by John Armarego

SOPWITH PUP 1/3 SCALE CONTROL COLUMN AND RUDDER BAR

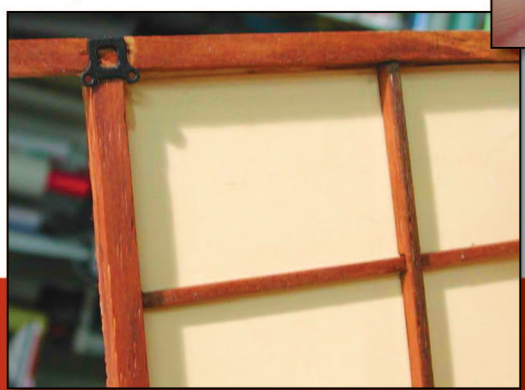
1/3 Scale Sopwith Control handle and rudder bar.

This issue, Scale Matters reveals and explains the techniques I have developed to construct the control column, rudder bar and some more general cockpit detail on my 1/3 scale Sopwith Pup. This aircraft was presented in my introductory article in a previous edition of Airborne but the techniques I use can be used or adapted for use on many other scale model aircraft.

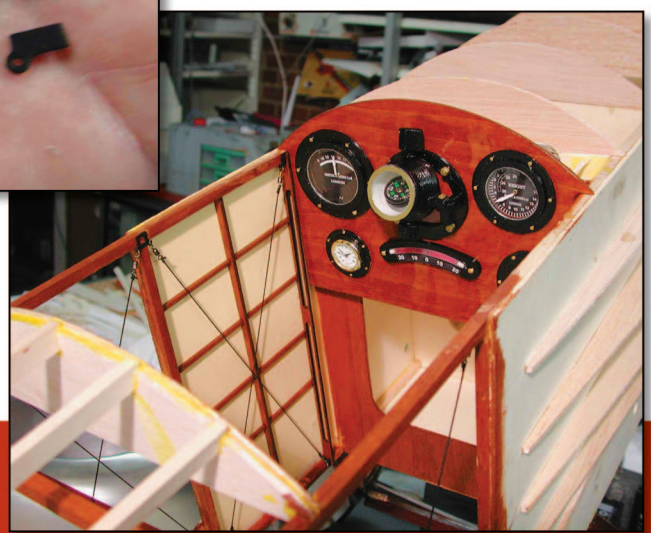
As explained in the previous article, the first step is to collect as much information as can easily be obtained on the subject aircraft, then decide what is going to be replicated. In this case I also wanted to make the controls in my cockpit move to add some additional realism. This makes it all the more important when planning the cockpit area, to ensure that there is sufficient room and access. I have found a good way to do this is to put any relevant fuselage bulk heads in the correct scale positions, even if it means redesigning some of the fuselage construction. You need sufficient room to work within the cockpit area to be able to fit the scale detail.

In this case I also wanted to add to the illusion of scale detail. To do this the inside surface of the plywood fuselage was lined with the fabric covering material and the internal structure was added. When looking inside the fuselage the structure looks just like the real aircraft and the non-scale plywood side structure is hidden. In this model the sides are required to be made from plywood sheet for strength and to house the attachment points for the rear flying wires. All the flying and landing wires in this model are extremely important as this aircraft solely relies on the flying wires for wing strength in the same way the real aircraft does.

Laser cut WW1 scale fuselage bracing wire attachment points.



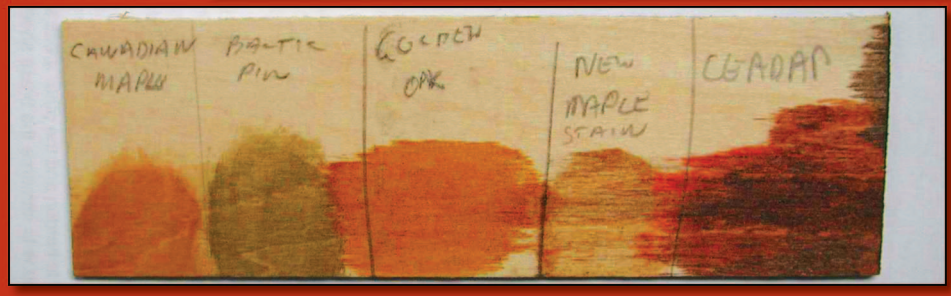
Fabric covering material glued to the plywood solid inside surface of the fuselage.

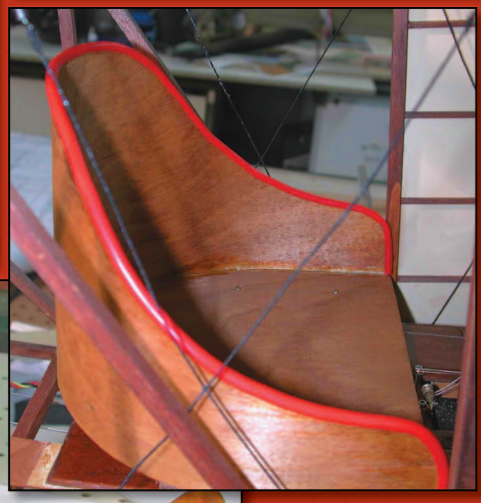


Scale fuselage bracing wire attachment points glued in position with swivels and black cotton.

Cockpit floor and control assembly. Note the small brass wood screw.

Wood stain colour chart to assist with colour selection.





Top: Pilot's seat constructed from 0.3mm ply and stained and then glued together.

Above: Completed pilots seat in location, note the red beading referred to in the text.

Seat fixed to control assembly using four small screws that can easily be removed.

To add additional detail to the inside of the cockpit area I drew and laser cut the fuselage bracing wire attachment points out of 0.3 mm ply. Theses attachment points are then painted black to simulate the metal plates used on the original aircraft. These attachment points are then glued to the correct positions and I then use fishing swivels and black cotton to simulate the bracing wires. The swivels are available from fishing tackle shops, in this case, TSUNAMI ProBlack rolling swivels size 6 or Black Magic rolling snap swivels to suit 2-3kg line was used. It is worth getting a selection of these as they can also be used to make simulated flying wires on smaller WW1 aircraft.

Cockpit Floor & Control Assembly

The cockpit floor and control assembly were simply made from sheet and square sections of balsa stained and glued together. These parts could have been made from hardwood and ply, however when constructing scale detail, I always use the lightest materials available that have sufficient strength. I work by the rule that 'the best thing to add to a flying aircraft is lightness'. The Pup has a very light wing loading but you should always be weigh conscious.

The main challenge in building the cockpit floor was ensuring that the whole unit could be withdrawn from the cockpit area once completed. Easy removal allows for maintenance and also make constructing the assembly in the first place a lot easier.

Pilot Seat

The two pieces that make up the Pilot seat were drawn using CoralDraw on my computer. These pieces were then printed out on paper and then cut out to check for fit and form. Once these two patterns were correct I used the generated CorelDraw file to laser cut the two pieces out of 0.3mm ply wood. The two patterns could just as easily been used to cut the ply pieces using a jigsaw if you don't have the luxury of you own laser!

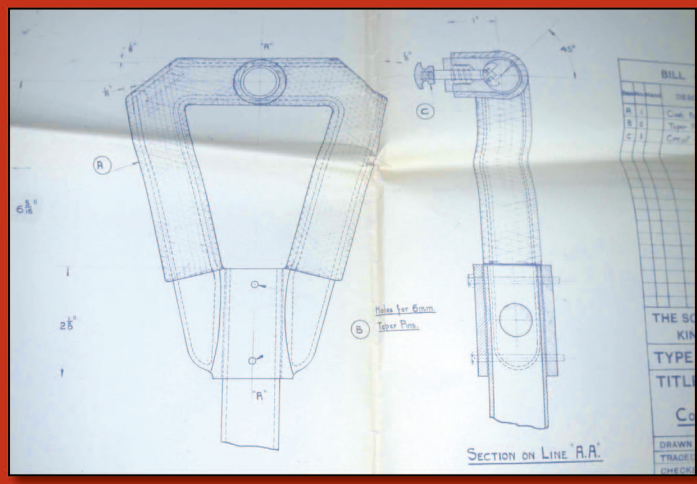
The next step is to stain the two set pieces as this makes the parts look more authentic.

The stain won't take to glued areas so it's important to stain the parts before any gluing takes place. As you'll see, I use a range of different stains when building my aircraft. If you have the stains always available then they can be very easily applied with a soft cloth or brush. Bunnings or your local hardware shop may have FEAST WATSON PROOFTINT traditional spirit based stains. The 50ml bottle is very handy for aeromodelling and can be over painted with clear vanish for a deeper look. I keep a range of stains, Canadian Maple, Baltic Pine, Golden Oak, New Maple, and Cedar as a basic selection. I use a simple test piece to assist in my colour selections.

A trick I use when gluing parts like this together which have complex shapes and bends can save a lot of frustration. Apply medium CA super glue (ZAP PT-01) to the entire edge of one of the pieces to be glued. Apply CA Accelerator (ZIP Kicker PT-15 or equivalent) to the entire edge of the other piece to be glued. The next step is to role the edges of the two pieces that are to be glued together and hold them as they set.

Another trick is to store your Cyanoacrylate (CA super glue) in you work shop fridge, CA requires moisture to set, the fridge is a very dry place and this can extend the life of you CA glue. You should however be building at such a rate that CA does not have time to set in the bottle.

The red beading around the completed seat adds a finishing touch. This red beading is made by selecting some red power cable of the correct diameter. I run a sharp blade down the length of the wire being careful only to cut through to the centre. Once cut the centre conducting wires can be pulled out. The beading is then glued to the edge of the seat using the cut in the wire to locate it.



Original Sopwith drawing of the control handle.

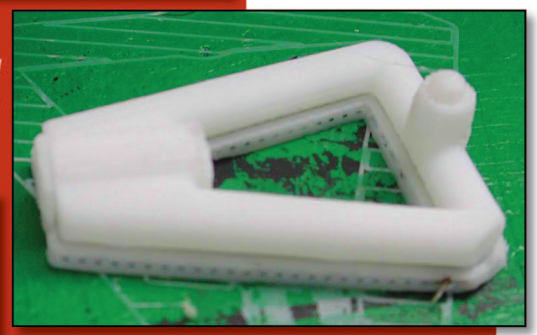
Control Handle

The control Handle was relatively easy to construct because I had access to a copy of the original Sopwith manufacturing drawings of the control handle.

The control handle was drawn using 3D Computer Aided Design (CAD) package to the full scale size and then loaded into the 3D plastic printer and printed to 1/3 scale. This part can just as easily be made using pieces of Evergreen Styrene (www.evergreenscalemodels.com) by cutting and trimming suitable pieces with a balsa saw and sharp blade and then gluing them with an appropriate glue such as EFD Simple Glues TETRA or Revell Contacta Professional liquid glue.

Once the control handle was constructed it was then painted silver using TAMIYA Acrylic paint (Chrome silver X-11) to look like the original aluminium part. A suitable thick cotton twine was wrapped around the handle area to form the grip as per the original aircraft. Two small brass screw were used to fix the control handle to the control column. The control column as with the other tubing used in the construction of this assembly was made from Evergreen Strip Styrene tube Item number 231 (11/32" TUBE, 0.343 DIA 8.7mm) and painted black using TAMIYA Acrylic paint (Black X-1).

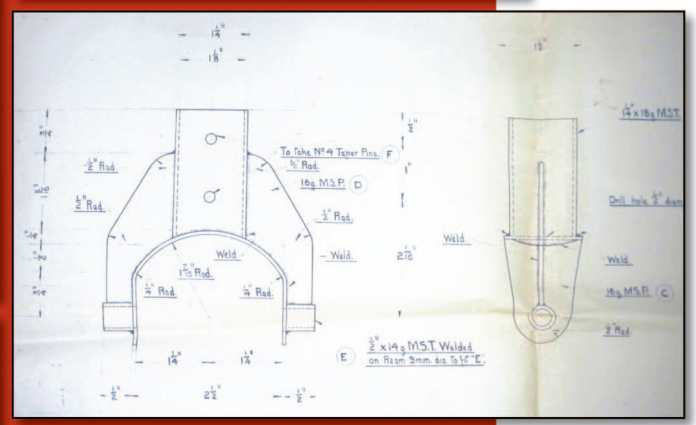
Sopwith Pup control handle printed to 1/3 scale using ABS plastic.



Control handle painted and the hand grip made from twine added. Note the ignition blip button.

Lower Control Stick Pivot

Again the control stick pivot was drawn using 3D CAD package and drawn to full scale and then loaded into the 3D plastic printer and printed to 1/3 scale. A small piece of Brass tubing was used as the pivot point. One of the handiest things you can have when making scale bits is a K&S Tube Assortment pack Stock Number #320. This pack is just perfect for all the little bits of brass and aluminium tubing that you may need. This should be available at your local hobby shop.



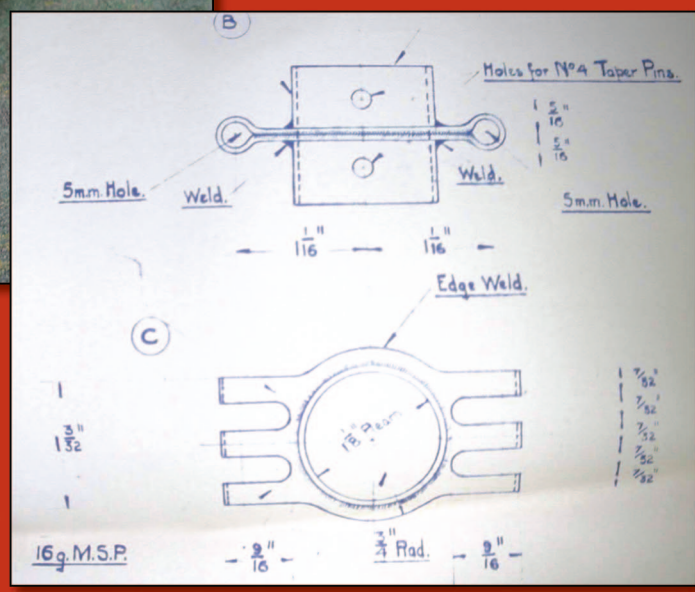
Original Sopwith manufacturing drawing of the lower control stick pivot.

Control Stick Elevator Cable Attachment Bracket

The control elevator cable attachment bracket fits along the control column in the original aircraft. As the control stick is moved forward and back, the pull-pull cable system attaches to this bracket. One set of cables runs straight down the fuselage to the bottom elevator horns and the other cable set runs from the attachment bracket forward to a pulley and then back down the fuselage to the top elevator control horns. By moving the control back, the elevator is raised and by moving the control stick forward the elevator is lowered.

Again the control stick elevator cable attachment bracket was drawn using 3D CAD package and drawn to full scale, and then loaded into the 3D plastic printer and printed to 1/3 scale. Small holes were drilled in the 3D printed part so that the cables could be attached to the bracket. Again the part was painted black with Tamiya paint.

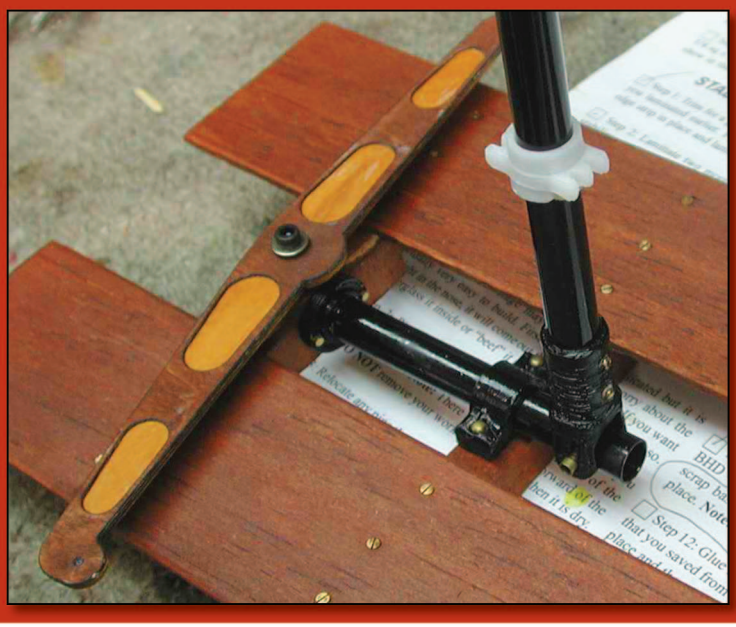
Aileron torque tube and control stick pivot manufactured using the 3D printer.



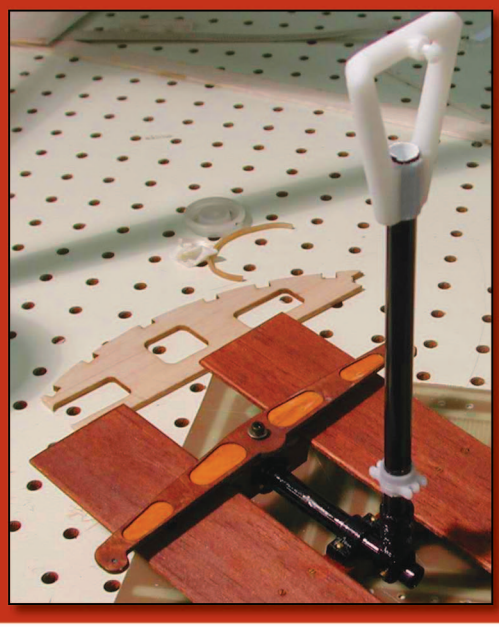
Original Sopwith Pup control stick elevator cable attachment bracket manufacturing drawing.

Rudder Control Bar

The rudder control bar in the full sized Pup is operated by the pilot's feet and moves the rudder using steel braided cables running back to the rudder horns. In this case the rudder control bar was drawn using CorelDraw, and again this file was used to make the two parts. The main part was cut out of 1mm ply and stained using a light stain and the other part was cut out of 0.3mm ply and stained a deeper colour. The two pieces were then glued and laminated together to form the completed rudder bar.



Control stick elevator cable attachment bracket mounted on the control column.



Trial fitting of control handle.

Movement Mechanism & Control System

To make the control column and rudder bar functional, I mounted three small servo's under the control assembly. One servo provided the movement for the rudder bar control cables, another servo provided the movement for the elevator control cables and the last servo provided the elevator movement for the control stick.

The positioning of the control cables, pulleys, turnbuckles and shackles is as close as possible to the original aircraft layout.

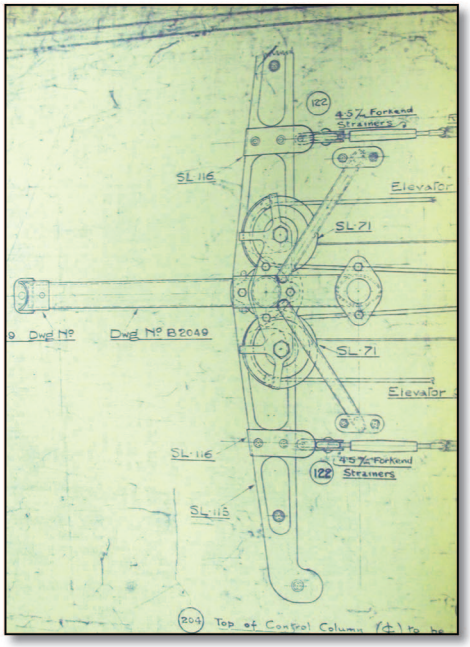
To prevent any damage to the mechanism in the case that the controls are fouled, for example, by the pilots feet or hands, you will notice the use of springs. The springs are attached to the control cables running from the servos. If the controls get fouled the springs will just stretch instead of stripping servo gears or stressing any of the mechanism components.

The control cables are purchased from fishing tackle shops. I use for example: SureCatch 7 strand clear nylon coated stainless steel fishing wire 60lb strain. This comes with connecting crimp sleeves. These crimp sleeves can also be obtained separately and it is handy to keep a range of these at hand. The scale turnbuckles, pulleys and shackles can be purchased from model boat building suppliers. The best I have found by far is modellingtimbers.co.uk. The stuff this guy has is absolutely fantastic and can be used for all sorts of WW1 scale detail application. These model boat fitting are very nice and come in all different sizes, but they should not be used in any mission critical areas like working flying wires, BE WARNED.

I manufacture my own Computer Numeric Control (CNC) high strength flying wire turnbuckles tested to over 80kg or you can use DUBRO 1/4 scale turnbuckles.

A model aircraft weighing in at 20kg pulling a sharp manoeuvre at 3 G's can exert a force equivalent to 60kg. If the wire is loose then the jerk can be extremely high so you need to design in an acceptable safety margin.

Jerk is not the guy at the flying field down the road, it is an engineering term that is use to define the rate of change of acceleration; that is, the derivative of acceleration with respect to time, and as such the second derivative of velocity, or the third derivative of position.



Above: Manufacturing drawing of the rudder control bar.

Two ply parts laminated to form the rudder control bar.

Completed rudder control bar with attachment points for control cables.

Rudder control bar mounted using a brass tube as the pivot bush.

Movement mechanism and control system that activate the assembly movements are easily seen here. Note the springs used to protect the mechanisms components.

Above Right: Test fitting the control assembly.

The scale control cables, turnbuckles, pulleys and shackles can be clearly seen. With the seat in place the activation mechanisms are hidden from view.

Top view looking inside the cockpit with the seat detached and laid back revealing the movement mechanisms. There are two Allen head screws in the centre of the picture which allow the whole mechanism to be removed from the cockpit.

Control Of Servos

The servos used to provide the movement for the control column and rudder bar can be controlled in several way.

Method 1: Use a Y lead to connect to the primary flying channels to the flying servos and the cockpit control movement mechanism servos. I prefer this method least.

Method 2: Use a receiver with sufficient number of channels so that the servos for the control column and rudder bar can be mixed with the primary control channels used to activate the ailerons, elevators and rudder. A switch can then be programmed to turn these mixes on and off. This allows you to be able to deactivate the cockpit control movement mechanism when flying if required.

Method 3: Use two receivers, one for all the flying controls and one for the cockpit movement mechanism. Bind both receivers to the transmitter. The cockpit control movement mechanism can then be deactivated by simply not powering up the second receiver. I prefer this method.

In case you missed it in the last edition of Airborne, the below link is the Video clip showing the working controls in the cockpit as described in this article on my 1/3 scale Sopwith Pup.

www.youtube.com/watch?v=WqyAIN8DBLY

Working Tail Skid

In the next instalment of Scale Matters, I will be uncovering and explains the techniques developed to construct the working tail skid and scale flying control surface fittings in the Sopwith Pup.

Until then, happy building
and plenty of flying.