FSW-Tech

Friction Stir Welding European Qualifications

EUROPEAN FRICTION STIR WELDING OPERATOR (EFSW-O)

Co-funded by the Erasmus+ Programme of the European Union

INSTITUT ZA VARILSTVO
Welding Institute

ISQ

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EWF

ASR

6. Maintenance

Scope:

6.1 Tolerances for backing plate

6.2 Tool conditions

6.3 Tolerances for pin/tool

6.4 Clamping/positioning devices conditions

6.5 Tolerances for clamping/positioning devices

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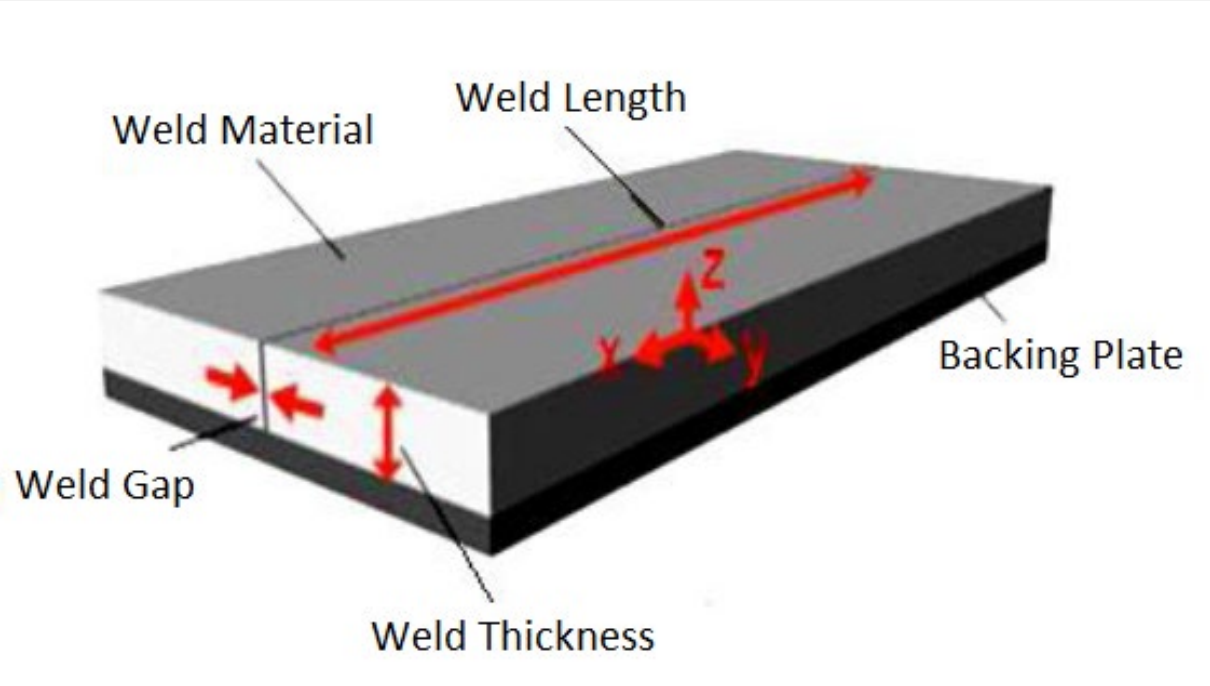
6.1 Tolerances for backing plate



Base material tolerances in FWS

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- A gap of 10 % of the weld thickness is tolerable before the weld quality is affected (in direction of *y* axis).
- The backing plate receives a proportion of the heat transferred by the weld nugget and so must not warp or deform under the heat applied.
- To make sure there is no deflection or gap between the weldment and the backing plate, a roller can lead the tool applying a constant force to press the material to the backing plate.

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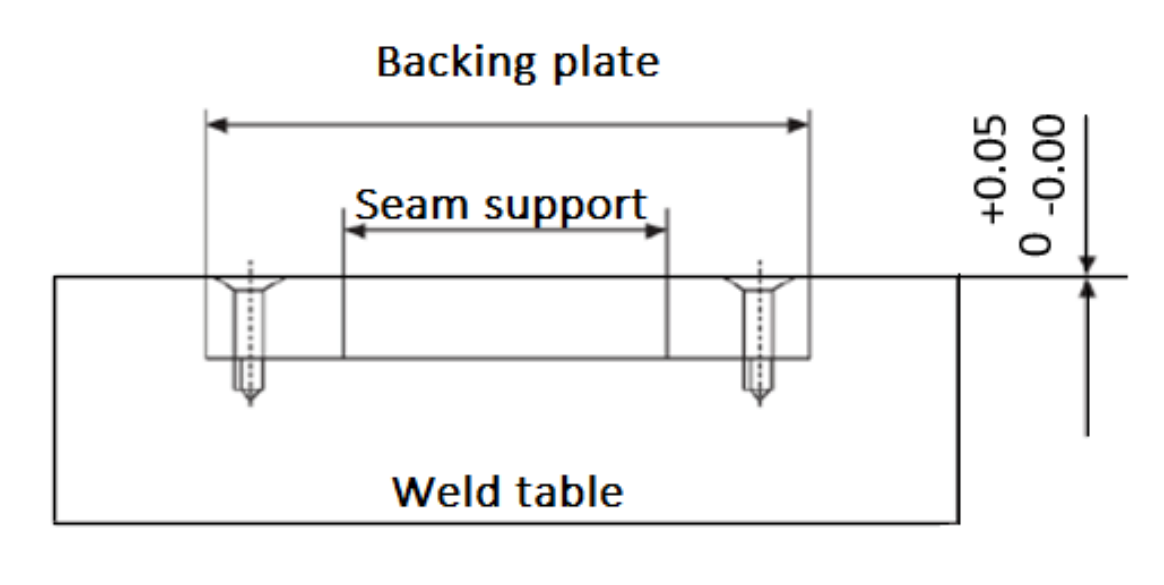
- Backing plate should be in an absolute plane. Tolerances of the wavy surface of backing plate are limited to 0,1 mm.
- Backing plate should be on the same levels as the weld table so that there are no mismatches between the parts being welded.



Backing plate tolerance to weld table [mm]

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6.2 Tool conditions

- Welding tool material selection is important consideration in developing successful FSW process.
- The rotation and translation of tool through the workpiece result in its wear.
- Diffusion and abrasion are the expected wear mechanisms.

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- Abrasion wear is significant in the presence of harder secondary phase in base material, like in aluminium metal matrix composites.
- Compared with the tool shoulder, the tool pin suffers much more severe wear and deformation, and the tool failures almost always occur in the pin.
- Lower welding speed, preheating of the base material and use of sufficient inert gas shielding can reduce tool wear.

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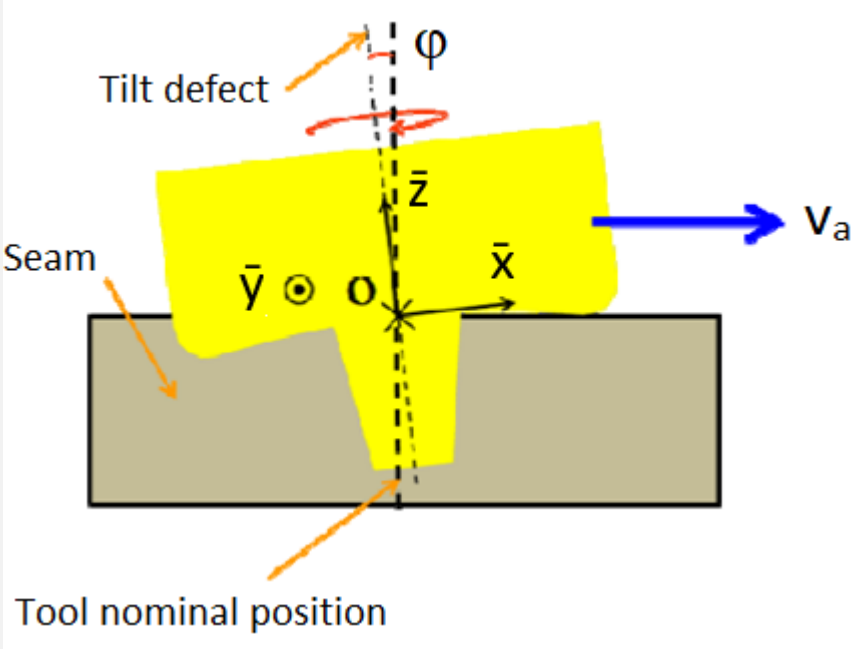
6.3 Tolerances for pin/tool

In general, three different tolerances are possible for FSW tool:

- Main tilt angle φ between the ideal vertical axis of tool rotation z and actual axis of rotation (this angle must be nominally > 0°)



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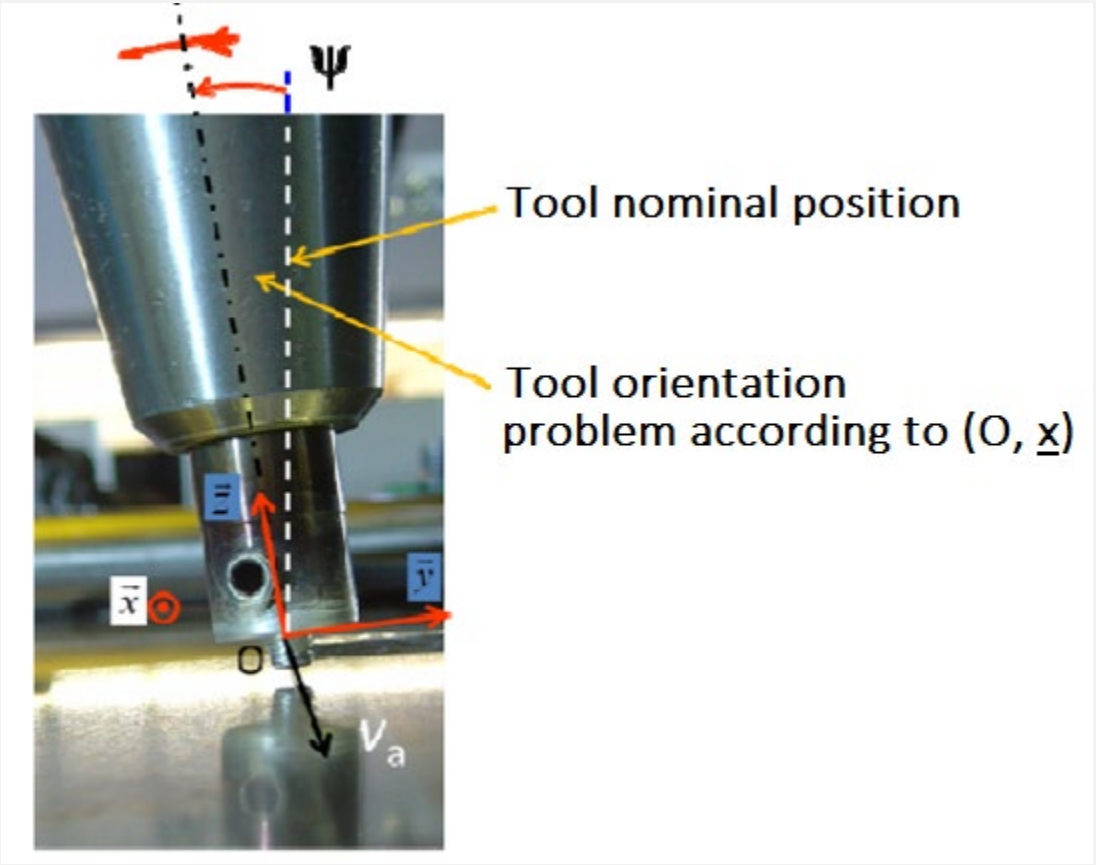
- Side tilt angle ψ between the ideal vertical axis of tool rotation z and tool orientation according to x axis (this angle must be 0°)



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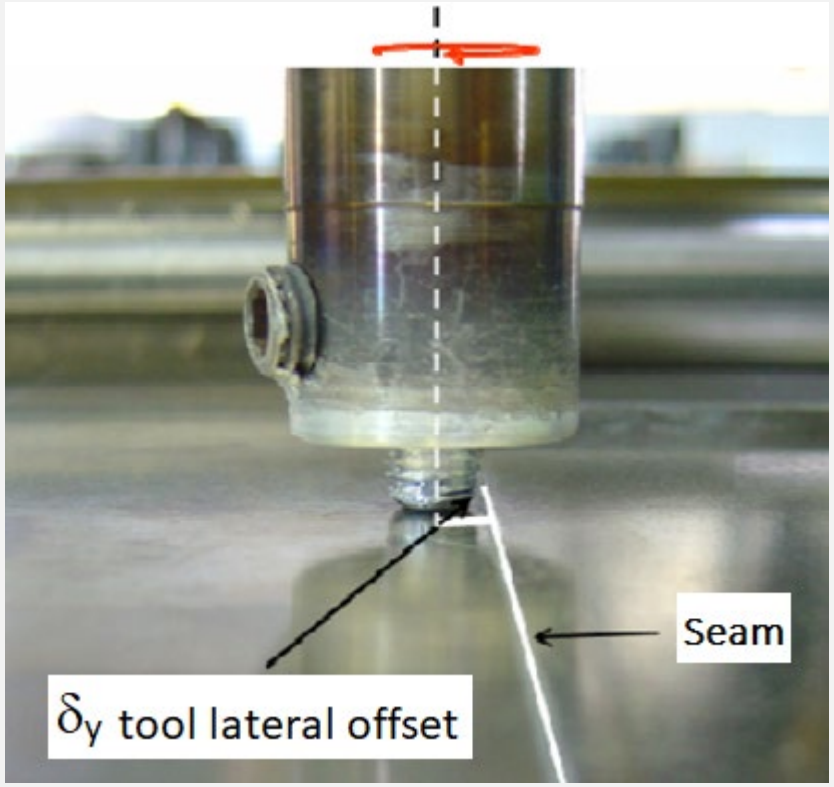
- Tool lateral offset δ_y between the ideal weld seam (gap) between two workpieces and actual longitudinal path of the tool



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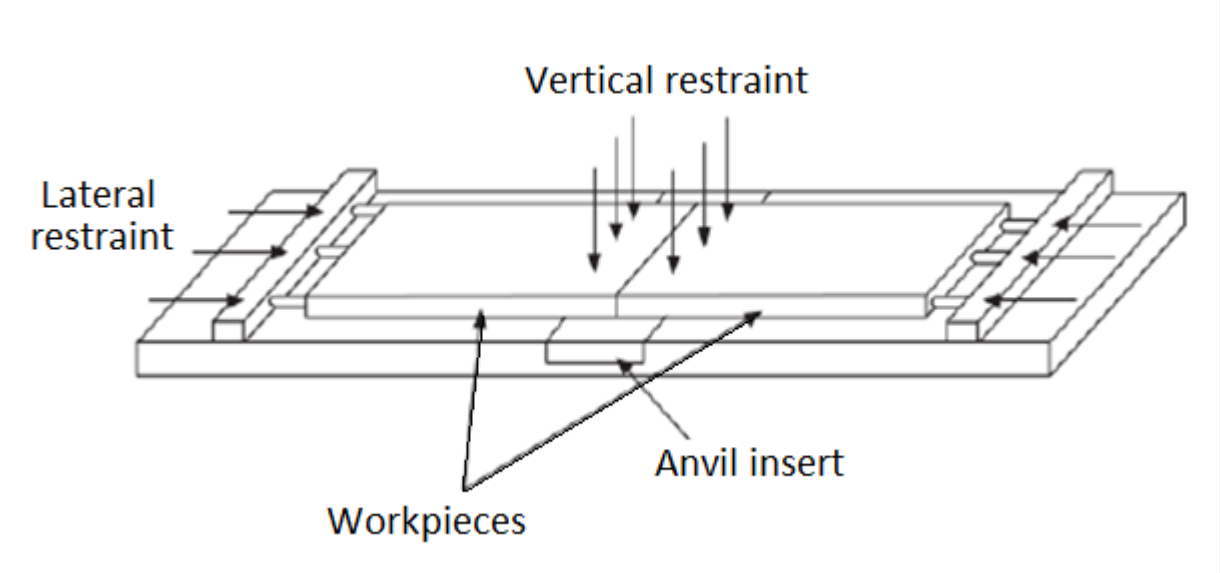
6.4 Clamping/positioning devices conditions

- Exact vertical and lateral clamping forces are dependent on base material, pin tool, workpiece geometry, weld joint type and weld schedule.



Conventional FSW clamping requirements

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- FSW requires that the workpiece shall be rigidly held in position during welding to ensure that the weld joint does not separate under the force of the welding tool and to ensure that the workpiece stays in close contact with the backing plate.
- Requirement to restrain the workpiece against the backing plate (vertical restraint) make it difficult to secure very large and thin workpieces.
- Requirement to restrain lateral separation of the weld joint (lateral restraint) can be difficult for very thick workpieces.

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6.5 Tolerances for clamping/positioning devices

- Increasing clamping force limits distortion, but above a certain threshold has diminishing returns.
- Distortion is in close connection with the tolerances of workpiece.
- Three main parameters affects the level of workpiece distortion:
  - rotation speed of the welding tool
  - clamp pitch
  - clamping force

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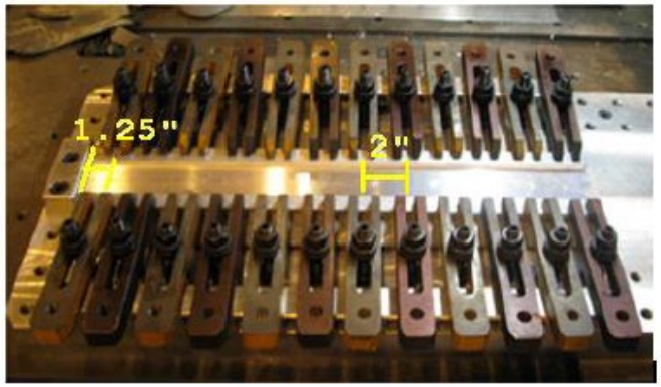
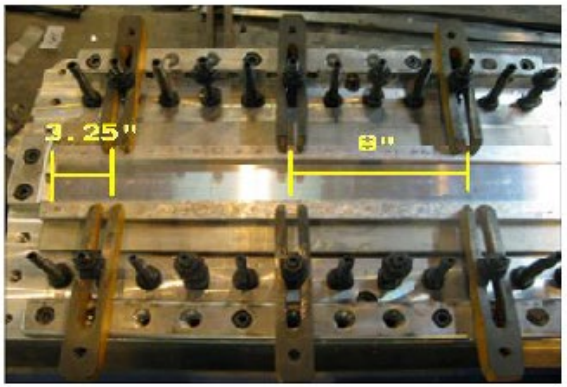


high clamping pitch



low clamping pitch

Above: highest distortion (low clamping pitch, low clamping force)

Bottom: lowest distortion (high clamping pitch, high clamping force)

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