

Quantifying Manual Lapping for Precision Beryllium Target Components

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Beryllium remains a key target material because of its low atomic number, stiffness, and favorable performance in demanding experimental configurations. Its finishing, however, presents persistent challenges due to brittle damage, edge sensitivity, and stringent dimensional requirements. Although manual lapping is often necessary for final sizing and surface preparation, the process is frequently treated as operator dependent rather than quantitatively controlled.

This work examines a precision manual lapping workflow for beryllium target components with emphasis on repeatability, dimensional control, surface quality, and defect mitigation. A staged finishing approach was assessed using routine production metrology to monitor thickness uniformity, flatness, surface finish, and edge condition throughout processing. Particular attention was given to removal behavior across abrasive steps, the role of intermediate inspection, and common failure modes such as chipping, edge rounding, and nonuniform stock removal.

The results show that manual lapping can be structured as a controlled fabrication process when supported by defined inspection checkpoints, disciplined handling practices, and clear transition criteria between finishing stages. Quantitative relationships between lapping strategy and part quality are used to identify practical operating windows that improve yield and reduce rework. These findings provide a manufacturing-relevant framework for converting a traditionally experience-driven operation into a reproducible method for precision target component fabrication.

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