



Development of Wheelchair Standards for Less-Resourced Settings

*International Society of Wheelchair Professionals (ISWP)
Standards Working Group*

03/02/2017

Ability Meets Mobility





USAID
FROM THE AMERICAN PEOPLE











Breakdowns!





DONATED
BY [illegible]
THROUGH
A.P.D.K.
COAST BRANCH

11/02/2007

What is different in less-resourced settings?















How they affect?

- Rapid aging
- Wear and tear
- Corrosion
- Contamination





Failures



Factors → Failures

- Delivery of inappropriate designs
- Poor maintenance
- Lack of resources
 - Repairs
 - Replacements
 - Skilled Labor
- Access to rehabilitation services is poor
- Lack of appropriate provision
- Policy issues



Global Need for High-quality Wheelchairs

- WHO Guidelines
- UN-Convention of Rights for People with Disabilities (Article 20)
- WC Consensus Conference – 2006
- WHO GATE initiative
- WSTP-B, WSTP-I
- ISWP



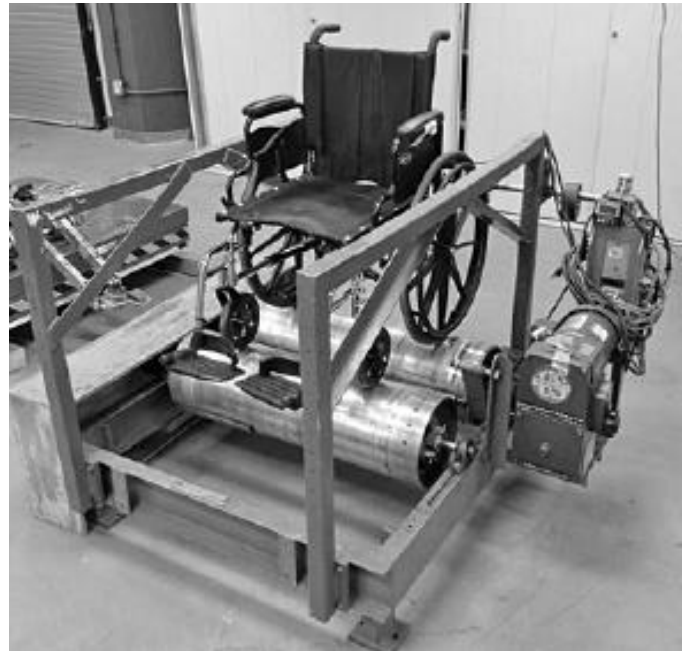
WHO Guidelines refer to ISO standards

- ISO 7176 series – Wheelchair Standards
 - Stability
 - Performance
 - Wheelchair Dimensions
 - Durability



ISO 7176-8 Tests

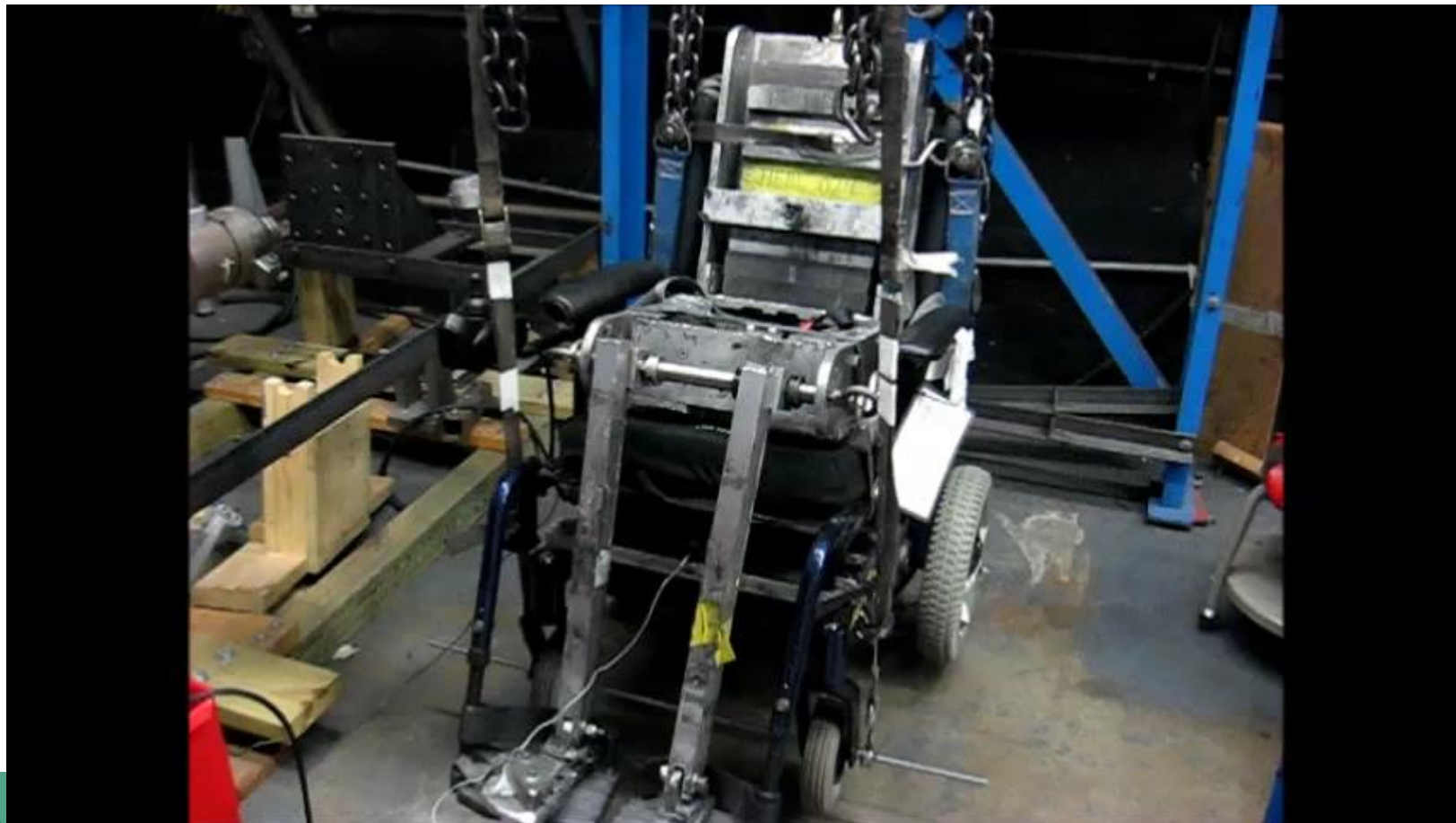
- Section 8 – strength, impact, fatigue



ISO Multi-drum fatigue test



ISO Kerb-drop test



Passing requirements on fatigue tests

- 200,000 test cycles on multi-drum test
- 6,667 test cycles on kerb-drop test
- Equivalent use of 3-5 years outdoors



WHO Guidelines recommend...

- For less-resourced settings,
 - ISO 7176 can be used as baseline standards
 - Develop additional quality testing standards
 - Based on local conditions



Research Evidence – Field studies

- Immediate failures with hospital-style chairs.
- Models appropriate for LREs, ISO tested
 - Short-term repairs, replacements and missing parts (3-8 months).
 - With 1-2 years of use, a host of failures which require repairs by technicians.



Types of Failures

- Common failures in ISO tests
 - Fractures with cross-braces, side frames, backrests, castor spindles and footrests.
 - Tire cracks
- Field failures in less-resourced settings
 - Flat and cracked tires
 - Wobbly rear wheels
 - Bent frames
 - Non-functional brakes
 - Worn-out bearings
 - Damaged armrests
 - Torn seat covers
 - Loose upholstery
 - Collapsed cushions
 - Rusting and loosening of several parts



Application of ISO durability tests

Components	Failure modes	ISO test methods	Test factors
Castors, Rear Wheels & Bearings	Tire type, wheel and castor features, and bearings affect rolling resistance.	Not in ISO 7176	Rollability: Effort required to propel wheelchairs on paved and unpaved surfaces
	Broken castor and wheel parts.	Yes (ISO 7176 – 8), but does not reproduce complex load conditions that occur in LREs.	Durability: impacts and loads; fracture loads
	Worn out tyres	Not in ISO 7176	Durability: abrasion
	Parts degradation	Not in ISO 7176	Durability: accelerated aging
	Corroded bearings and metallic parts	Not in ISO 7176	Durability: corrosion
	Fluttering castor may waste effort and cause accidents	Seen on ISO 7176-8 multi-drum test but not tested for.	castor flutter
	Tire puncture	Not in ISO 7176	Air retention for wheels, puncture tests
	Worn out bearings, dirt and dust in bearings	Not in ISO 7176	Test lubrication quality, seal design & quality
	Trueness of wheels over time is affected, camber issues	Not in ISO 7176	Wheel alignment
Seat Cushion & Upholstery	Seat cushions flatten over time.	Not in ISO 7176	Durability: cushion compression
	Exposure to fluids causes deterioration	Not in ISO 7176	Chemical resistance & Waterproof testing
	Tearing and wearing of cushion and cover, loosening upholstery	Not in ISO 7176	Durability: aging, tearing, abrasion, loosening
Footrest	Broken footrests	ISO 7176 – 8	Durability: strength
	Difficulty in folding, adjusting for height	Not in ISO 7176	Durability: corrosion
Brakes	Loosening and corrosion of locking mechanism	Not in ISO 7176	Durability: cyclic testing, aging, corrosion
Frame and cross braces	Bent push handles	Not in ISO 7176	Durability: loading
	Wear on coatings, coating deterioration	Not in ISO 7176	Paint chipping and corrosion
	Rusted holes, welds, and areas where paint is chipped off	Not in ISO 7176	Durability: corrosion & testing folding mechanism
Fasteners & Arm Pads	Bolts and pads loosen out	ISO 7176 – 8	Loosening
	Pads deteriorate, exposing edges	Not in ISO 7176	Aging and abrasion testing
	Rusted components	Not in ISO 7176	Durability: corrosion

ISWP Testing

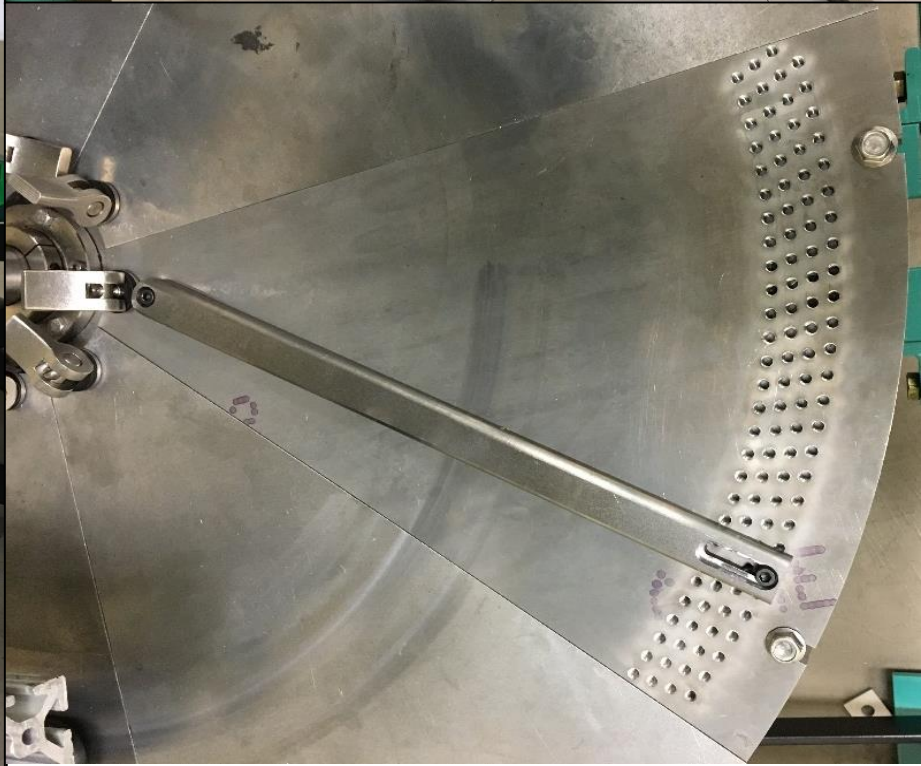
- Develop a series of wheelchair tests
 - Castor Durability Testing
 - Rolling Resistance Testing
 - Corrosion Testing
 - Whole-chair Testing
- Resources for wheelchair design and selection
 - ISWP Product List
 - Design Guidelines



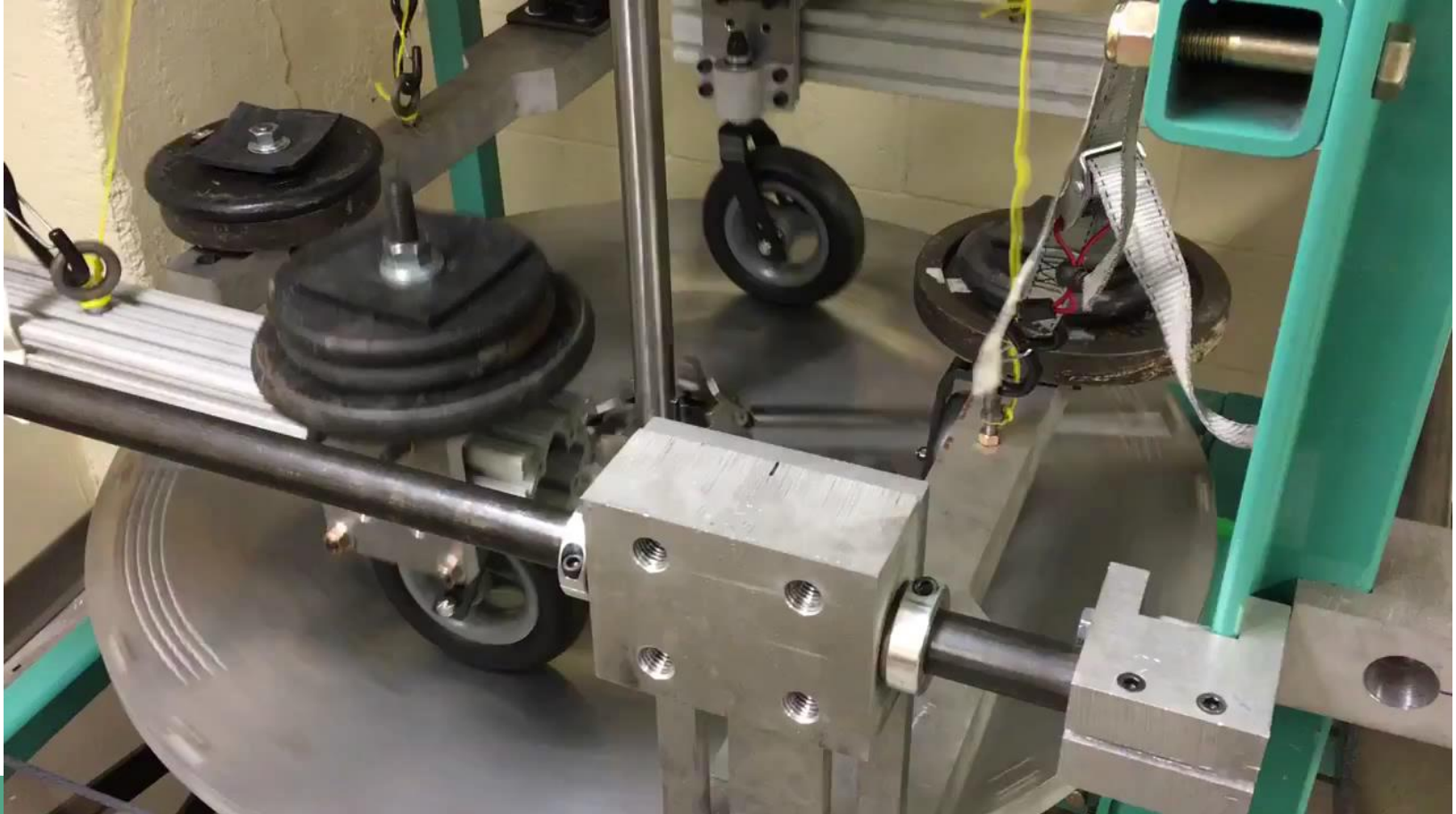
Castor Durability Testing

- Castor failure is frequent in the field
- Diversity in Castor failures
 - Tire failures
 - Bearing failures
 - Hub fractures
 - Fork fractures
 - Stem hub assembly issues
- ISO tests subject them to vertical loads
- Outdoor conditions are more stressful

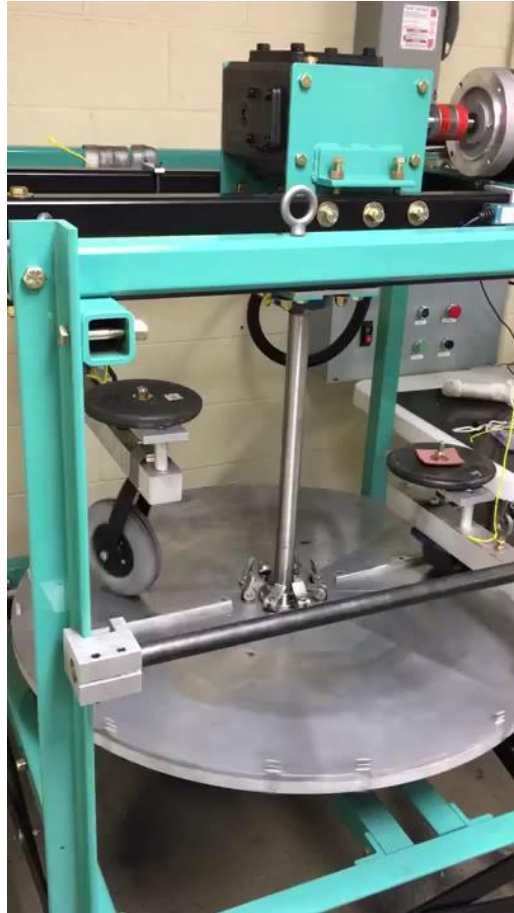




Video of Castor testing



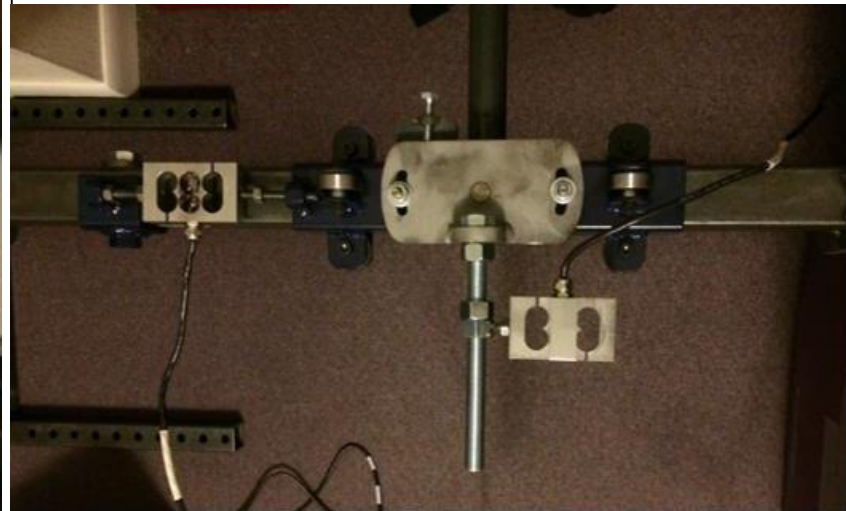
Castor bearing testing



Rolling Resistance Testing

- Resistance to wheelchair rolling - performance issue
 - Rear wheels
 - Castors
- Propelling wheelchairs on variety of surfaces is difficult.
- Resistance causing factors
 - Elastic rebound between the tyre and different surfaces
 - Tyre tread design
 - Type of tyre (pneumatic versus solid)
 - Camber level
 - Toe-in/toe-out
 - Type of spokes
 - Play characteristics of the axle hub bearings





Video

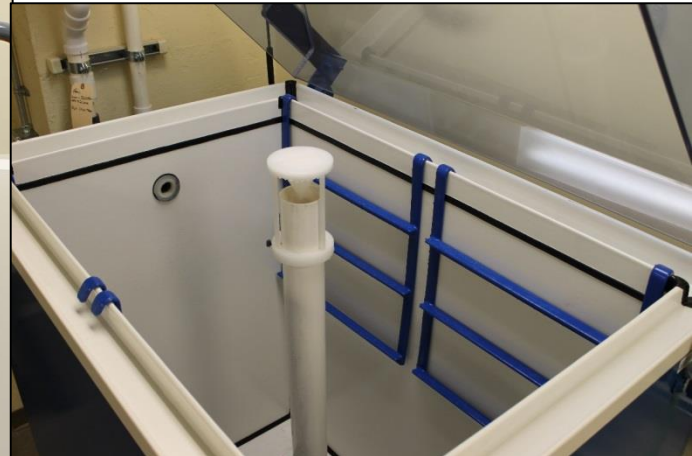


Corrosion Testing

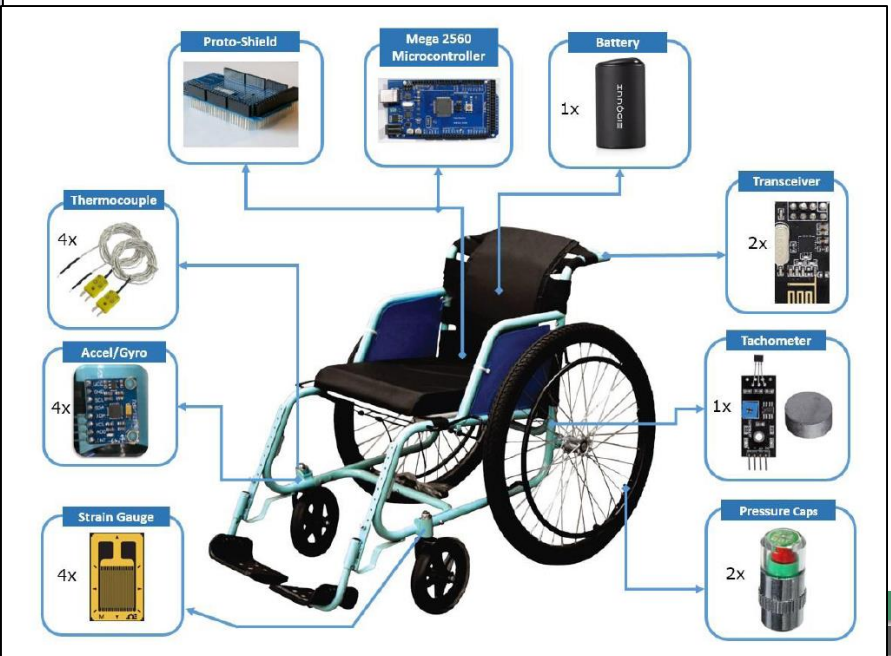
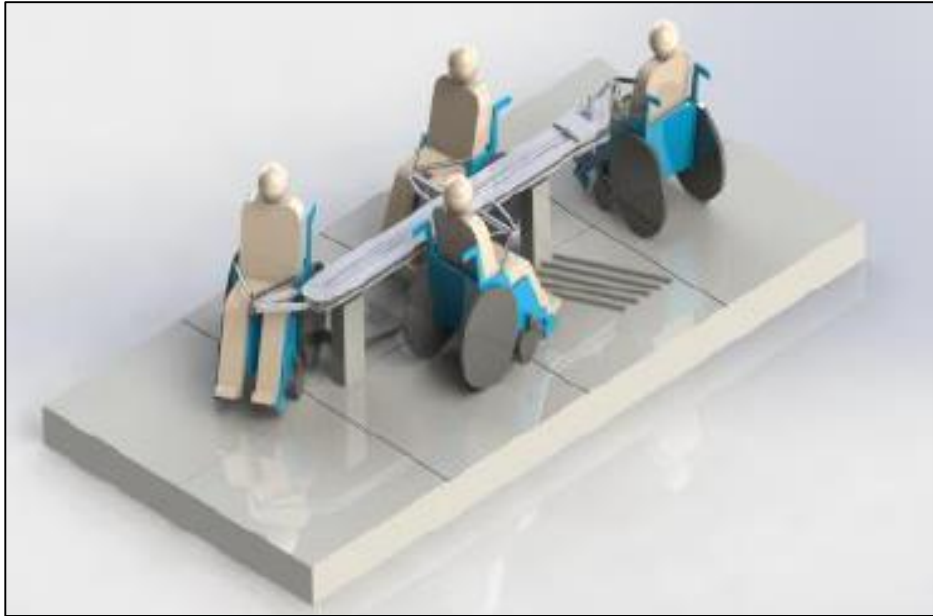
- Corrosion of wheelchairs is a universal issue
 - Parts are unable to operate after being rusted
 - Footrests don't fold, brakes don't engage and become non-functional.
- ISO testing includes climatic testing for power wheelchairs only
 - Does not simulate moisture and acidic exposure.
- Corrosion adds to fatigue during field use for certain wheelchair parts like bearings.
 - Conducting fatigue and corrosion testing simultaneously.
- Recommended standard – ASTM B117



Corrosion Testing



Whole Chair Testing



Resources - ISWP Product List

- In less-resourced settings, there is lack of information on
 - Product Quality and Specifications
 - Performance in the context of use
 - Product usability – ease of use, comfort
 - Other factors like reparability, portability, aesthetics



Filter by

- Context of Use

- ☐ Indoor only
- ☐ Indoor/Outdoor
- ☐ Outdoor only
- ☐ Institutional
- ☐ Evacuation

+ Terrain

+ Durability Testing

+ Intended Users

+ Chair Weight

+ User Rating

+ Frame Type



Whirlwind Roughrider

by Whirlwind Wheelchair

Chair Description: The award-winning RoughRider is designed to handle rugged terrain with ease. It has been proven in over 25 countries by thousands of riders who live in the worst of conditions and need the best of chairs. Riders use it as a super-durable daily-use...[more](#)

Intended Users: Teenagers, Adults, Older Adults, Older Adults with Postural Support Needs.

Website: www.whirlwindwheelchair.org

To send an inquiry about this product: info@whirlwindchair.org

[Leave a Comment](#)


UCP Wheels Expression

by UCP Wheels for Humanity

Chair Description: A custom fit active wheelchair for image-conscious users in urban and semi-urban areas who are economically disadvantaged. Chair features light weight, super durability, transportability, extensive fit and positioning options, and a sleek urban look.[more](#)

Intended Users: Children, Teenagers, Adults, Older Adults.

Website: www.ucpwheels.org

To send an inquiry about this product: kking@ucpwheels.org

[Leave a Comment](#)


Whirlwind Roughrider



Overview

Specifications

Comment

Testing

Report an Issue

Top Reviews

The award-winning RoughRider is designed to handle rugged terrain with ease. It has been proven in over 25 countries by thousands of riders who live in the worst of conditions and need the best of chairs. Riders use it as a super-durable daily-use chair or as a backup when life calls for off-pavement adventures. See it in action here. The RoughRider is Whirlwind's answer to expensive fragile chairs that unnecessarily limit access. Priced at less than half of other outdoor wheelchairs, the RoughRider is by far the best-value rugged wheelchair. Now available in the USA.

Manufacturer: Whirlwind Wheelchair

Make an inquiry about this product: info@whirlwindchair.org

Website: <http://www.whirlwindwheelchair.org/>

Features

- Adjustable back height
- Tension adjustable back
- Adjustable seat depth
- High-tension sling seat
- Fixed 10-degree tilt
- Padded back

Key Specs

Seat Width:

12 Inch / 30.5 Cm

14 Inch / 35.6 Cm

16 Inch / 40.6 Cm

18 Inch / 45.7 Cm

Seat Depth:

14 Inch / 35.6 Cm

16 Inch / 40.6 Cm

18 Inch / 45.7 Cm

Product Weight:

30 - 50 lbs / 13.5 - 22.5 kg

Rear Wheels:

24 In (61 Cm) Pneumatic

Caster Wheels:

11 x 8 In (27.9 x 20.3 Cm) Solid

[View All Specs](#)

More Info

Intended Users: Teenagers, Adults, Older Adults, Older Adults with Postural Support Needs.

Assembly: Optional – Ships with wheels on or off.

FDA clearance status:

Other information about the Whirlwind Roughrider: The award-winning RoughRider is designed to handle rugged terrain with ease. It has been proven in over 25 countries by thousands of riders who live in the worst of conditions and need the best of chairs. Riders use it as a super-durable daily-use chair or as a backup when life calls for off-pavement adventures. See it in action here. The RoughRider is Whirlwind's answer to expensive fragile chairs that unnecessarily limit access. Priced at less than half of other outdoor wheelchairs, the RoughRider is by far the best-value rugged wheelchair. Now available in the USA.

Since 1979 Whirlwind has worked with wheelchair riders around the world to design durable and highly functional wheelchairs that perform well on rough terrain and are built in factories that contribute to local economic development.



More about the product list...

- Users and clinicians can review products
- Post products to their social media
- Manufacturers can
 - Know about product performance
 - Optimize product as per reviews and ratings
- Connect with individual users for feedback
- Improved decision making
- Empower users – active participation in provision



Resources – Design Considerations

- Lack of resources and environmental factors present challenges for designers, engineers and manufacturers.
- Design Guidelines developed by experts for basic and intermediate wheelchairs.
- Pediatric wheelchairs are included too.
- Design trade offs have been highlighted
 - Manufacturability
 - Serviceability
- Wheelchair interactions with environment and users in less-resourced settings.



Resources – Design Considerations

- Indicates types of testing available
 - Qualification Tests
 - Research and Development tests
 - User Evaluation Tests
- Recommendations for individuals, service providers, and/or governments to select and purchase wheelchairs
- Aid engineers and manufacturers to develop appropriate, durable and functional wheelchair designs



Implementation of Standards

- ISWP is validating test methods currently.
- ISO integration
 - Attending ISO meetings
 - Add as Technical Specifications
- Referenced by WHO Guidelines
- Part of the WHO GATE initiative
- Collaboration with manufacturers and charitable organizations for implementation.



Thanks!

