DEPARTMENT *of* INFRASTRUCTURE, ENERGY *and* RESOURCES, TASMANIA

BRIDGEWORKS SPECIFICATION

B40 - EXPANSION JOINTS July 2004

Incorporates previous specifications B40, B41, B42 and MB35

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B40.1 SCOPE

This Specification sets out the requirements for the manufacture, installation and repair of bridge expansion joints.

B40.2 REFERENCES

The following standards are referenced in this Specification

A.S. 1554 Welding

A.S.5100.4 Australian Bridge Design Code *Bearings and deck joints*

ASTM D.395, 412, 545, 573, 1149 and 2628

B40.3 MATERIALS

B40.3.1 Fittings

Anchor bolts and bars shall conform to the requirements of the Bridge Design Code.

B40.3.2 Preformed Expansion Joint Filler

Preformed expansion joint filler for sealing expansion joints in the concrete shall consist of preformed strips that have been formed from clean granulated cork particles, securely bound together by a synthetic resin of an insoluble nature.

The material shall be supplied in a precompressed state so that it expands when it absorbs moisture, in order to provide a permanent watertight seal throughout the entire range of expansion and compression of the joint.

The expanded material shall be resilient and sufficiently dense to prevent the ingress of particles of grit and gravel under the action of traffic.

The preformed expansion filler shall be stored in a cool dry place.

B40.3.3 Elastomeric Seals

Preformed elastomeric joint seals of the open-cell compression type shall be made from an approved vulcanised compound using *rubber or* polymerised chloroprene as the base polymer. The seals shall possess the necessary compressibility and deformation properties to give the required range of movement nominated on the Drawings. All seals shall be extruded.

The material of each seal shall be completely uniform and homogeneous throughout. Any seal showing imperfections, surface splits, and indentations may be rejected.

B40.3.4 Physical Properties of Elastomer used for Seals

The elastomer used shall comply with the properties listed in Table B40.1 when tested in accordance with the specification stated:

Table B40.1 Elastomer Properties

Property	Test	Value
Minimum Tensile Strength	ASTM D.412	13.8 MPa
Minimum Elongation at Break	ASTM D.412	250%
Hardness	Type A Durometer	55 (Tolerance ± 5)
Maximum Permanent Set at Break	ASTM D.412	10%
Compression Set	ASTM D395-89 (70 hours @ 100°C)	40%
Ageing	ASTM D.573 (70 hours @ 100°C) accelerated ageing	Changes not to exceed
Tensile Strength		-30% to 0
Elongation at Break		-40% to 0
Hardness	Type A Durometer	0 to + 10
Low Temperature Stiffening	Type A Durometer	Change in hardness after 7 days @ - 10°C, 0 to + 15
Weight Change in Oil	ASTM Oil 3	after 70 hours @ 100°C; maximum weight change + 45%

*Resistance to Ozone: No cracking when tested to ASTM D.1149 (Ozone concentration 300 parts per million in air, -20% strain, -70 hours @ 40°C).

*(Specimens wiped with toluene before test to remove surface contamination).

B40.4 TESTS

B40.4.1 General

Testing of seals to verify compliance with the requirements of this Specification and the physical property tests on the elastomer used in the manufacture of the joints shall be performed, by a NATA or AALA registered laboratory, on specimens prepared by the manufacturer.

The manufacturer shall furnish the necessary set of specimens for physical property tests from the same batch of elastomer as used for each lot of joint delivered to Contractor. The cost of furnishing the specimens including any cutting and grinding shall be borne by the Contractor.

No extra payment will be made for such tests.

B40.4.2 Preformed Expansion Joint Filler

The properties enumerated below shall be determined by testing in accordance with "Standard Method of Testing Preformed Expansion Joint Fillers for Concrete", American Society for Testing and Materials, Designation D545-84, (ASTM D.545).

Each sample shall consist of sufficient material to provide at least 5 test specimens 115 mm x 115 mm.

B40.4.3 Physical Properties and Requirements

(i) Handling

Preformed strips of expansion joint filler shall be of such a character as not be deformed or broken by twisting, bending or other ordinary handling, when exposed to atmospheric conditions. Pieces of the joint filler that have been damaged shall be rejected.

(ii) Expansion

(For method of testing see sections 2 and 3 of ASTM D.545)

Test specimens, after being immersed in boiling water for one hour shall have a final thickness of not less than 140 percent of the thickness before test. Discolouration of the water shall not be considered an indication of failure.

(iii) Compression

(For method testing see section 4 of ASTM D.545)

The load required to compress a test specimen 115 mm long and 115 mm wide, with its edges unrestrained, by an amount equivalent to 50% of its thickness before test, shall be not less than 345 kPa nor more than 10.3 MPa. The load shall be applied without shock, and in such a manner that the specimen will be compressed at a rate of approximately 1 mm per minute.

(iv) Recovery

(For method of testing see section 4 of ASTM D.545)

A specimen shall recover to at least 90% of its thickness before test, within one hour of being compressed to 50% of its thickness before test, the load being released immediately.

(v) Extrusion

(For method of testing see section 5 of ASTM D.545)

The amount of extrusion of the free edge shall not exceed 6 mm when a test specimen 115 mm long and 115 mm wide, with three of its edges restrained, is compressed to 50% of its thickness before test.

(vi) Insolubility

(For method of testing see section 6 of ASTM D.545)

The specimen shall show no evidence of disintegration when immersed in hydrochloric acid (S.G. 1.18) and boiled for one hour. The test specimen shall be examined immediately after the end of the boiling period and shall be rejected if:

1. particles of cork have been dislodged,
2. the specimen lacks resiliency, is very friable and easily broken to pieces, or
3. the surface of the specimen appears porous, and particles of cork are dislodged by rubbing with the fingers.

(Particles of cork dislodged from edges cut during preparation of the samples should not be considered as constituting failure under this requirement.)

Discolouration, or a small amount of swelling shall not be grounds for rejection.

(vii) Weathering Test

A specimen shall show no disintegration when subject to the weathering test specified in Section 7 of ASTM D.545. De-lamination or separation of fibres shall be considered as disintegration.

Test specimens that have been subject to the weathering test shall be retested and shall meet the requirements of compression, recovery, and extrusion as specified above.

B40.4.4 Failure to Pass Test

Should the sample fail to satisfy any of the physical property tests specified, the strips represented by the sample shall be rejected.

B40.4.5 Test Samples of Elastomeric Compression Seals

For recovery tests at low and high temperatures, four test samples, 125 mm long, shall be supplied from every size of seal manufactured for the Contract or every batch of a particular size of seal manufactured at the same time. Each test sample shall be extruded with a stock length of seal and shall be cut from it. No separate payment will be made for the test samples.

B40.4.6 Sample Preparation

Test samples of compression joint seal for low temperature recovery tests shall be slightly dusted with talc on both the internal and outside surfaces to prevent adhesion between all internal surfaces and between the outside surface and the metal compression plates.

B40.4.7 Recovery Tests of Compression Joint Seal

Test samples for recovery properties shall be tested in accordance with ASTM D.2628, and the results must comply with the following requirements:

Minimum Recovery *after* 50% deflection;

High temperature recovery after 70 hours @ 100^{o}C:	85%
Low temperature recovery after *70* hours @ -10^{o}C:	88%

Two test samples shall be tested simultaneously for each recovery test and the recovery value will be the average result of the pair of samples, provided the lowest result does not exceed a tolerance of 0 to -3% of the minimum specified recovery.

If any test sample exhibits adhesion between any internal faces, or cracking in any walls after a recovery test, then the batch of seal represented by the sample will be rejected.

B40.4.8 Failure to Pass Test

Should the elastomer used in the manufacture of a seal fail to satisfy any of the physical property tests specified the seal and the batch of seals represented by such tests shall be rejected.

Should a seal fail to satisfy the test requirements for recovery at high and low temperatures as specified the seal and the batch of seal represented by such tests shall be rejected.

B40.4.9 Test Certificates

Prior to installation of the seals, copies of the test certificates shall be submitted to the Superintendent. The test certificate for the joint filler shall show the results of the physical property tests as specified. The test certificate for the elastomer shall show the elastomer properties as detailed in Table B40.1, the results of the recovery tests and note whether any faults have been observed.

B40.5 DIMENSIONS AND SHAPE OF SEALS

B40.5.1 Preformed Expansion Joint Filler

The strips of the preformed expansion joint filler shall conform to the dimensions shown on the Drawings within the permissible tolerances of -nil to + 1.5 mm in thickness, and $\pm$ 3 mm in depth. Strips shall be joined by 45 degree scarfed joints. The permissible tolerance of the overall length of the strips from that shown on the Drawings will be within a range of nil to + 6 mm.

Any material that does not conform to these tolerance dimensions shall be rejected.

B40.5.2 Elastomeric Seals

The overall compressed and relaxed dimensions, shape and suitable types of seals are shown on the Drawings.

The permissible tolerances are -nil to + 2 mm in relaxed width of seal and $\pm$ 3 mm in overall depth of seal.

The required profile of the seal to match the bridge cross section may be obtained either by removing portion of the seal and bending the seal to the required angle, or by joining straight lengths of seal by means of an adhesive approved by the manufacturer of the seal. All joining of seal lengths shall be performed in the factory, except that joining of seals at sharp changes in profile may be performed in the field subject to satisfactory procedures being set down in the Contract Management Plan.

B40.6 INSTALLATION

B40.6.1 Preformed Expansion Joint Filler

The preformed expansion filler shall not be placed in position until immediately prior to the pouring of the abutting concrete. If the two concrete surfaces of the joint are to be poured at different times, the preformed expansion joint filler shall not be placed in position until the second face is about to be poured.

Before the preformed expansion joint filler is placed in position, strip of masking tape shall be placed to seal the top edge of the filler.

Any concrete surface that the expansion joint filler is to be attached to shall have a smooth clean finish. The contact surfaces of the abutting concrete and the preformed expansion joint filler shall be covered with two applications of contact adhesive as recommended by the manufacturer of the filler. Concrete shall be poured, compacted and floated taking care not to damage or dislodge the filler strips.

Approximately four hours after finishing of the concrete, the masking tape on the top edge of the preformed expansion joint filler shall be removed. The preformed expansion joint filler shall be kept moist for four days after placing of the final concrete.

Where water sprays are not used for curing the concrete special provision shall be made for wetting the joint filler to ensure that its precompression is properly relaxed.

The joint type and manufacturer shall be included in the completion report.

B40.6.2 Elastomeric Compression Seals

The method of placing the seals shall be in accordance with the recommendation of the manufacturer.

The compression joint seal shall not be inserted into the deck openings until all deck concrete in adjacent spans or abutments is finished, except in the case of seals which are precompressed between permanent steel sections and the assembly fixed in position prior to placing the concrete.

Compression joint seals which are inserted into preformed deck openings shall be inserted with the aid of a lubricant-adhesive and, where necessary, with the aid of an insertion tool recommended by the manufacturer of the seals.

The joint type and manufacturer shall be included in the completion report.

B40.6.3 Requirements for Lubricant-Adhesive

The lubricant-adhesive used for inserting compression joint seals shall be a compound recommended by the manufacturer of the seals. The lubricant-adhesive shall have a suitable consistency at the temperature range nominated by the manufacturer for insertion of the seals into the structure; it shall be compatible with the seal and the concrete and shall be unaffected by moisture.

B40.6.4 Reinforced Elastomeric Seals

The Contractor shall supply all steel-reinforced elastomeric expansion joints including bolts, nuts, sealant, plugs and all other accessories for the effective installation of the jointing. The Contractor shall supply all reinforced elastomeric jointing including clipped washers, neoprene cavity plugs and sealant. Angle jointing sections for kerbs and parapets shall be supplied cut for a mitre joint to the height shown on the Drawings.

Prior to installation the jointing shall be inspected and all steel portions not completely enclosed in elastomer shall be coated with two field coats of zinc-rich epoxy coating by the Contractor.

Before the application of the coating, the area to be coated shall be cleaned to a bright metal surface.

Expansion joint material shall be handled with care and stored under cover by the Contractor to prevent damage. Any damage occurring after delivery shall be made good at the Contractor's expense.

Where jointing is seated directly in concrete any depressions shall be brought to the correct profile by filling with approved epoxy mortar and any high areas shall be corrected by grinding.

Areas to receive epoxy mortar shall be prepared in accordance with the manufacturer's recommendations.

Prior to construction of the bridge deck area adjacent to the joint, the supplier shall provide detailed working drawings showing the location of all bolts, recesses, and holes necessary for the installation of the joint. Reinforcing bars and steelwork cast into the deck or superstructure shall be amended as required to ensure that there will be no interference in the installation of the joint.

All bearing surfaces and recesses that are in contact with the joint assembly shall be checked with a straight edge to ensure flatness of profile to within 2 mm of its correct position.

The jointing shall be securely anchored by fixing bolts grouted in position by epoxy resin. No holes shall be drilled for fixing bolts within 7 days of concreting. Holes for the bolts shall be drilled to the size and depth shown on the Drawings. Prior to placing the epoxy resin the holes shall be prepared in accordance with the manufacturer's recommendation.

The fixing bolt shall be set accurately to fit the jointing. Epoxy resin shall be cured for a minimum of 24 hours before installation of the joint. Bolts that do not fit shall be removed and reset at the expense of the Contractor.

Sections of the jointing making the completed joint shall follow a straight line.

The fixing bolts shall not be placed into position until at least 4 weeks after stressing is completed in post-tensioned box or slab structures. Prior to placing sections of jointing, contact surfaces shall be cleaned to remove all grease, tar, paint, oil, mud or any other foreign material that may affect adhesion of the sealant. Sealant shall only be applied to dry contact surfaces. Sufficient sealant shall be applied to the contact surfaces to cause extrusion of sealant when the jointing is fixed in position.

The joint shall be installed strictly in accordance with the manufacturer's instructions.

The constructed gap for the overall width of the joint shall take into account residual shrinkage and creep.

The joint type and manufacturer and the recommended torque for the fixing bolts shall be included in the completion report.

The Contractor shall ensure that the designed bolt tension is maintained throughout the Defect Liability Period.

B40.7 ALTERNATIVE JOINTS

An alternative joint that offers the same level of service may be used provided:

(i) the joint complies with the requirements of this Specification.

(ii) any modification of the deck recess needed to accommodate the joint, from that shown in the Drawings, shall only be with the approval of the Superintendent and all materials and costs associated with such modification shall be met solely by the Contractor.

The Contractor shall submit the following information for each alternative joint type in writing for the Superintendent's acceptance at least one month prior to pouring the concrete adjacent to the joints:

(i) name of manufacturer

(ii) rated load and movement capacities

(iii) overall dimensions of the joint

(iv) dimensions of deck recess.

(v) aspects of variance from this specification and reason for, advantage of, variation.

B40.8 REQUIREMENTS FOR AN ALTERNATIVE JOINT

The expansion joint shall extend between the limits shown on the Drawings. The joint shall satisfy the following requirements.

(i) It shall withstand traffic loads and accommodate movements of the bridge deck due to temperature, creep and shrinkage and loading, and shall not give rise to unacceptable stresses in the joint or other parts of the bridge.

(ii) It shall have a good riding quality and the maximum width of open gap shall not exceed 70 mm. Any material in the joint not capable of sustaining a wheel load shall be neglected in determining the dimensions of the open gap.

(iii) The trafficked surface of the joint shall not contain a large area of steel that would constitute a skidding hazard.

(iv) The joint shall not generate excessive noise or vibration during the passage of traffic.

(v) Parts liable to wear shall be easily replaceable.

(vi) The joint shall seal the deck surface or have provision for carrying away water, silt and grit to prevent leakage onto the pier, and shall be self-cleansing.

(vii) The joint shall be supplied with a specially manufactured end to conform to the height and slope of the kerb face on the kerb of the bridge.

(viii) The joint shall be easy to inspect and maintain.

(ix) The joint shall be supplied complete with all fixing devices, sealants and adhesives necessary for its installation as approved by the supplier.

The joint shall be designed and installed so as to withstand the following loads:

(i) Vertical

Wheel loads as specified in the Bridge Design Code, including 30 percent impact shall be applied to the edge of the expansion gap, or in the case of a cantilever joint to the end of cantilever. It may be spread transversely over such a length as is justified by the continuity and rigidity of the joint to a maximum of 500 mm on either side of the centreline of the wheel.

(ii) Horizontal

A traffic force of 90 kN per metre length of joint acting on the joint at road level and parallel to the bridge centre-line combined with any forces that may result from the deformations of the joint filler, seal or elastomer.

The joint shall be designed and installed so as to accommodate the following movements:

(i) Longitudinal

The maximum contraction and expansion movements as specified on the Drawings.

(ii) Vertical

The joint shall be capable of accommodating a maximum relative vertical movement between the two sides of 3 mm.

B40.9 REPAIR AND REPLACEMENT

B40.9.1 Dimensions

The Contractor shall be responsible for verifying all joint dimensions on site prior to proceeding with the ordering of materials and execution of repair or replacement works.

Temperatures shall be recorded at the time of measurement and due allowance made for thermal expansion and differential temperature effects.

B40.9.2 Preparation

Sections of joints to be replaced shall be removed with the minimum amount of effort required to avoid damage to the structure.

Asphalt surfacing shall be cut with abrasive tools to provide a vertical surface.

Areas to be repaired shall be cleared with oil free compressed air, water or hand tools to removal all foreign matter.

B40.9.3 Concrete Repair

Where required, concrete repair shall be undertaken in accordance with Specification B15 - Concrete Repairs. Any curing compounds shall not affect the subsequent bond of other materials.

B40.9.4 Steel Repair

Welding for steel repair shall be in accordance with AS 1554.

B40.9.5 Joint Replacements ♦

The supply and installation of replacement joints shall be in accordance with this specification.

An approved sealant shall be applied to abutting sections of elastomeric joints to provide a continuous waterproof seal for the width of the deck.

Fixings shall generally be M16 chemical anchors, using a water-resistant resin. The supplier's minimum cure times shall be allowed before the *tensioning* of *bolts*.

The joint type and manufacturer and the recommended torque for the fixing bolts shall be included in the completion report.

Asphalt surfacing shall be reinstated so that the surface is slightly higher than the adjacent joint to avoid placing undue load on the joints.

Subject to prior approval by the Superintendent compression seals may be replaced by high movement silicone based sealant and nosings, if necessary, may be semiflexible polymer.

B40.10 PAYMENT

Payment shall include patterns, steel plates, testing, marking, handling, packing, delivery, storage traffic management and placing in their final position and no separate allowance shall be made for any of these.

All materials, tools and equipment supplied by the Contractor which do not form part of the completed works shall remain the property of the Contractor unless specified otherwise.

B40.10.1 Preformed Expansion Joint Filler

The rates in the Bill of Quantities for the supply and installation of expansion joint filler shall include full payment for providing labour, materials, tools, equipment and any other work incidental to the completion of the expansion joint filler and their subsequent installation as specified.

B40.10.2 Elastomeric Compression Seals

The rates in the Bill of Quantities for the supply and installation of compression joint seals shall include full payment for providing labour, materials, tools, equipment and any other work incidental to the completion of the compression joint seals and their subsequent installation as specified.

B40.10.3 Reinforced Elastomeric Seals

The rates in the Bill of Quantities for the supply and installation of expansion joint seals shall include full payment for providing labour, materials, tools, equipment and any other work incidental to the completion of the expansion joint seals and their subsequent installation as specified.

B40.10.4 Repair and Replacement

Payment for the repair and replacement of bridge joints shall be at the items listed in the Schedule of Rates.

Payment shall include the provision of all plans, labour and materials required for access, traffic management, preparation, supply and installation of replacement joints, maintenance of existing joints and the disposal of all waste and debris.

B40.11 HOLDPOINTS

The following holdpoints have been identified in this Specification

- Receipt of test certificates prior to installation. (B40.4.9)
- *Receipt of alternative joint details prior to installation* *(B40.7)*
- *Prior to use of high movement silicone sealant or polymer nosing* *(B40.9.5)*

B40.12 CONTRACT MANAGEMENT PLAN

The following details have been identified as relevant to the Contract Management Plan.

- Jointing procedure for seals. (B40.6.2)
- Details, as listed, for any alternative joints. (B40.8)