

Safety Standards

of the

Nuclear Safety Standards Commission (KTA)

KTA 3505 (2015-11)

**Type Testing of Measuring Sensors and Transducers of
the Instrumentation and Control System
Important to Safety**

(Typprüfung von Messwertgebern und Messumformern der Sicherheitsleittechnik)

Please note:

This translation includes the correction
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The previous versions of this safety
standard were issued in 1984-11 and 2005-11

If there is any doubt regarding the information contained in this translation, the German wording shall apply.

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Type Testing of Measuring Sensors and Transducers of the Instrumentation and Control System Important to Safety

KTA 3505

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PLEASE NOTE: Only the original German version of this safety standard represents the joint resolution of the 35-member Nuclear Safety Standards Commission (Kerntechnischer Ausschuss, KTA). The German version was made public in the Federal Gazette (Bundesanzeiger) of January 08, 2016. Copies of the German version may be mail-ordered through the Wolters Kluwer Deutschland GmbH (info@wolterskluwer.de). Downloads of the English translations are available at the KTA website (<http://www.kta-gs.de>).

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Comments by the Editor:

Taking into account the meaning and usage of auxiliary verbs in the German language, in this translation the following agreements are effective:

shall	indicates a mandatory requirement,
shall basically	is used in the case of mandatory requirements to which specific exceptions (and only those!) are permitted. It is a requirement of the KTA that these exceptions - other than those in the case of shall normally - are specified in the text of the safety standard,
shall normally	indicates a requirement to which exceptions are allowed. However, exceptions used shall be substantiated during the licensing procedure,
should	indicates a recommendation or an example of good practice,
may	indicates an acceptable or permissible method within the scope of the present safety standard.

Basic Principles

(1) The safety standards of the Nuclear Safety Standards Commission (KTA) have the task of specifying those safety-related requirements which shall be met with regard to precautions to be taken in accordance with the state of science and technology against damage arising from the construction and operation of the plant (Sec. 7, para. (2), subpara. (3) Atomic Energy Act - AtG) in order to attain the protective goals specified in AtG and the Radiological Protection Ordinance (StrlSchV) and further detailed in the Safety Requirements for Nuclear Power Plants (SiAnf) and in the SiAnf-Interpretations.

(2) Based on the SiAnf and the SiAnf-Interpretations, the devices required to be subjected to type testing in accordance with the present safety standard are specified in safety standard KTA 3501.

(3) In the present safety standard, it is presumed that conventional requirements and technical standards (e.g. Accident Protection Requirements, DIN-Standards, VDE-Regulations) are adhered to under consideration of the safety-related requirements specific to nuclear power plants.

(4) Type tests are performed by authorized experts to evaluate whether the devices are in accordance with the data sheet specifications and the specified characteristics.

(5) Requirements for the type testing of electrical modules for the safety-related instrumentation and control system are specified in safety standard KTA 3503.

(6) Requirements regarding the certification of satisfactory service life are specified in safety standard KTA 3507.

(7) Requirements regarding quality assurance and documentation are specified in safety standards KTA 1401, KTA 1402, KTA 1404, KTA 3506 and KTA 3507.

(8) Requirements regarding the proof of resistance to a loss-of-coolant-accident are specified in safety standard KTA 3706.

1 Scope

This safety standard applies to the type testing of the measuring sensors and transducers (referred to as 'devices' in this safety standard) of the instrumentation and control system important to safety in accordance with safety standard KTA 3501.

2 Definitions

(1) Functional unit

A functional unit is a unit under observation delimited within the system by its task and operating principle.

Note:

A functional unit may be realized structurally within a device or within an agglomeration of multiple devices, or may be realized as a part of a device.

(2) Device

A device is an arrangement of components or subunits that performs a specific function.

Note:

Devices are comprised of hardware and possibly software. A differentiation is made between:

- a) device comprised of discrete non-programmable components or subunits,
- b) device comprised of at least one discrete programmable component (e.g. field-programmable gate arrays (FPGA), programmable logic devices (PLD) and application-specific integrated circuits (ASIC)) and
- c) computer-based device comprised of at least one processor or controller.

(3) Type approval test

A type approval test is the test of representative test objects of a fabrication series (type series) regarding the characteristics specified in the data sheet and in the description of functionality.

(4) Authorized expert

An authorized expert is a qualified person or organization consulted by the nuclear licensing or supervisory authority based on Sec. 20 AtG.

3 Testing Procedures

(1) The type approval test shall be subdivided into the theoretical examinations and the physical tests.

(2) Any available operating experience and the results of previously performed tests may be taken into consideration for the type approval test, provided, the safety-related requirements of the present safety standard are fulfilled.

(3) In the case of computer-based devices or those with programmable components, the software and its quality characteristics shall be tested within the framework of the theoretical examinations specified under Section 4.2, and the function of the device shall be tested within the framework of the physical tests.

Note:

The different requirements for testing software and its quality characteristics for devices required to perform Cat A and Cat B instrumentation and control functions are specified in safety standard KTA 3501.

(4) The employed interfaces of the devices shall be subjected to the same requirements that are valid for the individual devices to be tested.

(5) Any modifications on type-tested devices shall be tested in accordance with the basic principles of the present safety standard. These tests may be theoretical examinations or physical tests or a combination of these test procedures. In the case of physical tests, the number of test objects specified in Section 5.2 may be reduced, provided, a prior agreement was reached with the authorized expert.

4 Theoretical Examinations

4.1 Extent of the Theoretical Examinations

(1) The theoretical examinations shall comprise an examination of the engineering documents of the devices specified in Section 4.2, of the certifications to be submitted as specified in Sections 4.3 through 4.5, and also of the test instructions and the test program specified in Section 4.6.

(2) The suitability of the quality assurance measures applied within the framework of the device fabrication shall be assessed during type testing. The quality assurance measures applied shall normally be comprehensibly documented in the form of audit reports regarding the quality audits performed, e.g. in accordance with safety standards KTA 3507 or KTA 1401. If the audit reports are not sufficient, then the required quality certifications shall be produced within the framework of type testing.

Notes:

(1) KTA 3501 specifies that the quality of fabrication and design shall meet Level B in accordance with DIN EN 61192-1. In addition to Level B of DIN EN 61192-1, safety standard KTA 3501 also cites Class 2 of IPC-A-610.

(2) Section 9 of DIN EN 60987 specifies requirements for the fabrication that are comparable to those of DIN EN 61192-1 and IPC A 610.

4.2 Engineering Documents of the Devices

4.2.1 General requirements

The respective engineering documents shall contain information on the manufacturer, the type and state of modification of the device. These documents shall comprise the documents specified in Sections 4.2.2 through 4.2.9.

Note:

Due to the growing degree of integration of the devices, the extent and degree of detail of the documents to be submitted shall be established in agreement with the authorized expert.

4.2.2 Index of engineering documents

The index of engineering documents shall list all documents required to ascertain the identity of each device.

4.2.3 Description of functionality

The description of functionality shall provide information on the range of application, the task and the mode of operation of the device including those of its interfaces.

4.2.4 Data sheet

(1) The data sheet shall contain all data including the permissible range of application as well as the tolerances characterizing the device type.

Note:

The data sheet shall contain, e.g. the following data:

- a) input parameters,
- b) output parameters,
- c) auxiliary power supply,
- d) ambient conditions,
- e) mechanical mounting and electrical connection,
- f) materials of pressurized or medium-contacted parts,
- g) signal transfer behavior,
- h) electrical characteristics,
- i) electromagnetic compatibility / stress
- j) signal processing times, cycle times, and
- k) interfaces, communication logs.

(2) Superordinate system data may be compiled in a system data sheet.

4.2.5 Operating instructions, technical manuals

(1) The operating instructions or the technical manuals shall normally contain instructions and information on:

- a) mounting and installation,
- b) commissioning,
- c) adjustments,
- d) special accessories,
- e) maintenance, and
- f) packaging, transport and storage.

(2) Superordinate operating instructions may be compiled in a system operating instruction.

4.2.6 Hardware documents

(1) The circuit diagram shall depict all components of the device and their interconnections.

(2) The parts list shall list all mechanical and electrical components of the device that are necessary to be able to evaluate their reliability and function. The parts list shall basically contain all relevant technical data for the components. Alternatively, the relevant technical data for components may be made available by referencing additional documents (e.g. the data sheet).

(3) The position diagram of components shall show the components and the arrangement of their connections.

(4) In the case of computer-based devices or devices with programmable components, the data sheets of the programmable components including the data-technological connections shall be submitted.

(5) The configuration and identification documents required for proper identification of the devices shall be submitted. In the case of computer-based devices or devices with programmable components, the hardware and software components as well as the software tools shall be listed together with the respective versions.

(6) If the fabrication anticipates variants of assembly by the installation of equivalent components, these shall be specified in the parts list and considered in the type approval tests. Provided, the variant components are truly equivalent, a theoretical analysis of the equivalency may be sufficient.

(7) The technical drawings of the pressurized or medium-contacted parts shall contain all data required for the stress analysis.

4.2.7 Software documents

(1) The development process of the software of computer-based devices and the development process of programmable components shall be substantiated by technical documents.

Note:

These documents can be, e.g.:

- a) requirement specification,
- b) tender specification,
- c) performance specification,
- d) development documentation including documentation of tools for new developments and modifications,
- e) test documentation including information on the range covered by the tests and
- f) configuration management in accordance with safety standard KTA 3506.

(2) The structure, program sequence and temporal behavior of the software for computer-based devices and devices with programmable components shall be described.

(3) The possibilities for the configuration and parameterization of the devices shall be specified as well as the software tools available for these tasks.

(4) The conditions and procedures to be observed during configuration and parameterization shall be described.

(5) A specification of the interfaces to other devices or systems shall be submitted and the data to be transferred via these interfaces shall be specified.

Note:

The requirements for the system environment (e.g. measures for avoiding or control sequential failures) are based on these data.

(6) In the case of pre-developed software, the procedure for its qualification or the procedure for demonstrating its suitability shall be described together with the results.

(7) The measures for protecting the software against manipulation and the measures for identifying, initiating alarms and documenting such manipulations of the software shall be described.