E-FLAME

Replace your old standing pilot with a safer, more efficient electronic ignition system.

In any fuel-burning heating equipment the heating process cannot take place without ignition of the fuel released by the burners. This may sound painfully obvious and somewhat simplistic, but over the years many different types of ignition systems using various technologies have been developed. Manufacturers have continually improved ignition systems to meet the following needs:

- Higher efficiencies mandated by government
- Conservation of fossil fuels
- Greater pilot-relighting convenience in remote locations
- Fewer annoying shutdowns caused by standing pilots blowing out
- Greater use of electronics to improve both efficiency and safety.

Ignition Systems

There are two basic types of ignition systems:

- Standing Pilot Ignition
- Electronic Ignition

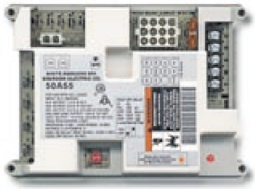
Standing Pilot Ignition (SPI)

The most widely used ignition system in the past was the SPI system. Many older units still in operation employ SPI. In SPI a pilot flame must always be available for burner ignition.

An important component of a typical SPI system is the thermocouple. A thermocouple is a device composed of two dissimilar metals that generates electricity when heated. The end of one piece of metal is placed in the pilot flame and the other end is kept cooler by combustion airflow. The temperature difference between the two ends causes a small DC voltage to be generated. This voltage is enough to allow the thermocouple to act as a safety device. As long as the hot junction is kept hot, sufficient current is generated to keep an electromagnetic relay open in the gas valve, allowing gas flow. If the thermocouple's hot junction cools due to flame loss, the thermocouple's electrical output drops. This, in turn, causes the electromagnet in the gas valve to be overcome by spring pressure, cutting off the gas supply. A manual reset button is used to start a thermocouple system. The main disadvantage of an SPI system is that it burns gas continuously at a rate of about 400 Btu/h, and only part of this heat is converted to useful energy.

Electronic Ignition

Standing Pilot Ignition systems using thermocouples must be manually reset each time the pilot goes out. This isn't always possible, so manufactures developed electronic systems to overcome this problem.



Control module for the White-Rodgers 50a55 Integrated Electronic Ignition System.

There are three types of electronic ignition systems: *intermittent-pilot ignition*, *direct-spark ignition*, and *hot-surface ignition*. Direct spark ignition and hot surface ignition are called *direct-ignition* systems because they do not need a pilot to ignite the main burner.

Intermittent-Pilot Ignition

In a typical intermittent-pilot ignition system a call for heat causes an electronic module to generate a spark that lights a pilot. The pilot, in turn, lights the burner. An ignitor sensor is used to create ignition and "prove" that flame has occurred. When the heating need is satisfied, the pilot goes out with the burner. There is no constantly burning pilot, as with an SPI system.

Direct-Ignition

Direct-ignition systems are standard features on many of today's heating systems. The primary difference between a direct-ignition system and intermittentignition systems is the absence of a pilot flame in any form.

There are two types of direct-ignition systems: *direct-spark ignition* (DSI) and *hot-surface ignition* (HSI). In direct-spark ignition, a spark lights the main burner directly. In hot-surface ignition, a hot element made of silicon carbide or silicon nitride is used to light the main burner.

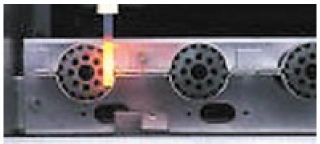
A typical direct-ignition system is composed of the following components:

- Electronic control module
- Ignitor
- Flame sensor
- Gas valve

Hot surface ignitor with silicon carbide element

Electronic ignition systems function as complete integrated systems, with adaptive control to adjust to ever-changing conditions.

Inputs to the control module are received from the thermostat, flame sensor and possibly an optional pressure switch. When the thermostat calls for heat the control module initiates the precise microprocessor-controlled timing of the ignitor and gas valve. The flame sensor provides proof of ignition. If no flame is detected, ignition is retried. The control module will stop the ignitor and initiate a safety lockout if no flame is detected within a preset amount of time. Control modules have automatic reset, internal and external system diagnostics, and an optional pre-purge period before ignition. In addition, they usually provide control of the circulation blower.



Correct positioning of the ignitor over the burner is essential for proper ignition.

Inexpensive upgrades

An electronic ignition system offers many benefits over older ignition systems using pilots:

- Eliminates the potential danger associated with open flame standing pilots
- Saves fuel; there is no pilot to consume fuel
- The control modules provide precise control, better system monitoring and greater safety capabilities.

With such benefits available at low cost, upgrading a heating system equipped with a standing pilot to electronic ignition makes good sense, especially in the face of sharply rising natural gas prices.

Hard Stuff

Silicon carbide (SiC) is an exceedingly hard, synthetically produced crystalline compound of silicon and carbon. It was discovered by American inventor Edward G. Acheson in 1891, while attempting to produce artificial diamonds. His early product initially was offered for the polishing of gems. The new compound soon became an important industrial abrasive.

Properties and applications

Until the invention of boron carbide in 1929, silicon carbide was the hardest synthetic material known. With a hardness approaching that of diamond, few materials are harder. In addition to hardness, silicon carbide crystals have fracture characteristics that make them extremely useful in grinding wheels and in abrasive paper and cloth products. Its high thermal conductivity, together with its high-temperature strength, low thermal expansion, and resistance to chemical reaction, makes silicon carbide valuable in the manufacture of high-temperature bricks and other refractories. It is also classed as a semiconductor, making SiC a promising substitute for traditional semiconductors such as silicon in high-temperature applications.

Methods of manufacture

To make silicon carbide a mixture of pure silica sand and carbon in the form of finely ground coke is built up around a carbon conductor within a brick electrical resistance-type furnace. Electric current is passed through the conductor, producing a chemical reaction in which the carbon in the coke and silicon in the sand combine to form SiC and carbon monoxide gas. The lump aggregate is crushed, ground, and screened into various sizes appropriate to the end use.

For special applications, silicon carbide is produced by a number of advanced processes. Reaction-bonded silicon carbide is produced by mixing SiC powder with powdered carbon and a plasticizer, forming the mixture into the desired shape, burning off the plasticizer, and then infusing the fired object with gaseous or molten silicon, which reacts with the carbon to form additional SiC. Wear-resistant layers of SiC can be formed by chemical vapour deposition, a process in which volatile compounds containing carbon and silicon are reacted at high temperatures in the presence of hydrogen. For advanced electronic applications, large single crystals of SiC can be grown from vapour and sliced into wafers much like silicon for fabrication into solid-state devices. For reinforcing metals or other ceramics, SiC fibers can be formed in a number of ways, including chemical vapour deposition and the firing of silicon-containing polymer fibers.