EOTA®

EUROPEAN ASSESSMENT DOCUMENT

EAD 120093-00-0107

August 2019

FLEXIBLE ASPHALTIC PLUG 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 flexible asphaltic plug expansion joints (FAPEJ) for road bridges. The bituminous mixture used for the asphaltic part of the products according to this EAD is based on petroleum derived products.

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

FAPEJ are in-situ constructed joints comprising a bituminous mixture (binder and aggregates), which also forms the surfacing, in general supported over the bridge deck gap by thin metal plates. The joint filling mixture is flush with the running surface. Other components may be part of the kit.

Limitations on the skew angle, if any, are included in the product description and defined according to Clause 1.3.18.

The binders used in a joint filling mixture for FAPEJ according to this EAD are based on bituminous mixture.

Examples of design of FAPEJ are shown in Annex A.

FAPEJ for moveable bridges are not covered by this EAD.

For products according to this EAD, there are no components which are replaceable.

FAPEJ 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 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.

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.

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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
- 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)

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 FAPEJ for the intended use of 10 years when installed in the works (provided that the FAPEJ 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 working life of the kit is based on N_{obs} = 0,5 million/year (see EN 1991-2, Table 4.5 and EAD 120109-00-0107, Annex D, Clause D.2.3.3).

It is likely that the working life of the FAPEJ is influenced by the following:

- Adjacent pavement
- Traffic behaviour (including stationary, rolling, queuing traffic)
- Climatic conditions
- Slope of pavement

The aspects stated above have to be given in the ETA in conjunction with the indication on the working life.

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.

[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 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 and resistance to fatigue EAD 120109-00-0107, Annex D applies. For additional terms and definitions specific for this EAD, see below.

1.3.1 Aggregate

Aggregates according to this EAD are of mineral skeleton and consist of a hard durable crushed mineral rock of certain particle size (for example a single sized aggregate) used to form the skeletal structure of the joint filling mixture.

1.3.2 Binder

A bituminous flexible material which fills the voids created in the packed aggregate layers of the joint.

1.3.3 Caulking

A backing material which is placed in the structural gap to provide support for sealant in an expansion joint.

1.3.4 Filled bituminous material

A compound of bitumen and mineral filler, used as a binder, in a FAPEJ. The bitumen may be modified with additives.

1.3.5 Anchorage system

A means of locating a component of the FAPEJ to the bridge structure.

1.3.6 Joint filling mixture

A solid mass made up of a mixture of bituminous binder and aggregates providing a strong waterproof and traffic resistant filling for the joint recess.

1.3.7 Movement aids

Optional components which are incorporated in the joint to ensure appropriate behaviour with respect to the intended use of the joint.

1.3.8 Bridging plate

A thin plate of metal which bridges over the bridge deck gap and prevents ingress of the joint filling mixture into the bridge deck gap. The bridging plate is providing the mechanical resistance of the FAPEJ.

1.3.9 Primer

A liquid used to pre-treat a surface with the purpose of improving adhesion.

1.3.10 Sealant

A flexible material poured into a bridge deck gap with the purpose of sealing the gap.

1.3.11 Surface dressing

Application of small sized aggregate to provide texture and skid resistance to the surface of a FAPEJ.

1.3.12 Trench (joint recess)

A regular opening cut or formed in the road surface symmetrically over the bridge deck gap to contain the FAPEJ system.

1.3.13 Pre-coat layer

A layer applied to the internal surfaces of the trench for the purpose of improving adhesion between the filling mixture and sealing the internal faces of the trench.

1.3.14 Axle load

The load applied on the FAPEJ by one axle.

1.3.15 Batch

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

1.3.16 Bridge deck gap (structure gap)

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).

1.3.17 Movement capacity

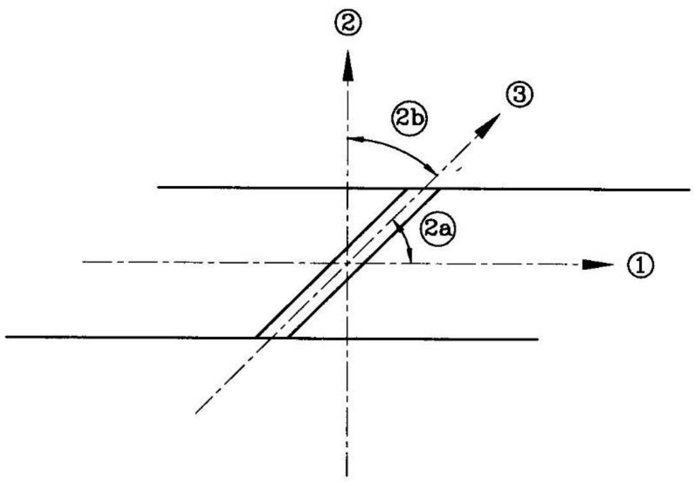
The range of the relative displacement between the extreme positions (e.g. maximum and minimum opening) of an expansion joint (See also EAD 120109-00-0107, Annex D, Clause D.2.2).

1.3.18 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 road axis 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



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)

1.3.19 Wear

The loss of material due to friction between two parts of the expansion joint or between a part of the expansion joint and the structure.

2 ESSENTIAL CHARACTERISTICS AND RELEVANT ASSESSMENT METHODS AND CRITERIA

2.1 Essential characteristics of the product

Table 1 shows how the performance of FAPEJ is assessed in relation to the essential characteristics.

Table 1 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	Movement capacity	Clause 2.2.3	Level
4	Resistance to wear	Clause 2.2.4	Description
5	Watertightness	Clause 2.2.5	Description
6	Durability	Clause 2.2.6	Description
Basic Works Requirement 3: Hygiene, health and the environment			
7	Content, emission and/or release of dangerous substances	Clause 2.2.7	Level Description
Basic Works Requirement 4: Safety and accessibility in use			
8	Ability to bridge gaps and levels in the running surface	Clause 2.2.8	Level
9	Sid resistance	Clause 2.2.9	Level

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 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:

- the load models
- adjustment factors
- load factors
- combination factors

Whereas:

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

The mechanical resistance of the kit depends mainly on the bridging plate behaviour in the usual range of temperature. Therefore, the mechanical resistance of the binder and filler materials in the ULS and SLS condition is considered not relevant.

Table 2 gives details on the assessment criteria for concerned limit states.

Table 2: Limit state and assessment criteria

Limit State	Limit State requirement	Remark
ULS	No collapse of bridging plate.	Assessment criteria given in this EAD are related to the defined design situations in EAD 120109-00-0107, Annex D, Clause D.1.
SLS	No permanent deformation of bridging plate. Only reversible deformations, displacement or rotation. Allowance of creep or hysteresis effect.	

Actions, loads and combinations in relation to the user and actions categories given in Clause 1.2.1.2 of this EAD for mechanical resistance are given in Annex D.

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.

Note: The horizontal loads are not taken into account.

Mechanical resistance of the FAPEJ shall be assessed by means of calculation.

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 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 3:

- 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 3: Guidance on assessment of mechanical resistance by calculation

Component	**Eurocode**	**Relevant clauses (exemplary)**
Bridging plate	EN 1993-1-1	6.2.1

The assessment of mechanical resistance at ULS and SLS of the bridging plate shall be carried out using the design situation as defined in Annex D and in accordance with design standards for the material used for this bridging plate. For steel: EN 1993-1-1, for aluminium alloy: EN 1999-1-1.

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

- Fulfilment of the requirements given in Table 2
- the load models
- adjustment factors
- load factors
- combination factors

2.2.2 Resistance to fatigue

The FAPEJ shall have sufficient fatigue resistance with respect to its intended working life. The requirements in Table 4 apply.

Table 4: Requirements and assessment criteria

Limit State	Limit State requirement	Remark
SLS	No permanent deformation exceeding the requirements given below. No cracking at the surface of width and depth exceeding the requirements given below or debonding of filling mixture. After testing according to Annex B there shall be no cracking or debonding of the filling mixture (minor cracking < 1 mm width and < 5 mm depth allowed) and the resulting deformation shall be less than 10 mm.	Only reversible deformations, displacement or rotation. Allowance of creep or hysteresis effect. Assessment criteria are related to the defined design situations in EAD 120109-00-0107, Annex D, Clause D.1.

Note: The horizontal loads are not taken into account.

Resistance to fatigue for FAPEJ shall be assessed by testing for repeated loading and repeated movement, as stated below:

- Repeated loading by vehicle wheels which typically would lead to deformation or wheel rutting, taking into account dynamic loading by traffic (Annex B)
- Loading of the structure resulting in fast movements at the expansion gap which have to be accommodated by the FAPEJ (see Clause 2.2.3 and Annex C)

The FAPEJ shall withstand the action of dynamic repeated loading of traffic and show no significant deformation or cracking within the limits of tolerance as stated above.

The test specimen dimensions and the boundary conditions are selected in such a way that the structural behaviour complies with the behaviour in a real structure under reduced conditions of opening of the joint gap. The test specimen shall be subjected to repeated dynamic loading using the over-rolling test as described in Annex B.

Fatigue assessment due to movement is described in Annex C.

The amplitude and the frequency used for the test defined in Annex C and the results of the assessment shall be stated in the ETA.

For a particular metallic component, such as bridging plate for example, it could be appropriate to carry out fatigue assessment by calculation.

The actions, loads and combination are given in Annex D.

The partial factors for fatigue of the bridging plate shall be determined either:

- in accordance with 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 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)**
Bridging plate	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 $\Delta\sigma_{FLM1,EJ}$.

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

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

- Fulfilment of the requirements given in Table 4

If relevant for particular metallic parts, as the bridging plate for example:

- the load models
- adjustment factors
- load factors
- combination factors

shall be given in the ETA as well.

2.2.3 Movement capacity

The movement capacity of an expansion joint kit is the capability to allow the displacement of the parts of the main structure under unloaded and loaded conditions.

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

It is a characteristic of FAPEJ that, as the structure expands and contracts, it generates tension or compression in the joint filling mixture. This results in large but slowly occurring movements mainly resulting from seasonal temperature changes and relatively small but often repeated movements induced by the traffic. The joint filling mixture shall be able to sustain these loading effects without restricting its function as well as not causing detrimental effects on the structure and surrounding surfacing material.

The movement capacity for slowly occurring movements as well as fast dynamic repeated movements shall be assessed.

The respective movement capacities of slow expansion and contraction (Annex C, Clause C.7, method a), and fast (traffic induced) expansion and contraction (Annex C, Clause C.7, method b) shall be assessed by testing according to the test method given in Annex C.

Assessment of movements as a result of traffic action shall be carried out in horizontal displacement only.

Note: It is assumed that the FAPEJ has the same behaviour to traffic action on three axes. Therefore, it is only necessary to test the transversal horizontal displacement (means in the main direction of movement of the FAPEJ).

After testing there shall be no cracking or debonding of the joint filling mixture (minor surface cracking of less than 1 mm depth and width is allowed) and the FAPEJ shall remain watertight.

The results of the assessment of the movement capacity shall be stated in the ETA. The reaction forces shall be stated in the ETA.

2.2.4 Resistance to wear

Resistance to wear for FAPEJ is related to movements either between two parts of the joint or between parts of the joint and the main structure.

If the kit contains component(s) subject to wear, assessment is covered by the assessment of movement capacity for fast occurring movements (see test method b in Annex C). There shall be no de-bonding and/or cracking.

2.2.5 Watertightness

For the assessment of the watertightness, the test method is described in EAD 120109-00-0107, Annex D, Clause D.4. The test is executed after the movement test, method a, described in Annex C at the same test specimen at the maximum opening position and at room temperature.

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.

In addition:

Where a watertight connection between the waterproofing system of the main structure and the 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.

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.

2.2.6 Durability

2.2.6.1 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.

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.

2.2.6.2 Ageing resulting from temperature

For FAPEJ ageing resulting from temperature is covered by the assessment of resistance to heating of the binder by comparing mechanical properties (elastic recovery and dynamic viscosity) before and after ageing.

Therefore, the binder material is aged according to EN 12607-3 (RFT test) and the weight loss is assessed.

After ageing the change of elastic recovery (according to Clause 3.4.1.2) and dynamic viscosity (according to Clause 3.4.1.3) shall be assessed.

For products according to this EAD the ageing temperature is the pouring temperature specified by the manufacturer and the ageing time is 8 hours.

For bituminous mastics assessment according to EN 13880-4 applies. The penetrability and resilience before and after ageing for 168 hours (=7 days) at 70°C are assessed.

2.2.7 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 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 scenarios for this product and intended use with respect to dangerous substances are:

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

2.2.7.1 Leachable substances

As far as relevant for the intended use covered by the release scenario S/W2 the performance of the joint filling mixture 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 joint filling mixture EAD 120109-00-0107, Annex D, Clause D.6 applies.

Deviating to EAD 120109-00-0107, Annex D, Clause D.6, for the test specimen the following applies:

Cubes of the joint filling mixture with dimensions of 100 mm x 100 mm x 100 mm shall be prepared.

2.2.8 Ability to bridge gaps and levels in the running surface

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). See Figure 1.

This rule is applied in a horizontal position. As this is of relevance for the product before/without loading, the assessment shall be done by measurement on the specimen subject to testing according to Annex B or Annex C respectively, before the test.

After loading, level differences observed during mechanical resistance according to Clause 2.2.1 (deflection of the bridging plate under SLS conditions) and including deformation resulting from the assessment of the assembled kit as stated in Annex B, Clause B.7 (see detailing in Annex B, Clause B.8) shall not be more than ± 12 mm.

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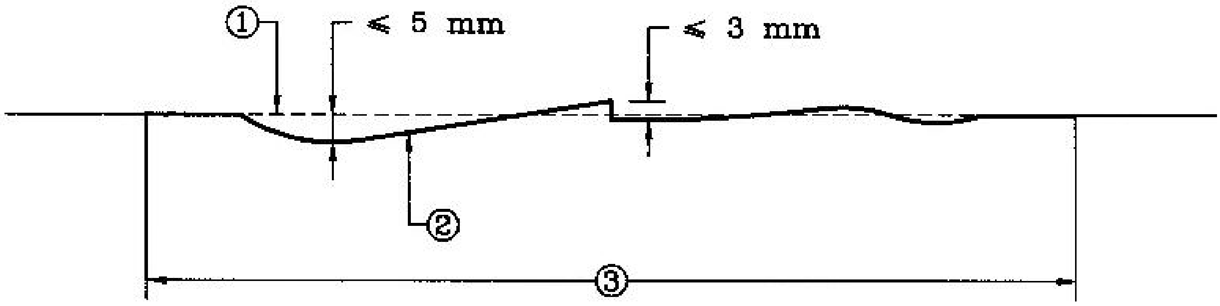
3 The manufacturer may be asked to provide to the TAB the REACH related information which he must accompany the DoP with (cf. Article 6(5) of Regulation (EU) No 305/2011).

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.



① Ideal connection line

② Running surface of the joint

③ Expansion joint

The level differences could be in the opposite direction.

Figure 1: Example of level differences in the running surface for unloaded condition

The level differences shall be stated in the ETA.

As appropriate for the material used, the rutting resistance of the joint filling mixture shall be assessed according to EN 12697-22 at the maximum operating temperature.

2.2.9 Skid resistance

The skid resistance of the FAPEJ shall be assessed without surface dressing 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.

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 :				
	▪ Binder and pre-coat layer	See Table 6b, No1	See Table 6b, No1	See Table 6b, No1	See Table 6b, No1
	▪ Primer	See Table 6b, No2	See Table 6b, No2	See Table 6b, No2	See Table 6b, No2
	▪ Components made of metal	See Table 6b, No3	See Table 6b, No3	See Table 6b, No3	See Table 6b, No3
	▪ Other components	See Table 6b, No4	See Table 6b, No4	See Table 6b, No4	See Table 6b, No4
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	**Binder and pre-coat layer**		Laid down in the control plan	According to the relevant standard/ Clause in the EAD	
1.1	Density	Cl. 3.4.1.1 in this EAD			Each batch
1.2	Softening point	EN 1427			Every 6 months
1.3	Elastic recovery	Cl. 3.4.1.2 in this EAD			Every 6 months
1.4	Dynamic viscosity viscosity/temperature characteristics	Cl. 3.4.1.3 in this EAD			Every 6 months
1.5	Determination of complex modulus G vs temperature	Cl. 3.4.1.4 in this EAD			Every 6 months
1.6	Flow length at 60 °C	EN 13880-5			Each batch
1.7	Cone penetration	EN 13880-2			Each batch
1.8	Ash content	Cl. 3.4.1.6.2 in this EAD			Each batch
1.9	Segregation	Cl. 3.4.1.5 in this EAD			Every 6 months
1.10	Composition of the binder material	Cl. 3.4.1.6 in this EAD			Every 5 years
1.11	Composition of the binder molecular fingerprint	Cl. 3.4.1.7 in this EAD			Every 5 years
Parameters 1.1-1.11 for the **binder and pre-coat layer** are related to the essential characteristics 2, 3, 4, 5, 6, 7 and 9 in Table 1 of this EAD for the FAPEJ kit					
2	**Primer**	Laid down in the control plan	Laid down in the control plan	Laid down in the control plan	Laid down in the control plan
2.1	Parameters according to relevant technical specification (e.g. EN 14188-4)				
Parameter 2.1 for the **primer** is related to the essential characteristics 2, 3, 4 and 5 in Table 1 of this EAD for the FAPEJ 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 metal (e.g. bridging plate (Figure A.1, No. 6) and L-Brackets (Exemplarily given in Figures A.2 and A.3, No. 3) according to Annex A)**</td><td rowspan="6">According to the concerned material.
EN 10025
EN 10088
EN 755-2
EN 485-2
(relevant part of standard laid down in control plan)</td><td rowspan="7">Laid down in the control plan</td><td rowspan="7">According to the relevant standard.</td><td rowspan="6">Each delivery</td></tr>
<tr><td>3.1</td><td>Elasticity limit $f_{0,2k}$ at 0,2 %</td></tr>
<tr><td>3.2</td><td>Tensile strength</td></tr>
<tr><td>3.3</td><td>Elongation at break</td></tr>
<tr><td>3.4</td><td>Energy absorption (Charpy V test)
(if dynamically loaded)</td></tr>
<tr><td>3.5</td><td>Chemical composition</td></tr>
<tr><td>3.6</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 3.1-3.6 for the **components made of metal** are related to the essential characteristics 1, 2, 3 and 6 in Table 1 of this EAD for the FAPEJ kit</td></tr>
<tr><td>4</td><td>**Other components** such as aggregates, surface dressing, fixation kits, movement aids, debonding strip, sliding plate etc. (see also Annex A for examples)
Characteristics according to the agreement between TAB and manufacturer</td><td>Laid down in the control plan</td><td>Laid down in the control plan</td><td>Laid down in the control plan</td><td>Laid down in the control plan</td></tr>
<tr><td colspan="6">Parameter 1 for the **other components** such as fixation kits, debonding strip, sliding plate etc. (see also Annex A for examples) is related to the essential characteristics 1, 2, 3, 4, 5, and 6 in Table 1 of this EAD for the FAPEJ kit</td></tr>
</table>

*) 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	Conformity to the specification drawings e.g. preset, corrosion protection, correct elements, dimensions, pre assembly.	Laid down in the control plan	Laid down in the control plan	Laid down in the control plan	Each assembled product.

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 FAPEJ 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

3.4 Special methods of control and testing used for the verification of constancy of performance

3.4.1 Binder material

3.4.1.1 Density

Density of the binder material shall be investigated. The relevant standard shall be chosen relating to the binder composition (for example EN 13880-1, EN 15326).

3.4.1.2 Elastic recovery

This property shall be assessed according EN 13880-3 or alternatively according to EN 13398, whereas in case of applying EN 13398 the test shall be carried out at 0 °C.

The same method shall be used in combination with the heat ageing (Clause 2.2.6.2) test to determine the change in properties of the material.

3.4.1.3 Dynamic viscosity; viscosity-temperature-characteristics

The basis is: EN 13702 or EN 13302.

Whereas, dynamic viscosity shall be assessed in a rotating viscometer. The measurement equipment consists of a plate-plate measuring system with the upper plate having a diameter of 25 mm and a bedplate diameter of 55 mm. As a function of the characteristics of the binder material and the area of application of the viscometer, the application of other measurement geometries (cylindrical measurement system Z4) and/or differing diameter may prove necessary.

Measurements shall be performed at temperatures of 60 °C, 100 °C and 140 °C, and at the heating temperature specified by the manufacturer, on fresh samples of the binder material in each case. After the relevant temperature is set with a precision of 0,1 K, in the plate-plate measurement mode the zero point of the movable top and then the selected plate gap are set without sample material. For the tests described here, a gap of 1 mm is set as a rule but this shall be checked and evaluated for each binder material as required, as a function of the mean particle size of the filler of the binder material and the measurement range of the viscometer. The criterion here is that the plate gap shall be 5 to 10 times larger than the largest particle diameter in the binder material in order to prevent turbulent flow phenomena. This is also valid for cylindrical measurement mode.

In order to guarantee comparability in the results, the same shearing-strain gradient and determination of viscosity at identical shearing strain are necessary. As a function of the measurement geometry, a certain volume of binder material shall be placed and then be melted carefully by means of temperature equalization to the temperature of the softening point by ring and ball method or the softening point by the Wilhelmi method. Overfilling or under filling of the test gap with the test material shall be excluded; the measurement temperature shall be approached. After temperature equilibrium is reached, a temperature adaptation of 20 minutes shall be effected and the measurement shall then be made.

In order to record the flow curves, the shear velocity shall be continuously increased as a function of the applied shear force in the so-called "shear-force-controlled measurement mode" in the range 0 – 2 000 Pa with a constant shearing-strain gradient of 12,5 Pa/s in the various temperature ranges. A recording density of one measured value every seven seconds shall be selected. Dynamic viscosity in [Pa s] shall be determined from the following equation:

$\eta = \tau / D$ [PA s]

where
τ = shear force
D = shear gradient
η = dynamic viscosity

The dynamic viscosity of the binder material at the test temperatures mentioned above shall be determined at a shear force of 100, 250, 500 and 1 000 Pa. The viscosity-temperature curve shall be drawn.

3.4.1.4 Determination of complex modulus G* versus temperature

The test method of EN 14770 shall be used with the following precisions.

The determination of the dynamic-mechanical behaviour over a temperature range from -30 °C up to +140 °C (temperature sweep) and the interpretation of the results is according ISO 6721-1.

Temperature sweeps at constant frequency and constant amplitude or constant shear force shall be used for the measurement of the dynamic-mechanical behaviour of the binder mass. The shear force required for deformation and the deformation amplitude shall be measured. Depending on the binder material (for instance the dimension of the filling materials) and the test equipment, a plate-plate measuring device (e.g. diameter of 12,5 mm, 25 mm or 50 mm) shall be used as the measuring geometry. The gap between the plates to fill in the test material shall have a minimum distance of 2 – 3 times the dimension of the filler materials. The preparation of the test and the installation of the sample shall comply with the procedure given in Clause 3.4.1.3. The measurement frequency shall be 1 Hz. The tests shall be performed with falling temperature.

First, in a preliminary test, the deformation range within which the structure of the investigated binder material is retained (linear viscoelastic range), shall be determined by a so-called "amplitude sweep". While observing the limits thus set for deformation, the complex modulus, storage modulus, loss modulus and loss angle shall then be determined (for most products, a deformation amplitude of 0,005 has been shown to be expedient). The dynamic elastic characteristic values shall be calculated from the following equations:

$G' = [T_0/\gamma_0] \times \cos \delta$	storage modulus G'
$G'' = [T_0/\gamma_0] \times \sin \delta$	loss modulus G'
$G^* = [(G'^2) + (G''^2)]^{1/2}$	complex modulus
$\tan \delta = G''/G'$	loss factor

where:

T_0 = shear-force amplitude in Pa
γ_0 = deformation amplitude
f = angular frequency in s^{-1}
$|G^*|$ = complex modulus in Pa
G' = storage modulus in Pa
G" = loss modulus in Pa
δ = loss angle

The dynamic elastic characteristic values shall be recorded over a temperature range of -30 °C to 140 °C and serve as a rheological fingerprint for the relevant binder material.

3.4.1.5 Segregation tendency

The procedure described is designed to determine the segregation tendency of filled bituminous materials to describe the homogeneity of the binder under pouring temperature conditions. The measure of the segregation tendency is defined as the difference in ash contents of the top quarter and bottom quarter of the test specimen processed. The test temperature is the pouring temperature defined by the manufacturer.

3.4.1.5.1 Apparatus and test devices

- Cylindrical upright tubes*) of aluminium of 40 mm diameter and approximately 110 mm height, bright finish inside and outside
- Hot cabinet for temperatures up to 250 °C at least
- Temperature measuring device
- Sand bath as receptacle for 2 upright tubes
- Incineration crucible of approximately 25 ml capacity, of porcelain or platinum
- Muffle furnace, controllable to (900 ± 25) °C, provided with an aperture on the front plate and with a flue pipe at the back, enabling an interchange of air to take place inside the furnace
- Desiccator with desiccant
- Balance with a precision of ± 1 mg

3.4.1.5.2 Samples

The test shall be carried out on two test specimens. A laboratory sample shall be taken and heated to the test temperature. The quantity of sample shall be sufficient to ensure that the height of the fill in the upright tube in hot condition amounts to 100 mm ± 5 mm. After having attained the test temperature the binder is filled into the upright tubes to the specified height.

3.4.1.5.3 Procedure

Immediately after the tube has been filled the two tubes containing the binder are put upright in the pre-heated sand bath of the hot cabinet at the test temperature ± 2 °C for a period of 60 ± 5 minutes.

The temperature measuring device provided for checking the temperature shall be planted in the sand bath in such a way that the temperature sensor is located mid-way between the two upright tubes in the sand bath.

After the test the upright tubes with the test specimens are cooled down in upright position to ambient air temperature, before it is cooled down further to <5°C and the upright tube is removed. A slice of 4 to 5 mm thickness is then cut with a heated knife blade from the zone of the top quarter point and of the bottom quarter point of the test specimen (see Figure 2). A sample quantity of approximately 5 g required for the ash determination is then cut from each of the two slices and placed in separate crucibles. The weight of the crucibles with and without samples are weighed to recorded 1 mg.

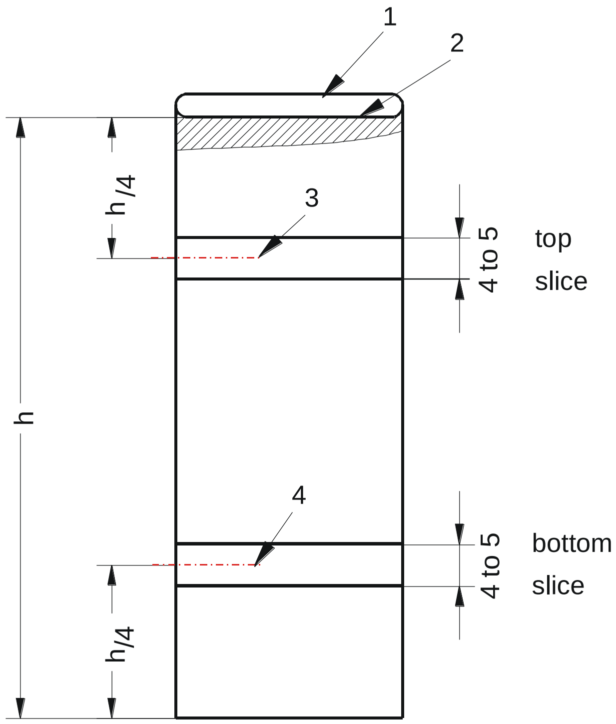


Figure 2: Test specimen after removal of the upright encasing tube

Key to Figure 2:

1 = Surface of the test specimen in the hot state,
2 = Surface of the test specimen in the cooled-down state (sectioned),
3 = Top quarter Point,
4 = Bottom quarter Point,
h = Distance from bottom face of the test specimen to centre of top face of the test specimen in the cooled-down state after removal of the upright tube.

The ash content is determined as follows:

- The four crucibles are placed in the muffle furnace at 550 ± 25 °C.
- The crucible is baked until constant mass is attained, and is weighed to the nearest 2 mg after cooling-down.
- Constant mass for the ash determination is deemed to have been attained when the change in mass after renewed baking and cooling-down to room temperature in the desiccator does not exceed 6 mg.

Note: A baking period of 30 minutes in usually necessary and sufficient for the baking of the empty crucible.

- Approximately 5 g of the sample are then filled into the crucible prepared as described above. The initial mass shall be measured and recorded to within 2 mg accuracy. Then the crucible is gently heated with the gas burner until the escaping vapours from the crucible burn away gently, until only ash and carbon remain. If the sample contains a large amount of moisture which is liable to froth on heating, then it will suffice to add a small amount of isopropyl alcohol or some paper. After completion of burning off, the crucible is placed in the muffle furnace and is annealed at (550 ± 25) °C until constant mass has been attained. Thereafter the crucible with annealing residue is left to cool down in the desiccator and is then weighed to within 2 mg accuracy.

Note: An annealing time of 60 minutes is usually required for annealing of the sample.

As soon as the filter paper starts burning, this is an indication that most of the water has been driven off.

3.4.1.5.4 Evaluation and presentation of result

The segregation tendency E_{abs} is calculated in % by mass in accordance with equation given below is reported rounded to the nearest 0,1 % by mass:

$$E_{abs} = a – b$$

Where:

E_{abs} = Segregation tendency in % by mass
a = Ash content of test specimen from the bottom quarter point, in % by mass
b = Ash content of test specimen from the top quarter point, in % by mass

3.4.1.6 Composition of the binder material

The composition of a bituminous mass shall be determined by extraction with solvents, mechanical separation of the insoluble component from the soluble component and incineration of the insoluble organic contents. In the extraction the nature of the binder, fillers and additives shall be considered. Furthermore, certain conditions relating to extraction speed, etc. may be complied with. If the manufacturer of the binder material has not specified any solvent for the extraction, toluene shall be used. In addition to the filler sieve, a wire sieve tray with a mesh of 0,2 mm complying with ISO 3310-1, shall be used as a protective sieve.

After extraction, the fillers are separated by sieving and then centrifugation. They may be inorganic fillers (rock dust) and/or insoluble organic fillers (rubber powder).

3.4.1.6.1 Proportion of soluble binders in the binder material

The investigation shall be performed in accordance with EN 12697-1 using the Soxhlet-procedure. The residues separated out in centrifugation and any that are left on the sieves shall be rinsed with solvents until the liquid draining off remains practically colourless. The residues shall then be dried for 15 hours in air under a laboratory extractor and then at (110 ± 5) °C to constant mass. After cooling in a desiccator (drying agent: silica gel), the fillers remaining on the sieves and in the beaker of the through flow centrifuge shall be gravimetrically determined and stated, with consideration of the initial mass of the sieve and/or beaker of the through flow centrifuge (tare). The sum of the individual amounts shall be stated as mass of insoluble component $m_{A,Unl}$. The proportion of soluble binders in the binder material is then given by the following equation:

$B_{lösl} = (m_{E,0} - m_{A,Unl}) / m_{E,0} \times 100$ [M.-%]

Where:

$m_{A,Unl}$ = mass of recovered insoluble component in the binder material [g]
$m_{E,0}$ = originally weighed-in quantity of sample [g]
$B_{lösl}$ = proportion of soluble binders in the binder material [% by mass]

3.4.1.6.2 Proportion of inorganic fillers in the binder material

A new sample of the binder material shall be prepared and shall be incinerated in accordance with EN 12697-39 at an incandescent temperature of T = 550 °C. To calculate the proportion of inorganic fillers, the gravimetrically determined ash residue $m_{A,M}$ after incineration is referred to. The content in terms of inorganic fillers in the binder material is given as % by mass by the following equation:

$M = (m_{A,M} / m_{E,0}) \times 100$ [M.-%]

where:

$m_{A,M}$ = mass of ash residue [g]
$m_{E,0}$ = originally weighed in quantity of sample for determination of binder content [g]
M = content in terms of inorganic fillers (e.g. mineral aggregate) in the binder material [% by mass]

3.4.1.6.3 Proportion of insoluble organic component

This investigation shall be based on the results of the procedures described in the clauses above. First the mass of the insoluble content $m_{A,Unl}$ obtained after extraction and the ash residue $m_{A,M}$ after incineration at

T = 550 °C are determined. The proportion of total insoluble organic component (insoluble binders and insoluble organic fillers) is given by the following equation:

$G_{ges} = 100 – B_{lösl} – M$ (M-%)

where:

G_{ges} = proportion of insoluble organic component in the binder material [% by mass]
M = content in terms of inorganic fillers (e.g. mineral aggregate) in the binder material [% by mass]
$B_{lösl}$ = proportion of soluble binders in the binder material [% by mass]

3.4.1.7 Composition of the binder molecular fingerprint

For the binder material the Gel Permeation Chromatography (GPC) method is used.

This method is useful for the identification of the binder (fingerprint) and determination of the thermal damage of the binder during application.

The GPC-fingerprint of the binder has to be stated for characterisation testing.

Comparing the fingerprint of a sample with the fingerprint, it can be assessed whether the correct binder is used or whether the binder has been modified in terms of polymer content, polymer type and binder origin.

3.4.1.7.1 Method

The molecular mass distribution relative to polystyrene and the relative amount of the polymer in the binder are determined using gel permeation chromatography (GPC). GPC separates the compounds in solution according to their size in solution. The approximate molecular mass is deduced from the analysis of a polystyrene standard under the same conditions.

3.4.1.7.2 GPC equipment

Detectors:

- UV-detector with single wavelength detection between 200 and 300 nm
- Universal detector such as refractive index detector (RI detector), Evaporative Light Scattering Detector (ELS detector), etc.

Note: Results between different detectors are not comparable.

- Column oven: Temperature range 20 °C – 40 °C, temperature constancy: ±0,1°C
- GPC-Column: Range of molecular mass distribution: 200 to 1 000 000 g/mol
- Column efficiency: >20 000 plates

Solvent: Tetrahydrofuran (THF) HPLC-grade. For UV-Detection at 215 nm non-stabilised high purity Tetrahydrofuran with low absorbance at 215 nm is necessary.

Syringe filter: Disk filter with 0,2 - 0,5 µm pore size, compatible with the solvent used.

Polymer standard: Polystyrene

3.4.1.7.3 Test parameters

- Number of injections: minimum 2 for each sample
- Sample concentration: depending on the injection volume and detector type: For RI detectors concentrations of 10 to 50 mg binder per ml and for UV-Detector about 1 to 5 mg binder per ml Tetrahydrofuran (THF) are typically for 50 µl injection volume
- Flow rate: 1 ml/min
- Sample rate of the detector: ≥ 1 per second
- Injection volume: 10 - 50 µl (depending on detector type and sample concentration)
- Oven temperature: 30 ± 0,1 °C
- Wavelength of UV-detector: 215 nm
- Sampling

Binder samples are taken with a cold knife. If homogeneity of the binder is a problem, at least two samples have to be taken at different places. A minimum amount of 200 mg binder per sample has to be taken. The binder is dissolved in THF and diluted to the desired concentration. Check whether the binder has properly dissolved before the first dilution step. The solutions are filtered through the disc filter to prevent clogging of the GPC-column with filler and rubber particles.

3.4.1.7.4 GPC-Analysis

Before starting the analysis, ensure the base line and the retention time are constant. The first and last sample shall be a standard, to be sure that the conditions of the analysis have not changed.

To identify component coming from the solvent, filter, syringe, etc., a blank sample (THF) has to be analysed with the same procedure. It is important that the blank sample undergoes the same pre-treatment (filtration, dilution, etc.) as the binder samples.

Calibration:

To determine the molecular size distribution a calibration curve shall be made with a minimum of four polystyrene standards with peak molecular mass in the range of 200 up to 1×10^6 Daltons. Depending on the column type a linear or polynomial calibration curve has to be applied.

Data analysis:

The determination of the molecular mass distribution of the polymers and bitumen is made using the calibration curve with polystyrene standards. The molecular mass Mw is a function of the retention time R_t: $\log(Mw) = f(R_t)$

Area-% F determined from the Chromatogram is referred to the area of the bitumen and polymer peaks and not to the mass of the binder and shall be calculated as follows:

$$F_i = P_i / P_S \cdot 100\%$$

where:

F_i: Area-% of the determined peak
P_i: Area of the peak in the chromatogram
P_S: Total area of all polymer and bitumen peaks (without artefacts)

3.4.1.7.5 Report

The test report shall include at least:

- Sample parameters: type and complete identification of the sample, sample concentration
- Detector parameters: detector type, sample rate, wavelength, etc.
- Solvent used with solvent purity
- GPC-parameters: temperature of the analysis, injection volume
- Date of sample preparation and analysis
- Result of the GPC-analysis: peak molecular mass and area-% of each polymer and bitumen peak for all detectors
- GPC-chromatogram
- Reference to this clause

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 1427:2015	Bitumen and bituminous binders - Determination of the softening point - Ring and Ball method
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 1992-2:2005 + 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 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 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 12607-3:2014	Bitumen and bituminous binders - Determination of the resistance to hardening under influence of heat and air - Part 3: RFT Method
EN 12697-1:2012	Bituminous mixtures - Test methods for hot mix asphalt - Part 1: Soluble binder content
EN 12697-22:2003 + A1:2007	Bituminous mixtures - Test methods for hot mix asphalt - Part 22: Wheel tracking
EN 12697-39:2012	Bituminous mixtures - Test methods for hot mix asphalt - Part 39: Binder content by ignition
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 13302:2018	Bitumen and bituminous binders — Determination of dynamic viscosity of bituminous binder using a rotating spindle apparatus
EN 13398:2017	Bitumen and bituminous binders - Determination of the elastic recovery of modified bitumen
EN 13702:2018	Bitumen and bituminous binders — Determination of dynamic viscosity of modified bitumen by cone and plate method
EN 13880-1:2003	Hot applied joint sealants - Part 1: Test method for the determination of density at 25 °C
EN 13880-2:2003	Hot applied joint sealants - Part 2: Test method for the determination of cone penetration at 25 °C
EN 13880-3:2003	Hot applied joint sealants - Part 3: Test method for the determination of penetration and recovery (resilience)
EN 13880-4:2003	Hot applied joint sealants - Part 4: Test method for the determination of heat resistance; Change in penetration value
EN 13880-5:2004	Hot applied joint sealants - Part 5: Test method for the determination of flow resistance
EN 14188-4:2009	Joint fillers and sealants - Part 4: Specifications for primers to be used with joint sealants
EN 14770:2012	Bitumen and bituminous binders - Determination of complex shear modulus and phase angle using a Dynamic Shear Rheometer (DSR)
EN 15326:2007+A1:2009	Bitumen and bituminous binders - Measurement of density and specific gravity - Capillary-stoppered pyknometer method
EN ISO 2081:2018	Metallic and other inorganic coatings - Electroplated coatings of zinc with supplementary treatments on iron or steel
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 12944-1:2017	Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 1: General introduction
EN ISO 14713:2017	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 3310-1:2016	Test sieves - Technical requirements and testing - Part 1: Test sieves of metal wire cloth
ISO 6721-1:2011	Plastics - Determination of dynamic mechanical properties - Part 1: General principles
EOTA TR034	General BWR3 Checklist for EADs/ETAs - Dangerous substances
EAD 120109-00-0107	Nosing expansion joints for road bridges

ANNEX A – EXAMPLES FOR FLEXIBLE ASPHALTIC PLUG EXPANSION JOINTS

Examples of design of FAPEJ are shown in the Figures below.

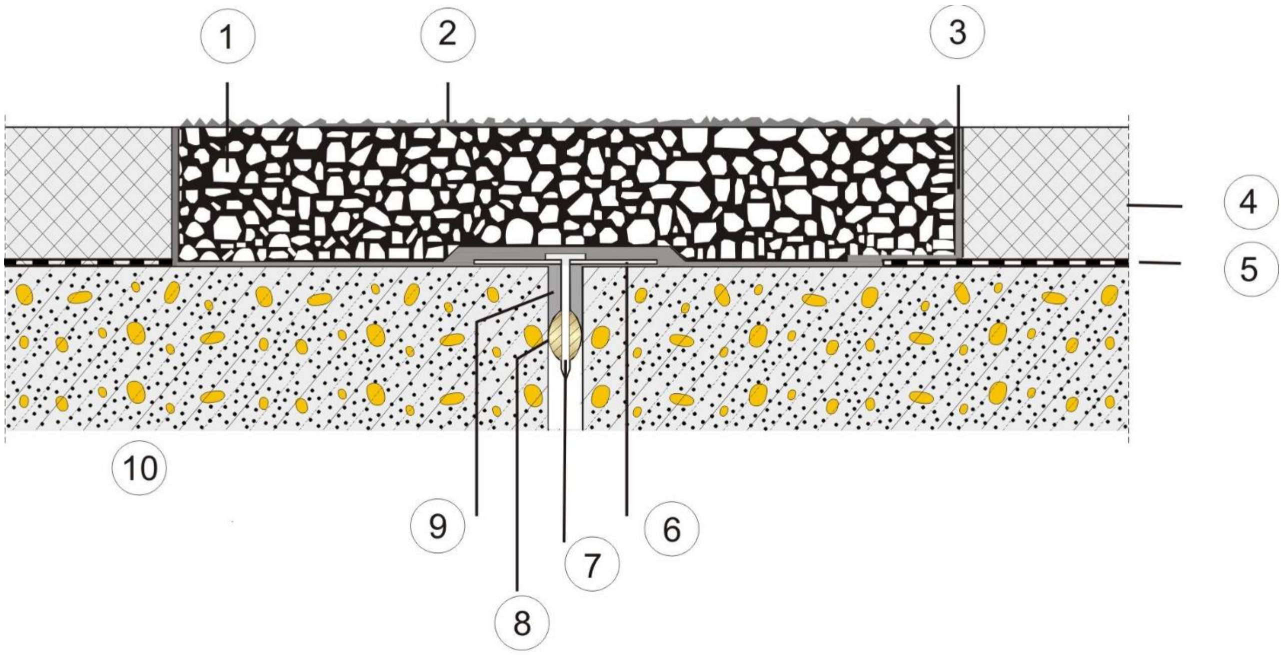


Figure A.1: Cross section of a typical FAPEJ

Key

1 - Joint filling mixture (binder, aggregate),	6 – Bridging plate,
2 - Surface dressing,	7 - Fixing,
3 – Pre-coat layer,	8 - Caulking,
4 - Pavement*,	9 - Sealant,
5 - Bridge deck waterproofing*,	10 - Bridge deck*.

* Not part of the kit

This picture (Figure A.1) shows methods of joining waterproofing layer with the joint filling mixture (butt joint and overlap joint arrangements).

Note: As a schematic illustration this figure does not cover all possible system designs.

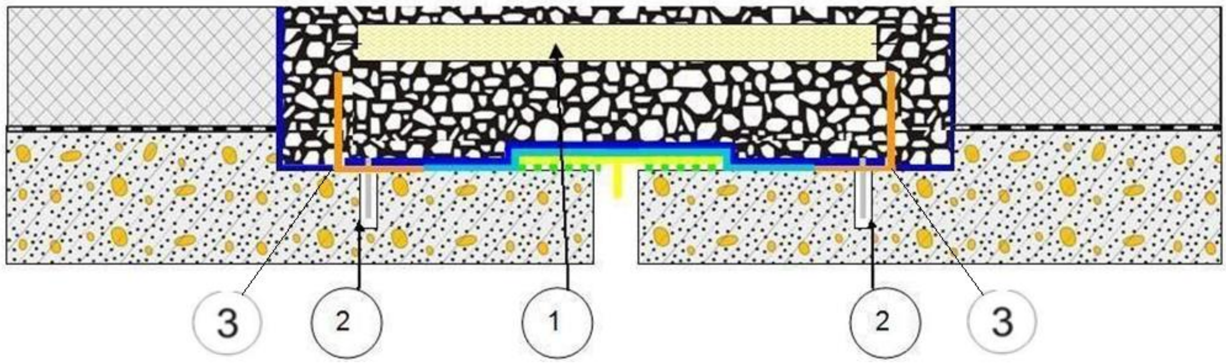


Figure A.2: Cross section of a typical FAPEJ showing movement aids with anchorage

Key

1 – Movement aid

2 – Anchorage system

3 – L- Brackets

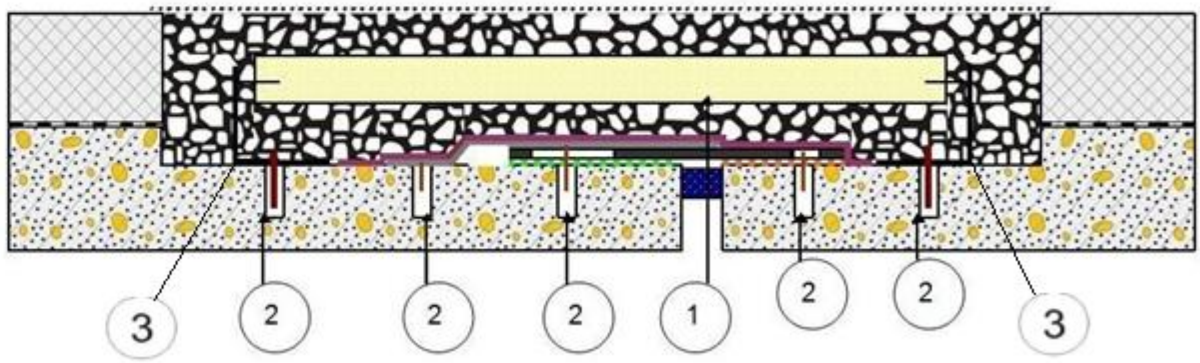


Figure A.3: Cross section of a typical FAPEJ showing movement aids and plate anchorage system

Key

1 – Movement aid

2 – Anchorage system

3 – L- Brackets

Note: Schematic illustrations. These figures do not cover all possible system designs.

ANNEX B – RESISTANCE TO FATIGUE – OVERROLLING TEST

B.1 – OBJECTIVE

This annex specifies a method to assess by testing the resistance of an expansion joint to dynamic vertical loading resulting from the action of vehicles traversing the joint. This method is intended to assess resistance to repeated vertical load of the expansion joint.

B.2 – SCOPE

This method applies to FAPEJ installed on road bridges. Although generally applicable to FAPEJ installed in the asphalt surfacing applied over concrete bridge decks, it can also be used for concrete surface course and bridge decks of materials other than concrete, provided that the test specimen is suitably constructed.

B.3 – TERMS AND DEFINITION

See Clause 1.3 of this EAD.

Test Specimen: the assembly of the expansion joint representative of the product itself and submitted for testing to assess performance against the requirements.

Deformation: the change in shape and dimension of the surface of the FAPEJ in response to the applied load and tyre action.

B.4 – METHOD

A section of the joint assembly (the Test Specimen) shall be mounted in the test rig and subjected to simulated traffic action by the repeated passage of a loaded pneumatic tyre over the test specimen. The temperature of the specimen and the load carried by the tyre are significant factors determining performance of the product.

B.5 – EQUIPMENT

The equipment shall consist of a strong frame for mounting the specimen. The pneumatic tyre shall be mounted on an axle in such a way as to be able to move over the specimen perpendicular to the axis of the joint (i.e. transverse to the joint). The tyre shall be able to pass from the surface course onto the joint and over to the adjacent surface on the other side. The tyre shall be treaded. The tyre shall be loaded via the axle. This may be achieved by directly loading the axle with suitable weights or by use of hydraulic cylinder connected to the axle. The axle shall be able to move laterally under control. There shall be a facility for control and measurement of specimen temperature.

B.6 – SAMPLES AND PREPARATION OF SPECIMENS

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

One specimen of each type has to be tested.

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

Specimen length shall be defined as the width of the joint plus the surfacing either side of the joint.

The specimen length shall be at least the width of the joint plus 3 x tyre contact length.

1. Specimen width shall be defined as the distance between the end plates mounted at each end of the joint recesses, which confine the ends of the joint filling mixture. The specimen width shall be 300 mm or 3 x the width of the contact area of the tyre whichever is the greater.
2. The specimen shall be constructed as a 1:1 scale (in traffic direction and regarding its thickness) of the actual joint complete with gap filling and sealing devices (bridging plates, etc.). The specimen shall be mounted on a base with surfacing representing the foreseen intended use. A joint recess shall be formed in the surfacing to contain the joint filling mixture. The ends of the joint recess shall be closed using steel end plates thereby containing the joint filling mixture.

B.7 – PROCEDURE

1. The specimen shall be loaded via the pneumatic tyre.
2. Lateral movement shall be applied at least as much equivalent to the groove separation.
3. Load to be applied vertically at constant force e.g. by dead load or by hydraulic pressure.
4. No skew angle on the tyre is required.
5. Contact pressure = 0,49 N/mm².
6. Contact area derived from 250 mm x 300 mm (axle type B according to EAD 120109-00-0107, Annex D, Table D.4). For practical purposes other contact areas for the test tyre may be used. The width of the contact area of the tyre on the test specimen shall be a minimum of 7 cm.
7. Action of loaded tyre: Uni-directional under load (reciprocating but only one way under load).
8. Speed of traverse of the tyre at (constant over the joint surface) between 0,2 m/s and 1,0 m/s.
9. Number of passes shall be 2 000, applied continuously.
10. The test shall be carried out at 60 % of the maximum opening position specified by the manufacturer. For this purpose the specimen has the gap pre-set to this opening position and the recess filled with joint filling mixture.
11. Temperature of test specimen shall correspond to the maximum operating temperature. Temperature shall be constant (tolerance ±2°C) and measured 20 mm ±2 mm into the body of the joint.
    By means of this, surface areas, directly exposed to the sun, and to be assessed for the maximum operating temperature increased by 15 °C is covered.

B.8 – EXPRESSION OF RESULTS

Displacements are expressed in mm and the forces in N.

The following results shall be recorded and expressed using charts or figures:

1. Number of passes
2. Temperature of specimen and method of temperature control
3. Load on the tyre and variation over test period
4. Inflation pressure of the tyre
5. Tyre condition
6. Condition of specimen surface
7. Deformation profile transverse to the joint
8. Deformation profile longitudinal to the joint
9. Damages (such as debonding or cracking), if any

Note: The profile measured in item 7 and 8 shall be measured over the width of the contact area + extended to 50 mm either side. This is to take into account any build-up of material along the edges of the tracked area.

B.9 – TEST REPORT

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

- The origin of the expansion joint, name of manufacturer and source of the specimen tested and how sampled, including details of specimen preparation
- The product model identity, batch number, description, date of manufacture, date of sampling
- Mass and size of sample
- Test results as required above
- Date of tests
- Date of report
- Identification of test authority and credentials of the test laboratory

ANNEX C – FAPEJ MOVEMENT CAPACITY TEST METHOD

C.1 – OBJECTIVE

This annex specifies methods to assess, by testing, the ability of an FAPEJ to accommodate movement resulting from changes in the relative position of the expansion gap. Differentiation shall be made between the movement capacity under slow occurring and fast occurring deformations. Slow occurring movements cover deformations of the bridge deck gap mainly resulting from seasonal and diurnal temperature changes but also shrinkage and creep.

The test assesses extension and compression performance. Fast occurring movements cover dynamically repeated deformations of the bridge deck resulting from over-rolling traffic. For each movement rate a special test procedure is described.

C.2 – SCOPE

This method applies to FAPEJ installed on road bridges. Although generally applicable to FAPEJ installed in the asphalt surfacing applied over concrete bridge decks, it can also be used for concrete surface course and bridge decks of materials other than concrete provided that the test specimen is suitably constructed.

C.3 – TERMS AND DEFINITIONS

See Clause 1.3 in this EAD.

C.4 – PRINCIPLE

A section of the joint assembly (the test specimen) is mounted in the test rig and subjected to simulated bridge movements in the horizontal plane by changing the relative position of one side of the joint to the other. The movements may be relatively slow to simulate thermal changes in the bridge structure (($\geq$ 0,2 mm/h for test method (a)) or relatively fast ($\geq$ 0,6 mm/s test method (b)) to simulate changes due to the effect of vehicles passing over the structure. Deformation rates higher than 0,2 mm/h for test method (a) respectively 0,6 mm/s for test method (b) may also be carried out. In this case additional tests at lower rates are not required. Because of the thermoplastic behaviour of this type of expansion joint the temperature of the specimen at the time of application of movement is a significant factor determining performance of this type of product. The temperature of the specimen throughout the test shall correspond to the manufacturer's specified operating temperature range. The test apparatus is deformation controlled.

C.5 – EQUIPMENT

The equipment shall consist of a strong frame for mounting the specimen. The frame shall be arranged in two halves such that the two sides of the expansion joint can be moved with minimal friction relative to one another in a horizontal plane and vertical plane (if appropriate). The equipment shall be housed in chamber which can be climate controlled. There shall be a facility for control and measurement of specimen temperature, deformation and loads. The movements shall be applied at constant temperature or shall be programmed with temperature change. For Method a) the maximum gap opening should be connected with the minimum operating temperature and the minimum gap position with the maximum operating temperature. For Method b) a constant temperature (minimum operating temperature) is to be preferred. The deformations have to be generated step-less and shall be continuously measured. A sinusoidal wave form shall be used. Additionally the forces should be measured. The movement function shall be generated by a controller able to create sinusoidal and other load functions and controlled directly at the specimen's gap.

C.6 – SAMPLES AND PREPARATION OF SPECIMENS

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

Specimen length shall be defined as the width of the joint plus a reproduction of the adjacent pavement, if appropriate, to ensure similar bond conditions (protection and surface course: asphalt, concrete or other) either side of the joint. The width of the joint shall be specified by the manufacturer.

Specimen width shall be defined as the distance between the end plates mounted at each end of the joint recesses, which confine the ends of the joint filling mixture. The specimen width shall be at least 0,2 m.

The specimen shall be constructed as a 1:1 scale (height and width) of the actual joint complete with gap filling and sealing devices, bridging plates, etc. The specimen shall be mounted on a support that replicates actual bridge deck preparation. A joint recess shall be formed in the surface course to contain the joint filling mixture. During the test the ends of the joint recess shall be open to permit movement.

One specimen of each type has to be tested.

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

C.7 – PROCEDURES

Method a) Movement capacity under slow occurring movements

The specimen shall be subjected to horizontal movement to the maximum extension and to the maximum compression as specified by the manufacturer either:

- at a controlled temperature variation which covers the operating temperature range (initially temperature 15 °C),

or

- at two constant temperatures, which are the lowest operating temperature for the extension and the highest operating temperature for the compression.

Temperature shall be measured at least 20 mm into the body of the joint.

The speed range for application of horizontal movement shall be a minimum of 0,2 mm per hour (any higher rate will automatically cover the normal rate).

The specimen shall be loaded at least one complete cycle (full extension, full compression and re-expansion to the original expansion gap setting).

Assessment of performance shall include:

- Assessment criteria: adhesion between joint filling mixture and its adjacent flanks and cohesion in the joint filling mixture (no debonding)
- Integrity of the surface of the joint (no cracks or fissures)
- Watertightness at full extension
- The tensile and compression load necessary to create the maximum deformations specified by the manufacturer (compression; extension) shall be measured during the expansion and contraction.

Method b) Movement capacity under fast occurring movements

The specimen shall be horizontally deformed only by opening extension compared to its initial gap opening with fast occurring dynamic repeated deformations at constant temperature specified by the manufacturer according to the possibilities given below.

The number of load cycles at 15 °C is 5×10^6. The number of load cycles can be reduced to $1,3 \times 10^6$ if the test is done at the minimum operating temperature specified by the manufacturer.

The manufacturer shall state at which temperature (15 °C or minimum operating temperature) the test is to be done.

Temperature shall be measured at least 20 mm into the body of the FAPEJ.

Assessment of performance shall include:

- Assessment criteria: adhesion between joint filling mixture and its adjacent flanks and cohesion in the joint filling mixture (no debonding)
- Integrity of the surface of the joint (no cracks or fissures)
- Watertightness at full extension
- The tensile and compression load necessary to create the deformations
- After demolition of the expansion joint, expose moving part(s) and check evidence of wear

The load-deformation-graphs (Hysteresis curve) shall be measured and recorded during the test.

The stiffness value ΔF/ Δw for every 250 000 load cycles is to be calculated.

C.8 – EXPRESSION OF RESULTS

Displacements are expressed in mm and the forces in N.

The following results shall be recorded and expressed using charts or figures.

Method a) Movement capacity under slow occurring movements

- Details of specimen preparation
- Number of test cycles
- Temperature of specimen or temperature/movement profile as appropriate
- Load generated during the movement cycles (e.g. load/deformation graph)
- Movements of the 2 halves of the joint relative to each other
- Condition of specimen surface (e.g. cracking, hogging, dishing)
- Adhesion between adjacent surfacing and joint filling mixture
- After application of the watertightness test, whether there is ingress of water

Method b) Movement capacity under fast occurring movements

- Details of specimen preparation
- Number of test cycles
- Movement capacity
- Mean deformation rate
- Test frequency
- Temperature of specimen
- Max. load generated during the movement cycles (e.g. the report shall include a load/deformation graph (Hysteresis curve) over the complete test duration)
- Stiffness values for each 250 000 load cycle
- Loss of stiffness of the joint over the test period
- Condition of specimen surface (e.g. cracking, hogging, dishing)
- Adhesion between adjacent surfacing and joint filling mixture
- After application of the watertightness test, whether there is ingress of water
- the extent of damage due to wear

C.9 – TEST REPORT

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

- The test method and test parameters used to test the product
- The origin of the expansion joint: name of manufacturer and source of the specimen tested and how sampled including details of specimen preparation
- The product model identity, batch number, description, date of manufacture, date of sampling
- Mass and size of sample
- Test results as required above
- Date of tests
- Date of report
- Identification of test authority and credentials of the test laboratory

ANNEX D – MECHANICAL RESISTANCE AND RESISTANCE TO FATIGUE – CALCULATION OF LOADS

D.1 – GENERAL

General loads and loading conditions are determined according to EAD 120109-00-0107, Annex D, Clause D.2 and EN 1991-2.

Load conditions as relevant to FAPEJ and their required performance are represented by the following provisions. Expansion joint parameters (EAD 120109-00-0107, Annex D, Figure D.1 and Table D.2). For FAPEJ:

L_j(fapej) ≤ 0,5 m; w_j(fapej) ≤ 1,2 m; Q_{1k} = 300 kN

D.2 – ULS LIMIT STATE

At ULS the design situation for FAPEJ is given by:

$$\mathbf{C_{ULS}} = \psi_{0T}\,\gamma_{Q1}\,Q_{1k} \text{ "+" } \psi_{0d}\,\gamma_{dE}\,d_{Ek} \qquad \text{[EQ. D.1]}$$

Where: (in accordance with EAD 120109-00-0107, Annex D, Clause D.2)
Q_{1k} = Axle load
γ_{Q1} = Partial factor traffic loads
ψ_{0T} = Combination factor for traffic loads
ψ_{0d} = Combination factor for opening position
d_{Ek} = Maximum manufacturer specified opening position of the joint

Design situation $\mathbf{C_{ULS1}}$:

$$\mathbf{C_{ULS1}} = 1{,}0 \times 1{,}35 \times 300 \text{ kN "+" } 0{,}60 \times 1{,}0 \times d_{Ek} \qquad \text{[EQ. D.2]}$$

$\mathbf{C_{ULS1}}$: Q_{1d} **=** 405 kN with 60 % of manufacturer's specified opening (d_{Ek})

Design situation $\mathbf{C_{ULS2}}$:

$$\mathbf{C_{ULS2}} = 0{,}7 \times 1{,}35 \times 300 \text{ kN "+" } 1{,}0 \times 1{,}0 \times d_{Ek} \qquad \text{[EQ. D.3]}$$

$\mathbf{C_{ULS2}}$: Q_{1d} **=** 284 kN with full manufacturer's specified opening (d_{Ek})

Q_{1d} = Design value for axle load

Calculation of contact pressure

Design contact pressure = $\sigma_{contact} = \gamma_{Q1}$ [(Q_{1k} /2) x (1/contact area 2 x 250 x 300)] [EQ. D.4]

$$\sigma_{contact} = 1{,}35 \times 150000 \times 6{,}7 \times 10^{-6} = 1{,}35 \text{ N mm}^{-2}$$

This design contact pressure may be reduced at the bridging plate with the application of the dispersal effect (D) in accordance with EN 1991-2, 4.3.6.

D = Dispersal effect of bridge deck surfacing and thickness of FAPEJ (effectively the ratio of contact area at surface level (A_1) over the contact area at the level of the bridge plate (A_2)).

D.3 – SLS LIMIT STATE

At SLS the design situation is given by:

$$\mathbf{C_{SLS}} = \psi_{0T}\,Q_{1k} \text{ "+" } \psi_{0d}\,d_{Ek} \qquad \text{[EQ. D5]}$$

Where: (in accordance with EAD 120109-00-0107, Annex D, Clause D.2)
Q_{1k} = Axle load
ψ_{0T} = Combination factor for traffic loads
ψ_{0d} = Combination factor for opening position

d_{Ek} = Maximum manufacturer specified opening position of the joint

As an envelope approach, covering all design situations, the ψ_0 factors can be taken as follows:

$$\psi_{0T} \text{ and } \psi_{0d} = 1{,}00.$$

Design situation $\mathbf{C_{SLS1}}$**:**

$$\mathbf{C_{SLS1}} = 1{,}0 \text{ x } 300 \text{ kN "+" } 1{,}0 \text{ x } d_{Ek} \qquad \text{[EQ. D.6]}$$

$\mathbf{C_{SLS1}}$: Q_{1d} = 300 kN with full manufacturer's specified opening (d_{Ek})

Q_{1d} = Design value for axle load

Calculation of contact pressure

$$\text{Contact pressure (SLS)} = \sigma_{contact,SLS} = [(Q_{1k}/2) \text{ x } (1/\text{contact area } 2 \text{ x } 250 \text{ x } 300)] \qquad \text{[EQ. D.7]}$$

$$\sigma_{contact} = 150000 \text{ x } 6{,}7 \text{ x } 10^{-6} = 1{,}00 \text{ N mm}^{-2}$$

This design contact pressure may be reduced at the bridging plate with the application of the dispersal effect (D) in accordance with EN 1991-2, 4.3.6.

D = Dispersal effect of bridge deck surfacing and thickness of FAPEJ (effectively the ratio of contact area at surface level (A_1) over the contact area at the level of the bridge plate (A_2)).

D.4 – FATIGUE LOADS

See EAD 120109-00-0107, Annex D, Clause D.2 and Table 4 of this EAD.

Dynamic loads

Table D.1: Vertical loads for fatigue (axle load distribution derived from EN 1991-2)

$Q_{1k,fat}$ Applicable to FAPEJ Vertical axle load kN	Axle number rate	Axle type
77	1,10	A
92	1,25	C
115	0,20	B
131	0,45	B
146	0,45	B

For axle types, wheel prints and axle geometries see EAD 120109-00-0107, Annex D, Clause D.2.

The loads mentioned in EAD 120109-00-0107, Annex D, Clause D.2 include the following additional amplification factors:

$$\Delta\varphi_{fat} = 1{,}3 \text{ and } \Delta\varphi_{fat,h} = 1{,}0.$$

For FAPEJ they do not apply and the $\Delta\varphi_{fat}$ = 1,0.

Horizontal loads for FAPEJ do not apply.

Combination for resistance to fatigue:

$$\mathbf{C_{FAT}} = Q_{1k,fat} \text{ "+" } \psi_{0d} d_{Ek} \qquad \text{[EQ. D.8]}$$

Where: (in accordance with EAD 120109-00-0107, Annex D, Clause D.2)
ψ_{0d} = 0,6 Combination factor
d_{Ek} = Maximum opening position of the joint as specified by the manufacturer.

C_{FAT}: $Q_{1k,fat}$ = 146 kN with 60 % of manufacturers specified opening position of the joint.

Contact pressure (FAT)

$$\sigma_{contact,fat} = [(Q_{1k,fat} /2) \text{ x } (1/\text{contact area } 2 \text{ x } 250 \text{ x } 300)] \quad \text{[EQ. D.9]}$$

$\sigma_{contact,fat}$ (at surface) = 73000 x 6,7 x 10^{-6} = 0,49 N mm^{-2}

$Q_{1k,fat}$ are axle loads in relation to the number of vehicles for the fatigue load model considered, the number of vehicles (N_{obs}) shall be in accordance with EN 1991-2 and Clause 1.2.2 of this EAD.

This design contact pressure may be reduced at the bridging plate with the application of the dispersal effect (D) in accordance with EN 1991-2, 4.3.6.

D = Dispersal effect of bridge deck surfacing and thickness of FAPEJ (effectively the ratio of contact area at surface level (A_1) over the contact area at the level of the bridge plate (A_2)).