Volume 41, Issue 1 (January 2013)

ISSN: 1945-7553
CODEN: JTEVAB
Published Online: 11 December 2012
Page Count: 9

Effect of Electrical Discharge Machining (EDM) on Charpy Test Results from Miniaturized Steel Specimens

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(Received 25 November 2011; accepted 9 July 2012)

Abstract

Electrical discharge machining (EDM) is a manufacturing process whereby a desired shape is obtained through electrical discharges between an electrode and a workpiece, which are separated by a dielectric fluid. EDM produces a recast layer on the surface of the workpiece, which in carbon steels is typically harder and more brittle than the base metal, and is often characterized by microcracks. This type of damage, particularly in the notch region of a steel specimen, can adversely affect impact test results. The objective of this investigation is to assess the possible influence of EDM on miniaturized Charpy test results. We tested Kleinstprobe (KLST)-type Charpy specimens of two reactor pressure vessel (RPV) steels, machined with different combinations of two machining processes (EDM and milling). Comparison of the impact results, combined with metallographic observations and microhardness measurements on the recast layers and the base metals, indicated no detrimental effect of EDM on the impact toughness of the materials investigated. The maximum thickness of the recast layer was about 16 μm, and the magnitude of the EDM-induced hardening varied between 34 % and 84 % with respect to the hardness of the base material, depending on the carbon content of the steel. No microcracks were observed.

Keywords:
electrical discharge machining, milling, miniaturized Charpy test, KLST specimen, recast layer, hardening, microcracks

Paper ID: JTE20120195
DOI: 10.1520/JTE20120195