TRIAVIATHON TROPHY

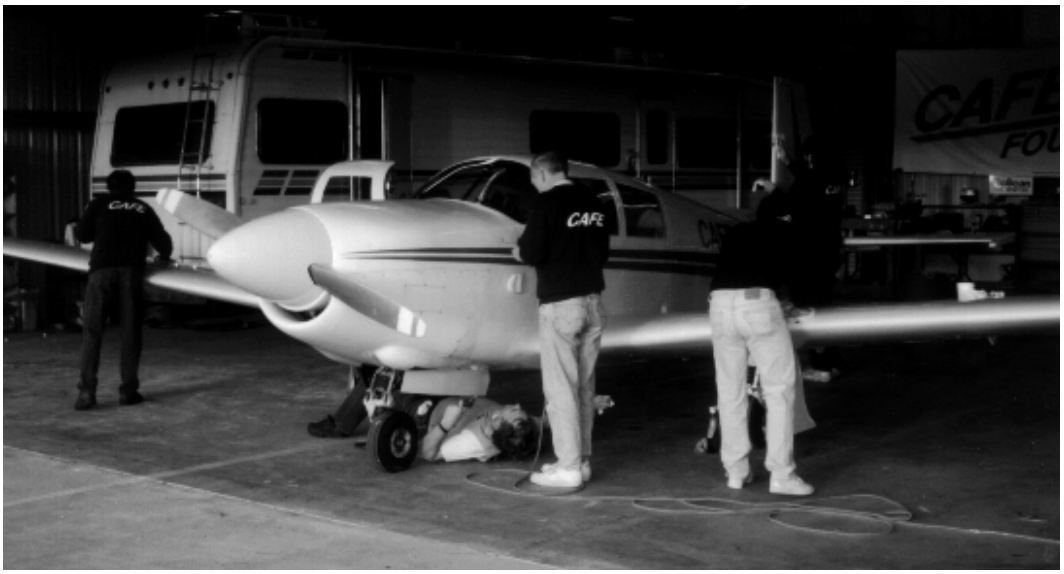
CHALLENGE TROPHY

CAFE FOUNDATION
AIRCRAFT PERFORMANCE REPORT

Sponsored and Funded by the Experimental Aircraft Association and the Federal Aviation Administration

Wax Job

BY BRIEN A. SEELEY AND THE CAFE BOARD



The drag reducing effect of a "wax job" on an aircraft has been informally debated for many years. The CAFE Foundation attempted to quantify this effect by performing the flight tests reported here.

These tests were conducted VFR on the same morning through the same airspace, at the same power setting and altitude with and without wax. The speeds and altitudes were accurately recorded with the CAFE cabin barograph.

The test aircraft was the CAFE Foundation's Experimental Mooney M20E with 200 hp Lycoming IO-360-A1B6 engine. The first flight began about 15 minutes before sunrise on 4/26/97 in calm wind conditions with a substantial inversion. The second flight began 1 hour and 10 minutes after sunrise. The OAT at the chosen altitude of 4000' remained within 1 °F of on the two flights. Winds aloft were very light. The aircraft weight, crew and c.g.were the same on both flights.

The speed runs were maintained for nearly 5 minutes on each fixed heading which allowed sampling of about 17 miles of air space.

A team comprised of CAFE Board members Larry Ford, Cris Hawkins, Otis Holt, Scott Nevin, Brien Seeley, C.J. Stephens and Steve Williams rapidly waxed the airplane immediately after the unwaxed flight. The wax produced a slipperyness which could be felt and heard when sliding a terrycloth towel over the waxed wing surface. The unwaxed surfaced had been clean, and free of dust or bugs. Because of some mild oxidation of the paint on this aircraft, a faintly audible "hash" sound could be heard when the towel was slid over its unwaxed surface. The hash sound was nearly eliminated by the wax job.

Every square inch of the aircraft surface was waxed, including the propeller and spinner.

The flight test results were analysed by averaging the speeds as shown in the table below. The selected data are from reasonably smooth air with a stable power setting and altitude. The flight crew continuously recorded their observations about turbulence, trim alterations, power setting stabilization, etc. The barograph data shown below illustrate the typical altitude

Level Flight Data	Run duration	Seconds	Density altitude range	TAS range	TAS run ave.	Sec x V	Net TAS	Video comments
	Unwaxed							
Turtle Wax "Vision" wax	06:20:24-06:24:35	252.0	5692-5746	200.52-204.25	202.52	51035		Long run
Mooney N6057Q, 4/26/97	06:20:24-06:21:31	68.0	5692-5724	201.79-203.47	202.58	13775		Smooth air
26.0" M.P. + 2606 RPM	06:21:37-06:21:48	12.0	5709-5714	202.13-203.05	202.58	2431		
13.8 gph, full fuel	06:22:10-06:24:33	144.0	5713-5746	200.52-204.25	202.46	29154		
approx. 4000' press. alt.	06:29:32-06:32:53	202.0	5612-5659	200.73-204.86	202.78	40962		
CJ Stephens, Pilot	06:33:16-06:33:47	32.0	5579-5613	201.87-203.51	202.71	6487		
Otis Holt, Flight Engineer	total seconds of data	710.0			totals	143844	202.60	
Yaw ball centered								
Pitch trimmed	**Waxed**							
30 readings per second	07:33:42-07:34:51	70.0	5735-5749	204.71-205.98	205.51	14386		
are averaged to get the	07:35:20-07:36:21	62.0	5712-5734	204.68-206.24	205.30	12729		
TAS for each second.	07:38:54-07:40:29	96.0	5725-5750	203.93-205.81	204.77	19658		
TAS ave. is computed as	07:44:44-07:48:31	228.0	5749-5797	202.54-207.36	205.08	46758		
the sum of each second's	07:46:20-07:47:02	43.0	5757-5779	205.44-207.36	206.54	8881		Smooth air
TAS value divided by	07:50:40-07:56:08	329.0	5700-5774	203.26-207.84	205.65	67659		Good data here
the total seconds in	07:50:40-07:51:13	34.0	5741-5762	204.11-206.61	205.29	6980		Light chop
that run.	07:54:26-07:54:50	25.0	5721-5740	205.19-206.61	206.22	5156		Smooth, good data
	total seconds of data	887.0			totals	182206	205.42	
					Total	mph	2.82	

altitude and speed stability during the runs. The flights did not include any testing of the climb rate or stall speed effects of the wax job.

Analysis of the results indicates a speed improvement of 2.82 mph with the wax job. The Mooney's 200 hp engine would have to be increased to 208.3 hp to achieve such a speed improvement without the wax!

At Oshkosh '96, when asked about such an effect, laminar flow expert John Roncz suggested a flight test of one of the newer polymer waxes. The wax chosen for these tests was "Vision" Advanced Auto Polish manufactured by Turtle Wax, Inc., P.O. Box 547, Chicago, Illinois. 60638-6211. This wax claims to utilize a "patented 3M Acrylic Silicone Fluoropolymer (A.S.F.) Barrier Technology." Other information provided by the manufacturer is ". . . A.S.F. is a 'smart' polymer that aligns itself on the car's finish. As the polish is applied, the acrylic fluoropolymer chain rotates until it adheres to the finish. . . Vision also contains a revolutionary combination of ingredients that actually sheets water and virtually eliminates water spots."

The effect of water "sheeting" rather than beading on a wing surface may be important to the drag behavior of certain laminar flow sections when flying in rain. In addition, alterations of pitch trim on a canard-equipped aircraft flying in rain may depend upon whether the rain sheets rather than beads upon the canard surfaces.

The speed difference demonstrated here emphasizes the importance of controlling the degree of surface polish on any aircraft undergoing flight test evaluation. Along with the influence of turbulent air masses, surface polish can be a significant source of error in precise performance measurement.

CAFE has no financial interest in nor any correspondence with the Turtle Wax company or its products.

Time	Press. alt.	Density alt.	IAS	TAS	OAT
Unwaxed					
06:20:58	3972.3	5716.9	185.87	202.32	71.9
06:20:59	3968.6	5716.8	185.81	202.23	71.9
06:21:00	3966.8	5715.7	185.80	202.24	71.9
06:21:01	3967.4	5716.4	185.96	202.42	71.9
06:21:02	3966.8	5713.5	186.22	202.69	71.9
06:21:03	3966.8	5713.5	186.26	202.74	71.9
06:21:04	3964.4	5711.6	186.24	202.70	71.9
06:21:05	3966.2	5714.9	186.18	202.65	71.9
06:21:06	3964.4	5712.7	185.96	202.41	71.9
06:21:07	3964.4	5712.7	185.79	202.22	71.9
Waxed					
07:34:07	4010.6	5741.8	188.66	205.43	71.5
07:34:08	4009.4	5738.1	188.80	205.57	71.5
07:34:09	4008.8	5739.6	189.02	205.83	71.5
07:34:10	4008.2	5737.7	188.94	205.73	71.5
07:34:11	4007.0	5740.6	189.01	205.81	71.6
07:34:12	4007.0	5739.5	188.91	205.70	71.5
07:34:13	4007.6	5738.1	188.80	205.57	71.5
07:34:14	4008.2	5738.8	188.68	205.42	71.5
07:34:15	4008.8	5740.7	188.72	205.50	71.5
07:34:16	4007.6	5738.1	188.65	205.42	71.5

Actual CAFE Barograph sample data.