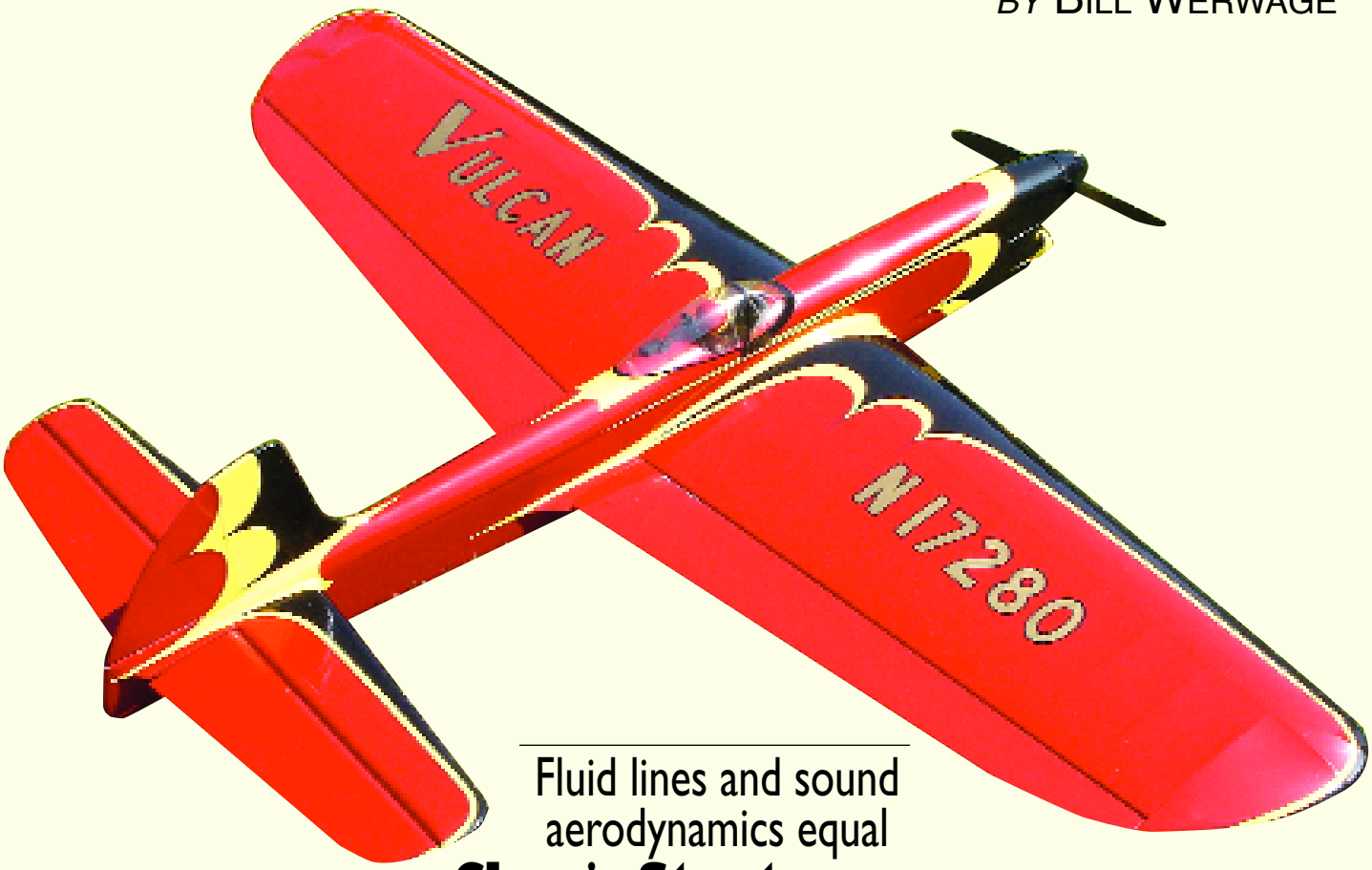
*BY* BILL WERWAGE




## Fluid lines and sound aerodynamics equal **Classic Stunt success**

# VULCAN


**"Classic" is the word for the shape of the Vulcan's nose. Notice the beautifully shaped cowl!**

**CONTRARY TO** popular belief, the Ares family of CL Aerobatics models (Stunters) was not my first attempt at designing and building original airplanes by a long shot. There were several notable models, at least on the Midwest, local, and regional level, I designed that might have become more famous if I had used them when I started flying on a national level. Among those early designs were the Lancer, Thor, Polaris, Comet, and Vulcan.

When I was a teenager I had lots of building time, and I used it to produce as many as four new Stunt designs per year. Some of those models were never named, but I learned a great deal, which (usually) made each one better. Much of that development was educated trial and error; I basically knew what I wanted and tried to make logical choices and progressions toward an ever better-performing model.

Sometimes I built two or three versions of a particular design and used a different type of wing construction in each. In that era (approximately 1955-1958) I started using the light and mysterious I-Beam type of wing construction.

I also tried D-Tube-, C-Tube-, and double-I-Beam-type wings in the same basic design to see what effect they would have on performance and weight. The subject of this article was originally built in both C-Tube and I-Beam versions.

In 1984 I decided to build a totally accurate replica of one of my

**Bill crisply pulls the Vulcan up into a Wingover maneuver on the way to another VSC victory. Will Hubin photo.**

old .35-size Vulcans just to see how far we had really come in airframe and engine development. I guess you could call it a sort of benchmark check and nothing more; this model was not built with the thought of ever using it in competition. In fact, the Classic event did not exist, to my knowledge, and the Vintage Stunt Championships (VSC) was not even a gleam in Mike Keville's eye.

I chose the Vulcan as the benchmark for several reasons, among which was that I liked the overall appearance and the paint job that was originally used. I "borrowed" the latter from one of Ray Marlo's models. To be truthful I also "borrowed" the Vulcan name from Ray, but it was not the same design in any other respect.

**The Design:** The most significant difference about the Vulcan, compared with most designs of the era, was the high amount of forward sweep in the TE. This was done with two thoughts in mind, one of which was that I wanted to keep the center of pressure (CP) from moving aft on the wing when the flaps were deployed.

With the forward-swept hinge line, the average flap position

Photos by Bob Hunt


**Notice the design's gracefully rounded wingtips and the swept-forward wing TE.**

**Bill tried several engines in the Vulcan, and he settled on the popular, powerful Aero Tiger .36. Notice the "tongue" muffler and the lightweight Hobby Lobby plastic spinner.**


**The Vulcan sports a fantastic finish. Bill used modeling dope for the base coats. Automotive polyurethane clear was applied over the top and rubbed out.**

**The Vulcan's trim scheme seems to flow onto its fuselage. Streamlined wheel pants add loads of character and reduce drag. This model has a balanced look.**

was ahead of the point where it would be on a straight-hinge-line model. Therefore, when deployed the flaps would not move the CP as far aft. That had the effect of not overstabilizing the model by moving the CP too far back from the CG. The model would not become as nose-heavy with the flaps deployed.

One of this arrangement's major benefits is that the stick pressure felt in the handle, especially in high-wind conditions, is dramatically reduced. When the flaps are moved up or down the airfoil is changed to an undercamber type, which increases the wing's lift. It also changes the point of the center of the lift, which is also known as the CP.

When the flaps are deployed on a straight-TE model, the CP moves a much greater distance and overstabilization occurs. The result is high stick pressure and a model that requires more input to achieve directional change. In calm conditions this is almost unperceivable, but in heavy wind it can be dramatic.

Another benefit of the forward sweep in the TE hinge line is the effectively longer tail moment. The moment is measured from the average of the flap's position in relation to the stabilizer/elevator hinge line.

The Vulcan was designed with larger-than-average flaps, and that, combined with the highly swept TE, would allow me to use a thin-tip airfoil section. In effect I was getting a model that had plenty of lift, would be easy to turn in the wind, and had less drag because of the reduction in frontal area (average airfoil thickness).

In those days we had limited power to work with, and we had to optimize the model to best utilize the power we did have. The combination I have described was a successful attempt at this.

**Clockwise from bottom left: Phil Granderson, Glen Kaler, Bob Hazle, Bill Werwage with their Vulcans at the VSC.**

**Type:** Classic CL Stunt
**Wingspan:** 50.25 inches
**Wing area:** 500 square inches
**Length:** 38.25 inches
**Weight:** 36 ounces
**Engine:** Aero Tiger .36
**Construction:** Balsa and plywood
**Covering/finish:** Silkspan and modeling dope

The Vulcan turned easily in the wind, and the wing's frontal area allowed the available power to pull the model effectively. All this proved to be a valid concept that is still highly regarded today.

The original Vulcan was powered by a Fox .35 engine swinging a 10 x 5 Y&O wood propeller. I flew it on 60 feet of .015 cable. Surprisingly the C-Tube and I-Beam versions of the Vulcan flew virtually alike. In either form it was a nice combination, and that may also have had something to do with my choosing to build it as the benchmark check so many years later.

The replica Vulcan did not disappoint initially. I set it up as close to the original as possible, including installing a Fox .35 from that time frame that I knew ran well. I also used a vintage Y&O 10 x 5 propeller I had in my collection.

I flew the model on .015 lines, and within a short amount of time I had it performing great. I was really happy with it! Then reality struck in the form of wind.

The power that was accepted as good in the 1950s didn't stand up to the power to which I had become accustomed. As I mentioned in the Ares article (in the July 2002 *MA*), these are the good, old days when it comes to powerful model-airplane engines. I felt like I was flying terrific patterns, by any standard, with the Vulcan in calm conditions, but performance suffered when the wind came up to an appreciable degree.

I decided to see what effect more power would have on this excellent airframe. I tried a Webra .28 with the same Y&O propeller. I increased the rpm and went to slightly longer .012 solid lines. This was an improvement, but I still felt that I could get more performance.

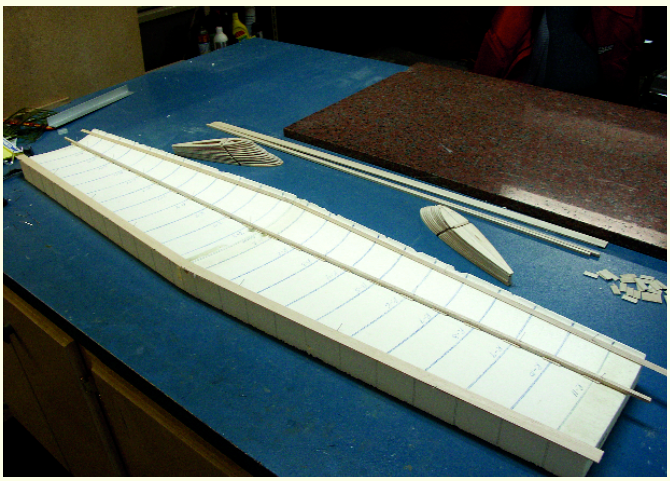
The next engine I tried was a drastic improvement. I installed one of my lightened SuperTigre. 46s and used an 11 x 5 Rev-Up propeller. Because of the line-size rules I had to go to .014 solid lines. I also increased the line length to 63 feet.

The airplane flew wonderfully with this combination, but the model's small size did not allow proper vibration dampening for the "hard-hitting" .46. I didn't want to age the airframe prematurely because of the vibration, so I made yet another engine change.

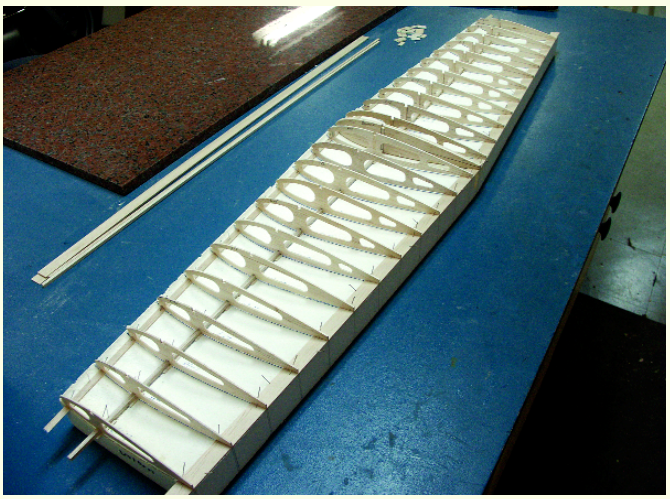
I tried the well-balanced O.S. .32, which proved to be quite good, but, again, I felt that more power was needed; the .46 had spoiled me! At this point I called Randy Smith, of Aero Products, to see if he could suggest an alternate path. Enter the other Tiger ...

Randy suggested something that had completely escaped me; Thunder Tiger had introduced a new aluminum brass chrome (ABC) .36 engine that seemed to have considerable promise. It ran great in stock form and was used in Stunt competition by several Advanced fliers and a many-time Junior National Champion, Dondy Garrison, in his Randy Smith-designed Vector 40.

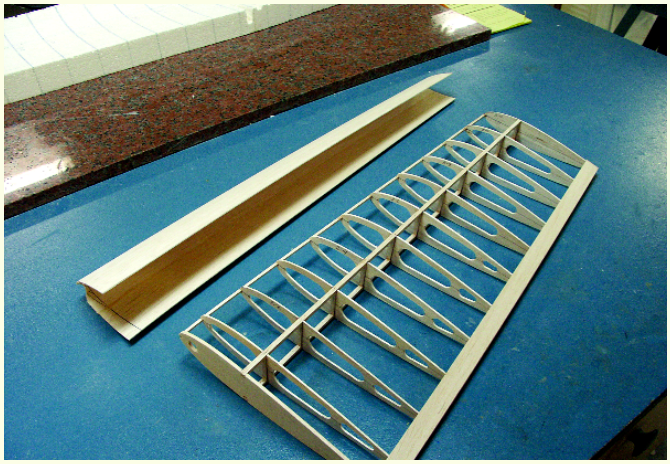
The only problem with all these new engines was weight. The ABC sleeve/piston combination, dual-ball-bearing configuration, larger diameter and heavier crankshafts, and overall robust construction added approximately 2.0-2.5 ounces compared with the original Fox's 6-ounce weight.



**Bill prefers to use the Lost Foam method to construct his models' wings. The TE, spars, and LE shims are shown pinned in the building cradle.**



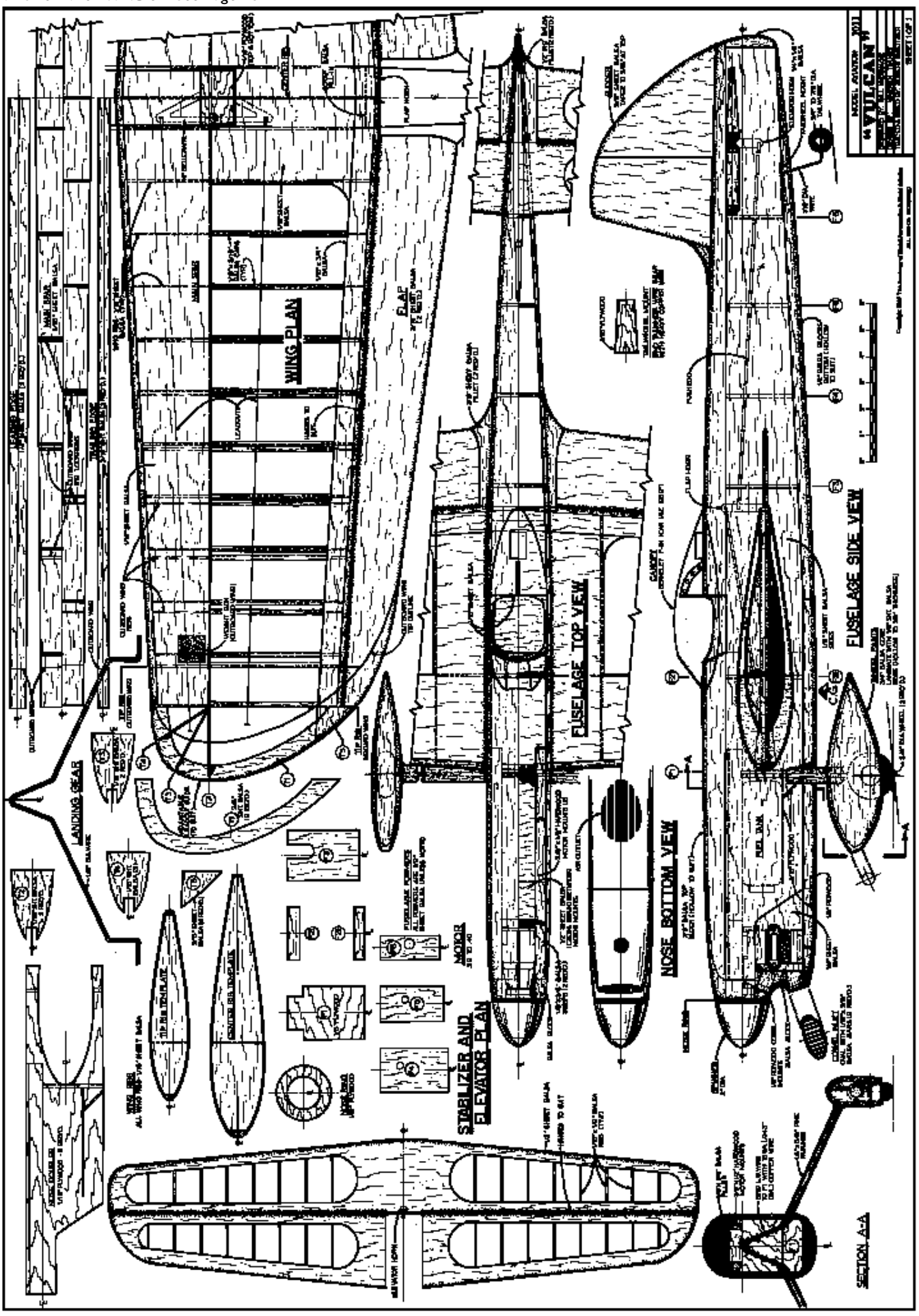
**The ribs have been positioned and pinned in place. The top spar and top TE edge pieces go in next.**



**The LEs are molded around a foam form and are then fitted to the individual wing panels.**

**The LE shells are joined to the wing panels and are held in place accurately in the Lost Foam building cradle.**

*Full-Size Plans Available—See Page 191*



There's more. Compounding that problem is the fact that we now have to fly two laps between maneuvers; only one was required and flown in the 1950s and early 1960s. That means a larger, heavier fuel load needs to be carried nowadays.

There were no muffler requirements in the old days and none were used. Even today's lightest mufflers weigh something. In addition, modern carbon-fiber propellers—although more efficient—are certainly heavier than the light wooden propellers that were used then.

The result of all this is that the old designs are not ideally suited to modern power setups from strictly a balance perspective. Some of this can be overcome by using lightweight plastic tanks and by moving them as far aft in the tank compartment as possible. I use a lightweight .007-.008 tin stock tank in my Vulcan.

Another help is the availability of lightweight plastic or composite spinners. Extension shafts can be used in extreme cases. These spinners *must be* properly machined and balanced; they can do more damage than good if they induce vibration.

Randy suggested that the Thunder Tiger .36's weight could be reduced significantly by producing a custom-made aluminum-aluminum chrome (AAC) piston and liner. That's exactly what he did.

He also retimed the new, lighter sleeves to our specifications for a good Stunt run. The AAC-equipped "Aero Tiger" was close to 0.7 ounce lighter than the stock ABC version! And it ran great.

All the new ABC/AAC, Schnuerle engines run and produce their power at a higher rpm than the loop-scavenged engines of the past; therefore, they require far less pitch. Many of these setups are running with propellers ranging in pitch between 3.6 and 4.0, whereas the old setups required 5.0-6.0 inches of pitch.

Lower-pitch propellers allow the airplane to turn easier than the higher-pitch varieties, and because of that these setups' extra nose weight can be overcome. They don't feel nose-heavy—particularly in wind!

During the development and experimentation with engines in the Vulcan that I have related, the Classic Stunt event became popular and the VSC was conceived. Even though the Vulcan was not built to compete in these events, it was a natural for them. Classic seemed like fun, and I started flying it with the Vulcan.

I attended my first VSC with the Vulcan in 1994, at which point it still had the SuperTigre .46 for power. Things went well and I had my first win with the Vulcan design in 38 years.

Since that time I've flown it, the 1959 Ares, and the 1962 Ares at the VSC and have been fortunate to win eight times. The Vulcan captured four of those victories, and the last three were with the Aero Tiger .36 for power. The model also won the Classic event in its only appearance at the Nats, in 1996.

*(Editor's note: Bill has added a couple more VSC wins since this article was written!)*

## CONSTRUCTION

Building the Vulcan is not much different from building any Stunt model of that era. It is a smallish design, spanning 50 inches with 491.24 square inches of wing area, so, as always, weight is a consideration when building.

Use appropriate light materials with an eye toward structural integrity. Think about the part you are making and what its duty is, and select materials accordingly.

The lightest piece of wood is not always the right piece; it depends on its intended use. Wing spars should be made from firm material, but fuselage top and bottom blocks can be made from the softest blocks you can find.

The C-Tube version of the Vulcan is presented here; it is the variation I built as a replica in 1984. There are a number of ways to build a C-Tube wing, but the easiest and most accurate method is the Lost Foam wing-building system; it keys in on the outside shape of the wing.

The Lost Foam method also allows the LEs to be accurately molded and installed. This is a distinct advantage because it

guarantees a perfectly shaped LE radius—something we have found to be extremely important.

Lost Foam wing systems and LE mold bucks for the Vulcan are available from Robin's View Productions. The company also sells a set of comprehensive videos that shows and explains, in detail, how to build a wing using the Lost Foam system. I highly recommend viewing them before you begin construction.

One thing I'm often questioned about is the use of a normal, straight control horn on forward-swept hinge lines. The geometry would seem to suggest that the flaps would bind as they are deflected and "spring" back to neutral. The degree of this is negligible to the point of being a nonissue if you adhere to the following rules.

A flat must be sanded on the rear face of the TEs that is exactly 90° to the wing centerline as viewed from above. The length of the arms of the horn from the upright at the center must be the same.

The horn's pivot point must be centered and in line with the flap's hinge center. I also keep the flap-horn length as short as possible. I have never had a problem with binding using this method.

On the subject of flaps, I used the 3/16-inch-thick ones shown on the plans when I could find optimum firm, light "C"-grain wood. Unless you have this perfect wood stock for the flaps, I recommend that you use light 1/4-inch stock.

I like to use cloth hinges on these Classic-type models because they provide a light way to achieve an almost perfectly sealed hinge line. If you use pinned hinges you will probably have to seal the hinge line with tape, unless the gap is kept to a minimum.

The plans presented with this article are extraordinarily detailed. I thank Warren Tiahrt for producing a great set of pencil drawings from my original etchings and Bob Sweitzer for doing such an outstanding job of tracing and inking the drawings.

There is an abundance of building notes on the plans, and anyone who has built this type of model should have no problem reproducing it after studying them.

**Finish:** I covered the Vulcan with Japanese tissue and applied the base and color coats using modeling dope. I like to mix my own colors by purchasing the color toners used to mix auto paint.

I mix the toners in clear dope in a 1/3 toner-2/3 clear ratio. Then I thin the mixture and spray it on the model. Auto toners allow a wide range of color choices to be used, and they generally cover better than modeling dopes.

The Vulcan's final topcoat is catalyzed polyurethane clear. I have forgotten which one I used, but there are so many new and improved versions on the market that you probably wouldn't be able to find the exact clear now anyway.

I do not advise using this type of clear topcoat unless you have a modern spray booth with an effective exhaust fan and at least a good charcoal respirator. Catalyzed polyurethane clears are extremely toxic and should be handled with extreme care.

A good alternative is to use a quality brand of clear modeling dope for the topcoat. Even with that option you should use an exhaust fan and a respirator!

**Some of my** friends have built several Vulcans, and all of them appear to fly wonderfully. Bob Hazle and Bill Little have built I-Beam variants. Phil Granderson, Glen Kaler, and Frank MacMillan have campaigned C-Tube-wing versions at the VSC.

Built light and straight and powered properly, the Vulcan will reward you with many happy flights and maybe more than a few trophies. *MA*

*Bill Werwage*

**Sources:**

Aero Products
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www.aeroproduct.net

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