



## Comparison: Indirectly Cooled vs Directly Cooled Circular Targets

	<b>Indirectly Cooled Target</b>	<b>Directly Cooled Target</b>
<b>Coolant</b>	Barrier exists between the target and the cathode body. No coolant exposure to vacuum chamber when changing target. No vacuum to coolant seal.	Backside of backing plate or target is in direct contact with the coolant. There is coolant to vacuum seal. Precaution should be taken to minimize coolant leaking into the chamber. Leak check is necessary before pump down.
<b>Target Change</b>	Quick, threaded design no tools necessary. Approximately 2 minutes.	Tools necessary to remove screws. Approximately 30 to 60 minutes including leak check.
<b>Power</b>	Typically 100 watts/ in <sup>2</sup> (15.5 watts/cm <sup>2</sup> ) with targets that are high in both electrical and thermal conductivity.	Typically 250 watts/ in <sup>2</sup> (38.7 watts/cm <sup>2</sup> ) with targets that are high in both electrical and thermal conductivity.
<b>Target Materials</b>	A wide variety of materials can be used with various mechanical properties. No exposure to coolant if target cracks during deposition.	Targets which are brittle such as Silicon risk coolant exposure so they must be bonded to a backing plate to minimize risk.
<b>Physical Head Diameter</b>	Smaller, typically 1-2"/ 25-50mm smaller outside diameter than Directly Cooled Cathodes.	Larger
<b>Magnet Interchangeability</b>	Complete dis-assembly to access magnets. 60-90 minutes with leak test.	Magnets are easily exchanged when target/backing plate is removed. 10-15 minutes.
<b>Target Configurations</b>	Clamped Only - Monolithic or Bonded	Bolted or Clamped - Bolted – Monolithic or Bonded - Clamped – ‘Indirect Cooled Mode’ (monolithic target clamped to backing plate) Can operate in Directly Cooled mode or Indirectly Cooled mode.

