

Safety Standards

of the

Nuclear Safety Standards Commission (KTA)

KTA 3205.3 (2018-10)

**Component Support Structures with
Non-Integral Connections;
Part 3: Series-Production Standard Supports**

(Komponentenstützkonstruktionen mit
nichtintegralen Anschlüssen
Teil 3: Serienmäßige Standardhalterungen)

The previous versions of this safety standard
were issued in 1989-06 and 2006-11

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

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KTA SAFETY STANDARD

October
2018

Component Support Structures with Non-Integral Connections; Part 3: Series-Production Standard Supports

KTA 3205.3

Previous versions of the present safety standard: 1989-06 (BAnz. No. 229a of December 7, 1989)
2006-11 (BAnz. No. 163a of August 31, 2007)

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PLEASE NOTE: Only the original German version of the present safety standard represents the joint resolution of the 35-member Nuclear Safety Standards Commission (Kerntechnischer Ausschuss, KTA). The German version was made public in Bundesanzeiger (BAnz) of April 24, 2019.

Copies of the German versions of KTA safety standards may be mail-ordered through Wolters Kluwer Deutschland GmbH (info@wolterskluwer.de). Downloads of the English translations are available at the KTA website: www.kta-gs.de

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Comments by the Editor:

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

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

Basic Principles

(1) The safety standards of the Nuclear Safety Standards Commission (KTA) have the objective to specify safety-related requirements, compliance of which provides the necessary precautions in accordance with the state of the art in science and technology against damage arising from the construction and operation of the facility (Sec. 7, para. (2), subpara. (3) Atomic Energy Act - AtG) in order to achieve the fundamental safety functions specified in the Atomic Energy Act (AtG), in the Radiological Protection Law (StrlSchG) as well as the Radiological Protection Ordinance (StrlSchV) and further detailed in the Safety Requirements for Nuclear Power Plants (SiAnf) as well as in the Interpretations of the Safety Requirements for Nuclear Power Plants (Interpretations of SiAnf).

(2) Based on the Safety Requirements for Nuclear Power Plants (SiAnf) the present safety standard specifies the requirements for series-production standard supports which need to be qualification tested. These supports include, e.g., rigid standard supports and hangers, shock absorbers, dampers, and rigid struts.

(3) Component support structures with integral connections to the primary coolant circuit or to systems outside the primary coolant circuit are dealt with in series KTA 3201 and KTA 3211, respectively. Component support structures with non-integral connections are dealt with in safety standards KTA 3205.1 and KTA 3205.2.

(4) The safety-related function of standard supports is the transfer of forces from the supported component into the load-carrying parts of the power plant. Movable standard supports shall normally allow for additional relative movements.

(5) The aim of the present safety standard is to achieve a simplification by standardizing the requirements for the qualification testing of standard supports. These qualification tests shall normally verify the quality characteristics specified by the manufacturer with a view to the intended application range of the standard support. Upon a successful completion of the qualification test, the usual tests and inspections of individual standard supports during the manufacturing process can be reduced to a minimum.

(6) In addition to the requirements for the qualification test, the present safety standard deals with the manufacture, testing and inspection as well as the requirements for planning, assembly and commissioning. Furthermore, the present safety standard includes specifications for in-service inspections and maintenance and the documentation of standard supports.

(7) Those parts of standard supports which fall under the scope of the present safety standard and have not been subjected to a qualification test shall meet the requirements of KTA 3205.1 or KTA 3205.2, respectively.

(8) Qualification-tested standard supports may be used in various applications. The extent of the tests and inspections and the participation of the plant vendor, the plant operator, and the authorized expert in these tests and inspections during assembly, commissioning, in-service inspections and documentation depend on the respective requirements to be fulfilled by the standard supports.

1 Scope

(1) The present safety standard applies to series-production standard supports – hereinafter referred to as standard supports – which are used in the component support structures specified in KTA 3205.1 and KTA 3205.2 up to a design temperature of 350 °C and which are subjected to a qualification test.

(2) The present safety standard deals with rigid standard supports, e.g.,

- a) weld-on eye plates, weld-on plates and lugs made of metal plates,
- b) tie rods, threaded rods and pins made of steel bars,
- c) eye nuts, clevises, turnbuckles and couplings made of forgings or metal plates,
- d) bearing elements,
- e) weld-on brackets and weld-in rods made of welded plates, sections or forgings,
- f) vertical clamps, horizontal clamps and dynamic clamps (e.g. for shock absorbers and rigid struts),
- g) pipe clamp bases, clamps with weld-on parts, e.g., slide bearings,
- h) beams, consoles, supported consoles and plane frames made of steel component.

(3) In addition, movable standard supports and rigid struts are addressed, e.g.

- a) spring hangers, spring supports, constant hangers and constant supports (hereinafter referred to as hangers),
- b) hydraulic and mechanical shock absorbers (hereinafter referred to as shock absorbers),
- c) viscoelastic vibration dampers (hereinafter referred to as dampers),
- d) rigid struts.

(4) Parts welded onto the component, e.g., shear lugs, serving as connection between the component and the standard support, are not within the scope of the present safety standard.

(5) The qualification test of standard supports smaller than or equal to DN 50 is dealt with in Section 12.

2 Definitions

Note:

The nomenclature of the equations are listed in Appendix G.

(1) Load cases

Load Cases are defined as follows (cf. Tables 4-2 and 4-3 of KTA 3205.1.):

- Load Case H: (Main loads) Allowable constant and temporary standard loads (B1 and B2) and the component loads A (cf. Table 4-3 of KTA 3205.1)
- Load Case HZ: (Main and additional loads) Allowable constant and temporary standard loads (B1 and B2) and the component loads B and P (cf. Table 4-3 of KTA 3205.1)
- Load Case HS: (Main and special loads) Allowable loads from the load combinations 4 through 7 (cf. Table 4-3 of KTA 3205.1).
In the present safety standard HS includes the Load Cases HS2/HS3 as specified in KTA 3205.1.

(2) Load chains for standard supports

Load chains consist of several rigid or movable standard supports arranged either in series or in parallel.

(3) Nominal load

The nominal load F_N is a component-specific characteristic load. It shall be determined by analysis or if required experimentally. The nominal load is defined component dependently as follows:

- Spring hangers: the maximum theoretical spring force, cf. **Figures B 2-1 and B 2-2**,
- Constant hanger: the maximum set load, cf. **Figure C 2-2**,
- Shock absorbers: the maximum allowable damping force for dynamic excitation at the operating temperature
- All other components: load smaller than or equal to the load of Load Case H (when applying the σ_{zul} -procedure - Allowable Strength Design (ASD)),
load smaller than or equal to the design value for the load capacity F_{Rd} divided by 1.5
(when applying the method of partial safety factors - Load and Resistance Factor design (LRFD))

For rigid struts, shock absorbers and dynamic pipe clamps, the nominal loads are determined from the smaller values from tensile or compressive loading.

(4) Authorized expert

An authorized expert is the expert person appointed in accordance with § 20 AtG by the proper licensing or supervisory authority for the performance of the tests as specified in the present safety standard.

(5) Series-produced products

Series-produced products are products that are fabricated in similar design and quality and in larger quantities at manufacturing facilities.

Note:

Series-produced products are generally manufactured without prior knowledge regarding their later application.

(6) Standard supports, movable

Movable standard supports are series-produced non-integral component support structures or parts thereof, which are similar to each other in design and quality. The function of movable standard supports is to allow for a relative movement between the component supported and the load-absorbing support structure in the direction of the load applied during specified normal operation.

(7) Standard supports, rigid

Rigid standard supports are series-produced non-integral component support structures or parts thereof, which are similar to each other in design and quality. The function of rigid standard supports is the transfer of loads between the component and the support structure without any relative movement.

3 Qualification Test

3.1 General Requirements

- (1) Qualification tests shall only be carried out after completion of the development of a specific type of standard support.
- (2) Qualification tests shall be performed as investigations by analysis and, if so required, as experimental tests.
- (3) For the performance of experimental tests, such test equipment and measuring instrumentation shall be used which are suitable to verify that the quality requirements specified in the present safety standard have been met.

3.2 Applications

The manufacturer of the standard support or the plant supplier shall submit the application for the qualification test to the authorized expert together with the documents listed in the following paragraph.

3.3 Documents

The licensee shall create the following documents and submit them for a review:

- a) description of the quality assurance system of the manufacturing plant as detailed in KTA 1401,
- b) materials specification identifying the tests to be carried out and certificates to be issued,
- c) test schedule for the fabrication,
- d) work and test instructions by the manufacturer,
- e) welding procedure specifications unless they are included in work instructions,
- f) list of all documents including their latest state of revision which are needed to determine the identity of the standard support,
- g) function description (the function description shall, as far as necessary, include information on the application range, task and function of the standard support),
- h) design data sheet including all data which characterize the standard support; in the case of, e.g., a constant hanger this includes information on:
 - ha) nominal load,
 - hb) minimum and maximum set loads,
 - hc) allowable loads for Load Cases H, HZ and HS, and the design value for the load capacity
 - hd) entire travel range,
 - he) allowable tolerances of pre-set values,
 - hf) load deviation under vertical tension
 - hg) load deviation under oblique tension,
 - hh) operating temperatures,
 - hi) ambient conditions,
- i) assembly and detail drawings,
- k) parts list including allocation of the respective materials specifications,
- l) strength calculations,
- m) component related extent of testing,
- n) application instructions; as far as necessary, these include information regarding:
 - na) packaging and storage,
 - nb) installation and assembly,
 - nc) maintenance.

3.4 Testing Program for Qualification Tests

- (1) The testing program shall describe the type of tests and inspections, the testing equipment and the execution of the tests and inspections. The chronological order and the extent of the test steps shall be as specified in Appendix A through Appendix F for some of the standard supports. For other standard supports a testing program on the basis of these appendices shall be agreed upon with the authorized expert.
- (2) The experimental tests under static loading shall be performed at room temperature unless otherwise specified in the cited appendices.
- (3) Cyclic load tests are only required for those standard supports subjected to cyclic loadings, e.g., dampers, rigid struts and shock absorbers with their connected parts.

(4) The experimental tests shall be performed in the presence of the authorized expert.

3.5 Certificate for the Qualification Test (Test Certificate)

Following the successful performance of the qualification test, a test certificate shall be issued by the authorized expert responsible for the qualification test; this certificate shall include the following information:

- a) test number,
- b) designation of the standard support including its state of revision,
- c) list of the test documents,
- d) manufacturer of the standard support and his qualification,
- e) testing program including the test steps,
- f) evaluation of the test results,
- g) conditions for the application,
- h) testing organization, name and signature.

3.6 Period of Validity of the Qualification Test

(1) The period of validity of the qualification test shall be limited to 3 years beginning with the successful performance of the theoretical and experimental tests.

(2) Upon application by the manufacturer, the term of validity shall be extended by another 3 year period, provided, neither the product nor the quality assurance system have been modified.

3.7 Modifications

(1) The authorized expert who certified the qualification test shall be notified of any modification of the qualification-tested standard support.

(2) In the case of modifications that influence the safety related function of the standard support, e.g., change in design or use of a lower-strength material, a supplementary qualification test or, if necessary, a new qualification test as specified in Sections 3.1 through 3.6 shall be performed.

3.8 Considering Qualification-Tested Standard Supports in the Design Planning Stage

3.8.1 Suitability regarding the intended application

(1) If qualification-tested standard supports as specified in the present safety standard are planned to be used in a nuclear power plant, the properties confirmed by the qualification test shall satisfy the conditions of the intended application. A certificate stating that these conditions are met shall be obtained from the authorized expert.

(2) If this test reveals that, regarding the intended application, other or additional requirements have to be fulfilled, it shall be ensured that an agreement is reached with the authorized expert regarding the further procedure.

3.8.2 Rigid elements

(1) Austenitic metal plates shall be inserted between austenitic pipelines and any non-alloyed or low-alloyed steels of the pipe-enclosing components.

(2) For slide bearing guides, sufficient clearance (play) shall be provided regarding the operating condition. Under operating conditions, the total clearance should not exceed 3 mm.

(3) Pipe clamp bases and clamps shall be secured in their position on the pipe if axial forces or torsional moments are expected (cf. Section 12).

(4) In the case of clamps in connection with rigid struts, shock absorbers or dampers, it shall be verified that the clamps will not be dislocated or twisted when subjected to the design loads. This may be verified based on a form fit, a permanent frictional fit, or a stable positioning under the design loads.

3.8.3 Connecting elements

Bolts should not be subjected to bending forces in the threaded region. Deviations from the plane-parallel bearing surfaces of bolt heads and nuts are allowed, provided, the angle does not exceed $\pm 1^\circ$.

3.8.4 Spring hangers and spring supports

(1) The specified travel range s_S shall be specified such that the travel reserve s_R are not utilized (cf. **Figure B 2-2**). The travel reserve to be provided shall be at least 20 % of the specified travel range, but at least 5 mm in each end position.

(2) In the case of spring supports, the horizontal forces shall be limited to 7 % of the vertical load by suitable design measures.

(3) The allowable load for the blocked condition shall be 1.5-fold nominal load.

3.8.5 Constant hangers and constant supports

(1) The specified travel ranges s_S shall be specified such that the travel reserves s_R are not utilized (cf. **Figure C 2-1**). The travel reserve to be provided shall be at least 10 % of the specified travel range, but at least 5 mm in each end position.

(2) Constant hangers and constant supports shall be chosen such that within the planned adjustment range a load setting of ± 15 % is possible without limitation of the travel reserves.

(3) In the case of constant supports, the horizontal forces shall be limited to 7 % of the vertical load by suitable design measures.

(4) In the blocked condition the allowable load shall be the 1.5-fold nominal load.

3.8.6 Mechanical and hydraulic shock absorbers

For shock absorbers, a travel reserve of at least 10 mm shall be provided in each end position.

3.8.7 Viscoelastic vibration dampers

(1) Dampers shall damp operational oscillations over the entire travel range expected during normal operation. However, during start-up and shut-down operations they shall normally not significantly influence the components. This requires considering the resistance forces that are dependent on the temperature of the damping medium and the velocity of the piston, both values to be specified by the manufacturer.

(2) The damping behavior shall normally be adapted to the operating temperature of the pipeline. To this end, a damping medium shall be chosen in consultation with the manufacturer that is suited to the temperature occurring within the medium.

Note:

At lower temperatures than the operating temperature the damper can react with larger dynamic parameters.

(3) For dampers, a travel reserve of at least 10 mm shall be provided in each end position.

4 Requirements Regarding Design and Construction

4.1 Loads

(1) For each standard support as far as applicable, the allowable loads for Load Cases H, HZ and HS and the design value for the load capacity shall be specified.

Note:

In the present safety standard HS encompasses the Load Cases HS2/HS3 detailed in KTA 3205.1. The design value for the load capacity is defined in DIN EN 1993-1-1.

(2) Standard supports which are subjected to oblique tension or oblique compression loading shall be capable of absorbing the additional lateral forces acting perpendicular to the main direction of load application.

(3) The allowable load and the design value for the load capacity shall be specified for the blocked condition and for the end position of hangers. The allowable load shall be assigned to Load Case HZ.

(4) For load chains, the allowable load of the standard component shall be either

- the lowest allowable load in the respective load case, or
- the lowest design value for the load capacity.

4.2 Design Temperatures

(1) The design shall be based on the temperatures corresponding to the intended application.

(2) If the temperature distribution is not verified, the design temperature of the standard support and its parts (cf. **Figure 4-1**) shall be as specified in the following wherein T_M is the design temperature of the pipeline:

a) Parts located inside the thermal insulation:

aa) parts immediately adjacent to the component:

$$T = (T_M - 20 \text{ K}) \quad (4-1)$$

ab) bolts and nuts:

$$T = (T_M - 30 \text{ K}) \quad (4-2)$$

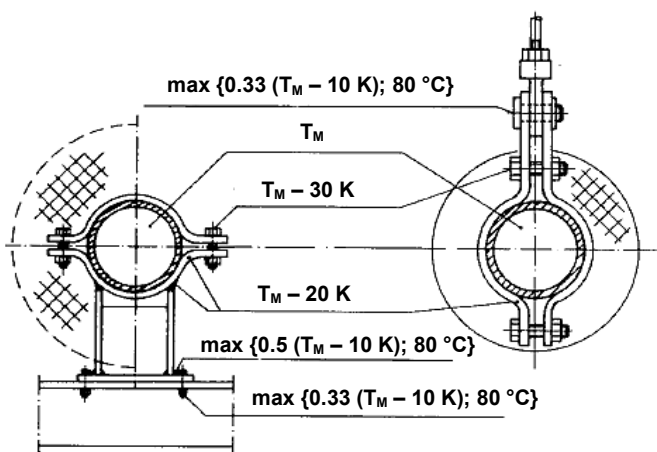


Figure 4-1: Temperature distribution

b) Parts outside of the thermal insulation:

ba) in constructional parts immediately connected to the adjacent parts:

$$T = \max \{0.5 \cdot (T_M - 10 \text{ K}); 80 \text{ °C}\} \quad (4-3)$$

bb) in connecting pins or bolts and nuts:

in frictional fit clamp bases:

$$T = \max \{0.33 \cdot (T_M - 10 \text{ K}); 80 \text{ °C}\} \quad (4-4)$$

in clamps: 80 °C

bc) in all other parts, out to the contact area of the steel component: 80 °C.

(3) For standard supports the functionality of which must be sustained during design basis accidents with ambient temperatures exceeding 80 °C, the design shall be based on correspondingly higher temperatures.

4.3 Structural Design

4.3.1 General requirements

(1) Standard supports shall be designed such that their functionality is maintained under the occurring ambient conditions, e.g., dirt or humidity. With regard to their application under special ambient conditions, e.g., corrosive media, the qualification test shall be supplemented, if necessary. The surface of standard supports shall normally be such that their decontamination is possible.

(2) Observing the boundary conditions of the standard support, the welding execution class, EXC, shall be specified prior to the suitability test and shall be documented in the test schedule. The execution class, EXC, shall be specified by applying the procedure in accordance with DIN EN 1090. At least, consequence class CC2 in accordance with DIN EN 1090 shall be specified.

(3) Welds welded from both sides shall be preferred to one-side welds. One-sided fillet welds are only allowed for the connection of closed parts or if transmitted local bending moments are considered in the design.

(4) Single-layer welds are only allowed for weld thicknesses smaller than or equal to 5 mm.

(5) For those weld seams located within the flow of force (verification using partial safety factors) or those whose quality class must be verified (verification using the σ_{zul} -concept), the extent of testing shall be as specified in KTA 3205.1. Sec. 7.9.2.4, and KTA 3205.2, Sec. 7.8.2.2. The testability of these weld seams shall be ensured.

(6) The thread engagement of threaded parts shall normally be at least 0.8·d for suitable material combinations; d represents the nominal diameter of the threaded part. The admissibility of shorter thread engagement shall be individually verified.

(7) If tensile-loading in the through-thickness direction is expected for product forms made from ferritic steel with a wall thickness greater than 20 mm, the weldings shall be verified to be Quality Class Z25 in accordance with DIN EN 10164.

(8) The slenderness ratio of standard supports subjected to compressive loadings may not be larger than 150.

(9) In the case of slotted holes subjected to loadings perpendicular to their longitudinal axis, a sufficiently large edge distance shall be observed.

(10) Standard supports with non-metallic parts including their lubricants shall normally not lose their functionality up to a radiation dose of 10^5 Gy during their specified service life.

(11) Manufacturing tolerances of the dimensions that are decisive during planning of the plant or are essential for the function of the standard support shall be specified.

4.3.2 Rigid elements

(1) The minimum dimensions for load-bearing parts are:

- | | |
|--|--------|
| a) welding lugs and weld-on eye plates | 6 mm, |
| b) clamps | 5 mm, |
| c) weld-on plates | 8 mm, |
| d) bolts, pins, threaded rods | 10 mm. |

Exceptions are allowed in well-founded cases.

(2) Sharp edges shall be chamfered. This applies in particular to edges of cuts, bore-holes and clamps on the side contacting the pipe.

(3) The thread of U-bolts may not directly contact the pipe.

(4) Where pipe-enclosing parts made of non-alloyed and low-alloyed steels with a nominal diameter exceeding DN 50 are cold formed, the minimum radii for S 235 or S 355 shall be as required in accordance with DIN EN 10025-1.

(5) In case austenitic steels are cold formed, the minimum radii shall basically be chosen such that the degree of cold forming is smaller than or equal to 15 %. In case the degree of cold forming exceeds 15 %, it shall be verified in each individual case that even after cold forming the residual elongation A_5 is at least 15 %.

(6) The dimensions of the clamp shall be chosen such that the legs of the clamp are parallel to each other in the assembled condition.

(7) Austenitic metal plates inserted between the pipeline and the clamp shall be secured in their position, e.g., by flanging.

(8) Pipe clamp bases shall be designed such that jamming can be excluded. Slide plates and slide coatings shall be secured in their respective positions. The instructions specified by the manufacturer shall be observed.

4.3.3 Connecting elements

(1) Bolted connections shall be secured. Suitable securing elements for bolts are, e.g., securing plates, lock nuts and counter nuts. A planned pre-tensioning may also be regarded as a securing measure.

(2) Pins shall be secured, e.g., with washers and cotter pins. Lock rings are allowable provided, the clearance (play) between bore-hole and pin is smaller than 0.5 mm and corrosion can be excluded.

4.3.4 Hangers

(1) Hangers shall normally have a suitably designed casing suited for the transmission of forces; these casings shall be provided with inspection openings. In addition, care shall be taken that any penetrating water can run off.

(2) Springs shall be protected by suitable measures against surface damage.

(3) The design and analysis of compression springs shall comply with the requirements of DIN EN 13906-1. The spring plates shall be designed and centered such that no friction occurs between the spring and the casing wall.

(4) It shall be ensured that only such springs are used that retain their functionality even after 48 hours of thermal loading at 80 °C and at maximum spring tension.

(5) It shall be possible by simple means to block hangers in any position within their nominal travel range.

(6) A freedom of movement of at least 4° from the main direction of loading shall be possible.

4.3.5 Shock absorbers, rigid struts and their connected parts

(1) Hydraulic as well as mechanical shock absorbers shall be designed such that the load-absorbing function acts exclusively in the case of a dynamic loading on the components. The shock absorbers shall be capable of equally absorbing tensile or compressive forces.

(2) The position of the piston rod shall be made visible by marking the scale of the travel range and marking the possible end position. The travel reserves shall be specifically marked.

(3) A freedom of movement of at least 5° from the connecting axis shall be possible. The maximum possible stroke shall normally be at least 100 mm.

(4) The lifetime of the wear parts, e.g., bearings, seals or guides, shall be specified.

(5) Local jointly acting shock absorbers shall basically be arranged as statically determined structures. Deviations are allowable, provided, they are properly verified.

(6) The overall clearance of rigid struts, including connected parts, shall be less than 0.5 mm in the case of pins or body-fit bolts up to a diameter of 33 mm; if larger diameter pins or bolts are used the clearance shall be less than 1.5 % of the bolt diameter.

(7) The length of the rigid strut shall be adjustable for all types and sizes. The maximum allowable adjustment of each ball bushing joint shall be visibly marked.

(8) The eccentricity v_0 between eye and rod axis shall not be greater than 1 mm for lengths smaller than or equal to 1000 mm and not greater than $L/1000$ for lengths L greater than 1000 mm.

4.3.6 Dampers

(1) Dampers shall be designed such that the load-absorbing function acts exclusively in the case of a dynamic loading on the components. They shall be capable of absorbing loads in any of the specified directions and shall damp operational oscillations over the entire travel range.

(2) The initial position, end position and operating position of the damper piston shall be visibly marked. The travel reserves shall be specially marked.

(3) The response of dampers shall be free of play.

(4) The damping medium shall be capable of regenerating itself even after having been overloaded. After the regeneration the damper shall be fully functional.

(5) The dynamic characteristics of dampers such as operating load, damping resistance and equivalent stiffness shall be specified for each direction of movement at the specified operating temperature and within the specified frequency range. The dynamic characteristics apply to the working position of the damper piston; this shall normally be the center position of the piston. The tolerances for each damper shall be specified in the test certificate of the qualification test.

(6) Dampers which are not self-supporting shall be provided with a mounting device for their assembly.

(7) The damper piston and damper pot shall both be designed for a sustained 0.1-fold nominal load.

5 Verification of Allowable Loads and Design Value of Load Capacity

5.1 Allowable Loads

(1) The allowable load shall be verified as follows:

- a) A verification by analysis without supplementary experimental tests is allowable, provided, calculable geometries are given.
- b) A verification by analysis with supplementary experimental tests is required if the structure can only be modelled by approximation. In this case, experimental tests shall be performed for selected sizes which shall cover the entire range of application. This applies to rigid struts, eye nuts, clevises, turnbuckles, clamps, and pipe clamp bases.
- c) Without verification by analysis, an experimental test shall be performed for each parameter, e.g., physical dimension, material and direction of load application.

(2) The load capacity shall be verified in such a way that the procedure can be reproduced.

(3) The stress analyses shall be performed as specified in KTA 3205.1, Sec. 4.

(4) The maximum allowable load for Load Case H shall be calculated on the basis of the maximum transmittable loads as determined by experimental tests (ultimate load P_{Tr} , buckling load P_K or yield load P_F); this analysis shall be based on the design factors listed in **Table 5-1**; hereby, the yield load shall be determined for a permanent elongation of 0.2 % of the initial measured length (cf. **Figure A 2-1**) of the individual elements of the rigid standard support, and for a permanent elongation of 1 % of the initial measured length of hanger clamps.

(5) Based on the maximum allowable load for Load Case H, the allowable loads for Load Cases HZ and HS shall be determined dependent on the kind of load applied, on the temperature and on the allowable stresses specified in KTA 3205.1, Sec. 4.

(6) If no permanent deformations appear when rigid standard supports are subjected to a 2-fold nominal load, F_N , or if the ultimate load is greater than a 4-fold F_N , then a 1.5-fold F_N shall be assumed for the loading of Load Case HZ and a 1.7-fold F_N for the loading of Load Case HS.

(7) The ultimate load of shock absorbers under static tensile stress shall be greater than a $(2.4 \cdot K_2)$ -fold F_N and the buckling load under static compressive load shall be greater than a 2.5-fold F_N .

(8) For shock absorbers, the nominal load, F_N , is the allowable load for all load cases on the basis of the qualification tests, provided, the vibration tests specified under Section D 3.2.4 have been completed successfully. Where the overload test specified under Section D 3.2.5 has been completed successfully, the allowable load shall be a 1.5-fold F_N for dynamic loads resulting from design basis earthquake, if the verification is carried out by means of an equivalent static method; in all other special dynamic load cases of Load Case HS (including the superposition of various load cases), the allowable load shall be a 1.7-fold F_N .

(9) In addition to paragraph (3), rigid struts shall fulfill the following requirement:

If the additional tests and inspections specified under Section F 3.2.4, have been completed successfully, then a 1.5-fold F_N shall be assumed for the loading of Load Case HZ and a 1.7-fold F_N for the loading of Load Case HS.

(10) For hangers, the nominal load F_N is the allowable load for all load cases on the basis of the qualification tests, provided, the tests and inspections specified in the Appendices were completed successfully. For the blocked condition, a 1.5-fold F_N shall be assumed as the allowable load.

(11) For dampers, the nominal load F_N is the allowable load for all load cases on the basis of the qualification test, provided, the tests and inspections specified in Appendix E have been completed successfully.

5.2 Design Value of the Load Capacity

The design value of the load capacity (procedure applying partial safety factors) shall be calculated as follows:

- a) qualification-tested components that have a load ratio H : HZ : HS equaling 1 : 1.15 : 1.5:

$$F_{Rd} = 1.5 F_{(Load\ Case\ H)} \quad (5-1)$$

- b) qualification-tested components that have a load ratio H : HZ : HS equaling 1 : 1.15 : 1.7:

$$F_{Rd} = 1.7 F_{(Load\ Case\ H)} \quad (5-2)$$