

Lesson 2.3: Fact Sheet - Welding Defects

Examples of Weld Defects

- Porosity
- Undercut
- Overlap
- Incomplete penetration
- Incomplete fusion
- Excessive concavity (Improper reinforcement)
- Excessive convexity (excessive reinforcement)
- Spatter
- Cracks

Defects:

- Weaken the weld
- Poor structural quality
- Poor appearance
- Some defects will cause weld failure
- Considered unacceptable by employers and quality control personnel even if the structural integrity is not compromised

Porosity

- AKA pinholes
- Holes formed in the weld bead, not always visible
- Most common at the beginning and end of welds
- Porosity creates weak spots in the weld with the possibility of weld failure
- Causes:
 - Improper shielding (lack of shielding gas, lack of deoxidizers in electrode)
 - Contaminants on the base metal (oil, grease, rust,)
 - Low amperage

Troubleshooting Porosity

If you get porosity in your weld:

- Make sure the base metal is clean before welding
- Check your welder settings
- If GMAW welding:
 - check the nozzle for spatter build up or other obstructions in the flow of the shielding gas
 - check your shielding gas supply
- If SMAW welding:
 - with an E7018 electrode, make sure the electrode was warmed in a rod oven
 - make sure welding rods are completely dry

Undercut

- Groove cut in the toe of the weld
- Undercut creates a weak spot at the toe of the weld and can lead to weld failure
- Causes:
 - Improper work angle
 - Improper travel speed
 - High amperage setting
 - Long arc length
 - Rust

Troubleshooting Undercut

If you get undercut in your weld:

- Adjust your work angle so that it is proper for the weld joint and position
- Travel at a proper speed for the settings and desired size of the weld
 - If undercutting a weld that is too big, speed up
 - If undercutting a weld that is too small, slow down
- Check for proper settings, adjust the amperage lower if needed
- Use the proper arc length
 - SMAW: arc length should be the diameter of the electrode
 - GMAW: wire stick out should be about ¼- ½ inches
- Clean the base metal before welding

Overlap

- The weld metal protrudes beyond the toe or the root of the weld without fusing to the base metal
- Overlap is an indication of weak or stressed areas in a weld
- Causes
 - Travel speed too slow
 - Wire speed too high (GMAW)
 - Improper work angle
 - Improper work angle often results in a weld bead with overlap on one toe and undercut on the other

Troubleshooting Overlap

If you get overlap in your weld:

- Travel at a proper speed for the settings and desired size of the weld
- Check for proper settings, adjust wire feed speed if needed
- Adjust your work angle so that it is proper for the weld joint and position

Incomplete Penetration

- The weld metal does not extend to the required depth into the joint root
- Incomplete penetration can cause weld failure at the root of the weld
- Causes:
 - Improper joint preparation
 - Low amperage setting
 - Travel speed too fast
 - Arc length too long
 - Improper work or travel angle

Troubleshooting Incomplete Penetration

If your welds lack penetration:

- Check joint preparation techniques
 - Make sure to bevel material to the proper angle with a proper root face when needed
 - Make sure to prepare groove joints with the proper root gap
- Check for proper settings, increase amperage or wire feed speed if needed
- Travel at a proper speed for the settings and desired size of the weld

- Use the proper arc length or wire stick-out
- Adjust your work and travel angles so that they are proper for the weld joint and position

Incomplete Fusion

- The weld bead does not properly fuse or obtain coalescence with the base metal
- Common in one leg of a fillet weld or one toe of a groove weld due to imbalanced heat distribution
- Incomplete fusion may not always be obvious and can cause weld failure or cracks
- Causes:
 - Improper work and travel angles
 - Low amperage setting
 - Travel speed too fast
 - Contaminated base metal

Troubleshooting Incomplete Fusion

If your welds lack fusion:

- Adjust your work and travel angles so that they are proper for the weld joint and position
- Check for proper settings, increase amperage or wire feed speed if needed
- Travel at a proper speed for the settings and desired size of the weld
- Clean the base metal before welding

Concavity, Convexity, Reinforcement

- Fillet welds may be concave, convex, or flat
- Excessive concavity is when a fillet weld lacks the required throat
 - Caused by fast travel speeds and low amperage or wire speed
- Excessive convexity is when a fillet weld has too much weld metal
 - Caused by slow travel speeds and high amperage or wire speed
- Groove welds typically require 10-20 % reinforcement
- Improper reinforcement is when the weld metal lacks sufficient build up above the base metal
 - Caused by fast travel speeds, and too few weld passes in a multi-pass weld
- Excessive reinforcement is when the weld metal has too much build up above the base metal
 - Caused by slow travel speeds, low amperage, and too many passes in a multi-pass weld
- Too little weld metal in a weld joint will lack strength and structural integrity, leading to weld failure or cracking
- Too much weld metal in a weld joint will cause extra stress in the weld area, distortion, and is a waste of weld metal

Spatter

- Small particles of weld metal expelled from the welding operation which adhere to the base metal surface
- Spatter is an indicator of improper settings or technique and is also considered unsightly and unsafe
- Small amounts of spatter is considered normal
- Caused by high amperage settings, improper angles, long arc length, or contaminated metal

Cracks

- Defect due to stresses from shrinkage, fast cooling, improper filler metal, improper bead contour, improper travel speed, hydrogen
- There are several types of cracks that can form in welds for many different reasons
- Common types of cracks include:
 - Longitudinal
 - Transverse
 - Crater

Longitudinal cracks:

- Run parallel along the axis of the weld
- Sometimes called Centerline cracks, although longitudinal cracks may occur anywhere in the weld bead or base metal
- Caused by improper filler metal, improper preheat, fast cooling, or internal shrinkage stresses in the weld due to high amperage setting or fast travel speed

Crater cracks:

- At the end of every weld, a small dimple called a crater is formed
- Cracks can form in the crater if the crater is not properly filled or the center of the crater cools before the outside
- Caused by improper crater fill; pause at the end of a weld or

Transverse cracks:

- Run perpendicular to the axis of the weld
- Common when the weld metal is significantly stronger or harder than the base metal
- Caused by improper filler metal, improper preheat, hydrogen in the weld (use a low hydrogen electrode/filler metal)