SECTION 713 -- CONFINED ELASTOMERIC BEARING DEVICES (POT BEARINGS)

713.01 -- Description

This work shall consist of furnishing and installing confined elastomeric bearing devices at the locations shown in the plans. Bearing devices furnished under this *Specification* shall adequately provide for thermal expansion and contraction, rotation, camber changes, creep, and shrinkage of structural members, where applicable.

713.02 -- Material Requirements

1. Unless otherwise specified in the plans or special provisions, the pot bearings shall be designed in accordance with the applicable requirements of the AASHTO *Standard Specifications for Highway Bridges*.

2. Before fabrication, the Contractor shall submit shop drawings to the Engineer for review. The shop drawings shall show complete details for inspection and construction purposes, detailed by the manufacturer with all appropriate notations and instructions for field installation.

3. a. Confined elastomeric bearing devices shall be supplied as fixed bearings, guided expansion bearings, and non-guided expansion bearings as shown in the plans.

b. Fixed Bearings:

(1) Fixed bearings shall allow rotation but no longitudinal or transverse movement.

(2) Fixed bearings shall consist of an elastomeric rotational element, confined and sealed by a steel piston and steel base pot.

c. Guided Expansion Bearings:

(1) Guided expansion bearings shall allow rotation and longitudinal movement, but transverse movement shall be restricted.

(2) Guided expansion bearings shall consist of an elastomeric rotational element, confined and sealed by a piston and steel base pot.

(3) To allow longitudinal movement, the upper surface of the steel piston shall be faced with a polytetrafluorethylene (PTFE) sheet and support a sliding steel top bearing plate.

(4) The mating surface of the sliding steel bearing plate shall be faced with polished stainless steel.

(5) Guided expansion bearings shall be designed to resist a transverse load of 10 percent of the rated capacity of the device.

(6) To restrict transverse movement, either a guide bar or keyway system shall be used.

(7) The guide bar or keyway systems and their mating steel surfaces shall be faced with strips of PTFE (may be filled or unfilled as per AASHTO specifications) and stainless steel.

d. Non-guided Expansion Bearings:

(1) Non-guided expansion bearings shall allow rotation and longitudinal and transverse movement in the bearing plane.

(2) Non-guided expansion bearings shall consist of an elastomeric rotational element, confined and sealed by a steel piston and steel base pot.

(3) To allow longitudinal and transverse movement, the upper surface of the steel piston shall be faced with polytetrafluorethylene (PTFE) sheet and shall support a sliding steel top bearing plate.

(4) The mating surface of the sliding steel bearing plate shall be faced with polished stainless steel.

4. The elastomeric discs shall meet the following requirements:

a. The physical properties of neoprene and natural rubber used in these bearings shall conform to AASHTO specifications.

b. Confined elastomeric discs shall have a minimum thickness as determined by the following formula:

Elastomeric Disc Thickness Formula			
	t	=	ID/C
where:	t	=	minimum elastomeric disc thickness
	ID	=	inside diameter of pot cylinder
	C	=	25 for less than 0.011 radians of rotation
	C	=	20 for 0.011 thru 0.016 radians of rotation
	C	=	15 for over 0.016 radians of rotation

c. Areas of elastomeric discs shall be designed for a working stress of 3,000 psi ± 5 percent at the total dead and live loads of the structure.

d. The upper edge of the elastomer shall be recessed to receive the brass rings.

e. The entire top and bottom of the elastomeric disc shall be lubricated with an even film (approximately 1 to 3 mils thick) of silicone grease meeting Specification MIL-S-8660C.

f. Elastomeric discs may be either chloroprene or natural polyisoprene with a 50 ± 5 Shore A durometer hardness and shall be individually molded and monolithic. No layering of elastomers will be allowed.

5. The steel pot shall conform to the following requirements:

a. All steel used in pot bearings shall conform to the minimum requirements of ASTM A 709, Grade 36, Grade 50, or Grade 50W.

b. Pots shall be made from a solid plate by machining.

c. The depth of the pot cavity shall be equal to or greater than the design rotation + 0.02 radians + 0.1 inch + the thickness of the elastomeric disc.

d. Inside diameters shall be the same as the elastomeric disc.

e. (1) The pot shall be seated in a machined recess of 0.000125 inch RMS max. profile (before metallizing) in the masonry plate, without welding, to a depth required by design, but not less than 0.25 inch.

(2) The inside dimension of the finished recess shall be 0.03 inch to 0.05 inch larger than the actual outside dimension of the finished pot base.

(3) The juncture formed between the edge of the pot and the top masonry plate surface must be caulked with a durable moisture sealant recommended by the bearing manufacturer and approved by the Engineer.

(4) The anchor bolt spacing in the masonry plate and any other considerations shall be incorporated in the design of the bearings to allow for future removal, replacement, or repair of the pot cylinder and piston assembly.

f. Pots or masonry plates must be designed to transmit a maximum bearing stress of 1,200 psi (working stress design) to the concrete surface.

g. Lead sheet used under the masonry plate shall be of the shape and thickness shown in the plans, but not less than 1/8 inch thick, conforming to the requirements of ASTM B 29.

6. The piston shall conform to the following requirements:

a. (1) The piston and/or top plate shall be seated in a machined recess of 0.000125 inch RMS max. profile (before metallizing) in the sole plate, without welding, to a depth required by design, but not less than 0.25 inch.

(2) The inside dimension of the finished recess shall be 0.03 inch to 0.05 inch larger than the actual outside dimension of the finished piston or top plate.

b. Pistons shall be designed with outside diameters as follows:

(1) Flat brass sealing rings, 0.03 inch to 0.05 inch less than pot inside nominal diameters.

(2) Round brass sealing rings, 0.02 inch to 0.1 inch less than pot inside nominal diameters.

c. Piston thickness shall be:

(1) POT ID x 0.08 (minimum) for square shape pots.

(2) POT ID x 0.06 (minimum) for round shape pots.

d. Pistons for round cross section sealing rings shall have the lower outside edge bevelled to accept and retain the ring and allow full design rotation.

e. For laterally restrained pot bearings having a shear key in the piston, the top surface shall have keyway slot and cold finished bar press fit and welded at the ends. Pistons of this design shall be machined from one piece of steel.

7. Elastomeric sealing rings shall conform to the following requirements:

a. Flat brass sealing rings shall meet the following requirements:

(1) Width shall be 0.375 inch minimum for bearings up to 1,000 kips of capacity and 0.5 inch minimum for over 1,000 kips capacity. Rings must be manufactured to a tolerance of ± 0.005 inch.

(2) The thickness shall be 0.05 inch minimum.

(3) Up to 1,000 kip capacity, 2 rings shall be used; from 1,000 kips to 3,000 kips, 3 rings; and over 3,000 kips, 4 rings shall be used.

(4) Rings shall fit the ID of the pot snugly, and the ends shall be cut at 45 degrees. When installed in the pot, the maximum gap shall be 0.05 inch.

(5) Flat brass rings shall conform to the ASTM B 36, half hard requirements.

(6) Round cross section brass rings shall conform to the Federal Specification QQB626, composition half hard requirements.

(7) When 2 seal rings are used, the ring gaps must be staggered 180 degrees apart. When more than 2 rings are required, the gaps of the successive rings must be evenly spaced around the perimeter of the pot.

b. Round cross section brass sealing rings shall meet the following design requirements:

(1) Rings shall fit the POT ID snugly.

(2) Rings shall be made from one piece rolled into a circle and brazed.

8. The PTFE sliding surface shall conform to the following requirements:

a. The PTFE shall be manufactured from pure, virgin, unfilled TFE resin.

b. The properties of the PTFE shall conform to the current AASHTO Specifications for the PTFE bearing surfaces.

c. The area of the PTFE shall be designed for a working stress of 3,500 psi at the full dead and live loads of the structure.

d. Unfilled PTFE shall meet the following requirements:

(1) PTFE shall be bonded and recessed into the surface of the piston for half its thickness. It shall be a minimum of 1/8 inch thick and not more than 3/16 inch thick.

(2) PTFE shall have a minimum ultimate tensile strength of 2,500 psi.

9. The stainless steel sliding surface shall meet the following requirements:

a. Stainless steel shall conform to the requirements of ASTM A 240, Type 304. Stainless steel in contact with the PTFE sheet shall be polished to a finish of 0.01 mil RMS or less.

b. The stainless steel surface shall cover the PTFE surface in all operating positions plus 1 inch in every direction of movement.

c. Stainless steel shall be a minimum of 0.07 inch to a maximum of 0.08 inch thick and shall be connected to the sole plate by means of a neat seal weld around the entire perimeter of the plate. Welding slag or other residues on the stainless sliding surfaces are not acceptable. Stainless steel used on guide bars or in keyways shall also meet these thickness and other general quality requirements.

d. Welding procedures shall be chosen such that the stainless steel surface is in contact with the sole plate and the surface is smooth and flat.

e. For pot bearings designed with center guided key, the finished recess in the sole plate shall be a maximum of 1/8 inch wider than the PTFE bonded shear key.

f. Stainless sliding surfaces shall face downward.

10. Guide bars shall meet the following requirements:

a. Guide bars may be connected to sole plates by means of either welding or recessed high tensile fasteners. High tensile fasteners, if required by design, shall be designed using 0.2 x Fu (stress ultimate) for allowable stress in single shear.

b. Guide bars and their connections to the sole plate shall be designed for the horizontal forces on the bearing and not less than 10 percent of the vertical capacity of the bearing.

c. Unless the space between the guide bars is specified, it shall be a total of 1/8 inch.

d. Guiding arrangements shall be designed so that the guided member is always within the guides at all bearing translation points.

e. Guiding off the fixed base or any extension of it will not be allowed.

11. Fabrication Tolerances:

a. Steel pots shall meet the following tolerances:

(1) The inside diameter shall be machined to a tolerance of ± 0.005 inch up to 20 inch diameter and ± 0.007 inch over 20 inch diameter.

(2) Pot undersides shall be machined parallel to the inside to a Class "A" tolerance as defined in Paragraph 12.a.(4)(i) of this Subsection.

(3) Internal finish shall be 0.000125 inch RMS or better.

b. Elastomeric disc tolerances shall be as follows:

(1) Diameters greater than 20 inches: + 3/32 inch.

(2) Diameters less than 20 inches: ± 1/16 inch.

(3) Thickness shall be -0.0 inch to + 1/8 inch.

(4) Discs shall be manufactured in one piece.

c. Piston tolerances shall be as follows:

(1) Diameters greater than 20 inches: ± 0.007 inch.

(2) Diameters less than 20 inches: ± 0.005 inch.

(3) Upper side flatness: Class "A" tolerance.

(4) Lower side flatness: Class "B" tolerance.

(5) Machine finishes shall be 0.000125 inch RMS or better.

d. Masonry and distribution plate tolerances shall be as follows:

(1) Plan dimensions over 30 inches: -0.0 inch to + 3/16 inch.

(2) Plan dimensions under 750 mm: -0.0 inch to + 1/8 inch.

(3) Flatness: Class "B" tolerance.

e. PTFE and stainless steel sliding surface tolerances shall be as follows:

(1) Plan dimensions: total nominal design area -0.0 inch to + 5 percent.

(2) Flatness: Class "A" tolerance.

(3) Bonding of the PTFE, where required, shall meet the peel test requirements (ASTM D 903) of 25 lb/in at an angle of 180 degrees. Bonding must be complete and without air gaps under the PTFE sheet in order to seal out moisture and provide a smooth, flat slide surface.

f. Sole plates shall conform to the following tolerances:

(1) Plan dimensions over 30 inches: -0.0 inch to + 3/16 inch.

(2) Plan dimensions under 30 inches: -0.0 inch to + 1/8 inch.

(3) Thickness: -1/32 inch to + 1/8 inch.

(4) Flatness of the upper surface: Class "B" tolerance.

(5) No bevelled edge shall be less than 5/8 inch thick.

g. Guide bar tolerances shall be as follows:

(1) Length: ± 1/8 inch.

(2) Section dimensions: ± 1/16 inch.

(3) Flatness, where it bears on another plate: Class "A" tolerance.

(4) Bar-to-Bar tolerance: "Nominal Dimension" ± 1/32 inch.

(5) Parallelism: The finished PTFE bonded guide bars shall not be more than 1/32 inch out of parallel, vertically or horizontally.

h. The overall height of a bearing shall not exceed the nominal height by more than 3/16 inch or be less than 1/16 inch under.

i. The edges of all parts shall be rounded by grinding so that there are no sharp edges.

12. Confined Elastomer Bearings-Tolerances for Flatness:

Flatness of bearing surfaces shall be determined by the following method:

a. A precision straightedge longer than the nominal dimension to be measured shall be placed in contact with the surface to be measured as parallel to it as possible.

b. An attempt shall be made to insert a feeler gauge, equal to the tolerance allowed and having an accuracy of ± 0.001 inch, under the straightedge.

c. Plates are "acceptable" if the feeler gauge does not pass under the straightedge.

d. Flatness tolerances shall be as follows:

(1) Class "A": 0.0005 x "Nominal Dimension".

(2) Class "B": 0.001 x "Nominal Dimension".

(3) Class "C": 0.002 x "Nominal Dimension".

e. "Nominal Dimension" shall be interpreted as the actual dimension of the plate, in inches, under the straightedge where the straightedge is not parallel to any plan dimension of the plate being measured.

f. In determining the flatness, the straightedge may be located in any position on the surface being measured.

13. Metallizing:

a. (1) All exposed carbon steel surfaces shall be blasted clean to a near white finish, degreased, and zinc metallized to a minimum uniform thickness of 8 mil.

(2) All interior surfaces, including the pot and piston assembly and masonry plate recess, shall receive no less than 1 mil nor more than 3 mil thickness of zinc metallizing.

(3) All metallizing must be performed with good work quality in accordance with American Welding Society Specification AWS C 2.2.

b. Anchor bolts, nuts, and washers shall conform to ASTM A 307 and shall be galvanized in accordance with ASTM A 153.

14. Confined Elastomer Bearing - Testing:

a. The bearing manufacturer shall notify the NDR Materials and Tests Division at least 10 NDR work days before the time of the required bearing tests. The Engineer shall be allowed to witness all testing and approve the testing agency or other parties involved in the testing operation.

b. The coefficient of friction shall be determined for at least one sample chosen at random from the production lot. Specially made or test bearings shall not be used. Other than these requirements, the test shall be conducted in accordance with the requirements of AASHTO *Standard Specifications for Highway Bridges*.

c. A proof load test shall be performed on at least one sample of each type (fixed, non-guided expansion, and guided expansion) selected at random from the production lot. Each bearing tested shall be loaded to 150 percent of the maximum vertical design load for a period of one hour. The fixed and guided expansion bearings shall also be loaded as follows:

(1) 100 percent of the minimum vertical design load in combination with 150 percent of the maximum horizontal load, whether lateral or longitudinal.

(2) These loadings shall be maintained for at least 1 hour.

d. All bearing devices tested shall show no signs of failure or any other defects while under load or subsequently upon disassembly.

e. Elastomer Seal Test:

(1) Where the Engineer requires the efficacy of any particular sealing system of different design or material than those detailed in these *Specifications* to be demonstrated, an additional elastomeric seal test shall be made.

(2) This test shall be conducted by a recognized testing laboratory.

(3) It shall be witnessed and certified by a registered Professional Engineer.

f. The bearing to be tested shall be selected at random from the production lot and tested as follows:

(1) The test equipment and test method shall be approved by the Engineer.

(2) A bevel plate equal to the design rotation of the bearing shall be inserted between the test machine and the test bearing.

(3) The load shall be applied to the test bearing uniformly and smoothly over a period of 5 minutes up to the full test load.

(4) The test load shall be 3 times the capacity of the bearing and shall be maintained for a period of 6 hours with no change in the load.

(5) During the test, the bearing shall be carefully examined for any sign of extrusion of the elastomer.

(6) After removal of the test load, the bearing shall be disassembled and examined for any sign of damage or permanent deformation of the sealing system. Bearings which show no sign of extrusion of the elastomer and no deformation of the sealing system may be considered acceptable.

15. Certification:

a. A copy of the test certificates documenting tests performed and mill tests for all materials used in the bearing fabrication shall be submitted to the NDR Materials and Tests Division for review and approval.

b. In addition, the manufacturer or their representative must contact the NDR Materials & Tests Division to confirm materials are approved one week before shipping the bearings.

16. Inspection:

Before installation, confined elastomeric bearing devices will be disassembled on the project site by Department personnel to inspect for conformance with the approved shop drawings and contract specifications.

713.03 -- Construction Methods

The Contractor shall install elastomeric bearing devices in accordance with the manufacturer's recommendation and as prescribed in the plans.

713.04 -- Method of Measurement

"Fixed Bearing Devices, Type I", "Guided Bearing Devices, Type II", and "Non-Guided Bearing Devices, Type III" are measured by the each.

713.05 -- Basis of Payment

1.

Pay Item	**Pay Unit**
Fixed Bearing Device, Type I	Each (ea)
Guided Bearing Device, Type II	Each (ea)
Non-Guided Bearing Device, Type III	Each (ea)

2. Payment is full compensation for all work prescribed in this Section.