



## Picosecond Laser Machining of Shaped Holes in Thermal Barrier Coated Turbine Blades

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### Abstract

Increasing the operating temperature of an aircraft engine has the benefit of increasing thrust and fuel efficiency. However, increased operating temperatures can lead to temperatures in sections of the jet engine reaching or exceeding the melting point of the superalloys materials used for engine components. In order to maintain the structural integrity of the engine parts at the extreme operating temperatures, cooling methods must be supplied to the engine components. Cooling of the engine component is accomplished by air flow through cooling holes and through the application of thermal barrier coatings. One method of fabrication for the cooling holes in turbine blades is a two step process where the holes are drilled in the base blade metal by either laser or electrical discharge machining, a thermal barrier coating (TBC) system is applied and the holes are drilled again to clear out and shape the TBC layer. Mound Laser & Photonics Center, Inc. (MLPC) has conducted research utilizing the ability of a picosecond laser system to machine shaped holes through both the TBC and underlying superalloy in a single step. The short pulse duration of the picosecond laser allows for fast hole shaping and drilling without inducing spallation of the TBC or generating recast that can be encountered with high power, long pulse duration lasers.

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