Stick Welding Basics: Settings, Polarity, Techniques

Stick welding, formally known as Shielded Metal Arc Welding (SMAW), is the most portable and versatile welding process. This guide covers essential settings, polarity selection, and fundamental techniques for successful stick welding across various applications.

1. Understanding Polarity - The Foundation

Polarity determines the direction of electrical current flow and profoundly affects penetration, deposition rate, and electrode performance. Stick welding uses two polarities:

Polarity	Connection	Heat Distribution	Best For	Characteristics
DCEP (DC+) Electrode Positive	Electrode to + Work to -	70% electrode 30% work	Deep penetration Most common 6010, 7018, 309	Maximum penetration Cleaner welds Stable arc
DCEN (DC-) Electrode Negative	Electrode to - Work to +	30% electrode 70% work	Thin materials Surfacing 7024, hardfacing	Fast deposition Minimal penetration Flatter bead
AC Alternating Current	Switches 120x/second	Balanced 50/50	General purpose 6011, 6013 Stick conditions	Moderate penetration Arc blow resistant All-position

2. Electrode Selection Guide

Understanding AWS Electrode Classification:

Example: E7018 breaks down as: E = Electrode, 70 = 70,000 PSI tensile strength, 1 = all-position capable, 8 = low-hydrogen iron powder coating, DCEP or AC.

Electrode	Polarity	Penetration	Applications	Key Features
E6010	DCEP only	Deep	Pipe, root passes, dirty metal	Aggressive arc, all-position, spray transfer
E6011	AC or DCEP	Deep	General purpose, farm/field	Similar to 6010, works on AC machines
E6013	AC/DC Both	Light	Sheet metal, body work	Easy striking, smooth arc, low penetration
E7014	AC/DC Both	Medium	Production welding, fast fill	Iron powder, high deposition, drag technique
E7018	AC/DCEP	Medium-Deep	Structural steel, pressure vessels	Low hydrogen, smooth arc, code quality
E7024	AC/DCEN	Shallow	Flat/horizontal fillets, fast	Very high deposition, drag rod technique
E308L-16	DCEP	Medium	Stainless steel (304)	Stainless rod, low carbon version

E309L-16	DCEP	Medium	Dissimilar metals, mild to stainless	Versatile, higher alloy content

3. Amperage Settings Chart

Amperage selection depends on electrode diameter, position, and joint configuration. These are starting points—adjust based on arc behavior and weld appearance:

Electrode Size	Flat/Horizontal	Vertical Up	Vertical Down	Overhead
1/16" (1.6mm)	20-40 A	20-35 A	25-40 A	20-35 A
5/64" (2.0mm)	30-50 A	30-45 A	35-50 A	30-45 A
3/32" (2.4mm)	60-90 A	55-80 A	65-90 A	55-80 A
1/8" (3.2mm)	90-150 A	80-130 A	100-150 A	80-120 A
5/32" (4.0mm)	140-200 A	120-180 A	150-200 A	120-170 A
3/16" (4.8mm)	180-275 A	160-240 A	200-275 A	Not recommended
1/4" (6.4mm)	275-425 A	Flat only	Flat only	Not recommended

Amperage Adjustment Guidelines:

• Too Low: Electrode sticks frequently, arc sputters, poor penetration, convex bead
• Too High: Excessive spatter, undercut, fast electrode consumption, burn-through on thin material
• Correct: Stable arc sound (like bacon frying), electrode melts smoothly, good penetration, slight convex bead
• Rule of Thumb: 1 amp per .001 inch of electrode diameter (1/8" = 125 amps as starting point)

4. Fundamental Welding Techniques

Arc Starting Methods

Scratch Start (recommended for beginners): Drag electrode across work like striking a match, then lift slightly to establish arc length. Tap Start: Touch electrode perpendicular to work, then lift quickly. Avoid jabbing—creates slag inclusions.

Arc Length Control

• Correct Arc Length: 1x electrode diameter (1/8" rod = 1/8" arc gap)
• Too Short: Electrode sticks, arc goes out, poor penetration
• Too Long: Spatter increases, unstable arc, poor penetration, wide inconsistent bead
• Listen: Tight arc = smooth, steady crackle; loose arc = irregular popping
• Visual: Proper arc length creates focused, intense white cone at electrode tip

Travel Speed and Angle

Work Angle: Perpendicular to joint (90°) for equal penetration on both sides. Travel Angle: 5-15° drag (electrode pointing backward) for most applications. Push angle used only for specific applications like thin materials or vertical down. Speed: Move consistently—too fast creates narrow, weak bead with poor penetration; too slow causes excessive buildup and possible burn-through.

5. Position-Specific Techniques

Position	Electrode Angle	Technique	Common Issues
Flat (1G, 1F)	90° work, 5-15° drag	Straight stringer or slight weave, consistent travel	Slag inclusion if too slow, undercut if too fast
Horizontal (2G, 2F)	90° work, 5-10° drag, slight upward tilt	Stringer or small weave, watch for sag on lower edge	Overlap on bottom, undercut on top
Vertical Up (3G, 3F)	90° work, 5-10° push up	Tight zigzag or triangular weave, pause at sides	Incomplete fusion, uneven bead if too fast
Vertical Down	90° work, 30-45° drag down	Fast travel, straight stringer, no weave	Slag inclusion if too slow, cold lap if too fast
Overhead (4G, 4F)	90° work, 5-15° drag	Small diameter rod, fast travel, stringer preferred	Spatter, sagging weld metal, burns through jacket

6. Common Problems and Solutions

Problem	Cause	Solution
Electrode sticks repeatedly	Amperage too low, arc too short, poor grounds	Increase amperage 10-15A, maintain proper arc length, chec
Excessive spatter	Amperage too high, arc too long, wrong polarity	Reduce amperage, shorten arc, verify polarity for electrode ty
Porosity in weld	Moisture in electrode, dirty base metal, drafts	Use dry electrodes from proper storage, clean metal, shield fr
Undercut at weld toe	Amperage too high, travel too fast, improper angle	Reduce amperage, slow travel speed, adjust work angle to 9
Incomplete penetration	Amperage too low, travel too fast, joint gap too small	Increase amperage, slow travel, ensure proper joint preparati
Cracking in weld	High carbon steel, rapid cooling, wrong electrode	Preheat base metal, use low-hydrogen rod (7018), reduce co

7. Electrode Storage and Handling

Low-hydrogen electrodes (E7018, E7016) absorb moisture from air, causing porosity and cracking. Proper storage is critical:

• Store unopened cans in dry location at 40-120°F
• Once opened, store E7018 in rod oven at 250-300°F
• E6010, E6011, E6013 can be stored at room temperature in dry location
• Discard E7018 rods exposed to atmosphere for over 4 hours
• Re-dry E7018 at 650-750°F for 1 hour if moisture exposure suspected
• Never re-dry electrodes more than once—flux becomes brittle
• Use rod quiver or insulated holder to keep rods hot during use
• Do not mix electrode types in storage—can cause confusion

Quick Reference - Critical Points

■ Match polarity to electrode: Most common rods use DCEP or AC
■ Start with 1 amp per .001" electrode diameter (1/8" = 125A)
■ Maintain arc length equal to electrode diameter
■ Use 5-15° drag angle for most applications
■ Listen for steady, crisp bacon-frying sound
■ Store low-hydrogen rods (7018) in heated oven
■ Clean base metal—wire brush minimum, grinder better
■ Use smallest electrode that provides needed penetration
■ Practice on scrap before production welding
■ Chip slag completely between passes on multi-pass welds