

# PRIME MOVER ACTUATORS

ENGINEERED BELLOWS SOLUTIONS  
FOR SEMICONDUCTOR MARKET



SYNCHRONIZED PNEUMATIC MOTION  
VARYING LOAD, STROKE & SPEED  
NO PARTICLE GENERATION  
SERVO CONTROL OPTIONS  
COMPACT ENVELOPE  
SUPERIOR QUALITY

senior  
**Metal**  
**Bellows**



## Defying The Impossible With Custom Engineering

We develop new products (and reimagine conventional ones) for semiconductor manufacturing processes, including assemblies and components for precision actuation. Our PRIME MOVER actuator was the first to combine actuation and sealing into a single integrated device. We design for extremes of temperature, pressure, and corrosive environments—especially when high lifecycle, zero leakage, maintenance-free operation, and high performance are essential. Our process is fast and efficient, with full in-house resources, including: 3D solid modeling (rapid proof-of-concept), finite-element structural analysis, flow simulation and sizing—along with all required qualification and documentation to meet global manufacturing standards.

[metalbellows.com/semiconductor](https://metalbellows.com/semiconductor)

# PRIME MOVER™ Precision Linear Actuators

Using our advanced metal bellows technology, the PRIME MOVER™ is a unique linear actuator that provides superior reliability and maintenance-free performance.

Metal Bellows has shipped thousands of these actuators for semiconductor applications requiring a hermetic seal for vacuum application. The actuator design eliminates stiction during motion and provides excellent synchronicity for highly repeatable placement of wafers, etc., at the micron level.

**The PRIME MOVER™ is designed to deliver precise linear actuation time-after-time from the day you install it.**

- Factory preset and tested
- Repeatability and Reliability
- Fast system level integration
- Completely maintenance-free

## Construction

The Prime Mover is available in stainless and high-nickel alloys. SMB's designs enable reliable and long-life maintenance-free operation for wide temperature ranges and aggressive environments found in plasma etch. As a pneumatic actuator, there is no EMI for RF sensitive processes.

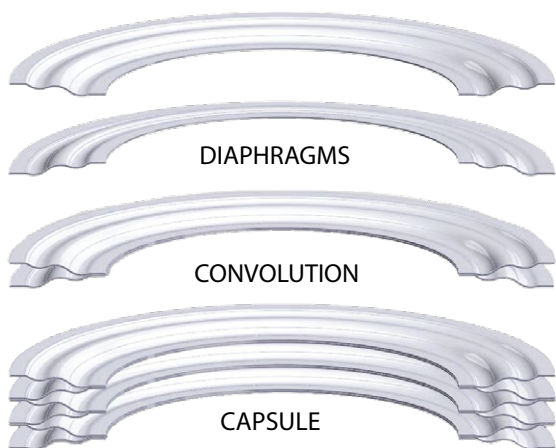
## Welded Metal Bellows

Welded metal bellows provide for a zero leakage dynamic seal capable of operation in extreme environments.



## SMB Benefits

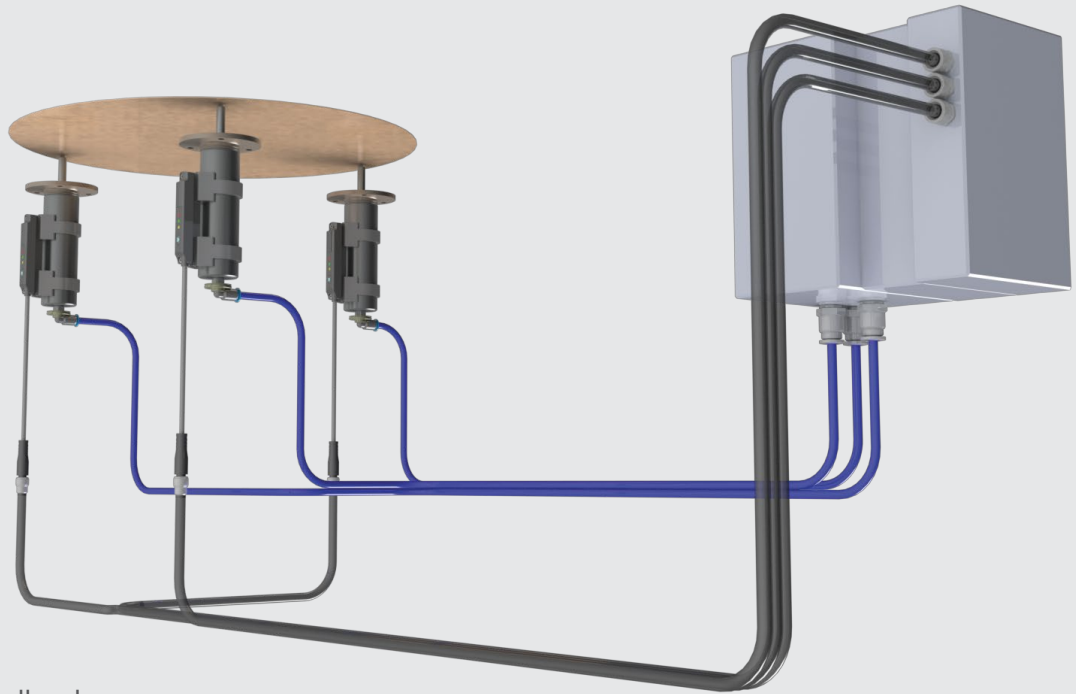
- Wide range of operating temperatures
- Constant effective area with change in pressure
- Capable of millions of cycles
- > 6 bar supply capability
- Long stroke per unit length
- Short nested length
- Corrosion resistance
- Leak tightness to less than  $1 \times 10^{-7}$  scc/sec



# Servo Pneumatic Actuator

SMB has advanced the capabilities of servo-pneumatic actuators to eliminate the longstanding issues with stiction that has prevented its use as wafer lifts due to wafer walking.

Now, a range of stroke requirements and stroke speeds may be accommodated with a single design when coupled with an appropriate controller and proportional valve.



**Silver tube:** Position feedback

**Blue tube:** Proportional valve output

## Benefits

### ■ Compact & easy installation

- 1 design for varying speed & stroke
- Integrated vacuum seal & actuator
- Lightweight & fast installation
- Maintenance free operation

### ■ Low energy consumption

- Pneumatic actuation with piezo valve control
- Low energy consumption
- Very low heat generation



## Features

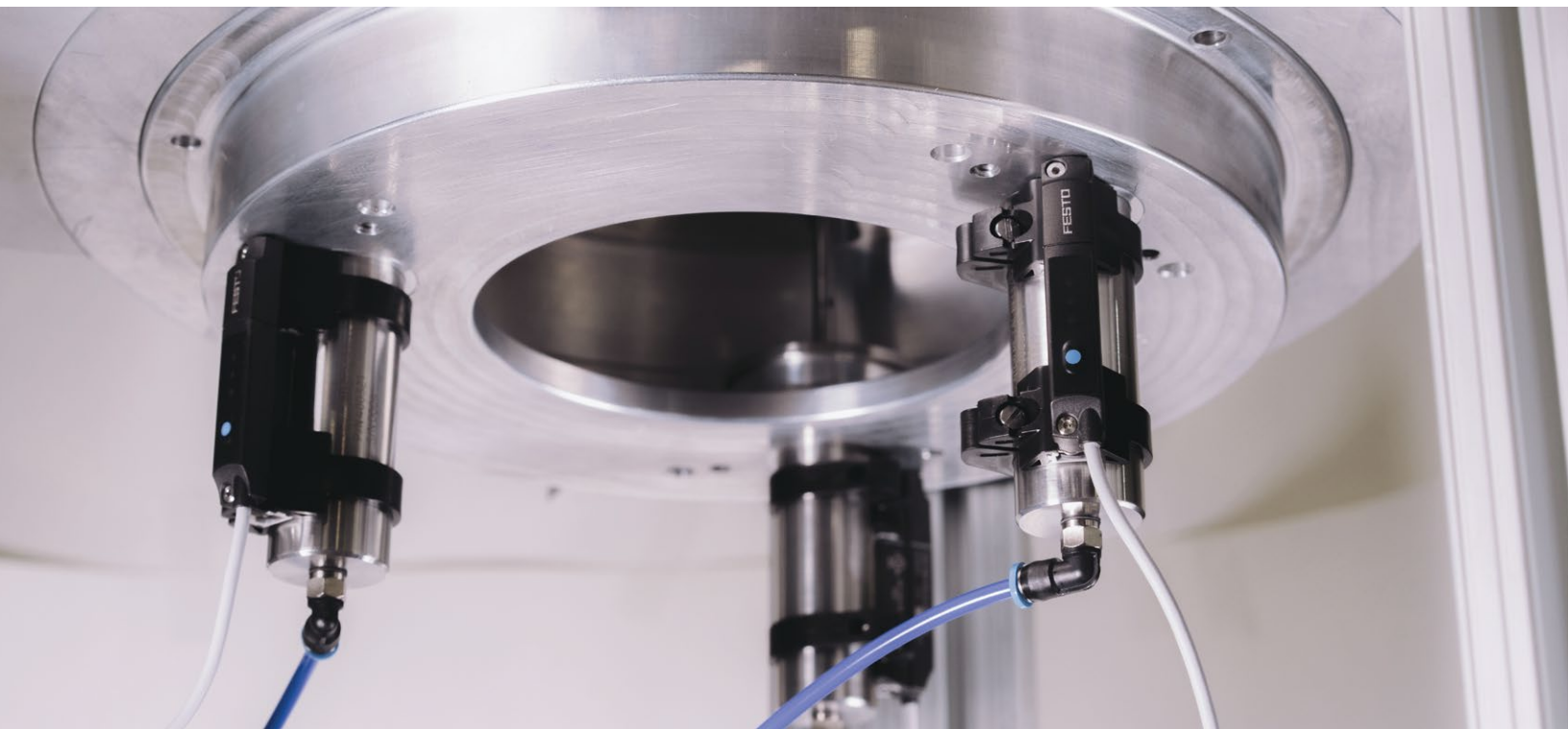
- Helium leak tight hermetic seals
- 1 million minimum cycles
- Ultra-clean actuation, meets ISO-14644-1 Class 1
- Actuation forces up to 100+ lbs.
- Accurate and repeatable positioning
  - Stroke accuracy  $\pm .025\text{mm}$  (.001 in) as a standard
  - Lateral accuracy(true position)  $.25\text{mm}$  (.01 in)
  - Capable of  $<5\mu\text{m}$  of wafer walk



## Senior Advantages

By combining sealing and actuator capabilities in one unit, the PRIME MOVER™ delivers a number of unique performance and cost advantages.

- Superior reliability and performance – virtually zero friction
- Compatible with all process gases – all wetted surfaces stainless steel construction or high nickel alloys as required.
- Particle free actuation
- Cost-effective – simplifies system design with fewer components
- Lower power consumption
- Facilitates system level integration – true plug-and-play, factory preset and tested
- Compact design – By combining a pressure seal and actuator in the same envelope, the PRIME MOVER™ is significantly smaller than conventional actuators
- Completely maintenance free – long life without service
- Pneumatic or mechanical actuation



## Applications

The PRIME MOVER™ is ideally suited for a wide range of applications.

- Pin lifters
- Wafer handling
- Shutters
- High temperature valves
- Robotics
- Wherever linear actuation is required

## Custom Designs are available on request

- Materials selection to suit various environmental extremes with temperature or corrosive gasses
- Specific force output and stroke requirements
- Position monitoring options

### Housing

- 304L Stainless Steel
- 316L Stainless Steel
- Inconel 625

### Bellows

- AM-350 Stainless Steel
- Inconel 625
- Hastelloy C-276
- Haynes 242

### Position Monitoring

- Magnetic switch
- Fiber Optic Switch
- Continuous Position Sensing

**WE GET  
YOUR  
PRIORITIES!**

*Start a conversation with our engineers  
to discover a way forward.*



Facility in Sharon, MA



1075 PROVIDENCE HIGHWAY  
SHARON, MASSACHUSETTS 02067

PHONE:  
+1 781-784-1400  
FROM THE USA 1(800)BELLOWS

FAX:  
781-7841405

WEBSITE:  
[WWW.METALBELLOWS.COM](http://WWW.METALBELLOWS.COM)

EMAIL:  
[MARKETING@METALBELLOWS.COM](mailto:MARKETING@METALBELLOWS.COM)

senior  
**Metal**  
**Bellows**

The logo graphic consists of three concentric, semi-circular arcs that resemble a stylized bellows or a fan, positioned to the right of the word "Metal".