



Expansion joints

Specification for flexible plug expansion joints

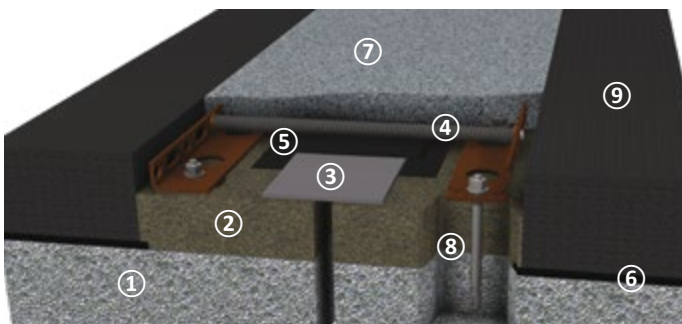
1. Scope

This work shall consist of the supply and installation of non-bituminous flexible plug expansion joints for the deck of the Bridge at the following locations:

The scope of this specification shall include supply of all materials, services, labor, tools and equipment required to design, fabricate, inspect, test and install the joints as specified in this document – including any separate/optional features such as barrier cover plates, asphalt-strengthening ribs or surfacing transition strips indicated on the drawings.

2. Requirements to be satisfied by the selected expansion joints – General

- a. **Type:** Expansion joints (also referred to simply as “joints” below) shall be flexible plug expansion joints. They shall not be of the bituminous type.
- b. **Key function:** Joints shall span the movement gaps between sections of the bridge’s deck or between the deck and its abutments, providing a safe, suitable, durable driving surface for traffic.
- c. **Movements and rotations:** Joints shall accommodate the specified movements and rotations of the bridge deck. Unless otherwise specified, all joints shall be able to accommodate vertical movements of at least $\pm 3/8$ ”, in order to facilitate the replacement of bridge bearings.
- d. **Loading:** Joints shall be capable of supporting all loading as specified in the contract documents. Unless otherwise specified, the joint shall be suitable for use by vehicular, cycle and pedestrian traffic, including pedestrians with stiletto / high-heeled shoes.
- e. **Top surface:** The driving/trafficable surface of all joints shall be completely flat and continuous.
- f. **Water tightness:** Joints shall be completely watertight, and not susceptible to damage from standing water. If the superstructure at either side of the joint features a waterproofing membrane, it shall be integrated into the joint in a way that maintains water tightness of the entire system.
- g. **Operating temperatures:** Joints shall be suitable for use, and remain elastic and fully functional, at all specified temperatures. Unless otherwise specified, the range of operating temperatures shall be -40°F to $+140^{\circ}\text{F}$ (-40°C to $+60^{\circ}\text{C}$). Operating temperatures are to be understood as temperatures of the structure, not of the air and not of the surface.
- h. **Resistance to plastic deformation, tearing, etc:** Joints shall be highly resistant in normal service to damage including tearing, cracking, puncture and non-elastic deformations such as wheel rutting and deformations from studded tires. The elastic material used in the joints shall offer tensile strength of at least 2.0 ksi (14 N/mm²) and tear strength of at least 2.9 ksi (20 N/mm²).
- i. **Reaction forces at connecting structures:** The joint’s elastic material shall be capable of elastically accommodating elongation deformations of minimum 500%.
- j. **Easy repair of damage:** It shall be possible to repair damage to a joint’s elastic material, such as scraping from snow plows etc., e.g. with reactivation of the affected area and placement of fresh material as required.
- k. **Skid resistance:** Unless otherwise noted, the joint’s surface shall incorporate anti-slip granulate or similar, to avoid a slick surface when wet.
- l. **Specific material properties:** Joints shall be resistant to environmental influences and chemicals including bases, acids, chlorides, etc. and shall be free of solvents, germs and fungus.
- m. **Health/Safety:** Once installed, with poured materials fully cured as required, the joint and its constituent materials shall be physiologically safe.
- n. **Color:** The color of the joint’s elastic material, when installed, shall be gray unless otherwise specified. Contact the supplier for available alternate colors.
- o. **Maintenance:** Installed joints (except for optional features such as cover plates) shall be essentially maintenance-free and not require cleaning.



- 1 Abutment
- 2 Polymer concrete bedding
- 3 Cover plate
- 4 Perforated steel angle
- 5 EPDM sliding sheet
- 6 Bridge sealing
- 7 Tensa® Polyflex® Advanced PU flexible material
- 8 Anchoring
- 9 Surfacing made of asphalt or concrete

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Expansion joints

3. Requirements to be satisfied by the selected expansion joints – Installation

- a. **Suitability for new and existing structures:** The expansion joint type shall be suitable for installation on new structures and alternatively for replacement of expansion joints on existing structures, unless otherwise specified.
- b. **Installation in sections:** It shall be possible to install a joint in stages without any reduction in performance or durability (e.g. lane-by-lane) to minimize impacts on traffic.
- c. **Installation by hand:** It shall be possible to install the joint without any need for mechanical lifting equipment.
- d. **Viscosity:** The poured material of the joint shall have high viscosity when poured (e.g. it shall not be self-levelling), to facilitate formation of its surface profile to suit that of the connecting superstructure surface.
- e. **Adaptability:** It shall be possible to adapt each individual joint to the unique requirements of each structure or application, in terms of thickness, width and shape of the joint, even if these vary along the joint's length.
- f. **Installation temperature:** Installation (with complete curing of the poured elastic material) shall be possible at any ambient/substructure temperature from 41 °F to 95 °F (5 °C to 35 °C). The poured elastic material shall not require heat during mixing/placing.
- g. **Installation humidity:** It shall be possible to install the expansion joint at a relative air humidity of 0% – 85%. The blockout shall be clean and dry at time of installation.

4. Requirements to be satisfied by the selected expansion joints – Type testing

The specific expansion joint type/make shall have verified its functionality and durability in testing which shall be or have been carried out or witnessed by an approved independent body or expert. The Supplier shall provide for acceptance evidence that appropriate and comparable expansion joint specimens or their components passed laboratory testing which demonstrates the ability of the expansion joint to withstand the conditions to which it will be subjected in service and to continue performing as expected for the expected service life.

The following types of testing, or accepted equivalents, shall be or have been successfully conducted in accordance with a recognized international standard:

- **Wheel tracking test** - verifying that the expansion joint can be expected to have a service life of at least 15 years.
- **Mechanical resistance testing** - testing of resistance to vertical static loading and recovery after unloading.
- **Fatigue testing** - resistance to repeated vertical dynamic loads.
- **Movement capacity testing** - full movement testing plus small high-speed movement testing, the latter with minimum 7,500,000 movement cycles at approximately 60 °F (15 °C), plus at least 300,000 cycles at approximately -40 °F (-40 °C).
- **Material characteristics testing** - resistance to ozone, UV radiation, weathering and freeze-thaw conditions of artificially aged material samples.
- **Water tightness test:** The joint type shall be proven by testing to be watertight following subjecting of a specimen of at least 2" longitudinal movement capacity to its appropriate service movements. The depth of the water must be minimum 2" and the duration of the test must be minimum 8 hours. During the test, no moisture or water shall have been observed on the underside of the joint.

5. Prequalification

Evidence, and certification as appropriate, shall be provided with the tender to demonstrate compliance with all of the following basic requirements:

- a. **Experience:** The Supplier of the expansion joint shall be specialized and experienced in the design, manufacture, and installation of expansion joints of the specified type. The Supplier shall have suitable experience in manufacturing expansion joints at least matching the project requirements, having at least 3 existing applications of similar expansion joints in service (with similar movement capacity or higher), each at least 5 years under traffic.

The acceptance of the Supplier's qualifications to perform the work will not in any way relieve the Supplier from responsibility for the adequacy of the supply work.



Movement capacity tests of TENSAPOLYFLEX®Advanced PU



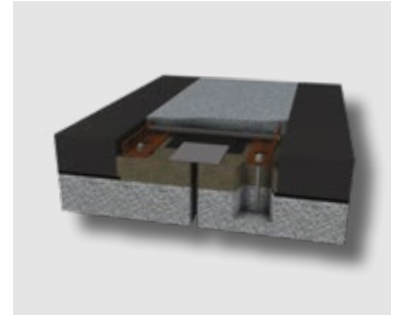
Expansion joints

6. Design

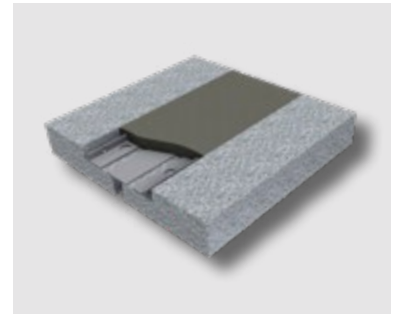
Design of each expansion joint shall comply with the following requirements.

- a. **Responsibility for design:** Design of the expansion joint shall be the responsibility of the Supplier. The expansion joint shall be designed to accommodate all structure movements and rotations as indicated on the project drawings, and to suit all provided geometry and details. The expansion joint shall be designed to be installed with the same longitudinal slope (in direction of bridge span) as the bridge deck.
- b. **Service life:** The expansion joint shall be designed for a service life of at least 15 years. Renewal of corrosion protection on any separate cover plates or the like shall be allowed.
- c. **Continuity across roadway:** Unless otherwise indicated, the expansion joint system shall be continuous across the full width of the roadway including walkways etc., and extend beneath the traffic barriers at each side.
- d. **Design input information:** The design shall be carried out based on the relevant design input information (provided by the bridge designer), which should include:
 - i. Bridge design drawings showing deck cross-sections at location of expansion joint (including structural and surfacing materials) and blockouts (including reinforcement steel). If the joint is at a skew angle, a section along the joint's longitudinal axis should be provided.
 - ii. Details of deck movements (longitudinal, transverse and vertical) and rotations (about longitudinal, transverse and vertical axes), for SLS, ULS and seismic conditions where appropriate.
 - iii. Details of skew angle, if any.
 - iv. Details of deck movement gap width at various relevant temperatures.
 - v. Details of any additional features required, such as asphalt-strengthening measures at each side of the joint.
 - vi. Details of any further special requirements or limitations, such as phasing of installation, the need for "splicing"/phasing at specific locations along the joint's length, location and type of traffic barriers, etc.
- e. **Water tightness of connection to asphalt deck surfacing:** If the deck at either side of the expansion joint features asphalt surfacing or similar and a waterproofing membrane, the expansion joint shall be appropriately detailed and planned for proper watertight connection of the waterproofing membrane.
- f. **Design for surface water drainage:** Unless noted otherwise, the expansion joint's longitudinal profile shall be designed to prevent surface water (from rainfall etc.) from flowing off the end of the expansion joint. In the absence of a level change for a footway or similar, and where possible, this shall be achieved by means of an upturn at each end of the expansion joint, beyond the edge of the driving surface (e.g. under a traffic barrier). The upturn shall be at least 4" higher than the lowest point of the adjacent driving surface.
- g. **Submission of design for approval:** The Supplier shall submit drawings as described below to the Owner or Engineer of Record for review and approval prior to any required pre-fabrication of components or installation of the expansion joint.
- h. **Drawings:** The drawings shall include, but not be limited to, the following:
 - i. Plan and section views of the expansion joint for each location, showing all relevant dimensions.
 - ii. Dimensions and material designations for all parts and components.
 - iii. Any phasing/staging required or proposed.
 - iv. Details of corrosion protection for any cover plates.
 - v. Details of any required changes to deck blockouts or reinforcement to accommodate the expansion joint.

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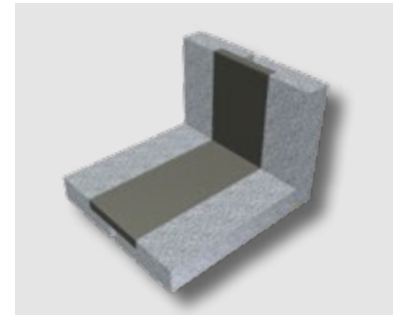
Standard Road



Standard Light Load



Intersections



Vertical Joints



Expansion joints

7. Materials

Expansion joints shall be fabricated exclusively from high quality materials. The following stipulations shall apply where appropriate.

- a. Steel shall be ASTM A36 in accordance with ASTM, or approved equivalent. Properties of all steel shall be verified by mill test certification.
- b. Where applicable for cover plates or the like: Bolts shall be ASTM A325 HDG or approved equivalent; Nuts shall be in accordance with ASTM A563 HDG or approved equivalent; Washers shall be in accordance with ASTM F436 HDG or approved equivalent.
- c. Flexible plug material shall be 2-part polyurethane resin, mixable onsite at ambient temperatures between 41°F (5°C) to 95°F (35°C). Once cured the flexible plug material shall retain full functionality at temperatures between -58°F (-50°C) and 158°F (70°C).

8. Transportation, Handling and Storage

- a. **Checking:** Joint components and materials must be checked for completeness and for damage or lack of consistency with plans or drawings, immediately following delivery to site. If any deficiency is detected, or if a joint is found to not comply with specifications or fulfil the Contractor's requirements in any way, the Supplier must be informed within three days of delivery to site.
- b. **Storage:** Prior to installation, joint components and materials must be stored / protected in a way that will prevent damage or loss, including from mechanical damage, moisture, excessive heat, sunlight, oils, fuels and other deleterious effects. Polyurethane resin components shall be stored at room temperature between 64°F (18°C) to 77°F (25°C) and protected from direct sunlight. Temperature for overnight storage shall be the same.
- c. **Repair of damage:** Damage to the corrosion protection of any steel parts shall be repaired to the satisfaction of the Owner or Engineer of Record and the Supplier.

9. Installation

- a. **Installation Manual:** Prior to commencement of installation, the Supplier shall provide an installation manual describing the installation procedure. If required, this shall include details of how field "splicing" of sections between stages is to be performed.
- b. **Installation per design and instructions:** Installation shall be in accordance with all relevant design drawings, design specifications, installation manuals and client or supplier instructions. In case of any inconsistency or lack of clarity, the Contractor shall obtain guidance from the Supplier, where authorized, or the Owner or the Owner's representative / Engineer of Record.
- c. **Supervision of installation:** Unless installation is done by the Supplier or an approved installation specialist, the Contractor shall ensure that supervision of installation is provided by the Supplier.
- d. **Checking of "pre-setting":** The Contractor shall check, after consulting with the Supplier and bridge designer if necessary, that the width of the superstructure's movement gap (which varies depending on temperature of deck, remaining creep and shrinkage of deck concrete, etc.) at the time of installation is suitable to ensure that all future movements which must be accommodated by the joint, in closing and opening, can be accommodated within the normal movement range of the joint when starting from its current condition. If the gap width is not suitable, the Contractor shall ensure that appropriate measures are taken, as discussed and agreed with the structure's responsible Design Engineer and the Supplier.
- e. **Concrete condition:** Concrete substrate shall have a minimum compressive strength of 3,600 psi, and minimum bonding strength of 217.6 PSI. At time of installation the residual dampness of the concrete substrate shall be less than 3%.
- f. **Surfacing:** The surfacing shall be either concrete or highly durable asphalt. In case of asphalt a durable mastic asphalt is preferred. Rolled asphalt shall have a void content of less than 6%. In order to avoid damages on the rolled asphalt, polymer concrete headers of minimum 4" width shall be positioned before and after the flexible plug joint.
- g. **Secure connections to main structure:** The joint shall be securely connected/bonded to the main structure as detailed on the expansion joint design drawings, as specified by the Supplier.
- h. **Care of installed joints:** The Contractor shall ensure that the joint, once installed, is protected from damage of any sort until the contract is completed. Loading and damage from construction traffic, equipment and processes must be prevented, e.g. by bridging over the expansion joint in an approved manner. Impacts or pressure (e.g. from steel tracked vehicles or asphalt compacting equipment) can damage flexible surfacing and must be avoided.

10. Inspection and Maintenance Manual

The Supplier shall provide an Inspection and Maintenance Manual for use in ongoing inspection and maintenance activities.

11. Warranty

The Supplier shall provide its standard warranty, with a duration of 1 year after installation.