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TROPHY

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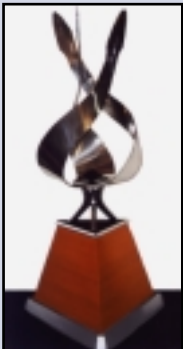
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AIRCRAFT PERFORMANCE REPORT

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RV-4 -- New CAFE Triaviathon Champion

BY BRIEN A. SEELEY, AND THE CAFE BOARD



Dave Anders' RV-4 carries the CAFE Barograph
along Point Reyes National Seashore.

The CAFE Board was initially surprised to learn that an RV-4 builder wanted an opportunity to break the Triaviathon record. We explained to him that the CAFE Triaviathon record attempts were made by invitation only. To qualify, an aircraft was required to exhibit outstanding performance in top speed, climb and stall speed. The typical candidates were aircraft with well over 300 horsepower.

We politely told the RV-4

builder that we would consider hosting his record attempt if he would submit an explanation of how his aircraft could realistically qualify as a contender. This was, after all, a very difficult record to break. The original Triaviathon record, set by John Harmon in the Harmon Rocket on May 8, 1993 had stood for over 4 years. Jeff Ackland's record attempt in March, 1997 in the 500 HP Legend, had missed the record by about 8%. Jeff had vowed to return with more horse-

power in the Legend.

The RV-4 builder was persistent. He submitted an impressive list of his RV-4 performance modifications. That list, shown in the sidebar, unquestionably qualified him as a true student of CAFE racing ideas. But could an aircraft with only 200 hp seriously challenge the record? We decided to let him have a shot at it.

When he arrived at the CAFE Foundation hangar, it became apparent that this RV-4 builder meant business. He

RV-4 N230A Aircraft History

by David W. Anders, Builder

Completed: 1991 in 5 years 7 months
1991 Kit Built Champion Oshkosh
1992 Reserve Grand Champion “ “
1993 Wright Brothers Award Dayton

1992 speed: 225 mph with
Stock Lycoming IO-360 and
“y” stack exhausts

Modifications:

Electronic ignition
Lower firewall cleanup and fairing
Increased RPM settings
Dynamic balancing of engine/prop
1993 speed: 230 mph (Sun 100 Race)

Racing tailwheel
Gap seals
Lamb tires with 2 piece wheel pants
1994 speed: 235 mph (Sun 100 Race)

B&C alternator
Engine/prop/injector servo mods
Cooling plenum revision
Cowl inlet rings with diffusers
4 into 1 exhaust system
Augmentor outlet (jet effect)
Cooling exit mods
Improved firewall fairings
New gear leg fairings
1995 speed: 248 mph (K.L. Trials)

Inlet ring/diffuser for ram induction
Aileron cuff position
Aileron hinge canoe fairings
Flat top pistons, 10:1 compression
Wing tips
1997 speed: 254 mph @ 1800'

Engine: Lycoming IO-360 A1B6
Balanced crank, rods, flywheel, pistons
Flow tested: cylinders, fuel injection
Engine by LYCON of Visalia, CA.
dyno reading: 236 HP.

Prop: Hartzell M2YR + 76-66 blades
70.5" diameter
Prop mods by: Johnson & Son Propeller,
Bakersfield, CA.

Claimed cruise performance:
216 mph @ 32.7 mpg @ 14,000'
195.5 mph @ 36.2 mpg @ 14,000'

Dry empty weight: 975 lb with oil.



CRIS HAWKINS

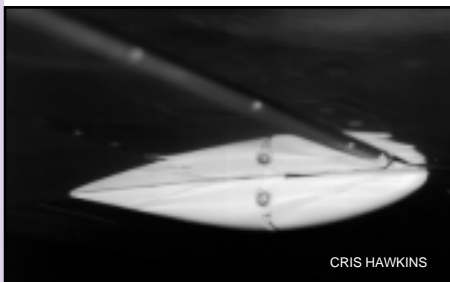
Above: Dave Anders' superior metalwork is revealed by N230A's polished aluminum finish. Note the very clean gear leg fairing and wheel pant installation.

Below: Otis Holt custom fits the camcorder mounting bracket to record the power settings during the stall speed measurements. Manifold pressure must be kept below 14" Hg. during the stall in order to qualify the record attempt.

Bottom: Left, a 'canoe' fairing for the aileron hinge. Right, the racing tailwheel. Opposite, the interior was kept as lightweight as possible.



LARRY FORD



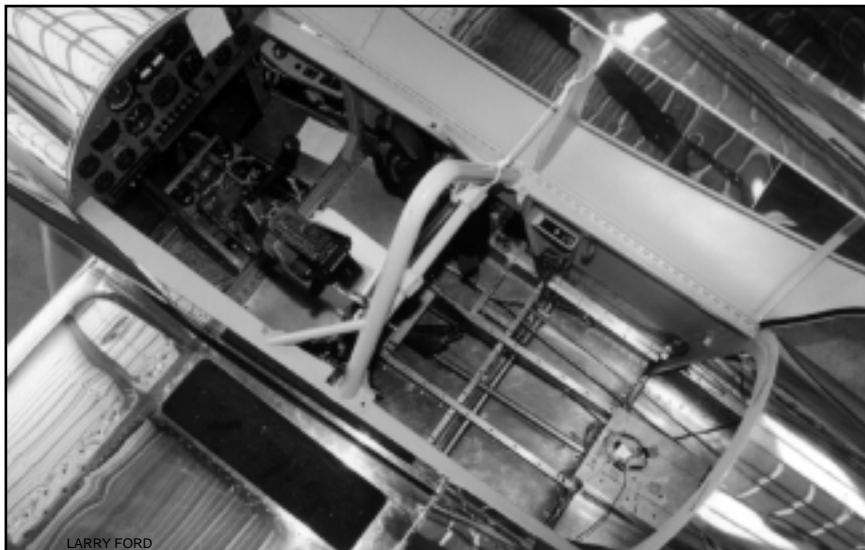
CRIS HAWKINS



CRIS HAWKINS

Vmin	Vmax	Climb	Vmin	Vmax	Climb
20	100	6008	65	100	13636
20	150	4005	65	150	9091
20	175	3433	65	175	7792
20	200	3004	65	200	6818
20	225	2670	65	225	6061
20	250	2403	65	250	5455
20	300	2003	65	300	4545
20	350	1716	65	350	3896
20	400	1502	65	400	3409
20	450	1335	65	450	3030
35	100	6888	75	100	17400
35	150	4592	75	150	11600
35	175	3936	75	175	9943
35	200	3444	75	200	8700
35	225	3061	75	225	7733
35	250	2755	75	250	6960
35	300	2296	75	300	5800
35	350	1968	75	350	4971
35	400	1722	75	400	4350
35	450	1531	75	450	3867
45	100	8335	90	100	24301
45	150	5557	90	150	16200
45	175	4763	90	175	13886
45	200	4168	90	200	12150
45	225	3704	90	225	10800
45	250	3334	90	250	9720
45	300	2778	90	300	8100
45	350	2381	90	350	6943
45	400	2084	90	400	6075
45	450	1852	90	450	5400
55	100	10595	105	100	32625
55	150	7063	105	150	21750
55	175	6054	105	175	18643
55	200	5297	105	200	16312
55	225	4709	105	225	14500
55	250	4238	105	250	13050
55	300	3532	105	300	10875
55	350	3027	105	350	9321
55	400	2649	105	400	8156
55	450	2354	105	450	7250

Rate of Climb required to tie 1997 RV-4 CAFE Triaviathon record.



practiced dentistry in Visalia, California as his day job. By night, however, he was a passionate airplane builder. His name was Dave Anders. He seemed deceptively calm and mild mannered for a man who was about to make a world record attempt. The care and precision evident in all of his many RV-4 modifications spoke volumes about the depth of his commitment to this project. Several of these modifications merit comment:

The polished aluminum finish on this aircraft, which revealed every rivet head, showed superb metalwork. The elegantly simple and clean design of the controls, hardware and interior must also have been a factor in this aircraft winning so many workmanship awards. However, besides perfecting the aircraft's appearance, Dave also focused intensely on drag reduction and increasing the engine's power output. This passion for excellence in both cosmetics and performance suggested he might surprise us with his score.

Preparing N230A for the record attempt would mean achieving an optimized power to weight ratio. This meant removing as many non-essential parts of the aircraft as was legal within the FARs. At the August 1997 Oshkosh Convention, when Dave made the decision to go after the record, he began dieting. By the time he arrived at CAFE, he had lost 23.5 pounds of body weight in 7 weeks! He figured that every pound he lost would increase his rate of climb by 3 fpm.

The cooling system modifications include 34 square inches of total inlet area through two machined, axi-symmetric inlets with internal diffusers to a downdraft plenum. The cooling outlet is 24.7 square inches and is augmented with exhaust flow. The fuel injector servo throat was opened and its diffuser re-profiled, eliminating 3 of the 4 ram sensing tubes in the throat. Holes, radii, and polished chamfers were used everywhere possible to save weight.

TRIAVIATHON HISTORY

The CAFE Triaviathon rewards the best combination of top speed, stall speed and rate of climb. These 3 flight regimes represent an aircraft's 'athleticism' and mutually conflict from an aircraft design point of view. For example, designing for low stall speed typically limits an aircraft's top speed, and top speed often demands shorter



CAFE Foundation President Brien Seeley, left, congratulates Dave Anders after his sensational new record score was confirmed.

wing spans which reduce climb performance.

The perpetual CAFE Triaviathon Trophy, created by the CAFE Board in 1993, symbolizes this conflict in aircraft design. On display in the EAA Air Adventure Museum, it honors the aircraft designer and the pilot who set records in this event. These records are also certified by the National Aeronautics Association.

The Triaviathon scoring formula is:

$$\text{Score} = \frac{28110625 \times [V_{\text{max}} \times \text{ROC}]^2}{[4100625 + V_{\text{so}}^4] \times 10^9}$$

where V_{so} is stall speed, ROC is rate of climb and V_{max} is the top speed at 6000' pressure altitude.

The formula is complex because it was designed to proportionately reward stall speeds between 35 and 70 mph. Stalls above 70 mph receive a progressively increasing scoring penalty. Stalls below 35 mph do little to improve the score.

The measured rate of climb is converted to equal that for the altitude window of 2500'-3500' in standard day atmosphere.

An initial, high speed calibration flight is performed while recording airspeed and altitude on both a wingtip barograph and a cabin barograph. The

barograph, mounted on the wingtip, uses its own calibrated pitot-static source while the cabin barograph is connected to "T" fittings in the aircraft's pitot static system. The calibrated airspeeds (CAS) recorded on the wingtip barograph provide a correction table for the cabin barograph recordings.

The wingtip barograph is removed for the second flight and the maximum speed is recorded by the cabin barograph only. That speed is then corrected to CAS using the airspeed correction table derived from the wingtip mounted barograph. If the test flight shows that the stock static system is accurate, the rate of climb performance of the second flight, made without the wingtip barograph, can be used for scoring. If the static system is not accurate, the ROC from the first flight is used in the scoring.

PREPARATIONS

Dave arrived at the CAFE hangar on Friday, September 26, 1997 with his wife, Diane and an entourage of well-wishers. The first task was to drain all of the fuel from his aircraft and measure its empty weight. N230A weighed just 975 lb. empty including the IO-360 A1A Lycoming engine and Hartzell constant speed propeller. In-

stallation of the barographs and camcorder was made by the CAFE team in preparation for a record attempt at dawn. Everyone hoped for clear skies and smooth air.

Meanwhile, Dave applied thin blue translucent mylar tape to all gaps and surface slits on the aircraft to reduce leakage drag. He installed a very small "racing" tailwheel. Tiny, precisely-built afterbody fairings for the fuel tank quick-drains and aileron hinges (using scaled airfoil coordinates!) were installed in preparation for the record run. Dave arrived the next morning wearing very light clothing ("Hammer pants") and very lightweight shoes like those used by wrestlers. He skipped breakfast and made one last trip to the bathroom before climbing into N230A.

The first flight was made with about 12 gallons of fuel. Stall

speed was recorded on the wingtip barograph. Dave exhibited great piloting skill as he delicately approached stall using the maximum allowable manifold pressure (14" Hg.). The V_{max} speeds registered on the wingtip and cabin barograph were recorded and compared.

The second flight was made with about 8 gallons of fuel, allowing just enough for VFR minimums. The rate of climb and V_{max} part of Dave's record derived from the second flight. During those V_{max} runs, the propeller turned at just over 2900 RPM, the limiting speed for a constant speed prop.

TRIAVIATHON RECORDS

The original Triaviathon record was set by John Harmon in the Lycoming IO-540 powered Harmon Rocket II on May 8, 1993. His achievements were:

Top Speed 244.79 mph.

Rate of Climb 3330.21 fpm.

Stall Speed 56.36 mph.

For a score of 1316.45.

Dave Anders' RV-4, on September 27, 1997, achieved the following:

Top Speed 250.71 mph.

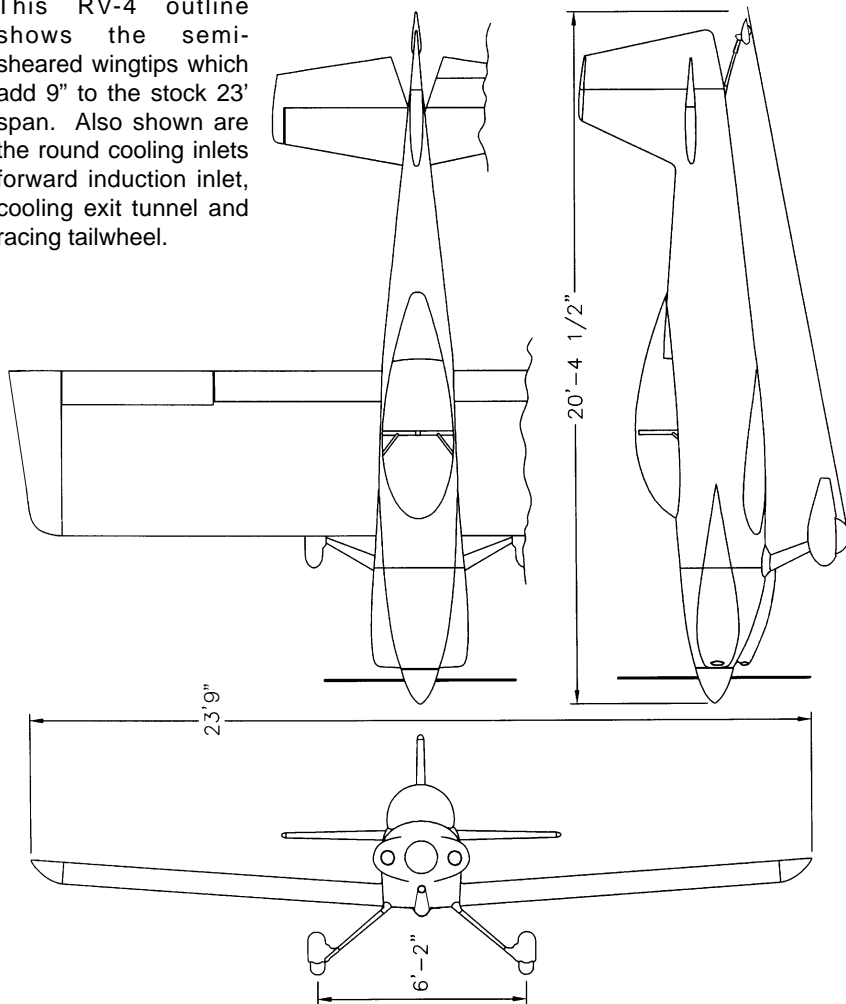
Rate of Climb 3308.39 fpm.

Stall Speed 44.78 mph.

For a score of 2381.24.

This bettered John Harmon's previ-

This RV-4 outline shows the semi-sheared wingtips which add 9" to the stock 23' span. Also shown are the round cooling inlets forward induction inlet, cooling exit tunnel and racing tailwheel.



ous record by over 1000 points and 'raised the bar' so high that future Triaviathon contestants may have to use aircraft that are 'purpose-built' for the event. As one considers what kind of aircraft that would be, many very challenging design questions arise. Would it have more span? a thinner wing? retractable gear? full span Fowler flaps?

Dave's plans for future modifications are a carbon fiber cowl, elevator and rudder, along with a fastback canopy to reduce flow separation at the canopy trailing edges. There is a clear possibility that his record may be broken in the near future by a woman aviator--his wife, Diane!!

CONCLUSIONS

A highly modified RV-4 has shattered the CAFE Triaviathon record. David W Anders, pilot/manufacturer and Richard VanGrunsvan, designer will have their names inscribed upon the perpetual CAFE Triaviathon Tro-

phy and will be officially recognized at the 1998 Oshkosh Convention for this new world record.

It is noteworthy that the RV-4 aircraft is not purpose-built for Triaviathon competition; it remains a 2-place, aerobatic, efficient cross-country travelling machine. The big lesson from this new record is that keeping an aircraft's weight to a minimum has a magical effect upon its performance. Efficient structural engineering deserves the same attention as drag reduction and engine hot-rod-ding.

It was a pleasure and a privilege to host Dave Anders and his RV-4 for its record attempt in the CAFE Triaviathon. He should be congratulated for his extraordinary achievement in producing this remarkable aircraft and its new world record.

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