API VS MULTI-PASS NON-API THERMAL FLUID HEATERS

OVERVIEW

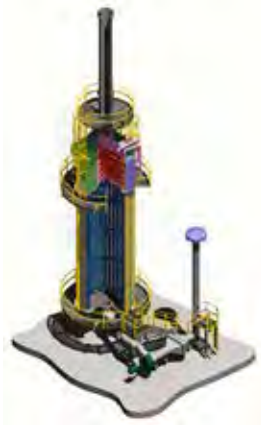
Struthers Wells™, a TEi line of products, has been designing and supplying fired heaters and thermal fluid systems for more than 70 years. Their design and manufacturing expertise competitively supplies all types of fired heaters from small vertical cylindrical furnaces to complex specialty chemical, petrochemical and refinery heaters.

CONFIGURATIONS COMPARISON

Fired heaters come in a variety of configurations. The information in this overview is intended to cover some of the differences between a multi-pass packaged thermal fluid heater and a thermal fluid heater designed to API-560. It should be noted that we have limited this comparison to the cylindrical arrangement but the API standard allows for many different configurations including cylindrical, box/cabin, each with multiple allowable coil configurations.

API THERMAL FLUID HEATER

API style heaters have two main heat transfer regions. The first is the radiant section, where radiation is the primary heat transfer mode. The second is the convection section, where cross-flow forced convection is the primary heat transfer mode. The convection section improves fuel efficiency. The heater can be either horizontal or vertical with serpentine or helical coils.



API Thermal Fluid Heater

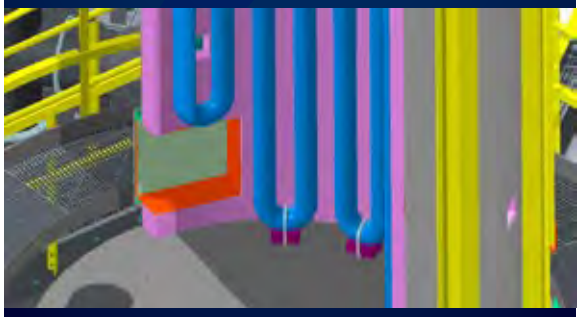
Non-API Thermal Fluid Heater

MULTI-PASS NON-API THERMAL FLUID HEATERS

Non-API heaters incorporate both radiant and convective heat transfer on the same coils. These heaters force flue gas to flow across the outside of the coil, such that the coil experiences radiant transfer on the flame side, and convective on the shade side. The heater can be vertical, either up or down fired, or horizontal. (Down-fired shown)

MAINTENANCE COMPARISON

- API style heaters are more easily maintained than multi-pass non-API heaters
- Serpentine coils allow access to the unit for inspection and servicing
- Individual tubes can be replaced if required in a serpentine coil. Each pipe is individually supported and does not impact adjacent tubes during replacement
- Helical coils do not have easy access for inspection. This is particularly true of three-pass heaters with concentric coils
- Individual tube replacement in a helical coil is not typically possible. Full coil replacement may be necessary and requires significant disassembly of the unit to achieve

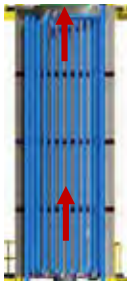


Door and Access Lane through Serpentine Coil

DESIGN COMPARISON

FLUE GAS FLOW COMPARISON

API Heaters

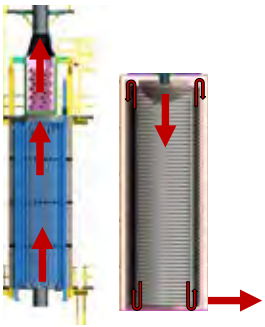


- Firebox is designed with burner(s) on one end and the flue gas exit on the other
- Primary flue gas flow is straight through the heater
- Recirculation currents form along the wall, mixing the flue gas ("Well-Stirred Box"), and assists with stabilizing the flame in the center of the heater

Helical Heaters

- Design can be either two-pass (single coil) or three-pass (concentric coils as shown)
- Flue gas flow is forced to double back at the end of each coil
- Flue gas exit can be on burner end, or opposite, depending on number of passes
- Three-pass heaters are typically smaller than two-pass heaters and API style heaters, but have high radiant flux rates due to the reduced radiant surface area
  - Flux in these heaters can be 2-3x that in an equivalent API design, and can result in high film temperatures
  - High film temperatures can lead to increased fluid degradation, impacting the heaters as well as upstream and downstream equipment

FLUE GAS PATH COMPARISON



- API style heaters have inline flow
- Limits potential of pockets of stagnant air. Easy to purge
- Stack mounts on top of heater, low footprint for complete system
- Helical heaters have complex flow path
- Potential for stagnant pockets. Increases complexity of purge during start up
- Flue gas typically leaves the side of the unit, requiring additional space for air preheat and stack
- Overall stack length may be higher due to starting at grade
- Down-fired heaters must overcome natural propagation of flames and flue gas

SIZE AND CAPACITY COMPARISON

- Serpentine coils of API heaters are much more flexible in terms of overall heater size
  - Straight lengths can be up to 60 feet
  - No limitation on heater diameter. Coils can be installed in the field for heaters too large to ship as a single section
  - Cabin style heaters available for very large units
- Helical coils are limited in size by a number of factors
  - Achievable bend radius of the coil
  - Achievable pipe size/thickness for bending
  - Coil must be able to ship as a single item. This prohibits medium and large capacity heaters
- API style heaters are custom designed for each application. Helical heaters are typically "off the shelf" items sized to cover a range of duties

DRAINABILITY COMPARISON

- Helical coils are inherently drainable. For services where the unit will be routinely drained, or in some cycling applications this can be a benefit

  Note: API heaters can utilize helical coils when appropriate in the radiant section

- Serpentine coils can be made drainable by addition of drain lines on the low point of each elbow. Drains are located below the heater floor and would not be affected by radiant heat

VAPORIZING DUTY COMPARISON

- Vaporization within a fired heater can be either internal (happening within the coils as they are heated) or external (flashing at a point outside the heater coils)
- Serpentine coils in an API style heater can support both forms of vaporization, with internal being the preference
- Helical coils are recommended only for external vaporization. Due to the flow of the fluid, internal vaporization can result in separation due to centrifugal forces, resulting in dry areas on the radiant side of the coil. These areas are then prone to overheat and potential coil damage

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