Application of the in-plane torsion test to a set of engineering metallic materials

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Abstract

One of the major advantages of the in-plane torsion test is that it provides shear loading of a sheet specimen up to fracture while using a specimen exempted from free edges.
During the test, the dish-shaped specimen is clamped on its outer diameter while a hydraulic rotary motor applies torque to the inner side of the specimen for quasi-static tests. During high-strain rate testing, a preloaded Hopkinson-type torsion bar is used to apply the loading to the inner clamping. A circular groove is machined on one face of the specimen. This local thickness reduction ensures a strain localization away from the clamped central area of the specimen. The setup grants full optical access to the sheared gauge section, allowing 2D-DIC measurements on the flat side of the specimen. The sheet anisotropy leads to a periodic evolution of the strain along the circular gage section. This effect is illustrated on a set of engineering metals tested under quasi-static conditions. The capabilities of the high-strain rate in-plane torsion test are illustrated on a deep drawing and a dual-phase steels.

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