FLAME CURRENT MEASUREMENT

What is flame current
When two electrodes are placed side by side in the flame and if they are connected to an ac voltage source, an ac current will flow.
Conduction in the flame takes place because the flame itself is ionised. The relatively large and heavy positive particles in the flame, called ions, are attracted to the electrode that is negative. The small and light negative particles in the flame, called electrons, are attracted by the positive electrode.
If both electrodes are equal, current in both halves of the sine is equal (see fig. 1.).

This principle can be used for flame sensing, by making the two electrodes unequal.
If one electrode is at least 4 times larger than the other, the current in both halves of the sine will not be equal. This is caused by the difference in mobility due to size and weight of the positive and negative particles.
In practice in most cases the main burner is used as the large electrode.
If the large electrode is positive, the small electrons are easily attracted by it. On the contrary, the heavy ions do not easily come in contact with the small electrode. This limits the current (see fig. 2.)

The other way around, ions are easily captured by the large electrode and also the electrons by the small electrode, so current is not limited (see fig. 3.)

In figure 4, the current signal during one sine wave is shown. Because positive and negative half wave are unequal, a dc current is the result.
This is the signal on which flame sensing is based and which can be in the range of 0.5 μA to several tens of μA depending on applied voltage, position in the flame and measuring circuit.
**How can it be measured**
The flame current can be measured with a common multimeter measuring mV across a 1 KΩ resistor in series with the electrode, giving 1 mV per μA. (see fig. 5.)

**What protection is needed**
Ignition controls can be differentiated in **dual rod** systems and **single rod** systems.

**Dual rod systems**
Dual rods systems have separate electrodes for ignition and flame sensing and a multimeter can be connected to the flame sensing electrode without any problem.

**Single rod systems**
Single rod systems use one electrode for ignition and sensing.
A multimeter connected to the electrode will get disturbed and it's very likely that it gets damaged by the high voltage ignition peaks. To avoid this problem, a circuit was designed to be able to measure flame current without risk of damage. (see fig. 6.)

Important part of the protection is the so called spark gap
A circuit like this, in combination with a battery powered digital panel meter, is in use now for many years in the Application Center of Honeywell Combustion Control Center in Emmen without being damaged in single rod systems.

![Diagram of dual rod system](image)

**Fig. 5.**

**Spark electrode**

![Diagram of single rod system](image)

**Fig. 6.**

Diode D1 t/m D4: type 1N4148
Spark gap: Siemens B1-A230

*For suggestions or comments, please contact the Application Center or send an E-mail to: application.center@honeywell.com*