Assistive Technology & Seating Service
Vancouver Coastal Health

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Performance Analysis Outdoor

Overview

Consumers with a broad spectrum of abilities are using power wheelchairs. At one end of the spectrum we have users with single switch access; at the other end are young paraplegics who want to avoid the long-term consequences of repetitive strain injury to their shoulders. These users demand more from their chairs. Gone are the days when a manufacturer could hide their chairs shortcomings behind the old defence "But quads don?t do that!"

Handling characteristics determine to a large extent how well the chair performs outside. Other factors include: - comfort, range, top speed, and tracking. Ability to handle changes in terrain and the occasional lumps along the way are important for people who use the chair both indoors and outdoors.

A chair used primarily outdoors should be easy to drive requiring minimal user input to keep going in the desired direction; uneven terrain should not throw the chair for a loop (literally). The chair should offer adequate range such that top up charging is not needed. The chair must be comfortable on rough terrain as well as on smooth surfaces.

Users must consider their outdoor performance needs carefully. A chair which performs well indoors may not meet outdoor handling needs. Some chairs offer the driver a chance to programme the chair to respond completely differently in outdoor and indoor modes. The drawback to this solution is the driver must come to a complete stop and cycle a switch through various modes until the appropriate one is selected. None of our testers found this level of control necessary or satisfactory.

General comments		
LR RWD	K	Quite a lot of shock is transmitted through the casters when they encounter a bump. Good tracking properties but reluctant to make sharp turns on slippery surfaces. Range tends to be better than average.
HR RWD	J	Less shock transmitted from casters when they encounter a bump. Good tracking properties and a willingness to make sharp turns with minimal skidding. Range tends to be better than average.
CWD	K	Less shock transmitted from casters when they encounter a bump. Tendency to lift the drive wheels off the ground when negotiating terrain like curb cuts. Good tracking properties and a willingness to make sharp turns with minimal skidding. Range tends to be better than average.

HR FWD	K	Less shock is transmitted from the pneumatic drive wheels when they encounter a bump. There is a slight tendency for these chairs to over steer making tracking inferior. Tendency for the chair to pitch forwards when descending terrain like a curb cut. Range tends to be average.
LR FWD	L	Less shock is transmitted from the pneumatic drive wheels when they encounter a bump. The weighted casters tend to transmit some impact to the driver. There is a tendency for these chairs to over steer making tracking inferior. Range tends to be inferior.

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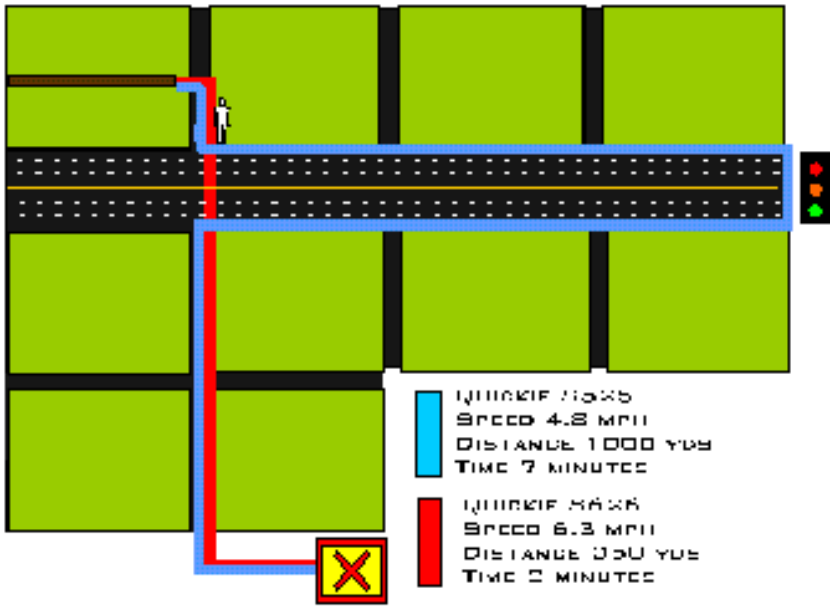
Known exceptions		
LR FWD Ω megaTrac®	J	Over-steering is prevented by a unique arrangement of motors. One drives the chair forward. The second adds power to one wheel or the other to create a steering force.

Speed

User ability plays a significant role in determining the appropriate speed for any given situation. In our experience a top speed of around 6 mph (10 km/h) is fine for open spaces such as shopping malls or sidewalks. However when the route is clear and the journey long, 10 mph (16 km/h) is awfully nice. Speed can reduce the comfort of the ride and must be taken into account. Speed also contributes to user safety and I must stress this is a two edged sword. It is quite easy, not to mention safe, for armchair clinicians and policy makers to limit top speed in the name of safety. In some circumstances this is appropriate. But, anyone who has crossed six lanes of traffic at an uncontrolled intersection in a chair with a top speed of 4.8 mph appreciates just how much safer 6 mph can be.

During the course of the testing we had to make a round trip of 5 blocks to test the chairs on an uneven stretch of pavement. See illustration. In the S525 testers did not feel safe crossing at the crosswalk, they felt that the chair wouldn?t respond fast enough to get out of the way of traffic. Instead they chose to drive down to the main intersection to cross. In the S626 the testers felt perfectly safe crossing at the crosswalk. This reduces the round trip time from 14 minutes to 4 minutes. This savings in time goes beyond speed. This is a lifestyles issue. People may nip out to the corner store if it is going to take five minutes. If it?s a fifteen minute slog they may just choose to stay home!



General comments		
LR RWD	J	Caster flutter is the main limit on top speed potential; casters with weight on them tend to flutter at higher speeds than unweighted casters.
HR RWD	J	
CWD	J	
HR FWD	K	The slight tendency for the casters to overtake the drive wheels makes this configuration unsuitable for speeds in excess of 7mph (11 km/h)
LR FWD	L	The strong tendency for the casters to overtake the drive wheels makes this configuration unsuitable for speeds in excess of 5mph (8 km/h)

Known exceptions		
LR FWD Ω megaTrac®	J	Over-steering is prevented by a unique arrangement of motors. One drives the chair forward. The second adds power to one wheel or the other to create a steering force.

LR FWD Arrow FWD	K	Invacare uses inertia to reduce the casters attempts to overtake the drive wheels. A 44lb (20kg) weight has been placed over the casters.

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Handling

Predictable handling characteristics are particularly important in a chair being used outdoors. Negotiating poorly located curb cuts is often a risky proposition with traffic flying past your elbow and it is occasionally necessary to take immediate evasive action. Spinning wheels, delayed, or overly enthusiastic response to steering input will make a chair less safe and therefore less desirable.

We have found more variety in handling characteristics between brands than between various configurations at outdoor speeds. However, some generalizations may be made since the increased speed usually associated with outdoor use tends to emphasize differences.

General comments		
LR RWD	K	Chairs are reluctant to change direction at speed if the traction is in the least bit compromised e.g., wet pavement. The wheels spin and the chair skids until speed is reduced sufficiently to allow the tires to regain traction.
HR RWD	J	Generally the best handling configuration.
LR CWD	K	CWD chairs with plenty of weight on the drive wheels respond more accurately to joystick input than CWD chairs with lots of weight on the auxiliary wheels.
HR CWD	J	
HR FWD	K	Require frequent steering adjustments to keep the chair rolling in the desired direction. (see Tracking)
LR FWD	L	Chairs require continuous steering adjustments to the joystick to keep the chair moving in the desired direction. (see Tracking)