



# Cushioned Carpet and Wheelchair Mobility:

## Testing Methods, Results, and Interpretation

### Introduction

Today's cushioned carpet offers several advantages over non-cushioned carpet. It is soft enough to provide underfoot comfort while remaining firm enough to support postural stability. Cushioned carpets can also prevent moisture penetration and deliver excellent noise reduction properties. Historically, decreased wheelchair mobility has been considered a drawback, leading to the perception that building owners or occupants must weigh this trade-off when evaluating its benefits. However, due to recent advances in flooring science, this assumption is no longer accurate. This paper examines how cushioned carpet affects wheelchair mobility, with a particular focus on manual wheelchairs. It outlines a testing method used to measure the force required to roll a wheelchair over two types of commercial carpets and introduces an approach to assess potential injury risks. Understanding rolling resistance is essential for selecting safe flooring in wheelchair-accessible spaces while benefiting from the many advantages of cushioned carpets.

### Human Factors

Pushing wheelchairs can result in musculoskeletal injuries, particularly affecting the back, shoulders, and wrists due to repetitive movements and applied forces. Common injuries include soft tissue damage, sprains, strains, and chronic pain. <sup>1</sup>

### Rolling Resistance

Rolling resistance, or rolling friction, is the force that opposes a rolling object's motion. Factors affecting it include wheel diameter, tire type, pressure, alignment, weight distribution, passenger weight, and floor compressibility. Compressible flooring typically increases rolling resistance more than rigid flooring. Some commercial carpets, even with cushions, generally have low compressibility.

### Rolling Resistance Testing

Manufacturers employ various laboratory methods to measure rolling resistance by determining the force needed to move a wheelchair forward. <sup>3</sup> While laboratory testing provides precise measurements, it does not always reflect real-world wheelchair mobility. Accredited testing laboratories have developed more practical methods for simulating in-field conditions. <sup>4</sup>

#### These tests require:

- A wheelchair weighed up to simulate an occupant (typically 150-200 lbs.)
- A load cell to measure resistance
- A laptop for recording data
- A mechanism to move the wheelchair at a constant rate

During testing, both the force required to initiate movement, and the force needed to sustain motion are recorded. By comparing results across different flooring types, decision-makers can select flooring with the lowest rolling resistance to enhance accessibility.

### Testing Data

The table below illustrates the force required to initiate and maintain motion for two cushioned carpet types produced by Mohawk Group. ComfortGuard is a broadloom carpet with a urethane cushion backing, while EcoFlex® ONE is a modular carpet featuring an integrated cushioning layer. Both carpets have low compressibility.

SAMPLE	FORCE TO INITIATE MOVEMENT	FORCE TO SUSTAIN MOVEMENT
ComfortGuard	6.8 lbs.	4.8 lbs.
EcoFlex® ONE	6.1 lbs.	4.0 lbs.



Despite their structural differences, both carpets show comparable rolling resistance. However, the key concern is whether this resistance level poses an injury risk.

## Human Factors Analysis

To assess potential injury risks, specifiers can utilize the Manual Materials Handling Analysis Tool, widely referenced by OSHA for ergonomic evaluations. This calculator, accessible via the Liberty Mutual Insurance Company website, applies to tasks involving equipment pushing, including wheelchair mobility. <sup>5</sup>

### Required inputs include:

- Push frequency (per minute or hour)
- Initial and sustained force (pounds)
- Horizontal distance (feet)
- Vertical hand height above the floor

Based on the rolling resistance test data for Mohawk's ComfortGuard and EcoFlex® ONE carpets, results indicate that with a push frequency of one push per hour over a horizontal distance of 500 feet and a vertical hand height of 40 inches, more than 90% of both men and women can push a wheelchair across either flooring type without risk of injury.

This conclusion represents the highest positive rating determined by the Manual Materials Handling Analysis Tool.

**The Liberty Mutual Manual Materials Handling Tables—also known as the Snook Tables—**were developed from research by Stover Snook and Vincent Ciriello at Liberty Mutual Insurance Company. Based on psychophysical studies, they measured the maximum acceptable loads (MALs) people could handle for tasks like lifting, pushing, and carrying without fatigue.

First published in 1991, the tables used data from both men and women. In 2021, updated equations were introduced using data from 12 more studies, allowing for more flexible and accurate ergonomic assessments.

## Conclusion

This study shows how rolling resistance impacts wheelchair mobility and the role of flooring construction in movement ease. Lab tests give precise force data, while real-world simulations offer practical evaluations for better decision-making. Using ergonomic tools, such as the Manual Materials Handling Analysis Tool, helps ensure safe and accessible flooring for wheelchair users and caregivers.

## References

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3. Scoping review of the rolling resistance testing methods and factors that impact manual wheelchairs
4. Proprietary information, available on request.
5. Manual Materials Handling Analysis Tool | Liberty Mutual Manual Materials Handling Tables