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Process measurement and control devices - General methods and procedures for evaluating performance -
Part 3: Tests for the effects of influence quantities

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Process measurement and control devices - General methods and procedures for evaluating performance - Part 3: Tests for the effects of influence quantities

FOREWORD

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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 61298-3:2008. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

IEC 61298-3 has been prepared by sub-committee 65B: Devices and process analysis, of IEC technical committee 65: Industrial-process measurement, control and automation. It is an International Standard.

This third edition cancels and replaces the second edition published in 2008. This edition constitutes a technical revision.

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

a) process measurement transmitters (PMT) have been removed from the scope of this document;
b) contents of subclauses referring to EMC and electrical safety have been deleted, only leaving reference to the IEC standards.

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

Draft	Report on voting
65B/1314/FDIS	65B/1331/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts of the IEC 61298 series, under the general title *Process measurement and control devices - General methods and procedures for evaluating performance*, 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 webstore.iec.ch in the data related to the specific document. At this date, the document will be

– reconfirmed,
– withdrawn, or
– revised.

INTRODUCTION

This document is ~~not intended as a substitute for existing standards, but is rather~~ intended as a reference document for any future standard developed within the IEC, or other standards organizations, concerning the evaluation of process instrumentation~~. Any revision of existing standards should take this standard into account~~, except the Process Measurement Transmitters (PMT) which are standardized by IEC 62828 series.

This common standardized basis ~~should~~ can be utilized for the preparation of future relevant standards, as follows:

– any test method or procedure, already treated in this document, ~~should~~ will be specified and described in the new standard by referring to the corresponding clause of this document. Consequently, new editions of this document are revised without any change in numbering and scope of each clause;

– any particular method or procedure, not covered by this document, ~~should~~ will be developed and specified in the new standard in accordance with the criteria, as far as they are applicable, stated in this document;

– any conceptual or significant deviation from the content of this document ~~should~~ will be clearly identified and justified if introduced in a new standard.

1 Scope

This part of IEC 61298 specifies general methods and procedures for conducting tests and reporting on the functional and performance characteristics of process ~~measurement and control devices~~ instrumentation except process measurement transmitters (PMT) which are standardized by IEC 62828 series. The tests are applicable to any such devices characterized by their own specific input and output variables, and by the specific relationship (transfer function) between the inputs and outputs and include analogue and digital devices. For devices that require special tests, this document ~~should~~ can be used, together with any product-specific standard specifying special tests.

This document covers tests for the effects of influence quantities.

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 60050-300, *International Electrotechnical Vocabulary (IEV) - Part 300: 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,* available at https://www.electropedia.org/

IEC 60050-351, *International Electrotechnical Vocabulary (IEV) - Part 351: Control technology,* available at https://www.electropedia.org/

~~IEC 61298-1:1995, *Process measurement and control devices – General methods and procedures for evaluating performance – Part 1: General considerations*~~

~~IEC 61298-2:1995, *Process measurement and control devices – General methods and procedures for evaluating performance – Part 2: Tests under reference conditions*~~

~~IEC 61298-4:1995, *Process measurement and control devices – General methods and procedures for evaluating performance – Part 4: Evaluation report content*~~

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

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

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

IEC 60068-2-30, *Environmental testing - Part 2-30: Tests - Test Db: Damp heat, cyclic (12 + 12 h cycle)*

IEC 60068-2-31, *Environmental testing - Part 2-31: Tests - Test Ec: ~~Drop and topple~~ Rough handling shocks, primarily for equipment-type specimens*

IEC 60654-1~~:1993, *Operating conditions for*~~, *Industrial-process measurement and control equipment - Operating conditions - Part 1: Climatic conditions*

IEC 60654-2~~:1992~~, *Operating conditions for industrial-process measurement and control equipment - Part 2: Power*

IEC 60654-3~~:1983~~, *Operating conditions for industrial-process measurement and control equipment - Part 3: Mechanical influences*

IEC 61298-1:2026, *Process measurement and control devices - General methods and procedures for evaluating performance - Part 1: General considerations*

IEC 61298-2:2026, *Process measurement and control devices - General methods and procedures for evaluating performance - Part 2: Tests under reference conditions*

IEC 61298-4, *Process measurement and control devices - General methods and procedures for evaluating performance - Part 4: Evaluation report content*

~~IEC 61326 (all parts), *Electrical equipment for measurement, control and laboratory use – EMC requirements*~~

IEC 61326-1~~:2005~~, *Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements*

~~IEC 61000-4-2:2001, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test. Basic EMC publication*~~

~~IEC 61000-4-3:2002, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test. Basic EMC publication*~~

~~IEC 61000-4-4:2004, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test. Basic EMC publication*~~

~~IEC 61000-4-5:1995, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test. Basic EMC publication*~~

~~IEC 61000-4-6:2006, *Electromagnetic compatibility (EMC) – Part 4-6: Testing and measurement techniques – Immunity to conducted disturbances, induced by radio-frequency fields*~~

~~IEC 61000-4-8:2001, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test. Basic EMC publication*~~

~~IEC 61000-4-11:2004, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests . Basic EMC publication*~~

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-300, IEC 60050-351 and the following apply.

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

– IEC Electropedia: available at https://www.electropedia.org/
– ISO Online browsing platform: available at https://www.iso.org/obp

3.1
influence quantity
test parameter chosen to represent a condition representing one aspect of the environment under which a device ~~may~~ can operate

~~**3.2**~~
~~**variable**~~
~~quantity or condition whose value is subject to change and can usually be measured (e.g. temperature, flow rate, speed, signal, etc.)~~
~~[IEV 351-21-01, modified]~~

~~**3.3**~~
~~**signal**~~
~~physical variable, one or more parameters of which carry information about one or more variables which the signal represents~~
~~[IEV 351-21-51, modified]~~

~~**3.4**~~
~~**range**~~
~~range of values defined by the two extreme values within which a variable can be measured within the specified accuracy~~
~~[IEV 351-27-11, modified]~~

~~**3.5**~~
~~**span**~~
~~algebraic difference between the values of the upper and lower limits of the measuring range~~
~~[IEV 311-03-13]~~

~~**3.6**~~
~~**unexpected event**~~
~~device breakdown, failure to work, anomaly, or inadvertent damage occurring during an evaluation which requires correction by the device manufacturer~~

~~**3.7**~~
~~**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~~

~~**3.8**~~
~~**type tests**~~
~~a test of one or more devices made to a certain design to show that the design meets certain specifications~~

~~NOTE The type tests are in principle applied only on a sample. Normally are not repeated on all the individual units of equipment made in series.~~

4 General considerations

4.1 Criteria

Unless otherwise stated, any effects of the tests described in this document shall be assessed by determining the change in the functional and performance characteristics due to the single influence quantity applied. A test is only to be performed if it is applicable to the Device Under Test (DUT). If the specification of the DUT states limits for the influence considered, these limits shall be noted and respected.

~~NOTE~~ It is recommended to perform each influence test described in this document, except if the DUT operates under an environment that excludes the influence considered.

Rates of change of influence quantities shall be sufficiently slow to ensure that no overshoot of the influence quantities occurs at any point in the DUT. Sufficient time shall be allowed for stabilization at each value or state of the influence quantity before taking readings. It ~~may~~ can be useful to check, by means of specific measurements of the effects, whether the influence quantities cause variations in the characteristics of the DUT other than those addressed in this part of the document.

In the case of discontinuous-output devices such as alarms, the tests shall be conducted to establish the effects of the specified influence.

Only that influence quantity for which a specific test is being conducted shall be applied during a specified test. All other influences shall be maintained at the reference operating conditions.

However, consideration should be given to any combination of two or more influence quantities which ~~may~~ can aggravate the operating conditions (e.g. for an electrical device, temperature and supply voltage).

The limit values of influence quantities specified in this document should be used if no other limit values are specified by the manufacturer or by the user. Testing at these values shall be agreed by the parties and the results of tests shall be added to the report.

4.2 General procedures

The procedures used for the determination of the effects of influence quantities depend on the kind of test, on the type of device and on its most significant characteristics (e.g. zero, span, etc.).

The procedures ~~should~~ shall be established in accordance with the criteria given in 5.1 and 5.2 of IEC 61298-1:2026 in order to avoid tests which are too severe.

To satisfy these criteria, the DUT should be tested by assessing the effects of all the quantities which might influence the performance of the DUT; this general statement is strictly valid for performance evaluation and for type tests.

For routine and sampling tests, only the influence quantity which is considered to have the most effect or is agreed between the parties should be applied. Wherever possible, all the tests shall be carried out by measurement of the change of the output of the DUT.

The deviations caused by the effect of the specific influence quantity should be expressed generally as a percentage of the output span. On certain devices, it may be more convenient to express it in terms of the input span (see 4.1.6 of IEC 61298-2:2026). ~~It is important that~~ The input should be set so that the output is not limited; so in all tests, inputs corresponding to, for example, 5 % and 95 % may be used instead of 0 % and 100 %. For the same reason, tests that can produce large deviations on output (for example, supply voltage interruptions, electrical fast transients, and so on) may be executed at input levels held at a value which produces 50 % output signal.

In the case of discontinuous output devices such as alarms, the tests shall be conducted in the same way to establish the conditions at which the performance is affected, with the alarm/switching level set to 10 % above or below the nominal output.

4.3 General EMC requirements

~~In the first edition of this standard, some EMC requirements were described with reference to IEC 61326. In the meantime, IEC 61326 has been transferred into the IEC 61326 series with more detailed requirements. If a reference to this standard series is given in the following clauses, this standard series shall be applied, if applicable, and as far as the DUT is not covered by a more dedicated IEC product standard. In the latter case, the more dedicated IEC product standard shall be applied.~~

~~As far as no other performance criteria are specified, the following performance criteria (conforming to the IEC 61326 series) shall be applied.~~

- ~~Performance criteria A for continuously present disturbances (electromagnetic field, magnetic field, HF currents induced by RF transmitters).~~
- ~~Performance criteria B for short time transient disturbances (EDS, bursts, surges).~~
- ~~Performance criteria C for long time transient disturbances (supply voltage interruption).~~

~~As far as no other test severity levels are specified, the test severity levels shall be at least according to Table 1 of IEC 61326-1:2005.~~

For what concerns this 4.3, see the IEC 61326 series.

5 Ambient temperature effects

5.1 Criteria

Sufficient time shall be allowed at each test temperature to permit thermal stabilization of the DUT before test measurements are taken (as specified in IEC 60068-2-1 and 60068-2-2).

The stabilization period is a function of the DUT mass and of energy dissipation. It is normally checked by recording the output signal of the DUT. It ~~may~~ can be as long as 3 h.

Whatever the temperature cycle prescribed, during the temperature cycles, it is important to carry out the measurements at the same temperatures during repeat cycles so as to permit comparison.

Pneumatic devices shall have sufficient air supply tubing inside the test chamber to ensure that the supply and input air are at the same temperature as the DUT.

5.2 Test procedure

The effects of ambient temperature shall be measured in the temperature range specified by the ~~manufacturer~~ technical documentation or, if no value is specified, between the limits shown in Table 1 (according to the standard range specified in IEC 60654-1).

The test limits for ambient temperature should be appropriate to the temperatures at the intended operational location of the DUT.

The test shall be carried out by conducting the same performance test at each selected test ambient temperature, beginning at the reference temperature (+20 °C).

Table 1 – Ambient temperature test ranges

Temperature °C		Temperature class (IEC 60654-1)	Typical service application
min.	max.		
+5	+40	B2	Heated or/and cooled enclosed locations
–25	+55	C2	Sheltered locations
–33	+40	D1	Outdoor locations
–40	+85	DX	Special outdoor locations
NOTE For others temperature classes, see IEC 60654-1.			

The test ambient temperatures should be chosen generally at 20 °C intervals, up to the specified limit temperatures for the DUT.

For example, for the temperature class C2, the test temperature cycle should be +20 °C (reference), +40 °C, +55 °C, +20 °C, 0 °C, -25 °C, +20 °C.

If agreed by all parties in the test programme, a test at only four temperatures, 20 °C (reference), maximum, minimum, and 20 °C, ~~may~~ can be sufficient.

The tolerance for each test temperature should be ±2 °C and the rate of change of ambient temperature should be less than 1 °C per minute. No adjustments to the DUT shall be made during the test cycle.

A second or third temperature cycle, without any adjustment of the DUT, may be specified in the test program. At each test temperature, data shall be recorded for increasing and decreasing values of output at each 25 % of span.

The output changes at each test value shall be calculated from the average of the upscale and downscale readings and reported in percent of ideal output span. Any significant changes in hysteresis or linearity ~~or repeatability~~ shall also be calculated and reported, as described in IEC 61298-4.

Any effects on a digital display indicator shall also be reported, including loss of contrast, brightness, distortion or missing bits.

6 Ambient relative humidity effects

The effects of ambient relative humidity shall be determined by placing the DUT in a humidity test chamber in which the value of relative humidity ~~should~~ shall be controlled within +2 % to -3 % of the specified relative humidity levels as specified in IEC 60068-2-30.

The DUT shall be stabilized at the reference relative humidity < 60 % at the temperature of 40 °C ± 2 °C.

Measurements shall be taken at each 25 % of output span in each direction.

The relative humidity shall then be increased in not less than 3 h up to ~~(93^{+2}_{-3})~~ 90 % to 95 % avoiding the deposition of condensation on the DUT and maintained at this value for a period of at least 48 h. If agreed in the test program, the DUT may be de-energized during this period.

The measurements shall again be taken at 25 % intervals of output span in each direction.

With the DUT remaining in operation, the relative humidity shall be reduced in not less than 3 h to the original reference value of < 60 %.

After stabilization for at least 12 h, the measurements shall be repeated.

Any changes in lower range value and span shall be calculated and reported in per cent of output span.

In addition, any significant changes in hysteresis or linearity ~~or repeatability~~ should be calculated and reported.

In addition, a visual examination shall be made after the test to check for indications of component deterioration or moisture having entered sealed enclosures.

7 Vibration

7.1 General considerations

The general procedures of this test ~~comply~~ shall be in accordance with the test procedure Fc of IEC 60068-2-6, and the vibration ranges and values are in accordance with those reported in IEC 60654-3.

The effect of vibration shall be determined by the following procedure using the peak amplitudes, acceleration levels, and frequency ranges reported in Table 2 or specified by the manufacturer.

Measurements shall be made before and after the vibration exposure.

The DUT shall be mounted, in accordance with the manufacturer's instructions for a normal installation, on a vibration table where it shall be subjected to rectilinear sinusoidal vibrations in each of three mutually perpendicular axes, one of which shall be the vertical.

The rigidity of the vibration table and of the mounting means for the DUT shall be such that the vibration is transferred to the normal mounting point of the DUT with a minimum of loss or gain.

The test vibration level shall be measured at the normal mounting point of the DUT.

Vibrations shall be applied with the DUT powered and operating with 50 % input signal.

The output signal shall be recorded in order to report any change in output.

Table 2 – Vibration test levels

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

[a] For a list of all test frequency ranges, see IEC 60654-3.

[b] Test frequency range derived from low-frequency classes (IEC 60654-3) but limited to 10 Hz (instead of 0,1 Hz) and with crossover frequency at 8 ÷ 9 Hz.

[c] Test frequency range derived from high-frequency classes (IEC 60654-3) but limited to 1 000 Hz (instead of 10 000 Hz) and with crossover frequency at 57 ÷ 62 Hz.

The crossover frequency is the region of change from constant amplitude and constant acceleration.

The vibration tests shall include three stages:

– an initial resonance search;
– an endurance conditioning by sweeping the frequency over the appropriate frequency range specified in Table 2 (or over another range reported in IEC 60654-3), or as specified by the manufacturer or by the user;
– a final resonance search.

These three stages shall be performed in sequence. At each stage, the DUT shall be vibrated in each of the three major axes before proceeding to the next stage.

7.2 Initial resonance search

The initial resonance search shall be carried out to study behavior of the DUT to determine any component resonances and the corresponding resonance frequencies, and to obtain information for comparison with the final resonance search.

The sweep rate shall be not greater than 0,5 octave per minute.

During the resonance search, frequencies shall be noted which cause

a) significant changes in the output signal;
b) mechanical resonances of components or sub-assemblies.

All the amplitudes and frequencies at which these effects occur shall be noted in order to be compared with those found during the final resonance search specified below.

7.3 Endurance conditioning by sweeping

The test is carried out by sweeping the vibration frequency at a rate of one octave per minute over the range selected.

The total number of sweep cycles should be 60, being 20 in each of the three mutually perpendicular directions.

7.4 Final resonance search

The final resonance search shall be made in the same way as the initial resonance search and with the same vibration characteristics.

The resonance frequencies, and the frequencies which cause significant changes in the output signal, found in the initial resonance search and final resonance search shall be compared.

7.5 Final measurements

The satisfactory mechanical condition of the DUT shall be verified at the end of the tests with a visual examination for any deformation or cracks in the components or mountings.

The satisfactory performance of the DUT shall be verified with a measurement test; any change in the lower range value and span shall be recorded in percent of output span.

8 Shock, drop and topple

The test shall be made according to the test procedure Ec of IEC 60068-2-31 and according to the free fall method reported in IEC 60654-3.

Before the test, reference measurements of lower range-value and span shall be recorded.