Tech Brief | Circulating Fluid Coil Designs

This broad category of coils uses a fluid in the tubes, and a gas stream over the fins, to satisfy a variety of heat transfer applications:

- Heating air with hot water, glycols or other secondary heat transfer fluids for comfort heating, process drying or other applications.
- Cooling and (or) dehumidifying air with chilled water, natural water sources, glycol solutions or brines for comfort cooling or process applications.
- Cooling fluids with ambient air such as in dry cooler applications.
- Cooling process fluids such as oil with ambient air:
- Heating fluids with waste heat gas streams for various heat recovery applications.

The coils used to satisfy these applications do not vary significantly in terms of basic de- sign. There are, however, three circulating fluid coil types available to satisfy specific operating characteristics. In addition to basic coil types, there are several other considerations that influence the overall coil design.

In this tech brief we will limit discussion to those factors that primarily influence the selection of a coil type. Performance related considerations such as surface requirements, fluid velocities, temperatures, pressure drop, etc., will be addressed in future Tech briefs. Material selection was covered in previous Tech Briefs titled "Coil Corrosion," "Temperature Considerations," and Specific Environments." These back issues are available by calling our Heat Transfer Products Group at the number on the last page of this report.

Coil Type

Serpentine Coils

This is the most common circulating fluid coil design and is used in a large variety of commercial and industrial applications. This coil design offers the largest degree of flexibility in materials, circuiting arrangements and size. It is also the least expensive.

With a serpentine type coil, groups of tubes are connected, with return bends, to form a circuit **(see Figure 1)**. One end of the circuit is attached to a supply header while the other end is attached to an outlet header. The headers are normally arranged perpendicular to the air flow so that the fluid entering the coil is equally distributed across the coil face.

Serpentine coils can be any number of rows deep. Coils used for heating tend to be 1 or 2 rows while coils used for cooling tend to be 3, 4, 5, 6, 8 or 10 rows.

Serpentine coils can be used for horizontal or vertical air flows. The tube should always be horizontal and reasonably level.

Cleanable Tube Coils

This type of coil is designed to allow the in- sides of the tubes to be mechanically cleaned. This is often necessary when the circulating fluid is water from rivers or lakes. However, any application using a liquid source capable of depositing dirt, sand, silt, marine organisms, scale or other foreign matter should benefit from this design. There are several variations of cleanable tube coils. The best designs allow for the removal of a header cover on both ends of providing full access to all tubes **(see Figure 2).**

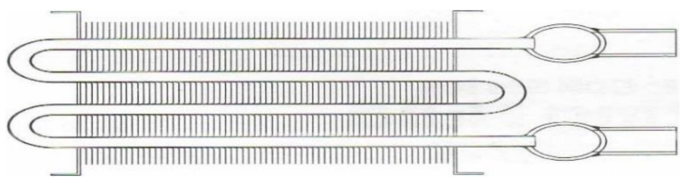


Figure 1: Top Section View of Typical 4-Row Full Circuit Serpentine Coil

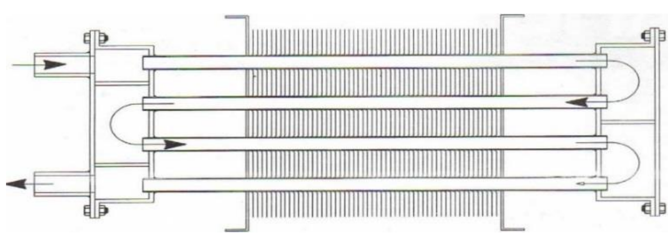


Figure 2: Top Section View of Typical 4-Row Full Circuit Cleanable Tube Coil with Removable Header Covers

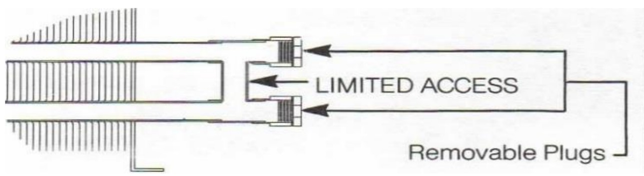
Another design uses removable plugs on the tube ends with a cross-over tube functioning as a return bend between them **(see Figure 3).** This design has a limitation in that it's not possible to fully clean the crossovers, and there is much more labor is required to re- move the plugs for access to the tubes.

Cleanable tube coils can be manufactured out of most materials and can be supplied with any number of rows.

Circuiting on cleanable tube coils is generally limited to full or double circuiting (see circuiting section) although some manufacturers will custom design a special circuiting when required.

Cleanable tube coils can be installed in any position since the header cover can be re- moved to drain the coil or remove any sediment.

Figure 3: "Cleanable" Tube Coil Design Without Removable Header



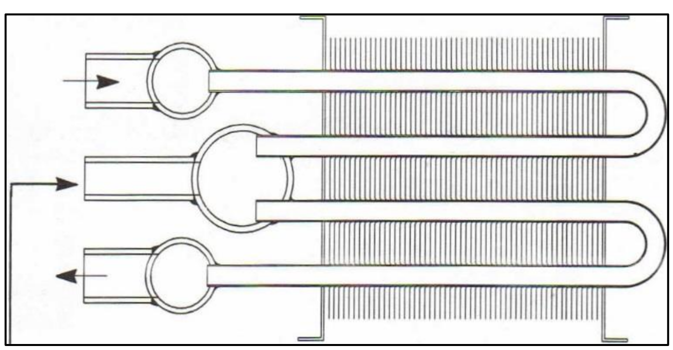
Due to limited manufacturing capabilities, cleanable tube coils are sometimes designed with a crossover tube and two removable plugs. However, as shown here, this design approach permits only limited access for cleaning the cross-over tube.

Drainable Tube Coils

This type of coil is designed to provide quicker and more complete draining than standard serpentine type coils. This is accomplished by using auxiliary headers in place of return bends on one end of the coil and sloping the tubes toward that end of the coil **(see Figure 4).**

Drainable tube coils are normally only avail- able with copper or copper alloy tubes (due to the necessity of brazing the tube joints be- cause of limited space). This coil type can be supplied with 4, 6, 8 or 1O rows with full or double circuiting only.

Figure 4: Top Section View of Typical 4-Row Full Circuit Drainable Tube Coil



Drain connection, normally closed.

Other Considerations

Circuiting

Coil circuiting is determined based on liquid velocity requirements, allowable pressure drop, and physical characteristics of the coil. The liquid velocity is a function of the flow rate of liquid, density of fluid, the number of tubes and the size of the tubes. Liquid velocities that are too low result in a laminar flow condition which causes a significant reduction in capacity. Excessive liquid velocities cause erosion/corrosion problems. The ideal velocity varies depending on the fluid involved and the tube material.

The quantity of circuits that are available in a coil is a function of the number of tubes in the face and the rows deep. Most coil manufacturers offer circuiting options as shown on the table below. Some coil manufacturers will custom design circuiting when conditions warrant.

Circuit Type	Description	Available On
Full	All tubes in the face are fed	Any number of rows deep
Double	Two rows of tubes are fed	4, 6[1], 8, & 10' row deep coils
Half 2	½ of the tubes in the face are fed	All number of rows deep
One & a half	1 ½ rows of tubes in the face are fed	6 & 1O row deep coils

NOTES: 1) 6 & 1O double circuit coils would have headers on opposite ends. 2) Half circuit coils must have an even number of tubes in the face.

Aside from the quantity of circuits, the arrangement of the circuits is also important. The circuits should always be designed to be both drainable and self-venting.

Tube Size

Most coil manufacturers standardize on a 5/s" diameter tube for circulating fluid coils. This diameter offers a good efficiency to cost ratios. Occasionally, other tube diameters would be preferable. For example, a 5/s" diameter tube coil using raw river water may tend to plug where a larger diameter tube may not. On the other hand, a very small coil with less than 2gpm may work better with a smaller diameter tube since a more reasonable liquid velocity could be attained.

Fin Height

Depending on the manufacturers equipment and fabrication methods, fin heights are generally available in specific increments that re- late to the tube spacing. With 5/s" tube fins the increments generally range from Pia" to 11'2". The maximum fin heights are usually 48” or less due to handling difficulties and manufacturing limitations of some manufacturers. Also, larger coils generally require high liquid flow rates. When liquid flows exceed about 250gpm, the connection and header sizes can get large and exceed the capabilities of many coil manufacturers.

Fin Length

Fin lengths are normally available up to 120". Longer fin lengths, up to 240", can be sup- plied by some manufacturers