

# Scale Soaring UK

The forum for all your modelling requirements relating to scale gliders  
<https://scalesoaring.co.uk/phpBB3/>

## Schweizer SGS 1-23H/15

<https://scalesoaring.co.uk/phpBB3/viewtopic.php?f=12&t=974>

### Schweizer SGS 1-23H/15

Page 1 of 1

by **B Sharp**

Posted: **27 May 2016, 18:46**

First some background to this build. Way back in 1968 I went to the cinema to see Steve McQueen in The Thomas Crown Affair and was totally grabbed by the glider sequence in the film. I had only just started full size gliding at that point and I really wanted to be Steve and I really wanted to fly that little yellow Schweizer. Recently I was given a DVD of the film and the obsession was reignited.

The Schweizer 1-23 was first designed and built in 1948 and progressed through a number of models till production ceased in 1967. A 1-23, flown by William Ivans, set a world altitude record for gliders in 1950, reaching a height of 42,089 ft and Paul Bikle flew a 1-23E to a world absolute altitude record of 46,267 in 1961. The model I intend to build is the 1-23H/15 which is the model featured in the film.



1-23H.jpg (9.57 KiB) Viewed 3088 times



A little while ago I put out a request on this forum for a set of plans for this machine and my new "best friend" ARUP over in the USA was able to acquire for me a set of plans originally drawn by TRMC models. These plans are to 1/4 scale and are highly detailed and cover most of the 1-23 model types, including the "H" model I am interested in. Thanks ARUP, you are a STAR. I have decided in this case to stick with 1:4 scale rather than enlarging the plans to 1:3.5 as I am finding that carrying big heavy gliders 1/2 mile to the top of my local hill is starting to get to me as I grow older by the year.

I started cutting wood a couple of weeks ago and I now have a pile of plywood components ready to assemble onto my jig.

### Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **03 Jun 2016, 19:06**

Construction of the 1-23 has now started. It seems to have taken ages to manufacture all the

various plywood bits and pieces that go to make the fuselage. The formers have been mounted on my jig with the lower and upper crutches tack glued in place and it all looks straight and even. 😊

It was only when I started to offer up the full length plywood side stringers that the problems started. The formers which I so carefully transferred from the plans and cut have slots and checks in the wrong places. Some slots are too long, others too short and some just totally in the wrong place. I have two formers, unfortunately large important ones, which are the wrong shape entirely. (I should have checked basic sizes between the drawing of the former and the plan itself) Some of the longerons on the back of the fuselage have kinks along their length where location slots are misplaced. 🙄



Most of the formers attached to the upper and lower crutches and tacked in place.



Everything looks pretty straight and even.

The question is, do I re-draw and replace these parts or do I bodge them? The plans may look splendid but that doesn't mean that they are accurate. Oh POOK! 🙄🙄🙄

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **03 Jun 2016, 23:54**

No Arup, it will all come good in the long run. It is just disappointing when you get a lovely plan and the drawn parts don't fit.

Brian.

## Re: Schweizer SGS 1-23H/15

by **roo Hawkins**

Posted: **04 Jun 2016, 11:46**

Hi Brian are you doing it in the same color as Steve McQueen's and also to have his head 3d printed. Best of luck with the build mate .ROO 😊😊 windmills in my mind

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **07 Jun 2016, 21:26**

I have now got a bit more done of the 1-23 fuselage. I had to re-draw and re-cut two of the main formers as they were just plain wrong. I have also adjusted the position of a number of the slots in the formers for the stringers so that the lengths of spruce now run in straight lines along the back of the fuselage.

The side frames have been fitted and checked for alignment. These have effectively joined the

front and rear sections of the fuselage together. The cut-outs for the wing joiner boxes will need a little final fettling when the wings are offered up at some point in the future.

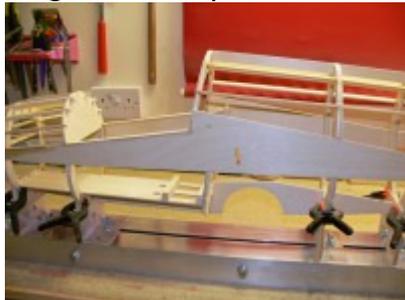
I have installed the cockpit floor with mountings for the elevator and rudder servos. I have also installed a ply plate across the front section of the fuselage to house the aerotow release servo. This will be mounted upside down on the plate with a solid push/pull rod to the release mechanism in the nosecone.



Progress as of 7pm this evening.



Progress as of 7pm this evening.



Cockpit area and center section all joined together by the side frames.



The cockpit floor added with the servo locations.



The tray added to the nose to provide a home for the aerotow release servo.

So far so good, I find that I am doing a lot of dry assembly, tearing it down, modifying parts several times then reassembling long before I get to the gluing part.

Brian. 😊

## Re: Schweizer SGS 1-23H/15

by **RobbieB**

Posted: **07 Jun 2016, 23:18**

Coming on nicely now Brian but the dust on the rubbish bin.....tut tut, standards are really dropping.

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **08 Jun 2016, 21:17**

After doing a bit more work on the fuselage this afternoon with more stringers I started on the tail mounting. It quickly became clear that I could only take this so far without a tailplane to offer up to the structure. So, this evening I have started the tailplane and elevator construction over the plan. The tailplane and elevator are balsa frames which are sanded to plan and profile then fully sheeted with 1/16 balsa top and bottom. An hour or so's work saw me with the basic frames ready for sanding to profile.



Tailplane and elevator frames ready for profiling.

Robbie, I was mortified when you spotted the dust on my dustbin lid. You will be pleased to know that I have now wiped down the whole bin and applied a coat of glade household polish to return it to it's usual immaculate condition. 😊

Brian. 😊

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **10 Jun 2016, 18:33**

The tailplane and elevator frames have now been sheeted with 1/16 balsa and sanded to their final shape and profiles. The plan calls for a fairly complex retention arrangement for the tailplane onto the fuselage. There is a piece of 1/8 ply mounted on the rear fuselage with four mounting lugs which protrude out beyond the sides of the fuselage. The plans suggest that a piece of shaped 1/16 ply is stuck to the top surface of the tailplane and 4 @ 3mm bolts pass down through the tailplane on either side of the rudder location and into retaining nuts. This seemed overly complex to me, and apart from anything else it would be a nightmare getting four bolts to line up during assembly.



The completed tailplane and elevator mounted on the fuselage frame.



The simplified single bolt attachment to the fuselage.

I modified/simplified the setup by installing a 1/8 plywood tray inside the central structure of the underside of the tailplane. A single 6mm retaining bolt comes down from the top of the tailplane and the head is neatly buried in the tailplane itself. The whole tail unit is very secure and it is stopped from swiveling by the front of the tailplane being notched into the fuselage. No more posts for a little while as I am about to be whisked of to foreign climes for a couple of weeks.

Brian. 😊

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **26 Jun 2016, 23:24**

Ok, back from my travels and on with the build. It made sense to continue with the rest of the tail feathers so the next task was the fin and rudder. The fin was framed up on the tail post with the addition of internal spar and leading edge and then sanded down to its finished profile ready for skinning with 1/64 ply.



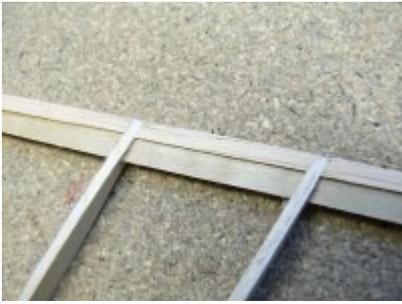
The fin all framed up ready for sanding to profile.



Fin sanded to profile and ready for skinning.



The rudder framework taken to the same stage.



Balsa infill added to the TE for additional gluing support for the skin.



The completed fin and rudder frames ready for their plywood skins.

The fin was then constructed in a similar manner. The trailing edge was cut from 1/32 plywood, and after sanding the ribs to shape it struck me that there wasn't a great deal of gluing area for the 1/64 ply skins. I decided to add some 1/4 x 3/32 balsa infill pieces to the ply TE to provide a better gluing surface for the skins.

Brian. 😊

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **28 Jun 2016, 16:49**

I have now completed the fin and rudder. The shaped frames were skinned with 1/64 ply. The ply was attached to one side of the frames with cyano and the other side using pvc with the skin ironed into place when the glue was dry. Balsa leading edges and tip blocks were added before final shaping. A notch was cut in the base of the rudder to take the epoxy board control horn at a later date.



The completed fin and rudder with skins attached and LE and tips added.



1/4 balsa added each side of the spine and everything sanded to the formers.

With the tail feathers now complete I started back on the fuselage. I decided to add 1/4 balsa

strips to each side of the upper spine to increase the gluing area for the 1/8 balsa fuselage sheeting. It does not have this on the plan but I am trying to anticipate possible problems as I go along, purely based on past experience. The upper stringers and spine have now all been sanded to match the profile of the formers.

Brian. 😊

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

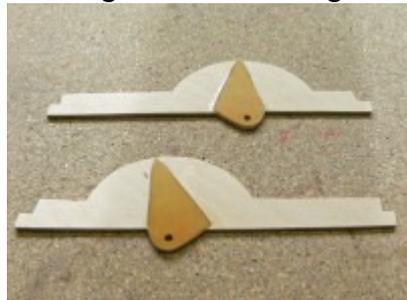
Posted: **29 Jun 2016, 18:29**

The fuselage is now off the jig and I have fitted the remaining stringers to the lower portion. Once again this took a fair amount of sawing, cutting and filing to get them to fit the formers straight and true but it's done now. 😊

Next up was the undercarriage mounting frames where once again I encountered inconsistencies on the plans. The side elevation specifies the frames be made of 1/4 ply, and this is what I cut a few weeks ago. I have to say that at the time they looked very thick and chunky. However when I offered them up to their location points in the formers they were way over-thick. 😞



The original undercarriage mounting frames now consigned to the bin.



The revised frames with the reinforcing plates added.



The undercarriage frames in place with the axle fitted to get things straight.

The plan view and the former layout drawing both have 1/8 inch slots. I re-cut the undercarriage frames in 1/8 birch ply but now I worried whether they would be strong enough - some of my landings can be less than perfect don't you know. I ended up cutting reinforcing plates from 1mm epoxy board and gluing them to the side frames. These have now been added to the fuselage and I am happy the wheel axle is sitting square. 😊

Brian. 😊

## Re: Schweizer SGS 1-23H/15

by **RobbieB**

Posted: **29 Jun 2016, 22:36**

Brian, I have never used anything bigger than 3mm ply for wheel bay cheeks, like you, reinforced with epoxy sheet right up to my Skylark at over 10kg.

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **30 Jun 2016, 20:28**

I have now completed the inner surface of the wheel well and attached balsa strips round the undercarriage frames to provide support for the balsa fuselage skins. I have done the same for the lower fuselage spine as well to provide extra gluing area.



Balsa support for the sheeting all around the wheel mount.



The elevator pushrod arrangement.



The pushrod support mid way up the fuselage.

The fuselage is quite long and the servos sit beneath the pilots seat so the elevator push rod is also rather long, 1 metre in fact. After much debate I opted to use a length of 8mm alloy tube with rods and clevises attached at each end. Due to the length of the pushrod I ran it through a supporting bracket made of brass tube and ply, mounted mid-way back the fuselage, to avoid any bowing of the pushrod under flight loads.

Brian. 😊

## Re: Schweizer SGS 1-23H/15

by **Barry\_Cole**

Posted: **30 Jun 2016, 20:51**

Don't forget to put the screw in that servo horn.....



BC

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **30 Jun 2016, 23:11**

Done!

Brian. 😊

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **02 Jul 2016, 13:53**

I have now started on the fuselage sheeting which is specified on the plan as 1/8 inch balsa. The plans also specify applying the sheeting in sections. I started with the extreme tail and found that I could not get 1/8 sheet to bend round the extreme curve of the fuselage, even after being soaked with water containing ammonia. I ended up applying 1/16 balsa sheeting followed by a second lamination of 1/16 balsa.

The rudder pull-pull controls run through short plastic conduits which are lined up with the servo at the front and held in place with a couple of balsa braces glued to the framework.



The rear end double sheeted with 1/16 balsa.



The pull-pull cable conduits firmly located in the rear fuselage.



A start made on the aft fuselage 1/8 balsa sheeting.

The main rear section of the fuselage is once again to be sheeted with 1/8 balsa. Once again because of the curvature at the top and bottom I have elected to do this with wide planks rather than in whole sheets. These planks will narrow as I get towards the top and bottom. I don't suppose I would have had so much of a problem if I had chosen to use very soft balsa sheet. However I don't like using soft sheet, preferring instead a medium density for improved resilience when in use.

Brian. 😊

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **07 Jul 2016, 20:45**

The sheeting of the fuselage is progressing surely but slowly. I have only a couple of bits of sheeting to place on the wing seat before I start setting up the wing joiner assemblies. However I have currently run out of adhesives and I am patiently waiting for these to arrive in the post. While I waited for the glue on the sheeting to set I blocked up the wood for the nose cone. As you will notice I left some space in the centre for the aerotow release mechanism.



The fuselage is getting there slowly.



The nose cone all blocked up with a hollow centre.



The aerotow release installed.



Some lead added to the extreme nose.

I have also taken the opportunity to load the area around the tow release with slices of lead glued into place. I am working on the basis that I will probably need a fair bit of the heavy stuff to balance the finished model and it seemed sensible to get some of this as far forward as it will go.

Brian. 😊

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **09 Jul 2016, 13:13**

I have now reached the point where I need to consider the wing joining system and for that I

also need a wing.

The drawn plan shows a traditional built-up wing structure with an airfoil section which is very close to Clark-Y and a joiner made from a piece of bent aluminium round bar. It's at this point that I start to go seriously "off piste" and do my own thing for a variety of reasons.

For starters, I am not an enormous fan of Clark-Y, especially when I saw that the designer had built 3.5 degrees of washout into the tip panels, presumably to prevent tip stall at low speeds. I decided very early on that I was going to substitute HQ3.5/12 as my wing section. It is about the same thickness as Clark-Y, it has known and docile flight characteristics, it is rather closer in shape to the airfoil used on the full size aeroplane and it doesn't require a whole pile of washout at the wing tip.

Secondly, I don't use aluminium bar for wing joiners - full stop - ever. (I did that once on a very expensive thermal soaring kit from the US and watched the wings clap hands on the second winch launch) I have chosen instead to use the well known and proven steel blade and brass box system. It is easy to set up, sufficiently strong and I have it in stock.

The third change is probably the most controversial. The full size aeroplane is of all-metal construction and I intend to cover the whole finished airframe in glass cloth to replicate the full size machine. In a moment of brilliance (or madness - you choose) I realised that I could construct a foam/ veneered wing which would fit the purpose perfectly. However after checking my stocks of foam and veneer I discovered that my foam cutting bow was too short to cut the tapered outer wing panels (Drat and Blast) and I didn't have veneer long enough to cover the whole wing panel. After a bit of head scratching I contacted Philip at Cloud Models and he gave me a very reasonable quote for a pair of wings to my specifications. I now have the wings and they are exactly what I required. The surface finish and the shape are perfect, there are spars fitted to half way out the tip panel, there is a space left between the spars at the root for the joiner system, boxes cut for the aileron servos and ducting for the wiring.



One perfect wing panel, just as it arrived, straight from Cloud Models.



The wing root showing the HQ3.5/12 profile, the wiring conduit and the spruce spars.



I started work by marking out the aileron and spoiler positions.

So it is with these panels that I am beginning the wing construction. I suppose that some scale

purists will be appalled at this approach but I feel it will produce a better, more flyable model of this aeroplane.

Brian. 😊

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **10 Jul 2016, 17:21**

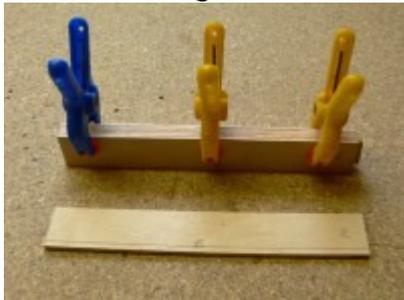
I have spent the afternoon making the joiner boxes for the wing (and watching the Grand Prix). The 16mm brass boxes are sandwiched between layers of 1/8 ply in such a way that the boxes are staggered fore and aft and the total thickness is 1/2 inch to fit neatly between the spars. Please note that I have named the boxes left and right as mistakes can happen when gluing them into the wings.



The components for a joiner box.



The brass box glued to the front face, the top and bottom rails and filler.



The rear face glued and clamped to the assembly.



The filler piece which provides a stagger on the boxes glued in place.



Two completed and "handed" units showing the stagger between the boxes.  
The attached photos will explain the process more easily than words.

Brian. 😊

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **14 Jul 2016, 21:06**

The hard 1/4 balsa leading edges have now been added and shaped. The joiner boxes were glued in with 24 hour epoxy and carefully alligned on both axis. The incidence peg units were manufactured and also glued into place after careful allignment.



The two 1/4 plywood inserts fore and aft are the attachment points for the wing retaining system.

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **25 Aug 2016, 14:10**

Its been a while since I last posted any progress on the 1-23. Other projects, holidays and life in general have conspired to keep me out of the workshop. However today I have started setting up the wing joiner boxes in the fuselage and ensuring that everything is straight and true. There wasn't a lot of fettling to do in order to get lined up so my building must be getting better.



The first full assembly.

There was only 0.01 degrees difference in the angle of incidence between left and right wings so I felt quite good about that. The first full assembly on the floor gave me what looks like a

recognisable aeroplane - so happy days.

Brian. 😊

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **28 Aug 2016, 17:48**

A bit more done today on the joiner system. I have enclosed the brass joiner boxes with 1/8 ply front, back, top and bottom so that should stop the joiners wandering about with the flight loads.



The brass joiner boxes securely "boxed in" with ply.



The incidence peg tubes reinforced with home made brackets.

I have also reinforced the location tubes for the incidence pegs with home made alloy brackets.

The next job will be to finish of the fuselage sheeting.

Brian. 😊

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **01 Sep 2016, 11:49**

The top of the fuselage has now been enclosed with sheeting. I have now started the planking on the nose of the model. I have also installed the tow release servo on a tray in the nose as it wont be readily accessible after the nose is fully sheeted.



Upper fuselage sheeting complete, nose planking started and tow release servo just visible in the nose.

Brian. 😊

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **09 Sep 2016, 18:22**

Well time rolls on and I have managed to progress the 1-23 a bit further in the last week. The

fuselage section forward of the cockpit is now fully planked and rough sanded. There are still plenty of cracks and hollows to be filled before final sanding can take place. The blocked out nose block has been glued in place, remembering to attach the pushrod from the release servo to the line release mechanism buried in the nose block. The nose block has also now been shaved and sanded down to profile.



Planking completed on the forward fuselage.



The nose block glued in place.



Noseblock shaped up and sanded and the root doublers glued into thier final place. I have cut the plywood root doubler ribs and these have now been located over the joiner tube stubs and glued into their correct final places on the fuselage sides. I have even left some of the wood shavings in the photos to prove that I do have a messy bench at times.  
Brian. 😊

### Re: Schweizer SGS 1-23H/15

by Barry\_Cole

Posted: 09 Sep 2016, 18:28

AAAAAAAAAAAAHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH



BC

### Re: Schweizer SGS 1-23H/15

by B Sharp

Posted: 12 Sep 2016, 11:53

AAAAAAAAAAAAHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH

Sore throat again Barry?



I have now added the distinctive tail cone which is particular to the 1-32H model. The slot in the top surface is for access to the pushrod and the elevator horn clearance.

Brian. 😊

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **13 Sep 2016, 21:08**

Now that the fuselage construction is pretty near finished it's the turn of the wings to get some attention. I could in theory fly the 1-23 as rudder/elevator but it would be best if I gave it some ailerons and airbrakes.



"The first cut is the deepest", sounds like a song to me.



All faced up and note the block inserts to support the hinges.



The servo bay and cover.

After measuring three times and cutting once I sliced out the ailerons from the outer panels of each wing half. After shaping I faced the cut edges of the wing and aileron with hard 1/8 balsa sheeting. At four points along each cut-out I have inserted additional block of balsa under the veneer as a seating for the pin hinges. The servo bays have been floored with 1/32 ply and lined out with 1/16 balsa sheeting. I have also formed ducts in the rear of the wing for the pushrods to run from the servo arms out to the aileron horns. The servos will be located on the servo well covers and I built little shelves round the inside edges of the bays so that the completed servo cover will sit flush with the finished wing surface.

Brian. 😊

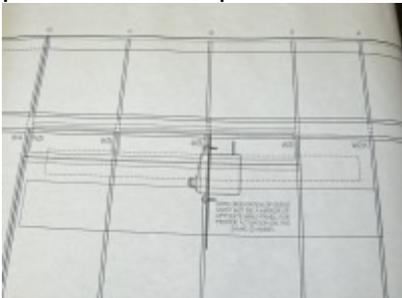
## Re: Schweizer SGS 1-23H/15

by **B Sharp**

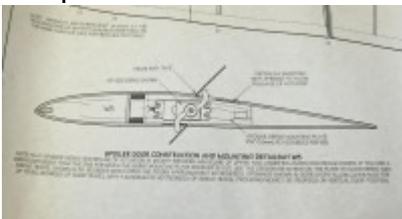
Posted: **18 Sep 2016, 18:28**

I have started this afternoon on the airbrakes/spoilers on the 1-23. Once again, after careful study of the plans, I have decided to head off down my own route for the brake assemblies and housing and here is why. 😊

The plans for the wings show a spoiler blade opening on the top surface of the wing and a separate smaller spoiler blade opening on the lower surface. These appear to be actuated by a circular arm mounted on the servo which in turn bears on the spoiler under surface to create the opening motion (there are no horns shown on the spoiler blades - so there is nothing to hold the blades shut in flight). Not only that, but the lower blade is hinged at the rear rather than the front, opening rather like the "suicide doors" on certain vintage cars. What keeps this blade in place against the wing structure in flight lord only knows. 😊 I can tell you now that this scheme has been abandoned as being totally impractical as the lower blade assembly would last less than the first millisecond of my first landing on my local hill. I have attached a couple of pictures of the spoiler assembly taken from the plans for you to work it out. 😊



The plan view of the airbrake/spoiler assembly.



The section showing the suggested operation. Note the "suicide door" brakes on the underside.



Scale position of the top spoiler box marked out.



Spoiler box excavated and lined.



The servo position .

Instead I have decided to use a single blade spoiler at the scale position on the top surface only, actuated by a short push-rod from the servo. As you can see I have started on the left wing by excavating a shallow seat for the blade with a deeper location pit for the servo and pushrod. All of this has been neatly lined with balsa sheet. The right wing will follow in the next couple of days. 😊

Brian.

## Re: Schweizer SGS 1-23H/15

by **Barry\_Cole**

Posted: **19 Sep 2016, 19:10**

Surely, the bottom door wold just blow fully open...

Brian,

I put a small round magnet on the two rear corners, to keep mine shut and level with the wing surface.

BC

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **19 Sep 2016, 22:20**

You are absolutely right Barry, as drawn, the bottom door would just drop down and flap in the breeze. If it was connected to a servo by a horn it would probably remain in place in flight but would be ripped off on landing on anything other than a bowling green surface.

I have used spoilers successfully in the past both with, and without, magnets. However on one very large thermal soarer I mounted a camera in the fuselage pointing down the wing. I was surprised to see that an unrestrained spoiler was partially opening in turns, obviously as the angle of attack increased during the turn.

On the 1-23 I have the depth in the wing to attach a short push rod from the servo arm to the underside of the spoiler blade which, with the correct geometry, should open the blade to about

75 to 80 degrees when deployed and still hold it firmly closed in normal flight.

Brian. 😊

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **24 Sep 2016, 17:11**

I now have most of the fuselage filled and sanded, ready for covering with glass cloth and it is convenient at this point to try and deal with the canopy. I had hoped that I would have been able to adapt a commercially available canopy however nothing seemed to have the correct shape or profile.

So I have had to start creating a plug/tool for pulling a custom formed canopy. This is not a job I enjoy doing as it usually takes me a week of fairly intensive effort to create a usable tool that will give me a satisfactory plug.



The big chunk of foam fitted to the cockpit opening.



The shaping process well under way.

I had a suitable piece of high density pink foam in the garage which had previously been used to form a plug for my BG135 canopy. I made up a couple of 1/32 ply templates and was able to hot-wire cut a close fitting chunk of foam to fit the cockpit opening. I have now started the shaping process using an old bread knife and some 60 grade sand paper (there is dust everywhere)!

Brian.

## Re: Schweizer SGS 1-23H/15

by **Stuart Ward**

Posted: **24 Sep 2016, 19:54**

Nice work Brian.

Is that a new blind. Not sure I like the colour 😊

Stu

## Re: Schweizer SGS 1-23H/15

by **RobbieB**

Posted: **24 Sep 2016, 22:00**

Stu,

Never mind the colour - feel the cleanliness 😊

## Re: Schweizer SGS 1-23H/15

by **RobbieB**

Posted: **24 Sep 2016, 22:05**

**B Sharp wrote:**

'..... I have now started the shaping process using an old bread knife and some 60 grade sand paper (there is dust everywhere)!  
Brian.

But not for long.

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **25 Sep 2016, 08:20**

Yeah, tell me about it Robbie. I am even having to wear a face mask as I work. Even Darth Vader would get a fright if he walked in right now.

Brian. 😊

## Re: Schweizer SGS 1-23H/15

by **RobbieB**

Posted: **25 Sep 2016, 09:21**

Brian, I know. I did the Skylark canopy plug in blue foam, if the dust wasn't enough its ability to attract an electric is something else making it stick to everything particularly your latest Gucci Kashmir sweater 😞

Outside doesn't help, the wind blows it everywhere.

## Re: Schweizer SGS 1-23H/15

by **SP250**

Posted: **25 Sep 2016, 11:16**

You old lags never heard of putting the vacuum cleaner hose next to the work while you sand foam, balsa etc.?

No fuss, no mess and no cleaning up afterwards.

Use a good one like a Henry though with plenty of suction.

JM

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **25 Sep 2016, 11:40**

JM, if I bought a vacuum for the workshop my wife would want to use it for the carpets. This would detract from the fun she has of hanging them over a line and beating them with a big stick.

Brian. 😊

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **25 Sep 2016, 17:07**

Got the canopy block sanded down to shape this afternoon. I find its a nerve wracking process because it is all too easy to take too much away but if you get it right it is a very satisfying process.



The raw canopy plug finish sanded.



Oh look, I've got an aeroplane!



I couldn't resist the temptation to fit all the components together and have a look at the fully assembled airframe for the first time. If I'm not very careful I may end up with a model that looks a bit like a Schweizer.

Brian. 😊

## Re: Schweizer SGS 1-23H/15

by **roo Hawkins**

Posted: **26 Sep 2016, 18:22**

Looking good . are you vac forming the canopy or are you stretching it around the plug?.

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **26 Sep 2016, 21:49**

Neither Roo, I'm not that clever. In the dim and distant past I did attempt to pull a canopy for a mosquito (don't ask!) following the instructions in an Aeromodeller Annual. I ended up with an unrecognisable blob of plastic attached to the inside of my mother's oven and a very pungent aroma pervading the house.

All of my more recent creations have been formed from tools made by me and sent off to a professional company (now Traplet) for the actual finished product. At close of play this evening

I have a high density pink foam canopy plug with the addition of wedged sections front and rear ( to aid release) and a ½ inch slice of foam on the base to give extra depth. Tomorrow it will be covered in brown tape and then chopped strand mat and polyester resin. The day after that It will be covered in a thick layer of filler before being sanded to it's finished shape.  
Brian.

## Re: Schweizer SGS 1-23H/15

by **chris williams**

Posted: **26 Sep 2016, 23:42**

Hmmm, sounds horribly familiar 😊

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **04 Nov 2016, 18:47**

In my last post on 26th Sept I predicted *“Tomorrow it will be covered in brown tape and then chopped strand mat and polyester resin. The day after that It will be covered in a thick layer of filler before being sanded to it's finished shape”*. Well that didn't happen then did it?

Due to a number of factors (harvest time, family commitments, damaged back and leg meaning I couldn't stand or walk or fly!!!) progress has been almost glacial. However this afternoon I have finished the mould/tool to my satisfaction. The final stage of shaping the filler to the finished tool has taken forever. The initial shaping happened quite quickly but there were numerous holes and indentations which required a second pass of filler. I have now done six passes of filler over the surface with fewer and fewer blemishes and pin holes remaining on each pass. I have just finished with a final polish with 1200 wet & dry and I am done. It's as smooth as an infant's posterior.



The completed foam form.



Covered with a layer of parcel tape.



The chopped strand mat and resin in place.



The tool covered with P38 car body filler.



The finished tool ready to send to Sarik.

The tool will head off to Barry at Sarik on Monday with a request for two pulled canopies (the second one in case of a fitting screw-up).

Brian. 😊

## Re: Schweizer SGS 1-23H/15

by **john greenfield**

Posted: **05 Nov 2016, 09:46**

Interesting that you finished the job with 1200 grade Brian. I have been told in the past that working to such a fine finish can cause problems with releasing from the mould.

I know Barry from Traplet looks on this forum so would be interested to hear from him as to the level of finish required for the ideal tool.

Great work though and I bet your workshop is spotless despite all that sanding dust !!?

AEB

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **05 Nov 2016, 11:02**

John, the 1200 was used because I ran out of 600 W&D. I always try to get the best surface finish I can so that the tool leaves as few marks on the moulding as possible. For my BG135 I used Herculite for the tool and it provided a superb, flawless alabaster finish but weighed a ton. However I have been speaking with Barry at Sarik and have pretty much followed his recommendations.

I have just been out to the workshop and have noticed a further four pinholes/flaws in the most noticeable parts of the canopy. That has meant a further application of filler in those locations.

Dam and blast! 😡

As to the dust - wrong once again - its everywhere. I intend to spend the afternoon planing a flat surface back onto my bench before I start the wing and fuselage covering, followed by a good clean up. Dam, Dam, Dam and Blast! 😞😞😞😞😞

## Re: Schweizer SGS 1-23H/15

by **Geoff Pearce**

Posted: **05 Nov 2016, 18:24**

Hi Brian,

Very interesting as I about to make a canopy plug for my Orlic.

Geoff

## Re: Schweizer SGS 1-23H/15

by **Geoff Pearce**

Posted: **06 Nov 2016, 10:25**

*Geoff Pearce wrote:*

Hi Brian,

Very interesting as I about to make a canopy plug for my Orlic.

I also have a 1/3 scale plug for a K8 if anybody wants the use of it.

Geoff

## Re: Schweizer SGS 1-23H/15

by **john greenfield**

Posted: **06 Nov 2016, 10:33**

*Geoff Pearce wrote:*

Hi Brian,

Very interesting as I about to make a canopy plug for my Orlic.

Geoff

Geoff

You do not need a canopy plug for your Orlik. All the glazing is flat panels (its one reason why I picked the subject !!).

AEB

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **09 Nov 2016, 16:44**

Now that the tool is off to Sarik to have a couple of canopies pulled I though I had better build a frame to hang them on. I used 1/8 plywood throughout with the corners reinforced with shaped spruce. It is held firmly onto the fuselage with eight little button magnets (four in the frame and four in the cockpit surround).



Finished canopy frame awaiting the canopy.



First batch of surfaces covered in cloth and awaiting the epoxy.

I have now begun to set up for the glassing of the airframe. The whole model will be covered in ½ oz/ m2 (excuse the mixed units) standard weave cloth. This will be fixed in place with laminating epoxy. It is quite a while since I covered a whole aeroplane with glass and epoxy and it can be a bit messy and time consuming.

Brian. 😊

### Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **22 Nov 2016, 17:49**

I have just received my canopy mouldings back from Sarik Hobbies and I am ever so pleased with the results. They are crystal clear and almost flawless. The fact there are a few tiny little marks is down to flaws on my tool rather than their workmanship. The cockpit frame fits perfectly inside and the shape looks absolutely spot-on.



What a lovely crystal clear canopy.

Well done Barry at Sarik - you are my hero.

Brian. 😊😊😊😊😊

### Re: Schweizer SGS 1-23H/15

by **VinceC**

Posted: **25 Nov 2016, 14:44**

Well done Brian, coming on well

### Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **28 Nov 2016, 18:47**

In the last week I have managed to cover the whole airframe in glass and epoxy. I stepped away from my time honoured methods and used what the supplier, Bucks Composites, recommended. I usually use 1 oz/ yd2 cloth and apply the epoxy with brushes and credit card squeegees. On this occasion I used ½ oz/m2 cloth and applied the epoxy with a plastic foam roller. This grade of cloth is so light that it can be a bit tricky to handle however it went on easily and the rollers applied the epoxy like a treat. I also think I applied a fraction of the epoxy that I would otherwise have applied with my traditional brush approach.



The trimmed up moulding attached to the frame.



The completed canopy in place on the fuselage with "Mini Steve" in the cockpit. I have also now trimmed a canopy to size and shape and attached it to the painted canopy frame. I used my usual "evostik" contact adhesive for the job and once again it all turned out well. The next task will be to wet & dry the whole airframe - not a lot of fun. Brian. 😊😊😊

## Re: Schweizer SGS 1-23H/15

by **VinceC**

Posted: **28 Nov 2016, 18:57**

That looks a really smooth streamlined fuselage. Another good Brian achievement

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **02 Jan 2017, 11:47**

Its been a while since my last post in November. Since then I have rubbed down the tailplane, elevator, fuselage, fin and rudder. I have applied multiple coats of primer/filler followed by wet and dry sanding back in an attempt to fill the weave and pinholes.

I have now started experimenting with paints to try to get a satisfactory finish. Here is the rudder showing the panel lines and three full coats of spray paint. The panel lines are created by first spraying with a slightly lighter "Signal Yellow" then masking the panel lines with Mick Reaves panel masking tapes followed by three coats of "Daytona Yellow". When the panel masking tape is removed you are left with slightly indented thin lines on the surface. I thought that Daytona Yellow was the closest colour match I could get to the pictures and video film that I have of the full size machine but I am now not so sure. I suspect that I will have to rub back all that I have done and start again.

At this rate of progress the model is not going to be finished anytime soon.

Brian. 🍷



## Re: Schweizer SGS 1-23H/15

by **VinceC**

Posted: **02 Jan 2017, 12:04**

Good to see you experimenting with your model finish.  
Better get a move on as summer is on the way - that applies to me as well as I seem to be dragging my heels.

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **16 Jan 2017, 21:18**

I hate painting, I really do! As I wasn't happy with the colour of the rudder I rubbed it back with some wet and dry and tried a different colour on top. Well the new coat of paint reacted with the paint already on the surfaces and went all crazy (i.e. the surface was totally crazed). At this point I gave in and stripped all the paint back to the glassed surface with paint stripper and solvent before starting all over again. 😞😞😞

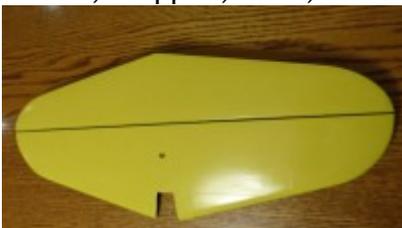
Most people would think that yellow is yellow is yellow - not so. I ran the glider sequence from the film over and over again trying to get a good colour match to no avail. Eventually I took seven separate screen dumps from different parts of the film and checked them all against paint charts. I ended up with seven different shades and tones of yellow. 😞😞😞

I discarded the two darkest and the two lightest, and from the remaining three I chose the one I liked the most (scientific huh?). Upon checking this turned out to be RAL 1003. I paid a visit to my local motor factors who quickly rustled up a few 400ml rattle cans mixed to that formula. So, the rudder, tailplane and elevator have now been taped up for panel lines and re-sprayed in my final choice of colour. 😊

Brian. 🙏



Rudder, stripped, lined, and resprayed.



Tailplane stripped, lined, resprayed and hinged.

**Re: Schweizer SGS 1-23H/15**by **Stuart Ward**Posted: **16 Jan 2017, 22:11**

looks pretty good from where i'm sitting  
Stu

**Re: Schweizer SGS 1-23H/15**by **VinceC**Posted: **21 Jan 2017, 17:17**

So a ton of yellow spray cans appearing soon in the Classifieds then? Good work and dedication  
Brian

**Re: Schweizer SGS 1-23H/15**by **B Sharp**Posted: **25 Jan 2017, 20:58**

I have made a little more progress today. After rubbing down the glass on the fuselage with wet and dry grit I have added the epoxy board tail wheel mounts and also the plywood under-nose skid.

Brian. 😊

**Re: Schweizer SGS 1-23H/15**by **B Sharp**Posted: **06 Feb 2017, 11:18**

There has been a little more progress on the 1-23 in this last week. The fuselage was primed and then given a light spray coat of yellow. I then laid up all the thin masking tapes over all the positions of the panel lines on the fuselage and fin. The fuselage was then hung from the ceiling and sprayed with two full coats of yellow gloss paint and allowed to dry and set for 36 hours. After that came the fiddly task of unpicking all the tapes to leave embedded panel lines in the paintwork. I have attached pictures of the process and a detail of the finished article on the fin. In essence it was a whole lot of work to produce a detail feature that no-one but me will ever notice. 😊

In addition, my workshop is now mm deep in yellow spray dust which will have to be wiped up. Yuck!!! 🤢🤢🤢 I would normally have used to garage for spraying but it's occupied by a Spitfire that I am restoring at the moment.

Brian. 😊



A light coat of yellow sprayed on.



Pannel taping in place.



Fin detail.



The finished product ready for the next stage.

## Re: Schweizer SGS 1-23H/15

by **Geoff Pearce**

Posted: **06 Feb 2017, 13:03**

You won't miss that in the sky, looks really nice.  
Spraying is messy.  
See you again soon I hope

G

## Re: Schweizer SGS 1-23H/15

by **roo Hawkins**

Posted: **06 Feb 2017, 13:32**

Nice paint job. What type of paint did you use Brian?

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **06 Feb 2017, 13:49**

Roo,

Standard cellulose from a rattle can to RAL1003 supplied by my local motor factors.

Brian.

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **12 Feb 2017, 10:48**

I have managed to make significant progress in the last few days. The rudder with it's pull-pull control system has now been installed. The servos, radio gear and batteries are now located in the cockpit area, all hooked up and checked. The amount of down elevator movement I can get is restricted by the tail cone to about 12 degrees but I suspect that it will be absolutely adequate for normal flight, and I don't envisage doing outside loops with this model. The wing root areas are now fitted out with multiplex wing retainers and the sockets for the aileron and spoiler plugs. The main and tail wheels have been fitted and the pilot (Mini-Steve) had been permanently attached to the canopy frame where I hope he has a long and happy life. As a finishing touch the vinyl registrations have been added to the aft fuselage and tail.

This afternoon will be split between completing the wiring to the wing roots and watching the rugby (its called multi-tasking).

Brian.



Radio installation



Wing fixings



Mini Steve in place.



Mini Steve at home.



Now starting to look like an aeroplane.

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **23 Feb 2017, 15:57**

In the last week I have flatted the epoxy/glass covering on the wings and ailerons down to a fairly smooth finish and then re-coated them with a very (very) thin coat of laminating epoxy. In a couple of days once it has crisped up I will attack this with 400 wet & dry to get down to the final smooth finish.

I have been working on the spoiler assemblies. The blades are of 1.5mm alloy sheet and have a small pivot point glued to the underside. The servos have a short push rod which attaches to the pivot and provides a positive open and shut movement. After a bit of fiddling I have managed to adjust them to fully open, fully close and visit all points in between.

Brian. 😊



Blade in place flush with wing surface.



Servo, push rod and pivot.



## Re: Schweizer SGS 1-23H/15

by **VinceC**

Posted: **23 Feb 2017, 16:54**

looks like a piece of Furniture Brian. Good work, well done

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **28 Feb 2017, 20:23**

The build inches slowly forward. I have cut the aileron horns from 1.5mm epoxy board and slotted and glued them into place. The wings have been rubbed down smooth and sprayed with white primer. Next comes the colour.

Brian. 😊



Aileron horns manufactured and glued in place.

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **02 Mar 2017, 12:37**

The wings have now been primed and sprayed with a thin coat of colour. I have then picked out the panel lines with thin 1mm tape.

The next stage is to spray the wings with at least two full coats of colour and leaving them 24 hours to dry. I will then remove the tapes which will leave thin panel lines with a slightly lighter shade of yellow embedded into the paint surface.

I am not going as far as adding rivets on this model as there are literally tens of thousands of flush rivets on the full size aeroplane and life is too short - I do want to fly it this year.

Brian. 😊



Wing with lining tape on the panel lines.

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

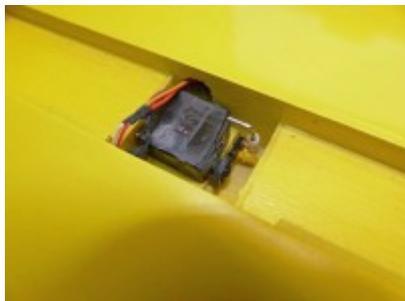
Posted: **06 Mar 2017, 18:29**

The wings have now been painted and I'm fairly happy with the finish. The ailerons have been hinged using "hingepoints" and they have a nice free movement. I have started the wiring and I have one aileron and one spoiler servo wired up and located in their permanent homes. I have used a little mold to pot up the wires on the "multiplex" 6 pin plugs and sockets, it gives the most professional finish and is a total joy to use - a great tool!

Brian. 😊



Aileron servo.



Spoiler servo.



The mold for the potting of the plug wires and a finished unit.



The finished job.

## Re: Schweizer SGS 1-23H/15

by **Stuart Ward**

Posted: **06 Mar 2017, 20:04**

Hi Brian. Where did you get the mold from. An you post a photo of it showing both halves.  
I might have to make one.

Stu

## Re: Schweizer SGS 1-23H/15

by **Peter Balcombe**

Posted: **06 Mar 2017, 20:19**

Stuart,

They are called Winkler formers and are sold by E soaring gadgets.

They do moulds for the MPX plugs, XT60 connectors and D type connectors.

Look on their website under Accessories/bits & bobs.

They work very well using hot gun glue as the casting material - just pump it into the assembled mould until it comes out of the vent ports (remember to use a release wax on the mould & give time to let the hot glue cool down before trying to separate the mould).

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **08 Mar 2017, 00:08**

Wiring all complete. Tonight I have fully assembled the 1-23 for the first time and set up all the controls and movements. Will get it on the balancer and get the CofG located.

Brian. 😊



Ready for balancing.

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **08 Mar 2017, 08:29**

Shock, gosh, Horror! It looks like I am going to have to add between 1.30 and 1.40 kg of lead to the nose to get it to the correct CofG. 🙄🙄🙄

I checked the calculations three times with the same result. The 1.30 figure is with a static margin of 10 and the 1.40 figure is with a static margin of 15, the more usual setting. I am a bit horrified!

I suppose the nose moment is a bit short and the wing tip panels are quite heavily swept forward, but even so that's a lot of additional weight. 🙄

I'm off to find a large church roof.

Brian. 🙄🙄🙄🙄🙄

## Re: Schweizer SGS 1-23H/15

by **patte de loup**

Posted: **08 Mar 2017, 12:51**

have you already used PREDIM RC to calculate the balance point?

Usually gives some good results 😊

Pat'

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **08 Mar 2017, 14:24**

Pat, I currently use the RCplanes CofG calculator which I have found to be very flexible with regardt to multi taper wings and also pretty accurate in its results. (I have used others which were rather less usefull in the past) This can be accessed at [rcplanes.000webhostapp.com/cg\\_calc.htm](http://rcplanes.000webhostapp.com/cg_calc.htm).

Not only have I used this on new aircraft to set the CG but I have checked out some of my existing fleet. I have found the results are within a few mm of the best CG locations I have achieved by trial and error.

In this case I entered the data twice and got the same answers I then checked the results using my old graphical and calculator method and got pretty much the same answer.

Brian. 😊

## Re: Schweizer SGS 1-23H/15

by **Stuart Ward**

Posted: **08 Mar 2017, 20:23**

Not good news Brian

So.. what will be the AUW with the new lead in the nose?

I generally fly at 5% of static margin. 10% to 15% is of course a good starting point for the maiden.

Stu

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **08 Mar 2017, 23:34**

Yes, you are right Stu. I generally start at 15%SM then fly the model. I then remove noseweight till the model starts turn feel uncomfortable. At that point I add a little back - job done. I don't tend to worry too much, it will weigh what it weighs.

Brian. 😊

## Re: Schweizer SGS 1-23H/15

by **VinceC**

Posted: **09 Mar 2017, 09:33**

I feel your pain Brian, it is always surprising how much weight has to go into the nose, especially when you try and build light in the rear, but it always turns out right in the end. Good luck on your maiden flight.

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **09 Mar 2017, 17:53**

Well that's it, my build of the Schweizer SGS 1-23 H/15 is now complete.

The aircraft is now balanced and the CofG is now permanently located under the wing (although its final position there is yet to be determined). The final weight came out at 12 lbs 3 oz which is quite satisfactory. At this weight it will perform well on the slope but should still retain a fairly good flat field performance.

All the controls have been checked out and everything waggles in the right direction. The pre-flight photos have been taken (see below) and all that remains is the maiden flight. If the weather forecast is correct that may be some time this weekend.

Thanks for following this build and for all your helpful comments. Hopefully proof of flight photos will follow in due course.

Brian. 😊😊😊😊😊





## Re: Schweizer SGS 1-23H/15

by **Geoff Pearce**

Posted: **09 Mar 2017, 18:47**

Hi, it looks very nice in mello yellow.  
It will fly superbly I have a lot of faith in your work and flying.  
Look forward to seeing you soon I hope .....MW..".?

Geoff

## Re: Schweizer SGS 1-23H/15

by **john greenfield**

Posted: **10 Mar 2017, 09:34**

Brian.

MW 22 / 23 April

AEB

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **10 Mar 2017, 10:03**

Thanks Geoff, I will hopefully make it down to MW at some point this year.

Sorry John, the April dates are out of the question at present, but I will try to come and bother you later in the year.

Brian. 😊

## Re: Schweizer SGS 1-23H/15

by **Mark Richards**

Posted: **13 Mar 2017, 11:05**

Hi Brian,

Really enjoyed following this build thread.

You've timed the completion just right for the new season.

Very best of luck with the maiden, looking forward to seeing the model in the air soon.

All the best,

Mark

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **13 Mar 2017, 23:12**

Thanks again guys, as I said, I will post flying pics when I'm able.

ARUP, not Roy McMaster but mini Steve - Mr McQueen is/was the king of cool.

Brian. 😊😊😊

## Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **15 Mar 2017, 14:18**

The Schweizer had its maiden flights this morning and I would say they were fairly successful.

I flew with the CofG where it is shown on the plan (on the spar) and this gives a static margin of 4 when checked on the CG calculator. I had to roll in a fair bit of up trim on the elevator to achieve level flight and even so the model was almost neutrally stable in pitch (if I pushed the nose down it stayed down). This is all right on an F3f racer but less comfortable on a scale model. I will have to increase the nose weight slightly to get the SM up around 10 and also add a shim under the trailing edge of the tailplane to increase the longitudinal dihedral a little bit. This should get rid of the up trim as well as increasing the pitch stability.

The roll and yaw rates are good and the stall characteristics are very benign. The brakes are positive and progressive with no pitch change at all which makes landings very precise.

All in all I think this is going to be a very pleasant model to fly off the slope and on the flat.

Brian. 😊



Proof of flight.



### Re: Schweizer SGS 1-23H/15

by **Geoff Pearce**

Posted: **15 Mar 2017, 14:39**

Well done, congratulations, look forward to seeing it at MW

Geoff

### Re: Schweizer SGS 1-23H/15

by **VinceC**

Posted: **15 Mar 2017, 16:14**

Well done Brian. Always a relief, but a great achievement. Drinks all round tonight then

### Re: Schweizer SGS 1-23H/15

by **Barry\_Cole**

Posted: **15 Mar 2017, 20:10**

Congrats Brian... 😊😄😄

What's next??

BC

### Re: Schweizer SGS 1-23H/15

by **Martin Gough**

Posted: **15 Mar 2017, 20:45**

Brilliant. Well done you.

### Re: Schweizer SGS 1-23H/15

by **B Sharp**

Posted: **16 Mar 2017, 11:48**

Thanks once again guys, your comments keep me going when the going gets tricky.

Barry, the bench is going to be clear for a little while, of aeroplanes at least. I have other restoration projects which will take up bench space for a bit. I do however have a wish list of gliders that I want to build and the next project will come from that list. I do have a front runner but it is a little radical and I may build a smaller cartoon version first just to check out the structure and controllability before spending a lot of time and money on a 1/4 or 1/3.5 version.

Brian 😊

