ELA-07 Autogyro

2003 NOT ONLY MARKS THE CENTENARY YEAR OF AVIATION, IT IS ALSO THE 80TH ANNIVERSARY OF THE FIRST SUCCESSFUL ROTARY WINGED FLIGHT. JERRY WEST VISITED THE BIRTHPLACE OF THE AUTOGYRO – AND TEST-FLEW THE NEW ELA-07.

ELA - after the founder Emilio Lopez Olmany - is based at Grinon, Spain not for from Getafe, which was the birthplace in 1923 of the autogyro concept. The company is run by Emilio and his two sons.

The two-seat dual-control ELA-07 is the latest in a series of autogyros from ELA.

In a field in Getafe, a small village to the south west of Madrid, on the morning of January 9, 1923, Lt Alejandro Gomez Spencer took Juan de la Cierva's pioneering invention, the C-4, into the air for the very first time. Cierva called his invention the 'Autogyro' and his vision was of a safer aeroplane; one that could not stall. This first flight marked another major milestone in aviation history and - whilst the flight at Getafe may have only lasted for a few minutes - the legacy, like that of Kittyhawk, has lasted a life time.

Ironically, Cierva died 13 years later, in 1936, when the KLM DC-2 he was flying in stalled and crashed in heavy fog after take-off from London. The same year saw the first helicopter fly... thanks to Cierva's rotary wing innovations. Helicopter designers ever since have been using Cierva's patents in one way or another to build their machines, machines that would ultimately put the autogyro in the shade for many years to come.

Fortunately, the autogyro is emerging from that shade. The persistence of the numerous enthusiastic home-builders, spawned by Dr Igor Benson and his designs, has kept the autogyro from fading away all together. Today, modern manufacturers, such as Magnigyro and Chayair, are helping to put the autogyro back into mainstream sport flying. New materials, better design and performance, combined with better training and therefore safety, are winning over more pilots than ever to this unique and exciting form of flight. Commercial applications are also in the pipeline - such as those being developed by CarterCopter and the Groen Brothers in the USA. There have been many false dawns for the autogyro but perhaps now, at long last, the unique potential of them is finally being realised, establishing their place in aviation's future even if they were not fully appreciated in the past.

I had always wanted to see the site of that first flight and visit the nearby museum at Cuatro Vientos, where some of Cierva's aircraft are on display. So, when I heard that a new gyro was being built under the same skies that saw Cierva's first flights, it was just the excuse I was looking for.

AS EMILIO RELEASED THE BRAKES AND ROLLED INTO THE STRONG WIND HE WAS AIRBORNE IN LESS THAN 10M!

My destination was Grinon, a village less than 10km from Getafe. In a small hangar near the village, Emilio Lopez Alimany (whose initials make up the company name, ELA) together with his two sons, Emilio Sanchez and his younger brother Daniel, have designed and built several autogyros. I was there specifically to fly their latest model, the ELA-07; a two-seat, dual-controlled ultra-light gyro. I first saw the machine by chance on the Internet and was very impressed with the published specifications and performance figures... so much so that I wanted to see and fly it for myself.

I was met by Emilio and his friend Peregrino, who came along to help translate, and taken from Madrid airport the 35kms straight to their modest hangar at the edge of a small private airstrip near to the village. I was told that the next day was forecast to be wet, so if I was up to it, we would fly straight away.

When we arrived at the hangar Emilio opened the hangar door to reveal several machines in various stages of completion. They looked as good as I had hoped and I was defi-

sign for 'you have control'. Accepting control, the aircraft immediately felt very stable with only minimal vibration through the control column, the least I had experienced in any gyro.

ELA uses French-built aluminium rotors. They did experiment with composite blades themselves, as they faced a similar problem to that of other gyro manufacturers in that they could not find rotors that were of a consistent

be pre-rotated to between 250 and 300rpm, much higher that any other machine I had flown. This would dramatically decrease the take-off run, which in still-air is quoted at 50m, but as Emilio released the brakes and rolled into the strong wind he was airborne in less than 10m!

Emilio climbed steeply before hovering in the strong breeze and then continued by carrying out several tight manoeuvres which graphically illustrated the machine's agility. He ended by landing just in front of us, with virtually no landing roll at all, and enough energy left in the rotor to reverse a little way back to us. It was a very impressive display and I could not wait to fly it myself.

The primary flight controls and engine throttle are duplicated in the rear of the aircraft, but the rotor controls, trim and flight instruments are only in the front. They had intended that I was initially going to fly with Emilio's eldest son as he spoke some English and would instruct from the rear. Unfortunately, he was unfit to fly due to a painful back problem, so I would fly with his dad. Emilio however, did not speak English and as my Spanish is the equivalent of Manuel's English in *Fawlty Towers*, there loomed the likely prospect of miscommunication. Therefore I would fly from the rear seat at first, which would give me the opportunity to look over Emilio's shoulder to see how things worked.

With both of us in this time, Emilio took more of an angle across the runway to increase the distance available. The pre-rotator is located on the left-hand side of the front cockpit, just in front of the co-located throttle and wheel brake assembly. Emilio set 1000rpm on the engine and pulled the pre-rotator lever aft to engage it, keeping the control column forward at first. The control column remained still as the pre-rotator engaged and the rotor began to turn. The rotor rpm increased towards 200, at which point the power was increased to 2000rpm and the control column moved slightly back. As the rotor approached 250rpm, the pre-rotator was pushed forward and off, then the brakes were released as the throttle was opened up. As we rolled forward, the control column was pulled progressively aft until the nose began rise, at which point Emilio checked forward, balancing on the main wheels only.

THE AIRCRAFT IMMEDIATELY FELT VERY STABLE WITH ONLY MINIMAL VIBRATION THROUGH THE CONTROL COLUMN

Passing 60km/h Emilio allowed the 07 to take to the air. Initially we maintained a shallow climb until reaching 90km/h, at which speed we climbed away at over 1,000ft/min. We flew off, over the fields and vineyards that surround Grinon. As soon as was safe, and with the aircraft fully trimmed, Emilio held both of his hands up in the air and pointed one finger at me, a signal which I understood to be the internationally recognised enough quality to be acceptable for their machines. The problem with blades is that it is very hard to produce a set of uniform blades in span, width and chord. With composite blades the crucial stage is the final curing process where each blade has to be heated along its length to produce a uniform profile. Any imperfection means that the blades will be hard to balance, and any imbalance will translate into vibration. Aluminium rotors can be more consistently produced and therefore are easier to balance, and this one was very good... even though, as I was to find out later, the 8.4m rotor had not yet been fully balanced!

The open cockpit gave an incredible view as we flew low over the vineyards, following the various tracks and paths that criss-crossed them. The rear seat was as comfortable as the front and, surprisingly, there was much less wind buffet than I had expected. Emilio's son told me that it was even better in the front, as the

LEFT TO RIGHT: **Accepting control the aircraft felt very stable with only minimal vibration through the control column, the least I had experienced in any gyro. ...Pulling up from the fields we did some steep turns before returning to the airfield.... The approach speed was 100km/h reducing to 60km/h in the final phase. The landing role was less than a couple of metres** (ALL EXPOSURE UNLESS STATED)

ELA-07 SPECIFICATIONS

DIMENSIONS:		
FUSELAGE LENGTH	15ft 5in	4.7m
HEIGHT	8ft 6in	2.6m
ROTOR DIAMETER	27ft 6in	8.4m
ROTOR AREA	86.4ft2	26.4m2
PROP DIAMETER	5ft 2in	1.73m
WEIGHTS AND LOADINGS: (912/914)		
EMPTY WEIGHT	543/592lb	245/250 kg
MAX AUW	1105/1,215lb	500/550 kg
USEFUL LOAD	564/663lb	255/300 kg
FUEL CAPACITY	13.2 Imp gal	60 lit
RANGE	310 nm	500 km
PERFORMANCE: (Rotax 912/914)		
VNE	92/102 mph	170/190 km/h
CRUISE	70/75 mph	130/140 km/h
CLIMB RATE	800/1200 ft/m	4/6 m/sec
SERVICE CEILING	14,000ft	4.2 km
MAXIMUM RANGE	310 miles	500 km
ENGINE OPTIONS		
	ROTAX 912 ULS (100hp)	ROTAX 914 TURBO (115hp)
MANUFACTURER		
ELA AVIACIÓN S.L. SENDA DEL PINO SN, 28971 GRINON, MADRID, SPAIN.		
TELEPHONE: (34) 680 460932		FAX: (34) 918 138159
E-MAIL: ela@elaaviacion.com		WEB: www.autogiro-ela.com
PRICE:	Approx 51,000 EU (£22,100) with Rotax 912. 36,000 EU (£25,700) with Rotax 914 Turbo.	

The fuel tank holds 13.2 gallons, enough for a range of over 300nm.

The first flyable ELA, the -03, flew in 1995 and through a process of development led to the -07. Its first flew in January 2002 and although it has only recently been officially marketed nine have been sold and six more are on order.

nitely ready to fly, having to save the numerous questions I had until later.

ELA built its first gyro, logically the 01, in 1992. It was essentially a feasibility study and remained in the workshop. With some valuable lessons learnt, the engineless 02 took to the air in 1993, by being towed behind a car.

More testing eventually led to the first powered autogyro, the 03. It flew in 1995 and was fitted with a Rotax 582 two-stroke engine. The design was more than encouraging and the evolution continued with three more models, including the fully-enclosed 05 powered by a Volkswagen engine, the open cockpit 06 with a Honda engine, and now the Rotax-powered 07. Since the 07 first flew in January 2002, nine have been sold and a further six are on order. Not bad when you consider that ELA has only just begun to market the aircraft.

Back at the hangar, Emilio and his sons wheeled out the orange demonstrator into a sunny but windy afternoon. Emilio wanted to fly on his own at first to check that it was fully serviceable, during which he would put on a short display. The demonstrator was fitted with the 100hp 912 Rotax engine, although the 115hp 914 turbo engine is also an option.

Emilio started up and taxied a short distance to face across the grass strip into the 15 to 20kt wind. With the brakes on and engine warmed up, Emilio began pre-rotating the rotor. ELA's web site said that the 07 could

screen was so effective he was even able to smoke in flight! I said that that sounded dangerous, but he said he only smoked ten a day. Later I would get my chance to fly from the front, without a cigarette, but it was indeed as effective as he said.

Pulling up from the fields, we gained height and did some steep turns before returning to the airfield, lining up across the runway again... this time to land. The approach speed was 100km/h reducing to 80 in the final phase. The landing role was less than a couple of meters.

The flight over, it only served to whet my appetite and, fortunately, the weather was not as bad as predicted over the days to come so I was able to fly several more times to satisfy the thirst.

Over those next few days I also took the chance to take a closer look at the gyros and to ask the questions I had saved from the day I arrived. Firstly I asked about the unique, angled tail design. As I understood it, the design was primarily intended to accommodate their preferred 'DUC' carbon fibre propeller. Larger than many other props currently in use, measuring 1.73m in diameter, either the engine would need to be mounted higher or the tail would have to be redesigned. Obviously, the latter won out... and for a very good reason.

Raising the engine would also raise the thrust line, which in gyros generally undesirable. The Achilles' heal of 'pusher' gyros, those with a rearward facing engine mount, is the possibility of pitching forward violently at high speed and high thrust settings. Such an event is known as a 'power push over' (PPO) and is catastrophic. Gyro rotors are not rigid, pivoting like a see-saw on a single teeter bolt. It was Cierva who first realised that the rotor had to able to rise and fall as it rotated to balance the lift generated. This type of rotor, however, has to remain positively loaded to produce lift. Negative loads would cause the rotors to collapse... dumping all of their lift.

Imagine cycling with an umbrella over your shoulder, which is already inside out, representing a normal loaded rotor disc. Moving the umbrella progressively forward into wind would eventually cause it to snap back into place. Early gyro designs of the 1950s and '60s were typically fitted with 40hp engines mounted relatively high above the centre of gravity. In such a position, gyros tend to pitch nose down as the power is increased. As new machines were built with more powerful engines but little or no adjustment in the engine position, the problem of PPO became more evident. These gyros now had enough power, under certain circumstances, to pitch the nose beyond the point of no return, bringing the rotor 'over the shoulder'. Today, with over 100hp available, the position of the engine is one of the safety critical factors.

ELA'S TAIL NOT ONLY KEEPS THE THRUST LINE LOWER, IT HAS OTHER ADVANTAGES TOO AS IT CONTRIBUTES TO A STRONGER FRAME

Like all good design solutions, ELA's tail not only keeps the thrust line lower, it has other advantages too as it contributes to a stronger frame, whilst also producing a natural shape for the take-off and landing flare. From what I could tell on the first flight, this not only looked good but also seemed to achieve a high level of pitch stability. Subsequent flights in various conditions would confirm this impression.

Fuselage and tailplane designs have also come a long way since the early 'bed frame' constructions of the past. Tailplanes, in particular ones combining both a vertical and horizontal stabiliser, have dramatically increased pitch and yaw stability. The fuselage section essentially hangs below the rotor by the teeter bolt. Lift, pitch and roll are all provided by the rotor. Therefore the flight controls are flying the rotor, with the fuselage following it.

The fuselage and tail, whilst reducing drag, should also be designed with the ability to follow the required flight path as closely as possible in order to provide the correct visual cues to the pilot and prevent any disorientation or confusion. An unstable airframe, one without any pitch and yaw dampening, could oscillate wildly beneath the rotor providing the pilot with some very misleading visual cues. These cues could easily be misinterpreted by both experienced and inexperienced pilots, leading to incorrect control inputs causing further instability. This pilot-induced oscillation could, left uncorrected, lead to a power push-over as described earlier. ELA's fuselage and tail design seemed to fly true, despite the gusty conditions, and gave a real sense of stability.

Adding to the ease of control of the 07 was the ability to trim accurately. ELA uses a pneumatic system for trimming the rotor head and for the rotor brake mechanism. The company prefers this system as it provides a smoother, more progressive trim than that of a more conventional electric system. Trimming is via a switch located to the left of the throttle and pre-rotator lever. Future models will have the switch moved to a more conventional position on the control column. The small pneumatic pump lies behind the rear seat on the rotor mast.

The most impressive aspect of the 07 for me was still the ability of the pre-rotator system to spin the rotor up to 300rpm. To achieve this, ELA uses two strong shafts connecting the engine drive to the rotor head. This efficient and robust design reduces transmission losses, maximising the power available to the rotor head for spin-up. The 07 can achieve rotor spin-ups close to those required for flight, and Emilio hopes to one day build a gyro that can take off vertically. The ability to 'jump' into the air has already been achieved with Cierva's C-40 autogyro, built in 1936, which could jump nearly 30ft vertically before flying forward.

Another fresh approach could be found in the rudder pedals, which are pivoted around a horizontal axis instead of a vertical one. The pedals are simple to use, and move the rudder and front wheel steering by the ball and heel of the feet rather than the more conventional fore and aft motion of the legs.

Further technical specifications for the ELA-07 are as published and, having flown the machine, I believe them to be fairly accurate. The figures are based on either the Rotax 100hp 912 or the 115hp 914 turbo engine. Respectively, the basic weights are 245kg/250kg, with the maximum take off weights of 500kg/550kg. The maximum speeds are given at 170/190km/h, cruising at 130/140km/h. Normal take off distances are 80/50m in still air, with a maximum rate of climb of at 4·6m/s.

The aluminium fuel tank has a capacity of just over 60 litres, giving an average range for both engine variants of approximately 500km.

Emilio and his sons modestly say that they hold the gyros of the Italian manufacturer Vittorio Magni as their bench mark. I believe that they deserve to have their own mark on the same bench. Undoubtedly, Magni's gyros are very refined machines but judged on performance, the 07 can hold its own against this or any other factory-built gyro currently available on the market.

Emilio, like Cierva before him, believes in uncomplicated, practical design and the 07 reflects this. ELA has designed and built an original autogyro, aiming to produce a simple, practical machine that is safe and fun to fly. From what I could see, they have achieved that aim.

The competition can only be good. The ELA-07 offers superb performance and handling qualities at a more affordable price than those currently available. The 07 costs 31,000 Euros (around £22,100) for the 912 version, and an extra 5,000 Euros (£3,600) for the 914 turbo. Standard equipment includes all the primary flight, rotor and engine instrumentation, although an intercom/radio is extra. As always, it is the cost of the engine that is a major factor in the final price, with Rotax having a virtual monopoly in this area. All we need now is some competition to rival its products and even better value gyros would be within our reach.

As a postscript to this article, one thing that did surprise and slightly disappoint me on my visit to the area where it all began was the lack of recognition that Cierva seems to have been given locally, especially as this year coincides with the 100th anniversary of aviation. Indeed the Cierva Autogyro collection at the museum at Cuatro Vientos was closed to the public when I visited. When we did eventually find a way in, there was still no acknowledgement of the importance of the autogyro in the history of rotary winged flight. There is little doubt that Cierva's work made the helicopter a possibility far sooner than it otherwise would have been and, had he lived longer, perhaps he would have been the one to build the first. Maybe then at least a plaque may have been mounted to at the scene of his first flight to commemorate his achievements.

He probably would have been content in the knowledge that his work is being continued through people with similar passion and foresight, like Emilio and his sons, over 80 years after that first flight at Getafe. ■

Above **The rear seat w as comfortable as the front and, surprisingly there was much less v buffet than I had expect This shot looking back shows the lack of clut at the back of the airc**

Left **1993 and the engineless ELA-02 was being towed by a car to check basic aerodynamics.** (ELA)

Below **According to Emilio's son the screen was so effective that in the front seat he was even able to smoke in flight!**