

(ONE-) PIECE OFFERING

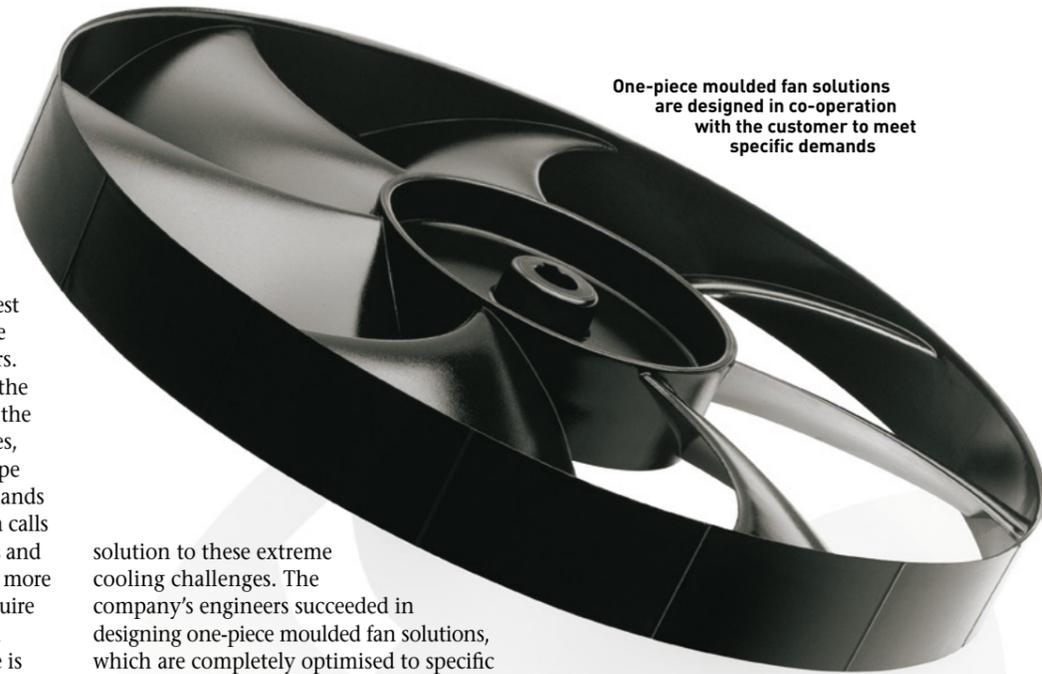
ONE-PIECE MOULDED FAN SOLUTIONS DRAWING ON THE PERFORMANCE BENEFITS OF CUSTOM ENGINEERING OFFER AN OLIVE BRANCH TO OEMs BATTLING AGAINST THE TOUGH COOLING DEMANDS CREATED BY TIER 4

▶ Going right back to the implementation of Directive 97/68/EC from the European Parliament on 1 January 1999, and the Environmental Protection Agency's Clean Air Nonroad Diesel Rule on 11 May 2004 in the USA, meeting the resulting emissions regulations has been one of the greatest challenges facing the world's engine manufacturers and their fan suppliers.

These regulations, which govern the systematic reduction of pollutants in the exhaust of off-highway diesel engines, have now reached Stage IIIB in Europe and Tier 4i in the USA. Cooling demands are increasing as a result, which often calls for greater performance requirements and larger cooling packages. However, the more stringent exhaust limitations also require the addition of emissions reduction components – and installation space is already limited inside any given machine.

Therefore, installation space to fit Tier 4 engines is a crucial variable in developing compliant cooling solutions, and engine manufacturers and their partners must explore all options to cope with these space limitations and cooling demands.

Multi-Wing's R&D team analysed the Tier 4 challenge and worked closely with its customers in the off-highway and agricultural markets to develop a special



One-piece moulded fan solutions are designed in co-operation with the customer to meet specific demands

solution to these extreme cooling challenges. The company's engineers succeeded in designing one-piece moulded fan solutions, which are completely optimised to specific performance requirements, inlet conditions and driving arrangements. To design these custom one-piece moulded solutions, Multi-Wing follows an innovative process using cutting-edge technologies and a wealth of engineering experience, working in close collaboration with every customer.

Co-operative process

The supplier helps its customers meet complex air-moving requirements by tailoring solutions based around one of the broadest ranges of modular axial fan components on the market. "We are well known for engineering custom air-moving solutions to answer each customer's needs," explains Multi-Wing's global innovation manager, Lisbeth Tonsberg Dahl.

"However, there is still a difference between what we accomplish by working with customers whose engine-cooling projects have been designed, and what we can achieve with a one-piece moulded fan that we design to fit the construction, driving arrangement and fan together as an optimised package.

"Imagine what we can accomplish with a fan that was precisely designed for a customer's requirements for airflow, or reduced noise, or static pressure. With these new capabilities we're engineering

fans that are a vital part of the engine design and performance, instead of merely selecting fans to accommodate an engine after it has been designed."

Once Multi-Wing added custom-engineered, one-piece moulded fans to its array of almost 10,000 axial fan selections, it refined its processes for the one-piece fans. "We developed a fast-track in our innovation process and the related tools for tailoring operational performance management, including a review-and-update process after each customer's specific project," Dahl notes.

Delivering tailored, one-piece moulded solutions in conjunction with a layered understanding of each customer's specific needs and applications requires firm project management and communication.

"The ability to manage projects in accordance with tight schedules and on-time delivery is essential," she adds. "Multi-Wing defines clear roles and responsibilities for every phase of the project together with the customer, and conducts weekly meetings with meticulous action plans to ensure follow-up. Some of our OEM partners have extreme cooling challenges, and we supply those customers with professional, global support across all our business functions."

Cutting-edge technologies

Multi-Wing's long-term investment in new technologies has pushed its R&D team beyond conventional fan designs, enabling them to engineer one-piece moulded fan solutions that target specific air-moving challenges in the off-highway diesel-engine cooling industries. Using computational fluid dynamics and other innovative technologies, Multi-Wing's R&D team studies the performance of specific sections of a fan blade, and then optimises that performance for the targeted design criteria.

The company's engineers use flow diagnostics to determine key variables including mean velocity, turbulence intensity, and the effect of contraction ratio in the working section of the fan blade. This wealth of performance data and geometric requirements enables the R&D team to design an exact scale model of a fan blade from a 3D file using its in-house rapid prototyping machine. Each model also goes through exhaustive wind tunnel analyses at its global R&D facility.

Emissions regulations worldwide have presented various air-moving challenges for off-highway diesel engine users, and the company has successfully translated its axial fan expertise and technical

knowledge into versatile one-piece moulded fan designs.

The company's advances in fan engineering have been fuelled by customer partnerships and driven to success by the long-term experience of its engineers, as well as aerodynamic research. That level of experience is a vital asset in working in co-operation with its customers' development departments to design one-piece moulded axial fans. The resulting one-piece fans are completely optimised to performance and engineering requirements.

"In short, our design now follows a three-step iterative process," Dahl explains. "Firstly, we use advanced optimisation algorithms to construct the blade. Second, we pre-qualify the blade performance using computational fluid dynamics (CFD). Finally, we use experimental verification of the blade performance, which provides feedback to optimisation with preferences from the designer.

"Multi-Wing complements the design process with a rigorous test phase to validate performance, ensure durability and document the results. Therefore, to ensure success we have systemised and quality assured every design iteration step with failure mode effects analysis (FMEA) methodology," Dahl notes. "And prior to

these standard operating procedures, we will supplement the methodology with advanced product quality planning (APQP), which is used within the automotive industry as an essential quality assurance tool. We also see APQP required more and more often outside this sector."

The impact

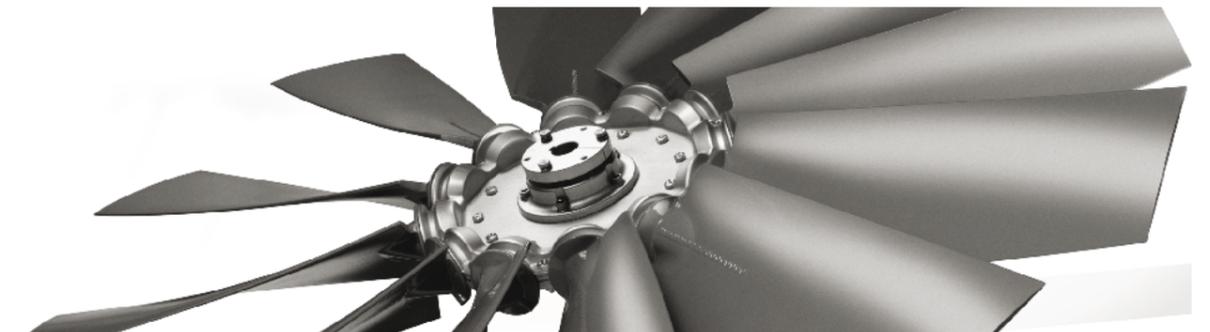
"Multi-Wing has designed one-piece moulded fan solutions that provide distinct advantages for its customers across a variety of applications," Dahl concludes.

"For example, we have been able to improve efficiency by 5% in an engine cooling application, and we also reduced noise by approximately 10dB(A) in a radiator application. In fact, one of our customers received an environmental award for launching a new and much more energy-efficient solution using our moulded fan. It's already proving to be a valuable piece in a variety of cooling puzzles." **IVT**

Rikke Juel Erlandsen is brand manager at Multi-Wing International, responsible for marketing activities and branding, and has worked at the company since 2008

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The PressureMAX™: Engineered for Tier 4 cooling packages

Multi-Wing designed the new PressureMAX™ blade profile to handle the high heat rejection requirements and ambient temperatures that result from Tier4/Stage III B emissions standards.

The PressureMAX™ delivers 20 percent more static pressure and is 5-7 percent more efficient than standard airfoil profiles, saving horsepower and fuel. And with nearly zero blade deflection its narrow axial depth makes it a perfect fit for Tier 4 engine compartments.

The PressureMAX™ has an available diameter range of 627 to 1295 millimeters and is molded in glass-reinforced polyamide.

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Cooling challenges and emission regulations can be ably met by one-piece moulded fan solutions