beneficial designs

designing beyond the norm to meet the needs of all people

Stanford University

Peter Axelson

2025-02-25


BRING ME MEN
STOP

The need:

To get back out on the snow

The Mono Ski

Now a Paralympic sport


200
205
AMERICAN EXPRESS
When you ne

How I got to where I am…

Initial intentions and objectives

Redirected with a new purpose

Found another great place to grow

Personal needs directed my designs

Focused on AT and access for life

beneficial designs

designing beyond the norm to meet the needs of all people

research

design

education

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.

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.

beneficial designs

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It takes a team of people…

to design, test and assess

to write, map and build

to plan, support and present

Bill Blythe

IT and facility manager

Stephanie Stephens

research assistant – remote from India

Stephen Pieters

wheelchair test lab leader

Ben Hubbard

graphic artist GIS map designer

Debbie Hester

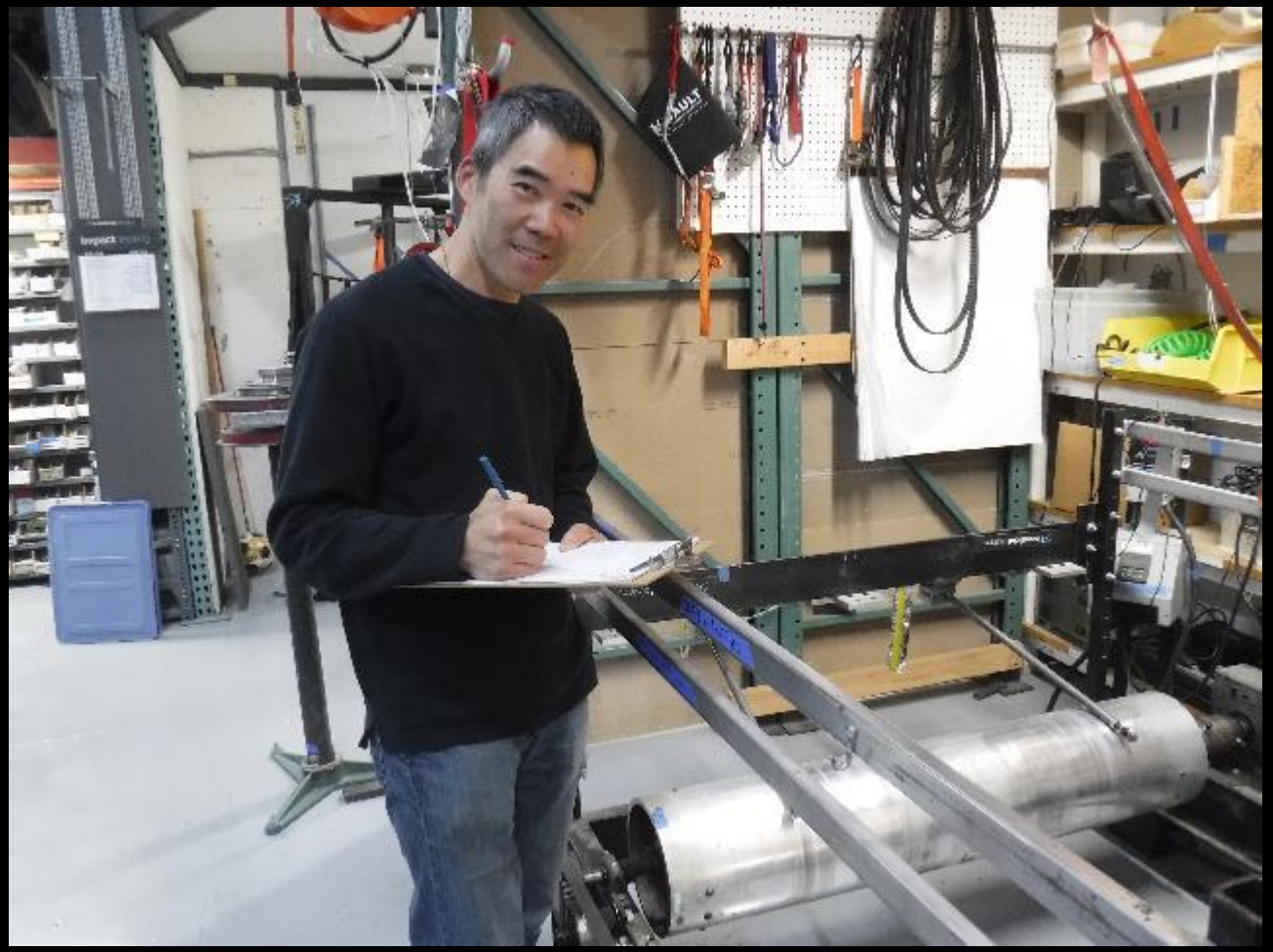
GIS technician

Ria Axelson

office manager and welder

Paul Schnorbus

machinist



Thomas Lee

IT and quality control

Todd Ackerman

sidewalk assessment coordinator

Travis McDonald

assessment technician

Jeremy Kennemur

assessment technician

Abraham Lesiuk

assessment technician

Wynter Sturtevant

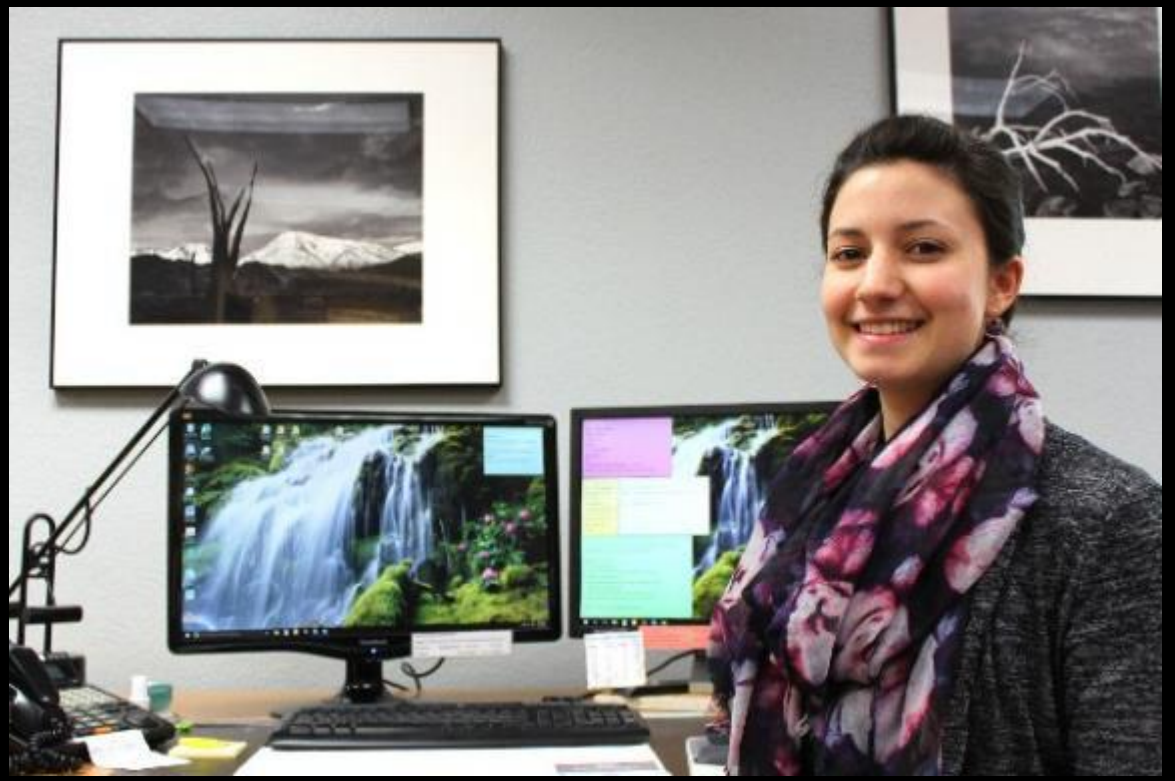
data analyst

Jonathan Miller

technical assistant

Joshua Wetmore

test lab assistant



Maegan Elkaraki

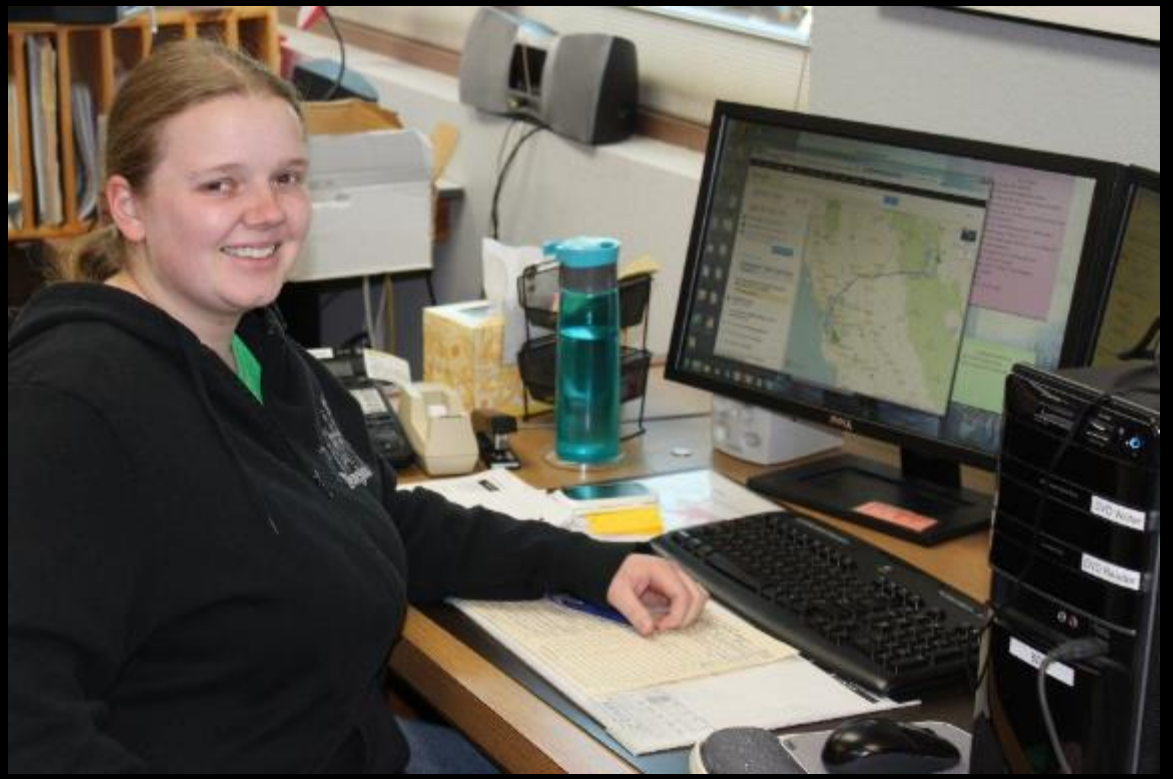
bookkeeping and financial

Annabeth Johnson

administrative assistant

Paola Vazquez

office assistant



Sharon Vazquez

bookkeeping assistant – remote

Peter Axelson

Director of R&D

A working space with tools…

to design and create

to build, test and break

with material and stuff to assemble


N20K


R2-A
JC Metal Fabrication Inc.
231-832-3551


N-C
N-8


N-D
N-C

Testing

- Wheelchairs
- Surfacing
- Adaptive sports equipment
- Forensics

Wheelchair testing

- People get hurt using them
- Design and manufacturing defects
- Making sure the product is safe
- Determine the performance of the product
  - How fast will it go?
  - How far it will go?
  - How high it can climb?

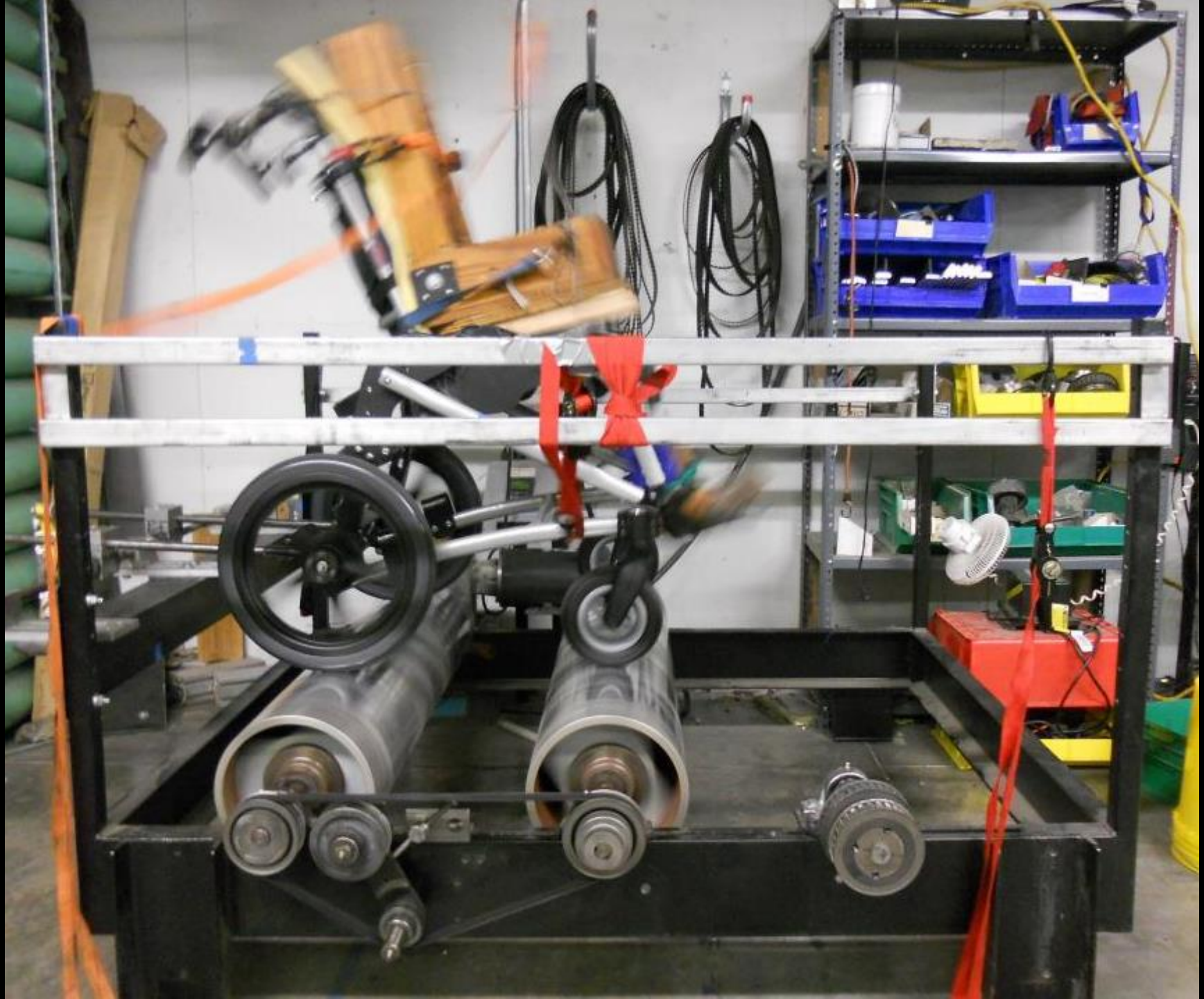
Accredited wheelchair testing

American RESNA Vol. 1 & 2 test procedures

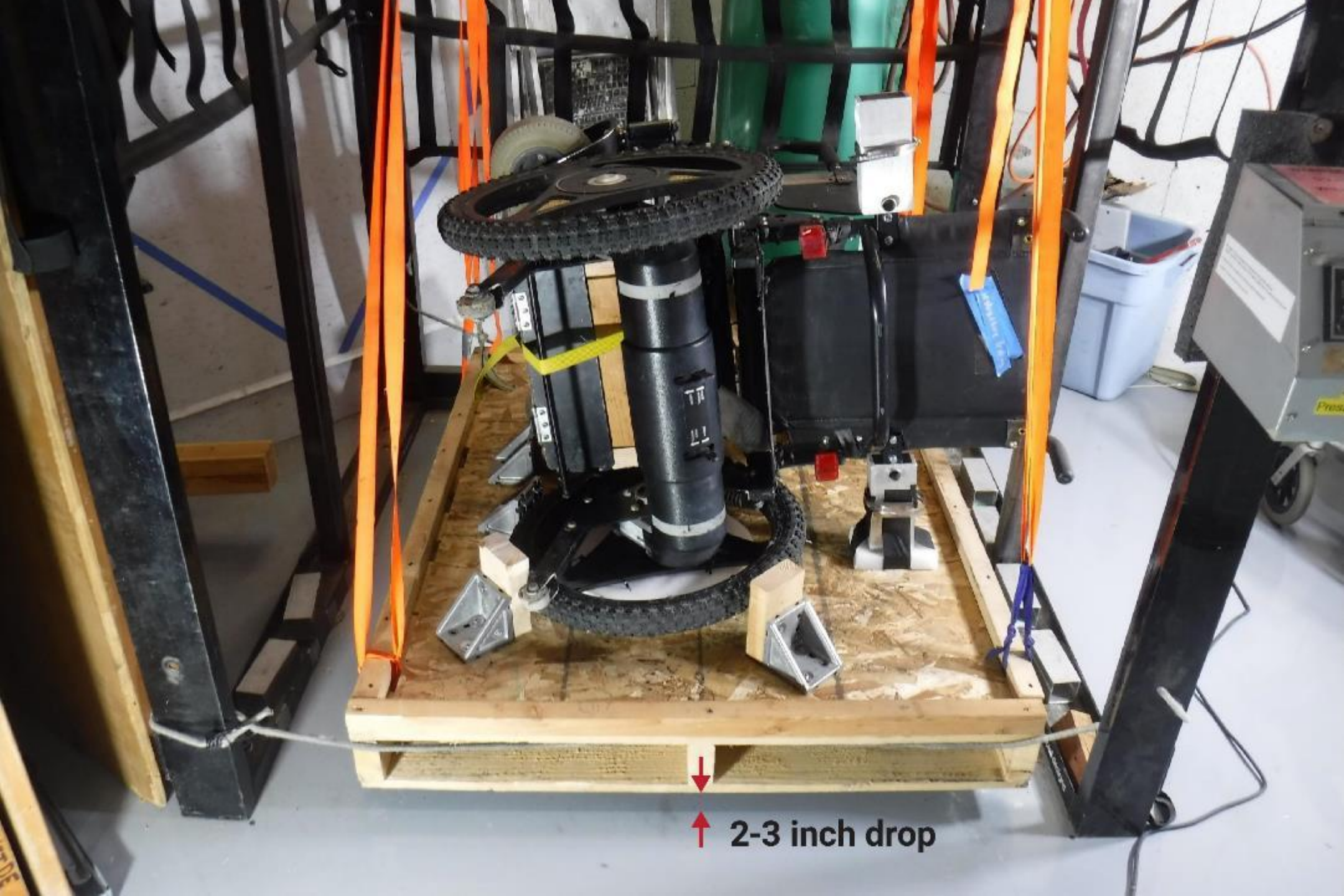
International Standards Organization ISO testing procedures Sections 1 through 30

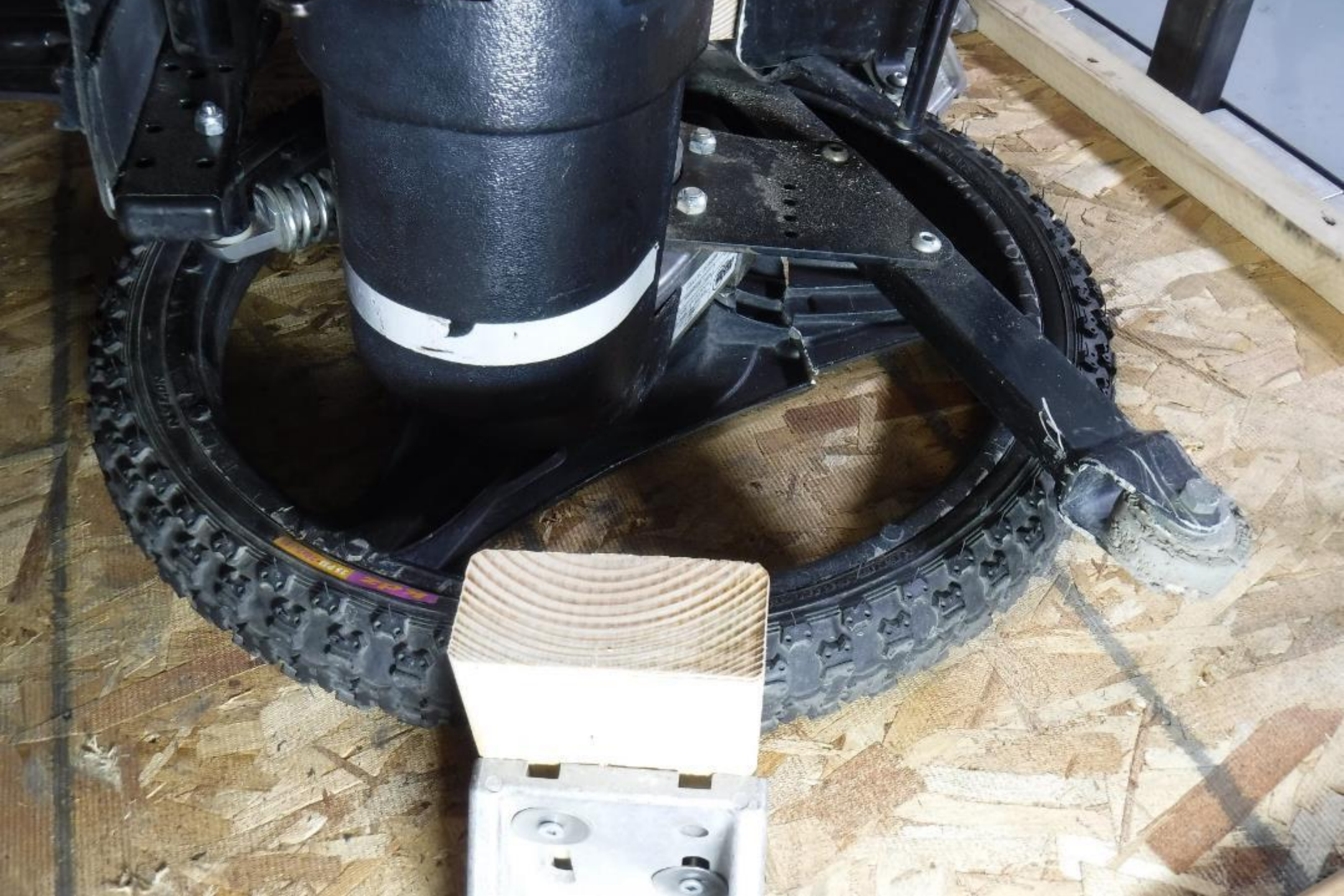
European National EN12183 and 12184 testing requirements and test methods

ANAB
ANSI National Accreditation Board
ACCREDITED
ISO/IEC 17025
CALIBRATION AND TESTING LABORATORY



Damage


2-3 inch drop





10°


10°


2014-2


Action Trackstander


dynamic stability test ramp


7.5°

Surface testing

- People get hurt using playgrounds
- Soft but firm and stable
- Making sure the product is safe
- Making sure I don’t get stuck in them
  - How firm is the surface?
  - How stable is the surface?

Accredited firmness and stability testing

ASTM F1951 Playground testing

Instrumented Surface Indenter ISI

Calibration laboratory for ISI

ANAB
ANSI National Accreditation Board
ACCREDITED
ISO/IEC 17025
CALIBRATION AND TESTING LABORATORY

Instrumented Surface Indenter (ISI)

objective surface measurement device


BDRP100


BDRP100
Start Here

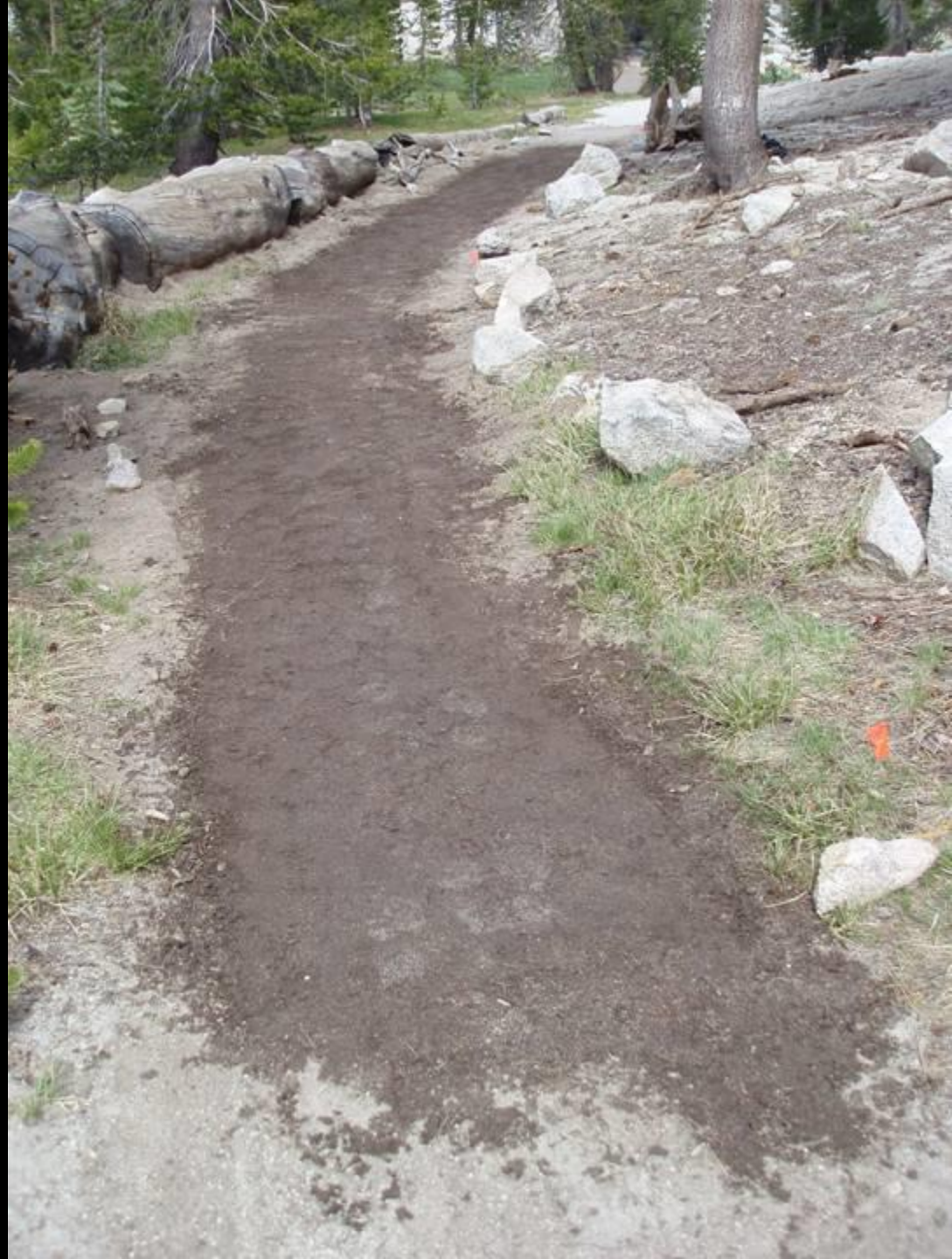
USA
in/mm
ON
ZERO
ABS
UNLOADED

Trail surface

Trail with firm but unstable sandy surface

Final surface

Trail after installation of surface stabilizer



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

Seat cushion testing

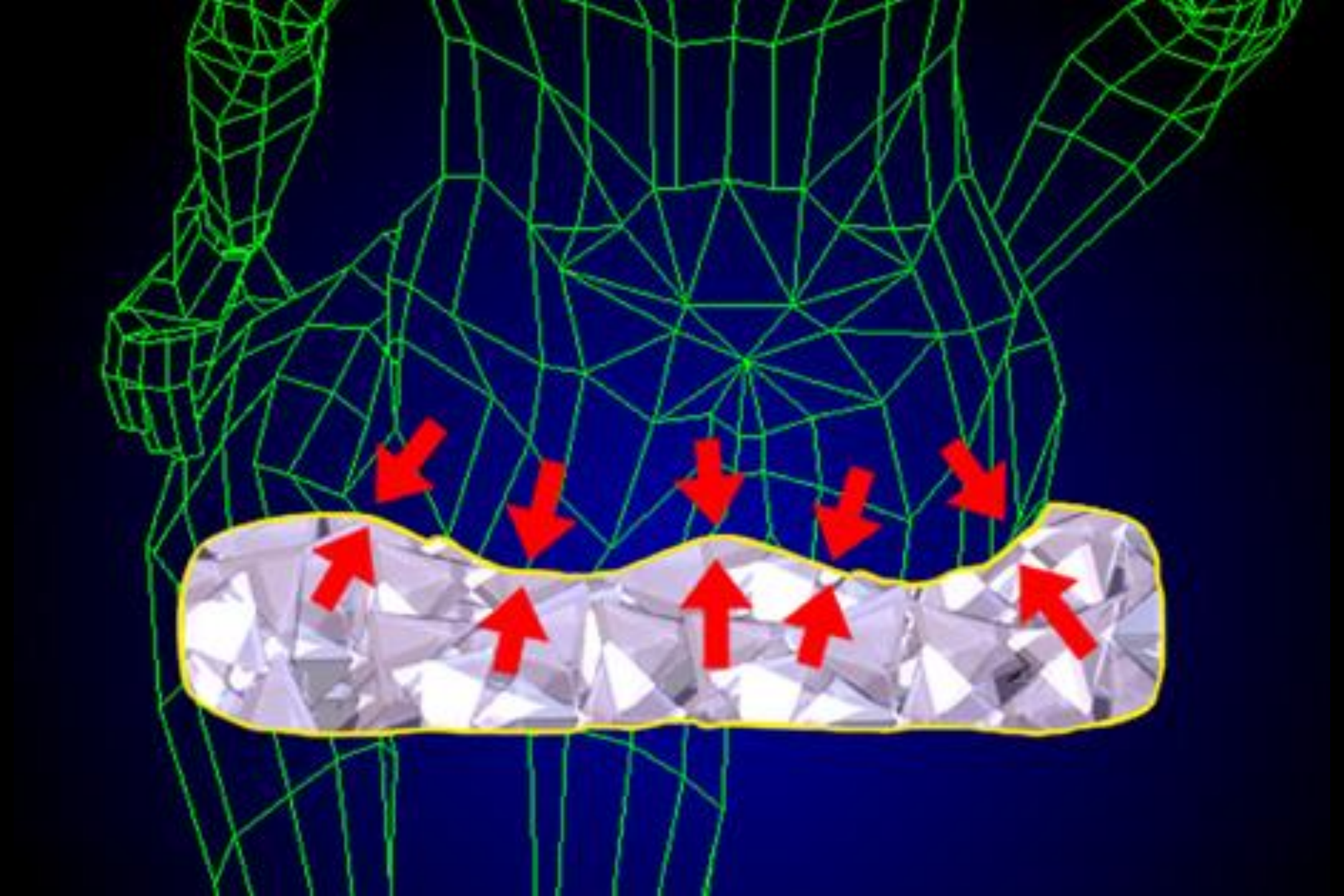
People die from pressure sores

Soft but firm and stable

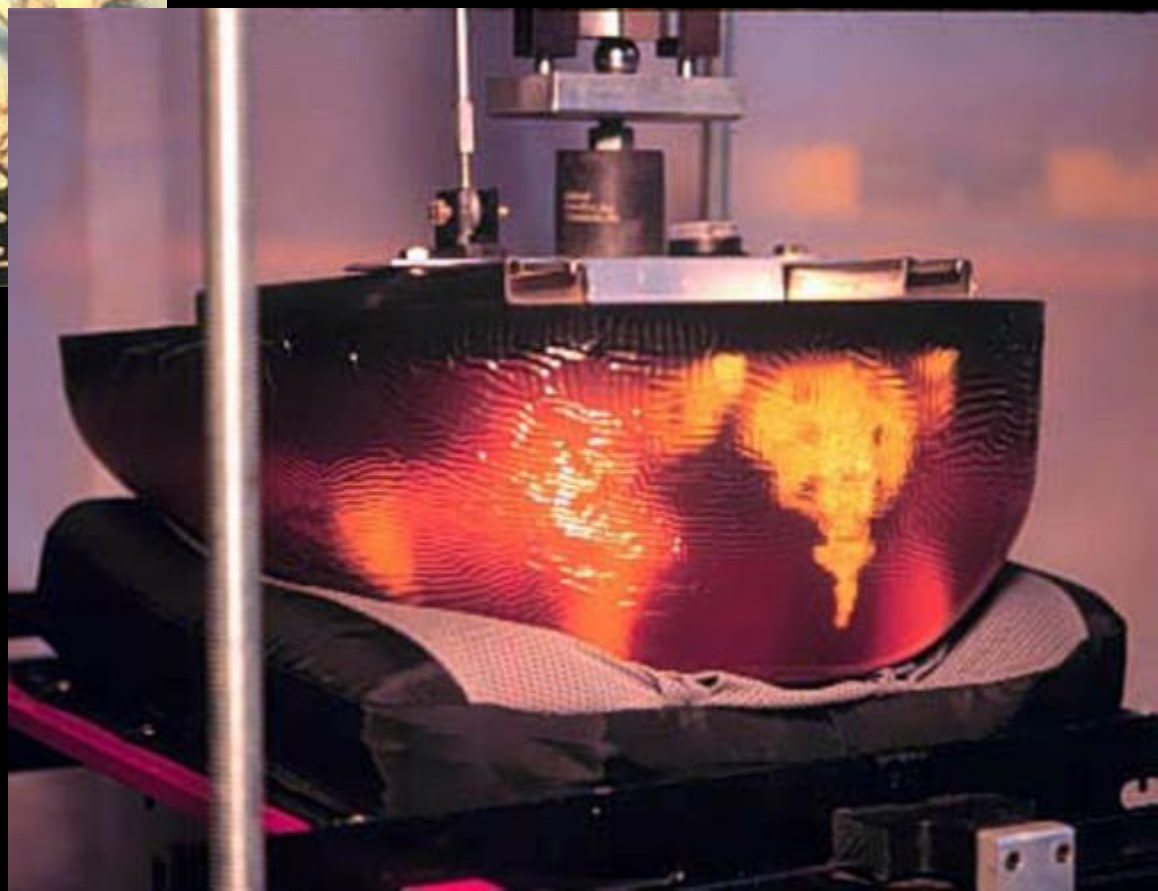
Making sure the product is safe

Making sure I don’t get a pressure sore

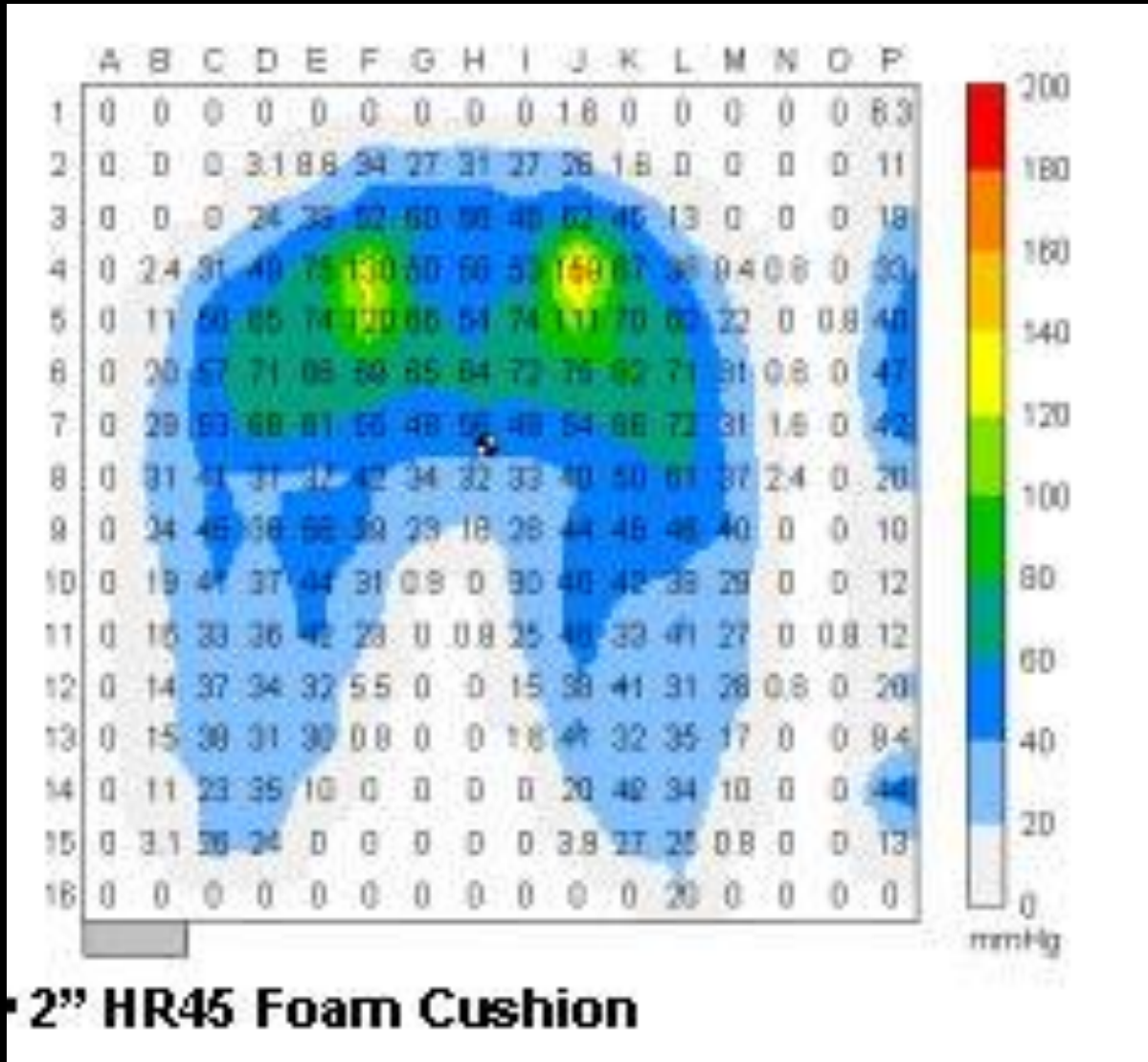
- How high are the sitting pressures?
- How long can I sit on it?



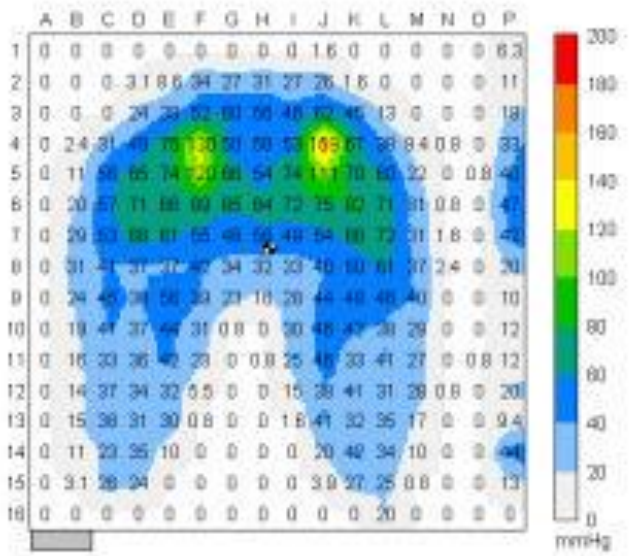
Testing with Gel Butt



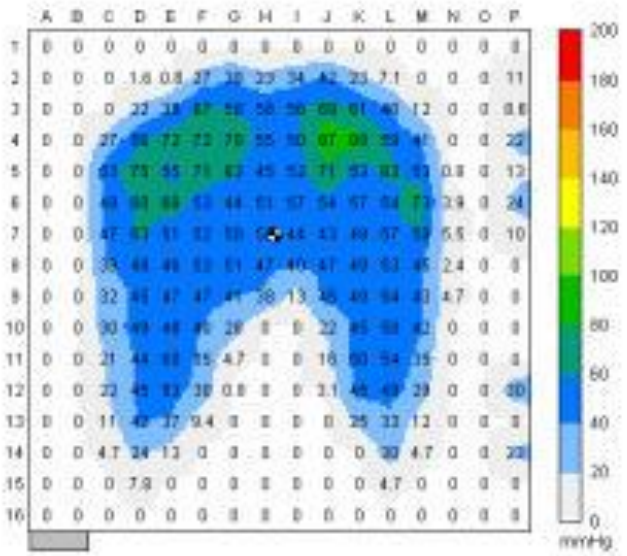
SKELI used on foam



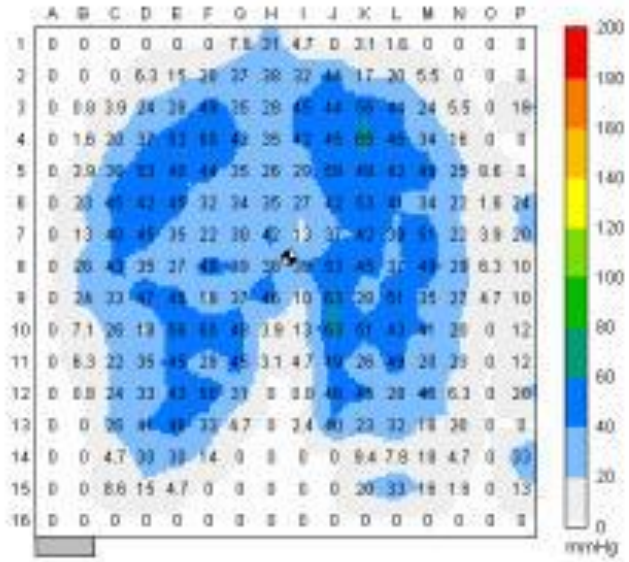
2" HR45 Foam Cushion



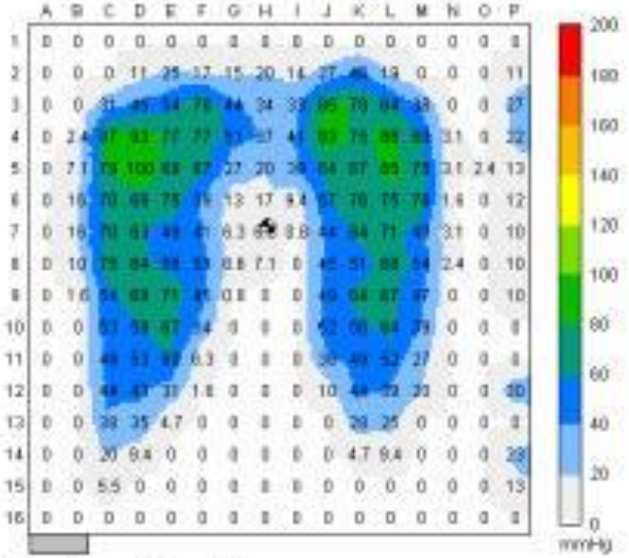
2" HR45 Foam



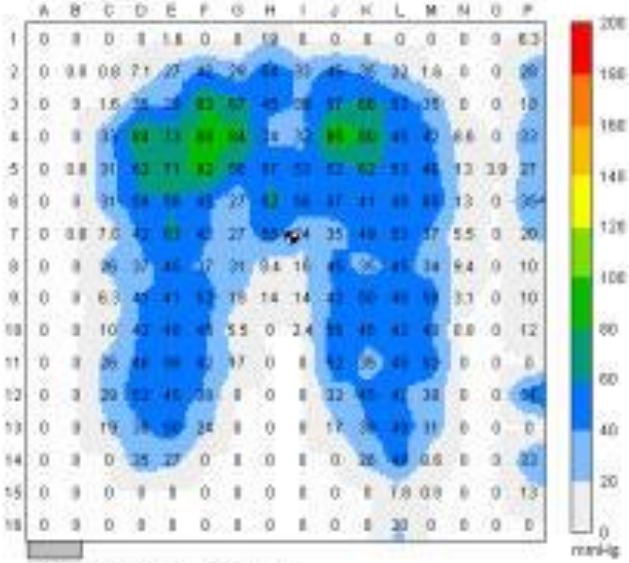
Jay 2 by Sunrise Medical



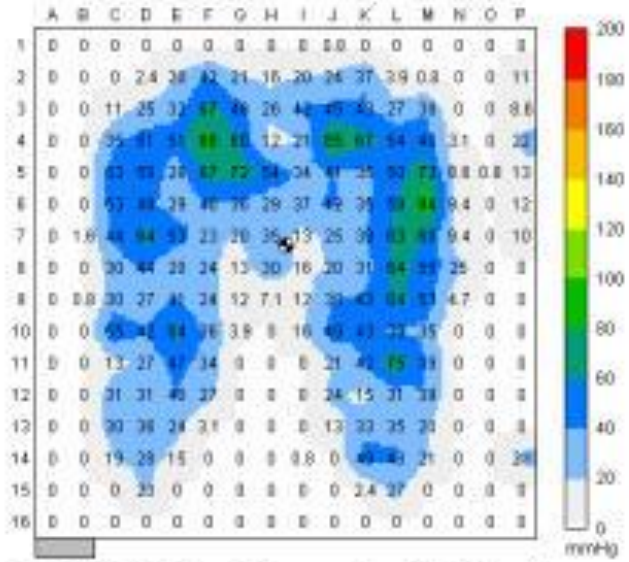
ROHO High Profile by ROHO Inc.



Contoured by Supracor



Model P by Vicair



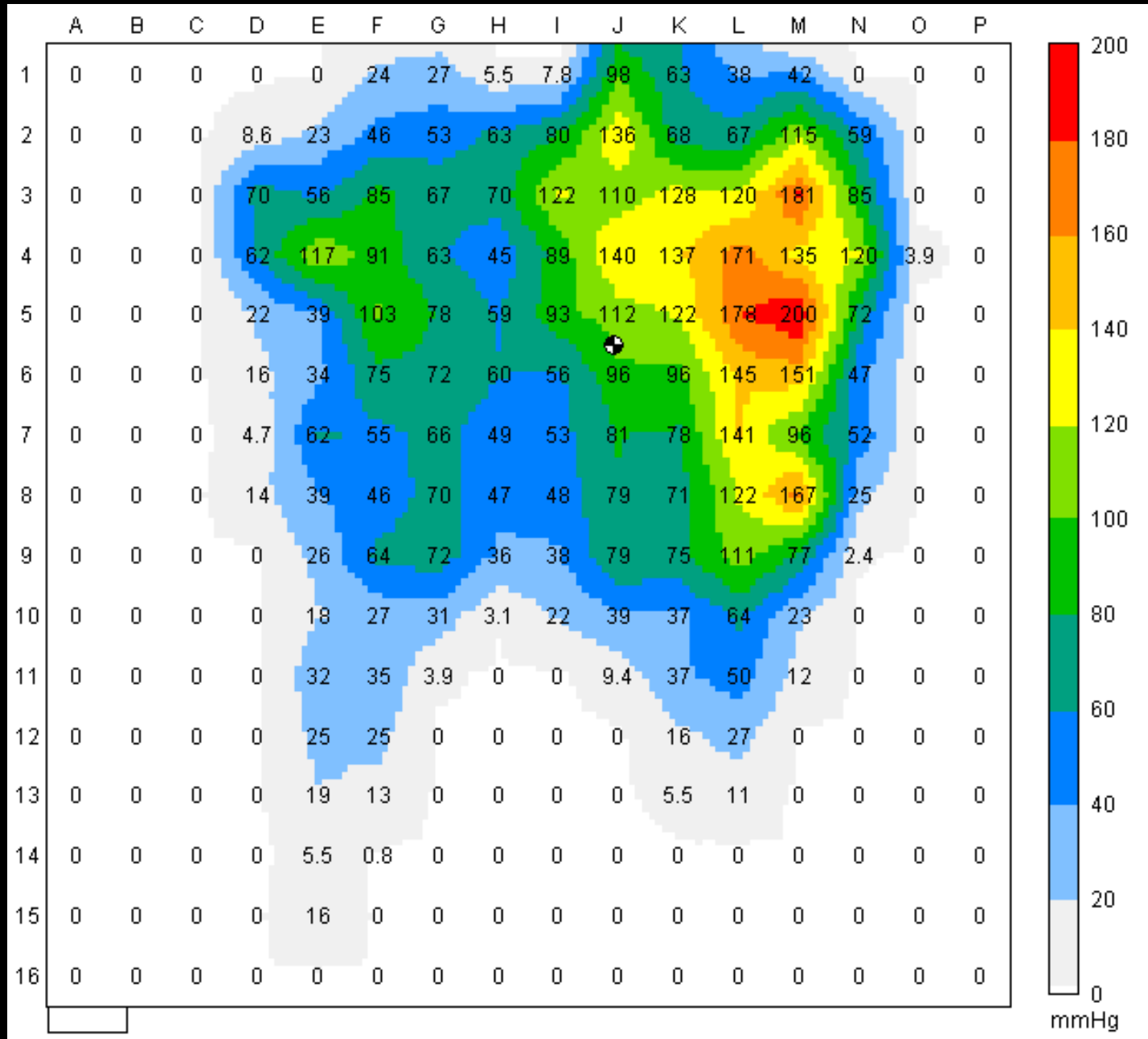
Model P Deep Immersion by Vicair

ASLI prototype

became an ISO shape

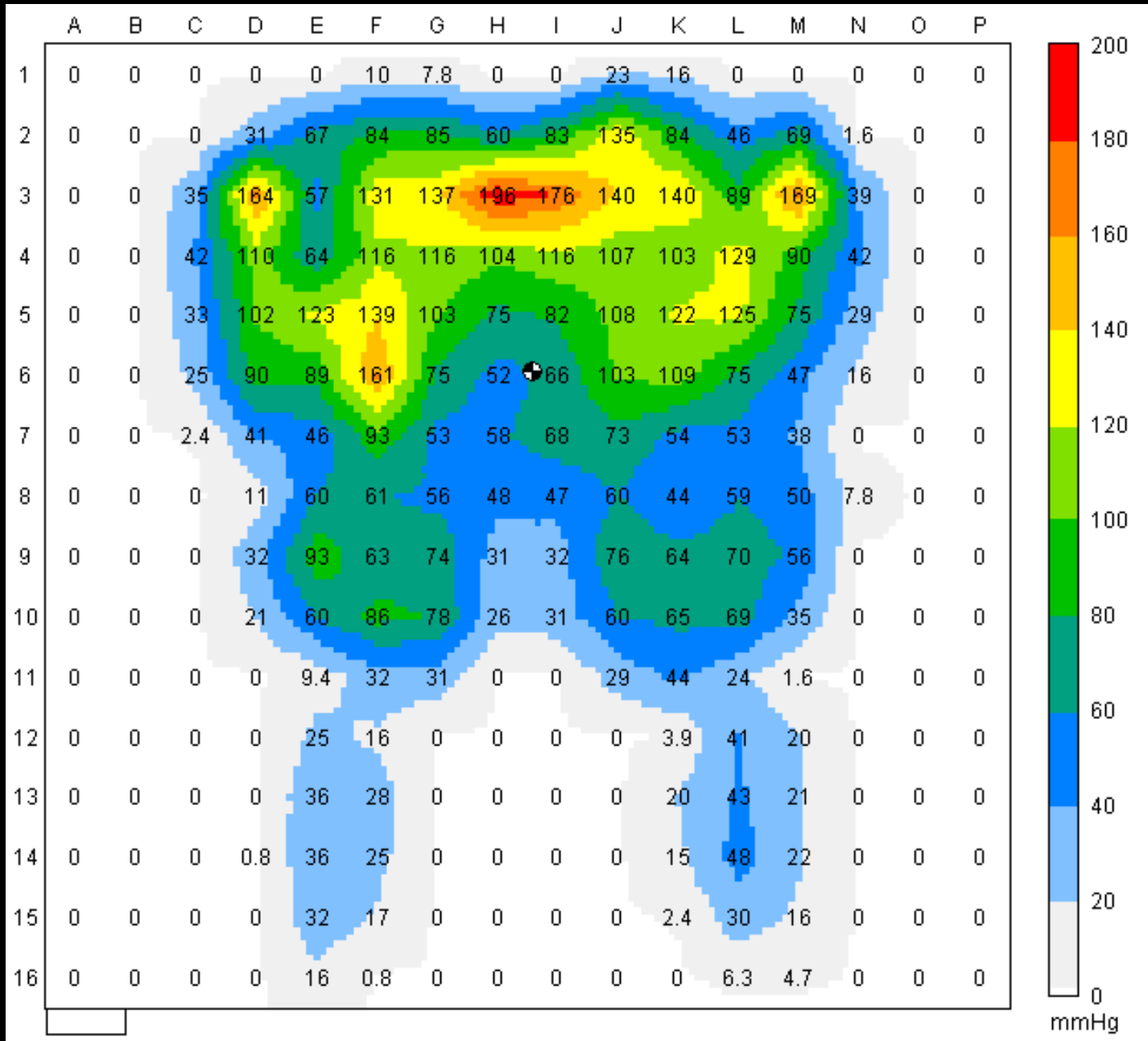
Pressure measurements

10° pelvic obliquity



Pressure measurements

15° posterior pelvic tilt



Personal technologies

Activity-specific technologies

Environmental technologies

Personal technologies

Things that you wear

My personal wheelchair

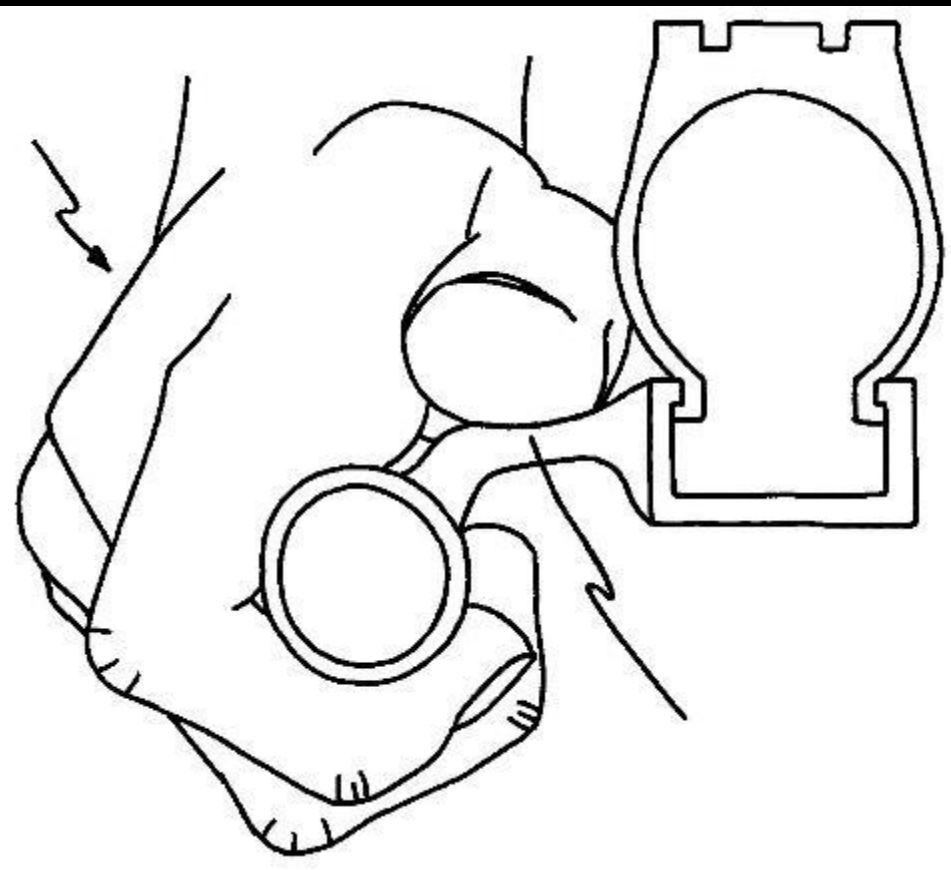
The need:

More comfort sitting

The need:

A better grip

Solution: an ergonomic pushrim

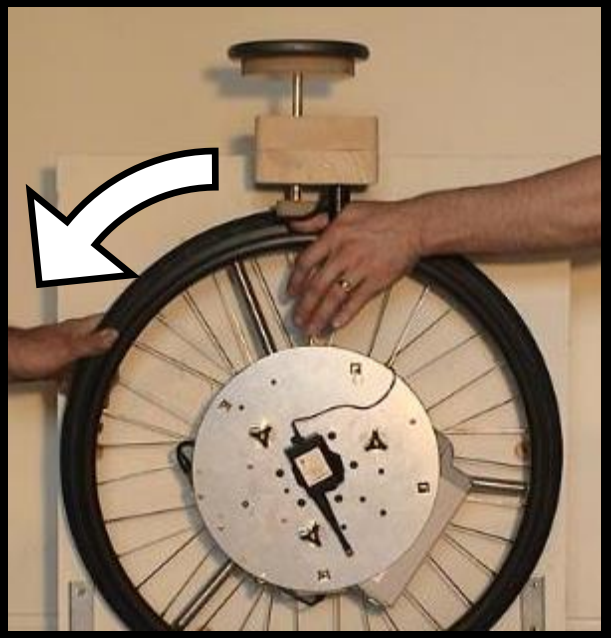


FlexRim

Combining the discrete compliant fasteners into one

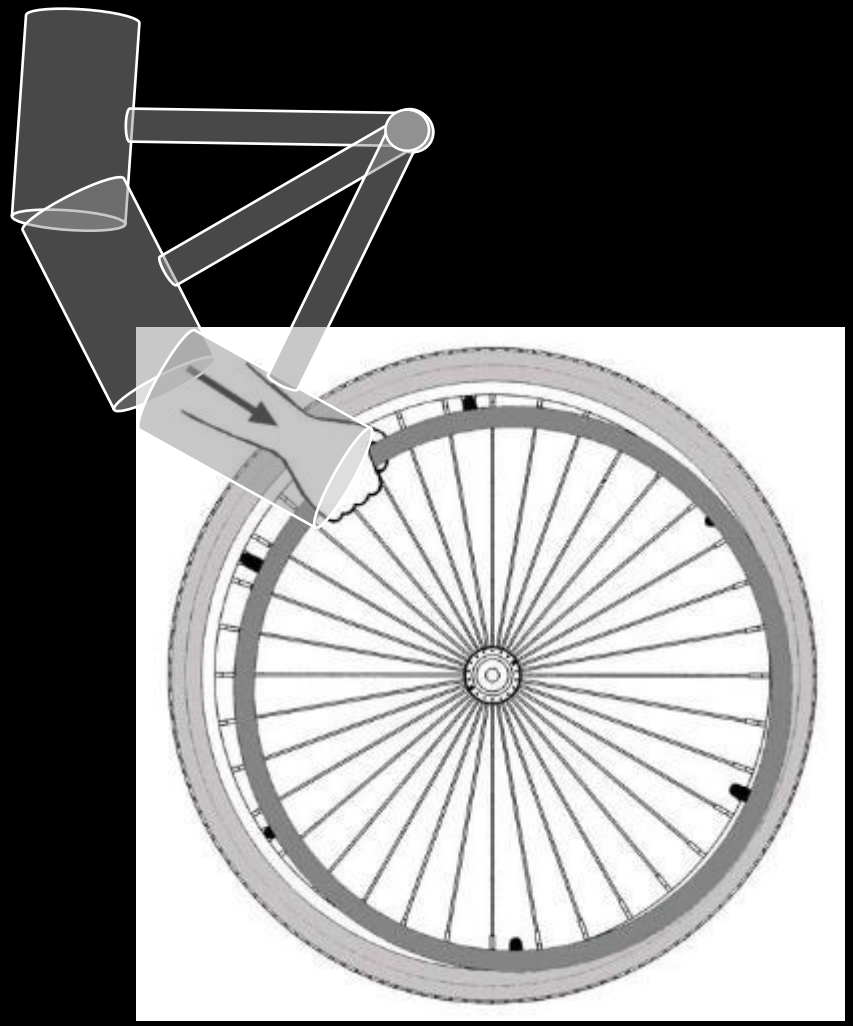
Frictional improvements

To reduce the grip force required to push



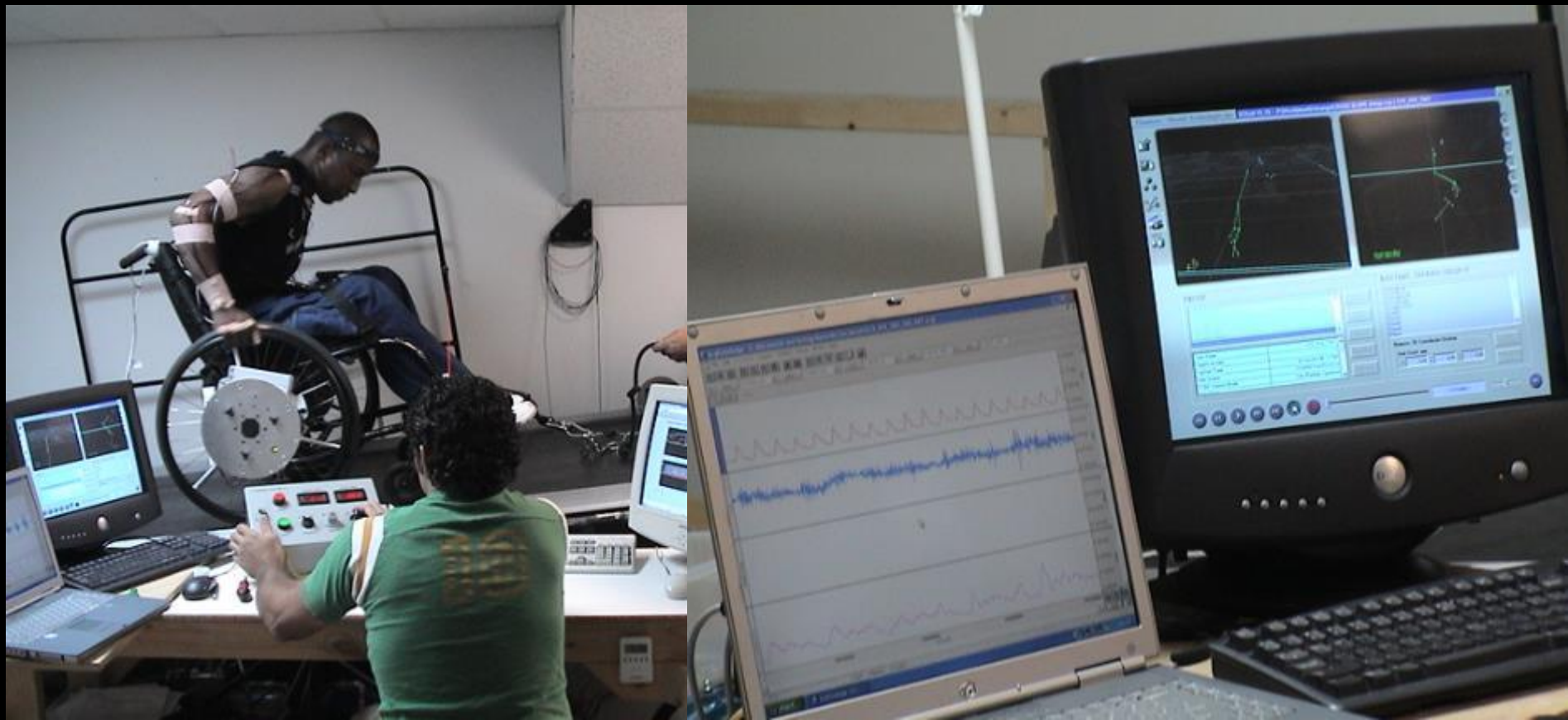
Impact absorbtion

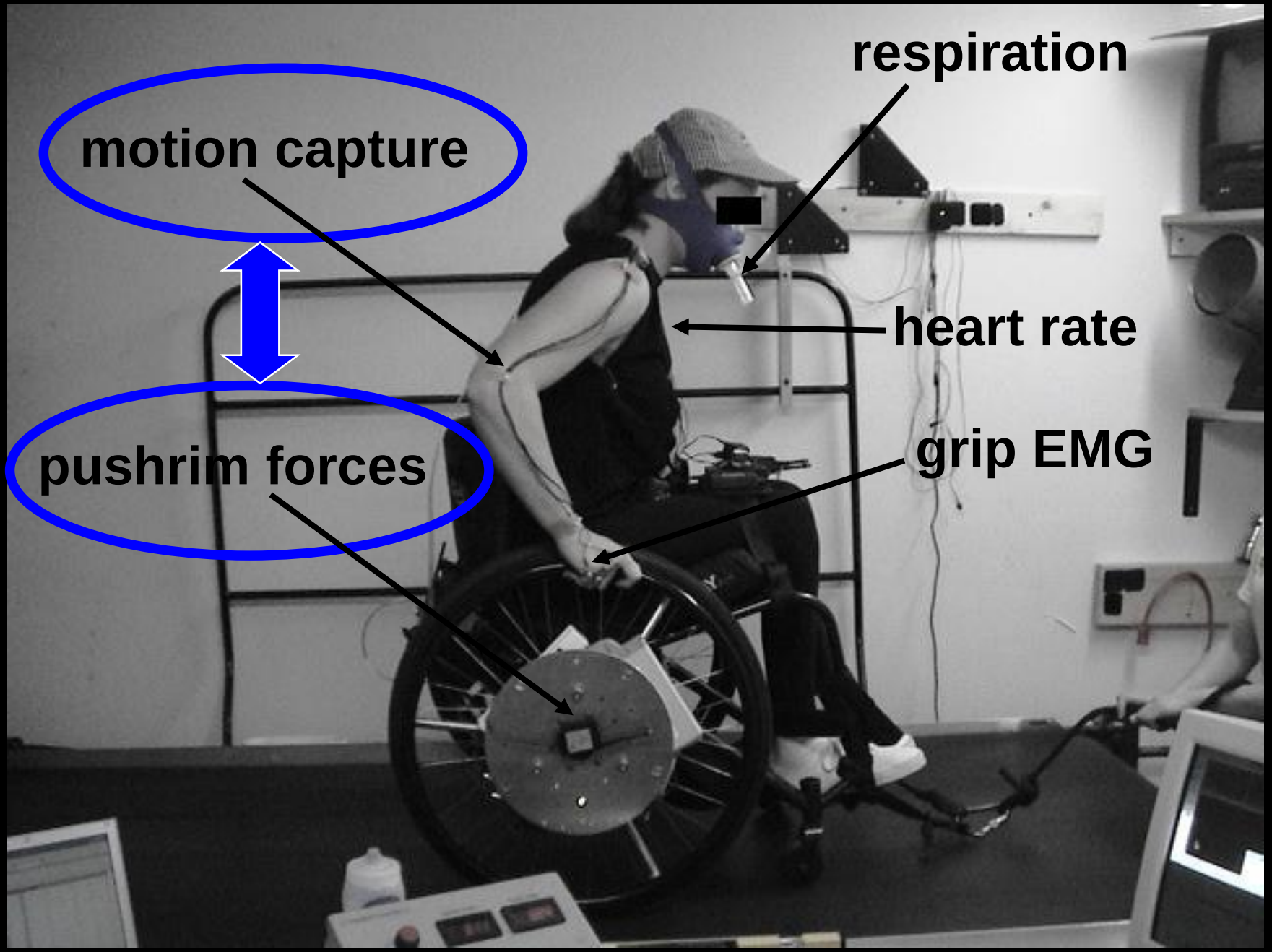
Like running shoes



Subjects are tested

over a wide variety of usage environments




respiration
motion capture
heart rate
grip EMG
pushrim forces

End product – the FlexRim

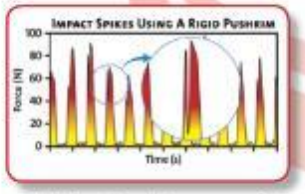
Design

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 ***18% 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

Activity-specific technologies

And the desire to recreate


Back ∠
20°
Seat ∠
20°
seat depth 14.75
height 20.325
2020. 3. 4


MONIQUE

Dynamic seating spring assist


celebrating
Peter

The desire:

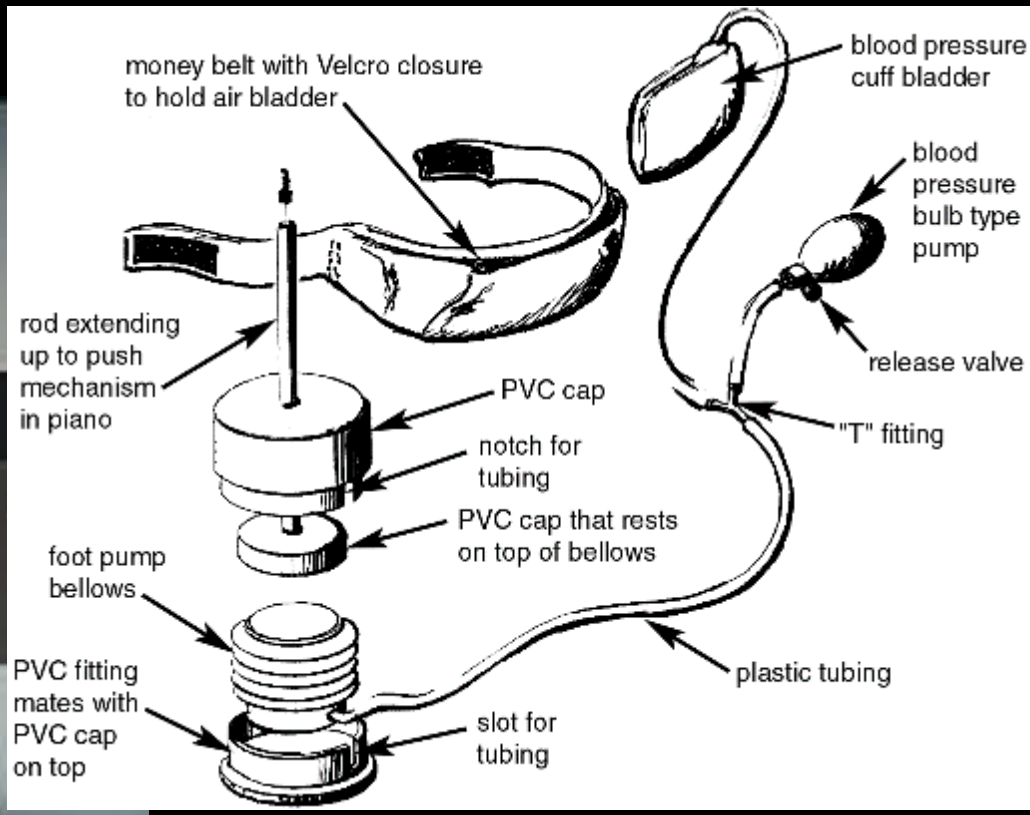
Get back into the backcountry


4 12'98


FOX SHOX
4 12 '98

The need:

Use the pedal again to play the piano



The desire:

Drive a manual shift vehicle

The desire:

Balance and ride a bike again

The desire:

Ride a tandem bike with a friend

The desire:

Paddle a canoe again without the required balance

Lateral balance test

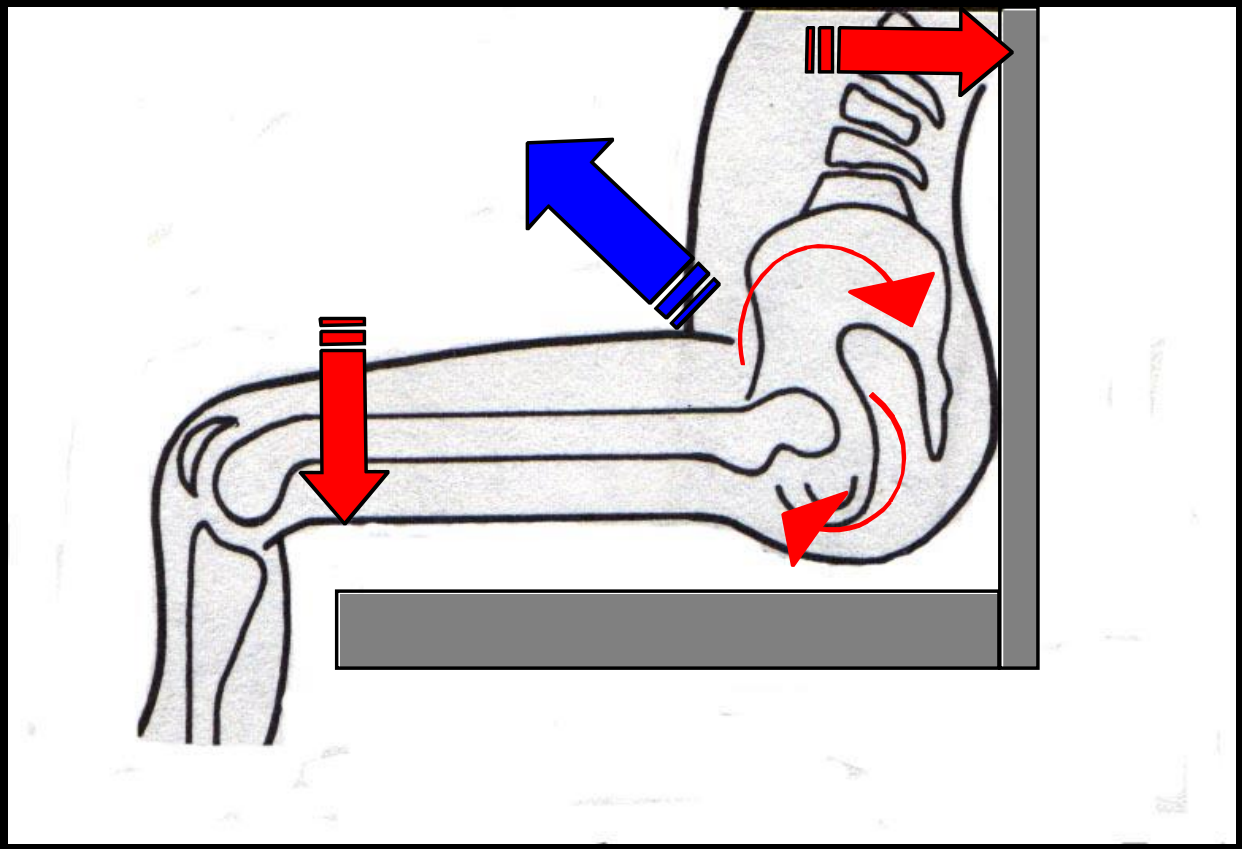
Water egress testing

The desire:

Surf again

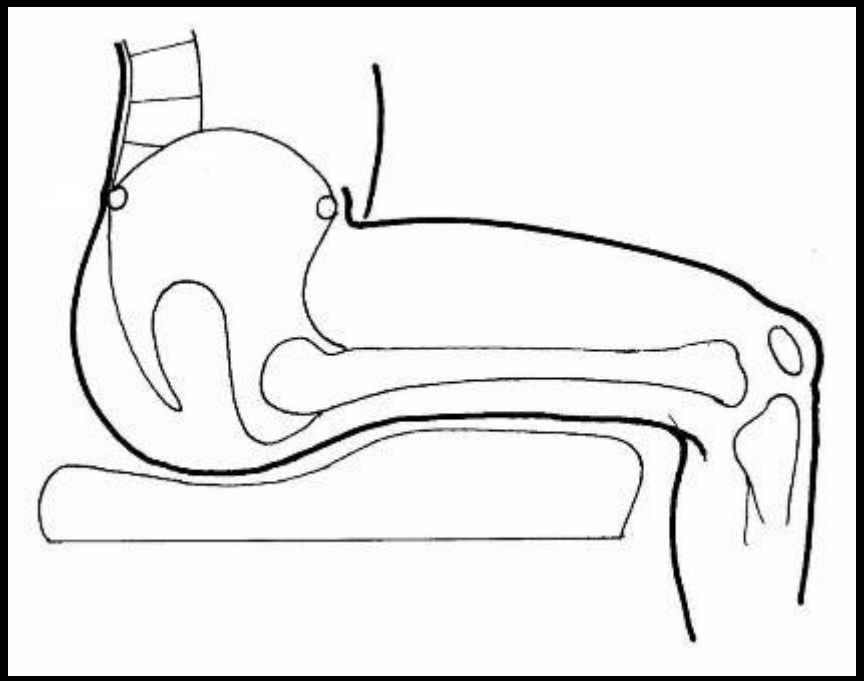
The problem:

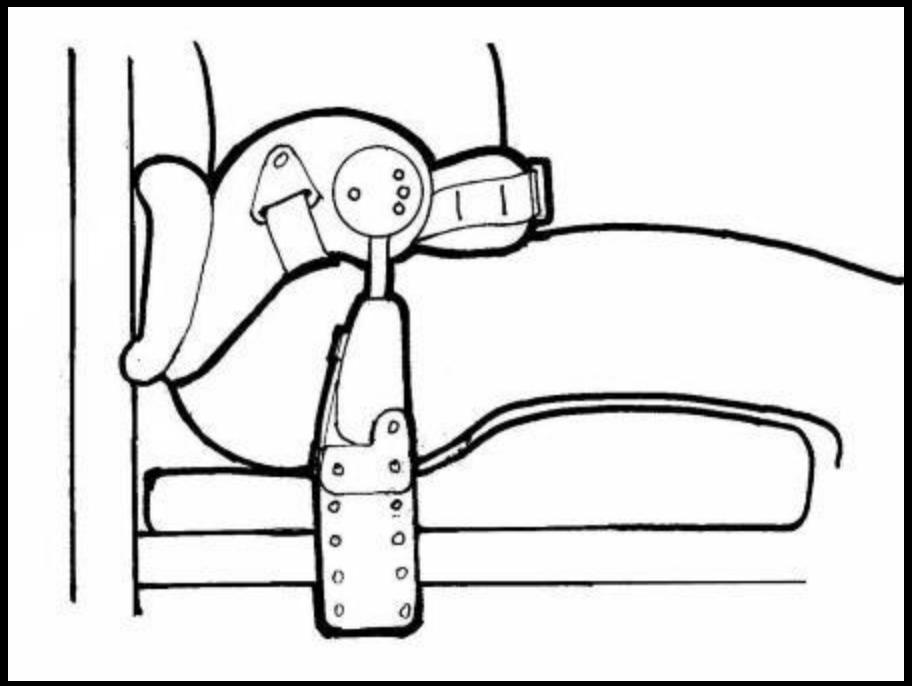
Unwanted pelvic movement due to spasticity



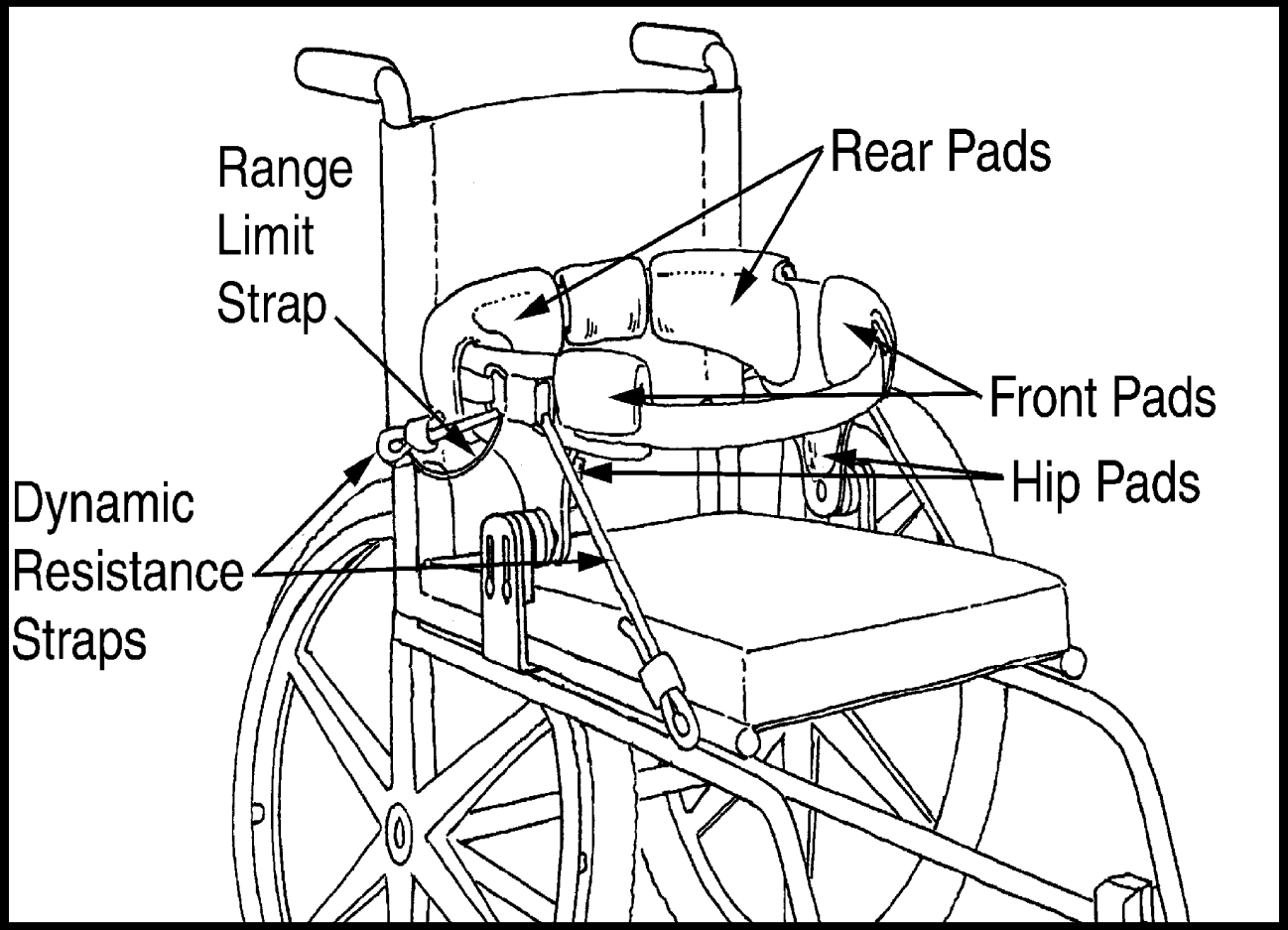
Concepts developed

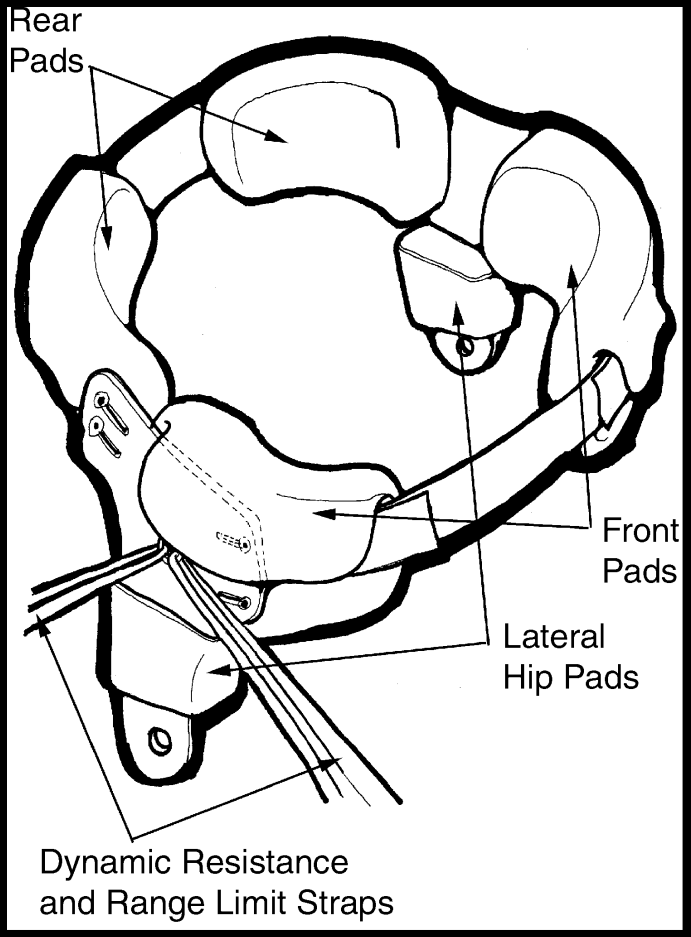
to allow the movement, but return to the desired position





Early prototypes





Fatigue testing of concept

The finished product

Environmental technologies

Things that do not move

ADA recreation trail grade

grade	
> 8.33%	up to 30% of length
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 other attributes

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

Universal Trail Assessment Process (UTAP)

Key UTAP information

length

grade

width

surface

cross slope

features & facilities

UTAP assessment team


SMARTTOOL

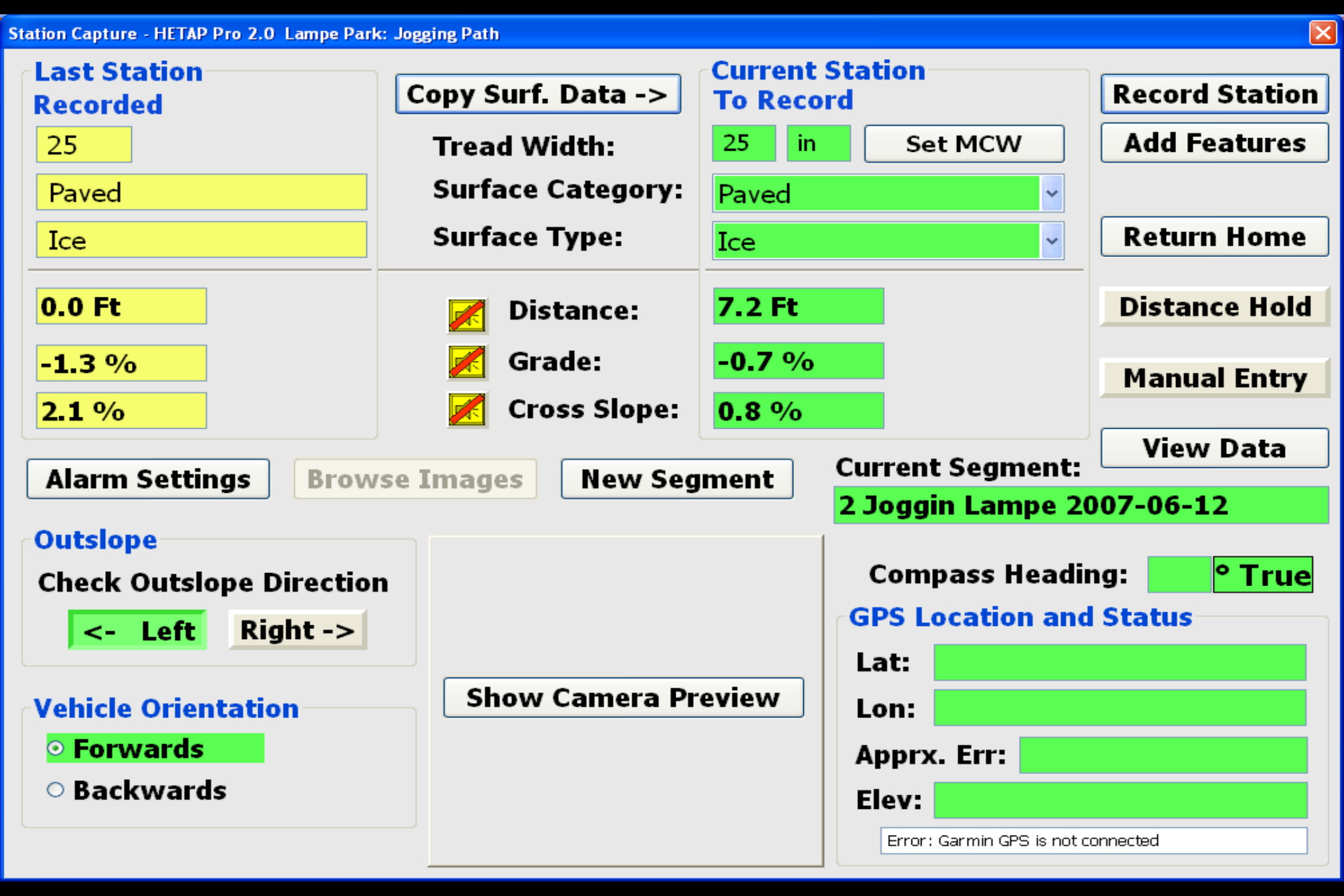
UTAP implementation status

Over 1900 people
trained to lead UTAP assessments

Over 155 trainers
to teach UTAP workshops

High-Efficiency Trail Assessment Process (HETAP)

HETAP wheel


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:
Current Station To Record
25
in
Set MCW
Paved
Ice
Distance:
Grade:
Cross Slope:
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


Red
Road
To Peavine Falls Road
Length 5.5 mi (8.9 km)
Elev Gain 787 ft (240 m)
Elev Loss 420 ft (128 m)
Hikers
Bikes
Dogs on Leash
No Motorized Vehicles
No Equestrians

Trail Access Information

TAI for Users

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

Bikes

No Bikes: Spooner Summit to North Canyon Hobart Rd

Dogs

Equestrians

No Motor Vehicles

GRADE

Typical Grade	**7.3%**
27% of trail is	**10%** to **20%**
1829 ft (557 m) is	**20%** to **29%**
Standard Ramp Grade	8.3%

CROSS SLOPE

Typical Cross Slope	**3.2%**
18% of trail is	**5%** to **10%**
2433 ft (741 m) is	**10%** to **20%**

TREAD WIDTH

Typical Width	**28 in** (71 cm)
Minimum Width	**18 in** (45 cm)

TAHOE RIM TRAIL

TREAD WIDTH

Typical Width	**28 in** (71 cm)
Minimum Width	**18 in** (45 cm)

SURFACE

Surface Type	**Soil**
Typical Firmness	**0.17 in** (F)

Minimum Firmness	**0.40 in** (MF)
1% of trail is	**Moderately Firm**
Typical Stability	**0.51 in** (MS)

Minimum Stability	**0.73 in** (MS)
25% of trail is	**Moderately Stable**

OBSTRUCTIONS

Multiple Rocks	**18 in** (46 cm)

VIEW MAP

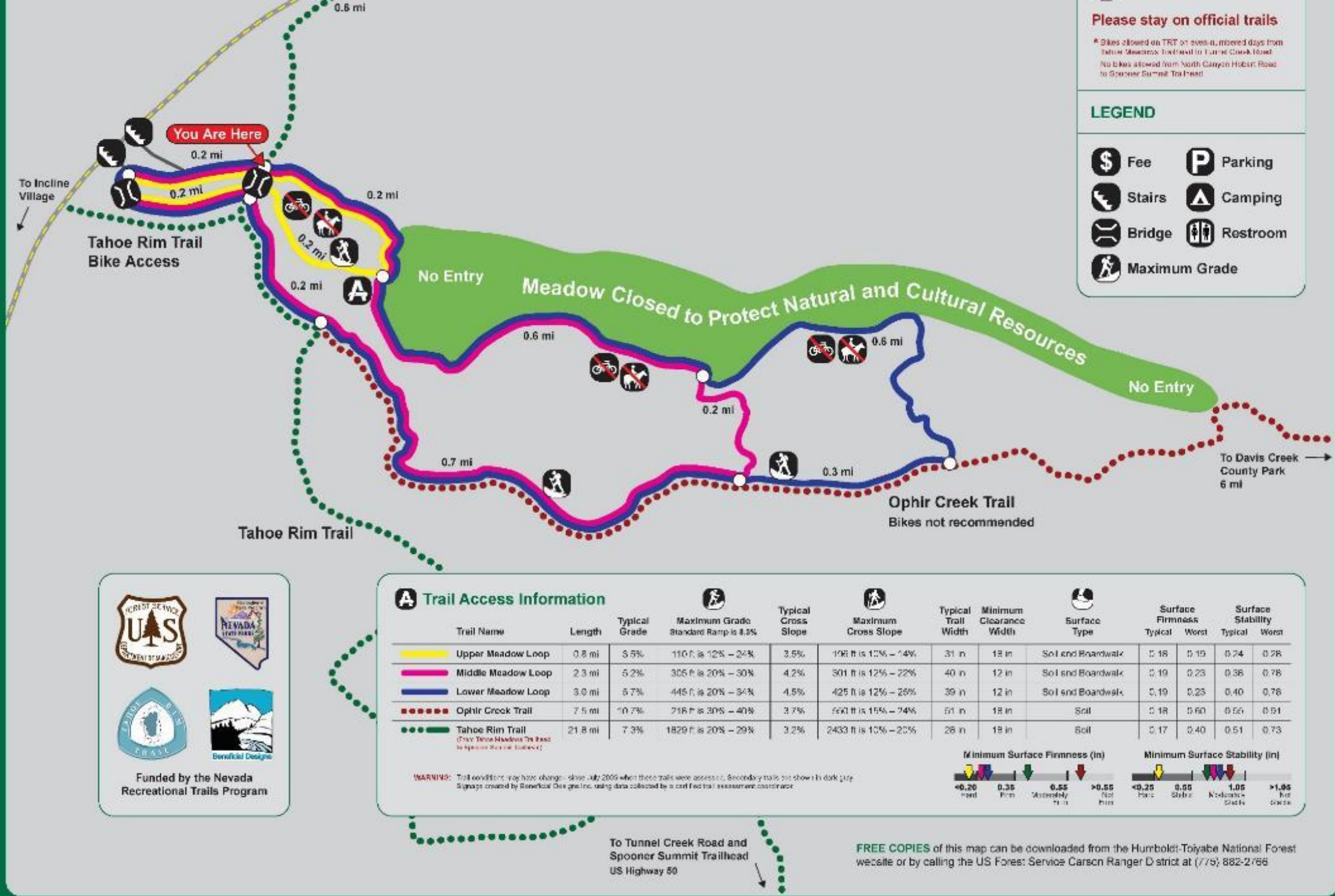
Scan QR code to view **Tahoe Meadows to Spooner Summit Map**

www.tahoerimtrail.org

WARNING: Trail conditions may have changed since December 2008 when this trail last was assessed. Temporary obstructions were not recorded. Firmness values ≤ 0.30 inch and Stability values ≤ 1.00 inch correlate to surfaces tested per ASTM F1951.

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

TRAIL ACCESS INFORMATION



Funded by the Nevada Recreational Trails Program

Trail Access Information

Trail Name	Length	Typical Grade	Maximum Grade Standard Ramp is 8.3%	Typical Cross Slope	Maximum Cross Slope	Typical Trail Width	Minimum Clearance Width	Surface Type	Surface Firmness Typical	Surface Firmness Worst	Surface Stability Typical	Surface Stability Worst
Upper Meadow Loop	0.8 mi	5.5%	110 ft is 12% – 24%	3.5%	198 ft is 12% – 14%	31 in	18 in	Soil and Boardwalk	0.18	0.19	0.24	0.28
Middle Meadow Loop	2.3 mi	5.2%	305 ft is 20% – 30%	4.2%	301 ft is 12% – 22%	40 in	12 in	Soil and Boardwalk	0.19	0.23	0.36	0.78
Lower Meadow Loop	3.0 mi	5.7%	445 ft is 20% – 34%	4.5%	425 ft is 12% – 25%	39 in	12 in	Soil and Boardwalk	0.19	0.23	0.40	0.78
Ophir Creek Trail	7.5 mi	10.7%	216 ft is 30% – 40%	3.7%	660 ft is 15% – 74%	51 in	18 in	Soil	0.18	0.60	0.56	0.91
Tahoe Rim Trail (From Tahoe Meadows Trailhead to Spooner Summit Trailhead)	21.8 mi	7.3%	1829 ft is 20% – 29%	3.2%	2433 ft is 15% – 25%	28 in	18 in	Soil	0.17	0.40	0.51	0.73

WARNING: Trail conditions may have changed since July 2009 when these trails were assessed. Secondary trails not shown in dark grey. Signage created by Beneficial Designs Inc. using data collected by a certified trail assessment coordinator.

Minimum Surface Firmness (in): <0.20 Hard; 0.35 Firm; 0.55 Moderately Firm; >0.55 Not Firm

Minimum Surface Stability (in): <0.25 Stable; 0.55 Stable; 1.05 Moderately Stable; >1.05 Not Stable

To Tunnel Creek Road and Spooner Summit Trailhead
US Highway 50

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

Trail Access Information

Trail Name	Length	Typical Grade	Maximum Grade (Standard Ramp is 8.3%)	Typical Cross Slope	Maximum Cross Slope	Typical Trail Width	Minimum Clearance Width	Surface Type	Surface Firmness Typical	Surface Firmness Wo
Upper Meadow Loop	0.8 mi	3.5%	110 ft is 12% – 24%	3.5%	196 ft is 10% – 14%	31 in	18 in	Soil and Boardwalk	0.18	0.
Middle Meadow Loop	2.3 mi	5.2%	305 ft is 20% – 30%	4.2%	301 ft is 12% – 22%	40 in	12 in	Soil and Boardwalk	0.19	0.
Lower Meadow Loop	3.0 mi	5.7%	445 ft is 20% – 34%	4.5%	425 ft is 12% – 25%	39 in	12 in	Soil and Boardwalk	0.19	0.
Ophir Creek Trail	7.5 mi	10.7%	218 ft is 30% – 40%	3.7%	550 ft is 15% – 24%	51 in	18 in	Soil	0.18	0.
Tahoe Rim Trail (From Tahoe Meadows Trailhead to Spooner Summit Trailhead)	21.8 mi	7.3%	1829 ft is 20% – 29%	3.2%	2433 ft is 10% – 20%	28 in	18 in	Soil	0.17	0.

Minimum Surface Firmness (in)

<0.20 Hard | 0.35 Firm | 0.55 Moderately Firm | >0.55 Not Firm

Minimum S

<0.25 Hard | 0.55 Stable

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

To Tunnel Creek Road and Spooner Summit Trailhead
US Highway 50

FREE COPIES of this map can be downloaded from the Humboldt-Toi website or by calling the US Forest Service Carson Ranger District at

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

Table

ABA/FSORAG

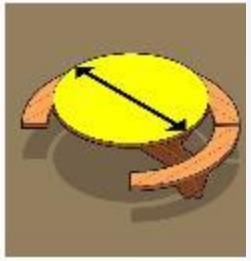
What type of assessment?

◯ ABA ◯ FSO

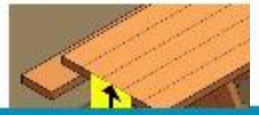
REQUIRED SPACES

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

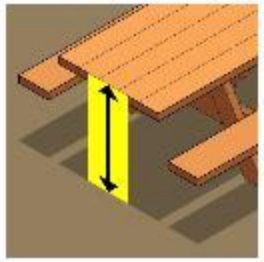


Table surface height (min 28 in
- max 34 in)

Compliant

CLEAR SPACE

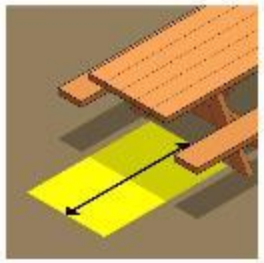
Does one full unobstructed side
clear ground space around the t
adjoin or overlap an ORAR trail

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

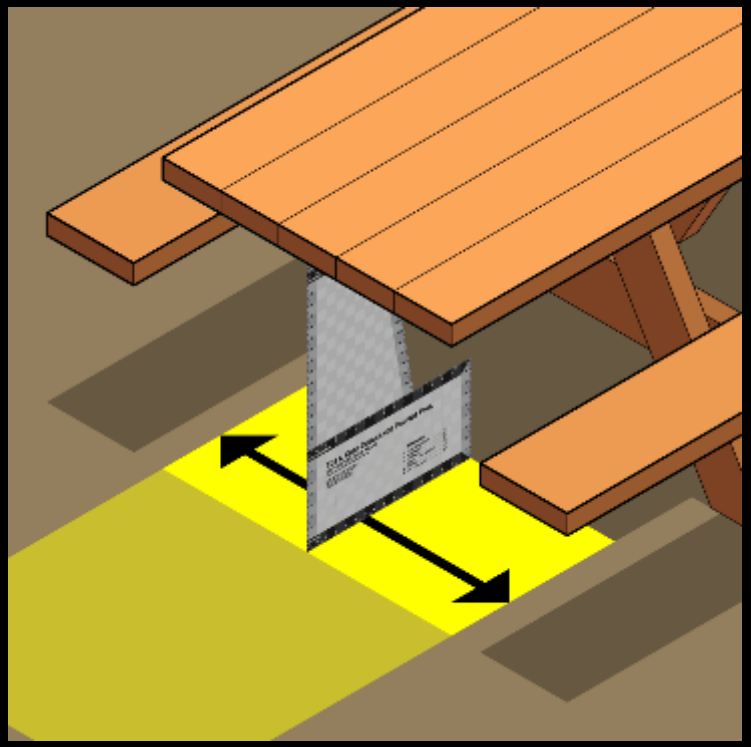
If available, enter the model and manufacturer of the feature.

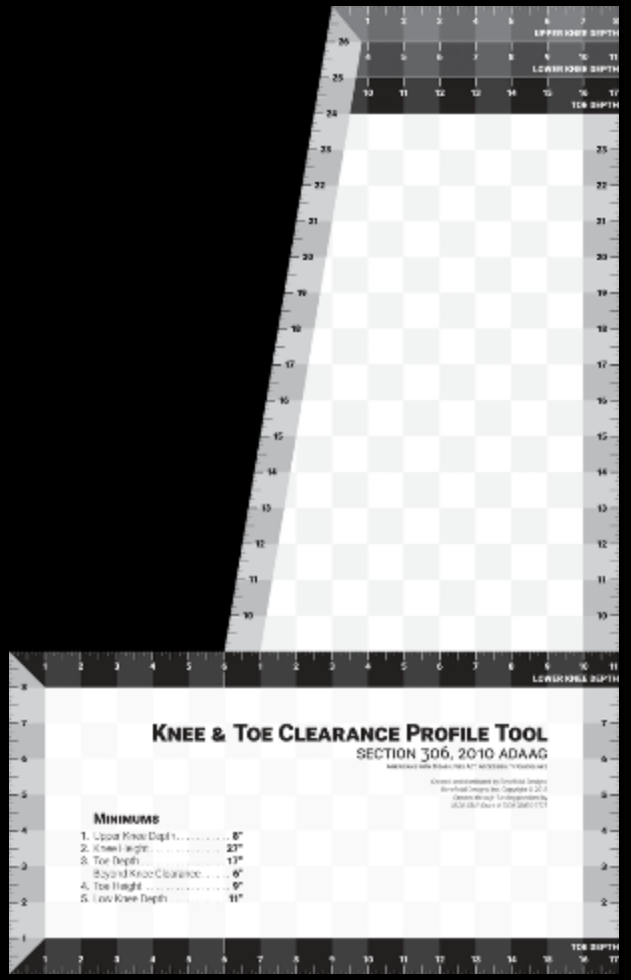
Manufacturer

Model

Knee & Toe Clearance Profile Tool

unobstructed knee & toe space





Adjustable height cooking grill

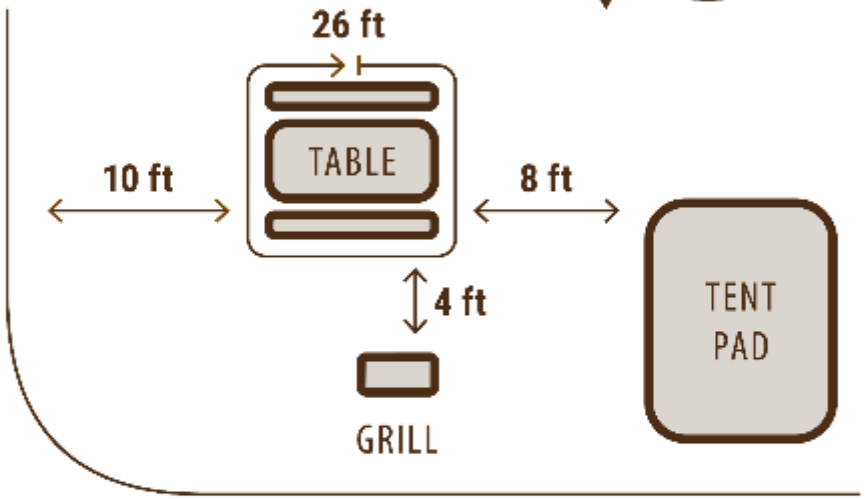
Water pump

Actuation force

Campsite

Access Information

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**

Develop standards for

Trail and sidewalk design

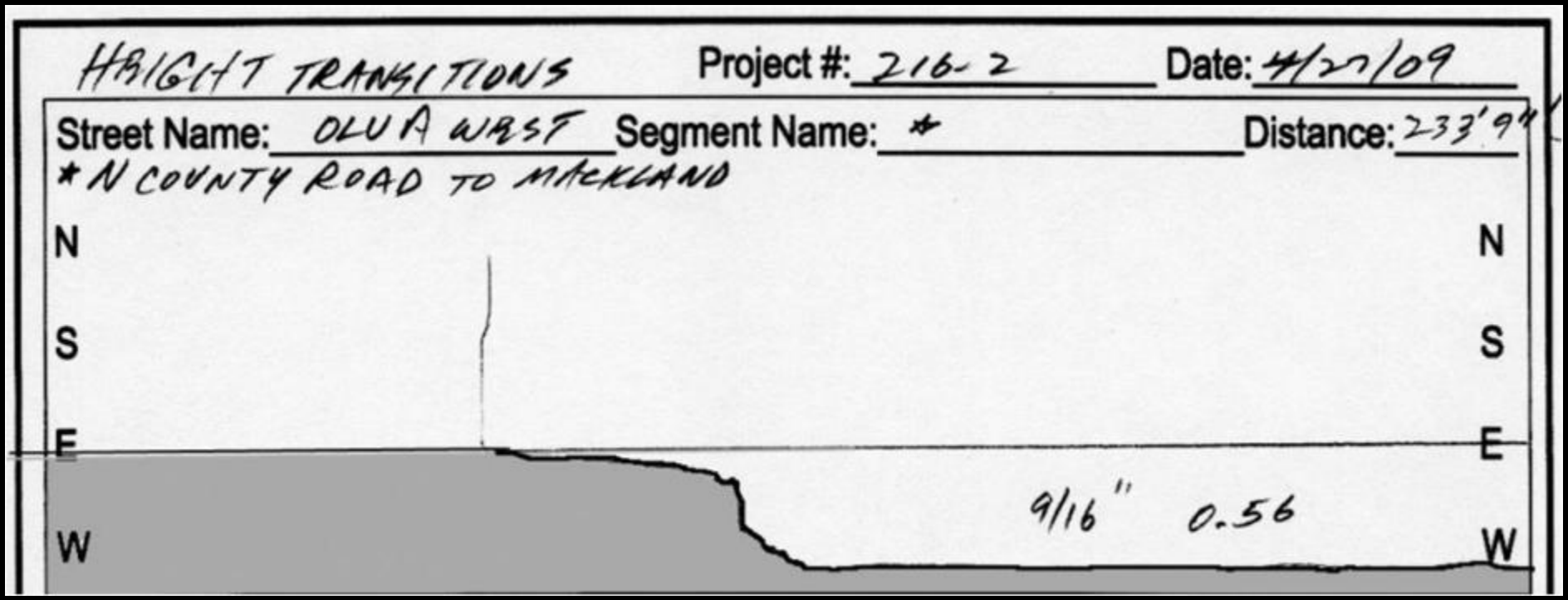
Architectural Barriers Act (ABA)
Outdoor Recreation Access Guidelines

Public Rights of Way Access Guidelines (PROWAG)

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

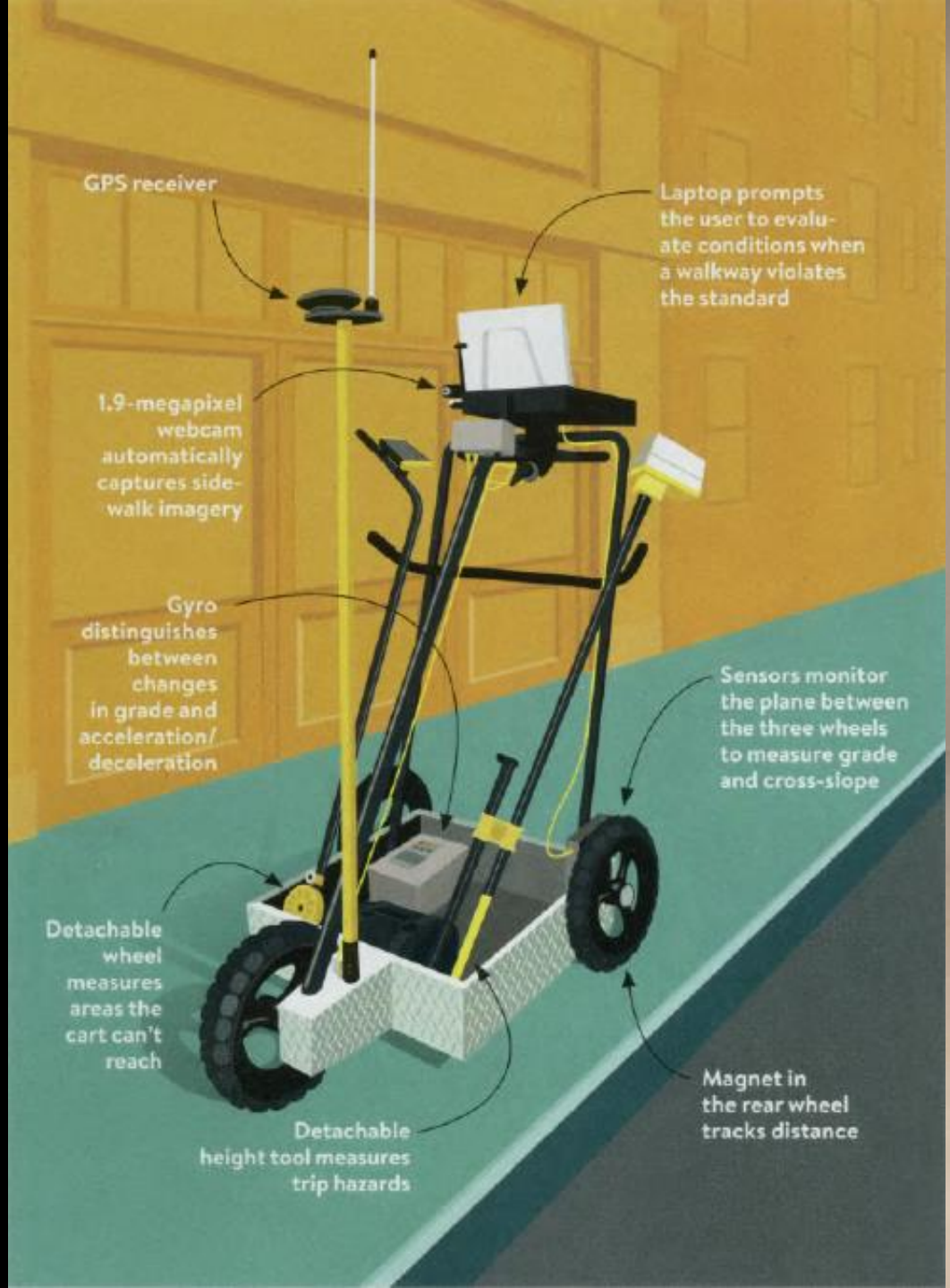
Street Name: OLIVE WEST Segment Name: * Distance: 233'9"

*N COUNTY ROAD TO MACKLAND



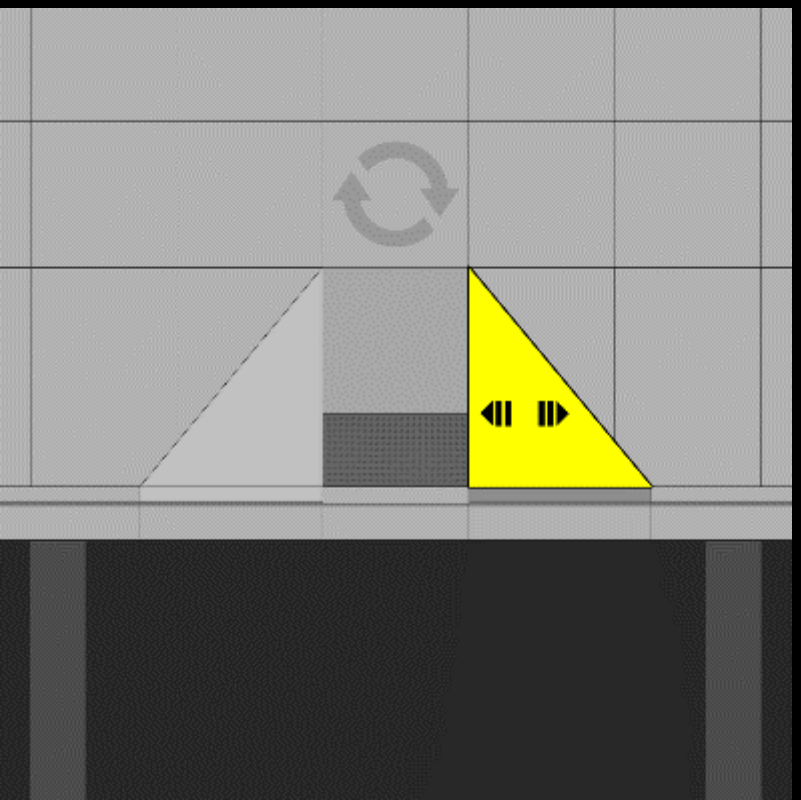
Sidewalk assessment

Public Rights-of-Way Assessment Process (PROWAP)

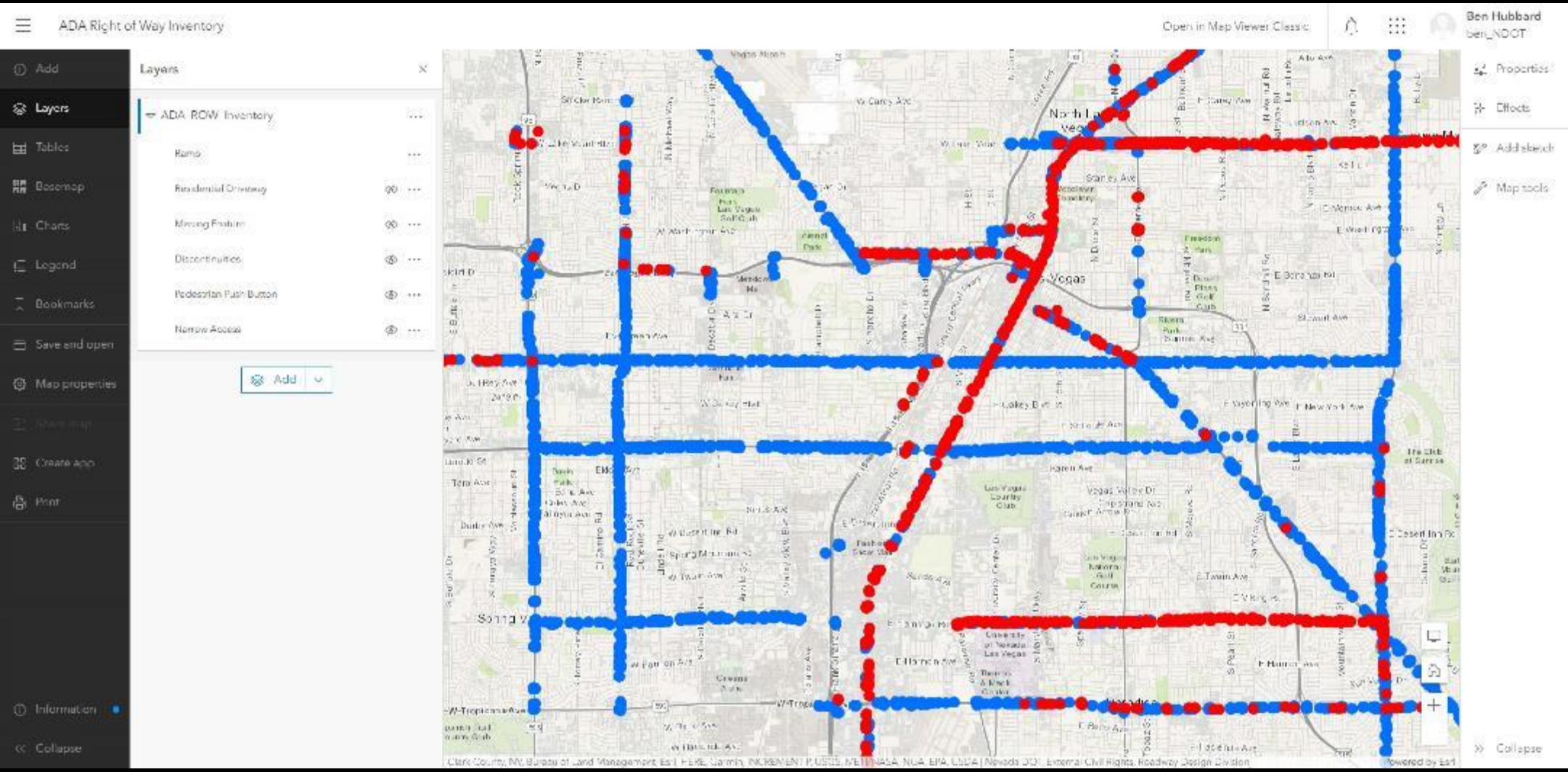

GPS receiver
Laptop prompts the user to evaluate conditions when a walkway violates the standard
1.9-megapixel webcam automatically captures sidewalk imagery
Gyro distinguishes between changes in grade and acceleration/deceleration
Sensors monitor the plane between the three wheels to measure grade and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

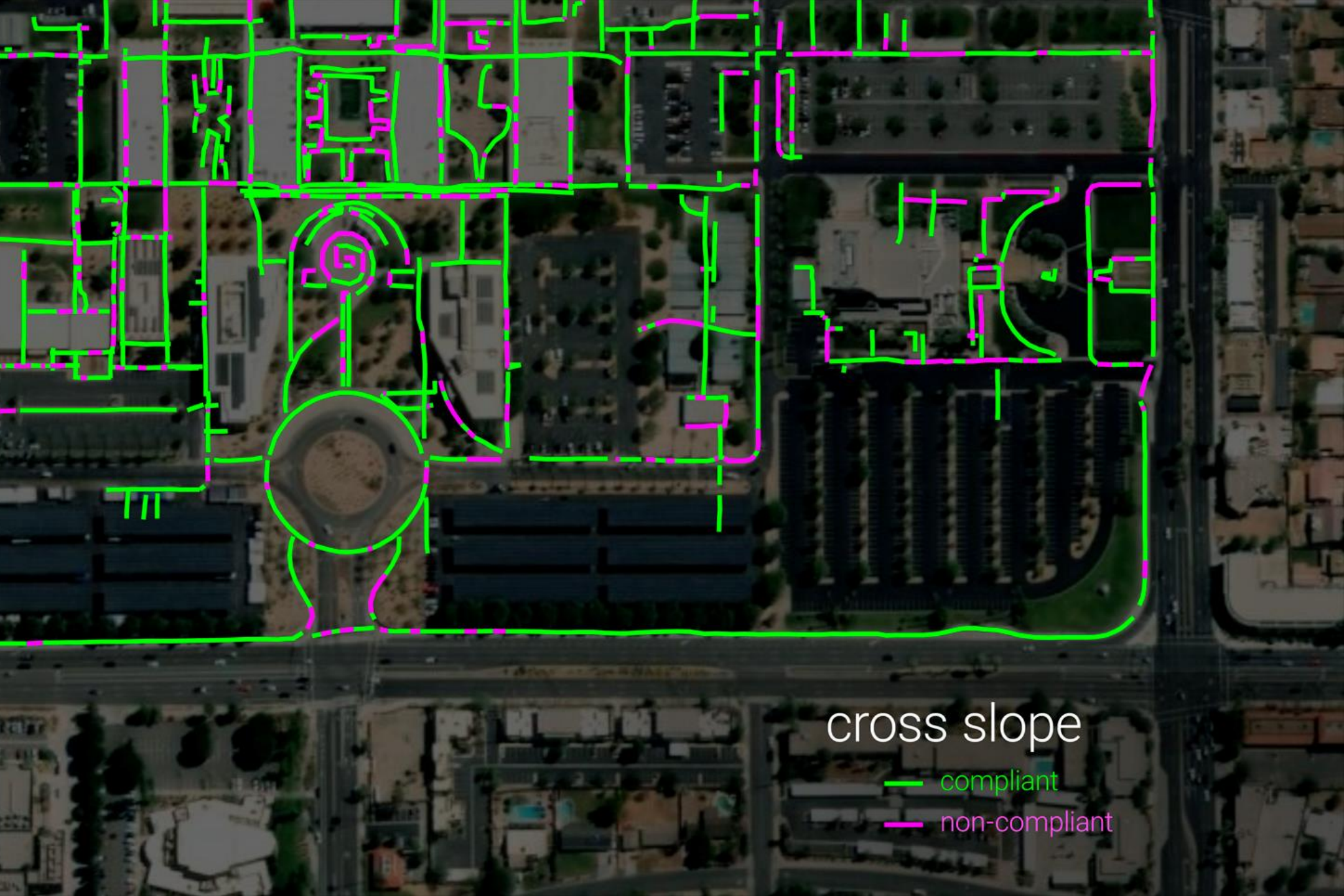
Digital Measuring Wheel (DMS)

Digital Height Measuring Device



NDOT Curb Ramps




cross slope
compliant
non-compliant

Rest stop assessment

Rest Stop Assessment Process (RSAP)

Compliance Check

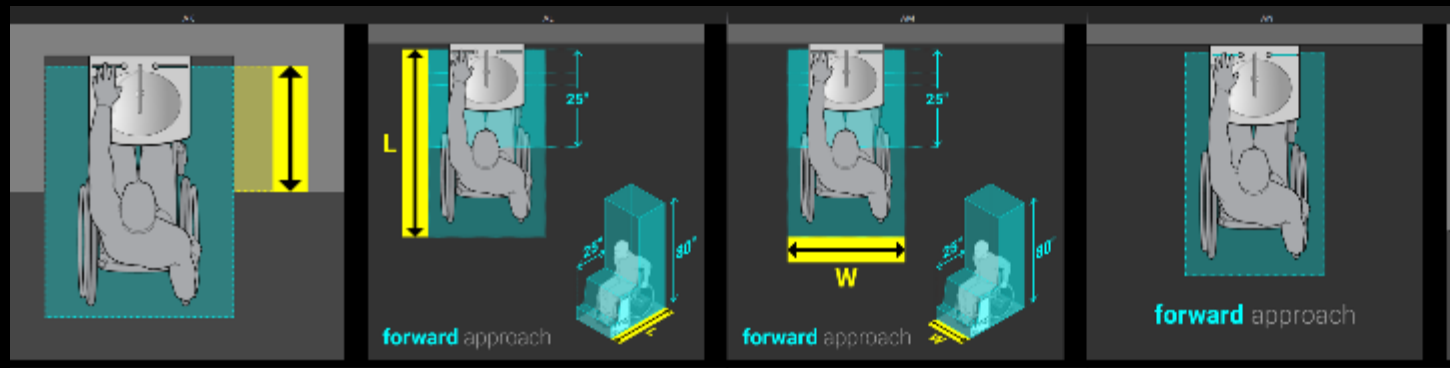
attributes

visual guides

feature data

instructions

requirements



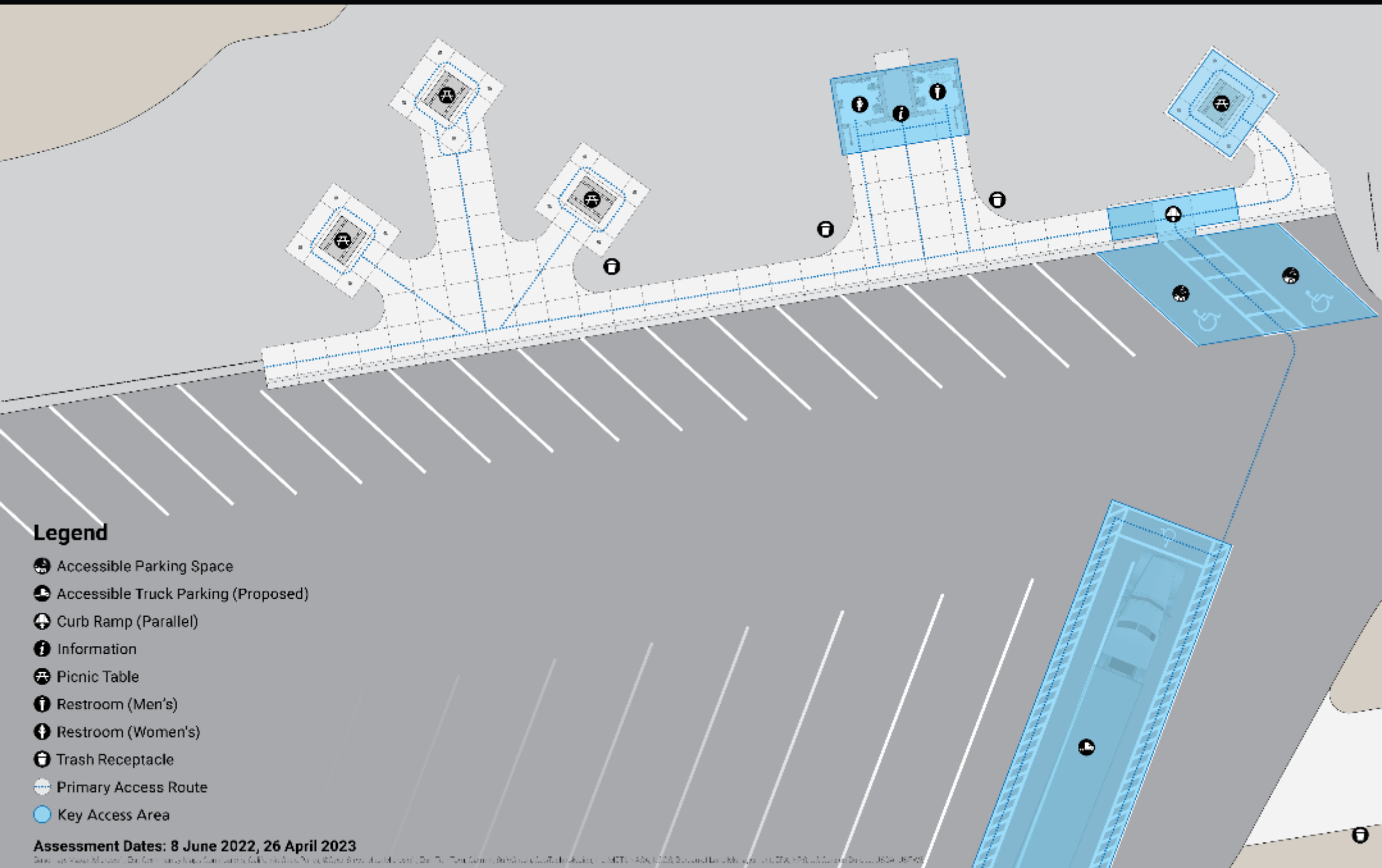
Feature	Path/Location	Non-Compliant Attribute	Technical Requirements	Priority/Action	Additional Info
 ID: **142361** Drinking Fountain Assessed: 2021-04-28 Const/Alt: xxxx-xx-xx	**Primary** Non-functional drinking fountain mounted on wall of restroom facility, between the two restroom doors. Lat: 35.959605° Lon: -117.561901°	**Potential Barrier** I Scope/Compliant No compliant accessible drinking fountains are provided at this location.	**2006 DOT ADA Standards** 211.2 Minimum Number. No fewer than two drinking fountains shall be provided. One drinking fountain shall comply with 602.1 through 602.6 and one drinking fountain shall comply with 602.7. EXCEPTION: Where a single drinking fountain complies with 602.1 through 602.6 and 602.7, it shall be permitted to be substituted for two separate drinking fountains.	**Moderate Priority** II Replace Remove current drinking fountain and replace with either two compliant drinking fountains, one of which is designed for seated use and the other for standing use—or install one compliant drinking fountain which complies with seated and standing requirements.	Drinking fountain is non-functional. Operable part is partially missing.
		Potential Barrier I Knee/Height (in) The knee clearance underneath the drinking fountain is 26.5 in from the ground surface.	**2006 DOT ADA Standards** 306.3.1 General. Space under an element between 9 in and 27 in above the finish floor or ground shall be considered knee clearance and shall comply with 306.3. 306.3.2 Maximum Depth. Knee clearance shall extend 25 in maximum under an element at 9 in above the finish floor or ground. 306.3.3 Minimum Required Depth. Where knee clearance is required under an element as part of a clear floor space, the knee clearance shall be 11 in deep minimum at 9 in above the finish floor or ground, and 8 in deep minimum at 27 in above the finish floor or ground.	**Moderate Priority** II Replace Install compliant, sealed drinking fountain with exactly 27 in of knee clearance, measured from the ground surface.	
		Potential Hazard II CS/Changes in Level An expansion joint located within the clear space serving the drinking fountain is causing a vertical change in level that is 0.3 inches in height.	**2006 DOT ADA Standards** 303.2 Vertical. Changes in level of ¼ inch (6.4 mm) high maximum shall be permitted to be vertical. 303.3 Beveled. Changes in level between ¼ inch (6.4 mm) high minimum and ½ inch (13 mm) high maximum shall be beveled with a slope not steeper than 1:2. Advisory 303.3 Beveled. A change in level of ½ inch (13 mm) is permitted to be ¼ inch (6.4 mm) vertical plus ¼ inch (6.4 mm) beveled. However, in no case may the combined change in level exceed ½ inch (13 mm). Changes in level exceeding ½ inch (13 mm) must comply with 405 (Ramps) or 406 (Curb Ramps).	**High Priority** III Repair Grind discontinuity down to a slope no greater than 1:2 (50.0%).	
 ID: **10** Picnic Facility Assessed: 2022-06-21 Const/Alt: xxxx-xx-xx	**Primary** Picnic table area located in grass area. Lat: 35.959698° Lon: -117.562231°	**Potential Barrier** I Picnic Units/Total Accessible No accessible picnic units are provided in the picnic facility.	**2006 DOT ADA Standards** 226.1 General. Where dining surfaces are provided for the consumption of food or drink, at least 5 percent of the seating spaces and standing spaces at the dining surfaces shall comply with 902. In addition, where work surfaces are provided for use by other than employees, at least 5 percent shall comply with 902. **2015 ABA Standards** F245.2.1 Picnic Facilities with Two or Fewer Picnic Units. Where picnic facilities contain two or fewer picnic units, each picnic unit shall provide mobility features complying with F245.2. F245.2.2 Picnic Facilities with More Than Two Picnic Units. Where picnic facilities contain more than two picnic units, at least 20 percent, but not less than two, of the picnic units shall provide mobility features complying with F245.2.	**Moderate Priority** II Remodel Design picnic facility with accessible routes to accessible picnic units. Ideally, at least 20 percent of picnic units should be accessible.	**Specified in the ABA Standards** Although the ADA Standards provide some guidance regarding dining surfaces, the 2015 ABA Standards provide specific technical and scoping requirements for picnic facilities, units, and tables.

Sunnyside Rest Area

Public Amenities

0 ft 50 ft

North



Legend

- Accessible Parking Space
- Accessible Truck Parking (Proposed)
- Curb Ramp (Parallel)
- Information
- Picnic Table
- Restroom (Men's)
- Restroom (Women's)
- Trash Receptacle
- Primary Access Route
- Key Access Area

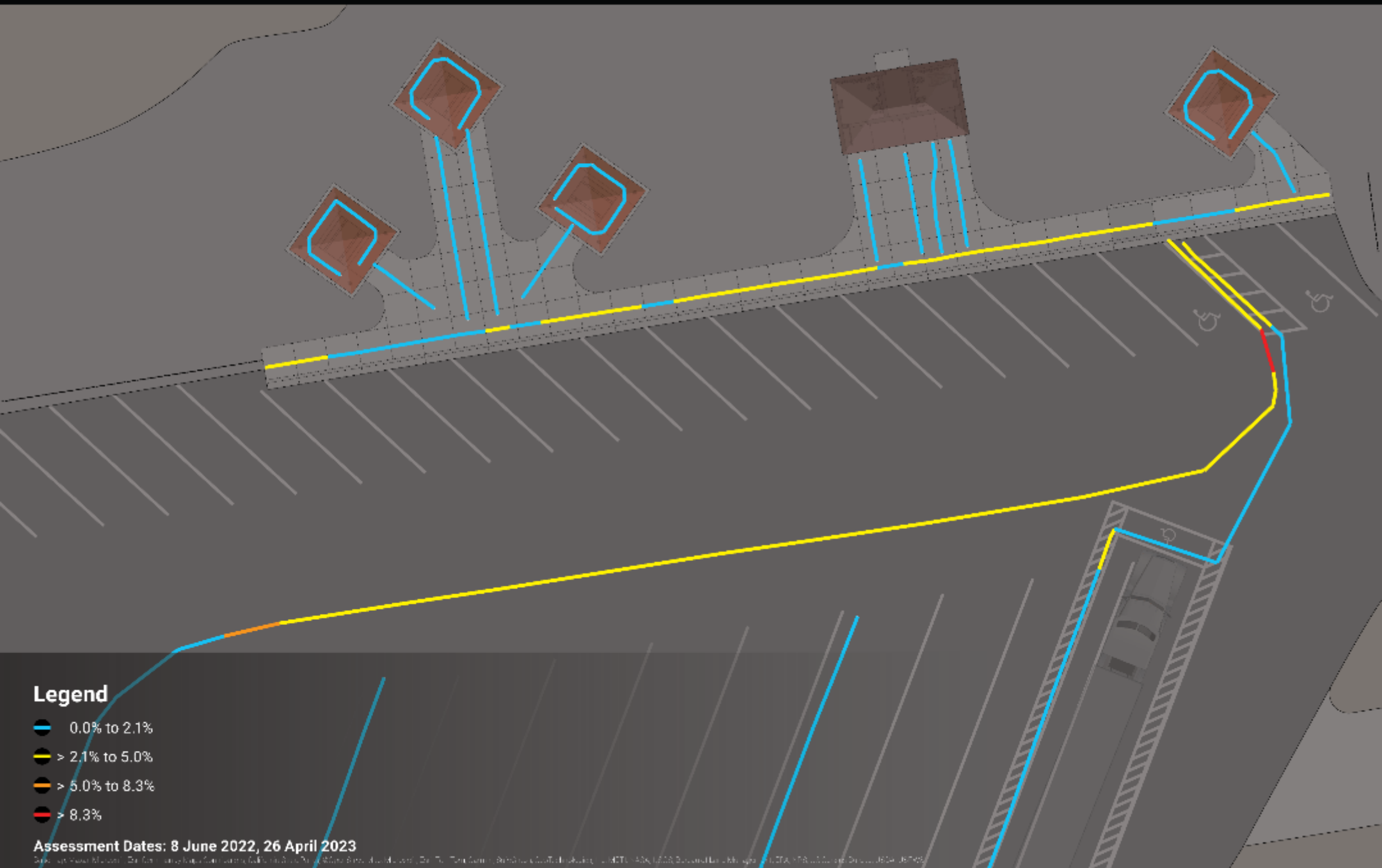
Assessment Dates: 8 June 2022, 26 April 2023

Sunnyside Rest Area

Paths of Travel: **Cross Slope**

0 ft — 50 ft

North

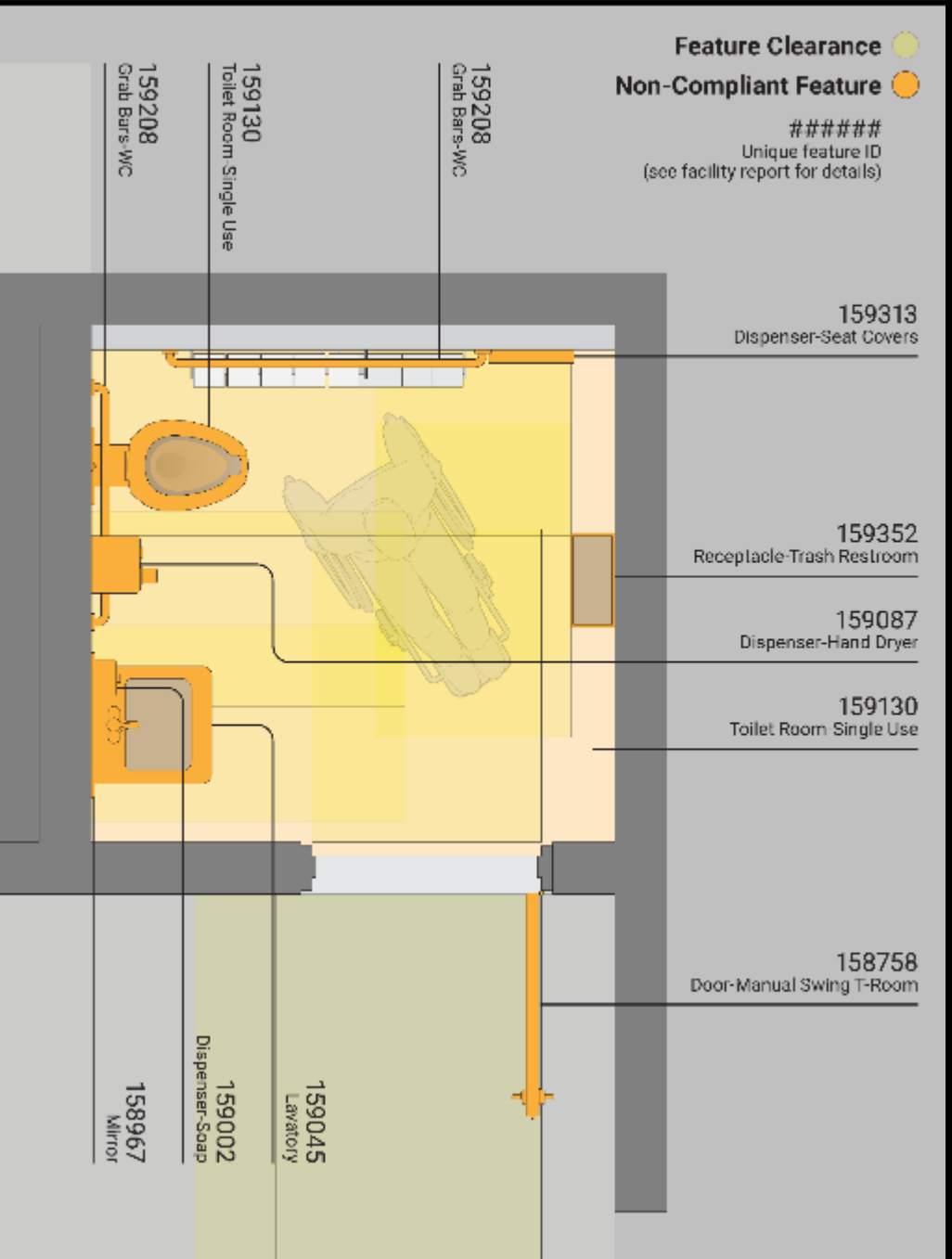


Assessment Dates: 8 June 2022, 26 April 2023

Sunnyside Rest Area

Men's Restroom Current Condition

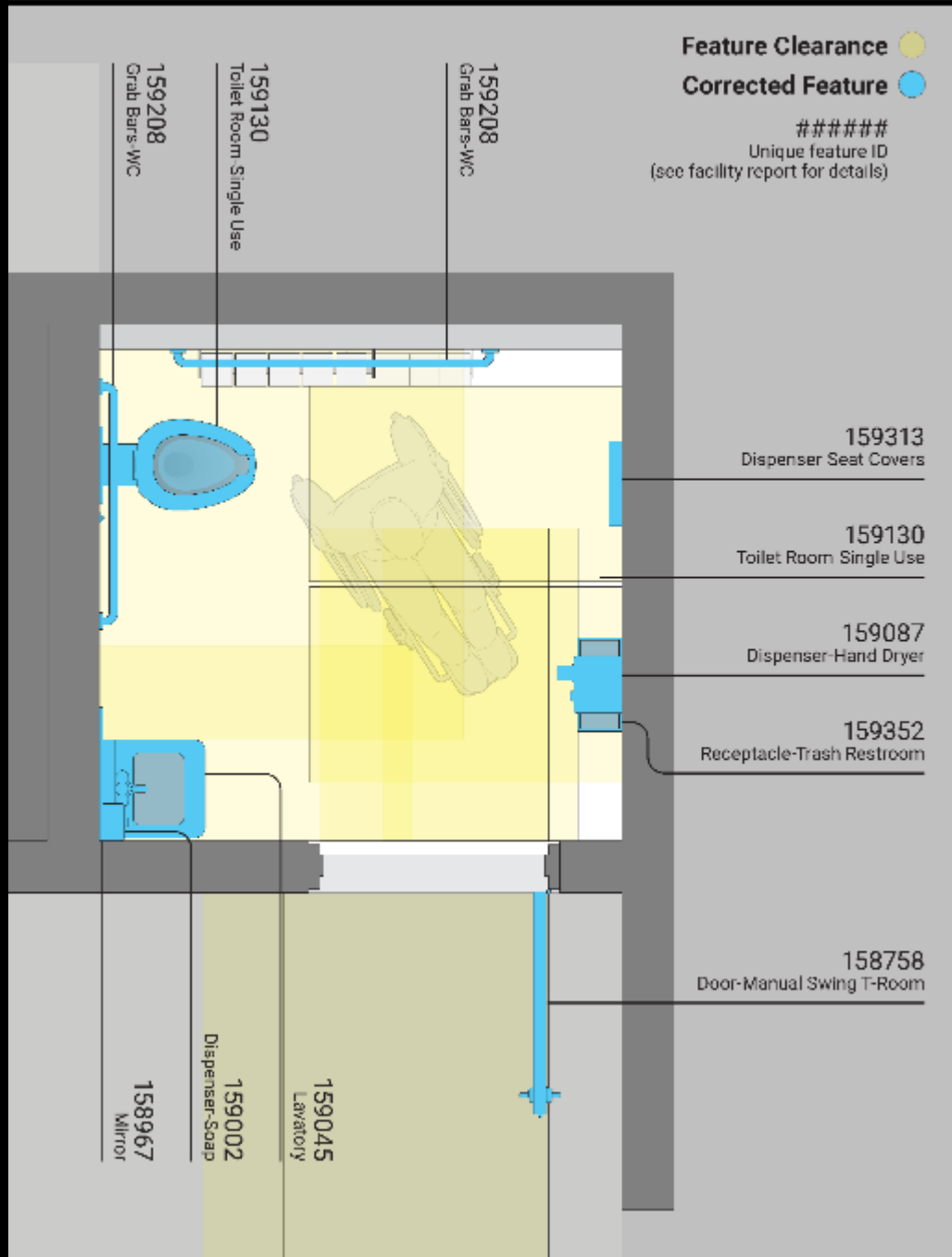
North



Sunnyside Rest Area

Men's Restroom Recommendations

North



Universal Design of Fitness Equipment (UDFE) Standards

Low step-up height design

Finding the

Weight Adjustment Pin

color contrast

value contrast

color contrast

value contrast


MAURER SÖHNE


2013. 12. 23 13:18


2013. 12. 23 13:19

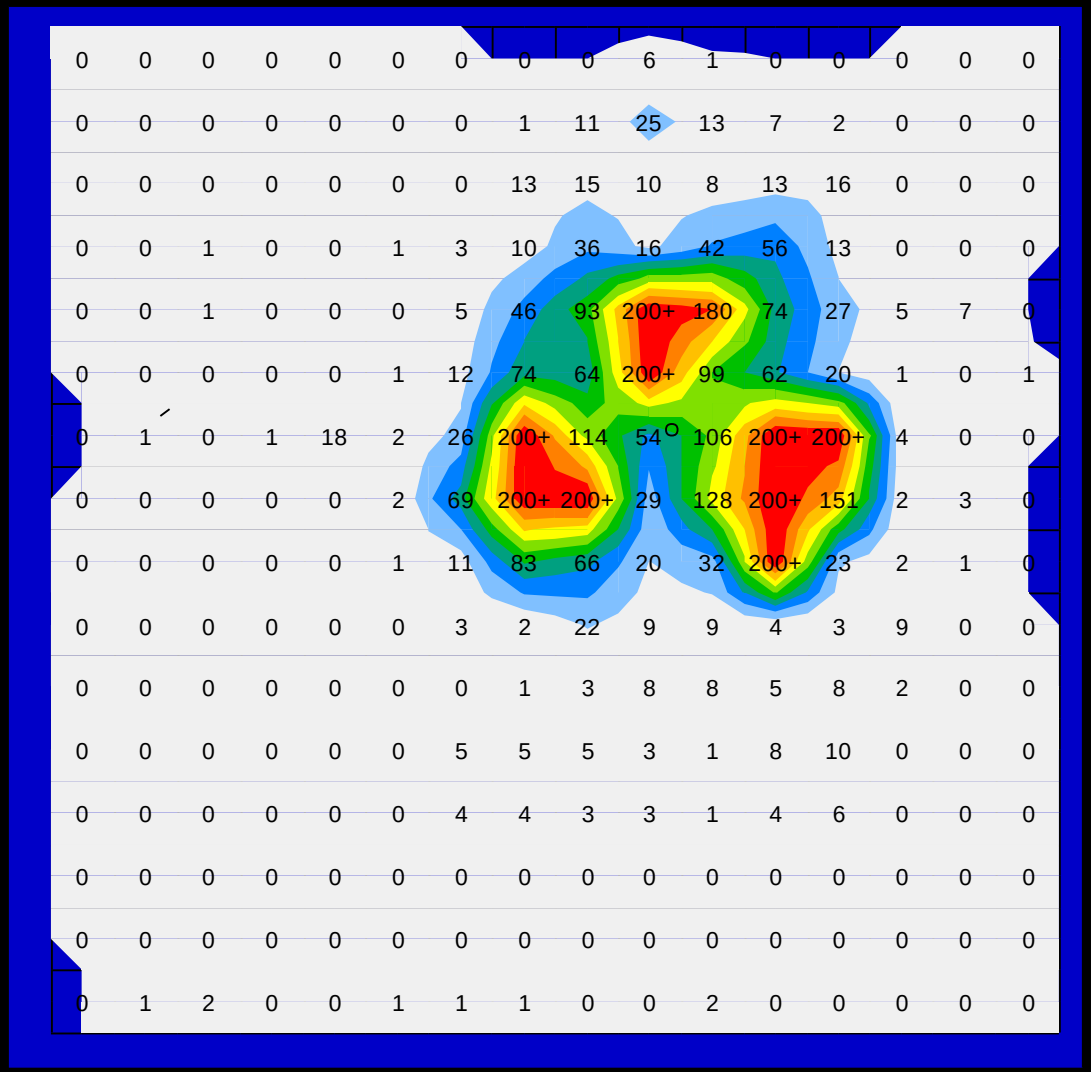

2013. 12. 23 13:43

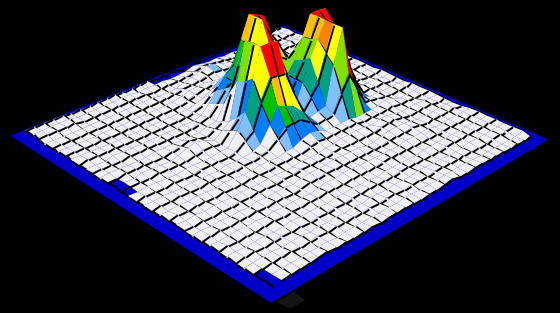

214
6°


29
SabadellCAM
6°

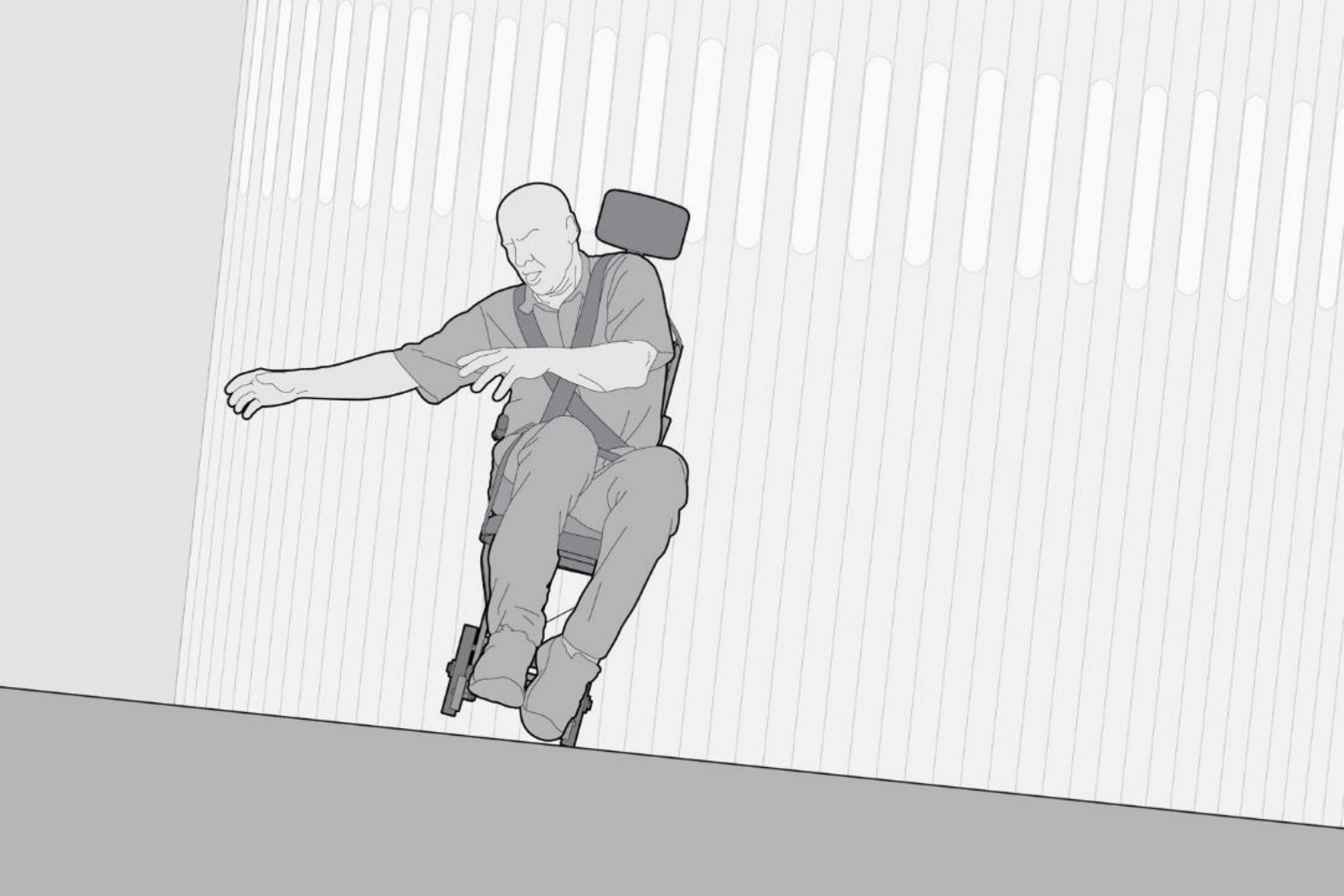
Boarding devices

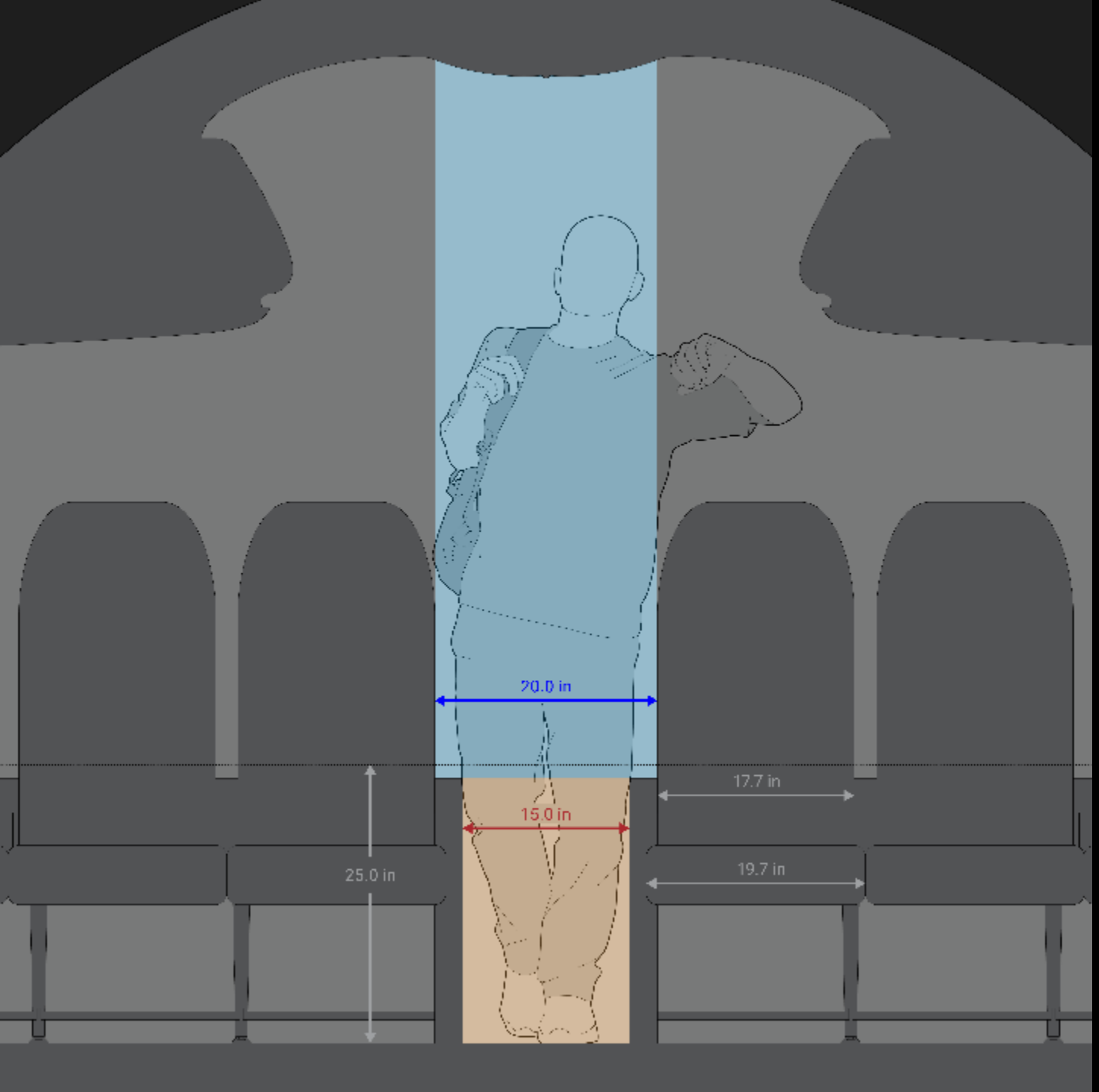
Boarding device seating pressures





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

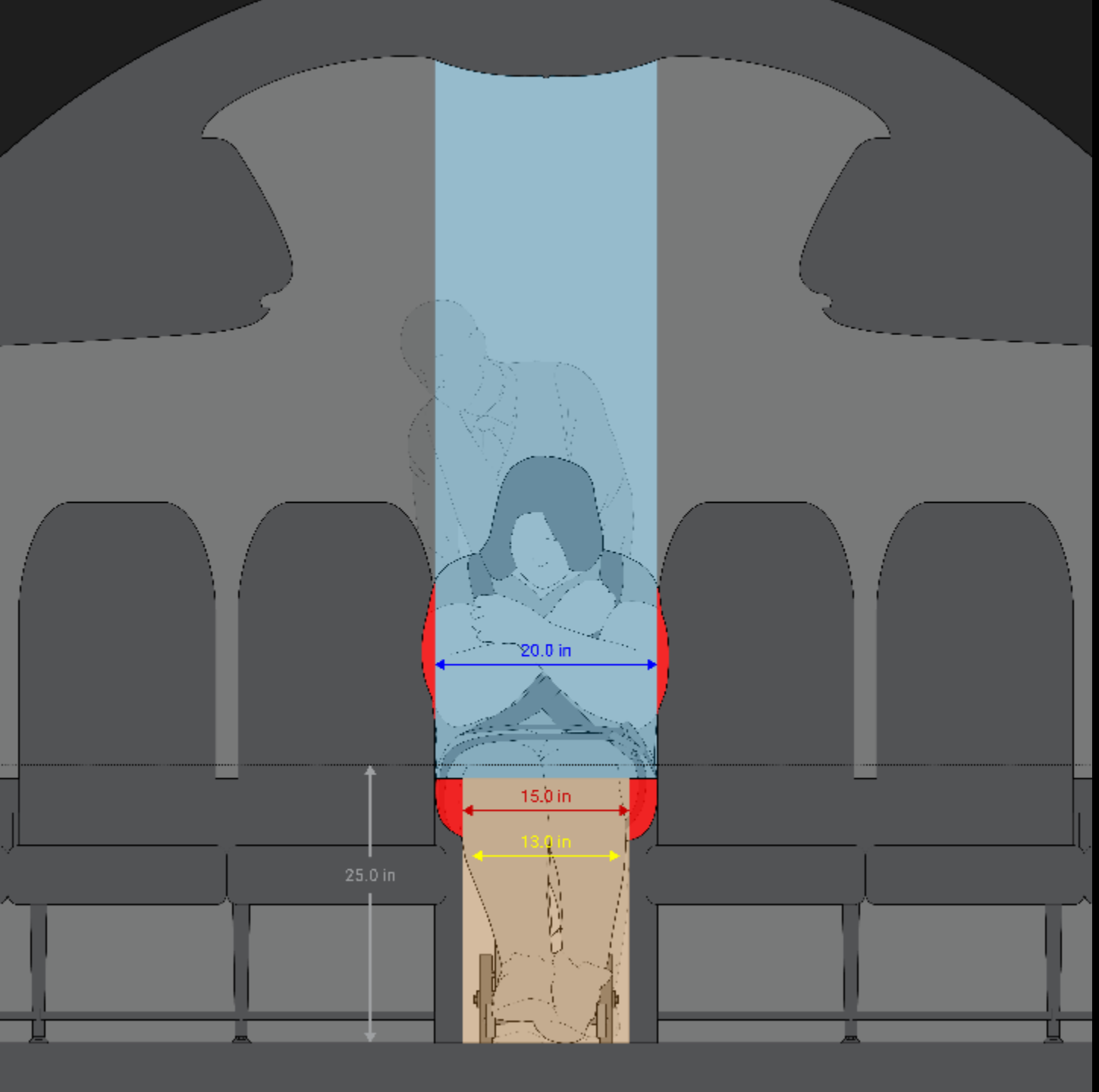




15.0 in aisle width

74.2 in height

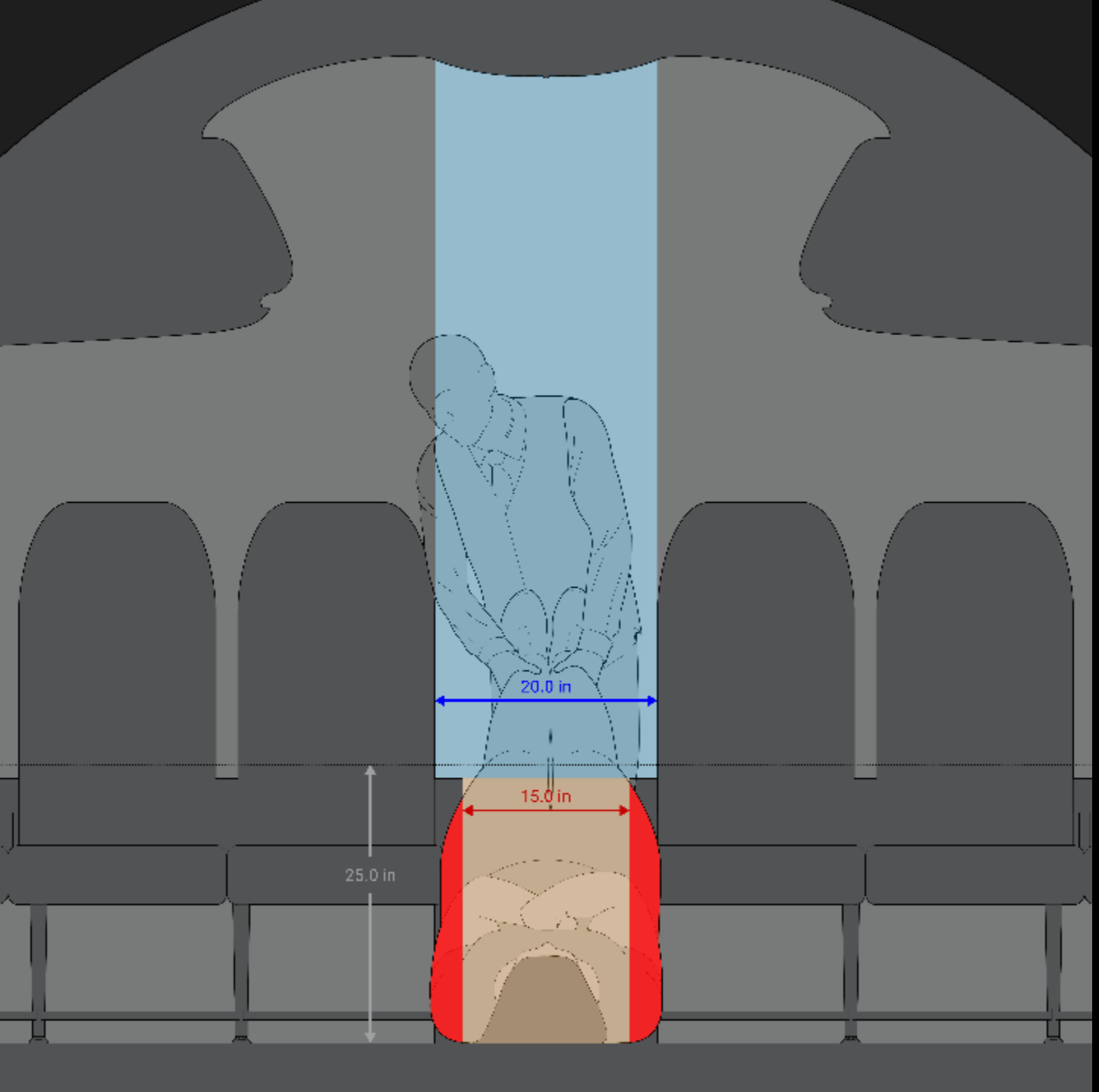
95th percentile
US Male



15.0 in aisle width

19.8 in hip width

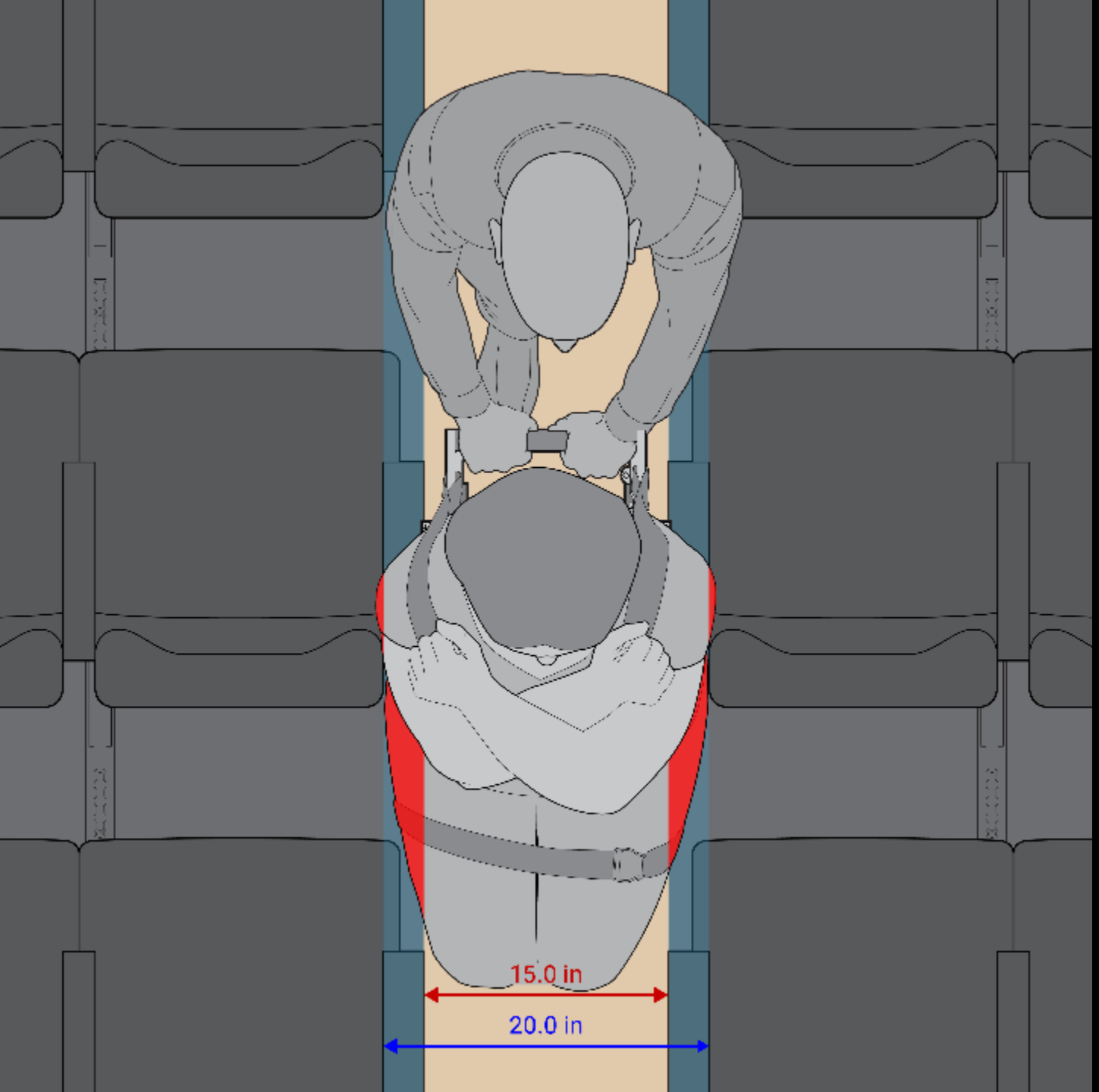
95th percentile
US Female



15.0 in aisle width

19.8 in hip width

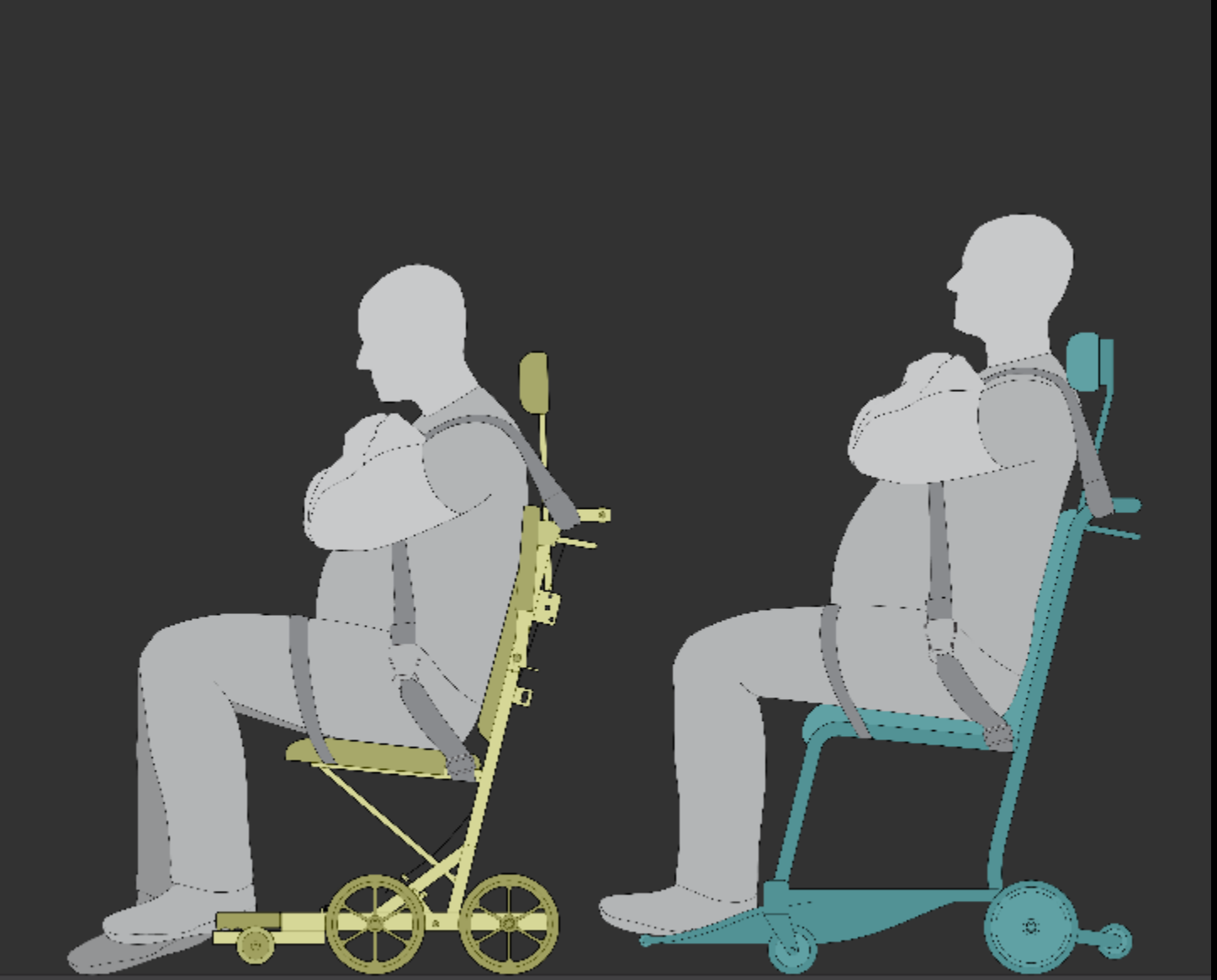
95th percentile
US Female



15.0 in aisle width

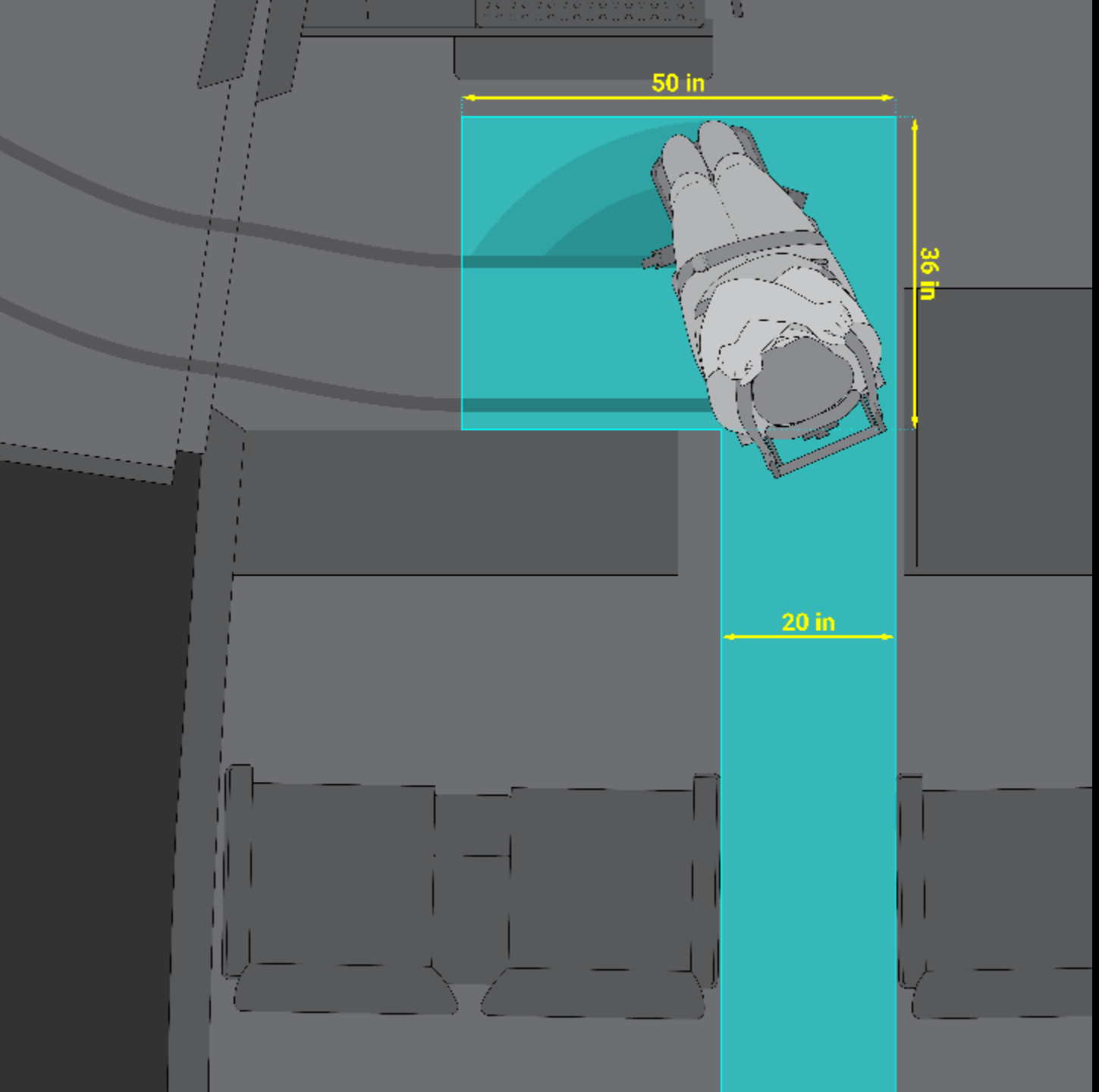
19.8 in hip width

95th percentile
US Female



Device Comparison

95th percentile
US Male



Rear Wheel Pivot with Rotating Casters

36.0 in clearance

20.0 in aisle width

19.8 in hip width

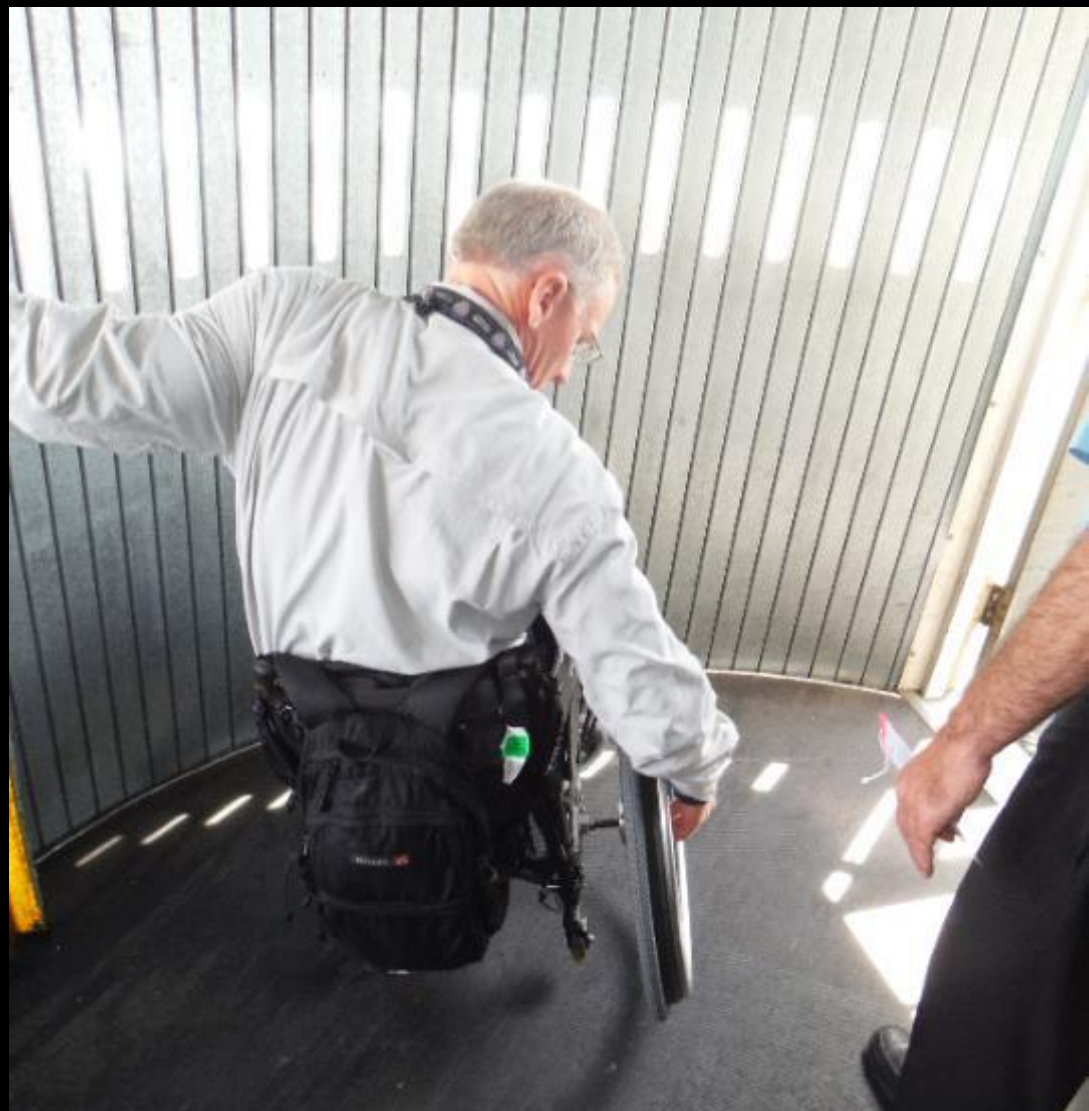
95th percentile US Female

Aircraft-compatible wheelchair

Aircraft boarding using a wheelchair with

Narrow accessory wheels

- Fewer transfers




EXIT
DEWALT

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

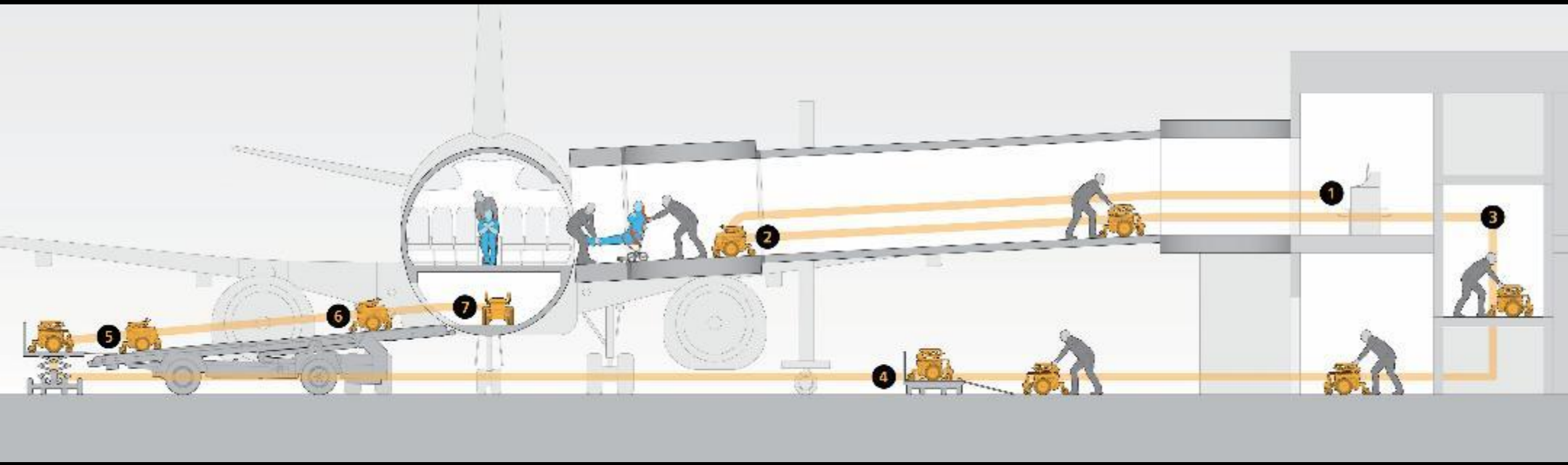
Adequate pressure relief and posture

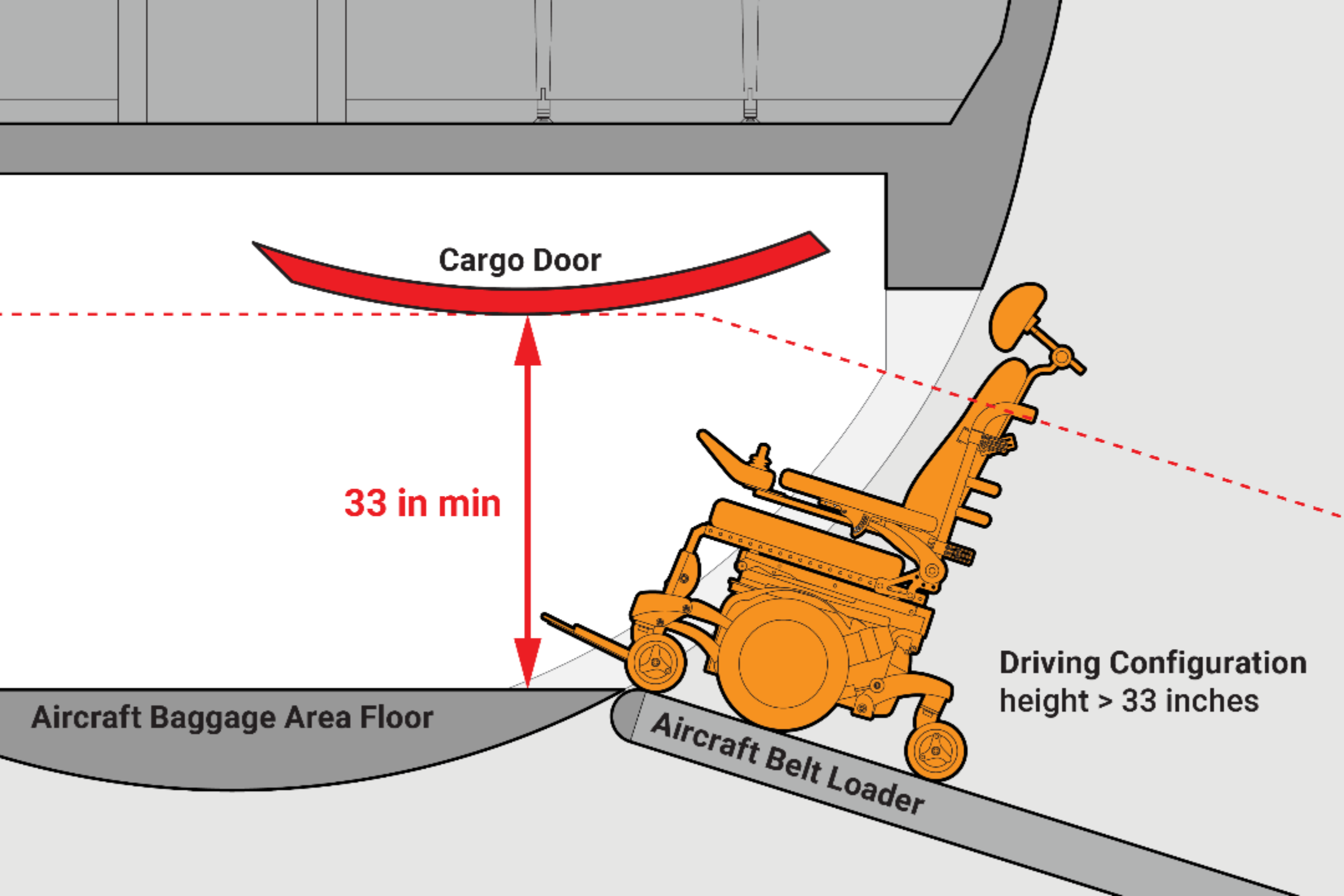
- Feet supported lumbar and
- Spine supported
- Neck/head support
- Arm supported

Storage of wheelchair in aircraft

From jetway to cargo hold

The path the mobility device takes to get to the cargo hold




Cargo Door
33 in min
Aircraft Baggage Area Floor
Aircraft Belt Loader
Driving Configuration
height > 33 inches


PWC tilted on side to fit through door

Device damage

Damage to drive wheel that came off powered wheelchair

Rehabilitation Institute of Chicago/ Beneficial Designs/ PVA #3028

responded that their...

mobility devices were damaged after air travel

and over 50% still experience device damage when proper procedures are followed by carrier agents.

RESNA AT-1 Section 4 Standard

American National Standard

RESNA AT-1:2021

for Assistive Technology for Air Travel–

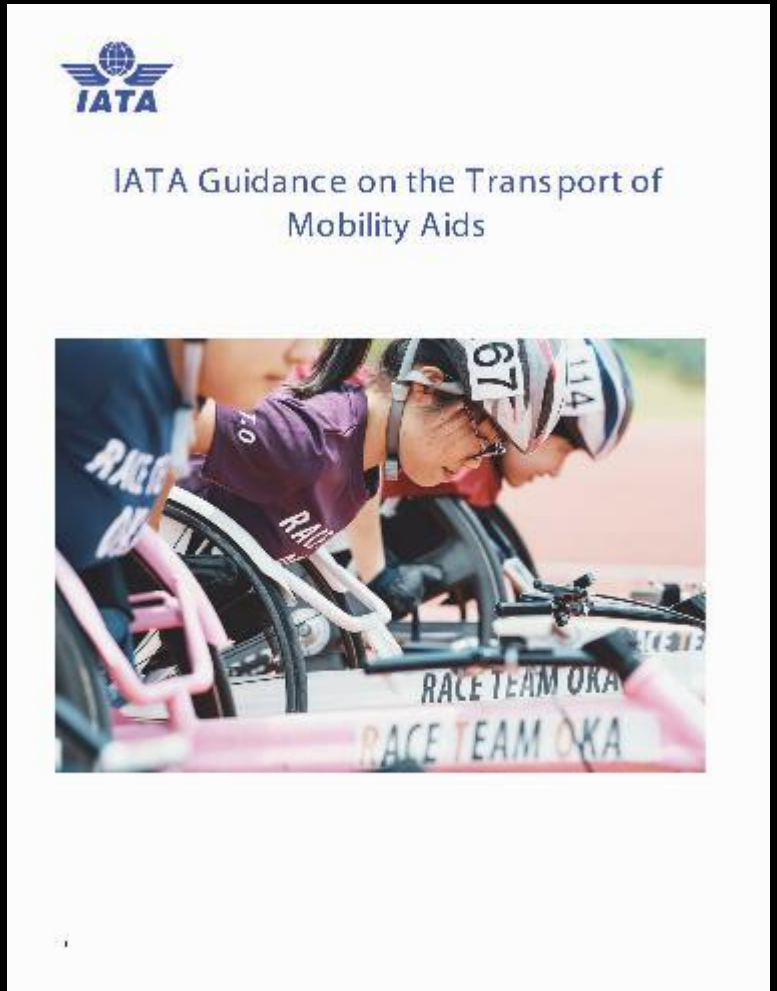
Volume 1: Requirements and Test Methods Related to Mobility Devices

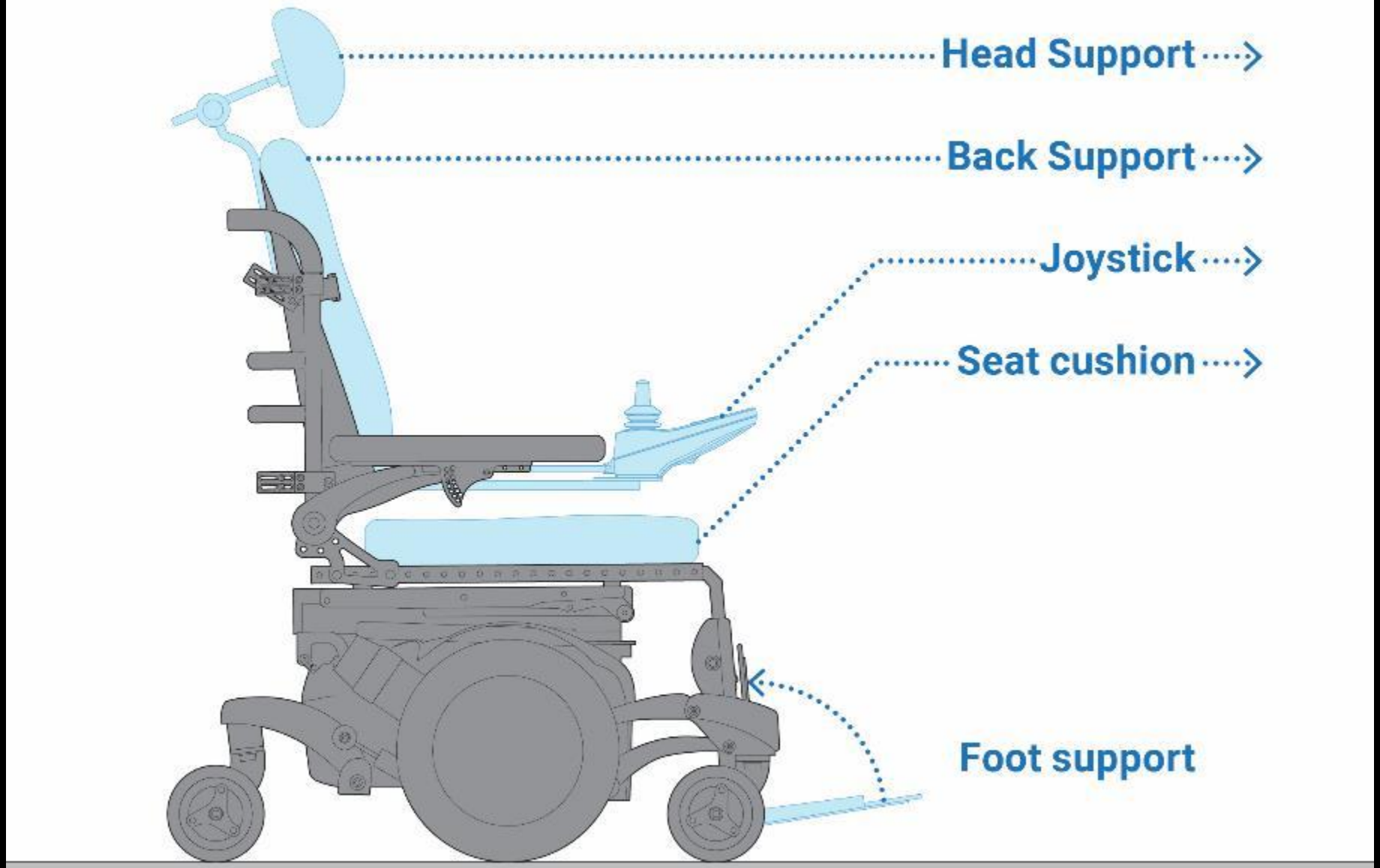
RESNA

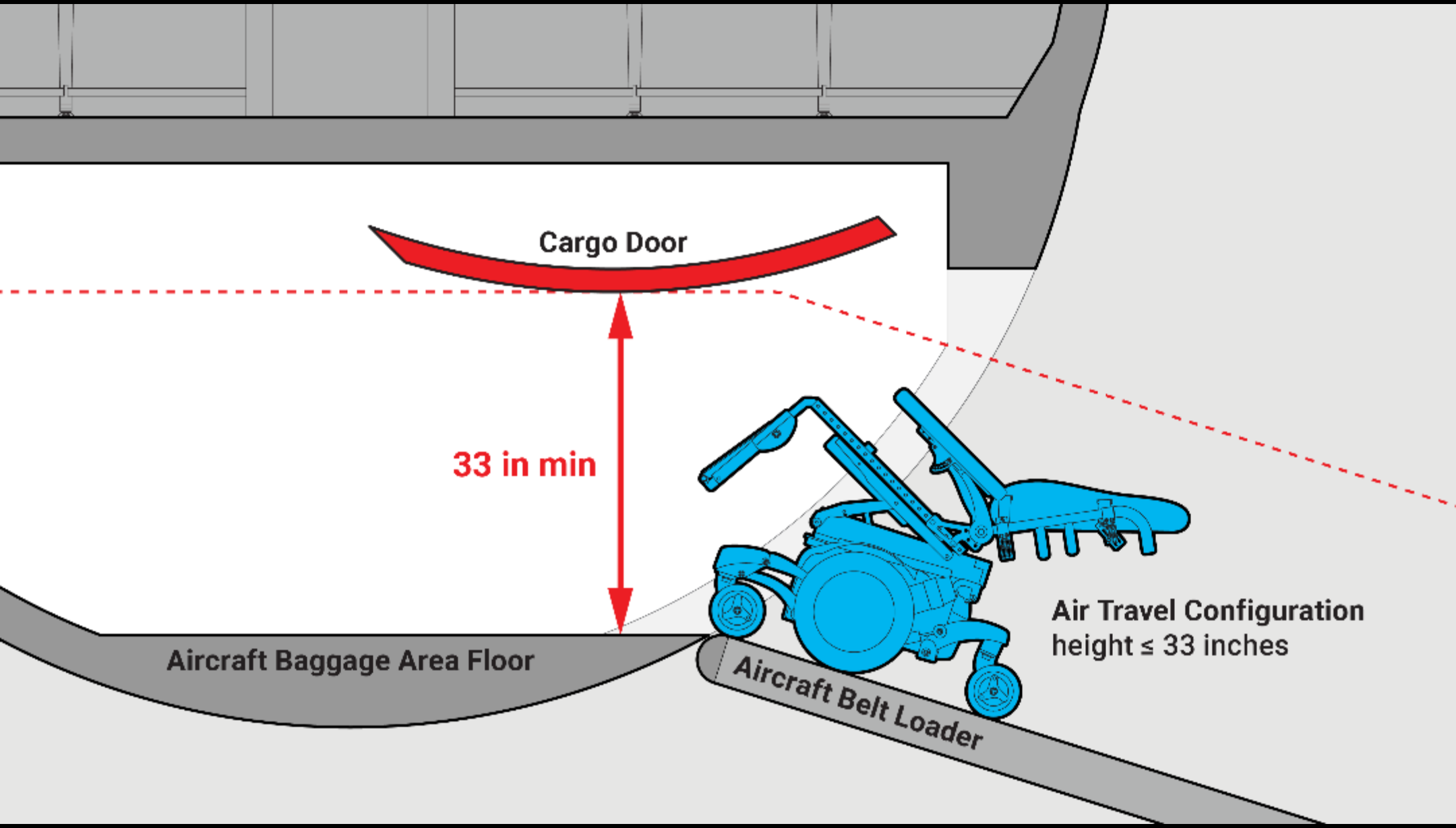
Rehabilitation Engineering and Assistive Technology Society of North America

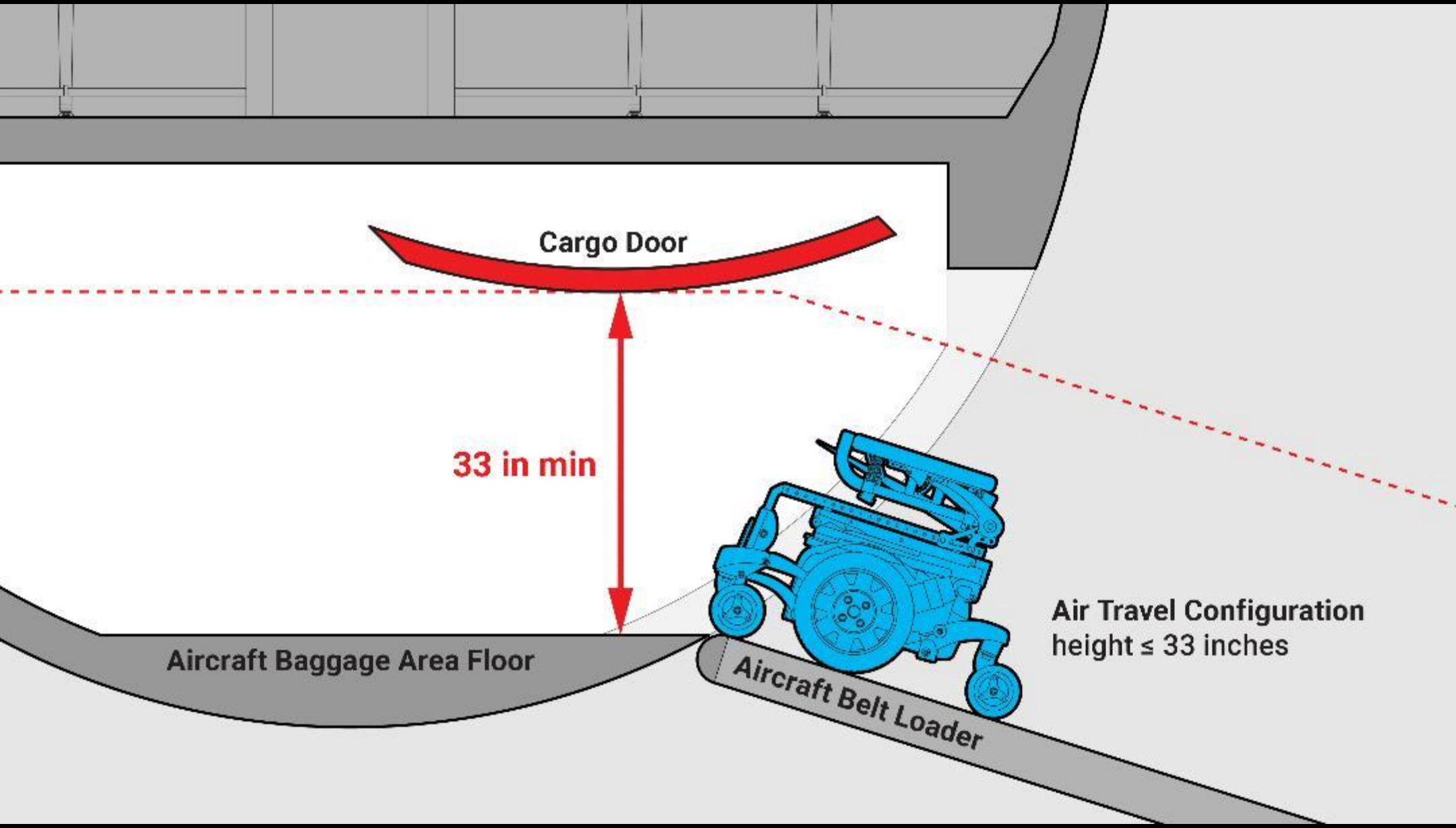
International Air Transport Association (IATA)

IATA Guidance on the Transport of Mobility Aids




Head Support
Back Support
Joystick
Seat cushion
Foot support


Cargo Door
33 in min
Aircraft Baggage Area Floor
Aircraft Belt Loader
Air Travel Configuration
height ≤ 33 inches


Cargo Door
33 in min
Aircraft Baggage Area Floor
Aircraft Belt Loader
Air Travel Configuration
height ≤ 33 inches

PMD Labeling Guidelines

Weight

WHEELCHAIR WEIGHT

150 kg

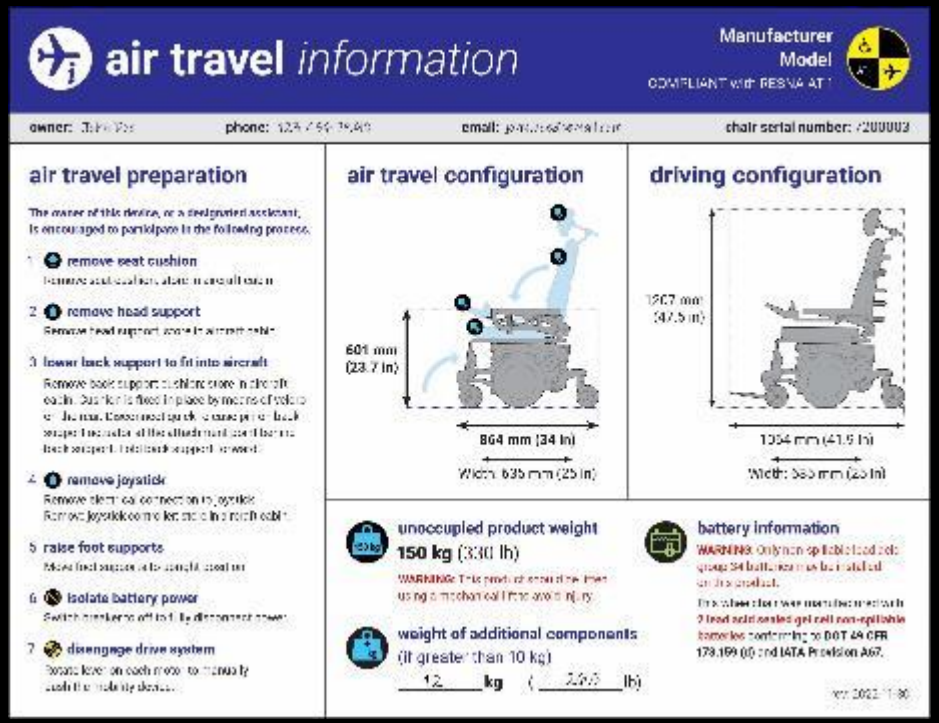
330 lb

https://wheelchairtravel.org/air-travel/reduce-risk-wheelchair-damage/


C400

For existing devices, create an

Air Travel Information Card



air travel information

Manufacturer
Model
COMPLIANT with RESNA ATP

owner: [redacted] phone: [redacted] email: [redacted] chair serial number: [redacted]

air travel preparation

The owner of this device, or a designated assistant, is encouraged to participate in the following process.

1. remove seat cushion
2. remove head support
3. lower back support to fit into aircraft
4. remove joystick
5. raise foot supports
6. isolate battery power
7. disengage drive system

air travel configuration

601 mm (23.7 in)

864 mm (34 in)

Width: 635 mm (25 in)

driving configuration

1067 mm (42.0 in)

1054 mm (41.5 in)

Width: 565 mm (22.3 in)

unoccupied product weight
150 kg (330 lb)

WARNING: This product should not be lifted using a mechanical lift to avoid injury.

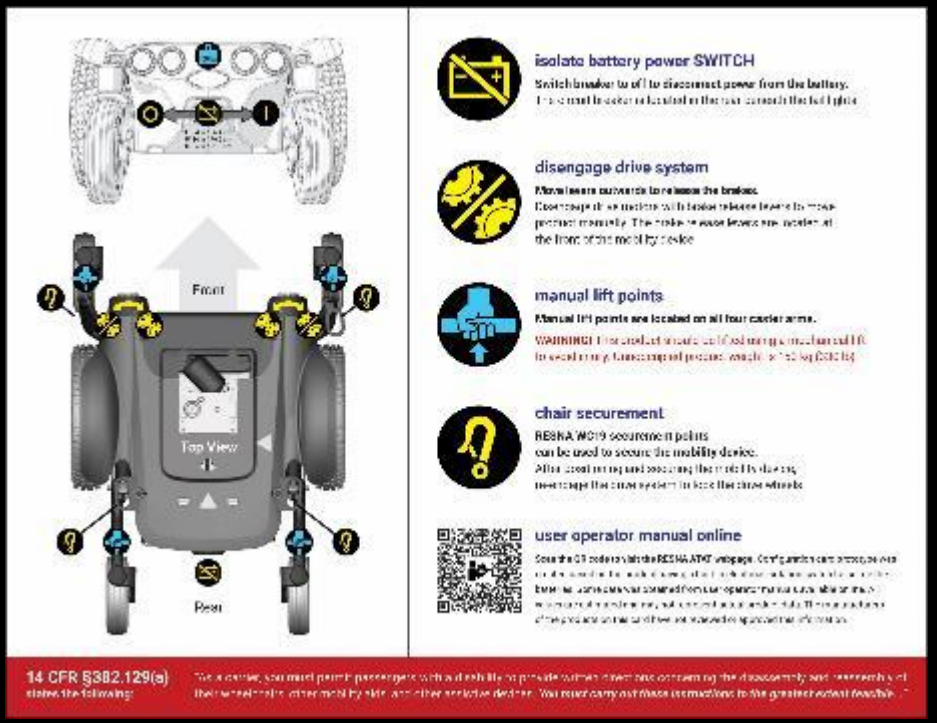
weight of additional components
(if greater than 10 kg)
12 kg (26.5 lb)

battery information

WARNING: Only non-spillable lead acid group 24 batteries may be installed on this product.

This chair has been manufactured with 2 lead acid sealed gel cell non-spillable batteries conforming to DOT 49 CFR 173.159 (d) and IATA Provision A67.

ver 2022.1-00



Front

Top View

Rear

isolate battery power SWITCH

Switch breaker to off to disconnect power from the battery.

disengage drive system

Move levers outwards to release the brakes.

manual lift points

Manual lift points are located on all four caster arms.

WARNING! This product should not be lifted using a mechanical lift to avoid injury. Unoccupied product weight 150 kg (330 lb)

chair securement

RESNA WC19 securement points can be used to secure the mobility device.

user operator manual online

14 CFR §382.129(a) states the following:

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