

© Copyright SEK. Reproduction in any form without permission is prohibited.

Bestämning av exponering för elektromagnetiska fält från kortdistansradiosändare (SRD) i frekvensområdet 0 GHz - 300 GHz – Del 1: Fält från utrustning för artikelövervakning (EAS), identifiering (RFID) och liknande system

Evaluation of human exposure to electromagnetic fields from short range devices (SRDs) in various applications over the frequency range 0 GHz to 300 GHz – Part 1: Fields produced by devices used for electronic article surveillance, radio frequency identification and similar systems

Som svensk standard gäller europastandarden EN 62369-1:2009. Den svenska standarden innehåller den officiella engelska språkversionen av EN 62369-1:2009.

Nationellt förord

Europastandarden EN 62369-1:2009

består av:

- **europastandardens ikraftsättningsdokument**, utarbetat inom CENELEC
- **IEC 62369-1, First edition, 2008 - Evaluation of human exposure to electromagnetic fields from short range devices (SRDs) in various applications over the frequency range 0 GHz to 300 GHz - Part 1: Fields produced by devices used for electronic article surveillance, radio frequency identification and similar systems**

utarbetad inom International Electrotechnical Commission, IEC.

Tidigare fastställd svensk standard SS-EN 50357, utgåva 1, 2002, gäller ej fr o m 2012-03-01.

Standarder underlättar utvecklingen och höjer elsäkerheten

Det finns många fördelar med att ha gemensamma tekniska regler för bl a säkerhet, prestanda, dokumentation, utförande och skötsel av elprodukter, elanläggningar och metoder. Genom att utforma sådana standarder blir säkerhetskraven tydliga och utvecklingskostnaderna rimliga samtidigt som marknadens acceptans för produkten eller tjänsten ökar.

Många standarder inom elområdet beskriver tekniska lösningar och metoder som åstadkommer den elsäkerhet som föreskrivs av svenska myndigheter och av EU.

SEK är Sveriges röst i standardiseringsarbetet inom elområdet

SEK Svensk Elstandard svarar för standardiseringen inom elområdet i Sverige och samordnar svensk medverkan i internationell och europeisk standardisering. SEK är en ideell organisation med frivilligt deltagande från svenska myndigheter, företag och organisationer som vill medverka till och påverka utformningen av tekniska regler inom elektrotekniken.

SEK samordnar svenska intressenters medverkan i SEKs tekniska kommittéer och stödjer svenska experters medverkan i internationella och europeiska projekt.

Stora delar av arbetet sker internationellt

Utformningen av standarder sker i allt väsentligt i internationellt och europeiskt samarbete. SEK är svensk nationalkommitté av International Electrotechnical Commission (IEC) och Comité Européen de Normalisation Electrotechnique (CENELEC).

Standardiseringsarbetet inom SEK är organiserat i referensgrupper bestående av ett antal tekniska kommittéer som speglar hur arbetet inom IEC och CENELEC är organiserat.

Arbetet i de tekniska kommittéerna är öppet för alla svenska organisationer, företag, institutioner, myndigheter och statliga verk. Den årliga avgiften för deltagandet och intäkter från försäljning finansierar SEKs standardiseringsverksamhet och medlemsavgift till IEC och CENELEC.

Var med och påverka!

Den som deltar i SEKs tekniska kommittéarbete har möjlighet att påverka framtida standarder och får tidig tillgång till information och dokumentation om utvecklingen inom sitt teknikområde. Arbetet och kontakterna med kollegor, kunder och konkurrenter kan gynnsamt påverka enskilda företags affärsutveckling och bidrar till deltagarnas egen kompetensutveckling.

Du som vill dra nytta av dessa möjligheter är välkommen att kontakta SEKs kansli för mer information.

SEK Svensk Elstandard

Box 1284
164 29 Kista
Tel 08-444 14 00
www.elstandard.se

**Evaluation of human exposure to electromagnetic fields
from short range devices (SRDs) in various applications
over the frequency range 0 GHz to 300 GHz -
Part 1: Fields produced by devices used for electronic article surveillance,
radio frequency identification and similar systems
(IEC 62369-1:2008)**

Evaluation de l'exposition humaine
aux champs électromagnétiques
produits par les dispositifs radio
à courte portée dans la plage
de fréquence 0 GHz à 300 GHz -
Partie 1: Champs produits
par les dispositifs utilisés pour
la surveillance électronique des objets,
l'identification par radiofréquence
et les systèmes similaires
(CEI 62369-1:2008)

Ermittlung der Exposition
von Personen gegenüber
elektromagnetischen Feldern
im Frequenzbereich 0 GHz bis 300 GHz
durch Geräte mit kurzer Reichweite
für verschiedene Anwendungen -
Teil 1: Felder, die durch Geräte erzeugt
werden, die zur elektronischen
Artikelüberwachung,
Hochfrequenz-Identifizierung und für
ähnliche Anwendungen verwendet werden
(IEC 62369-1:2008)

This European Standard was approved by CENELEC on 2009-03-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: avenue Marnix 17, B - 1000 Brussels

Foreword

The text of the International Standard IEC 62369-1:2008, prepared by IEC TC 106, Methods for the assessment of electric, magnetic and electromagnetic fields associated with human exposure, was submitted to the Unique Acceptance Procedure and was approved by CENELEC as EN 62369-1 on 2009-03-01 without any modification.

This European Standard supersedes EN 50357:2001.

The following dates were fixed:

- latest date by which the EN has to be implemented
at national level by publication of an identical
national standard or by endorsement (dop) 2010-03-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2012-03-01

Endorsement notice

The text of the International Standard IEC 62369-1:2008 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 61566	NOTE Harmonized as EN 61566:1997 (not modified).
IEC 62209-1	NOTE Harmonized as EN 62209-1:2006 (not modified).
IEC 62311	NOTE Harmonized as EN 62311:2008 (modified).
ISO/IEC 17025	NOTE Harmonized as EN ISO/IEC 17025:2005 (not modified).

CONTENTS

INTRODUCTION.....	7
1 Scope.....	8
2 Normative references	9
3 Terms, definitions, and abbreviations	9
3.1 Quantities.....	9
3.2 Constants.....	9
3.3 Terms and definitions.....	10
4 Measurements and calculations for equipment evaluation	15
4.1 Introduction	15
4.2 Evaluation against reference values	16
4.2.1 General	16
4.2.2 Direct measurement for comparison against reference values	16
4.2.3 Spatial measurements for comparison against reference values	17
4.2.4 Modelling and analysis including field non-uniformity.....	17
4.3 Specific absorption rate (SAR) measurements.....	24
4.3.1 General	24
4.3.2 Internal electric field strength measurements.....	24
4.3.3 Internal temperature measurements	25
4.3.4 Calorimetric measurements of heat transfer	26
4.3.5 Phantom models and fluid	26
4.4 Numerical evaluations for comparison against basic restrictions.....	26
4.4.1 General	26
4.4.2 Evaluations using homogeneous models	26
4.4.3 Special case of inductive near-field exposure 100 kHz to 50 MHz.....	28
4.4.4 Frequencies > 50 MHz.....	29
4.4.5 Localised SAR (100 kHz to 10 GHz)	29
4.5 Evaluations using non-homogeneous models for comparison against basic restrictions	30
4.5.1 General	30
4.5.2 Anatomical body models.....	30
4.5.3 Calculation/modelling method.....	31
4.5.4 Position of the body in relation to the unit under evaluation	31
4.6 Measurement of limb and touch currents	31
5 Measurements for field monitoring.....	32
5.1 General.....	32
5.2 Field measurements	32
5.2.1 Measurement where persons spend significant periods of time.....	32
5.2.2 Detailed measurements for non-transitory exposure	32
5.3 Additional evaluation	32
6 Exposure from sources with multiple frequencies or complex waveforms.....	33
7 Exposure from multiple sources.....	33
8 Uncertainty.....	34
8.1 General.....	34
8.2 Evaluating uncertainties	34
8.2.1 Individual uncertainties	34

8.2.2 Combining uncertainties	35
8.3 Examples of typical uncertainty components	35
8.3.1 Measurement.....	35
8.3.2 Numerical calculation	35
8.4 Overall uncertainties	35
9 Evaluation report	35
Annex A (informative) Characteristics of equipment	37
Annex B (informative) Information for numerical modelling.....	47
Annex C (informative) A simplified method for summation of multiple sources	67
Annex D (informative) Uncertainty	70
Bibliography.....	71
Figure 1 – General torso grid	19
Figure 2 – General head grid	19
Figure 3 – Single floor standing antenna.....	20
Figure 4 – Dual floor standing antenna	20
Figure 5 – Single floor antenna	21
Figure 6 – Single ceiling antenna.....	21
Figure 7 – Combined floor and ceiling antennas.....	22
Figure 8 – “Walk-through” loop antenna	22
Figure 9 – Counter or desk mounted antenna	23
Figure 10 – Vertical, wall or frame mounted antenna.....	23
Figure 11 – Hand-held antenna.....	24
Figure 12 – Disk model	28
Figure 13 – Cubic model	28
Figure 14 – Spheroid model.....	28
Figure A.1 – Example of exit mounted equipment showing detection range.....	40
Figure A.2 – Example of aisle mounted equipment.....	40
Figure A.3 – Inductive coupling.....	42
Figure A.4 – Electromagnetic coupling	42
Figure A.5 – Capacitive coupling.....	42
Figure A.6 – Overview of an RFID system.....	44
Figure B.1 – Current induced in a loop.....	47
Figure B.2 – Disk model.....	51
Figure B.3 – Disk model used for validations	51
Figure B.4 – Cubic model.....	52
Figure B.5 – Cubic model example showing current induced in 3 dimensions.....	53
Figure B.6 – Prolate spheroid	54
Figure B.7 – Helmholtz coils and prolate spheroid.....	55
Figure B.8 – 60 cm by 30 cm prolate spheroid results (magnetic field)	56
Figure B.9 – 60 cm by 30 cm prolate spheroid results (induced current density)	56
Figure B.10 – 120 cm by 60 cm prolate spheroid results (magnetic field)	57
Figure B.11 – 120 cm by 60 cm prolate spheroid results (induced current density).....	57
Figure B.12 – 160 cm by 80 cm prolate spheroid results (magnetic field)	58

Figure B.13 – 160 cm by 80 cm prolate spheroid results (induced current density).....	58
Figure B.14 – Homogeneous human shape body model.....	60
Figure B.15 – Homogeneous human shape (induced current)	60
Figure B.16 – Homogeneous hand model.....	61
Figure B.17 – Approximate conductivities for LF homogeneous body modelling	66
Table 1 – Dimensions and distances for Figures 1 to 11	18
Table 2 – Dimensions and distances for simplified body shapes	27
Table 3 – Maximum total evaluation uncertainties	35
Table A.1 – Frequency ranges and typical system characteristics	43
Table A.2 – Example frequency bands and their applications	43
Table B.1 – Disk model dimensions for Figure B.2	51
Table B.2 – Cubic disk model dimensions for Figure B.4	52
Table B.3 – Prolate spheroid dimensions for Figure B.6	54
Table B.4 – Summary of results	59
Table B.5 – Examples of anatomical models	62
Table B.6 – Conductivity of tissue types.....	64
Table B.7 – Relative permittivity of tissue types	65

INTRODUCTION

Electromagnetic fields interact with the human body and other biological systems through a number of physical mechanisms. The main mechanisms of interaction are based on nervous system effects and heating. These effects are dependent on frequency and are defined by biologically relevant quantities. Based on these scientifically established health effects, there are international, regional and sometimes national exposure requirements. These are set as basic restrictions on quantities, which are not necessarily directly measurable, and contain high safety factors to ensure a high level of protection. These quantities may be determined either by calculation for each case, or by measuring a reference value that has a pre-derived relationship to them, usually under worst-case, far-field conditions. Respect of the reference value will ensure respect of the relevant basic restriction, except in some specific near field situations which would normally be identified or highlighted within the applicable exposure guidelines. If the measured quantity exceeds the reference value, it does not necessarily follow that the basic restriction is also exceeded. Under those circumstances, more detailed evaluation techniques will be necessary which are specific to that type of equipment and exposure.

This document is part of a multi-part standard covering the evaluation of human exposure to electromagnetic fields from short range devices (SRDs) in various applications over the frequency range from 0 GHz to 300 GHz.

EVALUATION OF HUMAN EXPOSURE TO ELECTROMAGNETIC FIELDS FROM SHORT RANGE DEVICES (SRDS) IN VARIOUS APPLICATIONS OVER THE FREQUENCY RANGE 0 GHz to 300 GHz –

Part 1: Fields produced by devices used for electronic article surveillance, radio frequency identification and similar systems

1 Scope

This part of IEC 62369 presents procedures for the evaluation of human exposure to electromagnetic fields (EMFs) from devices used in electronic article surveillance (EAS), radio frequency identification (RFID) and similar applications. It adopts a staged approach to facilitate compliance assessment. The first stage (Stage 1) is a simple measurement against the appropriate derived reference values. Stage 2 is a more complex series of measurements or calculations, coupled with analysis techniques. Stage 3 requires detailed modelling and analysis for comparison with the basic restrictions. When assessing any device, the most appropriate method for the exposure situation may be used.

At the time of writing this International Standard, electronic article surveillance, radio frequency identification and similar systems do not normally operate at frequencies below 1 Hz or above 10 GHz. EMF exposure guidelines and standards can cover a wider range of frequencies, so clarification on the required range is included as part of the evaluation procedures.

The devices covered by this document normally have non-uniform field patterns. Often these devices have a very rapid reduction of field strength with distance and operate under near-field conditions where the relationship between electric and magnetic fields is not constant. This, together with typical exposure conditions for different device types, is detailed in Annex A.

Annex B contains comprehensive information to assist with numerical modelling of the exposure situation. It includes both homogeneous and anatomical models as well as the electrical properties of tissue.

This International Standard does not include limits. Limits can be obtained from separately published human exposure guidelines. Different guidelines and limit values may apply in different regions. Linked into the guidelines are usually methods for summation across wider frequency ranges and for multiple exposure sources. These shall be used. A simplified method for summation of multiple sources is contained in Annex C. This has to be used with care as it is simplistic and will overestimate the exposure; however it is useful as a guide, when the results of different evaluations are in different units of measure which are not compatible.

Different countries and regions have different guidelines for handling the uncertainties from the evaluation. Annex D provides information on the two most common methods.

A bibliography at the end of this standard provides general information as well as useful information for the measurement of electromagnetic fields. See [1],[2],[3],[4],[5],[6]¹⁾.

Similar national or international standards may be used as an alternative.

1) Figures between brackets refer to the bibliography.