

A Funding Agency Rep contacted me requesting the weight difference between Spinergy and "regular" wheels. My response may be useful to you. I weighed four different wheels and tried as much as possible to eliminate variables like tire selection and push rim style. I used Pr1mo V Trak tires and anodized push rims.



The "regular wheels" I tried were the 36 spoke, double walled Sunrims. classicsport with a high flange hub and stainless steel spokes.

Each wheel weighed 3.2 lbs.



I also tried a 36 spoke single walled Sun rims Classic with a low flange hub and stainless steel spokes.

Each wheel also weighed 3.2 lbs per wheel.

I strongly advise against the single walled rims; they are too fragile for most people to use, and are not tolerant of reduced tire pressure. The rims tend to warp and go out of round, attempting curbs with less than optimal tire pressure will make them resemble Pac Man. It would be false economy to buy them.

The Spinergy wheels I weighed were the 18 spoke Everyday and the twelve spoke Light Extreme complete with a high flange hub, double walled rims and PBO spokes



Each 18 spoke wheel weighed 2.9 lbs



Each 12 spoke wheel weighed 2.6lbs

The Spinergy wheels offer a 10% - 20% weight reduction combined with an increase in durability and subsequently lower rolling resistance than lesser wheels this is particularly evident as the wheel ages.

The bicycle industry has done exhaustive analysis of wheel performance and while I rely heavily on their research, I have to be careful not to apply their principles indiscriminately. For example, the weight of a bicycle wheel is much less significant a factor than rider aerodynamics/ bike aerodynamics and rolling resistance. But then a bike is tested at around 10 m/s and wheelchairs are most often wheeled at 2 m/s (7 km/h) or less. The critical issue here is that aerodynamic drag increases geometrically as speed is doubled. It is the most significant single factor in determining energy expenditure at speeds above 2 m/s. E.g. - At 10 m/s aerodynamic drag is 32 times greater than at 2 m/s. This indicates that wheel weight, trueness, roundness, etc, all have more impact at lower (wheelchair) speeds.

In addition, to actual rolling performance we have to consider that wheels are removed from chairs to facilitate transfers and transportation. Often the wheel has to be lifted while the arm is stretched out reaching over the chair. A 30" reach combined with a 3.2 lb wheel applies 10.85 Nm of torque on the client's shoulder. The 2.9 lb wheel would put a little over 8.81 Nm of torque on the shoulder. That is significantly less strain. And if we are to reduce the likelihood of repetitive strain injuries of the users most critical joint, this factor needs serious consideration.

## 2011 Supplement

Since this opinion was originally penned we purchased 6 sets of Spinergy Light Extreme wheels in our facility mounted on chairs that we loan to clients pending ordering of their own. We also acquired another 4 sets of Everyday wheels through donation. Our maintenance staff report the following:-

- Spinergy wheels have never needed truing. Conventional wheels are trued as needed and given the sporadic use of each chair I would say once every three months is a reasonable estimate. I can report that we have to true about four wheels a month. We also have to discard around ten conventional wheels per year due to irreparable damage.
- Three steel spokes have snapped as a result of heavy contact with sharp objects. (Repair was as simple as replacing and tensioning the damaged spoke).
- One spinergy wheel was returned to us with fraying of the PBO fibres. This was due to a poor set up resulting in the spokes contacting a metal bracket mounted to the wheelchair frame. The fraying was cleaned up for cosmetic reasons and the spokes are still working a year later with no evidence of deterioration. The Spinergy website suggests that 30% of the material can be damaged before spoke replacement is required.

We considered making Spinergy wheels standard on our fleet chairs, the performance improvement combined with the decreased maintenance made it almost a no brainer. Unfortunately that doesn't take the light fingered element into account. We have had five sets of Spinergy wheels stolen and replaced with conventional wheels in the last three years.

## Research

Hughes and Sawatzky compared Spinergy to regular wheels and found no difference in energy expenditure required to propel a manual wheelchair. Participants however reported a smoother ride on the Spinergies, which Hughes and Sawatzky believe, has an impact on pain and spasticity issues.

### A Comparison of Spinergy Versus Standard Steel-Spoke Wheelchair Wheels

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#### Objectives

To compare the energy efficiency of straight-line wheeling using Spinergy wheels as compared with standard steel-spoke wheels, and to assess the 2 wheels in terms of user comfort and wheeling preference during a wheeling course with multiple turns and surfaces.

#### Design

Nonblinded randomized crossover trial.

#### Setting

Rehabilitation centre.

#### Participants

Twenty persons with paraplegia (neurologic level T6 and below).

#### Intervention

Wheeling a straight line and obstacle course with Spinergy or standard spoke wheelchair wheels.

#### Main outcome measures

Velocity and Physiological Cost Index (PCI) while wheeling over ground at a self-selected pace, and the User Preference Questionnaire after wheeling an obstacle course, using Spinergy or standard spoke wheelchair wheels.

#### Results

There was no significant difference in wheeling energy efficiency between the Spinerger and the steel-spoke wheels as measured by PCI ( $P=.975$ ). When rated for overall comfort, the Spinerger wheels were preferred over steel-spoke wheels ( $P=.002$ ).

#### Conclusions

Spinerger wheels provided a more comfortable ride, but did not differ from standard steel-spoked wheels in terms of energy efficiency. The increased comfort may have important implications in patient management of pain and spasticity.

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#### Summary

In my studies I have come to appreciate the most critical element determining performance of a chair is the location of the drive wheel. The next most critical element is the performance of the drive wheel.

The critical elements that make up wheels are: bearing, hub, spoke, rim, tube, tire, and of course push rim. Apart from each component performing well it is critical the interface between components is as effective and precise as possible.

Each component in a Spinerger wheel has more desirable characteristics than a regular wheel.

The bearings are of a high standard they fit the axle more precisely, spin more freely and have better seals.

The hubs are machined using CNC milling which results in a tighter tolerance between the bearing and housing and also between the spoke and hole than a conventional forged hub does. The microscopic structure of the aluminum is more uniform in a machined hub than a forged hub and it is less likely there will be weak spots that can break.

The PBO spokes are flexible and can be tensioned to a higher level than stainless steel ones which makes them more impact resistant and transfer the propulsive effort more efficiently to the ground. They may also provide a damping effect as reported by Hughes and Sawatzky.

The double walled heat-treated rim resists warping is stronger and about the same weight as a single walled rim. The double walled rims resistance to dents and warping helps to minimize the energy cost to the wheeler.

The 12 spoke LX had some breakage issues at the hub when it was introduced but this has been corrected in the current model. The 18 spoke is perhaps more suited to situations where there is potential for impact, the larger number of spokes make it more likely that the forces will be dissipated more effectively, if regular impacts are expected, spoke guards should be used to spread the impact even further.

These are the benefits of Spinerger wheels. The drawback is the initial cost, which is twice as much as a regular wheel. Whether the benefits justify the cost is dependent on the individual situation.

There you go, more than you wanted to know I bet.

Ian