

INTERNATIONAL STANDARD

NORME INTERNATIONALE



Reference conditions and procedures for testing industrial and process measurement transmitters –

Part 4: Specific procedures for level transmitters

Conditions de référence et procédures pour l'essai des transmetteurs de mesure industriels et de processus –

Partie 4: Procédures spécifiques pour les transmetteurs de niveau



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2020 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 l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

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

Tel.: +41 22 919 02 11
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 corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables 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 It also gives information on projects, replaced and withdrawn publications.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 online and once a month by email.

IEC 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: sales@iec.ch.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary

67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) 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 IEC

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

Recherche de publications IEC -

webstore.iec.ch/advsearchform

La recherche avancée permet de trouver des publications IEC 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.

IEC Just Published - webstore.iec.ch/justpublished

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

Service Clients - webstore.iec.ch/csc

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

Electropedia - www.electropedia.org

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 000 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary

67 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Reference conditions and procedures for testing industrial and process
measurement transmitters –**

Part 4: Specific procedures for level transmitters

**Conditions de reference et procedures pour l'essai des transmetteurs
de mesure industriels et de processus –**

Partie 4: Procédures spécifiques pour les transmetteurs de niveau

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 17.200.20; 25.040.40

ISBN 978-2-8322-8757-6

**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.....	5
INTRODUCTION.....	7
1 Scope.....	8
2 Normative references	8
3 Terms and definitions	8
3.1 Basic definitions.....	9
3.2 Level transmitter definitions	11
3.2.2 Pressure-based level transmitter definitions.....	11
3.2.4 Float level transmitter definitions	12
3.2.6 Microwave/Radar level transmitter definitions	12
3.2.7 Optical based level transmitter definitions.....	12
3.2.9 Capacitance and admittance level transmitter definitions	13
3.2.10 Mechanical level transmitter definitions	13
3.2.11 Electrical resistance level transmitter definitions.....	14
3.3 Measurement parameters	14
3.4 Influence quantity definitions.....	14
3.5 Reference to the IEC common data dictionary (CDD).....	15
4 General description of main types of level transmitters	16
4.1 General.....	16
4.2 Pressure-based level transmitters.....	16
4.3 Microwave/radar level transmitter	18
4.3.1 General	18
4.3.2 Free-space radar level transmitter	18
4.3.3 Guided-wave radar level transmitter	19
5 Reference test conditions	20
5.1 General.....	20
5.2 Standard reference test conditions	20
5.2.1 General	20
5.2.2 Environmental test conditions	20
5.2.3 Power supply conditions	21
5.2.4 Load conditions	21
5.2.5 Mounting positions for testing	21
5.3 Reference test conditions for ambient and process quantities influencing operation	21
5.3.1 General	21
5.3.2 Process conditions	22
5.3.3 Environmental atmospheric conditions	22
5.3.4 Mechanical vibration	23
5.3.5 Shock, drop and topple	23
5.3.6 Power supply	23
5.3.7 Electromagnetic compatibility (EMC)	23
5.4 Reference design criteria	23
5.4.1 General	23
5.4.2 Enclosure protection against solid, liquid (IP) and impact (IK).....	23
5.4.3 Enclosure protection against corrosive and erosive influences.....	23
5.4.4 Electrical safety (insulation resistance, dielectric strength)	24
5.4.5 Hazardous environment (for application in explosive atmosphere)	24

5.4.6	Functional safety	24
6	Test procedures	24
6.1	General.....	24
6.1.1	Overview	24
6.1.2	Specific test setups and procedures	25
6.2	Type tests at standard reference conditions	28
6.2.1	General	28
6.2.2	Accuracy and related factors	29
6.2.3	Static behaviour.....	30
6.2.4	Dynamic behaviour	31
6.3	Type tests at operating reference test conditions	31
6.3.1	General	31
6.3.2	Ambient temperature effects	31
6.3.3	Ambient relative humidity effects	32
6.3.4	Vibration effects	32
6.3.5	Shock, drop and topple	32
6.3.6	Accelerated operational life test.....	32
6.3.7	EMC tests.....	32
6.3.8	Further test procedures	32
6.3.9	Additional test for digital transmitters	32
6.4	Routine tests.....	32
6.5	Acceptance, integration, periodic and maintenance tests	32
6.5.1	General	32
6.5.2	Periodical verification	32
6.5.3	Periodical calibration	32
7	Test report and technical documentation	32
7.1	Test report	32
7.2	Technical documentation	33
7.3	Total probable error TPE.....	33
7.3.1	General	33
7.3.2	Specific errors	33
Annex A	(informative) Main characteristics for level transmitters.....	34
A.1	Properties of level transmitter classes.....	34
A.1.1	General	34
A.1.2	Pressure-based level transmitter	34
A.1.3	Microwave/Radar level transmitter	36
A.2	Product properties	42
A.2.1	Library of properties used in the device classes.....	42
A.2.2	Value lists of properties	46
Annex B	(informative) Example for the calculation of the TPE based on 7.3 and the MRU and MRE	48
B.1	Overview of the parameters used for the error calculation.....	48
B.2	Example test report pressure-based level transmitter	48
B.2.1	General	48
B.2.2	Test protocol	48
B.2.3	DUT characteristics	48
B.2.4	TPE calculation	49
B.2.5	MRU calculation	50

B.3	Sub test processes	51
B.3.1	Inaccuracy test	51
B.3.2	Ambient temperature effect test	52
B.3.3	Process temperature effect test	53
B.3.4	Long-term stability test	54
Bibliography		56
Figure 1	– Principle diagram of time values and their meanings	10
Figure 2	– Principles of pressure-based level transmitters	18
Figure 3	– Free-space radar level transmitter	19
Figure 4	– Guided-wave radar level transmitter	20
Figure 5	– Schematic example of a test set-up for pressure PMT	25
Figure 6	– Typical test set-up for radar level transmitter	26
Figure 7	– Test setup simulated targets and simulated environment	27
Figure 8	– Example of test setup for wet test	28
Table 1	– Environmental test conditions	21
Table 2	– Influence quantities for the various level measurement principles	22
Table 3	– Number of measurement cycles and number and position of test points	24
Table 4	– Example of statement of maximum error	29
Table A.1	– Pressure-based level transmitter	34
Table A.2	– Free-space radar level transmitter	37
Table A.3	– Guided-wave radar level transmitter	39
Table A.4	– Library of properties used in the device classes	42
Table A.5	– Value lists of properties	47
Table B.1	– Abbreviated terms	48
Table B.2	– DUT characteristics	49
Table B.3	– TPE calculation	49
Table B.4	– MRU calculation	50
Table B.5	– Reference test devices	51
Table B.6	– Reference test conditions	51
Table B.7	– Test results	52
Table B.8	– Reference test equipment	52
Table B.9	– Reference test conditions	53
Table B.10	– Test results	53
Table B.11	– Reference test equipment	53
Table B.12	– Reference test conditions	54
Table B.13	– Test results	54
Table B.14	– Reference test equipment	55
Table B.15	– Reference test conditions	55
Table B.16	– Test results	55

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**REFERENCE CONDITIONS AND PROCEDURES FOR TESTING
INDUSTRIAL AND PROCESS MEASUREMENT TRANSMITTERS –****Part 4: Specific procedures for level transmitters****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 62828-4 has been prepared by subcommittee 65B: Measurement and control devices, of IEC technical committee 65: Industrial-process measurement, control and automation.

The IEC 62828 series cancels and replaces the IEC 60770 series and proposes revisions for the IEC 61298 series.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
65B/1178/FDIS	65B/1182/RVD

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

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

This International Standard is to be used in conjunction with IEC 62828-1:2017.

A list of all parts in the IEC 62828 series, published under the general title *Reference conditions and procedures for testing industrial and process measurement transmitters*, can be found on the IEC website.

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

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

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

Most of the current IEC standards on industrial measurement transmitters are rather old and were developed having in mind devices based on analogue technologies. Today's digital industrial and process measurement transmitters are quite different from those analogue transmitters: they include more functions and newer interfaces, both towards the computing section (mostly digital) and towards the measuring section (mostly mechanical). Even if some standards dealing with digital transmitters already exist, they are not sufficient, since some aspects of the performance are not covered by appropriate test methods.

In addition, the existing IEC test standards for industrial and process measurement transmitters are spread over many documents, so that for manufacturers and users it was difficult, impractical and time-consuming to identify and select all the standards to be applied to a device measuring a specific process quantity (pressure, temperature, level, flow, etc.).

To help the manufacturers and users, it was decided to review, complete and reorganize the existing IEC standards on the industrial and process measurement transmitters and to create a more suitable, effective and comprehensive standard series that provides, in a systematic way, all the needed specifications and tests for the different industrial and process measurement transmitters.

To solve the issues mentioned above and to provide an added value for the stakeholders, the new standard series on industrial and process measurement transmitters covers the following main aspects:

- applicable normative references;
- specific terms and definitions;
- typical configurations and architectures for the various types of industrial and measurement transmitters;
- hardware and software aspects;
- interfaces (to the process, to the operator, to the other measurement and control devices);
- physical, mechanical and electrical requirements and relevant tests; clear definition of the test categories: type tests, acceptance tests and routine tests;
- performances (their specification, tests and verification);
- environmental protection, hazardous areas application, functional safety, etc.;
- structure of the technical documentation.

To cover in a systematic way all the topics to be addressed, the standard series is organized in several parts. At the time of publication of this document IEC 62828 consists of the following parts:

- IEC 62828-1: *General procedures for all types of transmitters*
- IEC 62828-2: *Specific procedures for pressure transmitters*
- IEC 62828-3: *Specific procedures for temperature transmitters*
- IEC 62828-4: *Specific procedures for level transmitters*
- IEC 62828-5: *Specific procedures for flow transmitters*

In preparing the IEC 62828 series (all parts), many test procedures were taken, with the necessary improvements, from the IEC 61298 series. As the IEC 61298 series is currently applicable to all process measurement and control devices, when the IEC 62828 series is completed, the IEC 61298 series will be revised to harmonize it with the IEC 62828 series, taking out from its scope the industrial and process measurement transmitters. During the time when the scope of the IEC 61298 series is being updated, the new IEC 62828 series takes precedence for industrial and process measurement transmitters.

When the IEC 62828 series is published, the IEC 60770 series will be withdrawn.

REFERENCE CONDITIONS AND PROCEDURES FOR TESTING INDUSTRIAL AND PROCESS MEASUREMENT TRANSMITTERS –

Part 4: Specific procedures for level transmitters

1 Scope

This part of IEC 62828 establishes specific procedures for testing level transmitters used in measuring and control systems for industrial process and machinery control systems. For general test procedures, reference is to be made to IEC 62828-1:2017, applicable to all types of transmitters.

Throughout this document, the term "industrial transmitters" covers all types of transmitters used in measuring and control systems for industrial processes and for machinery.

The requirements of this document are applicable to all level measurement principles.

Detailed description of transmitters is given for two main principles for improved clarity.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

IEC 60068-2-6:2007, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-27:2008, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60068-2-64:2008, *Environmental testing – Part 2-64: Tests – Test Fh: Vibration, broadband random and guidance*

IEC 61326-2-3:2012, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 2-3: Particular requirements – Test configuration, operational conditions and performance criteria for transducers with integrated or remote signal conditioning*

IEC 62828-1:2017, *Reference conditions and procedures for testing industrial and process measurement transmitters – Part 1: General procedures for all types of transmitters*

IEC 62828-2:2017, *Reference conditions and procedures for testing industrial and process measurement transmitters – Part 2: Specific procedures for pressure transmitters*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62828-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>