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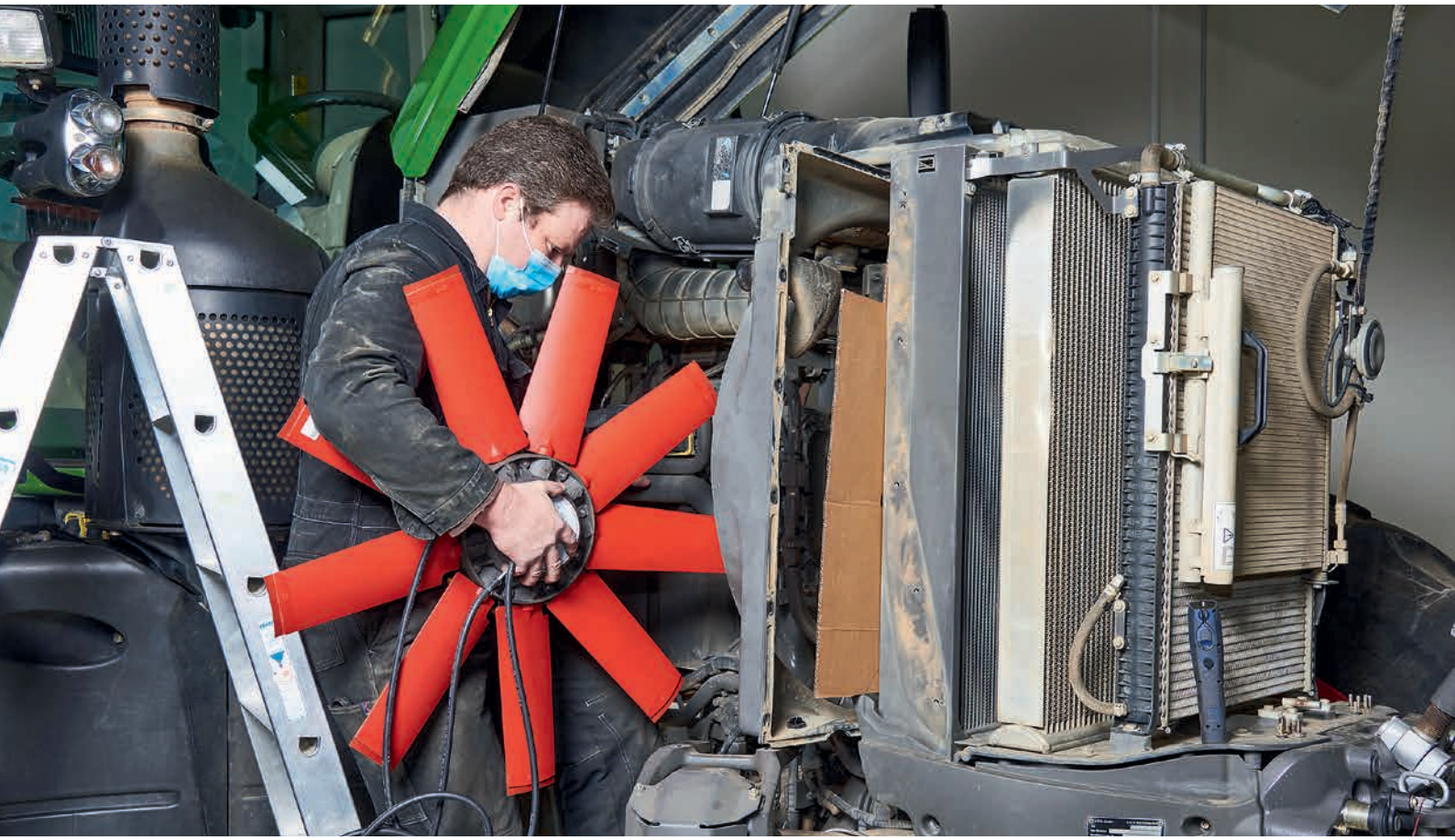
Hägele Cleanfix cooling fan:

Expand your fanbase

Reversible cooling fans are pretty common these days. But this one really does come with a useful twist...



He's a big fan. Retrofitting a Cleanfix unit isn't necessarily difficult but can take a while. To see the effect we asked the DLG to measure pto power and specific fuel consumption on New Holland and Fendt tractors, before and after fitting. Photos: Uhlig.

Engineer Karl Hägele reckons that simply spinning a conventional fan backwards doesn't generate much air blast. It is, he says, "Like trying to eat soup with an upside-down spoon."

While you ponder that little nugget, here's how his family of Cleanfix fans – developed over the last 20 years – serve their version of air soup. Rather than reversing drive direction, they reverse each of their blades. Air should then move just as efficiently as before, but in the opposite direction. So, where a fan normally sucks cooling air through a radiator pack, it will now blow it. More flow means that dust and chaff clears more readily, says the maker, maintaining cooling efficiency so power output and fuel consumption don't suffer.

Notionally that's a step forward. Another is to control blade movement according to the engine's cooling demand. That's hardly new either, but Hägele fans do it without a hydraulic or viscous coupling; they retain direct mechanical drive from the engine, so there is no energy lost though coupling slip.

This all looks promising. To see how theory translates to practice, we asked the DLG's test centre to measure full load pto power and fuel consumption of two tractors, both before and after fitting a Cleanfix fan. The candidates were a fresh-out-the-box New Holland T7.270 and a 2017 Fendt 936 Vario with 4,725hrs on the clock. Before conversion, a separate run checked pto power and fuel use with 20% of the coolant radiators' area blanked off. As neither tractor carried a reversible fan, this simulated part-blockage by chaff. Here's a bit more detail.

Operation, options, cost

How is fan blade direction reversed? There are two retrofit options (SC and VP), both working in the same basic way. The fan's hub holds short vertical racks, one for each blade, moved by a small hydraulic or air actuator. Each blade carries a pinion on its inboard end which engages with one rack. Operation can be triggered by the user from a cab switch, or automatically via a timer: when triggered, the racks move in unison. Every blade turns swiftly through a pre-set angle to reverse airflow completely, then after switch-off return to their start position under spring pressure.

Cleanfix VP models adds an external wax pellet actuator to the root of each blade. Similar to the unit which opens an engine's coolant thermostat, it varies blade angle

THE SHORT VERSION

- Hägele Cleanfix fans reverse airflow by reversing their blades, not the whole fan's direction of rotation
- Operation can be manual or automatic, with or without automatic modulation
- Retrofit kits suit many tractors
- DLG measurements showed more pto power and lower fuel consumption with a Fendt 936 Vario, but not a New Holland T7.270
- Factory-fit versions from John Deere, CNH and Fendt offer fully integrated, closer fan control.

according to the temperature of air coming from the radiator(s). Beyond 60°C, the actuators progressively alter the angle of attack of the blades, increasing or decreasing airflow through the rad(s) in line with changing air temperature. Hägele says that the VP can reduce fan power requirement by up to 60% at low engine loads. Additionally, blades on both models can carry optional Flex-Tips, which the maker says increase airflow by 8-15% and so allow lower fan speeds.

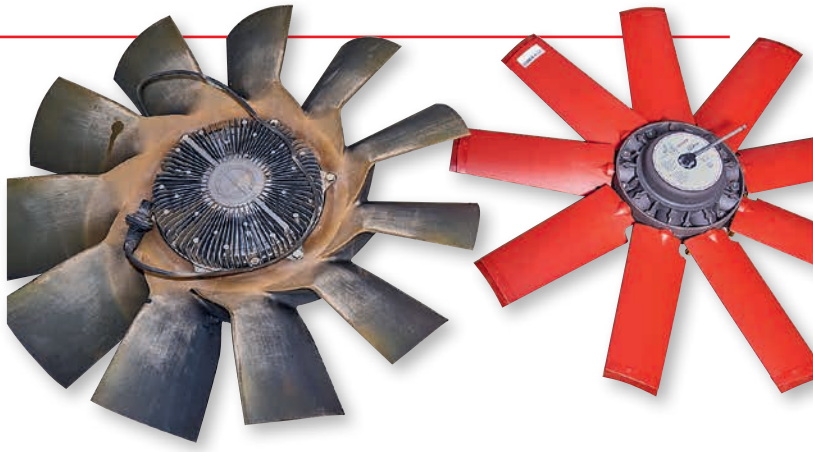
There's also the SF (Seasonal Reversing Fan), which can replace designs where the user would normally reverse all blades by hand to avoid overcooling in winter – though there's not much call for that in the UK. And beyond all three are the PH/HT (Pulstronic/Hydtronic) variants, which integrate with engine management and are supplied only to machinery makers. For more on those two, see p26.

You might guess that Cleanfix fans are not cheap. An SC kit for a New Holland T7.270 comes in at €1,600 + VAT, while extras for a Fendt 936 Vario (an engine speed sensor and pneumatic valving) lifts this to €2,000 + VAT. Fitting will take around 10hrs depending on complexity – so consistent savings on running cost will be needed to pay for conversion.

Effects

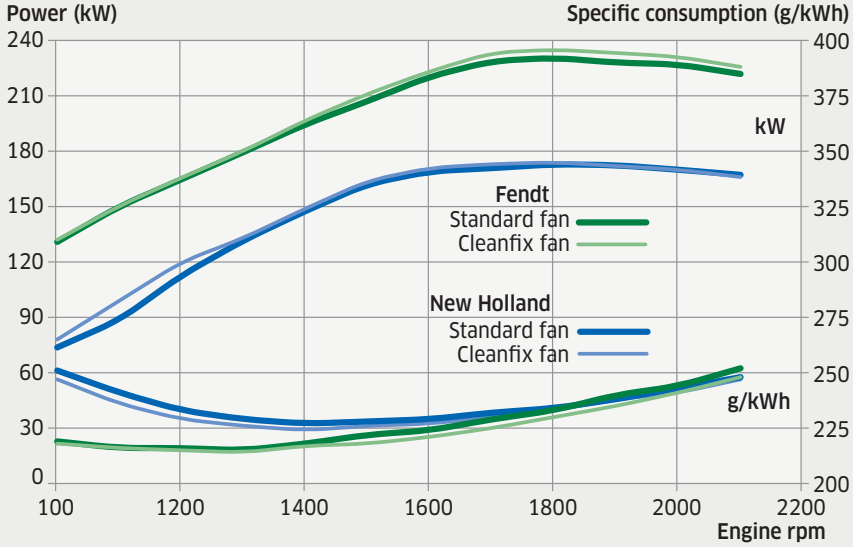
New Holland first. At rated engine rpm, pto power was 167.2kW/224.2hp with the standard fan and 166.0kW/222.6hp after conversion. A drop, but inside measurement tolerance. The position flipped at maximum power rpm; 172.9kW/231.8hp with the standard fan climbed a tad to 173.9kW/233.2hp, but again inside measurement tolerance. Things were much the same with specific fuel consumption: before and after values were 248/247g/kWh at rated speed, and 234/233g/kWh at max power. So there was no significant improvement at two key points on the full load curve. However, both power and fuel consumption did benefit from the Cleanfix fan below 1,400rpm, which in some work would be useful.

Coolant temperature, though, did change. At max power with the standard fan this steadied at 93°C, yet with the Cleanfix in place it dropped to 850C at the same point. If the engine was effectively overcooled at max power, it could explain the lack of improvement in output and fuel use in that area. Hägele suggested that a better solution for this tractor would be New Holland's factory-fit Cleanfix option, which promises much closer temperature control. Interestingly, blanking 20% of radiator area didn't affect either the NH's max power (173kW/232hp) or specific consumption at max power (234g/kWh).



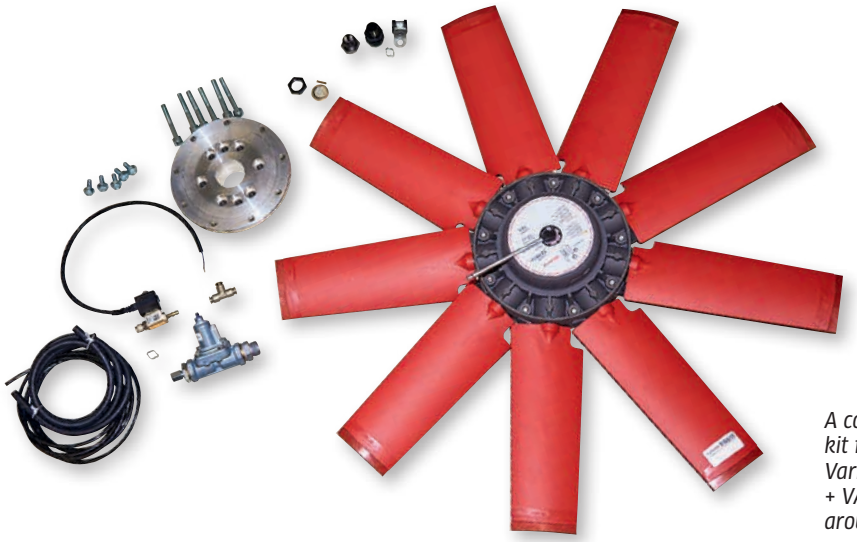
Compare the Fendt 936 Vario's viscous-coupled fan (left) with the equivalent Cleanfix item.

PTO POWER AND SPECIFIC FUEL CONSUMPTION



With the New Holland T7.270 the Cleanfix fan has little effect beyond 1,300rpm. Fendt's 936 Vario benefitted more, showing higher power and lower fuel use at both rated and max power rpm. Graph: Tovornik.

		New Holland T7.270		Fendt 936 Vario	
	Fan	Standard	Cleanfix	Standard	Cleanfix
Engine RPM	Rated power	167.2 kW	166.0 kW	221.8 kW	225.7 kW
	maximum power	248g/kWh	247g/kWh	252g/kWh	248g/kWh
Maximum power	Power	172.9 kW	173.9 kW	230.6 kW	235.0 kW
	Consumption	234g/kWh	233g/kWh	233g/kWh	230g/kWh
	Temperature	93°C	85°C	92°C	88°C



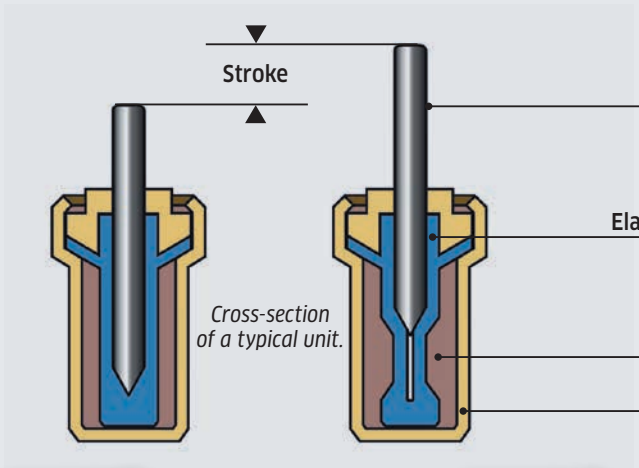
A complete retrofit kit for a Fendt 936 Vario lists at €2,000 + VAT. Fitting takes around 10hrs.

And the Fendt? Definitely more effect. On its standard viscous-coupled fan, the 936's pto power at rated speed was 221.8kW/297.4hp, rising to 230.6kW/309.2hp maximum at 1,800rpm. Specific consumptions at these points were 252g/kWh and 233g/kWh. The Cleanfix fan lowered water temperature by 40°C and raised pto power: this went up by 3.9kW/5.2hp at rated speed, and by 4.4kW/5.9hp at max power rpm. And in parallel, specific fuel consumption dropped by 1.5% at rated speed. The Fendt's coolant radiator may have less spare capacity than the New Holland's, as blanking off 20% of its area saw the standard viscous fan's speed rise by 100rpm, max pto power drop by over 5kW and specific consumption climb by 4g/kWh.

HOW THE BLADE ACTUATORS WORK

Each Cleanfix VT blade has a wax pellet actuator. The principle is simple. Wax contained in a metal body surrounds a block of elastic material; in this sits a pin. Beyond a threshold temperature the wax expands, squeezing the elastic material and pushing up the pin. Fan blade angle increases, airflow through the radiator(s) goes up and water temperature drops. Cooler air coming from the rad(s) means the wax contracts, so the pin moves back and fan blade angle decreases. Coolant thermostats commonly use a similar actuator to move a flow restrictor.

WAX ACTUATOR WITH ELASTIC INSERT



Cross-section of a typical unit.

Below the actuator's threshold temperature, blade angle is at minimum and the actuator pin retracted.

Right: As air temperature rises, the actuator pin extends and blade angle goes up in proportion.

BEYOND RETROFIT

Separate from its retrofit business, Hägele supplies fans to machine makers across various industries. These units tap into the engine's electronic management, reading coolant temperature directly and so allowing finer-grained and faster reaction to changes. Blade angle on such fans can be varied from 30° to 43°, using either compressed air (Pulstronic) or pressurised oil (Hydtronic). Farm machinery with a Hägele fan as standard or an option include the new John Deere X9 combine and tractors from Case IH/New Holland (Optum/T7HD) and Fendt (800/900 series).

Summary: Hägele Cleanfix fans set out to move air through radiators efficiently in both directions. They do this by reversing all fan blades automatically, rather than changing rotation direction of the whole fan. The engine's original fan drive stays put but any viscous coupling is removed, so the associated slip loss disappears. The VT version adds actuators to let fan blade angle track air temperature as it leaves the radiator(s), while both SC and VT versions can carry optional fan tips said to reduce power requirement.
Measurement of rated and maximum pto power at full load, plus associated specific fuel consumption, was made with standard and Cleanfix fans fitted to two tractors. Results showed little change to one tractor, although its coolant temperature reduced. The second tractor showed significant gains in pto power and a reduction in fuel consumption.
A separate test with the standard fan in place assessed powers and fuel consumptions with the coolant radiator partly blocked, simulating chaff build-up. Again, one tractor showed no change in power or fuel use. But with the second, pto power dropped and both water temperature and specific fuel consumption rose. With that tractor, the ability to unblock the radiator effectively from the cab would further boost gains already produced by the Cleanfix SC fan.

Hubert Wilmer, Andrew Pearce

profi international, Kelsey Publishing, The Granary, Downs Court, Yalding Hill, Yalding, Maidstone, Kent ME18 6AL, UK Email: Mark.Brazier@kelsey.co.uk Tel: 07813 671484