FRACTURE MECHANICAL VALUES
OF MODERN PIPELINE-STEELS

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ABSTRACT
This paper deals with the determination of CTOD- (Crack Tip Opening Displacement-) values
according to BS 7448 using three point bend specimens and CA (Crack-Arrest Fracture-
Toughness) values using three-point bend specimens (test proposal of TVFA), compact-crack-
arrest specimens (ASTM E 1221), and full-thickness compact-crack-arrest specimens (test
proposal of Crosley and Ripling). The problems in determining the crack tip opening displacement
and crack-arrest fracture-toughness are discussed in detail, the results are compared. Finally the
different resulting fracture mechanical values, as for example CTOD (Crack Tip Opening
Displacement) values and CA (Crack-Arrest) values etc., of the welds (welding metals and heat
affected zones) are compared with each other and with the values of the base material.

The tested materials were the base material, the weld metal, and the heat affected zone of welds,
using different welding processes, as Shielded Metal Arc Welding, Gas Metal Arc Welding, or
Submerged Arc Welding, of the pipeline steels X 70 according to API 5L (STE 480.7 TM according
to DIN 17 172 or L 485MB according to OENORM EN 10 208 – 2) and X80 according to API 5L (L
555MB according to OENORM EN 10 208 – 2) and the duplex-steel 1.4462 according to DIN 17
440, DIN 17 441, SEW 400, OENORM EN 10 088, part 1 to 3, and TÜV-Austria (1.4462 according
to OENORM EN 10 027 – 2, X 2 CrNiMoN 22 5 3 according to OENORM EN 10 027 – 1 or S31803
according to ASTM UNS).

BENEFITS

Overview about the variations of the fracture mechanical values (CTOD and CA) of the pipeline-
steels X70, X80, and the duplex-steel 1.4462 according to different standards or test proposals.
Comparison of the values for the base material, the weld metal, and the heat affected zone of
welds according to different welding processes.

KEY WORDS
Fracture mechanical values, CTOD (Crack Tip Opening Displacement), CA (Crack-Arrest Fracture
Toughness), BS 7448, ASTM E 1221, three-point bend specimens, compact-crack-arrest
specimens, full-thickness compact-crack-arrest specimens, pipeline-steels, X70, X80, duplex-
steel, 1.4462, base material, weld metal, heat affected zone, different welding processes.