TUTCO HEATING SOLUTIONS GROUP

TUTCONNECT
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TUTCO FARNAM | TUTCO SUREHEAT | TUTCO CONDUCTIVE

Electric heaters used in thermal oxidizers.

A thermal oxidizer, also known as a thermal incinerator or thermal oxidiser, serves as a pivotal unit for air pollution control within numerous manufacturing facilities. Its core function involves breaking down hazardous gases at elevated temperatures, subsequently releasing them into the atmosphere.

Thermal oxidizers find widespread use in eliminating hazardous air pollutants (HAPs) and volatile organic compounds (VOCs) from industrial air streams. These pollutants are primarily hydrocarbon-based and are chemically oxidized to form CO_2 and H_2O through thermal combustion. The efficiency of thermal oxidizer design hinges on three key factors: temperature, residence time, and turbulence. The temperature must be sufficiently high to ignite the waste gas. In pursuit of near-complete destruction of hazardous gases, most fundamental oxidizers operate at significantly elevated temperature thresholds. Unfortunately, this often translates to unnecessary energy consumption, leading to unnecessary waste.

At TUTCO Farnam, a noticeable transition is unfolding from direct-fired natural gas to electric heat, driven by the dual objectives of enhancing control and reducing carbon footprints. Our Flow Torch™ Family of Products emerges as the optimal solution for this transformative endeavor.

The Flow Torch™ products are uniquely suited for elevating industrial heating endeavors involving substantial airflows. These process heaters present a suite of distinct advantages that propel them to the forefront of the field. With their low-profile design, Flow Torch heaters minimize airflow obstruction, ensuring minimal pressure drop and making them an optimal choice for systems reliant on low-pressure blowers. Embracing high-volume airflows, these heaters efficiently heat air to temperatures as high as 482°C (900°F). The versatility of these heaters extends to their seamless compatibility with suitable flexible duct or pipe fittings, facilitating easy integration a variety of applications.

To learn more about energy transition, click here.

Journey through temperature scales: from Fahrenheit to Kelvin and beyond.

by Ian Renwick

Measure temperature and the use of temperature scales have played a pivotal role in human history, aiding in scientific discoveries, technological advancements, and everyday life. Over the centuries, various temperature scales have been developed, each with its unique origin and applications. In this article, we will explore four different temperature scales, Fahrenheit, Celsius, Kelvin, and Rankine, tracing their historical origins and delving into their modern day uses.

The Fahrenheit Scale (°F)

The Fahrenheit scale was created by Daniel Gabriel Fahrenheit in 1724. He was Polish, of German decent. At the age of 15 he moved to the Netherlands where he lived the rest of his life. His scale is one of the oldest temperature scales still in use today. Fahrenheit initially based his scale on the temperature of a brine of ice, water, and salt. He assigned 0°F to the lowest temperature he could achieve using this mixture, and 92°F or 96°F to the average human body temperature, depending on which historical source you choose. The scale was adjusted slightly so that there would be 180 degrees between the freezing and boiling points of water. That explains why we see them as such unusual numbers as 32°F and 212°F.

The Fahrenheit scale was the common temperature scale in most English speaking countries until the 1960s at which time it was replaced with the Celsius scale over a period of about a decade. The scale remains popular in the United States where it has been used for weather measurements for many years, as well as for cooking and baking measurements. It is preferred in the United States primarily for historical reasons and familiarity. It might be seen in the UK where degrees Fahrenheit might appear alongside degrees Celsius on the news or in newspapers, regarding weather temperatures. The only other countries that use the Fahrenheit scale on a regular basis are the Cayman Islands and Liberia. Some scientific research fields, such as chemistry and engineering, continue to use the Fahrenheit scale for specific applications.

The Celsius Scale (°C)

The Celsius scale was developed by Swedish astronomer Anders Celsius in 1742. Celsius originally defined 0°C as the boiling point of water and 100°C as the freezing point of water, which is backwards from today's conversion. This scale was later inverted to its current form by either the Carl Linnaeus (Swedish, in 1745) or Jean-Pierre Christin (French, in 1777), depending on your source of history. With that inversion in place the scale was called the "forward Celsius scale" for a while before the 'forward' was dropped.

It should be noted that craftsman Pierre Casati, under the direction of Jean-Pierre Christin, built the first mercury filled thermometer. It provided much better accuracy and repeatability than the alcohol based thermometer that was in use until then.

Outside of Sweden, it was called the Centigrade scale (from the Latin centum, meaning 100, and gradus, meaning steps), but that had its own problems. In French, Centigrade was already a word that meant one hundredth of a gradient, which is an angular measurement. The name Centesimal degree was tried for a while but that caused problems in the French and Spanish languages, meaning one hundredth of a right angle. In 1948 the world changed the name to Celsius in honor of its inventor. In 1972, however, Australia was still using Centigrade in their televised weather forecasts. It wasn't until February of 1985 that it was mandated that all measurements must be given in degrees Celsius. The Celsius scale gained widespread adoption in Europe and most of the world. Its simplicity and alignment with the freezing and boiling points of water making it ideal for most scientific purposes. When it comes to standardization, Celsius has been through a heck of a run.

The Kelvin Scale (K)

The Kelvin scale, named after the Scottish physicist Lord Kelvin (William Thomson), was developed in the mid-19th century. Unlike the Fahrenheit and Celsius scales, the Kelvin scale is an absolute temperature scale, starting from absolute zero or 0 K (-273.15°C or -459.67°F). Absolute zero is the theoretical temperature at which all molecular movement stops or a system has zero thermal energy. There is no temperature lower than 0 K, meaning there are no negative numbers on the Kelvin scale.

The Kelvin scale revolutionized the study of heat. It provided a fundamental framework for understanding the behavior of gases and the laws of thermodynamics. The scale is primarily used in scientific and engineering disciplines, such as physics, chemistry, and engineering, where reference to an absolute zero value is critical. It is an essential scale for research involving extreme temperatures, such as in cryogenics and (strangely enough) high-temperature physics.

The Kelvin scale is one of the few temperature scales that isn't marked in degrees. There are no degrees Kelvin or °K. It's not 293 degrees Kelvin or 293 °K, but simply 293 K or 293 Kelvin. 293 Kelvins (the common plural) is acceptable too, though not preferred.

The Kelvin scale and Celsius scale are related. The size of a step in each scale is exactly the same. If it's 20°C (293.15 K) outside, and the temperature goes down by 1°C, the temperature in Kelvin goes down by 1 Kelvin to 292.15 K. That makes conversion between the two temperature scales very easy. K = °C + 273.15 and °C = K-273.15.

Some interesting information about absolute zero and how absolute it really is….The average temperature of the universe (remembering that it's mostly empty space) is 2.3 Kelvin, with areas like the Boomerang Nebula in the Centaurus constellation at a chillier 1 Kelvin. That's about as cold is at gets.

But not quite. In August of 2021, the lowest temperature ever achieved in a laboratory was 38 picokelvins or 38 trillionths of a Kelvin (0.000000000038 K) using a cloud of rubidium atoms, a magnetic field, a vacuum, and putting the equipment into freefall to eliminate the effect of gravity. Now that's COLD. The temperature was achieved for about 2 seconds.

(Continued on next page)

The Rankine Scale (°R)

The Rankine scale is named after the Scottish engineer and physicist William John Macquorn Rankine. It is another absolute temperature scale developed in the 19th century though it is the rarest of the four scales discussed here. It is similar to the Fahrenheit scale but starts from absolute zero, meaning that a step in temperature in the Rankine Scale is the same size as a step in temperature in the Fahrenheit scale. Just as the Kelvin scale has no negative numbers, neither does the Rankine scale because its 0°R is absolute zero.

The Rankine scale is used in engineering applications, particularly in the United States and sometimes the UK. Much like Kelvin, it provides a convenient absolute temperature scale for calculations involving gases and thermodynamics. It is used where calculations are performed using imperial units instead of metric units (as with the Kelvin scale). Some specific engineering disciplines are thermodynamics, fluid mechanics, and refrigeration. Since it is a temperature scale based on absolute zero, the National Institute of Standards and Technology (NIST) advises against using the degree symbol (°) when citing Rankine temperatures, though that is often not the case and degrees (°R) are used. I

Here's a bonus temperature scale; the Réaumur scale (°Ré)

The Réaumur temperature scale, denoted as °Ré, is a historical temperature scale named after René-Antoine Ferchault de Réaumur, a French scientist who introduced it in 1730. The Réaumur scale was widely used in Europe during the 18th and 19th centuries, particularly in France, where it was developed. Unlike modern temperature scales like Celsius and Fahrenheit, the Réaumur scale had specific applications. More on that later. His scale was based on the freezing and boiling points of water set at 0 °Ré and 80° Ré, respectively. The scale divided this range into 80 equal parts. Réaumur thermometer was alcohol based (look at the year, it was 1730!), so it was not as accurate as today's thermometers.

The Réaumur scale found applications primarily in the cheese industry. Cheese production is highly sensitive to temperature control and the Réaumur scale provided a convenient reference for cheese makers at the time. Specific cheeses like Camembert and Brie require precise temperature and the Réaumur thermometer was used to maintain the appropriate conditions. At the time, the Réaumur scale was revolutionary.

Its limitations became apparent, though, as scientific understanding and temperature measurement technology advanced. The Réaumur temperature scale did not account for temperature behavior at extreme values (being alcohol based), and over time it lacked universality, making it less suitable for modern, globalized industries. As temperature measurement standards evolved, it was largely replaced by the Celsius scale, which offered greater precision and general acceptance. While the Réaumur scale is no longer the primary choice in cheese production, it is rumored to be found in use by a few cheesemakers in a few remote valleys in Switzerland and Italy. It remains a part of the historical heritage of temperature measurement.

While doing research for this document, the author discovered 73 different temperature scales that had been developed over the years, the vast majority of which are now obsolete. A scale called the Wedgwood scale (°W), for example, was used for temperatures above the boiling point of mercury (673°F). It's purpose was in the fields of pottery, glass making and metallurgy where the scale would be used to measure the temperature of kilns. The only problem was, they had the temperature of the boiling point of mercury incorrect (by a lot!), so their scale was useless. It fell out of favor very quickly!

A most peculiar temperature scale that still exists today, but is mostly unused, is the Planck scale, named after the German physicists Max Planck. It ranges from 0 to 1 Plancks, and that's it. There's nothing outside that range. 0 is absolute zero and 1 is the hottest temperature ever achievable in the universe, believed to be ≈2.555 hundred thousand trillion trillion trillion °F.

Temperature scales have evolved over centuries, with each having their unique historical origins and applications. While Fahrenheit, Celsius, Kelvin, and Rankine serve different purposes and are used in various fields, they all contribute to our understanding of temperature and its impact on the world around us. Whether measuring the weather, conducting scientific research, or designing engineering systems, these temperature scales continue to play a crucial role in our lives.

MORE FROM ASK IAN

That's some quality H_2O – a feel good story.

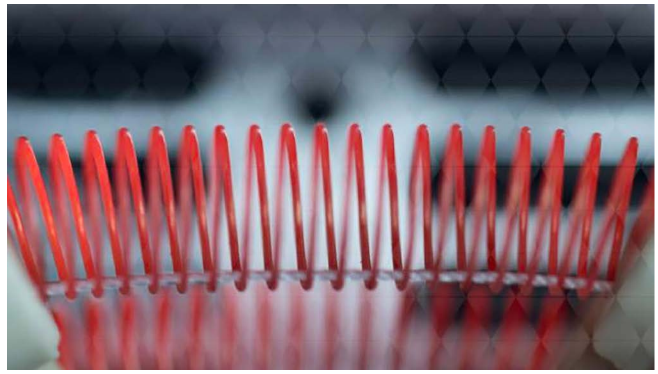
WAPIs for the World, a non-profit company, approached us seeking cartridge heaters for their manufacturing process, which involved building a water purification capsule. This capsule consists of a specially formulated wax enclosed in a tube, designed to melt at a specific temperature, thereby purifying water by eliminating harmful substances. The end-use product is not sold but rather donated and distributed to missionaries, traveling medical personnel, and people living in areas with inadequate access to clean drinking water. The capsules expedite the purification process, consume less fuel, and can be reused multiple times.

TUTCO cartridge heaters can be modified to meet the demands of special applications like this one. Our engineers utilized a variety of alternative features and options to customize the heater to meet the needs of this unique application. We not only developed a custom cartridge heater to meet the company's specific requirements but also decided to donate the heaters to support the company's noble mission. To learn more about WAPI's for the World and this cause, visit https://www.wapisfortheworld.com/wapis-are-unique.html

MORE THINKING OUTSIDE THE BOX

TUTCO Farnam

Custom Solutions



When it comes to custom heating solutions, TUTCO Farnam stands at the forefront of design and engineering excellence. Our commitment to precision and innovation sets us apart in the dynamic world of manufacturing and product design.

Customized solutions for tight schedules

We understand the challenges of demanding production schedules, and our capabilities are finely tuned to meet them head-on. With over 2,000 custom heater designs in our repertoire, chances are we've already tackled projects similar to yours. We're not just manufacturers; we're problem solvers. Our engineers scrutinize every opportunity, listening to your needs and applying their expertise to design solutions that work better for your business.

Collaboration with OEMs for success

Whether you're a small shop or a Fortune 500 company, our manufacturing and assembly process seamlessly scales to your required capacity. We offer add-ons that simplify assembly, reduce costs, and speed up product delivery. From small components to larger assemblies, we've got you covered.

Effortless retrofits and scalability

If you're in need of a new heater design or retrofitting existing equipment, TUTCO Farnam has the expertise to make it happen. We've successfully executed hundreds of retrofits, each tailored to unique requirements. Whether you're dealing with outdated technology or unreliable service providers, we have the solutions to optimize your heating needs.

Engineering service and support

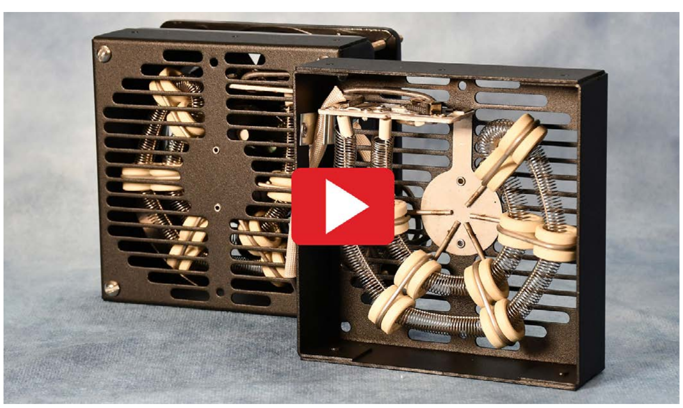
Our commitment to your success extends to engineering service and support, provided on an application-by-application basis. Leveraging our extensive experience in heat applications, we bring a wealth of knowledge to the table. While we generally won't design your entire process, we're more than happy to provide invaluable assistance, ensuring your heating solutions align perfectly with your objectives.

TUTCO Farnam is your trusted partner for custom heating solutions that excel in design, functionality, and scalability. Contact us today, and let's embark on a journey of innovation and efficiency tailored specifically to your needs. Your success is our priority.

LEARN MORE

Feature Video

Axial Fan Heaters



Axial Fan Heaters are one of TUTCO Farnam's most widely produced family of heaters. These versatile heaters are used in a variety of applications and industries, serving essential functions like drying, curing, and warming. Our Axial Fan Heaters are available in three sizes: a compact 2.4-inch model, a 3.1-inch model, and a larger 4.7-inch version. Installation is easy, as these heaters mount directly onto square axial fans, utilizing the same mounting holes as a protective guard for both the heaters and fans.

WATCH THE VIDEO

USE OUR ONLINE TOOL TO BUILD YOUR AXIAL HEATER