

Sled Impact Test

NH 1001

New Haven Moving Equipment Corporation

**Frontal Impact of the New Haven 7VA16 Four-Point Wheelchair Tiedown System
with Track Anchorages**

Used to Secure the ISO/SAE Surrogate Wheelchair

Loaded with a Hybrid III Midsize Adult Male ATD

Restrained by a New Haven Lap and Shoulder Belt with Track Anchorages

Tested in accordance with Appendix A of SAE J2249

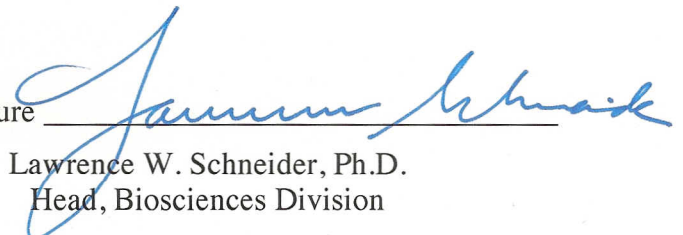
Test Date: February 19, 2010

Submitted to:

New Haven Moving Equipment Corporation
13571 Vaughn Street, Building E
San Fernando, California 91340

The University of Michigan
Transportation Research Institute
2901 Baxter Road
Ann Arbor, Michigan 48109

Authorized Signature _____


Lawrence W. Schneider, Ph.D.
Head, Biosciences Division

ACKNOWLEDGMENT AND DATA USE RESTRICTION

This test was sponsored by New Haven Moving Equipment Corporation of San Fernando, California, and was conducted in accordance with procedures set forth in Appendix A of SAE J2249 *Wheelchair Tiedowns and Occupant Restraint Systems for Use in Motor Vehicles*, hereafter referred to as SAE J2249. The performance of the wheelchair tiedown and occupant restraint system has been measured and evaluated according to the requirements of Section 6.2 of this recommended practice.

Advertisements and marketing literature should refer to the requirements and provisions of SAE J2249, but should not mention the University of Michigan Transportation Research Institute. Requests for copies of this report, test films, and videos should be directed to the test sponsor.

TEST METHODS

This frontal impact test was conducted on the UMTRI impact sled in accordance with Appendix A of SAE J2249. The sled operates on the rebound principle, achieving a desired change in velocity by reversing its direction of motion during the impact event. The sled crash pulse is trapezoidal in shape and is reported as an average deceleration level in *g*. The sled velocity is monitored immediately before and after impact.

Data generated during the test were digitized live using a TDAS onboard data acquisition system. All signals were filtered to the requirements of SAE J-211. The photo documentation consisted of high-speed (1000-frames/sec) digital video from right and right-rear side views of the impact event. A strobe flash and simultaneous voltage pulse record and synchronize the onset of impact deceleration on video and transducer signals.

TEST SETUP

The ISO/SAE surrogate wheelchair (SWC) was secured facing forward using the New Haven 7VA16 four-point strap-type tiedown system with track anchorages. The tiedown consists of four strap-type tiedown assemblies that were hooked to the SWC securement points and attached to the track anchorage strips that were bolted to the sled platform.

The SWC was loaded with a Hybrid III midsize-male anthropomorphic test device (ATD) that was restrained by a New Haven three-point belt, with the lap belt anchored to the same track anchorage strip as the rear tiedowns on both sides of the SWC and connected by a buckle near the left hip of the ATD. The D-ring at the upper fixed shoulder belt anchor point was bolted to a simulated sidewall fixture so that the D-ring was positioned to achieve shoulder belt angles as specified in SAE J2249. The latch plate at the lower end of the shoulder belt was buckled into a buckle receptacle on a length of webbing sewn onto the right half of the lap belt that was positioned near the right hip of the ATD. The lap and shoulder belts were tensioned to remove all slack prior to the test.

The test was conducted using 48-kph (30-mph) and 20-g average impact conditions to determine the frontal-impact response of the New Haven 7VA16 wheelchair tiedown and occupant restraint system with track anchorages, and compliance of the WTORS with Section 6.2 of SAE J2249 when dynamically loaded by the surrogate wheelchair and midsize-male ATD. The part numbers of the various wheelchair tiedown and occupant restraint components are listed in the table below. The table on the following page provides further details about the test equipment and setup geometry.

Part Description	Part Number
Tiedown Mechanisms	NH56178PO28
Left Lap Belt	NH56179HT
Right Lap Belt	NH5826ACUM1
Shoulder Belt	NH5827BR
Rear Track Anchorage Strip	NH34030V-30.11
Front Track Anchorage Strips	NH34030V-6

SUMMARY OF TEST SETUP AND PRE-TEST MEASUREMENTS

<p>GENERAL TEST INFORMATION</p> <p>Test number Test date Wheelchair type Wheelchair tiedown</p> <p>Occupant restraint Anthropomorphic Test Dummy (ATD) Wheelchair orientation Sled platform Desired impact velocity (ΔV) Desired average sled deceleration</p>	<p>NH 1001 February 19, 2010 ISO/SAE surrogate wheelchair New Haven 7VA16 wheelchair arrangement with track anchorages</p> <p>New Haven three-point belt Hybrid III midsize-male @ 77.1 kg (170 lb) Forward facing Rigid steel plate 48 kph (30 mph) 20 g</p>
<p>WHEELCHAIR TIEDOWN</p> <p>Front-to-rear anchor-point distance Rear tiedowns Lateral distance between anchor points Angle wrt horizontal Angle wrt to wheelchair center plane Anchor point to rear-wheel hub Length (anchor point to securement point) Front tiedowns Lateral distance between anchor points Angle wrt horizontal Angle wrt to wheelchair center plane Length (anchor point to securement point)</p>	<p>1270 mm (50.0 in)</p> <p>432 mm (17.0 in) 35 degrees 0 degrees 387 mm (15.3 in) 495 mm (19.5 in)</p> <p>711 mm (28.0 in) 35 degrees 18 degrees 546 mm (21.5 in)</p>
<p>OCCUPANT RESTRAINT</p> <p>Shoulder belt upper anchor point location Behind ATD shoulder Above ATD shoulder Above sled platform Left of wheelchair centerline Angle of pelvic belt wrt to horizontal Angle of shoulder-belt Projected frontal view wrt horizontal Projected lateral view wrt horizontal</p>	<p>305 mm (12.0 in) 178 mm (7.0 in) 1232 mm (48.5 in) 305 mm (12.0 in) 45 degrees</p> <p>55 degrees, measured on ATD torso 30 degrees, measured above ATD shoulder</p>
<p>FOOTSTRAP POSITIONING</p> <p>In front of ATD knee center Above ATD knee center</p>	<p>457 mm (18.0 in) 51 mm (2.0 in)</p>
<p>ATD POSITIONING</p> <p>Shoulder height above sled platform H-point height above sled platform</p>	<p>1054 mm (41.5 in) 565 mm (22.3 in)</p>
<p>WHEELCHAIR</p> <p>Weight Wheelbase Seatback angle wrt vertical Seatback height (with headrest) Seatpan angle wrt horizontal Seat surface height from floor @ SB junction Seatpan length</p>	<p>85.0 kg (187 lb) 533 mm (21.0 in) 10 degrees 559 mm (22.0 in) 7 degrees 470 mm (18.5 in) 445 mm (17.5 in)</p>

TEST RESULTS

The New Haven 7VA16 wheelchair tiedown system with track anchorages effectively secured the ISO/SAE surrogate wheelchair from forward excursion during frontal-impact loading and the ATD was effectively restrained from forward excursions by the New Haven lap and shoulder belts. The SWC remained upright on the sled platform with the ATD seated in the SWC seat after the test and the peak forward excursion of point P on the surrogate wheelchair was 66 mm, which is below the SAE J2249 limit of 200 mm. The SWC could be released from all tiedowns without the use of tools.

Peak forward excursion of the ATD's head was limited to approximately 422 mm and peak forward knee excursion was limited to about 214 mm, which are below the SAE J2249 limits of 650 mm and 375 mm, respectively. The ratio of the ATD's knee excursion to the wheelchair point-P excursion is 3.2, which is above the minimum required ratio of 1.1.

The results of this test indicate that the New Haven 7VA16 wheelchair tiedown and occupant restraint system with track anchorages meets all of the frontal-impact performance requirements of Section 6.2 of SAE J2249. The following table summarizes the test results and compliance of the system with SAE J2249.

SUMMARY OF TEST RESULTS

GENERAL TEST INFORMATION Test number Actual impact velocity (ΔV) Actual average sled deceleration level Actual peak sled deceleration level Total time of deceleration over 20 g Total time of deceleration over 15 g Deceleration pulse duration	NH 1001 49 kph (30.4 mph) 20.2 ms 25.2 ms 27.1 ms 66.1 ms 81.5 ms
ATD MEASUREMENTS Peak resultant head acceleration Peak resultant chest acceleration Head injury criteria (15 ms) Maximum forward head excursion [†] Maximum forward knee excursion ^{††}	66 g 48 g 429 422 mm (16.6 in) 214 mm (8.4 in)
BELT LOADS AND PELVIC BELT ANGLE Peak left pelvic-belt load Peak shoulder-belt load	8581 N (1929 lb) 9586 N (2155 lb)
WHEELCHAIR MEASUREMENTS^{††} Maximum forward wheelchair excursion at Point P* Maximum forward excursion of front-wheel hub Maximum forward excursion of rear-wheel hub	66 mm (2.6 in) 87 mm (3.4 in) 88 mm (3.5 in)

[†]The forward head excursion is the total forward change in position of the leading edge of the head, measured at the initial position prior to impact and at the time of maximum forward head travel.

^{††}Excursions reported are the total horizontal change in the position of the affixed targets relative to the sled platform from just prior to impact to the time of maximum forward or rearward excursion.

*Point P is a seating reference point located 50 mm above and 50 mm in front of the junction of the seatback and seat cushion planes

SUMMARY OF WTORS FRONTAL-IMPACT PERFORMANCE

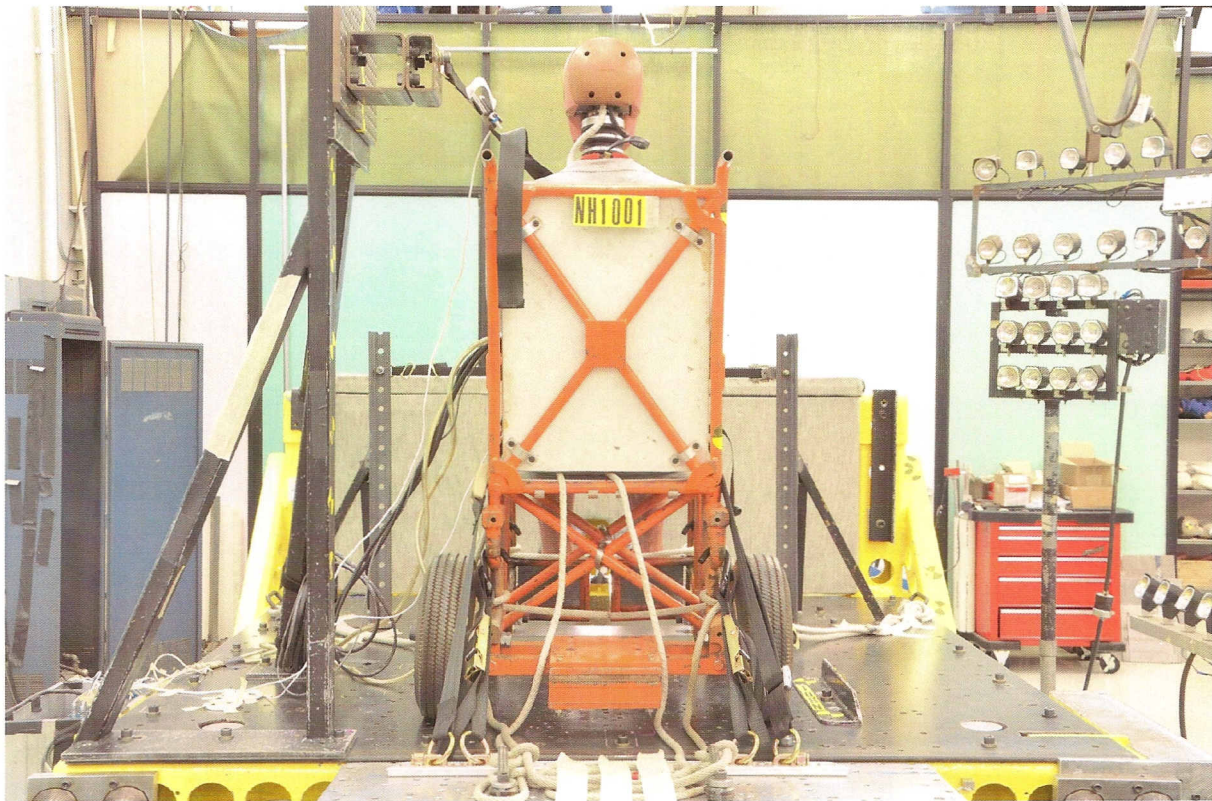
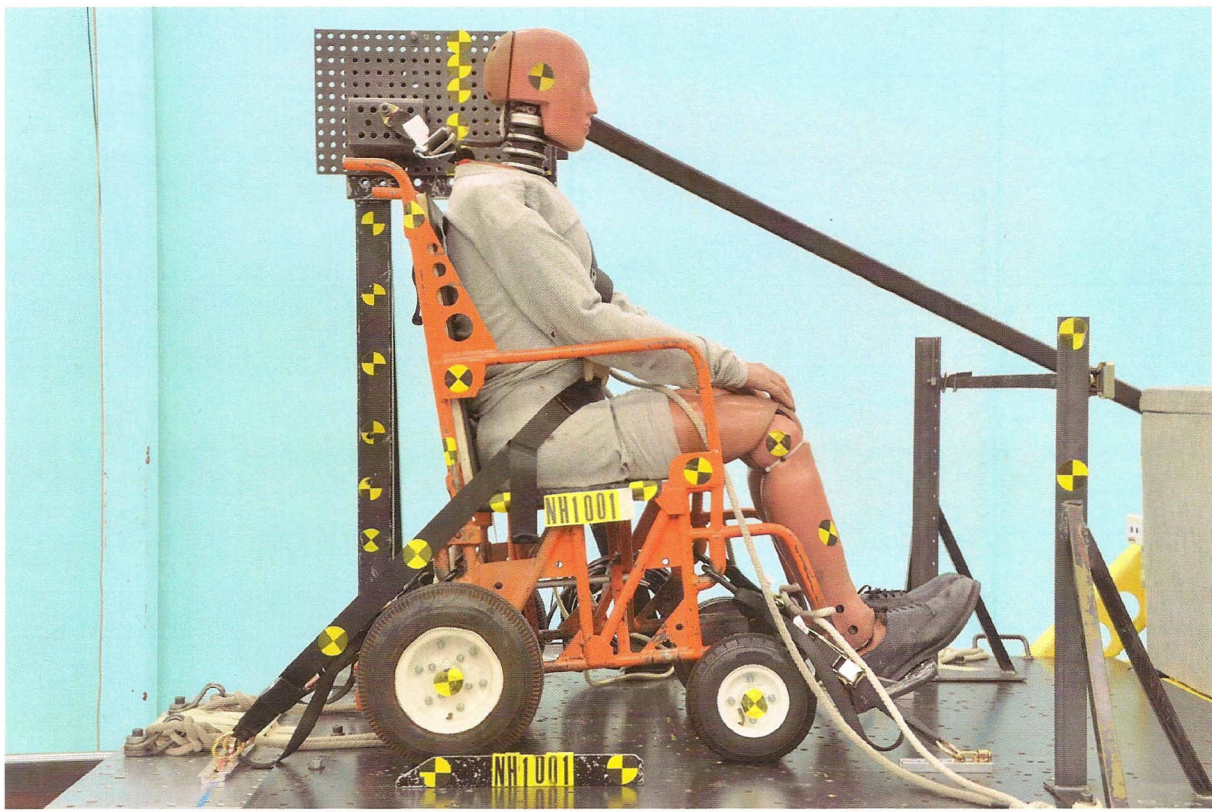
SLED TEST NH 1001

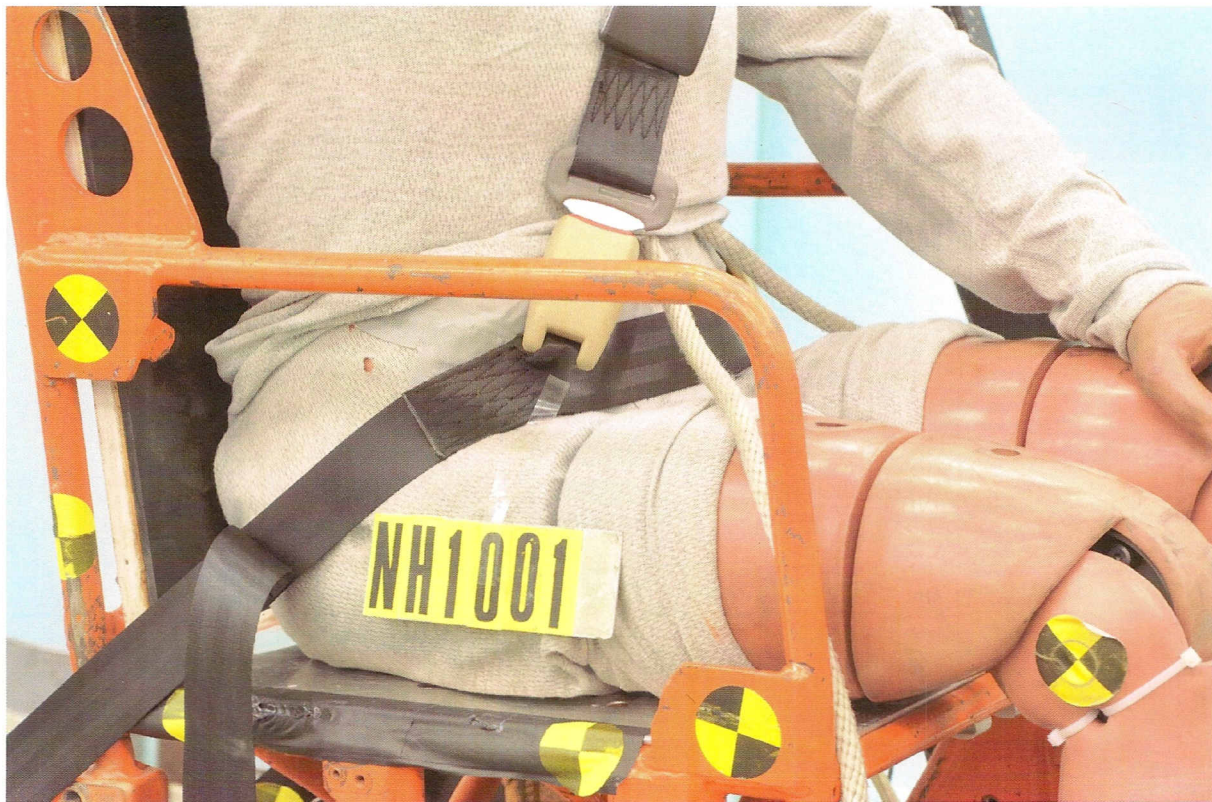
Clause SAE J2249 (ISO 10542)	Requirement Description	Observed Performance	
		Description	Pass/Fail
6.2a (6.2.1 a&b)	Retain ATD in SWC and on test sled with SWC upright.	SWC remained upright on sled platform with ATD in seat	Pass
6.2b (6.2.1 g)	WTORS cannot show visible signs of failure that is not anticipated by its design.	WTORS did not show any signs of failure	Pass
6.2c (6.2.1 c)	WTORS cannot detach from anchorages or securement points.	WTORS remained attached at all anchorages and securement points	Pass
6.2d (6.2.2 a)	Forward excursion of Point P < 200 mm	66 mm	Pass
6.2d (6.2.2 a)	Forward knee excursion < 375 mm	214 mm	Pass
6.2d (6.2.2 a)	Forward head excursion < 650 mm	422 mm	Pass
6.2e (6.2.2 b)	Ratio of ATD knee excursion to Point P excursion must exceed 1.1.	Ratio of ATD knee excursion to Point P excursion = 3.2	Pass
6.2f (6.2.1 d&e)	Allow removal of ATD and SWC without the use of tools.	No tools required for disassembly	Pass

Note: SWC = surrogate wheelchair

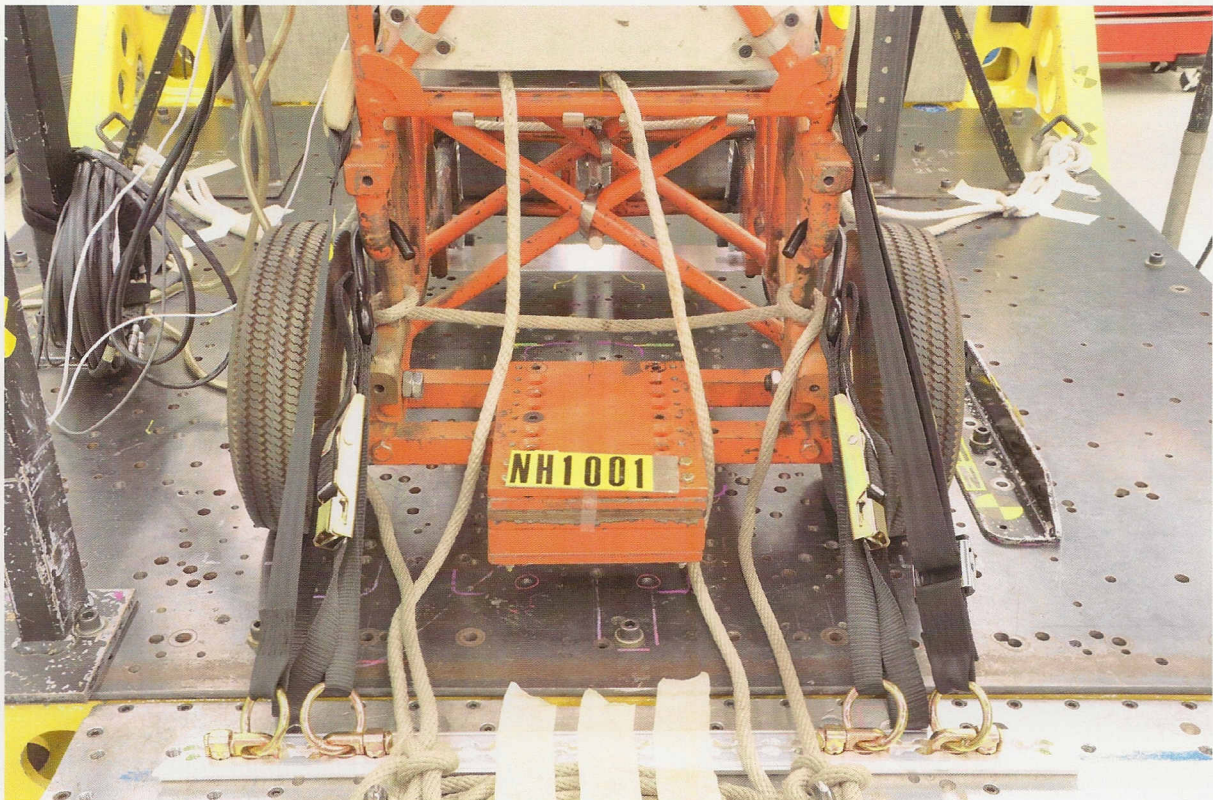
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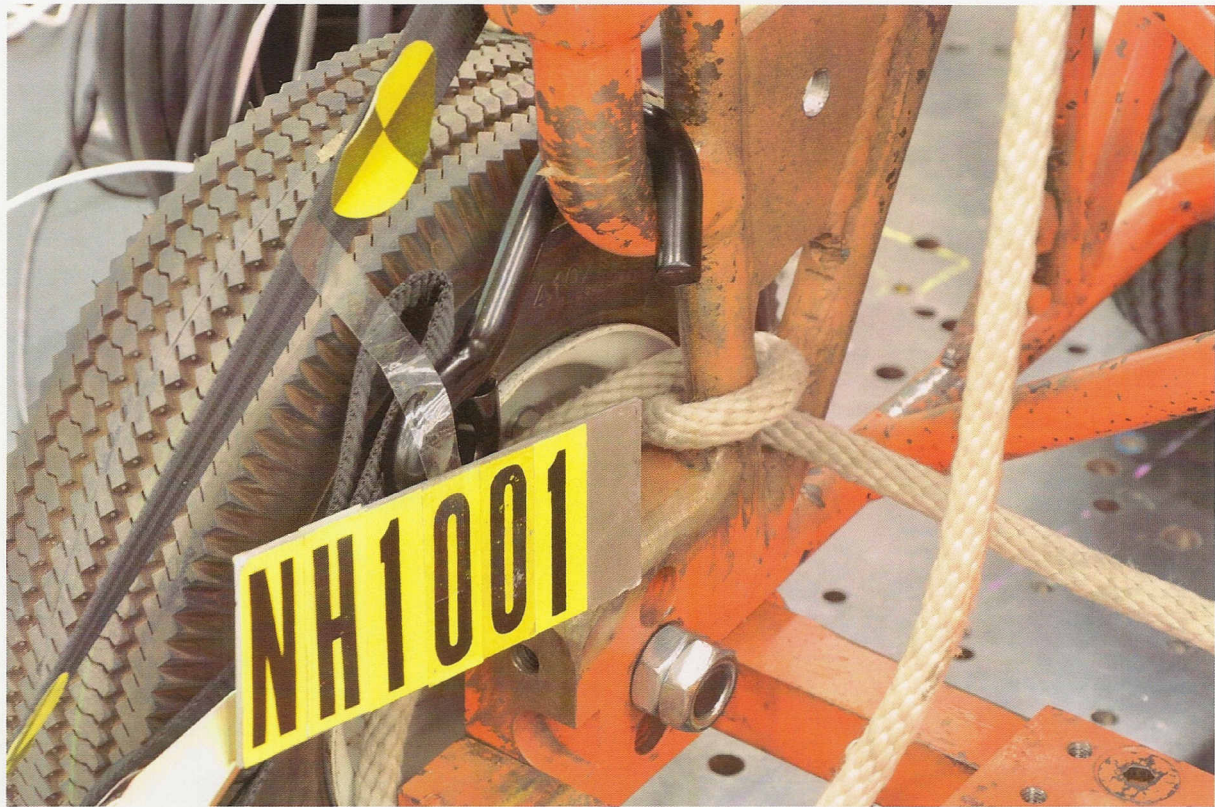








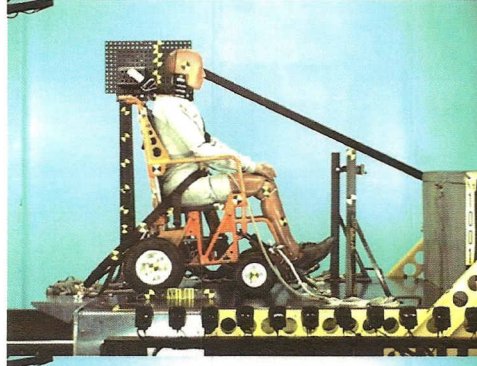




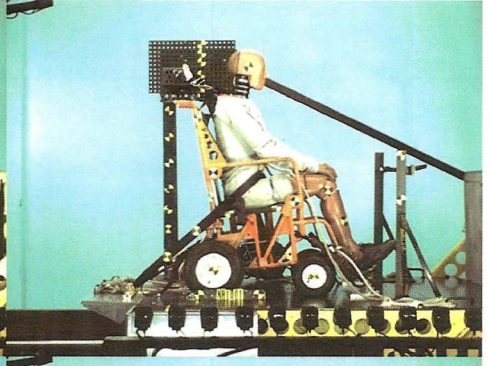
TEST AND POST-TEST PHOTOS

NH1001

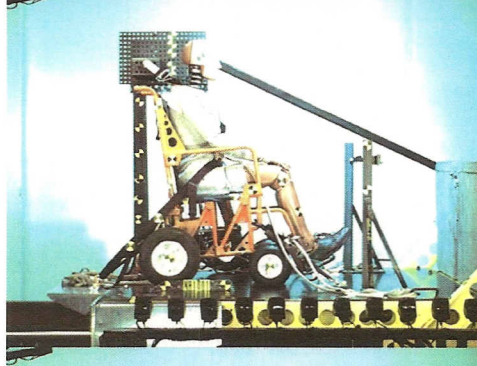
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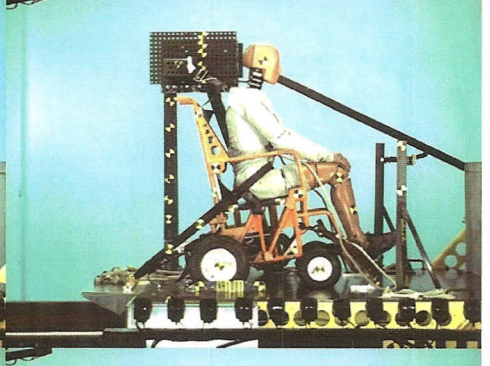
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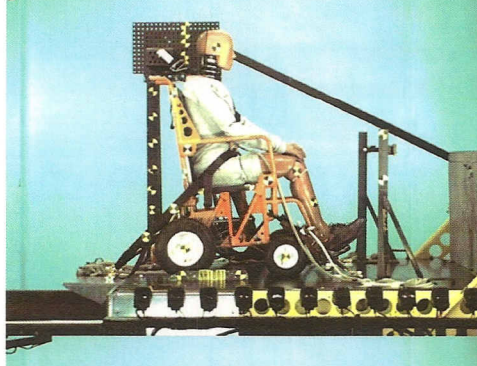
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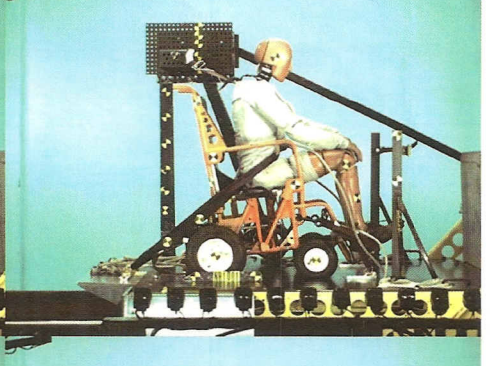
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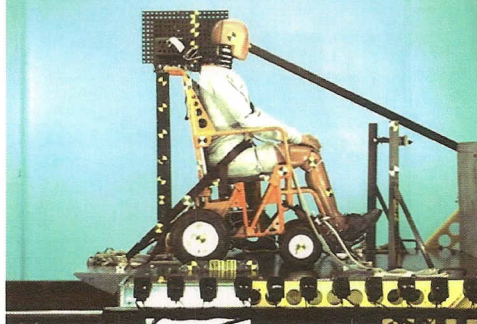
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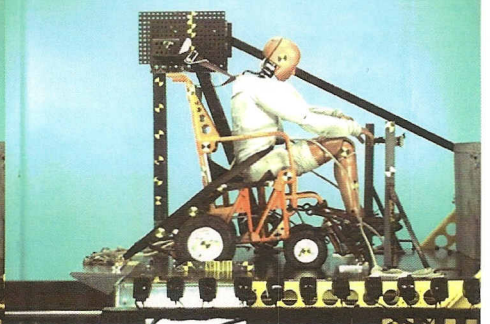
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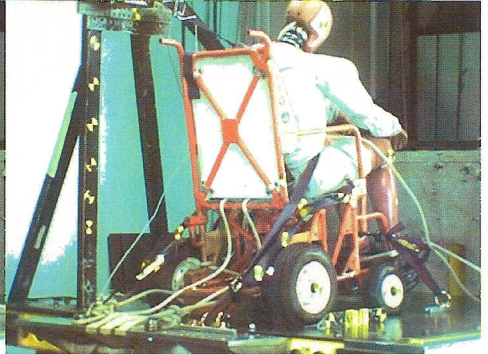
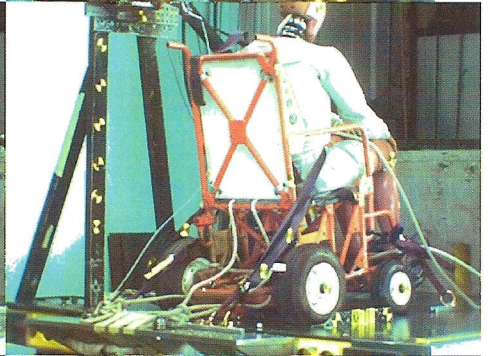
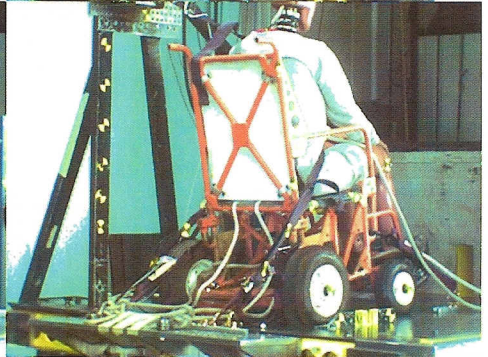
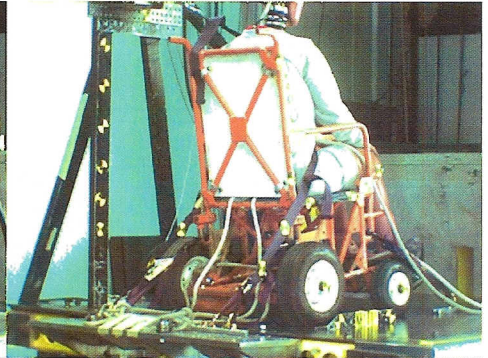
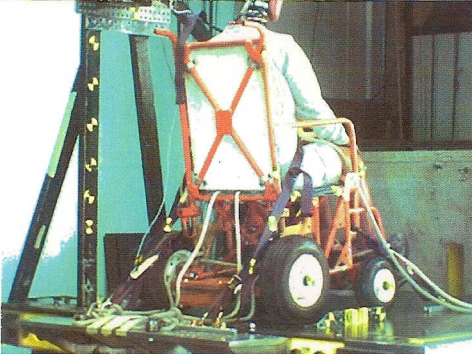
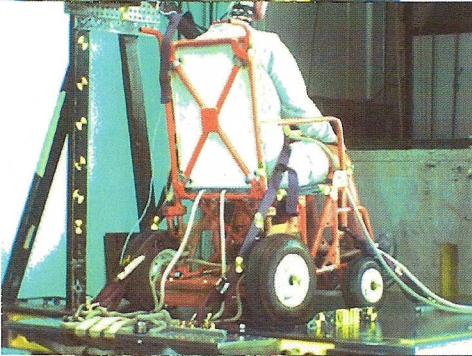
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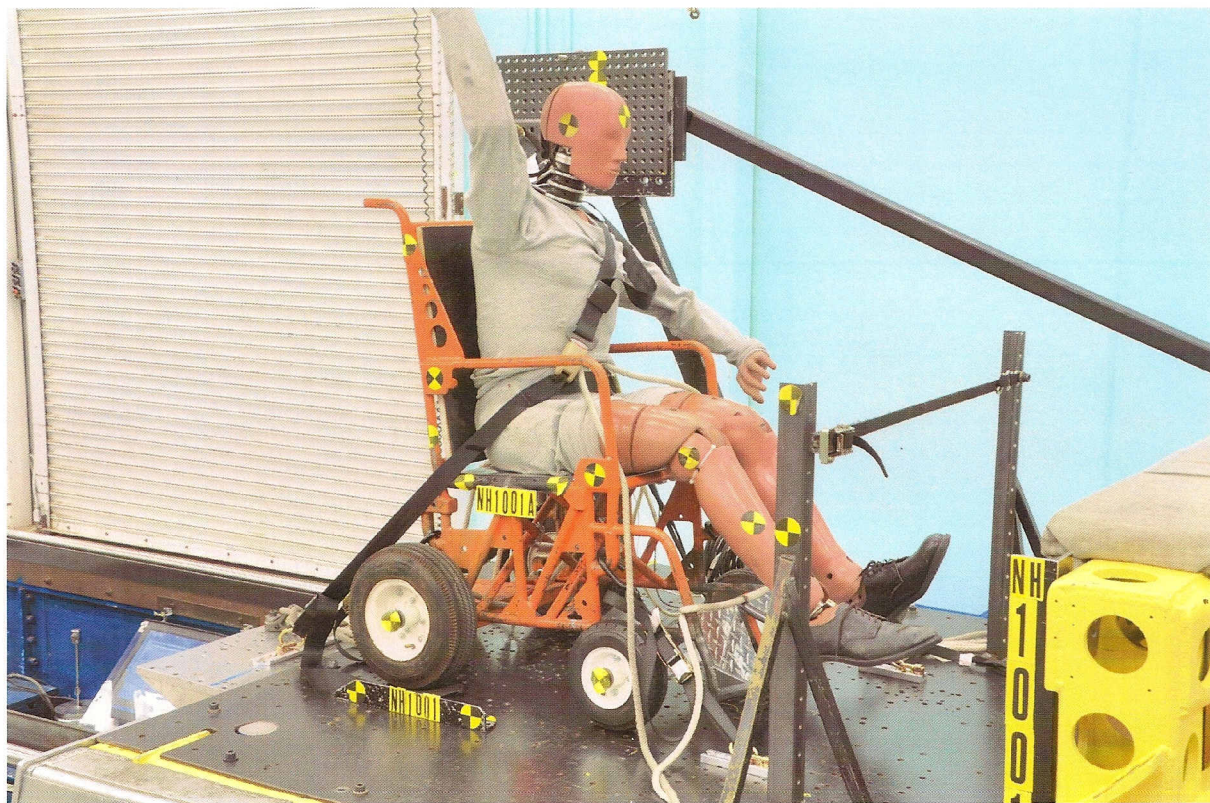
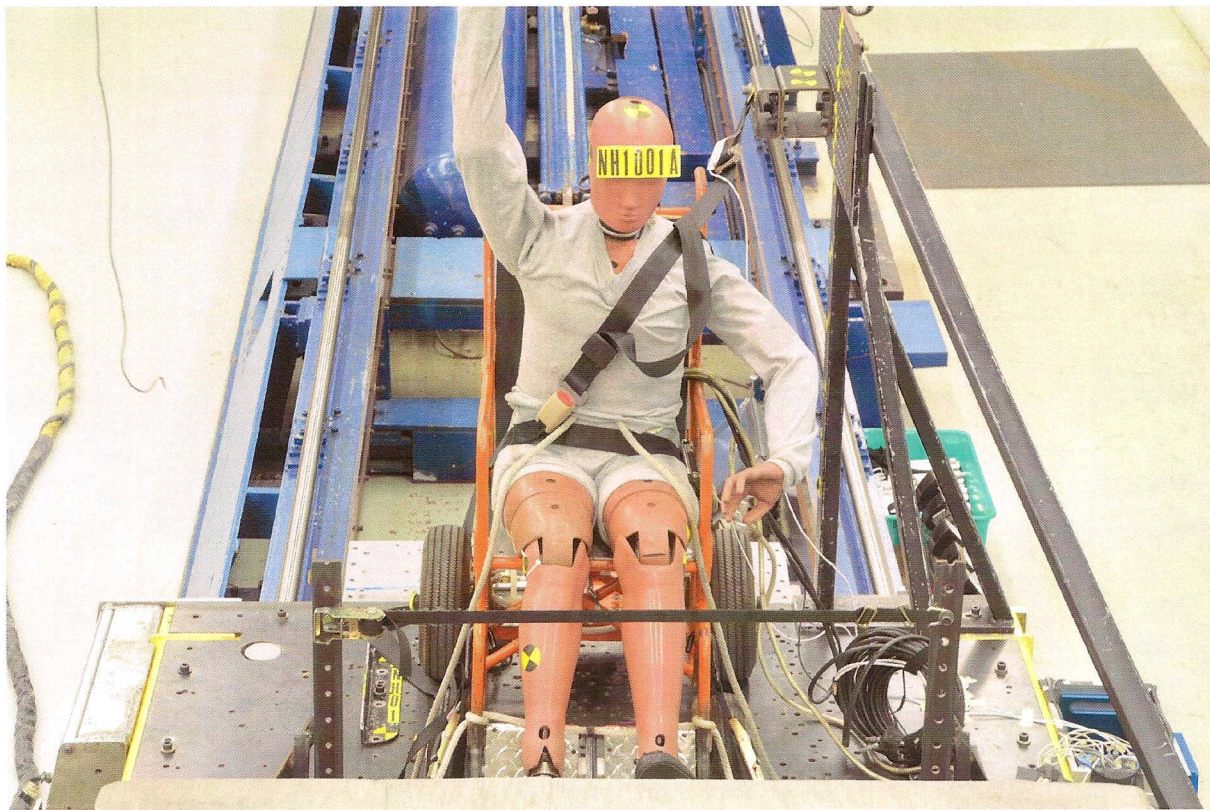
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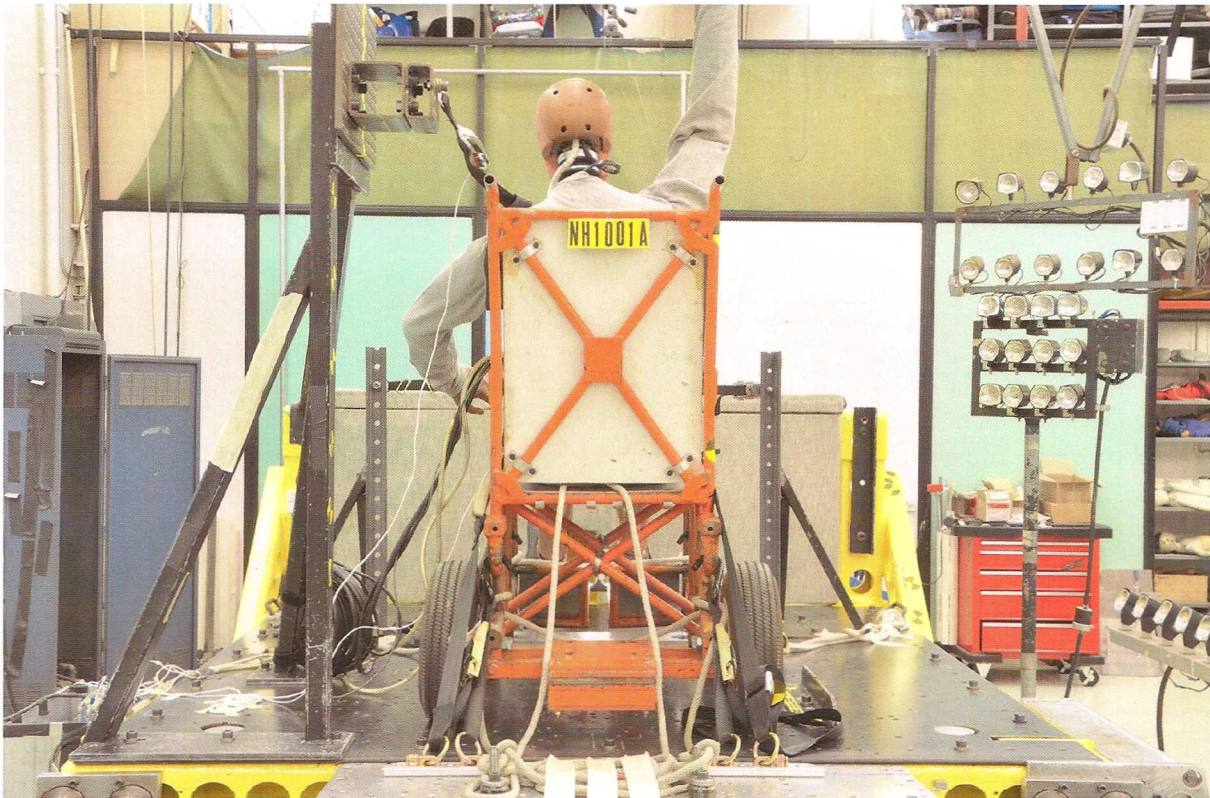
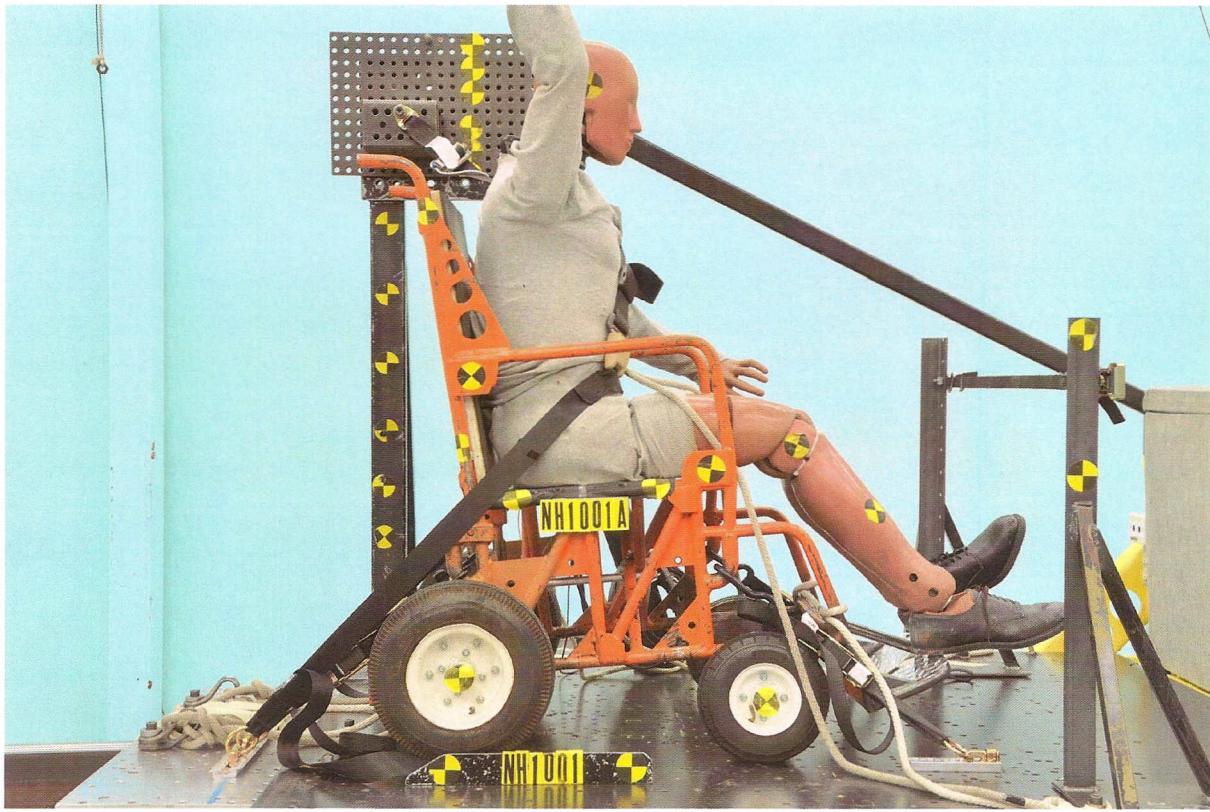
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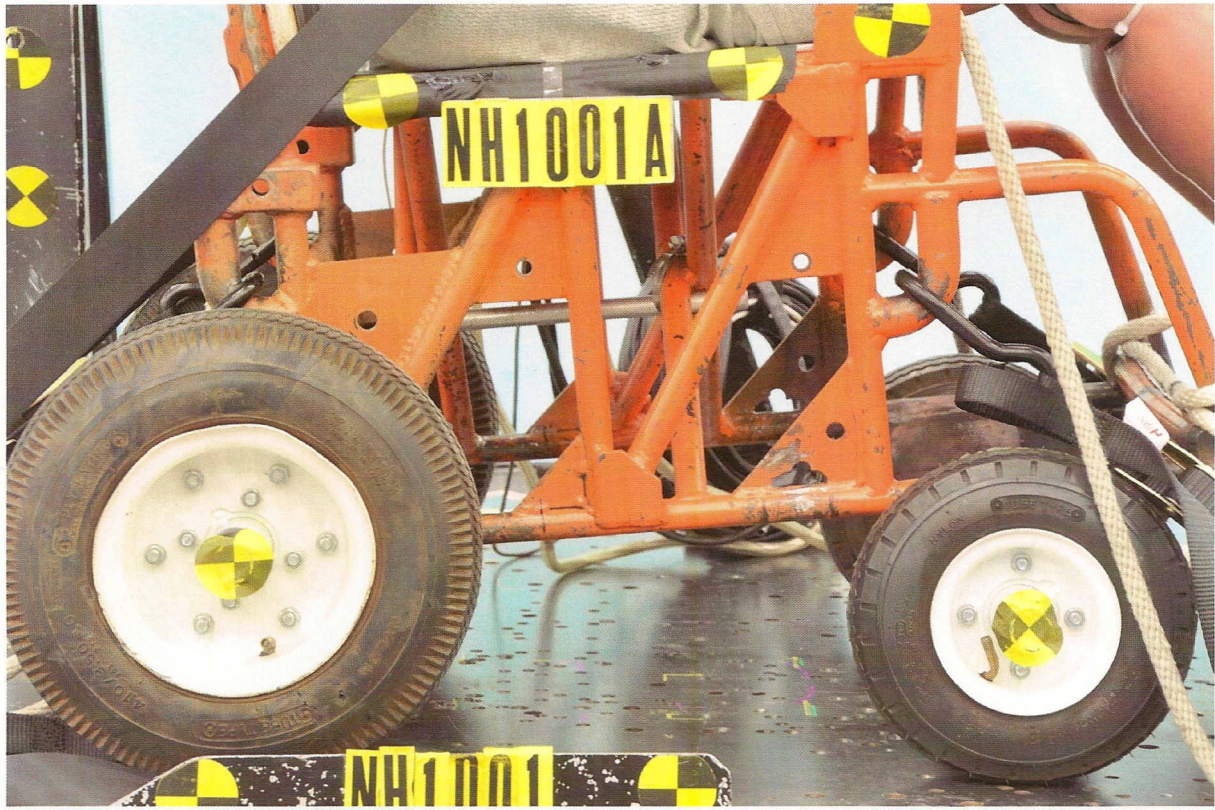
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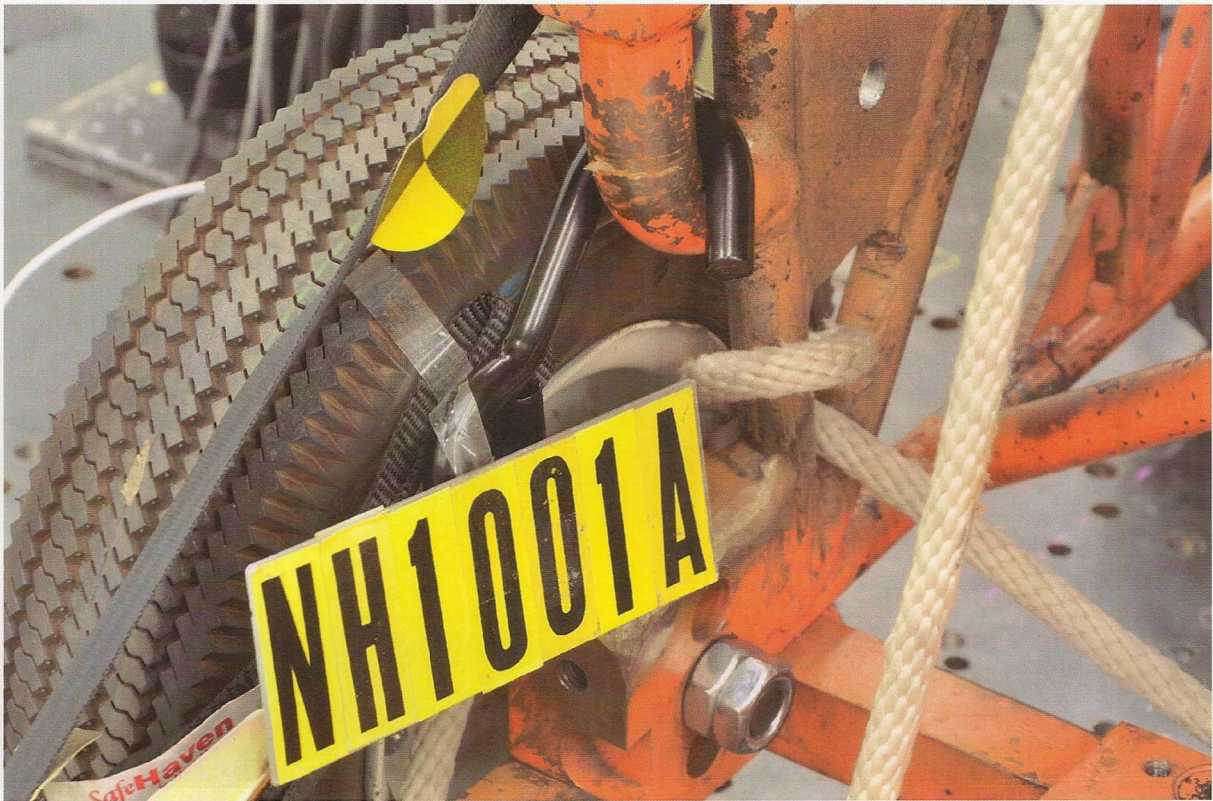
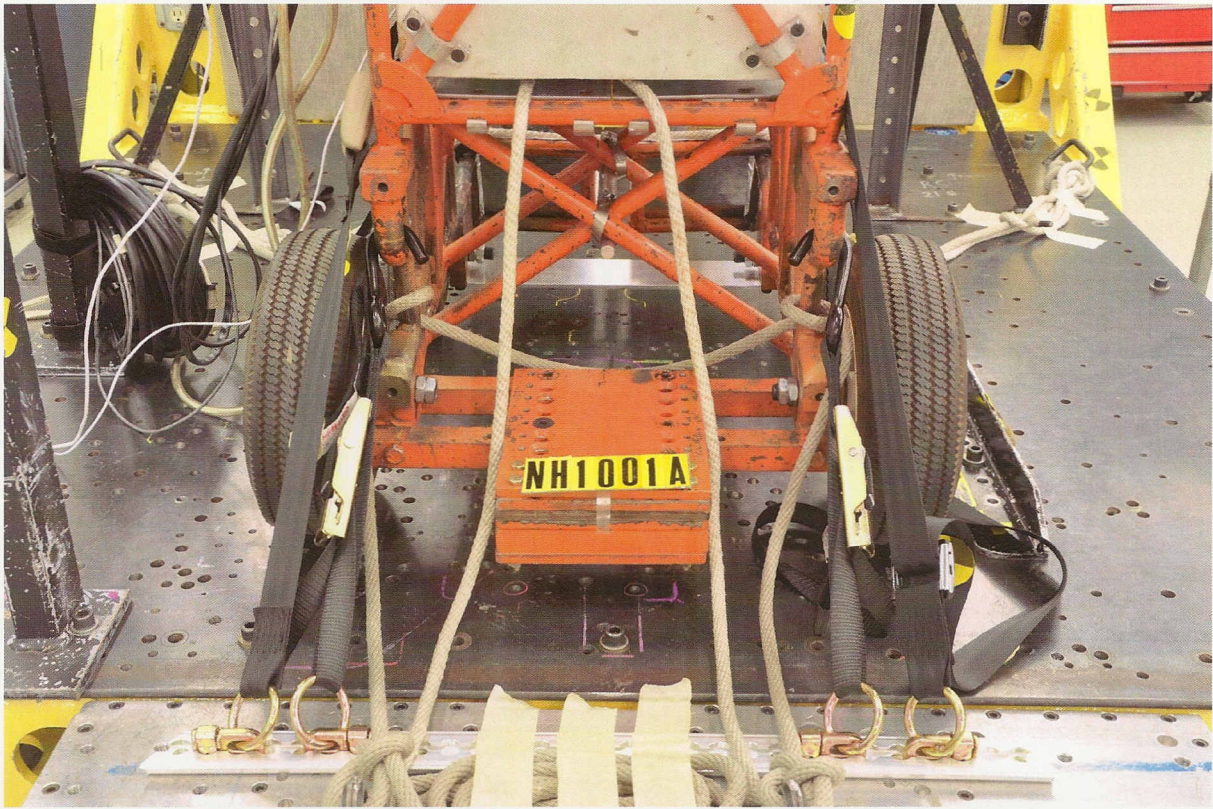
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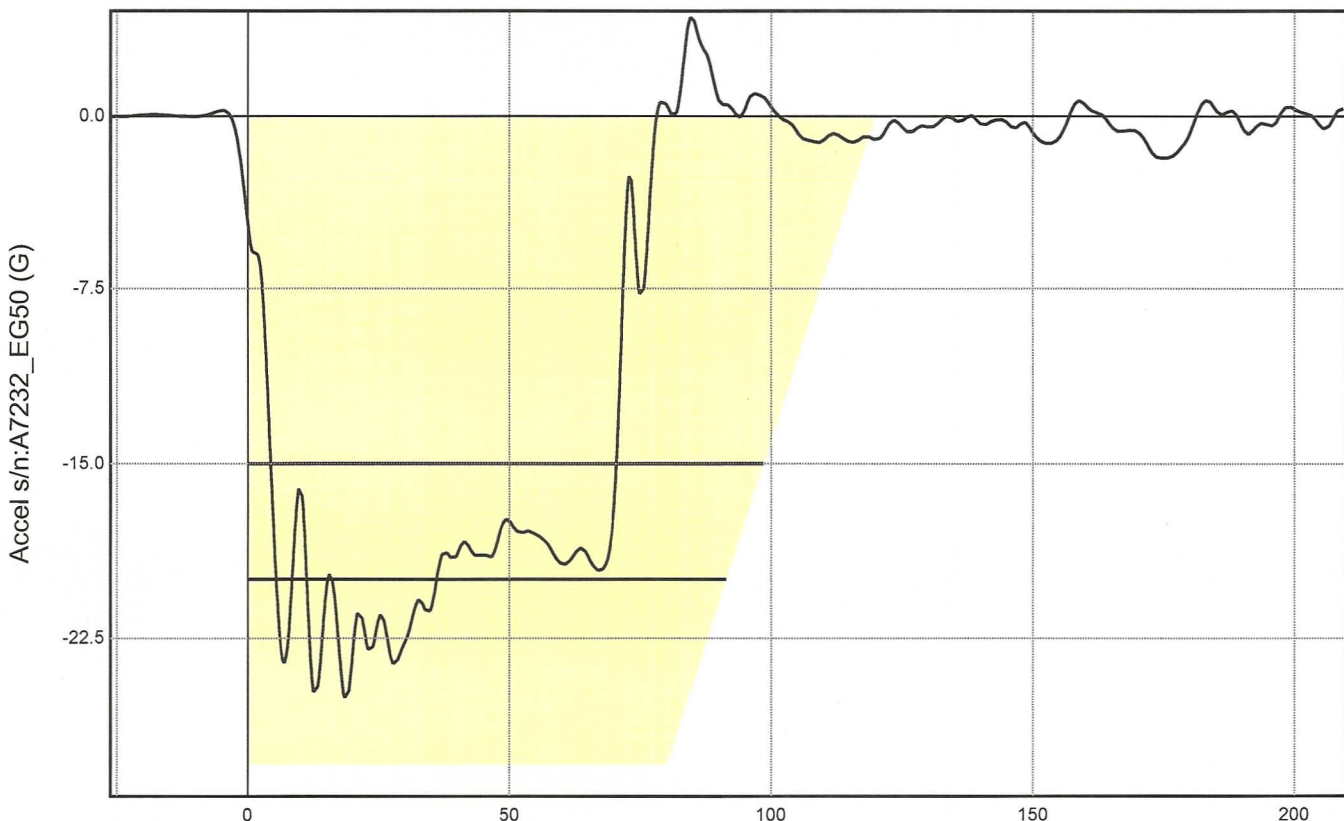
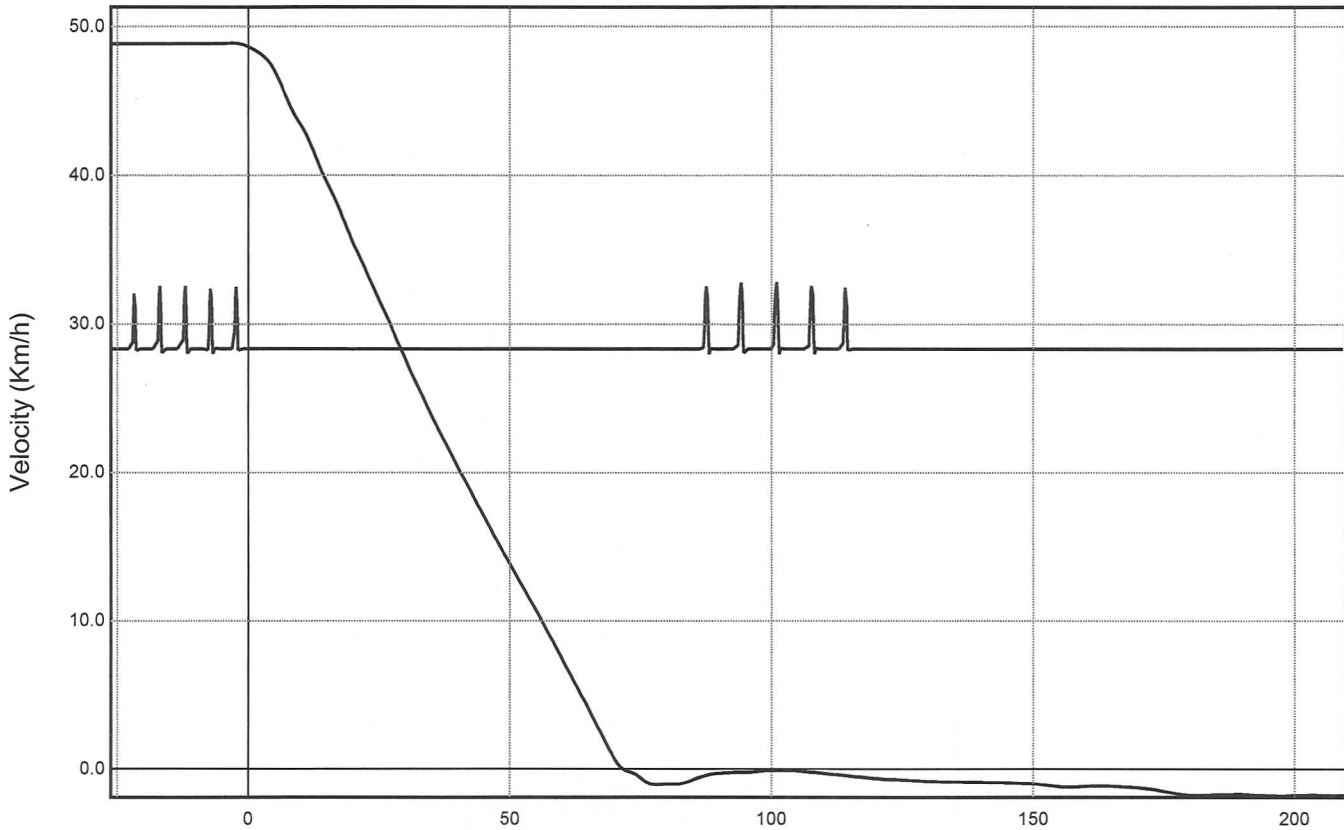






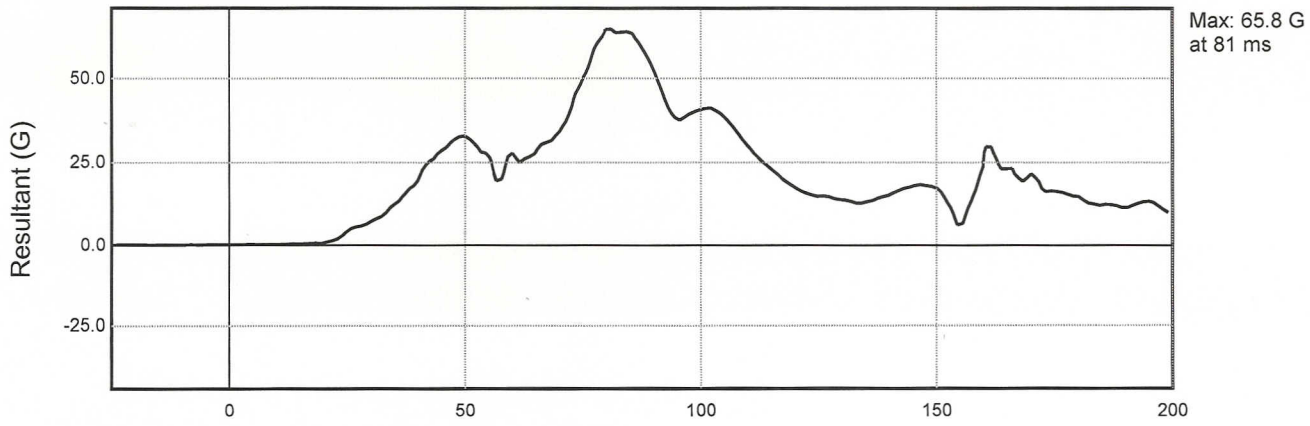
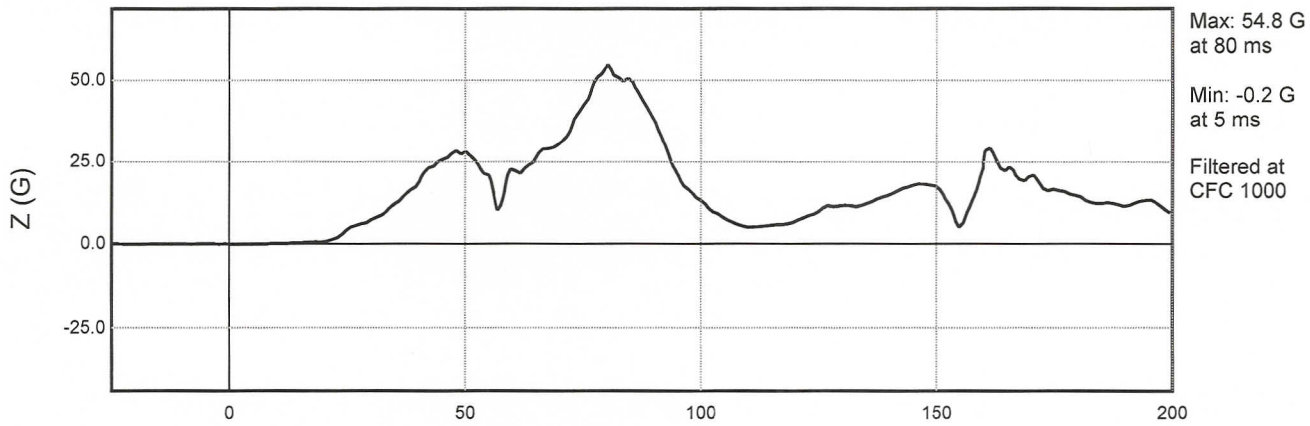
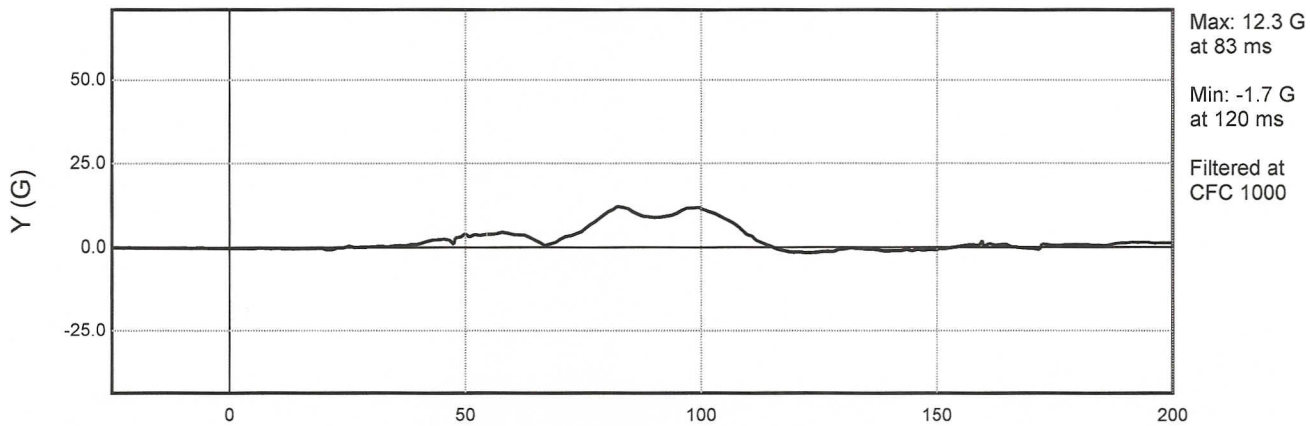
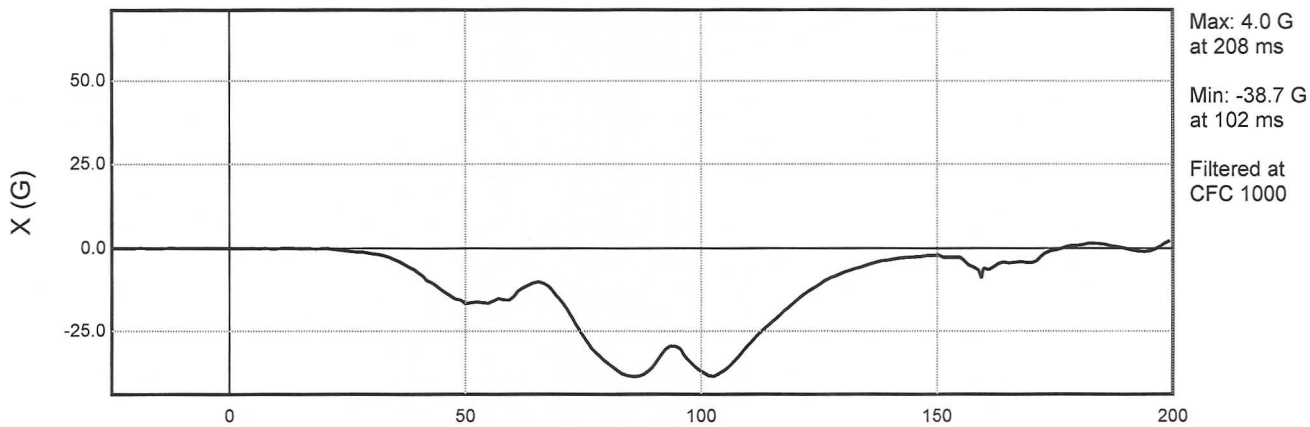


TEST SIGNALS

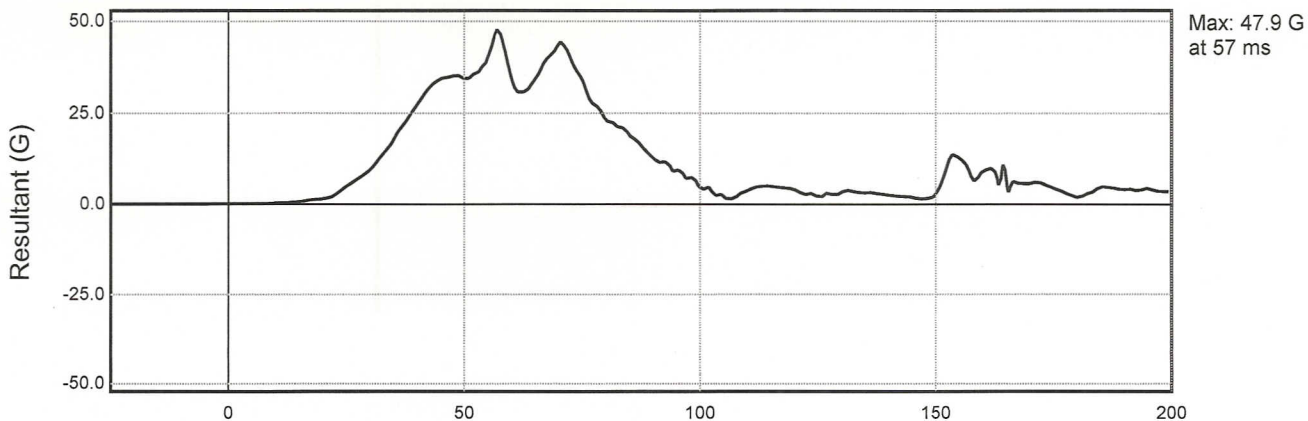
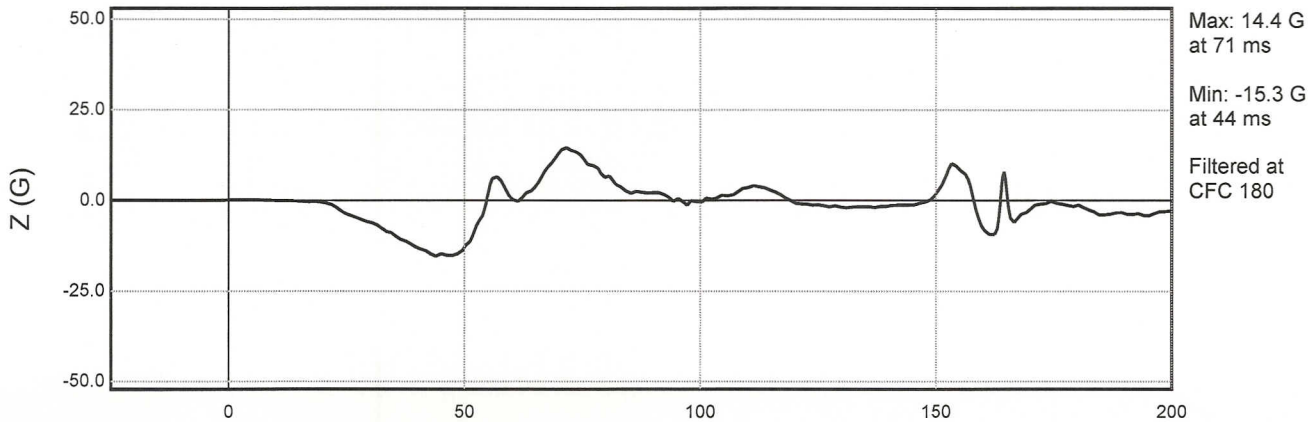
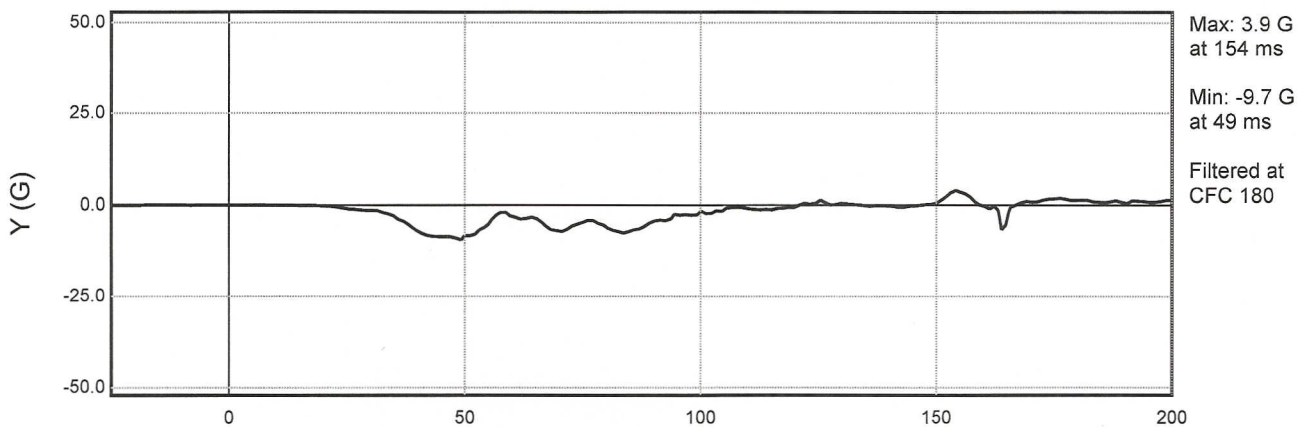
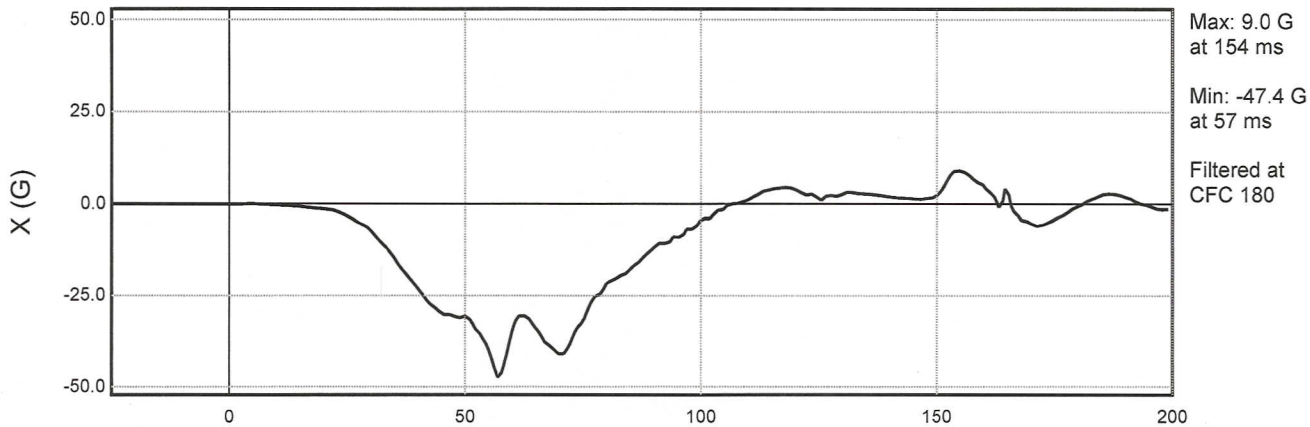


Sled Pulse Duration = 81.5 ms
 Sled Plateau Average Level = -20.2 G
 Sled Decel Peak = -25.2 G
 Total time under -20.0 G was 27.1 ms
 Continuous time under -15.0 G was 66.1 ms

Efficiency = $V_{out} / V_{in} = 20.63 / 28.28 = 72.9\%$
 Sled Delta V = 48.9 kph (30.4 mph)
 Stopping Dist. (est) = 0.580 m



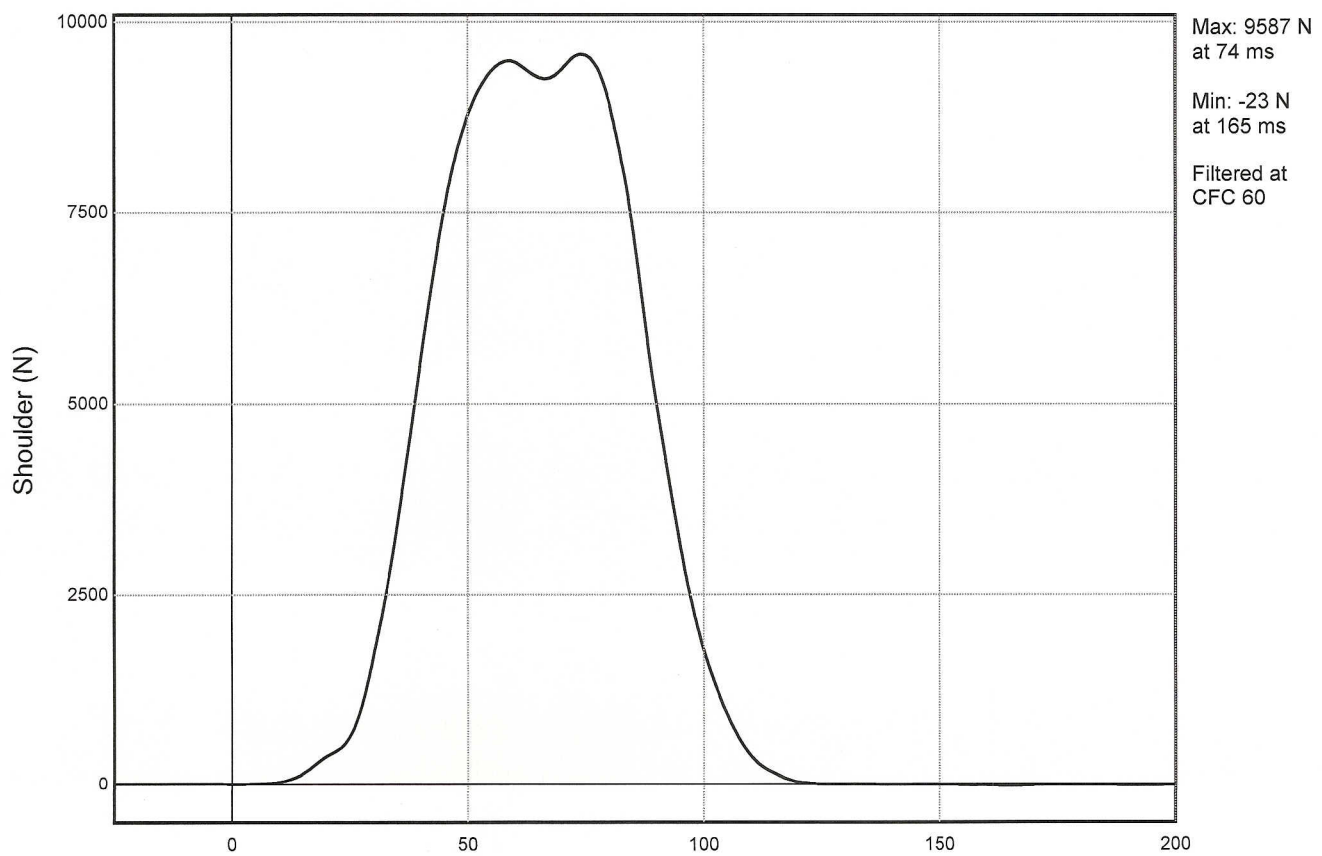
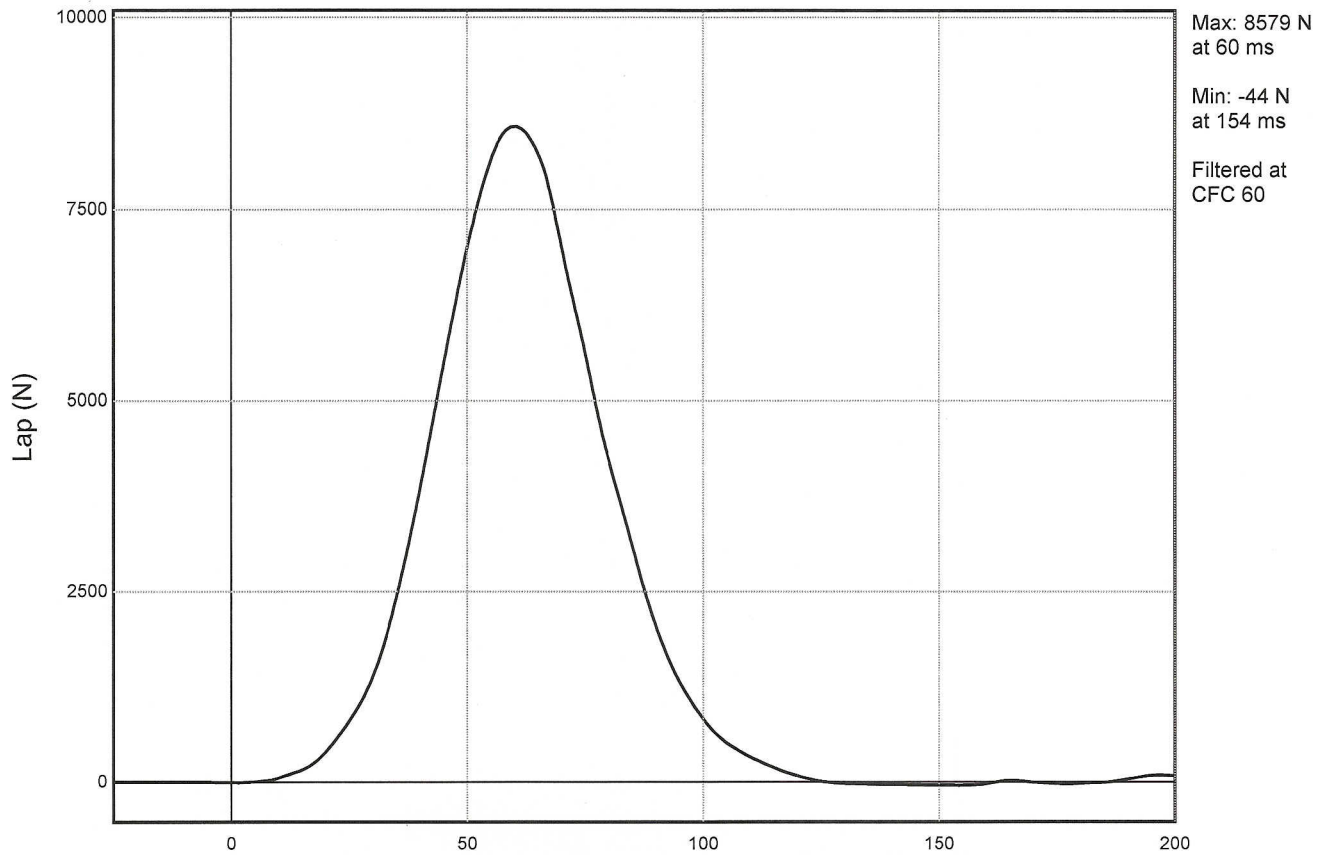
H.I.C. (UN) = 682.3 From: 41.1 to 114.8 ms
H.I.C. (15) = 429.0 From: 75.4 to 90.4 ms



3.0 ms Clipped Peak = 42.3G

From: 55.5 to 58.5 ms

Total time over 60.0 G was 0.0 ms





Formal Certifications

Conformance
 Proof Test

Vantage Mobility International
5202 South 28th Place
Phoenix, Az. 85040

In regards to items shown below, which are being submitted to "Vantage Mobility International" for PPAP submission, We hereby certify the following:

That the tracks listed below are all from the same lot of material than those used in the performance of the frontal impact test per Appendix A. of publication SAE J2249. Documentation of test entitled "Frontal impact of New Haven 7VA16 Four Point Wheel Chair Tiedown system" Dated February 19th, 20010:

- 10-ea. NH34030V-6. 6" aluminum track track (used on test)
- 10-ea NH34030V30.11. 30.11" aluminum track (used on test)
- 10-ea. NH34030V43.75. 43.75" aluminum track
- 10-ea. NH34030V-60. 60" aluminum track
- 10-ea. NH34030V-61.38. 61.38" aluminum track

All the above are from material lot #337710 and are labeled as such.

Inspection reports, certificates of material, and dimesion data are attached.


Bernie Maytorena
Quality Control Manager
Safe Haven
13571 Vaughn St. Bldg E.
San Fernando, Ca. 91340