

705.3 LOAD-TRANSFER UNITS FOR REINFORCED AND PLAIN CEMENT CONCRETE PAVEMENTS—

(a) **General.** As shown on the Standard Drawings and as follows:

1. Coated Dowel Bars and Supporting Members. Section 709.1(a)2, or ASTM A513, and AASHTO T 253 Section 5, or Structural adequacy testing according to PTM No. 642 showing a maximum Linear Variable Differential Transformers (LVDT) differential deflection for dynamic and static loading, for both the approach and leave sides of the joint of not more than 7.5 mils at 1 million cycles and not greater than a 2.5-mil increase in the LVDT differential deflection at 10 million cycles from the corresponding 1 million cycle LVDT deflection. The differential deflection is the absolute difference in deflection between the loaded and unloaded sides of the joint.

Provide bars with their free end a true circle and without burrs.

2. Alternate Shaped Coated Dowel Bars. Bars with properties equivalent to conventional, round steel-coated dowel bars may be used if documentation of conformance to applicable requirements of Section 705.3 are accepted by LTS.

3. Bondbreaking Requirements. AASHTO M 254

3.a Type A. Coating material develops sufficiently low bond strength with concrete so a shop applied bond breaker or bond breaker lubricant is not necessary.

3.b Type B. Coating material develops bond strength with concrete so a shop applied bond breaker or bond breaker lubricant is necessary. Shop-applied bond breakers are to conform to the pull-out load requirements of AASHTO M 254.

(b) **Dowel Bar Coating.** AASHTO M 254 modified as follows:

Provide fusion-bonded epoxy coating as a Type B coating with a minimum non-abraded thickness of 8 mils. No more than 2 holidays per linear foot average, as detected with a 67.5 V holiday detector, are allowed. Repair areas damaged during shipment, handling, fabrication, or placement. The sum of all damaged areas to be repaired per linear foot may not exceed 2% of the bar surface area per linear foot. Repair all visible signs of rust and all visible defects. Repair is accomplished by means of a mechanical wire brush cleaning, or another acceptable procedure, followed by application of an approved epoxy paint utilizing the paint manufacturer's recommended procedure. Do not cover more than 5% of the total bar surface area with patching material.

(c) **Mechanically Galvanized Dowel Bars.** Provide galvanizing as specified in Section 1105.02(s) (ASTM B695 and B 696). Coating thickness to be not less than 3.4 mils (2.0 ounces per square foot).

(d) **Stainless Steel Dowel Bars.** If specified, provide stainless steel dowel bars and stainless steel dowel baskets conforming to ASTM A955/A955M as specified in Section 709.1(f) for stainless steel reinforcement

1. Storage. Section 1002.4(i)3.

(e) **Uncoated, Corrosion-Resistant Dowel Bars.** If specified, provide steel dowel bars conforming to AASHTO M 334 categorized as Level 3 by AASHTO T 374 for uncoated, corrosion-resistant steel reinforcement.

(f) **High Performance Dowel Bars.** As shown on the Standard Drawings and as follows:

1. Physical Requirements. Provide dowel bars or tubes with a smooth-finished surface meeting the requirements of Table A and as follows:

- Diameter of 1.5 inches or 1.25 inches (+ 0.25 inch, - 0.001 inch) as shown on the Standard Drawing RC-20M or as indicated.
- Length of 18 inches (+/- 1/2 inch)

- For tubular dowels, provide nonmetallic or epoxy coated metallic caps on the ends of the tube that do not exceed the outside diameter of the tube, and prevent intrusion of concrete or other materials.
- Submit structural adequacy testing according to PTM No. 642 showing a maximum Linear Variable Differential Transformers (LVDT) differential deflection for dynamic and static loading, for both the approach and leave sides of the joint of not more than 7.5 mils at 1 million cycles and not greater than a 2.5-mil increase in the LVDT differential deflection at 10 million cycles from the corresponding 1 million cycle LVDT deflection. The differential deflection is the absolute difference in deflection between the loaded and unloaded sides of the joint.

Table A – High Performance Dowel Bar Requirements

Dowel Surface Material	Configuration	Solid Bar or Tube Material		Cladding or Coating Material	
		Material	Minimum Wall Thickness (in.)	Material	Minimum Wall / Coating Thickness (in.)
Stainless Steel	Solid Bar	Stainless Steel ⁽¹⁾	—	—	—
	Clad Bar	Steel ⁽²⁾	—	Stainless Steel ⁽¹⁾⁽⁴⁾	0.04
	Clad Tube	Steel ⁽²⁾	0.12	Stainless Steel ⁽¹⁾⁽⁴⁾	0.04
	Solid Tube	Stainless Steel ⁽¹⁾	0.12	—	—
Zinc Clad	Clad Bar	Steel ⁽²⁾	—	Rolled Zinc Alloy ⁽⁵⁾	0.04
	Clad Tube	Steel ⁽²⁾	0.12	Rolled Zinc Alloy ⁽⁵⁾	0.04
Glass Fiber-Reinforced Polymer Coated (GFRP)	Coated Bar or Tube	Steel ⁽²⁾	—	GFRP ⁽³⁾	0.125
Multi-Layer Epoxy Coated	Coated Bar or Tube	Steel ⁽²⁾	—	Minimum 2 Coats of Epoxy ⁽⁶⁾	0.02

- (1) ASTM A955, Grade 60 or higher for solid steel dowels. For tubular dowels, ASTM A312 for solid tubular dowels, and ASTM A249 for clad tubular dowels meeting one of the following UNS Designations: S31603, S31653, S31803.
- (2) ASTM A615, Grade 40 or higher for solid steel dowels, or ASTM A513 with a minimum yield strength of 60 kips per square inch or higher for tubular dowels.
- (3) GFRP coating according to the requirements of Section 3 of AASHTO LRFD Bridge Design Guide Specification for GFRP Reinforced Concrete Bridge Decks and Traffic Railings. Provide clips that firmly hold the GFRP dowel bars in the Load Transfer Unit. Provide clips to positively secure the GFRP dowels to the Load Transfer Unit. Do not weld GFRP dowel bars to Load Transfer Unit.
- (4) Press fit the stainless steel tube using an epoxy adhesive between the tube and the carbon steel core.
- (5) Rolled zinc alloy (U.N.S. Z41121) sleeve mechanically bonded to a steel bar or tube.
- (6) Provide epoxy coated bars with a minimum of two layers of epoxy coating. Provide epoxy coating according to ASTM A934 for the first epoxy coating layer and an abrasion resistant second epoxy layer passing NACE TM0215 using 110 pound weight, and the Smooth Cut Carbide Bit gouge tool with a

maximum gouge depth of 17.3 mils. Provide a total non-abraded epoxy coating thickness of 20 mils to 60 mils. Zero holidays are allowed. Weld areas used for dowel basket attachments must be ground for welding, and cleaned, and recoated after welding. Remove and replace dowel bars that have epoxy coating damaged (including the ends of the dowels) during shipment, handling, fabrication, or placement, prior to paving.

2. **Alternate Shaped Coated Dowel Bars.** Bars with properties equivalent to conventional, round steel-coated dowel bars, may be used, if documentation of conformance to applicable requirements of Section 705.3(f) are accepted by LTS.

3. **Bond Breaking Requirements.** AASHTO M 254

3.a. **Type A.** Coating material develops sufficiently low bond strength with concrete so that a bond breaker is not necessary.

3.b. **Type B.** Coating material develops bond strength with concrete so that a bond breaker is necessary. Shop-applied bond breakers are to conform to the pull-out load requirements of AASHTO M 254.

(g) **Certification.** Section 106.03(b)3

705.4 JOINT SEALING MATERIAL—

(a) **Silicone Joint Sealing Material.** Low modulus, non-sag-silicone, sealing material in a nonacid-curing, one-part formulation, which requires tooling, from a manufacturer listed in Bulletin 15. Furnish silicone joint sealing material conforming to the following physical requirements:

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| • Tensile Stress at 150% elongation, pounds per square inch, max. (ASTM D412, Die C) 7-day cure at 77F ± 3F and 45% to 55 % relative humidity | 45 |
| • Elongation at maximum tensile strength, %, min. (ASTM D412, Die C) | 600 |
| • Extrusion rate, grams/minute, min. 0F to 100F (Test for extrusion using an air-powered caulking gun, having a 1/8-inch orifice, at 90 pounds per square inch) | 75 |
| • Specific gravity (ASTM D792, Method A) | 1.010 to 1.515 |
| • Durometer hardness, shore “A” (ASTM D2240) 7-day cure at 77F ± 3F and 45 to 55% relative humidity. | 10 to 25 @ 0F |
| • Shelf life, days, min., from date of manufacture. | 180 |
| • Ozone and ultraviolet resistance (ASTM C793) | No chalking, cracking, or bond loss after 5000 hours. |
| • Flow (ASTM C639-Type II) | Nil |
| • Bond to cement mortar, pounds per square inch, min., primed if required. (Mold three cement mortar briquets according to AASHTO T 132 and moisture cure for at least 28 days. Saw briquets in half, clean, and oven dry to a constant weight in an oven at 110 °C ± 5 °C. After cooling, bond halves together with approximately 10 mils of silicone sealant, cure 7 days at 77F ± 3F and 45 to 55% | 50 |