JOHNSON ELECTRIC

Case Study

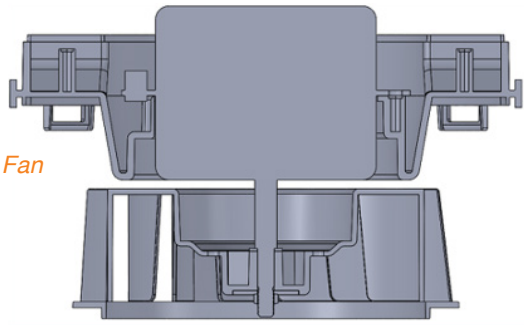
Aerodynamic Optimization
Streamlined Efficiency

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.

- **Efficiency**
- **RPM reduction**
- **Mixed-flow solution**

Challenge

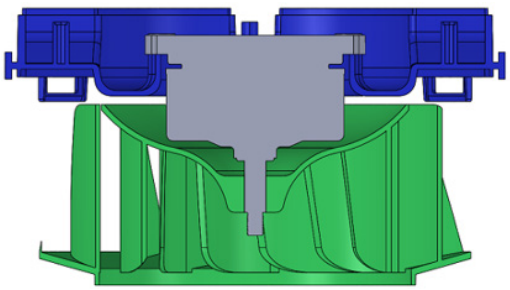
Johnson Electric's customer was working on the next generation design of their air purification device. The improvement goal of this next generation device was to increase airflow, improve system efficiency and reduce noise while adding a heating element to the design. The customer gave JE engineering the opportunity to modify the complete internal hydraulics of the solution; however, the package size of the industrial design needed to stay the same.



Original Fan

Solution

Johnson Electric proposed moving to an Outer-Rotor, EC mixed-flow fan solution to answer the customer's pain points. Due to the EC Outer-Rotor technology, we were able to reduce the motor size significantly; therefore, giving room to increase the diameter and height of the fan. On the right is a screenshot to highlight the differences:



JE Fan

Given a heating element has been placed in the design, we would need to design the fan so that the air flow is more concentrated. This would allow the airflow to pass through the heating element. The mixed-flow solution above was simulated through CFD analysis and was able to highlight the changes between the original design and JE's new proposal. Please see the results to the right:

Results

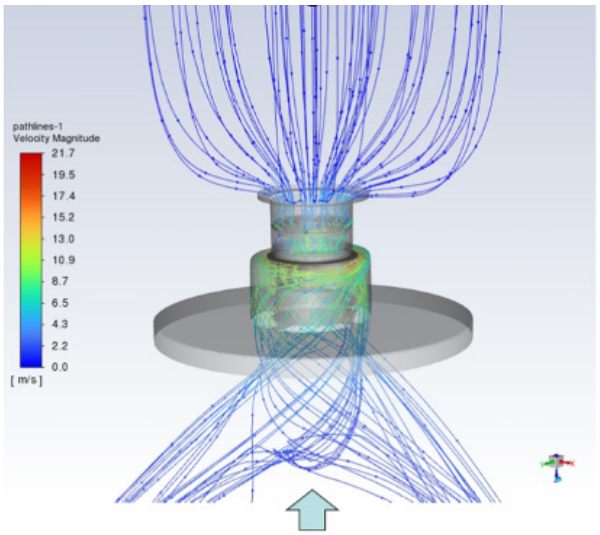
Johnson Electric's CFD results found that by adjusting the fan and airflow path, the customer achieved significant improvements. These included a 13% increase in fan airflow (CFM), a 16% improvement in fan efficiency, a 3% improvement in system level efficiency, and a 14% reduction in motor speed (RPM).

These enhancements were achieved despite the addition of an additional heating element feature in the design, thanks to the modification made to concentrate the airflow path.

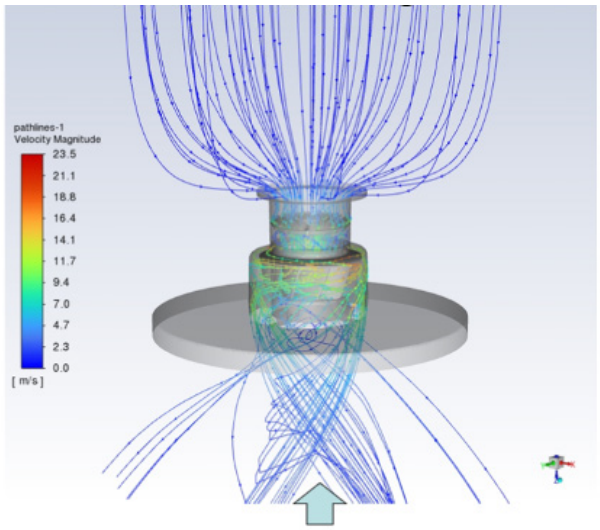
To validate the CFD analysis, JE used specialized 3D printing and balancing processes to create quick samples. Two samples were tested, and the results were within a 3% tolerance of the simulation.

By implementing an Outer-Rotor, EC mixed-flow fan solution and optimizing the airflow path, the air purification device now operates with greater efficiency and reduced noise levels. This enhanced air purification system delivers improved performance and heightened comfort for the end user.

Original



JE I New Design



Model	Speed (rpm)	Q_Max (CFM)	Torque (N-m)	Shaft Power (W)	CFM/W
Original fan	2800	181.7	0.048	14.0	12.9
Original fan + Unit	2800	109.6	0.044	12.8	8.6
JE fan	2400	205.0	0.054	13.7	15.0
JE fan + Unit	2400	110.2	0.049	12.4	8.9

**SIMULATION RESULTS

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