Fabrication of holes using electric discharge machining on Titanium alloys

Vishal Kumar¹, J. Ramkumar^{1*} and R. K. Gupta²

¹Indian Institute of Technology Kanpur, Department of Mechanical Engineering, 208016, India

²Vikram Sarabhai Space Centre, Materials and Mechanical Entity, Trivandrum, 695022, India

*Email: jrkmur@iitk.ac.in

Commercially pure (CP70) titanium is used for aerospace application because of its high specific strength, thermo-mechanical strength and corrosion resistance. However, its poor thermal conductivity and strong alloy forming tendency with tool material make conventional machining a challenging task [1]. Electric discharge machining (EDM) processes, being independent of workpiece mechanical properties, are found suitable for machining these materials. Holes of diameter 6 mm in CP70 sheets of 1 mm thickness are required to be drilled for bracket joining operation in aerospace components. Electric discharge trepanning operation is proposed for fabricating these holes with a hypothesis that it can reduce heat affected zone and improve geometry. The holes of diameter 6 mm formed by this process using tool electrode of diameter 0.5 mm are shown in Figure 1.

Manufacturers of EDM tools do not provide optimal parameters to be followed for processing advanced materials [2]. Hence, drilling experiments were first conducted on a μ -EDM tool (Mikrotools DT-110) using 0.5 mm tungsten carbide electrode at varying gap voltage and capacitance. A tool spindle rotation of 100 rpm is given to improve flushing of debris. Evaluations of MRR, tool wear and overcut have been carried out, which were further analyzed using Design-Expert® software. The response behaviours are shown in Figure 2 and Figure 3.

Based on the data analysis, optimum sets of parameters selected for experimental study of trepanning operation are given in Table 1.

Table 1: Parameters selected for ED trepanning

Sl. No.	Capacitance, nF	Gap Voltage, V
1	400	100
2	400	110
3	400	120
4	400	130

Further, evaluation of MRR and geometry were carried out, and it is observed that optimum set of parameters for trepanning operation is gap voltage of 120 V and capacitance of 400 nF, which provides maximum MRR with improved geometry.

Figure 1: Electric Discharge trepanned holes of diameter 6 mm

Figure 2: Relation between machining time and gap voltage at difference capacitance values

Figure 3: Relation between tool wear and gap voltage at difference capacitance values

References

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