



NSAI
Standards

Irish Standard
I.S. EN 60584-1:2013

Thermocouples -- Part 1: EMF specifications and tolerances

© CENELEC 2013 No copying without NSAI permission except as permitted by copyright law.

I.S. EN 60584-1:2013

Incorporating amendments/corrigenda/National Annexes issued since publication:

The National Standards Authority of Ireland (NSAI) produces the following categories of formal documents:

I.S. xxx: Irish Standard — national specification based on the consensus of an expert panel and subject to public consultation.

S.R. xxx: Standard Recommendation — recommendation based on the consensus of an expert panel and subject to public consultation.

SWiFT xxx: A rapidly developed recommendatory document based on the consensus of the participants of an NSAI workshop.

This document replaces/revises/consolidates the NSAI adoption of the document(s) indicated on the CEN/CENELEC cover/Foreword and the following National document(s):

NOTE: The date of any NSAI previous adoption may not match the date of its original CEN/CENELEC document.

This document is based on:

EN 60584-1:2013

Published:

2013-12-13

This document was published under the authority of the NSAI and comes into effect on:

2013-12-24

ICS number:

17.200.20

NOTE: If blank see CEN/CENELEC cover page

NSAI
1 Swift Square,
Northwood, Santry
Dublin 9

T +353 1 807 3800
F +353 1 807 3838
E standards@nsai.ie
W NSAI.ie

Sales:
T +353 1 857 6730
F +353 1 857 6729
W standards.ie

Údarás um Chaighdeáin Náisiúnta na hÉireann

English version

**Thermocouples -
Part 1: EMF specifications and tolerances
(IEC 60584-1:2013)**Couples thermoélectriques -
Partie 1: Spécifications et tolérances en
matière de FEM
(CEI 60584-1:2013)Thermoelemente -
Teil 1: Thermospannungen und
Grenzabweichungen
(IEC 60584-1:2013)

This European Standard was approved by CENELEC on 2013-10-02. 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 CEN-CENELEC Management Centre 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 CEN-CENELEC Management Centre has the same status as the official versions.

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

CENELECEuropean Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung**CEN-CENELEC Management Centre: Avenue Marnix 17, B - 1000 Brussels**

Foreword

The text of document 65B/873/FDIS, future edition 3 of IEC 60584-1, prepared by SC 65B "Measurement and control devices" of IEC/TC 65 "Industrial-process measurement, control and automation" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60584-1:2013.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2014-07-02
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2016-10-02

This document supersedes EN 60584-1:1995 and EN 60584-2:1993.

EN 60584-1:2013 includes the following significant technical changes with respect to EN 60584-1:1995 and EN 60584-2:1993:

- a) EN 60584-1:1995 and EN 60584-2:1993 have been merged;
- b) the standard is now explicitly based on the reference polynomials which express thermocouple EMF as functions of temperature. The tables derived from the polynomials are given in Annex A;
- c) inverse polynomials expressing temperature as functions of EMF are given in Annex B, but inverse tables are not given;
- d) the range of the polynomial relating the EMF of Type K thermocouples is restricted to 1 300 °C;
- e) values of the Seebeck coefficients are given at intervals of 10 °C;
- f) thermoelectric data (EMF and Seebeck coefficients) are given at the fixed points of the ITS-90;
- g) some guidance is given in Annex C regarding the upper temperature limits and environmental conditions of use for each thermocouple type.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 60584-1:2013 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 60584-1:1995	NOTE	Harmonized as EN 60584-1:1995 (not modified).
IEC 60584-2:1982	NOTE	Harmonized as EN 60584-2:1993 (not modified).
IEC 60584-3:2007	NOTE	Harmonized as EN 60584-3:2008 (not modified).
IEC 61515	NOTE	Harmonized as EN 61515.



INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Thermocouples –
Part 1: EMF specifications and tolerances**

**Couples thermoélectriques –
Partie 1: Spécifications et tolérances en matière de FEM**





THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2013 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester.

If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de la CEI ou du Comité national de la CEI du pays du demandeur.

Si vous avez des questions sur le copyright de la CEI ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de la CEI de votre pays de résidence.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

Useful links:

IEC publications search - www.iec.ch/searchpub

The advanced search enables you to find IEC publications by a variety of criteria (reference number, text, technical committee,...).

It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available on-line and also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 30 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary (IEV) on-line.

Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.

A propos de la CEI

La Commission Electrotechnique Internationale (CEI) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications CEI

Le contenu technique des publications de la CEI est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Liens utiles:

Recherche de publications CEI - www.iec.ch/searchpub

La recherche avancée vous permet de trouver des publications CEI en utilisant différents critères (numéro de référence, texte, comité d'études,...).

Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

Just Published CEI - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications de la CEI. Just Published détaille les nouvelles publications parues. Disponible en ligne et aussi une fois par mois par email.

Electropedia - www.electropedia.org

Le premier dictionnaire en ligne au monde de termes électroniques et électriques. Il contient plus de 30 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans les langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (VEI) en ligne.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: csc@iec.ch.



INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Thermocouples –
Part 1: EMF specifications and tolerances**

**Couples thermoélectriques –
Partie 1: Spécifications et tolérances en matière de FEM**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE **XB**
CODE PRIX

ICS 17.200.20

ISBN 978-2-8322-1047-5

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	7
2 Terms and definitions	7
3 Thermocouple designations	8
4 EMF – Temperature reference functions	9
5 Thermocouple tolerances	14
6 Thermoelectric values at the fixed points of the ITS-90.....	15
Annex A (informative) Tables for EMF as a function of temperature	17
Annex B (informative) Inverse polynomial functions	57
Annex C (informative) Guidance on the selection of thermocouples	64
Bibliography.....	68
Table 1 – Thermocouple types	9
Table 2 – Type R reference function	10
Table 3 – Type S reference function	11
Table 4 – Type B reference function	11
Table 5 – Type J reference function	11
Table 6 – Type T reference function.....	12
Table 7 – Type E reference function	12
Table 8 – Type K reference function	13
Table 9 – Type N reference function	13
Table 10 – Type C reference function	14
Table 11 – Type A reference function	14
Table 12 – Thermocouple tolerances	15
Table 13 – EMF and Seebeck coefficients of the thermocouples at the fixed points of the ITS-90 (EMF: upper row, Seebeck coefficient: lower row)	16
Table A.1 – Type R: Platinum - 13 % rhodium / platinum (1 of 5)	17
Table A.2 – Type S: Platinum-10 % rhodium / platinum (1 of 5).....	21
Table A.3 – Type B: Platinum-30 % rhodium / platinum-6 % rhodium (1 of 4)	26
Table A.4 – Type J: Iron / copper-nickel (1 of 4).....	30
Table A.5 – Type T: Copper / copper-nickel (1 of 2)	34
Table A.6 – Type E: Nickel-chromium / copper-nickel (1 of 3)	36
Table A.7 – Type K: Nickel-chromium / nickel-aluminium (1 of 4)	39
Table A.8 – Type N: Nickel-chromium-silicon / nickel-silicon (1 of 4).....	43
Table A.9 – Type C: Tungsten-5 % rhenium / tungsten-26 % rhenium (1 of 5).....	47
Table A.10 – Type A: Tungsten-5 % rhenium / tungsten-20 % rhenium (1 of 5)	52
Table B.1 – Type R Inverse function coefficients.....	58
Table B.2 – Type S Inverse function coefficients	59
Table B.3 – Type B Inverse function coefficients	59
Table B.4 – Type J Inverse function coefficients	60
Table B.5 – Type T Inverse function coefficients	60

Table B.6 – Type E Inverse function coefficients	61
Table B.7 – Type K Inverse function coefficients	61
Table B.8 – Type N Inverse function coefficients	62
Table B.9 – Type C Inverse function coefficients	62
Table B.10 – Type A Inverse function coefficients	63
Table C.1 – Recommended maximum temperature of use, t_{\max} / °C	64
Table C.2 – Environmental recommendations and limitations of the conductors	66
Table C.3 – Neutron irradiation effects	67

INTERNATIONAL ELECTROTECHNICAL COMMISSION

THERMOCOUPLES –

Part 1: EMF specifications and tolerances

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60584-1 has been prepared by sub-committee 65B: Measurement and control devices, of IEC technical committee 65: Industrial-process measurement, control and automation.

This third edition cancels and replaces the second edition published in 1995. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) IEC 60584-1:1995 and IEC 60584-2:1982 have been merged;
- b) the standard is now explicitly based on the reference polynomials which express thermocouple EMF as functions of temperature. The tables derived from the polynomials are given in Annex A;
- c) inverse polynomials expressing temperature as functions of EMF are given in Annex B, but inverse tables are not given;

- d) the range of the polynomial relating the EMF of Type K thermocouples is restricted to 1 300 °C;
- e) values of the Seebeck coefficients are given at intervals of 10 °C;
- f) thermoelectric data (EMF and Seebeck coefficients) are given at the fixed points of the ITS-90;
- g) some guidance is given in Annex C regarding the upper temperature limits and environmental conditions of use for each thermocouple type.

The text of this standard is based on the following documents:

FDIS	Report on voting
65B/873/FDIS	65B/888/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of the IEC 60584 series, under the general title *Thermocouples* can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

This International Standard relates the electromotive force (hereafter abbreviated as EMF) generated by the designated thermocouple types to temperature, based upon the International Temperature Scale of 1990 (ITS-90).

The reference polynomials for Types R, S, B, J, T, E, K and N are those used in the previous edition of this standard, IEC 60584-1:1995¹. They were originally produced by the National Institute of Standards and Technology of the USA and published in NIST Monograph 175, 1993.

The major revision of this version is standardization of two kinds of tungsten-rhenium thermocouple, designated Type C and Type A. Both of them have been used in industry for a long time. Temperature versus EMF relationships for Type C and Type A are those published in the ASTM E230/E230-M12 and GOST R 8.585-2001 standards, respectively.

This edition merges two parts of the former IEC 60584 series, IEC 60584-1:1995 (*Reference tables*) and IEC 60584-2:1982 (*Tolerances*) and supersedes both standards. IEC 60584-3:2007 remains valid.

¹ See Bibliography.

THERMOCOUPLES –

Part 1: EMF specifications and tolerances

1 Scope

This part of IEC 60584 specifies reference functions and tolerances for letter-designated thermocouples (Types R, S, B, J, T, E, K, N, C and A). Temperatures are expressed in degrees Celsius based on the International Temperature Scale of 1990, ITS-90 (symbol t_{90}), and the EMF (symbol E) is in microvolts.

The reference functions are polynomials which express the EMF, E in μV , as a function of temperature t_{90} in $^{\circ}\text{C}$ with the thermocouple reference junctions at 0°C . Values of EMF at intervals of 1°C are tabulated in Annex A.

For convenience of calculating temperatures, inverse functions are given in Annex B which express temperature as functions of EMF within stated accuracies.

This International Standard specifies the tolerances for thermocouples manufactured in accordance with this standard. The tolerance values are for thermocouples manufactured from wires, normally in the diameter range 0,13 mm to 3,2 mm, as delivered to the user and do not allow for calibration drift during use.

Annex C gives guidance on the selection of thermocouples with regard to temperature range and environmental conditions.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1

thermoelectric effect

Seebeck effect

production of an electromotive force (EMF) due to a temperature gradient along a conductor

2.2

Seebeck coefficient of a thermocouple

change in EMF of a thermocouple combination per unit of temperature change, being the first derivative of EMF with respect to temperature.

Note 1 to entry: The Seebeck coefficient dE/dt_{90} , is expressed in $\mu\text{V}/^{\circ}\text{C}$.

2.3

thermocouple

pair of conductors of dissimilar materials joined at one end and forming part of an arrangement using the thermoelectric effect for temperature measurement

2.4

measuring junction

junction of the thermocouple subjected to the temperature to be measured

This is a free preview. Purchase the entire publication at the link below:

I.S. EN 60584-1:2013 - PDF

-
- ⋙ Looking for additional Standards? Visit SAI Global Infostore
 - ⋙ Learn about LexConnect, All Jurisdictions, Standards referenced in Australian legislation
-

Need to speak with a Customer Service Representative - Contact Us