Counterflow Performance

Plenum Height/Fan Coverage

Fan efficiency and uniform air distribution over the tower plan area are strongly affected by the coverage of the fan opening over the eliminator plan area.

Coverage is defined as the percentage of eliminator plan area covered by a circle projected at 45° from the fan cylinder opening (or equal in diameter to the opening plus twice the plenum height).

Do not include the projected circle area which goes beyond the cell boundaries. Coverage should be at least 80% for reasonably good air distribution and pressure drop.

A vendor with a coverage below 80% may not account for the effect of poor coverage on the total system. Specify 80% minimum fan coverage.

Fan Exit Velocity

Correct fan exit velocity will result in tower performance less sensitive to wind variations.

High ambient winds will push the exit air over to one side of the fan cylinder recovery cone resulting in less actual velocity recovery and lower fan performance.

High ambient winds can also cause the exit air stream (plume) to bend over and flow (recirculate) into the downwind air inlets of the tower. Warm air "recirculation" as you might imagine, has a very significant effect on cooling tower performance. The higher the fan exit air velocity, the higher the wind would need to be to affect the plume and cause recirculation.

Marley cooling towers do not use fan exit velocities lower than 1200 feet per minute at 10 mph ambient wind speed, which by the way, is the maximum allowed during cooling tower performance testing. At lower exit velocities, the variation of tower performance in 10 mph winds will be noticeable. Windier sites may require even higher exit velocities.

Specify 1200 fpm minimum fan exit velocity, or even higher if the typical winds at the site are over 10 mph.

Fan Efficiency

Multi-segment fiberglass fan cylinders on cooling towers are difficult to correctly position concentric with the fan, and do not stay completely round during high wind loads or when the sun heats up one side on very hot days. As a result, fan cylinders are normally designed to leave acceptably safe clearance between blade tips and cylinder sides to avoid contact and damage.

Typical fan performance data used by some manufacturers reflect fan performance data in ideal operating conditions, almost no blade tip clearance, tall idealized eased inlets, and very large plenums. This type of data indicates far better fan efficiency than is possible at realistic blade tip clearances, actual cooling tower eased inlets, and plenums that occur in real world cooling towers. Peak fan efficiency varies with the fan used and the tower operating point, but based on Marley's experience in scale modeling of complete cooling tower fan systems along with field testing, peak efficiency does not exceed about 82% for any of the fans currently used on cooling towers.

Ask for the impact on guaranteed cold water temperature with a more realistic fan efficiency, and evaluate the differences on the bids. Specify a maximum acceptable fan efficiency of 82%.

Pressure Ratio – Air Inlet Configuration

The higher the entering air velocity compared to the pressure drop through the tower, the less likely the air will turn and enter the outer edges of the tower. Cooling tower fill doesn't perform well without air flowing through it. Modeling and full scale studies at the SPX R&D center have shown that a minimum pressure drop through the tower of 5 times the entering air velocity pressure is required to avoid large penalties in performance even with air inlet guides installed. Specify a minimum acceptable pressure ratio of 5.

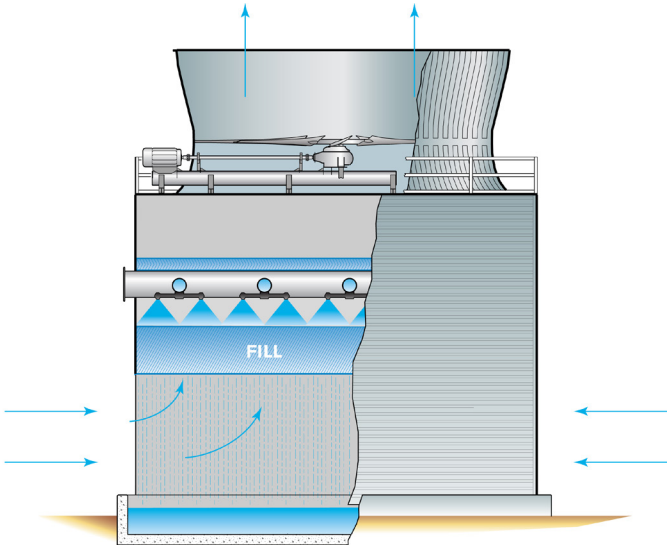
Research has shown that the falling water zone between the underside of the fill and the cold water basin has a significant pressure drop. The pressure loss from the eliminators to the fan entrance is also important. Require that vendors supply separate louver, falling water zone, fill plus spray system, eliminator, and plenum pressure drops as a part of the technical data, along with velocities at each component of the pressure loss. Some vendors may lack knowledge of the component losses, and may overestimate performance as a result.

Our research has also discovered that closely spaced louvers cause entering air to miss the outer areas of the fill. Performance can be significantly affected. If a vendor is using closely spaced louvers, require the derate factor used in the rating to compensate for the difference in louver spacing, and compare bids accordingly. Require the louver spacing in the technical data, and the derate factor in addition to pressure drop used for spacings less than 6 feet.

Net Effective Fill Area

The average structural interference of fill with bottom support in cooling towers has been determined to be about 5%. Part of this is due to the volume occupied by columns and diagonals. Part is due to the air flow blockage as a result of the bottom support, especially at the outer edges of the tower where the entering air velocity is the highest.

Specify maximum effective fill plan area of 95% of the area inside the casing of a cooling tower with bottom fill supports. Review the technical data supplied to assure that the water loading per square foot and velocities are actually based on this net plan area when comparing bids.



Third-Party Testing

Experience has shown that cookbook combinations of laboratory component data do not yield expected results in full scale performance. This is due in part to many of the preceding factors listed. In order to develop valid cooling tower performance prediction, experience in field testing a variety of tower configurations is essential. Specify a minimum of 5 successful independent third-party tests conducted by CTI certified testing agencies as a requirement to bid. Require full independent test history of the product line with the technical data, and use the relative number of successful tests in the evaluation of bids.

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