

## Aligning the Poles: Discovering Polarity

With DC, welding can be done on *electrode negative* or *electrode positive* (which is rarely used for TIG). These two options cause a change in the electrical charge that the electrode has and changes the direction that the electrons are flowing in the welding circuit. This positive or negative charge is referred to as *polarity*. If you use a negative electrode while welding, you get a negative polarity.

When TIG welding, the welder has three choices of welding-current type and polarity. These choices are

- ✔ **Direct current electrode negative** (DCEN, or straight polarity)
- ✔ **Direct current electrode positive** (DCEP, or reverse polarity)
- ✔ **Alternating current** (AC), which is actually a combination of both electrode negative and electrode positive polarity

Each of these current types has its applications, its advantages, and its disadvantages, which we cover in the next few sections. Taking a look at each type and its uses helps you to select the best current type for your job.

### *Direct current electrode negative*

Direct Current Electrode Negative (DCEN) is also sometimes called *straight polarity*. DCEN is used while welding steel, stainless steel, copper, titanium, gold, and pretty much any other material that can be welded with the exceptions of aluminum and magnesium, which are welded using AC.

The torch is connected to the negative terminal of the power source and the work lead is connected to the positive terminal. Power sources with polarity switches have the output terminals marked *electrode* and *work*.

When the arc is established while welding in DCEN, electrons flow from the negative electrode to the positive work piece. In

a DCEN arc, approximately 70 percent of the heat generated by the arc occurs in the work piece — thus you can use a smaller electrode, as well as a smaller gas cup and reduced gas flow. The more concentrated arc allows for faster travel speeds. This concentrated arc also accounts for the deep penetration when using DCEN for TIG welding.

## *Direct current electrode positive*

Direct Current Electrode Positive (DCEP) is also known as *reverse polarity*. Welding is not typically done with DCEP. When using this polarity, the electron flow is still from negative to positive; however, the electrode is now the positive side of the arc and the work is the negative side. About 70 percent of the heat of the arc is focused on the positive side of the welding arc. On DCEP, 70 percent of the heat is focused directly on the tungsten, which creates a large ball on the tungsten. For welding with DCEP, a very large tungsten is typically needed. Between the large tungsten and the nature of a DCEP arc, the arc can be very erratic and quick to wander — which is the main reason that this polarity is typically undesirable for TIG welding.



The arc, though erratic, does create a cleaning effect for welding on aluminum and magnesium.

## *Alternating current*

To weld aluminum, the best combination is the good penetration of electrode negative plus the cleaning action of electrode positive. To obtain the advantages of both polarities, use alternating current to weld aluminum.

During a complete cycle of alternating current, there is theoretically one half-cycle of electrode negative and one half-cycle of electrode positive. Therefore, during every cycle, there is a time when the work is positive and the electrode is negative, and a time when the work is negative and the electrode is positive; in theory, the half-cycles of alternating current sine wave arc are of equal time and magnitude.