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Industrial process control systems –

Part 2:
Methods of evaluating the performance of intelligent valve positioners with pneumatic outputs

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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INDUSTRIAL PROCESS CONTROL SYSTEMS –

Part 2: Methods of evaluating the performance of intelligent valve positioners with pneumatic outputs

FOREWORD

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International Standard IEC 61514-2 has been prepared by subcommittee 65B: Devices, of IEC technical committee 65: Industrial-process measurement and control.

This standard is to be read in conjunction with IEC 61514.

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

FDIS	Report on voting
65B/515/FDIS	65B/522/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.

The committee has decided that the contents of this publication will remain unchanged until 2009. At this date, the publication will be

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- withdrawn;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

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

New instruments for process control and measurement including valve positioners are mainly equipped with microprocessors thereby utilising digital data processing and communication methods and/or artificial intelligence, making them more complex and giving them a considerable added value.

Modern intelligent valve positioners are no longer only controlling the valve position, but they are in many cases also equipped with various facilities for self-testing, actuator/valve condition monitoring and alarming. The variety of added functionalities is large. They can no longer be compared with the single function "cam-type" positioners. Therefore, accuracy related performance testing although still very important is no longer sufficient to demonstrate their flexibility, capabilities and other features with respect to engineering, installation, maintainability, reliability and operability.

In this standard the evaluation considers performance testing and a design review of both hardware and software. The layout of this document follows to some extent the framework of IEC 62098. A number of performance tests described in IEC 61514 are still valid for intelligent valve positioners. Further reading of IEC 61069 is recommended.

INDUSTRIAL PROCESS CONTROL SYSTEMS –

Part 2: Methods of evaluating the performance of intelligent valve positioners with pneumatic outputs

1 Scope

This part of IEC 61514 specifies design reviews and tests intended to measure and determine the static and dynamic performance, the degree of intelligence and the communication capabilities of single-acting or double-acting intelligent valve positioners. The tests may be applied to positioners which receive standard analogue electrical input signals (as specified in IEC 60381) and/or digital signals via a data communication link and have a pneumatic output. An intelligent valve positioner as defined in Clause 3 is an instrument that uses for performing its functions digital techniques for data processing, decision-making and bi-directional communication. It may be equipped with additional sensors and additional functionality supporting the main function.

The performance testing of an intelligent valve positioner needs to be conducted with the positioner mounted on and connected to one or preferably more actuator/valve assemblies in turn. The specific characteristic parameters of these combinations such as size, stroke, friction (hysteresis), type of packing, spring package and supply pressure for the pneumatic part, are to be carefully chosen and reported. It should be noted that the performance of a positioner in such combinations is actuator dependent. Tests on different sizes of actuators are required in particular for the determination of the operational range (dynamic response and stability) of a positioner.

The methods of evaluation given in this standard are intended for use by manufacturers to determine the performance of their products and by users or testing laboratories to verify equipment performance specifications. The manufacturers of intelligent positioners are urged to apply this standard at an early stage of development.

This standard is intended to provide guidance for designing evaluations of intelligent valve positioners by providing:

– a checklist for reviewing their hardware and software design in a structured way;
– test methods for measuring and qualifying their performance under various environmental and operational conditions;
– methods for reporting the data obtained.

When a full evaluation, in accordance with this standard, is not required or possible, the tests which are required should be performed and the results reported in accordance with the relevant parts of this standard. In such cases, the test report should state that it does not cover the full number of tests specified herein. Furthermore, the items omitted should be mentioned, to give the reader of the report a clear overview.

The standard is also applicable for non-intelligent microprocessor-based valve positioners without means for bi-directional communication. In that case an evaluation should be reduced to a limited programme of performance testing and a short review of the construction.

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 60068-2-1: 1990, *Environmental testing – Part 2: Tests. Tests A: Cold*

IEC 60068-2-2: 1974, *Environmental testing – Part 2: Tests. Tests B: Dry heat*

IEC 60068-2-6: 1995, *Environmental testing – Part 2: Tests. Test Fc: Vibration (sinusoidal)*

IEC 60068-2-31: 1969, *Environmental testing – Part 2: Tests. Test Ec: Drop and topple, primarily for equipment-type specimens*

IEC 60068-2-78: 2001, *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, *Degrees of protection provided by enclosures (IP Code)*

IEC 60534-1, *Industrial-process control valves – Part 1: Control valve terminology and general considerations*

IEC 60654 (all parts), *Operating conditions for industrial-process measurement and control equipment*

IEC 60721-3, *Classification of environmental conditions – Part 3 Classification of groups of environmental parameters and their severities*

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

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

IEC 61032:1997, *Protection of persons and equipment by enclosures – Probes for verification*

IEC 61069 (all parts), *Industrial-process measurement and control – Evaluation of system properties for the purpose of system assessment*

IEC 61158 (all parts), *Digital data communications for measurement and control – Fieldbus for use in industrial control systems*

IEC 61298 (all parts), *Process measurement and control devices – General methods and procedures for evaluating performance*

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

IEC/PAS 61499 (all parts), *Function blocks for industrial-process measurement and control systems*

IEC 61514:2000, *Industrial-process control systems – Methods of evaluating the performance of valve positioners with pneumatic outputs*

IEC 62098:2000, *Evaluation methods for microprocessor-based instruments*

CISPR 22, *Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61514 and IEC 60050(351), in addition to the following apply.

3.1
intelligent valve positioner
position controller as defined in 3.1 of IEC 61514 based on microprocessor technology, and utilising digital techniques for data processing, decision-making and bi-directional communication; it may be equipped with additional sensors and additional functionality supporting the main function.

NOTE 1 In this standard, only positioners with pneumatic output signals are considered. The input signal may be an electric current or voltage, or a digital signal via a fieldbus.

NOTE 2 For non-intelligent microprocessor-based position controllers without bi-directional communication an evaluation is reduced to a limited amount of performance testing and an abridged design review of the construction.

3.2
configuring
process of implementing the functionality required for a certain application

3.3
configurability
extent to which an intelligent positioner can be provided with functions to control various applications

3.4
calibration
process of adjusting the range of travel to the required value for acquiring a defined input-to-travel characteristic. The adjusted travel can either be from stop to stop or to a value in between as defined by the valve manufacturer

NOTE Instruments may exist that are provided with an automatic procedure for travel range adjustment, which may then be addressed with the term auto-calibration.

3.5
tuning
process of adjusting the various control parameters for a certain application

NOTE The stem tuning procedure can range from "trial and error" to an automatic proprietary procedure provided by the manufacturer and often addressed as auto-tuning.

3.6
set-up
process of configuring, calibrating and tuning a positioner for optimal controlling of a specific actuator/valve assembly

3.7
travel cut-off
point close to the extreme end (low or high) of the characteristic curve at which the positioner forces the valve to the corresponding mechanical stop (fully closed or fully open)

3.8
stroke time
time required to travel between two different positions under a defined set of conditions

3.9
dead band
finite range of values within which reversal of the input variable does not produce any noticeable change in the output variable

3.10
operating mode
selected method of operation of the positioner

3.11
setpoint
input variable, which sets the desired value of the controlled variable (travel)

NOTE The input variable may originate from an analogue source (mA or voltage) or from a digital source (fieldbus) or local keyboard).

3.12
balance pressure
average of the pressures on the opposite chambers of a double acting actuator in steady state condition

NOTE The balance pressure must be expressed as a percentage of the positioner supply pressure to evaluate the stiffness of the double acting system.

4 Design review

The observations of this clause shall be based on open literature (manuals, instruction leaflets, etc.) provided to a user on delivery of the instruments and whatever the manufacturer is willing to disclose. They shall not contain confidential information.

The design review is meant to identify and make explicit the functionality and capabilities of the intelligent valve positioner under consideration in a structured way. As intelligent positioners appear in a great variety of designs a review has to show in a structured way the details of

– their physical structure;
– their functional structure.

Subclause 4.1 guides the evaluator in the process of describing the physical structure of intelligent positioners through identifying the hardware modules and the I/O's to the operational and environmental domains.

Thereafter the functional structure is described using the checklist of 4.2. The checklist gives a structured framework of the relevant issues, which have to be addressed by the evaluator through adequate qualitative and quantitative experiments.

4.1 Positioner identification

The structured identification process, based on the following considerations, leads to a blockscheme and a concise description of the positioner under test, which shall be included in the evaluation report. It may be enhanced with photographs or drawings of important details.