The cross-compression-tension-bar experiment for the investigation of ductile fracture behavior near pure shear conditions

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Abstract. Recent publications indicate that there is a significant difference of fracture behavior under pure shear and simple shear conditions. While these studies are of numerical nature, this publication introduces a specimen geometry and experimental setup that leads to fracture under near pure shear conditions. The experiment makes use of a pre-notched rectangular bar specimen, which is compressed between two stamps with cylindrical contact surfaces. The experiment is simulated and the fracture strains are compared with data from experiments performed under simple shear conditions (Torsion). It is found that fracture strains in the new experimental setup under pure shear conditions are higher than in torsion under simple shear, which is in accordance with expectations from literature. A generalization of the proposed experimental setup is introduced, the cross-compression-tension-bar experiment, that makes use of a biaxial testing machine keeping the specimen's geometry constant. With this machine an additional, variable tensile load portion is superimposed to the compressive load, with an angle of 90° between the compressive and the tensile stresses. This variability allows for testing of the specimen under a wide range of stress triaxiality values with only one specimen geometry and experimental setup. Like this, the newly proposed cross-compression-tension-bar experiments have a high potential for the experimental investigation of ductile bulk fracture behavior.