

Industrial-process control systems — Instruments with analogue inputs and two- or multi-state outputs —

Part 1: Methods of evaluating performance

The European Standard EN 61003-1:2004 has the status of a
British Standard

ICS 32.240.50; 25.040.40

National foreword

This British Standard is the official English language version of EN 61003-1:2004. It is identical with IEC 61003-1:2004. It supersedes BS EN 61003-1:1993 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee GEL/65, Measurement and control, to Subcommittee GEL/65/2, Elements of systems, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the *BSI Catalogue* under the section entitled “International Standards Correspondence Index”, or by using the “Search” facility of the *BSI Electronic Catalogue* or of British Standards Online.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 30, an inside back cover and a back cover.

The BSI copyright notice displayed in this document indicates when the document was last issued.

Amendments issued since publication

Amd. No.	Date	Comments

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 6 May 2004

© BSI 6 May 2004

ISBN 0 580 43730 2

English version

**Industrial-process control systems -
Instruments with analogue inputs
and two- or multi-state outputs
Part 1: Methods of evaluating performance
(IEC 61003-1:2004)**

Processus industriels -
Instruments avec entrées analogiques
et sorties à deux ou plusieurs états
Partie 1: Méthodes d'évaluation
des performances
(CEI 61003-1:2004)

Systeme der industriellen
Prozessleittechnik -
Geräte mit analogen Eingängen
und Zwei- oder Mehrpunktverhalten
Teil 1: Verfahren zur Bewertung
des Betriebsverhaltens
(IEC 61003-1:2004)

This European Standard was approved by CENELEC on 2004-03-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

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

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

The text of document 65B/516/FDIS, future edition 2 of IEC 61003-1, prepared by SC 65B, Devices, of IEC TC 65, Industrial-process measurement and control, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61003-1 on 2004-03-01.

This European Standard supersedes EN 61003-1:1993.

It takes into account the common standardized basis specified in the EN 61298 series. Any test method or procedure specified and described herein is referred to the corresponding Clause of the EN 61298 series. Any particular method or procedure not covered by the EN 61298 series is developed and specified in this standard in accordance with the criteria stated in the EN 61298 series, as far as they are applicable.

The following dates were fixed:

- latest date by which the EN has to be implemented
at national level by publication of an identical
national standard or by endorsement (dop) 2004-12-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2007-03-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61003-1:2004 was approved by CENELEC as a European Standard without any modification.

CONTENTS

INTRODUCTION.....	4
1 Scope.....	5
2 Normative references.....	5
3 Terms and definitions	6
4 General conditions for tests	7
4.1 Documentary information	7
4.2 Safety.....	7
4.3 Installation.....	7
4.4 Supply conditions.....	8
5 General testing procedures and precautions.....	8
5.1 Checking of calibration made prior to delivery	8
5.2 Set point.....	8
5.3 Switching differential.....	8
6 Test methods and procedures.....	8
6.1 Tests under reference conditions	8
6.2 Tests for the effects of influence quantities	11
6.3 Other tests	18
7 Multi-state instrument	20
7.1 Action.....	20
7.2 Tests.....	20
7.2.1 Characteristics of the multi-state instrument.....	20
7.2.2 Mutual influence of pairs of switching points.....	20
7.2.3 Determination of switching range	20
8 General observations.....	20
8.1 Protective finishes	20
8.2 Design features	21
8.3 Tools and equipment	21
9 Test report and summary of tests.....	22
10 Other considerations.....	26
10.1 Routine maintenance and adjustment	26
10.2 Repair	26
10.3 Partial evaluation.....	26
Annex ZA (normative) Normative references to international publications with their corresponding European publications	30

INTRODUCTION

The methods of evaluation specified in this part of IEC 61003 are intended for use by manufacturers to determine the performance of their products and by users, or independent testing establishments, to verify the manufacturer's performance specifications.

The test conditions in this standard, for example the range of ambient temperatures and power supply, represent those, which commonly arise in use. Consequently, the values specified herein shall be used where the manufacturer specifies no other values.

The tests specified in this standard are not necessarily sufficient for instruments specifically designed for unusually arduous duties. Conversely, a restricted series of tests may be suitable for instruments designed to perform within a more limited range of conditions.

It will be appreciated that the closest communication should be maintained between the evaluating body and the manufacturer. Note shall be taken of the manufacturer's specifications for the instrument, when the test programme is being decided, and the manufacturer should be invited to comment on both the test programme and the results. His comments on the results should be included in any report produced by the testing organisation.

INDUSTRIAL-PROCESS CONTROL SYSTEMS – INSTRUMENTS WITH ANALOGUE INPUTS AND TWO- OR MULTI-STATE OUTPUTS –

Part 1: Methods of evaluating performance

1 Scope

This part of IEC 61003 is applicable to pneumatic and electric industrial-process instruments using measured values that are continuous signals in accordance with IEC 60382, or IEC 60381-1. The other input value (i.e. the set point value) may be either a mechanical (position, force, etc.) or a standard signal.

It should be noted that tests specified herein may be applied to instruments which have other continuous measured values, provided that due allowance is made for such differences.

These instruments may be used as controllers or as switches for alarm and other similar purposes.

Instruments with feedback are not covered by this standard.

Electronic security issues may impact only a few products covered by this document. Consequently this document does not address such security issues.

This standard is intended to specify uniform testing methods for performance evaluation of industrial-process instruments with analogue measured values and two- or multi-state outputs.

Considerations other than the performances are listed in Clause 10.

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 60050-351:1998, *International Electrotechnical Vocabulary (IEV) – Part 351 Automatic control*

IEC 60381-1:1982, *Analogue signals for process control systems – Part 1: Direct current signals*

IEC 60382:1991, *Analogue pneumatic signals for process control systems*

IEC 61010-1:2001, *Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements*

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 61298-3:1998, *Process measurement and control devices – General methods and procedures for evaluating performance – Part 3: Tests for the effects of influence quantities*

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

IEC 61326:2002, *Electrical equipment for measurement, control and laboratory use – EMC requirements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-351 and in IEC 61298-1, IEC 61298-2, IEC 61298-3, IEC 61298-4, together with the following definitions apply.

3.1

switching point x_1, x_2

measured value (with the input moving either upscale or downscale), at which the output (y) changes from one state to another

3.2

two-state instrument

action illustrated in Figure 1, where x is the value of the input variable and y is the value of the output signal.

The two-state instrument, having one pair of switching points x_1 and x_2 (x_2 greater than x_1) has the relationships:

$$y = y_1 \text{ for } x < x_1$$

$$y = y_2 \text{ for } x > x_2$$

For $x_1 < x < x_2$, y may be either y_1 or y_2 .

It is y_1 if the last switching point crossed by x was x_1 .

It is y_2 if the last switching point crossed by x was x_2 .

3.3

multi-state instrument

a multi-state instrument (see Clause 7 and Figure 4) has n possible output values and $n-1$ pairs of switching points. Each pair of switching points may be investigated by the procedure given for the two-state instrument.

3.4

switching differential X_{sd}

difference between the switching point x_2 with the measured value moving upscale and the switching point x_1 with the measured value moving downscale

3.5

instrument with no switching differential

this is considered to be a special case where the switching differential approaches zero

3.6

mean switching point x_m

the mean of the values of upscale and downscale switching points

3.7

switching range X_{sr}

in a multi-state instrument the range of measured values corresponding to the extreme switching points

3.8

set point w (reference input variable)

the point (value) at which it is desired that switching (at x_2 or x_1 as specified) should occur

4 General conditions for tests

For the purpose of this standard the general test conditions (e.g. environmental test conditions, supply conditions, load conditions, mounting position, externally induced vibrations, external mechanical constraints, delivery of the instrument) specified in IEC 61298-1, Clause 6 apply, together with the additional information below.

4.1 Documentary information

The manufacturer shall supply to the evaluating body information for installation, commissioning, operation, routine maintenance and repair of the instrument. A spare parts list, together with a recommendation of the spare parts to be held in stock, shall be supplied. The language of written information for installation should be the language of the local user.

All the relevant publications supplied by the manufacturer, automatically and on request, should be listed.

If they do not contain a clear description, with adequate diagrams, of the operation of the instrument, or if they do not contain an adequate spare parts and specifications list, the nature of the inadequacy should be noted.

Additionally, any certificates indicating the degree of intrinsic safety and flameproofing, etc. of electrically powered instruments should be listed. This information should give details of the certificate numbers and the degree of protection provided.

Procedures for installation, routine maintenance and adjustment, repairs and overhaul should be examined by the actual performance of the required operation. This should be performed in accordance with the manufacturer's instructions, so that an evaluation of the instructions can be carried out concurrently.

4.2 Safety

Electrically powered instruments should be examined to determine the degree to which their design protects them against accidental electric shock.

4.3 Installation

The instrument should be installed and set to work according to the manufacturer's instructions, taking account of the various applications which may be met in practice and which require different procedures.

The method of mounting specified by the manufacturer should be reported. Any restrictions on the use of the instrument caused by this method of mounting shall be noted with explanations.

Any other aspects that may seem relevant to the ease or difficulty of installation should be noted with explanations.

4.4 Supply conditions

Tolerances on supply conditions for mains supplied equipment are given in 6.2.2 of IEC 61298-1. For instruments with self-contained power supplies (e.g. battery-powered) the tolerances are different and shall be agreed.

NOTE For pneumatic instrument care should be taken to ensure that pneumatic connections are leak tight.

5 General testing procedures and precautions

For the purpose of this standard, the general testing procedures and precautions, specified in Clause 7 of IEC 61298-1, shall be applied, together with the additional information below.

5.1 Checking of calibration made prior to delivery

The input-output characteristic that shall be checked (see 7.6 of IEC 61298-1) is the values of the switching points x_1 and x_2 found during the calibration (if any) made prior to delivery.

5.2 Set point

Except where otherwise specified, the set point shall be set to the midscale value or, where no scale is provided, to the middle of the effective range of adjustment.

5.3 Switching differential

Except where otherwise specified, if the switching differential X_{sd} is adjustable, it shall be set to the midscale value or, where no scale is provided, to the middle of the effective range of adjustment.

6 Test methods and procedures

For the purpose of this standard, the tests general methods and procedures – if any – specified in IEC 61298-2 and IEC 61298-3 apply, together with the additional information stated below.

6.1 Tests under reference conditions

Methods and procedures for each test are described in the last column of the following table.

In the others column are indicated:

- Clause N° and designation of test;
- Clause number of the reference where the general procedures are specified.

Clause and Designation	Reference	Test methods and procedures description
6.1.1 Switching accuracy related factors	IEC 61298-2 4.1.7	The input measured value x shall be varied slowly at least five times in each direction through its entire range. By observation of the output, the values of points x_1 and x_2 and their average shall be determined. For each cycle, the switching differential ($x_1 - x_2$) shall be noted.
6.1.1.1 Inaccuracy of switching points	IEC 61298-2 4.1.7.1	Switching point inaccuracy is determined by selecting the greatest positive and negative deviations of any measured value of x_1 and x_2 , of any cycle, from the set point w for increasing and decreasing inputs and reporting this in percent of nominal span of measured value.
6.1.1.2 Non-repeatability of switching points	IEC 61298-2 4.1.7.6	Non-repeatability shall be computed observing the maximum difference, in percent of nominal span of measured value, among all x_1 values and among all x_2 values. The maximum value, from either the x_1 maximum difference or the x_2 maximum difference, is reported as non-repeatability.
6.1.1.3 Inaccuracy of switching differential	IEC 61298-2 4.1.7.1	The switching differential X_{sd} is calculated by subtracting the average value of x_1 from the average value of x_2 (see 6.1.1). Switching differential inaccuracy is determined by selecting the greatest positive and negative deviations of any measured value of the switching differentials – calculated in each of the five cycles – from the X_{sd} value and reporting this in percent of the nominal span of measured value.
6.1.1.4 Non-repeatability of switching differential	IEC 61298-2 4.1.7.6	Non-repeatability shall be computed calculating the differences, in percent of the nominal span of measured value, among all switching differential values noted in 6.1.1. The maximum of those values is reported as non-repeatability of switching differential.
6.1.2 Mean switching point		Mean switching point x_m is calculated as the mean of the average values of x_1 and x_2 (see 6.1.1).
6.1.3 Set point		For the adjustment of set point value w , four cases shall be considered: 1. a) w is an adjustable and directly measurable value; b) w is adjustable at the instrument and an adjusting scale for w is provided; 2. w is adjustable at the instrument, but there is no adjusting scale; 3. w is a pre-selected fixed value.