How to ….. produce realistic rigging

Rob Hamann

Over the years I have developed a standard way to produce bracing wires and control cables on 1:48 and 1:72 model airplane models. The material that I use is fishing line with a diameter of 0.06 or 0.08 mm, painted black or silver to improve visibility. The corresponding 1:1 diameters are shown in the table. For 1:48 scale models a larger diameter line could be used, but the disadvantage is, that the line is stiffer and bends more difficult around corners.

	1:48	1:72
0.06 mm	2.9 mm	4.3 mm
0.08 mm	3.8 mm	5.8 mm

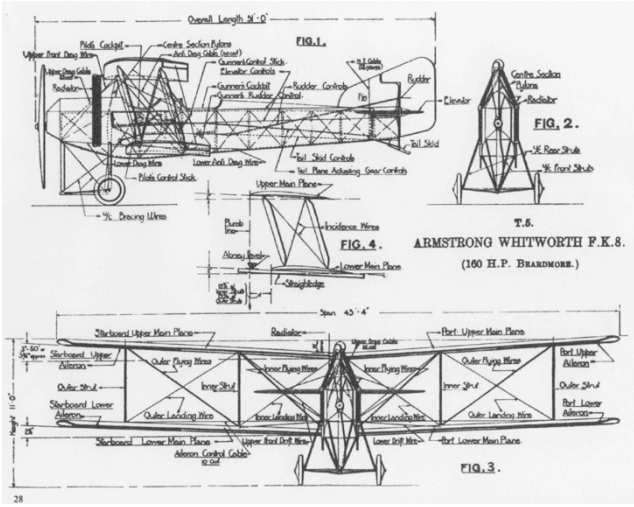
The method described is better suited for modellers that paint their models with the brush, but can in many cases also adapted if airbrush techniques are used.

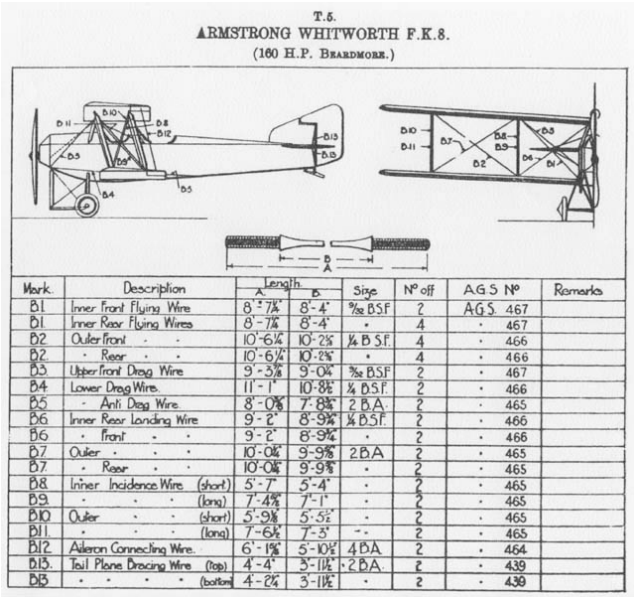
Materials and tools needed

- Fishing line 0.06 or 0.08 mm diameter
- A piece of glass or plastic
- Silver and/or black Marabu Brilliant Painter gloss marker pens, 0.8 and 2-4 mm (from your local art accessories shop)
- 0.3 mm drill
- Thin cyanoacrylate glue (super glue)
- Tamiya masking tape
- Sharp scalpel blade (no. 27)
- 800 and 1200 grain sanding paper
- 0.25 mm metal wire (to apply the glue and as stabilizer rods)

Preparations

Before starting some preparations have to be made. The most important one is to establish a list and sketch of all bracing wires and control cables that must be made. Sometimes such documentation is available from book or the Internet, as in this example for the Armstrong-Whitworth F.K.8. But in most cases it has to be constructed from photographs of the original aircraft. It is important to have an accurate picture of what has to be done, as often several bracing wires have to be attached on the same location, which then determines the order in which the wires have to be applied and glued. I liked this example in particular, because it gives the functional names of all bracing wires on a biplane.

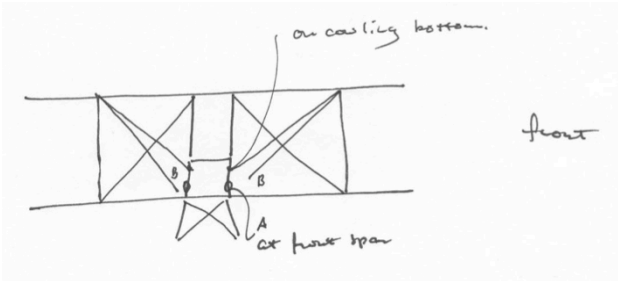




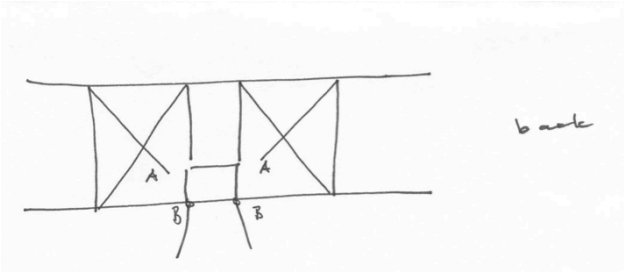
T.5.
ARMSTRONG WHITWORTH F.K.8.
(160 H.P. BEARDMORE.)

Mark	Description	Length A	Length B	Size	Nº off	A.G.S Nº	Remarks
B1	Inner Front Flying Wire	8'-7¼"	8'-4"	9/32 B.S.F	2	A.G.S. 467	
B1	Inner Rear Flying Wires	8'-7¼"	8'-4"	·	4	· 467	
B2	Outer Front · ·	10'-6¼"	10'-2⅝"	¼ B.S.F.	4	· 466	
B2	· Rear · ·	10'-6¼"	10'-2⅝"	·	4	· 466	
B3	Upper Front Drag Wire	9'-3⅛"	9'-0¼"	9/32 B.S.F	2	· 467	
B4	Lower Drag Wire.	11'-1"	10'-8⅝"	¼ B.S.F.	2	· 466	
B5	· Anti Drag Wire.	8'-0⅝"	7'-8⅝"	2 B.A.	2	· 465	
B6	Inner Rear Landing Wire	9'-2"	8'-9⅝"	¼ B.S.F.	2	· 466	
B6	· Front · ·	9'-2"	8'-9⅝"	·	2	· 466	
B7	Outer · · ·	10'-0⅝"	9'-9⅝"	2 B.A	2	· 465	
B7	· Rear · ·	10'-0⅝"	9'-9⅝"	·	2	· 465	
B8	Inner Incidence Wire (short)	5'-7"	5'-4"	·	2	· 465	
B9	· · · (long)	7'-4⅝"	7'-1"	·	2	· 465	
B10	Outer · · (short)	5'-9⅛"	5'-5½"	·	2	· 465	
B11	· · · (long)	7'-6⅝"	7'-3"	·	2	· 465	
B12	Aileron Connecting Wire.	6'-1⅝"	5'-10½"	4 B.A.	2	· 464	
B13	Tail Plane Bracing Wire (top)	4'-4"	3'-11½"	2 B.A.	2	· 439	
B13	· · · · · (bottom)	4'-2¼"	3'-11½"	·	2	· 439	

Often a couple of simple sketches are sufficient,



as for this 1:72 resin model of the Fokker M.17E by HR Models.

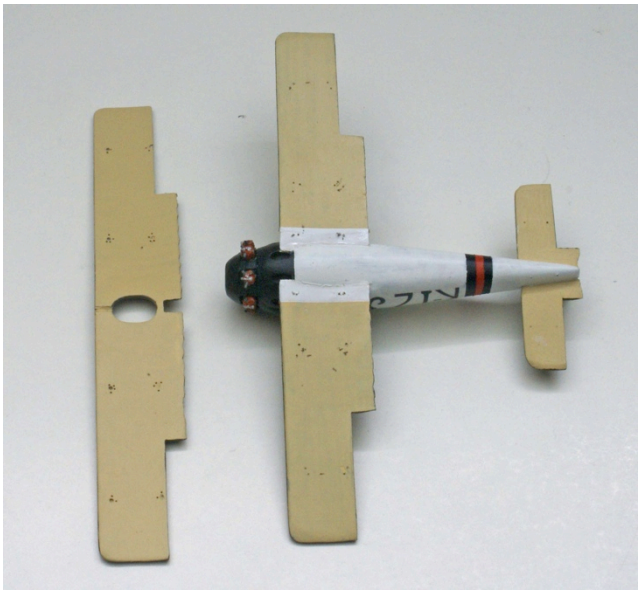


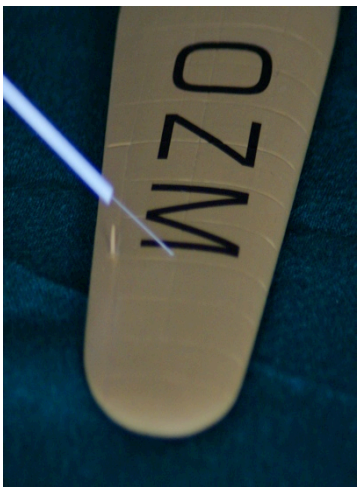
The rigging on this model is rather simple, and such a sketch is easily made. However, even if a rigging scheme is given in the instruction sheets of

the kit, always check whether this is correct from other sources (books, Internet, building reports). Many kit producers allow themselves quite a lot of artistic freedom.

Fishing line is rather transparent, and as a result it only shows up against a dark background, and even then it is not really well visible in all lighting conditions, so it is worthwhile to give it some colour. I use Marabu Brilliant Painter black or silver (pending the major background colour) marker pens to paint the fishing line. The process is simple: just place the stick on a piece of glass or plastic and draw the fishing line along the tip of the pen. The advantage of this method is that there are absolutely no paint drops hanging on the fishing line, which is difficult to avoid when painting the line with a brush. In my experience it is easier to paint the line before applying the rigging lines and correct deficiencies with a thin marker pen afterwards then to postpone it until after the application.

Next 0.3 mm holes must be drilled at all locations where bracing wires or control cables need to be attached to struts, wings, tail surfaces and fuselage. In the fuselage these holes must be at least 2 mm deep, in the other elements I drill them generally all the way through the parts. Often it is easier to make these holes before the part is assembled. The result may be something like in this 1:72 vac form model of the B.A.T. F.K.23 of Libramodels.



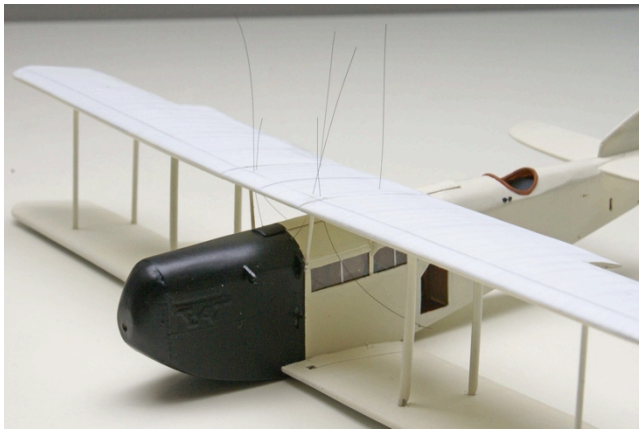


Try to drill the holes in the direction the fishing line will stand when finished; this prevents that a bend in the fishing line will be visible when ten-

sioning the line later on. A method to drill holes up to a very small angle relative to the surface is illustrated in the picture at the left for the application of an aileron control cable of the 1:72 vac form model of the Fokker F.VIIa of Broplan; start drilling vertically and then rotate the shaft while drilling gradually to the horizontal. This is specifically useful for making the attachment point for control cables leaving fuselage of wing surfaces.

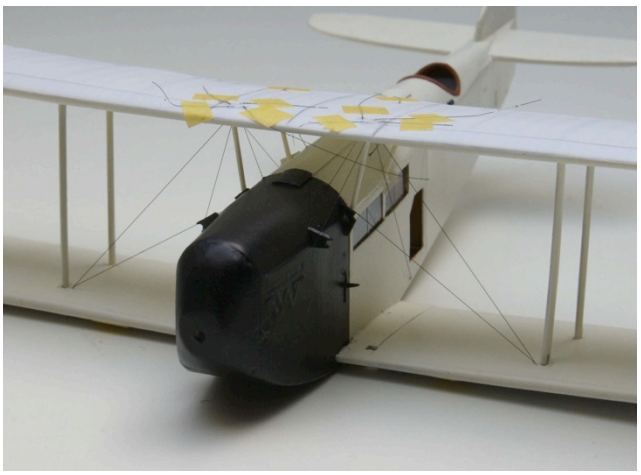
Drill the holes always from the same side where the bracing wires will enter the surface. Even if the wing or tail surface is thin, you may end up quite in the wrong place, if you try otherwise; the very thin drill is difficult to steer. Be sure that all surfaces where the bracing wires and control cables have to be attached have their final finish and that all decals are applied on these surfaces. It is virtually impossible to do this after the bracing wires and control cables have been applied. And clean up the drilled holes after each paint activity.

Applying bracing wires and control cables

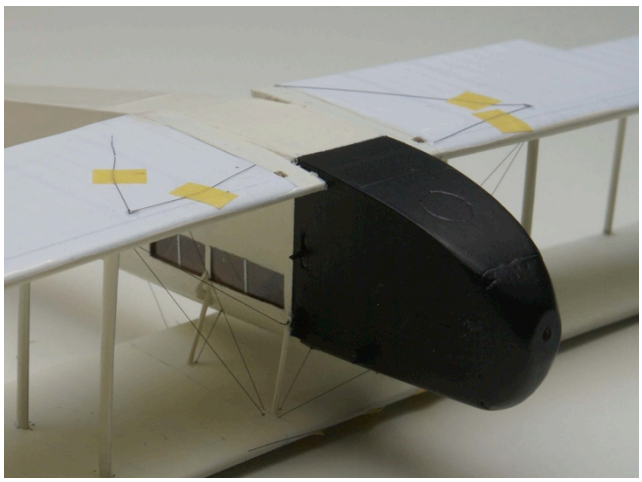


It is advisable to insert wires in the holes from the side where the colour of wire and model contrast most. It works easiest when you take the wire between tweezers some 5 mm from the end and insert it that way in the hole. Use a magnifying glass if needed. Take pieces of fishing line that are at least 6 cm longer than the length of the bracing wire.

The process is illustrated by the application of bracing wires and control cables of a 1:72 scratch-built model of the B.A.T. F.K.26. Start with the wires at the locations, where there are not through-and-through holes (generally this is at the fuselage side). Let a small quantity of thin cyanoacrylate glue drop on a piece of glass or plastic. Insert the wire in the hole and, if possible, guide the fishing line also through its destination hole. Take a small drop of glue with the metal wire from the glass and apply it to the wire in the hole. Apply another drop of glue some 15 seconds later. If the drops get to big, cut off the end of the metal wire, so that the drop are again small; it is better to apply two small drops than one drop that is to big.

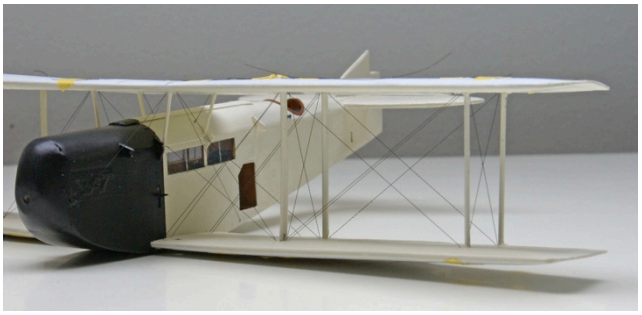


After one or two minutes the glue should have set. Check whether the wire holds by pulling it gently. If it holds, you will be able guide the line through its destination hole (if you haven't done so yet) and to tension the lines with your fingers or a pair of tweezers. Fix them on the surface of wing or tail with a piece of tape you have prepared beforehand. Make sure the tape does not cover neighbouring holes, where other bracing wires have to pass. I both ends of the wire pass



through a wing or tail surface, fix also the other side with a piece of tape.

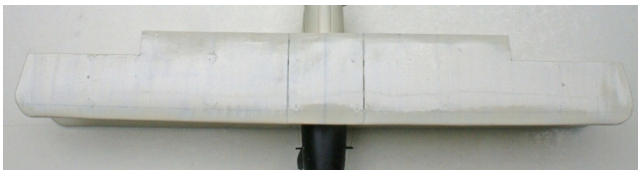
Continue until you have completed all wires that end up at one specific location. Then you can glue the wires. Do so by applying a drop of glue with the metal wire at the side of wing or tail surface, where you have applied the pieces of tape. Apply a second drop of glue after some 15 seconds and leave to set.

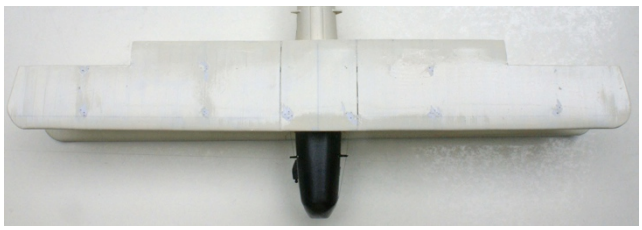


If the wire has to pass through a strut, apply the glue again at the side where you have tensioned it, and fixed it with a piece of tape. If a wire continues at the other side of the strut or the wing or tail surface, apply one small drop of glue at each side of the strut or surface. In general this should be sufficient to solidly fix the line.

Continue until you have finished all bracing wires or at least all wires at one side of wing or tail surface. After some 15 minutes you can remove the tape and cut off the excess fishing line with a sharp, curved scalpel blade (e.g. no. 27) as close to the surface as possible. If you do this well only the “black” pits of the core fishing line will be visible; the glue bubble will have been removed completely, as shown on the left wing of the model. Lightly sand the surface locally with grain 800 and 1200 sanding paper.

Apply now a coat of paint on the surface. Any leftovers of glue or fishing line will show up clearly (left), and can be removed again with the scalpel and sandpaper. Now the surface is ready for its final coat of paint and the application of decals (right).





Special cases: stabilizer rods

Sometimes stabilizer rods are used to prevent vibrations of the bracing wires. I generally use a piece of 0.25 mm metal wire (the core of an electricity wire) for this, straightened by rolling it between two flat surfaces.

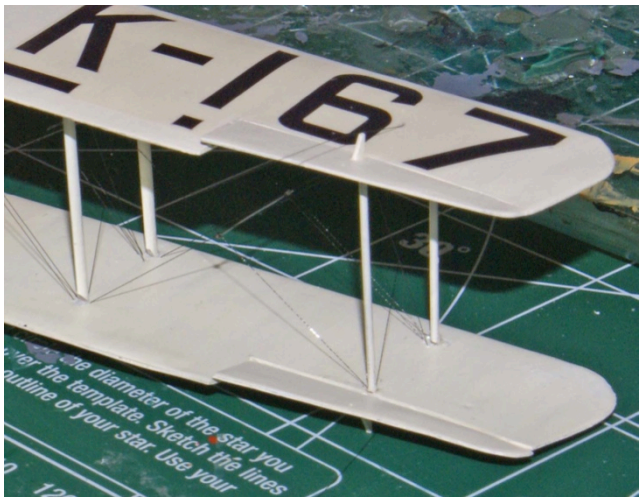
Cut the metal wire to the correct length, take it in between a pair of tweezers, dip one end in the cyanoacrylate glue and fix that side to the bracing wire crossing and glue then the second side. If the stabilizer rod is too short to follow this procedure, you will have to place it in one time at its correct location. Be prepared for a rough match between you and your model, because the bracing wire act like a catapult, shooting your small piece of metal to all directions before the glue takes, or the metal

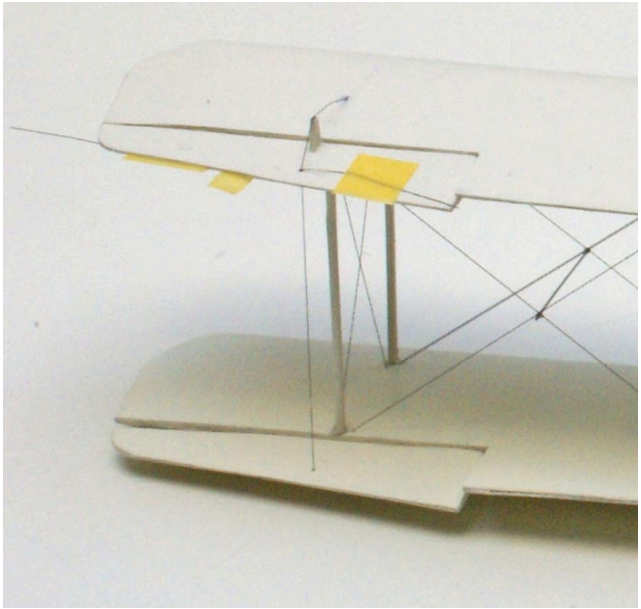
wire having a pertinent preference for gluing to your tweezers and not to the bracing wire (and you don't have the choice which option will occur).

Special cases: control cables

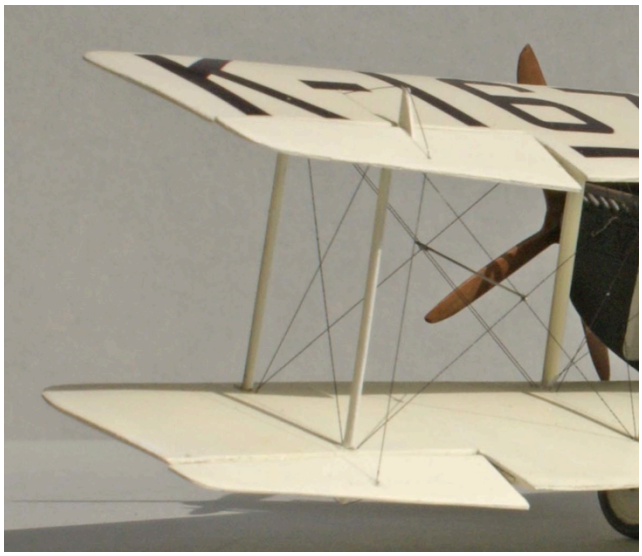
Control cables have to be attached to ailerons, elevator and rudder. In general, I use the same procedure as for the bracing wires. In case of the F.K.26 it is a bit complicated, as both upper and lower wing have ailerons and the control cables are passing through both. First I glue the control surface in the desired position, holding it with a piece of tape.

I then insert the fishing line in the slanted holes in the wing and apply a drop of glue. When that has set I guide the fishing line through the holes and over the control horns, tension the line and fix them with a piece of tape on the lower aileron; in this case the hole in the lower aileron receives both the line from the upper and from the lower wing.





Tensioning must be done very carefully, as large forces may destroy the connection between aileron and wing. In this position the fishing line is glued in the lower aileron hole, one drop from the top and one drop of glue from the bottom. When dry the excess wire is carefully cut.



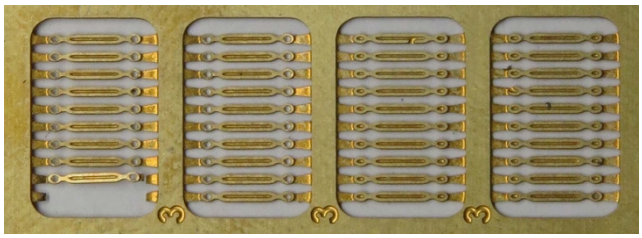
I have also tried to do the same job with the elastic EZ-line. Application is a lot easier, but the final result is a lot more crude, as the elastic line cannot be tensioned very much, as the large forces required for it destroy the wing-aileron con-

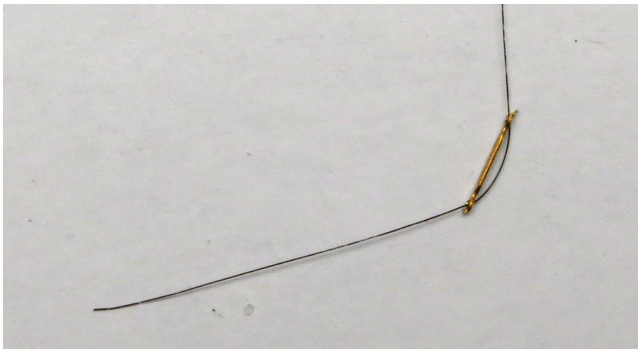
nection, hence the diameter of the control cable stays too large, as shown in the pictures at the above.

In general the application of control cables is quite a lot simpler, as illustrated in the picture of the rudder configuration of the F.K.26.

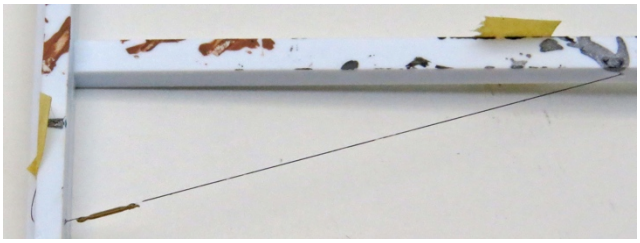
Special cases: turnbuckles

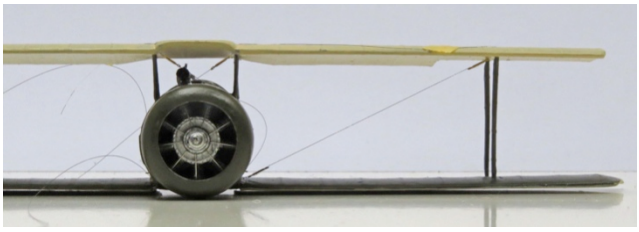
Bracing wires are generally tensioned with turnbuckles. Generally I don't care to model these on 1:72 scale models; to be in scale they should be less than 2.5 mm long, and that really is too small to handle. There is a 1:72 set of Part Etchings, S72-161, Control horns & turnbuckles, but they are already quite big, some 3 mm, which scales to almost 22 cm in real life. In a 1:48 Special Hobby kit of the Fokker D.V I found a set of turn buckles, which were 4 mm long, so 18 cm in real life, and I have decided to use these in the model. First I have made a test item to find out what is the best way to apply them. First I have checked whether the 0.06 mm fishing line could pass through the eyelets of the turnbuckles. Negative, so I have enlarged the eyelets with a 0.3 mm drill has been

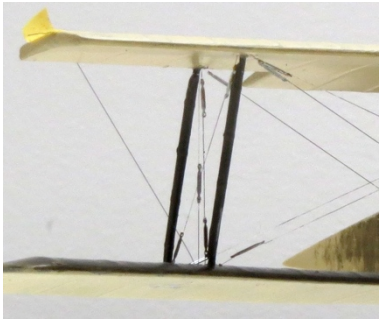




I do not tie the fishing line to the holes of the turnbuckle; neither do I glue it to them. It is sufficient to pass the line through the eyelets; when it is tensioned, the black line is hardly visible anymore. Adjusting the position of the turnbuckle is difficult; it is kind of self-braking when the line is tensioned. This is not a problem, when the bracing wire can be adjusted on both sides, but when this cannot be done, for example with wires glued in fuselage holes or wires with two turnbuckles, the correct position has to be found by trial and error. In this process the paint layer on the fishing line is locally damaged, but this is easily retouched with the fine marker pen.







To disguise the black wire completely you can paint the turnbuckle with aluminium or brass paint.