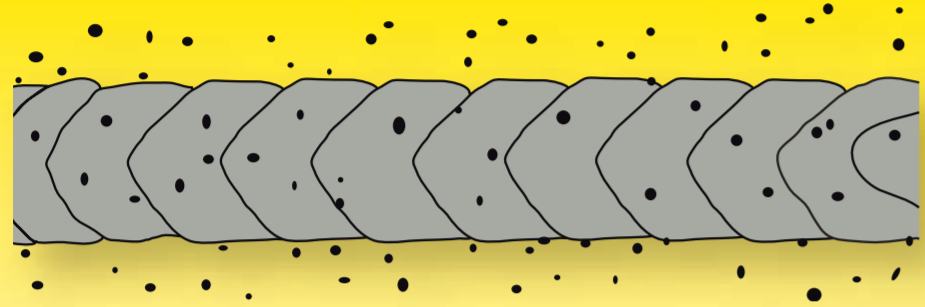


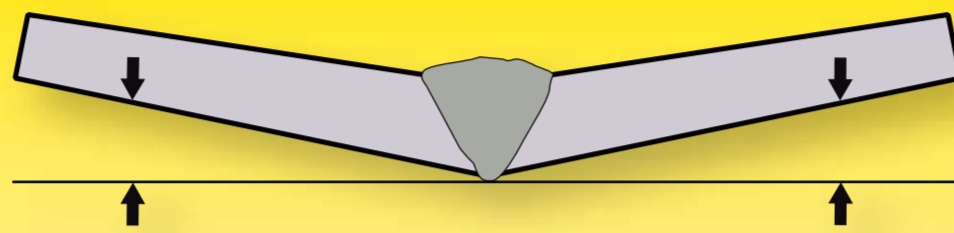


# Welding problems and defects – causes and remedies



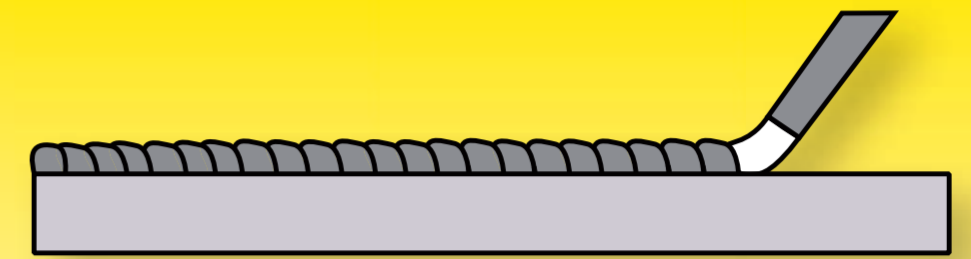
## Spatter

- Causes**
- Welding current too high.
  - Arc too long.
  - Incorrect polarity – arc blow.
  - Insufficient gas shielding.
- Remedies**
- Reduce welding current.
  - Reduce arc length.
  - Check use of correct polarity for the consumable in question.
  - Check shielding gas type and flow rate. Clean gas nozzle. Increase torch to plate angle.



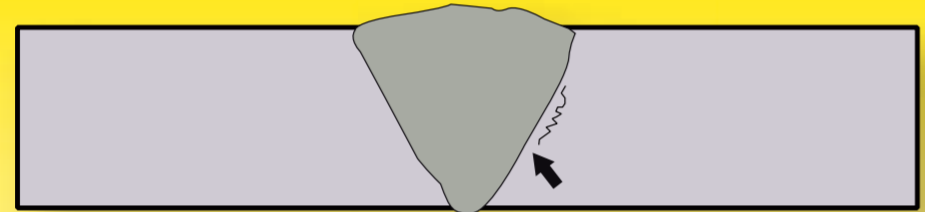
## Deformation

- Causes**
- Unsuitable welding sequence.
  - Too many and too thin beads, usually because the electrode is too small.
  - Poor plate fit-up before welding.
  - Plates clamped insufficiently.
- Remedies**
- Weld from both sides of the joint. Weld from the centre out, in opposite directions.
  - Use a larger electrode. If possible, a high recovery type.
  - Compensate for shrinkage by fixing the work pieces with a counter-angle.
  - Clamp.



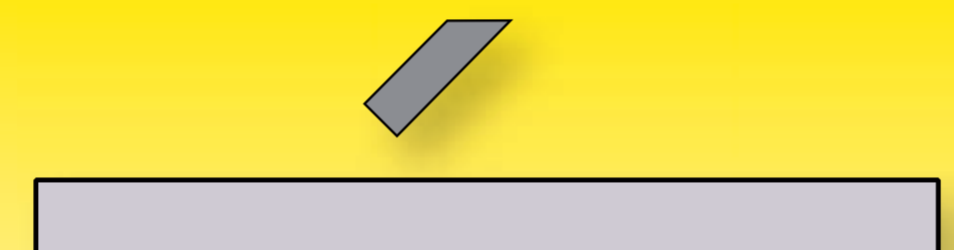
## Arc blow

- Causes**
- Arc deflection as a result of magnetic effects into the opposite direction of the earth lead clamp.
  - Arc deflection as a result of magnetic effects in the direction of heavy parts of the work piece (with magnetic materials) – especially at corners and edges.
- Remedies**
- Use an AC electrode where possible.
  - Try welding away from the earth clamp connection. Try splitting the earth clamp and connect to both sides of the joint.
  - Use an AC electrode where possible. Position earth lead clamp such that it counteracts the influence of heavy work piece parts. Keep arc as short as possible.



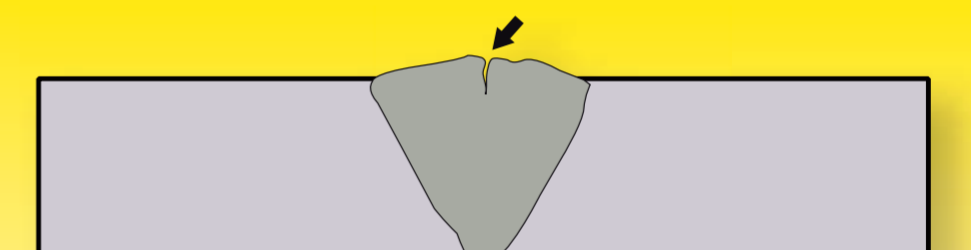
## Longitudinal cracks in the heat affected zone

- Causes**
- The base material is prone to hardening (because of a high C content or other alloying elements).
  - Weld cools down too rapidly.
  - Hydrogen in the weld e.g. because of wet weld edges, wrong or damp electrodes or shielding gases.
- Remedies**
- If possible, choose a material with a better weldability. If not, apply and maintain preheat and interpass temperature and delayed cooling.
  - Apply a higher preheat temperature.
  - Remove moisture from welding zone. Use low-hydrogen welding consumables from moisture protective packagings or rebake welding consumables.



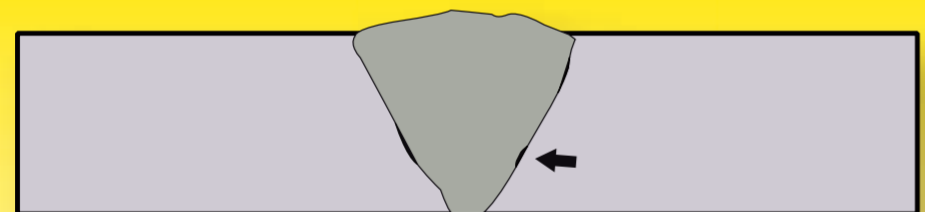
## Arc striking difficulties

- Causes**
- Welding current too low.
  - Arc voltage too low.
  - Earth lead is not connected properly.
  - Striking end of electrode covered by coating.
- Remedies**
- Increase welding current.
  - Use power source with a higher open circuit voltage.
  - Ensure proper earth lead connection.
  - Uncover striking end and touch-strike.



## Solidification cracks

- Causes**
- Formation of phases with a low melting point in the weld, due to P, S, Cu – mostly from the parent metal).
  - Unfavourable joint geometry – width/depth ratio <1.
  - Weld pool too large.
  - Travel speed too high (weld solidifies in an arrow shape).
  - Tack welds or root passes not sufficiently strong for shrinkage forces, in case of restrained joints.
- Remedies**
- Select cleaner parent material or buffer plate edges.
  - Increase joint angle, use lower welding current.
  - Use smaller electrode, use lower welding current. Apply stringer bead technique.
  - Lower the travel speed until weld solidifies in an elliptical form.
  - Apply stronger tacks and bottom passes.



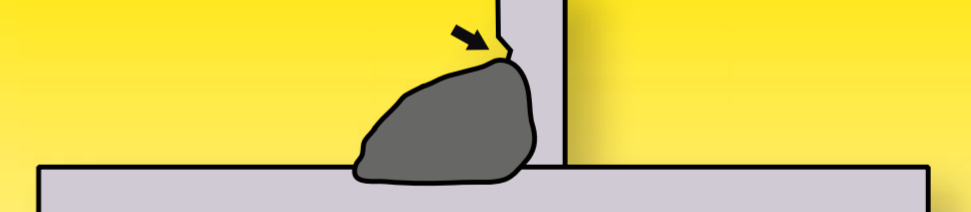
## Lack of fusion defects

- Causes**
- Heat input too low.
  - Weld pool too large and running ahead of the arc.
  - Joint included angle too small
  - Electrode or torch angle is incorrect.
  - Unfavourable bead positioning
- Remedies**
- Increase welding current and lower travel speed.
  - Reduce deposition rate and/or increase travel speed.
  - Increase joint included angle.
  - Position electrode or torch in such a way that the plate edges are melted.
  - Position beads in such a way that sharp angles with other beads or plate edges are avoided.



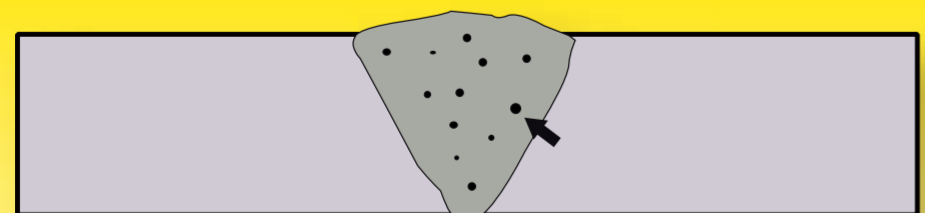
## Crater cracks

- Causes**
- The welding ended far too abruptly. The crack begins at a void in the welding crater, caused by the solidification shrinkage.
- Remedies**
- When finishing, move back the electrode to fill-up the crater.
  - With root pass welding, quickly move the arc from the weld pool to the plate edge.
  - Increase crater fill time on power source.



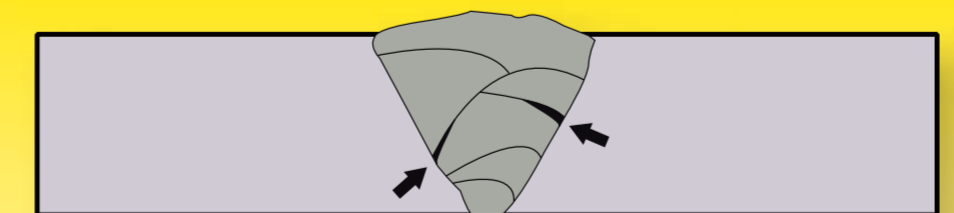
## Undercut

- Causes**
- Arc voltage too high.
  - Arc too long.
  - Incorrect electrode use or electrode angle.
  - The electrode is too large for the plate thickness in question.
  - Travel speed too high
- Remedies**
- Lower arc voltage.
  - Reduce arc length.
  - Apply electrode angle of 30° to 45° with the standing leg. Weld lightly trailing.
  - Use a smaller diameter electrode.
  - Reduce travel speed.



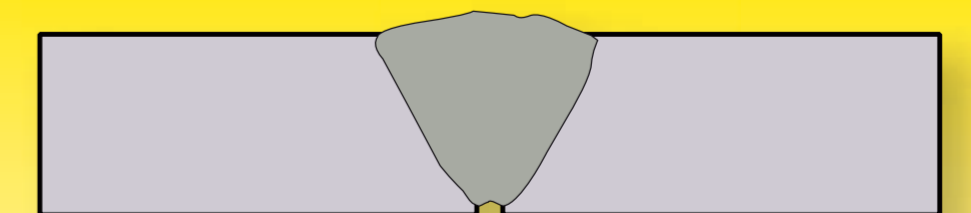
## Porosity

- Causes**
- Moisture, for example from incorrectly stored electrodes or fluxes, humid shielding gas or leaks in water-cooled welding torches.
  - Moisture, rust, grease or paint on the plate edges.
  - Insufficient gas shielding.
  - Welding onto small gaps filled with air.
- Remedies**
- Rebake or use fresh welding consumables, connect new gas bottle, check welding torch for leaks.
  - Dry or clean plate edges.
  - Check shielding gas type and flow-rate. Clean gas nozzle. Ensure torch to plate angle is not too small.
  - Increase welding gap. When possible, apply butt joints instead of fillet or overlap welds.



## Slag inclusions

- Causes**
- Slag runs ahead of the weld
  - Insufficient de-slagging between passes
  - Convex passes which produce slag pockets.
  - Unfavourable bead sequence.
- Remedies**
- Increase the travel speed or electrode angle.
  - Remove slag carefully, grind if necessary.
  - Avoid sharp angles or grooves between beads and layers. Increase arc voltage.
  - Plan bead sequence such that sharp corners are avoided. Apply stringer bead technique.



## Lack of root penetration

- Causes**
- Root gap too small.
  - Electrode size too big.
  - Travel speed too high.
  - Incorrect use of electrode.
- Remedies**
- User wider root gap.
  - Use electrodes with a diameter of approximately the gap width.
  - Apply lower travel speed.
  - Weave between plate edges. Weld on ceramic weld metal support at high currents.