



XPRESSO

Reg Clarke's Subaru Powered Dragonfly

BY JACK COX

Sometimes it pays **not** to know everything about a given subject, at least initially — and Reg Clarke (EAA 376693) of Wetaskiwin, Alberta is good case in point. When he decided he wanted to replace the VW engine in his Dragonfly with a Subaru EA81, he saw no reason why he couldn't run it direct

drive as he had the VW. To his surprise, however, when the word got out on his conversion, "experts" from all over began predicting it just wouldn't work. The engine couldn't produce enough power at the low rpm he would be restricted to, they said, to offset the additional weight of the radiator, coolant, hoses and such. Fortunately,

he had already been flying the airplane long enough to know better, so he just continued to zip off to Oshkosh, Sun 'n Fun, Copperstate and anywhere else that struck his fancy. Today, with well over 300 flight hours on the Subaru, he feels he is building a pretty good case for his conversion.

Reg grew up on a farm in central



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Alberta and was 21 when he and his brother, Bud, decided to buy an airplane and learn to fly. They bought a Cessna 140 from another farmer and had it delivered to them — then quickly found that was the easy part of winning their wings.

“It was a challenge to find an instructor who could fly a taildragger and was willing to get up at 5:00 a.m. to give us flying lessons before our work day began,” Reg recalls, “but we eventually succeeded.”

As soon as he obtained his license, Reg decided it was time to go on a little trip.

“That’s what planes are for, right? I had three friends who wanted to go with me, but for various reasons, including the fact that I was a brand new pilot, they all canceled out before the day of departure. So, I went alone . . . east to Toronto, south through Duluth, MN, down to Arkansas and Texas, west

to Arizona, back to the east side of the Rockies and north to Alberta. All the ‘problems’ my friends had anticipated — availability of rental cars, the weather, my inexperience, etc. — proved to be no problem at all. I don’t understand that way of thinking. If you have a goal, you just go for it!”

After a few years, Reg bought a Cessna 120 of his own and replaced its Continental C-85 with a 100 hp O-200. It was a perfect match, he thought, but after a time he came to realize that it really didn’t satisfy his need for speed. It was also too expensive to own and operate. Reg wanted to be able to do his own maintenance and annuals, and he wanted to be able to make modifications without all the paperwork and hassle from the government, so, inevitably perhaps, he found himself being drawn to homebuilts. In surveying the amazingly large and diverse number of designs

available, the Q-2 and Dragonfly were the airplanes that caught his eye, so he proceeded to learn as much as he could about them. In the end he chose the Dragonfly, largely because it had more wing area and thus could be used to visit more of the private strips that dot the wide open spaces of Alberta.

To get a head start, Reg sought and managed to find a partially completed airframe. He bought it and finished it up with an 1835 VW for power and the optional inboard-type main gear rather than the standard canard tip gear. Finally in his element, he really enjoyed the building process, as well as dreaming up and making modifications to squeeze a little more performance out of the airplane. Wing fillets, his own cowling with side opening exits for the cooling air and low drag wheelpants were among his improvements, and, indeed, they did increase performance. The Dragonfly was already a very



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clean design, however, so his program of aerodynamic cleanup quickly reached the point of diminishing returns — with the next logical step being an increase in power.

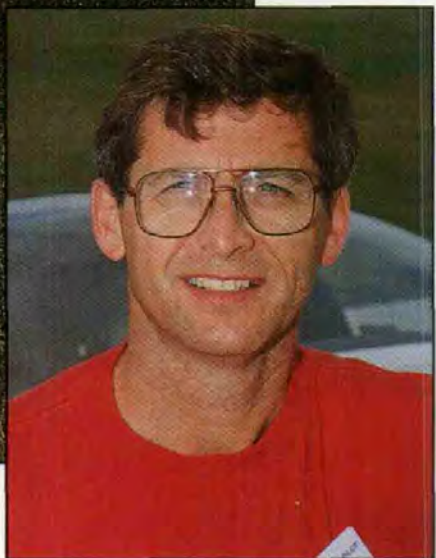
Choosing a Subaru engine for use in the Dragonfly was fairly straightforward. Other than the VW, it was virtually the only affordable powerplant that would fit in the low-slung airframe

and not significantly alter its sleek lines. It was a flat four with dimensions similar to those of the VW, so a cheek cowl could still be used, and the Dragonfly's side-by-side fuselage was wide enough to provide sufficient room ahead of the firewall for the radiator needed for the liquid cooled Subaru. From the beginning, Reg recognized the need for using a 3-blade propeller in order to absorb the power he eventually hoped to pull out of the engine and still have adequate ground clearance.

Reg ordered his EA81 from an importer in Albuquerque in order to get the Asian version of the engine, which is a little easier to convert to aircraft use than the U.S. version that has all the anti-pollution devices and systems required by law. After installation, he flew the engine about five hours and found that it seemed to have about the same power as the 1835 VW. After be-



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Reg Clarke



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ing satisfied that it was reliable and had enough muscle to fly the airplane with a direct drive propeller, Reg pulled the four banger out to add a turbocharger. Subaru makes its own turbochargers, so he picked one that appeared to be best suited for his anticipated needs and installed it on the engine, with a manual wastegate so he could control the boost from the cockpit. He used the stock auto electronic ignition, except for MSD racing wires for the spark plugs. The plugs themselves were stock automotive items. The Asian EA81 runs two carbs, but Reg chose to use an Ellison throttle body injector. He had to make up his own intake manifold in order to get it

within the cowling, and his exhaust system ended up as little more than two tubes running to the turbocharger and a single outlet extending from it to the slipstream.

The turbocharger made a world of difference, increasing the speed of the airplane significantly, tripling the rate of climb to 12,000 ft. and cutting down a great deal on noise (the turbo is an efficient muffler). In anticipation of higher speeds, all the airplane's control surfaces had been balanced to just over 100% . . . and, as it turned out, the propeller had to be tweaked. To pull the

desired power out of the Subaru at cruise, Reg turns its 54 inch, 3-blade Warp Drive propeller between 3,400 and 3,800 rpm, but initially the prop tips were going supersonic at that speed. Gary Hunter, who is the crew chief of Bruce Bohannon's Formula One racer, Pushy Galore, and has a few tricks up his sleeve regarding high rpm operation of propellers, reshaped the blades for Reg and now they function normally as fast as the Subaru is capable of turning them in level flight. On high speed passes at air shows, Reg sees 4,200 to 4,500 rpm, which very definitely has



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the tips going supersonic, but without the noise one might expect.

Cooling the engine, it turned out, was the biggest challenge Reg would face in converting the Subaru for aircraft use, with his problems largely centered around the radiator, its positioning and the difficulty of getting an adequate flow of air through it. Initially, Reg used a VW Rabbit radiator, mounted inside the engine cowling. It was adequate for most operations, but

limited him somewhat at high altitude where he likes to cruise. The engine, itself, always performed flawlessly. It was torn down at 100 hours and found to be in excellent condition. It was re-assembled with lower compression "turbo" pistons and has been operating without problems ever since.

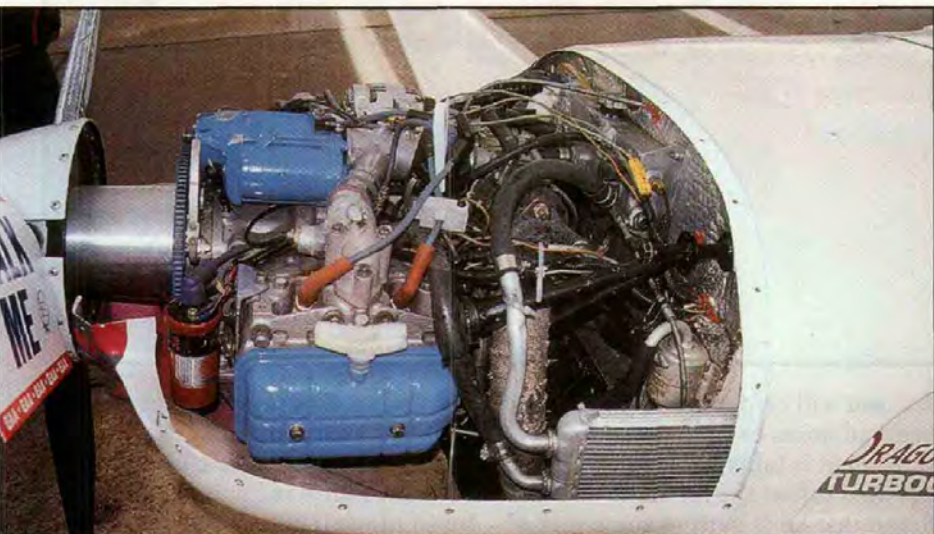
Reg flew the Dragonfly with the turbocharger and radiator inside the cowling through the 1994 fly-in season, then put it back in his shop last

winter for a major upgrade. First, he had a radiator custom made for the airplane and mounted it on the belly of the fuselage, directly under the cabin. The scoop in which it was enclosed was extended well back along the bottom of the fuselage and shaped so that the exhausted cooling air was accelerated back up to the speed of the slipstream. Steel braided aircraft hoses mounted on the outside of the fuselage were used to run the coolant between



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(Below) The direct drive, turbocharged Subaru EA81 engine used in Xpresso. It has been balanced and blueprinted, the cylinder heads have been match-flowed and the combustion chambers have been cc'ed. A six inch prop extension is used to put the 54 inch, three-blade Warp Drive propeller out in clean air to improve its efficiency. This picture was taken before the intercooler was installed.



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the engine and radiator. Moving the radiator aft also moved the CG back a bit, but this was compensated for by moving the battery.

A key to the successful operation of the engine after the turbocharger was installed was the use of an automobile knock sensor, because it allowed Reg to lean more precisely — but it also told him his induction temperature was too high and he needed an intercooler. (An intercooler is simply a radiator mounted downstream between the turbocharger and the engine to cool the intake air.) Initially a VW intercooler was used, but on one of the early test flights, its plastic header tank literally blew apart. After a successful forced landing, Reg welded up his own header tank out of aluminum and there have no subsequent problems. The intercooler lowered the induction temperature by 100 degrees and allowed much harder running of the engine at high altitude — and, of course, better performance.

With all of last winter's mods in place, Reg flew Xpresso to Oshkosh this past summer, truing out at 175 mph at 7,500 ft. and burning about 4.5

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gallons per hour. He has an aux tank mounted behind the cabin, which gives him a total fuel capacity of 26.5 gallons and a duration of over four hours, with VFR reserve. The airplane weighs a little over 750 pounds, varying, of course, each time a modification is made, and has a gross of 1,200 pounds.

Reg operates an aircraft upholstery business, so it's not surprising that he has a beautiful leather interior in his Dragonfly. He says the semi-supine seating is very comfortable on the longest trips, and that one of the great advantages of having a liquid cooled engine is that it enables him to have a real heater. It's a must for winter flying in Alberta and keeps the cabin comfortable at high altitude any time of the year. The Subaru, 3-blade prop and turbocharger package is a very smooth and quiet combination that makes flying more enjoyable than anything else he has ever flown, Reg says.

"I can sit in it all day and not get tired. In my Cessna 120, I was worn out after half a day. I really love flying the Dragonfly and with the turbocharged Subaru, it's quite a performer. Best of all, it's still very economical to operate."

This winter Reg is doing a little more tweaking on his airplane. He has torn the engine down again for a look-

see, and will continue to do this every hundred hours or so to determine exactly what is taking place inside. He has also tufted the airframe and has found that he is getting some turbulence in the air outlet gills on the sides of the fuselage and on the bottom of the fuselage ahead of the radiator. He will close up the gills a bit and try to fair the exposed radiator hoses on the bottom of the cowl — and hopes to show up on the fly-in circuit this spring with an even faster airplane. He also expects to have company in 1996. His brother, Bud, who lives in Helena, MT, is finishing up his own Dragonfly which is powered by an EA82 Subaru, also turbocharged and intercooled, with a Ross planetary reduction unit. They are looking forward to comparing their direct drive and geared reduction setups to see what the advantages and disadvantages really are. If they can make it out of still wintry Alberta and Montana in April, they plan to have both airplanes at Sun 'n Fun '96.

Back in the early days of EAA, there were very few aircraft designs available for homebuilding. Individuals designed and built their own airplanes and took them to fly-ins to show them off, and if others liked them they would bug the builder for plans. That's the way many of the early

marketing programs got their start, and it still happens today. Reg Clarke simply wanted an affordable high performance airplane and proceeded to build himself one. When he showed up at Oshkosh and Sun 'n Fun with it, other EAAers began asking for information on his Subaru conversion and eventually he responded by producing a couple of video tapes that show how and what he did. The first one shows how he zero timed, blueprinted and balanced his EA81, and the second details the firewall forward installation, including the various systems he's designed and built. The tapes sell for \$49.95 (U.S.) each, and you can get both for \$89.95 (U.S.), plus \$6.00 U.S. for shipping. The address is Air-Ryder Manufacturing, Inc., P. O. Box 6896, Wetaskiwin, Alberta T9A 2G5, Canada, phone/fax: 403/352-5001. Reg will also build up a Subaru ready to bolt on your airplane and can make prop extensions, intake and exhaust systems, etc., like those he has on his Dragonfly. Call him for details.

The message in Reg Clarke's story is obvious: it is still possible to build an affordable, high performance sportplane, if one is willing to do most of the work. Actually, there has never been a time when you couldn't, you just have another engine option now. ♦