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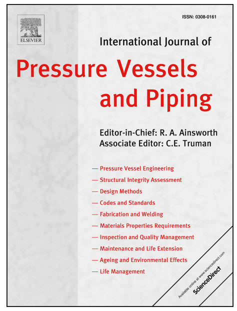


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# Evaluation of a self-equilibrium cutting strategy for the contour method of residual stress measurement

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**Abstract**

An assessment of cutting-induced plasticity (CIP) is performed, by finite element (FE) prediction of the plastic strain accumulation along the cut tip when the EDM wire sections the NeT TG4 weld benchmark specimen along two cutting directions. The first direction corresponds to a conventional (C) cutting strategy, whereby the EDM wire cuts through the thickness of the weld specimen and travels in a direction transverse to the weld. The second direction corresponds to a self-equilibrating cutting (SE) strategy, whereby the EDM wire cuts across the transverse direction of the weld specimens and travels through the thickness of the plate. The cutting thus progresses simultaneously through the compression-tension-compression regions of present weld residual stress (WRS) field. This type of cutting strategy is believed to minimize the CIP by minimising residual stress redistribution during cutting, due to stress equilibration across the sectioned material. The simulated cutting procedures are conducted under a range of clamping conditions to assess whether mechanical restraint has a primary or secondary influence on CIP accumulation. Both predictions of CIP and the resultant back-calculated WRS demonstrate that (i) mechanical restraint is the primary variable influencing CIP development, and (ii) under no circumstance does a self-equilibrating cutting strategy perform significantly better than a conventional cutting approach. The reason that self-equilibrating cuts are not effective is illustrated by calculating the Mode I ($K_I$) stress intensity factor (SIF) along the cut tip, and correlating trends in $K_I$ to CIP development.

*Keywords: Residual stress; contour method; optimisation; finite element analysis; cutting direction*