# beneficial designs

designing beyond the norm to meet the needs of all people

Stanford University

Peter Axelson

2022-01-25

# 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

# Areas of focus

Testing of assistive technology - AT
Assessment of outdoor facilities
Design of assessment equipment
Standards development
Writing publications for AT usage
Development of assistive technology

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…

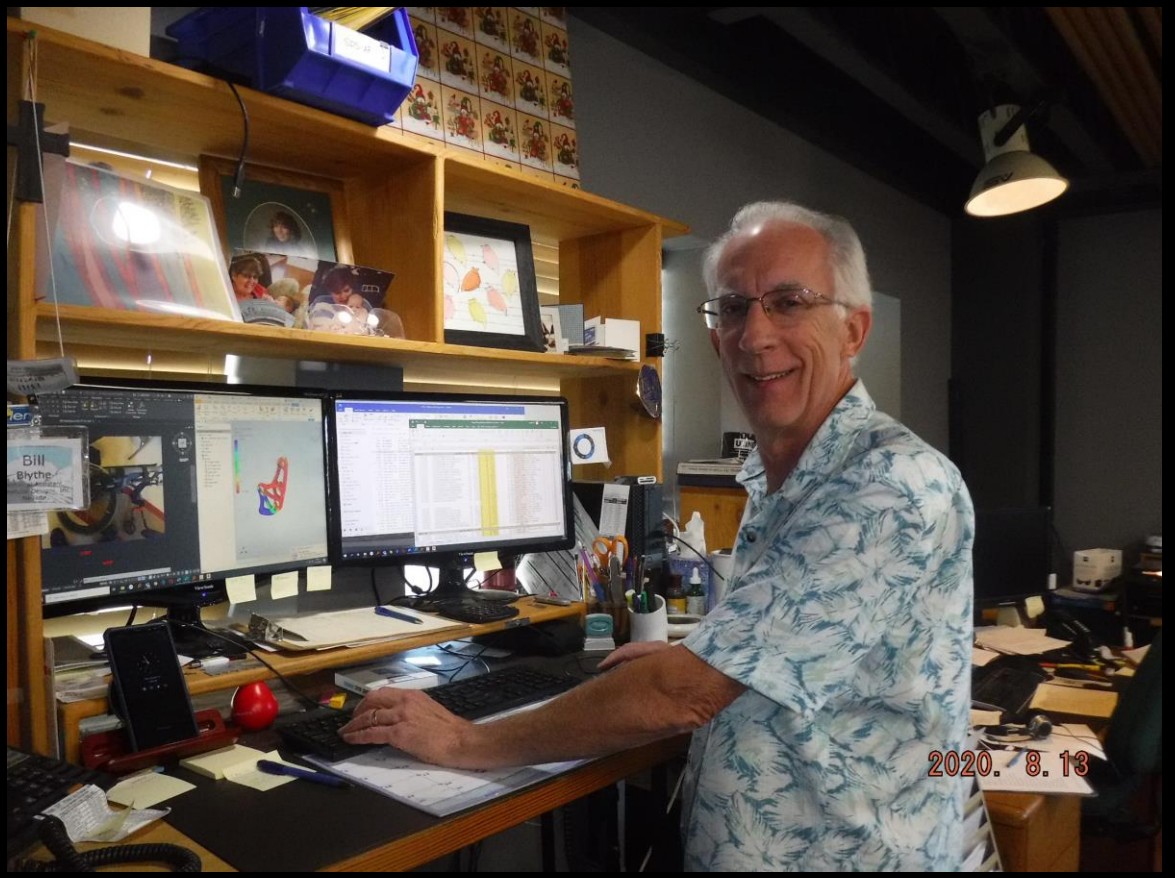
to design, test and assess

to write, map and build

to plan, support and present

Peter Axelson

Director of R&D

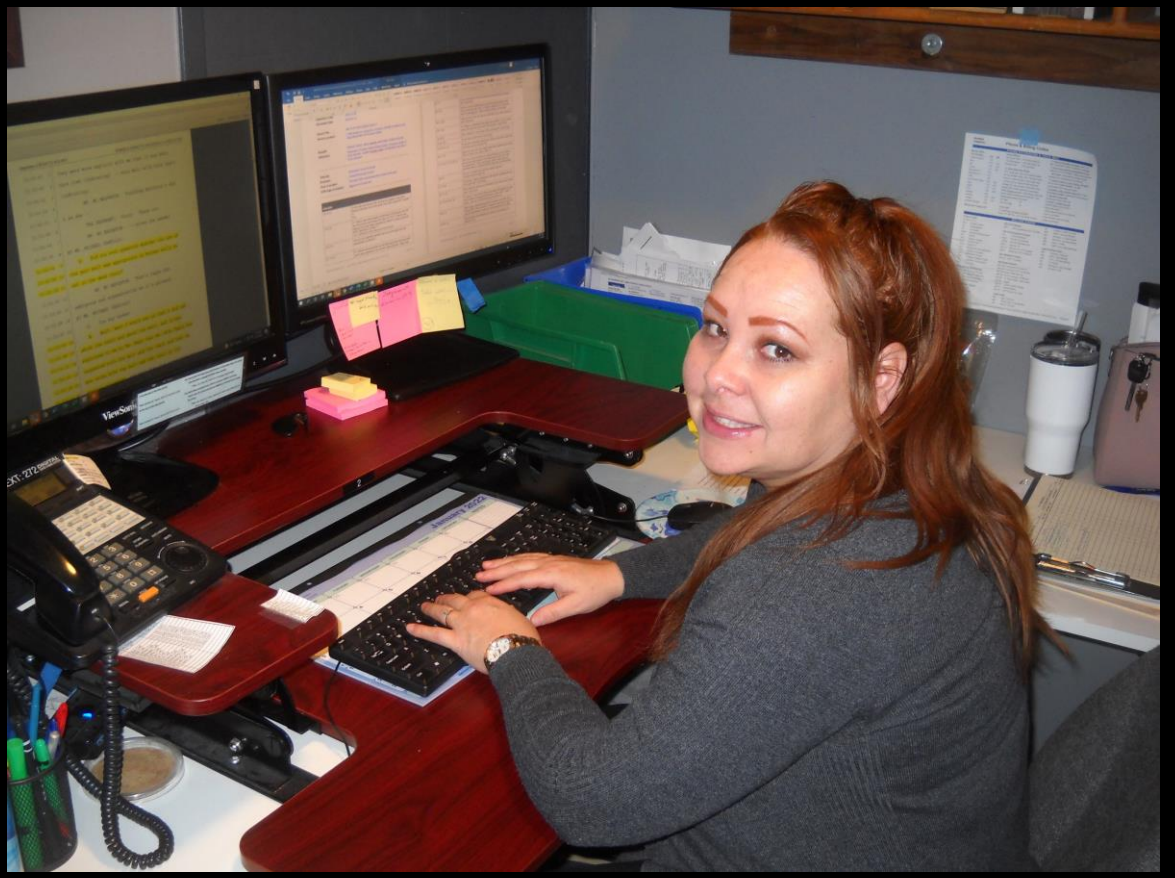



# Bill Blythe

it and facility manager

Stephanie Stephens

research assistant – remote from India



Andrea Janota

office assistant

Maegan Elkaraki

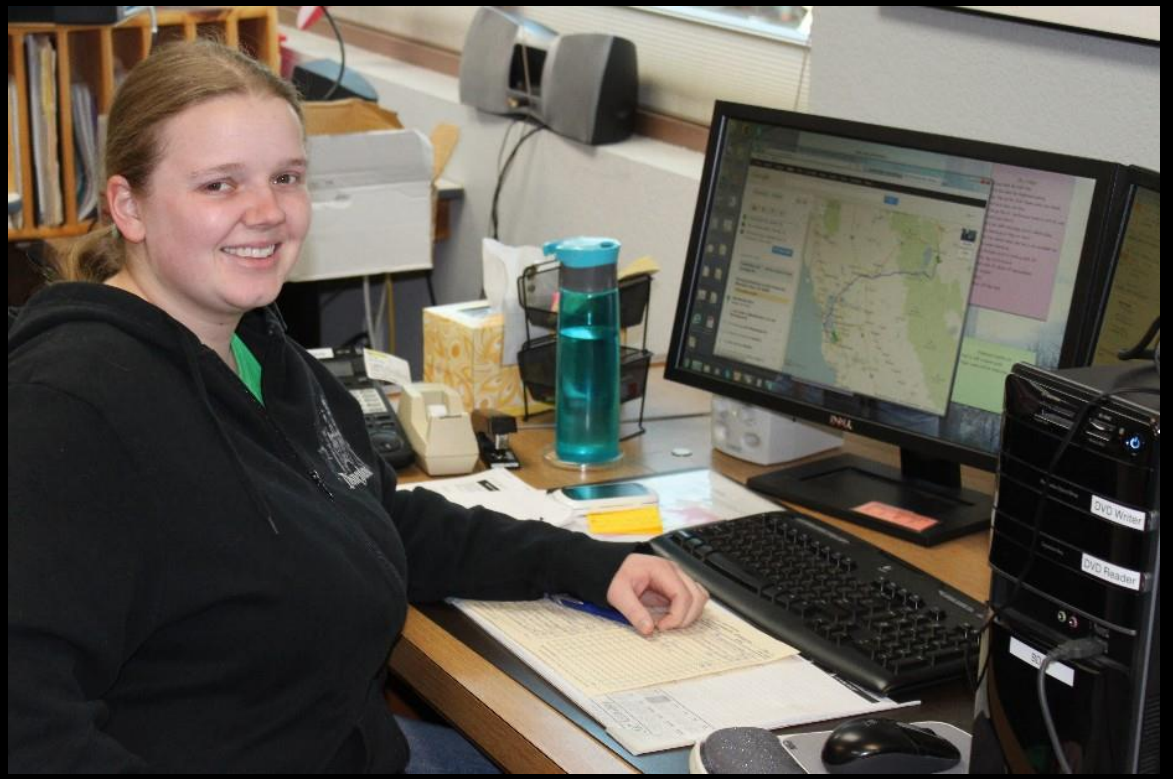
bookkeeping and financial

Paola Vazquez

office assistant

Ria Axelson

office assistant




# Sharon Vazquez

office assistant – remote


# Julia Woodruff

office assistant

Paul Schnorbus

machinist

Stephen Pieters

wheelchair test lab leader


# Ben Hubbard

graphic artist map builder

Debbie Hester

GIS technician

Todd Ackerman

sidewalk assessment coordinator

Travis McDonald

assessment technician

# Wynter Sturtevant

technical assistant

# Rob Palmer

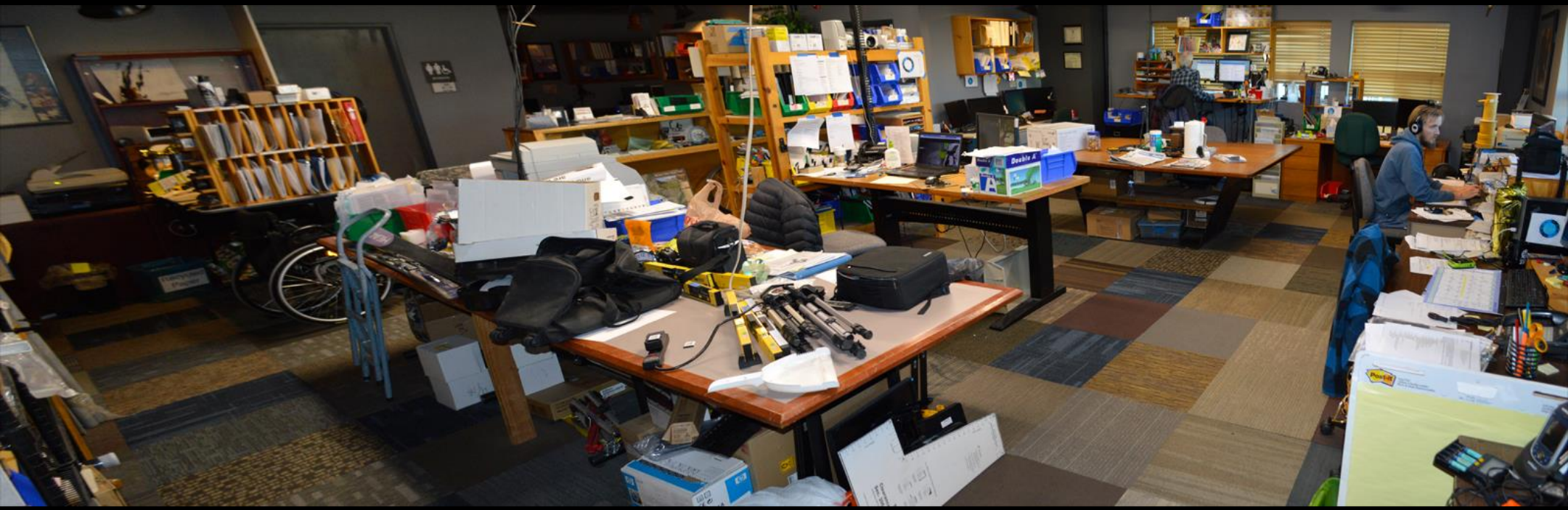
assessment technician

# A working space with tools…

to design and create

to build, test and break

with material and stuff to assemble

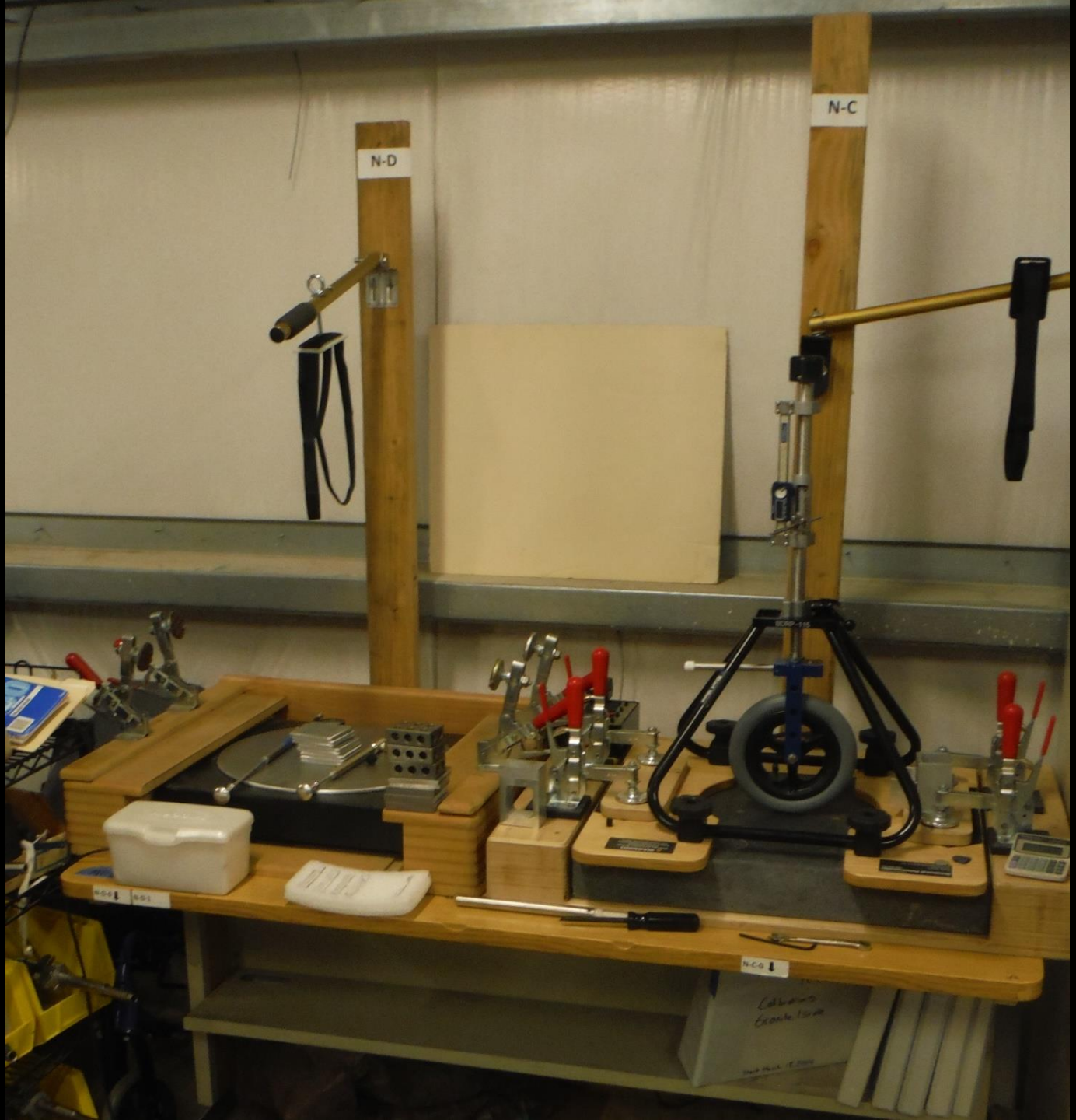

Double A


N20K


Mobil


R2-A
JC Metal Fabrication Inc.
21831 9 Mile Rd.,Reed City, MI 49677
231-832-3551
MADE IN
U S A
FAN
LIGHT


N-C
N-B

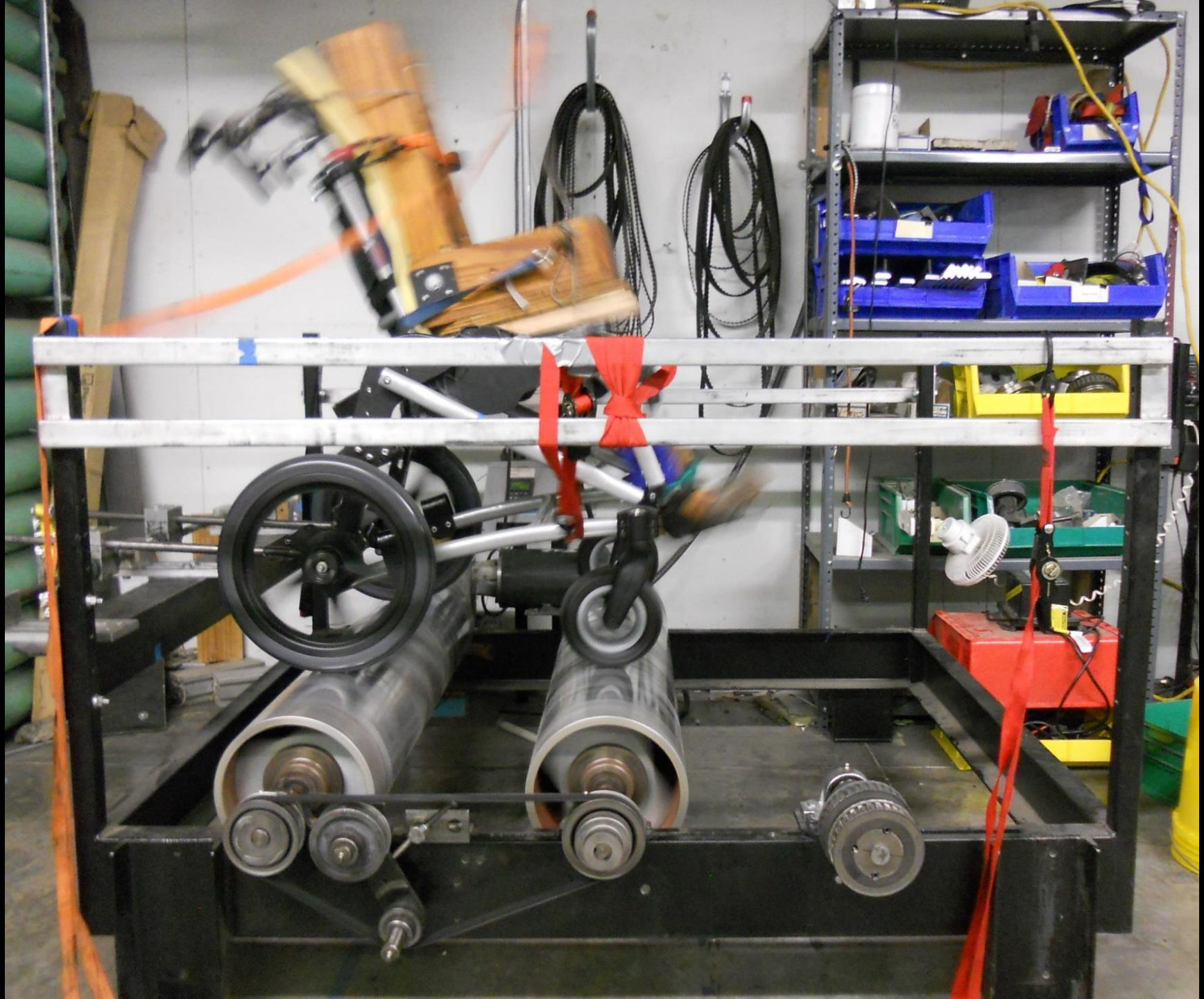

N-D
N-C

# Testing

- Wheelchairs
- Surfacing
- Adaptive sports equipment
- Forensics

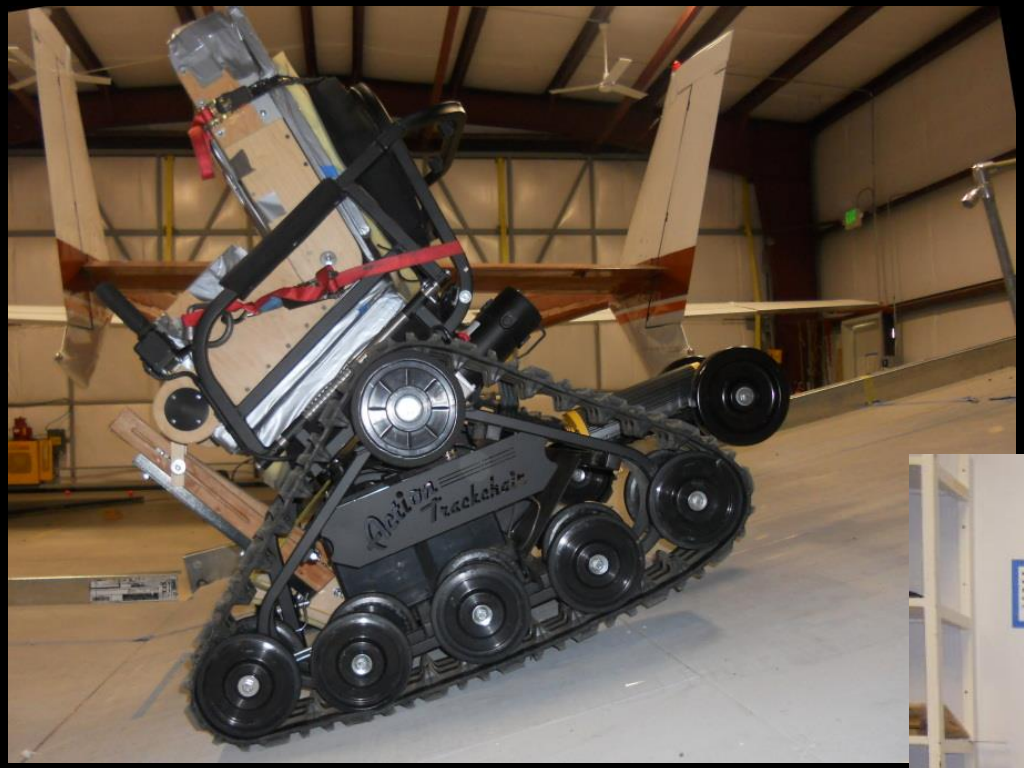
# Wheelchair testing

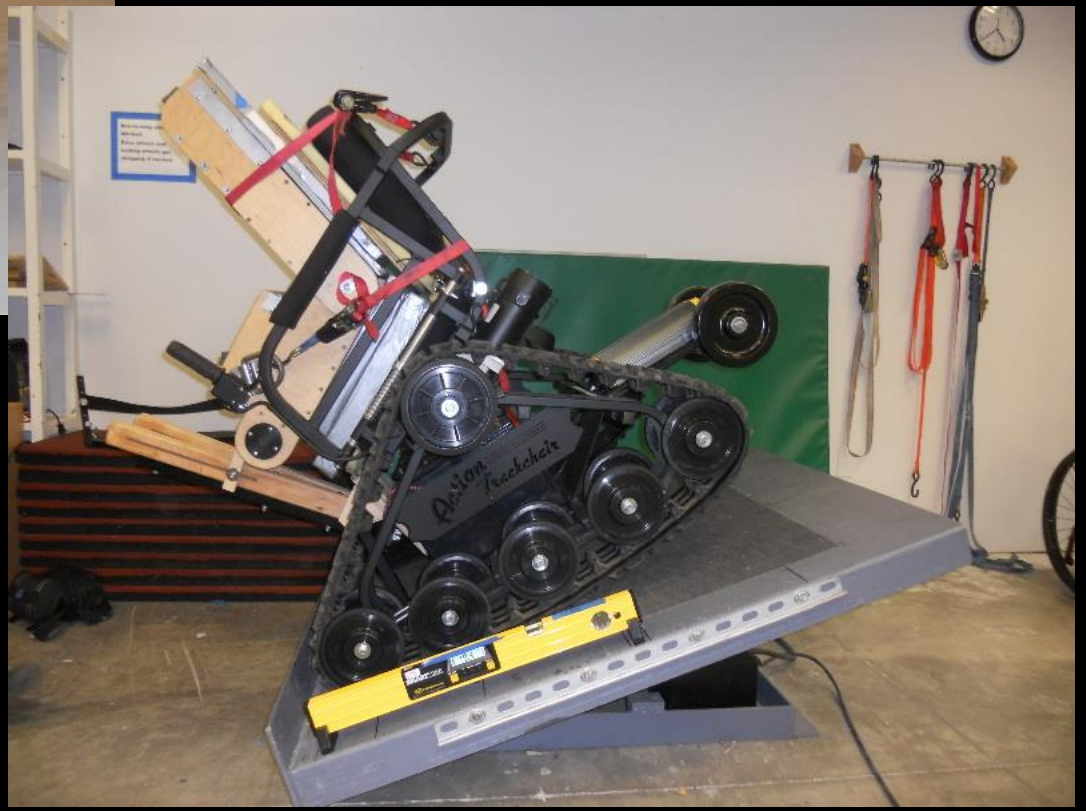
- People get hurt using them
- Design and manufacturing defects
- Making sure the product is safe
- Determine the performance of the product
  - How fast will it go?
  - How far it will go?
  - How high it can climb?



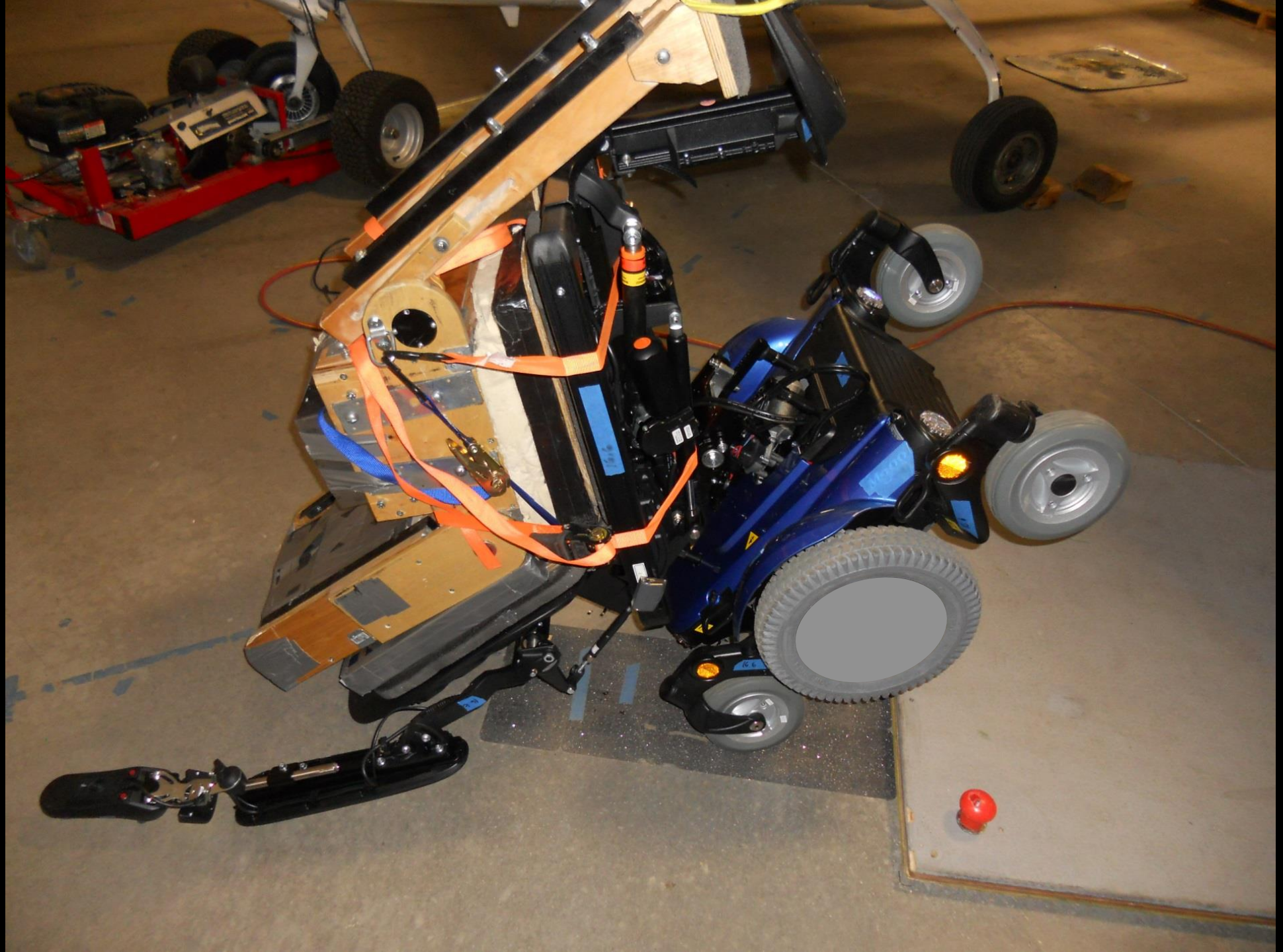

2014-2


N2QK Tools
Action Trackstander


Action Trackchair


Action Trackchair


7.5°



# Playground 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?

# Rotational Penetrometer

objective surface measurement device


BDRP100
Start Here

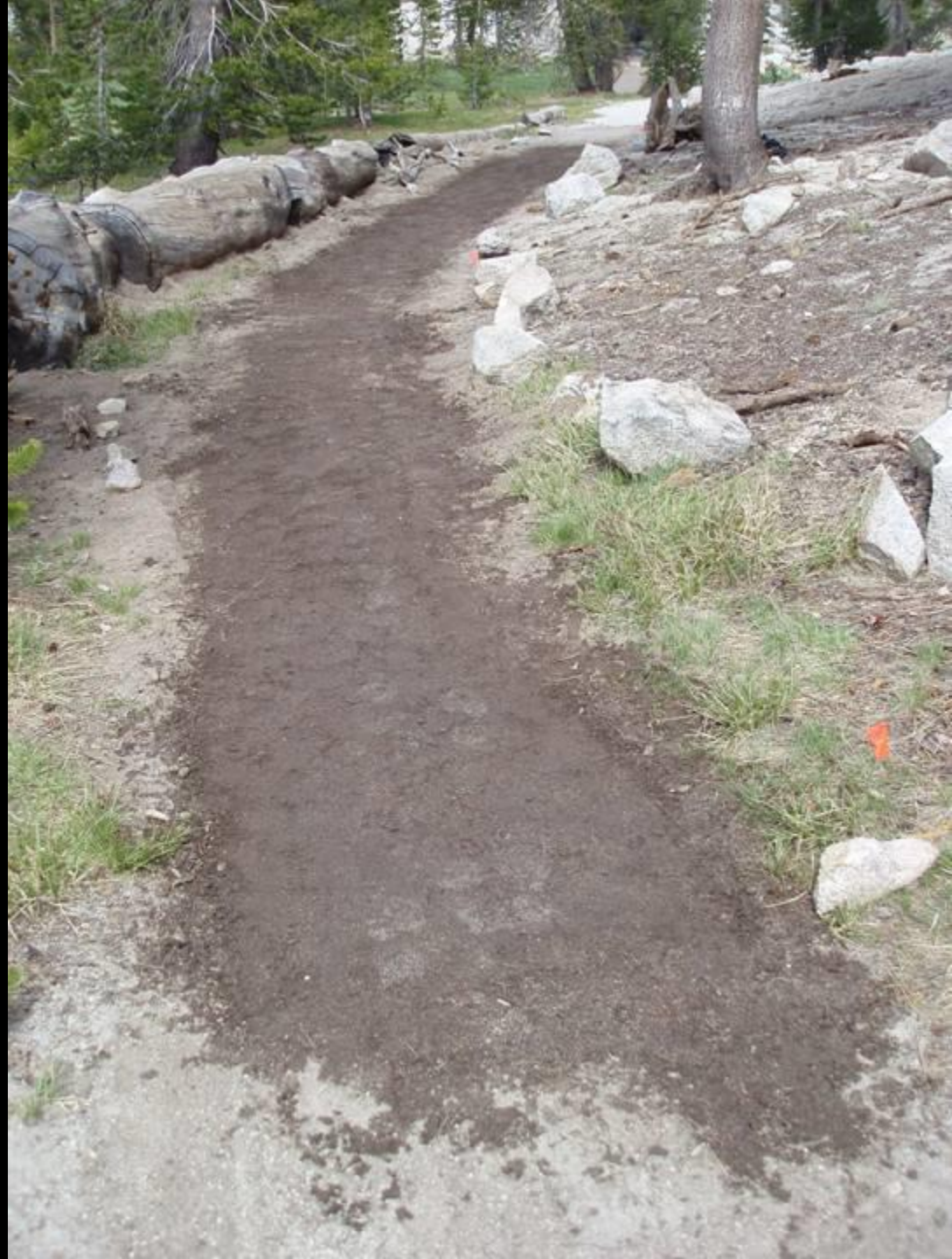

USA
UNLOADED
ON
ZERO
ABS
0.000
in/mm

# Trail surface

Trail with firm but unstable sandy surface

# Trail 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

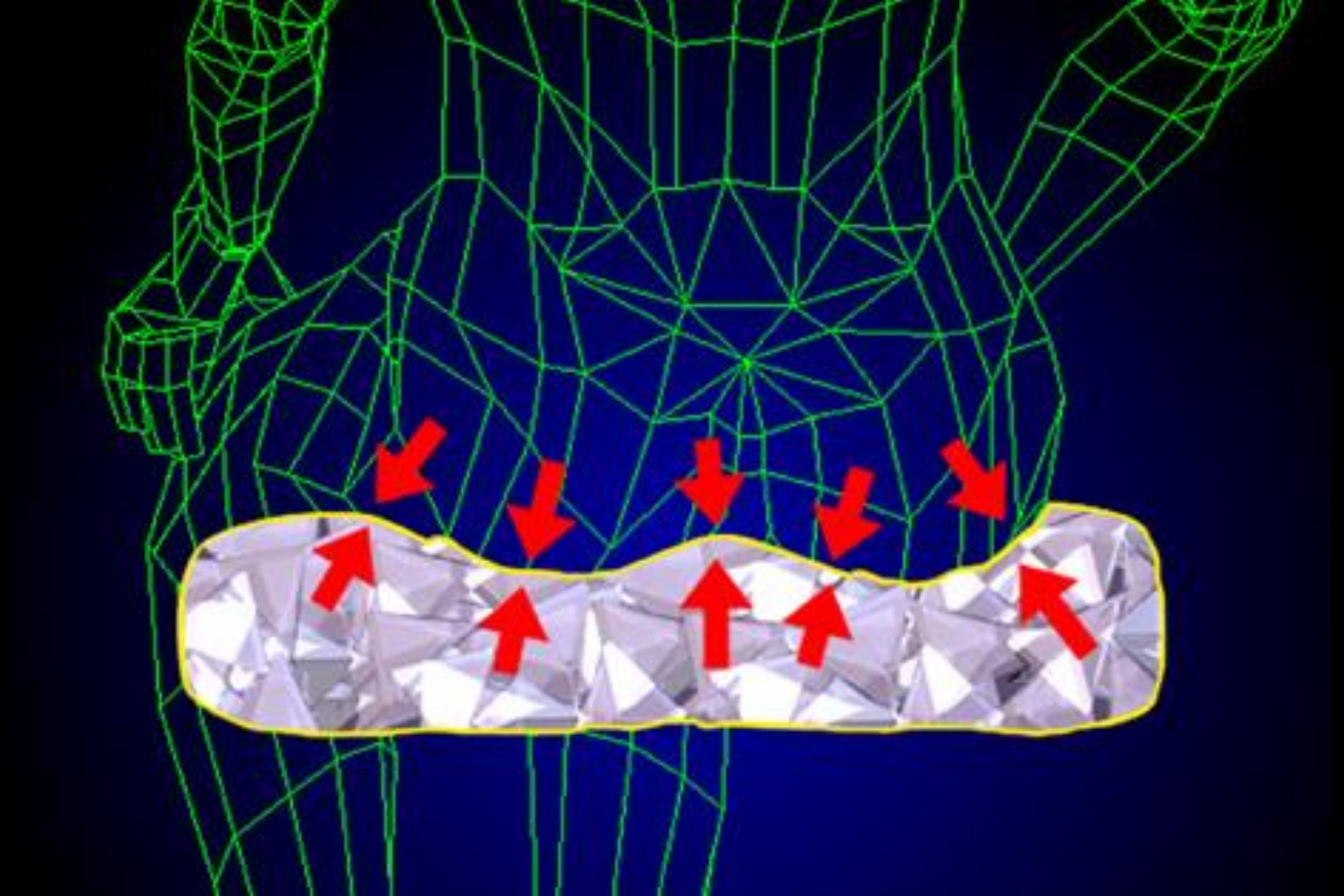
People die from pressure sores

Soft but firm and stable

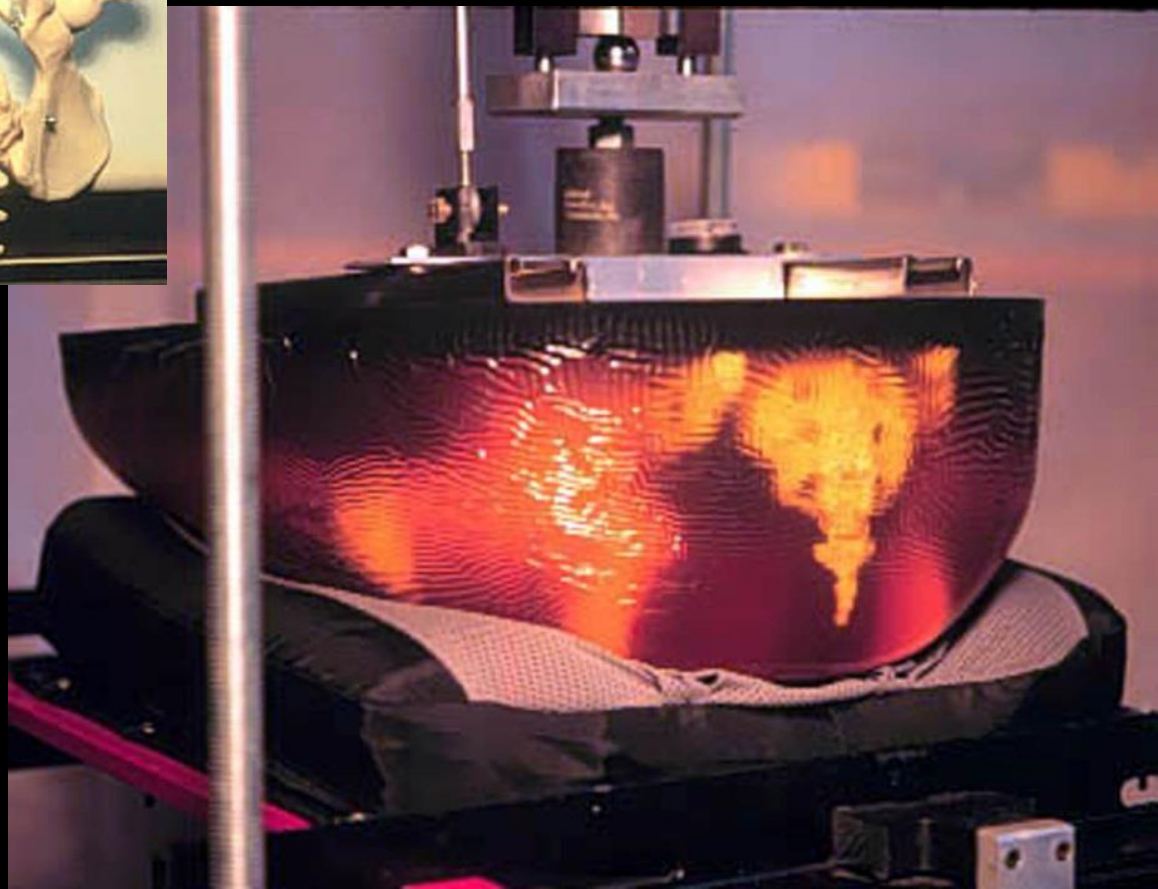
Making sure the product is safe

Making sure I don’t get a pressure sore

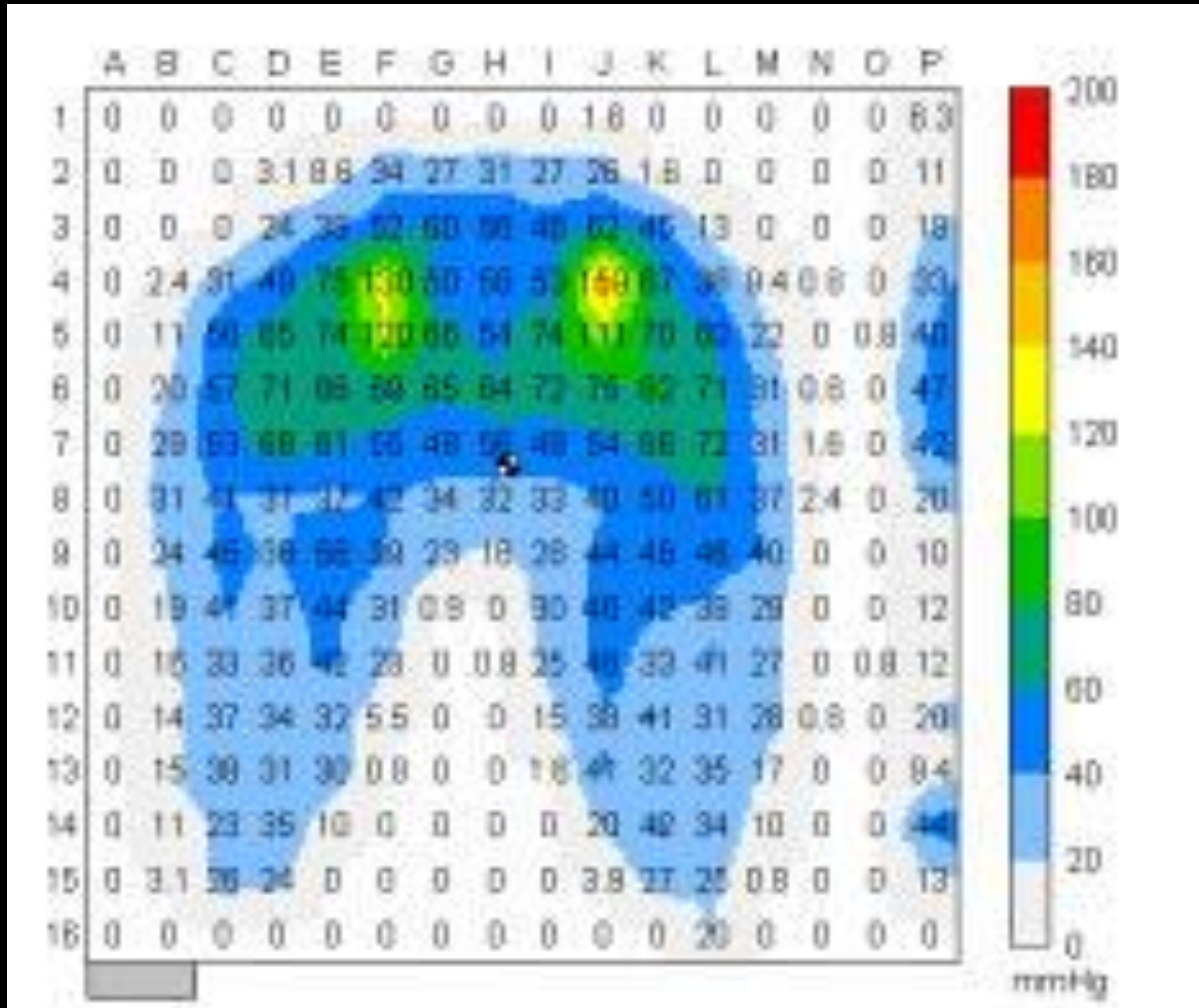
- How high are the sitting pressures?
- How long can I sit on it?



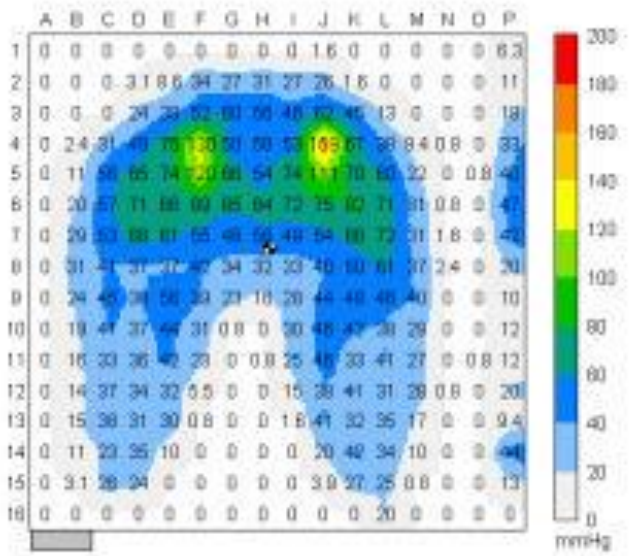
# Seat cushion testing



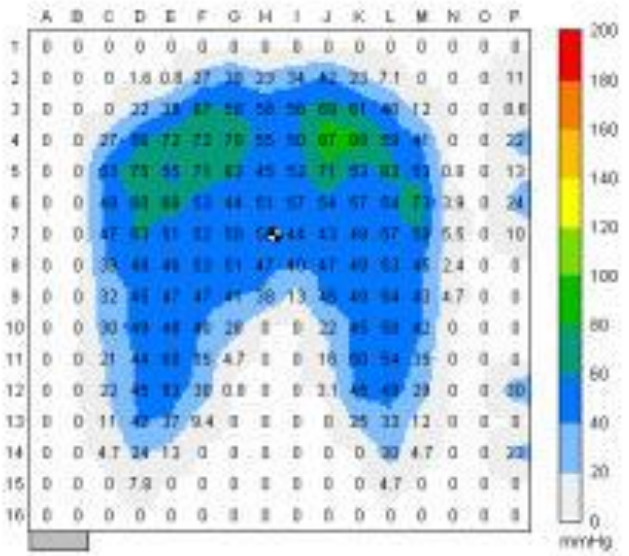
# SKELI used on foam



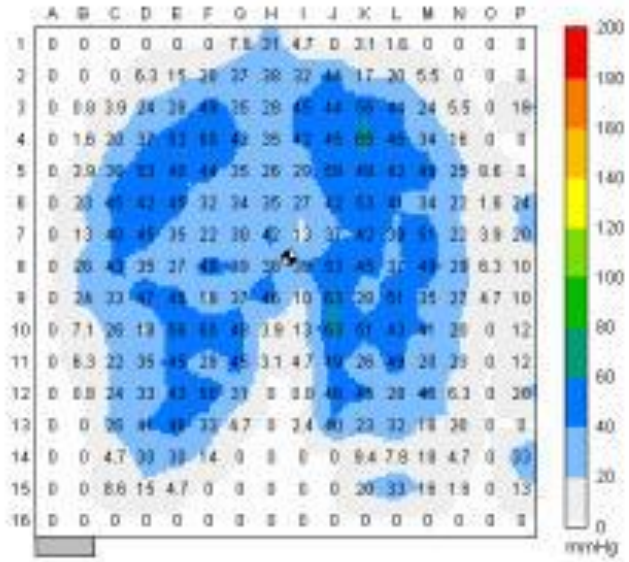

2" HR45 Foam Cushion



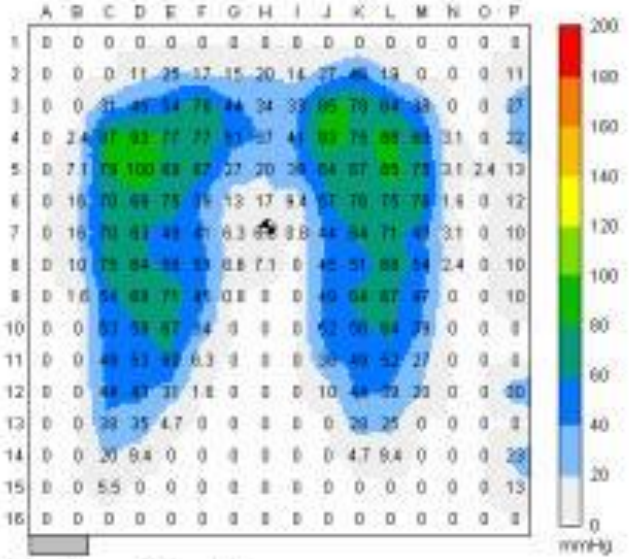
**2" HR45 Foam**



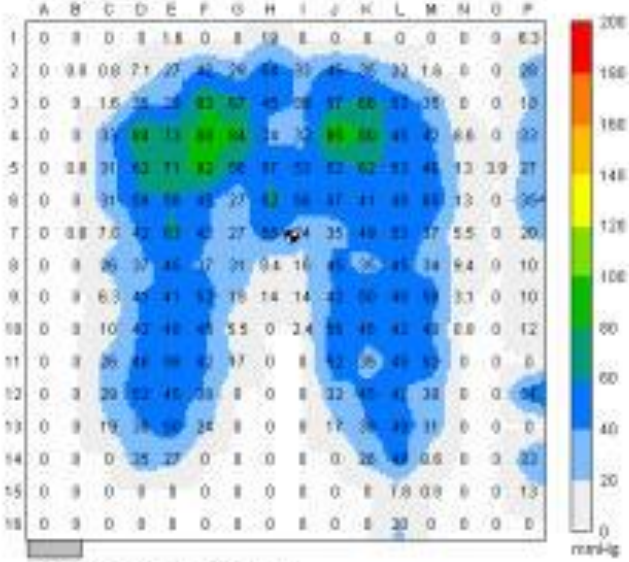
**Jay 2 by Sunrise Medical**



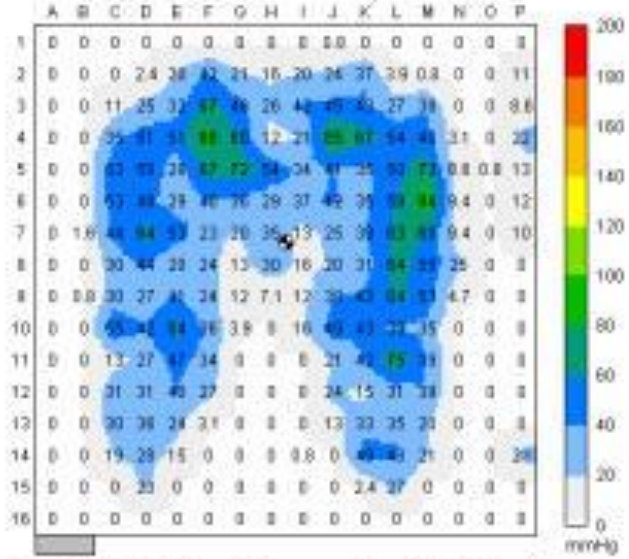
**ROHO High Profile by ROHO Inc.**



**Contoured by Supracor**



**Model P by Vicair**



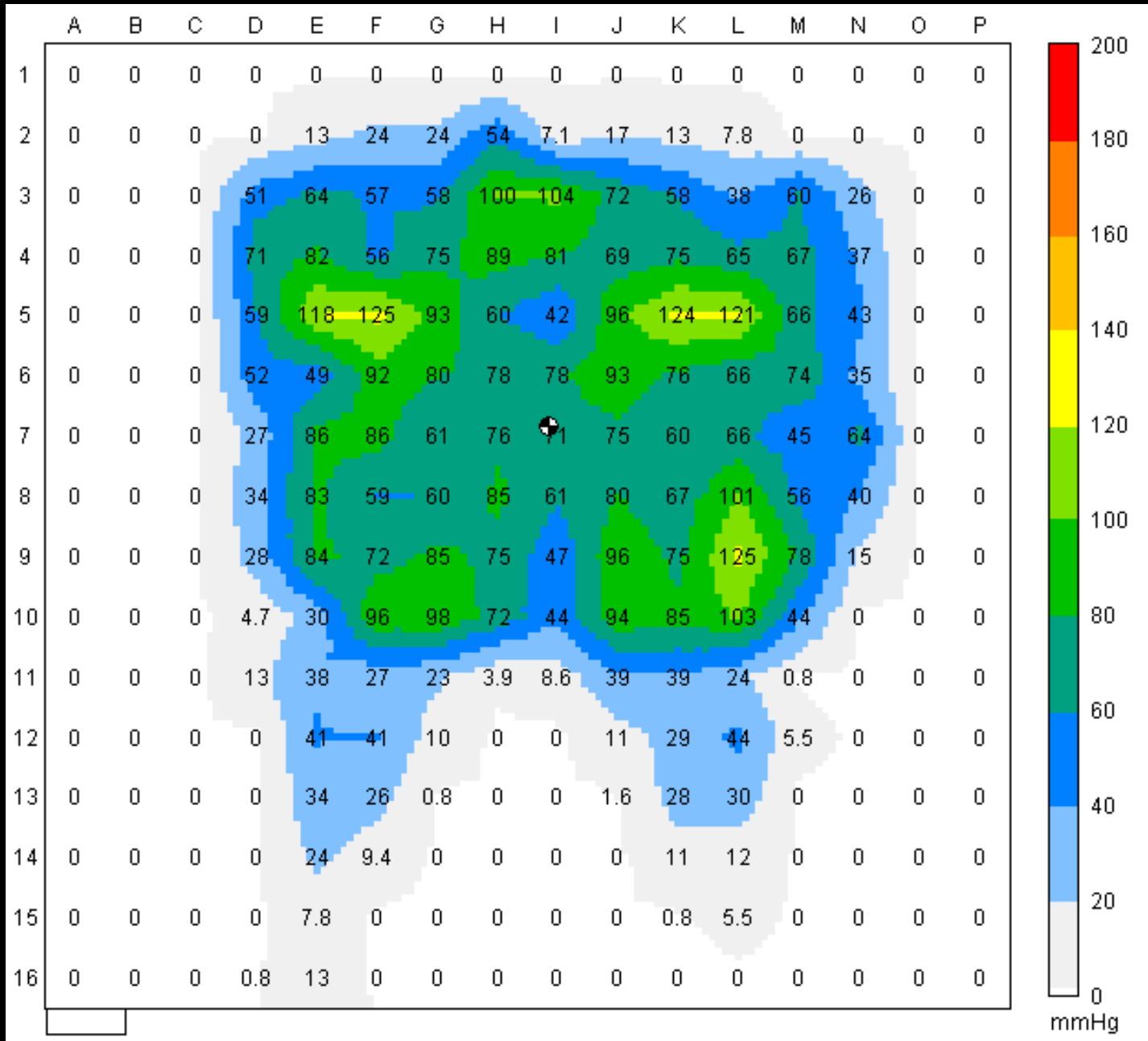
**Model P Deep Immersion by Vicair**

# ASLI prototype

became an ISO shape

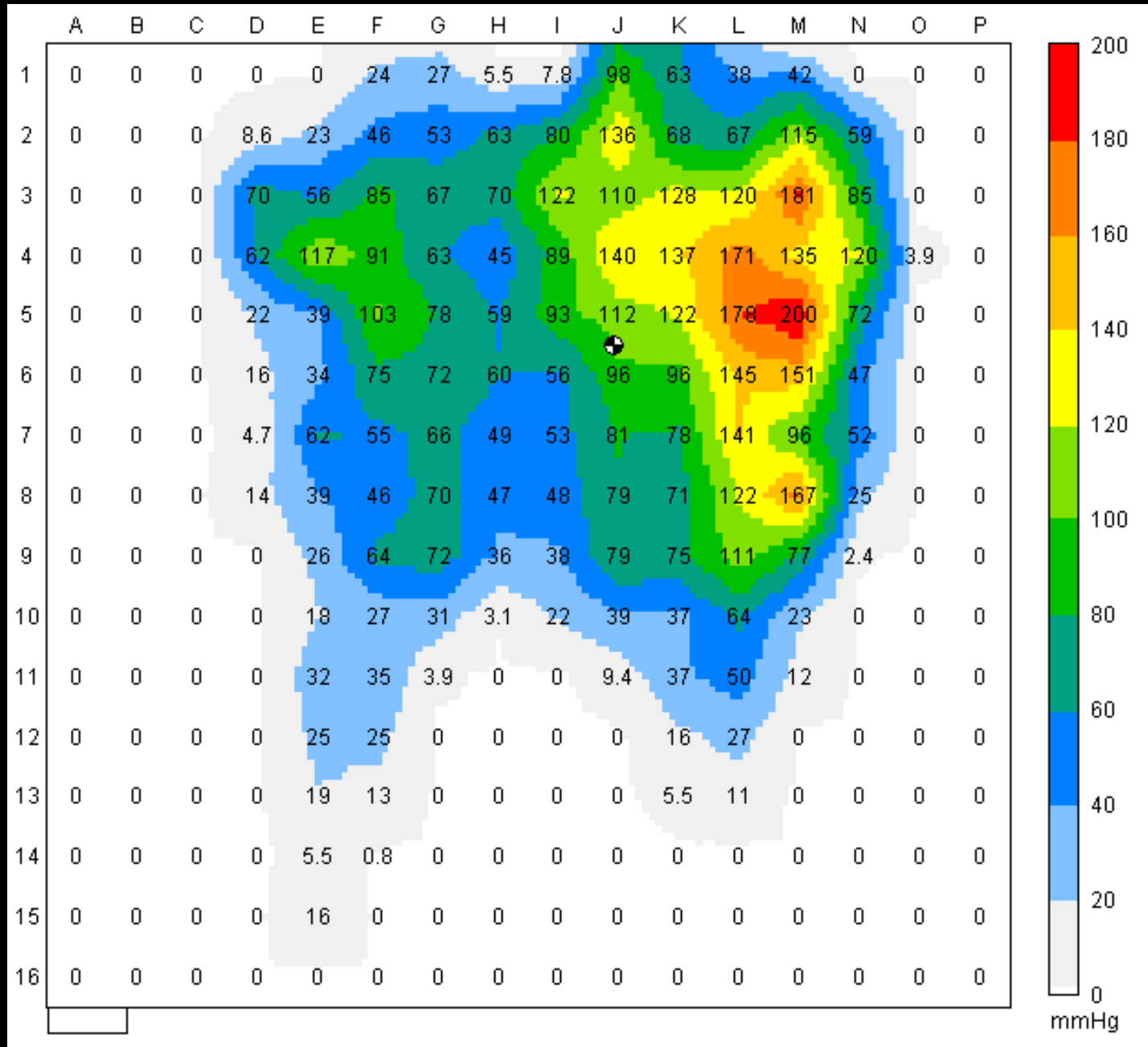
# Pressure measurements

symmetric



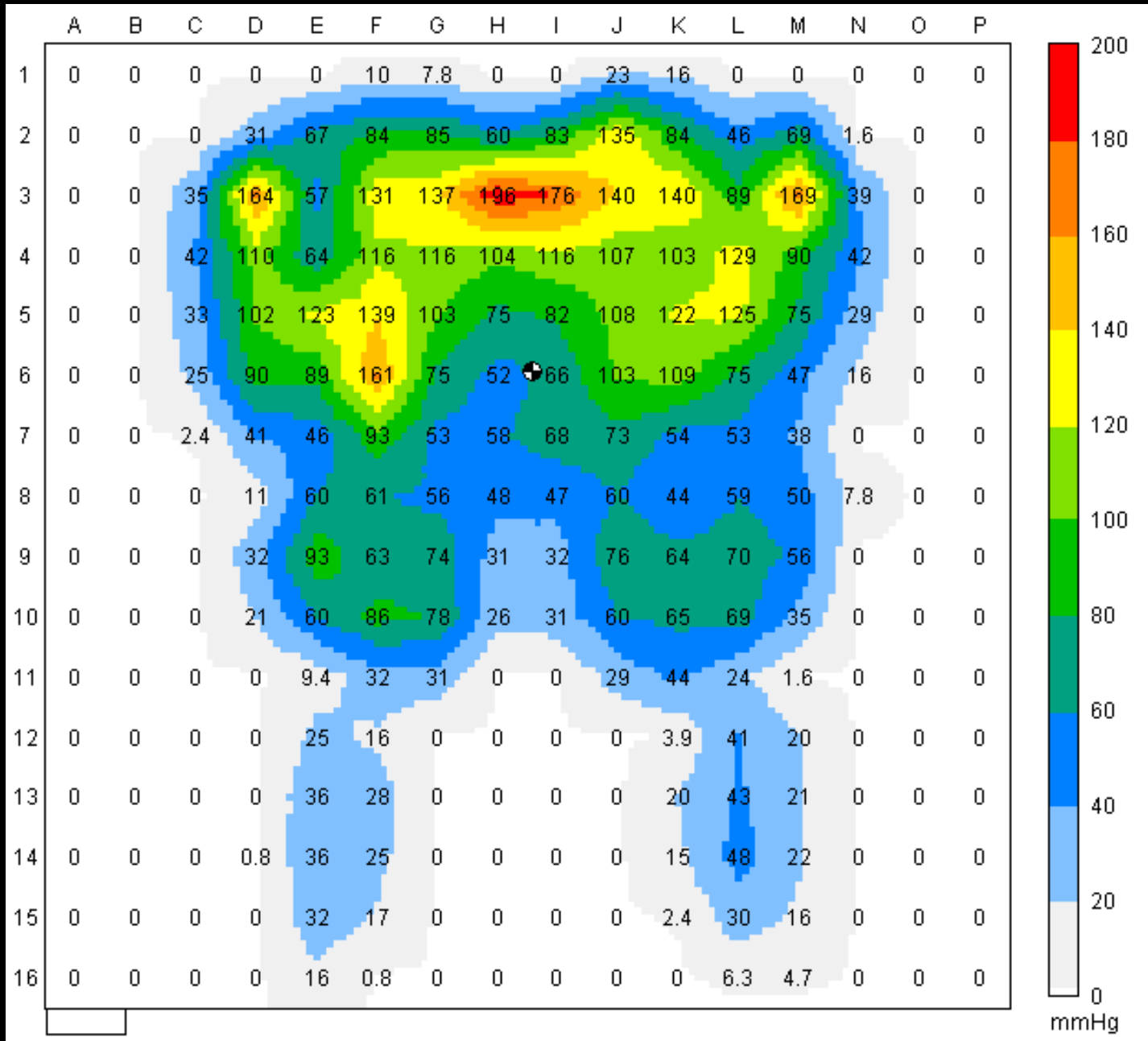
# Pressure measurements

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 wheel and handrim

a rough surface burns the hands

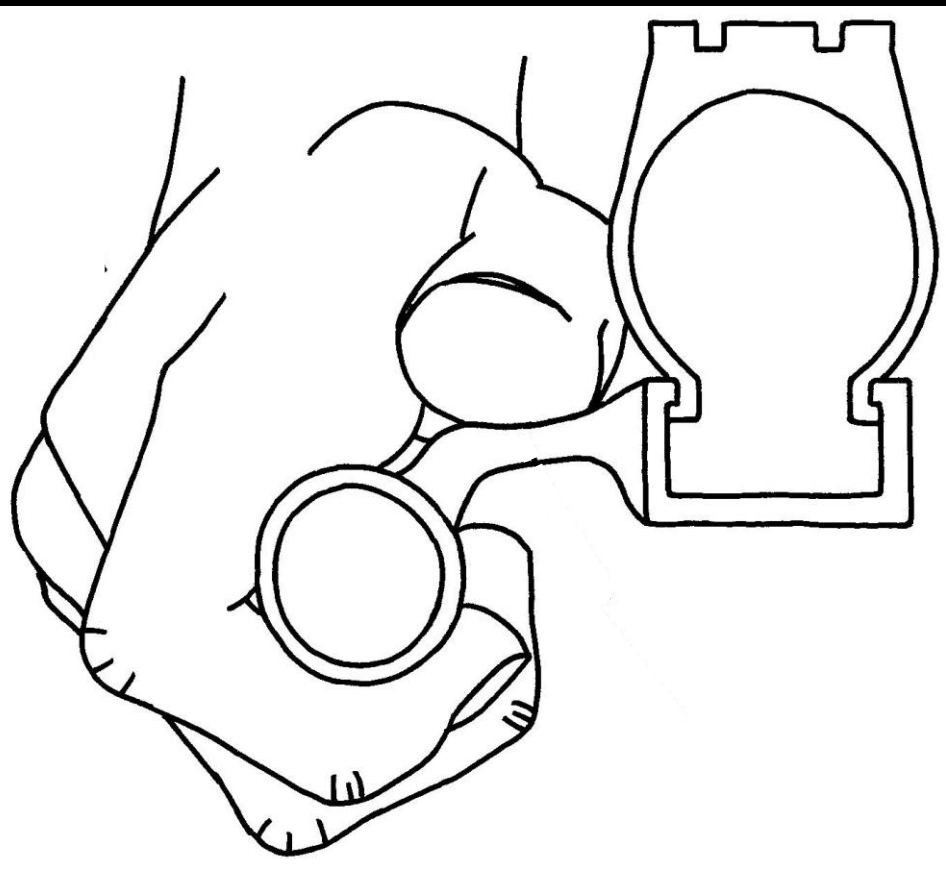
difficult to grip a smooth surface

repeated motion leads to injury

# The need:

A better grip

Solution: an ergonomic pushrim

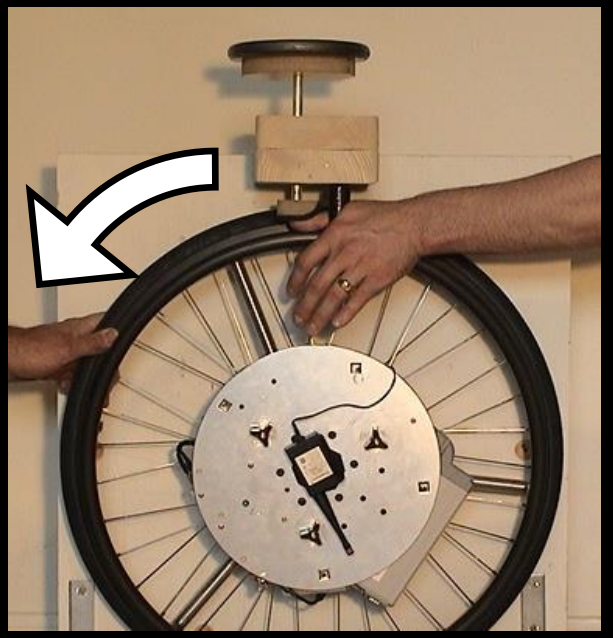


# FlexRim

Combining the discrete compliant fasteners into one

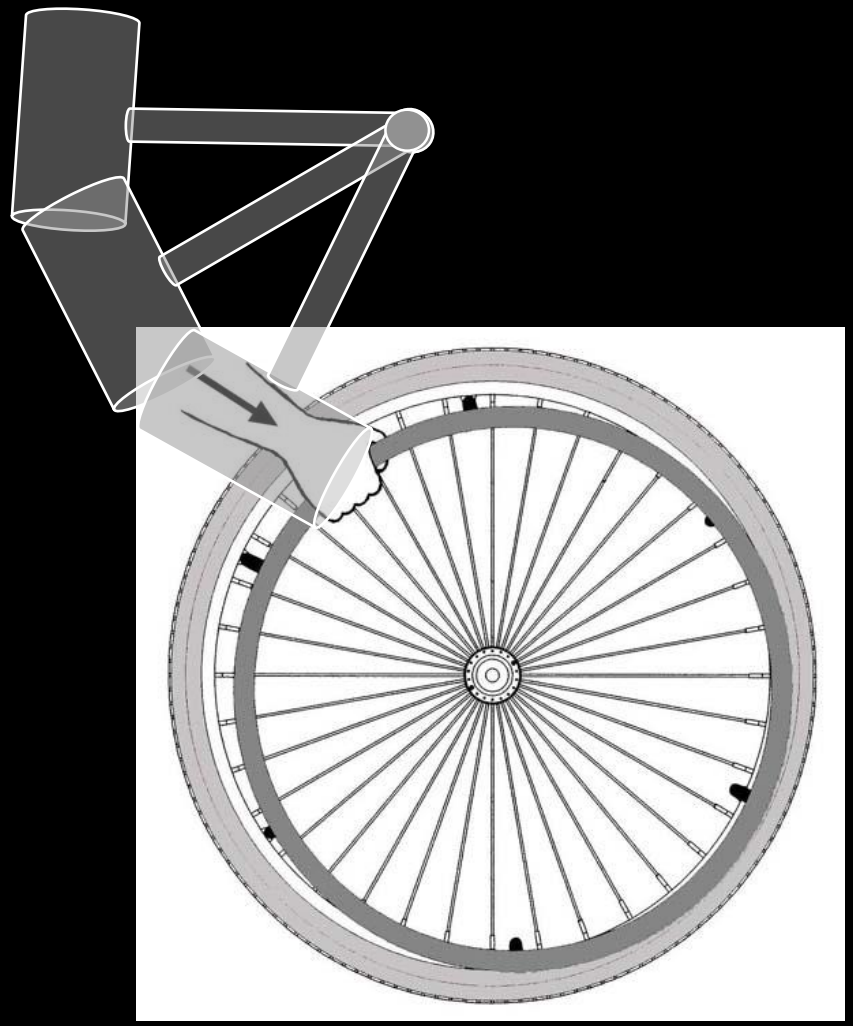
# Frictional improvements

To reduce the grip force required to push



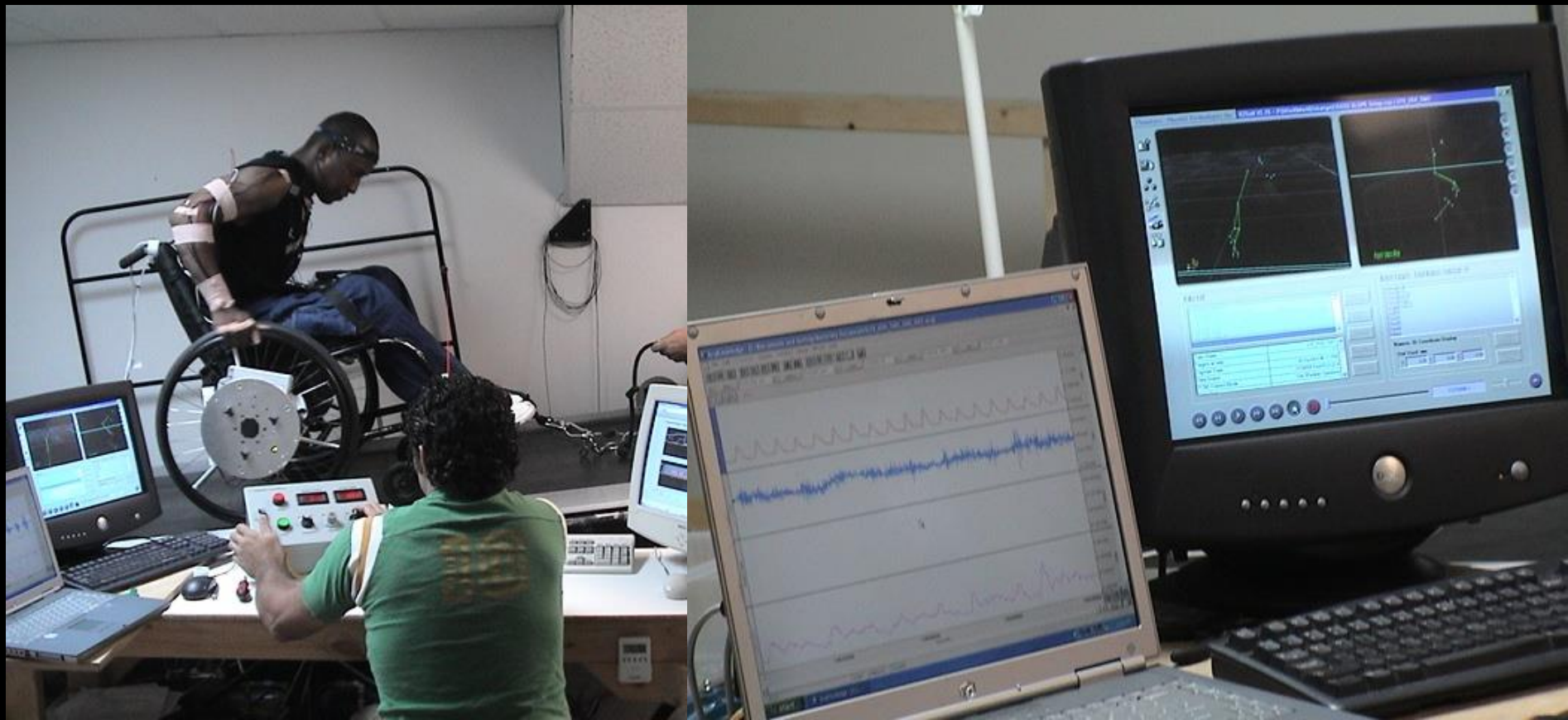
# Impact absorbtion

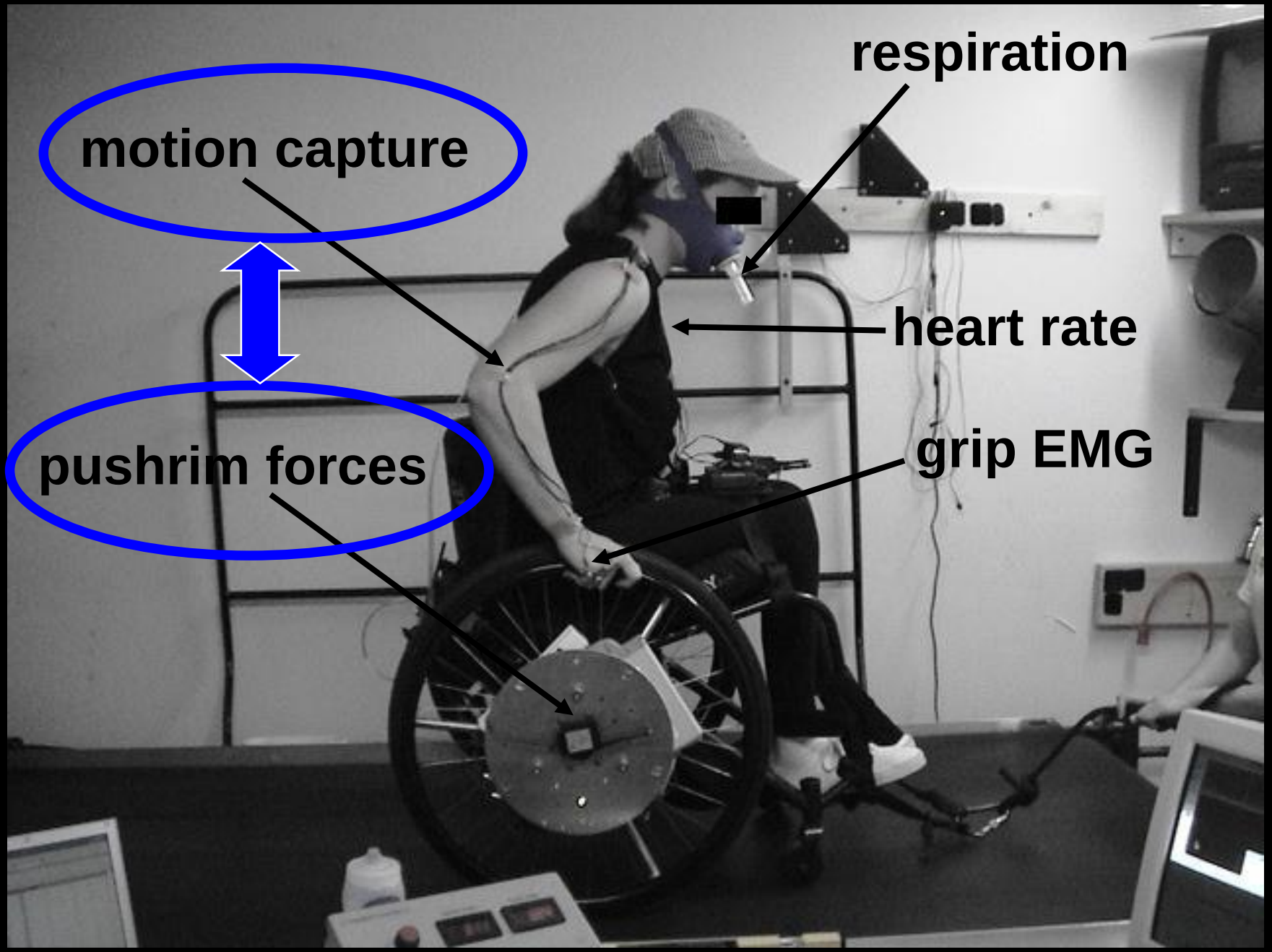
Like running shoes



# Subjects are tested

over a wide variety of usage environments




respiration
motion capture
heart rate
grip EMG
pushrim forces

# End product – the FlexRim

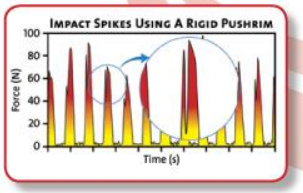
### Design

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 ***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*

# Activity-specific technologies

And the desire to recreate

# The need:

To get back out on the snow

# The Mono Ski

## Now a Paralympic sport


200
205
AMERICAN EXPRESS
When you

# Dynamic seating spring assist


celebrating
Spectacular
Poker

# The desire:

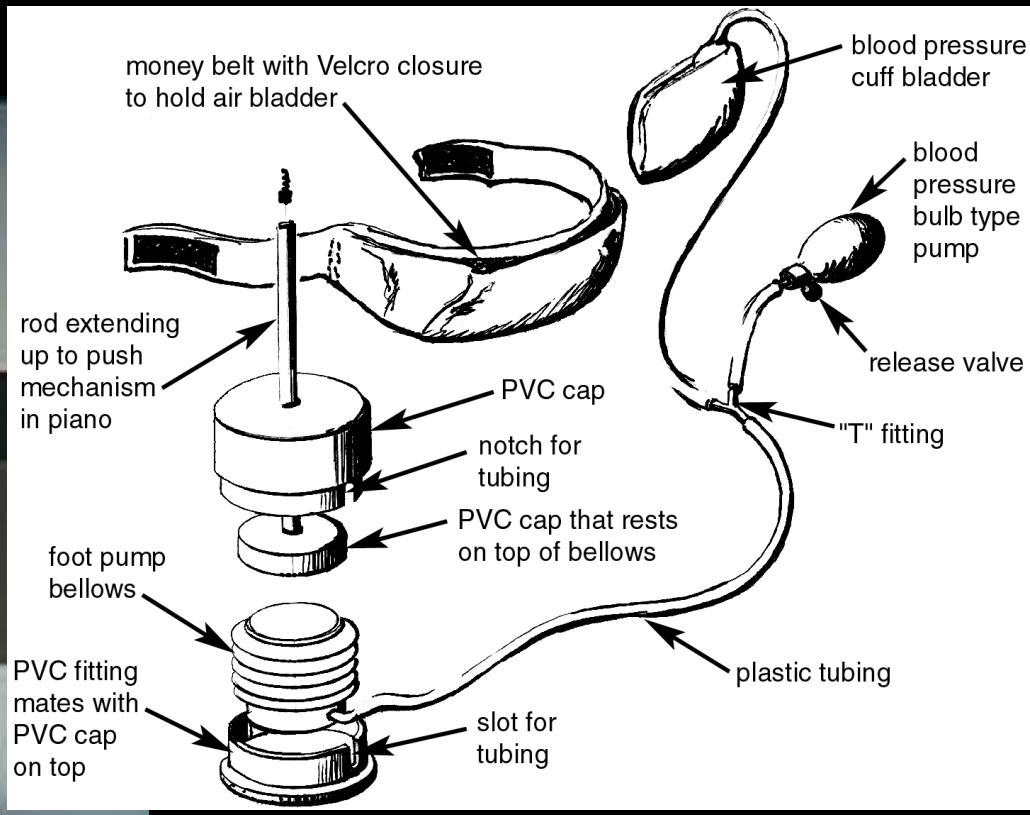
Get back into the backcountry


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


NIMBUS
MARATHON

# lateral balance test

# water egress testing

**Creating Ability**

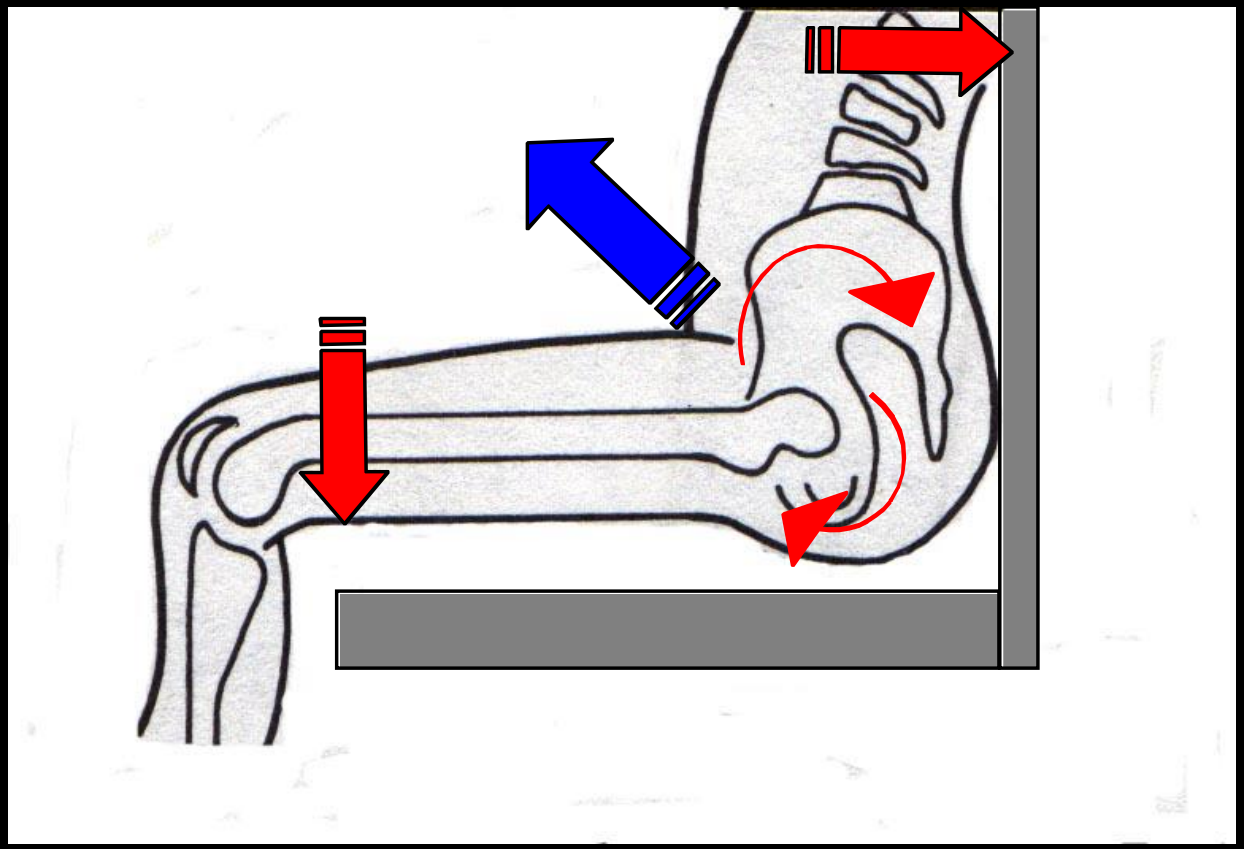
Canoe and Kayak Seating

# The desire:

Surf again

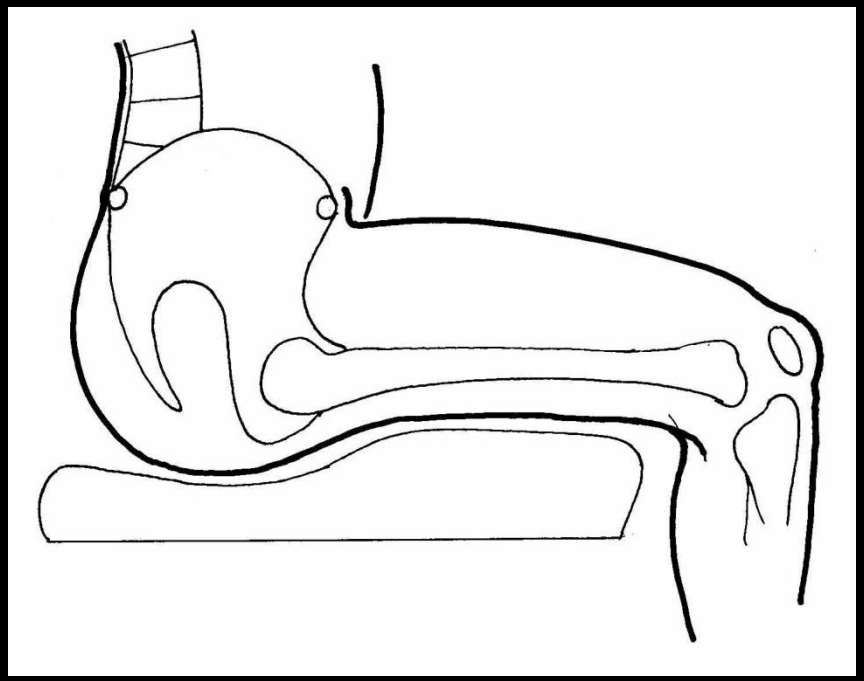
# The problem:

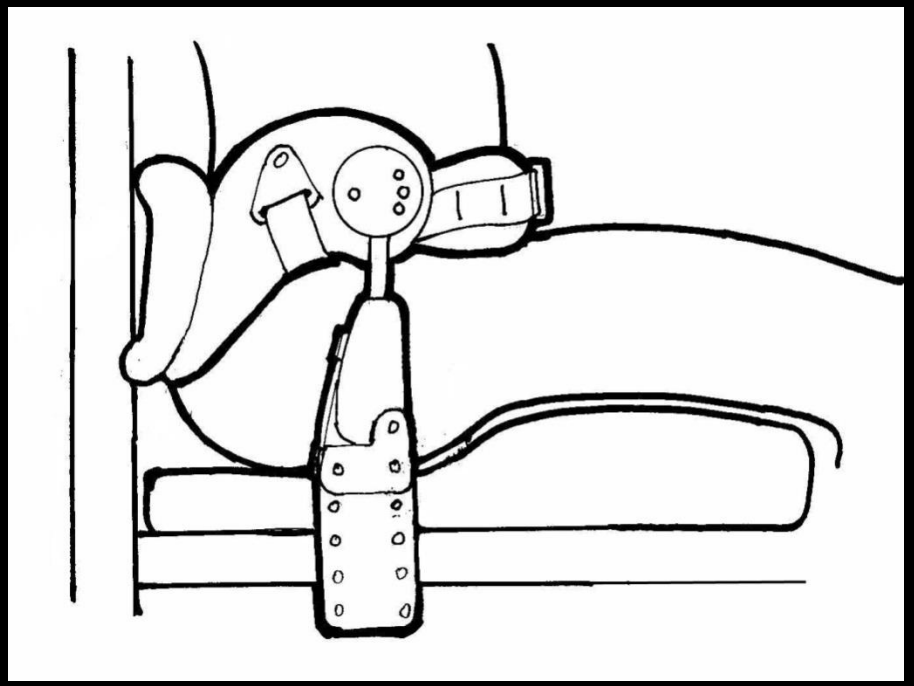
Unwanted pelvic movement due to spasticity



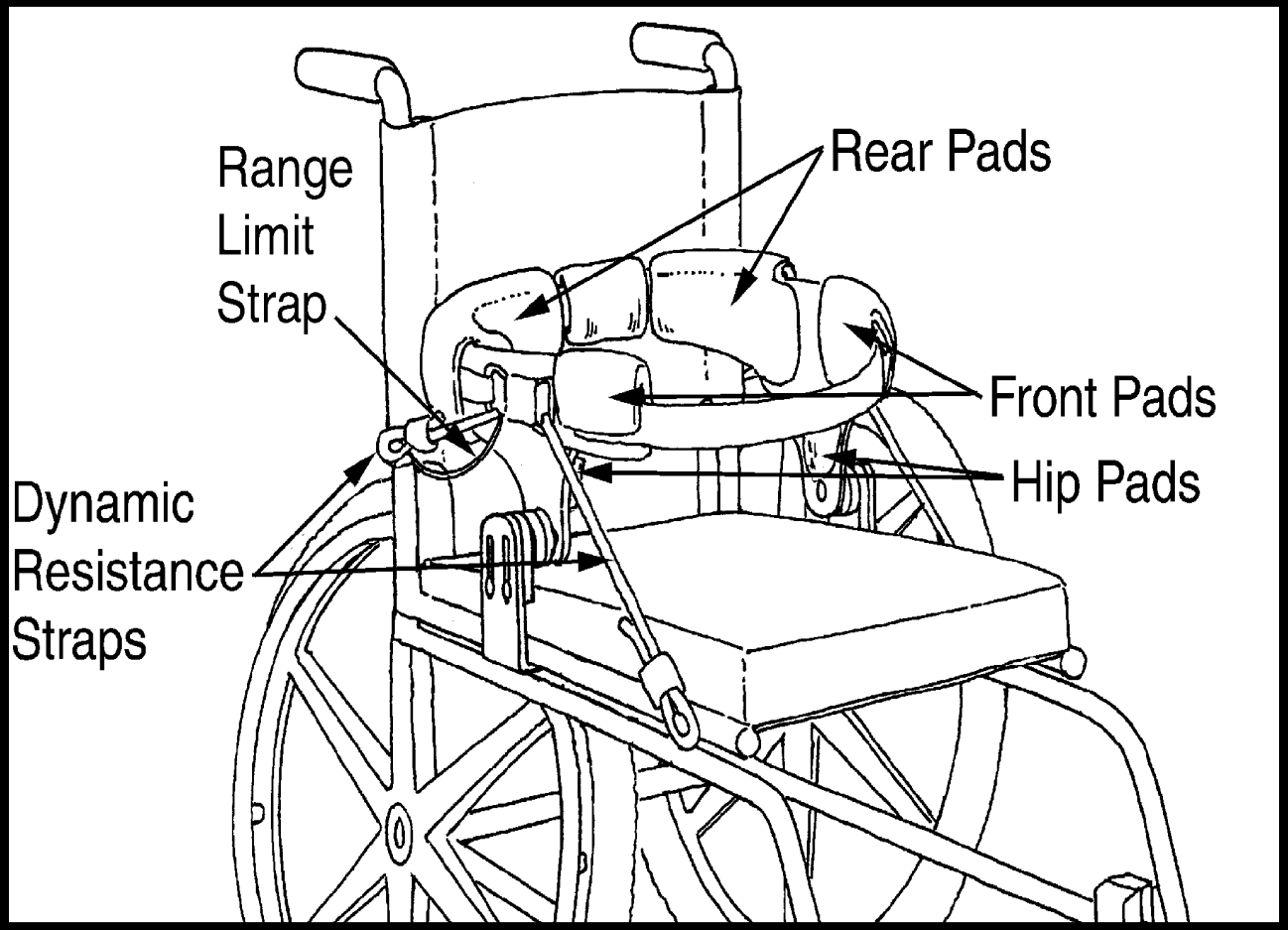
# Concepts developed

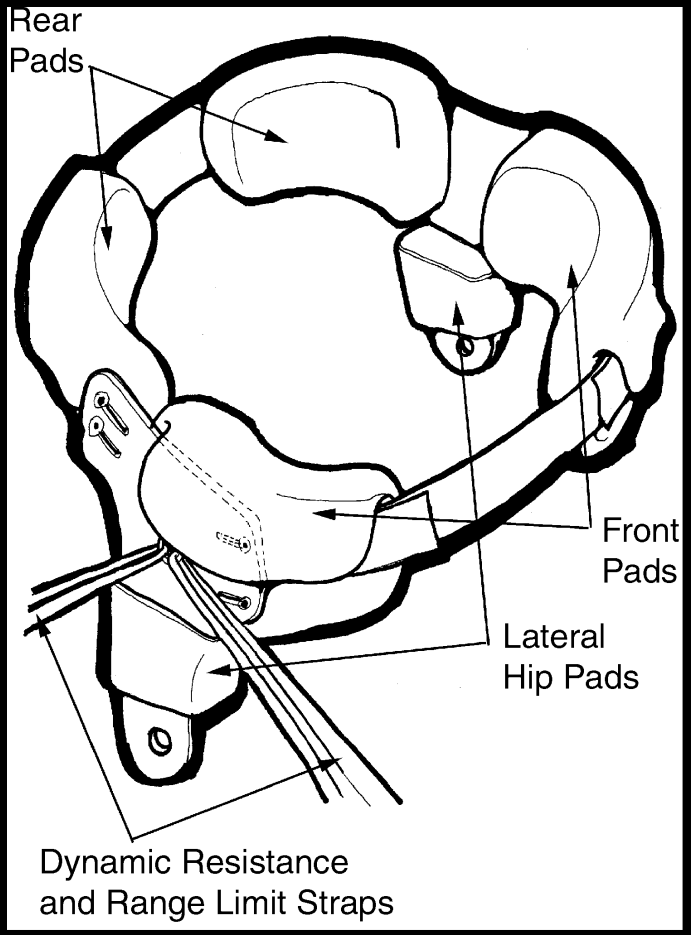
to allow the movement, but return to the desired position





# Early prototypes



# Fatigue testing of concept

# The finished product

# Environmental technologies

Things that do not move

# ADA recreation trail

## grade

| | |
|---|---|
| > 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

**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

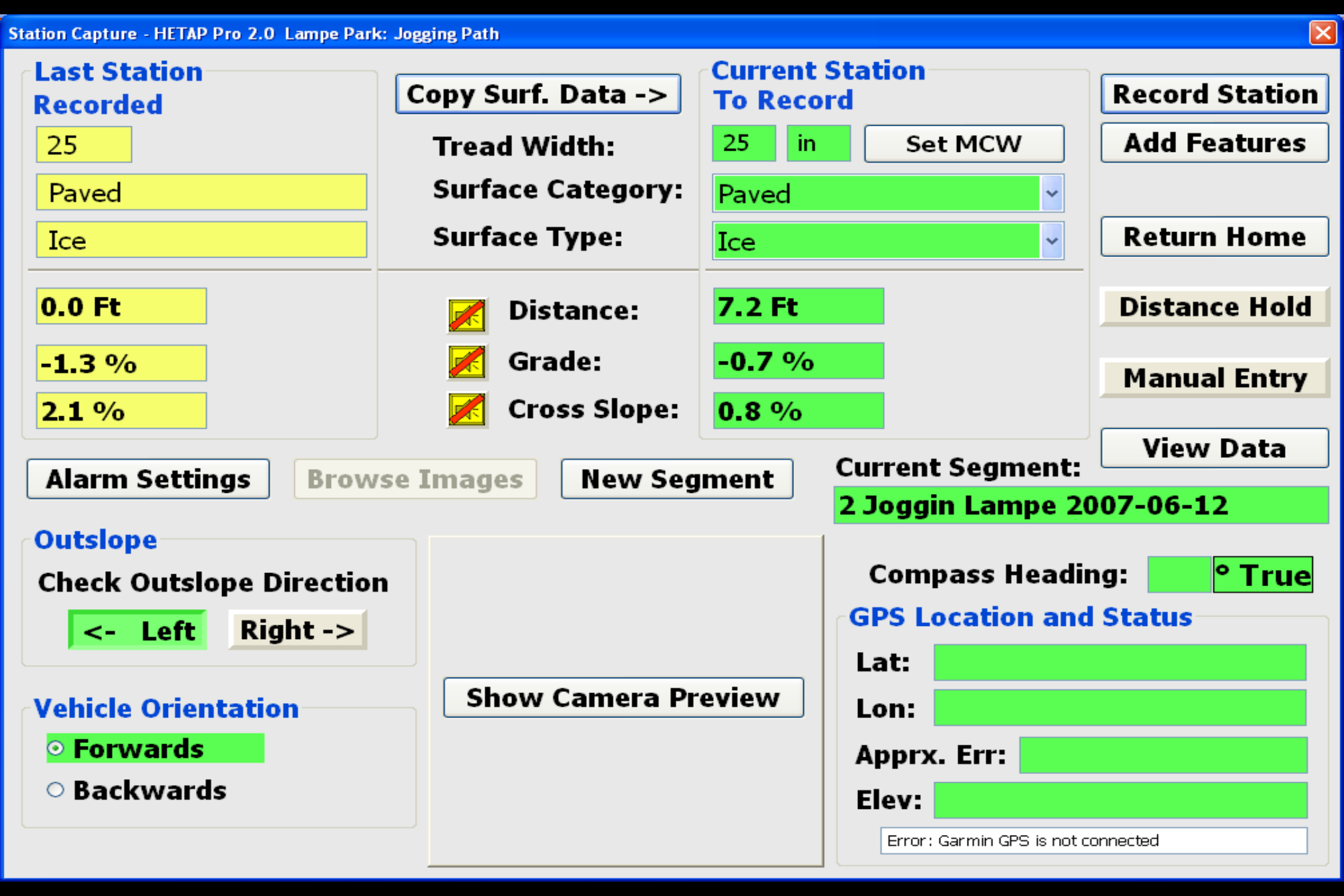
# UTAP implementation status

**Over 1300 people**
trained to lead UTAP assessments

**Over 155 trainers**
to teach UTAP workshops

# High-Efficiency Trail Assessment Process (HETAP)

# HETAP wheel

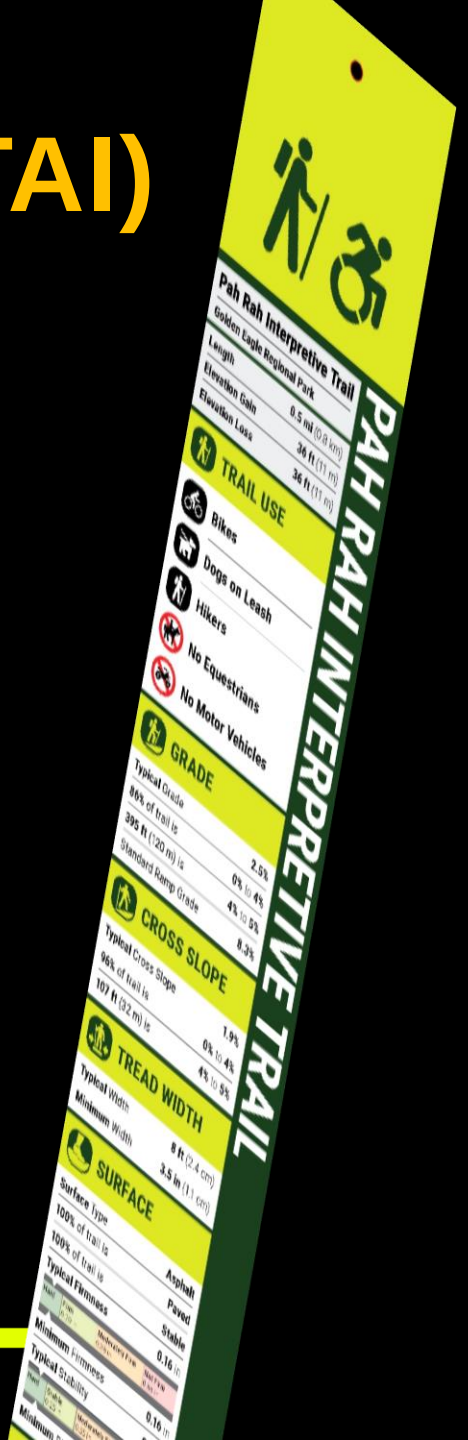

Station Capture - HETAP Pro 2.0 Lampe Park: Jogging Path
Last Station Recorded
25
Paved
Ice
0.0 Ft
-1.3 %
2.1 %
Copy Surf. Data ->
Tread Width:
Surface Category:
Surface Type:
Current Station To Record
25
in
Set MCW
Paved
Ice
Distance:
Grade:
Cross Slope:
7.2 Ft
-0.7 %
0.8 %
Record Station
Add Features
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)

TAI SignPosts to convey to users in a Nutrition Facts label format:

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




TRAIL ACCESS INFORMATION

## Spooner Lake Loop Trail

| | |
|---|---|
| Length | 2.2 (3.6 km) |
| Elevation Gain | 199 ft (60.7 m) |
| Elevation Loss | 349.2 ft (106.5 m) |

### TRAIL USE

- Hikers
- Mountain Bikes
- Dogs on Leash
- Equestrians
  North Side of Lake Only
- No Motor Vehicles

### GRADE

| | |
|---|---|
| Typical Grade | 4.6% |
| 20% of trail is | 6% to 11% |
| 929 ft (283.2 m) is | 11% to 24.5% |
| Standard Ramp Grade | 8.3% |

### CROSS SLOPE

| | |
|---|---|
| Typical Cross Slope | 5.4% |
| 21% of trail is | 7% to 11% |
| 947 ft (288.6 m) is | 11% to 28.1% |

### TREAD WIDTH

| | |
|---|---|
| Typical Width | 37 in (94.9 cm) |
| Minimum Width | 24 in (61.0 cm) |
| 2502 ft (762.6 m) is | 24 in (61.0 cm) |

### SURFACE

| | |
|---|---|
| Surface Type | Soil |
| 1% of trail is | Hard |
| 99% of trail is | Firm |

### OBSTRUCTIONS

| | |
|---|---|
| Multiple Rocks | 6-12 in (15-31 cm) |

**WARNING:** Trail conditions may have changed since August 2017 when this trail last was assessed. Temporary trail obstructions were not recorded. Obstructions less than 2 in (5.1 cm) or outside of the tread area (36 in (91.4 cm) wide by 120 in (304.8 cm) high) were not reported.

Signage created by **Beneficial Designs Inc.** using Trail Access Information data collected by a certified trail assessment coordinator. Funded by the Nevada Recreational Trails Program and the Nevada Department of Conservation & Natural Resources.

ACCESS INFORMATION

1 SPOONER LAKE LOOP TRAIL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- Equestrians
  North Side of Lake Only
- No Motor Vehicles

### GRADE

| | |
|---|---|
| Typical Grade | 4.6% |
| 20% of trail is | 6% to 11% |
| 929 ft (283.2 m) is | 11% to 24.5% |
| Standard Ramp Grade | 8.3% |

### CROSS SLOPE

| | |
|---|---|
| Typical Cross Slope | 5.4% |
| 21% of trail is | 7% to 11% |
| 947 ft (288.6 m) is | 11% to 28.1% |

### TREAD WIDTH

| | |
|---|---|
| Typical Width | 37 in (94.9 cm) |
| Minimum Width | 24 in (61.0 cm) |
| 2502 ft (762.6 m) is | 24 in (61.0 cm) |

### SURFACE

| | |
|---|---|
| Surface Type | Soil |
| 1% of trail is | Hard |
| 99% of trail is | Firm |

### OBSTRUCTIONS

| | |
|---|---|
| Multiple Rocks | 6-12 in (15-31 cm) |

**WARNING:** Trail conditions may have changed since August 2017 when this trail last was assessed. Temporary trail obstructions were not recorded. Obstructions less than 2 in (5.1 cm) or outside of the tread area (36 in (91.4 cm) wide by 120 in (304.8 cm) high) were not reported.

Signage created by **Beneficial Designs Inc.** using Trail Access Information data collected by a certified trail assessment coordinator. Funded by the Nevada Recreational Trails Program and the Nevada Department of Conservation & Natural Resources.

ACCESS INFORMATION

1 SPOONER LAKE LOOP TRAIL



### No Motor Vehicles

### GRADE

| | |
|---|---|
| Typical Grade | 4.6% |
| 20% of trail is | 6% to 11% |
| 929 ft (283.2 m) is | 11% to 24.5% |
| Standard Ramp Grade | 8.3% |

### CROSS SLOPE

| | |
|---|---|
| Typical Cross Slope | 5.4% |
| 21% of trail is | 7% to 11% |
| 947 ft (288.6 m) is | 11% to 28.1% |

### TREAD WIDTH

| | |
|---|---|
| Typical Width | 37 in (94.9 cm) |
| Minimum Width | 24 in (61.0 cm) |
| 2502 ft (762.6 m) is | 24 in (61.0 cm) |

### SURFACE

| | |
|---|---|
| Surface Type | Soil |
| 1% of trail is | Hard |
| 99% of trail is | Firm |

### OBSTRUCTIONS

| | |
|---|---|
| Multiple Rocks | 6-12 in (15-31 cm) |

**WARNING:** Trail conditions may have changed since August 2017 when this trail last was assessed. Temporary trail obstructions were not recorded. Obstructions less than 2 in (5.1 cm) or outside of the tread area (36 in (91.4 cm) wide by 120 in (304.8 cm) high) were not reported.

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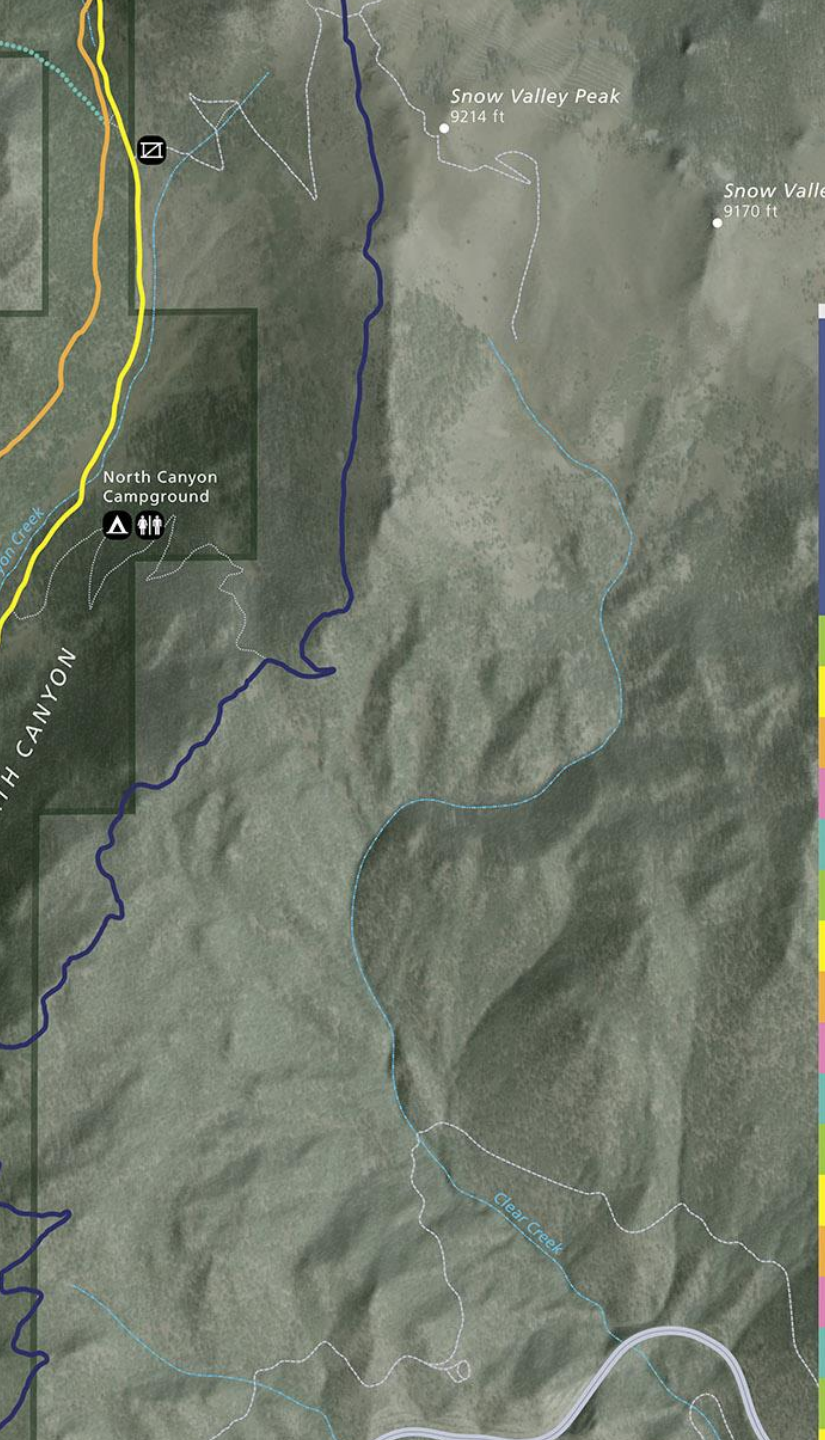
ACCESS INFORMATION

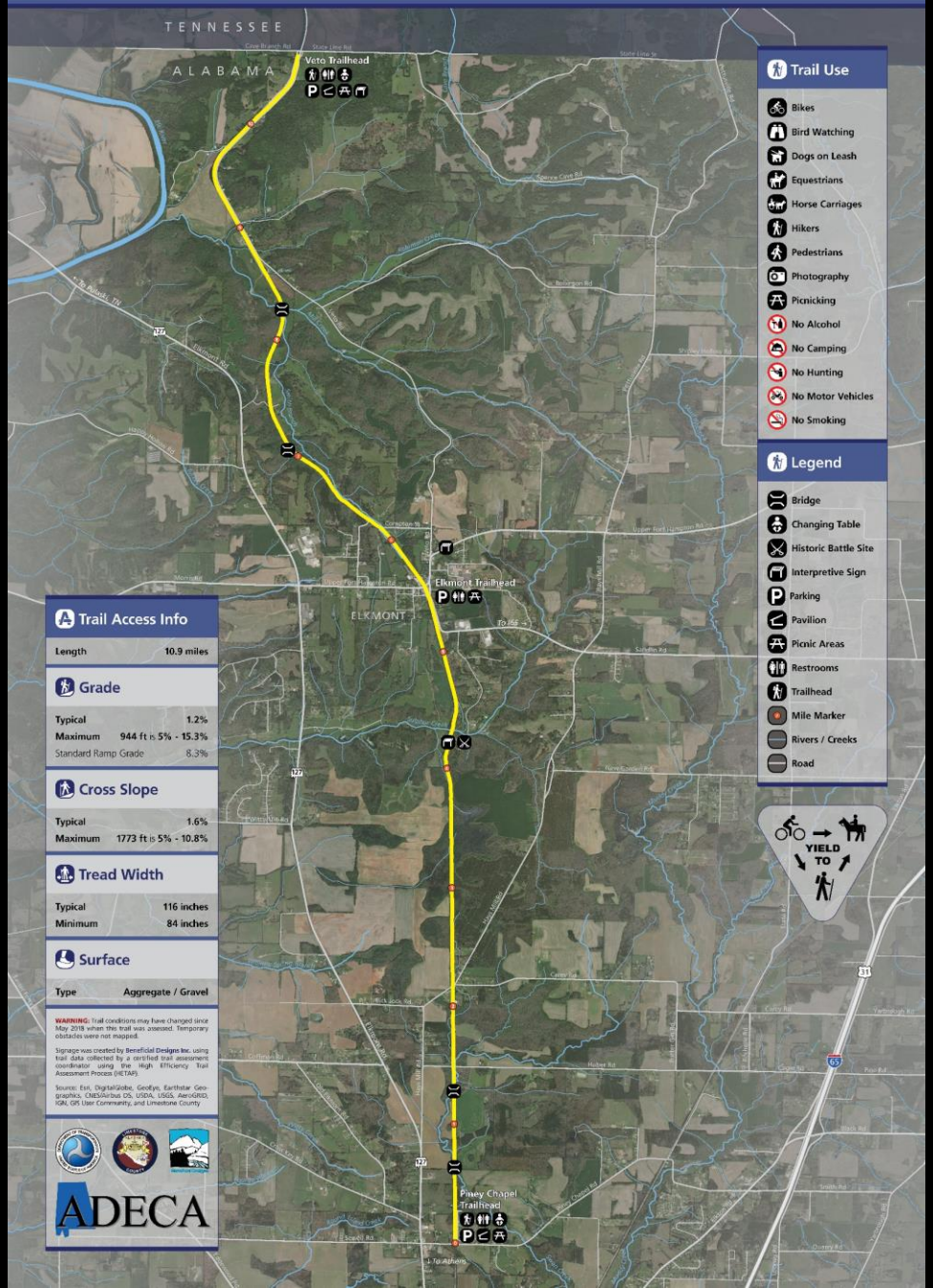

OAK MOUNTAIN STATE PARK
North
TRAIL USE
LEGEND
WHITE TRAIL
YELLOW TRAIL
ORANGE TRAIL
RED ROAD
TREETOP NATURE TRAIL
BLUE TRAIL
GREEN TRAIL
RED TRAILS
Peavine Falls Trailhead
MOUNTAIN BIKE TRAILS
RED TRAIL SYSTEM
TRAIL
Trail Name
Length
Typical Grade
Maximum Grade
Typical Cross Slope
Maximum Cross Slope
Typical Tread Width
Minimum Tread Width
Surface Type
Alabama STATE PARKS
Alabama Trails Commission
LAKESHORE


# ACCESS INFORMATION

| Trail | | Grade | | Cross Sl | |
|---|---|---|---|---|---|
| Name | Length | Typical | Maximum | Typical | |
| 1 Spooner Lake Loop Trail | 2.5 mi | 5.0% | 1254 ft is 11% - 25% | 5.4% | 9 |
| 2 North Canyon Road | 4.5 mi | 7.4% | 3098 ft is 13% - 23% | 3.2% | 120 |
| 3 Marlette Lake Trail | 3.8 mi | 8.2% | 2831 ft is 14% - 28% | 4.5% | 12 |
| 4 Marlette Lake Road | 1.3 mi | 3.2% | 712 ft is 7% - 21% | 2.5% | |
| 5 Marlette Creek Trail | NA | NA | NA | NA | |
| 6 Hobart Road | 3.3 mi | 8.3% | 1750 ft is 17% - 24% | 4.4% | 15 |
| 7 Sunflower Hill Trail | 2.8 mi | 8.4% | 1641 ft is 15% - 33% | 3.9% | 1 |
| 8 Franktown Road | 1.9 mi | 5.8% | 816 ft is 15% - 25% | 3.9% | 5 |
| 9 Red House Flume Road | 2.3 mi | 3.6% | 916 ft is 8% - 38% | 3.7% | 1 |
| 10 Franktown Connector | 0.8 mi | 7.8% | 326 ft is 20% - 29% | 3.5% | |
| 11 Pipeline Road | 2.9 mi | 2.1% | 394 ft is 6% - 11% | 3.6% | 1 |
| 12 Lakeview Road | 3.6 mi | 9.2% | 1523 ft is 20% - 30% | 5.3% | 21 |
| 13 Muskgrove Road | 1.0 mi | 7.6% | 528 ft is 18% - 26% | 5.1% | 3 |
| 14 Little Valley Road | NA | NA | NA | NA | |
| 15 Hannah's Cabin Trail | 0.2 mi | 5.5% | 153 ft is 8% - 14% | 4.5% | |
| 16 Snapdragon Trail | 1.0 mi | 10.4% | 631 ft is 21% - 46% | 7.6% | 5 |

# Richard Martin Trail




0 1.0 km
0 1.0 mi

North

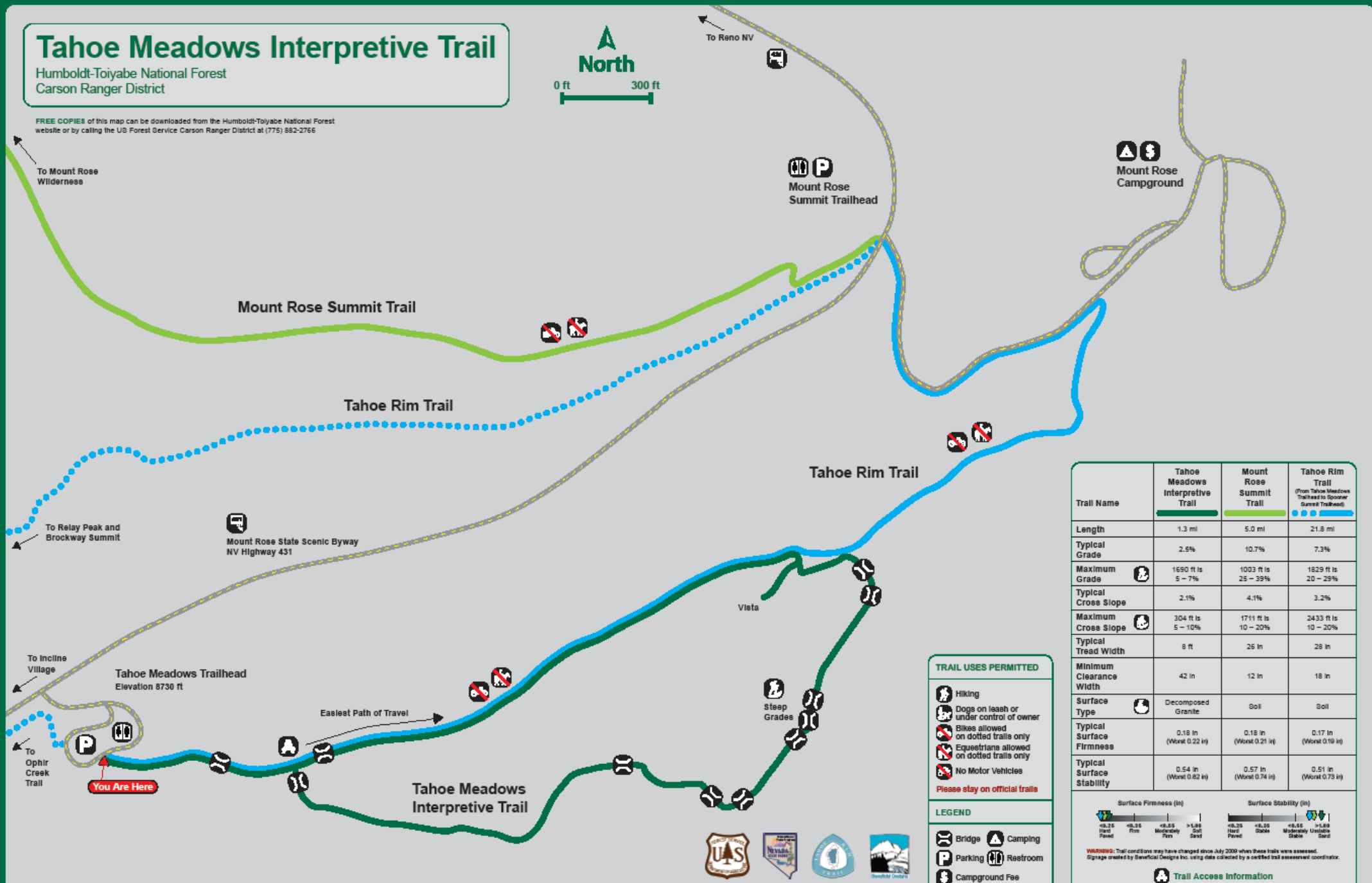
# Tahoe Meadows Interpretive Trail

Humboldt-Toiyabe National Forest
Carson Ranger District

North

0 ft 300 ft

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 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 0.82 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

## 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

Funded by the Nevada Recreational Trails Program


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

## 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

Phase I & II funding for the Developed Outdoor





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)

Table

## ABA/FSORAG

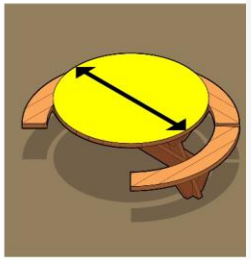
What type of assessment?

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

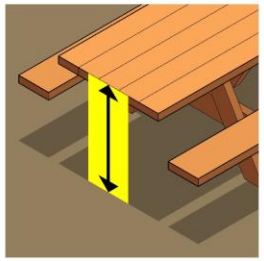


Table surface height ( min 28 in
- max 34 in)

Compliant

## CLEAR SPACE

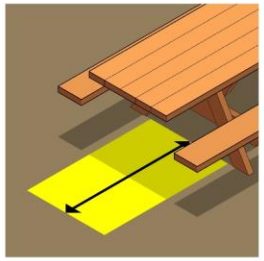
Does one full unobstructed side
clear ground space around the t
adjoin or overlap an ORAR trail

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

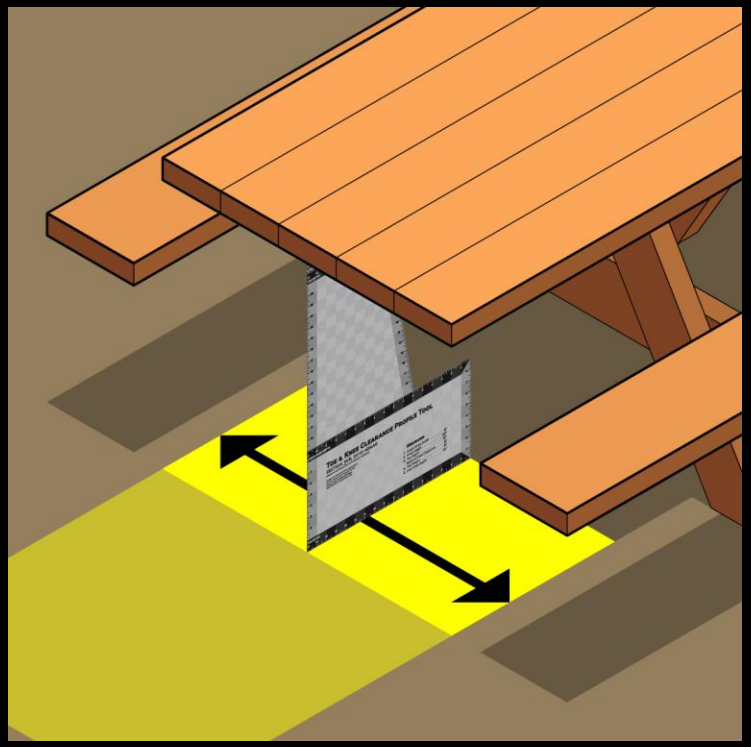
If available, enter the model and manufacturer of the feature.

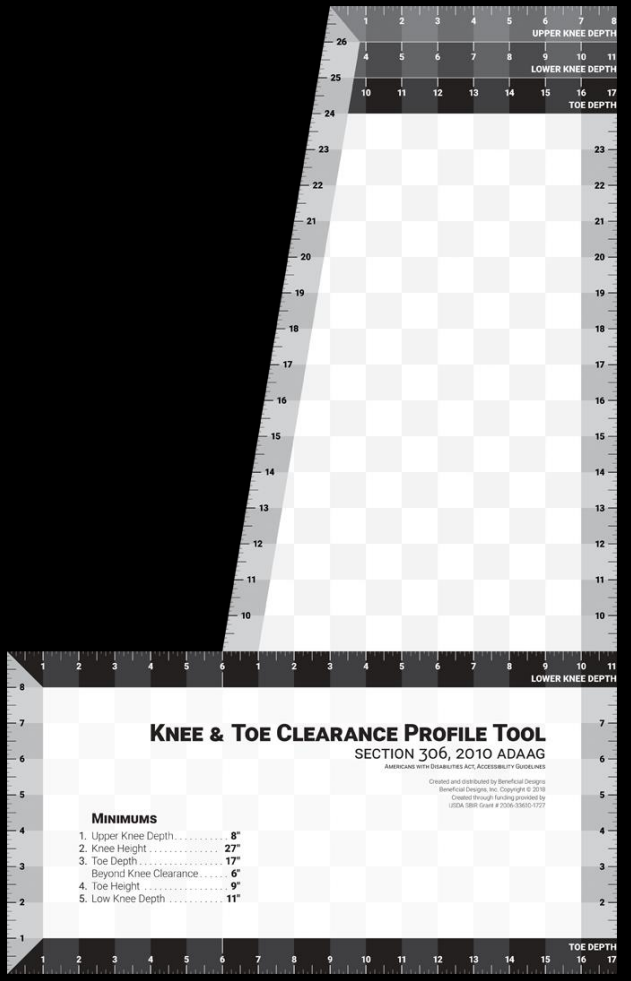
Manufacturer

Model

# Knee & Toe Clearance Profile Tool

unobstructed knee & toe space





# Adjustable height cooking grill

# Water pump

With closed-fist operation

# Water pump

## Actuation force

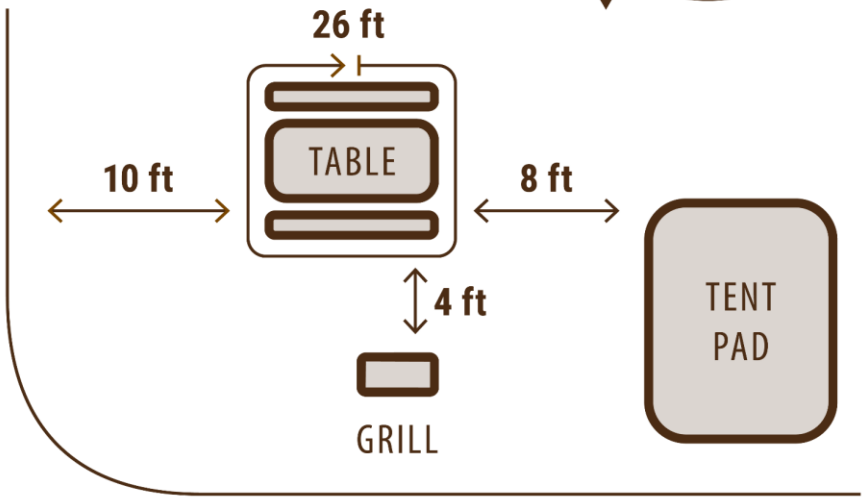
# Water pump

## Height measurement

# Campsite

## Access 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**

# Site 18

Single Site

**PRIORITY USAGE**

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

**11AM** **6PM**

**Accessible Elements**

**Tent Pad**

| | |
|---|---|
| Size | 11.6 ft x 16.0 ft |
| Accommodates | 4 Persons |

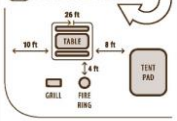
**Table**

**Pivot Grill**

**Fire Ring**

**Hydrant**

**RESET** *BEFORE YOU GO*




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 2003-33610-21051

**CAMPSITE ACCESS INFORMATION**

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

# 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 |

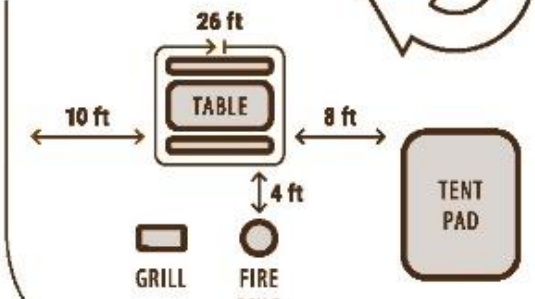
## Table

## Pivot Grill

## Fire Ring

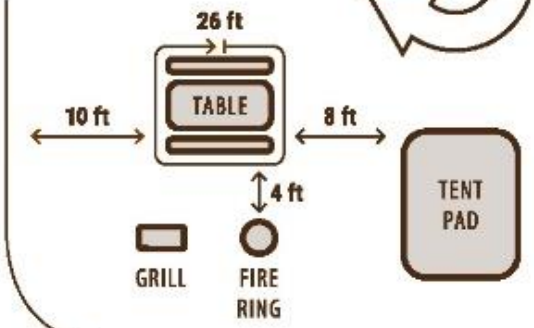
## Hydrant

## 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

Develop standards for

# Trail and sidewalk design

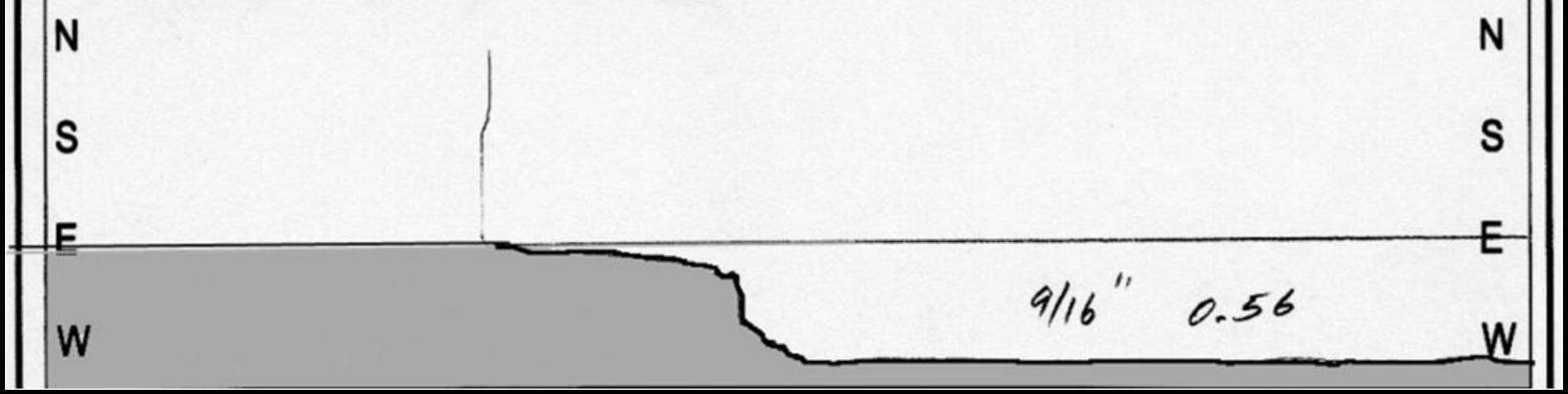
Architectural Barriers Act (ABA)
Outdoor Recreation Access Guidelines

Public Rights of Way Access Guidelines (PROWAG)

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

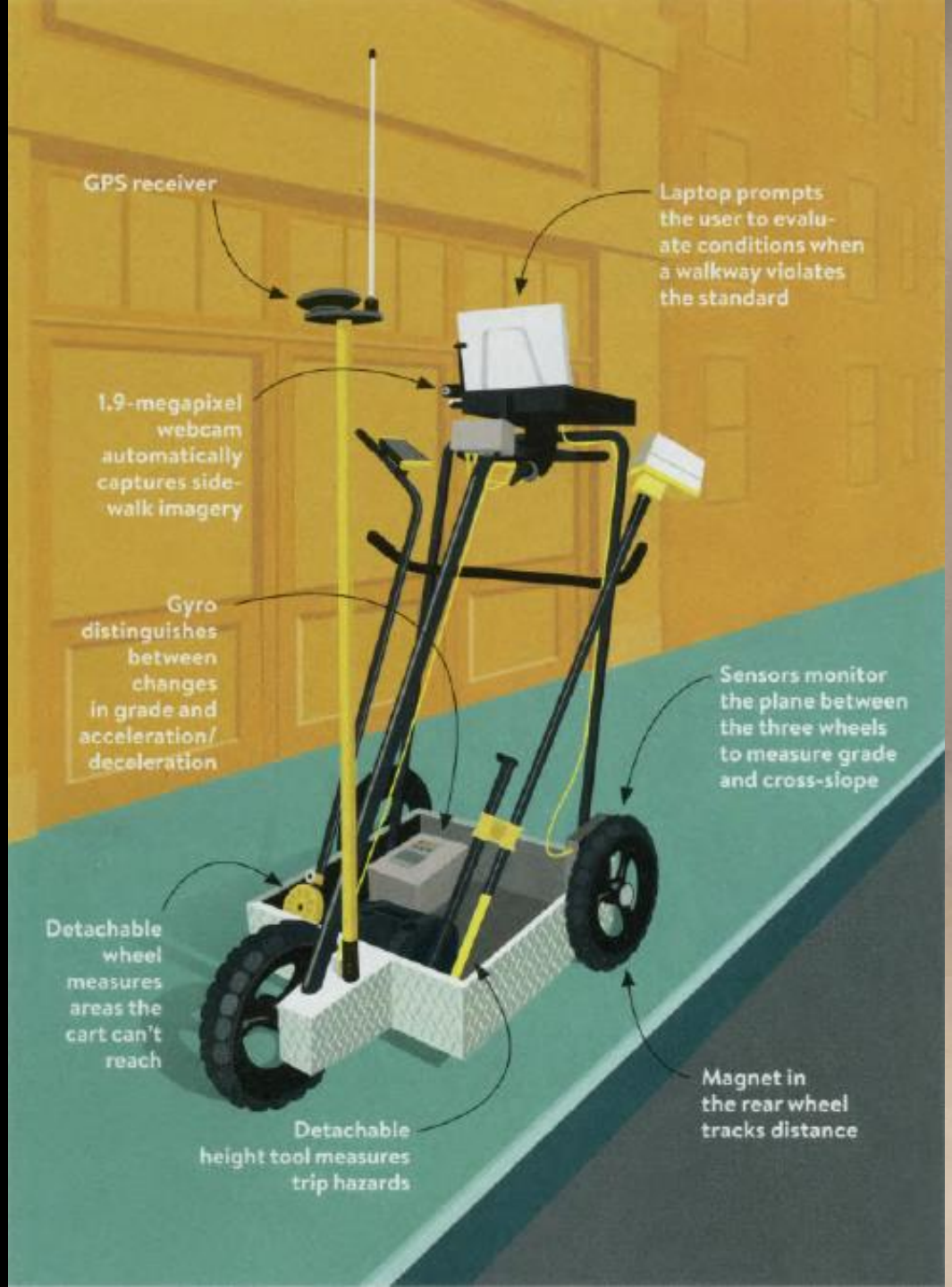
Street Name: OLIVE WEST Segment Name: * Distance: 233'9"

*N COUNTY ROAD TO MACKLAND



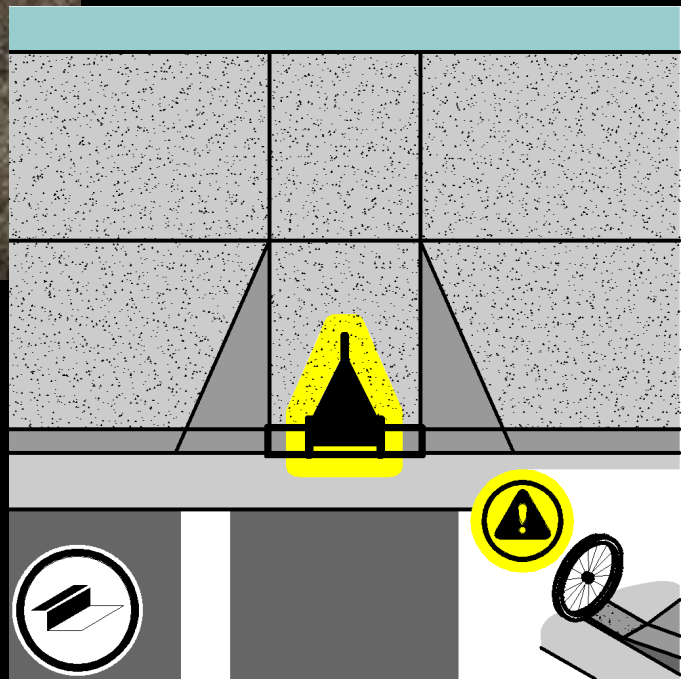
# Sidewalk assessment

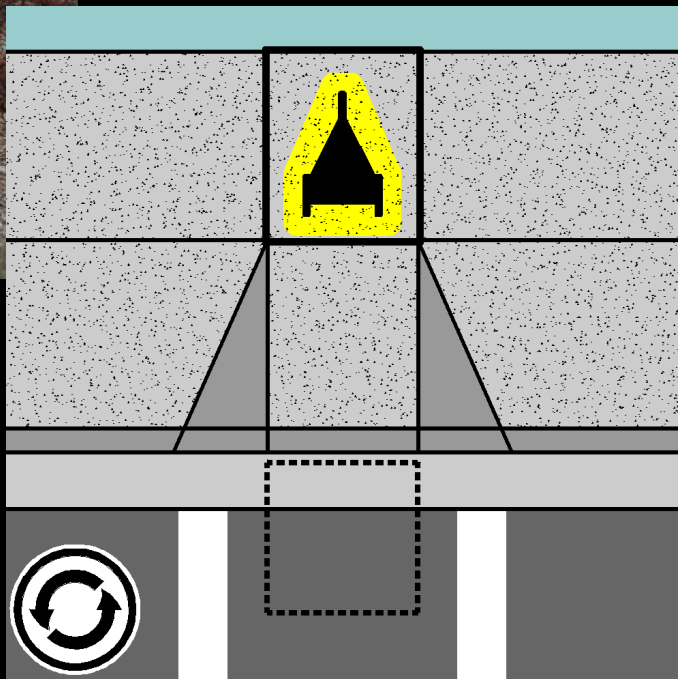
## Public Rights-of-Way Assessment Process (PROWAP)


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

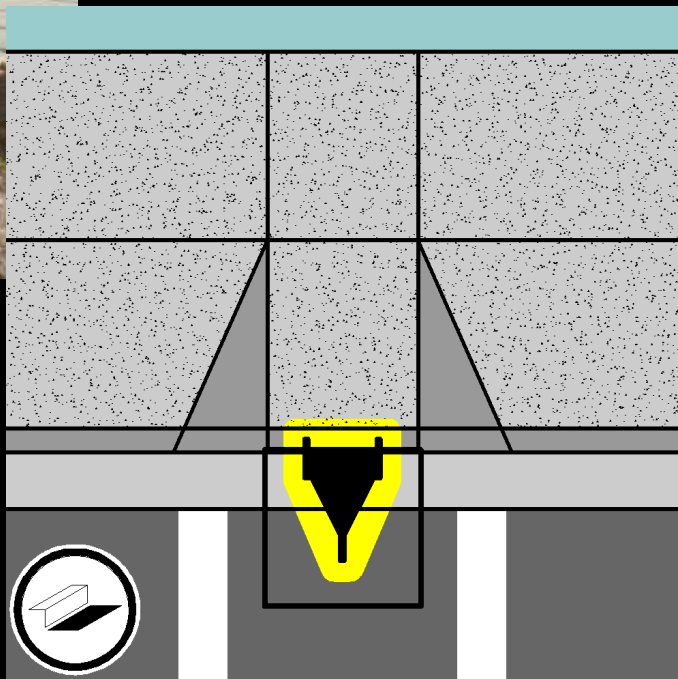
# Digital Measuring Wheel (DMS)

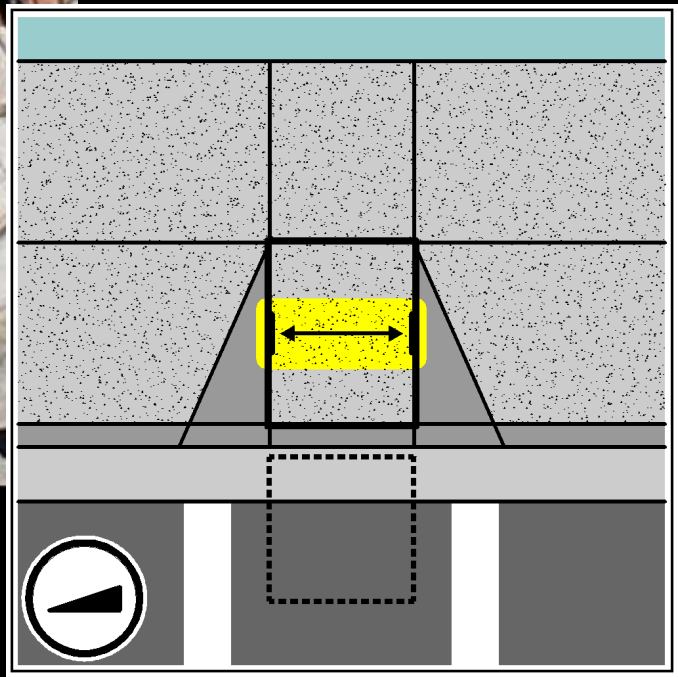
# Digital Height Measuring Device

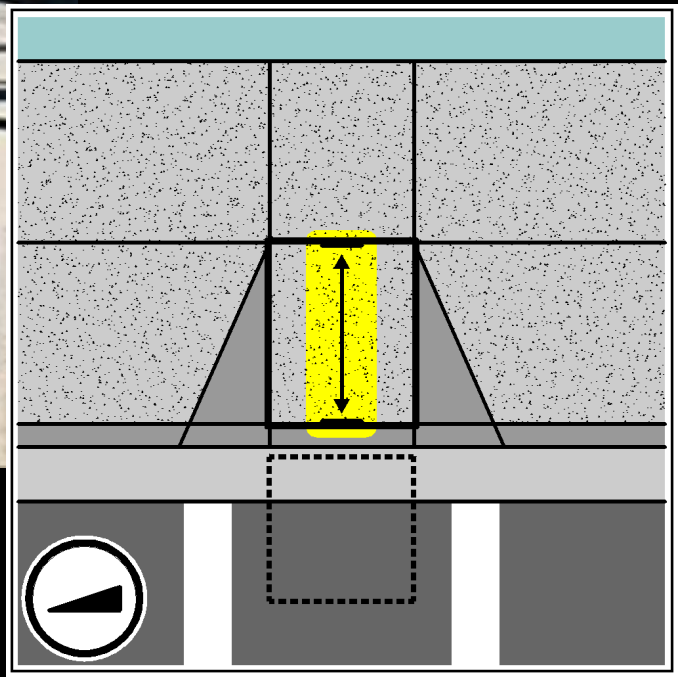





ONE STOP
AUTO REPAIR







# NDOT

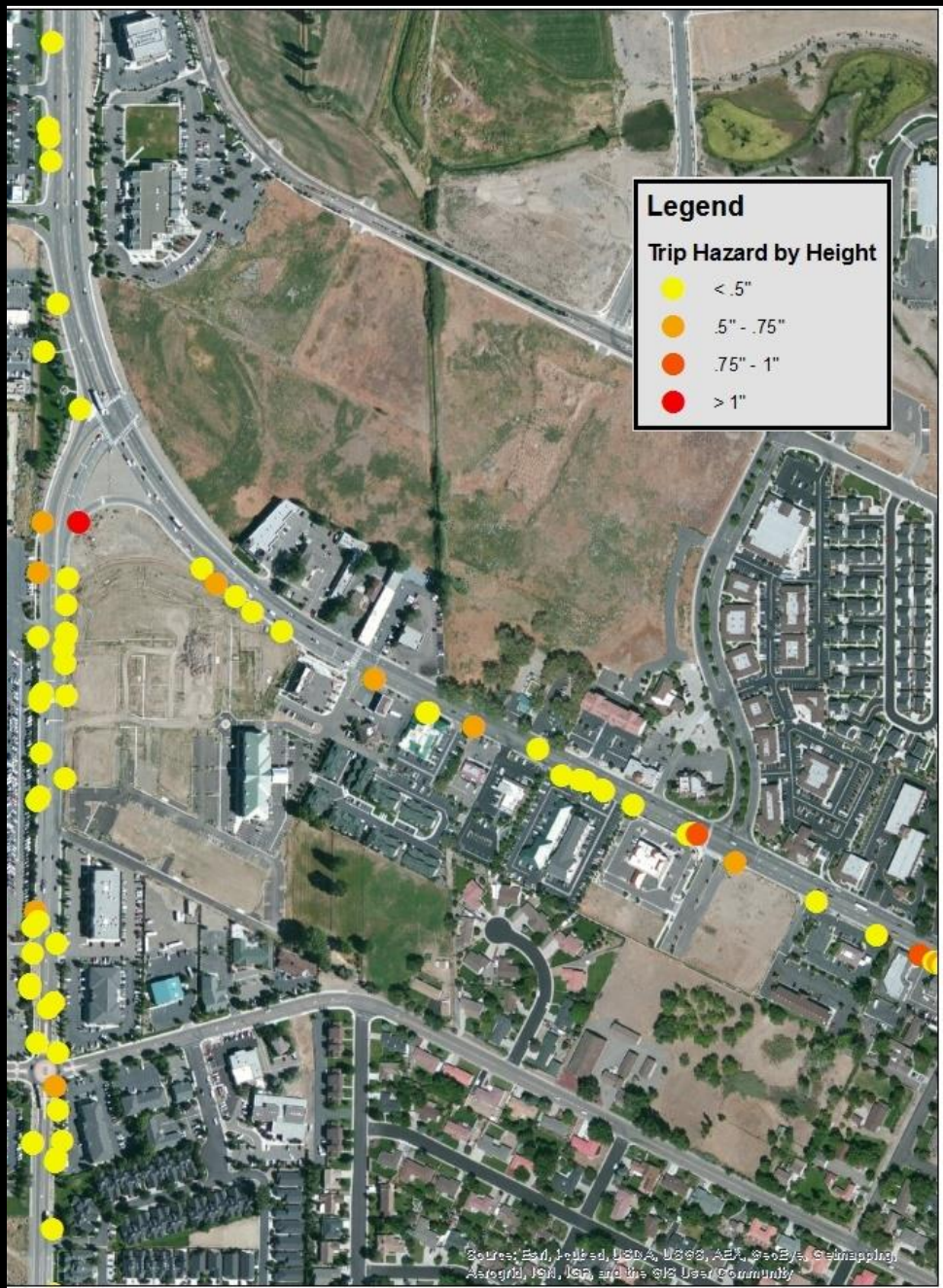
Tread width

# NDOT

Cross Slope

# NDOT

Tripping hazard height

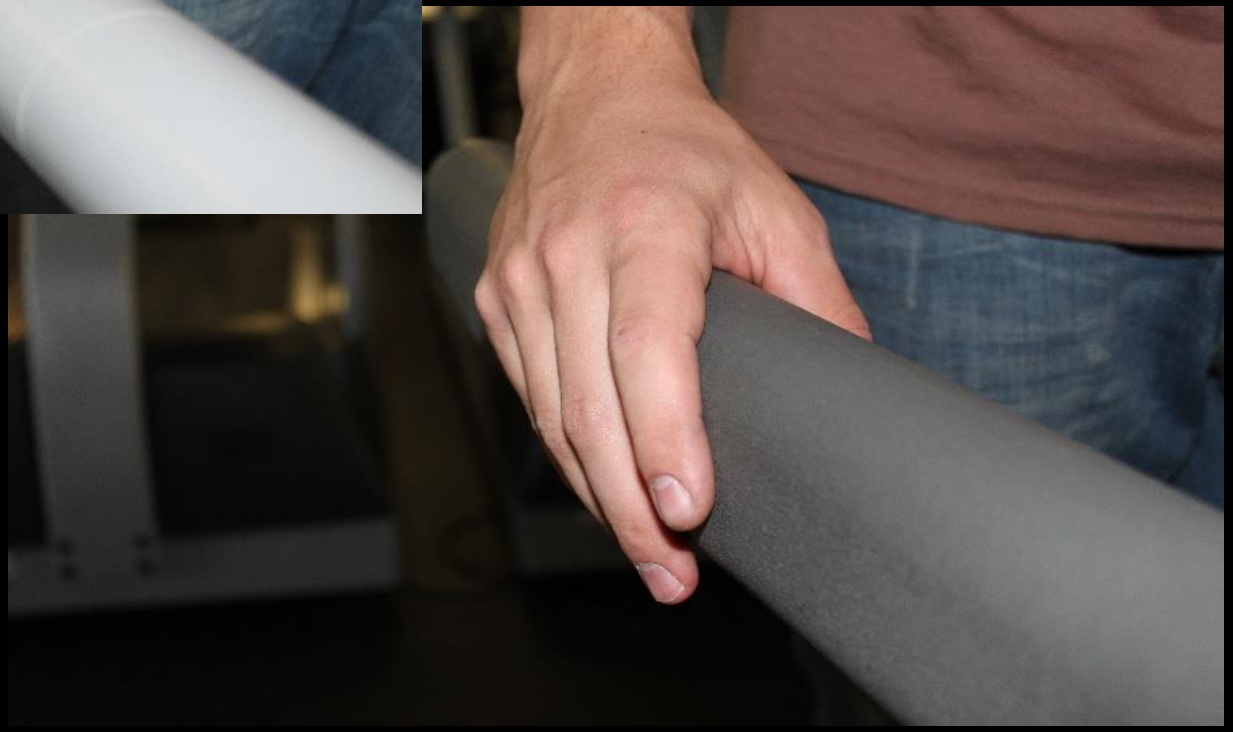


# Universal design standards

for products

# Universal Design of Fitness Equipment (UDFE) Standards

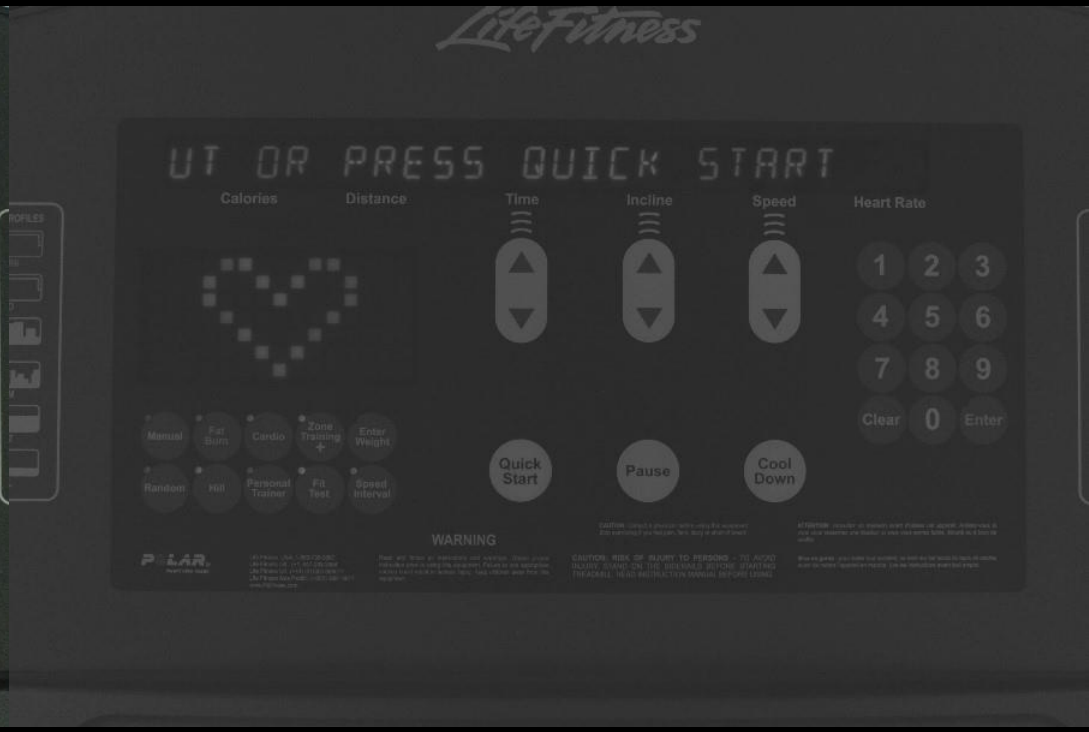
# Low step-up height design



Finding the

# Weight Adjustment Pin


color contrast




value contrast



color contrast

value contrast

# Universal design standards

For amusement park rides


DIR 24


2013. 12. 23 13:43


MAURER SOHNE


2013.12.23 13:17


2013.12.23 13:18


2013.12.23 13:19


2013.12.23 13:19

# New area of focus on air travel

One focus area is

**Air Travel Assistive Technologies Standards**

ISSUE

# Steep jetway slopes

- Typically steeper than standard ramp
- Dangerous for mobility device users
- Exempt from ADA guidelines


214
6°


29
SabadellCAM
6°

# Boarding devices

Assessment of

# Traditional aircraft boarding devices

Stability

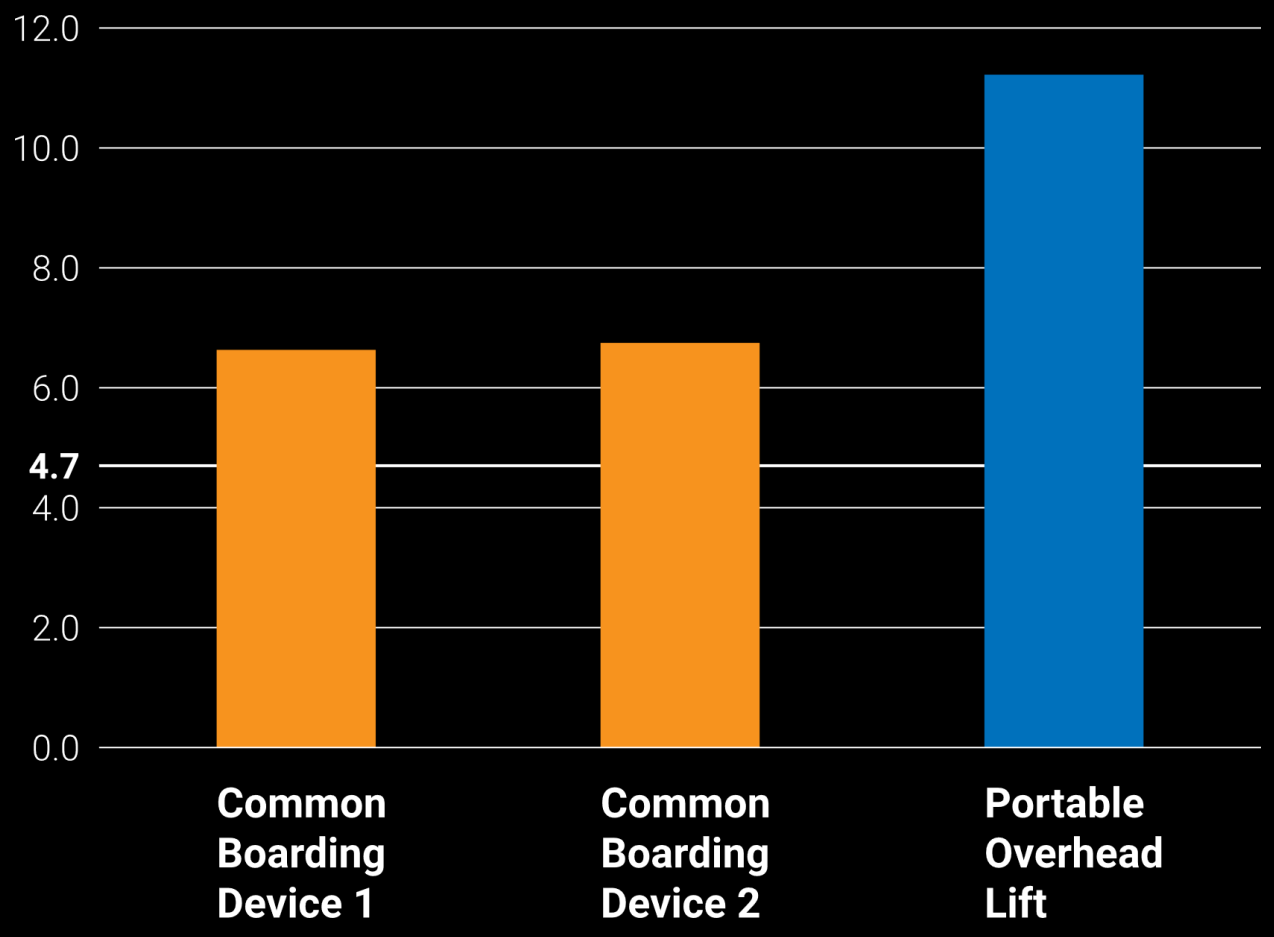
# Lateral Tipping Angle

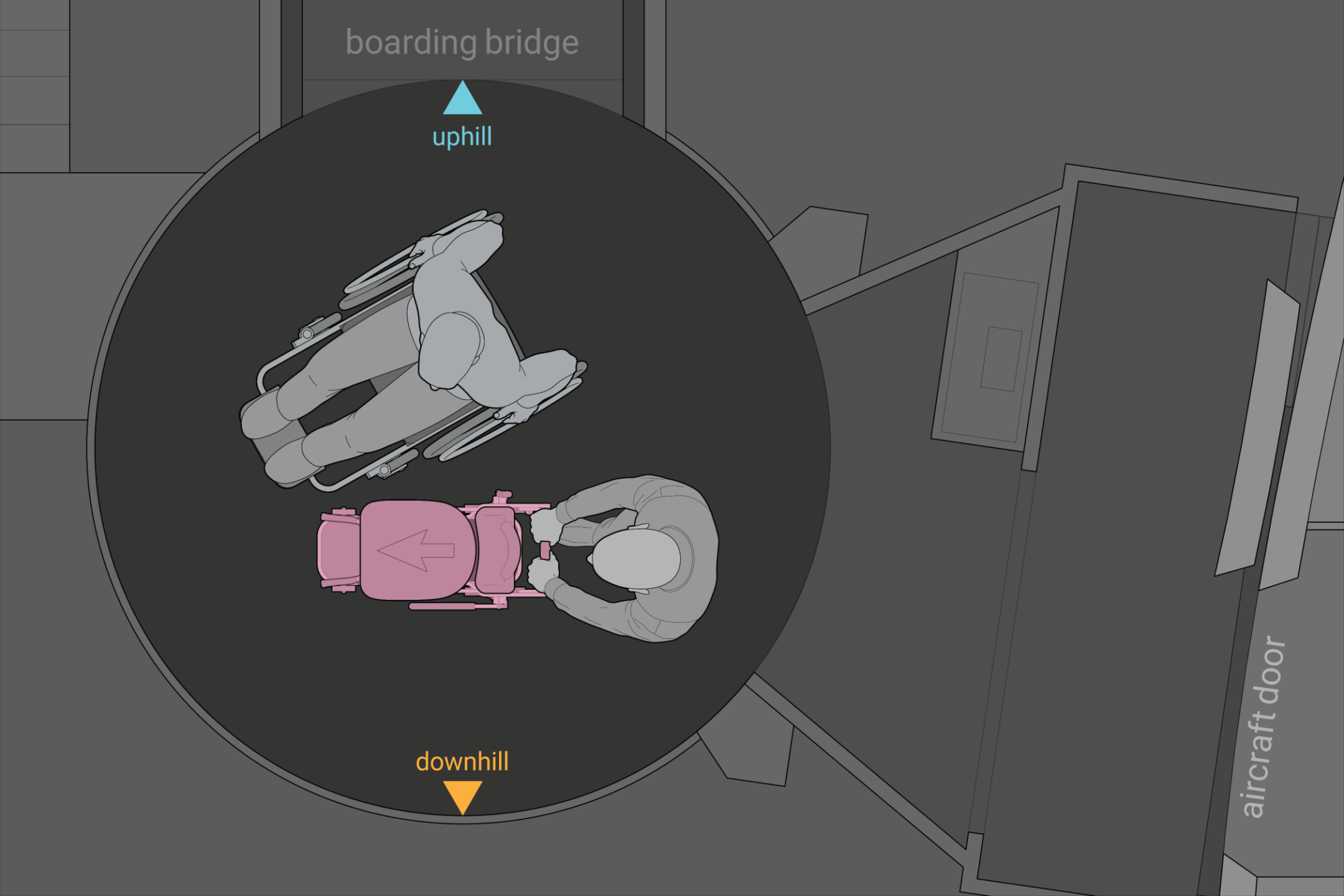
Common Boarding Device 1

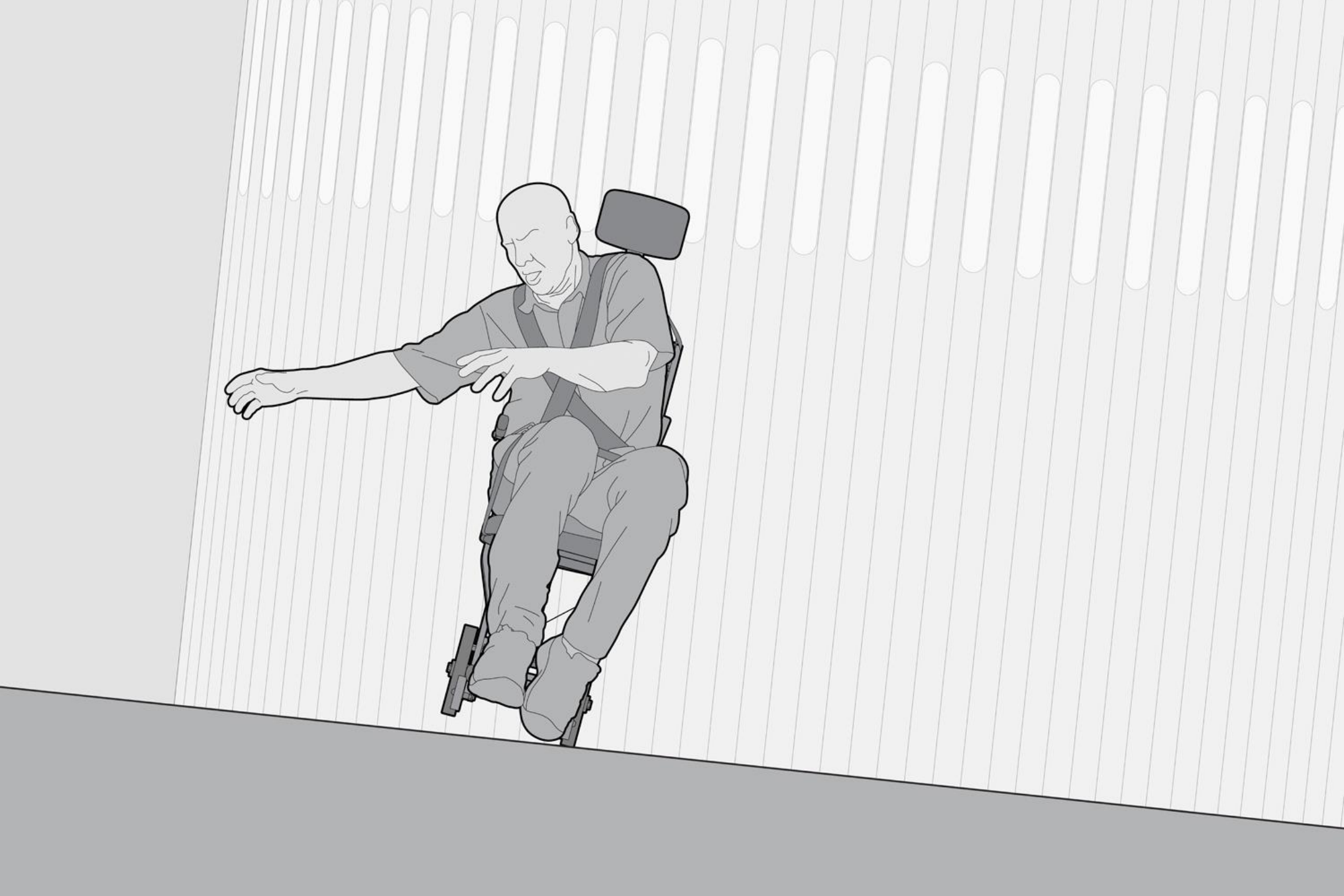
**Common Boarding Device 2**

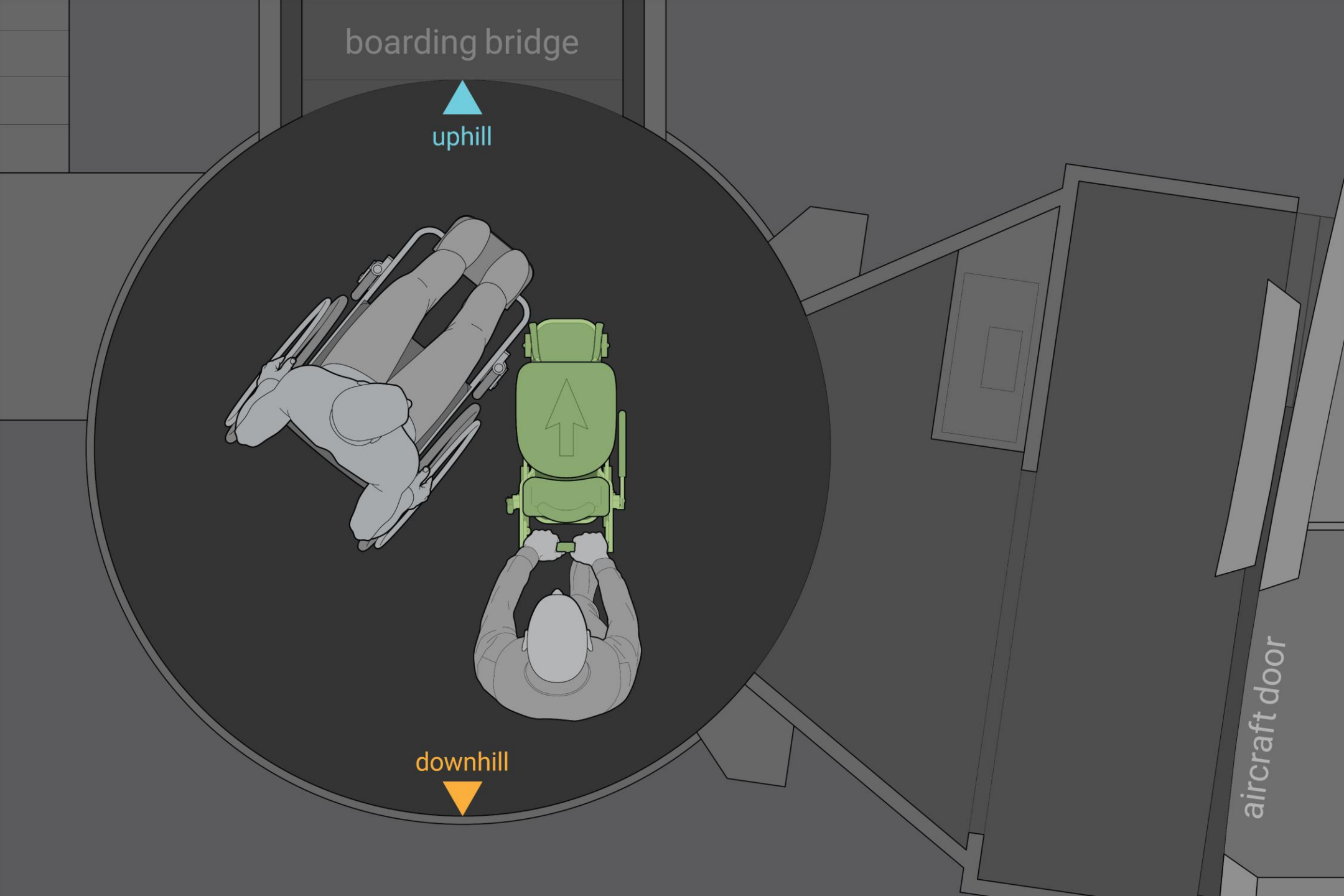
**Portable Overhead Lift**

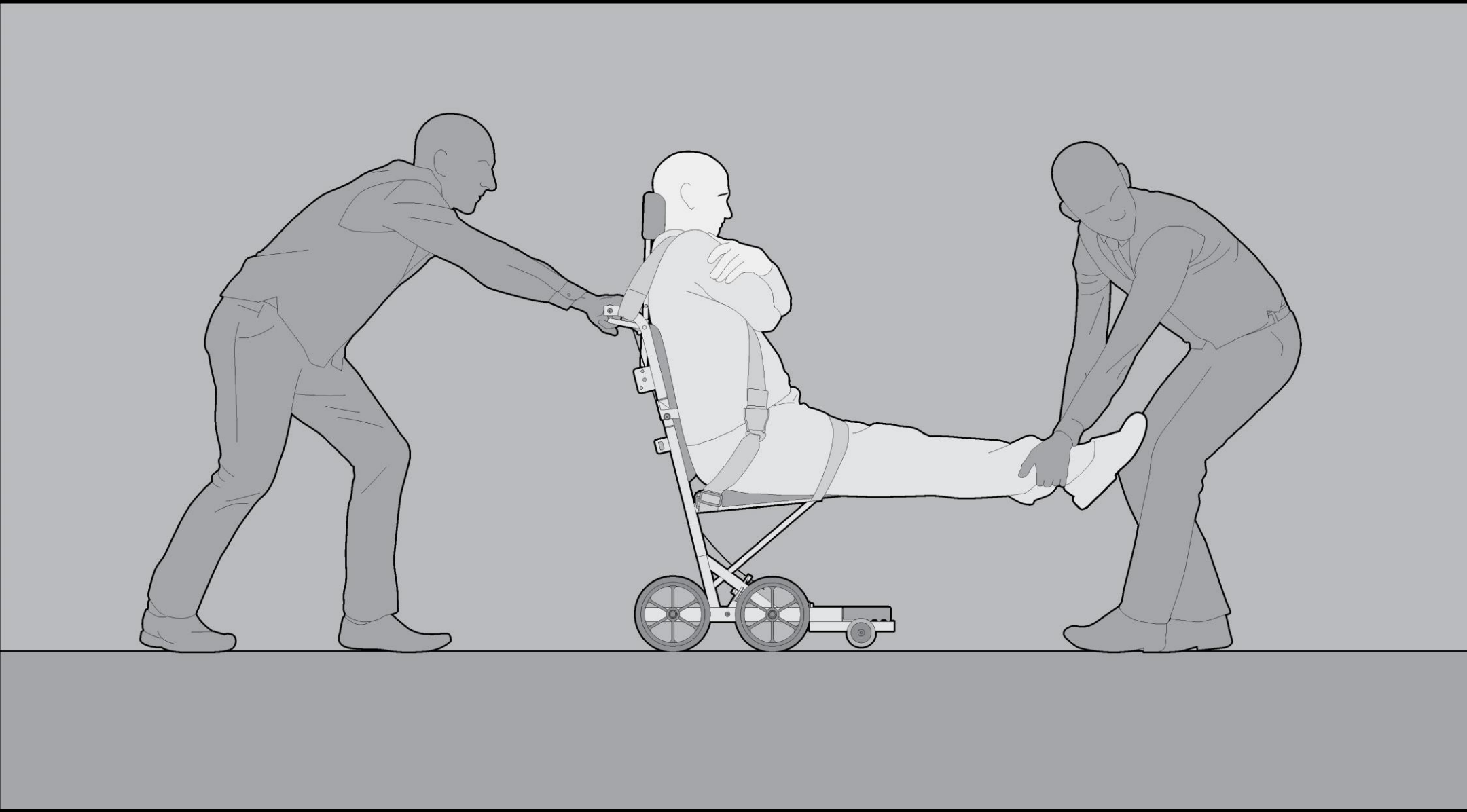
# Lateral Tipping Angles

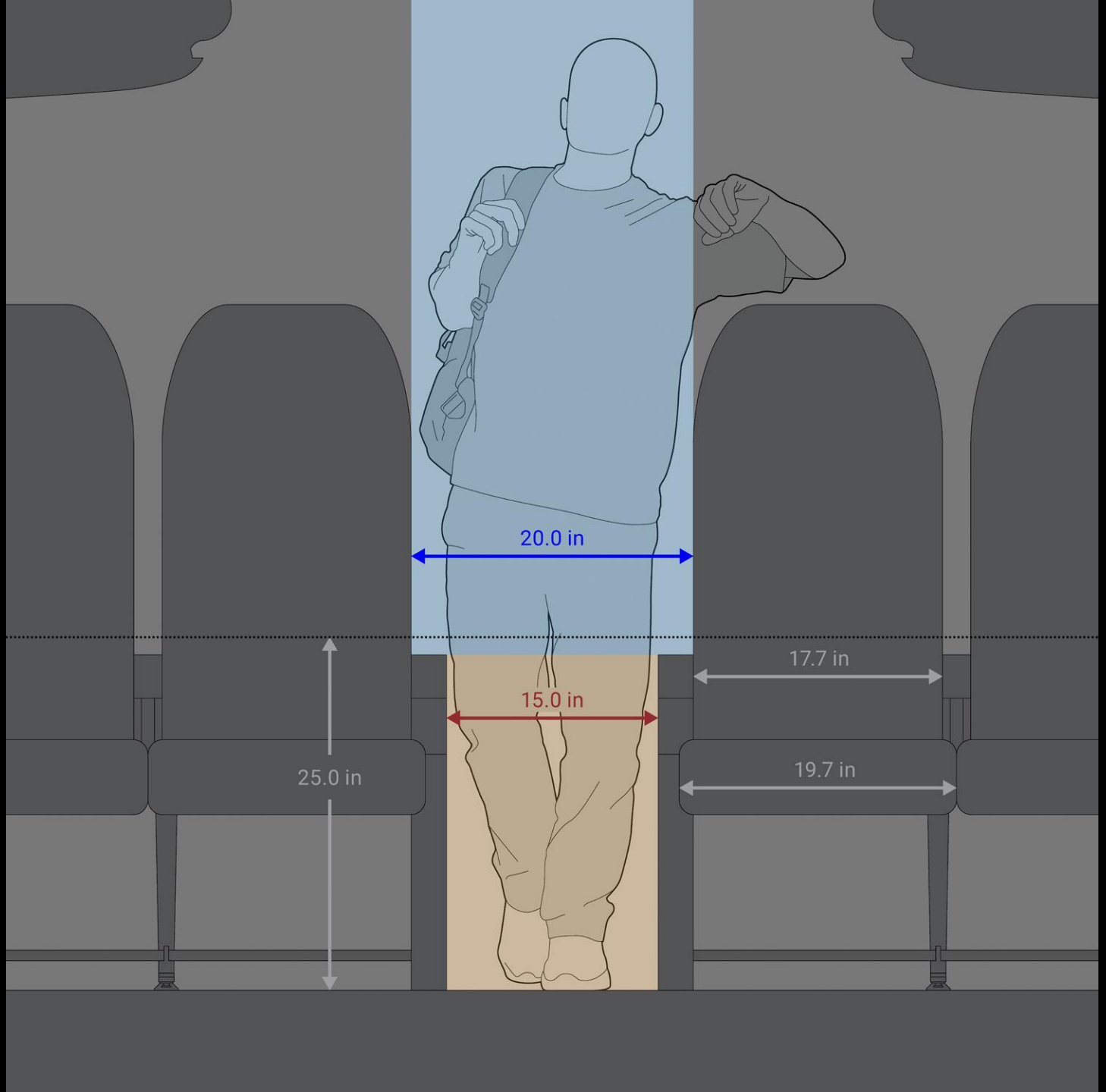


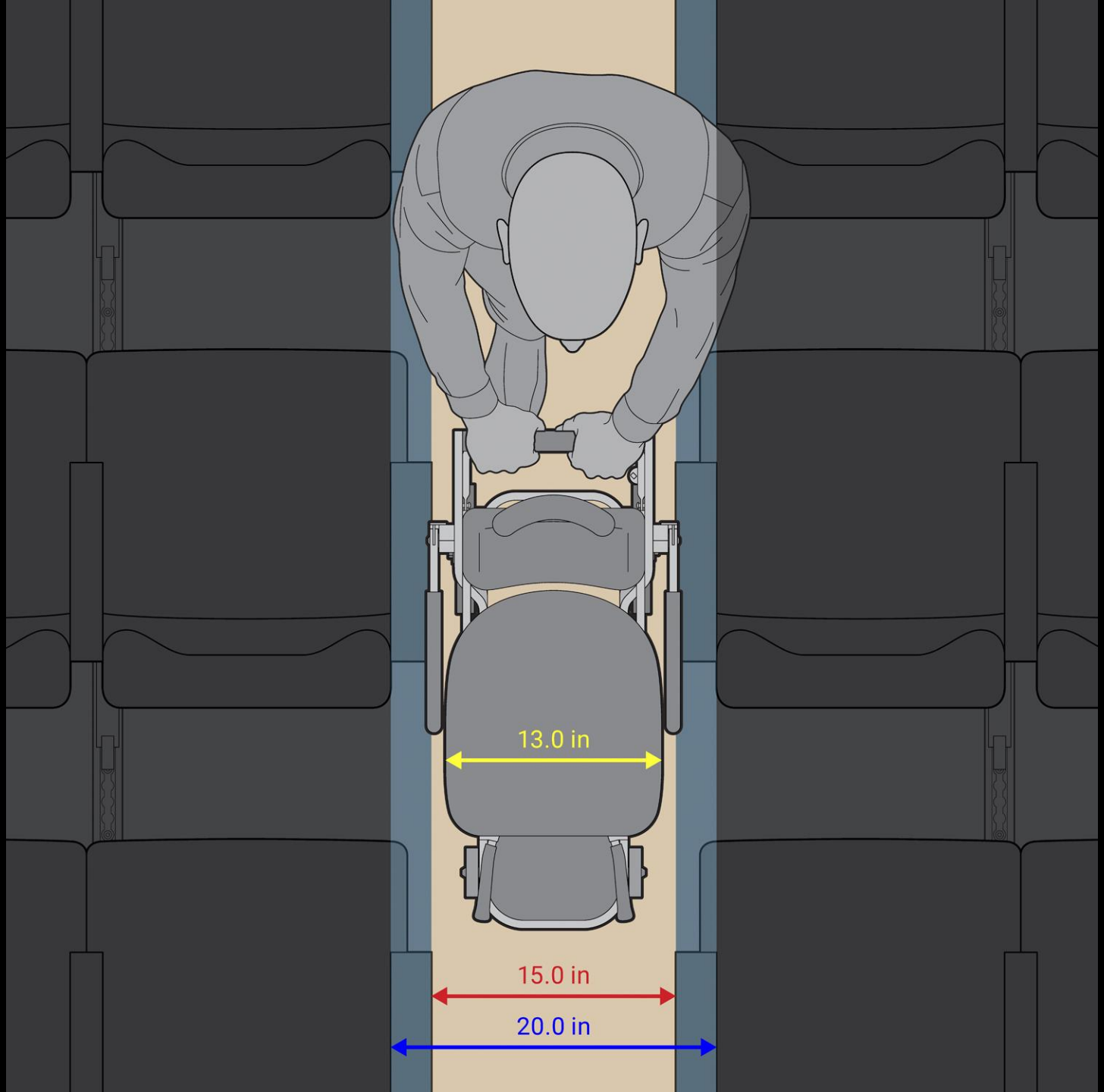

boarding bridge
uphill
downhill
aircraft door

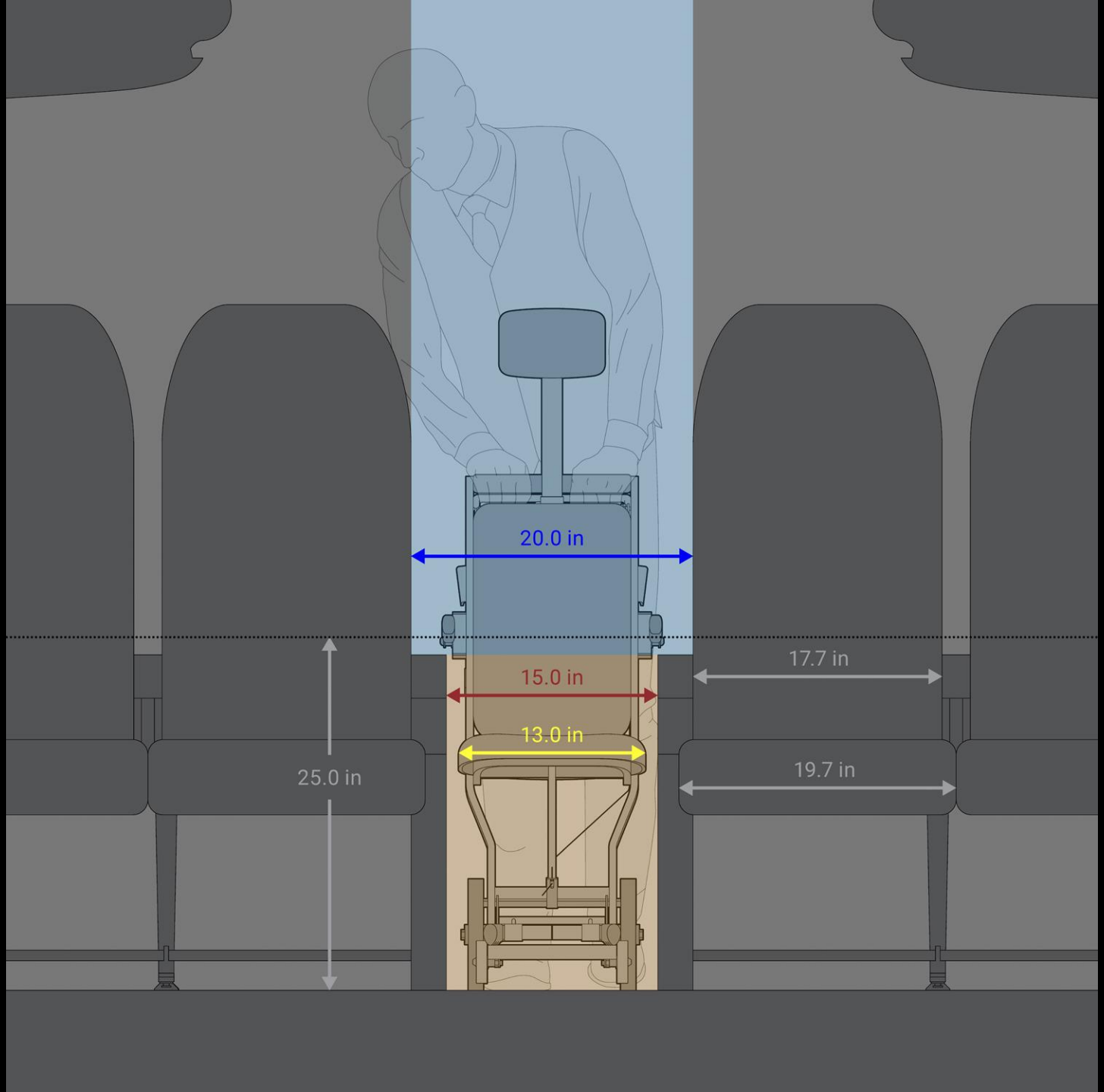


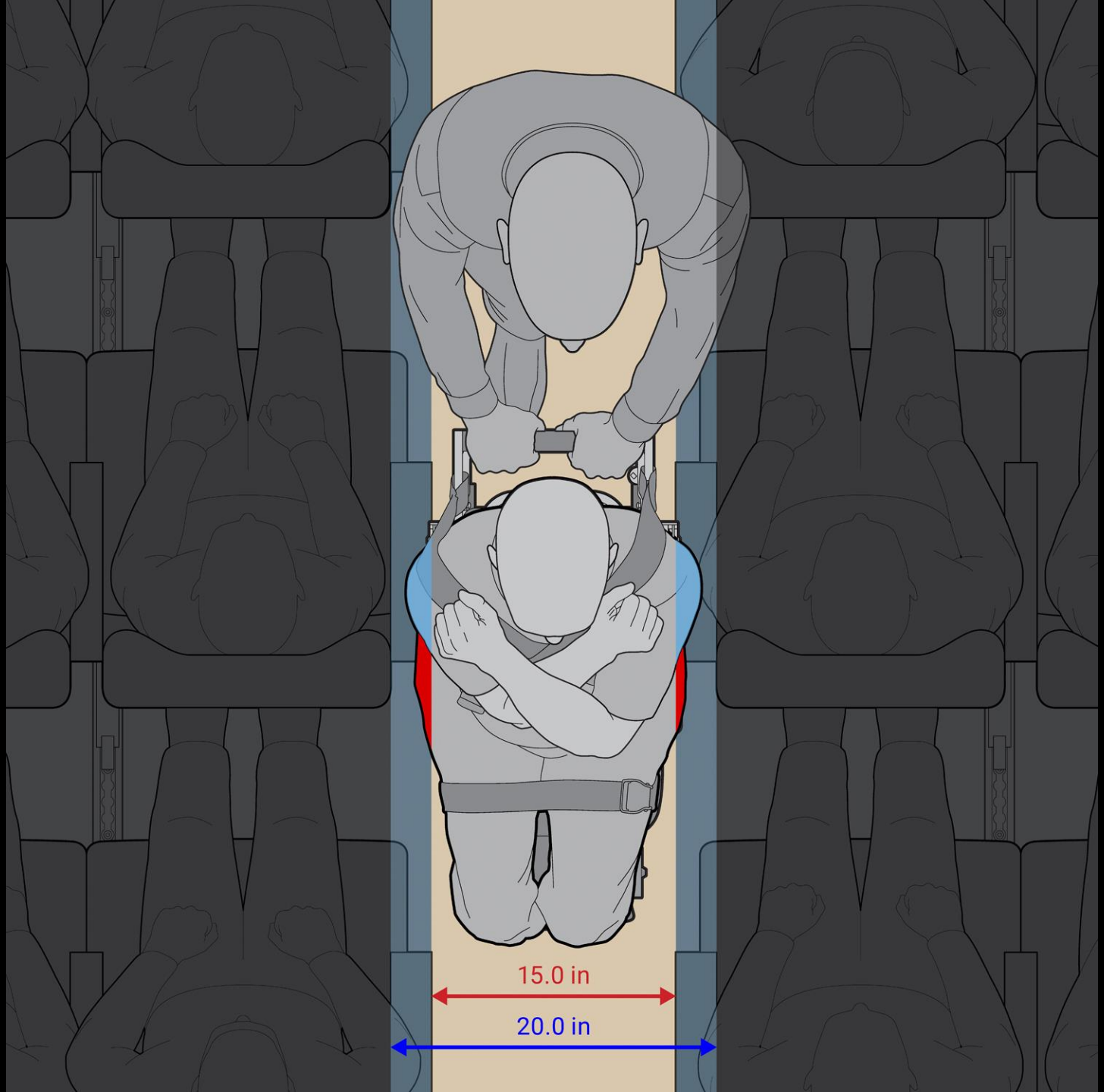

boarding bridge
uphill
downhill
aircraft door




20.0 in
25.0 in
15.0 in
17.7 in
19.7 in

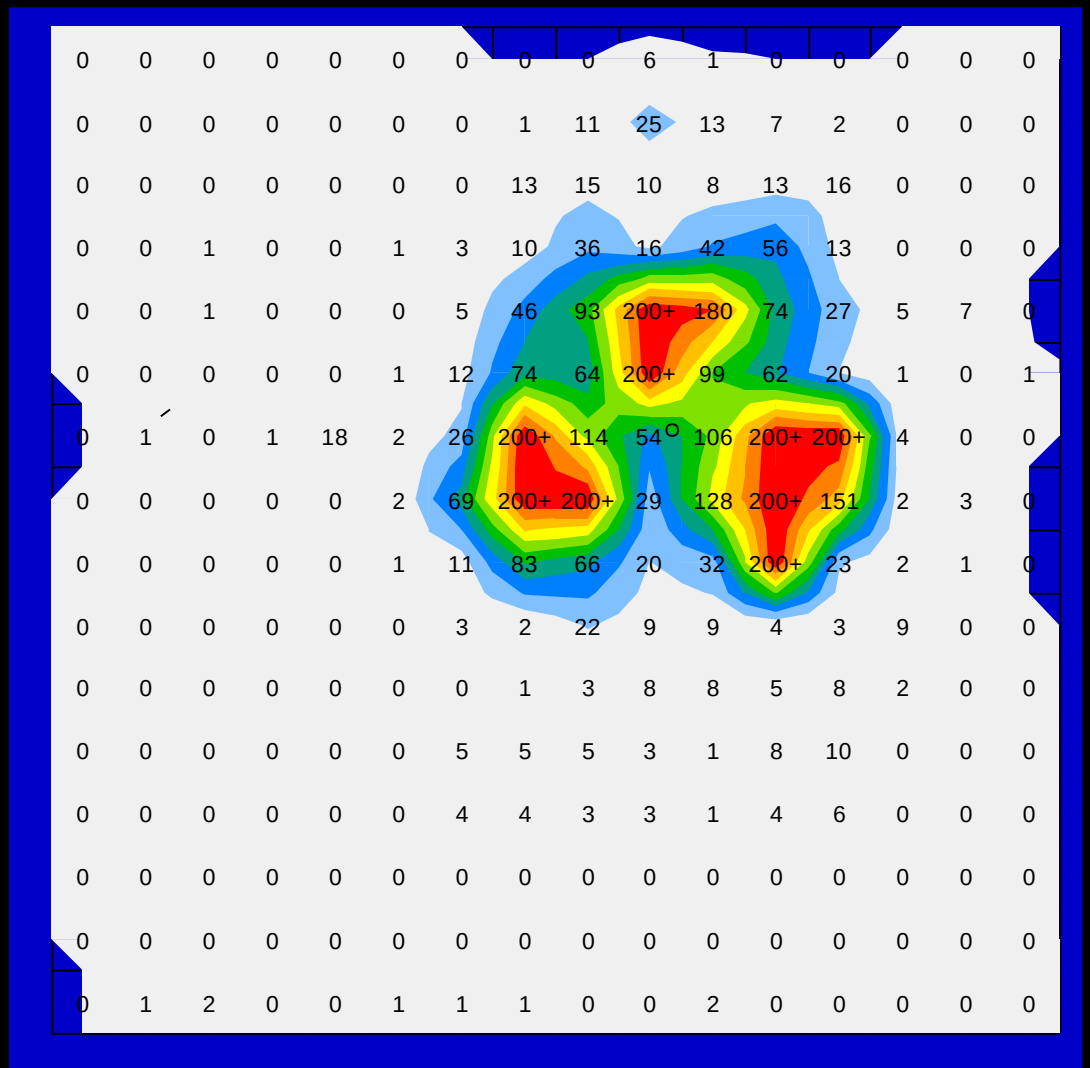

13.0 in
15.0 in
20.0 in

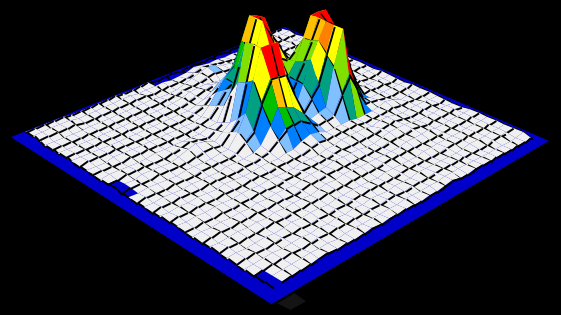

20.0 in
15.0 in
13.0 in
25.0 in
17.7 in
19.7 in


15.0 in
20.0 in

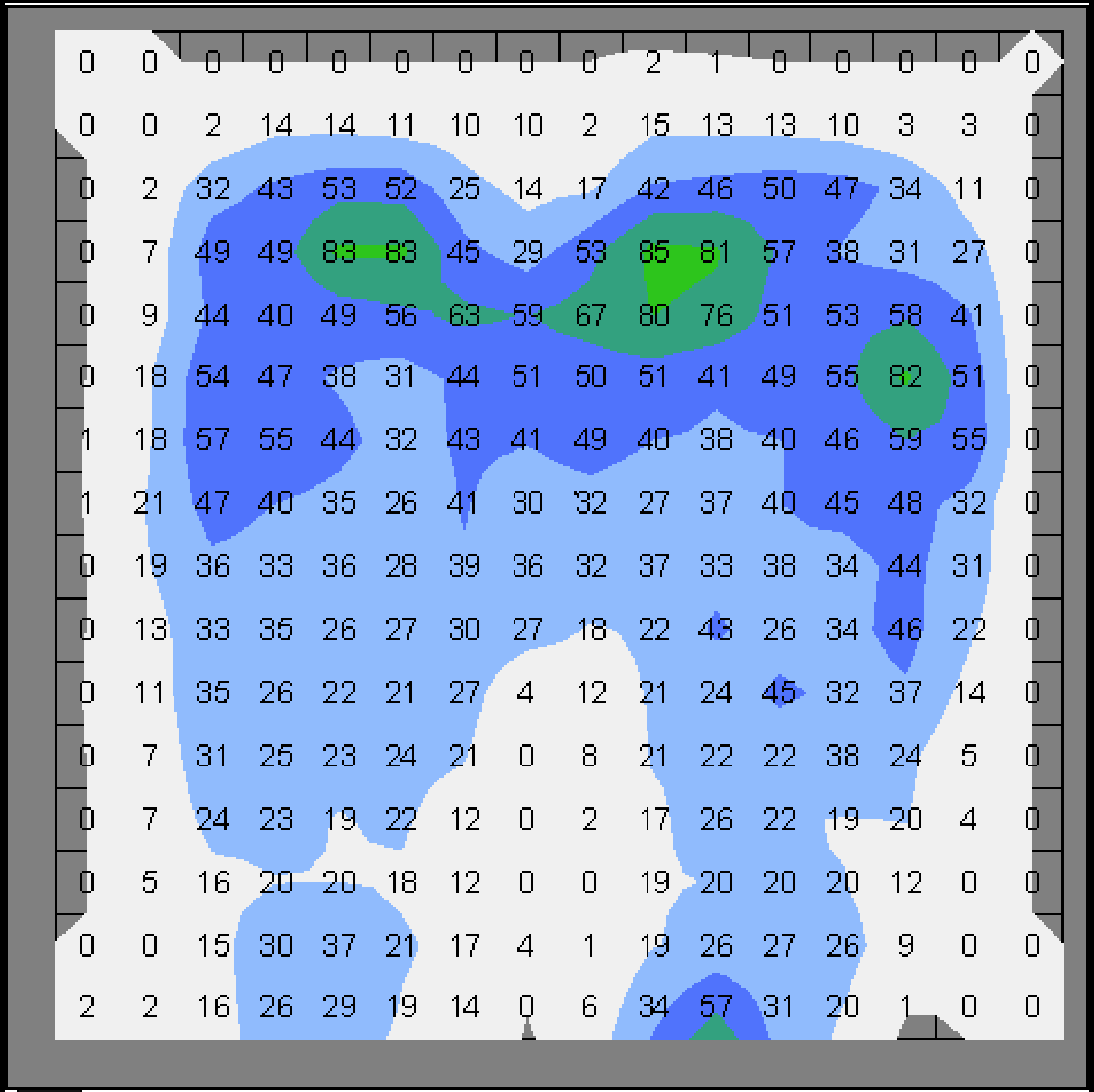
Sitting on an

# 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

Aircraft boarding using

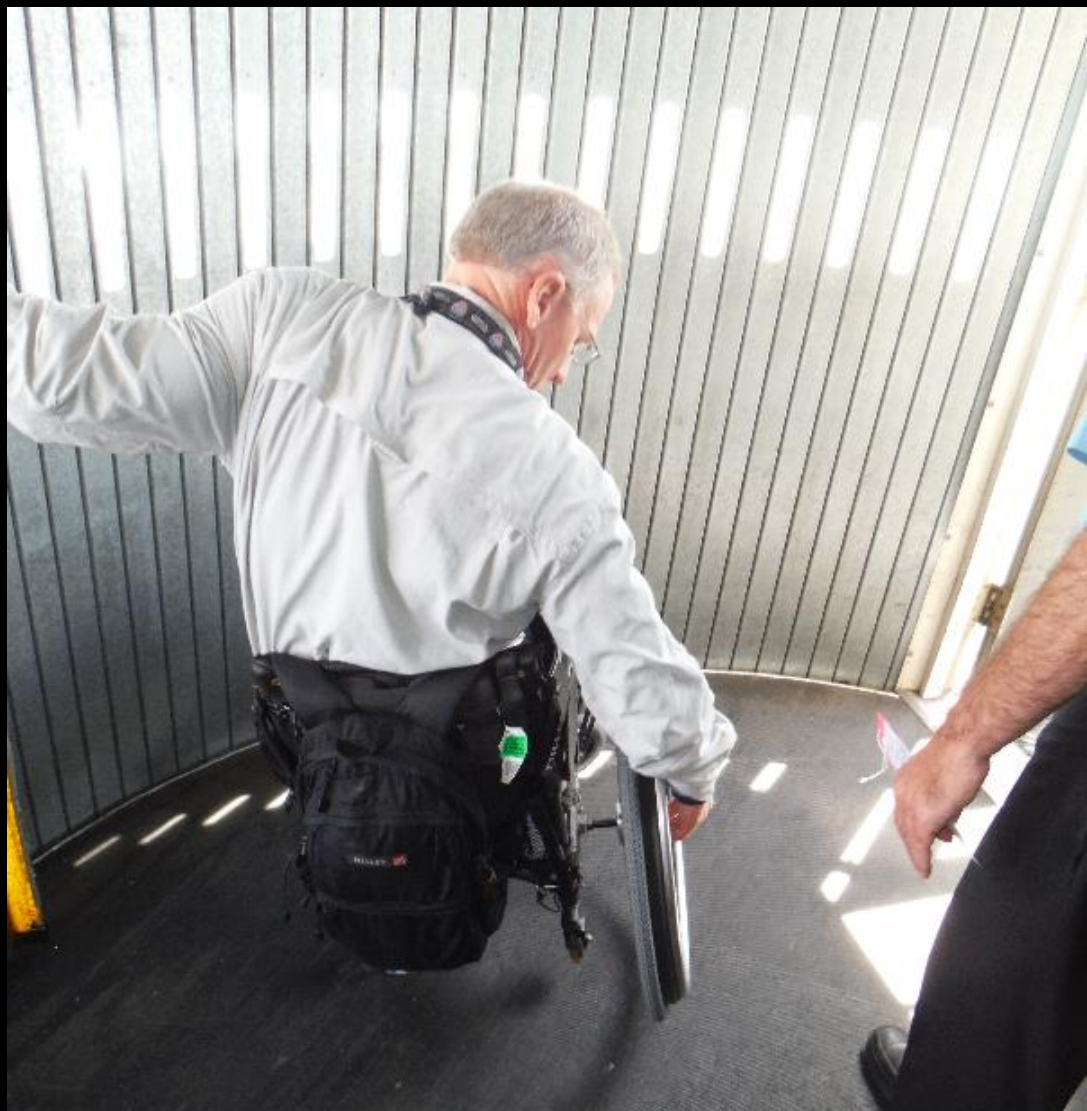
# A personal aisle chair

Removable wheels

Aircraft boarding using a wheelchair with

# Narrow accessory wheels

- Fewer transfers



# Aircraft-compatible wheelchair

# Transfer assist technology

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

Educate travelers without sensation to use pressure relief seating accessories when sitting in aircraft

Allow for wheelchairs to be secured in aircraft like they are in buses

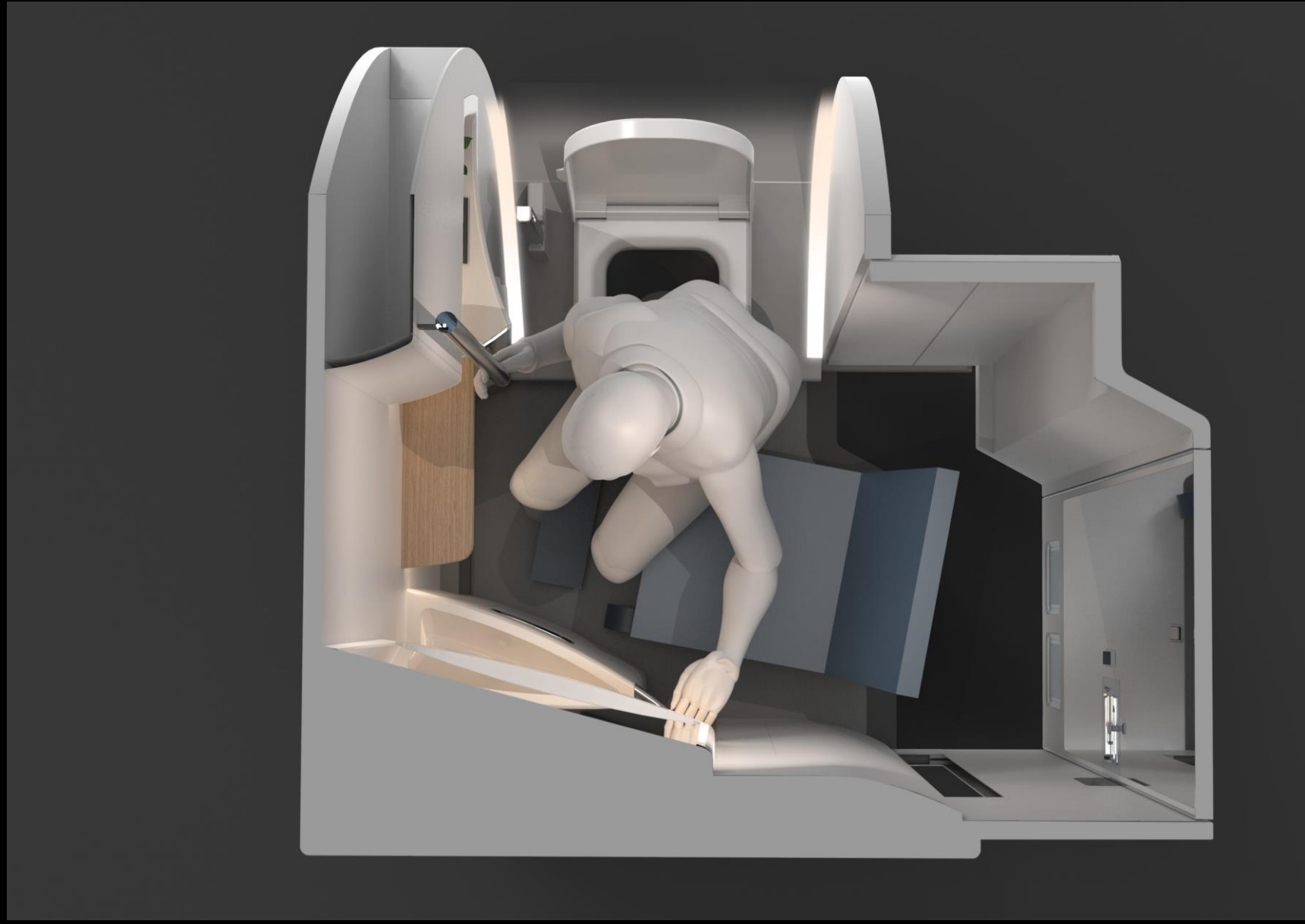
ISSUE

# Lack of accessible lavatories

Passengers needing a personal caregiver are not accommodated by the current size of lavatories

Including infants and older adults and non-ambulatory passengers that must use an on-board aisle wheelchair

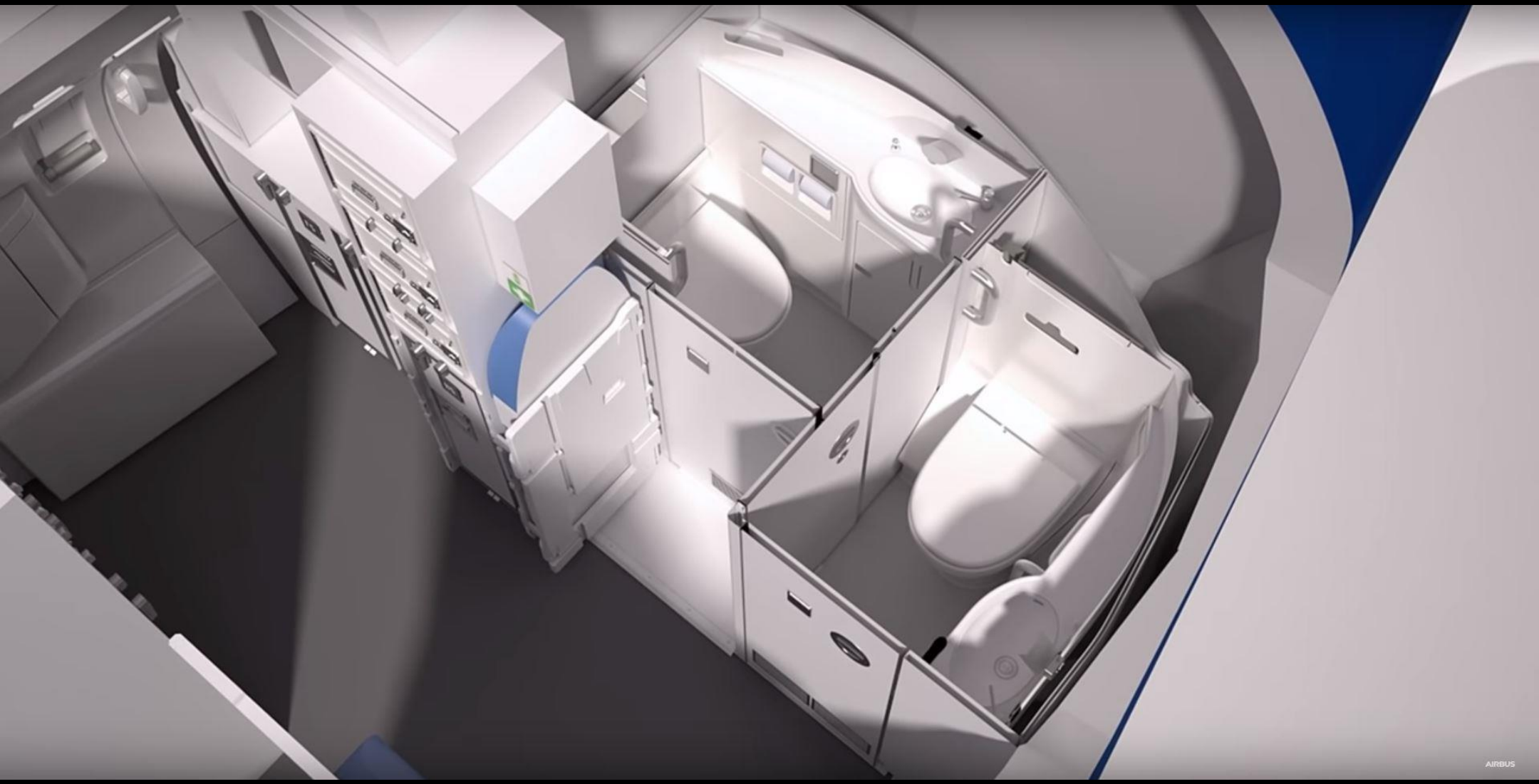
Would only fly 2-3 hours without lavatory access



# ACCESS

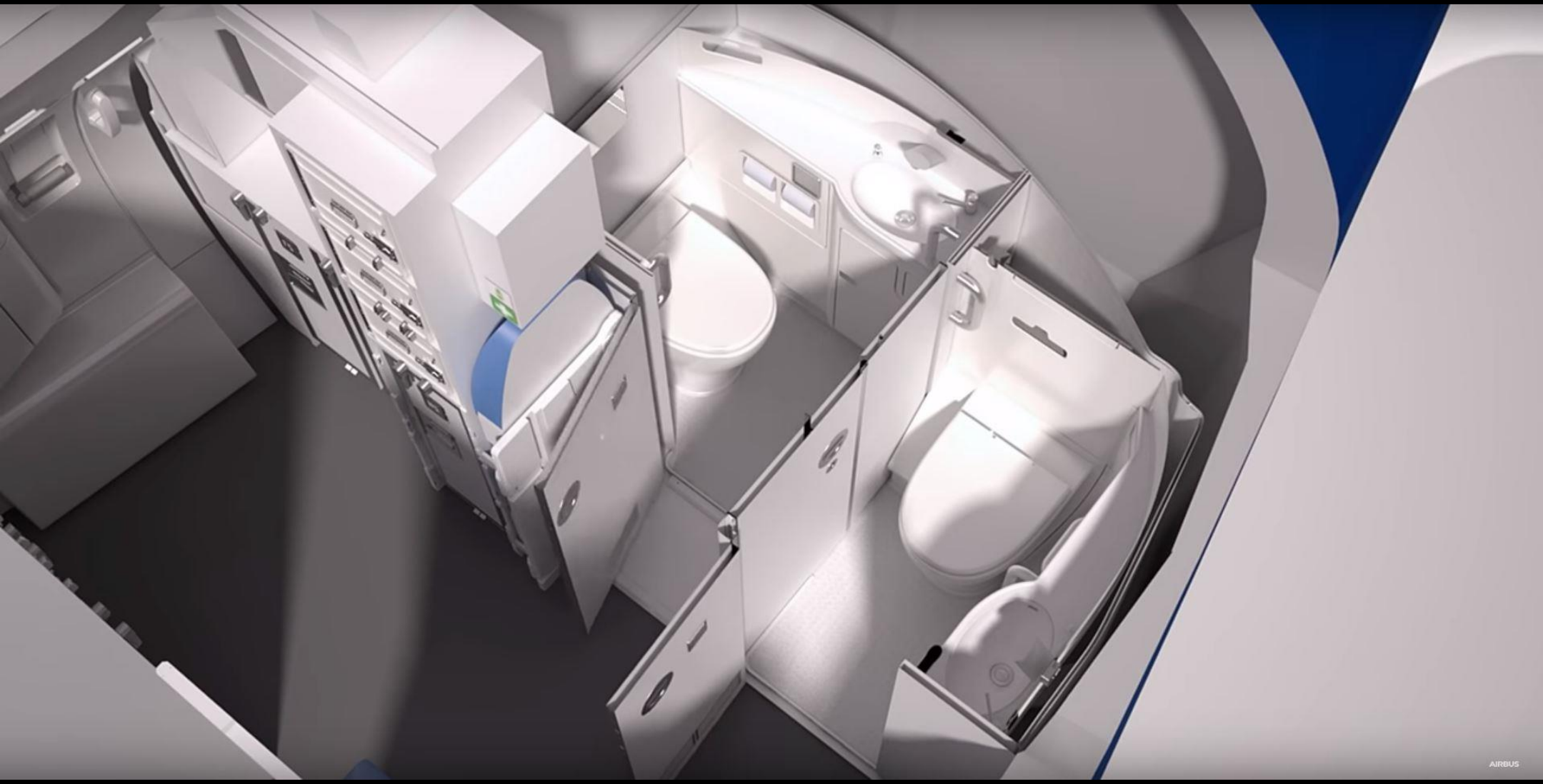
Acumen Design Associates
ST Engineering

apex
https://apex.aero/2020/02/12/access-aircraft-lavatory-design




# Airbus 320 Space Flex

Airbus
https://www.youtube.com/watch?v=Any6R1dGnrM

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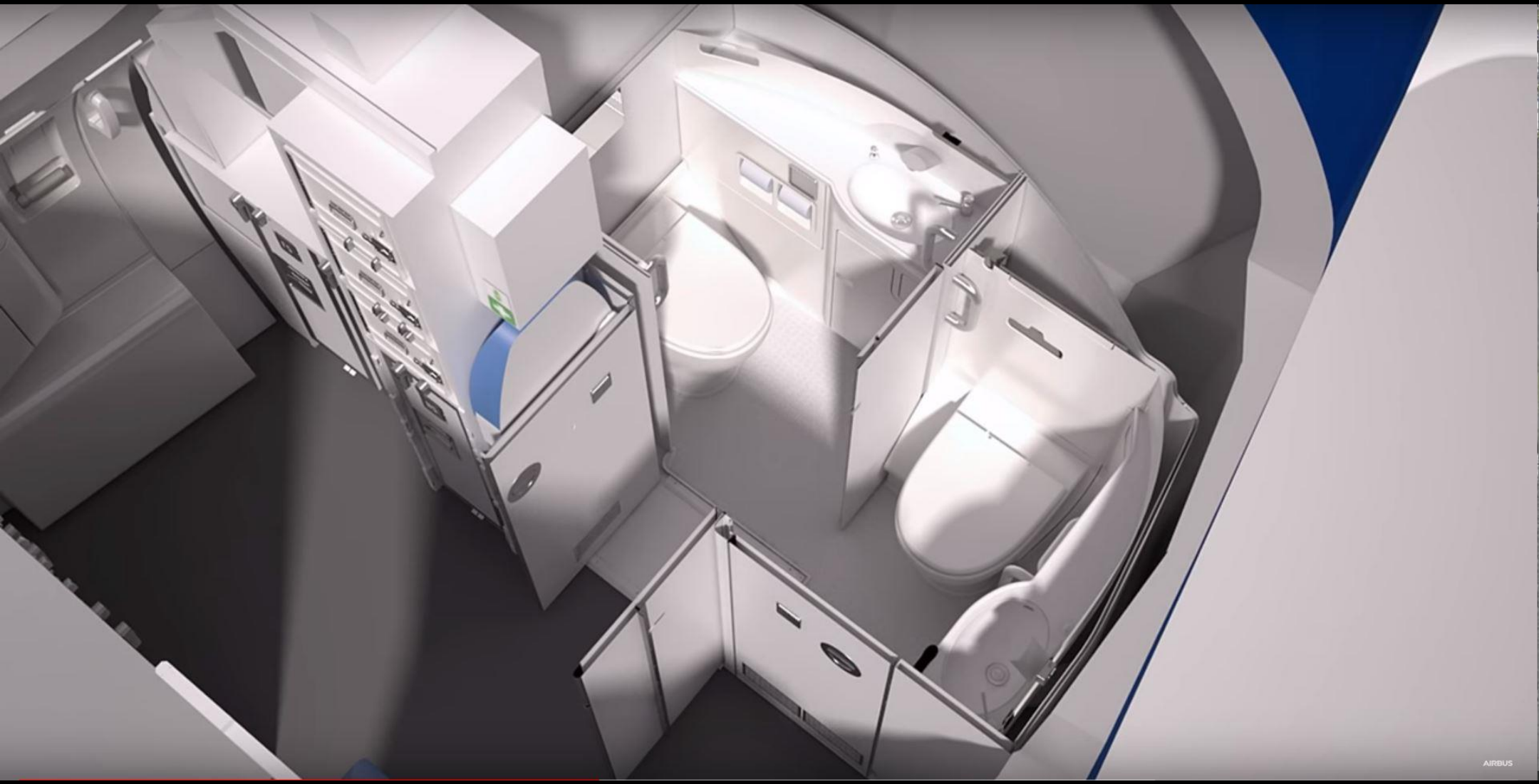


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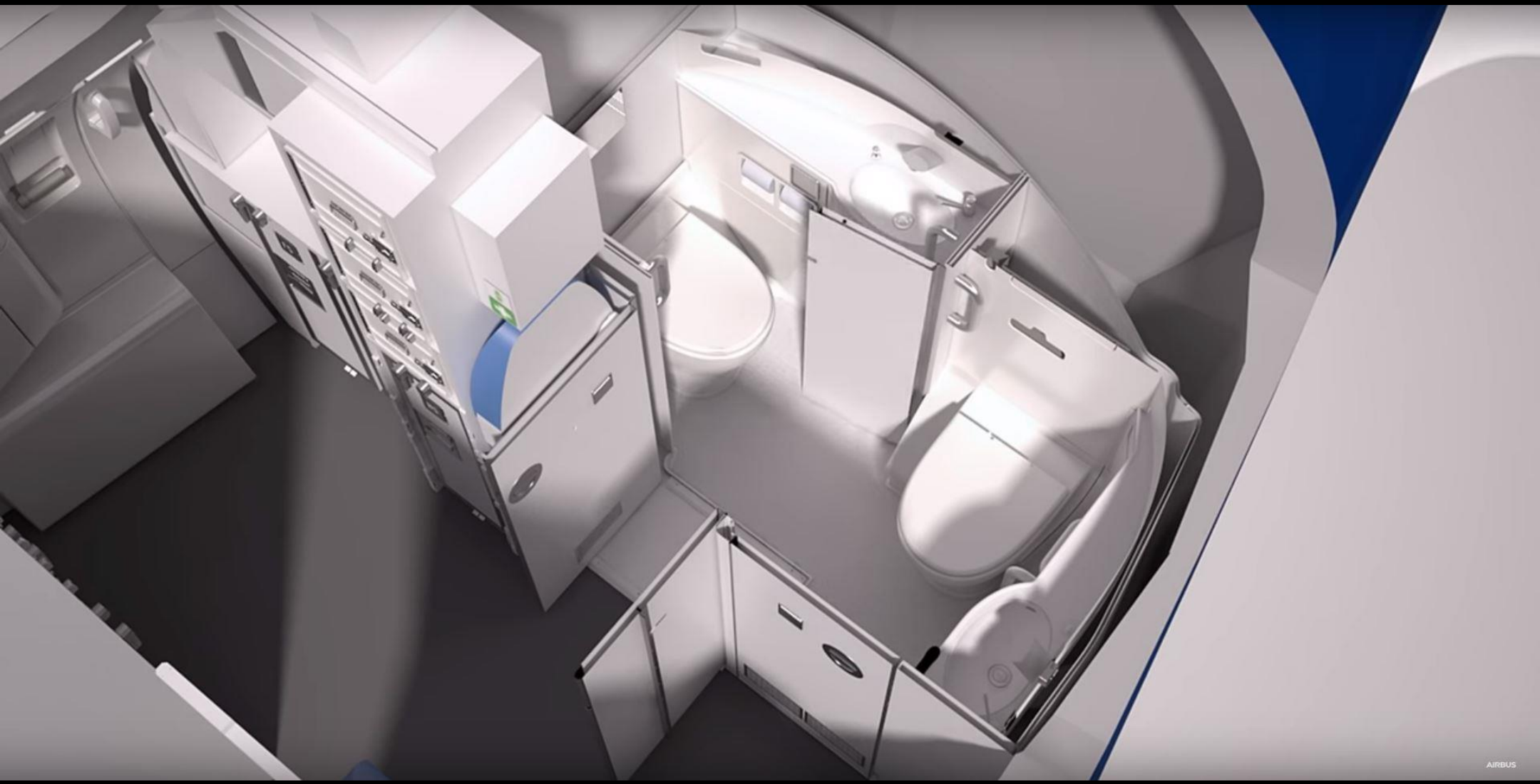


# Airbus 320 Space Flex

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# Airbus 320 Space Flex

Airbus
https://www.youtube.com/watch?v=Any6R1dGnrM

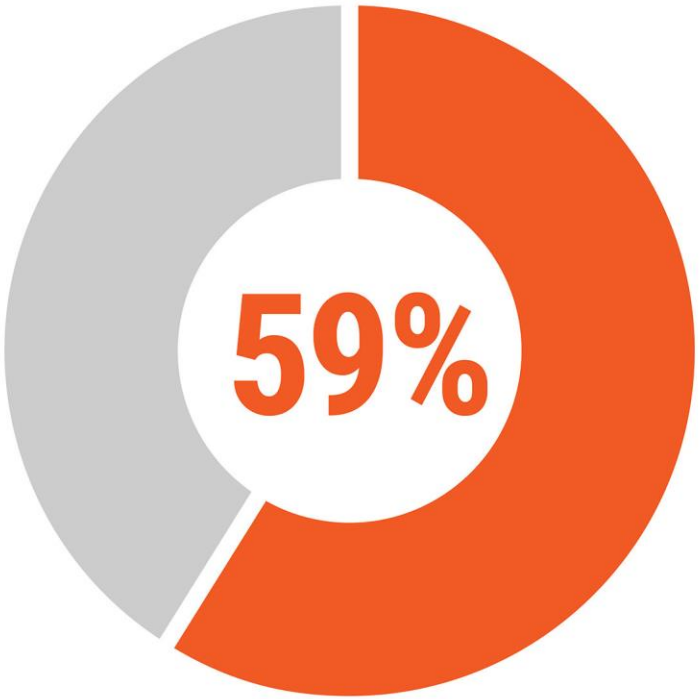

# Airbus 320 Space Flex

Airbus
https://www.youtube.com/watch?v=Any6R1dGnrM



# Damage

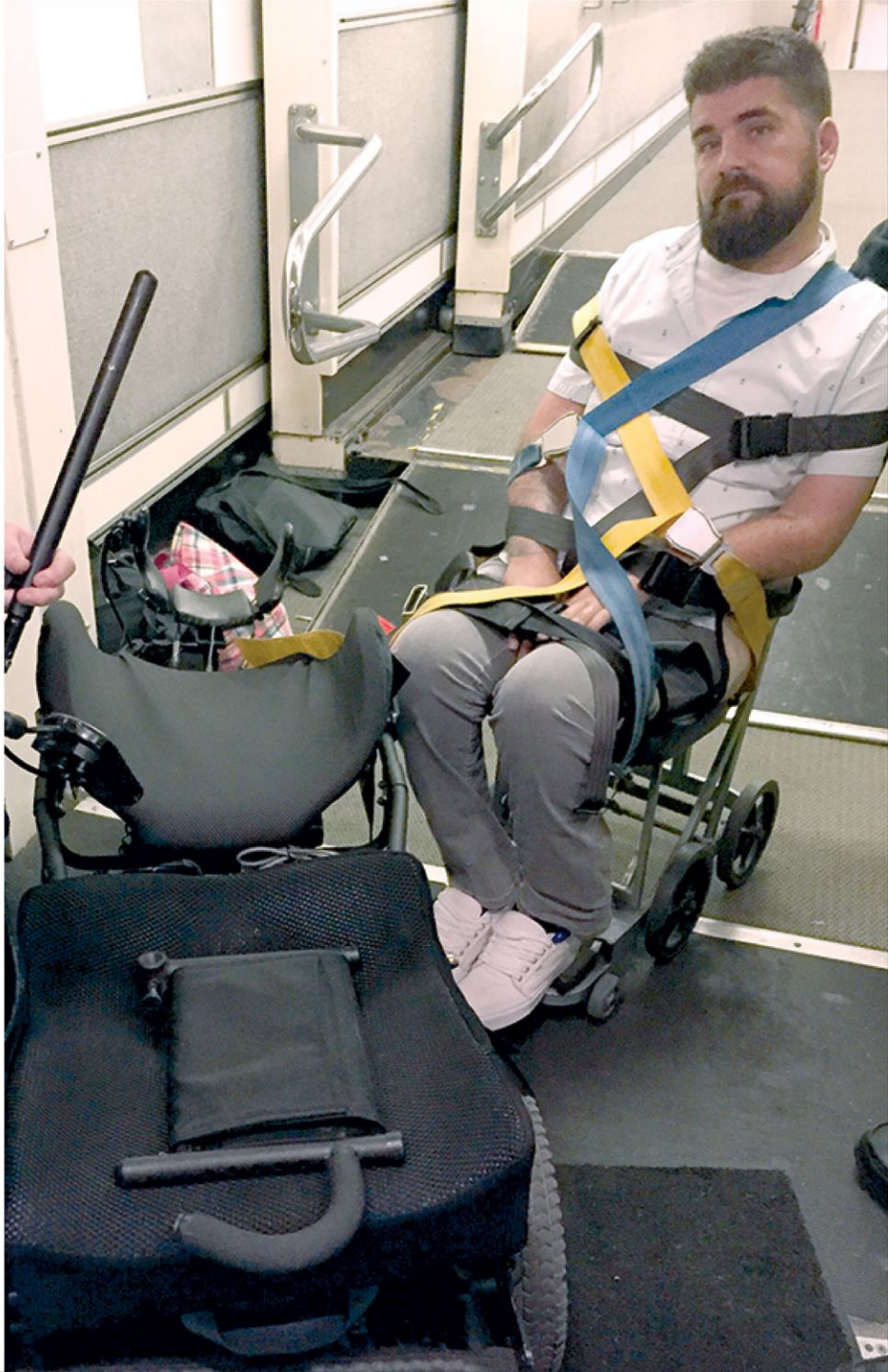
Damage to drive wheel that came off powered wheelchair




responded that their...

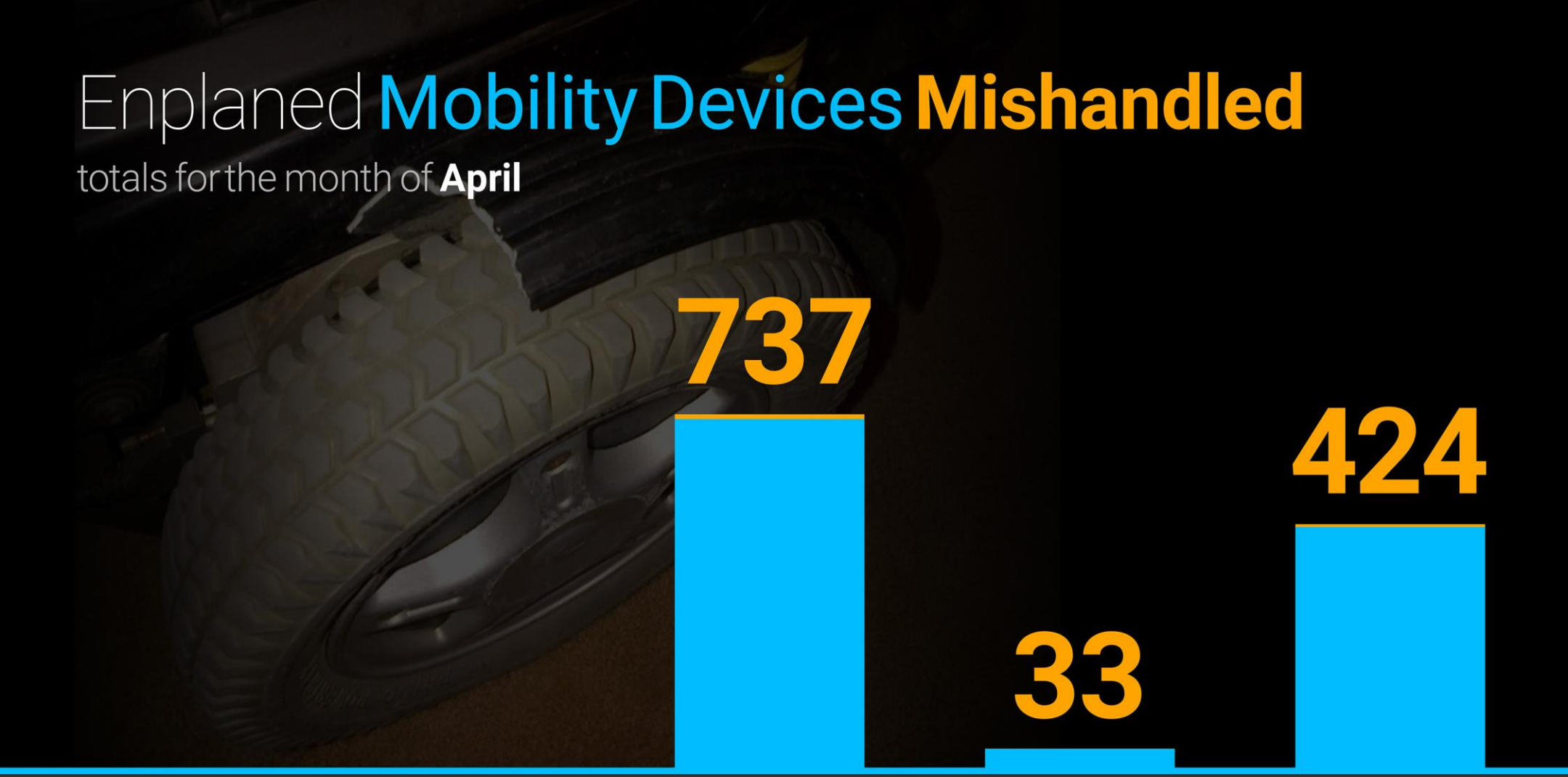
# mobility devices were damaged after air travel

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



# Enplaned Mobility Devices Mishandled

totals for the month of **April**




| April | 2019 | 2020 | 2021 |
|---|---|---|---|
| Percentage | 1.35% | 1.13% | 1.13% |
| Total Enplaned | 54,637 | 2,927 | 37,635 |

# Enplaned Mobility Devices Mishandled

**year** end totals


| Year | 2019 | 2020 |
|---|---|---|
| Percentage | 1.54% | 1.29% |
| Total Enplaned | 685,792 | 268,676 |

# Assistive Technology for Air Travel Standards

Airline carriers and manufacturers

Wheelchair manufacturers

Disability organizations

Government agencies – DOT - FAA

Wheelchair repair companies

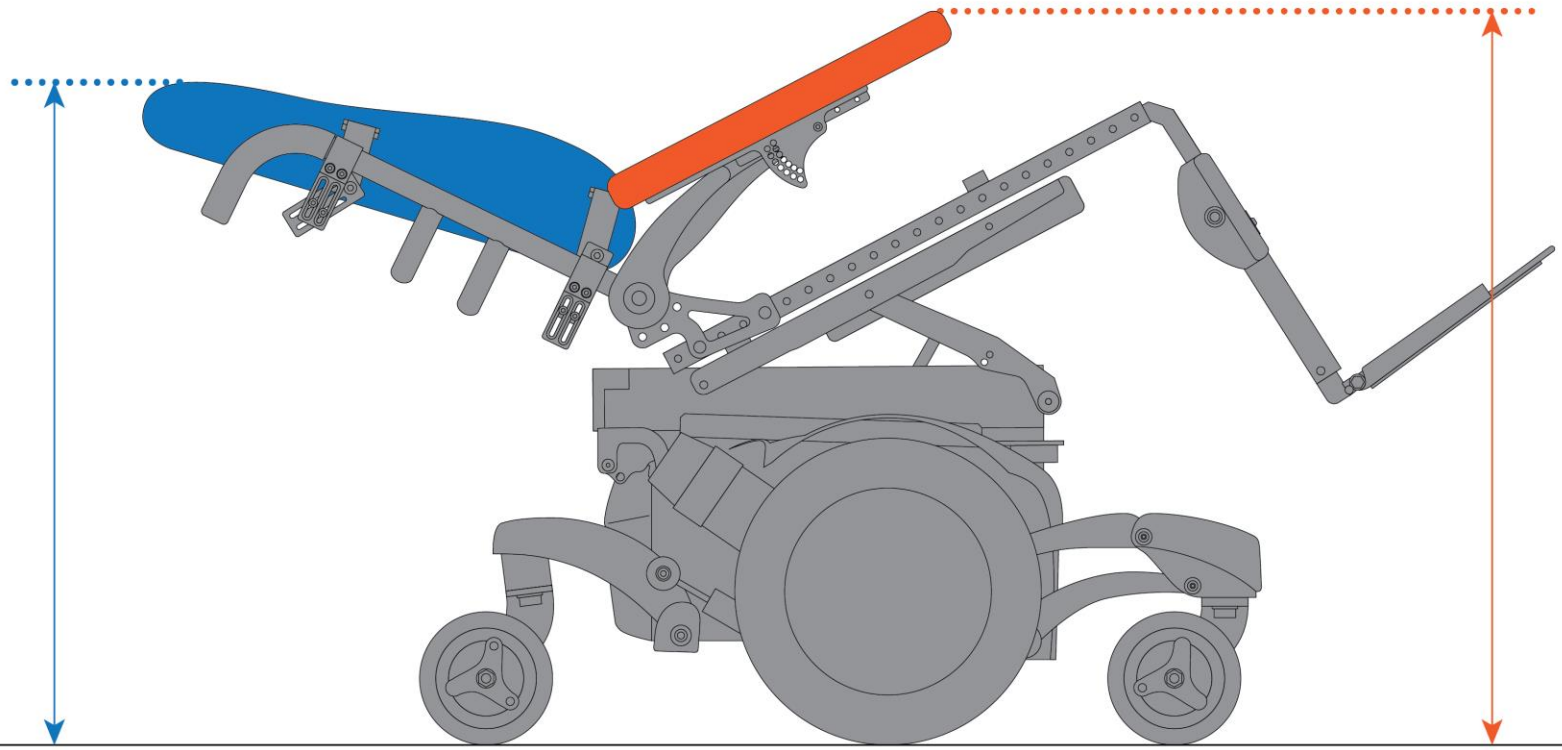
Standards for

# 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


N855VA

33" max



Travel
**Back**

Travel
**Arm**

# Drive Disengagement System

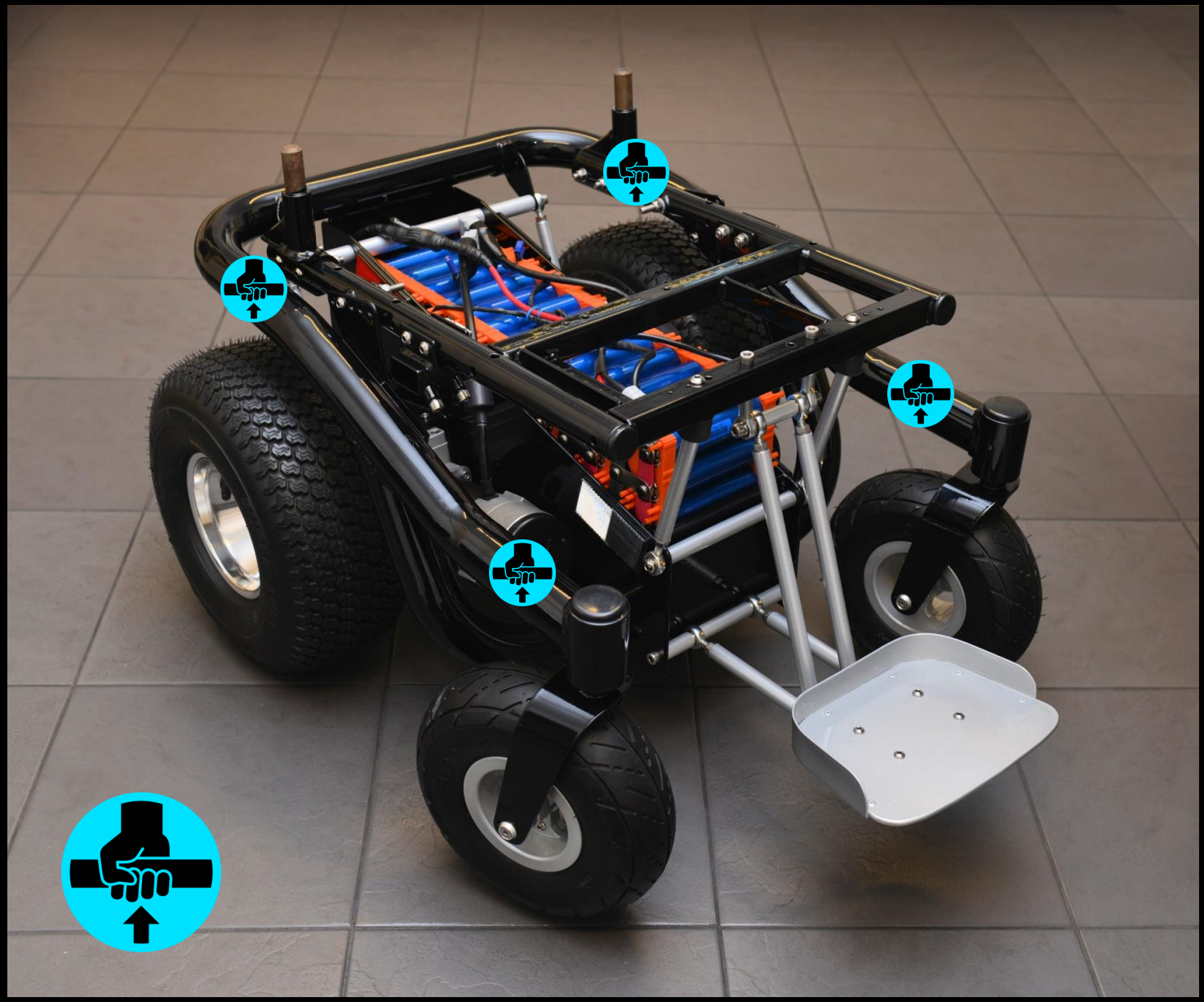
Disengagement of drive mechanism

Engagement of drive mechanism


DWR1235L798 REV C

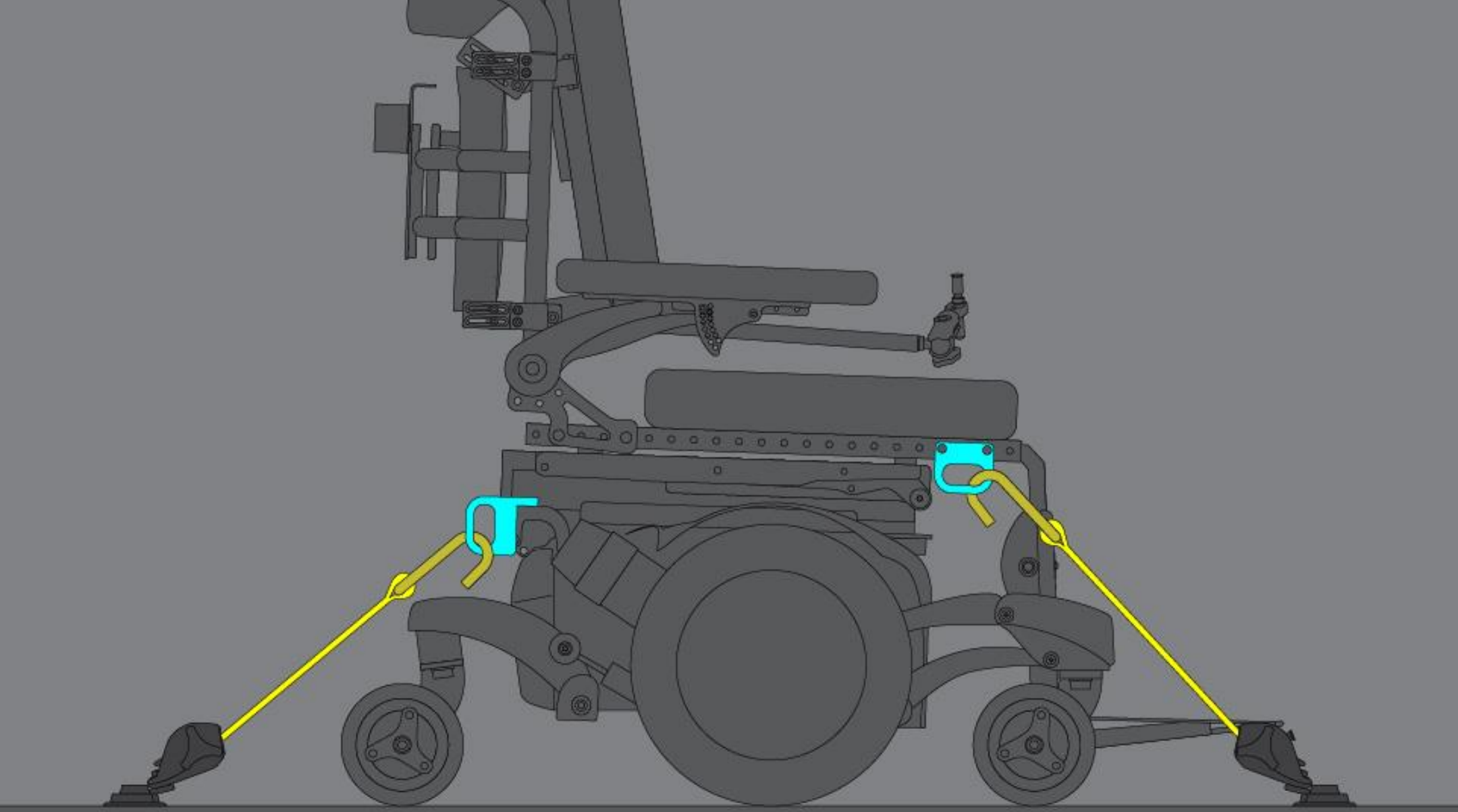

https://wheelchairtravel.org/air-travel/reduce-risk-wheelchair-damage/


C400



# PMD with transit option

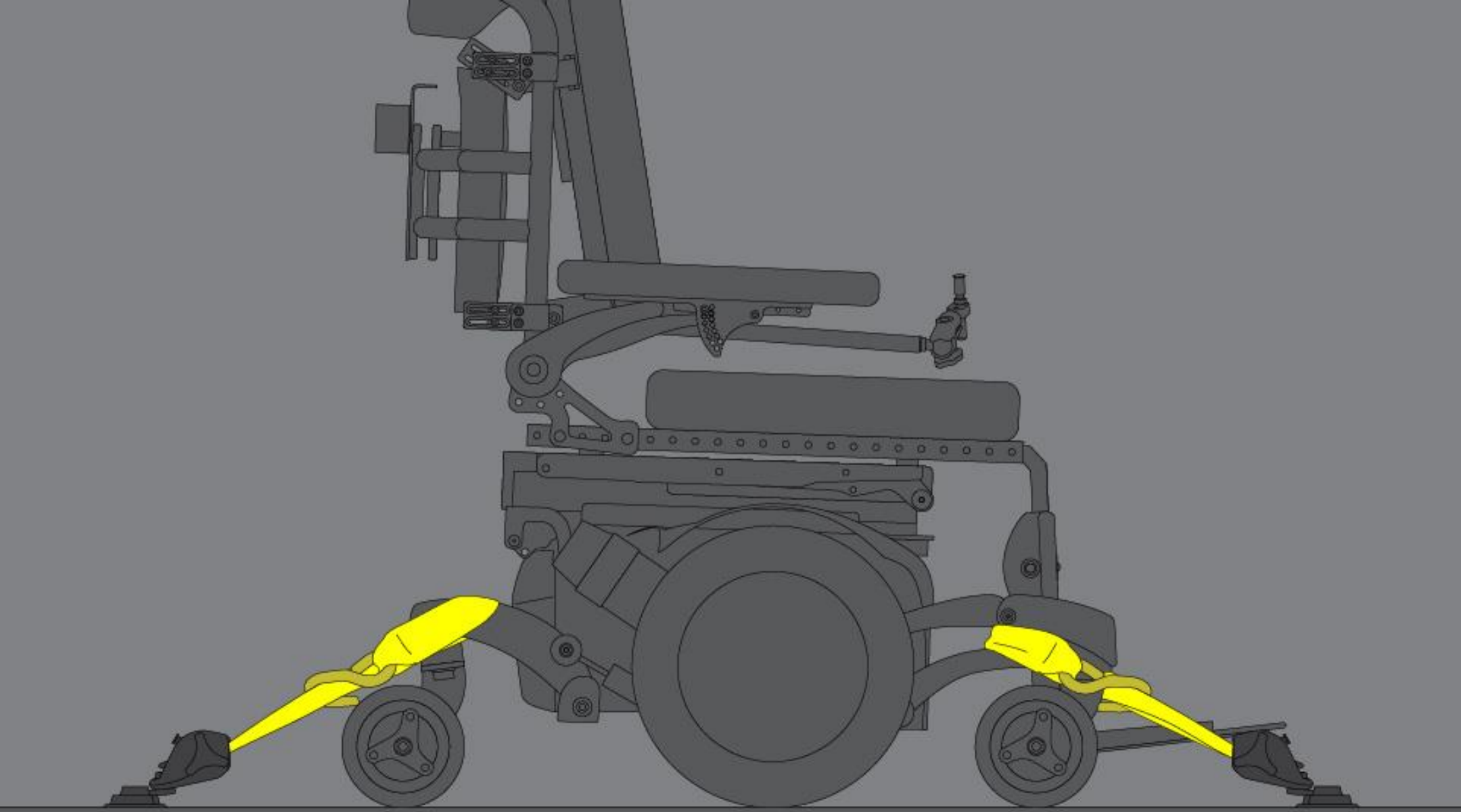

https://www.qstraint.com/wp-content/up
qrt-360-gallery-3.jpg

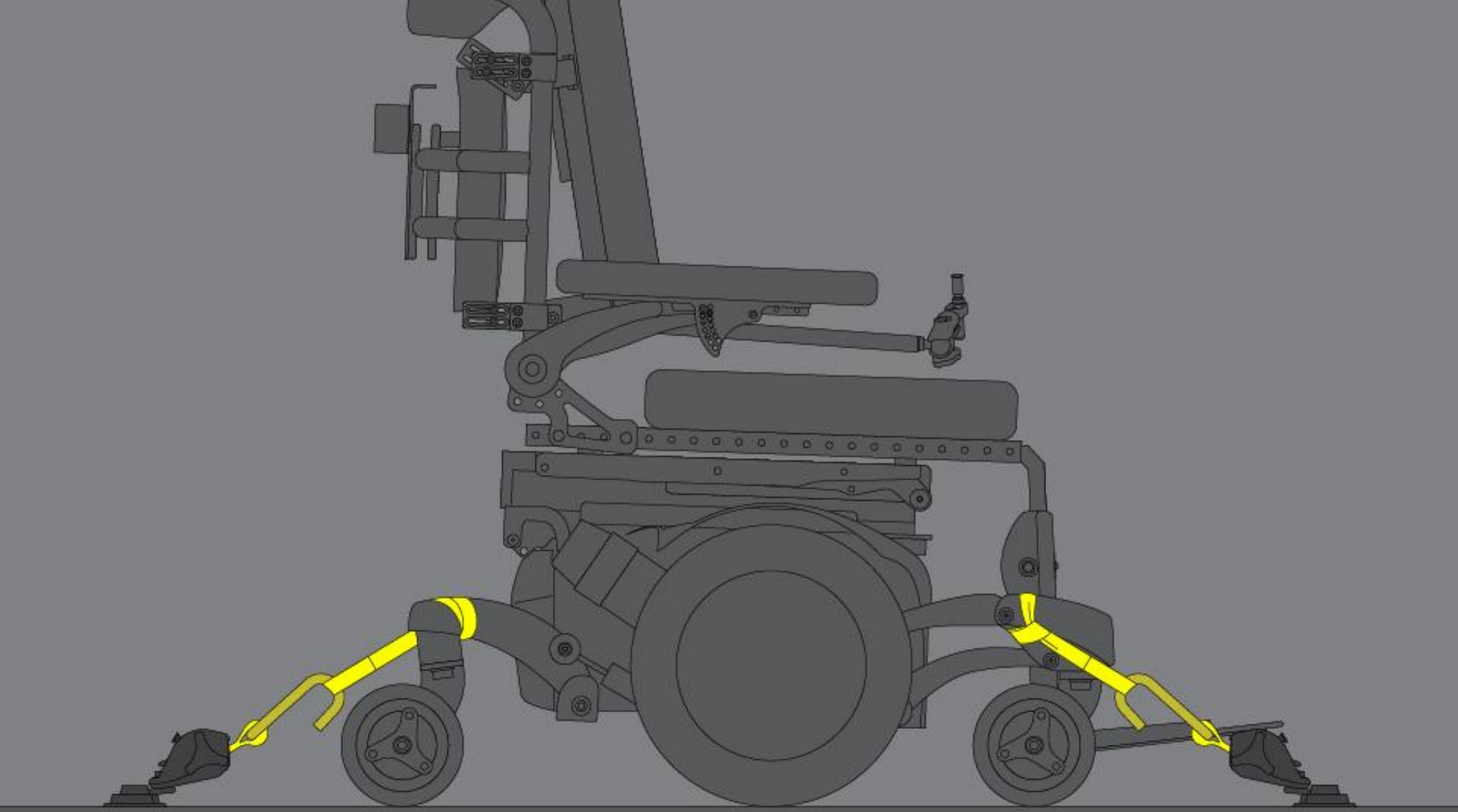


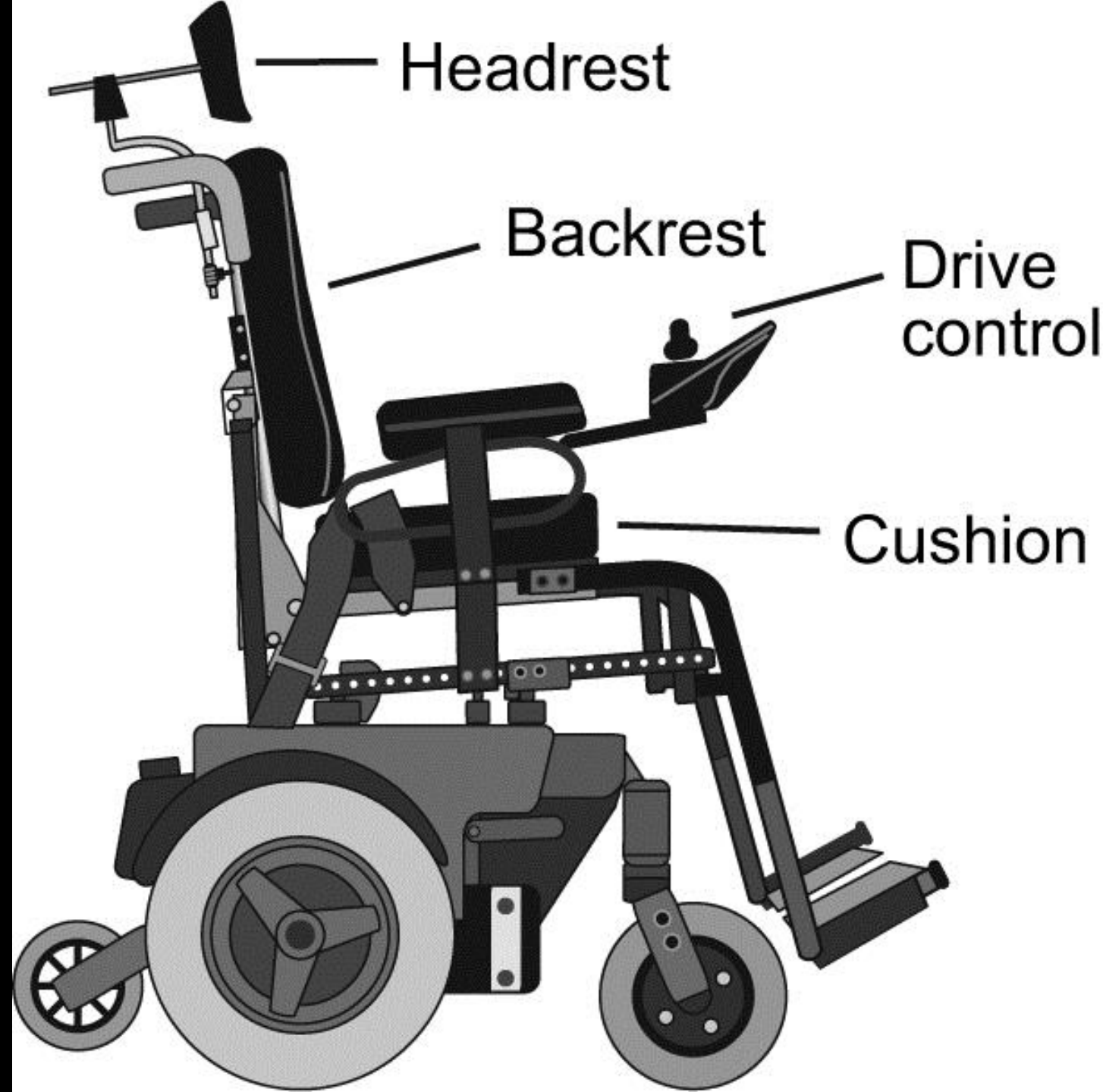
# Attachment Points for Securement

Securement Sling securement point

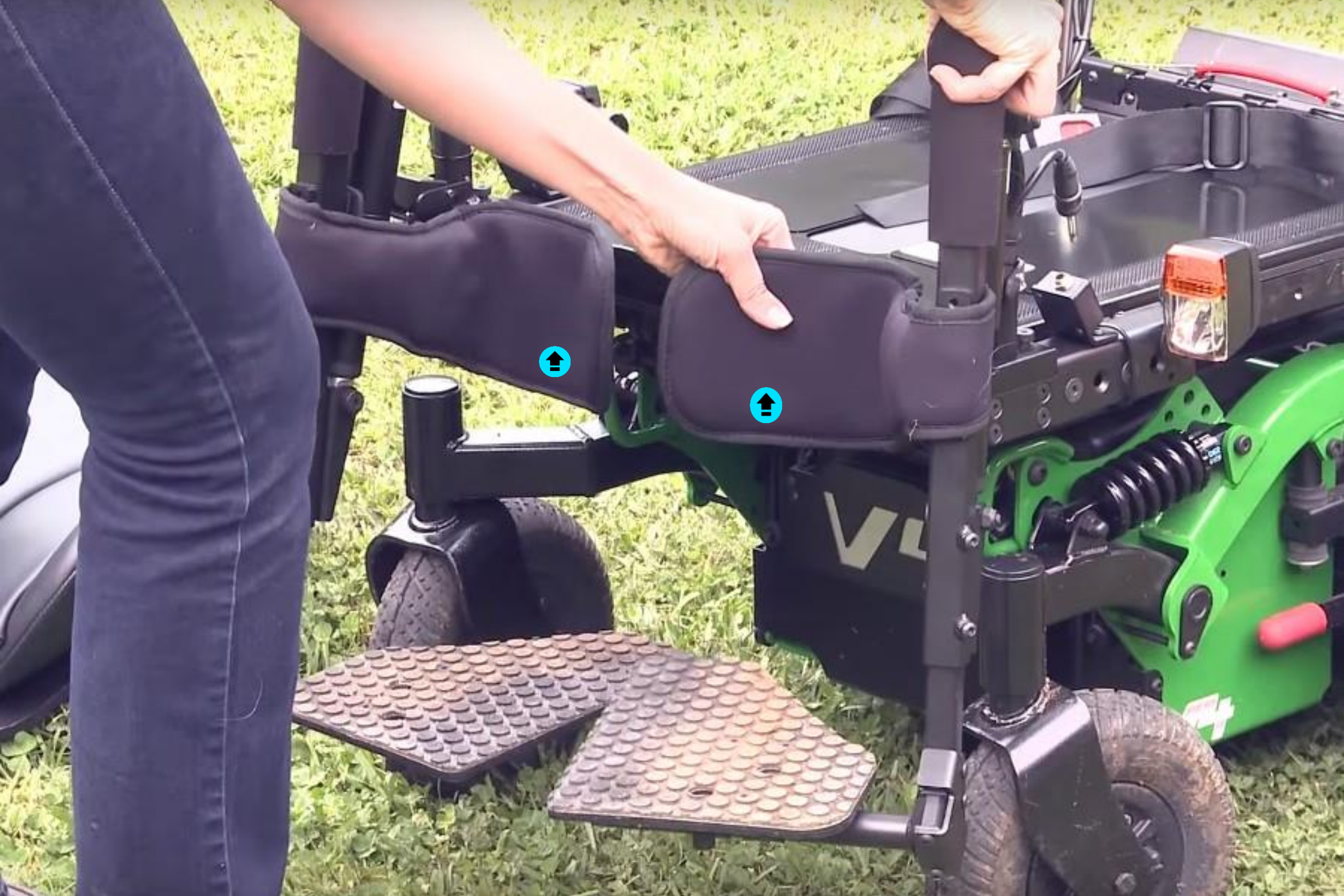
Cargo strap securement point






Headrest
Backrest
Drive control
Cushion


Magic Mobility Fold Forward Backrest
MORE VIDEOS



# Wheelchairs with power assist wheels

Power assist wheels shall be clearly labeled as removable or non-removable.

# Wheelchairs with power assist

Power assist devices shall be clearly labeled as removable or non-removable.

PMD Labeling Guidelines

# Weight

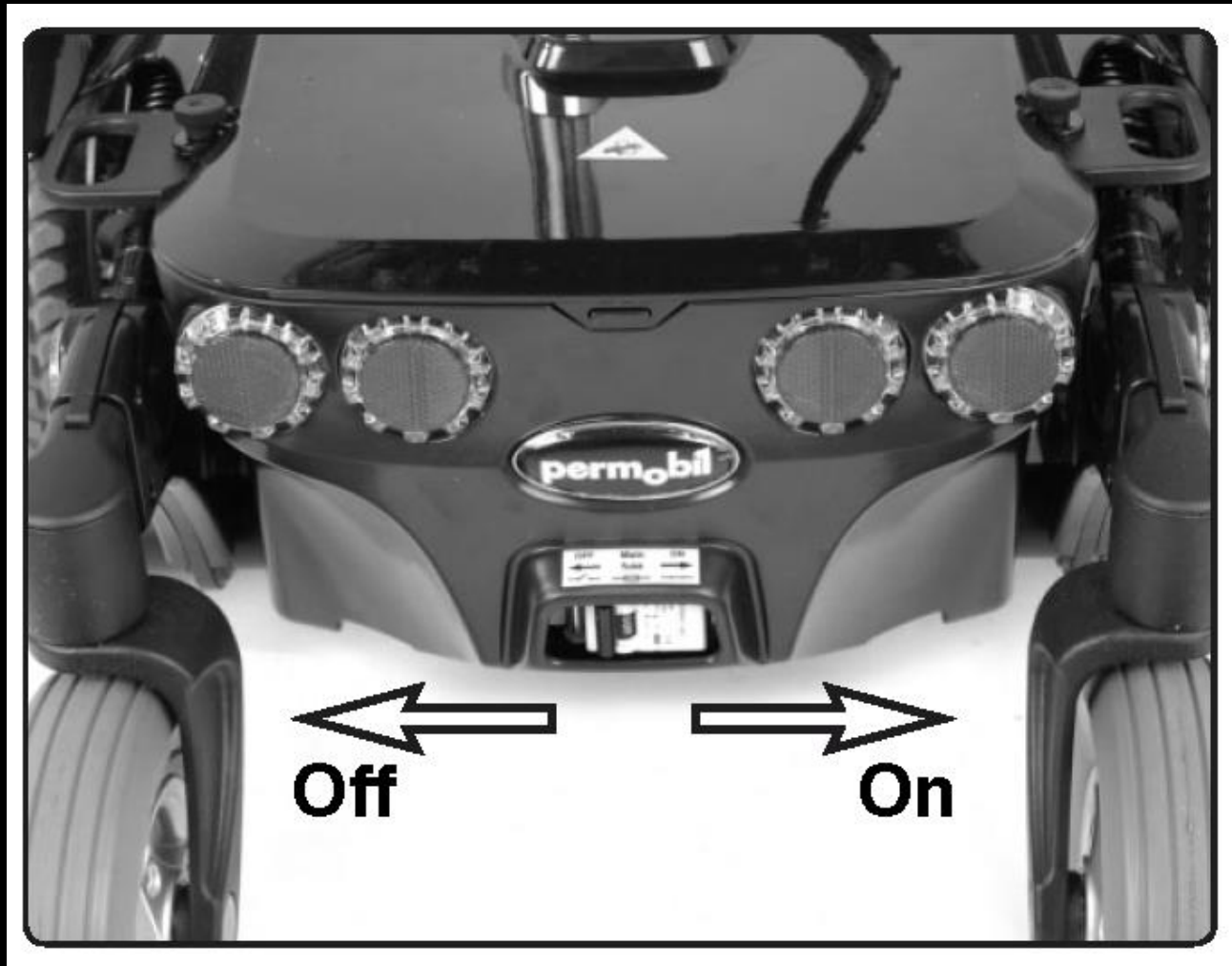

WHEELCHAIR WEIGHT

150 kg

330 lb

PMD Labeling Guidelines

# Location of power disconnect



For existing devices, create an

# Air Travel Configuration Card

Manufacturer LOGO

Model

## Air Travel Configuration

v1.2 rev: 2021-06-21

Owner Name: John Doe
Owner Phone: (775)123-4567
Owner Email: john.doe@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.

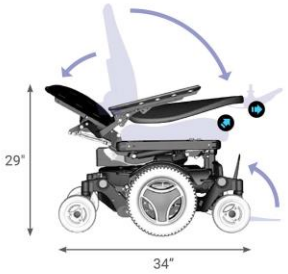
4 **Remove joystick** (User)
Remove joystick controller; store in aircraft overhead bin.

5 **Isolate battery power**
Switch breaker to off to fully disconnect power.

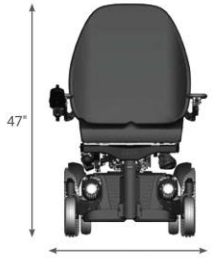
6 **Raise foot supports**
Move foot supports to upright position.

7 **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.

### Air Travel Configuration




### Driving Configuration




### Unoccupied Product Weight

**150 kg** (330 lb)

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

### Weight of Additional Components

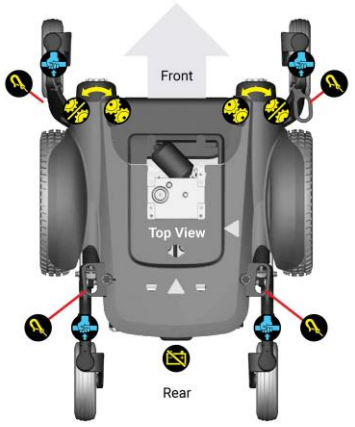
(if greater than 10 kg)

12 **kg** ( 26.5 lb)

### Battery Information

**WARNING:** Only 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.**





### 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.**

### 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 [make and model] 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 straps to RESNA WC19 securement points.**

### Operator's Manual Online

The wheelchair illustrated in this Air Travel Configuration Card prototype was selected based on the product having a built-in electrical isolation switch to isolate the batteries. Data was obtained from the operator's manual available online. Some values are estimated and may not represent actual product data. The manufacturer of this product has not reviewed or approved this information.

# Symbols

# beneficial designs

designing beyond the norm to meet the needs of all people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peter@beneficialdesigns.com

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775.783.8823 fax