Functional on every medium. The wheeled version.

Bernie Huber's

Pilatus PC-6 Porter

A Veco Lee .61 in a Scale STOL type aircraft . . .

♦ For some time now, Telaves Model Engineering, composed of Bernhard, Gerd and Berni Huber, have talked about building a scale model of the Swiss-built Pilatus "Porter." In these discussions we wondered if it would be possible for the model to duplicate the STOL characteristics of the real aircraft. To our pleasure, we found the model in flight much the same as the real Porter.

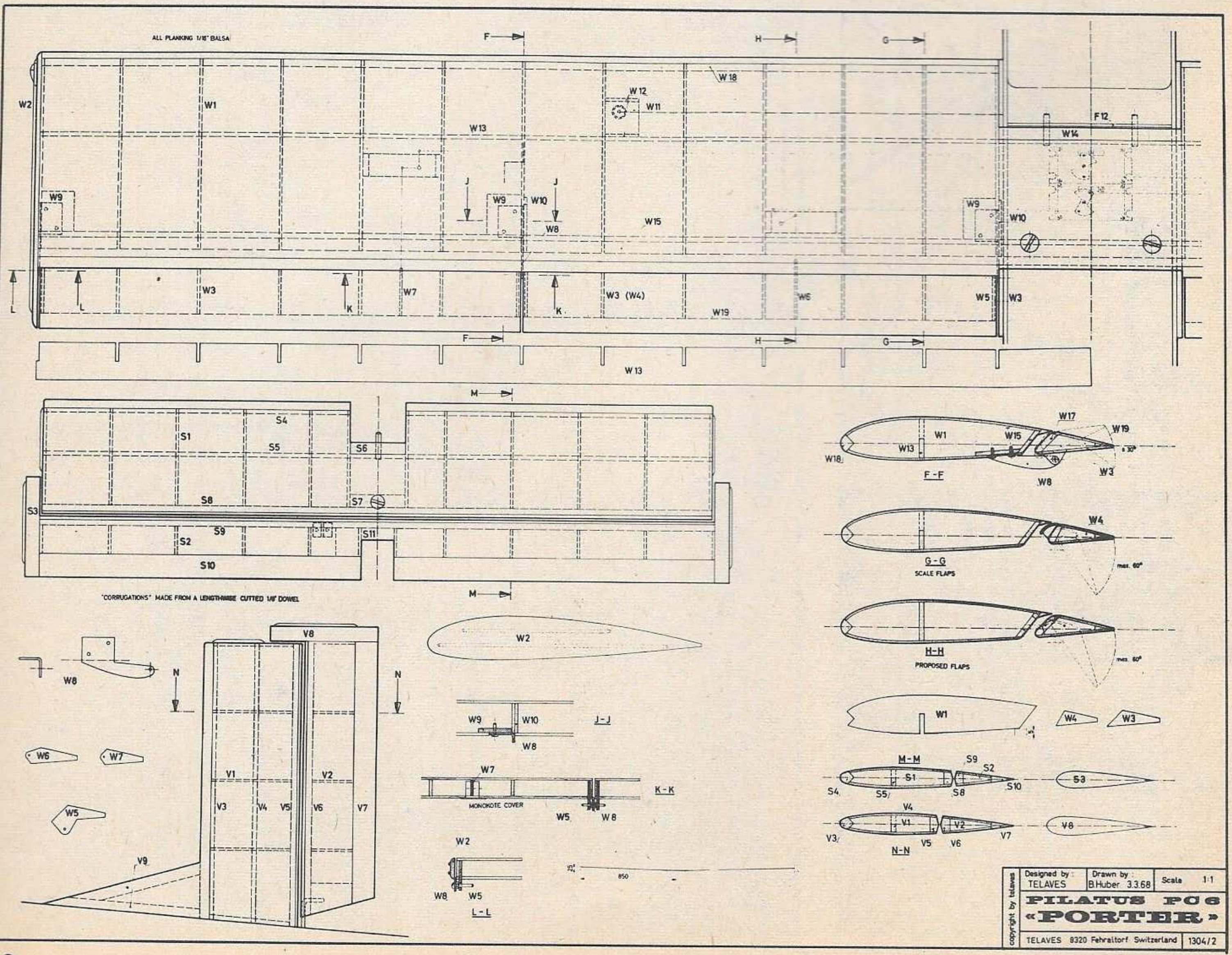
The Pilatus "Porter PC-6" is manufactured at Stans, Switzerland, by the Pilatus Aircraft Company, Ltd., in the following versions:

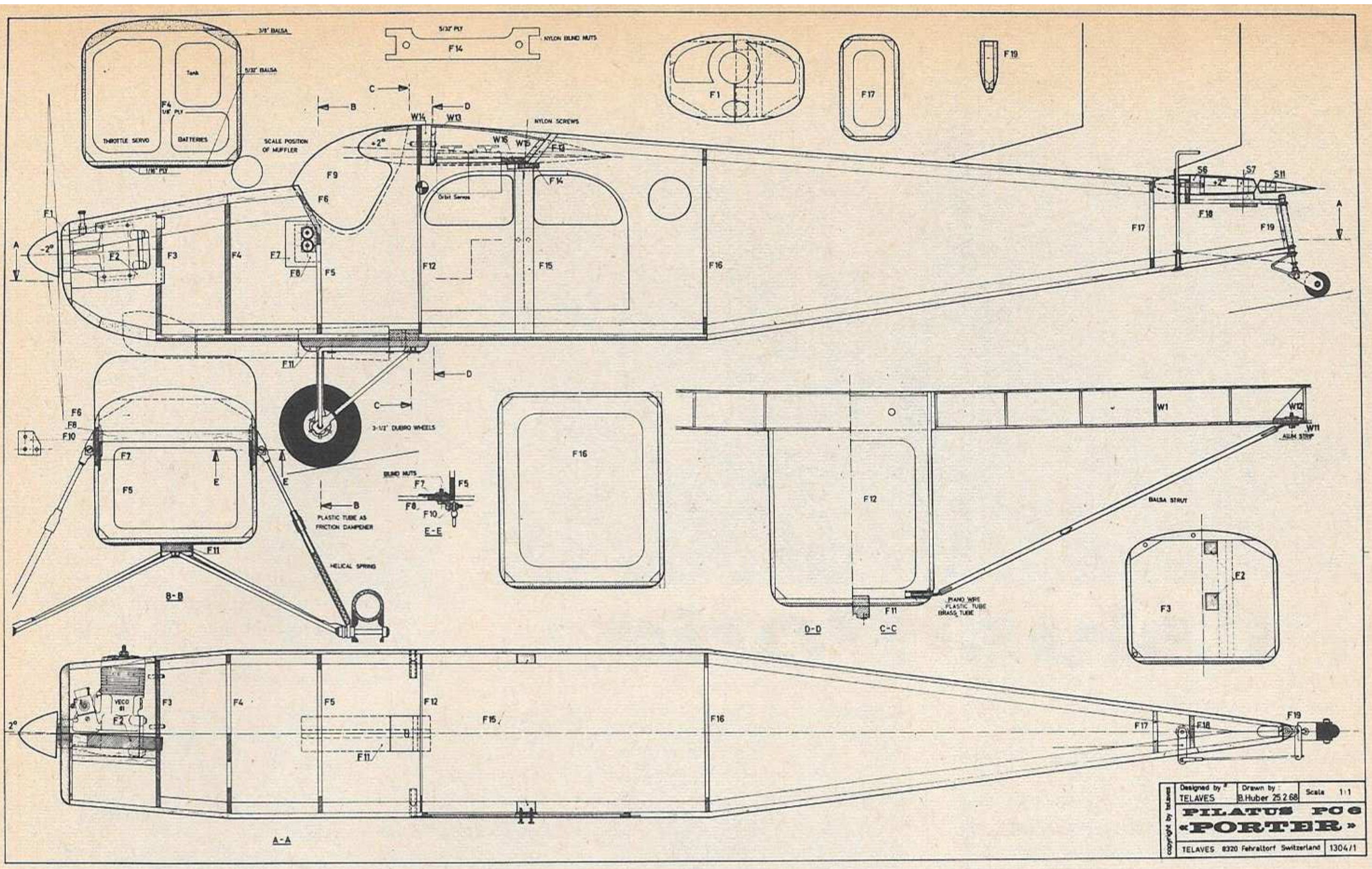
PC-6/340—Powered by a Lycoming GSO-480-BIA6 engine of 340 hp.
PC-6/350—Powered by a Lycoming IGO-540-AIA of 350 hp.
PC-6/A—Powered by a Turbomeca Astazou II Turboprop of 530 shp.
PC-6/B—Powered by a Pratt & Whitney UACL PT6A of 550 shp. and several specially powered versions were equipped with Garrett Airesearch turbines for operation in Thailand.

Stans is at the foot of the Pilatus Peak, near Lucerne, and the company so named after that mountain.

Over 160 Porter aircraft have been manufactured in Switzerland and some

FULL SIZE PLAN MPS 132 AVAILABLE THROUGH "MODEL PLAN SERVICE"





additional 45 Porters were built in America. The "Porter" may be considered as a special plane, used where the "average" aircraft have no chance to take off and land. The Porter has extremely short take-off and landing characteristics, and even more so with the new Turboprop engines. It is likened to an "Air-Jeep"; because of its usefulness. The useful load of this aircraft is more than its empty weight, testifying to its good performance. The Porter was designed as a multi-purpose plane and as it may be used with wheels, skis and floats, it fills the need as a transport at high altitudes, a photographic plane, for agriculture and for other special purposes. It has flown to Alaska, Canada, Asia, Japan, Australia and from the Antarctic to Norway. One was flown by a lone pilot to Australia, over open sea, mountains and deserts, through the Middle East, Pakistan, India, down through Singapore and Indonesia to Darwin and finally the length of Australia to Melbourne. This 14,000 mile trip, in 16 stages, took only two weeks. Such is

Wheels, Floats or Skis, an able, rugged, flyable ship.

A dead calm sea and a ship like this.

Born for the Alps. Full scale Pilatus Porter.

Flaps down, on final. This ship is a joy!

Pilatus Porter

. . . continued . . .

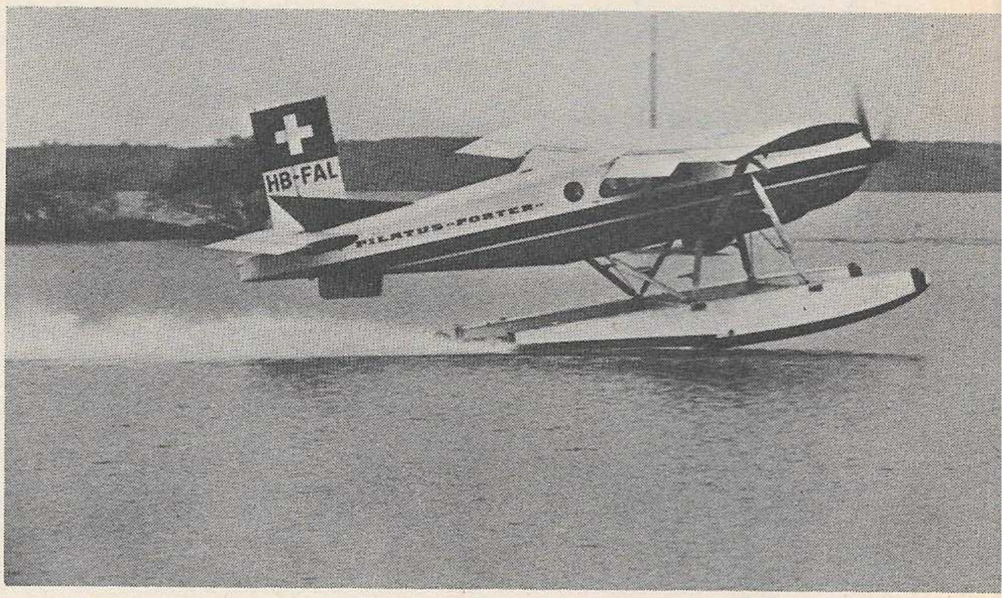
the nature of the full size Pilatus Porter.

Before detailing the aircraft, we would like to define the term STOL. It is the abbreviation for "Short Take Off and Landing." Aircraft with a STOL classification and perform jobs that cannot be handled by a conventional plane, and for which a helicopter or VTOL aircraft are not necessary or too expensive.

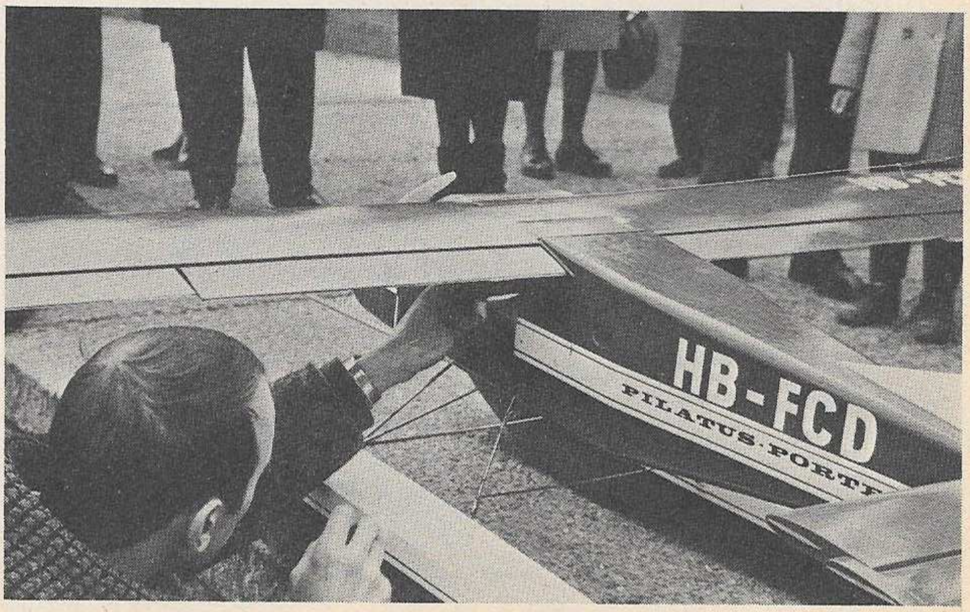
To obtain STOL characteristics the following is required:

1. Low wing loading.
2. High power-to-weight ratio.
3. Effective flaps.

Only the right combination of all three factors will give a perfect STOL aircraft. Some modern R/C stunt models with a power-to-weight ratio of over 1/1 may be considered as STOL models! However, the correct use of flaps is the main feature of an STOL aircraft. In the plans we see that the flaps extend over one half of the entire wing span (inner half). Section G-G shows the flaps of the original aircraft. Just below (Section H-H) is the flap cross-section used on the prototype model. The original aircraft used a spoiler to divert the air to prevent the flap from stalling (See sketch #3) at high angles. This is not necessary with the model because the flight is at a much lower Reynolds number. Minimum speed is limited by the critical Reynolds-number and not by the maximum lift produceable, when "double flaps" were used. The experiments with our prototype proved the theory to be correct. In addition, the maximum flap angle used by the full size aircraft is only 38°. Our flaps are capable of 38°deflection. Another advantage in not trying to incorporate the "double flap" is that the aileron and flap construction are identical, thus producing a simple, rectangular wing



'Porter" on floats, planing on afterbody.

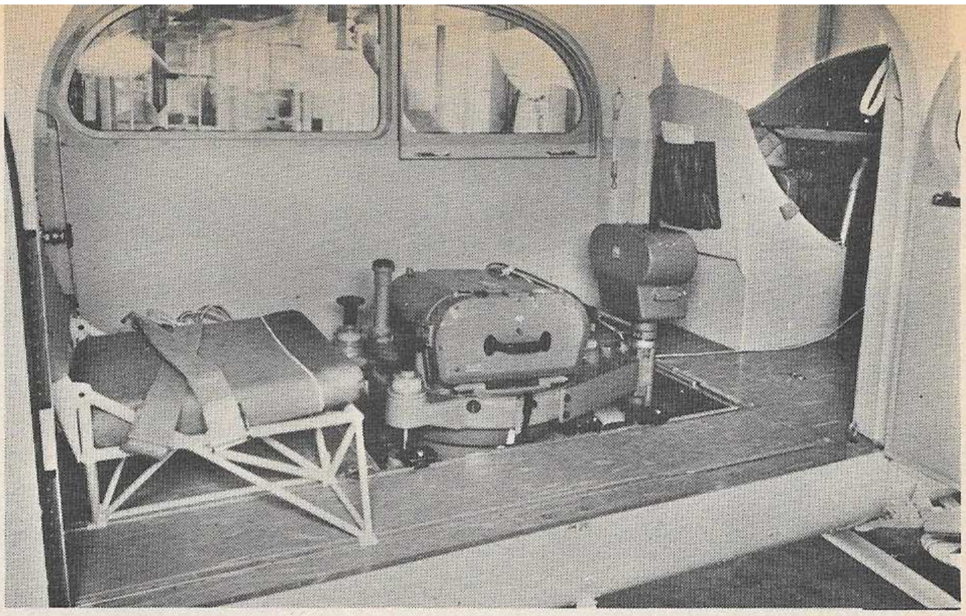


This model delivers a full measure of STOL performance.

with the same rib over the whole span. We have shown Section GG for a purpose. For those who think that the "double flap" effort would be worthwhile, and the linkage not too cumbersome, additional scale points are possible by constructing the wing in this manner.

The original aircraft wing airfoil is nearly the same as NACA 65_2 415 and the stabilizer uses an airfoil similar to NACA 2415 only inverted. For our model we used the NACA 2415, upright as the wing airfoil and the NACA 0015 for the stabilizer and rudder. Our reasons are detailed in "Konstruktionsbuch fur R/C-Flugmodelle" by the author, obtainable for $5.00 from Telaves. However the text is in German. All measurements for this model are true to scale.

It is necessary to understand the aerodynamic factors of stability of this model Porter, especially if the flaps are used. And if they are not used, this model is just another scale model, without the potential of a STOL aircraft. We computed therefore the variations of the aerodynamic center as a function of the lift coefficient (ce) as shown below. Of course, the flap deflection gives a big variation of the position of the aerodynamic center (given in percent of the mean aerodynamic chord (MAC). The position of the center of gravity is chosen that way, to provide the model with adequate stability (not too stable and not unstable) at all flap deflection angles. We expected the cruising speed to be about 47 mph and so the model had to be trimmed out at this speed. We found that at different flap deflection angles and throttle settings, the model could be trimmed to fly level at a pre-determined speed. Thusly:



The interior, full scale aircraft.

Flap angle = 0° — V = 74 kmh or 47 mph
Flap angle —15° — V = 44 kmh or 28 mph
Flap angle —30° — V = 38 kmh or 24 mph
Flap angle —60° — V = 31 kmh or 19 mph

Consequently there exists a flap deflection angle for every throttle setting in which the model Porter is trimmed for level flight. Conversely, this formula will not be correct with full power at say 15° flap angle. Under these conditions the aerodynamic center will be ahead of the C. G. and the plane will climb very steeply. To reduce the climbing angle, retard the throttle, or crank in down trim on the elevator. With the flap setting at a 60° angle or more, a large increase in lift will not be evident, as the drag will increase severely. This setting (up to 90° with the model Porter) was used for airbrakes on a slow "Fly-by" or for landing.

In looking at the 3-view scale plans obtained from the factory, it was ap-

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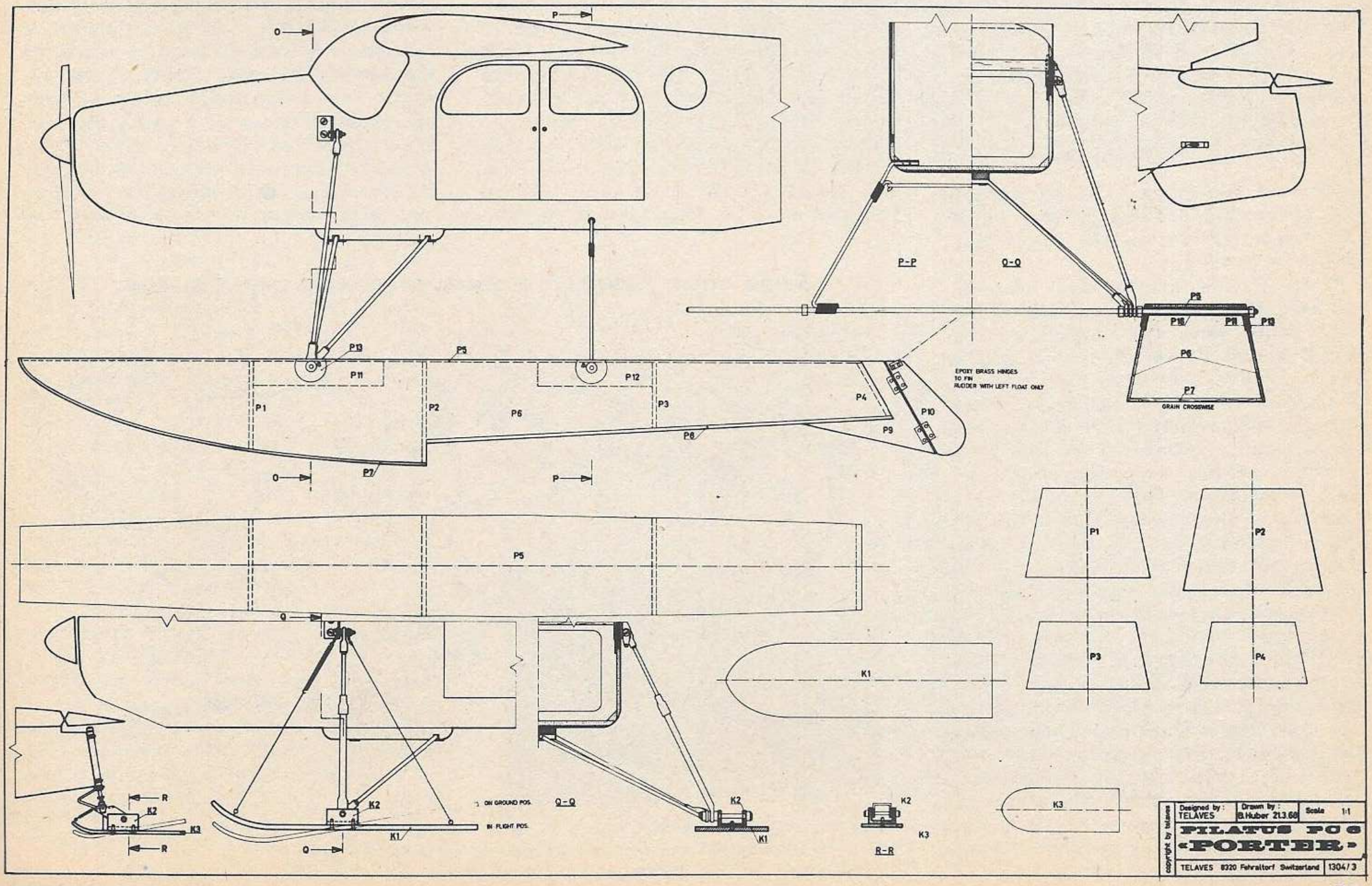

Pilatus PC-6 Porter

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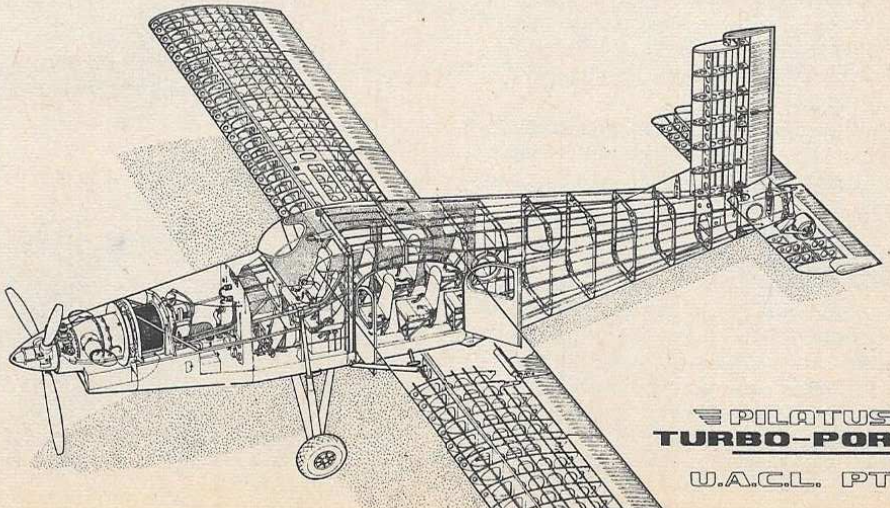
parent the design was a simple, straightforward one, with few frills. Telaves tried to build up a model even simpler with only a few deviations from scale practices.

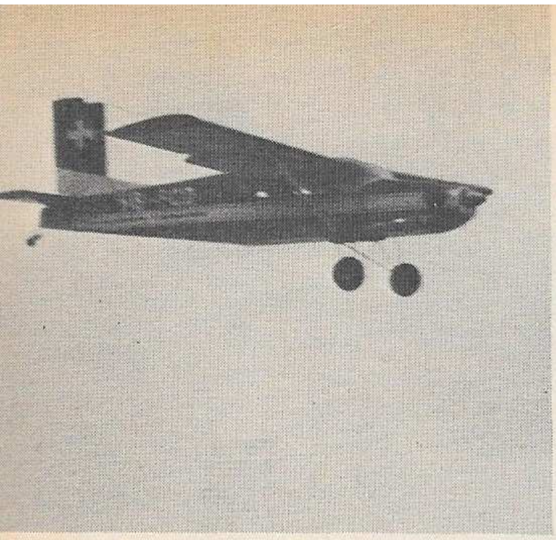
The fuselage is an orthodox box-shaped construction with no special problems. The engine is side-mounted so the front left half of the nose must be designed with a removeable cowl. The doors are built up of plywood and may be mounted on either side. The actual Porter had them mounted on either side and opposite the engine exhaust. In addition to the conventional hinged doors, sliding doors were also used. Don't eliminate "working" doors for they simplify installation. The windshield is drawn hot on a mold by means of a vacuum.

The main landing gear is built up in the same manner as on the original Porter, but round tubing was used instead of the streamline ones. For more scale points, add streamlining with a balsa fillet. Shock absorbing is very effectively gained by means of a lengthwise torsion bar (a part of the main wire acts as a torsion bar) and a helical spring inside the landing gear leg. The wheel axles are held parallel by means of a lever going back to the attachment point. (F-11). The spring is equipped with a friction dampener (plastic tube) which is very effective. This positively dampened landing gear gives very smooth take-offs and landings, both on runways and on rough ground, even at high speed. Taxiing on rough ground is a pleasure to watch as the Porter moves forward without any vertical movement while the wheels "dance" on the ground. The tail wheel is also spring equipped and steerable, and provides good directional control on the ground.

Mounting the wing was a problem in this design as the center-section mounting area is very small. The wing is held by two dowels inserted in a fuselage former in front (F-12) while the T/E is screwed down by two nylon screws at the auxiliary spar position into a plywood bracket. The two spruce spars in the fuselage section (F-15) bear most of the weight imposed by the wing. The balsa wing struts are screwed to the wing and the other ends inserted into the brass tube in the fuselage. To prevent them from falling out, music-wire is covered by a rubber tube and bent in a slight angle. We do not have any illusions that the struts help the rigidity of the wing. The vertical fin is glued to the fuselage while the stabilizer is fixed with a dowel and nylon screw. If you have no problems in transporting this model



PILATUS
TURBO—PORTER
U.A.C.L. PT-6



Pilatus PC-6 Porter

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(space wise), we recommend that the stabilizer be firmly cemented in place.

The wing structure is very simple. Use the same rib pattern throughout. The original had straight wings with only 1" dihedral. The wing is entirely planked with 1/16" balsa, with rib doublers at the center-section. Mount bellcranks, pushrods, and plywood wing mounts with blind nuts for the struts, install hinges and insure free action with no bind for each control prior to planking the bottom section of the wing. The pivot mounts for the flaps and ailerons hang below the wing with small bolts as pins. Rudder horns as shown on the plans are mounted to the flaps and ailerons. Provide holes in the planking so the Kwik-Links can be hooked up. These holes are covered with MonoKote afterwards. The end ribs are ⅛" plywood with the stiffening pressed metal simulated by cutting ⅛" dowels in half and cementing to the rib in the proper location. Because the area at the wing junction is fairly limited, mount the two servos in the center-section in such a manner that they clear the fuselage when the wing is removed, and no binding when the servo travels.

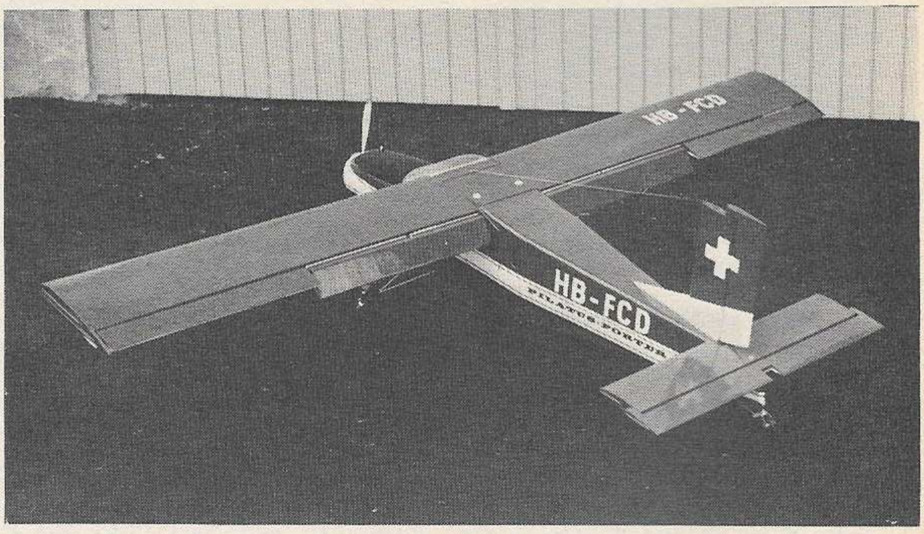
Tail surfaces are likewise of one rib section throughout and are built up as the wing is, and then fully planked with 1/16" balsa. Do not use pulpy soft balsa for planking, as it tends to sag between the ribs with the application of silk or tissue paper.

There is lots of room in the fuselage to mount the radio equipment and servos. Mount the batteries as far to the front as possible to maintain the correct C. G. position.

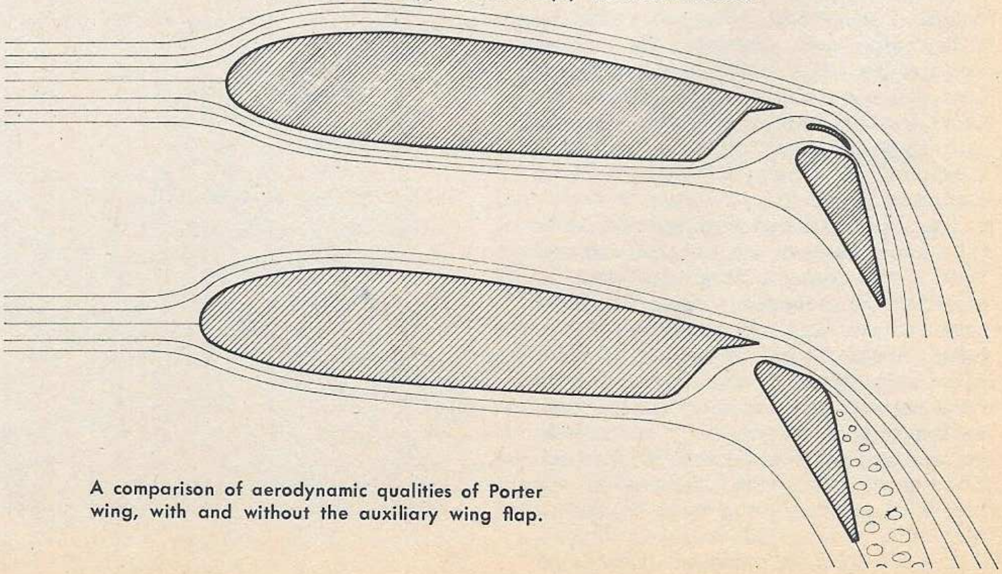
The prototype Porter used a Veco Lee .61 R/C engine, which is noted for its high power output and good idling characteristics. We recommend a powerful and consistent engine for the scale Porter and would like to add here that it is ideally suited for a twin cylinder engine, providing it is comparable in thrust to the Veco or Enya .61 engines.

The model Porter is covered with medium Silkspan and painted according to a known color scheme. The markings were made with MonoKote, while the words Pilatus Porter were written with Letraset lettering (Sheet #514).

Just a word about the flight characteristics. Look for a larger flying site than usual for the first test flights, because the Porter tends to turn to the left when power is applied suddenly on take-off. Probably due to the large side area, but after the first five flights, it was learned that holding right rudder corrected this tendency, and subsequent take-offs were straight and true. The tail comes up almost immediately when the throttle is advanced and it takes off after about 15 feet. Do not hesitate to use at least 15° of flap for the first flights for there is an advantage in high lift at low speed on the Porter. After take-off you must control the climbing angle and if it tends to be too steep and the model loses airspeed, give a small amout of down trim on the elevator. Climbing angles of 30° to 45° continuously under full power will be normal, just like the real STOL aircraft. When the desired height is reached, retract the flaps entirely, then the model will pick up speed and fly fairly fast. Aerobatics are possible with the Porter, but



Climbs out and approaches steeply when commanded.



A comparison of aerodynamic qualities of Porter wing, with and without the auxiliary wing flap.

you must fly very smoothly as it is not designed for this function. Like the British RAF General said about an outside loop, "What a silly flaming thing to do!!" Landings are a cinch! Just throttle back and crank in enough flap where a steadily descending flight path is reached to your liking and just touch down, ease way back on the stick and flare it in to a greased landing. Patience and practice will get results, but the landing gear on the Porter is very forgiving with its dampening characteristics.

Hydroplane Version: This model may also be equipped with floats with no severe changes in the flight characteristics. Because the model itself weighs about 7 pounds, the floats must be built as light as possible. The Telaves floats weighed less than one half pound each. Take-off will be in about 50 feet if 15° to 25° flap angle is used, with a very high climbing rate. On landing, be careful as it tends to jump (skip) on the water due to the rigidly mounted floats. To counteract this, retract the flaps as soon as the model touches the water. Build the floats conventionally, or from foam, but make certain they are water-tight as water-logged floats can change the C. G. position. Do not round the edges of the floats that are in contact with the water because these help to get the Porter "up on the step" easier.

Winter Time Version: This Porter may also be ski equipped as shown on the plans. They are held in level position during flight and as the tips are higher than in the "on the snow" position, smoother landings and less damage to the skis is possible. As shown on the plans they are glued from three layers of lightweight 1/16" plywood bent around a carved wooden form.

The Porter has proven to be a good flying, nice looking scale model, worthy to be built. And because of its STOL capabilities it may be flown anywhere. Further, it is something different for an experienced pilot to fly. We would like to say that we built the prototype in 2½ weeks, but it would not be true because Bernhard Huber, Senior, built the model alone in 2½ weeks, notwithstanding the fact that he works 9 hours a day as Works Manager in a shoe factory. From this you can deduce that building time is relatively small for the scale Porter.

Building Instructions

A quick look at the plans shows the simplicity of the fuselage, and really no problems should arise even for a beginner for this model. We have listed the main parts for this reason in a Parts List, however, it must be understood that it is not complete in every respect as balsa gussets and other parts will normally be found in the scrap pile to complete this Porter. Construction is very sturdy as it has crashed several times due to pilot error but never damaged severely. Just before writing this article it entered a vertical dive from 30 feet due to loss of speed, broke the wing in the middle which was repaired in two hours and flown with no further damage. So do not try to reinforce this design any further, but strive for lighter weight.

Cut out all fuselage sides, tops and bottoms, and formers, then glue the plywood doubler to the nose of the fuselage bottom. Now fix both bottom parts to the building board at the correct angle, cement in triangular stringers, add the formers and fuselage sides. Cut out the window openings and cement reinforcement parts F-7 and F-8 (with blind nuts installed), to the sides before mounting them. Then cement the top triangular stringers (See Section at former F-16) and glue the rear fuselage top section with the grain crosswise. Next cement the engine mount (F-2) and the front nose blocks, shape roughly, cut out engine cowl with a sharp gouge or power tools. Next cement the landing gear transverse beam (mounting plate F-14) and door center post. Complete the rear of the fuselage after the rudder control mechanism has been installed.

Bend the 5/32″ piano wire for the main landing gear as per pattern on the drawing. Use brass tubing of 5/32″ I.D. for the brackets and for the spring leg, soldering them carefully to the piano wire as shown. The tail wheel uses ⅛″ piano wire with the appropriate brass tubing. The tail wheel is held in a U-shaped bracket. The 3/64″ tail wheel axle and strut must be soldered only to the lower part of the assembly, as it must be free to turn. The entire tail wheel assembly is epoxied to the fuselage.

Mounting the engine is up to the individual modeler, but provision must be made for sufficient cooling and exhaust. Note that the real Porter has a very large exhaust stack, which could house a muffler of the tailor-made variety. In Switzerland, mufflers are mandatory, so naturally our Lee .61 carried one in flight which was made by Mr. Koelliker, a very famous modeler in Switzerland.

Make a jig from flat stock, raising the tip to a desired angle. The ribs will be correctly positioned if a 3/16″ balsa strip is placed under the auxiliary spar over the whole wingspan. Cut out both spars W-13 and W-15 and cement in W-13. All ribs are W-1. Build up the wing, cement the leading edge W-18 and auxiliary spar W-15 in place and when dry plank the top of the wing. Now remove wing from jig, mount the bellcranks, etc. Build the flaps and ailerons over the plans separately, and the W5 are epoxied in place when dry. The struts are from ¼″ balsa slightly streamlined, while the piano wire fixture and aluminum bracket are epoxied in place. After the wing is dry glue the dowels to the wing and add the front and rear rib sections to the fuselage. Drill dowel holes into the fuselage former F-12) and slide the wing into place. Now drill the holes for the nylon screws through the wing and into fuselage transverse beam (F-14) As noted before, the servos must be mounted in such a manner as to permit the wing to slide into place without binding, so it must be properly fitted.

Both the stabilizer and rudder are mounted conventionally and we recommend them to be permanently installed if your car is large enough to transport it in that manner.

The landing gear may need some attention. If pressed down fully and released, the model should come up within 0.5 to 1 second for correct dampening. Any slower will not produce the desired results. A smooth meadow (in America?_ is better for the first take-off than a runway. Taxi on the ground with the flaps up and with full up elevator so the model does not run the risk of jumping off under a sudden gust or wind direction change. Prior to flying the Porter the first time, review its Flight Characteristics again. It will make test flying a bit more pleasurable.

PARTS LIST—
Legend:

B—Balsa wood
BP—Balsa ply (laminated balsa)
P—Plywood (laminated spruce, etc.)
A—Aluminum or dural
S—Spruce or basswood (Limba wood)

No. Required	Part Name		Material	Dimensions
2	Fuselage sides		5/32″ BP	(in inches)
1	″ Bottom front		5/32″ B	36 x 9
1	″ Bottom doubler		3/32″ P	18 x 6
1	″ Bottom rear		5/32″ B	18 x 6
1	″ Top rear		5/32″ B	24 x 6
1	″ Top front		3/8″ B	24 x 6
6	Fuselage Triangular stringers		3/8″ x 3/8″ B	10 x 6
1	Former	F-1	5/16″ P	24
1	Engine mount	F-2	1/2″ P	As per plan
1	Former	F-3	5/32″ P	″
1	Former	F-4	5/32″ P	″
1	Former	F-5	1/8″ P	″
1	Fuselage Panel	F-6	5/32″ B	″
1	Doubler	F-7	3/32″ P	″
1	Doubler	F-8	5/32″ P	″
1	Canopy	F-9	Clear Plastic	″
2	Supports	F-10	1/16″ A	TELAVES PART
1	Landing Gear Mount	F-11	1/2″ P	As per plan
1	Former	F-12	1/16″ P	″
1	Cover	F-13	1/4″ B	″
1	Transverse Beam	F-14	5/32″ P	″
				″

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