Big Boy IV

Wiener Neustadt, Austria. In the dwindling light of a summer evening, a local free flighter takes one last flight with his FAI power ship. The design is a basic one that he has been refining for 13 years. Less than two minutes later his plane lands. . .and the man and the model are World Champions. / by Vaclav Horcicka

The origin of the Big Boy FAI series reaches as far back as 1960, when the FAI announced an engine run reduction from 15 to 10 sec. Till then, I had stuck to small models of conventional layout, using mainly 09 diesels. The ultimate 1960 model used a Webra 1.5 cc diesel, and followed the lines of Carl Wheeley's 1954 Internationals winner.

Obviously, with the engine run reduced by 35%, a design with more potential would be needed. Some 09-engined experimental models were made, among them two high thrust line designs, which seemed to bring about the best results in terms of performance *and* reliability. On this basis, Big Boy I was designed for 15 power, using the then new Austrian Bugl 15 Oliver diesel, with the highly efficient Czech 8¼-3½" MVVS wooden props. An ED timer for cutoff, plus a Tatone DT were used. Neither autorudder nor autostab were employed.

The initial experience with Big Boy I was quite good, and prompted me to conceive Big Boy II for the 1961 Internationals. Some modifications were incorporated, including omission of the wind LE sheeting and a more highly cambered version of the original NACA 4409 airfoil. Big Boy II finished 13th at Leutkirch in '61.

In subsequent years, quite a number of local and regional contests were won, mainly by Big Boy II with Big Boy I as a standby. In 1962, '66 and '70 Austrian Nationals trophies were brought home, each time with a full house score. In 1963, Big Boy I was damaged beyond repair and, therefore, Big Boy III was constructed. This was almost identical to Big Boy II, and employed a Supertigre G 15, a modified Autoknips for flood-off. It refused to fly properly. In a January 1964 contest, it flew away and was not returned until April—after the snow had melted away. Having dried it thoroughly and replaced both timers, I went out to retrim it. Big Boy III now flew as never before!

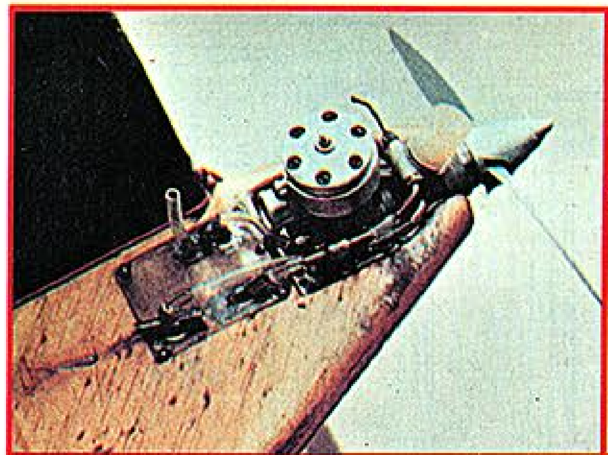
Meanwhile, various glow plug engines were tried in Big Boy II, finally sticking to a Czech MVVS RL, which stayed in the model until July 1973.

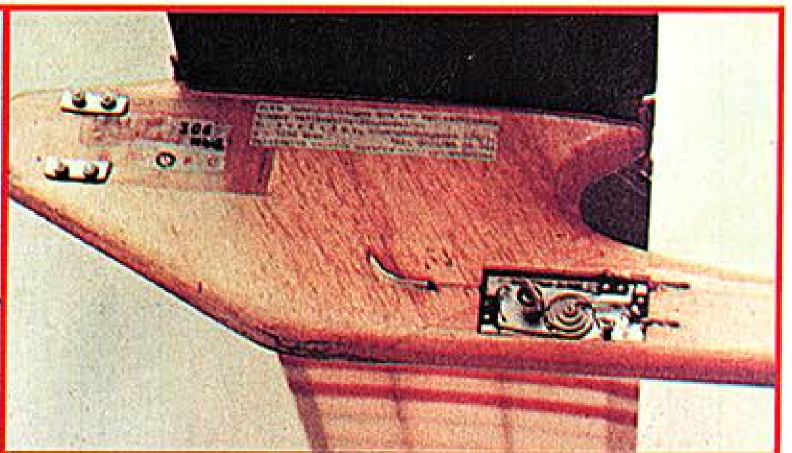
After the 1966 Austrian NATS win, plans for Big Boy IV were made. Autorudder and a variable incidence tail were to be incorporated. The use of the then new .5 horsepower HP 15 diesel was envisaged. As I could spare less and less time for modeling, construction did not start before 1967. Wing and stab were finished, and then no further building activities could be carried out until 1972. I flew very few contests during this period.

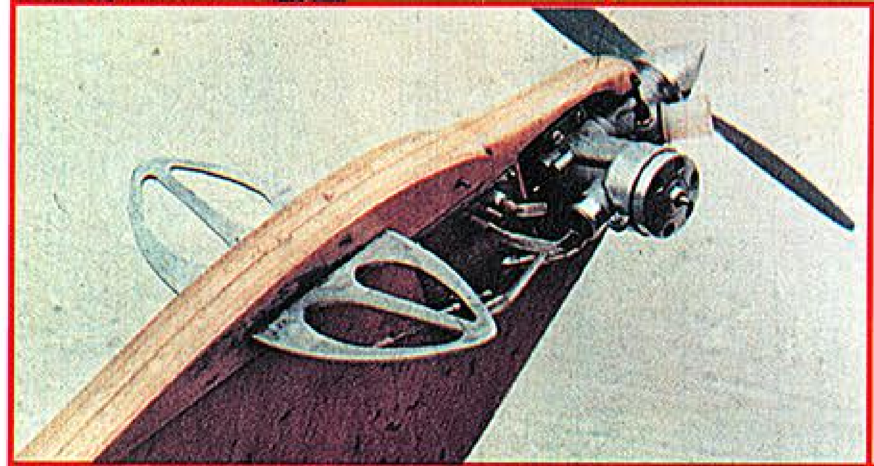
In 1969, Big Boy III was fitted with a tuned pipe Supertigre G 15 and was used in the World Champs eliminations. Here, it flew away, due to DT timer failure. This made me a spectator at Wiener Neustadt that year, and stopped my flying activities altogether for a year and a half. I resumed flying at very short notice in the fall of 1970, using the sole remaining Big Boy II to win the Austrian NATS. After this unexpected success it was decided to go in for the 1973 Internats, to be held on my "home field" at Wiener Neustadt.

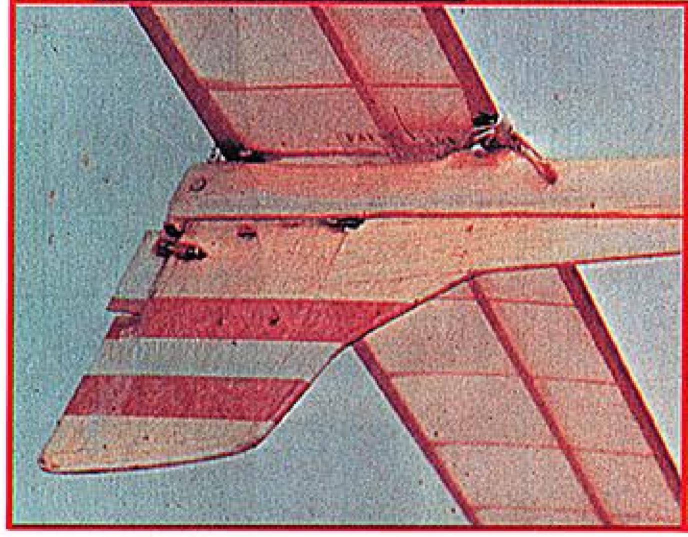
Let me remark here that it is a genuine three-year task to compete in a World Championship as member of the Austrian Team. Every year, the Austrian Aero-Club issues an official contest calendar, which lists between eight and ten national and international free flight contests counting for the elimination. The best five times of each contender for 1971 and '72 are tallied, and the top three form the Austrian team for 1973. The 1973 results of the Austrian free flight and RC teams confirm that this system works. It is relatively cheap for the Aero-Club (no separate elimination contest), and gives a chance to every modeler interested.

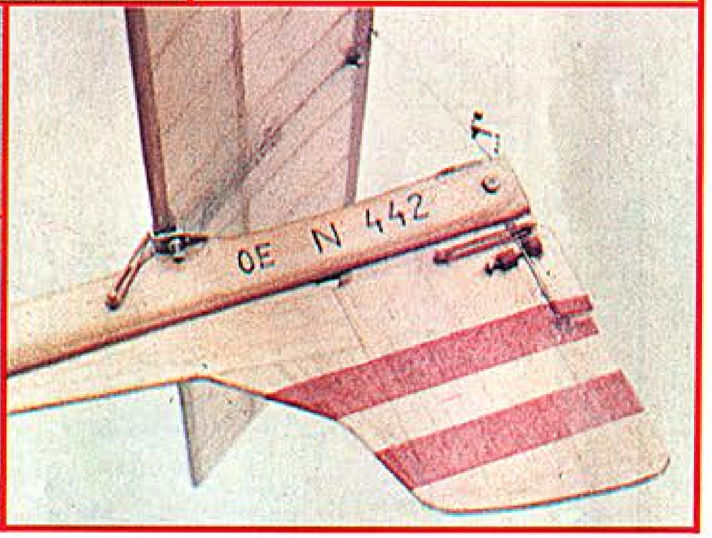
Andrea holds a world-beater. The Big Boy IV proved its claim to fame by winning the 1973 Internats.











TOP LEFT: Fuel tank plumbing is well thought out. In upper part of the tank are the fill tube (which is sealed by connecting it to the adjacent overflow tube), and the pressure line (in the corner). At the bottom left corner is the flood-off valve. Bottom front is, of course, the feed line, with the all-important filter. TOP RIGHT: In the text, the author evaluates the pros and cons of high-thrust aerodynamics. One thing for sure, it makes for convenient installation of all the gadgetry. LEFT: With aluminum wing plugs exposed, the power side of the nose assembly is all business. . .no wasted space here. Engine is a Rossi 15, with a Czech MVVS prop. BELOW: When Horcicka first began the Big Boy series, he regarded autorudder and V.I.T. as detrimental to contest reliability. After 13 years of development, the Big Boy IV has everything moving. Adjustment screws on the stab platform, V.I.T. lever and autorudder must be "tweaked" to optimize climb as engine run is reduced.

You have 15-20 contests, out of which you have to choose at least five, or more if you wish to improve. There is no absolutely fixed date you could miss. You only have to see that you retain a high standard of flying and you *have* to fly anyway. As it was questionable to take on this much competition with only one model, Big Boy IV was finished in the spring of 1972.

For propulsion, an exceptionally good G 20 was chosen, for this model, but plans to install it fully cowled inverted were dropped. Great emphasis was put on reliability of the autorudder and V.I.T., which are operated by a Seelig timer, along with DT and flood-off.

Originally, Big Boy IV came out with the CG at 100%, and was virtually useless. Also, the G 20 proved to be powerful, but erratic. Lacking the time to make a new model, I first took away every fraction of dispensable weight behind the CG (see pictures), and then started to experiment with different stabs. By spring of 1973, the correct stab was found. With a hot G 15 up front, Big Boy IV suddenly began to show its teeth. At the Munich International Contest, I came in fourth, when one of the set screws loosened during the flyoffs, and the model stalled all the way down.

In July, a brand-new Rossi 15 replaced the G 15, making careful retrimming necessary. Big Boy II, still going strong as my No. 1 reserve, inherited the G 15 and was set aside after only a few flights. Time was scarce for Big Boy IV, so I decided to employ a time saving trimming technique. This meant going out to the field early in the morning and after the working hours, for one to one and a half hours at a time. This leaves time to make only one to three flights per session. However, you encounter different atmospheric conditions each time, and you practice the complete sequence from leaving home

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BIG BOY

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(without forgetting anything) to returning with (hopefully) undamaged models. This gives excellent results for a relatively low number of flights—I made only about 40 flights with Big Boy IV between the Munich contest and the first round of the World Champs, all of them at Wiener Neustadt.

Let's turn to the conception of Big Boy. The original design was rather progressive for its period, with an aspect ratio of 8:5 and a tail moment of 26 in. A lot of thought was put into details.

The high thrust line design was chosen because it offered a fast and stable climb, without having to resort to autorudder and autostab. In 1960, I regarded both autorudder and autostab as devices detrimental to contest reliability. The high thrust line arrangement offers the advantage of the thrust line passing approximately through the centers of gravity and drag, thus reducing looping tendencies. Usually, increased drag, due to the prop slip stream passing over the wing center section, is quoted as the main disadvantage of a high thrust design. This is true, but for partial compensation, the tailboom, most of the stab and underslung fin are out of the slipstream. Such a model gets as high as a conventional design of similar parameters. The higher CG proved to be a definite advantage in the glide.

The wings are conventional and straightforward, except perhaps for the tongue joint. This adds a lot of work and weight (which does not matter, being near the CG), but offers a combination of elasticity and rigidity exactly as it is needed. The NACA 4409 airfoil was chosen as a compromise, and was originally also used for the stab. It gives good overall results, without any structural problems. The nonsheeted wing was found to have a slightly better glide and markedly better glide stability, as well as better thermaling abilities. This is no doubt due to the lower critical Reynolds' Number of the tissue covered wing.

The fuselage structure represents a personal solution to achieving the goals of structural integrity, stiffness of the boom in the vertical plane, a certain elasticity in the horizontal, low frontal area, ability to land without ground looping, distribution of lateral areas (side areas), and finally—it should not look too ugly. It seems to have worked out, with the 12-year-old Big Boy II still contest-worthy after over 60 contests. The original Big Boy I fuselage is still in the basement.

The idea of good "maintenance characteristics," while being part of the reliability concept, was carried out in full with Big Boy IV. Engine, tank, timer and the V.I.T. lever are easily removable for inspection, all being fastened with screws. All fuel tubing is easily accessible, as are the flood-off valve and fuel filter. Cowling and streamlining are fine, as long as no potential trouble spot is hidden from view. In this respect, all high powered free flight models are unforgiving.

If I would have to employ autorudder and autostab to obtain the full potential of the more powerful engines available, I did not intend to trade off reliability and flexibility. Here it pays to work really carefully. If you succeed in getting the gadgets to work without unwanted play or sticking, trimming is relatively easy, since climb and glide are treated separately. All that is needed for adjusting is a small screwdriver and a wrench for the counter nuts.

By the way, Big Boy is a prop saver. Usually, you only break props when stalling into the ground or crashing under power. I have been flying on a single fiberglass prop for two years. At $3 apiece, this could add up to that new Rossi 15 for next season!

The flight pattern of the original Big Boy IV is an almost vertical climb, with one half to one turn to the left and a flick roll transition to the glide. The radius of the left glide circles should be set up to taste (50-100 ft. on an average). It helps to heave the model up as mightily as possible—not only does it add precious height, but it also stabilizes the initial, relatively slow portion of the climb. Big Boy is not at all vicious in respect to slightly wrong adjustment—it merely does not get as high as it could. When trimmed properly, it will climb to the left *or* to the right without any change, depending only on launch attitude. Transition from a climb to the right is erratic, however, even with a glide to the right—you may lose 50 ft. or more. With the CG at 77% (as was the original Big Boy IV), adjustment for an optimal climb is rather tricky, although there is little danger of crashes. Constant readjusting of the autorudder, often as little as .01" at a time, may be necessary. If you know your model and its response to changing conditions, trimming flights between rounds are superfluous. You only have to remember the conditions of the preceding flight as a reference.

With the CG at 72-75%, trimming should be easier. A certain amount of left thrust (start with 1°) is useful. Adjust the glide for convenient lefthand circles. When heaved chuck-glider style to the left, Big Boy should go up to about 25 ft., recover and fly on for a good 20 sec. on its glide setting. Use an old prop for this, since "hard landings" may occur.

For initial power trimming, give the model about 1/4" right turn, taking the glide setting as reference. The stab should be about 1/8" down from glide position. For the first flight, with engine at full speed, a one and a half to two sec. engine run and four to six sec. DT are safe. Heave hard at about 60°, and slightly to the left. The (usual) sequence of the "gadgets" operation is autorudder, engine flood-off, autostab. Only your skill will find the optimum combination.

Power run should be increased by one sec. or less at a time, and not until you are certain that nothing will "happen." Fine adjustment of the glide on less than a five sec. power run is virtually useless. Also, transition is dependent on length of power run, readjustment being necessary when going down from ten to eight sec., then six, and finally four sec. in the FAI flyoffs (you need more climb incidence and earlier autorudder for shorter runs).

A correctly trimmed Big Boy is virtually stallproof in the glide. The left inner wing panel should have a wash-in of about 3/32", while both outer panels are washed out about 1/16". A slight stab tilt for left circling may be of advantage. Usually, it will be sufficient to alter only the glide turn radius in order to adapt the glide to varying conditions. The original Big Boy IV goes straight, or even slightly to the right, in downdraughts, while taking on and holding weak or medium thermals very nicely. In strong lift, it will not climb as quickly as other models.

Finally, let me remark that I used to carry out three complete checks before every contest flight, and at least two before every other flight. The first check, before fueling up, takes about three min. and comprises all screws, rubber bands, engine, timer setting, autorudder and autostab. Second check, before firing up engine, and third one, while engine is warming up, includes all set screws, rubber bands, correct seat of wing and stab, and engine and timer. This procedure gives confidence, and helps to avoid unnecessary crashes or other mishaps.

CONSTRUCTION

As the plan contains a lot of information and virtually all material specification and dimensions, study it carefully before beginning actual work. For most of the joints, white P.V.A. glue is perfect. In some cases, epoxy resin is preferable (see drawing). Use your experience.

Let's start with the wing. First, cut out all LE, TE and spars. Note that the spars change from spruce to balsa. The ribs of the outer panels are cut and sanded from balsa strips clamped between ply templates (ribs No. 6 and 15). Assemble the tongue box. Start assembly of wing by pinning down LE and TE, then glue in ribs. When dry, slide in tongue box and glue carefully, then slide spars into place and glue. Let dry overnight.

Next, fit in and glue spar webs, then sheeting (inner panels) and tips (outer panels). When dry, sand all panels to shape and epoxy on the 1/32" aluminum root ribs, rubber band hooks. Finally glue in the false ribs (for the outer panel, these are best cut slightly oversize, with the corresponding next larger rib as a template). Sand to final shape. The last operation is the joining of inner and outer panels, including the dihedral braces and break rib (No. 7).

Apply one or two layers of thin clear dope to the structure, and finish with fine sanding paper before covering. For covering, medium weight silkspan is applied with cellulose glue. When dry, two coats of clear dope are necessary before applying the trim and lettering. In all, four to eight coats of clear dope (depending on type of dope) are needed before you can affix the glass fibers on the upper and lower surfaces for torsional rigidity and strength. Glue on with thinners. To finish wing, apply a single coat of a fuelproofer.

The stab is made in a similar manner. Try to get it as light as possible (3/4 oz. or less). It is a good idea to have two identical stabs, as this is the most vulnerable part of the model. I prefer to transport the two stabs on a simple flat board jig, and to protect them with foam panels shaped to fit over the upper surfaces. To obtain a light yet sufficiently strong structure, it is helpful to select the balsa with care, to save on glue, to use as light jap tissue as you can obtain, and to dope with thinned dope and fuelproofer. Here, too, glass helps to improve torsional rigidity, making geodetic ribs superfluous.

Construction of the fuselage begins by cutting out and putting together the crutch. Add the longerons, engine bearers and pylon framework. Prebend and epoxy in the thin-walled aluminum tubes for autorudder, autostab, DT and flood-off lines. When set, add the boom "bulkheads," and glue on the boom sides by sliding the ends of the tubes into the prepared holes. Add pylon sides, including the engine bay cover, and the root ribs (No. 0). Cut out holes for the timer and tank. Epoxy and screw on the tongue (make sure it retains the correct position) and engine mount. On the tail, fit fin parts and stab rest. When all is dry, sand fuselage to shape (see sections).

Prepare V.I.T. lever, spring and rudder stops. Cut out the rudder and glue in the ply plates inside the boom sides to strengthen the V.I.T. lever axle holes. Close all aluminum tube ends with balsa cement.

Apply two coats of clear dope or sanding sealer to the entire fuselage, sanding between coats. Cover with either thin silkspan, lightweight silk, or lightweight glass cloth (max. weight .07 oz. per sq. ft.). The first two can be applied with clear dope, but use thinned epoxy resin for the glass. On the silkspan or silk, three to six further coats of clear dope (or sanding sealer) are required before the final coat of fuelproofer can be applied.

Remove cement drops from tube ends, and fit links as per drawing. Install the timer (links shown are arranged for Seelig timer). Install tank, engine, and fuel and pressure tubing, including a fuel filter in the fuel line. If you cannot obtain a flood-off valve, modify the arrangement to take a fuel tubing "squeeze-release" system. Finally, rig all your links to operate without undue play and stress. This rigging may take several hours, but it will pay off.

With careful balsa choosing and high quality work, Big Boy IV should come out at 25-26 oz. ready-to-fly, including a Rossi 15. In the drawing, the component weights correspond to the Big Boy IV original, which incidentally is overweight at 28 oz. Minimum weight for FAI will be 27.1 oz. at 595 sq. in. total area. Make sure that the CG is in the 72-75% bracket and add lead as necessary. There is sufficient space behind the engine, under the engine mount for some lead. The timer compartment can also hold some lead.

Your Big Boy is ready to fly. Good luck and many maxes!