Performance of the Easy Built Models P-30 propeller

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Introduction

A number of different P-30 propellers were compared in the April 2005 issue (No. 15) and October 2014 (No. 53) of Free Flight Quarterly, Refs. 1,2. The Gizmo Geezer (GG) and 9.5 in. Peck prop (notwithstanding its defects in manufacture, see note 1) were found to give the longest total flight durations with 4 strands of 1/8 in. rubber. Since then, a 9.5 in. white plastic propeller has become available from Easy Built Models (EBM) and we thought it might be interesting to compare the performance of this prop with the Peck.

The Propeller.

The blade angles and chords were measured at nine equally spaced stations from 20% to 100% of the radius (i.e. r/R = 0.2 to 1.0). The angle data is accurate to +/- 0.5 degree and the chords to +/- 0.5 mm and represent the averages of measurements made on two different propellers in each case. The results are shown compared with a Peck prop (averaged over the two blades to allow for the differences) in Table 1 and figures 2 and 3. This shows that the pitch distributions are quite similar, but with the EBM prop having a lower pitch overall. The blade profiles are also similar, though the EBM prop has a more blade area near the hub with the maximum chord near the middle of the blade, while the Peck has a more paddle-shape, with the maximum chord at about 70% of the radius.

Table 1. Chord and pitch data for the EBM and Peck propellers.

	EBM white		Peck (avg)	
r/R	Chord (mm)	Angle (deg)	Chord (mm)	Angle (deg)
0.2	22.5	48	17	56.5
0.3	28.5	39	22	48
0.4	33	35.5	27	40
0.5	35.5	32	32	35.5
0.6	36	29	35	32
0.7	34.5	27	36	30
0.8	32	23.5	34	28
0.9	26	21	26	24.5
1	0		0	

Drag due to the freewheeling propeller during glide was determined using the equations of Sergio Montes presented in FFQ Issue 14, (Ref. 2), with CD = 0.03, CL/CD = 5, angle of attack = 4 degrees and appropriate values for the solidity and pitch angles as given in Table 2. The Peck has a slightly lower drag due to its lower solidity and higher pitch.

Fig. 1. Peck (gray) and EBM (white) 9.5" propellers.

Calculated performance comparison

As before, the performance analysis was done using a computer program ffCalc, the operation of which was briefly described in the earlier Free Flight Quarterly article. For the simulation it was assumed that the thin propeller blades could be represented by a Benedek 6405b airfoil thinned to 2%. The simulation takes some account of Reynolds Number effects, but not the transition from laminar to turbulent flow as observed in wind-tunnel testing. Unfortunately this occurs at Reynolds numbers quite typical of rubber power propellers (around 20,000 – 70,000) and so represents a possible caveat on the results produced. With the higher pitch and running nearer to stalled conditions this is more a problem with the Peck results that are more sensitive to the actual propeller airfoil parameters.

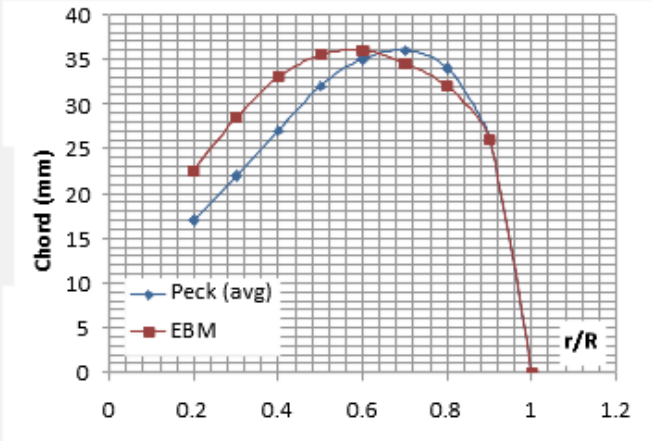

Fig. 2. Chords of the Peck and EBM white propellers at various radii.

Table 2. Pitch angle, solidity and corresponding drag coefficient due to free-wheeling propeller.

	Solidity	Pitch angle (degrees at 75% radius)	Tc	Cd
EBM	0.071	26	0.0188	0.026
Peck (av)	0.067	29	0.0135	0.019

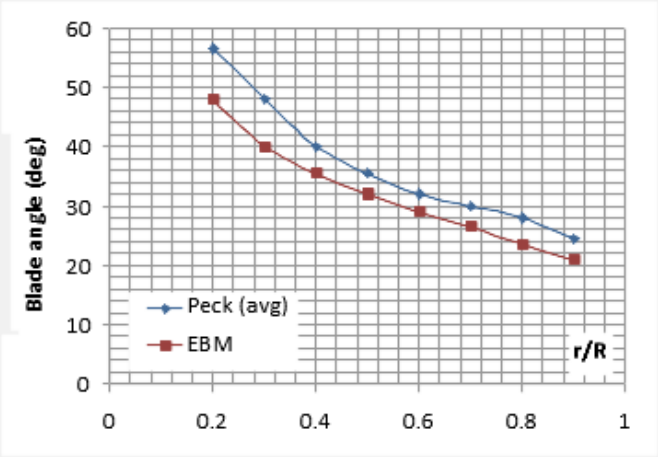

Fig. 3 Blade angles of the Peck and EBM white propellers at various radii.

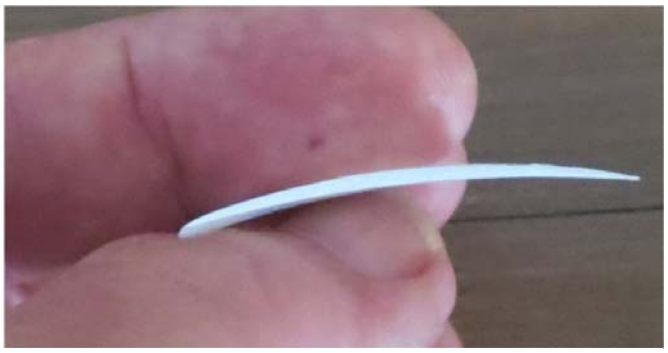

Fig. 4 EBM white propeller airfoil shape.

The airframe parameters were appropriate to a 45g "generic" P30, with a wing area of 8.4 dm2 and aspect ratio of 6.8. The rubber parameters were for 1/8 in. March Tan 2 (a good batch!), producing rather good predicted flight times, but the relative differences in the data are maintained for rubber with lower energy. Note that, even with a 4 strand motor, if it is fully wound there is sufficient thrust for a near vertical climb and controlling this is one of the main challenges in trimming these models. The program allows such a flight path, though this is difficult to achieve with these models and their fixed flight surfaces. Nevertheless, we have now become accustomed to near vertical launches transitioning into spiral climbs.

The maximum climb heights and total flight times for the Peck and EBM propellers are shown in Table 3.

Table 3. Calculated climb height and total flight duration for the different propellers and 4, 5 and 6 strand motors, wound just to breaking point.

	Peck		EBM	
Number of 1/8" strands	Climb Height (m)	Flight Duration (s)	Climb Height (m)	Flight Duration (s)
4	58	216	72	223
5	69	192	83	204
6	70	169	82	182

This shows that a 4 strand motor is predicted to give the longest flight times, just as in the earlier study (and nearly all the top P30's in Australia use this configuration),

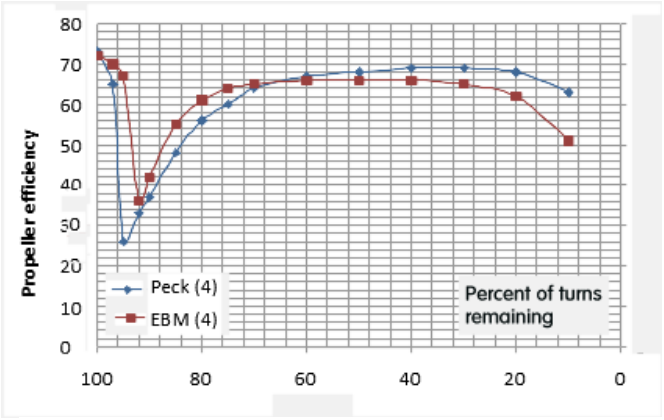

Fig. 5. Efficiency of the Peck and EBM propellers as the 4-strand motor unwinds.

with the EBM prop giving essentially the same total flight time as the Peck.

It is interesting to consider these differences in terms of the propeller efficiencies throughout the flight. The efficiencies of the Peck and EBM props with 4 stand motors are compared in Figure 5. The dip in efficiency that occurs at about 90% turns marks the transition from a near vertical climb to a spiral cruise, and the efficiency drops as the airspeed falls at the top of the steep climb, rising again as the airspeed builds up again during the cruise. The slightly higher efficiency of the EBM prop during the initial burst is offset by the slightly higher efficiency of the Peck during the cruise, giving very similar overall flight times.

The advantage of 4 strands over 5 or 6 is apparent in figure 6, where the propeller efficiencies are compared. The 4 strand motor can only sustain a steep climb for a short while but this is more than compensated by the higher efficiency for most of the cruise. In contrast, the 6 strand motor gives a higher initial climb but this is partly offset by the lower efficiency during the cruise. The shorter motor run of the 6 strand motor (47 vs 103 seconds) then leads to shorter total flight duration.

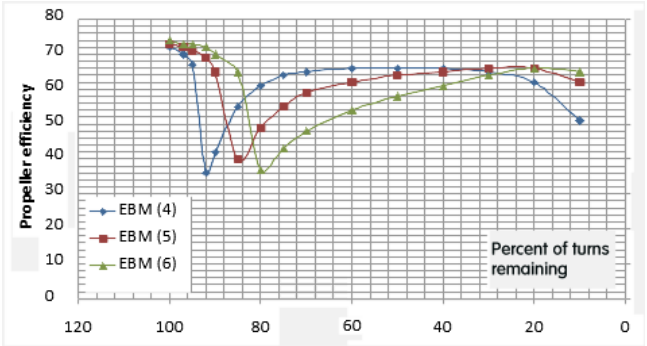

Fig. 6. Propeller efficiency of the EBM prop with 4, 5 and 6 strand motors.

Initial Flight tests

A couple of initial test flights with the white prop were just possible before the North America winter weather set in. In each case a new 6 strand 3/32 in. Super Sport motor was used. Climb height on the first flight was about 34m and climb height on the second flight was about 38m, both measured with an on-board altimeter. The motors were wound to about 6 in.-oz. (85% of the breaking torque), partially explaining the climb heights that were a

bit lower than expected for maximum turns, as indicated in Table 3. The same model with the orange Chinese prop typically climbs to about 37m, similar to that with the white prop. However, the flight characteristics are a bit different, with the white prop leading to a moderate power stall at the end of the burst, not observed with the other props, indicating that some change of trim might be needed with the white prop to get an optimum result. The overall impression was that the white prop was at least as good as the others, with possibly just a slightly better climb. More testing will be possible once the weather begins to improve.

Conclusion

The EBM white propeller is suitable replacement for the Peck, Gizmo Geezer and orange Chinese props and possibly one of the best available for P-30, though this still needs to be verified with more flight testing.

Note 1

The blades of the Peck prop sit at different angles with respect to the shaft axis in the hub. These props also have significant run out (amounting to about a 5+mm wobble at the tips, and so it appears that the problem might be a misalignment of the hub/shaft in the mould. For this comparison it was assumed that the hub alignment had been corrected, giving pitch angles that are the average of the two blades. The two blades of the EBM white prop had the same pitch within the limits of measurement error.

References

1) "P-30 Propeller Analysis", Paul Rossiter, Free Flight Quarterly #15, April 2005, pp. 24-27.
2) " A New Propeller for P-30" Paul Rossiter, Free Flight Quarterly #53, October 2014, pp. 31-32.
3) "The Drag of Free Wheeling Propellers", Sergio Montes, Free Flight Quarterly #14, 2004, pp. 35-40.

Appendix by Dave Niedzielski from Easy Built Models with the story of the white props:

Seems to be about 18 years ago we added a range of white props we named EB Props. These were made in the USA by the brothers Bob and Ed Bojanowski, friends I've known and flown with for decades through the Flying Aces Club. Not happy with the Peck Props at the time we were in discussions with plastic companies for making molds for props ourselves. Lucky for us, Bob and Ed talked with me at the FAC Nats in Geneseo of their plans to get the old Lindberg propeller molds. They were looking to see if there would be enough interest. Well a fine marriage occurred as we agreed on putting these props into our Easy Built Models kits giving them confidence to move ahead with the costs associated with cleaning up the molds, some modifications, modernization, as well as some new molds. Production molds of this type can run $20-30K each if made today.

Former Navy pilot Ed Bojanowski after serving his time went to work at Lindberg Plastic Models (LPM) for a couple of decades into the late '80s. Ed recollected the fun times they all had working at this company including getting out and flying some of their creations after work inside the building. It was during his time there that one of their craftsmen, Bill Goss carved the master props used for the molds for LPM's line of model planes. Ed seemed to strongly remember these props as fantastic. Fast forward a couple of decades, Ed is now working at the well-equipped r/c product company DU-BRO in Chicago. During this time RPM plastic models was acquiring LPM and one of the old managers knowing Ed, offered to work out a deal to sell the molds. With his brother's help, they began producing the white EB Props you've come to know today. Well, life happens and Ed now in his 80's was looking to retire, so earlier this year we acquired his business with the injection molds to maintain continuity and a supply of quality props for the future.

The original selection of EB props we started with were 5", 6" and 8". The props are produced from virgin plastic resin made in the US, again for consistency and strength. In these sizes and material, the builder could easily change the diameter and shape by simply cutting the blades and rebalancing. Ed had asked me several years ago if we were interested in adding a 9.5", 10" and 12" props which we agreed with except the 9.5" because we all have budgets to work within and well you know how it is. When we picked up all of Ed's inventory and the molds we didn't realize he had gone ahead and made the 9.5"prop. Well the money now spent for his prop business it was logical for the 9.5" prop to become our newest prop to the lineup. Ed was targeting the P30 market with this prop. He always felt the 7"master was the best prop design and worked the 9.5" up from there for the new molds. The mold was created at the same time when he was having the new 10" and 12" molds made. So all these sizes are available at www.easybuiltmodels.com or by mail order. A catalog can be requested by providing your address by mail or phone – PO Box 681744, Prattville, AL 36068 or 334-358-5184. Easy Built Models turns 88 years old in 2020 manufacturing and distributing hobby supplies and kits, shipping daily around the world.

The Russell Chambers 1938 R-1 Chambermaid is a laser cut 22" span balsa wood kit from EBM. This kit is a modified Bill Henn Greve Racer competition design.