

American National Standard

for Wheelchairs –

Volume 2:

**Additional Requirements for Wheelchairs
(including Scooters) with Electrical Systems**



RESNA

This is a preview of "ANSI/RESNA WC-2:2019". [Click here to purchase the full version from the ANSI store.](#)

**RESNA
WC-2:2019**

2019-12-3

American National Standard
for Wheelchairs –

**Volume 2:
Additional Requirements for Wheelchairs
(including Scooters) with Electrical Systems**

Secretariat

**Rehabilitation Engineering and Assistive
Technology Society of North America**

Approved 26 April 2019

**Rehabilitation Engineering and Assistive
Technology Society of North America**

Approved 5 June 2019

American National Standards Institute, Inc.

COPYRIGHT PROTECTED DOCUMENT

© ISO

© RESNA 2019

These materials are not for resale.

These materials are subject to copyright claims of ISO, ANSI and RESNA. No part of this publication may be reproduced in any form, including an electronic retrieval system, without the prior written permission of RESNA. All requests pertaining to the American National Standard for Wheelchairs – Volume 2: Additional Requirements for Wheelchairs (including Scooters) with Electrical Systems should be submitted to RESNA.

RESNA

Executive Director: **Andrea Van Hook**

2025 M Street NW, Suite 800, Washington, D.C. 20036

Tel **202-367-1121**

Fax **202-367-2121**

Web **www.resna.org**

RESNA Assistive Technology Standards Board

E-mail **technicalstandards@resna.org**

Published in the United States of America

RESNA American National Standard

RESNA is accredited as a standards organization by the American National Standards Institute (ANSI). Approval of a RESNA American National Standard requires review by the RESNA Assistive Technology Standards Board (formerly Technical Standards Board) and by ANSI to determine that the requirements for due process, consensus, and other criteria for approval have been met by the standards developer.

Consensus means substantial agreement has been reached by directly and materially affected interest categories. This signifies the concurrence of more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that an effort be made towards their resolution.

The use of American National Standards is completely voluntary; their existence does not in any respect preclude anyone, whether he has approved the standards or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standards.

The American National Standards Institute does not develop standards and will in no circumstances give an interpretation of any American National Standard. Moreover, no person shall have the right or authority to issue any interpretation of an American National Standard in the name of the American National Standards Institute or RESNA. Requests for interpretations should be addressed to the secretariat or sponsor whose name appears on the title page of this standard.

CAUTION NOTICE: This American National Standard may be revised or withdrawn at any time. The procedures of the American National Standards Institute require that action be taken periodically to reaffirm, revise, or withdraw this standard. Purchasers of American National Standards may receive current information on all standards by calling or writing the ANSI office.

Foreword

This standard covers manual and powered wheelchairs, including scooters, and personal mobility devices that may be supplied as accessories to wheelchairs and scooters. A wheelchair is generally tested as a complete system in a standard reference configuration that facilitates comparison of test results among different models. Accessory manufacturers often test their product on one wheelchair for which the accessory is recommended and determine those performance specifications that are affected by the addition of the accessory to the wheelchair.

In all cases, the information that is disclosed with regard to the testing should be considered with respect to the following note:

The results obtained are based on testing one or more wheelchairs of a specific model and type. The performance a specific individual gets from his/her own wheelchair will depend upon his/her own personal wheelchair set-up, driving skills and techniques and may not represent the results obtained using the standardized RESNA test procedures.

RESNA WC Volumes 1 and 2 consist of the following sections under the general title Wheelchairs:

Volume 1: Requirements and Test Methods for Wheelchairs (including Scooters)

- Section 0: **Test reports**
- Section 1: **Determination of static stability**
- Section 3: **Determination of effectiveness of brakes**
- Section 5: **Determination of dimensions, mass and maneuvering space**
- Section 7: **Method of measurement of seating and wheel dimensions**
- Section 8: **Requirements and test methods for static, impact and fatigue strengths**
- Section 11: **Test mannequins**
- Section 13: **Determination of coefficient of friction of test planes**
- Section 15: **Requirements for information disclosure, documentation and labeling**
- Section 16: **Resistance to ignition of postural support devices**
- Section 20: **Determination of the performance of stand-up type wheelchairs**
- Section 22: **Set-up procedures**
- Section 26: **Vocabulary**

Volume 2: Additional Requirements for Wheelchairs (including Scooters) with Electrical Systems

- Section 2: **Determination of dynamic stability of electrically powered wheelchairs**
- Section 4: **Energy consumption of electrically powered wheelchairs and scooters for determination of theoretical distance range**
- Section 6: **Determination of maximum speed of electrically powered wheelchairs**
- Section 9: **Climatic tests for electrically powered wheelchairs**

Section 10: **Determination of obstacle-climbing ability of electrically powered wheelchairs**

Section 14: **Power and control systems for electrically powered wheelchairs, scooters and add-on devices – Requirements and test methods**

Section 21: **Requirements and test methods for electromagnetic compatibility of electrically powered wheelchairs and scooters, and battery chargers**

Section 25: **Batteries and chargers for powered wheelchairs**

The following sections are also on the work program:

Section 28: **Requirements and test methods for stair-climbing devices**

The following RESNA WC Volumes have been approved for publication:

Volume 3: Wheelchair Seating

Volume 4: Wheelchairs and Transportation

These standards had their inception in March of 1982 when the RESNA Standards Committee on Wheelchairs began creating standards in the United States as a result of awareness of International Organization for Standardization (ISO) activities related to wheelchairs. Eighteen standards were originally developed by the 26 member committee that was composed of a variety of people including rehabilitation engineers, wheelchair manufacturers, governmental representatives (Department of Veterans Affairs and Food and Drug Administration), and wheelchair users and prescribers. The committee completed the development of these standards in 1990. The committee grouped the standards into two volumes in 1998.

The standards are test procedures designed to produce objective information about wheelchairs. Some of the test methods establish minimum performance criteria for durability and safety reasons.

The American National Standards Institute (ANSI) originally sanctioned the ANSI/RESNA Standards on Wheelchairs in 1982. RESNA is now accredited as a standards organization and the Assistive Technology Standards Board (formerly Technical Standards Board) oversees the work of the RESNA standards committees. RESNA is an interdisciplinary organization that promotes assistive technology for people with disabilities. The committee has also worked concurrently with other countries as an ANSI member body to the International Organization for Standardization (ISO) to create international standards pertaining to wheelchairs.

Suggestions for the improvement of this standard are welcome. They should be sent to the following address:

**RESNA Assistive Technology Standards Board
2025 M Street NW, Suite 800
Washington, D.C. 20036**

This standard was approved by the RESNA Standards Committee on Wheelchairs and the RESNA Assistive Technology Standards Board for submittal to ANSI. Committee approval of the standard does not necessarily imply that all the committee members voted for its approval or the approval of every test method or requirement in the standard. Throughout the time period this version of the

standards was developed, the following people participated as members of the RESNA Standards Committee on Wheelchairs:

Organization Represented	Name of Representative
Ammer Consulting.	Chair, William Ammer
Beneficial Designs, Inc.	Secretary, Peter Axelson
.....	Technical Standards Editor, Seanna Kringen (deceased)
All Wheels Up, Inc.	Michele Erwin
Burke, Inc.	DuWayne Kramer, Jerry Traylor
Convaid, Inc.	Don Griggs, Sue Johnson, Brandon Roberts
Curtis Instruments (UK) LTD.	Rob Woodcock
Dalhousie University-Nova Scotia Rehab Centre	R. Lee Kirby
DEKA Research and Development Corp.	Phil Brown, Stewart Coulter, Kurt Heinzmann,
.....	Dave Mower
East Penn Manufacturing Co./MK Battery.	Michale McCarthy, Scott McCaskey,
.....	Daniel Seidel, Mark Sherwood
Florida Atlantic University	Oren Masory
Golden Technologies.	Fred Kiwak, Gene Kulon
Hoveround, Corp.	Tony DiGiovanni, Robert Munch
Human Engineering Research Laboratories	Samuel Connor, Ben Gebrosky, Rory Cooper,
.....	Jeremy Puhlman
Independence Technology, L.L.C.	James O'Donnell, Susan Eichler, William Farnella
Invacare Corporation	Kevin Hankins, Howard Loewenthal, David Mahilo,
.....	Ramakant Rambhatla, Brian Rich, Lee Sheffield,
Laird Technologies.	Gary Fenical
Leisure-Lift, Inc.	DuWayne Kramer, Jr., Jerry Trayler
Lester Electrical	Jamie Jesse, Mark Bauer, Gary Bouc
McIlwain Mobility Services	Chris McIlwain
MET Laboratories, Inc.	Nehemya Cohen, Rick Cooper, Leonard Frier
Microsoft Research	Jay Beavers
Minkel Consulting.	Jean Minkel
MK Battery	Rick Spiegel, Dennis Sharpe
Mobility Designs, Children's Healthcare of Atlanta	Kay Koch
New York University – Occupational Therapy Dept.	Anita Perr
Otto Bock HealthCare GmbH.	Robert Clarke
Paralyzed Veterans of America	Fred Downs, Sherman Gillums, Lee Page, Thomas Stripling
PDG Product Design Group Inc.	Matt Delorme
Permobil, Inc.	Marita Brundin, Tara Gentile, Mehdi Merhazi, Herbert Van de Wal
Precision Calibration, Inc.	Michael Heckrotte
Pride Mobility Products, Corp.	Harry Etheart, Mark Maguire,
.....	Thomas Shappert, Michael Zablocky
Radiometrics Midwest, Corp.	Dennis Rollinger
StairMaster Wheelchair Co.	Ken Cox

Sunrise Medical Jim Christofferson, Paul Dickie, Mark Greig, Gary Hite, Dennis Hooper,
..... Steve Lindquist, Richard Runkles
U.S. Food and Drug Administration (FDA)..... Angela DeMarco, Ann Ferriter, John Marszalek,
..... Matthew Schwerin, Amy Skrzypchak, Donald Witters
University of New Hampshire – Dept. of Occupational Therapy Sajay Arthanat
University of Pittsburgh Douglas Hobson
Veterans Health Administration National Center for Patient Safety Kendra Betz
Individual Members:
Jerome Connelly Farmer
Chris Field
Alexander G. Reed
Norman Reese

Dedication

As this revised edition of the RESNA Standard on Wheelchairs is completed, the Committee remembers the work of Seanna Kringen, Technical Standards Editor. Seanna was an amazing person and a real driving force behind the development of these standards. Seanna herself had a mobility impairment that made working on these standards important to her. She was also aware of the sometimes serious or fatal consequences of failures in manual and powered wheelchairs. She recognized that every person has the right to have mobility to participate equally in all aspects of life. The Committee thanks her family for her leadership, dedication, professionalism, and attention to detail. We will truly miss her energy, passion and expertise. She will also be missed as a dear friend to many.

Contents

Scope of Volume 1 and Volume 2	ix
Section 2 Determination of dynamic stability of electrically powered wheelchairs	2.1
Section 4 Energy consumption of electrically powered wheelchairs and scooters for determination of theoretical distance range.....	4.1
Section 6 Determination of maximum speed of electrically powered wheelchairs	6.1
Section 9 Climatic tests for electrically powered wheelchairs	9.1
Section 10 Determination of obstacle-climbing ability of electrically powered wheelchairs.....	10.1
Section 14 Power and control systems for electrically powered wheelchairs, scooters and add- on devices – Requirements and test methods	14.1
Section 21 Requirements and test methods for electromagnetic compatibility of electrically powered wheelchairs and scooters, and battery chargers	21.1
Section 25: Batteries and chargers for powered wheelchairs	25.1

Scope of Volume 1 and 2

Volume 1: Requirements and Test Methods for Wheelchairs (including Scooters) of the RESNA wheelchair standard applies to (1) single passenger occupant and attendant propelled wheelchairs, (2) single passenger electrically powered wheelchairs including scooters, and (3) add-on power kits for single passenger occupant and attendant propelled wheelchairs, intended to provide indoor and outdoor mobility for people with disabilities.

Volume 2: Additional Requirements for Wheelchairs (including Scooters) with Electrical Systems of the RESNA Wheelchair Standard applies to (1) single passenger electrically powered wheelchairs including scooters and (2) add-on power kits for single passenger occupant and attendant propelled wheelchairs, intended to provide indoor and outdoor mobility for people with disabilities. Volume 2 also applies to electrically powered ancillary equipment of all wheelchairs and scooters that are included within the scope of Volume 1 and/or Volume 2.

Hereafter, the words "wheelchair" and "wheelchairs" shall refer to all wheelchairs including scooters and add-on power kits within the scope of this standard.

The RESNA wheelchair standard does not apply to: (1) wheelchairs intended for special purposes, such as sports, and one of a kind custom-made wheelchairs, (2) wheelchairs specially designed and fabricated for specific people with disabilities, or (3) powered office chairs.

NOTE 1 Changes such as different sizes or production upon receipt of an order do not qualify a wheelchair as "one of a kind".

NOTE 2 Appropriate sections of this standard may be applied to wheelchairs and wheelchair accessories outside this scope, to the extent that it is practical.

In summary, Volume 1 specifies tests and methods of measurement applicable to all wheelchairs (manual and electric), while Volume 2 specifies additional tests and methods of measurement applicable to electrically powered wheelchairs and to the electrical systems of all wheelchairs. Thus, both volumes are required for testing powered wheelchairs. However, only Volume 1 is required for testing manual wheelchairs.

This standard specifies requirements and test methods for determining wheelchair performance. It also specifies requirements for the disclosure of the test results.

These test methods may be used to verify manufacturers' claims that a product exceeds the minimum requirements of this standard.

Standardized means of preparing and adjusting wheelchairs are provided to enable the test results to be used for the comparison of performance.

WARNING: This RESNA Standard calls for the use of procedures that may be injurious to the testing technician if adequate precautions are not taken.

Section 2

Determination of Dynamic Stability of Electrically Powered Wheelchairs

Contents

Section 2 Introduction	3
1 Scope	4
2 Normative references	4
3 Terms and definitions.....	5
4 Principle	5
5 Apparatus	5
6 Initial set-up of test wheelchair.....	6
7 Test procedure	7
8 Tests for rearward dynamic stability.....	7
9 Tests for forward dynamic stability.....	11
10 Tests for dynamic stability in lateral directions.....	14
11 Test report	16
12 Disclosure of results.....	16
Annex A (informative) Wheelchair set-up for remote control.....	18
Annex B (informative) Use of a human test occupant	21
Annex C (normative) Stability scoring system	22
Annex D (informative) Recommended format for reporting test results.....	23
Bibliography	26

Section 2 Introduction

This section of RESNA WC-2 is based on ISO 7176-2:2017. RESNA amended ISO 7176-2:2017 to eliminate redundancies and highlight discrepancies between the various sections of the ISO Wheelchairs standards, and to include editorial and technical revisions.

At the time of publication of this section, ISO 7176-2:2017 was valid. All standards are subject to revision, and parties to agreements based on this section of RESNA WC-2 are encouraged to investigate the possibility of applying the most recent edition of the ISO standard. Members of ISO maintain registers of currently valid International Standards. More recent versions of this ISO document may have resolved some of the highlighted discrepancies. If ISO resolves these discrepancies in a different manner than described herein, the RESNA amendments shall supersede the ISO revision.

In this section, ~~strikethrough~~-text indicates text that is published in the ISO standard, but was deleted from the RESNA standard. Blue text indicates text that is not published in the ISO standard, but was added to the RESNA standard. Wherever there is blue text there will also be a sidebar to help locate the text.

It is important to understand the dynamic stability characteristics of a wheelchair for prescription and adjustment purposes. Wheelchair users and prescribers should understand the safety implications of dynamic stability, particularly when setting up seating systems that offer a large range of configurations. They should consider the environment in which the wheelchair is to be used and the hazards that are likely in that environment while considering possible configurations of the wheelchair when meeting those hazards.

This document specifies tests for dynamic stability under a range of operating conditions with various wheelchair configurations. The effectiveness of stability controlling systems are evaluated by the procedures listed in this document.

Wheelchair instability is a significant contributor to accidents causing injury. Consequently, it is desirable that all parties involved in the supply of wheelchairs understand the factors that contribute to instability. Parties interested in this document could be wheelchair designers and manufacturers, prescribers, therapists, building designers, public facility providers and test houses.

The purpose of this document is to define tests that will consistently demonstrate dynamic stability limits under a variety of proven stability challenges. Tests are designed to reveal the effects of adjustments and configurations.

This document will help interested parties define suitable environments and intended use of the wheelchair.

Although this document does not specify requirements, it is an essential reference document for other documents that do specify stability.

Section 2: Determination of dynamic stability of electrically powered wheelchairs

Warning – This section of RESNA WC-2 requires the performance of test procedures that could result in injury or death to test personnel. To avoid injuries, proper precautions must be taken to prevent hazardous situations from occurring. Never allow test personnel to be positioned during testing such that the wheelchair and or test mannequin and its weights could run them over or hit them in the case of instability or loss of control.

1 Scope

This section of RESNA WC-2 specifies test methods for determining the dynamic stability of electrically powered wheelchairs.

This document is applicable to electrically powered wheelchairs, including scooters, and add-on devices intended to carry one person with a mobility impairment.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

[RESNA WC-1:2019, Section 5: Determination of dimensions, mass and maneuvering space](#)

[RESNA WC-1:2019, Section 11: Test mannequins](#)

[RESNA WC-1:2019, Section 13: Determination of Coefficient of Friction of Test Surfaces](#)

[RESNA WC-1:2019, Section 15: Requirements for information disclosure, documentation and labeling](#)

[RESNA WC-1:2019, Section 22: Set-up procedures](#)

[RESNA WC-1:2019, Section 26: Vocabulary](#)

[RESNA WC-2:2019, Section 10: Determination of obstacle-climbing ability of electrically powered wheelchairs](#)

[RESNA WC-2:2019, Section 25: Batteries and chargers for powered wheelchairs](#)