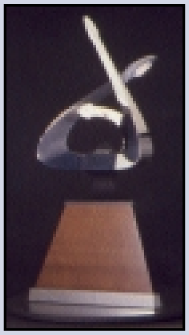
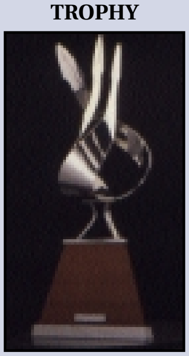


TRIAVIATHON TROPHY

CHALLENGE TROPHY



CAFE FOUNDATION
AIRCRAFT PERFORMANCE REPORT

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

RANS S-7C

BY JO DEMPSEY, BRIEN SEELEY, OTIS HOLT AND THE CAFE BOARD

This report on the two-place tail dragger known as the Courier, or RANS S-7C, includes the achievement of some new firsts in the EAA/CAFE Foundation Aircraft Performance Report flight testing program. This was the first time that we have tested an aircraft built by its kit manufacturer. It also had the lowest horsepower, lightest weight, slowest stall speed, and shortest takeoff distance of any aircraft yet investigated by our team.

During the 1997 EAA Convention in Oshkosh Brien Seeley stopped by the RANS exhibit and presented Mike Stevens, chief engineer of the RANS company, with an information kit describing the CAFE flight test program. He subsequently called Brien and arranged for the weekend of test flying the Courier.

Mike flew the S-7C Courier out to our facility from the RANS factory in Hays, Kansas in early November. Randy Schlitter, designer, builder and owner of RANS flew along in a Coyote II, which provided us with a look at a RANS side-by-side design aircraft.

Randy started his company in 1974 with the production of sail trikes using aircraft materials. In 1983 he built and flew his first ultra light, which looked like an airplane, (based on the Coyote). His first airplane design was the Coyote, followed by the RANS S-7 in July, 1985.

The S-7C is among nine models of aircraft that RANS produces, and although not the most popular of the designs (approximately 1100 Coyote II's are flying), there are about 300 Couriers flying in a variety of uses - on floats, as tow planes, spray planes, border patrol and sport aviation planes. Because it is an inexpensive kit to build it is quite popular overseas.

The aircraft we tested, N11632, first flew a year ago. The cost of the kit is $16,300 which includes the Rotax 582, 65 horsepower, liquid-cooled engine with dual CDI ignition, and some instruments. The builder would probably spend $2500 to $3000 more for paint and other options to

KIT SUPPLIER

RANS, Inc.
4600 HWY 183 Alt.
Hays, KS. 67601
785-625-6346 FAX: 785-625-2795

OWNER/BUILDER N11632

RANS, Inc.
4600 HWY 183 Alt.
Hays, KS. 67601
785-625-6346 FAX: 785-625-2795

DESIGNER'S INFORMATION

Cost of basic kit	**$16.300**
Kits sold to date	**300**
Number completed	**270**
Estimated hours to build, from prefab kits	**500-700**
Prototype first flew, date	**1985**
Normal empty weight, with 912 Rotax	**690 lb**
Design gross weight, with 912 Rotax	**1200 lb**
Recommended engine(s)	**Bombardier/Rotax 912 UL, 80 hp**
Advice to builders:	**Keep it light, build it like the book, and read the factory newsletter updates.**

CAFE FOUNDATION DATA, N11632

Wingspan	**29 ft 4 in**
Wing chord	**62 in**
Wing area	**147.1 sq ft**
Wing loading, 1200 lb/147.1 sq ft	**8.16 lb/sq ft**
Power loading	**15 lb/hp**
Span loading,	**40.9 lb/ft**
Airfoil, main wing	**S-7C-96**
Airfoil, design lift coefficient	**0.24**
Airfoil, thickness to chord ratio	**12.8 %**
Aspect ratio, span^2/ sq ft wing area	**5.84**
Wing incidence	**+2.5°**
Thrust line incidence, crankshaft	**0.0°**
Wing dihedral	**3°, (1.5° per side)**
Wing taper ratio, root/tip	**.938**
Wing twist or washout	**0.3°**
Wing sweep	**0°**
Steering	**steerable tail wheel, with free swivel cam**
Landing gear	**fixed with tailwheel**
Horizontal stab: span/area/AR	**108.5 in/25 sq ft/3.3**
Horizontal stabilator chord, root, tip	**45 in/23 in**
Elevator: total span/area	**102 in/11 sq ft**
Elevator chord: root/tip	**18 in/10 in**
Vertical stabilizer: span/area incl. rudder	**54 in/13 sq ft**
Vertical stabilizer ave. chord/AR	**36 in/1.603**
Rudder: average span/area	**54 in/6.63 sq ft**
Rudder chord: bottom/ top	**24 in/10 in**
Ailerons: span/average chord, each	**67 in/9 in**
Flaps: span/chord, each	**90 in/11 in**
Tail incidence	**-1.0°**
Total length	**21.19 ft**
Height, static with full fuel	**96.4 in**
Minimum turning circle	**33 ft**
Main gear track	**69 in**
Wheelbase, nosewheel to main gear	**see Sample c.g.'s**
Acceleration Limits	**+4/-2.0 at gross weight**
AIRSPEEDS PER OWNER'S P.O.H., CAS	
Never exceed, V_{ne}	**113.7/131 kt/ mph**
Maneuvering, V_a	**84.4/97.2 kt/ mph**
Best rate of climb, V_y*	**53/61 kt/ mph**
Best angle of climb, V_x*	**41.7/48 kt/mph**
Stall, clean$_s$	**46 mph**
Stall, dirty,	**41 mph**
Flap Speed, full 36°, V_f	**59.9/69 kt/mph**

* Using "Computing Airplane Performance with the Bootstrap Approach" by John T. Lowry Ph.D

complete the project. The larger, four-stroke Rotax 912 engine of 80 horsepower comes as a $7370 extra cost option, and was the engine used in N11632.

CONSTRUCTION

The fuselage, tail group and spring steel, tapered rod landing gear is constructed of 4130 pre-welded steel tubing. A plasma miter machine is used to orient, cut and miter each tube end to length. The kit comes "raw" with the option to oil the interior or epoxy prime the steel tubing of the fuselage. The wings - struts, spars, ribs, stampings and other wing components are either anodized or aluminum clad.

The construction is fairly standard apart from the wings. The wing design departs from tradition by employing the "ladder wing" which consists of two aluminum tubes drilled very accurately on the computer drill machine with holes located for rib attachments. All hardware that bolts to it for strut attachments and wing channels to hold anti-drag and compression tubes are anodized and require no primer.

The aluminum ribs are round pre-curved tubes that come with stampings to hold them together. The kit also comes with a jig so that the builder can pre-build all ribs. They can then be dropped into the pre-drilled locations. The brackets are also pre-drilled.

Holes can be pre-drilled for pop-riveting the skin to the ribs, or spiral-wrap rib lacing can be used to hold the fabric to the rib.

If the builder chooses to pop-rivet the fabric on, strips of Lexan sheared to width and the pop rivets would be included in the kit. The clear Lexan is used as a thickener along the ribs through which the holes can be easily seen for drilling. After the pop rivet is in place, surface tape is applied.

Although builders may feel that working with fabric is at first a daunting proposition, with the help of technical counselors at EAA chapters and other available experts they should become proficient at it with a little practice. A good coat of primer, sanding and a top coat of paint is all that is needed for UV protection of the fabric. The most labor intensive process of multiple layers of dope on fabric is not necessary, according to Schlitter.

He also claims that the time required to build this kit is among the lowest. The literature claims a build time of 500 to 700 hours; but a builder might spend up to 1000 hours on this project.

Mike Stevens, RANS chief engineer originally came from Canada. He studied aeronautical and mechanical engineering technology at Embry-Riddle University in Florida where he earned his Bachelors and Masters degrees.

RANS S-7C, N11632

Estimated Cost: $ 33,000 total cost including materials, engine, prop, interior, instruments and radios.
Hours to build: 800 hr.
Completion date: December 1996

SPECIFICATIONS

Empty weight, gross wt.	698.9 lb with oil
Payload, full fuel	385.5 lb
Useful load	501.1 lb
ENGINE:	
Engine make, model	Rotax 912 UL
Engine horsepower	80 BHP
Engine TBO	1200 hr
Engine RPM, maximum	5800 RPM
Man. Pressure, maximum	29.5 in Hg
Turbine inlet, maximum	na
Cyl head temp., maximum	300° F
Oil pressure range	22-104 psi
Oil temp., maximum	285° F
Fuel pressure range, pump inlet	5.8 psi
Induction system	dual carb
Induction inlet area	4 sq in
Exhaust system	na
Oil capacity, type	2.5 qt. Mobil One
Ignition system	dual breakerless CDI, RF suppression
Cooling system	hybrid, water to heads, air to cyl barrels
Cooling inlet area	32
Cooling outlet area	84 sq in (stock cowl)
PROPELLER:	
Make	Warp Drive
Material	carbon fiber/aluminum
Diameter	72 in
Model	Model RT-2, 2 blades
Prop extension, length	1.5 in
Prop ground clearance, level/tail low	8.1 in/21 in
Spinner diameter	12 in
Electrical system	12V
Fuel system	2 wing tanks, gravity feed, eng-driven pump, 2 carbs
Fuel type	100 LL or premium grade autogas
Fuel capacity, by CAFE scales	19.26 gal
Fuel unusable	1 gallon
Braking system	Cleveland cylinders, Matco wheels/discs
Flight control system	aileron + rudder by cable, push-pull elevator
Hydraulic system	na
Tire size, main/tail	6.00x6 (6 PR) mains/solid tailwheel of 6 in diam.
CABIN DIMENSIONS:	
Seats	2
Cabin entry	top-hinged doors each side
Width at hips	24.5 in
Width at shoulders	26.5 in
Height, seat to frame tubes above	36 in
Baggage capacity, rear cabin	50 lb
Baggage door size	14x17 in opening above seatback
Lift over height to baggage area	42.5 in
Step-up height to wing T.E.	na
Approved maneuvers:	non-aerobatic except for spins

DESIGNER'S COMMENTS

Randy foresees new pilots getting interested in flying tail draggers and many learning on the S-7C. He describes his view of the S-7C as follows:

"Among tail draggers it is a 'medium' one — good for training. A pilot could learn the nuances of tail dragger flying from this plane. But the high deck angle makes it more difficult to make three-point landings with finesse every time. The high deck angle is needed to make such short field landings as are possible in this design; so the pilot needs to learn how long the 'legs' are in order to plant the three-pointer perfectly. Typical owners rely on wheel-landings until proficiency with the full stall landing is achieved."

The RANS company considers itself a "green" company. They don't like to waste materials, time or people. Randy believes in "squaring in the reverse" - making planes more efficient by taking off drag through weight reduction, fine-tuning power plants, optimizing wing areas and power plants rather than succumbing to adding more power. He believes that "doing more with less" is the way of the world and the future. This philosophy is incorporated in all of Randy's aircraft designs and should make anyone who builds one of his kits feel as though they are taking part in the future of general aviation.

We thoroughly enjoyed working with Randy and Mike during the testing. Their preparations and product information were very complete and well-documented. They were also dedicated helpers during the preparations and launching of the flights, working late into the night with the CAFE team."

FUTURE

At this point RANS produces one aircraft a week. But when the S-7C Courier receives certification for factory production of the aircraft, possibly two planes will roll off the assembly line per week. RANS just spent 1.3 million dollars to expand their operation at the Hays Municipal Airport and would have to employ more than the seventy current employees if the Courier becomes certified. This could push production up to 1 1/2 aircraft per day.

FLIGHT TEST DETAILS

Four flights were made over the course of 3 days in November 1997, during a stable high pressure system with good visibilities and minimal turbulence. The flights were made solo at approx. 100 pounds below gross weight. The empty weight of the aircraft, 698.9 pounds, was the lowest of any aircraft yet tested. A FlowScan fuel flow transducer was used for the gph determinations and was calibrated by measuring the weight of fuel burned on each flight.

Cruise flight data using the cabin Barograph (#1) was corrected to TAS using the airspeed correction table shown here. Our data suggest that Vy is 66 mph and Vx is 50 mph, CAS. The stalls were performed power off at 1 g in level flight using less than 12" of M.P. after a 1 mph per second deceleration.

The takeoff distance test was flown by Randy Schlitter.

C.J. Stephens shows the Courier's profile in a high speed pass.

Randy Schlitter, (left), congratulates Otis Holt, CAFE Test Pilot, on the successful completion of the flying qualities evaluation of the Courier.

Steve Williams downloads the flight data from the cabin Barograph to the laptop computer.

ABOUT THE OWNER

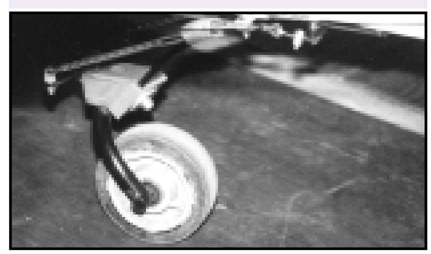
Randy Schlitter grew up in the Russell and Hays areas of Kansas where flying has always been a part of his life. His dad ran two airports and was a spray pilot who would buy airplane wrecks and repair them. Randy would crawl around inside the wrecks, fascinated with the intricate details under the skin. Randy's dad took him flying all over the country.

At age thirteen he made a 'lifting body' in his garage after a NASA design he had seen. Two and a half years later he towed it down the runway at Hays Airport with enough weight in it to simulate himself. He controlled it remotely with curtain rods and pulleys in the back of the tow vehicle.

After the 'lifting body' developed an oscillation and became damaged his dad told him to "Dismantle that thing and I'll teach you about real airplanes." He was taught how to regap plugs and polish planes. Any questions he had about dihedral or angles of incidence fell on deaf ears and all of his aerodynamics was self taught.

Randy soloed at sixteen and earned his Private Certificate at age twenty. After earning his A & P he worked as an aircraft mechanic for awhile before realizing that he'd rather design his own aircraft than work on current production aircrafts' design flaws. He vowed that if he ever built an airplane it would be easy to work on!

The work week for Randy consists of demo flights, talking to folks about his aircraft and keeping a hand in the production end of the company out in the factory. Every night he draws and works at new designs and improvements on his existing designs. He'd prefer to devote all of his work time to product development. Outside time is devoted to his wife Paula and his four creative sons - one of whom is already a pilot.



SUBJECTIVE EVALUATION
RANS COURIER S-7C, N11632

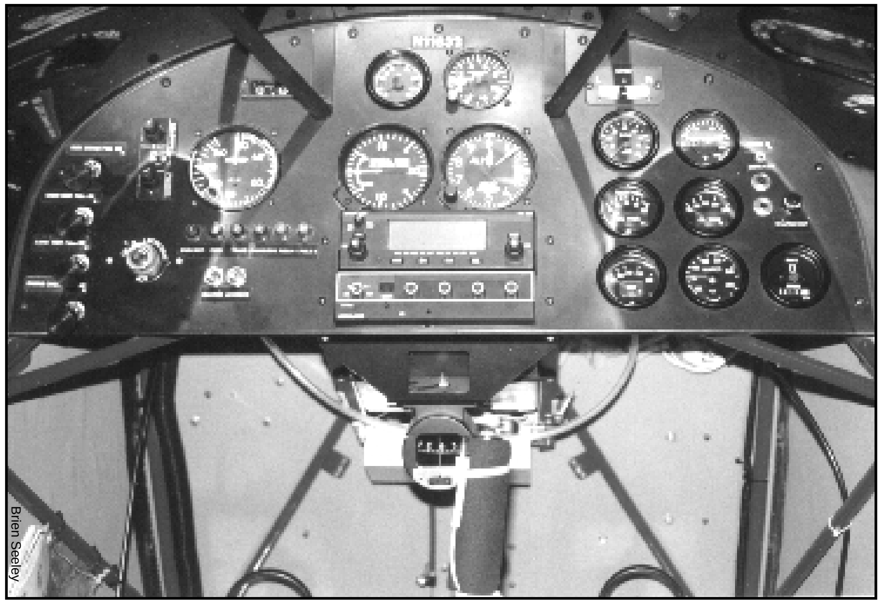
by Otis Holt
CAFE Test Pilot

The RANS Courier S-7C is the first aircraft from the lighter, slower end of the spectrum to be the subject of a CAFE Foundation APR and, as such, it provided my first opportunity to serve as primary test pilot. In spite of knowing how much time and effort CAFE chief test pilot C.J. Stephens expends on these reports, very little arm-twisting was needed when it was suggested that I take on the project. I'd been under C.J.'s tutelage for some time, by going along for the ride during many of his subjective evaluation flights and serving as flight engineer on nearly all CAFE performance data flights. Perhaps my mid-range pilot experience (about 1,200 hrs. total/200 hrs. tailwheel) would even be a plus, putting me a bit closer to the group of pilots likely to fly the Courier.

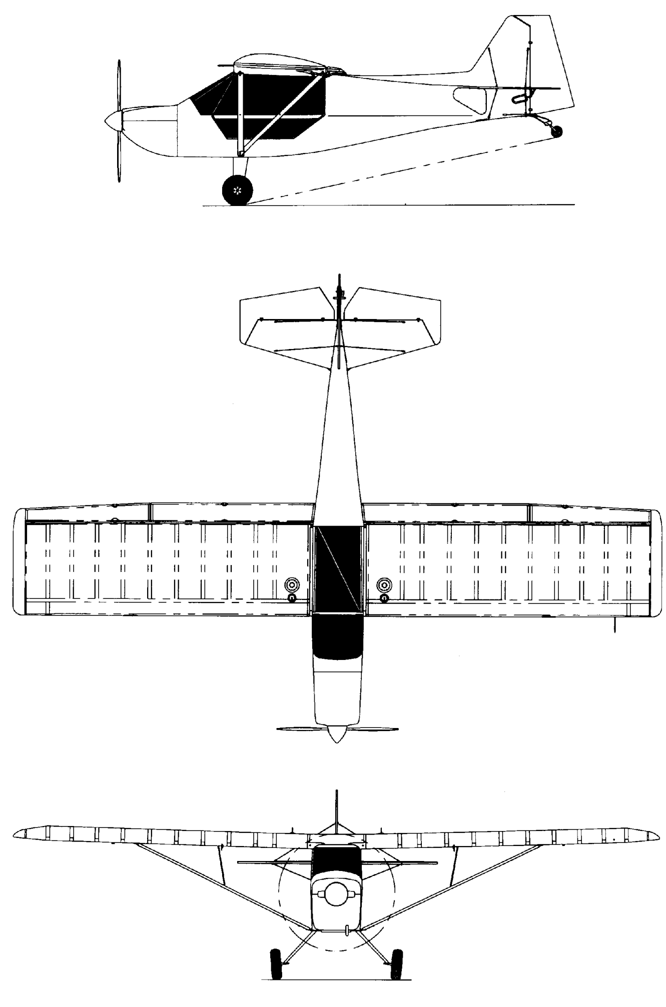
FIRST IMPRESSIONS

Within moments of its arrival at the CAFE Flight Test Facility it became clear to me that the RANS Courier S-7C is a very well thought out design, and my respect for Mr. Schlitter's work began to grow. At first glance, the Courier could be mistaken for a slightly scaled-down Citabria, and it is to the designer's credit that he has adopted all the time-proven advantages of that configuration, while incorporating modern materials, techniques and innovations. The result is an aircraft having similar performance and useful load to that of a Citabria, but with an empty weight nearly 40% lower, and far lower operating costs.

My first impression of N11632 was that it was a very straight, well built aircraft that had gone together as it was intended to, without a lot of tweaking on the part of the builders. The designer credits this in large part to RANS' extensive use of Computer Numerically Controlled (CNC) technology to form, punch, cut, drill, or machine most of the parts on the aircraft. The S-7 has been offered in kit form for many years, with more than 200 flying, but N11632 is the somewhat modified factory prototype, designated "S-7C", of the version intended for FAA certification. Even so, it could be proudly displayed on any showroom floor as-is. The finish of all parts was excellent, with mig-welded steel assemblies powder-coated, exposed aluminum parts satin anodized, and a well executed but light-weight finish on all fabric surfaces.



The first thing that caught my eye while looking for features which set the S-7C apart from its venerable tandem ancestors was the absence of cowl cheeks. The Rotax 912 power plant is



so slender that the cowl is the narrowest part of the forward fuselage, allowing a smooth transition to the widest point, which occurs about midway back on the huge, slightly bulged doors. Another welcome feature is a very elegant transition from the upper cowl to the windscreen; one of the best I've seen. This is achieved by a formed fiberglass part interfacing between the cowl and the crystal-clear lexan windscreen, which itself is a simple flat-wrap extending all the way back over the top of the cabin to form a huge skylight.

All control surfaces are aerodynamically and statically balanced to within a specified range; the ailerons by large aerobatic-style spades projecting forward below the wings (watch your head!). Lift and jury struts are of streamlined-section extruded aluminum secured by beautifully made fittings and AN hardware. All of this, together with the nicely faired main gear legs, contribute to a clean, business-like appearance that inspires confidence.

The wing structure borrows heavily from ultra-light technology, with tubular aluminum spars, ribs, and internal bracing, and features a sheet-aluminum leading edge wrap. Tubular spars may not yield the world's most efficient structures, but the economy and ease of construction of the S-7 wing make their use compelling. All of the wing's structural components are also CNC formed and drilled, and it shows in the results. Only time and extensive experience in the field will establish the very long term viability of this type of wing structure. We did note some "oil canning" type deformity set into the upper surface of the leading edge wrap, and this was observed to be more pronounced in flight from the photo plane. Randy Schlitter said that additional stiffeners are planned to reduce this problem in the production version, but seemed to feel that some degree of oil canning is inevitable with this structural configuration.

A peek inside the cabin reveals the S-7C to be a true pilot's airplane, with not so much as a nod given to hiding the 'guts', so all structural tubing, hardware, control linkages, and hydraulic lines are fully exposed to view. Personally, being of the "don't put it on your airplane unless it levitates" school of thinking, I don't see this as a negative. Besides saving weight, it has the definite advantage of making everything very easy to inspect. On the other hand, it does increase the need for vigilance against loose objects that could jam the controls, and passengers will require careful briefing about where they can and cannot put their fingers, purses, and such.

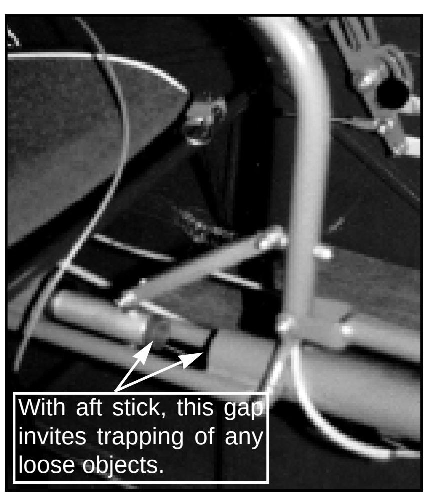
My only serious criticism of the interior treatment has to do with the elevator linkage. Control stops on the push-pull tubes are set up such that, as the elevator is cycled, a gap opens and closes just forward of the rear seat so as to invite items of a certain size (a seat belt buckle would be about right) to migrate into the gap, jamming the elevator. (see photo below) I'd recommend devising some kind of shroud to prevent this possibility. Also, I would have appreciated some additional stowage areas in the cabin for charts, tools, flashlights, etc. True, there are a number of places where things can be tucked between the skin and tubing, but this is probably not a good habit to get into and might lead to damage of the fabric.

ERGONOMICS

That "as one with the airplane" feeling sets in quickly when flying the S-7. It is telling that after one intense, task-filled test flight lasting 2-1/2 hours, I felt no particular desire to disembark after engine shutdown. Although the seating position would be described as upright, there is enough recline to be comfortable, especially when taxiing. The rudder pedals are spread far enough apart to give a sense of stable footing and allow free movement of the control stick. Once seated, the hands fall very naturally to stick and throttle, and there is no combination of control deflections that feels awkward or over-extended.

The pilot's view to the outside is extraordinarily good both in-flight and on the ground. At bank angles over about 30 degrees, it is possible to look right over the top of the wing during turns, thanks to the giant skylight. The minimal extent to which the wing restricts the field of view contributes greatly to the pleasure of flying the Courier. Although some welded steel fuselage structure passes through the cabin, it is placed so as not to be annoying or interfere with the view.

The uncluttered but well-equipped panel on the test aircraft is unusual in being tilted about 20 degrees out of the vertical, so that the instrument faces are pleasantly perpendicular to the pilot's line of sight. It extends right up to the lower edge of the windshield, and some magic prevents the total absence of a glare shield from being a problem. All switches and controls are within easy reach. a King KLX 135 GPS-Comm, ICOM intercom, and encoding transponder make up the entirely adequate avionics suite. The magnetic compass is somewhat hidden away below the panel, but is readable.



With aft stick, this gap invites trapping of any loose objects.

The flap-actuation lever, with a thumb-button release, is located directly below the pilot's left leg, and is the only downright anti-ergonomic feature of the aircraft. With the pilot secured by a properly adjusted four point harness, the flap handle is almost impossible to reach. It's even hard to decide which side of your leg to reach around. Also, the large forces required to actuate the flaps are of a very different order than those applied to the other controls, so it becomes a challenge to finesse control of the aircraft while bent forward positioning the flaps immediately after takeoff or during the approach to landing. Perhaps a shorter lever, pumping hydraulic fluid to a slave cylinder, could be more easily placed in a pilot-friendly location.

What appear to be ram-air fuel vents protruding from the lower surface of each wing near the cabin are actually nifty brackets for supporting the open doors by their external pulls. As mentioned earlier the doors are huge, measuring fully five feet wide by almost three feet tall. Flight with the doors open or removed is permitted, though not done as part of this APR. Because the doors flex easily, some care is required when closing them to insure that all three pins, actuated by a single lever, engage properly.

With one or both doors open, ingress and egress are fairly straightforward. The rear seat, which is equipped with its own control stick, throttle, elevator trim, and rudder/brake pedals, is entered by simply sitting down and swinging one leg past the stick. The pilot's seat, being higher and at the same station as the wing strut and landing gear attachments, is a bit more challenging to mount. I tried four or five different methods, each of which required a small amount of human pretzeling at some point. Whatever the method used, there is an abundance of handy structural tubing exposed overhead to assist as handholds, and getting in and out should provide no real problem for anyone in reasonably good physical condition.

Prior to entry, either seat can be repositioned along a pair of sloped tracks by removing a pair of pins, which also free the seat for removal. The first time I did so, I nearly threw

CAFE MEASURED PERFORMANCE

Propeller max. static RPM	2400 RPM
Max engine RPM, 2 min. maximum	5800 RPM
Max prop RPM, 2.273 gear ratio	2550 RPM
Takeoff distance, no wind, 1140 lb., 55˚ F, 125 ft MSL elevation	270 ft
Liftoff speed, per barograph data, CAS, typical normal takeoff	57 mph
Touchdown speed, barograph, CAS, typical normal approach	55 mph
Noise level, ambient/idle/full power climb/75% cruise	62/81/100/98 dBA
Triaviathon score	26.5

the seat through the skylight because it weighed mere ounces, rather than the pounds I was expecting (bravo!). The inability to change seat position in-flight could be a plus considering the number of accidents that have been linked to improperly secured seats. There is no provision for shock absorption within the seat support structure during a crash or hard landing , but considering the S-7's slow touch-down speeds, the landing gear itself might be adequate. The Courier features a fairly generous, fifty pound capacity, luggage compartment aft of the rear seat, with easy access when the doors are open.

GROUND OPERATIONS

Taxiing the Courier is a real pleasure, as the engine is so narrow you can see straight ahead, without S-turns, by moving your head side to side a bit. In fact, I was able to look right over the top with only a slight stretch of the neck. The S-7 tracks straight ahead with a secure feeling, and is very easy to control even at moderate speeds. The tail wheel, another assembly manufactured in-house by RANS, is of the full-swiveling type, breaking free with the firm application of the brake on one side to allow tight turns pivoting about a main wheel.

TAKEOFF AND CLIMB

After a routine run-up, two notches of flaps are normally set for departure. The ensuing takeoff is almost a non-event because the Courier is ready to fly by the time the tailwheel has lifted to a height of about six inches. The sequence is simple: Full throttle; oil pressure check; let the stick find its own neutral point and hold it there till the plane flies off on its own; hesitate briefly in ground effect, ease off the flaps, and fly away. Takeoffs without flaps are more conventional, with the tail coming up almost immediately, followed by acceleration on the mains until flying speed is reached. The Courier lets you know when it is ready to fly, and directional control is very positive throughout the takeoff.

A variety of climb speeds were explored during the course of testing. Sixty-five mph IAS produced a very pleasant cruise-climb, with good visibility over the nose, good cooling flow, and a healthy climb rate. The best rate of climb seemed to be nearer to 60 mph, but anything over 70 resulted in a much reduced climb rate. Elevator trim is very effective, but the control lever's high breakout force makes it a bit twitchy. This could be due to the very long push-pull cable actuating the tab. A little greater mechanical advantage might help.

The combined air and water cooling of the Rotax 912 seems to be a winning combination, as all of the gauges were well behaved throughout the flight tests, in spite of some fairly punishing extended climbs. I was quite impressed with the Rotax by the end of the test flights. It always started eagerly and did its job in an uncomplaining fashion. The automatic altitude compensating carburetors greatly reduced cockpit workload during the tests, and I enjoyed the freedom from concern about mixture settings. I got a chance to try out the very effective cabin heater at altitude, which produced instant results, but there was no provision for de-fogging the windscreen.

Cabin noise escalates as speed is increased, continuing to do so right up to Vne, so I was grateful for the active noise reducing headset I was wearing. The noise was less from the engine and prop than from the drumming sounds coming from the windscreen and fabric surfaces, sounding a bit like a crowd of people beating on the fuselage sides with spoons. The magnitude of the noise was really not all that great, just different, and I grew used to it after a couple of flights. Still, it is unlikely that an S-7 pilot would exceed Vne without suspecting that something was amiss. Randy Schlitter mentioned that the production version will have a formed-acrylic windscreen, rather than the thinner Lexan flat-wrap, so this may reduce the drumming noise somewhat.

With the useful load of the S-7 making up over 40% of its gross weight, significant performance variability can be expected with different loadings. For this reason subjective flights were made at two weights, the first at 1000 pounds and the other at about 1150 pounds. Naturally, acceleration and climb rate were more brisk, and the airplane more fun to fly at the lighter weight. Nonetheless, performance was sufficiently good at the higher loading to convince me that the 1200 pound gross published by RANS is a realistic operating weight, provided that the pilot is cognizant of limitations imposed by density altitude, obstacles, etc. Pilots regularly operating fully loaded S-7's out of high country airports would be well advised to maintain the ground-adjustable Warp Drive prop at a climb pitch-setting.

STABILITY AND CONTROL

It is important to note that time constraints prevent the exploration of stability and control issues through the full range of C.G. and loading configurations during CAFE APR's. The Rans S-7C was flown at two loadings, but all flights were conducted with the C.G. located about 40% aft of the forward limit. Loading and C.G. can, and usually do, have significant effects on stability and control. Speeds given in

SAMPLE C.G. CALCULATIONS, RANS S-7C N11632

Aft sample item	Weight	Arm	Moment	Forward sample item	Weight	Arm	Moment
Main gear	648.4	34.0	22045.6	Main gear	648.4	34.0	22045.6
Tailwheel	50.5	207.0	10453.5	Nose gear	50.5	207.0	10453.5
Pilot, front	150.0	34.9	5235.0	Pilot, front	220.0	34.9	7678.0
Passenger, rear	200.0	69.0	13800.0	Passenger, rear	0.0	69.0	0.0
Fuel, rt. wing 1/2 full	57.8	52.3	3022.9	Fuel, rt. wing 1/2 full	18.0	52.3	941.4
Fuel, lt. wing 1/2 full	57.8	52.3	3022.9	Fuel, lt. wing 1/2 full	18.0	52.3	941.4
Oil, 2.5 qt. included	incl	na	0.0	Oil, 7 qt. included	0.0	na	0.0
Baggage, 40 lb. cap.	15.0	113.7	1705.5	Baggage	0.0	113.7	0.0
TOTALS	1179.5		59285.4	TOTALS	954.9		42059.9
Gross weight	1200 lb			19.26 gal.	fuel capacity		
Empty weight	698.9 lb			Useful =	501.1 lb		
Datum used is	firewall front face			Payload =	385.5 lb		
Empty weight c.g.	46.5						
c.g. range, inches	43.0-50.25						
c.g. range, % MAC	17-29						
aft c.g. in inches	50.3			fwd c.g. in inches	44.1		

Cruise flight data	Flight #/date/clock	A/C weight	IAS Cabin	CAS, mph	Pres. alt.	OAT °F	Dens. alt.	M.P.	RPM	Gph	MPG	VFR endurance, hrs.	Range, miles	TAS, mph
RANS S-7C	2/97.11.08/16:00:0	1103	89.6	103.6	5407	49.5	6065	23.8	5500	5.30	21.4	3.3	369	113.4
N11632	2/97.11.08/16:03:1	1102	84.1	97.1	5461	51.1	6235	23.5	5250	5.00	21.3	3.5	368	106.5
solo pilot at mid	2/97.11.08/16:06:5	1101	78.4	90.4	5381	51.0	6126	22.5	5000	4.40	22.5	3.9	389	99.1
17.25 gal. usable	2/97.11.08/16:09:4	1100	59.8	64.8	5373	50.8	6104	19.4	4000	2.81	25.3	6.1	436	71.0
for computing	2/97.11.08/16:11:0	1099	53.9	57.9	5311	50.2	5993	20.1	4000	2.75	23.0	6.3	397	63.3

Computation of cruise TAS from cabin Barograph #1 corrected to CAS. Speeds in mph. There was no external barograph drag during these flights.

the text refer to panel indicated airspeeds in miles per hour, with corrected values, derived from the CAFE barograph, appearing in parenthesis (CAS).

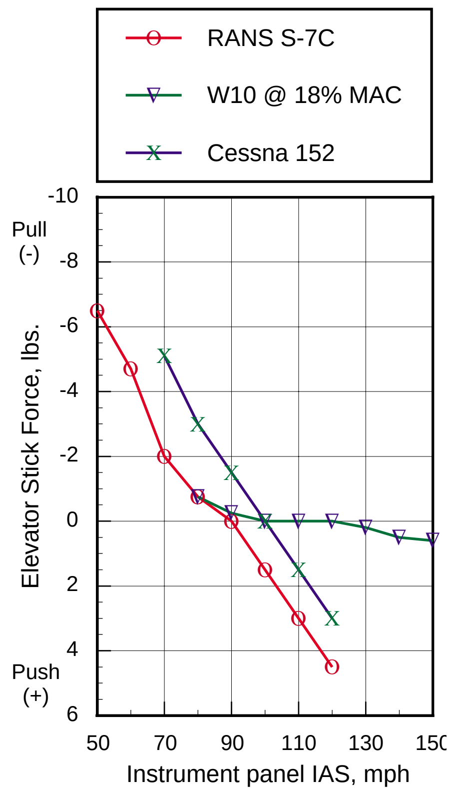
Stability in pitch and yaw was explored by trimming the aircraft, inducing control doublets, and observing the resulting behavior. Static stability refers to the aircraft's initial tendency after being disturbed out of a trimmed condition. Dynamic stability refers to its subsequent behavior while returning to the trimmed condition.

LONGITUDINAL STABILITY

The S-7C displayed strong positive static stability and deadbeat dynamic damping in pitch in both stick-fixed and stick-free modes, returning directly to the trimmed condition with little or no overshoot. The test was repeated at several speeds with the same result. Static longitudinal stability was also quantified by trimming the aircraft at the V_a of 90 mph IAS, and measuring the stick force required to hold speeds in ten mph increments from just above the stall to near V_{ne}. As can be seen in the graph to the right, the fairly light forces increase appropriately as speed deviates from trim speed, without becoming excessive, resulting in a pleasant, intuitive stick feel.

DIRECTIONAL STABILITY

The situation proved to be a bit more complicated in yaw with the S-7C. After inducing large-input rudder doublets the test aircraft did tend strongly back toward neutral, indicating positive static stability, and the return was deadbeat-damped, demonstrating strong dynamic stability. However, a region of neutral static directional stability was observed to extend a little over half a ball-width to either side of center, so the aircraft was happy to fly along with the ball located anywhere within this range. The rudder control system on the test aircraft featured a stiff pair of centering springs, and I suspect that without them the region of neutral static stability would have been even larger. Perhaps due to the spring's high breakout force, I also found it difficult to consciously finesse the position of the ball within the neutral range and ended up chasing it quite a bit. As a sailplane pilot, I am accustomed to attending to the ball, but it is frustrating when it cannot be smoothly centered. Any difficulty with directional stability will tend to affect a pilot's impression of an aircraft quite strongly, and I would describe this more as a minor annoyance than a major problem.



Static longitudinal stability trimmed hands-off at Va

ROLL DUE TO YAW

What the S-7C's rudder lacks in finesse, it makes up for in sheer power; particularly in its ability to induce roll. Roll due to yaw was examined first by noting that about 45 degrees of bank was required to hold a constant heading against full rudder at approach speed. Next, the ample force (about twelve pounds at Va) required to hold the wings level against full

DESCENTS/CLIMBS	Clock	A/C weight	Final PresAlt.	CAS	Rate, fpm
RANS S-7C Courier, N11632	DESCENT MODE				
descents at idle throttle	03:32:10 PM	1111	4149.2	103	-1600
	03:44:44 PM	1108	9118.2	*45	-571
	03:47:38 PM	1107	8471.7	61	-570
* full flaps	03:50:01 PM	1106	7680.8	@64	-661
@ glide ratio = 8.4	03:55:31 PM	1104	4606.0	139	-3898
	CLIMB MODE				
climbs at w.o.t.	10:12:15 AM	1123	1804.7	68	765
no flaps during climbs	10:17:37 AM	1119	1784.8	61	786
	10:23:03 AM	1114	1747.8	53	739
	10:27:55 AM	1109	1750.7	74	766
~ 2500'-3500' DensAlt.	03:07:35 PM	1126	3308.0	~65	682
^^ 9500'-10500' DensAlt.	03:26:00 PM	1115	9405.4	^^63	385
^^ 9500'-10500' DensAlt.	03:40:50 PM	1109	9513.0	^^62	427

rudder was observed. This is a pleasant maneuver, kind of like sitting on a merry-go-round. Finally, I observed the rudder's ability to lift the wing with almost as much authority as the ailerons themselves.

All of these indicate very strong dihedral effect in the S-7C; much stronger, in fact, than it really needs to be. It is possible to have too much of a good thing where roll due to yaw is concerned; negatively affecting control during crosswind takeoffs and landings, for example. We did not have the opportunity to fly the Courier in strong crosswinds, but the ample surplus aileron power remaining in full slips in the landing configuration, and good damping of Dutch-roll oscillations indicate that excess dihedral effect is probably not a concern.

MANEUVERING STABILITY

The increase of stick force with G-loading at Va was measured in 1/2-G increments through three G's, with the results appearing in the graph. The ample force gradient observed should serve well to prevent unintentional overloading of the wing during maneuvers. Maneuvering forces were not measured directly in the landing configuration, but a similar healthy progression was noted subjectively.

SPIRAL STABILITY

The RANS demonstrated perfectly acceptable neutral spiral stability, as evidenced by it's willingness to hold bank angle indefinitely with the stick free in 20 degree coordinated turns in either direction.

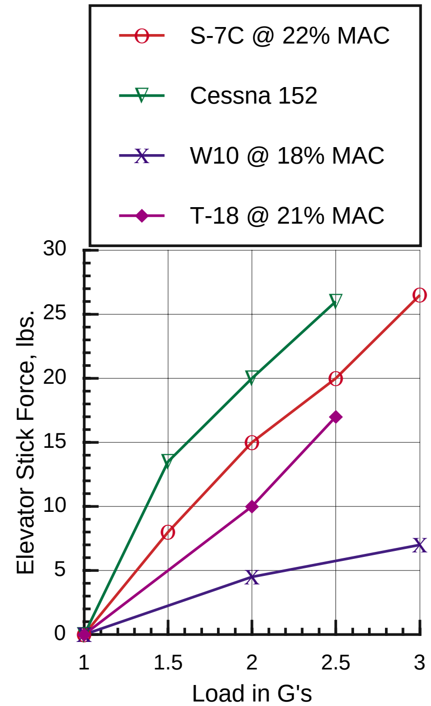
ROLL RATES

The standard technique for measuring roll rates for CAFE APR's is to establish the aircraft in a coordinated 60 degree bank and time a roll to passage through a 60 degree bank in the opposite direction, so as to include the time required for control input and roll acceleration. It should be kept in mind that the rate for a sustained roll would be higher. Rates and control forces were measured at Va and at 1.3 Vso with full flaps.

For so light a wing-loading, the S-7 displays a very decent roll rate, as shown below. In spite of the spades, stick forces in roll would not be described as feather-light, but they are not excessive. I would place them somewhere between a Cessna 150 and a Citabria without spades. At Va, stick force required to achieve rapid full deflection of the ailerons was measured at 23 lbs. in both directions. At reduced power with full flaps, 13 lbs. of force got the same result.

ROLL RATE, degrees/second, includes input time

	Va	1.3 Vso
RV-6A	80	36
Tailwind	47	45
Cessna 152	47	34
RANS S-7C	61 Rt./63 Lt	50 Rt./53 Lt



Maneuvering stability

ADVERSE YAW

Adverse yaw was explored using full aileron inputs with the rudder centered. In the landing configuration, the nose deviated about five degrees opposite, hesitating briefly before moving in the desired direction. In the clean configuration, deviation of the nose was less than 10 degrees at all speeds tested. Although the S-7C demonstrated significant adverse yaw, it was in all cases very easy to overcome with coordinated use of the powerful rudder.

STALLS

Stalls were fairly uneventful, with noticeable airframe buffet onset at about three miles per hour above the stall, and becoming quite intense about 1 mph above the break. No tendency

Stall speeds	Clock	Mode	Weight in pounds	Cabin Baro IAS	CAS mph
RANS S-7C	10:34:55 AM	Clean	1105	47.30	44.16
Various weights	03:17:58 PM	Clean	1122	47.47	44.30
c.g. midrange	10:39:23 AM	Full Flaps	1104	41.45	38.69
Less than 12" M.P.	03:19:01 PM	Full Flaps	1121	42.80	39.10

Panel IAS	Cabin Barograph	CAS
42	42.8	39.1
47	47.5	44.3
50	50.7	52.8
60	60.8	65.5
65	65.6	73.8
70	71.3	81.5
80	81.0	93.7
90	87.5	101.3
100	94.6	110.0
110	104.5	121.2
120	119.8	138.9

RANS S-7C N11632
Airspeed Calibration, mph

toward wing drop was observed during coordinated stalls, and recovery was immediate upon easing of back pressure. While holding the aircraft on the edge of a stall for an extended period of time, the wings were easily kept level using rudder alone. At a lighter weight of about 1,000 pounds, the panel indicated stall speeds were 45 mph (42 CAS) clean and 40.5 mph (37.6 CAS) in the landing configuration. Nearer to gross weight, the corresponding speeds were 47 mph (44.3 CAS) and 43 mph (40 CAS). All stalls were done power-off at a loading of 1.0 G by decelerating at a very low rate while holding the VSI and altimeter steady until the break.

APPROACH AND LANDING

The S-7C's unobstructed field of view, in combination with a very light pilot workload, makes the approach and landing a real delight. The drill is thus: Check fuel and gauges; slow to 60 mph before turning base; shed a little more speed to bring it well into the white arc before extending full flaps; establish a stable approach at 55; and bring her over the fence at 50. You choose the landing type: three-point, wheel, or combo. I tried them all, and my clear preference was for the wheel landing, wherein you bring the S-7C close to the runway in a level attitude, slowly bleed speed with the upwind main a few inches off the deck until the tail is just below level, then plant the main with a little forward stick pressure. Once both mains are down you've got ample time to decide when to ease the tail down, and it feels like you could hold it off almost to a standing stop. The whole process seems to happen in slow motion, with the initial touchdown occurring somewhere in the low forties.

Randy Schlitter recommends the combo landing, warning that full stall landings require very good judgment of height. Apparently, the bottom can fall out in an embarrassing fashion if you reach the three-point attitude too far off the ground. In the combo, the flare is taken to the point where the tail is a foot or so above the three point attitude, held it there until contact with the mains occurs, and the tail eased the rest of the way down. This works well in the S-7C, but I'd be concerned about getting into a habit of making this type of landing exclusively, as it is less universally applicable.

The S-7C should present little difficulty to low-time pilots who have received basic tail dragger training. In fact, it will make them look good. My only cautionary note would be that they should obtain proper instruction when transitioning from the S-7 to other tail draggers.

CONCLUSIONS

If I had to use a single word to describe the RANS Courier S-7C, I'd choose 'benign'. Given two, they would be 'benign' but 'fun'. It is a challenge to design safe, highly stable aircraft without robbing them of the ease of control that makes flying enjoyable, and it is to Randy Schlitter's credit that he has produced a very effective compromise of these opposing goals. The S-7 should offer its owners years of economical, safe, and pleasurable flying.

I want to thank Randy Schlitter for letting me fly his airplane, and RANS engineer Mike Stevens for ferrying it to and from the CAFE Foundation from Kansas. Their trip, with Randy flying along-side in a plush RANS S-6 "Super" Coyote, attests to the Courier's viability for cross-country flight for the patient pilot. I also want to thank C.J. Stephens for his great generosity as mentor. I'd like to dedicate this, my first APR, to former CAFE test pilot Russell Scott, who instilled a high standard of professionalism in the CAFE Foundation's APR program.

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

IMPORTANT NOTICE

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