ENGINEERING WHITE PAPER

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Heat Exchangers

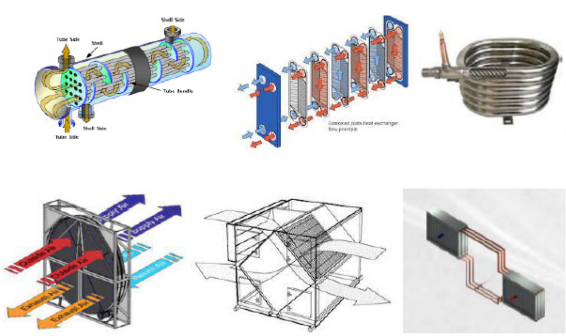
The HVAC industry is inundated with heat transfer equipment or heat exchangers. This white paper is designed to make you aware of the most common you will find in our industry. This is not a compressive list but more of a primer to get you thinking big picture.

Heat Exchangers

To move heat from one fluid (gas or liquid) to another without mixing them, we use a heat exchanger. All heat exchangers have flow passages for the two fluids and a solid barrier separating them. The barrier must be thermally conductive to allow heat to move between the two fluids.

There are many types of heat exchangers, but I'll name a few for example:

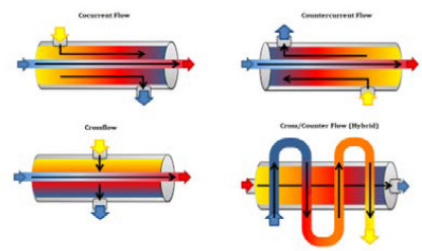
- Shell and Tube
- Double pipe (co-axial)
- Plate
- Condenser, Evaporators, & Boilers
- Energy Wheel
- Plate-to-Plate air exchangers
- Heat Pipe



As outlined above, all heat exchangers operate under the same basic principles. However, these devices can be classified by the fluids that flow on either side of the exchange and by their flow configuration.

The flow configuration, also referred to as the flow arrangement, of a heat exchanger refers to the direction of movement of the fluids within the heat exchanger in relation to each other. There are four principal flow configurations employed by heat exchangers. Below examples show liquid-liquid exchangers but these configurations apply to gas-gas (like air-to-air) exchangers too:

- Cocurrent
- Countercurrent
- Crossflow
- Hybrid



The physics behind the heat exchangers performance

As we you can see there are many different ways to exchange energy. What is listed above is are the most common you will see in HVAC. We deal with all these exchangers and more in our industry from components of our packaged equipment to stand-alone heat exchangers. You will be selecting & troubleshooting heat exchangers in your hvac career. Therefore, it is important that you know what can affect the performance of a heat exchanger and why. The following can affect the performance of any heat exchanger:

- **Approach**—the smallest difference between the hot and cold streams. The closer you get the bigger the exchanger gets and the more it will cost.
- **Range**—the temperature different between the entering fluid & exiting fluid of a single stream
- **Percent of glycol in water**—glycol is added to water to prevent freezing in pipes. Propylene glycol (PG) is typically used in hvac as it is safer to humans than ethylene glycol. There are derate tables you can reference to know the capacity loss & pressure drop increase resulting from certain % of PG. But in general, the more glycol % the lower ambient

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temperature pipes can see, yet the higher water pressure drop and the lower capacity will occur. Using turbulators (when available as an option) in chilled water coils can help with high %PG in cooling operation.

- **Laminar flow**—occurs when the flow through a pipe is so slow that it drops below the Reynolds number. Once laminar flow occurs heat transfer drops off and also become unpredictable. So be sure to note fluid velocities in tubes & passages in heat exchangers because they all want turbulent flow to perform.

It is also important to realize when you are at diminishing returns when designing or sizing a heat exchanger. For example, a gasketed plate heat exchanger can be designed for an approach of 0.1F but it may also result in excessive pressure drops, very large footprint, & exorbitant cost. This is when you have to ask the question- why am I designing to 0.1F approach. Is it necessary and at what cost is it worth?

When you know the 'why' and you understand the 'how' in heat exchangers it makes selecting & sizing straight forward & easy.

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