PLAN FEATURE

Tony Nijhuis

> "To build a model and have it flying before the full-size leaves the ground... now there's a challenge..."

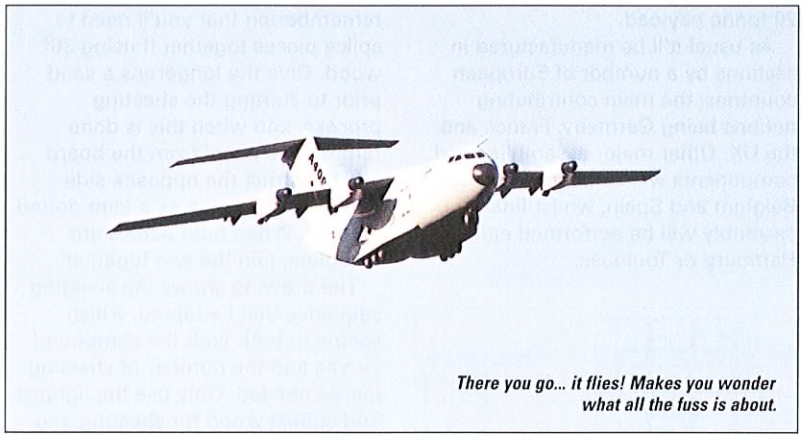
Airbus 400M

TOP DESIGNER TONY NIJHUIS ACCEPTS YET ANOTHER MULTI-ENGINE CHALLENGE

Now here's a question for you - when is a scale model not a scale model? When the full-size aeroplane hasn't been built yet! Confused? Then let me explain. About a year ago I had a 'phone call from avid scale modeller Mark Burns asking whether or not I would be interested in a commission to design and build a particular scale model. Nothing unusual there, as I get quite a few calls from modellers asking whether I could design their particular favourite as a free plan or plan feature for *RCM&E*. In fact, I have quite a long list of subjects, probably enough to keep me designing until the eyesight goes and senility sets in! Although there's no particular order to the list, when something interesting comes along it tends to rise to the top of the pecking order.

In typical Nijhuis fashion, Tony had the A400 knocked up in less time than it would take most of us to assemble a complicated ARTF. Makes you sick doesn't it?

Since the real one hasn't been painted yet, let alone assembled, the colour scheme is a little open to interpretation. Looks the part though.



There you go... it flies! Makes you wonder what all the fuss is about.

Anyway, during our discussion, Mark gave me chapter and verse on the particular aircraft in question: the Airbus A400M. I had to admit I'd not even heard of the A400M, so Mark explained that the aircraft was a cross between a C17 Globemaster and a Hercules. The subject sounded interesting but didn't quite send me hankering for the balsa wood and glue, until he mentioned two things that swung it for me. Firstly, he had accumulated a lot of pictures and drawings by trolling various public domain websites and had managed to turn this information into a simple CAD drawing; this would help me enormously with the design of the model. Secondly, he mentioned that the prototype full-size aeroplane hadn't even flown yet and isn't due to until late 2006, early 2007... This was the clincher. To build a model and have it flying before the full-size leaves the ground... now there's a challenge, and one I just couldn't resist.

Mark kindly sent all the information he had so that I could start the design process, with a view to drawing up an electric version. In the meantime, our man, who also has contacts at the PR department within Airbus Industries, let them know that a model of the A400M was being built and asked whether they had any objections. Since the full-size was generally still under wraps it always pays to be a bit cautious. However, after a month or so I got the nod from Mark that Airbus didn't have a problem with a model being produced, though I believe they were jokingly keen to know how it might fly, and equally concerned that it might not! Mark's typically optimistic answer was: "of course it'll fly"... Hmm, no pressure there then!

'BUS BACKGROUND

Given the huge success of the Airbus European Consortium over the last two decades it was only a matter of time before Airbus would challenged the military stranglehold that US manufacturers have on the aviation world with aeroplanes such as the C-130 Hercules, C-17, C-5a and C-141.

The A400M is destined to be technologically superior to the

A collection of humble direct drive Speed 600 motors provide the urge... but is it enough? Tune in next month and find out.

Tony Nijhuis

Lovers of utility aircraft will find the A400 difficult to resist. After all, she has many of the qualities associated with the 'greats' of the military transport world.

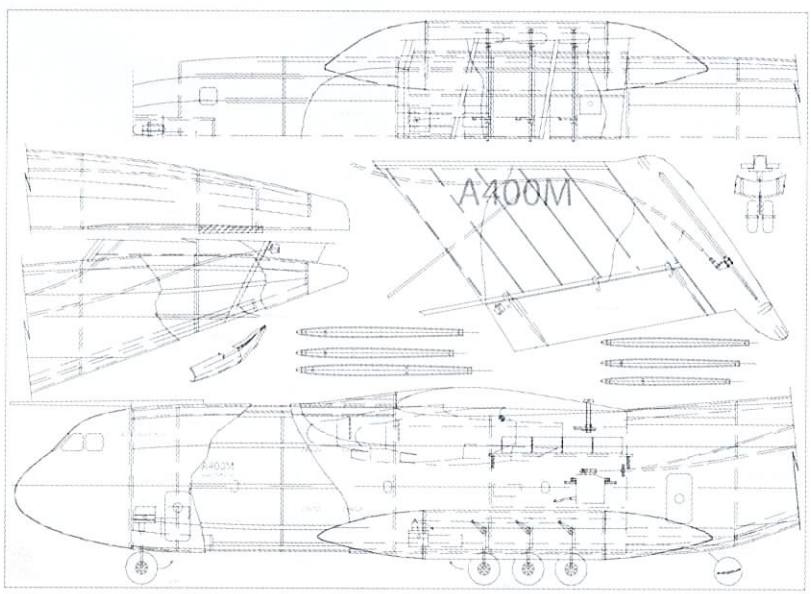
Hercules by having a predominantly composite construction, state of the art avionics, enhanced cargo handling systems, a superior power plant, advanced propeller technology, and performance criteria close to that of a turbofan-powered aircraft. The internal design of the A400 has been maximised to permit payloads such as air-to-air refuelling tanks, attack helicopters, armoured combat vehicles, 116 troops, 66 stretchers plus 25 medical staff for medical evacuation, food, civil excavators and dump trucks. Payloads can be either palletised or stored in containers, and personnel can be sat in four rows of seats running along the length of the fuselage.

The distinctive but somehow familiar nose profile of the new Airbus workhorse.

The load management system of the aircraft is designed so that it can be loaded and unloaded by a single load master without the use of any special ground equipment. When required, a specialist crane (with a 5 tonne lift capability) can be installed over the tailgate. The operational range of the aeroplane is 2600km at 30 tonne payload and 3750km with a 20 tonne payload.

As usual it'll be manufactured in sections by a number of European countries; the main contributing nations being Germany, France and the UK. Other major assemblies and components will be produced in Italy, Belgium and Spain, whilst final assembly will be performed either in Hamburg or Toulouse.

Plans comprising three sheets are available from the RCM&E Customer Service department - see Order List for pricing details.



CONSTRUCTION

Let's get on with building the model. Construction is very conventional, and almost identical to the approach I used when building my twin electric DC-3 (*RCM&E* plan feature November 2003). Since the fuselage is the trickiest part of the build it's worth getting it out of the way.

Start by pinning and gluing the top and bottom spines over the plan, then fit all the half fuselage formers (including the wing seat) into position. The 1/4" (6mm) square longerons should be added next remembering that you'll need to splice pieces together if using 36" wood. Give the longerons a sand prior to starting the sheeting process, and when this is done remove the panel from the board and construct the opposite side (shown on the plan as a faint dotted outline). When both panels are complete, join the two together.

The drawing shows the sheeting sequence that I adopted, which seems to both limit the compound curves and the number of sheeting pieces needed. Only use the lightest and softest wood for sheeting and make sure you select the same grade of wood throughout, for both sides. Sheet the top and bottom surfaces first, as this will give the fuselage structure some much needed rigidity. Continue to sheet the fuselage, applying wetted balsa to areas requiring compound curves. When sheeting the top surface against F5, follow the fuselage line. The leading edge fairing is added later. The fuselage top and bottom corner edges, between F7 and F8, are made from block balsa, to which the sheeting is butt joined; this makes lighter work of the rather nasty compound curves in these areas. At this point don't sheet between the three main undercarriage supports bars as these will now need to be cut out and the wire undercarriage legs attached.

The plan outlines the retract design that was adopted on my prototype, though it's interesting to note that the full-size will have 12 main wheels (6 pairs), and a single steerable pair at the front. Anyway,

Order list

Item	Code	Price
Plan	RC2027	£15.75 plus £2.15 UK p&p (£3.50 overseas)
Mouldings	COWRC2027	£29.50 including UK p&p £34.50 overseas, inc. p&p
CNC parts	CNCRC2027	£55.00 plus £5.00 UK p&p (£10.00 overseas)
A400 plan pack inc. all of the above	SETRC2027	£95.00 plus £5.00 UK p&p (£10.00 overseas)

To place an order telephone *RCM&E* Customer Services on 01689 886660

to make things easier for the main undercarriage I used single wheels rather than pairs. Fabricating the mechanism for retracting the main wheels is quite complicated if you're not an experienced builder, though there's no need for specialist tools or machinery in its construction. If the thought of making retracts leaves you cold, then fixing the undercarriage in position (mains and nose leg) using proprietary saddle clamps is a simple operation. In the down position the wheels are hardly noticeable in flight, so even the scale purists shouldn't be too offended.

sheeting and make sure there's enough cable overhang from the top and bottom of the fin to reach the servos and elevator horn. The top section, where the tailplane slots through, is made from solid 12mm balsa; cut this out and form two curved channels to take the control cable. When happy, glue this to the top of the fin and shape to the profile shown on the plan.

The rudder is made from 9mm ($^3/_8$") balsa, the tailplane and elevators from 6mm ($^1/_4$") medium soft balsa; profile these as per the plan using a razor plane. Mark out

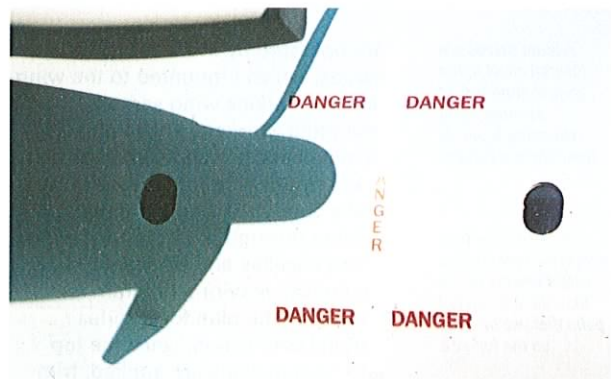
With the undercarriage and support bars positioned, the final infill sheeting can be completed. Take your time and sand the fuselage to a smooth finish, taking off any high spots with sandpaper and filling low spots with lightweight filler. Leave the frontal area in a rough-sanded state until the vacuum formed nose cone (see Order List) has been fitted.

TAIL AND FIN

The fin is a built-up rib / sheeted affair that provides a route for the dual elevator control cable. Cut out the ribs, l.e. and t.e. and build the fin over the plan. Remember to insert the control cable outers prior to the where the fin t.e. and longerons are positioned on the fuselage and remove a section of balsa to the width of the fin, to reveal the top 'keel'. A small section of this keel needs to be removed to allow the fin t.e. to pass through. Now test fit the fin into the fuselage and make any adjustments necessary. Don't glue the fin in position at this point as it will just get in the way.

MAINPLANE

The wings are built-up, fully sheeted over ribs and constructed in two sections. Pin the lower front spar to the plan and then glue the ribs into position, remembering to angle the root ribs W1 (note that the wing has anhedral). Now fit the upper front and rear spars along with the inner leading edge. When the glue is dry the wing panel can carefully be removed from the building board. Fit the remaining lower rear spar and trailing edge where the aileron abuts. Using 1.5mm ($^1/_{16}$") balsa, add the webs between the leading top and bottom spars. Take a sanding block and carefully smooth the inner l.e. flush with the wing ribs and flatten



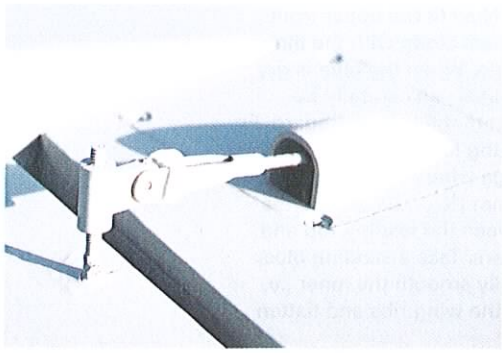
any high spots resulting from the fitting of the spars. When nice and smooth, skin the top surface to give the wing panel a little more rigidity (don't skin the bottom yet). My favoured way of cladding a wing is to lay sheets of 3 or 4" wide balsa side-by-side, trimming the assembled wood to the approximate shape of the wing before gluing together on a flat surface to make a single skin. When dry the skin is sanded to remove any irregularities prior to gluing over the ribs.

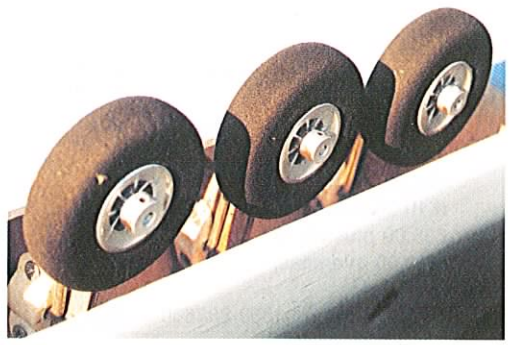
If all those compound curves look a little daunting, you needn't worry - a vacuum formed accessory pack is available and includes the cockpit / nose cone, wheel sponsons and spinners.

Fit all the servos and power wiring to the nacelle positions. The ailerons

You may notice a small amount of flex at the tip of the fin which will be exaggerated with the tailplane fitted. However, you needn't worry, the prototype has proved its strength.

Tony Nijhuis





Aileron servos are located close to the control surface and secured using mounting brackets from Messrs Perkins.

For simplicity Tony adopted a row of three single wheels rather than the anticipated pairs that will be used on the full-size.

are operated by individual micro servos, which I mounted to the wing using J. Perkins wing servo mounting brackets. These are easy to install and are shown on the plan.

When skinning the underside, make sure you bring the power cabling through the bottom sheeting at the nacelles and adjacent to W1. An indicative wiring diagram is shown on the plan for a series / parallel connection. Once the top and bottom skins are applied, trim all the edges flush and sand to shape. The outer l.e. can now be fitted and shaped to the correct profile, followed by the 12mm ($^1/_2$") sheet balsa wing tips. These are subsequently razor planed to the wing profile in order to produce a smooth, flowing curve.

Next, make up the ailerons. This is carried out by cutting the bottom sheet to size, then trimming and fitting the aileron l.e. to sit at the angle shown on the plan. This angle can be checked by test fitting one of the aileron ribs. Now mark out and fit the ribs to the bottom sheet. When complete, trim the top edge of the aileron l.e. flush with the ribs. Enclose the structure with the top sheeting and then trim to the finished shape.

To secure the wings to the fuselage, drill the two holes for the wing dowels into former F5 and then offer the wing into position. Using a marker pen, locate the dowel hole positions on the wing l.e., remove the wing, drill the holes in the locations marked, and fit the dowels. If not already done, add the wing nut retaining plate to the fuselage. Now offer the wing back to the fuselage and drill through both the wing and the plate in the position indicated on the plan. Fit the captive nuts and check that the wing can be properly secured. With the mainplane in place we can now fabricate the upper fuselage fairing, which blends the wing root into the fuselage. For this, you'll need a mixture of sheet and solid balsa, as detailed on the plan. Alternatively, foam lovers could use a bit of the blue stuff... it's up to you.

The full-size will need to operate from grass strips, too!

BITS 'N' BOBS

Assuming you've bought the vacuum formed accessory pack containing the nose cone, front and rear undercarriage sponsons and spinners, glue the nose onto F1 and trim any overhanging plastic. At this point (if you wish to), cut out the cockpit windows. Now glue the nose centrally onto F2. There should be a slight step against the wood sheeting so, using a sanding block, blend the fuselage into the plastic cone so there's a smooth and seamless transition between the two. If you wish, the cockpit section could be made detachable to give better access to the retractable nose wheel.

To make the undercarriage sponsons, cut out and glue the four F7a parts into position. Sheet the top and underside between these formers, leaving sufficient space for the wheels to retract. To fit the plastic front and rear sections, firstly trim the excess so the components fit snugly against the fuselage and the formers F7a. When happy, mark around them with a pen and, using 1.5mm balsa, make up doublers to provide an edge for the plastic fairings to glue onto. Then make doublers F7b and glue these onto F7a. When happy, fit the fairings and, in similar fashion to the nose cone, blend the wood into the plastic.

With the fuselage complete, the fin can now be attached. To secure it, the longerons and fin trailing edge need to extend to the bottom keel of the fuselage. You'll need to cut a small hole in the fuselage at this point to access and glue the longerons and t.e. to the keel. To really secure the fin t.e., make up some gussets to bridge the glue joint. This method of mounting the fin gives it great strength but you will notice a small amount of flex at the tip. This will seem exaggerated when the tailplane is fitted but don't be concerned, the prototype has proved its strength. You can now make up the rudder closed loop control and elevator cable, and install the associated servo.

NACELLES

The nacelles are quite straightforward, though you do have

to construct four of them! Make left- and right-hand sides, line the sides with 9mm triangular balsa and glue formers NF1 and NF2 into position. Pull the back end together and glue; when dry, check that the motor fits correctly and bolt to the nose ring. Now sheet the top and bottom and shape to the profile shown on the plan. The dummy air intake chin is made from 12mm balsa and should be pre-shaped before fitting. Once attached, blend it smoothly into the nacelle. Mark the location of the nacelle on the underside of the wing and offer it into position. Trim the nacelle wing seat so it sits flush against the wing, then wire up the motor and secure it in the nacelle. Build the three remaining nacelles in similar fashion, then glue them all into position and fillet the top nacelle sheeting into the wing l.e.

KETTLE'S BOILING

Right, I'm off for a well-earned cuppa. Next month we'll finish the A400M and commit her to the skies!

DATAFILE

Name:	Airbus A400M
Model type:	Scale military transport
Designer:	Tony Nijhuis
Wingspan:	82"
Fuselage length:	72"
Wing area:	820 sq. in.
All-up weight:	$10^1/_2$ lb
Wing loading:	28oz / sq. ft.
Rec'd motors:	Speed 600 8.4V (direct drive)
Rec'd no. channels:	Five

PLAN FEATURE - Pt. 2

Tony Nijhuis

AIRBUS 400M

COVERING, GEARING UP AND FLYING - TONY NIJHUIS CONLUDES THE STORY OF HIS CARGO-CARRYING ELECTRIC MULTI

For what is an entirely unattractive colour scheme the A400 looks remarkably good and has tremendous presence due to that very prominent 'T' tail.

Last month we brought the A400M up to the 'bare bones' stage of construction, with the promise of a great-looking model - but such promise can only be fulfilled if the finishing's up to par! Indeed. this part of the build can make or break a scale model. In this respect it's imperative that you have a smooth finish to cover, so do take your time in achieving it. No doubt some areas will need lightweight filler to blend in edges,

Concerned about making that rather curvaceous nose and cockpit area? You needn't be, it's available as an ABS moulding!

and there'll most probably be a few dents as a result of hangar rash. A little tip here - if you do mark or dent balsa, the easiest way to remove the damage is soak the area with water. By the time it dries the dent will have gone - saves on filler, too. Ok, so you've toiled long and hard to get that smooth surface, guess we'd best get it covered!

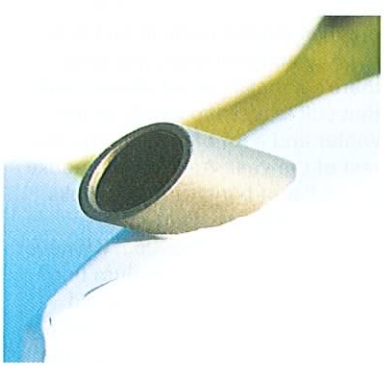
FILM WORKS

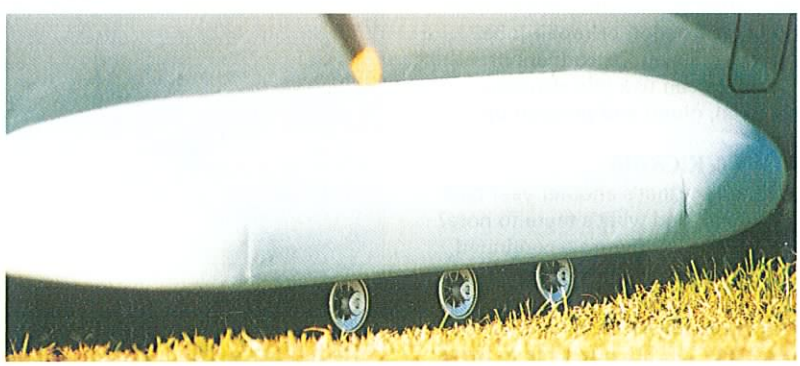
I covered the prototype in silver Easycoat Solarfilm and then keyed the surface using 800 grade wet 'n' dry, ready for the paint to be applied. The only problem with this stuff is that, as a heat-applied medium, the spectre of wrinkles is ever-present - but it does at least give a strong, light finish. The alternative is to use either tissue / nylon and dope, or of course, lightweight glass cloth (17g/m^2) and acrylic varnish (available through Falcon Aviation). Personally, I'd suggest the latter as the best alternative to Solarfilm. Oh, and if you're really feeling lazy and don't fancy painting, then J. Perkins stock a mid-grey Profilm that would suffice for a Royal Air Force scheme.

Bearing in mind the full-size hasn't yet been built, a scale colour scheme doesn't effectively exist yet... so you could do it in black and white stripes and it wouldn't be wrong... might get some funny looks at the club field, though. The Airbus Military website shows some virtual colour schemes, but generally for this type of aircraft you can have any colour you like as long as it's grey!

FINISHING

My decals were originated on the computer using AutoCAD, printing them onto clear, self-adhesive A4 labels (Avery). Clear is best used for dark colours, if a white background is needed then use white self-adhesive labels instead. It's also a good idea to seal the decals with a spray-on acrylic varnish before cutting them out, to protect against water / rain.





Sponson construction is also made easy with a set of plastic fairings at front and rear.

Climbing out on the second flight, this time with much more authority.

Installing the radio is quite straightforward, with the relevant hardware generally contained in the section of the fuselage that's under the wing. As such you'll need to remove the wing to access the flight packs, as these fit just behind the balance point.

POWERING UP

After discussing various set-ups with John Emms of Puffin Models I decided to go with conventional 600-size motors, John suggesting the use of a 'softer' 600-8.4V and connecting them in series / parallel. 'Series / parallel' means wiring the two sets of motors in a 'daisy chain' arrangement in each wing half, then connecting the two positives together and the two negatives from each wing half. This type of electrical connection requires 16 cells or two packs of eight cells (in series) to operate, therefore your speed controller must be rated at up to 16 cells.

The benefit of this arrangement is that it offers operation at a higher voltage of 19.2V (16 x 1.2V per cell). The electrical input power to fly this model is around 500W, so as power equals voltage x current, it's easy to see that the higher the voltage, the less current is needed to maintain the same power. So, in short, as all battery packs have an amp/hour (Ah) rating on them, the lower the current being drawn, the longer the battery pack will last. Using 16 cells and connecting through a wattmeter, the input power at full throttle was 750W, with a current draw of around 40A.

I used two eight-cell packs of Puffin Hi-Flow 3300mAh cells on the prototype and I'm pleased to report these have proved to be a very good, robust cell with flights in excess of eight minutes regularly being achieved.

She's agile, too - a real joy to fly.

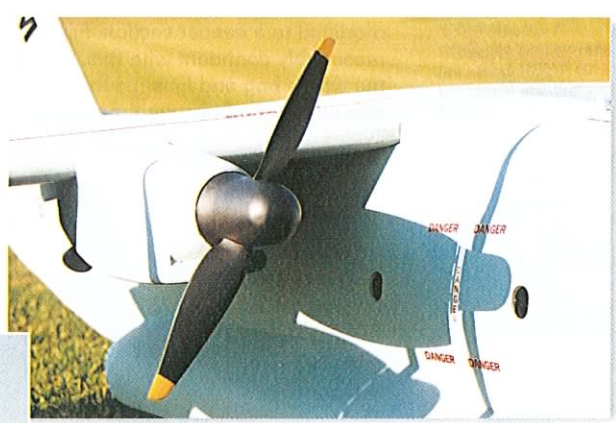
INTO THE UNKNOWN

There's an old saying that says: 'If it looks right, it'll fly right'. I remember thinking this on a cold day in February with long grass, a 10-knot wind, puddles festooned all over the Hastings club patch and an uncovered model with a taped-on flower pot plugging the big nose opening (I always test fly electric models prior to covering and making the vac-formings). It didn't look very pretty and the 'looks right / fly right' wisdom seemed inappropriate - but my hopes were high as I opened the throttle and started to puddle-dodge.

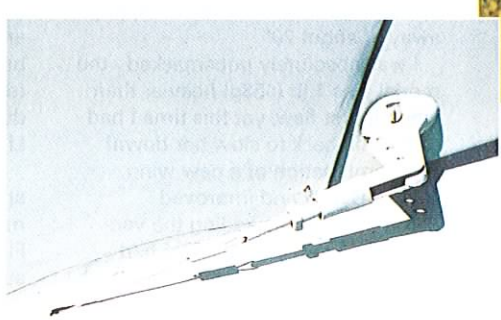
'I must be blinking mad', I thought, as water sprayed up and the tiny wheels struggled through the long grass. I think the model thought this too, because it stayed firmly fixed to terra firma even after applying full up elevator. I was aware of the C of G being further forward than it should be, but this was a safety margin I employ for all my new designs.

So, three attempts later and the model still hadn't left the ground. The ground speed was part of the problem (not enough of it due to the grass and water), but also the model wasn't rotating. This was partly due to the forward balance, but not wanting nor being able to change this at the field I decided to bodge it and drastically increase the up elevator movement!

On the fourth attempt the nose finally rose on applying full up elevator, and she was airborne... creeping into the slowest climb-out I'd ever seen. Although the model felt incredibly sluggish, all the controls seemed very positive. Almost all the up trim was used, and flying speed was maintained only at full power. Not ideal. After a few circuits the Airbus was guided in for a landing (in the middle of a puddle, of course) where it



Matching the powertrain and the airframe perfectly, the flying props are 9 x 7" APC Electric jobs.



A closed loop system is employed for rudder control - seen here exiting the fuselage at the junction with the fin.

Tony Nijhuis

came to an unceremonious halt. Pleased to return home with the model still in one piece, I allowed it to dry out for a few days and gave the project some more thought.

FURTHER DEVELOPMENT

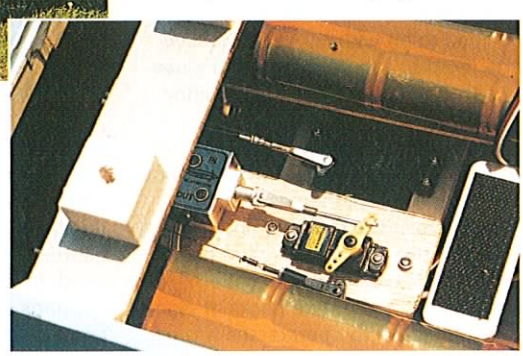
Compared to its fuselage length the A400M has a very short wingspan, which, I understand, is incredibly efficient in providing lift. On the model, rather than getting involved with this complexity of aerodynamics, I'd used a fully symmetrical section and increased the wing area by around 15%. With the final weight of the aeroplane looking to be around 10 lb (4.5kg), and after such a lacklustre test flight performance, the wing size was starting to concern me. Alas, there was nothing for it but to redesign a slightly larger wing and use a semi-symmetrical RAF38, modified to a deeper section. Feeling reasonably confident with this, I went the whole hog and finished the aeroplane, complete with mouldings, covering, suitable paint finish and decals.

Order list

Item	Code	Price
Plan	RC2027	£15.75 plus £2.15 UK p&p (£3.50 overseas)
Mouldings	COWRC2027	£29.50 including UK p&p £34.50 overseas, inc. p&p
CNC parts	CNCRC2027	£55.00 plus £5.00 UK p&p (£10.00 overseas)
A400 plan pack inc. all of the above	SETRC2027	£95.00 plus £5.00 UK p&p (£10.00 overseas)

To place an order telephone *RCM&E* Customer Services on 01689 886660

Any colour as long as it's grey! 'Twas ever thus, I suppose.



The two eight cell NiMH packs sit on either side of the fuselage with the retract servo in-between.

THREE MONTHS ON

For once I didn't hurry the finishing process, mainly due to the weather and the need for a runway cut with short grass... something only the summer months can provide. When that day did arrive and the A400 was rolled out in all its finery, the 'if it looks right it'll fly right' saying seemed more appropriate. Incidentally, I'd moved the C of G back about 25mm, but the large elevator movement was maintained.

As the throttle was opened the A400M accelerated quickly, and after 30 metres or so with just a touch of up she rotated and climbed happily away at about 20°.

I was absolutely gobsmacked - the model was 1 lb (453g) heavier than when it first flew, yet this time I had to throttle back to slow her down! The combination of a new wing, correct C of G and improved aerodynamics (by adding the vac-formed nose and sponsons) had turned this tortoise in to a real hare! The next 7 minutes were an absolute joy, and I have to say that, if the model is anything to go by (wing tinkering aside), Airbus have got a real winner with this aircraft. It's incredibly agile, it goes where you point it and the power now seems more than adequate. My 6-minute timer buzzed at me all too soon, so a landing was reluctantly called. Here again, she was an absolute delight, the stability allowing me to pitch a nose up attitude and control the descent accurately with elevator. The result was a real 'greaser' of an arrival, without even trying. The next flight after an impatient recharge just reaffirmed how much I enjoyed this model. Could things get any better?

Mission accomplished. A delighted Tony having built and flown his A400M before the full-size leaves the ground.

LITHIUM HEAVEN

Now I have to say I'm a bit of a dinosaur when it comes to batteries and I've resisted going the Lithium Polymer route, not only because of the large number of conventional NiCads and NiMHs I already have, but also through lack of knowledge and perceived expense. The biggest bugbear with electric models (especially larger examples) is duration, and it's something I knew Li-Po cells would cure.

So I made a call to the helpful guys at Flight Power and in particular their main man, Julian Cox. Conveniently, Flight Power can fabricate a pack to suit your exact requirements, which in my case was a 5-series item (18.5V) to give the equivalent voltage of a 16-cell NiMH. As for capacity, I wanted to

Go the Li-Po route and you too could enjoy 20 minute flights. Electric flight really has 'come of age'.

match the weight of a conventional NiMH pack, so Julian suggested a 6.5Ah capacity. When the pack arrived it was beautifully put together, with carbon plates top and bottom to protect the cells from mechanical damage and prevent any distortion that might occur during charging or discharging. Better still, when the cells were weighed they were a full 8oz (227g) lighter than the NiMH I'd been using! Flight Power use top-of-the-range Li-Po cells, which are capable of unloading at 20c - over 120A in this case. Awesome!

WHOA THERE!

With the pack fully charged (approx 21.5V) the model was unleashed once again... wow! What a transformation. With the reduction in AUW and a touch more voltage available, I was able to reduce the throttle to a little under half stick. Subsequent flights have proved just how good these cells are, and flight times are edging towards 20 minutes, which for this type of model is fantastic. The best thing of all is that the carrying capacity has space for a second or even third similar pack. So in theory, flying constantly for one whole hour is conceivable - a real breakthrough.

In comparing cost on a like-for-like basis, Li-Po may be twice the price of NiCad / NiMH - but I'm now totally convinced that where duration and weight is concerned, the cost is well worth it.

DATAFILE

Name:	Airbus A400M
Model type:	Multi-engine military transport
Designed by:	Tony Nijhuis
Wingspan:	82"
Fuselage length:	72"
Wing area:	820 sq. in.
All-up weight:	10 lb 8oz
Wing loading:	28oz / sq. ft.
Rec'd motors:	4 x Speed 600-8.4V direct drive (Puffin MIG-600)
Propellers:	9 x 7" APC Electric
Batteries:	16 x 3300 NiMH 5s3p 6.5Ah Li-Po
Speed controller:	50A / 16-cell
Rec'd no. channels:	Five