

## SECTION 913

### EXPANSION JOINTS

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**913.01 SCOPE**

The scope of this specification is to cover the design, supply, material, fabrication and installation of expansion joint assemblies of the type as shown in the contract documents.

Typical strip seal expansion joint systems are comprised of two separate metal assemblies which hold a seal consisting of a flexible material between them. Movement in the bridge is accommodated by the flexible seal which is free to stretch and compress to a specified degree. The system also includes sealants, backer rods, caulking, foams, drainage, and metal plates used to accommodate movement in the deck, curbs, and barriers.

Typical asphalt plug expansion joints consist of a mixture of elastic material (binder) and aggregate placed over the joint between sections of the bridge. Movement in the bridge is accommodated by the binder/aggregate mix compressing and stretching to a specified degree. The system also includes sealants, backer rods, caulking, foams, and metal plates used to accommodate movement in the deck, curbs, and barriers.

Expansion joint design, materials, fabrication and installation shall comply with the latest edition of CSA S6 "Canadian Highway Bridge Design Code."

## 913.02 APPROVALS

Prior to any fabrication or the purchase of materials, shop drawings must be reviewed by the Owner's Representative.

Contractor shall submit 1 hardcopy and 1 electronic copy of the shop drawings with 2 weeks required for review.

The shop drawings shall show:

- a. Movement chart showing total rated movement.
- b. The required setting width for temperatures in increments of 5°C within the normal setting range.
- c. Grade, type and dimension of all material used.
- d. Location and full details of all splices and welds.
- e. Full details of anchors, clamping devices and curb details.
- f. Preset shipping dimensions.
- g. Site storage and installation procedures.
- h. Relationship of expansion joint assembly to deck, approach slab, roadway and all adjacent reinforcement.
- i. For strip seal expansion joints, confirmation from the neoprene seal manufacturer that the lubricants to be used during installation are compatible with the seal.
- j. For asphalt plug expansion joints confirmation from the neoprene seal binder and aggregate plug manufacturer that all other components of the system are compatible with the plug.

## 913.03 STRIP SEAL EXPANSION JOINT SYSTEM

The expansion joint assembly shall be a mechanically locked joint of the type shown on the contract drawings or an accepted equivalent. It shall be capable of satisfactory operation between -35 and +40 degrees Celsius.

### 913.03.01 Materials

#### 913.03.01.01 Seal

The seal shall be a neoprene seal conforming to OPSS.PROV 1210 "Material Specification for Deck Joint Assemblies" and having the following properties:

Seal Physical Requirements Preformed Seal Physical Requirements Property	Physical Requirements	Test Procedure
Tensile Strength	Minimum 13.5 MPa	ASTM D 412

		Test Method A
Ultimate Elongation	Minimum 250%	ASTM D 412 Test Method A
Hardness, Oven Aging Test, 70 h @ 100 °C Change in Tensile Strength	55 Shore A, + 7, -5 Maximum 20%	ASTM D 2240 ASTM D 573 ASTM D 412 Test Method A
Change in Elongation	Maximum 20%	ASTM D 412 Test Method A
Change in Hardness	Maximum 10 points	ASTM D 2240
Permanent set at break	Maximum 10%	ASTM D 412 Test Method A
Low Temperature Crystallization Hardness, ShoreA 7 d @ -10 °C Change in Hardness	Maximum 15 points	ASTM D 832 ASTM D 2240
Oil Swell, ASTM Oil No. 3, 70 h @ 100 °C Weight Change	Maximum 45%	ASTM D 471
Ozone Resistance, 20% Strain, 150 pphm in air 70 h @ 40 °C	No cracks	ASTM D 1149 Method B, Procedure B1
<p>Notes:</p> <p>A. All tests shall be made on specimens prepared from the preformed seals.</p>		

Manufacturer's storage and handling requirements shall be followed. The seal shall not be exposed to ultraviolet rays for more than 3 days before installation.

### **913.03.01.02 Lubricant**

The Contractor shall supply a suitable lubricant to facilitate the installation of the seal into the expansion joint rail. The lubricant shall be compatible with the neoprene seal and the Contractor shall provide a letter from the seal manufacturer to this effect when requested by the Owner's Representative.

### **913.03.01.03 Steel**

All steel used in the expansion joint assembly shall conform to CSA-G40.21 "Structural Quality Steels." The steel grade shall be 300W and galvanized in accordance with 913.03.02.

Reinforcing steel shall be as specified in the contract documents and in accordance with Section 905.

If the protective galvanized coating is damaged prior to final acceptance, regardless of cause, the Contractor shall wire brush to clean the metal and hand paint with a cold

galvanizing compound accepted by the Owner's Representative. The cleaned surface shall receive one application of metal conditioner to de-oxide, degrease and phosphatise the metal surface to be treated. Pre-mixed, ready-to apply, liquid cold galvanizing compound should be applied to the prepared clean dry metal surface. The cold galvanizing compound must be of a type that imparts cathodic action against corrosion. The cold-galvanizing compound shall have a minimum 50 mm overlap of the surrounding galvanized metal. Both metal conditioner and cold galvanizing compound must be accepted by Underwriters Laboratories of Canada for component coatings (organic) and meet or exceed CGSB 1.181-99 "Ready Mixed Organic Zinc Rich Coating.". All materials must be applied in accordance with the manufacturer's instructions.

#### **913.03.01.04 Concrete**

Concrete in the expansion joint dam shall be as per "Superstructure Concrete" of Section 904.

Concrete which does not meet the specified compressive strengths shall be rejected or payment will be reduced as per Section 913.06.03.

#### **913.03.02 Fabrication**

All cut edges shall be smooth, regular and free of slag.

All holes shall be drilled and bleed holes shall be 12 millimetre diameter.

All welding shall be in accordance with CSA W59 "Welded Steel Construction." The company undertaking welding fabrication shall be certified in Division 1 or Division 2.1 of CSA W47.1 "Fusion Welding of Steel Company Certification."

The roadway part of the expansion joint shall be bent up 150 millimetres at a 45 degree angle into the curb, the neoprene seal shall extend 25 millimetres beyond the end of the joint.

Unless otherwise indicated, all joints shall be fitted with snowplow deflector plates. Snow plow deflectors shall be placed parallel to the center line of the roadway.

The steel shall be zinc metallized or hot dipped galvanized.

Zinc metalizing shall be in accordance with CSA G189 "Sprayed Metal Coatings for Atmospheric Corrosion Protection" providing a minimum metallized coating of 200 $\mu$ m.

Hot dip galvanizing shall be in accordance with the most recent edition of CSA G164 "Hot Dip Galvanizing of Irregularly Shaped Articles" providing a minimal galvanized coating thickness of 200µm.

The neoprene seal shall be continuous. If the seal is cut over the installation length, it shall be rejected, removed, and replaced at the Contractor's expense. No schedule extensions shall be given for this reason.

### **913.03.03 Transportation and Storage**

The joint assembly shall be shipped with the preset dimensions of 50 millimetres for 10 degrees Celsius unless otherwise indicated on the drawings. Care shall be taken in the shipping to prevent bending, warping or other damage.

The joint assembly shall be stored such that it is protected from rusting, dirt and distortion.

### **913.03.04 Installation of Strip Seal Expansion Joint Systems in New Construction**

#### **913.03.04.01 General**

The Contractor shall provide a technician, accepted by the Owner's Representative, familiar with the expansion joint assembly being installed, to supervise all works involved with its installation.

Before the placement of the expansion joint assembly, all deck concrete shall have been placed and cured for a minimum period of 3 days with enough area for the proper placement of the expansion joint assembly "boxed-out" as per detail on contract drawings.

Seals shall be continuous over their installation length. No cutting of the seal shall be permitted, except for trimming of excess length at the ends. If the seal is cut over the installation length, it shall be rejected, removed, and replaced at the Contractor's expense. No schedule extensions shall be given for this reason.

The expansion joint installation sequence is outlined as follows:

- a. Install steel expansion joint assembly. Adjustment for the prevailing temperature shall be made and clamps re-tightened.
- b. Erect form work, prepare concrete surfaces, place expansion joint and dam concrete; this concrete is to be cast separately from the deck concrete. Clamps shall be removed shortly after the concrete has set.

- c. Remove form work, polystyrene and debris, request inspection and approval to install seal from the Owner's Representative. The use of heat, fire, gasoline or the application of corrosive chemicals is not an acceptable means of polystyrene removal.
- d. Install the seal in the expansion joint.

Concrete the same as that specified for "Superstructure Concrete" in accordance with Section 904, shall be placed around the expansion joint in the previously boxed-out area with great care being taken during consolidation that no voids are left under the steel components.

The joint assembly shall be placed precisely as called for in the drawings and such that it will remain true to elevation and grade and remain firm after the concrete has hardened. Deviation from the grade or elevation shall be cause for rejection. Rejection would mean the complete removal of the expansion joint assembly and its subsequent replacement.

After the concrete has hardened, the exposed face of the seal and structural steel shapes shall be cleaned of deleterious material. Bleeder holes and bolt holes shall be cleaned and filled with an accepted epoxy grout and any scratches in the metallizing shall be touched-up with zinc rich touch-up paint.

### **913.03.05 Installation of Strip Seal Expansion Joint Systems in Rehabilitation Projects**

#### **913.03.05.01 General**

Where existing expansion joints on the structure(s) are to be replaced by a new strip seal expansion joint system, the expansion joint system shall be in accordance with Section 913.03.

For rehabilitation projects, areas of the deck adjacent to the expansion joints may have an undetermined degree of deterioration and it may be necessary to remove sections of the deck and backwall to accommodate the new joint system. All existing reinforcing steel in the deck and backwall is to remain intact.

All concrete to asphalt joints must be sawcut and a space provided and filled with an accepted sealant, as described on the drawings.

It will be the Contractor's responsibility to ensure that exact dimensions of the replacement joint are correct.

All deck repairs adjacent to joints and overlays must be complete prior to the installation of concrete in expansion joint dams and asphaltic plug joints.

#### **913.03.05.02 Removal of Existing Joint**

The work shall entail the removal of concrete, existing sealants and joint fillers, and water stops. The work shall be performed as detailed on the drawings. All existing formwork remaining from the original construction along with any accumulated debris on the beam seats shall be removed and disposed of to the Owner's Representative's satisfaction.

Concrete shall be removed to 300mm each side of the joint in plan view and removal shall be to a depth of 200mm in the deck and 300mm in the backwall, unless otherwise indicated on the contract drawings. If concrete is to be removed by jackhammer, the maximum hammer mass permitted is 13 kg. All tools used in concrete removal should be pointed. Existing reinforcing steel in the deck or backwall is not to be cut.

If any reinforcing steel is found to be exposed, the concrete shall be removed to a clear distance of 25mm below the underside of the reinforcement.

If any concrete is required to be removed around reinforcing steel, then the maximum hammer size permitted shall be 7 kg. The Contractor shall take care not to damage any existing steel reinforcing. Reinforcing that is damaged shall be replaced by dowelling into the existing member at the Contractor's own cost.

Existing reinforcement with a cross-sectional area that is corroded more than 10% of its original cross section shall be replaced. The Contractor shall supply and install new steel reinforcement to match the original diameter, new bars shall be spliced with the original reinforcement or dowelled into the existing member. The Owner's Representative may specify additional reinforcement in the field to ensure the expansion joint concrete is adequately tied into the existing deck.

#### **913.03.05.03 Surface Preparation**

At the edge of areas to be repaired, a neat line shall be saw cut a minimum of 30mm to preclude feather edges.

Prior to restoration of these areas, the concrete substrate and all exposed reinforcing steel shall be satisfactorily blast cleaned and painted in accordance with Section 919.06 and 919.07 until the steel is free of all rust and all loose particles of concrete. Remaining blasting medium shall be removed with oil-free jets of compressed air or water producing a minimum pressure of 6 MPa. If the substrate is wet at the time of cleaning, then it shall

be cleaned with high pressure jets of water. A pressure gauge shall be installed in the water or air lines in order to verify the specified pressure.

The deck and backwall shall then be restored as per the drawings. However, no concrete shall be placed until the prepared surface to be restored is inspected and approval in writing is given by the Owner's Representative.

Concrete substrate shall be kept damp for a minimum of 24 hours prior to placement of concrete.

Contractor shall provide and apply a bonding agent, SikaTop Armatec-110 EpoCem manufactured by Sika or an accepted equivalent, prior to pouring concrete. Bonding agents shall be applied in accordance with the manufacturer's instructions.

#### **913.03.05.04 Supply And Placement Of Concrete**

The joint assembly shall be placed precisely as called for in the drawings and such that it will remain true to elevation and grade and remain firm after the concrete has hardened. Deviation from the grade or elevation shall be cause for rejection. Rejection would mean the complete removal of the expansion joint assembly and its subsequent replacement.

All aspects of concrete supply and placement are subject to approval of the Owner's Representative. High range water reducing agents (superplasticizers) may be used at the Contractor's request if so indicated when the mix design is submitted. The Contractor must demonstrate competence and experience in their use and specific approval must be obtained.

Concrete shall meet the requirements of "Superstructure Concrete" specified in Section 904.

If superplasticizers are used, the maximum slump permitted will be 90 mm.

#### **913.03.05.05 Finishing**

Concrete must be finished immediately after strike off before the appearance of bleed water using a magnesium float. All concrete must be broom finished. The surface shall not be overworked. The Contractor shall supply a 3 m straight edge and the surface shall not deviate from the design grade by more than 8 mm.

### **913.03.05.06 Curing**

Immediately after the concrete has been placed and finished, the Contractor shall apply the evaporation retardant “MasterKure ER 50” manufactured by Master Builders Company Ltd, SikaFilm manufactured by Sika, or an accepted equivalent. The product shall be applied as per manufacturer's instructions and recommendations.

All aspects of curing shall be in accordance with Section 904.05.

After the concrete has hardened, the exposed face of the seal and structural steel shapes shall be cleaned of deleterious material. Bleeder holes and bolt holes shall be cleaned and filled with an accepted epoxy grout and any scratches in the metallizing shall be touched-up with zinc rich touch-up paint.

### **913.03.06 Removal and Replacement of Expansion Joint Seal**

For rehabilitation projects that only require the removal and replacement of the Neoprene Seal, the existing seal shall be removed and debris removed from the gap. The steel assembly shall be painted with a zinc-rich paint as per Section 919 before the new seal is installed.

Seals shall be continuous over their installation length. No cutting of the seal shall be permitted, except for trimming of excess length at the ends. If the seal is cut over the installation length, it shall be rejected, removed, and replaced at the Contractor's expense. No schedule extensions shall be given for this reason.

Lubricant as specified in Section 913.03.01.02 shall be used to install the seal.

## **913.04 ASPHALT PLUG EXPANSION JOINTS**

### **913.04.01 Materials**

#### **913.04.01.01 Binder and Aggregate Plug**

Binder and aggregate plug shall be WABO Expandex, Prismo Thormajoint, or an accepted equal.

All components of the joint system shall be accepted, in writing, by the manufacturer of the binder and aggregate plug.

### **913.04.01.02 Steel**

The steel grade shall be 300W and galvanized in accordance with Section 913.03.02 unless otherwise noted on the contract drawings.

New steel shall be provided for all Asphalt Plug Expansion Joints unless otherwise indicated on the drawings.

### **913.04.01.03 Concrete Backers**

When concrete backers are specified in the contract documents the concrete shall meet the requirements of "Superstructure Concrete" in Section 904 and the reinforcing steel shall meet the requirements of the steel type specified in Section 905.

### **913.04.02 Installation**

Installation shall be as per manufacturer's instructions.

Asphalt or concrete adjacent to the plug joint shall be sawcut the full depth of the plug to ensure a clean joint.

For rehabilitation of existing asphalt plug joints, all components of the existing plug joint and any debris shall be removed from the joint prior to the new plug joint being installed.

For rehabilitation projects, areas of the deck adjacent to the expansion joints may have an undetermined degree of deterioration and it may be necessary to remove sections of the deck and backwall and reconstruct before installation of the plug joint. Any repairs to these areas shall be in accordance with Section 919.

## **913.05 TESTING**

All expansion joints are to be tested once installation is complete, by the following method in the presence of the Owner's Representative:

The area around the expansion joint shall be enclosed with sand bags, or an approved similar watertight method, to ensure that a minimum of 100mm of water is held over the full width of the joint. Water shall be left for a minimum of 1 hour. Both underneath the joint and the water level shall be monitored to ensure that no water is leaking through the joint. For bridge rehabilitations where the joint is constructed in two parts, the test shall overlap the connection area a minimum of 200mm.

Any joints that are showing any water leakage shall either be repaired or replaced at the Contractor's own cost to the Owner's Representative's satisfaction.

## **913.06 MEASUREMENT FOR PAYMENT**

### **913.06.01 Supply and Install Expansion Joints**

Measurement for payment will be made for each expansion joint assembly installed and accepted by the Owner's Representative. The assembly shall include the preparation of the expansion joint block-out, expansion joint, neoprene seal, all related components within the boxed-out area or zone, drainage, concrete, and reinforcing steel.

Materials to protect the seal, fill gaps, and accommodate movement in the deck, curbs, sidewalks, and barriers are also included as part of the expansion joint. This includes, but is not limited to, sealants, backer rods, caulking, foams, and metal plates used to accommodate movement in the deck, curbs, and barriers.

### **913.06.02 Remove and Replace Expansion Joint Seal**

Measurement for payment will be made for each expansion joint seal removed and installed in the works and accepted by the Owner's Representative.

Materials to protect the seal, fill gaps, and accommodate movement in the deck, curbs, sidewalks, and barriers are also included as part of the expansion joint. This includes, but is not limited to, sealants, backer rods, caulking, foams, and metal plates used to accommodate movement in the deck, curbs, and barriers.

### **913.06.03 Supply and Install Asphalt Plug Expansion Joint**

Measurement for payment will be made for each expansion joint assembly installed and accepted by the Owner's Representative.

Asphalt plug joint thickness shall match the adjoining asphalt or as indicated on the contract drawings or as directed by the Owner's Representative. No additional payment will be made for plug joint thicknesses up to 100 millimetres. For plug joints which exceed 100 millimetres in thickness, the payment shall be prorated for the amount exceeding 100 millimetres.

Materials to protect the asphalt plug, fill gaps, and accommodate movement in the deck, curbs, sidewalks, and barriers are also included as part of the expansion joint. This includes, but is not limited to, sealants, backer rods, caulking, foams, and metal plates used to accommodate movement in the deck, curbs, and barriers.

## 913.07 BASIS OF PAYMENT

### 913.07.01 Supply and Install Strip Seal Expansion Joint System

Payment at the contract price for "Supply and Install Strip Seal Expansion Joint" in the Unit Price Table shall be full compensation for all labour, equipment, materials, plant and services required for the design, supply, fabrication, transportation to the job site, storage, handling, satisfactory preparation and installation for the expansion joint assembly of the type as indicated on the contract drawings.

The supply and application of all metal plates, drainage components, lubricants, grouts, sealants, galvanizing compound, epoxy, styrofoam, evafoam, or accepted equal, adhesive, caulking, bonding agents, evaporation retarder, and backer rods shall be incidental to the work and payment will not be made for such.

Concrete and steel reinforcement in the expansion joint block out shall be incidental to the cost of the expansion joint assembly.

The removal of all polystyrene, form work, and debris between the back face of the deck and the front face of the stem shall be incidental to the works.

For rehabilitation projects, the cost of demolition, disposal, and preparation of the expansion joint block out for the replacement expansion joint shall be incidental to the works.

Payment for repairs to the adjacent concrete deck outside of the expansion joint block out shall be as per Section 919. Additional reinforcing or reinforcing to replace existing corroded reinforcement in the deck or backwall shall be paid as per Section 905.

Concrete which does not meet the specified compressive strengths shall be rejected or penalized as per Section 913.06.03.

### 913.07.02 Remove and Replace Expansion Joint Seal

Payment at the contract price for "Remove and Replace Expansion Joint Seal" in the Unit Price Table shall be full compensation for all labour, equipment, materials, plant and services required for the design, supply, fabrication, transportation to the job site, storage, handling, satisfactory preparation and installation for the expansion joint seal of the type as indicated on the contract drawings.

Application of zinc-rich paint to the expansion joint steel shall be incidental to the work.

If joint seals specified in the contract are ordered and delivered to site but not used, they shall be paid at invoice price only. Unused seals shall be delivered to a Department of Transportation and Infrastructure depot as directed by the Owner's Representative.

### **913.07.03 Concrete Rejection and Penalties**

Expansion joints constructed where the average tested 28 day strength of the concrete in the expansion joint dam is less than the specified strength but otherwise meets the specifications will be accepted at a reduced payment provided the difference between the specified strength and the average tested 28 day strength is no greater than 5 MPa. If the difference is greater than 5 MPa than the expansion joint shall be rejected. The Contractor shall remove the expansion joint dam and re-pour the concrete.

When concrete is rejected, those provisions outlined in CSA A23.1 "Concrete Materials and Methods of Concrete Construction" shall be followed to determine whether or not the concrete may remain in the work. Such work shall be done at the Contractor's expense. Notwithstanding the above, should the concrete remain in the work it shall be subject to a reduction as outlined below, for having a strength less than that specified.

If the concrete in any portion of the expansion joint is found to have a strength deficiency of less than 5 MPa than the lump sum bid price for the expansion joint will be adjusted in accordance with the following:

$$\text{ALSP} = \text{BLSP} * (\text{SS} / \text{TS}) * (\text{LJDC} / \text{LJ})$$

where:

ALSP = Adjusted Lump Sum Price for the Expansion Joint

BLSP = Bid Lump Sum Price per Expansion Joint

SS = Specified 28 day strength (MPa)

TS = Tested Average 28 day strength (MPa)

LJDC = Length of Joint with Deficient Concrete (m)

LJ = Length of Joint (m)

### **913.07.04 Supply and Install Asphalt Plug Expansion Joint**

Payment at the contract price for "Supply and Install Asphalt Plug Expansion Joint" in the Unit Price Table shall be full compensation for all labour, equipment, materials, plant and services required for the design, supply, fabrication, transportation to the job site, storage,

handling, satisfactory preparation and installation for the expansion joint as indicated on the contract drawings.

The supply and application of all metal plates, lubricants, grouts, sealants, galvanizing compound, epoxy, Styrofoam, evafoam, or accepted equal, adhesive, caulking, backer rods shall be incidental to the work and payment will not be made for such.

For rehabilitation projects, the cost of demolition, disposal, and preparation of the expansion joint block out for the replacement expansion joint shall be incidental to the works.

The cost of concrete and reinforcing steel for concrete backers shall be incidental to the works. This includes the costs of any demolition of asphalt, concrete, and steel to install the backers. Payment for the joints will be reduced as per section 913.07.03 for concrete where the average tested 28 day strength of the concrete in the expansion joint dam is less than the specified strength but otherwise meets the specifications, provided the difference between the specified strength and the average tested 28 day strength is no greater than 5 MPa, any concrete less than this will be rejected.

Payment for repairs to the underlying or adjacent concrete shall be as per Section 919 "Rehabilitation of Concrete Structures." Additional reinforcing or reinforcing to replace existing corroded reinforcement in the deck or backwall shall be paid as per Section 905.

Payment for repairs to the adjacent asphalt wearing surface shall be as per "Asphaltic Patching" in Section 332.10.2.