

# Crack paths in cold drawn pearlitic steel subjected to fatigue and fracture

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## INTRODUCTION

The aim of the present paper is to analyse the evolution of the crack path in progressively drawn pearlitic steels under fatigue and fracture. The cold drawing process produces microstructural anisotropy with direct consequences on the fatigue and fracture behaviour of the steels, as well as on the crack paths.

## RESULTS AND DISCUSSION

The *fatigue crack path* is always contained in the transverse section of the wires, so that the main crack path is associated with mode I and some very local deflections take place to produce a roughness in the fatigue crack path depending on the drawing level. The fatigue micromechanism consists of ductile microtearing events with very localised plastic strain, the microtearing patterns becoming more curved as the drawing level increases. With regard to the shape of the crack front, it is semielliptical, with retardation in the central area in steels with an intermediate drawing degree, caused by compressive residual stresses in that area.

The *fracture crack path* evolves from a global mode I propagation in slightly drawn steels to a global mixed-mode growth associated with crack deflection in intermediate and heavily drawn steels, the deviation angle being an increasing function of the drawing degree (Fig. 1). Such an evolution is associated with a change in the fracture micromechanisms from purely brittle cleavage in slightly drawn steels to the more ductile micro-void coalescence fracture micromechanism appearing in heavily drawn steels that exhibit also oriented and enlarged cleavage fracture mode in the deflection crack path aligned in vertical direction.

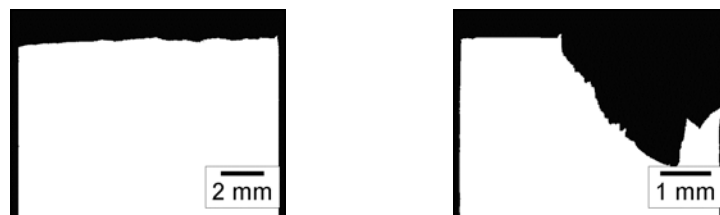


Figure 1. Fracture crack paths in the hot rolled bar and the prestressing steel wire.

## CONCLUSIONS

The microstructural anisotropy of the steels (consequence of the drawing process) creates a change in the *fracture crack path* with crack deflection in the most heavily drawn steels. Nevertheless, the *fatigue crack path* remains globally in mode I, even in the most heavily drawn steels. In this latter case the microstructural orientation produces only an increase of micro-roughness in the fatigue crack path.