STRETCHLEARN · WORKBOOK

Welding Basics (MIG & TIG) — Workbook

This workbook turns the course into bench time. Each section pairs with a course module and gives you setup checklists, settings logs, bead-and-joint drills, and inspection sheets to run at your own welder. Work through it with scrap mild steel and your machine in hand, and keep the templates open so every weld starts from chart settings and a clean fit-up instead of a guess.

Safety, Gear, and the Welding Area

Verify your PPE, ventilation, fire control, and electrical setup before any arc is struck.

Checklist: Pre-Arc Safety and Setup

[ ] Auto-darkening helmet on, shade set to the process (MIG ~10-11, TIG 11-13), grind mode known
[ ] Flame-resistant cotton or leather worn, collar buttoned, no synthetics, sleeves over glove tops
[ ] Coatings (paint, galvanizing, plating) ground off the weld zone to bright bare steel
[ ] Cross-ventilation set: door/window open, fan pulling fume away from your face (not at the puddle)
[ ] 35-foot radius cleared of fuel, solvents, sawdust, rags; no welding near closed fuel containers
[ ] Charged ABC extinguisher within reach and a water/sand bucket for hot offcuts
[ ] Welder on the correct circuit; work clamp on bare metal close to the joint; cables uncoiled
[ ] Body, gloves, and footing dry; standing on a dry insulating surface

Worksheet: PPE and Workspace Inventory

List the gear and workspace controls you have versus what you still need before welding. Fill in the shade and circuit you will actually use so there is no improvising once the bottle is open.

Helmet make/model and shade range

Shade selected for this job

MIG gauntlet gloves (have/need)

TIG goatskin gloves (have/need)

FR clothing / leather (have/need)

Ventilation method (cross-draft fan / extractor / outdoors)

Respirator (P100/P2) for galvanized work (have/need)

Fire extinguisher type and last-checked date

Welder circuit (120 V 20 A / 240 V 30 A+) and plug type

Exercise: Run a Fire and Fume Walkthrough

Before your first session, physically walk the welding area and act out where sparks will fly and fume will rise. Move or shield every hazard you find, then set the fan and confirm the plume clears your helmet when you simulate a weld position.

• Where do sparks land when you face the joint, and what flammable item sits in that path?

• Does the fume plume rise into your helmet, and how did you re-angle the work or yourself to clear it?

• What is your fire-watch plan for the 30 minutes after you stop welding?

MIG Machine Setup End to End

Load and tension wire, confirm polarity and gas, and prove a clean feed before you weld.

Checklist: MIG Setup Verification

[ ] Wire type and diameter chosen for the metal (e.g., 0.030 ER70S-6 for general mild steel)
[ ] Drive-roll groove, contact tip, and liner all match the wire size
[ ] Polarity correct: DCEP for solid wire with gas, DCEN for self-shielded flux-core
[ ] Spool feeds off the bottom; hub tension stops it coasting without overrunning
[ ] Drive tension passes the wood test: wire buckles without the rolls slipping
[ ] Gas type correct (75/25 or 100% CO2) and bottle valve fully open
[ ] Flow set to ~20-25 CFH on the flowmeter; connections leak-checked with soapy water
[ ] Stickout trimmed to about 3/8 inch; nozzle clear of caked spatter

Worksheet: Consumable and Feed Setup Card

Fill this in each time you load a new spool or change wire size, then jog the wire and confirm a smooth feed before welding. Drilling this habit prevents birdnests and mismatched-tip arc flutter.

Wire spec and diameter (in)

Drive-roll groove used (in)

Contact tip size (in)

Polarity set (DCEP / DCEN)

Shielding gas (75/25 / 100% CO2 / none for flux-core)

Flow rate set (CFH)

Hub tension set (coasts? yes/no)

Wood-test feed result (slips / buckles cleanly)

Exercise: Load, Tension, and Prove the Feed

Load a fresh spool from scratch: mount it, thread through the drive rolls and liner, set hub and drive tension, and jog the wire out the tip. Then run the wood test and a short bead on scrap to confirm the feed is smooth and the polarity and gas are right.

• Did the wood test slip, crush the wire, or buckle cleanly, and how did you adjust drive tension?

• Did you confirm DCEP for solid wire (or DCEN for flux-core), and where are those leads on your machine?

• When you triggered, did you hear gas flow and see a stable arc, or signs of a draft or empty bottle?

Running Beads and Welding Joints on Mild Steel

Dial settings from the chart, run uniform beads, then weld and read butt and fillet joints.

Worksheet: Voltage and Wire-Speed Settings Log

For each thickness you weld, record the chart starting point and the setting that actually produced a sound, frying-bacon bead on scrap. Build your own proven chart over time so you stop guessing. Use the settings-log template to track this across sessions.

Metal thickness (in / gauge)

Wire diameter (in)

Shielding gas

Chart voltage start (V)

Chart wire-feed speed start

Final voltage that worked (V)

Final wire-feed speed that worked

Sound (frying / popping / soft hiss) and bead result

Exercise: Stringer Bead and Puddle-Control Drill

Chalk lines an inch apart on flat scrap of one thickness and run a row of stringer beads. Hold ~3/8-inch stickout, a 10-15 degree travel angle, and a steady speed, watching the puddle, not the spark. Critique each bead for width, height, and ripple consistency before moving on.

• Which way did you lean (push vs pull), and how did the bead width and penetration change?

• When the bead went ropey or undercut, was the fix travel speed, voltage, or wire-feed speed?

• Did the ripple spacing reveal your hand speeding up or slowing down, and where on the line?

Worksheet: Joint Fit-Up and Tack Plan

Plan a butt and a fillet joint before you weld them. Record the gap, tack locations, work angle, and target fillet leg so the parts are aligned and the weld fuses both members.

Joint type (butt / fillet T / lap / corner)

Plate thickness (in)

Root gap (in)

Tack locations (ends / middle / count)

Work angle (90 flat / 45 into fillet root)

Target fillet leg length (in)

Number of passes planned

Cleaned to bare metal? (yes/no)

Checklist: Defect Diagnosis Quick-Reference

- [ ] Porosity (line of pinholes): restore gas shield, raise flow, kill draft, clean nozzle
- [ ] Undercut (groove at the toe): lower voltage, slow travel, or correct gun angle
- [ ] Cold lap (bead sits on top, no fusion): add wire-feed speed and slow travel
- [ ] Burn-through on thin steel: drop settings, speed up, or stitch short tacks
- [ ] Ropey/tall cold bead: too much wire for voltage, raise voltage or slow wire
- [ ] Break-test a fillet coupon: confirm it tears in the parent metal, not off the plate

Finishing, Inspection, and Intro to TIG

Finish and inspect the weld safely, then set up TIG and form your first steel puddle.

Checklist: Grinding and Finishing Safety

- [ ] Full face shield over safety glasses, gloves, hearing protection, no loose clothing
- [ ] Correct wheel chosen: grinding wheel for stock, cut-off only for cutting, flap disc for blending
- [ ] Cut-off wheel never used for side-grinding (shatter risk)
- [ ] Grinder brought to full speed before touching metal; kickback directed away from body
- [ ] Structural welds: dress spatter and sharp edges only, leave reinforcement intact
- [ ] Painted area ground to bright bare metal, wiped with solvent, then primed before topcoat

Worksheet: Weld Inspection Sheet

Inspect each practice weld against these criteria and record what you find, then note the corrective action. Repeat after the fix to confirm it worked, building the habit of qualifying your settings on scrap.

Weld ID / joint type

Bead width and ripple uniform? (yes/no)

Undercut at the toes? (none/slight/heavy)

Surface porosity or cracks? (yes/no)

Crater filled at the end? (yes/no)

Fillet: equal legs and root fusion? (yes/no)

Break/bend test result (tore in parent / peeled off)

Corrective action and re-test result

Exercise: Strike a TIG Arc and Form a Puddle

Set up TIG for thin steel: DCEN polarity, pure argon at ~15-20 CFH, a 2% tungsten ground to a point with marks running lengthwise. With no filler, strike a low-amperage arc on scrap, form a small shiny puddle, and walk it slowly down a line keeping the puddle a steady size. Add a filler dip only once the puddle is controlled.

• Did you confirm DCEN and argon (not the MIG settings), and how is the tungsten ground?

• How low did you set the amperage for the gauge, and did the metal flash to a clean puddle?

• When you added the filler dip, did you keep the hot rod end inside the argon shield?

Your Action Plan

1. Assemble PPE first: auto-darkening helmet (shade 10-13), MIG gauntlets, TIG goatskin gloves, FR clothing, face shield, P100 respirator, and an ABC extinguisher.
2. Set up a fire-safe, ventilated bench on steel or concrete, clear a 35-foot spark radius, and confirm the welder is on the correct circuit with the work clamp on bare metal.
3. Load MIG wire from scratch, set hub and drive tension, confirm DCEP and 75/25 gas at ~20-25 CFH, and pass the wood feed test.
4. Run stringer beads on flat scrap until the bead is uniform and sounds like frying bacon, adjusting one dial at a time.
5. Log the voltage and wire-feed-speed pair that works for each thickness, starting from the door chart and tuning on scrap.
6. Fit up, tack, and weld a butt joint with a small root gap, then check the back side for full penetration.
7. Weld a T-fillet at a 45-degree work angle, then break-test a coupon to confirm it tears in the parent metal.
8. Diagnose and fix one example each of porosity, undercut, and cold lap by changing the specific setting or motion responsible.
9. Finish a weld safely with the correct wheel, then prep, prime, and topcoat the bare steel.
10. Set up TIG for thin steel and practice forming a steady puddle with no filler before adding the filler dip, then review your settings log and repeat your weakest drill.