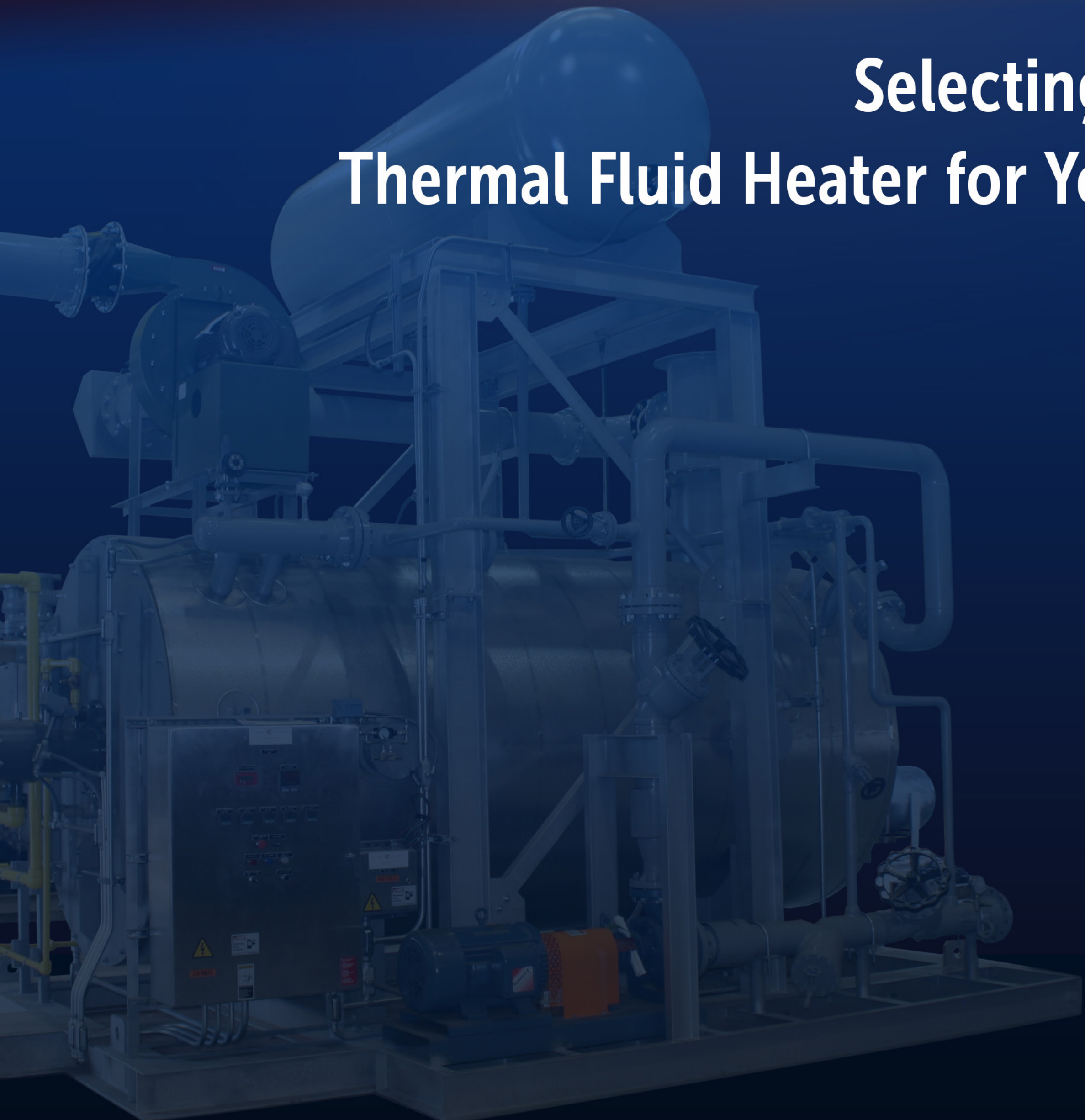
SIGMA THERMAL

Selecting the Right Thermal Fluid Heater for Your Process



There are many heater manufacturers out there, and what can seem like an endless array of heater design options. Each of these myriad designs was conceived with a particular application, environment, or budget in mind. When selecting a thermal fluid heater, one must first understand the application, installation requirements and space restrictions. Let's review a few important factors to consider when comparing heater types and heater options.

When choosing a thermal fluid heater, one must first understand the application, installation requirements and space restrictions.

By the Process Engineering Group, Sigma Thermal

Cost is always a factor for any purchase; however the true cost of a heater is more complex than just the initial purchase price. The tradeoff between capital costs, operating cost, and long term maintenance costs must be considered in a proper evaluation. A well designed and efficient engineered heating system may cost you more initially than an 'off-the-shelf' heater or a heater with a lower efficiency, but the less expensive options can become far more expensive than you think. Once operating costs such as fuel costs, thermal fluid replacement, parts and maintenance begin to accumulate over the first years of use, your initial savings may not seem so significant.

Fuel efficiency requirements vary depending on fuel type, fuel availability, application, run time, etc... A simple process requiring low supply temperatures and an inexpensive thermal fluid may not demand a customized highly efficient system, in which case a less expensive heater option may be ideal. In direct contrast, a more complex or demanding application requiring high temperatures and a more expensive fluid will certainly see the benefits of a properly designed engineered heating system. The difference in cost between a system designed specifically for an application with higher efficiencies, higher heating temperatures, and /or heavy duty operation can typically be made up in short payback periods when looking at the total operating costs of the equipment.

Note: Pay close attention to the method of fuel efficiency calculation used by different vendors. These numbers can be skewed based on the chosen method of calculation, and seemingly small differences in efficiency can actually represent large differences in operating cost. Compare carefully and don't be afraid to ask your potential vendors to explain their efficiency claims, support their design calculations, and guarantee the stated efficiency at your operating conditions.

The single helical coil is simple to design and fabricate, and it can be built in horizontal orvertical configurations.

Design Parameters to Consider

Surface area of the heater coil (heat transfer surface) is crucial. A generous surface area, whether the heater is fired or electric, is the starting point for a sound heater design. Inadequate surface area in your heater coil or heating element will limit your efficiency and lead to a higher film temperature. This ultimately means thermally degrading your expensive heat transfer fluid. Running poor quality oil in your system will shorten coil life, coke heating elements and decreased heater efficiency over time. Of course the primary benefit to a reduced coil or element surface is less cost. Be sure to carefully consider coil and element surface area and relative heat flux rates when comparing heater options. This is an important area where initial savings can result in massive costs down the road.

Fluid velocity and pressure drop are inherently related and vital in engineering an appropriate heater for any application. In general, a higher fluid velocity means better heat transfer and lower film temperatures. This comes with a tradeoff though, as pressure drop increases with fluid velocity. Higher pressure drop means more pump horsepower, which indirectly increases your operating costs due to the increase in power consumption. You can have one heater design that has very low pressure drop resulting in low fluid velocities that yield higher film temperatures, while another heater design is masking a low coil surface area with extremely high velocities resulting in reasonable film temperatures, but very high pressure drop. This design parameter is just one piece to the puzzle. In order to compare more appropriately, be sure to obtain fluid velocities, pressure drops, film temperatures, and heat flux rates. Be sure to discuss and understand what pressure drops your heat user system may allow in addition to what minimum and maximum flows are safe for your heater.

Combustion chamber size and flame impingement are also critical to heater design. The biggest potential for damaging your coil and your fluid lies within the radiant zone of your heater. A well sized combustion chamber will ensure proper heat release within the radiant zone, but it also ensures that there is no potential for flame impingement on the coil. Flame impingement causes local hot spots on a heater coil which result in localized fluid degradation and potentially even coil damage. Ask your potential suppliers to discuss their combustion chamber size as it relates to the burner flame size and its proximity to the heater coil.

The design of the double helical coil thermal fluid heater incorporates two concentric helical coils, one inside of the other. This allows for three passes of flue gases.

Heater Design Types

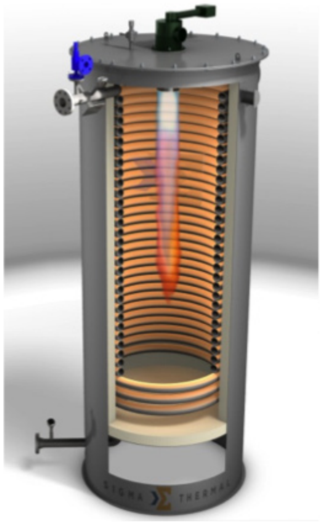
Armed with a basic understanding of what is important to your application and/or facility, you now need to select the right heater design. Unfortunately it is not always obvious to the casual buyer which type is best for their application. Each manufacturer will tout the merits of their specific designs, and you need to be able to understand how those differences relate to your needs. We will try to summarize several types and discuss the pros and cons of each relative to performance, cost, and footprint.

Single Helical Coil Thermal Fluid Heater

• The single coil is a simple cost effective design. Utilizing a single helical coil, this design allows for two passes of flue gas along the heat transfer surface. The single helical coil is very simple to design and fabricate, and can be built in horizontal or vertical configurations

• Generally speaking, this heater style will have lower efficiencies than other heater with more available surface area. In some cases a manufacturer will require an additional waste heat recovery unit to achieve the efficiencies capable in other base heater designs.

• High exhaust temperatures at the first turn require internal insulation to protect the heater shell from extreme temperatures. This internal insulation is subject to wear and could need to be replaced over time.



Single Helical Coil Heater

Double Helical Coil Thermal Fluid Heater

• This design incorporates two concentric helical coils, one inside of the other. This allows for three passes of flue gasses, and this additional pass of flue gas (compared with a single coil heater) allows for additional heat transfer surface for a comparably sized unit. The additional surface area typically makes these heaters more efficient than a comparable single coil design.

• The double helical coil is typically more expensive than a single helical coil design. It can be configured in either a horizontal or vertical arrangement.

• A dual helical coil allows for a large heat duty in a small overall footprint. If size is an issue for your facility this may very well be a deciding factor. Larger duty requirements may dictate that a dual helical design be used, as it is difficult to build a shippable single coil unit above 25MM Btu/hr.

Double Helical Coil Heater

• The flue gasses are relatively cool when first contacting the heater shell, eliminating the need for most internal shell insulation. This minimizes long term insulation maintenance and/or replacement.

Heater Design Types (cont.)

Radiant-Convective Thermal Fluid Heater


Cabin Style Radiant-Convective Heater

• Worldwide, the traditional radiant-convective style heater is the most well-known and commonly used style of direct fired heater. These heaters are physically larger than their helical coil counterparts, utilizing both a bare tube radiant zone in combination with a separate bare / finned convection zone.

• Radiant-convective style heaters are more complicated to design and build, and are therefore typically more expensive than other heater types.

• A wide range of design capabilities allow for flexible performance and configuration options. Efficiencies of a new heater can also vary from 70 – 90%, and footprints can be small and tall with vertical-cylindrical heaters, or shorter and wide with cabin style heaters.

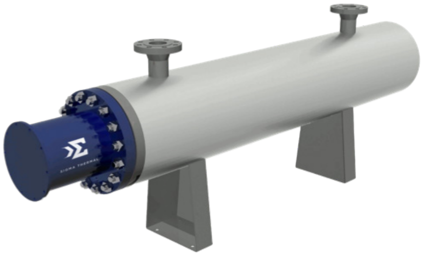
• Several manufactures have their own proprietary design for this radiant convective style of heater, but the most widely accepted standard is API 560. API 560 heaters have been used for many years in the oil & gas industry to heat petroleum streams in various stages of production. This specification is often applied to thermal fluid systems, which in almost all cases is unnecessary. This specification is extremely conservative in nature, and is really only necessary when heating a non-homogenous petrochemical stream with varying thermophysical properties. When applied to a thermal fluid, which is an engineered fluid with well-known and homogenous properties, it adds unnecessary size, cost and complexity.

Heater Design Types (cont.)

In-Line Electric Circulation Heater

- This design uses an electric flanged immersion heater with a shell to allow flow directly over the heating elements. Since there is no combustion, virtually 100% of the energy goes into the media being heated.

- Can be mounted in horizontal or vertical position for space savings.



- Typically a smaller footprint because of smaller duties. Mounting options include saddles, skirts, legs or mounting blocks.

- Vessel can be ASME Section VIII Div 1. Certified and "U" stamped.

- Simple design and lower maintenance that fired heaters.

- Can be installed in hazardous areas

For questions about this article or its contents, contact Sigma Thermal at sales@sigmathermal.com or 770-427-5770.