IEC 61298-3

Edition 2.0 2008-10

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

Dispositifs de mesure et de commande de processus – Méthodes et procédures générales d'évaluation des performances –
Partie 3: Essais pour la détermination des effets des grandeurs d'influence

IEC 61298-3:2008

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

PROCESS MEASUREMENT AND CONTROL DEVICES – GENERAL METHODS AND PROCEDURES FOR EVALUATING PERFORMANCE –

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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.
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International Standard 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.

This second edition cancels and replaces the first edition published in 1998. This second edition constitutes a technical revision.

This edition is a general revision with respect to the previous edition and does not include any significant changes (see Introduction).

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

FDIS	Report on voting
65B/687/FDIS	65B/695/RVD

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

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

A list of all parts of the IEC 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 publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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- withdrawn,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

INTRODUCTION

This standard 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.

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

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

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

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

PROCESS MEASUREMENT AND CONTROL DEVICES – GENERAL METHODS AND PROCEDURES FOR EVALUATING PERFORMANCE –

Part 3: Tests for the effects of influence quantities

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. 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 standard should be used, together with any product-specific standard specifying special tests.

This standard covers tests for the effects of influence quantities.

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, *International Electrotechnical Vocabulary (IEV) – Electrical and electronic measurements and measuring instruments (composed of Part 311, 312, 313 and 314)*

IEC 60050-351, *International Electrotechnical Vocabulary (IEV) – Part 351 : Control technology*

IEC 61298-1:2008, *Process measurement and control devices – General methods and procedures for evaluating performance – Part 1: General considerations*

IEC 61298-2:2008, *Process measurement and control devices – General methods and procedures for evaluating performance – Part 2: Tests under reference conditions*

IEC 61298-4:2008, *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, primarily for equipment-type specimens*

IEC 60654-1:1993, *Operating conditions for industrial-process measurement and control equipment – 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 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 purpose of this document, the following relevant terms and definitions, some of them based on IEC 60050(300) or IEC 60050(351), apply.

3.1
influence quantity
test parameter chosen to represent a condition representing one aspect of the environment under which a device may 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 standard 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 standard, 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 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 standard.

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 aggravate the operating conditions (e.g. for an electrical device, temperature and supply voltage).

The limit values of influence quantities specified in this standard 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 be established in accordance with the criteria given in 5.1 and 5.2 of IEC 61298-1 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). 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.

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 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 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 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 programme. 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, linearity or repeatability shall also be calculated and reported. See 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 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 to (93^{+2}_{-3}) % 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 programme, 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, 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 with the test procedure Fc of IEC 60068-2-6 and the vibration ranges and values are in according 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 Note 1 Hz	Displacement peak amplitude mm	Acceleration amplitude m/s^2
Control room or field with low vibration level	10 to 150 Note 2	0,35	1
Control room or field with medium vibration level	10 to 150 Note 2	0,75	2
Field with general application or pipeline with low vibration	10 to 1 000 Note 3	0,15	20
Field with high vibration level or pipe line with high vibration	10 to 1 000 Note 3	0,35	50

NOTE 1 For a list of all test frequency ranges, see IEC 60654-3.

NOTE 2 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.

NOTE 3 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.