

Understanding Common Welding Defects

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Study guide – concise, organized, and easy to read

1. Why Knowing Defects Matters

- **Safety:** Defects can weaken a joint, leading to failure under load.
 - **Quality & Cost:** Detecting and preventing defects reduces rework, scrap, and inspection expenses.
 - **Compliance:** Many codes (AWS, ASME, ISO) require specific limits on allowable defects.
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2. Classification of Defects

Category	Typical Appearance	Primary Cause	Typical Inspection Method
Porosity	Small, round gas-filled cavities (often spherical)	Trapped gases, moisture, inadequate shielding gas, dirty base metal	Visual, radiographic (X-ray), ultrasonic
Cracks	Linear openings, can be surface or internal	High stress, rapid cooling, hydrogen embrittlement, insufficient preheat	Visual, dye penetrant, ultrasonic, magnetic particle
Lack of Fusion / Lack of Penetration	Unbonded areas at joint root or face; visible gaps	Incorrect torch angle, insufficient heat, poor fit-up	Visual, radiographic, ultrasonic
Undercut	Groove cut into base metal along the toe of the weld	Excessive travel speed, high current, improper angle	Visual, profile measurement
Overlap	Weld metal runs over base metal without bonding	Too high travel speed, low current, incorrect angle	Visual
Spatter	Droplets of molten metal adhering to surrounding surface	Excessive current, poor shielding, incorrect polarity	Visual

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Category	Typical Appearance	Primary Cause	Typical Inspection Method
Burn-through / Blow-through	Hole through the base metal	Excessive heat input, too high voltage/current	Visual, radiographic
Incomplete Joint Penetration (IJP)	Weld does not extend through the full thickness of the joint	Improper joint design, insufficient heat, poor positioning	Radiographic, ultrasonic
Distortion / Warping	Dimensional change of the workpiece	Uneven heating/cooling, restraint, high heat input	Dimensional inspection, laser scan
Metal Flow Defects (e.g., sagging, excessive reinforcement)	Excess metal buildup or sagging in the weld pool	Improper travel speed, high heat input, poor torch manipulation	Visual, profile measurement

3. Root Cause Overview

Root Cause	Related Defects	Preventive Actions
Contamination (oil, rust, paint, moisture)	Porosity, lack of fusion, spatter	Clean workpiece, use dry consumables, store electrodes properly
Improper Shielding (gas flow, coverage)	Porosity, spatter, undercut	Verify gas flow rate, check nozzle condition, maintain proper distance
Incorrect Parameters (current, voltage, speed)	Burn-through, undercut, lack of penetration, spatter	Follow welding procedure specification (WPS); perform trial welds
Poor Joint Fit-up / Preparation	Lack of fusion, lack of penetration, cracks	Ensure proper bevel angles, root gaps, and edge preparation
Hydrogen Embrittlement (moisture, certain electrodes)	Cracks (hydrogen-induced)	Use low-hydrogen consumables, pre-dry electrodes, keep humidity low
Excessive Heat Input	Distortion, grain growth, burn-through	Control travel speed, use appropriate amperage, apply pre-heat/cool-down as required
Improper Technique (		