**ONTARIO PROVINCIAL STANDARD SPECIFICATION**

**METRIC**
**OPSS.MUNI 1202**
**NOVEMBER 2023**
(Formerly OPSS 1202, November 2008)

**Note: The MUNI implemented in November 2023 replaces OPSS 1202 COMMON, November 2008 with no technical content changes.**

# 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 Specification Significance and Use

This specification has been developed for use in municipal oriented Contracts. The administration, testing, and payment policies, procedures, and practices reflected in this specification correspond to those used by many municipalities in Ontario.

Use of this specification or any other specification shall be according to the Contract Documents.

**1202.01.02 Appendices Significance and Use**

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their Contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

**1202.02 REFERENCES**

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

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 Parallelism of Steel Laminates of Laminated Bearings

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

**Canadian Standards Association (CSA)**

S6-06 Canadian Highway Bridge Design Code

**ASTM International**

| | |
|---|---|
| D 395-03 | Standard Test Methods for Rubber Property - Compression Set |
| D 412-06a | Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension |
| D 429-03e1 | Standard Test Methods for Rubber Property - Adhesion to Rigid Substrates |
| D 518-99 | Standard Test Method for Rubber Deterioration - Surface Cracking |
| D 573-04 | Standard Test Method for Rubber - Deterioration in an Air Oven |
| D 2240-05 | Standard Test Method for Rubber Property - Durometer Hardness |
| D 4014-03 (2007) | Standard Specification for Plain and Steel-Laminated Elastomeric Bearings for Bridges |

**American Association of State Highway and Transportation Officials (AASHTO)**

M251-06-UL 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 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.

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

**Proposal** means a Contractor's submission for which engineering design is required that provides a written:

a) alternative to requirements specified by the Owner in the Contract Documents;

b) course of action or undertaking by the Contractor as delegated by the Owner in the Contract Documents.

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

## 1202.04 DESIGN AND SUBMISSION REQUIREMENTS

### 1202.04.01 Design Requirements

#### 1202.04.01.01 General

Elastomeric bearings shall transmit vertical loads, excluding uplift, and accommodate the rotations and translations of the structure. At serviceability limit states, the design shall be such that the bearings do 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.

#### 1202.04.01.02 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 states 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, Division 1.

**1202.04.01.03 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.

**1202.04.01.04 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 $0.22S^2$, but not greater than 7.0 MPa.

b) 4.5 MPa under permanent loads.

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

a) Serviceability Limit State loads

   i. 4.5 MPa under permanent loads.
   ii. 7.0 MPa under all loading combinations.

b) Ultimate Limit States

   i. 7.0 MPa under permanent loads.
   ii. 10.0 MPa under all loading combinations.

**1202.04.01.05 Deflection**

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

**1202.04.01.06 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.

**1202.04.01.07 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.

**1202.04.01.08 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.

**1202.04.01.09 Steel Thickness**

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

**1202.04.01.10 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

**1202.04.02 Submission Requirements**

**1202.04.02.01 General**

The Contractor shall notify the Contract Administrator in writing of the name and address of the supplier and manufacturer of the bearings within 30 Days of the Contract award.

Proposals 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 5 weeks prior to the commencement of work.

**1202.04.02.02 Working Drawings**

The Contractor shall submit 3 sets of Working Drawings for the bearings to the Contract Administrator at least 1 week prior to commencement of bearing fabrication, 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.

The Contractor shall have a sealed and signed copy of these drawings at the site prior to and during site installation of the bearings.

These drawings shall clearly indicate the following:

a) Material properties.

b) The number and thickness of internal steel plates.

c) Compressive stiffness.

d) Shear stiffness.

e) Bearing alphanumeric identification.

### 1202.04.02.03 Manufacturer's Certification

Upon completion of fabrication and prior to installation of the bearings, the Contractor shall submit a Certificate of Compliance, signed by the manufacturer, to the Contract Administrator. The certificate 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 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 elastomer 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 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) 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 molding. 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 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 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 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.

**1202.07.04 Quality Control**

**1202.07.04.01 Test Specimens**

All test specimens of steel laminated bearings used 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 0.05 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 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 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 mm |

## 1202.09 OWNER PURCHASE OF MATERIAL

### 1202.09.01 Measurement and Payment

For measurement purposes, a count shall 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 the supply of complete bearings or individual components delivered to the destination on the date and 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**

| Property | Test | Requirements | |
|---|---|---|---|
| | | **Polyisoprene** | **Polychloroprene** |
| Shear modulus $G_{RT}$, MPa @ 20 °C (Note 1) | ASTM D 4014, Annex A1, as modified by AASHTO M251 | $0.80 \pm 0.15$ | $0.80 \pm 0.15$ |
| Shear modulus @ - 40 °C ($G_{LT}$) MP (Note 1) | ASTM D 4014, Annex A1, as modified by AASHTO M251 | Not more than 3 times the value at room temperature<br>$G_{LT} \leq 3\ G_{RT}$ | Not more than 3 times the Value at room temperature<br>$G_{LT} \leq 3\ G_{RT}$ |
| Tensile strength, MPa | ASTM D 412, Method A | minimum 17.0 | minimum 17.0 |
| Ultimate elongation, % | ASTM D 412, Method A | minimum 400 | minimum 400 |
| Heat resistance | ASTM D 573 | 70 h at 70 °C | 70 h at 100 °C |
| Change in hardness, Shore A | ASTM D 2240 | maximum + 10 | maximum + 15 |
| Change in tensile strength, % | ASTM D 412, Method A | maximum - 25 | maximum - 15 |
| Change in ultimate elongation, % | ASTM D 412, Method A | maximum - 25 | maximum - 40 |
| Compression set, % | ASTM D 395, Method B | 22 h at 70 °C maximum 25 | 22 h at 100 °C maximum 35 |
| Ozone | ASTM D 518, Method A 20% strain $40 \pm 2$ °C | 25 pphm, 48 h no cracks | 100 pphm 100 h no cracks |
| Peel bond test, N/mm | ASTM D 429, Method B | minimum 7.0 | minimum 7.0 |

Note:

1. Shear Modulus shall be determined at ambient temperature in accordance with ASTM D 4014 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.

**Appendix 1202-A, November 2023**
**FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS**

**Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.**

## 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 serviceability limit states and the ultimate limit states. (1202.04.01.02)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

## Related Ontario Provincial Standard Drawings

No information provided here.