NEMA Standards Publication

NEMA MS 10-2010

Standard for Determination of Local Specific Absorption Rate (SAR) in Diagnostic Magnetic Resonance Imaging

National Electrical Manufacturers Association

NEMA Standards Publication MS 10-2010

Determination of Local Specific Absorption Rate (SAR)
in Diagnostic Magnetic Resonance Imaging

Published by:

National Electrical Manufacturers Association
1300 North 17th Street, Suite 1752
Rosslyn, VA 22209

www.nema.org

NOTICE AND DISCLAIMER

The information in this publication was considered technically sound by the consensus of persons engaged in the development and approval of the document at the time it was developed. Consensus does not necessarily mean that there is unanimous agreement among every person participating in the development of this document.

The National Electrical Manufacturers Association (NEMA) standards and guideline publications, of which the document contained herein is one, are developed through a voluntary consensus standards development process. This process brings together volunteers and/or seeks out the views of persons who have an interest in the topic covered by this publication. While NEMA administers the process and establishes rules to promote fairness in the development of consensus, it does not write the document and it does not independently test, evaluate, or verify the accuracy or completeness of any information or the soundness of any judgments contained in its standards and guideline publications.

NEMA disclaims liability for any personal injury, property, or other damages of any nature whatsoever, whether special, indirect, consequential, or compensatory, directly or indirectly resulting from the publication, use of, application, or reliance on this document. NEMA disclaims and makes no guaranty or warranty, express or implied, as to the accuracy or completeness of any information published herein, and disclaims and makes no warranty that the information in this document will fulfill any of your particular purposes or needs. NEMA does not undertake to guarantee the performance of any individual manufacturer or seller's products or services by virtue of this standard or guide.

In publishing and making this document available, NEMA is not undertaking to render professional or other services for or on behalf of any person or entity, nor is NEMA undertaking to perform any duty owed by any person or entity to someone else. Anyone using this document should rely on his or her own independent judgment or, as appropriate, seek the advice of a competent professional in determining the exercise of reasonable care in any given circumstances. Information and other standards on the topic covered by this publication may be available from other sources, which the user may wish to consult for additional views or information not covered by this publication.

NEMA has no power, nor does it undertake to police or enforce compliance with the contents of this document. NEMA does not certify, test, or inspect products, designs, or installations for safety or health purposes. Any certification or other statement of compliance with any health or safety–related information in this document shall not be attributable to NEMA and is solely the responsibility of the certifier or maker of the statement.

CONTENTS

Foreword

This Standards Publication is classified as a NEMA Standard unless otherwise noted. It describes a measurement method for local specific absorption rate (SAR). The measurement method requires construction of a radio frequency phantom for a given frequency and the use of radio frequency-transparent thermometry. The procedure is intended for local SAR only. The method specifically does not address whole-body SAR.

This Standards Publication has been developed by the Magnetic Resonance Section of the National Electrical Manufacturers Association.

Section approval of the standard does not necessarily imply that all section members voted for its approval or participated in its development. At the time it was approved, the section was composed of the following members:

Computer Imaging Reference Systems—Norfolk, VA
GE Healthcare, Inc.—Milwaukee, WI
Hitachi Medical Systems America, Inc.—Twinsburg, OH
Medipattern – Toronto, Ontario
Philips Medical Systems North America—Bothell, WA
Siemens Medical Solutions, Inc.—Malvern, PA
Time Medical – Toronto, Ontario
Toshiba America Medical Systems—Tustin, CA

User needs have been considered throughout the development of this publication. Proposed or recommended revisions should be submitted to:

Vice-President, Technical Services
National Electrical Manufacturers Association
1300 North 17th Street, Suite 1752
Rosslyn, VA 22209

Section 1
GENERAL

1.1 RATIONALE

Local SAR is a parameter that relates to the safety of magnetic resonance (MR) scanners. The primary safety concern with both transmit surface coils and receive-only surface coils involves local SAR. Local SAR may be highest near conductors. Methods for determining local SAR are needed for ensuring safe operation of coils during MR exams. This standard does not attempt to establish relationships between SAR and body temperature.

1.2 SCOPE

This document defines methods for determining the local specific absorption rate of diagnostic magnetic resonance imaging radio frequency coils under a specific set of conditions. This document does not address whole-body SAR. Local SAR may be determined near coil conductors, transmission lines, or any other desired region. It may be useful in some cases to first do the pulse energy method described in NEMA MS-8 so that both whole-body and local SAR are measured. Heating other than radio frequency heating (such as thermal heating from surface coil blocking networks) is not addressed in this standard.

1.3 REFERENCES

1. Durney, C.H., Johnson, C.C., Barber, P.W., et al, 1978. Radiofrequency radiation dosimetry handbook. USAF School of Aerospace Medicine, Report SAM-TR-78-22, Brooks Air Force Base, Texas, 2nd ed.

2. Schenck, J.F., E.B. Boskamp, D.J. Schaefer, W.D. Barber and R.H. Vander Heiden, “Estimating Local SAR Produced by RF Transmitter Coils: Examples Using the Birdcage Coil.” Abstracts of the International Society of Magnetic Resonance in Medicine, Sixth Meeting, Sydney, Australia, p. 649, 1998.

3. Chou CK, Chen GW, Guy AW, Luk KH (1984): Formulas for preparing phantom muscle tissue at various radiofrequencies. Bioelectromagnetics 5(4):435-441.

4. Gandhi, OP and Chien, JY, 1992, "Absorption and Distribution Patterns of RF Fields," Annals of the New York Academy of Sciences, 649:132.

5. Grandolfo, M, Polichetti, A, Vecchia, P, and Gandhi, OP, 1992, "Spatial Distribution of RF Power in Critical Organs during Magnetic Resonance Imaging," Annals of the New York Academy of Sciences, 649:178.

6. Schaefer, D.J. and E.C. Burdette, 1981, "Complex Permittivity of Chicken Brain from 13.56 MHz to 2.45 GHz," Abstracts of the Third Annual Meeting of the Bioelectromagnetics Society, Washington, D.C., August, 1981, abstract published, p. 59.

7. M. A. Stuchly, S. S. Stuchly, "Coaxial line reflection method for measuring dielectric properties of biological substances at radio and microwave frequencies - A review," IEEE Trans. Instrum. Meas., vol. 29, no. 3, September 1980, pp 176 - 183.

8. IEC 60601-2-33, 2nd edition, Medical Electrical Equipment - Part 2: Particular Requirements for The Safety of Magnetic Resonance Equipment for Medical Diagnosis, International Electrotechnical Commission (IEC)*, 3, rue de Varembé, P.O. Box 131, CH - 1211 Geneva 20, Switzerland (In the United