

Safety Standards

of the
Nuclear Safety Standards Commission (KTA)

KTA 3507 (2014-11)

Factory Tests, Post-Repair Tests and the Certification of Proven Performance of Modules and Devices of the Instrumentation and Control System Important to Safety

(Werksprüfungen, Prüfungen nach Instandsetzung und Nachweis der Betriebsbewährung der Baugruppen und Geräte der Sicherheitsleittechnik)

The previous versions of this safety standard were issued in 1986-11 and 2002-06

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

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Factory Tests, Post-Repair Tests and the Certification of Proven Performance of Modules and Devices of the Instrumentation and Control System Important to Safety

KTA 3507

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PLEASE NOTE: Only the original German version of the present safety standard represents the joint resolution of the 35-member Nuclear Safety Standards Commission (Kerntechnischer Ausschuss, KTA). The German version was made public in Bundesanzeiger (BAnz) of January 15, 2015. 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 Criteria", the "Design-Basis Accident Guidelines" and in the Safety Requirements for Nuclear Power Plants (SiAnf).

(2) In accordance with SiAnf and the SiAnf-Interpretations, this safety standard specifies the requirements regarding preparation, extent and execution of factory tests, of post-repair tests and of the certification of proven performance for the instrumentation and control equipment of the safety-related instrumentation and control (I&C) system.

(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) Requirements for the radiological protection equipment are specified in safety standard series KTA 1500.

(5) Requirements for the seismic instrumentation are specified in safety standard KTA 2201.5.

(6) Requirements for the instrumentation and control (I&C) system important to safety, in particular, for the reactor protection system and monitoring equipment of the safety system are specified in safety standard KTA 3501.

(7) Requirements for the type testing of electrical modules of the instrumentation and control (I&C) system important to safety are specified in safety standard KTA 3503.

(8) Requirements for type testing the measuring sensors and transducers of the instrumentation and control (I&C) system important to safety are specified in safety standard KTA 3505.

(9) Requirements for the system test of the instrumentation and control equipment of the instrumentation and control (I&C) system important to safety are specified in safety standard KTA 3506.

(10) Requirements for testing the instrumentation and control equipment of the safety system are specified in Section 7 of the RSK Guidelines.

(11) General requirements regarding quality management are specified in DIN EN ISO 9000.

(12) A model regarding quality assurance in design, development, production, assembly and servicing is specified in DIN EN ISO 9001.

(13) General requirements for quality assurance are specified in safety standard KTA 1401.

(14) Requirements for the documentation during the construction and operation of nuclear power plants are specified in safety standard KTA 1404.

1 Scope

(1) This safety standard applies to factory tests, post-repair tests and the certification of proven performance of the modules and devices of the instrumentation and control (I&C) system important to safety in accordance with safety standard KTA 3501 (*In the present safety standard, modules and devices are often referred to as products*).

(2) This safety standard specifies the requirements regarding planning, executing and documenting factory tests, post-repair tests and regarding the certification of proven performance.

(3) Furthermore, Appendix A specifies requirements regarding the selection, processing and testing of materials for pressurized, medium-contacted or structural component parts.

Notes:

(1) Pressurized component parts are parts of measuring devices that are under internal or external overpressure. These include, e.g., pressure covers of measuring transmitters, bolted nozzle connections.

(2) Medium-contacted component parts are, e.g., parts of measuring devices that are in immediate contact with the measurement medium.

(3) Structural component parts are parts with which the measuring devices are connected to, e.g., the supporting structure.

(4) This safety standard does not specify any requirements for the tests and inspections during on-site assembly and commissioning.

2 Definitions

(1) Quality audit

The quality audit is the verification of the quality assurance system or of its parts.

(2) Factory test

Factory tests are quality tests and inspections performed and documented at specified hold points and at the completion of fabrication either by the module or equipment manufacturer or are performed during and after completion of a repair task by a repair division certified in accordance with safety standard KTA 1401.

Note:

Cf. Sec. 7.2 of safety standard KTA 1401.

(3) Authorized expert

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

3 Quality Audit

3.1 Superordinate Requirements

(1) The factory tests specified in this safety standard may be performed by the manufacturer or a repair division certified in accordance with safety standard KTA 1401 in own responsibility, provided, the structural and procedural organization for carrying out the quality assurance and the product- and procedure-related quality assurance measures are demonstrated to the licensee or her contractor in quality audits and, provided, these quality audits are accepted by the licensee or her contractor.

(2) The responsible persons specified in the quality assurance system (head of quality assurance, plant expert, chief inspector) shall supervise the factory tests with respect to their proper execution in accordance with the schedules for fabrication and testing, and they shall evaluate the operating experience gathered with the installed products. Their areas of responsibility and range of authority and their independence from fabrication shall be clearly documented in the quality assurance system. This shall be verified in the quality audit.

(3) Within the scope of testing the product-related quality assurance measures, the documents and activities specified under para. (2) and under Section 4 shall be checked.

(4) The quality audits shall be performed in regular intervals in accordance with a fixed schedule. The quality audits

shall normally be jointly carried out by at least two inspectors. The inspectors shall have qualified product-related knowledge and shall have been trained in the performance of quality audits.

(5) The quality audits shall normally be carried out in three-year intervals. In case of a repeated occurrence of deficiencies in delivered products, a quality audit in consultation with an authorized expert shall be performed.

(6) The focal points of the quality audit shall be specified in the form of checklists based on written specifications regarding the structural and procedural organization of the quality assurance of the division to be audited and based on the product-related requirements to be inspected. Also based on checklists, random inspections shall be performed of the divisions responsible for quality assurance. In this context, it shall be checked whether

- a) the described quality assurance measures are being applied,
- b) the corresponding and valid regulations, standards, guide lines and instructions are available and known at the level of work performance,
- c) the instructions are sufficient and appropriate.

(7) The licensee or her contractor may accept the quality audits of other licensees or their contractors, provided, the quality audits were carried out based on this safety standard.

3.2 Assessment of the Results

The results of the quality audits shall be documented in a report. Any detected inadmissible deviations from specified quality assurance measures shall be described. Based on the results, the quality assurance system and the product quality shall be assessed. The acceptance of the quality assurance system and of the product quality shall be documented by the issuance of a certificate.

3.3 Corrective Measures

If the quality audit reveals inadmissible deviations, the following shall be established in consultation with the manufacturer:

- a) the planned measures,
- b) the schedule for their realization,
- c) the dates for their completion and
- d) the responsible divisions.

The effectiveness of these corrective measures shall be verified.

3.4 Alternative Measures

In the exceptional case that a manufacturer cannot demonstrate a quality assurance system or its application during fabrication, the licensee or her contractor, neither of whom may be identical with the manufacturer, shall ensure and document the product quality by tests and inspections performed during fabrication or on the finished product.

4 Factory Tests during Fabrication

4.1 General Requirements

The factory test shall basically be performed in accordance with the requirements specified under Sections 4.2 through 4.7. Exceptions are admissible, provided, they are approved of by the persons specifically appointed for this task in the quality as

urance system and these exceptions are recorded in non-conformance reports.

4.2 Quality Characteristics

The quality characteristics to be checked shall be specified by the manufacturer under his own responsibility, specifically, by evaluating

- a) the technical specifications,
- b) the fabrication schedules,
- c) the plant-internal tests and inspections, e.g., examinations regarding choice of materials,
- d) the results of the type tests,
- e) the results of certifying the proven performance,
- f) the stress calculations for pressurized parts,
- g) the plant-internal repair reports,
- h) the failure reports by the fabrication division,
- i) the available operating experience,
- j) the fabrication procedure and
- k) the configuration and version management.

The quality characteristics to be checked shall be specified in lists.

Note:

Quality characteristics are, e.g., transmission behavior, electromagnetic compatibility, self-diagnosis, functionality, temperature influence, influence of auxiliary power, high-voltage resistance, material properties, pressure resistance, leak tightness, packaging, traceability of the fabrication.

4.3 Test Instructions

(1) For each of the specified quality characteristics the test instructions shall contain specifications regarding

- a) test facilities,
- b) test procedure,
- c) test parameters, e.g., temperature of the testing chamber, voltage, frequency, testing pressure,
- d) extent of test,
- e) required values with permissible deviations and
- f) version and revision identification.

(2) Regarding tests under critical load conditions, the manufacturer shall specify in the test instruction at which worst-case combination of the two test parameters, ambient temperature and auxiliary power, the function of the product is still assured.

4.4 Schedules for Fabrication and Testing

(1) Within the framework of the factory test, schedules shall be established for each product regarding

- a) receiving inspection,
- b) fabrication test and
- c) final inspection.

(2) In these schedules, every fabrication and testing procedure shall be specified including the necessary fabrication and test instructions as well as their sequence. These shall include the necessary material and fabrication tests of pressurized, medium-contacted or structural component parts. These schedules shall normally assure that the quality characteristics to be demonstrated are tested at that point in time when an unrestricted testing is possible.

(3) In case parts with the same specification are installed in assorted products, only one schedule is required.

4.5 Requirements for Auxiliary Test Equipment

(1) The (factory) test shall be performed with the auxiliary test equipment specified in the test instruction. The auxiliary test equipment shall be subjected to a maintenance and calibration service as specified in Sec. 10 of safety standard KTA 1401. The respective check performed and the point in time for the subsequent check shall be visible on the auxiliary test equipment and contained in the documents accompanying this equipment. Any test sequences controlled by auxiliary test equipment shall be designed such that the execution of the test sequence is documented in the test record. It shall normally be clearly recognizable that program-controlled test sequences are completely executed. The version status of the test software shall be documented.

(2) Reference standards, measuring devices and auxiliary test equipment shall be calibrated and tested before their first deployment. The responsible division shall specify the time intervals in which the regular calibrations shall be performed. Likewise, the procedure for the calibration and maintenance shall be specified. The responsible persons shall be named and known to the relevant organizations.

(3) A calibration certificate by the manufacturer or another renowned organization may be accepted as test certificate prior to the first application, provided, the calibration certificate is not older than twelve months.

(4) Results and findings from the maintenance and calibration performed on measuring devices and auxiliary test equipment shall be evaluated and documented. Whenever the measuring devices and auxiliary test equipment do not meet the requirements, adequate measures shall be taken regarding their repair or removal. In this case, the prior measurements and test results shall be evaluated and the results documented. If this uncovers possible implications for the previously performed tests, the user (customer) shall be immediately informed.

4.6 Extent of Tests of Modules and Devices of the Instrumentation and Controls

4.6.1 Extent of the receiving inspection

(1) Prior to further processing, the manufacturer shall test whether the parts delivered by his contractor are in correspondence with the quality characteristics specified in the procurement documents. In case random tests are required, these shall be specified in plant-internal random-test schedules.

(2) If the receiving test is reduced to an identity check, the contractor shall either confirm that the tests and inspections specified in the procurement documents were performed, or it shall be ensured by other quality assurance measures that the specified quality characteristics are achieved.

4.6.2 Extent of the fabrication tests and final inspection

(1) Within the scope of the final inspection, an identity check shall be performed. The identity check shall verify that the device and its modified condition is in conformance with the valid manufacturing documents listed in the index of engineering documents for the certification of proven performance or for the type test, and that the device is in conformance with the procurement documents.

(2) The final inspection, with exception of the critical load test, shall be performed on each module or individual device with each quality characteristic being tested according to the test instructions specified under Section 4.3. If this test is not possible anymore without restrictions, then the quality characteristics shall be tested during fabrication on each test object by performing corresponding fabrication tests.

(3) The critical load test in accordance with Section 4.3 para. (2) shall be performed as a random-sample test of the fabrication batch. The size of the random sample shall be equal to or larger than five per hundred but shall include at least three pieces. If this test reveals an inadmissible deviation, each device shall be tested and a non-conformance report written up.

(4) A random sample test under critical load condition may be waived, provided, it can be demonstrated that the associated combination of test parameters will lead to no additional insight regarding quality of the device.

4.7 Modifications

(1) If modifications are carried out on a module or a device or on the manufacturing process, then the requirements affected by these changes shall be revised with special regard to

- quality characteristics as specified under Section 4.2,
- test instructions as specified under Section 4.3,
- fabrication and test schedules as specified under Section 4.4, and
- extent of tests of modules and devices of the instrumentation and controls as specified under Section 4.6.

The revisions to these requirements shall be documented and shall be archived as specified under Section 6.3.3 para. (1), items a) and b).

(2) In case the changes of a module or device involve the replacement of components, these components shall be classified as specified under Appendix C. Depending on this classification, a supplementary type test in accordance with safety standards KTA 3503 or KTA 3505 may be required.

4.8 Testing of System Components of the Instrumentation and Control (I&C) System Important to Safety

(1) Circuitry tests of the, e.g., circuit frames, module racks or cabinets, shall normally be performed in the manufacturing plant and do not need to be repeated at the final place of installation, provided, a prior agreement was reached with the authorized expert regarding the extent, execution, surveillance and documentation of these tests.

(2) If functional tests of system components or integral system tests are performed in the manufacturing plant, these tests do not need to be repeated at the final place of installation, provided, the extent, execution, surveillance and documentation of these tests are in accordance with Sec. 4.1.3 of safety standard KTA 3506 and a prior agreement was reached with the authorized expert.

5 Post-Repair Testing of Modules and Devices

5.1 Prerequisites for Performing the Repairs

(1) A repair division may perform the repairs and tests on modules and devices under its own responsibility, provided, this division demonstrates the structural and procedural organization for performing quality assurance and the product- and procedure-related quality assurance measures in quality audits to an organizationally independent and qualified division.

(2) Within the scope of the quality audits, it shall be demonstrated that the repair division has at its disposal appropriate technical equipment, qualified personnel and responsible persons for these post-repair tests. The responsible persons shall be organizationally independent of the repair division.

5.2 Basic Requirements for the Post-Repair Tests

5.2.1 Documents

(1) The repair division shall have at its disposal the following documents:

- a) description of the function,
- b) data sheet,
- c) circuit diagram,
- d) parts list,
- e) position diagram of the components,
- f) test instructions and test sequence schedule.

(2) In addition, the following documents shall be present:

- a) operating instructions,
- b) assembly instructions and
- c) repair instructions.

Note:

A reference that can be consulted regarding repairs is, e.g., IPC 7711/7721.

5.2.2 Quality Characteristics

The repair division under its own responsibility shall specify the quality characteristics to be tested, specifically by evaluating:

- a) the documents specified under Section 5.2.1,
- b) the results of the plant-specific suitability tests and of the type tests,
- c) the operating experience with the modules and devices.

Note:

The operating experience may be derived from, e.g., failure statistics as well as the analyses of failures and findings.

5.2.3 Test instructions and test sequence schedules

Test instructions and test sequence schedules shall be available which meet the requirements specified under Sections 4.3 and 4.4.

5.2.4 Execution of post-repair tests

(1) After a module or a device has been repaired, those testing steps shall be performed that are necessary to confirm that the repair was properly executed.

(2) The surveillance of the post-repair test shall be carried out by the persons responsible for the post-repair tests.

(3) The surveillance of the auxiliary test equipment shall be carried out as specified under Section 4.5.

5.3 Modifications during Repairs

(1) If a module or device is modified (during repairs) then the requirements affected by these modifications shall be revised with special regard to

- a) quality characteristics specified under Section 5.2.2,
- b) test instructions specified under Section 5.2.3,
- c) assembly schedules and
- d) post-repair tests specified under Section 5.2.4.

The revisions to these requirements shall be documented and shall be archived as specified under Section 6.3.3, para. (1), items a) and b).

(2) In case the modifications of a module or device involve the replacement of components, these components shall be analyzed regarding their comparability to the original component and shall be classified as specified in Appendix C. Depending

on this classification, a supplementary type test in accordance with safety standards KTA 3503 or KTA 3505 may be required.

6 Documentation

6.1 Certifying Factory Tests during Manufacturing

(1) The successful completion of the factory tests shall be certified in the form of a test certificates. This may also occur in the form of collective test certificates.

Note:

The term 'collective test certificate' is herein understood to mean the summary of the test results of multiple type-identical modules or devices in a single test certificate.

(2) The test certificate shall contain at least the following information:

- a) product identification,
- b) revision state of the product (hardware, firmware) according to the index of engineering documents,
- c) number and state of revision of the index of engineering documents,
- d) fabrication numbers or the coding of the test marking,
- e) test location, date,
- f) signature of the person responsible as specified in the quality assurance system.

(3) The successful completion of the factory test shall be certified on each product by affixing a test marking, e.g., a test stamp or a test label, and in such a way that this test marking cannot get lost. It shall be ensured that the test marking is unambiguously correlated to the test records and test certificates. The test marking shall include references to

- a) the proof of the identity checks, fabrication tests and final inspections as specified under Section 4.6.2 as well as
- b) in the case of pressurized, medium-contacted or structural component parts, the proof of the quality of the materials used and of the proper materials-conforming fabrication as specified in Appendix A.

(4) The fabrication number or the coding of the test marking affixed to the product shall, together with the documents archived by the manufacturer, allow identifying the product-specific fabrication and test documents and the test date (month and year).

(5) Additionally, in the case of tests on the system components specified under Section 4.8, the requirements regarding documentation in accordance with Secs. 3.3 and 5.8 of safety standard KTA 3506 shall be met.

6.2 Post-Repair Test Certificates for Modules and Devices

For each repair measure performed on a module or a device, the identified failures and the failure causes as well as the derived repair measures shall be documented. After the repair, the successful completion of the tests to be performed as specified under Section 5.2.4 shall be affirmed by issuing a certificate of the fabrication test (cf. Section 6.1). A fabrication or repair number shall make it possible to properly correlate the repair measure, the repaired object and the certificate of the fabrication test including the repair report.

6.3 Archiving

6.3.1 Quality audit reports and certificates

(1) The most recent versions of the quality audit reports and certificates shall be stored for seven years by the individual division that performed the respective audit. The reports may be

reviewed by the authorized expert. Copies of the certificates (individual certificate or listing of the qualified manufacturers) shall be made available to the authorized expert upon his request.

(2) Copies of the reports regarding the fabrication tests and the tests on the final product to ensure the product quality as specified under Section 3.4 shall be made available to the authorized expert upon his request.

6.3.2 Certificate of the fabrication test

The certificate of the fabrication test and the documents specified under Section 6.2 shall be stored by the licensee for the duration of the product's term of operation.

6.3.3 Manufacturing documents, test instructions and non-conformance reports

(1) All versions of the following documents shall be archived and listed in a revision index:

- a) all manufacturing documents listed in the index of engineering documents regarding the certification of proven performance or the type testing,
- b) all test instructions for the fabrication tests and the post-repair tests,
- c) all non-conformance reports created during fabrication as specified under Section 4.1.

(2) The documents specified under para. (1), items a), b) and c) shall be stored by the manufacturer for a duration of at least seven years after final production of the products. (Duplicates of) the documents specified under para. (1), item (a) shall be stored at the operating utility for the duration of the term of operation of the product's.

(3) The test instruction and test sequence schedules specified under Section 5.2.3 shall be stored at the operating utility or at the repair division for the duration of the term of operation of the products.

7 Certification of Proven Performance for Modules and Devices

7.1 General Requirements

The proven performance of the hardware of modules and devices shall be proven by assessing the records from the observation period of the series-fabricated unit under observation, with this assessment being based on the characteristics and ambient conditions for the respective product

Notes:

(1) A unit under observation may be, e.g., a fabrication series, a type of device, a functional unit or a type of component. The observation period is considered sufficient for a unit under observation if design errors can be detected and the maintenance measures can be evaluated (cf. safety standard KTA 1401).

(2) A proven performance of software can, in general, not be determined by this method.

7.2 Certification of Proven Performance for the Hardware of Modules and Devices Lacking a Type Test Certification

(1) Lacking a type test certification, the proven performance shall be certified by assessing the records created during the observation period of the unit under observation or of comparable units; this assessment shall be based on statistical methods.

(2) In the case of comparable units under observation, it shall be verified that comparable electrical component types, structural elements and design principles were employed and that similar ambient and operational conditions were specified for the components.

(3) For this certification of proven performance, the following information shall be provided spanning the duration of the observation period:

- a) annual number of units delivered over the years,
- b) total number of units delivered,
- c) estimated number and term of operation of the units in operation,
- d) annual number of repairs over the years that are evaluated in accordance with para. (4),
- e) estimated annual number of repairs over the years that are not evaluated in accordance with para. (4),
- f) estimated annual number of the units under observation that failed over the years but were not repaired.

(4) For the repairs of the units under observation the following information shall normally be provided:

- a) type and extent of the failures,
- b) causes of the failures,
- c) assessment of the failure causes.

(5) For every unit under observation intended for Cat A instrumentation and control functions, each one of the following requirements shall be met to enable applying the statistical methods referred to in para. (1):

- a) A collective sample shall be chosen of which at least ten units have been in operation for two years.
- b) The collective sample specified under item a) shall have accumulated at least 10^7 operating hours. If the requirement under item a) is met, however, without proof of 10^7 accumulated operating hours, then, in addition to the statistical proof, the reliability data in accordance with Sec. 4.3 of safety standard KTA 3503 or Sec. 4.3 of safety standard KTA 3505 shall be verified.

c) For the evaluation of the failure effects, the average failure rate and the confidence interval shall be specified with a safety margin of 95 % according to the chi-square distribution.

(6) For the other units under observation not intended for Cat A instrumentation and control functions, deviating requirements may be specified in agreement with the authorized expert.

7.3 Certification of Proven Performance with a Supplementary Type Test for the Characteristics Not Proven During Operation

The required characteristics of a unit under observation shall normally be verified by the certification of proven performance as specified under Section 7.2. Those characteristics not verified shall be proven by a supplementary type test.

7.4 Responsibility for the Certifications

The certifications of proven performance specified under Sections 7.2 and 7.3 shall be carried out and documented by the license applicant and shall be submitted to the authorized expert.

Appendix A

Choosing, Processing and Testing of the Materials for Measuring Devices

A 1 Basic Requirements

The materials for the pressurized, medium-contacted or structural component parts of the measuring devices shall be chosen and tested in accordance with the type of load conditions.

A 2 Choosing and Testing the Materials

(1) The materials for pressurized parts of measuring devices which cannot be isolated from the connected systems shall basically meet the requirements specified by the German Society for Pressure Vessels (AD 2000-Code) and listed in **Tables A-1, A-2 and A-3** (exceptions are specified under para. (3)).

(2) The materials for pressurized parts of measuring devices which can be isolated from the connected systems by at least two valves (e.g., primary isolation valve and device isolation valve) or the materials for medium-contacted or structural component parts shall meet the requirements of the DIN-Standards listed in **Tables A-1, A-2 and A-3**. The type of certificates for the material tests in accordance with DIN EN 10204 shall be specified for these materials by the manufacturer.

(3) In the case of metallic materials not included in the DIN-Standards and AD 2000-Code listed in **Tables A-1, A-2 and A-3**, the employed standards shall be specified and their requirements shall be met. In the case of materials for parts specified under para. (1), the type of certificates for the material tests shall either be specified in accordance with AD 2000-Code or, if these do not specify corresponding requirements, they shall be specified in agreement with the supervisory division approved in accordance with Sec. 17 of the Equipment Safety Act (GPSG).

(4) If other materials are used (e.g., glass, ceramics or plastics) then, for the parts specified under para. (1), a consent is required from the supervisory division approved in accordance with Sec. 17 of the Equipment Safety Act (GPSG); for the parts specified under para. (2), a manufacturer-internal specification is required.

A 3 Product Fabrication and Product Testing

(1) The fabrication and testing of pressurized products specified under Section A 2 para. (1), e.g., welded parts, shall basically meet the requirements specified in Series HP of the AD 2000-Code. Any deviations from the requirements specified in Series HP of the AD 2000-Code require the consent of the supervisory division approved in accordance with Sec. 17 of the Equipment Safety Act (GPSG).

(2) The parts specified under Section A 2 para. (2) shall be fabricated and tested in accordance with the manufacturer-internal specifications.

(3) In the case of parts-tested, type-tested or proven-in-service proved measuring devices, the requirements shall be applied that were agreed to by the supervisory division approved in accordance with Sec. 17 of the Equipment and Product Safety Act (GPSG).

Product Form	Material and Quality Standards	
	DIN Standards	AD 2000-Code
Seamless pipes	DIN EN 10216-1 DIN EN 10216-2 DIN EN 10216-3 DIN EN 10216-4	W 4
	DIN EN 10216-5	W 2
Longitudinally welded pipes	DIN EN 10217-1 DIN EN 10217-2	W 4
	DIN EN 10217-7	W 2
Arcs, T-pieces, reducers and caps	DIN EN 10253-2	W 4
	DIN EN 10253-4	W 2
Sheet metal and steel bands	DIN EN 10028-1	W 1
	DIN EN 10028-2	W 13
	DIN EN 10028-7	W 2
Cast parts	DIN EN 1563	W 3/2
	DIN EN 10213	W 5
Forged parts and flanges	DIN EN 10222-1	W 2
	DIN EN 10222-5	W 13
	DIN EN 10272	W 9
Bolts, nuts and other threaded parts	Note: Medium-contacted bolts or nuts in accordance with DIN EN 3506 only of steel types A3 or A5.	W 2 W 7
Rod steels	DIN EN 10025 DIN EN 10250-2 DIN EN 10207 DIN EN 10222-2 DIN EN 10222-3 DIN EN 10222-4 DIN EN 10273	W 13
	DIN EN 10222-5 DIN EN 10272	W 2

Table A-1: Materials for pressurized, medium-contacted or structural parts of measuring devices within the scope of the European Pressure Equipment Directive (PED)

Product Form	Material and Quality Standards
Seamless pipes	DIN EN 10224, DIN EN 10297-1, DIN EN 10297-2
Longitudinally welded pipes	DIN EN 10224, DIN EN 10296-1, DIN EN 10296-2, DIN EN 10312
Sheet metal and steel bands	DIN EN 10025-1, DIN EN 10025-2, DIN EN 10088-2, DIN EN 10088-3
Cast parts	DIN EN 1563, DIN EN 10283
Forged parts and flanges	DIN EN 10250-1, DIN EN 10250-2, DIN EN 10250-4, DIN EN 10083-1, DIN EN 10083-2, DIN EN 10083-3, DIN EN 10088-3
Bolts, nuts and other threaded parts	DIN EN ISO 3506-1, DIN EN ISO 3506-2, DIN EN ISO 3506-3 However, medium-contacted bolts or nuts in accordance with DIN EN 3506 only of steel types A3, A4 and A5 DIN EN 10269

Table A-2: Materials for pressurized, medium-contacted or structural parts of measuring devices not within the scope of the European Pressure Equipment Directive (PED)

Product Form	Material and Quality Standards
Seamless pipes	DIN EN 10216-2, DIN EN 10216-5
Longitudinally welded pipes	DIN EN 10217-2, DIN EN 10217-7
Sheet metal and steel bands	DIN EN 10028-1, DIN EN 10028-2, DIN EN 10028-7
Cast parts	DIN EN 1563, DIN EN 10283
Forged parts and flanges	DIN EN 10222-1, DIN EN 10222-5, DIN EN 10272
Bolts, nuts and other threaded parts	DIN EN ISO 3506-1, DIN EN ISO 3506-2, DIN EN ISO 3506-3, DIN EN 10269
Rod steels	DIN EN 10025, DIN EN 10222-5, DIN EN 10250-2, DIN EN 10207, DIN EN 10222-2, DIN EN 10222-3, DIN EN 10222-4, DIN EN 10272, DIN EN 10273

Table A-3: Materials for pressurized, medium-contacted or structural parts of measuring devices deployed for use with combustible liquids

Appendix B

Regulations Referred to in the Present Safety Standard

(Regulations referred to in the present safety standard are valid only in the versions cited below. Regulations which are referred to within these regulations are valid only in the version that was valid when the latter regulations were established or issued.)

AtG		Act on the peaceful utilization of atomic energy and the protection against its hazards (Atomic Energy Act – AtG) of December 23, 1959, revised version of July 15, 1985 (BGBl. I, p. 1565), most recently changed by Article 1 of the Act of July 31, 2011 (BGBl. I 2011, p. 1704)
GPSG		Act on the equipment and product safety of January 6, 2004 (BGBl. I, p. 2, 219), most recently changed by Article 2 of the Act of March 7, 2011 (BGBl. I, p. 338)
StrlSchV		Ordinance on the protection from damage by ionizing radiation (Radiological Protection Ordinance – StrlSchV) of July 20, 2001 (BGBl. I, p. 1714; 2002 I, p. 1459), most recently changed by Article 1 of the Act of October 4, 2011 (BGBl. I, p. 2010)
PED		97/23/EG 97/23/EC 97/23/CE - Guidelines related to the Pressure Equipment Directive (1997-05-29): Guideline 97/23/EG of the European Parliament and of the Council of May 29, 1997 to approximate the laws of the Member States relating to pressure equipment
Safety Criteria	(1977-10)	Safety criteria for nuclear power plants of October 21, 1977 (BAnz No. 206 of November 3, 1977)
SiAnf	(2012-11)	Safety requirements for nuclear power plants of November 22, 2012, (BAnz of January 24, 2013)
SiAnf-Interpretations	(2013-11)	Interpretations of the safety requirements for nuclear power plants of November 29, 2013 (BAnz AT of December 10, 2013)
Design Basis Accident Guidelines	(1983-10)	Guidelines for the assessment of the design of nuclear power plants with pressurized water reactors against design basis accidents as defined in Sec. 28, para. 3 StrlSchV (Design Basis Accident Guidelines) of 18 October 1983 (Addendum to BAnz. No. 245 of 31 December 1983)
RSK-Guidelines	(1981-10)	RSK-Guidelines for pressurized water reactors; 3 rd edition of October 14, 1981 (Banz 1982, No. 69a) with changes: in Sec. 21.1 (BAnz 1984, No. 104), in Sec. 21.2 (BAnz 1983, No. 106) and in Sec. 7 (BAnz 1996, No. 158a) and the corrigendum (BAnz 1996, No. 214)
KTA 1401	(2013-11)	General requirements regarding quality assurance
KTA 1404	(2013-11)	Documentation during the construction and operation of nuclear power plants
KTA 1501	(2010-11)	Stationary system for monitoring the local dose rate within nuclear power plants
KTA 1502	(2005-11)	Monitoring volumetric activity of radioactive substances in the inner atmosphere of nuclear power plants
KTA 1503.1	(2013-11)	Monitoring the discharge of radioactive gases and airborne radioactive particulates; Part 1: Monitoring the discharge of radioactive matter with the stack exhaust air during specified normal operation
KTA 1503.2	(2013-11)	Monitoring the discharge of radioactive gases and airborne radioactive particulates; Part 2: Monitoring the discharge of radioactive matter with the vent stack exhaust air during design-basis accidents

KTA 1503.3	(2013-11)	Monitoring the discharge of radioactive gases and airborne radioactive particulates; Part 3: Monitoring the non-stack discharge of radioactive matter
KTA 1504	(2007-11)	Monitoring and assessing of the discharge of radioactive substances in liquid effluents
KTA 1505	(2011-11)	Suitability verification of the stationary measurement equipment for radiation monitoring
KTA 1507	(2012-11)	Monitoring the discharge of radioactive substances from research reactors
KTA 1508	(2006-11)	Instrumentation for determining the dispersion of radioactive substances in the atmosphere
KTA 2201.5	(1996-06)	Design of nuclear power plants against seismic events; Part 5: Seismic instrumentation
KTA 3501	(1985-06)	Reactor protection system and monitoring equipment of the safety system
KTA 3503 (SRD)	(2013-11)	Type testing of electrical modules for the safety-related instrumentation and control system (Standard-Revision Draft)
KTA 3505 (SRD)	(2013-11)	Type testing of measuring sensors and transducers of the safety-related instrumentation and control system (Standard-Revision Draft)
KTA 3506	(2012-11)	System testing of the instrumentation and control equipment important to safety of nuclear power plants
DIN EN 1563	(2010-03)	Founding - Spheroidal graphite cast irons; German and English version prEN 1563:2010
DIN EN 3506	(2003-03)	Aerospace series - Hot rolled sheets and plates in heat resisting alloys - Thickness 2,0 mm ≤ a ≤ 100 mm; Dimensions; German and English version EN 3506:2001
DIN EN ISO 3506-1	(2010-04)	Mechanical properties of corrosion-resistant stainless-steel fasteners - Part 1: Bolts, screws and studs (ISO 3506-1:2009); German version EN ISO 3506-1:2009
DIN EN ISO 3506-2	(2010-04)	Mechanical properties of corrosion-resistant stainless-steel fasteners - Part 2: Nuts (ISO 3506-2:2009); German version EN ISO 3506-2:2009
DIN EN ISO 3506-3	(2010-04)	Mechanical properties of corrosion-resistant stainless-steel fasteners - Part 3: Set screws and similar fasteners not under tensile stress (ISO 3506-3:2009); German version EN ISO 3506-3:2009
DIN EN ISO 9001 <i>Corrigendum</i>	(2009-12)	Quality management systems - Requirements (ISO 9001:2008); Trilingual version EN ISO 9001:2008, Corrigendum of DIN EN ISO 9001:2008-12; Trilingual version EN ISO 9001:2008/AC:2009
DIN EN 10025	(2011-04)	Hot rolled products of structural steels - Part 1: General technical delivery conditions; German version prEN 10025-1:2011
DIN EN 10028-1	(2009-07)	Flat products made of steels for pressure purposes - Part 1: General requirements; German version EN 10028-1:2007+A1:2009
DIN EN 10028-2	(2009-09)	Flat products made of steels for pressure purposes - Part 2: Non-alloy and alloy steels with specified elevated temperature properties; German version EN 10028-2:2009
DIN EN 10028-7	(2008-02)	Flat products made of steels for pressure purposes - Part 7: Stainless steels; German version EN 10028-7:2007
DIN EN 10083-1	(2006-10)	Steels for quenching and tempering - Part 1: General technical delivery conditions; German version EN 10083-1:2006
DIN EN 10083-2	(2006-10)	Steels for quenching and tempering - Part 2: Technical delivery conditions for non-alloy steels; German version EN 10083-2:2006
DIN EN 10083-3	(2007-01)	Steels for quenching and tempering - Part 3: Technical delivery conditions for alloy steels; German version EN 10083-3:2006

DIN EN 10083-3 <i>Corrigendum</i>	(2009-01)	Steels for quenching and tempering - Part 3: Technical delivery conditions for alloy steels; German version EN 10083-3:2006, Corrigendum to DIN EN 10083-3:2007-01; German version EN 10083-3:2006/AC:2008
DIN EN 10088-2	(2012-01)	Stainless steels - Part 2: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes; German version prEN 10088-2:2011
DIN EN 10088-3	(2012-01)	Stainless steels - Part 3: Technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resisting steels for general purposes; German version prEN 10088-3:2011
DIN EN 10207	(2005-06)	Steels for simple pressure vessels - Technical delivery requirements for plates, strips and bars; German version EN 10207:2005
DIN EN 10213	(2008-01)	Steel castings for pressure purposes; German version EN 10213:2007
DIN EN 10213/A1	(2011-08)	Steel castings for pressure purposes; German version EN10213:2007/prA1:2011
DIN EN 10216-1	(2009-11)	Seamless steel tubes for pressure purposes - Technical delivery conditions - Part 1: Non-alloy steel tubes with specified room temperature properties; German version prEN 10216-1:2009
DIN EN 10216-2	(2009-11)	Seamless steel tubes for pressure purposes - Technical delivery conditions - Part 2: Non-alloy and alloy steel tubes with specified elevated temperature properties; German version prEN 10216-2:2009
DIN EN 10216-3	(2009-11)	Seamless steel tubes for pressure purposes - Technical delivery conditions - Part 3: Alloy fine grain steel tubes; German version prEN 10216-3:2009
DIN EN 10216-4	(2009-11)	Seamless steel tubes for pressure purposes - Technical delivery conditions - Part 4: Non-alloy and alloy steel tubes with specified low temperature properties; German version prEN 10216-4:2009
DIN EN 10216-5	(2009-11)	Seamless steel tubes for pressure purposes - Technical delivery conditions - Part 5: Stainless steel tubes; German version prEN 10216-5:2009
DIN EN 10217-1	(2009-10)	Welded steel tubes for pressure purposes - Technical delivery conditions - Part 1: Electric welded and submerged arc welded non-alloy steel tubes with specified room temperature properties; German version prEN 10217-1:2009
DIN EN 10217-2	(2009-10)	Welded steel tubes for pressure purposes - Technical delivery conditions - Part 2: Electric welded non-alloy and alloy steel tubes with specified elevated temperature properties; German version prEN 10217-2:2009
DIN EN 10217-7	(2009-10)	Welded steel tubes for pressure purposes - Technical delivery conditions - Part 7: Stainless steel tubes; German version prEN 10217-7:2009
DIN EN 10222-1	(2002-07)	Steel forgings for pressure purposes - Part 1: General requirements for open die forgings; German version EN 10222-1:1998 + A1:2002
DIN EN 10222-2	(2000-04)	Steel forgings for pressure purposes - Part 2: Ferritic and martensitic steels with specified elevated temperatures properties; German version EN 10222-2:1999 + AC:2000
DIN EN 10222-3	(1999-02)	Steel forgings for pressure purposes - Part 3: Nickel steels with specified low temperature properties; German version EN 10222-3:1998
DIN EN 10222-4	(2001-12)	Steel forgings for pressure purposes - Part 4: Weldable fine grain steels with high proof strength; German version EN 10222-4:1998 + A1:2001
DIN EN 10222-5	(2000-02)	Steel forgings for pressure purposes - Part 5: Martensitic, austenitic and austenitic-ferritic stainless steels; German version EN 10222-5:1999

DIN EN 10224	(2005-12)	Non-alloy steel tubes and fittings for the conveyance of water and other aqueous liquids - Technical delivery conditions; German version EN 10224:2002 + A1:2005
DIN EN 10250-1	(1999-12)	Open die steel forgings for general engineering purposes - Part 1: General requirements; German version EN 10250-1:1999
DIN EN 10250-2	(1999-12)	Open die steel forgings for general engineering purposes - Part 2: Non-alloy quality and special steels; German version EN 10250-2:1999
DIN EN 10250-4	(2000-02)	Open die steel forgings for general engineering purposes - Part 4: Stainless steels; German version EN 10250-4:1999
DIN EN 10250-4 <i>Corrigendum</i>	(2008-12)	Open die steel forgings for general engineering purposes - Part 4: Stainless steels; German version EN 10250-4:1999, Corrigendum of DIN EN 10250-4:2000-02
DIN EN 10253-2	(2008-09)	Butt-welding pipe fittings - Part 2: Non-alloy and ferritic alloy steels with specific inspection requirements; German version EN 10253-2:2007
DIN EN 10253-4	(2008-06)	Butt-welding pipe fittings - Part 4: Wrought austenitic and austenitic-ferritic (duplex) stainless steels with specific inspection requirements; German version EN 10253-4:2008
DIN EN 10253-4 <i>Corrigendum</i>	(2009-11)	Butt-welding pipe fittings - Part 4: Wrought austenitic and austenitic-ferritic (duplex) stainless steels with specific inspection requirements; German version EN 10253-4:2008, Corrigendum to DIN EN 10253-4:2008-06; German version EN 10253-4:2008/AC:2009
DIN EN 10269	(2011-12)	Steels and nickel alloys for fasteners with specified elevated and/or low temperature properties; German version prEN 10269:2011
DIN EN 10272	(2008-01)	Stainless steel bars for pressure purposes; German version EN 10272:2007
DIN EN 10273	(2008-02)	Hot rolled weldable steel bars for pressure purposes with specified elevated temperature properties; German version EN 10273:2007
DIN EN 10283	(2010-06)	Corrosion resistant steel castings; German version EN 10283:2010
DIN EN 10296-1	(2004-02)	Welded circular steel tubes for mechanical and general engineering purposes - Technical delivery conditions - Part 1: Non-alloy and alloy steel tubes; German version EN 10296-1:2002
DIN EN 10296-2	(2006-02)	Welded circular steel tubes for mechanical and general engineering purposes - Technical delivery conditions - Part 2: Stainless steel; German version EN 10296-2:2005
DIN EN 10296-2 <i>Corrigendum</i>	(2007-06)	Welded circular steel tubes for mechanical and general engineering purposes - Technical delivery conditions - Part 2: Stainless steel; German version EN 10296-2:2005, Corrigenda to DIN EN 10296-2:2006-02; German version EN 10296-2:2005/AC:2007
DIN EN 10297-1	(2003-06)	Seamless circular steel tubes for mechanical and general engineering purposes - Technical delivery conditions - Part 1: Non-alloy and alloy steel tubes; German version EN 10297-1:2003
DIN EN 10297-2	(2006-02)	Seamless steel tubes for mechanical and general engineering purposes - Technical delivery conditions - Part 2: Stainless steel; German version EN 10297-2:2005
DIN EN 10297-2 <i>Corrigendum</i>	(2007-06)	Seamless steel tubes for mechanical and general engineering purposes - Technical delivery conditions - Part 2: Stainless steel; German version EN 10297-2:2005, Corrigenda to DIN EN 10297-2:2006-02; German version EN 10297-2:2005/AC:2007
DIN EN 10312	(2005-12)	Welded stainless steel tubes for the conveyance of water and other aqueous liquids - Technical delivery conditions; German version EN 10312:2002 + A1:2005
DIN EN ISO 9000	(2005-12)	Quality management systems - Fundamentals and vocabulary (ISO 9000:2015); German and English version EN ISO 9000:2005

DIN EN ISO 9001	(2008-12)	Quality management systems - Requirements (ISO 9001:2015); Trilingual version EN ISO 9001:2008
AD 2000-Merkblatt HP 0	(2011-05)	General principles of design, manufacture and associated tests
AD 2000-Merkblatt HP 1	(2009-10)	Design and construction
AD 2000-Merkblatt HP 2/1	(2011-05)	Procedure testing for joining processes - Procedure testing for welded joints
AD 2000-Merkblatt HP 3	(2007-02)	Welding supervisors, welder
AD 2000-Merkblatt HP 4	(2002-04)	Test supervisors and testers in non-destructive testing
AD 2000-Merkblatt HP 5/1	(2008-02)	Manufacture and testing of joints - Principles of welding practice
AD 2000-Merkblatt HP 5/2	(2011-05)	Manufacture and testing of joints - Production testing of welds, testing of the parent metal after post-weld heat treatment
AD 2000-Merkblatt HP 5/3	(2011-05)	Manufacture and testing of joints - Non-destructive testing of welded joints
AD 2000-Merkblatt HP 5/3 <i>Addendum 1</i>	(2002-01)	Non-destructive testing of welded joints - Minimum requirements for non-de- structive testing methods
AD 2000-Merkblatt HP 7/1	(2000-10)	Heat treatment - General principles
AD 2000-Merkblatt HP 7/2	(2009-03)	Heat treatment - Ferritic steels
AD 2000-Merkblatt HP 7/3	(2001-09)	Heat treatment - Austenitic steels
AD 2000-Merkblatt HP 8/2	(2000-10)	Testing of steel sections
AD 2000-Merkblatt HP 30	(2003-01)	Performance of pressure tests
AD 2000-Merkblatt W 1	(2006-07)	Flat products of unalloyed and alloy steels
AD 2000-Merkblatt W 2	(2008-02)	Austenitic and austenitic-ferritic steels
AD 2000-Merkblatt W 3/2	(2000-10)	Cast iron materials - Spheroidal-graphite cast iron non-alloy and low alloy
AD 2000-Merkblatt W 4	(2008-05)	Tubes made from non-alloyed and alloy steels
AD 2000-Merkblatt W 5	(2009-03)	Cast steel
AD 2000-Merkblatt W 7	(2008-05)	Bolts and nuts made from ferritic steels
AD 2000-Merkblatt W 9	(2010-11)	Steel flanges
AD 2000-Merkblatt W 13	(2008-11)	Forgings and rolled components made of non-alloy and alloy steels

Appendix C

Classification of Components

Class	Definition	Description
K-I	Original / Equivalent	Original or equivalent components are listed by the manufacturer of the module in the parts list. The suitability of the component is verified in the framework of the quality management system by the works inspector of the manufacturer. The suitability of the original or equivalent component regarding its specific purpose is validated in the framework of type testing the module.
K-II	Same component type as Original / Equivalent, however, a different manufacturer	<p>Same as K-I, however, a different manufacturer.</p> <p>The suitability of the component is verified and validated in the framework of the quality management system by the works inspector in accordance with safety standard KTA 3507 and is asserted by the factory test certificate of the module.</p> <p>The deployment of the component shall be reported to the type-testing division.</p>
K-III	Different component type with equivalent characteristics	<p>The type coding can deviate from the listing in the parts list specified under K-I. However, the technical data of the component are equivalent to the Original / Equivalent (K-I) component, in particular with regard to the following criteria:</p> <ul style="list-style-type: none"> electrical data, geometry, functional principle, structure / technology, material, transmission behavior. <p>The deployment of this K-III component will have no effect on the technical data and characteristics of the device.</p> <p>The suitability of the component is verified and validated in the framework of the quality management system by the works inspector in accordance with safety standard KTA 3507 and is asserted by the factory test certificate of the module.</p> <p>The procedure for validating the suitability of the component shall be reported to a type-testing division.</p>
K-IV	Different component type, different characteristics	<p>The type coding and the technical data of the component deviate from those in the parts list.</p> <p>The suitability of the component is verified in the framework of the quality management system by the works inspector in accordance with safety standard KTA 3507 and is asserted by the factory test certificate of the component. The suitability of the component regarding its specific purpose is validated in the framework of a type test or supplementary type test of the module.</p>