MARLEY®

thermal science

Addressing Fan Sound in Crossflow and Counterflow Cooling Towers

Quieter cooling tower operation is critical as more stringent sound standards are adopted by facilities and communities. Minimizing sound from the fan is often the first step. However, lowering fan sound alone is not equally beneficial for all cooling tower configurations. It is important to understand when minimizing fan sound is the best option to achieve the desired sound level.

There are two main components that can contribute to cooling tower sound: fan and splash. Fan sound is generated at a lower frequency and has a greater influence on far field receptor locations (50 or more feet away). Splash sound is higher frequency and has the most impact on near field receptor locations (closer than 50 feet). Inlet sound levels of many crossflow cooling towers are directly impacted by fan sound. Crossflow film fill is designed to be in contact with the water surface in the cold water basin, so water does not splash. Counterflow cooling towers have a splash sound characteristic, so there is a point of diminishing returns when decreasing fan sound. Eventually, splash sound from the inlet becomes dominant, which is especially true for near field sound, necessitating inlet or splash attenuation. Further information on cooling tower sound principles can be found in the SPX Cooling Technologies white paper "Understanding and Evaluating Cooling Tower Sound Levels Among Manufacturers."

The implementation of ultra quiet fans on crossflow cooling towers provides a distinct advantage in sound performance relative to counterflow towers at the same tonnage. To achieve similar benefits on a counterflow cooling tower, splash and inlet attenuation can be employed, but these have impacts on thermal performance and cost. Crossflow towers also have the advantage of sound directionality, as only two inlet faces are open for entering air. The crossflow tower cased (or closed) faces are very quiet compared to an open inlet. Counterflow towers require even larger attenuation to match the cased face sound. The table below compares the different counterflow sound options discussed above to a comparable crossflow tower with ultra quiet fan as the only sound reducing method.

Sound Improvement Options

Tower Type	Sound Reduction Method	Cost Increase	Sound Performance Improvement	Thermal Performance Impact
Marley Crossflow	UQ Fan	$	↓↓	↔
Counterflow	UQ Fan	$$	↔	↓
Counterflow	Splash	$	↓	↔
Counterflow	UQ Fan + Splash	$$$	↓↓	↓
Counterflow	Inlet + Splash	$$$	↓↓↓	↓↓
Counterflow	UQ Fan + Splash + Inlet	$$$$$	↓↓↓↓	↓↓

↔ *Negligible Change* ↓ *Decrease*

Significant sound reduction on crossflow towers can be achieved more easily with fan type and speed as splash sound is lower. Counterflow towers need to mitigate the splash noise before applying any low-sound fan properties in order to reduce cooling tower sound.

Key Takeaways

- On crossflow cooling towers, fans are the primary sound source.
- On counterflow cooling towers, splash sound is more predominant, so fans have less influence.
- Ultra quiet fans alone are very effective at reducing inlet sound on crossflow cooling towers.
- Other sound reducing features (such as splash attenuation, inlet attenuation, or both) are necessary for a counterflow cooling tower to match the same crossflow inlet sound level.
- Inlet attenuation often causes negative thermal performance impacts, while ultra quiet fans may reduce thermal capability as well.
- Ultra quiet fans reduce above tower sound level on induced draft cooling towers, whether crossflow or counterflow configuration.

Case Study

The Figures below compare sound levels of different fan configurations for a counterflow and crossflow cooling tower, at the same capacity of 1900 tons per cell, operating with the same fan tip speed and motor nameplate of 100 hp.

Figure 1: Inlet noise measured at 5 feet

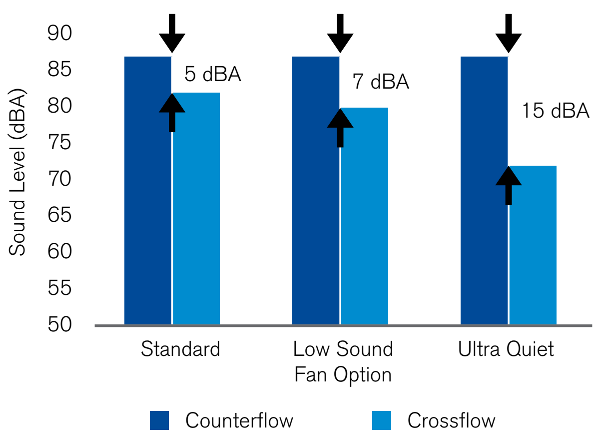
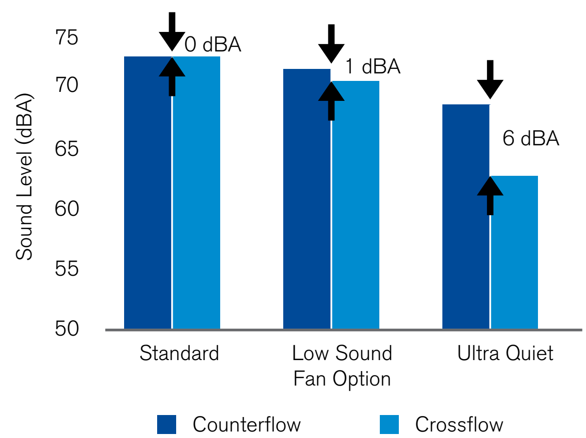


Figure 2: Inlet noise measured at 50 feet



The Figures above show that varying fan type alone has no impact on near field noise for counterflow cooling towers and minimal impact on sound pressure levels at 50 feet. In contrast, the crossflow cooling tower sound is proportional to the change in fan type. This case study illustrates that overall sound reduction can be achieved on a crossflow tower simply by reducing fan noise.

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