MATERIAL SPECIFICATION FOR
BEARINGS - ELASTOMERIC PLAIN AND STEEL LAMINATED

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1202.01 SCOPE

This specification covers the requirements for materials, design, and fabrication of plain and steel-laminated elastomeric bearings for bridges.

1202.01.01 Significance and use of Appendices

Appendices are not a mandatory part of this specification unless invoked by the Owner.

Appendix 1202-A is a commentary appendix to provide designers with information on the use of this specification in a Contract.
1202.02 REFERENCES

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

**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 Parallelism of Steel Laminates of Laminated Bearings

Structural Manual
- Division 1, Exceptions to the Canadian Highway Bridge Design Code

**Canadian Standards Association**

- S6-00  Canadian Highway Bridge Design Code

**ASTM International**

- D 395-02  Standard Test Methods for Rubber Property - Compression Set
- D 412-98a (2001)e1  Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
- D 429-02a  Standard Test Methods for Rubber Property - Adhesion to Rigid Substrates
- D 518-99  Standard Test Method for Rubber Deterioration - Surface Cracking
- D 573-99  Standard Test Method for Rubber - Deterioration in an Air Oven
- D 746-98e1  Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
- D 832-97  Standard Practice for Rubber Conditioning for Low-Temperature Testing
- D 2240-02b  Standard Test Method for Rubber Property - Durometer Hardness

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 outer layers of laminated bearings.

**Elastomer** means a compound containing virgin natural polyisoprene (natural rubber) or virgin polychloroprene (neoprene).

**Engineer** means a Professional Engineer licensed by the Professional Engineers of Ontario to practice in the Province of Ontario.

**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.
Proposal means a Contractor’s submission of changes, where engineering design is required.

Shape Factor means the area of the loaded face of an elastomeric layer divided by the area free to bulge.

1202.04 SUBMISSION AND DESIGN REQUIREMENTS

1202.04.01 Submission of Drawings

1202.04.01.01 General

The Contractor shall notify the Contract Administrator in writing of the name and address of the supplier and manufacturer of the bearings within thirty Days of the Contract award.

All bearing drawings shall bear the seal and signature of an Engineer.

Proposals shall bear the seal and signature of the design and checking Engineers.

When another Authority is involved, the submission shall be made a minimum of five weeks prior to the commencement of work.

1202.04.01.02 Layout and Installation Drawings

Five sets of layout and installation drawings shall be submitted to the Contract Administrator, a minimum of three weeks before the commencement of placing bearings.

These drawings shall clearly indicate the following:

a) Bearing layout and orientation.

b) Material properties.

c) Dimensions and details.

d) The number and thickness of internal steel plates.

e) The top or bottom or both plate details including anchorages or dowels or both.

f) Installation details.

g) Load resistance at serviceability and ultimate limit states including maximum compressive permanent and total loads.

h) Compressive stiffness.

i) Shear stiffness.

j) Bearing identification letter and numbers.

1202.04.01.03 Return of Submissions

Two copies of the submission will be returned as follows:

a) Stamped with the wording that allows for permission to construct.

In this case, work can commence on receipt of the drawings by the Contractor. A copy of these drawings shall be available at the site prior to and during construction.
b) Stamped with the wording that allows for permission to construct as noted.

In this case, work can start on receipt of the drawings by the Contractor. The drawings shall be updated as noted and shall bear the seal and stamp of an Engineer stating the drawings have been revised according to the noted comments. A copy of the stamped updated drawings shall be available at the site prior to and during construction.

c) Showing only required changes.

In this case, the drawings shall be updated as required and the submission process repeated.

1202.04.02 Design Requirements

1202.04.02.01 General

Elastomeric bearings shall transmit vertical loads, excluding uplift, and accommodate the rotations and translations of the structure. At serviceability limit state, the design shall be such that the bearings will not suffer damage that would affect their performance. At ultimate limit states, the strength and stability of the bearings shall be adequate to resist the factored load and accommodate movements of the structure.

1202.04.02.02 Design

The bearings shall be proportioned to function satisfactorily under the combination of the maximum and minimum factored loads and factored translations and rotations at the serviceability limit state and the ultimate limit states specified in the Contract Documents.

All steel components of the bearings including any fasteners or dowels shall be proportioned according to CAN/CSA S6 and the Structural Manual, Div.1.

1202.04.02.03 Shape factor

The shape factors for plain and the inner layers of laminated bearings shall not be less than 1.25 or greater than 12.

1202.04.02.04 Design Bearing Pressure

The average pressure on a plain bearing at serviceability limit state loads shall not exceed the following:

a) The value corresponding to the shape factor (S) of the bearing is calculated as 0.22S², but not greater than 7.0 MPa.

b) 4.5 MPa under permanent load.

The average pressure on a laminated bearing shall not exceed the following values:

a) Serviceability Limit State loads
   i. 4.5 MPa under permanent load.
   ii. 7.0 MPa under all loading combinations.

b) Ultimate Limit States
   i. 7.0 MPa under permanent load.
   ii. 10.0 MPa under all loading combinations.

1202.04.02.05 Deflection

The average vertical deformation of plain and laminated bearings at serviceability limit state loads shall not exceed 7% of the effective elastomer thickness.
1202.04.02.06 Translation

Provision for translation shall be through shear deformation of the elastomer.

The shear deformation in any direction of plain and laminated bearings at serviceability limit state loads shall not exceed 50% of the effective elastomer thickness.

1202.04.02.07 Rotation

Provision for rotation shall be through vertical deformation of the elastomer without any uplift at the edge of the bearing at serviceability limit state loads.

The total vertical deformation at the edge of plain and laminated bearings due to the vertical load and rotation at serviceability limit state loads shall not exceed 14% of the effective elastomer thickness.

1202.04.02.08 Elastomer Thickness

The effective elastomer thickness for plain bearings shall not be less than 15 mm and not more than 25 mm.

1202.04.02.09 Steel Thickness

The thickness of the internal steel plates for laminated bearings shall be greater than 3 mm and less than 5 mm.

1202.04.02.10 Geometric Proportions

The bearings shall have the following proportions to ensure stability:

a) Plain Bearings
   \[ L > 5 \, T_e \] or
   \[ R > 3 \, T_e \]

b) Laminated Bearings
   \[ L > 3 \, T_e \] or
   \[ R > 2 \, T_e \]

where

\[ L \] is the lesser plan dimension of a rectangular bearing
\[ R \] is the radius of a circular bearing
\[ T_e \] effective elastomer thickness

1202.05 MATERIALS

1202.05.01 General

Reclaimed material shall not be incorporated in the finished bearing.

1202.05.02 Steel

Internal steel plates for laminated bearings shall be rolled mild steel with a minimum yield strength of 230 MPa.
1202.05.03 Elastomers

The elastomers shall be according to the following:

a) Virgin natural polyisoprene or virgin polychloroprene shall be the only raw polymers permitted.

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

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 as a single unit under pressure and heated in moulds that have a smooth surface finish.

Steel plates shall be according to the following:

a) All steel plates shall be of uniform thickness.

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

c) Steel plates shall be completely bonded on all surfaces to the elastomeric material during moulding. The cover on the edges and top and bottom surfaces shall be 5 mm except that no cover is required over pintle holes.

d) When pintles are specified in the Contract Documents, the depth of pintle holes shall be such as to fully engage only one steel plate.

Elastomer laminates shall be of uniform thickness.

1202.07.03 Identification

Each laminated elastomeric bearing shall be marked with the date of manufacture and an individual alphanumeric identification. The latter shall consist of the designated identification letter of the supplier and source followed by the letter I for polyisoprene or C for polychloroprene and a sequential five digit number. 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.

1202.07.04 Quality Control

1202.07.04.01 Test Specimens

All test specimens of steel laminated bearings for compression set test ASTM D 395, Method B, shall be prepared from the representative bearing pads and may consist of a single layer or multiple layers of elastomer.
1202.07.04.02 Performance and Testing

1202.07.04.02.01 Compressive Deformation of Laminated Bearings

The bearings shall be tested according to LS-428. The increment in compressive deformation of laminated bearings shall not exceed 0.04 of the effective rubber thickness when the bearing load is increased from an initial pressure of 1.5 MPa to a pressure of 7 MPa.

1202.07.04.02.02 Compressive Deformation of Plain Bearings

Plain bearings shall be tested according to LS-427. The increment in compressive deformation of plain bearings shall not exceed 0.06 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.

1202.07.05 Tolerances

- Bearing thickness \( \leq 40 \text{ mm} \) - 0 to + 3 mm
- Bearing thickness > 40 mm - 0 to + 6 mm
- Bearing plan dimension - 0 to + 6 mm
- Thickness of individual layers of elastomer \( \pm 20\% \)
- Deviation from plane parallel to theoretical surface
  - Top and bottom 1 in 200
  - Sides 1 in 100
- Steel Laminates when tested according to LS-429. 0.25 \( T_e \)
- Cover to embedded steel - 0 to + 2 mm
- Pintle hole diameter - 0 to + 2 mm
- Position of pintle holes relative to each other \( \pm 2 \text{ mm} \)
1202.09  OWNER PURCHASE OF MATERIAL

1202.09.01  Measurement and Payment

For measurement purposes, a count will be made of the number of complete bearings delivered and accepted.

Payment at the price specified in the Purchasing Order shall be full compensation for all labour, Equipment, and Material to supply and deliver the complete bearing or individual components to the destination at the time specified.

The cost of all testing, except that performed in the Owner’s laboratory, shall be included in the price.
Table 1
Physical Requirements for Polyisoprene and Polychloroprene

<table>
<thead>
<tr>
<th>Property</th>
<th>Test</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Polyisoprene</td>
</tr>
<tr>
<td>Hardness, Shore A</td>
<td>ASTM D 2240</td>
<td>55 ± 5</td>
</tr>
<tr>
<td>Tensile Strength, MPa</td>
<td>ASTM D 412 Method A</td>
<td>minimum 17.0</td>
</tr>
<tr>
<td>Ultimate Elongation, %</td>
<td>ASTM D 412 Method A</td>
<td>minimum 400</td>
</tr>
<tr>
<td>Heat Resistance</td>
<td></td>
<td>70 h at 70°C</td>
</tr>
<tr>
<td>Change in hardness, Shore A</td>
<td>ASTM D 573</td>
<td>maximum + 10</td>
</tr>
<tr>
<td>Change in tensile strength, %</td>
<td>ASTM D 2240</td>
<td>maximum - 25</td>
</tr>
<tr>
<td>Change in ultimate elongation, %</td>
<td>ASTM D 412 Method A</td>
<td>maximum - 25</td>
</tr>
<tr>
<td>Compression Set, %</td>
<td>ASTM D 395 Method B</td>
<td>22 h at 70°C</td>
</tr>
<tr>
<td>Ozone</td>
<td>ASTM D 518 Method A</td>
<td>25 pphm, 48 h no cracks</td>
</tr>
<tr>
<td></td>
<td>20% strain 40 ± 2°C</td>
<td></td>
</tr>
<tr>
<td>Bond between steel and elastomer laminates, N/mm</td>
<td>ASTM D 429 Method B</td>
<td>minimum 7.0</td>
</tr>
<tr>
<td>Brittleness at - 40°C</td>
<td>ASTM D 746 Procedure B</td>
<td>no failure</td>
</tr>
<tr>
<td>Low temperature crystallization increase in hardness, Shore A</td>
<td>ASTM D 2240 ASTM D 832</td>
<td>168 h at - 25°C maximum + 15</td>
</tr>
</tbody>
</table>
Appendix 1202-A, Commentary for OPSS 1202, November 2003

Note: This appendix does not form part of the standard specification. It is intended to provide information to the designer on the use of this specification in a Contract.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- Pintles for laminated bearings. (1202.07.01.02)
- Minimum and maximum factored loads and factored translational and rotational loads at the serviceable limit states and the ultimate limit states. (1202.04.02.02)

Related Ontario Provincial Standard Drawings

None.