

Performance Analysis Other Factors

Portability

Some people want their frail, yet dexterous granny to be able to dismantle, lift, store in a trunk, and reassemble their power wheelchair. Others have strong, ham-fisted cousins who eagerly await the opportunity to throw it in the back of a pick-up truck.

Anyone who travels by air may at some point find a total stranger dismantling their pride and joy, not to mention another stranger at the destination airport having to reassemble it. The world traveller will appreciate a chair featuring a simple, obvious, and foolproof process.

Transportability

Another aspect to consider is transportation in an accessible taxi. The ideal chair will have tie down locations that are obvious, easy to access, and conform to ANSI / RESNA standards. Most people tying down chairs are not familiar with the appropriate recommendations and look for a handy location to fix the straps or hooks to. In many instances these locations are not available or not appropriate. In the former situation the owner may be justifiably denied transportation. In the latter case the owner is not safely secured and may be unknowingly be placed in a hazardous situation.

Testers found it easy to get all chairs in the tests on and off both styles of Coast Mountain Trans-Link accessible buses.

Adjustability

The chair must be adjustable to fit the client. A wide range of adjustability in the standard components increases the likelihood of achieving a correct fit. The need for as few tools as possible to make these adjustments is indicative of a well designed chair. Adjustment is a major headache for dealers and clinicians when the chair is initially fitted. Once the fitting period is over however, most clients do not change the configuration. That being said, adjustability should be a concern for the clients whose balance, size, or physical condition will likely change during the life of the chair. If the user is continuing to grow, it is important a wider and longer seat be accommodated at minimal cost.

Seating systems

If the user needs a sophisticated seating system now or in the near future this should be identified prior to chair selection. Once the specific system has been identified, compatibility with the chair should be determined. Placement of seating systems utilizing existing canes and seats can be compromised by the position of stabilizing bars that are permanently welded and lower cane attachment brackets. Removal of back upholstery is usually a one-time endeavour for clients and consequently not an issue. However, it can prove to be a headache for clinicians and dealers regularly involved in seating

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assessments.

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Noise

If you spend time indoors or like to be as unobtrusive as possible, a quiet chair should be a major consideration. In our experience chairs become noisier as they get older.

Programmer

Most clients do not purchase a programmer with their chair due to the \$400-\$1000 cost. However, a well-designed programmer will allow clients to fine-tune the performance of their chair to meet their specific needs. Clear terminology, straightforward, and logical adjustment scales, and ease of implementation make it easier for inexperienced clients and clinicians to make essential changes to chair performance. Some programmers allow the user to adjust settings by as little as 1%. We found increments of less than 5% can scarcely be felt.

Joystick

This is the most common way a user interfaces with the wheelchair. If this interface doesn't work the user won't be able to control the chair. The shape and size of the knob on the joystick makes a difference to the ease of control. The displacement range and direction need to be matched to the users abilities. It must be placed and secured where the driver needs it. The controls must be within easy reach but not located in such a way that they can be accidentally activated. If a display is incorporated it should be easy for the user to see and interpret. Sometimes the joystick has to be moved for transfers or other ADL, it is nice if this can be achieved simply and if the normal position is indexed so that replacing is easy too.

The joystick has to be strong since it is often quite exposed.

Finally, some joysticks can be used as mouse emulators to facilitate computer access, remote access, augmentative communication access or other tools that aid daily living.

Damage

All chairs were exposed to the same situations and obstacles during their time with us. We feel that reporting the damage sustained during the testing can highlight potential weak spots. The factors contributing to damage are handling characteristics, design, and quality of construction. We do not expect many people to put their own chairs through the type of testing we performed, but if a user has a tendency to bump footrests into walls or is persistent, if not particularly adept at curb climbing, this section is relevant.

Transfers

Small wheels, easily removable armrests and seats that are the same width as the base combine to make transfers easier. A stable platform is also beneficial, as is an elevating seat if the owner transfers to a variety of different heights.

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Battery Charger

All the chairs came complete with a dual mode fully automatic battery charger.

Chargers must be matched to the battery being used and the connector on the chair

Battery	Ideal charger	OK charger
U1	4 amp	
Group 22	6 amp	8amp
Group 24	8 amp	6 amp
Group 27		8 amp

Dual mode means that the charger can be used with either non-spillable or spillable batteries each of which requires unique charging patterns. Nearly all wheelchair batteries are the non-spillable type: either gel, absorbed glass mat (AGM), or sealed lead acid (SLA).

Fully automatic means the charger monitors the battery's state of charge and supplies the appropriate charge automatically.

- The Lester 8 amp dual mode linear charger has been the industry standard for more than a decade. It converts 115v AC to 24v DC at 50 to 60 Hz. This requires a large, relatively heavy transformer that gets quite hot. It is housed in a large vented metal box (9" x 7" x 5"). The charger emits a quiet buzz while working. The Lester will recharge a pair of Group 22 batteries in about 8 hours.
- The Soneil 6 amp charger uses switch mode technology to convert 115 v AC to 24v DC at 100,000 Hz. This requires a relatively small transformer and produces less heat. The Soneil weighs only 1.5 lbs (2" x 4" x 7"). A small fan incorporated in the design helps to keep the unit cool. The fan is audible but by no means loud. The Soneil lends itself to unobtrusive mounting on a chair. The Soneil will recharge a pair of Group 22 batteries in about 12 hours.
- The Dynamic 8 amp charger uses switch mode technology and is capable of charging batteries up to Group 24. The unit weighs about 2 lbs; the case is a little larger than the Soneil unit (3" x 6¹/₄" x 7¹/₂"), and it does not use a fan so there is very little noise associated with charging. The case however gets quite warm.

All chargers offer "fully automatic charging" although the Lester must be set for either gel or wet cell. The Soneil also

automatically accommodates 240v AC should you venture abroad.

All manufacturers recommend charging chairs frequently and advise against opportunity charging (plugging in while eating at a restaurant, for example). As a rule of thumb, it is best to charge a chair at the end of every day it has been used. If the chair will not be used for a while the charger may be left connected or the chair may be charged twice a month.

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Specialty Controls

These include Alternate Controls and Environmental Access Controls.

Alternate Controls

All too frequently it is necessary to by-pass joystick control and use alternate means of controlling the chair. The joystick is a multipolar proportional switch. Multipolar in that if it is moved in a certain direction, it sends a signal to turn the chair that way. Proportional, in that the further the joystick is displaced the greater the chair's response. Theoretically replacing this switch (joystick) with a more suitable alternative is a simple process.

With the exception of video games a wheelchair joystick is unique in that it is the only single device used to control both direction and speed. Therefore it should not come as a surprise that it is not the most appropriate control device for all people.

Alternate controls include Sip and Puff, RIM controls, proximity switches, head arrays, or individually tailored controls incorporating switches activated by the driver's functional movements e.g., knee activation. The cost of these switches can be relatively modest. E.g., a number of our ALS clients control their wheelchairs via four, momentary, single pole switches and a TASH CA-5 module at an approximate cost of \$200. Proximity switches range from \$300 to \$800, while a complete head array costs about \$3000.

Unfortunately for the consumer the interface (Specialty controller) between these alternate controls and the wheelchair controller costs between \$1800 and \$2700 depending on the manufacturer.

The current trend in controllers is to provide more rather than less. We applaud this effort and encourage this responsible approach by industry.

Many alternate controls have the forward or reverse command latched, in that a single command results in the chair driving forwards until the opposite command is issued. It is desirable for a chair in the latched mode to travel as straight as possible thus negating the need for frequent course corrections. Most chairs can be calibrated to run straight on flat surfaces. On uneven surfaces the chair's tendency to deviate from the straight and narrow impacts significantly on suitability to task (see the Tracking section in Performance Analysis Outdoor).

When a chair is fitted with alternate controls, some degree of fine control is sacrificed. It is no longer possible to turn a RWD or FWD chair within the aforementioned diagonal dimension. The shape of the space required to perform a manoeuvre becomes even more important in determining which chair will prove suitable for an individual.

The bottom line is that it is imperative the chair characteristics match the driver's physical and cognitive strengths as well as the environment.

Environmental Access Controls

Our experience has shown that given adequate functional ability, most consumers prefer environmental controls separate from a chair's drive control. Integrated environmental controls require the driver to stop the chair, cycle through drive options that may include tilt control, recline control etc, until ECU mode 1 or 2 is selected. Then the joystick/sip and puff (or whatever) can be used to operate the triggering device be it Infra-red, RF, ultra sonic (or whatever) which in turn controls the light switch (or whatever).

Unfortunately for the consumer the interface allowing alternate control mode selection (often the same Specialty controller as mentioned above) costs between \$600 and \$2700 depending on the manufacturer.

It amazes us that the cost of one of these black boxes is more than half the list price of the least expensive chair in this test. This exorbitant cost will certainly preclude some people from this option the very people, in many instances, who have the greatest need.

We are pleased to discover that multiple drive input systems are easier to acquire, install, maintain and use. So if someone becomes weaker as the day progresses, they can change from joystick control to head array as easily as changing drive mode. It is just as simple to temporarily surrender control to an attendant operated joystick to facilitate precise positioning when getting into a vehicle.

Go to [Comparison of Wheelchairs - test results](#)