

SPECIFICATION SECTION 07600 – BRIDGE BEARINGS

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SPECIFICATION SECTION 07600 - BRIDGE BEARINGS

1. DESCRIPTION

This Specification Section prescribes the requirements and procedures for the supply and installation of bridge bearing pads as indicated on the Drawings, or as may be directed by the Engineer.

2. MATERIAL REQUIREMENTS

2.1 Reference Standards

The Standard Specifications for Highway Bridges and the most recent edition of the following Standards shall be applied to the Works covered by this Specification Section.

AASHTO M270M/M183 (ASTM A709M)	Structural Steel
ASTM A240M	Stainless Steel
ASTM A123	Zinc (Hot-Dip Galvanized) Coating on Iron and Steel Products
ASTM C881	Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C1107	Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories
AASHTO M251 (ASTM D4014) ASTM D412	Natural rubber and virgin neoprene Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomer Tension
ASTM D429	Rubber Property-Adhesion to Rigid Substrates
ASTM D518 ASTM D573	Standard Test Method for Rubber Deterioration-Surface Cracking Rubber - Deterioration in an Air Oven
ASTM D746	Brittleness Temperature of Plastics and Elastomers by Impact
ASTM D1149	Rubber Deterioration - Surface Ozone Cracking in a Chamber
ASTM D2240	Rubber Property - Durometer Hardness
ASTM D3182	Materials, Equipment, and Procedures for Mixing Standard Compounds and Preparing Standard Vulcanized Sheets
ASTM D3183	Preparation of Pieces for Test Purposes from Products
ASTM D3184	Evaluation of NR (Natural Rubber)
ASTM D3185	Evaluation of SBR (Styrene-Butadiene Rubber) Including Mixtures With Oil
ASTM D3186	Rubber-Evaluation of SBR (Styrene-Butadiene Rubber) Mixed With Carbon Black or Carbon Black

	and Oil
ASTM D3187	Evaluation of NBR (Acrylonitrile-Butadiene Rubber)
ASTM D3188	Evaluation of IIR (Isobutene-Isoprene Rubber)
ASTM D3189	Evaluation of Solution BR (Poly-butadiene Rubber)
ASTM D3190	Evaluation of Chloroprene Rubber (CR)
ASTM D3192	Carbon Black Evaluation in NR (Natural Rubber)
ASTM D395	Rubber Property - Compression Set
TCCS02:2110/ TCĐBVN	AASHTO LRFD Bridge construction Specifications

2.2 Submittals

The Contractor shall obtain the approval of the Engineer before beginning fabrication of the bearings. The Contractor shall prepare and submit the following to the Engineer for his approval.

- a) Certification by the manufacturer that the elastomer in the elastomeric bearing pads to be provided conforms to all of the requirements indicated in this Specification Section. The certification shall be supported by a certified copy of the results of tests performed by the manufacturer upon samples of the elastomer to be used in the pads.
- b) Certification by the manufacturer that the bearing devices to be provided have been widely applied in other projects, listing the project name, country and bearing codes and properties.
- c) Shop drawings for the bearings prepared according to Section 18 of the Vietnamese Standard TCCS02:2110/TCĐBVN, or equivalent, subject to the approval of the Engineer. The Shop drawings shall show all details of the bearings including the material proposed for use and confirmation that the proposed bearings have been designed to comply with the loading requirements detailed in the Drawings.
- d) Shop drawings and calculations demonstrating the compliance of all bearings with the schedule shown on the Drawings.
- e) Detailed statement describing the procedures for packaging, handling and storage of the bearing devices to be used for the Works.
- f) Detailed schedule for all the required testing of materials or bearing devices to be used for the Works.
- g) Detailed statement of the method for construction and installation of the bearing devices to be used for the Works.
- h) Once the Engineer has approved these submissions, they shall not be changed without prior approval by the Engineer.

3. ELASTOMERIC BEARINGS

3.1 General

- a) Elastomeric bearings shall consist of laminated elastomeric pads or assemblies of laminated elastomeric pads as indicated on the Drawings and as specified herein.
- b) Variation in thickness of an individual elastomer lamination shall not exceed 3 mm within the width or length of a bearing pad and the variation in thickness of all elastomer laminations within a bearing pad shall be such that each metal or fabric lamination will not vary by more than 3 mm from a plane parallel to the top or bottom surface of the bearing pad.
- c) The total thickness of a bearing pad shall not be less than the thickness indicated on the Drawings nor more than 6 mm greater than that thickness. Variation of total thickness within an individual bearing pad shall not exceed 3 mm.
- d) The length and width of a bearing pad shall not vary more than 3 mm from the dimensions indicated on the Drawings.
- e) The bond between the elastomer and the steel laminate shall be such that, when a sample is tested for separation, failure shall occur within the elastomer and not between the elastomer and the steel.

3.2 Materials

- a) All materials used in the manufacture of the bearing assemblies shall be new and unused with no reclaimed material incorporated into the finished assembly. All bonding of components shall be done under heat and pressure during the vulcanizing process. The bond shall be continuous throughout the plan area with no air spaces greater than 0.25 mm within the bonding material. The bearing assemblies shall be furnished as complete units from one manufacturing source.
- b) The materials for the elastomeric bearings and assemblies shall comply with the following requirements:

3.2.1 Elastomeric Materials

The elastomeric materials of the compounds shall be 100% virgin polychloroprene synthetic rubber meeting the requirements of Table No.1. The properties of the elastomeric compounds shall be determined from test specimens complying with ASTM D3182 through D3190 inclusive and D3192. A variation of $\pm 10\%$ in tensile strength and ultimate elongation under “physical properties” will be permitted when test specimens are cut from the finished product.

3.2.2 Internal Steel Laminates

The internal steel laminates for the laminated elastomeric bearing pads shall be rolled carbon steel sheets complying with AASHTO M183.

3.2.3 Laminated Elastomeric Bearing Pads

Laminated elastomeric bearing pads shall be individually moulded to the required size. Corners and edges may be rounded with a radius at the corners not exceeding 9 mm and a radius at the edges not exceeding 6 mm. All edges of the steel laminations shall be covered with not less than 4 mm and not more than 6 mm of elastomer. The characteristics of the elastomeric bearing pads shall be within the tolerances in Table 1:

Table 1 - Requirements of Elastomeric Bearing Pads

ASTM Standard	Physical Properties	Value
D2240 D412	Hardness, ASTM D2240 Tensile strength, min.kg/cm ² Ultimate elongation, min. %	60 ± 5 175 425
D573, 70 HR. @ 100 °C	Heat Resistance Change in durometer hardness, max. points Change in tensile strength, max. % Change in ultimate elongation, max. %	+ 15 - 15 - 40
D395. Method B	Compressive Set 22 hours @ 100°C max. %	35
D1149	Ozone 100 pphm ozone in air by volume, 20% strain, 37.7°C ± 1 °C, 100 hours mounting Procedure D 518, Procedure A	No Cracks
D429, A D429, B	Adhesion to Steel Bond made during vulcanization Bond Strength (per square cm) Peel Strength (per cm of width)	80% R 2.8kg 7 kg
Polychloroprene - Synthetic Rubber	Low Temperature Test-Durometer Change Bearing or sample to be exposed for 96 hrs. at - 28 ±2°C, (The specimen shall have a 24 hr. conditioning period at room temperature prior to low temperature exposure). The durometer test shall be made at -28°C on an unbuffed surface. Durometer hardness increase, Max. ASTM D2240, 30 second reading. Durometer to be placed in freezer with test specimen	+ 15
D746	Brittleness temp., 3 min., at -40°C	No failure
	Structural Steel. The internal steel laminates for the laminated elastomeric bearings shall be rolled mild steel sheets conforming to AASHTO M183.	
	Laminated elastomeric bearings shall be individually moulded to the required size. Corners and edges may be rounded with a radius at the corners not exceeding 9 mm and	

ASTM Standard	Physical Properties	Value
	radius at the edges not exceeding 6 mm. The dimensions of the elastomeric bearings shall be within the following listed tolerances:	
	Overall vertical rubber dimension.	
	Average total rubber thickness 32 mm or less	-0, +3 mm
	Average total rubber thickness over 32 mm	-0, +6 mm
	Overall Horizontal Rubber Dimension 90 cm or less	0, + 3 mm
	Thickness of individual layers of elastomer (60 Durometer Only)	± 20%
	Variation from a plane parallel to the theoretical surface per 300 mm	tops 1.5 mm sides 6 mm
	Edge cover of embedded metallic laminate	4 mm min. 6 mm max.

Source: Reference Bart Facilities Standards – Standard Specifications

The rubber laminates shall be of uniform integral units, capable of being separated by mechanical means into separate, well defined elastomeric layers.

- a) In addition, shear resistance of the bearing shall not exceed 2.1 kg/cm^2 for 60 durometer, Table No. 1 compounds at 25% strain of the total effective rubber thickness after an extended four day ambient temperature of 28 °C.
- b) The Contractor shall furnish to the Engineer a certification by the manufacturer that the elastomer in the elastomeric bearing pads to be furnished conforms to all of the above requirements. The certification shall be supported by a certified copy of the results of tests performed by the manufacturer upon samples of the elastomer to be used in the pads.

4. MECHANICAL BEARINGS

- a) Mechanical Bearings shall be pot type bearings. Movement bearings will normally have sliding surfaces of stainless steel and polytetrafluoroethylene and may also have been fitted with guide bars or keyways.
- b) All structural steel except stainless steel which is used for the manufacture of bearings shall comply with ASTM A709M. Stainless steel which is used for manufacture of sliding surfaces shall comply with ASTM A240M, type 304, 2B; for surface finishing and sliding surfaces, then polished as mirror surface with a roughness of under 0.4 micro C.L.A. If anchor steel for pot bearings is used it must comply with the requirements in AS 2074 Grade 1 Type A, or BS 3100 Grade A. Anchor of carbon steel is not warping and cohesive with cast seam, foam, cracking, blistered or other damages at positions where affect to the aesthetics or strength of steel.

4.1 Packaging, Handling, and Storage of Mechanical Bearings

- a) Prior to shipment from the point of manufacture bearings shall be packaged in such a manner to ensure that during shipment and storage the bearings will be protected against damage from handling, weather or any normal hazard.
- b) Each completed bearing shall have its components clearly identified, be securely bolted, strapped or otherwise fastened to prevent any relative movement, and marked on its top as to location and orientation in each structure in the project in conformity with the plans.
- c) Dismantling at the Site shall not be done unless absolutely necessary for inspection or installation.
- d) All bearing devices and components shall be stored at the Site in an area that provides protection from environmental and physical damage.
- e) When installed bearings shall be clean and free of all foreign substances.

5. DOWELS

- a) Steel dowels shall be provided and installed in accordance with requirements and with accessories noted on the Drawings.
- b) Dowels shall be smooth plain billet steel bars conforming to requirements of ASTM A615, 400 MPa and shall be zinc (hot dip galvanized) in accordance with ASTM A123.
- c) Dowels may be cast insitu as shown on the Drawings or drilled and grouted with an approved epoxy compound.
- d) If dowels are drilled and grouted:
- e) Holes shall provide at least 10 mm in diameter greater than the largest diameter of the dowel;
- f) Holes shall be thoroughly cleaned with compressed air and water prior to grouting of dowels so as to remove all loose or extraneous materials;
- g) The epoxy compound used shall be ASTM C881, Type IV or approved equivalent and mixed and placed in accordance with manufacture's requirements.

6. BEARING INSTALLATION

- a) The bearings shall be clearly marked with their longitudinal and transverse axes, their type number and their intended locations in the Works.
- b) Unless otherwise approved by the Engineer bearing beds shall be of non

shrink grout conforming to ASTM C1107, Grade A. Proposals for the thickness and type of bearing plinths and beds shall be submitted by the Contractor and approved by the Engineer in advance of bearing installation.

- c) Bearings shall not be dismantled. Any transit bolts, straps or other temporary fixing shall not be removed until the bearing is fixed in its final position and the structure immediately above the bearing is in place. Care shall be taken to ensure that all transit bolts, straps or other temporary fixings are finally removed.
- d) All bearings shall be set horizontal in both directions and shall be positioned so that the inscribed longitudinal axis is parallel to the structure axis at the point of support, unless otherwise noted on the Drawings.
- e) Any devices such as steel packs used to hold bearings level whilst being fixed, must be removed so that the bearing seats only on its mortar bedding.
- f) Where pre-cast beams and segments are placed on elastomeric bearings, immediately prior to the placing of each beam and segment the top of the bearing shall be coated with a sufficient thickness of approved mortar to take up any irregularities between the surface of the beams and segment and the bearings.
- g) The characteristics of all bearing shall be within both the manufacturer's tolerances and the following tolerances as shown on Table 2:

Table 2 - Tolerances

Alignment, maximum departure from required vertical or horizontal plane:	
Entire assembly	1:400
Lower part of bearing	1:1000 relative to upper
Plan position	
Laterally	3mm
Longitudinally	6mm
Center/Center Spacing	3mm

7. TESTING OF BEARINGS

The testing of bearings shall be carried out in accordance with related latest edition of ASTM by a licensed independent testing facility to be approved by the Engineer. The Contractor shall obtain consent from the Engineer prior to the test. Frequency of test for bearing is as follows unless otherwise instructed by the Engineer;

Test for Mechanical Bearing: 4.0% of total

Test for Elastomeric Bearings: 2.0% of total

The bearings, which have been tested will not be reused for bridge bearings.

7.1 Mechanical Bearing Tests

a) Vertical Proof Load Test of Complete Bearing.

The vertical proof load shall be 1.5 times the maximum vertical design ultimate load specified in the bearing schedule. The proof load shall be maintained for a minimum period of three minutes.

b) Horizontal Proof Load Test of Complete Bearing.

Bearings, which are required to resist lateral forces shall be further tested to 1.5 times the lateral load stated on the Drawings while loaded in compression to the minimum vertical load shown on the Drawings. The load shall be maintained for three minutes.

c) Rotation Test of Complete Bearing

- i) The bearings shall be tested in rotation to the value for rotation shown on the Drawings while being loaded in compression to the maximum vertical load shown on the Drawings. Bearings, which are required to resist lateral forces, shall also have the specified lateral load stated on the Drawings applied during this test.
- ii) The direction of application of the lateral load and the axis of rotation shall be compatible with the in service loads and rotational requirements. The lateral load shall be applied using a calibrated sliding surface to minimize any frictional restraint. All PTFE and stainless steel interfaces shall be lubricated prior to the test. The test loads shall be maintained for three minutes.

7.2 Elastomeric Bearings

a) Long Duration Compression Tests on Bearings.

Selected bearings shall be loaded in compression to 1.5 times their maximum design ultimate load for a minimum period of 15 hours. If, during the test, the load falls below 1.3 times the maximum design load the test duration shall be extended by the period of time for which the load is below this limit. The bearing shall be examined visually at the end of the test while it is still under load. If the bulging pattern suggests laminate parallelism or a layer thickness that is outside the specified tolerances or poor laminate bond, the bearing shall be rejected. If there are three or more separate surface cracks that are greater than 0.08 in. (2mm) wide and 0.08 in. (2mm) deep the bearing shall be rejected.

b) **Shear Modules Tests on Material from Bearings**

The shear modulus of the material in the finished bearing will be evaluated by testing a specimen cut from the bearing using the apparatus and procedure described in Annex-A of ASTM D4014 or, at the discretion of the Engineer, a comparable non destructive stiffness test may be conducted on a pair of finished bearings. The shear modulus shall fall within 15 percent of the specified value or within the range for its hardness given in Vietnamese Standard TCCS 02:2110/TCĐBVN if no shear modulus is specified. If the test is conducted on 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.

7.3 Rejection of Bearings

Any bearing that, as a result of the testing specified, exhibits any signs of failure such as:

- a) Splitting or permanent deformation of the elastomer;
- b) Tearing, cracking or permanent deformation of the PTFE sliding surface;
- c) Cracking or permanent deformation of the sealing ring or other part of the bearing;
- d) Abrasive marks indicating abnormal contact between the metal surfaces of the bearing plates or piston and the pot;
- e) Non compliance with the requirements and tolerances of this Specification Section, shall be rejected and shall be replaced immediately.
- f) Bearings damaged during transport, installation or subsequent construction operations shall also be liable for rejection and replacement.

8. MEASUREMENT AND PAYMENT

8.1 Method of Measurement

- a) The bearings shall be measured for payment according to the number of each type fully installed in accordance with the Drawings to the approval of the Engineer.
- b) The Bridge Bearing provisions, material requirements, elastometric bearings provisions, mechanical bearings provisions, dowels provisions, bearing installation provisions and testing of bearing provisions identified in this Specification Section shall be measured for payment in pay items 07600-01, 07600-02, 07600-03, 07600-04, 07600-05, 07600-06, 07600-07, 07600-08, 07600-09 and 07600-10.
- c) Any Bridge Bearing Works not specifically indentified in this Specification Section but which are necessary for the performance of the

Works shall be deemed to be included in pay items 07600-01, 07600-02, 07600-03, 07600-04, 07600-05, 07600-06, 07600-07, 07600-08, 07600-09 and 07600-10.

- d) Galvanized steel dowels installed to the approval of the Engineer shall not be measured separately.

8.2 Basis of Payment

- a) The work under this Specification Section shall be paid for in accordance with the applicable unit prices indicated in the Bill of Quantities and given below. Payment shall constitute full compensation for performing the requirements of the Contract for the item of work as specified including furnishing all necessary labor, materials, tools, equipment, incidentals and testing.
- b) The unit prices shall also include full compensation for bearing bedding and furnishing, fabricating, transporting, coating and placing all galvanized steel dowel bars with epoxy grout and proper placement of dowels and grout.

<u>Pay Item</u>	<u>Description</u>	<u>Unit</u>
07600	Bridge Bearings	
07600-01	Elastomeric Bearing, Type (300x400x69)mm	set
07600-02	Elastomeric Bearing, Type (300x450x69)mm	set
07600-03	Elastomeric Bearing, Type (350x450x84)mm	set
07600-04	Elastomeric Bearing, Type (350x500x84)mm	set
07600-05	Pot Bearing, Type (380x410x90)mm	set
07600-06	Pot Bearing, Type (555x555x130)mm	set
07600-07	Pot Bearing, Type (690x600x140)mm	set
07600-08	Pot Bearing, Type (690x710x140)mm	set
07600-09	Pot Bearing, Type (780x705x160)mm	set
07600-10	Pot Bearing, Type (780x820x160)mm	set