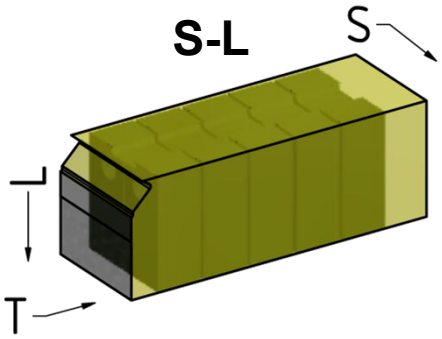
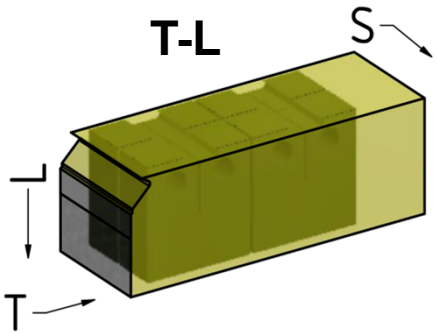
Testing of miniature 0.16T-C(T) specimens

0.16T-C(T) specimens were machined from already tested 0.4T-SE(B) specimens in the initial condition:

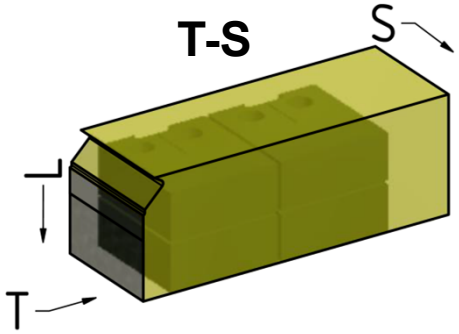
- orientation of the weld metal specimens



ANP-2, ANP-5, ANP-6

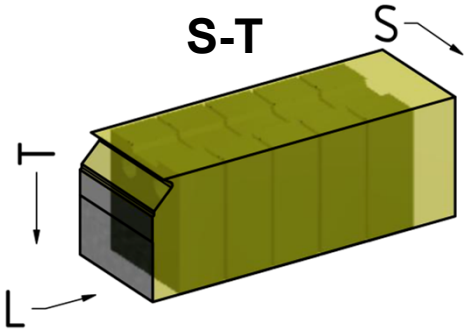


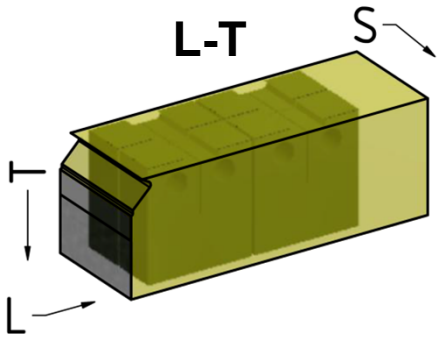
ANP-2, ANP-5, ANP-6

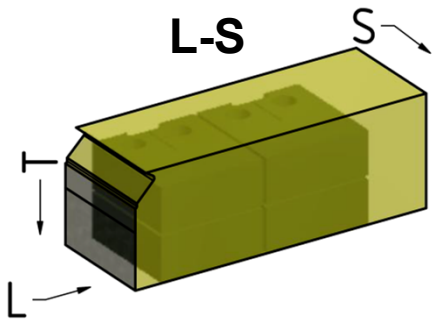


ANP-5, ANP-6

- orientation of the base metal FZD-4 specimens

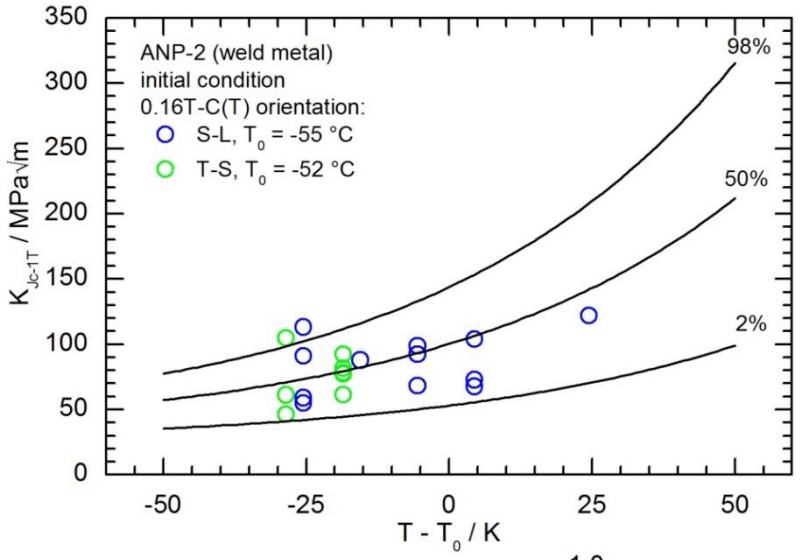


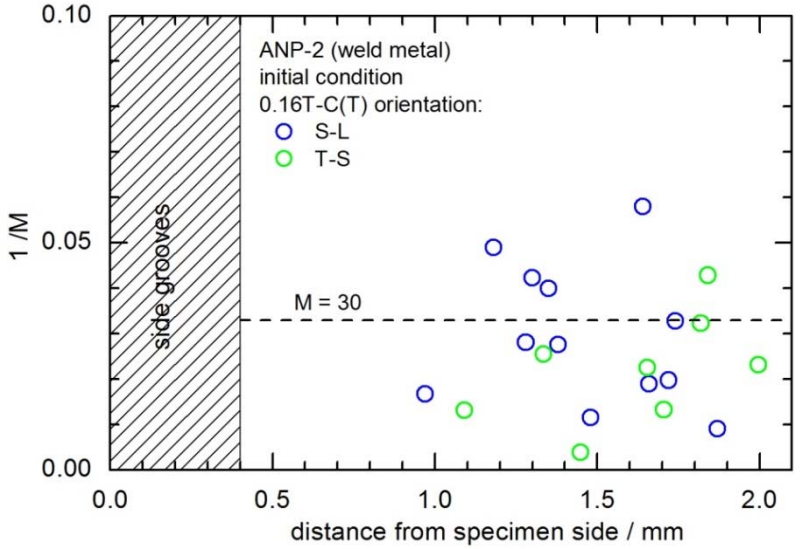




Fracture toughness testing according to ASTM E1921 (Master Curve approach)

ANP-2: 0.16T-C(T)

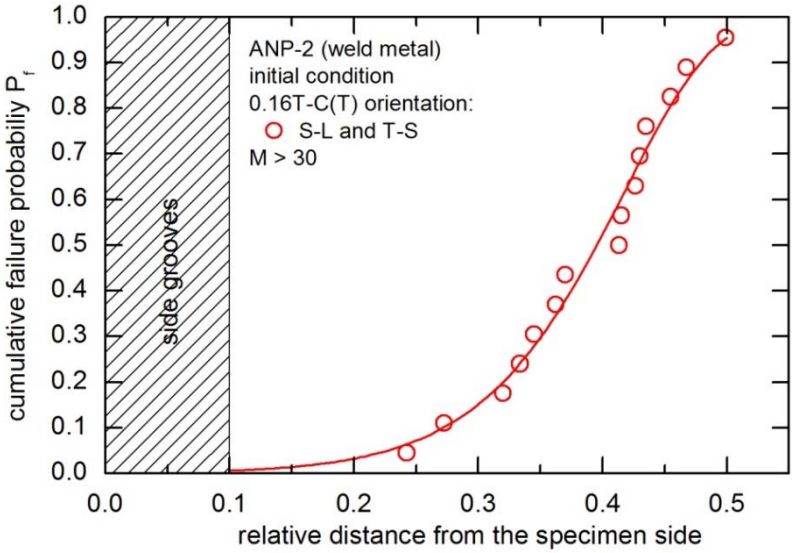




$K_{Jc\text{-}1T}$ values outside 2 % and 98 %:

- S-L: 1 out of 11 (8 %)
- T-S: 1 out of 8 (13 %)

0.4T-SE(B), T-L: T_0 = -28°C

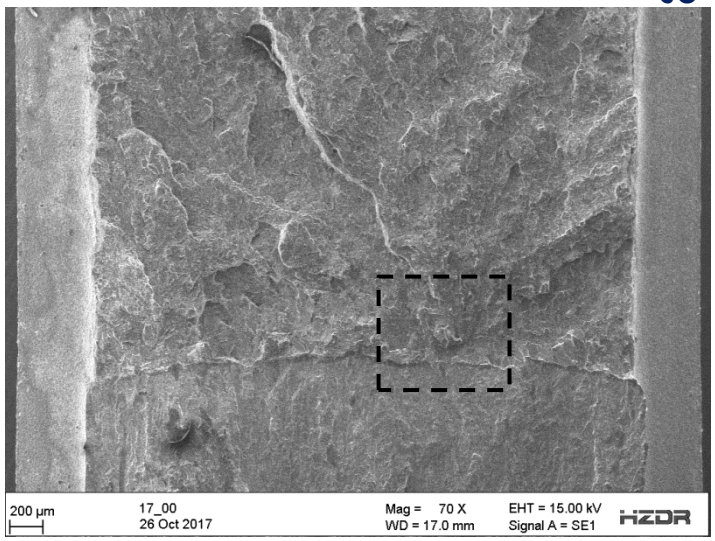


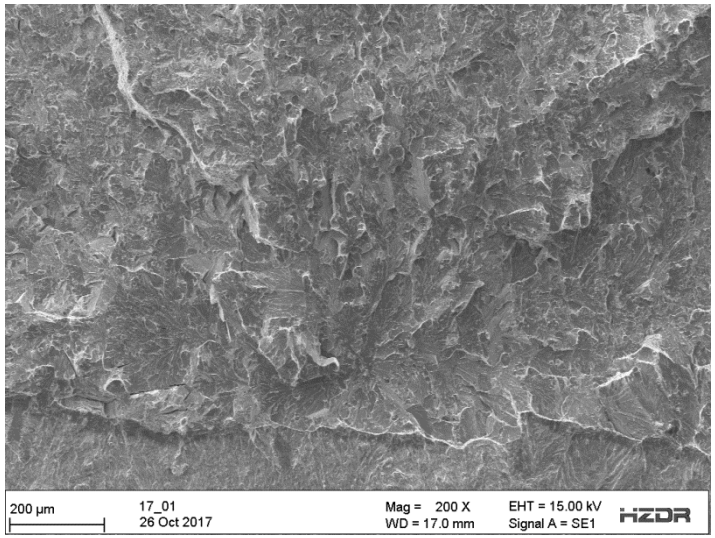
$$K_{Jclimit} = \sqrt{\frac{E \cdot b_0 \cdot \sigma_{YS}}{M \cdot (1 - \nu^2)}}$$

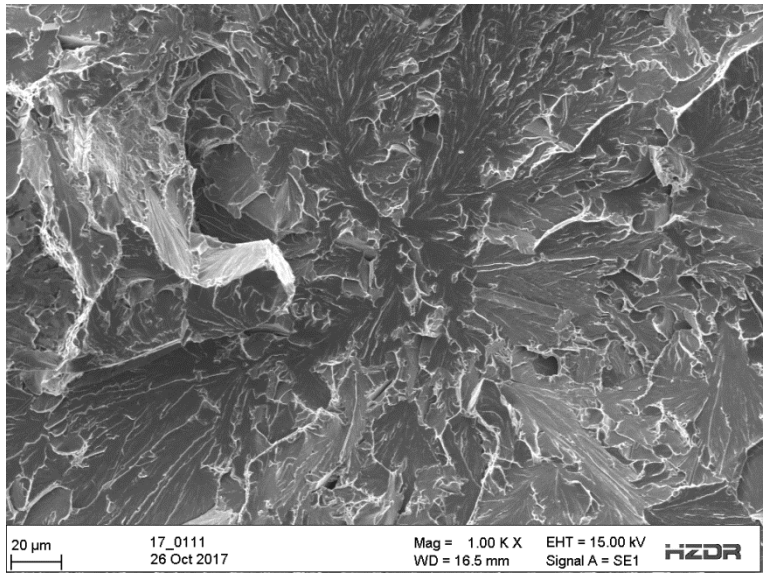
$$M = \frac{E \cdot b_0 \cdot \sigma_{YS}}{K_{Jc}^2 \cdot (1 - \nu^2)}$$

Fracture toughness testing according to ASTM E1921 (Master Curve approach)

ANP-2: 0.16T-C(T) specimen tested at -70°C, K_{Jc} = 118 MPa√m

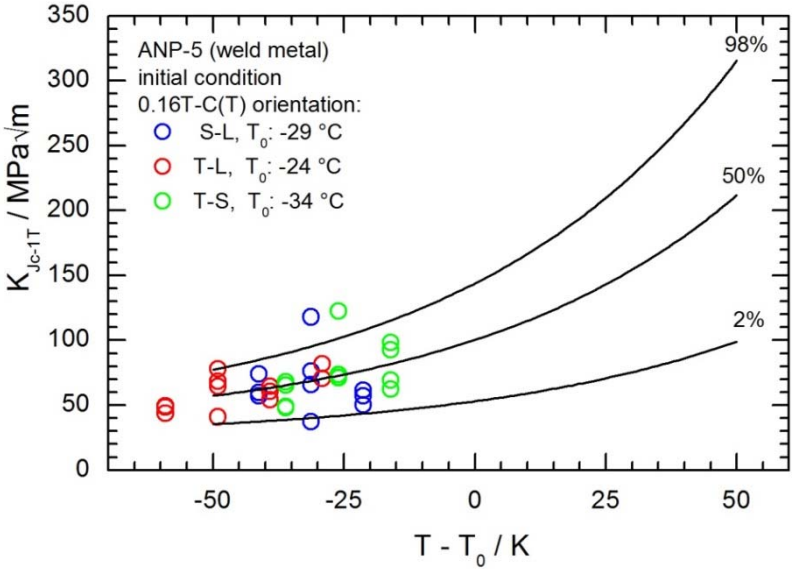


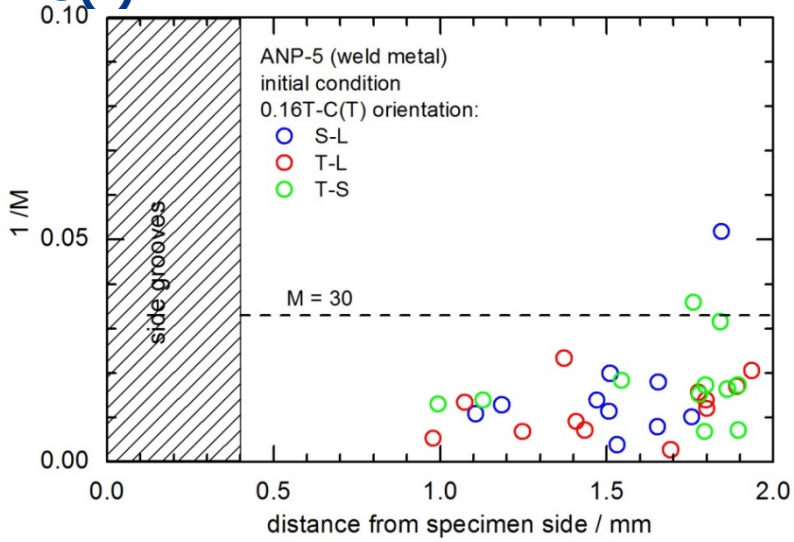




Fracture toughness testing according to ASTM E1921 (Master Curve approach)

ANP-5: 0.16T-C(T)

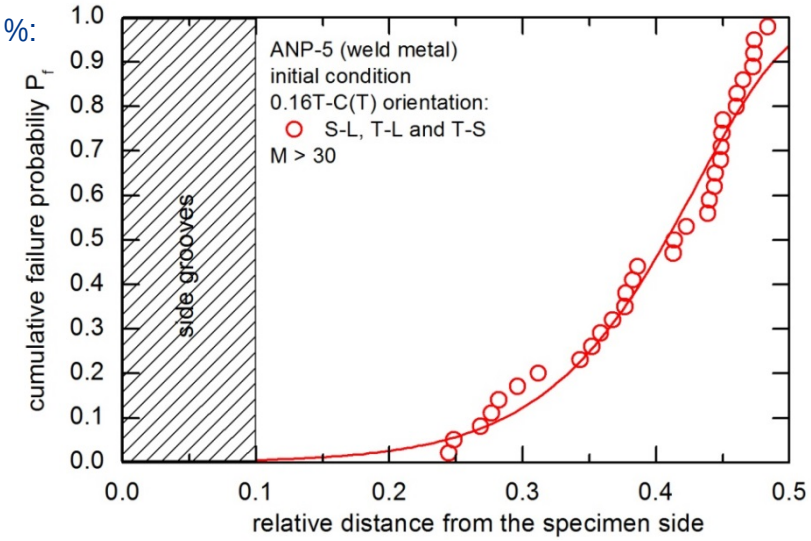




$K_{Jc\text{-}1T}$ values outside 2 % and 98 %:

- S-L: 2 out of 10 (20 %)
- T-L: 0 out of 12 (0 %)
- T-S: 1 out of 12 (8 %)

0.4T-SE(B), T-L: T_0 = -39°C

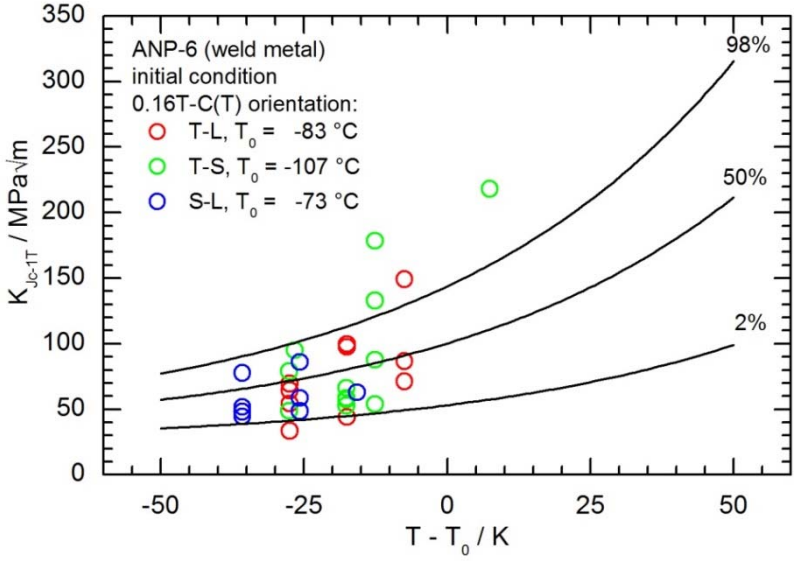


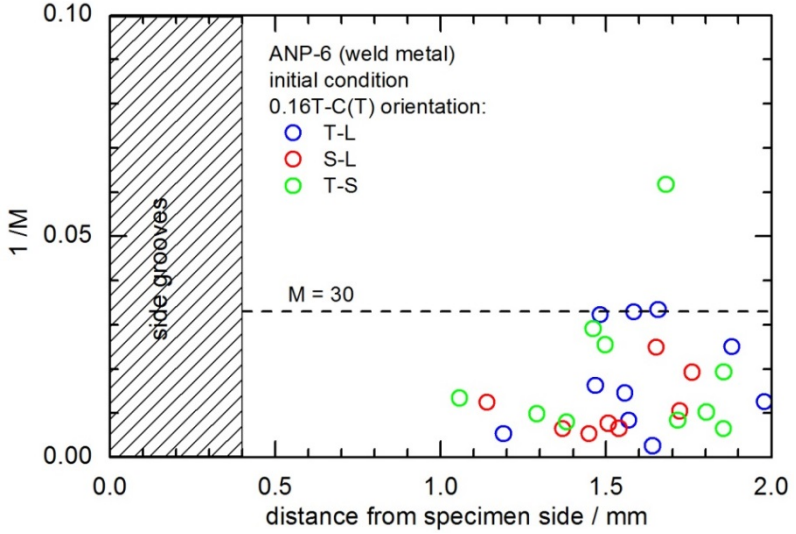
$$K_{Jclimit} = \sqrt{\frac{E \cdot b_0 \cdot \sigma_{YS}}{M \cdot (1-\nu^2)}}$$

$$M = \frac{E \cdot b_0 \cdot \sigma_{YS}}{K_{Jc}^2 \cdot (1-\nu^2)}$$

Fracture toughness testing according to ASTM E1921 (Master Curve approach)

ANP-6: 0.16T-C(T)

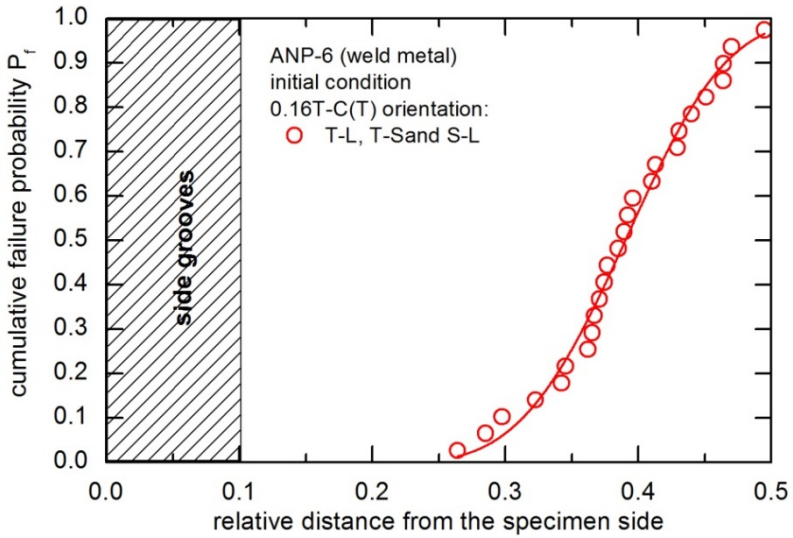




$K_{Jc\text{-}1T}$ values outside 2 % and 98 %:

- S-L: 0 out of 8 (0 %)
- T-S: 3 out of 12 (25 %)
- T-L: 3 out of 11 (27 %)

1T-C(T), T-L: T_0 = -86°C

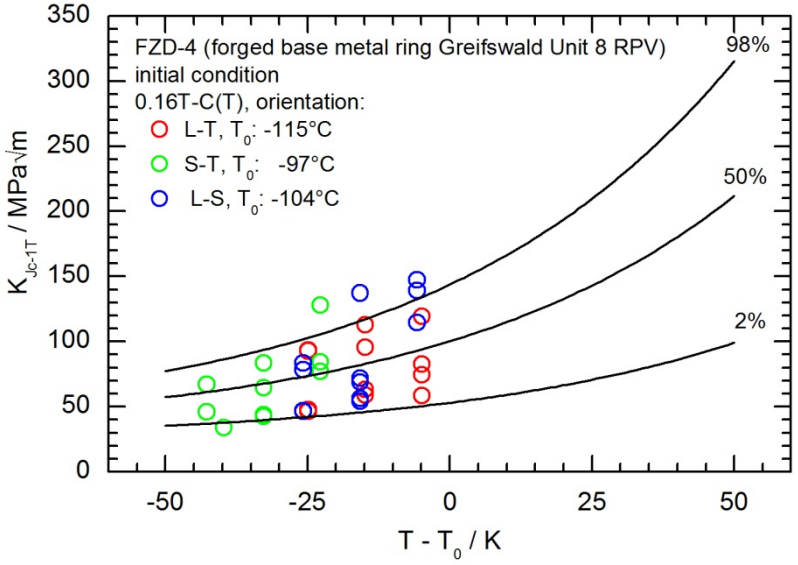


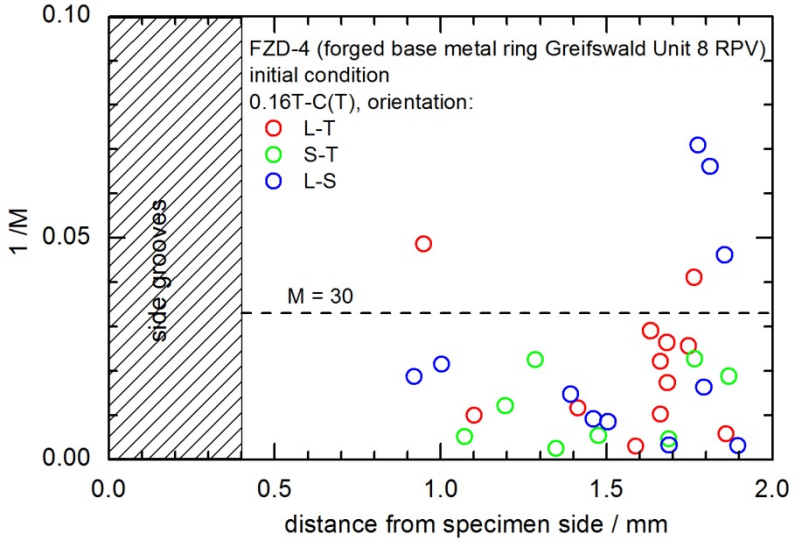
$$K_{Jclimit} = \sqrt{\frac{E \cdot b_0 \cdot \sigma_{YS}}{M \cdot (1-\nu^2)}}$$

$$M = \frac{E \cdot b_0 \cdot \sigma_{YS}}{K_{Jc}^2 \cdot (1-\nu^2)}$$

Fracture toughness testing according to ASTM E1921 (Master Curve approach)

FZD-4: 0.16T-C(T)

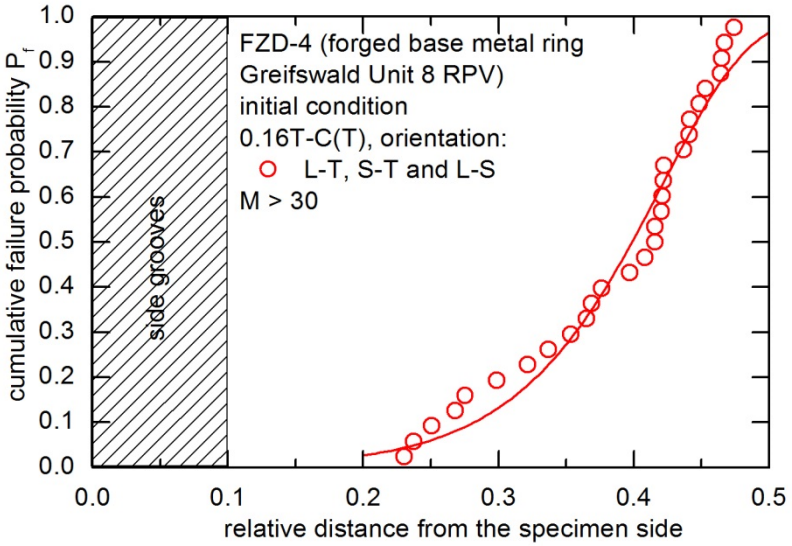




$K_{Jc\text{-}1T}$ values outside 2 % and 98 %:

- L-T: 0 out of 12 (0 %)
- S-T: 2 out of 10 (20 %)
- L-S: 3 out of 12 (25 %)

0.4T-SE(B), L-S: T_0 = -104°C

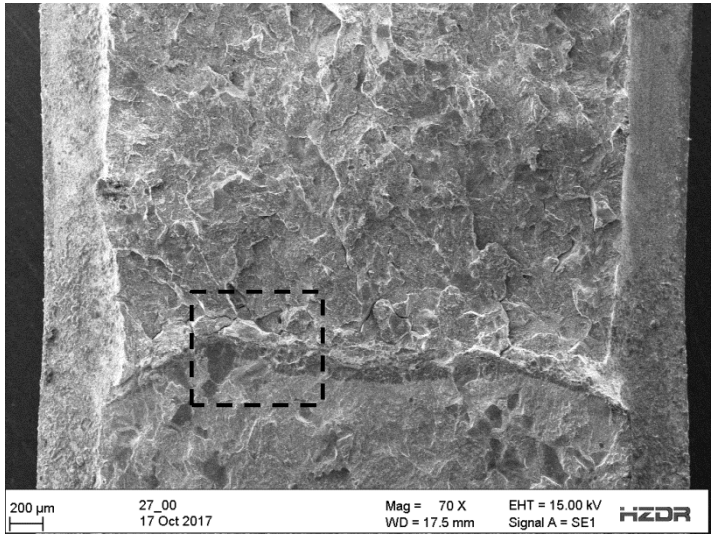


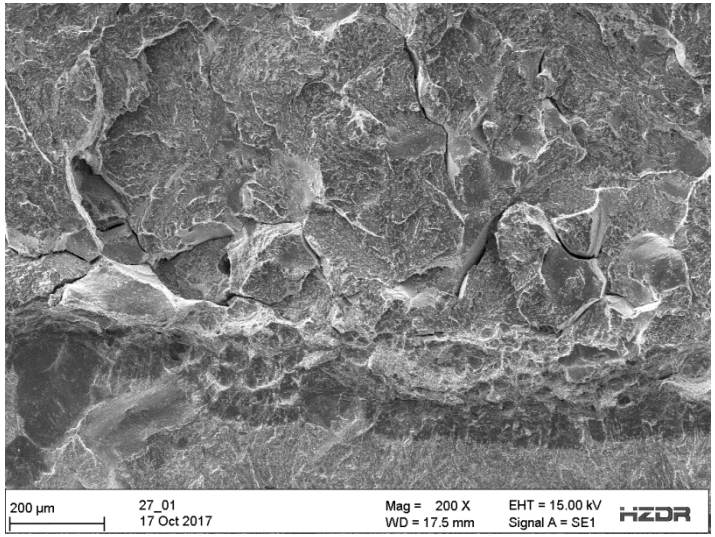
$$K_{Jclimit} = \sqrt{\frac{E \cdot b_0 \cdot \sigma_{YS}}{M \cdot (1 - \nu^2)}}$$

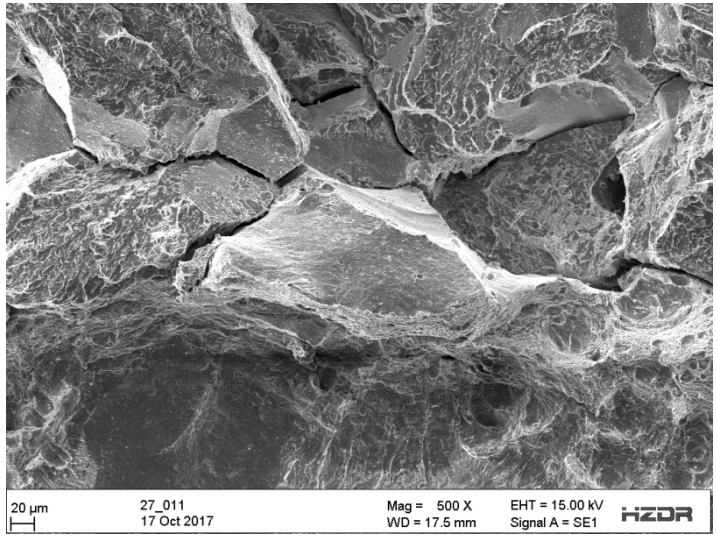
$$M = \frac{E \cdot b_0 \cdot \sigma_{YS}}{K_{Jc}^2 \cdot (1 - \nu^2)}$$

Fracture toughness testing according to ASTM E1921 (Master Curve approach)

FZD-4: 0.16T-C(T) specimen tested at -110°C, K_{Jc} = 222 MPa√m

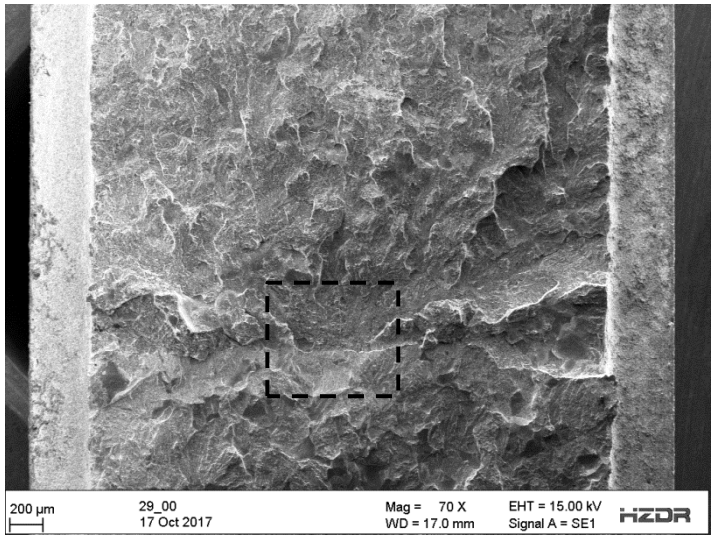


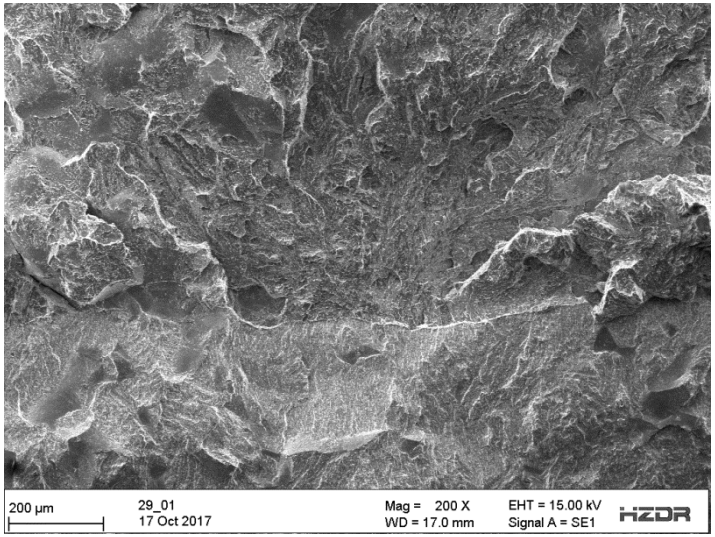


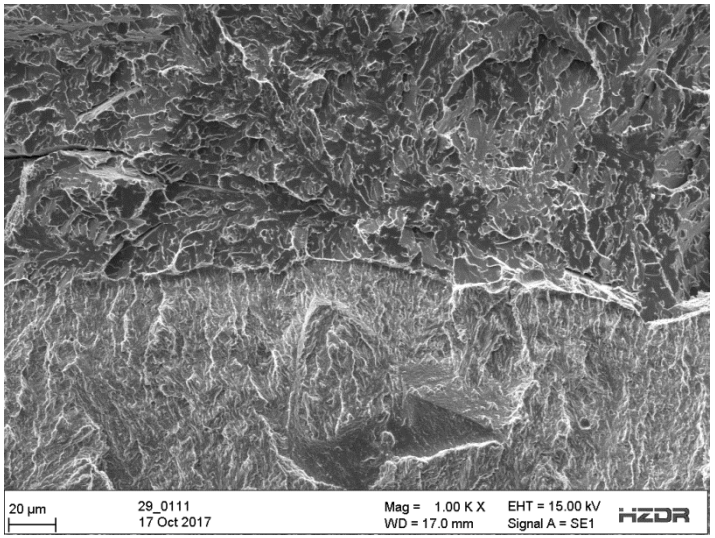


Fracture toughness testing according to ASTM E1921 (Master Curve approach)

FZD-4: 0.16T-C(T) specimen tested at -130°C, K_{Jc} = 46 MPa√m



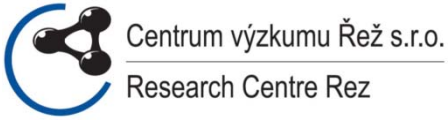




Summary and conclusions

- Investigation of the irradiation behaviour of selected RPV steels showing inhomogeneity.
- Measurement of the irradiation susceptibility by hardness.
- Determination of the fracture toughness on standard SE(B) and miniature C(T) specimens.
- Fractographic characterisation of the miniature C(T) specimens.
- Microstructural characterisation of the irradiated RPV steels by TEM, SANS and APT.
- The steels investigated showed the irradiation-induced hardening as expected in terms of chemical composition.
- The Master Curve based reference temperatures measured with Charpy size SE(B) and miniature C(T) specimens in the initial condition are different.
- The orientation of the miniature specimens machined from the irradiated SE(B) specimens was fixed with T-S and L-S for the weld and base metal, respectively.

The SOTERIA Consortium



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SOTERIA Website – coming soon

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