HWDMAC SPAD Combat Trainer (02/10/2005)
"Kombat Train" MK4 Plan (Minimal Version)
no copyright
Designer : I. Scottow
Independently Tested by : K.Hitchen ; R.Stephens

Input or Queries welcome :- ian@scottowi.freeserve.co.uk

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1) Introduction

Having had my ear bent for a few weeks now by certain members of the Club (no names - no pack drill !) regarding a suitable Combat Trainer aircraft which is both cheap and expendable, I finally gave in to the inevitable. The prototype (MK4) was tested on an MDS.40 deliberately as it is one of the lowest power .40's I know, on the basis that if this is a minimum standard, then performance with your engine should be better. The .40-.46 class was chosen deliberately as most Fliers start with a .40 , then progress upwards in power. Therefore, there should be a gold mine of unused .40 engines around the Club, just waiting to be put to "bad" use ! MK1 used an ASP .40/1 ; MK2 now uses ASP .40/3's . MK3 uses an MDS .48.
Equally, old non-computer PPM radio Tx's and Rx's are ideal for this use.

The plane was designed to satisfy two camps a) The Combat Trainee b) The experienced Combat flier. Upgrading the plane is therefore covered also, but the main plan accent has to be on the Trainee who has never built a **well handling** SPAD (Simple Plastic Aircraft Design) before, let alone flown one !

Do not let the "Balsa Bashers" influence you – this plane flies better than a Bill Kits FF15 and that is a compliment !
The prototype will be used to introduce interested Trainees and allow potential builders to try before they commit to building, so anyone who wishes to test fly arrange in advance with me !.

2) Specifications

a) Engine size : .40 - .46
b) Tank Size : 9oz (9-10mins. is more than adequate as most competitive bouts last 5mins.
c) 4mm Correx based.
d) 3CH (Ailerons/Elevator/Throttle) only.
e) 4 standard servos.
f) 1.3mm drain pipe.
g) Symmetrical aerofoil.
h) Build Time = Approx. 4hours.
i) Airframe Cost = £10.00 approx.
j) A.U. Weight – 4.5 lbs

3) Characteristics Required

a) Sensitive, but not excessively - tight turning circle and rolls quickly.
k) Fast but stable enough to fly hands off.
l) Materials to be easily and cheaply available.
b) Tough and withstands abuse.
c) Hand Launch stable.
d) Easy to build and repair.

4) Materials Required

a) ½ sheet (48 x 48") 4mm Correx (sizes on plan).
b) 1.3m Drainpipe (35"minimum) (sizes on plan). (Hunter Squareflo PVC 65mm x 1.3mm
c) Pine Spar 18mm x 7mm (44")
d) Pine Firewall 61mm x 61mm
e) 3/8" Dowel for wing (5" long x 2).
f) ¼" dowel for Tailplane.
g) 3/32" ply for ailerons.
h) 8 x ¾" screws for Firewall.

Model Shop Bits

a) Throttle rod; plastic outer ; plastic screw-on clevis.
b) 2mm Aileron and Elevator rods and 2mm metal clevises.
c) Radio Active 30-45 Engine Mount or similar.
d) 9oz SLEC (yellow) Tank.
e) Combined charging and On/Off switch.
f) 700ma Rx Battery.
g) "Y" lead and 2 wing extension leads.
h) Rx and 4 servos.
i) Lead weights for Lateral balance.
j) Fuel Tube.
k) Radio Active Engine Mount – (30-45 size).

5) Material Suppliers

a) 1.3m Drainpipe – Homebase (8ft length – around £8.00)
b) 4mm Correx - (8ft x 4ft sheet – around 7.50 each) (see K. Hitchen or M. Hockley initially for some off-cuts) – Otherwise Paperco on 0161-8648000 for "Euroflute" 4mm sheets(8' x 4') – Companies only – £7.41 each.
c) Spar – Homebase – (18mm x 7mm x 5ft length approx. £1.20)

d) Firewall – Homebase – (18mm shelf pine – around £4.00)

6) Building Instructions

A) Fuselage

1) Cut drainpipe to a 30"length with Dremel or similar, making sure it's square.
2) Cut rear section to size and keep offcut for horns/plates etc.
3) Cut Radio access rectangle in top (5 or 6" long)
4) Mark 4 pilot Firewall holes on Fuse. depending on Firewall thickness, at half depth of firewall. In my case, the Firewall is 18mm thick, so mark at 9mm depth.
5) Drill pilot holes with 1.5mm drill size.
6) Cut 2 x 4mm (5" long) slots for Tailplane in Fuse. rear, starting 8mm from the edge. Make sure both are the same distance so the Tailplane sits horizontal to Fuse..

B) Engine/Mount/Firewall/Tank/Throttle servo

1) Select mount and drill engine holes for 3mm bolts. Use nuts plus lock nuts.
2) Cut Firewall to size, round off corners and test fit. Drill 3 holes vertically to allow fuel tank pipes through. File to size. File cut-out in Firewall r.h.s. for plastic outer to fit in. Fit engine mount to Firewall with 4 screws.
3) Insert Firewall in Fuse. and keeping Firewall/mount square, drill firewall through fuselage pilot holes. No upthrust or downthrust is required.
4) Make plastic horizontal mount for Throttle servo. CA small ¼" balsa lengths to both horizontal sides, where the screws will go. Fit servo and mark holes for drilling. Drill holes and mount servo to mount. CA mount to Fuse. sides making sure height of arm is under normal Fuse. height. Arm height should match the cut-out in the Firewall.. Leave enough space under the mount to allow the battery to be moved forward if necessary.
5) Fit servo arm, make Z bend in throttle rod and fit outer plastic tube.
6) Put Tank (SLEC 9oz (yellow)) and Firewall plus feed tubes together and fit to Fuse. , making sure the plastic outer fits the path cut for it in the Firewall.
7) Make Fuse. screw holes larger to allow screws to go through the Fuse. easily.
8) Use 4 x ¾" screws to secure Firewall to Fuse.

C) Tailplane/Elevator

1) Cut Tailplane and elevator to size. (from plan)
2) Cut flute at 2" mark as per plan.
3) Test fit to Fuse. , line up square, and glue with CA into position.
4) When dry, cut four ¼" dowel rods and glue to top (inside and outside) surfaces to secure Fuse. and Tailplane together.
5) Drill hole through Fuse. base and secure into plate in Fuse. on top of Tailplane centre.

D) Fin

1) Cut Fin from 4mm Correx (flutes vertical) and temporarily line up in Fuse. Mark holes to be drilled through fuse.. Drill holes with 1.5mm drill and attach to Fuse. side using ½" plates. Fin should be between plates and Fuse. side.
2) Use 3 plates to secure evenly spaced.

E) Wing & Aileron Servos

1) Cut wing to 48 x 22" size, 48" flutes horizontal.
2) Mark 11" flute at each end of 48" length.
3) Score with screwdriver and fold carefully in two, so fold and chord length is the same on both sides. (Correx does not always fold straight !)
4) Mark and cut the servo holes at the 12" positions as per plan. Cut plywood plates as per plan. Rough up Correx wing around servos. Glue to the wing. Cut 4mm Correx plates to the same shape as the ply and rough up. Glue Correx on top of the ply.
5) Cut the Ailerons as one piece to size and mark the flute to be cut so it's obvious how much will disappear inside the wing halves. Cut hinge at the 1.5" mark as per plan. Note that the Aileron has to be aligned straight with the wing TE. Glue the aileron to the wing bottom. Clamps can be used here. (rough up both the areas on the aileron and the wing with sandpaper so the CA has something to stick to. I use a piece of wire to help spread the glue evenly over the area. .
6) When dry, run servos but do not finalise mounting yet. Attach the extensions inside the wing. Note that small zip ties should be use to secure the servo leads to both the "Y" lead and the extension leads. Make a hole in the wing bottom central to allow the single side of the "Y" lead to exit the wing bottom. Prior to wing completion, test that the "Y" lead and servos work by attaching them to the Rx and Tx.
7) Rough up the other inside side of the wing and the aileron top.
8) Glue the same way and clamp the whole TE to hold the wing straight.
9) The spar should be cut to 44" length and tapered 2" at both ends.
10) Measure and mark the proposed CG point on the wing. (27.5% of 11")
11) Insert the spar flat and twist into it's final vertical position.

12) Place the wing vertically on a flat surface (make sure this surface is not required as the CA will run down the wing onto it !) and run some CA down between the spar and the wing.
13) This has to be done on all 4 spar joins after each has dried.
14) When dry, drill servo holes and mount both permanently with the horn end nearest to the ailerons.
15) Mark wing ends shape as per plan , rough up the inside wing ends, and glue and clamp. When dry, cut off the wing tip angles as per plan.
16) Mark Aileron mid point of wing and measure and mark 2.5" on either side. Cut Ailerons vertically at this point to allow movement around the fuselage and room for wing wrap.
17) Test fit the 18" wing wrap. Mark end points so both are equal (roughly) on the underside of the wing. Bend LE and TE portions to shape. Rough up both mating surfaces and glue flat part first, (top side) then each under side portion. When dry, use 4mm dowel inserted in the top and bottom of TE and LE's, to prevent elastic band crush.
18) Mark aileron ends and LE cut-offs and cut to shape as per plan.

F) Radio Installation
1) Position Rx temporarily under radio hatch so that all servos leads can reach it.
2) You may have to use an extension on the aileron lead, so don't forget the zip tie(s).
3) Check that the Elevator servo proposed position (on lhs) is a) the servo lead can reach the Rx b) the control rod length is enough to reach the elevator.
4) Mark servo outline and cut. Fix servo to Fuse..
5) Zip tie the Rx to the rhs of the Fuse.
6) Battery should also be on the lhs of the fuse. to counteract the silencer weight on the rhs.

G) Security & Setting Rates
1) Secure all servo connections, especially the Battery with zip ties. Make sure the Battery cannot move - zip tie Battery to fuse with two ties.
2) Set rates on Elevator to full (hole 4 on Futaba horns)
3) Set Aileron rates to hole 2 of 4 (this can be adjusted later after the test flight if required)

H) Control Surface Connection
1) Make 3 Horns (2 left hand and 1 right hand) and Plates as per plan.
2) Use 9" 2mm ? threaded rods, Z bent at servo end and metal clevises at the control surface end.
3) Secure clevises with fuel tube.
4) Horns have one hole at the top only for both ailerons and elevator.
5) Set all surfaces to mid-points on Tx (trims at neutral). Elevator flat. Ailerons flat and parallel with fuselage top.
6) Set throttle up (servo arm at mid-way point should correspond to ½ carb. opening movement.

I) CG and Lateral Balance
1) The CG has been deliberately moved forward slightly as this is a Trainer hence the calculation only using the wing and not taking into account the aileron width. It is my view that a Combat beginner needs a plane that is stable (flies "hands-off") and predictable above all else.
Already Combat experienced Pilots can use 27.5% of the wing plus Ailerons (chord) to calculate the CG. Moving the CG further backwards will make the plane more sensitive to elevator movement and thus less able to fly "hands-off". It will however, roll quicker and loop/bunt tighter but be harder to fly.

a) CG Balance
1) Make sure all components are in place. (switch banded also)
2) Cut two pieces of dowel about 5" long and rubber band them to fuselage. Rubber band wing to the fuse via the two dowels and test the CG already marked.
3) Move Battery to obtain balance. Mark Battery position and zip tie.
4) Mark edge of win LE and TE on top of fuse.
5) Mark holes for 3/8" dowel ½" before the wing LE and TE marks, and ½" below Fuse. edge.
6) Drill holes for dowel rods, making sure they do not foul anything like the tank etc.
7) Drill hole on top of fuse. for switch and mount behind wing. Do not mount on sides as it can be switched off during the launch by accident very easily.

b) Lateral Balance
1) Screw a hook into the fuse. at the rear mid-point of the fuse.
2) Suspend the plane at the front and rear with (nylon) rope over the washing line or similar.
3) First line goes around the engine front, second to the rear hook.
4) Balance the plane so that the left and right wings are horizontal. Add weight to the higher side until this is obtained. The plane will now take-off and glide straight without dropping a wing -important in a hand-launch plane.

7) Test Flying

1) Get an experienced Pilot to take-off and trim the plane for you.
2) Hand-Launch should be done by a second helper until the plane is trimmed.
3) Once trimmed, the plane is stable enough to be self hand-launched.

8) Independent Testers Comments

K.Hitchen

Stability :- "very good"
Speed :- "very good"
Loops and Rolls :- "very good"
Glide :- "very good"
Hand-Launch stability :- "very good"
Overall Impression :- "very good"

R.Stephens

Stability :- "good"
Speed :- "enough"
Loops and Rolls :- "quick loops"
Glide :- "superb"
Hand-Launch stability :- "fine"
Overall Impression :- "excellent"

9) Fine Tuning the Design (Expert only)

a) Engine

A ball bearing engine will improve power delivery.
A .46 will be ballistic in this plane and is not for the Trainee.

b) Wing aerofoil thickness

The thinner this is the faster the plane. 18mm was a compromise between fitting the servos in the wing and the wing aerofoil height.

c) Lighter Wing

A 2mm wing would be much lighter but less strong.

d) Lighter Fuselage

The Fuselage could be swiss-cheesed to save weight, at the expense of strength.

e) CG

CG moved to 27.5% of chord (aileron + wing)

e) Horns

A second hole ½ way down horn could be used for more movement if necessary.

10) Design Don't's

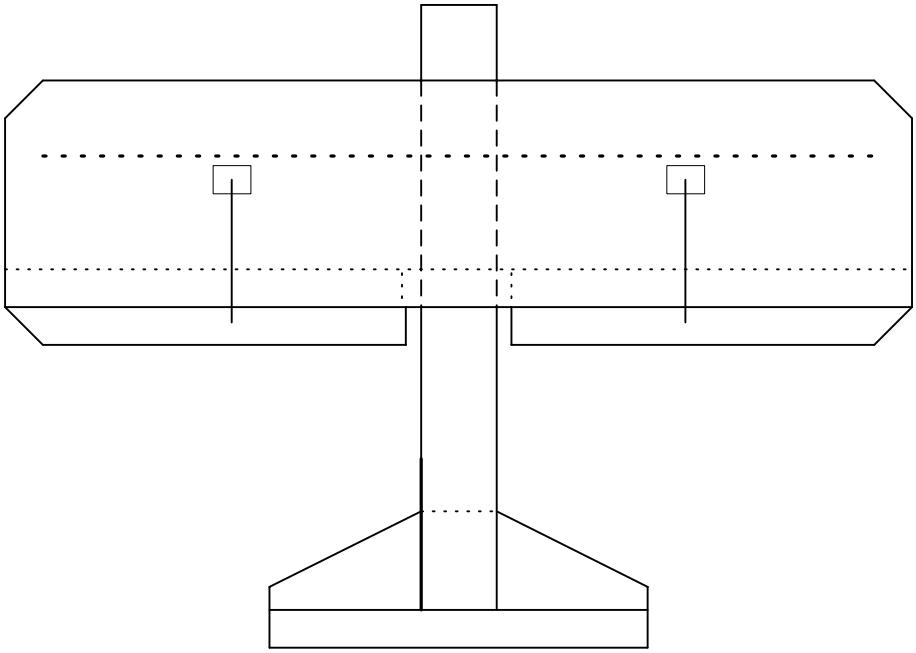
a) Change firewall to HPDF – the fuselage breaks instead of the firewall in a crash.
b) Change the wing/tailplane positions – this ruins the stability performance.
c) Use a single servo for the Ailerons – this bends the ailerons (warps) out of shape, necessitating constant trim adjustments every time you fly. Only one flute cut-out is fine for dual servos.
d) Zip tie the throttle servo to the fuselage – this causes excessive friction on the throttle wire due to the bend and ruins fine control.
e) Fly with all settings on full throws, especially ailerons – the plane will be uncontrollable in a wind.

11) Plans

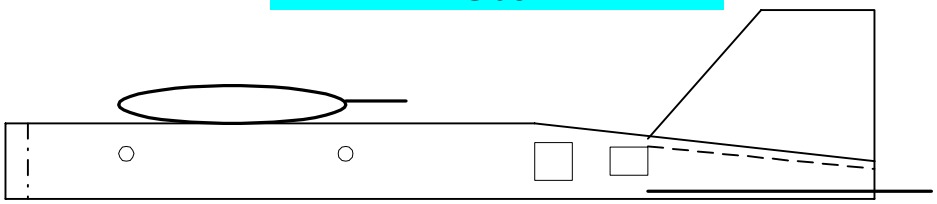
Designed by I. Scottow
No copywright applies
for further ideas see
www.ianscottow.wingers.co.uk or
www.spadtothebone.com

HWDMAC Combat Trainer
"Kombat Train"MK4
Overview

Plan



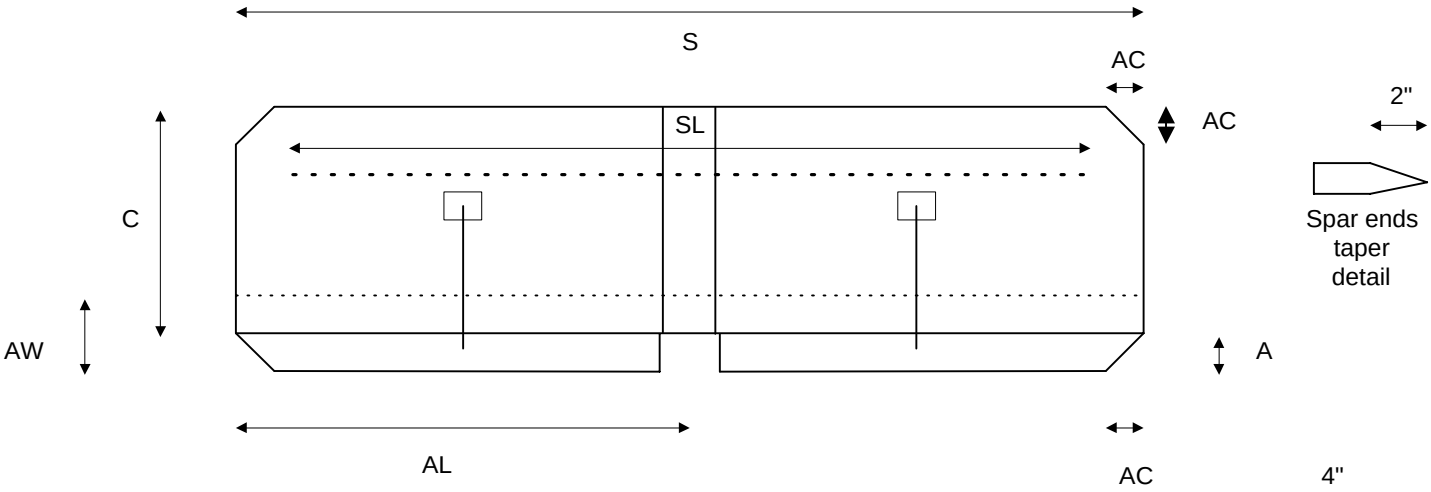
Side



Notes

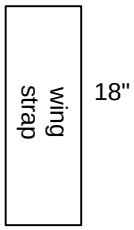
1) Wing on top of fuse, Tailplane inset into fuse.
2) Dowel holes and final wing position are determined by final CG position.
3) Fin is screwed to one side of fuselage and is cosmetic.
4) Preferred position for Elevator servo and Battery is lhs of fuse to offset weight of silencer.
5) Dual servos used to prevent aileron warp.
6) Use servo wheel screwed to rhs or bottom fuse to tie on streamer.

Wing Dimensions

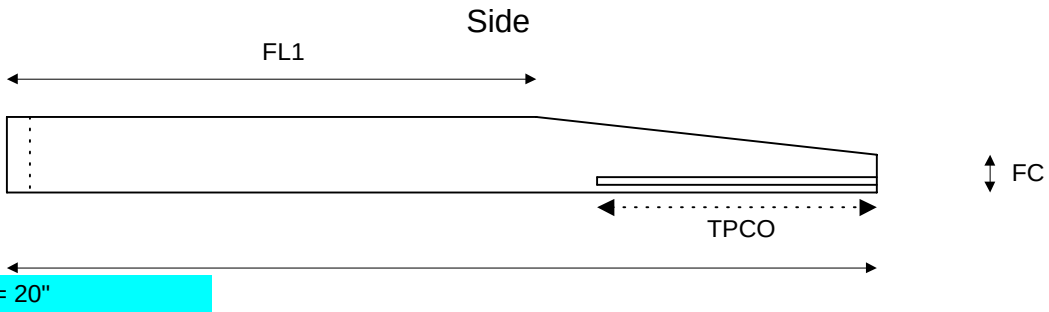


S = Span = 48"
C = Chord = 11"
AW = Aileron Width =2.5"
A = Aileron = 1"
SL = Spar Length = 44"
F= Filler = 65mm x 1"
AC = Aileron Cut = 1.5"

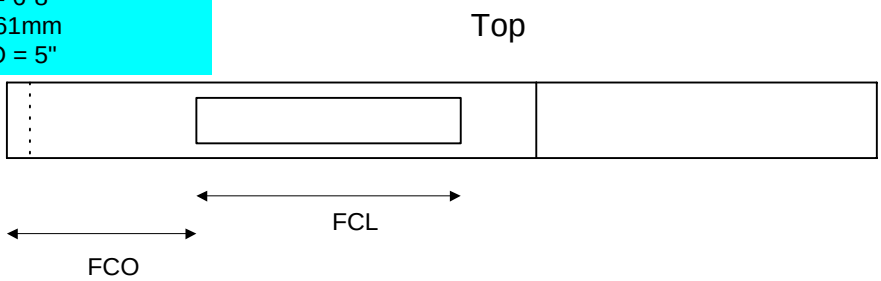
Notes
1) Spar (CG) is 27.5% of C (77mm from LE)
2) Servos at 12" points.

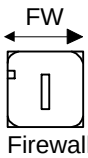


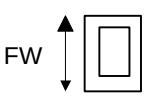
Fuselage Dimensions



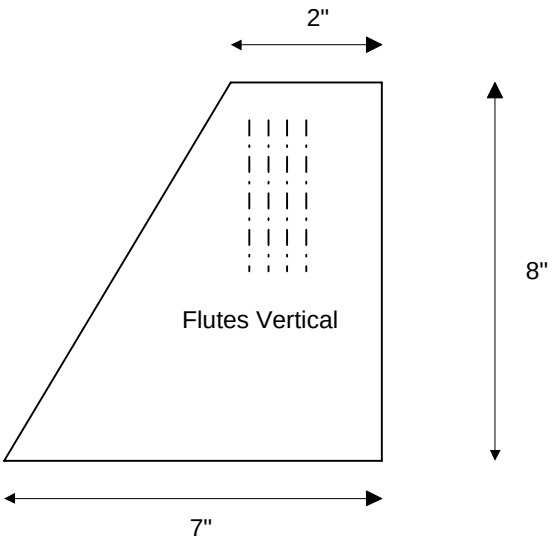
FL1 = 20"
FL = Fuselage Length = 30"
FC = 1"
FCO = 8"
FCL = 6-8"
FW = 61mm
TPCO = 5"



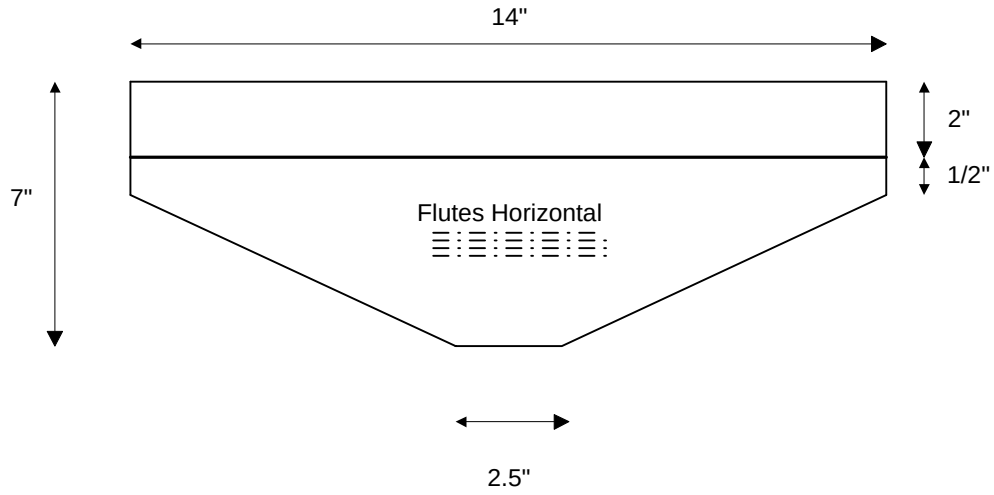




Tailplane/Elevator and Fin



Fin

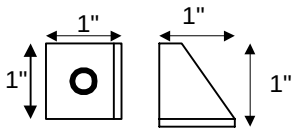


Tailplane/Elevator

Notes

1) A single flute is used for the elevator hinge.
2) Fin flutes are vertical.
3) Fin has an extra 1" height to allow fuse. connection.
3) Tailplane flutes are horizontal.

Horns



Plates