

## *Rutan – The Canard Guru*



If there was a Noble prize for Aircraft Design, Burt Rutan would have been a unanimous choice. This brilliant designer has dramatically revolutionized aircraft design – particularly general aviation. While most of the designers live through a few designs in their life time, Rutan has gone at a phenomenal pace from a simple homebuilt VariViggen to White Knight - a dream machine for manned space flight – a private venture which no one ever dreamt or realized. The technological breakthroughs Rutan has brought in airplane design and composites are exceptionally unique. With Williams mini jet engines, he ushered in the dawn of jet powered small aircraft. Rutan's flying machines speaks for him. He is aptly called the "Canard Guru" as most of his designs have a foreplane or canard. It is not surprising that in February 2000, he was honored by the Engineers Council with Clarence L. "Kelly" Johnson "Skunk Works" award. Interestingly, Kelly tops the list of great designers admired by Rutan. Time magazine put him as "one of the century's most innovative designers". Let us know more about ***this magnificent man and his flying machines.***



**Elbert Rutan** was born in Dinuba, California, in June 1943. After obtaining a B.S. in Aeronautical Engineering in 1965, he took up the career of a Civilian Flight Test Project Engineer at Edwards AFB, California. This career, which he pursued until 1972, shaped him and his design approach. He was the specialist in flying qualities for 13 programs and wrote MIL 83-691, the spec. for testing stall and spin on all types of airplanes.

After working for two years designing and developing the Bede BD-J5, he formed the Rutan Aircraft Factory (RAF). For the next 10 years, he shaped the landscape of homebuilt aircraft with the VariViggen, VariEze, Quickie, Defiant, Long-EZ, Grizzly, Solitaire and Catbird.

Having participated in innumerable stall and spin test flights, he understood the need for a stall resistant design for the general aviation enthusiast. Individual fliers with a Private Pilot License (PPL) will not have experienced spin. An inadvertent input from the pilot during stall could lead to spin which could be fatal. Large number of fatal accidents in general aviation was of this kind and Rutan realized that the best solution to prevent spin is to prevent stall. It is here; he used the canard to its best advantage. If the canard were to stall first, the aircraft will automatically pitch down and wing stall is prevented.

Rutan's revolution in light airplane design started with the Vari-viggen, which he built in 1972. Its name and shape were inspired by SAAB AJ-37 Viggen, the Swedish AF attack plane. With a wing of 19 ft. span and a canard, powered by 150hp Lycoming

O-320 engine driving a pusher propeller, Vari-viggen had a max. Speed of 163 mph, range of 400miles and a ceiling of 14,000ft. It had remarkable flying characteristics - it displayed no conventional stall and could climb, cruise, glide, turn, and land with continuous full back-stick at a stable speed of 52mph throughout. It was like a fighter to fly and gave lot of thrill. Nearly 250 VariViggens were built based on the plans sold by Rutan.



Vari-viggen (1972)



In 1975, with Vari-Eze, Rutan ushered in the era of composite home-built aircraft. Vari-Eze –getting its name from the ease of construction –was an all-composite aircraft using fiberglass and rigid urethane foam core. Vari-Eze had winglets instead of the conventional fin, and rudders were located in them. While the proto-type used a 63hp VW engine, 100Hp Continental O-200 was typically used.

This was followed by an enlarged, longer-range and easier-to-fly version of **VariEze** named **Long-EZ**. With looks similar to Vari-Eze and using a more powerful 115hp Avco Lycoming O-235 engine, Long-Ez had a top speed of 183 mph and a range of 1430 miles and.

A few thousand plans of this pair were sold and a few hundred were built and flown. Using these two aircraft Dick Rutan (brother of Burt) and Jeana Yeager broke a series of world records for speed and distance.



Vari-Eze



Long-Ez

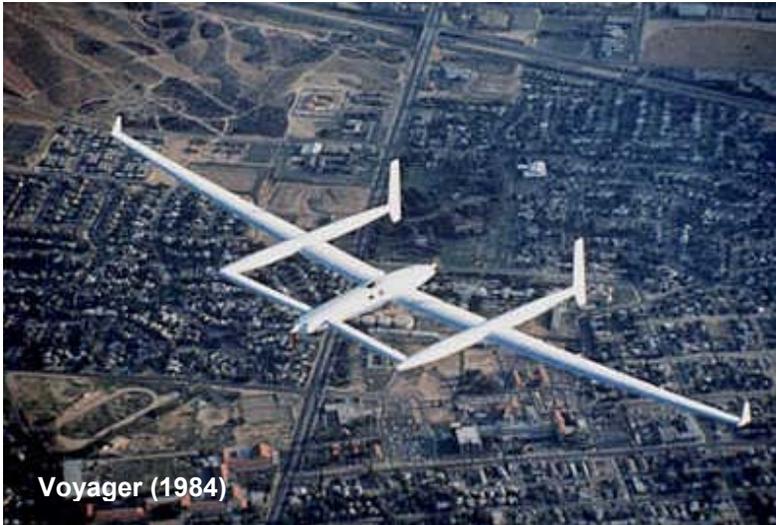
In 1978, Rutan brought out a four-place canard design named **Defiant**. This had two 160hp Avco Lycoming O-320 tractor-pusher engines. With a wing span of 29 ft. this machine had a range of 1130 miles.



In 1982, Rutan built a single place self-launching sailplane. As usual it has a canard – a hall mark of Rutan’s designs. A 23hp KFM 107E Retractable engine located in the nose driving a prop gave it the self launching capability. With a span of nearly 42’ it had a glide ratio of 32:1. Solitaire sailplane was the winner of a contest by the Soaring Society of America, to make soaring more accessible by removing the need for the tow plane. The aircraft worked very well, but few were ever built.

The real glory to Rutan and the Rutan Aircraft Factory (RAF) came from the Voyager. Designed for maximum fuel efficiency, the twin-engine *Voyager* was an all-composite aircraft with an airframe weighing only 939 pounds (426 kilograms). Its main wing was so flexible that the tip deflection in flight was around 0.9 - 1.5 m. Carrying 3180 Kg fuel (accounting 72 percent of its gross weight), it was a virtual “flying fuel tank”. This fuel was distributed in 17 fuel tanks and to maintain c.g. at a suitable value, pilots had to shift fuel from tank to tank. Construction of Voyager took almost two years from 1982-84 involving more than 22,000 man-hours.

*Voyager* made its first test flight on June 22, 1984. On December 14, 1986, with Dick Rutan and Jeana Yeager at the controls, the *Voyager* took to the skies. Nine days, three minutes and 44 seconds, later Voyager touched down at Edwards AFB, California, on December 23, 1986, having successfully circled the globe on the first non-stop, un-refueled flight. Only 106 pounds (48 kilograms) of fuel remained in the *Voyager*’s tanks at landing. This flight nearly doubled the previous distance record set in 1962 by a USAF/Boeing B-52H.



Voyager (1984)

The **Voyager** is now on permanent display in the main gallery of the Smithsonian Institution's National Air and Space Museum in Washington, D.C., alongside Wright *Flyer* and Charles Lindbergh's *Spirit of St. Louis*. The Voyager earned Burt Rutan the FAI Gold Medal, the Collier Trophy, and the Society of Experimental Test Pilots' Doolittle Trophy.

President Ronald Reagan presented the Presidential Citizens Medal to Burt Rutan, Dick Rutan and Jeana Yeager.

In 1982, Beech aircraft approached Rutan and his company, Scaled Composites in Mojave, California, to participate in the final configuration study of their new business turbo-prop to replace their King air. Thus emerged the Starship, the world's first FAA certified pressurized all-composite business turboprop.

Starship had a compound sweep wing, rear-mounted Pratt & Whitney turboprops in pusher configuration and a canard. Designed with a glass cockpit, Starship was quite advanced in technology and took five and half years and a funding in excess of 300 Million dollars to get FAA certification.



Starship (1987)



Boomerang (1993)

In 1993, Rutan brought out an all asymmetric beauty called Boomerang. Deriving its name from the forward swept wing in the shape of a boomerang, it had a main fuselage and second boom with engines and fins on both. While there was a horizontal stabilizer between the two fins, an asymmetric extension was provided on the right side. Powered by two Lycoming TIO-360 it has a great performance too. With a

gross weight of 4242Lbs, five seats and 170 gals of fuel it could cruise at 300 mph and cover a distance of 2100 n.m.



In 1997, Rutan designed a high-altitude, long endurance aircraft for telecommunication, atmospheric sampling & Earth monitoring science missions. Named Proteus after the mythological Greek sea-god who could change his appearance at will, it features an unconventional tandem-wing, twin-boom configuration with two rear-mounted turboprops on the fuselage. Its

modular construction allows payloads to be carried in a variety of locations. Removable tip sections can be added to or removed from the rear wing or the forward canards to tailor the Proteus' aerodynamics for various external payloads or for maximum altitude. The main landing gear is set wide apart to allow large payloads to be carried externally under the fuselage. Mainly built with epoxite graphite composite materials except for the left wing tip is made of glass fiber to make it radio transparent, it is designed for extreme reliability. With the Rutan trademark of Canard, Proteus takes off and lands in a characteristic three-point attitude. With short take-off and landing rolls, it can be operated from regional airports. Normally flown by two pilots in a pressurized cabin, the Proteus has potential to perform its missions semi-autonomously.

In October 2000, the Proteus set three world altitude records during envelope-expansion flights over California's high desert. The records were certified by the Swiss-based international aviation record certification agency Federation Aeronautique Internationale. The first records were for a peak altitude of 63,245 feet and sustained horizontal flight at 62,385 feet. On a second flight, the Proteus reached a peak altitude of 55,994 feet while carrying a 1,000 kg (2,200 lb.) payload. All three records were certified for aircraft in the Class C-1E, Group III with gross weights of 12,500 lbs. or less.

It continues to participate in the scientific missions of NASA and has supported the international atmospheric science community. In April 2003 -- Proteus flew as a surrogate UAV in a follow-on "Detect, See and Avoid" flight demonstration for NASA involving both cooperative and non-cooperative (non-transponder-equipped) target aircraft.

On April 18, 2003, in Mojave, Calif., Rutan unveiled his mega plan - **Private travel into space – at an affordable cost**. His space system is designed to achieve sub-orbital space travel, and win the \$10-million "X-Prize" offered to the creators of the first private vehicle to accomplish such a feat. It comprises of a three-person craft "Spaceship One"

which will be taken up to 52,000 ft. by another carrier aircraft called the White Knight under its fuselage.

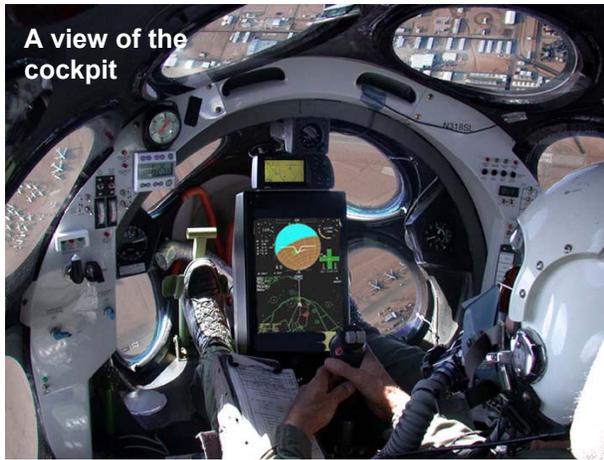
Once clear of the aircraft, Spaceship One will fire its single rocket engine and climb steeply. The engine will burn for just over a minute, putting the spacecraft on a trajectory to reach an altitude of 100 kilometers, a widely accepted boundary between the earth's atmosphere and space.

After passing through its peak altitude, Spaceship One will quickly descend, again on a steep trajectory. The spacecraft also has a unique feature to deal with the heat of reentry: the trailing edge of its wings, and the twin tail sections attached to them, rise from the horizontal to nearly the vertical position. The White Knight and Spaceship One have almost identical cockpits and share system components. The cockpit is quite

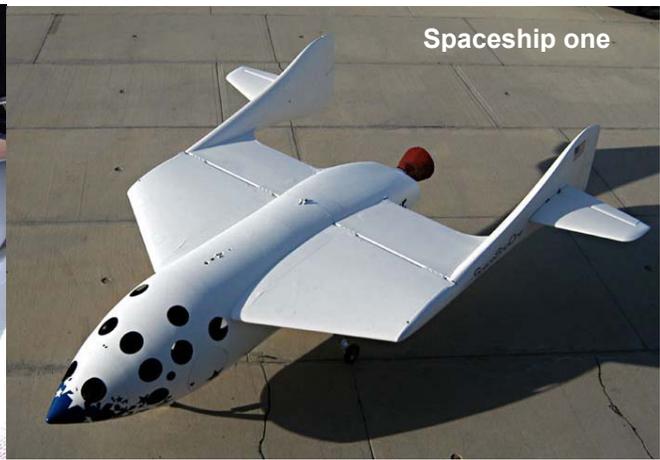


unique as can be seen in the picture below.





A view of the cockpit



Spaceship one

On June 28, 2003, the sixtieth birthday of Burt Rutan was celebrated at Mojave, California in a unique way. About 100 pilots flew to Mojave in canard aircraft, mainly Long-Ez, designed by Burt Rutan. The pictures below tell it all - A flock of Long-Ez with their nose down is virtually saluting the master who created them and the men & women who touched the skies with these machines saying **THANKS BURT**.

I join them *in admiring and thanking this great designer, whose flying machines have given innumerable aviators the joy of flight and the freedom of the sky.*



A flock of Long-Ez With a boomerang at Mojave



on Rutan's birthday

-- Dr.M.S.Rajamurthy  
C-CADD

Credits: Most Photos are from Rutan's Scaled composites