

FRACTURE PREDICTION USING MODIFIED MOHR COULOMB THEORY FOR NON-LINEAR STRAIN PATHS USING AA3104-H19

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Abstract. Experiment results from uniaxial tensile tests, bi-axial bulge tests, and disk compression tests for a beverage can AA3104-H19 material are presented. The results from the experimental tests are used to determine material coefficients for both Yld2000 and Yld2004 models. Finite element simulations are developed to study the influence of materials model on the predicted earing profile. It is shown that only the YLD2004 model is capable of accurately predicting the earing profile as the YLD2000 model only predicts 4 ears. Excellent agreement with the experimental data for earing is achieved using the AA3104-H19 material data and the Yld2004 constitutive model. Mechanical tests are also conducted on the AA3104-H19 to generate fracture data under different stress triaxiality conditions. Tensile tests are performed on specimens with a central hole and notched specimens. Torsion of a double bridge specimen is conducted to generate points near pure shear conditions. The Nakajima test is utilized to produce points in bi-axial tension. The data from the experiments is used to develop the fracture locus in the principal strain space. Mapping from principal strain space to stress triaxiality space, principal stress space, and polar effective plastic strain space is accomplished using a generalized mapping technique. Finite element modeling is used to validate the Modified Mohr-Coulomb (MMC) fracture model in the polar space. Models of a hole expansion during cup drawing and a cup draw / reverse redraw / expand forming sequence demonstrate the robustness of the modified PEPS fracture theory for the condition with nonlinear forming paths and accurately predicts the onset of failure. The proposed methods can be widely used for predicting failure for the examples which undergo nonlinear strain path including rigid-packaging and automotive forming.

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