



Hot-wire system provides new ignition alternative.

by **steve hussell**

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Reliable ignition is the top priority for design engineers developing gas appliances, and is of utmost concern for other functions such as marketing, sales, quality assurance, and field service. Until recently, the designers of gas appliances had to choose between two on-demand ignition technologies: spark and hot surface. Now there is a third choice, a system that utilizes a low-voltage, resistive-wire coil that can be adapted to different burner systems. This adaptable technology has emerged as a strong alternative for designers seeking a higher level of ignition reliability.

To fully grasp the characteristics of the hot-wire ignition system, it's best to first review the traditionally used technologies that have preceded it. For many decades, gas appliance burners were lit by means of a standing pilot light flame. Recognizing that the always-on pilot flames wasted gas, the industry moved to on-demand ignition.

The patriarch of the on-demand realm is direct-spark ignition, easily recognizable by its telltale clicking sound. Spark ignition shares its roots with piezoelectric

push-button igniters, where the mechanical impact on piezoelectric materials can provide the necessary spark for ignition without the need for a connection to an electric power source. Piezoelectric igniters continue to be used on appliances such as gas barbeque grills.

The typical spark ignition system uses a transformer to generate a high voltage (15,000 V or more) spark to ground, which ignites gas flowing into the burner, usually at a spark electrode. The electrode designs are quite versatile and usually can be designed to a specific style of burner to optimize the point of ignition. The high-voltage spark works well to ignite a gas burner if the spark occurs at the proper electrode ignition point.

However, a number of problems can arise that can prevent the spark from reaching this ignition point, including contamination and moisture. The electrode can become covered with scale, dirt or other foreign material. The ground plane, which is necessary for sparking to occur, can also become compromised through corrosion, improper

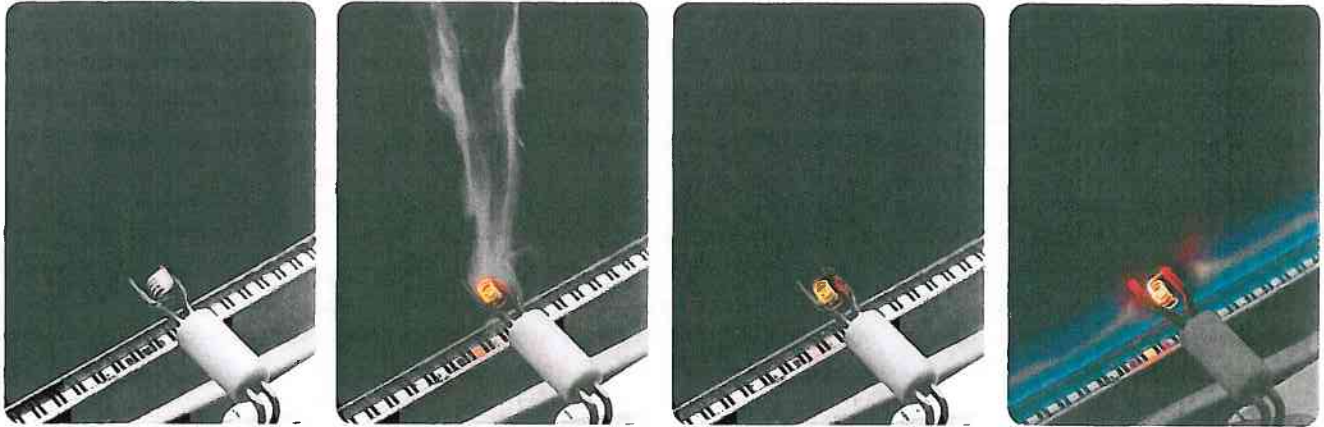


Fig. 1. Sequence of images demonstrates ability for hot-wire igniter to burn off contamination. Image at far left shows the element covered with ranch dressing, a thick liquid containing fats, water, sugars, and dairy products. The middle two photos occur during the energized phase. Smoke indicates contaminant burn-off and elimination. Photo on far right confirms successful burner ignition.

bonding, or high-moisture environments. When this happens, the high voltage will find the path of least resistance to ground. This occurs most frequently through the wire connecting the high-voltage source to the electrode at the ignition point. This wire, which is required to be high-voltage rated by CSA or UL, is difficult to find in a high-temperature rating, precluding reliable usage in high-temperature applications, such as low NOx burner systems. In addition, as the spark ignition system ages, ignition tends to become less and less reliable.

For European applications, the electromagnetic interference (EMI) generated by all high-voltage spark systems can be especially problematic for the design engineer. European standard EN 298 mandates system immunity to radiated EMI. This requirement can create many challenges for the product designer and require greater complexity for many ignition systems. Often, other electronic components in the appliance system can experience erratic operation due to EMI. This is a concern not only for OEMs exporting to the European market, as this require-

ment may also make its way to the North American market in the near future.

The next, and more recent stage in on-demand ignition history was the development of hot-surface ignition systems, which typically utilize a ceramic-based resistive element that heats up to ignition temperature when energized. One of the alluring attributes of traditional hot-surface systems is the amount of thermal mass that is available for natural gas ignition, which occurs at around 1,200 DegF, while propane ignites at about 900 DegF. Hot-surface technology provides a number of advantages over spark ignition, but also brings a new set of issues to the table that must be considered.

A traditional hot-surface system typically uses 24 V or 120 V applied to the ignition element, which achieves adequate ignition temperature in roughly 30 seconds or more. This is much slower than spark ignition, where ignition occurs almost immediately, and the lag is mostly due to the thermal mass of the igniter that must be heated. The longer heat-up times may not be fast enough for some

* ANSI Standard, ANSI Z21.20, Automatic Electrical Controls for Household and Similar Use - Part 2: Particular Requirements for Burner Ignition Systems and Components.

GAS TECHNOLOGY

gas appliance applications.

Some newer hot-surface ignition elements have faster heat-up times, but these typically do not have the large thermal mass inherent to the traditional hot-surface elements. In terms of physical design, a hot-surface ignition element is usually a standard, off-the-shelf component, requiring the designer to design the burner system around the standard element geometry.

Furthermore, because a hot-surface element is comprised of ceramic materials, the thermal cycling inherent to ignition systems will cause a change in physical and operating characteristics. This includes the possibility that the element will not achieve adequate ignition temperature over time. Thermal cycling also causes the ceramic element to become more brittle, increasing the potential for breakage and failure, often before the ANSI Z21.20* life requirement of 100,000 cycles for household appliances incorporating a safety control. Additionally, the hot-surface element does not tolerate contamination very well, forcing the designer to

fashion elaborate shielding schemes to protect the element. Water and dirt negatively affect the system and can cause failure catastrophically – the element can shatter.

The third, and newest, gas ignition technology can address some of the concerns with the other two and can provide an optimal technical solution for many gas burner ignition applications.

This hot-wire ignition system utilizes a small coil of resistive wire that operates off 3 V and usually achieves ignition temperature within three seconds. The hot-wire coil is not ceramic, but a coil of extremely durable metallic resistive wire that is welded between two electrodes. The key distinction of the system is its ability to provide an adequate thermal mass to achieve ignition, while optimizing design flexibility for a variety of applications. The hot wire is coiled to a diameter of about 1/8 in. and to a length of about 1/4 in., with wire gauge determined by the application. This geometry is uniform throughout all applications, as ignition is a function of location relative to the burner.

When energized, the coil achieves more than 2,000 DegF and is suitable for either natural gas or propane systems.

The wire used in the coil is not the common nickel-chrome, which is often used in toasters, nor is it any similar material that can become brittle. Instead, the wire is made from a unique, proprietary metallurgical alloy that is designed to be in the flame of the burner (where required by the application) and will maintain its ductile properties throughout its life. The hot-wire coil is CSA certified to 100,000 cycles and passes the ANSI Z21.20 ignition system requirement.

Hot-wire design versatility is similar to that of spark electrodes in that it can be retrofitted to existing platforms with little burner system redesign. Unlike spark ignition, however, the low-voltage characteristics of the hot-wire system eliminate concerns about radiated EMI, or a high-voltage spark not finding the correct point of ignition. In addition, designers need not worry about finding a high-voltage/high-temperature wire that will degrade over

GAS TECHNOLOGY

time and cause arcing and sparking everywhere but where it is supposed to happen: at the burner. Low-voltage/high-temperature wire, which is easier to apply, works well with the hot-wire system.

The hot-wire system tolerates contamination well by easily burning off the contaminants. Evidence for this can be found in the gas barbecue grill industry, where the hot-wire system is already being used and deftly handling contaminants such as animal fats, dirt, BBQ sauce, water, marinades, and spider webs. The ignition element powers through the contamination and ignites the burner every time – on both propane and natural gases – eliminating the need for designers to construct igniter-shielding schemes. This capacity for burning off contaminants and still igniting the burner can be observed in the sequential images in *Fig. 1*.

The design flexibility does not end with the physical geometry of the element. The hot-wire

ignition system is available with 10,000-cycle and 100,000-cycle elements paired with systems using a portable battery, or 12-V, 24-V, 120-V or 240-V input integrated controls. Higher life systems may also be available as required by the design or application.

The application flexibility of the hot-wire ignition system makes it an excellent candidate for a variety of appliance applications. The ability to burn off contaminants makes it ideal for commercial foodservice equipment that must operate in an environment where contamination is omnipresent. The rapid time to ignition also opens up new options for cooktop applications where consumers expect flame to appear quickly. Cooking applications also can benefit from the solid ignition characteristics of the system, making the application of combination controls and relight systems less problematic.

For appliances that will operate in humid or wet zones, such as certain types of space-

and water-heating equipment or outdoor appliances, the hot-wire igniter eliminates concerns over moisture affecting ignition, because any moisture will be boiled off instantly. The hot-wire igniter is also a fit for high-heat appliances, like low-NOx water heaters, where its low-voltage operation makes it unnecessary for design engineers to search for high-heat/high-voltage wire.

The hot-wire ignition system won't always be the optimal choice for every application, as each ignition system has its own set of considerations. Comparisons between the three systems can help appliance designers make the best decision for their application. (*See Table 1.*) However, having a third choice in the world of ignition increases the design flexibility for designers of gas appliances who require durability and reliability from their gas-ignition systems. ■

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Attribute	Hot-Wire	Spark	Hot-Surface
Ignition Speed	Fast (3 seconds)	Fast (almost immediate)	Slow (30 seconds +)
Mechanical Durability	Excellent	Excellent	Poor
Moisture and Contaminant Resistance	Very Good	Poor	Poor
Corrosion Contamination	Very Good	Poor	Good
Time Effects	Use causes a protective oxidation layer on the coil	Corrosion/scale and loss of ground	Thermal cycling causes brittleness and change in resistance
Effects of Voltage Variation	No effect – voltage supply is regulated	Can cause change in spark rate	Low voltage causes longer warm-up times; High voltage causes premature element failure
Electromagnetic Interference (EMI)	None	Large effect – special control designs needed	Almost None
Geometry/construction	Very flexible, no need for shielding or protection	Flexible, but needs good path to ground	Not flexible, and requires shielding and protection from contaminants
Wiring and Connectivity	Low-voltage wire can be used	High-voltage wire required	Normal wiring

Table 1. Comparison of three different ignition systems highlights advantages and disadvantages of each. *Source: Channel Products.*

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