Introduction

As with any technology, in the electric heating sector the choice of one system over another is driven by its space application and its specialized electric heat requirements. Both open coil and metal sheath elements, also known as tubular heating elements, both with and without fins, utilize a helical coil resistance wire typically composed of 80% nickel and 20% chromium, sometimes referred to as nichrome wire.

These three technologies are currently available on the market, each with its own uses and characteristics. The design features of open coil heating elements provide numerous benefits and important competitive advantages over their tubular counterparts that make them a preferred choice in the heating industry with heating solutions designed to optimize manufacturing efficiency and comfort. These benefits include efficiency, performance, extended product life, and economic savings. In the light of rising energy costs and increasing eco-consciousness by manufacturers and consumers alike, open coil elements meet the growing need for technologies that combine thermal efficiencies, reduce energy consumption, and meet budgetary requirements.

Applications

In the industrial setting, the primary use for open coil elements is in the duct heater, custom duct heater and wall fan driven heater market. In Canada and the United States, the heating industry uses metal sheathed (with or without fins) electrical resistance heaters to a great extent, consisting of a steel tube with either a steel fin or aluminum crimp fin attached. While the metal sheath technology is in widespread use, in most settings this practice is more a function of habit than efficiency.

Design properties and advantages of open coil elements

Rapid response time: Desired heat is achieved faster with open-coil than with metal sheath elements. Direct heating element contact with the air flow provides efficient heat transfer. Fast heat-up allows for greater efficiency, representing a major advantage in industrial, commercial, institutiuonal and residential settings: On and off modes are instantaneous, thereby eliminating waiting transition time which reduces labour expense.

Less post-usage waste generated that can be captured in the cabinet of the space heater. No heat storage occurs compared with metal sheaths which, due to their enclosed design, provide less clearance leading to heat build-up. With less air circulation, heat is maintained for longer periods. With the addition of fins, even more thermal inertia has to dissipate. If there is a lot of thermal storage when the unit turn off, higher than normal temperatures are being passed on to the fan delay, the thermostat, or whatever is above or near the unit. As a result, radiant and convected heat remain inside the box that is not being dissipated. This residual heat plays a role in the life of the components, potentially overheating the unit's motor or controls, leading to degradation. Open coil heater elements may prevent heat sensitive materials from breaking down.

High heat resistance with reduced risk of over-heating: A key benefit of the open coil design is large electrical clearances between the coil and the frame, allowing more free air to circulate, enabling the coils to withstand much higher temperatures than enclosed elements, with a high melting point of roughly 2550ºF (1400ºC).

Heating Technology	**Operating Temperature**
Open coil Grade A	2101°F potential, normal <500F
Tubular Coil	650-760°C depending on the coil alloy

Broader applications where space limitations are a factor: Open coil is less limited in its applications, provides more flexibility, and is more customizable than enclosed sheath and finned elements. For example, open coil eliminates the need for an oversized motor. As metal sheath units continue to be exposed to heat when they're turned off, their motor needs to be protected, requiring a heavier insulation class for wiring.

Broader applications and greater flexibility: More customizable than enclosed sheath and finned tube design. Open coil heaters have a lower pressure drop as a result of the amount of open space across the heater. With potentially reduced fan motor horsepower, these heaters can be retrofit into existing systems using the same fan motor.

Product safety, durability and longevity: Some experts consider tubular heating elements safer, particularly in an industrial setting where a lot of shaking and rattling takes place. However, open coil elements typically have a product life of 20 to 30 years, as opposed to the alternative which generally last 12 to 15 years.

Cost advantage: Open coil elements require less raw material to produce, are smaller, therefore they are less costly to manufacture and operate. What's more, replacement parts are inexpensive.

Additional advantages of open coil heating elements:

- No fan delays: Many enclosed units use a fan delay to dissipate the heat, but even with a switch on the wall to turn the heater off, the fan delay doesn't have any impact
- Less maintenance

The superiority of open coil heating elements compared to enclosed sheath and finned tubular technologies in functionality, design properties and product life make it a practical choice in duct heaters and wall heaters. In fact, a well-known U.S. element manufacturer has stated that for applications where there is no water spray and conductive particles do not contaminate the air, open coil construction is best.