



LASER DRILLING OF THE PRIMARY NOZZLE OF A JET ENGINE

Task

Approximately 74,000 holes with a diameter of 1.5 mm shall be drilled in the primary nozzle of a jet engine. The nozzle has a diameter of about 900 mm and a length of about 350 mm. The holes should be distributed in 2048 rows, each with 36 holes around the circumference of the nozzle. With a material thickness of 1.5 mm, the material consists of titanium alloy Ti 6-2-4-2.

Method

To produce these holes, a pulsed fiber-laser beam source from IPG Photonics was used. Its advantages are the flexible beam guidance by means of a beam-guidance fiber and process stability thanks to an almost maintenance and adjustment-free fiber-laser beam source. Since the diameter of the drill hole is 1.5 mm, the trepanning drilling method is used. Preliminary experiments identified a pulse peak power of 1.4 kW, a pulse duration of 0.5 ms and a repetition rate of 200 Hz as suitable process parameters. As a process gas, argon is used to protect the processing optics from melting splashes as well as to expel the melted material from the holes. To avoid distortion, the holes are divided into 32 segments distributed around the nozzle circumference. Two rows of holes are produced per segment before the process continues with two rows at the next segment.

Applications

Fluidic tests are carried out on the primary drilled nozzle. Through the drilled area, a defined volume flow shall be derived.

The drilling process can be applied to many components. Since suitable plant technology is available, large-dimensioned components can be processed. Thanks to an appropriate programming system and to the stable beam source, time-consuming, fully automated drilling processes can be carried out having processing times greater than 40 hours.

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3 Laser drilling of a primary nozzle of a jet engine.

4 Close up of the drilling process.