

Introduction to Welding Defects

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Quick reference guide for students, trainees, and professionals

1. Why Study Welding Defects?

Reason	Benefit
Safety	Prevents catastrophic failures in pressure vessels, bridges, aircraft, etc.
Quality	Ensures products meet specifications and standards (AWS, ISO, EN).
Cost Efficiency	Early detection avoids costly rework, scrap, and downtime.
Certification	Required knowledge for welders, inspectors, and engineers.

2. Classification of Defects

Category	Definition	Typical Causes	Common Inspection Methods
Surface Defects	Visible irregularities on the weld face or root.	Improper technique, contamination, poor fit-up.	Visual inspection (VT), dye penetrant (PT).
Internal (Volumetric) Defects	Flaws located inside the weld metal or HAZ.	Gas entrapment, solidification issues, excessive heat.	Radiographic (RT), ultrasonic (UT), phased array (PAUT).
Geometric Defects	Deviations from the required shape or size.	Incorrect welding parameters, misalignment, poor joint design.	VT, dimensional measurement, 3D scanning.
Mechanical Property Defects	Areas with reduced strength or toughness.	Over-tempering, rapid cooling, improper filler metal.	Hardness testing, tensile testing, impact testing.

3. Common Surface Defects

Defect	Appearance	Primary Cause	Remedy / Prevention
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Cracks	Linear, sharp?edged openings.	High residual stress, rapid cooling, hydrogen embrittlement.	Pre?heat, inter?pass temperature control, low? hydrogen electrodes.
Porosity	Small round cavities, often clustered.	Trapped gases, moisture, contaminated filler.	Clean surfaces, proper storage of consumables, correct shielding gas flow.
Undercut	Groove beside the weld toe, metal loss.	Excessive travel speed, high voltage, incorrect angle.	Adjust parameters, use proper torch angle, practice technique.
Lack of Fusion	Unbonded area between weld and base metal.	Insufficient heat input, poor joint preparation.	Increase heat input, improve fit? up, clean joint edges.
Spatter	Droplets of molten metal adhering to surrounding area.	High current, improper shielding, incorrect electrode angle.	Optimize current, adjust shielding gas, maintain correct angle.
Overlap	Weld metal flows over base metal without bonding.	Excessive travel speed, low voltage, too much filler.	Reduce travel speed, increase voltage, adjust filler rate.
Burn? through	Complete penetration of base metal, leaving a hole.	Too high current or voltage, thin workpiece.	Lower current/voltage, use appropriate filler size.

4. Common Internal (Volumetric) Defects

Defect	Description	Typical Location	Root Cause	Detection
Lack of Penetration (LOP)	Weld does not fully fuse through joint thickness.	Root of groove or fillet.	Insufficient heat, poor joint design.	RT, UT, visual check of root.
Lack of Fusion (LOF)	Incomplete bonding between successive passes.	Between passes or between weld and base.	Low inter?pass temperature, contamination.	RT, UT.

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