# Air Bearing Basics

*Our Recipe:* ABTech Air Bearings are "*Orifice Compensated*" and float on a specific *Air Gap* (thickness of air film) and many design aspects revolve around the air gap specification.

**What is an orifice, what does it do?**

- An insert placed in specific locations along the air supply path to restrict flow. The orifice must be the predominant restriction in supply to the air gap.
- Qty, size and location of orifices is critical to air bearing performance.

**Why do we target a 0.0005" – 0.0007" air gap?**

- High load capacity
- High stiffness
- Economical geometry requirements
- Economical orifice design
- Economical and robust material selection

**Other Air Bearing approaches and disadvantages:**

- Porous Graphite (expensive to make complex shapes and is easily damaged)
- Slot Feed (requires very tight gaps and geometries driving up cost)



Orifice

Air Gap

worktable

Air Gap

Air Path

Shaft

Journal

Thrust Plate

Air Gap
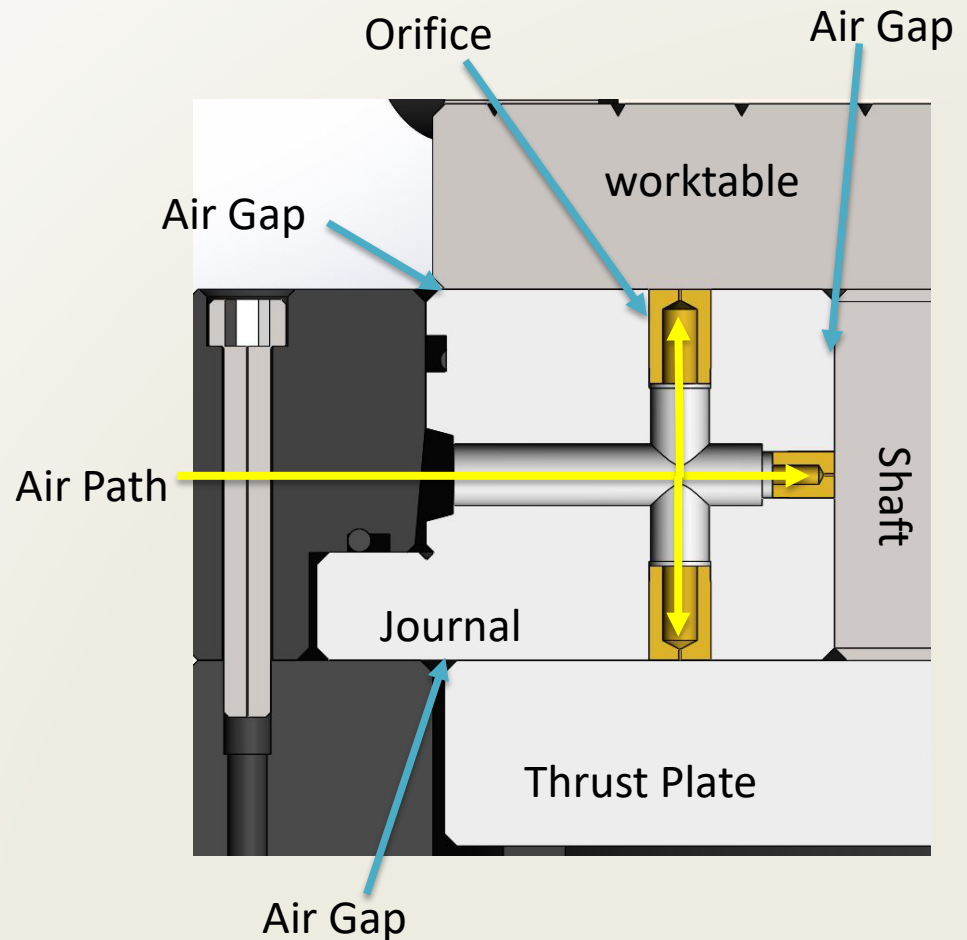
# Geometries

*All components in our products have very tight manufacturing tolerances in order to achieve a functional air bearing. While the **Journal** is very important for **load capacity and stiffness**, the **rotating components** are the most critical for achieving air bearing **accuracy.***

- **Journal** critical features and effect on performance:
    - Roundness of ID: radial stiffness and load capacity (some influence on accuracy)of air bearing
    - Flatness of Faces and Perpendicularity of ID to Faces: Axial stiffness and load capacity *(some influence on accuracy)* of air bearing

- **Worktable and Thrust Plate** critical features and effect on performance:
    - Flatness of Air Pad side: Axial accuracy of air bearing and load capacity

- **Shaft** critical features and effects on performance:
    - Roundness of OD: Radial Accuracy of air bearing
    - Flatness of Faces and Perpendicularity of OD to Faces: *Tilt Accuracy (Coning) of air bearing.*
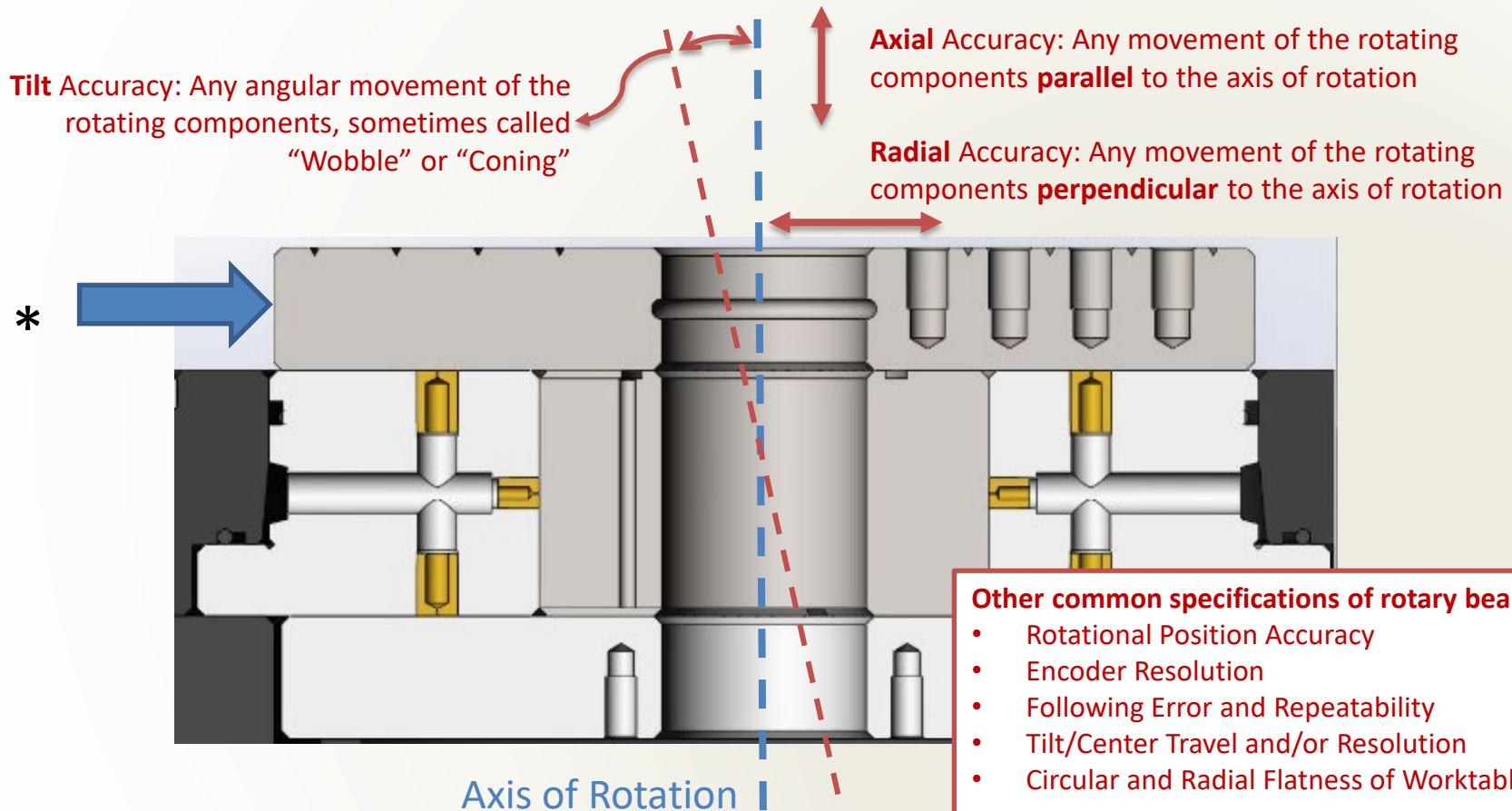
**Drivers of tolerances:**
- ABTech recipe
- Desired Accuracy of air bearing
    - *(Radial, Axial and tilt error)*
- Size of components
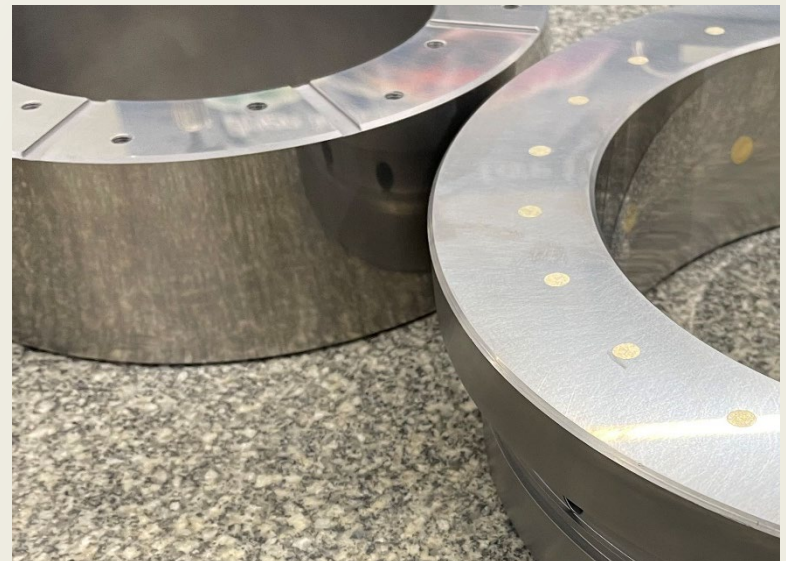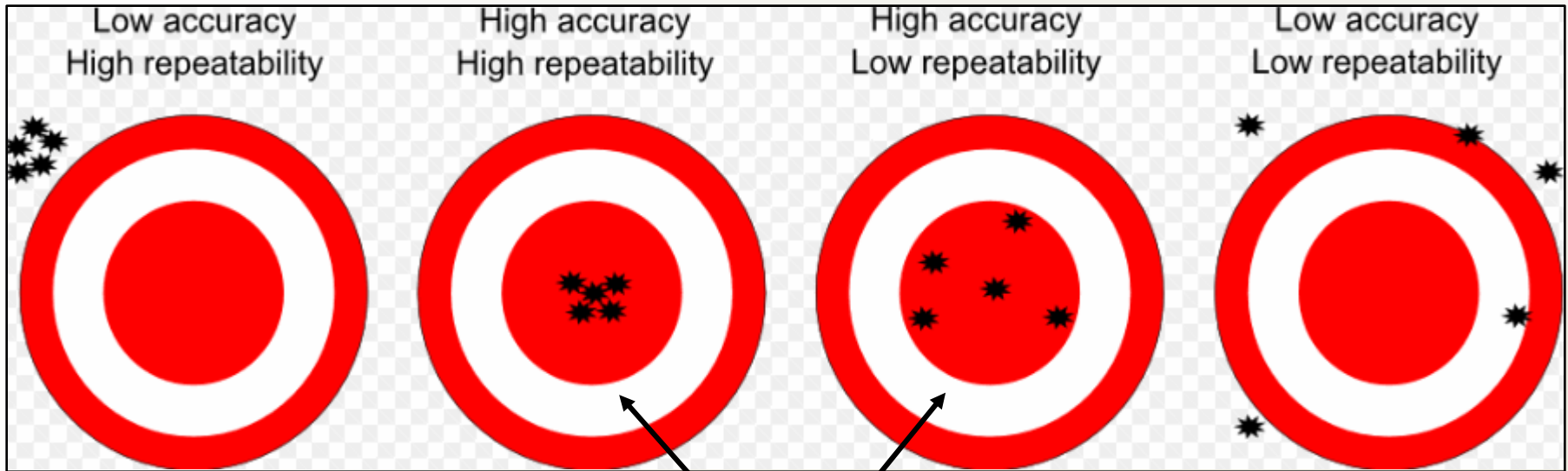
# Air Bearing "Accuracy"

*Air Bearing accuracy is defined as the Radial, Axial and Tilt (Coning) Errors.* Essentially this is how much the theoretical centerline of the rotating components deviate from a perfect axis of rotation
***Note:** this is not the roundness, flatness or runout of the worktable surfaces*

**Axial** Accuracy: Any movement of the rotating components **parallel** to the axis of rotation

**Tilt** Accuracy: Any angular movement of the rotating components, sometimes called "Wobble" or "Coning"

**Radial** Accuracy: Any movement of the rotating components **perpendicular** to the axis of rotation

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Axis of Rotation

**Other common specifications of rotary bearings are:**
- Rotational Position Accuracy
- Encoder Resolution
- Following Error and Repeatability
- Tilt/Center Travel and/or Resolution
- Circular and Radial Flatness of Worktable

# Accuracy, Repeatability, & Resolution

## Accuracy-vs-Repeatability



| Low accuracy | High accuracy | High accuracy | Low accuracy |
| High repeatability | High repeatability | Low repeatability | Low repeatability |

*Is there a difference between these two?* They are both within the red circle so are they the same? It depends on your resolution. If all you care about is hitting the red circle then it doesn't matter.

<u>Resolution</u>;  the smallest incremental measurement step detected by the encoder.