

Safety Standards

of the
Nuclear Safety Standards Commission (KTA)

KTA 3205.3 (11/06)

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

(Komponentenstützkonstruktionen mit nichtintegralen
Anschlüssen; Teil 3: Serienmäßige Standardhalterungen)

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

KTA 3205.3

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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. 163a on August 31, 2007. Copies may be ordered through the Carl Heymanns Verlag KG, Luxemburger Str. 449, D-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.

Fundamentals

(1) The safety standards of the Nuclear Safety Standards Commission (KTA) have the task of specifying those safety related requirements which shall be met with regard to precautions to be taken in accordance with the state of science and technology against damage arising from the construction and operation of the facility (Sec. 7 para 2 subpara 3 Atomic Energy Act) in order to attain the protection goals specified in the Atomic Energy Act and the Radiological Protection Ordinance (StrlSchV) and which are further detailed in the "Safety Criteria for Nuclear Power Plants" and in the "Guidelines for the Assessment of the Design of PWR Nuclear Power Plants against Incidents pursuant to Sec. 28 para 3 of the Radiological Protection Ordinance (StrlSchV) - Incident Guidelines" (in the version published on 18.10.1983).

(2) Based on the Safety Criteria for Nuclear Power Plants issued by the Federal Minister of the Interior, this safety standard specifies the requirements for series-production standard supports for which a qualification test shall be carried out. These supports include e.g. rigid standard supports and hangers, shock absorbers, dampers, and rigid struts.

(3) Component support structures with integral connections to be used for the primary circuit or for the outer systems are dealt with in safety standards KTA 3201 and 3211. Component support structures with non-integral connections are dealt with in safety standards KTA 3205.1 and KTA 3205.2.

(4) The safety function of standard supports is the transfer of forces from the part supported into the load-absorbing parts of the plant. Movable standard supports shall normally permit additional relative movements.

(5) The aim of this safety standard is to achieve a simplification by standardising the requirements for the qualification test of standard supports. This qualification test shall demonstrate the quality characteristics specified by the manufacturer with a view to the intended field of application of the standard support. Following a successful qualification test, the usual tests and inspections of each individual standard support during the manufacturing process may be reduced to a minimum.

(6) Apart from the requirements for the qualification test, this part of the safety standard deals with the manufacture and inspection and testing as well as the requirements for assembly and commissioning. In addition, this safety standard contains specifications for in-service inspections and maintenance and for the documentation of standard supports.

(7) Parts of standard supports which fall under the scope of this safety standard and have not been subjected to a qualification test shall satisfy the requirements of safety standards KTA 3205.1 and KTA 3205.2, respectively.

(8) Standard supports which have been subjected to a qualification test may be used in various applications. The extent of the tests and inspections and the attendance of the plant supplier, the manufacturer, the user and the authorized inspector as per § 20 of the Atomic Energy Act at the tests and inspections during assembly, commissioning, in-service inspections and documentation depend on the relevant requirements to be met by the standard supports.

1 Scope

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

(2) This safety standard deals with rigid standard supports such as

- a) weld-on eye plates, weld-on plates and single connecting plates made of plates,
- b) tie rods, threaded rods and bolts made of steel bars,
- c) eye-nuts, clevises, turnbuckles sleeves and rod couplings made of forgings,
- d) bearing elements,
- e) weld-on brackets and weld-in rods made of welded sheet metal and sections,
- f) vertical clamps, horizontal clamps and dynamic pipe clamps (e.g. for snubbers and rigid struts),
- g) clamp bases, clamps with welded parts, e.g. sliding supports
- h) beams, brackets, support brackets and plane frames made of steel structural elements.

(3) In addition, movable standard supports and rigid struts are addressed such as

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

(4) Parts welded onto the component, such as shear lugs serving as connection between the component and the standard support, are not part of this safety standard.

2 Definitions

(1) Load chains for standard supports

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

(2) Authorized inspector

An expert or competent agency called in by the licensing or supervisory authority in accordance with § 20 of the Atomic Energy Act

(3) Standard support, movable

Movable standard supports are series-production non-integral component support structures or parts thereof, which are identical in design and quality. The function of movable standard supports is to permit relative movements in the direction of the loadings applied during specified normal operation between the part supported and the load-absorbing part of the plant.

(4) Standard support, rigid

Rigid standard supports are series-production non-integral component support structures or parts thereof, which are identical in design and quality. The function of rigid standard supports is the absorption of loads between the part and the building structure.

(5) Symbols and notations:

- F_N : rated load, smaller than or equal to the allowable load of design loading level H
- F_R : load reserve for constant hangers and constant supports
- F_S : specified load as calculated load
- P_F : yield load
- P_K : buckling load
- P_{Tr} : ultimate load
- S_N : rated displacement (travel range) of the movable standard support

- SR : overtravel safety margin
 SS : specified travel range as the displacement calculated on the basis of thermal expansions and dynamic loadings, if any
 T_M : design temperature for the piping
 v_o : eccentricity

3 Qualification Test

3.1 General requirements

- (1) Qualification tests shall be carried out upon completion of the development of a specific type of standard support.
- (2) Qualification tests shall be subdivided into theoretical investigations and, to the extent required, experimental tests.
- (3) For the performance of experimental tests, such test and measuring equipment shall be used which is suitable to demonstrate that the quality requirements specified in this safety standard have been met.

3.2 Applications

The qualification test shall be applied for by the manufacturer of the standard support or by the plant supplier; the application documents shall be submitted to the authorized inspector and shall be accompanied by the documents specified below.

3.3 Documents

The applicant shall prepare the following documents and submit them for review:

- a) a description of the quality assurance system in compliance with KTA 1401,
- b) a materials specification specifying the tests to be carried out and certificates to be established,
- c) the test and inspection sequence plan for manufacturing,
- d) the manufacturer's working and testing instructions,
- e) welding procedure sheets unless they are included in working instructions,
- f) a list of all documents including the latest state of revision which are needed to identify the standard support,
- g) the description of functions (if required, the description of functions shall provide information on applications, task and functioning of the standard support),
- h) a design data sheet including all data which characterise the standard support, e.g. in the case of a constant hanger:
 - ha) rated load,
 - hb) minimum and maximum pre-set loads,
 - hc) allowable loads,
 - hd) total travel range,
 - he) admissible tolerances of set values,
 - hf) load deviation under vertical load,
 - hg) load deviation under oblique load,
 - hh) temperature-use limits,
 - hi) ambient conditions
- i) assembly and detail drawings,
- k) a parts list with allocation to the relevant materials specifications,
- l) stress analyses,
- m) the extent of testing relating to the respective part
- n) instructions for use including the following information if necessary:

- na) instructions for packaging and storage
- nb) instructions for installation and assembly
- nc) maintenance instructions.

3.4 Test and inspection program for the qualification test

- (1) The test and inspection program shall describe the type of tests and inspections, the test equipment and the performance of the tests and inspections. The chronological order and the extent of the hold points are specified in Annexes A through F for some of the standard supports. For other standard supports a test and inspection program in conformance with these Annexes shall be agreed with the authorized inspector.
- (2) Unless specified otherwise in the Annexes, the experimental tests under static loading shall be carried out at room temperature.
- (3) Cyclic load tests are only required for standard supports subjected to cyclic loadings, e.g. dampers, rigid struts and shock absorbers with their connecting parts.
- (4) The experimental tests shall be carried out in the presence of the authorized inspector.

3.5 Certificate covering the qualification test (test certificate)

Following a successful qualification test, a test certificate shall be obtained from the authorized inspector responsible for the qualification test; this certificate shall contain the following information on the:

- 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 manufacturer's qualification,
- e) test and inspection program including indication of the hold-points,
- f) evaluation of the test results,
- g) conditions for application,
- h) organisation, name and signatures.

3.6 Term of validity of the qualification test

- (1) Following the successful performance of theoretical and experimental tests, the term of validity of the qualification test shall be limited to 3 years.
- (2) Upon the manufacturer's application, the term of validity shall be extended for another 3 years period provided that neither the product nor the quality assurance system have been modified.

3.7 Modifications

- (1) The authorized inspector who certified the qualification test shall be notified of any modification of a qualified standard support.
- (2) In the case of a major change, such as change in design or use of a different material, a supplementary qualification test or a new qualification test, if necessary, shall be carried out in accordance with Sections 3.1 to 3.6.

3.8 Fitness for purpose

- (1) If standard supports subjected to a qualification test in accordance with this safety standard are 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 to state that these conditions are met shall be obtained from the authorized inspector.

(2) If the test reveals that other or additional requirements have to be met with a view to the intended application, the further procedure shall be agreed upon with the authorized inspector.

4 Design requirements

4.1 Loads

(1) For each standard support, the allowable loads for design loading levels H, HZ and HS shall be stated as far as applicable.

Note:

The design loading levels H, HZ and HS are defined in KTA 3205.1. Design loading level HS in KTA 3205.3 corresponds to design loading level HS 3 in KTA 3205.1

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

(3) The allowable load shall be stated for the blocked condition and for the end position of hangers. This load shall be allocated to design loading level HZ.

(4) For load chains, the allowable load shall be that of the standard part which is characterised by the lowest allowable load in the respective design loading level.

4.2 Design Temperatures

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

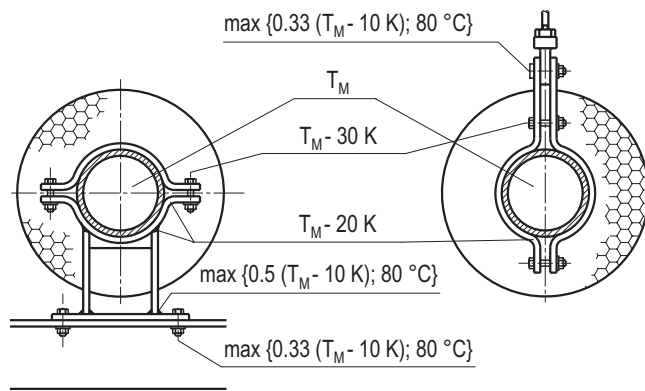


Figure 4-1: Temperature distribution

(2) If the temperature distribution is not verified, the following specification shall apply to the design temperatures of the standard support and its parts, as indicated in **Figure 4-1**, with T_M being the design temperature of the piping.

a) parts inside the thermal insulation:

aa) for parts immediately adjacent to the component:

$$T = T_M - 20 \text{ in } ^\circ\text{C}$$

ab) for bolts and nuts:

$$T = T_M - 30 \text{ in } ^\circ\text{C}$$

b) parts outside the thermal insulation:

ba) for equipment immediately connected with the adjacent parts:

$$T = 0.5 \cdot (T_M - 10) \text{ in } ^\circ\text{C}, \text{ but not less than } 80 \text{ } ^\circ\text{C}$$

bb) for connecting pins or bolts and nuts:

in the case of friction-contact bearings:

$$T = 0.33 \cdot (T_M - 10) \text{ in } ^\circ\text{C}, \text{ but not less than } 80 \text{ } ^\circ\text{C}$$

in the case of clamps: $80 \text{ } ^\circ\text{C}$

bc) for all other parts up to the contact area of the structural steel part: $80 \text{ } ^\circ\text{C}$.

(3) For standard supports whose operability is to be maintained during incidents involving ambient temperatures of over $80 \text{ } ^\circ\text{C}$, the design shall be based on correspondingly higher temperatures.

4.3 Design

4.3.1 General requirements

(1) Standard supports shall be designed such that their operability is maintained under the existing ambient conditions, e.g. dirt or humidity. For operation under special ambient conditions, such as corrosive fluids, the qualification test shall be supplemented, where required.

(2) The surfaces of standard supports shall normally be such as to ensure decontamination.

(3) Double-welded joints shall be preferred to single-welded joints. Single-side fillet welds shall only be allowed if they do not transfer any local bending moments.

(4) Single-pass welds of a thickness less than or equal to 5 mm are permitted.

(5) Where the quality of the weld has to be demonstrated, it shall be ensured that the welded connections can be tested.

(6) The thread engagement length of threaded parts shall normally be at least $0.8 d$ for suitable material combinations, with d being the nominal diameter of the thread. The admissibility of shorter thread engagement lengths shall be demonstrated separately.

(7) Where plates made of ferritic steel are loaded in thickness direction (tension), it shall be ensured that at plate thicknesses greater than or equal to 20 mm the plates have been qualified to DIN EN 10164, quality class Z 25 and have been examined for laminations in the connecting weld area.

(8) In the case of standard supports subjected to compressive loadings, only slenderness ratios less than or equal to 150 are permitted.

(9) In the case of slotted holes which are subjected to transverse loading in relation to their longitudinal axis, care shall be taken to ensure that the edge distances are sufficient.

(10) Standard supports made of non-metallic parts including lubricants shall normally maintain their operability during their specified lifetime if exposed to radiation doses of up to 10^5 J/kg .

(11) Manufacturing tolerances shall be stated.

4.3.2 Rigid parts

(1) For standard supports made of ferritic materials and located in the flux of forces (load path), the following minimum dimensions shall normally be adhered to:

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

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

(3) The thread of round steel U-bolts shall not be immediately adjacent to the pipe.

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

(5) Where austenitic steels are cold formed, the minimum radii shall be selected such that the plastic equal strain is less than or equal to 15 %. In the case of a cold forming degree exceeding 15 %, it shall be demonstrated in each individual case that the residual elongation at fracture A_5 upon cold forming is at least 15 %.

(6) The dimensions of the clamp shall be selected such that the legs of the clamp are in parallel in the as-assembled condition.

(7) Austenitic plates inserted between pipe and clamp shall be secured in their position, for example by flanging.

(8) Pipe clamp bases shall be designed such that any jamming is excluded. Slide plates and slide coatings shall be secured in their respective positions. The manufacturer's instructions shall be complied with.

(9) For slide bearing guides, sufficient clearance shall be provided for the operating condition. In the operating condition, the total clearance should not exceed 3 mm.

4.3.3 Connections

(1) Bolts shall normally not be subjected to bending forces in the threaded area. Deviations from the plane-parallel bearing surfaces of bolt heads and nuts shall be permitted up to an angle of $\pm 1^\circ$.

(2) Bolted connections shall be locked. Bolt securing elements such as retaining plates, counter nuts and lock nuts shall be used for locking purposes. Rated pre-loading shall also be regarded as a securing measure.

(3) Pins shall be locked with washers and cotter pins, for example. Locking rings are permitted if the clearance between bore-hole and pin is smaller than 0.5 mm and corrosion is excluded.

4.3.4 Hangers

(1) For the purpose of transferring forces, hangers shall normally have an adequately designed casing to be provided with inspection holes. In addition, care shall be taken to ensure that penetrating water can be drained.

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

(3) The design and calculation of compression springs shall comply with the requirements of DIN EN 13906-1 and DIN EN 13906-2. The spring plates shall be designed and centred such that no friction occurs between spring and casing wall.

(4) Only such springs shall be used as to ensure that their operability is still maintained after 48 hours of thermal loading at 80 °C and at maximum spring tension.

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

(6) Angularity from the main direction of loading shall be possible for at least 4° .

(7) The specified displacements (travel ranges) s_S shall be selected such that the overtravel safety margins s_R are not utilised. For constant hangers the overtravel safety margins (travel reserve) to be provided shall be at least 10 % of the specified displacement, and for variable spring hangers, they shall be at least 20 % of the specified displacement, but at least 5 mm in each end position.

(8) For constant and variable supports, the horizontal forces shall be limited to 7 % of the vertical load by suitable design measures.

(9) For constant hangers and constant supports, a load adjustment of at least $\pm 15\%$ shall be possible within the regular adjusting range, without restricting the overtravel safety margins.

4.3.5 Snubbers, rigid struts and their connecting parts

(1) Hydraulic as well as mechanical snubbers shall be designed such as to assume a load-absorbing function exclusively in the case of dynamic loadings on the components. The snubbers shall be capable of absorbing tensile and compressive forces alike.

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

(3) For snubbers, an overtravel safety margin (travel reserve) of at least 10 mm shall be provided in each end position.

(4) Angularity from the connecting axis shall be possible for at least 5° . The possible maximum stroke shall normally be at least 100 mm.

(5) The lifetime of wear parts such as bearings, seals or guides shall be stated.

(6) Snubbers acting jointly at certain locations shall basically be arranged as statically determined structures. Deviations are permitted if corresponding verifications are submitted.

(7) The total clearance of rigid struts, including their connecting parts, shall be less than 0.5 mm if pins or body-fit bolts up to a diameter of 33 mm are used, and less than 1.5 % of the bolt diameter if greater diameters are used.

(8) The length of the rigid strut shall be adjustable for all types and sizes. The admissible maximum adjustment of each ball bushing joint shall be indicated.

(9) 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 greater than 1000 mm.

4.3.6 Dampers

(1) Dampers shall be designed such as to assume a load-absorbing function exclusively in the case of dynamic loadings on the components. They shall be capable of absorbing loads in any direction specified.

(2) The initial, end and operating positions of the damper plunger shall be made visible by corresponding markings. The travel reserves shall be marked separately.

(3) During normal operation, the dampers shall dampen operational vibrations over the entire range of travel. However, they shall normally not cause any major impact on the component, even during start-up and shutdown operations. For this purpose, the frictional resistance of the damper as a function of temperature, damper fluid and plunger rate shall be stated by the manufacturer.

(4) The damping behaviour shall normally be adapted to the operating temperature of the pipe. To this end, a damping fluid shall be selected which is suited for the temperatures occurring. In the case of lower operating temperatures, the damper shall normally respond with greater dynamic characteristics.

(5) An overtravel safety margin (travel reserve) of at least 10 mm in each end position shall be provided for dampers.

- (6) Dampers shall respond without play.
- (7) Upon application of the load, the damper fluid shall be capable of regenerating even when having been set under overload. Upon regeneration of the damper fluid the damper shall be fully functional again.
- (8) The dynamic characteristics of dampers such as operating load, damping coefficient and equivalent stiffness shall be stated 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 plunger which shall normally be identical to the centre position. The tolerances shall be specified for each damper in the test certificate evidencing the qualification test.
- (9) Dampers which are not self-supporting shall be provided with a mounting device for assembly.
- (10) Damper plunger and dash-pot shall be designed for $0.1 \cdot$ rated load (endurance strength).

4.3.7 Position locking

- (1) Clamp bases and pipe clamps shall be locked in secure position on the pipe in order to permit the transfer of axial forces and torsional moments.
- (2) In the case of clamps in connection with rigid struts, snubbers or dampers it shall be demonstrated that the clamps cannot be dislocated or twisted when subjected to the design loads. This demonstration may be based on form-fit, remaining friction capacity, or stable positioning at design loadings.

5 Proof of allowable loads and stresses

5.1 Allowable loads

- (1) The allowable load shall be substantiated as follows:
- a proof by way of calculation without supplementary experimental tests is permitted if calculable geometries are available.
 - proof by way of calculation with supplementary experimental tests is required if the structure can only be modelled

by approximation. In such a case, experimental tests shall be carried out for selected sizes which cover the entire range of application. This applies to rigid struts, eye-nuts, clevises, turnbuckles, clamps, and clamp bases.

- without calculation, an experimental test shall be carried out for each parameter, e.g. dimensions, materials and direction of load application.
- (2) The load-carrying capacities shall be substantiated such that the calculation can be reconstructed.

5.2 Allowable stresses

For the purpose of strength calculation, Section 7 of KTA 3205.1 applies to the determination of allowable loadings.

5.3 Determination of allowable loads

- (1) The allowable load for design loading level H shall be determined on the basis of the maximum absorbable load as determined by experimental tests (ultimate load P_{Tr} , buckling load P_K or yield load P_F), considering the design factors in accordance with **Table 5.3-1**, with the yield load being obtained at a permanent elongation of 0.2 % (offset yield strength) of the measured initial length (see **Figure A 2-1**) of the individual elements of the rigid standard support, and at 1 % of the measured initial length of hanger clamps.
- (2) On the basis of the allowable loads of design loading level H, the allowable loads at design loading levels HZ and HS shall be determined as a function of the type of load applied and the allowable stresses in accordance with Section 7 of KTA 3205.1.
- (3) If no permanent deformations occur where rigid standard supports are subjected to 2 times the rated load F_N , or if the ultimate load is greater than 4 times F_N , 1.5 times F_N shall apply to the allowable load at design loading level HZ and 1.7 times F_N at design loading level HS.
- (4) The ultimate load of snubbers under static tensile stress shall be greater than $(2.4 \cdot K_2)$ times F_N , and the buckling load under static compressive stress shall be greater than 2.5 times F_N .

Part	Ultimate load ¹⁾ P_{Tr}	Yield load P_F	Buckling load P_K	Notes
Rigid standard support	4.0 or $2.4 \cdot K_2$	$1.6 \cdot K_3$	—	—
Hanger clamps	4.0 or $2.4 \cdot K_2$	$1.6 \cdot K_3$	—	The smaller value of the allowable load from P_{Tr} and P_F shall govern
Rigid strut / snubber	4.0 or $2.4 \cdot K_2$	—	2.5	—
Damper	4.0 or $2.4 \cdot K_2$	—	2.5	—
Hanger	4.0 or $2.4 \cdot K_2$	—	—	—

¹⁾ The values quoted for P_{Tr} may be used as equivalent values. With the exception of the yield load for pipe clamp bases they refer to tensile loadings.

The following shall apply:

	for ferritic materials:	for austenitic materials:
$K_2 = \frac{R_m \text{ tensile test}}{R_m \text{ material standard}}$	$K_3 = \frac{R_{eH} \text{ tensile test}}{R_{eH} \text{ material standard}}$	$K_2 = \frac{R_{p0,2} \text{ tensile test}}{R_{p0,2} \text{ material standard}}$

These factors may also be determined from the minimum and maximum values quoted in the material standards.

For standard supports made of austenitic materials the factors for design against buckling load shall be agreed upon in each individual case.

Table 5.3-1: Design factors for the determination of the allowable load for design loading level H on the basis of the loads determined experimentally

(5) For snubbers, the rated load F_N in accordance with the qualification test as per Annex D is qualified as allowable load at all design loading levels, provided that the vibration tests to Section D 3.2.4 have been completed successfully. Where the overload test to Section D 3.2.5 has been completed successfully, the allowable load shall be 1.5 times F_N in the case of 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 design loading level HS (including combination of various load cases), the allowable load shall be 1.7 times F_N .

(6) For dampers, the rated load F_N is qualified as allowable load for all design loading levels on the basis of the qualification test if the tests to Annex E have been completed successfully.

(7) In addition to para. (3), the following applies to rigid struts:

If the additional tests to Section F 3.2.4 have been completed successfully, 1.5 times F_N shall apply to the additional loads at design loading level HZ and 1.7 times F_N to the loads at design loading level HS.

(8) For hangers, the rated load F_N is qualified as allowable load for all design loading levels on the basis of the qualification tests if the tests to the Annexes were completed successfully. For the locked condition, 1.5 times F_N shall apply as allowable load.

6 Requirements for materials

(1) The materials specified in Sec. 6 of KTA 3205.1 are the admissible materials.

(2) Materials other than those listed in the above document shall be admissible if their fitness for the intended purpose has been acknowledged by the authorized inspector responsible for the qualification test.

(3) The material tests to Section 6 (1) shall be carried out as required by the respective standards and be provided with test certificates for the respective product forms in accordance with DIN EN 10204:

- | | |
|---|----------------------|
| a) plates | 3.1 to DIN EN 10204, |
| b) bar steels | 3.1 to DIN EN 10204, |
| c) springs | 3.1 to DIN EN 10204, |
| d) forgings | 3.1 to DIN EN 10204, |
| e) sections, pipes | 3.1 to DIN EN 10204, |
| f) small parts,
(e.g. washers, cotter pins
and other pins). | 2.1 to DIN EN 10204 |

(4) Welding filler metals and consumables shall be adapted to the respective welding procedure and be qualified to VdTÜV material data sheet 1153 or be allowed as per DIN 18800-1, para. 4.2.2.

(5) For standard supports which fall exclusively under the scope of KTA 3205.2, the material tests shall be carried out for the following product forms made of steel S 235 and be provided with a test certificate to DIN EN 10204:

- | | |
|--------------------|----------------------|
| a) plates | 2.2 to DIN EN 10204, |
| b) bar steels | 2.2 to DIN EN 10204, |
| c) sections, pipes | 2.2 to DIN EN 10204. |

(6) For fasteners the tests required by DIN EN ISO 898-1 and DIN EN 20898-2 shall be carried out at the manufacturer's works. Stamping is considered a certification. For bolts of strength category 10.9, the tests shall be certified with certificate 3.1 to DIN EN 10204 or to AD 2000 W 7.

DIN EN 10269 and DIN 267-13 with certificate 3.1 to DIN EN 10204 shall apply to high-temperature bolts.

(7) Where plates made of ferritic steel are loaded in thickness direction (tension), it shall be ensured that at plate thicknesses greater than or equal to 20 mm the plates have been qualified to DIN EN 10164, quality class Z 25 and have been examined for laminations in the connecting weld area.

(8) Parts made of materials with already completed documentation (e.g. material taken from stock) may be used if no objections exist as to safety.

(9) The hydraulic oil and the damping fluid shall meet at least the following characteristics:

- | | |
|------------------------------|--|
| a) admissible radiation dose | $\leq 10^5$ J/kg, |
| b) pour point | ≤ -40 °C (does not apply to bituminous damping fluids), |
| c) flash point | ≥ 300 °C, |
| d) ignition point | ≥ 400 °C. |

(10) The hydraulic oil and the damping fluid shall be resistant to ageing, humidity and water vapour. In addition, they shall not be corrosive or toxic. The manufacturer's certificate shall be considered an attestation of properties.

7 Requirements for manufacture

(1) The manufacturer shall ensure the proper performance of all necessary work while complying with the provisions of this safety standard. The demonstration of qualification to DIN 18800-7, class E (manufacturers' qualification extended to dynamically loaded components) shall basically be effected. The demonstration of qualification to DIN 18 800-7, class C (manufacturers' qualification without extension to dynamically loaded components) shall only be admissible if agreed upon with the authorized inspector.

(2) The manufacturer shall employ responsible and competent supervisory personnel for all manufacturing stages and hold-points to be carried out under his responsibility.

(3) The manufacturer shall specify in writing the functions and responsibilities within the scope of his quality assurance system.

(4) The persons or departments performing the quality-assuring activities by quality controls or tests and inspections shall be independent of the persons or departments responsible for manufacturing.

(5) The manufacturer shall normally have equipment and personnel at his disposal for the proper processing, testing and inspection or transportation of the standard supports. Equipment and personnel of other organisations which meet these requirements may also be employed.

(6) Equipment and machines for welding, forming and testing shall be subjected to maintenance and inspection at regular intervals. The manufacturing processes shall have been qualified (e.g. welder's approval test, procedure qualifications for welding and forming). This shall be confirmed to the authorized inspector. The authorized inspector is entitled to satisfy himself at any time in the course of manufacture that the conditions of (2) through (6) are satisfied.

8 Tests and inspections

8.1 Tests during manufacture

The current series shall be tested by the manufacturer's quality control department. In addition, the authorized inspector shall supervise the tests and inspections at random intervals.

8.2 Testing and inspection of the finished standard support

8.2.1 Rigid standard supports and rigid struts

(1) 5 % of the rigid standard supports and rigid struts shall be subjected to visual inspections and dimensional checks. The inspection shall cover the first item and the last item of each series.

(2) The inspections shall be confirmed by the manufacturer.

8.2.2 Hangers

(1) The following tests and inspections shall be carried out by the manufacturer on each hanger:

- a) visual inspections and dimensional checks
- b) functional test
 - ba) checking of set values,
 - bb) follow-up of the load/travel curve over the specified travel range and, for constant hangers, additional recording of the load/travel diagram including evaluation,
 - bc) checking of the marks indicating hot and cold position settings as well as locking of the cold setting point and inclusion of setting points in the list of set values,
 - bd) checking of overtravel safety margins, if necessary also for movements resulting from dynamic loads, and inclusion in the list of set values.

(2) 10 % of the hangers of a series shall normally be subjected to these tests and inspections, including the recording of the load/travel diagram for variable spring and constant hangers, in the presence of the authorized inspector. If the manufacturer has sufficient experience, the extent of the authorized inspector's attendance in the tests and inspections may be reduced accordingly by agreement with the authorized inspector who shall confirm his attendance in the tests and inspections accordingly.

(3) The fulfilment of the requirements for springs in accordance with Section 4.3.4 (4) shall be confirmed to the authorized inspector.

8.2.3 Snubbers

(1) The following tests and inspections shall be carried out by the manufacturer on each snubber:

- a) visual inspections and dimensional checks,
- b) functional test
 - ba) measurement of the frictional resistance and the breakaway force,
 - bb) measurement of the stroke,
 - bc) measurement of the response acceleration in the case of mechanical snubbers, and recording of a diagram,
 - bd) measurement of the lockup velocity in the case of hydraulic snubbers, and recording of a diagram,
 - be) measurement of the piston rod travel in the case of alternating directions of load application below the rated load F_N at a frequency of 5 Hz at room temperature, and recording of a diagram. If the test equipment available does not permit to obtain the test load, another suitable test method shall be selected.
 - bf) check of the bypass velocity.

(2) In addition, hydraulic snubbers shall be examined for the following characteristics:

- a) level of the hydraulic fluid by means of a level indicator,
- b) visual inspection for leak tightness,
- c) check of venting by means of a suitable method.

(3) 10 % of the snubbers of a series, but at least 2 items, shall normally be subjected to these tests and inspections in the presence of the authorized inspector. If the manufacturer has sufficient experience, the extent of the authorized inspector's attendance in the tests and inspections may be reduced accordingly by agreement with the authorized inspector.

(4) Every fiftieth snubber, and a minimum of one and a maximum of five snubbers of each series, shall be examined for the required quality characteristics which have been confirmed within the scope of the qualification test; the tests and inspections shall comprise the following:

In addition to the tests and inspections specified in clauses 8.2.3 (1) and 8.2.3 (2), the dynamic function of the snubber under vibrating loads shall be determined in the presence of the authorized inspector at three different frequencies between 2 Hz and 15 Hz. The load application time at each frequency shall normally be at least 10 seconds. In the respective mid-position, the snubbers shall be subjected to loads applied alternately by the displacement control and force control methods until the rated load F_N is obtained. Force and displacement shall be recorded both as a function of time and in parameter representation (phase plot).

If the test equipment available does not permit to obtain the test load, another suitable test method shall be used.

(5) The authorized inspector shall confirm in the test record that the results obtained meet the requirements.

8.2.4 Dampers

(1) For each type of damper, the following tests and inspections shall be performed by the manufacturer per batch supplied and operating temperature:

- a) Visual inspections and dimensional checks
- b) Functional test
 - ba) measurement of the total travel range,
 - bb) measurement of the damping resistance both horizontally and vertically for the following frequencies and amplitudes:

1	20	35	Hz
10	0.75	0.1	mm

- bc) measurement of 1.7 times F_N by means of displacement-controlled or force-controlled 4-cycle-beat excitation (modulated sinus to DIN EN 60068-2-59), considering the admissible deflection,
- bd) determination of the moving resistance for specified velocities and temperatures.

(2) About 10 % of the dampers, but at least 2 items, shall be subjected to these tests and inspections in the presence of the authorized inspector. If the manufacturer has sufficient experience, the extent of the authorized inspector's attendance in the tests and inspections may be reduced accordingly by agreement with the authorized inspector.

8.3 Certificate

(1) The manufacturer shall prepare a certificate evidencing the tests and inspections performed on the finished standard support; the certificate shall summarise the following items:

- a) test requirements,
- b) materials and material tests,
- c) in-process inspections,
- d) functional tests,
- e) marking
- f) test result.

- (2) The following documents shall accompany the certificate:
- a list of set values for hangers,
 - diagrams and records for constant hangers, constant supports, snubbers and dampers.

9 Markings

- (1) Rigid standard supports including rigid struts shall be marked at least with the:
- manufacturer's name,
 - type or type code; in the case of tension rods with material identification.
- (2) Movable standard supports shall be marked at least with the:
- manufacturer's name,
 - type or type code,
 - rated load,
 - operating (travel) range,
 - hot and cold load settings (only for hangers),
 - serial number,
 - manufacturer's acceptance stamp,
 - position number which shall be affixed at the latest in the course of assembly of the support in the nuclear power plant.
- (3) The marking shall be durably attached, and it shall not be easily removable.

10 Assembly and commissioning

10.1 Documents

- (1) The following documents shall be available for assembly:
- drawings of the component support structures with parts lists or equivalent documents and
 - instructions for assembly and operation.
- (2) The following documents shall be available for the tests and inspections on the site:
- a list of the movable standard supports with statement of specified and actual values of loads and travel ranges and
 - the manufacturer's certificate evidencing the test of the finished standard support.

10.2 General requirements

- (1) The assembly and commissioning of movable standard supports may only be carried out by instructed personnel observing the instructions for installation and assembly.
- (2) Where steel parts are joined by welding on the site to form standard supports, the tests and inspections in accordance with Sections 8.1 and 8.2.1 shall be carried out and certified in accordance with Section 8.3.
- (3) When carrying out welding work on pipe systems or steel structures, care shall be taken to ensure that no welding current flows through snubbers, constant hangers or constant supports. If no electric bridge connectors can be used, snubbers, constant hangers or constant supports shall be removed.
- (4) Load adjustments on constant hangers or constant supports may only be effected by personnel instructed accordingly by the manufacturer. These adjustments shall be recorded.
- (5) During transport and storage, standard supports shall be protected against damage as well as dirt and humidity.

- (6) In the case of hydraulic shock absorbers, the fluid level shall be monitored in accordance with the manufacturer's instructions.

10.3 Tests and inspections on site

For the performance of tests and inspections on the site, the erector shall prepare a test and inspection sequence plan which shall contain data relating to the:

- receiving inspection of the standard supports,
- compliance of the standard supports installed with the drawings,
- check of the locking of bolted joints,
- inspection of connections to structural attachments as to positive locking,
- inspection of the site welds in accordance with the test and inspection sequence plan,
- inspection for sufficient play of guides,
- inspection of the mounting positions of movable standard supports with a view to unrestrained movement in the case of thermal expansion and dynamic load applications, in due consideration of the overtravel safety margin, as well as inspection for possible deflection from the main direction of load application or from the connecting axis,
- inspection of the fluid level of hydraulic snubbers,
- inspection of the actual position under cold and hot load conditions after the operating load was applied to the entire support system and the locking of the hangers was removed,
- check of the actual position after subsequent operation to cold position.

10.4 Certificate

The tests and inspections performed on the site shall be summarised in lists and certified. Load adjustment records shall be attached.

11 In-Service Inspections

11.1 General

Standard supports involving relative movements shall be subjected to in-service inspections.

11.2 Performance

- (1) The performance of in-service inspections shall be laid down in the testing manual of the plant. The manual shall particularly specify the extent of the inspections, the inspection intervals, the performance of the inspections based on checklists, the inspection responsibilities and the type of documentation.
- (2) The following shall be taken into account when preparing the inspection documents:
- inspection recommendations of the manufacturer of the standard support, including the information on the results obtained from the qualification tests,
 - visual inspections, such as for dirt, friction marks, damage, visible deformations, unrestrained movement, actual position in the cold load condition and, as far as possible, actual position in the hot load condition, as-built position of standard supports,

c) for hydraulic snubbers: also lifetime, monitoring of leak tightness and level indications for the fluid.

(3) Additional in-service inspections of the function of snubbers shall be carried out by agreement with the authorized inspector. A test report shall be prepared and be confirmed by the inspector.

12 Standard supports of pipes and valves with a nominal diameter of less than or equal to DN 50

(1) In principle, Sections 10 and 11 apply to the standard supports for pipes and valves of a nominal diameter smaller than or equal to DN 50.

(2) If sufficient corrosion protection is provided, smaller dimensions than specified in Section 4.3.2 (1) may be used.

(3) Friction contact between clamp and pipe is admissible. A demonstration of the unstable condition of the connection is not required. The value of $2.4 \cdot K_2$ in accordance with **Table 5.3-1** shall be used as design factor for the determination of the resulting allowable normal force. The design factor for the determination of the allowable loading from the experimentally determined friction forces shall be at least 1.7.

13 Documentation

(1) All documents, test records, test reports and certificates as well as further records shall be part of the documentation the distribution and filing of which shall be as indicated in **Table 13-1**:

- a) application documents for the qualification test,
- b) test records of the qualification test,
- c) certification as to the performance of qualification tests (test certificate), including design data sheet,
- d) materials certificates,
- e) documents for manufacture,
- f) certificate of the tests and inspections of the completed standard support (manufacturer's certificate), including lists of set values, diagrams and test records,

- g) documents concerning the assembly,
- h) certificates of tests and inspections performed on the site,
- i) documents for in-service inspections and maintenance,
- k) records of in-service inspections, and
- l) reports on functional tests within the scope of in-service inspections.

(2) The documents of the qualification test shall be kept by the manufacturer for at least 7 years upon expiry of the term of validity of the qualification test in question.

(3) Documents d) through f) shall be kept by the manufacturer.

(4) Documents c) and f) through l) shall be kept by the user as part of its final file.

(5) The documentation records may be attached to the respective documentation in the form of originals, copies or microfilms.

Type of test / inspection	Type of document in acc. with Sec. 13 (1)	Standard support manufacturer	Nuclear power plant user
Qualification test	a)	X	–
	b)	X	–
	c)	X	X
Manufacturing tests and inspections	d)	X	–
	e)	X	–
	f)	X	X
Tests and inspections on the site	g)	–	X
	h)	–	X
In-service inspections	i)	–	X
	k)	–	X
	l)	–	X

Table 13-1: Filing of documentation records

Annex A

Testing Program for the Qualification Test for Rigid Standard Supports (Experimental Tests)

A 1 Scope

This Annex applies to the testing program of experimental tests which shall be carried out within the scope of the qualification test for rigid standard supports.

A 2 Definitions and explanations

Measured initial length L_0

In general, the measured initial length L_0 is equal to the geometric reference length. For threaded rods and turnbuckles, L_0 is equal to the length of the part; for clamps, L_0 is equal to d_a , i.e. the outer diameter of the pipe (see **Figure A 2-1**).

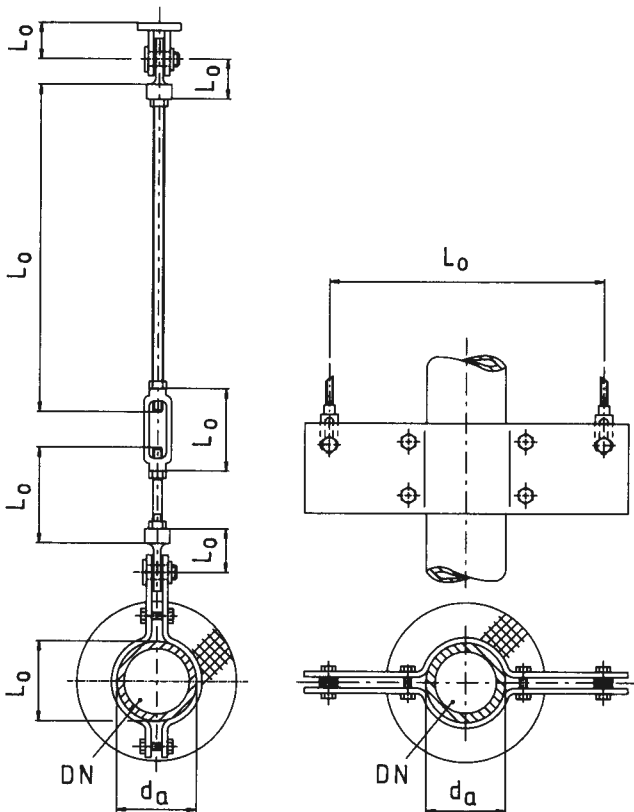


Figure A 2-1: Measured initial length L_0

A 3 Testing program

A 3.1 Performance of the test

(1) If the allowable loads determined by means of strength calculation are to be confirmed or verified by experimental tests within the scope of the qualification test, three tests each shall be carried out for each type of rigid standard support for three different dimensional ranges.

(2) If the allowable loads are to be determined only by experimental tests within the scope of the qualification test, three tests each shall be carried out for each type and size of rigid standard support and for each direction of load application.

(3) The intended installation position of the standard support shall be taken into account in the testing arrangement.

A 3.2 Extent of testing

(1) The yield load or ultimate load shall be determined in order to ascertain the allowable load in accordance with **Table 5.3-1**.

(2) For rigid standard supports which are subjected to loads under an angle greater than 5° as a result of oblique tension or compression, for example in the case of pipe base clamps, an additional experimental test shall be carried out using oblique tension or compression.

(3) If a test load greater than 5 is ascertained, the experimental tests may be stopped.

(4) Dynamic pipe clamps (e.g. for snubbers and rigid struts) shall be additionally tested in accordance with Section F 3.2.2 (1).

A 4 Evaluation of the test results

(1) The smallest measured yield or ultimate load shall be used for the evaluation of the test results.

(2) The allowable load to be determined from **Table 5.3-1** for design loading level H shall be greater than or equal to the maximum operating load.

(3) Dynamic pipe clamps for snubbers and rigid struts which were subjected to additional tests in accordance with Section F 3.2.2 (1) shall be evaluated in accordance with Section F 4.2.

A 5 Documentation

All tests shall be recorded in test records which shall be part of the documentation.

Annex B

Testing Program for the Qualification Test for Variable Spring Hangers and Spring Supports (Experimental Tests)

B 1 Scope

This Annex applies to the testing program for the experimental tests which shall be carried out within the scope of the qualification test for variable spring hangers and supports.

B 2 Definitions and explanations

The essential explanations for the function of a variable spring hanger or a variable spring support are as indicated by the force/travel characteristics plotted in **Figures B 2-1 and B 2-2**.

B 3 Test program

B 3.1 Performance of the test

- (1) Two variable spring hangers or two variable spring supports per type and size shall be tested in accordance with the scope of the test as indicated in **Table B 3-1**.
- (2) Variable spring hangers or variable spring supports characterised by comparable properties may be combined to be tested as one unit.
- (3) The intended installation position of the standard support shall be taken into account in the testing arrangement.

$$F = F_{\min} + \frac{F_N - F_{\min}}{s_N} \cdot s$$

$F_{\text{ist,o}}$: actual force at increasing load

$F_{\text{ist,u}}$: actual force at decreasing load

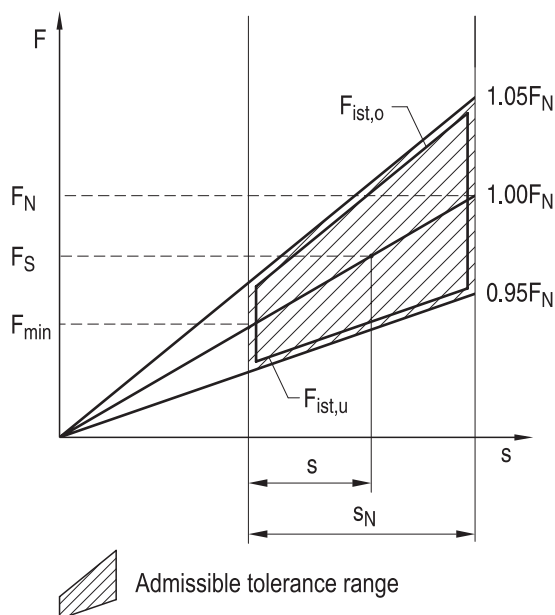


Figure B 2-1: Force/travel characteristic for variable spring hangers and variable spring supports

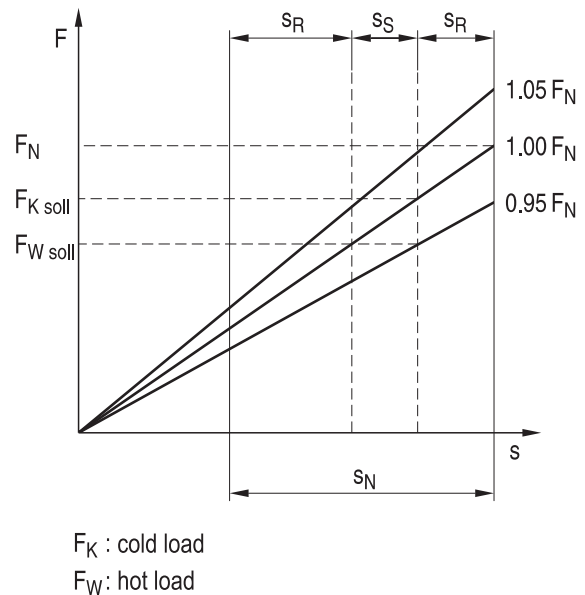


Figure B 2-2: Range of application for variable spring hangers and supports

B 3.2 Extent of testing

B 3.2.1 Quasi-static tests

- (1) Both variable spring hangers or both variable spring supports shall be subjected to quasi-static tests.
- (2) During the tests involving oblique tension or oblique compression, the casings of the variable spring hangers or variable spring supports shall be fixed in position.

B 3.2.2 Vibration test

- (1) One variable spring hanger or one variable spring support shall be subjected to a vibration test.
- (2) In the middle of the rated travel of the variable spring hanger or variable spring support, loads shall be applied in the following order in a displacement-controlled way at the following displacement amplitudes and the following frequency reference values:
 - 1 • 10³ cycles at ± 20 mm and 1 Hz
 - 2 • 10⁴ cycles at ± 5 mm and 5 Hz
 - 1.8 • 10⁶ cycles at ± 0.5 mm and 15 Hz
 - 2 • 10⁴ cycles at ± 5 mm and 5 Hz
 - 1 • 10³ cycles at ± 20 mm and 1 Hz.
- (3) If the rated travel range s_N is less than 40 mm, the tests shall be carried out for 10³ cycles at ± 0.5 • s_N .
- (4) After the vibration test, the quasi-static tests shall be repeated, except for the oblique loading test in the case of variable spring hangers or the oblique compression test in the case of variable spring supports.

B 3.2.3 Ultimate load testing

(1) A variable spring hanger or variable spring support shall be subjected to ultimate load testing in order to determine its load capacity. Subsequently, the variable spring hanger or variable spring support shall be disassembled and inspected visually for weak spots.

(2) The ultimate load testing may be stopped if 5 times the rated load F_N is obtained.

B 4 Evaluation of test results**B 4.1 Quasi-static tests**

(1) Variable spring hangers subjected to vertical tension and variable spring supports subjected to vertical compression shall withstand $2.5 \cdot F_N$ without any permanent deformation (see **Table 5.3-1**).

(2) Variable spring hangers or variable spring supports shall operate within the rated travel range s_N as follows

a) for vertical tensile loading in the case of variable spring hangers or for vertical compression in the case of variable spring supports:

$$\frac{|F_S - F_{ist,o}|}{|F_S|} \leq 0.05 \quad (\text{B 4-1})$$

$$\frac{|F_S - F_{ist,u}|}{|F_S|} \leq 0.05 \quad (\text{B 4-2})$$

b) for 4° oblique tensile loading in the case of variable spring hangers or 4° oblique loading, corresponding to a lateral force of 7 %, in the case of variable spring supports:

$$\frac{|F_S - F_{ist,o}|}{|F_S|} \leq 0.06 \quad (\text{B 4-3})$$

$$\frac{|F_S - F_{ist,u}|}{|F_S|} \leq 0.06 \quad (\text{B 4-4})$$

B 4.2 Vibration test

(1) The vibration test is considered to have been passed if the subsequent quasi-static tests meet the requirements of Section B 4.1.

(2) Wear which does not affect the operability of the equipment is permitted.

B 4.3 Ultimate load testing

The allowable load to be determined in accordance with **Table 5.3-1** shall be greater than or equal to the rated load F_N .

B 5 Documentation

All tests shall be included in test records which shall be part of the documentation.

Tests	Number of tests	Variable spring hanger no. 1 Variable spring support no. 1	Variable spring hanger no. 2 Variable spring support no. 2
Quasi-static tests			
a) load $2.5 \cdot F_N$ (blocked)	1	X	X
b) vertical tension for variable spring hanger and vertical compression for variable spring support at $v \leq 1 \text{ mm/s}$	3	X	X
c) 4° oblique tension for variable spring hanger and 4° oblique compression for variable spring support ¹⁾ at $v \leq 1 \text{ mm/s}$	3	X	X
d) check of travel scale	—	X	X
Vibration test			
a) vibration	—	X	—
b) load $2.5 \cdot F_N$	1	X	—
c) vertical tension for variable spring hanger and vertical compression for variable spring support at $v \leq 1 \text{ mm/s}$	3	X	—
d) check of travel scale	—	X	—
e) visual inspection for wear	—	X	—
f) surface crack detection	—	X	—
Ultimate load testing			
a) vertical tension for variable spring hanger and vertical compression for variable spring support	1	—	X
b) visual inspection	—	—	X
¹⁾ It is also permitted to apply a lateral force of $0.07 \cdot F_N$ simultaneously to the force F_N .			

Table B 3-1: Extent of testing for variable spring hangers and variable spring supports

Annex C

Testing Program for the Qualification Test for Constant Hangers and Constant Supports (Experimental Tests)

C 1 Scope

This Annex applies to the testing program for the experimental tests which shall be carried out within the scope of the qualification test for constant hangers and constant supports.

C 2 Definitions and explanations

(1) The essential explanations for the function of a constant hanger or a constant support are as indicated by the force/travel characteristics plotted in **Figure C 2-1**.

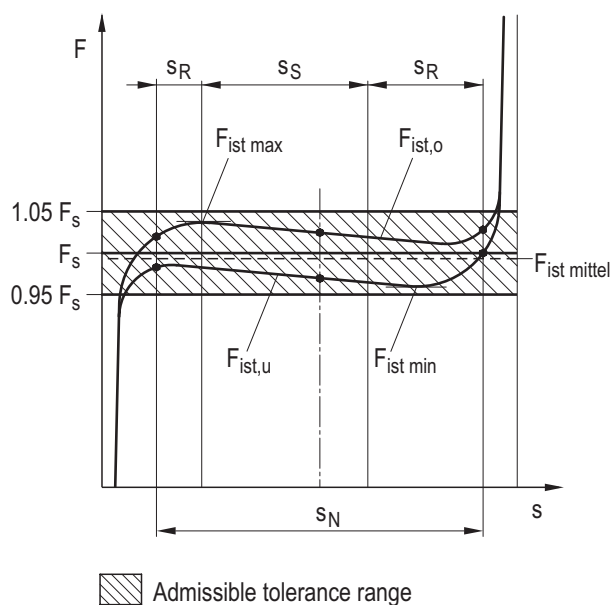


Figure C 2-1: Force/travel characteristic for constant hangers and constant supports

C 3 Test program

C 3.1 Performance of the test

- (1) Two constant hangers or two constant supports per type and size shall be tested in accordance with the extent of testing as indicated in **Table C 3-1**.
- (2) The intended installation position of the standard support shall be taken into account in the testing arrangement.

C 3.2 Extent of testing

C 3.2.1 Quasi-static tests

- (1) Both constant hangers or both constant supports shall be subjected to quasi-static tests.
- (2) During the tests involving oblique tension or oblique compression, the housings of the constant hangers or constant supports shall be fixed in position. This test shall only be carried out if the housing is rigidly attached to the structure in this particular case of application.

C 3.2.2 Vibration test

- (1) Three force/travel characteristics shall be recorded one after the other at either F_N or $(F_{s \max} + F_{s \min})/2$ on one constant support spring hanger or one constant support.
- (2) In the middle of the rated travel of the constant hanger or constant support, loads shall be applied subsequently in a displacement-controlled way at the following displacement amplitudes and with the following frequency reference values:
 - $2.0 \cdot 10^4$ cycles at ± 5 mm and 5 Hz
 - $1.8 \cdot 10^6$ cycles at ± 0.5 mm and 15 Hz
 - $2.0 \cdot 10^4$ cycles at ± 5 mm and 5 Hz
 - $1.0 \cdot 10^4$ cycles at $\pm 0.4 s_N$ and 1 Hz.
- (3) After the vibration test, the quasi-static tests a) and b) of **Table C 3-1** shall be repeated.
- (4) In addition, it shall be checked whether at least 15 % load reserves (F_R in **Figure C 2-2**) can be set, considering the admissible load deviations, without restricting the overtravel safety margins.
- (5) Finally, the constant hanger or the constant support shall be disassembled and examined for wear and incipient cracks by means of a surface crack detection examination.

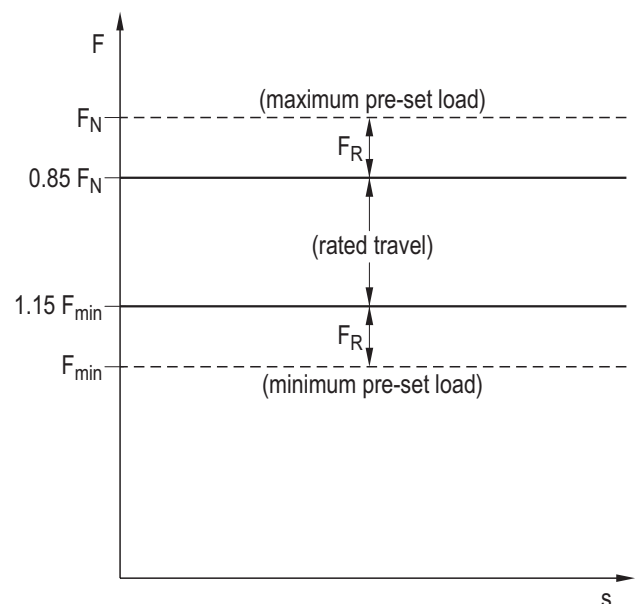


Figure C 2-2: Load adjustment range for constant hangers

C 3.2.3 Temperature test

Following a 48 h application of 80 °C and a subsequent cooling to room temperature, a force-displacement characteristic shall be determined for a constant hanger set to F_N or a constant support set to the same value.

C 3.2.4 Ultimate load testing

- (1) A constant hanger or a constant support shall be subjected to a ultimate load testing. Subsequently, the constant

hanger or constant support shall be disassembled and inspected visually for weak spots.

(2) The ultimate load testing may be stopped if 5 times the rated load F_N is obtained.

C 4 Evaluation of test results

C 4.1 Quasi-static tests

(1) Constant hangers subjected to vertical tension and constant supports subjected to vertical compression shall withstand $2.5 \cdot F_N$ without any permanent deformation.

(2) Constant hangers shall supports shall operate within the rated travel range s_N as follows:

a) for vertical tensile loading in the case of constant hangers or for vertical compression in the case of constant supports at $v \leq 1$ mm/s:

$$\frac{|F_S - F_{\text{ist min}}|}{|F_S|} \leq 0.05 \quad (\text{C 4-1})$$

$$\frac{|F_S - F_{\text{ist max}}|}{|F_S|} \leq 0.05 \quad (\text{C 4-2})$$

b) for 4° oblique tensile loading in the case of constant hangers or 4° oblique compression loading, corresponding to a lateral force of 7%, in the case of constant supports:

$$\frac{|F_S - F_{\text{ist min}}|}{|F_S|} \leq 0.06 \quad (\text{C 4-3})$$

$$\frac{|F_S - F_{\text{ist max}}|}{|F_S|} \leq 0.06 \quad (\text{C 4-4})$$

c) the following equation applies to the mid-load setting:

$$\frac{|F_S - F_{\text{ist mittel}}|}{|F_S|} \leq 0.02 \quad (\text{C 4-5})$$

(3) Constant hangers shall also comply with the above tolerances when set at F_N and F_{min} if vertical tension is applied. The same applies to constant supports if vertical compression is applied.

C 4.2 Vibration test

(1) The vibration test is considered to have been passed if the subsequent quasi-static tests meet the requirements of Section C 4.1.

(2) Wear which does not affect the operability of the equipment is admissible.

C 4.3 Temperature test

The temperature test is considered to have been passed if the force-displacement characteristics are within the tolerance ranges of equations C 4-1, C 4-2 and C 4-5.

C 4.4 Ultimate load testing

The admissible load to be determined in accordance with **Table 5.3-1** shall be greater than or equal to the rated load F_N .

C 5 Documentation

All tests shall be included in test records which shall be part of the documentation.

Tests	Number of tests	Constant hanger no. 1 Constant support no. 1	Constant hanger no. 2 Constant support no. 2
Quasi-static tests			
a) load $2.5 \cdot F_N$ (blocked)	1	X	X
b) vertical tension for constant hanger and vertical compression for constant support at $v \leq 1$ mm/s	3	X	X
c) 4° oblique tension for constant hanger and 4° oblique compression for constant support ¹⁾ bei $v \leq 1$ mm/s	3	X	X
d) vertical tension for constant hanger and vertical compression for constant support at F_{min}	3	X	X
e) vertical tension for constant hanger and vertical compression for constant support at F_N	3	X	X
f) check of load adjustment data	1	X	X
Vibration test			
a) vertical tension for constant hanger and vertical compression for constant support at $v \leq 1$ mm/s	3	X	—
b) vibration	—	X	—
c) load $2.5 \cdot F_N$ (f.s.d)	1	X	—
d) vertical tension for constant hanger and vertical compression for constant support at $v \leq 1$ mm/s	3	X	—
e) visual inspection for wear	—	X	—
f) surface crack detection	—	X	—
Temperature tests			
a) vertical tension for constant hanger and vertical compression for constant support at $v \leq 1$ mm/s	3	—	X
b) temperature load (48 h, 80°C)	1	—	X
c) vertical tension for constant hanger and vertical compression for constant support at $v \leq 1$ mm/s	3	—	X
Ultimate load testing			
a) vertical tension for constant hanger and vertical compression for constant support	1	—	X
b) visual inspection	1	—	X
¹⁾ It is also permitted to apply a lateral force of $0.07 \cdot F_N$ simultaneously to the force F_N .			

Table C 3-1: Extent of testing for constant hangers and constant supports

Annex D

Testing Program for the Qualification Test for Mechanical and Hydraulic Snubbers (Experimental Tests)

D 1 Scope

This Annex applies to the testing program for the experimental tests which shall be carried out within the scope of the qualification test for mechanical and hydraulic snubbers used in frequency ranges between 1 and 35 Hz.

Note:

- (1) The snubber as such also include their connecting bracket and pins.
- (2) This Annex does not cover loads resulting from operational vibrations.

D 2 Definitions and Explanations

The explanations which are important for the function of a snubber are shown in **Fig. D 2-1**.

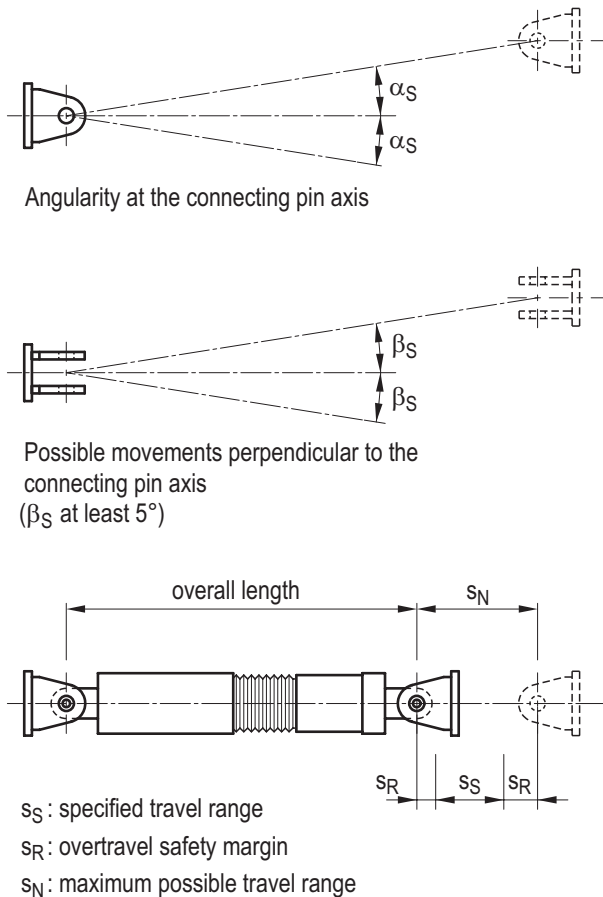


Figure D 2-1: Possible movements of a snubber

D 3 Test Program

D 3.1 Performance of the test

- (1) Three snubbers of each type and size shall be tested in accordance with the extent of testing as per **Table D 3-1**.
- (2) Snubbers shall be tested horizontal at the mid-stroke-position.

D 3.2 Extent of testing

D 3.2.1 Verification of the ageing resistance of non-metallic materials

(1) If parts made of non-metallic materials are used in snubbers, they shall be subjected to artificial ageing to simulate temperature and radiation exposure with respect to the period of installation and operating conditions. This test shall give information as to what period of time can be specified, for example for the seals (at least 8 years), in order to ensure proper functioning of the snubber.

(2) The program for the demonstration of ageing resistance shall be specified for the respective material. The functional tests and the constant load test shall be carried out on one snubber of each type and size.

(3) The ageing resistance shall be demonstrated by the tests listed below:

- a) materials tests of untreated materials,
- b) materials tests of aged materials to simulate irradiation (40 years) and temperature (stepwise, every 4 years), including:
 - ba) functional test of the snubber with materials aged by radiation,
 - bb) long-term test with $2.0 \cdot 10^5$ load cycles, with frequency and load to be specified,
 - bc) functional test of the snubber with materials aged by temperature (4 years),
 - bd) long-term test with $2.0 \cdot 10^5$ load cycles, with frequency and load to be specified.
- e) This procedure shall be repeated until failure of the snubber.

D 3.2.2 Dimensional check

A dimensional check shall be carried out on the basis of the drawing. In addition, the rated travel s_N and the possible movements perpendicular to the connecting pin axis shall be measured.

D 3.2.3 Functional test

D 3.2.3.1 Forces and response behaviour

The following shall be measured at room temperature:

- a) frictional resistance and breakaway force,
- b) stroke,
- c) reaction acceleration and lockup velocity,
- d) bypass velocity, and
- e) piston rod travel during change of direction of load application under rated load F_N at a frequency of 5 Hz.

D 3.2.3.2 Cyclic loadings

(1) Starting from its mid-stroke-position, the dynamic function of the snubber shall be tested under vibrating loads. The piston rod travel ranges s_a and s_b shall be measured (**Figure D 3-1**).

- (2) These tests shall be carried out at frequencies of 1, 2, 5, 10, 15, 20, 25, 30 and 35 Hz. The time of load application at each frequency shall normally last at least 10 seconds.
- (3) Force and travel range shall be recorded both as functions of time and in parameter representations (phase plot) (see **Figures D 3-1 and D 3-2**).

- (4) During the tests, hydraulic snubbers shall be observed with a view to possible leakage of hydraulic oil. No oil drops or films shall be found. Functional tests shall also be carried out at a fluid level of 90 %, provided the function of the snubber can still be ensured at this level.

Test	Hydraulic snubber No.			Mechanical snubber No.		
	1	2	3	1	2	3
Dimensional check	X	X	X	X	X	X
Check of the characteristics of the hydraulic oil	X	-	-	-	-	-
Functional test at room temperature	X	X	X	X	X	X
Functional test at 90 % hydraulic oil level, if necessary	X	-	-	-	-	-
Vibration test at 80 °C	-	X	-	-	X	-
Vibration test at 150 °C	-	-	X	-	-	X
Functional test at room temperature	-	X	X	-	X	X
Surface crack examination	-	X	X	-	X	X
Overload test at 1,7 • F _N	-	X	-	-	X	-
Ultimate load testing with application of tension	-	-	X	-	-	X
Ultimate load testing with application of compression	X ¹⁾	-	-	-	X ¹⁾	-
Visual inspection of the individual parts	X	X	X	X	X	X
Check of the characteristics of the hydraulic oil (oil from the snubber)	-	X	X	-	-	-
Ageing program (snubber no. 1 may be used for this test)	X	-	-	X	-	-

1) May be replaced by a substantiation by way of calculation.

Table D 3-1: Extent of testing for hydraulic and mechanical snubbers

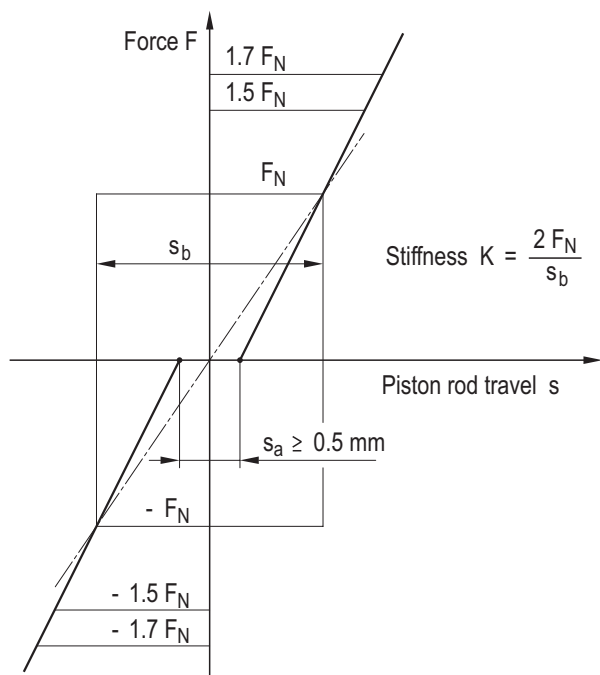


Figure D 3-1: Force/travel diagram

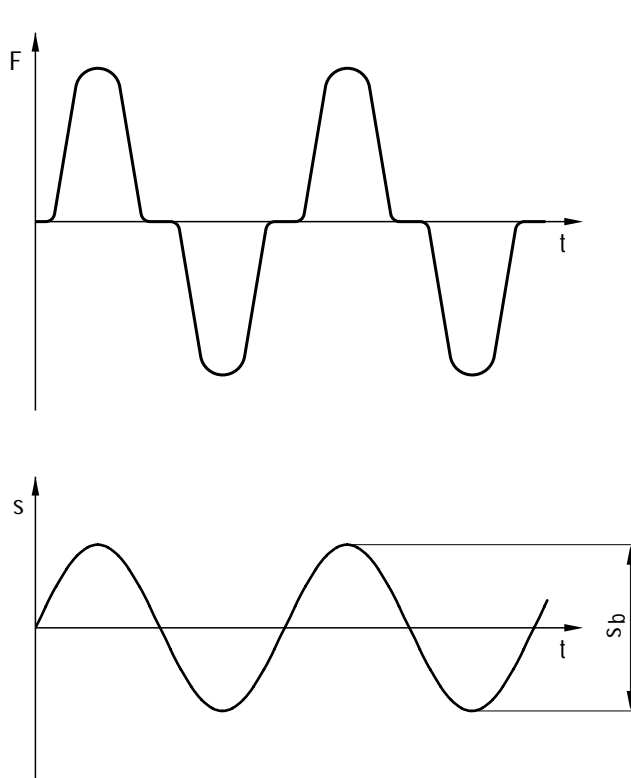


Figure D 3-2: Time-dependent representation

D 3.2.4 Vibration test

(1) One snubber of each type and size shall be subjected to the following load cycles at 80 °C and at 150 °C at a frequency of approx. 10 Hz.

a) at 80 °C

The above load cycles correspond to $1.0 \cdot F_N$ at 10,000 load cycles.

$1.5 \cdot F_N$ 25 load cycles

$1.0 \cdot F_N$ 3,300 load cycles

$0.5 \cdot F_N$ 47,000 load cycles

$0.1 \cdot F_N$ 1.8×10^6 load cycles

If it is ensured that, in case of application, the number of load cycles occurring is equal to or less than 330,000 load cycles, a qualification with $0.1 \cdot F_N = 330,000$ load cycles will suffice.

b) at 150 °C

$1.5 \cdot F_N$ 25 load cycles

$1.0 \cdot F_N$ 1,800 load cycles

$0.5 \cdot F_N$ 18,000 load cycles

$0.1 \cdot F_N$ 72,000 load cycles

(2) Subsequently, the functional test shall be repeated and evaluated.

(3) Surface crack examinations and, if necessary, dimensional checks shall be carried out on bearing and sliding surfaces, on load-bearing welds as well as on articulated parts.

(4) Prior to and after the vibration tests, the characteristics of the hydraulic fluid shall be checked for compliance with the manufacturer's data.

D 3.2.5 Overload test

(1) A snubber already tested at 80 °C shall be subjected fifty times to 1.7 times the load F_N at a frequency that is greater than or equal to 3 Hz.

(2) Subsequently, this snubber shall be disassembled and checked for incipient cracks and permanent deformations.

D 3.2.6 Ultimate load testing

(1) One ultimate load testing each under tension and compression shall be carried out. This test may be stopped if 5 times F_N is obtained.

(2) Subsequently, this snubber shall be disassembled and inspected visually for possible weak spots.

(3) A ultimate load testing under compressive load may be substituted by way of calculation. This particularly applies to snubbers with extensions.

D 4 Evaluation of test results**D 4.1 Demonstration of ageing resistance**

The criterion of ageing resistance is satisfied if the functional capability of the snubber is maintained after the vibration tests.

D 4.2 Dimensional check

The manufacturer's dimensional data as well as the requirements of Section 4.3.5 shall be complied with.

D 4.3 Functional test**D 4.3.1 Frictional resistance and breakaway force**

(1) The frictional resistance shall be smaller than the greater value of $0.02 \cdot F_N$ and 200 N (see **Figure D 4-1**).

(2) The breakaway force shall be smaller than the greater value of $0.02 \cdot F_N$ and 300 N (see **Figure D 4-1**).

D 4.3.2 Reaction acceleration

For mechanical snubbers, the reaction acceleration shall be between 0.1 m/s^2 and 0.22 m/s^2 at room temperature in the case of uniformly increased acceleration.

D 4.3.3 Lockup velocity

For hydraulic snubbers, the lockup velocity shall be between 3 mm/s and 6 mm/s at room temperature in the case of a uniformly increased velocity.

D 4.3.4 Bypass velocity

(1) The bypass velocity following the lockup of the hydraulic snubber at rated load F_N and at constantly uniform motion may be between 0.2 mm/s and 2 mm/s at room temperature.

(2) In the case of mechanical snubbers which lock upon response and unlock in the follow-up mode, the bypass velocity may be zero for a short period of time.

D 4.3.5 Piston rod travel

Note:

The piston rod travel range is the sum of the following:

- the lost motion as a result of the physical mode of operation,
- the elastic behaviour resulting from load application, and
- the play at the connection points.

(1) In the case of change in the direction of load application, the piston rod travel s_b shall not exceed the values shown in **Table D 4-1** up to the load F_N less than or equal to 750 kN (see **Figure D 3-1**):

Temperature	Frequency	
	1 Hz to 3 Hz	> 3 Hz
Room temperature	$\pm 0.025 \cdot s_N$ max. 8 mm	$\pm 0.02 \cdot s_N$
150 °C	$\pm 0.04 \cdot s_N$ max. 12 mm	$\pm 0.04 \cdot s_N$

Table D 4-1: Piston rod travel as a function of temperature and frequency

(2) The piston rod travel s_a shall not be less than 0.5 mm in the case of change in the direction of load application until the beginning of load build-up (see **Figure D 3-1**).

(3) In the case of snubbers with F_N greater than 750 kN, agreement shall be reached with the authorized inspector on the allowable values of s_a and s_b .

D 4.4 Vibration test

The vibration test is considered to have been passed if the subsequent functional test meets the requirements of Section D 4.3.

D 4.5 Overload test

Following the overload test, the snubber shall not show any permanent deformation. Cracks are not permitted.

D 4.6 Ultimate load testing

The allowable load to be determined in accordance with **Table 5.3-1** shall be greater than or equal to the rated load F_N .

D 5 Documentation

All tests shall be included in test records which shall be part of the documentation.

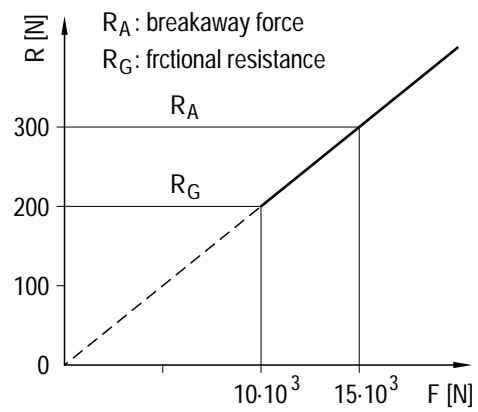


Figure D 4-1: Frictional resistance and breakaway force

Annex E

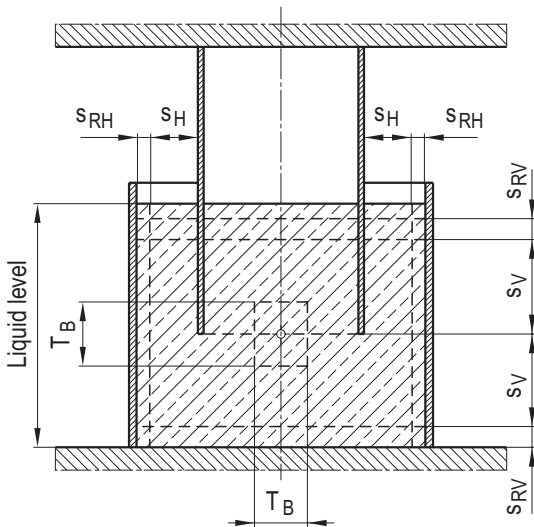
**Testing Program for the Qualification Test for Viscoelastic Vibration Dampers (Dampers)
(Experimental Tests)**

E 1 Scope

This Annex applies to the testing program for the experimental tests which shall be performed within the scope of the qualification test for viscoelastic vibration dampers (dampers) which are used in the frequency range between 1 and 35 Hz.

E 2 Definitions and explanations

(1) The explanations which are important for the function of a damper are shown in **Figure E 2-1**.



- ⊕ : centre position in operating condition (hot position)
- s_V : maximum allowable vertical travel
- s_H : maximum allowable horizontal travel
- s_{RV} : vertical overtravel safety margin, at least 10 mm
- s_{RH} : horizontal overtravel safety margin, at least 10 mm
- T_B : tolerance range for mid-position

The allowable deviation from mid-position in operating condition shall be laid down for each specific damper in the qualification test certificate.

Figure E 2-1: Possible movements of the damper

(2) Operating temperature

The operating temperature is the temperature obtained in the damping fluid during continuous operation for the intended load case.

(3) Dynamic characteristics

a) Damping resistance

The damping resistance is the quotient of the force amplitude and the amplitude of the rate of vibration.

b) Equivalent stiffness

The equivalent stiffness is the quotient of the force amplitude and the displacement amplitude

(c) Rated load

The rated load is the maximum damping force which is admissible at operating temperature and under dynamic excitation.

E 3 Test program

E 3.1 Performance of the test

(1) Two dampers of each type and size shall be tested in accordance with the extent of testing as indicated in **Table E 3-1**.

(2) The intended installation position of the dampers shall be taken into account in the test arrangement.

(3) In the horizontal direction of load application, the force shall normally be applied at half the immersion depth level of the damper piston.

Test	Damper no. 1	Damper no. 2
Verification of ageing resistance	X	X
Dimensional check	X	X
Damping fluid, characteristics	X	X
Functional test	–	–
Dynamic characteristics		
Damping resistance	X	X
Equivalent stiffness	X	X
Displacement resistance		
Medium at room temperature	X	–
Medium at operating temperature	–	X
Vibration test	X	X
Overload test	X	X
Visual inspection and surface crack examination of welds	X	X
Ultimate load testing ¹⁾	X	X
¹⁾ May be replaced by a calculation.		

Table E 3-1: Extent of testing for dampers

E 3.2 Extent of testing

E 3.2.1 Verification of the ageing resistance of non-metallic materials

The extent of testing to demonstrate the ageing resistance shall be specified for the respective material. This test shall provide information on the possible lifetime of the packings and the damping fluid.

E 3.2.2 Dimensional check

A dimensional check shall be carried out on the basis of the drawings. In addition, the rated travel, the overtravel safety margin, also during tilting, as well as the tilting angle shall be determined.

E 3.2.3 Damping fluid

The characteristics of the damping fluid, in particular the viscosity, shall be checked as a function of temperature in accordance with the data submitted by the manufacturer.

E 3.2.4 Functional test**E 3.2.4.1 Dynamic characteristics**

(1) The dynamic characteristics shall be determined according to E 2 (3).

(2) The following tests shall be carried out, both at room temperature and at the specified maximum operating temperature, as a function of the damper fluid used, in vertical and horizontal direction of load application from the central position of the damper piston:

a) Determination of the damping resistance and the equivalent stiffness for the following frequencies and amplitudes:

1	2	5	10	20	30	35	Hz
10	5	3	2	0.75	0.25	0.1	mm

aa) Measurement of the damping resistance with displacement-controlled continuous sine excitation for a testing time of 10 seconds,

ab) Measurement of the equivalent stiffness for sudden load applications with 5 load cycles of a 4-cycle-beat excitation (modulated sinus to DIN EN 60068-2-59).

b) Determination of the frictional resistance using the values specified by the manufacturer.

(3) Between two tests there may be a break of up to 30 minutes in the case of great test amplitudes and up to five minutes in the case of small test amplitudes.

(4) The evaluation amplitudes shall be formed separately for each quantity to be evaluated, as the average value of the amplitudes of the compressive and tensile load ranges.

E 3.2.5 Vibration test

$2 \cdot 10^6$ load cycles shall be applied at a frequency of 15 Hz and an amplitude of 0.1 mm.

E 3.2.6 Overload test

(1) The respective rated load stated by the manufacturer shall be verified by an overload test in a specified frequency range by displacement-controlled or force-controlled 4-cycle-beat excitations (modulated sinus to DIN EN 60068-2-59) or continuous sine loads. For this purpose, and considering the admissible excursion, the test frequency and the test ampli-

tude shall normally be set in such a way that at least 1.7 times the rated load is obtained.

(2) After the test, the individual parts shall normally be subjected to a visual inspection to include a surface crack examination of the welds.

E 3.2.7 Ultimate load testing

The ultimate load testing may be substituted by a calculation.

E 4 Evaluation of test results**E 4.1 Verification of ageing resistance**

The ageing resistance is demonstrated if the functional capability of the damper is maintained after the tests.

E 4.2 Dimensional check

The manufacturer's dimensional data shall have been adhered to.

E 4.3 Damping fluid

The damping fluid shall fulfil the requirements specified by the manufacturer.

E 4.4 Functional test

(1) The damping resistance and the equivalent stiffness shall be plotted as a function of the frequency and shall meet the requirements specified by the manufacturer.

(2) The frictional resistance shall not exceed 2% of the operating load.

E 4.5 Overload test

Upon completion of the overload test there shall be no permanent deformations and no cracks.

E 5 Documentation

All tests shall be included in test records which shall be part of the documentation.

Annex F

**Testing Program for the Qualification Test for Rigid Struts
(Experimental Tests)**

F 1 Scope

This Annex applies to the testing program for the experimental tests which shall be carried out within the scope of the qualification test for rigid struts.

F 2 Definitions and explanations

(1) The explanations which are important for a rigid strut are shown in **Figure F 2-1**.

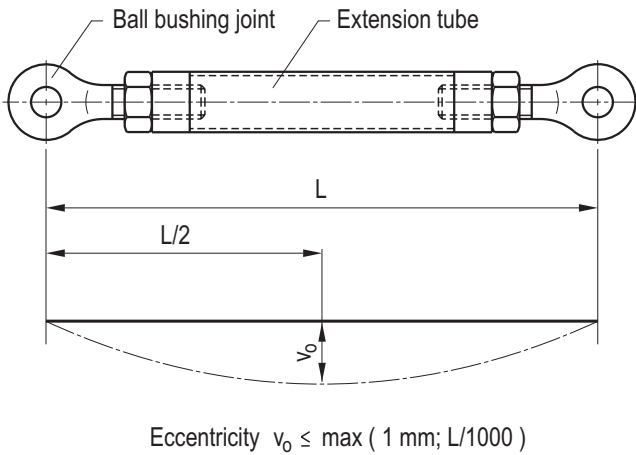


Figure F 2-1: Rigid strut

- (2) Rigid struts consist of a rigid part as connecting piece and two ball bushing joints.
- (3) The eccentricity resulting from initial deflection or misalignment shall not exceed the values specified in Section 4.3.5 (9).

F 3 Test program

F 3.1 Performance of the test

(1) Two rigid struts of each type and size shall be tested in accordance with the extent of testing as indicated in **Table F 3-1**.

Test	Rigid strut no. 1	Rigid strut no. 2
Dimensional check	X	X
Measurement of eccentricity	–	X
Measurement of play	X	–
Vibration test	X	–
Surface crack examination	X	–
Ultimate load testing		
a) tension (5° angularity)	X	–
b) compression (maximum length)	–	X

Table F 3-1: Extent of testing for rigid struts

- (2) The two ends of the rigid strut shall be linked to the respective connecting parts and tested in this form.
- (3) Rigid struts shall be subjected to both tension and compression, with the compressive load tests being carried out at the maximum length.
- (4) Unless otherwise provided for in individual cases, the tests shall be carried out at room temperature in the horizontal installed position.

F 3.2 Extent of testing

F 3.2.1 Dimensional check

A dimensional check, including a measurement of the play, shall be carried out on the basis of the drawings.

F 3.2.2 Vibration test

(1) One rigid strut of each type and size shall be subjected to a vibration test at about 10 Hz under the following load collectives and load cycles:

$1.5 \cdot F_N$	25 load cycles
$1.0 \cdot F_N$	3,300 load cycles
$0.5 \cdot F_N$	47,000 load cycles
$0.1 \cdot F_N$	330,000 load cycles

The load cycles specified above corresponds to $1.0 \cdot F_N$ at 10,000 load cycles.

(2) After the vibration test, surface crack examinations shall be carried out on the ball bushing joints and welds, and the play of the tested arrangement shall be measured.

F 3.2.3 Ultimate load testing

(1) One rigid strut each shall be subjected to tensile and compressive forces to destruction. The tensile force shall be applied to the rigid strut which was also subjected to the vibration test.

(2) The ball bushing joints shall be tested for the most unfavourable direction of load application at 150 °C.

(3) For the test involving tensile loads, the eye of the ball bushing joint shall be rotated about 5° in relation to the plane of the ball bushing joint; 0° shall be adhered to in tests involving compressive loads.

F 3.2.4 Additional Tests

(1) If 1.5 times the rated load is to be admitted for design loading level HZ and 1.7 times the rated load for design loading level HS, the following additional tests shall be carried out for each size:

- a) On one rigid strut where the compressive load governs the design, a dynamic load of $1.7 \cdot F_N \cdot 1.2$ ($= 2.04 \cdot F_N$) shall be applied.
- b) On one rigid strut where the tensile load governs the design, a dynamic load of $1.7 \cdot K_2 \cdot F_N \cdot 1.1$ ($= 1.87 \cdot K_2 \cdot F_N$) shall be applied.

(2) The rigid struts to be tested shall have been produced from the same batches as the rigid struts used to determine the ultimate load.

(3) The dynamic tests shall be carried out at a frequency of 6 Hz and shall comprise at least 7 load cycles.

F 4 Evaluation of test results

F 4.1 Dimensional check

The manufacturer's dimensional data as well as the requirements for play and eccentricity shall have been observed.

F 4.2 Vibration test

(1) The vibration test is considered to have been passed if the subsequent measurement of the total play does not result in more than 2 % of the bolt diameter or more than 1.5 mm.

(2) The surface crack examination shall not reveal any cracks.

F 4.3 Ultimate load testing

(1) The allowable load to be determined in accordance with **Table 5.3-1** shall be greater than or equal to the rated load F_N .

(2) It is admissible to determine the buckling load P_K by means of a load deflection measurement from the critical buckling load P_{Kr} (**Figure F 4-1**).

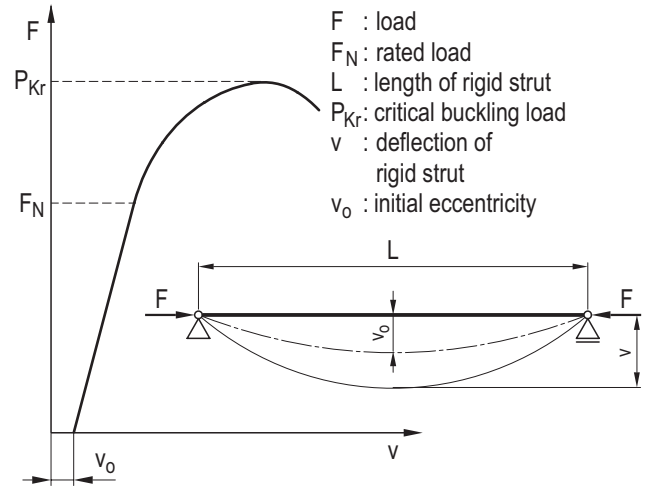


Figure F 4-1: Load deflection diagram of buckled bars

F 4.4 Additional tests

The additional tests are considered to have been passed if the play of the total arrangement does not exceed 3 mm after the load applications.

F 5 Documentation

All tests shall be included in test records which shall be part of the documentation.

Annex G

Regulations Referred to in this Safety Standard

(The references exclusively refer to the version given in this annex. Quotations of regulations referred to therein refer to the version available when the individual reference below was established or issued)

AtG		Act on the Peaceful Use of Nuclear Energy and the Protection against its Hazards (Atomic Energy Act) dated 23 December 1959 as published on 15 July 1985 (BGBl. I, p. 1565, No. 41), at last amended on 31 October 2006 (BGBl. I 2006, No. 50)
KTA 1401	(06/96)	General Requirements Regarding Quality Assurance
KTA 3205.1	(06/02)	Component Support Structures with Non-Integral Connections; Part 1: Component Support Structures with Non-Integral Connections for Components of the Reactor Coolant Pressure Boundary
KTA 3205.2	(06/90)	Component Support Structures with Non-Integral Connections; Part 2: Component Support Structures with Non-Integral Connections for Pressure and Activity-Containing Components in Systems Outside the Primary Circuit
DIN 267-13	(08/93)	Mechanical Fasteners - Technical Conditions of Delivery; Part 13: Parts for bolted connections with specific properties for use at temperatures ranging from - 200 °C to + 700 °C
DIN EN ISO 898-1	(11/99)	Mechanical Properties of Fasteners Made of Carbon Steel and Alloy Steel - Part 1: Bolts, Screws and Studs (ISO 898-1:1999); German version EN ISO 898-1:1999
DIN EN 10025-1	(02/05)	Hot Rolled Products of Structural Steels - Part 1: General Technical Delivery Conditions; German version EN 10025-1:2004
DIN EN 10164	(03/05)	Steel Products with Improved Deformation Properties Perpendicular to the Surface of the Product - Technical Delivery Conditions; German version EN 10164:2004
DIN EN 10204	(01/05)	Metallic Products - Types of Inspection Documents; German version EN 10204:2004
DIN EN 10269	(07/06)	Steels and Nickel Alloys for Fasteners with Specified Elevated and/or Low Temperature Properties; German version EN 10269:1999
DIN EN 13906-1	(07/02)	Cylindrical Helical Springs Made from Round Wire and Bar - Calculation and Design - Part 1: Compression Springs; German version EN 13906-1:2002
DIN EN 13906-2	(07/02)	Cylindrical Helical Springs Made from Round Wire and Bar - Calculation and Design - Part 2: Extension Springs; German version EN 13906-2:2001
DIN 18800-1	(11/90)	Structural steelwork; design and construction
DIN 18800-7	(09/02)	Steel structures - Part 7: Execution and constructor's qualification
DIN EN 20898-2	(02/94)	Mechanical Properties of Fasteners; Part 2: Nuts with Specified Proof Load Values; Coarse Thread (ISO 898-2:1992); German Version EN 20898-2:1993
DIN EN 60068-2-59	(03/95)	Environmental Testing - Part 2: Tests Methods; Test Fe: Vibration, Sine Beat Method (IEC 60068-2-59:1990); German version EN 60068-2-59: 1993
AD 2000-Merkblatt W 7	(02/05)	Bolts and Nuts from Ferritic Steels
VdTÜV MB 1153	(01/06)	Guidelines for the Qualification Testing of Weld Filler Metals