



# Low Friction, Low Stiction Gimbal/Pod/Pan-Tilt Seals

## Bal Seal® spring-energized seal: The ultimate low-friction sealing solution

With the Bal Seal® spring-energized seal, you can finally achieve the elusive balance between friction and sealing effectiveness. Our seal combines low friction materials, a canted coil spring energizer, and custom jacket profiles to improve accuracy and reliability in gimbals, pods, pan-tilt systems and other demanding rotary/oscillating applications.

 **BAL SEAL**  
ENGINEERING  
BY KAMAN





**In C4ISR, high energy laser, LaserComm, and other gimbal/pod/pan-tilt applications, no other seal can match the superior protection and low-friction performance of the Bal Seal®. Here's why:**

Bal Seal® feature	Why is it relevant?	What's the benefit?
<b>PTFE Seal Material</b>	• Lower friction and stiction	<ul style="list-style-type: none"> <li>• Reduces torque required to move pod, allowing for smaller motor size and lower overall system weight (SWaP)</li> <li>• Helps prevent jitter during target tracking, promoting faster, more accurate positioning and better pointing stability</li> <li>• Manages high-speed bi-directional rotational movement</li> </ul>
	• Media resistance	• Seals effectively against salt, dust, hydraulic fluid, fuel, and other media, preventing corrosion and contamination
	• Tolerance for high temperature variances	• Performs well in temperatures ranging from cryogenic up to 500 °F
<b>Bal Spring® Energizer</b>	• Nonlinear spring behavior	<ul style="list-style-type: none"> <li>• Promotes consistency of friction</li> <li>• Ensures effective sealing in adverse conditions such as weather, speed, elevation, and extreme temperatures</li> </ul>
	• Compensates for large tolerances and stack-up	<ul style="list-style-type: none"> <li>• Provides greater design flexibility</li> <li>• Helps reduce hardware cost and complexity</li> </ul>
<b>Unique Bal Seal® Geometry</b>	• Smaller seal cross section	• Reduces space requirements (SWaP)
	• Greater frictional consistency over operating range	<ul style="list-style-type: none"> <li>• Offers improved frictional control of dynamic seal lip</li> <li>• Optimizes lip contact to seal effectively with minimal stiction/stick-slip</li> <li>• Reduces wear for prolonged service life</li> <li>• Compensates for thermal expansion</li> </ul>
<b>Custom-Engineered Locking Ring</b>	• Consistent sealing despite thermal cycling	<ul style="list-style-type: none"> <li>• Lowers risk of extrusion, cold flow, and leakage</li> <li>• Prevents seal jacket shrinkage</li> <li>• Eliminates unwanted seal movement</li> </ul>

## Factors Impacting Gimbal Design

### FRICTION

- Presents challenges for precision pointing/stability
- Influenced by temperature, pressure, hardware surface finish
- Drives actuator selection/sizing and impacts power usage

### ENVIRONMENTAL CONDITIONS

- Application in air, land, sea, and space, with demanding accuracy and service life requirements
- Exposure to moisture, salt spray, dust, hydraulic fluid, fuel, other potential contaminants
- Broad temperature variations (-40 °F to >180 °F), vibration, rotation, high speeds and pressures

## Key Gimbal Seal Design Considerations

- Low friction/low stiction (drives selection of other system components)
- Sealing efficacy (prevents contamination, corrosion)
- Survivability (withstands range of temperatures, vibration, rotation)
- Seal service life (meets field maintenance requirements)

**Get a custom seal proposal in 3 working days and a prototype in 4-6 weeks. Leverage our FMEA, engineering expertise, and gimbal experience to save time and money in development and testing.**

**REQUEST A DESIGN**

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