MATERIAL SPECIFICATION FOR BEARINGS - ELASTOMERIC PLAIN AND STEEL LAMINATED

TABLE OF CONTENTS

1202.01 SCOPE

This specification covers the requirements for Materials, design, and fabrication of plain and steel-laminated elastomeric bearings for bridges and for approach slab bearings and ballast wall bearings.

1202.02 REFERENCES

This specification refers to the following standards, specifications, or publications:

Ontario Ministry of Transportation Publications

Laboratory Testing Manual:
LS-427 Method of Test for Compressive Deformation of Plain Bearings
LS-428 Method of Test for Compressive Deformation of Laminated Bearings
LS-429 Method of Test for Measurement of Tolerances for Steel Laminated Bearings

Structural Manual:
Division 1 - Exceptions to the Canadian Highway Bridge Design Code CSA S6 for Ontario

CSA Standards

S6-19 Canadian Highway Bridge Design Code

ASTM International

D395-18	Standard Test Methods for Rubber Property - Compression Set
D412-16	Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
D429-14	Standard Test Methods for Rubber Property - Adhesion to Rigid Substrates
D573-04 (2019)	Standard Test Method for Rubber - Deterioration in an Air Oven
D1149-18	Standard Test Method for Rubber Deterioration - Cracking in an Ozone Controlled Environment
D2240-15e1	Standard Test Method for Rubber Property - Durometer Hardness
D4014-03 (2018)	Standard Specification for Plain and Steel-Laminated Elastomeric Bearings for Bridges

American Association of State Highway and Transportation Officials (AASHTO)

M251-06 (2016) Plain and Laminated Elastomeric Bridge Bearings

1202.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Effective Elastomer Thickness means the sum of the thickness of all layers of elastomer, excluding the outer top and bottom layers of the laminated bearings.

Elastomer means a compound containing virgin natural polyisoprene (natural rubber).

Laminated Bearing means a bearing composed of elastomer laminates separated by and fully bonded to steel plates.

Plain Bearing means a bearing, which consists wholly of elastomer.

Plan Dimension means the dimensions of an object, when viewed perpendicular to the top of the object.

1202.04 DESIGN AND SUBMISSION REQUIREMENTS

1202.04.01 Design Requirements

1202.04.01.01 Design

The bearings, including any fasteners or dowels, shall be designed according to CSA S6 and the Structural Manual, Division 1.

1202.04.01.02 Elastomer Thickness

The effective elastomer thickness for plain bearings shall be greater than or equal to 15 mm and less than or equal to 25 mm.

All internal layers of elastomer in a laminated elastomeric bearing shall have the same thickness.

1202.04.01.03 Steel Thickness

The minimum and maximum nominal thickness of the internal steel plates for laminated bearings shall be 3 mm and 5 mm respectively, except bearings with an area that is 0.25 m^2 or larger shall have internal steel plates of 5 mm nominal thickness. All internal steel plates in a bearing shall be the same thickness, and each plate's thickness shall be uniform.

1202.04.01.04 Compressive Deformation

Compressive deformation of laminated elastomeric bearings shall not exceed 0.05 of the effective elastomer thickness when tested according to LS-428 and this specification.

Compressive deformation of plain elastomeric bearings shall not exceed 0.06 of the effective elastomer thickness when tested according to LS-427 and this specification.

1202.04.02 Submission Requirements

1202.04.02.01 General

Within 30 Days of the Contract award, the name and address of the supplier and manufacturer of the bearings shall be submitted in writing to the Contract Administrator.

Change Proposal shall bear the seal and signature of the design and checking Engineers.

When another authority is involved, all submissions shall be made a minimum of 35 Days prior to the commencement of work.

1202.04.02.02 Working Drawings

At least seven Days prior to commencement of bearing fabrication, one hardcopy set and one electronic PDF copy of Working Drawings for the bearings shall be submitted to the Contract Administrator for information purposes only. An Engineer shall affix their seal and signature on the Working Drawings verifying that the drawings are consistent with the Contract Documents and sound engineering practices.

A sealed and signed copy of these drawings shall be kept on site prior to and during the installation of the bearings.

These drawings shall clearly indicate the following:

a) Specified bearing design data (Dead Load and Total Load at SLS and ULS, movement at SLS, rotation at SLS).

b) The number and thickness of internal steel plates.

c) Compressive stiffness.

d) Shear stiffness at 20 °C and -40° C.

e) Bearing alphanumeric identification.

1202.04.02.03 Manufacturer's Certification

Upon completion of fabrication and prior to installation of the bearings, a certificate of compliance signed by the manufacturer, shall be submitted to the Contract Administrator. The certificate of compliance shall include test results according to Table 1 and shall state that the fabricated bearings are according to the Working Drawings and Contract Documents.

1202.05 MATERIALS

1202.05.01 General

Reclaimed material shall not be incorporated in the finished bearing.

1202.05.02 Materials for Elastomeric Plain and Steel Laminated Bearings

1202.05.02.01 Steel

Internal steel plates for laminated bearings shall be according to CSA S6.

1202.05.02.02 Elastomers

Elastomers shall be according to the following:

a) Virgin natural polyisoprene elastomer shall be the only raw polymer permitted.

b) The physical properties of any polyisoprene used shall be according to the requirements of Table 1.

1202.05.03 Approach Slab Bearings and Ballast Wall Bearings

The physical properties of elastomer used for the manufacture of approach slab bearings or ballast wall bearings shall be according to the following:

a) Hardness, when tested according to ASTM D2240 shall be 55 +10 / -5 Shore A.

b) Minimum tensile strength shall be 15 MPa, when tested according to ASTM D412, Method A.

c) Minimum ultimate elongation shall be 400%, when tested according to ASTM D412, Method A.

1202.07 PRODUCTION

1202.07.01 Plain Bearings

Plain bearing pads shall be moulded individually, cut from moulded strips or slabs of the required thickness, or extruded and cut to length.

1202.07.02 Laminated Bearings

Laminated bearings shall be moulded under pressure as a single unit and heated in moulds that have a smooth surface finish.

Steel plates shall be according to the following:

a) Internal steel plates shall be free from sharp edges.

b) Steel plates shall be completely bonded on all surfaces to the elastomeric material during molding. The cover on the vertical side surfaces shall be 6 mm. The cover on the top and bottom surfaces shall be 5 mm, except that no cover is required over pintle holes.

c) When pintles are specified in the Contract Documents, the depth of pintle holes shall be such that the pintle engages only one steel plate through the entire thickness of the plate.

Elastomer laminates shall be of uniform thickness.

1202.07.03 Identification

Each laminated elastomeric bearing shall be marked with the date of manufacture (i.e., yyyy-mm-dd) and an individual alphanumeric identification. The alphanumeric identification shall consist of the designated identification letter of the supplier and source followed by the letter I for polyisoprene and a five-digit number. Bearings shall be sequentially numbered. The characters shall be not less than 10 mm in height, stamped or engraved into two adjacent sides, with the indentations or protrusions not less than 1 mm in width and 1 mm in depth.

Plain, approach slab and ballast wall bearings shall be marked every 1 m with the name of manufacturer, the date of manufacture, and the lot number.

1202.07.04 Tolerances

Tolerances shall be according to Table 2.

1202.08 QUALITY ASSURANCE

1202.08.01 General

Bearings shall be acceptable if they meet the requirements of this specification.

12.02.08.02 Acceptance of Physical Properties of Elastomers for Laminated and Plain Bearings

Bearing physical properties shall be acceptable if they meet the requirements of Table 1 of this specification.

1202.08.02.01 Referee Testing of Physical Properties of Elastomers for Laminated and Plain Bearing

A written request may be submitted for referee testing the physical properties of elastomers for any sample within five Business Days of receiving notification of rejection of the lot. Referee testing shall be done on the remaining piece of sample representing the failed acceptance test result. The results of the referee test shall be used for acceptance determination and shall be binding on both parties. If the referee testing results in rejection of the lot, the Contractor shall bear the cost of the referee testing. If the referee testing results in the material passing all test criteria, the referee testing charge shall be paid by the Owner.

1202.08.03 Acceptance of Compressive Deformation

1202.08.03.01 Compressive Deformation of Laminated Bearings

The method of testing bearings shall be according to LS-428. The increment in compressive deformation of laminated bearings shall not exceed 5% of the effective elastomer thickness, when the bearing load is increased from an initial pressure of 1.5 MPa to a pressure of 7 MPa.

1202.08.03.02 Compressive Deformation of Plain Bearings

The method of testing of plain bearings shall be according to LS-427. The increment in compressive deformation of plain bearings shall not exceed 6% of the thickness of the bearing when the bearing load is increased from an initial pressure of 20% of the average pressure to the average pressure, and not greater than 7 MPa.

1202.08.03.03 Compressive Deformation Referee Testing

A written request may be submitted for referee testing of compressive deformation within five Business Days of receiving notification of rejection of the lot. Referee testing shall be done on the same sample. The results of the referee test shall be used for acceptance determination and shall be binding on both parties. If the referee testing results in rejection of the lot, the Contractor shall bear the cost of the referee testing. If the referee testing results in the material passing all test criteria, the referee testing charge shall be paid by the Owner.

1202.08.04 Acceptance of Approach Slab Bearings and Ballast Wall Bearings

Approach slab bearings and ballast wall bearings shall be acceptable if properties meet the requirements of this specification.

TABLE 1
Physical Requirements for Polyisoprene

Property	Test	Polyisoprene Requirements
Shear modulus G_{RT}, MPa @ 20 °C (Note 1)	ASTM D4014, Annex A1, as modified by AASHTO M251	0.80 ± 0.15
Shear modulus G_{LT}, MPa @ - 40 °C (Note 2)	ASTM D4014, Annex A1, as modified by AASHTO M251	Not more than 3 times the value at room temperature $G_{LT} \leq 3\ G_{RT}$
Tensile strength, MPa	ASTM D412, Method A	minimum 17.0
Ultimate elongation, %	ASTM D412, Method A	minimum 400
Heat resistance	ASTM D573	70 h at 70 °C
Change in hardness, Shore A	ASTM D2240	maximum + 10
Change in tensile strength, %	ASTM D412, Method A	maximum - 25
Change in ultimate elongation, %	ASTM D412, Method A	maximum - 25
Compression set, % (Note 3)	ASTM D395, Method B	22 h at 70 °C maximum 25
Ozone Resistance	ASTM D1149, Method B, Procedure B1 20% strain, 40 ± 2 °C	25 pphm, 48 h no cracks
Peel bond test, N/mm	ASTM D429, Method B	minimum 7.0

Note:

1. Shear Modulus shall be determined at ambient temperature in accordance with ASTM D4014 Annex A1 modified as follows: the initial cycles shall be taken to a strain of 0.7 and on the last cycle the shear modulus shall be determined at 0.5 strain.

2. Shear Modulus testing shall be performed with the test specimen in an enclosed freezer unit capable of maintaining the specified conditioning temperature. A ± 25 percent strain cycle shall be applied for a period of 100 seconds. The first three-quarter cycle of strain shall be discarded and the shear modulus shall be determined by the slope of the force deflection curve for the next half cycle of loading.

3. All test specimens of steel laminated bearings used for compression set test ASTM D395, Method B, shall be prepared from the representative bearing pads and may consist of a single layer or multiple layers of elastomer.

TABLE 2
Tolerances

Criteria		Tolerance
Bearing thickness ≤ 40 mm		0 to + 3 mm
Bearing thickness > 40 mm		0 to + 6 mm
Bearing plan dimension		0 to + 6 mm
Thickness of individual measurement of each elastomer layer according to LS-429		± 20% of design value
Deviation from plane parallel to theoretical surface:	Top and bottom	1 in 200
	Sides	1 in 100
Cover to embedded steel on vertical side surfaces		-1.0 to + 4.0 mm
Cover to embedded steel on top and bottom surfaces		-1.0 to +2.0 mm
Pintle hole diameter		0 to + 2 mm
Position of pintle holes relative to each other		± 2 mm