Human Powered Aircraft Group

Gossamer Albatross Drawings

By

A. A. P. Lloyd

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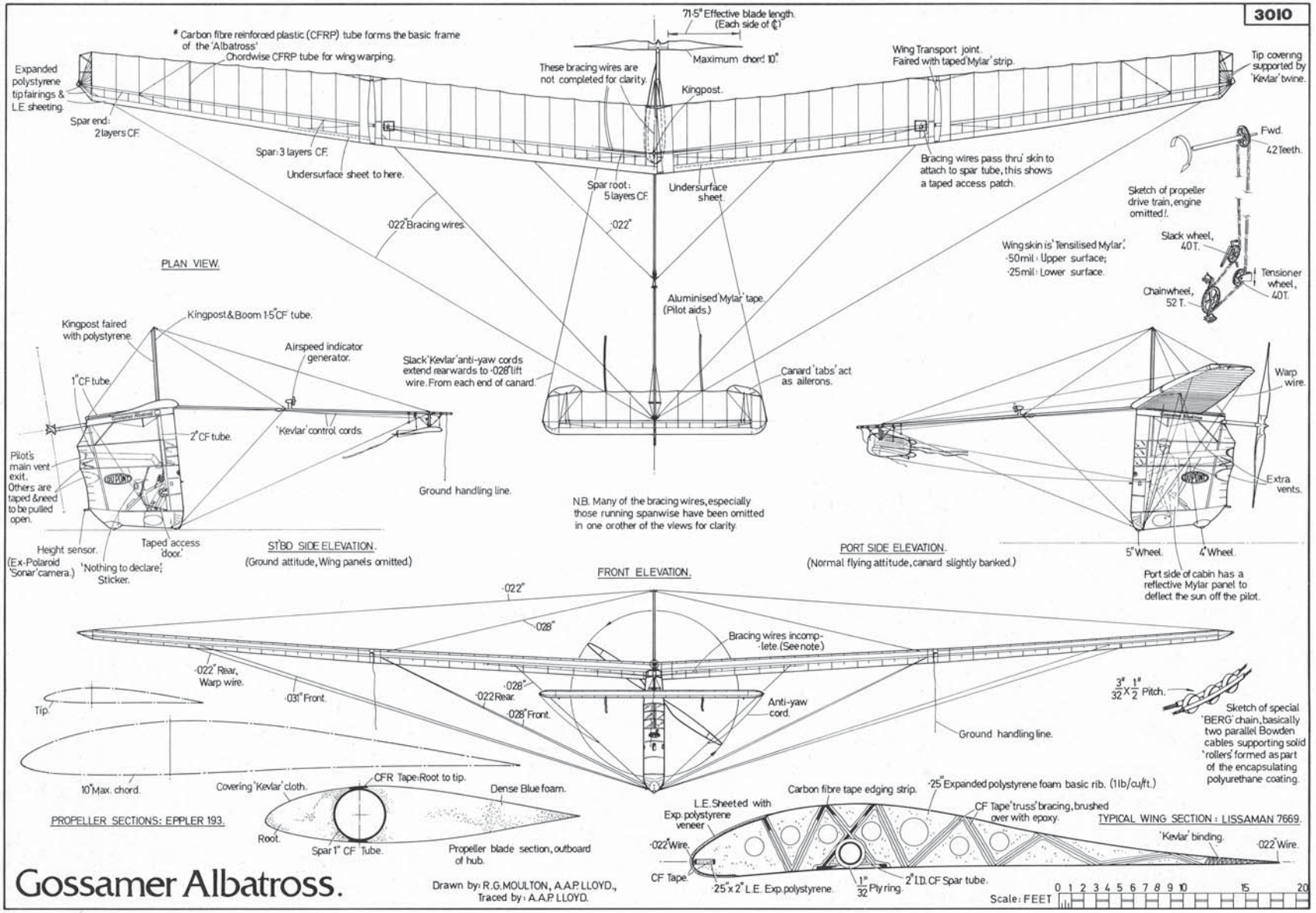
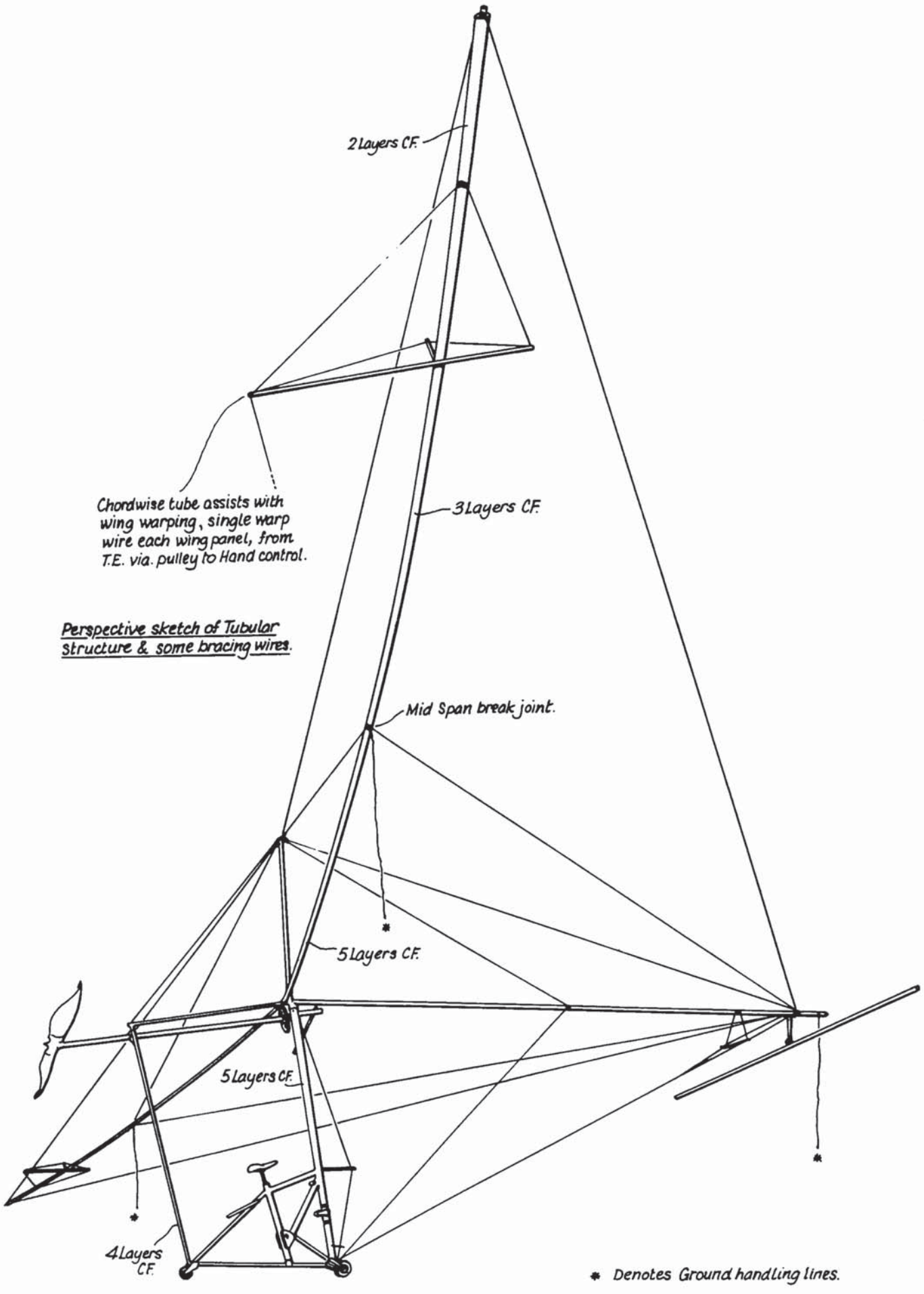
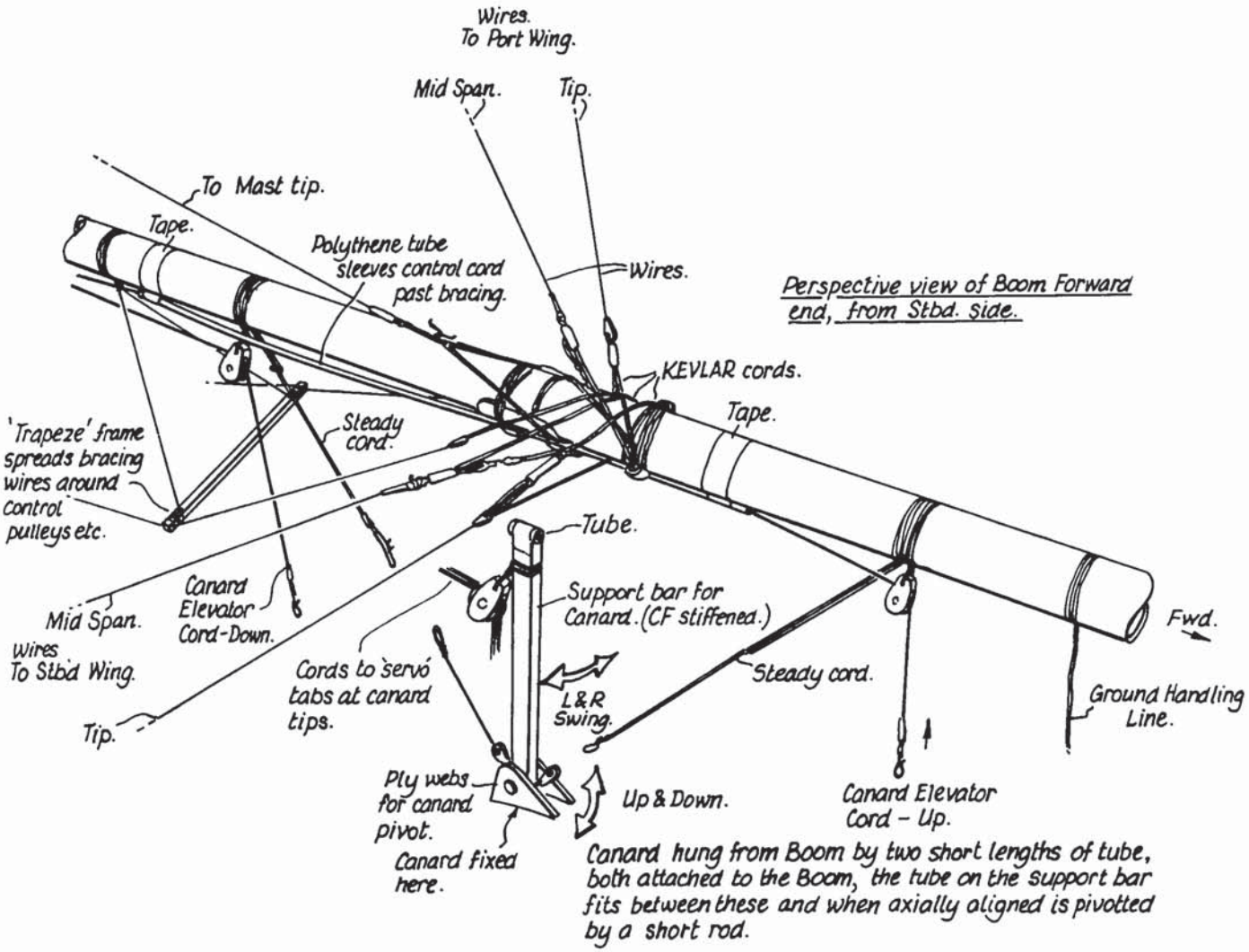
Royal Aeronautical Society
4 Hamilton Place London

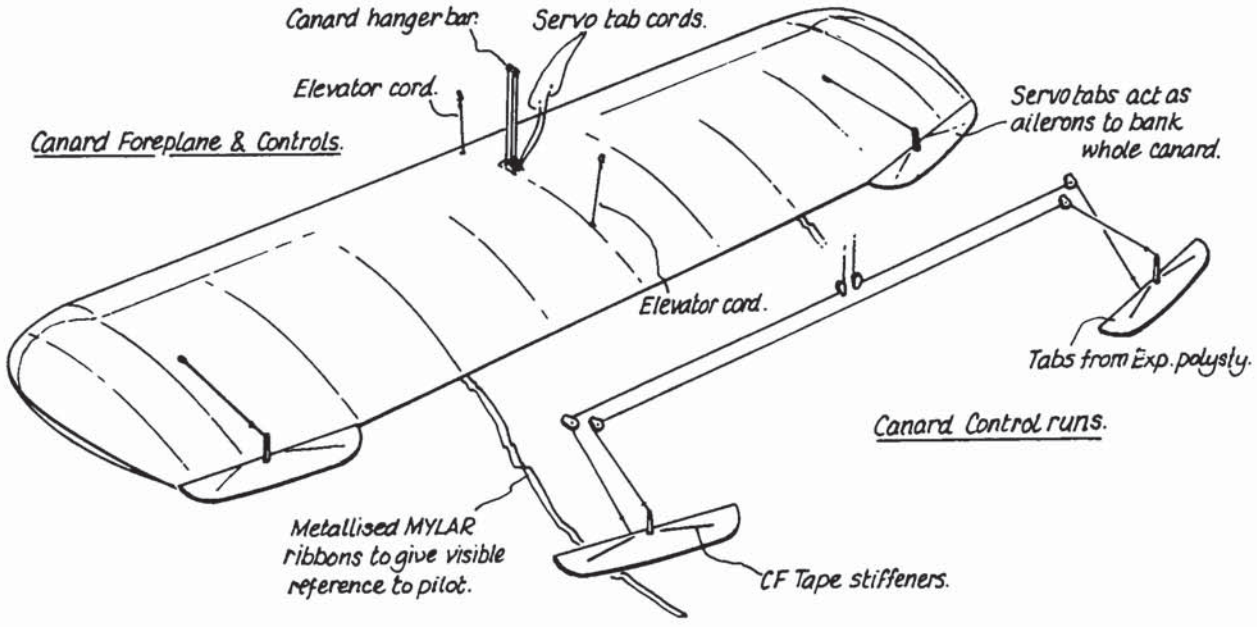


Gossamer Albatross.

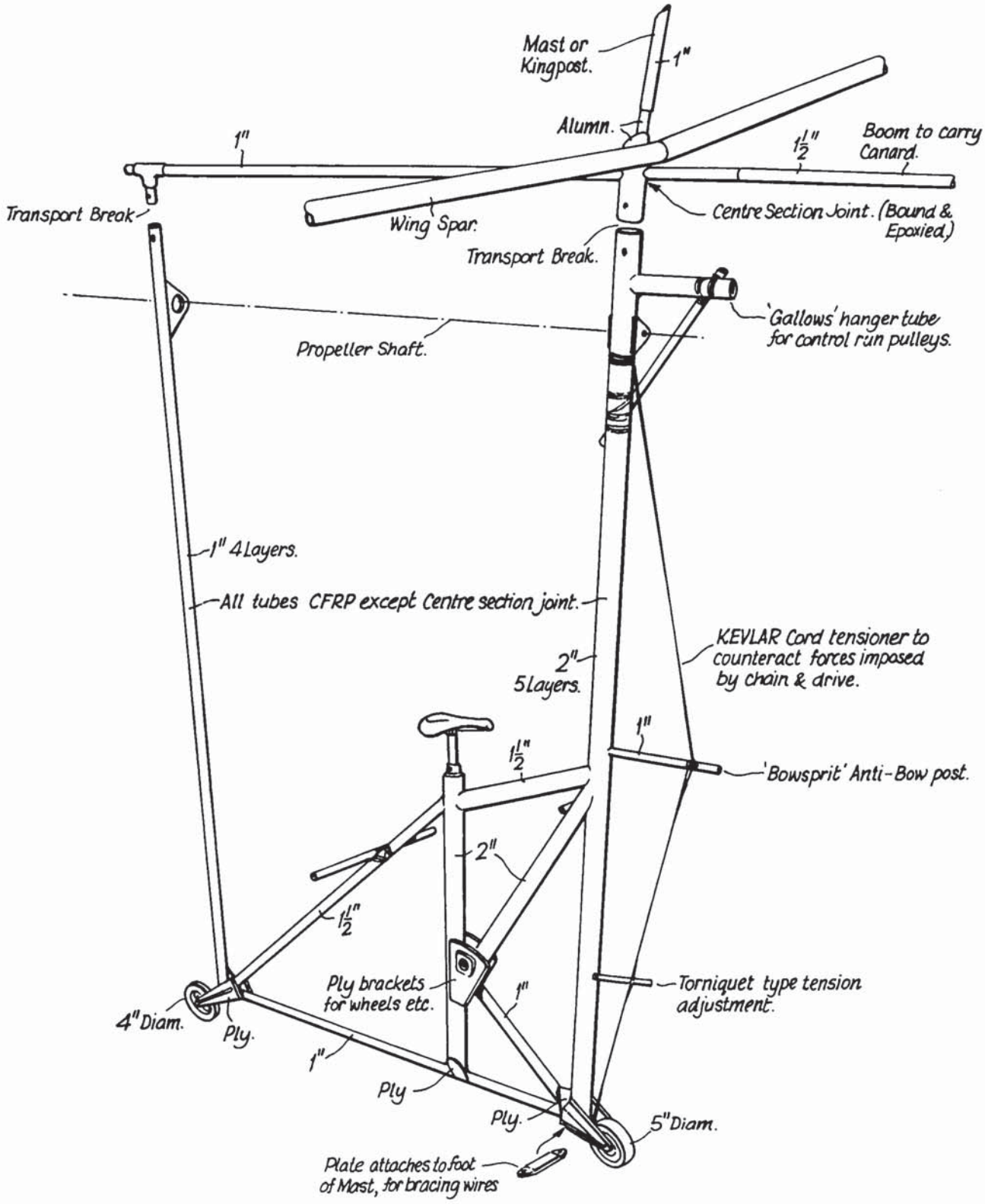
Drawn by: R.G.MOULTON, A.A.P. LLOYD.,
Traced by: A.A.P. LLOYD.


2 Layers CF.
Chordwise tube assists with wing warping, single warp wire each wing panel, from T.E. via. pulley to Hand control.
3 Layers CF.
Perspective sketch of Tubular Structure & some bracing wires.
Mid Span break joint.
5 Layers CF.
5 Layers CF.
4 Layers CF.
* Denotes Ground handling lines.


Wires.
To Port Wing.
Mid Span.
Tip.
To Mast tip.
Tape.
Polythene tube sleeves control cord past bracing.
Wires.
Perspective view of Boom Forward end, from Stbd. side.
KEVLAR cords.
Tape.
'Trapeze' frame spreads bracing wires around control pulleys etc.
Steady cord.
Tube.
Mid Span.
Wires To Stbd Wing.
Canard Elevator Cord-Down.
Support bar for Canard. (CF stiffened.)
Fwd.
Cords to servo tabs at canard tips.
L&R Swing.
Steady cord.
Ground Handling Line.
Tip.
Ply webs for canard pivot.
Up & Down.
Canard Elevator Cord - Up.
Canard fixed here.
Canard hung from Boom by two short lengths of tube, both attached to the Boom, the tube on the support bar fits between these and when axially aligned is pivotted by a short rod.

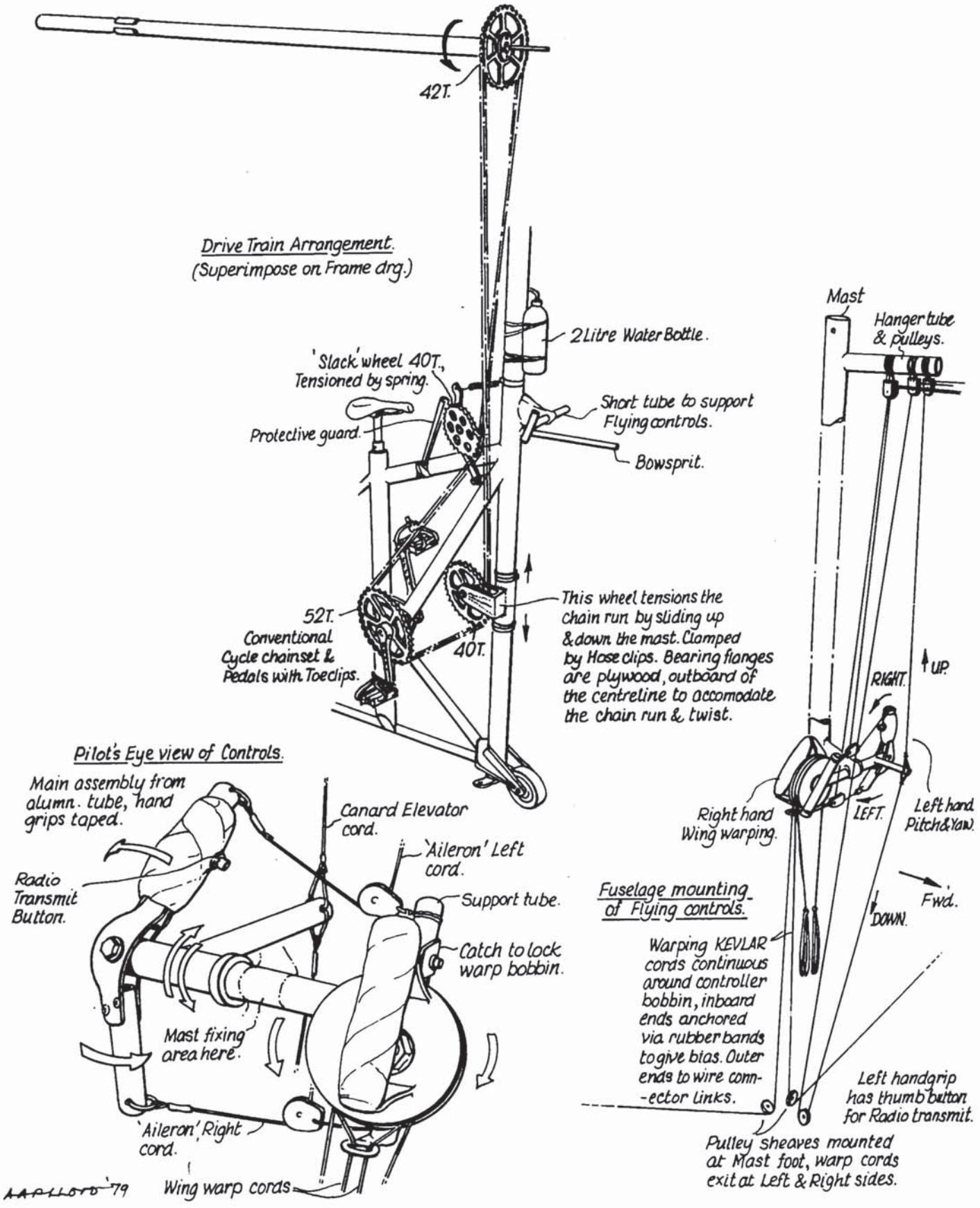

Canard hanger bar.
Servo tab cords.
Elevator cord.
Canard Foreplane & Controls.
Servo tabs act as ailerons to bank whole canard.
Elevator cord.
Tabs from Exp. polysty.
Canard Control runs.
Metallised MYLAR ribbons to give visible reference to pilot.
CF Tape stiffeners.

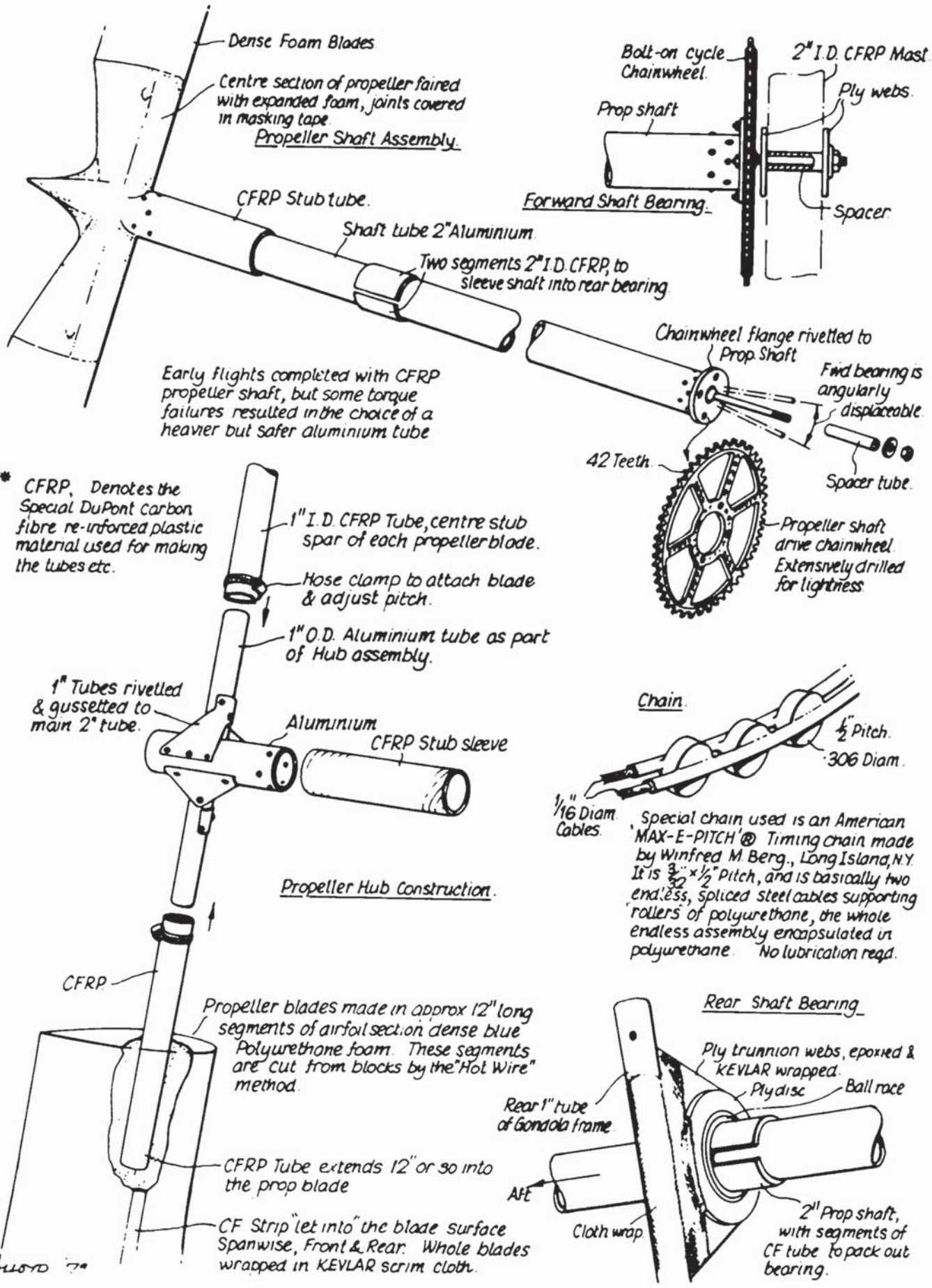
MAPLIN '79.

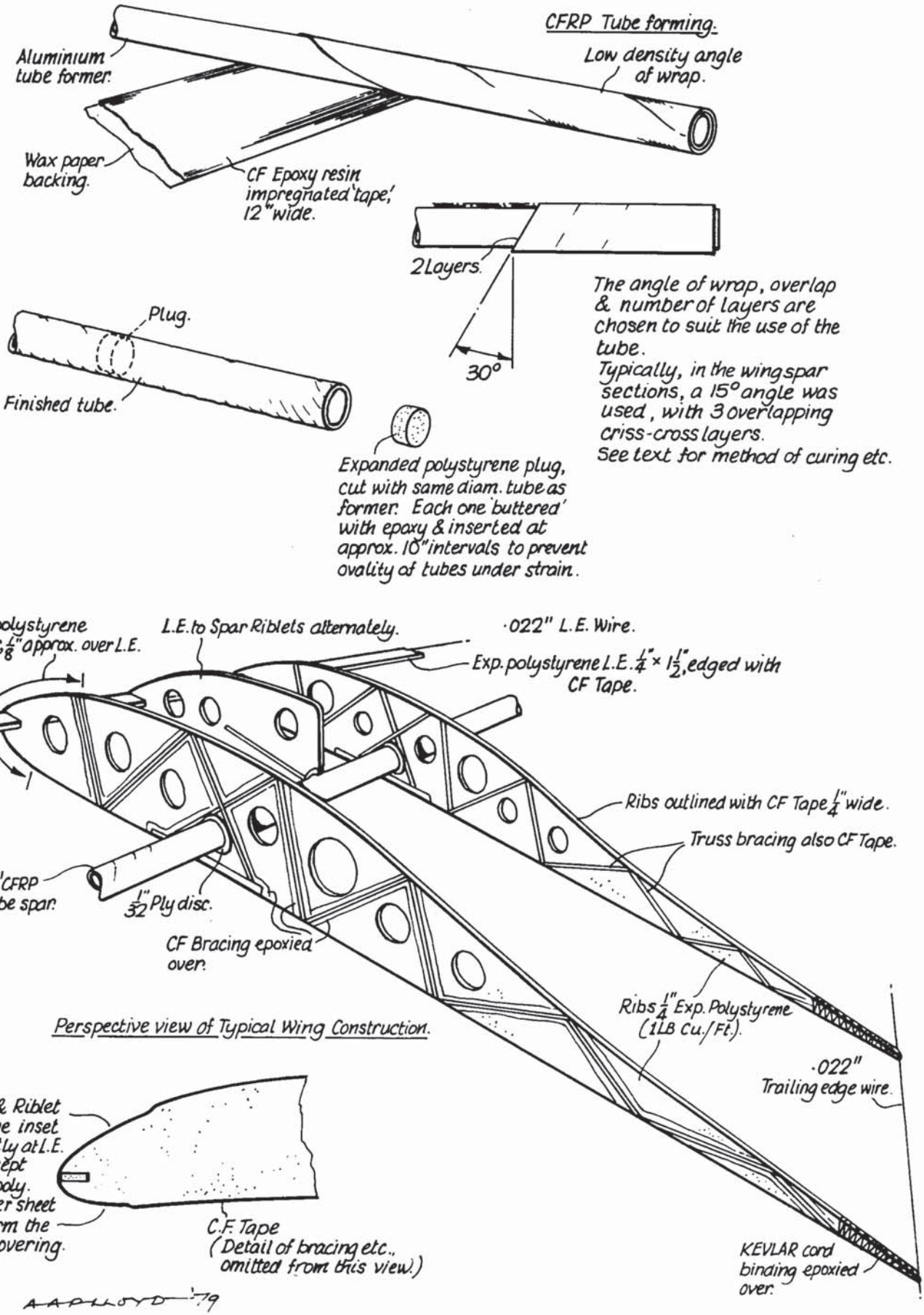


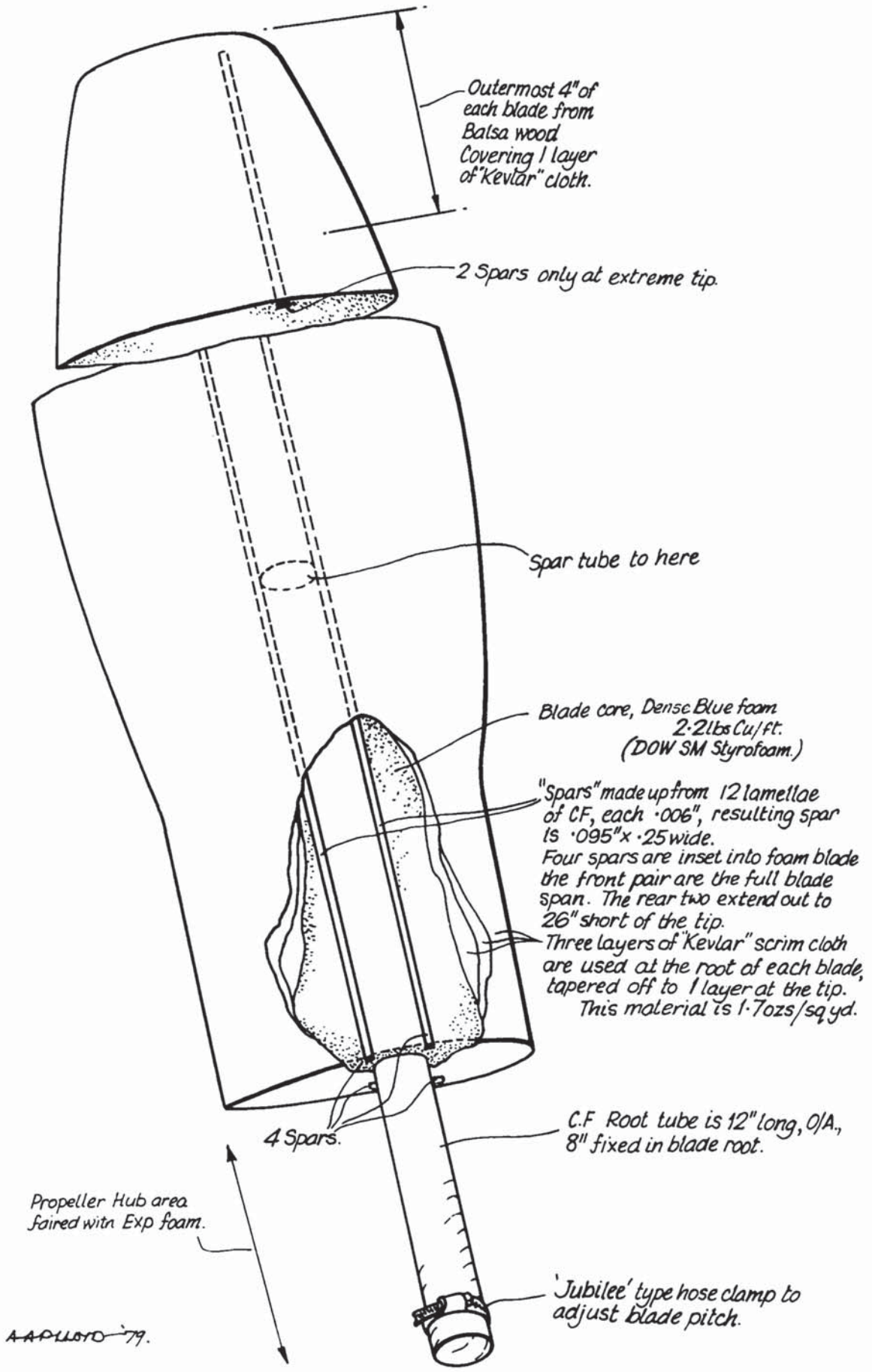
General Arrangement of Gondola Basic Structure & Attachment of Wing Unit.

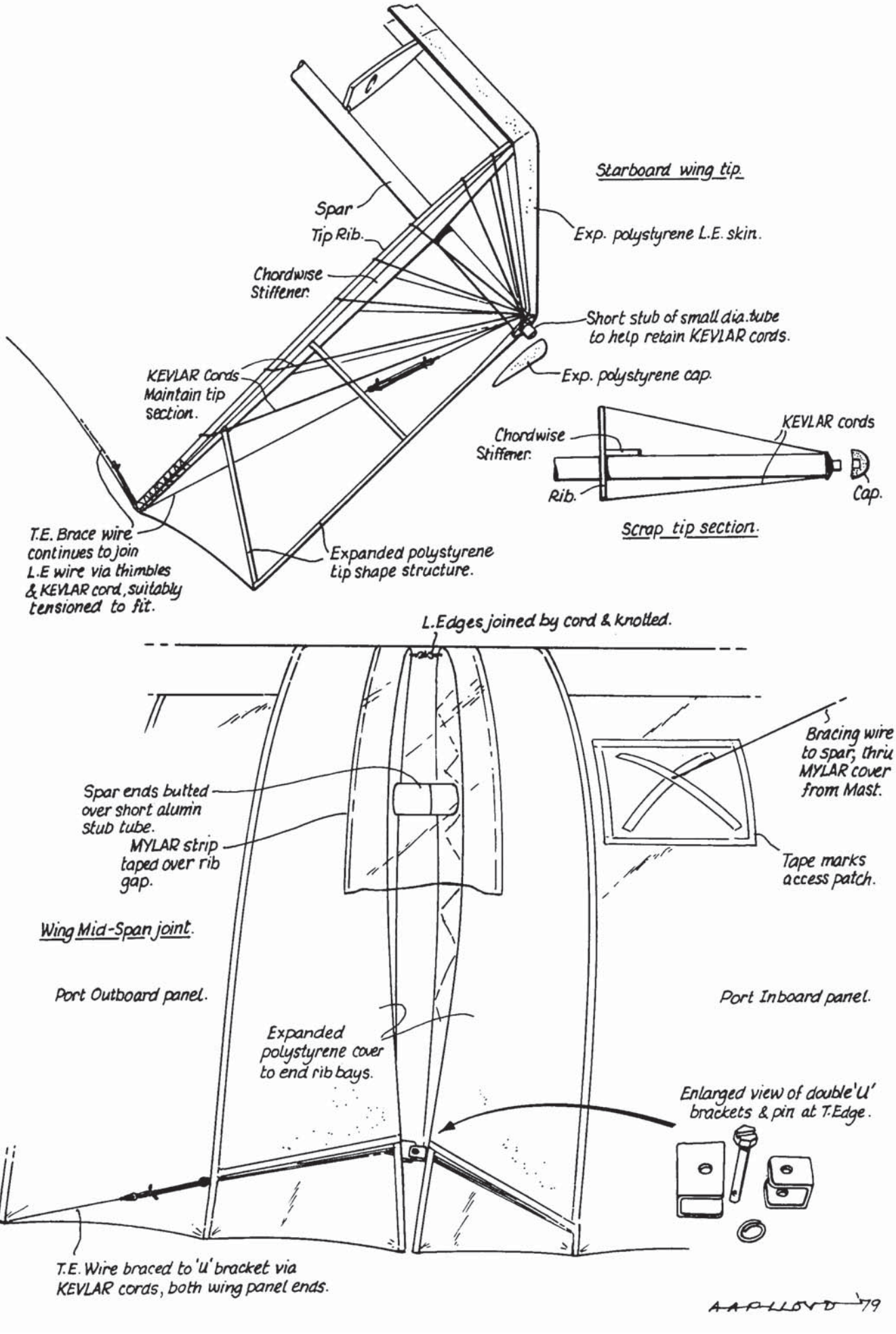
AAPLLOTD '79.

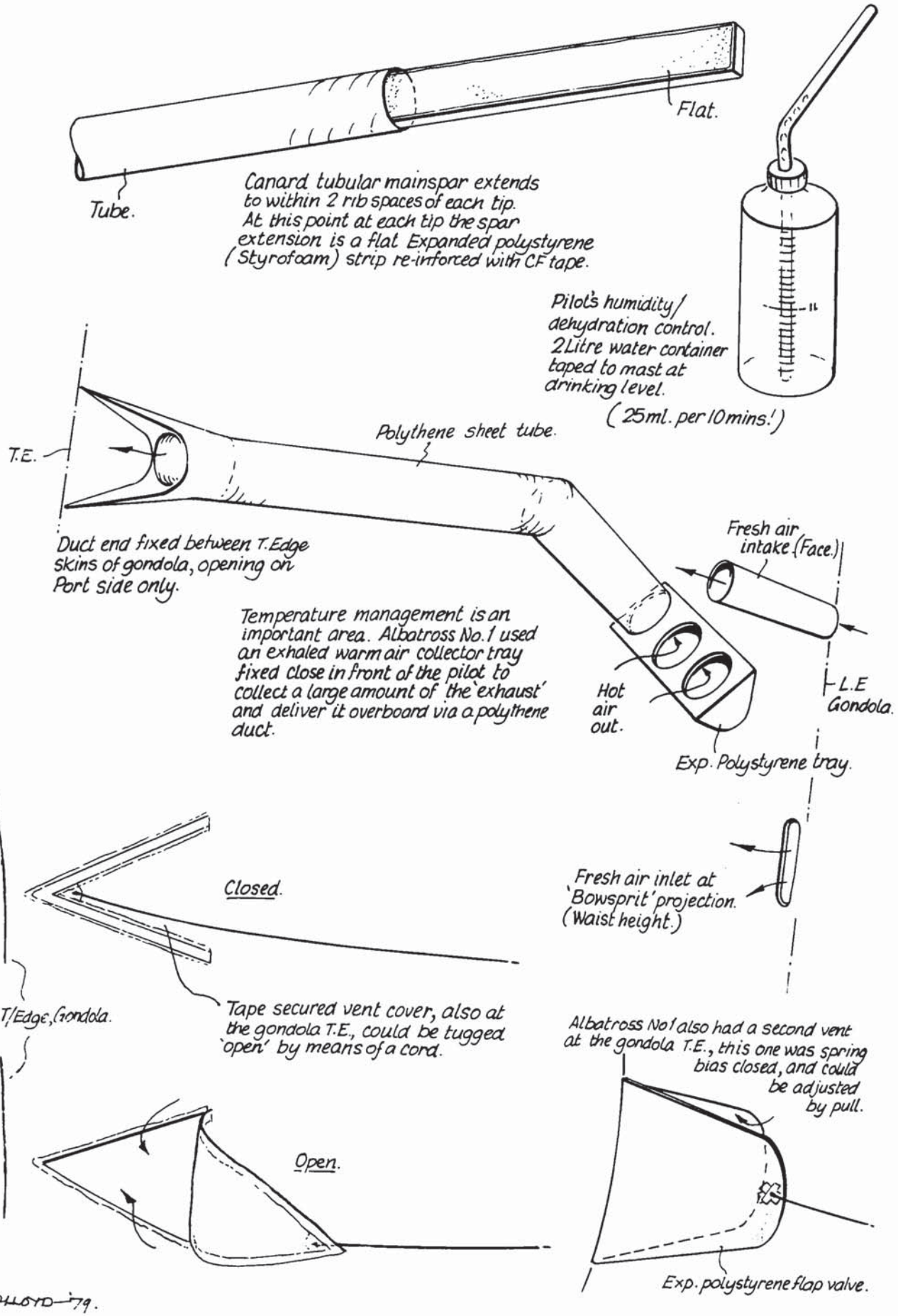

42T.
Drive Train Arrangement.
(Superimpose on Frame drg.)
2 Litre Water Bottle.
'Slack' wheel 40T., Tensioned by spring.
Short tube to support Flying controls.
Protective guard.
Bowsprit.
This wheel tensions the chain run by sliding up & down the mast. Clamped by Hose clips. Bearing flanges are plywood, outboard of the centreline to accomodate the chain run & twist.
52T.
Conventional Cycle chainset & Pedals with Toeclips.
40T.
Mast
Hanger tube & pulleys.
UP.
RIGHT.
LEFT.
Right hand Wing warping.
Left hand Pitch & Yaw.
Fwd.
DOWN.
Fuselage mounting of Flying controls.
Warping KEVLAR cords continuous around controller bobbin, inboard ends anchored via rubber bands to give bias. Outer ends to wire connector links.
Left handgrip has thumb button for Radio transmit.
Pulley sheaves mounted at Mast foot, warp cords exit at Left & Right sides.
Pilot's Eye view of Controls.
Main assembly from alumn. tube, hand grips taped.
Canard Elevator cord.
'Aileron' Left cord.
Radio Transmit Button.
Support tube.
Catch to lock warp bobbin.
Mast fixing area here.
'Aileron' Right cord.
Wing warp cords
APOLLO '79


Dense Foam Blades
Centre section of propeller faired with expanded foam, joints covered in masking tape.
Propeller Shaft Assembly.
CFRP Stub tube.
Shaft tube 2" Aluminium.
Two segments 2" I.D. CFRP, to sleeve shaft into rear bearing.
Bolt-on cycle Chainwheel.
2" I.D. CFRP Mast.
Ply webs.
Prop shaft
Forward Shaft Bearing.
Spacer
Chainwheel flange rivetted to Prop. Shaft
Fwd bearing is angularly displaceable.
Early flights completed with CFRP propeller shaft, but some torque failures resulted in the choice of a heavier but safer aluminium tube
42 Teeth.
Spacer tube.
Propeller shaft drive chainwheel. Extensively drilled for lightness.
* CFRP. Denotes the Special DuPont carbon fibre re-inforced plastic material used for making the tubes etc.
1" I.D. CFRP Tube, centre stub spar of each propeller blade.
Hose clamp to attach blade & adjust pitch.
1" O.D. Aluminium tube as part of Hub assembly.
1" Tubes rivelled & gussetted to main 2" tube.
Aluminium
CFRP Stub sleeve
Chain.
1/2" Pitch.
.306 Diam.
1/16" Diam. Cables.
Special chain used is an American 'MAX-E-PITCH'® Timing chain made by Winfred M. Berg., Long Island, N.Y. It is 3/32" × 1/2" Pitch, and is basically two endless, spliced steel cables supporting 'rollers' of polyurethane, the whole endless assembly encapsulated in polyurethane. No lubrication read.
Propeller Hub Construction.
CFRP
Propeller blades made in approx 12" long segments of airfoil section dense blue Polyurethane foam. These segments are cut from blocks by the "Hot Wire" method.
CFRP Tube extends 12" or so into the prop blade
CF Strip "let into" the blade surface Spanwise, Front & Rear. Whole blades wrapped in KEVLAR scrim cloth.
Rear Shaft Bearing
Ply trunnion webs, epoxied & KEVLAR wrapped.
Ply disc
Ball race
Rear 1" tube of Gondola frame.
Aft
Cloth wrap
2" Prop shaft, with segments of CF tube to pack out bearing.

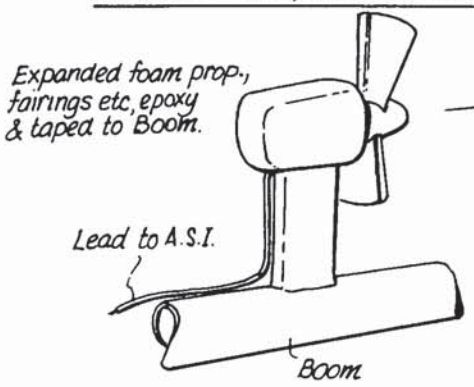

CFRP Tube forming.
Aluminium tube former.
Low density angle of wrap.
Wax paper backing.
CF Epoxy resin impregnated 'tape,' 12" wide.
2 Layers.
30°
The angle of wrap, overlap & number of layers are chosen to suit the use of the tube.
Typically, in the wing spar sections, a 15° angle was used, with 3 overlapping criss-cross layers.
See text for method of curing etc.
Plug.
Finished tube.
Expanded polystyrene plug, cut with same diam. tube as former. Each one 'buttered' with epoxy & inserted at approx. 10" intervals to prevent ovality of tubes under strain.
Exp. polystyrene veneer, 1/8" approx. over L.E.
L.E. to Spar Riblets alternately.
·022" L.E. Wire.
Exp. polystyrene L.E. 1/4" × 1 1/2", edged with CF Tape.
Ribs outlined with CF Tape 1/4" wide.
Truss bracing also CF Tape.
2" CFRP Tube spar.
1/32" Ply disc.
CF Bracing epoxied over.
Ribs 1/4" Exp. Polystyrene (1LB Cu./Ft.).
·022" Trailing edge wire.
KEVLAR cord binding epoxied over.
Perspective view of Typical Wing Construction.
Rib & Riblet outline inset slightly at L.E. to accept Exp. poly. veneer sheet to form the L.E. covering.
C.F. Tape
(Detail of bracing etc., omitted from this view.)
A.A. LLOYD '79

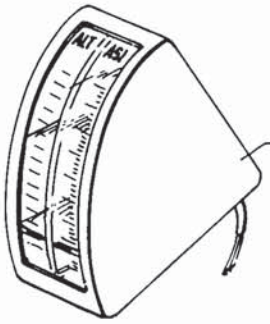

Outermost 4" of each blade from Balsa wood Covering / layer of "Kevlar" cloth.
2 Spars only at extreme tip.
Spar tube to here
Blade core, Dense Blue foam 2·2lbs Cu/ft. (DOW SM Styrofoam.)
"Spars" made up from 12 lamellae of CF, each ·006", resulting spar is ·095" x ·25 wide. Four spars are inset into foam blade the front pair are the full blade span. The rear two extend out to 26" short of the tip.
Three layers of "Kevlar" scrim cloth are used at the root of each blade, tapered off to 1 layer at the tip. This material is 1·7ozs/sq yd.
4 Spars.
C.F Root tube is 12" long, O/A., 8" fixed in blade root.
Propeller Hub area faired with Exp foam.
'Jubilee' type hose clamp to adjust blade pitch.
A.A.Pilloro '79.


Starboard wing tip.
Spar
Tip Rib.
Chordwise Stiffener.
Exp. polystyrene L.E. skin.
Short stub of small dia. tube to help retain KEVLAR cords.
Exp. polystyrene cap.
KEVLAR Cords Maintain tip section.
T.E. Brace wire continues to join L.E wire via thimbles & KEVLAR cord, suitably tensioned to fit.
Expanded polystyrene tip shape structure.
Chordwise Stiffener.
KEVLAR cords
Rib.
Cap.
Scrap tip section.
L.Edges joined by cord & knotted.
Bracing wire to spar, thru MYLAR cover from Mast.
Spar ends butted over short alumin stub tube.
MYLAR strip taped over rib gap.
Tape marks access patch.
Wing Mid-Span joint.
Port Outboard panel.
Port Inboard panel.
Expanded polystyrene cover to end rib bays.
Enlarged view of double 'U' brackets & pin at T.Edge.
T.E. Wire braced to 'u' bracket via KEVLAR cords, both wing panel ends.
A.A.PLLOYD '79

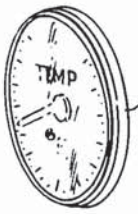

Flat.
Tube.
Canard tubular mainspar extends to within 2 rib spaces of each tip. At this point at each tip the spar extension is a flat Expanded polystyrene (Styrofoam) strip re-inforced with CF tape.
Pilot's humidity/ dehydration control. 2 Litre water container taped to mast at drinking level.
(25ml. per 10 mins.!)
Polythene sheet tube.
T.E.
Duct end fixed between T.Edge skins of gondola, opening on Port side only.
Temperature management is an important area. Albatross No.1 used an exhaled warm air collector tray fixed close in front of the pilot to collect a large amount of the 'exhaust' and deliver it overboard via a polythene duct.
Fresh air intake (Face.)
L.E Gondola.
Hot air out.
Exp. Polystyrene tray.
Closed.
Fresh air inlet at 'Bowsprit' projection. (Waist height.)
T/Edge, Gondola.
Tape secured vent cover, also at the gondola T.E., could be tugged 'open' by means of a cord.
Albatross No1 also had a second vent at the gondola T.E., this one was spring bias closed, and could be adjusted by pull.
Open.
Exp. polystyrene flap valve.
AAPLLOYD '79.

Instrumentation, Radio & Electronics Equipment.



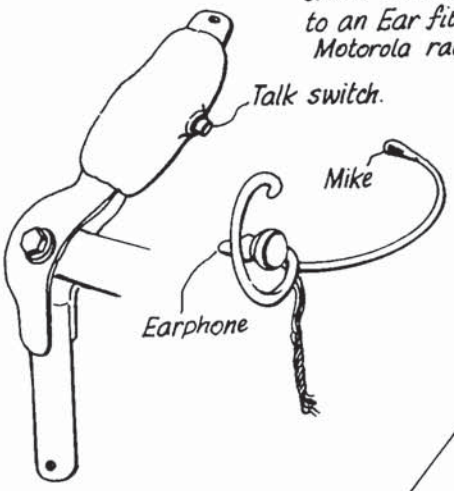


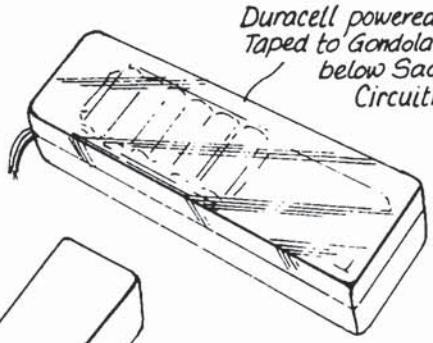
Combined Altimeter & Airspeed Indicator, taped to Mast, port side, at pilot's eye level.

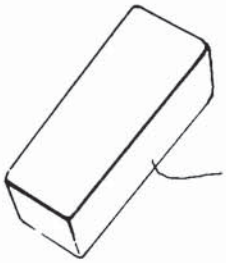


Internal temperature indication of Gondola/cabin via small Bi-metallic type thermometer stuck to panel below window of Gondola.

Radio contact via a Boom Microphone, with a "Talk" switch on Left hand controls, attached to an Ear fitting receiving phone, thru a 2-way Motorola radio.

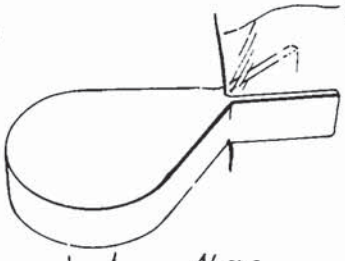






Motorola radio, taped in place to Rear wheel/Seat stay tube.

Below.



Vertical distance measured with this "Sonar" rangefinder cell, from a POLAROID camera. Cell window faces down.

Above.

AAPILOTO—'79.