

COOLING COIL SPECIFICATIONS

Heat exchange coils used for removing heat from air in air-conditioning systems operate under very complex circumstances. However, if certain guidelines are followed trouble should not be encountered. These notes are not intended to cover the determination of duties or air volumes but rather the specifying of an economical coil after these have been established.

- (1) **COIL SIZING:** The size of the face of a coil should be governed by the air volume the coil is to handle. Face velocities should be above 1.5 M/S to encourage even air distribution but below 2.6 M/S to ensure condensed water is not carried off the coil by the air stream. This figure may be exceeded if eliminators are placed downstream of the coil to catch water carried over, however air pressure drop usually becomes excessive at higher velocities. The efficiency of the coil increases with face velocity, so provided air pressure drop is within the desired limits then 2.5 M/S is most often a good figure to aim for.

Selecting a maximum face velocity will determine a minimum face size but the length to height ratio will have effect on cost. A long narrow coil has less tubes, welding and manifold than a more square coil making it cheaper to manufacture. If taken to an extreme this can result in excessive ducting costs and so a 2:1 ratio is often called for. The finned height of a cooling coil can have an effect on the performance when the coil is operating under "wet" conditions if the water running off the upper part of the coil begins to effect the air flow through the lower part. For this reason height is often limited to 750 - 900mm. If a higher coil is necessary it should be specified as 2 coils installed with a drip tray between them.

- (2) **COIL LOAD:** The load or duty of the coil should be determined from heat load calculations of the space to be conditioned. The duty of the coil can be specified directly or by specifying the air off conditions required. This duty will normally have a latent heat component as well as sensible heat content. The two are added together and stated as the "Total" load and the "Sensible" load is usually specified separately. For a given duty the air off conditions can be calculated provided air volume and air on conditions are known.

The resulting air off figures tell something of the nature of the system. Very low air off temperatures indicate a low air flow or excessive duty. Representative examples would be 12 deg dry bulb and 11.5 deg Wet Bulb or lower. These conditions result in more expensive coils as the design must bring the air temperature closer to the entering cooling medium temperature. It is of course not possible to go below this temperature and very difficult to get even within a few degrees of it. On the other hand air off temperatures above 17 deg DB / 16 deg WB may indicate excessive air flow or an under estimation of load. High air off temperatures will result in cheaper coils due to greater temperature differences but care should be taken to ensure the design conditions will actually be met.

- (3) **AIR ON CONDITIONS:** The air on temperatures specified will have a big bearing on the selection of the number of rows and fin spacing for a given duty. Coil performance is determined by the temperature difference between the water and air and so the lower the air on conditions the more difficult it becomes for a coil to meet a given load. The air on humidity will also effect the total load to sensible load ratio. Specified air on should be as close as possible to normal running conditions. Higher temperatures that may exist at system start up, will increase coil performance so need not be allowed for.

Systems supplied with a mixture of fresh and return air should have the mixed air on temperature calculated using a psychometric chart. Common figures used in Melbourne are 28 Deg Celsius dry bulb and 19 deg Celsius wet bulb. Full fresh air systems are often quoted as 35DB / 21WB. If in doubt use lower dry bulb or higher wet bulbs than suspected, However keep safety margins to a minimum as the effect on cost and pressure drop can be great.

- (4) **WET BULB DEPRESSION:** The difference between the air off dry bulb and wet bulb is sometimes called the wet bulb depression. Wet bulb depression is effected by the condition of the air entering the coil, the nature of the heat exchange surfaces and the temperature of that surface. When air on temperatures and total load are specified and if moisture is to be removed then only a very narrow range of control over wet bulb depression is available to the coil designer.

Wet bulb depression of the air leaving the coil usually falls between 0.1 - 2 degrees C. Wide fin spacing lowers it. The velocity of the air through the coil also has some effect. Specifying large wet bulb depression usually results in an over design in order to meet the actual sensible load rather than the specified sensible load. When really necessary large wet bulb depression can usually only be achieved with over cooling, then reheating with a separate heating coil up to the required dry bulb temperature. As a general guide, duties or air off temperatures should be specified to result in a wet bulb depression of between 0.5 and 1 degree C. The coil designer should alert you to any unusual situations past there.

- (5) **WATER SUPPLY TEMPERATURES:** The water temperatures existing in a system are the other factor determining the temperature difference that drives the heat transfer of the coil and so should be accurate. Variations in the supply temperature have a large effect on the heat exchange surface required, especially when air off temperatures are low. The return water temperature and flow rate relationship also effects coil performance. High flow rates with low temperature increases result in a reduced heat transfer surface requirement in the coils, however other factors should be considered.

Increases in pipe sizes and water pressure drop increased effecting running costs may negate any savings on the coils. Lower water entering temperatures may also result in lower efficiencies in the refrigeration equipment.

The water velocity within the tubes should be kept above 0.3 M/S to ensure turbulent flow and reasonable efficiency but below 1.5 M/S to avoid erosion problem. Often there are limited choices on the available circuitry options for a given size coil and the lower limit cannot be met. The upper limit will not be exceeded if a reasonable maximum

water pressure drop is followed so water velocities need not be of concern to the specifier. Generally water temperatures are 6 - 12 degrees or 7 - 13 degrees Celsius. Water pressure drop is often restricted to 30 - 40 kPa.

- (6) **FIN SPACING:** This can be varied by the manufacturer to obtain the required thermal capacity from 236 to 551 Fins Per Meter (FPM). Close fin spacing is the most economical way to increase heat transfer performance, however the coil will collect dirt at a greater rate. Often 472 or 394 FPM are specified as a maximum to slow this process. If restricted on fin spacing and unable to satisfy a particular duty, the coil designer has no choice but to increase the face size or rows deep of the coil which can become relatively expensive. Care should be exercised in calling for less than 394 FPM unless air off temperatures are quite high. Incoming air filtration and ease of access for cleaning should also be considered in this matter.

- (7) **CONSTRUCTION:** Standard coil construction is generally copper tubes with aluminum fins and galvanized steel frames. For salt air, and mid city applications, longer life can be obtained by specifying corrosion coatings, such coils are about 30% more expensive than standard construction.

Little extra cost is involved when frames are specified as aluminum and this results in one less dissimilar metal being present. Brass and Stainless Steel are also possible however cost more. Brass can lack the necessary strength in larger coils. The aluminum fins are usually the first element to fail in a coil. In a clean air situation a useful life of between 20 and 30 years is possible. Surprisingly the failure normally occurs at the fin tip rather than at the collar where it is bonded to the dissimilar copper tube, however almost all modern coils are constructed this way.