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Abstract

Assessment of Work-Hardening Behavior of Sheet Metal Materials Using Meso- and Macro-Scale Specimens †

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The increasing use of lighter metallic materials, in combination with the complexity of the components to be produced, has presented new challenges for the sheet-metal-forming industry, such as the need for wider and better material characterization. The forming processes of these materials involve operations where the material is subjected to tensile or compressive stresses, which may be applied in alternating combinations.

This study considers an experimental procedure to accurately capture the mechanical hardening behavior of sheet metal materials [1]. An experimental test device was developed to perform tension and compression tests, with reverse loadings in meso-scale specimens. This scale has two main advantages: (1) it reduces buckling during compression (compared to standard tensile test specimens) and, consequently, (2) it enables the characterization of the mechanical behavior under reverse tension-compression strain path changes. The main challenge of the current methodology is related to the small size of the specimens, with 2×2 mm gauge area, especially in the measurement of the strain field distribution using the digital image correlation (DIC) technique. Two different classes of sheet metal materials were tested, namely a DP600 and AA5754-H11, with a thickness of 0.8 mm and 1 mm, respectively [2].

The monotonic tensile test results using miniaturized specimens showed good agreement with the standard tensile test (macro specimens), indicating that meso-specimens can be used to assess material characterization behavior.

Additionally, it was observed that the strain values in compression were adequate to evaluate the tension-compression asymmetry, thus indicating that the developed system has good potential for the extended characterization of metallic sheets.

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