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Standard Specification for Plain and Steel-Laminated Elastomeric Bearings for Bridges[1]

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1. Scope

1.1 This specification covers bearings, which consist of all elastomer or of alternate laminates of elastomer and steel, when the function of the bearings is to transfer loads or accommodate relative movement between a bridge superstructure and its supporting structure, or both.

1.2 The values stated in SI units are to be regarded as the standard.

NOTE 1—The words "elastomer" or "elastomeric" will be used interchangeably with the word "rubber" in this specification.

1.3 The following safety hazards caveat pertains only to the test methods portion, Section B, of this specification: *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.*

2. Referenced Documents

2.1 *ASTM Standards:*

A 36/A36M Specification for Structural Steel[2]

D 395 Test Methods for Rubber Property—Compression Set[3]

D 412 Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers in Tension[3]

D 518 Test Method for Rubber Deterioration—Surface Cracking[3]

D 573 Test Method for Rubber—Deterioration in an Air Oven[3]

D 832 Practice for Rubber Conditioning for Low-Temperature Testing[3]

D 1149 Test Method for Rubber Deterioration Surface Ozone Cracking in a Chamber[3]

D 1415 Test Method for Rubber Property—International Hardness[3]

D 1418 Practice for Rubber and Rubber Latices—Nomenclature[3]

D 2000 Classification System for Rubber Products in Automotive Applications[4]

D 2137 Test Methods for Rubber Property—Brittleness Point of Flexible Polymers and Coated Fabrics[3]

D 2240 Test Method for Rubber Property—Durometer Hardness[3]

D 3183 Practice for Rubber—Preparation of Pieces for Test Purposes from Products[3]

E 4 Practices for Force Verification of Testing Machines[5]

3. Terminology

3.1 *Definitions:*

3.1.1 *design load*—the mean compressive stress applied to the area of the steel laminate.

3.1.2 *external load plate*—a steel plate bonded to the top or bottom elastomeric surface of a bearing, or both.

3.1.3 *lot*—unless otherwise specified in the contract or purchase order, a lot shall consist of a single type of bearing, of the same design and material, submitted for inspection at the same time.

3.1.4 *plain elastomeric bearing pad*—a bearing that consists only of elastomeric material.

3.1.5 *plain elastomeric sandwich bearing*—a bearing that consists of a single layer of elastomeric material bonded to one or two external load plates (3.1.2).

3.1.6 *steel-laminated elastomeric bearing*—a bearing molded of elastomeric material with one or more steel laminates embedded in and bonded to it, and to which one or two external load plates (3.1.2) may be bonded.

4. Classification

4.1 The bearings are furnished in four types as follows:

4.1.1 Plain Elastomeric Bearing Pad.

4.1.2 Plain Elastomeric Sandwich Bearing.

4.1.3 Steel-Laminated Elastomeric Bearing.

4.1.4 Steel-Laminated Elastomeric Bearing with External Load Plate(s).

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[2] *Annual Book of ASTM Standards*, Vol 01.04.

[3] *Annual Book of ASTM Standards*, Vol 09.01.

[4] *Annual Book of ASTM Standards*, Vol 09.02.

[5] *Annual Book of ASTM Standards*, Vol 03.01.

NOTE 2—Examples of the types of elastomeric bearing construction are given in Fig. 1.

NOTE 3—The adjective elastomeric is omitted in this specification when referring to bearing types.

4.2 The elastomer for the manufacture of the bearing is furnished in two types as follows:

4.2.1 *Type CR*—Chloroprene rubber.

4.2.2 *Type NR*—Natural rubber.

4.2.3 If none is specified then the manufacturer shall use one of those types.

NOTE 4—Appendix X1 relates to elastomeric materials which do not have fully documented in-service records or sufficiently widespread use or both.

NOTE 5—The abbreviations for the elastomer types are taken from Practice D 1418.

4.3 The elastomer for the manufacture of the bearing is furnished in four grades of low-temperature properties. The grades and typical operating temperature conditions for each grade are as follows:

4.3.1 *Grade 0*—Suitable for continuous use down to + 5°C.

4.3.2 *Grade 2*—Sub-zero temperatures occur at night and occasionally persist for no more than 1 or 2 days.

4.3.3 *Grade 3*—Same as 2 but occasional periods of up to 2 weeks continuously below zero.

4.3.4 *Grade 5*—Sub-zero temperatures down to − 40°C persisting for several months each year with up to 2 months continuously below − 15°C.

4.3.5 If a grade is not specified Grade 0 shall be furnished. An elastomer of a higher grade number may be substituted for any lower grade.

NOTE 6—A discussion of low-temperature properties of elastomeric materials is given in Practice D 832.

NOTE 7—The grade numbers for the low-temperature properties correspond to those in Table 5 of Classification D 2000.

5. Ordering Information

5.1 Orders for each type of bearing under this specification shall include the following:

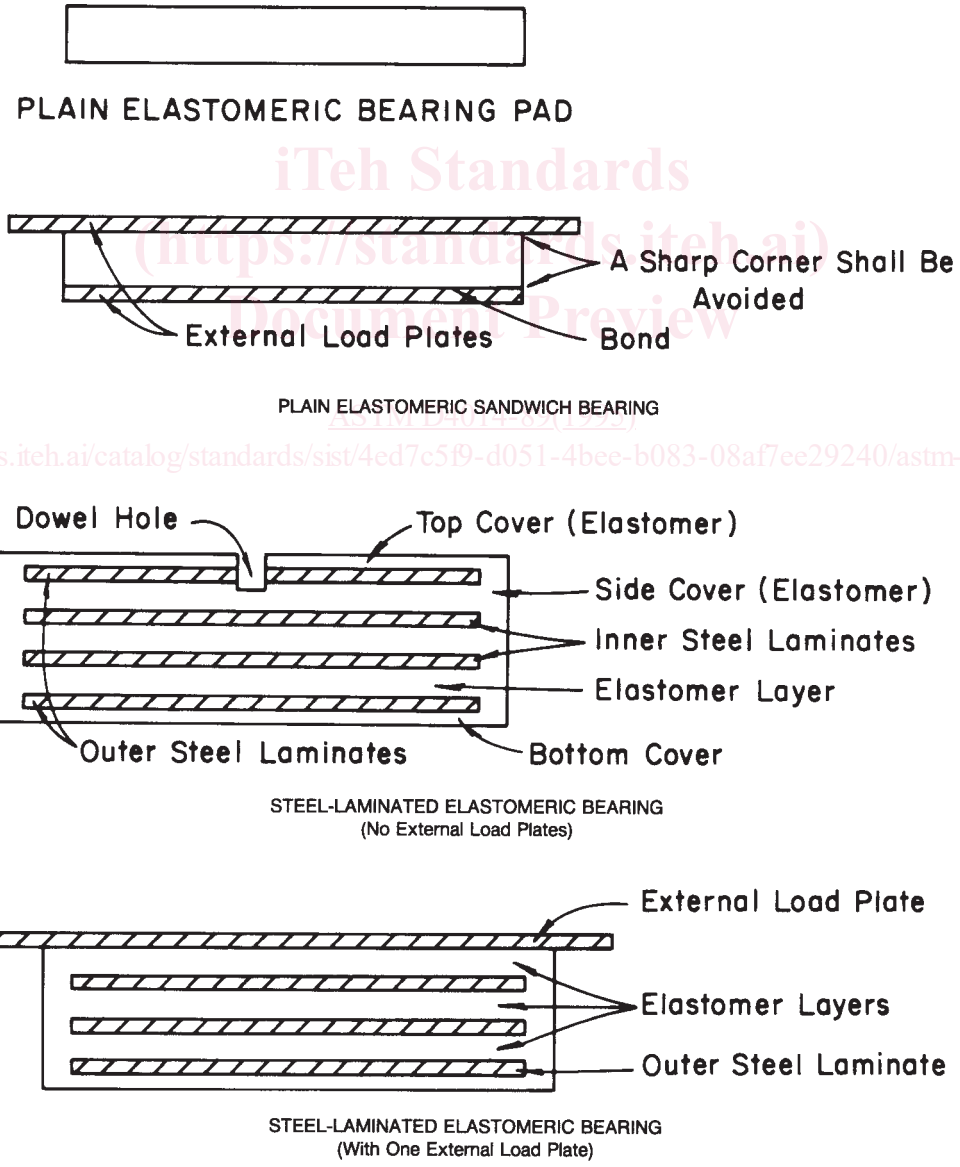

FIG. 1 Examples of the Construction of Elastomeric Bearings

5.1.1 Quantity,

5.1.2 Bearing design,

NOTE 8—An example of the design information required is given in Appendix X2. Working drawings may be substituted.

5.1.3 Design load,

5.1.4 Shear modulus of the elastomer,

5.1.5 Rubber type,

5.1.6 Rubber grade,

5.1.7 Ozone test partial pressure, if higher than 50 mPa (formerly referred to as a concentration of 50 parts per hundred million (pphm)).

6. Materials and Manufacture

6.1 The elastomeric compound used in the construction of a bearing shall contain only either natural rubber or chloroprene rubber as the raw polymer. No reclaimed rubber shall be used.

6.2 Internal steel laminates shall be of rolled mild steel.

6.3 External load plates shall conform to the requirements of Specification A 36/A 36M unless otherwise specified in the contract or purchase order.

6.4 Plain bearing pads shall be molded individually, or cut from previously molded strips or slabs, or extruded and cut to length. Cutting shall produce a smooth surface and no heating of the elastomer.

6.5 A steel-laminated bearing or a plain sandwich bearing shall be molded as a single unit under pressure and heat.

6.6 All bonding of elastomer to steel laminates and to external load plates shall be carried out during molding. The elastomer at the outer edges of bonds to external load plates shall be shaped to avoid serious stress concentrations (see Fig. 1).

6.7 Internal steel laminates shall be free of sharp edges.

6.8 External load plates shall be protected from rusting when supplied by the manufacturer.

6.9 All molds shall have a standard shop-practice mold finish.

7. Dimensions and Permissible Variations

7.1 All elastomeric layers, for example, plain-bearing pads, laminates, and covers, shall be of uniform thickness unless otherwise specified in the contract or purchase order.

7.2 All internal steel laminates shall be of uniform thickness. When specified in the contract or purchase order, the thickness of the outer steel laminates may differ if not adjacent to an external load plate (see Fig. 1).

7.3 The minimum thickness of internal steel laminates shall be 1.5 mm or 0.060 in. (16 gage) when the greater of the length or width of a rectangular bearing or the diameter of a circular bearing is less than 450 mm or 18 in. In all other cases, the minimum thickness shall be 2 mm or 0.075 in. (14 gage).

7.4 External load plates shall be of uniform thickness unless otherwise specified in the contract or purchase order.

7.5 Bearing dimensions and elastomer layer thicknesses shall satisfy the tolerances in Table 1, in which D is the length, width or diameter as appropriate, and T is the total elastomer thickness.

TABLE 1 Tolerances for Bearing Dimensions and Elastomer Layer Thicknesses

Dimension	Tolerance	
	minimum	maximum
Length, width or diameter of bearing, mm (in.)	0	5 (0.2) + 0.005D
Height of bearing, mm (in.)	0	2 (0.1) + 0.04T
Thickness of elastomer cover at top, bottom or side, mm (in.)	0	3 (0.1)
Thickness of internal elastomer laminate, %	±20 % of design value	

7.6 Variation from a plane parallel to a design surface shall not exceed an average slope of 0.005 for the upper surface and 0.006 for a side surface.

8. Test Methods and Acceptance Requirements

8.1 *Bearing Compression Tests*—All bearings sampled from a lot shall be subjected to the compression tests. The cost of replacement bearings and of testing them shall be borne by the supplier.

8.1.1 The bearings shall be brought to a temperature of 23 ± 6°C and shall be tested at this temperature.

8.1.2 *Compression Stiffness*—Load the bearing to the design load (3.1.1) by increments of one fifth of the design load. For each load increment, the loading time shall be within the range of 1.4 to 2.6 min. When the increment has been applied the load or deflection (depending on the type of testing machine) shall be maintained constant for 30 s then the load and deflection measured. From a plot of load against deflection, the compression stiffness shall be determined as the slope of the best straight line through the points, ignoring the first point at zero load. Record the compressive stiffness for each bearing.

8.1.3 *Visual Inspection*—Increase the load to 1.5 times the design load then maintain either load or deflection constant while the bearing is inspected for visual faults, as follows:

8.1.3.1 If lack of elastomer to steel bond is indicated, the bearing shall be rejected.

8.1.3.2 If laminate placement faults are observed which result in elastomer layer thickness that exceed the tolerances in 7.5, the bearing shall be rejected.

8.1.3.3 If there are at least three separate surface cracks which are each at least 2 mm wide and 2 mm deep, the bearing shall be rejected.

8.1.4 Record the median compressive stiffness (K) of the bearing of median stiffness. The compressive stiffness of each bearing tested shall not differ from (K) by more than 10 %.

8.1.5 For each bearing that fails to meet the requirements in 8.1, two additional bearings may be sampled and shall meet all the requirements in 8.1 or the lot shall be rejected.

8.1.6 If the lot is not rejected, the bearing of median stiffness (K) shall be subjected to the elastomeric material tests in 8.2.

8.2 *Elastomeric Material Tests*:

8.2.1 All test specimens used for the determination of the properties of the vulcanized elastomeric material shall be taken from bearings (see Practice D 3183). Tensile and hardness