What is a Spring Energized PTFE Seal?

Spring energized PTFE seals perform reliably in a variety of applications where conventional elastomeric seals fail due to chemical attack, extreme heat or cold, friction, extrusion or compression set.

PTFE seals have three basic design elements:

- A pressure-actuated U-shaped jacket
- A metal spring loading device
- High performance polymeric seal materials

So what is a spring energized PTFE seal? It’s a spring-energized U-cup that uses a variety of jacket profiles, spring types and materials in rod and piston, face and rotary seal configurations. They are used when elastomeric seals fail to meet temperature range, chemical resistance or friction requirements.

Jacket profiles are made from PTFE and other high performance polymers. Spring types are available in corrosion-resistant alloys, including stainless steel, Elgiloy and Hastelloy.

Since jackets are machined and not injection molded, the seal configuration can be easily adjusted when needed to enhance seal performance. The seal is machined on CNC lathes to very close tolerances, using only premium grade materials. Each design is available in standard and special diameters and cross sections in inch-fractional, AS4716, and metric sizes. The full size range includes diameters from 1/32 to 150 inches, with radial cross-sections ranging from 1/32 to several inches across.

Spring energized seal lips and spring energizer are compressed when installed into the seal gland. The resilient spring responds with constant force, pushing out the sealing lips and creating a gas tight seal against the sealing surfaces. The seal expands as pressure is introduced – increasing the sealing force beyond that provided by the spring and the jacket material.
Spring Load

A stainless steel spring energizes the seal and supplies all of the load needed for sealing when the media pressure is too low to fully actuate the lips.

The spring also makes up for variations in gland tolerance and normal seal wear. As a seal loading device, a metal spring is more accurate than devices such as O-rings for controlling friction. There are three different spring types, each with one to three different load ratings (light, medium and heavy) to meet the exact linear friction or torque requirements.

In dynamic applications, the spring expands to offset seal wear while continuing to provide load. In conditions involving thermal cycling, the spring system continues to energize the seal lips without taking a compression set or becoming too soft or hard, the way an elastomer can.

The flexible spring allows for an extensive tolerance range that can help surmount hardware misalignment and eccentricity, without causing added friction or the inability to seal. Three different spring energized PTFE seal designs are available, offering individual attributes for each application.

High Performance

The unique design and material properties of these seals provide design engineers with a new assortment of solutions to difficult applications.

Some of the more remarkable capabilities of the seal include:

- Very low friction
- Universal chemical compatibility
- High speed service
- Cryogenic service to -425 degrees Fahrenheit
- High temperature service to 575 degrees Fahrenheit
- High pressure ratings (over 30 Kpsi)
- Permanent elasticity with immunity to aging embrittlement and compression set.

Many of these capabilities are the result of the materials used to make the seal. Seal jackets, made from low-friction PTFE and various blends, are chemically inert, extrusion resistant and capable of operating over a wide temperature range. The lack of resilience of the polymer is overcome by a spring load made from one of several corrosion resistant metals.

The spring energized seal’s combination of material and design configuration eliminates many of the problems associated with O-rings or other elastomeric seals. For example, when
selecting an elastomeric seal to handle a variety of solvents, it is necessary to review the compatibility of the elastomer in each of the solvents. In many cases, none of the commonly used elastomers are satisfactory for the intended range of fluids.

The problem is further aggravated when the operating temperature exceeds a few hundred degrees Fahrenheit. If we consider the above factors in a rotary or reciprocating application, we now have a very difficult problem for the equipment designer trying to select an elastomeric material.

With spring energized PTFE seals, however, there is no need to worry about compatibility since the PTFE blends are inert to essentially all industrial chemicals and solvents even at elevated temperatures and pressures. In dynamic service there is no need to worry about slip-stick or elastomeric adhesion. The chart below compares spring energized seals to elastomeric seals in general. See the table below for a comparison of general seal properties.

The aim isn’t to devalue an elastomer’s capability, as they are made to handle a variety of sealing applications. Rather, our purpose is to educate design engineers on the significant difference offered by spring-energized PTFE seals.

For more information on these seals, be sure to download our new Spring Energized Seal Guide.

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