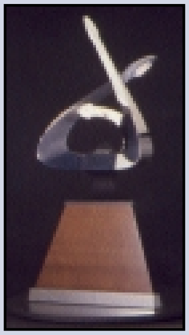

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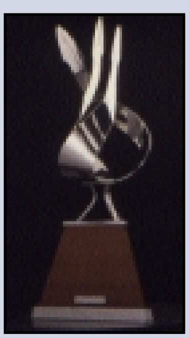


CAFE FOUNDATION

AIRCRAFT PERFORMANCE REPORT

Sponsored and Funded by the Experimental Aircraft Association

Europa Classic

BY BRIEN SEELEY, OTIS HOLT AND THE CAFE BOARD

CAFE Test Pilot Otis Holt and flight engineer Brien Seeley in the Europa over Pt. Reyes National Seashore

LARRY FORD

The Europa is a kit aircraft manufactured in England whose design began in January 1990. It underwent flight testing in line with JAR-VLA requirements in 1993 and was introduced in the United States in 1995. That summer, its designer, Ivan Shaw, was awarded the prestigious August Raspet Memorial Award for the Advancement of Light Aircraft Design. The Europa's wing design was performed by Don Dykins, who had directed the development of the advanced technology wing of the Airbus as former Chief Aerodynamicist at British Aerospace.

This report examines a Europa Classic, N111EU, serial # UK111, built by Kim Prout of Running Springs, California. Initially, Europa's were built with wet layup composite construction; the kit now uses pre-preg, vacuum-bagged composite moldings with a smooth gel-coat finish.

The Europa incorporates a mid-fuselage wing, monowheel landing gear and can be converted to trailerable mode in just minutes. The newer version, the Europa XS, incorporates a number of detail changes including an 18” longer wingspan with more washout and 9” longer ailerons each side, more propeller ground clearance, more baggage space, a 2” deeper footwell for the pilot, a ceramic firewall, an optional 12 gallon aux fuel tank, a 70 lb increase in gross weight and a longer wheelbase. The Europa has interchangeability of wings with its motorglider version and a tri-gear version is now available.

A variety of engines can be used in this aircraft; the 4 stroke 80 hp Rotax 912UL engine being the standard. N111EU used a lightweight composite constant speed propeller manufactured by Whirlwind.

The kit supplier also offers a custom trailer, cowl, spinner, engine instruments, speed fairings, lighting kit, etc.

There are about 175 Europa builders in the U.S. with a total of over 600 worldwide. A wealth of detailed information is available by visiting www.europa-aircraft.com.

SUBJECTIVE EVALUATION

EUROPA CLASSIC N111EU

By Otis Holt
December, 1999

INTRODUCTION

This APR is based upon about twenty-five hours of flight time including more than 1000 NM of cross-country travel ferrying Europa N111EU to and from its home base in Pomona, California. An especially thorough evaluation of the Europa was made possible by owner/builder Kim Prout's generous, open-ended loan of the aircraft and the benign weather we enjoyed during early December.

FIRST IMPRESSIONS

N111EU was not built to be a showplane, but Kim Prout's attention to detail and pride of workmanship is evident throughout. Close examination leaves no doubt that the aircraft was constructed with care and a desire to keep it straight and reasonably lightweight. A walk-around reveals pleasing proportions generally enhanced by the paint scheme Kim devised. Several minor modifications Kim had made were very well documented but did not alter the aircraft sufficiently to have much impact on the conclusions drawn here. I viewed it as a typical, well-built example of the type, making it an ideal candidate for this APR. The most significant unique feature of N111EU is the prototype Whirlwind constant speed propeller with which it had been fitted, which ultimately proved itself to be a good match for both the Rotax 912 engine and the Europa itself.

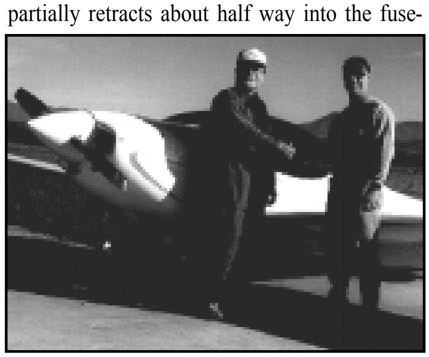
BRIEN SEELEY

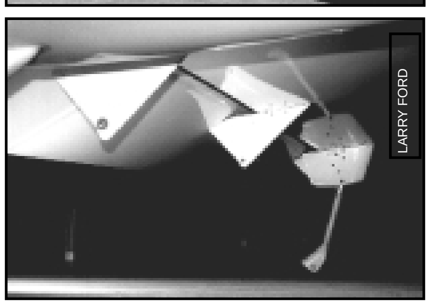
THE DESIGN

The Europa's small size, distinctive profile and mono-wheel landing gear set it apart from other aircraft on the flight line. "Cute" is a descriptor often heard coming from those seeing it for the first time, but the temptation to dismiss the Europa as a mere toy should be resisted. The attention of a careful eye will be drawn to numerous features and innovations with good design reasoning behind each of them. Taken together, they result in an aircraft that is economical to own and operate but which derives unusually high performance and utility from a small powerplant.

The wing's main spar passes behind the seat backrests permitting the Europa to benefit from the low intersection drag of a mid-wing configuration. The engine compartment overlaps the occupant footwells, placing the engine as far aft as possible to control the center of gravity and minimize wetted area. A tapering wing and an all-moving horizontal stabilizer also help reduce wetted area and drag. At 13.5 PSF, the wing loading is relatively high for this class of aircraft, contributing to an impressive top speed and to a good ride in turbulence. A very effective displaced-hinge flap tames behavior at the slow end and is mechanically deployed by the same lever that extends the undercarriage.

The Europa's large single main wheel is located a bit further forward of the CG range than are the mains on most taildraggers, and partially retracts about half way into the fuselage. Stiff nylon outriggers with small wheels are located near the outboard ends of the flaps and rotate to the horizontal position when the flaps are retracted. The outriggers are sized to hold the wings nearly level when taxiing. Cables from the rudder pedals are linked directly to a beefy tailwheel, providing positive steering on the ground. The rudder is actuated by a





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ACKNOWLEDGEMENTS

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CAFE MEASURED PERFORMANCE, N111EU

Propeller max. static RPM	2462 RPM
Vmax, TAS, 1117' dens.alt., 1270 lb, 29", 2548 rpm, 6.1 gph	149.2/171.9 kt/mph
Stall speed, 1300 lb, 22.4" M.P., 2022 RPM, dirty, CAS	43.2 kt/49.8 mph
T.O. distance., 5 mph headwind, 52°F, 125 ft MSL, 1315 lb	650 ft
Liftoff speed, by Barograph, 1319 lb, CAS	53.3/61.4 kt/mph
Touchdown speed, Barograph, 1279 lb, CAS	49.9/57.5 kt/mph
Minimum sink rate, 1287 lb, 71 mph CAS, 78 mph TAS	591 fpm
Glide ratio, idle, 88 mph CAS, 92 mph TAS	10.4
Noise levels, ambient/idle/full power climb/75% cruise	55/74/95/92 dB
Peak oil temp. in climb, 93 mph CAS, full power	250° F
Cowl exit air temp, 93 mph CAS, 56°F OAT	152° F


LARRY FORD

rod linking it to the tailwheel assembly, which does raise a concern that damage to the tailwheel could result in a jammed or inoperable rudder.

Trailerability is one feature of the Europa that will appeal to many. Although wing removal is a two-person operation, I watched Kim Prout and his assistant Ralph Peterson, with just a few minutes effort, load N111EU onto the specially designed trailer Kim obtained from the company. I was impressed by the foolproof, automatic aileron linkage, which is provided by contact pads that require no pins or fasteners. To accommodate the removable wings, the Europa carries its fuel in a crush-resistant polypropylene tank just aft of the main spar. While I've never liked the idea of fuel in the cabin, this solution makes sense when you consider that the aft of spar location is probably the region least likely to receive damage during an accident. One non-standard feature of N111EU was the static port location inside the aft fuselage, rather than on the fuselage surface. The airspeed calibration table below may imply that this location is less than ideal.

It should be noted that the currently available Europa kit, the "XS", differs in a number of ways from N111EU, which is a Europa Classic. In particular, the tailwheel assembly of the XS has been altered to increase the wheelbase substantially, and instead gets its steering inputs from the rudder through a spring-connection. Also, numerous modifications of the cabin interior have been made to accommodate larger passengers and improve comfort. As a result, some of the commentary in this report will not apply to the XS. Perhaps an XS owner will come forward at some point so we can publish a supplement.

The Rotax 912UL installed in N111EU performed flawlessly throughout our flight tests and seemed very well matched to the aircraft. Our only criticism of the installation relates to the lack of aircraft-standard fittings in the fuel system. The carburetors, fuel pump, and other fuel system components were instead fitted with nipples designed for use with slip-on hoses and clamps. The fuel lines used on N111EU were flexible hoses with braided stainless steel outer sleeves, and we experienced some problems with leakage of these fittings when the auxiliary pump was activated. The leakage was due to several factors including the inability of standard stainless hose clamps to compress the outer sleeves adequately to make a reliable seal, a poor fit between some of the lines and nipples, and minor degradation of the hose material from exposure to auto fuel. I would recommend the installation of aircraft-grade lines and fittings throughout the fuel system. Also, N111EU was not fitted with a gas-collator or quick-drain for the removal of contaminants, the installation of which I'd also recommend.

ERGONOMICS AND COMFORT

The chief limitation of the Europa Classic, particularly in the US market, is probably the physical size of the pilots that it can comfortably accommodate. A console about 8 inches wide at the pilot's knee separates the occupants and provides the well into which the main wheel retracts. The first impression, after climbing in, is that it is a bit snug about the feet and against your outboard shoulder. In reality, the cabin is fairly spacious, measuring 43 inches at its widest point, and the footwells are similar in width to those of a Cessna 150. Ultimately, I came to appreciate the secure, "bucket seat" quality of the arrangement. To have a view over the cowl when taxiing and for takeoffs and landings, it is important that the top of pilot's head be about one inch below the canopy. As there is no provision for adjustment of the seat or rudder pedals, this must be done using removable cushions.

Dimensions limiting pilot size include the immutable 44 inches separating the rudder pedals from the wing spar, and the 39-inch seatpan to canopy height. Both of these measurements are exclusive of seat cushions. Also, the occupant's legs are constrained to the 17.5inch space separating the cabin's outboard sidewall from the console, so the thighs of larger occupants can limit the control stick's lateral travel. This is a significant issue as full deflection of the ailerons is occasionally required during takeoffs. For this reason, I'd recommend that builders provide for easy removal of the passenger side control stick.

Fortunately, CAFE Foundation Board members come in a wide variety of shapes and sizes. By experimenting with various arrangements of cushions, we determined that pilots up to about 6'-1"/190# could be accommodated, but only with some compromise to comfort and ergonomic back and thigh support for anyone over about 5'-10". Larger pilots thinking about building would be well advised to seek out a finished Europa XS to try on for size. I'd also recommend that builders optimize the passenger seat for size rather than comfort and provide a number of removable cushions for smaller passengers to use.

The console does serve as a comfortable armrest and provides a home for the throttle, brake,

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
Derek Hine--Lancair IVP
Kim Prout--Europa

Cruise data, mph	Config./flight #	Clock	CAS, Baro	CAS, no cuffs	Alt.	Dens. ratio	New TAS	Cabin dBA	M.P., in. Hg.	PROP RPM	GPH	MPG	Weight, lb.	Range, miles	**CAFE score	Endur., hrs.	Comment
Europa N111EU	#2, cuffed, Baro #3	11:30	131.8	136.1	8004	0.786	153.6	90.4	22.2	2286	4.8	32.0	1293	613	22.2	4.0	8K, 5200 RPM
20.66 gallons fuel cap.	#2, cuffed, Baro #3	11:28	133.5	138.0	8059	0.785	155.7	91.7	22.3	2374	5.1	30.5	1294	585	21.6	3.8	8K, 5400 RPM
for computing range	#2, cuffed, Baro #3	11:27	134.2	138.7	8032	0.785	156.5	90.4	22.3	2416	5.2	30.1	1294	577	21.5	3.7	8K, 5500 RPM
1.5 gallons VFR reserve	#2, cuffed, Baro #3	11:26	132.1	136.5	8057	0.785	154.0	92.0	22.2	2548	5.3	29.1	1295	557	20.3	3.6	8K, 5800 RPM
Wing cuff	#2, cuffed, Baro #3	11:33	92.9	95.1	8099	0.784	107.4	87.1	18.9	1988	2.5	43.0	1292	823	18.8	7.7	Max. MPG
drag penalty = 6.6 mph	#2, cuffed, Baro #3	11:34	83.1	84.8	8116	0.783	95.8	88.2	18.3	1988	2.3	41.7	1292	798	15.7	8.3	75 kts V tour
at 162.5 mph CAS	#2, cuffed, Baro #3	11:38	73.7	75.1	7975	0.787	84.6	89.9	18.1	1990	2.1	40.3	1291	772	12.9	9.1	Max Endurance
**TAS^1.3 x MPG/1000	#2, cuffed, Baro #3	12:13	155.9	162.0	1057	0.969	164.5	96.1	28.3	2548	6.1	27.0	1281	517	20.5	3.1	Vmax 1K cuffed
CAS from calib. table	#3, cuffed, Baro #1	13:51	141.5	146.5	6244	0.830	160.8	95.5	24.2	2548	5.4	29.8	1074	571	22.0	3.5	Vmax Triav 6000'
CAS from calib. table	#4, no cuff, Baro #1	14:28	162.5	169.1	1117	0.968	171.9	96.1	29.0	2548	6.1	28.2	1270	540	22.7	3.1	Vmax 1K, no cuffs

and gear levers. Also mounted on the console are controls for the propeller, parking brake, and choke. All of these are arranged very conveniently for the pilot and their operation quickly becomes second nature. A door at the rear of the console provides access to the fuel selector, which has "Off", "On", and "Reserve" positions. A portion of the main tank, isolated by a saddle shape through which the elevator and rudder controls operate, provides the 2.5 gallon reserve. I'd prefer somewhat easier access to the fuel selector, but I've seen much worse.

The built-in panel was designed to provide the pilot with easy access to all switches and controls, with plenty of space for an ample selection of avionics and instruments for VFR flight. The area forward of the passenger seat is open except for a small shelf to the right of the instrument panel. NACA inlets with eyeball-valves are located on each side of the cabin to provide ventilation. The inlets had been modified with small scoops to direct some of the propeller's blast inside when on the ground. The vents generally performed quite well but the smell of exhaust was occasionally noted during extended periods of slow flight during our tests. A cabin heat vent was installed but without provision for canopy de-fogging; an important feature that would be easy to add.

As with most light aircraft available today, neither seat was equipped with a crush zone or any special provision for energy absorption during a crash landing, except for that which the seat cushions and landing gear would provide. The shoulder harness attach point was located behind the seat about 10 inches below shoulder height. I was concerned that this would contribute to spinal compression during a crash landing. The cabin ceiling aft of the door would make a better attach point. Ingress and egress was moderately easy. After stepping onto the wing-walk provided, I'd place one foot on the seat while ducking below the gull-wing door, sit on the seat back, then lower myself into position. Some upper body strength is helpful, but most reasonably healthy adults should be able to get in and out without great effort.

ABOUT THE BUILDER

Kim Prout works as a Fire Captain in the Big Bear Lake area of Southern California. He caught the flying "bug" from his father, an aerospace enginner, during family trips in their Stinson Voyager.

Kim built and flew a Long EZ in 1982 and enjoyed flying a J-4 Cub. He wanted a plane that would offer him the best features of these two aircraft. His father helped him in both selecting and building the Europa.

Together they travelled to England to evaluate the Europa design. A meeting with Ivan Shaw, followed by a ride in the Europa with Peter Clark, chief test pilot for Europa, convinced Kim that this was a the stable, maneuverable, and efficient aircraf for which he had been looking.

Prior to departing England, Kim placed an order for the 2nd kit to be sold in the U.S, #111. N111EU's first flight was July 4, 1996 at Chino airport with none other than Ivan Shaw as the test pilot.

Ivan was very impressed with the workmanship and the modifications that Kim had incorporated, as well as the overall performance and handling of Kim's particular airplane. As a result, Ivan asked Kim to serve as Europa sales agent in the Western States area.

Kim continues to support Europa in many ways through performance enhancements, airshow displays, and direct builder support. He assists builders by coordinating the Europa Squadron #1 meetings, offering hands-on training, and providing EAA tech counselor visits and EAA flight advisor services.

GROUND OPERATIONS

Taxiing the Europa is easy, thanks to positive tailwheel steering and side-to-side stability provided by the outriggers. The pilot's field of view on the ground is generally good, except that the view over the nose requires a little neck craning. Significant optical distortion in the lower inch or so of the windscreen adds to the challenge of interpreting the view straight ahead, but s-turns are not required when the pilot's seat position is correct. I quickly became accustomed to making greater use of peripheral vision during operations on and near the ground. When taxiing, some thought must be given to vulnerability of the flaps, which are always deployed when on the ground, and to keeping the outriggers clear of obstacles and deep ruts alongside the taxiway.

It is easy for one person to move the 800-pound Europa about on the ground manually without the use of a towbar. One needs only push the aircraft using the vertical fin as a grip while steering with the rudder. This technique worked equally well moving forward or reverse.

The brake on the single main wheel is effective and easy to use. Pulling a lever alongside the throttle lever activates it, so both tasks go to the pilot's right hand. I was especially pleased with the operation of the parking brake; a simple one-way valve that traps hydraulic pressure when engaged. It easily restrains the aircraft from moving during the runup prior to takeoff. The pre-takeoff check is straightforward. Particular care must be taken to insure that both the front and rear bullet pins securing each gull-wing door are engaged prior departure. Minor flexing of the door panel was required to line up the rear pin with its receptacle before it could be engaged.

TAKEOFF AND CLIMBOUT

Both takeoffs and landings in the monowheel Europa are moderately challenging, as some adaptation to the aircraft's unique behavior is required. During the takeoff roll aggressive directional control is essential. Although the forces acting upon aircraft are the same as for other taildraggers during this phase of flight, its response to them is not. As the tailwheel is lifted off the ground, the outriggers, being located well aft of the main wheel, also rise. The aircraft subsequently tends to pivot about the single main wheel's contact patch in both the vertical (yaw) and longitudinal (runway) axis. As the outriggers leave the ground, the pilot must be prepared to use significant

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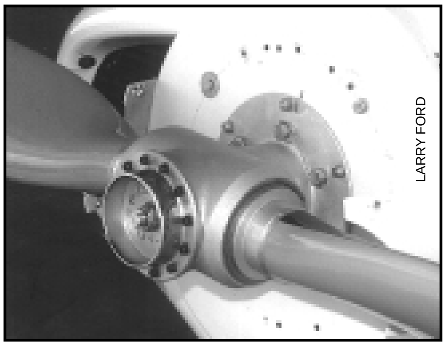
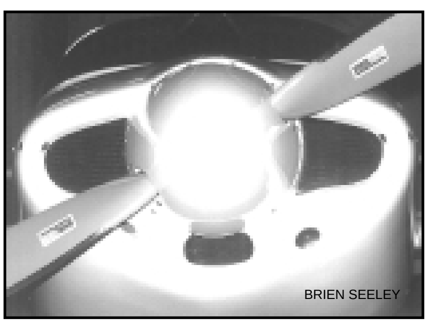


LARRY FORD

BRIEN SEELEY



BRIEN SEELEY

aileron inputs to counter a rolling tendency caused by the combination of engine torque, an adverse rolling moment induced by rudder inputs, and the side-force of any crosswind component acting upon the entire aircraft. In other aircraft, these rolling forces are absorbed by the main gear and generally go unnoticed by the pilot.

The tendency to pivot about the vertical axis through the tire's contact patch is due to the combined effects of the propeller's blast on the vertical fin and to the weather-vane effect of any crosswind after the tailwheel has been lifted. This is similar to the response of other taildraggers with positive tailwheel steering, but intensified a bit by the more forward location of the main wheel.

The recommended technique is to keep the tailwheel planted a bit longer than one's intuition might suggest so as to assure adequate aileron authority, and to be prepared to use substantial control inputs to maintain lateral and directional control once the tail does leave the ground. Steady crosswinds from the right actually make the takeoff easier, whereas those from the left require extra care. My only aborted takeoff occurred during my first encounter with a gust from the left just after having lifted the tailwheel. As I got to know the Europa better, takeoffs become quite enjoyable, and I experienced little difficulty holding to the centerline.

The constant speed prop installed on N111EU permits the engine to develop maximum rated power at 5800 engine RPM during the takeoff roll, so acceleration is quite brisk for just 80 horsepower. The tailwheel is lifted at about 35-40 KIAS, after which the Europa accelerates rapidly to a rotation speed of 45-50 KIAS. After a slight pause to accelerate in ground effect the initial climb should be stabilized at about 65-70 KIAS before raising the undercarriage (and flaps) to insure being above the clean-configuration stall speed. Takeoff distance was substantially less at weights 125 pounds or so below gross when compared with takeoffs at gross weight. My general impression was that the gross weight limit of 1300 pounds was appropriate and should not be exceeded.

The main wheel is fitted with a bungee assist, which pre-loads the gear downward, such that in flight the gear seeks a neutral position about midway through its range of travel. As a result, the forces required for extension and retraction are fairly symmetrical. After pivoting a small mechanical lock with one finger, a firm sidewise pull on the gear/flap extension lever frees it from the down-position detent. An opposing (pull) force is required initially as the lever seeks the neutral point, after which a pushing force growing to about 25 pounds is needed by the time the lever reaches a detent at its forward limit. Gear extension is essentially the reverse process. Though a bit awkward at first, both are easily accommodated with a little practice.

Freed from the very substantial drag imposed by the gear and flaps, the Europa accelerates smartly into the climb. After re-setting the propeller to bring the Rotax below the 5500-RPM limit for continuous operation, the aircraft is trimmed to 90-100 KIAS for sustained climbs, which gives a good balance between forward visibility and rate of climb. The best sustained rate of climb we measured at gross weight (density altitude of 1000 feet) was 1297 FPM at 99 MPH (CAS). This equates to a panel indicated airspeed of 90KIAS, a good deal faster than the 75 KIAS published as Vy by the manufacturer. The oil temperature displayed a tendency to increase slowly during sustained climbs in spite of fairly low outside temperatures, and would probably impose a limit on the duration of full-power climbs in warmer weather. When stabilized in cruise all engine temperatures were well behaved.

Europa N111EU	Panel IAS, kts	Panel, IAS, mph	Cabin Baro, mph	CAS, mph Wing	Config.
Airspeed	39	44.9	47.4	40.8	dirty stall
Calibration	45	51.8	52.8	51.7	dirty
CAFE Barographs	50	57.6	61.5	57.4	
Baro #3 on wing	55	63.4	65.4	64.6	
Baro #1 in cabin	60	69.1	71.5	69.6	
	65	74.9	76.0	73.7	
	70	80.6	81.2	78.1	
	75	86.4	86.7	82.2	
	80	92.2	92.5	88.3	
	85	97.9	98.8	93.0	
	90	103.7	104.3	99.2	
	100	115.2	116.5	109.8	
	110	126.7	128.8	121.1	
	120	138.2	141.4	130.1	
	130	149.8	153.5	140.4	
	140	161.3	164.5	153.3	
	150	172.8	178.7	165.1	
	160	184.3	189.7	174.0	

STABILITY AND CONTROL

Once airborne, the Europa is free of bad habits and a real delight to fly throughout the portion of the envelope we explored. The control system is smooth and well harmonized with no detectable slop or play. Direct aerodynamic loading of the control surfaces provides all pilot feedback through the control system, contributing to an excellent sense of "linkage" with the aircraft. Light breakout forces, minimal adverse yaw, and the Europa's quick, fluid response to control inputs makes maneuvering the aircraft easy. This combination of qualities should make the Europa a good platform for Sportsman-level aerobatics.

We flew N111EU to evaluate stability and control with the load ballasted to 15% of range aft of the forward limit, and again at 85% aft of the forward limit. Takeoff weight at the most forward c.g. was about 1150 pounds, and about 1175 at the most aft. Differences in handling qualities observed between the two loadings were minor, suggesting that the designer's selection of the center of gravity limits is fairly conservative.

LONGITUDINAL STABILITY

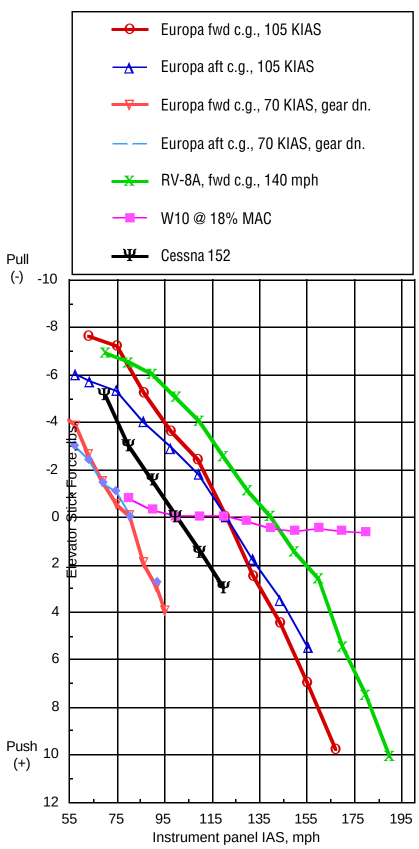
Dynamic longitudinal stability was explored by inducing elevator doublets, and found to be deadbeat at all speeds tested both stick fixed and stick free. This contributes solid feel during maneuvers and in cruising flight for so small an aircraft.

Static longitudinal stability was measured by trimming to Va (105 KIAS) in the clean configuration and then measuring stick force required to hold speeds in ten-mph increments while maintaining altitude by adjusting power. The test was repeated with the speed trimmed to 70 KIAS in the landing configuration. Healthy

Europa N111EU, Sample c.g.

	Weight, lb	Arm	Moment
Main gear, empty	723.5	45.562*	32964
Nosewheel, empty	83.4	175.625	14647
Pilot, front seat	150.0	54.56*	8184
Passenger, front seat	168.1	54.56*	9172
Fuel, fuselage tank	120.0	75.4*	9048
Oil, included	0.0		0
Baggage, aft limit 80 lb.	50.0	88.00	4400
Baggage, aux. box 15 lb lim.	0.0	97.00	0
TOTALS	1300.0		78415
Datum = fwd face of cowl			
c.g., inches	60.30		
c.g., % aft of fwd limit	52%		
c.g. in % MAC	21.6		
Gross weight, lb	1300.0		
Empty weight, lb	801.65*		
Useful load, lb	498.4		
Payload, lb, full fuel	374.4		
Fuel capacity, gallons*	20.66		
Empty weight c.g., inches	58.98		
c.g. range, inches	58-62.5		
c.g. range, % MAC	17%-26%		
*as determined by CAFE			

stick force gradients were observed in all configurations tested. The significance of this is that the Europa provides the pilot with ample feedback in the form of increasing stick pressure as airspeed deviates more and more from the trim speed. This makes both unintentional speed gain and unintentional stalls far less likely to occur.



Static longitudinal stability

Trimmed to zero pounds, stick- free and flaps up.

DIRECTIONAL STABILITY

The Europa responded to rudder doublets with about 4 overshoots before damping rudder-free and about 3 overshoots with the rudder fixed at Va in the clean configuration. This is well within the acceptable range, given that it resulted in no discomfort or annoying Dutch-roll tendency. Artificially induced Dutch-rolls at Va damped completely within 2 cycles. There was no detectable dead-band or undue breakout force observed when actuating the rudder, which has ample control authority to do its job during all phases of flight.

ROLL DUE TO YAW

Roll due to yaw was examined by measuring the opposing stick force required to hold a constant heading with the rudder deflected. At Va (105 KIAS), one-half right rudder required 3 pounds of opposing lateral stick force, with 5 pounds needed to oppose full right rudder. For left rudder inputs, the numbers were 4 and 6 pounds. These results indicate adequate dihedral effect. This was further confirmed by observing that either wing could be raised easily by the application of rudder alone.

Typical of most light aircraft, the rudder displayed much less authority to induce rolls in the landing configuration at 1.3Vs (55 KIAS), and only about 2 pounds of force is required to maintain a constant heading against full rudder in either direction. Although the nose drops when rudder is held in either direction with the gear and flaps down, multiple light taps on the rudder can be used to adequately control bank without the use of aileron. Positive force gradients were observed throughout the rudder's range of travel at all speeds and configurations tested.

MANEUVERING STABILITY

The pilot's perception when maneuvering the aircraft is generally that forces required are reasonably light, with no undue effort required to obtain the desired result when maneuvering at loads below three G's. At the same time, the substantial force per G-load gradients shown in the chart below insure that the pilot is getting ample feedback from the aircraft when structural loads are imposed, making unintentional overstressing of the airframe less likely.

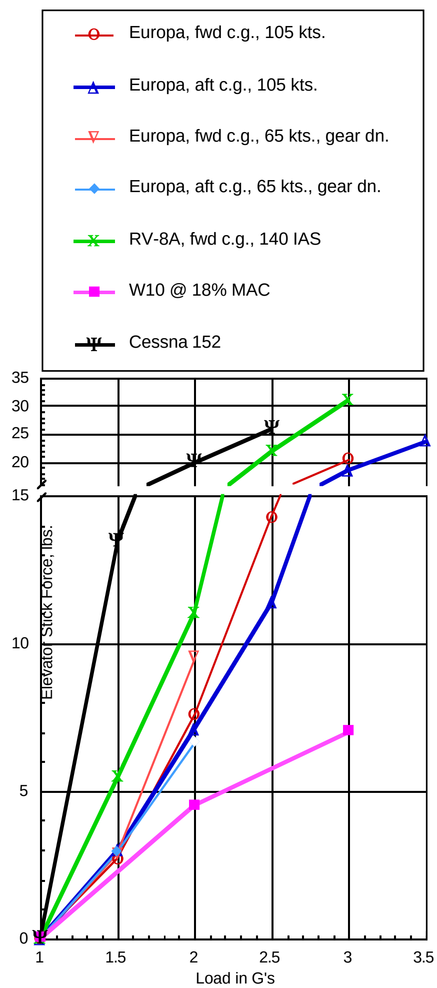
ADVERSE YAW

Fairly abrupt aileron inputs without the use of rudder resulted in no more than a slight hesitation before the nose followed into a well-coordinated turn. I suspect that more than just differential aileron rigging was contributing to this near absence of adverse yaw. It's possible that the two 1.5 inch-wide mass-weight horns projecting from the leading edge of each aileron create enough drag to help out when they are deflected downward. For whatever reason, little or no rudder is needed to coordinate most turns and this contributes to the ease of maneuvering the aircraft.

ROLL RATES

The low inertia of the lightweight, tapered wing contributes to the respectable roll rates we

ROLL RATE, deg./second, includes input time		
Airspeeds are panel IAS	Va	1.3 Vso
Europa N111EU	81 Rt./ 71 Lt.	62 Rt./ 53 Lt.**
Europa N111EU		50 Rt./ 40 Lt.***
RV-8A N58VA	109 Rt./102 Lt.	78 Rt./80 Lt.
Cessna 152 N65398	47	34
GlaStar N824G	52 Rt./50 Lt.	47 Rt./43 Lt.
**clean @ 70 Kts. IAS		
***dirty @ 62 Kts. IAS		



Maneuvering stability

Europa N111EU	Flight/Date	Start time	Presalt., ft.	Densalt. range	Weight, lb	CAS, mph	TAS, mph	fpm	comment
Climbs and Descents	Climbs							Rate of climb	
28.6" MP, 2410 RPM, 5.9 gph, CXT 139°F	#2, 12/12/99	10:36:45	830	489.8-1508.2	1314	87	88	1239	
28.4" MP, 2412 RPM, 5.7 gph, CXT 137°F	#2, 12/12/99	10:44:08	826	512.2-1510.1	1311	83	84	1222	
28.4" MP, 2412 RPM, 5.8 gph, CXT 137°F	#2, 12/12/99	10:49:45	822	500.4-1505.6	1310	93	94	1231	
28.5" MP, 2416 RPM, 5.8 gph, CXT 135°F	#2, 12/12/99	10:55:02	857	515.8-1510.4	1308	99	100	1297	Best rate
29.2" MP, 2504 RPM, 6.9 gph, CXT 136 °F	#2, 12/12/99	11:00:12	63	(-610.3)-(-132.9)	1306	64	64	573	Best angle
26.8" MP, 2416 RPM, 5.6 gph, CXT 150°F	#2, 12/12/99	11:03:45	2252	2391.6-3387.4	1304	94	98	982	Triav. climb
20.7" MP, 2420 RPM, 5.0 gph, CXT136°F	#2, 12/12/99	11:43:41	8886	9515.9-10503.5	1288	87	102	373	Too rich
All data with Wing Barograph #3									
C.X.T. = cowl exit air temp.									
All descents with coarse pitch	Descents							Rate of sink	
3" MP, 1680 RPM, 0.2 gph, CXT 111°F	#2, 12/12/99	11:48:10	8864	9563.4-8331.5	1287	114	130	1143	Va, idle
5" MP, 1702 RPM, 0.6 gph, CXT 87°F	#2, 12/12/99	11:49:37	6055	6672-5950	1287	180	199	2708	Vne, idle
6.9" MP, 1140 RPM, 0.5 gph, CXT 88°F	#2, 12/12/99	11:50:32	5591	6008.2-5671.5	1287	71	78	591	Vx, min. sink
6.9" MP, 1160 RPM, 0.5 gph, CXT 89°F	#2, 12/12/99	11:51:11	5178	5563.3-5363.4	1287	74	81	595	Vx, min sink
6.9" MP, 1702 RPM, 0.3 gph, CXT 86°F	#2, 12/12/99	11:52:23	4475	4910.7-3946	1286	68	72	749	Gear, flaps down. 6.7°
5.5" MP, 1704 RPM, 0.3 gph, CXT 86°F	#2, 12/12/99	11:54:10	2980	3316.1-2307.9	1286	88	92	772	Glide ratio 10.44, slope

measured for the Europa, which can be found in the table below. Roll rates were dramatically lower in the landing configuration, but adequate for situations normally encountered in the landing pattern. Roll damping was quite good in both configurations, with the roll stopping immediately and the stick tending back to the neutral position when pressure is released. Rapid aileron deployments were easy to coordinate and the nose of the aircraft showed little tendency to rise or drop.

SPIRAL STABILITY

After being placed in a stable, coordinated turn with a 20-degree bank in either direction N111EU showed no particular tendency to deviate from that angle with the stick free at any speed tested in either the clean or landing configuration. This implies that the Europa will not tend to quickly drop off into a spiral if the pilot's attention is diverted momentarily.

TRIM AUTHORITY

The aircraft is equipped with electric trim for both pitch and roll, activated by four buttons atop the pilot's control column. No position indicator was installed for aileron trim, which had such marginal authority that it was often difficult to perceive its effect. Given that no fuel is carried in the wings, I didn't really feel that aileron trim is needed in this aircraft.

By contrast, elevator trim authority is excellent on the N111EU, which uses a Mac-servo motor to reposition a servo tab on the all-flying tail, and is equipped with a very nice panel-mounted position indicator. When the trim control was operated through its full range of motion while holding the airspeed at 105 KIAS, the stick force ranged from a 9-pound pull at full forward trim to an 28-pound push at full aft trim. We had no occasion to use full pitch-trim authority for normal operations during our flight tests. My only complaint was that the button activating the trim responded to so light a touch that it could be inadvertently engaged by the weight of the pilot's thumb alone.

Stall speeds--Europa N111EU	Flight/Date/Clock	Mode	MP/ Prop Rpm	Weight, lb	CAS, kt/mph
mid c.g. at various	#2--12/12/99/1:14:17	clean	18.1/1796	1300.4	53.0/61.1
M.P. and RPM's	#2--12/12/99/11:15:37	dirty	22.4/2022	1300.0	43.2/49.8

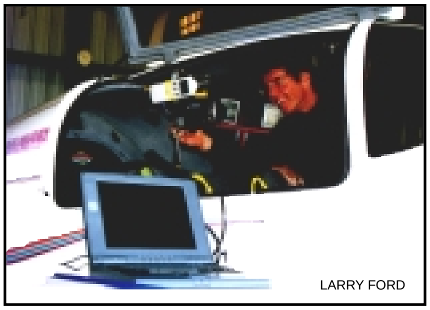
STALLS

One-G and mildly accelerated stalls were found to be benign in all configurations and loadings tested. No stall warning device or angle of attack indicator was installed on the aircraft, but stall onset was indicated by substantial airframe buffeting and stick-shake, which preceded the stall by about two knots clean and a bit less dirty. It should also be noted that no leading-edge stall strips were installed on N111EU, as they were judged by the builder to be unnecessary.

In the landing configuration, the aircraft displayed a tendency to fall off gently to the right at the stall. Recovery in all cases occurred almost instantly upon release of back pressure on the stick, and resulted in the loss of no more than 100 feet of altitude when positive recovery techniques were used. One-G stalls occurred at 49-52 KIAS clean and at 41-44 KIAS in the landing configuration, depending upon weight. CAFE calibrated stall speeds, compensated for instrument and position error, can be found in the measured performance section. Modest amounts of power were found to significantly reduce the speed at which stalls occurred. For example, a one-G stall at a weight of 1075 pounds with power set to the limit allowed by CAFE Triaviathon rules (15" MP, 1500 propeller RPM) occurred at a panel indicated airspeed of just 39 Knots.

CROSS COUNTRY FLIGHT

I had several opportunities to fly N111EU cross-country and was quite impressed by the experience. The wings are fairly flexible for so short a span, and this, coupled with the relatively high wing loading, gave a good ride in turbulence. The pitch attitude in cruise is fairly nose-


LARRY FORD

Brien Seeley checks the flight test recorders in the Europa.

down, yielding an excellent field of view even over the nose. The Whirlwind propeller locks onto the RPM set, and with the Rotax 912 singing along at 5300rpm or so the sensation is more akin to that of a turboprop than to a direct drive Lycoming or Continental. The ANR headsets Kim provided further reduced an already low cabin noise level.

There isn't much room to move around in the cabin, but it is possible to reduce fatigue by repositioning one foot forward between the rudder pedals occasionally and the other on the floor aft of the pedals. The temperfoam seat cushions Kim installed in the aircraft were a bit heavy at 18.25 pounds total, but they do provide comfort through the 3-4 hour legs the aircraft is capable of. I doubt that I'd install a CD player in my own homebuilt, but I must confess that I enjoyed listening to the one installed in N111EU when cruising cross country.

Cross-country performance and economy is quite impressive. A comfortable cruise can be sustained at about 5200 engine RPM while burning 4.2 GPH indicating about 125 Knots (135MPH-CAS). Unfortunately, the Rotax is not equipped with mixture control, and the carburetors do not fully compensate for altitude, so it is difficult to take advantage of winds aloft and the TAS advantage of high-altitude flight. Nonetheless, we measured a range of 823 miles at 2.5 gph at 107.4 mph TAS (43 mpg). Fuel consumption as low as 2.1 gph in level flight , and a climb rate of 373 FPM even at 10,000' DA. After our flight-testing was completed, I returned N111EU to its home base flying alongside the CAFE Flying Club's highly modified Cessna 152. At 6,500 feet, the Cessna was burning 7 GPH of 100LL at 110 KIAS and nearly wide-open throttle. I was loping alongside in the Europa burning 3.2 GPH of auto-fuel at about half-throttle!

EUROPA, N111EU, SPECIFICATIONS

Empty weight/gross weight	801.65 lb/1300 lb
Payload, full fuel	371.9 lb
Useful load	498.4 lb
ENGINE:	
Engine make, model	Rotax 912 UL, dry sump, geared 2.2727 :1
Engine horsepower	80 BHP max, 77.8 BHP continuous
Engine TBO	na
Engine RPM, maximum	5800 RPM for 5 min., 5500 RPM continuous
Man. Pressure, maximum	30" Hg.
Starter	electric
Generator	250 watt Bombardier, Ducati 3408 regulator
Governor	Jihostrot (Czech), P-910-01
Oil temp., maximum	250° F continuous, 300 ° F red line
Oil pressure range	22-58 psi warm, 72 psi cold
Fuel pressure range, pump inlet	3-7 psi
Induction system	Dual constant velocity Bing carbs
Induction air filters	2 ea. K&N 110 sq in air filters
Induction air inlet	1 ea. 1.8 in diam. circular inlet
Exhaust system	1.25" O.D. ss, 4 ea. into dual mufflers
Oil capacity, type	0.66 gallons, motorcycle 15W/50 semi-synth.
Oil cooler	3" x 5" cooler face on 5.5" x 2.5" fwd air inlet
Ignition system	dual magneto, electronic
Cooling system	dual radiators, oil cooler, air-cooled barrels
Cooling inlet area	pitot inlets, 38 sq in to each coolant radiator
Cooling outlet	fixed, no cowl flap
Propeller:	
Make	Whirlwind Series 100
Material	composite 2 blade
Diameter/Pitch	63 in
Prop extension, length	na
Prop ground clearance, full fuel	3.75 in
Spinner diameter	14 in
Fuel system	single midline saddle tank , no drains
Fuel pump	engine driven pump and electric boost pump
Fuel type	92 octane mogas preferred
Fuel capacity, by CAFE scales	20.66 gallons
Fuel unusable	0.2 gallons
Flight control system	pushrod elevator and ailerons/ rudder by cables
Flight controls cabin	dual, both control sticks and rudder pedals
Braking system	single hydraulic disc brake on monowheel
Braking controls	midline pull lever, center console
Tire size, mains	7.00-6 tube type, 6 ply rating, 1900 lb max
Tire size, tailwheel	210 x 65, 45-50 psi
Seats	2
Cabin entry	gull wing doors, each side
Width at hips	18.3 in per seat
Width at shoulders	40.5 in
Height, seat front to canopy	39.5 in, no cushions
Baggage capacity, rear	80 lb
Baggage capacity, rear shelf	15 lb
Baggage door size	35 in L x 24 in W
Baggage lift over height	34 in
Wing step-up height	21 in
Cabin ventilation	dual ball vents off 2.5" x 0.7" NACA inlets
EQUIPMENT:	Garmin GNC 250 GPS/COMM, Allegro M816 engine monitor, Terra TRT 250D transponder, Sigtronics SPA400 intercom, Ameri-King ELT, Hamilton card compass, Pioneer DEN-225 SuperTuner CD player, Whelen strobes, turn coord.

APPROACH AND LANDING

The Europa's excellent field of view in flight and its relative simplicity make for safe, easy descents and entry into the landing pattern. Once established on downwind, the first objective is to gradually re-trim the aircraft to about 75-80 KIAS prior to extending the gear/flaps just before turning base. Very little re-trimming is required after extending the gear because the Europa magically re-assumes the same trim speed. A notable advantage of having the undercarriage and flaps operate together is the reduced likelihood of an unintended gear-up landing. The attitude of the aircraft at approach speed is decidedly more nose-up with the gear and flaps retracted, giving the pilot a strong clue that something is amiss when the runway disappears from view upon turning final.

As with takeoffs, landings in the mono-wheel Europa require their own set of special techniques and adaptations from the pilot. This is due mainly to two factors. First, successful landings require that pitch attitude at the moment of touchdown be controlled within a fairly narrow range. It is possible to either over or under-rotate during the flare. Also, with the outriggers sized to hold the wing fairly level on

KIT SUPPLIER IN USA	OWNER/BUILDER
Europa Aircraft 3925 Aero Place, Lakeland, FL 33811 941-647-5355 Fax: 941-646-2877 www. Info@avnet.co.uk www.europa-aircraft.com	Kim Prout at K.P. Aviation Enterprises 1302 N. Monte Vista Ave #5 Upland, CA 91786 Tel/fax 909-920-3055 kpav@worldnet.att.net http://www.kpaviation.com

DESIGNER'S INFORMATION

Cost of airframe materials, no engine or inst.	$27,000
Estimated cost of this particular aircraft	$59,000
Kit starts sold to date	631, worldwide
Number completed	na
Hours to build this particular aircraft	1800 hr in 2 years and 2 weeks
Prototype first flew/ N111EU first flew	2/92 and 7/96
Empty weights of aircraft built thusfar	728 to 850 lb
Design gross weight, lb, Takeoff/Landing	1300 lb for N111EU, 1370 lb for XS version
Recommended engine(s)	Rotax 912 UL (80 HP), 912S (100 HP) 914 turbo (115 HP)
Advice to builders:	Rolls, loops, Cuban 8, split S, though no inverted systems are installed)

CAFE FOUNDATION DATA, N111EU

Wingspan	26 ft 1 in
Wing chord @ root/tip	52.5 in with flaps down, 40.5 in at tip
Wing area	95 sq ft
Wing loading	13.7 lb/sq ft
Power loading	16.3 lb/hp
Span loading	49.8 lb/ft
Airfoil, wing	Dykins Europa Super-Efficient Wing
Airfoil, design lift coefficient	na
Airfoil, thickness to chord ratio	12 %
Aspect ratio	7.2
Wing incidence	+1.8 °
Thrust line incidence, crankshaft	-1 °
Wing dihedral	3.2 ° per side
Wing taper ratio, tip/root,	.8
Wing twist or washout	1.5 °
Wing sweep	1.9 °
Steering	tailwheel linked to rudder
Landing gear	midline monowheel, retractable
Horizontal stabilator: span/area	97.5 in/22.4 sq ft
Horizontal stabilator chord, root/tip	36 in/30.3 in
Elevator: total span	stabilator
Elevator chord: root/tip	stabilator
Vertical stab: span/area incl. rudder	48 in/12.2 sq ft
Vertical stab chord: average	36.5 in
Rudder: average span/area	53 in tall at L.E./5.2 sq ft
Rudder chord, bottom/top	10 in/18 in
Ailerons: span/chord, root/tip	54.6 in/ 8.5 in/7.8 in
Flaps: span/chord, root/tip	77.3 in/ 14 in/12.5 in
Total length	19 ft 2 in
Height, static with full fuel	59.5 in (73.5 in when canopy open)
Minimum turning circle	na
Main gear track	na
Wheelbase, tailwheel to monowheel	132 in
Acceleration Limits per factory:	+4.0 g/-1.5 g at 1300 lb
Airspeeds per Owner's Manual	
Never exceed, Vne	165/190 kts/mph
Maneuvering, Va	105/121 kts/mph
Best angle of climb, Vx	61/70 kts/mph
Best rate of climb, Vy	75/87 kts/mph
Stall, clean, 1300 lb GW, Vs	49/56 kts/mph
Stall, dirty, 1300 lb, GW, Vso	44/51 kts/mph
Flap Speed, (gear too) extended, Vfe	83/96 kts/mph

FLIGHT TEST DETAILS

11 flights including 4 data collection flights were made during December, 1999, all during day VFR conditions.

A Flowscan 201A fuel flow transducer was used for the gph determinations and was calibrated by measuring the weight of fuel burned on each flight. A PropTach digital tachometer was mounted on the top of the instrument panel. Performance data flights were conducted with pilot and flight engineer aboard and flying qualities were evaluated with solo flights using an analog G meter and Brooklyn Tool & Machine Co., Inc. NJ hand-held stick force gauge.

Cruise flight data were obtained with the wingtip CAFE Barograph (#3) mounted on a wing cuff with a dummy barograph and cuff mounted on the opposite wing. These were correlated with the panel airpseed indicator to produce the airspeed correction table shown here. Our data suggest that Vy is 99 mph CAS and Vx is 74 mph CAS for N111EU.

Cowl exit temp (C.X.T.) is a function of the OAT & CHT. Because the Europa uses a liquid cooled engine, this parameter is not comparable to the usual air-cooled engines tested at the CAFE Foundation. The maximum C.X.T. observed on the Europa was 152° F occuring with an oil temperature of 245° F during a protracted climb at 93 mph CAS.

An attempt was made to collect stall speeds at lowered aircraft weight. The data showed stall at 228 lb below gross weight was below 45 mph CAS but was very much affected by the amount of power utilized during the stall. The flaps are very effective.

the ground, it is necessary to touch down in a wing-level attitude. This means that approaches to crosswind landings are made at a crab angle to the runway and the pilot must use rudder to kick the aircraft into runway alignment just prior to touchdown. All of this requires a degree of precision from the pilot that is considerably higher than for the typical trainer. To be fair I should confess that several aborted landings provided my own transition to the Europa with a few humbling moments. The saving grace is that, when landings are aborted, application of full power has you back in the air almost instantly for a go-around or a chance to re-stabilize for a second attempt further down the runway.

The factory discourages wheel landings for several reasons. One is minimal prop clearance (a mere 3.75 inches in the level attitude on N111EU); so prop strikes could result from a botched wheel landing. Also, the Europa sits on the ground at a shallow angle of only about eight degrees from the horizontal, far less than the stall angle of attack. With the main wheel well forward of the cg, a main-wheel-first landing invariably results in an abrupt re-launch at a nose-high pitch as the tail's downward momentum forces the wing into a higher angle of attack. Conversely, if the tail touches down too far ahead of the main wheel, the bounce off the main wheel can have a similar result if speed is much above stall.

I did settle upon a few techniques that helped make landings easier. It is a good idea to offset to the right slightly on final approach so that the runway centerline remains in view as a directional reference throughout the landing and rollout. I also found it helpful to set the final approach speed to about 60 KIAS and carry sufficient power to produce a sink rate of about 300 FPM over the fence; leaving the power in all the way through the flare to touchdown. This puts the approach slightly onto the backside of the power curve, so that the wing is ready to stop flying when power is eased out following touchdown. My best landings were achieved by arresting the flare at a slightly tail-low pitch attitude about 1-2 feet off the ground, letting the Europa decelerate and settle on its own, cutting power after touchdown, and holding the stick back during the rollout. I found little difficulty with basic directional control after touchdown provided that the stick was held in the full-aft position and positive control is maintained all the way to a full stop. The forward location of the main wheel allows aggressive use of the very effective main-wheel brake without fear of nosing over.

Regardless of the type of aircraft you are flying prior to the Europa, first flights should be thought of as transition training rather than a simple checkout, and include the qualified assistance of someone who is comfortable in the aircraft's right seat. The stick and rudder skills required to master takeoffs and landings in the mono-wheel Europa will serve the pilot well in all the flying he or she does, but a tri-gear version of the kit is available for those who would prefer a less challenging alternative.

CONCLUSIONS

Our favorable first impressions of the Europa were generally confirmed by a growing appreciation of the design as we studied its capabilities in greater depth. I predict that its excellent performance, economy, and great handling qualities will earn a growing worldwide following for the design.