CAFE FOUNDATION

AIRCRAFT PERFORMANCE REPORT

Sponsored and Funded by the Experimental Aircraft Association

RV-9A

by Brien A. Seeley, C.J. Stephens and the CAFE Board

PHOTOS BY LARRY FORD AND JO DEMPSEY

Dick VanGrunsven has demonstrated genius for designing the most popular aircraft in the category between $100,000+ hot-rod homebuilts and sub $35,000 recreational Light Sport Aircraft (LSA). The popularity of his all-metal RV series of aircraft arises from their excellent balance between cost, performance and flying qualities.

Dick designed the RV-9/9A to use the less expensive Lycoming 118-160 BHP engines to extend access to such versatile aircraft to homebuilders on tighter budgets. An RV-9A like our test candidate, N129RV, (built with the QuickBuild kit) would cost about $65,000, including $21,300 for a 160 BHP Lycoming engine and $5,300 for a propeller. This is about $7,000 less than a 180 BHP RV-7A and $10,000 less than a 200 BHP RV-8A.

CAFE Foundation, Inc., Comparative Aircraft Flight Efficiency, a non-profit, tax-exempt, all-volunteer, educational organization.

CAFE Flight Test Facility, Charles M. Schulz Sonoma County Airport
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website: cafefoundation.org
Founded in 1982

Elaborate CAFE flight test gear sits atop N129RV's glare shield.

If a mid-time Lycoming engine, wood prop and day VFR basic equipment were used and all of the construction were performed by the builder, the cost could be as low as $37,500. Equally shared by 4 members of a homebuilder flying/building club, the cost of an RV-9A thus becomes just $16,250, or $9,375 for the examples just mentioned, respectively. Such a partnership would offer very affordable access to such a versatile cross-country flying machine. It would also reduce the member's burden of insurance, parking, taxes, hangaring, upgrades, etc.

Another of Van's design priorities for the RV-9/9A was that it be suitable for inexperienced pilots. Thus, it uses a longer-throw control stick that has higher stick forces than the other RV's.

With 123.67 square feet of wing area and 28 foot wingspan, the RV-9A has an aspect ratio of 6.34 versus 4.8 for the RV4/RV-6. The RV-9A also has 12% more wing area than the RV4/6 series. These features, along with a high lift airfoil designed by renowned wing designer, John Roncz, enable the RV-9A to climb and cruise almost as well on 160 BHP as do the RV4/6 using 180-200 BHP.

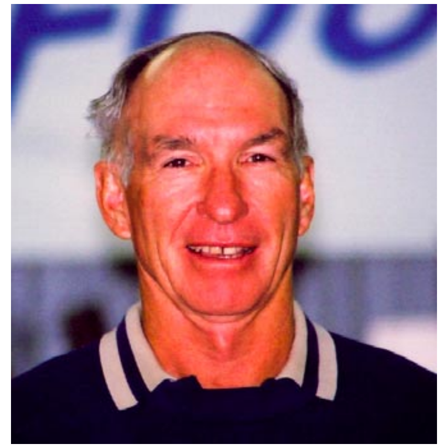
The fuselage structure of the RV-9A is like the RV-7/7A except at the wing attach points. The RV-9A also uses a constant-chord horizontal tail and larger vertical tail surfaces than other RV's.

N129RV has the late-style tuna-shaped wheel pants like those popularized by John Sharp's renowned Formula One racer, Nemesis. Its long span slotted flaps are claimed to reduce its stall speed by 7 mph compared to the other RV designs.

The construction of the RV-9/9A, like all others in the RV series, is by stressed aluminum skin with riveted structural components. A QuickBuild option with pre-riveted components and matched-hole pre-drilled skins is claimed to save 35-40% of the building time while providing quality-built, pre-inspected assemblies that are assembled in either the Phillipines or in the Czech Republic by experienced metal workers.

Detailed information is available on Van's excellent website; vansaircraft.com. Complete technical results for the RV-9A are available at cafefoundation.org.

The CAFE Foundation wishes to extend a special thanks to Ken Krueger, engineer with Van's Aircraft, who delivered N129RV from Van's factory in Oregon to the CAFE Foundation flight test center. Ken briefed CAFE test pilot, C.J. Stephens, for his first flight in the aircraft and was very helpful to the CAFE flight test team in the installation of the flight test instrumentation used in this report.



Subjective Evaluation

RV-9A N129RV

by
C.J. Stephens

The RV-9A is light in weight and one person can easily move it around on the ramp. Its turning radius is small enough that we could easily turn it around inside the 50 foot CAFE hangar.

COCKPIT FEATURES

The cockpit is uncluttered and roomy. This pilot, who is 5'10" used a 1" seat pad to get the proper sitting height. Even so, there is plenty of headroom in the RV-9A. Although it gives good leverage, the control stick is longer than I like and makes the control movements seem exaggerated.

The bubble canopy, which rolls back along rails, allows easy entry for both pilot and passenger.. The canopy latching system is easy to understand and leaves no doubt as to its security. A single latch with a solidly positive mechanism rotates to lock the canopy.. It can be opened during taxi to improve ventilation.

The ample baggage compartment, located just behind the seats, is accessed through the cockpit.

The cockpit layout is very efficient. All primary controls

CAFE MEASURED PERFORMANCE, N129RV	
Vmax, TAS, 8509.7 ‘ dens.alt., 1703 lb, 23.7”, 2605 RPM, 9.7 gph	192.7 mph
Stall speed, CAS, 1758 lb, 12” M.P., 1800 RPM, full flaps, mph	49.08 mph
Max climb rate, 5500’ dens.alt., 1732 lb, 26”, 2703 RPM, 10.8 gph	1348.9 fpm
T.O. distance, 1731’ dens.alt., 1747.9 lb, 5 kt. wind, T 23° DP 12°	385 feet
Vy, speed for best climb rate, CAS, 5500’ dens.alt, @103 mph TAS	95 mph
Vx, speed for best climb angle, CAS, 5500’ dens., @88.3 mph TAS	81.6 mph
Liftoff speed, CAS, (panel IAS= 74), 1300’ dens., full flaps, 1744 lb	66.0 mph
Touchdown speed, CAS, (panel IAS= 68), 1520’ dens., 1715.8 lb	59.1 mph
Min. sink rate, idle power, coarse pitch, 1725 lb, 81.7 mph TAS	664.2 fpm
Best glide ratio, idle power, coarse pitch, 1738 lb, 95 mph CAS	12 to 1
Noise levels, gliding at idle power/max climb/high cruise, dB	82/99/100
Peak oil temp. in climb, 10,500’ dens., 95 mph CAS, OAT 62° F	228° F
Max. cowl exit air temp., 60 mph CAS, full flaps, 2000 RPM, 15”	168° F
Empty weight per CAFE Scales, including headsets and oil	1078.05 lb

are easy to reach and operate. Starting the Lycoming engine is straight-forward. On every attempt it starts flawlessly.

GROUND OPERATIONS

Taxiing is easy using differential braking for directional steering. The plane tracks straight on the taxiway. Very slight power is needed to attain taxi speed, yet at idle throttle, the plane does slow down.

Field of view for ground maneuvering is excellent in all directions.

The cabin ventilation is plentiful with two “eyeball” vents on the panel. Even at taxi speeds, there is adequate cooling air from these vents. There are no vents directed at the windshield and, I would suspect that in a very humid environment, condensation would accumulate, restricting the visibility.

The RV-9A has a very nice electric elevator trim system. A green LED light on the panel indicates trim position and is used to set trim prior to takeoff. There is a switch to operate the electric flaps from both the top of the control stick and on the instrument panel. This redundancy adds both a failure point and undesirable cockpit complexity.

TAKEOFF

I consistently used 15 degrees of flap for takeoff with good results. This particular airplane has the manifold pressure gauge positioned above the propeller control and the RPM gauge above the throttle, and it is difficult to get used to this illogical arrangement.

Even at maximum weight on a nearly standard day in light wind, the minimum run (flaps 15 degrees) takeoff roll with 15° of flap measures only 385 feet. Directional control during takeoff is very easy to maintain. Lift off is at 75 mph panel IAS and climbing at 110 mph panel IAS gives 1600 fpm on the VSI. Stick forces on rotation, with the c.g. at 13% aft of the forward limit, are light yet comfortable.

FLYING QUALITIES

Field of view during climb is excellent in all directions. The initial feel of the controls is light and brisk. The controls are very responsive and well balanced in all axes. On a day with the OAT measuring 76° F at a panel altitude of 4000 feet, a maximum performance climb produces a peak CHT of 462° F on cyl. #3.

The spiral stability is neutral, i.e., once established in a shallow bank it does not tend to overturn or level out. This is true both with and without flaps and at both 1.3Vs and Va. Dynamic longitudinal stability is sampled at several airspeeds to determine the natural damping qualities of the RV-9A. It is essentially deadbeat at all speeds with both stick free and stick fixed. In stick fixed mode the elevators can add to the pitch dampening, producing a different amount of natural stability.

With the use of a hand-held stick force gauge, I measure the amount of stick force necessary to change the airspeed in 10 mph increments both above and below a given trimmed airspeed, i.e., static longitudinal stability. The measurements are taken after the airplane is well trimmed in level flight at the given airspeed. The plane is not re-trimmed throughout the measurements. The resulting measurements indicate the natural propensity of the airplane to return to its trimmed airspeed--the higher the forces, the greater the longitudinal stability.

Roll due to yaw is explored by establishing a 15 degree bank, and then, with no aileron input, determining if the rudder alone can level the wings. The RV-9A rudder gives a very prompt and favorable response. It provides accurate control to about 30 degrees of bank in either direction

Cowl bluff body for carb inlet also serves as cooling and exhaust exits.

Cowling attaches with several piano hinge pins.

Van's engineer Ken Krueger helped prepare the aircraft.

with no aileron input.

Adverse yaw is examined by roll inputs using aileron only at 1.3Vs. Initial adverse heading displacement is nearly zero. Such very mild adverse yaw contributes to the RV-9A's pleasant flying qualities during flight at slow airspeed.

Lazy-eights are accomplished with a pleasing sense of smoothly blended control forces throughout each maneuver at all airspeeds.

An interesting characteristic occurs when making rapid and full aileron inputs. There is a definite, momentary kick-back on the control stick. I believe this occurs when the aileron exceeds its maximum angle of attack and induces a temporary stall of the aileron. It is brief and the airplane responds properly to the commanded input. However its effect on the controls is noticeable.

Maneuvering stability is investigated using the stick force gauge to determine the force required to generate more G force. The graph shows the results for the RV-9A. The RV-9A required substantial increases in stick force to generate more G's. This helps the pilot avoid excessive G's during any pull-up maneuver and adds to the airplane's overall safety and stability.

STALL CHARACTERISTICS

Stall characteristics are examined with and without flaps at both 15% and 85% aft c.g. locations. All stalls exhibit a mild break with the wings remaining level throughout the entire recovery. The only buffet occurs 2 mph above the stall. The nose drops promptly upon stall at all c.g. positions tested. Recovery is instantaneous in all cases once the stick is repositioned. Control of the angle of attack is positive throughout the recovery. 100'-150' is a typical altitude loss for full recovery.

During the flight with the c.g. @ 85% aft of the forward limit the already light controls become even lighter. On takeoff very little aft stick force is required to raise the nose to the proper attitude. Particular attention is likely to be necessary whenever the airplane's c.g. is toward its aft limit.

DESCENT AND LANDING

During descent, the field of view is excellent and, with its easy maneuverability, dropping a wing helps improve the view. The plane accelerates quickly when descending, requiring a little planning for approach. At 80 mph panel IAS the final approach is very easy to control. Even as the speed bleeds down to around 70 mph in the flare with the power at idle, there is no difficulty in gently settling the tires on the pavement at touch down.

I believe that, in a crash landing situation, the RV-9A aircraft occupants would have a very good likelihood of survival due to its having a slow landing speed, fuel contained solely in the wings, and an engine located forward of the occupants. In an off-runway landing, if the airplane flipped upside-down, the sliding canopy may offer an advantage in egress from the cockpit compared to designs with hinged canopies.

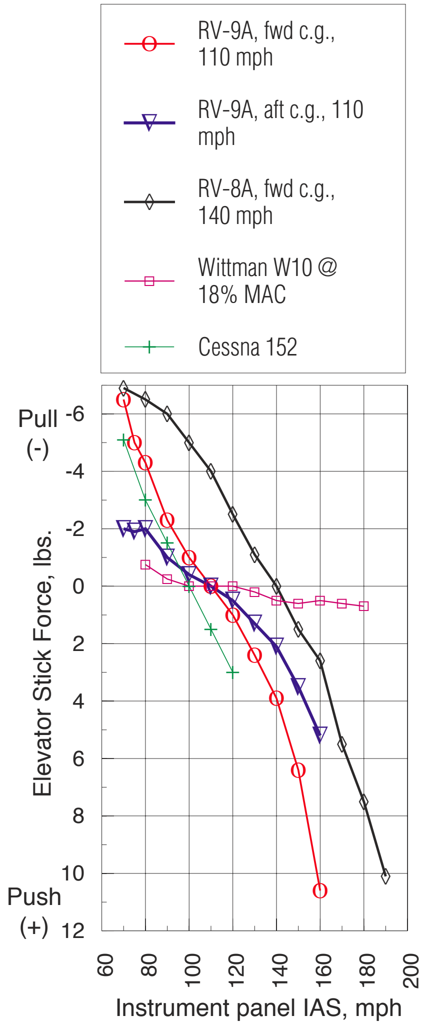
CONCLUSION

I find the RV-9A to be a simple, straightforward airplane. It is very responsive, making it a joy to fly, yet with its good stability, even a low-time aviator could manage it. It is the kind of plane in which a pilot and a full-sized friend can take a normal amount of baggage and travel a good distance at 185 mph. Its minimum runway requirement does not limit the places chosen as destination. It also seems well suited for local flying with the 'fun factor' set on high.

STICK FORCE GRAPHS:

Stick forces are shown on the vertical axis of the two adjacent graphs, "Static longitudinal stability" and "Maneuvering stability at Va". It is the slope of the various colored lines on the two graphs that indicate how much pull or push on the stick is needed to command the aircraft to change its speed or G force. A steep vertical slope means that the aircraft's control stick stiffly resists change, while a flatter slope means that speed or G force can be changed with little effort by the pilot. Steeper slopes thus indicate more stability. For safety, "pulling G's" should take a lot of effort.

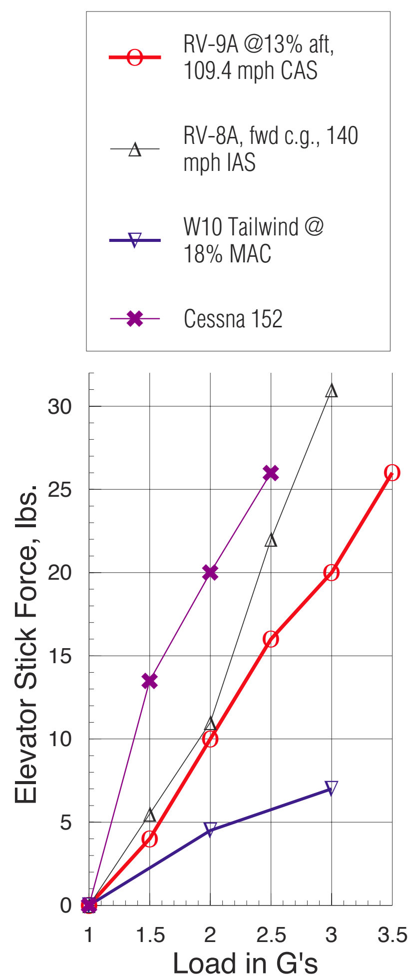
Note: For any aircraft, the slopes generally will flatten as the c.g. moves aft. Indeed, the aft c.g. limit is usually determined as the point at which the stick force slope becomes so flat that the aircraft becomes unstable.



Static longitudinal stability

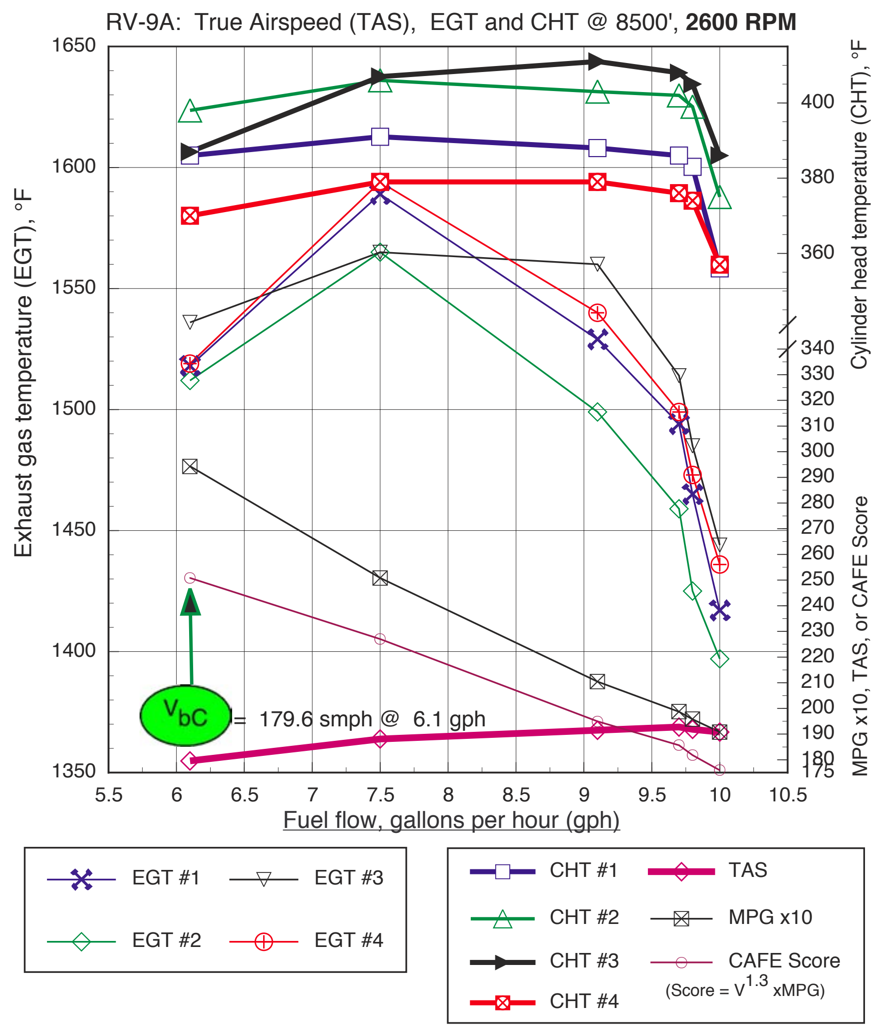
Trimmed to zero pounds, stick- free, flaps up, near V_a.

(For RV-9A, 110 mph IAS = 101 CAS)



Maneuvering stability at Va.

The RV-9A being weighed before flight on the CAFE Scales.



RV-9A N129RV: wide open throttle, CAFE data 8/18/02. CHT for 100°F day.
Lycoming O-320-D3G engine, 160 BHP. V_{bC} = velocity for best CAFE Score.

Darrel Harris, below left, and Test Pilot C.J. Stephens both devoted major efforts to assure that the RV-9A flight tests were complete. See cafefoundation.org for added details.

CAFE's pitot/static missile self-aligns with airstream.

HOW TO READ THIS GRAPH

This graph summarizes the cruise performance of the aircraft in terms of TAS, EGT, CHT, CAFE score and MPG relative to its fuel flow.

The top family of four curves show the CHT (top right vertical axis) for each engine cylinder versus fuel flow (shown on the bottom horizontal axis). Note that, at a given fuel flow, the different cylinders have very different CHT's, reflecting uneven mixture distribution, a feature common to carbureted engines.

Below the family of CHT curves are the four EGT curves, with temperatures shown on the left vertical axis. Peak EGT occurs at 7.5 gph of fuel flow. The spread in EGT from cylinder to cylinder again reflects uneven mixture distribution.

The peak CHT tends to occur at about 100° F rich of peak EGT (at 9.0 gph) and CHT cools off at mixtures lean of peak EGT.

Below the four EGT curves, are the MPG and CAFE score, each rising almost linearly as the fuel flow is leaned. MPG peaks at about 30 MPG (bottom right vertical axis). V_{bC} , velocity for best CAFE score, is 179.6 mph at 6.1 gph.

True airspeed (TAS), the bottom curve, is shown to be highest at the higher fuel flows with rich of peak (ROP) EGT mixtures, but TAS falls only slightly at lean mixture settings.

CAFE HONORARY ALUMNI

Steve Barnard--RV-6A
Jim Clement--Wittman Tailwind
Jim Lewis--Mustang II
Ken Brock--Thorp T-18
Larry Black--Falco F.8L
Chuck Hautamaki--Glasair III
Jeff Ackland--Legend
Jerry Sjostrand--Express
Randy Schlitter--RANS S-7C
Stoddard Hamilton Aircraft, Inc.--GlaStar
Fred Baron--Lancair 320
Mark Beduhn--Cozy Mark IV
Dick VanGrunsven--RV-8A, RV-9A
Derek Hine--Lancair IVP
Kim Prout--Europa
Neal Roach--Glasair Super IIS FT

ACKNOWLEDGEMENTS

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Engineered Software "PowerCadd" and WildTools
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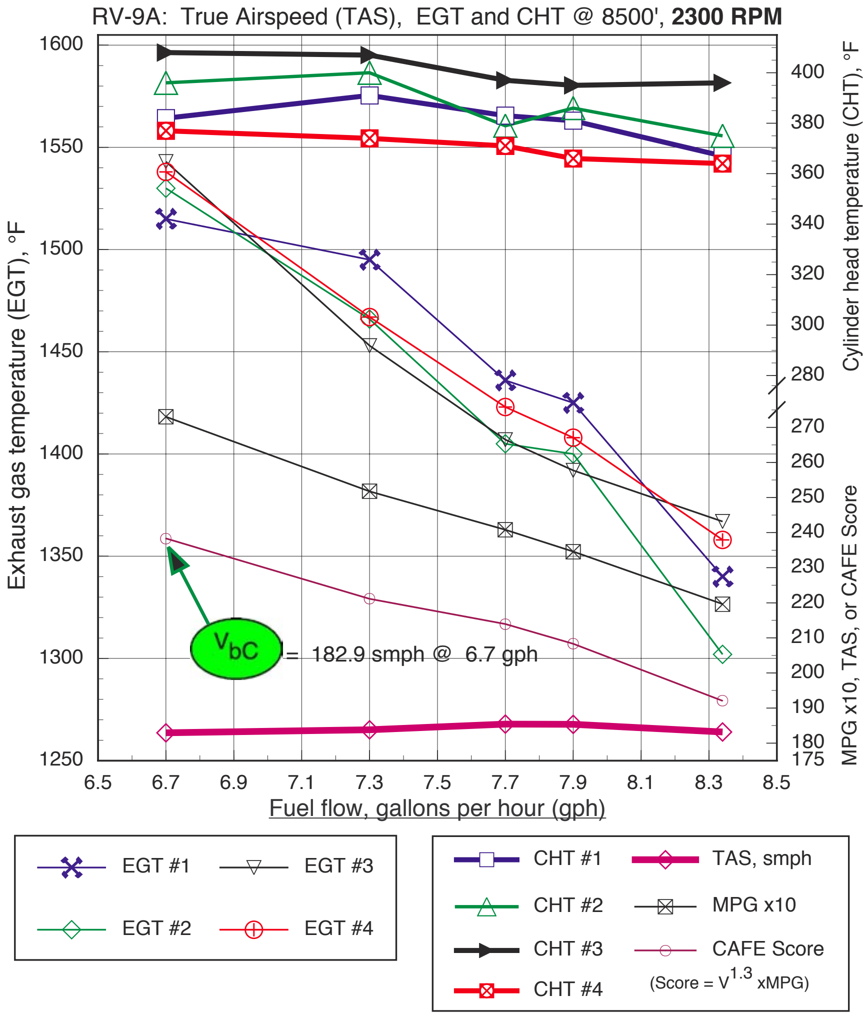

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Below the family of CHT curves are the four EGT curves, with temperatures shown on the left vertical axis. Peak EGT occurs at or below 6.7 gph of fuel flow. The spread in EGT from cylinder to cylinder again reflects uneven mixture distribution.

The peak CHT normally occurs at about 100° F rich of peak EGT and cools off at mixtures lean of peak EGT.

Below the four EGT curves, are the MPG and CAFE score, each rising almost linearly as the fuel flow is leaned. MPG peaks at about 27 MPG (bottom right vertical axis). V_{bC} , velocity for best CAFE score, is 182.9 mph at 6.7 gph.

True airspeed (TAS), the bottom curve, is shown to be highest at the higher fuel flows with rich of peak (ROP) EGT mixtures, but TAS falls only very slightly at lean mixture settings.

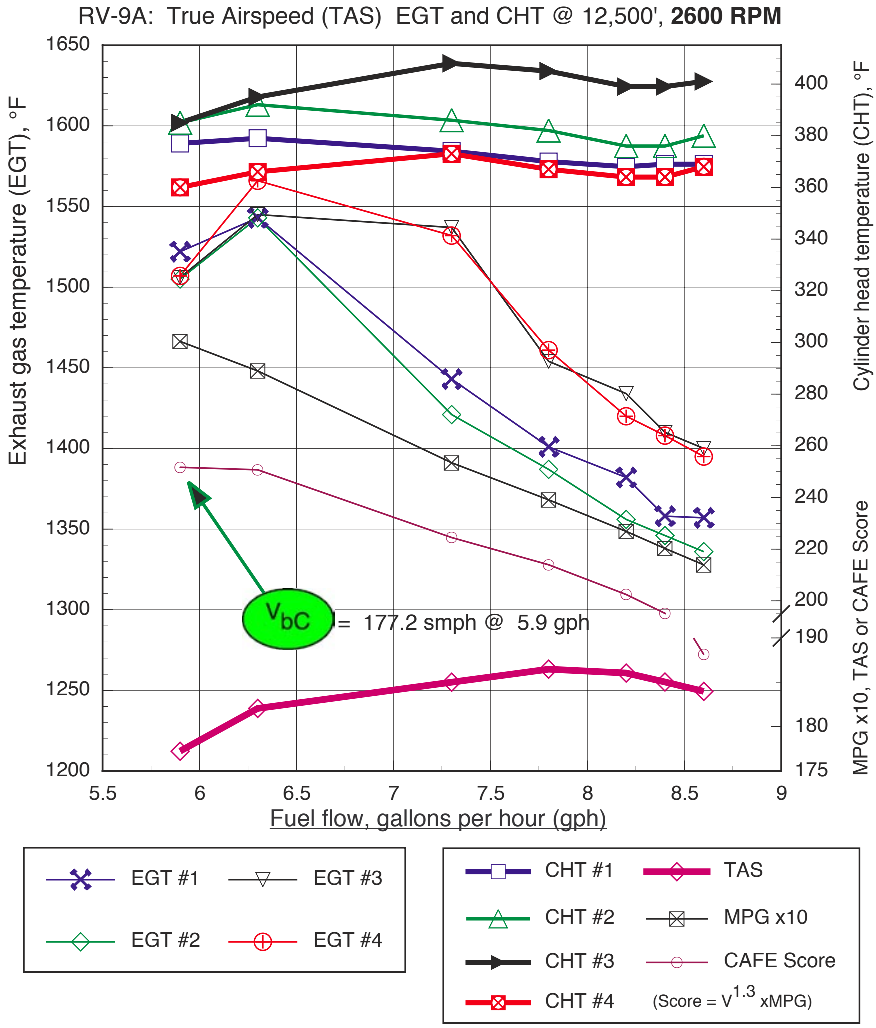
RV-9A N129RV, Sample c.g.

Sample center of gravity	Weight, lb	Arm*	Moment	c.g.
Main gear, empty	806.8	91.94	74177	
Nosewheel, empty	271.3	34.50	9358	
Pilot	170.0	94.08	15994	
Passenger	190.0	94.08	17875	
Fuel, 35.4 gallons, full	212.4	76.71	16293	
Oil, included 6.25 qt.	0.0	0.00	0	
Baggage, 100 lb. limit	100.0	123.51	12351	
TOTALS	1750.5		146048	83.43
Datum = 70" fwd of L.E.				
c.g. this sample:	83.4			
c.g. range, inches	6.89			
c.g. range, % MAC	15%-28%			
c.g., % aft of fwd limit	20%			
Gross weight, lb	1750.0			
Empty weight, lb	1078.1			
Useful load, lb	672.0			
Payload, lb, full fuel	459.6			
Fuel capacity, gallons*	35.4			
Fuel capacity, pounds*	212.40			
Empty weight c.g., inches	77.49			
c.g. range	77.95-84.84			
Main gear track	84.0			
Wheelbase	57.4			
*as determined by CAFE				

RV-9A N129RV: Speed Calibration

Panel IAS, smph	CAS (Baro #3)	Total error	Cabin Baro.stock pitot	Pitot-static error	Instrument error	Config.
60.0			49.5	na		Flaps down
63.0			52.0	na		Flaps down
65.0			54.9	na		Flaps down
70.0	61.4	8.6	61.7	0.3	8.3	Flaps up
75.0	66.2	8.8	68.7	2.5	6.3	" " "
80.0	71.4	8.6	73.2	1.8	6.8	" " "
85.0	76.3	8.7	78.0	1.7	7.0	" " "
90.0	80.5	9.5	82.9	2.4	7.1	" " "
95.0	87.0	8.0	89.2	2.2	5.8	" " "
100.0	91.6	8.4	94.1	2.5	5.9	" " "
105.0	96.1	8.9	99.1	3.0	5.9	" " "
115.0	105.5	9.5	108.7	3.2	6.4	" " "
120.0	109.4	10.6	113.2	3.8	6.8	" " "
125.0	113.1	11.9	117.1	4.0	8.0	" " "
130.0	118.3	11.7	122.3	4.0	7.7	" " "
135.0	122.3	12.7	126.4	4.1	8.6	" " "
140.0	129.0	11.0	133.6	4.6	6.4	" " "
145.0	136.4	8.6	141.3	4.9	3.7	" " "
150.0	142.4	7.6	147.5	5.1	2.5	" " "
155.0	147.5	7.5	152.5	5.0	2.5	" " "
160.0	154.4	5.6	159.5	5.1	0.5	" " "
165.0	160.7	4.3	166.1	5.4	-1.1	" " "
170.0	164.9	5.1	170.4	5.5	-0.4	" " "
175.0	169.3	5.7	175.3	6.0	-0.3	" " "
180.0	174.6	5.4	180.7	6.1	-0.7	" " "
185.0	175.2	9.8	181.4	6.2	3.7	" " "
190.0	183.2	6.8	189.8	6.6	0.2	" " "
195.0	189.1	5.9	196.3	7.2	-1.3	" " "
200.0	192.5	7.5	199.7	7.2	0.3	" " "

Pitot-static and Instrument errors are here determined by comparing CAS from the CAFE Barograph's gimbled pitot-static missile to the aircraft's instrument panel ASI and to a separate CAFE Barograph in the Cabin that shares the aircraft's stock pitot-static ports with the panel ASI.



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Below the family of CHT curves are the four EGT curves, with temperatures shown on the left vertical axis. Peak EGT occurs at 6.3 gph of fuel flow. The spread in EGT from cylinder to cylinder again reflects uneven mixture distribution, though not bad at 6.0 gph.

The peak CHT normally occurs at about 100° F rich of peak EGT and cools off at mixtures lean of peak EGT.

Below the four EGT curves, are the MPG and CAFE score, each rising almost linearly as the fuel flow is leaned. MPG peaks at about 30 MPG (bottom right vertical axis). V_{bC}, velocity for best CAFE score, is 177.2 mph at 5.9 gph.

True airspeed (TAS), the bottom curve, is shown to be highest at the higher fuel flows with rich of peak (ROP) EGT mixtures, but TAS falls only slightly at lean mixture settings.

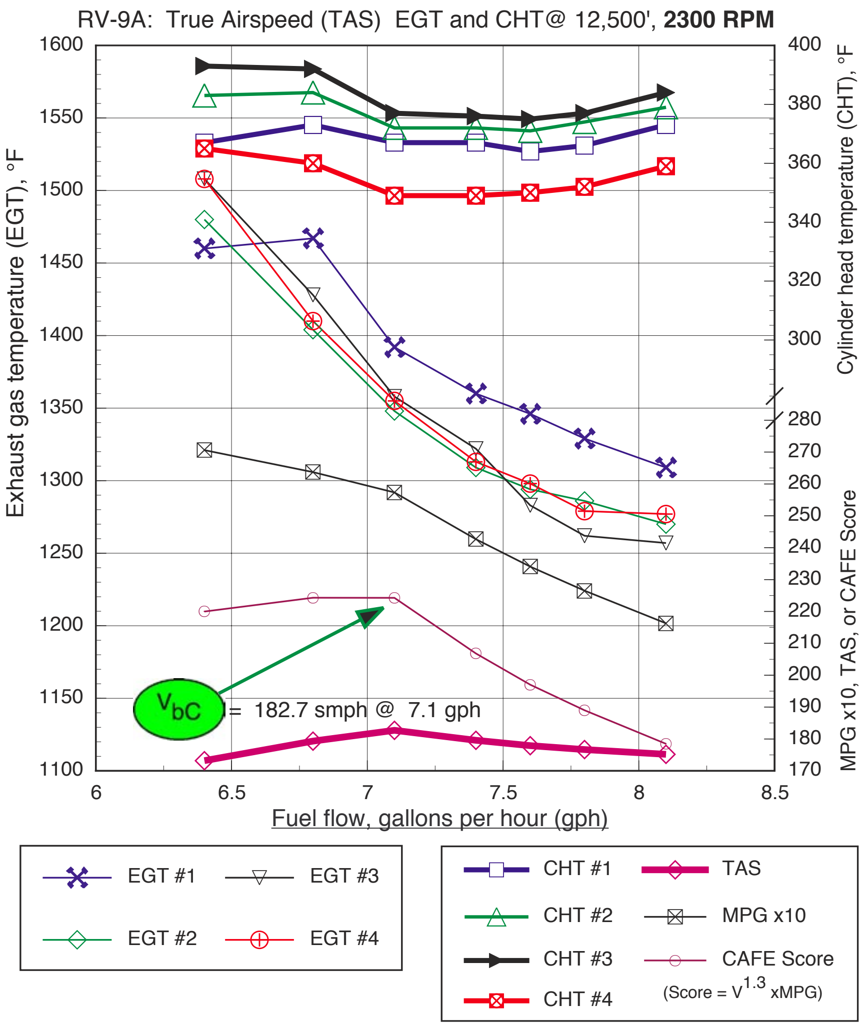
Co-pilot Bill Bourns operated the flight recorders on data flight #1.


C.J. Stephens, on wing, preflights N129RV.


Steve Williams installs the flight recorders.

Miscellaneous notes:

All flights except the 5th data flight were made by test pilot C.J. Stephens. The first two flights were subjective evaluations. The 1st Barograph data collection flight (3rd flight overall) was for calibrating the panel airspeed indicator and the pitot-static system and used both Cabin and Wing-mounted CAFE Barographs. The 2nd data flight used the Wing-mounted CAFE Barograph to collect the Vmax and cruise data. The 3rd data flight used only the Cabin Barograph and collected climb and descent rate data, takeoff distance, liftoff and touchdown speeds. and The 4th data flight measured cooling system ram recovery by water manometer. The 5th data flight was performed by Jim Reinemer and was made to determined the full flaps stall speed without wing cuffs.



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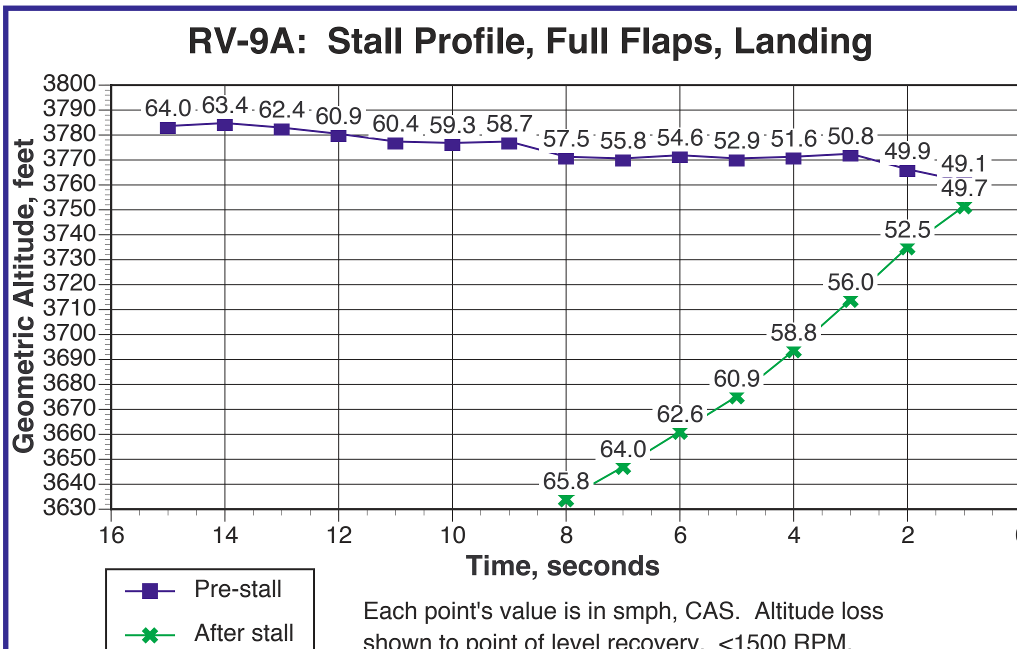
Below the family of CHT curves are the four EGT curves, with temperatures shown on the left vertical axis. Peak EGT occurs at 6.4 gph of fuel flow. The spread in EGT from cylinder to cylinder, though better than at 2600 RPM, again reflects uneven mixture distribution,. The peak CHT tends to occur rich of peak EGT (here at about 6.8 gph) and CHT tends to cool off at mixtures lean of peak EGT.

Below the four EGT curves, are the MPG and CAFE score, each rising as the fuel flow is leaned. MPG peaks at about 27 MPG (bottom right vertical axis). V_{bC}, velocity for best CAFE score, is 182.7 mph at 7.1 gph.

True airspeed (TAS), the bottom curve, is shown to be highest at the rich of peak (ROP) EGT mixture of 7.15 gph, but TAS and CAFE score fall only slightly at leaner mixture settings.

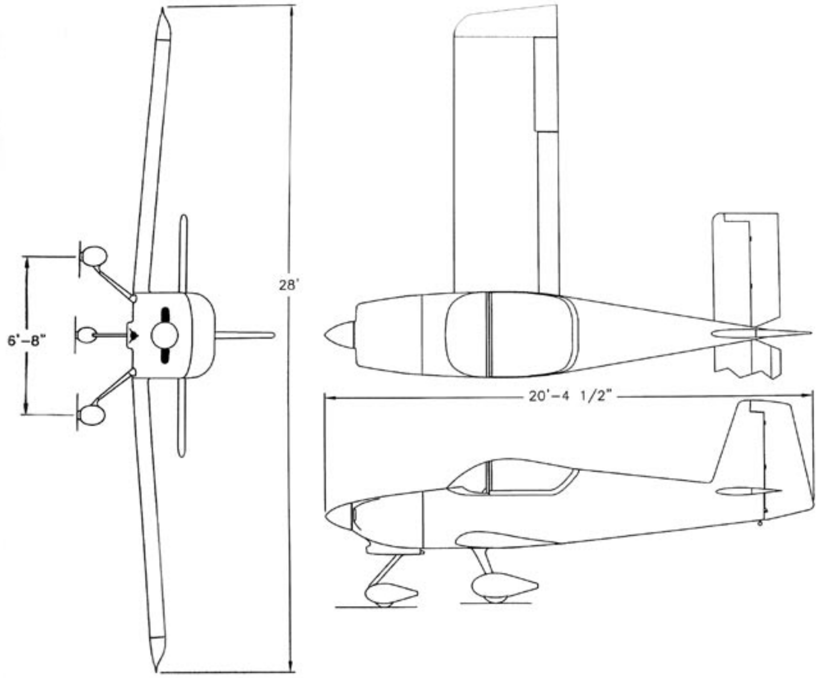


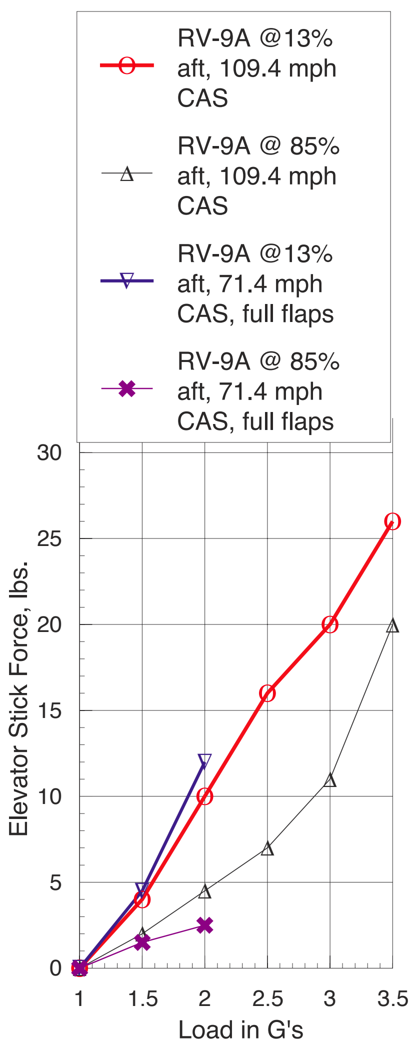
Each point's value is in smph, CAS. Altitude loss shown to point of level recovery. <1500 RPM.

HOW TO READ THE STALL PROFILE GRAPH

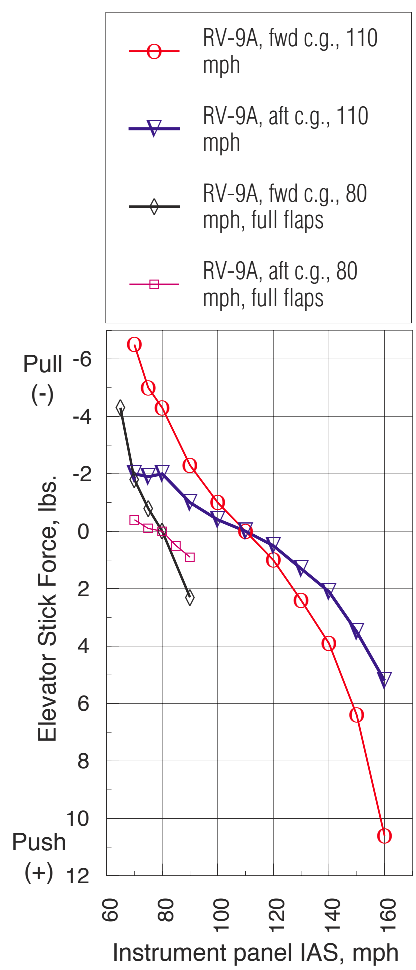
This graph shows the altitude profile during both deceleration to stall and re-acceleration after stall. Test pilot Jim Reinemer did a commendable job of holding the altitude nearly level while approaching the stall with close to the desired standard deceleration rate of 1 knot per second.

The aircraft only loses about 130 feet of altitude in this power off recovery. It must be emphasized that the altitude loss for a given aircraft after stall will vary widely according to piloting technique and the amount of power applied.





Maneuvering stability, flaps down.



Static longitudinal stability

Trimmed to zero pounds, stick- free, flaps up, near V_a.

(Note: 110 IAS = 101 CAS and 80 IAS = 71.4 CAS)

FLIGHT TEST DETAILS

All flights were made in day VFR conditions and with minimal level of turbulence.

A FlowScan 201A fuel flow transducer was used for the gph determinations and was calibrated by accurately measuring the weight of fuel burned on each flight. The takeoff weight and c.g. were measured prior to each flight. By subtracting fuel burn from known takeoff weight, the instantaneous weight of the aircraft is tabulated throughout the flight.

A PropTach digital tachometer was mounted on the top of the instrument panel and fed readings once per second to the flight data recorder. A Toshiba Toughbook laptop computer using CCT4C.c software was used to record the multi-channel flight data.

Flying qualities were evaluated using an analog G meter and a hand-held stick force gauge from Brooklyn Tool & Machine Co., Inc., N.J..

Cowl exit temperature (CXT) is a function of both OAT and CHT and serves as a key number for calculating the cooling system performance. Our measurement of cooling ram recovery uses both total pressure and piccolo static tubes inside the high pressure plenum of the cowl. The pressures from those tubes are recorded using a water manometer and the results are compared to the calculated freestream ram pressure.

The subjective evaluation flights were flown using the panel indicated airspeeds for V_a, V_x, V_y, V_f, and V_{ne} that were suggested by the aircraft owner. CAFE subsequently measured V_x and V_y by glide, climb and 'power required to maintain level flight' techniques. The glide and climb tests utilized geometric altitude rather than pressure or density altitude in order to keep them cross comparable from aircraft to aircraft. An average density altitude of 5500' for the climb segments meant that the rate of climb measured is well below that to be expected at sea level.

The level cruise performance values for the aircraft were recorded by CAFE Barograph #3, which, along with its pitot/static source, was calibrated to an accuracy of 0.1 mph in NASA's wind tunnel. Cruise speeds are selected only from runs in stable, non-turbulent conditions that were found to show steady total energy values, calculated as the sum of the aircraft's kinetic and potential energy.

The sum of the kinetic and potential energy, under constant power, trimmed level flight conditions, should remain nearly constant. If that sum is increasing, then atmospheric lift is likely to be occuring and the data is unsuitable. If total energy is decreasing, then the aircraft is likely flying through sinking air, again unsuitable data for our purposes.

All cruise speeds are corrected for the measured drag coefficient of the wing cuffs that attach the Barograph.

RV-9A N129RV	Start time	Seconds	Presalt., ft.	Geo alt.	Gain, ft.	Ave. Densalt.	Weight, lb	Panel IAS	CAS, mph	TAS, mph	ROC, fpm	Comment	X/Y	Climb angle, deg.
w.o.t., 2703 RPM, 26.0", 10.8	04:33:	60	3652	2467.8	1265.	5500.0	1736	90	82	88.3	1265.4	Vx best	6.1	9.4
w.o.t., 2703 RPM, 26.0", 10.8	04:42:	45	2709	2739.8	1011.	5500.0	1732	105	95	103.	1348.9	Vy	6.7	8.5
w.o.t., 2703 RPM, 26.0", 10.8	04:47:	48	2699	2715.1	1053.	5500.0	1728	100	90	97.7	1316.8	Below	6.5	8.8
w.o.t., 2703 RPM, 26.0", 10.8	04:54:	40	2687	2707.4	855.6	5500.0	1724	95	85	92.3	1283.4	Near Vx	6.2	9.1
w.o.t., 2703 RPM, 26.0", 10.8	05:00:	49	2621	2623.9	1073.	5500.0	1721	110	100	108.	1314.5	Above	7.2	7.9
w.o.t., 2703 RPM, 26.0", 10.8	04:18:	30	1098	1043.7	658.5	2800.0	1747	107	98	106.	1317.0	T.	7.0	8.1
20.1", 2703 RPM, 9.0 gph,	01:58:	30	9520	10004.	384.8	11800.	1729	104	95	114.	769.6	High	13.0	4.4
w.o.t. = wide open throttle														
Glides made during Data Flight #3:	**Start**	**Second**	**Presalt.,**	**Geo alt.**	**Loss, ft.**	**Densalt.**	**Weigh**	**Panel**	**CAS**	**TAS**	**Sink rate**	**Comment**	**Glide**	**Glide angle**
Coarse pitch, 1250 RPM, 5.2",	04:30:	80	3696	3796.2	-	5500.0	1738	105	95	103.	751.7	near Vy	12.0	4.8
Coarse pitch, 1250 RPM, 5.2",	04:36:	113	4037	4157.5	-	5500.0	1735	100	90	97.4	736.8		11.6	4.9
Coarse pitch, 1230 RPM, 5.2",	04:44:	110	3958	4062.4	-	5500.0	1730	90	80	86.8	692.6		11.0	5.2
Coarse pitch, 1200 RPM, 5.4",	04:50:	130	4088	4192.1	-	5500.0	1725	85	75	81.7	664.2	?Vx	10.8	5.3
Coarse pitch, 1180 RPM, 5.8",	04:57:	96	3793	3870.4	-	5500.0	1722	80	70	76.0	701.1		9.5	6.0

ROLL RATE, deg./second, includes input time

	Va	1.3 Vso
RV-9A N129RV	53 Rt./ 61 Lt.	40 Rt./ 42 Lt.^^
Lancair IVP N114L	79 Rt./ 90 Lt.	70 Rt./ 56 Lt.
RV-8A N58VA	109 Rt./102 Lt.	78 Rt./80 Lt. ++
Cessna 152	47	34
RANS S-7C	61 Rt./63 Lt.	50 Rt./53 Lt.
GlaStar	52 Rt./50 Lt.	47 Rt./43 Lt.
^^full flaps, 71.4 mph		
++ full flaps, 80 mph		

Stall Speeds, RV-9A N129RV

Flight/Date	Data clock	Mode	MP/RPM	Weight, lb	CAS, mph	CAS, kts
#4--8/21/02	06:44:07 PM	clean	na	1759	58.16	50.5
#4--8/21/02	06:47:20 PM	full flaps	12/1800	1758	49.08	42.6

RV-9A N129RV Cruise Data: All True Airspeeds Corrected For Wing Cuff Drag

Clock	CAS	Densalt., ft.	TAS	M.P., in.	RPM	GPH	MPG	Wt, lb.	Range, miles	CAFE score	Endur., hrs.	Oil temp	CHT 1	CHT 2	CHT 3	CHT 4	EGT 1	EGT 2	EGT 3	EGT 4	CXT	Comment	Peak EGT, cyl#4
03:05:04 PM	187.1	1828.9	192.2	28.5	2708	14.0	13.7	1682	417	12.8	2.2	170	375	406	408	369	1511	1495	1565	1588	91	Vmax run @ 1100'	
04:28:27 PM	173.7	6525.6	191.5	25.9	2698	10.7	17.9	1739	544	16.6	2.8	206	408	417	424	399	1499	1461	1527	1520	122	No cuffs	
02:10:43 PM	152.8	12529.7	185.0	20.0	2604	8.4	22.0	1720	670	19.5	3.6	198	369	376	399	364	1358	1346	1410	1408	100	12.5K rich	
02:11:10 PM	153.6	12531.7	186.1	20.0	2602	8.2	22.7	1720	690	20.2	3.7	197	368	376	399	364	1382	1356	1434	1420	100	12.5K rich	
02:12:36 PM	153.9	12546.0	186.5	20.0	2599	7.8	23.9	1718	727	21.4	3.9	196	370	382	405	367	1401	1387	1454	1461	100	12.5K rich	
02:13:32 PM	152.8	12520.7	185.0	20.0	2596	7.3	25.3	1718	770	22.5	4.2	196	374	386	408	373	1443	1421	1537	1532	102	12.5K rich	
02:14:33 PM	150.3	12542.9	182.1	20.0	2596	6.3	28.9	1717	879	25.1	4.8	197	379	392	395	366	1543	1543	1545	1566	108	12.5K peak	1566
02:15:03 PM	146.3	12529.1	177.2	20.0	2597	5.9	30.0	1717	913	25.2	5.2	197	377	385	385	360	1522	1505	1506	1507	108	12.5K lean	
02:17:32 PM	145.8	12554.1	176.7	20.0	2306	7.8	22.7	1715	689	18.9	3.9	194	366	374	377	352	1329	1286	1262	1279	97	12.5K rich	
02:18:22 PM	147.0	12492.8	177.9	20.0	2297	7.6	23.4	1714	712	19.7	4	192	364	371	375	350	1346	1294	1283	1298	95	12.5K rich	
02:19:17 PM	148.3	12511.4	179.6	20.1	2300	7.4	24.3	1714	738	20.7	4.1	190	367	372	376	349	1360	1309	1322	1313	94	12.5K rich	
02:20:16 PM	150.8	12548.8	182.7	20.1	2298	7.1	25.7	1713	782	22.4	4.3	188	367	372	377	349	1392	1348	1358	1355	94	12.5K rich	
02:21:58 PM	148.2	12464.8	179.3	20.1	2294	6.8	26.4	1712	802	22.4	4.5	188	373	384	392	360	1467	1404	1428	1410	97	12.5K rich	
02:22:47 PM	143.0	12514.2	173.2	20.0	2293	6.4	27.1	1711	823	22	4.8	188	367	383	393	365	1460	1480	1508	1508	99	12.5K peak	1508
02:31:25 PM	168.7	8530.4	191.9	23.6	2604	9.8	19.6	1704	595	18.2	3.1	190	383	399	405	374	1465	1425	1485	1473	109	8.5K rich	
02:31:59 PM	169.5	8509.7	192.8	23.7	2605	9.7	19.9	1703	604	18.6	3.1	194	386	402	408	376	1494	1459	1514	1499	110	8.5K rich	
02:32:41 PM	168.5	8489.2	191.5	23.7	2605	9.1	21.0	1703	640	19.5	3.3	196	388	403	411	379	1529	1499	1560	1540	112	8.5K rich	
02:33:22 PM	165.5	8507.7	188.1	23.7	2605	7.5	25.1	1702	762	22.7	4.1	199	391	406	407	379	1589	1565	1565	1594	115	8.5K peak	1594
02:33:50 PM	158.0	8499.3	179.6	23.6	2603	6.1	29.4	1702	895	25.1	5	201	386	398	387	370	1518	1512	1536	1519	115	8.5K lean	
02:41:49 PM	162.8	8616.6	185.4	23.6	2294	7.9	23.5	1695	713	20.8	3.8	195	381	386	395	366	1425	1400	1392	1408	110	8.5K rich	
02:42:35 PM	162.9	8603.5	185.4	23.6	2295	7.7	24.1	1695	732	21.4	3.9	195	383	379	397	371	1436	1405	1407	1423	110	8.5K rich	
02:43:55 PM	161.4	8613.6	183.8	23.6	2295	7.3	25.2	1694	765	22.1	4.2	195	391	400	407	374	1495	1466	1453	1467	112	8.5K rich	
02:44:33 PM	160.7	8603.4	182.9	23.6	2291	6.7	27.3	1693	830	23.8	4.5	196	382	396	408	377	1515	1530	1543	1538	112	8.5K peak	1538
02:48:51 PM	89.4	8545.5	101.7	13.0	1800	5.9	17.2	1691	524	7	5.2	197	345	345	353	334	1280	1282	1311	1305	118	Vy cruise	

Conditions: CAFE Barograph #3, data flight #2 with wing cuffs. Dew pt 12°C/Temp 21°C. Wing cuff drag = 4.9 smph @ 192.23 smph TAS. All temps in °F. Relative CAFE score = TAS^1.3 x MPG/1000. Range and Endurance calculations assume 5 gallon 30 minute reserve and fuel capacity of 35.4 gallons.. CHT's corrected to a 100°F day. CXT = cowl exit air temperature, °F. Total energy calc used to select valid data. "No cuffs" applies only to Triaviathon Vmax data run at 6525.6' densalt.

KIT SUPPLIER	OWNER/BUILDER N129RV
Van's Aircraft, Inc.	Van's Aircraft, Inc.
14401 NE Keil Rd. Aurora, OR 97002	14401 NE Keil Rd. Aurora, OR 97002
503-678-6545 voice	503-678-6545 voice
FAX 503-678-6560 www.vansaircraft.com	FAX 503-678-6560 www.vansaircraft.com

DESIGNER'S INFORMATION

Cost of QuickBuild kit wihtout engine or prop	$25,025
Cost of engine/cost of prop, each new	$21,330/ $5,100
RV-9/9A kits completed to date	68
Estimated hours to build, QuickBuild	500-800 hrs
RV-9A, N129RV ser #2, prototype first flew, date	June 15, 2000
Normal empty weight per factory, 160 BHP	1057 lb
Design gross weight, per factory	1750 lb
Recommended engine:	Lycoming 118 - 160 BHP
Advice to builders:	Keep it light, use the
	recommended engines

SPECIFICATIONS, N129RV

Wingspan	27 ft 11 in
Wing chord, root/tip	53.375 in/ 53.375 in
Wing area	123.67 sq ft
Wing loading dl	14.11 lb/sq ft
Power loading	10.94 lb/BHP
Span loading	62.7 lb/ft
Wetted area fuselage/wing/hor./vert./total	na
Airfoil, main wing, CL max.	2.3
Airfoil, design lift coefficient	.35
Airfoil, thickness to chord ratio	15%
Aspect ratio, span^2/sq ft of wing area	6.34
Wing incidence	0.66°
Thrust line incidence, crankshaft	0.0° nose down
Wing dihedral	3.5° per side
Wing taper ratio, root to tip	1.0
Wing twist or washout	none
Wing sweep	0
Steering	castering nose wheel
Landing gear	tricycle, steel spring
Horizontal stab: span/area	10 ft 4.375 in/ 29.4 sq ft
Horizontal stab: chord, root/tip	34 in/ 34 in
Elevator: total span/area	57 in/ 5.84 sq ft
Elevator chord: root/tip	14.75 in
Vertical stab: section/area incl. rudder	42.875 in/ 6.1 sq ft
Vertical stabilizer chord: average	20.5 in
Rudder: ave. span/area	56 in/ 7.5 sq ft
Rudder: chord, average	19.25 in
Ailerons: span/average chord, each	48 in/ 11.625 in
Flaps: span/chord, each	81.5 in/ 9.875 in
Flaps: max deflection angle, up/down	na
Tail incidence	0.0°
Total length	20 ft 8.75 in
Height, static with full fuel	7 ft 10 in
Minimum turning circle on ramp	16 ft 5.5 in
Main gear track	84 in
Wheelbase, nosewheel to main gear	57.44 in
Acceleration limits	+3.8 and (-)1.5 at GW
	+4.4 and (-) 2.2 at < 1650 lb
AIRSPEEDS AS MEASURED BY CAFE: smph/kts, CAS	
Best rate of climb, V_y	95 smph/82.5 kt
Best angle of climb, V_x	82 smph/71.2 kt
Stall, clean, 1759 lb, V_{s1}	58.16 smph/50.5 kt
Stall, full flaps, 1758 lb, V_{s0}	49.08 smph/42.6 kt
CL max, at 49.08 mph stall	2.3
AIRSPEEDS PER OWNER'S P.O.H., smph, Panel IAS	
Never exceed, V_{ne}	210 smph/182.3 kt
Maneuvering, V_a	118 smph/102.4 kt
Flap extension speed, V_f	90 smph/78.1 kt
Gear operation/extension, V_{ge}	na

SPECIFICATIONS, N129RV

Empty weight/gross wt.,	1078.05 lb/ 1750 lb
Payload, full fuel	459.6 lb
Useful load	671.95 lb
ENGINE:	
Engine make, model	Lyc. O-320 D3G
Engine horsepower	160 BHP
Engine TBO/compression ratio	2000 hr./8.5
Engine RPM, maximum	2700 RPM
Man. Pressure, maximum	30 in
Cyl head temp., maximum	475° F
Oil pressure, normal operating range	55-95 psi
Oil temp., operating, maximum	245° F
Fuel pressure range, pump inlet	0.5-8.0 psi
Induction system	Marvel Schebler MA-45 SPA carb
Induction inlet area	5.2 sq in
Exhaust system	4 into 2, crossover
ave. header/collector lengths	na
Oil capacity, type	8 quarts
Ignition system	Dual Slick magneto, #4371 and 4370
Cooling system	dual pitot inlets
Cooling inlet area	6.5x3.5 in each (45.5 sq in)
Cooling outlet area	fixed, 42.45 sq in
PROPELLER:	
Make, model	MTV-12-C/180-119d, 3 blades
Material	wood, graphite with metal leading edge
Diameter	71 in
Prop extension, length	same as std. Hartzell
Prop ground clearance, empty of fuel	na
Spinner diameter/length	13 in x 15.25 in long
Electrical system	Alternator, 35 amp Nippondenso
Fuel system	R/L wing tanks, selector, elect + mech pumps
Fuel type	91/96 or 100LL
Fuel capacity, by CAFE Scales	35.4 gal
Fuel unusable	near zero
Braking system	Cleveland discs, Matco master cyl.
Flight control system	push/pull rods excepting cable rudder, 2 sticks
Hydraulic system	na
Tire size, main/nose	5:00 x 5 main/ Lamb nosetire
CABIN DIMENSIONS:	
Seats	2, side by side, baggage behind seats
Cabin entry	canopy slides back
Width at hips	41 in
Width at elbows	42.5 in
Width at shoulders	43 in
Height, seat pan to canopy, torso axis	41 in
Legroom, rudder pedal to seatback*	47.5-51 in
Baggage dimen. to height of seatback	na
Baggage weight limit	100 lb
Liftover height to baggage area	na
Step-up height to wing T.E.	a step is provided on each side
*builder selects this fixed dimension	
Demonstrated maneuvers:	standard category, no aerobatics
Equipment list:	
Oil cooler:	Aero Classics LTD 8000075
Governor:	Woodward B210 776A
Starter:	Sky-Tec 149-12LSX 12V. 12/14 pitch
Vacuum pump:	none
Engine instruments:	analog
Strobes:	Whelen Double Flash
Shoulder harnesses:	yes
Battery:	Hawker Energy Odyssey PC-680
Radios:	
Apollo SL60/map GPS/Comm	
Apollo SL70 transponder	
Flightcom 403 intercom	
Flight instruments:	
TAS indicator	
Electric turn coordinator	
Compass	
VSI, altimeter.	