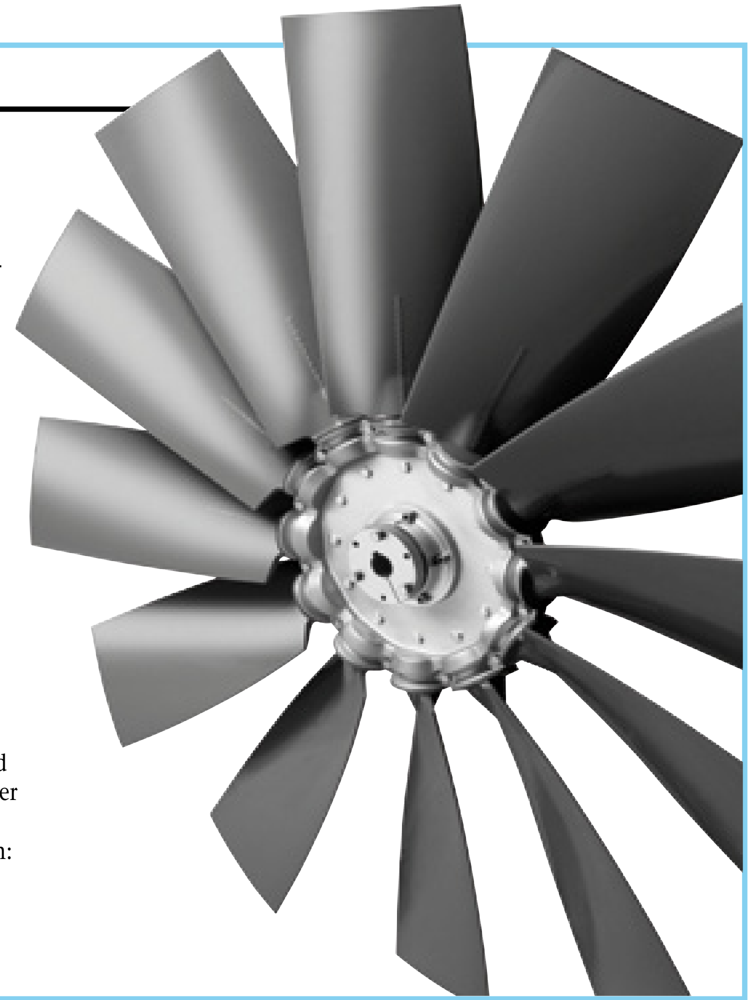
THE NEED FOR HIGH-PRESSURE FANS



When Multi-Wing launched its PressureMax design initiative, the axial fan manufacturer wanted to create a vital tool to assist engine manufacturers in meeting Tier 4 emissions standards. Achieving compliance has resulted in some complex aftertreatment systems that have increased heat-rejection by 40% in some configurations. As space in engine compartments dwindled to accommodate these systems, the need for a narrow-profile versatile impeller that can generate higher static pressures in the cooling package was evident.

Using CFD, 3D modelling, flow diagnostics and rapid prototyping, the design team studied variables such as turbulence intensity and the effect of contraction ratios in the working section of the blade to hone the impeller's performance for the target design criteria.

Tier 4 engine compartments essentially require high-pressure fans, and the PressureMax delivers up to 20% more pressure than standard airfoils. The new profile is also a high-efficiency fan, which helps reduce emissions. In fact, the PressureMax reduces parasitic power loss, providing 5-7% more efficiency than high-efficiency airfoil blades. That translates to a real return on investment through increased fuel savings over available fans.

Multi-Wing's R&D engineers used several special techniques to study blade behaviour during operation, inspiring designers to create a blade that delivers virtually zero deflection. This high-efficiency design reduces airflow turbulence across the blade, giving the impeller a low noise signature.

Ultimately, the new profile has combined revolutionary engineering and a glass-reinforced polyamide construction to deliver a high-pressure, high-efficiency fan with virtually zero deflection: crucial for the broad range of demands and limited space in Tier 4 installations.

www.multi-wing.com

A STATE OF INDEPENDENCE WITH HYDRAULIC FAN DRIVES

Traditional direct-drive engine-mounted fan systems consume excess power because the fan speed is dependent on engine rpm – as this changes, the fan is often driven faster than what is required to cool the engine. This inefficiency becomes even worse at high fan speeds as the power required to increase fan speed increases exponentially by the power of 3. Direct-drive systems also have difficulty achieving high cooling levels at the intermediate speeds that form a large part of industrial vehicles' duty cycles.

These systems also require a larger tip clearance to allow for independent movement between the engine and radiator assembly. This reduces the efficiency of the cooling air flow across the radiator by as much as 10-15% compared with a hydraulic fan-drive system where the radiator, fan motor and fan are attached to each other.

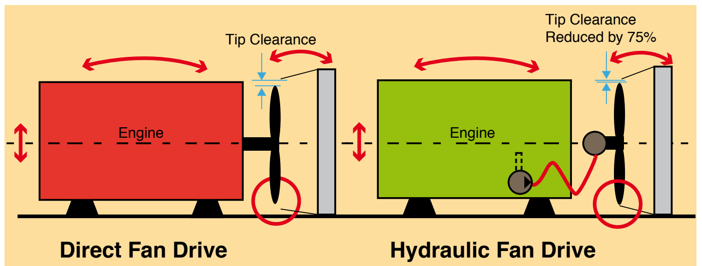
A hydraulic fan-drive system enables variable fan speed that is independent of the engine rpm, providing only the cooling that is required throughout the whole operating range, including such requirements as the maximum engine-rated torque point where high cooling may be required at lower-than-maximum rpm. It also allows for ramping of the fan speed command to avoid shock and to idle the fan during engine start-up to preserve power. This full fan control can yield considerable fuel savings.

Parker has three fan drive motor and pump technologies that can be supplied for fan drive functions. Each of these technologies – gear, vane and piston – offers distinct advantages in terms of initial purchase cost, lifetime cost, efficiency and noise.

The most efficient hydraulic fan-drive solution consists of a variable piston pump driving the vane motor. This produces the exact flow needed to control all the functions, including the desired fan speed, with no inefficient bypass flow diverted to tank. A fan-reversing valve cleans the radiator and ensures optimal radiator efficiency. A fan-speed sensor can also be installed in the vane motor to, for example, ensure fan speed is at its lowest before it reverses.

Total efficiencies of Parker's P1 piston pump range from 85-91% depending on pump size and operating conditions to ensure maximum power stays with the vehicle.

www.parker.com



AVID – OUR FRIENDS ELECTRIC

Providing for the highly accurate control of the fan system with a degree of packaging flexibility can be achieved via electrification of the cooling fans and the use of hydraulic drives. However, for a fully featured system that has been correctly designed for the application, an electric fan solution can offer the greatest degree of flexibility and, when combined with an efficient vehicle charging system, the best overall efficiency.

Avid Technology and its partner EMP Advanced Products are seeing their eFan Micro Hybrid systems become widely adopted across the heavy-duty vehicle industry, with over 6,000 units fitted in the USA, delivering fuel savings of 5-15%. The system uses ultra-high-performance electric cooling fans, an electronic controller and a new heat exchanger design to create a highly efficient thermal management system.

The fans can be easily reversed to clear trapped debris out of the heat exchangers, so the cooling pack can be kept cleaner more easily, which not only leads to a reduction in overheating, but also increases the life of the heat exchanger. The risk of damaging the heat exchangers during cleaning is also greatly reduced.

Another factor in increased machine uptime is that it uses a bank of several fans, which provide a certain degree of redundancy should any one part of the system develop a fault. The system also has a greater degree of control, so it is better designed to cope with sudden surges of heat in the cooling module.

The technology has been embraced by the bus industry and Avid is now developing systems for off-highway applications in heavy-duty mining and construction machinery. The system offers great potential to improve fuel consumption, and also increase machine reliability.

For example, one customer, who previously suffered overheating-related breakdowns at least every week in a bus application, has not had a single incident for over nine months (including the summer months) since adopting the eFan Micro Hybrid system.

Another customer reported that maintenance cost savings resulted in a payback of under 12 months, because the extensive heat exchanger cleaning and replacement regimes that were

needed to keep its vehicles operational have now been reduced to a weekly press of the system's fan reversal button. The same customer also noticed a significant fuel saving.

Avid has recently designed and installed a Micro Hybrid system to suit the engine characteristics and packaging constraints on a rigid dump truck (see above) operating in an opencast mine. The system included a high-efficiency 12kW alternator, which provides the electrical power for the system at full load, with the total load on the engine being around 14kW – comparing very favourably to over 110kW used by the standard fan. This should result in a corresponding reduction in fuel burn. Avid is keen to develop systems for other off-highway machinery and is looking for partners with suitable applications.

www.avidtp.com/microhybrid