CONSTRUCTION SPECIFICATION FOR INSTALLATION OF BEARINGS

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922.01 SCOPE

This specification covers the construction requirements for the installation of bearings.

922.02 REFERENCES

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

Ontario Provincial Standard Specifications, Material

OPSS 921	Jacking of Bridge Superstructure
OPSS 1202	Bearings - Elastomeric Plain and Steel Laminated
OPSS 1203	Bearings - Rotational and Sliding Surface

CSA Standards

A3004-C2	Test Method for Determination of Compressive Strengths* * Part of A3000 Cementitious Materials Compendium
S6-19	Canadian Highway Bridge Design Code

Ontario Ministry of Transportation Publications

Designated Sources for Materials (DSM)

MTO Forms:

PH-CC-701 Request to Proceed
PH-CC-702 Notice to Proceed

922.03 DEFINITIONS

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

Anchor means a device employed to secure a bearing to the structure or to restrict movement of the structure or both.

Bearing means a structural device that transmits load while permitting translation or rotation or both.

Superstructure means all parts of a bridge above the bearings.

922.04 DESIGN AND SUBMISSION REQUIREMENTS

922.04.01 Design Requirements

922.04.01.01 Jacking

When jacking is not specified in the Contract Documents, design requirements shall be in accordance with OPSS 921 with the following additional requirements:

a) Detailed calculation of all anticipated jacking and temporary support loads, and member resistances, shall be performed in accordance with CSA S6.

b) The calculated jacking and temporary support loads shall reflect the actual loads that will be present on the bridge during jacking and temporary support, including all anticipated construction dead and live loads.

c) Jacking loads shall be calculated for the jacking operation at serviceability limit states, and when the bridge is on temporary supports at ultimate limit states.

922.04.02 Submission Requirements

922.04.02.01 Layout and Installation Drawings

922.04.02.01.01 General

At least seven Days prior to commencement of bearing installation, one hardcopy and one electronic PDF copy of bearing layout and installation Working Drawings shall be submitted to the Contract Administrator for information purposes only. An Engineer's seal and signature shall be affixed on the bearing layout and installation Working Drawings verifying that they are consistent with the Contract Documents.

A copy of the bearing layout and installation Working Drawings shall be kept on site prior to and during the installation of the bearings.

922.04.02.01.02 Elastomeric Bearings

The layout and installation Working Drawings for elastomeric bearings shall clearly indicate the following:

a) Bearing layout and orientation.

b) Dimensions and details of the bearings.

c) Details of the top or bottom plate, or both, including anchorages or dowels or both.

d) Installation details.

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

f) Individual alphanumeric identification of each bearing and lot identification.

922.04.02.01.03 Rotational and Sliding Surface Bearings

The layout and installation Working Drawings for rotational and sliding surface bearings shall clearly indicate the following:

a) Bearing layout and orientation.

b) Top and bottom plate details, including anchorages.

c) Installation details.

d) Method of attachment of bearings to the top and bottom plates.

e) Bearing identification letter and numbers.

922.04.02.02 Jacking

When jacking is not specified in the Contract Documents, submission requirements shall be in accordance with OPSS 921 with the following additional requirements:

a) Submissions shall be made at least seven Days in advance of the planned jacking operation for approval.

b) The jacking drawings shall clearly show the anticipated loads during the jacking operation at serviceability limit states, and while the bridge is on temporary supports at ultimate limit states.

c) Dimensioned locations of all jacking points shall be clearly shown in an elevation view across the entire substructure, and in a section view of each substructure location cut from elevation at a minimum.

d) Jacking loads shall be clearly shown for each individual jacking point and shall represent the actual loads anticipated at each location.

e) The maximum allowable lift shall be specified on the jacking drawing.

922.05 MATERIALS

922.05.01 Bearings

Bearings shall be according to OPSS 1202 or OPSS 1203 and as specified in the Contract Documents.

922.05.02 Grout

Grout for installation of rotational and sliding surface bearings or anchors shall be cement based, non-shrink, non-staining, and shall be supplied from a source named on the ministry's DSM. Grout shall have a minimum 7-Day compressive strength of 35 MPa.

922.07 CONSTRUCTION

922.07.01 General

The bearings shall be protected from damage, distortion, excessive heat, and deleterious matter during the handling, transportation, storage, and installation.

The bearings shall not be disassembled without the permission of the bearing supplier. The bearing supplier's representative shall be present during disassembly and reassembly.

Upon completion of the structure, the top and bottom surfaces of the bearings shall be in full contact with the structure.

Where pintles are specified in the Contract Documents, they shall engage the steel plate of the bearings through the entire thickness of that plate.

When elastomeric bearings are replaced on an existing structure, the top and bottom of the bearings shall be in full contact with the structure. Work required to achieve full contact shall be as specified in the Contract Documents. If the work as specified in the Contract Documents does not achieve full contact of the bearings, the Contract Administrator shall be notified and the work shall proceed only when directed.

922.07.02 Bearing Seats

The bearing seats shall be finished to an elevation as specified in the Contract Documents and shall be finished level or as specified in the Contract Documents.

For elastomeric bearings, the finish of the concrete surface shall be smooth and not vary greater than 1 mm along a straightedge placed in any direction across an area that extends at least 25 mm beyond the outside limits of the bearing. For other types of bearings, deviation along the straightedge shall not vary greater than 3 mm.

Any concrete surface area prepared by grinding shall not allow water to pond in the area. For elastomeric bearings, the bearing seat areas prepared by grinding shall have a finish equivalent to a trowel finish. All surface areas shall be inspected and deemed acceptable by the Contract Administrator prior to installation of bearings.

922.07.03 Installation of Anchors

The diameter, length, and material of the anchor and the diameter and depth of the anchor hole shall be as specified in the Contract Documents.

Holes for anchors shall be formed into abutments and pier caps prior to casting concrete. Coring for installation of bearing anchors is not permitted, unless specified elsewhere in the Contract Documents. If sleeves are used as forms, they shall be removed prior to installation of anchors.

When coring of the bearing seats to receive anchors is specified in the Contract Documents, coring shall be done without damaging or cutting the steel reinforcement by using either a concrete covermeter or a concrete scanner (such as a ground penetrating radar unit) to locate the steel reinforcement in advance. Where permitted, coring shall not commence earlier than three weeks prior to bearing installation.

The holes shall be protected against entry of moisture and shall be completely filled with grout, when the anchors are installed.

922.07.04 Grouting

Where the anchors for rotational and sliding surface bearings require core drilling or preformed holes, the bearings shall be bedded over their entire area on grout that does not contain any voids. The use of permanent shims to achieve the theoretical elevation at the top of the bearing shall not be allowed.

Grouting operations shall be according to the manufacturer's recommendations, with the following exceptions:

a) The temperature of the air, concrete, and bearings shall not be less than 10 °C at the time of grouting and shall be maintained at not less than 10 °C for a minimum of 96 hours after grout is placed.

b) The thickness of the grout bedding for rotational and sliding surface bearings shall be 12 mm ± 3 mm.

The substrate shall be roughened by bushhammering, cleaned, and prewetted prior to grouting. Transfer of superstructure load to the bearings shall not be allowed until the grout has reached a minimum strength of 30 MPa.

The grout material shall be mixed, handled, and cured according to the manufacturer’s instructions.

Grout is not permitted in contact with elastomeric bearings.

922.07.05 Alignment and Elevation Tolerances

Bearings shall be set level to within a 500H:1V slope in any direction. The top of the bearing shall be set at the theoretical elevation specified in the Contract Documents, within the following tolerances:

Concrete deck and precast I-type girders	± 5 mm
Steel plate girders	0 to + 3.0 mm
Steel and precast concrete box girders	0 to + 2.0 mm

The longitudinal and transverse centrelines of the bearings shall be installed within ± 10 mm of the position specified in the Contract Documents. The centreline of the bearing along the direction of movement shall be parallel to the direction of movement of the bridge at that bearing location within 0.02 radians of the value specified in the Contract Documents.

922.07.06 Temporary Attachments

Temporary clamping devices shall be used to maintain correct orientation and setting and to prevent movement or separation of the bearing components during the handling, transportation, and installation. The clamping devices shall not be used for lifting or suspending the bearings. Clamping devices shall be removed after each bearing is in its final position, with all permanent connections made, and after all grout and concrete in contact with the bearing have been placed.

922.07.07 Jacking

Jacking shall be in accordance with OPSS 921.

922.07.07.01 General

All jacking and temporary support components shall have sufficient strength and stability for the entire duration that they are in use. All jacking surfaces shall be level.

Repairs shall be performed to the existing structure prior to jacking if necessary, so that jacking and temporary support bearing surfaces are sound and competent. Concrete shall reach a minimum strength of 75% of the specified 28-day compressive strength prior to loading.

Jacks may be fitted with appropriate locking collars to function as temporary supports.

922.07.07.02 Adjusting or Resetting Bearings

When jacking is required in order to adjust or reset the bearings, the structure shall be jacked the minimum amount required to allow the bearings to be adjusted.

For girder type bridges, all girders at each abutment or pier shall be jacked simultaneously if the amount of total lift required to adjust or reset the bearings exceeds 3.0 mm and a concrete deck is present.

Each girder may be individually jacked to adjust or reset the bearings if:

a) The total lift required is less than or equal to 3.0 mm and a concrete deck is present; or,

b) The total lift required is less than or equal to 5.0 mm and a concrete deck is not present.

The total lift amount shall include the amount to decompress the bearings plus the additional amount to lift the girders enough to do the bearing adjustment or reset.

For all other bridge types, the entire superstructure shall be uniformly lifted across the entire width of the abutment or pier.

922.07.08 Positive Attachment of Elastomeric Bearing Strips

Where positive attachment is specified for elastomeric bearing strips on ballast walls, wing walls, elastomer shall be attached with stainless steel concrete nails spaced at 400 mm or epoxy adhesive.

922.07.09 Sampling for Quality Assurance Testing

922.07.09.01 Sampling of Bearings

After the bearings have been fabricated, the Contract Administrator shall be notified in writing of the identification and availability of the bearings.

When continuous strip bearings have been specified for precast boxes placed side-by-side, each strip bearing shall be supplied at least 600 mm longer than required. A sample, 600 mm in length, shall be cut in the field from one end of each strip bearing and supplied for testing.

Elastomeric bearings beyond the number of bearings specified for installation shall be supplied as specified in the Contract Documents. Lot size shall be as specified elsewhere in the Contract Documents.

All bearings shall be available for sampling either at the project site or at a location acceptable to the Contract Administrator. Sample bearings for testing purposes shall be randomly selected by the Contract Administrator from the lot. When there is more than one lot containing bearings with the same dimensions, the Contract Administrator shall group the bearings based on sequential dates of manufacture. The Contract Administrator shall advise in writing which bearings have been selected for testing from each lot, and the identification of all other bearings within the lot.

Elastomeric bearings sampled for testing, and a copy of the bearing layout and installation Working Drawings according to OPSS 1202, shall be delivered to:

Head, Concrete Section
145 Sir William Hearst Avenue, Room 15
Downsview, Ontario, M3M 0B6

Bearings weighing more than 30 kg shall be delivered on a wooden pallet which can be lifted by a forklift.

922.07.09.02 Sampling of Approach Slab Bearings and Ballast Wall Bearings

Elastomers delivered to the site shall exceed the required length to allow for a 1 m labelled test sample to be taken from the approach slab or ballast wall elastomers on each structure.

Elastomers shall be delivered, along with a transmittal form to:

Head, Concrete Section
145 Sir William Hearst Avenue, Room 15
Downsview, Ontario, M3M 0B6

922.07.09.03 Grout Sampling

One set of three compressive strength cubes shall be cast for each day of production of grout. Casting of cubes shall be according to CSA A3004-C2. For early strength testing, additional cubes shall be cast. Cubes for compressive strength testing shall be delivered, with a transmittal form, to the Regional Quality Assurance Laboratory.

922.07.10 Inspection after Installation of the Bearings

Inspection after installation of the bearings shall be according to the Contract Documents.

920.07.13 Management of Excess Materials

Management of excess material shall be according to the Contract Documents.

922.08 QUALITY ASSURANCE

922.08.01 Acceptance of Bearings

Acceptance of bearings shall be on a lot basis. The number, type, and size of elastomeric bearing samples to be selected for destructive testing shall be as specified in the Contract Documents.

The acceptance of bearings shall be according to the requirements of this section. If the bearing tested does not meet the requirements of this section, all bearings from the lot are unacceptable and shall not be included in the Work. Unacceptable bearings that have been included in the Work shall be removed and replaced at no additional cost to the Owner. Repairs to elastomeric bearings are not permitted.

Bearings supplied as replacements for rejected bearings shall be sampled, tested, and accepted on the same basis as the original bearings.

An allowance of 60 days shall be made for the Owner's testing program from the time of submission of elastomeric bearings and Working Drawings, according to this specification.

922.08.02 Acceptance of Approach Slab Bearings and Ballast Wall Bearings

Acceptance of bearings shall be on a lot basis. For testing of approach slab bearing and ballast wall bearing elastomers, a lot shall be all the bearings on a structure.

The acceptance of bearings shall be according to the requirements of OPSS 1202. For each lot, one 1 m sample of elastomer shall be tested according to OPSS 1202. If the bearing tested does not meet the requirements of this specification, all bearings from the lot shall be considered unacceptable but with the agreement of the Owner may be permitted to remain in the Work with a payment adjustment. The payment adjustment shall be calculated based on individual lots and applied according to the Basis of Payment section of this specification.

922.08.03 Acceptance of Grout Compressive Strength

One set of three cubes shall be tested for 7-Day compressive strength according to CSA A3004-C2. Grout shall be acceptable if the average 7-Day compressive strength of the set of three cubes is greater than or equal to 35 MPa. Unacceptable grout shall be removed and replaced at no additional cost to the Owner.

922.09 MEASUREMENT FOR PAYMENT

922.09.01 Bearings – Elastomeric, Laminated
Bearings – Rotational

For measurement purposes, a count shall be made of the number of the bearings installed.

922.10 BASIS OF PAYMENT

922.10.01 Bearings – Elastomeric, Plain – Item
Bearings – Elastomeric, Laminated - Item
Bearings – Rotational - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the Work.

Payment at the Contract price shall include full compensation for any additional bearings supplied for destructive testing.

For structural rehabilitation, when repairs to the existing bearing seat or soffit above the bearing areas is required prior to the installation of the new bearings to ensure full contact is achieved, and if the work is not specified in the Contract Documents, payment for such work shall be administered as a Change in the Work.

922.10.02 Payment Adjustment for Bearings

922.10.02.01 Elastomeric Bearings with Steel Laminates

When the elastomer cover to each of the embedded steel plates in the test sample is within the tolerances of the specifications, a payment adjustment factor of 1.00 shall be applied to the Contract price for the bearings location represented by the sample. Bearings that do not meet tolerances are rejectable and shall be removed and replaced at no additional cost to the Owner.

When the elastomer cover to any or all of the embedded steel plates in the test sample is within the payment adjustment range shown in Table 1 and/or Table 2, and a request is made that the Owner accept the bearings in the lot represented by the sample as is, the cover payment adjustment factor equal to 0.5, shall apply to the lot. In the case where both Table 1 and Table 2 indicate a cover payment adjustment factor of 0.5, the payment adjustment factor of 0.5 applies.

When multiple test samples are represented by the tender item, the payment adjustment shall apply to the total plan area of laminated elastomeric bearings represented by the sample, divided by the total plan area of all laminated elastomeric bearings represented by the tender item.

When the average top or bottom elastomer cover to the embedded steel plates in the test sample exceeds the tolerance specified in the Contract Documents and exceeds 70% of the average effective elastomer thickness of internal layers, or when the average thickness of individual layers of elastomer exceeds the tolerance specified in the Contract Documents, a request may be made that the Owner accept the bearings if they meet the design requirements. The bearing supplier shall update the bearing design on the shop drawings for the as-built configuration and shall evaluate the bearing for the design loads based on the as-built geometry.

922.10.02.02 Approach Slab and Ballast Wall Bearings

The payment adjustment for each unacceptable lot of approach slab and ballast wall bearings shall be minus $5,000.

TABLE 1
Payment Adjustment Factors for Elastomer Cover to Embedded Steel Plates – Low Cover at Top and Bottom and Low Cover at Sides

		Minimum Top and Bottom Cover, mm		
		< 3.0	3.0 to 3.5	> 3.5
Minimum Side Cover, mm	< 4.0	Rejectable	Rejectable	Rejectable
	4.0 to 4.5	Rejectable	Rejectable, a request may be made to have bearings within this range accepted with a payment adjustment factor of 0.5	Rejectable, a request may be made to have bearings within this range accepted with a payment adjustment factor of 0.5
	> 4.5	Rejectable	Rejectable, a request may be made to have bearings within this range accepted with a payment adjustment factor of 0.5	Acceptable

TABLE 2
Payment Adjustment Factors for Elastomer Cover to Embedded Steel Plates – Low Cover at Top and Bottom and High Cover at Sides

		Minimum Top and Bottom Cover, mm		
		< 3.0	3.0 to 3.5	> 3.5
Maximum Side Cover, mm	≤ 12.0	Rejectable	Rejectable, a request may be made to have bearings within this range accepted with a payment adjustment factor of 0.5	Acceptable
	> 12.0 to ≤ 15.0	Rejectable	Rejectable, a request may be made to have bearings within this range accepted with a payment adjustment factor of 0.5	Rejectable, a request may be made to have bearings within this range accepted with a payment adjustment factor of 0.5
	> 15.0	Rejectable	Rejectable	Rejectable