JOHNSON ELECTRIC

Case Study

Aerodynamic Optimization
Breathing Innovation

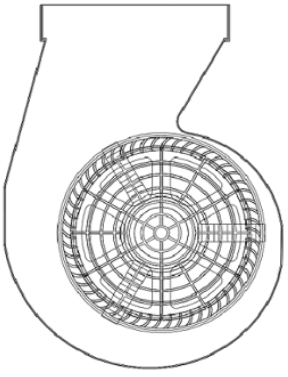
In airflow applications, Computational Fluid Dynamics (CFD) is used to simulate and analyze the behavior of airflows around various objects and structures. This can include buildings, aircraft, vehicles, and other structures. CFD helps to provide insights into the flow characteristics such as velocity, pressure temperature distribution and turbulence. By analyzing these characteristics, engineers can optimize the design of structures to improve their aerodynamics performance, reduce drag and enhance energy efficiency.

- **Airflow**
- **Efficiency**
- **Noise Reduction**

Challenge

Johnson Electric's customer was developing a novel air purification device featuring a distinct airflow path compared to its predecessors. The primary objective of this advanced iteration was to enhance airflow, optimize system efficiency, and minimize noise levels while transitioning from a vertical to a horizontal airflow direction.

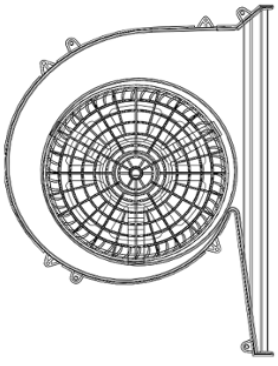
The customer granted JE the opportunity to overhaul the entire internal hydraulics of the solution while maintaining the existing industrial design.



*Customer's Original Design I **A***

Customer Design Performance

Air Volume: 223 CFM
System Efficiency: 4.3 CFM/W
Abnormal Noise at High Speed



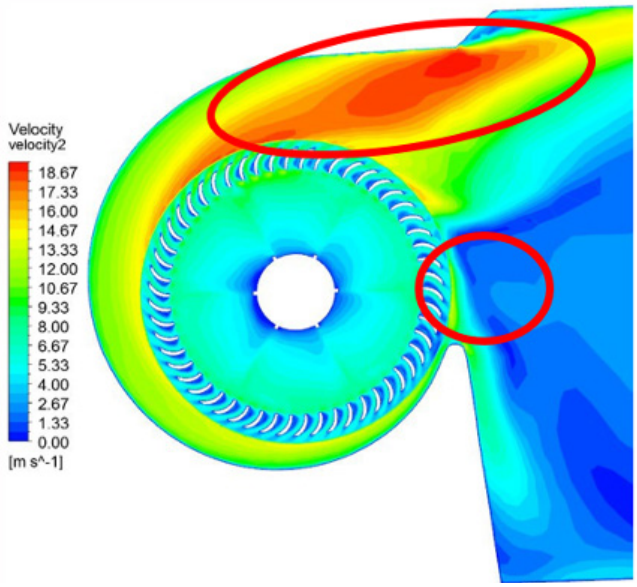
*Customer's Design Change I **B***

Performance Target

Air Volume: 241 CFM
System Efficiency: 6 CFM/W
Remove Abnormal Noise

Problem-Solving Process

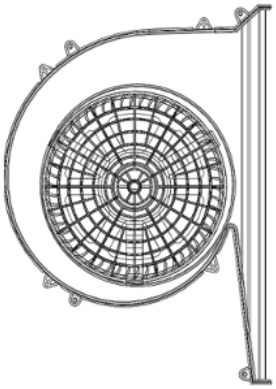
Upon receipt of the customer's 3D model and subsequent simulation of the design's airflow characteristics, Johnson Electric identified high air velocity and turbulence at the outlet point of the blower. These factors resulted in a decrease in maximum CFM (Cubic Feet per Minute) and gave rise to unusual noise levels.



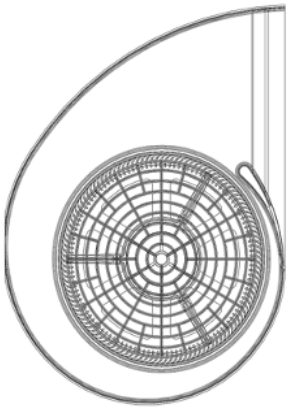
Solution

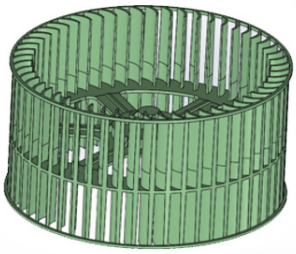
Johnson Electric's proposal encompasses the optimization of the blower housing, impeller, and transition to an Outer-Rotor EC fan solution to address the customer's concerns. In the initial step, Johnson Electric's Aerodynamics team refined the blower housing to enhance the outlet airflow characteristics. The outcome of this modification is evident below, showcasing a substantial reduction in both air velocity and turbulence within the design.

Customer's Design Change



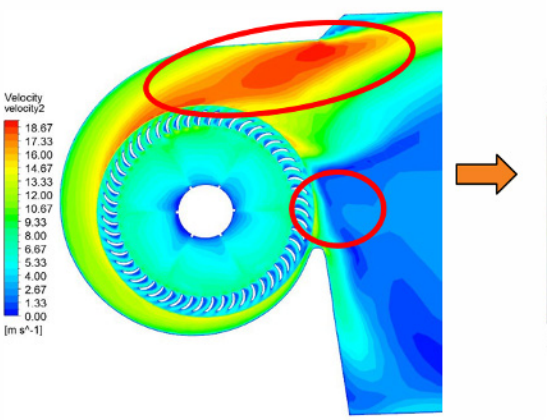
JE Final Optimization





Customer's Design Change / ***B***

Blades: 54
OD: 182mm
Height: 114mm



JE Final Optimization / ***D***

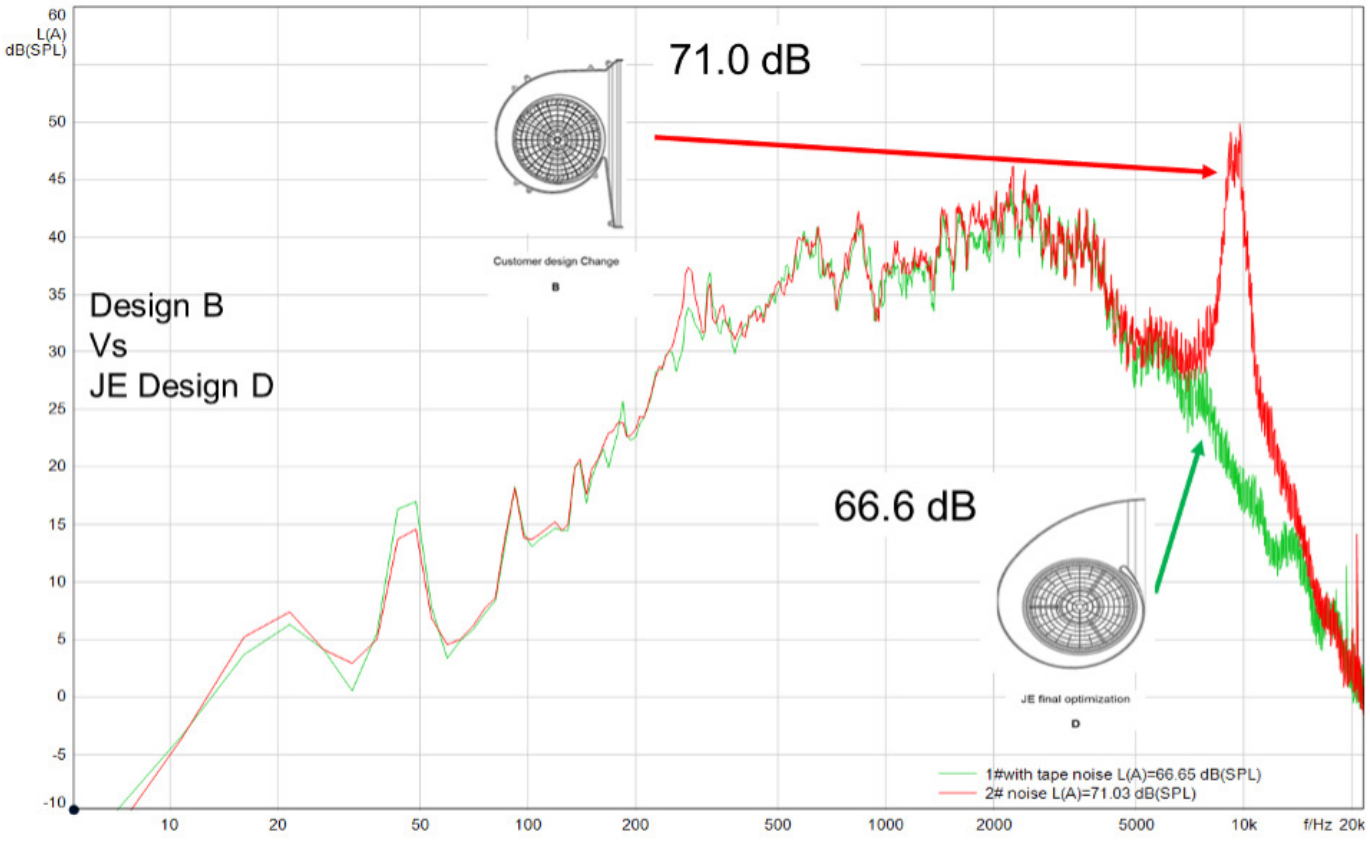
Blades: 61
OD: 180mm
Height: 112mm

Secondly, leveraging the compact design of EC Outer-Rotor technologies, we successfully augmented the number of fans while also reducing the height and dimensions of the impeller. This enhancement to the impeller played a pivotal role in endowing JE's solution with improved air volume and system efficiency, thereby attaining the customer's desired performance targets.

Testing Results

Our CFD results underwent validation through the rapid sample process. Within a span of one week, both an impeller and blower housing were 3D printed for in-lab prototype validation. The outcomes of this validation are outlined below:

- Air Volume: 248 CFM
- System Efficiency: 6.5 CFM/W
- Noise: Abnormal noise was successfully eliminated



With the support of Johnson Electric's aerodynamic team, these enhancements not only optimize system efficiency but also lead to a quieter and more effective air purification device, providing a better experience for the end user.

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