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Responsible committee: GEL/65/2 Measurement and control devices

Interested committees:

Title: BS EN IEC 62828-1 Reference conditions and procedures for testing industrial and process measurement transmitters

Part 1: General procedures for all types of transmitters

Please notify the secretary if you are aware of any keywords that might assist in classifying or identifying the standard or if the content of this standard

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- ii) affects other national standard(s)
- iii) requires additional national guidance or information

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



COMMITTEE DRAFT FOR VOTE (CDV)

PROJECT NUMBER:

IEC 62828-1 ED2

DATE OF CIRCULATION:

2024-03-08

CLOSING DATE FOR VOTING:

2024-05-31

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65B/1239/RR

IEC SC 65B : MEASUREMENT AND CONTROL DEVICES

SECRETARIAT:

United States of America

SECRETARY:

Mr Wallie Zoller

OF INTEREST TO THE FOLLOWING COMMITTEES:

PROPOSED HORIZONTAL STANDARD:



Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.

FUNCTIONS CONCERNED:

☐ EMC☐ ENVIRONMENT☐ QUALITY ASSURANCE☐ SAFETY☒ SUBMITTED FOR CENELEC PARALLEL VOTING☐ NOT SUBMITTED FOR CENELEC PARALLEL VOTING**Attention IEC-CENELEC parallel voting**

The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this Committee Draft for Vote (CDV) is submitted for parallel voting.

The CENELEC members are invited to vote through the CENELEC online voting system.

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Recipients of this document are invited to submit, with their comments, notification of any relevant "In Some Countries" clauses to be included should this proposal proceed. Recipients are reminded that the CDV stage is the final stage for submitting ISC clauses. (SEE [AC/22/2007](#) OR [NEW GUIDANCE DOC](#)).

TITLE:

Reference conditions and procedures for testing industrial and process measurement transmitters - Part 1: General procedures for all types of transmitters

PROPOSED STABILITY DATE: 2029

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

REFERENCE CONDITIONS AND PROCEDURES FOR TESTING INDUSTRIAL AND PROCESS MEASUREMENT TRANSMITTERS Part 1: General procedures for all types of transmitters

FOREWORD

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- International Standard IEC 62828-1 has been prepared by Subcommittee 65B: Measurement and control devices, of IEC Technical Committee 65: Industrial-process measurement, control and automation.

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

FDIS	Report on voting

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.

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

- 206 • reconfirmed,
- 207 • withdrawn,
- 208 • replaced by a revised edition, or
- 209 • amended.

210

211 The National Committees are requested to note that for this publication the stability date
212 is 202X.

213 THIS TEXT IS INCLUDED FOR THE INFORMATION OF THE NATIONAL COMMITTEES AND WILL BE DELETED
214 AT THE PUBLICATION STAGE.

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INTRODUCTION

Most of the current IEC standards on industrial and process 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 electronic) and towards the measuring section (mostly mechanical). Even if some standards dealing with digital process measurement transmitters already exist, they are not sufficient, since some aspects of the performance are not covered by appropriate test methods.

In addition, existing IEC test standards for industrial and process measurement transmitters are spread over many documents, so that for manufacturers and users it is 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, flow, level, etc.).

To help manufacturers and users, it was decided to review, complete and reorganize the relevant IEC standards and to create a more suitable, effective and comprehensive standard series that provides in a systematic way all the necessary specifications and tests required for 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 process 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
- Performance (its 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. An updated list of all parts of the IEC 62828-x series, published under the general title "Reference conditions and procedures for testing industrial and process measurement transmitters", can be found on the IEC website. At the moment of the publication of this standard, the IEC 62828 consists of the following parts:

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

REFERENCE CONDITIONS AND PROCEDURES FOR TESTING INDUSTRIAL AND PROCESS MEASUREMENT TRANSMITTERS

Part 1: General procedures for all types of transmitters

1. Scope

This Part of IEC 62828 establishes a general framework for defining reference conditions and test procedures applicable for assessing the measurement performances of all types of industrial and process measurement transmitters (PMTs) used in measuring and control systems for industrial process and machinery.

For the purpose of this document, an analogue PMT is a process measurement transmitter with only analogue current and/or voltage output(s), irrespective the technology adopted and the complexity of the circuitry. All the other process measurement transmitters, with digital output(s) only or with hybrid analogue and digital output(s), are considered to be digital PMTs.

This part of IEC 62828 constitutes a common reference for the other parts of the series.

Specific test procedures and additional requirements for given types of PMTs (pressure, temperature, level, flow, etc.) are covered by other parts of this series.

Proximity devices according IEC 60947-series with analogue output are excluded from the scope of this standard.

Note 1: in industrial and process applications, to indicate the process measurement transmitters it is common also to use the terms “industrial transmitters”, or “process transmitters”.

Note 2: for better clarity, when the complete definition “industrial and process measurement transmitter” makes the sentence too long in this standard, the short term “transmitter”, or PMT, is used instead.

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.

IEC 60050-300:2020, *International Electrotechnical Vocabulary (IEV)*
– *Electrical and electronic measurements and measuring instruments*
– *Part 311: General terms relating to measurements*
– *Part 312: General terms relating to electrical measurements*
– *Part 313: Types of electrical measuring instruments*
– *Part 314: Specific terms according to the type of instrument*

IEC 60068-2-1:2007, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-2:2007, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

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 60068-2-31:2008, *Environmental testing – Part 2-31: Tests – Test Ec: Rough handling shocks, primarily for equipment-type specimens*

IEC 60068-2-78:2012, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

- IEC 60079 (all parts), *Electrical apparatus for explosive gas atmospheres*
- IEC 60529:1989 + Amd1:1999 + Amd2:2013, *Degrees of protection provided by enclosures (IP code)*
- IEC 60654-1:1993, *Industrial-process measurement and control equipment - Operating conditions - Part 1: Climatic conditions*
- IEC 60654-3:1983, *Operating conditions for industrial-process measurement and control equipment - Part 3: Mechanical influences*
- IEC 60654-4:1987, *Operating conditions for industrial-process measurement and control equipment. Part 4: Corrosive and erosive influences.*
- IEC 61158 (all parts), *Industrial communication networks – Fieldbus specifications*
- IEC 61326-1:2020, *Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements*
- IEC 61499 series, *Function blocks*
- IEC 61804 (all parts), *Function blocks (FB) for process control*
- IEC 61918:2018 *Industrial communication networks - Installation of communication networks in industrial premises*
- IEC 61987-1:2006, *Industrial-process measurement and control - Data structures and elements in process equipment catalogues - Part 1: Measuring equipment with analogue and digital output*
- IEC 61987-11:2016, *Industrial-process measurement and control - Data structures and elements in process equipment catalogues - Part 11: List of Properties (LOP) of measuring equipment for electronic data exchange - Generic structures*
- IEC 61987-13:2016, *Industrial-process measurement and control - Data structures and elements in process equipment catalogues - Part 13: Lists of properties (LOP) for pressure measuring equipment for electronic data exchange*
- IEC 62262:2002, *Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK Code)*
- IEC 62381:2012, *Automation systems in the process industry - Factory acceptance test (FAT), site acceptance test (SAT) and site integration test (SIT)*
- ISO 10012:2004, *Measurement management systems - Requirements for measurement processes and measuring equipment*
- ISO/IEC Guide 98-3:2008, *Uncertainty of measurement - Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*
- ISO/IEC Guide 99:2007, *International Vocabulary of Metrology - Basic and general concepts and associated terms (VIM:2007)*

3. Terms, definitions and abbreviated terms

3.1 Terms and definitions

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

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

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

The terms are divided in four groups for consistency.

3.1.1 Terms related to accuracy

3.1.1.1

accuracy (of a measuring instrument)

quality which characterizes the ability of a measuring instrument to provide an indicated value close to a true value of the measurand

Note 1 to entry: This term is used in the "true value" approach.

Note 2 to entry: Accuracy is all the better when the indicated value is closer to the corresponding true value.

[SOURCE: IEC 60050-311:2001, 311-06-08]

3.1.1.2

communication interface

Interface for input or output of variable parameters (e.g. correction of the characteristic curve) and data (e.g. measurement and calibration data, electronic nameplate, device status) of the pressure transmitter.

3.1.1.3

conformity

ability of a measuring instrument to provide an indication having a specified characteristic curve which can be linear, logarithmic, parabolic, etc.

3.1.1.4

dead band (dead zone)

finite range of values within which a variation of the input variable does not produce any measurable change in the output variable

Note 1 to entry: When this type of characteristic is intentional, it is sometimes called neutral zone

Note 2 to entry: This entry was numbered 351-24-14 in IEC 60050-351:2006.

Note 3 to entry: This value is usually insignificant for the actual instruments.

[SOURCE: IEC 60050-351:2013, 351-45-15, modified (Note 3 added)]

3.1.1.5

error

discrepancy between a computed, observed or measured value or condition, and the true, specified or theoretically correct value or condition

Note to entry: An error within a system may be caused by failure of one or more of its components, or by activation of a systematic fault.

[SOURCE: IEC 60050-192:2015, 192-03-02]

3.1.1.6

hysteresis

phenomenon represented by a characteristic curve which has a branch, called ascending branch, for increasing values of the input variable, and a different branch, called descending branch, for decreasing values of the input variable

Note to entry: the CDD code of this entry for Electronic Data Exchange is ABB661 and the hysteresis is defined as the difference between consecutive upscale and downscale outputs for any single test cycle at the same input test point

[SOURCE: IEC 60050-351:2013, 351-45-16, modified (Note to entry added)]

3.1.1.7

inaccuracy

maximum positive and negative deviation from the specified characteristic curve observed in testing a device under specified conditions and by a specified procedure

Note to entry: Accuracy is defined in IEC 60050-300, definition 311-06-08.

3.1.1.8

linearity

ability of a measuring instrument to provide an indication having a linear relationship with a defined quantity other than an influence quantity

Note to entry: The method of expression of lack of linearity is different for different kinds of instrument and is established in each particular instance.

[SOURCE: IEC 60050-311:2001, 311-06-05]

3.1.1.9

long term drift

drift in output monitored for 30 days at 90 % of span

[SOURCE: IEC 61987-1:2008, 3.22]

3.1.1.10

long term stability

drift of zero output signal in percent of full scale limit after a given period of normal operating conditions

Note 1 to entry: the long term stability can be evaluated over a different period of time, e.g. 6 months, 1, 2 or 5 years. Sometime manufacturers declare a life-time stability.

Note 2 to entry: depending the type of PMT, the drift can be referred to an upper range limit (e.g. digital pressure PMTs), a fixed value (e.g. certain level PMTs), a full scale (e.g. some analogue PMTs), etc.

Note 3 to entry: the CDD code of this entry for Electronic Data Exchange is ABB551, modified (time period)

3.1.1.11

measured error

largest positive or negative value of errors of the average upscale or downscale values at each point of measurement

3.1.1.12

measuring range

range defined by two values of the measurand, or quantity to be supplied, within which the limits of uncertainty of the measuring instrument are specified

Note to entry: An instrument can have several measuring ranges

[SOURCE: IEC 60050-311:2001, 311-03-12]

3.1.1.13

non-conformity

deviation from ideal behavior for devices that have a non-linear input/output relationship (which can be linear, logarithmic, parabolic, etc.), determined from the curve plotted using the overall average of corresponding upscale and downscale errors

Note 1 to entry: Non-conformity can be calculated and expressed in one of three ways:

– independent: curve positioned so as to minimize the maximum deviation;

– terminal-based: curve positioned so as to coincide with the actual characteristic curve at the upper and lower range-values;

– zero-based: curve positioned so as to coincide with the actual characteristic curve at the lower range-value.

Note 2 to entry: The corresponding properties are to be found in the CDD.

[SOURCE: IEC 61987-13:2016, modified]

3.1.1.14

non-linearity

deviation from ideal behavior for devices that have a linear input/output relationship, determined from the curve plotted using the overall average of corresponding upscale and downscale errors

Note 1 to entry: Non-linearity can be calculated and expressed in one of three ways:

– independent: line positioned so as to minimize the maximum deviation;

– terminal-based: line positioned so as to coincide with the actual characteristic curve at the upper and lower range-values;

– zero-based: line positioned so as to coincide with the actual characteristic curve at the lower range-value.

Note 2 to entry: The corresponding properties are to be found in the CDD.

[SOURCE: IEC 61987-13:2016]

3.1.1.15

overrange

An input signal larger than an instrument is designed to accept or measure

Note 1 to entry: That part of the proportional range where the analogue output signal represents a process value above the configured measuring range.

NOTE 2 to entry: The output signal can be not calibrated in overrange state.

3.1.1.16

overshoot

for a step response, the maximum transient deviation from the final steady-state value of the output variable, expressed as a percentage of the difference between the final and the initial steady-state values

Note to entry: the CDD code of this entry for Electronic Data Exchange is ABD684

[SOURCE: IEC 60050-351:2013, 351-45-38 modified]

3.1.1.17

repeatability

closeness of agreement between the results of successive measurements of the same measurand, carried out under the same conditions of measurement, i.e.:

- by the same measurement procedure,
- by the same observer,
- with the same measuring instruments, used under the same conditions,
- in the same laboratory,
- at relatively short intervals of time.

Note to entry: The concept of "measurement procedure" is defined in VIM 2.5

[SOURCE: IEC 60050-311:2001, 311-06-06]

3.1.1.18

settling time

for a step response the duration of the time interval between the instant of the step change of an input variable and the instant, when the difference between the step response and their steady-state value remains smaller than the transient value tolerance

[SOURCE: IEC 60050-351:2013, 351-45-37, modified (Figure and Note missing)]

3.1.1.19

signal

physical variable quantity, one or more parameters of which carry information about one or more variable quantities

Note 1 to entry: These parameters are designed "information parameters".

Note 2 to entry: This entry was numbered 351-21-51 in IEC 60050-351:2006.

[SOURCE: IEC 60050-351:2013, 351-41-17]

3.1.1.20

span

algebraic difference between the values of the upper and lower limits of the measuring range

Note 1 to entry: limit has not to be intend as physical limits regarding the capabilities of the device, rather the upper and lower values defined for the relevant application,

Note 2 to entry: the CDD code of this entry for Electronic Data Exchange is ABB785, modified ("other variables" removed)

[SOURCE: IEC 60050-311:2001, 311-03-13, modified (Notes added)]

3.1.1.21

span error

difference between the actual span and the ideal span, expressed as percentage of ideal span

Note to entry: the CDD code of this entry for Electronic Data Exchange is ABB655.

[SOURCE: IEC 61987-13:2016, modified (Note added)]

3.1.1.22

stability

ability of a measuring instrument to keep its performance characteristics unchanged during a specified time interval, all other conditions being the same

[SOURCE: IEC 60050-311:2001, 311-06-12]

3.1.1.23

start-up drift

drift in output monitored over a period of 4 h after power is switched on

3.1.1.24

step response time

duration between the instant when the measurand (or quantity supplied) is subjected to a specified abrupt change and the instant when the indication (or quantity supplied) reaches, and remains within specified limits of, its final steady-state value

Note 1 to entry: this definition is the one conventionally used for measuring instruments. Other definitions exist.

Note 2 to entry: the dead time of the transmitter response is included in the step response time (see Figure 5 and Figure 6)

[SOURCE: IEC 60050-311:2001, 311-06-04, modified (Note 2 added)]

3.1.1.25

true value

value consistent with the definition of a given particular quantity

Note 1 to entry – This term is used in the "true value" approach.

Note 2 to entry – This is a value that would be obtained by a perfect measurement.

Note 3 to entry – True values are by nature indeterminate.

Note 4 to entry – The indefinite article "a", rather than the definite article "the", is used in conjunction with "true value" because there can be many values consistent with the definition of a given particular quantity.

[SOURCE: 311-01-04]

3.1.1.26

conventional true value (of a quantity)

value attributed to a particular quantity and accepted, sometimes by convention, as having an uncertainty appropriate for a given purpose

Note 1 to entry: This term is used in the "uncertainty" approach.

Note 2 to entry: The "conventional true value" is sometimes called "assigned value", "best estimate of the value", "conventional value" or "reference value". The term "reference value", in this sense, should not be confused with "reference value" in the sense used in 311-07-01.

Note 3 to entry: Frequently, a large number of results of measurement of a quantity are used to establish a conventional true value.

Note 4 to entry: Traditional definitions, based on the true value approach, treated the conventional true value as a value approximating to a true value of the quantity such that the difference could be neglected for the purposes for which that value was used.

[SOURCE: IEC 60050-311:2001, 311-01-06]

3.1.1.27

variable quantity

variable

physical quantity the value of which is subject to change and can usually be measured

Note to entry: The term "variable" alone is frequently used to circumvent the lengthy but correct designation "variable quantity".

[SOURCE: IEC 60050-351:2013, 351-41-01]

3.1.1.28

zero offset

deviation of the actual zero output from the specified zero output

Note to entry: For example, the specified output of a 4-20 mA pressure transmitter is 4 mA,

3.1.1.29

zero output

output signal of a PMT at the lower range value

3.1.1.30

zero point error

absolute error of a device under reference conditions, when the input is at the lower range value

Note to entry: the CDD code of this entry for Electronic Data Exchange is ABB656

3.1.2 **Terms related to the uncertainty**

3.1.2.1

combined standard measurement uncertainty

standard measurement uncertainty that is obtained using the individual standard measurement uncertainties associated with the input quantities in a measurement model

[SOURCE: ISO/IEC Guide 99:2007, 2.31, modified (Note missing)]

3.1.2.2

coverage factor

number larger than one by which a combined standard measurement uncertainty is multiplied to obtain an expanded measurement uncertainty

NOTE to entry: A coverage factor is usually symbolized by k (see also ISO/IEC GUM Guide 98-3:2008, 2.3.6).

[SOURCE: ISO/IEC Guide 99:2007, 2.38]

3.1.2.3

expanded measurement uncertainty

product of a combined standard measurement uncertainty and a factor larger than the number one

Note 1 to entry: The factor depends upon the type of probability distribution of the output quantity in a measurement model and on the selected coverage probability (unless otherwise specified, the factor is set to 2, to have a coverage probability of 95%).

Note 2 to entry: The term "factor" in this definition refers to a coverage factor

[SOURCE: ISO/IEC Guide 99:2007, 2.35, modified (Note 3 missing)]

3.1.2.4

measurand

particular quantity subject to measurement

Note to entry: measurand is often called "measured value"

[SOURCE: IEC 60050-311:2001, 311-01-03, modified (Note added)]

3.1.2.5

measurement

process of experimentally obtaining one or more quantity values that can reasonably be attributed to a quantity

[SOURCE: ISO/IEC Guide 99:2007, 2.1, modified (Notes 1, 2 and 3 missing)]

3.1.2.6

measurement uncertainty

non-negative parameter characterizing the dispersion of the quantity values being attributed to a measurand, based on the information used

[SOURCE: ISO/IEC Guide 99:2007, 2.26, modified (Notes 1, 2, 3 and 4 missing)]

3.1.2.7

total error

total probable error TPE

the number obtained by taking the square root of the total sum of the squares of the individual error factors, adopted to consistently compare the performances of two (or more) PMTs

Note 1 to entry: It is assumed that the variables of the individual errors are independent of each other.

Note 2 to entry: When combining all the error factors, the units of measure must all be the same.

3.1.2.8

uncertainty budget

statement of a measurement uncertainty, of the components of that measurement uncertainty, and of their calculation and combination

[SOURCE: ISO/IEC Guide 99:2007. 2.33, modified (Note missing)]

3.1.3 Terms regarding operation and practical installation

3.1.3.1

influence quantity

quantity which is not the subject of the measurement and whose change affects the relationship between the indication and the result of the measurement

Note 1 to entry: This term is used in the "uncertainty" approach.

Note 2 to entry: Influence quantities can originate from the measured system, the measuring equipment or the environment.

Note 3 to entry: As the calibration diagram depends on the influence quantities, in order to assign the result of a measurement it is necessary to know whether the relevant influence quantities lay within the specified range.

[SOURCE: IEC 60050-311:2001, 311-06-01]

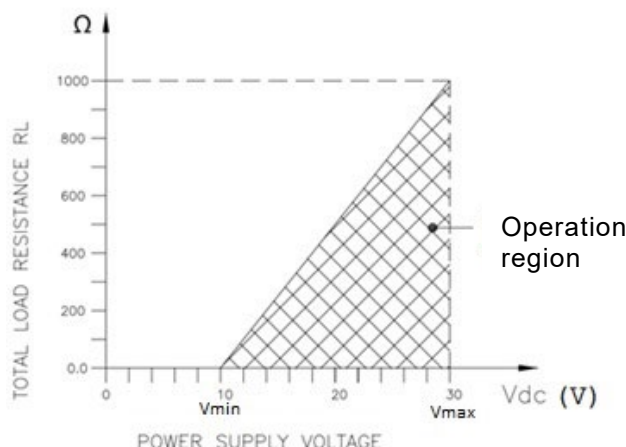
3.1.3.2

operation region

permissible range of supply voltage and output load resistance within with which a transmitter can operate within the specifications

EXAMPLE: Figure 1 referring to an output current at full scale of 20 mA.

Note 1 to entry: The supply voltage is often referred to as the input terminal voltage or auxiliary power.



Key:

Vdc = Actual supply voltage in volt

Vmax = Maximum supply voltage, 30 V in this example

Vmin = Minimum supply voltage, 10 V in this example

RL = Max. load resistance in ohm at the actual supply voltage:

$RL \leq (Vdc - 10) / 0,02$ (in the example reported in Figure 1)

Figure 1 – Example of limit operation region in terms of output load resistance versus supply voltage

3.1.3.3

turndown ratio TD**maximum turndown ratio**

ratio of the maximum span to the minimum span to which an instrument can be adjusted within the specified accuracy rating

Note 1 to entry: $TD = |URV - LRV|_{\text{Max}} / |URV - LRV|_{\text{min}}$, where Upper and Lower Range Value (URV and LRV), are both always related to the same datum point.

Note 2 to entry: TD is always ≥ 1

3.1.3.4

ambient temperature range

range of ambient temperature for the PMT enclosure over which the device must function within the specified tolerances

Note to entry: Whenever required, a temporary limiting operating condition could be specified as well.

3.1.3.5

process temperature range

range of process temperature medium in contact with the PMT sensing element over which the device must function within the specified tolerances

3.1.4 **Terms related to test procedures**

3.1.4.1

acceptance test

contractual test to prove to the customer that the device under test meets certain conditions of its specification

[SOURCE: IEC 60050-151:2001, 151-16-23]

3.1.4.2

routine test

conformity test made on each individual item during or after manufacture

[SOURCE: IEC 60050-151:2001, 151-16-17]

3.1.4.3

test procedure

statement of the tests to be carried out, and the conditions for each test, agreed between the manufacturer, the test laboratory, and the purchaser/user before the evaluation starts

3.1.4.4

type test

conformity test made on one or more items representative of the production

[SOURCE: IEC 60050-151:2001, 151-16-16]

3.2 **Abbreviated terms**

For the purpose of this standard, the following abbreviations apply.

CDD Common Data Dictionary

DCS Distributed Control System

DUT Device Under Test

EMC Electro Magnetic Compatibility

FAT Factory Acceptance Test

GUM Guide to expression the Uncertainty of Measurement

LOP List Of Properties

684 MRU Maximum Relieved Uncertainty
 685 MTU Maximum Tolerated Uncertainty
 686 PMT Process Measurement Transmitter (Industrial and Process Measurement Transmitter)
 687 SAT Site Acceptance Test
 688 SCADA Supervisory, Control And Data Acquisition
 689 RTD Resistance Thermal Detector
 690 SIT Site Integration Test
 691 TD Turn Down
 692 TPE Total Probable Error
 693 VIM International Vocabulary of Metrology

694

695 3.3 Reference to IEC CDD

696 The IEC Common Data Dictionary (CDD) contains a classification of measuring devices with
 697 Lists Of properties (LOPs) for the device types most often met in practice. These properties can
 698 be used to describe the performance of a device, the effect of any quantities influencing its
 699 performance as well as the reference standards against which it was tested with test results.

700 Each property has a unique identifier, e.g., ABB551, which is quoted in this standard as
 701 appropriate. By entering the appropriate properties in the LOPs it is possible to exchange test
 702 results electronically between interested parties. The CDD is to be found at the following
 703 address: <http://std.iec.ch/cdd/iec61987/cdddev.nsf>.

704 The various measuring devices are to be found in the domain “Process automation (IEC 61987
 705 series)”; ABA000 – Equipment for industrial-process automation; ABV000 – Characterization;
 706 ABA001 – Measuring Instruments. The device characterization is also to be found in IEC 61987-
 707 11.

708 4. General description of the PMT

709 The definition of a detailed test protocol requires a deep knowledge of the specific PMT under
 710 test and its components. This is obtained by a close collaboration between the assessor and
 711 the manufacturer during the evaluation.

712 For the scope of the present standard, which only defines general test procedures, a short
 713 description of the functional blocks of the PMT is sufficient (see Informative Annex A). However,
 714 a simplified block diagram of a PMT is described in Figure 2.

715

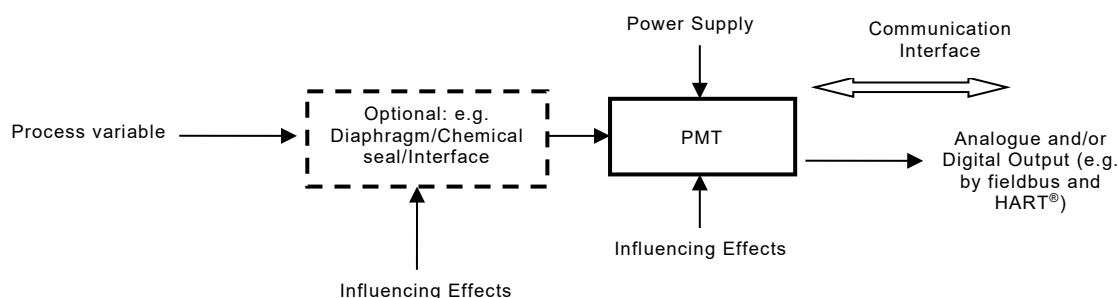
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721

Figure 2 – Block diagram of a generic PMT

722 In general terms, a PMT can be defined as “fixed scale transmitter” when the measuring range
 723 is set by the manufacturer, and “variable scale transmitter” when the measuring range is
 724 adjustable (turn-down ratio).

5. Reference test conditions

5.1 General

This clause defines “standard reference test conditions” and “ambient and process reference test conditions” for quantities influencing operation for type and routine tests to be considered when evaluating the static and dynamic behaviour of the analogue and digital PMTs during tests performed according to the procedures described in Clause 6. “Reference design criteria” considers mechanical, electrical and functional properties of a device that are not in themselves influence quantities but for which design standards exist, against which the device can be assessed.

The standard reference test conditions are a reduced set of standardized conditions implemented to assess the performance values of the PMT. These conditions do not represent the actual operating conditions in which the PMT is intended to be installed.

The reference test conditions for ambient and process quantities influencing operation represent the real conditions that the PMT might encounter at the location in which it is intended to be installed. These test conditions are made in order to determine the impact of the influence quantities on the performance of the PMT and to verify the mechanical and the electrical conditions which a PMT can withstand and still work within its specifications.

These operating conditions are defined in terms of ranges (classes) of the parameters characterizing the various locations and are determined in laboratory tests that evaluate the performance of the PMT by means of a variation of the influencing parameters around the reference test values.

5.2 Standard reference test conditions

5.2.1 General

The reference test conditions are essentially related to the environmental conditions, power supply conditions, load conditions and mounting arrangements.

5.2.2 Environmental test conditions

The PMT shall be evaluated under the conditions specified in Table 1.

Table 1 – Environmental test conditions

Environmental test conditions	Temperature °C	Relative humidity %	Atmospheric pressure kPa
Standard reference atmosphere	20	65	101,3
Limits for the atmosphere test conditions	15 ÷ 25	50 ÷ 70	86 ÷ 106
Note: Different environmental conditions can be used if agreed between user and manufacturer			

The test temperature shall be stated in the test report, and if it is possible and requested, the test results shall be corrected to the standard reference atmospheric conditions reported in Table 1.

Note: It is recognized that a factor to correct humidity is not always available.

The maximum rate of change of the ambient temperature permissible during any test shall be 1 °C in 10 min, but not more than 3 °C/h.

Note: Special equipment could be required to maintain the basic test conditions within the specified limits.

5.2.3 Power supply conditions

The reference values for voltage and if applicable frequency shall be specified by the manufacturer.

Unless other tolerances are agreed between user and manufacturer, the following shall apply:

- rated voltage: $\pm 1 \%$;
- rated frequency: $\pm 1 \%$;
- harmonic distortion (AC supply): less than 5 %;
- ripple (DC supply): less than 0,1 %.

NOTE: Tolerances on supply conditions are not applicable to PMTs with self-contained power supplies (e.g. battery-powered). The tolerances for battery powered equipment can be agreed.

5.2.4 Load conditions

The reference minimum and maximum load conditions during the evaluation tests shall be specified by the manufacturer.

5.2.5 Mounting positions

The instrument shall be installed in only one of its specified normal operating positions, with a $\pm 3^\circ$ tolerance or less, in accordance with the manufacturer's instructions. The position used shall be clearly stated in the test report.

Where appropriate, the mounting bracket supplied with the instrument shall be used.

All covers supplied with the instrument shall be in place.

5.3 Reference test conditions for ambient and process quantities influencing operation

5.3.1 General

This clause defines all the parameters that have to be considered as influence quantities for the operating conditions. Whenever possible, they are identified in terms of ranges (classes) for the various parameters affecting the test results.

5.3.2 Process conditions

For process conditions (rated process temperature, pressure, pulse, etc.) reference is generally made to the applicable international or national standards. These conditions shall be specified by the manufacturer or agreed with the user.

5.3.3 Environmental atmospheric conditions

5.3.3.1 General

The PMT shall be evaluated using the limiting operating conditions specified by the manufacturer or, if no specific values are given, according to the conditions specified in IEC 60654-1.

For the definition of environmental atmospheric conditions, the climatic conditions in various locations are usually expressed in terms of ranges (classes) of air temperature and humidity.

Note: the barometric pressure is usually not relevant for the PMTs.

The standardized location classes typically used are the following:

Class A: weather-protected locations, air-conditioned locations

Class B: weather-protected locations, heated and/or cooled enclosed locations;

Class C: weather-protected locations, sheltered and/or unheated enclosed locations;

Class D: non weather-protected locations, outdoor locations.

5.3.3.2 Ambient temperature

The PMT shall be evaluated using the conditions specified by the manufacturer, or if the manufacturer does not indicate any limits, under the conditions specified in IEC 60654-1 for the typical operating application.

Table 2 gives an example of common ambient temperatures ranges for various operating applications.

Table 2 – Common ambient temperatures ranges

Temperature °C		Temperature class (IEC 60654-1)	Typical operating application
min.	max.		
+20	+25	A1	Air conditioned locations
+15 +5	+30 +40	B1 B2	Heated or/and cooled enclosed locations
-5 -25	+45 +55	C1 C2	Sheltered locations
-33	+40	D1	Outdoor locations

5.3.3.3 Ambient relative humidity

The PMT shall be evaluated using the conditions specified by the manufacturer, or if the manufacturer does not give any limits, under the conditions specified in IEC 60654-1 for the typical operating application.

Table 3 gives an example of reference ambient relative humidity ranges for various operating applications.

Table 3 – Common ambient relative humidity ranges

Relative humidity %		Humidity class (IEC 60654-1)	Typical operating application
min.	max.		
20	75	A1	Air conditioned locations
10 5	75 85	B1 B2	Heated or/and cooled enclosed locations
5 10	95 100	C1 C2	Sheltered locations
15	100	D1	Outdoor locations

5.3.4 Mechanical vibration

The PMT shall be evaluated using the conditions specified by the manufacturer, or if the manufacturer does not specify any limits, the reference values specified in Table 4 for various typical operating applications shall be used. Reference test procedures are those specified in IEC 60068-2-6.

Table 4 – Vibration test levels

Typical application	Test frequency range Hz	Displacement peak amplitude mm	Acceleration peak amplitude m/s ²
Control room or field with low vibration level	10 to 150	0,35	1
Control room or field with medium vibration level	10 to 150	0,75	2
Field with general application or pipeline with low vibration	10 to 1 000	0,15	20
Field with high vibration level or pipe line with high vibration	10 to 1 000	0,35	50

5.3.5 Shock, drop and topple

The PMT shall be evaluated using the conditions specified by the manufacturer, or if the manufacturer does not specify any limits, the following values for shock, drop and topple in terms of height for free fall shall be used: 25 mm, 50 mm, 100 mm, 250 mm, 500 mm, 1000 mm or >1 000 mm for more severe conditions. Reference test procedures are those specified in IEC 60068-2-27.

5.3.6 Power supply

The PMT shall be evaluated using the conditions specified by the manufacturer, or if the manufacturer does not specify any limits under the conditions specified in Table 5 for voltage and frequency according the conditions specified in IEC 60654-1 for the typical operating application.

Table 5 – Power supply ranges for voltage and frequency

Power supply class for voltage	Tolerance of AC power supply voltage	Tolerance of DC power supply voltage
1	± 1 %	± 10 %
2	± 10 %	+10 % / –15 %
3	+10 % / –15 %	+15 % / –20 %
4	+15 % / –20 %	+30 % / –25 %
Power supply class for frequency	Tolerance of AC power supply frequency	
1	± 0,2 %	
2	± 1 %	
3	± 5 %	

5.3.7 Electromagnetic compatibility (EMC)

The PMT shall be evaluated against electromagnetic immunity and emission using the limits specified in the IEC 61326 standard series, that shall be used as a reference also for test set-up and test procedures.

The choice of the relevant limits shall be determined after taking into account the emission and immunity requirements appropriate for the location of use.

6. Test procedures

6.1 General

6.1.1 Overview

This clause specifies the test procedures required to verify the performance characteristics of the PMT for the standard and ambient and process conditions given in Clause 5.

These test procedures are generally applicable for both analogue and digital PMTs. Specific test procedures for digital PMTs are defined in the relevant clauses.

In case of a PMT with integrated sensing element, a process variable adequate to the test to be performed shall be generated in a suitable way. When the sensing element can be separated (e.g. RTD or thermocouple), the process variable can be electrically simulated.

6.1.2 Classification of the tests

The tests are classified into: **type tests**, **acceptance tests** and **routine tests** according to the definitions given in Clause 3. In addition, the term **evaluation tests** is used to indicate, a complete set of tests to establish the performance of a PMT under any likely operating conditions, to permit comparison with the manufacturer's published or stated performance specification for the PMT, or the user's requirement.

The **type tests** are normally performed by the manufacturer on one or more PMTs taken from the normal production or pre-production. They are intended to assess the performance strictly dependent on the design of the PMT. They are made on new products or on products on which significant design modifications have been made.

The **routine tests** are performed by the manufacturer at the production stage in order to check the proper manufacturing process and the final calibration of the PMT. These tests are often limited to the safety and metrological aspects. Usually, these tests are much simpler than the type tests and usually do not provide evidence of behaviour in severe climatic and/or electromagnetic conditions.

The **acceptance tests** are also performed by the manufacturer, usually in the presence of the customer, in order to verify if the PMTs supplied by the manufacturer meet the requirements set out in the specification of the manufacturer and/or of the customer. Typically, these tests are similar to the routine tests, if not otherwise specified and/or requested by the customer.

The tables of informative Annex B and informative Annex C give a list of the complete set of test procedures considered in this Clause, in relation to the standard and operating reference test conditions respectively. These tables summarize the procedures, highlighting the peculiarities of each test and indicating which tests are to be considered as type tests and/or acceptance tests and/or routine tests.

Generally, routine and acceptance tests contain a smaller number of test procedures than type tests and the procedures are simpler.

Note: For example, the routine accuracy test is done taking only one measurement cycle for each 25% of the device span, while a type test consists of at least 3 measurement cycles for each 20 % of the device span. In addition, only type tests are conducted at different zero and span adjustments, when applicable.

For analogue devices another classification is made in relation to the settings of span and lower range value adjustments (Table 7) and in relation to the number of measurement cycles and number and location of test points (Table 6), for the various tests, namely:

- **FT1**: for 1 full traverse cycle test (for example for routine tests)
- **FT3**: for 3 full traverse cycle test (for example for type tests)
- **FT5**: for 5 full traverse cycle tests (for example for extended tests, although rather unusual)
- **Z/S**: verifying the change in lower range-value (zero) and upper range-value (span) caused by the influencing factor (for example for over range, mounting position, etc)
- **10%**: verifying the change only with a 10% input signal (for example for output ripple)