EOTA®

EUROPEAN ASSESSMENT DOCUMENT

EAD 120112-00-0107

August 2019

SUPPORTED EXPANSION JOINTS FOR ROAD BRIDGES

This European Assessment Document (EAD) has been developed taking into account up-to-date technical and scientific knowledge at the time of issue and is published in accordance with the relevant provisions of Regulation (EU) No 305/2011 as a basis for the preparation and issuing of European Technical Assessments (ETA).

Contents

1 SCOPE OF THE EAD

1.1 Description of the construction product

This EAD covers supported expansion joints for road bridges.

Supported expansion joints for road bridges are used to ensure the continuity of the running surface and its load bearing capacity and the movement of the bridges whatever the nature of the structure constitutive material is.

Expansion joints for moveable bridges are not covered by this EAD.

A supported expansion joint consists of one sub-component flushed with the running surface, which is fixed by hinges on one side and sliding supports on the other side (by a second element), and which spans the deck joint gap. The expected structure movement is allowed through sliding on the non-fixed side of the hinged sub-component, i.e. on the supporting element that is anchored to the substructure.

Supported expansion joints can be classified in the following subfamilies:

- Bridging plate expansion joints without fingers
- Bridging plate expansion joints with fingers

Bridging plate expansion joints without fingers consist of a plate supported by a rotational bearing at one side and sliding element at the other side, supported by a plate (see Figure 1).

Bridging plate expansion joints with fingers (such as comb or saw-tooth or sinusoidal plates) consist of a plate supported by a rotational bearing at one side and sliding fingers at the other side, supported by a plate with intersecting fingers (see Figure 2).

Figures 1 and 2 show examples of supported expansion joints, other details are possible.

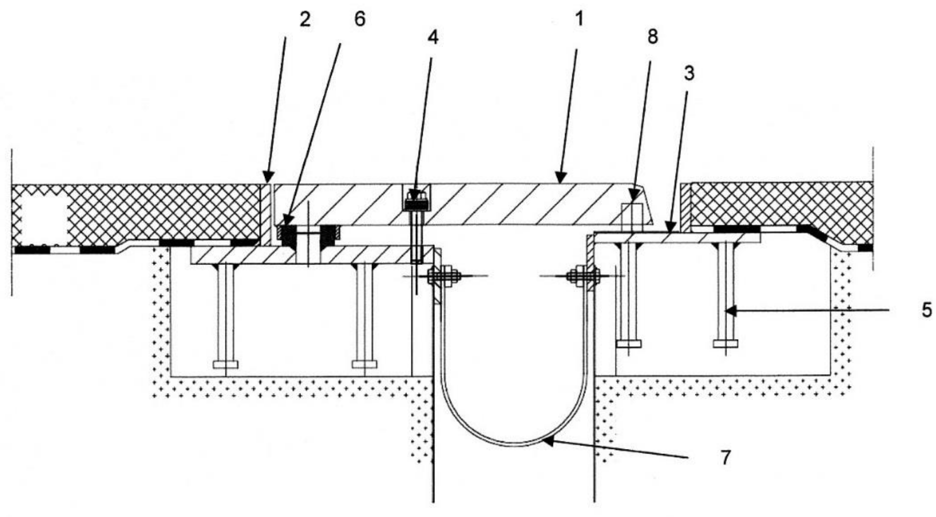


Figure 1: Example of supported expansion joint without fingers

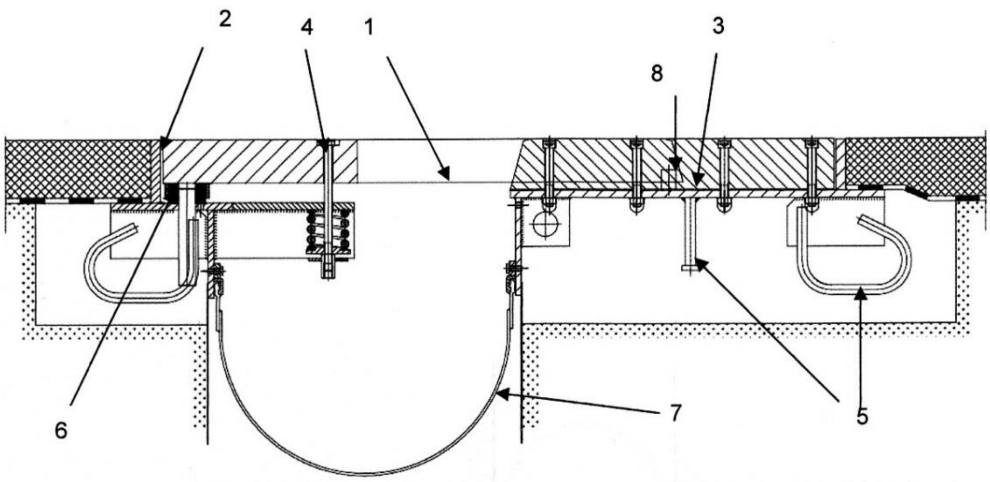


Figure 2: Example of supported expansion joint with fingers

Key for Figures 1 and 2:

1	Sliding plate
2	Fixed support base
3	Sliding support base
4	Holding down device (flexible) of sliding plate
5	Anchorage system (dowels, anchor loops)
6	Rotational bearing
7	Gutter (devices for drainage system)
8	Sliding support

Bridging plate expansion joints without fingers consist at least of the following:

- Bridging plate
- Anchorage system
- Holding down devices
- Rotational bearing [1)]
- Sliding support and cover layer

(1) May be combined with other elements.

In addition, the following optional devices may be included in the supported expansion joint kit to be assessed and subject of the ETA:

- Kerb elements
- Covers for pedestrian areas and running surfaces
- Gutter (devices for drainage system)
- Supporting substructure (linking the joint to the main structure)
- Adaptations for snow plough impacts (e.g. impact protection strip)
- Connections to the watertight membrane
- Flexible expansion element
- Drainage device made of aluminium or stainless steel (defined in EAD 120109-00-0107, Annex D, Figure D.11)

Bridging plate expansion joints with fingers consist at least of the following:

- Bridging plate with fingers and counter plate
- Anchorage system
- Holding down devices
- Rotational bearing [2)]
- Sliding support and cover layer with fingerplate

(2) May be combined with other elements.

In addition, the following optional devices may be included in the supported expansion joint kit to be assessed and subject of the ETA:

- Kerb elements
- Covers for pedestrian areas and running surfaces
- Gutter (devices for drainage system)
- Supporting substructure (linking the joint to the main structure)
- Adaptations for snow plough impacts (e.g. impact protection strip)
- Connections to the watertight membrane
- Drainage device made of aluminium or stainless steel (defined in EAD 120109-00-0107, Annex D, Figure D.11)

Flexible gutters made of vulcanised elastomer and other components of the kit made of vulcanised elastomer are based on e.g. Polychloroprenerubber (CR), Ethylene-Propylene-Diene Material (EPDM), Styrol-Butadiene-Rubber (SBR) or natural rubber (NR).

Rigid gutters made of plastics are based on PVC or PE or made of stainless steel or galvanized steel.

The material used for connecting the joint to the substructure (e.g. concrete for recess filling and reinforcement in case of concrete bridges) considered in the assessment of the product shall be described in the ETA but is not forming a part of the product covered by the ETA.

Supported expansion joints according to this EAD are related to the atmospheric corrosivity categories C4 or C5 according to EN ISO 9223[1], whereas durability classes according to EN ISO 12944-1 and EN ISO 14713-1 respectively apply.

This EAD applies for products with the following corrosion protection aspects:

- Structural steel surfaces in contact with concrete have no coating. Only at the transitions an overlap of approximately 50 mm of the full corrosion protection system is applied.
- In case of use of stainless steel for components, the steel type is selected under consideration of the corrosivity categories of the atmosphere using the conditions given in EN 1993-1-4, Annex A, A.2, A.4 and A.5.
- Aluminium alloys have a corrosion resistance of at least category “B” according to EN 1999-1-1, Table D1, or equivalent. Furthermore, interaction between concrete and the aluminium alloy is prevented.
- Permanent steel bolts are at least electrolytic zinc plated. For coating with Fe/Zn 25 EN ISO 2081 applies, for hot dip galvanisation EN ISO 10684 applies. In case of stainless steel EN ISO 3506-1 applies, whereas EN 1993-1-4, Annex A, A.2, A.4 and A.5 needs to be considered.

In case of using aluminium for the bridging plate (with or without fingers) this should be accompanied by the following information to be stated in the ETA:

- declaration about protection of aluminium parts when in contact with concrete under humid circumstances
- information about insulation measures taken to avoid galvanic elements (electrolytic corrosion)

The product is not covered by a harmonised European standard (hEN).

Concerning product packaging, transport, storage, maintenance, replacement and repair it is the responsibility of the manufacturer to undertake the appropriate measures and to advise his clients on the transport, storage, maintenance, replacement and repair of the product as he considers necessary.

It is assumed that the product will be installed according to the manufacturer’s instructions or (in absence of such instructions) according to the usual practice of the building professionals.

Relevant manufacturer’s stipulations having influence on the performance of the product covered by this European Assessment Document shall be considered for the determination of the performance and detailed in the ETA.

1 All undated references to standards or to EADs in this document are to be understood as references to the dated versions listed in Clause 4.

1.2 Information on the intended use(s) of the construction product

1.2.1 Intended use(s)

The product according to this EAD is intended to be used for road bridges.

1.2.1.1 Operating temperature categories

The operating temperature is defined as the shade air temperature according to EN 1991-1-5, clause 1.5.2.

The product according to this EAD is intended to be used under operating temperatures given below:

- Levels of minimum operating temperature categories: -10 °C, -20 °C, -30 °C, -40 °C
- Levels of maximum operating temperature categories: +35 °C, +45 °C

Operating temperature range shall be stated in the ETA.

1.2.1.2 Use categories

The use categories to be stated in the ETA are specified with regard to the user and action categories.

1.2.1.2.1 User categories

- Vehicle
- Cyclist
- Pedestrian

1.2.1.2.2 Actions categories

- Standard action (traffic load action)
- Optional action (accidental effects of heavy wheel on footpath, seismic phenomena; wheel shock on the upstand)

Actions are defined in EAD 120109-00-0107, Annex D, Clause D.2.3 and D.2.4.

1.2.2 Working life/Durability

The assessment methods included or referred to in this EAD have been written based on the manufacturer's request to take into account a working life of the supported expansion joint for road bridges for the intended use according to the working life categories as given in Table 1 when installed in the works (provided that the supported expansion joint for road bridges is subject to appropriate installation (see 1.1)). These provisions are based upon the current state of the art and the available knowledge and experience.

The intended working life of the kit is based on the following working life categories, with N_{obs} = 0,5 million/year or (see EN 1991-2, Table 4.5 and EAD 120109-00-0107, Annex D, Clause D.2.3.3).

Table 1: Working life categories of the expansion joint kit

Working Life category	Years
1	10
2	15
3	25
4	50

Replaceable components which have a working life shorter than for the kit shall be indicated in the ETA.

When assessing the product the intended use as foreseen by the manufacturer shall be taken into account. The real working life may be, in normal use conditions, considerably longer without major degradation affecting the basic requirements for works[2].

The indications given as to the working life of the construction product cannot be interpreted as a guarantee neither given by the product manufacturer or his representative nor by EOTA when drafting this EAD nor by the Technical Assessment Body issuing an ETA based on this EAD, but are regarded only as a means for expressing the expected economically reasonable working life of the product.

1.3 Specific terms used in this EAD (if necessary in addition to the definitions in CPR, Art 2)

For definitions, abbreviations and symbols regarding the terminology applying for assessment of mechanical resistance, resistance to fatigue and seismic behaviour EAD 120109-00-0107, Annex D, applies. For additional terms and definitions specific for this EAD, see below.

1.3.1 Anchorage system

Bars and/or rods that connect the supported expansion joint to the main structure or the abutment.

1.3.2 Batch

Quantity of product or components manufactured to the same specification within a determined period.

1.3.3 Bridging plate without fingers or with fingers and counter plate

Load bearing surface elements fixed to the bridge structure.

1.3.4 Flexible expansion element

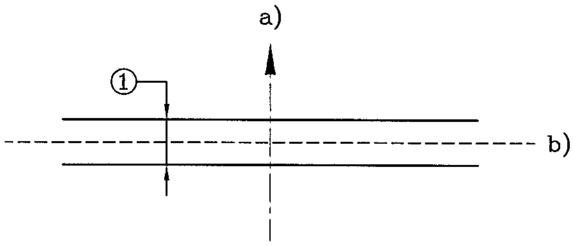
Element providing a running surface in cases where the allowances for gaps and voids would be exceeded without it.

1.3.5 Gap

1.3.5.1 Expansion joint gap (surface gap (1))

Opening (generally defined by one dimension) with a great length and a relatively small width in the road surface between sub-components of the expansion joint (perpendicular distance between two straight edges or planes):

a) Traffic direction
b) Longitudinal axis of the expansion joint.

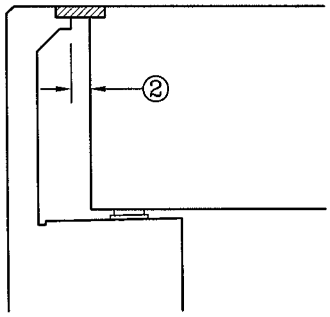


Note: In principle, the term gap is not restricted to straight border lines. (See also EAD 120109-00-0107, Annex D, Clause D.2.2)

2 The real working life of a product incorporated in a specific works depends on the environmental conditions to which that works is subject, as well as on the particular conditions of the design, execution, use and maintenance of that works. Therefore, it cannot be excluded that in certain cases the real working life of the product may also be shorter than referred to above.

1.3.5.2 Bridge deck gap (structure gap (2))

Opening between two adjacent parts of the main structure, which is bridged by the expansion joint (distance between two structural elements) (See also EAD 120109-00-0107, Annex D, Clause D.2.2)



1.3.6 Gutter (devices for drainage system)

Component(s) with the purpose of draining surface water from the expansion joint.

1.3.7 Holding down devices

System preventing the uplift of surface elements.

1.3.8 Kerb

The upstand which forms the boundary of the carriage way and the footpath.

1.3.9 Movement capacity

The range of the relative displacement between the extreme positions (e.g. maximum and minimum opening) of an expansion joint. (See also EAD 120109-00-0107, Annex D, Clause D.2.2)

1.3.10 Replaceability

The ability to replace is given when a component, incorporated in the assembled expansion joint, can be exchanged during the intended working life of the expansion joint.

1.3.11 Rotational bearing

Element transferring loads to the substructure and main structure respectively, allowing a certain degree of rotation.

1.3.12 Secondary elements

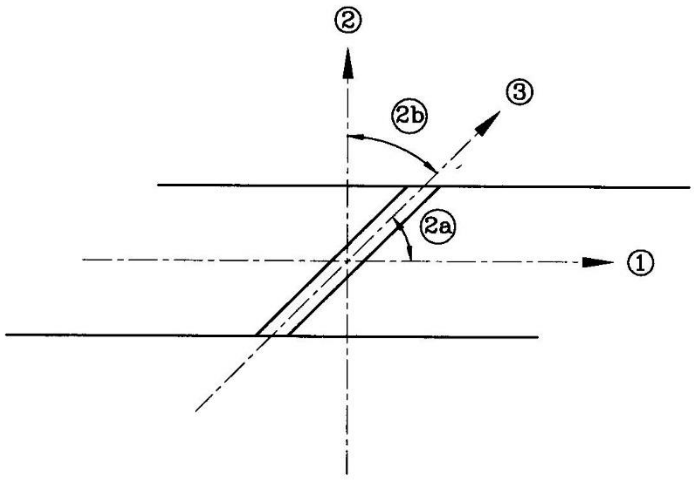
Components of the kit not contributing to mechanical resistance and stability of the kit.

1.3.13 Skew angle (of the expansion joint)

Considering the existence of two interpretations of the skew of the bridge in Member States, it has two definitions:

a) the skew angle is the angle between the traffic direction and the longitudinal axis of the joint

b) the skew angle is the angle between the axis perpendicular to the road and the longitudinal axis of the joint



Legend

1: Road axis in traffic direction
2: Perpendicular to the road axis
2a and 2b: Skew angle
3: Longitudinal expansion joint axis
(See also EAD 120109-00-0107, Annex D, Clause D.2.2)

1.3.14 Sliding support and cover layer / sliding support and cover layer with finger plate

Load bearing element including a sliding surface.

1.3.15 Supporting substructure (linking the joint to the main structure)

Intermediate structure connecting surface elements and anchorage system to the main structure.

1.3.16 Transition strip

Material between the expansion joint and the adjacent surfacing.

1.3.17 Void

An opening in the road surface (generally defined by two dimensions) with no load bearing capacity.

2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

2.1 Essential characteristics of the product

Table 2 shows how the performance of the supported expansion joint for road bridges is assessed in relation to the essential characteristics.

Table 2 Essential characteristics of the product and methods and criteria for assessing the performance of the product in relation to those essential characteristics

No	Essential characteristic	Assessment method	Type of expression of product performance
Basic Works Requirement 1: Mechanical resistance and stability			
1	Mechanical resistance	Clause 2.2.1	Description
2	Resistance to fatigue	Clause 2.2.2	Description
3	Seismic behaviour	Clause 2.2.3	Description Level
4	Movement capacity	Clause 2.2.4	Level
5	Cleanability	Clause 2.2.5	Description
6	Resistance to wear	Clause 2.2.6	Description
7	Watertightness	Clause 2.2.7	Description
8	Durability	Clause 2.2.8	Description
Basic Works Requirement 3: Hygiene, health and the environment			
9	Content, emission and/or release of dangerous substances	Clause 2.2.9	Level Description
Basic Works Requirement 4: Safety and accessibility in use			
10	Ability to bridge gaps and levels in the running surface	Clause 2.2.10	Level
11	Skid resistance	Clause 2.2.11	Level
12	Drainage capacity	Clause 2.2.12	Level Description

2.2 Methods and criteria for assessing the performance of the product in relation to essential characteristics of the product

This chapter is intended to provide instructions for TABs. Therefore, the use of wordings such as “shall be stated in the ETA” or “it has to be given in the ETA” shall be understood only as such instructions for TABs on how results of assessments shall be presented in the ETA. Such wordings do not impose any obligations for the manufacturer and the TAB shall not carry out the assessment of the performance in relation to a given essential characteristic when the manufacturer does not wish to declare this performance in the Declaration of Performance.

Testing will be limited only to the essential characteristics which the manufacturer intends to declare. If for any components covered by harmonised standards or European Technical Assessments the manufacturer of the component has included the performance regarding the relevant characteristic in the Declaration of Performance, retesting of that component for issuing the ETA under the current EAD is not required.

2.2.1 Mechanical resistance

Assessing the mechanical resistance of the supported expansion joint shall not lead to:

- collapse of the whole or a part of the works
- major deformations to an inadmissible degree
- damage by an event to an extent disproportionate to the original cause

Assessment shall be based on:

- Relevant load distribution and load model according to EAD 120109-00-0107, Annex D, Clause D.2
- Actions (according to Clause 1.2.1.2.2) considered according to EAD 120109-00-0107, Annex D, Clause D.2.3 and D.2.4
- Safety factors used and assessment criteria according to Table 2

Calculations shall be done according to the conditions in the Eurocodes mentioned thereafter as far as relevant due to materials used and shall include information on calculation models used, whereas conditions and criteria defined thereafter shall be considered. Input from testing for calculation shall be introduced in the calculation, where relevant.

In case of testing, either in addition to or instead of calculation, as defined in the sub clauses thereafter, relevant components/assembled kit shall be referred to.

Assessment criteria used and based on the detailing thereafter shall be defined for the calculation.

In the ETA the assessment shall be stated in terms of description for the relevant product to be addressed (dimensions, materials, welds or bolted connections etc.).

Conditions for the assessment shall be stated in the ETA as far as relevant:

- Anchor forces for load distribution to the adjacent parts of the expansion joint
- the load models
- adjustment factors
- load factors
- combination factors

Whereas:

External loads on supported expansion joints are generated by traffic. Further loads on expansion joints may be generated as internal loads from imposed deformations or displacements or change of temperature of the joint itself.

Table 3 gives details of the assessment criteria for concerned limit states.

Table 3: Limit state and assessment criteria

<table>
<tr><th>Limit State</th><th>Limit State requirement</th><th>Remark</th></tr>
<tr><td rowspan="2">ULS</td><td>Static equilibrium</td><td rowspan="3">Assessment criteria given in this EAD are related to the defined design situations in EAD 120109-00-0107, Annex D, Clause D.1.
The supported expansion joint includes its anchoring system.</td></tr>
<tr><td>No fatigue failure during the intended working life (see Clause 1.2.2 in this EAD).
(Stress ranges below constant amplitude fatigue limit [CAFL] or cumulative damage assessment D<1,0).</td></tr>
<tr><td>SLS</td><td>- No yielding of any part of the joint
- Vertical deflections under loaded conditions of the expansion joint itself shall be less than 5 mm
- No contact between intersecting cantilevers *)
- No separation of contact surfaces between the bridging plate and its support structure in all service conditions (i.e. all contact surfaces shall be under compression stress)
- In the unloaded situation uplift shall not occur</td></tr>
</table>

*) Only relevant for bridging plate expansion joints with fingers

The skew angle between the traffic direction and the longitudinal axis of the joint influences the load transfer and shall be considered in the assessment based on the technical documentation of the manufacturer. The skew angles have to be considered for the load distribution from the wheel to the joint. The most adverse situation is relevant. The skew angles which apply shall be stated in the ETA.

Effects of the holding-down system shall be considered (no uplift at SLS due to upswing) in the calculation.

The specific design of a supported expansion joint restricts the movement in the direction perpendicular to and in the same plane as the main sliding direction for dilatation purposes. Therefore, maximum relative vertical displacements (+/-) and non-parallelism of supporting lines, as specified by the manufacturer (see also Clause 2.2.4) for SLS, shall be considered in the assessment.

EAD 120109-00-0107, Annex D, Clause D.2, D.2.3 and D.2.4 is relevant for the product according to this EAD.

The actions, loads and combination in relation to the user and actions categories described in Clause 1.2.1.2 are given in EAD 120109-00-0107, Annex D, Clause D.2.

Assessment of the minimum operating temperature according to Clause 1.2.1.1 for metallic components of the kit is done according to EN 1993-1-10, Table 2.1.

The load distribution given in EAD 120109-00-0107, Annex D, Figure D.2, applies.

For supported expansion joints mechanical resistance shall be assessed by calculation or calculation assisted by testing of the load bearing components representing the performance of the kit. If calculation is not possible, calculation assisted by testing according to Clause 2.2.1.2 applies.

For the assessment under SLS and ULS respectively, the load shall be applied on the most adverse position of the supported expansion joint kit, related to the concerned design situations.

For SLS the assessment shall include the effects of upswing in order to evaluate that no uplift occurs (means the clamping force is larger than the upswing force) for the maximum declared relative vertical displacement of the fixed and sliding support in combination with the effect of elastic unloading and/or suction effects. Relaxation and creep, if any, of clamping elements or holding-down systems, shall be considered.

Note: Background for derivation of loads for SLS and ULS assessment in relation to EAD 120109-00-0107, Annex D, Clause D.2.3 and D.2.4: See EAD 120109-00-0107, Annex E.

The following details used for assessment shall be described in the ETA (as far as relevant):

- Fulfilment of the requirements given in Table 3
- Anchor forces for load distribution to the adjacent parts of the expansion joint shall be stated in the ETA
- the load models
- adjustment factors
- load factors
- combination factors

2.2.1.1 Calculations

Models used for calculation shall take into account relevant boundary conditions (e.g. actions, operating temperature, opening of the joint).

The partial factors γ_M shall be determined either:

- in accordance with Clause 6.3 of EN 1990 and,
- where relevant, using the recommended values given in the relevant Eurocode stated below, related to the materials.

In the ETA it shall be stated in terms of description that the product fulfils the mechanical resistance for the designs stated in the ETA and the partial factor γ_M values used for assessment shall be stated in the ETA.

Calculation of mechanical resistance, under the design situations stated in EAD 120109-00-0107, Annex D, Clause D.1 are following Eurocodes, in particular, those mentioned in Table 4:

- EN 1992-2
- EN 1993-1-4
- EN 1993-1-8
- EN 1993-1-10
- EN 1993-2
- EN 1994-2
- EN 1999-1-1
- EN 1999-1-4

Table 4: Guidance on assessment of mechanical resistance by calculation

Component	**Eurocode**	**Relevant clauses (exemplary)**
Anchorage system	EN 1992-1-1	6.5
Bridging plates with/without fingers	EN 1993-1-1	6.2.1
Support base (Sliding/fixed)	EN 1993-2	9.5.1

2.2.1.2 Calculation assisted by testing

Testing shall be done according to EAD 120111-00-0107, Annex B.

The specimen shall include the relevant part of the kit.

The test loads and assessment criteria for the components to be tested shall be derived from a static calculation for the relevant design situations taking into account EAD 120109-00-0107, Annex D, Clause D.2.

The test specimen dimensions and the boundary conditions shall be selected in such a way that the structural behaviour complies with the behaviour in a real structure.

The loads shall be derived from EAD 120109-00-0107, Annex D, Clause D.2.

2.2.2 Resistance to fatigue

The supported expansion joint shall have sufficient fatigue resistance with respect to its intended working life category according to Clause 1.2.2 in this EAD.

The requirements given in Table 3 for ULS including vertical and horizontal loads apply.

The actions, loads and combinations are given in EAD 120109-00-0107, Annex D, Clause D.2.

The interference of loads on the expansion joint and imposed vertical displacement is not to be considered. The sum of the damage of both phenomena shall be used for fatigue assessment.

ULS criteria for the joint under imposed displacements at ULS of the main structure are not of relevance.

Relevant for bridging plate expansion joints without fingers only:

- For supported expansion joints including flexible expansion elements for consideration of bridge movements under traffic (without consideration of traffic loads on the joint) no debonding in the elastomeric parts or vulcanized connections is allowed.

The load distribution given in EAD 120109-00-0107, Annex D, Figure D.2, applies.

For supported expansion joints resistance to fatigue shall be assessed by calculation or calculation assisted by testing. If calculation is not possible, calculation assisted by testing according to Clause 2.2.2.2 applies.

Assessment shall be carried out with 60 % of the movement capacity.

For metallic parts, the unlimited fatigue life (CAFL according to Table 3) is characterized by 5 x 10^6 cycles at the maximum stress/strain interval in relation to $FLM1_{EJ}$.

CAFL for other materials shall be based on fatigue classifications derived from the relevant standards or testing.

For metallic parts, the limited fatigue life is characterized as a number of cycles (N_{obs} according to Clause 1.2.2) in relation to $FLM2_{EJ}$.

For other materials fatigue classifications shall be derived accordingly.

The amplification factor $\Delta\varphi_{fat}$ = 1,3 given in EAD 120109-00-0107, Annex D, Clause D.2 may be reduced, considering unevenness effects (in the meaning of level differences of adjacent parts or structural elements) by more than 4 mm, based on dynamic testing (rollover test) according to Annex D.

Upswing effects shall be taken into account. The assessment of upswing effects shall be done in order to assess the concerned deflection and to determine the related forces to be taken into account. The fatigue assessment shall be done with a fatigue load amplitude of +100 % and -30 % (this means a fatigue load interval of 1,3 times the fatigue load in EAD 120109-00-0107, Annex D, Clause D.2) of the load defined in EAD 120109-00-0107, Annex D, Clause D.2. The amplification factor $\Delta\varphi_{fat}$ and the values for consideration of upswing effects may be reduced based on dynamic testing (rollover test) according Annex D in this EAD.

Upswing U_v and U_h shall be considered by factored vertical loads for fatigue assessment according the following equations based on equations [D.5] and [D.6] in EAD 120109-00-0107, Annex D, Clause D.2.3.3.2:

$$Q_{1k,fat,mod} = \Delta\varphi_{fat} \times Q_{1k} \times 0{,}7 \times (1 + U_v)$$

$$Q_{1lk,fat,mod} = 0{,}2 \text{ x } \Delta\varphi_{fat,h} \text{ x } Q_{1k} \text{ x } 0{,}7 \times (1 + U_h)$$

The following details used for assessment shall be described in the ETA (as far as relevant):

- Fulfilment of the requirements given in Table 3
- Anchor forces for load distribution to the adjacent parts of the expansion joint shall be stated in the ETA
- the load models
- adjustment factors

- load factors
- combination factors

2.2.2.1 Calculations

The partial factors for fatigue shall be determined either:

- in accordance with Clause 6.3 of EN 1990 or,
- where relevant, using the recommended values given in the relevant Eurocode stated below, related to the materials.

In the ETA it shall be stated in terms of description that the product fulfils the resistance to fatigue for the designs stated in the ETA and the partial factor γ_M values used for assessment shall be stated in the ETA.

Calculation of resistance to fatigue, under the design situations stated in EAD 120109-00-0107, Annex D, Clause D.2 are following Eurocodes, in particular, those mentioned in Table 5:

- EN 1992-2
- EN1993-1-9
- EN 1993-2
- EN 1994-2
- EN 1999-1-3

Table 5: Guidance on assessment of resistance to fatigue by calculation

Component	**Eurocode**	**Relevant clauses (exemplary)**
Anchorage system	EN 1992-1-1 / EN 1994-2	6.8.7 / 6.8
Bridging plates with/without fingers	EN 1993-2	9.5.1
Support base (Sliding/fixed)	EN 1993-2	9.5.1

Note: $\Delta\sigma_{E2}$ according EN 1993-2, clause 9.5.1 relates to number of cycles equal to 2,0 x 10^6, while loads given by EAD 120109-00-0107, Annex D.2.3.3.2 for fatigue load model $FLM1_{EJ}$ relate to number of cycles equal to 5,0 x 10^6. Therefore stresses $\Delta\sigma_{FLM1,EJ}$ resulting from loads according to EAD 120109-00-0107, Annex D.2.3.3.2 for fatigue load model $FLM1_{EJ}$ have to be increased by a factor of 1,356 (equal to $1/(2/5)^{1/3}$) to reach the equivalence level of $\Delta\sigma_{E2}$ = 1,356 x $\Delta\sigma_{FLM1,EJ}$.

The structure shall be modelled in such a way that the model represents the real structure.

For fatigue detail classifications EN 1993-1-9, Clause 8, and EN 1993-2, Clause 9, apply.

For calculation the load transfer and load introduction into the main structure shall be considered appropriately.

Regarding resistance to fatigue caused by upward and downward movements, this shall be considered in the calculations, taking into account infinite fatigue life, depending on the working life category.

2.2.2.2 Calculation assisted by testing

Principles of calculation are given in Clause 2.2.2.1.

Testing shall be done for the most adverse conditions according to Annex A.

The test loads and assessment criteria (see Annex A, Clause A.6) for the load bearing components representing the performance of the kit to be tested shall be derived from a static calculation for the relevant design situations (traffic loads and displacements). The concerned contact pressure, the wheel print and the number of cycles, given in EAD 120109-00-0107, Annex F, in conjunction with an opening position of 60 % of the maximum opening position, and the kinematic conditions and concerned stiffness shall be taken into account.

Relevant for bridging plate expansion joints without fingers only:

- Assessment of resistance to fatigue caused by bridge movements due to traffic on the bridge but without loads on the joint itself shall be done according to Annex B.

2.2.3 Seismic behaviour

The assessment of seismic behaviour is referred to the categories given in EAD 120109-00-0107, Annex D, Clause D.2.4.2.3.

Bridging plate expansion joints without fingers:

"Gap" according to EAD 120109-00-0107, Annex D, Table D.8, is not applicable for this type of expansion joint due to the fact that there are no gaps but recesses.

Bridging plate expansion joints with fingers:

"Gap" according to EAD 120109-00-0107, Annex D, Table D.8, in this context reads "distance between the tooth ends of the opposing supported fingers in opening position".

The movement capacity of a supported expansion joint including a bridging plate with fingers does not allow movements in all directions, depending on the design of the finger shape. The limitations of movements in all directions shall be assessed by analysis of the technical file and given in the ETA.

The seismic behaviour shall be assessed by analysis of the design of the expansion joint in relation to the categories given in EAD 120109-00-0107, Annex D, Clause D.2.4.2.3 using the principles for the total design value of the displacement (dealt with in EAD 120109-00-0107, Annex D, Clause D.2.4.2.3.2) in the seismic design situation according to EN 1998-2, Clause 2.3.6.3.

The assessed category and the relevant indications according to EAD 120109-00-0107, Annex D, Table D.8 and limitations of movements in each direction, if relevant, shall be stated in the ETA.

2.2.4 Movement capacity

The movement capacity of an expansion joint is the possibility to allow the displacement of the parts of the main structure under unloaded and loaded conditions as given in EAD 120109-00-0107, Annex D, Clause D.2.

The movement capacity shall be assessed for 3 directions: longitudinal, transversal and vertical.

The movement capacity, including the minimum opening in closed position, may either be defined by the manufacturer or is an outcome of the assessment.

The influence of displacement velocity and the temperature is not relevant for products according to this EAD.

It shall be assessed which bridge deck uplift is feasible, based on analysis of the technical file. The related value in relation to the opening position shall be stated in the ETA.

There shall be overlapping.

Horizontal displacements:

For SLS the following additional requirements for displacements apply:

- The remaining opening in the closed position shall be stated for the longitudinal direction

Vertical displacements:

The relative vertical displacement and rotation in the vertical plane of the supporting lines, not leading to damage to the product for loaded and unloaded conditions shall be assessed.

The assessment of the movement capacity in horizontal, vertical and rotational directions shall be done according to the method in EAD 120109-00-0107, Annex D, Clause D.3.

The influence of longitudinal slopes shall be also assessed by kinematic check using the assessment methods given above.

The results of the assessment of the movement capacity for the concerned directions shall be stated in the ETA, whereas the skew angle for related combinations shall be taken into account. The reaction forces shall be stated in the ETA. The minimum opening shall be stated in the ETA.

2.2.5 Cleanability

The ability for cleanability shall be assessed based on the design of the supported expansion joint.

Cleanability is assessed by means of accessibility (e.g. dismountable bridging plates) to the relevant part of the expansion joint (gutter).

The proper functioning of the expansion joint shall not be affected by accumulation of debris, whereas the following results of assessment apply: Cleanable; Not cleanable.

Cleanable means that debris can be removed manually.

Not cleanable means it cannot be cleaned manually for all opening positions.

For supported expansion joints without a gutter the assessment of cleanability is not relevant.

2.2.6 Resistance to wear

The intended working life of the kit/component shall not be affected by wear which is caused by movements either between two parts of the joint or between parts of the joint and the main structure.

Resistance to wear of a component shall be assessed assuming that on average each day results in a horizontal movement of the expansion joint equal to 33 % of the maximum movement capacity.

Vertical and rotational movement capacity shall be considered by arrangement (positions of the sliding components representing the performance of the kit) in the test rig.

This means that, in relation to temperature effects in the bridge, the total slide path for the test procedure in relation to a working life of “a” years of a component is derived from [a] x 365 x 0,33 x maximum movement capacity of the expansion joint = 120 x [a] cycles with maximum movement capacity of the joint (a = number of years).

The sliding element(s) and/or surfaces of the supports are subject to wear. The accumulation of wear during the working life shall not result in (as far as relevant):

- change in kinematic conditions (e.g. loss of original contact pressure in the sliding surface or increase of friction coefficient, resulting in overload of components of the expansion joint)
- complete disappearance of the original cover layer leading to insufficient protection against corrosion

Resistance to wear of supported expansion joints shall be assessed by full-scale testing of the concerned sliding part(s) of the joint taking into account the clamping effects (contact force).

Assessment shall include geometrical affects from the wear limits, specified by the manufacturer.

The assessment method is given in Annex C.

The assessed resistance to wear of the concerned component(s) of the kit, considering the movement capacity in the concerned directions, shall be stated in the ETA by means of description “resistant” in relation to the working life category addressed.

2.2.7 Watertightness

It shall be assessed whether the main structure and where relevant the sub-components of the supported expansion joint under the running surface are protected from water and its chemical contents.

Watertightness of supported expansion joints is achieved by a sub-surface drainage system (gutter).

The durability of the gutter and its drainage capacity are considered to be the crucial aspects and have to be assessed. For durability aspects of the gutter, the concerned requirements and assessment methods, given in Clause 2.2.8, apply. For the assessment of the drainage capacity, Clause 2.2.12 applies.

The result of the assessment of the watertightness shall be stated in the ETA, whereas the following results of assessment apply: Watertight; Not watertight.

In addition:

Where a watertight connection between the waterproofing system of the main structure and the supported expansion joint is foreseen as component of the expansion joint, for the assessment according to EAD 120109-00-0107, Annex D, the last paragraph in Clause D.4.4.1 applies in addition accordingly.

The type of the connection shall be described in the ETA.

The result of the assessment of the watertightness (moisture under the joint) shall be stated in the ETA, whereas the following results of assessment apply: Watertight; Not watertight.

2.2.8 Durability

2.2.8.1 Corrosion

For metallic surfaces of components the climatic classification in accordance with EN ISO 9223 (see Clause 1.1) with respect to the intended use of the product is taken into account.

It shall be assessed whether the corrosion protection layout for the concerned kit conforms with the conditions given in the scope of the EAD (possibly using the technical documentation of the manufacturer).

Galvanic corrosion is not assessed.

For use of aluminium for bridging plate the conditions in Clause 1.1 shall be assessed based on manufacturer's technical documentation.

Based on the manufacturer's technical documentation for the corrosion protection system, the durability class in relation to the corrosivity class according to the standards given in Clause 1.1 shall be given in the ETA.

2.2.8.2 Chemicals

Assessment of the resistance to de-icing salts of components made of elastomer (if exposed) shall be done according to ISO 1817 and according to EN ISO 175 for sliding elements made of plastics (if exposed) respectively (immersion for 14 days 23 °C, 4 % sodium- chloride solution or equivalent).

The components shall show no decrease of hardness exceeding 5 points and no increase of volume exceeding 10 %.

2.2.8.3 Loss of performance due to ageing resulting from temperature and ozone

The performance of the supported expansion joint shall not be affected by ageing. For the product according to this EAD this applies to components made of elastomer or gutter made of plastics.

2.2.8.3.1 Resistance to ageing resulting from temperature

To assess the sensitivity of the components made of elastomer to elevated temperature, the material shall be subjected to test method ISO 188 (Method A). The minimal conditions of exposure are the following: 14 days at a temperature of 70 °C.

The hardness before and after ageing is measured according to ISO 48-2 or ISO 48-4 respectively, the tensile strength and the elongation at break are measured according to ISO 37.

To assess the sensitivity of the gutter made of plastics to elevated temperature, the material shall be subjected to test method ISO 2578 and EN ISO 11403-3, clause 6.5 respectively at +50°C.

The hardness before and after ageing is measured according to ISO 2039-1, the tensile strength and the elongation at break are measured according to ISO 527-2.

After ageing of the elastomer, the change in hardness and the change of tensile properties of the aged specimen shall be within:

Hardness ≤ + 7 points

Tensile strength ≥ -20%

Elongation at break ≥ -30%

For plastics, assessment shall be done in equivalence to the values for elastomers.

These values apply for all working life categories.

For the assessment of the resistance of the components made of elastomer to low temperatures, the brittleness test according to ISO 812, Method B applies.

With respect to the operating temperature according to Clause 1.2.1, for the execution of the brittleness test for components made of elastomer the following temperatures apply:

-25 °C for operating temperatures down to -20 °C,

-40 °C for operating temperature equal to -30 °C,

-55 °C for operating temperature equal to -40 °C.

With respect to the operating temperature according to Clause 1.2.1, for the execution of the brittleness test of components made of plastics the following temperatures apply:

-25 °C for operating temperature down to -20 °C,

-40 °C for operating temperature equal to -30 °C and -40 °C.

2.2.8.3.2 Resistance to ageing resulting from ozone

To assess the sensitivity to ozone of the components made of elastomer, the material shall undergo a test. The test specimen shall be assessed according to test method ISO 1431-1 (Test procedure A: static condition).

The test conditions are the following: 72 hours of exposure at the temperature of 40 °C, with an ozone concentration of 50 pphm. The test specimen is submitted to 20 % of elongation.

After the test no cracks shall occur.

2.2.8.3.3 Resistance against freeze thaw

If relevant, the degradation of porous materials (e.g. mortar), to freeze-thaw shall be assessed by testing. Test specimen(s) of the material or component shall be subjected to freeze/thaw cycles in accordance with EN 13687-1. According to the use of the product, the number of cycles shall be 50 (see EN 1504-2, Table 5, line 9 and Table 1, 1.3 and 5.1).

After the test, no degradation shall be observed.

2.2.9 Content, emission and/or release of dangerous substances

The performance of the product related to the emissions and/or release and, where appropriate, the content of dangerous substances will be assessed on the basis of the information provided by the manufacturer[3] after identifying the release scenarios (in accordance with EOTA TR 034) taking into account the intended

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[3] The manufacturer may be asked to provide to the TAB the REACH related information which he must accompany the DoP with (cf. Article 6(5) of Regulation (EU) No 305/2011).

The manufacturer is **not** obliged:

- to provide the chemical constitution and composition of the product (or of constituents of the product) to the TAB, or
- to provide a written declaration to the TAB stating whether the product (or constituents of the product) contain(s) substances which are classified as dangerous according to Directive 67/548/EEC and Regulation (EC) No 1272/2008 and listed in the "Indicative list on dangerous substances" of the SGDS.

Any information provided by the manufacturer regarding the chemical composition of the products may not be distributed to EOTA or to TABs.

use of the product and the Member States where the manufacturer intends his product to be made available on the market.

The identified intended release scenario for this product and intended use with respect to dangerous substances is:

S/W2: Product with indirect contact to soil, ground- and surface water

2.2.9.1 Leachable substances

For the intended use covered by the release scenario S/W2 the performance of the components made of elastomer or plastic and which are exposed to rain concerning leachable substances has to be assessed. A leaching test with subsequent eluate analysis must take place, each in duplicate. For the leaching tests of the components made of elastomer or plastic EAD 120109-00-0107, Annex D, Clause D.6 applies.

2.2.10 Ability to bridge gaps and levels in the running surface

2.2.10.1 Allowable surface gaps and voids

The maximum dimensions of the gaps and voids of the joint at the surface level depend on the three user categories.

For the range of the skew angle β (see Figure 4) to be assessed for all user categories the following requirements shall be met and the chosen approach according to Clause 1.3.13 shall be stated in the ETA.

For vehicles and cyclists categories the expansion joint shall not allow a vertical displacement of more than the radius of a 10,0 cm diameter sphere placed anywhere on the running surface level.

a) Vehicles

The expansion joint shall not allow a vertical displacement of 1,0 cm or more of the following bodies, in conjunction with the traffic direction:

- a horizontal prism with plan dimensions 10,0 cm by 20,0 cm placed horizontally anywhere and in any direction,
- a horizontal prism with plan dimensions 6,5 cm by 22,0 cm placed horizontally anywhere with a deviation from the traffic direction α of -20° to +20°,
- a horizontal prism with plan dimensions 4,5 cm by 35,0 cm placed horizontally anywhere with a deviation from the traffic direction α of -20° to +20°.

b) Cyclists

The expansion joint shall not allow a vertical displacement of 1,0 cm or more of the following bodies, in conjunction with the traffic direction:

- a horizontal prism with plan dimensions 2,0 cm by 22,0 cm placed horizontally everywhere with a deviation from the traffic direction α of -20° to +20°,
- a horizontal prism with plan dimensions 10,0 cm by 20,0 cm placed horizontally everywhere and in any direction.

The design of the expansion joint for the carriageway can be adapted by special measures to fulfil the above requirement (see Clause 1.1).

c) Pedestrians

The expansion joint shall not allow a vertical displacement of 2,0 cm or more of a disk with a diameter of 8,0 cm placed horizontally everywhere.

Assessment shall be carried out by analysis of the technical file and, when needed, by use of measurements tools given above.

The ETA shall state the maximum skew angle β (relative to the traffic direction) in relation to the maximum opening related to the concerned user category.

The definition of the skew angle used for the assessment shall be stated in the ETA (see Clause 1.3.13 for different possibilities).

The design of the expansion joint for the carriageway can be adapted by special measures to fulfil the above requirement (see Clause 1.1).

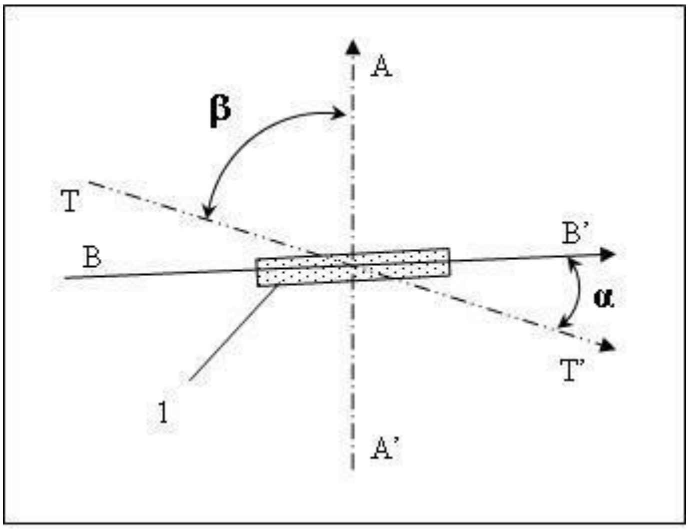


Figure 4: Assessment of the allowable gaps and voids

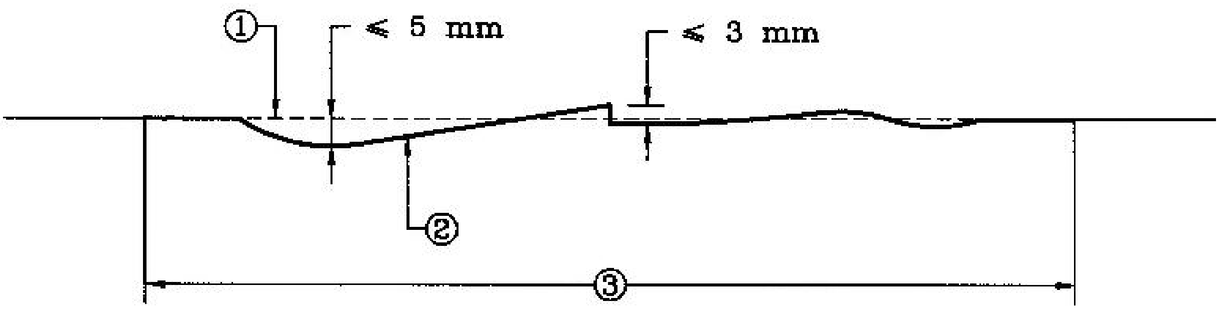
Key to Figure 4:

TT': Traffic direction
AA': Expansion joint axis
BB': Orientation of the measuring prism
1: Measuring prism
α: Deviation from traffic direction
β: Skew angle

2.2.10.2 Level differences in the running surface

Without any imposed horizontal deformations and in unloaded condition the difference in the levels of the running surface of the joint from the ideal connection line between the two adjacent pavements in the traffic direction shall not be greater than 5 mm. Steps shall not be greater than 3 mm (without considering surface texture and discontinuities due to gaps and voids). See Figure 5.

This rule is applied in a horizontal position.



① Ideal connection line
② Running surface of the joint
③ Expansion joint

Note: The level differences could be in the opposite direction.

Figure 5: Example of level differences in the running surface under unloaded conditions

Assessment for the unloaded condition shall be undertaken on the basis of analysis of the technical file and drawings.

The maximum dimension of steps and the difference of the running surface levels under unloaded conditions shall be stated in the ETA.

For the assessment of level differences in the running surface under loaded conditions the following applies:

Vertical deflections under loaded conditions at SLS of the expansion joint itself shall be not greater than 5 mm.

Under loaded conditions, the maximum vertical deflection, according to the assessment by calculation or calculation assisted by testing (see Clause 2.2.1), shall be stated in the ETA by means of the maximum dimension of steps and difference of the running surface levels.

2.2.11 Skid resistance

This essential characteristic only applies for supported expansion joints with flat running surfaces larger than 150 mm x 150 mm square and with surface textures less than ± 1,2 mm (possibly met by special design, e.g. chequered plate). This applies to the carriageway and footpath.

The skid resistance of the supported expansion joint shall be assessed by the portable skid resistance pendulum tester as described in EN 13036-4, clause 9.2 using the 57 rubber slider for carriageways and the 96 rubber slider for footpaths. For both, the normal slider width of 76.2 mm shall be used.

The PTV values assessed shall be stated in the ETA.

2.2.12 Drainage capacity

Where relevant due to the supported expansion joint kit is including a gutter, the drainage capacity shall be assessed by calculation using the following formula based on EN 12056-3:

$$Q_0 = k_0 * D^2 * h^{0.5} /15000 \text{ [l/s]}$$

Where:
k_0 = 1,0 for free down pipe and 0,5 for downpipes with dirt filter [-]
D = Flow diameter [mm]
h = Pressure height (depending on planned target water height) [mm]

The value for Q_0 shall be stated in the ETA.

Where relevant due to the supported expansion joint kit is including a drainage device according to EAD 120109-00-0107, Annex D, Figure D.11 the drainage capacity shall be assessed according to the assessment method described in EAD 120109-00-0107, Annex D, Clause D.5.

The drainage capacity in mm^3/sec together with definition of the porous pavement as defined according to the assessment method in EAD 120109-00-0107, Annex D, Clause D.5, shall be stated in the ETA.

3 ASSESSMENT AND VERIFICATION OF CONSTANCY OF PERFORMANCE

3.1 System(s) of assessment and verification of constancy of performance to be applied

For the products covered by this EAD the applicable European legal act is: Decision 2001/19/EC

The system is: 1

The performance of any kit component which is obtained from a component manufacturer and is CE marked on the basis of a hEN or an EAD will, (for the purposes of verification of constancy of performance) be considered to be the performance declared by the component manufacturer in his DoP. The component does not need to be re-assessed regarding this performance aspect.

3.2 Tasks of the manufacturer

The cornerstones of the actions to be undertaken by the manufacturer of the kit in the procedure of assessment and verification of constancy of performance are laid down in Table 6a.

The actions to be undertaken by the manufacturer of the kit are laid down in Table 6b when the components are produced by the manufacturer himself and Table 6c when the components are not produced by the manufacturer himself but by his supplier under the specifications of the manufacturer.

Table 6a Control plan for the manufacturer; cornerstones

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Factory production control (FPC)					
1	Components produced by the manufacturer himself :				
	▪ Components made of elastomer	See Table 6b, No1	See Table 6b, No1	See Table 6b, No1	See Table 6b, No1
	▪ Plastics for bearings	See Table 6b, No2	See Table 6b, No2	See Table 6b, No2	See Table 6b, No2
	▪ Components made of structural steel, cast steel, cast iron, stainless steel	See Table 6b, No3	See Table 6b, No3	See Table 6b, No3	See Table 6b, No3
	▪ Components made of aluminium	See Table 6b, No4	See Table 6b, No4	See Table 6b, No4	See Table 6b, No4
	▪ Welded dowels for dynamically loaded components	See Table 6b, No5	See Table 6b, No5	See Table 6b, No5	See Table 6b, No5
	▪ Other components	See Table 6b, No6	See Table 6b, No6	See Table 6b, No6	See Table 6b, No6
2	Components not produced by the manufacturer himself (*)	See Table 6c	See Table 6c	See Table 6c	See Table 6c
3	Kit	See Table 6d	See Table 6d	See Table 6d	See Table 6d
(*) Components produced by the supplier under the specifications of the manufacturer.					

Table 6b Control plan when the components are produced by the manufacturer himself; cornerstones

No	Subject/type of control (product, raw/constituent material, component - indicating characteristic concerned)	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control *)
Factory production control (FPC) including testing of samples taken at the factory in accordance with a prescribed test plan					
1	**Components made of elastomer**		Laid down in the control plan	According to the relevant standard.	Each batch or each delivery.
1.1	Density	ISO 2781			
1.2	Hardness	ISO 48-2 or ISO 48-4			
1.3	Tensile strength	ISO 37			
1.4	Elongation at break	ISO 37			
1.5	Tear resistance	ISO 34-1, Method A			
1.6	Rheometric characteristics	ISO 3417, ISO 6502-2			
1.7	Thermogravimetric analysis (TGA)	ISO 9924-1 or ISO 9924-3			
1.8	Resistance to de-icing agents	Cl. 2.2.8.2 in this EAD			
1.9	Resistance to ageing	Cl. 2.2.8.3.1 in this EAD			
1.10	Compression set	ISO 815-1, type B test piece			
Parameters 1.1-1.10 for the **components made of elastomer** are related to the essential characteristics 1, 2, 3, 4, 5, 7, 8, 9, 10 and 12 in Table 2 of this EAD for the supported expansion joint kit according to their use in the kit. Relevant characteristics for each component to be laid down in the control plan.					
2	**Plastics for bearings**		Laid down in the control plan	According to the relevant standard.	Each batch or each delivery.
2.1	Density	ISO 1183-1			
2.2	Hardness	ISO 2039-1			
2.3	Tensile strength	ISO 527-2			
2.4	Elongation at break	ISO 527-2			
2.5	Resistance to de-icing agents	Cl. 2.2.8.2 in this EAD			
Parameters 2.1-2.5 for the **plastics for bearings** are related to the essential characteristics 1, 2, 3 and 8 in Table 2 of this EAD for the supported expansion joint kit.					

<table>
<tr><th>No</th><th>Subject/type of control
(product, raw/constituent material, component - indicating characteristic concerned)</th><th>Test or control method</th><th>Criteria, if any</th><th>Minimum number of samples</th><th>Minimum frequency of control *)</th></tr>
<tr><td>3</td><td>Components made of structural steel, cast steel, cast iron, stainless steel, reinforcement</td><td rowspan="11">According to the relevant technical specification, e.g.:
Structural steel:
EN 10025
Cast steel: Relevant standards, i.e.
EN 10283, EN 1562
Stainless steel:
EN 10088
Cast iron:
EN 1561, EN 1563
Reinforce-ment:
EN 10080</td><td rowspan="12">Laid down in the control plan</td><td rowspan="12">According to the relevant standard.</td><td rowspan="11">Each delivery.</td></tr>
<tr><td>3.1</td><td>Yield point</td></tr>
<tr><td>3.2</td><td>Tensile strength</td></tr>
<tr><td>3.3</td><td>Elongation at rupture</td></tr>
<tr><td>3.4</td><td>Energy absorption</td></tr>
<tr><td>3.5</td><td>Ductility
(for bridging plate only)</td></tr>
<tr><td>3.6</td><td>Charpy-V value
(if dynamically loaded)</td></tr>
<tr><td>3.7</td><td>Chemical composition</td></tr>
<tr><td>3.8</td><td>Weldability</td></tr>
<tr><td>3.9</td><td>Bendability</td></tr>
<tr><td>3.10</td><td>Bond property</td></tr>
<tr><td>3.11</td><td>Corrosion protection:
- Assessment of the thickness and the continuity of the layer
- Surface characteristics before corrosion protection application (roughness, cleanliness)
- Drying time</td><td>Laid down in the control plan</td><td>Each batch or every assembled expansion joint</td></tr>
<tr><td colspan="6">Parameters 3.1-3.11 for the components made of structural steel, cast steel, cast iron, stainless steel, reinforcement are related to the essential characteristics 1, 2, 3, 4, 8, 10 and 11 in Table 2 of this EAD for the supported expansion joint kit and the specific relevance of the individual component, to be detailed in the control plan.</td></tr>
</table>

No	Subject/type of control (product, raw/constituent material, component - indicating characteristic concerned)	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control *)
4	**Components made of aluminium**	EN 755-2 or EN 485-2	Laid down in the control plan	According to the relevant standard.	Each delivery.
4.1	Yield point				
4.2	Tensile strength				
4.3	Elongation at rupture				
4.4	Chemical composition				
4.5	Stress-strain				
4.6	Ductility				
4.7	Charpy-V value				
Parameters 4.1-4.7 for the **components made of aluminium** are related to the essential characteristics 1, 2, 3, 4, 8, 10 and 11 in Table 2 of this EAD for the supported expansion joint kit. Relevant characteristics for each component to be laid down in the control plan.					
5	**Welded dowels for dynamically loaded components**	EN ISO 13918	Laid down in the control plan	According to standard.	Each delivery.
5.1	Relevant material parameters (laid down in the control plan) and welding				
Parameter 5.1 for the **welded dowels for dynamically loaded components** is related to the essential characteristics 1, 2 and 3 in Table 2 of this EAD for the supported expansion joint kit.					
6	**Other components (e.g. gutter made of plastics, springs made of metal, sliding support, cover layer, rotational supports)** Relevant parameters are laid down in the control plan.	Laid down in the control plan	Laid down in the control plan	Laid down in the control plan	Laid down in the control plan
Parameters for the **other components** are related to the essential characteristics in Table 2 of this EAD for the supported expansion joint kit according to their use in the kit.					

*) In case of irregular production it is possible to agree different frequency between manufacturer and notified body.

Table 6c: Control plan when the components are not produced by the manufacturer; cornerstones.

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Factory production control (FPC)					
1	Components belonging to Case 1 (*)	(1)	Conformity with the order	Testing is not required	Each delivery
		(2)	Acc. to Control Plan	Testing is not required	Each delivery
2	Components belonging to Case 2 (**):	(1)	Conformity with the order	Testing is not required	Each delivery
	▪ Characteristics declared in DoP for the specific use within the kit.	(2)	Acc. to Control Plan	Testing is not required	Each delivery
	▪ Characteristics not declared in DoP for the specific use within the kit.	(3)	Acc. to Control Plan	Acc. to Control Plan	Acc. to Control Plan
3	Components belonging to Case 3 (***):	(1)	Conformity with the order	Testing is not required	Each delivery
		(3)	Acc. to Control Plan	Acc. to Control Plan	Acc. to Control Plan

(1) Checking of delivery ticket and/or label on the package.
(2) Checking of technical data sheet and DoP or, when relevant: supplier certificates or supplier tests or test or control acc. to Table 6b above.
(3) Checking of supplier documents and/or supplier tests and/or test or control acc. to Table 6b above.
(*) Case 1: Component covered by a hEN or its own ETA for all characteristics needed for the specific use within the kit.
(**) Case 2: If the component is a product covered by a hEN or its own ETA which, however, does not include all characteristics needed for the specific use within the kit or the characteristic is presented as NPD option for the component manufacturer.
(***) Case 3: The component is a product not (yet) covered by a hEN or its own ETA.

Table 6d: Control plan of the complete kit; cornerstones.

No	Subject/type of control	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Factory production control (FPC)					
1	**Surface elements**	Laid down in the control plan	Laid down in the control plan	Laid down in the control plan	Each element
1.1	Dimensions, thickness				
1.2	Corrosion protection including layer thickness measurement				
2	**Support structure, anchorage devices and kerb elements**	Laid down in the control plan	Laid down in the control plan	Laid down in the control plan	Each part
2.1	Surface characteristics, manufacturing tolerances				
2.2	Weld method statements, weld method qualifications				
2.3	Corrosion protection, including layer thickness measurement				
3	**Gutter**	Laid down in the control plan	Laid down in the control plan	Laid down in the control plan	Each delivery
3.1	Dimensional check				
4	**General assembly**	Laid down in the control plan	Laid down in the control plan	Laid down in the control plan	Each assembled product.
4.1	Conformity to the specification drawings e.g. preset, corrosion protection, correct elements, dimensions, pre assembly.				

3.3 Tasks of the notified body

The cornerstones of the actions to be undertaken by the notified body in the procedure of assessment and verification of constancy of performance for supported expansion joints for road bridges are laid down in Table 7.

The performance of the components covered by hTSs regarding those characteristics declared already by the component manufacturers in their DoP should not be assessed when the product (the kit) will be assessed by the TAB. The performance of those components for the purpose of issuing the ETA will be considered to be the performance declared by the manufacturers of the component. TABs may only assess the performance of the components only for essential characteristics not declared by the manufacturer of the component in his DoP.

Table 7 Control plan for the notified body; cornerstones

No	Subject/type of control *(product, raw/constituent material, component - indicating characteristic concerned)*	Test or control method	Criteria, if any	Minimum number of samples	Minimum frequency of control
Initial inspection of the manufacturing plant and of factory production control					
1	Ascertain that the factory production control with the staff and equipment are suitable to ensure a continuous and orderly manufacturing of the expansion joint.	As defined in the control plan.	As defined in the control plan.	As defined in the control plan.	1
Continuous surveillance, assessment and evaluation of factory production control					
2	Continuous surveillance, assessment and evaluation of factory production control carried out by the manufacturer (parameters according to Tables 6a to 6d of this EAD).	As defined in the control plan.	As defined in the control plan.	As defined in the control plan.	At least once a year

4 REFERENCE DOCUMENTS

EN 485-2:2016+ A1:2018	Aluminium and aluminium alloys - Sheet, strip and plate - Part 2: Mechanical properties
EN 755-2:2016	Aluminium and aluminium alloys - Extruded rod/bar, tube and profiles - Part 2: Mechanical properties
EN 1504-2:2004	Products and systems for the protection and repair of concrete structures - Definitions, requirements, quality control and evaluation of conformity - Part 2: Surface protection systems for concrete
EN 1561:2011	Founding - Grey cast irons
EN 1562:2012	Founding - Malleable cast irons
EN 1563:2018	Founding - Spheroidal graphite cast irons
EN 1990:2002 + A1:2005 + A1:2005/AC:2010	Eurocode: Basis of structural design
EN 1991-1-5:2003 + AC:2009	Eurocode 1: Actions on structures - Part 1-5: General actions - Thermal actions
EN 1991-2:2003 + AC:2010	Eurocode 1: Actions on structures - Part 2: Traffic loads on bridges
EN 1992-1-1:2004 + AC:2010	Eurocode 2: Design of concrete structures - Part 1-1: General rules and rules for buildings
EN 1992-2:2005 + AC:2008	Eurocode 2: Design of concrete structures — Part 2: Concrete bridges — Design and detailing rules
EN 1993-1-1:2005 + AC:2009	Eurocode 3: Design of steel structures - Part 1-1: General rules and rules for buildings
EN 1993-1-4:2006 + A1:2015	Eurocode 3: Design of steel structures - Part 1-4: General rules - Supplementary rules for stainless steels
EN 1993-1-8:2005 + AC:2009	Eurocode 3: Design of steel structures — Part 1-8: Design of joints
EN 1993-1-9:2005 + AC:2009	Eurocode 3: Design of steel structures - Part 1-9: Fatigue
EN 1993-1-10:2005 + AC:2009	Eurocode 3: Design of steel structures - Part 1-10: Material toughness and through-thickness properties
EN 1993-2:2006 + AC:2009	Eurocode 3: Design of steel structures - Part 2: Steel Bridges
EN 1994-2:2005 + AC:2008	Eurocode 4: Design of composite steel and concrete structures — Part 2: General rules and rules for bridges
EN 1998-2:2005 + A1:2009 + A2:2011 + AC:2010	Eurocode 8: Design of structures for earthquake resistance - Part 2: Bridges
EN 1999-1-1:2007 + A1:2009 + A2:2013	Eurocode 9: Design of aluminium structures - Part 1-1: General structural rules
EN 1999-1-3:2007 + A1:2011	Eurocode 9: Design of aluminium structures — Part 1-3: Structures susceptible to fatigue
EN 1999-1-4:2007 + AC:2009	Eurocode 9: Design of aluminium structures — Part 1-4: Cold-formed structural sheeting
EN 10025-2:2004	Hot rolled products of structural steels - Part 2: Technical delivery conditions for non-alloy structural steels

EN 10025-3:2004	Hot rolled products of structural steels - Part 3: Technical delivery conditions for normalized/normalized rolled weldable fine grain structural steels
EN 10025-4:2004	Hot rolled products of structural steels - Part 4: Technical delivery conditions for thermomechanical rolled weldable fine grain structural steels
EN 10025-5:2004	Hot rolled products of structural steels - Part 5: Technical delivery conditions for structural steels with improved atmospheric corrosion resistance
EN 10025-6:2004 + A1:2009	Hot rolled products of structural steels - Part 6: Technical delivery conditions for flat products of high yield strength structural steels in the quenched and tempered condition
EN 10080:2005	Steel for the reinforcement of concrete - Weldable reinforcing steel - General
EN 10088-2:2014	Stainless steels - Part 2: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes
EN 10088-3:2014	Stainless steels - Part 3: Technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resisting steels for general purposes
EN 10088-4:2009	Stainless steels - Part 4: Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for construction purposes
EN 10088-5:2009	Stainless steels - Part 5: Technical delivery conditions for bars, rods, wire, sections and bright products of corrosion resisting steels for construction purposes
EN 10283:2010	Corrosion resistant steel castings
EN 12056-3:2000	Gravity drainage systems inside buildings - Part 3: Roof drainage, layout and calculation
EN 13036-4:2011	Road and airfield surface characteristics - Test methods - Part 4: Method for measurement of slip/skid resistance of a surface - The pendulum test
EN 13687-1:2002	Products and systems for the protection and repair of concrete structures - Test methods; Determination of thermal compatibility - Part 1: Freeze-thaw cycling with de-icing salt immersion
EN ISO 175:2010	Plastics -- Methods of test for the determination of the effects of immersion in liquid chemicals
EN ISO 2039-1:2003	Plastics - Determination of hardness - Part 1: Ball indentation method
EN ISO 2081:2018	Metallic and other inorganic coatings - Electroplated coatings of zinc with supplementary treatments on iron or steel
EN ISO 2578:1998	Plastics - Determination of time-temperature limits after prolonged exposure to heat
EN ISO 3506-1:2009	Mechanical properties of corrosion-resistant stainless steel fasteners - Part 1: Bolts, screws and studs
EN ISO 9223:2012	Corrosion of metals and alloys - Corrosivity of atmospheres - Classification, determination and estimation
EN ISO 10684:2004 + AC:2009	Fasteners - Hot dip galvanized coatings
EN ISO 11403-3:2014	Plastics - Acquisition and presentation of comparable multipoint data - Part 3: Environmental influences on properties
EN ISO 12944-1:2017	Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 1: General introduction

EN ISO 13918:2018	Welding - Studs and ceramic ferrules for arc stud welding
EN ISO 14713-1:2017	Zinc coatings - Guidelines and recommendations for the protection against corrosion of iron and steel in structures - Part 1: General principles of design and corrosion resistance
ISO 34-1:2015	Rubber, vulcanized or thermoplastic - Determination of tear strength - Part 1: Trouser, angle and crescent test pieces
ISO 37:2017	Rubber, vulcanized or thermoplastic - Determination of tensile stress-strain properties
ISO 48-2:2018	Rubber, vulcanized or thermoplastic - Determination of hardness - Part 2: Hardness between 10 IRHD and 100 IRHD
ISO 48-4:2018	Rubber, vulcanized or thermoplastic - Determination of hardness - Part 4: Indentation hardness by durometer method (Shore hardness)
ISO 188:2011	Rubber, vulcanized or thermoplastic - Accelerated ageing and heat resistance tests
ISO 527-2:2012	Plastics - Determination of tensile properties - Part 2: Test conditions for moulding and extrusion plastics
ISO 812:2017	Rubber, vulcanized or thermoplastic - Determination of low-temperature brittleness
ISO 815-1:2014	Rubber, vulcanized or thermoplastic - Determination of compression set - Part 1: At ambient or elevated temperatures
ISO 1183-1:2012	Plastics -- Methods for determining the density of non-cellular plastics -- Part 1: Immersion method, liquid pyknometer method and titration method
ISO 1431-1:2012	Rubber, vulcanized or thermoplastic - Resistance to ozone cracking - Part 1: Static and dynamic strain testing
ISO 1817:2015	Rubber, vulcanized or thermoplastic - Determination of the effect of liquids
ISO 2781:2018	Rubber, vulcanized or thermoplastic - Determination of density
ISO 6502-2:2018	Rubber -- Measurement of vulcanization characteristics using curemeters - Part 2: Oscillating disc curemeter
ISO 9924-1:2016	Rubber and rubber products - Determination of the composition of vulcanizates and uncured compounds by thermogravimetry - Part 1: Butadiene, ethylene-propylene copolymer and terpolymer, isobutene-isoprene, isoprene and styrene-butadiene rubbers
ISO 9924-3:2009	Rubber and rubber products - Determination of the composition of vulcanizates and uncured compounds by thermogravimetry - Part 3: Hydrocarbon rubbers, halogenated rubbers and polysiloxane rubbers after extraction
EOTA TR034	General BWR3 Checklist for EADs/ETAs - Dangerous substances
EAD 120109-00-0107	Nosing expansion joints for road bridges
EAD 120111-00-0107	Cantilever expansion joints for road bridges

ANNEX A – ASSESSMENT OF RESISTANCE TO FATIGUE OF THE PRODUCT REPRESENTED BY FULL-SCALE COMPONENT TESTING

A.1 SCOPE

This annex describes the method for assessing by testing the resistance to fatigue of the product represented by components of supported expansion joints caused by traffic loads and vertical bridge displacements.

A.2 PRINCIPLES

The two following situations shall be considered:

- traffic load on the expansion joint and
- vertical displacements caused by bridge movements

The principle of this test procedure is to investigate the different fatigue life categories in relation to the working life categories.

The concerned test load shall be derived from the loads on the expansion joint, taking into account the concerned contact pressure, the wheel print and the number of cycles, given in EAD 120109-00-0107, Annex F, in conjunction with an opening position of 60 % of the maximum opening position.

At least three specimens shall be tested.

If there is a range with the same type, then take one test at each border of the range and one test in the middle of the range.

A.3 SAMPLES AND PREPARATION OF TEST SPECIMENS

The test specimens shall correspond to the relevant part of design including all features.

The preparation of the test specimen is under the responsibility of the manufacturer.

A.4 TESTING ARRANGEMENT (TEST LOADS, DISPLACEMENTS AND NUMBER OF CYCLES)

The application of loads shall take into account the representative introduction of the loads into the component and into the substructure.

The test conditions shall represent an appropriate modelling of the built-in conditions.

For the number of cycles and related conditions EAD 120109-00-0107, Annex F, applies.

A.5 EXECUTION OF THE TEST

Depending on the design situation of the component(s) considered, the test shall be carried out either displacement controlled or load controlled. The procedure selected shall be stated in the test report.

The test shall be carried out at ambient temperature.

If relevant, load reversals (tension/compression) shall be considered.

A.6 EXPRESSION OF THE RESULTS

The following shall be monitored and recorded:

- Applied loads (kN), displacements and cycles, corresponding deformations
- Cracks (supported by photographs)
- Loosening, breaking
- Specific elongations/stresses

A.7 TEST REPORT

The test report shall refer to the present Annex and shall include at least the following:

- Name of the manufacturer and production centre
- Name and signature of testing body
- Model identification (type, theoretical movement capacity, N° of batch)
- Description of the test equipment
- Date of the preparation of specimens, the date of test and the mean test temperature
- Dimensions and characteristics of test specimens
- Expression of monitored phenomena according to A.6

ANNEX B – ASSESSMENT OF RESISTANCE TO FATIGUE CAUSED BY BRIDGE MOVEMENTS UNDER TRAFFIC BY FULL-SCALE COMPONENT TESTING

B.1 SCOPE

This annex describes the method for assessing of the resistance to cyclic movement of supported expansion joints in case of bridge movement with no traffic loads on the expansion joint.

B.2 PRINCIPLES

The principle of this test procedure is to apply a simulation of the imposed movements, caused by bridge movements with no traffic loads on the expansion joint. These conditions are considered to represent the design situations. One test shall be carried out.

B.3 SAMPLES AND PREPARATION OF TEST SPECIMENS

The test specimens shall correspond to the relevant part of the design, including all features of the concerned component(s) (e.g. fixing).

The length of the test specimen shall be at least 400 mm, representative for the transfer of the reaction forces.

One specimen of each type has to be tested.

If there is a range with the same type, then take one test at each border of the range and one test in the middle of the range.

The preparation of the test specimen is under the responsibility of the manufacturer.

B.4 LOAD AND MOVEMENT ARRANGEMENTS

This test phase describes the imposed bridge movements, leading to cyclic movement.

B.5 TESTING ARRANGEMENT

The support of the test specimen shall simulate realistic support conditions, including anchorage and other relevant components.

The testing arrangement shall allow the application of the movements within a tolerance of ±5 % and shall include a suitable device for counting the number of cycles.

The actuators shall be calibrated and the actuating system shall not cause inaccuracies in the measurements.

The test arrangement shall show no resonance effects.

B.6 EXECUTION OF THE TEST

The test shall be carried out at ambient temperature[1)].

Horizontal translations:

Phase 1a: Expansion joint at closed position; 2 500 cycles of 1/3 of the related movement capacity.

Phase 1b: Expansion joint at maximum opening position; 2 500 cycles of 1/3 of the related movement capacity.

Condition for phase 1a and 1b:

1. One cycle shall take at least half a minute in order to avoid inadmissible heating of the test specimen.

2. For joints accommodating translations in two horizontal directions, the cycles in phase 1 shall be applied in the resulting transversal and longitudinal direction.

Vertical translation:

Phase 2: Expansion joint at the nominal opening position; 2 500 cycles of vertical translation Δh (Δh = 3 mm up, 8 mm down).

For phases 1 and 2 the reaction forces shall be measured.

[1)]: Low and high operating temperatures according to Clause 1.2.1.1 are covered by the concerned tests of the elastomer in Clause 2.2.8.

B.7 EXPRESSION OF THE RESULTS

For the expansion joint the following shall be monitored and recorded in steps of five hundred load cycles:

- movements and corresponding reaction forces during and at the end of the test
- debonding

For its anchorage system the following shall be monitored and recorded: Loosening, breaking, debonding of its elements.

B.8 TEST REPORT

The test report shall refer to this annex and shall include at least the following:

- Name of the manufacturer and production centre
- Name and signature of testing body
- Model identification (type, theoretical movement capacity, N° of batch)
- Description of the test equipment
- Date of the preparation of specimens, the date of test and the mean test temperature
- Dimensions and characteristics of test specimens
- Expression of monitored phenomena according to B.7

ANNEX C – ASSESSMENT OF WEAR OF SLIDING SURFACES

C.1 SCOPE

This Annex describes the method for assessing the resistance to wear of supported expansion joints by full-scale model testing of the concerned sliding part(s) of the joint representing the performance of the kit.

C.2 PRINCIPLES

The principle of this test procedure is to apply a simulation of the bridge movements in the most unfavourable position of the supported expansion joint in respect to wear. One specimen shall be tested.

C.3 SAMPLES AND PREPARATION OF TEST SPECIMENS

The dimensions of the test specimen shall be representative for the concerned entire contact surface. The minimum length of the moving part sample (representing the part of the sliding plate or finger respectively) should be the length of the concerned contact area of the sliding element and may be reduced to a length of 50 mm.

The preparation of the test specimen is under the responsibility of the manufacturer.

C.4 LOAD AND MOVEMENT ARRANGEMENTS

The total slide path for the test procedure in relation to a working life of “a” years of a component is derived from a x 365 x 0,33 x maximum movement capacity = 120 x a cycles with maximum movement capacity of the joint.

For “a” see working life categories in Table 1.

Contact force (including the effects from vertical displacement) in sliding surface(s):

Note: Contact force is related to 50 % of opening position of the expansion joint.

The wear test on the component shall be carried out with the prestress of the built-in component taking account of creep and relaxation if any.

C.5 TESTING ARRANGEMENT

The testing arrangement shall allow the application of the movements and forces within a tolerance of ±2 % and shall include a suitable device for counting the number of cycles.

The actuators shall be calibrated and the actuating system shall not cause inaccuracies in the measurements.

The test arrangement shall show no resonance effects.

C.6 EXECUTION OF THE TEST

The test shall be carried out at ambient temperature.

In case of sensitivity of materials against low or high temperatures (see range of temperatures according to Clause 1.2.1.1), this has to be taken into account when choosing the testing temperature in order to obtain results for the most adverse temperature conditions.

Apply the movements with a minimum mean velocity of 4 mm/s on the test specimen. One stroke shall be at least three times of the length of the contact surface of the test specimen (see Clause C.3). In case of movement capacity less than three times of that contact surface, the stroke is defined by movement capacity value itself.

The increase of temperature during test is limited to the range of operating temperature (see Clause 1.2.1.1). If the temperature of the specimen exceeds the maximum operating temperature, the test may be interrupted.

C.7 EXPRESSION OF THE RESULTS

Depending on the design concept, the following shall be monitored and recorded in steps of 20 % of the total wear path:

- abrasion of sliding material expressed in loss of thickness (mm)
- movements and corresponding horizontal reaction forces
- debonding of sliding material, resulting in loss of corrosion protection

C.8 TEST REPORT

The test report shall refer to the present annex and shall include at least the following:

- Name of the manufacturer and production centre
- Name and signature of testing body
- Model identification (type, theoretical movement capacity, N° of batch)
- Description of the test equipment, including amount and types of debris used
- Date of the preparation of specimens, the date of test and the mean test temperature
- Dimensions and characteristics of test specimens
- Expression of monitored phenomena according to C.7

ANNEX D – DYNAMIC ASSESSMENT AND FIELD TESTING

D.1 Introduction

A expansion joint is a kit, assembled from components. In addition field-testing allows the determination of the dynamic behaviour of the kit or single components of joints.

This annex describes how field tests of the kit shall be arranged and carried out and how the dynamic behaviour can be evaluated. Here, field-testing means that tests are carried out on full-scale joints which can be situated in an existing road or at testing facilities.

D.2 Objective

The objective of this test method is to derive the dynamic properties, dynamic factors for vertical and horizontal loads, system and material damping, free vibration, the (dynamic) loads for the kit and boundary conditions for the component testing, where necessary.

D.3 Principles

The principle of this test is that a full-scale joint is subjected to moving loads exerted by a reference lorry (over rolling test) and that the measurements, e.g. carried out by accelerometers, strain gauges and recordings of laser signals enable a proper dynamic analysis.

One test specimen, subjected to two passing test lorries with different speeds, is sufficient.

The results of the test and analyses apply for joints of the same type, but with other dimensions, provided the calculated vertical, horizontal and rotation natural frequencies do not fall below 90% of those of the originally tested and analysed expansion joint.

Dynamic amplifications and upswing shall be directly calculated from strains.

D.4 Scope and range of application

The evaluation of test results based on this annex is applicable for joints loaded by one axle in the traffic direction only (expansion joint width approximately 1 200 mm). For larger joints the test results can be used in conjunction with additional analyses.

The dynamic assessments described in this annex are based on joints positioned perpendicular to the traffic direction and perpendicular to the main axis of the bridge.

Joints not perpendicular to the traffic direction will show a smoother load application effect and therefore can be considered included. Skew joints are considered covered by investigations on perpendicular joints, if their dynamic properties are equal to perpendicular joints.

D.5 Samples and preparation of test specimens for over rolling tests

The test pieces shall be full-scale joints. The type, which is the most susceptible against dynamic influences, shall be tested (e.g. longest cantilever, worst relations of geometries).

The evenness of the joint shall meet the manufacturer's design specifications. The evenness of the adjacent pavement shall be of medium quality (See EN 1991-2, 4.2.1, Note 3). The alignment shall be smooth, without discontinuities.

One specimen of each type has to be tested.

The preparation of the test specimen is under the responsibility of the manufacturer.

D.6 Testing arrangement and conditions

D.6.1 Location and conditions

The joint is located in a road and installed similarly to real “built-in” situations. The opening positions of the joint shall be at 60 % of movement capacity (middle position +/- 5 mm. The tests are carried out at ambient temperatures (between +5 °C and +35 °C).

D.6.2 Instrumentation

The instrumentation of the expansion joint shall consist of a combination of accelerometers, strain gauges and displacement sensors on e.g. bridging plates, bolts (see Figure D.1).

For supported expansion joints:

- The minimum required opening has to be defined
- Strain gauges for measuring bending stress below the bridging plate without/with fingers
- Strain gauges for measuring shear stress at both sides
- Instrumented bolts to measure forces in bolts

The instrumentation shall allow a clear analysis of vertical bending, horizontal bending, torsion and/or tilting. The sampling frequency of the instrumentation shall allow a proper analysis of the dynamic behaviour. The accuracy of measured variable shall be at least 5% of the maximum measured value.

The vehicle (see D.7.2) does not need to be instrumented.

A minimum sampling frequency of 10 to 15 times the highest relevant natural frequency (e.g. 1 500 Hz) is recommended for the data acquisition. In addition a minimum sampling frequency shall correspond to 10 times the inverse of the loading time (equal to the sum of length of the wheel print and length of a single contact surface, divided by the vehicle speed).

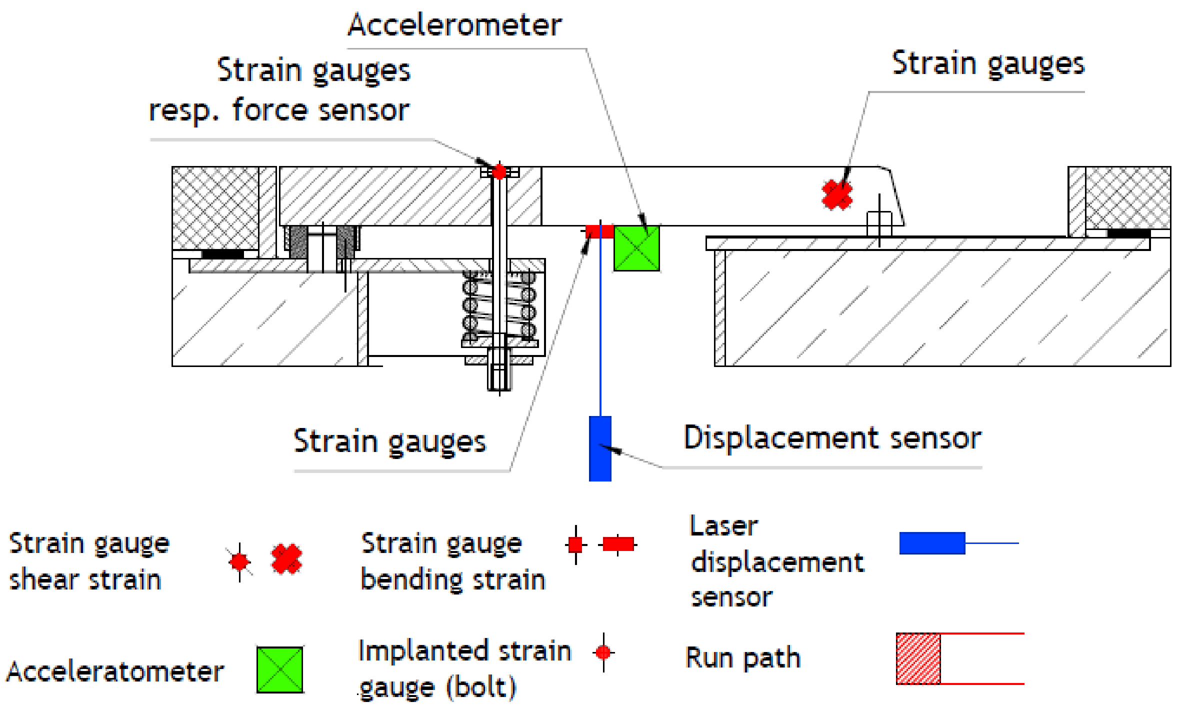


Figure D.1: Typical arrangements of measuring devices

D.6.3 Positioning of measuring devices

The position and the type of measuring devices shall be reported in a plan, which also shows the over rolling positions of the wheels (see Figure D.2). The plan shall also indicate the channel numbers etc. in order to allow full traceability of the records during interpretation and evaluation.

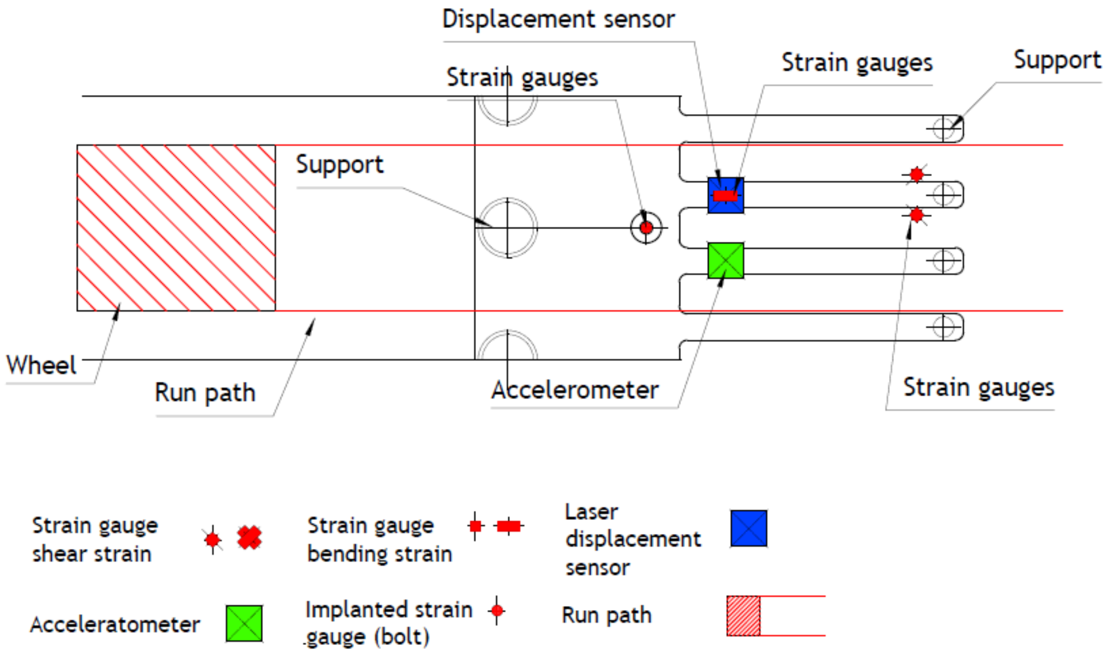


Figure D.2: Transverse positions for over rolling

D.7 Load arrangements and execution of over rolling tests

D.7.1 Excitation

Prior to the over rolling test, the natural frequencies and natural vectors of the joint shall be determined.

D.7.2 Over-rolling test

Prior to the over rolling tests, a static measurement of the axle (wheel) loads shall be carried out. The geometry of the wheel prints shall be recorded. This can be achieved with a special measuring device, but also with a contour, drawn on a piece of paper. The static measurement shall be carried out with the same transverse slope as the expansion joint. The tyre inflation shall be recorded.

Subsequently the over-rolling tests are carried out:

A reference lorry travels over the expansion joint with the following speeds:

Table D.7.2: Lorry speeds and positions

Sequence	Speed (km/h)
1	≤ 5
2	50*
3	70*
4	90*

* Determination of test speed by axle spacing and natural frequency

40 km/h < $v=(a_i * f_1 *3{,}6) / n_{v2} <= 60$ km/h
60 km/h < $v=(a_i * f_1 *3{,}6) / n_{v3} <= 80$ km/h
80 km/h < $v=(a_i * f_1 *3{,}6) / n_{v4} <= 100$ km/h
$v = l_{wheel\ print} \times f_1 <= 120$ km/h

Where a_i [m] minimum axle spacing of the test lorry
f_1 [Hz] first natural frequency (in vertical and/or horizontal direction)
n_{v2}, n_{v3}, n_{v4} integer
$l_{wheel\ print}$ length of the wheel print
v Lorry speed [km/h]

Sequence 1 simulates a static load transfer through the joint. Sequences 2 – 4 generate dynamic load transfer through the joint.

For each speed and each transverse position the number of over-rollings with the vehicle is at least 3.

The transverse position of the wheel shall be the same as a measuring device.

The vehicle speeds may be achieved by cruise control or manually and shall be recorded.

The (transverse) position of the over rolling wheels shall be reported.

The centre-to-centre distances and the width of the finger plates shall be reported (gap width).

The as-built drawings of the joint (and its components) are part of the documentation of the test set up.

The following lorry types are recommended:

- Two axle lorry with axle loads as EN 1991-2 FLM4 Type 1: Front axle 70 kN and rear axle 130 kN.
- Five axle lorry with axle loads as EN 1991-2 FLM4 Type 3: Tractor: Front axle 70 kN, Rear axle 150 kN, Trailer tridem 3 x 90 kN.

D.8 Measurements and analyses

The following aspects shall be measured for further interpretation.

D.8.1 Lorry

1. Wheel print geometry (static) (5% accuracy),
2. Tyre pressures (5% accuracy),
3. Travelling speed of the lorry above the joint (5% accuracy),
4. Travelling position in transverse direction (10% accuracy).

D.8.2 Expansion joint

The following shall be measured:

1. Width of bridging plates,
2. Gap width (5% accuracy),
3. Strains (with gauge) (5% accuracy),
4. Accelerations (5% accuracy),
5. Distance (with laser) (5% accuracy).

Interference effects and phase shifts between vertical, horizontal and rotation movements shall be filtered, prior to further analysis.

D.8.3 Over-rolling tests

D.8.3.1 Effects in the vertical plane

D.8.3.1.1 Initial dynamic impact factor

The vertical dynamic impact factor $\Delta\varphi_{fat}$ shall be derived from the vertical section moments. The section moments shall be derived from the section moments at the strain gauge locations, taking into account the transversely distributed load introduced by the wheel print and offsets, if relevant. The moments shall be summed for the determination of the dynamic impact factors. The vertical dynamic impact factor $\Delta\varphi_{fat}$ [-] for the considered velocity is the vertical moment interval (sum of support and midspan moments) for sequence “i” M_{Svi} [kNm], divided by the vertical moment interval for sequence 1 (v = 0) M_{Sv0} [kNm].

Analysis:

- Vertical support moment: M_{sv} [kNm],
- Vertical moment interval static: M_{Sv0} [kNm],
- Vertical moment interval at sequence “i” with ($v \neq 0$): M_{Svi} [kNm],
- Dynamic impact factor: $\Delta\varphi_{fat} = M_{Svi}/M_{Sv0} \geq 1.0$. The dynamic impact factor shall be calculated with the 95%-fractile of the test results.

D.8.3.1.2 Upswing

Derive in the same way the vertical moment interval (M_{Svu} [kNm] = M_{svu} [kNm] + M_{mvu} [kNm]) after unloading.

The vertical Upswing ratio $U_v = M_{Svu}/M_{Sv}$ [-]

The vertical upswing ratio shall be calculated with the 95%-fractile of the test results.

D.8.3.1.3 Combined dynamic vertical effect

The dynamic load (moment etc.) design interval ($E_{d,dyn}$) to be used for fatigue assessments shall be based on:

$$E_{dv,dyn} = E_{dv0} \times \Delta\varphi_{fat} \times (1 + U_v) \text{ [kN]}$$

D.8.3.2 Effects in the horizontal plane

The section moments shall be derived from the section moments at the strain gauge locations, taking into account the transversely distributed load introduced by the wheel print. The moments shall be summed for the determination of the transfer factor. The transfer factor “tr” for the considered velocity is the measured horizontal moment interval for sequence “i” M_{Sh}, divided by the vertical M_{Sv0}.

Analysis:

- Vertical support moment for a static load (v=0km/h): M_{sv0} [kNm],
- Vertical moment interval for a static load (v=0km/h): $M_{Sv0} = M_{sv0} + M_{mv0}$ [kNm],
- Horizontal moment interval for a moving load (v_i > 0km/h): $M_{Shi} = M_{shi} + M_{mhi}$ [kNm],
- Transfer factor V/H incl. $\Delta\varphi_{fat}$: $tr = M_{Shi}/M_{Sv0} \geq 1.0$ [-]. The transfer factor shall be calculated with the 95%-fractile of the test results.

D.8.3.3 Response ratio

Derive in the same way the vertical moment interval ($M_{Svu} = M_{svu} + M_{mvu}$) after unloading.

The horizontal response ratio $U_h = M_{Shu}/M_{Sh}$ [-].

Without further analyses U_h shall be taken as 1,0.

D.8.3.4 Combined dynamic vertical effect

The dynamic load (moment etc.) design interval ($E_{dh,dyn}$) to be used for fatigue assessments shall be based on:

$$E_{dh,dyn} = E_{dh0} \times \Delta\varphi_{fat} \times (1 + U_h) \text{ [kN]}$$

D.9 Calculations

Parallel to the over-rolling test a calculation shall be carried out of the full-scale test expansion joint with a 3-D model.

D.9.1 General

The overall dimensions of the model shall be such that all relevant frequencies and natural vectors are found; therefore the model shall include the relevant features e.g. offsets, inflexion points (bends), cantilevering parts. The model shall enable the calculation of the relevant section forces and bending moment at all cross sections with locations susceptible to fatigue; e.g. butt joint locations.

D.9.2 Calculation results

The natural frequencies and natural vectors shall be calculated. The results shall be compared with the measured natural frequencies and natural vectors that can be derived from the measurements.

For the assessment of the model the measured natural frequencies and mode shapes shall be compared with calculated ones. The strains and deflections due to walking speed over-rolling (according to sequence 1 in Table D.7.2) shall be compared with the simulated ones.

Note: The full-scale test results only allow the derivation of the natural frequencies, whereas the model allows the derivation of natural frequencies and 2nd harmonics. Further small deviations in geometry can give rise to differences between the measurements and the model calculations.

If the model results do not deviate more than 10 %, no further action has to be taken. If the results deviate more than 10 %, additional analyses are needed for a better adjustment, or modifications of the model.

Note: No response calculations need to be carried out if: For upswing effects less than 2% of the quasi static load it can be considered no upswing, for dynamic amplification effects responses not larger than 1.05 the quasi static response can be considered no additional amplification.

D.9.3 Combination of effects

Without further analyses the dynamic stress intervals from vertical loads shall be combined with the dynamic stress intervals from horizontal loads.

For stresses at a specific location from both load effects into the same direction applies:

$$\Delta\sigma_{comb} = \Delta\sigma_v + \Delta\sigma_h \text{ [N/mm}^2\text{]}$$

If needed, the combined stress interval may include the phase shift between vertical and horizontal vibrations, based on additional analyses.

D.10 Test report

The test report shall comprise at least:

- Description of the joint, including the adjacent pavement over 30 m before and after the joint, slopes in traffic direction and perpendicular to the traffic direction;
- Drawing of the joint (dimensions, dimensions of components, material specifications etc.);
- Test lorry (configuration and static wheel loads, wheel print dimensions, inflation pressure of tyres, wheel and axle distances, position relative to the joint in transverse direction during over-rolling, over-rolling speed);

- Measuring devices (types, accuracy) and their locations (detailed sketches, related to the joint dimensions);
- Sampling frequency of measuring devices;
- Natural frequencies (vertical, horizontal, torsional);
- Vertical dynamic amplification factor $\Delta\varphi_{fat}$ for each crossing and 95% quantile;
- Transfer effects tr for each crossing;
- Upswing effect U_v, and horizontal response effect U_H for each crossing and 95% quantile;
- Date of test execution (environmental aspects: air temperature etc.).

D.11 Keys

v	[km/h]	lorry speed
a_i	[m]	minimum axle spacing of the test lorry
$l_{wheel\ print}$	[m]	length of the wheel print
f_1	[Hz]	first natural frequency in vertical and/or horizontal direction
d	[-]	damping ratio
n_{vi}	[-]	integer
$\Delta\varphi_{fat}$	[-]	vertical dynamic impact factor
M_{sv0}	[kNm]	Static vertical support moment (v = 0km/h)
M_{mv0}	[kNm]	Static vertical midspan moment (v = 0km/h)
M_{Sv0}	[kNm]	Static vertical moment interval (v = 0km/h)
M_{Svi}	[kNm]	Vertical moment interval at sequence i (v_i > 0km/h)
M_{svu}	[kNm]	vertical support moment after unloading (v_i > 0km/h)
M_{mvu}	[kNm]	vertical midspan moment after unloading (v_i > 0km/h)
M_{Svu}	[kNm]	vertical moment interval after unloading (v_i > 0km/h)
M_{Shi}	[kNm]	Horizontal moment interval (v_i > 0km/h)
M_{shi}	[kNm]	Horizontal support moment (v_i > 0km/h)
M_{mhi}	[kNm]	Horizontal midspan moment (v_i > 0km/h)
U_v	[-]	vertical upswing ratio
U_h	[-]	horizontal response ratio
$E_{d,dyn}$	[kN, kNm or N/mm^2]	vertical dynamic load (moment etc.) design interval
E_{dv0}	[kN, kNm or N/mm^2]	vertical static load (moment etc.) design interval (v = 0km/h)
$E_{dh,dyn}$	[kN, kNm or N/mm^2]	horizontal dynamic load (moment etc.) design interval
E_{dh0}	[kN, kNm or N/mm^2]	horizontal static load (moment etc.) design interval (v = 0km/h)
tr	[-]	transfer factor
$\Delta\sigma_{comb}$	[N/mm^2]	combined stress interval
$\Delta\sigma_v$	[N/mm^2]	vertical stress interval
$\Delta\sigma_h$	[N/mm^2]	horizontal stress interval
A_n	e.g. [µm/m]	response Amplitude "n"