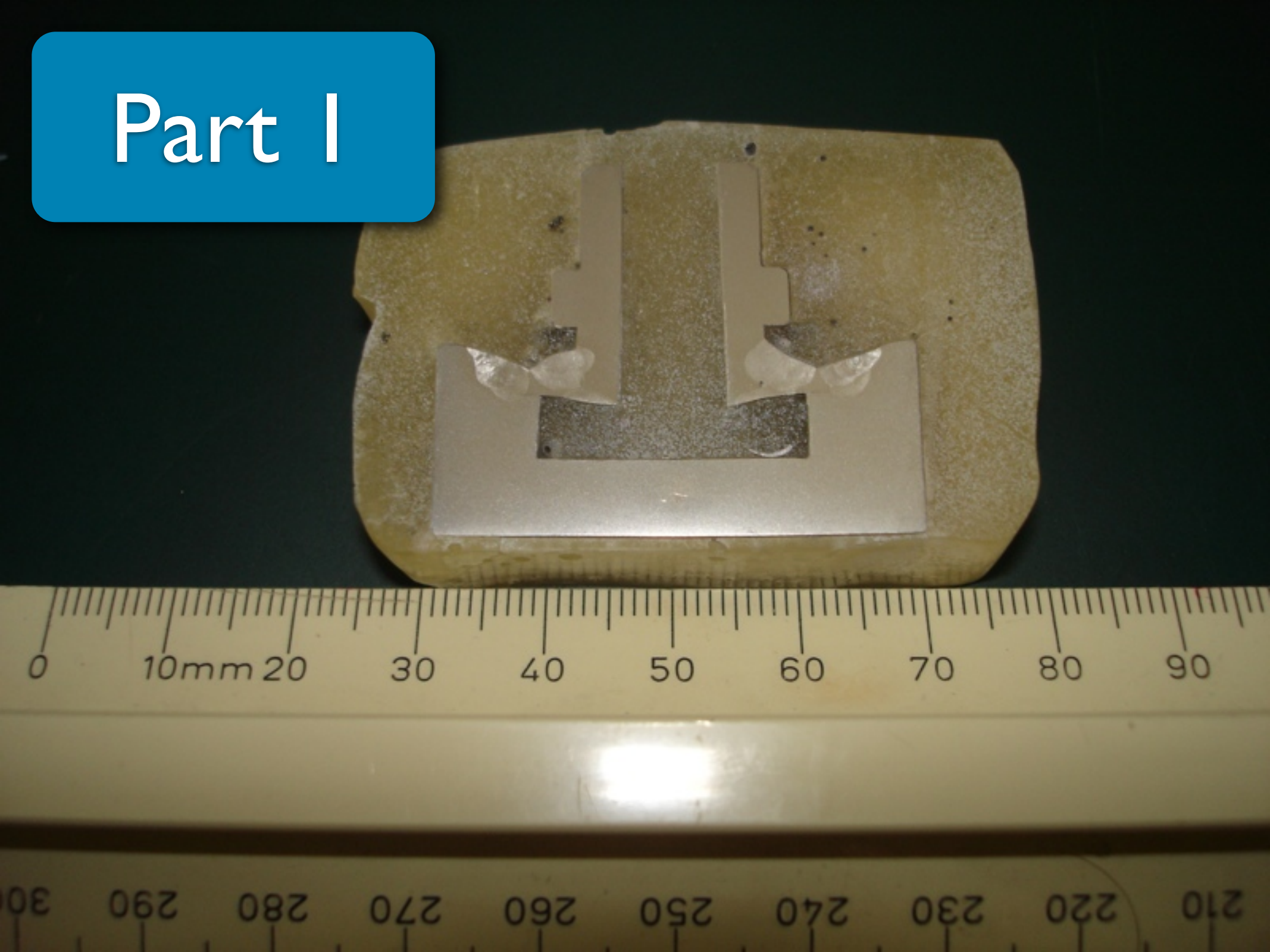
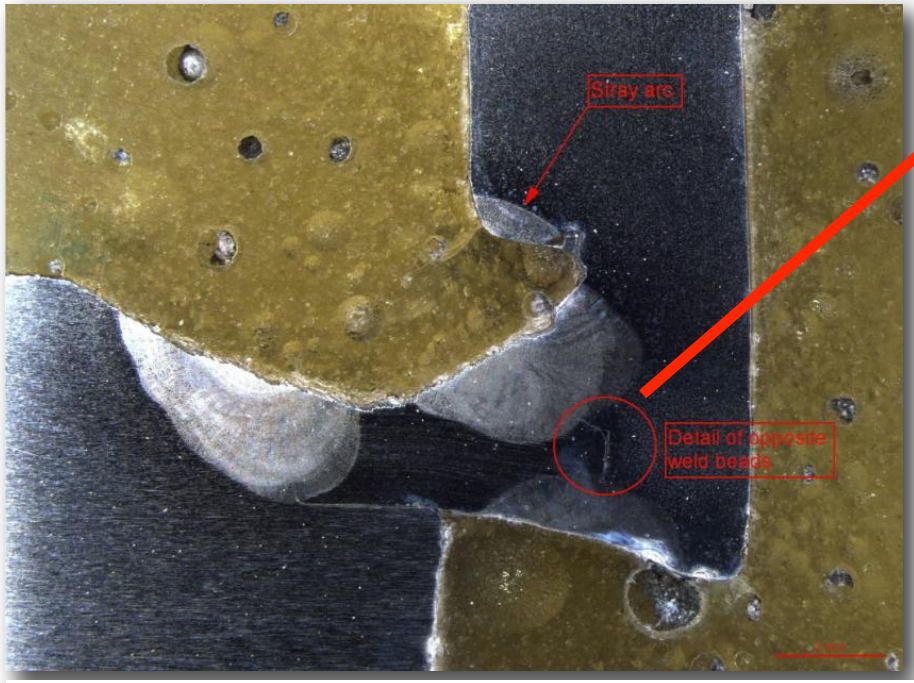
welding qualification according to ISO 5817 level B

(cooling channel welds)

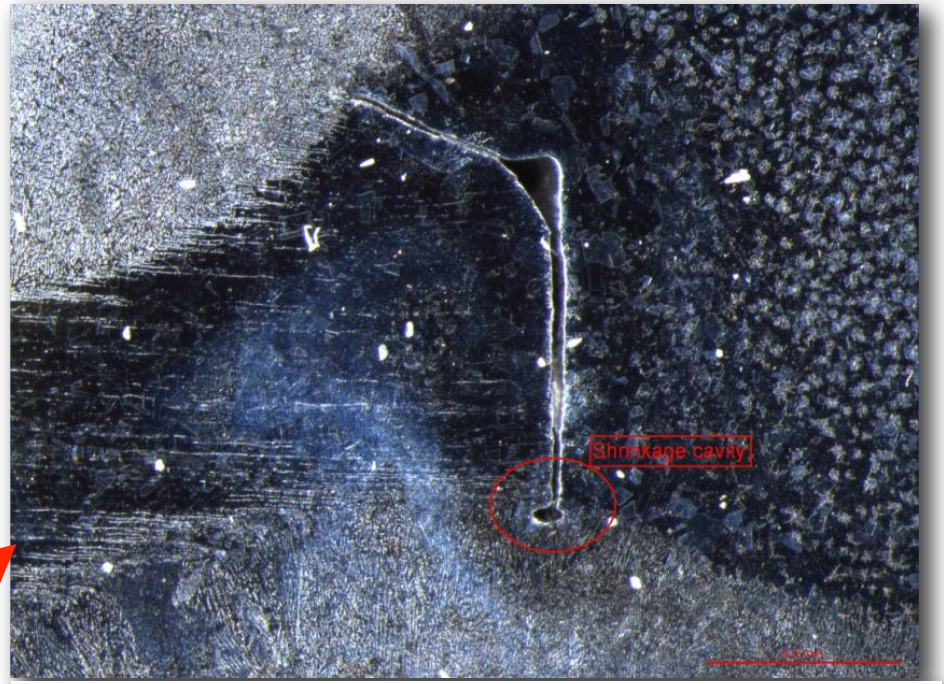
Part 1



Part 1 (left), welder 1



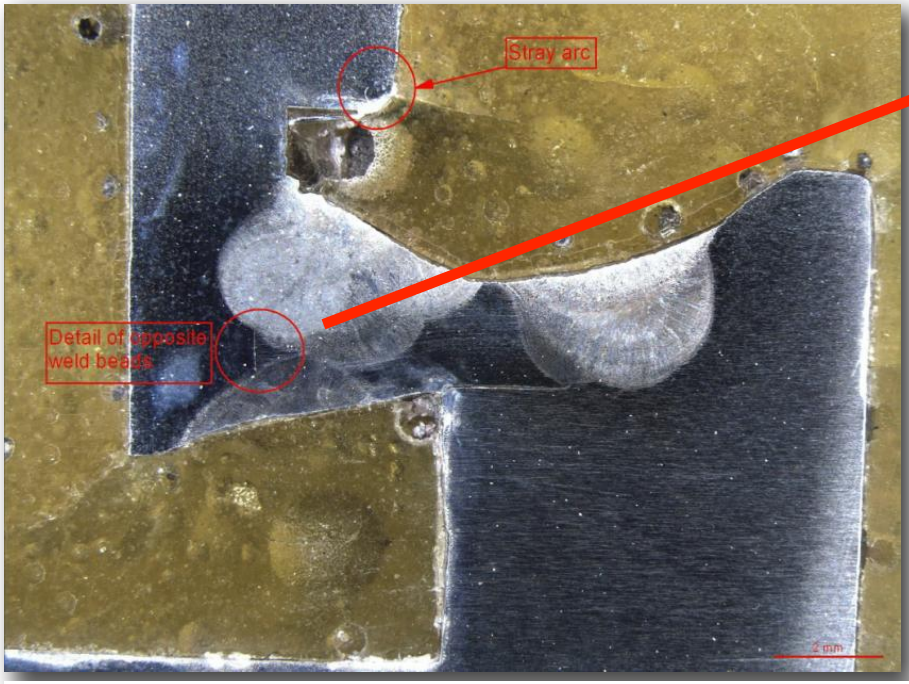
Sample Id: Welder 1-part 1
Description: Global view of the assembly, imperfection ISO 6520-1-520, excessive distortion and imperfection ISO 6520-1-601, stray arc
Original magnification: 7.1 x sans coaxial



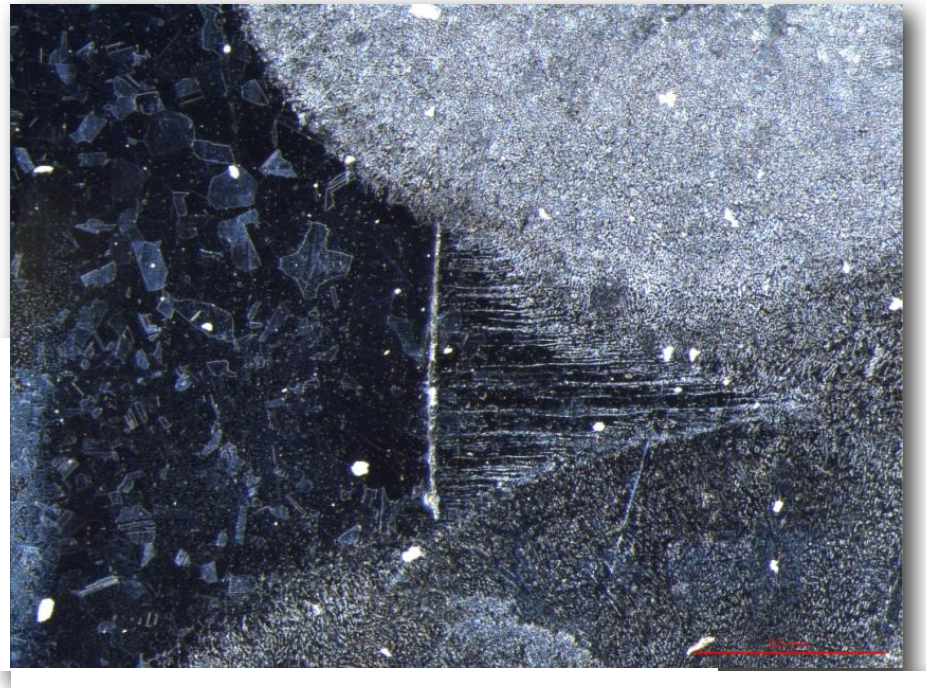
Sample Id: Welder 1-part 1
Description: Detail of opposite weld beads, imperfection ISO 6520-1-202, shrinkage cavity at the root of the weld
Original magnification: 50.0 x sans coaxial

- distortion is not specified in norm,
- stray arc and small cavity do not fulfil the norm.

Part 1 (right), welder 1



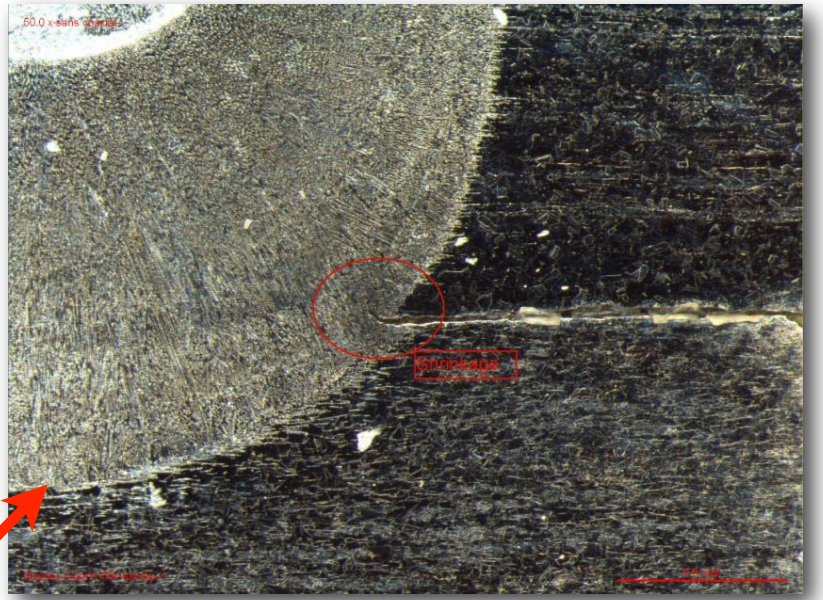
Sample Id: Welder 1-part 1
Description: Global view of the assembly, imperfection ISO 6520-1-520, excessive distortion and imperfection ISO 6520-1-601, stray arc
Original magnification: 7.1 x sans coaxial



Sample Id: Welder 1-part 1
Description: Detail of opposite weld beads, no visible imperfection
Original magnification: 50.0 x sans coaxial

- distortion is not specified in norm,
- stray arc does not fulfil the norm.

Part 1 (left), welder 11

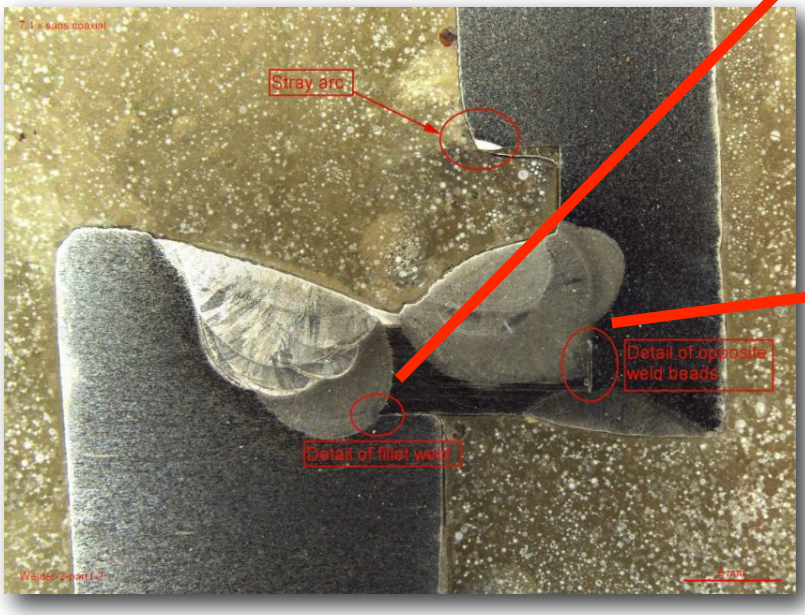


Sample Id:
Welder 2-part 1

Magnification:
50.0 x sans coaxial

Date:
15.07.2010

Description:
Detail of fillet weld, imperfection ISO 6520-1-202, shrinkage at the root of the weld

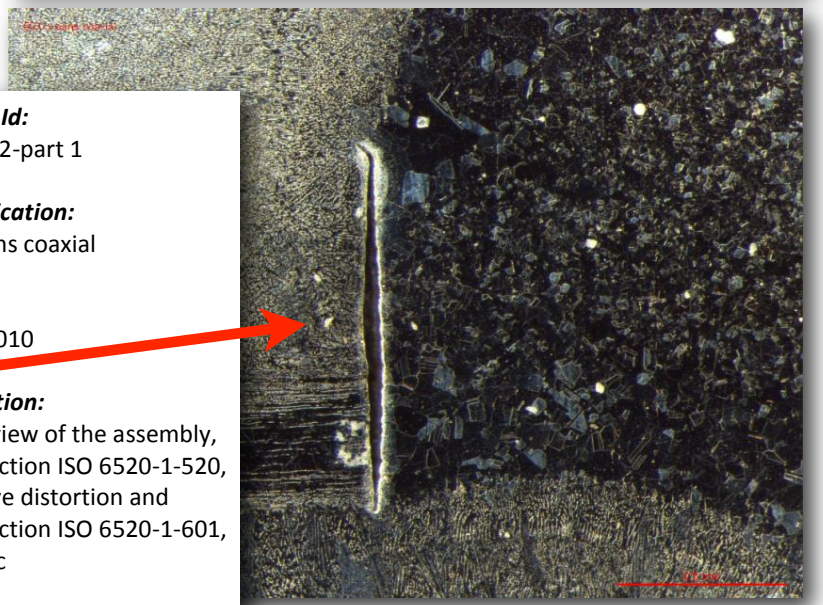


Sample Id:
Welder 2-part 1

Magnification:
7.1 x sans coaxial

Date:
15.07.2010

Description:
Global view of the assembly, imperfection ISO 6520-1-520, excessive distortion and imperfection ISO 6520-1-601, stray arc



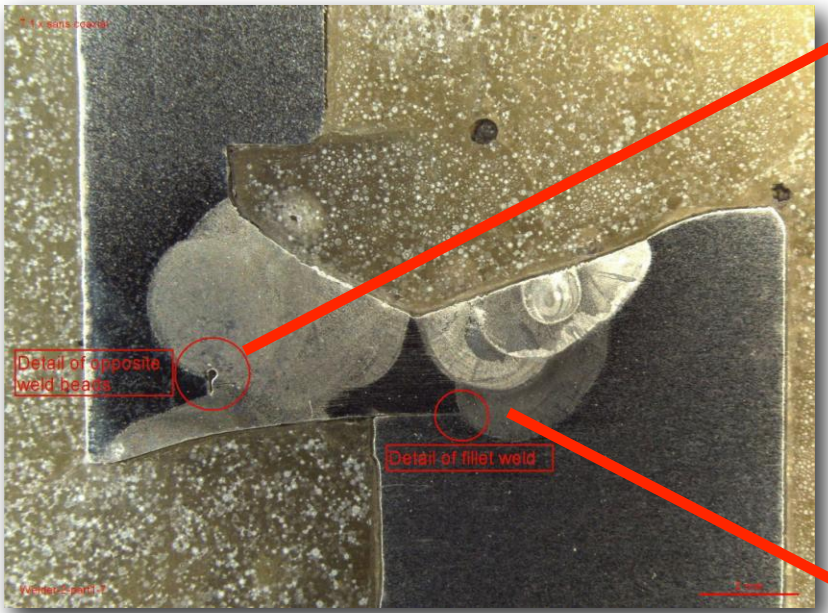
Sample Id:
Welder 2-part 1

Magnification:
50.0 x sans coaxial

Date:
15.07.2010

Description:
Detail of opposite weld beads, no visible imperfection

Part 1 (right), welder 11

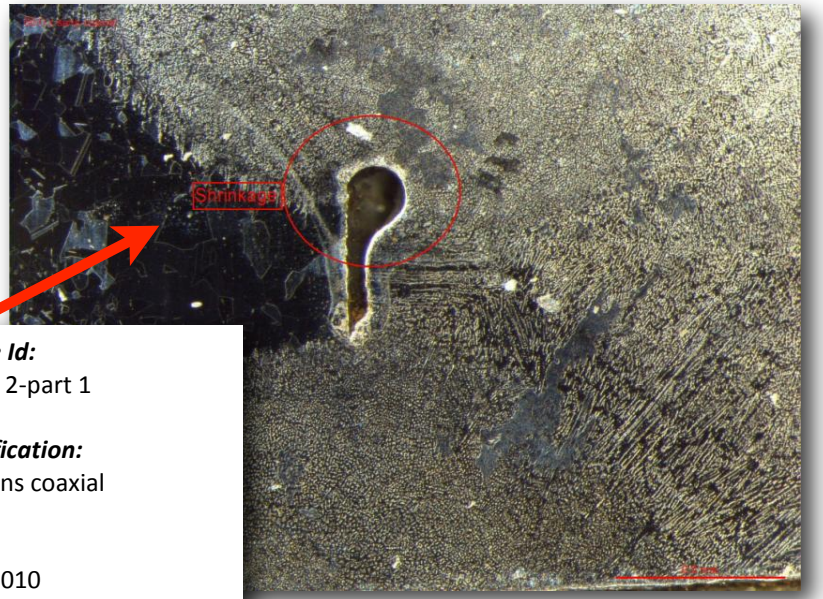


Sample Id:
Welder 2-part 1

Magnification:
7.1 x sans coaxial

Date:
15.07.2010

Description:
Global view of the assembly, imperfection ISO 6520-1-520, excessive distortion

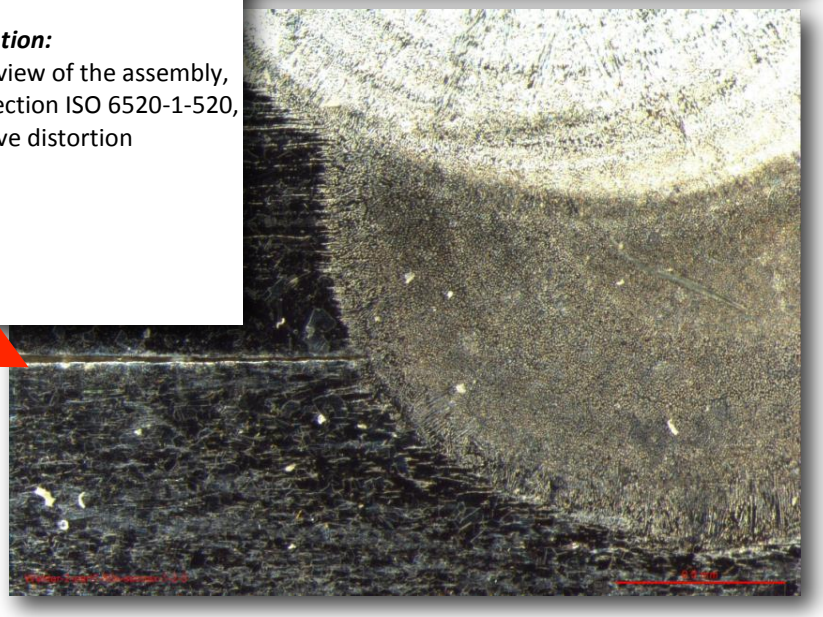


Sample Id:
Welder 2-part 1

Magnification:
50.0 x sans coaxial

Date:
15.07.2010

Description:
Detail of opposite weld beads, imperfection ISO 6520-1-202, shrinkage at the root of the weld



Sample Id:
Welder 2-part 1

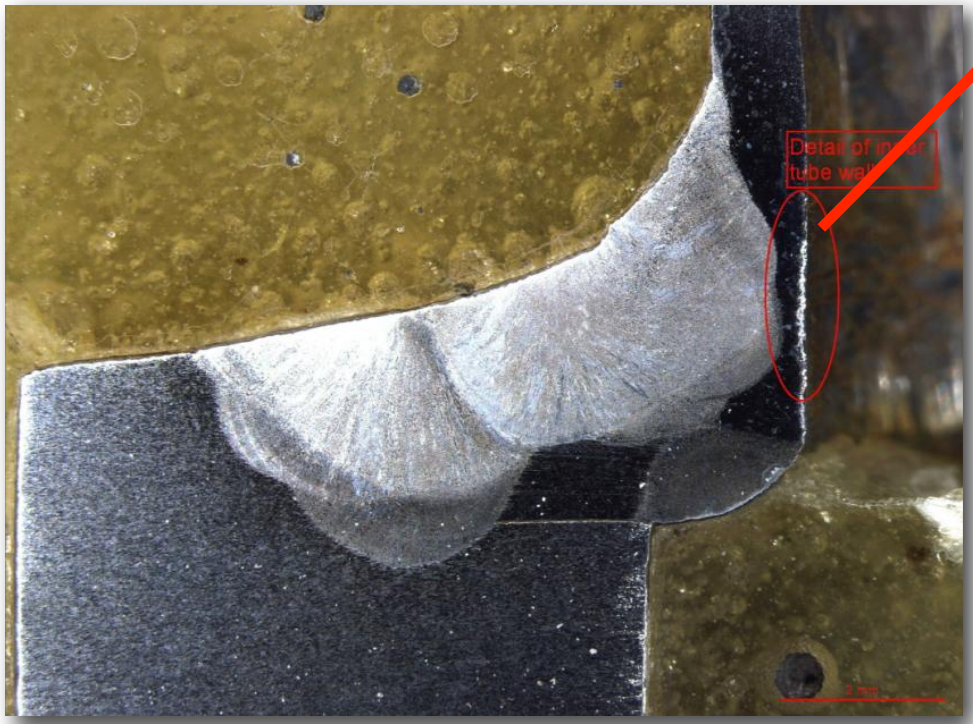
Magnification:
50.0 x sans coaxial

Date:
15.07.2010

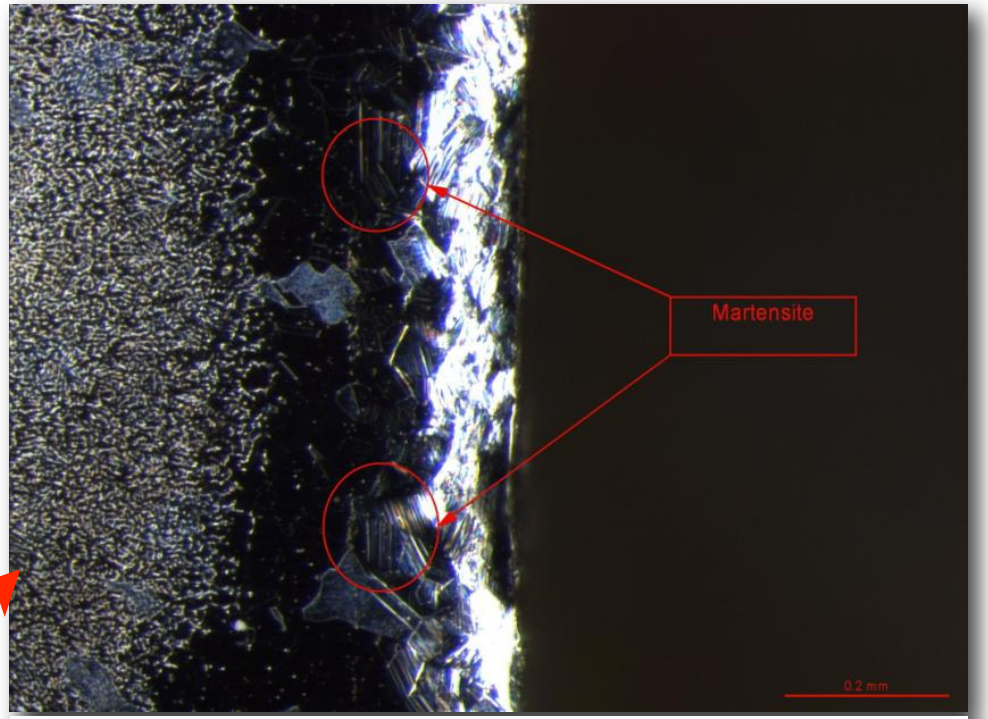
Description:
Detail of fillet weld, no visible imperfection

Part 11

Part II(left), welder I



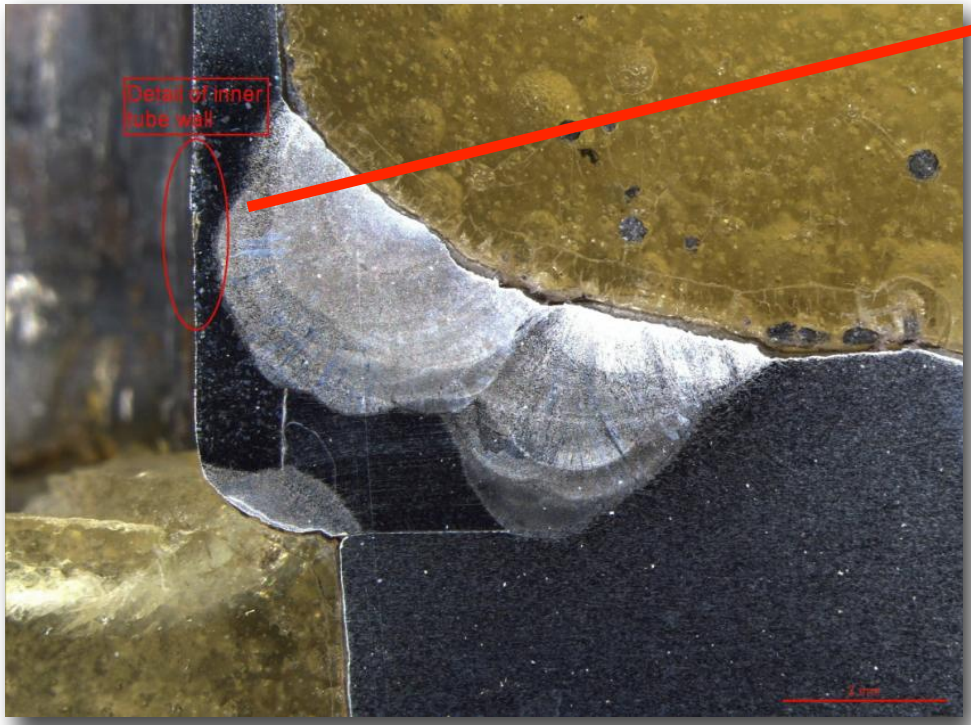
Sample Id: Welder 1-part 2
Description: Global view
Original magnification: 10.0 x sans coaxial



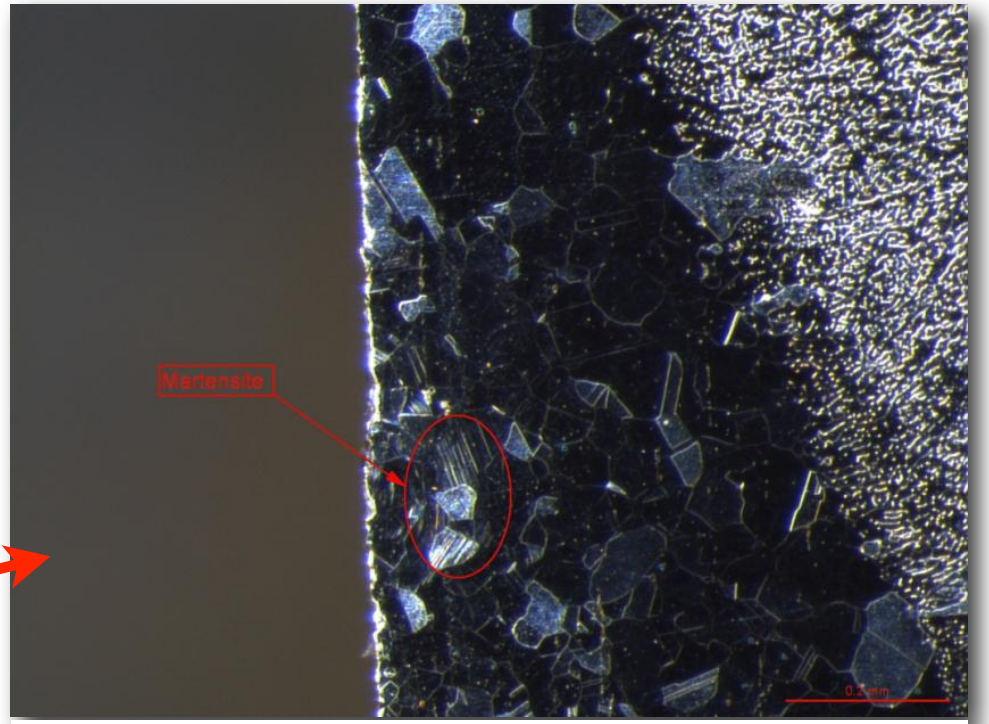
Sample Id: Welder 1-part 2
Description: Detail of inner tube wall, probable presence of martensite
Original magnification: 100.0 x sans coaxial

- martensite probably formed because tube was held in position by an inner pin, when the weld cooled down, and the material was subject to plastic deformation,
- only a problem for cryogenic temperatures or if magnetism is critical.

Part II(right), welder I



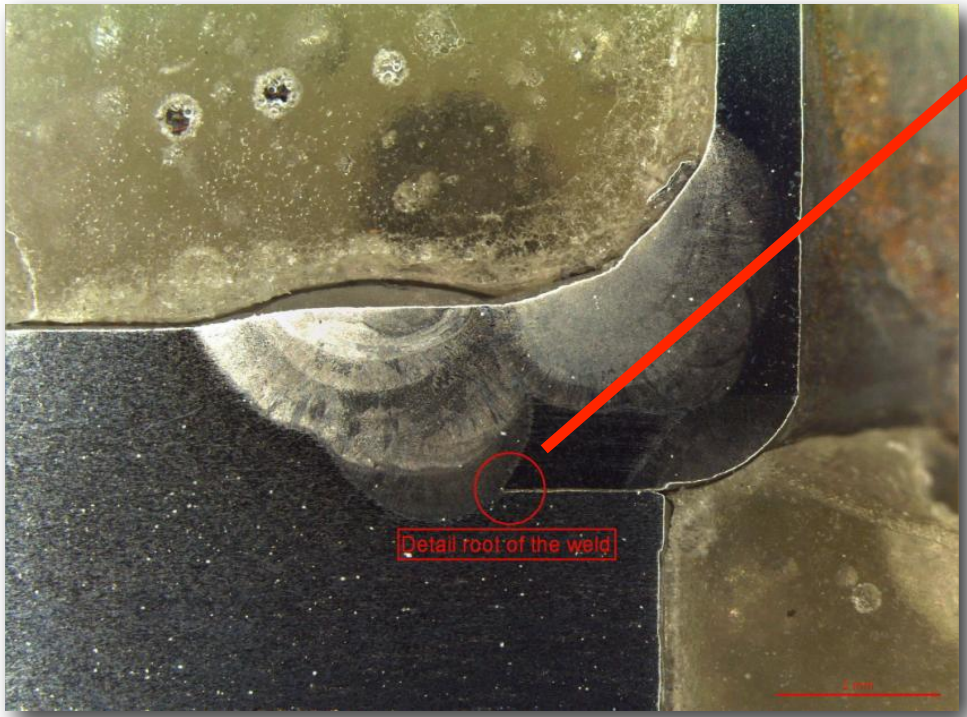
Sample Id: Welder 1-part 2
Description: Global view
Original magnification: 10.0 x sans coaxial



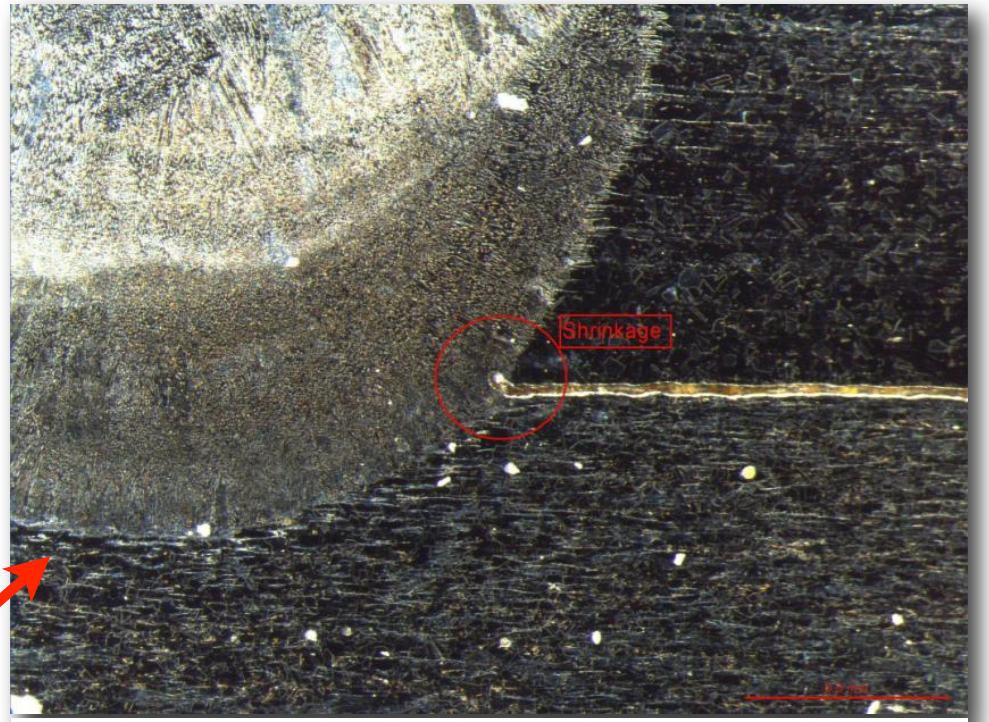
Sample Id: Welder 1-part 2
Description: Detail of inner tube wall, probable presence of martensite
Original magnification: 100.0 x sans coaxial

- same as for left side,

Part II(left), welder II



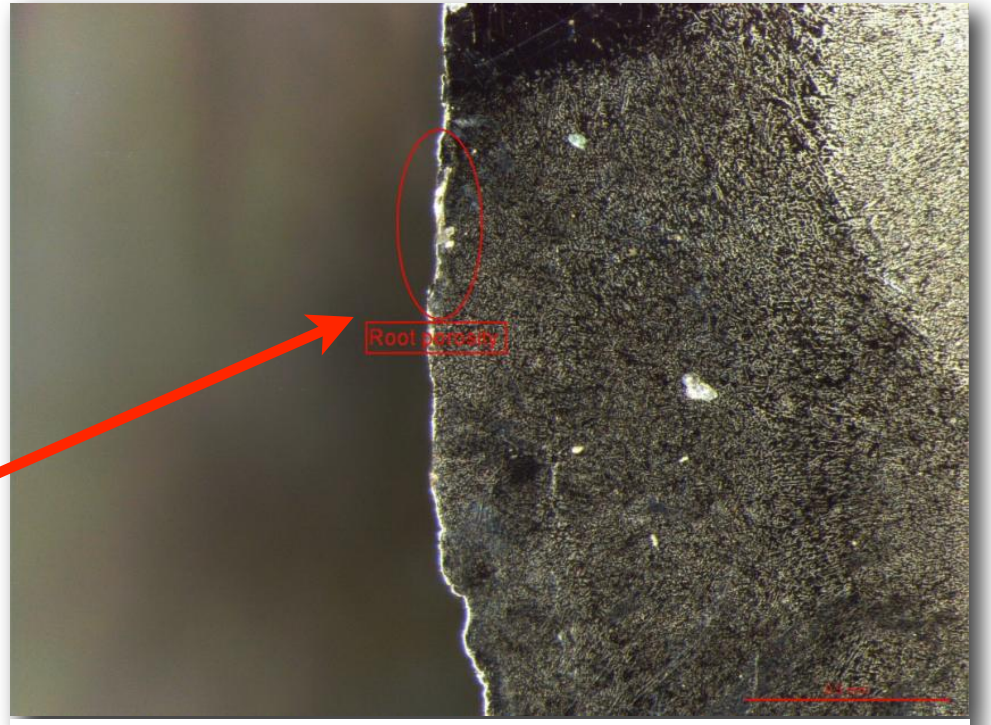
Sample Id: Welder 2-part 2
Description: Global view
Original magnification: 10.0 x sans coaxial



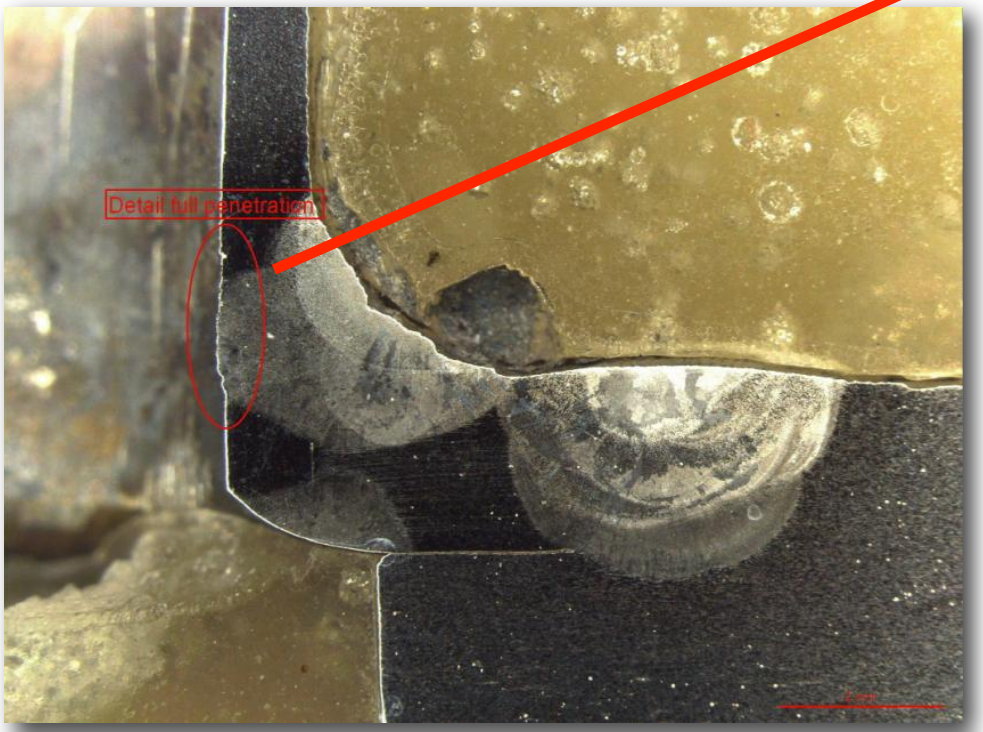
Sample Id: Welder 2-part 2
Description: Detail root of the weld, imperfection ISO 6520-1-202, shrinkage at the root of the weld
Original magnification: 50.0 x sans coaxial

- does not fulfil the norm,
- but is not significant.

Part 11(right), welder 11



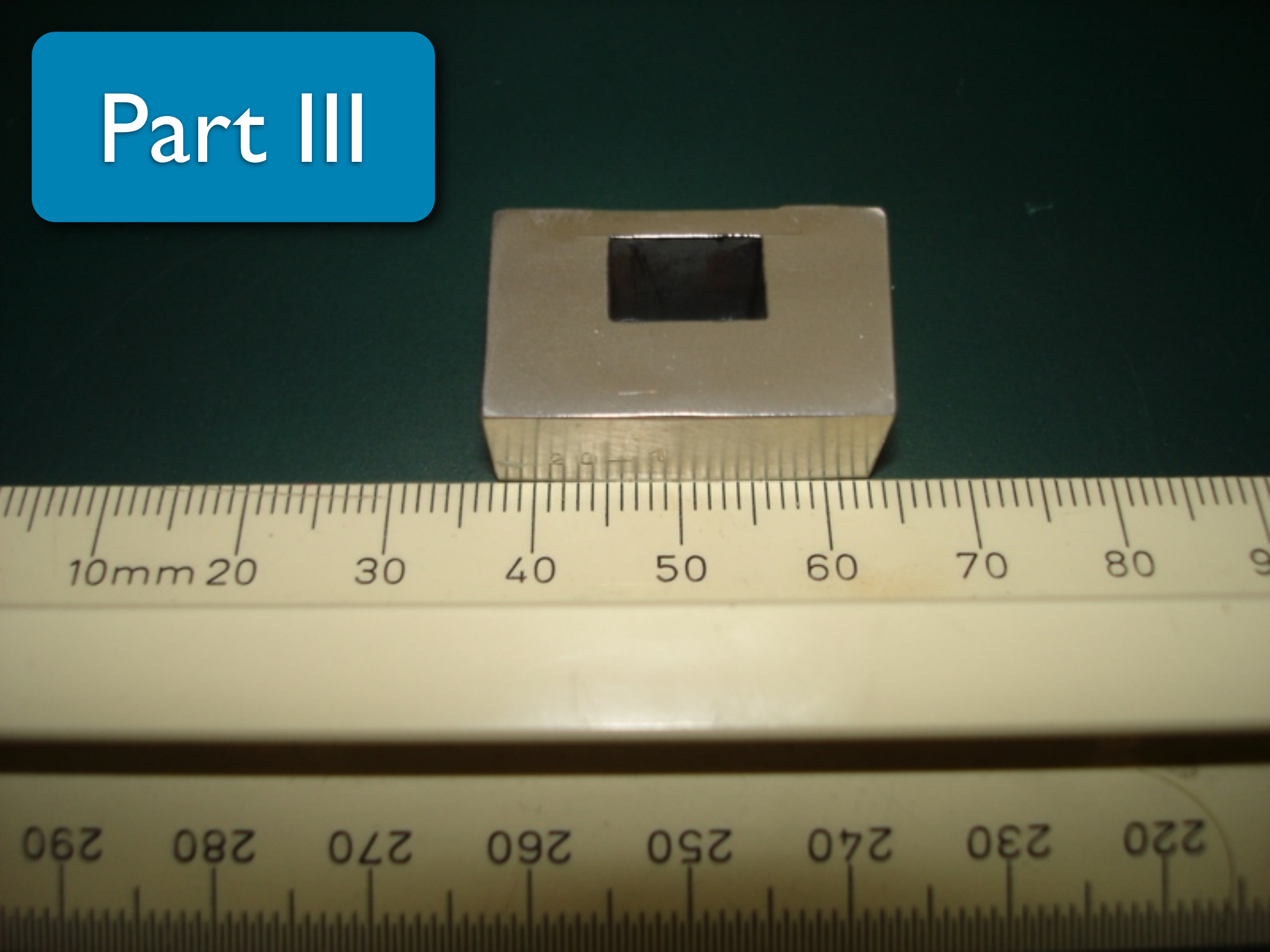
Sample Id: Welder 2-part 2
Description: Detail full penetration, imperfection ISO 6520-1-516, root porosity
Original magnification: 50.0 x sans coaxial



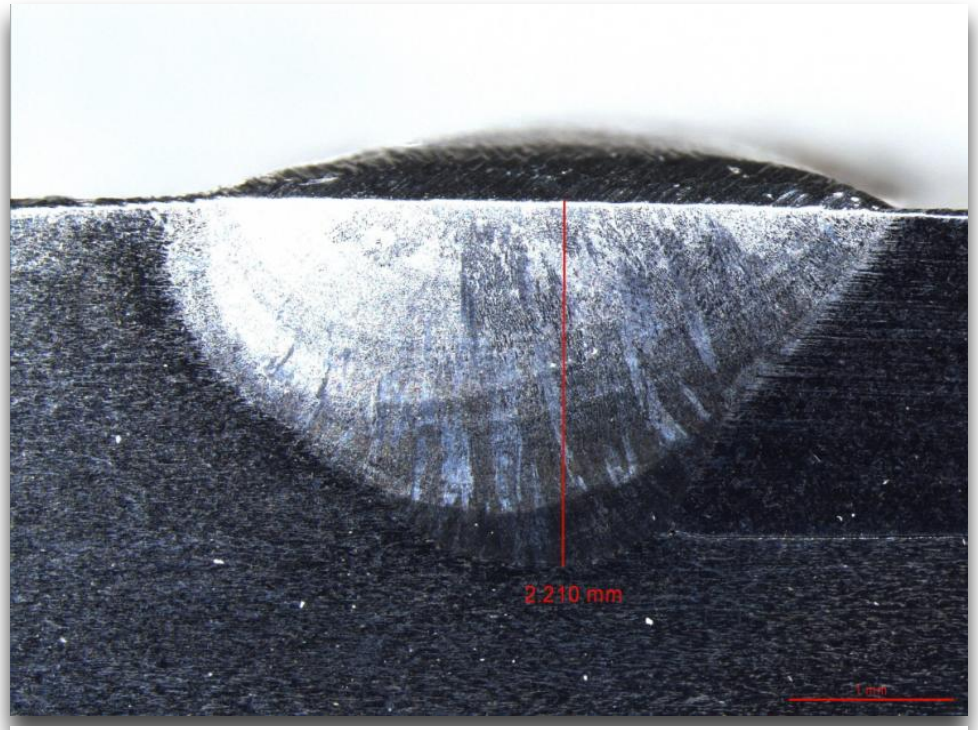
Sample Id: Welder 2-part 2
Description: Global view
Original magnification: 10.0 x sans coaxial

- does not fulfil the norm,
- but is not significant.

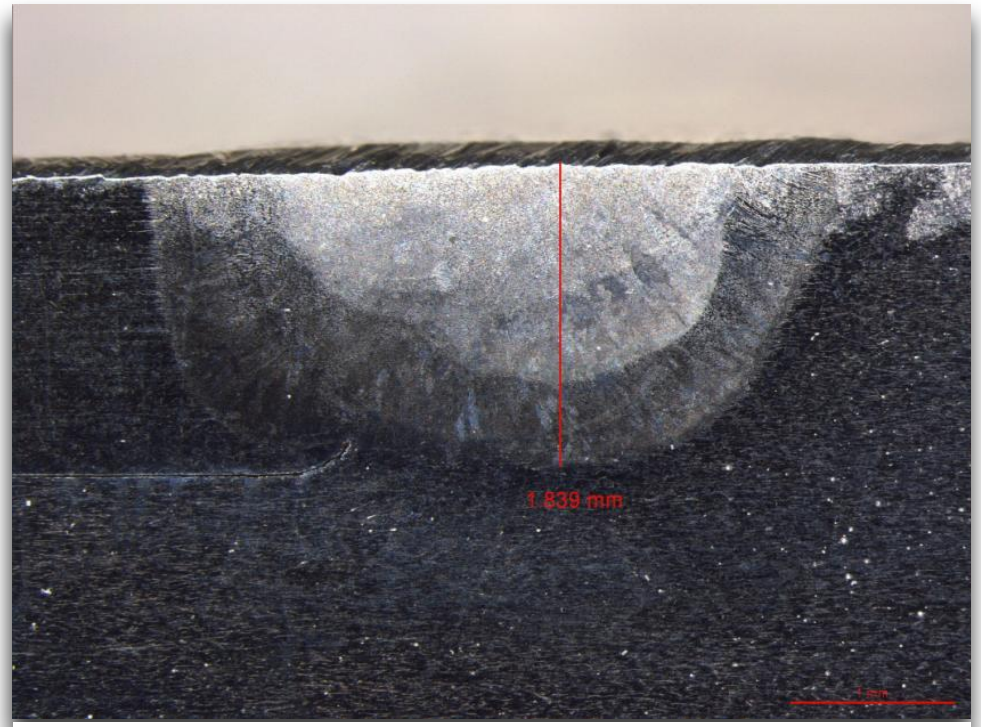
Part III



Part III (left + right), welder 1: perfect welds!

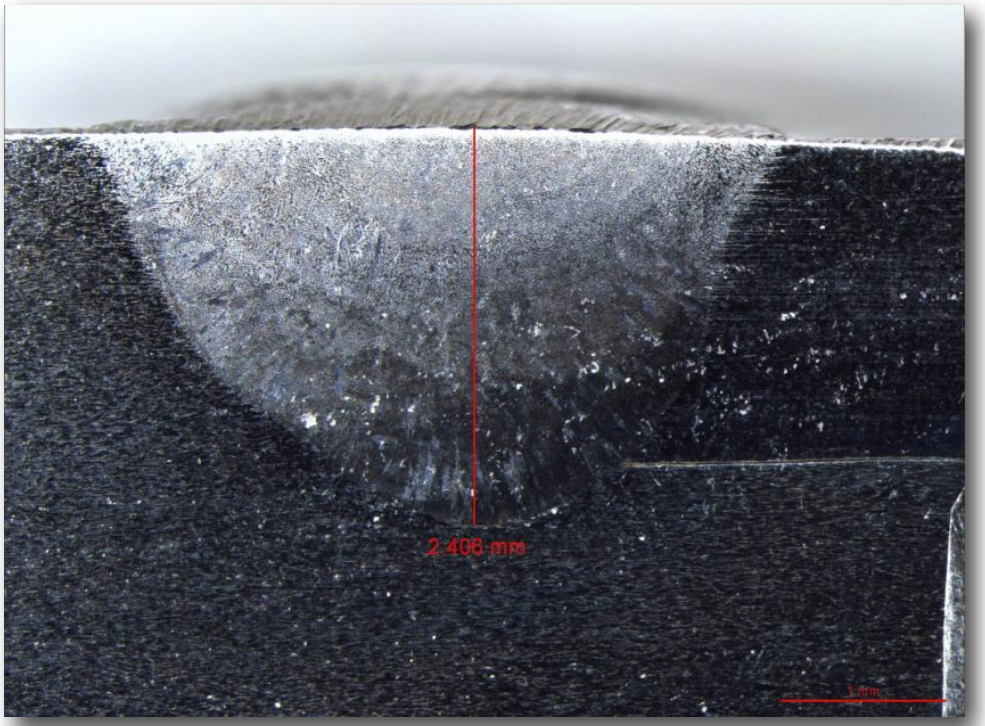


Sample Id: Welder 1-part 3
Description: Global view, no visible imperfection, penetration of 2.21 mm
Original magnification: 20.0 x sans coaxial

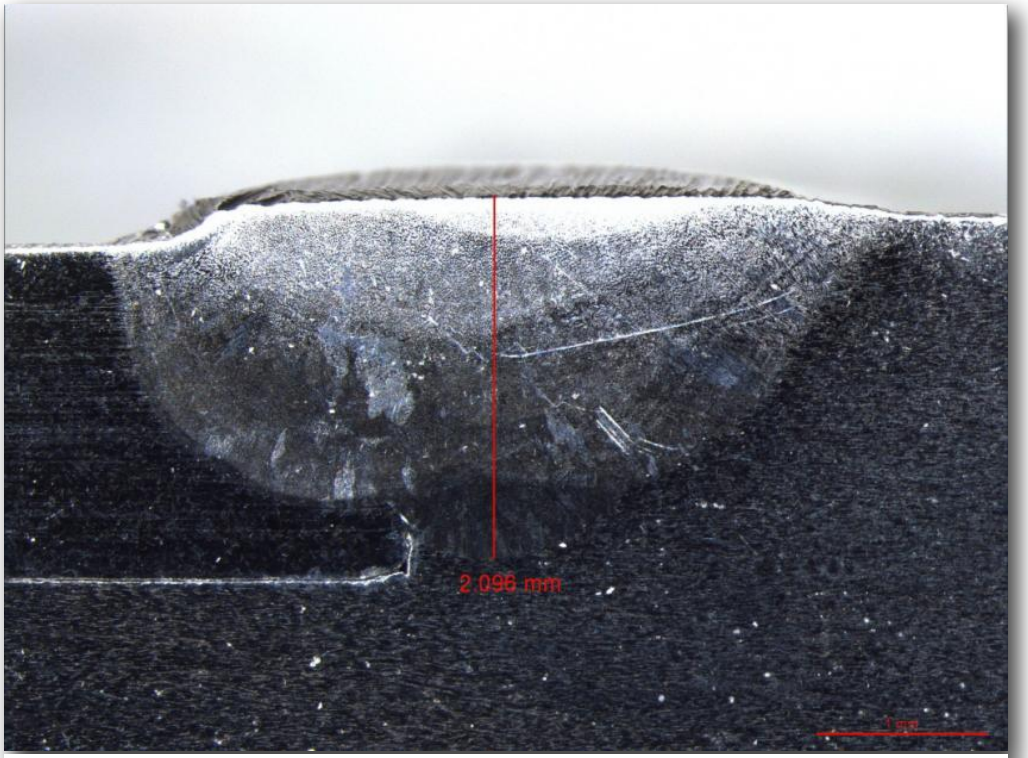


Sample Id: Welder 1-part 3
Description: Global view, no visible imperfection, penetration of 1.84 mm
Original magnification: 20.0 x sans coaxial

Part III (left + right), welder 11: perfect welds!

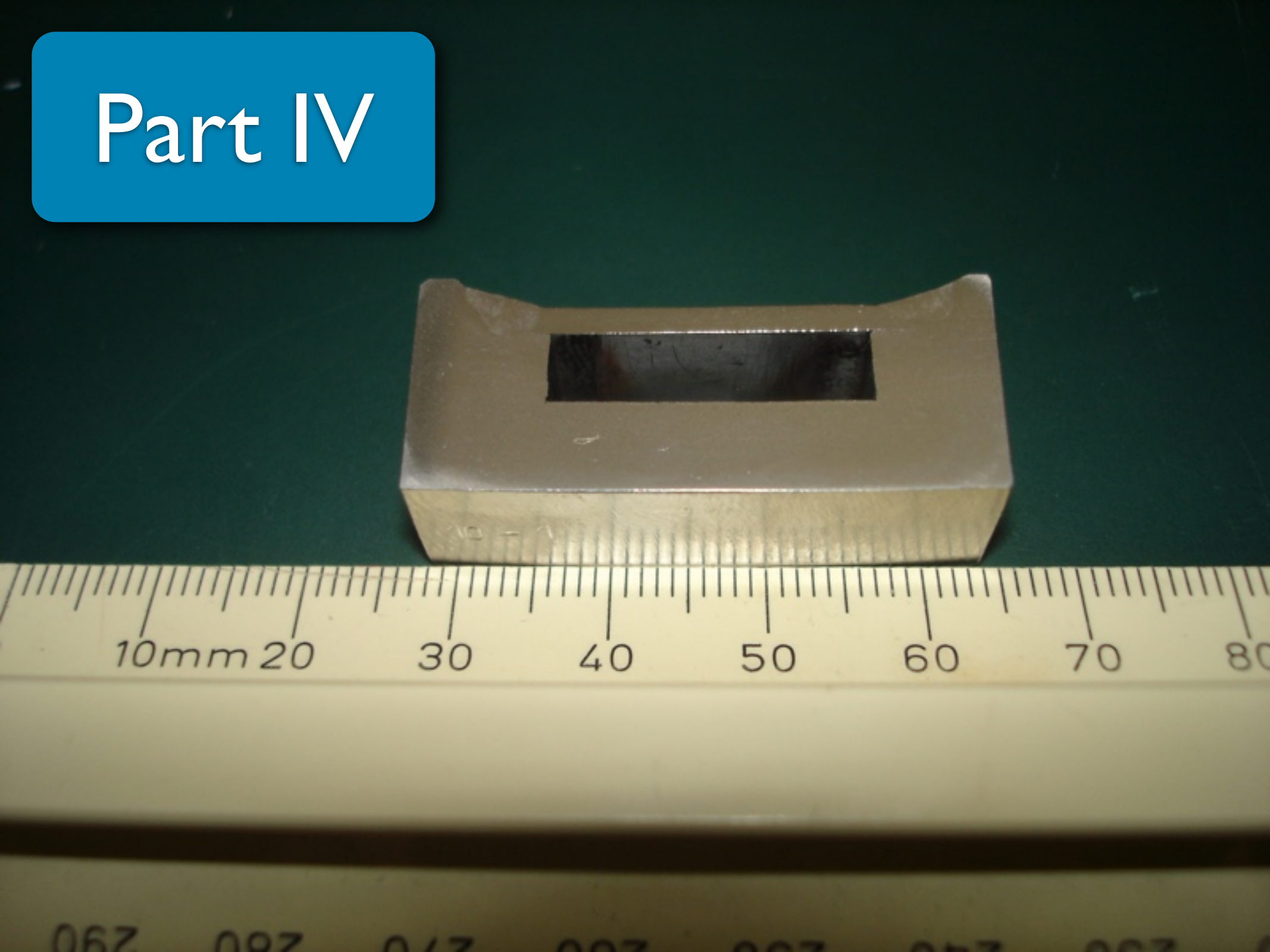


Sample Id: Welder 2-part 3
Description: Global view no visible imperfection, penetration of 2.41 mm
Original magnification: 20.0 x sans coaxial

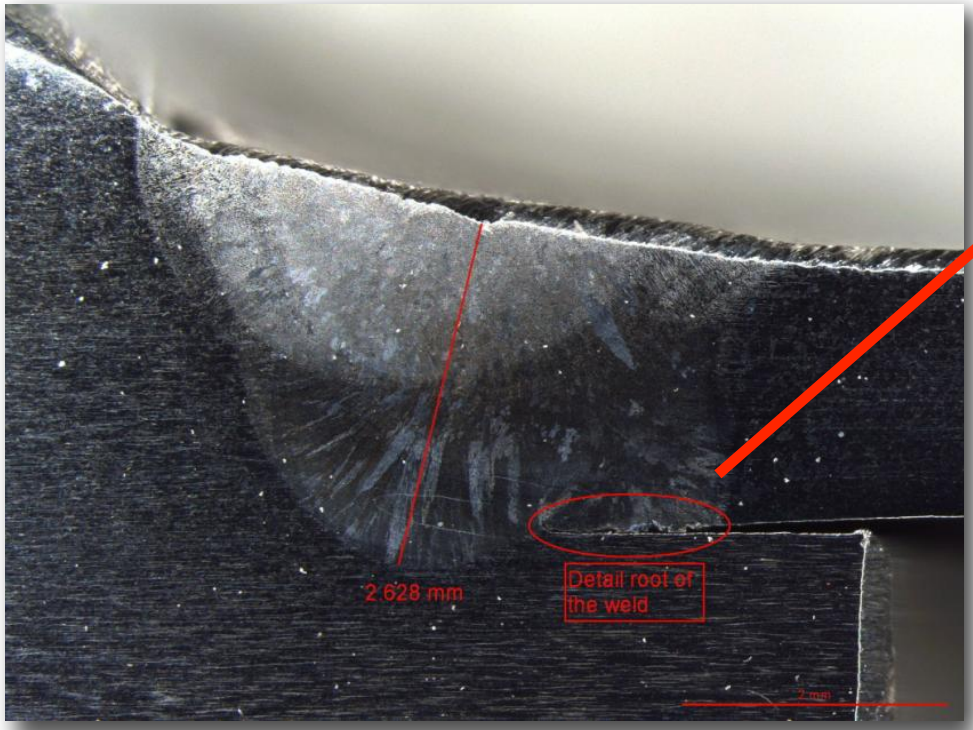


Sample Id: Welder 2-part 3
Description: Global view, no visible imperfection, penetration of 2.1 mm
Original magnification: 20.0 x sans coaxial

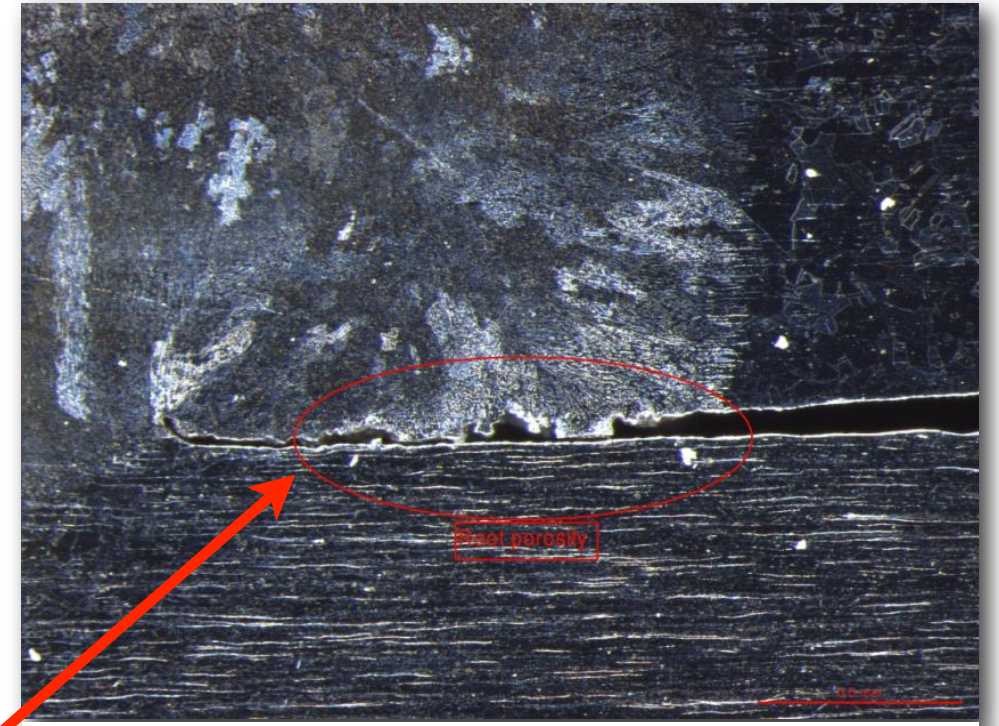
Part IV



Part IV(left), welder I



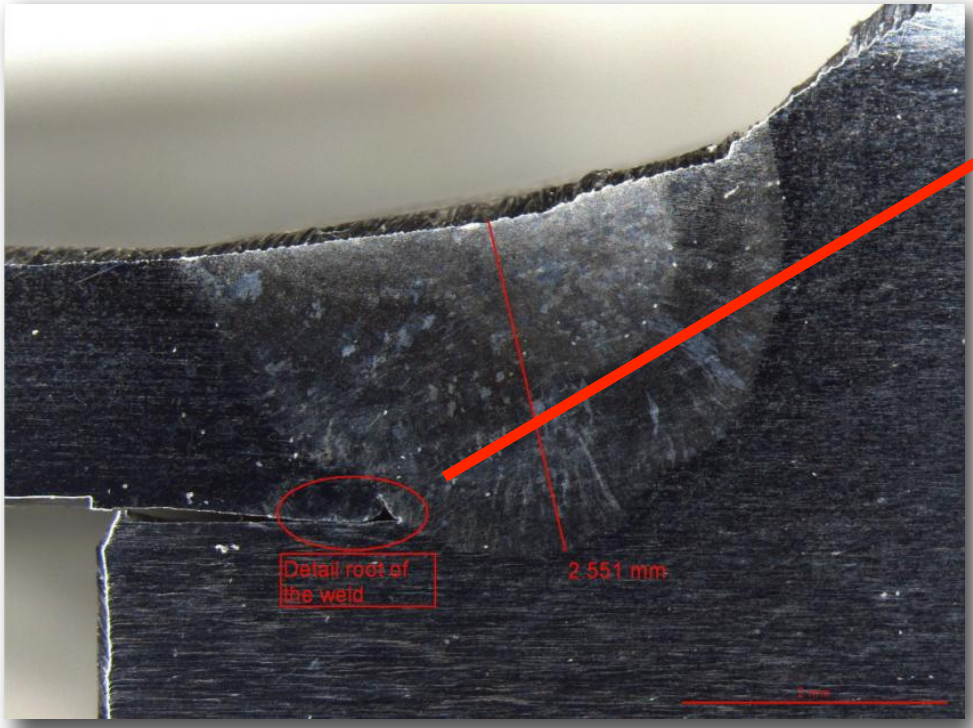
Sample Id: Welder 1-part 4
Description: Global view, penetration of 2.63 mm
Original magnification: 16.0 x sans coaxial



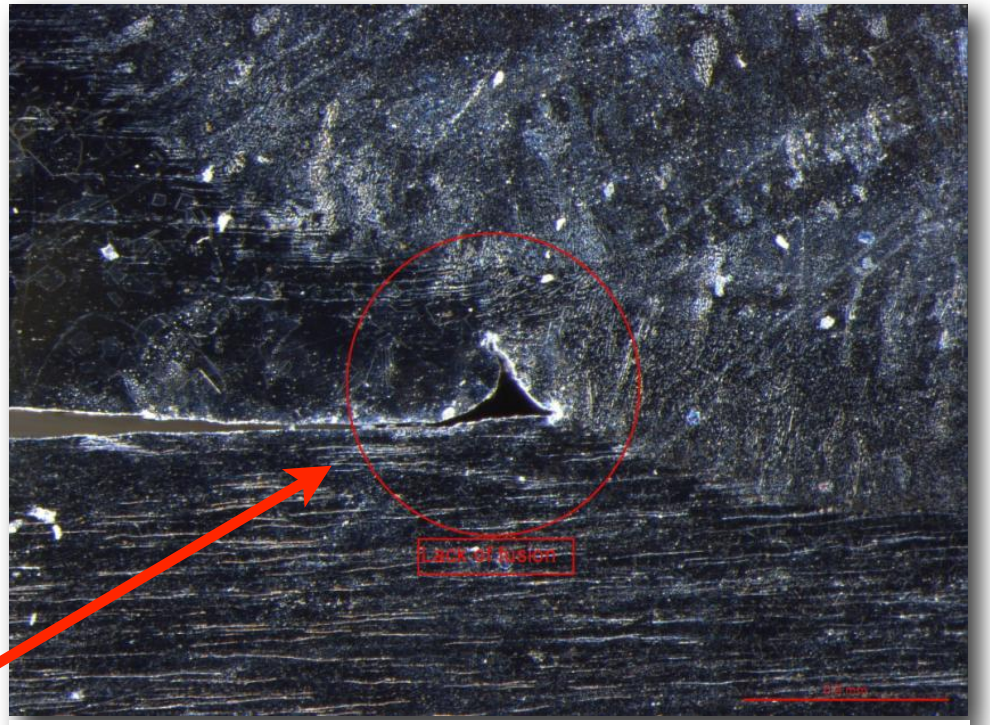
Sample Id: Welder 1-part 4
Description: Detail root of the weld, imperfection ISO 6520-1-516, root porosity
Original magnification: 50.0 x sans coaxial

- probably not critical,
- but could be improved ,

Part IV(right), welder I



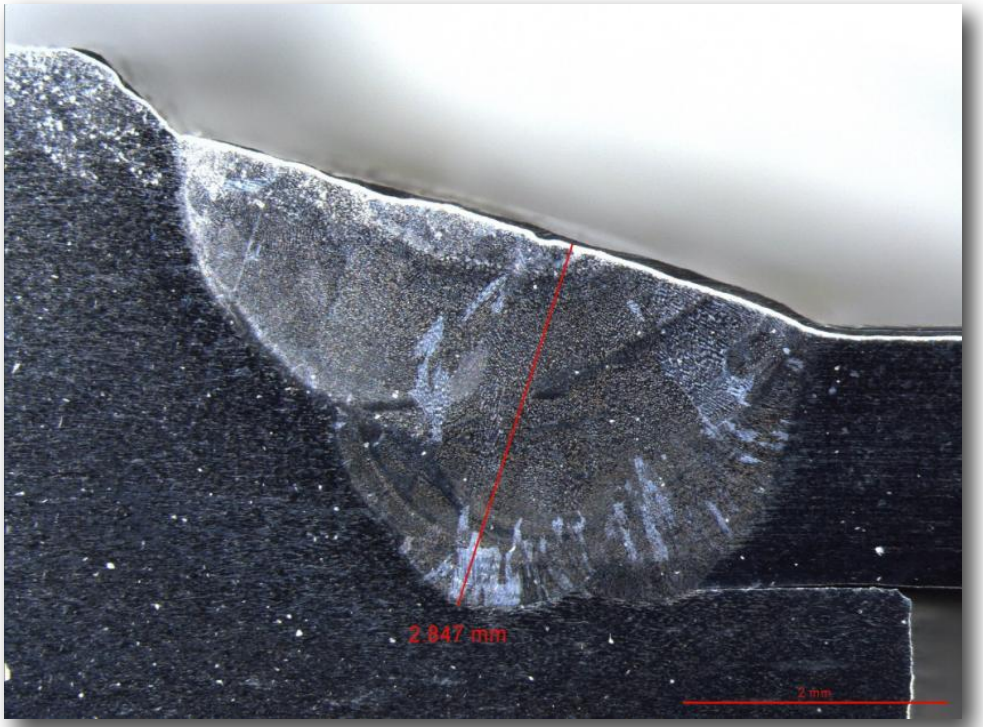
Sample Id: Welder 1-part 4
Description: Global view, penetration of 2.55 mm
Original magnification: 16.0 x sans coaxial



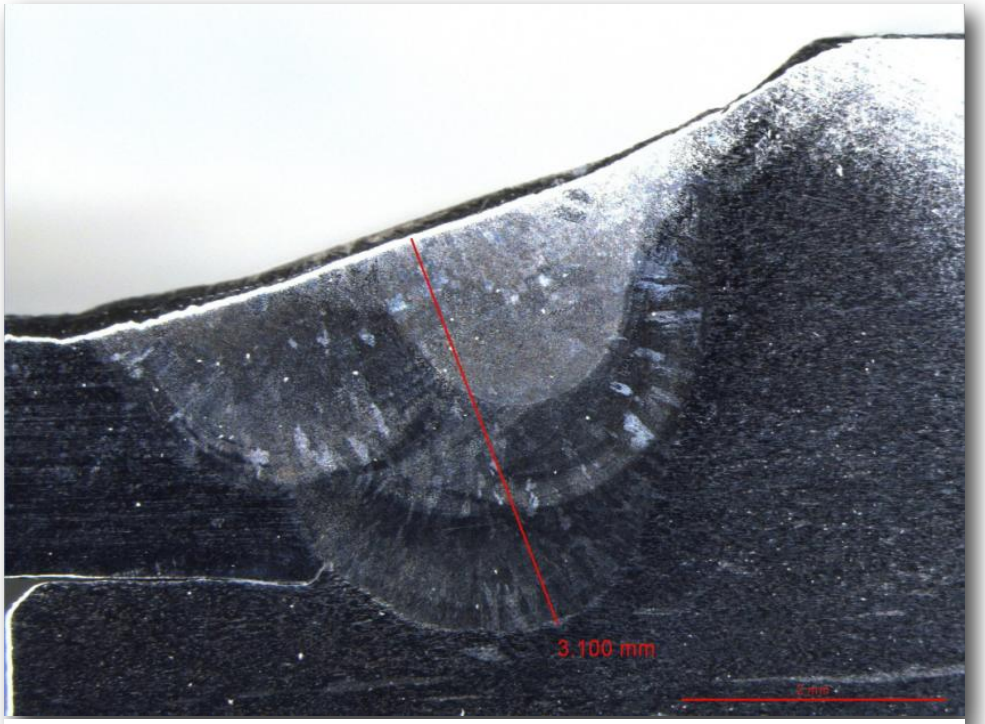
Sample Id: Welder 1-part 4
Description: Detail root of the weld, imperfection ISO 6520-1-400, lack of fusion
Original magnification: 50.0 x sans coaxial

- probably not critical,
- but could be improved,

Part IV (left + right), welder 11: perfect welds!



Sample Id: Welder 2-part 4
Description: Global view, no visible imperfection, penetration of 2.85 mm
Original magnification: 16.0 x sans coaxial



Sample Id: Welder 2-part 4
Description: Global view, no visible imperfection, penetration of 3.1 mm
Original magnification: 16.0 x sans coaxial

Summary

Welder I:

- **Part 1:** Excessive distortion + stray arc + shrinkage cavity could be observed.
- **Part 2:** No weld imperfection could be observed, probable presence of martensite.
- **Part 3:** Penetration between 1.8 mm and 2.2 mm.
- **Part 4:** Penetration of 2.6 mm, root oxidation + lack of fusion could be observed.

Welder II:

- **Part 1:** Excessive distortion + stray arc + shrinkage cavity could be observed
- **Part 2:** Full penetration on inner tube, root oxidation could be observed.
- **Part 3:** Penetration between 2.1 mm and 2.4 mm
- **Part 4:** Penetration between 2.9 mm and 3.1 mm

Root oxidation ("backfilling" with protective gas?) and lack of fusion are not permitted according to level B of ISO 5817