A Guide to Wheelchair Selection

How to Use the ANSI/ RESNA Wheelchair Standards to Buy a Wheelchair

Peter Axelson, MSME
Jean Minkel, MAPT
Denise Chesney, MEBME

Illustrations by Peter Thomas

Washington, DC 20006

PERFORMANCE

There are hundreds of manual wheelchairs on the market today. As you begin the process of comparison shopping, you will want to know exactly how your wheelchair will perform. The ANSI/ RESNA Wheelchair Standards address four aspects of the wheelchair that affect its performance:

- Weight
- Stability
- Durability—Fatigue Strength
- Maneuverability

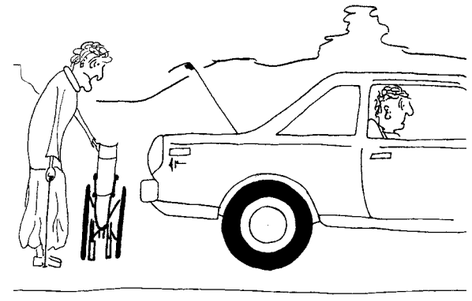
For these performance tests, the manufacturer gives the results as specific values. There are no minimum performance values; therefore, no wheelchair fails these tests. If the chair tips over backward on a slope of only one degree, that is what is reported. It will be up to you to determine if the wheelchair's performance is compatible with your abilities, lifestyle, and environment.

Until you understand exactly what these performance values mean, your experience with using a particular wheelchair will help you understand how other wheelchairs will perform. By comparing test results, you will learn how other wheelchairs perform compared with the wheelchair you currently use. The information provided by these tests will enable you to make true comparisons among wheelchairs, because each chair will be tested the same way.

WEIGHT

How heavy is the chair?

Whether you prefer a tank-style chair or a super lightweight chair, you will want to know and compare the weights of several different chairs. The weight of the chair may also be important if you need to stow it in the back of your car when you drive, or if the person assisting you needs to lift the chair into and out of the trunk.



The weight of your wheelchair is not just an issue for you as the rider…

Weight Test Procedure

ANSI/RESNA Wheelchair Standard Part 05: Determination of Overall Dimensions, Mass, and Turning Space

The total weight of the wheelchair equipped with standard armrests, legrests, wheels, and casters is measured.

Disclosure Format (as reported by manufacturers)

Name of Test	Test Result
Total mass of wheelchair with accessories	*___ lb (___ kg)*

Additional information not required for disclosure in the product literature:

Mass of each removable component of the wheelchair	*___ lb (___ kg)*

Interpretation of Results—Weight

The results of this test procedure help you to compare wheelchairs manufactured by different companies. Using these results, you will be able to identify the lightweights and the heavyweights. Most important, you will be able to find the chairs that fall within the weight range you desire. This information indicates how the wheelchair will perform and whether you or the person assisting you will be able to load it into a car.

Knowing the weight of each removable component of the wheelchair may also help in your selection process. If fully equipped wheelchairs (with standard armrests, legrests, wheels, and casters) are too heavy to lift, you may choose a wheelchair based on the weight of the heaviest component, which is usually the frame. This information is not required for disclosure in the product literature, but it is available upon request from the manufacturer. Using the weights of the wheelchair and each of the components, you can calculate the weight of the chair equipped the way you like it.

One component that significantly changes the weight of the wheelchair is the main drive wheels. Depending on the chair, either spoke or mag wheels are standard. In general, spoke wheels are lighter, but they require more maintenance, since the spokes can become loose or break. Mag wheels are heavier but are virtually maintenance free. The tire you choose also can make a difference in the weight. A lightweight, Kevlar-reinforced tire with a thin tube can be significantly lighter than a heavy rubber tire with a thick-walled tube. Your own body weight represents a large percentage of the combined weight of the wheelchair and rider. Therefore, shaving off a pound here and there on the wheelchair may not result in a significant difference in wheelchair performance, but it may be necessary if you need to load it into your car.

STABILITY

How tippy is the chair?

Let's face it, the world is not flat. Hills, ramps, curb cuts, and sidewalks with side slopes are just a few of the reasons you might want to know how tippy your wheelchair will be. The stability of the wheelchair standing still not only indicates how tippy the chair is when at rest; it also indicates how stable the chair will be when it is moving. If you have a lot of rider experience or are very active, you may prefer a chair that tips back into a wheelie position with just a slight shift of your weight. If you do not have much experience or upper body mobility, you may want a more stable, less tippy chair.

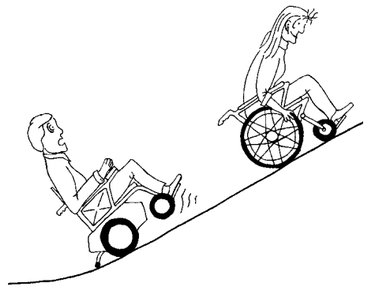
Stability Test Procedure

ANSI/RESNA Wheelchair Standard Part 01: Determination of Static Stability

The wheelchair is placed on a standardized test surface with a weighted test dummy positioned in the chair. The test surface is tilted with the wheelchair facing uphill, downhill, and sideways. The angle at which the wheels of the wheelchair lift off the test surface is recorded in degrees.

Disclosure Format (as reported by manufacturers)

Name of Test	Test Result
Facing downhill / brakes on	*tips at ___ degrees of slope*
Facing uphill / brakes on	*tips at ___ degrees of slope*
Facing sideways / brakes on	*tips at ___ degrees of slope*
Other critical direction / brakes on	*tips at ___ degrees of slope*



Having the ability to lean forward in your wheelchair allows you to negotiate steeper ramps…

Interpretation of Results—Stability

During the test, the wheel locks are engaged, simulating you, the wheelchair rider, holding onto the handrims on an incline. The best way to create the same effect during testing is to apply the wheel locks.

The smaller the uphill tip angle, the tippier the wheelchair. This means that the chair started to tip when the platform was tilted a small amount. A wheelchair that tips more easily will be easier to maneuver and will have less tendency to turn downhill on side slopes. Because a larger percentage of your weight is on the rear wheels, the wheelchair will have greater traction. However, the wheelchair will be less stable and more likely to tip over backward when you go uphill unless you can adjust your body weight by leaning forward. When your body weight is over the main drive wheels of your wheelchair, the chair is tippy. When you shift your weight forward—either by leaning forward or by moving the main drive wheels back—you make the wheelchair less tippy.

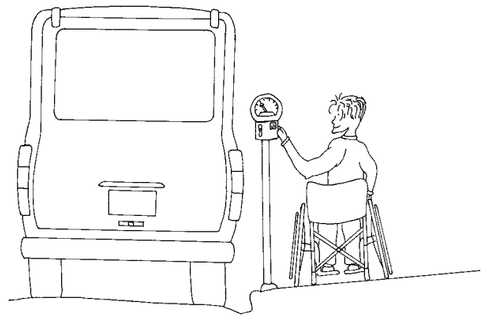
Conversely, a greater uphill tip angle means that the platform was tilted more before the chair's wheels lifted off the platform. Chairs with larger tip angles are less tippy, harder to maneuver, and have a greater tendency to turn downhill on side slopes. Less weight is distributed over the rear wheels, which may result in rear wheel slippage when you go down an incline.

A chair with a smaller downhill tip angle is less stable going forward. During testing the platform is tilted, raising the back end of the wheelchair. This simulates a wheelchair facing downhill. When you travel down ramps and curb cuts, you may need to lean back in the chair to prevent it from tipping forward. Unless you have good balance and a low-back chair, you may not be able to lean back in the wheelchair. If you cannot lean back in the chair, you should probably consider a chair that is more stable in the forward direction: one with a greater downhill tip angle.

If the manufacturer reports a range of tip angles, this indicates that the position of the rear wheel, front caster, and/or other features is adjustable. Some wheelchairs have only distinct vertical and/or horizontal positions in which the main drive wheels can be located. Other chairs offer an infinite number of horizontal axle positions. Adjusting the rear wheel forward will decrease the wheelbase and will decrease the stability of the chair in the rearward direction. Moving the rear wheel backward will increase the wheelbase and consequently increase the rearward stability of the chair. Changing the vertical position of the rear wheel changes the seat height and angle and may either increase or decrease stability, depending on the location of the center of mass of the system. The fore-aft adjustment of the caster, if available, changes the length of the wheelbase. The smaller the wheelbase, the tippier the chair in either the forward or rearward direction. Many users increase the tippiness of their wheelchairs as they gain more rider experience.

A chair with a smaller sideways tip angle is less stable side to side. A chair with a smaller sideways tip angle is more likely to tip over sideways when you travel across surfaces with steep cross slopes or lean over the side of the chair.

A range of sideways tip angles usually indicates that the amount of camber is adjustable. Camber is the angling of the main drive wheels out at the bottom of the chair. Some manufacturers allow users to customize their chair by changing the camber. Increasing the camber will make a wheelchair more stable from side to side but will also increase the overall width of the chair and make it difficult to get through narrow doorways. Camber also moves the pushrims in closer at the top of the main drive wheels, which will enable you to reach your pushrims easier and may actually prevent you from hitting your fingers as you pass through doorways.



Extra camber on your wheelchair makes your chair a little more stable on cross slopes and moves the handrims a little closer in on the sides. . .

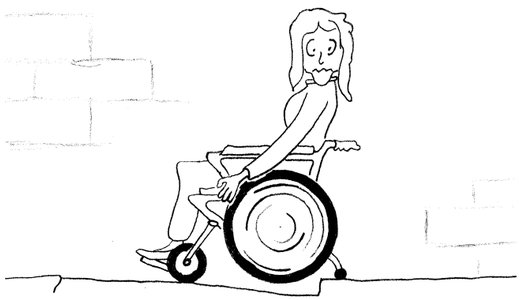
Note: Remember that the tip angle is not an indication of the quality of the wheelchair, but a matter of personal preference.

To give you an indication of the angles of the slopes you may encounter in public places, accessible environments that comply with the Americans with Disabilities Act Accessibility Guidelines (ADAAG) will not have slopes

greater than 1:12 (4.8 degrees). Therefore, a wheelchair with an uphill tip angle of greater than 5 degrees will probably not tip backward when you climb a public ramp, especially if you can lean forward in the wheelchair. If, however, the downhill tip angle is close to 5 degrees, you may end up performing somersaults while trying to wheel down the ramp, unless you can shift your body weight by leaning backward.

The disclosed test results apply only to the wheelchair as tested by the manufacturer. If you want different main drive wheels or casters, the stability of the chair may change. For example, smaller diameter rear wheels or larger front casters will tilt the wheelchair to the rear and possibly decrease its stability going uphill.

Anti-tippers are extra little wheels designed to prevent a wheelchair from tipping over backward. They will affect the stability of the chair when going uphill. Although anti-tippers prevent the wheelchair from tipping, many riders do not like using them. They restrict the chair's ability to go over obstacles, because they can get caught on the obstacle. In addition, it is almost impossible for the wheelchair rider to adjust anti-tippers from the down/engaged position to the up position or vice versa while sitting in the wheelchair because they are difficult to reach.



Anti-tippers can literally leave you spinning on your wheels...

DURABILITY—FATIGUE STRENGTH

How long will the wheelchair last?

A wheelchair is a major purchase; the last thing you want is a chair that falls apart after a week of taking it over bumps, up and down curbs, in and out of the car, and through all the other activities you do in your chair every day. How long will a wheelchair last? The durability of the chair is important, whether you are a very active rider or not. If a wheelchair component breaks, you could be hurt or stranded somewhere. Fatigue tests are intended to determine the durability of the wheelchair and its components by subjecting them to a large number of low-level stresses, similar to the forces the chair is subjected to in daily use.

Durability—Fatigue Strength Test Procedure

ANSI/RESNA Wheelchair Standard Part 08: Static, Impact, and Fatigue Strength Tests

The wheelchair, loaded with the test dummy, is positioned on a double drum fatigue test machine. This machine consists of two cylindrical drums that are rotated by an electric motor. The wheelchair is placed on these cylindrical drums and it rolls as the drums turn. Slats attached to the drums cause the chair to bump as it rolls. One cylinder turns more quickly than the other, making the bumping uneven. This bumping simulates a user riding over rough ground. The chair rolls on the cylinder for a set number of cycles.

A second fatigue test is the curb drop test. In the curb drop test, the loaded wheelchair is dropped in a free fall manner from a height of approximately two inches. One curb drop fatigue test is performed for every 30 cycles on the double drum fatigue test machine. The manufacturer is asked to disclose the number of double drum and curb drop cycles that the wheelchair makes it through without failure.

Disclosure Format (as reported by manufacturers)

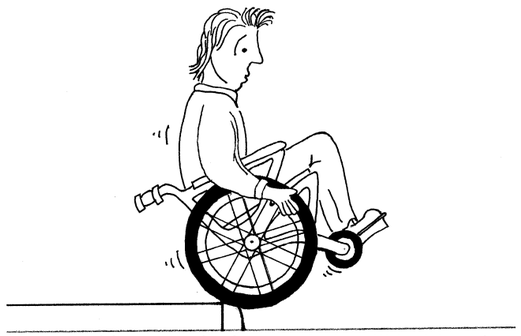
Name of Test	Test Result
Double drum test	___ cycles
Curb drop test	___ cycles

Interpretation of Results—Durability

If the manufacturer discloses that its chair has been tested with a large number of double drum and curb drop cycles, it means that the chair is more durable than one that only passed a smaller number of test cycles. However, if the man-

ufacturer discloses that its chair has been tested to a smaller number of double drum and curb drop cycles, it may only mean that they stopped testing after that many cycles. Unfortunately, the test procedures do not require the manufacturers to test their wheelchairs until they fail. The manufacturers are only required to disclose how many cycles the wheelchair completed without failure.

During fatigue testing the entire wheelchair (frame, seat upholstery, wheels, and all other components) is subjected to a large number of stresses. The composition and construction of each of these components affects the durability of the wheelchair. When a major component of the chair fails, the testing is terminated. If a bolt comes loose or an adjustment needs to be tightened, the testing is continued until a major component failure occurs.



You want to know that your chair will hold up to the sort of use it sees from day to day…

Frame Material

While many components can be replaced for a small fraction of the cost of the wheelchair, the frame cannot, because of the cost of frame construction. Wheelchair frames are usually made from mild steel, stainless steel, chromoly steel, aluminum, titanium, or a composite. A wheelchair constructed from one type of material is not necessarily more durable than one constructed from another. Although each material has a specific amount of strength per weight of material (strength-to-weight ratio), wheelchair designs vary so much that you cannot determine the durability of the product solely by the material used. The frame tubing thickness, tubing shape, welding technique, and how the components are assembled together are just a few of the factors affecting the fatigue strength of the chair.

While the type of frame material may not indicate how long the chair will last, it does provide some other helpful information.

Frame Material	Advantages	Disadvantages
Mild steel	• Easily repaired and welded in places where high-technology welding equipment is not available • Moderate strength-to-weight ratio	• Relatively heavy
Stainless steel	• Highly resistant to corrosion	• Lower strength-to-weight ratio than other steels
Chromoly steel	• High strength-to-weight ratio • Essentially a high-technology steel	• More expensive than mild steels
Aluminum	• High strength-to-weight ratio	• More expensive than mild steels
Titanium	• Very high strength-to-weight ratio • Highly corrosion resistant	• Very expensive
Composite	• High strength-to-weight ratio • Ability to form nonconventional shapes	• Surface finish chips easily

Frame Finish

The way the frame of the chair is chemically prepared, primed, and painted will affect the durability of the finish. Getting paint to adhere to stainless steel is difficult, and it is almost impossible for titanium. Composite materials are covered with colored gel coat or painted, but these finishes can chip. Steel and aluminum can be finished with various standard processes. One of the best processes is powder coating. This finishing process minimizes paint waste and results in a durable finish.

Casters

Both the size and the type of caster affect the durability of the wheelchair. During the double drum test, the slats on the cylindrical drum constantly hit the casters, and the forces generated are transferred to the rest of the chair. This is similar to what occurs when you ride over obstacles or uneven terrain (e.g., door thresholds, sidewalk cracks). Because the casters are the first part of the wheelchair that contacts the obstacles and because of their small diameter, they take a substantial beating. Large pneumatic casters can absorb these forces better than small solid casters and can cushion the wheelchair, causing less wear and tear on other wheelchair components.

MANEUVERABILITY

How much space does the wheelchair need to turn around?

You have probably created a home or office environment that allows you as much access as possible in your current wheelchair. Try to make sure your new wheelchair does not create new architectural barriers because its turning radius is larger than that of your current chair. On the other hand, you may want to improve your access so you can maneuver more easily in hotel rooms, small apartments, tight office spaces, narrow dormitory hallways, bathrooms, or those ridiculously small public toilet stalls.

Maneuverability Test Procedure

ANSI/RESNA Wheelchair Standard Part 05: Determination of Overall Dimensions, Mass, and Turning Space

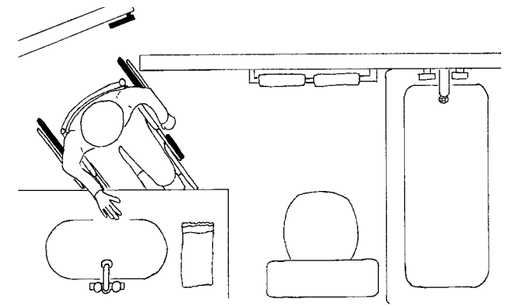
In order to measure turning space, an adjustable corridor is created and a three-point turn maneuver is performed. The corridor is narrowed until the wheelchair is unable to perform the maneuver. The minimum corridor width in which the chair can turn is disclosed.

Disclosure Format (as reported by manufacturers)

Name of Test	Test Result
Minimum turnaround width	___ inches (___ mm)

Additional information not required for disclosure in the product literature:

Minimum turning radius	___ inches (___ mm)



An extra inch can mean a lot in a small bathroom…

Interpretation of Results—Maneuverability

The results of this test are essential if you live or work in an environment with tight spaces. If there is a particularly narrow hall or space at home, work, or school, measure its width and search for chairs that can perform a three-point turn in spaces that size or smaller. Remember that footrest assemblies can be removed, if necessary, to improve the chair's ability to turn around in tight places. The size of the caster can also increase or decrease the wheelchair's maneuverability. Smaller caster wheels swivel more easily without hitting your feet.

Once you have limited your choice to a few chairs, you may want to check the turnaround space for each of the chairs to make sure they will be able to get you through or into and out of any tight spots in your home.