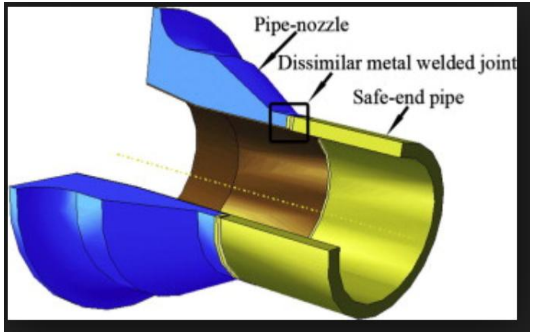
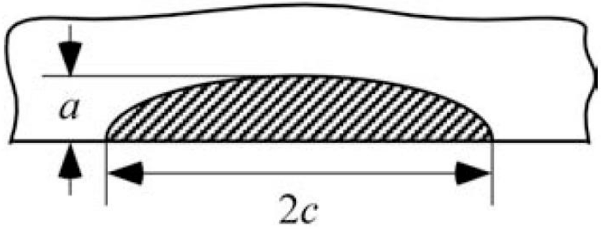
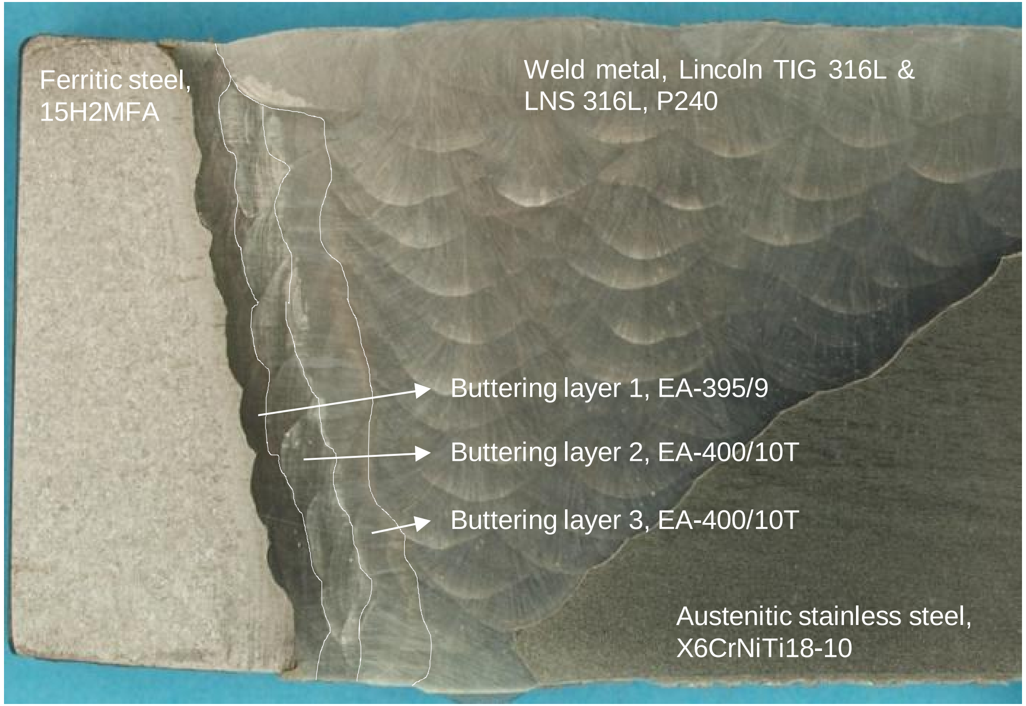
Project LOST: Innovations in safety analysis of dissimilar metal welds

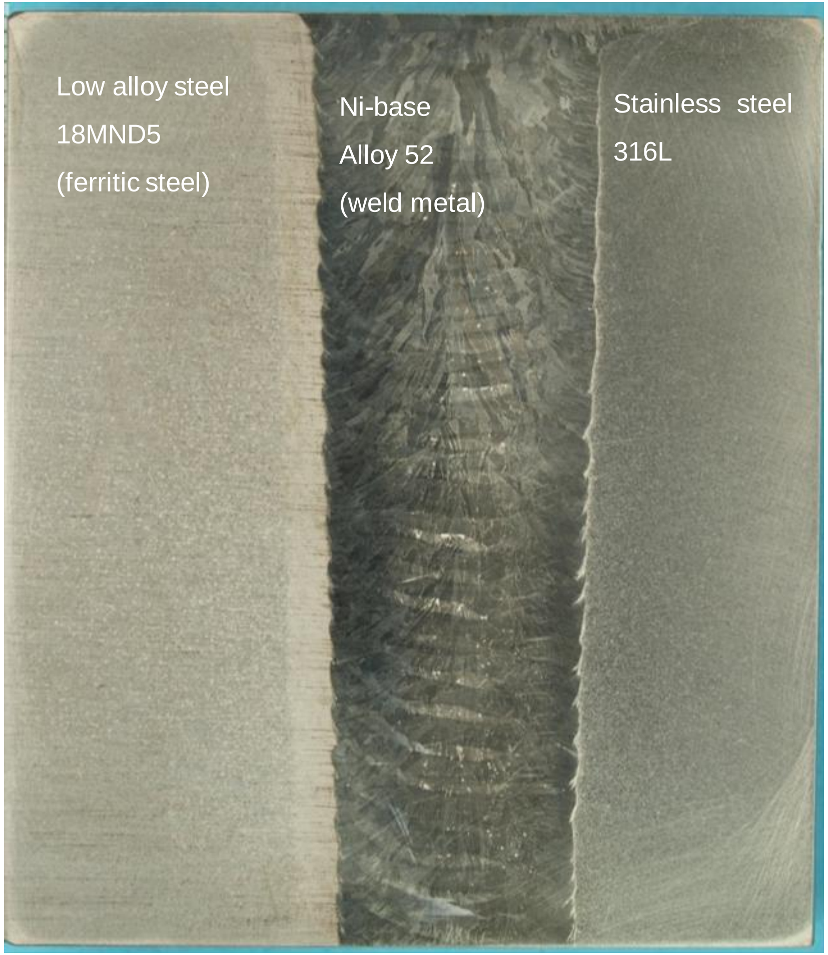
Sebastian Lindqvist

Cracks have been detected in dissimilar metal welds – safety class 1

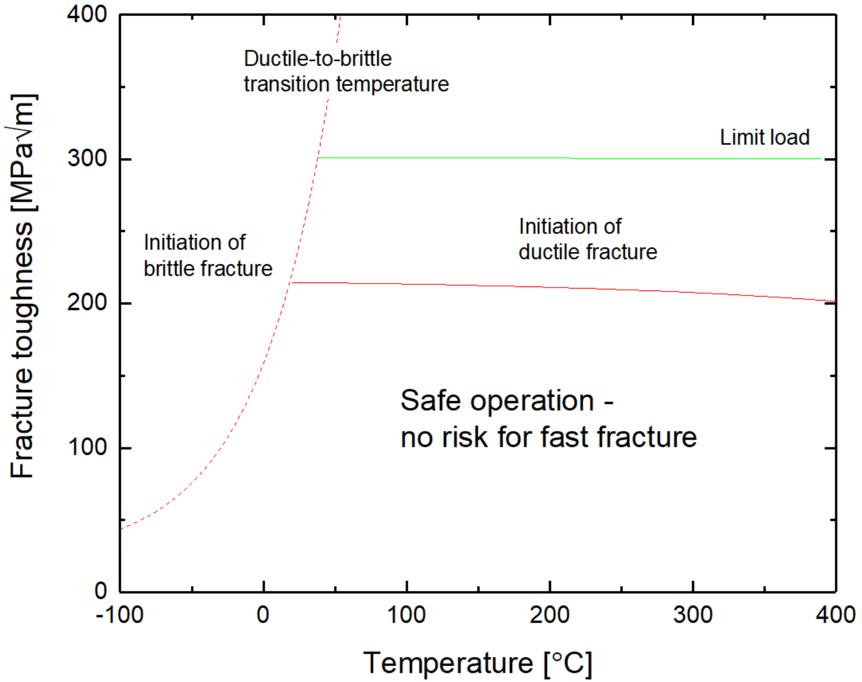





Ferritic steel,
15H2MFA
Weld metal, Lincoln TIG 316L &
LNS 316L, P240
Buttering layer 1, EA-395/9
Buttering layer 2, EA-400/10T
Buttering layer 3, EA-400/10T
Austenitic stainless steel,
X6CrNiTi18-10


Low alloy steel
18MND5
(ferritic steel)
Ni-base
Alloy 52
(weld metal)
Stainless steel
316L

Current methods to determine the lower boundary fracture toughness properties are developed for homogeneous materials – Safety concerns when applied to dissimilar metal welds?



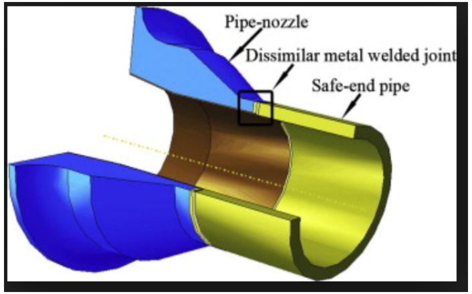
Fracture toughness = J

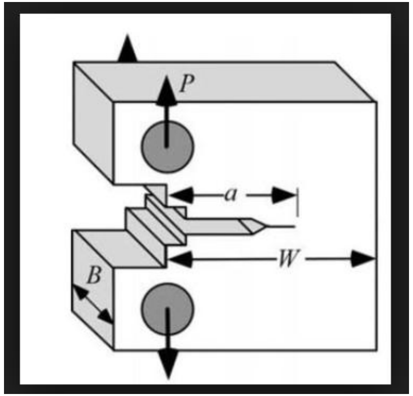
$$= \frac{\eta A}{Bb}$$

Fracture toughness = J or K

$$= \frac{\eta A}{Bb}$$

Area of the remaining ligament



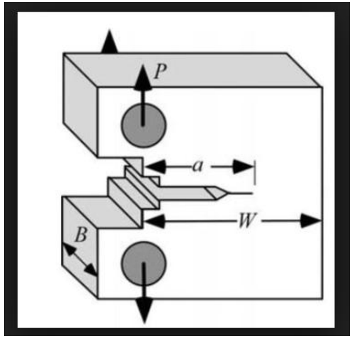


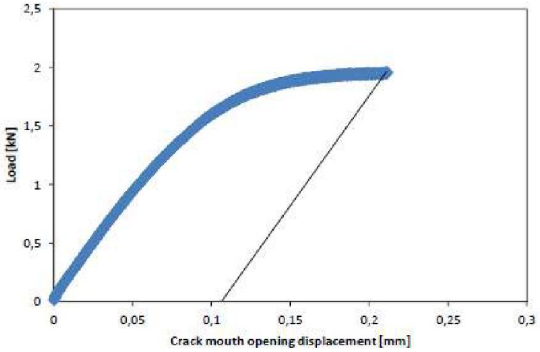
Fracture toughness = J

$$= \frac{\eta A}{Bb}$$

Energy stored in the specimen

Remaining ligament





Fracture toughness = J

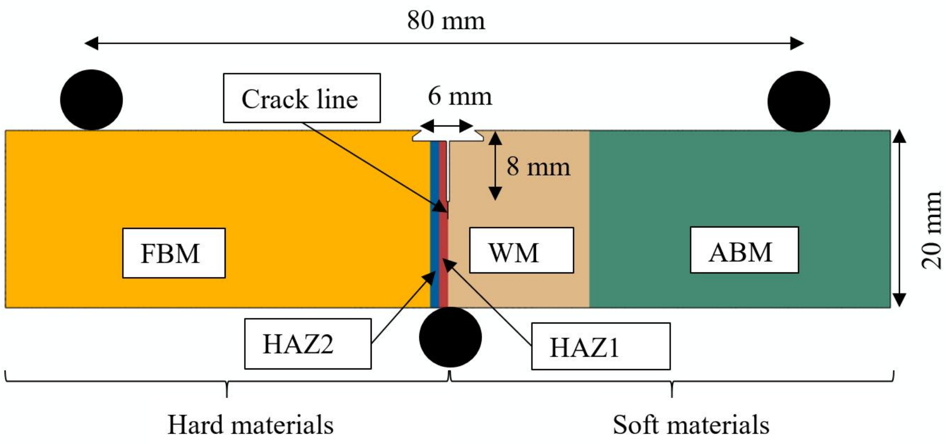
Parameter relating the measured work to the fracture toughness

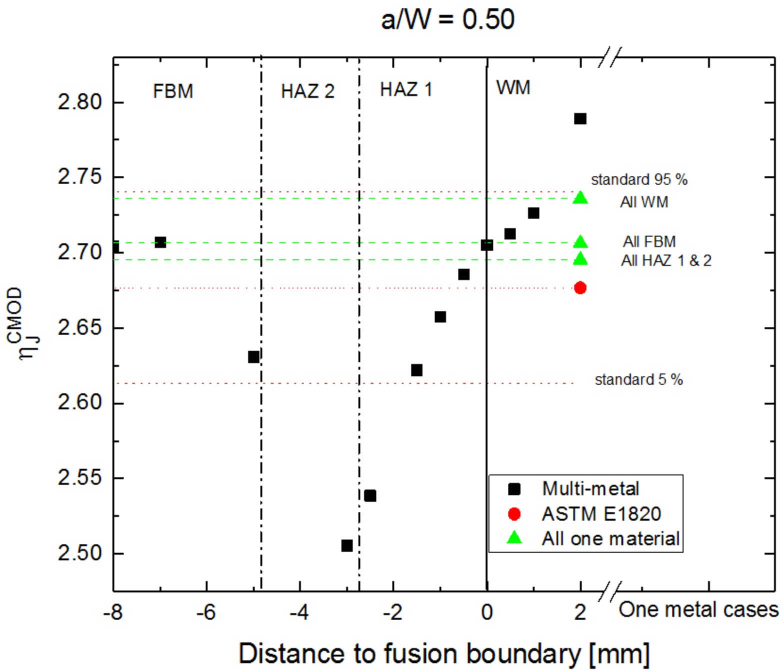
$$= \frac{\eta A}{B b}$$

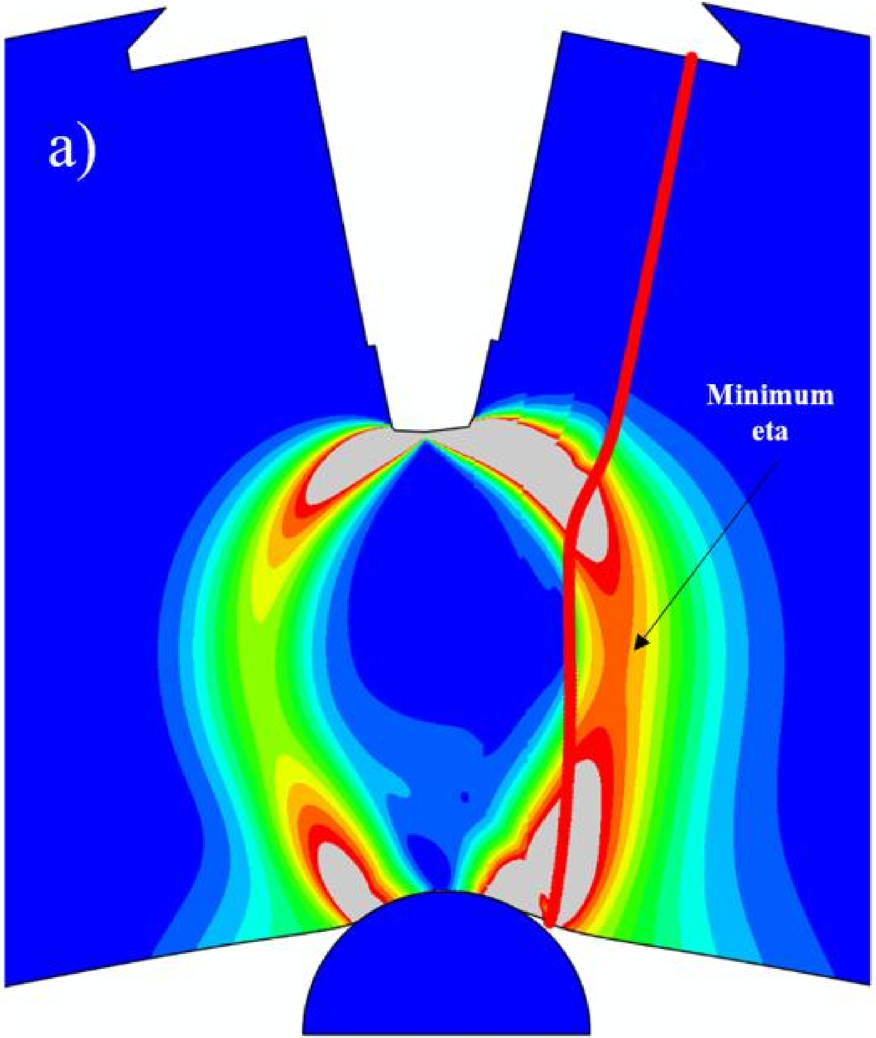
Energy stored in the specimen

Remaining ligament

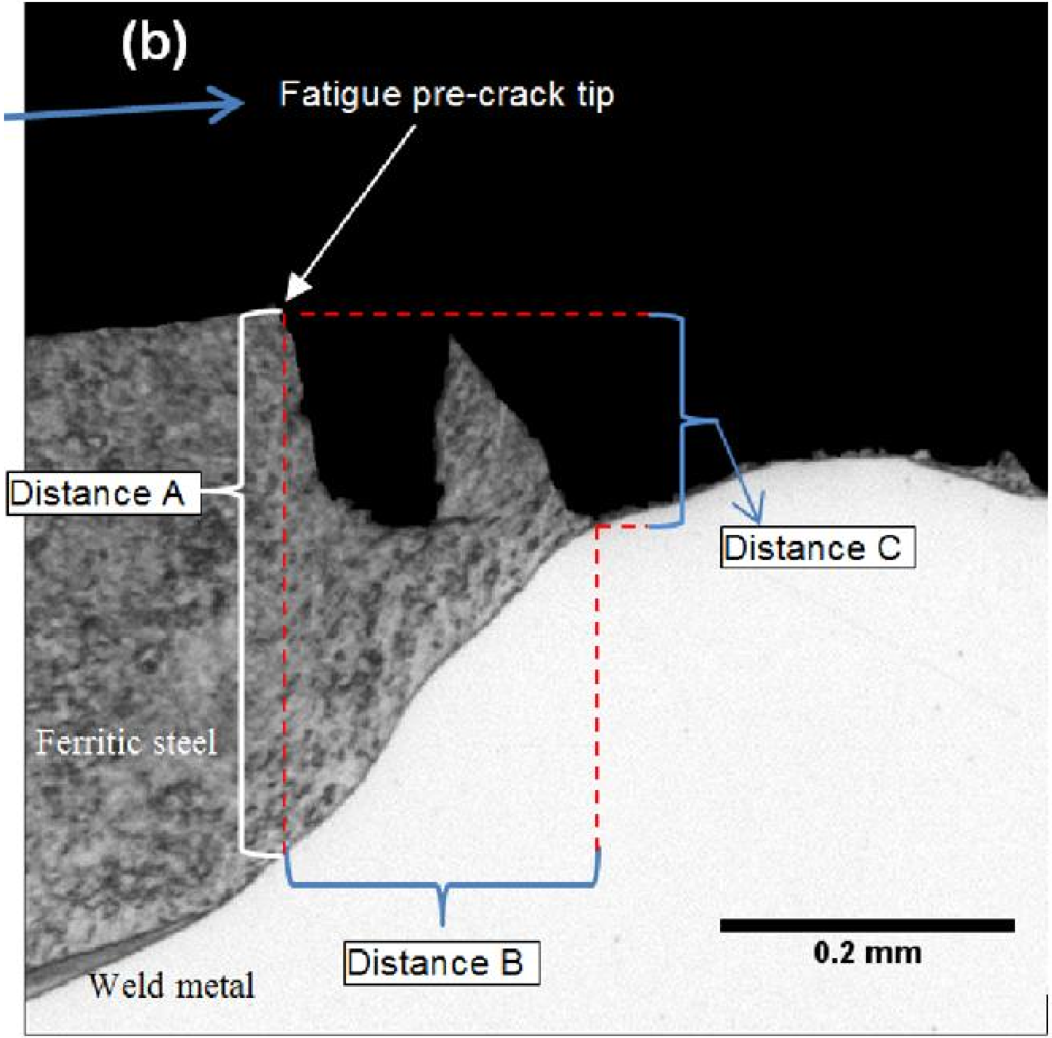
The η-factors developed for homogeneous materials can be used for cracks on the interface between a hard and a soft material



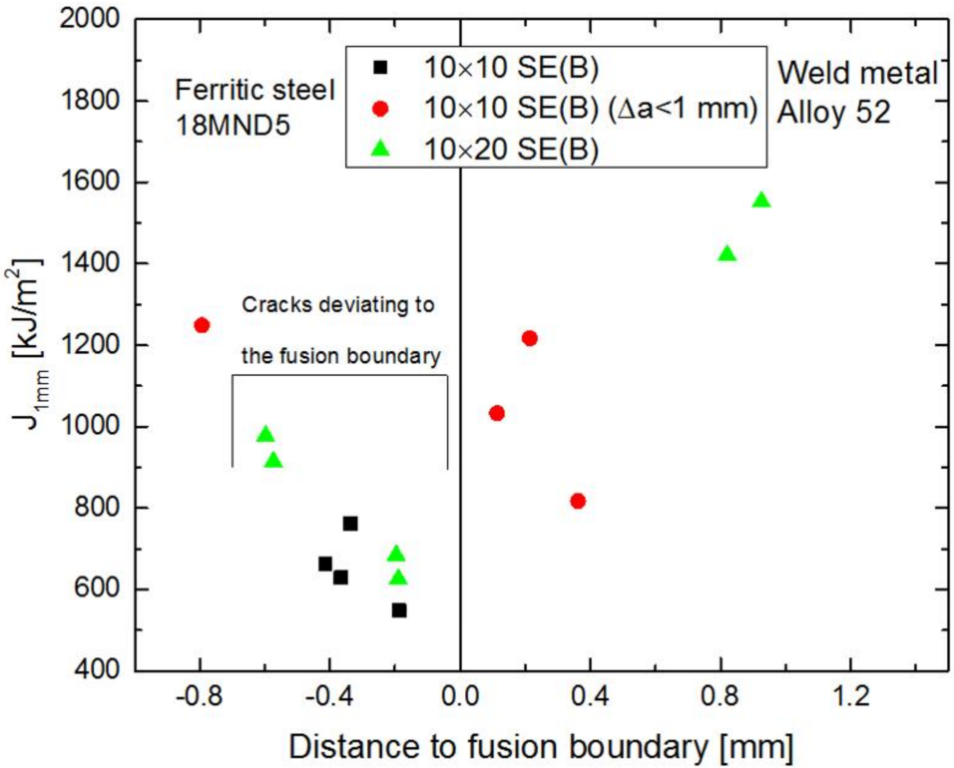


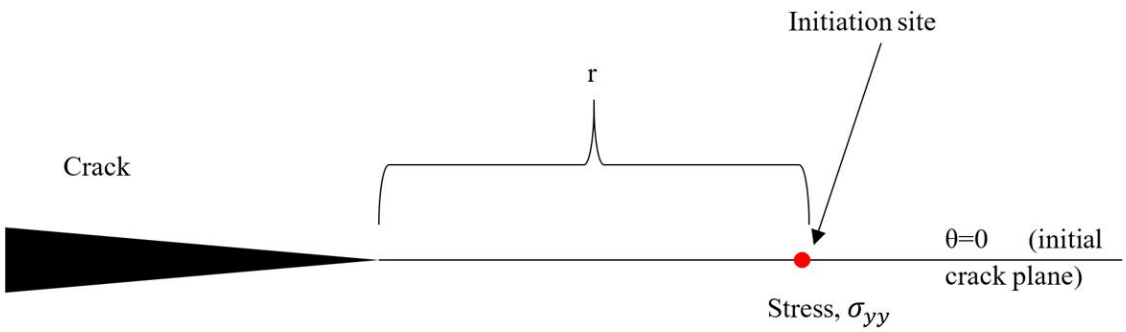

a)
Minimum
eta

Crack path – brittle and ductile regime

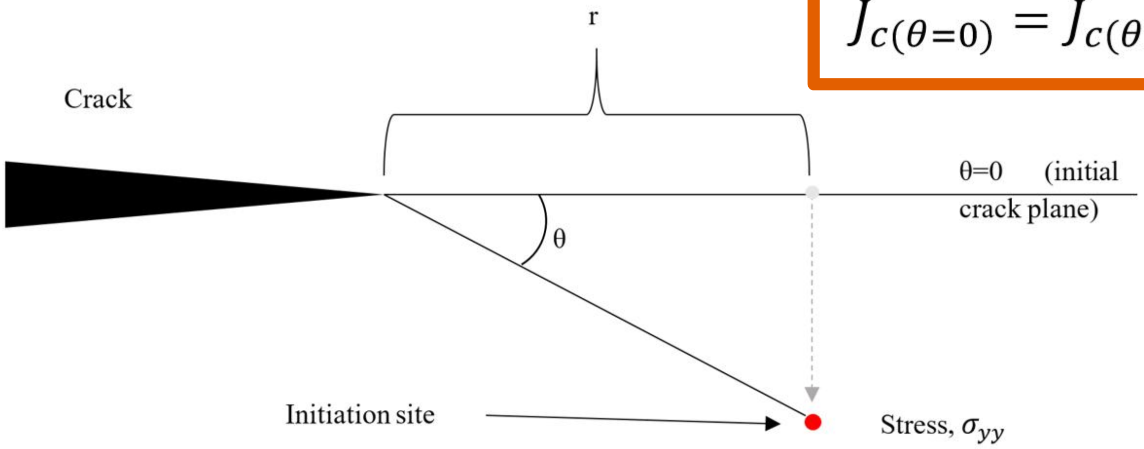


Lower boundary fracture toughness values are obtained at the fusion boundary, the weak zone

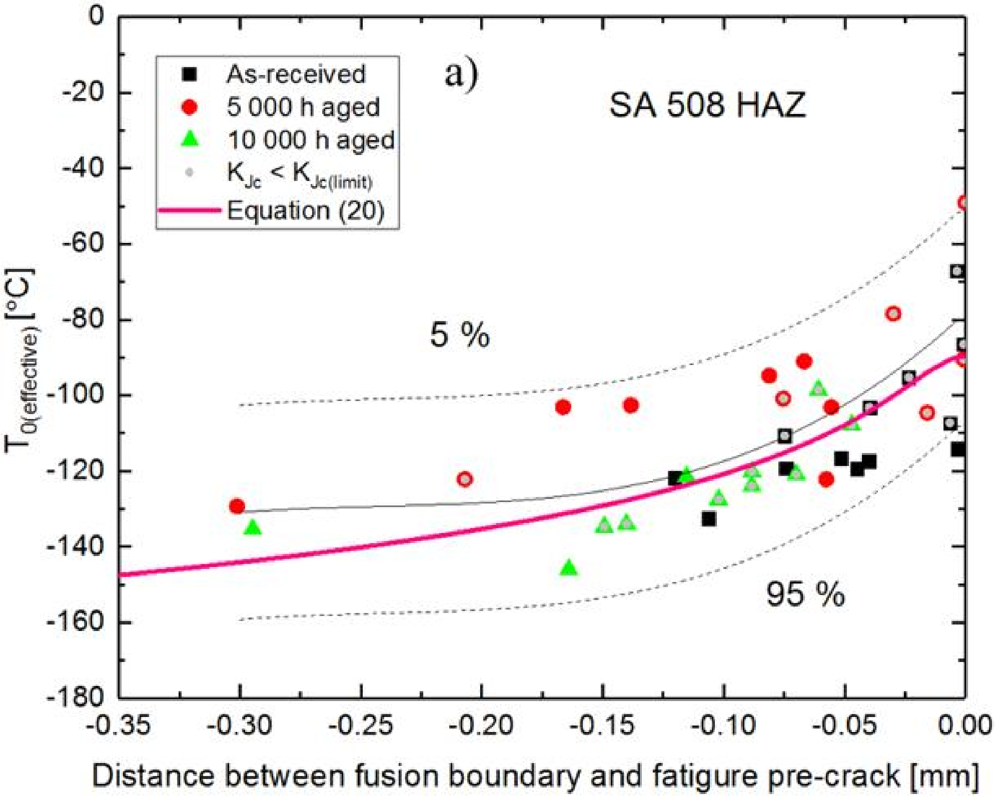


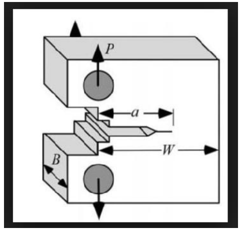


$$J_{c(\theta=0)} = J_{c(\theta>0)} \cdot (\cos(0.8 \cdot \theta))^{N+1}$$

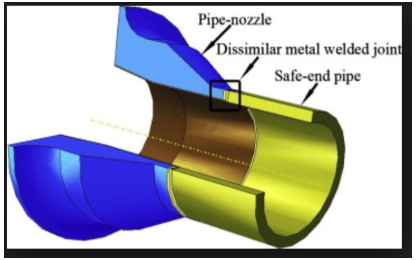


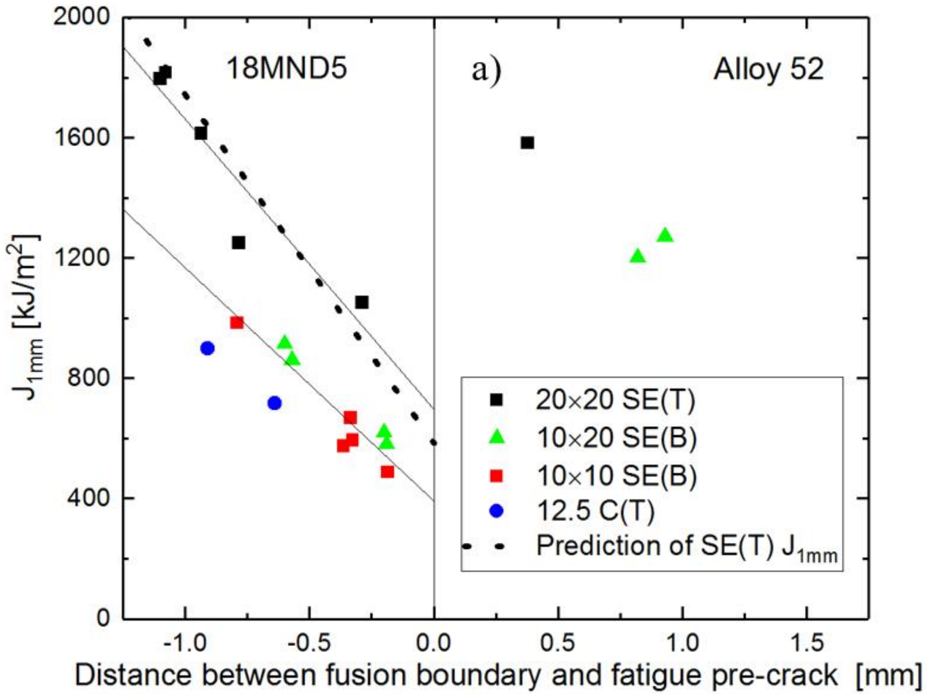
The model can be used for predicting the fracture toughness of/adjacent to the weakest zone





Transferability





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Characterization of J-R curves of a HSLA-steel and an Alloy 52 DMW with SE(T) specimens

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The effect of crack path on tearing resistance of a narrow-gap Alloy 52 dissimilar metal weld

Sebastian Lindqvist [a], Teemu Sarikka [b], Matias Ahonen [a], Hannu Hänninen [b]

Int J Fract (2018) 211:281–293
https://doi.org/10.1007/s10704-018-0288-5

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ORIGINAL PAPER

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Sebastian Lindqvist · Juha Kuutti

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A crack-location correction for T_0 analysis of an alloy 52 dissimilar metal weld

Sebastian Lindqvist [a], Matias Ahonen [a], Jari Lydman [a], Pentti Arffman [a], Hannu Hänninen [b]

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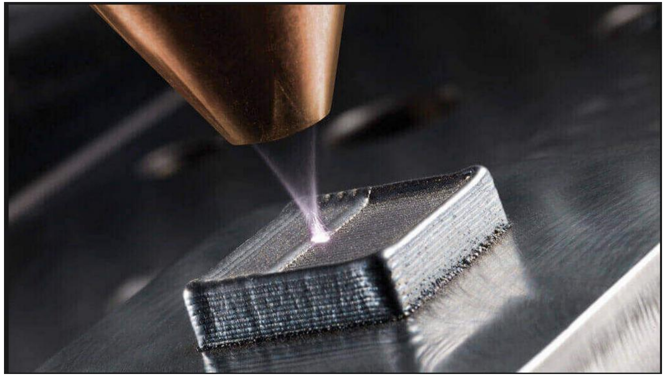
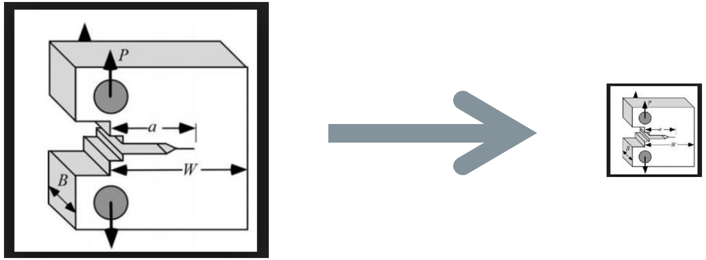
Towards better operation of NPPs by utilizing the full potential of fracture mechanics

New material solutions



Longer operation

Reduced material consumption



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