

Introduction to Welding Technology

Introduction to Welding Technology – Study Notes

1. What Is Welding?

- **Definition:** A fabrication process that joins two or more metal (or thermoplastic) parts by heating the base material, adding filler material (if required), and allowing it to cool to form a strong joint.
 - **Key Elements**
 - **Heat source** (arc, flame, laser, etc.)
 - **Filler metal** (optional)
 - **Shielding** (gas, flux, or both) to protect the molten pool from atmospheric contamination.
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2. Basic Welding Concepts

Concept	Explanation
Fusion	Melting of the base metals (and filler) to create a continuous metallurgical bond.
Solidification	Cooling of the molten pool; the microstructure formed during this stage determines joint strength and toughness.
Heat-affected zone (HAZ)	Area of the base metal that is heated but not melted; its properties may change (hardness, grain size).
Weld bead	The visible deposit of filler metal and melted base material after solidification.
Joint design	Geometry of the parts to be joined (e.g., butt, lap, corner, T-joint). Proper design controls stress distribution and accessibility for the welding process.

3. Major Welding Processes

Process	Energy Source	Typical Applications	Advantages	Limitations

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Shielded Metal Arc Welding (SMAW / Stick)	Electric arc	Construction, repair, outdoor work	Simple equipment, portable	Slower, more slag removal
Gas Metal Arc Welding (GMAW / MIG)	Electric arc + shielding gas	Automotive, sheet metal fabrication	High deposition rate, easy automation	Sensitive to wind, requires gas supply
Gas Tungsten Arc Welding (GTAW / TIG)	Electric arc + inert gas	Aerospace, thin? wall work, stainless steel	Precise control, clean welds, no slag	Slower, requires high skill
Flux?Cored Arc Welding (FCAW)	Electric arc + flux?filled wire	Shipbuilding, heavy ?section fabrication	High productivity, can be used with/without gas	More smoke, heavier equipment
Submerged Arc Welding (SAW)	Electric arc + granular flux	Large?scale pipe, pressure vessels	Deep penetration, high efficiency	Limited to flat/horizontal positions
Oxy?Fuel (Oxy? acetylene) Welding	Combustion of fuel gas & oxygen	Cutting, repair of cast iron	Portable, works without electricity	Lower productivity, higher heat input
Laser Beam Welding (LBW)	High?power laser	Electronics, automotive, aerospace	Precise, low HAZ, high speed	Expensive equipment, requires clean fit? up
Electron Beam Welding (EBW)	Focused electron beam (vacuum)	Aerospace, nuclear, high?value components	Deep penetration, excellent control	Very high cost, vacuum chamber needed

4. Weld Joint Types & Preparation

Joint Type	Description	Typical Use
Butt Joint	Edges of two plates are placed in the same plane	Pipe, plate fabrication
Lap Joint	One plate overlaps another	Sheet metal, automotive panels
T?Joint	One plate meets the face of another at 90°	Frames, brackets
Corner Joint	Two plates meet at right angles forming an “L”	Structural