Airplane Efficiency Contest

By Ladislao Pazmany (EAA 2431)

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(Photo by Frank Hartman)

The most-efficient lightplane? Willi Messerschmitt's 1933 design, the Bf.108 TAIFUN, had a level of efficiency unmatched by most lightplanes of today. In Swiss markings, this 108 was imported by Hans Gerstl of Charlottesville, Va., and now belongs to the Confederate Air Force.

In conjunction with the Oshkosh Fly-In, EAA's Design Review Committee will conduct the first of its Performance Trials. This is a part of the total evaluation package the committee is working on to provide on all homebuilt designs which are advertised in SPORT AVIATION. This will consist of: (1) an Aircraft Data Report completed by the designer/plan seller; (2) the Design Review Committee's evaluation report of the plans; (3) the results of the performance trials; and (4) an evaluation of the plans by a representative group of builders.

When completed, this package of information on the various designs will be available to all EAA members to aid in choosing a plane best suited to their own requirements. Further, it will serve as the basis for eligibility to advertise in SPORT AVIATION. It is hoped, of course, that this sort of exposure will spur designers of plans found lacking in any way to update and improve their drawings.

The Performance Trials to be held each day at Oshkosh (from 5:30 A.M. to 7:30 A.M. to take advantage of calm, cool morning air) will be based on an efficiency contest devised by DRC member Ladislao Pazmany. The Pazmany contest has been held for the past few years in the San Diego area, and in the San Francisco area supervised by Noel Becar.

The Oshkosh performance trials will be similar to the Pazmany Airplane Efficiency Contest described below with the exception that a high-speed pass through a 2,000 foot speed trap will be substituted for the cross-country rally-type event. This will be a truer indication of the plane's top speed, eliminating navigation errors and, to some extent, pilot skill involved in the cross-country run.

Each morning the trials will be held for planes being evaluated, after which anyone may enter his plane (stock or homebuilt) simply to see how it stacks up against others in the efficiency department.

It is hoped that the Pazmany Airplane Efficiency Contest will catch on with all the Chapters around the country with, perhaps, a national contest each year at Oshkosh — including the cross-country rally for the "sporting bloods."

EAA has been taken to task for not doing enough to "improve the breed" of lightplanes. Is this a valid criticism? Are homebuilts really more efficient — or less — than the "Wichita Wonders?" Would a contest such as this provide the necessary incentive for homebuilders to design for the purpose of being "most efficient" — such as Willi Messerschmitt did in designing the Me.108 to win the International Touring Competition in the early 30's? Is there a more-efficient airplane than a 90-hp Tailwind??

These are questions which could be answered by the Pazmany Airplane Efficiency Contest — "Paz" has provided us with the method; it is up to us to make something constructive of it.

DURING OUR CHAPTER 14 fly-ins held at Ramona, California in recent years, we had a "different" type of contest.

The purpose was to measure the **aircraft relative efficiency** through the use of basic aerodynamic equations. The most-efficient airplane had the widest speed range, carried the greatest weight with the least horsepower, and had the lowest drag.

This type of competition is not new. During the thirties, similar competitions were held in Europe. NACA TM No. 760 gives a good description of the 1934 International Touring Competition.

The European contest had an elaborate scoring system to measure parameters such as maximum speed, stalling speed, take-off and landing over an obstacle, fuel consumption, engine starting test, wing folding and extension, safety devices, metal construction, pilot's view, comfort, etc. They had more time than we had for a week-end fly-in. Nevertheless, the aerodynamic equations were similar, and just as in our Ramona contest the most important parameter was speed range.

Obviously, an aircraft with a stall speed of 80 mph, and a maximum speed of 90 mph, is a poor flying machine, while an aircraft like the Messerschmitt Bf.108 (a four-place, all-metal, low-wing monoplane, winner of the 1934 contest) had a speed range of 4.65, a feat that very few modern light aircraft could match.

Here is how the contest was run in Ramona. During Saturday afternoon, as soon as the airplanes arrived, each pilot was briefed on the competition. Each participating aircraft was accurately weighed on three aircraft scales. This weight included pilot, fuel, parachutes, etc., everything that would be on the airplane during the contest.

The wing area was calculated based on actual measurements. The area included portions intercepted by the fuselage, which is standard practice in aerodynamic calculations. Form No. 1 was used for this step.

Sunday morning the "real thing" started. At 10:00 A.M. we had a pilots' briefing to clarify all points and, immediately after, we started with the SLOW-SPEED RUNS.

The fastest aircraft took off first, in order to provide maximum spacing between airplanes. We let each participant finish the SLOW-SPEED RUN before we gave the start signal to the next participant.

Each aircraft executed a normal left-hand pattern, and approached the runway for the SLOW-SPEED RUN. Maintaining an altitude of approximately five feet over the ground, each

"PAZMANY" AIRPLANE EFFICIENCY CONTEST

(Held at Buchanan Airfield by EAA Chapter No. 20, on August 27, 1967)

Place	Pilot	Aircraft	P	W	S	S/P	$\sqrt[3]{S/P}$	W/S	$\sqrt{W/S}$	V_{min}	V_{max}	$\frac{V_{max}}{V_{min}}$	K_3
1	Lamb	Aeronca	85	1,157	168.17	1.978	1.255	6.88	2.623	99.12	36.86	2.689	8.852
2	Tileston	Tailwind	125	1,270	83.16	.665	.873	15.27	3.908	174.24	68.20	2.555	8.717
3	Korngold	Tailwind	90	1,216	82.07	.912	.970	14.62	3.850	151.24	64.95	2.328	8.694
4	Reid	Luscombe	85	1,289	136.25	1.603	1.171	9.46	3.076	113.96	48.71	2.340	8.429
5	Linn	Taylor	65	813	83.84	1.290	1.089	9.70	3.115	122.33	52.46	2.332	7.910
6	Pulliam	Stits Playboy	90	993	89.04	.989	.996	11.15	3.340	128.33	54.56	2.352	7.824
7	McKinney	J-3 Cub	85	1,079	175.87	2.069	1.274	6.14	2.478	82.79	40.12	2.064	6.516
8	Schuster	Miniplane	85	927	97.34	1.145	1.046	9.52	3.086	101.46	54.56	1.860	6.004

All computations triple checked and certified correct by: N. J. Becar, Contest Chairman

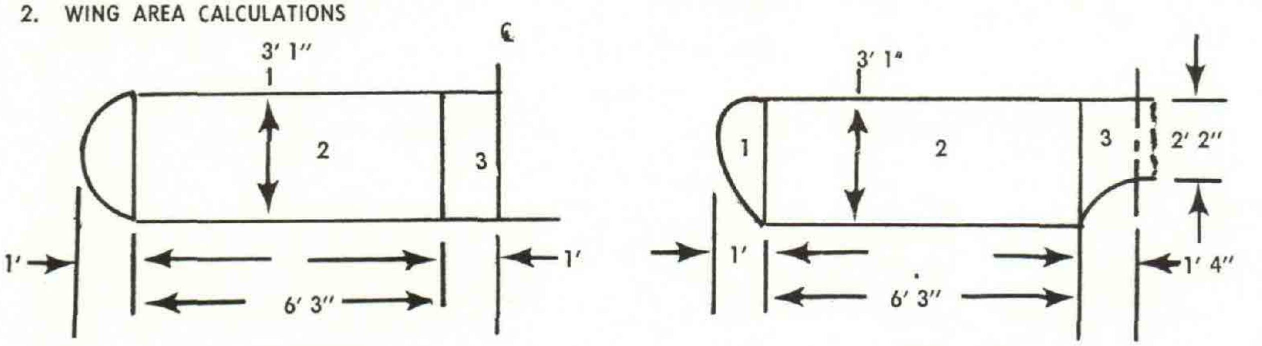
FORM NO. 1

AIRPLANE EFFICIENCY CONTEST

1. AIRCRAFT LICENSE—N4077K
   PILOT/OWNER—DON JANSON
   CONTESTANT NO. 6
   ESTIMATED CRUISE SPEED—100 mph

AIRCRAFT TYPE—SMITH MINIPLANE
AIRCRAFT COLOR—RED
ENGINE TYPE—CONTINENTAL
RATED H.P.—85

2. WING AREA CALCULATIONS



24.43
24.95
49.38
x 2
98.76 sq. ft.

LOWER WING

1 —	1 x 3.083 x .70	=	2.10 sq. ft.
2 —	6.25 x 3.083	=	19.25 sq. ft.
3 —	1. x 3.083	=	3.08 sq. ft.
			24.43 sq. ft.

HIGH WING

1 —	1 x 3.083 x .70	=	2.10 sq. ft.
2 —	6.25 x 3.083	=	19.25 sq. ft.
3 —	$\frac{2.166 + 3.083}{2} \times 1.4$	=	3.60 sq. ft.
			24.95 sq. ft.

3. AIRCRAFT WEIGHT

LEFT MAIN WHEEL	395 LBS.
RIGHT MAIN WHEEL	410 LBS.
TAIL OR NOSE WHEEL	137 LBS.
TOTAL WEIGHT	942 LBS.

FORM NO. 2

AIRPLANE EFFICIENCY CONTEST Slow Speed

Recorder..................... Witness.....................

No.	Pilot	Aircraft	Color	Reg. No.	Time in Seconds	Speed V mph	Wind Velocity	COS	Wind Comp. Velocity	True Speed V mph & Comp.
					t	$\frac{1364}{t}$	(mph)		(mph)	(mph)
1	Hamlyn	T-18	White	N137RT	17	80.0	0	—		80.0
2	Thorp	Skyscooter	Yellow	N91312	29	47.0	1.7	—		48.7
3	Lance	Starduster	White & Black	N173L	21	65.0	.5	—		65.5
4	Reely	Skycoupe	White & Brown	N4073K	25	54.6	1.7	—		56.3
5	Mooney	Honey Bee	Red & Black	90859	22.5	60.7	1.7	—		62.4
6	Janson	Smith Miniplane	Red	N4077K	22.5	60.7	1.8	—		62.5
7	Carrithers	Skycoupe	White & Blue	N35946	22.0	62.0	1.5	—		63.5
8	Callahan	Jodel	White	N94287	29.0	47.0	.6	—		47.6
9	Putney	Jodel	White	N5501K	27.5	49.6	.7	—		50.3
10	Martin	Miniplane	Yellow	N90P	25.0	54.6	.7	—		55.3

FORM NO. 3

AIRPLANE EFFICIENCY CONTEST High Speed

Recorder...................... Witness......................

No.	Pilot	Aircraft	Color	Reg. No.	START Hour	START Min.	START Sec.	FINISH Hour	FINISH Min.	FINISH Sec.	Total Time Sec.	V(mph)
											t	$\frac{201.600}{t\,(\text{sec.})}$
1	Hamlyn	T-18	White	N137RT	10	46	49	11	08	33	1304	154.5
2	Thorp	Skyscooter	Yellow	N91312	10	53	42	11	25	30	1908	105.5
3	Lance	Starduster	White & Black	N173L	11	24	12	12	13	30	2958	68.2
4	Reely	Skycoupe	White & Brown	N4073K	10	58	54	11	35	35	2201	91.6
5	Mooney	Honey Bee	Red & Black	90859	11	03	12	11	32	50	1778	113.4
6	Janson	Smith Miniplane	Red	N4077K	11	05	16	11	39	00	2024	99.5
7	Carrithers	Skycoupe	White & Blue	N35946	11	08	52	11	43	16	2064	97.6
8	Callahan	Jodel	White	N94287	11	14	13	11	47	15	1982	101.6
9	Putney	Jodel	White	N5501K	11	20	02	11	58	10	2288	88.2
10	Martin	Miniplane	Yellow	N90P	11	21	54	11	49	15	1641	122.8

FORM NO. 4

AIRPLANE EFFICIENCY CONTEST

Recorder...................... Witness......................

INTERMEDIATE CHECK POINT REGISTER CHECK NO. PALOMAR COLLEGE

No.	Aircraft	Color	Reg. No.	Time of Pass Hour	Time of Pass Min.	Time of Pass Sec.	Observations
1	T-18	White	N137RT	10	52		O.K.
2	Skyscooter	Yellow	N91312	11	01		O.K.
3	Starduster	White & Black	N173L	11	35		Missed Check Point to North—Continued West
4	Skycoupe	White & Brown	N4073K	11	07		Missed Check Point—Continued West
5	Honey Bee	Red & Black	90859	11	11		Clean Pylon Turn
6	Smith Miniplane	Red	N4077K	11	13		Clean Pylon Turn
7	Skycoupe	White & Blue	N35946	11	17		O.K.
8	Jodel	White	N94287	11	23		Clean Pylon Turn
9	Jodel	White	N5501K	11	31		O.K.
10	Miniplane	Yellow	N90P	11	29		Clean Pylon Turn

FORM NO. 5

AIRPLANE EFFICIENCY CONTEST —

$$\textbf{FINAL RESULTS}\quad K_3 = \frac{V_{max}}{V_{min}} \times \sqrt[3]{\frac{S}{P}} \times \sqrt{\frac{W}{S}}$$

No.	Pilot	Aircraft	Rated Power P (H.P.)	Weight W Lbs.	Wing Area S Sq. Ft.	$\frac{S}{P}$	$\frac{\sqrt[3]{S}}{P}$	$\frac{W}{S}$	$\frac{\sqrt[2]{W}}{S}$	V_{max} (MPH)	V_{min} (MPH)	$\frac{V_{max}}{V_{min}}$	K_3	Placing
1	Hamlyn	T-18	125	1133	86	.688	.883	13.18	3.63	154.5	80.0	1.93	6.20	5
2	Thorp	Skyscooter	65	930	105	1.615	1.171	8.85	2.97	105.5	48.7	2.17	7.55	1
3	Lance	Starduster	125	1053	105	.84	.943	10.02	3.16	68.2	65.5	1.04	3.10	Missed Palomar
4	Reely	Skycoupe	125	1268	147	1.176	1.054	8.62	2.94	91.6	56.3	1.625	5.04	9
5	Mooney	Honey Bee	65	891	101.4	1.56	1.158	8.78	2.96	113.4	62.4	1.817	6.228	4
6	Janson	Smith Miniplane	85	942	98.8	1.162	1.050	9.53	3.09	99.5	62.5	1.59	5.17	8
7	Carrithers	Skycoupe	85	1215	149	1.75	1.204	8.15	2.85	97.6	63.5	1.538	5.27	7
8	Callahan	Jodel	75	950	140	1.87	1.230	6.78	2.60	101.6	47.6	2.135	6.83	2
9	Putney	Jodel	65	1062	140	2.15	1.290	7.60	2.76	88.2	50.3	1.75	6.231	3
10	Martin	Miniplane	125	873	98.8	.79	.925	8.84	2.97	122.8	55.3	2.22	6.12	6

pilot did his best to fly at minimum speed practically in ground effect. We had previously measured a 2,000 foot long course, and posted an observer at each end with a very simple sighting device as illustrated in Fig. 1. At the initial marker a man with an improvised signal light sent a flash to the timekeeper at the far end of the 2,000 foot run, where the other spotter with the second sighting device gave the sign for the timekeeper to stop his count. A third man measured the wind velocity, watched the flights for possible "touch and go" landings, and made the recordings in Form No. 2.

Immediately after the aircraft crossed the end of the runway they accelerated for the HIGH-SPEED RUN flown over a triangular course. The total length of the course was 56 miles. Each pilot had a copy of the course map, and several had flown the course previously to become familiar with it.

The intermediate check points were selected away from airports in order to avoid interference with the traffic patterns and also for easily detectable landmarks. This was quite a problem for us, because we had to be away from the coast to avoid possible fog, stay away from the Miramar Naval Air Station control zone and, finally, we tried to avoid a few 4,000 foot plus mountains. This required several exploratory flights during the weeks previous to the fly-in. Also, we took photos of the check points, which were shown and explained individually to each contestant.

Early Sunday morning we had a coordination meeting at Ramona Airport for the spotters and radio amateurs, members of the Public Service Corps, who manned the intermediate check points and the START-ARRIVAL line. The spotters were EAA members familiar with the participating aircraft, and the radio amateurs with their mobile units provided the absolutely necessary communications systems. Without their aid we would never have made it.

Each pilot had to fly over the check points at no more than 500 feet above the ground. The spotter registered the time of passage, and the radio operator sent the message to the Ramona base. This way we had a very good control over unintentional (or otherwise) "short-cuts."

At the START-ARRIVAL point located at the end of the Ramona runway we had spotters and timekeepers with chronographs to measure the total time for each contestant.

We used Form No. 4 for the intermediate check points, and Form No. 3 at the START-ARRIVAL line. The final calculations were made on Form No. 5. All columns except the last five were already computed based on the data obtained during Saturday.

The rated power was based on the official engine rating. Unfortunately, it would be almost impossible to check actual horsepower during the race, so we assumed that each contestant will run his engine full-throttle or as high as safety and wear permit.

From the remarks of the spotters at the intermediate points, it seems that most of the pilots went "full bore" for the beautiful prize (a silver plate donated by NARMCO). Their "pylon" turns over the Pala Mission Cemetery probably shook some of the old California settlers in their graves!

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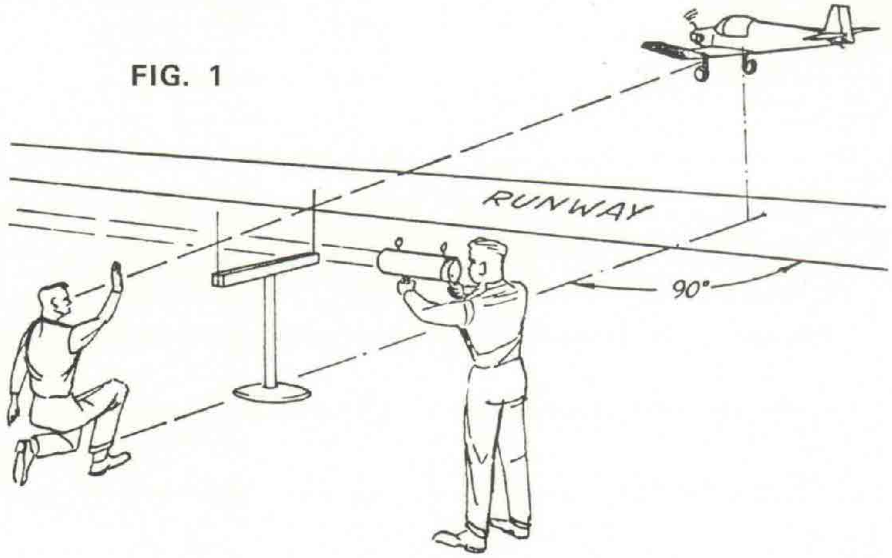
FIG. 1



K_3 VALUES FOR SOME LIGHT AIRPLANES

(Based on data published in LIGHT PLANE GUIDE)

*From NACA TM 760

Aircraft	Engine	P (HP)	W (LB)	S (Sq. Ft.)	$\frac{S}{P}$	$\sqrt[3]{\frac{S}{P}}$	$\frac{W}{S}$	$\sqrt{\frac{W}{S}}$	V_{max} Cruise (MPH)	V_{min} (MPH)	$\frac{V_{max}}{V_{min}}$	K_3
*Messerschmitt-Me 108	Hirth HM 8U	225	2320	172	.765	.915	13.50	3.67	181	39	4.64	15.60
Wittman Tailwind	Continental C-90	90	1300	83.5	.930	.976	15.50	3.93	150	55	2.72	10.50
Spezio Tuholer	Continental GPU	125	1400	118.0	.945	.980	11.87	3.44	128	45	2.84	9.58
Turner T-40	Continental C-65	65	1050	78.0	1.200	1.062	13.45	3.67	130	55	2.36	9.22
Piel Emeraude	Continental C-90	90	1345	117.0	1,300	1.092	11.45	3.38	120	48	2.50	9.21
Nesmith Gougar	Continental C-85	85	1250	80.0	.941	.976	15.60	3.95	140	60	2.33	9.00
Skyhopper	Continental C-85	85	1325	98.0	1.150	1.046	13.50	3.67	115	55	2.09	8.03
Pietenpol Air Camper	Ford A	37	1080	140.0	3.780	1.560	7.72	2.77	65	35	1.85	8.00
Bowers Fly Baby	Continental C-85	85	925	120.0	1.410	1.120	7.70	2.78	115	45	2.55	7.95
Starduster	Lycoming	125	1080	110.0	.88	.958	9.82	3.13	132	50	2.63	7.92
Pazmany PL-1	Continental C-90	90	1326	116.0	1.290	1.088	11.40	3.37	115	55	2.09	7.67
Stits Skycoupe	Continental C-85	85	1300	137.0	1.610	1.170	9.46	3.08	105	50	2.10	7.60
Druine Turbulent	Volkswagen	30	620	80.0	2.670	1.382	7.75	2.78	75	40	1.87	7.20
Stits Playboy	Continental C-85	85	870	96.0	1.150	1.045	9.06	3.10	120	55	2.18	7.12
Volmer Sportsman	Continental C-85	85	1500	183.0	2.160	1.290	8.20	2.86	85	45	1.89	7.00
EAA Biplane	Continental C-85	85	1000	120.0	1.410	1.120	8.33	2.89	110	55	2.00	6.48
Corben Baby Ace	Lycoming	65	850	125.0	1.920	1.240	6.80	2.61	90	45	2.00	6.45

FTA Time / Speed / Distance Computer

THE NENA COMPANY of Palatine, Illinois has announced the introduction of its new product, the **FTA Time/Speed/Distance Computer.**

The computer is designed for use by pilots of private aircraft in cross-country flights. It provides for location of the plane anywhere on the flight path by reference to the clock.

FTA means, **"Fly The Airplane"**, which the computer reminds the pilot to do between procedural steps in its use.

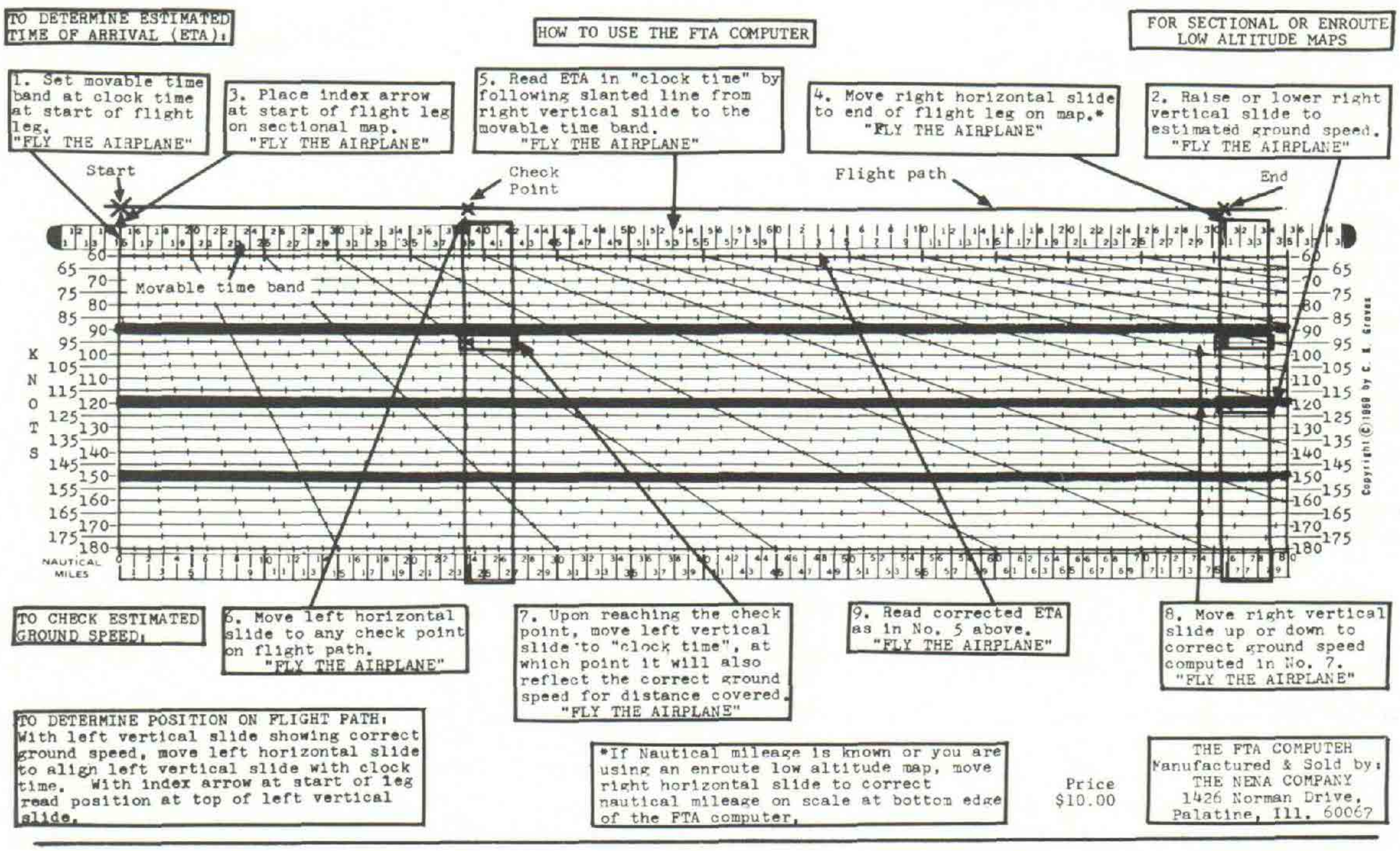
Writing is eliminated because the computer "remembers" beginning clock time, estimated speed, and estimated time of arrival while the pilot is rechecking ground speed or locating his present position from check points on the flight path. He does one short step at a time which permits him to "Fly The Airplane" before going on to the next step.

By reference to the clock he can tell exactly where he is on the flight path. The left horizontal and vertical slides will encourage frequent position checks which are so vital to safe flight. As time, speed and distance for the leg being flown are always recorded by the settings on the right horizontal and vertical slides and on the time band, reference to the map is kept to a minimum.

The speed range of 60 to 180 kts. is adequate for most single-engine planes, and the distance capacity of 80 nautical miles will include most flight legs laid out on sectional and instrument maps.

Construction is entirely of plexiglas, plastic and paper so as not to interfere with magnetic and electronic navigation instruments. Speed calibration is in five-knot multiples and each minute on the movable time band is clearly indicated by printed digits. The horizontal and vertical slides and the time band move freely by finger pressure but have sufficient tension to remain where placed.

For additional information, write to: C. Kenneth Groves, President, The Nena Company, 1426 Norman Drive, Palatine, Illinois 60067



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All together we — the organizers, the pilots, and the public — had an enjoyable time. Before the contest we had our doubts about the success because of the complexity of the task, but everything went smoothly and it was really good fun.

The winner of this particular contest — John Thorp with his **Sky-scooter** — obtained K =7.55. I added a table of K_3 values for several well-known light airplanes based on data published in **Light Plane Guide**. It will be very interesting to see in the coming meets the results based on "measured" performance for these same airplanes.

We intend to run this competition again next year during our fly-in, and I encourage other Chapters to consider it for their meets.

There could be variations to these rules and the equations used. Generally, they could be made more complex to consider other aircraft characteristics. But, I feel very confident that we can accept them as a fair exponent of aircraft efficiency. I polled several aerodynamicists at Convair and Ryan for their opinions, and they were in agreement that this is a simple and adequate approach considering time and measuring limitations.

For a while we considered the elimination of the HIGH-SPEED RUN over a triangular course, and having instead a high-speed pass over the 2,000 foot measured distance. But this would eliminate the "rally" atmosphere and a large share of the fun at local fly-ins. No doubt, there is some pilot technique involved and a previous flight along the course is of great help. Also, the same race run over flat country will result in different K_3 factors for the aircraft, just as the "par" varies among golf courses.