

MIG Welding: Beginner to Confident Basics

A practical shop guide covering history, setup, consumables, technique, troubleshooting, practice, and safety.

What MIG Welding Is

MIG is the common shop name for gas metal arc welding (GMAW). A continuously fed wire electrode melts into the joint while shielding gas protects the puddle. Flux-cored arc welding uses a tubular wire containing flux and may be self-shielded or gas-shielded.

- Fast learning curve and high deposition rate
- Excellent for fabrication, automotive work, repairs, and production
- Works especially well on mild steel; suitable consumables and setup also support stainless and aluminum

A Short History

Consumable-wire arc welding developed rapidly in the mid-20th century as shielding-gas technology improved. Early systems favored inert gases, leading to the name MIG (metal inert gas). Modern production includes argon/CO2 blends and active gases, so the formal process name GMAW covers more applications.

Machine Anatomy

- Power source: controls voltage/amperage characteristics
- Wire feeder and drive rolls: push wire at a controlled speed
- Gun: carries wire, current, and shielding gas
- Work lead/ground clamp: completes the welding circuit
- Gas cylinder, regulator/flowmeter, and hose: supply shielding gas when required
- Consumables: liner, diffuser, contact tip, nozzle, drive rolls, and wire

Polarity and Wire

Most solid-wire GMAW uses DCEP (electrode positive). Many self-shielded flux-core wires use DCEN, but not all. The wire manufacturer's label overrides any general rule.

- ER70S-6: common mild-steel solid wire with strong deoxidizers
- E71T-11: common self-shielded flux-core classification for portable outdoor work
- Stainless wire: match alloy and shielding gas to the base metal and procedure
- Aluminum: typically use a spool gun or push-pull system, appropriate liner, tips, and argon

Shielding Gas Basics

75% argon / 25% CO2 is a common short-circuit mild-steel mix with relatively smooth arc behavior. 100% CO2 is economical and can provide deeper penetration but often produces more spatter. Spray-transfer and specialty applications use different blends. Follow wire and machine recommendations.

Settings: What Each Control Changes

- Voltage primarily influences arc length and bead profile
- Wire-feed speed strongly influences amperage and deposition rate
- Travel speed affects heat input and bead size
- Contact-tip-to-work distance (stickout) changes resistance heating and arc behavior
- Inductance/arc-control features change puddle response on machines that provide them

Technique

Start with clean, correctly fit material. Hold a consistent work angle, travel angle, and stickout. Listen for a stable arc and watch the leading edge of the puddle rather than staring only at the arc. On short-circuit MIG, excessive weaving often adds heat without improving fusion.

Joint Practice Progression

- Run straight beads on plate until width and travel speed are consistent
- Make pad-of-beads exercises with controlled overlap
- Practice lap joints in flat position
- Practice T-joints and fillets
- Move to butt joints with appropriate gap/bevel
- Then practice horizontal, vertical, and overhead positions only when ready

Common Problems and Corrections

Symptom	Likely causes	What to check
Heavy spatter	Voltage/WFS mismatch, CO2-rich gas, long stickout	Verify recommended range; shorten stickout; inspect gas
Porosity	Wind, leaks, contamination, low/high gas flow	Shield from drafts; clean metal; leak-check hose/nozzle
Burn-through	Too much heat, slow travel, large gap	Reduce heat input; increase travel; improve fit-up
Cold/ropey bead	Low heat, excessive travel, poor work angle	Increase heat within procedure; slow slightly; correct angle
Birdnesting	Liner/tip restriction, drive pressure, gun cable bend	Inspect tip/liner; reduce drive pressure; straighten cable

Maintenance

- Clip or replace damaged contact tips
- Keep the liner clean and correctly sized
- Match drive-roll groove to wire type and diameter
- Keep the gun cable as straight as practical during feeding
- Check gas leaks and nozzle spatter buildup
- Inspect work-lead connection and cable condition

Safety

Welding can expose you to intense ultraviolet/infrared radiation, hot metal, electric shock, fire, compressed gas, fumes, and moving equipment. Use appropriate PPE, ventilation/fume control, fire prevention, and manufacturer instructions. Never rely on a quick-reference chart where a code, engineered procedure, or qualified welding procedure specification is required.

First Project Checklist

- Confirm base metal and thickness
- Choose the correct wire and polarity
- Set shielding gas and flow if applicable
- Remove coatings, rust, oil, and moisture from the weld area
- Make test coupons before welding the actual project
- Inspect weld profile and backside/edge fusion where visible
- Adjust one variable at a time and document what worked