

1. OVERVIEW

Linear motion components provide controlled, low-friction linear movement with high accuracy, repeatability, and stiffness for precision positioning systems.

Rolling-element linear systems are commonly used in semiconductor equipment, robotics, medical devices, aerospace assemblies, and automation platforms where motion accuracy and structural rigidity are critical.

- Load capacity
- Moment resistance
- Mounting accuracy
- Lubrication
- Environmental conditions

2. TYPES & CONFIGURATIONS

Type	Description	Engineering Benefit
Linear Ball Bearings	Round-shaft systems	Cost-effective, moderate rigidity
Profiled Guide Rails & Blocks	Recirculating ball rail systems	High rigidity, high load capacity
Shaft-Supported Systems	Supported round shaft	Improved deflection resistance

Profiled rail systems provide significantly higher moment capacity and stiffness compared to round shaft systems.

3. LOAD & MOMENT CAPACITY

Linear systems must be evaluated for:

- Dynamic load rating
- Static load rating
- Moment loads (Mx, My, Mz)
- Block spacing
- Rail support conditions

4. DESIGN & CONSTRUCTION FUNDAMENTALS

Rolling-element linear systems provide high stiffness, low friction, smooth motion, and controlled preload. Critical design factors include:

- Mounting flatness
- Parallelism of rails
- Alignment accuracy
- Base rigidity

5. PRELOAD & ACCURACY CLASSES

Preload options influence system rigidity, vibration behavior, positional accuracy, and heat generation. Higher preload increases stiffness but may increase friction and wear.

Typical accuracy classes may include Standard, High accuracy, and Precision (exact class naming may vary by manufacturer).

6. TYPICAL DIMENSIONAL RANGE (REFERENCE GUIDE)

Parameter	Typical Range
Rail Width	7 mm – 65 mm
Block Length	Series dependent
Travel Length	Application specific
Preload Options	Light / Medium / Heavy

Final sizing must consider load distribution and required life.

7. MATERIALS & SURFACE OPTIONS

Component	Options	Engineering Notes
Rails	Hardened steel	High wear resistance
Blocks	Steel / Stainless	Structural stability
Rolling Elements	Alloy steel	Standard load capacity
Surface Coatings	Optional	Corrosion resistance

Corrosion-resistant versions may be required for humid or cleanroom environments.

8. ENVIRONMENTAL & LUBRICATION CONSIDERATIONS

Factor	Engineering Notes
Cleanroom	Special low-particle grease required
Contamination	End seals and wipers recommended
Temperature	Influences lubricant viscosity
Corrosion	Stainless or coated rails recommended

Lubrication frequency and cleanliness directly affect service life.

9. STIFFNESS & DEFLECTION CONSIDERATIONS

System stiffness depends on:

- Rail size
- Block spacing
- Preload level
- Mounting base rigidity

10. AEROSPACE & SEMICONDUCTOR APPLICATION NOTE

For aerospace and semiconductor systems:

- Repeatability and positioning accuracy are critical
- Cleanroom compatibility may be required
- Vibration and particle generation must be minimized
- Material compatibility and corrosion resistance may be specified
- Precision installation and torque control during mounting are essential

11. TYPICAL APPLICATIONS

- Semiconductor equipment
- Robotics and automation systems
- Medical devices
- Precision positioning platforms
- Aerospace subsystems

12. SELECTION GUIDELINES

Consideration	Key Question
Load	Static, dynamic, and moment loads?
Accuracy	Required repeatability and positioning tolerance?
Speed	Maximum travel velocity?
Environment	Cleanroom or contamination risk?
Structure	Is mounting base sufficiently rigid?

TECHNICAL DISCLAIMER

This document is intended as a general technical reference only. It does not represent a product specification, guarantee of performance, or suitability for any specific application. Final system selection must be validated through detailed engineering analysis.