<td>-480</td>
<td>410</td>
</tr>
</tbody>
</table>

**Placement of Right Side, Instrumented HIII 50th Male Dummy:**

<table>
<thead>
<tr>
<th>Bus seat #23</th>
<th>x:</th>
<th>y:</th>
<th>z:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance from seat back hinge to head CG</td>
<td>-240</td>
<td>-385</td>
<td>1112</td>
</tr>
<tr>
<td>Distance from seat back hinge to H-point</td>
<td>-270</td>
<td>-250</td>
<td>462</td>
</tr>
<tr>
<td>Distance from seat back hinge to knee pivot</td>
<td>155</td>
<td>-290</td>
<td>507</td>
</tr>
</tbody>
</table>
Table 7  Dummy Measurement Data For Bus Seat Occupants, Cont’d.

All measurements are referenced to the front outboard seat mounting belt.

Placement of Right Side, Instrumented HIII 50th Male Dummy:
Bus seat #13
Distance from bus seat back hinge to head CG x: -265 y: -245 z: 1110
Distance from bus seat back hinge to H-point x: -270 y: -150 z: 393
Distance from bus seat back hinge to knee pivot x: 140 y: -170 z: 510

Placement of Right Side, Ballast 6-Yr.-Old Dummy:
Bus seat #24
Distance from bus seat back hinge to head CG x: -330 y: -145 z: 890
Distance from bus seat back hinge to H-point x: -300 y: -85 z: 465
Distance from bus seat back hinge to knee pivot x: -50 y: -100 z: 406

Placement of Right Side, Ballast HIII 50th Male Dummy:
Bus seat #24
Distance from bus seat back hinge to head CG x: -330 y: -585 z: 1145
Distance from bus seat back hinge to H-point x: -260 y: -475 z: 451
Distance from bus seat back hinge to knee pivot x: 140 y: -495 z: 471

Placement of Right Side, Ballast HIII 50th Male Dummy:
Bus seat #18
Distance from bus seat back hinge to head CG x: -260 y: -590 z: 1160
Distance from bus seat back hinge to H-point x: -276 y: -450 z: 448
Distance from bus seat back hinge to knee pivot x: 130 y: -505 z: 480

Placement of Right Side, Ballast HIII 50th Male Dummy:
Bus seat #18
Distance from bus seat back hinge to head CG x: -348 y: -70 z: 1160
Distance from bus seat back hinge to H-point x: -285 y: 40 z: 470
Distance from bus seat back hinge to knee pivot x: 115 y: 5 z: 498
### Table 8: Motion Picture Camera Locations

Vehicle year/make/model/body style: 1997/Thomas Built/Bus
Test number: 990421-1

<table>
<thead>
<tr>
<th>Camera Number</th>
<th>View</th>
<th>X</th>
<th>Y</th>
<th>Z</th>
<th>Camera Angle</th>
<th>Film Plane to Head Target</th>
<th>Camera Lens</th>
<th>Film Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Left front</td>
<td>7’ 4”</td>
<td>30’ 0”</td>
<td>4’ 10”</td>
<td>0°</td>
<td>NA</td>
<td>10 mm</td>
<td>1005 frames/s</td>
</tr>
<tr>
<td>2</td>
<td>Left rear</td>
<td>26’ 0”</td>
<td>28’ 10”</td>
<td>5’ 0”</td>
<td>0°</td>
<td>NA</td>
<td>13 mm</td>
<td>990 frames/s</td>
</tr>
<tr>
<td>3</td>
<td>Right front</td>
<td>9’ 0”</td>
<td>-29’ 0”</td>
<td>5’ 0”</td>
<td>0°</td>
<td>NA</td>
<td>13 mm</td>
<td>1012 frames/s</td>
</tr>
<tr>
<td>4</td>
<td>Right rear</td>
<td>27’ 3”</td>
<td>-34’ 0”</td>
<td>5’ 0”</td>
<td>0°</td>
<td>NA</td>
<td>13 mm</td>
<td>753 frames/s</td>
</tr>
<tr>
<td>5</td>
<td>Front roof line</td>
<td>-0’ 14”</td>
<td>22’ 0”</td>
<td>11’ 8”</td>
<td>0°</td>
<td>NA</td>
<td>Zoom</td>
<td>508 frames/s</td>
</tr>
<tr>
<td>6</td>
<td>Right #24 seat</td>
<td>10’ 6”</td>
<td>4’ 4”</td>
<td>6’ 4”</td>
<td>0°</td>
<td>NA</td>
<td>8 mm</td>
<td>968 frames/s</td>
</tr>
<tr>
<td>7</td>
<td>Right #23 seat</td>
<td>12’ 10”</td>
<td>4’ 4”</td>
<td>6’ 4”</td>
<td>0°</td>
<td>NA</td>
<td>8 mm</td>
<td>992 frames/s</td>
</tr>
<tr>
<td>8</td>
<td>Right #19 seat</td>
<td>22’ 3”</td>
<td>4’ 4”</td>
<td>6’ 4”</td>
<td>0°</td>
<td>NA</td>
<td>8.5 mm</td>
<td>455 frames/s</td>
</tr>
<tr>
<td>9</td>
<td>Right #18 seat</td>
<td>24’ 2”</td>
<td>4’ 4”</td>
<td>6’ 4”</td>
<td>0°</td>
<td>NA</td>
<td>8 mm</td>
<td>708 frames/s</td>
</tr>
<tr>
<td>10</td>
<td>Right #13 seat</td>
<td>34’ 8”</td>
<td>4’ 4”</td>
<td>6’ 3”</td>
<td>0°</td>
<td>NA</td>
<td>8 mm</td>
<td>828 frames/s</td>
</tr>
<tr>
<td>11</td>
<td>Left #9 seat</td>
<td>29’ 0”</td>
<td>-4’ 4”</td>
<td>6’ 3”</td>
<td>0°</td>
<td>NA</td>
<td>8 mm</td>
<td>1005 frames/s</td>
</tr>
<tr>
<td>12</td>
<td>Left #4 seat</td>
<td>17’ 7”</td>
<td>-4’ 4”</td>
<td>6’ 3”</td>
<td>0°</td>
<td>NA</td>
<td>8 mm</td>
<td>750 frames/s</td>
</tr>
<tr>
<td>13</td>
<td>Front (Frontal area)</td>
<td>7’ 0”</td>
<td>-3’ 0”</td>
<td>8’ 9”</td>
<td>0°</td>
<td>NA</td>
<td>8 mm</td>
<td>555 frames/s</td>
</tr>
<tr>
<td>14</td>
<td>Front (Rear area)</td>
<td>7’ 0”</td>
<td>0’ 6”</td>
<td>8’ 9”</td>
<td>0°</td>
<td>NA</td>
<td>13 mm</td>
<td>520 frames/s</td>
</tr>
<tr>
<td>15</td>
<td>Real-time panning</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>16 mm</td>
<td>24 frames/s</td>
</tr>
</tbody>
</table>

1. +X: Film plane forward of barrier face  
   +Y: Film plane to left of monorail centerline  
   +Z: Film plane above ground level
2. +Angle: Film plane angled upward from horizontal plane
Appendix A

Photographs
Figure A-35  Pre-Test Right Side Seat 12 Instrumented 50th - View 3

Intentionally Left Blank
Figure A-46 Post-Test Left Side Seat 4 Instrumented 6 Year Old - View 3

Figure A-47 Post-Test Left Side Seat 4 Instrumented 6 Year Old - View 4
Figure A-62 Post-Test Right Side Seat 12 Instrumented 50th - View 1

Figure A-63 Post-Test Right Side Seat 12 Instrumented 50th - View 2
Appendix B

Data Plots
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION #1 HEAD Z-AXIS ACCELERATION

CHANNEL: HEDZG1 FILTER: CH. CLASS 1000

PEAK DATA: 20.18 G @ 206.00 MS, -11.17 G @ 128.96 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 1 NECK OCCIPITAL CONDYLE
FLAT FRONTAL
TEST NUMBER: 990421-1

See Data Acquisition Explanations

TORQUE (N·M)

CHANNEL: NEKOM1  FILTER: CH. CLASS 600

PEAK DATA: 223.57 N·M @ 130.40 MS, -19.42 N·M @ 309.60 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION #1 CHEST Y-AXIS ACCELERATION

CHANNEL: CSTY61   FILTER: CH. CLASS 100
PEAK DATA: 3.43 G @ 171.20 MS, -1.61 G @ 128.16 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION #1 CHEST Z-AXIS ACCELERATION

CHANNEL: CSTZC1  FILTER: CH CLASS 180

TEST NUMBER: 930421-1

PEAK DATA: 11.68 G @ 135.28 MS, -5.60 G @ 126.00 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION #1 CHEST DEFLECTION

CHANNEL: CSTXD1  FILTER: CH. CLASS 180
PEAK DATA: 3.80 MM @ 143.76 MS, -0.27 MM @ 44.96 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION #1 PELVIS X-AXIS ACCELERATION

See Data Acquisition Explanations

CHANNEL: PEVXG1  FILTER: CH. CLASS 1000
PEAK DATA: 0.52 G @ 21.52 MS, -174.79 G @ 46.64 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 1 PELVIS Y-AXIS ACCELERATION

CHANNEL: PEVYGI   FILTER: CH. CLASS 1000
PEAK DATA: 4.65 G @ 153.68 MS, -6.28 G @ 101.84 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 1 PELVIS Z-AXIS ACCELERATION

TEST NUMBER: 990421-1

CHANNEL: PEVZC1          FILTER: CH. CLASS 1000

PEAK DATA: 6.80 G @ 182 MS, -8.72 G @ 126 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 1 PELVIS RESULTANT ACCELERATION
FLAT FRONTAL

See Data Acquisition Explanations

CHANNEL: PEVRC1 FILTER: CH. CLASS 1000

PEAK DATA: 174.79 G @ 46.64 MS, 0.16 G @ -3.84 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 2 HEAD Y-AXIS ACCELERATION

CHANNEL: HEDY62  FILTER: CH. CLASS 1000
PEAK DATA: 3.95 G @ 128.96 MS, -8.56 G @ 120.64 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 2 NECK Z-AXIS AXIAL FORCE

TEST NUMBER 930421-1

FORCE (N x 10^2)

TIME (MS)

CHANNEL: NEKZ2 FILTER: CH. CLASS 1000

PEAK DATA: 276.44 N @ 197.04 MS, -2133.85 N @ 163.12 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 2 NECK MOMENT ABOUT X AXIS

FLAT FRONTAL

TEST NUMBER: 990421-1

TIME (MS)

TORQUE (N m)

-180
-160
-140
-120
-100
-80
-60
-40
-20
0
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340

CHANNEL: NEKXM2 FILTER: CH. CLASS 600

PEAK DATA: 10.59 N m @ 124.08 MS; -8.88 N m @ 172.00 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION #2 NECK MOMENT ABOUT Y AXIS

FLAT FRONTAL

TEST NUMBER: 990421-1

TORQUE (N m)

CHANNEL: NEKYM2
FILTER: CH. CLASS 600

TIME (MS)

PEAK DATA: 96.78 N m @ 163.28 MS, -21.93 N m @ 206.48 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 2 NECK MOMENT ABOUT Z AXIS

TEST NUMBER: 990421-1

TORQUE (N.m)

CHANNEL: NEKZM2  FILTER: CH. CLASS 600

PEAK DATA: 13.40 N.m @ 162.56 MS, -3.91 N.m @ 222.16 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION #2 NECK OCCIPITAL CONDYLE

FLAT FRONTAL

TEST NUMBER: 990421-1

TRC INC.

DORQUE (N M)

180
120
60
0
-60
-120
-180
-20 10 40 70 100 130 160 190 220 250 280 310
TIME (MS)

CHANNEL: NEKOM2  FILTER: CH. CLASS 600

PEAK DATA: 74 96 N M @ 163.12 MS, -26 41 N M @ 206.88 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION #2 CHEST X-AXIS ACCELERATION

CHANNEL: CSTXG2   FILTER: CH. CLASS 180
PEAK DATA: 6.28 G @ 212.40 MS, -27.11 G @ 156.48 MS

TEST NUMBER 990421-1
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 2 CHEST Y-AXIS ACCELERATION

CHANNEL: CSTYG2  FILTER: CH. CLASS 180
PEAK DATA: 4.52 G @ 169.60 MS, -0.95 G @ 98.32 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION #2 CHEST RESULTANT ACCELERATION

CHANNEL: CSTRC2   FILTER: CH. CLASS 180
PEAK DATA: 30.86 G @ 157.76 MS, 0.01 G @ -20.00 MS

TEST NUMBER: 990421-1
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 2 CHEST DEFLECTION

TEST NUMBER: 990421-1

CHANNEL: CSTX02  FILTER: CH. CLASS 180
PEAK DATA: 3.53 MM @ 160.40 MS, -0.07 MM @ 67.12 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 2 PELVIS Y-AXIS ACCELERATION

CHANNEL: PEYV2       FILTER: CH. CLASS 1000
PEAK DATA: 8.53 G @ 131.28 MS, -11.08 G @ 165.12 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 2 LEFT FEMUR FORCE
FLAT FRONTAL
TEST NUMBER 990421-1

CHANNEL: LFMF2 FILTER CH. CLASS 600
PEAK DATA: 51.40 N @ 237.68 MS, -1269.00 N @ 146.00 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION #3 HEAD Y-AXIS ACCELERATION

CHANNEL: HEDY63      FILTER CH. CLASS 1000
PEAK DATA: 4.96 G @ 146.00 MS, -11.77 G @ 33.44 MS

TEST NUMBER: 990421-1
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION #3 HEAD RESULTANT ACCELERATION

CHANNEL: HEDRG3 FILTER CH. CLASS 1000
PEAK DATA: 83.77 G @ 145 12 MS, 0.11 G @ -20 00 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 3 NECK X-AXIS SHEAR FORCE

TEST NUMBER: 990421-1

FORCE (N X 10^3)

TIME (MS)

CHANNEL NEKXF3 FILTER: CH. CLASS 1000
PEAK DATA: 2924.35 N @ 175.44 MS, -70.93 N @ 302.24 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 3 NECK Y-AXIS SHEAR FORCE

FLAT FRONTAL  TEST NUMBER 990421-1

CHANNEL: NEKYF3  FILTER: CH. CLASS 1000  PEAK DATA: 142.36 N @ 187.92 MS, -193.00 N @ 161.76 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 3 NECK Z-AXIS AXIAL FORCE

CHANNEL: NEKZ3  FILTER: CH. CLASS 1000  PEAK DATA: 398.41 N @ 189.32 MS, -1299.72 N @ 160.80 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 3 NECK MOMENT ABOUT X AXIS

TEST NUMBER 990421-1

TORQUE (N M)

-180 -160 -140 -120 -100 -80 -60 -40 -20 0 20 40 60 80 100 120 140 160 180

TIME (MS)

-20 -10 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200 210 220 230 240 250 260 270 280 290 300 310

CHANNEL: NEKXM3  FILTER: CH. CLASS 600

PEAK DATA: 4.29 N M @ 144.64 MS; -10.17 N M @ 171.68 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 3 NECK MOMENT ABOUT Y AXIS

TEST NUMBER: 990421-1

CHANNEL: NEKYM3 FILTER CH. CLASS 600

PEAK DATA: 102 25 N M @ 166.40 MS, -15 00 N M @ 236.48 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 3 NECK MOMENT ABOUT Z AXIS

TEST NUMBER: 990421-1

TORQUE (N M)

TIME (MS)

CHANNEL: NEKZM3
FILTER CH. CLASS 600
PEAK DATA: 6.94 N·M @ 191.92 MS, -5.17 N·M @ 166.00 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 3 CHEST Z-AXIS ACCELERATION

TEST NUMBER: 990421-1

CHANNEL: CSTZC3      FILTER: CH. CLASS 180      PEAK DATA: 33.05 G @ 175.12 MS, -4.92 G @ 99.20 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 3 CHEST RESULTANT ACCELERATION

TEST NUMBER 990421-1

CHANNEL: CSTRGJ  FILTER: CH. CLASS 180  PEAK DATA: 39.66 G @ 175.04 MS, 0.01 G @ -20.00 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 3 PELVIS Y-AXIS ACCELERATION

CHANNEL: PEVYG3  FILTER: CH. CLASS 1000
PEAK DATA: 9.00 G @ 128.56 MS, -8.99 G @ 150.96 MS

TEST NUMBER: 990421-1
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 4 HEAD Y-AXIS ACCELERATION

CHANNEL: HEDYG4 FILTER: CH. CLASS 1000

PEAK DATA: 76.39 G @ 267.04 MS, -5.42 G @ 41.28 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION #4 HEAD RESULTANT ACCELERATION

CHANNEL: HEORG4  FILTER: CH. CLASS 1000
PEAK DATA: 89.52 G @ 267.04 MS, 0.11 G @ -912 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 4 NECK MOMENT ABOUT X AXIS

CHANNEL: NEKXM4    FILTER: CH. CLASS 600
PEAK DATA: 27.21 N M @ 235.12 MS, -58.03 N M @ 26.08 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION #4 NECK MOMENT ABOUT Y AXIS

CHANNEL: NEKYM4 FILTER: CH. CLASS 600
PEAK DATA: 179.55 N.M @ 138.88 MS, -10.96 N.M @ 278.72 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 4 CHEST X-AXIS ACCELERATION

CHANNEL: CSTXG4 FILTER CH. CLASS 180
PEAK DATA: 34.82 G @ 230.16 MS, -70.29 G @ 35.60 MS

See Data Acquisition Explanations
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 4 CHEST Z-AXIS ACCELERATION

FLAT FRONTAL  TEST NUMBER: 990421-1

CHANNEL: CS1ZC4  FILTER CH. CLASS 180

PEAK DATA: 19.84 G @ 229.76 MS; -10.34 G @ 268.08 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 4 CHEST RESULTANT ACCELERATION

See Data Acquisition Explanations

CHANNEL: CSTRC4  FILTER: CH. CLASS 100  PEAK DATA: 70.30 G @ 35.60 MS, 0.01 G @ -20.00 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 4 PELVIS Y-AXIS ACCELERATION

See Data Acquisition Explanations.

CHANNEL: PEVY44 FILTER: CH. CLASS 1000
PEAK DATA: 402.33 G @ 24.00 MS, -27.93 G @ 42.00 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 4 PELVIS RESULTANT ACCELERATION
FLAT FRONTAL

CHANNEL: PEVRG4  FILTER: CH. CLASS 1000
PEAK DATA: 403 03 C @ 34.40 MS, 0.11 C @ -19.28 MS

See Data Acquisition Explanations
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 4 RIGHT FEMUR FORCE

TRC INC. -20

FORCE (IN X 10^3)
-100
-80
-60
-40
-20
0
20

TIME (MS)
20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320

CHANNEL: RFM4 FILTER: CH. CLASS 600 PEAK DATA: 506.24 N @ 199.44 MS; -2769.00 N @ 93.12 MS

TEST NUMBER: 990421-1
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 5 HEAD Y-AXIS ACCELERATION

FLAT FRONTAL

TEST NUMBER 990421-1

CHANNEL: HEDY65  FILTER: CH. CLASS 1000

PEAK DATA: 5.81 G @ 190.48 MS, -0.83 G @ 120.08 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 5 HEAD RESULTANT ACCELERATION

CHANNEL: HEDRC5 FILTER CH. CLASS 1000
PEAK DATA: 93.68 G @ 123.44 MS, 0.10 G @ -12.40 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION #5 NECK X-AXIS SHEAR FORCE

CHANNEL: NEKXF5  FILTER CH. CLASS 1000  PEAK DATA: 3182.09 N @ 160 MS, -4.02 N @ 9.28 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 5 NECK Y-AXIS SHEAR FORCE

CHANNEL NEKYF5 FILTER: CH. CLASS 1000
PEAK DATA: 49.72 N @ 97.12 MS, -666.91 N @ 192.64 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 5 NECK MOMENT ABOUT X AXIS

TEST NUMBER: 990421-1

TORQUE (N m)

TIME (MS)

CHANNEL: NEKXMS FILTER CH. CLASS 600

PEAK DATA: 64.90 N m @ 194.96 MS, -1.05 N m @ 44.96 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 5 NECK MOMENT ABOUT Y AXIS

CHANNEL: NEKYM5       FILTER: CH. CLASS 600
PEAK DATA: 219.40 N.M @ 161.76 MS; -10.76 N.M @ 114.08 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 5 NECK MOMENT ABOUT Z AXIS

CHANNEL: NEKZ5
FILTER: CH. CLASS 600
PEAK DATA: 8.35 N.M @ 144.32 MS, -16.04 N.M @ 205.20 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 5 NECK OCCIPITAL CONDYLE

FLAT FRONTAL

TEST NUMBER: 990421-1

TORQUE (N m)

180
120
60
0
-60
-120
-180

-20  10  40  70  100  130  160  190  220  250  280  310

TIME (MS)

CHANNEL: NEKOMS  FILTER: CH. CLASS 600

PEAK DATA: 163.78 N m @ 162.32 MS, -10.99 N m @ 113.44 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION #5 CHEST Y-AXIS ACCELERATION

CHANNEL: CSTYG5  FILTER: CH. CLASS 180
PEAK DATA: 5.36 G @ 157.68 MS, -1.79 G @ 82.88 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION #5 LEFT FEMUR FORCE

FLAT FRONTAL

TEST NUMBER: 990421-1

FORCE IN X 10^2

0

-20

-40

-60

-80

-100

TRC INC.

TIME (MS)

-20 10 40 70 100 130 160 190 220 250 280 310

CHANNEL: LFHF5  FILTER: CH. CLASS 600

PEAK DATA: 286.65 N @ 80.32 MS, -3287.42 N @ 191.84 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION #6 HEAD X-AXIS ACCELERATION

FLAT FRONTAL

TEST NUMBER 990421-1

ACCELERATION (G)

CHANNEL: HEDXCG6   FILTER: CH. CLASS 1000

TIME (MS)

PEAK DATA: 2.13 G @ 96.80 MS, -47.73 G @ 132.96 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION #6 HEAD Y-AXIS ACCELERATION

TEST NUMBER 990421-1

CHANNEL: HEDY66  FILTER: CH. CLASS 1000
PEAK DATA: 8.41 G @ 192.48 MS, -2.35 G @ 266.00 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION #6 HEAD Z-AXIS ACCELERATION

CHANNEL: HEDZGG FILTER: CH. CLASS 1000
PEAK DATA: 16.27 G @ 197.76 MS, -4.69 G @ 161.44 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 6 NECK Y-AXIS SHEAR FORCE

FLAT FRONTAL

TEST NUMBER 990421-1

FORCE (N X 10^-2)

CHANNEL: NEKYFG  FILTER: CH. CLASS 1000

PEAK DATA: 35.23 N @ 0.08 MS, -742.51 N @ 149.36 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 6 NECK Z-AXIS AXIAL FORCE

FORCE (N x 10^6)

TIME (MS)

CHANNEL: NEK2FE  FILTER: CH CLASS 1000
PEAK DATA: 2323.31 N @ 130.88 MS, -497.51 N @ 162.72 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 6 NECK MOMENT ABOUT X AXIS

TEST NUMBER: 990421-1

CHANNEL: NEKXM6  FILTER: CH. CLASS G0O
PEAK DATA: 63.20 N M @ 214.16 MS, -4.84 N M @ 205.92 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION #6 NECK MOMENT ABOUT Y AXIS

CHANNEL: NEKYMG FILTER: CH. CLASS 600
PEAK DATA: 225.15 N-M @ 136.40 MS, -9.19 N-M @ 110.48 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION #6 CHEST X-AXIS ACCELERATION

CHANNEL: CSTXCG  FILTER: CH. CLASS 180
PEAK DATA: 0.92 G @ 252.40 MS, -20.94 G @ 141.44 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION #6 CHEST RESULTANT ACCELERATION

CHANNEL: CSTRG6  FILTER: CH. CLASS 180  PEAK DATA: 22.93 G @ 141.68 MS; 0.03 G @ -20.00 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 6 CHEST DEFLECTION

TEST NUMBER: 990421-1

CHANNEL: CSTXDG FILTER CH CLASS 180 PEAK DATA: 3.90 MM @ 149.36 MS, -0.01 MM @ -14.48 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 6 PELVIS X-AXIS ACCELERATION

CHANNEL: PEVXCG  FILTER: CH. CLASS 1000
PEAK DATA: 1.40 G @ 270.00 MS, -16.77 G @ 184.32 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
POSITION # 6 LEFT FEMUR FORCE

FLAT FRONTAL
TEST NUMBER 990421-1

FORCE (IN X 10^2)

TIME (MS)

CHANNEL: LFMF6   FILTER: CH CLASS 600

PEAK DATA: 145.62 N @ 261.68 MS, -4271.27 N @ 165.84 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
FLOOR TUNNEL X-AXIS ACCELERATION #1

FLAT FRONTAL

TEST NUMBER: 990421-1

CHANNEL: FTUXG1  FILTER: CH. CLASS G0
PEAK DATA: 1.14 G @ 257.28 MS, -23.58 G @ 76.32 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
FLOOR TUNNEL Z-AXIS ACCELERATION #1
FLAT FRONTAL
TEST NUMBER 990421-1

CHANNEL: FTUZG1  FILTER: CH. CLASS 60
PEAK DATA: 25.36 G @ 72.88 MS, -39.95 G @ 76.56 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
FLOOR TUNNEL RESULTANT ACCELERATION #1

Test Data:
- Channel: FTURG1
- Filter: CH. CLASS 60
- Peak Data: 46.73G @ 76.48 ms, 0.01G @ -19.84 ms
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
FLOOR TUNNEL X-AXIS ACCELERATION #2

TEST NUMBER: 990421-1

CHANNEL: FTUXC2  FILTER: CH. CLASS 60
PEAK DATA: 5.81 G @ 15.44 MS; -21.40 G @ 51.12 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
FLOOR TUNNEL RESULTANT ACCELERATION #2
FLAT FRONTAL
TEST NUMBER 990421-1

CHANNEL: FTURC2  FILTER: CH. CLASS 60
PEAK DATA: 39.23 G @ 50.48 MS; 0.01 G @ -20.00 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
FLOOR TUNNEL X-AXIS ACCELERATION #3

CHANNEL: FTUXG3  FILTER: CH. CLASS 60
PEAK DATA: 2.13 G @ 218.24 MS; -17.26 G @ 135.04 MS
Appendix C

Dummy Certification
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
FLOOR TUNNEL Z-AXIS ACCELERATION #3

CHANNEL: FTUZC3  FILTER: CH. CLASS 60
PEAK DATA: 44.90 G @ 86.56 MS, -38.87 G @ 91.44 MS
1997 Thomas Built Bus Into Flat Frontal Barrier
Vehicle Center of Gravity Y-Axis Acceleration

Test Number: 990421-1

Channel: YCGY1  Filter: CH. CLASS 60
Peak Data: 4.38 G @ 159.12 ms, -11.89 G @ 64.08 ms
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
VEHICLE CENTER OF GRAVITY Z-AXIS ACCELERATION

TEST NUMBER 990421-1

CHANNEL: VCGZC1    FILTER: CH. CLASS 60    PEAK DATA: 50.90 G @ 63.92 MS, -51.38 G @ 69.28 MS
1997 THOMAS BUILT BUS INTO FLAT FRONTAL BARRIER
VEHICLE CENTER OF GRAVITY RESULTANT ACCELERATION

TRC INC.

FLAT FRONTAL

TEST NUMBER: 990421-1

ACCELERATION (G)

TIME (MS)

CHANNEL: VCCRG1 FILTER: CH. CLASS 60

PEAK DATA: 53.37 G @ 63.92 MS, 0.02 G @ -19.84 MS
Pre-Test Dummy Certification

Hybrid III 50th Male Dummy S/N 045
<table>
<thead>
<tr>
<th>TEST PARAMETER</th>
<th>SPECIFICATION</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURE</td>
<td>18.9-25.6 DEG. C</td>
<td>21.1 DEG. C</td>
</tr>
<tr>
<td>RELATIVE HUMIDITY</td>
<td>10 - 70 %</td>
<td>33.0 %</td>
</tr>
<tr>
<td>PEAK RESULTANT ACCELERATION</td>
<td>225 - 275 G</td>
<td>244.28 G</td>
</tr>
<tr>
<td>PEAK LATERAL ACCELERATION</td>
<td>15 G MAX</td>
<td>-1.76 G</td>
</tr>
<tr>
<td>IS ACCELERATION CURVE</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>UNIMODAL?</td>
<td></td>
<td></td>
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</table>

TEST MEETS SPECIFICATIONS

TECHNICIAN

RUN NUMBER: 041599.1011;1
PART 572-E HYBRID III HEAD CALIBRATION
HEAD ACCELERATION X AXIS

TRC TEST NUMBER: 45C38H01
572E SN045 HEAD DROP CAL 38
RUN NUMBER: 041599.1011.1

ACCELERATION (G)

CHANNEL: HEDXG   FILTER: CH. CLASS 1000

TIME (MS x 10^-1)  PEAK DATA: 207.92 G @ 1.92 MS; -0.01 G @ -0.88 MS
PART 572-E HYBRID III HEAD CALIBRATION
HEAD ACCELERATION Y AXIS

TRA C TEST NUMBER: 45C38HD1
572E SN045 HEAD DROP CAL 38
RUN NUMBER: 041599.1011,1

ACCELERATION (G)

-225 -200 -175 -150 -125 -100 -75 -50 -25  0  25  50  75  100

TIME (MS X 10^-1)

-10 0 10 20 30 40 50 60 70 80 90 100

CHANNEL: HEDYG FILTER: CH. CLASS 1000

PEAK DATA: 0.98 G @ 4.88 MS, -1.76 G @ 3.60 MS
PART 572-E HYBRID III HEAD CALIBRATION
HEAD ACCELERATION Z AXIS

TRC TEST NUMBER: 45C38HD1
572E SN045 HEAD DROP CAL 38
RUN NUMBER: 041599.1011; 1

ACCELERATION (G)

CHANNEL: HEDZG
FILTER: CH. CLASS 1000

PEAK DATA: 0.01 G @ -0.96 MS, -128.22 G @ 1.92 MS
<table>
<thead>
<tr>
<th>TEST PARAMETER</th>
<th>SPECIFICATION</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURE</td>
<td>20.6-22.2 DEG. C</td>
<td>21.1 DEG. C</td>
</tr>
<tr>
<td>RELATIVE HUMIDITY</td>
<td>10 - 70 %</td>
<td>33.0 %</td>
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<tr>
<td>IMPACT VELOCITY</td>
<td>6.89 - 7.13 M/S</td>
<td>6.93 M/S</td>
</tr>
<tr>
<td>PENDULUM</td>
<td>10 MS</td>
<td>22.50 - 27.50 G</td>
</tr>
<tr>
<td></td>
<td>20 MS</td>
<td>17.60 - 22.60 G</td>
</tr>
<tr>
<td>DECELERATION</td>
<td>30 MS</td>
<td>12.50 - 18.50 G</td>
</tr>
<tr>
<td>MAX PENDULUM G</td>
<td>29 G MAX</td>
<td>24.04 G</td>
</tr>
<tr>
<td>MAX PENDULUM G ABOVE 30 MS</td>
<td>29 G MAX</td>
<td>15.50 G</td>
</tr>
<tr>
<td>DECELERATION-TIME CURVE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DECAY TIME TO 5 G</td>
<td>34 - 42 MS</td>
<td>38.16 MS</td>
</tr>
<tr>
<td>D PLANE</td>
<td>MAX</td>
<td>64 - 78 DEG.</td>
</tr>
<tr>
<td>ROTATION</td>
<td>TIME</td>
<td>57 - 64 MS</td>
</tr>
<tr>
<td>MOMENT ABOUT OCCIPITAL</td>
<td>MAX</td>
<td>88.2 - 108.5 NM</td>
</tr>
<tr>
<td>CONDYLE</td>
<td>TIME</td>
<td>47 - 58 MS</td>
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<tr>
<td>ROTATION ANGLE-TIME CURVE</td>
<td></td>
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<tr>
<td>DECAY TIME TO ZERO</td>
<td>113 - 128 MS</td>
<td>120.88 MS</td>
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<tr>
<td>POSITIVE MOMENT-TIME CURVE</td>
<td></td>
<td></td>
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<tr>
<td>DECAY TIME TO ZERO</td>
<td>97 - 107 MS</td>
<td>103.84 MS</td>
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</table>

TEST MEETS SPECIFICATIONS

TECHNICIAN

RUN NUMBER: 041599.1014;1
PART 572-E HYBRID III NECK FLEXION CALIBRATION
PENDULUM DECELERATION

TRC TEST NUMBER: 45C38NF1
572E SN045 NECK FLEXION CAL38
RUN NUMBER: 041599 1015.1

ACCELERATION (G x 10^-1)

CHANNEL: PENXG  FILTER: CH. CLASS 60

PEAK DATA: 24.05 G @ 8.80 MS, -2.75 G @ 43.92 MS
PART 572-E HYBRID III NECK FLEXION CALIBRATION

ROTATION ABOUT OCCIPITAL CONDYLE

TRC TEST NUMBER: 45C3BNF1
572E SN045 NECK FLEXION CAL38
RUN NUMBER: 041599 1015;1

CHANNEL: THETA
FILTER: CH CLASS 60

TIME (MS)

PEAK DATA: 39.45 ° @ 62.56 MS, -33.50 ° @ 191.04 MS
PART 572-E HYBRID III NECK FLEXION CALIBRATION
TOTAL MOMENT ABOUT OCCIPITAL CONDYLE

TRC TEST NUMBER: 45C3BNF1
572E SN045 NECK FLEXION CAL38
RUN NUMBER: 041599.1015.1

CHANNEL: NEKOM
FILTER: CH. CLASS 60
PEAK DATA: 91.94 N M @ 53.12 MS; -26.84 N M @ 13.28 MS
<table>
<thead>
<tr>
<th>TEST PARAMETER</th>
<th>SPECIFICATION</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURE</td>
<td>20.6 - 22.2 DEG. C</td>
<td>21.1 DEG. C</td>
</tr>
<tr>
<td>RELATIVE HUMIDITY</td>
<td>10 - 70 %</td>
<td>33.0 %</td>
</tr>
<tr>
<td>IMPACT VELOCITY</td>
<td>5.95 - 6.19 M/S</td>
<td>5.95 M/S</td>
</tr>
<tr>
<td>PENDULUM</td>
<td>10 MS</td>
<td>17.20 - 21.20 G</td>
</tr>
<tr>
<td></td>
<td>20 MS</td>
<td>14.00 - 19.00 G</td>
</tr>
<tr>
<td>DECELERATION</td>
<td>30 MS</td>
<td>11.00 - 16.00 G</td>
</tr>
<tr>
<td>MAX PENDULUM G</td>
<td>22 G MAX</td>
<td>18.63 G</td>
</tr>
<tr>
<td>MAX PENDULUM G ABOVE 30 MS</td>
<td>22 G MAX</td>
<td>14.09 G</td>
</tr>
<tr>
<td>DECELERATION-TIME CURVE</td>
<td>DECAY TIME TO 5 G</td>
<td>38 - 46 MS</td>
</tr>
<tr>
<td>D PLANE</td>
<td>MAX</td>
<td>81 - 106 DEG.</td>
</tr>
<tr>
<td>ROTATION</td>
<td>TIME</td>
<td>72 - 82 MS</td>
</tr>
<tr>
<td>MOMENT ABOUT OCCIPITAL</td>
<td>MIN</td>
<td>-80.0/-52.9 NM</td>
</tr>
<tr>
<td></td>
<td>TIME</td>
<td>65 - 79 MS</td>
</tr>
<tr>
<td>ROTATION ANGLE-TIME CURVE</td>
<td>DECAY TIME TO ZERO</td>
<td>147 - 174 MS</td>
</tr>
<tr>
<td>NEGATIVE MOMENT-TIME CURVE</td>
<td>DECAY TIME TO ZERO</td>
<td>120 - 148 MS</td>
</tr>
</tbody>
</table>

TEST MEETS SPECIFICATIONS

TECHNICIAN [Signature]  
RUN NUMBER: 041599.1121;4
PART 572-E HYBRID III NECK EXTENSION CALIBRATION
PENDULUM DECELERATION

TRC TEST NUMBER: 45C38NE2
572E SN045 NECK EXT CAL38
RUN NUMBER: 041599.1122,4

ACCELERATION (G X 10^-1)

CHANNEL: PENXG
FILTER: CH. CLASS 60

PEAK DATA: 18.63 G @ 9.52 MS, -2.49 G @ 48.64 MS
PART 572-E HYBRID III NECK EXTENSION CALIBRATION

ROTATION ABOUT BASE OF NECK

TRC TEST NUMBER: 45C38NE2
572E SN845 NECK EXT CAL38
RUN NUMBER: 041599.1122,4

ANGLE (°)

0

-30

-60

-20 0 20 40 60 80 100 120 140 160 180 200

TIME (MS)

CHANNEL: BETA
FILTER: CH. CLASS 60

PEAK DATA: 30.22 ° @ 75.44 MS, -13.48 ° @ 200.00 MS
PART 572-E HYBRID III NECK EXTENSION CALIBRATION
TOTAL ROTATION

TRC TEST NUMBER: 45C3BNE2
572E SN045 NECK EXT CAL30
RUN NUMBER: 041599.1122,4

CHANNEL: TOTAN
FILTER: CH. CLASS 60
PEAK DATA: 105.41 ° @ 76.32 MS, -33.06 ° @ 200.00 MS
PART 572-E HYBRID III NECK EXTENSION CALIBRATION
NECK MOMENT Y AXIS

TRC TEST NUMBER: 45C38NL2
572E SN045 NECK EXT CAL38
RUN NUMBER: 041599 1122,4

TORQUE (N·M)

-160
-120
-80
-40
0
40
80

TIME (MS)

-20
0
20
40
60
80
100
120
140
160
180
200

CHANNEL: NEKYM
FILTER: CH. CLASS 60
PEAK DATA: 25.34 N·M @ 187.52 MS; -58.94 N·M @ 72.32 MS
PART 572-E HYBRID III NECK EXTENSION CALIBRATION
TOTAL MOMENT ABOUT OCCIPITAL CONDYLE

TRC TEST NUMBER: 45C30NE2
572E SN045 NECK EXT CAL3B
RUN NUMBER: 041599.1122.4

CHANNEL: NEKOM
FILTER: CH. CLASS 60
PEAK DATA: 28.51 N.M @ 187.52 MS; -68.41 N.M @ 72.08 MS

TORQUE (N.M)
-160 -120 -80 -40 0 40 80
TIME (MS)
-20 0 20 40 60 80 100 120 140 160 180 200
TRANSPORTATION RESEARCH CENTER INC.

THORAX IMPACT TEST

HYBRID III 50th

15-APR-99

TRC INC. TEST NO: 45C38TH2 572E SN045 H.S.TORAX CAL38

<table>
<thead>
<tr>
<th>TEST PARAMETER</th>
<th>HIGH SPEED TEST SPECIFICATION</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURE</td>
<td>20.6-22.2 DEG. C</td>
<td>21.1 DEG. C</td>
</tr>
<tr>
<td>RELATIVE HUMIDITY</td>
<td>10 - 70 %</td>
<td>33.0 %</td>
</tr>
<tr>
<td>PENDULUM VELOCITY</td>
<td>6.59 - 6.83 M/S</td>
<td>6.68 M/S</td>
</tr>
<tr>
<td>MAXIMUM DEFLECTION</td>
<td>63.5 - 72.6 MM</td>
<td>63.7 MM</td>
</tr>
<tr>
<td>MAXIMUM RESISTIVE FORCE</td>
<td>5159 - 5894 N</td>
<td>5635. N</td>
</tr>
<tr>
<td>INTERNAL HYSTÉRESIS</td>
<td>69% - 85%</td>
<td>72.7%</td>
</tr>
</tbody>
</table>

TEST MEETS SPECIFICATIONS

TECHNICIAN: Kevin Watkins

RUN NUMBER: 041599.1347;3
PART 572-E HYBRID III THORAX CALIBRATION
PENDULUM DECELERATION

TRC TEST NUMBER: 45C30TH2
572E SN045 H.S.THRAX CAL30
RUN NUMBER: 041599.1348.3

ACCELERATION (G)

TIME (MS)

CHANNEL: PENXM
FILTER: CH. CLASS 180
PEAK DATA: 24.60 G @ 20.24 MS; 0.02 G @ 73.20 MS
PART 572-E HYBRID III THORAX CALIBRATION
STERNUM DISPLACEMENT

TRC TEST NUMBER: 45C30TH2
572E SN045 H.S.THRAX CAL38
RUN NUMBER: 041599.1348.3

CHANNEL: CSTXD
FILTER: CH. CLASS 180
PEAK DATA: 63.76 MM @ 25.20 MS, -0.05 MM @ 1.28 MS
<table>
<thead>
<tr>
<th>TEST PARAMETER</th>
<th>SPECIFICATION</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURE</td>
<td>18.9-25.6 DEG. C</td>
<td>21.1 DEG. C</td>
</tr>
<tr>
<td>RELATIVE HUMIDITY</td>
<td>10 - 70 %</td>
<td>33.0 %</td>
</tr>
<tr>
<td>ROTATION RATE</td>
<td>5 - 10 deg/sec</td>
<td>YES</td>
</tr>
<tr>
<td>TORQUE @ 30 deg ROTATION</td>
<td>&lt;= 94.9 Nm</td>
<td>88.6 Nm</td>
</tr>
<tr>
<td>ROTATION @ 203.4 Nm TORQUE</td>
<td>40 - 50 deg.</td>
<td>40.3 deg.</td>
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</tbody>
</table>

TEST MEETS SPECIFICATIONS

TECHNICIAN [Signature]

RUN NUMBER: 041599.0958;1
HYBRID III HIP FLEXION VERIFICATION - 0 DEGREES
RIGHT HIP FLEXION ROTATION

TRC TEST NUMBER: 45C38HR3
572E SN 045 HIPFLEX CAL 38
RUN NUMBER: 041599.1005.1

ANGLE (°)

-15
0
15
30
45
60
75

TIME (S x 10^-2)

0 80 160 240 320 400 480 560 640 720 800

CHANNEL: RHPXD  FILTER: CH. CLASS 60
PEAK DATA: 41.14 ° @ 5.17 S, -10.08 ° @ -1.00 S
HYBRID III HIP FLEXION VERIFICATION - 0 DEGREES
RIGHT HIP FLEXION MOMENT VS ROTATION ANGLE

TRC TEST NUMBER: 45C308HR3
572E SN 045 HIPFLEX CAL 38
RUN NUMBER: 041599.1005.1

TORQUE (N·m)

250
200
150
100
50
0
-50
-60
0
60
120
180
240
300
360
420
480
540
600

CHANNEL: RHPXD
FILTER: CH. CLASS 60

RHPYM
CH. CLASS 60

ANGLE (° x 10⁻¹)

PEAK DATA: 41.14 ° @ 5.17 s; -10.08 ° @ -1.00 s
220.98 N·m @ 5.13 s; -16.46 N·m @ -1.00 s
<table>
<thead>
<tr>
<th>TEST PARAMETER</th>
<th>SPECIFICATION</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURE</td>
<td>18.9-25.6 DEG. C</td>
<td>21.1 DEG. C</td>
</tr>
<tr>
<td>RELATIVE HUMIDITY</td>
<td>10 - 70 %</td>
<td>33.0 %</td>
</tr>
<tr>
<td>ROTATION RATE</td>
<td>5 - 10 deg/sec</td>
<td>YES</td>
</tr>
<tr>
<td>TORQUE @ 30 deg</td>
<td>&lt;= 94.9 Nm</td>
<td>93.6 Nm</td>
</tr>
<tr>
<td>ROTATION @ 203.4 Nm</td>
<td>TORQUE</td>
<td>40 - 50 deg.</td>
</tr>
</tbody>
</table>

TEST MEETS SPECIFICATIONS

TECHNICIAN

RUN NUMBER: 041599.0826;2
HYBRID III HIP FLEXION VERIFICATION - 0 DEGREES
LEFT HIP FLEXION ROTATION

TRC TEST NUMBER: 45C38HL1
572E SN 045 HIPFLEX CAL 38
RUN NUMBER: 041599.00264.2

CHANNEL: LHPXD
FILTER: CH. CLASS 60

PEAK DATA: 41.43° @ 5.20 s; -10.05° @ -1.00 s
HYBRID III HIP FLEXION VERIFICATION - 0 DEGREES
LEFT HIP FLEXION MOMENT

TRC TEST NUMBER: 45C30HL1
572E SN 045 HIPFLEX CAL 38
RUN NUMBER: 041599 0826,2

TORQUE (N·m)

CHANNEL: LHPYM
FILTER: CH. CLASS 60

TIME (s x 10^-2)

PEAK DATA: 217.73 N·m @ 5.17 s, -22.47 N·m @ -1.00 s
TRANSPORTATION RESEARCH CENTER INC.

RIGHT KNEE IMPACT TEST

HYBRID III 50th

16-APR-99

TRC INC. TEST NO: 45C38RK1 572E SNO45 RIGHT KNEE CAL 38

<table>
<thead>
<tr>
<th>TEST PARAMETER</th>
<th>SPECIFICATION</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURE</td>
<td>18.9-25.6 DEG. C</td>
<td>21.1 DEG. C</td>
</tr>
<tr>
<td>RELATIVE HUMIDITY</td>
<td>10 - 70 %</td>
<td>33.0 %</td>
</tr>
<tr>
<td>PROBE VELOCITY</td>
<td>2.07 - 2.13 M/S</td>
<td>2.10 M/S</td>
</tr>
<tr>
<td>PEAK KNEE IMPACT FORCE</td>
<td>4715 - 5782 N</td>
<td>5128.3 N</td>
</tr>
<tr>
<td>5.0 KG PENDULUM</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TEST MEETS SPECIFICATIONS

TECHNICIAN [Signature] RUN NUMBER: 041599.0839;1
PART 572-E HYBRID III RIGHT KNEE CALIBRATION
PENDULUM DECELERATION (5 KG PEND.)

TRC TEST NUMBER: 45C38RK1
572E SN045 RIGHT KNEE CAL 38
RUN NUMBER: 041599.0839.1

ACCELERATION (G)

-30
-20
0
30
60
90
120
150

CHANNEL: PENXG
FILTER: CH. CLASS 600

TIME (MS X 10^-1)

0
20
40
60
80
100
120
140
160
180
200

PEAK DATA: 104.81 G @ 2.88 MS; -0.91 G @ 7.60 MS
<table>
<thead>
<tr>
<th>TEST PARAMETER</th>
<th>SPECIFICATION</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURE</td>
<td>18.9-25.6 DEG. C</td>
<td>21.1 DEG. C</td>
</tr>
<tr>
<td>RELATIVE HUMIDITY</td>
<td>10 - 70 %</td>
<td>33.0 %</td>
</tr>
<tr>
<td>PROBE VELOCITY</td>
<td>2.07 - 2.13 M/S</td>
<td>2.10 M/S</td>
</tr>
<tr>
<td>PEAK KNEE IMPACT FORCE</td>
<td>4715 - 5782 N</td>
<td>5379.2 N</td>
</tr>
</tbody>
</table>

TEST MEETS SPECIFICATIONS

TECHNICIAN [Signature]    RUN NUMBER: 041599.0836;1
Pre-Test Dummy Certification

Hybrid III 6 Year Old Dummy S/N 27
<table>
<thead>
<tr>
<th>TEST PARAMETER</th>
<th>SPECIFICATION</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURE</td>
<td>18.9-25.6 DEG. C</td>
<td>21.1 DEG. C</td>
</tr>
<tr>
<td>RELATIVE HUMIDITY</td>
<td>10 - 70 %</td>
<td>33.0 %</td>
</tr>
<tr>
<td>PEAK RESULTANT ACCELERATION</td>
<td>245 - 300 G</td>
<td>266.35 G</td>
</tr>
<tr>
<td>PEAK LATERAL ACCELERATION</td>
<td>15 G MAX</td>
<td>-3.56 G</td>
</tr>
<tr>
<td>IS ACCELERATION CURVE UNIMODAL?</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

TEST MEETS SPECIFICATIONS.

TECHNICIAN [Signature]  
RUN NUMBER: 041999.1342;1
HYBRID III SIX YEAR OLD CHILD DUMMY HEAD CALIBRATION
HEAD ACCELERATION X AXIS

TRC TEST NUMBER: 27C9H01
H/3 6YR SN27 HEAD DROP CAL9

RUN NUMBER: 041999 1343,1

ACCELERATION (G)

-75
-150
-225
-300
-375

-10 0 10 20 30 40 50 60 70 80 90 100

TIME (MS X 10^-1)

CHANNEL: HEDXG
FILTER: CH. CLASS 1000

PEAK DATA: 2.98 G @ 5.92 MS; -235.63 G @ 2.08 MS
HYBRID III SIX YEAR OLD CHILD DUMMY HEAD CALIBRATION
HEAD ACCELERATION Y AXIS

TRC TEST NUMBER: 27C9HD1
H/3 6YR SN27 HEAD DROP CAL9
RUN NUMBER: 041999.1343,1

ACCELERATION (G)

-225 -150 -75 0 75 150 225

TIME (MS x 10^-1)

-10 0 10 20 30 40 50 60 70 80 90 100

CHANNEL: HEDYG FILTER: CH. CLASS 1000

PEAK DATA: 1.72 G @ 3.84 MS, -3.57 G @ 2.16 MS
HYBRID III SIX YEAR OLD CHILD DUMMY HEAD CALIBRATION
HEAD ACCELERATION Z AXIS

TRC TEST NUMBER: 27C9HD1
H/3 6YR SN27 HEAD DROP CAL9
RUN NUMBER: 041999 1343,1

CHANNEL: HEDZG
FILTER: CH. CLASS 1000

PEAK DATA: 2.52 G @ 6.00 MS, -124.14 G @ 2.08 MS
HYBRID III SIX YEAR OLD CHILD DUMMY HEAD CALIBRATION
CHECK PLOT - HEAD RESULTANT ACCELERATION

TRC TEST NUMBER: 27C9HD1
H/3 6YR.SN27 HEAD DROP CAL9
RUN NUMBER: 041999.1343.1

ACCELERATION (G)

TIME (MS)

CHANNEL: HEDRG
FILTER: CH. CLASS 1000
PEAK DATA: 266.35 G @ 2.08 MS, 0.07 G @ -14.96 MS
TRANSPORTATION RESEARCH CENTER INC.

HYBRID III SIX YEAR OLD  19-APR-99

NECK FLEXION TEST

<table>
<thead>
<tr>
<th>TRC INC.</th>
<th>TEST NO: 27C9NF1</th>
<th>H/3 6YR.SN27 NECK FLEX.CAL9</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEST PARAMETER</td>
<td>SPECIFICATION</td>
<td>TEST RESULTS</td>
</tr>
<tr>
<td>TEMPERATURE</td>
<td>20.6-22.2 DEG. C</td>
<td>21.1 DEG. C</td>
</tr>
<tr>
<td>RELATIVE HUMIDITY</td>
<td>10 - 70 %</td>
<td>33.0 %</td>
</tr>
<tr>
<td>IMPACT VELOCITY</td>
<td>4.83 - 5.07 M/S</td>
<td>5.05 M/S</td>
</tr>
<tr>
<td>INTEGRATED PENDULUM VELOCITY</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 MS</td>
<td>1.2 - 1.6 M/S</td>
<td>1.59 M/S</td>
</tr>
<tr>
<td>20 MS</td>
<td>2.4 - 3.4 M/S</td>
<td>3.13 M/S</td>
</tr>
<tr>
<td>30 MS</td>
<td>3.8 - 5.0 M/S</td>
<td>4.59 M/S</td>
</tr>
<tr>
<td>PEAK D-PLANE ROTATION</td>
<td>74 - 92 DEG.</td>
<td>76.94 DEG.</td>
</tr>
<tr>
<td>PEAK MOMENT ABOUT OCCIPITAL CONDYLE</td>
<td>27 - 33 NM</td>
<td>30.90 NM</td>
</tr>
<tr>
<td>POSITIVE MOMENT DECAY TIME FROM PEAK TO 5 NM</td>
<td>103 - 123 MS</td>
<td>112.08 MS</td>
</tr>
</tbody>
</table>

TEST MEETS SPECIFICATIONS

TECHNICIAN

RUN NUMBER: 041999.1357;1
HYBRID III SIX YEAR OLD CHILD DUMMY NECK FLEXION CALIBRATION
PENDULUM DECELERATION

TRC TEST NUMBER: 27C9NF1  H/3 BYR SN27 NECK FLEX CAL9  RUN NUMBER: 041999.1401;1

ACCELERATION (G X 10^-1)

CHANNEL: PENVGC  FILTER: CH. CLASS 180  PEAK DATA: 20.67 G @ 8.72 MS, -2.45 G @ 42.80 MS

TIME (MS)
HYBRID III SIX YEAR OLD CHILD DUMMY NECK FLEXION CALIBRATION

INTEGRATED PENDULUM VELOCITY

TRC TEST NUMBER: 27C9NF1
H/3 BYR SN27 NECK FLEX CAL9
RUN NUMBER: 041999.1401.1

VELOCITY (M/S X 10^-1)

-30 -20 0 20 40 60 80 100 120 140 160 180 200

TIME (MS)

CHANNEL: PENXVI
FILTER: CH. CLASS 100

PEAK DATA: 5.76 M/S @ 200.00 MS; -0.01 M/S @ -20.00 MS
HYBRID III SIX YEAR OLD CHILD DUMMY NECK FLEXION CALIBRATION

ROTATION ABOUT OCCIPITAL CONDYLE

TRC TEST NUMBER: 27C9NF1
H/3 6YR SN27 NECK FLEX CAL9
RUN NUMBER: 041999.1401,1

ANGLE (°)

-60  -30   0    30    60    90    120

-20  0  20  40  60  80  100  120  140  160  180  200

TIME (MS)

CHANNEL: THETA  FILTER: CH. CLASS 60  PEAK DATA: 53.38 ° @ 73.92 MS, -34.61 ° @ 200.00 MS
HYBRID III SIX YEAR OLD CHILD DUMMY NECK FLEXION CALIBRATION
TOTAL ROTATION

TRC TEST NUMBER: 27C9NF1
H/3 6YR SN27 NECK FLEX CAL9
RUN NUMBER: 041999.1401;1

CHANNEL: TOTAN
FILTER: CH. CLASS 60
PEAK DATA: 76.94 ° @ 73.76 MS; -47.38 ° @ 200.00 MS
HYBRID III SIX YEAR OLD CHILD DUMMY NECK FLEXION CALIBRATION

NECK FORCE X AXIS

TRC TEST NUMBER: 27C9NF1
H/3 SYR SN27 NECK FLEX CAL9
RUN NUMBER: 041999.1401;1

FORCE (N x 10^1)

TIME (MS)

CHANNEL: NEKXF
FILTER: CH. CLASS 1000

PEAK DATA: 340.66 N @ 58.40 MS; -89.18 N @ 192.48 MS
HYBRID III SIX YEAR OLD CHILD DUMMY NECK FLEXION CALIBRATION

NECK MOMENT Y AXIS

TRC TEST NUMBER: 27C9NF1
H/3 6YR SN27 NECK FLEX CAL9
RUN NUMBER: 041999.1401;1

TORQUE (N m)

-20 -20 0 20 40 60 80 100 120 140 160 180 200

TIME (MS)

CHANNEL: NEKYM
FILTER: CH. CLASS 600

PEAK DATA: 30.04 N·M @ 48.00 MS, -16.95 N·M @ 15.60 MS
HYBRID III SIX YEAR OLD CHILD DUMMY NECK FLEXION CALIBRATION
TOTAL MOMENT ABOUT OCCIPITAL CONDYLE

TRC TEST NUMBER: 27C9NF1
H/3 6YR Sn27 Neck Flex Cal9
RUN NUMBER: 041999.1401;1

CHANNEL: NEKOM
FILTER: CH. CLASS 600
PEAK DATA: 33.87 N·M @ 48.64 MS; -12.15 N·M @ 15.20 MS
TRANSPORTATION RESEARCH CENTER INC.

HYBRID III SIX YEAR OLD 19-APR-99

NECK EXTENSION TEST

<table>
<thead>
<tr>
<th>TRC INC.</th>
<th>TEST NO: 27C9N1</th>
<th>H/3 6YR.SNO27 NECK EXT.CAL09</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TEST PARAMETER</th>
<th>SPECIFICATION</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURE</td>
<td>20.6 - 22.2 DEG. C</td>
<td>21.1 DEG. C</td>
</tr>
<tr>
<td>RELATIVE HUMIDITY</td>
<td>10 - 70 %</td>
<td>33.0 %</td>
</tr>
<tr>
<td>IMPACT VELOCITY</td>
<td>4.18 - 4.42 M/S</td>
<td>4.30 M/S</td>
</tr>
<tr>
<td>INTEGRATED PENDULUM VELOCITY</td>
<td>10 MS</td>
<td>1.0 - 1.4 M/S</td>
</tr>
<tr>
<td>20 MS</td>
<td>2.2 - 3.0 M/S</td>
<td>2.42 M/S</td>
</tr>
<tr>
<td>30 MS</td>
<td>3.2 - 4.2 M/S</td>
<td>3.52 M/S</td>
</tr>
<tr>
<td>PEAK D-PLANE ROTATION</td>
<td>94 - 106 DEG.</td>
<td>96.45 DEG.</td>
</tr>
<tr>
<td>PEAK MOMENT ABOUT OCCIPITAL CONDUYLE</td>
<td>-19 / -24 NM</td>
<td>-20.05 NM</td>
</tr>
<tr>
<td>NEGATIVE MOMENT DECAY TIME FROM PEAK TO -5 NM</td>
<td>127 - 147 MS</td>
<td>135.12 MS</td>
</tr>
</tbody>
</table>

TEST MEETS SPECIFICATIONS

TECHNICIAN

RUN NUMBER: 041999.1422;1
HYBRID III SIX YEAR OLD CHILD DUMMY NECK EXTENSION CALIBRATION

ROTATION ABOUT BASE OF NECK

TRC TEST NUMBER: 27C9NE1
H/3 6YR SN027 NECK EXT.CAL09
RUN NUMBER: 041999.1422;1

ANGLE (°)

-60 -40 -20 0 20 40 60 80 100 120 140 160 180 200
TIME (MS)

CHANNEL: BETA
FILTER: CH. CLASS 60
PEAK DATA: 25.57 ° @ 87.52 MS; -3.84 ° @ 200.00 MS
HYBRID III SIX YEAR OLD CHILD DUMMY NECK EXTENSION CALIBRATION

ROTATION ABOUT OCCIPITAL CONDYLE

TRC TEST NUMBER: 27C9NE1
H/3 6YR_SN027 NECK EXT_CAL09
RUN NUMBER: 041999.1422,1

ANGLE (°)

-60 -30 0 30 60 90 120

TIME (MS)

-20 0 20 40 60 80 100 120 140 160 180 200

CHANNEL: THETA  FILTER: CH. CLASS 60  PEAK DATA: 70.91 ° @ 91.20 MS, -8.54 ° @ 200.00 MS
HYBRID III SIX YEAR OLD CHILD DUMMY NECK EXTENSION CALIBRATION

TOTAL ROTATION

TRC TEST NUMBER: 27C9NE1  H/3 6YR SN027 NECK EXT CAL09  RUN NUMBER: 041999 1422,1

ANGLE (°)  

0  -30  -60  0  30  60  90  120  180  200

TIME (MS)  

-20  0  20  40  60  80  100  120  140  160  180  200

CHANNEL: TOTAN  FILTER: CH. CLASS 60  PEAK DATA: 96.46 ° @ 90.64 MS; -12.38 ° @ 200.00 MS
HYBRID III SIX YEAR OLD CHILD DUMMY NECK EXTENSION CALIBRATION
NECK MOMENT Y AXIS

TRC TEST NUMBER: 27C9NE1
H/3 6YR SN027 NECK EXT.CAL09
RUN NUMBER: 041999.1422.1

TORQUE (N.M)

-100
-80
-60
-40
-20
0
20

TIME (MS)

0 20 40 60 80 100 120 140 160 180 200

CHANNEL: NEKYM
FILTER: CH. CLASS 600
PEAK DATA: 10.01 N.M @ 16.00 MS; -16.69 N.M @ 90.24 MS
HYBRID III SIX YEAR OLD CHILD DUMMY NECK EXTENSION CALIBRATION
TOTAL MOMENT ABOUT OCCIPITAL CONDYLE

TRC TEST NUMBER: 27C9NE1
H/3 6YR SN027 NECK EXT.CAL09
RUN NUMBER: 041999.1422.1

TORQUE (N·M)

CHANNEL: NEKOM
FILTER: CH. CLASS 600

TIME (MS)

PEAK DATA: 7.48 N·M @ 14.96 MS, -20.05 N·M @ 90.24 MS
TRANSPORTATION RESEARCH CENTER INC.

THORAX IMPACT TEST

HYBRID III SIX YEAR OLD 16-APR-99

TRC INC. TEST NO: 27C9TH1 H/3 6YR. SNO27 H.S.TORAX CAL9

<table>
<thead>
<tr>
<th>TEST PARAMETER</th>
<th>HIGH SPEED TEST SPECIFICATION</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURE</td>
<td>20.6-22.2 DEG. C</td>
<td>21.1 DEG. C</td>
</tr>
<tr>
<td>RELATIVE HUMIDITY</td>
<td>10 - 70 %</td>
<td>33.0 %</td>
</tr>
<tr>
<td>PENDULUM VELOCITY</td>
<td>6.59 - 6.83 M/S</td>
<td>6.72 M/S</td>
</tr>
<tr>
<td>MAXIMUM DEFLECTION</td>
<td>38 - 44 MM</td>
<td>34.3 MM</td>
</tr>
<tr>
<td>MAXIMUM RESISTIVE FORCE</td>
<td>1150 - 1300 N</td>
<td>1503 N</td>
</tr>
<tr>
<td>INTERNAL HYSTERESIS</td>
<td>69% - 85%</td>
<td>80.8%</td>
</tr>
</tbody>
</table>

* TEST DOES NOT MEET SPECIFICATIONS

TECHNICIAN By [Signature] RUN NUMBER: 041699.1318;1
HYBRID III SIX YEAR OLD CHILD DUMMY THORAX CALIBRATION
PENDULUM DECELERATION

TRC TEST NUMBER: 27C9TH1  H/3 BJR. SN027 H.S.THRAX CAL9  RUN NUMBER: 041999 1352,2

ACCELERATION (G)

-15 -10 0 10 20 30 40 50 60 70 80 90 100
TIME (MS)

CHANNEL: PENXC  FILTER: CH. CLASS 180  PEAK DATA: 53.66 G @ 7.36 MS, -0.78 G @ -0.64 MS
HYBRID III SIX YEAR OLD CHILD DUMMY THORAX CALIBRATION
PENDULUM FORCE

TRC TEST NUMBER: 27C9TH1
H/3 6YR. SN027 H'S THORAX CAL9
RUN NUMBER: 041999.1352,2

FORCE (N x 101)

TIME (MS)

CHANNEL: PENXF FILTER: CH. CLASS 180

PEAK DATA: 1503.89 N @ 7.36 MS, -21.91 N @ -0.64 MS
HYBRID III SIX YEAR OLD CHILD DUMMY THORAX CALIBRATION
STERNUM DISPLACEMENT

TRC TEST NUMBER: 27C9TH1      H/3 6YR  SN027  H S THORAX CAL9
RUN NUMBER: 041999.1352,2

CHANNEL: CSTXD   FILTER: CH. CLASS 180
PEAK DATA: 34.34 MM @ 12.56 MS; -0.00 MM @ 0.48 MS
TRANSPORTATION RESEARCH CENTER INC.

RIGHT KNEE IMPACT TEST

HYBRID III SIX YEAR OLD 19-APR-99

TRC INC. TEST NO: 27C9RK1 H/3 6YR.SN27 RIGHT KNEE CAL9

<table>
<thead>
<tr>
<th>TEST PARAMETER</th>
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<th>TEST RESULTS</th>
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<td>21.1 DEG. C</td>
</tr>
<tr>
<td>RELATIVE HUMIDITY</td>
<td>10 - 70 %</td>
<td>33.0 %</td>
</tr>
<tr>
<td>PROBE VELOCITY</td>
<td>2.07 - 2.13 M/S</td>
<td>2.10 M/S</td>
</tr>
<tr>
<td>PEAK KNEE IMPACT FORCE</td>
<td>1800 - 2800 N</td>
<td>2642.1 N</td>
</tr>
<tr>
<td>0.82 KG PENDULUM</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TEST MEETS SPECIFICATIONS

TECHNICIAN Kevin Watkins

RUN NUMBER: 041999.1456;1
HYBRID III SIX YEAR OLD CHILD DUMMY RIGHT KNEE CALIBRATION
PENDULUM FORCE

TRC TEST NUMBER: 27C9RK1
H/3 6YR SN27 RIGHT KNEE CAL9
RUN NUMBER: 041999.1457.1

FORCE (N X 10^1)

-10 -20 0 20 40 60 80 100 120 140 160 180 200
TIME (MS X 10^{-1})

CHANNEL: PENXF  FILTER: CH. CLASS 600
PEAK DATA: 2642.17 N @ 1.20 MS; -49.18 N @ 4.00 MS
TRANSPORTATION RESEARCH CENTER INC.

LEFT KNEE IMPACT TEST

HYBRID III SIX YEAR OLD

19-APR-99

TRC INC. TEST NO: 27C9LK1 H/3 6YR. SN027 LEFT KNEE CAL09

<table>
<thead>
<tr>
<th>TEST PARAMETER</th>
<th>SPECIFICATION</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURE</td>
<td>18.9-25.6 DEG. C</td>
<td>21.1 DEG. C</td>
</tr>
<tr>
<td>RELATIVE HUMIDITY</td>
<td>10 - 70 %</td>
<td>33.0 %</td>
</tr>
<tr>
<td>PROBE VELOCITY</td>
<td>2.07 - 2.13 M/S</td>
<td>2.10 M/S</td>
</tr>
<tr>
<td>PEAK KNEE IMPACT FORCE</td>
<td>1800 - 2800 N</td>
<td>2635.9 N</td>
</tr>
</tbody>
</table>

TEST MEETS SPECIFICATIONS

TECHNICIAN

RUN NUMBER: 041999.1450;1
HYBRID III SIX YEAR OLD CHILD DUMMY LEFT KNEE CALIBRATION

PENDULUM FORCE

TRA TEST NUMBER: 27C9LK1  H/3 6YR. SN027 LEFT KNEE CAL09  RUN NUMBER: 041999.1450.1

FORCE (IN x 10^1)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>275</td>
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<tr>
<td>227</td>
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</tr>
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<td>180</td>
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<tr>
<td>85</td>
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<td>37</td>
<td></td>
</tr>
</tbody>
</table>

TIME (MS x 10^-1)

-20 -0  20  40  60  80  100  120  140  160  180  200

CHANNEL: PENXF  FILTER: CH. CLASS 600  PEAK DATA: 2635.96 N @ 1.28 MS, -50.29 N @ 4.08 MS
Pre-Test Dummy Certification

Hybrid III 6 Year Old Dummy S/N 88
<table>
<thead>
<tr>
<th>TEST PARAMETER</th>
<th>SPECIFICATION</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURE</td>
<td>18.9-25.6 DEG. C</td>
<td>21.1 DEG. C</td>
</tr>
<tr>
<td>RELATIVE HUMIDITY</td>
<td>10 - 70 %</td>
<td>33.0 %</td>
</tr>
<tr>
<td>PEAK RESULTANT ACCELERATION</td>
<td>245 - 300 G</td>
<td>295.21 G</td>
</tr>
<tr>
<td>PEAK LATERAL ACCELERATION</td>
<td>15 G MAX</td>
<td>-4.57 G</td>
</tr>
<tr>
<td>IS ACCELERATION CURVE</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>UNIMODAL?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TEST MEETS SPECIFICATIONS

TECHNICIAN: [Signature]

RUN NUMBER: 041699.1429;1
HYBRID III SIX YEAR OLD CHILD DUMMY HEAD CALIBRATION
HEAD ACCELERATION X AXIS

TRC TEST NUMBER: 88C2HD1
H/3 BYR.SN88 HEAD DROP CAL2
RUN NUMBER: 041699.1430;1

ACCELERATION (G)

-375 -300 -225 -150 -75 0 75

TIME (MS X 10^-1)

-10 0 10 20 30 40 50 60 70 80 90 100

CHANNEL: HEDXG FILTER: CH. CLASS 1000
PEAK DATA: 0.98 G @ 7.04 MS; -262.64 G @ 2.24 MS
HYBRID III SIX YEAR OLD CHILD DUMMY HEAD CALIBRATION
HEAD ACCELERATION Y AXIS

TEST NUMBER: 88C2HD1
H/3 6YR SN88 HEAD DROP CAL2
RUN NUMBER: 041699.1430,1

ACCELERATION (G)

0 75 150 225

-75 -150 -225

TIME (MS x 10^{-1})

0 10 20 30 40 50 60 70 80 90 100

CHANNEL: HEDYG FILTER: CH. CLASS 1000

PEAK DATA: 0.71 G @ 3.28 MS, -4.58 G @ 2.24 MS
HYBRID III SIX YEAR OLD CHILD DUMMY HEAD CALIBRATION
HEAD RESULTANT ACCELERATION
H/3 6YR SN88 HEAD DROP CAL2

TRC TEST NUMBER: 88C2HD1
RUN NUMBER: 041699.1430;1

ACCELERATION (G)

CHANNEL: HEDRC
FILTER: CH. CLASS 1000

TIME (MS X 10^-1)

PEAK DATA: 295.22 G @ 2.24 MS; 0.12 G @ -0.88 MS
# Neck Flexion Test

**TRC INC.** | **TEST NO:** 88C2NF1 | **H/3 6YR.SN30 NECK FLEX.CAL2**

<table>
<thead>
<tr>
<th>TEST PARAMETER</th>
<th>SPECIFICATION</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TEMPERATURE</strong></td>
<td>20.6-22.2 <strong>DEG. C</strong></td>
<td>21.1 <strong>DEG. C</strong></td>
</tr>
<tr>
<td><strong>RELATIVE HUMIDITY</strong></td>
<td>10 - 70 <strong>%</strong></td>
<td>33.0 <strong>%</strong></td>
</tr>
<tr>
<td><strong>IMPACT VELOCITY</strong></td>
<td>4.83 - 5.07 <strong>M/S</strong></td>
<td>5.01 <strong>M/S</strong></td>
</tr>
<tr>
<td><strong>INTEGRATED PENDULUM VELOCITY</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 <strong>MS</strong></td>
<td>1.2 - 1.6 <strong>M/S</strong></td>
<td>1.55 <strong>M/S</strong></td>
</tr>
<tr>
<td>20 <strong>MS</strong></td>
<td>2.4 - 3.4 <strong>M/S</strong></td>
<td>3.02 <strong>M/S</strong></td>
</tr>
<tr>
<td>30 <strong>MS</strong></td>
<td>3.8 - 5.0 <strong>M/S</strong></td>
<td>4.37 <strong>M/S</strong></td>
</tr>
<tr>
<td><strong>PEAK D-PLANE ROTATION</strong></td>
<td>74 - 92 <strong>DEG.</strong></td>
<td>76.98 <strong>DEG.</strong></td>
</tr>
<tr>
<td><strong>PEAK MOMENT ABOUT OCCIPITAL CONDYLE</strong></td>
<td>27 - 33 <strong>NM</strong></td>
<td>32.06 <strong>NM</strong></td>
</tr>
<tr>
<td><strong>POSITIVE MOMENT DECAY TIME FROM PEAK TO ZERO</strong></td>
<td>103 - 123 <strong>MS</strong></td>
<td>106.24 <strong>MS</strong></td>
</tr>
</tbody>
</table>

**TEST MEETS SPECIFICATIONS**

**TECHNICIAN**

**RUN NUMBER:** 042099.0838;1
HYBRID III SIX YEAR OLD CHILD DUMMY NECK FLEXION CALIBRATION

INTEGRATED PENDULUM VELOCITY

TRC TEST NUMBER: 88C2NF1

H/3 BYR. SN30 NECK FLEX CAL2

RUN NUMBER: 042099.0839.1

VELOCITY (M/S X 10^-1)

-30 -20 0 20 40 60 80 100 120 140 160 180 200

0 30 60 90 120 150

TIME (MS)

CHANNEL: PENXVI  FILTER: CH. CLASS 100

PEAK DATA: 5.00 M/S @ 200.00 MS; -0.01 M/S @ -20.00 MS
HYBRID III SIX YEAR OLD CHILD DUMMY NECK FLEXION CALIBRATION

ROTATION ABOUT BASE OF NECK

H/3 6YR SN30 NECK FLEX CAL2

TRC TEST NUMBER: 88C2NF1

RUN NUMBER: 042099 0839,1

ANGLE (°)

0 30 60 90 120

-30 -60

0 20 40 60 80 100 120 140 160 180 200

TIME (MS)

CHANNEL: BETA
FILTER: CH. CLASS 60

PEAK DATA: 21.20 ° @ 68.40 MS, -12.30 ° @ 200.00 MS
HYBRID III SIX YEAR OLD CHILD DUMMY NECK FLEXION CALIBRATION

ROTATION ABOUT OCCIPITAL CONDYLE

H/3 6YR.SN38 NECK FLEX CAL2

TRC TEST NUMBER: 08C2NF1

RUN NUMBER: 042099.0839.1

ANGLE (°)

0

-30

-60

-20

0

20

40

60

80

100

120

140

160

180

200

TIME (MS)

CHANNEL: THETA
FILTER: CH. CLASS 60

PEAK DATA: 55.82 ° @ 71.12 MS, -34.88 ° @ 200.00 MS
HYBRID III SIX YEAR OLD CHILD DUMMY NECK FLEXION CALIBRATION

NECK FORCE X AXIS

TRC TEST NUMBER: 88C2NF1
H/3 6YR SN30 NECK FLEX CAL2
RUN NUMBER: 042099 0839,1

FORCE (N x 10^1)

-20 -10 0 10 20 30 40 50 60 70 80 90 100

TIME (MS)

-20 0 20 40 60 80 100 120 140 160 180 200

CHANNEL: NEKXF
FILTER: CH. CLASS 1000

PEAK DATA: 344.62 N @ 56.72 MS, -93.52 N @ 184.48 MS
HYBRID III SIX YEAR OLD CHILD DUMMY NECK FLEXION CALIBRATION
NECK MOMENT Y AXIS

TRC TEST NUMBER: 88C2NF1
H/3 6YR SN30 NECK FLEX CAL2
RUN NUMBER: 042099.0839;1

TORQUE (N.m)

-20 0 20 40 60 80 100

CHANNEL: NEKYM
FILTER: CH. CLASS 600

TIME (MS)

0 20 40 60 80 100 120 140 160 180 200

PEAK DATA: 28.84 N.m @ 50.40 MS; -16.44 N.m @ 15.28 MS
HYBRID III SIX YEAR OLD CHILD DUMMY NECK FLEXION CALIBRATION
TOTAL MOMENT ABOUT OCCIPITAL CONDYLE

TRC TEST NUMBER: 88C2NF1
H/3 6YR SN30 NECK FLEX CAL2
RUN NUMBER: 042099.0039.1

CHANNEL: NEKOM  FILTER: CH. CLASS 600

PEAK DATA: 33.53 N.M @ 50.64 MS; -11.59 N.M @ 14.56 MS
TRANSPORTATION RESEARCH CENTER INC.

HYBRID III SIX YEAR OLD

NECK EXTENSION TEST

TRC INC. TEST NO: 88C2NE3 H/3 6YR.SN088 NECK EXT.CAL02

<table>
<thead>
<tr>
<th>TEST PARAMETER</th>
<th>SPECIFICATION</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURE</td>
<td>20.6 - 22.2 DEG. C</td>
<td>21.1 DEG. C</td>
</tr>
<tr>
<td>RELATIVE HUMIDITY</td>
<td>10 - 70 %</td>
<td>33.0 %</td>
</tr>
<tr>
<td>IMPACT VELOCITY</td>
<td>4.18 - 4.42 M/S</td>
<td>4.40 M/S</td>
</tr>
<tr>
<td>INTEGRATED PENDULUM VELOCITY</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 MS</td>
<td>1.0 - 1.4 M/S</td>
<td>1.16 M/S</td>
</tr>
<tr>
<td>20 MS</td>
<td>2.2 - 3.0 M/S</td>
<td>2.28 M/S</td>
</tr>
<tr>
<td>30 MS</td>
<td>3.2 - 4.2 M/S</td>
<td>3.41 M/S</td>
</tr>
<tr>
<td>PEAK D-PLANE ROTATION</td>
<td>94 - 106 DEG.</td>
<td>94.24 DEG.</td>
</tr>
<tr>
<td>PEAK MOMENT ABOUT OCCIPITAL CONDYLE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-19 / -24 NM</td>
<td>-21.83 NM</td>
<td></td>
</tr>
<tr>
<td>NEGATIVE MOMENT DECAY TIME FROM PEAK TO -5 NM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>127 - 147 MS</td>
<td>130.72 MS</td>
<td></td>
</tr>
</tbody>
</table>

TEST MEETS SPECIFICATIONS

TECHNICIAN

RUN NUMBER: 042099.1023;2
HYBRID III SIX YEAR OLD CHILD DUMMY NECK EXTENSION CALIBRATION
PENDULUM DECELERATION

TRC TEST NUMBER: 88C2NE3
H/3 6YR SN088 NECK EXT. CAL02
RUN NUMBER: 042099.1023.2

ACCELERATION (G X 10^-1)

CHANNEL: PENXG
FILTER: CH. CLASS 180
PEAK DATA: 15.14 G @ 1.92 MS, -2.41 G @ 49.36 MS
HYBRID III SIX YEAR OLD CHILD DUMMY NECK EXTENSION CALIBRATION
INTEGRATED PENDULUM VELOCITY

TRC TEST NUMBER: 08C2NE3
H/3 6YR SN088 NECK EXT CAL02
RUN NUMBER: 042099.1023.2

VELLOCITY (M/S X 10^-1)

-30 -20 0 20 40 60 80 100 120 140 160 180 200

CHANNEL: PENXVI  FILTER: CH. CLASS 100
PEAK DATA: 4.00 M/S @ 200.00 MS; 0.00 M/S @ -0.56 MS
HYBRID III SIX YEAR OLD CHILD DUMMY NECK EXTENSION CALIBRATION

ROTATION ABOUT BASE OF NECK

TRC TEST NUMBER: 88C2NE3
H/3 6YR. SN088 NECK EXT. CAL 02
RUN NUMBER: 042099.1023,2

ANGLE (°)

-60 -30 0 30 60 90 120

TIME (MS)

-20 0 20 40 60 80 100 120 140 160 180 200

CHANNEL: BETA  FILTER: CH. CLASS 60

PEAK DATA: 24.15 ° @ 87.44 MS; -5.10 ° @ 200.00 MS
HYBRID III SIX YEAR OLD CHILD DUMMY NECK EXTENSION CALIBRATION
ROTATION ABOUT OCCIPITAL CONDYLE

TRC TEST NUMBER: 88C2NE3
H/3 6YR SN088 NECK EXT. CAL02
RUN NUMBER: 042099.1023;2

CHANNEL: THETA  FILTER: CH. CLASS 60
PEAK DATA: 70.15 ° @ 92.24 MS; -15.18 ° @ 200.00 MS
HYBRID III SIX YEAR OLD CHILD DUMMY NECK EXTENSION CALIBRATION

TOTAL ROTATION

UNIT TEST NUMBER: 88C2NE3  H/3 6YR SN088 NECK EXT CAL02  RUN NUMBER: 042099.1023.2

CHANNEL: TOTAN  FILTER: CH. CLASS 60

PEAK DATA: 94.24 ° @ 91.44 MS, -20.28 ° @ 200.00 MS
HYBRID III SIX YEAR OLD CHILD DUMMY NECK EXTENSION CALIBRATION

NECK FORCE X AXIS

TRC TEST NUMBER: 88C2NE3  H/3 6YR SN088 NECK EXT CAL02  RUN NUMBER: 042099.1023,2

FORCE (N x 10^1)

CHANNEL: NEKXF  FILTER: CH. CLASS 1000

PEAK DATA: 86.82 N @ 200.00 MS; -214.40 N @ 84.88 MS
HYBRID III SIX YEAR OLD CHILD DUMMY NECK EXTENSION CALIBRATION

NECK MOMENT Y AXIS

TRC TEST NUMBER: 08C2NE3
H/3 6YR.SN088 NECK EXT CAL02
RUN NUMBER: 042099.1023,2

TORQUE (N.M)

CHANNEL: NEKYM
FILTER: CH. CLASS 600

PEAK DATA: 10.53 N.M @ 12.96 MS, -18.23 N.M @ 89.44 MS
TRANSPORTATION RESEARCH CENTER INC.

THORAX IMPACT TEST

HYBRID III SIX YEAR OLD 16-APR-99

TRC INC. TEST NO: 88C2TH2 H/3 6YR. SN088 H.S.TORAX CAL2

<table>
<thead>
<tr>
<th>TEST PARAMETER</th>
<th>HIGH SPEED TEST SPECIFICATION</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURE</td>
<td>20.6-22.2 DEG. C</td>
<td>21.1 DEG. C</td>
</tr>
<tr>
<td>RELATIVE HUMIDITY</td>
<td>10 - 70 %</td>
<td>33.0 %</td>
</tr>
<tr>
<td>PENDULUM VELOCITY</td>
<td>6.59 - 6.83 M/S</td>
<td>6.72 M/S</td>
</tr>
<tr>
<td>MAXIMUM DEFLECTION</td>
<td>38.1 - 45.7 MM</td>
<td>36.6 MM</td>
</tr>
<tr>
<td>MAXIMUM RESISTIVE FORCE</td>
<td>1510 - 1690 N</td>
<td>1387. N</td>
</tr>
<tr>
<td>INTERNAL HYSTERESIS</td>
<td>69% - 85%</td>
<td>78.0%</td>
</tr>
</tbody>
</table>

* TEST DOES NOT MEET SPECIFICATIONS

TECHNICIAN

RUN NUMBER: 041699.1243;1
HYBRID III SIX YEAR OLD CHILD DUMMY THORAX CALIBRATION
PENDULUM DECELERATION

TRC TEST NUMBER: 88C2TH2  H/3 6YR  SN088 H.S.TORAX CAL2  RUN NUMBER: 041699.1243.1

CHANNEL: PENXG  FILTER: CH. CLASS 100  PEAK DATA: 49.50 G @ 8.40 MS; -0.81 G @ 80.80 MS
HYBRID III SIX YEAR OLD CHILD DUMMY THORAX CALIBRATION
PENDULUM FORCE

TRC TEST NUMBER: 88C2TH2
H/3 6YR SN088 H S THORAX CAL2
RUN NUMBER: 041699 1243;1

FORCE (N x 10^1)

-50
-10
0
10
20
30
40
50
TIME (MS)

CHANNEL: PENXF
FILTER: CH. CLASS 180
PEAK DATA: 1387.14 N @ 8.40 MS, -22.69 N @ 80.80 MS
HYBRID III SIX YEAR OLD CHILD DUMMY THORAX CALIBRATION
CHEST DISPLACEMENT VS PENDULUM FORCE

TRACE TEST NUMBER: 88C2TH2  H/3 6YR  SN088 H S THORAX CAL2  RUN NUMBER: 041699 1243;1

FORCE (N X 10^1)

DISPLACEMENT (MM X 10^-1)

CHANNEL: CSTMX  FILTER: CH. CLASS 100
PENXF  CH. CLASS 100

PEAK DATA: 36.65 MM @ 14.08 MS; -0.08 MM @ 0.64 MS
1387.14 N @ 8.40 MS; -22.69 N @ 80.80 MS
TRANSPORTATION RESEARCH CENTER INC.

RIGHT KNEE IMPACT TEST

HYBRID III SIX YEAR OLD  19-APR-99

TRC INC.   TEST NO: 88C2RK1   H/3 6YR.SN88 RIGHT KNEE CAL2

<table>
<thead>
<tr>
<th>TEST PARAMETER</th>
<th>SPECIFICATION</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURE</td>
<td>18.9-25.6 DEG. C</td>
<td>21.1 DEG. C</td>
</tr>
<tr>
<td>RELATIVE HUMIDITY</td>
<td>10 - 70 %</td>
<td>33.0 %</td>
</tr>
<tr>
<td>PROBE VELOCITY</td>
<td>2.07 - 2.13 M/S</td>
<td>2.11 M/S</td>
</tr>
<tr>
<td>PEAK KNEE IMPACT FORCE</td>
<td>1800 - 2800 N</td>
<td>2644.4 N</td>
</tr>
</tbody>
</table>

TEST MEETS SPECIFICATIONS

TECHNICIAN: [Signature]  RUN NUMBER: 041999.1442;1
<table>
<thead>
<tr>
<th>TEST PARAMETER</th>
<th>SPECIFICATION</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURE</td>
<td>18.9-25.6 DEG. C</td>
<td>21.1 DEG. C</td>
</tr>
<tr>
<td>RELATIVE HUMIDITY</td>
<td>10 - 70 %</td>
<td>33.0 %</td>
</tr>
<tr>
<td>PROBE VELOCITY</td>
<td>2.07 - 2.13 M/S</td>
<td>2.10 M/S</td>
</tr>
<tr>
<td>PEAK KNEE IMPACT FORCE</td>
<td>1800 - 2800 N</td>
<td>2619.6 N</td>
</tr>
</tbody>
</table>

TEST MEETS SPECIFICATIONS

TECHNICIAN: [Signature]

RUN NUMBER: 041999.1437;1
HYBRID III SIX YEAR OLD CHILD DUMMY LEFT KNEE CALIBRATION
PENDULUM DECELERATION

TRC TEST NUMBER: 88C2LK1  H/3 6YR SN088 LEFT KNEE CAL02  RUN NUMBER: 041999.1437,1

ACCELERATION (G)

350
290
230
170
110
50
-10
-20 0 20 40 60 80 100 120 140 160 180 200

TIME (MS X 10^-1)

CHANNEL: PENXG  FILTER: CH. CLASS 600

PEAK DATA: 327.20 G @ 1.20 MS, -5.66 G @ 4.08 MS
HYBRID III SIX YEAR OLD CHILD DUMMY LEFT KNEE CALIBRATION
PENDULUM FORCE

TRC TEST NUMBER: 88C2LK1  H/3 6YR  SN088 LEFT KNEE CAL02  RUN NUMBER: 041999.1437.1

FORCE (N x 10^1)

-20 0 20 40 60 80 100 120 140 160 180 200

TIME (MS x 10^-1)

-10 37 85 132 180 227 275

CHANNEL: PENXF  FILTER: CH. CLASS 600  PEAK DATA: 2619.68 N @ 1.20 MS, -45.33 N @ 4.08 MS
Pre-Test Dummy Certification

Hybrid III $5^{th}$ Female Dummy S/N 289
<table>
<thead>
<tr>
<th>TEST PARAMETER</th>
<th>SPECIFICATION</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURE</td>
<td>18.9-25.6 DEG. C</td>
<td>21.1 DEG. C</td>
</tr>
<tr>
<td>RELATIVE HUMIDITY</td>
<td>10 - 70 %</td>
<td>22.0 %</td>
</tr>
<tr>
<td>PEAK RESULTANT ACCELERATION</td>
<td>250 - 300 G</td>
<td>269.78 G</td>
</tr>
<tr>
<td>PEAK LATERAL ACCELERATION</td>
<td>15 G MAX</td>
<td>1.36 G</td>
</tr>
<tr>
<td>IS ACCELERATION CURVE</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>UNIMODAL?</td>
<td>YES</td>
<td></td>
</tr>
</tbody>
</table>

TEST MEETS SPECIFICATIONS

TECHNICIAN

RUN NUMBER: 040899.1119;1
SMALL FEMALE HYBRID III HEAD CALIBRATION
HEAD ACCELERATION X AXIS

TRA TEST NUMBER: 289C5HD1  S. FEMALE SN289 HEAD DROP CALS  RUN NUMBER: 040899.1119.1

CHANNEL: HEDXG  FILTER: CH CLASS 1000  PEAK DATA: 3.72 G @ 7.36 MS; -233.52 G @ 2.64 MS
SMALL FEMALE HYBRID III HEAD CALIBRATION
CHECK PLOT - HEAD RESULTANT ACCELERATION

TRC TEST NUMBER: 289C5HD1
S.FEMALE SN289 HEAD DROP CAL5
RUN NUMBER: 040899.1119,1

ACCELERATION (G)

-60 0 15 30 45 60 75 90 105 120 135 150
TIME (MS)

CHANNEL: HEDRG  FILTER: CH. CLASS 1000
PEAK DATA: 269.78 G @ 2.64 MS; 0.01 G @ -14.88 MS
### Neck Flexion Test - 6 Channel Transducer

**Test No:** 289C5NF1  
**S. Female SN289 Neck Flex. Cal5**

<table>
<thead>
<tr>
<th>Test Parameter</th>
<th>Specification</th>
<th>Test Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURE</td>
<td>20.6-22.2 DEG. C</td>
<td>21.1 DEG. C</td>
</tr>
<tr>
<td>RELATIVE HUMIDITY</td>
<td>10 - 70 %</td>
<td>22.0 %</td>
</tr>
<tr>
<td>IMPACT VELOCITY</td>
<td>6.89 - 7.13 M/S</td>
<td>7.06 M/S</td>
</tr>
<tr>
<td>INTEGRATED PENDULUM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VELOCITY</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 MS</td>
<td>2.1 - 2.5 M/S</td>
<td>2.37 M/S</td>
</tr>
<tr>
<td>20 MS</td>
<td>4.0 - 5.0 M/S</td>
<td>4.66 M/S</td>
</tr>
<tr>
<td>30 MS</td>
<td>5.8 - 7.0 M/S</td>
<td>6.49 M/S</td>
</tr>
<tr>
<td>PEAK D-PLANE ROTATION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PEAK MOMENT DURING ROTATION INTERVAL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>80 - 92 DEG.</td>
<td>83.38 DEG.</td>
<td></td>
</tr>
<tr>
<td>69 - 83 NM</td>
<td>71.68 NM</td>
<td></td>
</tr>
<tr>
<td>80 -100 MS</td>
<td>88.00 MS</td>
<td></td>
</tr>
</tbody>
</table>

**Test Meets Specifications**

**Technician**

**Run Number:** 040899.13072
SMALL FEMALE HYBRID III NECK FLEXION CALIBRATION

ROTATION ABOUT BASE OF NECK

TRC TEST NUMBER: 289C5NF1
S.FEMALE SN289 NECK FLEX. CAL5
RUN NUMBER: 040899.1308.2

ANGLE (°) vs. TIME (MS)

CHANNEL: BETA
FILTER: CH. CLASS 60
PEAK DATA: 36.30 ° @ 57.84 MS; -24.57 ° @ 196.16 MS
SMALL FEMALE HYBRID III NECK FLEXION CALIBRATION

TOTAL ROTATION

TRC TEST NUMBER: 289C5NF1  S.FEMALE SN289 NECK FLEX. CALS  RUN NUMBER: 040899.1308.2

ANGLE (°)

-60  -30   0   30   60   90  120

TIME (MS)

-20   0   20   40   60   80  100  120  140  160  180  200

CHANNEL: TOTAN  FILTER: CH. CLASS 60  PEAK DATA: 83.39 ° @ 64.32 MS, -64.24 ° @ 196.24 MS
SMALL FEMALE HYBRID III NECK FLEXION CALIBRATION

NECK FORCE X AXIS

TRC TEST NUMBER: 289C5NF1
S.FEMALE SN289 NECK FLEX. CAL5
RUN NUMBER: 040899 1308;2

FORCE (N X 10^1)

TIME (MS)

CHANNEL: NEKXF
FILTER: CH. CLASS 60
PEAK DATA: 733.54 N @ 56.64 MS, -150.05 N @ 190.08 MS
SMALL FEMALE HYBRID III NECK FLEXION CALIBRATION

NECK MOMENT Y AXIS

TRC TEST NUMBER: 289C5NF1
S.FEMALE SN289 NECK FLEX CALS
RUN NUMBER: 040899.1308,2

TORQUE (N-m)

-80 -40 0 40 80 120 160

TIME (MS)

-20 0 20 40 60 80 100 120 140 160 180 200

CHANNEL: NEKYM
FILTER: CH. CLASS 60

PEAK DATA: 63.57 N-m @ 60.24 MS; -32.39 N-m @ 13.52 MS
<table>
<thead>
<tr>
<th>TEST PARAMETER</th>
<th>SPECIFICATION</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURE</td>
<td>20.6 - 22.2 DEG. C</td>
<td>21.1 DEG. C</td>
</tr>
<tr>
<td>RELATIVE HUMIDITY</td>
<td>10 - 70 %</td>
<td>22.0 %</td>
</tr>
<tr>
<td>IMPACT VELOCITY</td>
<td>5.95 - 6.19 M/S</td>
<td>6.05 M/S</td>
</tr>
<tr>
<td>INTEGRATED PENDULUM</td>
<td>10 MS</td>
<td>1.5 - 1.9 M/S</td>
</tr>
<tr>
<td>VELOCITY</td>
<td>20 MS</td>
<td>3.1 - 3.9 M/S</td>
</tr>
<tr>
<td></td>
<td>30 MS</td>
<td>4.6 - 5.6 M/S</td>
</tr>
<tr>
<td>PEAK D-PLANE ROTATION</td>
<td>97 - 109 DEG.</td>
<td>105.65 DEG.</td>
</tr>
<tr>
<td>PEAK MOMENT DURING</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ROTATION INTERVAL</td>
<td>- 55 - 69 NM</td>
<td>-55.77 NM</td>
</tr>
<tr>
<td>NEGATIVE MOMENT DECAY TIME</td>
<td>94 - 114 MS</td>
<td>98.08 MS</td>
</tr>
</tbody>
</table>

TEST MEETS SPECIFICATIONS

TECHNICIAN [Signature]  RUN NUMBER: 040899.1443;1
SMALL FEMALE NECK EXTENSION CALIBRATION
PENDULUM DECELERATION

TRC TEST NUMBER: 289C5NE2
S. FEMALE SN289 NECK EXT. CALS
RUN NUMBER: 040899.1443;1

ACCELERATION
(G x 10^-1)

CHANNEL: PENXG  FILTER: CH. CLASS 60

PEAK DATA: 20.48 G @ 8.64 MS, -2.38 G @ 44.48 MS

TIME (MS)

-20  0  20  40  60  80  100  120  140  160  180  200
SMALL FEMALE NECK EXTENSION CALIBRATION
ROTATION ABOUT OCCIPITAL CONDYLE

TRC TEST NUMBER: 289C5NE2 S.FEMALE SN289 NECK EXT. CAL5 RUN NUMBER: 040899.1443.1

CHANNEL: THETA FILTER: CH. CLASS 60

ANGLE (°)  TIME (MS)
-60  -20  0  20  40  60  80  100  120  140  160  180  200
-60  -30  -30
-80  -60  -40  -20  0  20  40  60  80  100  120  140  160  180  200

PEAK DATA: 68.86 ° @ 74.88 MS, -21.95 ° @ 200.00 MS
CHANNEL: TOTAN
FILTER: CH. CLASS 60

PEAK DATA: 105.66 ° @ 73.52 MS; -38.51 ° @ 200.00 MS
SMALL FEMALE NECK EXTENSION CALIBRATION
NECK FORCE X AXIS

TRC TEST NUMBER: 289C5NE2
S.FEMALE SN289 NECK EXT. CAL5
RUN NUMBER: 040899.1443;1

FORCE (N X 101)

TIME (MS)

0 20 40 60 80 100 120 140 160 180 200

-160 -120 -80 -40 0 40 80

CHANNEL: NEKXF  FILTER: CH. CLASS 60

PEAK DATA: 162.30 N @ 192.08 MS; -508.43 N @ 65.44 MS
SMALL FEMALE NECK EXTENSION CALIBRATION
NECK MOMENT Y AXIS

TRC TEST NUMBER: 289C5NE2  S.FEMALE SN289 NECK EXT. CAL5  RUN NUMBER: 040899.1443;1

CHANNEL: NEKYM  FILTER: CH. CLASS 60

PEAK DATA: 20.48 N·M @ 11.84 MS; -55.78 N·M @ 70.00 MS
SMALL FEMALE NECK EXTENSION CALIBRATION
TOTAL MOMENT ABOUT OCCIPITAL CONDYLE
S. FEMALE SN289 NECK EXT. CAL5

TORQUE (N.M)

CHANNEL: NEKOM     FILTER: CH. CLASS 60

TIME (MS)

PEAK DATA: 21.24 N·M @ 195.20 MS; -64.05 N·M @ 69.84 MS
<table>
<thead>
<tr>
<th>TEST PARAMETER</th>
<th>HIGH SPEED TEST</th>
<th>SPECIFICATION</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURE</td>
<td>20.6-22.2 DEG. C</td>
<td>22.2 DEG. C</td>
<td></td>
</tr>
<tr>
<td>RELATIVE HUMIDITY</td>
<td>10 - 70 %</td>
<td>22.0 %</td>
<td></td>
</tr>
<tr>
<td>PENDULUM VELOCITY</td>
<td>6.59 - 6.83 M/S</td>
<td>6.65 M/S</td>
<td></td>
</tr>
<tr>
<td>MAXIMUM DEFLECTION</td>
<td>48 - 55 MM</td>
<td>51.7 MM</td>
<td></td>
</tr>
<tr>
<td>WITHIN DEFLECTION CORRIDOR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAXIMUM RESISTIVE FORCE</td>
<td>3900 - 4400 N</td>
<td>4361. N</td>
<td></td>
</tr>
<tr>
<td>INTERNAL HYSTERESIS</td>
<td>69% - 85%</td>
<td>75.3%</td>
<td></td>
</tr>
</tbody>
</table>

TEST MEETS SPECIFICATIONS

TECHNICIAN

RUN NUMBER: 040899.1640;4
SMALL FEMALE THORAX CALIBRATION
PENDULUM DECELERATION

TRC TEST NUMBER: 289CSTH1
S.FEMALE SN289 THORAX CAL05
RUN NUMBER: 040999.0005;4

ACCELERATION (G)

CHANNEL: PENXG    FILTER: CH. CLASS 100    PEAK DATA: 31.78 G @ 16.40 MS, -0.01 G @ 82.00 MS

TIME (MS)
SMALL FEMALE THORAX CALIBRATION
STERNUM DISPLACEMENT

S. FEMALE SN289 THORAX CAL05
RUN NUMBER: 040999.0005.4

DISPLACEMENT (MM)

CHANNEL: CSTXD  FILTER: CH. CLASS 180
PEAK DATA: 51.70 MM @ 20.32 MS, -0.01 MM @ -2.56 MS
SMALL FEMALE THORAX CALIBRATION
CHEST DISPLACEMENT VS PENDULUM FORCE
S. FEMALE SN289 THORAX CAL05
RUN NUMBER: 040999.0805,4

FORCE (N x 10^2)

DISPLACEMENT (MM)

CHANNEL: C8TXD  FILTER: CH. CLASS 180  PEAK DATA: 51.70 MM @ 20.32 MS, -0.01 MM @ -2.56 MS
PENXF  CH. CLASS 180  4361.41 N @ 16.40 MS, -1.46 N @ 82.00 MS
TRANSPORTATION RESEARCH CENTER INC.
RIGHT KNEE IMPACT TEST
HYBRID III SMALL FEMALE 08-APR-99

TRC INC. TEST NO: 289C5RK1 S.FEMALE SN289 R.KNEE CAL5

<table>
<thead>
<tr>
<th>TEST PARAMETER</th>
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<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURE</td>
<td>18.9-25.6 DEG. C</td>
<td>21.1 DEG. C</td>
</tr>
<tr>
<td>RELATIVE HUMIDITY</td>
<td>10 - 70 %</td>
<td>22.0 %</td>
</tr>
<tr>
<td>PROBE VELOCITY</td>
<td>2.07 - 2.13 M/S</td>
<td>2.13 M/S</td>
</tr>
<tr>
<td>PEAK KNEE IMPACT FORCE</td>
<td>3360 - 4080 N</td>
<td>4040.0 N</td>
</tr>
</tbody>
</table>

TEST MEETS SPECIFICATIONS

TECHNICIAN__________________________ RUN NUMBER: 040899.1037;2
SMALL FEMALE HYBRID III RIGHT KNEE CALIBRATION
PENDULUM DECELERATION (5 KG PEND.)

TRC TEST NUMBER: 289C5RK1
S.FEMALE SN289 R KNEE CALS
RUN NUMBER: 040899.1038,2

ACCELERATION (G) vs TIME (MS X 10^-1)

Channel: PENXG  Filter: CH. CLASS 600  Peak Data: 137.62 G @ 2.48 MS, -0.88 G @ 16.88 MS
SMALL FEMALE HYBRID III RIGHT KNEE CALIBRATION
PENDULUM FORCE (5 KG PEND.)

TRC TEST NUMBER: 289C5RK1
S. FEMALE SN289 R. KNEE CAL5

RUN NUMBER: 040899.1038,2

FORCE (N X 10^2)

-15 -10 -5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75

0 20 40 60 80 100 120 140 160 180 200

TIME (MS X 10^-1)

CHANNEL: PENXF
FILTER: CH. CLASS 600
PEAK DATA: 4040.02 N @ 2.48 MS, -25.79 N @ 16.88 MS
<table>
<thead>
<tr>
<th>TEST PARAMETER</th>
<th>SPECIFICATION</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURE</td>
<td>18.9 - 25.6 DEG. C</td>
<td>21.1 DEG. C</td>
</tr>
<tr>
<td>RELATIVE HUMIDITY</td>
<td>10 - 70 %</td>
<td>22.0 %</td>
</tr>
<tr>
<td>PROBE VELOCITY</td>
<td>2.07 - 2.13 M/S</td>
<td>2.13 M/S</td>
</tr>
<tr>
<td>PEAK KNEE IMPACT FORCE</td>
<td>3360 - 4080 N</td>
<td>3897.8 N</td>
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</tbody>
</table>

TEST MEETS SPECIFICATIONS

TECHNICIAN ___________________________  RUN NUMBER: 040899.1038;2
SMALL FEMALE HYBRID III LEFT KNEE CALIBRATION
PENDULUM DECELERATION (5 KG PEND.)

TRC TEST NUMBER: 289C5LK1
S.FEMALE SN289 LEFT KNEE CAL5
RUN NUMBER: 040899.1038.2

ACCELERATION (G)

CHANNEL: PENXC
FILTER: CH. CLASS 600
PEAK DATA: 132.78 G @ 2.16 MS; -0.61 G @ 17.44 MS

TIME (MS X 10^-1)
SMALL FEMALE HYBRID III LEFT KNEE CALIBRATION
PENDULUM FORCE (5 KG PEND.)

EXECUTION NUMBER: 289C5LK1
9.FEMALE SN289 LEFT KNEE CAL5
RUN NUMBER: 040899.1038;2

FORCE (N X 10^5)

TIME (MS X 10^-1)

CHANNEL: PENXF
FILTER: CH. CLASS 600
PEAK DATA: 3897.89 N @ 2.16 MS, -17.87 N @ 17.44 MS
Pre-Test Dummy Certification

Hybrid III 5th Female Dummy S/N 329
<table>
<thead>
<tr>
<th>Test Parameter</th>
<th>Specification</th>
<th>Test Results</th>
</tr>
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<tbody>
<tr>
<td>Temperature</td>
<td>18.9-25.6 DEG. C</td>
<td>21.1 DEG. C</td>
</tr>
<tr>
<td>Relative Humidity</td>
<td>10 - 70 %</td>
<td>33.0 %</td>
</tr>
<tr>
<td>Peak Resultant Acceleration</td>
<td>250 - 300 G</td>
<td>276.74 G</td>
</tr>
<tr>
<td>Peak Lateral Acceleration</td>
<td>15 G MAX</td>
<td>-4.44 G</td>
</tr>
<tr>
<td>IS ACCELERATION CURVE</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

TEST MEETS SPECIFICATIONS

TECHNICIAN

RUN NUMBER: 041999.1039;1
SMALL FEMALE HYBRID III HEAD CALIBRATION
HEAD ACCELERATION X AXIS

TRC TEST NUMBER: 329C2HD1
S FEMALE SN329 HEAD DROP CAL2
RUN NUMBER: 041999.1040.1

CHANNEL: HEDXG    FILTER: CH. CLASS 1000
PEAK DATA: 3.28 G @ 6.00 MS, -240.81 G @ 2.16 MS
SMALL FEMALE HYBRID III HEAD CALIBRATION
HEAD ACCELERATION Y AXIS

CHANNEL: HEDYG
FILTER: CH. CLASS 1000

PEAK DATA: 2.02 G @ 5.20 MS; -4.44 G @ 2.00 MS
SMALL FEMALE HYBRID III HEAD CALIBRATION
HEAD ACCELERATION Z AXIS

TRC TEST NUMBER: 329C2HD1
S FEMALE SN329 HEAD DROP CAL2
RUN NUMBER: 041999 104041

ACCELERATION (G)

-375 -300 -225 -150 -75 0 75

TIME (MS X 10^-1)
-10 0 10 20 30 40 50 60 70 80 90 100

CHANNEL: HEDZC
FILTER: CH. CLASS 1000
PEAK DATA: 1.92 G @ 7.76 MS, -136.33 G @ 2.16 MS
TRANSPORTATION RESEARCH CENTER INC.

HYBRID III SMALL FEMALE 20-APR-99

NECK FLEXION TEST - 6 CHANNEL TRANSDUCER

<table>
<thead>
<tr>
<th>TEST PARAMETER</th>
<th>SPECIFICATION</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURE</td>
<td>20.6-22.2 DEG. C</td>
<td>21.1 DEG. C</td>
</tr>
<tr>
<td>RELATIVE HUMIDITY</td>
<td>10 - 70 %</td>
<td>33.0 %</td>
</tr>
<tr>
<td>IMPACT VELOCITY</td>
<td>6.89 - 7.13 M/S</td>
<td>7.06 M/S</td>
</tr>
<tr>
<td>INTEGRATED PENDULUM</td>
<td>10 MS</td>
<td>2.1 - 2.5 M/S</td>
</tr>
<tr>
<td>VELOCITY</td>
<td>20 MS</td>
<td>4.0 - 5.0 M/S</td>
</tr>
<tr>
<td></td>
<td>30 MS</td>
<td>5.8 - 7.0 M/S</td>
</tr>
<tr>
<td>PEAK D-PLANE ROTATION</td>
<td>80 - 92 DEG.</td>
<td>81.34 DEG.</td>
</tr>
<tr>
<td>PEAK MOMENT ABOUT OCCIPITAL CONDYLE</td>
<td>69 - 83 NM</td>
<td>70.72 NM</td>
</tr>
<tr>
<td>POSITIVE MOMENT DECAY TIME FROM PEAK TO 10 NM</td>
<td>80 - 100 MS</td>
<td>85.84 MS</td>
</tr>
</tbody>
</table>

TEST MEETS SPECIFICATIONS

TECHNICIAN

RUN NUMBER: 042099.1123;1
SMALL FEMALE HYBRID III NECK FLEXION CALIBRATION

ROTATION ABOUT OCCIPITAL CONDYLE

TRC TEST NUMBER: 329C2NF1
S.FEMALE SN329 NECK FLEX. CAL2
RUN NUMBER: 042099.1123;1

ANGLE (°)

CHANNEL: THETA  FILTER: CH. CLASS 60
PEAK DATA: 47.83 ° @ 60.88 MS, -36.60 ° @ 194.16 MS
SMALL FEMALE HYBRID III NECK FLEXION CALIBRATION

TOTAL ROTATION

TRC TEST NUMBER: 329C2NF1
S.FEMALE SN329 NECK FLEX. CAL2
RUN NUMBER: 042099 1123,1

ANGLE (°)

-60 -30 0 30 60

-20 0 20 40 60 80 100 120 140 160 180 200

TIME (MS)

CHANNEL: TOTAN
FILTER: CH. CLASS 60

PEAK DATA: 81.35 ° @ 60.48 MS, -50.24 ° @ 193.28 MS
SMALL FEMALE HYBRID III NECK FLEXION CALIBRATION
TOTAL MOMENT ABOUT OCCIPITAL CONDYLE

TRC TEST NUMBER: 329C2NF1
S.FEMALE SN329 NECK FLEX. CAL2
RUN NUMBER: 042099.1123.1

TORQUE (N·M)
-80
-40
0
40
80
120
160

TIME (MS)
-20
0
20
40
60
80
100
120
140
160
180
200

CHANNEL: NEKOM
FILTER: CH. CLASS 60
PEAK DATA: 75.07 N·M @ 50.72 MS, -23.73 N·M @ 13.36 MS
<table>
<thead>
<tr>
<th>TEST PARAMETER</th>
<th>SPECIFICATION</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURE</td>
<td>20.6 - 22.2 DEG. C</td>
<td>21.1 DEG. C</td>
</tr>
<tr>
<td>RELATIVE HUMIDITY</td>
<td>10 - 70 %</td>
<td>33.0 %</td>
</tr>
<tr>
<td>IMPACT VELOCITY</td>
<td>5.95 - 6.19 M/S</td>
<td>6.00 M/S</td>
</tr>
<tr>
<td>INTEGRATED PENDULUM</td>
<td>10 MS</td>
<td>1.5 - 1.9 M/S</td>
</tr>
<tr>
<td>VELOCITY</td>
<td>20 MS</td>
<td>3.1 - 3.9 M/S</td>
</tr>
<tr>
<td></td>
<td>30 MS</td>
<td>4.6 - 5.6 M/S</td>
</tr>
<tr>
<td>PEAK D-PLANE ROTATION</td>
<td></td>
<td>97 - 109 DEG.</td>
</tr>
<tr>
<td>PEAK MOMENT ABOUT OCCIPITAL CONDYLE</td>
<td>-55 - -69 NM</td>
<td>-55.13 NM</td>
</tr>
<tr>
<td>NEGATIVE MOMENT DECAY TIME TO -10 NM LEVEL</td>
<td>94 - 114 MS</td>
<td>105.28 MS</td>
</tr>
</tbody>
</table>

TEST MEETS SPECIFICATIONS

TECHNICIAN [Signature]  
RUN NUMBER: 042099.1355;16
SMALL FEMALE NECK EXTENSION CALIBRATION
PENDULUM DECELERATION

TRC TEST NUMBER: 329C2NE3
S.FEMALE SN329 NECK EXT. CAL2
RUN NUMBER: 042099 1358,16

ACCELERATION (G x 10^-1)

-80 -60 -40 -20 0 20 40 60 80 100 120 140 160 180 200
TIME (MS)

CHANNEL: PENXG
FILTER: CH. CLASS 60

PEAK DATA: 18.76 G @ 8.96 MS; -1.87 G @ 48.72 MS
SMALL FEMALE NECK EXTENSION CALIBRATION

ROTATION ABOUT BASE OF NECK

S. FEMALE SN329 NECK EXT. CAL2

RUN NUMBER: 042099.1358.16

CHANNEL: BETA
FILTER: CH. CLASS 60

PEAK DATA: 38.82 ° @ 78.40 MS, -13.43 ° @ 200.00 MS
SMALL FEMALE NECK EXTENSION CALIBRATION

ROTATION ABOUT OCCIPITAL CONDYLE

TRC TEST NUMBER: 329C2NE3
S. FEMALE SN329 NECK EXT CAL2
RUN NUMBER: 042899.1358.16

ANGLE (°)

-60
-30
0
30
60
90
120

-20 0 20 40 60 80 100 120 140 160 180 200
TIME (MS)

CHANNEL: THETA
FILTER: CH. CLASS 60

PEAK DATA: 69.61 ° @ 80.72 MS, -20.08 ° @ 200.00 MS
SMALL FEMALE NECK EXTENSION CALIBRATION
TOTAL ROTATION

TRC TEST NUMBER: 329C2NE3
S.FEMALE SN329 NECK EXT CAL2
RUN NUMBER: 042099.1358,16

CHANNEL: TOTAN
FILTER: CH. CLASS 60

PEAK DATA: 108.39 ° @ 79.92 MS; -33.51 ° @ 200.00 MS
SMALL FEMALE NECK EXTENSION CALIBRATION
TOTAL MOMENT ABOUT OCCIPITAL CONDYLE

TRC TEST NUMBER: J29C2NE3
S.FEMALE SN329 NECK EXT. CAL2
RUN NUMBER: 042099.1358;16

CHANNEL: NEKOM FILTER: CH. CLASS 60
PEAK DATA: 20.74 N.M @ 200.00 MS, -55.13 N.M @ 75.28 MS
TRANSPORTATION RESEARCH CENTER INC.

THORAX IMPACT TEST

HYBRID III SMALL FEMALE

20-APR-99

TRC INC. TEST NO: 329C2TH2 S.FEMALE SN329 THORAX CAL2

<table>
<thead>
<tr>
<th>TEST PARAMETER</th>
<th>HIGH SPEED TEST</th>
<th>TEST RESULTS</th>
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<tbody>
<tr>
<td>TEMPERATURE</td>
<td>20.6-22.2 DEG. C</td>
<td>21.1 DEG. C</td>
</tr>
<tr>
<td>RELATIVE HUMIDITY</td>
<td>10 - 70 %</td>
<td>33.0 %</td>
</tr>
<tr>
<td>PENDULUM VELOCITY</td>
<td>6.59 - 6.83 M/S</td>
<td>6.59 M/S</td>
</tr>
<tr>
<td>MAXIMUM DEFLECTION</td>
<td>48 - 55 MM</td>
<td>54.6 MM</td>
</tr>
<tr>
<td>MAXIMUM RESISTIVE FORCE</td>
<td>3900 - 4400 N</td>
<td>4118. N</td>
</tr>
<tr>
<td>INTERNAL HYSTERESIS</td>
<td>69% - 85%</td>
<td>71.6%</td>
</tr>
</tbody>
</table>

TEST MEETS SPECIFICATIONS

RUN NUMBER: 042099.1547;5
SMALL FEMALE THORAX CALIBRATION
PENDULUM DECELERATION

TRC TEST NUMBER: 329C2TH2
S. FEMALE SN329 THORAX CAL2
RUN NUMBER: 042099.1549.5

ACCELERATION (G):

50
40
30
20
10
0
-10

TIME (MS):
-10
0
10
20
30
40
50
60
70
80
90
100

CHANNEL: PENXG
FILTER: CH. CLASS 100
PEAK DATA: 30.01 G @ 17.60 MS; 0.03 G @ 49.20 MS
TRANSPORTATION RESEARCH CENTER INC.

RIGHT KNEE IMPACT TEST

HYBRID III SMALL FEMALE

19-APR-99

TRC INC. TEST NO: 329C2RK1 S.FEMALE SN329 R.KNEE CAL2

<table>
<thead>
<tr>
<th>TEST PARAMETER</th>
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<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURE</td>
<td>18.9-25.6 DEG. C</td>
<td>21.1 DEG. C</td>
</tr>
<tr>
<td>RELATIVE HUMIDITY</td>
<td>10 - 70 %</td>
<td>33.0 %</td>
</tr>
<tr>
<td>PROBE VELOCITY</td>
<td>2.07 - 2.13 M/S</td>
<td>2.13 M/S</td>
</tr>
<tr>
<td>PEAK KNEE IMPACT FORCE 3.0 KG PENDULUM</td>
<td>3360 - 4080 N</td>
<td>3899.2 N</td>
</tr>
</tbody>
</table>

TEST MEETS SPECIFICATIONS

TECHNICIAN

RUN NUMBER: 041999.1551;1
SMALL FEMALE HYBRID III RIGHT KNEE CALIBRATION
PENDULUM DECELERATION (5 KG PEND.)

TRC TEST NUMBER: 329C2RK1
S.FEMALE SN329 R.KNEE CAL2
RUN NUMBER: 041999.1551,1

ACCELERATION (G)

-30 -20 0 20 40 60 80 100 120 140 160 180 200
TIME (MS x 10^-1)

CHANNEL: PENVXG
FILTER: CH. CLASS 600
PEAK DATA: 132.82 G @ 2.40 MS, -1.16 G @ 16.40 MS
SMALL FEMALE HYBRID III RIGHT KNEE CALIBRATION
PENDULUM FORCE (5 KG PEND.)

TRC TEST NUMBER: 329C2RK1
S.FEMALE SN329 R.KNEE CAL2
RUN NUMBER: 041999 1551,1

FORCE (N x 10^2)

-15 -10 -5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75

TIME (MS x 10^-1)

0 20 40 60 80 100 120 140 160 180 200

CHANNEL: PENXF  FILTER: CH. CLASS 600
PEAK DATA: 3899.27 N @ 2.40 MS, -33.99 N @ 16.40 MS
TRANSPORTATION RESEARCH CENTER INC.

LEFT KNEE IMPACT TEST

HYBRID III SMALL FEMALE 19-APR-99

TRC INC. TEST NO: 329C2LK1 S.FEMALE SN329 LEFT KNEE CAL2

<table>
<thead>
<tr>
<th>TEST PARAMETER</th>
<th>SPECIFICATION</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURE</td>
<td>18.9-25.6 DEG. C</td>
<td>21.1 DEG. C</td>
</tr>
<tr>
<td>RELATIVE HUMIDITY</td>
<td>10 - 70 %</td>
<td>33.0 %</td>
</tr>
<tr>
<td>PROBE VELOCITY</td>
<td>2.07 - 2.13 M/S</td>
<td>2.13 M/S</td>
</tr>
<tr>
<td>PEAK KNEE IMPACT FORCE 3.0 KG PENDULUM</td>
<td>3360 - 4080 N</td>
<td>4089.2 N *</td>
</tr>
</tbody>
</table>

TEST DOES NOT MEET SPECIFICATIONS

TECHNICIAN [Signature] RUN NUMBER: 041999.1548;1
SMALL FEMALE HYBRID III LEFT KNEE CALIBRATION
PENDULUM DECELERATION (5 KG PEND.)

TRC TEST NUMBER: 329C2LK1  S.FEMALE SN329 LEFT KNEE CAL2  RUN NUMBER: 041999.1548;1

ACCELERATION (G)

0 30 60 90 120 150

-30

-20 0 20 40 60 80 100 120 140 160 180 200

TIME (MS x 10^-1)

CHANNEL: PENXG  FILTER: CH. CLASS 600

PEAK DATA: 139.30 G @ 2.40 MS; -1.26 G @ 15.92 MS
SMALL FEMALE HYBRID III LEFT KNEE CALIBRATION
PENDULUM FORCE (5 KG PEND.)

TRC TEST NUMBER: 329C2LK1
S.FEMALE SN329 LEFT KNEE CAL2
RUN NUMBER: 041999.1548.1

FORCE (N x 102)

TIME (MS x 10^-1)

CHANNEL: PENXF
FILTER: CH. CLASS 600
PEAK DATA: 4009.26 N @ 2.40 MS; -36.93 N @ 15.92 MS
Pre-Test Dummy Certification

Hybrid III 50th Male Dummy S/N 90
TRANSPORTATION RESEARCH CENTER INC.

HEAD DROP TEST

HYBRID III 50th 16-APR-99

TRC INC. TEST NO: 90C25HD1 572E SN 90 HEAD DROP CAL 25

<table>
<thead>
<tr>
<th>TEST PARAMETER</th>
<th>SPECIFICATION</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURE</td>
<td>18.9-25.6 DEG. C</td>
<td>21.1 DEG. C</td>
</tr>
<tr>
<td>RELATIVE HUMIDITY</td>
<td>10 - 70 %</td>
<td>33.0 %</td>
</tr>
<tr>
<td>PEAK RESULTANT ACCELERATION</td>
<td>225 - 275 G</td>
<td>253.48 G</td>
</tr>
<tr>
<td>PEAK LATERAL ACCELERATION</td>
<td>15 G MAX</td>
<td>2.54 G</td>
</tr>
<tr>
<td>IS ACCELERATION CURVE UNIMODAL?</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>

TEST MEETS SPECIFICATIONS

TECHNICIAN

RUN NUMBER: 041599.1042;1
PART 572-E HYBRID III HEAD CALIBRATION
HEAD ACCELERATION X AXIS

TRC TEST NUMBER: 90C25H01
572E SN 90 HEAD DROP CAL 25
RUN NUMBER: 041599.1043.1

CHANNEL: HEDXC  FILTER: CH. CLASS 1000

TIME (MS X 10^-1) PEAK DATA: 0.74 G @ 10.00 MS, -223.99 G @ 1.84 MS
PART 572-E HYBRID III HEAD CALIBRATION
HEAD RESULTANT ACCELERATION

TRC TEST NUMBER: 90C25HD1
572E SN 90 HEAD DROP CAL 25
RUN NUMBER: 041599.1043.1

ACCELERATION (G)

TIME (MS x 10^-1)

CHANNEL: HEDRC
FILTER: CH. CLASS 1000
PEAK DATA: 253.48 G @ 1.84 MS, 0.05 G @ -0.00 MS
## NECK FLEXION TEST - 6 CHANNEL TRANSDUCER

**TRC INC.** | **TEST NO:** 90C25NF2 | **572E SN 90** | **NECK FLEXION CAL25**
---|---|---|---
### TEST PARAMETER | SPECIFICATION | TEST RESULTS |
---|---|---|
TEMPERATURE | 20.6–22.2 DEG. C | 21.1 DEG. C |
RELATIVE HUMIDITY | 10 – 70 % | 33.0 % |
IMPACT VELOCITY | 6.89 – 7.13 M/S | 6.99 M/S |
PENDULUM | | |
| 10 MS | 22.50 – 27.50 G | 23.86 G |
DECELERATION | | |
| 20 MS | 17.60 – 22.60 G | 20.43 G |
| 30 MS | 12.50 – 18.50 G | 17.34 G |
MAX PENDULUM G | | |
| | 29 G MAX | 24.59 G |
MAX PENDULUM G ABOVE 30 MS | | |
| | 29 G MAX | 17.31 G |
DECELERATION-TIME CURVE | | |
DECAY TIME TO 5 G | | |
| | 34 – 42 MS | 37.92 MS |
---|---|---|
D PLANE | MAX | 64 – 78 DEG. | 74.53 DEG. |
ROTATION | TIME | 57 – 64 MS | 61.60 MS |
MOMENT ABOUT OCCIPITAL | MAX | 88.2 – 108.5 NM | 92.44 NM |
CONDYLE | TIME | 47 – 58 MS | 51.76 MS |
---|---|---|
ROTATION ANGLE-TIME CURVE | | |
DECAY TIME TO ZERO | 113 – 128 MS | 120.64 MS |
POSITIVE MOMENT-TIME CURVE | | |
DECAY TIME TO ZERO | 97 – 107 MS | 104.64 MS |
---|---|---|
**TEST MEETS SPECIFICATIONS**

**TECHNICIAN** [Signature]  
**RUN NUMBER:** 041599.1235;1
PART 572-E HYBRID III NECK FLEXION CALIBRATION
PENDULUM DECELERATION

TRC TEST NUMBER: 90C25NF2
572E SN 90 NECK FLEXION CAL25
RUN NUMBER: 041599 1236;1

ACCELERATION (G x 10^-1)

-80 -60 -40 -20 0 20 40 60 80 100 120 140 160 180 200

TIME (MS)

CHANNEL: PENXG
FILTER: CH. CLASS 60

PEAK DATA: 24.59 G @ 8.48 MS, -3.13 G @ 43.84 MS
PART 572-E HYBRID III NECK FLEXION CALIBRATION

ROTATION ABOUT OCCIPITAL CONDYLE

TRC TEST NUMBER: 90C25NF1
572E SN 90 NECK FLEXION CAL25
RUN NUMBER: 041599.1236.1

ANGLE (°)

-60 -30 0 30 60 90 120

CHANNEL: THETA
FILTER: CH. CLASS 60
PEAK DATA: 43.89 ° @ 62.00 MS, -33.60 ° @ 183.84 MS

TIME (MS)

-20 0 20 40 60 80 100 120 140 160 180 200
PART 572-E HYBRID III NECK FLEXION CALIBRATION

NECK FORCE X AXIS

TRC TEST NUMBER: 90C25NF2  572E SN 90 NECK FLEXION CAL25  RUN NUMBER: 041599 1236,1

FORCE (N \times 10^1)

\[\begin{array}{c|c|c}
\hline
0 & 40 & 80 \\
\hline
-20 & 0 & 20 \ \\
\hline
\end{array}\]

TIME (MS)

\[\begin{array}{c|c|c|c|c|c|c|c|c|c}
0 & 20 & 40 & 60 & 80 & 100 & 120 & 140 & 160 & 180 & 200 \\
\end{array}\]

CHANNEL: NEKXF  FILTER: CH. CLASS 60  PEAK DATA: 956.24 N @ 57.36 MS; -195.65 N @ 170.56 MS
PART 572-E HYBRID III NECK FLEXION CALIBRATION
TOTAL MOMENT ABOUT OCCIPITAL CONDYLE

TRC TEST NUMBER: 90C25NF2
572E SN 90 NECK FLEXION CAL25
RUN NUMBER: 041599.1236;1

TORQUE (N·M)

-80 -40 0 40 80 120 160

TIME (MS)

-20 0 20 40 60 80 100 120 140 160 180 200

CHANNEL: NEKOM
FILTER: CH. CLASS 60

PEAK DATA: 92.44 N·M @ 51.76 MS; -24.53 N·M @ 14.64 MS
# Neck Extension Test - 6 Channel Transducer

**TRC INC.**  | **TEST NO: 90C25NE1**  | **572E SN 90 NECK EXT. CAL25**

<table>
<thead>
<tr>
<th><strong>TEST PARAMETER</strong></th>
<th><strong>SPECIFICATION</strong></th>
<th><strong>TEST RESULTS</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TEMPERATURE</strong></td>
<td>20.6 - 22.2 DEG. C</td>
<td>21.1 DEG. C</td>
</tr>
<tr>
<td><strong>RELATIVE HUMIDITY</strong></td>
<td>10 - 70 %</td>
<td>33.0 %</td>
</tr>
<tr>
<td><strong>IMPACT VELOCITY</strong></td>
<td>5.95 - 6.19 M/S</td>
<td>6.05 M/S</td>
</tr>
<tr>
<td><strong>PENDULUM</strong></td>
<td>10 MS</td>
<td>17.20 - 21.20 G</td>
</tr>
<tr>
<td><strong>DECELERATION</strong></td>
<td>20 MS</td>
<td>14.00 - 19.00 G</td>
</tr>
<tr>
<td></td>
<td>30 MS</td>
<td>11.00 - 16.00 G</td>
</tr>
<tr>
<td><strong>MAX PENDULUM G</strong></td>
<td></td>
<td>22 G MAX</td>
</tr>
<tr>
<td><strong>MAX PENDULUM G ABOVE 30 MS</strong></td>
<td></td>
<td>22 G MAX</td>
</tr>
<tr>
<td><strong>DECELERATION-TIME CURVE</strong></td>
<td></td>
<td><strong>DECAY TIME TO 5 G</strong></td>
</tr>
</tbody>
</table>

| **D PLANE** | **MAX** | 81 - 106 DEG. | 100.80 DEG. |
| **ROTATION** | **TIME** | 72 - 82 MS | 78.00 MS |
| **MOMENT ABOUT OCCIPITAL** | **MIN** | -80.0/-52.9 NM | -69.23 NM |
| **CONDYLE** | **TIME** | 65 - 79 MS | 73.68 MS |
| **ROTATION ANGLE-TIME CURVE** | **DECAY TIME TO ZERO** | 147 - 174 MS | 162.88 MS |
| **NEGATIVE MOMENT-TIME CURVE** | **DECAY TIME TO ZERO** | 120 - 148 MS | 142.00 MS |

**TEST MEETS SPECIFICATIONS**

TECHNICIAN [Signature]

RUN NUMBER: 041599.1307;1
PART 572-E HYBRID III NECK EXTENSION CALIBRATION

ROTATION ABOUT OCCIPITAL CONDYLE

TRC TEST NUMBER: 90C25NE1
572E SN 90 NECK EXT. CAL25
RUN NUMBER: 041599.1308;1

ANGLE (°)

-60 -30 0 30 60 90 120

TIME (MS)

-20 0 20 40 60 80 100 120 140 160 180 200

CHANNEL: THETA
FILTER: CH. CLASS 60

PEAK DATA: 63.71 ° @ 78.88 MS, -20.76 ° @ 200.00 MS
PART 572-E HYBRID III NECK EXTENSION CALIBRATION

TOTAL ROTATION

TRC TEST NUMBER: 90C25NE1
572E SN 90 NECK EXT. CAL25
RUN NUMBER: 041599.13081

ANGLE (°)

CHANNEL: TOTAN  FILTER: CH. CLASS 60
PEAK DATA: 100.81 ° @ 79.00 MS; -33.18 ° @ 200.00 MS
PART 572-E HYBRID III NECK EXTENSION CALIBRATION
TOTAL MOMENT ABOUT OCCIPITAL CONDYLE

TRC TEST NUMBER: 90C25NE1
572E SN 90 NECK EXT. CAL25
RUN NUMBER: 041599.1308.1

CHANNEL: NECOM
FILTER: CH. CLASS 60

PEAK DATA: 30.84 N M @ 187.92 MS, -69.23 N M @ 73.68 MS
### TRANSPORTATION RESEARCH CENTER INC.

**THORAX IMPACT TEST**  
**HYBRID III 50th**  
16-APR-99

<table>
<thead>
<tr>
<th>TEST PARAMETER</th>
<th>HIGH SPEED TEST SPECIFICATION</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURE</td>
<td>20.6-22.2 DEG. C</td>
<td>21.1 DEG. C</td>
</tr>
<tr>
<td>RELATIVE HUMIDITY</td>
<td>10 - 70 %</td>
<td>33.0 %</td>
</tr>
<tr>
<td>PENDULUM VELOCITY</td>
<td>6.59 - 6.83 M/S</td>
<td>6.68 M/S</td>
</tr>
<tr>
<td>MAXIMUM DEFLECTION</td>
<td>63.5 - 72.6 MM</td>
<td>69.6 MM</td>
</tr>
<tr>
<td>MAXIMUM RESISTIVE FORCE</td>
<td>5159 - 5894 N</td>
<td>5542. N</td>
</tr>
<tr>
<td>INTERNAL HYSTERESIS</td>
<td>69% - 85%</td>
<td>73.1%</td>
</tr>
</tbody>
</table>

**TEST MEETS SPECIFICATIONS**

**TECHNICIAN** Kevin Watkins  
**RUN NUMBER:** 041599.1451;4
PART 572-E HYBRID III THORAX CALIBRATION
PENDULUM DECELERATION

TRC TEST NUMBER: 90C25TH1
572E SN 90 H.S. THORAX CAL25
RUN NUMBER: 041599.1452.4

ACCELERATION (G)

CHANNEL: PENXG
FILTER: CH. CLASS 180

PEAK DATA: 24.19 G @ 19.76 MS; -0.03 G @ -0.72 MS
PART 572-E HYBRID III THORAX CALIBRATION
PENDULUM FORCE

TRC TEST NUMBER: 90C25TH1  572E SN 90 H.S.THRAX CAL25  RUN NUMBER: 041599 1452/4

FORCE (N X 10^2)

-20  0  20  40  60  80  100

TIME (MS)

-10  0  10  20  30  40  50  60  70  80  90  100

CHANNEL: PENXF  FILTER: CH. CLASS 180
PEAK DATA: 5542.64 N @ 19.76 MS; -6.97 N @ -0.72 MS
PART 572-E HYBRID III THORAX CALIBRATION
CHEST DISPLACEMENT VS PENDULUM FORCE

TRC TEST NUMBER: 90C25TH1
572E SN 90 H S THORAX CAL25
RUN NUMBER: 041599.1452.4

CHANNEL: CSTXD
FILTER: CH. CLASS 180
PENXF
CH. CLASS 180

DISPLACEMENT (MM)

FORCE (N X 102)

PEAK DATA: 69.68 MN @ 25.68 MS; -0.82 MN @ 0.48 MS
5542.64 N @ 19.76 MS; -6.97 N @ -0.72 MS
## RIGHT HIP JOINT FEMUR FLEXION TEST

**HYBRID III PART 572E**

**16-APR-99**

| TEST NO: 90C25HR1 | 572E SN 090 HIPFLEX CAL 25 |

<table>
<thead>
<tr>
<th>TEST PARAMETER</th>
<th>SPECIFICATION</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURE</td>
<td>18.9-25.6 DEG. C</td>
<td>21.1 DEG. C</td>
</tr>
<tr>
<td>RELATIVE HUMIDITY</td>
<td>10 - 70 %</td>
<td>33.0 %</td>
</tr>
<tr>
<td>ROTATION RATE</td>
<td>5 - 10 deg/sec</td>
<td>YES</td>
</tr>
<tr>
<td>TORQUE @ 30 deg ROTATION</td>
<td>&lt;= 94.9 Nm</td>
<td>83.0 Nm</td>
</tr>
<tr>
<td>ROTATION @ 203.4 Nm</td>
<td>40 - 50 deg.</td>
<td>42.0 deg.</td>
</tr>
</tbody>
</table>

**TEST MEETS SPECIFICATIONS**

**TECHNICIAN**

**RUN NUMBER: 041599.1116;1**
HYBRID III HIP FLEXION VERIFICATION - 0 DEGREES
RIGHT HIP FLEXION ROTATION

TRC TEST NUMBER: 90C25HRI  572E SN 090 HIPFLEX CAL 25  RUN NUMBER: 041599.1116,1

ANGLE (°)  TIME (s x 10^-2)
-15  -80  0  80  160  240  320  400  480  560  640  720  800
  15  0  30  45  60  75

CHANNEL: RHPXD  FILTER: CH. CLASS 60  PEAK DATA: 42.69 ° @ 5.56 s, -9.67 ° @ -1.00 s
<table>
<thead>
<tr>
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<th>SPECIFICATION</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURE</td>
<td>18.9-25.6 DEG. C</td>
<td>21.1 DEG. C</td>
</tr>
<tr>
<td>RELATIVE HUMIDITY</td>
<td>10 - 70 %</td>
<td>33.0 %</td>
</tr>
<tr>
<td>ROTATION RATE</td>
<td>5 - 10 deg/sec</td>
<td>YES</td>
</tr>
<tr>
<td>TORQUE @ 30 deg ROTATION</td>
<td>&lt;= 94.9 Nm</td>
<td>81.7 Nm</td>
</tr>
<tr>
<td>ROTATION @ 203.4 Nm TORQUE</td>
<td></td>
<td>40 - 50 deg.</td>
</tr>
</tbody>
</table>

TEST MEETS SPECIFICATIONS

TECHNICIAN [Signature]  

RUN NUMBER: 041599.1118;1
<table>
<thead>
<tr>
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<th>SPECIFICATION</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURE</td>
<td>18.9-25.6 DEG. C</td>
<td>21.1 DEG. C</td>
</tr>
<tr>
<td>RELATIVE HUMIDITY</td>
<td>10 - 70 %</td>
<td>33.0 %</td>
</tr>
<tr>
<td>PROBE VELOCITY</td>
<td>2.07 - 2.13 M/S</td>
<td>2.10 M/S</td>
</tr>
<tr>
<td>PEAK KNEE IMPACT FORCE</td>
<td>4715 - 5782 N</td>
<td>5525.8 N</td>
</tr>
</tbody>
</table>

TEST MEETS SPECIFICATIONS

TECHNICIAN [Signature]  
RUN NUMBER: 041599.0859;1
PART 572-E HYBRID III RIGHT KNEE CALIBRATION
PENDULUM DECELERATION (5 KG PEND.)

TRC TEST NUMBER: 90C25R1  572E SN 90 RIGHT KNEE CAL 25  RUN NUMBER: 041599.0859.1

ACCELERATION (G)

-30  0  20  40  60  80  100  120  140  160  180  200

TIME (MS X 10^-1)

CHANNEL: PENG  FILTER: CH. CLASS 600  PEAK DATA: 112.94 G @ 2.56 MS; -1.18 G @ 7.84 MS
## LEFT KNEE IMPACT TEST

**HYBRID III 50th**

16-APR-99

**TRC INC.**

**TEST NO:** 90C25LK2

**572E SN 90 LEFT KNEE CAL 25**

<table>
<thead>
<tr>
<th>TEST PARAMETER</th>
<th>SPECIFICATION</th>
<th>TEST RESULTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEMPERATURE</td>
<td>18.9-25.6 DEG. C</td>
<td>21.1 DEG. C</td>
</tr>
<tr>
<td>RELATIVE HUMIDITY</td>
<td>10 - 70 %</td>
<td>33.0 %</td>
</tr>
<tr>
<td>PROBE VELOCITY</td>
<td>2.07 - 2.13 M/S</td>
<td>2.10 M/S</td>
</tr>
<tr>
<td>PEAK KNEE IMPACT FORCE</td>
<td>4715 - 5782 N</td>
<td>5084.5 N</td>
</tr>
</tbody>
</table>

**5.0 KG PENDULUM**

---

**TEST MEETS SPECIFICATIONS**

**TECHNICIAN**

**RUN NUMBER:** 041599.0923;1
PART 572-E HYBRID III LEFT KNEE CALIBRATION
PENDULUM DECELERATION (5 KG PEND.)

TRC TEST NUMBER: 90C25LK2
572E SN 90 LEFT KNEE CAL 25
RUN NUMBER: 041599.0925,1

ACCELERATION (G)

TIME (MS x 10^-1)

CHANNEL: PENXG
FILTER: CH. CLASS 600
PEAK DATA: 103.92 G @ 2.64 MS, -1.39 G @ 8.08 MS
PART 572-E HYBRID III LEFT KNEE CALIBRATION
PENDULUM FORCE (5 KG PEND.)
TRC TEST NUMBER: 90C25LK2
572E SN 90 LEFT KNEE CAL 25
RUN NUMBER: 041599.0925,1

FORCE (N x 10^2)

CHANNEL: PENXF
FILTER: CH. CLASS 600
PEAK DATA: 5084.57 N @ 2.64 MS, -68.20 N @ 8.08 MS
Appendix D

Miscellaneous Test Information
Dummy Sign Convention

Accelerometers:
- +X: Forward
- +Y: Rightward
- +Z: Upward

Potentiometers:
- +Chest longitudinal deflection: Outward

Load cells:
- +Femur force: Tension

Neck load cells:
- +X force: Head rearward
- +Y force: Head leftward
- +Z force: Head upward (tension on neck)
- +X moment: Left ear rotating toward left shoulder
- +Y moment: Chin rotating toward chest
- +Z moment: Chin rotating toward left shoulder
Filtering Data

J211 MAR95

Load Cell Barrier Forces Class 60
Vehicle Structural Accelerations Class 60

Occupant
Head Accelerometer Class 1000
Neck Class 60
Chest Accelerometer Class 180
Chest Deflection Class 180
Femur Force Class 600
Sternal Accelerometer Class 180
Lower Leg Class 600
## Dummy Instrumentation Placement

**Dummy Manufacturer and S/N:** Humanetics/45  
**Seating position:** Position #1 (50th)

<table>
<thead>
<tr>
<th>Mnemonic</th>
<th>Location</th>
<th>Axis</th>
<th>Manufacturer</th>
<th>Model</th>
<th>Serial Number</th>
<th>Orientation (+ Sensing)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HEDXG1</td>
<td>Head</td>
<td>X</td>
<td>Endevco</td>
<td>7264-2000T</td>
<td>AJ4L1</td>
<td>Rear</td>
</tr>
<tr>
<td>HEDYG1</td>
<td>Head</td>
<td>Y</td>
<td>Endevco</td>
<td>7264-2000T</td>
<td>J23996</td>
<td>Left</td>
</tr>
<tr>
<td>HEDZG1</td>
<td>Head</td>
<td>Z</td>
<td>Endevco</td>
<td>7264-2000T</td>
<td>EJ97J</td>
<td>Up</td>
</tr>
<tr>
<td>NEKXF1</td>
<td>Neck</td>
<td>X</td>
<td>Denton</td>
<td>1716A</td>
<td>851FX</td>
<td>Head forward</td>
</tr>
<tr>
<td>NEKYG1</td>
<td>Neck</td>
<td>Y</td>
<td>Denton</td>
<td>1716A</td>
<td>851FY</td>
<td>Head leftward</td>
</tr>
<tr>
<td>NEKZF1</td>
<td>Neck</td>
<td>Z</td>
<td>Denton</td>
<td>1716A</td>
<td>851FZ</td>
<td>Head upward (tension)</td>
</tr>
<tr>
<td>NEKXM1</td>
<td>Neck</td>
<td>X</td>
<td>Denton</td>
<td>1716A</td>
<td>851MX</td>
<td>Right ear to Right shoulder</td>
</tr>
<tr>
<td>NEKYM1</td>
<td>Neck</td>
<td>Y</td>
<td>Denton</td>
<td>1716A</td>
<td>851MY</td>
<td>Chin to chest</td>
</tr>
<tr>
<td>NEKZM1</td>
<td>Neck</td>
<td>Z</td>
<td>Denton</td>
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**Seating position:** Position #2 (6YO)

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## Dummy Instrumentation Placement, Cont’d.

**Dummy Manufacturer and S/N:** First Technologies/088  
**Seating position:** Position #3 (6YO)

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**Dummy Manufacturer and S/N:** First Technologies/289  
**Seating position:** Position #4 (5th)

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## Dummy Instrumentation Placement, Cont’d.

**Dummy Manufacturer and S/N:** First Technologies/329  
**Seating position:** Position #5 (5th)

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## Dummy Instrumentation Placement, Cont’d.

**Dummy Manufacturer and S/N:** Alderson Research Laboratories/90  
**Seating position:** Position #6 (50th)

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<td>852FY</td>
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<td>Denton</td>
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### Vehicle Instrumentation Placement

**Test Number 990421-1**

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<th>Number</th>
<th>Location</th>
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<th>Manufacturer</th>
<th>Model</th>
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<td>7264-2000T</td>
<td>J22740</td>
<td>Up</td>
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</tbody>
</table>
Accelerometers:  
+X: Forward  
+Y: Leftward  
+Z: Upward  

Potentiometers:  
+ Chest longitudinal deflection: Outward  
+ Chest lateral deflection: Leftward  
+ Seat belt displacement: Outward  
+ Seat belt extension: Elongation  
+ Knee slider displacement: Distance between femur and tibia increased (in relation to a seated dummy)  

Load cells:  
+ Femur force: Tension  
+ Seat belt force: Tension  
+ Barrier force: Tension  

Neck load cells:  
+X force: Head pushed forward  
+Y force: Head pushed leftward  
+Z force: Head pulled upward (tension on neck)  
+X moment: Right ear rotating toward right shoulder  
+Y moment: Chin rotating toward chest  
+Z moment: Chin rotating toward left shoulder  

Tibia load cells:  
+X force: Ankle forward, knee rearward  
+Y force: Ankle rightward, knee leftward  
+Z force: Tension  
+X moment: Bottom of tibia moving leftward  
+Y moment: Bottom of tibia moving rearward
Description Of Timing Marks On TRC High-Speed Film

All TRC high-speed cameras are equipped with red LED's, which put timing, marks on the right edge of the film. TRC uses a single timing generator to generate the timing for all cameras. This allows the timing marks to be common to all cameras. The timing marks can be used to measure camera speed (frames per second) or to locate a point in time before or after the time-zero event.

The timing marks appear on the film as small red marks on the right edge of the film. Round marks are left by the Photo-Sonics and Stalex cameras while horizontal bars are left by the Hycam, Locam, and Fastax II cameras.

The timing generator puts out a pulse for every millisecond plus it generates additional pulses for hundredths and tenths of seconds. To explain this further, we can use an example of a camera running at 1000 frames per second.

1. Every frame will have one LED appear in it. This indicates a millisecond pulse.

2. Every ten frames will have two LEDs appear in it. These indicate a millisecond pulse plus a hundredth of a second pulse.

3. Every one hundred frames will have three LEDs appear in it. These indicate a millisecond pulse, a hundredth of a second pulse, and a tenth of a second pulse.