Guidance for Verifying Contract Compliance for Sealed Joints

Included in this attachment is general information and details to assist field engineers in verifying contract compliance for joint seals.

1 - General

All deck expansion joints and joint seals, except for special cases, will be specified by seal type and movement range (MR). The success or failure of joint seals will depend greatly on the enforcement of the *Contract Specifications*. Questions concerning joint seals will be handled in normal channels through the Structure Construction (SC) Office.

It is the Structure Representative's (SR) responsibility to:

1. Determine the proper groove width or installation width for the joint seal used, and to complete sections specified ″To be filled in by SR″ on Form DSD-D-0129, *Joint Movement Calculations*.
2. Install movement recording scribes on all expansion joints.

2 - Special Details

Check details such as water stop, formed joint openings, hinge restrainers, rollers or rockers, conduits, etc., for proper setting and movement capacity. All components in an expansion joint must be capable of withstanding more than the anticipated movement for the joint. In accordance with *Contract Specifications*, Section 5-1.36, *Control of Work – Property and Facility Preservation*, care should be taken so that existing utilities and encroachments spanning joints are not damaged by the cleaning operations.

3 - Saw Cutting

3.1 Type B Seals

In new construction, Type B seals are to be saw cut as follows:

Form DSD-D-0129, *Joint Movements Calculations* which includes saw cut information, is a form initiated by Bridge Design and included in the Resident Engineer (RE) Pending File. Figure 1 is an example of a completed Form DSD-D-0129, *Joint Movements Calculations*.

Saw cutting must not be started until the Type B seal material has been verified as having successfully been tested by the Materials Engineering and Testing Services (METS). The Contractor/subcontractor provides information to the SR regarding the manufacturer, lot number, date of manufacture and MR of the joint seal intended to be used prior to bringing the seal to the job site. The SR will verify the successful testing by contacting METS Representative (METS Rep) and to obtain the W_1 and W_2 values for the lot of seal that will be used by the Contractor. The MR ($W_1 - W_2$) of the Type B seal must be equal to or greater than that shown on the project plans.

When contacting METS for W_1 and W_2 information, the SR (caller) should have the following information readily available:

- Manufacturer of the Type B Seal
- Lot number shown on the side of the Type B seal
- Date of manufacture
- MR for the seal

If requested, a copy of the METS test report for the Type B seal can be sent to the SR. It is important to note that the Type B joint seal should arrive at the jobsite with the lot number provided by METS.

The minimum saw cut (groove) depth is to be checked by cutting, a 1/2 inch to 1 inch section of the actual seal to be used and placing it between two flat surfaces, such as 1″ x 4″ x 8″. Place the top of the seal to the dimensions shown on the contract *Standard Plans* and compress it to the W_2 position. At this position determine the saw cut depth required per the *Standard Plans,* B6-21.

When saw cutting begins, determine the groove or saw cut width as described on the joint movement calculation sheet shown in the example in Attachment 1, *Calculation of Points of No Movement*, of Memo to Designers 7-10, *Bridge Deck Joints and Deck Joint Seals*. Mark and check the initial saw cut so that it can be used later to check the tolerance of the completed joint. This is very important because the joints are usually moving while the saw cutting is in operation. It is the Contractor's responsibility to adjust the cut accordingly to match the initial saw cut width and maintain the tolerances specified for the completed joint.

In new construction projects joint geometry is readily controllable, i.e., the size of the saw cut is set to accommodate the joint seal. Rehabilitation projects differ from new construction projects in that the width and condition of the joints require special consideration. The new joint seal must provide the required MR and must be of sufficient size to fit the existing joint after saw cutting.

Rehabilitation projects require that the MR be indicated on the project plans. To ensure a correct fit, the W_1 of the joint seal must be greater than the minimum W_1 of the joint.

The *Special Provisions* require that the joint size be verified prior to ordering the seals. A joint should be remeasured only after that joint and its adjacent joints have been cleaned. Record the concrete temperature at the time of measurement.

Calculate the minimum W_1 required for the joints, using the actual measurements in the following formula:

$$\text{Min } W_1 = W_e + 1/2 + \frac{(T_{str}) - T_{min}}{(1)} \ (2) \ \frac{(4)}{(100)}$$

Where:

Min W_1	=	Maximum joint width in inches
W_e	=	Existing joint width in inches (measured at the widest point)
1/2	=	Minimum practical concrete removal (1/4 inch each side of the joint)
T_{str}	=	Structure temperature, deg F (measured at the time the existing joint width was measured, W_e)
T_{min}	=	Minimum temperature at structure site – from form DSD- D-0129
(1)	=	Temperature range at structure site - from form DSD- D-0129
(2)	=	Thermal movement in inches/100 feet - from form DSD- D-0129
(4)	=	Contributary length in feet - from form DSD- D-0129

If a calculated W_1 exceeds 4.25 inches, a compression seal should not be used. Contact the Designer for a recommended course of action to follow.

Again, saw cutting should not start until test data for the seal to be used is available. Saw cut widths should be set to provide the minimum joint width possible. Due to the variables involved, saw cut widths should be calculated using the formulas given below and the narrower width chosen, provided it will work.

$$S_1 = W_1 - \frac{(T_{str} - T_{min})}{1} (2) \ \frac{(4)}{100}$$

$$S_2 = W_2 + \frac{(T_{max} - T_{str})}{1} \ (2) \ \frac{(4)}{100}$$

$S_3 = W_e + 1/2 =$ Minimum practical saw cut width

Where:

$S_1, S_2, S_3,$	= possible saw cut widths
W_l	= W_1 taken from METS Structural Materials Testing Laboratory Test Report
W_2	= W_2 taken from METS Structural Materials Testing Laboratory Test Report
W_e	= Existing joint width in inches (measured at widest point)
1/2	= minimum practical concrete removal (1/4 inch each side of joint)
T_{str}	= Structure temperature, deg F (taken at the time of measurement of W_e)
T_{min}	= Minimum temperature at structure site - from Form DSD- D-0129
1	= Temperature range at structure site - from Form DSD- D-0129
2	= Thermal movement in inches/100 feet - from Form DSD- D-0129
4	= Contributary length in feet - from Form DSD- D-0129

4 - Installation

4.1 Type A Seals

Type A (modified) seals require placing the joint seal and rod stock 3 inches up into the curb or rail on the low side of the deck at the curb or rail joint that lines up with the deck joint. Also, it is essential that the polyethylene foam be placed at a uniform depth to preclude excessively thin or thick sections. Cut templates out of plywood to check the surface depths of the polyethylene foam.

4.2 Type B Seals

Table 1 gives the properties for some brands of Type B seals.

Repair all spalls and grind chamfer in advance of installing the seal.

As a final check, prior to installation, it is recommended to use a thin section of joint seal material to check the saw cut depth throughout the length of joint. Place the seal section in the planned position and check to see that the dimensions shown on the *Standard Plans* are maintained. Most joint seal failures result from improper saw cuts or from the seal being placed too near the deck surface.

Bend Type B seals 6 inches up into the curb or barrier rail on the low side of the deck as illustrated in Standard Plans, B6-21. If the curb or rail joints don't line up with the deck joint, an attempt must be made to abut the joint seal to the face of the curb or rail so that it will provide a watertight seal.

4.3 Joint Seal Assemblies

Details of a joint seal assembly are shown on the project plans. The SR is responsible to calculate the installation width of the joint seal assembly. Calculations are to be shown on Form DSD-D0129, *Joint Movements Calculations,* using a W_2 equal to 1/2 inch minimum at maximum temperature.

The *Special Provisions* permit alternate joint seal assemblies which the Contractor may use in lieu of the joint seal assembly detailed on the project plans.

If the Contractor proposes to use an alternate joint seal assembly, the SR shall send two copies of the initially submitted working drawings to the Bridge Design Structure Project Engineer for a determination as to the adequacy of the proposed alternate joint seal assembly.

If an alternate joint seal assembly is incorporated in the project work, the SR should make the necessary changes on the as-built project plans to indicate the details of the alternate joint seal assembly. An additional sheet may be necessary to show the as-built details. Do not submit the shop drawings as as-built project plans.

Note that prestressed concrete structures are expected to initially shorten about 0.50 in./100 ft. due to stressing. The total long-term shortening is anticipated to be 1.00 in /100 ft. for post-tensioned bridges and somewhat less for pretensioned bridges. The difference between the long-term shortening (1.00 in.) and the initial shortening is equal to 0.5 in./100 ft. This is the value shown on Form DSD-D-0129, *Joint Movements Calculations*, as "Anticipated Shortening for Post Tensioned Concrete Structures". For unusual situations when a substantial amount of time has elapsed between stressing and the placement of joint seals, an estimate may be made of the amount of prestress shortening that has actually occurred. For additional information refer to Attachment 1, *Prestress Shortening*, of Memo to Designers 7-1, *Bridge Bearings*.

4.4 Modular Joint Seal Assemblies (MR over 4 inches)

Refer to the *Special Provisions* for details concerning the installation of modular joint seal assemblies. Any questions can be directed to the area SC Bridge Construction

Engineer (BCE) or the Division of Engineering Services (DES) Joint and Bearings Technical Specialist.

4.5 Open Joint and Experimental Test Seals

Obtain the necessary brochures on installation procedures from the area SC BCE or DES Joint and Bearings Technical Specialist, if they are not included in the RE Pending File.

The proper installation width of open joints or experimental joint seals will be calculated on Form DSD-D-0129, *Joint Movements Calculations*. Determine the minimum width at maximum temperature (W_2) and insert this in Column 5. The adjustment of the width for temperature at time of installation will be the same as for the Type B seal.

5 - Expansion Joint Scribes

Scribes are to be placed at all expansion joints as shown on the instruction sheet in Figure 2. Placement of the scribes at a location other than that shown may be required when special barrier rails are used. Use the 8 inch steel railing scribe, 3/4″ x 8″ 24 gauge and 4″ aluminum scribe plate, 1-1/2″ x 4″ 16 gauge (Item No. 6635 1790 8) for joints having a MR of 2″ or less. Use the 10″ steel railing scribe, 3/4″ x 10″ 24 gauge and 6″ aluminum scribe plate, 1-1/2″ x 6″ 16 gauge (6) for joints having a MR greater than 2″. Use rapid set epoxy to attach the scribes and plates to the rail. Scribes, plates, and epoxy should be obtained from the District through the RE. Order one scribe per expansion joint and epoxy at the rate of 1 unit (1/4 pint can of ″A″ and 1/4 pint can of ″B″) per 20 scribe units. Skewed or extra wide structures may require a scribe unit on the joint on both sides of the structure.

Table 1. Approximate Properties for Preformed Elastomeric Type B Joint Seals (See Note 1)

Catalog Number Depth (See Note 2)	Uncompressed W_0 (See Note 4)	Uncompressed D_0 (See Note 4)	Approx. MR (See Note 3)	W_1 Max. Groove Width	W_2 Min. Groove Width	Recommended Saw Cut Depth
Brown H-2503	2.5″	2.625″	1″	2.13″	1.13″	4.0″
Brown H-3000	3.0″	3.25″	1″	2.55″	1.55″	5.0″
Brown H-3500	3.5″	3.75″	1.5″	2.98″	1.48″	5.85″
Brown H-4000	4.0″	4.25″	1.5″	3.40″	1.90″	6.0″
Brown H-5000	5.0″	5.00″	2″	4.25″	2.25″	7.75″
Brown H-6000	6.0″	5.5″	2.5″	5.10″	2.60″	9.25″
Watson Bowman WA-250	2.5″	2.75″	1″	2.13″	1.13″	3.56″
Watson Bowman WA-300	3.0″	3.38″	1″	2.55″	1.55″	4.31″
Watson Bowman WA-350	3.5″	3.5″	1″	2.98″	1.98″	4.44″
Watson Bowman WA-400	4.0″	4.38″	1.5″	3.40″	1.90″	5.00″
Watson Bowman WA-500	5.0″	5.0″	2″	4.25″	2.25″	5.94″
Watson Bowman WA-600	6.0″	6.0″	2.5″	5.10″	2.60″	7.75″

Notes:

1. The manufacturer's nominal properties in Table 1 are for design data only. These properties cannot be used in lieu of actual test results. Table 1 is included for additional information only. Actual values for W_1, W_2, and the MR are obtained from test results performed by the METS Laboratory on the Structural Materials Testing Laboratory Test Report.
2. Brand names other than those listed may be available.
3. The actual MR equals (W_1–W_2). W_1 shall be the smaller of the values determined as follows:
    a. 0.85 times the manufacturer's designated minimum uncompressed width of the seal (W_0).
    b. The width of seal on the third successive test cycle of the pressure-deflection test, when compressed to an average pressure of 3.0 pounds per square inch.

W_2 shall be the width of seal determined on the third successive test cycle of the pressure-deflection test, when compressed to an average pressure of 4 times the pressure measured at the seal width W_1.

4. Data shown may change significantly due to variations in extrusions. Dimensions must be verified in the field.

STATE OF CALIFORNIA • DEPARTMENT OF TRANSPORTATION

JOINT MOVEMENTS CALCULATIONS [a]

DSD-D-0129 (REV. 5/93)

EA	DISTRICT	COUNTY	ROUTE	PM	BRIDGE NAME AND NUMBER
07-000000	07	LA	5	0.2/2.4	Example Bridge O.C. 29-000

TYPE STRUCTURE	TYPE ABUTMENT	TYPE EXPANSION (2' elasto pads, etc.)
Reinf. Conc. Box & CIPP/S	A1- 70T Piles / A7 - Spd. Ftg	Bent 3 - Steel Hangers Bent 5 - 2 1/2" Pads

① TEMPERATURE EXTREMES (from Preliminary Report)			② THERMAL MOVEMENT (inches/100 feet)		ANTICIPATED SHORTENING (inches/100 feet)	③ MOVEMENT FACTOR (inches/100 feet)
Maximum 110 °F	Steel	Range ( ) °F) (0.0000065 x 1,200)	= .	+	0.00	= .
- Minimum 23 °F	Concrete (Conventional)	Range (87 °F) (0.0000060 x 1,200)	= 0 . 55	+	0.06	= 0 . 61
	Concrete (Pretensioned)	Range ( ) °F) (0.0000060 x 1,200)	= .	+	0.12[g]	= .
=Range 87 °F	Concrete (Post Tensioned)	Range (87 °F) (0.0000060 x 1,200)	= 0 . 55	+	0.63[g]	= 1 . 18

ITEM ① DESIGNER	DATE	ITEM ② CHECKED BY	DATE
John S Designer	1-1-20	Jane S Designer	1/10/20

To be filled in by Office of Structures Design [b]

To be filled in by SR [c]: James O Representative Date: 6/1/20

Location	Skew (degrees) Do not use in calculation	④ Contributing Length (feet)	Calculated Movement (inches) ③x④/ 100	M.R. (inches) (Round up to 1/2")	Seal Type A, B (Others) or Open Joint	Seal Width Limits[d] Catalog Number	W_1 (inches) Maximum	⑤ W_2 (inches) Min. @ Max. Temperature	Groove (saw cut) Width or Installation Width[e] Structure Temperature (°F) [f]	⑤ Adjust from Maximum Temp. (inches) Δ^c / ① × ② × ④ / 100	Width at Temp. Listed (inches) w = ⑤+⑥
Abut. 1 (Conv.)	0	64	0.39	1/2	A	PRC 3105					1.50
Span 3 Hinge (Conv.)	0	166	1.01								
Span 3 Hinge (CIPP/S)	0	220	2.60								
Span 3 Hinge Total	0	386	3.61	3 1/2	Assembly	Arm Neoprene	4.50	0.5**	90	0.49	0.99
Span 5 Hinge (CIPP/S)	0	100	1.18								
Span 5 Hinge (Conv.)	0	156	0.95								
Span 5 Hinge Total	0	256	2.13	2	B	Brown H-5000	4.25	2.00	94	0.26	2.26
Abut. 7 (Conv.)	0	34	0.21	1/2	A	PRC 3105					1.50

a Project Designer: Send to RE or SR with Preliminary Report.
b Show line drawing of structure on reverse side; show points of no movement and contributory lengths. Retain copy for design calculations file.
c RE or SR: Complete and return to Structure Construction with final report.
d Type B information from TransLab reports.
e Groove width adjustment based on Δ^c = (maximum temperature extreme) minus (superstructure temperature).
f Measure superstructure temperature by placing bulb of concrete thermometer ± 6 inches into expansion joint.
g When MR is greater than 4 inches, increase anticipated shortening 25%.

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Figure 1. Completed Form DSD-D-0129, Joint Movements Calculations

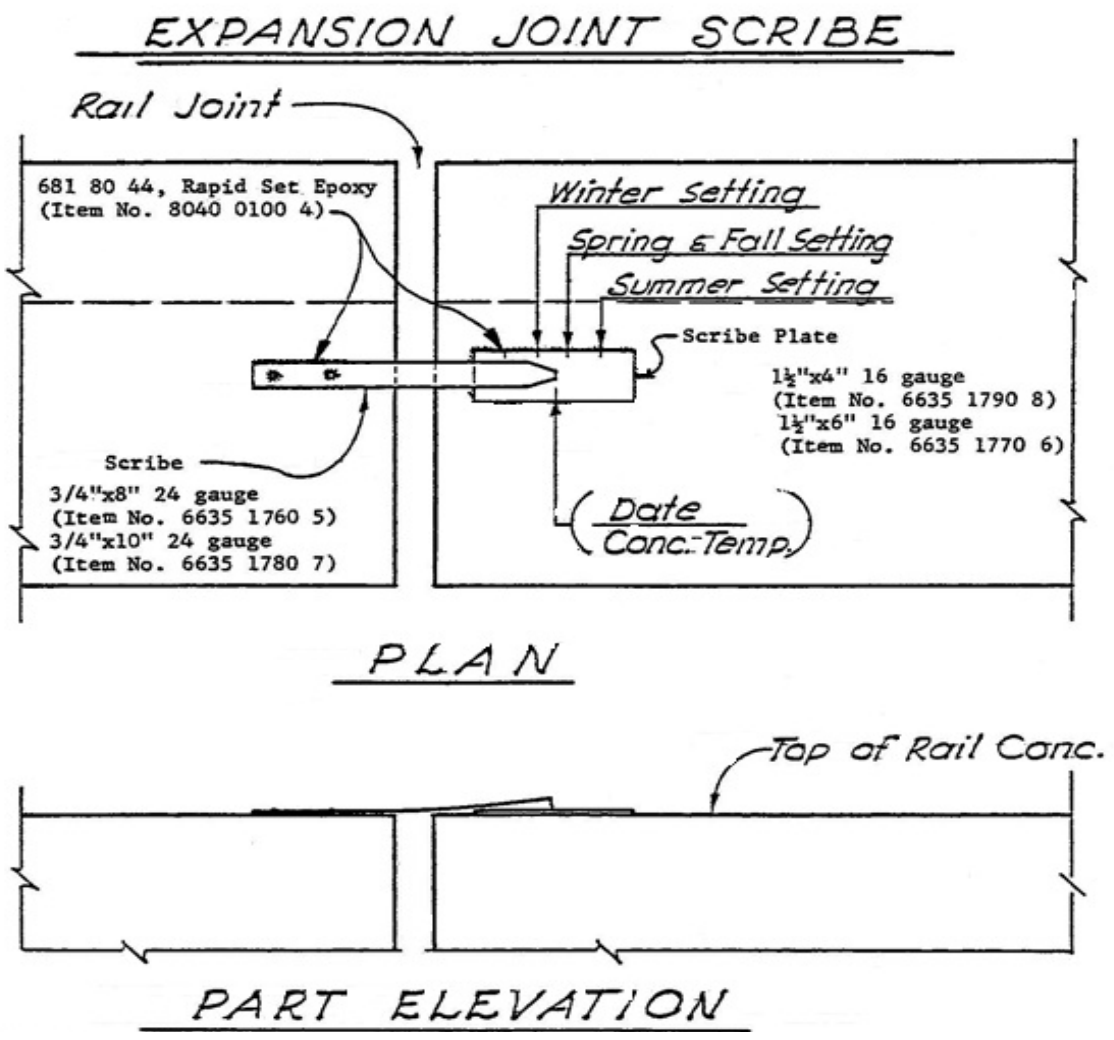

Figure 2. Expansion Joint Scribe

Notes for Figure 2:

1. Install one scribe at each deck joint on the most convenient side of the roadway i.e., widest shoulder. Use 8″ scribe and 4″ plate for joints having MR of 2″ or less. Use 10″ scribe and 6″ plate for joints having movement 2″.
2. Place scribe on top of the concrete portion of the barrier railing.
3. Sand or wire brush surfaces of scribe and concrete to insure good adhesion.
4. Mix only enough epoxy for one scribe and plate when using 681-80-44 Rapid Setting Epoxy. (5 min, pot life @ 70°F)
5. Use weight on a piece of paper to hold the scribe down on the concrete surface while the epoxy is setting.
6. Mark the initial position of the scribe, date, and concrete temperature on the plate as shown with a scriber. Measure the concrete temperature by placing the bulb of a concrete thermometer 6″+ into the deck section, if possible, or at any convenient location to obtain the approximate superstructure temperature.