AIRPOT ® PISTON/CYLINDER (P/C) SETS

OVERVIEW

Innovative engineers enhance their designs by adapting part or all of a standard purchased component to provide a non-traditional function. Our precision-matched piston / cylinder sets are often chosen to support such ingenuity due to the special properties of our basic components.

At the heart of every Airpot Corp. product is a precisely matched graphite piston and a Pyrex® glass cylinder. Over the years, many Airpot customers have taken advantage of their benefits for uses other than the well-known functions provided by our dashpot, actuator, or Airpel® air cylinder products. For example, Airpot **P/C sets** have been used as bearings, vacuum pickups, Stirling engine power pistons, rate of climb indicators, earthquake sensors, spool valves, flow meters, pumps, pressure sensors, and many other customer generated designs. Quite often, we are also asked to assemble or modify these parts to fabricate special subassemblies.

We are always happy to work with customers who would like to adapt our products to suit their novel requirements or take advantage of our value added subassembly services. If you are designing a mechanism that you think might benefit from a piston-cylinder combination with any of these properties, we invite you to call us to consider the possibilities.

To really appreciate the characteristics of our **P/C sets**, Airpot Corporation is pleased to offer a free sample to any interested engineer or technical student. Just email or call us and we'll be happy to send you one. There is no obligation.

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FEATURES

- Friction less than 1 gm
- Response to pressures as low as 0.2 psi.
- Low leak without seals
- No lubrication
- Clean operation
- Performance stability over an extreme temperature range
- Very Low mass
- Cycle life that can range into the billions
- No deterioration or change in performance due to age or non-use

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- Ability to provide or respond to exceedingly low forces
- Ability to run at ultra-high speeds
- Ability to move linearly and rotationally simultaneously
- No rust, corrosion, or deterioration over time
- Ability to operate submerged in water, oil, most gases, most solvents, and even many acids

HANDLING & MOUNTING RECCOMMENDATIONS

1. MATCHED SETS

Each piston and cylinder set is an individually matched pair fitted to extremely close tolerances. Proper performance depends on a precisely sized piston operating in its precisely measured cylinder with our assigned radial clearance. The cylinders and pistons within a given model series can cover a range of nominal sizes. Since most users do not have the measuring equipment required to properly identify the sizes that are matched to each other in a shipment, it is important that customers make every effort to keep the matched sets together and not try to interchange pistons and cylinders.

2. PISTON HANDLING

The graphite piston is machined to a high degree of roundness. Since the graphite is not very elastic and the piston is cup shaped, it can be deformed if squeezed radially. Please avoid holding or squeezing the piston tightly. A good rule of thumb is to treat the piston like an egg.

3. CYLINDER MOUNTING

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Because of the close fit between the piston and cylinder, it is actually possible to squeeze the glass cylinder to a degree that can interfere with the smooth running of the piston. Mounting the cylinder from the ends rather than squeezing it around its outer diameter can avoid this potential. **P/C sets** are provided with silicone rubber end seals for this purpose and to interface with the end mount method you design in your equipment. They will also help accommodate shock and vibration. If you prefer to mount by the O.D. of the cylinder, we recommend a method that will not be significantly affected by shrinkage due to temperature variations or long term chemical changes or out-gassing.

Silicone rubber, neoprene, or Buna-N O-rings that are not too tight on the cylinder are usually suitable. An alternative mounting method is to use silicone adhesive on the cylinder O.D.

Recommended mounting methods:

a) Mounting Using Airpot Cylinder Seals.

These molded silicone rubber parts seal on the ID of the cylinder and have a flange to protect the cylinder from axial shocks. A pilot on the mating part is required to energize the seal.

b) Epoxy Bonding Cylinder Directly to Another Part

The prerequisite for using this mounting method is that you must accommodate (or avoid) the thermal expansion mismatch between the ultra-low expansion borosilicate glass and a mating part that normally has high expansion. First, use an epoxy that is “toughened” (not too hard.) Do not use cyanoacrylates (super glue) Then, follow these guidelines for the material to be bonded to the glass cylinder.

- Best Choices: Invar or Kovar.

  Suitable epoxies can be cured at elevated temps and assembly can be used up to 200°C

- Second Best: 400 series Stainless Steel.

  OK to cure and use at slightly elevated temperature (40- 60°C)

- Third Best: Aluminum, Brass, 300 series Stainless Steel, Plastics.

  Bond at room temperature and always keep assembly at room temperature.

c) O-Rings

O-rings that pick up on the ID of the cylinder are best as the ID varies <.001" from piece to piece. Use P-80TM Rubber Lubricant to get temporary lubricity on the rubber O-ring.

OD O-rings also work well but take into consideration that the tolerance on the cylinder OD is large (+/- .010" typically). Also, the ID/OD concentricity of the cylinder can be several thousandths, which can be important if precise locating is needed. That said OD O-rings work great for prototypes because the OD of the cylinder can be measured and then the gland for the O-ring can be made to fit. Again, use P-80TM

d) Axial Squeeze Against A Rubber Washer

Use pilots to locate the cylinder then squeeze against a rubber flat washer. Make sure that for the stiffness of your washer, the squeeze force will be sufficient to create a seal if the cut end of the glass cylinder is ½° from square.

e) Potting with RTV Silicone

This is commonly done to mount the cylinder within an aluminum housing. A good method is to use a close fitting rod fitted inside the cylinder to precisely locate and maintain the position of the cylinder until the RTV cures. This method

can work well for prototypes and production but expect to experiment with your technique of applying and curing the RTV.

4. KEEPING CLEAN

The graphite piston is self -lubricating and runs extremely smoothly when it and the cylinder bore are clean and free of contaminants. Ambient dust or larger particles in the air will normally be swept aside by a moving piston. You may eventually notice a ring of dust or loose graphite particles that accumulate at the ends of the piston travel after some period of cycling. This will not normally affect **P/C** performance.

The **P/C** set can even operate quite nicely when fully submerged in clean liquids or oils. However, grease, oil, or water contamination of an unsubmerged piston or cylinder can affect performance. Liquids or grease (even the natural oil in fingertips) can influence the running properties of the piston by acting as a binder for ambient dust or dirt and cause it to drag in the cylinder rather than sweep aside. Additionally, liquids that are allowed to dry on the piston or cylinder bore can leave behind hard minerals or other contaminants that stick to the cylinder walls and interfere with piston travel.

It's always a good practice to keep the pistons in the cylinders unless it is essential to remove the piston temporarily. It is also wise to blow out the cylinder with clean air or nitrogen, and gently clean the piston OD (without squeezing) with a clean, untreated tissue or napkin before reinserting the piston. If the piston OD or the cylinder ID is contaminated with some substance (even finger prints), it is a good idea to gently clean it with isopropyl alcohol. To really appreciate the characteristics of our **P/C sets**, Airpot Corporation is pleased to offer a free sample to any interested engineer or technical student. Just email or call us and we'll be happy to send you one. There is no obligation.