Service Factors

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Service factors or safety factors are used in the preparation of specifications for most industrial equipment. These can be thought of as multipliers to help ensure that the device will equal or exceed the desired performance. In some cases, the factors are used to increase flexibility. Operation at conditions appreciably different from the design is sometimes made possible in this manner.

CTI Gear Standard STD-111 specifies a minimum service factor of 2.0 for cooling tower right angle spiral bevel gears. In some instances, electrical motors are specified with a 1.1 or 1.15 service factor for cooling tower duty. Likewise, quite often during the design stage of a cooling tower, it is considered appropriate that a service factor be built into the thermal performance capability of the cooling tower.

Consequently, in many instances the numbers presented in a cooling tower inquiry for thermal performance design represent a somewhat more stringent condition than that actually to be encountered in the operation of the unit. This conservative "factor" in the cooling tower design's parameters is certainly not an unjustifiable factor; however, we should give some close attention to where this factor should be applied and its consequent effect on the overall cost of the installed cooling tower.

1. **Lower Cold Water Temperature or Higher Wet Bulb Temperature:** A common misconception is to take the safety factor in the form of lower cold water temperature or higher wet bulb temperature, which in either case reduces the approach (cold water temperature minus wet bulb temperature). This, of course, is an effective manner in which to take a safety factor.

   However, it quite often can be misleading due to the fact that those unfamiliar with cooling tower rating procedures are unaware that closing the approach does not vary linearly with cooling tower size and cost. For example, a decrease in approach from 20°F to 19°F would result in an increase in cost of about 5%, while a decrease from 5°F to 4°F would require about 20% more cooling tower.

2. **Higher Water Flow Rate:** Another scheme that is often used to obtain "safety" is to state a larger GPM (gallons per minute) than will actually be required. Where this method is used, the effect on the cooling tower size and price is essentially a one-to-one or straight-line effect. Hence, a 10% service factor stated as a 10% increase above actual circulating water flow requirements is fairly representative of both tower size and tower cost.

   Nevertheless, one caution must be observed; competent manufacturers will endeavor to design for optimum performance at the inquiry conditions. If the actual operating water loading is appreciably lower, the efficiency of the tower may be markedly reduced due to poor water distribution and/or improper wetting of the fill. Thus, an overzealous effort to obtain a safety factor in this manner could, in some instances, result in an actual loss in performance.

3. **Higher Range:** The third method used to obtain a service factor is to overstate the range (hot-water temperature minus cold-water temperature) by arbitrarily raising the hot water temperature (HWT) requirement. With this method, it is much easier for the tower to accept additional load and perform satisfactorily when this load is being added in the form of higher hot-water temperature. For most ordinary conditions, an appreciable increase in HWT requires only a relatively small increase in the size and cost of the cooling tower. Consequently, this is usually a good method of obtaining safety.

   Again, there is a caution to be observed. Be certain that the condenser, or equipment being served with this cooling tower water, is capable of taking the higher hot-water temperatures on the leaving sides of the condenser without large adverse effects. This will allow the advantage to be taken of extra performance capabilities built into the cooling tower.

In summary, a safety factor in approach will cause an increase in the cooling tower size and price at a ratio that may be either higher than or equivalent to one-to-one, an increase in GPM is on a one-to-one ratio, and an increase in range is usually less than one-to-one ratio. The most realistic method, then, is a safety factor in water flow. Although not the cheapest, it gives the most flexibility in connection with possible future needs.

Thank you! If you have questions or comments, feel free to email me at oshuja@cyber.net.pk, or call me at Jalal Engineering at [021] 636-1960, 680-6374.