# THE AUSTRALIAN HOMEBUILT SAILPLANE

*Editor: James Garay*

**Volume 5 Issue 20** **March 2001**


*G'day folks*... Another year has gone by and here I am again in front of this square screen (computer monitor) trying to produce something that resembles a magazine for your reading and entertainment pleasure...but, it is only a newsletter, and it's our only medium to keep us informed on what is happening in the Australian Homebuilt Sailplane scene.

So far, so good...your support has been more than I expected and your input is appreciated. Its hard to try and satisfy everyone at the same time but your support keeps me going. Being the Editor is very demanding indeed and it takes a lot of time to reach the final result - like the one that you have in yours hands at the moment. If only you knew how much time it takes to produce!...phew!!

We are a group with the same interests who like to share knowledge and experience. In the beginning we used the word 'Association' but for legal reasons we had to take out such word. We do not have official bearers and we are not incorporated.

With this issue I completed my fifth year as Editor. I also take this time to remind you that all subscriptions are due for renewal (*renewal form on page 14*). This Newsletter is non-profit and is financed by your subscriptions, it just covers the cost of production and postal charges, all the work involved in its production is free of charge and I say this because behind me are a lot of people who make it possible.

Inside this issue you will find information about an Australian Made Digital Variometer with averager and audio. The TAS-V 1000 is made by a firm based in Melbourne "TASMAN INSTRUMENTS". Their email address is as follows: **info@tasmanintruments.com.au**

My 'WOODY-ROO' is almost ready for the fly test. Peter Raphael {The Erudite} and now master painter 'Rafael' the artist did the paint scheme with an aboriginal dreamtime theme, he was kindly helped by Malcolm Bennett. It looks superb!! I hope to fly it soon, I'll keep you informed.

A complete builders profile and Gary Sunderland's 'MOBA-2D' is also featured in this issue plus good news from the internet...happy reading!

**James Garay**
**Editor**




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*Australia*


***Inside This Issue***

# MAIL BOX

***Dear Ed,***
Saw your ad in A.G. under Gliding Publications.

Is there a 2 seat side by side motor glider available in kit or just plans?

What does the Australian Home built Sailplane provide in the way of publications and assistance to the homebuilders?

Thanks in anticipation.
John Williams. Port Arthur. Tasmania.

***Dear Ed,***
I am very interested to know what you guys are all about with the sailplane homebuilders movement in Australia.

I have done some glider building and repairs a few years back in Adelaide, and would be great to keep in touch with what is happening in the glider building dept, such as the designs that are available and the use of the new materials etc. etc.

Would be pleased to hear from you sometime and get some stuff on subs to pamphlets etc.

I am a member of the Vintage Gliders Australia and do articles for them. Your faithfully. Douglas Cole.Croydon Vic.

***Dear Ed,***
It is almost exactly one year since I wrote to you with an update on the Czech Republic company known as TeST and their self-launching gliders the TST-3 ALPIN TM single seat and the TST-8 ALPIN DM the two seats version.

Since my last letter I can report that the TST-# ALPIN TM lit that I ordered arrived safely by container ship at the beginning of July 2000. Rather than have the kit shipped in a large wooden crate I also ordered the custom made trailer so the whole shipment arrived ready to tow off the dock once unloaded and through customs.

My dreams were realised as soon as I opened up the trailer and saw, for the first time, the standard of the workmanship achieved by this small company.

The wings and fuselage are constructed of mainly wood (GRP cockpit) and as I have stated above is a pleasure to see. Gliding experts here at Caboolture have said that they have never seen better workmanship from any country anywhere. With this kind of endorsement I know that I have a winner in the making.

I started construction in September and currently have the wings and tailplane assembled to the fuselage and have most or the primary controls installed. At this stage I would assume that I am about 25% of the way and I am expecting completion around the end of the year.

In hours, I am thinking that it will be about a 800-1000 hour project to build from the kit components. Later during the year I will provide another update on the home building of this very nice glider.

TeST have an excellent web site which shows some pictures of some of their range of Ultralight/gliders.

The web address is www.test.infoline.cz and is definitely worth checking specially if you are interested in self launching sailplanes. Hope this may be of interest to the AHS members.
John Everest (john3391@aol.com)

***Dear Ed,***
Thank you for the info package on the AHS that you sent me.
I am a member with the Vintage Glider boys and fly out at Bacchus Marsh, when I can.
I did a lot of gliding in Adelaide when I was younger, and also at Alice Springs. Almost finished the "Jumbuck" ( A Keith Jarvis design) up in the Alice, but had to leave and come South, due to family affairs. One of the boys completed the assy; but flew off the trailer somewhere up there and that was that.( It happens ).
I do not do a lot of gliding these days, but keep my hand in by flying R/C Model gliders etc., and experimenting along the way.
I am very interested in the design and development of the micro sailplane area, and seems to show a lot of promise of things to come, and I always thought it was a part of gliding that needed a closer look and with a good combo of design and the use of modern materials. Lets go for it. Regards. Doug Cole.

***Dear Ed,***
You may remember that I completed my Woodstock whilst I was living in Hong Kong and that it first flew in England in July 1996.

The follow on was that I retired from HK in 1998 and returned to the UK, Since then it has flown occasionally but the UK weather has kept it in fairy close proximity to the ground. I have also been busy sorting out house and garden and have just completed and open trailer for a Slingby T-21- b in which I have a share.

1997 saw our son emigrate to Australia (Brisbane) with his wife and children and yes, you have guessed what is coming next. We have decided to join them and plan to move out about April this year.

So a 40feet container will be arriving in Brisbane about May with " John's Blue Woody", my Triumph Spitfire, and a few non important items of household furniture.

It will come with a UK certificate of Airworthiness, so I will be contacting the GFA to see when I can fly and what requirements will need to be meet, but I think that initially I can fly it on the British register as the precedent has been set with top UK pilots bringing their expensive glass toys out for the Aussie Summer.

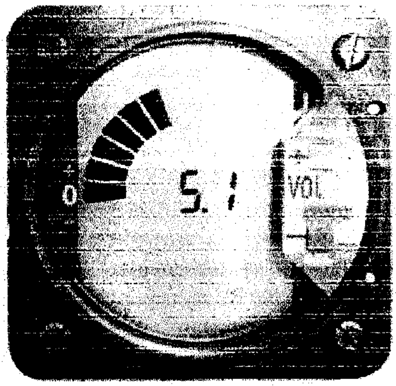
Currently I am making a glass fibre seat, following the article recently, but using that a guide only111 I will show you at the next year rally.

Over the few months I will keep you informed of my trials and tribulations in once again transporting my woody half way across the world and let you know our revised address when we get settled. All the best. John M Stockwell. England.

# TECHNICALITIES

## *Next generation*

## TAS-V1000 DIGITAL VARIOMETER WITH *AVERAGER* AND AUDIO




**FEATURES:**

. HIGH VALUE -REASONABLE COST.
· SIMPLE OPERATION - ONLY TWO BUTTONS.
· AVERAGE DISPLAY INCLUDED.
· INBUILT SPEAKER - EXTERNAL OPTION.
· CONCISE AUDIO.
· SELECTABLE RESPONSE RATE AND OPERATING MODES.
· NO FLASK REQUIRED - TE. PROBE CONNECTION.
· DIGITAL SIGNAL PROCESSING.
· FAST ACCURATE RESPONSE.
. VOLTAGE READ FUNCTION AND "LO BATT" WARNING.
· REPEATER DISPLAY AVAILABLE.
· COMPACT 58mm (2.25') CUTOUT - 85mm DEEP.
· 3 YEAR WARRANTY

**INTRODUCTION**

This Variometer is designed to satisfy a need for a product that utilizes the most current technology to produce the best possible performance at the lowest possible cost.

The Variometer has at its core a semiconductor pressure sensor with a digital output which can resolve some 32 million separate codes. This results in a Variometer which can measure only a few inches of altitude change without a practical upper limit in altitude. With such fine measurements possible, a fast sample rate results in a Variometer which is responsive and accurate. Digital signal processing allows the user to set the Variometer response time in fine increments, and select from a range of display and audio vario options. An important side benefit is that the parts count is minimised and so the cost and size of the final Variometer is reduced.

The Variometer accommodates and expands on all the most important functions of a standard vario, i.e. vario audio, current lift/sink rate, and includes the primary feature of the 20 second Variometer average simultaneously displayed. All in the same small package. This Variometer is designed to give years of trouble free service. (3 year warranty).

**OPERATION**

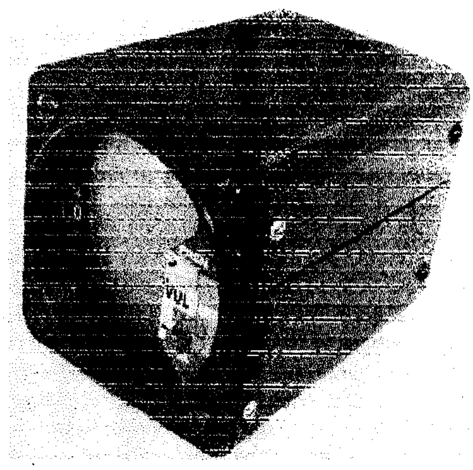
Simple controls of only two buttons which control the Variometer audio volume, read the battery voltage, and access to setup values if required. With the 20 second Variometer average continuously displayed and a warning signal for the battery voltage all on the screen, no other controls are required. Battery power consumption is minimal and the Variometer continues to operate when the battery can only supply 8.5 volts. A warning signal of "LO BATT" appears on the screen at 10.5 volts to give warning to the pilot to minimise power consumption.

**AUDIO**

Considerable effort has gone into developing an audio vario tone and pattern to convey to the pilot the maximum information without being intrusive or annoying. The vario audio response is non linear to give the greatest resolution at the lower climb rates. At climb rates below about 2.5 knots, a change of 0.1 knot can readily be detected in the audio tone. This gives the maximum amount of Variometer information to the pilot at times when a Variometer is most important i.e., when trying to recover in weak lift, or to extend a flight on winter days or during wave flights. This maximizes the pilots achieved climb rate without the need for visual reference to the Variometer for confirmation of the current climb rate. A concise audio is essential to maximize the lookout time for the pilot.

Installation of the Variometer is simple with only a TE probe connection required with the "T" piece and wiring cable supplied. All wiring connections are made to the Variometer with telephone type plugs.

A remote Variometer display is available and can be connected via the external data port with the cable supplied.
Development of a companion flight computer is currently underway and is planned to be available 2001.



**ORDERING**

V1000 VARIOMETER- INCLUDING POWER CABLE AND "T" - *PRICE:* US$334.80* (A$620.00)

RDV50 REMOTE DISPLAY- INCLUDING INSTALLATION CABLE.
*PRICE:* US$121.50* (A$225.00)
PLUS GST IF APPLICABLE.
SHIPPING FREE WITHIN AUSTRALIA.

**OPTIONS:**
PA325 ADAPTOR PLATE FOR 3 1/8 (90mm) INSTRUMENT HOLE PATTERN.
*PRICE:* US$13.5*(A$25.00)
SP190 EXTENSION SPEAKER KIT- INCLUDES CABLE AND CABLE SPLITTER.
*PRICE:* US$29.70* (A$55.00)
PLUS GST IF APPLICABLE.
SHIPPING FREE WITHIN AUSTRALIA.
* SUBJECT TO EXCHANGE VARIATION

## ANTENNAS FOR COMPOSITE AIRCRAFT

*by Bob Archer of* **Sportcraft Antennas**

The art of installing antennas internally into composite aircraft has left many people confused and perplexed so I have decided to try to give some tips and information on the subject. Some people have tried to install monopole antennas internally with a round plane installed for the antenna to work against and this is just totally bad. To work properly a ground plane should be at least a half wave length in diameter and at VHF frequencies this is about four feet. Needless to say there is no place this large to put a ground plane on a small composite aircraft

First of all I believe that only dipole type antennas should be used in composite (non-conductive) aircraft and that the best location for COM antennas is in the vertical stabiliser while the second best is in the fuselage tailcone. The reason being that COM antennas are vertically polarised and therefore require a vertical space of about 46" for a half wave dipole. The larger aircraft have enough height for an aperture of a full half wave length but the smaller types need an antenna that is shortened a bit. Think of aperture as the capture area of an antenna. Mounted high in the vertical tail the antenna is high enough to see all the way around while the fuselage mounted antenna may suffer some signal loss due to blockage from engine, passengers, and miscellaneous "stuff.. Graphite structures do complicate matters for antenna installations. If spar caps are constructed of graphite materials horizontally polarised antennas should not be mounted nearby because practically no signal will be able to get past the long conductors that will act as reflectors. The same goes for any long conductors in the same alignment as the antenna such as horizontal and vertical tall spars, control cables, push rods, wires etc.

Each aircraft needs to be analysed individually for the best antenna locations. I do not recommend any antenna on the market that has a little black box in the center of the antenna. This device is a ferrite transformer which provides a very good VSWR and a very good bandwidth but at the cost of being a very lossy device. The very best specification that I have seen on ferrite transformers is a loss of 2.5 dB and the worst goes up to 12dB. As a reference a 3dB loss gives an output of 50% and 10dB gives just 10% out. So if you have a 5 watt transmitter into an antenna like this, you get just .5 watts out, and it works the same on receiving. Not a bargain. An antenna you can easily make yourself would be to just solder quarter wave elements to the inner and outer conductors of the coaxial cable and go with it.

When installing any antenna remember that antennas do interfere with each other when installed too close together and that close metallic (or conductive: remember graphite) objects that are as long or longer in the same polarization-plane will reflect RF energy away from them. Close meaning one wave length or closer and closer being worse. One wave length is about eight feet at VHF frequencies. Less than a quarter wave length is really bad from both a VSWR and the radiation pattern stand point. The formula for wavelength is: 118031/ FREQ. in MHz. = wavelength in inches. So there being only one good location for an internal COM antenna (unless you have twin verticals) and antennas don't work well close together, it follows that for aircraft with dual transceivers and no good location for a second antenna there is a need for a two set switching device of some type. I recommend a RF switch, single pole double throw type. A switch like this will allow you to receive and transmit on a single frequency and when switching from one set to the other, the switch will connect the proper set to the antenna. This type of switch is available from ham radio outlets. Another type of switch that allows receiving on two sets at the same time while transmitting straight to the antenna is now available due to popular demand from Sportcraft Antennas.

These suggestions and recommendations come from 35 years of spacecraft and aircraft antenna experience and are meant to help in obtaining optimum antenna performance and do not mean that anything else will not "work". I have seen a lot of really bad antenna installations whose owners are perfectly happy with their antenna performance.

**DEFINITIONS**

Active Elements? The part of the antenna that actually does the radiating or the receiving of the RE energy. Aperture? The capture area of the antenna. On a dipole or monopode it is the overall dimension of the active elements, on dish antennas it is the diameter of the dish.
Feed point? Generally the point at which the coaxial cable attaches to the antenna but could be where the feed device attaches to the active elements

VSWR? Voltage Standing Wave Ratio. The measurement of the ratio of incident to reflected RI: energy. An indication of the quality of energy transference. The lower the number the better. 1:1 is perfect. 2:1 is good 3:1 is OK, 4:1 and up is poor to terrible.

Radiation Pattern? A pattern showing the relative signal level &sound an antenna. Signal strength can be severely reduced in particular directions by other antennas, vertical stabilisers, landing gears etc.
Balum? A device that converts a balanced transmission line (such as TV lead in) to a coaxial line which is an unbalanced line. Provides balanced currents on dipole antennas while matching the 50 ohm line to the nominally 150 ohm antenna

# A Basic Antenna

For simplicity and performance, you can't beat a 1/2 wavelength dipole antenna. The total length of the wire from end to end is equal to 468/ftequeneywhere the length is in feet and the frequency is in MHz. For soaring, a dipole would have this length:468/123.3 3.796 feet Get yourself a piece of coax that already has a connector for your radio. Cut the connector off the opposite end (if there is one) and use a knife to open up the coax. Separate the braid and bundle it together to form a wire. Strip the insulation from the center conductor, but ensure that the center conductor cannot contact the braid. Solder some wire to both the braid and the center conductor. Trim the wires so that the length, end to end, is 3.796 feet. Half the wire will be on the left of the coax, and half the wire will be on the right of the coax. Add some electrical tape to keep things from shorting out. If you have a VSWR meter, you can precisely tune the electrical length. however, unless your measurements are significantly off, you will find the VSWR to be close to 1.2:1 and probably better than 2:1 across the entire aircraft band (ie. perfectly useable antenna anywhere in the band). Note that the coax may be of any length. Shove it down your fuselage, preferably keeping the wire (not necessarily the coax) in a straight line. Affix it to your fuselage in whatever way you wish, being sure it cannot come free and jam a control. Voila! You now have an antenna as good as any others used on aircraft, and you built it for next to nothing! As a side note, the rigid antennas that you see protruding from powered aircraft are 1/4 wave verticals. The length of the radiator is exactly 1/2 the length oft he ½ wave dipole. The other "half" of the antenna is the metallic fuselage itself which form a ground plane.

## WHAT'S NEW?

A new book is in the market and it is highly recommended. One of the most important books ever written...it paved the way for the invention of thc airplane.

The name: **"BIRDFLIGHT AS THE BASIS OF AVIATION" by Otto Lilienthal.**

**6' x 9' Quality paper back $US 19.95 + $ 4.95 S/H (in the U.S.) See the classified at the end of this issue.**

Ever since man looked up and saw birds soaring overhead, he envied their freedom and ease of travel-and dreamed of flying.

Through the ages, countless men died in pursuit of that dream, but it was Otto Lilienthal who proved human flight was possible.

Not enough can be said about his great pioneering work. And it is to him that we can directly trace the true beginnings of human flight,

BIRDFLIGHT...features over 100 fascinating drawings, graphs,and diagrams, including many historic photographs of Lilienthal flying in the 1890 s.

Unlike so many other bird watchers, Lilienthal, with assistance from his brother Gustave, studied the details of how birds fly. They learned precisely what a bir does with its wings- how it alters dihedral to change stability and how it varies curvature to change lift and drag in various flight situations.

As a result of the Lilienthal's observations, they recognized the superiority of curved wing surface and developed a "theory of flight" forming the foundation for the science of aerodynamics. An by applying their insights they bridged the gag between those who dreamed of flying and those who flew.

BIRDFLIGHT AS THE BASIS OF AVIATION was read by nearly every early aviation pioneer who had a serious interest in building and flying an airplane. Lilienthal didn't find all the answers but he did more than anyone else-up until the Wright Brothers. In fact, he had such a tremendous influence on them that they considered him their hero!

It is incredible when you realize that the original edition of this book was first published in 1889! An it is proof positive Lilienthal was one of the greatest of all aviation pioneers. Until he applied his enthusiasm and engineering skill to " the problem of human flight" most previous attempts were done on a hit-or-miss, non-scientific basis.

Lilienthal was truly the first person to have deliberately and audaciously committed himself to learning the secrets of the birds, and to become accustomed to gliding through the air.

It is hoped that republishing this great book will give 21st Century people a genuine appreciation of what Otto Lilienthal did for mankind. *Ed.Note: Read the book review by Peter Champness some where in this issue.*

## GOOD NEWS FROM THE INTERNET

*By Gary Sunderland*

After many false starts, it looks as though the kit version of the PW-5 "World Class" sailplane may now be available.

Earlier plans to have kits made in Poland and then China came to nothing, and now a USA kit manufacturer has stepped in.

The fir is Composites, Inc/Composite Hobbies, Inc. who also build kits for the Lancair amateur built aeroplane.

The PW-5 kit is a comprehensive "fast build" kit, for 250-300 hours building time and costing US $ 15.500.

This may seem a lot, but you get a new type-certificate product, with spare parts support and immaculate flight handling, which can be flown in all levels of contest, up to and including international contests; and the glider can not be superseded in it class. All of this adds up to a good re-sale value when you come to sell it.
Their web site is at: http://www.empnet.com/composit

Another new kit sailplane is the "Russia" This is also a "fast build" composite structure kit, with 700 hours building time estimated. The price is not given, or is the certification status in Russia. In the USA it is flown on an "Experimental" certificate.

The web site is: ***www.northwestartists.com/russiakits***

People often ask for information on self-launching sailplane for amateurs to build. There are not many that have enough wing span and area to carry a normal pilot as well as an engine, propeller, fuel, oil and the extra structure required to cope with all that extra load. You need at least 15 metres span to achieve a reasonable span loading.

The most promising is the Strojknik S-2-A, for which information has been hard to come by. The S-2-a has genuine 1in 35 glide and at least one is being built in Australia.

A Canadian builder has now set up a web site for S-2-A enthusiasts at : *<http://www.wge.mb/mailman/listinfo/s2a>*

All of this information, and a lot more besides, is available in "Sailplane Builder" you can access the information from their web site: *http://www.sailplanehomebuilders.com*

## SHOP TALK

Malcolm Bennett has read the transcript of thc building and flying of the Windrose reported as crashed last issue and has made some observations in relation to this accident based on the builders writings..

The construction of this aircraft, appears from the writings of the builder to be considerably altered from the plans in regard to elevator and aileron throws.

It would appear that the spoiler flap was enlarged. Connections to controls could have been altered as throws were altered.

The description of the construction of some of the items suggests the aircraft could be overweight.

The description of the loss of control regarding elevator could suggest that the elevator was stalled. As this is an all-flying control surface exceeding maximum allowable deflections would stall the surface resulting in no reaction when pulling more back stick.

The pilot talks about playing with the flaps just before the stall and dropping a wing. As the wing and elevators are basically in line, flap deployment could change the airflow direction over the elevator making the maximum angles available with the elevator more critical at the stall.

Remarks are made that with spoiler deployed there was loss of elevator authority for landing. I wonder where the weight and balance was?

Remarks regards control load from ailerons suggest changes in design by the builder were not for the good.

Remarks from the pilot suggests that he is not very experienced, as he overshoots on landing. Difficulty in crosswinds, tows, turns, etc. questions the skill level.

His check of C of G position sounds strange as weight and measurement, physically of the plane are how you determine C of G, not where the seat is.

Tip stalls suggest that the wings are not constructed as drawn regards wash out. Turns and large amounts of flap result in a much stronger stall when it happens as the greater angle of attack the wing reaches with the flaps down is much more final and sharp when stall is reached.

At what speed did the rudder flutter and was it mass balanced?

Stiffer tail boom would not stop flutter of the surface is not correct and the control circuits are not rigid enough.

Deployed large spoiler mounted where it is would blanket rudder and part elevator with turbulent air resulting in poor control.

From Paul Johnson, Australia 8/25

Dear Janice,
Sorry it's taken me so long to respond, it's my usual excuse of not checking my emails very often. I was staggered to find so many emails waiting for me and hugely disappointed to find most were about Mat's accident. Like everyone else I'm relieved that Mat survived.

I, like all aviators, get that little sick feeling in the gut at the mention of an aircraft crash, as we all know that flying can be very unforgiving of error or structural failure or failure to keep a keen lookout. Non the less it is a rewarding pastime that is undertaken by large numbers of people in a safe manner.

Is the Windrose unsafe?

When I started building my WR 14 years ago (plan # 88) I did so because here in Australia I needed the approval of the Gliding Federation of Australia to build an "approved" design, and the Windrose was approved for home construction and the GFA had carried out a 'First of Type' evaluation and mandated some 35 modifications. The CTO/A had spent a couple of days with Jim Maupin, when in the US, discussing the proof loading of the 13m wings and the area of concern that the GFA had. Jim even proposed a couple of the suggested changes.

The advice I received from the CTO/A was that he did not think the design was very creative nor did it take advantage of new materials and techniques. It was pointed out that the performance would be quite modest but it would be capable of self-launching. The philosophy applied by the GFA is that the aircraft must be built using established construction techniques and using approved materials such that whoever may end up owning and operating the glider can do so confident of its ongoing airworthiness.

One such modification was the requirement to build the boom 1" wider and 1" higher and add extra bulkheads. The pylon also was modified to have the front and back skins made into 'double skins'. This was done because the GFA didn't consider the boom stiff enough and the original boom did not have sufficient reserve if full rudder was applied at the Max rough air speed.

Any modification that I might want to make, would require the designers approval, or an engineering justification carried out. Unlike in America we are not free to modify at will.

Back to is the Windrose safe. The flight reports that I have send to you and the group is the flight reports that I submit to the GFA. They are factual, and have highlighted the difficulties experienced such as:

- High level of noise both inside and outside the WR.
- The original props inadequate performance
- The improvement encountered when a modified Rotax exhaust was fitted.
- The difficulty experienced trying to fit the exhaust
- The near impossible task of effectively cowling the engine.
- The high rate of sink being experienced.
- The spoiler is only marginally effective.

What my 21 flights have shown me is that my 13m Windrose is fun to fly, it side slips very effectively, it maintains aileron control down to almost zero ground speed. It can handle +15 Kts crosswind at 45 degs on a wing down takeoff with no difficulty.

I have flown a flight where the conditions were as lumpy, bumpy, and down right unpleasant, but the WR answered the many and exaggerated control inputs magnificently. At no time did I feel that I had inadequate control over the glider.

I have a mentor, (Keith Nolan) an experienced old pilot, aircraft owner, and instructor, who has a no nonsense safety first approach to flying. Keith has been present at most of my flights and never fails to brief me on what possible effects the conditions may have on the WR's performance. He has been surprised like myself at the handling characteristics I have just described.

My one and only "Moment" came on my first flight (aerotow) when I carried out my 2nd stall. The first stall resulted in a wing drop, which was recovered as per normal. The second one resulted in the Windrose 'mushing' down wings level, I noted that I had about a ¼" travel left in the control 'fork' arrangement so I pulled the stick full back!

Instantly I was facing the ground, picking up speed quickly. As it was my fist full flight I just eased it out of it's dive and recovered what height I could, and continued on my way. A check of the elevator circuit revealed that if I loaded the elevator, as the trim tab does. The elevator had 12degs up elevator instead of 10 degs. I resolved to adjust the elevator travel in future with the elevator loaded. While I got a fright there was nothing untoward and recovery was straightforward.

I have not yet carried out a spin in my glider, and can't claim to be itching to do so. I know that my C of G is correct (28-29 % MAC) and I have no reason to believe that the spin performance of the prototype would not be replicated by mine.

To those who have built/building a Windrose and not jet flown one. Folks I can imagine your concern, despair, and frustration, for I have felt it to. A couple a years ago I received a letter from Hans Lhor from Canada who said among other things " The original prop made a lovely wall clock", "you'll need a 3000' runway" and "the trim doesn't work" all of which I came to understand fully. Hans also said "ring my son, who is working in Australia and ask him to send you a copy of my Windrose flying, he has a video" I did this and Han's son was true to word and a tape arrived of Han's first couple a flights.

To SEE it actually leave the ground, to watch it flying to watch it land and roll to a stop! Magic! They do fly! I had spent hours and hours and hours literally dreaming of it flying, but deep down what if it's a dud?

I'm indebted to Han's as his video reassured me greatly, and I would like to say to others in the group, my experience doesn't lead me to consider the Windrose unsafe, it's performance isn't flash but I never expected it to be.

Over the next few weeks I'll make an effort to compile a video of my test flights (PAL) and if I can find someone able to convert them to an AVI file I may make some copies onto CD's I'll send you one if I am successful.

Janice please copy this to the group and you have my continuing support. I don't know Mat's aircraft, or it's C of G position nor do I know what modifications may have been carried out. I do seem to recall that Mat had been claiming to WR was unsafe for some time and I'm surprised that he was still flying it if he held such a view?

Yours Faithfully
Paul Johnson

## THE MOBA STORY

*Gary Sunderland's profile*

After an early interest in model aeroplanes, at the age 16 I managed to wrangle a job as a junior assistant in the wind tunnel at the Aeronautical Research Laboratories, near Melbourne.

In the evening I studied engineering at Caufield Tech and after seven years graduated with a Diploma in Mechanical Engineering.

While at A.R.L. Alan Patching introduced me to gliding. I joined the VMFG at Berwick in 1955 and went solo on February 1956.

Shortly after I started power flying and soloed a DH 82 (tiger moth0 in September 1956. Then followed a private(power) license and a gliding Gold C, number 20 in Australia.

Many years of soaring contests followed, culminating in my becoming National Sports Class Champion in 1972.

Meanwhile my gliding interests led to my joining the Department of Civil Aviation, where I was involved in the certification of gliders and amateur built aeroplanes.

These aeronautical engineering duties led on to more complex aircraft, being project engineer on the civil "NOMAD" and eventually Manager of the Melbourne Engineering Office, from which I retired in 1991.

Recently I have returned to model building and flying as a leisure activity, with the accent on historical research and scale model contest flying.

I have been privileged to represent Australia at three World Contest; first as crew chief to Don Brown at the WGC in Lesno, Poland 1958, and to Derek Reid at South Cerney, England in 1965, finally as a competitor at the 1996 World Flying Scale Championship in France.

In these days, when pilots and crew get some financial assistance, it is worth noting that I have paid for all my own flying and to attend three world Contests

## The MOBA Story

*By Gary Sunderland*

I have always been interested in the possibility of designing and building my own sailplane. However, my desire was to achieve some advance in the art, or do something different, rather than copy other sailplanes.

My first thoughts on the subject were to utilise the jigless methods of construction, as for amateur built airplanes like the Thorpe T-18, and build a metal structure to which fiberglass fairings would be attached. The initial calculations showed that the idea looked feasible, confirmed by an account of the Darmstadt D-30 in 1938, which also had an aluminium spar and alloy tail boom, but was much larger and slower, being covered in wood and fabric.

At the time I was flying an Open Libelle in competitions, so my desire was to build something better, something that would approach a 40 to 1 glide, with a 15 meter span, and be easy to build by an amateur - namely me!

The MOBA-2 preliminary layout was completed in 1970, and a sheet metal rudder was built to try out the method. The rudder was scrapped as being too small and too heavy, but the construction method itself was a success, using alclad sheets and monel "pop" rivets.

Then "Australian Gliding" magazine published the "Sailplane Design Competition" rules for a similar type of sailplane, but with the span restricted to 13 meters. The very generous prize was to have donors complete the design and construction of a winning design, which would then be owned by the designer.

As I was still more interested in a 15 meter sailplane, I decided to keep on with its design, but also enter the "AG" 13 meter contest with a short span version.

This was a logical development, in that the "AG" version needed to be stressed to OSTIV "Utility" category requirements, whereas my 15 meter version was being designed to the BCAR "Normal" category rules, and to lower load factors.

The 13 meter version was then MOBA-2B, and the 15 meter became MOBA-2C. Both were to be fitted with the larger, fabric covered rudder, and were identical, apart from the wing tips.

The "AG" contest was to be judged from December 1971. In the meantime I drew up both versions and started a detailed analysis and weight estimation for the MOBA-2C.

A preliminary report in "Australian Gliding", November 1972, indicated a tied result between MOBA-2B and a design from a Romanian entrant (see Figure 1).

Two other very significant developments also occurred. Australia won the right to host the 1974 World Gliding Championships at Waikerie, and the CIVV altered the Standard Class rules to permit simple, camber changing flaps, as an alternative to dive brakes, for the 1974 contest.

Guess what, the MOBA-2 design, from the outset, had simple landing flaps and conformed in all respects with the new rules! This meant that, if all went well, I would be able to provide a member of the Australian team with the very latest design of a Standard Class sailplane to fly. It looked just possible. If the judges made a decision quickly, and the sponsors completed the 13 meter glider within twelve months, I could make the 15 meter tips and check fly it before the end of 1973. My estimates of performance indicated that MOBA-2C should be superior to all the existing Standard Class gliders.

Alas, it all came to nothing. First the AG Judging Panel refused to nominate a winner. My Romanian friendly rival travelled all the way to Waikerie to plead, but without result.

The rumours suggested that both designs contained "serious deficiencies" which were impossible to fix. My own opinion is that the sponsors "chickened out" when they came to realise the money and effort required of them to complete the certification of the winning design.

In any event, only two of the new "1974 Rules" Standard Class gliders made it to Australia in time for the contest. Helmut Reichmann won the event with the LS-2, which had a good glide performance but very poor handling. This was a fiberglass machine with a parallel wing for most of the span. This section was flapped. The tips tapered sharply and contained the small ailerons.

The other competitive design was the PIK-20. I flew one a couple of years later and it had reasonable handling, but with a multitude of windings to get the landing flaps down. Its performance suffered from a large fuselage, moderate aspect ratio and a thick 17% section at the root.

When it eventually flew, the MOBA design proved it would have been competitive, with its thin 15% section, high aspect ratio of 25, and a minimum section fuselage, which suits the designer but is too small for a production sailplane.

The only other "1974 Rules" sailplane flying was the formidable Schreder RS-15. For some reason it did not appear at Waikerie.

All this effort came to nothing as the CIVV shortly thereafter abandoned the special 1974 rules. Flaps were again prohibited in the Standard Class and the CIVV introduced the Racing Class, for which the span was restricted to 15 meters, with no other restrictions. Dive brakes were added to the PIK-20, which became the first of the new "Racing Class" sailplanes. The LS-2 disappeared without trace, and was replaced by the much more conventional and docile LS-3.

What to do next? So much design work had already gone into the MOBA-2C that I did not want to abandon it. Besides which, I had a point to prove. As a matter of honour, I really needed to disprove those rumours of"major design faults".

The whole story of building MOBA - "My Own Beautiful Aircraft" - has already been published in "Australian Gliding" Magazine in 1977-1978, and reprinted in "Soaring" in the December 1980 issue. New readers can refer to the "Collected Works of Stan Hall", which reproduces the "Soaring" information, so there is no need to repeat it here.
In summary, the construction took from 1974 to 1979, mostly evenings, plus one day each weekend. In those days we did not own a television! Later we bought one, to get the children home in the evenings!

Flight testing took most of 1980, and comprised 61 hours, including 24 hours of competition flying, after which the design was awarded a Type Certificate, and the aircraft, registered as VH-GVI, was issued with a Certificate of Airworthiness.

As the glider is now 20 years old, it may be in order to report on our experience.together and what has been learned in the process.

A few adjustments had to be made before certification, including a change to the aileron gearing, to lower the stick loads.

Another minor change had a big effect on flight characteristics. MOBA flew initially with very small wing tip wheels. These worked well on hard runways but were a hazard on soft grass. With a wing loading of about 8 pounds per square foot, it was very easy to drop a wing. The small wheels would then sink into the soft ground and we would perform a fast ground loop. The eventual fix was to fit much larger tip wheels, but even so, the preference is to take off from hard runways if at all possible.

The next modification was rather more substantial. The still air glide performance was about one in ten at 55 knots with full landing flap. This was adequate for airfields and most Australian paddocks, which are usually large. However, we have very small fields in the hill areas where we sometimes fly, and a more normal approach angle of about one in seven was desirable. The modification to add spoilers to the wing solves this problem, and also gives the glider pilot more control during all stages of the circuit, with infinite adjustments in performance between maximum glide, down to one in seven angle of approach.

This was the sort of flexibility that I had experienced with our previous sailplanes, like the LO 150 and the Open Libelle.

The spoilers for MOBA are positioned well aft of the spar, just forward of the flap hinge. This minimises any disturbance to the wing and they are, in fact, quite effective in providing the required approach angle. Full flap is always used for landing, with spoiler applied as required. Touch down speed is about 30 knots.

The effect of spoilers on the wing load/span distribution is to shed load from the center section, which then has to be carried outboard, resulting in increased wing bending from the inboard wing to the root.
The solution was to increase the chord at the root by two inches and maintain the inboard loading in this way in all conditions. This actually improves the total lift distribution clean, to a closer approximation to the ideal elliptical form.

Because this change involved some additional flight testing and a minor reduction in manoeuvring speed, the glider has been redesignated as the MOBA-2D version (See Figure 2).

Another major problem is caused by the method of manufacture used for the wing. You may recall that the wing is formed from a large alloy box spar, to which fiberglass and plywood ribs are bolted at two foot spaces. Between these ribs we have blocks of one pound per cubic foot urethane foam, which is sanded back to rib profile and covered with the fiberglass skin.

This type of urethane foam is weak and unstable, and tends to "grow" in dimension with time. This tends to produce a series of "hills" between the ribs, with "valleys" left over the ribs. The effect is more noticeable where the block is at maximum thickness, and is not apparent at the leading edges or over the spars.

When first constructed, the wing profile was reasonably accurate and the calculated performance of one in 38 to 40 seemed to be achieved, or bettered. Against sailplanes like the 17 meter Diamant the Open Libelle and the Nimbus 2, the MOBA glide performance at low speeds, from 50-70 knots, was very competitive. At higher speeds the Nimbus leapt away, as was expected.

After a year or so the "hills and valleys" effect started to be pronounced, so a great deal of time and effort went into re-profiling the wing and repainting it. This lasted for a few more years, but now we are back to square one, with a current best glide ratio of about 35.

The fix to this problem is to strip off all of the fiberglass skin and foam and start again, substituting a sandwich skin construction of fiberglass and nine pounds per cubic foot PVC foam. This would be about the same total weight, or lighter, in that there will be less microballoon and filler required to the outside profile.

If we had still been involved in' the contest flying scene, this would have been the only option. However, we have both retired from contest flying and the MOBA is only flown occasionally at rallies and for local soaring. In this situation it is not worth the effort and expense to restore the original profile, given that the existing wing works well enough as it is.

The whole project has been enjoyable and rewarding. Although six years to build sounds like a lot of effort, in fact it is no different, in time and difficulty, than building six model aircraft in a row. The final results are well worth it.
The actual cost was about $1000 in 1974 dollars. For comparison, the Kestrel canopy bubble cost $400 at the time, and costs about $4000 now, so I guess current materials would cost about ten times the original prices.

# BOOK REVIEW

*By Peter Champness*

Bird Flight as the basis of Aviation, a contribution toward a system of aviation.
Otto Lilienthal
American Aeronautical Archives
Markowski International Publishers
2001.

The translation of Otto Lilenthal's book has been republished by Michael Markowski (aeronautical engineer, pilot, aviation author and publisher). The original work was first published in 1889 and translated into English some years later in 1911. Otto's brother Gustav contributed a biographical introduction and an addendum after Otto's death. The Markowski edition is an unabridged facsimile of the original including all the original pictures and diagrams.

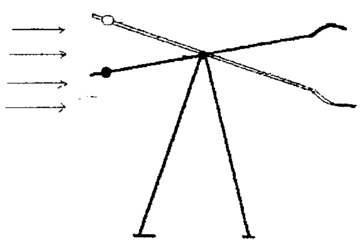
Otto Lilienthal was by far the most important contributor to the development of aviation before the Wright Brothers (who made the first powered flight in 1903) and was the first to achieve consistent and repeated gliding flights. He made many hundreds of flights from 1893 until his death in 1896. He died as a result of injuries received when his glider was upset by a gust of wind and crashed.

Otto and his brother grew up in the small German town of Anklam and even as small boys developed a fascination about the flight of birds. In Stork in particular was the source of their inspiration. This large and handsome gliding bird migrates from Africa to Northern Europe where the birds nest on the chimney tops of houses, particularly in the smaller towns. The birds are thus easily observed at close range, during the summer when the weather is fine and pleasant outdoors. Even more importantly the young birds can be observed and their early flying attempts studied. Otto and Gustav found that young storks were easily domesticated (at least for a short time) and hence their early flying lessons could be observed at even closer range. Otto was impressed by the rapidity with which the young birds learnt to fly. On one occasion when he was away from home for a period of only three days his young Storks has progressed from making tentative flapping hops across the ground to soaring flight and had joined a flock of passing birds migrating south before he came home!

The observation of young storks convinced Lilenthal that flying must be easy, at least as far as the basic qualities were concerned. Large gliding birds are the most efficient flying creatures found in nature. Lilienthal believed that by application of a proper understanding of the natural features of birds he would be able to construct a flying machine capable of carrying a man. The only remaining requirement was the development of the skill required to direct his wings against the wind in a controlled and efficient manner. This he reasoned could be achieved by practice.

One of the earliest of his discoveries was the greatly enhanced lifting property of a curved surface, such as the cross section of a birds wing, compared to flat surfaces. To test the properties of lifting surfaces he conducted experiments over a period of many years using a number a clever pieces of apparatus which he designed and constructed himself. One of these was a horizontal wind vane shaped like an arrow and pivoting about a horizontal axis. When fitted with a flat surface at the rear the vane remained horizontal , parallel to the wind. But when a curved surface was placed at the rear convex upward the back was lifted up, or alternatively if the curved piece was placed the other way round the back would be depressed.
Actually the wind vane experiment lead Lilenthal to one of his few wrong conclusions ( in my view). Lilenthal had observed that Storks have a good deal of difficulty getting of the ground in calm conditions, but that take off is much easier with a wind blowing and that they always take off toward the wind even if it means heading straight toward a threat. What is more, when the Stork clears the height of the surrounding trees where the wind blows more steadily it is able to stop flapping and begins sailing flight often without circling. These observations made him think that there must be some special lifting property of a wind that made flying easier.

The lifting property of the wind was confirmed by the wind vane experiment. Even with the flat surface of the rear he noticed that the vane whilst it oscillated with the gusts tended to point slightly down. Setting up a recording drum chart recorder he established that there was a mean upward component of the wind on a large inland plain of 3 degrees, and by setting his wind vane on a long pole he found that this effect persisted to an altitude of at least 30 feet.



Wind vane experiment demonstrating the lifting capacity of curved surfaces even at negative angles of attack!

Exactly how this effect occurred is unclear. Logic suggests that the wind near the surface must remain horizontal on average. Indeed the experience of glider pilots seems to be that the mean velocity of the wind is down in most places, with only a few isolated patches of rising air. I tried to check his result using the wind vane of a yacht held horizontally at arms length near the waters edge. The vane was well balanced in the calm but in the wind it did indeed point slightly down. Perhaps it was affect by the upward sloping beach just behind me. I might try to check it out with a more accurate experiment one day.
Lilenthal then began a series of experiments to establish the reaction of the wind on a variety of curved surfaces. Measuring lift and drag for all angles of attack from −12 to 90 degrees. He found that slightly curved surfaces similar to the curvature of a birds wing gave the best results, which did not surprise him as he had already decided that nature achieves the most efficient methods possible. He also found that small angles of attack (0-15 degrees) gave the best lift for minimum drag. He tables are published at the end of the book and are interesting to study. His results may have been slightly optimistic. The Wright Brothers certainly thought so. They based their first glider of the Lilienthal tables but were so disappointed by the lifting capacity (or lack of it) that they conducted their own experiments to estimate the coefficients of lift and drag for their aerofoils. Lilenthal used his results to calculate the L:D of a Stork as 40:1, which does indeed seem a bit too good to be true.

Lilenthal then set about building his gliders which were indeed the culmination of many models and kites which he had been making since his childhood. He spent a good deal of money on these projects including constructing a special hill, 15 metres high, from which to perform his glides. He constructed a hangar at the top of the hill to house the gliders and took off from the roof of the hangar. His glider were masterpieces of design, with very pleasing proportions even to the modern eye, compared with the Wright Brothers rather pragmatic designs. He even had a very elegant tail at the back on most gliders. He clearly understood the necessity for proper balance and used weight shift to control the flight. His last glider incorporated movable pinions at the end of the wings indicating the possibility of lateral control by aerodynamic forces. He had apparently intended to fit a motor to this glider.

A good deal of the book is devoted to analysis of flapping flight, especially the requirement to twist the outer parts to the wing on the down stroke to give the necessary forward thrust, a requirement which can be achieved by placing the spar very near the front of the wing, as with a feather. The twisting effect can then occur automatically. He also analyses the power requirement for sustained flight either by flapping or by the use of a propeller and concludes that about 1/3 horsepower is required, which he realized was too much for a man to sustain himself by his own efforts for any length of time.

Looking again at the plan view of the Lilienthal glider I noticed that the struts which support the fabric wing surfaces all come together at the inboard end of each wing. It seems a natural point to incorporate a flapping hinge and the flying wires below the wing come to a separate strut on each side, which could have been used as a lever for flapping the wings. I suspect therefore that the powered aircraft he intended would have been an ornithopter, a flying machine which still has not been successfully made to this day, except in model form! Unfortunately Lilenthal does not discuss the particular features of his gliders. Perhaps he would have written another book if he had lived a bit longer.

For those who would like to purchase this book, I regret that I do not know of an Australian distributor. I bought a copy on the Internet from http://www.buildersbooks.com but one could also write to them at PO Box 270 Tabernash, CO 80478 USA. Ph9708872207, Fax 970 887 2197. The cost including postage and insurance was US$31.95, which is quite expensive for a paperback of 151 pages. However if you are interested in Bird Flight as the basis for future designs, a subject still not fully explored, it is still a useful and interesting starting point, even 110 years after Otto Lilienthal's amazing contribution.

## HINTS & TIPS

# GOOD IDEAS

**by Peter Raphael (The Erudite)**

Here are a couple of good ideas we used in assembling wooden structures.

We used Epiglue, a gel-like epoxy and the instructions dictate a 2:1 glue/hardener mix by volume.
We find that the most convenient way of measuring this out for the usually moderate quantities required, is to use the large plastic syringes obtainable from chemists. Do not be self conscious in asking , by now people are probably convinced there is something wrong with you anyway! (And more if you tell them you are building a sailplane and you need it to mix something to make you fly high).

Two are required, one for the hardener and one for the resin, and marked accordingly. By cutting away the end of the syringe, this can be pushed into the glue as the plunger is drawn back, the calibrations allowing for accurate calculation of ratios. The excess is scraped off on the side of the can and once measuring is complete the syringe can be wiped with apiece of disposable paper towel ready for their next use.

Application of the epoxy to the structure can be messy at the best of times and when tackling major areas like wing skins, time id of the essence. A successful technique that we have adopted is to place the mixed epoxy into small ziplock plastic bags, similar to the type that banks store coins in (If only we could convince them not to punch holes in the top, tape these!).

These are perhaps a little heavier duty that the domestic variety and so can be dragged across a sharp edge to extract the last of the contents. A corner is cut off to give about a3 mm nozzle and allow the glue to be" piped" onto the structure. This must then be spread to completely coat the glue face and with a little practice will result in a very even squeeze-out.

The couple of added advantages with this method is that the glue is still being mixed during application and quick application minimizes the exothermic heating of the glue which would reduce the open time.

When skinning wing structures like the Woodstock or Duster the 6mm ribs used do not provide a good target for the staples, usually resulting in a number of misses. As part of the skin preparation we have found it useful to use a builders chalk line to lay out the position of the rib lines and spar margins on the outer skin surface. This provides for quick and accurate placement of tacking strips and assist in ensuring quality glue lines.

When rigging the aircraft incidence and attitude during initial assembly, several metres of clear plastic tube will be useful. This can be used as a water level and will allow the fuselage datum to be set accurately by extension to the extremes of the aircraft. With the ends taped to a straight edge a long and accurate level can be made to set washout and compare incidence settings.
When construction is complete the tubing can be put to work in plumbing the instruments.

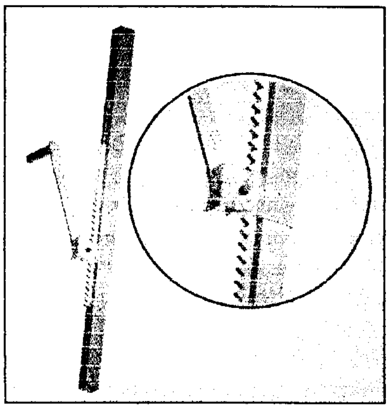
Of course we all wear gloves when handling epoxy, but there is nothing worse than hands covered in glue or resin when you are reaching for tools. Keep a can of talcum powder handy and sprinkle this onto your gloves when this happens. This will take care of the problem. A sprinkle over the hands before pulling on the gloves makes this task a little easier too.

A dab of bright nail polish (sneak this out of the bathroom), on the threads of bolts that have been final fitted will identify these when assembling the aircraft. This will prevent everyone having a go and overtightening the hardware.

# Trailer tilting device

*An excerpt from Australian Gliding*
Kevin Olerhead has designed and built a nifty rack and pinion tilting arrangement for his Standard Cirrus Trailer.

It consist of two Rolled Hollow Section (RHS) square tubes of approximately 1.3/3"(outer) and 1.1/2"(inner).



A slot of about eighteen inches in length has been cut in the outer tube to accommodate the rack which is welded onto the inner tube.

A flywheel was obtained from a wrecker's yard. The ring gear was removed by cutting through it with a hacksaw, after which it was straightened cold, on an anvil.

The pinion is from the same car's starter motor; it is mounted on the outside tube. It was brazed to a shaft with a handle. A good source for discarded pinions is your local auto electrician.

The two tubes have holes drilled through to accommodate a locking pin.

Because it takes 2 ½ turns of the handle to go from level to the desired tilt angle, it means that the forces on the handle are easily managed. With suitably located locking holes in the two tubes, a wide range of tilt angles can be achieved.

This simple device makes for effortless trailer tilting.

## ELECTRICAL.SYSTEMS FOR SAILPLANES.

A correctly installed and maintained electrical system is critical to the satisfactory performance and safety of a modern sailplane. Proper installation and maintenance of electrical system will result in many years of trouble free service.

### *DEFINITIONS*

***POSITIVE***. The positive (+ or red) terminal of the battery. Also wires connected to this terminal, through switches or fuses, up to the point of contact with any electrical equipment..

***NEGATIVE***. The negative (- or black) terminal of the battery. Also wires connected to this terminal up to the point of contact with any electrical equipment.

***BONDING***. The electrical connection of all metal components within an airframe. This is particularly important in aircraft which use the airframe to connect the negative battery terminal to the equipment ( only applicable to aluminium gliders) and for aircraft which will be flying in thunderstorms as lightning protection (this is not legal in Australia).

### *CONNECTORS*

These are the quick release joints between wires. For example the joint between the battery and the aircraft's electrical system.

### *TERMINALS*

Terminals are used to connect wire to components such as switches etc.etc.

### *ANNUAL INSPECTION*

At each Form 2 inspection the electrical system must be checked to ensure that it is still in airworthy condition. If the manufacturer has installed an electrical system in the glider it must be maintained in accordance with the manufacturers instructions. When checking the electrical system the following defects should be looked for.

A Damaged or overheated equipment, switches, connections, wiring and insulation.
B. Poor electrical bonding. If bonding was not fitted by the manufacturer there is no need to fit it.
C. Dirty equipment and connections.
D. Improper support of wiring.
E. loose connector and terminals.
F. insufficient clearance between exposed current carrying parts and ground.
G. Faulty circuit protection and current limiting devices.

All electrical equipment should be kept free of dust, dirt and grime. Fine sand paper may be used to clean terminals and mating surfaces if they are corroded or dirty.

When inspecting an electrical system the Form 2 inspector should ensure that the system has safe operating characteristics with respect to master switches, fuses, wiring quality etc .

### *THE BATTERY*

The battery is used to provide electrical energy to drive the equipment. Most gliders use 12 Volts batteries of at least 6-8 Amp-Hour capacity. In order to improve reliability many modern sailplanes (an a few older ones) are fitted with a dual battery system using the secondary battery as a back-up in case the first battery goes flat.

When installing a dual battery system it is necessary to install switching so that both batteries can be connected by one switch in case of a short circuit.

Note: A battery of 1 Ah is capable of delivering a current of 1 Amp for a period of 1 hour.

## NEW SUBSCRIBERS -

***We have new subscribers to welcome to the group, this time namely:***
***Douglas Cole.24 Gladys Gve.Croydon. Victoria 3136.***

***WELCOME ABOARD fellows!***

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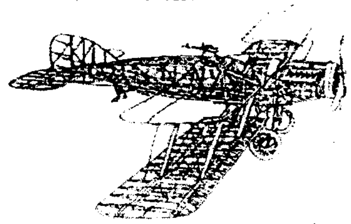

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## FOR SALE

Bench to build the Woodstock. Two already have been built on it the first being Les Squires and the second James Garay.
Asking price $ 50.00.
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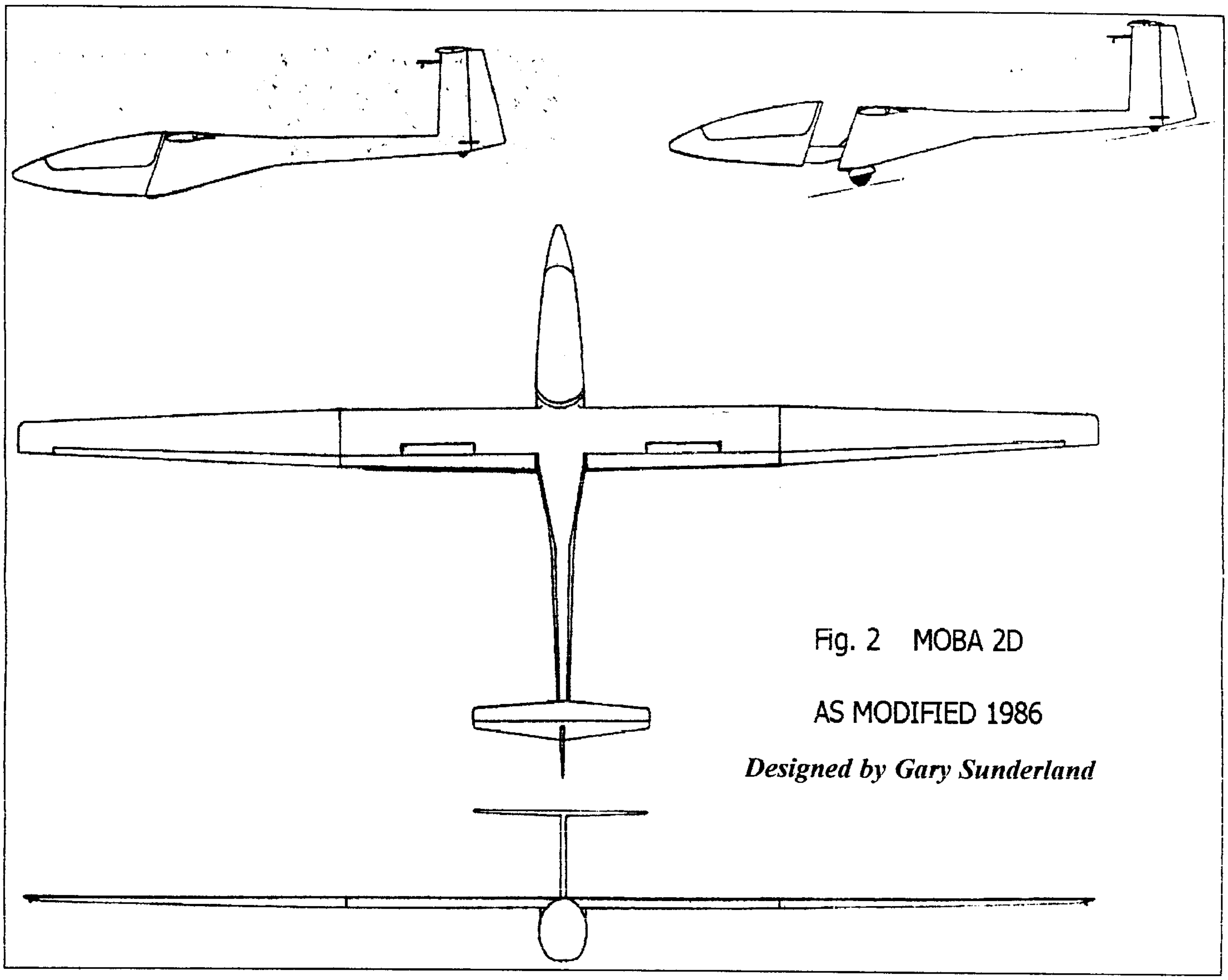

Fig. 2 MOBA 2D

AS MODIFIED 1986

***Designed by Gary Sunderland***

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**THE AUSTRALIAN HOMEBUILT SAILPLANE**

*3 Magnolia Avenue, Kings Park, Victoria 3021 AUSTRALIA*

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