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Abstract

Machining processes are known to drastically impact the performance and lifetime of a component subjected to fatigue in service. Therefore, understanding the effect of manufacturing processes on surface integrity is vital to determine their suitability for any given application. As part of a wider study investigating multiple production operations, results are presented here which characterise the fatigue performance and failure mechanisms of Ti-6Al-4V specimens subject to conventional (end milling, surface grinding) and non-conventional machining processes (abrasive waterjet machining, wire electrical discharge machining, large area electron beam melting). Post process shot peening was then applied on each of the 5 different surfaces generated and the resulting fatigue response similarly evaluated. The abrasive waterjet machined specimens generally exhibited the longest fatigue life, particularly at higher applied stress (≥ 700 MPa) irrespective of surface condition. Despite the difference in process mechanisms, fatigue results for the milled and wire electrical discharge machined surfaces were comparable. Examination of the fatigue specimen fracture surfaces however, revealed that the locations of crack initiation were inconsistent for the different processes and conditions assessed. In general, post process shot peening increased the fatigue strength / life of all the evaluated specimens, regardless of the base machining operation.

Keywords: *titanium alloys, non-conventional machining, surface integrity, fatigue life, shot peening*