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A new approach for the determination of the linear elastic modulus from uniaxial tensile tests of sheet metals

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Abstract

The determination of the linear elastic modulus is important for the numerical process design of forming operations. Test setups for the identification of the linear elastic modulus can be divided into dynamic methods like ultrasonic measurement and static methods like indentation tests or uniaxial tensile tests. Relevant standards recommend the determination of the linear elastic modulus via linear regression from stress vs. strain curves, while no information for an upper boundary exists. In this contribution, a new approach is presented, which uses the deformation work to identify a material-dependent upper boundary for the determination of the linear elastic modulus. The method is applied to two aluminum alloys AA5182-O and AA6016-T4, a deep drawing steel DX54, two advanced high strength steels HCT600X and HCT980X and a magnesium alloy AZ31B. The results confirmed a robust determination of the linear elastic modulus from the linear elastic behavior and a good reproducibility with a deviation below 5 %. Moreover, with exception of AA5182-O, all investigated materials exhibit a quasi-elastic-plastic (QPE) transition between elastic and plastic material behavior.

Keywords: Material characterization; Elasticity; Young's modulus