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Statistic Study of Fracture Properties of Aluminum Low Pressure Die Casting

by

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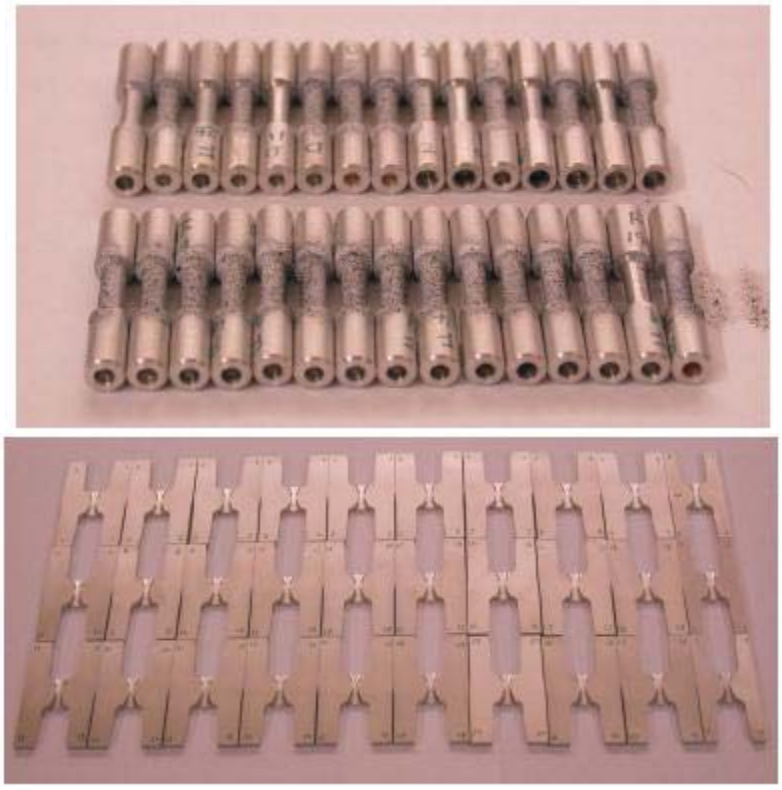

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Abstract

This paper studies the probability distributions of the effective plastic strains to fracture and the pore size of an aluminum low-pressure die casting prototype. A total of 60 fracture tests were conducted including the tensile test on 30 round bars and the simple shear test on 30 butterfly-like specimens. The projected area of pores on each fracture surface was measured by fractographic examination. Though either the Gaussian or the Weibull function is able to well describe the probability distribution of the fracture strains, the Type III extreme value function is preferable in terms of physical consideration. A simple formulation was proposed to construct probabilistic fracture loci in the space of the effective fracture strain and the stress triaxiality. The fracture loci can be implemented into a finite element procedure to predict the stochastic failure response of a cast aluminum component under complex loading. The goodness-of-fit test indicates that the projected area of all of pores on the fracture surfaces follows the log-normal distribution. At the same time, the maxima of the pore size on each fracture surface conform the Type III extreme value distribution instead of the Gumbel distribution. This study also establishes the mathematical relationship between the fracture strain and the projected area of pores. For the tensile fracture strain the relationship closely follows a linear function, while for the shear one a power function appears to be more suitable.

Keywords: Aluminum casting; Ductile fracture; Pores; Probability distribution;