

## Red Bull Racing: It's Different

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I hadn't been to a Red Bull Air Race since the series' first year, when a Red Bull event was held in conjunction with the 2004 Reno Air Races. A lot has changed: the courses are faster; there is less "stunt" flying and more speed; and there are fewer aerobatic maneuvers. It's also possible that g-loads have increased, as well, particularly negative g-loads.



First, let me apologize to the pilots for even using the term "stunt" flying, even in quotes; but when I think back to a 6-foot chalk strip on the ground at Reno, there is no better term. Pilots had to touch their tires to this line to grab points -- a 250-mph touch-and-go, as it were. Go ahead and tell me it's not a "stunt." I'll disagree. Exciting? Absolutely, but what else can you call it?

Anyway, there would be no touch-and-goes in Detroit, if for no other reason than the fact that the course was entirely over the Detroit River. This, of course, poses its own set of problems, particularly since the weekend was inordinately gusty.

On "Training Day" Friday, a dozen of the special pylons went down, clobbered by several pilots (some nailed more than one). The pylons are inflated by giant fans, and stay servicable in winds to 35 mph or even a little more. Whether anybody really wants to fly between them, level or knife-edge, 60 or so feet off the water at 250mph, is another consideration.

The original pylons, made of a paper-like material, were all of a single piece, and replacing them proved cumbersome and costly. The new pylons are equally safe (and thus

fragile), but are made in sections, zippered together, so that a single damaged section (rather than a whole pylon) can be replaced. Crews can fix them up in just a couple minutes, important in keeping to tight schedules using airplanes with a set amount of fuel.

Some aspects of the Red Bull series are notably European in flavor. For instance, speeds are reported in kilometers per hour, instead of the aviation-standard knots (nautical miles per hour) or American-crowd-appreciated miles per hour. Since kilometers are shorter than miles, the bigger numbers must please race promoters, but American audiences generally can't relate. In a venue so close in time and distance to the previous week's Indianapolis 500, air race fans should be given results in mph, rather than exclusively in the European measurement. It's a little thing that could easily be done, and should be. The organizers may be European, but the audience in US events is overwhelmingly more-familiar with the old English system (no longer used by the English -- go figure).

Is Red Bull Air Racing exciting? Though I've heard a few grizzled aviation types dismiss it, my own observations of the fans (and my own gut) tell me that it's one of the greatest spectator sports, anywhere, ever. It has speed; crowds are close enough to see the action; there's noise, smoke, color, and personalities -- and the show doesn't



pause interminably as in other sports (for pitchers to get signals; for coaches' challenges to be reviewed; for dozens of yellow flag laps; for singing and bands; for political speeches). In other words, people get a lot of what they came to see, and not much of anything else. And what they come to see is

brehtaking. The best place to see clips, etc., is at the Red Bull site. You will really appreciate what's going on here.

### Specifically, Behind the Scenes

Here's the part of the Red Bull that you won't get anywhere else: the scene behind the show.

At Detroit City Airport (DET), where the pits are located, Red Bull set up a stand-alone village, with lounges, press area, an event restaurant -- the works. Each team had a huge private pit area in its own graphics-intensive tent module, complete with logos, photos, a private area, and color-matched rubber flooring. The privacy of the teams was strictly enforced, even to the point of prohibiting most press coverage.



Detroit, May 30, 2008

This makes sense, since the Red Bull is more of a "general audience entertainment" series than an "aviation enthusiast" event, and the press that cover such events don't know much about the aviation-safety aspect. One day they cover school board meetings, another day they go to a political rally or make commercials for their car dealer sponsors. They cover building fires and interview police spokespeople. Then one day they are sent to get footage for an air race. How different could that be? Not to disparage the local and national TV crews -- they have to be versatile -- but they really *shouldn't* be amongst twirling propellers as they instinctively walk backwards to get a wider shot.

The downside of this is that the true aviation press can't always get into the areas where their audiences appreciate the stories. With

the help of some folks at Red Bull, I managed to get into the pits and get some of these stories, things you won't read anywhere else.

### The Differences Between Red Bull and Aerobatics:

There are a lot of differences, in both the airplanes and in pilot technique.

Michael Goulian, one of the top airshow performers in the world, who is performing nearly every week at one venue or another, looks forward to the less-frequent air races. "It's a little hard to do both [air racing and acro shows]. When you do so many airshows, it actually becomes



Goulian applies gap tape

almost a routine. Now, when I do an air race, I feel refreshed when I come back to the airshows. It's more fun, somehow, when you haven't done one in maybe three weeks."

Goulian's Edge 540 runs a Lycoming Thunderbolt AEIO 580 EXP with "plenty" of horsepower, though that engine is 48 pounds heavier than the more-common 540-inch engines that most of the field runs. He tries to shave weight in other places, and that's always expensive, sometimes inconvenient, and always important.



Goulian's engine really is that clean!

The "modified airplane" wave really started last year with Mike Mangold, who made numerous changes to his own Edge 540 to optimize it for air racing. "He made all the rest of us effectively obsolete," said Goulian.

"We're trying to maximize horsepower and minimize weight to get there. It's a bit of a game, and we don't have a lot of time to experiment. For instance, when this race is over, the airplane goes into a box and heads to Sweden. How it's going to work there depends on how it works at the end of this weekend."

"Now [since Mangold opened the floodgates] we're all doing things as race pilots that you'd never think of as aerobatic pilots," he said, "like lightweight oil lines, light skins, all sorts of things. We're building parts for these race planes that are 'one-year throwaways,' like, well, look at that lightweight belly pan: it's already all cracked; I'll throw it away at the end of the season -- and it's 5000 bucks!"

Some mods are cheap *and* effective. Everybody, for instance, uses 400 x 4 tires. They don't last long, but they save six pounds over the stock six-inchers. Every ounce saved eventually adds up to pounds saved, and better times. "This airplane, compared to how it was, standard, is probably 30 pounds lighter," said Goulian.



There isn't much time for development, either. "Between seasons, we have realistically about 6 weeks to work. I got the plane home on January 2nd, and we were gone again in early March. In that time, you've got to build, modify, test for at least two weeks - - and don't forget the paint. This paint job took 450 hours -- four days. The paint shop worked with a whole crew, night and day."

Goulian expects the Europeans' advantage to really take over for the later races. The series will not return to the US until next year, after this race in Detroit (where Arizonan Kirby Chambliss won, "edging" Paul Bonhomme by 0.15 second). "Mike's [Mike Mangold], Kirby's, and my airplanes will be sitting in crates in Sweden while the other guys are practicing..."

### A Crew Chief's View

The pilots get the publicity and are the face of the series. Some, like Mike Goulian, also do the work on the airplanes. For the majority of teams, though, duties are split. The crew chiefs make the team members function as one, and are the ones who keep the planes flying, cover all safety aspects, deal with maintenance, some of the logistics, personnel, and safety of flight issues. They also have input to the design of modifications.

Dennis Sawyer, crew chief on Mike Mangold's Edge 540 (with Lycoming Thunderbolt AEIO 540EXP power), talked about more differences between running, say, the US/Canada airshow circuit and the Red Bull series. "The Red Bull schedule is such that there is a minimum of assembly/disassembly," he said, "but there is still a lot, compared to the usual, where an airplane is assembled at the factory and stays together, unless there is major damage."



Keeping the airplane together, particularly an airplane that is not designed for routine disassembly, is a good thing. "The only thing that's unusual on this design is that the wing comes off in one piece. It's lifted up and carried out. We try to keep things below the spar because of that, but there was no real modification made for ease of disassembly." Sometimes, that's a problem, but more of an inconve-

nience than an obstacle. "The wiring runs over the wing, so we have to pull the panel. In transit, it rides on top of the engine." The fuel tank and plumbing all have to come out, too, since they reside above the wing.



Unlike in air racing, Sawyer says, "in competition acrobatics, speed is actually a disadvantage." In the Red Bull, though, "a powerful engine helps." So does a clean airframe. "We're cleaning it up, taking it from an acro plane to a race plane, and we save weight. We run the small tires, too; and we use the smallest battery that will do the job. The fuel load is set by the rules, so we can't limit fuel..."

Lest one think that there isn't a lot of hard acro in the race routine, Sawyer said he's grateful for the quick roll rate of the Edge: "We see about 450 degrees per second. Remember, we rarely roll more than 90 degrees at a time." Quick enough?

Both Sawyer and Goulian opined that their horizontal tail surfaces could be smaller for the Red Bull series, but as Goulian said, "Some day, though. we're going to have to sell these airplanes, and the buyers will probably want to do acro rather than race."

### **A Designer's View**

John Roncz has just christened his 47th aircraft design, to be announced publicly between now and Oshkosh [so I can't talk about it here]. His aerodynamic work and consulting projects range from the Beech Starship, to the Rutan *Voyager* (twin-engine piston) and *GlobalFlyer* (single-engine jet) 'round-the-world airplanes, to the Carter Copter, to the Eagle 150 canard.

Roncz was at the Red Bull race wearing his aerodynamic designer hat, supporting Mike Mangold's Edge 540, for which he designed some aerodynamic mods last year. Decades ago, he designed the airfoil. "Paul Finn and I optimized the wing around that," he said, "and then Paul did the structure." [The original idea was just to replace the wing on the Laser, but one idea led to another, and the Edge 540 was born.]



Roncz, Sawyer, and Mangold (L-R) at Detroit City Airport, 2008

He had mixed feelings. "It's like looking at your kids. You're proud to see them leading the competition; but it's also a sad commentary that in 20-plus years, nobody's been able to top it."

There are big differences in requirements between straight competition acro and racing, Roncz noted. "In aerobatics, you have sudden, abrupt movements -- snap rolls, negative gs -- in this class, there is no need for a symmetrical airfoil. You could certainly design a lower-drag airfoil."

The Edge has a  $CL_{max}$  of 1.90. (CL is the lift in pounds which one square foot of wing would make at a dynamic pressure of one pound per square foot.) So it's a measure of how hard the wing is working.  $CL_{max}$  then is the most lift the wing can make -- one way to visualize lift per area of wing. "For comparison, a King Air *with full flaps* runs only 1.8 -- and with a *lot* more drag," he explained.

While horsepower is good, weight is bad. That tends to equalize the horsepower advan-

tage of the 580 over the 540, for instance. "Sure, there's more power [in the 580], but there's about 70 pounds more weight." Roncz went on to show that it's not just the weight of the engine -- it's all the added structure needed to support the added power, and all that added structure itself adds weight. Then you factor all the added strength that will be needed to support that added weight, and you have to add more weight, or cut safety margins. It's not just the extra weight, either -- it's the mass and its momentum; plus it's all the extra weight at the 10g maneuvering point that add up to matter. So adding 70 pounds requires support for 700, plus safety factors, plus a higher aerodynamic load (which itself adds drag).

Another factor is the flying itself. With pylon gates spaced roughly 10-20 feet farther apart than the wingspan of the airplane, speeds of "350kph," and race altitude of about 60 feet, "flying is constrained by the pylons. These guys need a lot of precision: they can't be too high -- or hit the water."

## **Red Bull Future**

The pilots agree that there are more tricks to learn, but the overwhelming area for improvement seems to be in the aircraft themselves. There are various incentives here that keep ultimate designs from emerging, and that's probably good for the sport, as a single dominant design would probably make the series less-interesting and ultimately more-expensive, while holding back the incremental and more-general improvements realized under the current system.

The biggest factor in favor of keeping the Red Bull both interesting and competitive is that it's an entertainment series above all. All pilots are invited, and remain in the series subject to the corporation's rules, so hot-heads [and we all know there are no hot-heads in competitive sports, right?] are cooled off. Further, all pilots split the purse. First is better than last because of bragging rights, not prize money -- so there is little incentive to spend inordinate amounts of money to create a one-off world-beating design.

There are fantastic photos and video clips available at [www.RedBullAirRacing.com](http://www.RedBullAirRacing.com)