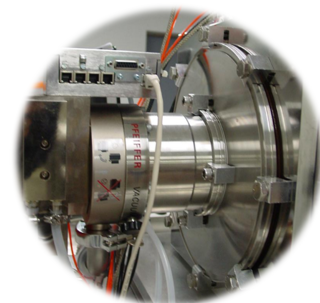
NANO-MASTER, Inc

Turbo Pump Speed vs Gate Valve Pressure Control

In vacuum-based thin film deposition systems such as sputtering, PECVD, or RIE, the configuration of the pumping system plays a critical role in process stability, pressure control, and contamination management. Two common configurations are the direct attachment of the turbo pump to the process chamber, and the use of a gate valve between the chamber and pump. This comparison evaluates the advantages and limitations of each setup, focusing on key parameters such as base pressure performance, process flexibility, mechanical reliability, and suitability for plasma-based applications.

Feature	Direct Turbo Pump Attachment	Turbo Pump via Gate Valve
Vacuum Conductance	✅ Maximum conductance, no restrictions between chamber and pump.	❌ Reduced conductance due to valve impedance. May affect pump-down time and base pressure.
Base Pressure	✅ Typically lower base pressures achieved.	❌ Slightly higher base pressure due to valve leakage or limited conductance.
Pump-Down Speed	✅ Faster evacuation due to unimpeded flow.	❌ Slower evacuation due to valve restriction.
Pressure Stability	✅ Smooth control if turbo speed and gas flow are well-regulated. ❌ Needs closed-loop PID control using pressure feedback from high precision gauge.	✅ Fine-grained pressure control (especially for plasma tuning) via valve positioning. ❌ Potential valve hysteresis. Possible issues for fast techniques like D-RIE and ALD
Pressure Control Flexibility	❌ Limited to adjusting turbo speed and gas flow. Needs closed-loop PID control using pressure feedback from high precision gauges and MFCs.	✅ Highly precise pressure control over wide range. Essential for complex plasma processes or multiple setpoints.
Plasma Process Compatibility	✅ Suitable for stable plasmas if pressure range is adequate. ❌ Challenging for reactive ion or ICP systems needing closed-loop PID control using pressure feedback from high precision gauge	✅ Ideal for pressure-sensitive plasma processes (e.g., ICP, high-density plasmas).
Mechanical Simplicity	✅ Fewer parts. No valve = fewer failure points. Easier to maintain and calibrate.	❌ Added complexity. Valve requires calibration, sealing, and may fail over time.
Cost	✅ Lower initial and maintenance costs.	❌ More expensive hardware and maintenance.
Footprint & Integration	✅ Compact design, simpler piping.	❌ Larger system footprint, more integration work.
Contamination Control	✅ Less chance for valve-generated particles. Better outgassing performance due to open flow.	❌ Valves may introduce particles during actuation.
Software & Control Requirements	✅ Simpler logic, fewer control loops.	❌ Requires valve control integration and feedback tuning.
Gas Flow Dynamics	✅ Easier to model in CFD or simulation tools.	❌ More complex flow path; harder to model gas residence time.

All nano-master systems have direct turbo pump attachment as a standard configuration. But the use of a gate valve is also possible in cases where it is considered necessary.



4115 Freidrich Ln., Suite 300, Austin, Texas 78744 • Tel: 512-385-4552• Fax: 512-385-4900
main@nanomaster.com • www.nanomaster.com