welding qualification according to ISO 5817 level B

(cooling channel welds)
Part I (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: 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.

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
Part I (left), welder II

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: Detail of opposite weld beads, no visible imperfection

Sample Id: Welder 2-part 1
Magnification: 50.0 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
Part 1 (right), welder II

**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 II (left), welder 1

• 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 1

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

- does not fulfil the norm,
- but is not significant.
• 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 II: 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 (left), welder 1

- probably not critical,
- but could be improved,
Part IV (right), welder 1

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 II: 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.