Master Specification
Part ST-BF-C2

Deck Expansion Joints

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Contents

Contents 3
ST-BF-C2 Deck Expansion Joints 4
1 General 4
2 Documentation 4
3 Materials 5
4 Joint installation 7
5 Warranty 9
6 Hold Points 9
7 Verification requirements and records 9

ST-BF-C2 Deck Expansion Joints

1 General

a) This Master Specification Part specifies the requirements for bridge deck expansion joints, including:

i) the documentation requirements, as set out in section 2;

ii) the material requirements, as set out in section 3;

iii) the joint installation requirements, as set out in section 4;

iv) the warranty requirements, as set out in section 5;

v) the Hold Point requirements, as set out in section 6; and

vi) the verification requirements and records, as set out in section 7.

b) This Master Specification Part applies to the following bridge deck expansion joints:

i) bonded metal-elastomer joints, comprising metal-reinforced elastomeric pad units rigidly attached to anchorages;

ii) elastomeric strip joints, comprising preformed elastomeric strips retained by metal seal anchorages;

iii) compression seal joints, comprising a preformed open-cell elastomeric compression seal with multiple webs, installed with an adhesive lubricant; and

iv) polymer nosing joints.

c) Bridge deck expansion joints must comply with the Reference Documents, including:

i) AS 1683.11 Methods of test for elastomers, Method 11: Tension testing of vulcanized or thermoplastic rubber;

ii) AS 1683.13 Methods of test for elastomers, Method 13: Compression set of vulcanized rubber under constant deflection;

iii) AS 1683.15.1 Methods of test for elastomers, Method 15.1: International rubber hardness;

iv) AS 1683.23 Methods of test for elastomers, Method 23: Rubber - Vulcanized - Determination of resistance to liquids;

v) AS 1683.24 Methods of test for rubber, Method 24: Determination of the resistance of vulcanized or thermoplastic rubbers to ozone cracking - Static strain test;

vi) AS 1683.26 Methods of test for elastomers, Method 26: Rubber, vulcanized or thermoplastic - Accelerated ageing and heat resistance tests;

vii) AS/NZS 3679.1 Structural steel, Part 1: Hot-rolled bars and sections;

viii) AS/NZS 4680 Hot-dip galvanized (zinc) coatings on fabricated ferrous articles; and

ix) AS/NZS ISO 9001 Quality management systems - Requirements.

2 Documentation

2.1 Construction Documentation

In addition to the requirements of PC-CN3 “Construction Management”, the Construction Documentation must include procedures and instructions for the installation of the deck expansion joint system, including (where applicable):

a) deck preparation, including blockout reinforcement, dimensions, and tolerances required, including details of how the Contractor will achieve a smooth ride across the installed joints;

b) anchor locations and pre-setting required to suit the bridge deck temperature at the time of joint installation;

c) preparation of the blockout base to ensure there is a true and even surface on which to bed the joint units;

d) methods of sealing joint units at kerbs, gutters, and horizontal directional changes in the bridge deck profile;

e) sequence of installation of the units;

f) method of achieving a watertight seal at the interfaces between the concrete blockout and the joint units;

g) method of joining adjacent joint units to ensure a watertight seal;

h) torque requirements for anchors and the method of sealing bolt hole cavities;

i) filling for the gap between the edges of the unit and the adjacent road surfaces;

j) time after completion of installation when traffic is allowed on the road; and

k) method for testing of the installed joint for watertightness and free draining (if water goes below the deck level, it is collected and completely drained away), and the effectiveness of draining.

2.2 Pre-installation Quality Management Records

a) In addition to the requirements of PC-QA1 “Quality Management Requirements” or PC-QA2 “Quality Management Requirements for Major Projects” (as applicable), the Quality Management Records must include either:

   i) test results of the elastomer used in the joint from a laboratory with appropriate NATA registration; or

   ii) evidence that the elastomer used in the joint has been manufactured under a third party certified quality system in accordance with AS/NZS ISO 9001 Quality management systems - Requirements, with test certificates for the properties required by Table ST-BF-C2 3-1 and from batches less than 6 months old.

b) The records required in section 2.2a) must be submitted at least 10 Business Days prior to the installation of the relevant joint and will constitute a **Hold Point**. Installation of the relevant deck expansion joint must not commence until the Hold Point has been released.

2.3 Quality Management Records

In addition to the requirements of PC-QA1 “Quality Management Requirements” or PC-QA2 “Quality Management Requirements for Major Projects” (as applicable), the Quality Management Records must include the verification records required by Table ST-BF-C2 7-1.

3 Materials

3.1 General

a) Subject to section 3.1b), the material used for bridge deck expansion joints must be either elastomer, aluminium, or steel.

b) Material other than steel or elastomer may only be used in the manufacture or installation of joints where accepted by the Principal as a Design Departure. As part of the Design Departure submission in accordance with PC-EDM1 “Design Management” the Contractor must provide certification from the manufacturer and include accompanying documentation to demonstrate its suitability for use.

3.2 Elastomer

a) The elastomeric material in the deck expansion joint must be uniform, homogeneous, and free of imperfections, surface splits or indentations.

b) The elastomeric components of the joint must:

i) be made from a vulcanized compound having polymerised chloroprene as the only base polymer; and

ii) comply with the requirements specified in Table ST-BF-C2 3-1 and Table ST-BF-C2 3-2.

Table ST-BF-C2 3-1 Elastomer material requirements for bonded metal-elastomer joints

Property	Test method	Acceptance limits
General		
Tensile strength	Dumb-bell test pieces, in accordance with AS 1683.11 Methods of test for elastomers, Method 11: Tension testing of vulcanized or thermoplastic rubber	12.0 MPa minimum
Elongation at break	Dumb-bell test pieces, in accordance with AS 1683.11 Methods of test for elastomers, Method 11: Tension testing of vulcanized or thermoplastic rubber	350% minimum
Hardness	AS 1683.15.1 Methods of test for elastomers, Method 15.1: International rubber hardness	IRHD 59 +5
Accelerated ageing		
Tensile strength change	a) Method A for 72 hours at 100°C, in accordance with AS 1683.26 Methods of test for elastomers, Method 26: Rubber, vulcanized or thermoplastic - Accelerated ageing and heat resistance tests; and b) Dumb-bell test pieces, in accordance with AS 1683.11 Methods of test for elastomers, Method 11: Tension testing of vulcanized or thermoplastic rubber.	-15% to +15%
Elongation at break change	Dumb-bell test pieces, in accordance with AS 1683.11 Methods of test for elastomers, Method 11: Tension testing of vulcanized or thermoplastic rubber	-40% to 0%
Hardness change	AS 1683.15.1 Methods of test for elastomers, Method 15.1: International rubber hardness	IRHD -15 to +15
Other		
Resistance to ozone	Ozone concentration 50 pphm in air, 20% strain, 72 hours at 40°C, in accordance with AS 1683.26 Methods of test for elastomers, Method 26: Rubber, vulcanized or thermoplastic - Accelerated ageing and heat resistance tests	No visible cracking
Change in volume in oil	Using oil no.3, after 72 hours at 100°C, in accordance with AS 1683.23 Methods of test for elastomers. Method 23: Rubber - Vulcanized - Determination of resistance to liquids	+30% maximum
Compression set	72 hours at 100°C, in accordance with AS 1683.13 Methods of test for elastomers, Method 13: Compression set of vulcanized rubber under constant deflection	40% maximum
Brittleness	At -30°C, in accordance with ASTM D746 Standard Test Method for the Fragility Temperature of Plastics and Elastomers on Impact	Not brittle

Table ST-BF-C2 3-2 Elastomer material requirements for bonded metal-elastomer joints and compression seal joints

Property	Test Method	Acceptance limits
General		
Tensile strength	Dumb-bell test pieces, in accordance with AS 1683.11 Methods of test for elastomers, Method 11: Tension testing of vulcanized or thermoplastic rubber	12.0 MPa minimum
Elongation at break	Dumb-bell test pieces, in accordance with AS 1683.11 Methods of test for elastomers, Method 11: Tension testing of vulcanized or thermoplastic rubber	250% minimum
Hardness	AS 1683.15.1 Methods of test for elastomers, Method 15.1: International rubber hardness	IRHD 59 ±5
Accelerated ageing		
Tensile strength change	a) Method A for 72 hours at 100°C, in accordance with AS 1683.26 Methods of test for elastomers, Method 26: Rubber, vulcanized or thermoplastic - Accelerated ageing and heat resistance tests; and b) Dumb-bell test pieces, in accordance with AS 1683.11 Methods of test for elastomers, Method 11: Tension testing of vulcanized or thermoplastic rubber.	-20% to 0%
Elongation at break change	Dumb-bell test pieces, in accordance with AS 1683.11 Methods of test for elastomers, Method 11: Tension testing of vulcanized or thermoplastic rubber	-20% to 0%
Hardness change	AS 1683.15.1 Methods of test for elastomers, Method 15.1: International rubber hardness	IRHD 0 to +10
Other		
Resistance to ozone	Ozone concentration 100 pphm in air, 20% strain, 72 hours at 40°C, in accordance with AS 1683.26 Methods of test for elastomers, Method 26: Rubber, vulcanized or thermoplastic - Accelerated ageing and heat resistance tests	No visible cracking
Change in volume in oil	Using oil no.3, after 72 hours at 100°C, in accordance with AS 1683.23 Methods of test for elastomers, Method 23: Rubber - Vulcanized - Determination of resistance to liquids	+70% maximum
Compression set	72 hours at 100°C, in accordance with AS 1683.13 Methods of test for elastomers, Method 13: Compression set of vulcanized rubber under constant deflection	40% maximum
Brittleness	At -30°C, in accordance with ASTM D746 Standard Test Method for the Fragility Temperature of Plastics and Elastomers on Impact	Not brittle
Low temperature stiffness (hardness change)	After 7 days at -10°C, in accordance with AS 1683.15.1 Methods of test for elastomers, Method 15.1: International rubber hardness	IRHD 0 to +15

3.3 Steel

a) Steel must be a minimum of Grade 250.

b) Anchors must be galvanized in accordance with AS/NZS 4680 Hot-dip galvanized (zinc) coatings on fabricated ferrous articles.

4 Joint installation

4.1 General

a) Deck expansion joints must:

i) be installed in accordance with the manufacturer’s specifications;

ii) make allowance for retaining the deck reinforcement and any embedments;

iii) not be installed until at least 3 days after all deck concreting in the adjacent spans or abutments is completed; and

iv) not have loads applied to them until they can carry loads without being damaged.

b) Where jointing is seated directly on concrete, any depressions, or high spots must be brought to the correct profile prior to installing the joint.

c) Compression seals or membranes must extend in one continuous length for the full width of the bridge.

d) The Contractor must ensure that an appropriately experienced and qualified technician, who is employed directly or nominated by the joint manufacturer and is not an employee of the Contractor, is present to oversee the installation of the deck expansion joint. The technician must provide certification that the joint has been installed in accordance with the manufacturer's specifications, as part of the Quality Management Records.

e) Prior to casting deck concrete, the Contractor must ensure that there is no conflict between the joint anchors and deck reinforcement, including any embedments.

f) For post-tensioned cast in place girders, fixing bolts for post-tensioned box girders and voided slabs must not be fixed in position until at least 4 weeks after deck stressing.

g) For bridges other than post-tensioned cast in place girders the levels of joints for post-tensioned box girders and voided slabs must be adjusted for any variation of design hog.

h) For all concrete bridges, concrete adjacent to the joint, and extending to or above the finished concrete surface, must be cast monolithically onto the underlying concrete.

i) After installation, joints and seals must be protected from any damage, including damage due to construction activities.

j) The upper surfaces of the joint must conform to the longitudinal grade and crossfalls of the completed deck surface with the top of the joint recessed 5 mm below the adjacent surface.

4.2 Installation temperature

a) Deck joints must be set in position with an appropriate gap adjusted to conform to the actual mean structure temperature at the time of installation.

b) Where the actual mean structure temperature at the time of installation cannot be determined, the installation temperature may be taken as the mean shade temperature at the underside of the deck or inside the cells of box girder bridges for:

i) the 2 consecutive days prior to joint installation in concrete structures; and

ii) the 1-day period prior to joint installation for steel and steel composite structures.

c) The Contractor must record and submit details of setting of the joint as part of the Quality Management Records, including installation date, temperature and setting dimension.

4.3 Tolerances

a) Joints must be installed within the tolerances in Table ST-BF-C2 4-1.

b) The Contractor must:

i) measure and record the tolerances included in Table ST-BF-C2 4-1 at 2 m intervals along the joints; and

ii) supply written verification that the requirements of this section 4.3 have been complied with as part of the Quality Management Records.

Table ST-BF-C2 4-1 Tolerance requirements

Property	Acceptance limit
Joint gap	±3 mm of specified gap
Deviation of joint from plan alignment	Less than 5 mm
Ride quality across the installed joints	Must achieve a smooth ride

5 Warranty

The Contractor must supply a written warranty in accordance with the process set out in PC-CN3 “Construction Management” for all deck expansion joints, that covers a minimum period of 5 years, and as a minimum covers the following:

a) workmanship;

b) serviceability (including water leaking through the joint);

c) materials for a minimum period of 5 years from the date of installation; and

d) the supply and installation of replacement joints.

6 Hold Points

Table ST-BF-C2 6-1 details the review period or notification period, and type (documentation or construction quality) for each Hold Point referred to in this Master Specification Part.

Table ST-BF-C2 6-1 Hold Points

Section reference	Hold Point	Documentation or construction quality	Review period or notification period
2.2b)	Submission of pre-installation Quality Management Records	Documentation	5 Business Days review

7 Verification requirements and records

The Contractor must supply written verification as part of the Quality Management Records that the requirements listed in Table ST-BF-C2 7-1 have been complied with.

Table ST-BF-C2 7-1 Verification requirements

Section reference	Subject	Record to be provided
4.1d)	Installation verification	Certification that the joint has been installed in accordance with the manufacturer’s instructions
4.2c)	Installation verification	Records of installation date, temperature and setting dimension
4.3b)ii)	Installation verification	Records of actual installation tolerances achieved, demonstrating that the requirements of section 4.3 have been met