No.1 ELECTRIC MODEL FLIGHT MAGAZINE

Electric Flight

INTERNATIONAL

AUGUST 1998

PRICE £2.75 (UK) • $6.25 (USA)

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Paul White, Julie Arnett
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Chris Hughes
(DTP System Manager)

ISSN No. 1355 2228

ALL CORRESPONDENCE SHOULD BE SENT TO ELECTRIC FLIGHT INTERNATIONAL MAGAZINE:
Traplet House, Severn Drive, Upton-upon-Severn, Worcestershire, WR8 0JL, England. Tel: +44(0) 1684 594505.
Fax: +44(0) 1684 594586.
E-mail: efi@traplet.co.uk
Website: http://www.traplet.co.uk

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Printed by Warners plc, The Maltings, Manor Lane, Bourne, Lincolnshire PE10 9PH, England.
Tel: 01778 423931 Fax: 01778 425888

Distributed to the Newsagency Trade by Seymour Distribution Ltd, 86 Newman Street, London. W1P 3LD.
Tel: 0171 396 8000. Fax: 0171 396 8002.

Distributed to North American hobby and craft stores, museums and bookshops by: Carstens Publications Inc., PO Box 700, Newton, New Jersey 07860.
Tel: (973) 383 3355, Fax: (973) 383 4064.

All US correspondence should be sent to: Electric Flight International Magazine, Traplet Distribution USA, P.O. Box 1121, Sierra Madre, CA 91025-1121, USA. Tel: (626) 256 7985, Fax: (626) 256 7988.

Electric Flight INTERNATIONAL

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Features

Editorial

Electric powered models get better every year. We do a lot of our own development. We will soon be getting help from unexpected sources, and we may not even have to play our cards right! We can help each other too.

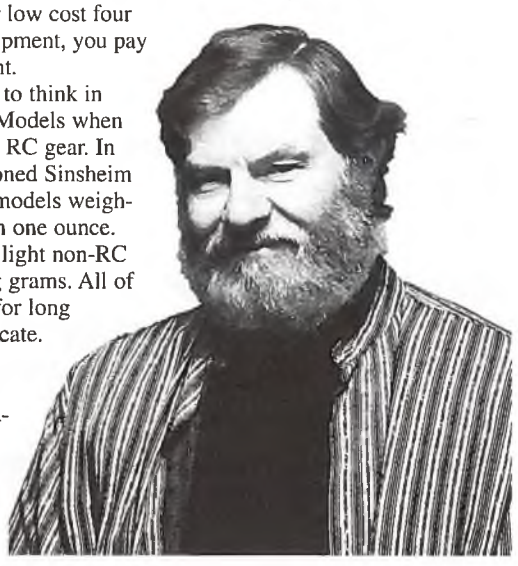
Small Models

This sub heading or 'Small RC gear' has appeared many times in EFI articles and in the editorial too. I hope it often will, equipment and models get smaller and more affordable every year.

There must have been a time when any RPV was considered a reasonably small 'model aeroplane' even though RPVs were often bigger than ultra light aircraft. Regular readers may have noticed my recurring 'small models' theme that has included anything smaller than 'normal'.

Small electric powered models can only get smaller if the RC gear is small. 'Mini' has moved to 'micro' has moved to 'nano' and these adjectives can become meaningless. How small is small? Receivers available to model flyers are now a few grams. Speed controllers are less than one gram. Servos are less than two grams. The Sinsheim report in the May 1998 issue of EFI showed very small WES Technik and Rick Ruijsink RC gear, very small, very light and only moderately expensive. Moderately? This gear is expensive for say four functions but is perhaps one hundredth the weight of regular low cost four function RC equipment, you pay for what you want.

Modellers tend to think in terms of Indoor Models when discussing micro RC gear. In the above mentioned Sinsheim report were RC models weighing 25g, less than one ounce. There were very light non-RC models weighing grams. All of these do not fly for long and are very delicate. Very lightweight indoor models have been recording flight times close to the hour for decades - on rubber power.



At these extremes of technology it is too easy to overlook established methods, techniques, materials and older acquired knowledge. I am not suggesting that we should dump our brushless neodym motors and microprocessor (or am I already out of date there) controlled speed controllers in favour of rubber bands. What I am saying is that if you are interested in really small RC models: "You ain't seen nothing yet."

Development

Many modellers are responsible for really ingenious advances in technology and construction techniques. Almost all of us at one time or another have sorted out a new method of achieving something. These minor accomplishments can add up to a major list of achievements. You only have to read through this magazine every month to find numerous clever ideas of others that you may wish to apply to your own model building. Some of these may be techniques used by one of you for years, not realising how much a better way it was than the regular method used by everybody else. You will most probably have done this in your own time with no particular target for achievement level or on a set time scale. Somebody may have a better system than yours.

Development often moves faster when it is controlled in a full time job. This costs money. There is not the funding available for deep research into model flying. There is not the 'payback' to inspire this investment - or is there?

Leisure activities like ours do not attract the funding because the rewards are just not big enough. But we can cream off a lot of useful bits. I am sure that none of the chips in our RC gear was developed specifically for models. This research must have cost billions of dollars, pounds or marks. By careful selection we model flyers can benefit from the results.

What would we get and how fast would we get it if research was directed towards very small flying models? We are about to find out. The quick way of solving any problem is to "Throw money at it." This is already happening in the USA.

This writer has time for little more than model flying but he does try to keep in touch with what is happening elsewhere.

I have been aware for some time of minute energy and propulsion systems. For reasons probably not at all connected with model flying there have been developed several very small 'motors/engines'. Who is normally best able to 'Throw money' at any problem? Normal answer - "Governments!"

The spending of public money in the USA has to be so open and records so available for scrutiny that it is not at all difficult to see where money is being spent and on what. That makes results - if successful - predictable too. At last, money is being spent on our size of models.

We are not the intended beneficiaries but we can 'cream off' again, components and techniques very beneficial to ourselves. I'm sure we can use almost all of what will be achieved because the target is close to OUR area. A lot of funding is being directed towards Micro Air Vehicles (MAVs).

Achievement

USA government funding for research is in distinct and predictable packages so it is possible to read from the outside both where the work is being done and what level is being achieved, or the funding would not proceed to the next 'step up' to keep pace with it. It is even easier for us to see and read the levels when achievements are made public.

Requirements to justify spending large sums of money are often military but even pacifist model flyers can reap the benefits. The Defense Dept requirement is for an MAV for survey work, a tiny 'eye in the sky'.

Larger RPVs and Drones can be built from available equipment. This is our size of regular RC gear and motors to utilise whatever energy source. The new requirement is for pocket size surveillance vehicles. Does this sound like models smaller than those in the Sinsheim report and carrying a TV camera? Discrete cameras in the sky need to be small or not noticed or regarded as something else, like a bird or a fly or a leaf. Who, busy, even notices a buzzard overhead? Model flyers, any flyers, take notice of what is in the sky but Joe Average walking in the street does not. Would you even notice a sparrow, the same sparrow, over you for 20 minutes?

From the advances we have

recently seen in models for not enormous sums of money, it is easy to believe that RC gear and cameras are not the problem. These MAVs will be used by soldiers who are not skilful model fliers. The MAVs will go/fly where they are told, look at what that guy needs to see and maybe come back - or be expendable - they have done their job. This is one step ahead of fly-by-wire and close to the Keyence 'Engager GS III' reviewed by Mike Goulette in the March 1998 issue of EFI.

The problems so far have been in the same areas that we have, the power train. MAVs have used rocket, gas turbine, IC and electric motors for propulsion. If they need to be quiet, electrics may be the way to go. Motors get smaller and the energy density of fuel cells or batteries gets better too. There is going to be something useful to us at the end of all this!

Revelation

Early achievements are now publicised. Several companies have released information on what their MAVs can do. AeroVironment Inc., have shown a hand sized flying wing disc about 6 inches, 150mm in diameter with an electric motor, prop and lithium battery. (Years ago, did not the editor of a UK model flying magazine go to work in the USA for a company with a name like that?)

Other companies have used micro helicopters, ornithopters and more conventional looking models. Cameras are down to two grams, piezo gyros are down to one gram, servos must be about the same, so what is there that is heavy? It is still the energy source, the battery. We are familiar with this problem, aren't we? Admitted flight times so far have been a few minutes. The duration target time is 20 minutes and I am sure this will be achieved this year or next. You can safely bet that some very high energy density batteries will come out of this that will be of great use to model flyers.

The flying machine

We all know that as models reduce in size, we lose efficiency at about the same rate. Throwing money at the MAV problem will provide them (and us eventually) with micro-micro colour TV cameras, servos you can hardly see (probably little 'muscles' rather than motors and gears) and RC receivers and speed controllers you are in danger of inhaling if you breathe too close to them. The battery may still be the biggest lump but it will do the job.

The problem is the aeroplane, airplane, or in this case 'air vehicle'. Materials used with success so far are very familiar to us. Any of us could built one of these micro air vehicles in minutes from our scrap boxes. Millions of dollars have been expended so far on all the above mentioned equipment but the fixed wing models have been made from polystyrene foam and balsa wood.

It is not a super-manoeuvrable aerobatic model. It is a very stable but controllable model that is required. (Ace pilots please do not tell me that 'stable' and 'controllable' contradict!) It needs to hover or fly slow enough to be useful for observation. This sounds to me very similar to the requirements for a trainer.

Trainer? Hand sized? Slow flying? ...and it will probably be electric. I think this could entice a lot of newcomers into our area. Just think of all the new equipment that will be made-available to us.

Think too of what we may be able to contribute. There may be some very interesting small models on the scene soon. Maybe some of us will come up with something sooner than those who are being employed to design them. Have any of you got any useful small models, electric powered and radio controlled? They do not need to be as small as those discussed above, just smaller than average, show us what you have got.

Hints and tips

We all have our own favourite ways of doing things. I have seen so many techniques on 'Hints and Tips' pages of other magazines and said: "I have been doing it that way for years!" I have mentioned this to other experienced modellers. Not many of these guys have seen much new to them in years of 'Hints and Tips'. We have a information communication gap here!

Think about it. 'Hints and Tips' need not be useful to experienced builders. They already know. It is the beginners and less experienced builders who need advice and direction. Tell us about you methods, for model building and especially electrics. Columnists like Martin Irvine have shown us techniques like the economy way to end-to-end solder cells. Many of you must have your own 'tricks'.

For the experienced...

Somebody may have a better system than yours, or your system may be better than the other guy's. We already have an intermittent 'How to' column. It should become more regular. Tell us how you do it. This column is a bit deeper and more specialised than the Hints and Tips for beginners but you can bet that beginners and very experienced model builders will be interested in how you do it. Tell us how YOU do it.

Promises!

Regular readers may have noticed that all the items listed on the 'Next Issue' page are not always included. We DO plan ahead but we too have to rely on promises and not everything promised gets to us on time. Kit reviews are the most difficult promises to keep. Nearly all of the of the reviewers are based in the UK and there is no need to tell UK readers that we have not had too many suitable flying days this year. This editor has an indoor/slow fly/park fly model that was taken out on a very calm day in January. The relative humidity was very high and the thin doped tissue sagged within the first minute outside and after about ten minutes looked as if it was virgin tissue that had just had its water-shrink spray. I have not been near any indoor space large enough so it is still waiting for its first flight. I believe all the reviewers who tell me they have not had weather suitable for test flying!

This Issue

I know what is here - no danger of broken promises. I would like to explain a little more than is contained in the sub-headings of the 'Contents' pages. I wouldn't dream of trying to direct your reading; you very probably read your favourite columns first, then likely looking feature articles and last of all the Editorial - so let me comment on what you have just read!

Our intention is always to provide what you want, we believe this to be: "new information about electric flying". Some of it is 'news', we hope that all of it is informative and some (don't misunderstand the word) 'educational'. I not talking school-type education, whatever your age, I mean information that will be of use to you. This covers anything from what is new from manufacturers to detailed instructions on how to program your PIC speed controller. We should never be reluctant to learn something new and so much new is happening in electrics that we may need to widen our breadth of knowledge.

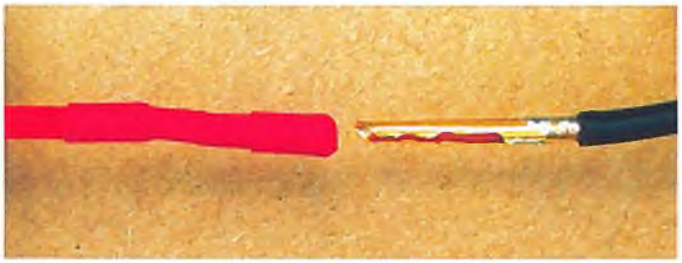
Some mature fliers who are beginners in electrics are mystified by what a motor does with amps and volts. They are reluctant to believe that all this is much more understandable and that motor performance is more predictable than with an IC engine. This lack of familiarity makes it just as hard to understand that an electric motor is more versatile and controllable too. This is usually because we sat at the back and did not pay sufficient attention during school physics lessons. I use 'we' with honesty. I too had a bit of scrubbing up to do when I got into electrics.

If I ask "Do you want some 'electrics' lessons?" I expect that all of you will be too shy to say "Yes". So I will put it a different way. We are going to start a slightly more technical but very understandable series on motors and the selection of suitable motors for types of models. If you think this is too basic, if you think you do not want this information or education - tell me.

Current Affairs

More new products from around the world make electric flying more easy with a wider selection of components.

▲ **2mm and 4mm lightweight plugs and sockets.**



▲ **2mm socket soldered to cable plus heatshrink and with the extra 6mm long heatshrink sleeve. You also see the plug soldered to the cable; when you see how far it fits into the socket, cover the exposed part of the plug with heatshrink too.**

Lightweight connectors

Mail Order Model Supply of York have been a UK source of gold plated 2mm and 4mm 'banana' connectors for several years. Mike Donkin of MOMS has discovered that his source of banana connectors has been manufacturing similar sizes of much lighter connectors for 36 years. He sees these being useful where weight really counts, for indoor models and lightweight floaters like electric gliders. The cost is reasonable, they are easy to solder to wire and offer good mechanical support to the soldered joint.

They come in 2mm and 4mm sizes and the split socket is designed to be held in a plastic bush but will function correctly when fitted with good heat shrink tube. When inserted, the plug squeezes to fit firmly into this socket. Mike describes his sequence of fitting:

"Do not attempt to put the plug into the socket as supplied. Connect the socket to its intended wire and cover with heatshrink before attempting to assemble. The sockets are fitted with a tag and the wire can be soldered to this. The plug has a tag on the side which can be used - or, I suggest that you remove the tag from the plug with side cutters (cutting along the length. I tin the intended wire lead and allow to cool. The inside of the plug is very lightly tinned or the tinned wire end dipped in flux. The wire is pushed inside the hollow plug which will open a little. The soldering iron is applied to the outside of the plug and a small amount of extra solder can be added if needed.

"DO NOT attempt to enlarge the end of the plug by force. Use wire of a suitable size (1.5mm or 2mm). Any cross cuts or other excess force could lead to a stress fracture in the plug. After fitting, the plug and socket MUST be insulated with heatshrink.

"The open end of the socket can be fitted with a 6mm length of extra heatshrink sleeve. This should be fitted over the insulating heatshrink and will increase the tight grip of the split socket."

The 4mm plug and socket cost 75p and the 2mm pair cost 55p. Packs of shrink for several plugs and sockets cost 50p for the 2mm (3.2 and 4.8mm shrink) and for the 4mm, £1.25 for 6.4mm shrink and 75p for 4.8mm shrink. 2mm components are rated at 15A and 4mm at 35A; this is probably conservative rating. These 'new' components are fully interchangeable with the existing high current ones but remember the current rating of the lightweights.

Available from: Mail Order Model Supplies, 37 Wydale Road, Osbaldwick, York, YO10 3PG, UK. telefax: 01904 414738

Airfoils

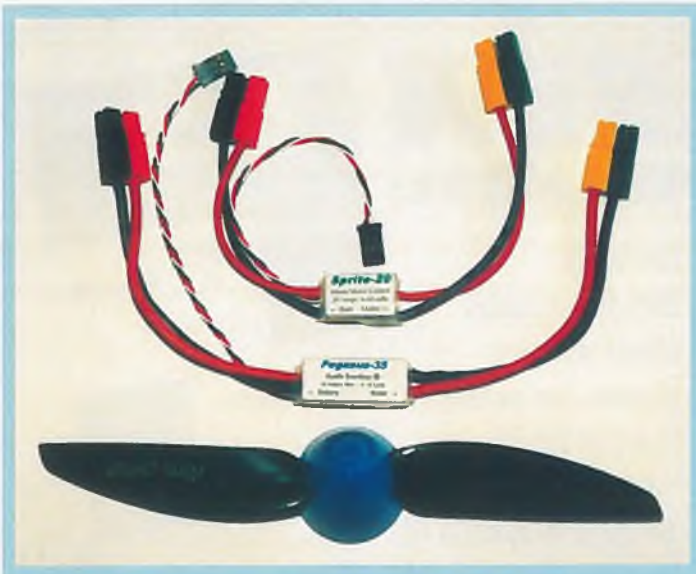
There are a few prominent names in "our size" airfoil design and one of the more currently prolific of these is Dr. Michael Selig. Reports have been issued and books have been published, containing scores of his airfoils. All of this is very useful to those of us with degrees in aeronautics but what about the rest of us that are still uncertain about which airfoil to use on the models we

Bigger cell

There is now available a Sanyo N-3000SCR. The cell in the photo was described by this number when it was purchased but it is not yet available in regular plastic sleeving, only in this cardboard sleeve, in which cells are often supplied for 'commercial' use - such as in power tools. I am not familiar with regulations elsewhere but in the UK it is not permissible to retail cells to the general public unless they carry the information we are accustomed to see regarding the nature of the product and the hazards of disposal. It is however permissible for the cells to be made up into battery packs and retailed with labels carrying this information.

When the cell is offered for sale to the 'leisure market' (that's us) it will probably have a number like RC-3000.

Size is 26mm diameter by 50mm high and the weight is 84g. You can see in the photo how much bigger it is than the RC-2000. Tests indicate a slightly higher operating voltage than 2000 cells, due presumably to a lower internal resistance. Users of packs are very enthusiastic; motor time increases about 50% for a slight increase in total model weight. These cells should be very popular with the pilots of larger models that can carry the extra weight.



▲ **Sprite-20 and Pegasus-35. You may prefer shorter cables to reduce flying weight and increase safety in operation.**

Speed Controllers

Martin Irvine's report on the Toledo show (in the July 1998 issue of EFI) contained news of Castle Creations' new micro 'Pixie-14' controller and his photo of the display at the show contained also the Sprite-20, Sprite-XLR and Griffin-50.

Since then, Patrick Del Castillo of Castle Creations has added to his range the Pegasus-35 for use at up to 35A continuous on 6 to 10 cells with BEC or up to 18 cells with BEC disabled. Size is 35 x 15 x 10mm. No weights are quoted but Martin Tyas who kindly supplied the photo reports that the item as you see with cables and connectors weighs 31g. The Sprite-20 also in the picture is for 20A continuous on 6 to 8 cells with BEC or up to 16 with BEC disabled and as viewed here with cables and connectors weighs 21g. (1 inch = 25.4mm and 1 ounce = 28.35g.) Patrick claims that the Sprite-20 is "The worlds smallest 20 amp RC motor controller." The RRP's are $49.95 for the Pegasus 35 and $54.95 for the Sprite 20. The smaller one is more expensive but has a brake. He has a number of distributors in the USA including New Creations and North East Sailplanes but if you are outside the USA go direct to: Castle Creations, 1625 E Drury Lane, Olathe KS, 66062 USA. Tel: (913) 397 0813. Email: pdelcast@idir.net.

design or who just want to know why some are better than others?

'Soaring Stuff' have announced a new video: "Everything You Always Wanted to Know About Airfoils"..... this exciting new video was produced in cooperation with Dr. Michael Selig and the University of Illinois Low Speed Airfoil Testing program. This video explains in non-engineering terms all of the aspects of airfoils, how they work and most important, how to choose the proper airfoil for your next project, or how to evaluate airfoils on an existing design. It shows wind tunnel testing and how to use the wind tunnel test graphs (called 'Polars') to select the right airfoil for the right task. Computer generated animation and live video footage will take you through this fascinating science with a minimal amount of mathematics.

Part of the proceeds of each video sold are being donated to the UIUC Airfoil Testing program, to further the research work of Dr. Selig and his team.

From the basic concepts of chord line, camber and thickness percentage, through airspeed, Reynolds numbers and angle of attack 'Everything You Always Wanted to Know About Airfoils' de-mystifies this essential part of aerodynamics.

NTSC (American) Format - $29.95 + $3.00 shipping & handling.

PAL (European) Format - $34.95 + $3.00 shipping & handling.

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Available from: Soaring Stuff, 9140 Guadalupe Trail N.W., 87114 USA. Telefax: (505) 898-8281. Website: http://www.soaringstuff.com

Bearings

Those of you who have needed small bearings for your own-design motor extension shafts, gearboxes and control surfaces and their control runs, will know what a long task it is to hunt down very small ball races. One company now claims to have more than one million miniature bearings in stock.

Boca bearings of Florida, USA are proud to announce that as of June 1st 1998 they now have a stock of over 1 Million miniature bearings, surely the most comprehensive selection in the world today. All the information you could possibly need is located on their web site at www.bocabearings.com where there are separate sections for car racers, heli pilots, fixed wing fanatics and jet jockeys, you can even order on-line as well. If you don't have internet access then don't despair, they are happy to deal with all their customers direct on the following numbers, tel: 001 561 9980004, fax: 001 561 9980119 (use the 001 if you are calling from outside the USA). Email: bearing@gate.net

Boca Bearings, 7040 W. Palmetto Park Rd. Suite 2304, Boca Raton, FL 33433, USA.

MaxCim brushless

One of the longest running manufacturers of brushless motors must be MaxCim. Tom Cimato has always preferred to satisfy the requirements of the discerning sports flier rather than search for glory at the extremes of performance at world championship level. Tom's motors have a reputation for smooth throttling and efficiency. Martin Irvine's Toledo report contained news of the prototype MaxCim MegaMax 3.7, a new monster motor.

▲ **MaxCim MaxNEO motor, controller and MaxGR gearbox.**

Announced earlier this year, available now and for use with the more popular size of model is the MaxNEO motor. Martin Tyas has kindly supplied a photo of this motor with its controller and the MaxGR gearbox which has advantages supplied by only a few other brands of gearbox. Experimenters can change gear ratios easily as the pinion is easily interchangeable, secured to the motor shaft with a machine screw. The gearbox to motor mounting is slotted to allow adjustment of the gears for the different sizes/ratios.

Available from: MaxCim Motors Inc, 57 Hawthorne Drive, Orchard Park, NY 14127-1958, USA. telefax 001 716 662 5651. Website: http://www.maxcim.com

Available in the UK from: Fanfare, 18 Hillside Road, Tankerton, Whitstable, Kent, CT5 3EX. Telefax: 01227 71331.

Small folders

Smaller sizes of Graupner CAM Folding Props were anounced at Nürnberg and are now available. The 6 x 3 is for 2.3mm motor shafts - Speed 400 motors. The 7.5 x 4 is for 3.17 motor shafts - 500 and 600 motors. Ask at for them at your local dealers. EFI

◀ **RC-2000 - 3000SCR - 3000SCR in its cardboard sleeve.**

▲ **Graupner 6 x 3 and 7.5 x 4 CAM folders.**

ELECTRIC FLIGHT

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JES JETI - Electronic Speed Controllers

FVK Modell are now importing the Jes JETI Range of electronic speed controllers in the UK.
Available in two ranges, with BEC or OPTO.

The Jes 05 to Jes 50 Range of Controllers, caters for 5 Amp to 50 Amp, and operate on 6 to 10 Cells. With BEC and Brake facility. (Individual model specifications may vary).

The Jes 40 to Jes 150 Range of Controllers, cater for 40 Amp to 150 Amp and operate on 8 to 30 Cells. With or without Brake. These OPTO Units feature galvanic separation so Do Not have the BEC facility.

Supplied with leads.

For full details and price list contact:

FVK Modell, Brian Anderson, 206 Hilda Park, Chester le Street, County Durham, DH2 2X. ENGLAND
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e-mail Address: Brian.Anderson@Onyxnet.co.uk

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July 25 & 26
INTER-EX 1998. Oistrach, (near Bodensee) Germany.

July 31 - August 2
Electric Flight Festival, Neuhardenberg, Germany.

August 2 - 9
F5B World Championship, Neuhardenberg, Germany.

August 1-2
Scottish Soaring Nationals, UK. Electroslot and 30 Minute Electric (plus Thermal soaring events). Contact: John Walker 01292 560341 or Colin Sparrow, 01505 850242, email: csparrow@clara.net

August 2
BEFA Fly-In at Leamington Spa.

August 2 - 4
USA AMA Nats.

August 8 - 9
Fort Wayne Flying Circuits Electri-Fly, 1998. Fort Wayne, Indiana, USA. 2 day event, AMA sanctioned. Dinner Saturday night. Camping available right by the flying field. Night flying planned. Contact: Pat Mattes, Yoder, IN, USA. email: Pat-Ingrid-Mattes@Juno.com

August 8 - 9
Eastnor Castle 1998 Model Spectacular, organised by the Border Counties MAC. Model Flying by leading professionals plus model cars and boats racing. Entertainment Saturday night. Camping and toilets available for the weekend. Disabled parking and toilet on site. Contact: John W. Ashton Tel: 01568 613163, Email: BCMACjwa@aol.com Web Site at http: //members.aol.com/bcmacjwa/

August 9
BEFA Fly-In at Woburn Abbey.

August 15-16
Family and Model Craft Show at Plumpton Racecourse, 4 miles from Lewes, Sussex. All Enquiries to: Dave Bishop of DB Sound, 17 The Square, Tatsfield, Kent, TN16 2AS. Tel 01959 577550. Mobile: 0850 752061.

August 16
Greenacres MAC Electric Fun-Fly 98. Walsall Airport, Off Bosty Lane, Walsall, West Midlands. Signposted from Junction 9 M6. Entry £2 per Tx. Food and refreshments on site. Trade stands welcome. Contact: (01922) 404658 or 448873.

August 22 - 23
Haverfordwest Model Club's annual show, Scolton Manor. Contact: Adam Pollard, 6 Castle High, Haverfordwest. Pembs. UK-SA61 2SP. Tel: 01437 762633.

August 22 - 23
2nd Annual MARCEE/St Paul RC E-Fun Fly, USA. Contact: Stevepauley@worldnet.att.net

August 23
Anglia MFC Electric Fly In, Stow Maries, near South Woodham Ferrers, Essex, UK. Fly anything (we've got the space!) plus AULD. Contact: Alan Bedingham (01268) 457615, email: alanbedingham@cableinet.co.uk Date is 23 August 1998 at the Anglia field near Stow Maries in Essex.

August 23
Dunfermline Model Aero Club Electric Fun Fly from 9.30am at the club flying field at Cleish. In addition to RC models, all types of electric powered flying models, electric free flight and electric control-line welcome (insurance essential). This event is primarily about sport flying. However informal competitions such as All Up Last Down, pylon racing, or aerobatics can be arranged on the day. The site has a concrete runway and a large area of open moorland for free flight models. For details of how to get to Cleish contact Neil Gillies 01383 823489 (evenings) or E-mail: neil@sea-gull.demon.co.uk or Mike Dodds, 01383 873132 (evenings) or E-mail: Mike.Dodds@gtnet.com Please let Neil or Mike know if you intend to come along, which frequencies you fly on and if you would like to participate in any 'competitions'.

August 29th - 30th
Irish National Rotorcraft Show, Galway, RoI. For more info contact RGI on 01974 821205.

August 29-31
BMFA Nationals, Scampton, UK. F5B on 30th. BEFA League Electroslot & Electroslot 400 on 31st. Contact: BMFA, Chacksfield House, 31 St. Andrews Road, Leicester, LE2 8RE.

September 6
Montrose Electric Fly-in, UK. Fun events. Contact: Ian Guthrie, 01674 672268 (business hours).

September 6
North London MFC Electric Fly-In at Baldock, Herts. RC only, insurance required. Contact: Brian Downham 0181 363 7528.

September 13
Ebor, York. BEFA League, Electroslot, Electroslot 400 & E400 pylon. Contact Eric Leadley, 01904 422615 or Mike Proctor, 01904 489386

September 15
SAM Champs at the AMA National site in Muncie, Indiana, USA.

September 19 - 20
KRC, Queen City Airport, Allentown, PA, USA.

September 20
BMFA F5B League, Owthorpe, Notts. Contact Mike Proctor, 01904 489386.

September 20
Pillerton Fly In, Pillerton Hersey, Warwickshire. Fun fly, carrier take-off and landing competition, AULD after lunch. Contact: John Lewthwaite, Home Farm, Pillerton Hersey, Warwick, UK-CV35 0QQ.

September 20
Linithgow. Electroslot (plus Open Thermal). Contact: Colin Sparrow, 01505 850242, email: csparrow@clara.net

September 20
Battle of Britain Fly-in, UK. Bring your WW2 aircraft. BBQ & raffle, clubhouse & toilets. Contact Gary Western

September 25 to 27
Lleyn Model Aero Club 'Bring and Fly' all flying model types. Contact: Frank Pilling, Crud y Gwnt, Abersoch, Pwllheli, LL53 7HR. Tel: 01758 712673.

September 27
Pilleton Hersey, Warks. BEFA League, Electroslot, Electroslot 400 & E400 pylon.

October 4
Mossmorran Electroslot (plus F3J Thermal). Contact: Colin Sparrow, 01505 850242, email: csparrow@clara.net

October 11
BMFA F5B League, Owthorpe, Notts. Contact Mike Proctor, 01904 489386.

November 15
BEFA Technical Workshop, Leamington Spa.

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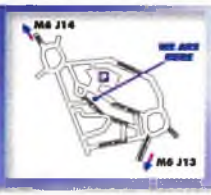

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The Light Fantastic

CHRIS GOLDS

Have I always built as light as I should, or could? Plus, a ducted fan ONLY meeting with a lot of EDF models.

▼ Dave Gardner Holding two KYOSHO T-33s - before WW3!

Lightness equals labour

"Arthur Sinjon Crudbucket, you have been found guilty of the charge of building overweight model aircraft and I hereby sentence you to the maximum punishment laid down in law for your most heinous crime, that being twenty-five years hard labour and may the modelling fraternity have mercy upon your soul. Constable - take him down!"

Frenzied screams of public protest filled the court as the grey-haired sixty-one year old ex-fighter pilot was led away to the cells: what surprised this reporter was that the guilty one was nodding his head as if in agreement with the judge's sentence! Such is life.

For the last two years, I have been designing, building and flying only EDF models and I have struggled hard to free myself of the habit of adding a bit of 4 x 4 oak here and a bit of 1/4 ply there and ending up with immensely strong models becoming extremely heavy ones. With lots of ICDF power and plenty of concrete for take-off, weight was not the thought uppermost in my mind when draughting a new model.

However, with my new discipline - EDF - the question of weight is the foremost when it comes to a new design. I always note down in my "data book" all the major measurements and an 'AIM WEIGHT' which then allows an 'AIM WING LOADING' to be calculated. Sometimes I achieve the weight with the finished model, usually I am a little (an ounce or two) over and occasionally I

am way over the top; my Concorde, using 4 x 480 RACE BBs in 4 x 480 WEMOTEC MINI FANS, was a staggering 34 ounces over the aim weight. A combination of a very conservative end weight assessment and lack of building weight-control. No wonder its performance was disappointing. I have remotored the model with 4 x PLETTENBERG 200-20-6s and I eagerly await the flight test. Test bench thrust is up by about one kilo over the 480s; let's hope that is enough to push through the delta drag-barrier! I recently had the chance to look very closely at KEVIN SAUNDER's A10 which has everything except a working multi-barrelled cannon (come on Kevin!) and his standard of finish, lack of weight and consequent full performance mark this as a star of recent EDF scale models. He has weight control down to a fine art.

▼ Kevin Saunders showing his splendid twin EDF A-10 'Warthog'- a really fine flyer (him too!).

So - to business

I spent Sunday 7th June 1998 at the BICKLEIGH MFC FUN FAN FLY near Sutton-at-Hone as a guest of His Fanness the Great Gaskin of Kent. What a splendid day it was - despite two sessions of rain the weather was good with scudding low cu and a wind of about 15 knots from the south-west. The field was very well prepared with grass mown smooth and plastic mesh barriers in place, while the ladies kindly set up food and drink stalls complete with a BBQ.

Although it was a FAN meeting, a couple of prop jobs flew demonstrations, one with a geared electric motor and new LC cells which performed bril-

▲ Warthog's business end - neat motor body shrouds. The square channel between pods is for speed controller cooling.

▲ Some of the EDF models at Bickleigh - note the well prepared grass. (The Viggen and Hawk are ICDF).

liantly in the very capable hands of Bob Ryan (Sir Bob - who else?) and the other an IC prop old-timer with a working TV camera fitted, flown by Kevin Saunders. There was quite a crush in the Tx control tent to watch the TV monitor screen, showing the field from high above our heads. We all waved - To ourselves!

I had a wonderful day, flew my DH110 twice without digging a hole, ate burgers and talked non-stop fannery with some old friends, notably - Paul, Dave, Pim, Sir Bob and Kevin and his Dad and a lot of new faces belonging to the club. The meeting was well organised, very friendly and contained lots of good quality flying. One young man, Lee Abbott, flew the Gaskin "MiG-thing" so well in the KYOSHO T-33 combats that he managed to claim one and a half kills against these very agile ARTF foam and plastic "shake the box" models. I was much impressed with him and the models.

A thank-you list will ALWAYS miss out someone but I must thank the meeting organisers Terry Adams and Geoff Wallace for a great fun-fan meeting. Also my thanks go to all those behind the scenes especially the ladies who cooked and served a fine meal through most of the day.

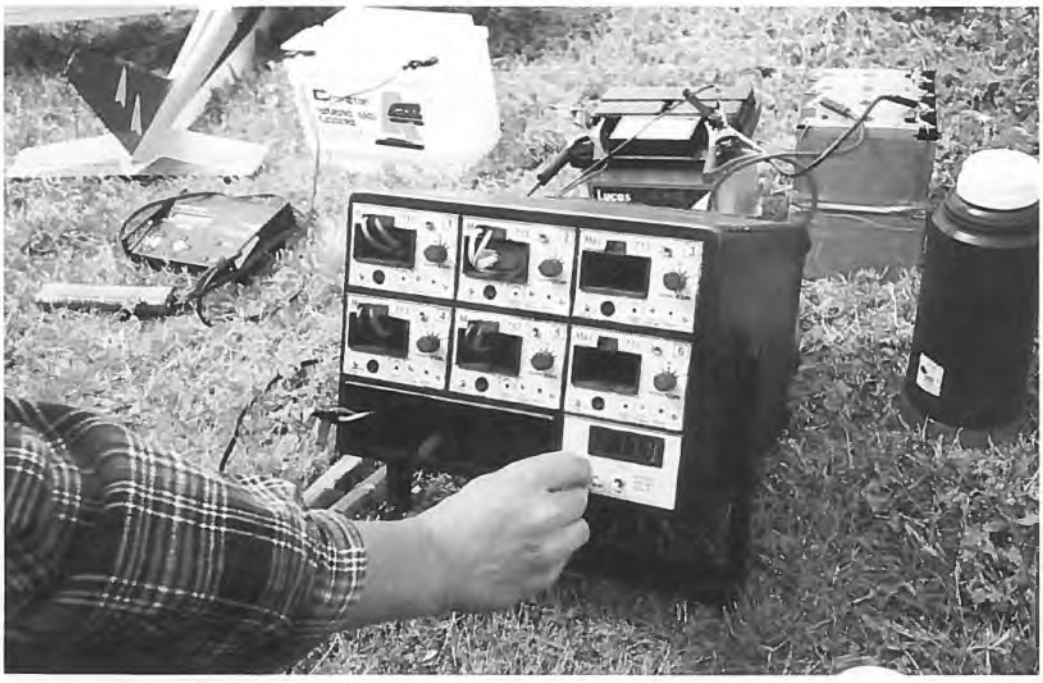
People and planes

First comes my old mate Dave Gardner of Borrough Green who flew - and nearly demolished - a KYOSHO T-33 ARTF EDF in the frequent 'air combat' sessions wherein up to four of these T-birds flew against the Gaskin "MiG-thing" - great fun and lots of audience ooh's and ah's when the grim reaper got in on the act. The stiff wind tended to blow the foam wreckage away which made re-assembling a very tricky procedure. One foam T-33s was DEMOLISHED, vertically, thoroughly and indecently yet was epoxied and brown taped back together and flew again with no apparent reduction in performance - quite extraordinary!

Kevin Saunder's A10 has been pictured before in the appropriate magazines but to see it in the flesh is something else. Power is from 2 x Speed 600 12V BB Turbos, 2 x EJT 540 Fans (now sold as WeMoTec Eco II fans) running on 22 x 1700 cells through a modified Fleet FPS 28A at around 40 amps. Even off grass it has performance to spare and it must represent a benchmark for current EDF models. I especially liked the twin interior cooling fans to keep the equipment bay from becoming a BBQ. I must get some of these myself as the passengers cannot sit in seat rows eleven to nineteen in my Concorde as they are too hot!

Kevin's electronic wizardry extends to making his own multi-charger called "the cooker" which runs from 18 volts to 24 volts. It is capable of charging 6 x twelve cell packs simultaneously with selectable charge rate between 3 and 5 amps using peak or temperature detection or auto time-out. Brian Gaskin remarked "we know you are a show-off" which caused much

▼ Kevin's Cooker! A really professional own designed and built multi charger - note twin 12 volt supply.



merriment considering most of the models in the EDF park were "Gaskoids"!

Last this month comes the ROWANAIR CROSSBOW by Rowan Houlding of the Bickleigh Club. It weighs one kilo and flies on 1 x EJT Fan and a 19 turn QUOD motor on 7 x 1700 cells. It flew with plenty of performance and will get better with one more cell - a mod soon to be added when Rowan can hack out some more internal space. He also displayed two alternative power units which are easily inter-changed using the simple but cunning motor/fan mounting bracket. One was an OS10 smelly/noisy engine with 4 ounces of oily stuff using a 7 x 4 pusher prop: as yet not flown. The other alternative was pusher Cox 6 x 4 powered by a re-timed (backwards) 20 turn motor which, says Rowan, has much more performance than the EDF version. Well then - it must go like boiled weasel urine 'cos the EDF went well enough for me - I just love twin booms!

Well, there you are for May and June '98, marred for me by having to say farewell to my Mum, who loved model 'planes and thought that they were much safer than real ones for her little boy (see photo of me as she always thought I looked!).

Fans

Continuing the education theme: there is a wonderfully evil black and white film from the nineteen thirties called "FANny by Gaslight". I suppose that today we should call that "Fanny by Gaskoid".

See you next month - FLY SAFE.

▼ As my Mum always saw me!

Chris Golds, Hideaway, Lower Loxhore, Barnstaple, N.Devon.EX31 4SX. Tel: 01271 850456. FAX: Same number, by arrangement. EFI

▼ Rowan Houlding holding his "Crossbow". Note alternative power units. A simple sheet wing but with a fine performance.

MANFRED MALTEN

Fans with Formulae

This month we explore the maths that tells us what size our fan unit needs to be.

CONSTANTS, UNITS, OPERATORS AND SYMBOLS USED IN FORMULAE:

Pi	π = 3.1415 [-]
rho	density of air, rho = 1.2 [kg/m^3]
[kg]	kilogram; I [kg] = 1000 [g]
[m]	meter; 1 [m] = 1000 [mm]
[mm]	millimetre;
[m^2]	square meter;
[m^3]	cubic meter;
[s]	second;
+	Sum, "plus"
-	Difference, "minus"
*	Product, "multiplied by"
/	Division, "divided by"
^	Exponent, "to the power of"
^2	Square
^3	Cubic
0^1/2	Square root of 0
SQR0	Square root of 0
Ao	annular area [m^2]
a	acceleration [m/s^2]
cax	axial velocity [through duct]
ce, c4	efflux velocity [m/s]
cf, c0	velocity of aircraft/flying speed
D	drag, force [N]
db	diameter of centerbody or hub [m]
ds	inside diameter of shroud, fan diameter [m]
F	force, 1 [N] = 1 [m * Kg/s^2]
m	mass [kg]
mdot	massflow [kg/s]
rb	radius of centerbody or hub [m]
rs	inside radius of shroud [m]
S	(wing-) surface [m^2]
T	thrust, force [N]
t	time [s]
v	volume [m^3]
Vdot	volumeflow [m^3/s]
v	velocity [m/s]

Remember

This is the last paragraph of Part Two, just to remind where we had got to: Finally, the formulae you find below are not my invention but are the very elementary ones used in industry to design hairdryers as well as high performance axial compressors. This and restricted space kept me from redeveloping them here (read this as not wanting to copy the books) but you ought to be able to find related reading material in abundance in the hydrodynamics section of your local library. (Sorry, no English book titles, mine are all in German.)

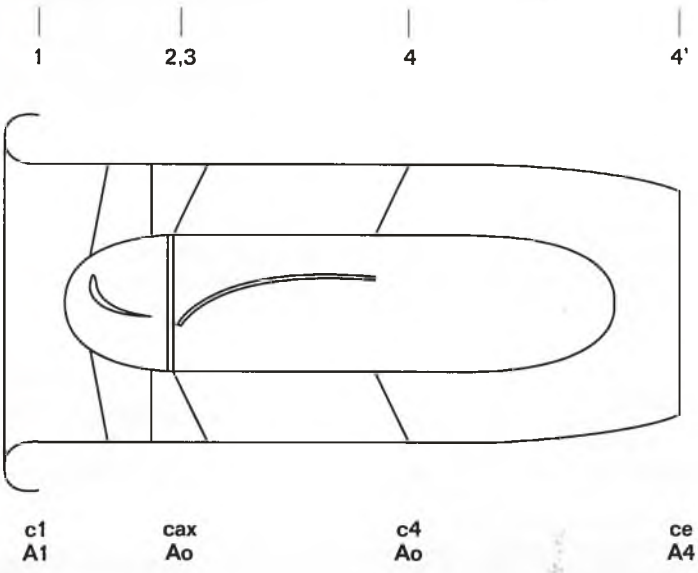
The size of it

We set out with our above requirement T = 3.5 [N]; c4 = 40 [m/s]. These two figures together with the motor diameter are all we need to determine the necessary size of our impeller! Why there is a "necessary size" will become apparent as we go.

It all starts with Sir Isaac Newton: F = ṁ * a; force equals mass times acceleration; [N] = [kg] * [m/s]; thrust is created by having a certain mass m [kg] of air suffer an acceleration [m/s^2]. In aero- and hydrodynamic machines, like axial pumps, blowers, compressors and, yes, ducted fans, mass is not a distinct "package", but the medium, in our case air, moves through the machines in a continuous stream. Their characteristic is best described by how much mass they put through during a certain interval of time, i.e. per second for convenience.

Above equation therefore is modified by introducing "massflow" mdot [kg/s], and in order to maintain equality, by substituting velocity c [m/s] = [m/s^2]*[s] for acceleration a [m/s^2]; the suffix in c4 designates the location where the velocity exists in the duct, in this case in cross section 4 (see sketch), which is in the outlet plane.

Drawing, simplified ducted fan unit showing locations and nomenclature used in calculations.

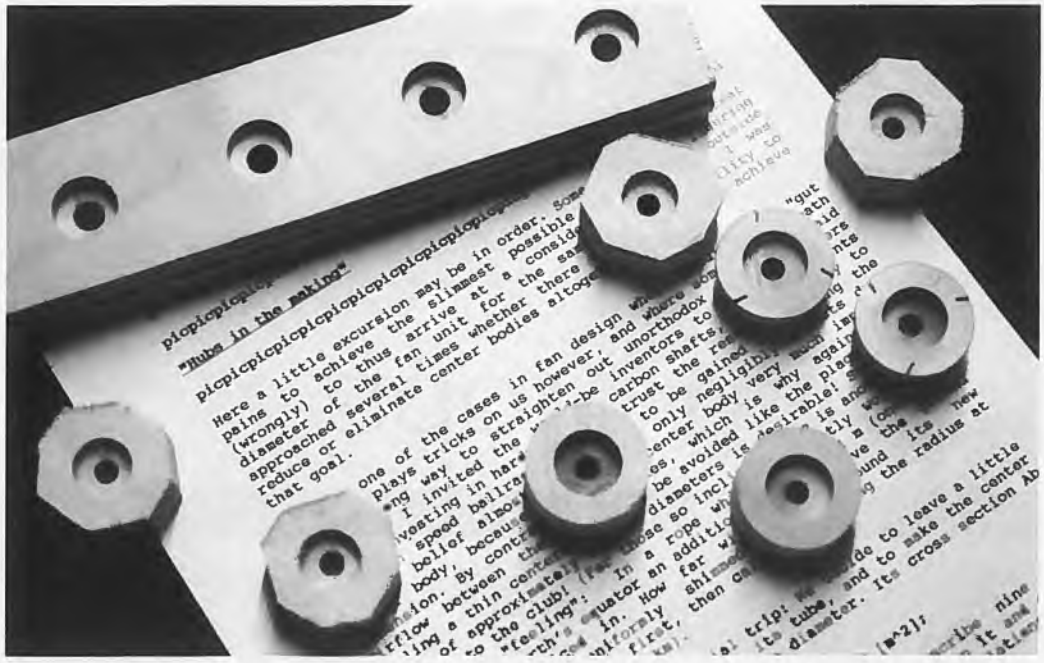


VELOCITIES, AREAS, STATIONS

Remark

The fan unit we design will be of the 'constant area' type from the fan leading edge downstream to the exit, i e. Ao = A4. This assures a maximum of static thrust, upon which we depend for a successful launch. Theoretically a higher flying speed can be had from a necked down nozzle but this will be of no use if the model never makes it to the air in the first place. Any decrease of the exit cross section goes in hand with a loss of thrust! For this reason and for our purposes, i.e. disregarding friction and pressure losses in the duct - c4 and ce are considered to be the same.

Maintaining a constant area from the fan downstream also rules out any sudden changes in cross section. This means that the motor must not have a bare rear end as often to be admired with commercial units, but needs a tailcone to keep the airflow smooth. All these little things add up to better performance.



▲ **Hubs in the making.**

{lA} T = mdot * c4; This is the principal equation: Thrust equals massflow times efflux velocity. Massflow mdot, as mentioned above, describes the mass of air which passes through the duct each second. As the required values for T and c4 are predetermined in the Scope Of Work, we can solve for mdot:

{2} mdot = T/c4; in our case mdot = 3.5/40 = 0.0875 [kg/s]; each second about 87.5g of air (or a little more than 3 ounces) has to pass through the system.

The passing mass of air takes up a corresponding volume, which can be calculated by introducing "rho", the density of air, which can be treated as a constant at our altitudes and temperatures, i.e. rho = 1.2 [kg/m^3]

{3} m = V * rho; mass equals volume times density.

If volume V is referred to time analogous to mass, volume V [m^3] becomes volumeflow Vdot ~m^3/s]:

{4} mdot = Vdot * rho; from which we can derive and calculate

{5} Vdot = mdot/rho; Vdot = 0.0875/1.2 = 0.0729 [m^3/s];

The results obtained so far can be summarized as follows: In order to deliver 3.5N of thrust at an efflux velocity of 40 m/s, our unit has to move a volume of 0.0729 m^3 (cubic meters) of air through its duct every second (i.e. about 2.57 cubic feet).

With a round outlet this volume can be visualised as a cylinder consisting of air, 40m long and of a cross section equal to the outlet. Because air is incompressible at our velocities, the knowledge of Vdot enables us to determine the necessary outlet cross-section A4: All we have to do is divide the volume of air by the "cylinder length", i. e. by exit velocity.

{6} A4 = Vdot/c4; A4 = 0.0729/40 = 0.0018 [m^2]; but A4 is also

{7} A4 = pi 8 r4^2; therefore its radius can be calculated

{8} r4 = SQR(A4/pi); r4 = SQR((0.0018/3.141592) = 0.024 [m];

{9} d4 = 2 * SQR(A4/pi); d4 = 0.048 [m]; outlet diameter is equal to twice the square root of outlet area divided by π.

Extended summary of results: For 3.5N of thrust and an efflux velocity of 40 m/s, our d/f unit needs An exit area of 18 cm^2, i.e. a round nozzle of 48mm in diameter.

Next step: On its way through the duct the air has to go around the center body which houses the motor. The size we envisage (Kyosho AP 29 BB, Speed 480 Race, etc) has a diameter of close to 29mm without flux ring, therefore the centerbody has to be wide enough to accommodate this diameter. There is no need however to look for an exactly fitting tube or to laminate a housing tightly around the motor from plywood, because a snug fit is not required. In fact a few more millimetres in diameter will even be beneficial.

Here a little excursion may be in order. Some modelers take great pains to achieve the slimmest possible centerbody, figuring (wrongly) to thus arrive at a considerably smaller outside diameter of the fan unit for the same annular area. I was approached several times whether there wasn't a possibility to reduce or eliminate center bodies altogether in order to achieve that goal.

This is one of the cases in fan design where intuition or "gut feeling" plays tricks on us however, and where some applied maths goes a long way to straighten out unorthodox ideas. On said occasions I invited the would-be inventors to do some numbers before investing in hardware like carbon shafts, universal joints and high speed ballraces and to trust the result: Contrary to popular belief almost nothing is to be gained by dieting the center body, because its diameter only negligibly effects duct dimension. By contrast, a thick center body very much improves airflow between the rotor blades, which is why against all feeling a thin centerbody is to be avoided like the plaque and a ratio of approximately 2:1 in diameters is desirable! Surprised? Welcome to the club! (For those so inclined, here is another good one about "feeling": In a rope which is tightly wound once around the earth's equator an additional piece of 1 m (one meter) length is spliced in. How far will it be-abov the ground afterwards if uniformly shimmed-up all around its new circumference? Guess first, then calculate, taking the radius at the equator to be 6400 km).

Back again from the equatorial trip: We decide to leave a little space around the motor inside its tube, and to make the center body 34mm = 0.0034m in outside diameter. Its cross section Ab then is:

{10} Ab = pi 8 0.017 * 0.017 = 0.0009079 [m^2];

This is a rather unwieldy figure to describe nine square centimeters to be sure, but we have to stick to it and carry on with "meter" [m] as a unit throughout the calculations, at the peril of becoming hopelessly lost if not.

By now we know two cross sections by numbers: A4 at the nozzle through which air can pass, and Ab, where it cannot. In the shroud therefore we have to provide an annular passage around the centerbody, identical in area to A4. In other words, we are

building an impeller system with a "constant area duct". The total area inside the shroud we call As, which therefore has to be

{11} As = A4 + Ab; As = 0.0018 + 0.0009 - 0.0027 [m^2];

This cross section can also be expressed as

{12} As = pi * rs^2; and if this is solved for rs,

{13} rs = SQR(As/pi) = (0.0027/3.141592)^(1/2) = 0.0293 [m]:

And this finally tells us that ds, the inside shroud or fan diameter needs to be

{14} ds - 2 * rs = 0.0586 [m];

which we generously round to 0.060m or 60mm.

Now is the time to do any conversions if you still feel like it, but why ruin these nice round figures:

T = 3.5N; c4 = 40 m/s; db = 34mm; ds = 60mm; d4 = 48mm;

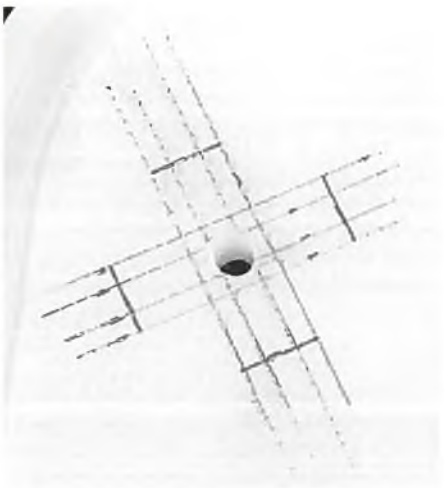
This is a good time to take a break. Next time we will investigate the significance of efflux velocity, which will not be too complicated either, but has some surprises in store. **EFI**

How to...

make your own folding props

WRITTEN BY: BRIAN GASKIN

Not only D-I-Y props but 4 blade ones too - as folders or even scale 4-bladers.



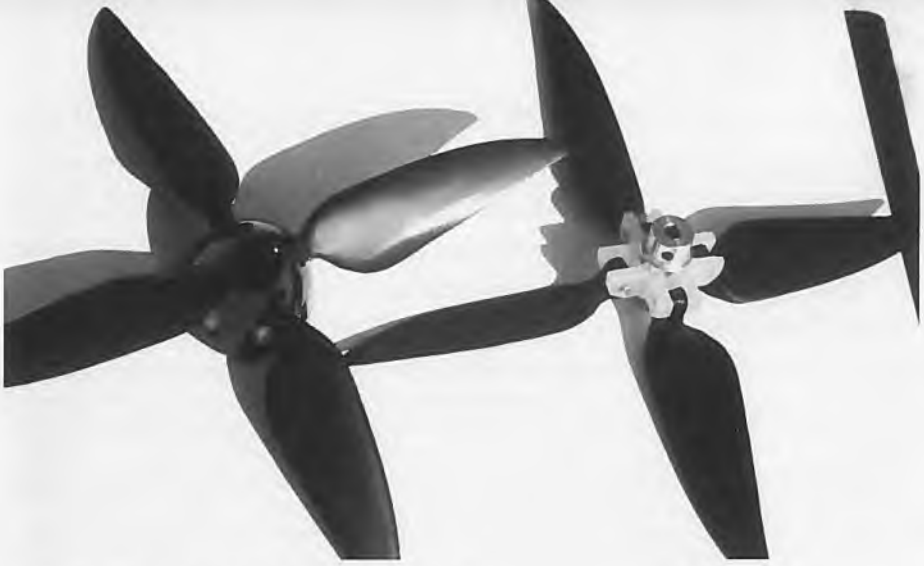
▲ **The only part you need to design and make - the centre. This one is drawn and ready for cutting from a kitchen cutting board.**

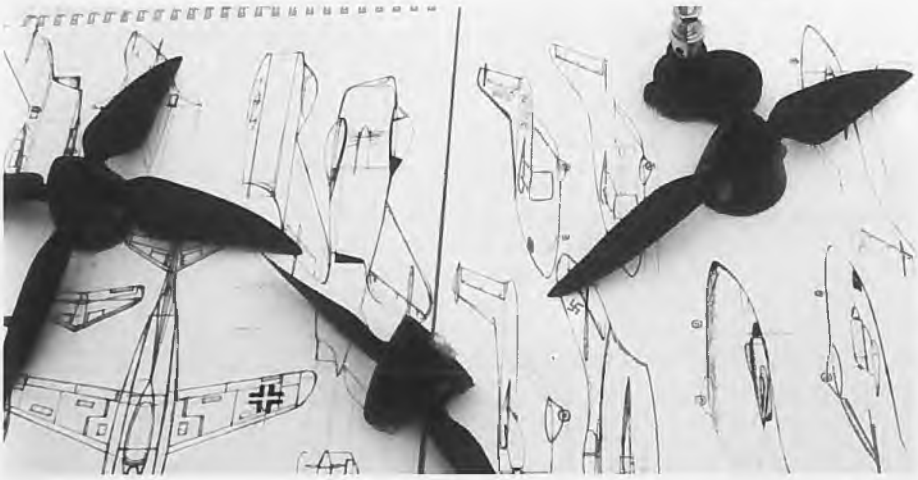
Some time ago I was wandering around the Sandown Show - as one does. At the SLEC stand one of their trays contained black folding prop blades, four in a packet for about £1.50. So as I was messing around making EDF fan units at the time (and I still am) I picked up a couple of packets with thoughts of using them as ducted fan blades. On my return home they went into a drawer and were promptly forgotten.

The other week I was hunting through the drawers for something - I forget what! By chance I came upon these blades again. "Ah! blades - folding - times four - that's an idea!" "I wonder if you could make a 4 bladed folder?" they said.

A quick look around the workshop for some suitable material proved fruitless - until I looked down at what my hands had been resting on. It was one of those kitchen chopping blocks of about 3/8" (10mm) thick plastic. I marked out a four blade centre with a marker pen, cut it out on my bandsaw, drilled some holes and fitted the blades with piano wire pins. I had one of those Goldberg spinners which have four pegs on the spinner and four pegs in the back plate. I cut two

▶ **SLEC blades, the D-I-Y centre and the prop adaptor.**





◀ Four blade folders, with and without the Goldberg spinner.

more prop blades holes in the front half and you see the result in the photos.

It works very well on our 540 powered fun-fly model and was fun to make even though (or because!) I had not planned it.

Advantages?

- Four blades folders are unusual; you might have problems finding a manufactured one.
- If you need a four blade non-folder for a scale model, this may be the easiest route.
- If you cannot fit a two blade folder big enough, without colliding with the wing of your model, you may have to go to 3 or 4 blades.

Test it

If you wish to build one of these, check carefully the quality and condition of the plastic centre before you use it. The load of prop blades on a centre hub, when the whole assembly is rotating, is considerable. Free flying blades are hazardous and an out-of-balance prop can very swiftly wreck a motor. When you test and before you launch, do not let anyone stand in front of the motor or in the plane of rotation of the prop. **EFI**

◀ What to do with a home made folder?

In a Learner's Shoes

By Steven Goff

Last month we took a look into choosing a model that suits you, this time round we will explore some of the tools required to get our little boxes of wood into the air.

Tools of the trade

Modellers are a little like cavemen, utilising tools and equipment to get the job done easier. Fred Flintstone had his axe, and we have our scalpels, sanding blocks and razor planes. And of course, like cavemen most of us live in our sheds.

A good selection of quality tools is important if we wish to produce anything other than a flying tree trunk, so chuck away that rusty bread knife, and let's look at what we should have in our toolbox .

"The Flying Doctor..."

Your primary weapon in the fight against balsa should be a decent scalpel blade holder and blades. Most people prefer to use the surgical type, with interchangeable blades, although a craft knife with the snap off type will suffice. A word of caution, for those of you who have never had the misfortune to cut themselves with one of these blades, they do cut deep, so engage basic common sense here when handling any modelling knife. A wonderful selection of blades is available, which you can use at your discretion (see photo of balsa cutting tools). Running from left to right we have a standard craft knife "pen". A "chuck" mechanism holds the interchangeable blade, which is perfect for most modelling tasks. The black and yellow device next to this is a special cutting tool, for covering materials. This is a cross between a hobby knife, and a pair of compasses, which cuts out perfect circles from most coverings. Just next to this, we see a selection of blades, looking like they came straight from the operating theatre. Next to those, is a selection of blade holders, the two surgical type and a standard craft bladeholder with the "chuck" mechanism.

Second in command would be a sanding block. Most people prefer to make their own, by sawing a block of wood to a suitable size, popping on a piece of double sided tape, and attaching sandpaper of their choice. It is also useful to have different types of sanding block for different jobs. Not only can we have rough and fine sandpaper, but we can have shaped blocks for specific areas of the plane (see photo of abrasive tools). Running from left to right we have a sanding block ideal for making the chamfered edges on control surfaces, this

◀ **Balsa cutting tools.**

▲ **Abrasive (sanding) tools.**

block has a "vee" shape, when looked at from the end. The next sanding block, was purchased from a model shop, and is of the"indestructible" Permagrit variety. Again, this is shaped to a semi circle when looked at from the end. The next one, is made from hardwood dowel, with our magic Permagrit material bent and glued around its surface. Next to this is my favourite and by far most useful. This homemade sanding block is special shaped to perform wonders on leading edges. The next two, are a variation on the previous ones. A slightly wider "round" sanding block and a straight one.

Whilst we are on the subject of cutting and shaping wood, I feel a junior hacksaw and mitre block would be invaluable when angles are involved. It is also handy when cutting thick pieces of wood such as ailerons, wing spars, leading and trailing edges. Also something to add to your shopping list, would be a razor plane. Looking like a miniature version of its bigger brothers, the razor plane utilises a "razor" blade. This makes a very useful tool for shaping cowling, nose blocks or any part of the plane where large amounts of balsa need to be removed.

It's Electrifying...

We have looked at a simple selection of tools which will care for the wooden structure of our models, but what about the electrical side? A basic selection of electrical tools is always going to be required. Although there is such a range of ARTF kits, ready made battery packs and speed controllers, there is going to be a point where you will have to grab that soldering iron and make a few connections.

In an ideal world, the only time you should be up to your eyes in solder fumes, is when making the connections from the speed controller to the motor, or when installing a fuse into your wiring. Beginners models usually come with some kind of motor harness, which incorporates a fuse holder, and has spade connectors for motor contacts. However, at some point you may wish to build your own battery pack, or install a custom speed controller. So, when this time comes, be sure you have the following in your toolbox.

Almost everyone has some basic electrical tools kicking around the house, and here (see photo of screwdrivers etc.) is what we should be looking for. From the top left hand corner we see a pair of wire cutters/strippers and a pair of needlenose pliers, possibly the two most useful tools in your electrical "kit". Next to this, are two standard sized screwdrivers, one a Phillips/Supadrive/"plus" driver, the other a blade type ("minus" driver). Next to this is a fairly specialist tool, which I don't expect everyone to have - a solder sucker. By pushing down the plunger, you"arm" the sucker, which is activated by the red button. To use, simply heat the joint until the solder is flowing freely, place the device on the joint and press the button. Quick, easy and safe.

Underneath that, we have a selection of jewellers screwdrivers, always handy for small jobs such as fixing control linkages etc. Apart from hand tools, something like a digital test meter is going to be one of the most treasured tools you could ever purchase, and need not cost a fortune. It will allow you to have a sneak peek at what your plane is doing, allow you to see how many amps that new motor/prop combination is drawing, check the condition of your battery packs, make sure you have connections the right way round, check the condition of your fuse, and much more.

Conclusion

Of course, there are so many specialist tools out there, it would be impossible to cover them all, but the simple selection of woodworking, and electrical tools I have mentioned, would be ideal to get you started. Obviously, your local model shop is going to be the best place to purchase these tools, although you can get them from other stores, such as Maplin Electronics for example.

Shop around, and find the best value for money but don't skip on quality, you will never know when you are going to rely on your tools to get the job done.

As usual, your feedback is much welcomed, for those of you with Internet access, you can drop me an e-mail at: steve@goff.powernet.co.uk EFI

▶ **Screwdrivers and electrics tools.**

JP Spec

Plan and Construction

REVIEW BY: PETER WILSON

Here is a 51 inch (1295mm) span lightweight that will do a lot on three Speed 400s and seven cells.

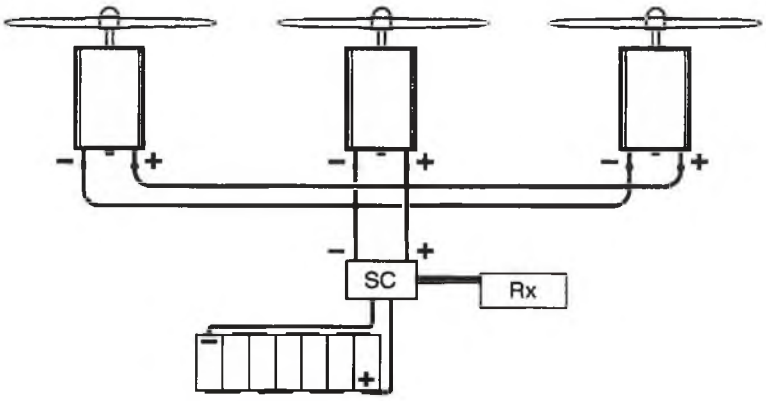


FIGURE 1. THREE MOTORS CONNECTED IN PARALLEL TO ONE BATTERY PACK. EACH MOTOR 'THINKS' IT IS RUNNING ON SEVEN CELLS.

◀ The canopy/front hatch is removed to show the Fleet speed controller. The 'hole' behind it is where the power pack fits. The 'black hole' at the back of the cockpit is for the Rx.

▼ The open structure shows through the white film covering.

It started as a twin

The editor saw Peter Wilson flying a twin 700 powered model very similar to the JP Special, at the annual Chester Fly-in two years ago and photographs of it appeared in EFI or in the 'Charged Flying' column in RC Model World. Peter was moving from IC power into electrics and had been inspired to build this quite big light twin after his success with a smaller 400 powered version for seven cells. This JP Special was that small twin.

By the time the editor saw this model it had its third motor in the nose. He had to ask the obvious question:

"Did you need the extra power?"

"Oh no..." replied Peter "... I needed three ounces of lead in the nose to balance it so I thought I may as well fit a motor the same weight. It balances now without any ballast, so it has 50% more power for no increase in weight."

"How much shorter is the flight time, with its shorter motor run?"

"Well - it actually flies longer. It climbs faster and it cruises on much less throttle."

The three engined JP Special certainly has a brief take-off run and Peter reckons it was already quite satisfactory as a twin; that twin had no problem with an ROG. It is now about

▼ The fuselage underside with the wing off. The hole is the captive nut for wing retention, you can see the upside-down servos and the aileron servo leads from the Rx.

ial

four years old and displaying a little 'hanger rash' - easier to spot on a white model!

Peter was persuaded to give us his own plan for Mike Freeman to CAD draw. The construction notes are Peter's. His building technique is very conventional as is obvious from the plan but he was asked to describe the sequence for the benefit of any builders who have not so far constructed a 'real built up' model. It is very straightforward and could be a pilot's first built-up model. Don't be scared-off by three motors, there is a little more wiring and soldering to do but it is actually much easier to fly that a single. Over to Peter:

Wing construction

I always build my wings on a dihedral board. Cut all 1/16" sheet, LE and TE, centre sheeting and cap strips for top and bottom, ribs are made by the 'Sandwich Method'. Do not cut the slot in the rear of the ribs until they are glued in place over the plan.

Set the dihedral board to provide 1" (25mm) dihedral at each tip. Place the plan on the board with the centre line exactly on the dihedral board's centre line and add all the bottom sheet, TE and LE, centre sheet and cap strips. Add spars with doublers as on the plan and add ribs. Glue the ribs to the bottom mainspar and to the cap strips and sheet behind the spar but do not glue the ribs to the front sheeting - yet. Cut the slots in the ribs for the rear spar and glue that in. (The next step will be easier if you do not glue the back edge of the spar to the ribs in the aileron area.) Now cut the slot for the aileron spar and glue that in, taking care to not glue to the rear spar. Next insert the top spar and the webbing. Pack up the bottom LE sheet to touch the ribs and glue it. (Slip in the edge of a plastic ruler or the edge of a 1/16" sheet.) Add the 1/8" (3mm) 'false' LE, tip blocks and add the undercarriage (UC) blocks. Insert wires for the motors, cut holes for aileron servo leads, add the top sheeting at LE, TE, centre and the top capstrips.

When thoroughly dry, remove from the board and add the 'true' LE strip. Sand this to shape and the wing tip blocks too, then drill the UC blocks to accept the legs. The UC legs are made from 6mm carbon rod.

Make up the mounts for the wing motors, ensuring that all thrust lines are 'zero-zero' with all the centre lines and datum lines shown for wing, fuselage and tail in plan and side views.

▲ **A wing motor with its hatch removed.**

Fuselage

Build two sides, left and right, make formers 2 and 3 from 1/8 x 1/4" (3 x 6mm) balsa strip. Place sides over plan view upside down, with formers 2 and 3 in between them. Add all cross pieces and diagonals, add nose former and motor mount, also 1/8" (3mm) sheet floor for cells and servo mounts. Push rods are 20 SWG wire in plastic Graupner tubes. Add bottom planking to nose, remove from plan, add top formers and top sheet, plank front to nose, cut out hatch and fix catch. Your flight pack is loaded in through this hatch.

Tail/fin/rudder

Build to plan, just keep it light. I used cyano for all the joints.

▼ **Wing centre, aileron servo leads and connections to wing motors.**

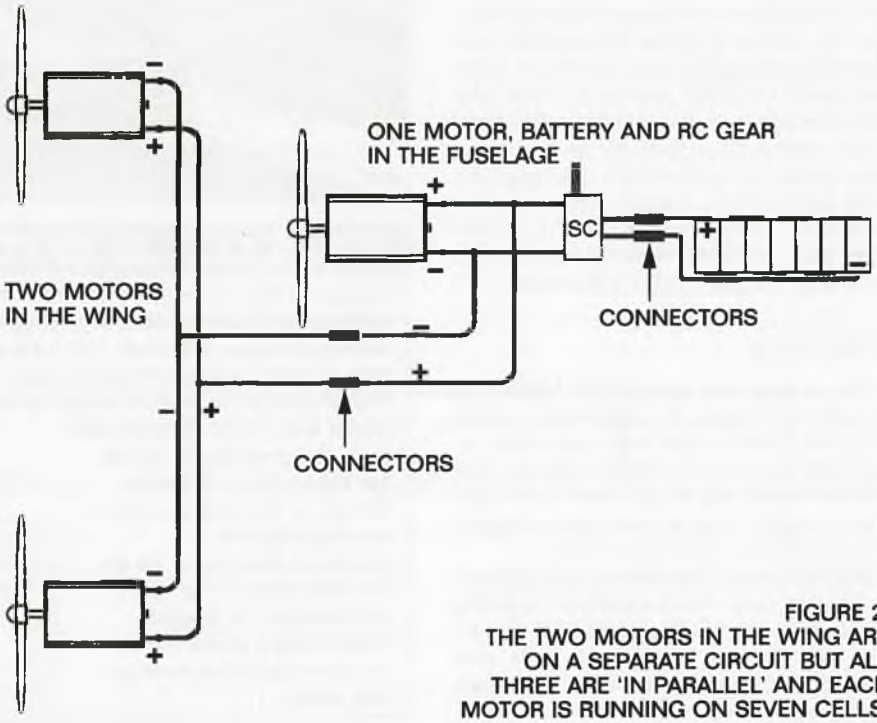


FIGURE 2.
THE TWO MOTORS IN THE WING ARE ON A SEPARATE CIRCUIT BUT ALL THREE ARE 'IN PARALLEL' AND EACH MOTOR IS RUNNING ON SEVEN CELLS.

▲ **Top of wing centre and underside of fuselage.**

Electrics

The three 400 7.2V motors are wired 'in parallel'. This means that the two battery leads are plugged into a speed controller and the two leads out (marked 'motor +' and 'motor -') each split into three leads. Each of the 'motor +' leads goes to a '+' tag on a motor and each of the '-' leads goes to the other (usually unmarked) tag of a motor - see figure 1. This means that each motor is running off seven cells. Each motor with a 6 x 4 prop takes/consumes/burns about 7 amps so the total current consumed is about 21A.

One motor is in the fuselage and two are in the wing. The wing is removable so the motor leads from the wing need to disconnect. This makes the above paragraph true as far as the electric theory is concerned but awkward in practice! It reads as if you will need two pairs of connectors (four) to get from fuselage to wing. The motors are in parallel so this is one of the few times in the life of a model flier when things actually get easier! You will see in figure 2 a schematic of a practical wiring diagram for this model. After the speed controller the wires divide into two, one pair (a '+' and a '-') go to the motor in the nose and the other pair go to connectors at the front of the wing mounting. Use male and female connectors that cannot be connected "wrong way round" or colour code them. Inside the wing these cables split so that a '+' and a '-' go to each motor.

Finishing

The original was covered in Fibafilm to maintain the target of a lightweight model. The trim 'flashes' were kept to minimum to not add much more weight. Ailerons and elevator were top hinged with clear tape. The 'canopy' is flat acetate sheet wrapped round and glued to the front hatch.

Balance is important with any model and so easy to get right. Move the battery pack forward or aft until it balances where shown on the plan. Fix the battery pack here with 'Velcro' to the floor or foam spacers in front of and behind it.

Controls

You will need a speed controller capable of handling at least 25A. This model uses a Fleet 27A with BEC. Control surface movements are: ailerons, 1/2" (13mm) up and 5/16" (8mm) down; the elevator is 1/2' (13mm) up and 3/8" (10mm) down; the rudder has 1 1/8" (29mm) movement each way.

Flying

I like my models to take off. 'JP Special' is so light that it will hand launch easily if you do not have a smooth runway but it does take off easily by itself. It took off OK when it was a twin, it takes off so much quicker

▼ **Don't be scared-off by three motors, there is a little more wiring and soldering to do but it is actually much easier to fly that a single.**

▲ **Links to control surfaces are conventional and simple.**

now it is a 'three'. Start your take-off run with a little up elevator to prevent a 'nose over', then ease off to permit the tail to lift - don't ease off too far or too early. It steers on the ground with rudder and will lift off by itself, or if you think it should have done so by now, give it a little up elevator.

You can fly it CAR (Coupled Aileron/Rudder) by mixing the functions at the Tx. If your Tx won't, you can do the same with two 'Y' leads. Or - perhaps you should leave rudder and aileron on two different functions. If you are not into some of the trickier aerobatics or a lot of ground handling, you can fly without rudder control. This model will do quite a lot if you want it to, its light weight helps a lot. It is also a very civilised sports model if you are not wishing to do anything exotic. **EFI**

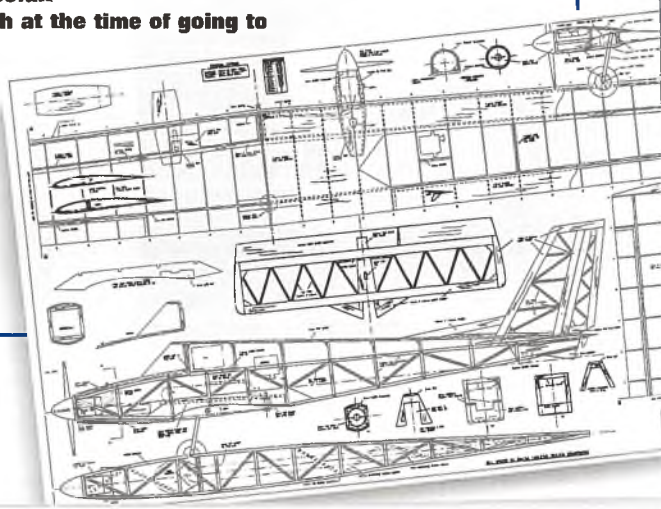
Specifications:

WINGSPAN:	51" (1295mm)
WING SECTION:	SD3021
WING AREA:	391 sq.in (25sq.dm)
WEIGHT:	48 oz (1360g)
WING LOADING:	17.6 oz/sq' (54g/sq.dm)
MOTORS:	3 x Speed 400 7.2V wired in parallel
PROPS:	6 x 4 Graupner (grey)
ENERGY:	7 x Sanyo N-1700SCR
CURRENT: (3 MOTORS)	21A
RPM:	11,000
STATIC THRUST:	24 oz (680g)

MW2637 - JP SPECIAL

Copies of plan number MW2637 "JP Special" are available from Electric Flight International (Plans Service), Traplet House, Severn Drive, Upton-upon-Severn, Worcestershire, WR8 0JL. Tel: +44 (0) 1684 594 505. Fax: +44 (0) 1684 594 586. E-mail: general@traplet.co.uk

The plan is price code H which at the time of going to press was £7.50/$12.50 plus post and packing of £2.00 for UK orders, £4.00 for Europe & Worldwide orders or shipping and handling charges of $6.80 for USA orders. For more information on Traplet Publications plans service see our advertisement in this issue.



Quiet Rotors

MIKE GOULETTE

No autogyros this time (who said "good"?) there is too much good stuff going on in the helicopter world. Amongst other good things, I will follow up on one of the less well known helicopter kits featured in Kiyoomi Kataoka's electric helicopter history from the last column, give you the latest on Alexander Van de Rostyne's Pixel exploits and bring hot news of new models available in the UK.

▲ **This is the first shot of the new ultralight Pixel 4.**

▲ **The basic chassis of Pixel 3.**

▲ **Pixel 3 transmission uses commercial gears.**

▲ **Pixel 3 rotor head capable of collective pitch control.**

Silence is still d... quiet

I reported last time on my tales of woe with the Vario Silence, culminating in my acquiring not one but two new brushless motors for it. Well, guess what, my luck has not improved in the meantime. The first motor I tried was the Kontronic. This is a long case, high torque motor designated the KBM 39-4. It comes with the Hall sensors built in but Kontronic recommend using it in this application with one of their new sensorless controllers, in this case, the 3SL 25-14-32 . This can handle up to 32 cells at 25 Amps continuous. The controller is programmable for a variety of applications and has a dedicated helicopter mode in which the RPM is governed by the controller and the throttle stick is only used for collective pitch. In order to use this mode, you do however need a spare proportional channel on your Transmitter. I will report more fully on this feature when I have had a chance to properly evaluate it.

So, on to the Aveox. This motor is a 1415 5-wind and has one of their new H160 controllers with the Hybridrive 11 circuitry which is much more efficient at part throttle settings. It uses Hall sensors and in their literature and in direct discussion Aveox are very opposed to going sensorless. The new controller is a little more compact than previous versions but is still roughly twice the weight and size of the Kontronic controller. There is no specific helicopter setting in the H160, the instructions recommend setting full throttle at one third stick and disabling the brake and low voltage and overtemperature cut off protection. The logic is that the motor RPM and, consequently, rotor RPM will be a function of the battery voltage and the torque will vary with the load, giving approximately constant RPM. All these settings are easily programmed-in using a push button and a flashing LED as the cue. On the bench, the combination worked fine except that if the throttle is set as recommended, the motor cuts out above half stick. I set it up to give full throttle at full stick and then used the Transmitter throttle curve to give 80% power at the quarter stick set point and then full power at half stick and above. Unfortunately, I made the mistake of not specifying a metric front end for my motor so it does not fit the standard Silence motor mount. I made up a custom mount from graphite/epoxy sheet and aluminium angle which works OK. With the motor installed on the new mount and the controller strapped to the chassis, I thought that I was ready to go, however when I checked out the controls for the first flight I found a judder in the collective pitch movement. This turned out to be a sick motor in one of the collective/roll servos. If I had tried to fly the model this could have been disastrous so I quickly replaced the servo, by which time it was too dark to fly. The next morning, the postman brought a letter from Aveox recalling the H160 controller because of a software fault. At the time of writing, the controller is in transit back to the UK after its repair. Sometimes you feel that you must have upset someone important upstairs!

Hopefully, by the time of the next column I will have flown the Silence with both motors and I will let you know how they perform

Anyone for Bingo?

Most model helicopters share basically similar design traits. Chassis which are made up from separate side frames and flybar stabilised heads are standard in practically all commercial designs. Karel Pustka's Bingo, which featured in Kiyoomi Kataoka's history of electric helicopters in the last column is significantly different and innovative in its approach. The basic chassis is a rectangular fibreglass tube on which all the other parts such as the undercarriage, motor mount, tail boom, servo board and flight nicads are mounted. The tailboom is a slightly tapered, round fibreglass tube, reinforced with carbon strips. The tail is belt driven from the first main reduction stage which is a 1:2 ratio belt drive. The second main reduction stage uses gears to give a further 1:4.1 reduction. An autorotation clutch is standard and is fitted in to the

pinion of the second reduction stage.

The rotor head is softly damped with a central flapping hinge and has no flybar. A substantial 10mm shaft is used to support it. Because there is no flybar, the head only weighs 105g all up. Karel claims that the head is very easy to fly due to the soft damping combined with weighted blades and is very suitable for beginners. 120 degree CCPM is used with the servos lying flat on the fibreglass/balsa ply sandwich servo board under the aluminium swashplate. Mini servos provide adequate power for both main and tail rotor control.

Bingo is designed for 16 of the 1700/2000 size cells and the Ultra 1600-8H, however any motor capable of around 700 RPM/V and good efficiency can be used provided it has a 5mm shaft. The pictures show Karel's current model which has a brushless motor with a rather sporty looking heatsink attached. The rotor diameter is 1270mm and the all up weight is around 2.75 kg. The rotor runs at the relatively low speed of 1100 RPM which is good for efficiency and flight times in the 8-12 minute bracket are claimed. The model is finished off by an unusual 'retro' styled fibreglass canopy which comes ready cut to shape.

I think that the overall package looks very interesting and attractive, not least because it is so different from anything else around in today's market. The Bingo is available for DM 700 directly from Karel Pustka at:

Am Buchl 39
D-82041 Oberhaching
Germany
Tel. +49 89 613 42 49

Karel also has a web site at http://ourworld.compuserve.com/homepages/putska/

▲ **Pixel 3 tail rotor.**

A Pair of Pixels

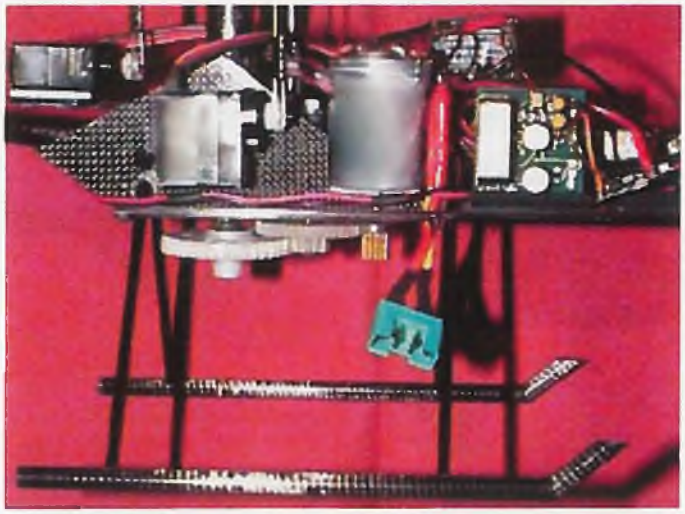
I showed a picture of Alexander Van de Rostyne's Pixel III in the last column. This is bigger than his previous Pixels, using a readily available commercial motor and RC equipment. There are a number of photos in the column which show more details of the construction of this model. Alexander is already developing another version called - amazingly! - Pixel IV. This is a sub micro model, like his earlier versions,

▼ **Bingo looks different - but very attractive.**

but it is significantly lighter which should greatly enhance flight performance and duration. The changes are described by Alexander:

"Pixel IV is a smaller version of Pixel II (the 99 gram one). With Pixel III (290 grams) I learned how to further simplify the design of a helicopter and that expertise was used in Pixel IV. Once again, all components were simplified, made lighter and creative solutions had to be found. As an example let me mention that I used to be convinced that the Pixel II swashplate at 2 grams was difficult to beat. Well, on Pixel IV I managed to make one at 0.8 gram. The tailrotor was 0.9 gram; now it is not even 0.2 gram."

Alexander has not yet flown the new model but when he does you will here about it here first. In the meantime, visit his web site at WWW.planetinternet.be/Pixel/

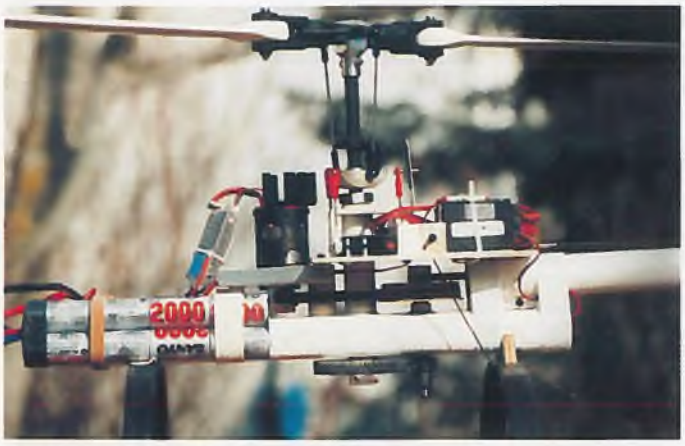


▲ **With RC installed and ready to go, Pixel 3 is still lighter than any commercial model helicopter.**

Watts New

I almost did not get to the Sandown show this year. My employer decided to run a business strategy meeting that weekend and I expected to be working. Fortunately, however they decided that I was not needed until the Saturday evening and the conference centre we were using was only five miles from Sandown. So it all worked out splendidly and I had a super day which was enhanced by the beautiful weather on the Saturday. There were two new models at the show that were especially interesting to us, the Mikado Logo and the Langnickel Edition.

The Logo was on the F2A Supplies stand. This is a big 30 cell model, similar in size to the Vario Silence. Unlike the Silence, however it has been designed from scratch as an electric model and it shows evidence



▲ **Side view of Bingo showing the two stage reduction to the main shaft and belt drive to the tail.**

▲ **Bingo's control set-up, very simple and direct.**

of being very carefully thought through. F2A had a video running continuously showing the model flying in a very lively manner and first reports in the UK suggest that it flies very well indeed. You can see the overall layout in the photos in the column. Basic construction is moulded plastic and appears to be immensely strong but lightweight. I will report on the Logo in more detail in a future column.

The Langnickel Edition is an eight cell model that has more than a passing resemblance to the Ikarus ECO. This is not surprising as they were both designed by the same person. The LE has a more compact chassis layout, however and may be stiffer than the ECO. It was selling for a remarkably low price at Sandown, helped no doubt by the favourable £/DM exchange rate at present. I apologise for the poor quality of the picture of the LE, it was taken in front of what was probably the busiest stand at the show in the middle of what felt like a rugby scrum. F2A Supplies will be importing the LE as well as the standard and 16 cell versions of the ECO. They also have a new range of Ikarus brushless motors at very low prices for these and other models.

One other model I have seen advertised in the USA but not yet over here is a fixed pitch version of the Kyosho EP Concept, called the 'Sport'. The idea is that you only need three micro servos and a standard aircraft radio to fly it so the outlay for a beginner is significantly reduced. It also sells for around $50 less than the standard EP. A few years ago I read about someone who converted their Whisper to fixed pitch and gained about 10% flying time. The downside is that fixed pitch models are more difficult to fly, particularly in a gusty wind when rapid control of altitude is desirable. It sounds interesting though, I hope Ripmax bring it in to the UK.

The Wrap Up

I have just received a letter offering me a Honeybee so I will have a go at flying it as soon as I get out of this staight-jacket!

Keep rotating quietly until next time and don't forget to email me at mikeg@globalnet.co.uk **EFI**

▲ **Front view of the Logo showing the rotor head and Kontronik motor.**

▲ **The Bingo tail rotor is controlled by a fibreglass push rod.**

▲ **Bingo's flybarless rotor head does not need complex mechanical mixing.**

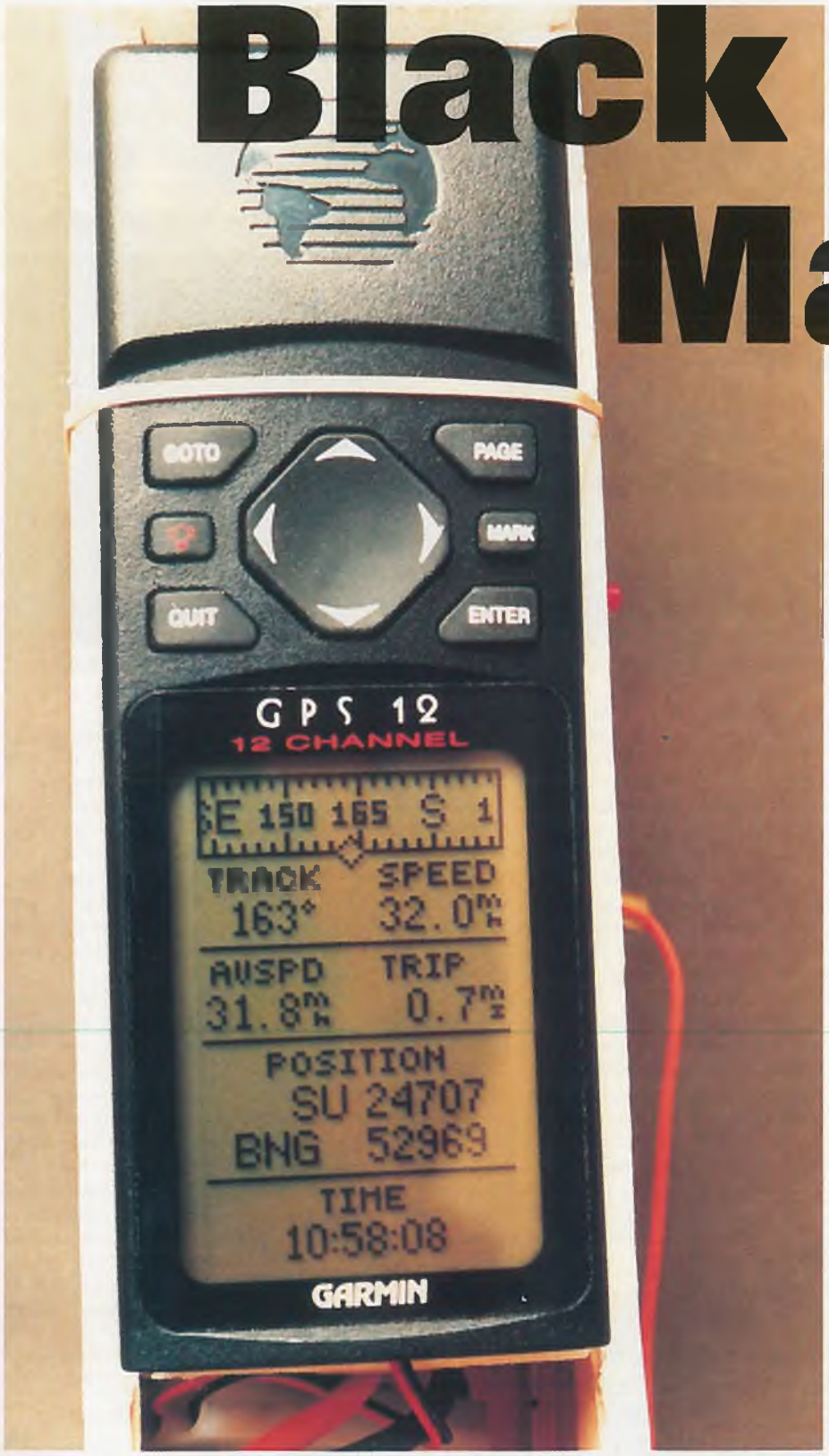
▲ **Logo shows its attractive lines.**

▲ **The Logo chassis and its twin 15-cell packs.**

▲ **Logo's tail rotor is clean and simple.**

▲ **The Langnickel EDITION, 8 cell helicopter as viewed at Sandown.**

Black Box Magic



▲ **The Garmin GPS 12 might have been built to fit this model.**

REVIEW BY: **PETE WELLS**

Do you want to know how far your model has flown, or how fast? Does your model wish to know where it is? If so it needs GPS.

All commercial aircraft are fitted with the Black Box Flight Data Recorder. It's usually orange in colour but it sounds more high tech than "Orange Box".

The recordings can be used by the operator to determine flight performance over a period of time thus providing a useful guide to maintenance requirements. The other use is, of course, provision of up to the second information of many aircraft parameters which may pinpoint the cause of an accident or worse still a crash.

What has this to do with model flying? Well, anyone unfortunate enough to witness the demise of his model (and who hasn't?) knows it was either pilot error or failure of the radio/servo system, batteries or associated mechanics.

To equip the average model with the means to record such data would be expensive in terms of cost, weight etc., and in general is totally unnecessary but several parameters come to mind that would definitely interest many model fliers:

- average speed
- maximum speed
- trip distance
- trip time
- record of the track over the ground

These are just five of the functions which can now be monitored for an outlay of around £140.

The equipment that can monitor these and other parameters is small, light weight and totally self contained. Self contained that is, if you discount the multi billion dollar investment the US Government has in its GPS (Global Positioning System) satellite constellation. These satellites cover the whole world and provide all the positioning and timing data required by the GPS receiver to provide a whole host of functions that present day units offer. The cost of the transmitted data is nil to the user although our tax-paying American cousins probably wouldn't agree. GPS units come in a large variety of models from only a handful of manufacturers, world-wide, from hand held units costing from around £100 to complex aircraft units costing thousands. Whatever the model however, the accuracy of the information presented by the GPS is the same, whichever one is chosen.

▲ **The WINDSTAR EP with GPS12 installed.**

The unit I chose for the experiment was the Garmin GPS 12, one of a large range of models from Garmin, who are probably the market leaders in this field. It involved a bit of delicate surgery to separate the back of the unit which includes the moulded-in container for the four AA batteries which normally power it. With the back removed together with the wires connecting the 'works' to the battery case terminals, I was left with a GPS recording device with a total weight of 100 grams (three and a half ounces) - an incredible feat of electronic engineering by those clever people at Garmin. Enough of this free publicity! The model chosen to carry this payload is a WINDSTAR, an electric powered glider of 77" (2m) span. The model is powered by a Speed 600 using a 7 cell, 2000 mAh battery pack. Power to the motor is via a proportional controller.

The GPS normally works from 4 x AA cells giving a nominal 6 volts and the unit will continue to work down to about 4 volts so the BEC supply to the receiver/servo system was adequate for the GPS. The power drain of the GPS is around 3/4 watt so the NiCd pack would hardly notice the extra load.

The GPS fits in the fuselage forward of the wing where the canopy would normally be. It fits snugly in between the fuselage sides but protrudes slightly above the sides so the canopy was left off for the flight. The GPS is retained in the fuselage with a low tech rubber band round the whole lot.

I didn't consider the extra weight forward of the CG would affect the performance very much and in fact the elevator trim was more than enough to cope.

One of the options of the GPS12 is to draw a track over the ground that the aircraft passes over. If the aircraft is hovering into wind or even moving backwards, the track is drawn on the map page. There is enough track memory to record for hours but there is no instant way when looking at the map page to know which trip was which. To overcome this, the track log should be cleared after each flight by a couple of key strokes and the same goes for the trip time, trip distance, average speed and maximum speed memories. Once they are all set to zero, fly it!

The first flight at our Perham Down site (Salisbury Plain) was in scattered cu-nim at about 1500 ft with a brisk NW wind around 25 kn. After a hand launch, the model climbed well and once above the tree line and into wind, soon made about 600 feet where the motor was shut off to leave some power in case it was needed later. After several laps of the field and some almost stationary crabbing along the wind-line I brought the model in after what seemed like half an hour or so. On landing, the results were immediately on view with a trip time of just over 14 minutes. Trip distance was 4.1 miles, average

▲ **Before you fly, zero it! Heading, position and time is shown.**

▲ **The GPS12 can provide a variety of data.**

speed 17.6 mph with a maximum speed of 56 MPH. The map page showed clearly the boundaries of the flight on the page scale of 0.5 miles (top to bottom) but inside the boundary, the track, although visible, is fairly confused which is not surprising when you consider 4 miles has been squashed into a small space. The value of the map would be to examine how precisely one could execute a square or figure of eight pattern. Do it once or twice, then bring it in to examine the trace.

The GPS has the capability of being connected to a PC. With a dedicated lead and some software called PCX5 from those clever Garmin people (there I go again) all the recorded data can be downloaded and the track plot examined in detail. Whilst not available in readout form on the GPS screen, the track detail is transferred to the PC with latitude and longitude information together with the time in UTC. (GMT is close enough if you only want it within a few nano seconds!) There are several options for the presentation of the position data which includes degrees, minutes and seconds and British Ordnance Survey co-ordinates. Now, with a downward looking motorised camera fired remotely and on the same command, store the position (a waypoint) in the GPS and we have the basis of a very economical aerial surveying system. That may be something to work on during the long winter evenings.

▼ **Figure 1**

Flight No.	Ave Speed MPH	Max. Speed MPH	Trip time min. sec.	Trip distance Miles
1	19.2	49.1	7 20	2.3
2	20.9	47.7	11 14	3.9
3	23.4	71.3	11 11	4.3

One last point

All of the information generated by the GPS is available as a constant stream of messages (in digital form) which can be connected to other devices like autopilots, radar plotters etc. It would not be a complex job to couple a GPS with a set of waypoints installed forming a 'round trip' to a free flight model thus auto-steering it within a predefined area. Now that is food for thought.

Figure 1 is a genuine printout of my flight log recorded today 15th March 1998. At the end of Flight Number Three, I deliberately nosed it down on the downwind leg to give me a high maximum speed. On the trial flights last weekend, I recorded 93.4 MPH and at that time discarded the result as a glitch - but now I'm not so sure! EFI

RBC Microbe

REVIEW BY: **MIKE DODDS**

A small quick-build fun machine for 400 size motors for pilots with at least a little aileron experience.

A small box

A very small box arrived by letter mail. Inside were a lot of CNC cut parts, a short length of balsa dowel, two short lengths of 3mm square stick, piano wire, a hardware pack including very light wheels, a plan and an instruction sheet. A five minute inspection of the plan and instructions and I knew that the construction would be fast, a speedy micro-bee!

As is often the case, the CNC cut parts are a little rough. A few minutes with a sanding block now will save time later. The wood is good quality and carefully selected. Almost every part in the kit is CNC cut, the exceptions are a balsa dowel leading edge and the 3mm square sub-spar. The parts are loose in the box and aren't marked, however every part is drawn on the plan (most are scaled down).

When I first saw the Microbe in EFI's 'Current Affairs' column, direct drive or geared Speed 400 motors was suggested. The motor mount supplied is drilled to accept direct drive, and Graupner or Aeronaut 1:1.8 or 1:2.33 gearboxes. The plan recommends using a gearbox but if you want to keep things simple it flies a treat on a 7.2V Speed 400, seven 500AR cells and a Graupner 6 x 3 folding prop.

As this is not a beginner's model or even a first aileron model, I'm not going to give a step-by-step account of the construction. The CNC cut parts make it very easy to make. The instructions are brief, but easily followed.

Four hours!

I started at 6pm and by 10pm the wings, fuselage and tail surfaces were complete! I used thin cyano and odourless cyano for all joints.

Tail

The tail surfaces take less than 5 minutes. Just butt-joint the two fin pieces. Using a straight edge join the two elevator halves with a short piece of spruce (it's already cut to the correct length).

Wing

The wing is a little more involved. It took about 2 hours and included some building over the plan. The wing tips need to be constructed flat, after that the wing is constructed 'in the hand'. Centre sheeting is added after the fuselage has been covered and the wing glued on. Bellcranks and pushrods are used for aileron control. Again these are fitted after joining the wing to the fuselage. I followed the plan, but I was tempted to use two of the new very small light servos instead.

Fuselage

The fuselage also took about 2 hours to construct. CNC parts with tabs ensure that it can be built 'in-hand' without any risk of warps. One suggestion: the plan shows four pieces of 1/64" (0.4mm) ply used to reinforce the cockpit floor for the servo mounting screws. The instructions do not mention these parts. Glue them on before assembling the cockpit, it's a bit of a bu*@$%r to do later!

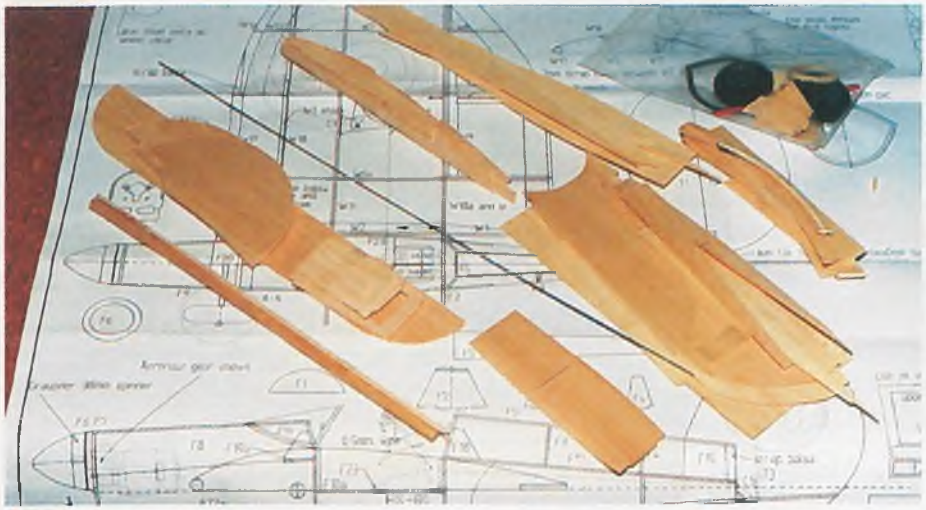
Assembly

After constructing the fuselage, the tailplane and fin are attached. Alignment is ensured by trial fitting the wing.

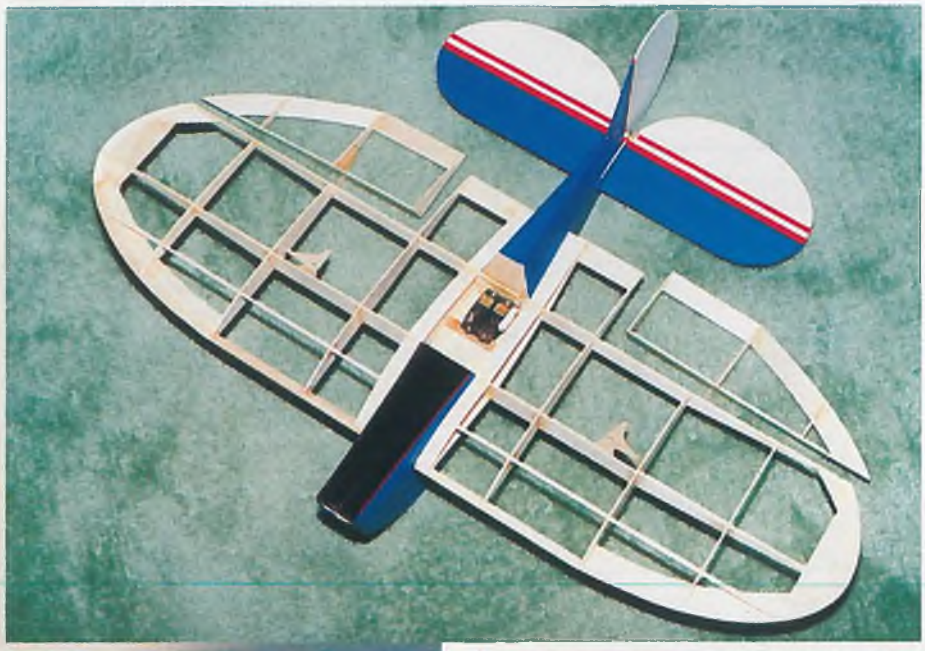
Now a gotcha. The instructions recommend fitting the elevator pushrod and then covering the fuselage, before fitting the wing. This I did and then discovered that I could not fit the wing because the pushrod (with Z bends at both ends) was in the way. I ended up with a right angle bend at the elevator horn and a screw-on clevis at the servo.

As recommended I covered the Microbe fuselage with Litespan. Covering the fuselage took longer than assembling it! Next the wing is glued onto the fuselage, the centre section sheeting fitted.

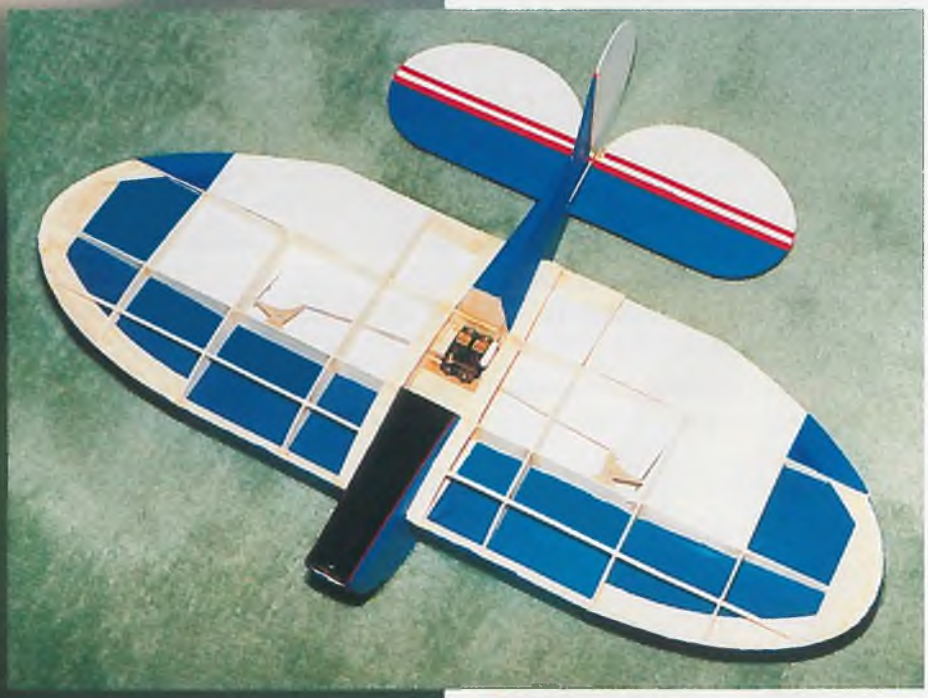
After covering the undersurface of the



▲ Not a lot in the box!



▲ Ready to cover the wing undersurface.



▲ Pushrods fitted.

wing, the aileron pushrods and bellcranks are fitted and adjusted. Here I have a small complaint about the kit. It would be much easier if the ribs were pre-drilled to take the pushrods, it's all a bit too hit-and-miss with the wing already attached to the fuselage. The underside of the wing is covered and the ailerons tested before covering the top of the wing. I used Diamond tape to hinge the ailerons and the elevator.

Finally, the undercarriage is glued on using 5-minute epoxy. The first, and only, joint not made with cyano.

RC gear

Fitting the radio gear is interesting if you don't have long thin fingers. I used a 4 channel Hitec micro receiver and two Irvine X6 servos. Stephen the Editor had asked me to review Benchmark Micro 10P speed controller (see the review elsewhere in this issue of EFI) which took only a couple of minutes to set up and fit.

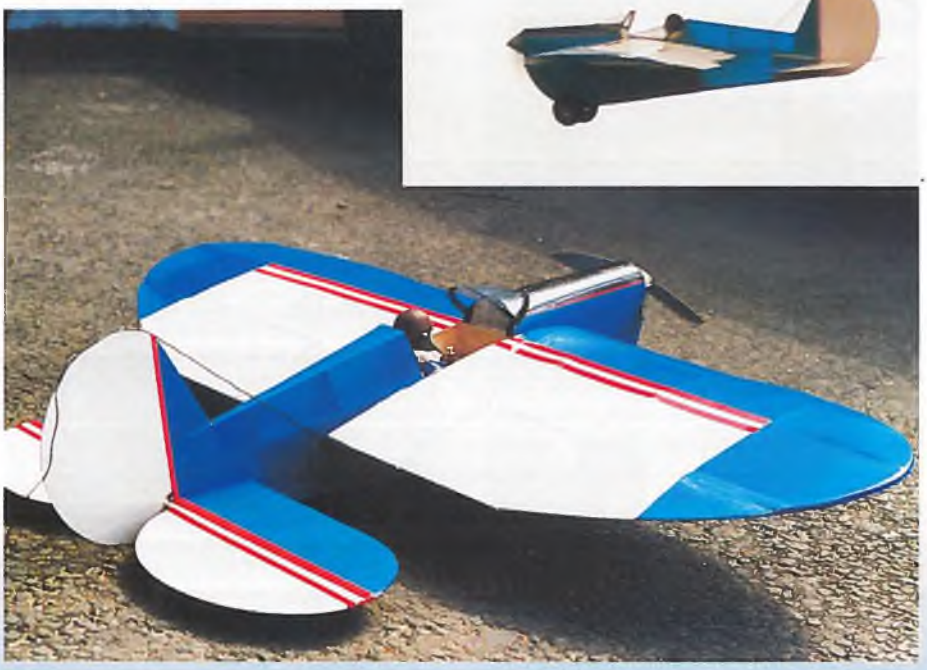
The Microbe was ready to fly after about 5 hours construction and 15 hours covering and finishing. If I'd used transparent Solarfilm instead of Litespan I would have covered and finished the model much faster. I'm sure the weight difference would be entirely negligible.

Test fright

The Microbe was finished during my lunch break on Friday so of course the weather forecast promised 90% chance of rain for the entire weekend. Friday evening however, was dry but with a blustery 10 to 15 knot wind. Hardly ideal conditions for test flying a new model. Neil Gillies again volunteered to do the test flights while I took the pictures. I'd fitted a 6V Speed 400 and 7 x 500AR cells for the first flight with a Graupner 6 x 3 folder. I'd like to say the Microbe climbed away with no need to change the trims, but that just wasn't the case. Seconds after launching the model Neil was asking for assistance to change the aileron trim and elevator trim as he battled to keep the model under control. The plan does not suggest that side thrust is necessary. Neil disagrees, vehemently. The glide is reasonably flat and the model can be slowed down nicely for the landing. After landing and adjusting the ailerons to give about 3/32" right aileron to counteract the torque, we launched the model again. Now, in trim, the model was very controllable and fast. Neil tried a roll and we were surprised to see how slow the roll rate was. We decided that the CG needed to be moved back a bit, particularly as quite a bit of up elevator trim was needed to maintain straight and level flight. After a minute or so of the second flight I'd finished the roll of film and Neil passed the transmitter to me. The Microbe coped beautifully with the gusty conditions. So home I went with some ideas for improvement.

The 6V Speed 400 had provided more than enough power, so I decided to try a 7.2V motor. If 7 cells turned out to be insufficient I had an 8 cell pack that I could substitute. When mounting the new motor I used a couple of bits of 1/64 ply to give a degree or

▲ The pilot is in and ready to fly.



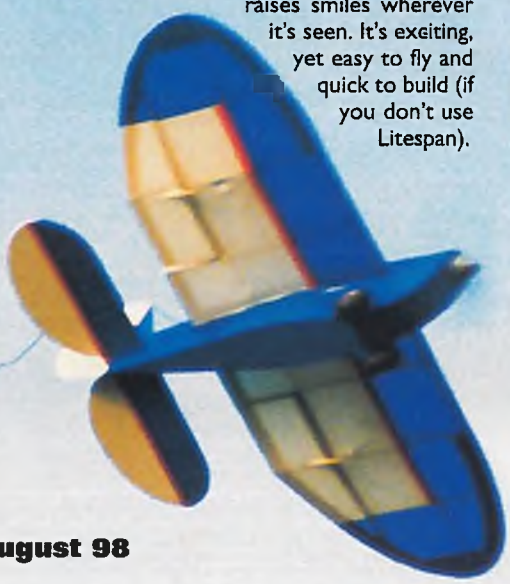
two of right side thrust. I also moved the battery back, moving the CG back about 3mm. Sunday dawned overcast, but dry. Once again the weather forecast was wrong, fortunately as Friday's flying photos were useless. The blustery conditions had made it difficult to fly the model low and slow. Sunday dawned fair but overcast.

Again Neil flew the Microbe so I could take pictures. Now the Microbe climbed away from the handlaunch convincingly, but I'd moved the CG too far back. The elevator was too responsive for comfort. Still, Neil was able to slow the Microbe down and do some low slow passes. The Microbe can fly very slowly. Neil tried another roll, which was still quite slow. I've since read that the Speedy Bee also has a strange roll, so I suspect it is to do with the configuration. The flight with the 7.2V Speed 400 was just over 5 minutes, It could be stretched further, but it's too much fun flying fast! I moved the battery pack forward for subsequent flights, splitting the difference. The final CG is just marginally behind the position marked on the plan.

I was going to try the Microbe with a Graupner 1:1.85 gearbox, but as this requires cutting off the bearer lugs I decided to stick with direct drive. An Aeronaut 1:1.85 gearbox fits without major surgery. Perhaps I'll try one soon.

This is a real fun model, which you can fly just about anywhere and it will sit happily on the passenger's seat while you charge the battery pack on the way to flying field (from my charging battery on the floor).

Buy a Microbe now! It's a fun model that raises smiles wherever it's seen. It's exciting, yet easy to fly and quick to build (if you don't use Litespan).



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Website: http://rbckits.www.cistron.nl/
email: rbckits@cistron.nl
UPI in the USA, www.unbeatenpath.com
The Electric Aeroplane Company in the UK.

Manufacturer's comments:

Mike's review model was built from an early production kit, in future kits wheels will not be supplied and the price will be adjusted. Roughness of wood: all new balsa will be Graupner Andino balsa, the better quality and grain of which will make cutting smoother. All parts in the box will be in plastic bags for safety. Tail: A CNC cut 2mm ply tail joiner of correct length is already in the kit. Fuselage: the instructions will be changed for the 0.4mm ply servo mounts, also for the elevator linkage. Wing: holes will be cut in the ribs for the aileron linkage. Undercarriage: I used cyano which is quicker, no epoxy needed. RC gear: I use a Multiplex PICO receiver and 2 HS80 servo's and a Schultze slim 18 speed control. Side thrust: In my airplane with a Speed 400 and Aeronaut gearbox and 8 x 500mAh cells it flys about 6 minutes, no side thrust is added and trim is straight. Rolling is quite fast at full speed and inverted flight is easy. I saw Stephan Hoellein flying an rolling circle, he flew for 10 minutes with gearbox and 7 x 600mAh cells. For covering I also suggest Mica film which is easy and looks good. EFI

Specifications:

SPAN:	700mm (27.5")
LENGTH:	540mm (21.25")
WING AREA:	15.5 sq.dm (240 sq.in)
FLYING WEIGHT:	425g (15oz)
WING LOADING:	27g/sq.dm (9oz/sq.ft)
MOTOR:	7.2V Speed 400 (Speed 400 6V)
BATTERY:	7 x 500AR cells
COST:	£34.00

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Cover Story

Tupolev ANT-20 'Maxim Gorki'

WRITTEN BY: **THE EDITOR**

The August issue looks a bit late to show you "this year's new models" but with the delay between flying and printing - that is how it works out!

Abrupt wing taper causes no problems on the model. Increase of camber towards the tip and washout maintain lateral stability throughout the speed range.

The early 'Electric Fly Ins' are always eagerly anticipated because so many of you have been beavering away during the off-season and these happenings are the first chance you have to publicly fly your new models. These may even be test flights, although genuine test flying is best carried out with the minimum of onlookers - no audience, just essential assistance.

My own first fly-in is usually the Blackpool and Fylde MAC's event each May. That club has several prolific and skilful builders whose models have been in this magazine and on the cover several times in the past and earlier this year.

Why?

Some builders like to build the more popular models. Popular for a variety of reasons:

The real ANT-20 had corrugated skins. Peter has painted/printed shaded lines to simulate ridges on both wing and fuselage panels.

▲ **Corrugations are to scale, so are the flying wires and the engine pod is tough enough for Peter to carry the model from it.**

builders to ask: "What have you got to show me this year?" Some modellers take advantage of the long close-season to build one model that demands much research and a lot of building time. I think they take advantage of me too - they know I am expecting something new!

This year at Blackpool was no exception. I had prior knowledge of Stan Craythorne's Ryan STA that was the June issue's Cover Story. I had also viewed before completion and photographed before all the paintwork was completed, another model in this issue, the Westland Whirlwind built by Peter Wilson for two Speed 700 motors.

The big surprise at Blackpool was from Peter Angus - again! I had heard rumours from club-mates and hints from Peter when we were discussing late in the previous year -interesting, little modelled multi engined subjects. I know he was interested in early Tupolev multis and I was half expecting to see a five engined Tupolev ANT-14 or six engined ANT-16.

the original may have been built in thousands, or tens of thousands. The original subject may have several claims to fame - the first to achieve this or the only one to succeed in that. The subject may have been the only one built, or one of very few. Some original subjects are built by many modellers. They are popular.

Some other builders prefer to build models that have not ever been built before. We soon run out of those! Some builders definitely prefer to build the rare ones - rarely modelled that is. Such builders often build these rare models in secret. Much of the delight in a rarely modelled aircraft is revealing it to a surprised audience at its early public displays.

I for one am delighted to see unusual models. This is what adds so much to the early fly-ins, new and unexpected models. As the editor of EFI, I am possibly in a privileged position, I get early 'news' of some models from their builders just before it is time to reveal all. I am getting to know which

◀ **There were windows everywhere on the original. Peter used Master Airscrew props and his own neat prop adaptors.**

▼ **I asked Peter if the airfoil section was to scale. He looked astonished: "Of course it is to scale, the wing root to fuselage join would look all wrong if it was not!" Silly me. You see how deep it is at mid span; the thickness/ chord ratio is greater at the root.**

The biggest!

The half-surprise was a Tupolev ANT-20. Only two 20s were built and each was quite different from the other. Peter's ANT-20 is the first to be built, and flown in 1934. Powerful engines were hard to come by in the 1930s and this Tupolev needed eight 900 HP Mikulins. It was the largest aeroplane in the world in 1934 and until the Hughes Hercules was built 13 years later. Wing span was 206.7 feet, 63 metres and maximum take-off weight was 42 tonnes, really exceptional in the 1930s.

This stable and easy to control aeroplane was exceptional for other reasons. It was named 'Maxim Gorki' and operated as a giant mobile propaganda office. It transmitted music and information from loudspeakers - whilst in flight. It carried a cinema and showed films outside the aircraft - whilst parked on the ground. It contained photo processing laboratories and a printing works to enable it to process, print and drop leaflets. On board was a pneumatic mail service and a telephone exchange. All this came to a sad end in 1935 when a Polikarpov I-5 fighter flying aerobatics round it over Moscow, hit the Tupolev and the 45 persons on board plus the fighter pilot died in the crash.

▲ **Dihedral is to scale. You can see why the model does not need ailerons.**

▼ **Undercarriage is close to scale, simple and with two gigantic wheels.**

The model

It was windy at Blackpool and I did not witness the ANT-20 flying until the Chester Fly In on June 28th. Another pilot's noisy Tx caused elevator glitches during the busy flying session but the model was landed without damage and flew well at a quieter time of day. Scale speed is high but the model is very controllable. It looks big in the air, I fear to think how big the original looked.

Peter has kindly supplied full information so it is probably most meaningful to read his own model specification and comments.

▲ **Each engine has two rows of six exhaust stubs, 96 stubs in total. Peter moulded eight sets of right and eight sets of left stubs.**

Specifications:

SCALE:	1/28.7 or 3.48%
WING SPAN:	84" (2134mm)
ROOT CHORD:	15.2"(386mm)
THICKNESS:	19%
CAMBER:	3%
TIP CHORD:	4.3" (109mm)
THICKNESS:	12%
CAMBER:	4.4%
WASHOUT:	5°
FUSELAGE LENGTH:	43" (1092mm)
WIDTH:	4" (102mm)
DEPTH:	3.4" (86mm)
CG POSITION:	25% MAC
GROSS WING AREA:	5.66 sq.ft (53 sq.dm)
WEIGHT PER MOTOR:	18 oz (630g)
BATTERY WEIGHT:	34 oz (964g)
BATTERY FRACTION:	27%
MOTORS:	7 x Speed 400 7.2V
PROPS:	Master 6 x 4
SPEED CONTROLS:	2 x Micron 600

"There are two battery packs, each of 8 x RC-2000. One pack drives the outer 4 motors via one controller. The other pack drives the 3 inner motors (2 wing inners and top tractor motor) and BEC. Top pusher motor is a dummy with freewheeling prop. The two controllers are on a Y-lead from the Rx. Initial current per motor is approx 7.5A. Take-off and climb are good, no flying vices and there is still energy in the packs after five minute flights." **EFI**

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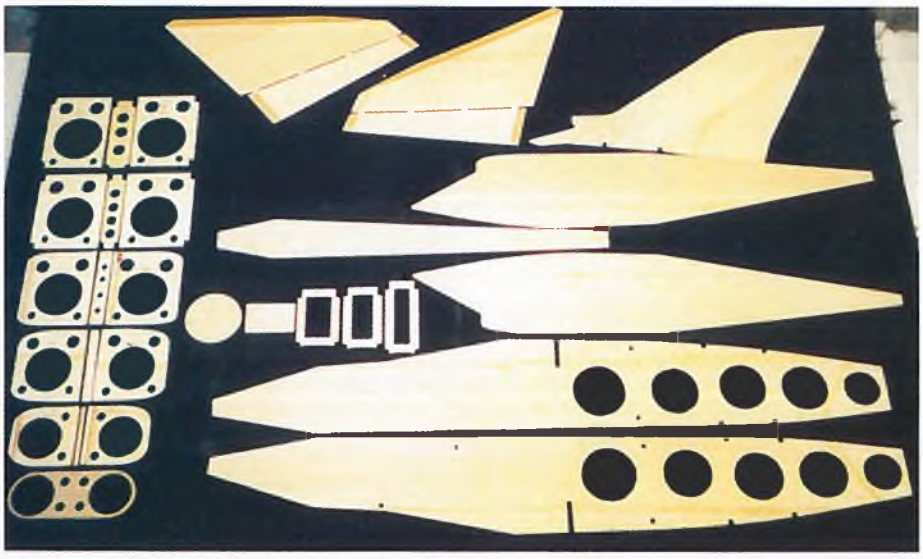
Tornado F3

REVIEW BY: **CHRIS GOLDS**

A swing-wing scale model for two EDF units. This is an exciting model for experienced pilots. If you can handle fast models and want to try jets - build this one

Some years ago I built a Tornado F3 for twin Rossi 81/Byron power and after a few frights during the initial sorties it settled down to be a stable and powerful model. The wing swing was at first driven by a servo with wire push/pull rods but after a rapid roll upon selecting maximum sweep for the first time (still on video and only for the strong-hearted to view!) I changed to a closed-loop cable wound upon a drum driven by a 6 volt motor via a gearbox. This was designed by my flying chum Ron Laden and it worked perfectly from the start. However, it was HEAVY, with the AUW of the model being 33 pounds dry.

Now that I have "gone electric" I wondered if flying with long ducting would be possible. I designed, built and flew (in under three weeks) yet another model of my Hunter XE546 this time for a single WEMOTEC 480 with a total duct length of 28.5 inches (724mm) from intake to exhaust! It flies very well for a single EDF but I really wanted more urge and was advised by Stephen Mettam to replace the Speed 480 by a PLETTENBERG 200-20-6. This motor gave the a stunning performance that it sparked off a thought in my head "What about another F3?". I felt it might be possible, off a bungee, at an AUW of 70 to 75 ounces (1985 to 2125g), powered by two PLETTENBERG 200-20-6 motors in WEMOTEC 480 fans running on 10 x 2000 cells.



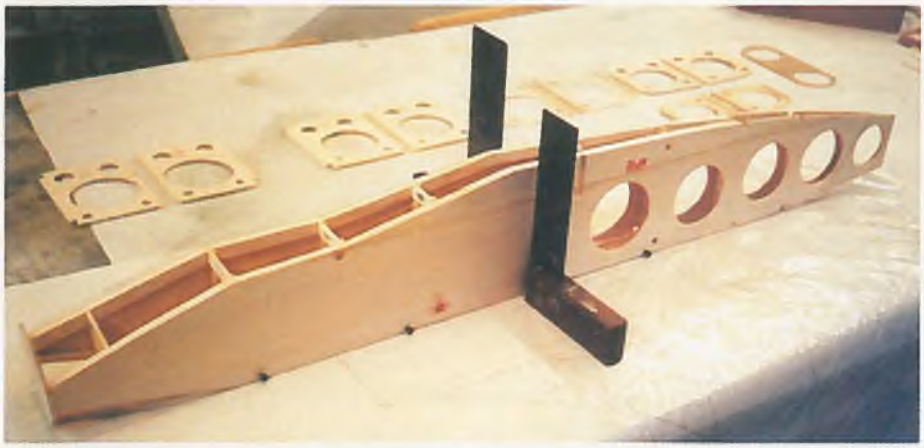
A couple of hours of ruler and pencil produced a working plan but it looked much too big for the available power. So I reduced it in size to the minimum fuselage depth within which I could fit the swing-wing mechanism above the WEMOTECs. Of course the intakes would be over-large as would the exhausts but when re-drawn the side-view looked just like an F3 with its huge fin and shark-mouth intakes. Obviously the wing panels would have to be enlarged but even so the wing loading would be quite high at about 23 ounces per square foot. At this stage there was only one choice - press the starter button and put into the gate!

The building sequence

Read the plan - thoroughly - and protect it with poly film. Trace and cut the fuselage sides: inners in 3/32 soft and outers in 1/16 soft. To each, glue (cyano) the 1/2 x 1/4 and 1/4 square edge reinforcements and cut the various holes for the bulkhead crossbars and tailplane halves. Next come the bulkheads A to K. Make them accurately as there is a lot of ducting depending upon your cutting skills. Using B, C, D, E and the centres of F, G, H, I, J join the fuselage centre sides using cyano. This will give you a long, thin triangular centre box: make sure all is SQUARE, then add A which is made from two cross grain laminations of soft 1/16. NB: A shows a slight "nose down" attitude to match that of the real aircraft.

Cut lengths of soft 1/4 square to plan lengths of bulkheads G, H, I and 1/4 x 1/8 J and push through the centre box; ensure that they are "square". Add the appropriate bulkhead outer halves ending with K which is in one piece. Note the vertical slot in K through the balsa and the 0.4mm ply: this takes the thumb-grip of 0.8mm ply which

◀ Bulkheads, fuselage skins and tail feathers cut out.



◀ **Inner fuselage set up square and glued.**

▲ **Crossbars, intake lips and outer bulkheads.**

▲ **Swing bar in place, swinging spars to check incidences.**

▲ **Intake fitted, note ring holding intake to 'G'.**

▲ **Fan shroud bearers in place, accuracy essential!**

▲ **Exhaust tubes fitted.**

▲ **Foam and balsa nose in block finish.**

glues (PVA) right through to mate with the rear box sides. This grip is necessary for bungee launching as there is nowhere to hold - the model is too wide!

Fit the 1/4 balsa dowel intake lip cross-bars and those at E from 3/32 and then the "swing-bar" at F from medium 1/4 with two face laminations of 0.4mm ply. With the "swing-bar" slot cut in the fuselage outer sides, these can be fiddled into position to now give you the bulk of the fuselage. DO NOT glue the outer sides in place yet! Remove.

Cut and dry fit the fan shroud mounting bars from medium/hard 1/2 inch balsa which fit between G and H. Place the shrouds onto the mounts so that they fit accurately into the hole in G. With the front of the raw plastic shroud (no plastic lips needed) flush with front face of G. Cyano the mounts into place and drill them to accept the mounting screws (about 3mm by 3/4 self tappers).

The ducts

Like all ducted fan models, the building of the inside is as important as that of the outside: cut a scrap paper pattern (from plan) of the intake "flat" shape about 1/2 inch oversize all round. Cut a 1/4 inch balsa disc to 69mm dia and roll the duct pattern so that the disc is inside at the shroud mouth end. Ease the duct through the intake dowels and F (the outer sides are NOT fitted here) and into the shroud mouth by 1/8 inch. Dry fit and pin the outer side and make the pattern conform to the square intake but leave it JUST rounded in the front corners. Check by eye that F is not causing any kinks - if it is then remove the duct, relieve F and repeat the fitting. Mark the pattern and fuselage with mating-marks and remove the pattern. Now cut the proper duct from thin card (slightly thicker than a postcard, try art shops) which has one face glazed - the inside face. Glue this pattern into a conical tube using the balsa disc at the rear and the mating marks at the front. Dry fit the balsa ring (see plan) outside the duct at the rear and slide the whole lot into place with the rear of the duct JUST into the shroud mouth and the front pinned to the fuselage and intake dowels. Slide the ring back to mate with the front face of G and PVA into place. This locates and reinforces the duct against damage in any subsequent removal of the shroud. Re-fit the outer side to ensure that the square-ness of the duct intake is correct but do not glue into place YET!

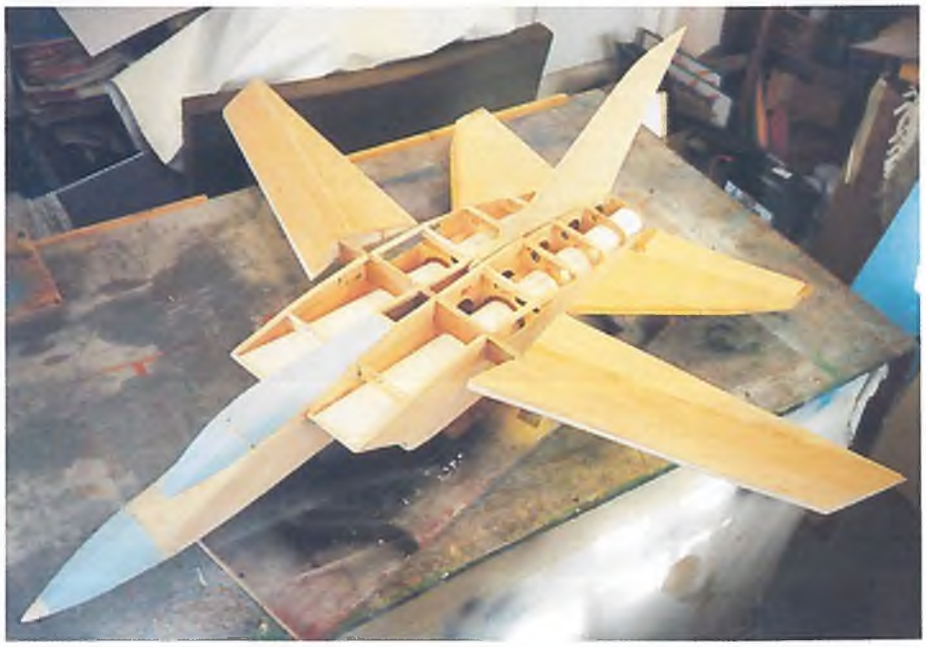
The exhaust ducts are much simpler. Cut a pattern (see plan) oversize and pass through K going forwards. Fit to the shroud exhaust rear outside and tightly inside K. Relieve H, I, J, as necessary. Mark "mating lines" and remove from the model. Draw and cut the duct from thin card ensuring that the gloss face goes on the inside. Glue the duct into a tube (a very shallow cone) using the transferred mating-marks. To get the duct forwards through K you must gently press the surface inwards opposite the seam until you have a "spectacles" section WITHOUT a hard crease line. Insert through K and when it is in its correct location with the shroud the duct will "pop" back to circular section. the front end of the exhaust duct is cut away in the lower half to allow the shroud and motor to be located on its mounts. The resultant gap is closed by a thin litho plate (try any printer - they usually throw thousands of sheets away!) which goes around the underneath of the shroud but inside the duct and is screwed down by the shroud mounting screws. ALL overlaps must face downstream - if not, the fan blast will find its way into an overlap and blow it open. See plan for patterns for all these parts. Always use a scrap pattern before the working pattern is cut. Fit the power cables running from the front fuselage inside E, F, G and entering the exhaust ducts just ahead of H. Leave about six inches of cables to allow you to solder to your motors prior to fitting the fan units, then the excess cables can be gently pulled into the fuselage centre and forwards. REMEMBER to leave the same amount of slack inside the front fuselage to allow for subsequent removal of the fan units.

With the intake and exhaust ducts fitted, you can now glue into place the fuselage outer sides with the swing-bar and tailplane slots already cut out. The swing-bar is made

▲ **Nose contoured and bottom right, the canopy blank.**

▲ **Intakes and front bottom skins faired in.**

▲ **Bottom wing glove in place with 'flying' LE.**



▲ **Airframe complete, wings at 25 degree sweep.**

▲ **Wing panel and aileron skinned in 1/16" balsa.**

to plan size of 1/4 soft sheet, faced front and back with 0.4mm all grains spanwise. The pivot plates are made from 0.8mm ply, length grain, and reinforced with 1mm Carbon Nylon (black) sheet as shown on plan. I used cyano to laminate. Drill the hole in the pivot plates and glue in place the bottom plates for wing panels and swing bar. Pin into place the top panels and join the panels to the swing bar with the 3mm pivot but the swing bar top plate loose. This allows you to mount the wing panels so that their incidence is ZERO and stays so when swept and the dihedral stays at ZERO also.

The bottom skins from the lower lip dowel back to G can now be glued in place, grain athwartships. When it comes to the time to fit the aft top and bottom skins - after the tailplanes are glued in and the elevator servos are in position - you can either plank them in soft 1/16 or, for a much better result make the four skin pieces, left top and bottom, right top and bottom, using the 'ammonia technique".

The Ammonia Technique

I learnt about this method of moulding thin balsa skins around double curves from Peter Shepherd of PRO-SCALE down in Cornwall. It allows you to mould quite tight curves in 1/16 or 3/32 soft balsa and the curves will not "uncurl" later on. You need some ordinary domestic liquid ammonia and a dish large enough to lay the balsa sheet in totally immersed in 1 part ammonia to 10 parts warm/hot water for about 15 minutes. You also need a form upon which to mould your sheet and this is easily and quickly made from a blue foam block sawn and sanded to the size needed. For this model I made one block from two inch thick foam stretching from G to K matching the curvature of the top rear of the fuselage and its plan form. Sand to a smooth surface and split the block along the fuselage centre-line into left and right blocks. Cut out the skin from 1/16 soft sheet, cyano butted to give enough size. Soak the skin (outside or in an open garage NOT indoors as 10% is quite a strong ammonia solution). Remove from the solution, shake dry then pat with a cloth to remove excess water. Lay onto the form and rubber-band into place at the front end - the almost flat end. Gradually add more elastic bands creeping towards the rear end where there will be too much wood for the curve and it will try to form into a "ploughed field". Keep pressing it down while squeezing the wood together adding more bands all the time. With practice you can get all the ploughed bit to lay flat against the form. When complete, place the lot inside your microwave oven having first ensured NO metal (ie: pins) have been picked up by the form and cook for about three minutes or until dry. Remove and carefully take off all the bands and whilst the skin is still on its form, sand to remove the very shallow hand crush marks from the balsa. Peel the balsa off the form and you will have a double curvature skin which, with judicious trimming, can be made to fit the fuselage exactly: it is light and smooth and easy to apply with PVA

▲ ...and at 67 degree sweep.

▼ Left rear top skin in position.

▲ Four 'half' Skyflash missiles.

over the bulkheads and cyano around the edges. It only needs dope and talc to fill and sand into a smooth shiny skin surface.

Tail feathers

The combined fin and rudder and tailplanes and separate elevators are all made from soft 1/8 sheet butt-joined as per plan to control the grain directions. Butt joins are cyano and two or three coats of dope/thinners/talc will give a nice finish. They can all be dry-fitted now but do not glue into place just yet. The elevators are hinged to the tailplane halves using small plastic hinges with metal pivots - I use KAVAN 26 x 11mm (number 12g). With care these will slot into 1/8 sheet without splitting the wood. They must be cyanoed or pinned into place. The tailplanes are notched to accept H, I and J and slid into position just touching the exhaust ducts. Holes to accept the servos are then marked and cut out. Once you are happy with the servos' positions to feed into the snakes on the under side, the tailplane halves can be glued into place. Dry fit the fin and rudder and glue in place the rear end skins, butting snugly against fin and rudder. It is best to leave the final gluing of the vertical surfaces until the very last moment before painting as the fin is large and gets in the way when the fuselage is being worked upside-down.

Wings

Time now to build the wing from blue foam cores skinned in soft 1/16 balsa. With the panels built around the spars you should be able to mount the wings on their swing hinge pivot and achieve controlled and equal incidence neutral as you swing the wings back to their full angle of 67 degrees of sweep.

Using the plan pattern cut the top and bottom wing "gloves" from soft 1/16 sheet and fit the bottom layers - but not YET the top layers. The "gloves" should achieve a gently tight fit on the wings and the best possible aerodynamic solution to the fit of a movable wing.

The swing wing

You will require a 180 degree servo to best fulfil this need so that the stress of the wings at maximum sweep (25 degrees) is taken through the servo centre line against stops also when fully swept, against physical stops. If you can only get a normal servo (45/45) extended by your Tx ATR to about 160 degrees then you must still aim to have the minimum sweep position travelling "through" the servo centre to prevent airstream "stress" on the servo and subsequent battery failure. This EDF model is very fast and the slipstream will be a considerable force against spread wings. The final setting-up of the pivot can now be made using a 6BA - or similar - thick bolt long enough to carry through the hinge plates and have a NYLOC nut at the bottom. The ply triangular pull-plate (see plan) which joins LE to spar carries a series of holes for a clevis pin or a Z wire link to your 180 degree swing servo which is mounted in the top of the centre fuselage just ahead of F. And now you have the main bulk of the airframe completed at a weight of about 28 ounces (790g). There remains the task of fitting the remainder of the servos, the Rx, battery and switch and then the fans/motors, speed controller and power pack. The total target weight is about 74 ounces (2.1kg).

Finishing

The F3 Tornado is painted in a very light grey which used to be called "low visibility tactical grey". It is a colour which very easily disappears against a grey sky background - so beware! If you can get it, HOLTS " Ceramic Blue LF 156 " spray colour is a very close match. Try B & Q. RAF Tornados are quite dirty in appearance especially at the rear end due to the smoke-dirt from the engines when reversed for stopping. The plan shows the size and position of the markings for an aeroplane of No.43(F) Squadron, of which I was B Flight commander, about two hundred years ago! A nice touch is to add the four Skyflash missiles to the belly of the model (see plan). These are made from 5/8 balsa dowel, nine inches (230mm) long and split into half so 18 inches makes all four Mx! Finished and painted the four only weigh 5/8 ounce (16g) total and are the essence of this potent Mach 2 interceptor.

Flying

The F3 needs a fairly strong bungee launch (see my article "TWANG" for details of making and using bungees) so do not ever consider hand launching it!

After your ground range check with motors both on and off to make sure you have no interference from inside the model, complete a top up charge and plan out your first F3 sortie. I like plenty of control surface movement for a first flight with 50% rates if

▲ **Winding up for a low pass.**

▶▲ **Flyover at 67 degree sweep.**

▶ **Grinning pilot with wings at 67 degree sweep.**

I need them. Make sure the A frame is leaning away from the model holding man in comparison to leaning towards him with light wing loading models which will easily climb above the A frame on launch. This allows the frame to collapse before the model reaches it.

When all is ready and the model is hooked on, start your stop watch, run up to full thrust and loudly call "GO". Remember, Your model holder has his ears close to a lot of thrust. As the model accelerates up the bungee, hold full up elevator: this can be relaxed as soon as the F3 leaves the bungee. Set up only a shallow climb to allow the model to reach to a decent airspeed before you begin to climb and turn - by this time the jet is travelling fast. As she turns, you will see for the first time her strange silhouette with a huge tailplane and little matchstick wings. At a sensible height, level and throttle back and get used to the controls. When you are ready, swing the wings back and go to pull power, check back on the stick to maintain level and try the ailerons - they will be quite soft with the wings swept back. Remember, she is now a slotted delta and if you have to pull a tight turn you will rapidly slow down with delta drag. Swing forwards and get into position for some circuits but beware of getting caught on overshoot with failing power. Turn into wind and glide down to a landing in the grass, not too fast but not too slow. I hope you will enjoy your first F3 as much as I did - WOW! What a thrill! FLY SAFE. EFI

▲ **Flyover at 25 degree sweep.**

MW2683 - TORNADO F3

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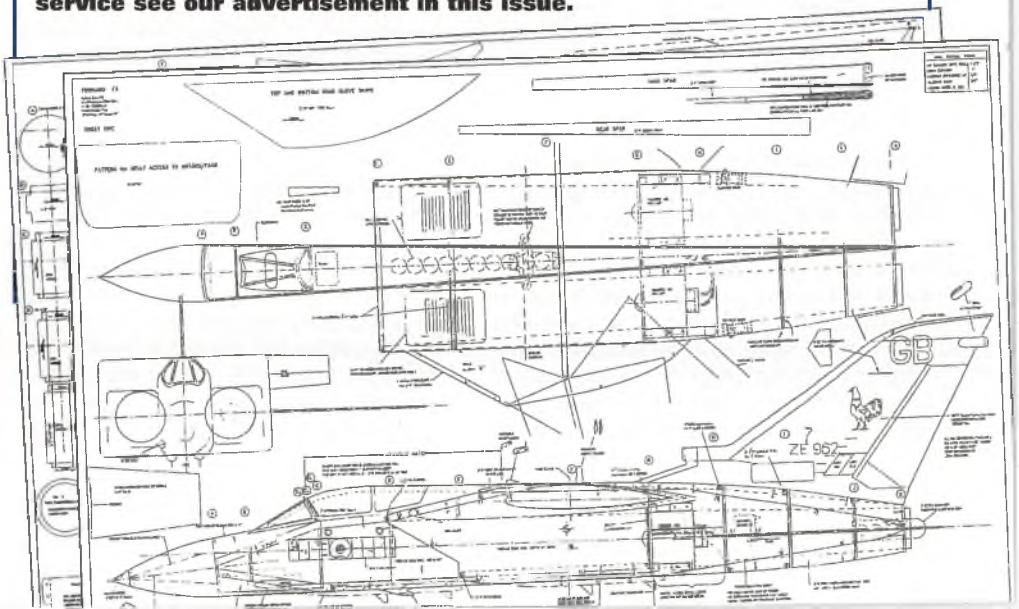

Wood sizes

If you wish to convert the Imperial (inch) sizes to metric (millimetres), here are the exact sizes to the nearest 0.1mm. Find the closest equivalents that you can.

inches	millimetres
1/16	1.6
3/32	2.4
1/4	6.4
1/2	12.7
5/8	15.9
3/4	19.0

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Other pilots' models

REVIEW BY: THE EDITOR

This is your page. You want to know what other builders and pilots are doing with their electric models and they want to know what you are doing. Send photos and details to the EFI editor at the "ALL CORRESPONDENCE..." address on page 2.

▲ John Mack's Avro Lancaster Mk I.

Spruce Geese

I knew it would happen! Sooner or later it had to happen. It takes only one of you to say "I am the only guy who has built a model of 'X'." - and Xs start falling out of the woodwork. In the first of this 'Other pilots' models' column, in the May issue I repeated what Robin Andrew had said to me about his Spruce Goose: "I don't think anyone has built an electric powered one, in this country." I typed that in, tongue-in-cheek, expecting that at least one of you would have beaten him to it. Within days of issue I received from Dick Comber the photo you see here.

Dick had intended to wait until it had flown, before telling us but Robin's model prompted early disclosure. He had in fact already started this model when he heard about Martin Lagerstedt's model for eight Speed 400s that was reported in the March/April 1997 issue of EFI (Spruce Goose flies again). We already have two of Dick's designs in our Plans Service. I wonder if anyone else out there would like to build this one? He could probably be persuaded. Here is the data for his 1/50th scale model:

Specifications:

SPAN:	75" (1905mm)
WING AREA:	626sq.in (40.sq.dm)
FLYING WEIGHT:	129 oz (3676g)
WING LOADING:	30oz/sq.ft (91g/sq.dm)
ENERGY:	14 x sub C cells (7 per motor)
MOTORS:	8 x speed 300 wired series/parallel

4 x 2" Graupner 3 blade props, 22,000 RPM
4 x 600mAh Rx battery
PowerMos 56 speed controller
Radio switched landing and navigation lights
1/64" (0.4mm) ply hull, all wood construction

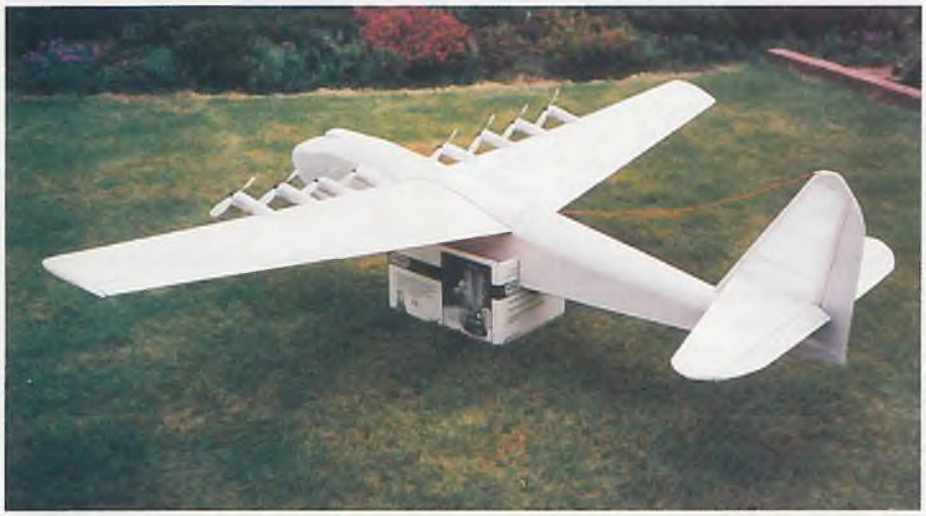
Both pilots were waiting for suitable weather for test flights and so both have probably flown by the time you read this.

Jet Airliner

Model construction techniques have developed fast during the past few years. Highly stressed competition models use materials and processes similar to modern combat aircraft. Sports models use modern production techniques and materials originally developed for mass produced consumer goods.

▲ Dick Comber's Spruce Goose.

▲ **Robin Andrew's Spruce Goose with his other two multi engined flying boats - a line up of twenty Speed 400s.**



▲ **Robins' Spruce Goose at 7' (2134mm) is a few inches bigger than Dick's and uses 8 x Speed 400s and 2 x 7 cell packs.**

Some of us still prefer to use long established build techniques. Your editor has had some interesting correspondence with Ian Monty in New Zealand.

"Our vision is to design and make available components and kits of electric modern commercial jet airliners and make it a survivable commercial enterprise. Getting the right product is a much loved and enjoyed passion. Achieving survivable commercial success is a cold reality requiring hard work.

"This vision came about after purchasing the first issue of Electric Flight International and a Morely fan. This was my entry into electrics.

"Our design philosophies came about because of my adamant opinion, most (but not all) designs of electric models have failed to jump the next generation, only being adaptations of IC model construction techniques. To this end I woke up one day, went downstairs and systematically threw every piece of balsa wood, balsa glue, and filler I could find into the rubbish. I then coined a very arrogant definition which is guarantied to offend most aircraft modellers - "stones in glass houses" type stuff. Notwithstanding I believe it to be true and live by it. - "The definition of a poor model aircraft engineer is someone who butt joins balsa wood with glue."

"After three years research and development I have one answer - a philosophy for the construction of model electric jet airliners.

"Our seven specific design philosophies became:

- no balsa wood.
- a simple, lighter and stronger airframe construction.
- Meccano in principle. No glues required in the final assembly of aircraft (epoxies in composite materials and composite sub-assemblies are acceptable).
- aircraft and components assembled according to detailed bill-of-materials (standard systems behind the design).
- each component be reproducible and capable of replacement.
- no surface finishing on external aircraft surfaces.
- models must be easily, quickly and totally capable of disassembly for ease of maintenance and transportation.

"These design philosophies are rigidly adhered to despite many a temptation to deviate. Most scale aircraft should be capable of being designed employing these same philosophies and the modeller enjoy the pleasure of design and construction.

"Our current emphasis is turning designs into a quality product. We have had some success. It is also true we have some way to go."

The photo on these pages is of Ian's prototype. Wingspan is 1600mm (63") and all-up-weight 2.9kgs (6.4 lbs). The model was originally powered by two EJT 540 (WeMoTec Eco Fan II) fan units with Speed 600 BB Turbo 12V motors but performance has been improved by using Fanfare 'Golds' and 14 x 1700mAh cells.

▲ **Prototype electric ducted fan airliner by Model Jet Airliners International of New Zealand.**

John Swain of 'Fanfare' has been pleased to advise Ian on choice of EDF units and motors. John has done a lot to 'champion the cause' of understandable and affordable electric jet models, in the UK. Kits will hopefully be available later this year. Enquiries please to John Swain of 'Fanfare', UK.

Lancaster

You will see that this 'Lanc' is a very carefully detailed model, even the grass is almost to scale. It was built by John Mee of the Isle of Wight in memory of his wife's late brother, Fl/Lt Barry S H Wadham, DFC, who while serving with 7 Squadron Path Finders at Oakington, took NG229 to Harburg on the night of 4/5 April 1945 and failed to return - the last Lancaster of 7 Squadron to be lost before the end of hostilities with Germany.

Details of model of Avro Lancaster Mk I, NG229

Specifications:

WING SPAN:	74" (1.8m)
LENGTH:	51"(1.3m)
WING AREA:	5.23 sq.ft (49 sq.dm)
WING LOADING:	17.6 oz/sq.ft (54g/sq.dm)
MOTORS:	Graupner Speed 400 7.2V 1.85:1
GEARBOXES:	Graupner 1.85:1
PROPS:	Zinger wood 9x6"
ENERGY:	8 x Sanyo RC-2000
SPEED CONTROLLER:	Hillcott Electronics FX35 Digital BEC
SERVOS:	4 x Hitec 80
CONTROLS:	via Sullivan 505 snakes

Construction is all balsa, built up and skinned, finished with light weight tissue and brush pained with acrylic. A belly light flashes red when the Rx power is on and the tail light is continuous when there is power to the motors.

John's own pedigree is must be typical for an electric modeller of his age. He started building model aircraft in 1933 as a school boy and from then onwards until the outbreak of WW2 had accumulated over 20 models ranging from 12" to 6 feet wingspan, the majority being in the 3 to 4 foot range.

◀ **If you look close, you will see the red belly light directly below the mid-upper gun turret.**

Waterplanes

Is it coincidence or do more electric builder/pilots go for flying boats and seaplanes than the IC guys? I have been pleasantly surprised at the high proportion of waterplanes at 'dry' fly-ins and information and photos submitted to the editorial offices. Another recent convert to electrics is Martin Hughes of the Southampton MAC and two of the five models of which he has sent photographs are flying boats. The data for each model is in the caption to its photo. EFI

Needless to say, all rubber driven. The last one to be built, the 6 foot span, was fitted with a home designed pendulum for longitudinal stability - of limited success, it needed damping.

All but one, a 12" span Curtiss P6E, were totally lost, destroyed by enemy bombing action in 1941. The Curtiss somehow survived as it was in a very strong cardboard box.

War years were spent as a Commissioned Air Engineer in the Fleet Air Arm, and after, attempts were made to revive the hobby but making a living took preference until recently. After retirement and about six years ago the balsa began to fly again. Seven models have been built including a 74" scale DH82A Tiger Moth with Laser 150 engine and most recently this Avro Lancaster with electric power.

John is looking for another project and is considering a large Beaufighter. Now that he is back in the building mood, he is finding it impossible to put down his modelling knife.

▲ **Martin Hughes Consolidated Catalina PBY won the Southampton MAC Concours competition in 1996. It was built using a highly modified EasyBuilt plan, the hull is 1/64" (0.4mm) ply and the built up wing is 1/16" (1.6mm) balsa sheeted. Power is two Kyosho AP29 motors driving 6 x 3" three blade Tornado props on 7 x Sanyo 1700SCRC cells via a PicoMos 33. Wingspan is 54" (1370mm) and all up weight 58 oz (1645g). Controls are rudder, elevator, ailerons and floats. It flies well but is unable to take off from water, Martin thinks it sits too low and in consequence there is insufficient prop clearance.**

▲ **Whilst Martin's Clipper was taking first spot in 1997, his DH Cirrus Moth got third place. It is built from a much modified and lightened DB kit and is covered with Litespan. Power is a Graupner Speed Gear 600, 2.8:1 with PicoMos 33, 12 x 10 Master Airscrew electric wood prop and 8 x Sanyo 1700SCRC cells. Wing span is 48" (1220mm) and weight 48 oz (1360g). Control is rudder, elevator, and aileron, all operated by closed loop. Martin says that it flies very well and fitted with floats, has once flown off water.**

▲ **Top is Martin Hughes Speed 400 trainer built from an Eric Leadley plan (EDL Plans). It has a 36" (914mm) span foam wing, direct drive Speed 400 with a 6 x 4" prop, 7 x Sanyo 600AA cells, control on rudder and elevator, weighs 24 oz (680g) and flies well as a first trainer. Nearer to you is another model build from an EDL plan, the Speed 400 Tucano. The power train and total model weight is identical to the above trainer but this time control is on aileron and elevator and this model too is reported to fly well.**

▲ **One year after the Catalina won, this Boeing Clipper won again for Martin Hughes the Southampton MAC Concours competition. It is a 1/32 scale model built using scaled up dimensions from a 1/144 scale Airfix plastic model. Construction is all balsa and liteply and wings and hull are all sheeted with 1/16" balsa and covered in Litespan. Power is four Speed 400s with Tornado 5 x 3" three blade props, 8 x 1700SCRC cells and a PicoMos 33. Wingspan is 60" (1525mm) and weight 70 oz (2kg). Control is on rudders, elevator and aileron and all concealed. This model has flown successfully off Stubbers Lake, Essex.**

Sandown Revisited

REPORT BY: **THE EDITOR**

Here are some models and electric bits that UK flyers who did not visit Sandown may still have not seen.

The Sandown Show report in the July 1998 issue of EFI contained new electric models and components on display for the first time. Models that had previously been shown to you in EFI after their release at the Stuttgart, Nürnberg, Sinsheim or Dortmund shows were not reported - you had already seen them on these pages.

You might have forgotten them too but they were still new to the UK. If you were not at Sandown, you will have missed these models that although not on view for the first time, were having their first UK outing at Sandown. EFI

▲ Robbe Schluter UK displayed all of their more recent models. Electric and new for 98 is: 'Ranger' the 2m (79") span all foam could-be-scale rudder/elevator/motor control electric glider for a direct drive 500 motor and 7 cells. Also new is the pair of all foam WW2 fighters the Me 109 and Spitfire for direct drive 600 motors and 7 cells, control is on ailerons, rudder and speed control. These can be supplied in white foam or with factory applied camouflage finish - all you need to do is fit the radio, motor and the decals. Wingspans are 40 and 43 inches

▲ One of the new small Multiplex controllers. This one from the middle of the range weighs 16g (0.6oz) bare and 47g (1.7oz) with the cables supplied. It is the Pico 400 Duo and suitable for any twin engined model on 6 to 12 cells not needing more than 40A.

▲ Multiplex 'Auto-Lader' is like everything in the 'PICO line' - small. It is probably the neatest and most simple charger you will find for 6 or 7 cells only.

▲ The Astro 050 brushless was in Current Affairs months ago but they are still not in plentiful supply - or get gobbled up as soon as they arrive in the UK. This one was on the West London Models stand.

◀ Multiplex Twin Star. You cannot get a model out of its box and into the air quicker than this one. It is for two Permax 400 motors, push-on props and a 7 cell pack. You will need at least a 4 function radio for control of rudder, elevator, ailerons and motors. It is very easy to fly but it does have ailerons so it is not an absolute beginner's model. Maybe it's an aileron trainer, it is definitely a fun sports model. Wingspan is 1420mm (56") and typical weight 1450g (51oz).

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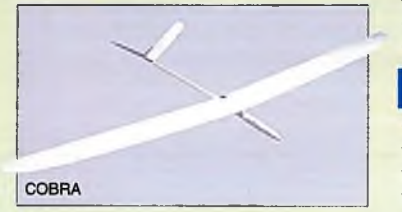
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10.5 x 6.0	£6.95	£9.95
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11.5 x 7.0	£7.95	£9.95
12.0 x 7.0	£7.95	£9.95
12.5 x 6.5	£8.95	£10.95
12.5 x 10.0	£8.95	£11.95
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Soft Switch 40 BEC	Y	6-10	40	£34.95
With Brake	Y	6-10	40	£40.95
Mini/Sw40	N	6-12	40	£32.95
Mini/Sw40 W/BEC	Y	6-12	40	£37.95

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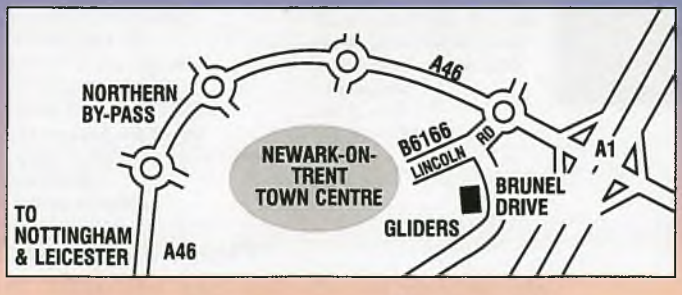

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(PAL Format only)

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WE APOLOGISE TO OUR USA READERS, BUT UNFORTUNATELY WE CAN NOT SUPPLY ANY OF THE DD VIDEOS IN NTSC FORMAT AT THIS TIME!

Microdrive M10P Speed Controller

REVIEW BY: **MIKE DODDS**

Benchmark Electronics Ltd manufacture and sell a range of advanced electronic speed controllers. The Microdrive M10P is intended for Speed 400 applications. Stephen the Editor asked me to try an M10P in the Microbe, which is reviewed elsewhere in this issue.

Two A4 sheets of specification and easy to follow instructions accompany the Microdrive M10P controller. I had a couple of suggestions for improvement and a minor correction, which Benchmark Electronics said would be incorporated.

First impressions count. My other speed controllers for Speed 400 are significantly smaller so I was a little concerned. However, the M10P's specification makes it clear why this speed controller is well worth its extra size:

Specifications:

NORMAL BATTERY VOLTAGE:	7.2 - 12v
NUMBER OF CELLS:	6 - 10
CONTINUOUS MOTOR CURRENT:	10A
PEAK MOTOR CURRENT (<30 SEC):	20A
BEC OUTPUT CURRENT:	1.5A
BEC OUTPUT VOLTAGE:	4.8 - 5.2v
SWITCHING FREQUENCY:	1000Hz
SIZE:	15x28x28mm
WEIGHT (INCLUDING LEADS)	20g

My other speed controls are limited to 7 or 8 cells and their BEC output current is significantly lower. The M10P can handle 4 micro servos, the others only 2 or at a push 3 servos. The Graupner Loop, which I reviewed in the July issue has 4 servos, the Microbe has only two. So I'll probably swap the two controllers.

Jeff Hancock, the M10P's designer, agreed that the ratings for continuous motor current and peak current are conservative. There are similar speed controllers around that claim double these limits. The M10P does not get even slightly warm running at 10 amps.

A speed controller's resistance is fairly meaningless. If you use Motocalc, specify 14 milliohms as the resistance of the M10P.

Setting up

The M10P has an optional BEC and a motor brake. You can disable each option by cutting a loop of wire: a red loop for the BEC and a blue loop for the brake.

A red LED (lamp) lights to indicate when the M10P is armed and when it determines it is at full throttle. When you switch on the power to the model (after switching on your transmitter and setting the throttle to minimum) the M10P calibrates, using the current throttle position as its closed position. The motor 'ticks' three times and the LED lights to show that the controller is armed. Except in my case it didn't. The M10P determined that the throttle was open too far and would not arm. I needed to reverse the throttle servo on my Futaba transmitter. (Futaba transmitters are out of step with the rest of the world regarding open/close of throttle controls.)

Once armed you can open the throttle and then, if necessary, adjust the transmitter to ensure that the LED lights at the full throttle position. I didn't need to make any adjustments.

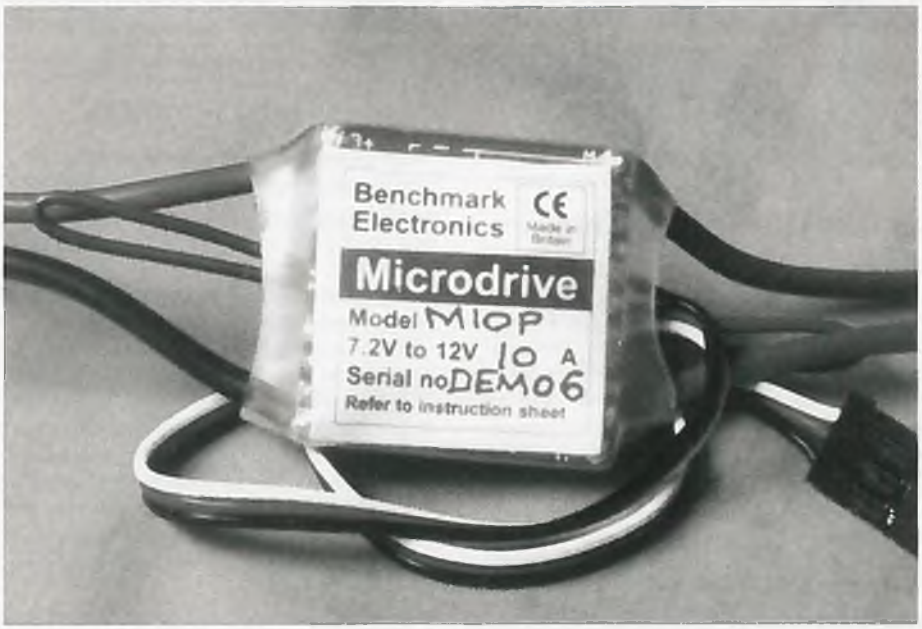
Note that if your transmitter throttle stick is not set to minimum when you switch on power to the model you may not get full power from the controller. If in doubt you can check that the LED lights at full throttle before you launch.

When flying the Microbe with the M10P I noticed that the brake is very effective and the throttle response is smooth and linear for slow changes. A Soft Start feature means that rapid changes in throttle are 'damped', reducing stress on the battery and motor.

After the BEC cuts power to the motor you can set the throttle to minimum, to arm for an 'emergency' 15 second burst of power.

I like this controller. It's British, it's robust and it does exactly what its instructions say it will do.

The Microdrive M10P costs £36.00 and is available from Benchmark Electronics Limited, Low Dryburn Farm, North End, Durham. DH1 4NJ. Telephone 0191 3846444. EFI



FVK Elekt

Kit Review

▶ **After the disaster and after the refit. Elektron in the company of a George Stringwell Sundancer 74.**

REVIEW BY: **IAN DALE**

There are Fairy Tales and fairy tales. This is a story of one man's romance with an ARTF electric glider.

▲ **Where to fit a rubber band to aid prop folding.**

This article is late, well very late really. It was all due to the fact that in the finest traditions of investigative journalism I had to give you the reader all the angles on this story. It's a story of a love affair that goes back in time, yes even before the birth of EFI.

One day a long long time ago....

Our hero was really enjoying life in early 90s Britain. Long working hours, the ever present threat of redundancy and high interest rates. But worst of all there was no model for the forthcoming E400 club competitions he had promised to run. Enthusiastic club mates who had answered his call to competition started asking awkward questions such as: "Where's yer model then?".

He found solace in what little spare time was - in his magazines. Beautiful models in perfect locations fuelled his dreams of the sun on his back and warm currents of air caressing his face. Then one day one such dream was cut short by a small advert. He hesitated briefly, then phoned the number. Reaching for his flexible friend he realised he had a way to make his dreams come true. The Elektron 400.

The anticipation....

The package when it arrived was discreet, very discreet and very light. Fearful thoughts raced through our hero's head. Had the nice man on the phone forgotten to put anything in the box, was the advert a scam. These fears where to prove groundless on opening the box and examining the contents.

Two beautifully built wing panels exquisitely adorned in transparent red Profilm. Together with their 3mm steel joiner they weighed a scant 120g. A crisp light balsa fuselage with just the odd curve for good measure expertly tailored in white Profilm. Tail feathers of the lightest balsa covered and hinged. There was no mutton dressed as lamb here, the Elektron 400's craftsmanship shone through.

Enthused, our hero set forth to complete the model. Servo rails where fitted for the Futaba 143 micro servos. A balsa push rod connected the elevator and a thin wire snake was used for the rudder. The tail was then simply aligned and glued in place.

An angled battery tray was fitted for the seven 600AA cells to enable them to leave in a hurry if the circumstances dictated it. The Futaba receiver squeezed in just over the rear of the cells keeping it safely out of harms way. A 7.2V Speed Gear 400 and PicoMos 18 controller where fitted neatly into the nose. In a very short space of time the whole cute package was finished off with a Graupner 12 x 10 Gear Prop giving an overall weight of 24.3 oz (689g).

The Oooh bit!

Our somewhat eager hero nervously carried out the preliminaries, bits that waggle waggled in the correct direction, everything charged, good solid radio link. The prop purposefully thrashed the air and she was airborne. The model showed off a brisk rate of climb and in a little over a minute and a half was easily at bungee height. The throttle was closed and the nose dipped sharply requiring quick correction. In glider mode she proved very responsive and sensitive to the air.

▲ **This is as much space as the rubber band occupies.**

ron

Four good climbs to bungee height and twenty odd minutes later our hero manoeuvred the Elektron into her landing approach gently slowed her up and watched her sail gracefully past. She went on and on finally kissing the grass some distance away. It was love at first flight...

Three years later

Our hero and the Elektron have developed a very happy relationship where all the little nuances and foibles have been found:

- Small triangular fillets at the fin tailplane joint add surprising strength but very little weight - but the glued on tailplane makes it difficult to hide her away when packing the car on holidays!

- A collision with a bungee meant she had to have a bit of a nose job. So 3 degrees of downthrust was added and that made the transition between power on and off much sweeter.

- The Gear Prop blades are a bit heavy and can droop in flight. A rubber band held by the spinner keeps everything prim and proper.

- Handling can be tuned very precisely with small adjustments of CG position and control throws.

Success has also come their way in the odd club E400 comp against the mighty hordes of Stringwell Sundancer 74s. When lift can be found the Elektron can more than hold her own against larger models. One flight of 40 seconds of motor run followed by eighteen nerve racking minutes trying to bring the Elektron down will always be remembered.

Disaster Strikes...

All relationships develop and our hero invariably decided to try something new. Surgery was performed and out came the geared motor and in went a 7.2V motor with Robbe RSC210 switch driving a Robbe 6 x 3.5 prop. New lighter Hitec HS 60 servos where also fitted and the receiver and battery moved to ensure balance and poise were maintained. After her refit the Elektron weighed a scant 21.5 ozs (602g).

A new first flight and no nervous preliminaries this time, our hero launched her into the stiff cold breeze. She lurched skywards, badly out of trim into a power on stall. Power was cut and she turned into a sharp left hand turn. Right stick was applied and she turned even more sharply left, this was not the same Elektron our hero knew and loved! The rudder movement was reversed. Too late, the Elektron spiralled behind the trees into Death Valley, the final resting place of many an errant glider.

Our hero was devastated and went in search of the remains. The intact fuselage and tail where found precariously lodged in the branches of a tree overhanging the river. One wing tip lay on the bank nearby. All was carefully retrieved but of the rest of the wing there was no sign.

A passing Park Ranger stopped to commiserate and then carried on walking down stream. Suddenly the Ranger shouted, the missing wing was spotted caught on a branch in the middle of the raging torrent. Bravely ignoring a leaking welly boot the Ranger plunged into the waters and retrieved the soggy remains.

Reconciliation

The Elektron's largely lucky escape from the river inspired our hero to rebuild the shattered wing. An easy process given the simple construction and traditional materials. The new covering was Esaki tissue and mylar to give increased stiffness and save a little weight after the repairs. In no time the Elektron was ready once more to take to the air. Surprisingly, the wings weighed the same after repair much to the relief of our hero.

Direct drive - the sequel

The second attempt after proper pre flight checks with the new power train showed the Elektron in a whole new light. Still very agile, but somehow more buoyant and able to pick out the very lightest lift. The glide was also slower and the power on/off transition much easier to control. The climb under power was of course much reduced requiring gentle use of up elevator.

The End

The Elektron is a very versatile E400 model, with a geared or direct drive 7.2V motor it is an excellent sports model. By using a 6V motor the model becomes very competitive in competitions where motor run time is restricted.

For a tyro pilot the direct drive option does give easier handling. Certainly the model's overall lighter weight gives it far nicer flying characteristics than the typical 40 plus ounces buggy motored beginner's job, that seem to career about the sky oblivious to any lift that may be about.

As far as build quality is concerned it cannot be faulted, it is absolutely first class. The Elektron now comes with an epoxy glass fuselage which should increase even further the model's durability.

Whilst some decry ready built models, when time is limited high quality models such as the Elektron are brilliant. Our hero could not build a better E400 model for the price. A marriage made for the heavens. **EFI**

Specifications:

WING SPAN:	150mm
LENGTH:	720mm
EMPTY WEIGHT:	280g
WEIGHT (GEARED DRIVE):	689g
WEIGHT (DIRECT DRIVE):	602g
AIRFOIL:	E205
PRICE:	£82 plus p&p
SUPPLIER:	FVK-Modell, Brian Anderson, 206 Hilda Park, Chester Le Street, County Durham, DX2 2X, UK. Tel: 0191 388 7469 Email: Brian.Anderson@Oxynet.co.uk

▲ Equipment layout with a Robbe RSC210 switch on the rear of the motor, no gearbox and a Robbe 6 x 3.5 prop, all running on 7 x Sanyo KR-600AE cells.

▲ The smaller spinner and prop is not so neat as a retrofit.

▲ Two proud model owners. When the editor met Junior he had more time for Thomas the Tank engine.

DERECK WOODWARD

Over Here!

If there is one true saying in e-flight, it has to be Keith Shaw's "Buy Cheap, Buy Twice". So business begins one late evening at a flying field, a long way from home.

▲ **Anatomy of a Mini-Bee, as perpetrated by Monk Morris. Those monstrous servos and receiver are Futaba - cries out for a FMA Tetra with a brace of S80 servos and a modern S400 speed controller. Points of note - the hi-tech motor mount, pushrod from kebab skewers and the deep bit at the bottom is where the battery lives - fitted from below. The UC is a clever look-alike for the Bee's Mignet style UC.**

Let's discuss your 'fuel supply'

For many e-fliers, and especially "newbies", it's usually the car's battery! A boring object in dull black, leading a tedious life sitting in the car, un-noticed until it dies.

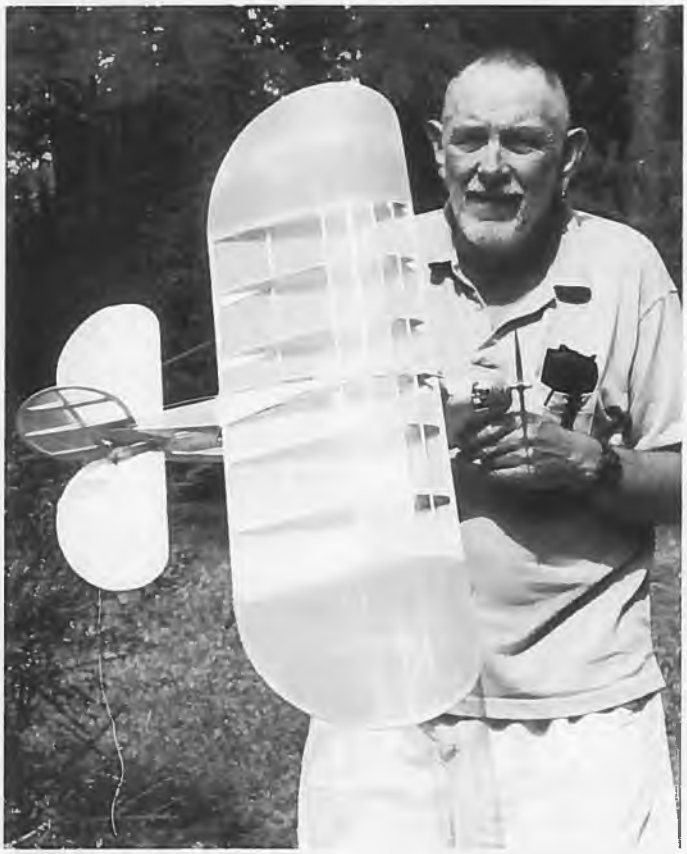
Been there, done that. When I started messing with electric flight, it was seven cell 1200's, charged at maybe 3A. Now, it's ten at 2000mAh, 5A charges and more to come. That day, I'd re-charged three packs from the van's battery - which is pretty hefty - when I loaded up for home and found I was going nowhere. Fortunately, a good Samaritan had a set of jumper leads.

Car batteries are designed to supply huge currents to start the engine, then sit there while the alternator tops them up and handles electrical demands. They don't like being flattened! Mine was a 60 amp/hour unit - that means one amp for sixty hours, translating into battery charge speak of around five amps for 12 hours. A long way short of flat, they won't start the engine - and mine was below par. That four year old battery was put out of commission by an hour at 5 amps.

Also, there is some suspicion that using a car battery thus might help it to an early recycle.

Now my 'deep cycle' battery (usually called a 'leisure' battery in the UK) goes along every session. I charge my flight packs at home, allowing me to hit the field with my 'fuel tank' recharged. It's a good idea to monitor its voltage in use - it can safely discharge to flat, but my charger responds to low input volts by sucking more amps to compensate (told you we'd duck technical speak in this column) and can do itself harm if the source drops too low. That still gives me a lot of flying in a day.

My suggestion is, once the



▲ "Monk" Morris and his "large scale" model - a 75% long wing "Lazy Bee". This would fit well into the new "Park Flier" class and better into Monk's truck easier than his full sized Lazy Bee did. "Plans" aren't available yet but word is that the Clancy Skunk Works is considering making a set.

e-flight bug bites hard - stop using the car battery and invest in a deep cycle battery, as used in caravans (RV's for our US readers), golf carts and so on. Mine is huge, as I stopped cutting corners a while back and bought it with twenty cell packs and my tendency to spend the minimum time on the ground in mind. I mutter every time I haul it up from the basement.

But not as loudly as when my van battery let me down that Sunday evening.

Take Control

I slipped easily into electric flight, but the initial shock is still well remembered. I had the radio gear - so buy a speed controller and away. Naturally, I started out buying cheap units and they worked at the time - but those huge frame rate controllers have made their last flight into "File 13".

If you are totally baffled by the controller market, good! Progress is on par with the PC. I'll leave real technical stuff to others, but here's the basic low-down on that widget between motor and nicad. First off - history can be very recent in controller-land! If the spec doesn't mention "high frame rate", forget it. A low frame rate will not control a direct drive motor well and beats up the gearbox . Yes, mankind managed with them for years, but we also got by without fire once.

In case you are baffled by recent ads - there is a new Astro 217, which is a bang up to date gem, unlike the old frame rate 217. Like I said, controllers are soon history. If starting the search, look to the old houses - Astro for one. I seriously looked at one highly recommended controller and was put off by the ten page manual. The Astro 210 I bought has one small sheet of instructions and behaves like all Astro gear - bulletproof.

But history is not all - two years ago, Patrick del Castillo appeared on the E-flight mailing list offering a Speed 400 controller at a great price for prototype units. Being a suspicious so-and-so, I didn't - and kicked myself every time I heard an owner praising his Sprite. When Patrick released the 50A Griffin, I was camping on the shop front step. Handling 50A and 16 cells, it's flawlessly running the "Wimpy" as a BEC unit. Patrick's range goes from a tiny S400 unit to a custom job for enough cells and current to make your eyes water! He hadn't got his web page up as I wrote, but can be reached at: Castle Creations, 1625 E. Drury Lane, Olathe, KS, 66082-1840 USA.

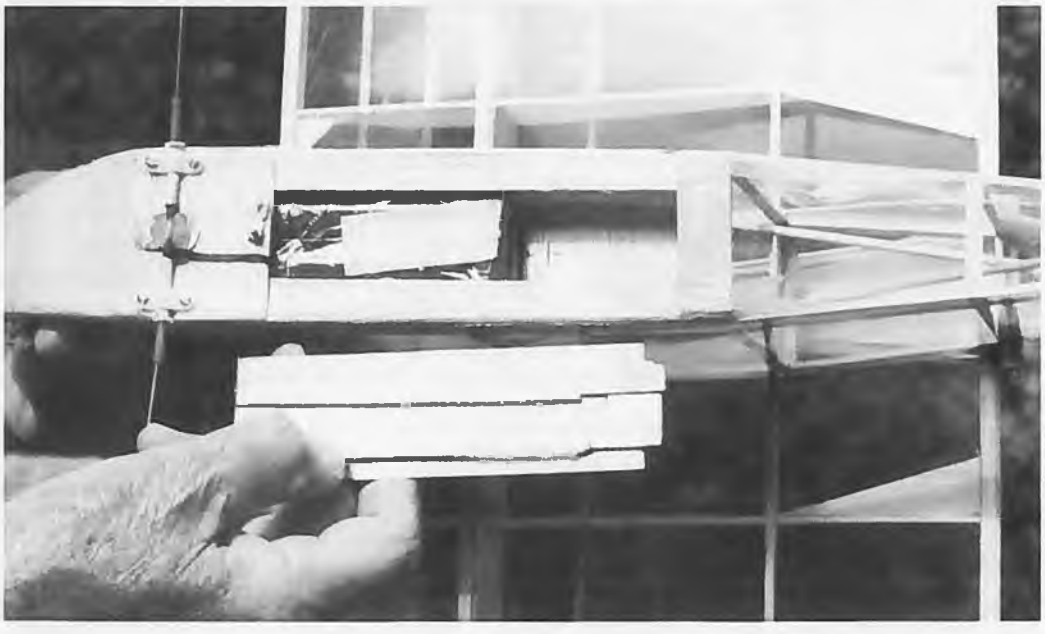
Go to e-flight meets and see what flies in the successful models. There are good units made in England and on the continent, but I am out of the loop over there these days. Forget car controllers, they are hyped up to appeal to kids one over video game level. Figure in growth - if you have it in you to become a real e-flight sports flier, you only have to see real electrics fly once and you'll be home soldering up those packs. Let's add "Do homework, spend money" to the e-flight commandments!

Scale modelling

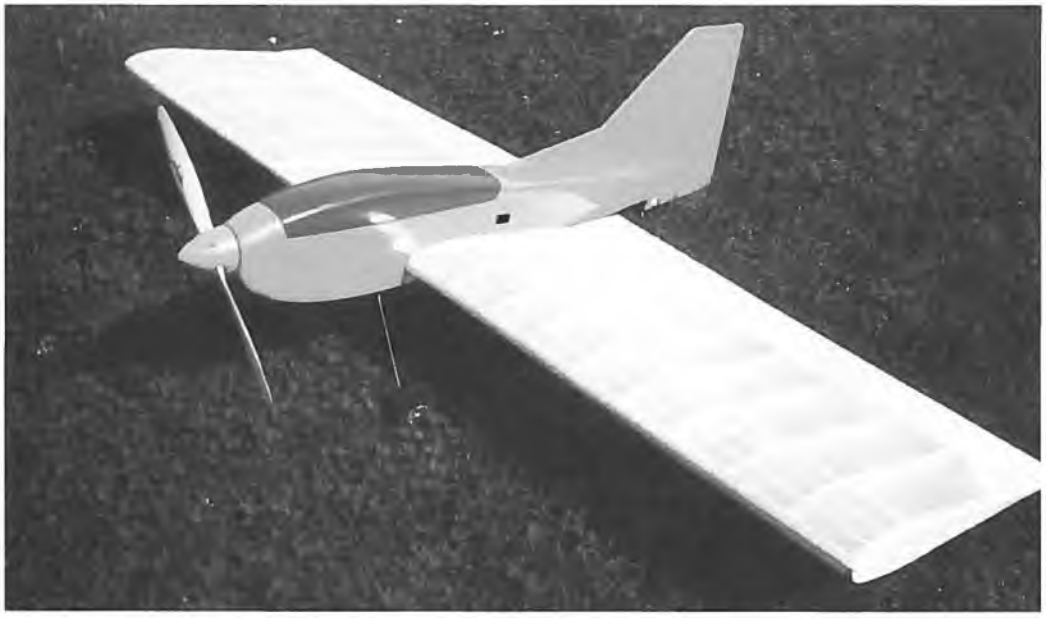
Not quite as practiced by young Martin down the corridor! How's about three quarters full size to twice life sized?

We'll start tame - with a mere three-quarter scale model from Oscar "Monk" Morris in Florida. "Monk" - a nickname acquired at University 50 years ago, perhaps it referred to his social life, like six footers are called "Shorty"? Enough of that, Monk took a break from modelling - 30 years - and now builds mostly from his own drawings. Now, he flies with a bunch of other retirees, on Tuesdays, Thursdays, Saturdays and Sundays - a hard life, he says.

Anyway, Monk flew a 48" Lazy Bee around for a while. However, it didn't fit well into his toy truck, one day the tail got broken and fell off - later, in flight! So he scaled down the Little Fat Fella to a 36" large scale model for Graupner's awesome S400. The details, for the "roll your own" lobby - Clancy is threatening Bee's at



◀ Bottoms up! Battery access to Monk's Megascale Bee hides a seven pack of 500ARs out of sight. By the look of it, battery is velcro'd to the model, and the hatch is velcro'd to the battery. Yes lawyers, we all know Velcro rates (tm). UC slopes down slightly from fuselage bottom, and has a brass plate soldered to the wire centre to prevent rotation.



▲ Carlo Ciarniello's "Wasp" tailless for geared Astro 15 and 12 cells - a potent 300 watts plus in a 70 ounce model. In the best traditions of "Over Here" (created approximately four months ago!), this won't thermal! Fast aerobatics is the aim of this definitely different shape. Once the timer says "land", practicality steps in - that whole red hatch comes off to allow a fast nicad change.

this size, and "OH" may well get on the design team. Hope we get them out before any more get 'reverse engineered'. Outside, it is a 75% long wing Bee. Up front is a S400 6V and Cox 6 x 3 feeding off 7 x 500ARs - Monk, an electronics engineer, made his own controller - while the nicad lurks in a box under the fuselage for easier access. A big Futaba Rx and huge S133 (?) servos waggle the back bits.

The woodwork is pretty much scale, with 3/32" wood replacing the original's vast amounts of 1/8" strip. There are ingenious touches everywhere - the main wheels are Dave Brown Lite wheels cut in half, the tailwheel is a rubber washer with a short piece of brass tube glued in for a bearing. Covering is clear Mylar; the control pushrods are kebab skewers.

All it takes to go "large scale" is a model you like at a size you don't - and good old ingenuity. The craze is inspired by indoor FF's favourite: the 16" span Bostonian. Now, here's a way to run a railroad. The spec includes an imaginary box that must fit under the wing - hence they tend to look like real aircraft. Before a comp, models are awarded a factor for "charisma" and this is applied to flight scores. Modellers have been known to photograph their "Bosty" in a diorama, even write histories of the "prototype". One very winning "Bosty" looks much like a flying boat!

▲ Who mentioned RC? Eric Leadley sent this shot of his cute "Lacey". At 16" span, with 3/4" diameter wheels, it would take determination - and the latest WesTek servos - to control this little fellow. Eric flies her free flight, for a change of pace from fast S400 sports, tri-motor thermal soarers and suchlike. Dihedral is non-scale, but not a lot of people know that.

Well, prolific small electric lover Ron Fikes - remember his so cool Lazy Bee - took a "Silver Shtick" Bosty, a rubber powered 16" Ugly Stik, and blew it up to twice size for rudder / elevator and S400. "Over Here" is awaiting a rush of these and might just have to do one personally. Over to you out there!

How long is -

An electric flight? This is a hot topic - the first thing glow fliers inevitably mention is short flight time for quiet models.

Do glow fliers ever time their flights? Do elephants? Researching this phenomena recently, I asked one such glow flier how long he thought my glow model had flown. "Around ten minutes". My timer said I'd landed at seven minutes and taxied in on fuel fumes! Perception is all - never mind the facts! One e-flier admits to replying "twelve minutes" when a glow flier asks how long his electrics fly. It doesn't really matter how long it is as he's the only one who really knows - and mostly he doesn't, as his model is so long legged that he seldom runs his batteries right down before he lands - just like the oilburners often do.

My fleet has been refined to where I know just when to head for the barn. "Pandora" is back in the circuit at six minutes for a couple of practice touch and goes - aerobatic ships are not fun when the electrons run out. "Wimpy" heads for home at ten minutes, but has logged twelve, while Sue's "Amptique" treats eighteen minutes as mundane and can do twenty if I want to show off - no crafty thermalling, I'll fly her in the weeds for that long!

Now, a timer is essential, especially as the performance rises. Getting caught short low, inverted and heading downwind is no fun. Next time you fly, wait until the urge to land strikes, then go up a touch higher and loaf around until the nicad suggests enough. Power down and head for the strip. You might just have a pleasant surprise on that timer when she rolls to a halt.

What's in a tail

Extra balsa and covering! Bilingual readers will know that yours truly is a sucker for a tailless, having done a fleet of oilburners - all based on a low AR wing with symmetrical section with a little reflex on the elevons. These are not for the faint hearted, though quite safe for the competent pilot. For US readers, they are not to be confused with Bill Winters' "Simitar's "which are stall and spin proof - mine spin and snap very, very fast!

Now here's the first of the genre for electrics - from an Italian in Canada (This column's definition of "International" is not a postcard from Benidorm on the office wall). Carlo Ciarniello is up in British Columbia and sells neat plans - the Wasp tailless being one.

While "Wasp" looks different, it oozes practicality. The canopy is a hatch for battery changing and access to the motor and controller for service. If you insist on crashing, the Rx and servos are in the back, where black boxes traditionally fare well. Servos are mounted on the outside for ease of maintenance. Very important - it has a huge rudder for snaps, spins and the awesome stall turns that only tailless, with their low inertia, can manage.

There is a deal cooking with Elliott Boulous at the "Institute of Silent Flight" to kit this 12 cell hotrod. The other numbers are a 48" span and 600 square inches of area with a weight around 70 oz - if you run at 25 amps, that is around 85 watts per pound and that spells performance! For now, the plan is available from Carlo at: C-35 Centennial Drive, RR #1,

▲ **Mike Harvey and his neat little "Praga" 44" span, red finish is "Litespan" - can't beat it for these little fellows. Model flies on a 7.2V S400 and MFA's venerable Mini Olympus - a great little gearbox that's been around since the dawn of time, and the price is hard to beat.**

▲ **Mike Harvey's home brewed S400 controller - used to be the PC board from a servo. A power handling FET where the motor used to be, and a different pot - this one will handle about 7 amps and weighs but 3/4 oz. Enough speed variation for practical usage and the price is pretty good, especially if someone else tosses out the servo.**

Powell River, BC, Canada V8A-4Z2. The Wasp plan costs $15.00 in US dollars, $20.00 in Canadian dittos as a money order - no plastic, no "local" cheques please!

Out of the seven cell trap (tm) ...with ingenuity, not a cheque book! Off to Australia for a visit with Mike Harvey and some bush flying for real - he lives "some miles" north of Perth in Western Australia where it apparently gets hot in summer - really hot!

Mike's model is unique for starters - this 44" span Praga is his own design, of a Czech high wing type if I guess right. Up front is a S400 7.2V - good for a slower model - and the venerable MFA Mini Olympus gearbox with an 8 x 6 prop. To get the revs up, Mike uses 8 cells - and this is where it stops being ordinary. As this is a low current model - I'll guess at flying on around 4A - Mike uses eight 270 mA cells!

These have a centre tap so he charges them as two four packs. Heresy, can't do it, no a good idea - been there, heard that. Well, what Mike does is to fly, let the battery cool and then charge one set of four for 10 minutes at 1.5A, then the other at ditto. I suppose you could also slow charge them as eight off a Tx charger for seven hours.

Our Mike is obviously of the ingenious bent - his speed controller is an old servo amp, a power FET where the motor was and a multi turn pot replaces the servo pot. This handles around seven amps - well within what a geared S400 7.2V pulls - and a little motor speed variation. He didn't include any details of his 'controller' but if you can do it, you can probably figure out the details. Your chicken columnist will stick to buying speed controllers and bow to skills such as Mike's!

As Mike reckons that battery cooling is a problem in his area, as it is during summertime here, I think it is time to photograph the Woodward battery cooler - built at stunning expense - and get that out in the world.

Positive feedback

So far, e-sports fliers are liking "Over Here" and e-mailing or writing to say so. One much bandied question involves that necessary evil, the humble plug. Yours truly runs the entire fleet on Astro's "Zero Loss" connectors, from S400 to the MaxCim brushless. But there is a demand for a decently priced and sized ("Cheap" and "Small " crop up lots!) plug for smaller S400 models.

A furious search of my files (so that's what he calls that heap - Sue) failed to divulge the name of the modeller who used to sell a good, small S400 plug and socket in England. While the Astro unit works well enough for S600 and larger sports models, we need ideas for the smaller models, especially the S400 - as an aside, watch this space for the latest 'cult' model from the USA for these little hummers.

Final hot stuff - for those in the UK who want to find out what all the e-flight jargon means, try this new slender volume from "Graham McAllister Designs" at Silent Aviation Works, 60 School Rd, Wales Village, nr. Sheffield S26 5QJ. The title is a pointed statement "A Basic Guide to Successful Electric Flight", cost is £3.50, or an IMO from the US for $8.00 would about cover the postage to across the pond. It certainly lives up to its title. A sawn off version will be in GMD's new electric sports kits, details of which should be out soon.

As always, while it is fun to chat on e-mail, your photos are what's really needed. Hard copy to 11159 Captains Walk Court, North Potomac MD 20878 USA or Traplet Towers. **EFI**

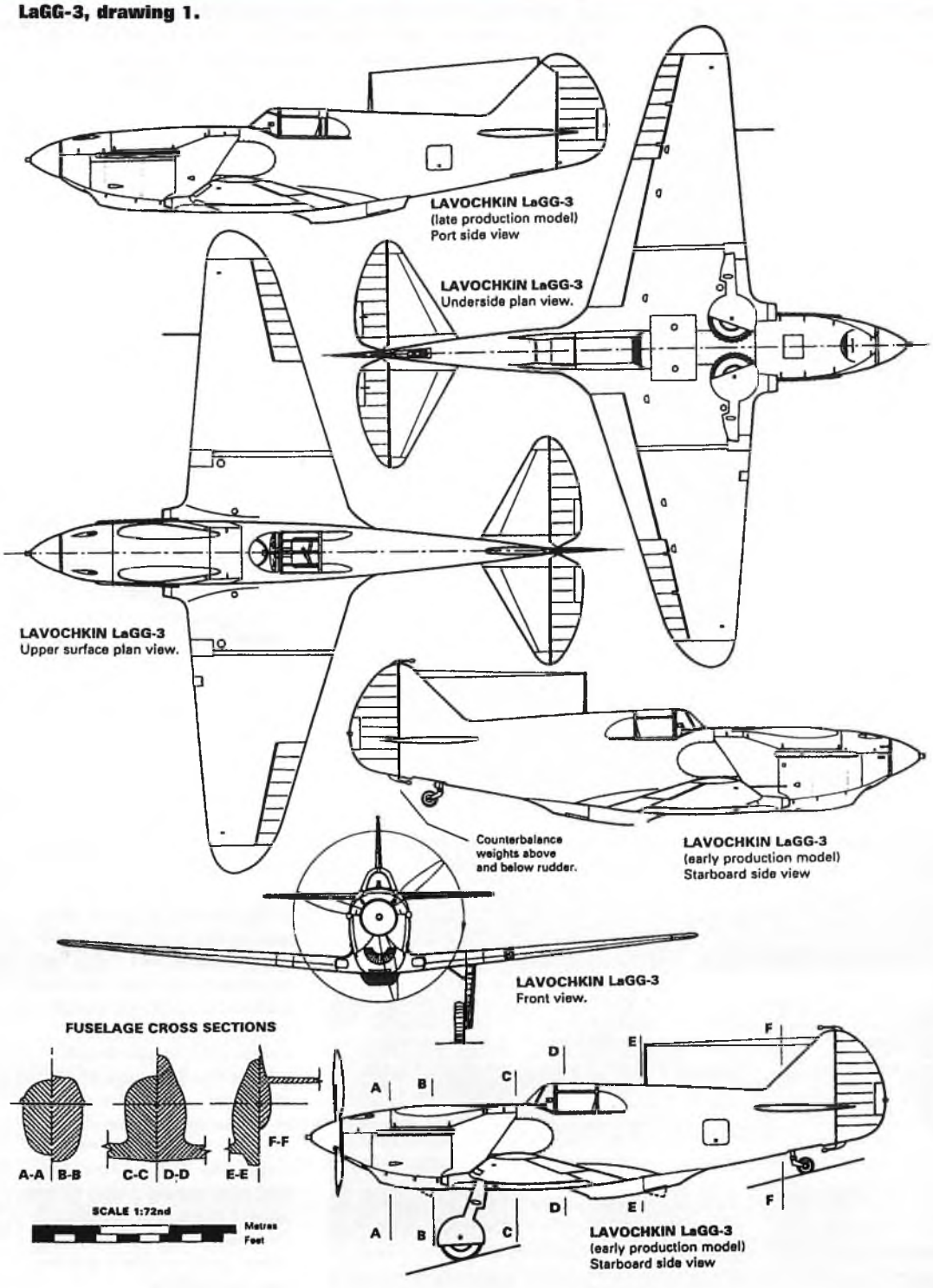
◀ **The march of time! That monstrous black box is an early controller - eight cells maximum and low currents with a direct drive Speed 600, it towers over the Castle Creations "Griffin 50" in the fuselage of my "Wimpy" - 16 cells and 50A if you insist. On the right is my new toy, CC's Sprite XLR - rated to 25A on 12 cells, BEC and barely a blip in the wires! These are Castle Creation's normal sized units - they make a small one for S400's!**

Quiet Scale

MARTIN IRVINE

How do YOU find accurate scale drawings? Martin explains some ways. He also tells you how he sorted out other scale problems and how he makes some scale decisions.

LaGG-3, drawing 1.



3-View Trouble

I like models of more unusual aircraft and so finding 3 views and information can sometimes be a challenge. Often, I consider myself lucky if I find a set that "look right" and have sufficient detail for a stand off scale model.

Recently I got interested in an uncommon subject and found that I had a couple of plans that "looked right". So, with ruler and calculator in hand I settled down with a cup of coffee in a comfy chair and started designing. It didn't take long before I started seeing problems with the drawings.

The drawings are of a LaGG 3, an early WWII Soviet fighter. Both sets are from sources I would normally think of as providing accurate drawings but as you can see, they disagree dramatically. The over lapping drawings show how the length and spans agree but not much else does! Note also that while the centre lines coincide, the wing platforms are skewed in relation to each other. Which is correct, or is one wing accurate and the other not?

A quick look at the front views (not overlapped) shows two completely different aircraft.

The easy solution is to just choose one drawing, build a model and then use the drawing for documentation. Even if a judge knows the drawing is wildly inaccurate, he is obliged to accept it as accurate. (I know that sounds screwy but it is the way things are, and all the alternatives are worse!)

The better solution to this problem is two part. First, look for more drawings and see if you can get some agreement among them. The second is to look at photos and redraw things more accurately. This is

Fokker Universal.

Cessna UC78.

going to cause problems if you want to compete in contests unless you first have the new drawings authenticated. I would suggest you contact your national scale representative about how to do this. Usually it involves sending your new drawings and copies of all your supporting documentation to that scale representative who then goes over it all and signs it off as accurate. This is a pain but just think, YOUR drawing could be the standard for that airplane. It could even be used by other modellers for their documentation (until someone finds problems with it and has to draw their own plans!)

Landing Gear versus Retracts

During a conversation with Robert Pike at a recent funfly, we discussed fixed gear vs retracts. He was flying a Cloud Dancer (an 18 cell sport plane)


▶ Problems with spinners is not always a problem with the spinner.

with a set of mechanical retracts and I asked about weights. It turns out that he carefully weighed the trunnion blocks and wire of the conventional fixed gear model and compared them to the HobbiCo mechanical retracts and their mounting plates. It turns out that the only additional weight was the retract servo, an FMA servo weighing less than 1.5 oz. My experience has been with pneumatics which, while very reliable and powerful, add 4 to 6 ounces (110 to 170g) with their heavier mechanics, tank, hoses, valves and actuating servo.

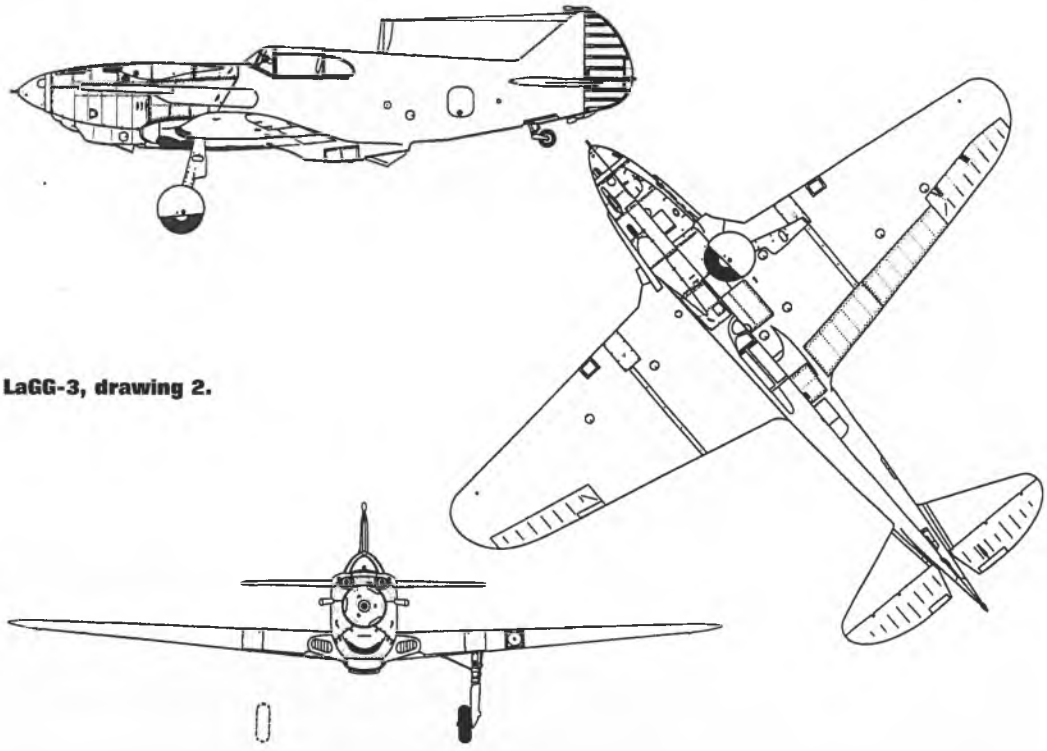
I think that for the smaller models, say under 6 lb (2.7kg), mechanicals are well worth considering. The only possible problem with these is that if a bent gear wire could cause the gear to bind and stall the servo, draining the flight pack. A separate battery pack avoids this but adds a lot of weight. Another solution would be a servo that shuts of if stalled for more than a second or two. If there isn't such a servo there should be! I'm sure there is as I would guess the circuitry wouldn't be difficult.

Spinner woes

One photo shows an assortment of spinners in front of an orange and black Midget Mustang, a home built pylon racer. This started with an Ultra 1200 direct drive motor. I installed the 3" Goldberg spinner on the far left but had a lot of vibration problems despite careful balancing of both the prop and spinner. Thinking that a more expensive metal backed spinner would help, I tried the CB spinner on the plane. Again, vibration set in at about 1/3 throttle. The red spinner~ (by this point I had given up painting before trying new spinners!) i8s a Thunder Tiger unit that also vibrated.

Finally I got an expensive turned spinner from TruTurn figuring that by going with the best, the problem would be solved. Much to my frustration, it still vibrated!

At this point, I figured that the problem was a combination of the large spinner and the 5mm shaft being just too thin for the load of the prop and spinner. (I had also tried two other 5mm shaft motors but without luck.) Out comes the Ultra and it is substituted with a geared Astro 15 with a 1/4" shaft. End of problem? @#$~^%! NO!'



LaGG-3, drawing 2.

At this point the light bulb finally comes on (albeit dimly). The problem is not the spinners) nor the output shaft but the solidity of the motor mount. It is 1/8" plywood and is allowing just enough flex to allow "whip" to start. The solution is a more robust motor mounting plate and probably a rear support for the motor. This is a good reason for the tube mounting system - support.

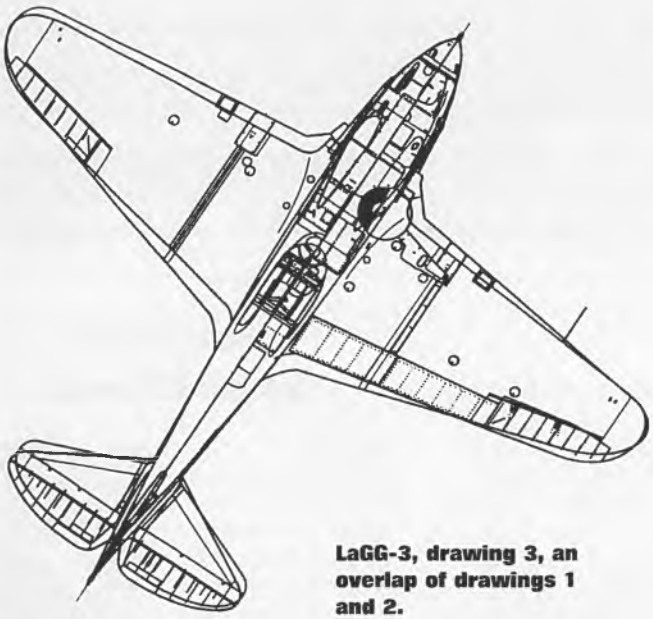
Models

The big yellow twin is a Cessna UC78, a WWII training aircraft, usually known as a "Bamboo Bomber" or "Bug Smasher". This was built from very old RCM plans by Andre Wedseltoft. Wingspan is 70" (1778mm), area is 700 sq.in (45 sq.dm) and weight is 8 lb (3.6kg). It uses a pair of geared Astro 05s on 16 x 1700SCRCs, spinning 11 x 7 APC props drawing 27 amps. It uses mechanical retracts and is covered with Solartex.

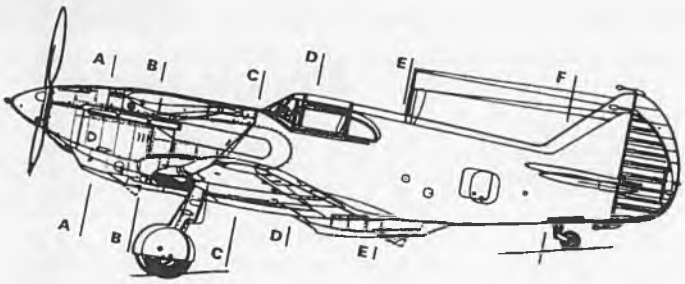
On take off, I heard some sort of vibration, (hmmm! I know someone else with that problem) but it stopped as soon as he pulled the throttle back a bit. The plane itself seems to work very well and looks a solid flier.

On landing, I went over and talked to Andre about vibration and he had come to the same conclusion I had (with no spinners, he probably got there faster than I). The model needs the rear of the motors supported.

Marc Thomson built this



LaGG-3, drawing 3, an overlap of drawings 1 and 2.



Speed 400 Horten Vc from the plans in the May/June 1996 issue of EFI. He did his test flights on a slope without the canopy. Then when he added the canopy, he had to test fly all over again. He is very happy with the way it flies. I commented on the fact that props further back from the trailing edge would be quieter as the slicing effect of the props at the TE is very noisy. He grinned and said THAT was why the props WERE as close as they are - for the noise!

The photo of a Fokker Universal is one built by Jack Humphries, co-owner of A & J Hobbies and a supplier - of course - of electrics. The original was used for inter city cargo and passenger travelling in the early days of Canadian aviation. Jack's model is powered by an Astro 40 on 18 cells. I didn't get the details before he had to leave, but it is quite lightly built and has about a 6' (1.8m) span.

Fury update

Not a lot to update on the Fury this month I'm afraid. Several things (some work and some modelling) have conspired to slow down progress but I have started covering and am aiming to have it done for the Kingston funfly at the end of June.

I have swapped motors for the Fury. Originally I had intended to use the Aveox 1412/2Y geared 3.69:1 but had second thoughts about that, as the Aveox speed controllers I have are the older analogue versions which are less efficient at partial throttle than the newer digital ones. Given the prospect of buying such a controller (and thinking ahead to a ducted fan project for which the 1412 might be perfect) I chose to get a MaxCim MaxNEO 13Y brushless motor and controller with the same 3.69:1 gearbox as on the Aveox. (A sensible person would take advantage of the $80.00 trade-in offer from Aveox, but a sensible person wouldn't be in this hobby!)

The MaxCim controller has impressed me for years with its smooth midrange, and if I had any doubts (I didn't) - watching Keith Shaw's Messerschmitt 35 with the same system would have put those to rest. Gordon Whitehead has also used this in the Duncan Hutson SE5a (reviewed in the July 1998 issue of EFI) and is managing nearly 10 minutes on 2000SCRCs. Given the drag of a fully rigged biplane and Gordon's love of aerobatics, this is all the more impressive.

What Giant Scale really means

I got a letter from Jerry Smartt who is building a rather large Sopwith Tabloid. For anyone who thinks that larger models don't take much longer, read this and reconsider!

"A normal task for a two-metre plane becomes enormous and very involved in giant scale models. As an example, I will move step by step through the application of just one capstrip. Keep in mind that this must be repeated fifty times on my 52% (!) Sopwith Tabloid. I will only cap the top surface to save weight.

"My workbench is eight feet by forty inches. The wing chord is 32.5 inches. First, I lay the cap on the rib and tape it at the TE. I then walk around the bench and measure the length, remove the strip and cut it. Once again I walk around the bench and retape the cap at the TE. I return to the LE around the bench and make certain that the length is correct. Now I return to the TE side of the bench and the cap is tacked with CA. In order to ensure that this 31 inch cap is snug to the top of the rib I begin securing it to the top of the rib with masking tape. There are many lightening holes in each rib. Beginning at the TE, I take a piece of tape and tape the capstrip to the rib by pressing the tape through one of the lightening holes. I repeat this four times every four inches until I must move around the bench and secure the cap at the LE with CA. By this time I have been around the bench a half dozen times or more and the rib isn't finished.

"All of the ribs must be done this way first and then I can remove the wing panel from the bench. Once the panel is turned over, I then can begin completing the attaching of the caps to the ribs with thin CA. Finally I can remove the masking tape ties and experience a huge relief. Now, I have only three more wing panels to do exactly the same."

At least Jerry's wife can't complain that he doesn't get enough exercise!

Martin Irvine, 1331 Rockwood Drive, Kingston, Ontario, Canada, K7P 2M8.
E-mail: mirvine@kos.net or: mirvine@limestone.kosone.com

EFI

▶ Horten Vc, built from EFI plan MW 2529.

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Scale Plans

MW2328
AVRO LANCASTER
Designed by Peter Angus. This 50" span 'Baby Lanc' is designed for one .09
2 stroke engine and 3 function radio with a target weight of 37 ozs.
Plan Price Code: K

MW2360
SPIRIT OF ST LOUIS
Designed by Brian Rice. This award winning design was built to 92.5" span for .90-1.20 4 strokes and 4/5 function radio.
Plan Price code: Q

MW2475
MINI-MIRAGE 2000B
Designed by Phillip Noel specifically for rough field sport, this little model will keep the adrenaline bubbling for hours at a time!
Wingspan 29", .25 fan engine 3 function radio
Plan Price code: J
MW2518
MIRAGE 2000B .46
Designed by Phillip Noel. A conversion is available for this fine plan.
Plan Price Code:R
Canopy Price code:E
MW2135
EXTRA 230
One of 1987's most dramatic display aircraft is reproduced by Roy Garner. This 60in. span model for four function radio suits .45 two strokes or .60-.90 four strokes.
Canopy Price Code:D,
Plan Price code:L
MW2381
EXTRA 300
Designed by Roy Garner this is not a beginners model. With 72" wingspan and 20-30 cc engine.
Plan Price Code:R,
Canopy Price Code:P
MW2154
F4U CORSAIR
An outstanding sport/scale warbird with a 48in. span designed by Pavel Bosak four function radio and .40 two stokes,
Canopy Price Code; D,
Plan Price code:I

MW2110
JU87B STUKA
Strong manoeuvrable and devastatingly accurate, the infamous Stuka with its evil-looking shape symbolised Hitler's Luftwaffe. Fitting a bomb release mechanism to this model is all that's necessary to complete reproduce this spinechiller.
Plan Price Guide:P
MW1258
P38 LOCKHEED LIGHTNING
By Gordon Whitehead. This 52in. wingspan twin engine model is designed for two .15-.25cu. in. two strokes. It flies as well as it looks.
Plan Price Code:M
MW2126
F15 EAGLE
Packed with character, the mighty Eagle is modelled by Pavel Bosak as a near-scale model fitted with retracts for a clean looking model in flight
Plan Price Code:L
MW2296
MIG 15
Designed by Paval Bosak. Ducted fan model displayed at many international shows and competitions. with 60in wingspan.
Plan Price Code: M
MW2120
CESSNA SKYHAWK
A classic modern light aircraft, the skyhawk is in use worldwide as a private flying aircraft and civil flying school machine.
Plan Price Code:P

Sport Designs

MW2615
JIANT JABBERWOCK
Enlarged one and a half times from the original drawing and designed for the Tartan 22cc engine many have been powered by ST 2000-3000 size engines. Virtually unstallable, however slowly its flown, this version weighs about 6.5kgs. Cowl and spats available separately.
Plan Price Code:Z+A
MW2622
HOT CANARY
Small, fast and smooth, this stand-off scale racer is not for the faint hearted but its simple construction wont pose any problems for the average builder.
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MW2364
CLOUDHOPPER
This microlight configured model will turn heads in every club with quite startling flight characteristics and easy construction.
Plan Price Code:Q

Sport and Scale Gliders

MW2576
ES60 BOOMERANG
This Quarter scale sailplane is a complex design for experienced builders and features a fully built up structure and an all moving tailplane.
Price Plan Code:Z

Electric Scale plans

MW2636
F-117 NIGHTHAWK
Designed for speed 400 motor and 7/8 cell. Built up construction. Requires 2 servos, aileron and elevator and motor speed control.
Plan Price Code:E
MW2590
Dh 108 PROFILE SWALLOW
Designed by Chris Golds flying wing model of an early jet can be built in a day. Wingspan 45in. with two function radio.
Plan Price Code:F

MW2575
HENSCHEL 132
Semi scale, Ducted fan, 1.2 Metre (47") Aileron / elevator / motor control for Morley Jet-Elec fan unit or equivalent.
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MW2529
HORTON FLYING WING
Designed by Rob Bulk. WWII fighter that did not enter service
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MW2671
JET TRAINER
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HITEC computer Tx's, Prism 7, £55. Flash 5, £50. Also new Focus 4, £40. All with nicads and in perfect working order. 0181 695 5770 eve/weekends (Bromley).

BIG clearout, making room for other projects, airframes, kits, engines, electrics, plans. For list 01388 819638.

CALYPSO Contest, 3 metre t-tail moulded glider, four JR3321 wing servos, 3311/3111 rudder/elevator servos (metal geared), 148DP receiver, 1400mah nicad, padded, carrying bags, vgc, £775, will pay postage. Alastair 0131 663 1574.

PHOENIX Camba, £35. Phoenix Vagabond, £25. Precedent Electra Fly 660 motor, £50. Hitec Flash 4 with spare receiver and four servos, £100 buyer collects, cash only. 01492 534795.

LATHE for sale, Myford ML7, most accessories, materials, hand tools, bench drill press, due to ill health, also De Winton steam loco, 5" gauge, 60% finished. 01234 743175 Beds.

Steve Greenfield of Horsham, West Sussex, sold 4 kits and 2 motors through EFI

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Suppliers of motors and accessories for small electric models.
Please send SAE for list to:
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MORLEY F1 carbon for sale, Futaba control, still in package, unwanted birthday gift, full kit for £250. Ask for Karran 0181 554 6628.

1400SCR Sanyo ex-equip, 10 cell batteries, £10. 2 volt Cyclone cells, 2.5ah pack of 6, £10. MFA mechanical timer charger, £9. Aeronaut Aerofly electric pusher, immaculate, c/w motor, £65. 01823 421751.

HITEC Prism 7 X 3 model memory including nicad, charger and crystal, 12 months old, £65. 01203 679831.

ROBBE Gnat, WeMoTec, 480BB race, 8 cell nicad, elevon conversion, only 5 flights as new, can be seen at West London Models, £75, just needs radio. Gregg 0181 909 3343.

T.TWO 72" glider, 2 channel including 35mhz, AM, Rx, Tx charger, nicads, etc., good flyer, also 2 Fox 19 engines, also 35FM Rx, 2 servos Futaba, other bits and pieces, £100 the lot or swap for scanner, Sony, Yupiteru, 500kmz to 950kmz. 01493 700162 ask for Dave.

SPITFIRE Futaba RC, nicads, s/control, etc., all few months old, RTF, £195 ono. Kalt Whisper heliset, mini gyro nicads, charger, completely RTF, £195 ono. Lancaster 4 electric motors, F/F, RTF, £95 ono. 01784 459585.

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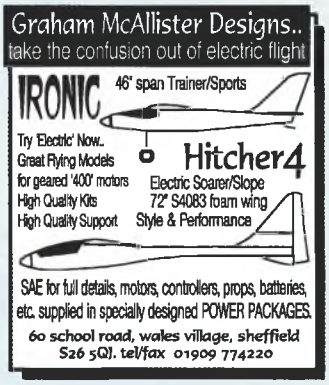
FLEET XP/FM PCM radio, boxed with 4 servos, immaculate, £100. Two PCM Rx, £25 each or make me an offer. 01889 505576 or 0468 354737.



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GRAUPNER JR MC16/20 transmitter with 1700mah battery and carry case, excellent condition, £220 ono. 01895 251551 Middx.

FUTABA Sky Sport hand held RC, no charger, also Futaba Ripmax hand held RC, no charger, no reasonable offer refused. 01777 708858 or 07970 948350.

WANTED

SELLING up, a friends electric goodies, planes, motors, gearboxes, batteries, chargers, more details. Mike Holmes 01922 475998 West Mids.

WANTED locally, very cheap RC aircraft/heli for beginner, electric or engine, with radio and ready to fly. 01823 491271 Someret, England.

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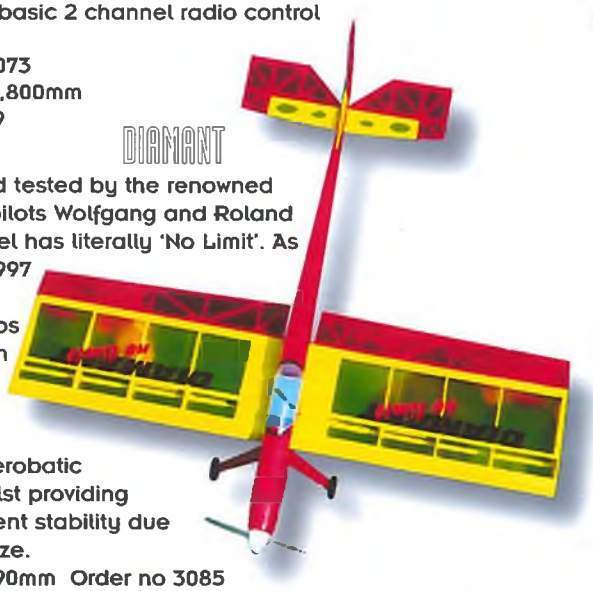

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