Technical guidelines for bridges

Valid from: 12-2013
to: 12-2018

Road-bridge expansion joints

No. F AT J0 13-12

EJ 85 – ETIC

Product name:

EJ 85

Company:

ETIC

These guidelines cancel and supersede the previous guidelines published under the reference F AT JO 06-02

Cantilever joint

These technical guidelines provide instructions for this type of joint.

They concern the cantilever type joint as described by the ETAG 032 part 6 "Cantilever joints" (previously called “comb joints” or “finger joints”).

Summary

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Ministère de l'Écologie, du Développement durable et de l'Énergie

(Rev) The paragraphs and subparagraphs added or modified since the previous expired Technical Guidelines, are preceded by ***(Rev)*** for 'revision'.

I. Identification datasheet

I.1 Proprietary information

I.1.1 Proprietary information

NAME AND ADDRESS OF THE MANUFACTURER/ INSTALLER:

ETIC

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78000 VERSAILLES, FRANCE

(Rev) Telephone*: + 33 (0) 1 39 50 11 20* *Fax: + 33 (0) 1 39 50 11 03*
e-mail: contact@etic-sas.fr – Web site: www.etic-sas.fr

PATENT RIGHTS (INDUSTRIAL AND COMMERCIAL):

This joint is covered by patent No. 95 09218 dated 5th September 1997.

I.1.2 Principle of this joint model

(Rev) This joint model belongs to the aluminium alloy **cantilever joints category**. An extruded rubber profile is inserted between the metallic elements to seal them off from water and materials. The joint is attached to the structure using pretensioned anchor rods.

I.1.3 Scope of use

I.1.3.1 - Classification

This joint can be used to equip bridges bearing **all types of traffic** in compliance with the SETRA/LCPC "Road Structure Design and Sizing" ("*Conception et dimensionnement des structures de chaussée"*) Technical Guidelines.

I.1.3.2 - Accommodated movement

The EJ 85 accommodates a nominal movement of 85mm. The gap between two opposite metallic components can vary between 5 and 90mm.

I.1.3.3 - Angle adaptation

As this joint is equipped with triangular 'teeth', it can be used for bridges with a slant of up to 20 grades.

Adjustment of opposite components and calculation of the movement accommodation capacity must be conducted taking into account the angle of movement (c.f. diagram p. 5 and p. 16). In this case, the joint's actual movement accommodation measured following the bridge's longitudinal axis is equal to the ratio between this model's accommodation movement capacity and the sine of the bias angle (c.f. angle definition in the Sétra "Expansion joints" document § 2.1.3, fig. 6).

I.1.4 Installation

This is ensured by the Manufacturer/Installer using the rebate installation technique.

Installation after laying the asphalt allows for precise joint adjustment to the adjacent surfacing.

Installation before laying the deck is possible, yet highly inadvisable, as adjusting the asphalt to the joint is more difficult (c.f. the Sétra "Expansion joints" document § 4.1).

I.1.5 References

(Rev) Between 1997 and 2010, 1,290 m of EJ 85 joints were installed in France. These include 58 ETIC references.

I.2 Overall plans

See pages 4 to 7.

I.3 Technical specifications

I.3.1 Description and general indications

The EJ 85 joint includes:

- A succession of paired upper metallic components, which materialise the edge of the zone to be equipped along a W-shaped track alignment. These two elements face each other to constitute a cantilever joint;
- The length of a single element is approximately 1m;
- A filler profile, continuous between upstand and upstand, solidly inserted between the extruded 3 metre-long metallic components (fixed under the aforementioned components), is designed to avoid extraneous matter from penetrating and ensure the joint is watertight;
- Twelve anchors per metre of component pairs comprised of prestressed HM 12 screws (quality class: 10.9), are tightened using a torque wrench;
- A sealing joint system between contiguous elements;
- Asphalt-covered screw holes and heads;
- A specific element for the footpath kerb;
- A footpath joint;
- A kerb trim part;
- A drain system for sealing between the watertight interface/road surface;
- A cement concrete anchorage beam.

I.2 OVERALL PLANS

Schematic representation

Cross section

INon-adherent sealing

(double-coat asphalt or prefabricated sheet + asphalt)

Rebate dimensions

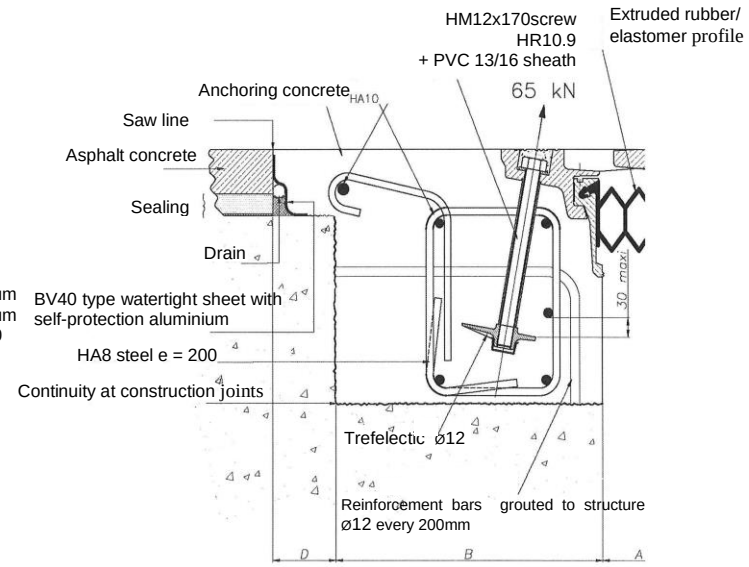
A: mini 20, maxi 105

B: 250

C: 250

D: 50 to 100

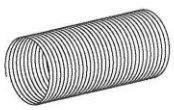
H: 200 minimum supposing a minimum encased thickness of 60



NB: Anchoring concrete reinforcement rods can be adjusted to the position of the bridge's existing armatures.

DRAIN

Schematic illustration



∅18 spring ∅1.5 thread

Non-contiguous coils (thread 3)

The drain can only be placed on the joint's upper side

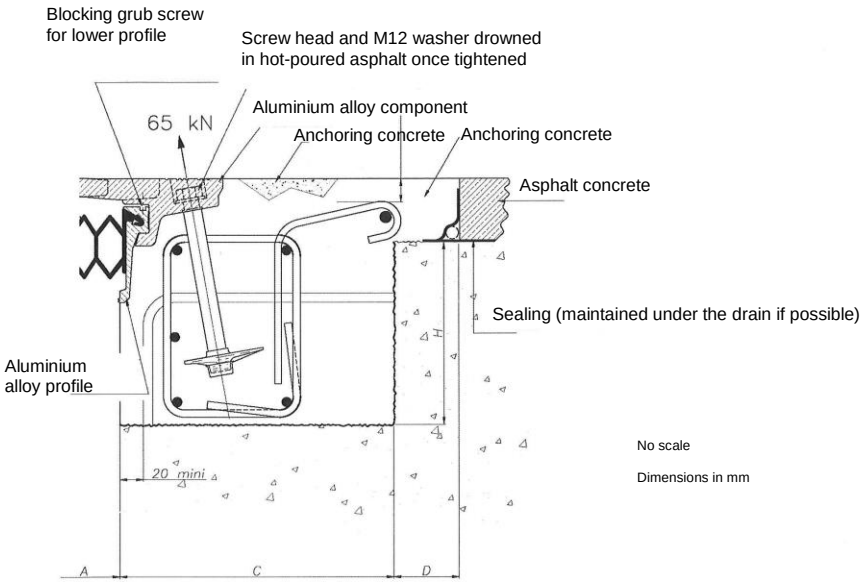
Dimensions in mm

I.2 OVERALL PLANS

Schematic representation

Cross section

Adherent sealing
(Thin film)

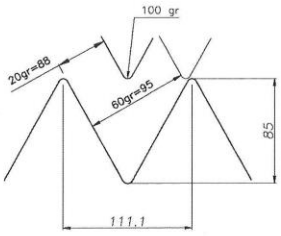


NB: - the type of drain is not linked to the bridge's existing sealing system

- Plan for additional reinforcement rods in the anchoring concrete.

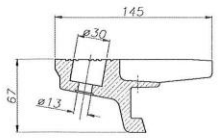
It is adjusted to rebates.

SKEW ANGLE



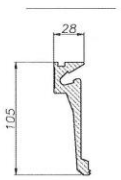
METALLIC COMPONENT

Cross sectional view

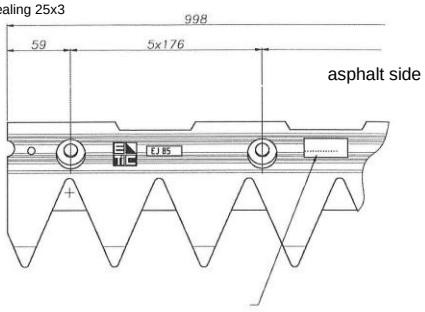


Lower element

Surface covered with sealing 25x3

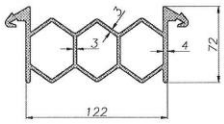


Partial plan view



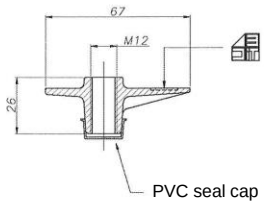
RUBBER PROFILE

Cross sectional view

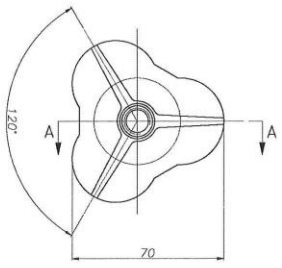


ANCHOR DOWEL

A-A cross sectional view



Top view

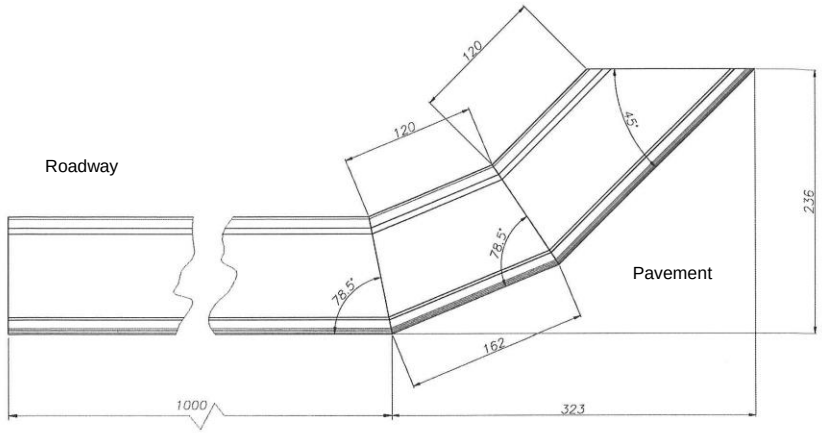


Scale 0.5

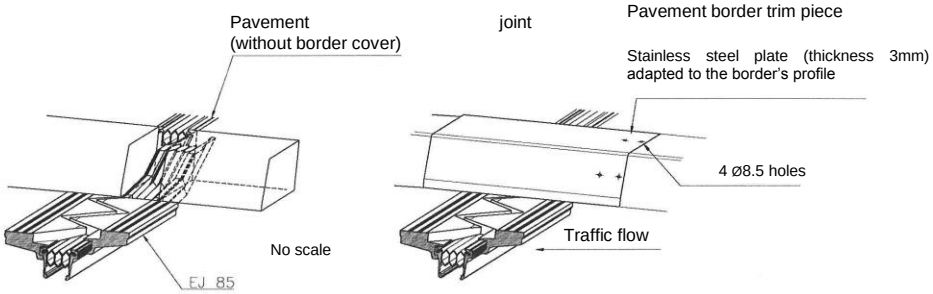
PAVEMENT

Pavement upstand

Side view

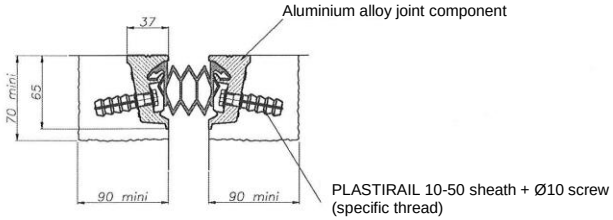


BASIC PERSPECTIVE



Pavement joint

Cross sectional view



No scale

Dimension in mm

I.3.2 Material and product specifications

I.3.2.1 – Metal components are made of an aluminium alloy. They are marked (month-year) on their upper side.

I.3.2.2 – The **screws binding the element** to the structure are made of anti-corrosion zinc flake coated steel. They are greased prior to installation. Once they are tightened, the screw bore is covered with pure hot-poured asphalt.

I.3.2.3 - The protective **sheath** is made of polyvinyl chloride.

I.3.2.4 - The moulded **anchoring part** is made of Cupro-aluminium.

I.3.2.5 - Washers are made of anti-corrosion zinc flake coated steel.

I.3.2.6 - The **filler blocks** are made of extruded elastomer (E.P.D.M.). They are marked (date of manufacturing every 5 metres) edgeways (invisible once the joint is operational).

I.3.2.7 - The **drain** is made of stainless steel.

(Rev) ~~**I.3.2.8 – Un système de drainage de l'interface étanchéité/couche de roulement,**~~

I.3.2.9 - The **upstand** is made of a specific machine-welded element inserted into the pavement edge. The **pavement kerb trim part** is made of Z2 CN 18-10 stainless steel.

Mis en forme

I.3.2.10 - The **pavement joint** is made of a specific T 85 extruded aluminium element or of S235JR hot-dip galvanised anti-corrosion steel slipping plates or protected by seal-enhanced metallisation with additional sealing and paint. These plates are fixed to the pavement structure using CoNETIC® anchors and masonry bolts.

I.4 Specific transportation and storage conditions

(Rev) Please comply with instructions on the products' technical sheets.

II. Tests and controls

II.1 Tests

II.1.1 Characterisation testing

At the manufacturer's request, the technical properties of materials and products have undergone a series of tests by a laboratory accredited by the **CO**mité **FR**ançais d'**AC**créditation (COFRAC), or, if there is no certified laboratory, by a laboratory approved by the Commission.

Analysis of these tests provides the following details on joint components:

Components	Properties	Standard (rating)	Test Report References (dates)	Remarks
Upper metal alloy components	Testing on specimens: - Chemical analysis - 0.2% yield strength - Fracture strength - Elongation at rupture	NF EN 755-2 (A 57-702)	LROP report No. 35353 AL (26/07/1999)	
Rubber profile	Testing on specimens taken before and after ageing: - Shore A hardness or IRHD - Fracture strength - Elongation at rupture	NF ISO 7619-1 NF ISO 48 NF ISO 37 NF ISO 37 (T 46-003 and T46-002)	LROP report No. 35353 Ca (26/07/1999)	Variation in mechanical properties after NF ISO 188 (72h at 100°C) oven ageing must be inferior to values stipulated by the aforementioned standard. While operational, the material must show good resistance to oils, adverse weather conditions, ozone and extreme temperatures.
Screws	- 0.2% yield strength - Fracture strength - Elongation at rupture - Anti-corrosion protection	NF EN 24016 (E25-115-1) NF EN ISO 4042 (E25-009)	LROP report No. 30480 V3 (17/02/1995) LROP report No. 35353 Ba/2 (26/07/1999)	Pull-off test on screw set in its anchor socket.
PVC protection sheath	Cf. standard	NF C68-107		
Anchoring part	- Mechanical properties - Chemical analysis	NF A53-709	LROP report No. 30480 T4 (17/02/1995)	Mechanical properties are checked by pull-off testing on a screw set in its anchor socket.
Washer under nut	- Cf. standard (mechanical properties) - Anti-corrosion protection	NF E25-513		
Nut	- Anti-corrosion protection	NF EN ISO 4042 (E25-009)	LROP report No. 35353 CA (26/07/1999)	

The aforementioned reports were submitted to the Commission when the Technical Guidelines were requested.

The manufacturer guarantees the properties of materials and products used to make the joint, in accordance with the accepted tolerances of applicable manufacturing specifications, especially pertaining to size.

To verify conformity of the product submitted to the Commission with the product supplied on site, the Project Manager can, within the scope of external control, conduct some of the component characterisation tests included in the above chart. In this case, and when signing the contract, the manufacturer will, upon request, provide a copy of the aforementioned reports.

II.1.2 Type tests

Tests conducted on the finished product are as follows:

Components	Properties	Standard (rating)	Test Report References (dates)	Remarks
EJ 160	Identify 3-dimensional movement accommodation capacity	XP P98-092-1	ETIC report No. 07-99 on 08/07/1999	

II.2 Quality control

The manufacturing and installation Quality Control for this model of joint has been established based on the NF EN ISO 9002 standard (X50-132 class). An ETIC Manual on Quality and a Plan to Ensure On-site Quality (monitoring of joint installation[1]) were submitted when the Technical Guidelines were requested.

A Manager of Works will monitor staff and the company also organises yearly technical seminars.

II.3 Minimum on-site conditions for implementation

Those required for bridge construction.

The undersigned Manufacturer/Installer Company Director, or its authorised representative, certifies the accuracy of the information provided in chapters I and II of the contents herewith.

13/12/2013

[1] At the date these Technical Guidelines were established, this manual's reference is 09/97.

III. Notice from the commission

The product presented above has been reviewed by the Commission on Expansion Joints, which includes representatives of contracting authorities and project supervisors, the French Department of Civil Engineering Laboratories, of Sétra and of the Trade, who have established a trade union: the SNFIJEES (Syndicat National des Fabricants-Installateurs de Joints, d'Equipements et d'Eléments de Structure).

III.1 Movement accommodation capacity – For road-user convenience

Nominal movement accommodation of 85mm is acceptable, based on laboratory testing. Even though the joint does have a movement accommodation safety coefficient, we advise against exceeding the nominal opening value. Indeed, with maximum aperture and for a 10mm closure force, this accommodation movement leads to a gap of 5mm between opposite 'teeth'.

The maximum closure forces registered are approximately 100 daN/linear metre.

Road user convenience, when properly installed and once the deck has been built, **is excellent due to its comb structure**.

This ergonomy can deteriorate over time, usually due to adjacent surface wear, whereas the joint itself remains at its initial level.

The **installation method** described in the manual should **guarantee the joint is well aligned with the adjacent deck**. In fact, on-site controls show how **installation teams perfectly master levelling.**

III.2 Robustness

III.2.1 Bonding with the structure

This model of joint is connected to the structure using the rebate installation principal with tensiocontrolled screws, where the head is protected against corrosion by pure hot-poured asphalt, anchor dowels and even-weight distribution components.

This means of anchorage, used under similar conditions for many years now, continues to be totally satisfactory over time, and also provides for easy replacement during repair work or road surface elevation (examples of these operations have been reviewed).

Anchor permanency is ensured if, as explained in the installation manual, the tightened screws are previously lubricated and protected against corrosion with zinc flakes, while the screw head counter bores are completely filled with asphalt.

The **screws remain easily accessible,** allowing for the rapid dismantling and replacement of a damaged component (following accidental collision of machinery, snow blade...). However, in this case, the attachment bolts must be replaced.

The manufacturer can provide the disassembly/reassembly procedure for a joint component, if requested by the administrator.

III.2.2 Simple mechanisms

This model of joint has a **simple design** with no relative motion parts, thus eliminating possible wear or blockage.

III.2.3 Quality of constituent materials

The file presented when the Technical Guidelines were submitted, specifies the characteristics of materials used.

Their quality is considered satisfactory with the current state of knowledge. To avoid any risk of possible corrosion caused by de-icing salt, surfaces of the metallic components in contact with concrete are protected by bituminous paint.

If a doubt subsists, we recommend the Project Manager take samples for laboratory testing. Results obtained will be compared with those indicated in the report(s) mentioned in chapter II.1. In the case of noncompliance, the Commission's Secretariat must be notified.

(Rev) Using cement concrete surfacing for connection flashing is conducive to joint durability, as it creates a protective mass against the impact of wheels on the joint. However, this good durability cannot be guaranteed unless the formulation is correct. In compliance with the NF EN 206-1 standard, the environmental exposure classes to be specified to the cement manufacturer are:

- Resistance to carbonation induced corrosion: XC4,
- Resistance to de-icing salt chloride corrosion: XD3,
- Resistance to sea water chloride corrosion: XS1 or XS3,
- Resistance to freeze-thaw cycles, depending on the freeze zone and the level of salting: XF1, XD3 + XF2, XF3 or XF4.

(Rev) Due to their specific formulation, these different types of concrete may be difficult to implement (trowelling, delayed required resistance...). Hence, workers must be informed of these conditions.

(Rev) The steels used to reinforce this flashing can be affected by corrosion, especially if they are insufficiently coated. Additional protection can be envisaged for highly aggressive environments.

(Rev) **PLEASE NOTE:** fissuring (in the direction of traffic) can, however, be caused by coating exceeding 50mm (c.f. NF EN1992-1-1/NA, Note under § 4.4.1.2 (5)), and also by water added for surface finishing.

III.2.4 Sizing and resistance to traffic loads

Certain elements of this joint model can be submitted to a calculation approach, in which case, there is no need for any specific comments on sizing.

(Rev) In order to fully determine how **the joint performs under traffic**, we have examined the resistance of joints in operation from 1997 to 2010. The total length examined represents approximately 22% of overall joint references declared installed for this period.

This control has identified **highly satisfactory resistance to traffic, even for heavy traffic loads (T0).**

However, the recesses behind the metallic elements (one of the patent's claims) intended to avoid flashing concrete shrinkage, and thus reduce fissuring often observed for this type of flashing, do not seem to provide the desired effect. Indeed, most concrete flashing showed the usual shrinkage cracks. The crack zone is unpredictable and can appear between connected joint elements, vertically to or between anchors.

This fissuring does not seem serious, yet illustrates the importance of monitoring the quality of the concrete used (choosing a formulation less liable to shrink, protecting concrete from desiccation, etc.).

Observation of certain sites where snow blades operate has shown how, as for all joint models, the joint may be affected, especially on skew angle bridges or those with variable slants. Efficiency of the optional system has not been proven. The administrator must be notified in order to apply the appropriate measures.

The first ETIC Technical Guidelines for this product were issued in September 2000.

III.2.5 Fatigue resistance

This joint does not seem to present any weakness concerning this aspect.

III.3 Watertightness

III.3.1 Connection with the bridge's overall tightness

In accordance with the technical file, **connection with the bridge's overall tightness is ensured** by applying the principle developed for concrete flashing joints: **install a sealing strip, pour bituminous sealant and install a "spring" drain**.

These measures require no specific comments. It is important, however, to provide each building site with details on the evacuation of this drain.

Moreover, bridge watertightness ends at the saw cut and the concrete flashing area is not treated for watertightness. However, based on over 20 years of experience in implementing this technique, it does not seem to affect resistance of the joint or underlying structure.

It is recalled that the **watertight sealant must systematically be placed vertically to any saw cut that ends sealing.**

(Rev) **PLEASE NOTE:** drain adjustment in the presence of MHC type sealing must undergo specific analysis and appropriate implementation.

III.3.2 Sealing the internal gasket vacuum - footpath upstand

(Rev) The sealing system used for the joint vacuum is a new design and is covered by one of the patent's claims. Internal gasket vacuum watertightness is ensured by a rubber profile inserted between the metallic elements located under the metallic combs supporting traffic.

Generally, when rubber profiles are fixed onto a metallic profile in this manner, this provides satisfactory watertightness, as confirmed by on-site visits, if:

- **A continuous rubber profile spans the full width of the road**; normally, rational site organisation should enable to obtain this continuous profile in most cases. If the length of the joint to be equipped (manufactured profiles usually present a unit length of 25 metres) or if site phasing requires butt-welded, the method used to join components must receive the Prime Contractor's prior approval,
- **Good performance profiles** (c.f. quality of materials),
- **Install sealants between contiguous metallic elements, as provided for in the Technical File**.

On-site monitoring of joint performance has not shown any watertight failure for the joint vacuum.

According to the technical file, at the **pavement edge upstand**, the joint has a special machine-welded part to allow for placing the rubber profile upstand in the pavement edge. This part, extended by an upright 1-metre-long element identical to the element maintaining the expansion joint's rubber profile, is butt-welded to the metallic batten-in-the-seam elements. This provides for efficient watertightness of the joint vacuum in this zone. A specific stainless steel cover ensures a continuous pavement edge. **This set of elements is acceptable**. However, it must be noted that the space required for the upstand's bulk may sometimes lead to difficulties at pavement insertion.

On the other hand, careful connection of the upstand with the bridge's overall sealing must be specifically and systematically examined.

III.4 Easy maintenance

III.4.1 Easy to maintain and replace

If damaged, the metallic components and rubber profiles can be replaced. Note how this operation allows for checking that the deck can dilate freely.

If the road surface is raised by 1 to 2 cm, (resurfacing, for example), it is **possible to raise the joint using wedging mortar (listed by NF, the French Standard)**. In this case, threaded rods of the appropriate length must replace the rods. Moreover, we advise asking ETIC for the specific installation procedure.

However, **the presence of inclined rods** will imply **joint closure of a few millimetres** (approximately 1cm per 2cm of additional height). **It is therefore necessary to check the remaining accommodation movement.**

PLEASE NOTE: for roadway regeneration or resurfacing, the joint must be adequately protected against possible damage caused by over-heating, planing or site machinery, preferably by removing the elements (once they have been marked).

III.4.2 Periodicity of maintenance interventions

In accordance with the maintenance provided for in fascicule 21 Bridge Equipment in the Technical Instructions concerning Bridge Surveillance and Maintenance, the manufacturer recommends specific monitoring of the following points:

- Visually check metallic components,
- Solidity of the joint anchors,
- No debris fouling of the joint,
- Solidity of concrete flashing.

The manufacturer recommends this be done **each year**, which is totally justified. This operation can thus be conducted (for state-managed structures) during the obligatory annual control, as stipulated by the Transport Infrastructure Department's circular dated 16/02/11 updating the aforementioned Technical Instructions.

A frequently mentioned aspect concerns debris between the 'teeth'. Because of their design and also the bridge's movement, sediments are evacuated by a slipstream effect. Therefore, they do not block the joint while there is traffic. Monitoring traffic-free sections is especially recommended in order to evacuate debris, when necessary, that may gather on the rubber profile between the joint's components.

The Manufacturer/Installer, if simply requested by the entity operating the bridge, can provide this joint's **maintenance manual**.

(Rev) **PLEASE NOTE:** administrators' attention is drawn to the fact that there is often a disbonding of the connection between flashing and surfacing, which must be repaired with adequate decking (to avoid ridge surface damage, roadway deterioration and alteration of the watertight/draining system).

III.4.3 Easy deck jacking

(Rev) **The joint's design does not enable opposite elements to shift vertically unless the aperture provides a distance of approximately 56mm between the 'teeth's' hollows and tines**. In this case, the level of opposite elements can differ by approximately 20mm, if the traffic load and speed is reduced. The dynamic effects on the bridge must, however, be checked. **This gap enables deck jacking** to change bearings or to measure support reaction. Exceeding this limitation, it is preferable to remove the joint prior to jacking.

III.5 Quality control

III.5.1 Manufacturing quality control

Attention is drawn to ETIC's decision concerning quality assurance, that is to say limited control at reception and screening suppliers who preferably implement a quality assurance model based on the NF EN ISO 9002 (X50-132 class) standard. Other suppliers must provide test results when they deliver their products, in compliance with instructions included in the call for tender as defined between ETIC and its suppliers.

The quality control system is based on a single document including the company's general and specific provisions relating to expansion joints.

III.5.2 Quality control for implementation and guaranteed after-sales service

Generally, the qualification of ETIC's installation teams does not seem to pose any problems and their experience seems satisfactory.

Moreover, for its on-site workers, ETIC has prepared an installation manual (referenced under § II.2). It is an important aspect of the quality control system for implementation.

This manual, which is the reference when implementing the joint, can be consulted at all times **by Project Managers or their authorised representatives.**

Please remember that Project Managers must ensure **the "site supervision" sheet is filled out and imperatively submitted when work is completed.**

It is furthermore recalled that joints installed by teams other than those provided by the Manufacturer/Installer are in no way covered by the guaranteed Technical Guidelines procedures, as the latter specify the Manufacturer/Installer must conduct installation.

III.6 Miscellaneous

III.6.1 Skew angle

(Rev) On-site monitoring of the performance of joints (with a skew angle of up to 73 grades) has shown no faulty adaptation.

III.6.2 Pavement and upstand

Concerning the **upstand**, please refer to § III.3.2 above.

For light pedestrian traffic, ETIC suggests using the T 85 "gap" joint. It is comprised of the EJ 50S joint's metallic components equipped with Plastirail® anchors (c.f. the corresponding Technical Guidelines). This joint model is acceptable despite the large gap at maximum aperture (10 cm).

For heavy pedestrian traffic, the footpath joint is comprised of steel plates fixed into the pavement using masonry bolts and Conetic® anchors (c.f. EJ 110 or EJ 160 Technical Guidelines). Installing this type of joint requires the pavement be at least 12cm thick. This block design only allows for partial disassembly. Moreover, to protect the slipping plates against corrosion, the Company propose two solutions offering different degrees of durability: one uses galvanisation, the other uses metallisation. The latter is only feasible when accompanied by additional sealing and paint, as specified in the technical file.

Please recall that the Technical Guidelines concerns the inseparable whole of "expansion joint-upstand-pavement joint" and technical proposals are made on this basis. Project Managers must clearly specify if they wish to obtain different equipment. In which case, they should clearly assess the reasons.

III.6.3 Two-wheeled vehicles

(Rev) When installing**,** Project Managers' attention is drawn to the fact that when the joint shows maximum aperture, the void created between the metallic components (between the teeth's hollows and tines) and the top of the rubber profile, does not provide adequate safety for two-wheeled vehicles (bicycles etc.). Moreover, a "tramway rail" incidence may occur on skew bridges if the direction of traffic is parallel to the teeth edges. To avoid this risk, existing adjustments can provide a solution.

III.6.4 Hygiene and safety during installation and when operating

(Rev) The materials used require no special precautions (*Cf.* § I.4).

(Rev) **PLEASE NOTE:** It is necessary to ensure appropriate protection for employees who install the joints.

Technical Guidelines for road-bridge expansion joints

The Technical Guidelines provide official advice on the predictable behaviour of products, processes or materials to inform Prime Contractors and Project Managers about how to proceed and on their technical choice, as well as to enable them to make fully informed decisions.

These Technical Guidelines are drawn up under the supervision of a commission associating representatives of Prime Contractors and Project Managers, the Laboratoires des Ponts et Chaussées, of Sétra and of the Profession, represented by their trade union: SNFIJEES (*Syndicat national des fabricants-installateurs de joints, d'équipements et d'éléments de structure*)

The Commission's secretariat and presidency are respectively ensured by Sétra and the Trade.

Technical Guidelines are drawn up subject to the following steps of procedure:
- Application;
- Prior investigation (in the case of an initial application considered as eligible);
- The technical file is examined and trials are programmed;
- The Technical Guidelines are drawn up.

These Technical Guidelines are available for consultation on Sétra's web sites:
- Internet:
  http://www.setra.developpement-durable.gouv.fr
- I2 (intranet of the French Ministry of Ecology and Sustainable Development):
  http://intra.setra.i2

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