

Power Wheelchairs *and* Residential Fire Safety

(MOTORIZED WHEELCHAIRS & SCOOTERS IN SHARED HOUSING)

Some residence managers contemplate barring the use or storage of electrically powered mobility aids in their buildings because of concerns they may cause fires. This paper explains how motorized wheelchairs and scooters can be safely used and stored indoors.

The National Institute for Rehabilitation Engineering (NIRE) is a non-profit organization which operated clinics to design, dispense and fit customized assistive equipment, with user training, from 1967 through 1996. Working with disabled people and their own doctors and therapists, these NIRE clinics assisted *hundreds* of people having severe and permanent motor impairments. *The N.I.R.E. pioneered the development and use of personalized power wheelchairs (some steered and controlled with inertial guidance systems or with breath controls, by people unable to use hand controls); these included indoor, outdoor, indoor-outdoor models, and some designs capable of climbing curbs or stairs.* During these years, a great deal was learned concerning USER SAFETY and PUBLIC SAFETY. This paper explains many safety questions and issues. The paper is intended to be of assistance to power wheelchair users, new and old. *PERMISSION is herewith granted for the free copying and distribution of this © paper, provided all copies are complete and unaltered and The NIRE is fully credited as the source.*

THIS PAPER is intended for building managers - and for people using, or planning to use, power wheelchairs or motorized scooters in multiple-unit housing. *In this paper, we discuss “Fire Prevention and Resident Safety in Group or Public Housing”, as related to the use and storage of power wheelchair mobility aids. This is an important safety issue for resident power wheelchair users, for all residents, and for building managers.* The truth is that light fixtures, televisions, computers and other common household appliances cause many more fires than do electrically powered mobility aids.

FIRE-SAFETY & PREVENTION CONCERNS

This Institute has received numerous requests for residential safety information concerning: (a) the prevention of interior fires caused by the presence or use electric wheelchairs and scooters; and (b) how to best evacuate people in power wheelchairs when there is a fire. This paper answers these questions as they can best be answered. *Please note that the safety of sleeping residents depends, not only on the safety of electric mobility equipment, but also on the safety of all other appliances and equipment used or stored in the premises.*

IMPORTANT SAFETY MEASURES for residential facilities and their occupants

1) **Prohibit, limit use of, or provide controls over flammables** in occupied buildings, with or without powered mobility aids. **Especially dangerous and to be avoided, or to be well-controlled, are:** natural gas, propane gas, and flammable liquids such as kerosene, gasoline, alcohol and cleaning fluids. Also, flammable solids such as pads, pillows, mattresses and curtains. Prohibit indoor use or storage of propane or gasoline powered devices such as lawn mowers, golf carts, scooters, grills, etc.

2) **Be certain all electrical appliances are isolated from flammable fumes and fluids.** This must include all light fixtures, television sets, radio receivers, telephones, personal computers, hair dryers, etc.

3) **Power wheelchairs and scooters can be limited to the safer types.** They should be electrically powered and have these characteristics, for maximum safety:

- (a) Use sealed gel type rechargeable batteries. (NO liquid electrolyte).
- (b) Use no-spark electronically controlled battery charger with safety cables & plugs.
- (c) Use wheelchair motors that are ac brushless induction motors. Avoid all brush-type motors, whether ac or dc powered, because the brushes spark.
- (d) The wheelchair controller should NOT have ON-OFF switches (which spark) unless they are sealed and fireproof. It should have continuously variable electronic speed & power controls.
- (e) Every wheelchair and scooter in a building should have fire-retardant cushions and upholstery. Likewise, all beds, sofas, upholstered furniture, cushion, pillows, carpets, and curtains should be of fire-retardant material.
- (f) Residents and visitors should be forbidden to smoke in the buildings.
- (g) All areas should be equipped with approved fire- and smoke- detectors. They should also have natural gas and carbon monoxide detectors. All areas should have audible fire alarm warning systems and, if deaf people are resident, visual and vibratory alarm signals for the deaf people.
- (h) All rooms, apartments, offices, closets, storage areas, waste storage, utility, and laundry areas should be subjected to regularly scheduled (and to occasional surprise) safety inspections, by qualified inspectors.
- (i) **Oxygen Users** may have in their living quarters, either of two types of breathing aids. (1) One type, often used by (normally mobile) people with COPD or other breathing disorders, is a **room-air oxygen concentration machine**. An apartment with such a machine is at increased **risk for fire**. The apartment should NOT have a gas heater or a gas stove because the atmosphere is much more explosive with the concentrator than without. Also, cigarettes and open flames should be avoided in such an apartment. (2) The other type oxygen device involves use of a **thin plastic tube in a person's nose**, to deliver the needed oxygen. This nasal tube does NOT normally release oxygen into the apartment and should be completely safe for everyone.
- (j) **Powered Ventilators - or Respirators** – may, when needed for life support, be in the bedroom and possibly on a powered wheelchair. In the residence, they are usually plugged into an outlet and ac-powered. On a wheelchair, they are battery powered. These are life-support devices that must be kept running and must be kept with the user, no matter what the emergency. Housing management and maintenance personnel should be aware of all residents using these devices; should have approved power backup arrangements; should evacuate these disabled people first; and should arrange for ambulances or EMT personnel to remove these residents and their ventilators quickly and

efficiently when there is an evacuation. **Note: Most of these devices will not start fires because they are designed to be used in oxygen enriched atmospheres.**

EVACUATION METHODS for power wheelchair users (if elevators not working)

1) **Six steps or fewer:** It may be possible for one or two strong men to manually roll an occupied power wheelchair down the steps. This may be safest with one strong man on top, and one below.

2) **More than six steps, but fewer than 15:** The disabled person may be taken down either in a lightweight manual wheelchair or on a stretcher. The power wheelchair may then be manually carried down, unoccupied.

3) **16 steps or more:** Leave the power wheelchair – and carry the disabled person down the stairs on a stretcher or in a light-weight manual wheelchair.

4) **Assuming elevators are inoperative,** the facilities should have outside ramp escape routes that interface with 1st, 2nd and 3rd floor emergency exits. *NOTE: This may be easier to implement for buildings on hilly terrain (than for buildings on flat, level terrain.)*

ENSURING FIRE-SAFE ELECTRICALLY POWERED MOBILITY AIDS (Powered Wheelchairs and Scooters ... and their Battery Chargers)

Equipment dealers and manufacturers who sell these types of mobility devices know which models are safest with regard to residential fire potentials, primary and secondary. These manufacturers and vendors know or should know about motors with and without brushes and non-sparking variable power & speed controls.

It is wise for all buyers of electric mobility aids to choose models that, first, are of the safest design and construction. From these models, they can then select specific configurations compatible with their physical and functional needs. These priorities are wise, even for a person living in his own single-family home. As for group living, whether in apartment buildings or in assisted living facilities, the electrically powered mobility aids must be fire-safe for the well-being of all residents of and visitors to the building. Thus, the building's management can and should be actively involved in establishing and maintaining the best possible fire prevention conditions. Because this goes well beyond the wheelchairs and scooters (as discussed in this paper), the services of an architect or safety engineer may be very helpful for planning and for periodic safety inspections.

For wheelchair users, every building should have emergency evacuation plans and there should be periodic evacuation tests or training drills. These will ensure preparedness for when a real emergency occurs.

Stair-Climbing Wheelchairs exist but are rarely used. If a disabled resident happens to own and use a stair-climbing wheelchair, then special precautions must be taken during an emergency evacuation – if it is to be used at all. It is preferable to NOT

use it because of the stress conditions, haste, and the presence of so many other people. If it is to be used to descend stairs, then it should be used for one flight of stairs – or less. Never for more. Even then, it should be used only by an experienced user; only with other people kept away for their own safety (should it fall); and only after the steps are visually inspected and found to be free of debris. Of course, if visibility (of the steps) is poor due to power failure, smoke or other factors, use of a stair-climbing/descending wheelchair should not even be considered.

SOME USEFUL ADDITIONAL INFORMATION – for wheelchair user evacuations - with or without powered mobility-device removals:

A BASIC DANGER OF STAIR-CLIMBING or DESCENT in a wheelchair is the fact that, if an occupied stair-climbing wheelchair falls down a flight of stairs (it could fall from near the top of a 32-step stairway) then serious injury or death to the user is the likely. Others in the area may also be injured or killed by such a fall.

Age & Health Factors can be very significant to safety, both in preventing – and in surviving accidents. Examples: (1) A young paraplegic with normal upper body functions and strength. This fast moving person, with good eyesight, may well maneuver fast and vigorously enough to prevent an accident. Even if his wheelchair turns over or falls down a flight of stairs, the person has the highest chance of surviving with minimal injuries. Or, (2) an elderly paraplegic, or a wheelchair user of any age with upper body weakness and impaired movement abilities, is less likely to prevent an accident or fall at the last moment and is much more likely to suffer serious injuries or death in a fall, collision or accident.

USERS of Power Wheelchairs – DISABILITY CATEGORIES & SAFETY RISKS as summarized below, do not include the added hazards of navigating a power wheelchair with poor vision or with susceptibility to fainting or unexpected seizures. It is assumed that all wheelchair users are strapped in for safety. Two straps should be used: one, down, lap to chair – and the other higher up, securing the upper body to the backrest of the wheelchair. *The wheelchair user must be secured both ways for maximum safety.*

- A) **Paraplegics - Healthy, Fit & Active** are typically the safest users of manual, power-assisted, and fully powered wheelchairs. **LOWEST RISK**
- B) **Amputees – Missing Legs and/or Arms but with active upper bodies** are usually safe users of power wheelchairs, depending on the type of control devices used. If planned and implemented properly, then **LOW RISK**.
- C) **People with Weak or Poorly Controlled Upper Bodies using standard joystick** to reliably control power wheelchairs. This category may include some people with Cerebral Palsy, some with Multiple Sclerosis, some with Parkinson Disease, and people with many other conditions. Some of these conditions may cause impaired eyesight, slowed reflexes and/or impaired judgment. All should be fully screened for such functional deficits just as for automobile driving safety. **MODERATE RISK.**

- D) **People with Little or No Upper Body Movement, using special quad controls** such as mouth joystick, puff & sip breath control, or gyroscopic (inertial) wheelchair controls. HIGH RISK.
- E) **Paralyzed Small People – Children and “very small” Adults ...in special seats** or carriers often need a power wheelchair, most of all when significantly paralyzed. Depending on mechanical implementations, individual conditions, and personalized mobility and safety training, these people are at HIGH RISK.

SAFETY - INFORMATION ... re Use of Power Wheelchairs (by users or rescuers)

- 1) **Mechanical BRAKES** that can be set or released by the wheelchair user are necessary safety items – an absolute “must” for outdoor wheelchair use. Some chairs have mechanical brakes that are hand-operated by a user with normal functioning of both hands - but not by users with impaired hands. Other chairs have no mechanical brakes but use “dynamic braking.” This helps slow the chair to a rapid stop when powered and moving. *It does NOT lock the wheels to prevent rolling down a steep incline. Buyers of power wheelchairs should always insist that the vendor includes mechanical brakes that the user can operate.* They must be operable when moving, to brake, stop and lock the chair. Also, it must be possible for the wheelchair user to manually lock or to release the mechanical brakes ... when stopped. For quadriplegics unable to move a lever, it is feasible to use standard mechanical brakes that are set, locked and unlocked by small user-controllable electric motors.
- 2) **FRONT-WHEEL Configurations** are very important for user safety. Power wheelchairs for outdoor use should always have powered large wheels in front; never free-swinging casters. Indoor wheelchairs with front casters are safe for outdoor use only on flat, level surfaces. They are at risk on sidewalks because of slab variations and irregularities, and totally unsafe on grass and soil. Wheelchairs with front casters are designed for indoor use because they offer better indoor maneuverability.
- 3) **USER ARM-STABILIZATION** should be considered for the wheelchair user with impaired arm and hand function. An orthotic elbow or forearm support can be installed on the wheelchair to support the hand used to operate the wheelchair’s controls. This support can provide vital stabilization for the hand that steers and controls the power wheelchair.
- 4) **SAFETY SHUT-OFF & BRAKING CONTROLS** should be provided for power wheelchair users who use mouth, breath, or other than hand controls. The user with normal use of one hand can steer the power chairs with the control stick, can operate auxiliary power control switches and can apply or release mechanical brakes. Quadriplegics should have special devices installed immediately to shut the power off and apply the brakes, if special sensors detect the wheelchair moving unsafely or out of control. The seller of the wheelchair and controls should include these safety

features, which should be tested with the user and be approved by an occupational therapist..

- 5) **Traversing INCLINES** – Always steer UP or DOWN an incline. *NEVER travel across an incline ...* because the wheelchair is likely to fall over sideways - if you do. For wheelchairs with casters in front, *avoid areas in the pavement or path that tilt to one side* to avoid having the wheelchair roll off the path and over an embankment.
- 6) **Avoiding GROUND OBSTACLES to Wheels ...** such as stones, cracks, curbs, etc. which must be seen and avoided by the wheelchair user to prevent sudden deflection of the chair to one side, off the path.
- 7) **BATTERIES should be Fully Charged** before leaving home. It is dangerous to be stranded outdoors in a power wheelchair with dead batteries. Periodically, the batteries should be checked by a technician for physical condition, cable connections and remaining charge capacities.
- 8) **Power wheelchair Users often have a CELL PHONE ...** for safety. People with impaired hand dexterity, unable to operate a standard cell phone, can have a cell phone attached to the wheelchair that is modified for use by even a quadriplegic. If you cannot afford monthly cell phone fees, then get a “911-only” cell phone for which there are no monthly charges. Cell phones should be wired to work from both internal battery and wheelchair battery. Electrical noise filters may be needed to suppress motor noise. Wiring should be “fire-safe”.
- 9) **Powered VENTILATOR Users** should have a separate rechargeable battery on the wheelchair, for the ventilator. This assures that the ventilator will not fail even if the power wheelchair battery is exhausted. There should be an audible alarm device and the chair should have a cell phone or a 911 phone.
- 10) **Avoid RAIN and SNOW** which are especially hazardous to power wheelchair users, and to the expensive equipment. Try to stay out of falling rain or snow; try to stay off wet, slippery surfaces coated with rain or snow. If you must travel in rain or snow, use a wheelchair van.
- 11) **When being TRANSPORTED in a Wheelchair Van** always make certain that: (a) the wheels of the wheelchair are locked to the floor of the van; (b) that the wheelchair undercarriage or seat is tightly strapped down to the floor. (c) that the user is strapped DOWN to the seat – and BACK , from the chest to the seat’s back structure. Countless wheelchair users have been thrown forward, out of their chairs, into the windshield and to their deaths because they did not follow these precautions. These must apply whether the van is privately owned, rented or a public for-hire service vehicle.
- 12) **Outdoor STAIR-CLIMBING Wheelchairs.** Outdoor steps are usually wider, deeper and shallower than inside steps, and often of shorter height.

Some outdoor power wheelchairs with large, powered wheels in front, are designed to safely carry the user up or down flights of outdoor steps, as found in front of courthouses or public buildings. *These chairs cannot safely carry a person up or down the types of stairs found indoors, in homes, offices and public buildings.* Never try on indoor stairways!

- 13) **Indoor STAIR-CLIMBING Wheelchairs** *are the most dangerous to use* because indoor steps are steep, narrow, high and have short depths as compared with outdoor steps. Most indoor stairways are not designed to support heavy weight in one area and can crack or break without warning. Also, indoor steps often have poor visibility so that unseen clutter, wet spots and damaged areas can cause the heavy power wheelchair to slip, slide, lose its grip on the stairs, and crash to the bottom injuring or killing the user. CAUTION: Always have an able-bodied wheelchair technician or mobility trainer who is familiar with the stair-climber, test climb and descend a particular flight of indoor stairs before the wheelchair user tries it. Even then, the user should climb and then descend the same stairway two or three times in the presence of the technician or trainer. **CAUTION: Stair-climbing wheelchairs may be unsafe in a private home** because they are heavy. With batteries, such a wheelchair may weigh about 400 lbs. Add 200 lbs. for the user and the total weight can equal 600 lbs. This is enough weight to crack, break or dislodge one or more steps, causing the wheelchair and user to fall down the entire flight of stairs.
- 14) **Periodic Preventive MAINTENANCE** is absolutely necessary to maintain the safety of any power wheelchair, stair-climbing or not. We recommend daily minor, and weekly major inspections by the user. We also recommend a professional inspection at least once every 3 months for most users, and as often as once a month for very active and/or severely disabled users. If tires are air-inflated, air pressure should be checked before each day's use. Solid tires should be visually inspected for breaks. *For SAFETY, legal and financial reasons, it is recommended that all power wheelchair service be provided by the seller, by the manufacturer or by a local mechanic who is designated as a "manufacturer's representative".*

For additional information or free technical support, please email: nire@warwick.net or contact us by regular mail or telephone.

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