

Eclipse Aviation Eclipse Series

General Aviation/Utility
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Program Briefing

Eclipse Aviation designed and is building its EA500 very light jet (VLJ), a twin-turboprop six-place private jet. The company was created in 2000 and the first EA500 prototype flew in August 2002. The first EA500 was delivered in December 2006. By September 2008 more than 200 had been delivered. It competes with Cessna's Mustang and Embraer's Phenom 100 (see Citation and Phenom reports).

Eclipse has also proposed development of the EA400, a smaller four-place single-engine micro-jet.



Source: DayJet

Manufacturer

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Subsystems

Airframe

The EA500 has rear-mounted engines and a T-tail. The EA400 is distinguished by its V-tail.

- Cox Machine: sheet-metal fabricated components and assemblies
- Ducommun: fuselage and cockpit skin panels
- EDO Corp: antennas
- ENAER: nose assembly structure
- Fuji Heavy Industries: wings
- Hampson Industries: empennage, vertical and horizontal stabilizers, rudders, elevators
- Mecaer Group: landing gear
- Michelin: tires
- Saint-Gobain: radomes

Propulsion

Engine

The Eclipse 500 is equipped with two pod-mounted Pratt & Whitney Canada PW610F turboprops, each rated at 900 lbst, with FADEC. The EA400 uses the PW615F.

Propulsion System Subcontractors

- Hispano-Suiza: FADEC on PW610F
- Meggitt Safety Systems: engine fire and overhead detectors
- TIGHITCO: engine mount thermal insulation system

Electronics

The EA500 uses the Avio NG avionics system, created and integrated by Eclipse. Avio partners include:

- Chelton Flight Systems: flight management system
- Curtiss-Wright (Autronics): Processing Center
- Garmin International: dual remote mounted Mode S enhanced surveillance transponders; GPS 400W (on Avio Version 1.5)
- Harco Laboratories: air data system
- Honeywell: Primus Apex KTR 2280 multi mode digital radios
- Innovative Solutions & Support: Primary flight and multi-function displays
- PS Engineering: PMA500 remote audio control system

Other than the Avio system, Eclipse uses a Japan Radio Co. color

weather radar. This replaced the Honeywell RDR-2000 radar in July 2007.

Honeywell's KGP 560 Terrain Awareness System is offered as an option. Crossbow Technology is providing the attitude heading reference (AHRs) system. Meggitt Avionics builds the flight guidance system. Comant Industries provides antennas.

Other Systems

Other Contractors

Other contractors involved in miscellaneous subsystems are as follows:

- Argo-Tech: integrated fuel system
- Astronics Corp: power conversion and distribution systems
- Crouzet: proximity switches
- Curtiss-Wright Controls: throttle quadrant assembly (with Novatronics)
- Dukes: digital interface cabin pressure control system, high temperature valving, air control components
- German Machined Products: instrument panel assembly and nose wheel steering assembly
- Heads Up Technologies: interior LED lighting
- Northstar Aerospace: seats
- Parker Hannifin: wheel and multi-disc brake system and related hydraulic components
- Seamech: air conditioning modules
- STEICO Industries: systems tube assemblies
- Zodiac-Aerazur: de-ice boots

Specifications

	<i>Eclipse 500</i>
Length overall:	33 ft 6 in (10.2 m)
Height overall:	11 ft (3.4 m)
Wingspan:	37 ft 11 in (11.6 m)
Weight empty:	3,634 lb (1,648 kg)
Max. T-O weight:	6,000 lb (2,722 kg)
Useful load:	2,400 lb (1,089 kg)
Max. cruise speed:	370 kts (685 km/h)
Max. range:	1,125 nm (1,295 mi; 2,084 km)

Costs

In May 2008 Eclipse raised the price of the EA500 by \$555,000, to the current (as of this writing) \$2.15 million.

The EA500 was originally priced at \$775,000. By mid-2001 the price

was \$837,500. In January 2003 it was raised to \$1.175 million for all new orders. In May 2005 the price reached \$1.295 million. One year later it hit \$1.445 million. The first customer (or at least the customer that took deliv-

ery of the first EA500), Jet Alliance/David Crowe, paid \$995,000 plus \$82,000 in options.

As of May 2008 an Eclipse 400 costs \$1.35 million.

Sales/Deliveries Data

Order Book

In May 2004 Eclipse claimed that it had firm orders for 2,100 EA500s. In May 2007 this number was stated

at "just under 2,700 units, including orders and options." However, that number included 1,400 orders for

failed air taxi company DayJet. A new number has not been provided.

Deliveries

The first 500 was delivered (on paper) in 2006, but the physical delivery did not take place until January 2007.

In 2007, another 98 were delivered. Another 112 were delivered in the

first half of 2008 for a total of 211 aircraft.

Program Overview

Eclipse History

Origins

Eclipse was created by ex-Microsoft executive Vern Raburn in 1998. In 1999 the company began development of the Eclipse 500, positioned as a \$775,000 entry-level jet capable of carrying five passengers 1,800 nm. The company named a board of directors the same year.

In 2000, the company established its offices in Albuquerque, N.M. In November 2001 Eclipse completed its move to Albuquerque. The same year the company selected most of its suppliers and cut the first metal for the aircraft.

In July 2002 Eclipse rolled out the first 500. The same month Eclipse announced that it was installing the Avio avionics package as standard equipment on the 500. The same year the FAA approved friction stir welding (FSW) as a manufacturing technology. Eclipse Aviation is the first aviation manufacturer to use FSW.

In February 2005 Eclipse won the National Aeronautic Association's Collier Trophy, the NAA's award for the greatest achievement in aviation in the United States.

Propulsion And Avionics Changes

A key technological enabler for the Eclipse was the Williams International EJ22 turbofan. Williams, a specialist in cruise missile engines, developed the EJ22 from its FJX-2. The FJX-2 was a growth version of the FJX-1, which was used to power Williams' own V-Jet. The V-Jet was one of the first VLJ concept planes, and appeared at EAA AirVenture, Oshkosh, Wisconsin, in 1997.

In August 2002 the EA500 made its first flight using EJ22s, each rated at 770 lbst. However, a few months later Eclipse announced that it was

dropping Williams International. There were several accounts of this development, but then-CEO Raburn said the EJ22 did not provide enough thrust and that "Williams International has not met its contractual obligations."

In February 2003 Eclipse selected Pratt & Whitney Canada as the new engine supplier. As an interim solution, the company used Teledyne Continental Model 382-10E turbojets to power a test aircraft, which flew 55 flights before the new engines were installed. In December 2004, the EA500 made its first flight with the new PW610F engines.

Integrated avionics are another key Eclipse technology, with the same level of difficulty as the engines. Originally the EA500 used Avidyne displays, but in March 2007 Eclipse announced that it would replace Avidyne with the Avio NG, a total aircraft integration system. Eclipse is acting as integrator for this system, but there are numerous major partners (see **Electronics**, above).

As a result of the engine situation, EA500 deliveries were delayed almost three years. Certification was re-scheduled for March 2006, with first deliveries in April or May.

Company Funding

Eclipse obtained its seed funding in 1999, with \$60 million raised from 30 high-net worth individuals. It also claimed that total development costs would be \$300 million-400 million. Another \$62 million was secured in September 2001, with a total of \$220 million raised by February 2002.

In July 2002 Eclipse announced that it had received a fourth round of private equity funding for \$18 million. An additional \$87 million was secured in July 2003. That round of fi-

nancing included a \$10 million investment from the New Mexico's State Investment Council. The total raised by that point by Eclipse was \$325 million.

In mid-2004, Eclipse secured \$45 million in an industrial revenue bond package from the Albuquerque City Council. This came with a \$770,000 property tax abatement.

In mid-2005 Raburn said that Eclipse had spent about \$400 million. He estimated that another \$35 million would carry the company through certification. However, in mid-2006 the company revealed that it had secured another \$225 million in pre-IPO convertible debt funding, arranged through UBS.

All told, Eclipse has raised and spent more than \$1 billion as of this writing.

Production Plans

The original plan, as of early 2000, was for production to begin in 2003 with 110 deliveries planned for that year. In mid-2001 the company stretched out the development program, with first deliveries scheduled for January 2004. Originally, Raburn's business plan called for the target production rate of 1,000 planes per year (four per working day) to be reached by 2007. In late December 2006 Raburn said Eclipse would deliver 500 planes in 2007.

According to Raburn in 2006, the minimum breakeven production rate was 500 planes per year (later raised to 625-650) but 750 per year were needed to be "comfortable."

The Air Taxi Market

Eclipse's ambitious production plans were largely predicated on the development of mass air taxi services. Originally also known as air limou-

sines, the air taxi idea was that small jets would be able to efficiently provide on-demand air service at relatively low prices. The FAA eagerly embraced the concept, and in February 2006 the agency forecasted 5,000 air taxis in service by 2017.

NASA, whose Small Aircraft Transport System (SATS) was intended to cater to air taxis, joined the FAA in embracing Eclipse as a harbinger of its vision of the future (the best example of this relationship can be found at www.sti.nasa.gov/tto/spinoff2002/t_1.htm). NASA declared that "Flying direct to nearly any city from the closest local airport may soon become a viable option for everyone." In 2005, it forecasted 400 air taxi flights per day by 2014, with demand for 8,900 VLJs by 2016.

The first large-scale air taxi business plan came from Nimbus Group. In February 2002 Nimbus arranged a \$1.2 billion finance commitment from Dafin Asset Finance, which purportedly had connections to the Royal Bank of Scotland. That figure was expected to cover an order for 1,000 EA500s, but in July 2002 the company withdrew its order and disappeared.

Numerous air taxi companies followed Nimbus. The biggest air taxi company yet created, by far, was DayJet. Created in 2002, the company, under the name Jetson Systems, placed an order for 1,400 EA500s. The same year that order was put under DayJet's name, but publicly DayJet only promoted placing 200 firm EA500 orders, with an option for an additional 70 planes. In 2006, DayJet selected Florida for its headquarters. It received its first three Eclipses in March 2007, and began operations in October 2007.

DayJet survived for just under one year. In May 2008 DayJet announced that it was scaling back its plans due to inadequate capital. It halted Eclipse deliveries and cut about 40% of its work force. In June, the company signed a five-year agreement with the FAA to accelerate NextGen technology employment to help modernize

the National Airspace System (NAS). In September the company discontinued all operations and cancelled all flights. No reservations were honored, and no refunds were provided. According to the company, a return to business was "unlikely."

As the company failed, DayJet founder Ed Iacobucci stated in September 2008, "During the past year, we have demonstrated, beyond a reasonable doubt, that customers will sign up, purchase and become frequent users of this new service - the DayJet 'per-seat, on-demand' model works." DayJet officials blamed the company's demise on the capital crisis, but also claimed that "The company's operations have also suffered as a result of Eclipse Aviation's failure to install missing equipment or functionality or repair agreed technical discrepancies in accordance with the terms of DayJet's aircraft purchase contract." DayJet's fleet of 28 Eclipses remains idle as of this writing, with United Technologies Finance, subsidiary of United Technologies Corp. as the lien holder. UTC is the parent company for Pratt & Whitney Canada.

Despite DayJet's demise, there are numerous other air taxi companies hoping to prove the concept, most notably POGO. Based in the Northeastern US, POGO has so far failed to attract funding. However, it would still like to start operations in 2009. Serving the Northeast and mid-Atlantic regions, Linear Air, which started in 2004, has ordered 30 EA500s. In October, Linear Air laid off 15 employees. It currently operates two of the four EA500s that it manages.

Another notable air taxi venture, later to acquire Eclipse, is European Technology and Investment Research Center (ETIRC) Aviation. In May 2007 ETIRC became the largest European customer with an order for 120 firm and 60 option EA500s. In mid-2006 ETIRC signed an agreement to distribute the EA500 in Russia, the Commonwealth of Independent States (CIS), Ukraine, and Turkey.

Certification And First Deliveries

In July 2006 FAA Administrator Marion Blakey awarded Eclipse a provisional type certificate. In September 2006 the FAA awarded full type certification for the EA500.

Eclipse applied for a production certificate in September 2006. On December 31st, Eclipse delivered the first and only aircraft of 2006. It was actually a virtual delivery, with the co-owners signing the documentation late at night via fax. A formal delivery ceremony took place in early January 2007, but the aircraft was officially counted as a 2006 delivery.

However, this one aircraft and several more were delivered under provisions of the type certificate. This meant that the FAA needed to sign a certificate of airworthiness for each aircraft until Eclipse received the production certificate. This wasn't awarded by the FAA until April 2007.

In June 2008 the FAA awarded flight into known icing (FIKI) certification for the Eclipse 500. This certification permits the Eclipse 500 to operate in conditions in which ice is known to be present. However, as of this writing, FIKI has not yet been installed on Eclipse planes. Aircraft that were produced without basic Avionics are not equipped to receive FIKI.

Eclipse 400 Concept Jet

In May 2007 Eclipse announced that it was studying a V-tailed single engine micro-jet known as the EA400. This four-seat (three passenger) aircraft uses a single Pratt & Whitney Canada PW615F engine. In July 2007 it made its first flight.

The EA400 was described as solely a concept aircraft (known as the Eclipse Concept Jet), but in May 2008 it was formally put on the market. Priced at \$1.35 million, it was offered to Eclipse 500 customers who balked at paying the new EA500 price (\$2.15 million). Eclipse also offered customers an additional \$125,000 discount off of the introductory price

if they placed their deposits before July 25.

In June, Raburn claimed that “nearly 100” EA500 buyers had traded their orders for EA400s. Deliveries are scheduled to begin in late 2011, but the status of this development program is unclear as of this writing.

Other Resources And Viewpoints

Two remarkable blogs have tracked Eclipse’s history over the past three years. They contain a wealth of information and opinion from both the pro and con sides. They also document the degree of anger and enthusiasm inspired by this program and by air taxis in general.

The first blog, Eclipse Aviation Critic (<http://eclipseaviationcritic.blogspot.com>) was started in 2006 by

Stan Blankenship, an aviation industry veteran. Citing concerns about retribution from Eclipse’s new financial backers (ETIRC and the Russian government), Mr. Blankenship terminated this blog in early 2008 (although as of this writing the blog is still accessible in its entirety). The mantle was taken up by Shane Price, an Irish publishing executive. He launched Eclipse Critic NG (www.eclipsecriticng.blogspot.com) immediately after the previous blog ended. In 2008 Eclipse filed an unsuccessful lawsuit to obtain identity details about the bloggers who posted on this site.

Primary documents relating to Eclipse’s New Mexico government support, the FAA certification officials’ complaint, and other matters can be found at www.eclipsecritic.net. Karen Di Piazza has provided

superb reporting on the subject at www.charterx.com/resources/industrynews.aspx and Airport Journals. Past notes on Eclipse written by the author of this report can be found at www.richardaboulafia.com at the December 2002, March 2006, April 2007, and August 2008 monthly newsletters.

From the other side of the aisle, author James Fallows has written numerous blog entries and magazine articles on the subject of air taxis and Eclipse. One of his many superb books (*Free Flight: From Airline Hell to a New Age of Travel*) concerns both subjects. There are myriad other air taxi and Eclipse supporters, including noted technophile and internet guru Esther Dyson and Rich Karlgaard, Forbes magazine publisher.

Current Developments

The Certification Controversy

In 2006 the FAA certification engineers’ union filed a grievance claiming that the FAA had certified the EA500 despite safety and regulatory concerns. In August 2008 the House Transportation and Infrastructure Committee announced that it would hold hearings on the Department of Transportation Inspector General’s findings relating to the certification engineers’ complaints. The same month, the FAA began a 30-day “special” review of the Eclipse, looking at safety and certification issues.

In September, the FAA review basically cleared the Eclipse certification process, with some relatively minor concerns. However, a few days later the DOT Inspector General (IG) issued a report strongly criticizing the FAA’s Eclipse certification process. The IG concluded that the FAA certified the EA500 “despite unresolved design problems.” According to the IG, the “FAA also awarded Eclipse a production certificate even though there were known deficiencies in its supplier and quality control systems.” The IG stated: “This isn’t about a certification process riddled with

flaws...What this case is about is an accommodative approach to a new manufacturer using new technology and a new business model to put a high-speed, high-altitude jet in the hands of relatively inexperienced private pilots.”

Ownership Changes, Company Problems

In January 2008 Eclipse received an equity infusion from ETIRC. Raburn called the infusion “substantially in excess of \$100 million” and said the money would allow Eclipse to achieve operational profitability as production ramped up to 625-650 aircraft per year by late 2008 or early 2009.

In July 2008 Raburn was ousted from his CEO position in exchange for the company receiving an additional unspecified investment from ETIRC. Raburn said he would stay on as vice chairman, but several weeks later he severed all ties with the company.

In August, the new ownership began restructuring Eclipse. The company fired 38% of its workforce — 650 employees — in order to deal

with cash flow problems. It also introduced an “operational excellence strategy” aimed at changing its production methods.

In September, new CEO Roel Pieper reorganized Eclipse into three separate units — Eclipse Manufacturing, Eclipse Customer and Process Improvement Teams. Pieper, who is chairman of both Eclipse and ETIRC, plans to ramp up production to one and a half jets per day by the second half of 2009.

Also in September, Russia’s Vnesheconombank (VEB) Supervisory Board, chaired by Russian Prime Minister Vladimir Putin, approved the construction of a Russian factory to produce and assemble the EA500. If the money is provided, production will take place at Ulyanovsk-Vostochny International Airport, but the Albuquerque plant will also continue to build planes. Eclipse says that Russian production will begin in 2010, with an anticipated rate of 800 jets per year. VEB said it expects to finance the project in full, with total funding of \$205 million.

Meanwhile, Eclipse is working with UBS to secure underwriting of a

new \$200-300 million investment. Eclipse plans to use funds from VEB

and/or UBS to resume “normal operations” in 2009.

Teal Group Evaluation

A Unique Program

The Eclipse program was designed from the outset to be revolutionary and unique. In Teal Group’s estimation, the people behind Eclipse have attained this objective. This program is the single worst aviation program Teal Group has ever covered.

It isn’t the aircraft itself. Rather, it was a business plan that makes no sense, except to attract investors who don’t know much about the aviation business. The plan called for 1,000 deliveries per year. As a reference point, in 2007 the world’s manufacturers delivered a total of about 4,000 turbine-powered aircraft of all types and models. This one company, an unknown start-up, proposed to grow that global figure by 25%, admitting that it couldn’t survive if it merely built 450 planes per year (100 aircraft more than any other turbine-powered aircraft model).

The formula was remarkably simple. A completely unrealistic production rate was predicated on an unrealistically low price (less than \$800,000, at first). That impossibly low price was predicated on the unrealistically high production numbers. This formula (promoted as a revolutionary paradigm) worked, as long as people gave Eclipse money. As soon as they stopped (which has been happening for the past 12 months), reality caught up to Eclipse, and it began hemorrhaging cash.

It was more than just numbers. Eclipse tried to become too big to fail in cultural and social ways too. Enormous sums were lavished on publicity and advertising. The company cultivated numerous celebrity relationships, attracting prominent fans and advocates. The air taxi concept was promoted as a revolutionary phenomenon that both justified the production numbers and attracted attention from investors and the gen-

eral public. “New” production methods (purportedly inspired by Raburn’s computer background, but actually originating years ago at Embraer and other aircraft manufacturers) were also used to justify the hyper-ambitious build rate objectives.

Despite the ludicrous business plan and the company’s aggressive arrogance, people gave Eclipse hundreds of millions of dollars. For Eclipse and for Raburn, this was a truly extraordinary achievement. One might almost say it was disruptive.

Counting The Cost

Combine the business costs of pursuing the jet air taxi myth with government spending on air taxi infrastructure (and subsidies to make it happen), add the cost of the Eclipse fiasco, and you get many billions of dollars in destroyed value. Jet air taxis and VLJs together constitute the worst misinvestment in recent aviation history.

In addition to the economic cost, this program and related air taxi schemes have had a toxic impact on a broad range of political and governmental entities. Somehow, the FAA got co-opted. If the IG’s report is correct, the FAA’s actions were reprehensible, a threat to the principals of good governance that keep society safe. It would be akin to the FDA deciding to approve possibly tainted milk because it came from a well-connected dairy. During recent congressional hearings, New Mexico Gov. Bill Richardson implied that jobs were more important than honesty, safety and good government. For possibly the first time, a US government entity provided equity cash for a private business.

Numerous luminaries were recruited for the Eclipse board lending their good names to this dubious venture. Several have distanced them-

selves from it. Government officials, journalists, pundits, and random people believed not only in Eclipse but in the dream of air taxis. Eclipse won a Collier Trophy, a highly suspect award decision that managed to demean all the other worthy recipients and the Collier itself.

What Happens Next

Keeping up with this program has become a surreal experience. Irrational investors make forecasting difficult, but socialist governments make it even tougher. The latest post-Soviet five-year plan calls for the Russian government to fund an Eclipse line in Russia. This is not a business decision made by the private sector, and therefore we can’t predict whether it will be provided. We also don’t know when the money will be provided. With numerous lawsuits from suppliers and customers, Eclipse faces the prospect of involuntary or voluntary bankruptcy.

It should be noted that there might be a good aircraft hiding under Eclipse’s deceptive business plan. Despite some serious and expensive teething problems with many of the EA500s built so far, some pilots are quite enthusiastic about its flying characteristics and economical operating costs (although many other pilots consider it a dysfunctional mass of parts flying in loose formation). Unlike most of the other failed VLJ wannabes, the EA500 is actually an innovative small jet. When fully matured, it might be regarded as an impressive engineering achievement.

This raises the prospect of someone acquiring Eclipse and changing all of the price and sales assumptions. Selling 100-200 jets per year would be quite reasonable. But the price needed to achieve profitability—probably about \$2.5 million—would make the EA500 much less competitive against Cessna’s

Mustang or Embraer's Phenom 100. For another \$300,000-400,000 buyers would get a more capable and robust aircraft with a much stronger guarantee of product support. Cessna and Embraer would also outgun any new Eclipse owner (other than Bombardier) in terms of sales, support and finance capability.

Eclipse's hypothetical new owners would also need to kick in large sums just to get the aircraft fully capable, to make good obligations to cur-

rent customers, and to get the production system straightened out. This would be a costly road map, especially since the light at the end of the tunnel would be a production program worth \$250-500 million in annual revenue with highly uncertain profitability.

There is also a respectable chance that a large company buys Eclipse and completely revamps the business plan and production system. This, of course, would happen after Eclipse

went bankrupt, removing any obligations to previous investors.

Without that kind of *deus ex machina*, we doubt that Eclipse can survive as an ongoing business. There is a chance that additional cash injections would keep it alive for another year or two. But for now, our forecast calls for production to end in 2009. And of course everything about the end of this program will be messy.

Production Forecast

User (Variant)	Through 2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
Eclipse Aviation												
All users (EA500)	99	165	65	—	—	—	—	—	—	—	—	329

**Excludes two prototypes*