EVALUATION OF EDGE FORMABILITY IN HIGH STRENGTH SHEETS THROUG A FRACTURE MECHANICS APPROACH

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Abstract. The edge fracture is considered as a high risk for automotive parts, especially for parts made of high strength materials as Advanced High Strength Steels (AHSS) or some aluminum grades. The limited ductility makes such materials more sensitive to the edge damage. Nevertheless, all the traditional approaches, such as Forming Limit Diagram (FLD) or tensile tests, are unable to predict this type of fractures. Thus, stretch-flangeability has become an important formability parameter in addition to tensile and formability properties. The damage induced in sheared edges affects stretch-flangeability, because microcracks are generated and they can propagate from the edge through the material thickness. Accordingly, a fracture mechanics approach may be followed to characterize the crack propagation resistance and, thus edge cracking sensitivity. This work addresses the applicability of fracture toughness as a tool to understand edge formability, i.e. stretch-flangeability and edge cracking, in different AHSS and aluminum grades. Fracture toughness is determined by following the Essential Work of Fracture (EWF) methodology and stretch-flangeability was characterized by means of Hole Expansion Tests (HET). Results show a good correlation between stretch-flangeability and fracture toughness. It allows postulating fracture toughness, in terms of EWF, as a key material property to rationalize crack propagation phenomena in high strength sheets used in the automotive industry.