
Standard Specification for Plain and Laminated Elastomeric Bridge Bearings

AASHTO Designation: M 251M/M 251-22

Technically Revised: 2022

Editorially Revised: 2022

Technical Subcommittee: 4e, Joints and Bearings



**American Association of State Highway and Transportation Officials
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1. SCOPE

- 1.1. This specification covers the material requirements for plain and laminated elastomeric bridge bearings. Elastomeric bearings furnished under this specification shall adequately provide for thermal expansion and contraction, rotation, camber changes, and creep and shrinkage, where applicable, of structural members. Elastomeric bearings as herein defined shall include plain pads (consisting of elastomer only) and laminated bearings with steel or fabric laminates.
- 1.2. The values stated in either SI units or inch-pound units are to be regarded separately as standard. The inch-pound units are shown in parentheses. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the standard.
- 1.3. *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*
- 1.4. The text of this specification references notes and footnotes that provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the specification.
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2. REFERENCED DOCUMENTS

- 2.1. *AASHTO Publications and Standard:*
- AASHTO LRFD Bridge Design Specifications
 - AASHTO LRFD Bridge Construction Specifications
 - M 339M/M 339, Thermometers Used in the Testing of Construction Materials
- 2.2. *ASTM Standards:*
- A36/A36M, Standard Specification for Carbon Structural Steel
 - A1011/A1011M, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
 - D395, Standard Test Methods for Rubber Property—Compression Set
 - D412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
 - D429, Standard Test Methods for Rubber Property—Adhesion to Rigid Substrates

- D573, Standard Test Method for Rubber—Deterioration in an Air Oven
- D751, Standard Test Methods for Coated Fabrics
- D2137, Standard Test Methods for Rubber Property – Brittleness Point of Flexible Polymers and Coated Fabrics
- D2240, Standard Test Method for Rubber Property—Durometer Hardness
- D3183, Standard Practice for Rubber—Preparation of Pieces for Test Purposes from Products
- D4014, Standard Specification for Plain and Steel-Laminated Elastomeric Bearings for Bridges
- E1, Standard Specification for ASTM Liquid-in-Glass Thermometers
- E4, Standard Practices for Force Verification of Testing Machines
- E29, Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
- E230/E230M, Standard Specification for Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples
- E879, Standard Specification for Thermistor Sensors for General Purpose and Laboratory Temperature Measurements
- E1137/E1137M, Standard Specification for Industrial Platinum Resistance Thermometers
- E2877, Standard Guide for Digital Contact Thermometers

2.3. *ANSI Standard:*

- ANSI B46.1, Surfaces and Surfacing

2.4. *The Association for Rubber Products Manufacturers (ARPM):¹*

- *The ARPM Rubber Handbook™ for Molded, Extruded, Lathe Cut and Cellular Products*, MO-1 (<https://www.arpminc.com/publications/44>)
 - Table 6—RMA Drawing Designation for Finish, RMA F2, Satin Finish
 - Table 6—RMA Drawing Designation for Finish, RMA F3, Commercial Finish
 - Table 7—RMA Drawing Designation for Flash Extension, RMA T 1.60 mm [T .063], Normal Tear Trim Tolerance

2.5. *The Association for Materials Protection and Performance (AMPP) Specification:²*

- SSPC-VIS 1-01, Visual Standard for Abrasive Blast Cleaned Steel

2.6. *International Electrotechnical Commission Standards:*

- IEC 60584-1:2013, Thermocouples - Part 1: EMF Specifications and Tolerances
- IEC 60751:2008, Industrial Platinum Resistance Thermometers and Platinum Temperature Sensors

3. GENERAL REQUIREMENTS

3.1. All bearings shall be designed in accordance with specifications contained in the latest edition of the *AASHTO LRFD Bridge Design Specifications*, and the plans or other contract documents shall indicate if the bearings were designed in accordance with Method A or B. The specified design value for shear modulus of the elastomer or design durometer grade of elastomer, as appropriate, shall also be indicated. In addition, the purchaser has the option to further specify in the plans or contract documents acceptance and testing criteria as described in Sections 8.8 and 8.9.

3.2. The dimensions of the furnished bearings shall be the dimensions required by the design documents within the tolerances shown in Section 6 of this specification. The bearings shall be

composed of the specified materials, shall be tested at the appropriate level, and shall satisfy any special requirements of the purchaser.

- 3.3. The contractor shall provide the purchaser with written notification 30 days prior to the start of bearing production. This notification shall include the contract number, quantity, and size of bearings being produced, as well as the manufacturer's name and location, and the representative who will coordinate production, inspection, sampling, and testing with the purchaser.
- 3.4. Testing for the physical properties of the elastomer will require the destruction of one or more bearings from a lot. In these instances, the cost of providing additional bearings for testing purposes shall be borne by the supplier.
- 3.5. In addition to material requirements for the bearing's individual components, this specification provides acceptance criteria for finished bearings.
- 3.6. Perform calculations using significant digits in accordance with ASTM E29 using the rounding method for determining compliance to the specification requirements herein, unless otherwise specified by the purchaser. See also Section 4.1.3.

4. MATERIALS

- 4.1. *Properties of the Elastomer*—The elastomer compound used in the construction of these bearings shall contain only virgin crystallization resistant polychloroprene (neoprene) or virgin natural polyisoprene (natural rubber) as the raw polymer. All materials shall be new with no reclaimed material incorporated in the finished bearing. The elastomer compounds shall be classified as being of low-temperature Grade 0, 2, 3, 4, or 5 as specified by the minimum grade requirements of Table 14.7.5.2-1, "Low Temperature Zones and Minimum Grade of Elastomer," of the *AASHTO LRFD Bridge Design Specifications*. Low temperature zones used in this table are as defined in Figure 14.7.5.2-1, "Temperature Zones," of the same publication.
 - 4.1.1. The cured elastomer shall meet the minimum requirements of Table 1. The properties of the cured elastomeric compound material listed in Table 1 shall be determined using samples taken from actual bearings. If possible, hardness, tensile, elongation and low-temperature brittleness test specimens shall include an outer surface of a bearing (i.e., cover layer). If possible, shear modulus test specimens shall be taken from the middle one-third of a bearing.
 - 4.1.2. All material tests shall be carried out at $23 \pm 2^{\circ}\text{C}$ [$73 \pm 4^{\circ}\text{F}$] unless otherwise noted. The thermometer for measuring the ambient temperature of the test environment shall meet the requirements of M 339M/M 339 with a temperature range of at least 19 to 27°C [65 to 80°F] and an accuracy of $\pm 0.5^{\circ}\text{C}$ [$\pm 1^{\circ}\text{F}$] (see Note 1).

Note 1—Thermometer types suitable for use include ASTM E1 mercury thermometers; ASTM E2877 digital metal stem thermometer; ASTM E230/E230M thermocouple thermometer, Type T, Special; or IEC 60584-1:2008 thermocouple thermometer, Type T, Class 1.
 - 4.1.3. For the purpose of determining conformance with this specification, an observed or calculated value shall be rounded off to the nearest 100 kPa [15 psi] for tensile strength, to the nearest 10 percent for elongation, and to the nearest 0.01 MPa [1 psi] for shear modulus.
- 4.2. *Steel Laminates*—Steel laminates used for reinforcement shall be made from rolled mild steel conforming to ASTM A36/A36M, ASTM A1011/A1011M (Type SS Grade 36), or equivalent, unless otherwise specified by the purchaser. The laminates shall be of the thickness specified by the purchaser or, if left unspecified, have a minimum nominal thickness of 1.897 mm [0.0747 in.]. Holes in plates for manufacturing purposes shall not be permitted unless considered in the design of the bearing.

Table 1—Elastomer Properties

Material Property	ASTM Standard	Test Requirement	Polyisoprene (Natural Rubber) Durometer Grade			Polychloroprene (Neoprene) Durometer Grade			Units
			50	60	70 ^a	50	60	70 ^a	
Physical Properties	D2240	Hardness ^b	50 ± 5	60 ± 5	70 ± 5	50 ± 5	60 ± 5	70 ± 5	Type A Points
	D4014 & Sec. 8.8.3	Shear modulus ^{c,d}	Specified Value ± 15% ^e			Specified Value ± 15% ^e			MPa [psi]
	D412	Min tensile strength	15.5 [2250]			15.5 [2250]			MPa [psi]
	D412	Min ultimate elongation	450	400	300	400	350	300	%
Low-temperature brittleness	D2137 Test Method C	Grades 0 and 2: No test required	—			—			
		Grade 3: Test at –40°C [–40°F]	Passes			Passes			
		Grade 4: Test at –48°C [–54°F]	Passes			Passes			
		Grade 5: Test at –57°C [–71°F]	Passes			Passes			

^a Durometer Grade 70 material is only permitted for plain elastomeric pads (unlaminated), and steel laminated elastomeric bearings with a polytetrafluoroethylene (PTFE) or equivalent slider on top of the bearing.

^b Required for bearings designed in accordance with Method A of the *AASHTO LRFD Bridge Design Specifications* when no target design shear modulus is specified.

^c Required for bearings designed in accordance with Method B of the *AASHTO LRFD Bridge Design Specifications*.

^d Required if a target design value is specified and the bearings are designed in accordance with Method A of the *AASHTO LRFD Bridge Design Specifications*.

^e Absolute minimum permitted 0.55 MPa [80 psi].

4.3. *External Load-Bearing Plates*—External load-bearing plates shall conform to the requirements of ASTM A36/A36M, ASTM A1011/A1011M (Type SS Grade 36), or equivalent, unless otherwise specified in the contract documents. Except as noted, all bearing surfaces of external load-bearing plates shall be finished or machined flat within 0.002 mm/mm [0.002 in./in.]. The bottom surfaces of external load-bearing plates (masonry plates) designed to rest on bearing pads shall not exceed an out-of-flatness value of 0.005 mm/mm [0.005 in./in.]. The external load-bearing plates shall be protected from rust until all exposed surfaces can be field painted. Any rust inhibitor utilized must be removed from all surfaces to be welded prior to welding.

4.4. *Fabric Laminates*—Fabric laminates shall be woven from 100 percent glass fibers of “E” type yarn with continuous fibers. The minimum thread count in either direction shall be 10 threads per cm. The fabric shall have either a crowfoot or an eight-harness satin weave. Each ply of fabric shall have a minimum tensile strength of 140 kN/m [800 lbf/in.] of width in each thread direction, which shall be determined by ASTM D751.

5. FABRICATION

5.1. Bearings with steel laminates shall be cast as a unit in a mold and bonded and vulcanized under heat and pressure. The molds shall have standard shop practice mold finish. The internal steel laminates shall be blast cleaned to a condition matching that of SSPC-VIS 1-01, Pictorial Standard BSP6 or CSP6, and additionally cleaned of any oil or grease before bonding. Plates shall be free of sharp edges and burrs. External load plates (sole plates) shall be protected from rusting by the manufacturer, and shall be hot bonded to the bearing during vulcanization. Bearings with steel laminates that are designed to act as a single unit with a given shape factor must be manufactured as a single unit.

- 5.2. Fabric-laminated bearings may be molded and vulcanized in large sheets and cut to size. Cutting shall be performed so as to avoid heating the materials and produce a smooth finish with no separation of the fabric from the elastomer. Fabric shall be free of folds and ripples and shall be parallel to the top and bottom surfaces. If external steel plates are required, a cold bonding process that will yield the strengths required in Section 8.8 of this specification may be used in lieu of hot bonding.
- 5.3. Plain pads may be molded or extruded and vulcanized in large sheets and cut to size. Cutting shall not heat the materials, and shall produce a smooth finish to ANSI B46.1, 6.3 μm [250 $\mu\text{in.}$]. Plain pads shall be molded or extruded to the finished thickness. Fabricators will not be allowed to make pads of finished thickness by plying pads of lesser thickness together. External load plates, when used, shall be protected from rusting by the manufacturer and shall be hot bonded by vulcanization during the primary molding process.
- 5.4. Flash tolerance, finish, and appearance of bearings shall meet the requirements of the latest edition of the Rubber Handbook as published by The Association for Rubber Products Manufacturers (ARPM), RMA A3-F3-T.063 for molded bearings and RMA A3-F2-T.063 for extruded bearings.

6. TOLERANCES

- 6.1. Plain pads and laminated bearings shall be manufactured to the design dimensions tolerances listed in Table 2, unless other tolerances are shown on the design drawings.

Table 2—Tolerances

	mm [in.]
1. Overall vertical dimensions:	
Design thickness 32 mm [1.25 in.] or less	−0, +3 [−0, +0.125]
Design thickness over 32 mm [1.25 in.]	−0, +6 [−0, +0.25]
2. Overall horizontal dimensions:	
For measurements 914 mm [36 in.] or less	−0, +6 [−0, +0.25]
For measurements greater than 914 mm [36 in.]	−0, +12 [−0, +0.50]
3. Thickness of individual layers of elastomer (i.e., top, bottom and middle layers of laminated bearings only)	±3 [±0.125]
4. Variation from a plane parallel to the theoretical surface (as determined by measurements at the edge of the bearings):	
Top	Slope relative to the bottom of no more than 0.005 radians
Sides	6 [0.25]
5. Position of exposed connection members	±3 [±0.125]
6. Edge (side) cover of embedded laminates of connection members	−0, +3 [−0, +0.125]
7. Size of holes, slots, or inserts	±3 [±0.125]
8. Position of holes, slots, or inserts	±3 [±0.125]

7. MARKING

- 7.1. Each elastomeric bearing shall be marked in indelible ink or flexible paint. The marking shall consist of the order number, lot number, bearing identification number, up station or face of abutment (tapered plates only) and elastomer type and grade. Unless otherwise specified in the contract documents, the marking shall be on a face that is visible after the bridge is erected.