Safety Standards

of the
Nuclear Safety Standards Commission (KTA)

KTA 3401.3 (November, 1986)

Steel Reactor Safety Containment
Part 3: Manufacture

(Reaktorsicherheitsbehälter aus Stahl;
Teil 3: Herstellung)

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

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KTA SAFETY STANDARD

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PLEASE NOTE: Only the original German version of this safety standard represents the joint resolution of the 50-member Nuclear Safety Standards Commission (Kerntechnischer Ausschuss, KTA). The German version was made public in Bundesanzeiger No. 194a on October 14, 2000. Copies may be ordered through the Carl Heymanns Verlag KG, Luxemburger Str. 449, 50939 Koeln (Telefax +49-221-94373-603).

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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, the 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 this 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 the damages arising from the construction and operation of the facility (Sec. 7 para. 2 no. 3 Atomic Energy Act), in order to attain the protective goals specified in the Atomic Energy Act and the Radiological Protection Ordinance and further detailed in the "Safety Criteria for Nuclear Power Plants" and in the "Guidelines for the Assessment of the Design of Nuclear Power Plants with Pressurized Water Reactors against Incidents pursuant to Sec. 28 para. 3 Radiological Protection Ordinance".

(2) The reactor safety containment has the purpose of withstanding the loadings of the pressures and temperatures to be assumed for incidents where radioactive materials are released inside the containment, especially with regard to the leakage cross-sections to be assumed for the reactor coolant piping, such that an impermissible release of radioactive materials to the environment is prevented. The reactor safety containment including the penetrations and cooling systems as far as their functioning is required for the control of incidents shall, there fore, be designed and constructed such that they will resist the static, dynamic and thermal loads which can occur in con junction with the above mentioned incidents and subsequent failures. The reactor safety containment, furthermore, has the purpose of guiding the air flow during normal operation.

(3) In the case of certain stationary light water reactors the reactor safety containment is conceived as a technically gastight steel sphere into which the required pipe and cable penetrations as well as tee personnel and materials locks are inserted.

(4) In order for this type of containment to fulfill its purpose certain technical and organizational measures are taken, for instance

a) choice and application of materials with a high application toughness and a good workability,
b) design and construction with regard to material strength,
c) choice of fabrication and testing procedures and the documentation of testing steps and results,
d) unambiguous instructions for activities with respect to the manufacture and further processing of the material.

(5) These measures are dealt with in our parts of the safety standard KTA 3401.

(6) The present Part 3 deals with the fabrication of the reactor safety containment and the tests required or the demonstration of its quality.

1 Scope

This safety standard applies to the manufacturing of the reactor safety ,containment of steel (referred to in the following text as containment) for stationary light water reactors and of the nozzles permanently connected with the containment and the pressure-retaining parts of the locks.

2 General Principles

2.1 Requirements Regarding the Manufacturer

(1) The manufacturer shall perform the tasks required regarding proper construction under consideration of this safety standard. The manufacturer may use only certified materials in accordance with KTA 3401.1 for the containment and qualification tested weld additives in accordance with KTA 1408.1.

Note:
In the following, the term "materials" shall stand for both the materials and their product forms.

(2) The manufacturer shall demonstrate to the authorized expert prior to taking up manufacturing that the following prerequisites are fulfilled:

Note:
In the case of tests in accordance with this safety standard, the experts are involved either on account of the nuclear or the building regulations:

- *the experts under Sec. 20 Atomic Energy Act called in by the licensing or the supervisory authority are called in the following "authorized expert",*
- *the licensing or supervisory authority responsible under the individual state s building code or the testing agencies or testing engineers for structural statics authorized by these authorities are called in the following "authorized civil engineer".*

a) The manufacturer shall possess the "Grossen Eignungsnachweis" (extensive proof of qualification) in accordance with Sec. 6.2 DIN 18 880 Part 7.
b) The manufacturer shall have a quality division that is independent of fabrication.
c) The manufacturer shall have at his disposal equipment with which he is able to shape, weld, heat treat, transport and perform the required tests on the materials, all in accordance with the quality requirements of the containment. Equipment of other organizations may be used if these fulfill the prerequisites.
d) The manufacturer shall have qualified personnel for the manufacturing at his disposal.
e) The manufacturer may involve only welders whose qualification is demonstrated in accordance with Section 3.3. The requirements regarding welding supervision are presented in Section 3.2, the requirements regarding testing supervision in Section 6.1.2.
f) The manufacturer shall demonstrate to the authorized expert in a process qualification test corresponding to the manufacturing process that he is in sure command of the intended welding procedure.
g) The manufacturer may carry out the fabrication only in accordance with design reviewed, valid drawings and documents.

2.2 Authorized Structural Engineer

The authorized structural engineer shall assure himself during fabrication that the quality assurance measures pertaining to his area of responsibility are applied.

2.3 Preserving the Material Marking

2.3.1 General Requirement

The marking of the materials shall be preserved (maintained) during the manufacturing process.

2.3.2 Transfer of Markings

If during manufacture the original material markings are removed they shall be transferred prior to the separation of the parts. In the case of rolled components the markings shall be transferred such that the main direction of rolling is clearly identifiable.

2.3.3 Transfer of Markings in Case of Materials with Acceptance Test Certificate C or A in Accordance with DIN 50 049

(1) In the case of materials with acceptance test certificate C or A in accordance with DIN 50 049, the marking shall be transferred by the authorized expert. Thereby, the marking of the original part (material identification, melting bath number and specimen number) shall be transferred to the part to be newly stamped; the identification shall then be stamped by the authorized expert.

(2) In the case of small parts it is sufficient that the stamp of the authorized expert is affixed together with an identification mark which enables the correlation with the tested, initial material. With written consent of the authorized expert, the transfer of markings to small parts may be carried out by the component manufacturer.

(3) A certificate shall be issued which contains the complete markings of the originally delivered material and of the newly stamped parts. This certification may be carried out by including a corresponding note in the acceptance test certificate.

2.3.4 Transfer of Markings in Case of Materials with Acceptance Test Certificate B, Production Test Certificate or Statement of Compliance with the Order in Accordance with DIN 50 049

(1) With written consent of the authorized expert, the markings of materials with acceptance test certificate B, production weld test certificate or statement of compliance with the order in accordance with DIN 50 049 may be transferred by the component manufacturer. The written consent shall include a list of plant personnel responsible for the transfer of markings and shall show the stamp of the plant.

(2) In the case of small parts it is sufficient that the stamp of the plant expert is affixed together with an identification mark which enables the correlation with the tested initial material.

2.4 Corrosion Protection

All parts of the containment shall be effectively protected against corrosion. Section 6.3.3.3 shall be considered.

3 Basic Principles Regarding Welding Tasks

3.1 Documents

Prior to any welding tasks including weld seam preparation, the documents required for the individual manufacturing step shall be at hand with the mark indicating a completed design review in accordance with Section 7.

3.2 Welding Supervision

3.2.1 General Requirements

(1) For every welding task on the containment a welding supervisor shall be designated in writing to the authorized expert. This welding supervisor shall belong to the personnel of the individual manufacturing plant.

(2) The welding supervisor shall, in particular, have practical experience in welding technology as well as in the particular welding process to be employed in fabrication. Within the framework of manufacturer appraisal and in the course of fabrication the authorized expert assures himself of the qualification and work of the welding supervisor.

(3) The welding supervisor shall with in the framework of the design reviewed welding schedule, be authorized to personally initiate the measures for achieving the prescribed quality of the weld seam. He shall make sure that the technical standards pertaining to his field of activity are adhered to. He is responsible for the assignment of the welders as well as for the correct operating condition of the welding and auxiliary equipment during fabrication. The welding supervisor shall supervise the welding tasks and is responsible for their documentation, e.g. he welding record.

(4) If more than one person is named as weld supervisor, their individual areas of responsibility shall be delimited with respect to each other.

3.2.2 Qualification

Only engineers with a special training in welding technology (Schweissfachingenieure) may become welding supervisor. After a corresponding period of vocational adjustment they must be qualified for the job on account of their training, experience and abilities. They may be supported by welding technicians, welding specialists and welding apprentices who may not however, perform the functions of welding supervision.

3.3 Welders

3.3.1 Training and Education

The welders shall have been trained and educated in training centers which are regularly involved with the education and training of welders.

3.3.2 Examination

(1) The examination of the welders shall be carried out in accordance with DIN 8560. The examination may be carried out

a) by the authorized expert,

b) with special approval of the authorized expert by the manufacturer or by the welding academies of the German Federation for Welding Technology (DVS or by training facilities of similar rank. Carrying out the examination with special approval by the authorized expert requires that a training facility qualified examiners and proper equipment are available. The results of the examinations shall be documented in writing and be available to the authorized expert. The certificate of examination shall contain the addendum “The examination was carried out with special approval of the authorized expert ... (name of the authorized expert) from .. (name of the institution).” The examination certificate shall a countersigned by the authorized expert. The authorized expert shall repeatedly assure himself of the proper execution of the examinations.

(2) The manufacturer shall present evidence to the authorized expert that the welding personnel for operating mechanical welding equipment has the required qualification and operating know-how. This proof may, among other possibilities, be presented within the framework of the procedure qualification tests or the production weld test prior to actual fabrication. The proof shall be in form of a manufacturer certificate which shall be countersigned by the authorized expert.

3.3.3 Reexamination

(1) The welders shall be reexamined in biannual intervals or after the welding activity was interrupted for more than six months this also applies to the qualification test of the welders for operating mechanical welding equipment. The results of the procedure qualification tests and of the production weld tests are acceptable as reexaminations.

(2) The reexaminations in accordance with DIN 8560 shall be carried by the institutions named in Section 3.3.2.

(3) In substantiated cases the reexamination may be carried out in the form of a single application examination (Einzweckschweisserpruefung). The welding supervisor shall make sure that the welder is deployed only for tasks within the restrictions of this reexamination.

3.3.4 Examination Certificates

The examination certificates of examinations or proofs in accordance with Sections 3.3.2 and 3.3.3 shall be kept available at the place of deployment of the welder.

3.4 Treatment and Application of Weld Filler Materials

(1) The weld filler materials shall enable a weld connection that is tuned to the base material and the specified requirements.

(2) Only weld filler materials may be applied that were qualification tested in accordance with KTA 1408.1 and manufactured in accordance with KTA 1408.2.

(3) Weld filler materials may only be treated and applied in accordance with KTA 1408.3.

3.5 Welding Task Procedures

3.5.1 Work Related Requirements

(1) The weld connections shall be welded to correspond to the specifications of the design reviewed documents and to the conditions of the procedure qualification test.

(2) All weld connections shall be welded in at least two layers.

(3) All welds, including those for weld attachments, shall be created with basic coated electrodes or with weld additives that result in a weld connection of similar quality.

(4) Butt weld connections of pressure retaining components shall be created such that, with regard to their outer appearance excepting edge offset, they will meet the requirements of evaluation group AS in accordance with Table 1 DIN 8503 Part 3 and will enable the nondestructive testing in accordance with Section 9.3.

(5) The midplane offset shall be within the tolerance limits in accordance with Section 5.

(6) Butt weld connections welded from only one side are allowed only in exceptional cases. In the case of unavoidable one-sided butt welds (pipe connection welds) it shall be ensured that, regarding the weld connection an unambiguous test result is achievable. The outer appearance of the root shall meet the requirements of evaluation group BS in accordance with Table 1 DIN 8563 Part 3.

(7) Fillet welds are allowed only in the case of

a) temporary weld attachments,

b) covers which are attached to penetration nozzles inside the containment, and

c) the cover of the leak-tight box (sealing sleeve of the penetration).

(8) The position of each weld connection shall be identifiable. The correlation of welders to each weld connection shall be recorded in drawings or welding records.

(9) Gouging with carbon electrodes shall be carried out only if the electrodes without copper cladding or vapor clad with copper were demonstrated to be qualified. The results of procedure qualification and production weld tests may be drawn upon for this demonstration.

(10) During gouging the preheating specified in the welding schedule shall be adhered to. The locations of carbonization and increased hardness due to gouging shall be removed by grinding or machining. The finished areas shall be subjected to a surface crack examination in accordance with Section 6.3.4. The examination results shall be assessed in accordance with Section 9.3.4.2.

(11) Testing the electric arc or igniting the electrodes on components outside of the weld edge is not allowed. If, however, arc strikes have occurred outside of the weld edge they shall, be ground smooth and subjected to a surface crack examination in accordance with Section 6.3.4. These locations shall be free of any flaws.

(12) The welding area or the work location of the welder shall be protected against weather factors, e.g., rain and wind. For cutting and welding tasks at temperatures below +5 °C, measures to be taken shall be established in agreement with the authorized expert.

(13) Those weld seams of pressure retaining walls where no subsequent heat treatment is carried out shall be welded with the temper-bead technique if the material used so requires; here the distance between the bond lines of the border covering bead and the temper bead shall be between 1 and 5 mm. In case that distance deviates from this requirement a special consent shall be obtained from the authorized expert.

Note:
Whether or not the temper-bead technique is required is specified for the containment in Appendix A KTA 3401.1. Accordingly, it is not required for the steel 15 MnNi 63.

(14) In addition the requirements of SEW 088 and KTA 3401.1 shall be considered.

3.5.2 Edge Zone Examination

(1) All components for pressure retaining walls shall be subjected to edge zone examinations with ultrasonics in accordance with Sec. 5.3.3.4 KTA 3401.1 in the regions of the intended weld connections including the regions of weld connections of longitudinally welded nozzles.

(2) The examination zone width shall be at least 50 mm to both sides of the edge faces. In the case of components with a nominal wall thickness larger than 50 mm, the examination zone width to both sides of the edge faces shall be equal to the nominal. wall thickness. In both cases it shall be ensured that, after undercutting the weld edge preparation surface, at least 20 mm of examined base material remain.

(3) The edge zone examination shall be carried out prior to undercutting the weld edge preparation surfaces. Any repairs of flaws in the base material require the consent of the authorized expert.

3.5.3 Fabrication Conditions for Weld Edge Preparation Surfaces and Wall Thickness Transitions

(1) Weld edge preparation surfaces may be fabricated by thermal cutting or by mechanical means. During welding, the weld edge preparation surfaces shall be free of rust, scale or other soiling.

(2) The thermal cutting shall be carried out in accordance with the requirements of Appendix A KTA 3401.1.

(3) Mechanical means, e.g. grinding procedures, are required if it cannot be ensured that the fusion zone is remolten during the welding procedure or if it is expected that the hard-

ness of the fusion zone would result in faults of the weld seam.

(4) The finished weld edge preparation surfaces and the weld areas o£ longitudinally welded nozzles shall be subjected to a surface crack examination in accordance with Section 6.3.4. The evaluation shall be carried out in accordance with Section 9.3.4.2.

(5) Areas of the metal surfaces which are beveled by thermal cutting, e.g., wall thickness transitions, shall be ground smooth and subjected to a surface crack examination in accordance with Section 6.3.4. The test results shall be evaluated in accordance with Section 6.3.3.4(2) KTA 3401.1. If this examination reveals indications that exceed the allowed level then, with special approval of the authorized expert, they shall be round out and, as necessary, be repaired y special repair weldings.

3.5.4 Weld Attachments

3.5.4.1 General Requirements

Weld attachments shall be welded under the same conditions as butt welds. Fillet welds are only allowed for weld attachments which must be removed prior to the pressure test (temporary weld attachments); in this case the last bead may not touch the base material of the pressure. retaining wall. In the case that a stress relief annealing after welding is required in accordance with Section, the weld attachment should be weld connected prior to the stress relief annealing. Deviation from this requirement is allowed with special approval of the authorized expert if the characteristics of the material and welding conditions so allow.

3.5.4.2 Permanent Weld Attachments

Weld seams on permanent weld attachments shall be subjected to nondestructive examinations in accordance with Section 9.3.

3.5.4.3 Temporary Weld Attachments

(1) The weld attachments should be removed by machining or grinding. In case a removal by thermal means is required a minimum distance of 5 mm to the surface of the component shall be adhered to. The remaining material shall be ground down to the surface of the component. A reduction of the wall thickness below the nominal wall thickness is not allowed without an analytical proof in accordance with KTA 3401.2. Remains of weld seams shall be ground off.

(2) After removal of the temporary weld attachments the areas possibly affected by the welding and by the removal process wall be marked and subjected to a surface crack examination in accordance with Section 6.3.4 with the magnetic particle procedure. The results shall be evaluated in accordance with Section 9.3.4.4. Furthermore, the hardness of 5 % of the locations shall be determined in one hardness row of HV 10 in accordance with Section 8.4.3(8). The results shall be documented.

3.5.5 Repair Welding

(1) In the case of repair weldings the requirements in accordance with Sections 3.5.1 through 3.5.4, 6, 7, 9 and 11 shall be met.

(2) Repair welding is only allowed with the consent of the authorized expert.

(3) If repair weldings are carried out on weld connections that were already heat treated, the weld connections all be subjected to a renewed heat treatment after the repair.

(4) In substantiated cases and with special approval of the authorized expert a renewed heat treatment may be dispensed with.

(5) In the case that weldings are required for the removal of undercuts or of locations were a reduction below the nominal wall thickness has occurred or for shape corrections, the consent of the authorized expert shall be obtained prior to starting the work.

(6) If there is no procedure qualification for a repair welding procedure then this procedure shall be simulated in a production weld test.

(7) Repair weldings and weldings for shape corrections shall be documented.

4 Principles for Heat Treatments after Weldings

4.1 Necessity for Heat Treatment (Stress Relief Annealing)

The necessity for the heat treatment after welding is dependent on the chemical composition of the materials, on the wall thickness of the component that is connected by a full penetration welding and on the mechanical characteristics. The requirement is specified in the certified material test report.

4.2 Requirements Regarding Heat Treatment Facilities

(1) Within the manufacturer qualification proof (see Section 2.1(2)) the qualification of the heat treatment facility shall be demonstrated to the authorized expert.

(2) Testing and calibration of the displaying and registering temperature measuring equipment shall not lie back further than one year and shall be repeated after every reconstruction and every transport and shall be certified by measuring records of the quality division that is independent of the fabrication.

5 Manufacturing Tolerances

5.1 Measuring Schedule

Prior to begin of manufacture a measuring schedule shall be set up to test the accuracy-to-gauge of the containment and the components. This schedule shall describe all measuring steps and their time sequence.

5.2 Containment

5.2.1 Diameter

The outer diameter of the individual zones shall be determined by measuring the outer circumferences of the zones of welded plates. The outer diameter may not deviate more than 0.5 % from the specified required outer diameter. The measurements shall be taken on the lower edge of each zone.

5.2.1 Out-of-Roundness

The deviation from circular shape (out-of-roundness) shall not exceed 0.5 %. The out-of-roundness shall be determined from the largest and the smallest radius in the cross-section plane using the following equation:

$$\text{out-of-roundness (\%)} = \frac{(R_{max} - R_{min})}{(R_{max} + R_{min})} \times 100 \qquad (5\text{-}1)$$

The radius shall be measured in 16 locations distributed along the circumference of each zone at the lower edge of the zone.

5.2.3 Indentations

Indentations are only allowed if they have a flat course. Their depth, measured as the deviation from the required shape, shall not exceed 1 % of the width of the indentation. The deviation shall be measured with a 2-meter-template.

5.2.4 Seam Retractions

Seam retractions are only allowed if they have a flat course. Their depth, measured as the deviation from the required shape shall not exceed 5 mm (template length 500 mm).

5.2.5 Height Tolerance

The overall height of the containment shall not deviate more than 0.1 % from the specified required height.

5.2.6 Effect of Fabrication Tolerances on Attached and Inserted Parts

The tolerances specified in Sections 5.2.1 through 5.2.5 are only allowed if the functional capability of the attached and inserted parts (e.g., locks, pipe penetrations) is not affected. Corresponding requirements shall be specified during planning.

5.2.7 Unplanned Midplane Offset

5.2.7.1 Equal Wall Thicknesses

Without a special proof regarding the calculated stresses, the unplanned midplane offset of butt welded product forms shall be less than 5 % of the wall thickness but shall not exceed 3 mm.

5.2.7.2 Unequal Wall Thicknesses With and Without Bevelled Edges

Without a special proof regarding the calculated stresses the unplanned midplane offset shall not be less than 5 % of the smaller wall thickness but shall not exceed 3 mm.

5.3 Locks

5.3.1 Diameter

The average outer diameter of the body of the lock as determined from its circumference shall not deviate more than ± 0.5 % from the specified required outer diameter.

5.3.2 Out-of-Roundness

The deviation from circular shape (out-of-roundness) of the body of the lock shall not exceed 0.5 %. The out-of-roundness shall be determined from the largest and the smallest diameter in one cross-section plane using the following equation:

$$\text{out-of-roundness } (\%) = 2 \times \frac{(D_{max} - D_{min})}{(D_{max} + D_{min})} \times 100 \qquad (5\text{-}2)$$

5.3.3 Indentations

Indentations are only allowed if they have a flat course. Their depth, measured as the deviation from the required shape, shall not exceed 1 % of the width of the indentation.

5.3.4 Seam Retractions

seam retractions are only allowed if they have a flat course. Their depth, measured as the deviation from the required shape shall riot exceed 3 mm (template length 200 mm).

5.3.5 Straightness

Cylindrically shaped lock bodies shall not be out of line more than 0.5 % of the cylinder length.

5.3.6 Effect of Fabrication Tolerances on Function and Leak-Tightness

The tolerances specified in Sections 5.3.1 through 5.3.5 are only allowed if the functional capability and the leaktightness is not affected. Corresponding requirements shall be specified during planning.

5.3.7 Unplanned Midplane Offset

5.3.7.1 Equal Wallthicknesses

Without special proof regarding the calculated stresses, the unplanned midplane offset of butt welded product forms shall be less than 10 % of the wall thickness but shall not exceed 2 mm.

5.3.7.2 Unequal Wallthicknesses With and Without Bevelled Edges

Without special proof regarding the calculated stresses the unplanned midplane offset shall be less than 10 % of the smaller wall thickness but shall not exceed 2 mm.

5.4 Nozzles

The tolerances for the nozzles shall be specified in accordance with the components to be connected.

5.5 Testing Capability

The execution of nondestructive examinations shall not be essentially impaired by bevelling nor by mid plane offsets. If necessary, the capability for testing shall be demonstrated on test objects of similar dimensions and tolerances.

5.6 Exceeding of Tolerances

In case tolerances are exceeded, Section 9.7 applies.

6 Basic Requirements for Non-Destructive Examinations

6.1 Organization of Non-Destructive Testing at the Manufacturer

6.1.1 Personnel Requirements

(1) The testing supervision shall be a part of the manufacturing plant.

(2) The testing personnel should belong to the manufacturing plant. Contract testing personnel may perform testing tasks only in the case of radiographic examinations. In the case of ultrasonic examinations and surface crack examinations, contract testing personnel may perform tests only in addition to the testing personnel of the manufacturing plant.

(3) In the case of changes in personnel or testing technology a renewed demonstration to the authorized expert is required that the requirements in accordance with Sections 6.1.2, 6.1.3

and 6.3 are met regarding the activities of the testing supervisor and the testing personnel.

6.1.2 Requirements Regarding Testing Supervisors

(1) The testing supervisors shall be independent of the fabrication and shall be reported by name to the authorized expert.

(2) The testing supervisors shall have the technical and basic knowledge required for their tasks and shall master the examinations to be performed by them in accordance with the specified requirements. The authorized expert shall assure himself of their qualification prior to the begin of manufacture.

6.1.3 Tasks of the Testing Supervisors

The testing supervisors shall ensure that the testing personnel has the necessary state of training and that the testing equipment is in perfect condition. They shall supervise the examinations to be performed by the manufacturer, shall evaluate their results and sign the test report.

6.1.4 Tasks of the Testing Personnel

The testing personnel shall have basic theoretical knowledge and shall master the examinations to be performed by them. The testing supervisor shall demonstrate this to the authorized expert on the basis of the testing personnel's practical testing experience, their plant-internal training or their certificates from external fasts.

6.2 Extent and Timing of Non-Destructive Examinations

(1) All of the following shall be subjected to nondestructive examinations

a) connection welds of the pressure retaining walls,

b) weld seams connecting to the pressure retaining walls,

c) edge zones (of the welds)

d) wed edge preparation surfaces and gouged weld seam areas to an extent that the occurrence of systematic errors can be precluded,

e) repair weldings,

f) locations where weld attachments were removed,

g) bevelled edges.

The examinations c) and d) shall be carried out as intermediate test (examinations during fabrication).

(2) The examination of the weld seams shall be scheduled such that systematic errors can be detected and remedied al ready during the welding procedure. The point in time of the examination shall, however, be chosen in consideration of possibly occurring delayed cracks. The time period specified in Appendix A 1 KTA 3401.1 shall be observed.

(3) The nondestructive examination shall be carried out after the final heat treatment. An additional nondestructive examination shall be carried out after the pressure test in accordance with Section 10.8.

6.3 Procedural Requirements for Performing Non-Destructive Examinations

6.3.1 General Requirements

(1) The weld connections shall be designed such that there is no unallowable impairment of the information from the test results.

(2) Prior to the begin of testing, the testing supervision of the manufacturer shall, in particular specify in detail and describe the type of examinations, the testing prerequisites and the testing techniques (testing instructions). The testing instructions shall be subjected to a design review.

6.3.2 System for Specifying the Location of Detected Flaws

Prior to performing nondestructive examinations, the manufacturer shall submit to the authorized expert his marking system which must ensure the reproducibility of detected flaws.

6.3.3 Ultrasonic Examination

6.3.3.1 Locations of the Coupling Surfaces

(1) In the case of nominal wall thicknesses up to 60 mm it is sufficient to scan from only one component surface.

(2) In the case of nominal wall thicknesses larger than 60 mm the scanning should be carried out from both surfaces.

(3) The position and dimensions of the coupling surfaces shall be chosen in accordance with Sections 6.3.3.2, 6.3.3.5 and 6.4.

(4) Any deviations from the requirements of the paragraphs 1 through 3 (above) need the consent of the authorized expert.

(5) It shall be ensured that the testing sensitivity is attained in each volume element (see Section 6.3.3.11).

6.3.3.2 Examination Area and Width of Coupling Surfaces

(1) The examination shall extend to the filler metal and the base metal on both sides of the weld connection. In the case of nominal wall thicknesses up to 50 mm the bordering base metal shall be tested to a width of at least 10 mm; in the case of larger nominal wall thicknesses the width shall be 20 mm.

(2) The coupling surfaces for examining for longitudinal errors shall be wide enough such that the areas to be examined can be examined in all scanning directions and with all beam angles.

6.3.3.3 Condition of Coupling Surfaces

(1) All accessible weld surfaces shall be in such a condition that they can be tested. As necessary, they shall be prepared accordingly.

(2) The coupling surfaces shall be in such a condition that the probes have a good contact and can be easily moved. All interfering unevenness and soiling (e.g., grooves, scale, weld spatter) shall be removed. Furthermore, the coupling surfaces shall be such that, even in consideration of a possible surface curvature, the distance between the probe base and the coupling surface shall nowhere exceed 0.5 mm. To meet this requirement in the case of curved surfaces, the probe base may have to be properly adapted.

(3) The center line average roughness value R_a shall not exceed the value of 20 μm.

(4) If, prior to the examination, the coupling surfaces are coated with a corrosion protection it shall be demonstrated to the authorized expert that this coating has no effect on the test results.

6.3.3.4 Ultrasonic Beam Angle

6.3.3.4.1 Butt Weld Connections

Butt weld connections shall be examined using the angle beam scanning technique. The following requirements shall be met:

a) In the case of nominal wall thicknesses ≤ 40 mm the examination shall be carried out with one beam angle. This beam angle should be chosen such that the incident angles β_1 and β_2 (**Figure 6-1**) lie between 45° and 55°. In case of larger incident angles it shall be demonstrated that, compared to the indication from a 1 mm deep and 1 mm wide rectangular groove, the testing sensitivity in the near-surface regions is larger by at least 6 dB for nominal wall thicknesses ≥ 7 mm and by at least 12 dB for nominal wall thicknesses between 5 and < 7 mm. Incident angles below 45° shall be avoided as far as possible.

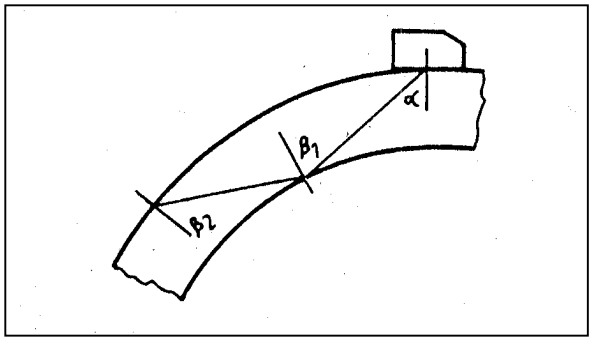


Figure 6-1: Incident angles for a product geometry curved in the direction of the sonic beam

b) In the case of a nominal wall thickness > 40 mm two angle probes shall be used in the examination. One beam angle shall be chosen such that, at the surface, the incident angles β_1 and β_2 lie between 35° and 55°. The second beam angle should be such that the angular deviation between the beam axis and the surface normal of faults running perpendicular to the surface (angle δ in **Figure 6-2**) is not larger than 30°.

c) In the case of a nominal wall thickness > 100 mm the incident angles shall be specified in agreement with the authorized expert.

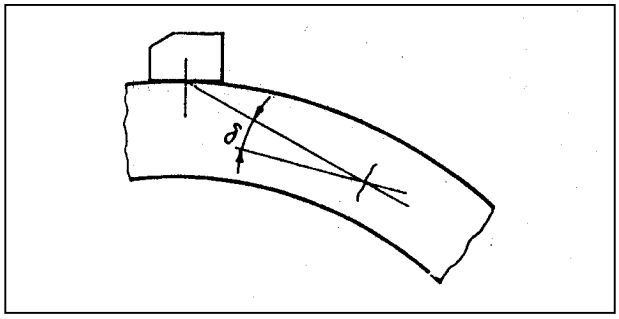


Figure 6-2: Additional incident beam angle

6.3.3.4.2 Weld Connections of Nozzles and of Permanent Weld Attachments

Weld connections of nozzles and of permanent weld attachments shall be examined using the angle beam scanning technique. The Following requirements shall be met:

a) Weld seams of set-through nozzles shall be examined in accordance with **Figure 6-4** of Section 6.3.3.5(3) with one sonic beam angle. In the case of a containment wall thickness > 40 mm, additionally, the positions 8 and 9 shall be examined with a second beam angle that differs from the first by at least 15°.

b) Weld seams of set-on nozzles shall be examined in accordance with **Figure 6-5** of Section 6.3.3.5(3) with one sonic beam angle. In the case of a nominal nozzle wall thickness > 40 mm, the positions 6 through 11 shall be examined with a second beam angle that differs from the first by at east 15°.

c) Weld seams of permanent weld attachments shall be tested in accordance with **Figure 6-6** with one sonic beam angle.

d) If the angle beam scanning from the side of the weld attachment is hindered then, in the case of a favorable geometry of the component and of the weld seam, a straight beam scanning may be carried out from the side of the weld attachment.

e) Regarding the incident angles for the angle beam scanning the requirements of Section 6.3.3.4 apply accordingly.

6.3.3.4.3 Butt Weld Connections of Unequal Wall Thicknesses with the Thicker Wall Bevelled down to the Thinner Wall

Butt weld connections of unequal nominal wall thicknesses where the thicker wall is bevelled down to the thinner wall shall be examined with the angle beam scanning technique. The following requirements shall, be met:

a) The number of beam angles shall be determined on the bass of the thinner wall.

b) The local coordinates of indications from reflectors located beyond the first reflection of the beam can only be determined with sufficient accuracy if the reflection occurs on plane parallel surfaces. If this is not the case the evaluation shall be carried out to only one half of the skip distance.

Note:
In the case of bevel ratios between 1:3 and 1:4, beam angles of 70° have been proven to be effective in the examination of the full weld seam volume including the surrounding base material for longitudinal flaws with the angle beam scanning technique applied to the plan parallel surface of he thicker wall.

c) With respect to ultrasonic examinations bevelled edges may be considered a plan parallel surfaces if the one-sided bevel angle is under an angle ≤ 6°; in the case of double-side bevelling the sum of the two angles should be ≤ 6°.

d) The requirements specified for the incident angles shall be met also in the case of special geometric features (e.g., bevels, curvatures) in the regions to be evaluated.

e) If, due to unfavorable geometric features of the component, these requirements cannot be met, the testing requirements shall be specified in collaboration with the authorized expert.

6.3.3.4.4 Additional Sonic Beam Angles

If sonic beam angles and beaming locations other than the ones specified in the testing instruction seem better suited for an accurate determination of the location and dimension of the flaw then these shall be used in addition to the ones specified.

6.3.3.5 Direction of the Sonic Beam

6.3.3.5.1 Basic Requirements

(1) With relation to the tangential plane of the coupling surface all side angles shall be considered regarding the possible

flaw orientations; therefore all directions of the sonic beam shall be used. In examining for flaws that are oriented parallel and perpendicular to the weld seam this requirement is met by repeatedly moving the probe back and forth in a fanlike fashion.

(2) If the examination can be carried out from only one side of the weld seam then the weld seam surfaces shall be machined or ground such that no shape indications will occur.

Note:
Generally, the region in close proximity of the probe cannot, or not to a full extent, be evaluated with regard to transmitter impulse or near field influence. This region can be examined either from the opposite surface using the same beam direction utilizing the surface reflections, or, if this is not possible, with special probes. In case of examinations with angle probes the close proximity region can also be covered by evaluating the entire skip distance.

(3) When examining over the full or half of the skip distance as specified below, the signal interference zone where no evaluation can be carried out shall be considered.

Note:
In the case of the DGS-method the sonic path that can be evaluated for single oscillator probes begins at 0.7 times the near field distance. Evaluations below 0.7 times the near field distance are allowed if it is demonstrated that the required testing sensitivity was adhered to.

6.3.3.5.2 Probe Positions

The following requirements shall be met with respect to probe positions:

a) Examinations of butt weld connections with nominal wall thicknesses ≤ 60 mm (**Figure 6-3**)
   aa) Positions 1 and 2 or positions 3 and 4 over the whole skip distance or position 1 through 4 over half the skip distance to test for longitudinal flaws with the angle beam scanning technique.
   ab) Positions 5 and 6 or positions 7 through 10 from one weld seam surface to test for lateral flaws with the angle beam scanning technique.
b) Examinations of butt weld connections with nominal wall thicknesses > 60 mm (**Figure 6-3**)
   ba) Positions 1 through 4 over half the skip distance to test for longitudinal flaws with the angle beam scanning technique.
   bb) Positions 5 and 6 or Positions 7 through 10 from both sides of the weld seam surfaces to test for lateral flaws with the angle beam scanning technique.
c) Examinations of set-through nozzles (**Figure 6-4**)
   ca) Position 1 or 2 over the whole skip distance or positions 1 and 2 over half the skip distance to test for longitudinal flaws with the angle beam scanning technique.
   cb) Position 3 to test for longitudinal flaws and lamellar tearing with the straight beam scanning technique.
   cc) Positions 4 and 5 over half the skip distance or positions 6 and 7 over the whole skip distance to test for under bead cracks with the angle beam scanning technique.
   cd) Positions 8 and 9 over the whole skip distance or positions 10 and 11 over half the skip distance to test for lateral flaws with the angle beam scanning technique.

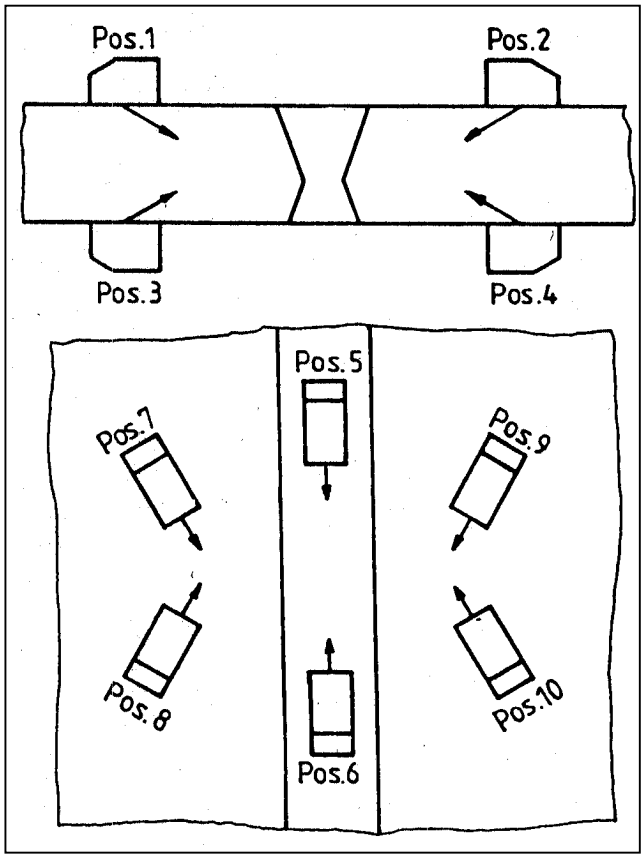


Figure 6-3: Probe positions for butt weld connections

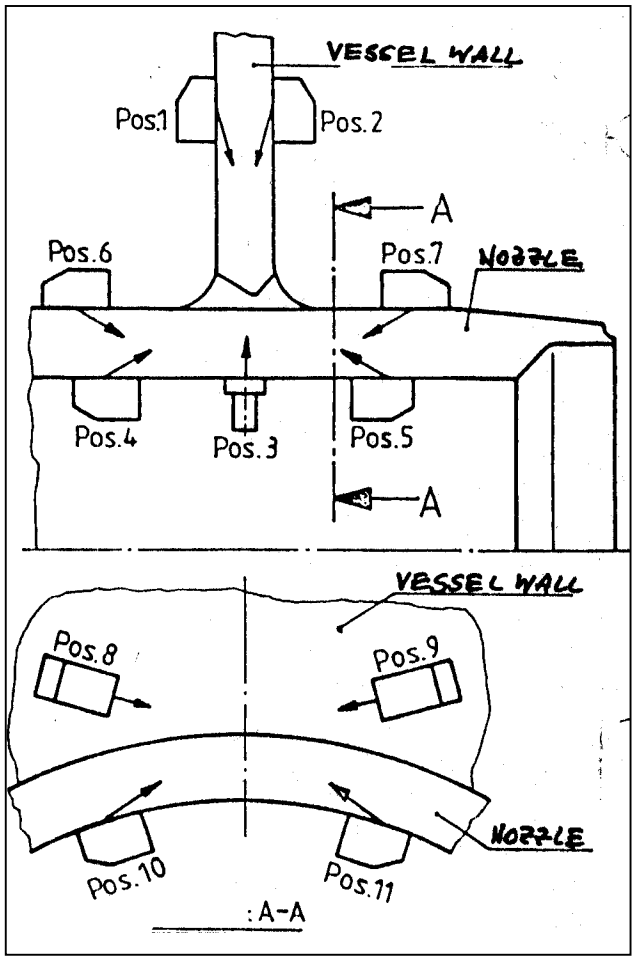


Figure 6-4: Probe positions for weld connections with set-through nozzles

d) Examinations of weld seams of set-on nozzles (**Figure 6-5**)

da) Position 1 or 2 over the whole skip distance or positions 1 and 2 over half the ski distance to test for longitudinal laws with the angle beam scanning technique.

db) Position 3 to test for longitudinal flaws with the straight beam scanning technique.

dc) Position 4 over half the skip distance or position 5 over the whole skip distance to test for under bead cracks with the angle beam scanning technique.

dd) Positions 6 and 7 over the whole skip distance or positions 8 and 9 or positions 10 and 11 over half the skip distance to test for lateral flaws with the angle beam scanning technique.

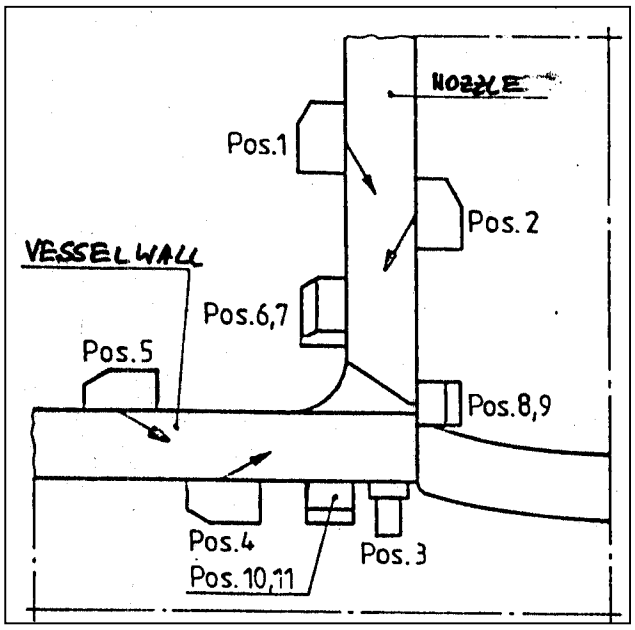


Figure 6-5: Probe positions for weld corrections

e) Examinations on weld seams of permanent weld attachments (**Figure 6-6**)

ea) Position 1 or 2 over the whole skip distance or position 1 and 2 over half the ski distance to test for longitudinal laws with the angle beam scanning technique.

eb) Position 3 to test for longitudinal flaws with the straight beam scanning technique if the examination was not carried out from positions 1 and 2.

ec) Positions 4 and 5 or positions 6 and 7 over the whole or half of the skip distance to test for under bead cracks with the angle beam, scanning technique. Instead of at these positions, the examination may also be carried out with a creeping wave probe in positions 4 and 5.

f) Special Cases

In the case of other geometries of the weld connections, e.g., cover plates or flanges, the examination directions shall be chosen in analogy to the requirements above. In the case of bevels and curvatures it shall be ensured that the heat affected zone and the bordering regions of the base material are also covered in testing for lateral flaws. If one of the testing directions is not possible then appropriate measures shall be specified in the testing instructions.

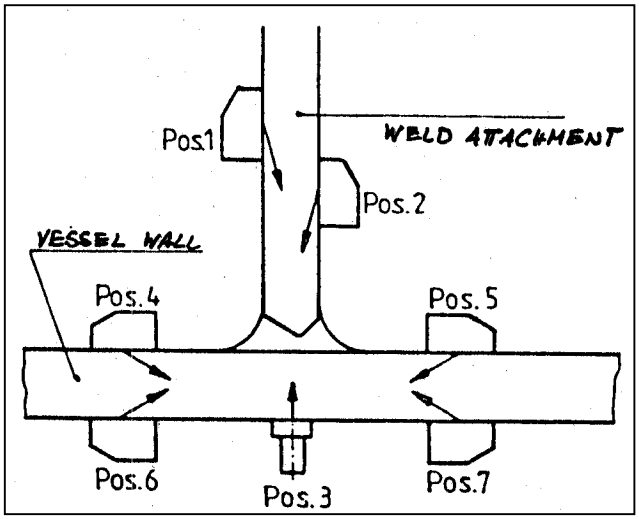


Figure 6-6: Probe positions for the weld seams of permanent weld attachments

6.3.3.6 Testing Frequency

(1) Independently of the type of probe used, the testing frequency should lie between 2 and 5 MHz.

(2) If in individual cases the exact determination of the position and extent of the flaw or the determination of the cause of the flaw requires other than the above mentioned frequencies, then these shall additionally be used.

6.3.3.7 Distance Calibration

The distance calibration shall be performed using calibration blocks in accordance with DIN 54 120 or DIN 54 122 or calibration reference blocks of similar geometry with special bore holes and grooves as calibration reflectors. The use of calibration reference blocks is necessary in particular if maximum requirements regarding the accuracy of the distance indication are to be met, e.g., to discern between geometry or flaw echoes in the case of one-sided welds with untreated roots.

6.3.3.8 Sensitivity Adjustment

(1) The sensitivity adjustment may be performed employing calibration blocks K 1 in accordance with DIN 54 120 or K 2 in accordance with DIN 54 122 taking correction factors into account. It may also be performed on reference reflectors in calibration reference blocks or by utilizing the geometry of the component itself (back reflection). In the case of straight beam scanning preference shall be given to the component back reflection method.

(2) The indications of the calibration reference blocks shall be recalculated as equivalent circular disc reflectors. In the case of grooves, the indications shall be presented either in percentages of the echo indication of a 1 mm deep and 1 mm wide groove, or in dB relative to the calibration reference block.

(3) The type of sensitivity adjustment shall be specified in the testing instruction and the test reports.

6.3.3.9 Losses from Coupling and Sound Attenuation

The coupling and sound attenuation conditions in the component and the differences with respect to the calibration block shall he accounted for by transfer adjustment factors. The coupling and sound attenuation values (transfer values) shall

be determined as the average values of a number of individual measurements. The sound path contributions in the weld material and the different surface conditions of the coupling surfaces shall be taken into account.

6.3.3.10 Adjustment of the Equipment Amplification

With consideration given to the coupling and sound attenuation losses, the CRT display shall be adjusted such that the recording threshold reaches at least one fifth of the CRT display height for the individual testing range. If the distance between the recording threshold and the noise level is less than 6 dB this shall be indicated in the test report and the further procedure shall be decided upon in agreement with the authorized expert.

Wallthickness [2] s(mm)	Type and Dimension of the Reference Reflector	
	angle beam method	straight beam method
5 < s < 7	25 % of the echo indication from a	2.0 mm diameter disc reflector
7 < s < 10	50 % 1 mm deep and 1 mm wide groove [1]	2.0 mm diameter disc reflector
10 < s < 15	1.0 mm diameter disc reflector	2.0 mm diameter disc reflector
15 < s < 20	1.5 mm diameter disc reflector	2.0 mm diameter disc reflector
20 < s < 40	2.0 mm diameter disc reflector	2.0 mm diameter disc reflector
40 < s	3.0 mm diameter disc reflector	3.0 mm diameter disc reflector
[1] Miniature angle probes with a testing frequency of 4 MHz shall be employed		
[2] In case of differing wall thicknesses the smaller wait thickness is the governing factor		

Table 6-1: Reference reflectors for different recording thresholds

6.3.3.11 Recording of Echo Indications

(1) All echoes which read or exceed the recording threshold shall be recorded as indications. Geometric reflectors identified as such shall be indicated as such in the test report. The recording thresholds are the indications from reference reflectors as specified in **Table 6-1** for different nominal wall thicknesses.

(2) It shall be ensured that the scanning sensitivity level prescribed by the recording threshold is achieved over the entire volume of material to be examined. This may require employing additional scanning directions beam angles, sonic frequencies or testing techniques.

(3) If the values in accordance with **Table 9-1** and Section 9.3.4.3.1 regarding the allowed frequency of occurrences or extents of reflector indications without further control examinations are exceeded, then in the affected area and in both directions for 500 mm of weld seam those indications from the longitudinal flaw examination shall be recorded that are up to 6 dB under the specified recording threshold. This is also required of indications down to 6 dB below the recording threshold whose lengths equal or exceed twice the maximum allowed length of an individual indication.

(4) The scanning sensitivity level for examining for transverse flaws shall be chosen such that even indications of 12 dB below the recording threshold can be detected. If multiple echo indications occur in this examination which cannot be separated from each other by probe movements (indication flock) or if one of a number o indications reaches the recording, threshold, then under similar conditions the recording threshold shall be lowered by 12 dB over the entire (the welded?) weld seam segment.

(5) It shall be noted in the test report if the distance between the individual recording threshold and the noise level is less than 6 dB or if the required scanning sensitivity for examining for transverse flaws cannot be achieved because of the noise level; the further procedure shall be specified in agreement with the authorized expert.

(6) In case of a lacking scanning position it may become necessary to lower the recording threshold by 6 dB.

6.3.3.12 Echo Indications from Geometric Reflectors

(1) Before echo indications may be classified as geometric reflectors they have to be verified as such by control measurements. Echo indications are considered verified to be from geometric reflectors if no echoes result from the location of reflection when scanning from the opposite side of the seam. This proof has to be carried out over the entire expanse of the location of reflection.

(2) If, in the case of seams welded from one side and in the as-welded condition, it is intended to use the measurements of distances between linear projections to prove that the echoes originate from the root and not from weld flaws, then the exact distances between linear projections shall be determined by adjusting grooves in calibration blocks.

(3) In as far as radiographs cover the location of reflection in a way that can be evaluated, these radiographs shall be considered in the evaluation.

(4) All reflection locations that originate from surface irregularities shall, as far as they are accessible, be mechanically removed.

6.3.3.13 Determining the Recording Lengths

(1) When in the course of the examination the echo amplitudes reach or exceed the recording threshold as specified in Section 6.3.3.11, the lengths of the individual reflectors shall be measured and logged. Reflectors with lengths under 10 mm shall be logged as “smaller than 10”.

(2) The expanse of a reflector is determined in terms of the distance of probe movement. This distance of probe movement is defined as lying between those positions where the amplitude of the indication

a) in case of nominal wall thicknesses less than or equal to 10 mm falls below the recording threshold,
b) in case of nominal wall thicknesses larger than 10 mm up to and including 40 mm falls below 6 dB under the recording threshold and

c) in case of nominal wall thicknesses larger than 40 mm falls below 12 dB under the recording threshold.

(3) In case of a lowered recording threshold, the expanse of those reflectors whose maximum echo amplitude is lower than the original recording threshold is determined from the probe positions where the echo amplitude is at 6 dB below the maximum echo amplitude. In case of surface curvatures, the expanse of reflectors shall be corrected for the position of depth.

(4) The accuracy in determining the expanse of reflectors shall be increased by additional examinations (e.g. focussing probes) if this examination alone is the determining factor in the evaluation of permissibility of the reflector.

6.3.3.14 Special Geometric Features in Direct Vicinity of the Weld Connection

(1) In the case of beveled edges and curvatures and other special geometric features in direct vicinity of the weld connections, attention shall be paid to ensuring the testability with nondestructive examination procedures. This shall already be evaluated in the design review.

(2) Special attention shall be paid to the requirements concerning the scanning directions (Section 6.3.3.5), the beaming and incidence an le (Section 6.3.3.4) and the adjustment of the CRT display (Section 6.6.3.10) with regard to a possible 6 dB lowering of the recording threshold.

(3) In case the beveled edges or curvatures serve as coupling surfaces, they must meet the requirements in accordance with Sections 6.3.3.2 and 6.3.3.3. The transition to the weld seam shall in any case be such as not to hinder the examination for transverse flaws even in the adjoining base material. This region shall, therefore, be ground-polished over a large area.

6.3.4 Surface Crack Examination

6.3.4.1 General

The surface crack examination using the magnetic particle method shall be used on ferro-magnetic materials. The current flow method may only be used with special approval of the authorized expert. The employment of different methods, e.g. the liquid penetrant method, is only allowed if this has been justified and an agreement has been reached with the authorized expert.

6.3.4.2 Preparation of Surfaces for the Surface Crack Examination

The surfaces to be examined must be in a condition corresponding to the goal of the examination. They must be free of scale, weld spatter and other interfering soiling. Any notches or grooves that might adversely affect the result of the examination shall be removed. The mean roughness value shall not exceed $R_a = 20\mu m$.

6.3.4.3 Magnetic Particle Method

6.3.4.3.1 Magnetization

(1) The magnetization shall be carried out in accordance with DIN 54 130.

(2) If in partial areas the magnetization is carried out with the current flow method or by yoke magnetization, alternating current magnetization should be employed. The residual field strength may not exceed a value of 10^3 A/m (12.5 Oe).

(3) Every point on the surface shall be examined under two different directions of magnetization which, if possible, should be at an angle of about 90° to each other. The angle between the two directions of magnetization should not be less than 50° and not larger than 150°. It shall be ensured that all flaw orientations are indicated.

6.3.4.3.2 Field Strength and Testing Agent

(1) The tangential field strength at the surface should be at least $2x10^3$ A/m (about 25 Oe) and shall not exceed $6.5x10^3$ A/m (about 80 Oe). The adherence to these values must be ensured either by surveillance measurements or by specifying the corresponding examination conditions.

(2) At random points before and during the examination, the testing agent shah be tested on the magnetized testing object by employing Berthold calibration locks.

(3) Special attention shall be directed to ensuring that the indication capability of the testing agent is not hindered by the carrier fluid.

Note:
The tangential flux density is used as an intermediary flux indicator since it is difficult to experimentally determine the magnetic flux inside the testing object.

6.3.4.3.3 Contrast

To enhance the possibility for detecting errors provisions shall be made for achieving a sufficient contrast. Corresponding methods are, using fluorescent testing agents or applying a thin, barely covering paint to the surface. A sufficient contrast is achieved when metallically shining surfaces are examined with black magnetic powder.

6.3.4.3.4 Contact Locations with the Current Flow Method

When employing the current flow method an overheating o the tested material at the contact locations shall be prevented. If this does occur, the overheated material shall be ground down. A subsequent reexamination of these locations is necessary and shall be carried out by the liquid penetrant examination or by the magnetic article examination using yoke magnetization.

6.3.4.4 Liquid Penetrant Examination

(1) The suitability of the examination procedure (penetrant, intermediate cleaner and developer) shall be demonstrated to the authorized expert in practical examination.

(2) The liquid penetrant examination shall be carried out in accordance with DIN 54 152 Part 1.

(3) The penetration period shall last for 30 minutes and the development period for 60 minutes.

(4) In this time the penetrant liquid may not dry up. Furthermore the developer shall be applied in a thin film only.

6.3.5 Radiographic Examination

Radiographic examinations shall be carried out using X-ray machines as the radiation source. The conditions of testing class B in accordance with DIN 54 111 Part 1 shall be adhered to. The image quality characteristics of image quality class in accordance with DIN 54 109 Part 2 shall be achieved. In order to limit image distortions at the film borders the lengths of film to be evaluated shall be limited such that, during perpendicular irradiation, the material thickness in direction of the divergent rays nowhere exceeds the component thickness by more than 10 %.

6.3.6 Hardness Test

The hardness test shall be carried out in accordance with DIN 50 133. The hardness shall not exceed 350 HV 10.

6.4 Requirements Regarding Scanning Distances of the Weld Connections

The scanning distance for the sonic beam examination shall be determined using **Equation 6-1** for scanning from only one side over the full skip distance and using **Equation 6-2** for scanning from both sides over one half the skip distance:

$$l = 0.5\ k + 2.3\ s \tan \alpha \qquad (6\text{-}1)$$

$$l = 0.5\ k + 1.3\ s \tan \alpha \qquad (6\text{-}2)$$

with s being the corresponding wall thickness.

Note:
*Examples are shown in **Figure 6-7** for butt weld connections and nozzle connections.*

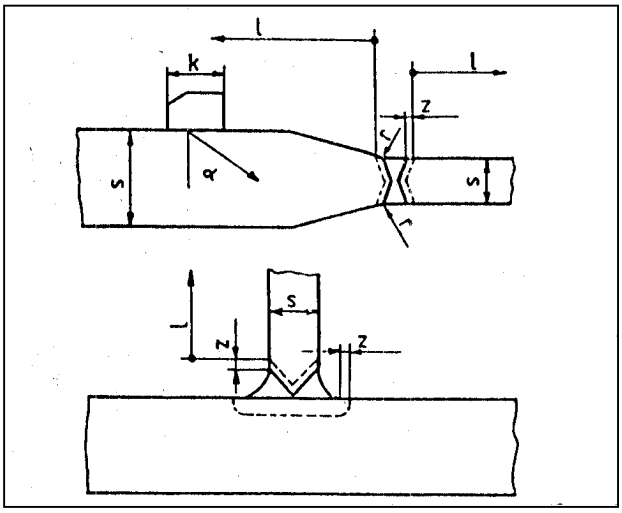


Figure 6-7: Examples for scanning distances

7 Design Review

7.1 Basic Principles

7.1.1 General

(1) In the design review, the authorized expert and the authorized civil engineer shall in their respective areas of competence review the submitted documents with respect to whether or not the safety relevant requirements have been met.

(2) The documents for design review shall be submitted early enough such that a proper review and, possibly, a consideration of required changes prior to the individual manufacturing step can be carried out.

(3) All documents shall be written in German.

(4) Drawings should be kept scaled.

(5) Before preparation of the documents is begun, an agreement with the authorized expert and the authorized civil engineer should be reached regarding, e.g., system assumptions, analysis procedures, required accuracies.

(6) If the documents are pre paced by a number of manufacturers, one shall be named as being responsible for coordinating the documents and for checking them for completeness.

(7) Using the abbreviations in accordance with Section 11.3, all tests and inspections specified in the design review documents shall be characterized with regard to how the execution of the individual testing steps are to be documented. The characterizations E, ST or Z should be used:

E = final documentation by the operator

This group encompasses all proofs and certifications of tests and examinations which describe the quality of the product (product form component, component group, system) In the condition prior to commissioning, as well as the nonconformance reports.

Note:
The documents in the final documentation are required, e.g., for:

a) demonstration of proper construction,
b) inservice inspections,
c) failure examinations,
d) repair procedures and
e) procurement of replacement and wear parts.

ST = certification stamping in design review documents

Stamping shall be allowed for tests and examinations with a yes or no result.

Z = short-term (intermediate) documentation by the manufacturer

These are certifications of tests and inspections which are not required for describing the quality of the product prior to commissioning (e.g., reports on tests and examination carried out to ensure a proper completion date of the product; reports on the quality assurance system).

(8) Proofs and certifications shall be documented in accordance with **Table 11-1**.

(9) If a collective (S) certification is intended for the proof of certain tests and inspections, these shall be identified as E/S or Z/S in the design review documents.

(10) In the case of series-produced product forms, parts components or component groups where similar manufacturing methods are used, the same design reviewed documents may be used (standardized plans).

7.1.2 Extent of the Design Review

The design review shall encompass the safety evaluation of

a) the engineering design, also with respect to the capability of performing the first and repeated inservice inspections and maintenance tasks,
b) the stress and stability analyses including the analyses of the conditions during erection and construction,
c) the load distribution to the support structures and the foundation,
d) the selected materials and
e) the intended fabrication and testing procedures

on the basis of the submitted documents.

7.2 Design Review Documents

7.2.1 Requirements Regarding Type and Shape of the Design Review Documents

(1) The documents shall be submitted to the authorized expert and, where necessary, to the authorized civil engineer.

(2) Prepared forms shall be used for the documents. Examples for these forms are collated in Appendix A. The subject matters listed shall be considered as requirements.

7.2.1.1 Cover Sheet - Form 1

A cover sheet for the design review documents shall function as the table of contents and shall contain the exact designation of the product forms, parts, components groups or components and shall list the design review documents and all documents required for the manufacture (e.g. design specification, work instructions, instructions for tests and examinations) together with abbreviations, number of pages and state of revision.

Note:
Considering the large number of similar design review documents, an additional document list, e.g. list of drawings, may become necessary.

7.2.1.2 Drawings

Drawings shall be prepared for the containment including the directly connected locks and nozzles as well as the directly connected structural and plant components and the containment's support structure and structural foundation. The drawings shall contain the specifications required for a design review, such as

a) design overpressure,
b) maximum pressure for the pressure test,
c) design temperature,
d) minimum temperature for the pressure test (cf. Section 10.2.3),
e) the dimensional measurements required for manufacture,
f) the reference number of the materials list,
g) reference to the analysis documents, welding plan, testing schedule and testing instructions.

7.2.1.3 Materials List - Form 2

The materials list shall extend to all positions in the drawings. During design review the columns 1 through 9 and 17 shall be filled out; the correlation of the material melts to the component parts and test certifications shall be noted in columns 10 through 13 in the course of manufacture.

7.2.1.4 Survey of Weld Seams

The weld seam numbers shall be noted in drawings or sketches of the individual component groups.

7.2.1.5 Documents of the Numerical Analyses

The documents of the numerical analyses to be submitted in accordance with KTA 3401.2 shall contain at least the following information:

a) compilation of the design data with regard to specified normal operation, pressure test and the design basis incidents,
b) compilation of all stresses and load cases as well the verification of all individually correlated loads to be distributed into the foundation from the containment, its internal and external structures including the support structures;
c) loadings of the containment for the design basis incidents and external events,
d) numerical verification of the displacement stability material stress and structural stability in different erection conditions as well as regarding the dynamic and the fatigue behavior of the containment and
e) numerical certification regarding deformation.

7.2.1.6 Location Plan for Strain and Displacement Measurements

As far as necessary, a location plan for strain and displacement measurements shall be submitted which should include at least the type, number and location of the measurement gauges.

7.2.1.7 Compilation of Locations to be Subjected to In-service Inspections

This compilation shall contain all locations which, in accordance with Section 3.1.8 KTA 3401.4, shall be subjected to inservice inspections.

7.2.1.8 Testing Schedule - Form 3

(1) The testing schedule shall cover the span from the tested product form to the finished part and shall give information on:

a) every testing step and the fabrication steps to be tested in chronological sequence,
b) indication of the required production weld tests,
c) pertinent welding procedure schedules, heat treatment schedule, work and testing instructions and
d) the organizational unit responsible for the testing and information on how the fabricating and testing step shall be recorded.

(2) In the course of the design review, the columns 1 through 8 and 12 shall be filled out.

7.2.1.9 Appendix to the Testing Schedule - Form 4

Similar fabrication and testing steps to be carried out on a component part component or component group can be clearly and concisely arranged on this form. Proper reference to form 4 shall be given in form 3 under the heading test number.

7.2.1.10 Welding Procedure Plan - Form 4

A welding procedure plan shall be established for all welds, including those for weld attachments which later will be removed from the component part. It shall contain information on:

a) type of weld preparation with a dimensioned picture of the weld edge including information of the preparation of the weld edge,
b) weld building sequence, where necessary the sequence of individual welding steps,
c) base material,
d) type of weld (e.g. STN, RN, LN),
e) welding position,
f) procedure qualification,
g) welder examination,
h) reference to the heat treatment schedule,
i) welding procedure,
j) welding parameters,
k) weld filler material,
l) instructions regarding drying of the rod and flux cored electrodes and
m) preheating and between-layer temperatures.

7.2.1.11 Heat Treatment Schedule - Form 6

A heat treatment schedule shall be prepared for each heat treatment and shall contain at least the following information:

a) type of heat treatment,

b) heat treatment equipment,

c) type and extent of temperature measurements,

d) course of temperature-over-time (heating up velocity, heat treatment temperature, temperature holding period, cool down velocity),

e) cooling down method and cooling medium.

7.2.1.12 Production Weld Test Schedule

The documents, for the production weld tests shall state the type and extent of the tests as well as their correlation to the component welding with reference to the welding schedule and heat treatment schedule and comprise of

a) cover sheet and

b) materials test and specimen removal plan.

7.2.1.13 Materials Test and Specimen Removal Plan - Form 7

(1) The materials test and specimen removal plan shall list the destructive and nondestructive tests and examinations on product forms and the production weld tests.

(2) With respect to the destructive tests, the number and position of the specimens in the test segment of the product form shall be specified. The position of the specimens and the test segments shall be presented in a specimen location plan.

(3) The specimens shall be unambiguously identified. No repeat of a specimen identification is allowed.

(4) Further information required concerns:

a) required work and testing instructions for the tests and examinations,

b) heat treatments,

c) the organizational units involved in the tests and examinations with an indication of their respective duties (e.g. active or passive participation) and

d) type of test record (final documentation, certification stamping, short-term (intermediate) documentation.

(5) In the course of the design review columns 1 through 11 and 15 shall be filled out.

(6) When testing similar product forms, the materials test and specimen removal plan may be employed as a standard plan if form 8 - the appendix to the materials and specimen removal plan - is used as a compilation of the verification certificates.

7.2.1.14 Appendix to the Materials and Specimen Removal Plan - Form 8

This form is employed for efficiently compiling information and verification certificates when testing a number of similar product forms in accordance with the materials and specimen removal plan (standard plan).

7.2.1.15 Pressure Test Schedule

A pressure test schedule shall be established for each pressure test and shall contain at least the following information:

a) testing pressure in bar,

b) testing temperature in C,

c) testing medium,

d) chronological sequence of pressure build up, holding period and pressure relief including the points in time for measurements,

e) description of the safety measures.

7.2.1.16 Leakage Rate Test Schedule

The leakage rate test schedule shall contain at least the following information:

a) testing pressure and medium,

b) number and locations of the measurement sensors,

c) allowed leakage rate and

d) test sequence diagram (cf. KTA 3405).

7.2.1.17 Repair Plan

Individual repair plans-shall be prepared for repair procedures and shall be marked accordingly with the letter R. Standard repair pans may be employed.

7.2.1.18 Functional Test Schedule

The functional test schedule shall list all tests required for demonstrating proper functioning.

7.2.1.19 Test Instruction

In the test instruction, the type of test or examination, the prerequisites for the test, the test procedure and the test equipment shall in accordance with Section 6.3.1, be listed.

7.3 Carrying-out the Design Review

(1) The authorized expert shall attest the fact that he carried out the design review by affixing a mark of approval together with his signature and date (to he document?). The authorized civil expert shall write a test report on the result of his design review.

(2) The mark of approval shall, generally, be valid until completion of the containment. A review will become necessary if fabrication is not begun within 24 months from the date of the mark of approval or if an interruption of fabrication longer than 24 months occurs.

(3) Changes and amendments by the authorized expert and the authorized civil expert shall be carried out and marked in such a way as to make clearly visible which of the design reviewers was the originator.

(4) All changes and amendments shall be considered in the next revision of the submitted documents and shall be again marked for approval by the authorized expert or the authorized civil expert.

(5) If the documents submitted for design review raise grounds for objection on account of content or external appearance the authorized expert or authorized civil expert shall return the documents with a written comment as to the reasons for rejection.

(6) Any deviation from the design reviewed documents needs the approval by the authorized expert and, were necessary, by the authorized civil expert.

(7) The design review by the authorized expert or the authorized civil expert may be carried out in sections.

7.4 Documentation

All design reviewed documents shall be included in the documentation in accordance with Section 11.

8 Procedure Qualification

8.1 General Requirements

(1) For all weld connections to be performed a procedure qualification shall be completed. Procedure qualifications which do not fully meet the requirements of this safety standard may be supplemented by advanced production weld tests.

(2) Procedure qualifications shall be carried out in the presence of the authorized expert.

(3) The manufacturer shall demonstrate by procedure qualification that the welding procedure to be employed for weld connections on pressure retaining parts is suited to this task. Hereby, he following points shall be coordinated with respect to the welding procedure:

a) welding conditions,

b) weld filler-materials and additives,

c) welding position,

d) required aiding equipment,

e) heat treatments,

f) qualification of the welding personnel.

(4) The procedure qualification shall be carried out with consideration of the actual conditions at the shop or construction site.

(5) The test results from the procedure qualification shall be available prior to commencement of fabrication.

8.2 Scope of Application for the Procedure Qualification

8.2.1 Materials

The procedure qualification shall be performed on the material actually to be employed. Its scope extends to similar materials with identical or lower strength characteristics. The materials for the procedure qualification shall be subjected to tests and examinations corresponding to the procedure form in accordance with KTA 3401.1, with the qualification to be certified by acceptance test certificate C in accordance with DIN 50 049.

8.2.2 Welding Procedures and Welding Conditions

The scope of the procedure qualification is defined by the welding procedure or combination of welding procedures employed including the welding conditions.

8.2.3 Dimensions

(1) In the case of butt weld connections, the procedure qualification performed shall extend to wall thicknesses between 0.75 s and 1.5 s. In the case of wall thicknesses larger than 100 mm the scope limitation shall be specified in agreement with the authorized expert. If in the case of a shielded metal electric arc welding with rod electrodes the procedure qualification is performed on a wall thickness $s \geq 10$ mm, its scope shall extend from 7 mm to 1.5 s.

(2) In the case of circumferentially welded butt joints on tubes, the scope shall extend to tube diameters down to 0.5 times the diameter of the tube on which the procedure qualification was performed. There is no upper limit for the scope.

(3) In the case of nozzle connections, the scope shall be limited by the wall thickness of the vessel. There is no limitation on the nozzle diameter.

8.2.4 Weld Fillers and Additives

(1) The scope extends to those weld fillers (rod electrodes including the type of coating, wire electrodes, welding wires and welding rods) and weld additives (shielding gases, fluxes) used in the procedure qualification. In as far as weld fillers are used within the scope specified by their qualification tests, a change of supplier requires a supplementary procedure qualification whose extent shall be specified in agreement with the authorized expert. In the case of shielding gases, a change of supplier is allowed if a similar chemical composition is ensured.

(2) The procedure qualification of the submerged-arc welding is limited to the combination of wire and flux employed; wires from different suppliers may be used if a similar chemical composition is ensured. The flux is limited to the same brand and the same manufacturer.

8.2.5 Heat Treatment

The procedure qualification applies to the actual heat treatment condition of the test specimen during the procedure qualification. If the heat treatment condition of the actual work piece deviates, the procedure qualification shall be supplemented, e.g., by a production weld test.

8.2.6 Period of Validity

(1) The successfully completed procedure qualification shall be valid for a period of 24 months. If, within this period of time, fabrication is started and production weld tests are successfully completed, the period of validity may be extended by another 24 months from the date of the last successfully completed production weld test.

(2) If fabrication is not started with in 24 months after successful completion of the procedure qualification or is interrupted by more than 24 months, a production weld test may. be welded as a repeated procedure qualification immediately upon resuming fabrication. The tests and examinations of this production weld test shall be specified to correspond to the original procedure qualification.

8.3 Performing the Procedure Qualification

8.3.1 Welders

The welders for the procedure qualification shall be qualified in accordance with the requirements of Section 3.3.2.

8.3.2 Welding Supervision

The welding tasks shall be supervised by the welding supervision. A welding record shall be kept on the procedure qualification.

8.3.3 Test Coupons

(1) The procedure qualification shall be performed for every occurring welding position.

(2) A vertical overhead position at 45° shall cover the overhead, the vertical and downhand position as well as all in-between positions.

(3) A transverse overhead position at 45° shall cover the overhead, the transverse and downhand position as well as all

in-between positions. In case of mechanized weldings, the transverse and downhand position shall cover all in-between positions.

(4) The test coupons shall be dimensioned such that the required test specimens as well as possibly required replacement specimens can be cut out. The weld seams 3.n the test coupons shall be oriented to be parallel to the rolling direction of the base metal.

(5) The procedure qualification shall be adjusted to any complicating conditions that exist e.g., welding in confined areas and fully positional welding.

8.3.4 Repair Welding

Repair welding on the test coupons is only allowed in agreement with the authorized expert; the reason, extent and type of repair shall be stated and the resulting test coupon must enable a representative statement on the welding procedure to be qualified. Each flaw shall be registered. Weld records shall be kept on the repair weldings.

8.4 Testing and Examining the Test Coupons

8.4.1 General Requirements

(1) After the heat treatments including stress relief annealing, the weld seam of the test coupon shall be subjected to the tests in accordance with Section 8.4.2 through 8.4.5, these tests to be performed by the manufacturer in the presence of the authorized expert.

(2) The extent of the procedure qualification of special cases, e.g. connection welding of watering nozzles, of nozzle elongations and of weld attachments, shall be specified in agreement with the authorized expert.

8.4.2 Nondestructive Examinations

(1) The nondestructive examinations in accordance with Section 6.3 shall be performed by the manufacturer and by the authorized expert. The results shall be evaluated in accordance with Section 9.3.4.

(2) The radiographic examination of nozzle connections, the ultrasonic examinations and the surface crack examinations shall be performed to 100 % each by the manufacturer and the authorized expert.

Bending angle	Tensile strength category of ferritic steels	Diameter of the plunger member as a function of the coupon thickness a
180°	Steels with a minimum tensile strength < 400 N/mm²	1 x a
180°	Minimum tensile strength between 400 and 430 N/mm²	2 x a
180°	Minimum tensile strength > 430 to 460 N/mm²	2.5 x a
180°	Minimum tensile strength > 460 N/mm²	3 x a

The bending angle shall be considered as achieved if the bending test is performed in accordance with DIN 50 121 Part 1 and if the specimen is pressed through the roller support without sign of incipient crack. After grinding down the weld reinforcement on the tensile side of the test specimen, the original surface structure of the specimen should be maintained as far as possible.

If this requirement is not met, the bending test shall still be considered successful if the following conditions are met:

≥ 90°: the bending strain (L_o = weld seam width + wall thickness symmetrically to the weld seam) shall reach at least the value of the minimum fracture strain A5 of the base material.

or

≤ 90°: the bending strain (measured over L_o = weld seam width) shall be ≤ 30%, however the fracture surfaces must be free of any unallowable flaws.

Table 8-1: Requirements regarding bending specimens in the destructive bending test

8.4.3 Destructive Tests

(1) The values listed in the material appendices of KTA 3401.1 and in **Table 8-1** are the requirements for evaluating the

results of the procedure qualification.

(2) Depending on the nominal wall thickness, the destructive testing of welds shall be carried out in the following testing layers:

a) nominal wall thicknesses ≤ 50 mm shall be tested in one testing layers.

b) nominal wall thicknesses > 50 mm shall be tested in two testing layers.

(3) In the case of nominal wall thicknesses ≤ 50 mm the tensile test transverse to the direction of the seam and the technological bending test shall, as far as possible, cover the entire weld seam cross-section.

(4) If a weld seam is produced with multiple welding procedures then the test specimens shall be located such that each welding procedure is tested.

(5) The locations of the test specimens shall be chosen in accordance with **Figure 8-1**. If for geometric reasons the specimen location for the notched bar impact test in the transition cannot be chosen as shown in Figure 8-1, then the test specimens shall be taken from locations parallel to the surface and such that the notch well lies between the bond line and 0.8 mm next to the bond line in the heat affected zone.

(6) The orientation of the notch for notched bar impact tests perpendicular to the bond line shall be chosen such that a line through the notch well lies between the bond line and 0.8 mm next to the bond line in the heat affected zone. The bond line shall be made visible by macro-etching.

(7) For each testing layer, the following tests shall be performed:

a) Two tensile tests on rectangular tensile specimens from the weld seam at room temperature in accordance with

DIN 50 120 Part 1, however, with a gauge length L_c = (weld seam width + 2 x 40 mm). The tensile strength R_m shall be determined. The fracture location (see **Figure 8-1** for the specimen location) shall be recorded.

b) One tensile test on a round test specimen at design temperature from the weld seam in accordance with DIN 50 125 and DIN 50 145. Tensile strength, yield strength, elongation and reduction of area shall be determined.

c) Bend tests in accordance with DIN 50 121 Part 1 on four test specimens (two specimens each subjected to tensile stress on one and the other side of the weld seam). After grinding down the weld reinforcement on the tensile side of the test specimen, the original surface structure of the specimen should be maintained as far as possible. Larger indentations such as undercuts or root concavities may not be removed. Bending strain (L_o = weld seam width plus wall thickness) and the bending angle shall be determined. Requirements regarding bending angle and diameter of the plunger member shall be taken from **Table 8-1**.

d) One impact energy versus temperature curve each for the weld material and the heat affected zone on ISO-V specimens in accordance with DIN 50 115 using six sets of specimens (1 set = three test specimens). The testing temperature for two sets shall be set at +5 °C and +80 °C. The testing temperatures for the remaining sets shall be chosen to determine the transition temperature and lower shelf. The impact energy absorbed and the lateral expansion shall be determined for the weld material (cf. **Figure 8-1**) and the heat affected zone.

(8) In the state prior to heat treatment one surface of the test coupon shall be subjected to a hardness test in accordance with DIN 50 133 along two rows 100 mm apart. The hardness shall not exceed 350 HV 10.

8.4.4 Structure Analysis

(1) A macrosection and a microsection shall be removed from each test coupon. In specifying the removal location consideration shall be given to the results from the nondestructive examinations.

(2) The following tasks shall be performed on the macrosection:

a) photographic picture of the entire cross-section of the weld connection,

b) hardness test in accordance with DIN 50 133 (cf. **Figure 8-1** for the distance of the measuring points).

(3) The following tasks shall be performed on the microsection:

a) photographic pictures with an enlargement factor of, generally, 200 (other enlargements in addition, if necessary) of the root of the weld seam, the cover layer of the weld and the heat affected zones in both the cover layer and the root,

b) microscope analysis of the heat affected zone over the entire weld seam width and an estimation and recording of the coarse-grain ratios.

8.4.5 Chemical Composition

The essential elements of the weld material shall be determined and compared with the characteristics from the qualification test.

8.4.6 Retest Specimens

(1) If a test specimen or set of specimens does not meet the requirements then, after determining and evaluating the cause, two further specimens or sets of specimens may be tested. All retest specimens must meet the requirements.

(2) If insufficient test results are clearly caused by influences from the test procedure or by a strongly localized flaw, then the corresponding test may be repeated.

Note:
Flaws occurring systematically or which are identified as being characteristic for the procedure may lead to a rejection of the procedure qualification.

8.4.7 Report on the Procedure Qualification

(1) The manufacturer shall prepare a written report on the procedure qualification on which the authorized expert shall prepare his written concluding opinion within the following six week period.

(2) The report of the manufacturer shall contain:

a) information on the base material and the weld fillers and additives,

b) information on the welding procedure,

c)) welding schedule and welding record,

d heat treatment schedule and heat treatment record,

e) materials test and specimen removal plan,

f) results of all tests including the evaluation of flaws and

g) summary and conclusion.

(3) The report of the authorized expert shall contain:

a) limits of the scope of application,

b) concluding opinion.

(4) In case of a positive result, the procedure qualification is considered to be completed upon presentation of this report.

8.4.8 Storage of the Test Specimens

The test specimens and the remaining arts of the test coupons as well all failed test specimens shall be stored until the final report of the authorized expert is presented in writing.

9 Tests and Examination During Fabrication

9.1 General Requirements

(1) The manufacturer and the authorized expert shall see to it that the entire manufacturing process is surveilled and documented.

(2) The tests and examinations should ensure that an evaluation of all fabrication steps which influence the characteristics of the manufactured component is possible.

(3) In the course of fabrication, the authorized expert shall satisfy himself that the quality assurance measures specified for the fabrication are observed.

9.2 Accompanying Fabrication Surveillance

9.2.1 General Principle

The fabrication shall be surveilled and the fulfillment of the requirements demonstrated both in accordance with the design reviewed test sequences schedule.

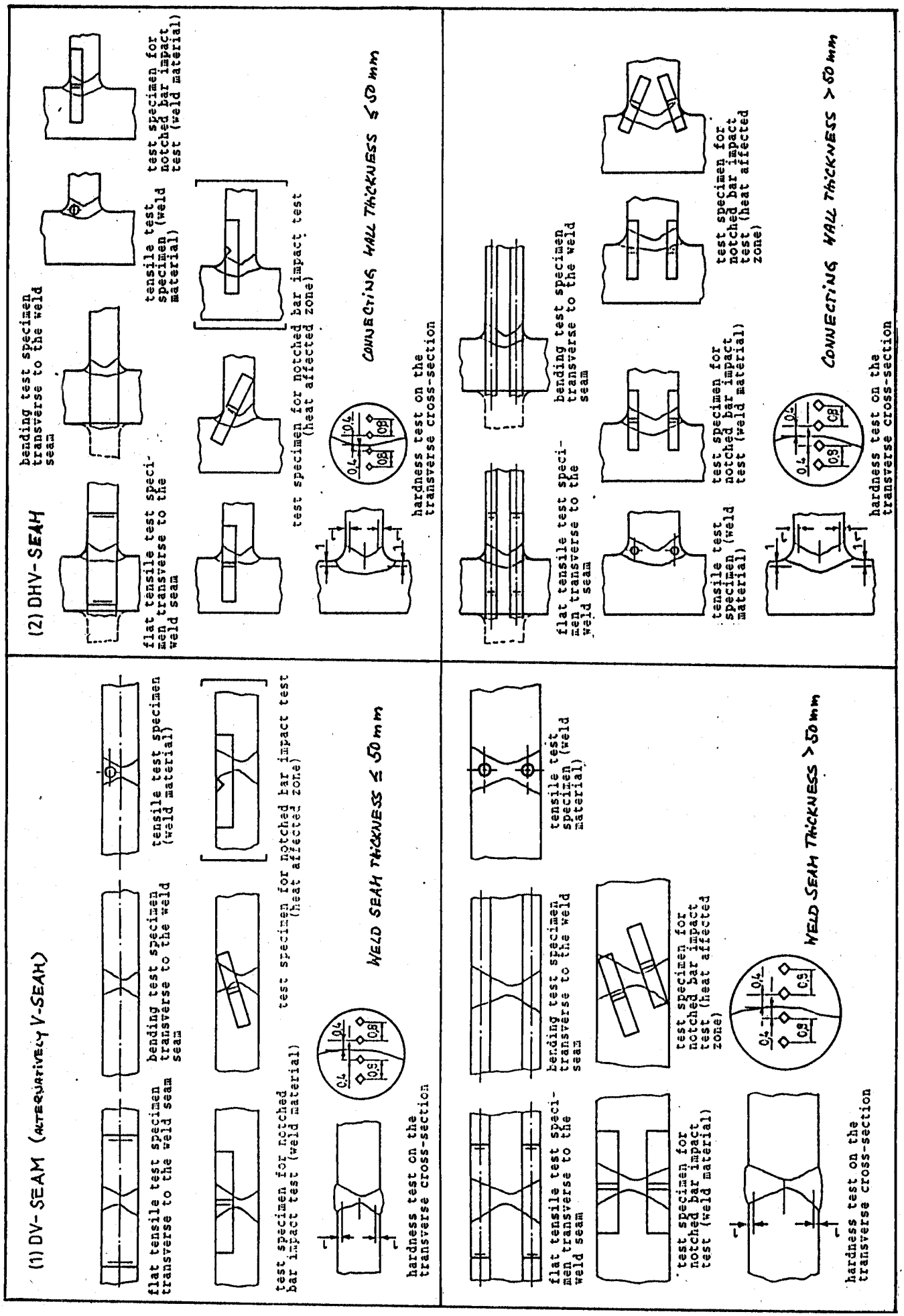


Figure 8-1: Examples of the Test Specimen Locations for the Procedure and Welder Qualification Tests

9.2.2 Surveillance of the Welding Tasks

9.2.2.1 Examinations by the Manufacturer

(1) The manufacturer's welding supervision shall individually test and examine:

a) the preheating the, if applicable the working temperature during thermal preparation of the weld edges (including gouging out the weld seam region),
b) the weld seam preparation,
c) the handling, be it the storage, drying, intermediate storage and preparation, of the weld fillers and additives,
d) the proper application of the weld fillers and additives as required,
e) the deployment of welders regarding their valid certification of qualification,
f) the observance of the welding parameters, bead sequence as well as the preheating and working temperatures specified in the welding schedule,
g) the quality of the final layer,
h) the identification marking of the weld seams and
i) the protective measures against atmospheric conditions.

9.2.2.2 Welding Record

(1) The manufacturer shall keep a welding record in accordance with Form 10 at the welding site in which all actual values of the important welding parameters and conditions cited in the welding schedule are recorded.

(2) The welding record shall contain statements to the following:

a) that, the limits from the design reviewed welding schedule were observed during fabrication,
b) which welder has performed which of the individual welding tasks,
c) in which cases and for which reasons activities had to deviate from the welding schedule and
d) which unforeseen interruptions of the welding tasks or other irregularities have occurred.

(3) For each welding sequence specified in the welding schedule at least one notation of the measured welding parameters including the length of weld seam shall be made. In the case of weldings of a longer duration within a single welding sequence, at least two notations shall be made in each work shift.

(4) The weld supervisor of the manufacturer after repeated intermediate checks shall certify the validity of the notations in the welding record by his signature.

9.2.2.3 Examinations by the Authorized Expert

The authorized expert shall perform random examinations in accordance with Section 9.2.2.1(1) items a through i and shall certify this in the welding record.

9.2.3 Surveillance of the Heat Treatment

9.2.3.1 Examinations by the Manufacturer

(1) The heat treatments shall be supervised by the manufacturer.

(2) The supervision shall extend to the following points:

a) position of the components and of the accompanying specimens in the furnace,
b) arrangement of the local heat treatment equipment on the component,
c) the location of possibly required temperature measuring devices on the component, to demonstrate uniform temperature distribution,
d) the marking of the temperature versus, time diagram with respect to its correlation to the component,
e) the heating up period, heat treatment temperature, temperature holding time, cooling down period as well as the conditions for cooling down to room temperature, all parameters specified in the heat treatment schedule.

(3) The heat treatment diagram shall be signed by the manufacturer. A certificate shall be drawn up for each heat treatment.

9.2.3.2 Examinations by the Authorized Expert

(1) Prior to each heat treatment and randomly thereafter, the authorized expert shall examine the furnace loading or the arrangement of the heat treatment equipment (cf. Section 4.2) on the component.

(2) The authorized expert shall countersign the heat treatment diagram and, upon proper completion of the Treat treatment, shall sign the certificate.

9.3 Nondestructive Examinations

9.3.1 Examinations by the Manufacturer

9.3.1.1 Ultrasonic Examinations

The manufacturer shall perform ultrasonic examinations on 100 % of:

a) the edge zones of the intended weld connections in accordance with Section 3.5.2(1),
b) all butt weld connections on components with DN ≥ 100 and a wall thickness ≥ 10 mm,
c) all weld connections between the vessel wall and nozzles with DN ≥ 120 and a wall thickness ≥ 15 mm. The determining factor is, in the case of set-through nozzles, the wall thickness of the vessel and, in case of set-on nozzles, the wall thickness of the nozzle.
d) all weld connections of permanent weld attachments to the vessel wall and the locations of repair weldings.

9.3.1.2 Surface Crack Examination

The following shall be subjected to a surface crack examination:

a) the weld edges and gouged regions of the weld seam to an extent that ensures that no systematic errors occur,
b) all surfaces for weld connections on set-on or set-through nozzles on which welding tasks will be performed,
c) all bevelled edges created by thermal cutting,
d) all weld seam surfaces including the repair locations; the adjoining region of base material shall be examined over a width specified in Section 6.3.3.2,
e) all locations were weld attachments were removed and
f) all arc strike locations.

9.3.1.3 Radiographic Examination

(1) The manufacturer shall prepare the film location plan and shall make and evaluate the radiographs.

(2) The following locations shall be subjected to a radiographic examination:

a) locations which cannot be fully examined by ultrasonics,
b) all butt weld connections on components with DN ≤ 100 mm. This examination may be replaced, if possible, by an ultrasonic examination. In this case, no examination for transverse flaws on circumferential welds and nozzle connections need be carried out.
c) all butt weld connections on components with wall thicknesses smaller than 10 mm,
d) Additionally and prior to the begin of fabrication, 5 % of the mechanically welded pre-erection seams and 10 % of all other weld seams on the component shall be subjected to radiographic examination with consideration given to weld lines, locations with difficult weld conditions as well as locations for clarifying indefinite ultrasonic indications. The extent of these tests may, in agreement with the authorized expert and as the qualification of the manufacturer is established, be reduced in steps in the course of progressing manufacture.

9.3.1.4 Hardness Test

If the production weld tests give grounds for checking the hardness values then the surfaces of butt weld connections shall be randomly subjected to hardness tests in accordance with Section 8.4.3.

9.3.2 Examinations by the Authorized Expert

9.3.2.1 Ultrasonic Examination

(1) The authorized expert shall examine 25 % of the weld seams. This shall occur independently from the manufacturer and with the component in the final condition. The results of the examinations by the manufacturer shall be considered. Interference conditions, such as wall thickness transitions tolerated shape deviations and manually welded seams shall be considered.

(2) If in the course of the random examinations by the authorized expert, the examination of a seam examined by the manufacturer turns up essential deviations to the results by the manufacturer, then the extant of the random examinations specified for the individual test coupon shall be doubled. If additional deviations between the test results are detected, then the extent of examinations on the individual test coupon shall be increased to 100 %. If the causes can be unambiguously determined and the mistakes ensuredly eliminated, the extent of random examinations nay again be reduced to 25 %.

9.3.2.2 Surface Crack Examinations

The surface crack examinations on the locations in accordance with Section 9.3.1.2 items c through f shall be mutually performed by the authorized expert and the manufacturer.

9.3.2.3 Radiographic Examinations

The authorized expert shall randomly examine the preparation of the radiographs and shall evaluate every one of them.

9.3.3 Documentation

(1) Every one of the examinations shall be documented by the manufacturer in records in accordance with the Forms 12-1 through 14-2. These records shall contain all the data relevant to the test object and to the examination that is necessary for reproducing the examination. The records should further contain the examination results and all details necessary for their proper correlation to the test object.

(2) The records shall be signed by the testers, by the manufacturer's testing supervision and by the authorized expert.

(3) The records shall be included in the plant documentation.

(4) Regarding the records of the ultrasonic examinations, the following applies:

a) If no recordable conditions exist, it is only necessary to fill out one mutual cover sheet.
b) If the testing agencies achieved common results regarding recordable conditions, then the manufacturer shall write up one mutual result sheet.
c) If the testing agencies achieved different results regarding recordable conditions, then separate result sheets shall be written up by the testing agencies.
d) Any differences in performing the individual examinations shall be noted in the corresponding cover sheet.

(5) In case of the surface crack examinations, a stamp in the testing sequence schedule is sufficient if the examination was performed in accordance with the required test instruction and if no unallowable indications were detected.

(6) The results of the radiographic examinations shall be noted in one mutual test record.

9.3.4 Evaluation of the Test Results

9.3.4.1 General Requirements

(1) If different examination procedures are prescribed for determining internal or external flaws, all test results shall be considered in the evaluation.

(2) The test results shall be evaluated also with respect to measuring tolerances of the testing equipment, to the shape and stress load of the component as well as to the characteristics of the product forms used in fabrication.

(3) If any of the allowed values in accordance with Sections 9.3.4.1 through 9.3.4.6 are exceeded, a repair is required (cf. Section 9.7.).

Note:
Prior to the repair of a flaw it shall be evaluated in how far the unchanged condition and the repaired conditions has safety relevant advantages or disadvantages.

9.3.4.2 Surface Crack Examinations of Weld Edges

(1) Indications which suggest the presence of cracks are not permissible.

(2) Line shaped indications are permissible only if they run parallel to the surface and if they are evaluated as not to be caused by non-metallic inclusions.

(3) The results of the ultrasonic examination of the edge zones shall be considered in the evaluation of the surface crack examination.

9.3.4.3 Ultrasonic Examination of Weld Connections

9.3.4.3.1 Examination for Longitudinal Flaws

(1) The evaluation of the indications shall be mainly oriented on their lengths and frequencies as far as the echo amplitudes do not exceed the recording thresholds in accordance with Section 6.3.3.11 by more than 6 dB.

(2) **Table 9-1** specifies criteria for evaluating indications from the ultrasonic examination for longitudinal flaws as well as from the volumetric straight through beaming examinations. One example each for a permissible and an impermissible

combination of indications is presented in **Table 9-2**. Recordable conditions are permitted as long as per meter of weld seam the value of $S \leq 1$, with S given by

$$S = \frac{(\beta - e)^2}{1 + e} \cdot \sigma_m^{'\delta}$$

RL = recorded length

$n(RL)_i$ = number of indications of equal recorded length per meter of weld seam

$n(RL)_{i,max}$ = maximum permissible number of indications of equal recorded length per meter of weld seam

(3) Indications with recorded lengths shown below the stepped line in **Table 9-1** are not permissible in close-to-the-surface regions.

(4) The thickness of close-to-the-surface regions as measured from the final surface is limited dependent on the wall thickness s as follows:

	$s \geq 40$ mm	thickness = 5 mm
40 mm <	$s \geq 80$ mm	thickness = 10 mm
	$s > 80$ mm	thickness = 20 mm.

(5) In the case of one-sided welds and of welds that can be examined from only one side, only one half of the values given in **Table 9-1** is allowed for the recorded lengths in the root region.

(6) In addition to the **Table 9-1**, the following requirements apply:

a) Indications at the same depth must beef apart from each other by at least double the length of the larger indication. Otherwise, the indications shall be counted as connected with each other. The distance apart in direction of width and breadth shall be at least one half the length of the larger indication but no less than 10 mm.

b) If the specified values for the maximum frequencies and lengths are surpassed, then, in the region concerned and beyond that for 500 mm in both directions along the seam, the assessment shall also consider indications that lie 6 dB below the recording threshold or below the values specified in **Table 6-1**. This procedure is also required whenever indications up to 6 dB below the recording threshold in accordance with Section 6.3.3.11 are detected whose lengths equal or exceed twice the maximum allowed length of an individual indication.

c) The reflection characteristics of indications whose echo amplitudes exceed the recording threshold in accordance with Section 6.3.3.11 by more than 6 dB shall be analyzed with regard to all specified beaming directions. If necessary additional beaming directions shall be used. The thereby detected echo amplitudes shall be compared and included in the assessment. The indications may be left as-is if there is no suggestion of areal reflectors and the previous requirements regarding length, frequency and distances are met. Otherwise the manufacturer shall undertake further analyses regarding the cause of the indications.

9.3.4.3.2 Examination for Transverse Flaws

(1) Indications that are not clearly caused by longitudinal flaws shall be assessed to a degree that is dependent on their amplitude and frequency.

(2) Recordable indications may be left as-is without control examinations only if they occur as isolated indications (no more than 3 per meter of weld seam) and with lengths smaller than 10 mm and if they are not accompanied by frequent indications up to 12 dB below the recording threshold.

(3) If during the examination for transverse flaws multiple echo indications are detected on the screen that cannot be separated from each other (echo flocks), then the cause of all indications up to 12 dB below the recording threshold shall be analyzed.

9.3.4.3.3 Control Examinations

(1) If control examinations, e.g. radiographic examinations and metallographic examinations, are carried out then no repairs are needed if

a) the radiographic examination shows unambiguously that the cause of the ultrasonic indication is an inclusion,

b) a cause of the ultrasonic indication is found which according to all parties involved can be left as-is with out any doubt.

(2) In the case of reflections from locations in near surface regions, the testing sensitivity adjusted by the DGS method (distance, gain, size) may be corrected by near surface reference reflectors.

9.3.4.4 Surface Crack Examinations of Weld Connections

(1) In the evaluation of surface crack examinations no indications with a maximum length of 3 mm need be considered as long as they do not occur systematically. The time of evaluation of the liquid penetrant examination shall be taken in accordance with Section 6.3.4.4.

(2) No surface faults which indicate the presence of cracks are allowed.

(3) In case of the magnetic particle examination, surface faults with a maximum length of 6 mm are allowed if it can be shown that they are caused by slag inclusions; the same holds for Indications in the liquid penetrant examination.

(4) The frequency of allowed single faults is limited locally to 10 faults per surface area of 100 mm by 100 mm. The cause of systematically occurring surface faults shall be determined even f their individual maximum lengths are less than 3 mm. Any cluster of pores visible on the surface of the weld shall be evaluated in accordance with Section 9.3.4.6.4.

9.3.4.5 Grain Indications in the Magnetic Particle Examination

Note:
Grain indications in the magnetic particle examination are such indications in the near surface region which are not caused by separation or inclusions but rather by the type of grain structure in the component.

(1) The following measures shall be taken in the case of indication locations which, on account of the indication picture during the magnetic particle examination cannot definitely be identified as grain indications:

a) The ultrasonic examination shall, in the near surface region over the whole area examined, not show any indications with length dimensions larger than 10 mm. In these examinations the recording threshold shall be lowered by 12 dB. The distance between the lowered recording threshold and the back round noise shall be at least 6 dB. This examination may be replaced by an examination in accordance with item b.

b) In regions that in examinations according to item a show unallowable indications, the freedom from faults shall be demonstrated by an ultrasonic examination with surface

waves, e.g. with a creeping wave probe. In this case the sensitivity shall be adjusted using a calibration block.

(2) If other procedures are used, the validity of the results shall be demonstrated to the authorized expert.

(3) Indications that are demonstrated to the authorized expert to be grain indications may be left unchanged.

Nominal wall thickness	Maximum individual occurrence frequencies for similar recording length per meter weld seam as a function of the nominal wall thickness s						
	$s \leq 10$	$10 < s \leq 20$	$20 < s \leq 40$	$40 < s \leq 60$	$60 < s \leq 120$	$120 < s \leq 250$	$250 < s$
10 mm	-	17	19	21	23	25	27
15 mm	-	12	14	16	18	20	22
20 mm	-	8	10	12	14	16	18
25 mm	-	6 *)	8	10	12	14	16
30 mm	-	4 *)	6 *)	8	10	12	14
35 mm	-	1 *)	4 *)	6	8	10	12
40 mm	-	-	1 *)	4	6	8	10
45 mm	-	-	-	2 *)	4	6	8
50 mm	-	-	-	1 *)	3	5	7
55 mm	-	-	-	-	2	4	6
60 mm	-	-	-	-	1	3	5
65 mm	-	-	-	-	-	2	4
70 mm	-	-	-	-	-	1	3
75 mm	-	-	-	-	-	-	2
80 mm	-	-	-	-	-	-	1

*) Any indications with a recorded length in this category are only permissible if it is shown by radiographic examination that they are definitely not caused by inclusion-type faults.

Table 9-1: Lead values or the evaluation of ultrasonic indications when testing for transverse flaws and of indications from volumetric straight-through beaming (applications are shown in **Table 9-2**)

1 Permissible Combination of Indications

Assume the following indications of similar recording Length were found in one meter of weld seam (thickness of the weld seam 50 mm):

RL = 10 mm $n(RL)_1 = 5$

RL = 15 mm $n(RL)_2 = 2$

RL = 30 mm $n(RL)_3 = 1$

Then, in accordance with Table 9-1, column $40 < s \leq 60$ mm, the following are the maximum allowed occurrence frequencies:

for RL = 10 mm it is seen that $n(RL)_{1,max} = 21$

for RL = 15 mm it is seen that $n(RL)_{2,max} = 16$

for RL = 30 mm it is seen that $n(RL)_{3,max} = 8$

With these results, a permissible value is calculated for $S = \frac{5}{21} + \frac{2}{16} + \frac{1}{8} \approx 0.5$

2 Impermissible Combination of Indications

Assume the following indications of similar recording length were found in one meter of weld seam (thickness of the weld seam 50 mm):

RL = 20 mm $n(RL)_1 = 5$

RL = 30 mm $n(RL)_2 = 1$

RL = 40 mm $n(RL)_3 = 1$

Then, in accordance with Table 9-1, column $20 < s \leq 40$ mm, the following are the maximum allowed occurrence frequencies:

for RL = 20 mm it is seen that $n(RL)_{1,max} = 10$

for RL = 30 mm it is seen that $n(RL)_{2,max} = 6$

for RL = 40 mm it is seen that $n(RL)_{3,max} = 1$

With these results, an impermissible value is calculated for $S = \frac{5}{10} + \frac{1}{6} + \frac{1}{1} \approx 1.7$

Table 9-2: Examples for applying Table 9-1

9.3.4.6 Radiographic Examination

9.3.4.6.1 General

(1) If the films of radiographic examinations in comparison to the ultrasonic examination show no or unclear indications or if the dimension of a reflector found in the ultrasonic examination is larger than the reflector to be detected in the radiographs of the identical fault - accounting for pores and smaller inclusions - then the evaluation shall be carried out in accordance with Section 9.3.4.3.

(2) If it is not unambiguously clear that a fault detected in the radiographic examination may be left unchanged, then, instead of repairing the fault, its allowableness maybe decided upon after a control examination, e.g. a radiographic examination with a different technique or an ultrasonic examination, was performed.

9.3.4.6.2 Cracks, Lack of Fusion, Root Imperfections

No crack or lack of fusion detected by the radiographic examination is allowed. The outer appearance of the untreated root of one sided weld seams shall be evaluated as evaluation group BS in accordance with DIN 8563 Part 3.

9.3.4.6.3 Inclusions

(1) The frequency and length dimensions of inclusions shall be evaluated according to the lead values presented in **Table 9-1**.

(2) If the distance between two neighboring inclusions in direction of the weld seam is larger than twice the length of the larger fault, then each inclusion shall be taken as an individual fault. This requirement does not apply to fault lengths ≤ 10 mm if the overall length of this region does not exceed the maximum allowed length of the single fault.

(3) In the case of wall thicknesses ≤ 10 mm isolated inclusions of small lengths are allowed.

9.3.4.6.4 Pores

(1) Pores occurring nonsystematically are allowed. Accumulations of pores detected over seam lengths larger than six times the wall thickness shall be considered as systematic faults. A maximum of three clusters of pores with a maximum diameter of 20 mm are allowed per meter of weld seam.

(2) Worm holes running perpendicular to the surface are only allowed as isolated fault locations in multi-layered welds.

(3) Worm holes running parallel to the surface shall be evaluated as inclusion faults in accordance with Section 9.3.4.6.3.

9.4 Production Weld Test

9.4.1 General Requirements

(1) For each welding procedure and we dint position employed in the manufacture o the containment, a test coupon shall be welded in each zone and under surveillance of the authorized expert. Hereby, in the course of manufacture, each welder should be once involved with the welding procedure which he is appointed to apply on the containment. More than one welder may work on a single test coupon if the authorized expert gives his consent. Also with the consent of the authorized expert, the production weld test on two zones may be combined if

a) they are manufactured in a continual sequence of each other and

b) a similar weld connection is involved with a combined length ≤ 160 m.

(2) In the case of the pre-erection welding with the submerged-arc procedure, for each containment four production weld tests shall be performed within the scope of the procedure qualification.

(3) In the case of the containment locks, for every containment each manufacturer shall within the scope of the procedure qualification perform one production weld test individually for

a) butt weld,

b) T-joint (e.g. door frame, nozzle)

c) erection welds (connection weld of the lock body to the containment nozzle). This production weld test may be omitted if the welding is carried out by the manufacturer of the containment and with similar weld procedures and weld conditions.

(4) In the case of longitudinally welded nozzles, for every containment each manufacturer shall, within the scope of the corresponding procedure qualification, weld one test coupon with the longitudinal weld.

(5) In the case of welds for connecting nozzles to the containment wall, each manufacturer shall perform one production weld test for each weld procedure (as well as combinations of weld procedures).

Note:
With the consent of the authorized expert and given similar parameters, the production weld test for the weld connection of nozzles shall also extend to butt weld connections.

(6) The extent of production weld tests with regard to special cases e.g. weld connections of drainage nozzles, weld attachments and supports, shall be decided upon in agreement with the authorized expert.

(7) The authorized expert shall specify the weld position prior to the start of the welding.

(8) The direction of the weld seams shall run parallel to the rolling direction of the base plate of the test coupon. The test coupons should cover as large a number as possible of the melts employed.

(9) Impermissible flaws detected in the nondestructive examination may only be repaired with the consent of the authorized expert. A repair is not required if no test specimens are removed from the region concerned.

(10) Special repair welds shall be simulated on a test coupon correlated to the actual component part.

(11) The test coupons shall be subjected to a heat treatment that corresponds to that of the actual manufacturing process.

(12) The test coupons of the production weld test shall be subjected to tests and examinations in accordance with Sections 9.4.2 through 9.4.5; these tests shall be performed in the presence of the authorized expert who will attest their proper execution.

9.4.2 Nondestructive Examinations

(1) The nondestructive examinations in accordance with Section 6.3 shall be performed by the manufacturer and the authorized expert. They shall be evaluated in accordance with Section 9.3.4.

(2) The radiographic examination of butt weld connections the ultrasonic examination and the surface crack examination shall be performed by the manufacturer and the authorized expert each to 100 %.

9.4.3 Destructive Tests

(1) The results of the destructive tests shall be evaluated in accordance with the requirements of the material appendices of KTA 3401.1 and with the values specified in **Table 8-1**.

(2) Depending on the nominal wall thickness the destructive testing of welds shall be carried out in the following testing layers

a) a nominal wall thickness ≤ 50 mm shall be tested in one testing layer.

b) a nominal wall thickness > 50 mm shall be tested in two testing layers.

(3) In the case of a nominal wall thickness ≤ 50 mm, the tensile test transverse to the direction of the seam and the technological bending test shall, as far as possible, cover the entire weld seam cross-section.

(4) If a weld seam is produced with multiple welding procedures then the test specimens shall be located such that each welding procedure is tested.

(5) The locations of the test specimens shall be chosen in accordance with **Figure 8-1**. If for geometric reasons the specimen location for the notched bar impact test in the transition cannot be chosen as shown in **Figure 8-1**, then the test specimens shall be taken from locations parallel to the surface. The notch shall be parallel to the surface with the notch well lying between the bond line and 0.8 mm next to the bond line in the heat affected zone.

(6) The orientation of the notch for notched bar impact tests perpendicular to the bond line shall be chosen such that a line through the notch well lies between the bond line and 0.8 mm next to the bond line in the heat affected zone. The bond line shall be made visible by macro-etching.

(7) For each testing layer of the weld seam, the following tests shall be performed:

a) Two tensile tests on rectangular tensile specimens from the weld seam at room temperature in accordance with DIN 50 120 Part 1, however, with a gauge length L_c = (weld seam width + 2 x 40 mm). The tensile strength R_m shall be determined. The fracture location shall be recorded (see **Figure 8-1** for the specimen location).

b) One tensile test on a round test specimen at design temperature from the weld seam in accordance with DIN 50 125 and DIN 50 145. Tensile strength, field strength, elongation and reduction of area shall be determined.

c) Bend tests in accordance with DIN 50 121 Part 1 on four test specimens (two specimens each subjected to tensile stress on one and the other side of the weld seam). After grinding down the weld reinforcement on the tensile side of the test specimen, the original surface structure of the specimen should be maintained as far as possible. Larger indentations such as undercuts or root concavities may not be removed. Bending strain (L_o = weld seam width plus wall thickness) and the bending angle shall be determined. Requirements regarding bending angle and diameter of the plunger member shall be taken from **Table 8-1**.

d) One set (3 test specimens) of ISO-V specimens in accordance with DIN 50 115 at the pressure test temperature in accordance with Section 10.2.3. The impact energy absorbed and the lateral expansion shall be determined for the weld material and the heat affected zone.

(8) In the state prior to heat treatment one surface of the test coupon shall be subjected to a hardness test in accordance with DIN 50 133 along one row. The hardness shall not exceed 350 HV 10.

9.4.4 Structure Analysis

(1) A macrosection and a microsection shall be removed from each test coupon.

(2) The following tasks shall be performed on the macrosection:

a) photographic picture of the entire cross-section of the weld connection,

b) hardness test in accordance with DIN 50 133 (see **Figure 8-1** for the distance of the measuring points).

(3) On the microsection, microscopic examinations of the heat affected zone of the entire weld seam thickness and an estimation and recording of the coarse grain ratio shall be performed.

9.4.5 Chemical Composition

The essential elements of the weld material shall be determined and compared with the characteristics from the qualification test.

9.4.6 Retest Specimens

(1) If a test specimen or set of specimens does not meet the requirements then; after determining and evaluating the cause of failure, two further specimens or sets of specimens may be tested. All retest specimens must meet the requirements.

(2) If insufficient test results are clearly caused by influences from the test procedure or by a strongly localized flaw, then the test specimen concerned may be left out of the decision whether or not the requirements are met and the corresponding test may be repeated.

Note:
Flaws occurring systematically may lead to a rejection of the procedure qualification.

9.4.7 Report on the Production Weld Test

(1) The manufacturer shall prepare a written report on the results of the production weld test. The authorized expert shall give his concluding opinion within the following week.

(2) The report of the manufacturer shall contain:

a) information on the base material and the weld fillers and additives,

b) information on the welding procedure,

c) welding schedule and welding record,

d heat treatment schedule and heat treatment record,

e) materials test and specimen removal plan,

f) results of all tests including the evaluation of flaws, and

g) summary and conclusion.

(3) The report of the authorized expert shall contain his concluding opinion.

(4) In case of a positive result, the production weld test is considered to be completed upon presentation of this report.

9.4.8 Storage of the Test Specimens and Remaining Material

The remaining material of the welded test coupons shall be stored at the manufacturer until commissioning of the nuclear power plant. The tested specimens shall be stored until the final report is presented in writing.

9.5 Testing of Non-slip Screw and Bolt Joints (GV and GVP Joints)

9.5.1 Identification Marking

The manufacturer shall examine all bolts, nuts and washers for their complete identification marking (strength category, marking of the manufacturer, as required the mark of acceptance); the authorized expert shall randomly examine at least 5 % of the units.

9.5.2 Examining Dimensions and Surface Structure

The manufacturer and, randomly the authorized expert and the authorized civil expert shall examine in particular:

a) positioning of the hole rows,
b) spacing of the holes,
c) hole diameters,
d) condition of the interfaces for GV and GVP connections,
e) condition of the bore holes,
f) relative tolerances of holes,
g) bolt shaft play,
h) length of thread,
i) condition of lubrication (thread, nut, washer) and
j) gaps.

9.5.3 Prestress of Bolts

(1) The procedure for prestressing shall be specified The prestress of the bolts shall be tested even if the non-slip component of the connection is not utilized.

(2) The manufacturer shall continuously test that the required prestress is achieved. The authorized expert and the authorized civil expert test the prestress of at least 5 % of the bolts.

9.5.4 Loosened Bolt Connections

(1) When re-tightening temporarily loosened prestressed bolt connections the examinations in accordance with Sections 9.5.1 through 9.5.3 shall be repeated.

(2) The same prestressing procedure shall be employed.

(3) Bolts that were prestressed according to the turning angle procedure in accordance with DIN 18 800 Part 7 shall not be reused.

9.5.5 Test Reports

Test reports shall be written up on all examinations in accordance with Sections 9.5.1 through 9.5.3 and shall contain the examination results, the time the examination were performed and the name of the tester. The test reports shall be included in the documentation in accordance with Section 11.

9.6 Examination of Accuracy to Gauge

The measurements determined following the measurement program in accordance with Section 5.1 shall be recorded by the manufacturer in measurement records. The authorized expert examines the dimensions and certifies the attainment of the manufacturing tolerances in accordance with Section 5.

9.7 Non-conformances

9.7.1 Non-conformances to be Tolerated

(1) For each non-conformance - i.e., the non-conformance of the actual condition with the specified condition - the manufacturer shall formulate a request for tolerance to be presented to the authorized expert and, if required to the authorized civil expert.

(2) The request for tolerance should contain:

a) information on the non-conformance,
b) reasons for tolerating the non-conformance.

9.7.2 Non-conformances not to be Tolerated

Non-conformances that may not be tolerated shall be repaired only after the authorized expert and, if required, the authorized civil expert have given their consent.

10 Tests and Examinations Prior to Commissioning

10.1 Assembly Test Prior to the Pressure Test

(1) After the completion of erecting the containment and of all tests and examinations in accordance with Sections 7 through 9, the authorized expert and, if required, the authorized civil expert shall assert, on the basis of the design reviewed documents in accordance with Section 7:

a) the correlation between the certificates from the partial assembly tests or the earlier performed assembly tests and the component groups or components on the basis of the identification markings,
b) that all requirements regarding material tests and examinations are met, on the basis of material certifications of all component parts.

(2) After examining the documentation in accordance with Section 11 prepared by the manufacturer, the authorized expert and, if required the authorized civil expert will certify that all requirements in accordance with Sections 2 through 9 are met.

(3) The completion of the assembly test shall be certified by the authorized expert and, if required, by the authorized civil expert.

10.2 Pressure Test

10.2.1 Prerequisites

(1) After completion of erection including the logs, the cable and pipe penetrations, a pressure test shall be performed with air as pressurizer.

(2) The pressure test shall be performed by the manufacturer in accordance with the design reviewed pressure test schedule and In the presence of the authorized expert and the authorized civil expert.

(3) Pipe lines through compensating penetrations shall, in correspondence to the later operating condition, be connected and anchored at least to the nearest fixed point.

(4) Chambers in the containment, e.g. the steam suppression chamber in steam suppression systems, shall be included in the pressure test.

(5) The results from the assembly test and the, design reviewed construction and design documents shall be available before and during the pressure test.

10.2.2 Test Pressure

The test pressure P_p should be equal to 1.1 times the design pressure P_a multiplied by the ratio of the yield strengths of the containment material at room temperature (R_{eH}) and design temperature ($R_{p0.2}$):

$$P_p = 1.1\ P_a \times \frac{R_{eH}}{R_{p0.2}}$$

10.2.3 Test Temperature

The test temperature and its measurement shall be specified during the design review in agreement between the manufacturer, the authorized expert and the authorized civil expert. The test temperature shall not be lower than the temperature at which, in the notched bar impact test, the base material, the heat affected zone and the weld material showed individual minimal values of 68 J and 0.9 mm lateral expansion. In case of test temperatures below +5 °C, special measures shall be specified in agreement with the authorized expert.

10.2.4 Pressure versus Time Diagram

The pressure test shall be performed in accordance with the pressure versus time diagram contained in the pressure test schedule. This diagram shall also contain the chamber pressures and additional loads to be considered. Upon achieving the test pressures of the two possible loading types of the locks hold periods of at east 20 minutes shall be specified.

10.2.5 Safety Zones

For the duration of the pressure test prohibited access areas shall, depending on the test pressure, be established as safety zones around the containment. Furthermore, it shall be specified what group of persons is allowed inside the safety zones and which safety measure regarding these persons are required.

10.2.6 Inspection of the Outer Surface of the Containment

After reduction of the test pressure down to the design pressure the outer surfaces of the containment shall be inspected by the authorized expert.

10.2.7 Displacement Measurements

(1) In the course of the pressure test, the displacement of specially chosen nozzles caused by the internal pressure shall be measured and checked against the theoretically determined values.

(2) The displacement measurements shall be specified in a measurement location plan.

10.3 Strain Measurements

(1) Locations where the strain can only be determined analytically with difficulty or for which no results from comparable strain measurements are available, e.g. shape deviations, should be equipped with strain gauges. The locations and number of strain gauges as well as necessary measurement details shall be agreed, up on between the manufacturer, the authorized expert and the authorized civil expert and shall be specified in a measurement location plan.

(2) During the installation of the measurement gauges, the authorized expert shall assert himself of the proper execution by random checks.

(3) The expansion shall be monitored continuously or measured in sufficiently small steps during the buildup, holding periods and reduction of the test pressure such that the course of expansion can be determined.

(4) Initial condition for the strain measurements is the unstrained containment before the pressure test; the final condition is the containment after complete pressure relief from the pressure test.

(5) The measurement steps shall be established with the authorized expert on the basis of the pressure versus time diagram.

(6) At the beginning and randomly during the measurements, the authorized expert shall assert himself that the measurements are properly taken and evaluated.

(7) If the structural or fabricational characteristics of the cross-section (local structural discontinuity or shape deviation) and the measured course of expansion show that these locations exhibit secondary strain or strain peaks, then the maximum strain at these locations is limited to 5 % of the minimum fracture strain A_5 of the base material of the particular component. In substantiated cases deviations from this value may be agreed upon between manufacturer authorized expert and authorized civil expert.

(8) The decision for breaking off the pressure test may be made by the manufacturer, the authorized expert or the authorized civil expert.

10.4 Examination of the Leaktightness of Sealing Surfaces

(1) Before or during the pressure test in accordance with Section 10.2 all sealing surfaces, e.g. on doors, flaps, blind covers, flanged pipe penetrations, shall be examined or leaktightness.

(2) The examination for leak tightness shallbe performed by the manufacturer in the presence of the authorized expert.

(3) Any of the detected leaks shall be corrected. The respective locations shall then be reexamined.

(4) Cable penetrations shall be examined in accordance with KTA 3403.

10.5 Leakage Rate Examination

Note:
The leakage rate at design pressure is a measure for the leak tightness requirement of the containment. It is individually specified and not within the scope of this safety standard.

The leakage rate examination and its evaluation shall be performed in accordance with KTA 3405 and after the pressure test of the containment.

10.6 Functional Examination

The functional examination of the locks shall be performed in the presence of the authorized expert and in accordance with KTA 3402 and KTA 3409.

10.7 Underpressure Test

Containments in which underpressure can occur or is an intended operating condition shall be so identified in the pressure test schedule. They should be tested at 1.5 times the maximum underpressure. This test shall be performed after the pressure test and in the presence of the authorized expert and the authorized civil expert. The containment shall be inspected during the underpressure test.

10.8 Nondestructive Examinations after the Pressure Test

After the pressure test, selected weld seam regions shall be subjected to an ultrasonic examination and the corresponding surfaces to a surface crack examination in accordance with Sections 6 and 9.3 respectively; these examinations shall be performed in agreement with the authorized expert. Locations to be examined are those where irregularities occurred during fabrication as well as those where he highest stresses occur.

11 Documentation

11.1 General Requirements

(1) The documentation shall allow a historic survey from the time of the product form to the finished containment including nozzles and locks of all fabrication and testing procedures were monitoring is required. The procedings in manufacturing and the actual condition of the containment as well as all non-conformities during manufacture - the latter in a separate list - must be visible in the documentation. It shall be possible to draw upon these documents for comparisions with inservice inspections.

(2) Repair procedings shall be documented in the same way as the original manufacturing documents.

11.2 Compilation of Documents

(1) The manufacturer shall ensure that, both in his plant and by his subcontractors, all documents required for documentation are prepared and compiled hand in hand (in parallel) with the manufacturing. This document compilation shall be headed by a table of contents (Form 9).

(2) The compilation shall contain the design reviewed documents in accordance with Section 7.2 as well as all certifications attesting the actual procedure and the required tests and examinations. These include, for example:

a) acceptance test certificates,

b) (test) records,

c) test reports,

d) attestations,

e) non-conformance reports.

11.3 Abbreviations

Abbreviations used in the documents for manufacture and documentation should be uniformly applied:

AP = production weld test
APM = production weld test on an accompanying test coupon
APS = production weld test on a test coupon with simulated heat treatment
ASG = weld cladding
AW = job instruction
BG = component group
BT = component part
DBL = cover sheet
DP = radiographic examination
DPP = radiographic test schedule
DRP = pressure test
DRPP = pressure test schedule
DU = performance of test or examination
E = final documentation
EK = receiving inspection
E/S = final documentation / collective certification
FE = liquid penetrant examination (surface crack examination)
H = manufacturer
KN = fillet weld
LN = longitudinal weld seam
MK = dimensional check
MP = magnetic particle examination (surface crack examination)
MSP = measurement location plan for the expansion and displacement measurements
MTP = destructive examinations
NV = test or examination after annealing
PA = test or examination instruction
PFP = test sequence schedule
QS = quality assurance
QST = quality division
RN = circumferential weld
S = authorized expert
SF = weld bead sequence.
SN = weld seam
SP = welding schedule
SPK = welding record
SST = weld location
ST = certification stamping in design review documents
STEL = weld location list
STN = nozzle weld
SZ = weld fillers and additives
TE = participation in the test or examination
UB = certification re transfer of identification stamping
US = ultrasonic examination
UEW = surveillance
VIP = visual examination
VP = procedure qualification
VWP = material identification check
WBP = heat treatment schedule
WL = list of materials
WP = material test and examination
WPM = material test and examination on the accompanying test coupon
WPP = material test and test specimen removal schedule
WPS = material test and examination of the simulation heat treatment test coupon
WPV = material test and examination after annealing
WSP = eddy current examination
Z = short-term (intermediate) documentation
ZG = construction drawing
ZHV = list of construction drawings
UP = nondestructive examination
Z/S = short-term documentation / collective certification
../R = identification marking of documents for repair tasks
../RM = identification marking of documents for reserve material

11.4 Forms

11.4.1 General

In the following, only those forms are referenced as examples where entries are required during manufacture for the sake of documentation.

11.4.2 Cover Sheet - Form 1

After completion of manufacture, it shall be certified in column 4 that the final state of revision was checked.

11.4.3 List of Materials - Form 2

With regard to the documentation, columns 10, 12 and 13 shall be filled out.

11.4.4 Test Sequence Schedule - Forms 3 and 4

With regard to the documentation columns 9, 10 and, if required, column 11 of Form 3 and columns 4 and 5 of Form 4 shall be filled out.

11.4.5 Materials Test and Specimen Removal Plan - Form 7

With regard to the documentation columns 12, 13 and, if required, column 14 shall be filled out.

11.4.6 Appendix to the Materials Test and Specimen Removal Plan - Form 8

With regard to the documentation, columns 1 through 5 and continuously onward shall be filled out.

11.4.7 Table of Contents - Form 9

All design reviewed documents and the certifications shall be collated in this table of contents. The numbers of the certifications shall be given out in running order, corresponding to the sequence of their receipt.

11.4.8 Welding Record - Form 10

(1) All information shall be entered that are required for the individual weld in accordance with the welding schedule. This also includes information on the type of weld, e.g., longitudinal weld, nozzle weld, test coupon for production weld test.

(2) After completion of the weld, the, welding record may be submitted to short-term (intermediate) documentation if Form 11, the weld location list, upon its confirmation by the manufacturer and the authorized expert is submitted to final documentation.

11.4.9 Weld Location List - Form 11

(1) The weld location list shall contain the following information:

a) number of the weld location,
b) number of the welding schedule,
c) weld fillers and additives,
d) correlation to the test sequence schedule,
e) particular occurrences during welding and
f) checkmark of the weld supervisor and of the authorized expert with regard to proper execution in accordance with the welding schedule.

(2) The weld location list shall be submitted to final documentation if the welding records remain with the shortterm (intermediate) documentation.

11.4.10 Forms for Nondestructive Examinations

The results of the ultrasonic examination, the surface crack examination and the radiographic examination shall be recorded in Forms 12.1 through 14.2.

11.5 Further Documents for Documentation

Besides the design reviewed documents all of the documents listed in the following shall also be included in the final. documentation in accordance with **Table 11-1**:

a) the results of the nondestructive examinations in accordance with Section 9.3. The originals of the radiographs shall be included in the final documentation of the operator,
b) certificates of the performed heat treatments with the correlation number to the test sequence schedule and the heat treatment schedule,
c) all manufacturing documents required for a production weld test and the report in accordance with Section 9.4.7,
d) additionally, a list showing the number and type of production weld tests performed and their correlation to the component welds,
e) the report on the pressure test,
f) the report on the leakage rate examination,
g) the documents on repairs tasks performed,
h) the report on the functional tests,
i) he certification on the assembly test.

11.6 Implementation

(1) The manufacturing documents shall be documented consecutively with the manufacturing by a central division of the manufacturer. This division shall be reported to the authorized expert.

(2) The central division shall

a) compile the documents and check them for complete and correct information,
b) procure required documents and information from the subcontractors.

(3) Before begin of the pressure test, all tests, examinations and control checks required during fabrication shall be finished and documented.

Assembly Testing Prior to Further Processing at the Manufacturing Plant	Certification of Test Performance and Type of Documentation		
Control check of the prerequisites for manufacture in accordance with Section 2	ST		
Receiving inspection	ST		
Transfer of material marking		Z	
Visual examination	ST		
Nondestructive examination of the weld seam regions before welding	ST		
Weld seam preparation (dimensional check)	ST		
Welding records in accordance with Section 11.4.8		Z	
Certification of the heat treatment (facility?)			E
Verification of (performed?) heat treatment		Z	
Hardness teat on the component			E
Dimensional test with a yes or no result	ST		
Control check of the weld fillers and additives	ST		
Dimensional check (as-is measurement) in accordance with Section 9.6			E
Report on the procedure qualification	ST		
Report on the production weld test			E
Test record of the radiographic examination including radiographs			E
Test record of the ultrasonic examination as an intermediate examination		Z	
Test record of the ultrasonic examination on the finished component			E
Test record of the surface crack examination as an intermediate examination	ST		
Test record of the surface crack examination on the finished component			E
Documents on the pressure test including expansion measurements			E
Documents on the leak tightness examinations			E
Documents on the functional test			E
Control check of the bolt corrections	ST		
Certification of the construction and assembly test			E
Documents on repair tasks			E
Nonconformance reports			E
Control check of the documentation	ST		
Release of documentation			E
Weld location list in accordance with Section 11.4.9			E
Documents on the product forms			E
Control check of the (corrosion protection) coating	ST		

Table 11-1: Examples of certifications during assembly testing

APPENDIX A - Form Sheets

Translation of Terms used in the Printed Form Sheets

Abmessungen	dimensions
Anforderungen nach	requirements in accordance with
Anlage/Projekt	plant/project
Anzahl je Prüfeinheit	number per testing lot
Arbeitsprüfung-Nr.	production test number
Auftrags-Nr.	contract number
Ausarbeiten der Wurzel	hollowing out of the root
Ausziehlänge	deposition length
Bemerkungen	remarks
Beschreibung	description
Beschreibung der Prüffolgeschritte	description of the test step
DBL-Nr.	running number of the cover sheet
Datum	date
Deckblatt	cover sheet
Doku-Ablage	archiving of document
Dokumentationsfreigabe	document release
Dokumentationsunterlage (Endablage)	documents (for permanent retention)
Drahtgeschwindigkeit Heißdraht	velocity of the hot filler metal
Durchf. H	wire execution by the manufacturer
Durchf. S	execution by this authorized expert
Durchführungsvermerk	attestation of examination performed
Erstellt von:	created by:
Erzeugnisform/Bauteil/Baugruppe	product form/part/subassembly
Fertigungseinheit-Nr.	lot number
Formiergas	backup gas
Gasverbrauch	gas consumption
Geforderte Schweißerprüfung	required welder test
Geprüft QST	checked by quality assurance unit
Geprüft QST:	checked by quality assurance department
Geschw (Geschwindigkeit)	weld velocity
Grund der Revision	reason for the document revision
Grundwerkstoff	base material
H	manufacturer
Handelsbezeichnung	trade name
Hersteller (H)	manufacturer
Hersteller Auftr.-Nr.	manufacturers order number
Hersteller und Normbezeichnung	Manufacturer and standard specification
Inhaltsverzeichnis (IVZ)	table of contents
Inhaltsverzeichnis für Vorprüfunterlagen	index of designs review documents
KKS power plant	identification system key
Kaltdraht	cold filler metal wire
Komponente	component
Kraftwerk-Kennzeichensystem (KKS)	power plant identification system
Lagenzahl	number of passes
Nachfolg. Wärmebehandlung	subsequent heat treatment
Nachweis-Schlüssel	type of test certification
Nachweise	certifications
Nachweisschlüssel	type of test certification
Naht/Teil Nr.	number of the weld seam or part
Nichtzutreffendes streichen	delete where not applicable
Ort	city
Pendelbr (Pendelbreite)	weave width
Pendelfrequenz	weave frequency
Polung der Elektrode	polarity of the electrode
Proben-Art u Nr.	type and number of test specimen
Probenabmessung	test specimen dimensions
Probenkennzeichnung	marking of test specimen
Probenlage	test specimen orientation
Prüf-Nr. gemäß WPP	test sequence number as per materials test and specimen removal plan
Prüfanweisung	examination procedure
Prüfart	type of examination
Prüffolgeplan PFP	test sequence schedule
Prüfgegenstand	test object
Prüftemperatur	testing temperature
Prüfung durch	examination carried out by
Prüfvermerk für schweißplangerechte Ausführung	checkmark regarding weld performance in accordance with welding plan
Prüfzeitpunkt	point in time of examination
Pulver Hersteller und Bezeichnung	flux manufacturer and brand name
Pulver-Fertigungseinheit	flux lot number
Oualitätsstelle (QST)	quality assurance department
Revisionstabelle	revision table
S	authorized expert
S-Prüfvermerk	mark of attestation by authorized expert (S)
Sachverständiger	authorized expert
Schmelze-Nr.	melt number
Schutzgas	shielding gas
Schweißdaten	weld parameters
Schweißer Nr.	identification number of the welder
Schweißfolge	weld sequence
Schweißnahtart	type of weld seam
Schweißnahtvorbereitung	weld seam preparation
Schweißplan SP	welding record
Schweißplan-Nr.	number of corresponding welding schedule

Schweißposition	weld position
Schweißprotokoll-Nr.	welding record number
Schweißstellen-Nr.	wild seam number
Schweißverfahren	weld procedure
Schweißzusätze	weld additives
Seite Nr.	page number
Seite: von-bis	page: from-to
Seite:_ von:_	page:_ of:_
Seitenzahl	number of pages
Skizze	sketch
Skizze/Schweißfolge/Aufbau der Schweißung	sketch/weld sequence/weld seam build up
Spannung	voltage
Stromart	type of current
Stromstärke	amperage
Stück-Nr.	item number
Trocknung Elektroden/Pulver	drying of electrodes or fluxes
Uhrzeit	time of day
Unterschrift (H)	signature (manufacturer)
Verfahrensprüf Nr.	number of the procedure qualification
Vorprüfunterlagen Nr.	design review document number
Vorwärm-Temp.	preheating temperature
Wärmebehandlungsdiagramm	heat treatment diagram
Wärmebehandlungsplan WBP	heat treatment schedule
Werkstoffliste WL	materials list
Werkstoffprüf- und Probenentnahmeplan (WPP)	materials test and test specimen removal schedule
Zeichnung ZG	technical drawing
Zugehörige WL-Mr.	corresponding materials list
Zwischenlagentemp.	interpass temperature

Hersteller	Auftrags-Nr		
Anlage/Projekt:	Deckblatt DBL-Nr.:		Seite: von:
1 Komponente KKS:			

2 Inhaltsverzeichnis für Vorprüfunterlagen		3 Revisionstabelle			
Vorprüfunterlagen Nr.	Seite von-bis	01 Seite Nr.	02 Seite Nr.	03 Seite Nr.	04 Seite Nr.
☐					
☐ Zeichnung ZG					
☐ Werkstoffliste WL					
☐					
☐ Prüffolgeplan PFP					
☐ Schweißplan SP					
☐ Wärmebehandlungsplan WBP					
☐ Werkstoffprüf- und Proben-entnahmeplan WPP					
☐					
☐					
☐					
☐					
☐					
☐					
☐					

4 Abschließende Überprüfung der Revisionstabelle	H	S	

5 Hersteller:						
Rev.	Datum:	Erstellt von:	Geprüft QST:	Grund der Revision		S-Prüfvermerk
00						
01						
02						
03						
04						

Form Sheet 1: Cover Sheet (Explanation of the columns)

Column 1 “Component” - Identification of the manufactured component, function key of the Power Plant identification System (KKS) by the VGB

Column 2 “Index of the Design Review Documents” - The corresponding documents shall be listed by name number of pages. In case that during manufacture repair tasks are carried out, the repair documents shall be included on the cover sheet.

Column 3 “Revision Table” - All revisions shall be listed on the cover sheet. The revision table shall identify the pages that were revised before or during manufacture.

Column 4 “Final Check of the Revision Table” - At the latest upon completion of manufacture, the entries into the revision table shall be checked and certified by the stamp and signature of the manufacturer (H) and the authorized expert (S) in this column.

Column 5 “Revisions to the Cover Sheet” - Entries in this part apply only to the revisions of the entries in the heading or in columns 1 and 2.

Note: The revision table, column 3, is not subject to this procedure; it represents a collation of the design review documents which are part of the quality documentation. The revision table (column 3) must be kept up to date by the manufacturer at all times.

1	2	3	4	5	6	7		8	9	10	11	12	13			14	15	16	17
Positions-Nr	Stückzahl	Stückgewicht	Bezeichnung	Abmessungen	Werkstoff	Anforderungen nach	Rev		PFP-Nr u WPP-Nr	Schmelzen-Nr Proben-Nr		Nachweise	Prüfvermerk Nachweiskontrolle	H	S				Hersteller Anlage/Projekt Komponente KKS Zeichnungs-Nr Auftrags-Nr Werkstoffliste WL-Nr Seite von

Rev.	Hersteller: Datum:	Erstellt von:	Geprüft QST:	Grund der Revision		S-Prüfvermerk	Dokumentationsfreigabe Hersteller Sachverständiger
00							
01							
02							
03							
04							

Form Sheet 2: Materials List (Explanation of the columns)

Columns 1 through 9 and 17 shall be filled in during the design review.

Columns 10 through 13 shall be filled in in the course of manufacture.

After all entries are complete on one form sheet page it shall be certified by stamp, date and name abbreviation in the space “document release" that the entries are correct and complete.

Column 1 The position number in accordance with the corresponding drawing.

Column 2 In the case of multiple similar parts having the same position number, the number of parts shall be listed here.

Column 3 If the weight of the item influences the extent of destructive testing then the weight shall be specified in this column (e.g. one tensile test per 0.5 t).

Column 4 Description of the item (e.g. nozzle, sheet)

Column 5 If the final dimensions of an item influence the extent of destructive or non-destructive testing then these shall be specified in this column.

Column 6 Specification of the material (e.g. 15 MnNi 6 3)

Column 7 Specification of the KTA safety standard or material specification including the state of revision applicable to the manufacture of the material

Column 8 open

Column 9 Specification of the materials test and specimen removal plan (WPP) in which the test of the materials for the items listed wider the position number are specified.

Column 10 The melt number and the test: specimen number of the product form shall be listed.

Column 11 open

Column 12 Specification of the certification number as per table of contents.

Column 13 Confirmation by stamp, abbreviated signature and date that the certification check was carried out and that the entries in columns 10 and 1e! are correct.

Columns 14-16 open

Column 17 Manufacturer = Name of the component manufacturer (abbreviation allowed)

Plant/project = corresponding identification of the plant (e.g. KKI2)

Component = specification of the component (e.g. personnel lock)

KISS = key in accordance with the identification system for power plants

Drawing camber = number In accordance with the overview drawing

Commission number = commission number of the manufacturer

1	2	3	4	5	6	7	8	9	10	11	12
Prüf-Nr	Anforderungen nach	Beschreibung	Prüfzeitpunkt	Prüfer	Prüfung durch	Nachweis-Schlüssel	Doku.-Ablage	Durchführungsvermerk	Nachweise	Bemerkungen	Hersteller: Anlage/Projekt: Komponente: KKS: Zugehörige WL-Nr.: Zeichnungs-Nr.: Auftrags-Nr.:

Rev	Hersteller Datum:	Erstellt von:	Geprüft QST:	Grund der Revision		S-Prüfvermerk	Dokumentationsfreigabe Hersteller	Prüffolgeplan
00								
01							Sachverständiger	PFP-Nr.:
02								
03								Seite: von:
04								

Form Sheet 3: Testing Schedule (Explanation of the columns)

Columns 1 through 8 shall be filled in during the design review.

Columns 9 through 11 shall be filled in in the course of manufacture.

After all test steps listed on one page of the formsheet are completed it shall be certified by stamp, date and name abbreviation in the space “document release” that the entries are correct and complete.

Column 1 Running test number of each fabrication step that has to be validated by testing or surveillance.

Column 2 indication of the specifications, work instructions, testing instructions, welding schedules, etc., which are to be employed during execution of a testing or surveillance step; the revision index need not be included.

Column 3 Description of the testing step.

Column 4 Indication of the point in timer of non-destructive examinations.

Column 5 Acronym for the type of testing involved:

US = ultrasonic testing	MP = magnetic particle examination
FE = liquid penetrant examination	DP = radiographic examination
MK = dimensional check	SUE = welding supervision.

Column 6 Indication of the participating parties: H = manufacturer; S = authorized expert.

Column 7 (left section) Description of the activities to be performed by the participants in accordance with column 6: DU = performance of test; TE = attendance during test; UEW = surveillance of test. This column needs to be filled in only if corresponding requirements are contained in safety standards.

(right section) Indication of the required type of test certification: ST = certification by stamp, date and signature (abbreviation allowed).

Column 8 indication of the type of documentation required: ./. = none required; E = final documentation; Z = intermediate documentation; collective certifications of tests and inspections for the final documentation are indicated as E/S and for the intermediate documentation as Z/S.

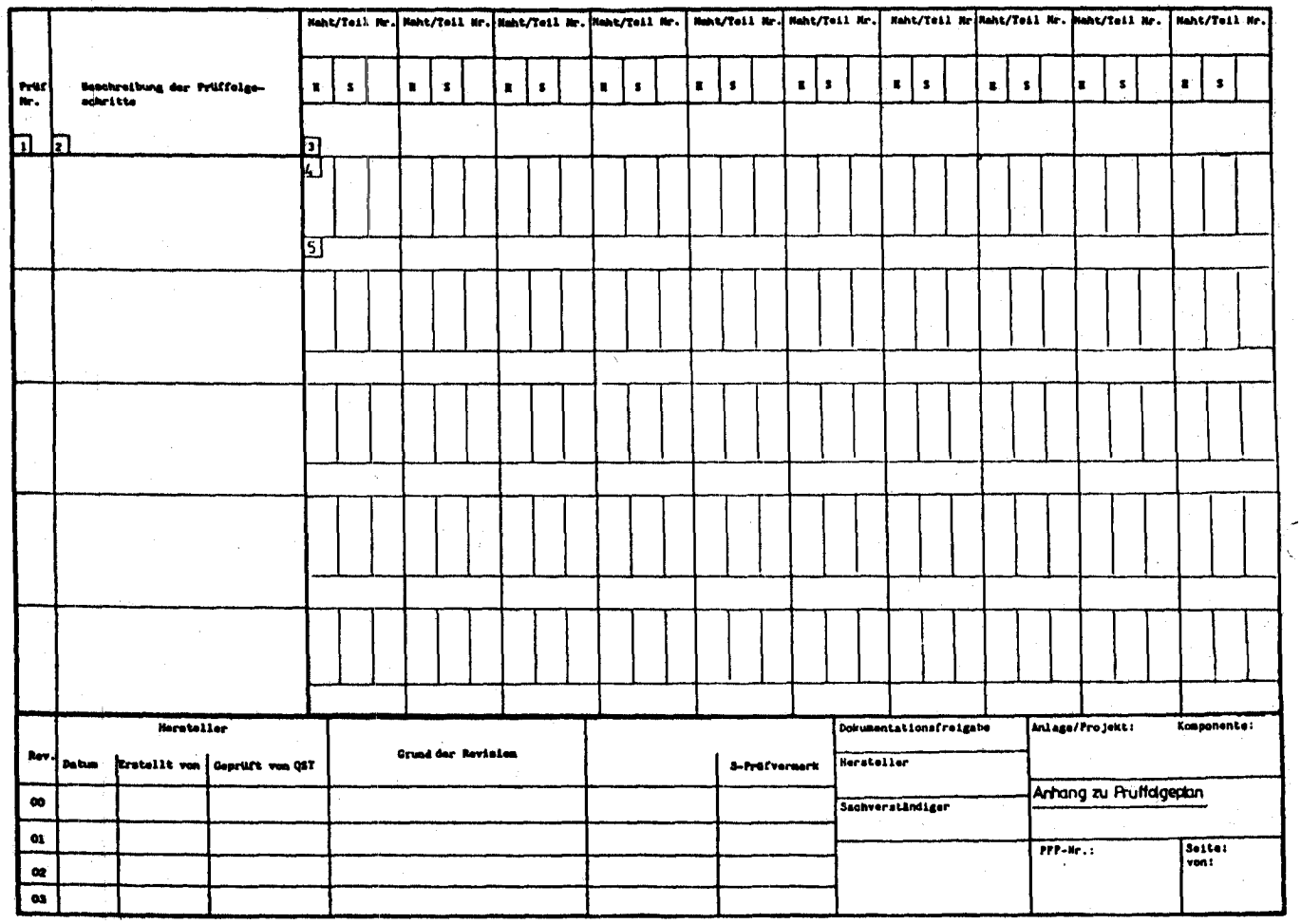
Column 9 Notwithstanding the requirements in accordance with column 8 (i.e. whether or not a certification is required) the execution of the test or inspection shall be certified by a stamp.

Column 10 If a certification is required, the identification number of the test certificate (e.g., US 4712) shall be entered in this column.

Column 11 Open for remarks in the course of manufacturing, e.g., indication of a nonconformance report or reference to repair documents.

Column 12

Manufacturer	=	Name of the component manufacturer (abbreviation allowed)
Plant/project	=	corresponding identification of the plant (e.g. KKI2)
Component	=	specification of the component (e.g. personnel lock)
KKS	=	key in accordance with the identification system for power plants
Corresponding WL number	=	corresponding materials list number
Drawing number	=	number in accordance with the overview drawing
Commission number	=	commission number of the manufacturer



Form Sheet 4: Appendix to the Testing Schedule (Explanation of the columns)

Columns 1 through 4 shall be filled in during the design review.

Columns 4 and 5 shall be filled in in the course of manufacture.

After all test steps listed on one page of the formsheet are completed it shall be certified by stop, date and name abbreviation in the space “document release” that the entries are correct and complete.

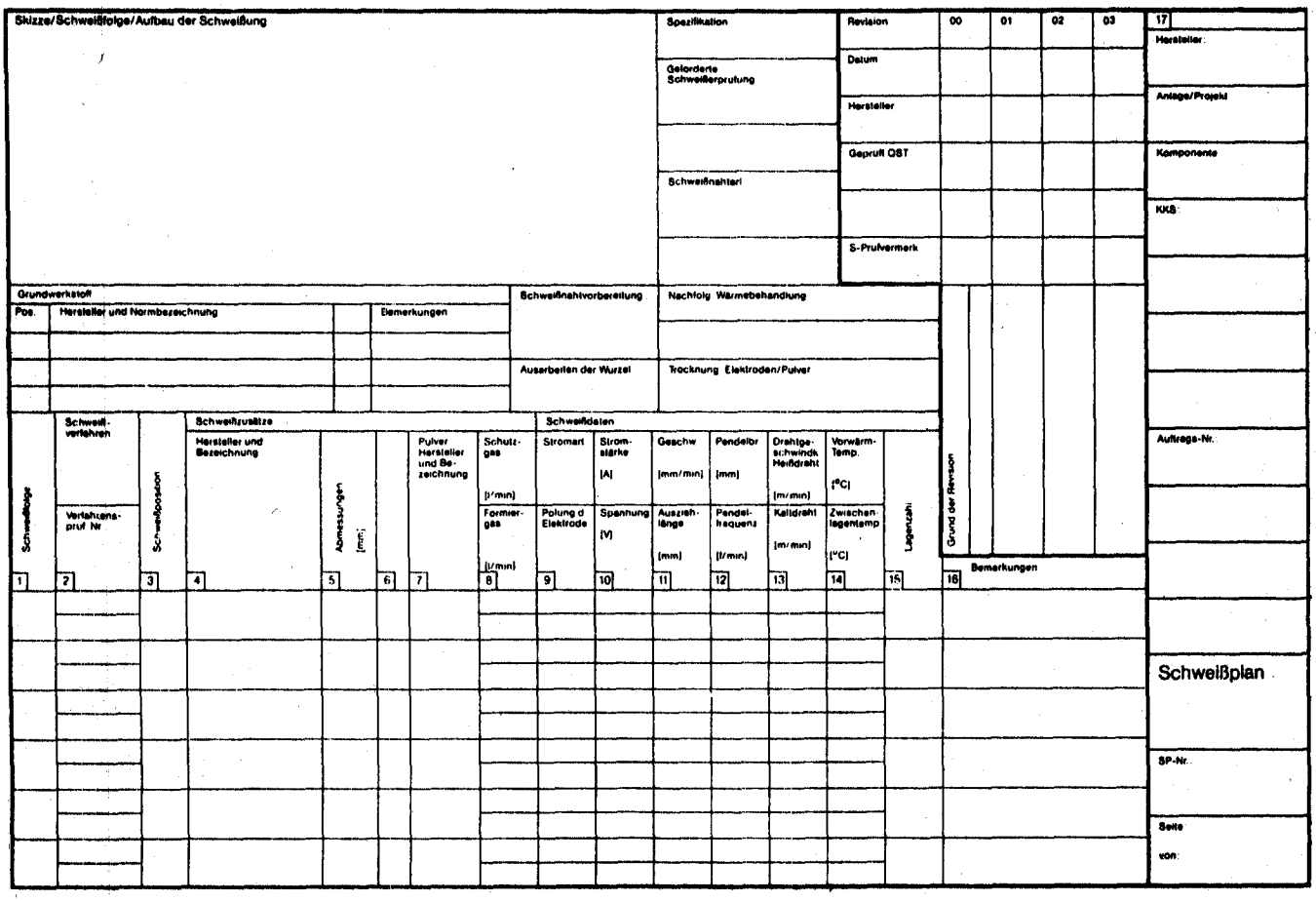
Column 1 Running test number in accordance with the corresponding testing schedule

Column 2 Short description of the testing step in accordance with the corresponding testing schedule.

Column 3 Identification of the component or weld seam involved.

Column 4 The participation is indicated by leaving the corresponding apace free. If no test or test participation is required, this is indicated by a diagonal line in the vertical column. In the course of manufacture the execution of the test is indicated by a stamp in the corresponding column H, S.

Column 5 If a certification is required, the identification number of the test certificate (e.g., US 4712) shall be entered in this column.



Form Sheet 5: Welding Schedule (Explanation of the columns)

Column 1 Indication of the bead sequence for building up the weld seam.

Column 2 Indication of the employed welding procedure and procedure qualification.

Column 3 Indication of the welding position.

Column 4 Indication of manufacturer and trade mark of the weld additives.

Column 5 Indication of the rod electrode dimension (e.g. 4 0 450 me).

Column 6 open

Column 7 Indication of manufacturer and trade mark of the flux.

Columns 8 through 15
These columns are filled in in accordance with the scope of application of the corresponding procedure qualification.

Column 16 Special remarks regarding the welding task (e.g. indication of a special bead overlap; grinding of end craters; immediatly following heat treatment) that take requirements of the component specification or safety standards into consideration.

Specification: Indication of the specification.

Required welder examination: Indication of the welder qualification (e.g. in accordance with DIN 8560) required for performing the welding task.

Type of weld seam: e.g., STN, RN, LN.

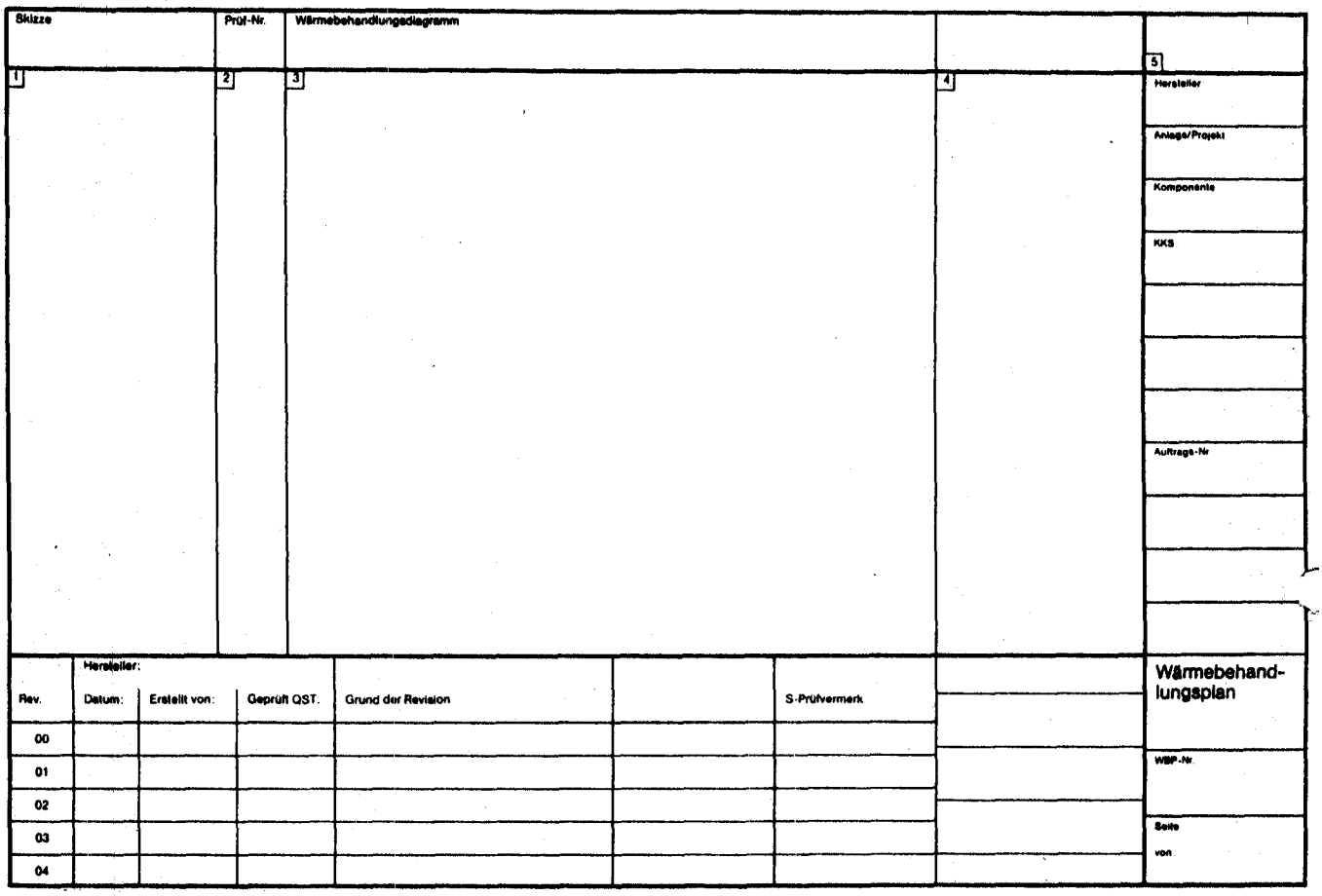
Post welding heat treatment: Indication of the post welding heat treatment or identification of the corresponding heat treatment schedule.

Baking of electrodes or flux: Indication of the baking temperature and duration.

Weld salon preparation: Type of (preparation to be employed (mechanical or thermal).

Hollowing out the root: Method of hollowing to be employed (mechanical or thermal).

Column 17
Manufacturer = Name of the component manufacturer (abbreviation allowed)
Plant/project = corresponding identification of the plant (e.g. KKI2)
Component = specification of the component (e.g. personnel lock)
KKS = key in accordance with the identification system for power plants
Commission number = commission number of the manufacturer



Form Sheet 6: Heat Treatment Schedule (Explanation of the columns)

Column 1 If necessary a sketch of the component to be heat treated with the arrangement of the thermal elements.

Column 2 open

Column 3 Graphic representation of the entire heat treatment with indication of the speed of heating up, the holding time, holding temperature and the speed of cooling down.

Column 4 open

Column 5

Manufacturer	=	Name of the component manufacturer (abbreviation allowed)
Plant/project	=	corresponding identification of the plant (e.g. KKI2)
Component	=	specification of the component (e.g. personnel lock)
KKS	=	key in accordance with the identification system for power plants
Commission number	=	commission number of the manufacturer

1	2	3	4	5	6	7	8	9	10		11	12	13	14	15
Prüf-Nr	Anforderungen nach	Beschreibung	Anzahl der Proben/Satz	Probenabmessungen	Prüftemperatur (°C)	Probenlage	Probenkennzeichnung	Prüfung durch	Nachweisschlüssel		Doku-Ablage	Durchführungsvermerk	Nachweise	Bemerkungen	Hersteller Anlage/Projekt Komponente KKS Zeichnungs-Nr Auftrags-Nr

Rev	Hersteller Datum	Erstellt von	Geprüft QST	Grund der Revision		S-Prüfvermerk	Dokumentationsfreigabe Hersteller Sachverständiger	Werkstoffprüf- u. Probenentnahmeplan WPP-Nr Seite von
00								
01								
02								
03								
04								

Form Sheet 7: Materials Test and Specimen Removal Plan (Explanation of the columns)

Columns 1 through 11 and 15 shall be filled in during the design review.

Columns 12 through 14 shall be filled in in the course of manufacture.

After all test steps listed on one page of the formsheet are completed it shall be certified by stamp, date and name abbreviation in the space “document release”, that the entries are correct and complete.

Column 1 Running number of the tests beginning with the test number 1.

Column 2 Indication of the standards, work instructions, testing instructions, welding schedules, etc., which are to be employed during execution of a testing or surveillance -step; the revision index need not be included.

Column 3 Indication of the test (e.g. tensile test, notch bend test) and surveillance (e.g. tempering).

Column 4 Number of test specimens per testing lot (e.g. one set of notch bend test specimens per melt / per lot / per 0.5 t).,

Column 5 Indication of the dimensions of the test specimens.

Column 6 Indication of the testing temperature.

Column 7 Indication of the test specimen location (e.g. inside, outside, middle, 1/2 T, 1/4 T) and their direction (e.g. tangential, radial, transverse, longitudinal).

Column 8 Identification of the test specimen with, e.g., a correlation to the specimen removal location.

Column 9 Indication of test participation: H = manufacturer; S = authorized expert.

Column 10 (left section) Description of the activities to be performed by the participants in accordance with column 9: this column needs to be filled in only if corresponding requirements are contained in safety standards.

(right section) Indication of the required type of test certification: ST = certification by stamp, date and signature (abbreviation allowed); AN = issuer of the test certificate.

Column 11 Indication of the type of documentation required.

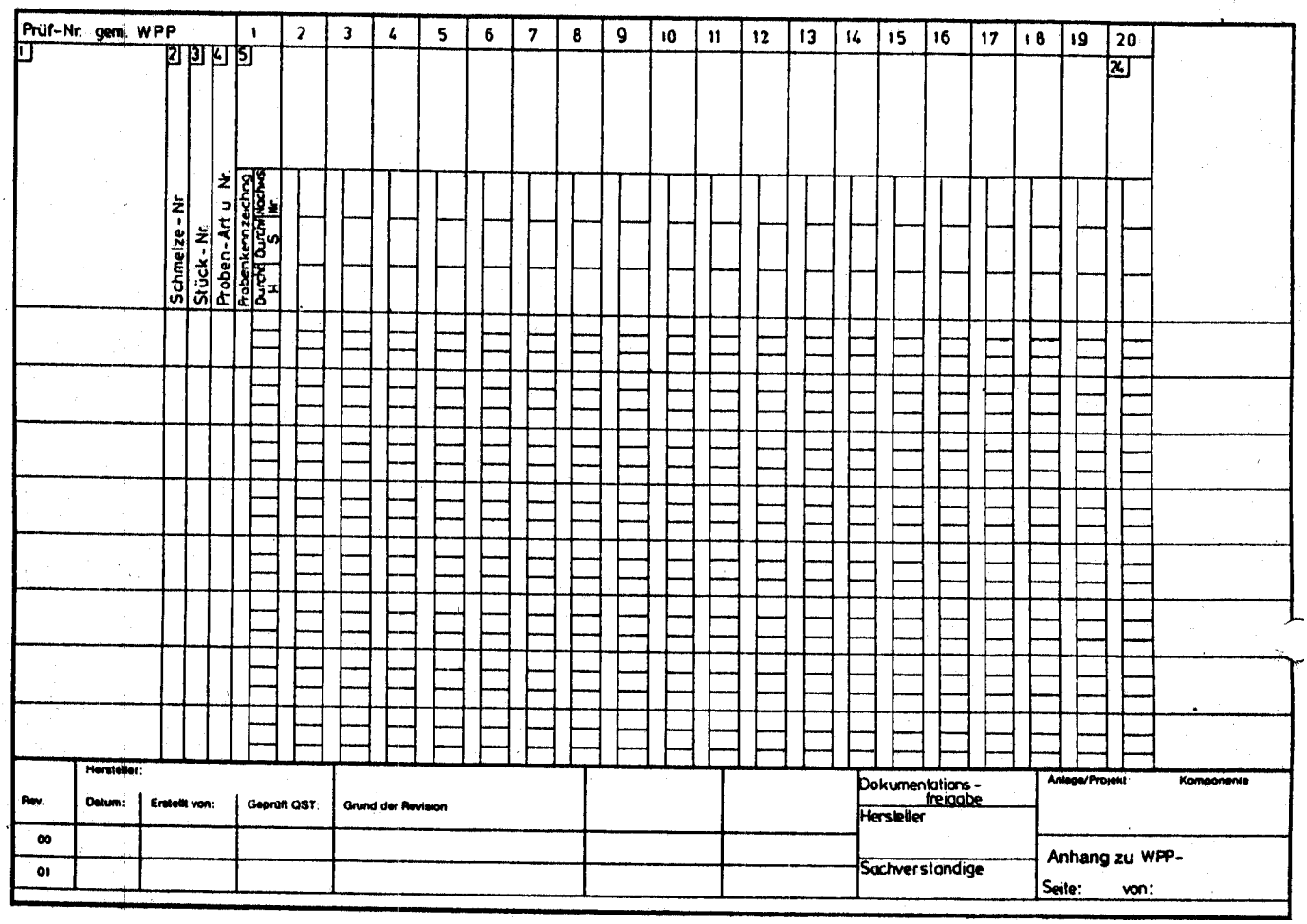
Column 12 Notwithstanding the requirements in accordance with column 11 (i.e. whether or not a certification is required) the execution of the test shall be certified by a stamp.

Column 13 If a certification is required, the identification number of the test certificate (e.g., MTB 68) shall be entered in this column.

Column 11 Open for remarks in the course of manufacturing, e.g., indication of a nonconformance report or reference to repair documents.

Column 12

Manufacturer	=	Name of the component manufacturer (abbreviation allowed)
Plant/project	=	corresponding identification of the plant (e.g. KKI2)
Component	=	specification of the component (e.g. personnel lock)
KKS	=	key in accordance with the identification system for power plants
Corresponding WL number	=	corresponding materials list number
Drawing number	=	corresponding drawing the contains further information on, e.g., the product form, production weld test.
Commission number	=	commission number of the manufacturer



Form Sheet 8: Appendix to the Material Test and Specimen Removal Plan (Explanations)

This form shoot serves the purpose of giving a concise overview of the certification of tests on a number of identical product forms; it can be continuously filled in during manufacture.

Column 1 Indication of the product form, its dimensions and if necessary position number.

Columns 5-24 Indication of the tests to be performed in accordance with the motorists test and specimen removal plan, of the identification marking of the test specimens, of the mark of the manufacturer (H) or the authorized expert (S) that the tests were performed.

	Inhaltsverzeichnis	IVZ Seite: von:
Anlage:	Komponente:	Erzeugnisform/Bauteil/Baugruppe :
KKS		
Hersteller Auftr.-Nr.:		

1 Dokumentationsunterlage (Endablage)	2 Seitenanzahl	3 PFP-Nr.	4 WPP- Nr.	5 Nachweis Nr.	

6 Unterschrift (H):	Unterschrift (S):	
Ort:	Ort:	
Datum:	Datum:	

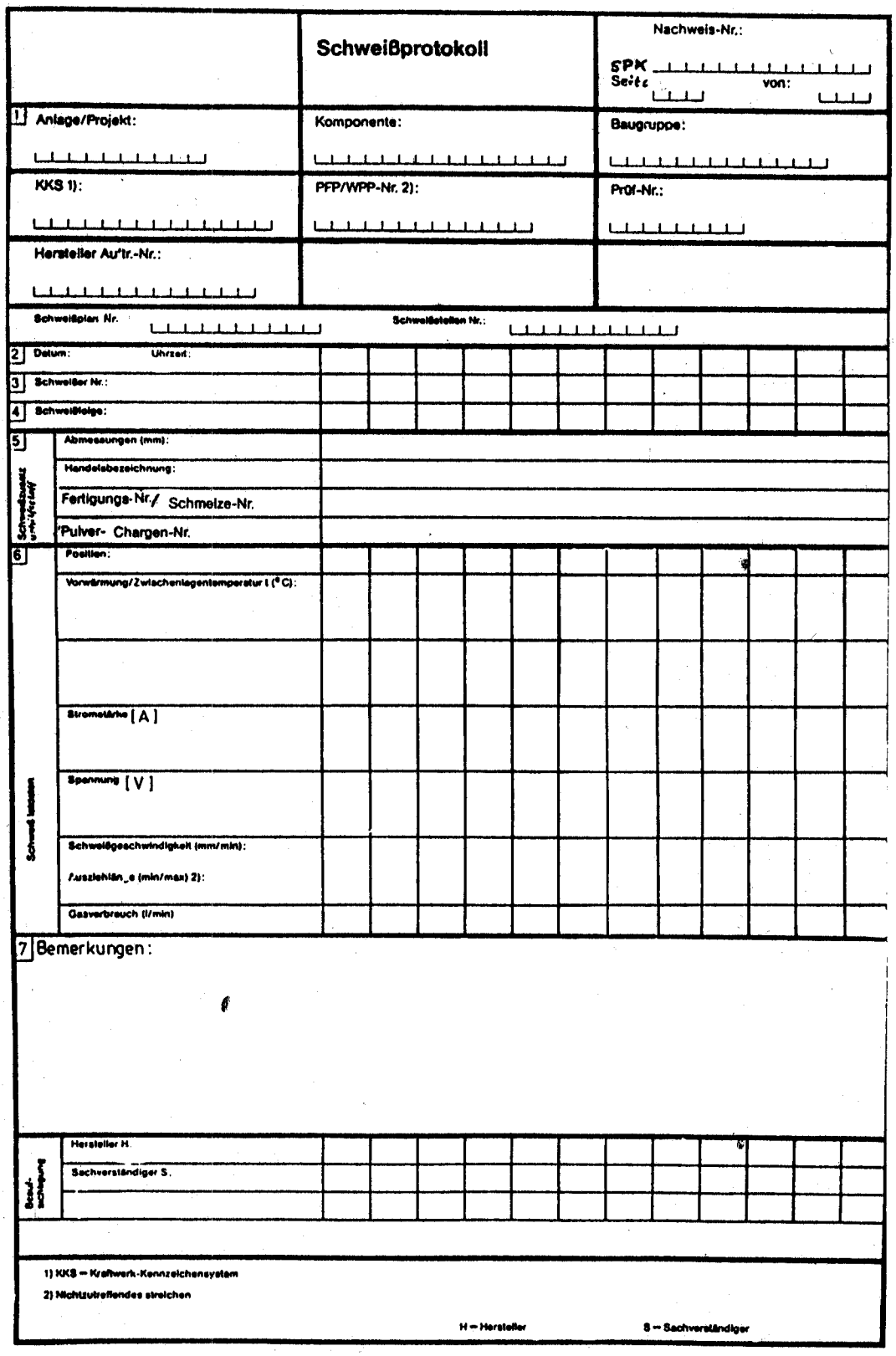
H = Hersteller S = Sachverständiger

KKS = Kraftwerk-Kennzeichensystem

Form Sheet 9: Table of Contents (Explanations)

The table of contents shall list all design review documents, material certificates, test report and attestations. When test certificates, test report and attestations are entered in the list, the running certificate number is simultaneously issued and listed in column 5.

Columns 1 and 2	All design review documents.
Columns 1, 2, 4 and 5	When entering material certificates, these columns are fitted in with a correct correlation to the materials test and specimen removal plan, and the running number of the test certificate-is issued.
Columns 1 through 4	When entering test records and attestations, these columns are filled in with a correct correlation to the materials test and specimen removal plan and to the tea sequence schedule, and the running number of the test certificate is issued.
Column 6	open
Column 7	In the course of the documentation review the table of contents is checked whether it is complete and correct.



	Schweißprotokoll	Nachweis-Nr.: SPK Seite ___ von: ___
1 Anlage/Projekt:	Komponente:	Baugruppe:
KKS 1):	PFP/WPP-Nr. 2):	Prüf-Nr.:
Hersteller Auftr.-Nr.:		

Schweißplan Nr.: Schweißstellen Nr.:

2 Datum: Uhrzeit:													
3 Schweißer Nr.:													
4 Schweißfolge:													
Schweißzusatz und -hilfsstoff: 5 Abmessungen (mm):													
Handelsbezeichnung:													
Fertigungs-Nr./ Schmelze-Nr.													
Pulver- Chargen-Nr.													
Schweißdaten: 6 Position:													
Vorwärmung/Zwischenlagentemperatur I (°C):													
Stromstärke [A]													
Spannung [V]													
Schweißgeschwindigkeit (mm/min):													
Auszieh-/Pendelgeschwindigkeit (min/max) 2):													
Gasverbrauch (l/min)													

7 Bemerkungen:

Bestätigung													
Hersteller H.													
Sachverständiger S.													

1) KKS = Kraftwerk-Kennzeichensystem

2) Nichtzutreffendes streichen

H = Hersteller S = Sachverständiger

Form sheet 10: Welding Record (Explanation)

If within a prescribed welding sequence any changes become necessary, then for each change
Column 2 shall reflect the corresponding date and time,
Columns 3 through 6 the type of change.

Form Sheet 11: Weld Location list

Schweiß-stellen-Nr.	Schweißplan-Nr.	Schweißzusätze und -hilfsstoffe			Schweißprotokoll-Nr.	Arbeitsprüfung-Nr.	Prüfvermerk für schweißplangerechte Ausführung			Bemerkungen
		Bezeichnung	Fertigungs-einheit-Nr.	Pulver-Fertigung-Nr.			H	S		

Hersteller:	Anlage:	PFP Nr.:	Dokumentationsfreigabe			**Schweißstellenerfassungsliste**	
			H	S		Nr.:	Seite: von:
Komponente:	KKS						

Protokoll über Ultraschallprüfung
Ultrasonic Examination Record

Nachweis-Nr.: *Record No.:*
US
Seite: *Page:* von: *of:*

1 Anlage: *Plant:*	Komponente: *Component:*	Erzeugnisform/Bauteil/Baugruppe [2]: *Semi-Finished Product/Part/Subassembly [2]:*
KKS [1]/Typ und DN [3]: *KKS [1] Key/Type Desig. and DN [3]:*	PFP/WPP/WB [2]: *PFP or WPP or WB [2]:*	Prüf-Nr.: *Test or Exam. No.:*
Hersteller Auftr.-Nr.: *Manufacturer's Order No.:*	Auftr.-Nr.: *Order No.:*	Werk-[3]/Kennzeichnung-Nr.[4]: *Manuf. Serial No. [3]/Ident. No.[4]:*
Spezifikation: Rev.: *Specification:*	Prüfvorschrift: Rev.: *Process Spec.:*	Prüfanweisung: Rev.: *Examination Procedure:*
Zeichnungs-Nr.: Rev.: *Drawing No.:*	Werkstoff: *Material:*	Prüfgegenstand: *Object:*

2 Oberflächenzustand-Prüffläche: *Surface Condition - Contact Surface:* – Gegenfläche: *– Opposite Surface:*

Prüfgerätetyp/Hersteller: *Type of Equipment and Manufacturer:* Koppelmittel: *Couplant:* Prüfklasse: *Quality Level:*

3

Einschallposition *Scanning Direction*	Prüfkopftyp/Bezeichnung *Type of Search Unit/Designation*	Angepaßt *Adapted*	Entfernungsjustierung *Calibration of Sweep Range*		Empfindlichkeitsjustierung *Calibration of Sensitivity*				Registrierverstärkung für max. auszuwertenden Schallweg Smax *Increase in Gain for Recording at max. Beam Path Smax*					Summe A bis C *Total of A to C*	Schallschwächung *Soundattenuation*
			Prüfbereich *Range* mm	Art (S, PA, vPA) *Method (BP, PD, SPD)*	Bewertungsmethode (AVG, BL, BE) *Evaluation Meth.; Reference Line Meth. (Echo Method (DGS, RL, RE)*	Justierkörper *Calibration Block*	Justierreflektor *Calibration Reflector*	Schallweg zum Justierreflektor *Beam Path to Calibration Reflector* mm	Registrierg. (KSR, %BL, %BE) *Rec. Threshold (CRR, %RL, %RE)*	Schallweg Smax *Beam Path Smax* mm	A ΔV aus AVG-Diagramm bzw. Prüfvorschrift (BE/BL) *ΔV from DGS diagram or Process Spec (RE, RL)* dB	B K2 Korrekturfaktor für K1 und K2 *Correction Value for K1 and K2* dB	C Transfer [5] *Transfer Correction [5]* dB	dB	dB/m

4 Prüfumfang: *Extend of Examination:*

- ☐ Erfüllt/Keine registrierpflichtigen Anzeigen *Acceptable/No Recordable Indications*
- ☐ Erfüllt/Mit registrierpflichtigen Anzeigen *Acceptable/Recordable Indications*
- ☐ Nicht erfüllt *Not Acceptable*

5		
Unterschrift (H): *Signature (H):*	Unterschrift (S): *Signature (S):*	Unterschrift *Signature*
Ort: *Place:*	Ort: *Place:*	Ort: *Place:*
Datum: *Date:*	Datum: *Date:*	Datum: *Date:*

[1] KKS = Kraftwerk-Kennzeichensystem *Power Plant Identification System*
[2] Nichtzutreffendes streichen *Delete where not applicable*
[3] Nur für Rohrleitungen, Armaturen und Pumpen *For pipes, valves and pumps only*
[4] z. B. Schmelze-Nr. oder Coupon-Nr., nicht zutreffend in Verbindung mit PFP/WPP *Not necessary to enter heat or coupon No., etc., if PFP or WPP enclosed*
[5] Ankopplungs- und Schallschwächungsunterschiede für Smax *Coupling and Acoustic Differencies for Smax*
H = Hersteller *Manufacturer*
S = Sachverständiger *Auth. Insp. Agency*

Form Sheet 12.1: Test Record of the Ultrasonic Examination

	Protokoll über Ultraschallprüfung *Ultrasonic Examination Record*	Nachweis-Nr.: *Record No.:* US Seite: *Page:* von: *of:*
1 Anlage: *Plant:*	Komponente: *Component:*	Erzeugnisform/Bauteil/Baugruppe [2]: *Semi-Finished Product/Part/Subassembly [2]:*
KKS [1]/Typ und DN [3]: *KKS [1] Key/Type Desig. and DN [3]:*	PFP/WPP/WB [2]: *PFP or WPP or WB [2]:*	Prüf-Nr.: *Test or Exam. No.:*

2

Schweißnaht Nr./Bauteil Nr. *Weld or Part No.*	Anzeige Nr. *Indication No.*	Einschallposition *Scanning Direction*	Prüfkopftyp/Bezeichnung *Search Unit Type/Designation*	Lage und Orientierung der Anzeige *Location and Orientation of Indication*					Ergebnis *Result*		Beurteilung *Evaluation*		Bemerkungen *Remarks*
				Schallweg, PA, vPA *Beam Path, PA, SPD* mm	Abstand vom Bezugspunkt *Distance from Reference Point* X mm	Y mm	Tiefe von *Depth from* Innen *Inside* mm	Außen *Outside* mm	Längs [4] *Parallel [4]*	Quer [4] *Transverse [4]*	Überschreit. der Registriergrenze *dB above Recording Threshold* dB	Registrierlänge/-fläche *Recording Length or Area* mm / mm²	Erfüllt *Acceptable*	Nicht erfüllt *Not Acceptable*	

3 Unterschrift (H): *Signature (H):*	Unterschrift (S): *Signature (S):*	Unterschrift *Signature*
Ort: *Place:*	Ort: *Place:*	Ort: *Place:*
Datum: *Date:*	Datum: *Date:*	Datum: *Date:*

[1] KKS = Kraftwerk-Kennzeichensystem *Power Plant Identification System*
[2] Nichtzutreffendes streichen *Delete where not applicable*
[3] Nur für Rohrleitungen, Armaturen und Pumpen *For pipes, valves and pumps only*
[4] Nur für Schweißnähte *For welds only*

H = Hersteller *Manufacturer*
S = Sachverständiger *Auth. Insp. Agency*

Form Sheet 12.2: Test Record on the Ultrasonic Examination

	Protokoll über Ultraschallprüfung ***Ultrasonic Examination Record***	Nachweis-Nr.: *Record No.:* US Seite: *Page:* ____ von: *of:* ____
1 Anlage: *Plant:*	Komponente: *Component:*	Erzeugnisform/Bauteil/Baugruppe [2]: *Semi-Finished Product/Part/Subassembly [2]:*
KKS [1]/Typ und DN [3]: *KKS [1] Key/Type Design. and DN [3]:*	PFP/WPP/WB [2]: *PFP or WPP or WB [2]:*	Prüf-Nr.: *Test or Exam. No.:*
2 Skizze: *Sketch:*		
3 Bemerkungen: *Remarks:*		
4 Unterschrift (H): *Signature (H):* Ort: *Place:* Datum: *Date:*	Unterschrift (S): *Signature (S):* Ort: *Place:* Datum: *Date:*	Unterschrift *Signature* Ort: *Place:* Datum: *Date:*

[1] KKS = Kraftwerk-Kennzeichensystem *Power Plant Identification System*
[2] Nichtzutreffendes streichen *Delete where not applicable*
[3] Nur für Rohrleitungen, Armaturen und Pumpen *For pipes, valves and pumps only*

H = Hersteller *Manufacturer*
S = Sachverständiger *Auth. Insp. Agency*

Form Sheet 12.3: Test Record of the Ultrasonic Examination

	Protokoll über Oberflächenrißprüfung ***Surface Crack Examination Record***	Nachweis-Nr.: *Record No.:* MP[2] FE[2] Seite: *Page:* von: *of:*
1 Anlage: *Plant:*	Komponente: *Component:*	Erzeugnisform/Bauteil/Baugruppe[2]: *Semi-Finished Product/Part/Subassembly[2]:*
KKS[1]/Typ und DN[3]: *KKS[1] Key/Type Desig. and DN[3]:*	PFP/WPP/WB[2]: *PFP or WPP or WB[2]:*	Prüf-Nr.: *Test or Exam. No.:*
Hersteller Auftr.-Nr.: *Manufacturer's Order No.:*	Auftr.-Nr.: ..... *Order No.:*	Werk-[3]/Kennzeichnung-Nr.[4]: *Manuf. Serial No.[3]/Ident. No.[4]:*
Spezifikation: Rev.: *Specification:*	Prüfvorschrift: Rev.: *Process Spec.:*	Prüfanweisung: Rev.: *Examination Procedure:*
Zeichnungs-Nr.: Rev.: *Drawing No.:*	Werkstoff: *Material:*	Prüfgegenstand: *Object:*

2 Oberflächenzustand: *Surface Condition:*		Prüftemperatur T (°C): *Surface Temperature:*	T < 5 5 ≤ T ≤ 50 T > 50
3 MP	Magnetisierungsart (DIN 54130)[5]: *Method of Magnetisation (DIN 54130)[5]:*	Prüfgeräte Typ/Hersteller: *Type of Equipment and Manufacturer:*	
Magnetpulverbezeichnung/Hersteller: *Magnetic Particle Powder Trade Name and Manufacturer:*		Trägerflüssigkeit und Zusätze: *Carrier Fluid and Additives:*	
Kontrastmittel: *Contrast Medium:*		UV-Prüflampe/Typ/Hersteller: *UV Lamp Trade Name and Manufacturer:*	
Elektroden-/Polabstand bei SS/JE[5]: *Prod Spacing/Pole Spacing for SS/JE[5]:*	Anzahl der Windungen bei LK[5]: *Number of Wrappings for LK[5]:*	Stromstärke (A) bei LK/SS[5]: *Current for LK/SS[5]:* Spannung (V) bei LK/SS[5]: *Voltage for LK/SS[5]:*	
Tangent. Feldstärke (kA/m): *Tangent. Field Strength:* Meßgerät: *Measuring Tool:*	Entmagnetisierung: *Demagnetisation:*	ja *yes* ☐ nein *no* ☐	Elektrodenmaterial bei SS[5]: *Prod Tip Material for SS[5]:*
4 FE	Prüfmittelsystem (DIN 54152)[5]: *Examination System (DIN 54152)[5]:*	UV-Prüflampe/Typ/Hersteller: *UV Lamp Trade Name and Manufacturer:*	
Eindringmittel/Hersteller: *Penetrant and Manufacturer:*	Zwischenreiniger/Hersteller: *Surface Penetrant Remover and Manufacturer:*	Entwickler/Hersteller: *Developer and Manufacturer:*	
Vorreinigung: *Precleaning:*	Trocknung: *Drying after Precleaning:*	Auftragart-Eindringmittel: *Penetrant Application:* Eindringdauer (min): *Dwell Time (min):*	
Zwischenreinigung: *Surface Penetrant Removal:*	Trocknung: *Drying after Surface Penetrant Removal:*	Auftragart-Entwickler: *Developer Application:*	
Beurteilungszeitpunkt (min): *Evaluation Time (min):*			
Wesentliche Änderungen: *Major Changes:*	ja/*yes* / nein/*no*		

5 Beurteilung: *Evaluation:*
☐ Erfüllt/Keine Anzeigen *Acceptable/No Indications*
☐ Nicht erfüllt/Unzulässige Anzeigen gemäß Anlage *Not Acceptable/Unacceptable Indications as given in Appendix*
☐ Kontrollprüfung erforderlich *Reexamination required*

6 Prüfumfang: *Extend of Examination:*	Bemerkungen: *Remarks:*

7 Unterschrift (H): *Signature (H):*	Unterschrift (S): *Signature (S):*	Unterschrift *Signature*
Ort: *Place:*	Ort: *Place:*	Ort: *Place:*
Datum: *Date:*	Datum: *Date:*	Datum: *Date:*

[1] KKS = Kraftwerk-Kennzeichensystem *Power Plant Identification System*
[2] Nichtzutreffendes streichen *Delete where not applicable*
[3] Nur für Rohrleitungen, Armaturen und Pumpen *For pipes, valves and pumps only*
[4] z. B. Schmelze-Nr. oder Coupon-Nr. nicht zutreffend in Verbindung mit PFP/WPP *Not necessary to enter heat or coupon No., etc., if PFP or WPP enclosed*
[5] Kurzzeichen nach DIN 54130 oder nach DIN 54152 Teil 1 *Designation as per DIN 54130 or as per DIN 54152 Part 1*

H = Hersteller *Manufacturer*
S = Sachverständiger *Auth. Insp. Agency*

Form Sheet 13: Test Record of the Surface Crack Examination

	Protokoll über Durchstrahlungsprüfung Schweißnähte ***Radiographic Examination Record for Welds***	Nachweis-Nr.: *Record No.:* DP Seite: von: *Page: of:*
1 Anlage: *Plant:*	Komponente: *Component:*	Erzeugnisform/Bauteil/Baugruppe [2]: *Semi-Finished Product/Part/Subassembly [2]:*
KKS [1]/Typ und DN [3]: *KKS [1] Key/Type Desig. and DN [3]:*	PFP/WPP/WB [2]: *PFP or WPP or WB [2]:*	Prüf-Nr.: *Test or Exam. No.:*
Hersteller Auftr.-Nr.: *Manufacturer's Order No.:*	Auftr.-Nr.: ..... *Order No.:*	Werk-[3]/Kennzeichnung-Nr.[4]: *Manuf. Serial No. [3]/Ident. No. [4]:*
Spezifikation: Rev.: *Specification:*	Prüfvorschrift: Rev.: *Process Spec.:*	Prüfanweisung: Rev.: *Examination Procedure:*
Zeichnungs-Nr.: Rev.: *Drawing No.:*	Werkstoff: *Material:*	Prüfgegenstand: *Object:*

2 Oberflächenzustand-Außenseite: *Surface Condition Outside:* — Innenseite: *Inside:*

Prüfplan Nr. (Filmlageplan): *Film Location Plan No.:*	Röntgengerätehersteller und -typ: *X-Ray Equipment Manufacturer and Type:*
Strahlenquelle: *Radiation Source:*	Abmessungen des Brennfleckes/Strahlenquelle: *Source/Focal Spot Size:* ____ × ____ mm × mm
Geforderte Prüfklasse nach DIN 54 111 Teil 1: *Required Quality Level as per DIN 54 111, Part 1:*	Filmhersteller und -typ *Film Brand and Type:*
Aufnahmeanordnung nach DIN 54 111 Teil 1, Bild: *Exposure Arrangement as per DIN 54 111, Part 1, Picture:*	Folienart und -dicke: vorne: hinten: *Screen Material and Thickness: front: back:*

3

Schweißnaht Nr. *Weld No.* Bauteil Nr. *Part No.*	Prüfabschnitt/Filmbezeichnung *Weld Section/Film Identification*	Werkstückdicke *Section Thickness* mm	Außendurchmesser [3] *Outside Diameter [3]* mm	Röhrenspannung *Tube Voltage* kV	Röhrenstrom *Tube Current* mA	Aktivität *Activity* Ci	Belichtungszeit *Exposure Time* min	Abstand Strahlenquelle Werkstückoberfläche *Source-to-Object Distance* mm	Bildgüteprüfkörper nach DIN 54 109 Teil 1 *Image Quality Indicator as per DIN 54 109, Part 1*	Filmseite *Film Side*	Filmfern *Source Side*	Bemerkungen *Remarks*

4 Prüfumfang: *Extend of Examination:*

- ☐ Erfüllt/Ohne Befunde *Acceptable/Without Discontinuities*
- ☐ Erfüllt/Mit zulässigen Befunden *Acceptable/With Acceptable Discontinuities*
- ☐ Nicht erfüllt/Unzulässige Befunde *Not Acceptable/With Unaccept. Discontinuities*

5

	Bewertung/*Evaluation:*	Bewertung/*Evaluation:*
Unterschrift (H): *Signature (H):*	Unterschrift (S): *Signature (S):*	Unterschrift *Signature*
Ort: *Place:*	Ort: *Place:*	Ort: *Place:*
Datum: *Date:*	Datum: *Date:*	Datum: *Date:*

[1] KKS = Kraftwerk-Kennzeichensystem *Power Plant Identification System*
[2] Nichtzutreffendes streichen *Delete where not applicable*
[3] Nur für Rohrleitungen, Armaturen und Pumpen *For pipes, valves and pumps only*
[4] z. B. Schmelze-Nr. oder Coupon-Nr., nicht zutreffend in Verbindung mit PFP/WPP *Not necessary to enter heat or coupon No., etc., if PFP or WPP enclosed*

H = Hersteller *Manufacturer*
S = Sachverständiger *Auth. Insp. Agency*

Form Sheet 14.1: Test Record of the Radiographic Examination of Held Seams

Protokoll über Durchstrahlungsprüfung Schweißnähte
Radiographic Examination Record for Welds

Nachweis-Nr.: *Record No.:*
DP
Seite: *Page:* von: *of:*

1 Anlage: *Plant:*
Komponente: *Component:*
Erzeugnisform/Bauteil/Baugruppe [2]: *Semi-Finished Product/Part/Subassembly [2]:*
KKS [1]/Typ und DN [3]: *KKS [1] Key/Type Design. and DN [3]:*
PFP/WPP/WB [2]: *PFP or WPP or WB [2]:*
Prüf-Nr.: *Test or Exam. No.:*

2

Schweißnaht Nr. *Weld No.* Bauteil Nr. *Part No.*	Prüfabschnitt/ Filmbezeichnung *Weld Section/ Film Identification*	Schwärzung *Density*		Bildgütezahl (BZ) nach DIN 54 109 [4] *Image Quality Index as per DIN 54 109* [4]		Befund *Description of Discontinuities*															Beurteilung *Evaluation*		Bemerkungen *Remarks*	Länge unzulässiger Befunde mit Längenausdehnung *Length of Unacceptable Linear Discontinuities*
						Kurzzeichen nach DIN 8524 *Designation as per DIN 8524*													Filmfehler *Film Flaw*	Ohne Befund *Without Discontinuity*	Erfüllt *Acceptable*	Nicht erfüllt *Not Acceptable*		
		Minimum	Maximum	Gefordert *Specified*	Erreicht *Achieved*	A	Aa	Ab	Ba	C	D	Ea	Eb	Ec	F	G	H	J	K					

3 Bemerkungen: *Remarks:*

4

Unterschrift (H): *Signature (H):*	Unterschrift (S): *Signature (S):*	Unterschrift *Signature*
Ort: *Place:*	Ort: *Place:*	Ort: *Place:*
Datum: *Date:*	Datum: *Date:*	Datum: *Date:*

[1] KKS = Kraftwerk-Kennzeichensystem *Power Plant Identification System*
[2] Nichtzutreffendes streichen *Delete where not applicable*
[3] Nur für Rohrleitungen, Armaturen, Pumpen *For pipes, valves, pumps only*
[4] ggf. Hinweis auf Vergleichsaufnahme in Spalte „Bemerkung" *Refer to reference radiograph when applicable in column „Remarks"*

H = Hersteller *Manufacturer*
S = Sachverständiger *Auth. Insp. Agency*

Form Sheet 14-2: Test Record of the Radiographic Examination of Held Seams

APPENDIX B

Regulations Referred to in this Safety Standard

Regulations referred to in this safety standard are valid only in the version 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.

KTA 1408.1	(6/85)	Quality Assurance of Weld Filler Materials and Weld Additives for Pressure and Activity Retaining Components in Nuclear Power Plants; Part 1: Qualification Testing
KTA 1408.2	(6/85)	Quality Assurance of Weld Filler Materials and Weld Additives for Pressure and Activity Retaining Components in Nuclear Power Plants; Part 2: Manufacture
KTA 1408.3	(6/85)	Quality Assurance of Weld Filler Materials and Weld Additives for Pressure and Activity Retaining Components in Nuclear Power Plants; Part 3: Processing
DIN 8560	(5/82)	Qualification Testing of Welders for Welding Steel
DIN 8563 Part 3	(10/85)	Quality Assurance of Welding Operations; Fusion-Welded Joints for Steels; Requirements, Evaluation Categories
DIN 18 800 Part 7	(5/83)	Steel Constructions; Manufacturing, Qualification Testing for Welding
DIN 50 049	(7/82)	Documents on Materials Testing
DIN 50 115	(2/75)	Testing of Metallic Materials; Notch Bend Testing
DIN 50 120 Part 1	(9/75)	Testing of Steel; Tensile Tests on Weld Seams, Fusion Welded Butt Welds
DIN 50 121 Part 1	(1/78)	Testing of Metallic Materials; Technological Banding Test on Welded Joints and Weld Platings; Fusion Welded Joints
DIN 50 125	(3/86)	Testing of Metallic Materials; Tensile Test Specimens
DIN 50 133	(2/85)	Testing of Metallic Materials; Vickers Hardness Test; Testing Force Range: HV 0.2 to HV 100 100
DIN 50 145	(5/75)	Testing of Metallic Materials; Tensile Test
DIN 54 109 Part 2	(10/64)	Nondestructive Testing; Picture Quality of X-Ray and Gamma Ray Radiography on Metallic Materials, Guidelines for Establishing Picture Quality Categories
DIN 54 111 Part 1	(3/77)	Nondestructive Testing Procedures; Examination of Metallic Materials with X-Ray and Gamma Ray Radiography, Taking of Radiographic Pictures
DIN 54 120	(7/73)	Nondestructive Testing of Materials; Calibration Block 1 and its Use for Adjusting and Checking Ultrasonic Echo Pulse Equipment
DIN 54 122	(12/73)	Nondestructive Testing of Materials; Calibration Block 2 and its Use for Adjusting and Checking Ultrasonic Echo Pulse Equipment
DIN 54 130	(4/74)	Nondestructive Testing; Magnetic Particle Procedure, General Requirements
DIN 54 152 Part 1	(3/79)	Nondestructive Testing; Liquid Penetrant Procedure, Performance of Test
SEW 088	(10/76)	Weldable Fines Grained Structural Steels; Guidelines for the Processing with Special Attention to Welding