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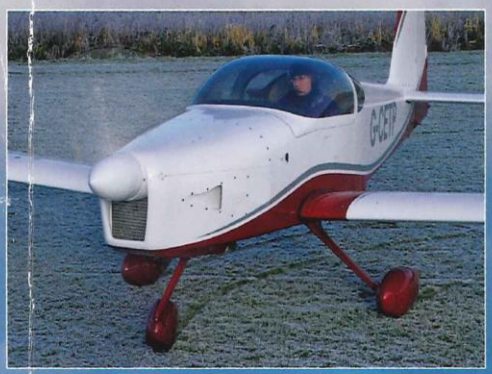
Diesel-powered two-seater kit



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Van's RV-9A

The RV-9A is a great handling two-seat tourer. When fitted with the Wilksch diesel engine the range grows and direct costs drop. Ian Seager takes a look

When Dave Boxall and Steve Hill decided to build an aeroplane neither of them held a fixed-wing licence, (although Dave had a balloon licence), and neither had any homebuilding experience either.

Building an aeroplane and learning to fly at the same time is an ambitious project, all the more so in their case, given that they went for the flat-pack rather than quick-build version of the RV-9A. To add to the challenge, during the build they decided to fit a Wilksch diesel, requiring the design and construction of a bespoke cowling and all the challenges that brings.

It took six years to build G-CETP, with the first flight in April 2009. Since then, the aircraft has flown about 90 hours. When I met with Dave at Wadswick strip, the conditions were positively arctic. Before pulling the aeroplane out of the hangar, he took the top cowl off and talked me through the engine install. While there are six WAM RV-9s flying in the UK and one in the USA, no two installations, or cowls for that matter, are the same. Dave and Steve decided to stick with the standard Wilksch cooling pack, which puts the intercooler and the coolant radiator at the front of the engine, the intercooler meeting the air before the coolant radiator. Their policy of sticking with the factory cooling pack significantly reduced the need to redesign systems and to source or fabricate non-standard parts – they may have been ambitious, but they knew where to draw the line!

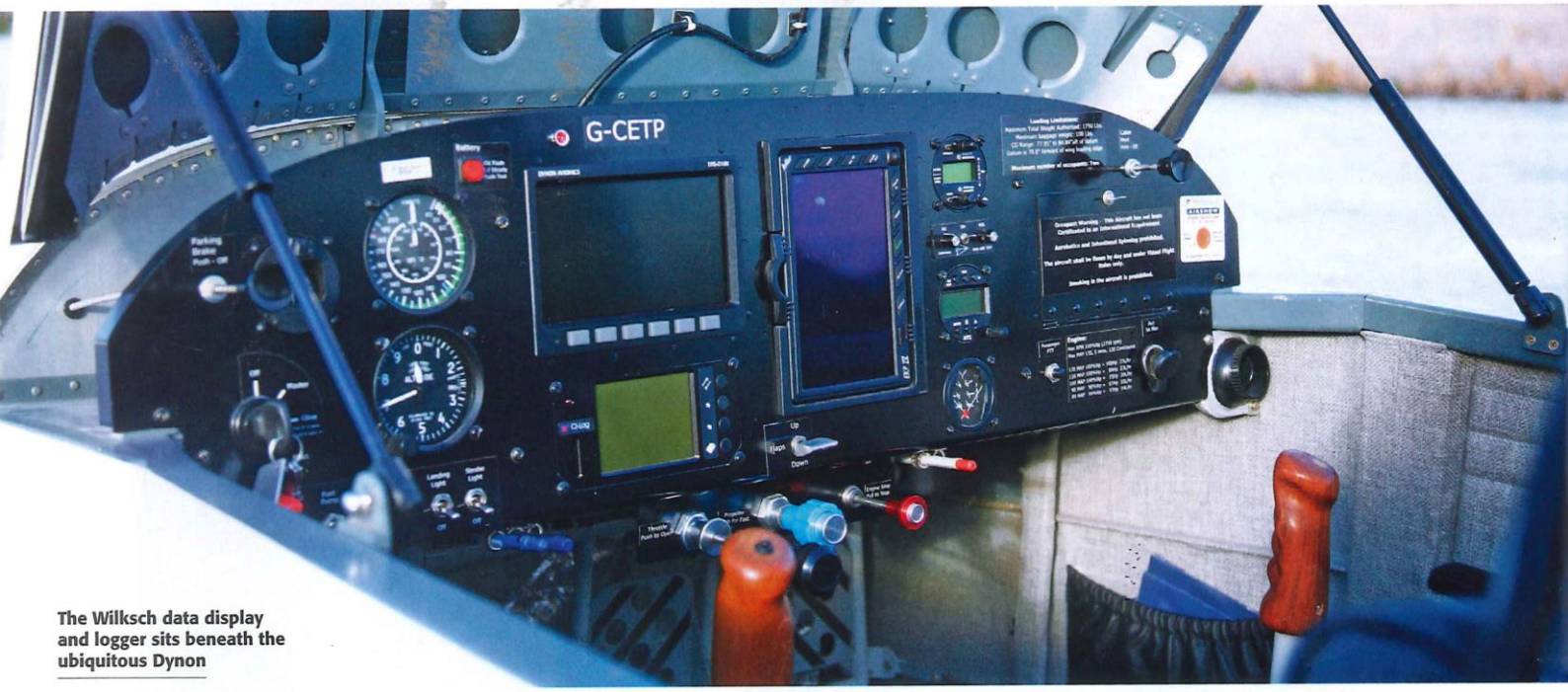
The result is an impressive installation; the Wilksch fits nicely in the cowls with plenty of room around it. The basic layout has the engine inverted, with the supercharger on the right (looking from the cockpit) and the turbocharger to the left. The mechanical fuel injection resides at the rear. Dave showed me the cowl plugs they had to make in order to be able to fabricate the cowls themselves – not a minor undertaking. That said, with six Wilksch-powered aircraft flying, new builders have the option to beg, borrow or steal a cowl plug from an existing builder.

With the factory cooling pack putting the large radiators at the front of the cowling, any builder is clearly stuck with some kind of large hole in order to get cooling air in. Additional air is required and here builders vary in their approach. Dave and Steve went for large, NACA ducts on the side of the cowl, while the Shobden RV-9 group opted for LoPresti-like intakes above the radiator inlet. It's difficult to compare the result of the two approaches, at least in terms of performance, as they tend to run slightly different power settings as standard, and the Shobden aeroplane has a three-bladed prop against TP's two-blader.

To be blunt, none of the cowls contribute to the beauty of the RV, although the vertical extent and configuration of the Wilksch does mean that the cowling is reminiscent of some of the types which house various Gipsy engines; the effect is enhanced if you rub your eyes before squinting.

After our good poke around the engine bay, Dave practised the Van's recowling ritual, threading a wire through hinge-like fasteners formed by mating the top and bottom cowls – it gets easier as the fixings wear a little bit, and

The deep cowling is necessary due to the engine's inverted in-line configurtation



The Wilksch data display and logger sits beneath the ubiquitous Dynon

easier still if you have a slow power drill rotating the wire. It's not the easiest of tasks, but the result is aesthetically pleasing and low drag.

After pulling the aircraft out, Dave ran me through the decision to build a nosewheel rather than taildragger aircraft. This subject causes arguments of biblical proportion. With a nosewheel aircraft, ground-handling is significantly easier and although there are weight and drag penalties they are pretty small. The flip side is that the nosewheel configuration is less robust than the taildragger, as several nosewheel RV owners have discovered. The Shobden group, which also operates an RV-9A (the 'A' designation means nosewheel), restricts operations to hard runways. Dave and Steve operate from a grass strip, and they've fitted a main-wheel-sized nosewheel.

Other choices include a flip-up canopy rather than a slider. The single-piece flip-up provides better visibility, while the slider, as chosen by the Shobden group, makes for easier entry and exit.

The temperature outside is hovering around minus-silly-something – and limited daylight means a warming trip to the farm shop's excellent café is out of the question. I stand there shivering while Dave jumps in to start the engine and taxi towards a bit of sunlight. It's bloody cold, the coolant temperature in the hangar reads minus five, so I'm not entirely surprised when the engine doesn't fire at the first attempt. In fact, it doesn't fire the second or third attempt either, and just as I'm contemplating a warming hot chocolate, the little WAM comes to life. It sounds like a diesel, but as there's no gearbox, there's no clatter either.

Getting into the cockpit involves climbing on the wing and then onto a mat placed on the seat. There's a pair of control sticks and a central plunger for throttle and prop alongside a fuel shut-off valve. Above those is the electric flap switch and, mounted centrally on the floor, is the manual elevator trim, with the manual aileron trim worked by a small lever between the seats. Electric trim is optional and one that I'd probably choose, were I ever to get riveting. Dave's chosen a combination of Dynon glass and AvMap IV GPS, there's also the Wilksch CI-Log which displays power settings and Ts & Ps, which also logs the engine parameter data.

Winter flight

Luckily the first start had got everything warmed up nicely. The glow plugs are activated not by a separate switch, but by moving the ignition key to a certain position. There's no indicator light telling you that they're on, or that they're warm enough; after a brief pause and turn of the key, the engine started. Sitting in the cockpit with a pair of Bose X it was pretty quiet, although there's no escaping a certain lumpiness at low rpm. Taxying is by differential brake and always done with the stick fully back. The power checks are brief and include making sure that the fuel cut-off works and that the propeller governor is fully supplied with nice warm oil.

A quick full-and-free and we're off (with that stick well back), the flaps come up and we climb away at full power. The CI-Log display has a couple of dials that represent manifold pressure and rpm, but they're not marked in inches, bar or anything else for that matter. Simply there's a number and MAP. The propeller is measured in %, so when it reads 100% you know that the engine is turning at 2,750rpm. Maximum power is 135MAP with max continuous being 110MAP. With max continuous power set and the prop dialled up to 100% we set the pitch for a cruise climb, which sees us heading up at about 800fpm (by my calculations we are at mauw).

Dave likes to cruise at a setting on 90/90, which roughly equates to a manifold pressure of 53in and an rpm of 2,475. Depending on weight,

High-hour RV-9

OF THE SIX RV-9S flying with the WAM engine in the UK, G-EGBS is the highest-hour example. As you can probably guess from the registration, the aircraft is kept at Shobden and the group is known as the Shobden RV-9 group. The group was formed in 2003 with the specific intention of building a diesel-engined aeroplane. Five years later, in April 2008, the RV was finished and flew. David Johnstone, the group secretary, has kept meticulous records and tells me that BS has notched up 415.88 hours and has consumed 6,232 litres of Jet A1, an average of just under 15lph. David goes on to explain that in those 415 hours the aircraft has made 693 landings, something explained by the amount of circuits flown by the six members as they got used to the aircraft – and that makes the fuel consumption even more impressive.

David tends to cruise with 85 set on the MAP and 85% of max prop rpm – figures that yield 110kt. Unlike G-CETP, BS has a three-bladed prop and although I wasn't able to compare it for myself, I'm told that the extra blade makes for a much smoother engine, particularly when the throttle is at idle on approach. As the highest-hour WAM in the field, the group has a particularly good handle on the maintenance requirements. Every fifty hours the oil is changed (four-and-a-half litres at £7/litre) and oil and fuel filters are changed (a total of £14). The engine is burning about one litre of oil every ten hours, so that adds about £35 every 50 hours.

The engine in BS experienced a premature failure of the pre-combustion chamber when in Scotland, resulting in the three-cylinder RV becoming a two-cylinder RV. This and one other failure led the factory to life the PCCs to fifty hours. Given that they're made with a mixture of unobtanium combined with expensium, a new set of three costs owners £500 every fifty hours. That's a lot of money (nearly a third of the hourly operating costs), but the group, which estimates the share value to be about £8,500, charges members £50 a month and then £40 per hour wet – excellent value, and that's even taking the expensive PCC replacement into account.

this yields a low-level TAS of between 117kt and 120kt. With those settings, it's burning about 16lph, so the 136lt tanks will give you maximum endurance of just over eight hours and a range of around 1,000nm, although I'd want to be pumping in some more cheap fuel before getting anywhere near those numbers. Every aeroplane seems to have a power and speed combination that feels right, and this RV-9A is a joy at 90/90. It's not blisteringly fast, but is probably ten knots quicker than most of the UK club fleet, while burning significantly less.

The handling is excellent, a bit stiffer than other RVs, but ideal for long-distance, relaxed touring. Don't get me wrong, the handling is not at all boring or turgid, in fact I think it's one of the nicest handling, easiest to fly aeroplanes that I've ever flown. Slow flight is also very stable and predictable, and we go on to fly a couple of stalls, one clean and one with full flap, both benign.

By now the warmth of the sun has both banished my shivers and burnt through the earlier cloud, leaving us with one of those magnificent winter days. Wiltshire is stretched out beneath us, it's a real joy just to be airborne in such a nice aeroplane, and what is even better is the knowledge that we are burning just 16lph of Jet A1 while doing it – at today's prices that puts the direct fuel cost at something like £11.50 an hour.

Much as I would like to stay airborne all day, it's time to head for home. The fact that the WAM is liquid-cooled means that shock cooling isn't a concern, so if you're hot and high (well, OK, perhaps just high in this aeroplane) a significant throttle reduction will see you heading down without speeding up too much. In fact, Vne is 182kt and the only way that you are ever going to get there is with a serious application of both power and forward stick.

As ever it's easy to fly and easy to trim and the big bubble canopy provides a great view out. I find that there is a slight temptation to fly the approach a little fast (no point, it'll just float and float) mainly because I want to carry a trickle more power during final to reduce the engine vibration, but a combination of the ASI and the AoA sees us safely back on the ground, all the time with as much weight as possible off that nosewheel.

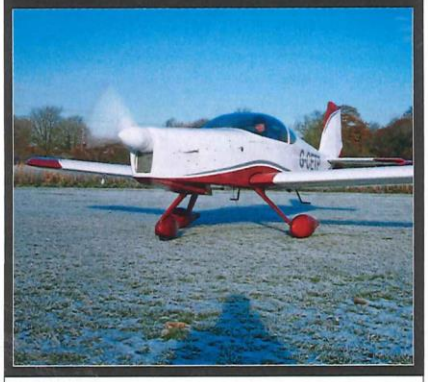
So, to the big question, does the WAM-engined RV-9 work as an aeroplane? There are a couple of caveats, but the answer has to be a resounding yes. The RV/WAM combination mates a fine airframe with a frugal engine and that results in a comfortable tourer that caresses rather than pillages your wallet every time you fill up.

What's not to like? Well, as ever there are some compromises that have been made and some calculated risks that have to be taken. Starting with performance, the WAM RV-9A is not the quickest RV on the block, returning about 120kt. That's certainly fast enough for relaxed touring or the weekend bacon butty run, but it's not a blistering pace. Then there's the RV-9's wing which has been optimised for the aforementioned comfortable touring. It does that very well, but if you're the kind of pilot that hankers after a quick loop or roll to end the day, then remember that the RV-9 is not an aerobatic machine.

When it comes to the engine, it's important to bear in mind that there are currently about twenty WAM engines flying (not all in RV-9s). The good news is that this small number means you can talk directly to the specialists at the factory, and that they're going to be pretty responsive. The downside is that with such a small number installed and with a relatively low number of hours flown in the field, it's still early days and as an early adopter you're really part of a larger development team. If you start straying from the factory norms you can find yourself off-piste and into long development cycles pretty quickly.

Notwithstanding those factors, the WAM RV-9 is a great two-seater that puts most of the UK certified fleet to shame. What's more, even taking into account the shorter TBO and the hefty £500/50hr cost of the pre-combustion chambers, it still works out significantly cheaper than fitting an O-230. Witnessing the care that's taken with the nosewheel and the hard runway-only restriction imposed by the Shobden group, I think that building a taildragger may be the way to go. ■

TECH SPEC
Van's RV-9A



DIMENSIONS

Length	6.2m/20ft 5in
Height	2.4m/7ft 10in
Wingspan	8.53m/28ft

WEIGHTS & LOADINGS

Empty weight	471kg/1,036lb
Mauw	727kg/1,600lb

PERFORMANCE

Vne	182kt
Cruise	120kt
Take-off	525ft
Landing	375ft
Rate of climb, mauw	800fpm
Fuel, usable	136lt

COST

Standard kit*	$21,610
WAM 120	£15,000

*Excludes engine, prop, avionics, paint, interior and tools.

ENGINE
Wilksch Airmotive WAM 120

SEATING
2

CONTACT DETAILS
www.vansaircraft.com
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Wilksch Airmotive

WILKSCH WAS STARTED by Mark Wilksch and Martin Long in Buckingham back in 1994. Phil Franklin joined them a few years later, bringing more technical expertise to the team. Mark is no longer involved in the project and it's now in a purpose-built facility at Gloucester Airport where it develops and manufactures diesel engines.

The current 'generation one' engine is a three-cylinder, 120hp, two-stroke indirect injection engine that is both supercharged and turbocharged. The engine's three cylinders are inline and the engine's inverted with a direct drive to the propeller. TBO is currently 1,000 hours.

The WAM enjoys a couple of potential advantages over the Thielert 2.0 and some other diesels: for starters, there's the issue of weight. While the WAM will never be as light as the Rotax

912, it is significantly lighter than the Thielert with a complete typical installation coming in at 135kg including VP prop and governor. The other potential advantage concerns electronics. While the Thielert and Austro AE300 both have FADEC at their heart, the Wilksch has purely mechanical injection. You need the glow plugs and starter to get it going, but once running, there's no need for any electrical power.

The company is busy testing the 'generation two' engine. It maintains the same three-cylinder block casting, but incorporates a bigger bore, new pistons and a new cylinder head. The pre-combustion chambers, parts that currently have a fifty-hour life, are also a completely new design and the plan is for these to be lifetime items. The 'generation two' engine will shortly begin endurance testing. The company is intending to offer it as a replacement to existing customers at a very advantageous cost. Longer term, the plan is to develop a four-cylinder variant by simply adding a cylinder. Most of the design work for this has been completed and if projections are correct it ought to deliver an engine in the 160-180hp range.