SECTION 523 - BEARINGS

523.01 Description This work shall consist of designing, furnishing, testing and installing bearings in accordance with this Specification, and in conformance with the details shown on the plans.

523.02 Materials

Elastomer	711.11
Stainless Steel	711.12
PTFE	711.13
Structural Steel	713.01
Preformed Pads	713.03

Miscellaneous materials, caulking or lubricant shall be as recommended by the manufacturer of the bearings.

523.03 Submittals The Contractor shall prepare shop detail, erection and other necessary working drawings in accordance with Section 105.7. The drawings will be reviewed and approved in accordance with the applicable requirements of Section 105.7. Changes and revisions to the approved working drawings shall require further approval by the Fabrication Engineer.

523.04 General Requirements Requirements for the type of bearing furnished are as follows:

Steel Bearings	Sections 523.10 thru 523.19
Elastomeric Bearings	Sections 523.20 thru 523.29
Pot or Disc Bearings	Sections 523.30 thru 523.39
Spherical Bearings	Sections 523.40 thru 523.49

523.06 Fabrication Tolerances Fabrication tolerances for all bearings shall comply with Section 18.1 of AASHTO, LRFD Bridge Construction Specifications (Table 18.1.4.2-1) unless otherwise noted on the plans or in this Section 523 - Bearings.

523.05 Fabrication Steel fabrication work, for all types of bearings, shall comply with Section 504 - Structural Steel.

523.07 Inspection The Contractor shall notify the Fabrication Engineer at least 10 days in advance of the start of fabrication so that inspection of the work can be provided by the Department. All work will be subject to inspection by the Fabrication Engineer.

Quality Control (Q.C.) is the responsibility of the Contractor. The Quality Control Inspector (Q.C.I.) shall inspect all aspects of the work and shall supervise all testing. The Q.C.I. shall record measurements and test results in a Job Control Record (JCR). The Q.C.I. shall reject materials and workmanship that do not meet contract requirements. The Contractor may perform testing in addition to the minimum required. The results of all measurements and testing shall be made available to the Quality Assurance Inspector (Q.A.I.).

Quality Assurance (Q.A.) is the prerogative of the Fabrication Engineer. The Q.A.I. will ensure that the Contractor's Q.C. is performing properly, verify documentation, periodically inspect workmanship and witness testing. Q.A. testing deemed necessary by the Fabrication Engineer in addition to the minimum testing requirements shall be scheduled to minimize interference with the production schedule.

523.08 Certification The Contractor shall furnish a materials certification letter in accordance with Division 700.

523.09 Installation Bearings Bearings shall be placed upon bridge seats that are properly finished. Bridge seat elevations shall be within ± 6 mm [¼ in] of the elevation shown on the plans and the differential elevation between any tow adjacent bearing areas shall not exceed ± 10 mm [• in] than that shown on the plans.

When the bearings are to be set directly on the concrete bridge seats, as indicated on the plans, the bridge seats shall be dressed 25 mm [1 in] larger all around than the bottom member of the bearing and to the exact elevations shown on the plans or as determined by the Resident. If dressed areas are lower than the surface of the surrounding bridge seat, a channel 50 mm [2 in] wide and with a minimum slope of 4 percent, shall be cut to the edge of the bridge seat for drainage.

Masonry plates shall be set level in their exact position and shall have a full and even bearing upon the masonry. They shall be placed on a preformed pad, the same size and shape as the masonry plate with holes to match the masonry plate.

523.09.1 Anchor Rods The contractor shall drill the holes and set the anchor rods with an Anchoring Material from the

Department's Pre-qualified List. The anchor rods shall be accurately set with an approved two part high-strength epoxy mortar. The epoxy mortar shall completely fill the holes. Anchor bolts shall be capable of developing unconfined pullout strength of 120 kN and 280 kN (30 kips and 70 kips) for M24 and M36 (1 in and 1 ½ in) anchor bolts respectively.

The Department reserves the right to perform in-place pullout tests. Bolts failing to meet the pullout strength requirements shall be replaced at the Contractor's expense.

523.09.2 Grout Pads When the bearings are to be set on a grout pad, the grout shall be composed of one part of Portland cement, Type I or II, to two parts fine aggregate by weight with non-shrink admixture, approved by the resident, well mixed with sufficient water to produce proper consistency.

The grout shall have a minimum compressive strength of 27.5 MPa [4000 psi] at 28 days. A sufficient quantity of the grout materials, including admixtures, and the design composition shall be submitted to the Resident for testing 60 days prior to placement.

The grout shall be well bonded to the adjacent concrete and shall be placed under pressure to ensure that all anchor holes and the entire area under the masonry plate is free of voids.

523.09.3 Sliding Surfaces The sliding surfaces of bearings shall be installed level. Special care shall be exercised at all times to ensure protection of the stainless steel and the PTFE surfaces from coming in contact with any foreign matter.

At no time shall any forms, debris, or other material interfere with the free action of the bearing assemblies.

When bronze or copper-alloy bearing and expansion plates are used, the sliding surfaces or the steel in contact with the bearing and expansion plates shall be recoated immediately prior to installation with a lubricant recommended by the manufacturer of the bronze or copper-alloy plates.

523.09.4 Final Adjustment Bearings shall not be welded in place until the deck is in place and dead load deflection(s) of the superstructure has occurred. Final adjustment of the bearings for temperature shall be made after dead load deflection of the superstructure has taken place. Welding of the sole plate to the flange shall be done, only after all adjustments have been made.

Sliding expansion bearings shall be set so that slotted holes in the sole plate will be centered on the anchor bolts, and rocker bearing assemblies shall be set so as to be plumb at 7ºC [45º F]. When determining temperature adjustments for bearings, the difference between the steel temperature (not the ambient temperature) and 7ºC [45º F] shall be used.

Nuts on anchor rods shall be brought in contact with the masonry plate or sole plate as shown on the plans. Threads on anchor rods shall be upset with a punch to prevent easy removal of the nuts. When anchor rods extend through slotted holes in a sole place, the lower of double nuts shall be left loose, bring to contact and loosen approximately ¼ turn, to allow movement of the sole plate.

STEEL BEARINGS

523.10 Steel Bearings Structural steel bearings, pedestal type, rocker type, sliding plate type shall be fabricated in accordance with the dimensions and finishes shown on the plans, Standard Details and the requirements of Section 504 - Structural Steel.

523.11 Materials Materials shall conform to Section 523.02 - Materials.

ELASTOMERIC BEARINGS

523.20 Description Two types of bearings are applicable for the following Sections; 1) Laminated Elastomeric Bearings consist of layers of elastomer laminated to steel plates and 2) Plain Elastomeric Bearings shall consist of a single layer of elastomer.

523.21 Materials Materials shall conform to Section 523.02 - Materials.
If the elastomer material is specified by its shear modulus on the contract drawings, the measured shear modulus value shall lie within the specified range. When the elastomer material is specified by shear modulus, the Contractor shall supply a consistent value of hardness for the purposes of defining limits for the tests of Table A and B in Section 711.11.

Shear modulus tests shall be carried out using the apparatus and procedure described in Annex A of the ASTM D4014 specifications.

Flash tolerance, finish, and appearance shall meet the requirements of the latest edition of the Rubber Handbook as

published by the Rubber Manufacturers Association, Inc., RMA F3 and T.063 for molded bearings and RMA F2 for extruded bearings.

523.22 Fabrication All components of Laminated Elastomeric Bearings shall be molded as an integral unit. Plain Elastomeric Bearings may be molded individually, cut from previously molded slabs, or extruded and cut to length. Cut edges shall have an ANSI 5 µm [250 mils] finish. Steel laminates shall be abrasive blast cleaned to an SSPC SP-6 and protected from contamination.

523.23 Testing The following testing shall be performed prior to delivery of the bearings:

1. Ambient Temperature Tests on the Elastomer (This test is required for each elastomer formulation.)

The bond to the reinforcement shall develop a minimum peel strength of 6.9 N/mm [39.4 lb/in]. Peel strength tests shall be performed by ASTM D429, Method B. The shear modulus of the material shall be tested at 23ºC [74ºF] using the apparatus and procedure described in Annex A of the ASTM Specifications. In lieu of performing a shear modulus test for each batch of material, the manufacturer may elect to provide certificates from tests performed, on identical formulations, within the preceding year.

2. Low-Temperature Test on the Elastomer (This test is required for each elastomer formulation.)

Low-temperature tests shall be performed in accordance with the requirements of Section 711.11; the compound shall satisfy all criteria for its grade. The manufacturer may choose to provide certificates from low-temperature crystallization tests performed, on identical material, within the last year for Grade 3 to Grade 5 material.

3. Visual Inspection of the Finished Bearing Each bearing shall be inspected for compliance with dimensional tolerances and for overall quality of manufacture. In steel reinforced bearings, the edges of the steel shall be protected everywhere from corrosion.

4. Short-Duration Compression Tests on Bearings Each bearing shall be loaded in compression to 150% of the Bearing Design Load. The load shall be maintained for 5 minutes and released. The same load shall be reapplied and maintained for a second period of 5 minutes. The bearing shall be examined visually during the second loading. If the load drops below the required value during either application, the test shall be performed again.

The bearing shall be rejected if:

The bulging pattern suggests laminate parallelism outside of the specified tolerance
A layer thickness is outside the specified tolerances,
A poor laminate bond exists, or
Three or more separate surface cracks greater than 2 mm [0.079 in] wide and 2 mm [0.079 in] deep exists.

5. Long-Duration Compression Tests on Bearings (This test is required on 10% of each type and size of bearing furnished.)

The long-term compression test shall be performed as specified in section 4 above, "Short-Duration Compression Tests on Bearings", except that the second load shall be maintained for 15 hours. The bearing shall be visually examined at the end of the tests while still under the load. If any patterns or cracks specified in section 4 above occurs, all bearings from that lot shall be rejected, unless the manufacture elects to test each bearing of the lot. If the additional testing does not reveal any rejectable defects as noted in 4 above, the bearings will be accepted.

6. Shear Modulus Tests on Material from Bearings (This test is required for each elastomer formulation.)

The shear modulus of the elastomer in the finished bearing shall be evaluated by testing a specimen cut from it using the apparatus and procedure described in Annex A of the ASTM specifications, amended where necessary in Tables A or B; or at the discretion of the Fabrication Engineer, a comparable nondestructive stiffness test may be conducted on a pair of finished bearings. The shear modulus shall fall within the specified range. If the test is conducted on the finished bearings, the material shear modulus shall be computed from the measured shear stiffness of the bearings, taking due account of the influence on shear stiffness of bearing geometry and compressive load.

Shear modulus tests performed on a sample of the same material as was used to fabricate the bearings will be acceptable. Shear modulus testing shall be performed using the apparatus and procedure described in ASTM D4014, Annex A.

POT or DISC BEARINGS

523.30 Design Pot or Disc bearings shall be designed for the loads and movements given on the plans. Configurations and dimensions other than those given on the plans may be accepted subject to the approval of the Fabrication Engineer. Design calculations to substantiate all the requirements stated in this specification shall be submitted as part of the shop drawings.

Except where indicated on the plans, the design shall also include the connections between the bearings and the superstructure, and the bearings and the substructure, along with adequate provisions for hold-downs equal to the tensile strength of the anchor bolts.

The bearings shall be designed to accommodate a rotation of not less than 0.015 radians.

The static coefficient of friction between the polytetrafluoroethylene (PTFE) and the stainless steel surface, for each size and type of bearing, shall not exceed 0.04 at the average unit bearing pressure for the minimum vertical load indicated on the plans.

The bearings shall be designed for a horizontal force at least equal to 10% of the vertical capacity of the bearing.

No more than two bearings, with guide bars, per bearing line, shall be considered to be carrying the total maximum lateral horizontal load as indicated on the plans.

Bearing friction shall not be considered when the horizontal load capacity of guided or fixed bearings is calculated.

The elastomeric discs shall be designed to meet the following:

1. The minimum thickness shall be $^{1}/_{15}$ of the diameter.

2. The average unit pressure shall be 24.1 MPa [3500 psi], -0%, +10%, for the maximum vertical load indicated on the plans.

3. The average unit pressure shall not be less than 4.8 MPa [700 psi] for the minimum vertical load indicated on the plans.

4. When utilizing flat brass sealing rings, the upper edge of the discs shall be recessed to receive the brass rings.

5. A PTFE sheet, filled or unfilled, 1.6 mm [$^{1}/_{16}$ in] minimum thickness and the same diameter as the design diameter of the disc, shall be placed below the discs.

The pot shall be designed to meet the following:

1. The depth of the cavity shall be equal to or greater than: twice the design rotation plus 2.5 mm [0.1 in] plus the thickness of the elastomeric disc and the PTFE sheet.

2. The inside diameter shall be the same as the design diameter of the elastomeric disc.

3. The pot shall be mounted, to provide a tight fit, in a 3 mm [• in] minimum depth recess in the steel masonry plate or distribution plate and shall be capable of being removed for inspection and repairs.

The piston shall be designed to meet the following:

1. The outside diameter shall be 0.76 mm [0.03 in] less than the inside diameter of the pot.

2. The minimum thickness shall be not less than 0.08 times the design diameter.

3. When utilizing round brass sealing rings, the lower outside edge shall be beveled to accept and retain the brass ring and to permit full design rotation.

4. Laterally restrained pot bearings shall have a keyway in the sole plate. The top surface of the piston shall have a keyway slot and a cold finished steel guide bar press fitted into it and welded at the ends.

5. A PTFE sheet, filled or unfilled, 1.6 mm [$^{1}/_{16}$ in] minimum thickness and the same diameter as the bottom surface of the piston, shall be bonded to the bottom surface of the piston.

The elastomer sealing rings shall be brass and shall be designed to meet the following:

1. Flat brass sealing rings, if utilized, shall:

   a. Have a width of 10 mm [• in] minimum with bearings up to a 4450 kN [1000 kip] capacity and a 13 mm [½ in] width with bearings over a 4450 kN [1000 kip] capacity.

   b. Have a minimum thickness of 1.3 mm [.050 in].

   c. Have two rings with a bearing capacity up to 4450 kN [1000 kip], three rings with a bearing capacity over 4450 kN [1000 kip], but less than 13,500 kN [3000 kip], and four rings with a bearing capacity of over 13,500 kN [3000 kip].

   d. Have the ends cut at 45° with a minimum gap in the installed position of 1.27 mm [.050 in] and shall fit the inside diameter of the pot snugly.

   e. Have the ring gaps staggered 180° apart.

2. Round brass sealing rings, if utilized, shall:

   a. Be of one piece with the ends brazed to make a solid ring.

   b. Have the outside of the ring fit snug in the inside diameter of the pot.

The PTFE sliding surface shall be designed to meet the following:

1. The average unit pressure shall be 24.1 MPa [3500 psi], -5%, +0%, for the maximum vertical load indicated on the plans.

2. Unfilled PTFE shall have a minimum thickness of 3.2 mm [• in] with half of its thickness recessed into the piston.

3. Filled PTFE shall be a minimum of 1.6 mm [$^{1}/_{16}$ in] thick and shall be bonded to the surface of the piston and to the

guide bar.

4. The maximum thickness of the PTFE, filled or unfilled, shall be 2.4 mm [$^{3}/_{32}$ in], except, if recessed it shall be 4.8 mm [$^{3}/_{16}$ in].

The stainless steel sliding surface shall be designed to meet the following:

1. The stainless steel shall cover the PTFE in all operating positions such that the stainless steel will have a minimum of 25 mm [1 in] edge clearance beyond the PTFE.

2. The thickness shall be not less than 1.02 mm [.040 in] nor greater than 2.29 mm [.090 in].

3. When a center guided key is utilized, a recess shall be machined in the sole plate and the vertical sliding surfaces of the recess shall be covered with stainless steel.

The guide bars shall be designed to meet the following:

1. The guide bars shall be designed for the maximum horizontal load, as indicated on the plans, but not less than 10% of the vertical capacity of the bearing.

2. The guided member shall be within the guide bars at all operating positions.

3. The overall width of the guide bar and the PTFE sliding surfaces shall be 3.2 mm [• in] less than the clear width of the keyway in the guided member.

4. A PTFE sheet, 1.6 mm [$^{1}/_{16}$ in] minimum thickness shall be bonded to the sliding contact surfaces of the guide bars. The sheets shall be filled PTFE.

523.31 Materials Materials shall conform to Section 523.02 - Materials and the following:

Sealing rings shall be brass. Flat rings shall conform to the requirements of ASTM B36, half hard. Round sealing rings

shall conform to the requirements of Federal Specification QQB626, Composition 22, half hard.

Elastomer shall have a Shore A hardness of 50 or 60 DURO.

523.32 Fabrication Bonding of PTFE sheets to the piston shall be under factory-controlled conditions and in accordance with written instructions of the manufacturer of the adhesive. After completion of the bonding operation, the PTFE surface shall be smooth and free from bubbles. PTFE surfaces shall not be polished, but shall be wiped clean using a solvent appropriate for the material.

The stainless steel sliding surfaces shall be seal welded around the entire perimeter. The surfaces shall be smooth and flat and the back shall remain in contact with the sole plate.

Pots shall be machined from a solid plate or fabricated by welding a cut shape to a plate. Fabricated pots shall be 100% ultrasonically tested at the inside weld and magnetic particle tested at the exterior weld.

The elastomeric discs shall be manufactured from no more than three pieces.

Each bearing shall be assembled at the plant and following assembly, shall be sealed at the joint between the piston and the pot with a continuous 6 mm [¼ in] bead of a flexible silicone rubber sealing compound approved by the Fabrication Engineer.

Each bearing shall have permanent match marks to indicate the neutral 7°C [45°F] position of the bearing. Each bearing shall also be marked for identification by die stamping on all steel parts (edge of sole plate, piston, masonry plate, and top edge of pot).

Each bearing shall be shipped and stored in moisture-proof and dust-proof covers until they are to be erected.

523.33 Fabrication Tolerances Tolerances shall comply with Section 523.04 - General Requirements, and as noted below.

Brass sealing rings shall have finished surfaces of less than 1.6 µm [63 mils] (ANSI B 46.1).

523.34 Protective Coating All structural steel, except surfaces bonded to PTFE and stainless steel surfaces, shall be zinc

metalized in accordance with Section 506 - Protective Coating. Thickness shall be 0.20 mm [8 mils] on exterior surfaces and 0.05 mm [2 mils] on interior surfaces.

523.35 Testing and Certification The manufacturer of the pot bearings shall furnish test facilities for testing and inspection of the completed bearings in their plant or at an independent test facility approved by the Fabrication Engineer. The Fabrication Engineer or their authorized representative shall be allowed free access to the manufacturer's plant and test facility. The Fabrication Engineer will select two completed bearings for testing. The test shall be arranged so that the static coefficient of friction on the first movement can be determined. The test shall first be conducted at an average bearing pressure of 24 MPa [3500 psi] on the PTFE surface with the test load applied continuously for not less than 12 hours nor more than 14 hours prior to measuring the friction. The first movement static coefficient of friction shall then be determined. The above test shall then be repeated for the minimum vertical load indicated on the plans for the bearings selected. The results shall not exceed that specified for the design.

A proof load test shall also be performed on each test bearing by applying a load equal to 150% of the maximum vertical load indicated on the plans for the bearings selected for a period of one hour. The test bearings shall show no sign of failure or other defects while under load or subsequently upon disassembly and inspection.

Before testing, the testing equipment and procedure shall be reviewed by the Fabrication Engineer.

523.40 thru 523.49 Reserved - Spherical Bearings

523.50 Method of Measurement Bearings will be measured for payment by each unit, tested and accepted. Bearing installation will be measured for payment by each unit in place and accepted.

523.51 Basis of Payment Bearings will be paid for at the contract unit price each, which price shall be full compensation for the design, fabrication, testing, and delivery. Bearing installation will be paid for at the contract unit price each which price shall be full compensation for installation, including all materials, equipment, labor and incidentals necessary for installing the bearings in accordance with the plans and this Specification. Removal of the existing bearings if present, including all materials, equipment, labor and incidentals necessary for jacking the superstructure, removal of the existing bearings and preparation of the bridge seat in accordance with the plans and this Specification shall be considered incidental to bearing installation.

Payment will be made under:

Pay Item		Pay Unit
523.52	Bearing Installation	Each
523.5301	Steel Bearings, Fixed, Sliding Plate	Each
523.5302	Steel Bearings, Expansion, Sliding Plate	Each
523.5303	Steel Bearings, Fixed, Rocker	Each
523.5304	Steel Bearings, Expansion, Rocker	Each
523.5401	Laminated Elastomeric Bearings, Fixed	Each
523.5402	Laminated Elastomeric Bearings, Expansion	Each
523.5403	Plain Elastomeric Bearings	Each
523.5551	Pot or Disc Bearings, Fixed	Each
523.5552	Pot or Disc Bearings, Expansion	Each
523.5601	Spherical Bearings	Each

SECTION 524 - TEMPORARY STRUCTURAL SUPPORTS

524.01 Description This work shall consist of the designing, fabricating, erecting, maintaining, and dismantling of temporary structural support(s) as called for on the contract plans, all in conformity with these specifications. Temporary structural supports proposed by the Contractor to facilitate the work shall also conform to these specifications.

524.02 Materials Materials used may be either sawn timber or steel, or a combination of both, at the Contractor's option, and, whether new or used, shall be sound and of adequate cross section for the intended loads. Blocking needed below the temporary supports to accommodate differences in elevation, and/or pads required to distribute loads to the soil may additionally incorporate plain and reinforced concrete.

524.03 Design Temporary structural support(s) shall be designed to support all vertical loading including live load and impact, differential settlement forces, horizontal and longitudinal forces, and shall account for any temporary unbalanced loading due to jacking forces and other loading during load transfer. Sufficient redundancy shall be designed into the support structure so that failure of one member will not cause the collapse of the entire system and the supported structure.