

Welding Defects - Fact Sheet

Examples of Weld Defects

About Defects & Discontinuities

- 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

Examples of Weld Defects

- Inconsistency
- Undercut
- Overlap
- Lack of Fusion
- Porosity
- Concavity
- Convexity
- Insufficient reinforcement
- Excessive reinforcement
- Spatter
- Slag Inclusion
- Arc Strike
- Undercut

Undercut

- 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

- Adjust your work angle to be proper for the weld joint and position
- Travel at proper speed for 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 and adjust the amperage lower if needed
- Use the proper arc length
 - GMAW: wire stick out should be about ¼- ½ inches
 - SMAW: arc length should be the diameter of the electrode
- Clean the base metal before welding

Overlap

- Overlap is an indication of weak or stressed areas in a weld

Causes:

- Travel speed too slow
- Wire speed too high (GMAW)
- Improper work or travel angle
- Improper work angle often results in a weld bead with overlap on one toe and undercut on the other
- Troubleshooting Overlap

Troubleshooting Overlap:

- 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

Lack of 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 amperage settings
- Improper work and travel angles
- Travel speed too fast
- Contaminated base metal



Troubleshooting Lack of Fusion

- Adjust your work and travel angles so 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

Inconsistency

- Proper welding technique is important for welding consistency. Consistency is importance for all quality welds.

Causes:

- Improper machine settings
- Improper welding technique (Work Angle, Travel Angle, Travel Speed, Contact to Work Distance (CTWD), and/or Straightness

Troubleshooting Inconsistency

- Check your welding machine
- Proper setup of your welding machine is important and can be obtained by following your machine's suggested settings for the particular weld you are working on.
- Many welds will have a WPS to help ensure your machine's settings are set correctly for each individual weld.
- Check your technique
- Keep Work Angle around 45 degrees for a fillet weld and 90 degrees for a groove weld
- Travel Angle should be around 0 degrees– 15 degrees for both fillet and groove welds
- Many welds will have a WPS to help ensure you are within the correct Travel Speed; check before doing your weld.
- CTWD for most welds should be $\frac{1}{4}$ - $\frac{1}{2}$ inches from material (GMAW)
- CTWD for most welds should be $\frac{1}{8}$ inches from metal (SWAM)

Spatter

- Spatter is an indicator of improper settings or technique and is also considered unsightly and unsafe
- Small amounts of spatter is considered normal

Causes:

- Improper settings
- Improper work and travel angles
- Too long wire stick out
- Contaminated base metal



Troubleshooting Spatter

- Check your welding machine
- Check for proper settings, adjust for the thickness of the base metal
- Decrease voltage if paired with undercut
- Check your technique
- Adjust the work angle so that it is 45 degrees for a fillet weld and 90 degrees for a groove weld
- Travel angle may be too steep, adjust angle to 0 degrees – 15 degrees
- Contact to work distance may be too long; try to stay ¼- ½” away
- Clean the base metal before welding

Weld Contour

Fillet welds can be concave, convex, or flat depending on the function of the weld

- Fillet weld gages are used to measure fillet welds
- Concave welds are measured by the throat
- Convex welds are measured by the legs
- Flat welds can be measured both ways

Groove welds are measured by the amount of reinforcement

- Reinforcement is the amount of weld metal above the base metal
- Groove welds typically require 10-20% reinforcement

Concavity

- Too little weld metal in a weld joint will lack strength, leading to weld failure or cracking
- Concavity is when a fillet weld lacks the required throat

Causes:

- Too low wire feed speed
- Improper travel speed
- Too few weld passes in a multi-pass weld

Troubleshooting Concavity

- Check your welding machine
- Increase wire feed speed
- Check your technique
- Slow down the travel speed
- Add more passes in a multi-pass weld



Convexity

- Too much weld metal in a weld joint will cause extra stress in the weld area, distortion, and is a waste of weld metal

Causes:

- Too high wire feed speed
- Improper travel speed
- Too many passes in a multi-pass weld

Troubleshooting Convexity

- Check your welding machine
- Decrease wire feed speed
- Check your technique
- Speed up the travel speed
- Weld less passes in a multi-pass weld

Slag Inclusion

- Slag will happen with SMAW and FCAW, this will need to be chipped away and cleaned to see the weld quality.

Causes:

- Improper welding technique
- Improper amperage
- Presence of coatings on certain metals
- Type of flux coating
- Not cleaning weld properly between passes in multi-pass welds

Troubleshooting Slag Inclusion

- Check your welding machine
- Increased amperage
- Check your technique
- Decrease Travel Speed
- Do not over-penetrate weld depth
- Remove all slag between welding passes (grind, chip or wire brush)

Insufficient Reinforcement

Too little weld metal in a weld joint will lack strength, leading to weld failure or cracking.

Insufficient reinforcement is when the weld metal lacks sufficient build up above the base metal.



Causes:

- Too low wire feed speed
- Improper travel speed
- Too few weld passes in a multi-pass weld

Troubleshooting Insufficient Reinforcement

- Check your welding machine
- Increase wire feed speed
- Check your technique
- Slow down the travel speed
- Add more passes in a multi-pass weld

Excessive Reinforcement

- Too much weld metal in a weld joint will cause extra stress in the weld area, distortion, and is a waste of weld metal
- Excessive reinforcement is when the weld metal has too much build up above the base metal

Causes:

- Too high wire feed speed
- Improper travel speed
- Too many passes in a multi-pass weld

Troubleshooting Excessive Reinforcement

- Check your welding machine
- Decrease wire feed speed
- Check your technique
- Speed up the travel speed
- Weld less passes in a multi-pass weld

Porosity

- Most common at the beginning and end of welds
- Porosity creates weak spots in the weld with the possibility of weld failure

Troubleshooting Porosity

- Make sure the base metal is clean before welding
- Check your welding machine 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

Arc Strike

- Be aware of what you are doing with your electrode when welding, as it can complete an electrical arc.

Troubleshooting Arc Strike

- Check your welding machine
- Make sure you are ready to weld before getting into welding position; have machine set before preparing to weld.
- Check your technique
- Make sure you are ready to weld before moving into the welding zone
- Use the proper “striking” or “tapping” method
- Remove arc strikes with sanding or grinding

