

INTRODUCTION – POT BEARINGS

Introduced nearly 50 years ago, Pot Bearings are now in service in thousands of structures throughout the USA and the world. There are good reasons for this popularity, all stemming from the confined elastomer principle.

A rubber pad, when tightly confined within a steel “pot”, will support an almost limitless stress. Tests to 57,000 psi show absolutely no change in the structure of the material.

Because rubber undergoes no change in its volume when loaded (Poisson’s ratio = 0.5), there is virtually no compression under load. If a freely loaded plate, bearing on such a pad, is tilted, the rubber flows within the confined space with almost no resistance to the rotation. Since the rubber reacts like a viscous fluid, pressure is uniformly distributed within the closed system. Figure 1 illustrates the complete system.

Practical bearings using this principle can be designed for any combination of loads (including uplift), angle of rotation or horizontal load found in today’s bridges and only Pot Bearings have all the following performance advantages:

a.) Negligible vertical deflection: In designing a structure, the Engineer only needs to consider a maximum 0.06” compression of Pot Bearings. By contrast, unconfined, un-reinforced Elastomer Disc or Pad Bearings will compress, (i) under dead load, (ii) under live load, and (iii) with time. All will have potentially damaging effects on expansion joints, rail connections, and water mains or utility pipes crossing the bridge.

b.) Uniform loading: A line of Pot Bearings along a pier will accept loading uniformly since the very small compression (0.06” max.) is typical for all Pot Bearings. By contrast, unconfined elastomer discs have a compression that varies with size and hardness.

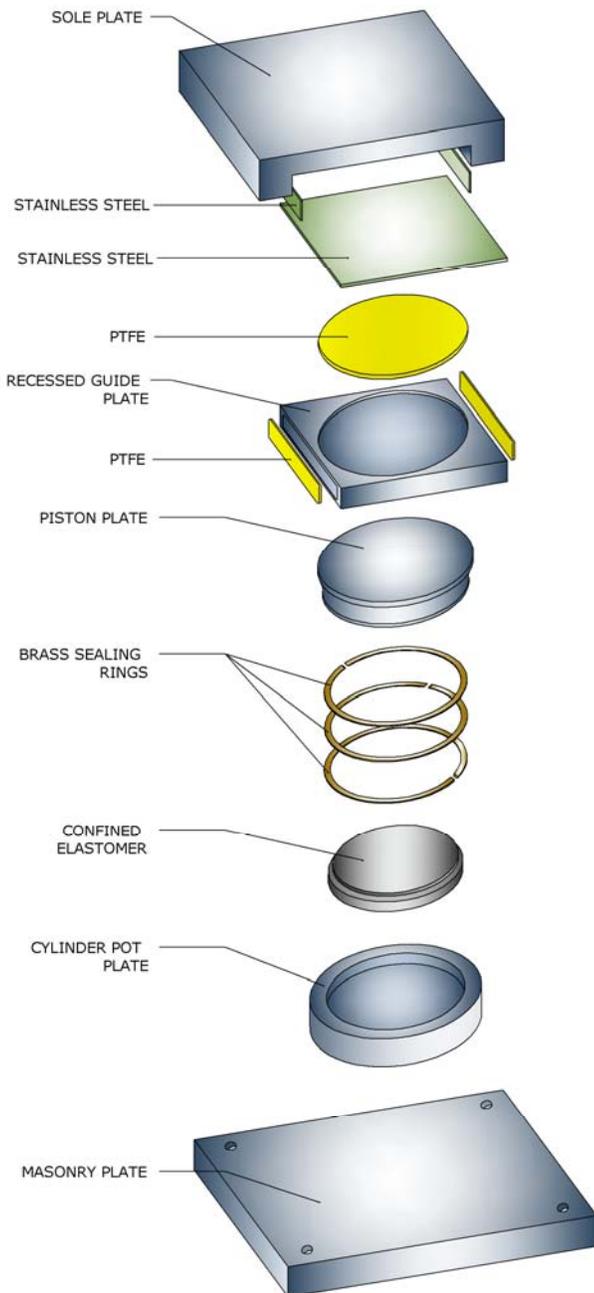


FIGURE 1: TYPICAL POT BEARING



A normal hardness tolerance of 4 durometer points (Shore) equates to a change in Young's Modulus of approx.. 30%! Therefore a line of these bearings along a pier may compress differently one from another by as much as 30% giving rise to significant secondary stresses within the structure.

c.) Minimal load eccentricity: Tilting of the piston caused by end rotation of the bridge beam results in a slight deformation. The resistance to this deformation is so small that the load eccentricity is no more than 3% of the disc diameter. Thus Pot Bearings have the least resistance of any bridge bearing in the critical range of 0.01 to 0.022 radians.

d.) Low stress on bearing seats: Due to the basically hydraulic design principles, the characteristic load distribution curve under a Pot Bearing is flatter than other bearing types, which means lower peak pressures on the supports.

e.) High horizontal load capacity: The naturally large bearing area of the piston against the pot wall inherently withstands high side forces. Although a figure of 10% of vertical capacity is normal, 50% and more can be provided by simply increasing this bearing area. Compare this with bearings having central pin-and-sleeve restraints. These restraints become so large when designed for high horizontal forces, that higher load-range bearings must be used.

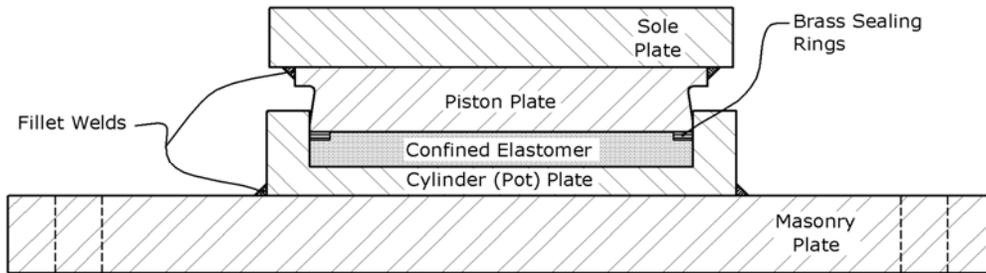
Also note that Spherical Bearings are sensitive to large horizontal loads which can cause the convex part of the bearing to "ride up" out of its socket and, in extreme cases, pop-out.

Expansion Pot Bearings feature slide interfaces of PTFE/stainless steel. The Pot Bearing works particularly well with a PTFE slide surface for several reasons. Many factors affect the coefficient of friction, but it has been found to decrease with increasing pressure. However, excessive pressures would cause the PTFE to cold flow. An ideal balance is struck at about the same pressure at which a Pot Bearing operates. Also, the very small load eccentricity under rotation of the Pot Bearing provides the lowest possible edge loading. Finally, the even pressure distribution inherent in the hydraulic principle of the pot ensures the lowest peak pressures on the PTFE.

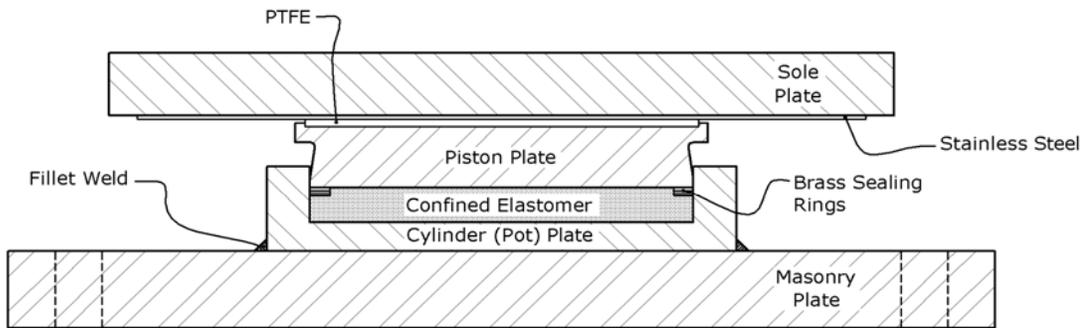
Pot Bearings have the additional advantages of compact size, low overall height and efficient use of materials.

STANDARD BEARINGS — POT BEARINGS

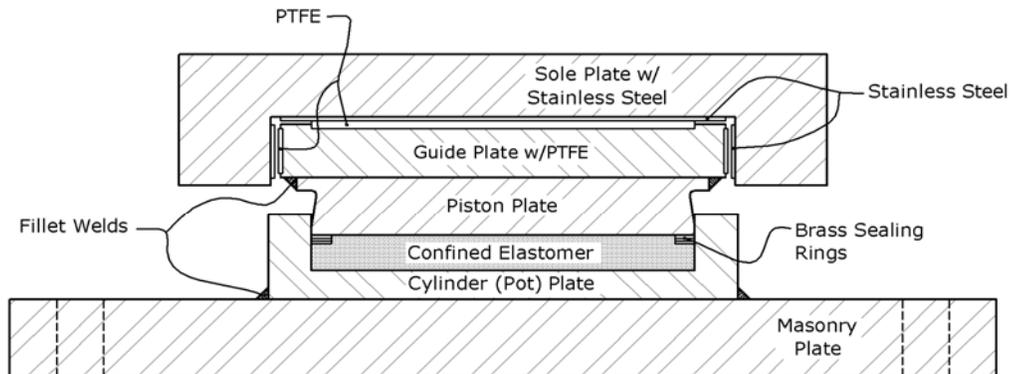
The bearings detailed in the following examples represent a typical range of economical units. Included are Fixed, Non-Guided Expansion and Guided Expansion Bearing Units. These units are the best for high side forces, are relatively low in height and are usually the lowest in cost.



FIXED POT BEARING

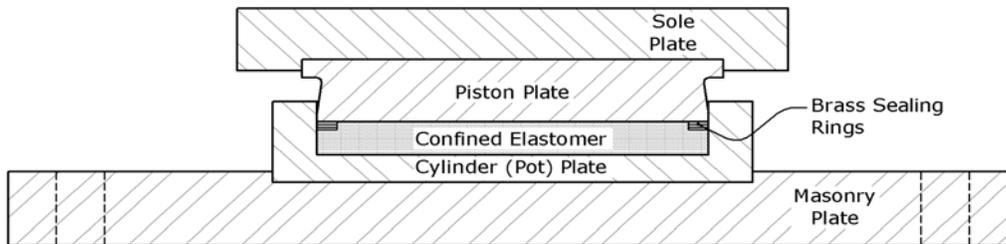


NON-GUIDED EXPANSION POT BEARING

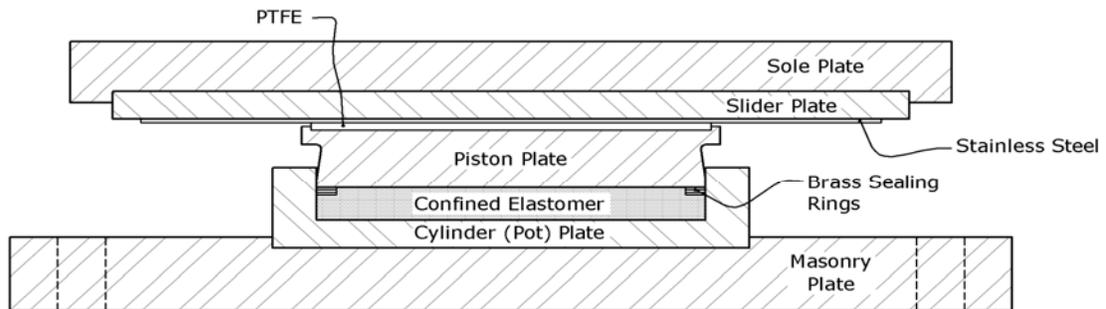


GUIDED EXPANSION POT BEARING

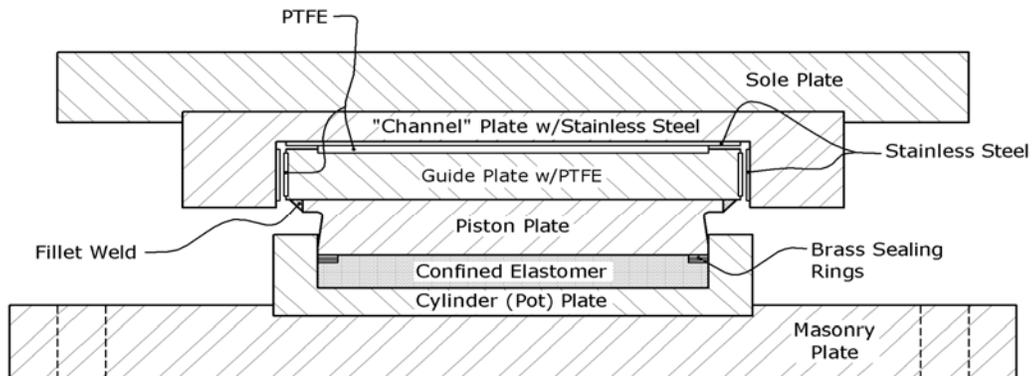
Where replaceability is an issue, the following Pot Bearing units with removable lower bearing plates are recommended:



FIXED POT BEARING



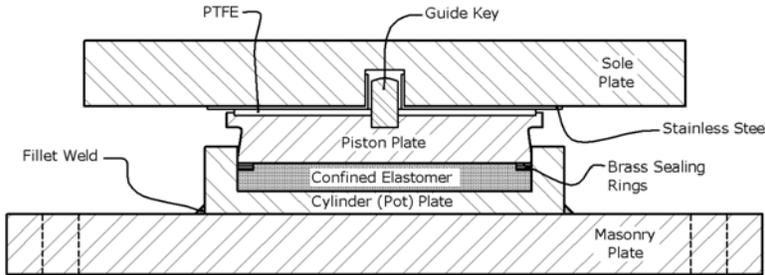
NON-GUIDED EXPANSION POT BEARING



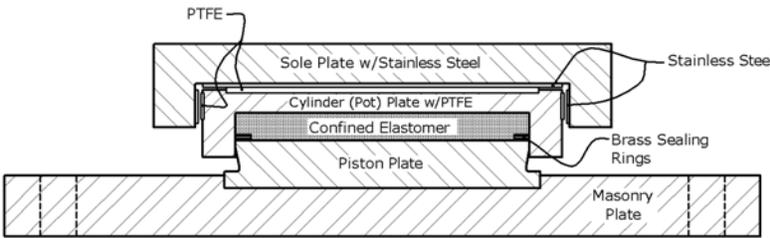
GUIDED EXPANSION POT BEARING

DESIGN ALTERNATIVES—POT BEARINGS

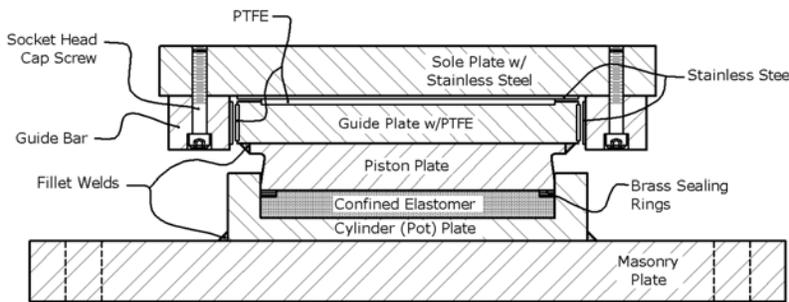
The bearings detailed in the following examples are alternative bearing configurations that are produced by Cosmec that may be used for specialized applications or special requirements:



CENTER-GUIDED EXPANSION POT BEARING



"INVERTED" GUIDED EXPANSION POT BEARING



GUIDED EXPANSION POT BEARING w/BOLTED GUIDE BARS

CENTER-GUIDED EXPANSION

POT BEARING: May be used when a lower profile is required. Is used best when horizontal loads are relatively small (less than 20% of vertical Load). Many different low-coefficient of friction surfaces are possible and different configurations are possible for the guide key.

"INVERTED" GUIDED EXPANSION POT

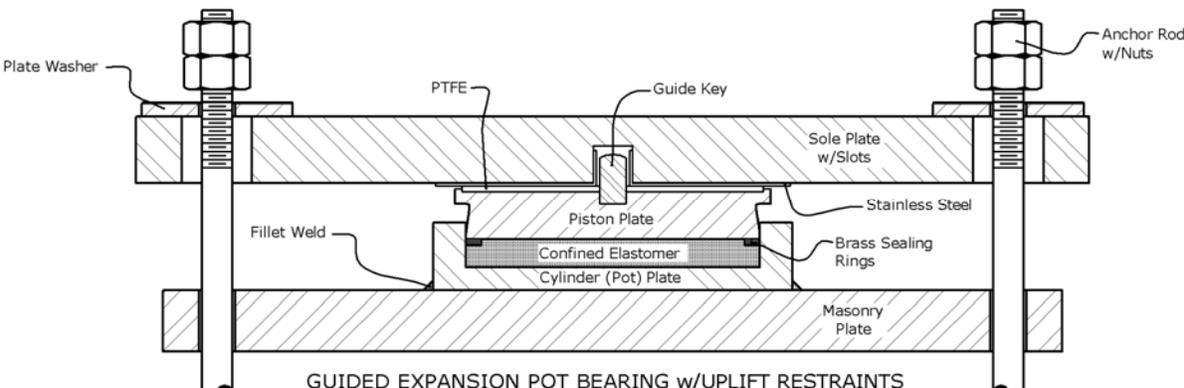
BEARING: Can be used when the height of the bearing must be kept as low as possible – such as for rehabilitation projects.

GUIDED EXPANSION POT BEARING WITH BOLTED

GUIDE BARS: These can be used when removable guide bars are desired.

POT BEARINGS WITH UPLIFT RESTRAINTS:

Cosmec can design Pot Bearings with uplift restraints when some uplift is anticipated. One possible configuration is shown, however many differing configurations are possible. We can customize bearings as required.



GUIDED EXPANSION POT BEARING w/UPLIFT RESTRAINTS



DESIGN and MATERIALS — POT BEARINGS

Cosmec's Pot Bearing designs draw from experience, full size bearing testing and the latest technology. Our team has total design and manufacturing experience in excess of 50 years and we participate in creating the very latest specifications.

Our designs are based on using ASTM A709 Grade 50 (AASHTO M270 Grade 50) steel, and ASTM A709 Grade 50W (AASHTO M270 Grade 50W) weathering steel. ASTM A709 Grade 36 (AASHTO M270 Grade 36) will be considered on demand. We prefer to maintain a maximum pressure on both the elastomer and on the primary PTFE surfaces of 3500 psi. PTFE on guided surfaces may be stressed considerably higher.

The brass sealing rings are of such strength that one can effectively seal the elastomer, but typically three rings are provided for a wide margin of safety and design redundancy. They are open ended and sprung so that they can accommodate tolerances of pot manufacture and shape changes during rotation. They are constantly pressed against the pot wall by the pressures within the elastomer.

All materials for all US bearings will be certified domestic material, manufactured and fabricated in the USA in accordance with the "buy American" requirements for all Federally funded work.

Material specifications include ASTM A240 Type 304 and Type 316 stainless steel with a #8 mirror finish; AASHTO Grade 50 Durometer elastomer; and ASTM D4894 PTFE; ASTM B36 for the brass.

Testing can be undertaken to fulfill all requirements of the AASHTO Specifications and any other specialized testing as may be required. Most testing can be performed in our own testing facilities.

Coating on the bearings can be the latest high performance paints, including high-solids zinc primers, or the bearing assemblies can be metallized (zinc or zinc/aluminum thermal spray coatings). Galvanizing of the carbon steel components can be considered on demand. Coating recommendations can be made to insure a long-lasting product no matter what the environment.



STRUCTURAL DESIGN CONSIDERATIONS — POT BEARINGS

These units are the best for high side forces, are relatively low in height and are usually the lowest in cost.

Expansion Bearings should be mounted with the primary stainless steel sliding surface facing down so as to avoid the accumulation of dirt and debris that can affect the sliding performance of the bearing over time. However, Cosmec has provided Expansion Bearings with the stainless sliding surface upwards and special debris brushes were provided to insure that the sliding surface was kept clean. Please contact our Design Team if such bearings may be required on your project.

Fixed Bearings may be mounted any face up.

Slide plate offsets can be provided when specified.

Pot Bearings are not designed to take bending moments. They must be provided with even, flat seats. High-strength grout or rubber or fabric pads are recommended. Leveling blocks or bolts must be removed after erection. Shims, when used, must cover the entire bearing area.

Formwork may be constructed around a bearing for poured-in-place concrete structures. Seal between bearing and formwork to prevent contamination by laitance or concrete. Offsets should be established in advance.

Pot Bearings can accommodate many anchoring systems. While we do not cover those systems here as they are considered to be part of the structural engineering design, suggestions for best compatibility with our bearings will be offered on request.



INSTALLATION — POT BEARINGS

Cosmec Pot Bearings are manufactured to close tolerances in a controlled environment. Care must be taken in the handling and installation to ensure they start their service life in a clean undamaged condition. They should be stored under cover and off the ground. Retainer clips or strapping are used to hold bearing parts together for shipping and erection; they must be removed to allow the bearing to function, but not before final positioning and only at the Engineer's direction. Slide plate offsets should be set in the shop, but they may be re-set on site.

Bearings should not be disassembled on site without direct supervision by qualified personnel. We will not be responsible for the subsequent non-performance of a bearing if disassembly occurs without our supervision and written approval. In case of inadvertent disassembly, call us immediately.

Lift bearings by their bases only. Do not rely on transportation straps or brackets to carry the bearing's weight.

Do not specify paint or coatings on the PTFE or in the interior of the Pot Bearing. The pot is hermetically sealed and should contain only the elastomer and the assembly lubricant for lifelong smooth rotation.

Specialized lifting "lugs" or setting fixtures can be designed and fabricated by Cosmec to meet special needs for the erection, installation and/or setting of the bearings. These items will be considered on demand. Please contact our Engineering Staff with any such requirements before the final design of the bearings.



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