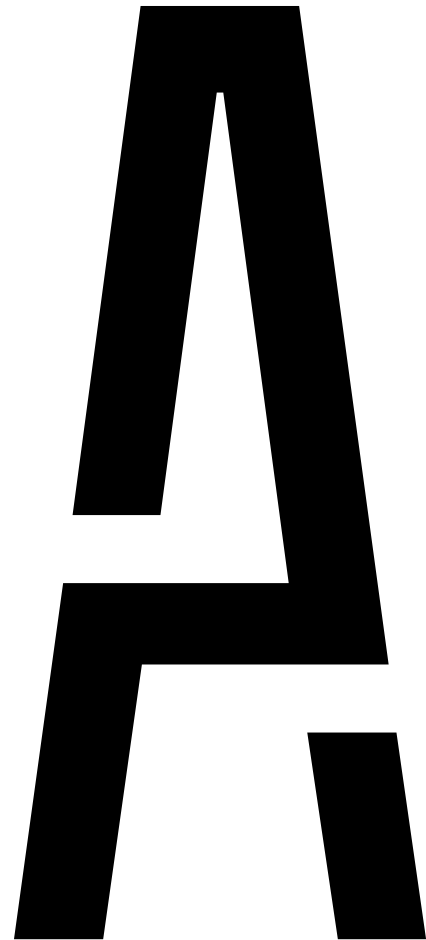


A dark green chalkboard with several pieces of pink and blue chalk scattered in the upper right corner. In the lower left, there are three white 'X' marks drawn in a diagonal line. In the lower right, there are two white arrows pointing upwards and to the right. The main title is written in large, bold, white capital letters across the center.

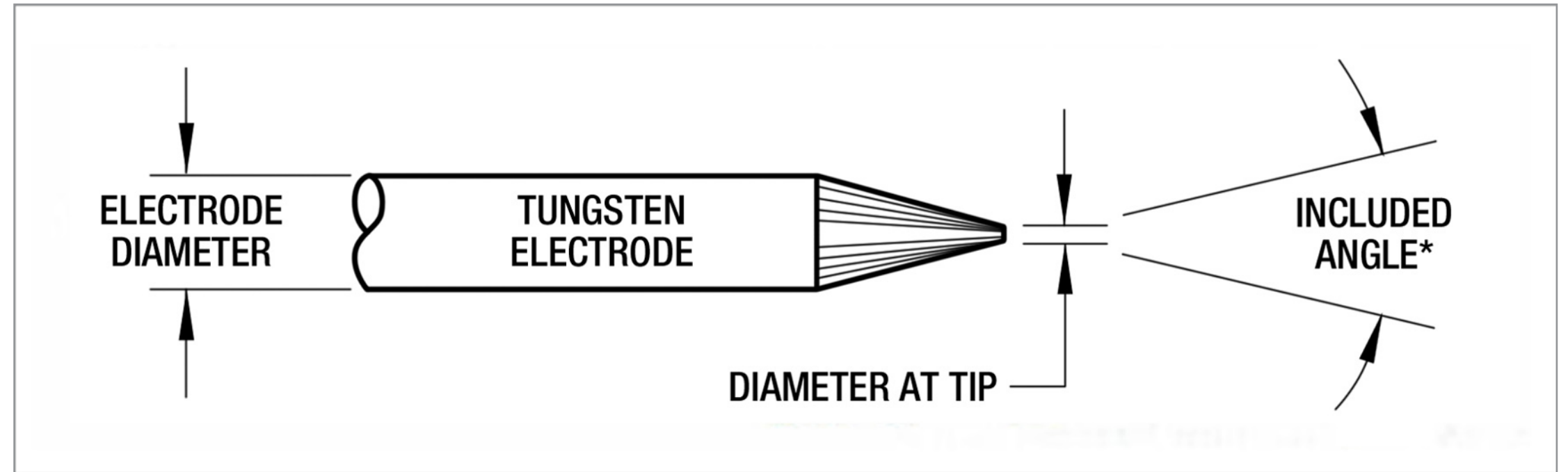
WINNING PREPARATION

by Jim Elizarraz, president, Diamond Ground Products

Proper preparation of tungsten electrodes for
arc welding begins with the fundamentals



A great tungsten welding electrode is a lot like a great NFL quarterback. While there is no shortage of variables in their surroundings, the ones that perform best will always focus on fundamentals and consistency.



Three fundamental considerations for the preparation of tungsten electrodes – electrode geometry, electrode preparation equipment and electrode preparation techniques – will help ensure that a welder is more like Tom Brady and less like Ryan Mallett.

Electrode geometry

Geometry choices affect key tungsten attributes, such as electrode life, ease

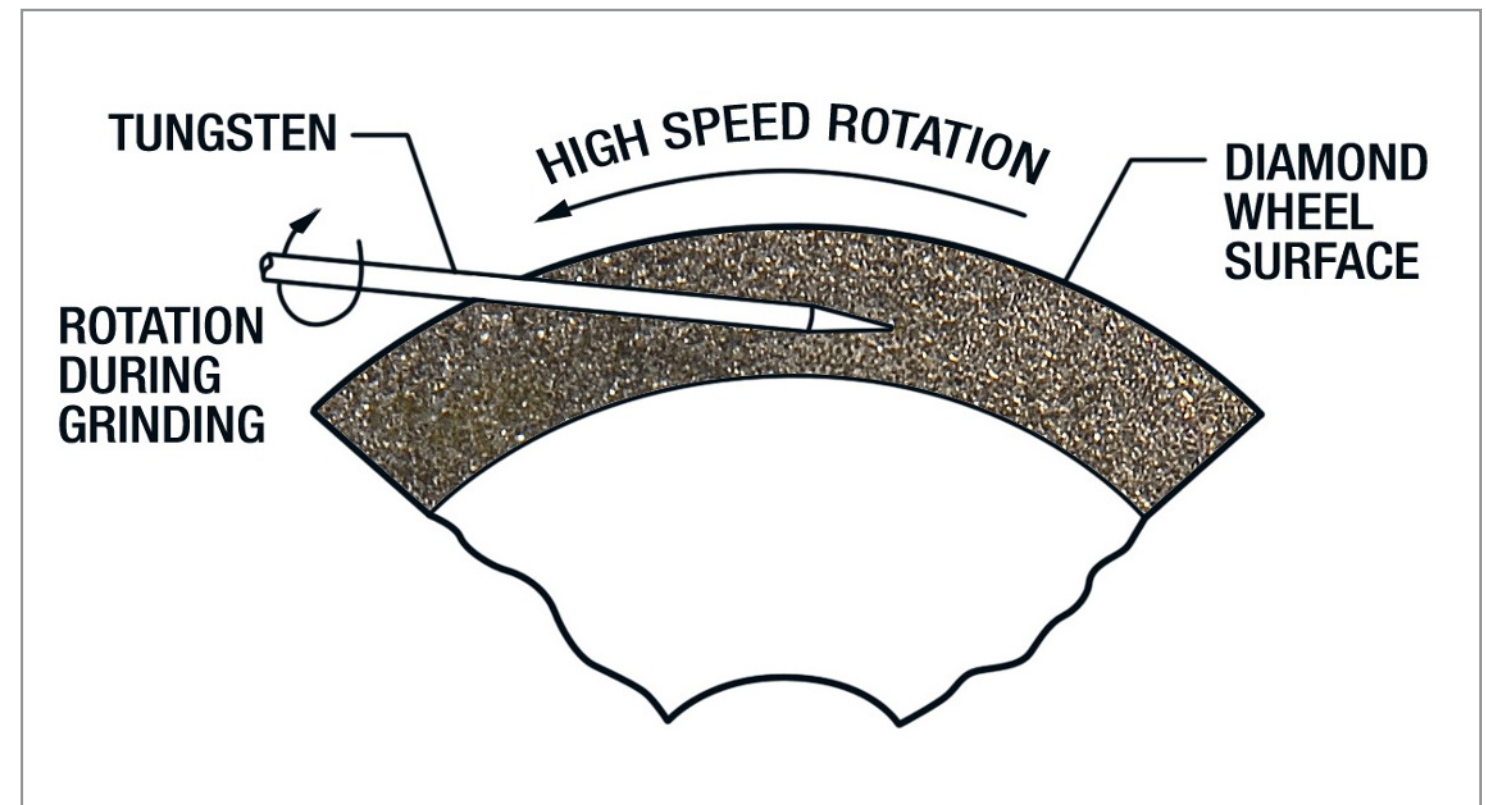
Tungsten electrode geometry.

of arc starting, weld penetration and arc shape. Clearly, it is a critical process variable that should be tested to create the optimum geometry for a welding application. Once optimized, it is essential to maintain the strictest tolerances for all subsequent welds.

Electrode diameter: Choosing the electrode diameter is often an attempt to maximize arc starting and tungsten life, two aspects that tend to work against each other. Welders should always begin by consulting the welding equipment manufacturer's recommendations, but testing to see what works best is an extra step that all great welders should take.

A small diameter is easier to arc start, but may deteriorate quickly and there is increased probability of particles contaminating the weld. A large diameter accommodates higher amperages and lasts longer but may have difficulty arc starting and may have arc instability if amperages are not high enough.

Electrode included angle (taper): DC welding electrodes should be ground longitudinally and concentrically to an included angle with a dedicated diamond grinding wheel. Different angles produce different arc shapes



The single most important aspect of proper electrode grinding is that the grind be done longitudinally.

For the best possible arc stability, diamond grinding of tungsten electrodes should be done with the length of the electrode at a 90° angle to the axis of the grinding wheel.



CORRECT

and offer different weld penetration capabilities.

Blunt electrodes (large included angle) last longer, have better weld penetration, have a narrower arc shape and can handle more amperage without eroding. Sharp electrodes (small included angle) offer less arc weld, have a wider arc and have a more consistent arc.

Electrode tip (flat): The shape of the tungsten electrode tip is important in precision arc welding because as the flat size increases, so does the chance of arc wander and starting difficulty. However, increasing the flat also improves weld penetration and increases electrode life.

An incorrect or inconsistent flat can cause pointed electrode tips to drop into the weld pool. It also can result in arc instability, reduced electrode life



INCORRECT

and changes in arc shape from one electrode to another.

Electrode prep equipment

A dedicated tungsten electrode grinder is essential for creating the highest quality tungsten electrodes consistently. Standard bench-type grinders or Dremel modifications do not offer the ability to grind longitudinally or provide any guarantee of consistency from electrode to electrode. In addition, a non-dedicated grinder contaminates the electrode with foreign material that compromises weld quality in a number of ways.

For efficient production of consistent and repeatable electrodes and welds, consider the following characteristics in a dedicated tungsten electrode grinder:

Correct = lengthwise grind marks do not restrict current. Incorrect = crosswise grind marks restrict welding current, cause arc wander and risk inclusions.

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Tungsten Electrodes

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Specifications:
ANSI/AWS A5.12, JIS
DIN EN 26848, ISO 6848

Diameter	Length
3/32"	7" (175mm)
Quantity	Batch No.
10	351968

GROUND
Finish

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REVERSE SIDE FOR WARNING

- Longitudinal grinding
- Diamond grinding wheel
- 20 R_a finish (or better)
- Measured cutting tool
- Dust collection
- Minimal variation in tolerances
- Ease of use, setup and modification

While some may argue the cost of a dedicated grinder is prohibitive, it's not nearly as expensive as the cost of welder downtime, rewelding of bad parts, cost of scrapped materials and safety of welding staff.

Electrode prep techniques

The tungsten electrode is the crucial carrier in the welding process and must be ground and cut properly. An improperly prepared electrode leads to arc wander, splitting, shedding, and inconsistencies or expensive mistakes in the form of material waste. Properly ground and cut electrodes improve arc starting, stability and all-around welder productivity.

Diamond wheels are recommended for all tungsten electrode grinding and cutting. While tungsten is a very hard material, the surface of a diamond wheel is harder, which makes for a smooth grind. Grinding with other types of wheels can

create jagged edges, imperfections or poor surface finishes that contribute to welding inconsistency and defects.

Electrode included angle (taper) prep:
The single most important aspect of

proper electrode grinding is that the grind be done longitudinally. Tungsten electrode manufacturing is done with the molecular structure of the grain running lengthwise. Grinding crosswise is grinding

against the grain.

Additionally, electrons flow at a greater density on the surface of the electrode. If electrodes are ground or polished crosswise, the electrons have to jump



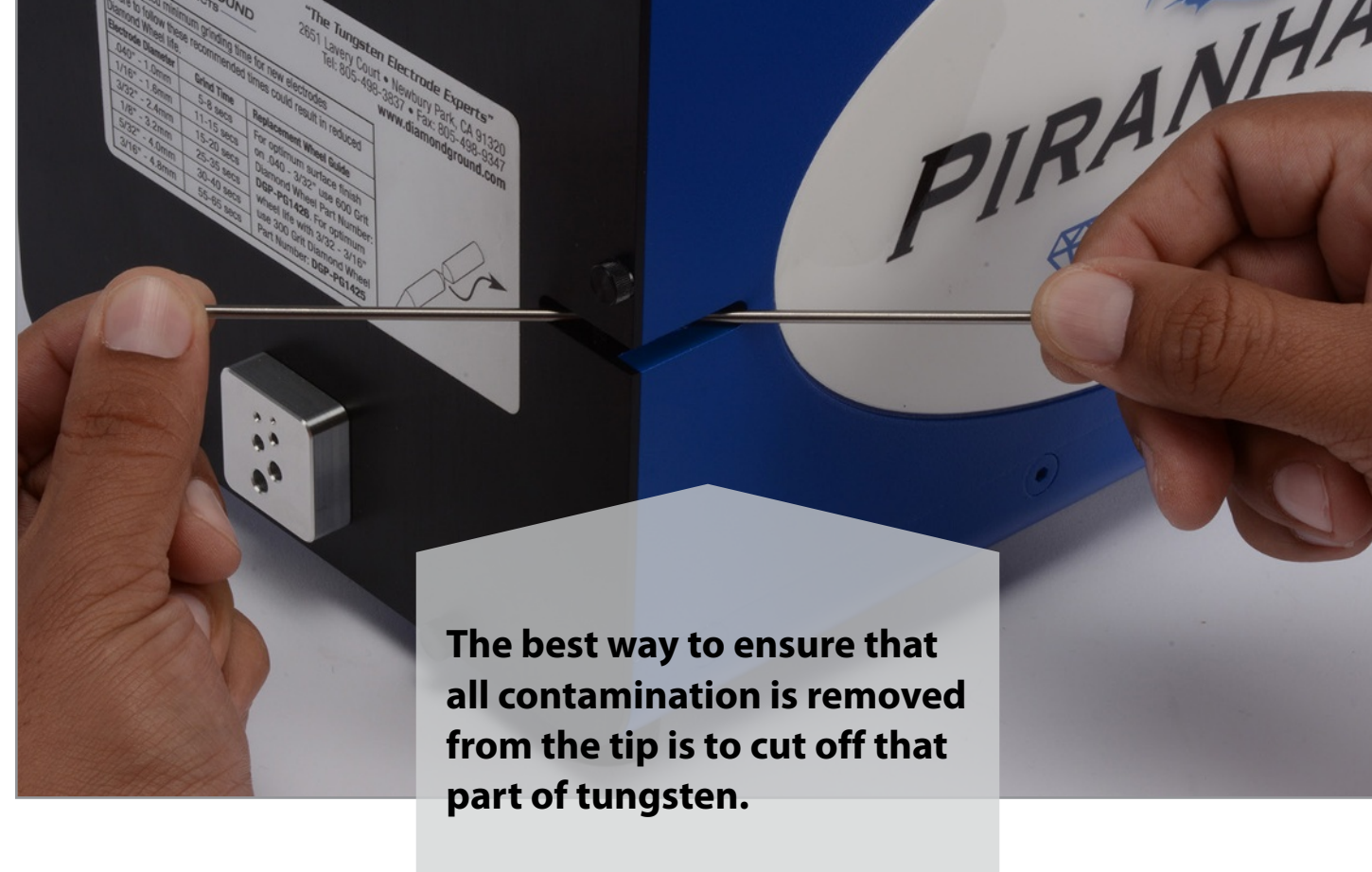
To recondition an electrode that has minimal contamination, either new or cut off, place the electrode at an exact 90° angle to the side of the grinding wheel.

across the grinding marks. The arc begins before the tip, spreads out and often wanders. The tungsten electrode becomes overheated and wears out more quickly. Longitudinal grinding allows an arc to start straight and remain stable and concentrated.

A diamond grinding wheel should not be used for grinding anything other than tungsten. This will help ensure the wheel and tungsten tip do not become contaminated during the grinding operation and do not transfer foreign material to the weld.

The smoothness of the finish on the prepared tip of the tungsten electrode determines some of the characteristics of the welding process. In general, points should be ground as fine as possible to improve welding properties and increase the electrode life. Electrodes that are ground too coarse result in unstable arcs.

A standard finish of approximately 20 roughness average (R_a), which would still show the longitudinally ground lines to the naked eye, is an all-purpose, quality finish for any application. A high-polished, mirror-like finish of 6 to 8 R_a , in which few or no lines can be seen, is better for the longevity of the electrode because it reduces the risk of contamination “sticking” to the electrode



point and causing erosion. However, for welding power supplies that do not have strong arc-starting characteristics, a finish of about 20 R_a is better because longitudinally ground lines help steadily lead electrons to the extreme point of the electrode, which assists in arc starting.

Electrode tip (flat) prep: Depending on the welding process, flat preparation might be on a new tungsten electrode or a previously used electrode. If the end of a used electrode is extremely contaminated, it should be removed before flat preparation. To recondition an electrode that has minimal contamination, either new or cut off, place the electrode at an exact 90°

angle to the side of the grinding wheel.

Cutting electrodes to length: A contaminated electrode produces an erratic arc and a contaminated weld. The best way to ensure that all contamination is removed from the tip is to cut off that part of tungsten. Grinding the tip when it is contaminated may not remove all of the contamination and will deposit the contamination on the grinding wheel, only to be picked up again in future grinding.

Because tungsten is a very hard material, proper cutting involves using a diamond cutting wheel for consistent, clean cuts. Many welders cut their

tungsten incorrectly using one of the following methods:

- Breaking the electrode manually or with wire cutters
- Twisting the electrode with two pairs of pliers
- Notching the electrode on the grinding wheel and then breaking it by hand or with a hammer or pliers
- Hitting the electrode with a hammer on a sharp metal edge

All of these methods can cause safety and weld problems. The tungsten electrode can splinter or shatter unnoticeably, which can cause arc instability and weld defects as well as the risk of eye or hand injury. It is much easier to cut an electrode quickly and properly with the correct cutting tool designed specifically for the hard and brittle tungsten.

Using a diamond cutting wheel helps ensure that the cut is clean and smooth and void of fractures or splintering. The tool should be quick and easy to use, have safety covers and provide a scale to ensure the exact length is measured and cut. ►

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