Peter Axelson

Beneficial Designs, Inc.
Minden, NV

Beneficial Design

Designing Beyond the Norm to Meet the Needs of All People

Research
Design
Education

Stanford University
19 February 2019
Peter Axelson

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research/design/education
Designing beyond the norm to meet the needs of all people.

Beneficial Designs' Mission Statement

Beneficial Designs works towards universal access through research, design, and education. We believe all individuals should have access to the physical, intellectual, and spiritual aspects of life.

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Designing beyond the norm to meet the needs of all people.

Beneficial Designs' Mission Statement

We seek to enhance the quality of life for people of all abilities, and work to achieve this aim by developing and marketing technology for daily living, vocational, and leisure activities.

Peter Axelson
Director of R&D

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Board of Directors

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Research Coordinator

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Facility Manager

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Research Assistant and Office Manager

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Office Assistant

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Office Assistant

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Office Assistant

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Office Assistant

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Hannah Wetmore
Office Assistant

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Sharon Vazquez
Office Assistant

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Bookkeeper

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Paul Schnorbus
Machinist

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Stephen Pieters
Wheelchair Test Lab Leader

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Sam Schnorbus
Testing / Assessment Technician

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Emery Schreckengost
Testing / Assessment Technician

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Kyle Hollingshead
Programing Assistant

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Ben Hubbard
Graphic Artist

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Debbie Hester
GIS Technician

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Martin Clemons
Electrical Engineer & Firmware Programmer

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Todd Ackerman
Sidewalk Assessment Coordinator

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Nathan Tolbert
Sidewalk Assessment Coordinator

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Kent Nelson
BOD, Travel Asst., Amusement Park Asst.

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DELTA


595
BALLOTIN

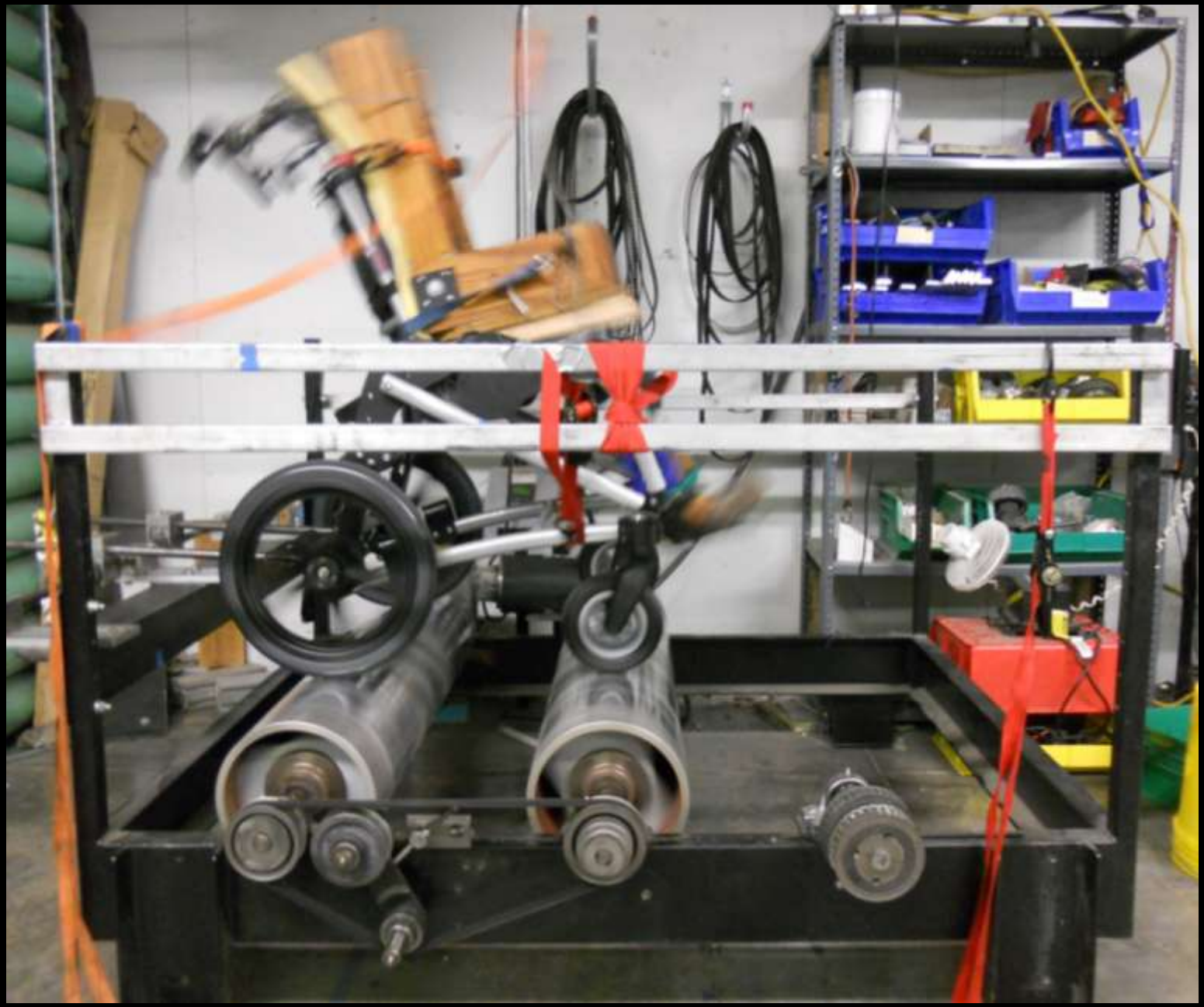

SENCOR


HAAS


N20K

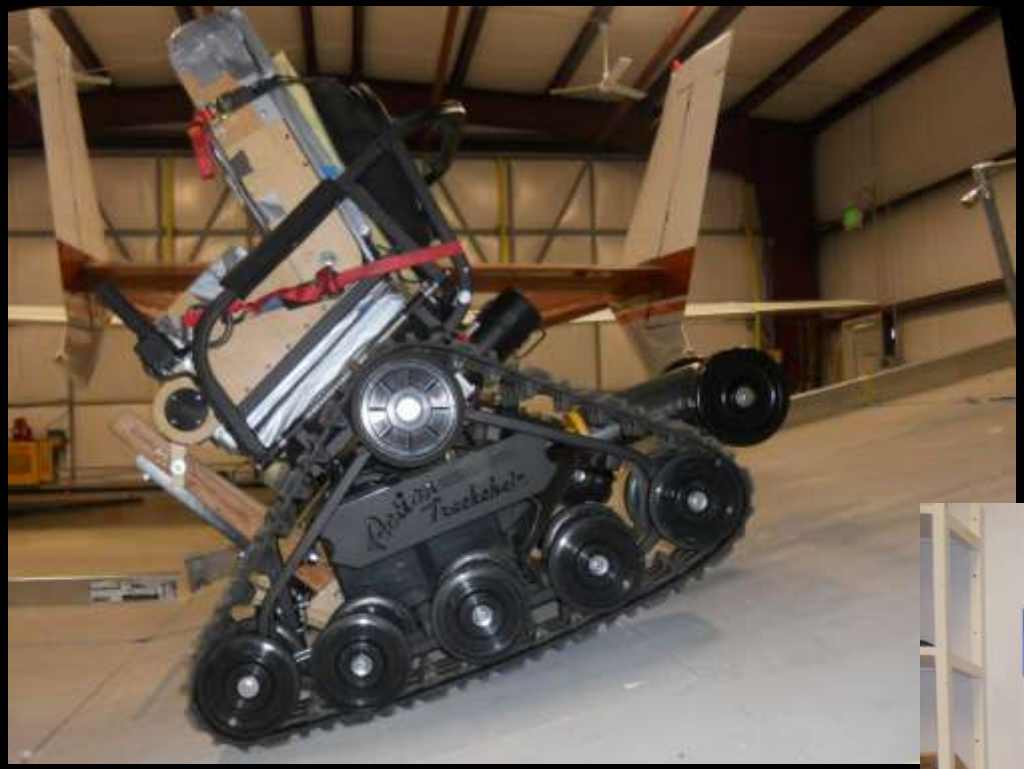

N-D
N-C

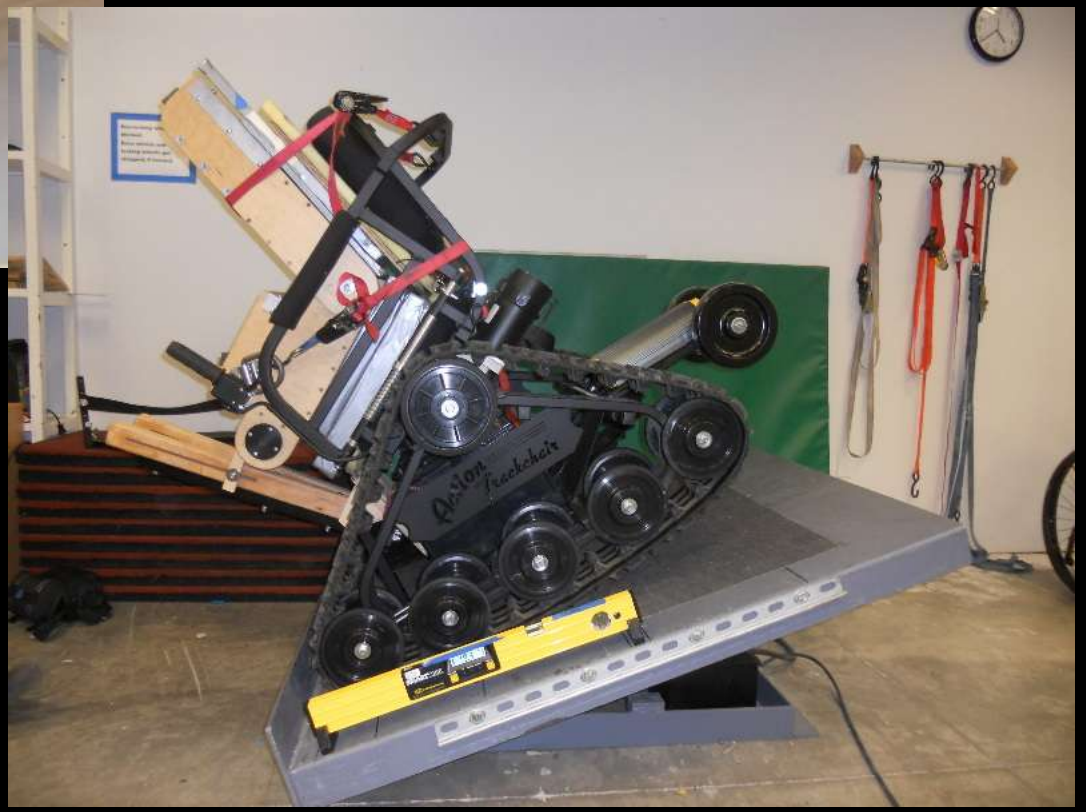

R2-A
JC Metal Fabrication Inc.




2014-2


Action Trackstander


Arctic Trackchair


Arctic Trackchair


7.5°

Design of Consumer Products

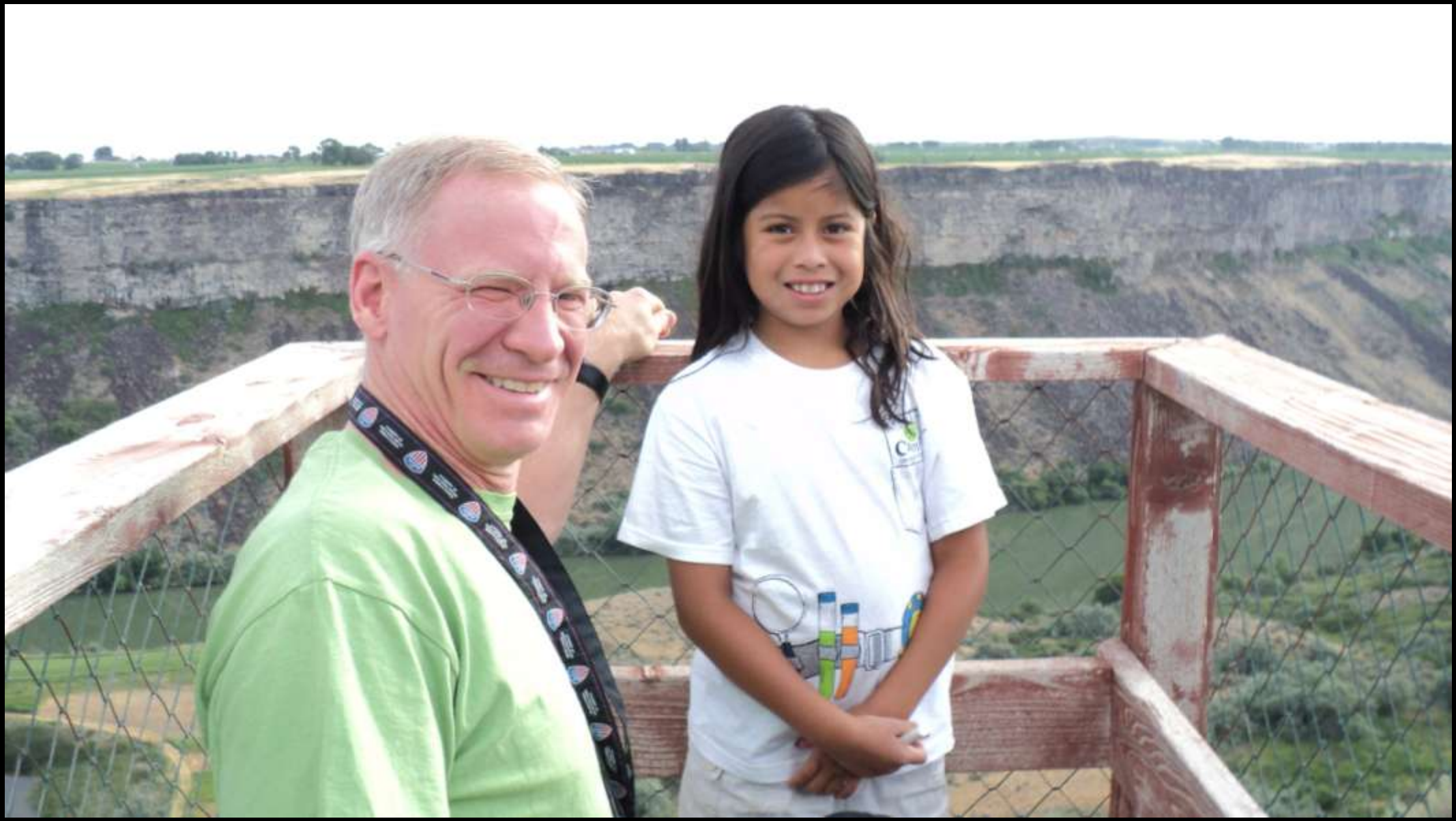
- Product Development
- Assessment of Products
- Universal Design of Products

Product Development

- Mainstream Products
- Opportunity for Universal Design
- Adaptive Products
  - Personal Technologies
  - Activity Specific Technologies

Establishing Balance

- Physical
- Intellectual
- Spiritual




PARADISE RAFTING


PETZL
PETZL

Sociological Dimension

Dependence

Independence

Interdependence

Personal Technologies
Activity-Specific Technologies
Environmental Technologies

Activity-Specific Technologies

Arroya Sit Ski

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200
205
AMERICAN EXPRESS
When you ne

Mono Ski

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WINTER PARK
WEST PORTAL
STATION
HEAD

Dynamic Seating Spring Assist

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Cross Country Ski

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4 12'98


FOX SHOX
4 12 '98

Pax Back

Available from

BES Rehab Ltd

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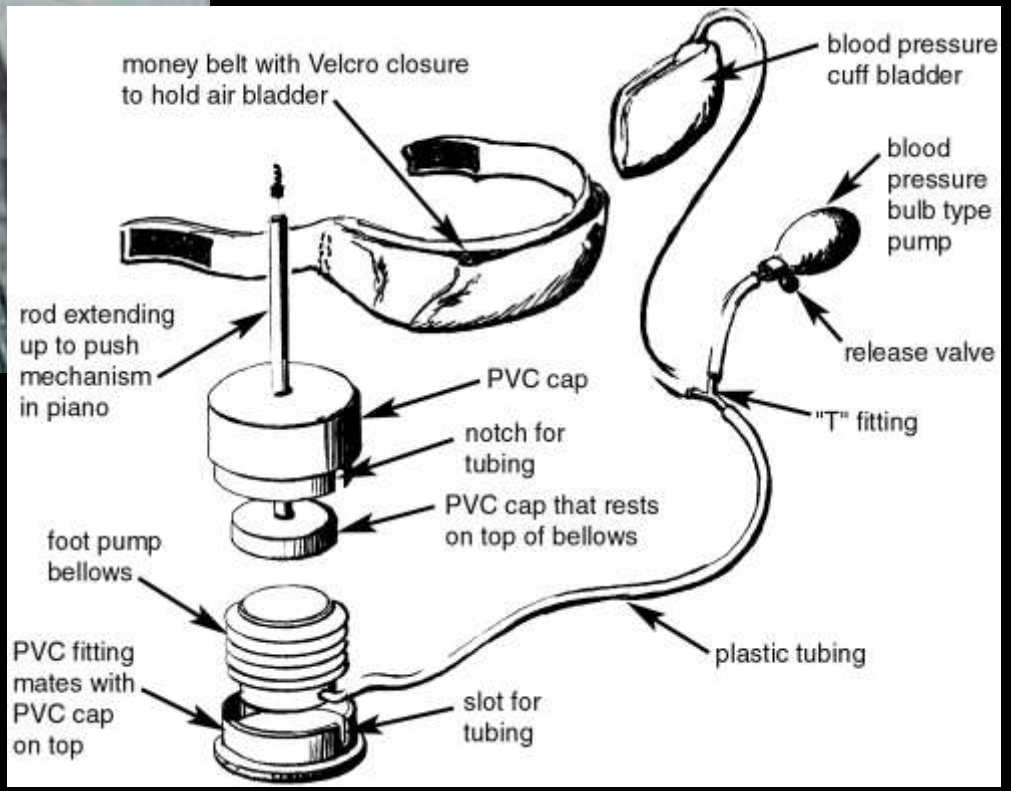
money belt with Velcro closure
to hold air bladder
blood pressure
cuff bladder
blood
pressure
bulb type
pump
release valve
rod extending
up to push
mechanism
in piano
PVC cap
notch for
tubing
"T" fitting
PVC cap that rests
on top of bellows
foot pump
bellows
plastic tubing
PVC fitting
mates with
PVC cap
on top
slot for
tubing

Clutch, Brake, and Gas on Hand Control

Dynamic Seating

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Dynamic Seating

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Hand Bike

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Hand Bike

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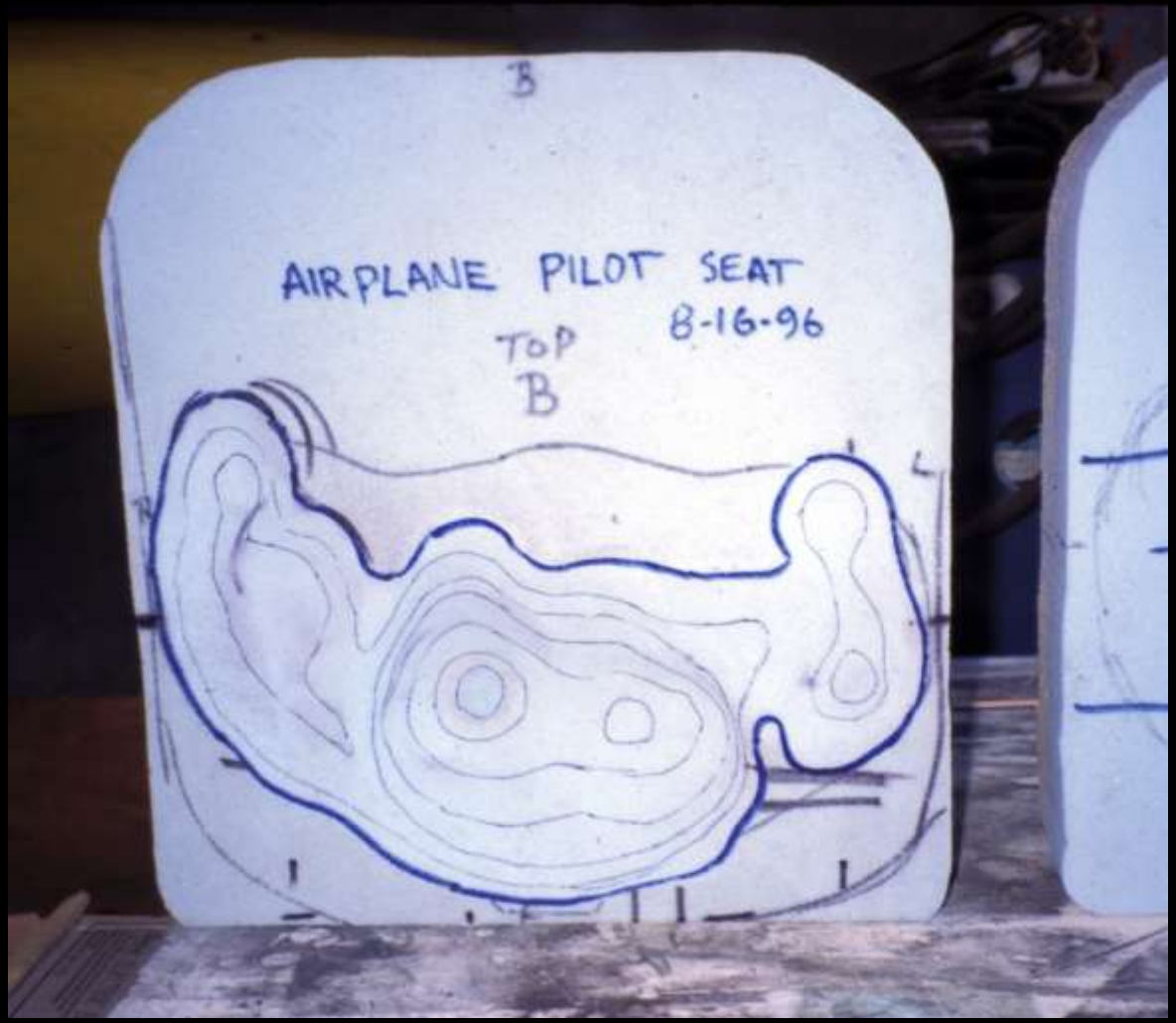

Contoured Seating

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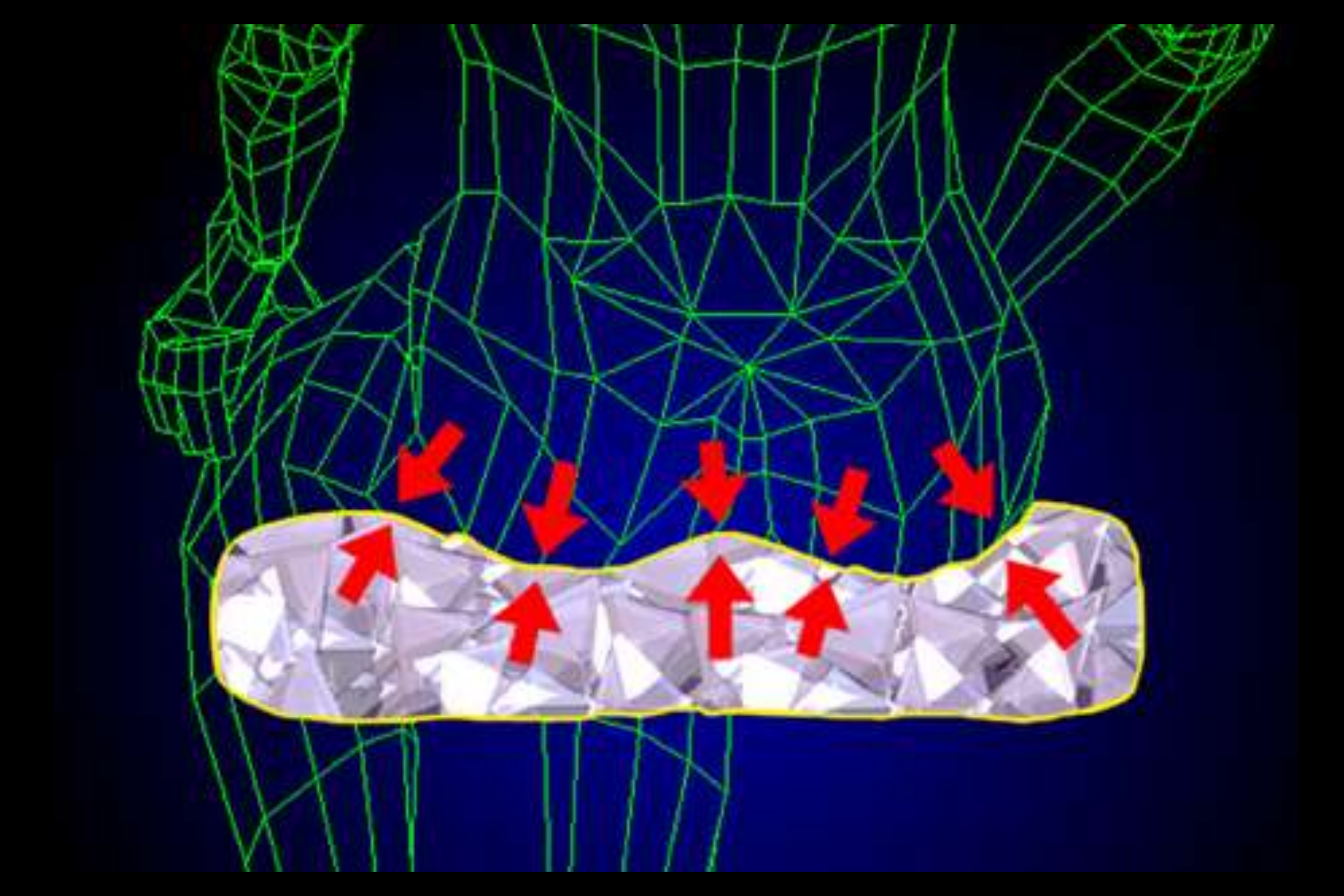
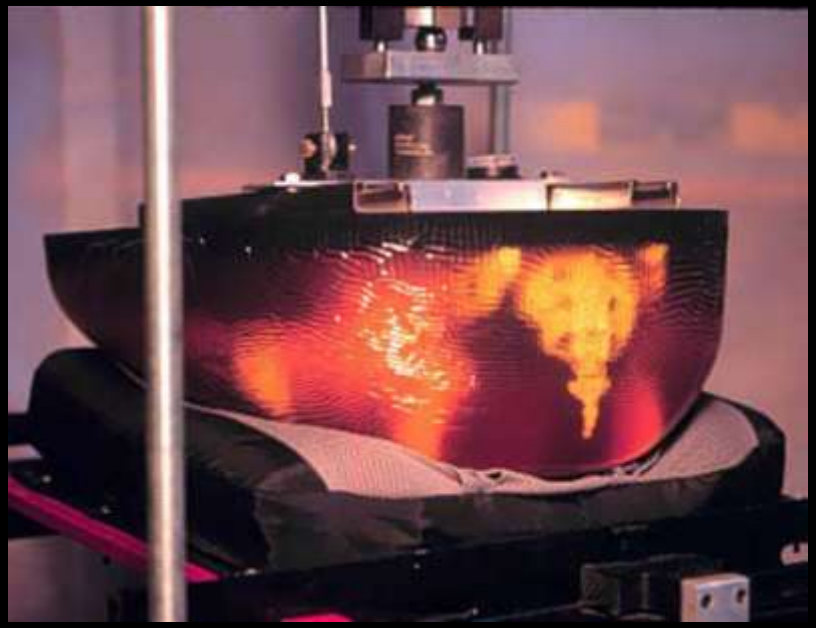


Seat Cushion Testing



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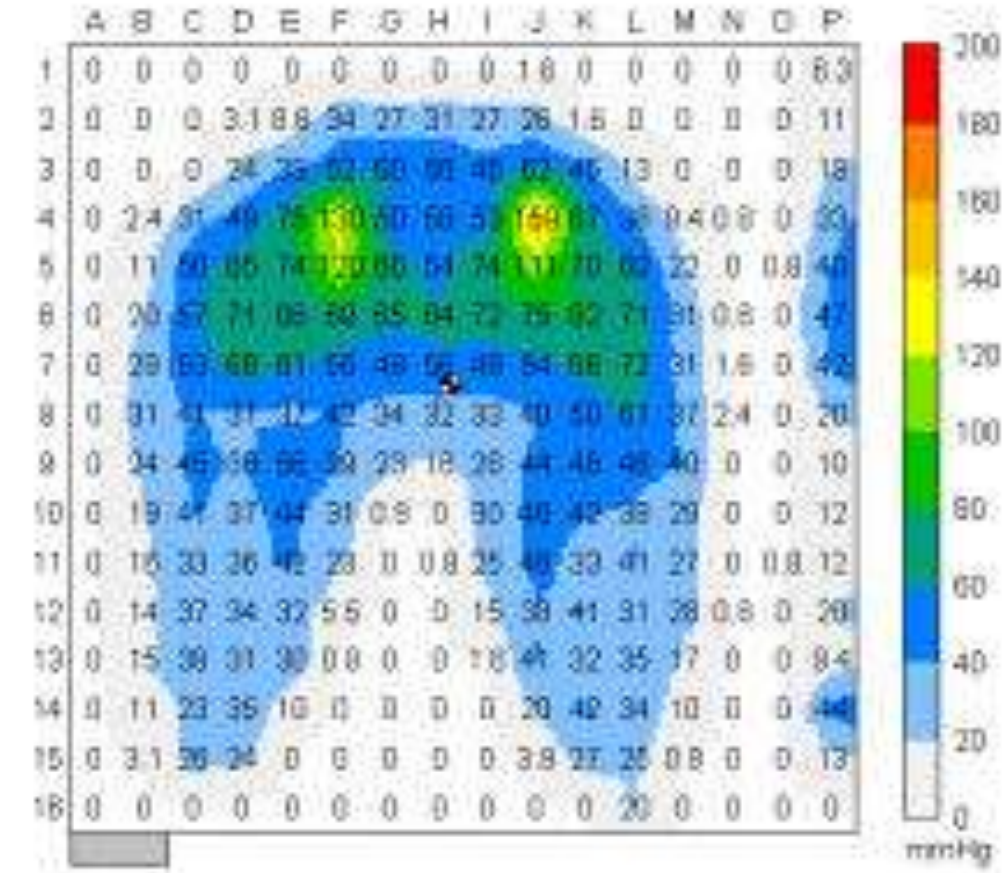
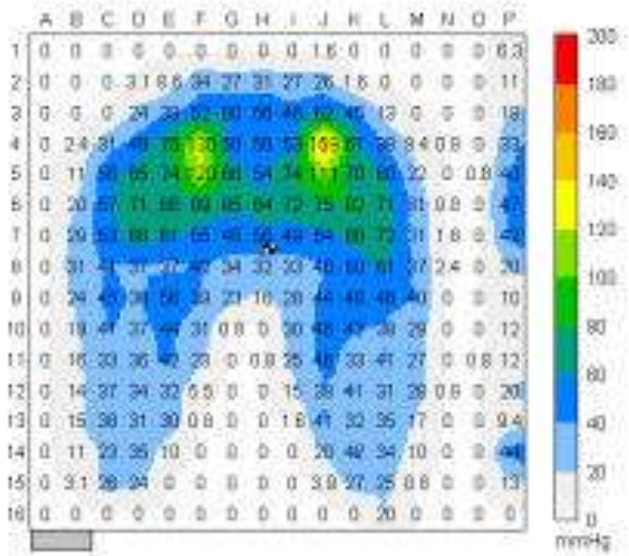
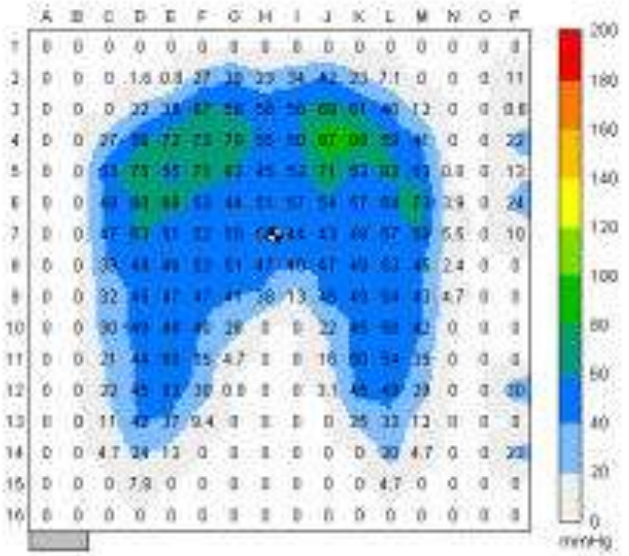
SKELI Used on Foam



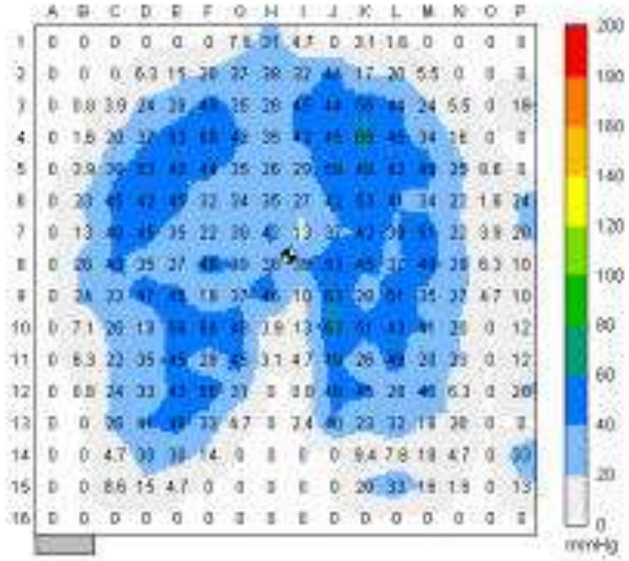
2" HR45 Foam Cushion



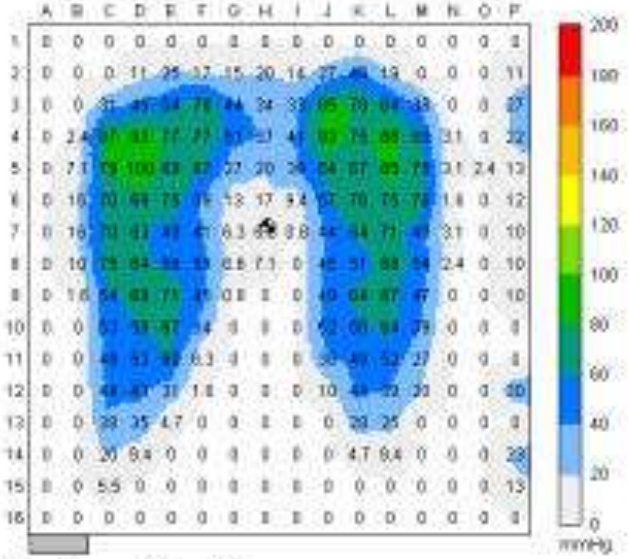
2" HR45 Foam



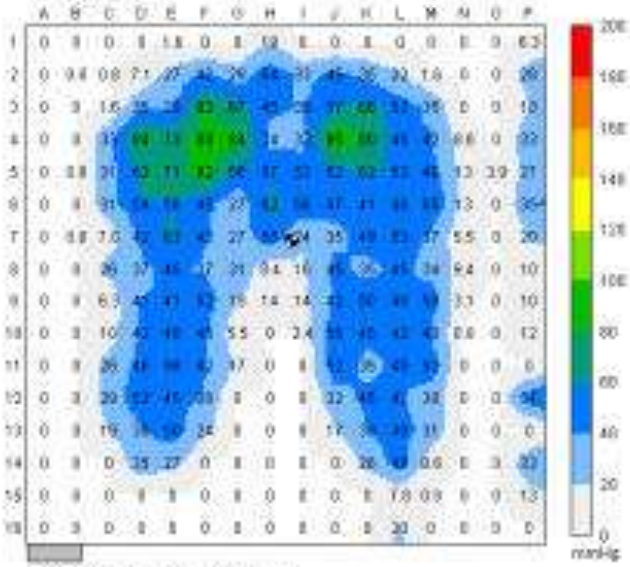
Jay 2 by Sunrise Medical



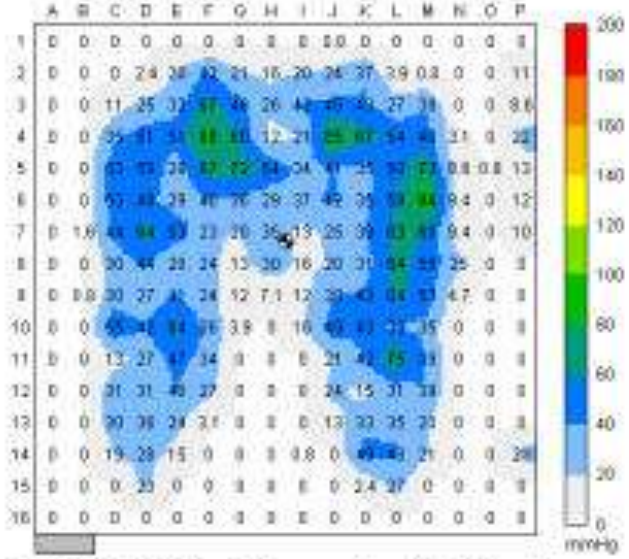
ROHO High Profile by ROHO Inc.



Contoured by Supracor



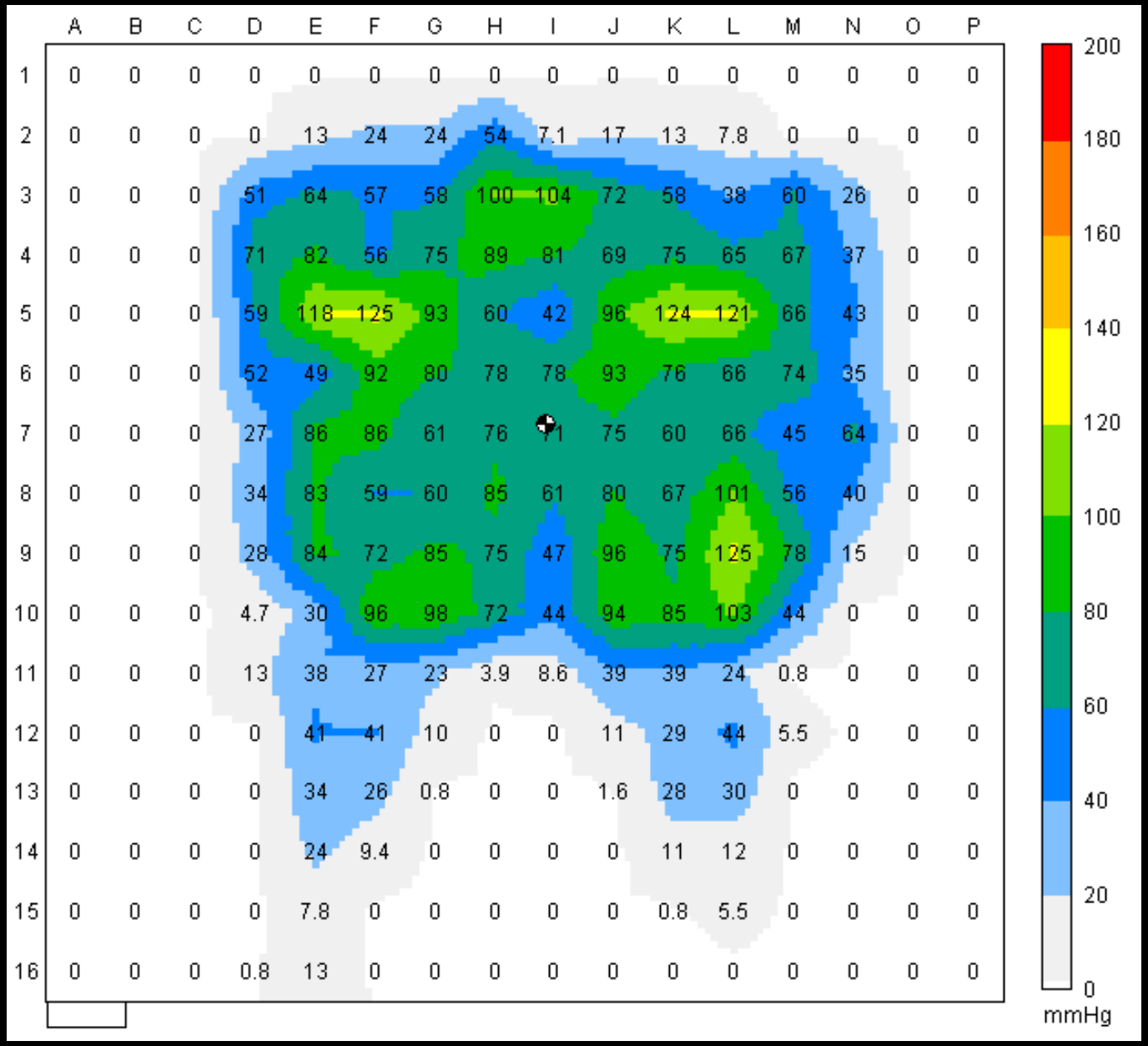
Model P by Vicair



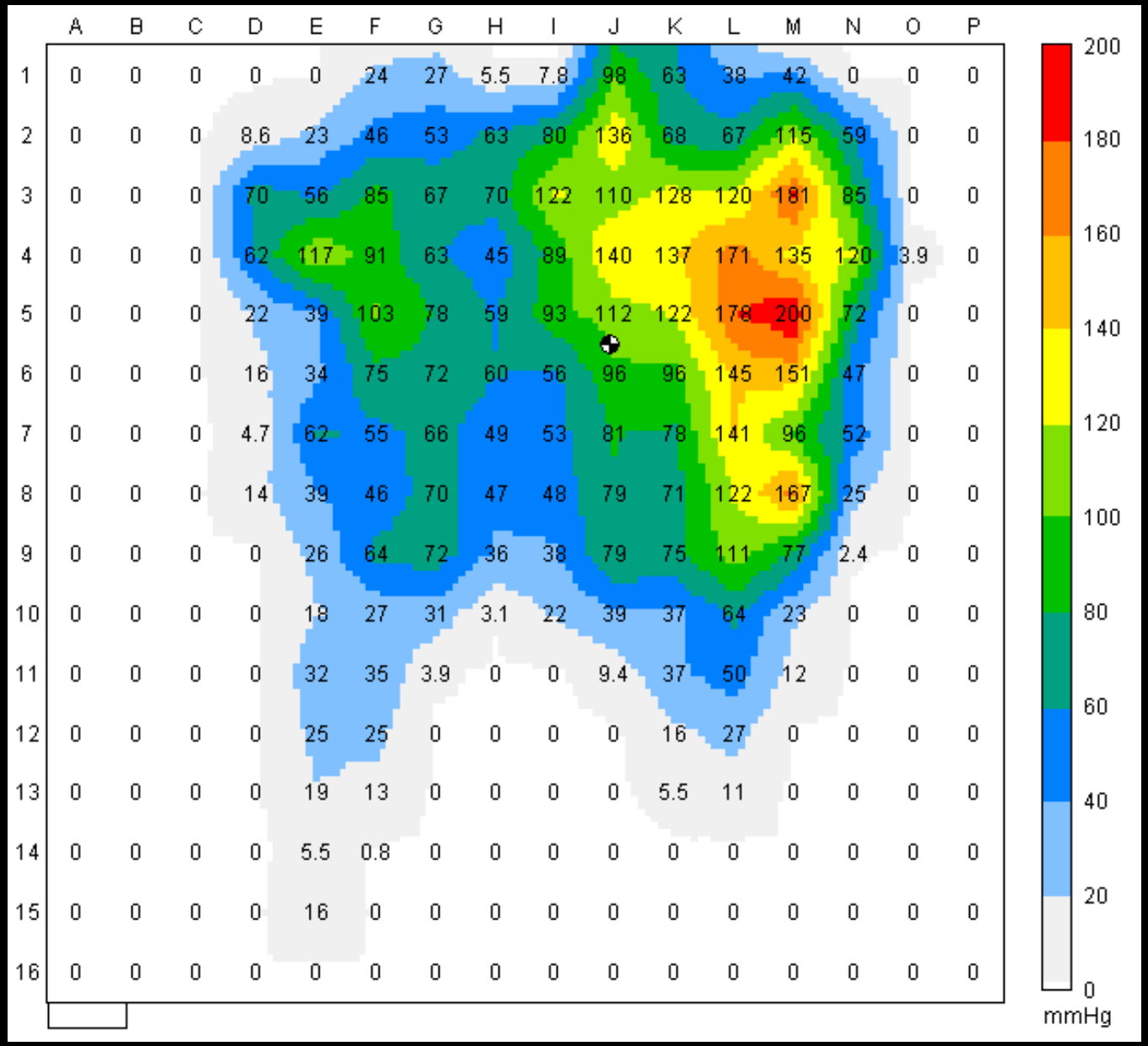
Model P Deep Immersion by Vicair

ASLI Prototype
ISO Part 2 Shape

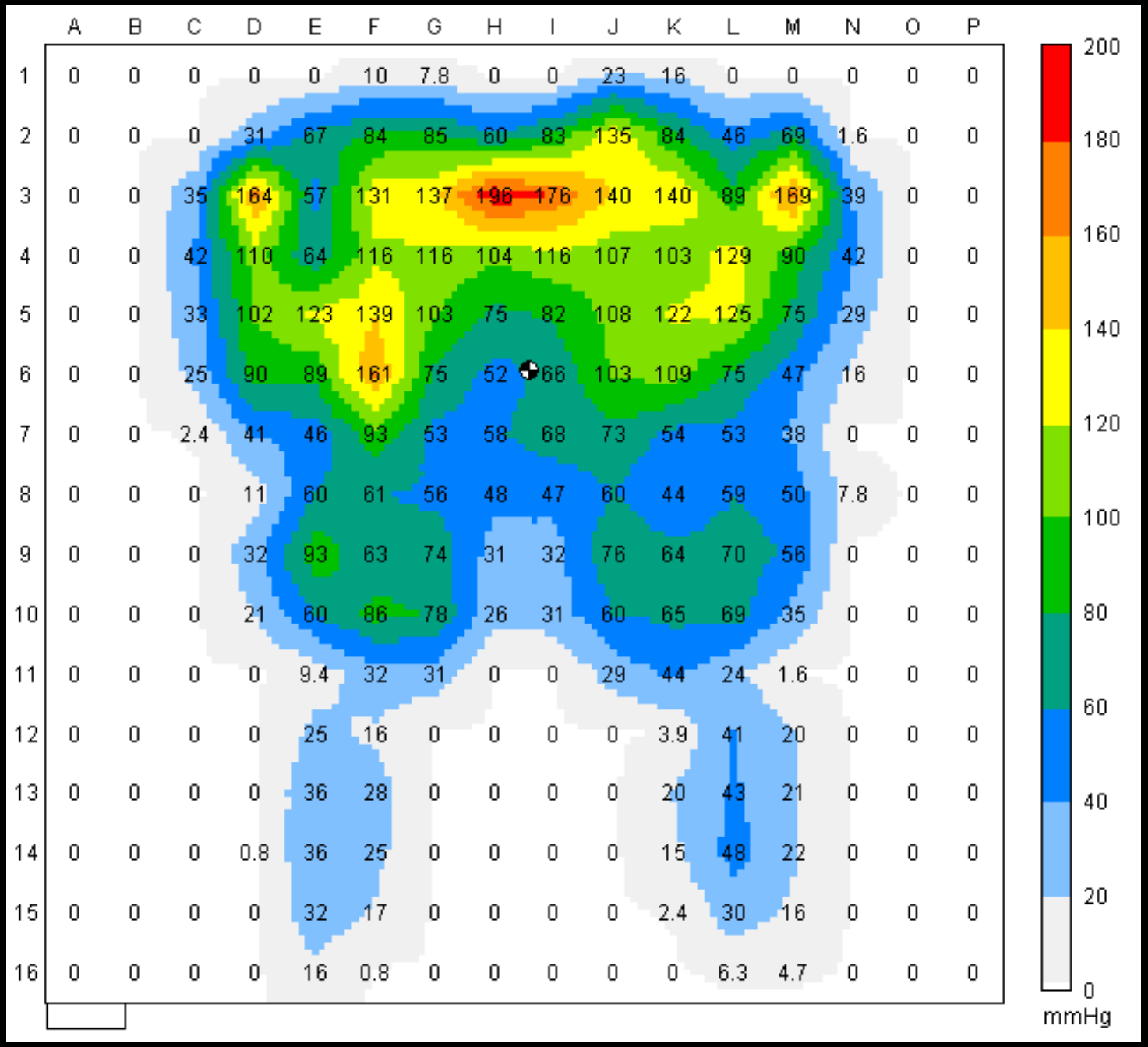
Pressure Measurements Symmetric



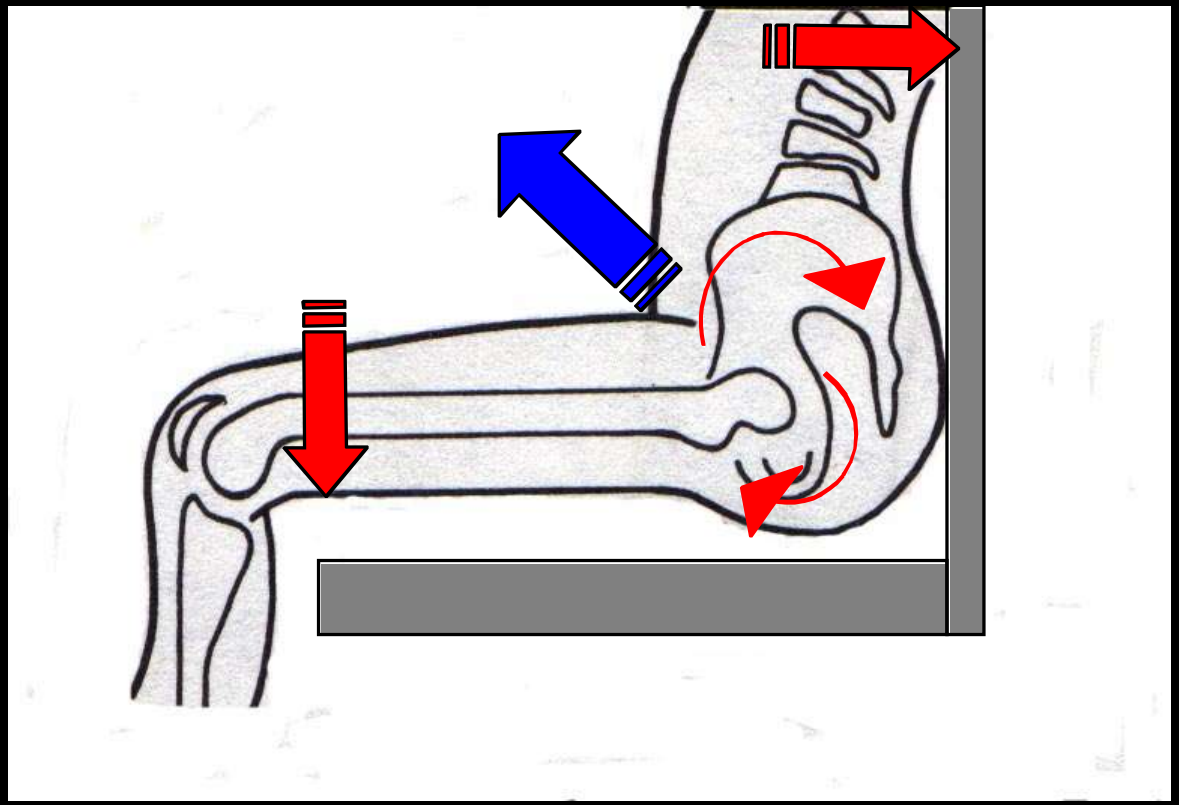
Pressure Measurements 10 Pelvic Obliquity



Pressure Measurements 15 Posterior Pelvic Tilt



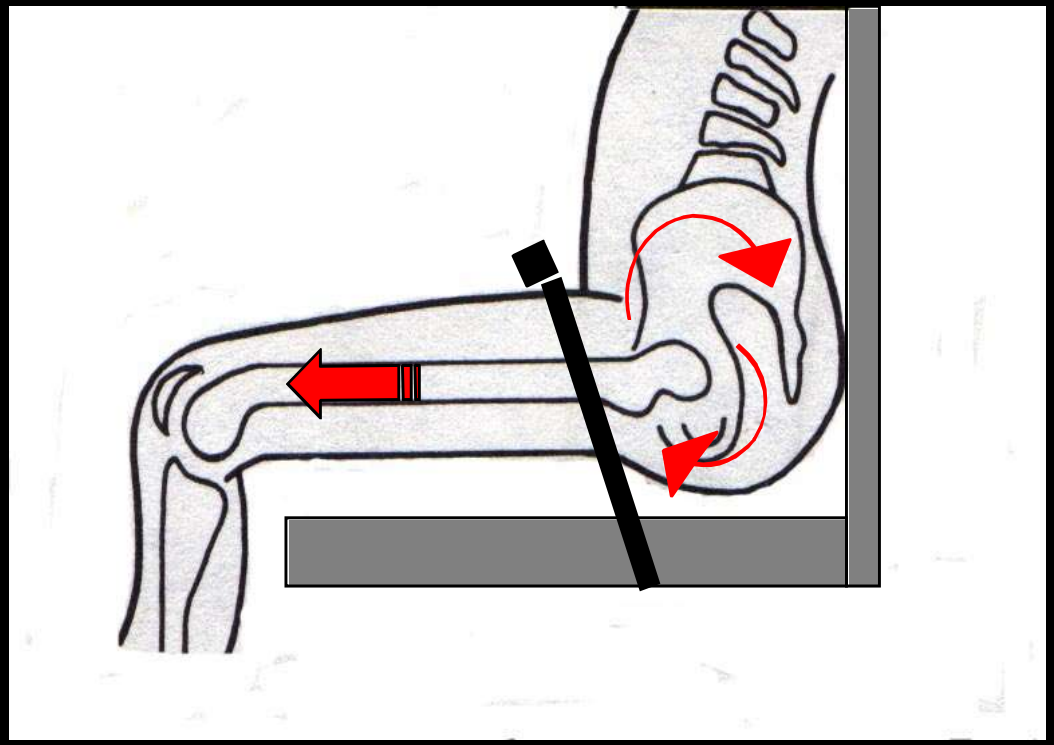
Pelvis Movement During Extensor Thrust Activity



Force at Thigh and Backrest During Extension

Pelvis Moves Up, Out and Rotates

Variations of Belt Angle

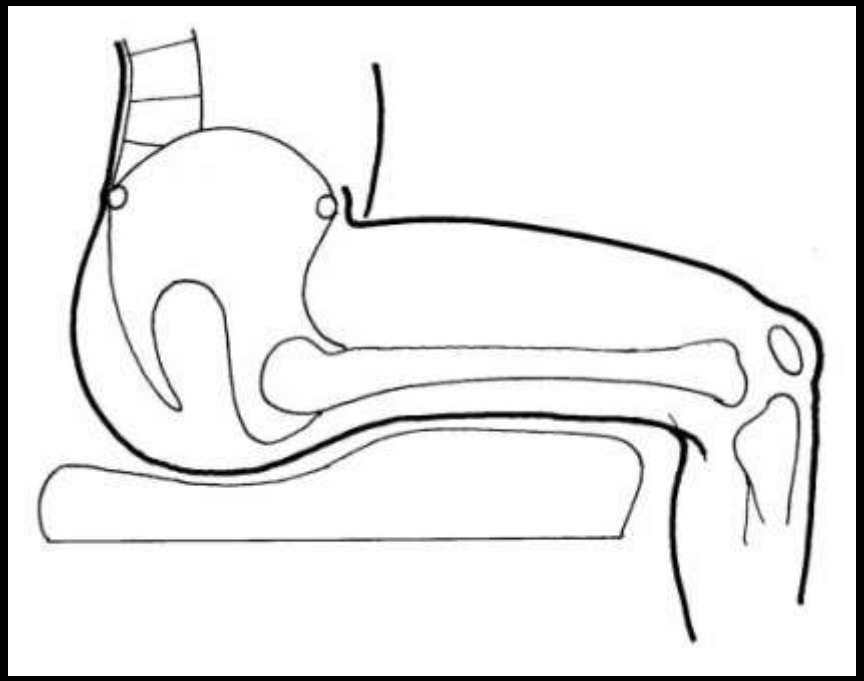


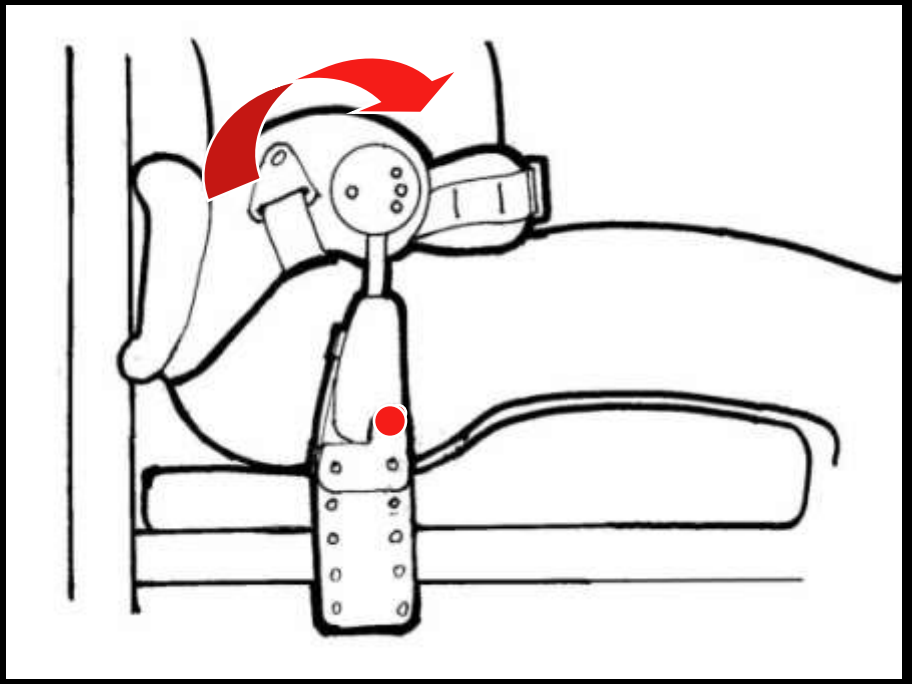
Downward Pull Limits Upward Movement

Allows Posterior Pelvic Rotation

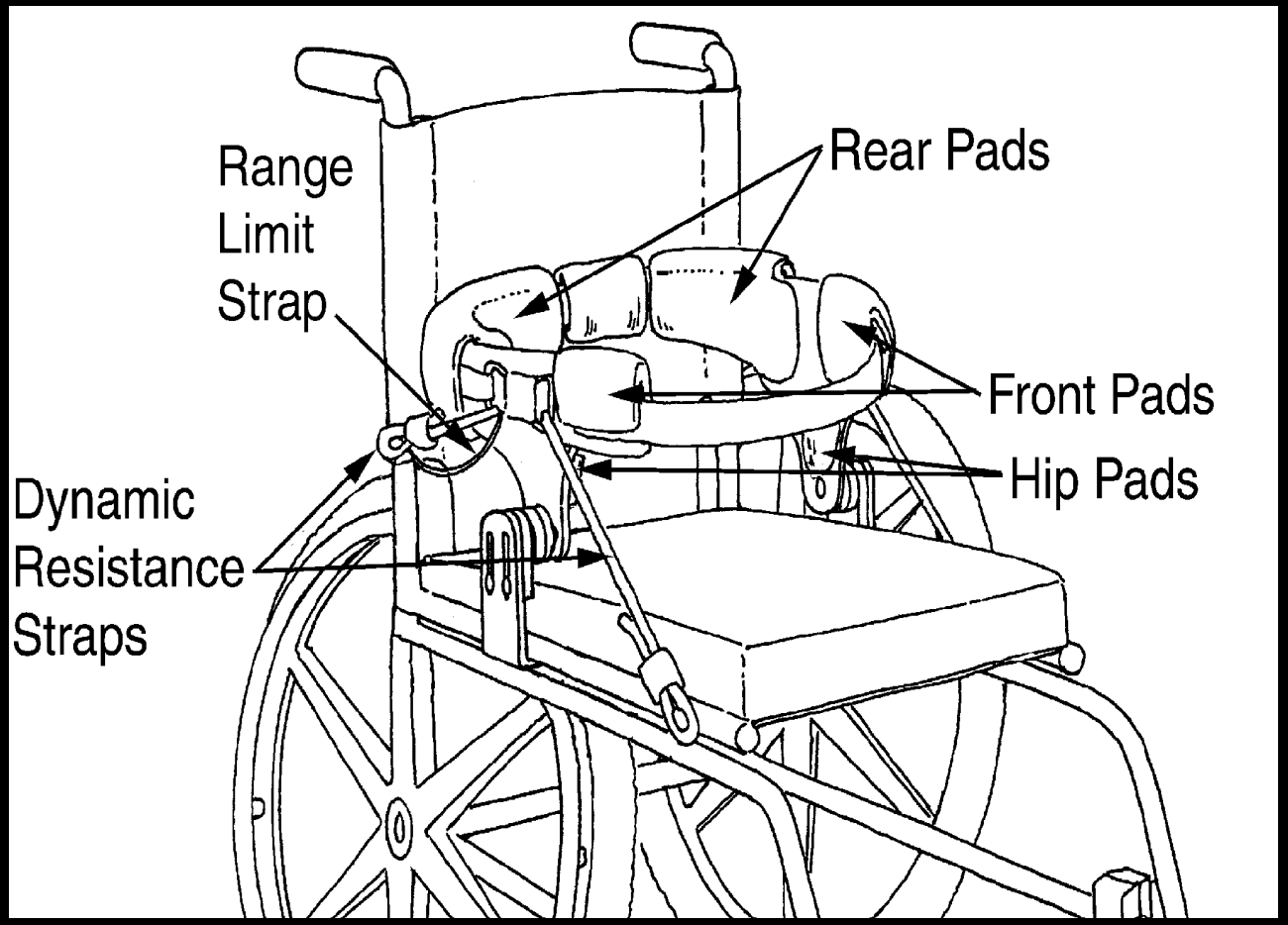
Limits Full Anterior ROM

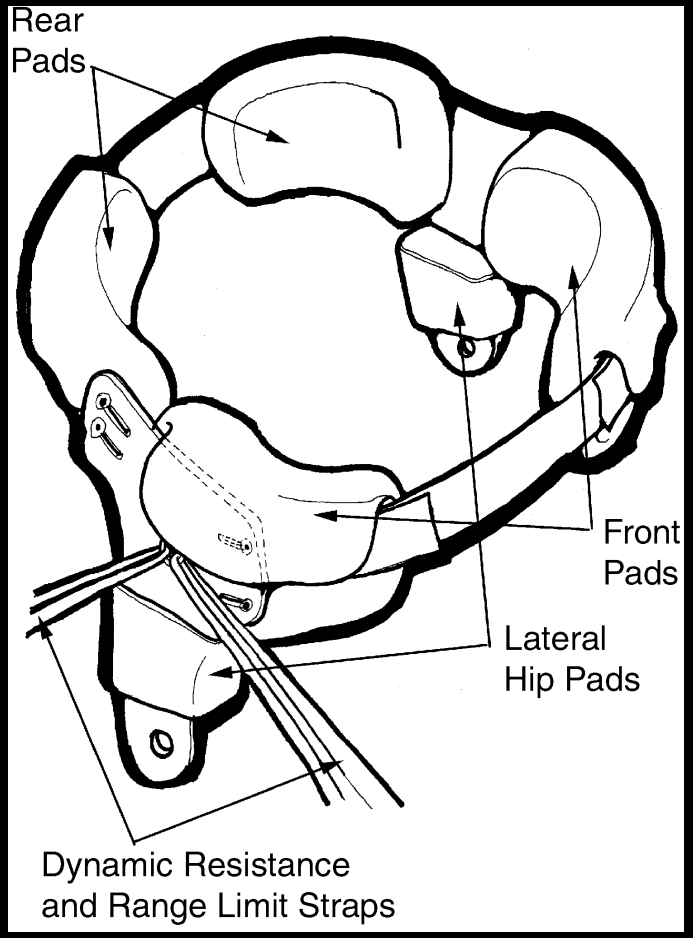
HipGrip Concept





HipGrip Ph1 - Prototype 2





What Is the HipGrip?

- Dynamic Pelvic Support
- Provides Pelvic Stability
- Allows Controlled Anterior Tilt ROM

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HipGrip Test Fixture

Functional Forward Reach

Functional Reach Downward

HipGrip

Available from
Bodypoint

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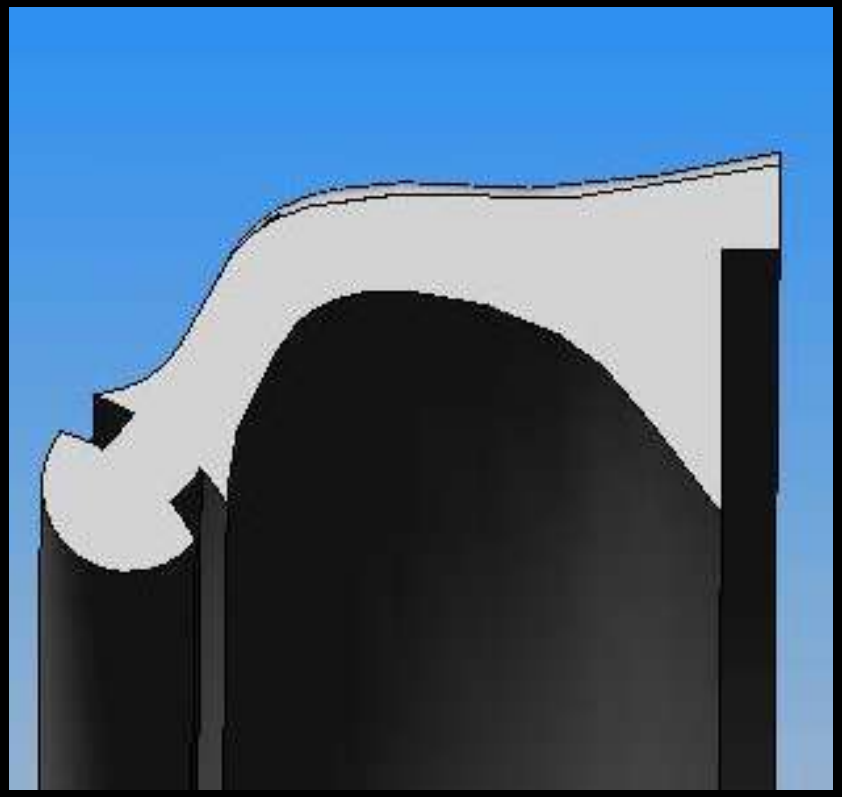
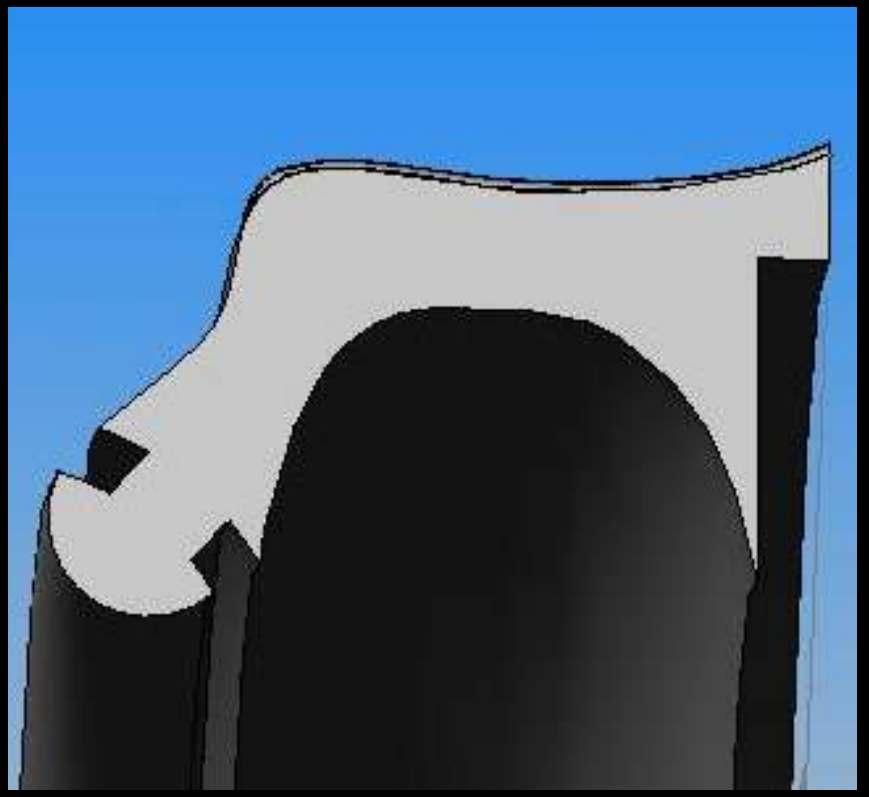
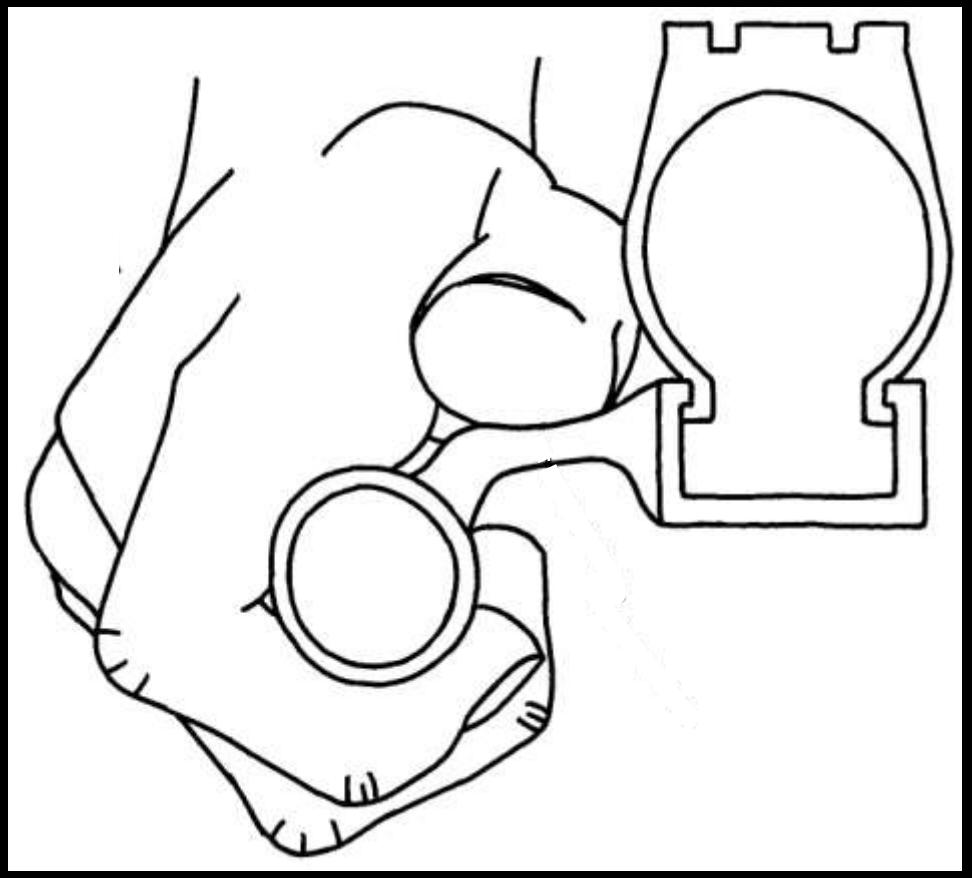
FlexRim – Combining the discrete compliant fasteners into one

The best profiles were fully developed and tested



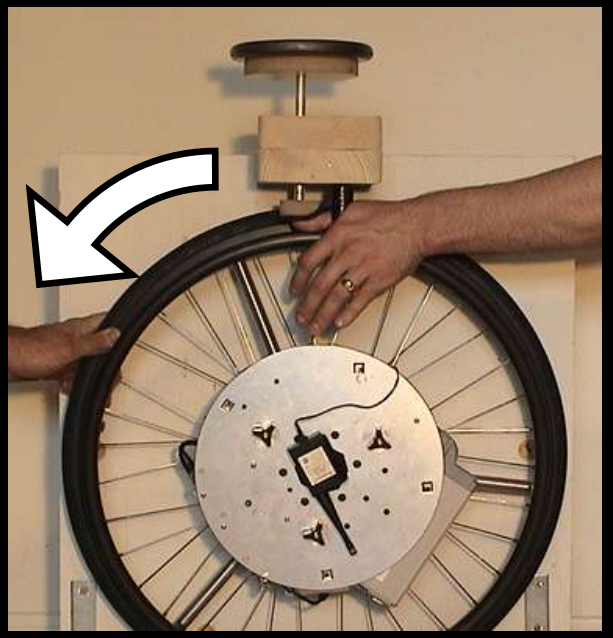


FlexRim Ergonomic Pushrim

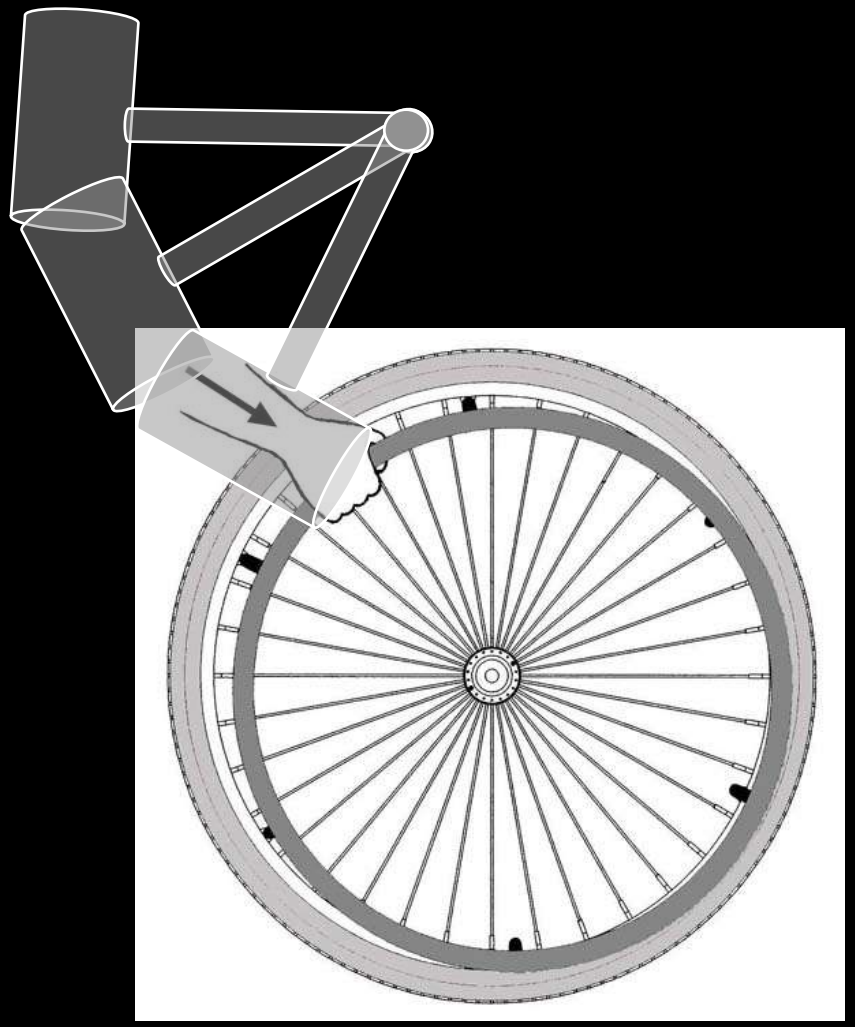


Frictional improvements

Preliminary tests show over a 2x increased frictional coefficient



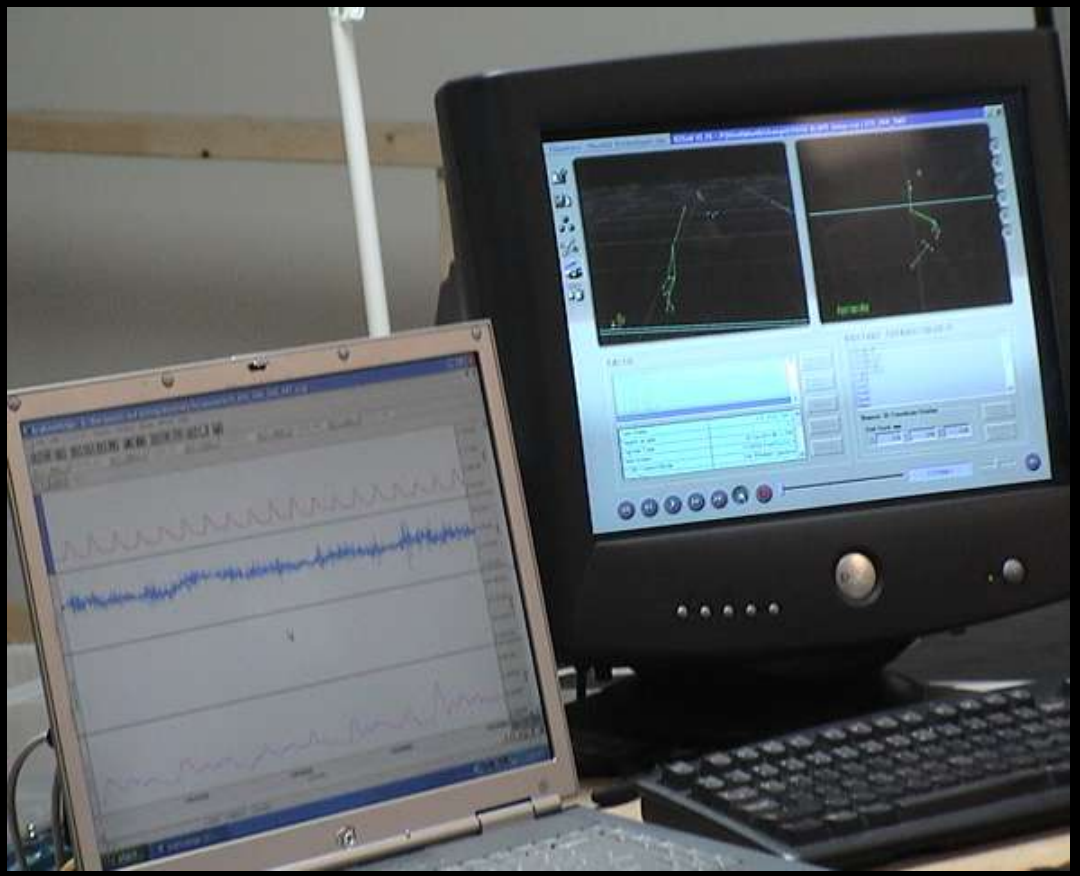
Impact absorption

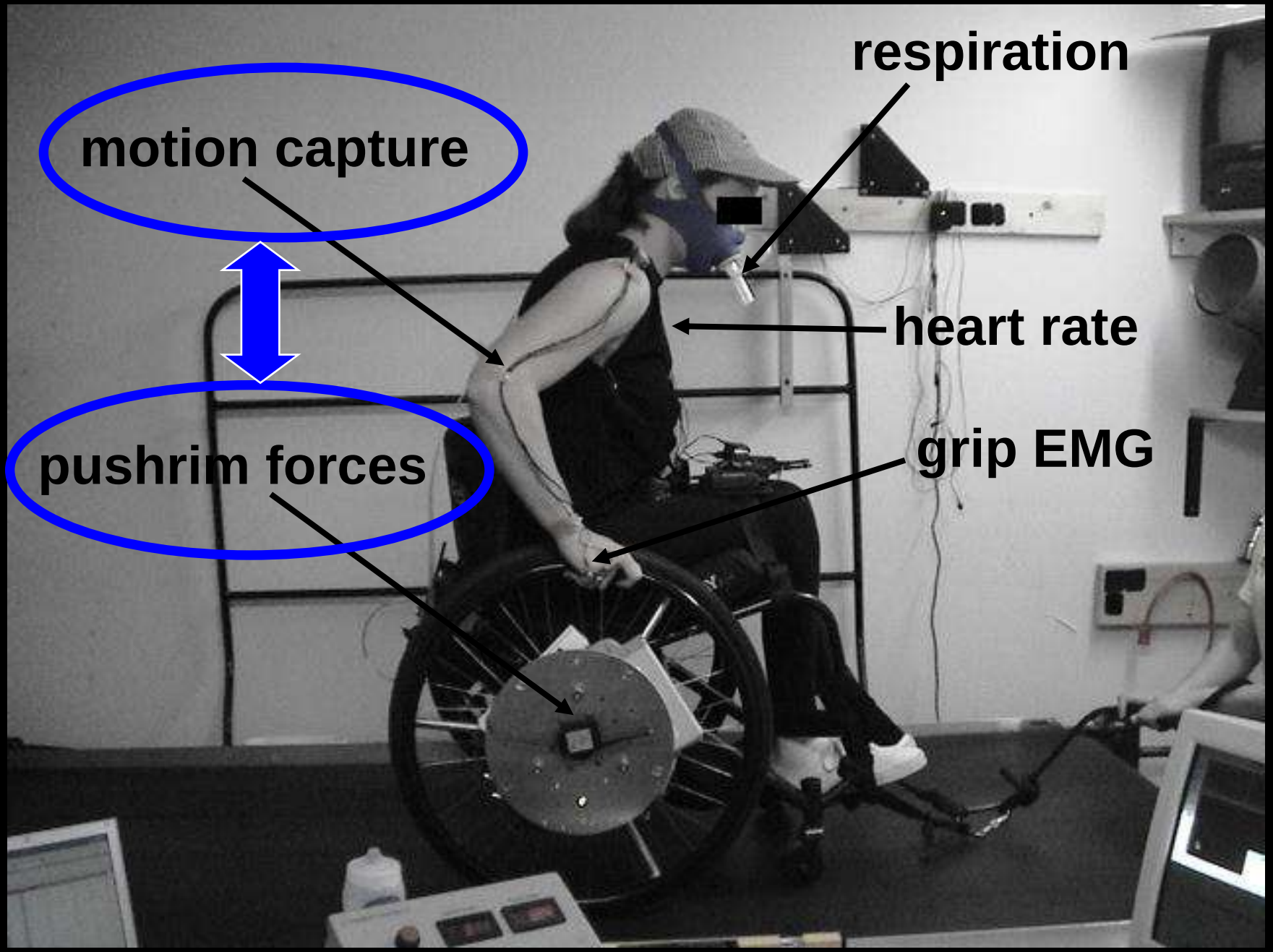


Applied a 120 lb repetitive load in one place until failure

Baseline study – FlexRim

Subjects are tested over a wide variety of usage environments




respiration
motion capture
heart rate
grip EMG
pushrim forces

FlexRim

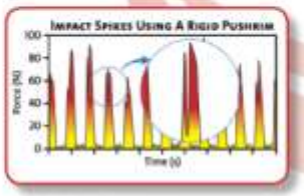
Design

The FlexRim consists of a durable high friction rubber surface that spans between the aluminum pushrim and the wheel. The shape of the rubber is ergonomically designed to conform to your hand when gripped, making it the most comfortable pushrim you will ever use.

Because the rubber is flexible, the pushrim can compress to allow your wheelchair to squeeze through narrow doorways.

Overuse Injuries

Shoulder and wrist problems are very common among wheelchair users. Impact loading is one of the contributing factors. Your hands and arms absorb impact spikes when you first hit the pushrim, illustrated in the graph below.



- Reducing impact is one strategy recommended to help protect you from developing overuse injuries.

Impact Testing

Impact loading of the FlexRim was studied for a wide range of impact intensities.

- The FlexRim was found to consistently ***reduce impact loading by 10%.***

Propulsion Testing

In lab testing, wheelchair users pushed with both a standard pushrim and the FlexRim on a research treadmill. Grip muscle activity, oxygen demand and power generated were all measured during propulsion and compared across pushrims.

Results of the testing were:

- Users required ***12% less grip force*** to push with the FlexRim.
- Overall ***grip exertion was reduced by 15%.***
- On average users required ***12% less oxygen*** to push with the FlexRim than with a standard pushrim.
- Users generated ***13% more power*** when using the FlexRim.

The ergonomic benefits of the FlexRim have been published in numerous scientific journals and in a PhD dissertation at Stanford University.

FLEXRIM BY SPINERGY

Advanced Ergonomics

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GripRim

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Adaptive Canoe Seating

Methods - Endurance

MedGraphics VO2000 portable metabolic system

Lateral Balance Test

Water Egress Testing

Wave Ski

Environmental Technologies

Things that do not move

Small Watercraft Launch Access

WATER TRAIL ACCESS INFORMATION

Crane Cove Park Watercraft Launch Site

Beach Access to San Francisco Bay Area Water Trail Network

Amenities & Allowed Uses

Amenities & Allowed Uses

- Boat Building
- Kayak
- Canoe Access
- Hand Launch
- Drinking Water
- Restrooms

Access Route

To Launch Environment

Length	**+ 350** ft
Elevation Loss	**5** ft
Grade	
Typical	**< 5%**
Maximum	
Cross Slope	
Typical	**< 2** ft
Tread Width	
Typical	**> 10** ft
Surface	
Type	**Asphalt / Concrete**
Stability	**Paved**
Amount	**100%**

Water Access Route

Pathway to MLLW to Transfer Area

Length	**+ 150** ft
Elevation Loss	**7.5** ft
Grade	
Typical	**< 5%**
Maximum	**< 8%**
Cross Slope	
Typical	**< 2** ft
Tread Width	
Typical	**72** in
Surface	
Type	**Sand w/ Structural Overlay**
Firmness	**Firm**
Penetration	**< 0.3** in
Stability	**Stable**
Penetration	**< 0.5** in

Transfer Area

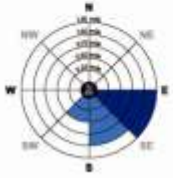
Above or At Water Line

Launch Type	**Beach**
Clear Space	
Length	**Unlimited**
Width	**200** ft
Grade	**< 5%**
Cross Slope	**< 2%**
Surface	**Sand w/ Structural Overlay**
Height Above Water	**Extends to MLLW**
Boat Orientation	**Unlimited**

Tide Fluctuation

Tide Fluctuation Information

Fetch:



Current:

HTL	**7.77**
MHHW	**6.34**
MHW	**5.73**
MLLW	**0.00**
LAT	**-2.09**

WARNING: Conditions may have changed since December 2016 when this facility was assessed. Temporary obstacles are not reported. Signage created by Beneficial Designs Inc. using data collected by a certified trail assessment coordinator.

The State Coastal Conservancy is leading the implementation of the San Francisco Bay Area Water Trail (Water Trail) in close collaboration with the Association of Bay Area Governments (ABAG), the San Francisco Bay Conservation and Development Commission, and the Department of Boating and Waterways. The Water Trail is a growing network of access sites (or "trailheads") that will help people using non-motorized, small boats or other beachable sail craft, such as kayaks, canoes, dragon boats, stand-up paddle and windsurf boards, to safely enjoy single and multiple-day trips around San Francisco Bay.

http://scc.ca.gov/2010/07/30/san-francisco-bay-area-water-trail/

Universal Trail Assessment Process (UTAP)

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Key UTAP Information

Length

Grade

Width

Surface

Cross slope

Features & Facilities

UTAP Assessment Team

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UTAP – Implementation Status

- Over 1300 people trained to lead UTAP assessments
- Over 155 trainers to teach UTAP workshops

High Efficiency Trail Assessment Process

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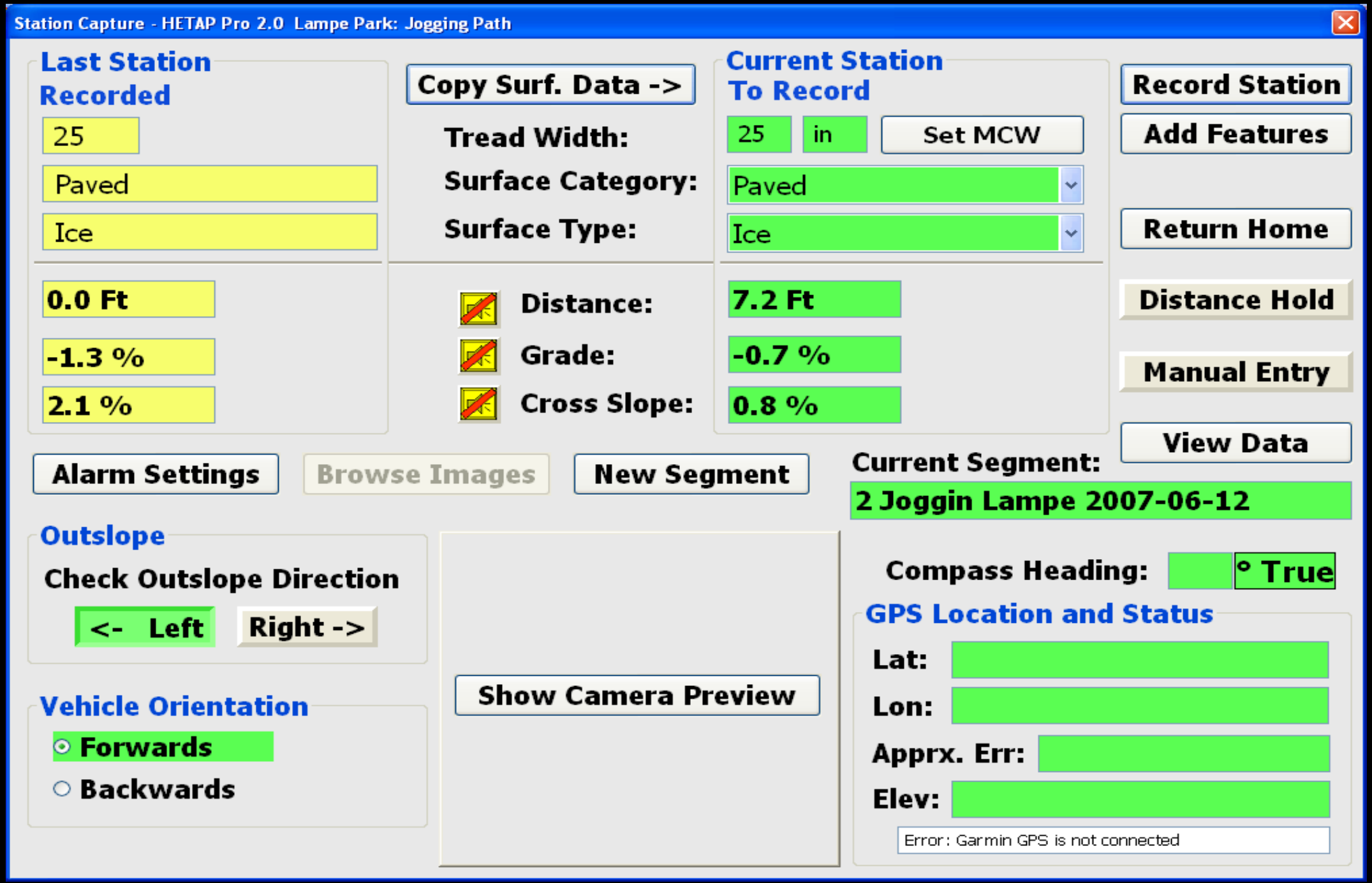
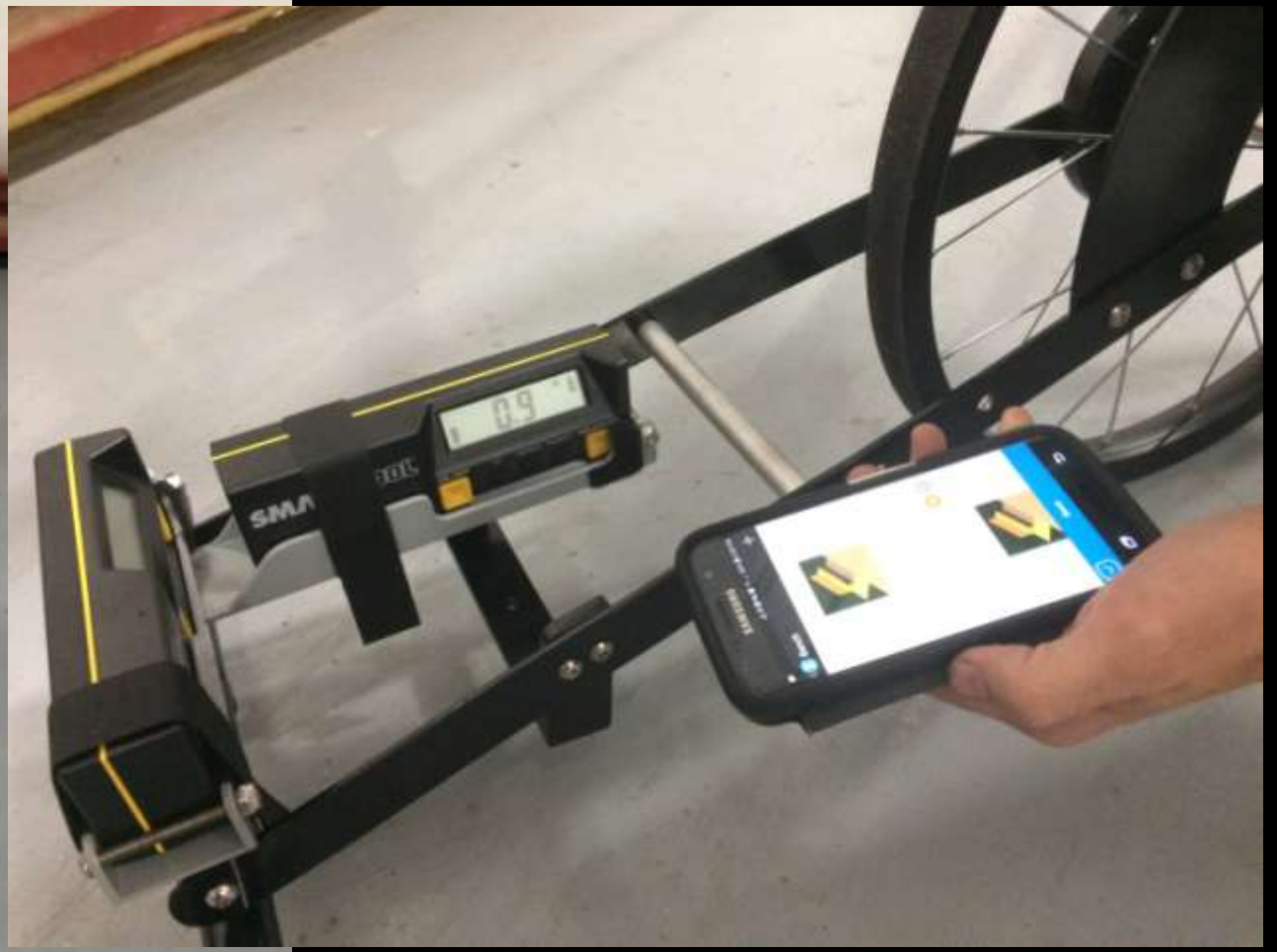
HETAP-Rollawheel


Station Capture - HETAP Pro 2.0 Lampe Park: Jogging Path
Last Station Recorded
25
Paved
Ice
0.0 Ft
-1.3 %
2.1 %
Copy Surf. Data ->
Tread Width:
Surface Category:
Surface Type:
Distance:
Grade:
Cross Slope:
Current Station To Record
25
in
Set MCW
Paved
Ice
7.2 Ft
-0.7 %
0.8 %
Record Station
Add Features
Return Home
Distance Hold
Manual Entry
View Data
Alarm Settings
Browse Images
New Segment
Current Segment:
2 Joggin Lampe 2007-06-12
Outslope
Check Outslope Direction
<- Left
Right ->
Vehicle Orientation
Forwards
Backwards
Show Camera Preview
Compass Heading:
° True
GPS Location and Status
Lat:
Lon:
Apprx. Err:
Elev:
Error: Garmin GPS is not connected




Dune Trek
Hikers
Bikes
Dogs on Leash
Equestrians
No Motorized Vehicles
Grade
Cross Slope
Tread Width
Surface

PAH RAH INTERPRETIVE TRAIL

Pah Rah Interpretive Trail

Golden Eagle Regional Park

Length	**0.5 mi** (0.8 km)
Elevation Gain	**36 ft** (11 m)
Elevation Loss	**36 ft** (11 m)

TRAIL USE

- **Bikes**
- **Dogs on Leash**
- **Hikers**
- **No Equestrians**
- **No Motor Vehicles**

GRADE

Typical Grade	**2.5%**
86% of trail is	**0%** to **4%**
395 ft (120 m) is	**4%** to **5%**
Standard Ramp Grade	**8.3%**

CROSS SLOPE

Typical Cross Slope	**1.9%**
96% of trail is	**0%** to **4%**
107 ft (32 m) is	**4%** to **5%**

TREAD WIDTH

Typical Width	**8 ft** (2.4 cm)
Minimum Width	**3.5 in** (1.1 cm)

SURFACE

Surface Type	**Asphalt**
100% of trail is	**Paved**
100% of trail is	**Stable**
Typical Firmness	**0.16** in

Herd	Firm	Moderately Firm	Not Firm
	0.20 in	0.35 in	0.55 in

Minimum Firmness	**0.16** in
Typical Stability	**0.18** in

Herd	Stable	Moderately Stable	Not Stable
	0.25 in	0.55 in	1.05 in

Minimum Stability	**0.18** in

OBSTRUCTIONS

Obstructions	**None**

VIEW MAP

Scan QR code to view
Golden Eagle Regional Park Map
Google Maps

WARNING: Trail conditions may have changed since June 2009 when this trail was assessed.
Temporary obstructions were not recorded.

Signage created by **Beneficial Designs Inc.** using data collected by a certified trail assessment coordinator.
Funded by the Nevada Recreational Trails Program.

ACCESS INFORMATION

Trail Access Information (TAI)

TAI to convey to users in a Nutrition Facts Label format:

- Grade
- Cross Slope
- Tread Width
- Surface
- Obstructions

TRAIL ACCESS INFORMATION

Tahoe Rim Trail

Tahoe Meadows to **Spooner Summit**

Length	**21.8 mi** (35.0 km)
Elevation Gain	**2894 ft** (882 m)
Elevation Loss	**5528 ft** (1685 m)

TRAIL USE

Hikers

Tahoe Meadows Interpretive Trail

Humboldt-Toiyabe National Forest
Carson Ranger District

FREE COPIES of this map can be downloaded from the Humboldt-Toiyabe National Forest website or by calling the US Forest Service Carson Ranger District at (775) 882-2766

North

0 ft — 300 ft

To Reno NV

To Mount Rose Wilderness

Mount Rose Summit Trailhead

Mount Rose Campground

Mount Rose Summit Trail

Tahoe Rim Trail

Tahoe Rim Trail

To Relay Peak and Brockway Summit

Mount Rose State Scenic Byway
NV Highway 431

Vista

To Incline Village

Tahoe Meadows Trailhead
Elevation 8730 ft

Easiest Path of Travel

Steep Grades

To Ophir Creek Trail

You Are Here

Tahoe Meadows Interpretive Trail

Funded by the Nevada Recreational Trails Program

TRAIL USES PERMITTED

- Hiking
- Dogs on leash or under control of owner
- Bikes allowed on dotted trails only
- Equestrians allowed on dotted trails only
- No Motor Vehicles

Please stay on official trails

LEGEND

- Bridge
- Camping
- Parking
- Restroom
- Campground Fee

Trail Name	Tahoe Meadows Interpretive Trail	Mount Rose Summit Trail	Tahoe Rim Trail (From Tahoe Meadows Trailhead to Spooner Summit Trailhead)
Length	1.3 mi	5.0 mi	21.8 mi
Typical Grade	2.5%	10.7%	7.3%
Maximum Grade	1690 ft is 5 – 7%	1003 ft is 25 – 39%	1829 ft is 20 – 29%
Typical Cross Slope	2.1%	4.1%	3.2%
Maximum Cross Slope	304 ft is 5 – 10%	1711 ft is 10 – 20%	2433 ft is 10 – 20%
Typical Tread Width	8 ft	26 in	28 in
Minimum Clearance Width	42 in	12 in	18 in
Surface Type	Decomposed Granite	Soil	Soil
Typical Surface Firmness	0.18 in (Worst 0.22 in)	0.18 in (Worst 0.21 in)	0.17 in (Worst 0.19 in)
Typical Surface Stability	0.54 in (Worst 0.62 in)	0.57 in (Worst 0.74 in)	0.51 in (Worst 0.73 in)

Surface Firmness (in): <0.25 Hard Paved; <0.35 Firm; <0.55 Moderately Firm; >1.00 Soft Sand

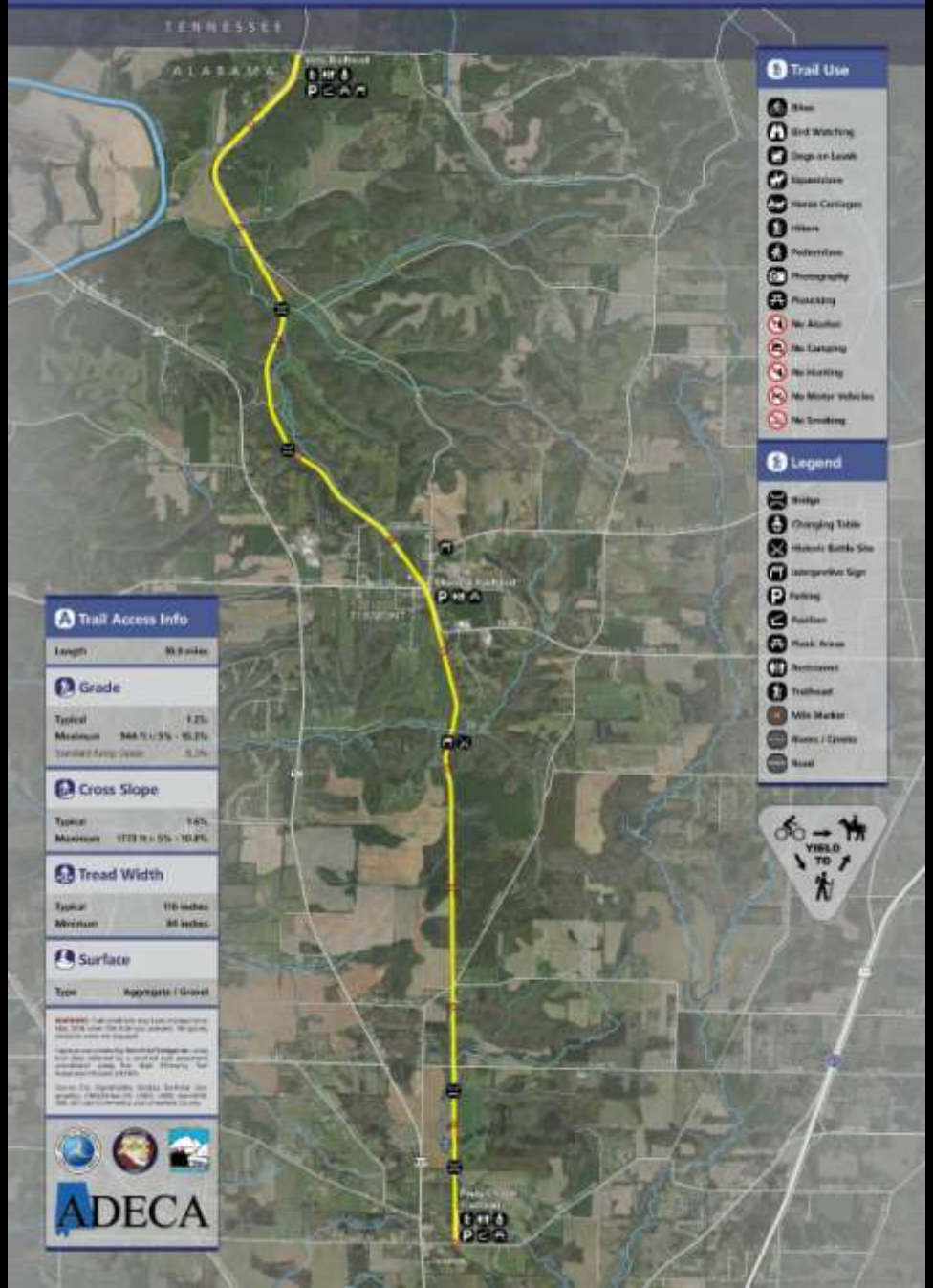
Surface Stability (in): <0.25 Hard Paved; <0.35 Stable; <0.55 Moderately Stable; >1.00 Unstable Sand

WARNING: Trail conditions may have changed since July 2009 when these trails were assessed. Signage created by Beneficial Designs Inc. using data collected by a certified trail assessment coordinator.

Trail Access Information

Richard Martin Trail

North



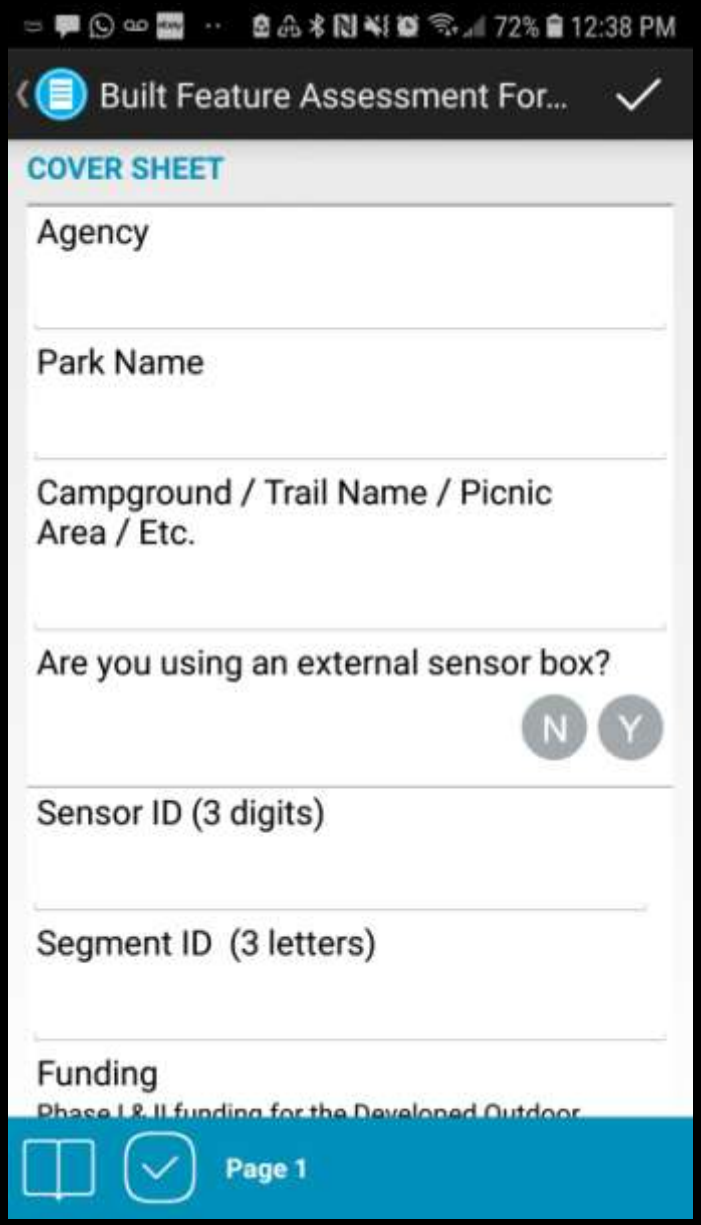
ASH TO KINGS TRAIL

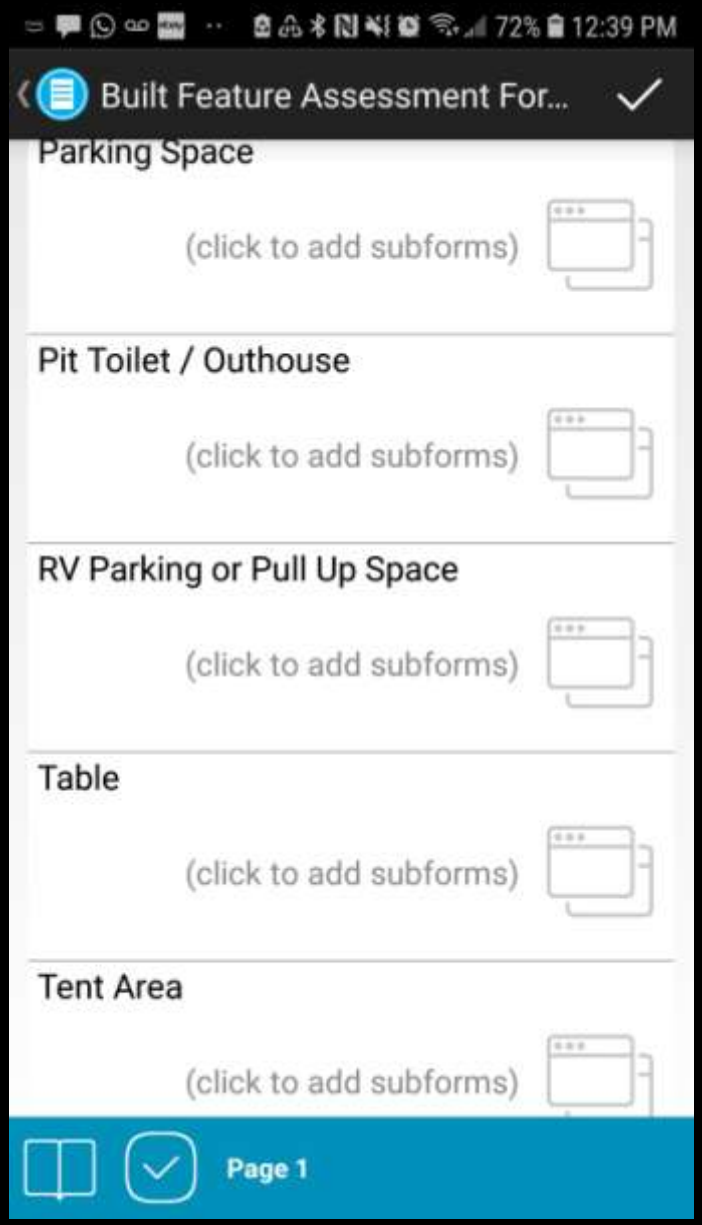
Developed Outdoor Recreation Assessment Process

Outdoor Constructed Features

- Bench
- Camp Shelter
- Cooking Surface/Grill
- Fire Ring, Wood Stove/Fireplace
- Outdoor Rinsing Shower
- Parking Area
- Picnic Table
- Pit Toilet
- Tent Pad/Platform
- Toilet Building
- Trash/Recycling Receptacle
- Utility/Sewage Connection
- Viewing Area at Overlooks
- Viewing Scope
- Water Spout

Picnic Table Clearance Space


72% 12:38 PM
Built Feature Assessment For...
COVER SHEET
Agency
Park Name
Campground / Trail Name / Picnic Area / Etc.
Are you using an external sensor box?
N
Y
Sensor ID (3 digits)
Segment ID (3 letters)
Funding
Page 1


72% 12:39 PM
Built Feature Assessment For...
Parking Space
(click to add subforms)
Pit Toilet / Outhouse
(click to add subforms)
RV Parking or Pull Up Space
(click to add subforms)
Table
(click to add subforms)
Tent Area
(click to add subforms)
Page 1

Table

ABA/FSORAG

What type of assessment?

○ ABA ○ FSO

REQUIRED SPACES

Is the table Circular?

Table Diameter

Measure the height from the
to the table top

Table

Table

Measure the height from the gro
to the table top

Table surface height (min 28 in
- max 34 in)

Compliant

CLEAR SPACE

Does one full unobstructed side
clear ground space around the t
adjoin or overlap an ORAR trail

Table

Table

WHEELCHAIR CLEAR SPACE

Measure the Wheelchair clear s
length. The length may extend a
maximum of 25 inches beneath
the table.

WC Clear space length (min 48 i

Not compliant

Measure the Wheelchair clear

Table

Table

Suggested maintenance

Notes

Optional photos

MANUFACTURER INFO

Manufacturer and Model

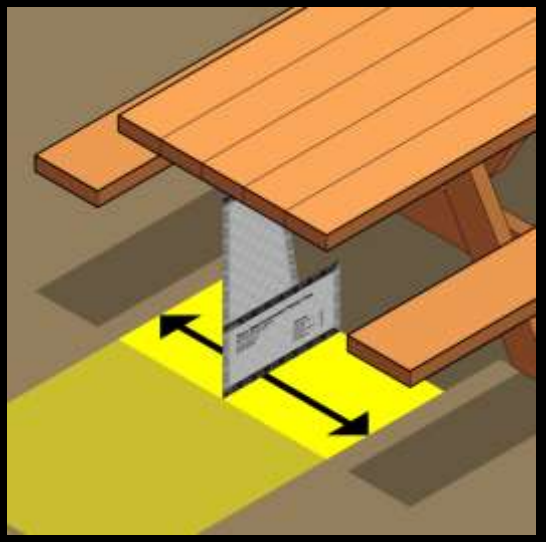
If available, enter the model and manufacturer of the feature.

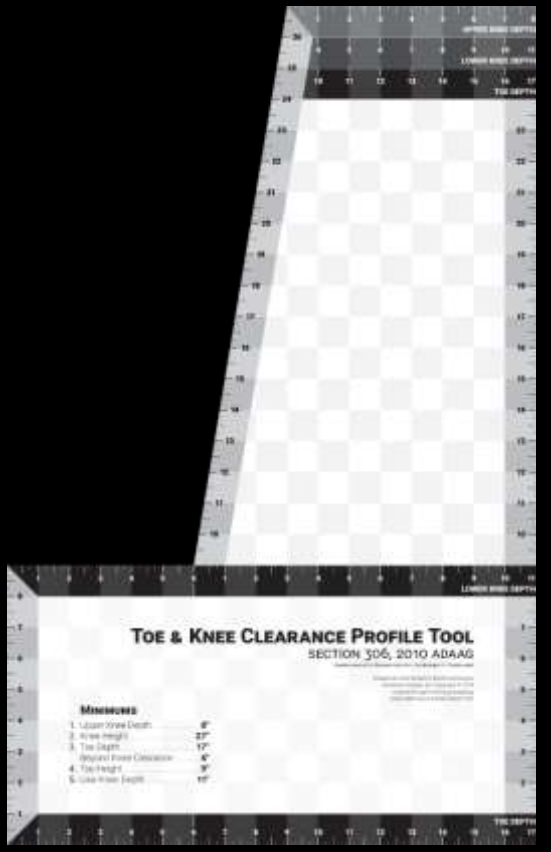
Manufacturer

Model

Knee & Toe Clearance Profile Tool

Unobstructed Knee & Toe Space





Adjustable Height Cooking Grill

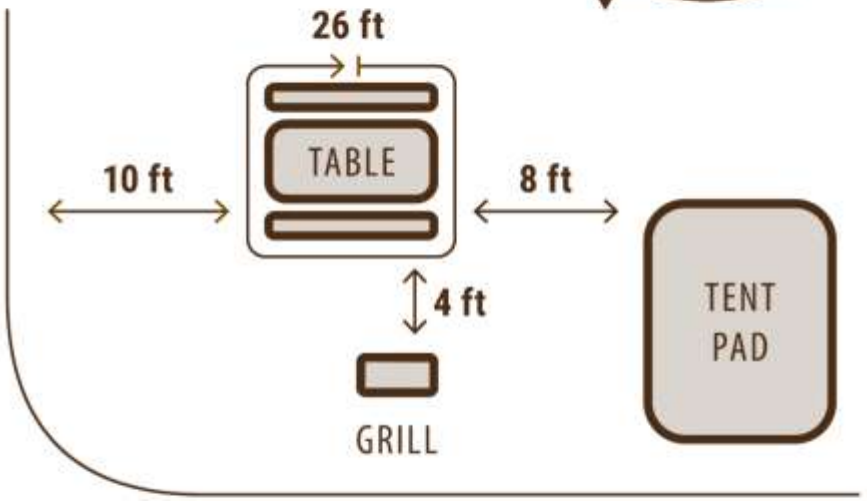
Water Pump with Closed Fist Operation

Water Pump Actuation Force

Water Pump Height Measurement

Campsite
Access Info

RESET
BEFORE YOU GO



Please return elements so that this campsite remains **accessible**

If you do not require access and mobility features, please do not use this site between **11AM and 6PM**


Site 18
PRIORITY USAGE
11AM 6PM
Accessible Elements
Tent Pad
Table
Pivot Grill
Fire Ring
Hydrant
RESET
BEFORE YOU GO
Please return elements so this campsite remains accessible
U.S. Department of Agriculture
CAMPSITE
ACCESS INFORMATION

Site 18

Single Site

PRIORITY USAGE

If you **DO NOT** require access and mobility features, please **DO NOT** use this site between:

11AM – **6PM**

11AM – 6PM

Accessible Elements

Tent Pad

Size	11.6 ft x 16.0 ft
Accommodates	4 Persons

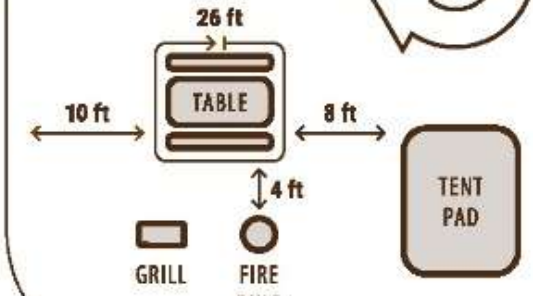
Table

Pivot Grill

Fire Ring

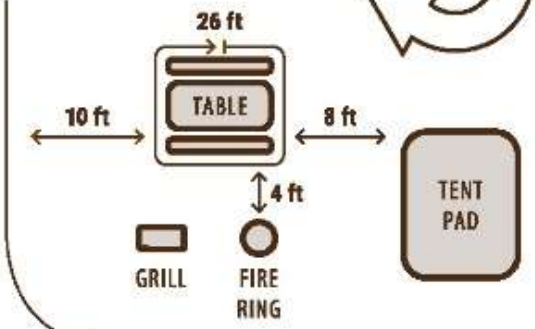
Hydrant

RESET BEFORE YOU GO



Hydrant

RESET BEFORE YOU GO



Please return elements so this campsite remains **accessible**

WARNING: Campsite conditions may have changed since March 2011 when this campsite was assessed. Temporary obstructions were not recorded.

Phase I & II funding for the Developed Outdoor Recreation Assessment Process is provided by the **U.S. Department of Agriculture** through the Small Business Innovation and Research Program Grant number 2013-33610-21051

CAMPSITE ACCESS INFORMATION

Signage created by **Beneficial Designs Inc.** using data collected by a certified campsite assessment coordinator

www.trailexplorer.org

Beneficial Designs
research/design/education
Designing beyond the norm to meet the needs of all people.

Trails with desired access features

TRAIL EXPLORER

HOME ABOUT US DEFINITIONS LINKS TRAIL ACCESS INFORMATION

Click on the trail name for more information. **Click on the column heading** to sort by column.
9 trails found. Use the "Back" button on your browser to refine your selection.

Trail	Park	Nearest Town(s) State	Length	Uses	Typical Grade	Surface Firmness	Trail Information
Trail 10	McCormick's Creek State Park	IN	0.7 miles (1.1 km)	Hiking	3.3%	Firm	Trail 10 begins near the stairs on Trail 3. The trail follows McCormick's Creek downstream to the Old Statehouse Quarry and Trail 2. Depending on the season and water levels, that trail borders the creek, crosses the creek numerous times, or is completely in the creekbed.
Trail 8	McCormick's Creek State Park	IN	0.7 miles (1.1 km)	Hiking	2.3%	Paved	Trail 8 connects the campground to the swimming pool and Nature Center. Pine Bluff Shelter and picnic/playground area can be reached from the trail.
Trail A	McCormick's Creek State Park	IN	0.2 miles (0.3 km)	Hiking	2.2%	Firm	Trail A is a connector trail from the Class A campground to Trail 7.
Trail 6	Spring Mill State Park	IN	0.4 miles (0.7 km)	Hiking	2.3%	Paved	Trail 6 is a paved loop trail near the Virgil I. "Gus" Grissom Memorial.
Trail 7	Spring Mill State Park	IN	0.9 miles (1.5 km)	Hiking	3.3%	Firm	Trail 7 loops around the Oak Ridge Picnic Area and connects with Trail 7 Spur that leads to Trail 4.
Trail 7 Spur to Trail 4	Spring Mill State Park	IN	0.4 miles (0.6 km)	Hiking	3.9%	Firm	Trail 7 Spur connects Trail 7 from the Oak Ridge Picnic Area to Trail 4
Trail 10 Spur to Camels Back	Turkey Run State Park	IN	0.1 miles (0.2 km)	Hiking	0.9%	Firm	The spur to Camel's Back begins at the junction of Trail 10. The short trail ends at Camel's Back. There is an observation deck and bench.
Trail 11	Turkey Run State Park	IN	0.2 miles (0.3 km)	Hiking	3.1%	Firm	Trail 11 starts from the Service Road besides the Turkey Run Inn. A short hike about Turkey Run Hollow to the Lieber Memorial and Log Church.
Trail 7 Spur to Campground	Turkey Run State Park	IN	0.1 miles (0.2 km)	Hiking	3.3%	Firm	Connector trail between the Campground and Trail 7.

home | about us | definitions | trail access information
links | acknowledgments | disclaimer

Develop standards for trail and sidewalk design

- Architectural Barriers Act Outdoor Recreation Access Guidelines
- Public Rights of Way Access Guidelines

Beneficial Designs
research/design/education
Designing beyond the norm to meet the needs of all people.

ADA Recreation Trail

Grade

- up to 30% of length > 8.33%
- 5% for any distance
- 8.33% for 200 feet
- 10% for 30 feet
- 12.5% for 10 feet
- 14% for 5 feet in drains if cross slope < 5%

ADA Recreation Trail

- Cross Slope
  - 5%
  - 10% in drains if width > 42 inches
- Rest Areas
  - 60 inches length, trail width, 5% slope
- Edge Protection
  - 3 inches minimum height when provided

ADA Outdoor Access Route

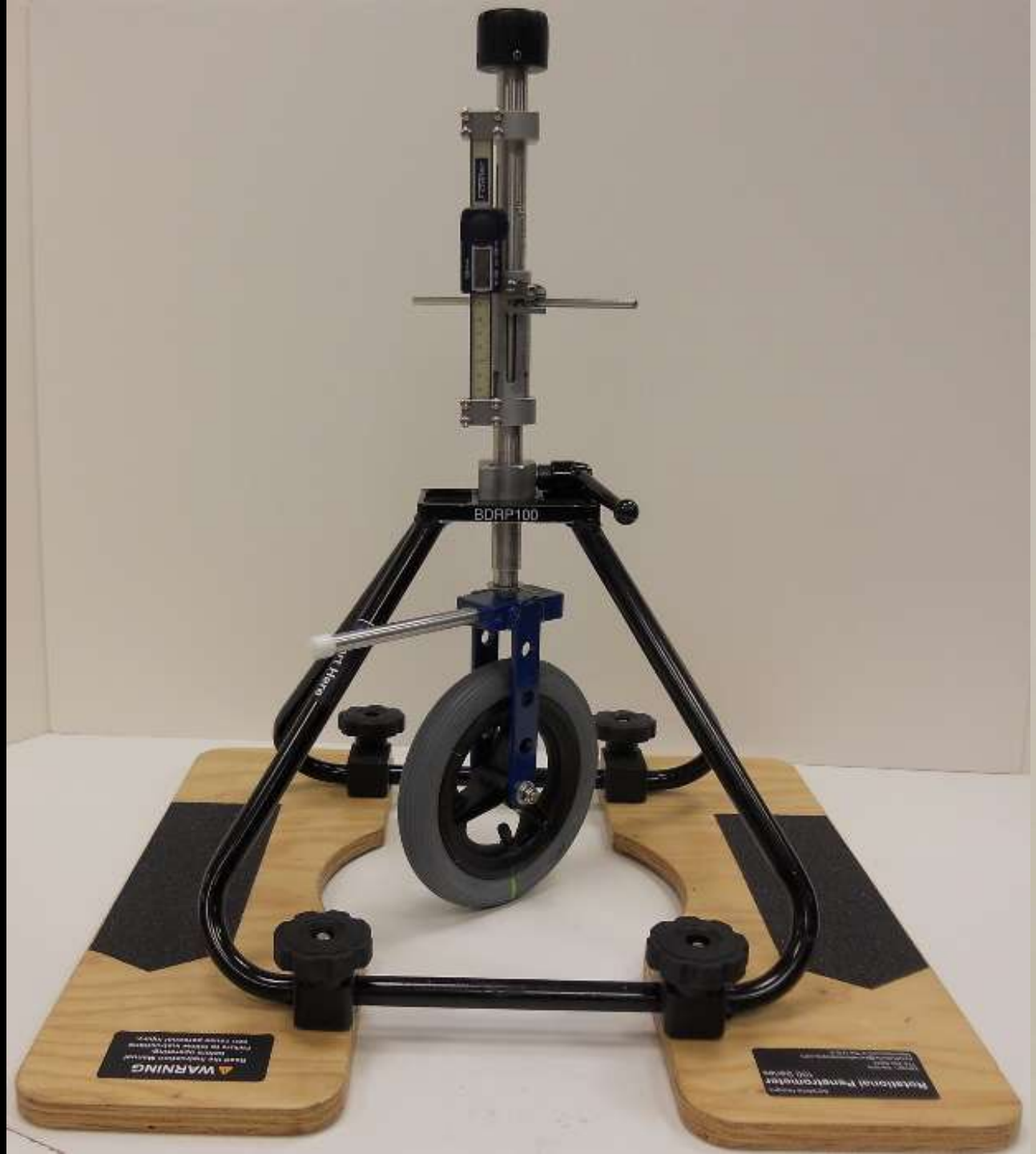
- Surface
  - firm and stable
- Width
  - 36 inches
  - exception 32 inches for up to 24 inches
- Openings
  - < 0.5 inch sphere

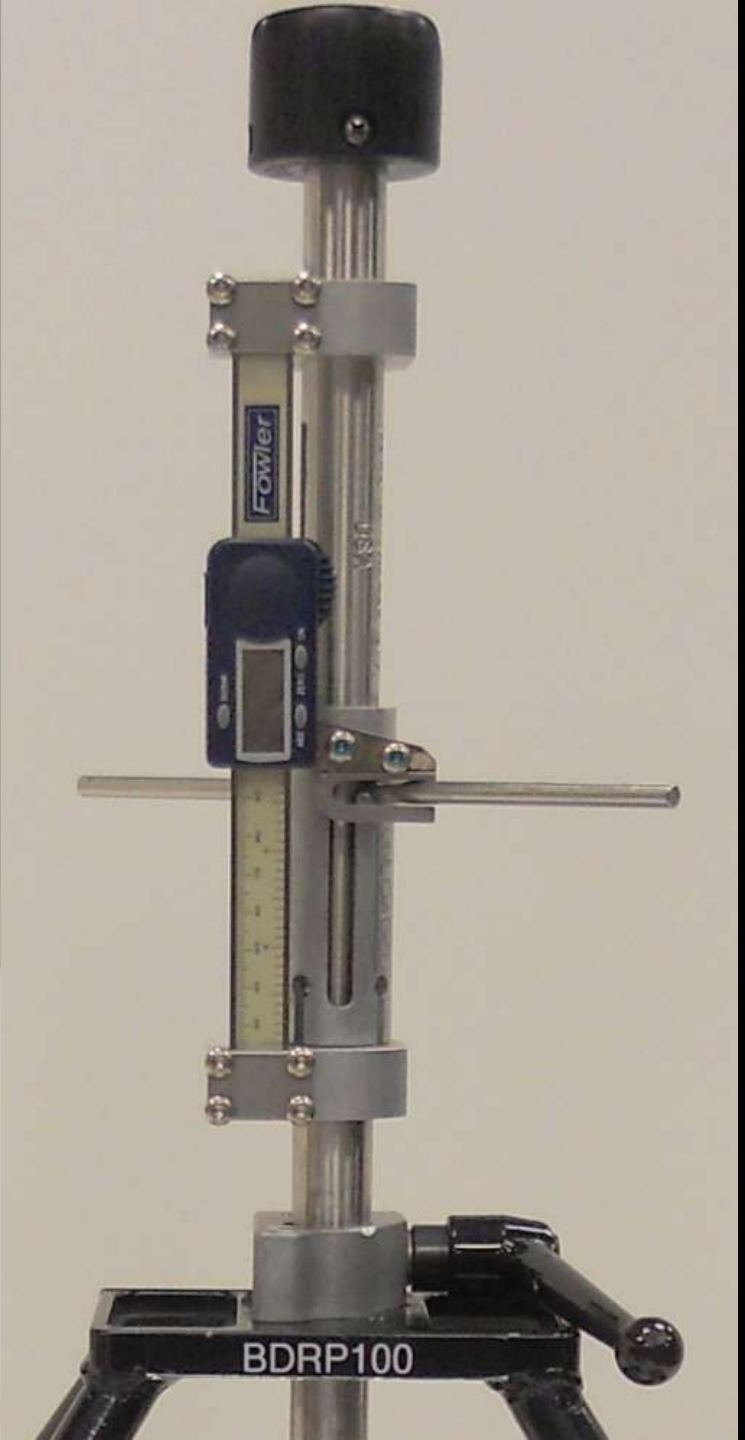
Rotational Penetrometer

Objective surface measurement device

Available from Beneficial Designs

Beneficial Designs
research/design/education
Designing beyond the norm to meet the needs of all people.


BDRP100


Fowler
BDRP100

Trail with firm but unstable sandy surface

Trail after Installation of surface stabilizer

Gravelpave2

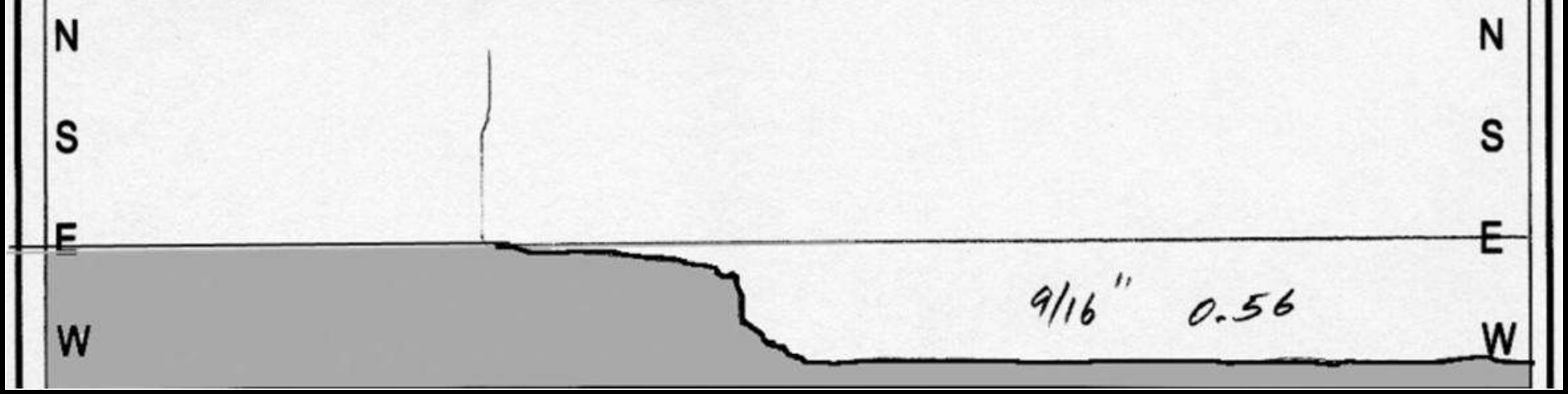
Rotational Penetrometer Readings-Gravelpave 2

Before Application			***After*** Application		
Firmness		Stability	Firmness		Stability
0.18		0.77	0.17		0.37
0.17		0.87	0.17		0.38
0.17		0.77	0.18		0.42
0.18		0.88	0.17		0.35
0.18		0.79	0.18		0.40
0.18	Avg	0.82	0.17	Avg	0.38

HEIGHT TRANSITIONS Project #: 216-2 Date: 4/27/09

Street Name: OLIVE WEST Segment Name: * Distance: 233'9"

*N COUNTY ROAD TO MACKLAND



Sidewalk Assessment Process


GPS receiver
Laptop prompts the user to evaluate conditions when a walkway violates the standard
1.9-megapixel webcam automatically captures sidewalk imagery
Gyro distinguishes between changes in grade and acceleration/deceleration
Sensors monitor the plane between the three wheels to measure grade and cross-slope
Detachable wheel measures areas the cart can't reach
Magnet in the rear wheel tracks distance
Detachable height tool measures trip hazards

Digital Measuring Wheel

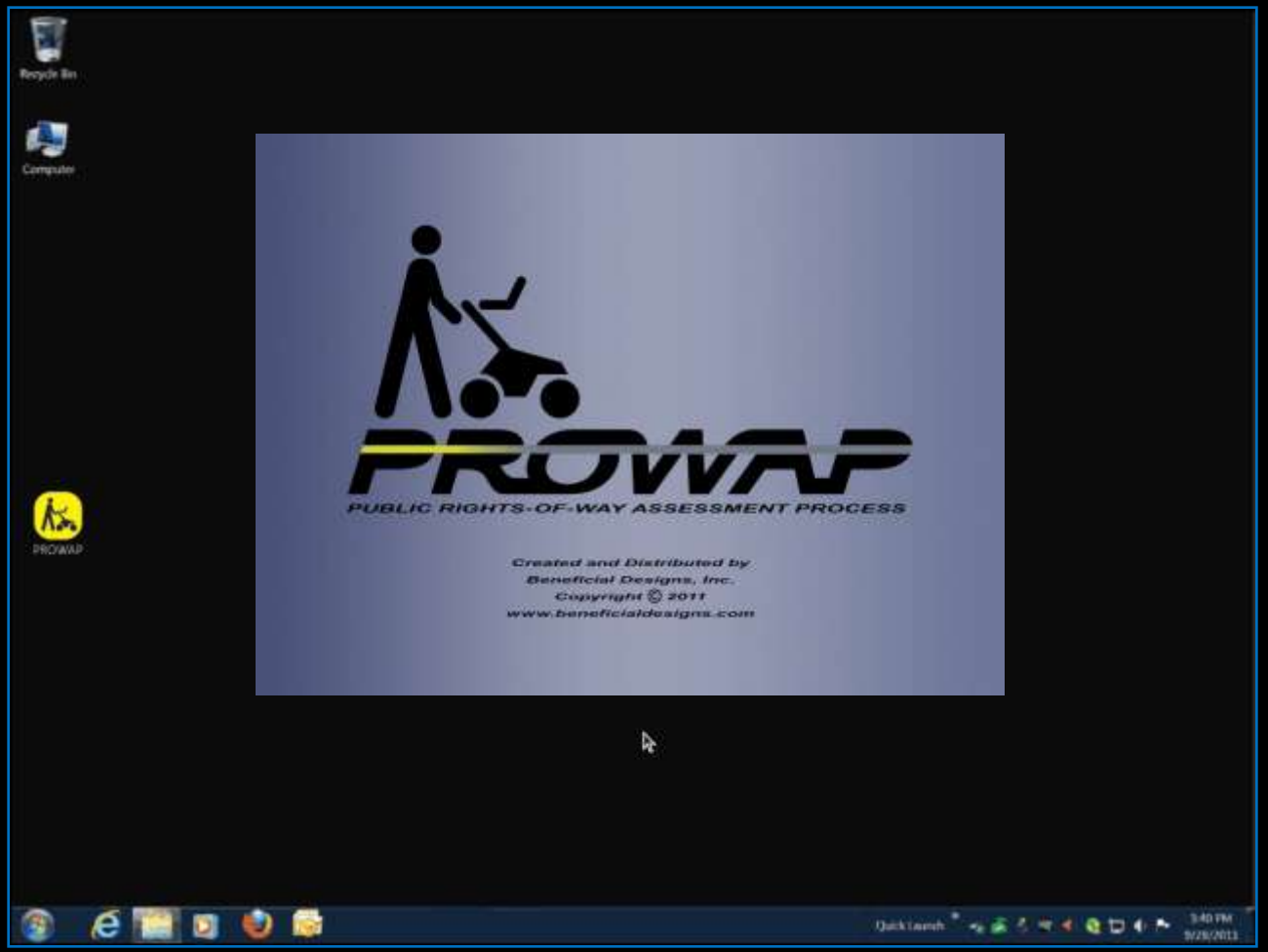
Wireless

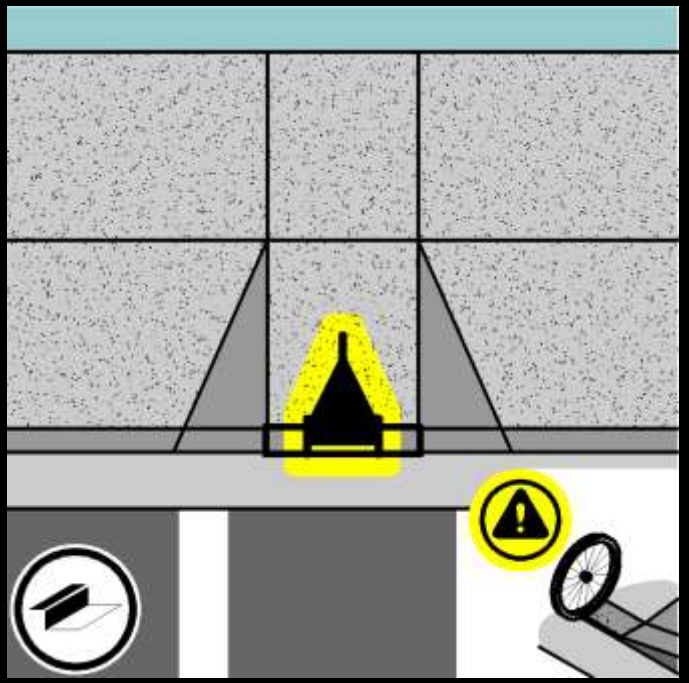
High accuracy
with resolution of
0.1 Inches (1 mm)

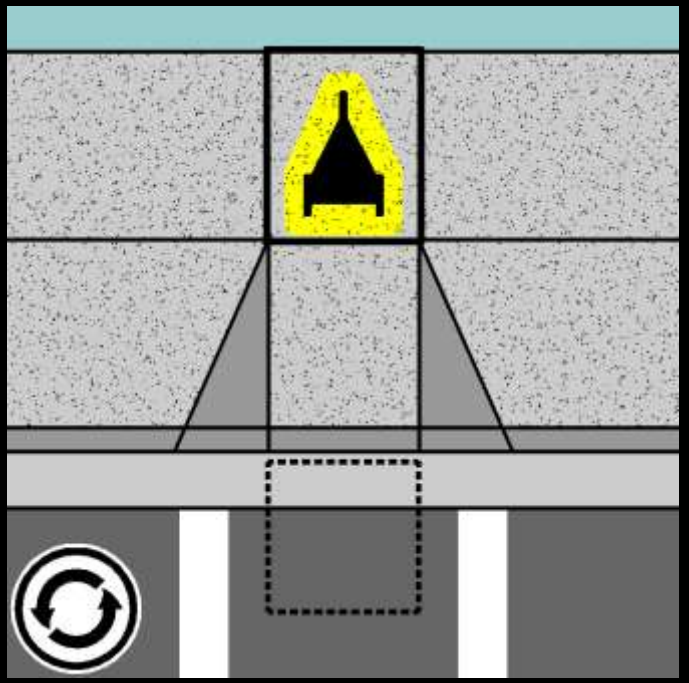
Digital Height Measuring Device

- High accuracy
- Fast measurement
- Resolution of
  0.01 inches (0.1 mm)

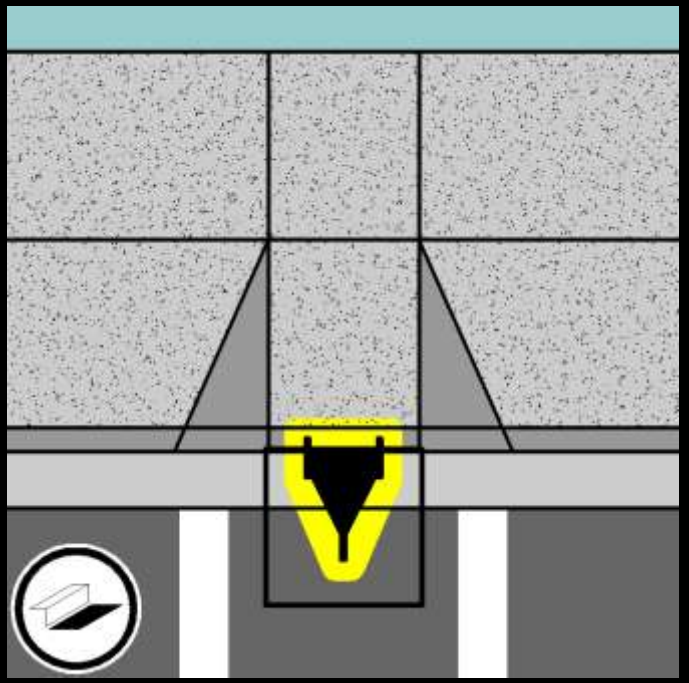
Data Collection Software

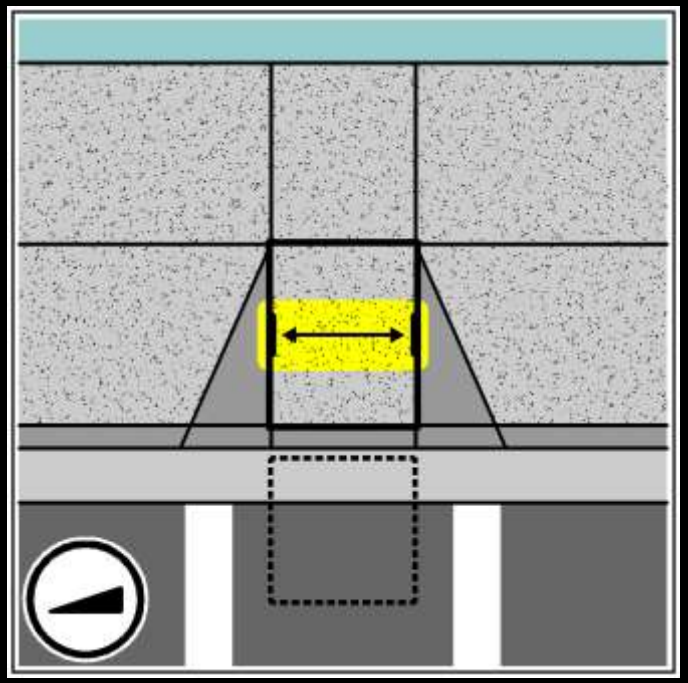


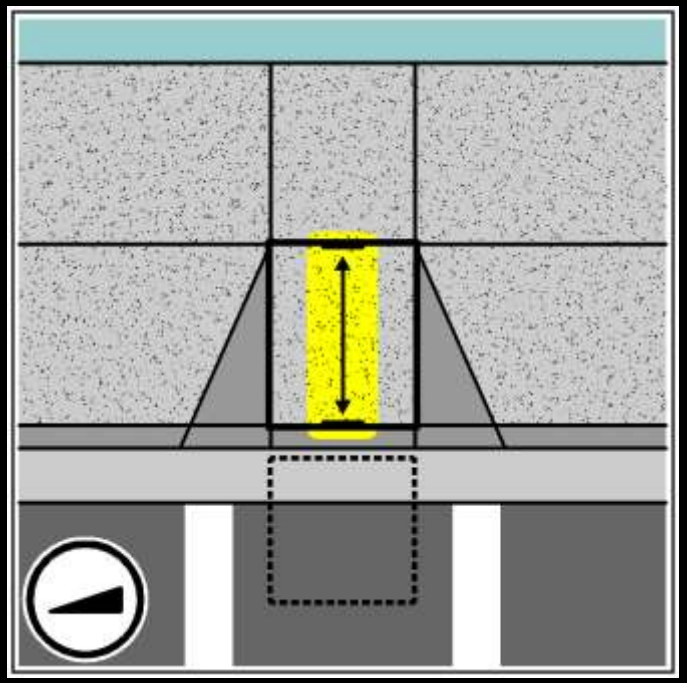





ONE STOP
AUTO REPAIR





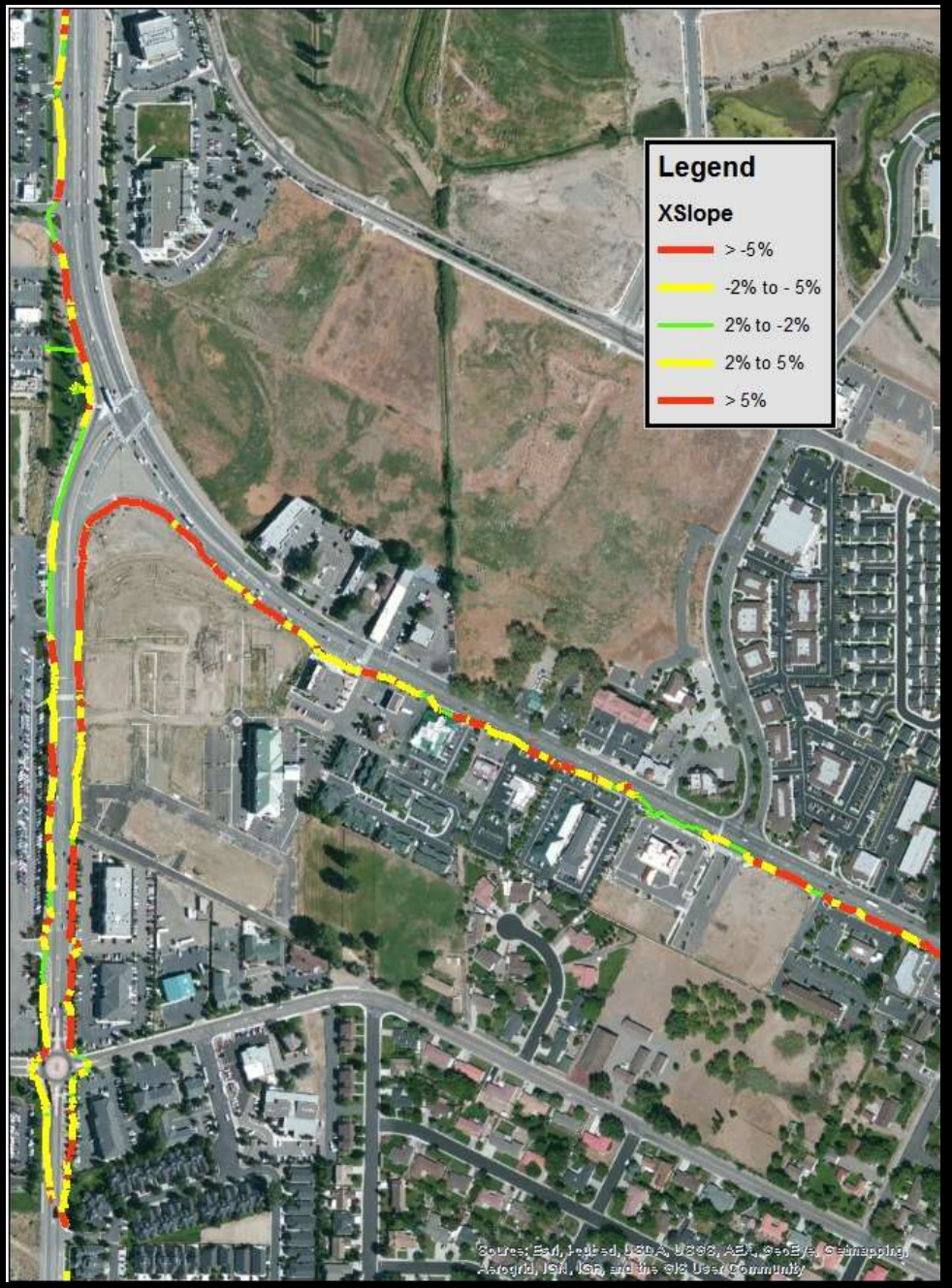


NDOT
Right of Way in Minden, NV

Tread Width

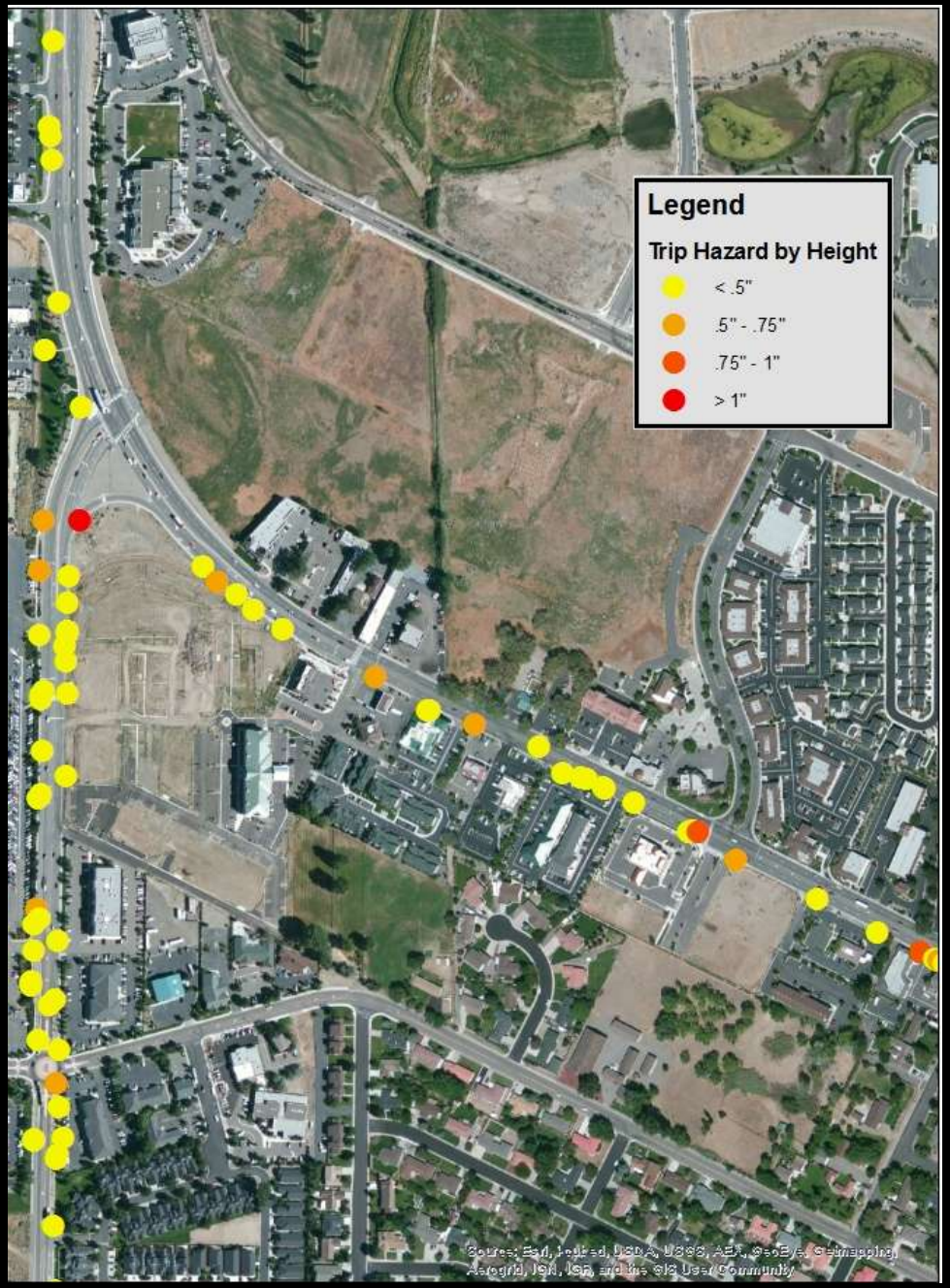
NDOT
Right of Way in Minden, NV

Cross Slope



NDOT
Right of Way in Minden, NV

Tripping hazard height



Main St

Route	**10th St** to **James St**
Side of Street	**East**
Length	**320** ft
Elevation Change	**- 7.5** ft

No Skateboarding

GRADE

Typical Grade	**13.6**%
420 ft (128 m) is	**5**% to **8**%
24 ft (7.3 m) is	**8**% to **10**%

CROSS SLOPE

Typical Cross Slope	**1.8**%
300 ft (91.4 m) is	**2**% to **4**%

WIDTH

Typical Width	**8.3** ft
2 ft (0.6 m) is	**33** in (84 cm)

WARNING: Sidewalk conditions may have changed since December 1917 when this sidewalk was assessed. Temporary obstructions were not recorded.

Funded by
Department of Transportation
City of Carson City

SIDEWALK
ACCESS INFORMATION

Signage created by **Beneficial Designs Inc.** using data collected by a certified sidewalk assessment coordinator.

Main St

Route	**10th St** to **James St**
Side of Street	**East**
Length	**320** ft
Elevation Change	**- 7.5** ft

No Skateboarding

GRADE

Typical Grade	**13.6**%
420 ft (128 m) is	**5**% to **8**%
24 ft (7.3 m) is	**8**% to **10**%

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420 ft (128 m) is	**5**% to **8**%
24 ft (7.3 m) is	**8**% to **10**%

CROSS SLOPE

Typical Cross Slope	**1.8**%
300 ft (91.4 m) is	**2**% to **4**%

WIDTH

Typical Width	**8.3** ft
2 ft (0.6 m) is	**33** in (84 cm)

WARNING: Sidewalk conditions may have changed since December 2017 when this sidewalk was assessed. Temporary obstructions were not recorded.

Funded by

Department of Transportation
City of Carson City

SIDEWALK ACCESS INFORMATION

Signage created by **Beneficial Designs Inc.** using data collected by a certified sidewalk assessment coordinator

Universal Design Standards for Products

Universal Design of Fitness Equipment (UDFE) Standards

Low Step-up Height Design


5.0 LB
10 LB
4.5 kg
20 9
35 16
50
65
80 36
95 43
110 50
125 57
140 64
155 71
170 77
185 84
200 91
215 98


LifeFitness
UT OR PRESS QUICK START
Calories
Distance
Time
Incline
Speed
Heart Rate
1 2 3
4 5 6
7 8 9
Clear 0 Enter
Manual
Fat Burn
Cardio
Zone Training
Enter Weight
Random
Hill
Personal Trainer
Fit Test
Speed Interval
Quick Start
Pause
Cool Down
WARNING
POLAR
CAUTION: RISK OF INJURY TO PERSONS - TO AVOID INJURY, STAND ON THE SIDERAILS BEFORE STARTING TREADMILL. READ INSTRUCTION MANUAL BEFORE USING.


LifeFitness
UT OR PRESS QUICK START
Calories
Distance
Time
Incline
Speed
Heart Rate
1 2 3
4 5 6
7 8 9
Clear 0 Enter
Manual
Fat Burn
Cardio
Zone Training
Enter Weight
Random
HRC
Personal Trainer
Fit Test
Speed Interval
Quick Start
Pause
Cool Down
WARNING
POLAR


CLIMBING
Display
Time Remaining
Calories/Hour
Floors Climbed
Level
Climb Max
Speed
Programs
Manual
Fat Burning
Strength
Endurance
HR Control
Advanced Options
1
2
3
4
5
6
7
8
9
0
Clear
Start
Enter


CLIMBING
Display
Time Remaining
Calories/Hour
Floors Climbed
Level
Climb Max
Speed
Programs
Manual
Fat Burning
Strength
Endurance
HR Control
Advanced Options
1
2
3
4
5
6
7
8
9
0
Clear
Start
Enter

Universal Design of Products used by persons with Cognitive Impairments

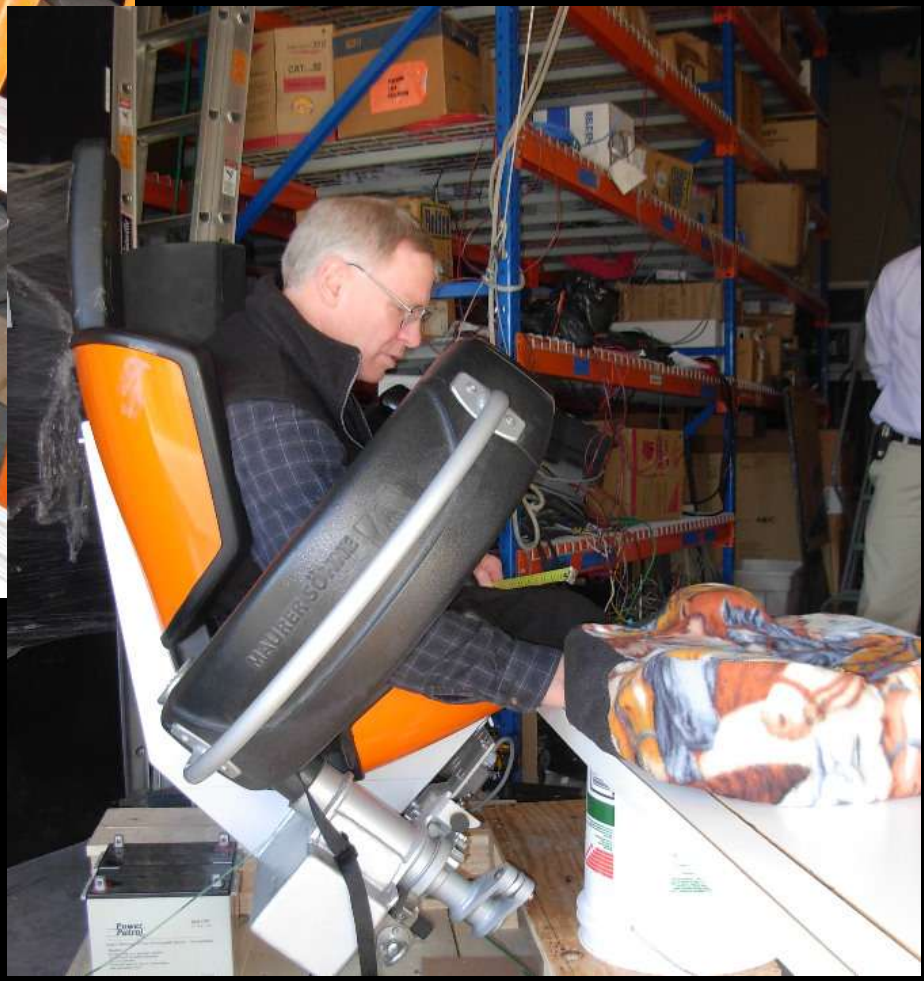
Goal – To increase Access to Technology for People with Cognitive Impairments


email
cell
ear.buds
DVD
phones
smoke.alarms
cell.phones
screen.readers
TV
social.networking
calendars
stoves
music.players
headphones
laptops
toaster.ovens
internet
audio.books
camera
Internet
video

Universal Design of Amusement Park Rides for Persons with Mobility and Sensory Impairments


DIR 24


car N-55
car N-54
car N-54
2013. 12. 23 13:43




2013. 12. 23


2013. 12. 23 13:18


2013.12.23 13:19


2013.12.28 13:19

Focus on Air Travel

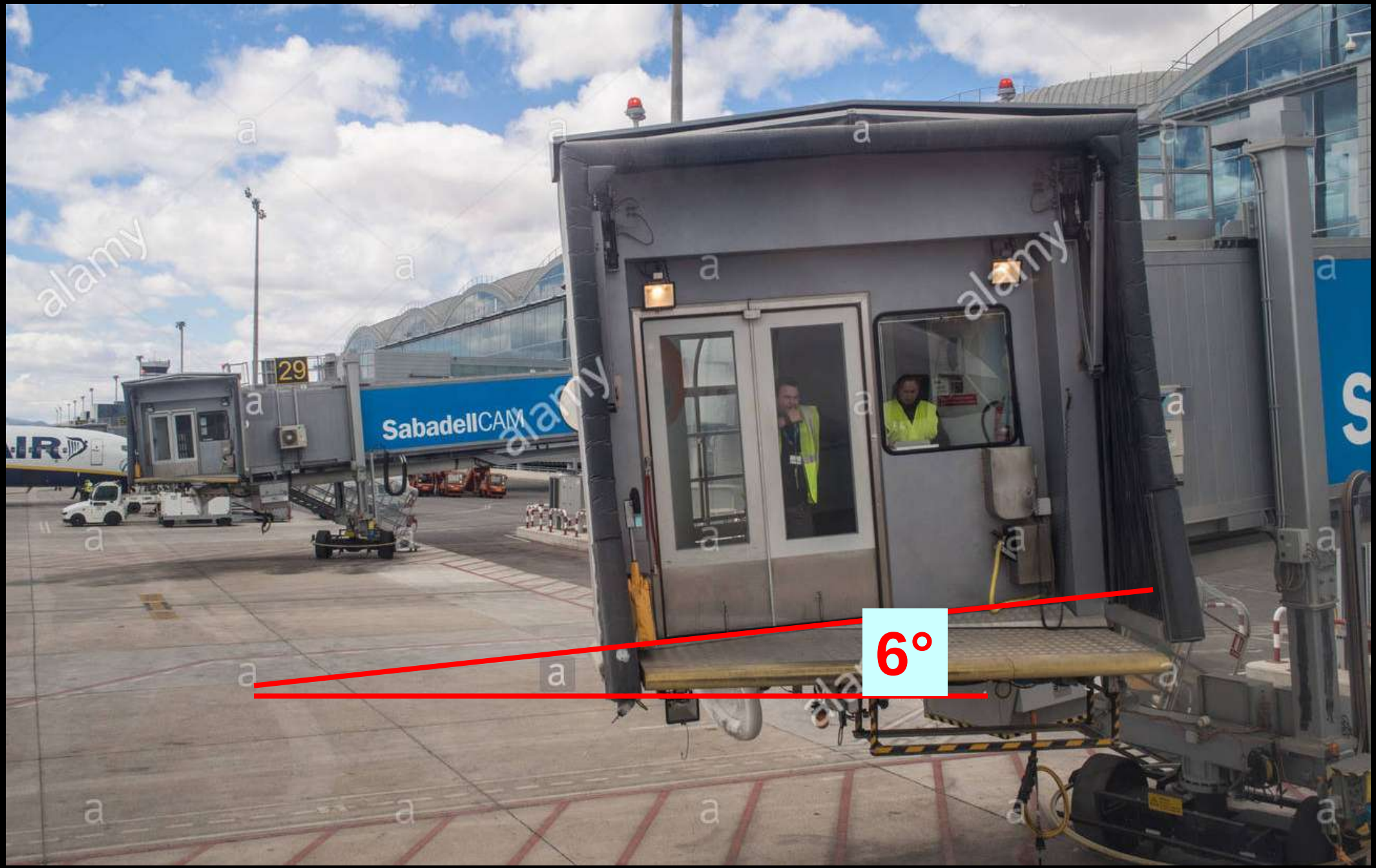
One focus area is air travel

- Assistive technologies
- Standards

Issue 1: Steep Jetway Slopes

- Typically steeper than standard ramp
- Dangerous for Mobility Device users
- Exempt from ADA guidelines


214
6°


29
SabadellCAM
6°

Dangerous Environment

- Over 300 non-ambulatory passengers have been surveyed
- 12% have tipped over laterally in boarding chairs because of this problem
- Causation is Jetway bubble area cross-slope of 6 to 14 degrees
- Boarding chairs have to be narrow and tip over at 7.5 degrees

Potential Solution to Issue 1

Develop technologies to level surface of bubble area of jetways

Issue 2: Poor Boarding Devices

- Non-ambulatory passengers are transported onto aircraft using narrow boarding devices
- Current boarding devices have many design issues that non-ambulatory passengers are dissatisfied with

Boarding devices

Assessment of Traditional Aircraft Boarding Devices - Stability

Chest support straps

Assessment of Aircraft Boarding Devices Observation

- Arm supports provide lateral stability
- Foot support issues

Potential Solutions to Issue 2

- Develop design specifications for improved boarding devices and on-board aisle chairs

Issue 3:
Dangerous Transfer Methods

- Passengers who are non-ambulatory must often be physically transferred by untrained contractors to boarding chairs and then into AC seating
- This results in injuries to the contractors and the passengers

Aircraft Compatible Wheelchair

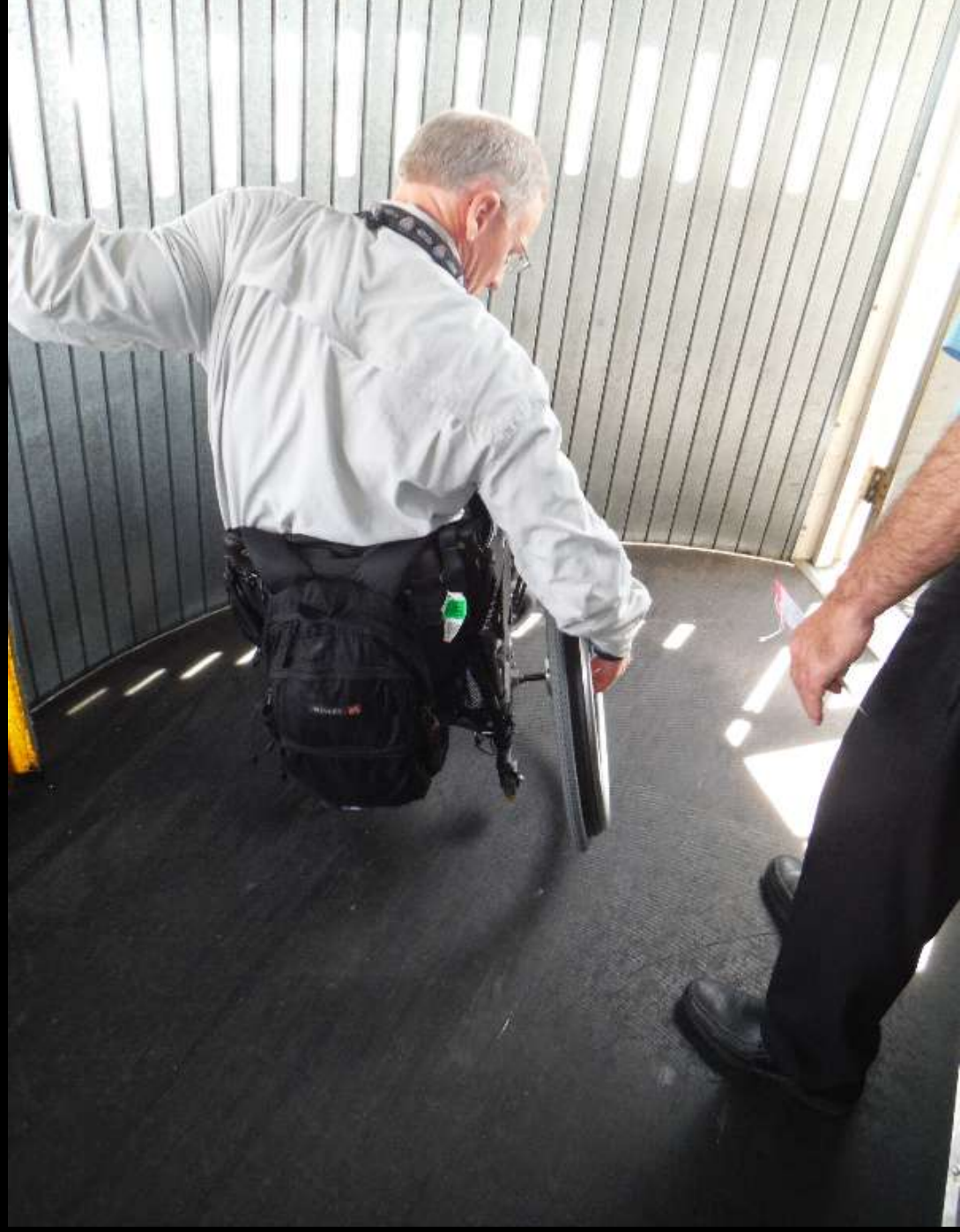
Beneficial Designs
research/design/education
Designing beyond the norm to meet the needs of all people.

Aircraft Boarding Using a Personal Aisle Chair

Removable Wheels

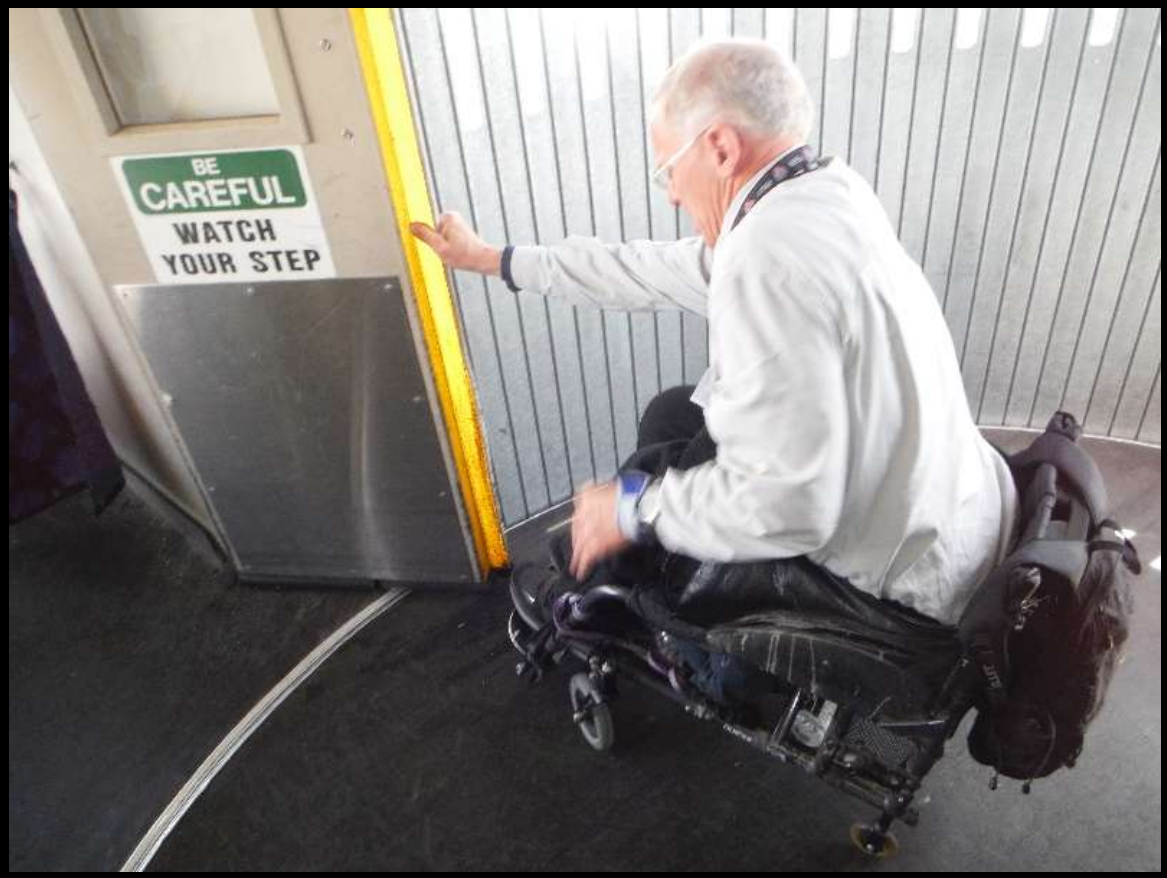
Aircraft Boarding Using a wheelchair with narrow accessory wheels

Fewer Transfers



Aircraft Seating Using a Personal Aisle Chair

Feet Remain Secure



Transfer Assist Technology

- Overhead Lift track
- Safety for
  - passengers
  - attendant providers

Transfer Assist Technology Eagle Lift

Overhead Gantry Style Boarding Device

Transfer Assist Technology

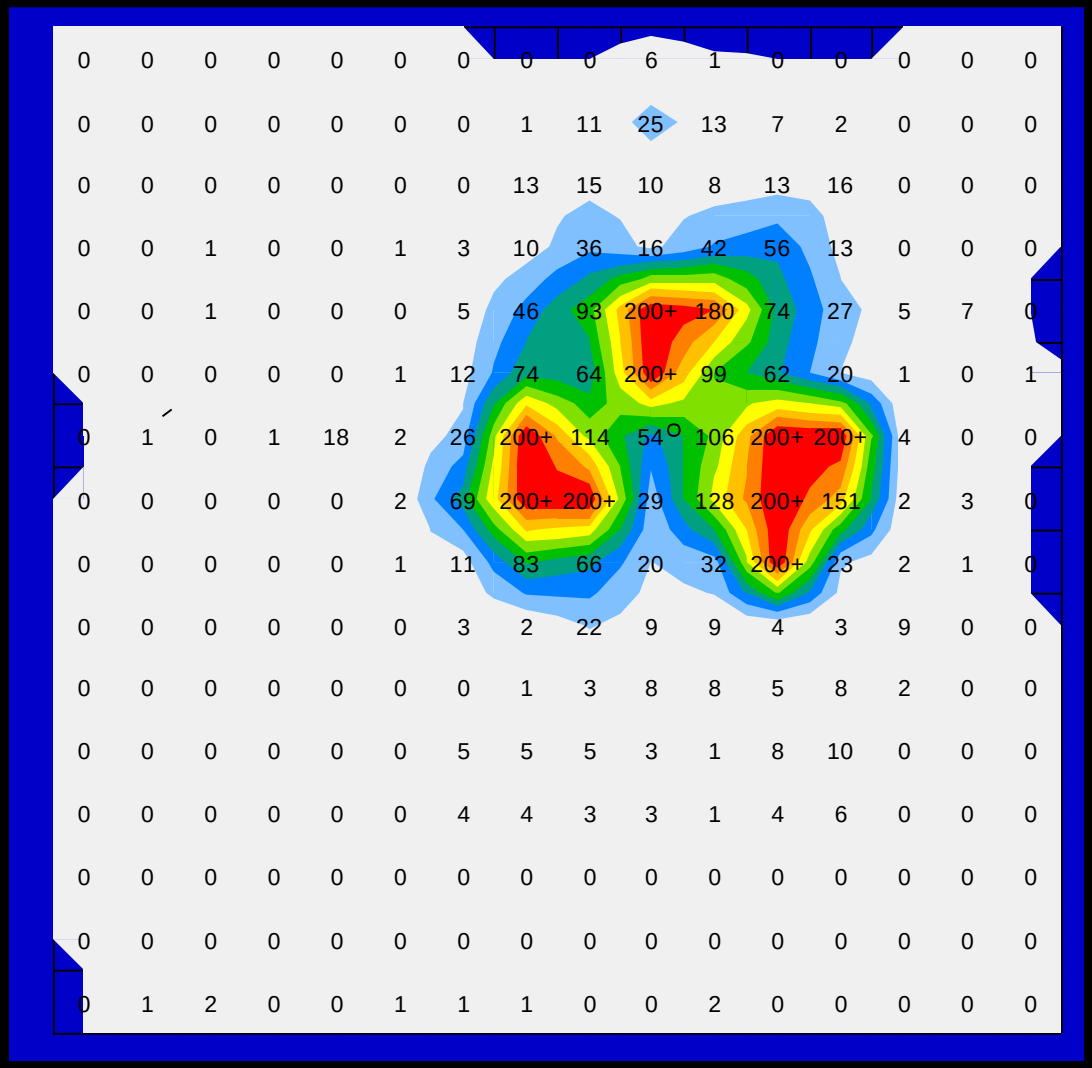
Moves laterally over aircraft seating

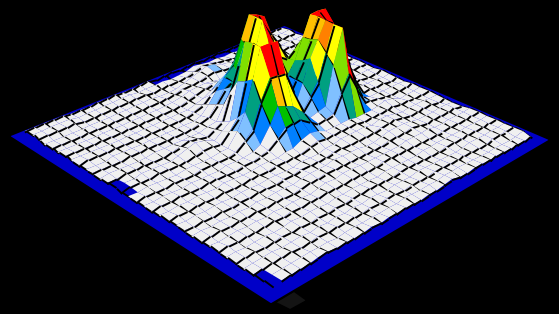
Issue 4:
Hazardous Sitting Pressures

Persons without sensation need pressure spread out to avoid sores

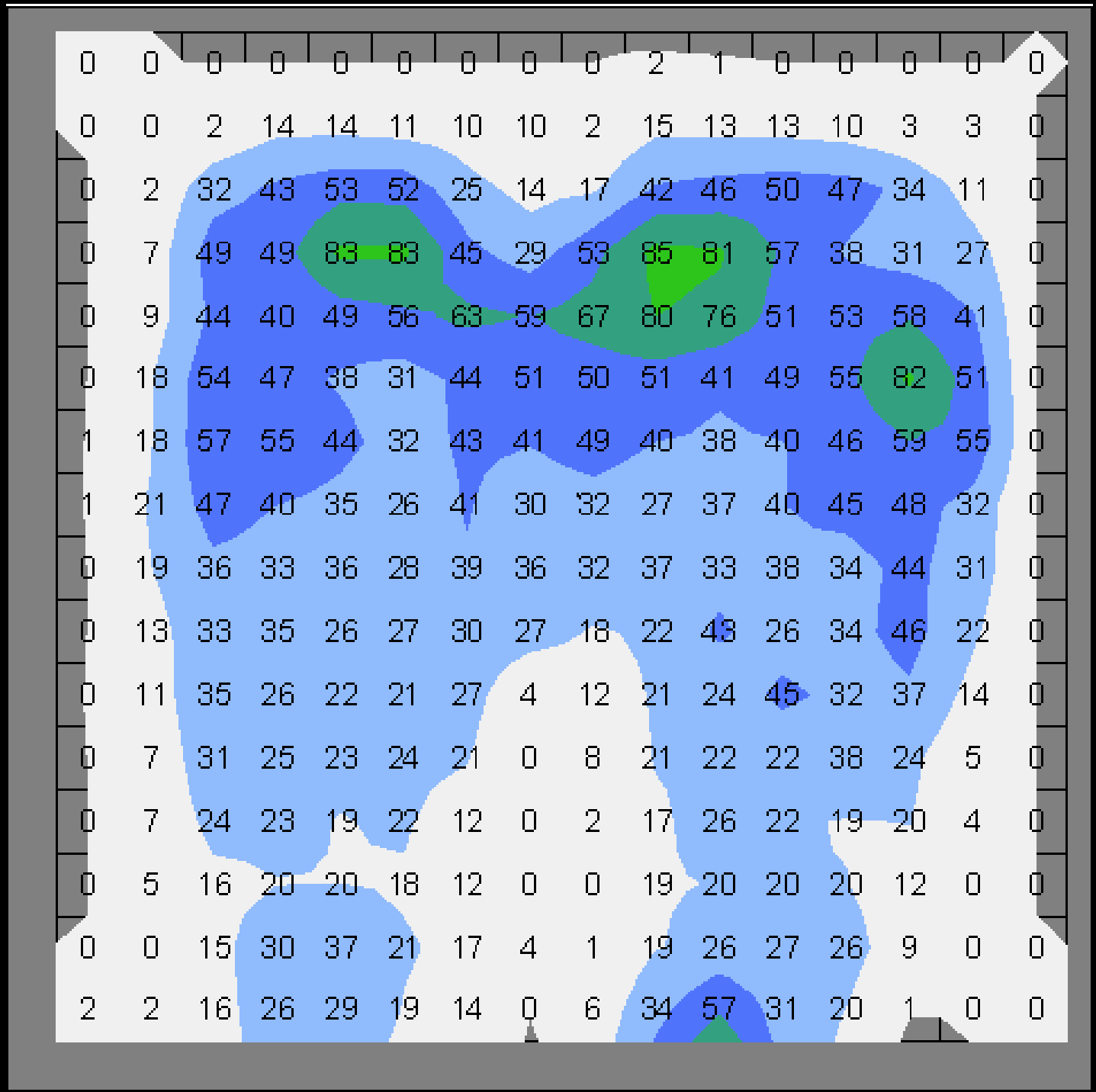
Boarding devices

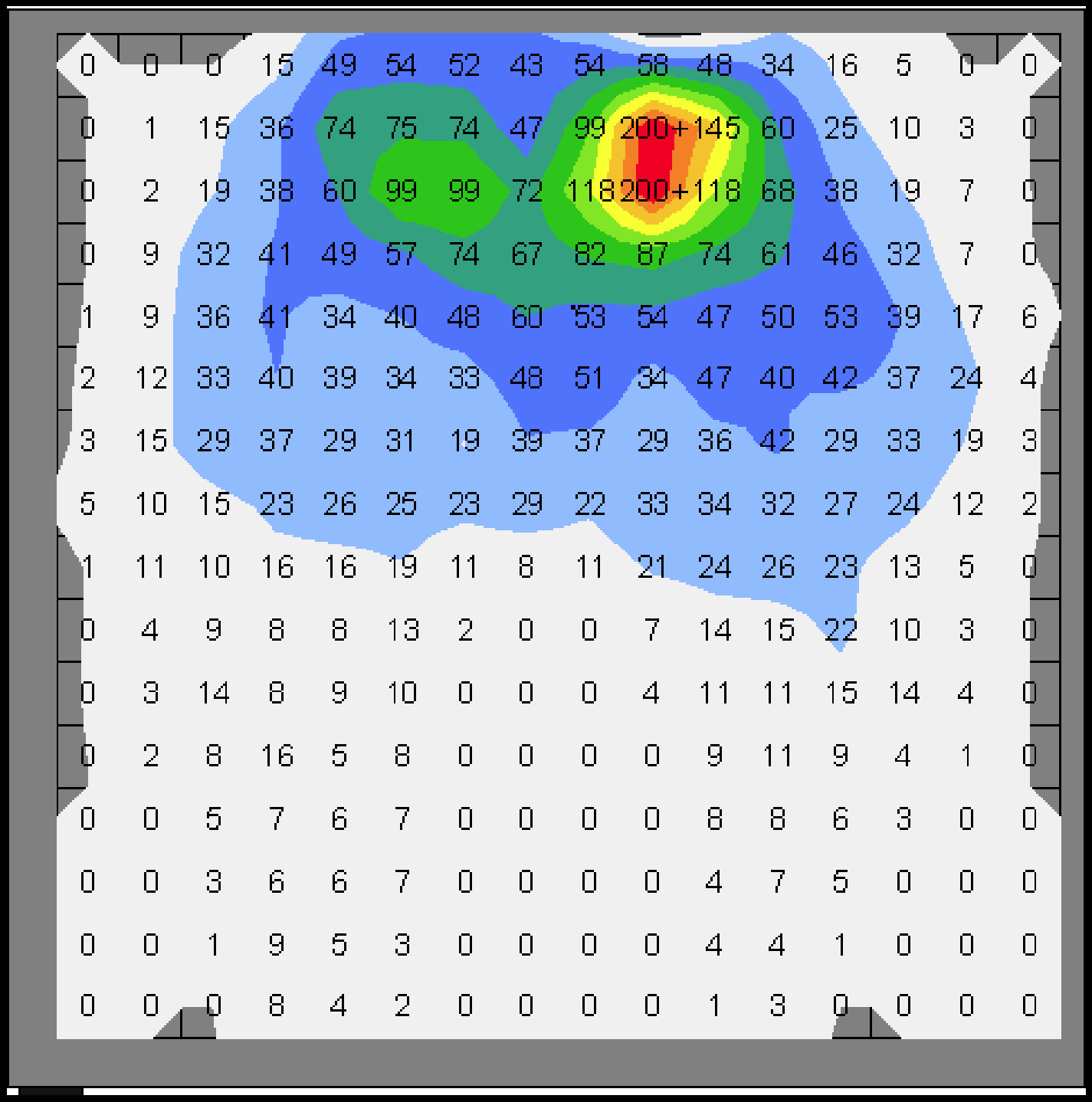
Sitting on an S boarding device without cushion





Minimum (mmHg)	0.00
Maximum (mmHg)	200.00
Average (mmHg)	15.64
Variance (mmHg²)	1823.88
Standard deviation (mmHg)	42.71
Coefficient of variation (%)	272.99
Horizontal center (in)	10.47
Vertical center (in)	10.20
Sensing area (in²)	289.27
Regional distribution (%)	100.00


0 0 0 0 0 0 0 0 0 2 1 0 0 0 0 0
0 0 2 14 14 11 10 10 2 15 13 13 10 3 3 0
0 2 32 43 53 52 25 14 17 42 46 50 47 34 11 0
0 7 49 49 83 83 45 29 53 85 81 57 38 31 27 0
0 9 44 40 49 56 63 59 67 80 76 51 53 58 41 0
0 18 54 47 38 31 44 51 50 51 41 49 55 82 51 0
1 18 57 55 44 32 43 41 49 40 38 40 46 59 55 0
1 21 47 40 35 26 41 30 32 27 37 40 45 48 32 0
0 19 36 33 36 28 39 36 32 37 33 38 34 44 31 0
0 13 33 35 26 27 30 27 18 22 43 26 34 46 22 0
0 11 35 26 22 21 27 4 12 21 24 45 32 37 14 0
0 7 31 25 23 24 21 0 8 21 22 22 38 24 5 0
0 7 24 23 19 22 12 0 2 17 26 22 19 20 4 0
0 5 16 20 20 18 12 0 0 19 20 20 20 12 0 0
0 0 15 30 37 21 17 4 1 19 26 27 26 9 0 0
2 2 16 26 29 19 14 0 6 34 57 31 20 1 0 0


0 0 0 15 49 54 52 43 54 58 48 34 16 5 0 0
0 1 15 36 74 75 74 47 99 200+ 145 60 25 10 3 0
0 2 19 38 60 99 99 72 118 200+ 118 68 38 19 7 0
0 9 32 41 49 57 74 67 82 87 74 61 46 32 7 0
1 9 36 41 34 40 48 60 53 54 47 50 53 39 17 6
2 12 33 40 39 34 33 48 51 34 47 40 42 37 24 4
3 15 29 37 29 31 19 39 37 29 36 42 29 33 19 3
5 10 15 23 26 25 23 29 22 33 34 32 27 24 12 2
1 11 10 16 16 19 11 8 11 21 24 26 23 13 5 0
0 4 9 8 8 13 2 0 0 7 14 15 22 10 3 0
0 3 14 8 9 10 0 0 0 4 11 11 15 14 4 0
0 2 8 16 5 8 0 0 0 0 9 11 9 4 1 0
0 0 5 7 6 7 0 0 0 0 8 8 6 3 0 0
0 0 3 6 6 7 0 0 0 0 4 7 5 0 0 0
0 0 1 9 5 3 0 0 0 0 4 4 1 0 0 0
0 0 0 8 4 2 0 0 0 0 1 3 0 0 0 0

Aircraft seating with pressure relief cushion from wheelchair

legs hanging
shoulders forward
neck extended
arm not supported

Aircraft seating with pressure relief cushion and “accessories”

foot support
lumbar and spine support
neck / head support
arm support

Aircraft seating with pressure relief cushion and “accessories”

feet supported
lumbar and spine supported
neck / head support
arm supported

Potential Solution to Issue 4

- Educate travelers without sensation to use pressure relief seating accessories when sitting in aircraft
- Educate health-care professionals who serve travelers without sensation

Issue 5: Lack of Accessible Bathrooms

- Wide body aircraft have two aisles and bathrooms that transform into one large accessible bathroom
- Medium and large size single aisle aircraft cannot do this without blocking the aisle

Issue 5: Lack of Accessible Bathrooms

- Passengers needing a personal caregiver are not accommodated by the current size of bathrooms
- Including infants and older adults and non-ambulatory passengers that must us an on board aisle wheelchair

Issue 5: Lack of Accessible Bathrooms

Would only fly 2-3 hours without bathroom access

Issue 5: Lack of Accessible Bathrooms

- Explained that removal of three seats to create an more accessible bathroom would cost a 2% increase in fare (based on 145 person cap)
- 9 of 14 knew persons that need assistance in a bathroom
- 14 out of 15 people indicated they would pay for one larger bathroom

Issue 5: Lack of Accessible Bathrooms

- Explained that removal of six seats creates 1.2 inches of increased legroom which would create a 4% increase in fare
- 11 out of 14 people indicated they would pay some amount for more legroom – 50% want 2.4 inches more

Potential Solutions to Issue 6

- Develop minimum clear width requirements for commercial aircraft….
- To allow boarding device manufacturers to optimize the lateral stability of boarding devices

Issue 7: Mobility Device (MD) Damage

MDs are often damaged

MDs typically stored with baggage

- Manual wheelchairs
- Powered wheelchairs
- Scooters

Examples of Damage

Courtesy Open Doors and Global Repair Group

Courtesy Open Doors and Global Repair Group

Damage to drive wheel that came off powered wheelchair

Rehabilitation Institute of Chicago / Beneficial Designs / PVA #3028

Potential Solution to Issue 7

Create design standards for Air Transportable Powered Wheelchairs through the RESNA Assistive Technology for Air Travel Standards Committee

Assistive Technology for Air Travel Standards

- Airline carriers and manufacturers
- Wheelchair manufacturers
- Disability organizations
- Government agencies – DOT - FAA
- Wheelchair repair companies

permobil Model: M300 Corpus HD

Air Travel Configuration

Owner Name: John Smith
Owner Phone: +1 012 345 6789
Owner Email: john.smith@gmail.com
Chair Serial Number: 7200003

1 **Remove Seat Cushion (User)**
Remove seat cushion; store in aircraft overhead bin.

2 **Remove Head Support (User)**
Remove head support to store in aircraft overhead bin.

3 **Lower Back Support to Fit Into Aircraft (User)**
Remove the back support cushion. It is fixed in place by means of velcro on the rear of the cushion.
Remove the upper section of the back support by carefully pulling it straight up.
Using the control panel, tilt the back support forward.
Store back support in aircraft overhead bin.

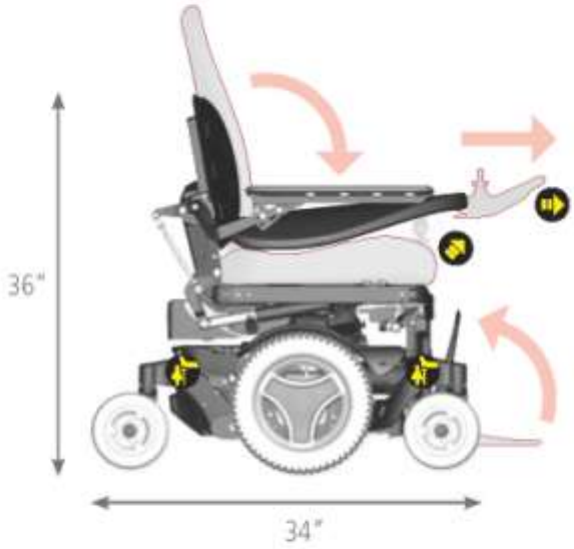
4 **Remove Joystick (User)**
Remove joystick controller; store in aircraft overhead bin.

5 **Disengage Drive System**
If the joystick controller is not removed, first shut off power using the control panel.
Rotate the lever on each motor to disengage the motors and release the brakes, enabling the chair to be manually pushed.

6 **Isolate Battery Power**
Switch breaker to off to fully disconnect power.

7 **Raise Foot Supports**
Move foot supports to upright position.

Travel Configuration



Driving Configuration

450 lb

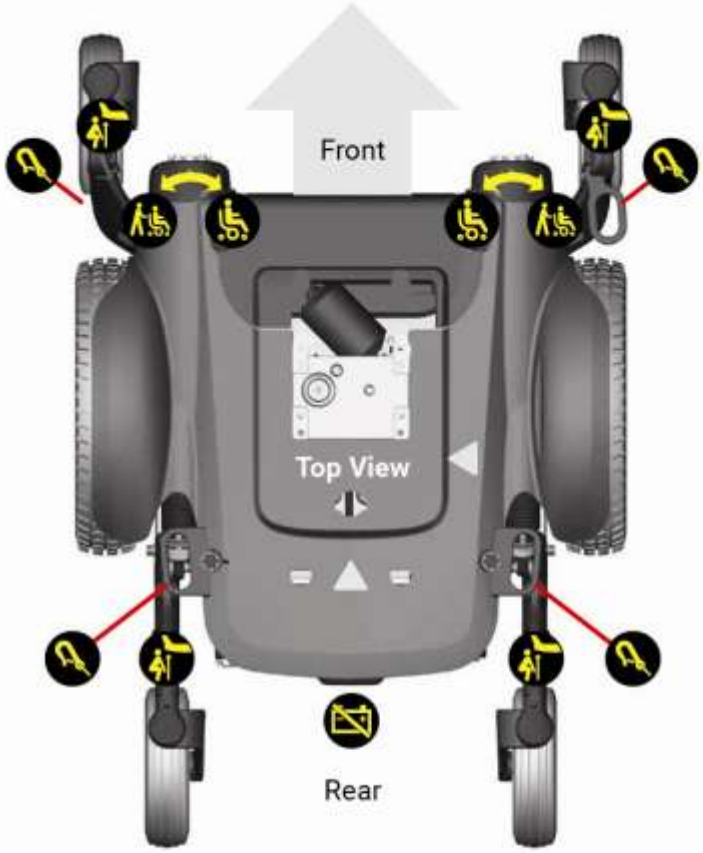
Unoccupied Product Weight (including accessories)

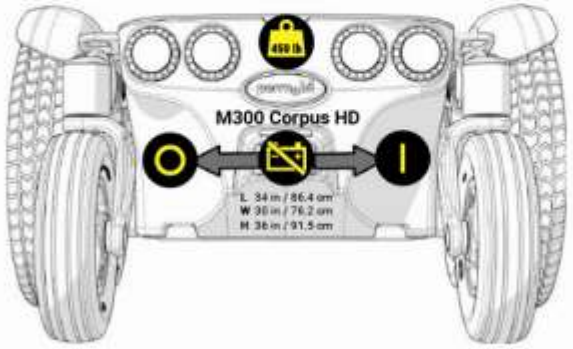
WARNING: This product should be lifted using a mechanical lift to avoid injury.

450 lbs / 205 kg

Battery Information

WARNING: Only sealed lead acid group 34 batteries may be installed on this product. This wheelchair was manufactured with **2 lead acid sealed gel cell non-spillable batteries** conforming to DOT CFR 173.159 (d), IATA Packing Instructions 806, and IATA Provision A67





Disengage Drive System

A manual brake release is located on each drive wheel that can be released to make it possible to move the chair manually. The brake release levers are located at the front of the wheelchair.
Move levers outwards to disengage motors which releases the brakes.

Manual Lift Points

WARNING! This product should be lifted using a mechanical lift to avoid injury. Unnoccupied product weight is 450 lbs / 205 kg.

The Permobil M300 Corpus HD unoccupied weight is 450 lbs. Manual lifting requires multiple lifters. Use designated lift points!

Manual lift points are located on all four caster arms.
When lifting chair with a device, use securement points.

Chair Securement

When fastening the chair, re-engage the drive system to lock the chair. Use fastening straps attached to the designated transport eye locations at the front and rear of the chair.
Attach fastening strap to RESNA WC19 securement location.

Isolate Battery Power

The circuit breaker is located in the rear beneath the tail lights. It also acts as a battery isolator and is controlled via the lever located inside the hole at the bottom of the rear battey cover.
Switch breaker to off to disconnect power from the battery.

The make and model of wheelchair selected to draft this prototype of an Air Travel Configuration card was selected based on the product having a built-in electrical isolation switch to isolate the batteries. The data was obtained from a user manual that was available online. Some values are estimated and do not necessarily represent the actual data for this product. The manufacturer of this product has not reviewed or approved this information.

Drive Disconnect

Front of chair

Move the levers **outwards to release** the brakes. The chair can now be moved manually.

PMD Labeling Guidelines
weight

WHEELCHAIR

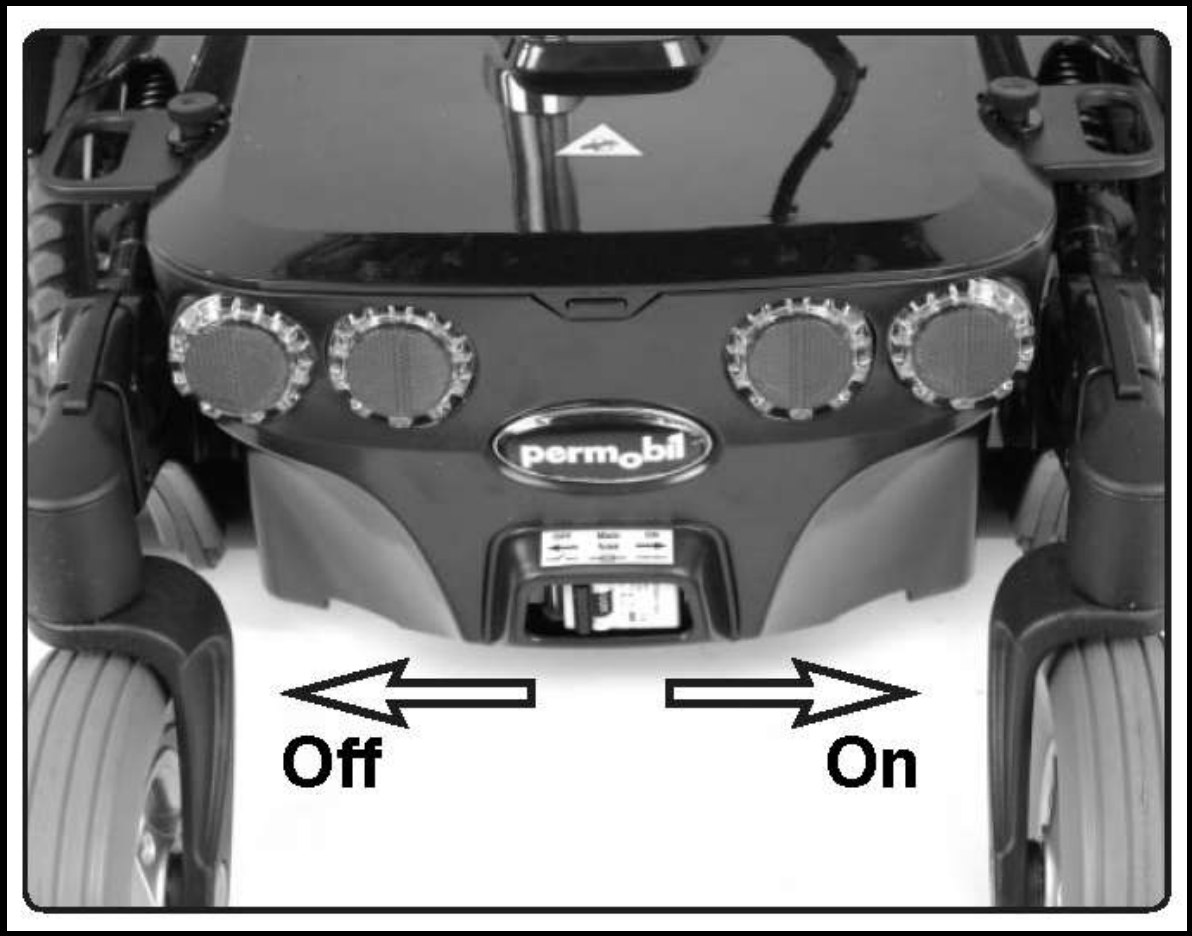
82 kg

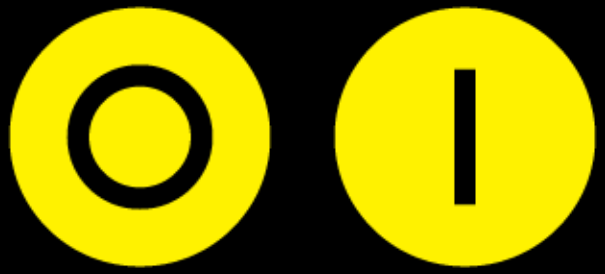
180 lb

WEIGHT

PMD Labeling Guidelines

Location of power disconnect





Air Travel Symbols

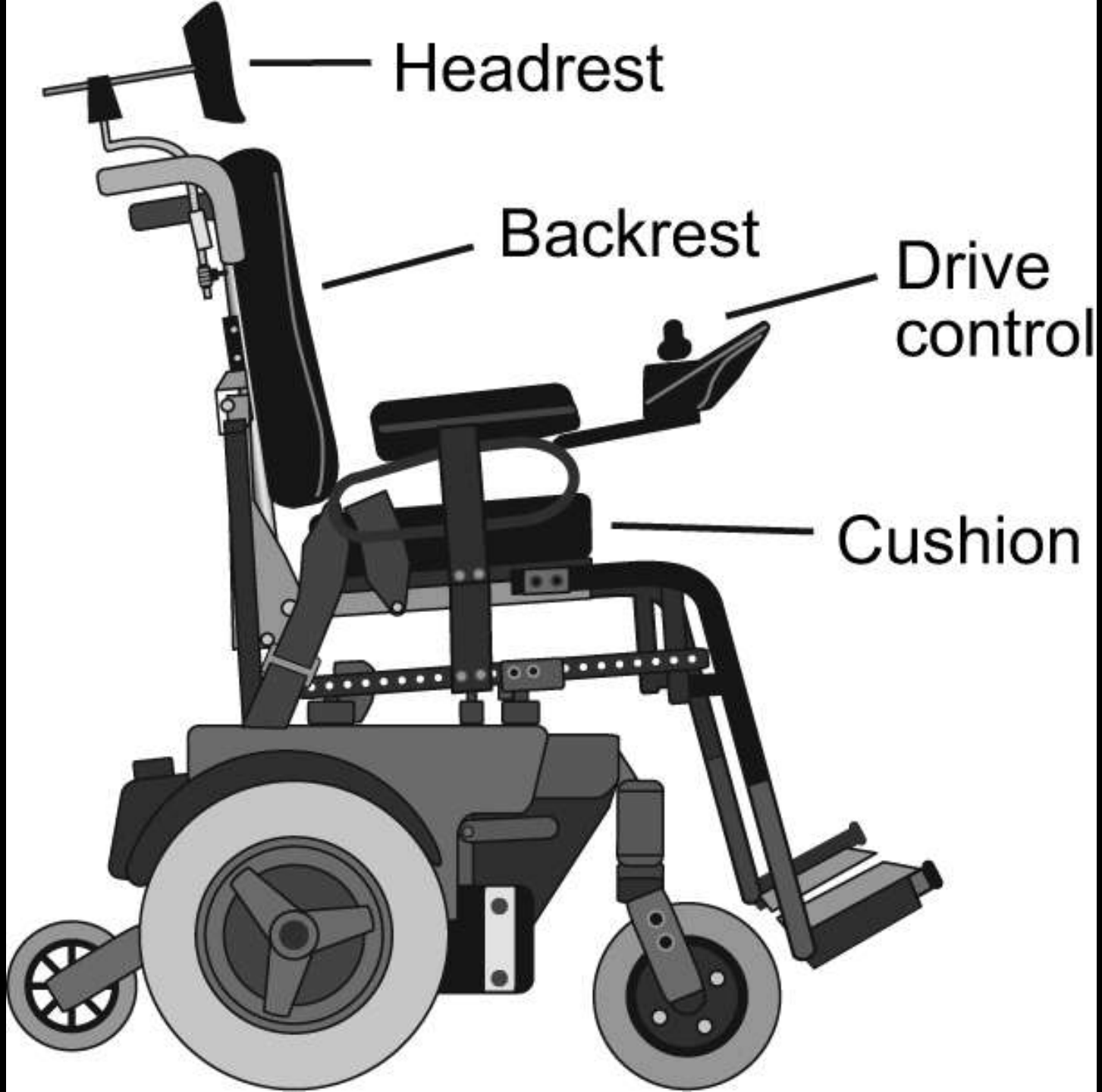
Development of PMD Handler Training Procedures

- Experience of handling different types of PMDs may be infrequent for baggage handlers
- Prevention of injury to handlers
- Prevent damage to PMDs

Standards for PMDs designed for air transport

Create specifications for design features that will enable powered mobility devices to be able to withstand the rigors of being loaded and unloaded from aircraft

PMD with transit option

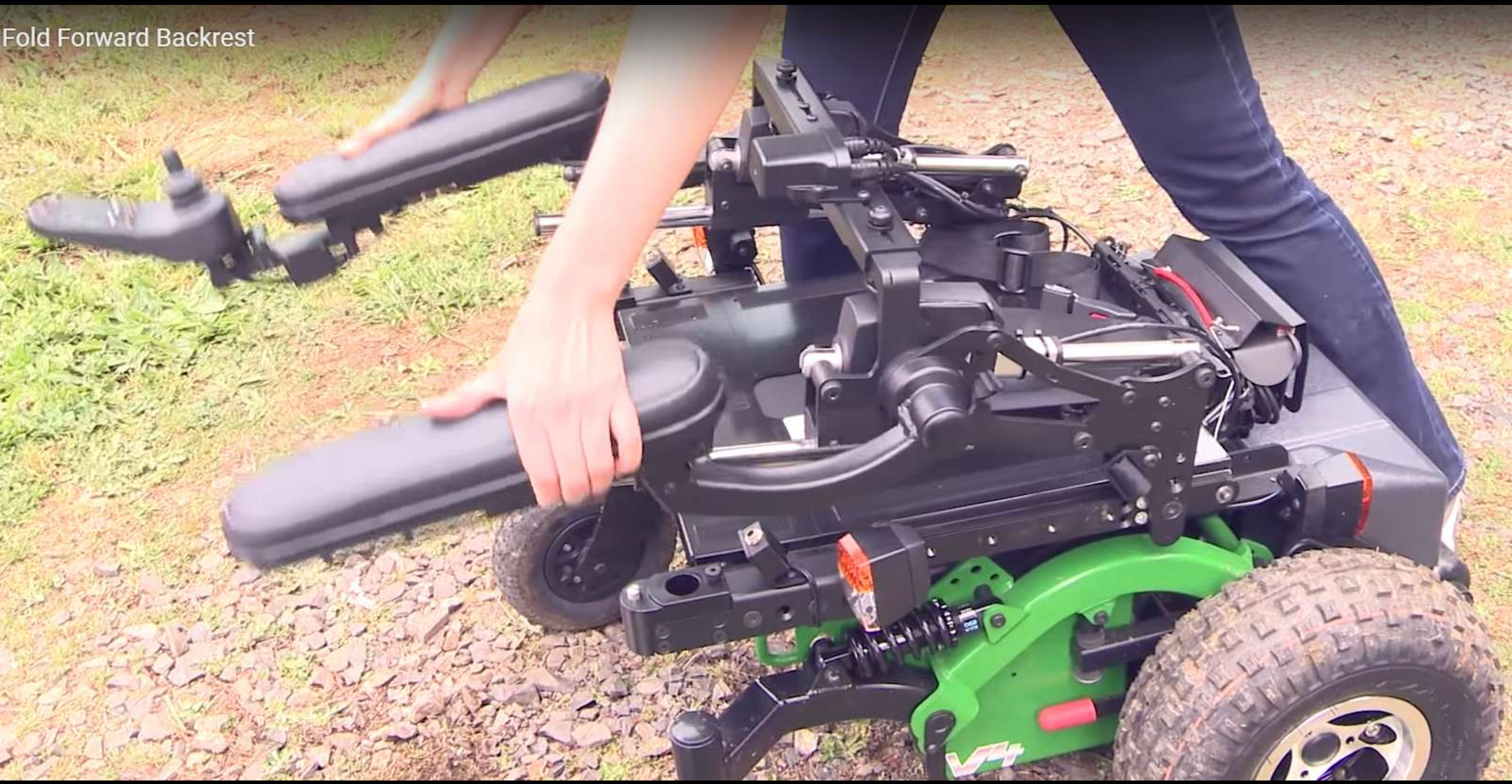

Headrest
Backrest
Drive control
Cushion

Identification of Power Disconnects

Air Transportable PMD design specifications

- Folding or removable back support to reduce height
- Height of typical baggage access door can be as short as 30 inches on DC-9 models


Magic Mobility Fold Forward Backrest
MORE VIDEOS


Fold Forward Backrest

Protect input control device

Fully protect input control device

Elastic strap to hold WC folded

Typical location of webbing with elastic and side release buckle

Paralyzed Veterans of America (PVA) Grant

This project was supported by award #3028 from the Paralyzed Veterans of America Research Foundation.

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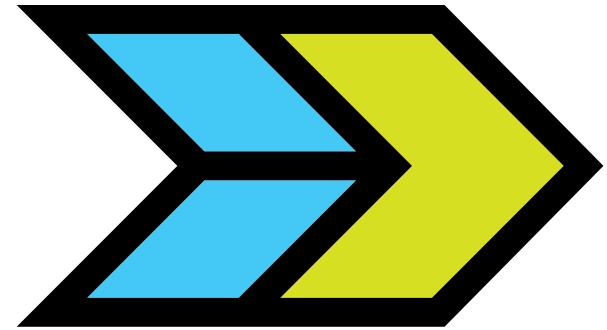
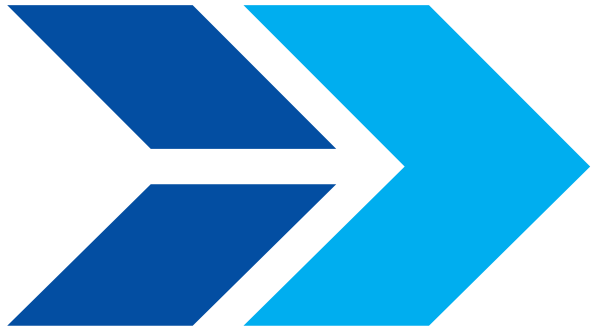
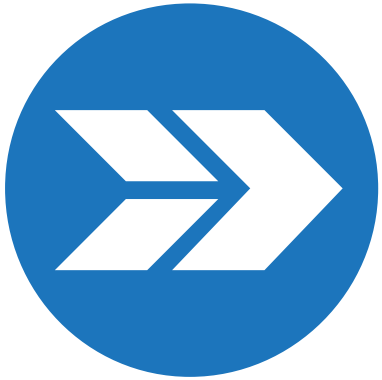
DESIGNS

BENEFICIAL DESIGNS

BD







beneficial designs