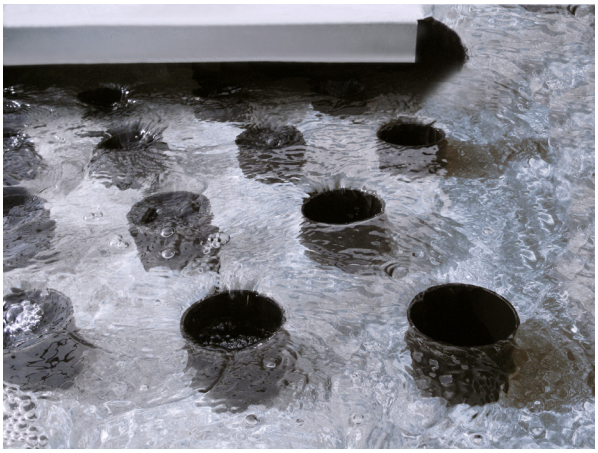
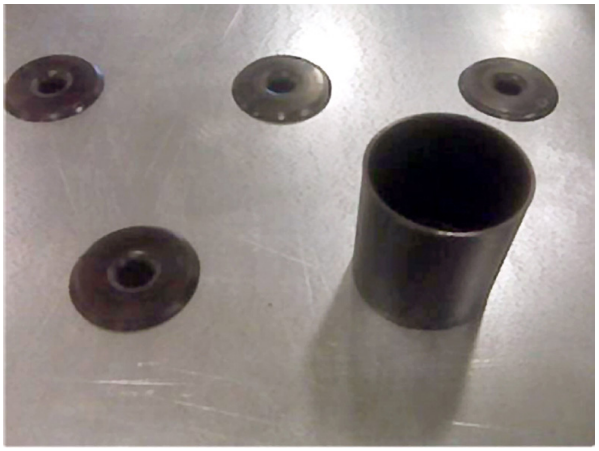
MARLEY®

MarleyGard™

LOW-FLOW NOZZLE CUPS





MarleyGard Low-Flow Nozzle Cups in Marley crossflow cooling towers permit variance in the flow rate over a wide range by varying the number of nozzles that are active as a function of the flow rate.

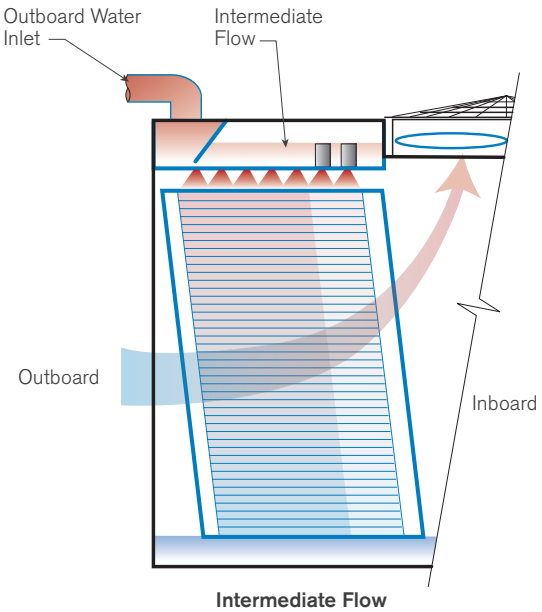
Installing nozzle cups can effectively divide the hot water distribution basin into outboard and inboard sections. This allows the cooling tower to manage variations in flow automatically, ensuring that adequate head over the active nozzles is maintained. Most importantly, uniform air-side pressure drop is maintained across the fill.

MarleyGard Low-Flow Nozzle Cups enable the ability to:

- Maintain uniform air-water contact for maximum efficiency
- Provide consistent off-design performance
- Minimize drift
- Minimize risk of icing in freezing weather

The following graphic illustrates intermediate flow condition of a Marley NC® crossflow cooling tower with MarleyGard Low-Flow Nozzle Cups. With less water over the cooling tower, the lower flow rate results in less head over the nozzles and the water depth decreases. As the depth decreases, the nozzle cups begin to restrict flow to the nozzles on the inboard side of the basin. Because cups are installed along the full length of the basin, the water flow rate is uniformly reduced along the inboard portion of the fill.

Note that uniform water depth across the entire outboard portion of the hot water basin is within the design



Intermediate Flow

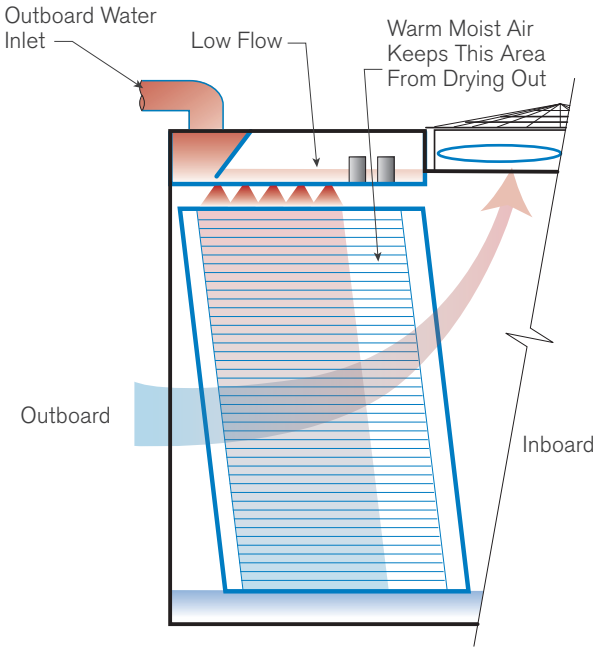
MarleyGard Low-Flow Nozzle Cups

operating range of the nozzles providing predictable water flow across the full length of the air inlet opening. The air side pressure drop through this portion of the fill is uniform.

In addition, lower water flow through the cupped nozzles means less water flowing into the inboard portion of the fill. Even if this reduced flow rate results in less-than-minimum head over the nozzle resulting in unpredictable flow through individual nozzles in this area, this area of unpredictable flow is still uniformly distributed along the entire length of the fill section.

Reducing the flow to the minimum flow rate - shown in the graphic below - results in the head in the basin dropping further and the cups becoming fully active. This completely cuts off water flow to the nozzles on the inboard side of the basin. The nozzles at the rear of the basin are now dry.

The inboard portion of the fill, however, is not dry. Since airflow in a crossflow cooling tower runs horizontal across the flow of the falling water in the fill, there is still a tendency of the airflow to pull the water back into that section of the fill. Further, the air picked up moisture as a result of passing through the outboard section of fill and is now saturated.



Low Flow

Saturated air results in the fill, drift eliminators and plenum structure remaining wet. There is no scale formation in either the drift eliminators or the cooling tower plenum on a cooling tower in normal operation. The fill is not flooded but is wet so there is no alternate wetting and drying taking place at the rear of the fill or in the eliminators or plenum.

Water depth in the outboard portion of the basin is at the proper head, so flow through the nozzles remains predictable at all times. Although there is still some water on the inboard portion of the fill as a result of the horizontal airflow through the front of the fill, some loss of effectiveness in the rear portion of the fill during very low-flow conditions only occurs at extremely low total heat loads relative to the cooling tower capacity, minimizing the effect.

Most importantly, uniform air side pressure drop across the fill occurs so the fan maximizes its intended function of cooling the water. No air bypasses the fill; it is all put to effective use.

When the process the cooling towers is serving is operating at reduced load, nozzle cups help provide consistent off-design performance and increased energy saving when operating cooling towers with lower fan speeds.

MarleyGard Low-Flow Nozzle Cups can be easily added to existing Marley NC, Quadraflow®, AV and Aquatower® cooling towers and specified as an option on new installations. To learn more about how variable flow can save energy cost see *Marley Technical Report TR-14* "Variable Flow Over Cooling Towers for Energy Savings" available at spxcooling.com.

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