

Ballistic pattern model for REFLEX XTR²

BRUSHFIRE

1978 pattern competition design by Ken Bonnema

Ken Bonnema designed and built the Brushfire for his friend and workmate Steve Rojecki and himself. After it's creation in 1978, it was a state-of-the-art pattern competition model until the early 1980s. It seems it was quite popular in the USA though not abroad. There are still people praising the model for its very neutral and smooth flight behavior.



Why Brushfire for REFLEX? That means why not Curare? – Well, obviously Brushfire was more appealing to me. While Curare is *the* typical design of the late 1970s and world-known, Brushfire is very typical of this time, too, but has some design elements of much later models as well.

Typical for the time are the swept wing and tail configuration, the almost completely symmetric shape, and the forward fuselage side area. A “tricycle” retractable landing gear was needed for good take-off and landing scores. Of course, the .61 glow engine with tuned pipe was standard as well. After all, there was a 10 ccm / 0.61 cin limit for all models, later modified to 10 ccm for two-strokes and 20 ccm for four-stroke engines in competition. But these two-strokes with their small propellers were screaming. And natural was the fast, jet-like “ballistic” pattern style flown with these “rocket ships”.

On the other hand, Brushfire is a rather big model with its big, thick wing and tall fuselage and is not a pronounced rocket ship. It is more suggestive of a real airplane than contemporary models, and it looks like a jet aircraft and not like a propeller aircraft as the modern pattern models. If built to low weight, Brushfire may also fly a different pattern style, called "turnaround". By varying the engine's power during the maneuvers, it is able to fly nice slow and round patterns in a confined space. This is as well practicable with several modern jet models, by the way, even though it is rarely done.

Brushfire is not that typical rocket ship, and it isn't a floater either; it's just a nice blend of both. You may fly huge loops and stall turns, rolls "from horizon to horizon", all "like on rails" and with horribly nice screaming engine. Then you may dissipate most of the model's energy in a few tight turns and continue with nice slow and smooth maneuvers close to you. Finally, land the model with ease and grace, on the spot and slowly, just without fear and stress. In other words: have fun!

Isn't that great? It doesn't matter that the model is hard to build, the engine is a pain to operate, and a paved runway is needed. That's no problem at all – we are in the simulator!

Sources

Credits are due to all those who published something about the Brushfire in the Web, may it be information, data, plans, pictures, or stories. Of course, you'll have to blame me for any errors, flaws, or misunderstandings.

Ken Bonnema himself cut in on a conversation at RC Universe about the Brushfire. He clarified some things in [this](#) and [this](#) post. Later he sent me an e-mail with some information and color photos. Thank you very much!

The pictures from the original April 1980 Model Builder magazine article by Ken Bonnema and Steve Rojecki are shown in a [thread](#) at RC Universe.

Stuart Chale presented the whole three-page article as scanned pages [at RC Universe](#). He reviewed a kit version of the Brushfire in the April 1986 Flying Models magazine and presented this article as well two posts later in the same thread. In [this](#) and [this](#) post earlier in the same thread he somewhat characterized the model.

The plan from the original article was posted [here](#) close to the end of the same thread, and later, in slightly better quality but the same small size, [here](#) in another thread at RC Universe, and full-size [here](#).

Dan Hines of Carolina Custom Aircraft posted two color photos of real Brushfire models [at RC Universe](#). These are the only color photos I knew of at first, and he has them because he makes Brushfire kits.

Especially the suitable propeller size for the Brushfire was discussed in another [thread](#) at RC Universe.

Contributions

These contributions were involuntarily; I simply borrowed some hard-to-get components of the REFLEX model from other authors. At least they should be given credit here:

Bo (Jörgen) Strömberg from Sweden made a Veco engine for his excellent Graupner Taxi for REFLEX XTR. He published it [at RC-Sim](#) in August 2005 and later granted permission to use the engine model. Thank you very much! The engine is enlarged to mimic a .61 on the Brushfire. The standard muffler was removed and the tuned pipe made in the REFLEX model builder program RSK (not after a real tuned pipe, but just to look about right).

The model got a wooden Master Airscrew because it looks nice and fits the fast model. Prop size in the visual model is 12" diameter and 11" pitch. The texture is borrowed from one of the many Internet shops.

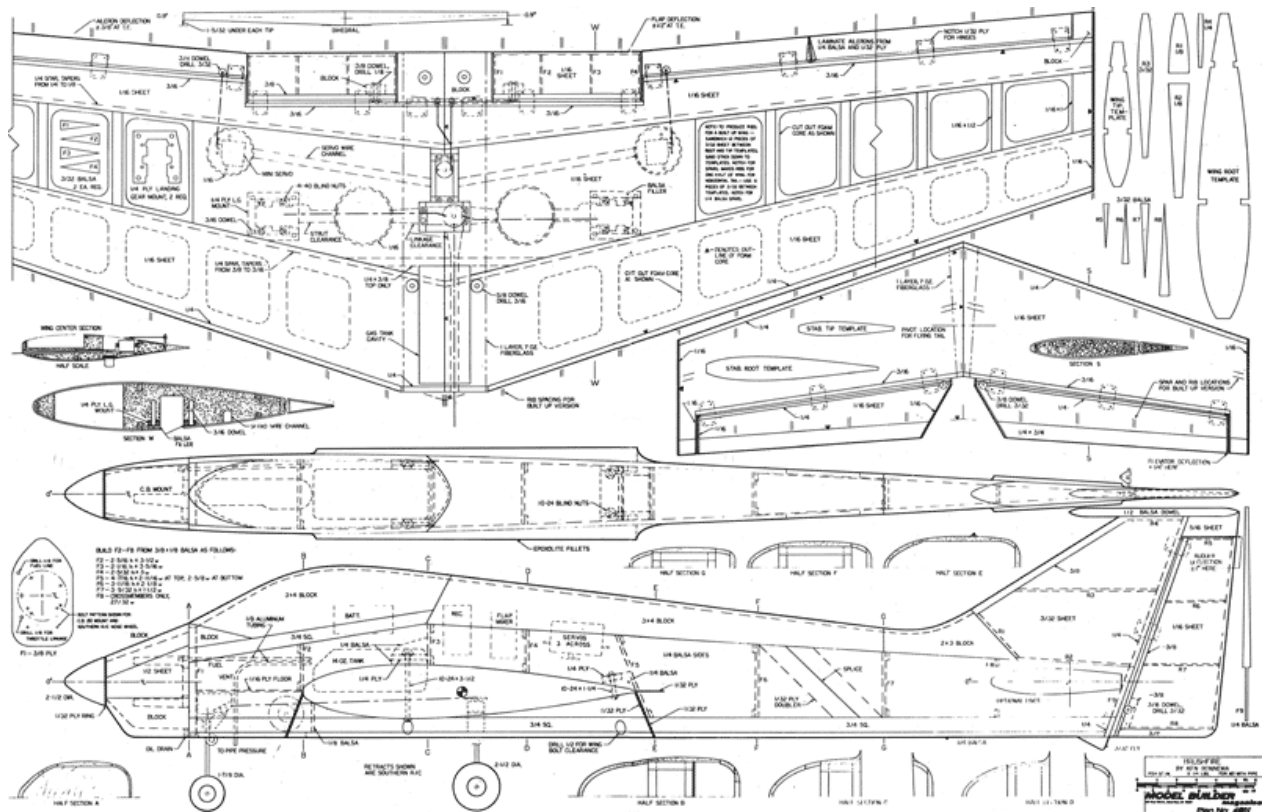
The wheel textures are borrowed from REFLEX and lightened for better look on this model.

There are not much engine/drive sounds for REFLEX and no sounds of tuned-pipe drives at all, at least for airplanes. But several years ago, Kay Thaele offered two such helicopter sounds at [Kay's RC-Helicopter Page](#), which is no longer available, though. I always thought I'd once build a REFLEX model with tuned pipe and preventively downloaded and kept the sound files. Of course, they're not really suited to airplane models. Especially the sound called "OS Musclepiper" lacks any propeller noise. But the sound called "YS Hatori" is louder and has some whine in it, and at least it is better than no tuned-pipe sound at all, so it was used for the Brushfire model.

Shape, Appearance, and Sound

The model has impressively clear and simple lines what makes for good look. But when you look at the fuselage cross-sections in the plan, you'll notice a rather complex shape. As Stuart Chale wrote, "the fuselage has many compound curves and it becomes a long, difficult process to accurately scratch build one out of balsa from the plans". But it looks so nice.

By simple means the impression of a military jet aircraft is achieved. The rather short spinner is like a Radar dome, the part below it looks like a jet air intake, and by shape and painting there seems to be a canopy. Actually, the fuselage is designed to have equal areas above and below the centerline and to have a rather forward aerodynamic center. The whole wing is close to the centerline, but that the airplane is a mid-wing design and not a low-winger is concealed by some dihedral and by the paint scheme. These are quite clever tricks!



The belly pan has to be rather big, contributing to the difficult build. Besides, the big wing is distinctly and doubly tapered with a long root chord. That's also why the flaps are effective even though they take up only a small part of the wingspan. The ailerons, on the other hand, take up a greater part of the wingspan but with shorter chord length.

The horizontal tail (as well as the prop shaft) is on the centerline and has neither di- nor anhedral. The vertical tail has its aerodynamic center only $1\frac{3}{4}$ " above the centerline what is quite good. This is achieved by the triangular shape with the long side of the triangle below the centerline. Obviously, a completely centered vertical tail is not possible because there has to remain some ground clearance for flare in landings. The protective skid below the fin is still needed – just in case.

Wing and horizontal tail are balsa-sheeted foam cores. The rather thick and big wing would make for much weight. Therefore, lightening holes are provided in the wing cores. The fuselage has to be carefully carved and sanded to come out lightweight. Wing and fuselage both have a big surface, so the covering should be Mylar film and not silk and dope. This all explains why some people reported an overall weight less than 8 lbs and others had even 11 lbs.

Actually, the model is quite big for the given .61 engine limit. Wingspan is 65" (1.65 m) and wing area is specified as 858 sqin (55.4 dm²). Wing aspect ratio is only 5, but that's no induced-drag problem at "ballistic" speed.

Since I intended to revive the original in the first place, I searched for color pictures of the model. Unfortunately, there weren't any. The only Brushfire color photos were those by Dan Hines mentioned above. They have been used for other REFLEX model versions, but the original had to be painted after the available monochrome pictures. At least the paint scheme's outlines were completely obvious.



In [this post](#) at RC Universe, Ken Bonnema says the original model, pictured in the Model Builder article, had orange wing tips. I couldn't make out any red wing tips in the monochrome pictures, but the mention of the Coast Guard paint scheme sparked an idea. I took white for the bright parts of the paint scheme, grey for the dark parts and Coast Guard red for the mid-tone parts. The result does not agree with the real model (maybe the dark parts were blue and the mid-tone parts medium red), but it looked consistent and I still like it.

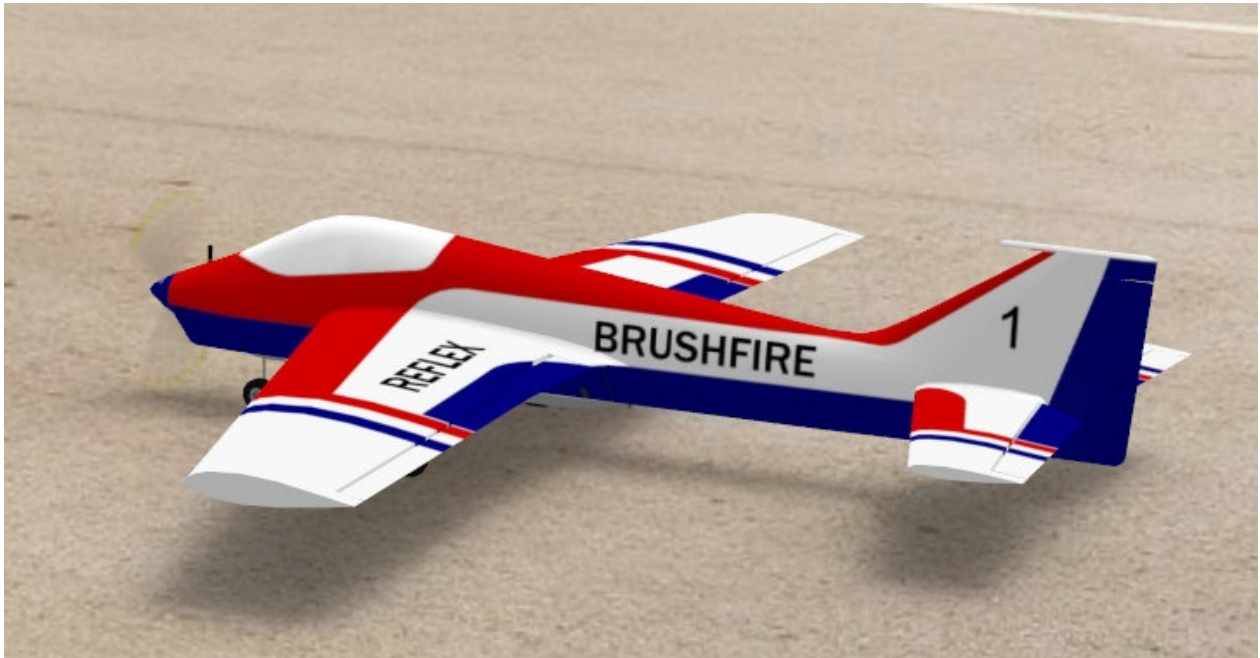


When Ken Bonnema found this article about his Brushfire, he sent an e-mail to clear up my confusion. Along with it he sent three color photos of the very first Brushfire (see also [at RC Universe](#)). He pointed out that the pictures in the Model Builder article show the second sample ever built. The first one was grey over white with day-glo orange tips and blue accents. This airplane had a full-flying stabilator while the second one had conventional elevators (and the first fiberglass fuselage, molds cast from the first model).



Not able to copy the colors exactly, I used Coast Guard red, Coast Guard blue, light grey, white, and black for the REFLEX model. The bottom side is white and blue only, by the way. This is a very attractive paint scheme, clearly visible and different at top and bottom. It is now used in REFLEX for the "original 1" version with a typical 9¼ lbs weight.

The paint scheme of the second Brushfire, which I had made with the wrong colors in the first place, is now used for the "original 2" version. I dared to make a guess of the colors, which are still not really known to me.



This is a cleverly made paint scheme. The lower fuselage is "darkened out" and the tuned pipe visually hidden. The white area between the red and the blue areas looks like an airplane painted onto the model. Upper and lower side are distinguishable by the red or blue looking fuselage.



The wrongly colored paint scheme is now used for the 11 lbs "heavy" version in REFLEX.

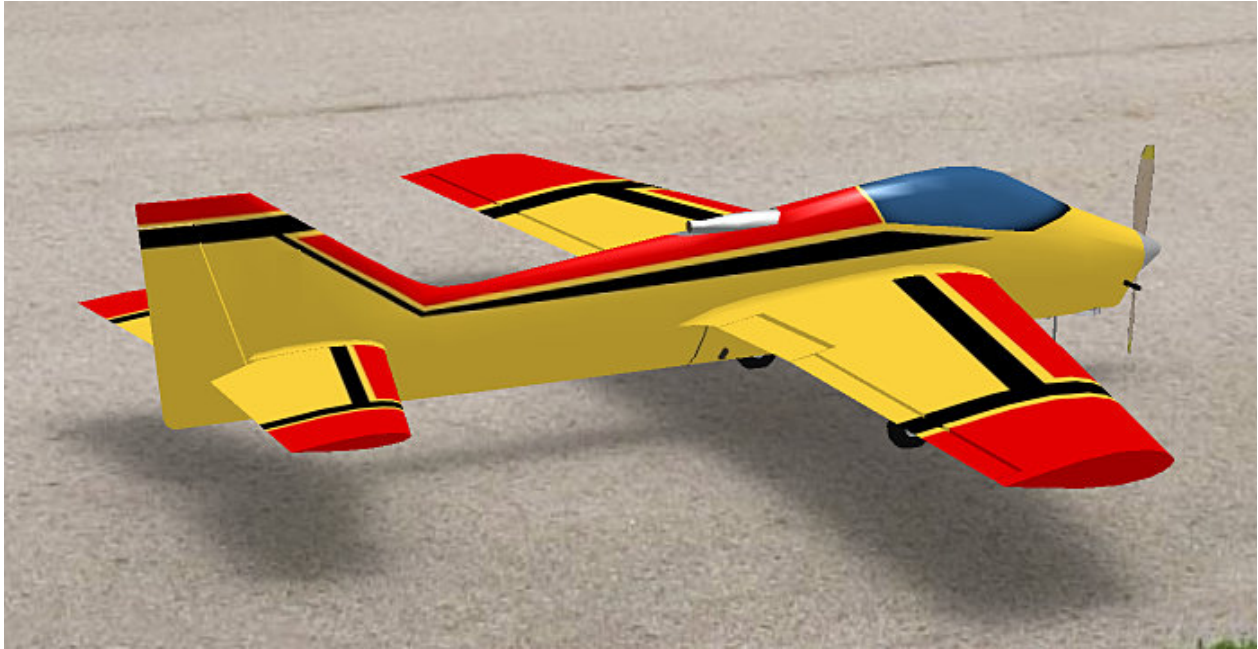
The Carolina Custom Aircraft kit should come out at less than 8 lbs, so one of the paint schemes shown in their color photos was used for the "lightweight" 8 lb version. It's quite colorful and might remind of a parrot, but I like these birds and this paint scheme. Especially the red parts make for good visibility.



This is the nice side of the model, no visible engine and tuned pipe.



And this is the ugly side of the model, but the blue parts of the fuselage visually hide engine and tuned pipe.



One of Dan Hines' photos shows an enhanced Brushfire with a hidden tuned pipe. In one of the RC Universe threads mentioned above, a modeler reports this had been a common modification. It's quite easy to take a rear-exhaust engine and install it upright. But now the cylinder is sticking out of the fuselage top what is looking ugly from all viewing angles.

Even the engine had been hidden in the fuselage. It was a real pain to mount the engine inverted, have an S-shaped header from the rear exhaust to the tuned pipe, and install all that in the cramped fuselage. Of course, there had to be sufficient cooling for the hot parts and for the duct in the fuselage.

In the simulator, there is no problem at all. Thus in the modern, enhanced version both tuned pipe and engine are hidden in the fuselage for low drag and clean looks. The cleanness is emphasized by the clear paint scheme. The lower part of the fuselage is not set off so the model looks more like a mid-wing configuration, what it actually is.



The cylinder head sticking out of the fuselage bottom for cooling is virtually invisible. The opening in the fuselage front below the spinner appears as a jet air intake though it is for the carburetor and some cooling air, of course.

As another enhancement, this version has an all-flying horizontal stabilizer. Stuart Chale writes in his article that the Brushfire Plus kit offered the option to install the Giezendanner mechanism. This stabilizer simply looks cleaner. The stick on top of the fin was omitted just for cleaner look as well.

For all REFLEX model versions Kay Thaele's helicopter sound was used. Even if it doesn't comprise a pronounced propeller noise, it has that screaming engine and tuned pipe sound. After all, that's what people expect and like to hear when flying a ballistic pattern ship.

Setup

As usual, I took the geometry from the plans and put it into Blaine Beron-Rawdon's excellent Plane Geometry spreadsheets (see the overview at [his website](#)) to get most of the physical parameters. The airfoil and wing coefficients were calculated in an own spreadsheet. All calculated values and the center-of-gravity position from the plan were simply transferred to REFLEX – and the model worked right away. This is another case where no tweaking or fudging was needed.

However, the C/G turned out to be too far forward to fly flick rolls and knife-edge as easily as described in the build articles. The model seemed to be a bit over-stabilized and refused to snap. Thus, the C/G has been moved back so far that all maneuvers are easily flown, might be even a tad too far.

Some plausible assumptions had to be made for the airfoil. The one shown in the plan has approximately 14.8% (root) to 12.2% (tip) thickness but is not a NACA 0015/0012, which has a rather blunt leading edge. The most similar airfoil for which I have German low-Re measurements is Eppler E 169. Its thickness is 14.4% and I simply used the coefficients unmodified.

The lift and drag coefficients for flaps and ailerons had to be estimated. They are rather small due to the small wing-chord percentage that flaps and ailerons are taking up. Still they have a decent effect because the wing chord is so big. It's not possible to render the wing's double taper in REFLEX, but it's small so the single taper comes close.

The original build article says the dihedral was set to get a stable knife-edge flight and was found out by trial. So the dihedral was set to 0.92 degrees because the article says the wing tip chord should be 0.52" above the root chord. As well by recommendation in the build article, zero decalage was set and no aileron differential. And the engine/propeller thrust line was not slanted down or to the right following the recommendations. Some experimenting with these parameters gave no improvement in flight behavior, so they are still set as recommended (except a tiny positive stab incidence).

Control deflections were set in a pragmatic manner. Rudder deflection is limited to 30 degrees by the cutout of the elevator. I simply set a bit less elevator deflection (25 degrees, full-flying stabilator 8 degrees) because vertical and horizontal tails are similar in geometry. The same nice round number, 25 degrees, has been set for the ailerons, and the customary 45 degrees flap deflection for much drag. All these settings turned out to be adequate.

Because the model needs these rather big deflections for some maneuvers but only very small deflections for others, -50% exponential was set for all three controls. That gives sensitive control in all patterns and a smoother flight. Of course, no linkage play is set in the parameters to the same end.

The original version's weight was set to 9¼ lb / 4.2 kg according to Stuart Chale's article. The moments-of-inertia were estimated correspondingly. The heavy version was assumed to have 11 lb / 5.0 kg weight due to heavy fuselage, foam cores, and covering. This weight spreading justifies equivalently higher moments-of-inertia, as well as lower ones for the 8 lb / 3.6 kg light-weight version. You'll hardly notice these differences, though.

The lightweight version was streamlined to the enhanced version by hiding engine and tuned pipe. This resulted in an estimated 30% reduction of parasitic drag (not wing and tail drag), but again you'll hardly notice a difference.

An O.S. MAX 61RF-ABC Hanno Special long-stroke with O.S. tuned pipe was assumed as Brushfire's engine. The drive settings in REFLEX are based on power and torque measurements published in an older German book. A conservative estimate is 6.6 lb / 3.0 kg static thrust with a 12x10.5" Asano propeller, if the pipe is tuned for 1.9 hp / 1.4 kW at 14000 rpm. It was assumed that the engine might rev up to 18000 rpm what determines the decrease of thrust with speed in REFLEX. Fuel consumption would be 85 oz / 2.5 l per hour at full power, giving only 10 minutes flight time with the 14 oz tank, but nonetheless I've set 15 minutes flight time.

Flight Characteristics

Brushfire is a very, very well flying pattern airplane.

One of its primary abilities is the roll. Several pattern designs of the time had substantially swept wings and a large fuselage side area with a forward aerodynamic center. One modeler wrote of "an automatic 10 for the roll" as score in competition. Brushfire is especially distinct in this respect.

Unfortunately, there is no parameter for the position of the fuselage's aerodynamic center in REFLEX (as well as in other simulators). It seems therefore some stick work is necessary to fly a decent slow roll with the Brushfire in REFLEX. But just as well this may be normal because the fuselage needs substantially more angle-of-attack than the wing. Anyway, rolls are still much easier than with most other models.

As well on account of the large fuselage lateral area (and of the large vertical tail) may be another good feature of the model. As Stuart Chale wrote, "the plane does a minimum amount of tail wagging as it comes out of a stall turn". This can be seen in REFLEX.

There are always some tales about a model and of course about Brushfire, too. One tale said it was hard to flick (or snap) roll, but that has to be a tale.

This model flicks *gracefully*. The classic, "old-school" method may be used to initiate a flick roll – rudder and elevator only. It flicks not as fast as a Pitts biplane, but it shouldn't either. The flick roll is neither fast nor slow; it's just right and very predictable, meaning easy to stop at an intended point. And it's nearly the same to the left and to the right.

Even though it's not possible in REFLEX to render the decreasing airfoil thickness from wing root to tip and the especially sharpened leading edge of the outer wing parts, the flick behavior shown seems very realistic to me. I just trust the stall model of REFLEX because the build articles say the real model flicks well.

Another tale goes about yaw-roll coupling in knife-edge flight. With its big lateral area and vertical tail, the model was just made for knife-edge flying. Both fuselage lateral area and vertical tail are not quite symmetrical, but that is compensated by a small amount of wing dihedral. In the build articles, the real model is said to knife-edge absolutely straight and stable, without any aileron or elevator input.

With exactly the same setup, the REFLEX model does as well, though unfortunately only on its left side (with right rudder). On the right side (with left rudder) it slowly turns out of knife-edge and needs a tad bottom aileron. The articles don't mention such a difference, so it's not clear if that's natural behavior or if it occurs only in REFLEX or with my setup. I can only think of the propeller torque turning the model to the left, counteracting a roll-out tendency in left knife-edge and adding to it in right knife-edge. Neither right and down thrust nor modifying the dihedral did really change something in REFLEX. Maybe a Brushfire expert could help out of this issue.

Another, corresponding issue is straightness of flight. Without any side or down thrust and aileron differential, the model flies absolutely straight. There's no noticeable adverse yaw. You may fly straight and level upright, then do half a roll, and the model will continue straight and level inverted without any correction. In the take-off run and the slow parts of a loop you have to apply a tad of rudder or aileron to cancel the big engine torque, but I think that's normal.

Finally, the wing flaps are very helpful for landing, even if not only for that. It's not the additional lift; it's not needed considering the big wing area. It's the additional drag that enables you to control the approach glide angle, and it's the reduced pitch that lets you flare the model to a lower touch-down

speed. Besides, the increased decalage makes for more stability in the pitch axis and a slight nose-up balance at low speed. For landing, very little up elevator is needed avoiding the otherwise big down force of the stabilizer and the compensating lift force of the wing needed without flaps. So even if the flaps are rather small, their effect is well sufficient and noticeable.

And even for the "heavy" version. The "original", "lightweight", and "heavy" versions are there to see the effect of the thrust-to-weight ratio. Since all versions have the same 2 hp drive, it's all about weight. It turns out that the "original" version is an excellent flyer for ballistic pattern. With "only" 0.72 thrust-to-weight ratio it has by far no "unlimited vertical" ability, but it still has some reserve to go through power-consuming maneuvers. The "heavy" version doesn't have any reserve and *has to* be flown with impetus, just ballistic. The "lightweight" version does not have to be flown ballistic; it may even fly slow patterns by means of the big wing and the high power.

To me, it makes sense to streamline just this "lightweight" version, giving the "enhanced" version. The reduced drag is not needed for top speed. As a matter of fact, there is only a small increase from 90 mph to 95 mph. But noticeably less energy is wasted for "parasitic" drag. Energy conservation in patterns is better so speed is more constant and maneuvers are nicer. The lightweight version has not as much kinetic energy to lose as the heavy version that fights drag with weight.

The REFLEX model's behavior is mostly what I would expect and what the experts describe in their articles. REFLEX is amazing because it credibly renders such a model's flight behavior. I just think this rendering is quite realistic – though I don't know for sure, of course.

Second Thought

In one of the threads referred to above, someone posted a high-resolution Brushfire plan with all specifications readable. A [thread at RC Universe](#) about trimming pattern models sparked new interest to try a "real" setup of the "virtual" Brushfire. Besides, REFLEX XTR² since version 5.05.0 allows using mixers in the transmitter, of which especially an elevator-flap mix (maneuver flaps, often called "snap flap") could be useful. So I revisited the setup of the simulator models and contrasted one new, rather different setup with them, together with the assumed paint scheme of the second real model ever built.

This "original 2" version is set up like "original 1", especially its weight, but it has conventional elevators (instead of the full-flying stabilator) and the C/G as recommended by Steve Rojecki. He recommends to start with the position shown in the plan, which means 20% static stability margin but is still a bit behind the 25% MAC point, which would mean even 25% static margin.

I even tried the latter as the starting point for "Triangulation Trimming" according to [Bryan Hebert](#). Even though it basically worked, I didn't manage

to remove all couplings but even got more severe couplings than before. In the end, I had to revert to the setup as specified in the build article, especially the 0-0-0 setup of thrust line, wing incidence, and stab incidence. The new trimming method worked for me on the simulator model of a modern pattern airplane but not here, so I'm at a loss with it.

To my surprise, the setup recommended in the original Brushfire build article turned out really well, though. That was when I followed Steve Rojecki's recommendation to move the C/G another half-inch back. In reality, this would make for just only 1/8" distance between the C/G and the main wheel axles, instead of 5/8" when the C/G is set like shown in the plan. That would raise a problem in reality, but fortunately we are in the simulator and can ignore it (what I did even more with the other setups).

A rather fore C/G position requires substantial elevator deflection for level flight, both upright and inverted. That even seems to be a setup preferred by many competition pilots. Verticals are pretty vertical, so the model is quite neutral (lacking couplings) in most if not all maneuvers, including knife-edge flight. This additionally requires the recommended, small control throws, and maybe is even helped by something like maneuver flaps.

The control deflections are specified in the plan as maximum (full-rate) throw in inches at a certain place on the control. Using the respective control width at that point gives the following deflections in degrees (rounded up):

rudder	24
elevator	8
ailerons	17
flaps	12

These seemed to be rather small, but to my surprise they turned out to be quite adequate and sufficient. The rudder throw is well enough for knife-edge flight, though not for snap rolls. Elevator throw is especially small, but it's just sufficient. The plan shows a "flap mixer" which is mentioned nowhere in the build article's text. I just assumed it means maneuver flaps and set my transmitter so that full up elevator makes for 12 degrees down flaps as well (and vice versa). Now looping patterns are perfect and especially smooth. I still prefer 45 degrees flap deflection for landings even though it's not mentioned in the article. The flaps seem to be intended as maneuver flaps since their leading edge is beveled for both down and up deflection and deflection is recommended as $\pm 1/2$ " at T.E. in the plan (\pm meaning up and down).

Aileron throw is just sufficient for 3 rolls in 5 seconds, but it's not sufficient to help the snap roll. However, neither more aileron nor more rudder throw make for a true snap roll, anyway, only much more elevator (25 degrees), together with a rearward C/G. That might mean such a dual-rate is needed for elevator, and better for ailerons as well, to enable snap rolls as needed in competition. The build article tells the specified throws are maximum rate, though, so I just don't know what is right.

To me it seems the special snap ability is due to the model's aerodynamic configuration and not the controls, and it requires a true stall. The small throws result in a maneuver that looks like a very slow snap roll, if full elevator leads full rudder and ailerons, and if maneuver flaps are used. Much elevator and rudder results in a graceful "automatic" snap roll, ailerons and flaps additionally helping. By the way, there's no expo set for any control in the "original 2" version.

Oh well, the setup seems to work and I still don't really know why. Maybe a Brushfire expert or at least a pattern trimming expert could help. He might even use the simulator to try and point out different setups because REFLEX seems to render at least the most relevant parameters. Anyway, I included not only the "original 1" and "original 2" parameter sets in the installer package, but also the "original 1 tx" and "original 2 tx" parameter sets. Implementing my neutral setup and the setup recommended by Steve Rojecki, they are both prepared for maneuver flaps with my Multiplex ROYALpro transmitter. Here's how my channel assignment looks with full-up elevator:

Control of FLUGZEUG\BE\BRUSHFIRE\ORIGINAL 2 TX.PAR

Control this model by ...

... general channel assignment (recommended)
The general channel assignment which can be defined in the radio menu controls all models without additional adjustments in transmitter or simulator.

... model specific channel assignment
Select this option in order to define a model specific channel assignment that will only be used to control the presently selected model. The model specific assignment offers the opportunity to utilize special mixing functions of your radio. Assign the appropriate channels to the control functions presented in the table below and adjust servo travel and servo reverse as required.

Channel display

1:		-2 %
2:		-100 %
3:		1 %
4:		-92 %
5:		27 %
6:		1 %
7:		-100 %
8:		0 %
9:		0 %
10:		0 %
11:		0 %
12:		0 %

Model specific channel assignment

control function	channel	servo travel -	current servo position	servo travel +	reverse
Aileron left	1	100 %	down	up 2 %	100 % <input checked="" type="checkbox"/>
Aileron right	1	100 %	down	up -2 %	100 % <input type="checkbox"/>
Elevator left	2	100 %	down	up 100 %	100 % <input checked="" type="checkbox"/>
Elevator right	2	100 %	down	up 100 %	100 % <input checked="" type="checkbox"/>
Rudder	3	100 %	left	right 1 %	100 % <input type="checkbox"/>
Flap left	5	100 %	down	up -27 %	100 % <input checked="" type="checkbox"/>
Flap right	5	100 %	down	up -27 %	100 % <input checked="" type="checkbox"/>
Throttle	4	100 %	min	max -92 %	100 % <input type="checkbox"/>
Landing gear	7	100 %	down	up 100 %	100 % <input type="checkbox"/>

OK Cancel Help

It's up to you, the esteemed reader, to adapt this setup to your transmitter and fiddle with some parameters to find a better setup. Even though Richard Hanson (in the [thread at RC Universe](#)) pointed out that there is no "correct" setup and trim, you may find one at least better than that I found. At any rate, I would appreciate if you could point it out to me in that case.

However, both setups and trims (forward and rearward C/G) can't be completely wrong. Dean Koger mentioned in an article that he flew the EU-1 (which is similar to Brushfire) balanced at 26% MAC at one contest and at 33% MAC at another where especially snap rolls were required. And Stuart Chale reports that his Brushfire Plus knife-edged well only after he set the C/G back about 9" behind the wing's leading edge (38% MAC). This is nearly as far back as the balance I'm fond of (41% MAC).

Beginning with [this post at RCU](#), Ken Bonnema cleared up several issues regarding the Brushfire: Snaps were enhanced by means of wing design details. The flaps were mere maneuver flaps not even used for landing. Since they were not really needed and only added weight they were omitted from the second Brushfire on. Landing is possible without flaps and still without much flare. Later, Ken Bonnema wrote a short history of his designs in this [thread at RCU](#). There he points out that Brushfire was intended to be „an absolutely uncoupled airplane“. That it actually is!

Warnings

In case you try the simulator models in REFLEX XTR² make sure the control deflections are well calibrated ("Radio" menu, "Calibrate center ..."). All model versions, except the "original 2" and "original 2 tx" versions, have even 50% expo set on all controls. If more than 100% servo travel is used by the simulator (check with "Radio" menu "Channel display"/F8 or "Model" menu "Control ..."Shift+F7), the models will get out of control when flying. Calibration should make for 100% travel in both directions. If that doesn't succeed at least the "... tx" versions can be calibrated in the "Control ..." dialog (picture above).

Even if calibration is correct, the Brushfire models may take you by surprise. All model versions, except the "original 2" and "original 2 tx" versions, have decent elevator throw that is sufficient to let the airplane stall. That has been set intentionally to get real snap (autorotation) maneuvers which require a true stall. Now even elevator alone (no rudder, let alone aileron), if only really snapped to full throw, will make for a left snap roll (due to propeller torque). To prevent that happening unintentionally you may use elevator dual rate on your transmitter.

Make sure that in the simulator also the power (throttle) channel has 100% travel in both directions. To this end, you may have to trim this channel fully back on your transmitter.

Sacrilege

Let's do that with pleasure! Isn't it a nice sacrilege to equip this model with an electric drive? A purist might argue that a rocket ship needs a screaming engine with tuned pipe. That's why he would decline to use a four-stroke engine. But a powerful, high-rpm electric drive has a quite screaming sound as well, and it's much easier to operate than the complicated combination of a glow engine and a tuned pipe. Its sole drawback is the short flight time, though it's just sufficient for a decent pattern sequence.



"electric 1" version

The model is even sleeker without any parts protruding from the fuselage. The enhanced version was taken as a basis for the electric version. You might think that an especially powerful drive is needed for a "ballistic" pattern ship, but consider that even today's big pattern models with their huge thrust-to-weight ratio are electrified.

Because I know a bit about AXI motors, I went to the [AXi Model Motors website](#) and looked for a suitable motor. Not one of the top-of-the-line AXI 53xx outrunners is needed but "only" one of the AXI 41xx, which are recommended for the sport model class. Of course, one of the strongest of this line is needed for this quite big "rocket" model, but it's not a pronounced rocket ship and will just do with such a motor.

A quick check with [Drive Calculator](#) gave a suitable drive consisting of an AXI 4130/16 motor, a Kontronik Jazz 80-6-18 ESC, a 3700 mAh 10s LiPo battery, and a 12x12" APC Sport propeller. Though the motor is close to its limits in this configuration and doesn't work at best efficiency, this drive is still appropriate because its weight is quite low.

The full-power flight time would be only about 4 minutes. An AXi 5330/18 with a 3300 mAh 12s battery would give the same power at peak efficiency, but it would increase flight time by only 1 minute and weigh 0.65 lb / 0.3 kg more. Replacing the 12x12" propeller by a 12x10" doesn't help either and won't give that "ballistic" feeling.

So let's take the 4130/16 with the small battery to have a lightweight model in the first place. I assumed an overall weight of 8.0 lb / 3.63 kg also for this electric version. Drive Calculator says the drive weighs 2.9 lb / 1.3 kg what might be even lighter than the glow drive. But there is some weight to assess for necessary installation parts (motor mount, battery tray). The thrust-to-weight ratio of this "electric 1" version is 0.89 and far better than that of the "original" version (0.72) – a benefit of an electric drive.



"electric 2" version

An alternative would be trading flight time for weight. Using a 6000 mAh 10s battery increases the full-power flight time to 6 minutes and the drive's weight to 4.9 lb / 2.2 kg. Thus this "electric 2" version weighs 10 lb / 4.54 kg and has a 0.72 thrust-to-weight ratio, but that's still not worse than the "original" glow version.

We might instead replace the 4130/16 motor by the 5330/18 and the 3700 10s battery by a 3300 12s. The model's weight increases only moderately to 8.65 lb / 3.92 kg giving a 0.83 thrust-to-weight ratio for this "electric 3" version. That's even the same as that of the "enhanced" version!

These three cases are prepared in REFLEX. The 3700 mAh "electric 1" version has 6 minutes flight time assumed you don't use full power all the time, the 6000 mAh "electric 2" version has 9 minutes, and the "electric 3" version still 7.5 minutes. Due to the big thrust you won't even notice the higher weight and don't have to fly "ballistic". I prefer a short but exciting flight to a longer but dull one, but there's no problem at all. See yourself!



"electric 3" version

Eventually I managed to make a new paint scheme for the electric version. I'm not good at that so I looked for examples and found the paint scheme of the Blue Angels, which is rather simple and quite attractive. I modified a bit, notably added a diamond on the model's "cheek". Unfortunately, the dark blue is not well visible in the air. To make it simple, I replaced the blue by a light and friendly red and the yellow by a lighter one.

The drive sound is that of a Hacker A30, which is a rather small drive. Nevertheless the sound fits well for the much stronger drive we are using here. Jorma Kinnunen kindly permitted to use the sound he recorded for his P-47 model published [at RC-Sim](#). Thank you very much!

By the way, did you notice that the model's name has a new meaning when considering electrics? (In German, brush sparking is called Bürstenfeuer, literally brush fire.)

Scenery

No grass runways! This model is made for paved runways. It has a retractable landing gear that is prone to damage on grass. The wheels are small for low weight, too small for grass. The propeller's ground clearance is less than half an inch, and it would take offense at mowing the grass. So use one of the nice USA sceneries of REFLEX: Muncie, Las Vegas, or Arizona. Or the MFC Salzburg field in Austria, or Ganderkesees in Germany which has even set some wind by default. Or use one of the paved-runway sceneries made by independent authors.



There is a scenery [at RC-Sim](#), very well suited to this model. *Horst Lenkeit* perfectly rendered one of the nicest model flying sites in Austria and maybe in the world. It's the field of the Klagenfurt model flying club in St. Johann, the field where *Hanno Prettnner* once practiced. There's a long tarmac runway (148 m / 485 ft) and much room on both ends.

That's well enough for all Brushfire versions, but the heavy 11 lb version might even use up the whole runway if flaps are not used. That's what the flaps are good for: By means of a controllable glide angle land the airplane on the spot and at moderate speed. You may practice this skill without fear of overshooting the runway, and you'll need only one third or even less of the runway when you know the trick.

There's another thing to learn in this scenery and with the different Brushfire versions: visibility.



Against the dark background, the paint scheme of the second original version with its white wingtips is well visible. But if the model is pulled up in the bright sky it's only visible by the small red parts of the paint. The more colorful other versions are well visible against both backgrounds, but not really good either.

You see the point: In some environments, visibility is a problem in any case. Add to this that a "ballistic" pattern model will often fly far away from the pilot. You'll see only a bright speck on the dark wood or a silhouette on the bright sky. No paint scheme does matter, regardless of color or different top and bottom.

If you don't fly "ballistic" style but slow maneuvers in a confined space, the model is near and well visible and the paint scheme can contribute much to your orientation and good scores in competition. The Brushfire with its big wing is able to fly such a "turnaround" style.

And the scenery has not only the dark side but also its bright side:



The scenery is just great, but it seems the digital camera failed finding a suitable white balance. At least the colors look quite cold. You might correct that yourself in a graphics program like the GIMP. But since I did that and besides removed a hump from the runway you may as well try [my version](#), which can be installed with the Brushfire installer.

By the way, you need this scenery to view my Brushfire demo flight. In REFLEX, hit F9 and under "Aircraft" select "Brushfire in St. Johann".

Patterns

If you would like to know more about the old maneuver schedules, well, that's a problem. Information on the old rules is rare; I found only a few scans, one of the [1982-83 AMA regulations](#) from the "ballistic age".

Conclusion

While the REFLEX model cannot be at all *completely* realistic, it yet shows the essence of the real model's flight behavior, which is best described as "smooth" and "neutral". So just enjoy the look and feel of "ballistic" pattern flying with this classic "rocket" model!

But if you're one of those veterans having own experience with the original Brushfire, I'd surely like to hear any corrections or suggestions from you.

Enjoy!

Burkhard Erdlenbruch

<mailto:Burkhard@Erdlenbruch.de>

<http://time.hs-augsburg.de/~erd/Modellflug/textReflex.html>

More REFLEX models and the latest versions are at my page

<http://time.hs-augsburg.de/~erd/Modellflug/textDownloads.shtml>

© July-August 2007,
updated March 2009,
December 2010 / January 2011,
July 2011, and April 2018