Fan Efficiency Case Study

REQUIRED NUMBER OF FAN BLADES TO ACHIEVE PRESSURE RISE

When researching industrial fans for cooling tower applications, you may find claims such as "most efficient" or "highest performing." To substantiate these claims it is important to evaluate laboratory data. For example, the performance advantages of the Marley® HP7000 Fan vs the Hudson Tuf-Lite III® Fan, and resulting operational cost savings, are examined in the TR-022 Fan Performance Case Study. An important point of comparison is the required number of blades to achieve the pressure rise. This case study elaborates on this performance feature and addresses the up-front cost benefit of the Marley HP7000 Fan.

The prominent field-erected cooling tower configuration is the counterflow design. It is important to note that the counterflow configuration often has more static pressure drop, demanding a higher pressure rise. The tower's tightly-packed heat transfer film fill and airflow moving directly counter to the falling water contribute to the increased pressure rise. The fan must deliver the required pressure rise to perform correctly and avoid stall—an unstable and inefficient operating condition. This study focuses on different counterflow operating points for fan diameters between 24 and 32 feet. Table 1 summarizes actual operating cases and compares the number of required blades for both the Marley HP7000 Fan and Hudson Tuf-Lite III Fan.

Performance results are based on Marley FIT™ component selection software for the HP7000 Fan selections and the Hudson Tuf-Lite V6.0 Web-based application for Tuf-Lite III selections. To ensure the selected fan is not in stall, a minimum 5% flow and 10% pressure margin were maintained for each selection in the Marley FIT and Tuf-Lite selection programs.

Table 1: Example Counterflow Cooling Tower Fan Operating Cases

Diameter	Speed	Airflow	Static Pressure	Blade Quantity Required		
ft	rpm	cfm	in. H2O	Marley HP7000	Hudson Tuf-Lite III	Marley Advantage
32	119	1404100	0.529	8	10	2
28	134	1180300	0.773	9	13	4
28	134	1015800	0.894	11	14	3
28	134	1260000	0.609	9	11	2
24	154	893200	0.677	7	10	3

Air Density of 0.07 lb/ft3
Nominal 12,000 ft/min tip speed

As shown in Table 1, the Tuf-Lite III Fan requires, on average, two or three additional blades compared to the Marley HP7000 Fan to maintain a minimum 5% flow margin. The reduced number of blades reduces initial cost as well as future maintenance to potentially pitch or resurface blades. At a value of $2,500 per blade, the initial cost savings from reduced blade count can be significant. Note that having more blades does not reduce fan noise; sound level is generally improved through reduced power draw and lower fan tip speed. These examples are representative of actual counterflow cooling tower operating points. Always consult an expert and evaluate actual design conditions for your specific fan application.

Summary

- Counterflow cooling towers have a higher pressure rise than crossflow cooling towers.
- Good design practices incorporate flow and pressure margins to avoid the cooling tower fan inadvertently operating in stall.
- For typical counterflow applications at the same flow margin and pressure margin, an HP7000 Fan requires 2-4 fewer blades than alternative fans.
- First cost savings of $5,000 or more can be realized when more additional blades are needed to achieve the duty point pressure rise.

Other Resources

- Fan Performance Case Study: https://spxcooling.com/library/fan-performance-case-study/

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TR-026 | ISSUED 06/2021