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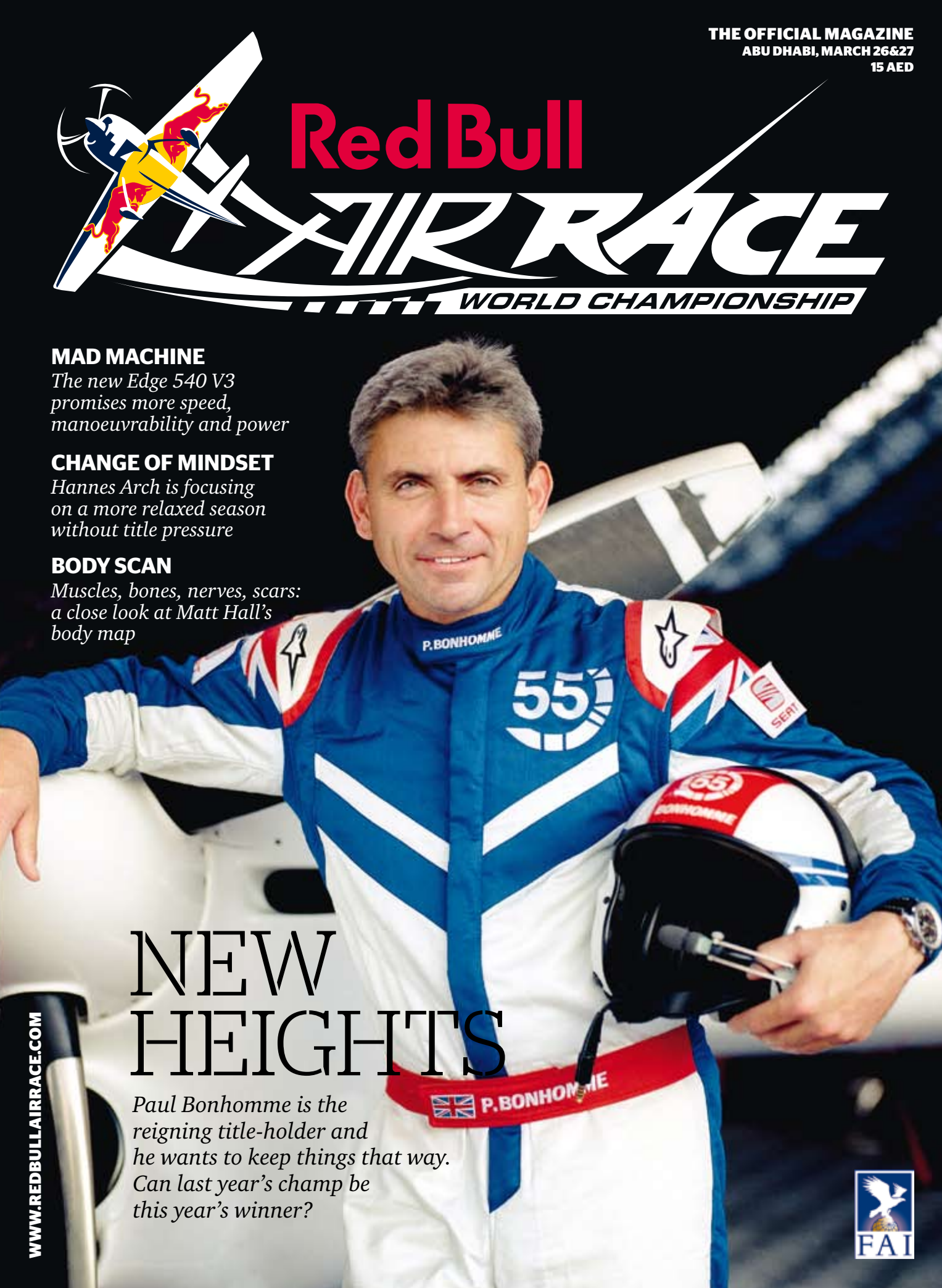
Red Bull AIR RACE WORLD CHAMPIONSHIP

MAD MACHINE
The new Edge 540 V3 promises more speed, manoeuvrability and power

CHANGE OF MINDSET
Hannes Arch is focusing on a more relaxed season without title pressure

BODY SCAN
Muscles, bones, nerves, scars: a close look at Matt Hall's body map



NEW HEIGHTS

Paul Bonhomme is the reigning title-holder and he wants to keep things that way. Can last year's champ be this year's winner?

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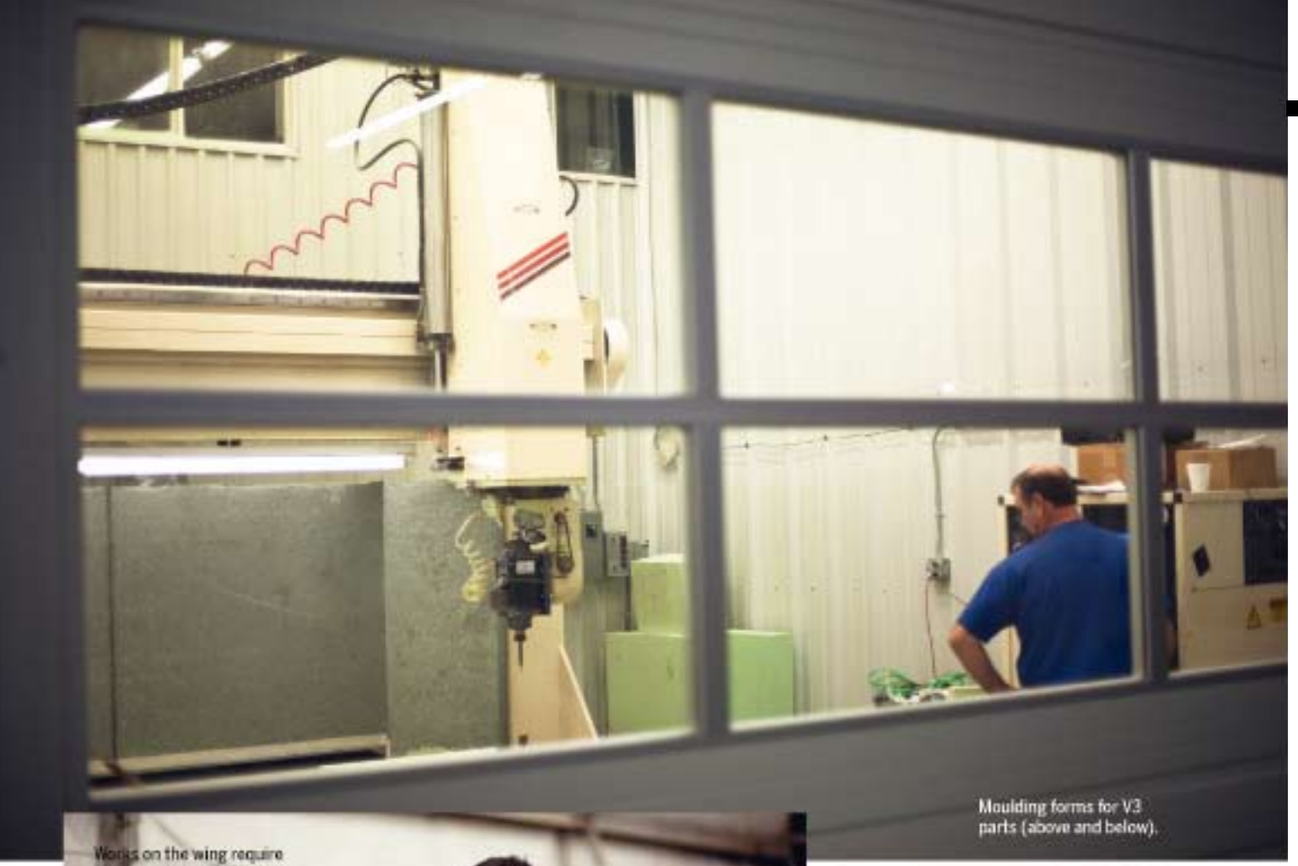
FAST BEAST

It arrived in February, in the middle of nowhere. They call it the beast, the mad machine or simply V3. Reason enough to check out its birthplace.

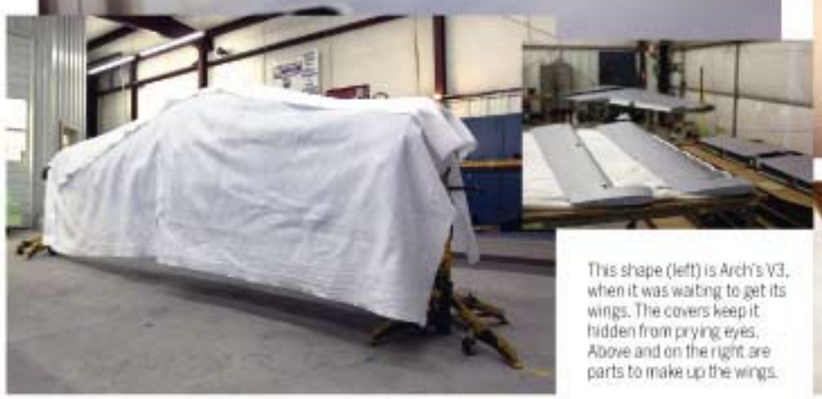
WORDS: NADJA ŽELE

Photography: Markus Kucera/Red Bulletin



Moulding forms for V3 parts (above and below).

Works on the wing require the precision and absolute focus of Eric Zivko's team.



This shape (left) is Arch's V3, when it was waiting to get its wings. The covers keep it hidden from prying eyes. Above and on the right are parts to make up the wings.

"The V3 is better overall than the V2. It's definitely quicker, but also more manoeuvrable than the old model."

Guthrie, Oklahoma, USA, is an out-of-the-way place. A couple of small houses dotted here and there. A highway with gas stations and motels on either side. Fast-food stands... There are no skyscrapers and you'd be wasting your time if you went looking for fine cuisine in nearby Oklahoma City. But who cares about that? The one thing we're really interested in right now is a plane so fast that its pilot will be able to fly through the Red Bull Air Race track even better than in 2009. And they've got it here, in Guthrie. This secret project is being worked on under corrugated iron roofs at the airfield and it's only being shown to anyone who's not connected with it covered up. And it will stay that way until its new owner decides to unveil what's hoped will be a very fast beast.

Just to get things straight, the Edge 540 V3 – or Version 3 – is not a new plane. It is said to be "just" a cosmetic improvement on its predecessor, the Edge 540 V2. There's a V1 too – the prototype – but it crashed a long time ago somewhere in Asia. It was slightly damaged, but it has been reassembled by mastermind and manufacturer Eric Zivko, Zivko Aeronautics's vice-president, and his team. It's now on show in one of the company's hangars.

It's hard to believe that the V3 is really just a redraft. "It is. A completely new plane, developed from scratch, would cost at least a million euros," explains Zivko. "And that would be just the basic model, before adjustments and improvements. The Red Bull Air Race pilots can't afford that kind of plane, which is why we haven't developed a new one and currently have no plans to do so." The brand-new Edge 540 V3 costs about €270,000, which Zivko considers a bargain when you think what you're getting for the price. "Our profit margin is very tight. But some of the pilots don't have sponsors and have to pay for the plane out of their own pockets." Clearly, this isn't the talk of a salesman, so surely it must be a passion for flying and racing that motivates Zivko rather than financial gain. "We certainly don't make a fortune from our involvement in the Red Bull Air Race," he stresses.

Zivko Aeronautics is mainly financed via other projects. Described simply, these are oval pods that look as if they're intended for secret missions. What they actually are, however, are enclosures for special measuring instruments that can be attached to the outside of aircraft. Customers include universities, the US Navy and security company Northrop. "The enclosures contain scientific instruments that measure things like air humidity or pollution over the sea. The customer wants to install an instrument package on a wing of a plane or a UAV and doesn't know how to package it and get it hung on a plane physically or legally. We develop and design an enclosure that does the job the customer wants, airflow-wise, shape-wise, size-wise, and we integrate it into the plane, to the wing, whether inside or on the fuselage. Our main line of business presents a new, often large project every four to five days, which means that work on the race planes always gets somewhat delayed."

Building a stock Edge 540 takes 4,700 working hours on average. It took twice as long to develop and manufacture the V3 that Hannes Arch was the first to get his hands on. "One reason for the redesign was to get the manufacturing time down. It's a six-month project from start to finish now. So if we could cut that six down to four and a half or so, that would benefit everybody: us and the customers," explains Zivko.

Normally there are three to four people working permanently on the plane, but as other projects constantly intervene, the manufacturing time can increase slightly day-to-day. Changes of plan are also to be cut back in future. Zivko hasn't been affected by the financial crisis and is increasing its employee base. The 24 members of staff are soon to be joined by a new engineer and two or three new production workers. A new building is also due. There is no shortage of orders; the Red Bull Air Race pilots alone have ordered at least four planes.

"I've heard rumours that there are six or seven on order, but it's not true. We're currently still working on three." Kirby Chambliss says he's marked down as number three on the waiting list, which really rankles. "You must understand that I can't confirm one way or the other whether he's on the list at all," says Zivko, guardedly. "We treat everyone the same. Anyone who orders a plane gets a number. Everyone seems to think they know who's got what number. No one's heard anything from me." And how quick are these highly sought-after machines? "The V3 is quicker and better overall than the V2." By how much? "Erm, a lot. Certainly quicker but also more manoeuvrable than the old model."

If Eric Zivko had things his way, he'd most like to take off in a lighter plane. The minimum weight of 540kg, which part E of the technical rules and regulations stipulates, is slightly too heavy as far as he's concerned. "I could make a plane

Photography: Markus Kucera/Red Bulletin

"Steel tube is tough. We won't switch to carbon-fibre. Well, maybe, but only if we build a completely new plane."

quite a bit lighter and we could hold the same strength and stiffness that we have now," he says. Structurally, the V3 is the same as its predecessors, but cosmetically and aerodynamically it's 60 per cent different. The wing's only been slightly modified. The tail design hasn't changed at all, as if it had it would have affected the overall structure and then Zivko would have had to do one test after another, which neither he nor his customers have time for. "This thing has 20,000 flight hours on it, it hasn't changed. It's a very good, known quantity."

Between the wing and the tail, though, everything is remarkably different. One thing, however, will probably never change: Zivko has kept with the steel-tube fuselage. "The biggest reason for that is that if it's damaged in any way, you can see it and it's fixable. Anybody with a welder at the race can fix a tube if it's broken. That's one of the disadvantages of the composites, if you break it, you can break it internally and it still looks OK on the outside. You won't know it's broken until it snaps and then it's broken. So you have to X-ray it. Steel-tube cracks first, you can see that it's cracked and then you weld up the crack and it's OK. Also the shape is great, the tubes are crossed all over the place, those are all different load pads that, if one tube would break, it goes through another tube, because there are so many of them. Steel-tube is tough and can get damaged. We won't switch to carbon-fibre. Well, maybe, but only if we build a completely new plane and who can say if that's going to happen!"

Work has been ongoing on the V3 for a year, chiefly thanks to engineers Todd Morse and Steve Morolyn. And in July last year it became known that the Edge 540 V3 would be racing in 2010. On the whole, the V3 is now much more of a racer than an aerobatics plane, which is what the Edge 540 was originally. "Although you'll still be able to do aerobatics in it, I don't think any aerobatics pilot would be willing to pay money for a plane that's really quick and just about OK for aerobatics."

Which doesn't mean that the V3 will be completely ill-suited to aerobatics competition, and things depend less on speed in that discipline anyway. In aerobatics the pilots have to manoeuvre their planes in a set area, a box of air which is 1,000m long by 1,000m wide. They have to fly precise figures in this limited space and are then judged by a jury. So if you start with too much horsepower under the bonnet, you'll have a hard time keeping the plane in the zone as there are extremely high G-forces to cope with. Zivko explains, "The Sukhoi is really nice for that. It's powerful, but it's incredibly draggy, it's not a fast plane."

Another reason for revamping the Edge 540 was Eric Zivko's desire to make the job better for his engineers.

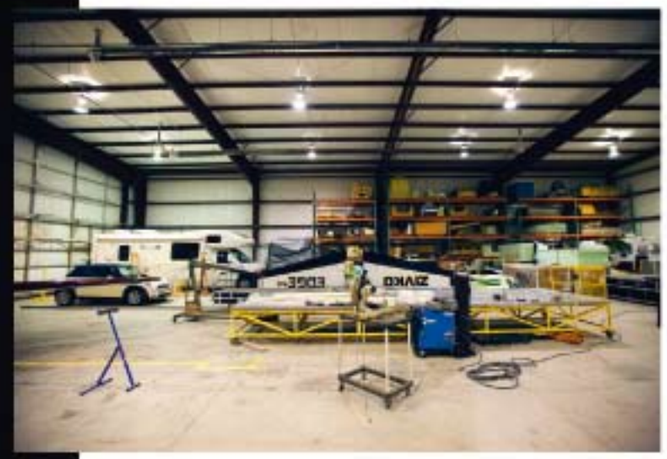
"I wanted to make it easier and quicker to disassemble and reassemble the plane and increase safety at the same time. Now the technician doesn't have to worry that he might have forgotten something when the plane was being assembled." It used to take six hours to take the Edge apart and one and a half days to put it back together again. Now the technician's job should take no longer than two hours, like for their MXS-R colleagues.

But how is it that the Edge 540, basically an aerobatics plane, still seems to be quicker than the MXS-R, which is supposedly almost tailor-made for the Red Bull Air Race? "I'll be kind. A lot of it has to do with our wing. Our plane is quite a bit stiffer than the MX, and I think that's a key component. And it is pretty tough too – you can break a big chunk of the tail off and the plane is still safe to fly. I know that there were a number of people wondering how the MX would have done with a bird-strike like the one Arch had in San Diego in 2009. It probably wouldn't have fared so well."

First and foremost, Arch was lucky, but Zivko stresses that the luck was also largely to do with the plane's design. "We've built lots of back-ups into the structure. If one part fails, the burden can be shifted and absorbed by something else that is strong enough to withstand it. Our plane is built to be tougher than it needs to be. And that's how it's going to stay. The Edge 540 was built based upon part 23 of the Federal Aviation Regulations (FAR), the design criteria of the American Federal Aviation Administration (FAA), which aircraft manufacturers such as Cessna and Beechcraft adhere to. We could have the Edge 540 certified, in theory, but then we'd have to do a whole host of tests for the purpose. And once the plane is certified, you can't change anything. You can't attach wing-tips or cowlings. You can't attach anything at all without doing tests for ages beforehand and having the part certified. Which is why racing planes are categorised as 'experimental', so that you can still legally make changes."

The Edge 540 V3 is a good-looking beast, a mad machine. The first pilot to try and tame it is Hannes Arch. Others will follow.

Last preparations before the wing finds it's way into the oven. Foil and fabric protect the actual component.



One of the company's many hangars (above); the bird-strike-damaged tail of Hannes Arch's plane (left), now has a new detail

The V3's strongest part (left). This part of the wing can withstand 34G. Baking time (above). The wing sizzles for almost four hours, first at 70 °C, then once the parts are joined, the heat goes up to 120°.

Photography: Markus Kucera/Red Bulletin

“LET’S BE MORE LIKE F1”

Eric Zivko has been involved with the Red Bull Air Race since 2004. He could be seen as one of the many consultants, as his expertise even flew into Part E of the technical regulations. Here are his thoughts and visions on the future of air racing.

Where do you think the Red Bull Air Race is going in terms of development?
I’ve always hoped and I’ve told them, too, that I would like to see it go more Formula One style. And I know that this is what they are looking for. They wanted to be a developmental arena for aircraft and that’s why they come up with safety equipment. Nobody has really done G-Race Suits for civilians before. The Red Bull Air Race have developed their own system, so they always kind of try to improve the safety aspect of the whole race. And one of the concepts behind it is to improve aviation in general, via the racing. I hope it becomes more like Formula One, where there are sponsored individual teams with possibly two aircraft.
One or more aircraft manufacturers, what makes more sense for you?
Well, a couple of years ago there was talk of having one design, but I was against it. Every time they asked me, I said that it was a bad idea. I know there are fans who go after the personalities, and then there are fans of the technology. And you can’t just cut the technology out by having one design. I think the more the better, I wouldn’t even be opposed of having each team have their own manufacturer. That’s were I would like to see it kind of progress to. The competition would be nice. It’s nice that the 540 has dominated, but I wouldn’t mind having more competition, and there really need to be larger sponsors and more sponsors. Each team needs to be sponsored and have a sizeable budget to race, because it is not cheap. There’s a reason Formula One costs as much as it does to keep everybody busy and always coming up with new stuff. I know that our sport is difficult and the teams now have to basically pay for themselves and do all modifications in a very short time. I would like to see new stuff being developed almost a year in advance, working not on next year’s stuff, but the year after’s.
The more manufacturers, the more dangerous this sport might get though...
I don’t know if it would be more dangerous. Whoever is writing the regulations now, it would make their job much more difficult, because they would have to stay on top of what everybody’s doing. The regulations are fairly loose now, only because the planes that are flying are known quantities. If somebody new came along, a new manufacturer, there would have to be a lot of testing done. Our plane has had a lot of flight time, the MX has a fair amount of flight time history on it. Somebody new, there is no history on it, so they would have to do a lot of testing – load testing, flight testing – and that would have to be all documented and submitted to Red Bull Air Race and approved, so it would make their job more difficult.
How much testing did you do with your new plane?
Structurally I know the plane is fine, as it’s based on the previous design. It was a month of flight testing in which we fine-tuned it.
Would you sell the V3 to anybody?
No, this plane is too specialised. It can do aerobatics fine, which is what the Edge 540 was, it was a competition aerobatics plane, that is where it started its life and it just happens to do racing well. The new plane is more race oriented, it does aerobatics fine, but I don’t think anybody is going to pay the money to get a plane that is really fast and does aerobatics well.
How happy or comfortable are you with the engine tuners?
I am more happy with some tuners than others. There are a couple that are very good and very safety conscious and they, I wouldn’t say they push the limits, some maybe more than others. I won’t name names. There are four, and a couple are really good and some that are not as good.
In what sense, not as good?
I think they don’t know all the secrets the other people do. There is an engine manufacturer that devotes a lot of time to developing new ways of doing things, new systems, new machinery. Some of the others don’t quite so much. I can’t answer for them, why they don’t. Maybe resources, money.
If you were a pilot, who would you co-operate with engine-wise?
Two of them actually. Ly-Con and Barrett. We’ve been associated with Ly-Con forever. We’ve been buying engines from them for our Edge 540 for a very long time. With the Edge 540 we kind of let our customer choose, but there were only two choices. Barrett or Ly-Con. We’ve tried some other ones and haven’t had good luck at all. But these two are our stable engine builders. But because we let our customers pick, most of them have been west-coast people and they’ve gone with Ly-Con. So we have probably bought 2:1, maybe 3:1 engines from Ly-Con than Barrett. I know Ken Tunnell quite well, and Rhonda and Allen Barrett. But we’ve been using Ly-Con more than Barrett, only because of our customer choice.
We’ve heard that Barrett is a slightly more conservative engine tuner. Is that true?
I would say yes. They build an extremely good engine. So, if you want a good-running, long-lasting engine, I think Barrett is hard to beat. Ly-Con seems to put a lot more money into development, but that’s kind of Ken’s strength, he does a lot more development.
Are you actually just dependent on the engine-builder or is more outsourced?
We outsource the canopy. We have it made to our specifications. The landing gear also. Everything else is built in-house.
What about the modifications the teams make on the Edge. Happy with those?
As long as they don’t mess with the plane structurally... There were a couple of people who did do some stuff and we had a fit about it. It didn’t help much, but it did help with the current planes, because the modifications that the people had done that we were very unhappy with, were grandfathered in, but it did change Part E of the regulations to be more strict on what you can and cannot do. Hopefully our complaining had a lot to do with that, because we told the Red Bull Air Race that it would end up with things going wrong. You simply can’t let people do these modifications to the planes unchecked and let them do whatever they want, so the regulations got tightened up quite a bit.
The new ones, for 2010?
Well, even last year’s. There was a G-limit, and I’d like to think that we had a lot to do with getting the G-limit set. It’s still too high in my opinion, but there were no limits before and there were no speed limits. The pilots fought for the speed limits. Really the only way you can govern the G-limit is by speed.
Would you make the Part E even stricter, if you had the chance to write it now?
It’s actually quite nice now. There’s some things I would like to see relaxed, but they’ve done it for the sake of safety.

Edge 540 mastermind Eric Zivko, vice-president of family-owned company Zivko Aeronautics.

Why does the MXS-R seem to be a little bit weaker than the Edge?
I don’t want to say anything too specific, because I don’t want to give them too many ideas, but I think a lot of it is just experience. MX Aircraft is a newcomer, to aerobatics even, we’ve been doing it for 20 years almost, and we have a lot of experience, a lot of experience with that plane, what does and what doesn’t work. If they had an issue, that’s probably the biggest one. Lack of experience.
Back to the new design of the Edge, have you integrated a lot of pilot feedback?
Some of it is feedback is from pilots, most of it is our own. We get feedback from some pilots, some pilots I don’t hear from at all. It’s our strict policy for any of our customers that I don’t reveal who our customers are and what we are doing for them, and that’s the only way we can survive.
So the newly built planes are not completely stock, they vary a little?
They are basically the same. We have some features on them that are customised. They are not completely identical.
And... who are the best race pilots?
I think the best pilots are all Edge 540 pilots, of course! I think the new guys are going to be a force to reckon with this year. Matthias Dolderer has certainly shown what he can do. I think he is somebody to watch very closely, and Pete McLeod. I think with a more current plane he is definitely somebody to watch. Yoshi Muroya and Matt Hall, too. They pretty much all are! However Paul Bonhomme and Hannes Arch are certainly hard to beat.

Photography: Markus Kucera/Red Bulletin