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Title

A coupled experimental/numerical approach for the characterization of material behavior at high strain-rate using electromagnetic tube expansion testing

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Highlights

- Instrumentation and modelling of electromagnetic tube expansion are developed.
- The behavior of AA-1050 at strain-rates of 1000 s-1 to 5000 s-1 is identified.
- The parameters of the Johnson-Cook model are highly correlated in these tests.
- The sensitivity of characterization to experimental uncertainties is evaluated.

Abstract: High speed forming processes such as magnetic pulse forming are gaining interest in the sheet metal industry. Their design and development require specific effort on numerical modeling as well as on the characterization of the high strain-rate mechanical behavior of metals. Standard dynamic tests (SHPB, plate impact, simple tension…) are limited in their representativeness of the deformation modes encountered in high speed processes. The present study describes how the electromagnetic tube expansion test can be used as a high strain-rate test for the identification of material constitutive parameters. Through numerical analysis, the deformation mode and the sensitivity of radial expansion to material constitutive behavior are depicted. Then, the material parameter identification methodology is applied to annealed 1050 aluminum tubes. It is shown that the test is capable of highlighting the strain-rate sensitivity of behavior, in spite of relatively high sensitivity to measurement uncertainties.