



GALACTIC AT A GLANCE!

The History: The Ansari X Prize

- Objective: to provide the catalyst for private sector innovation in the field of manned space exploration.
- Rules: private funding, design and manufacture of a vehicle capable of delivering the weight of 3 people including one actual person to sub-orbital space defined as an altitude of at least 100kms. The vehicle had to be 80% reusable and fly twice within a two week period.
- Winner: Mojave Aerospace Ventures a Paul G Allen company with Burt Rutan and SpaceShipOne on October 4th 2004. Pilot Brian Binnie (see www.scaled.com)

The History: SpaceShipOne

- Project funded by Paul Allen – co founder of Microsoft at an approx cost of approx \$26m
- Designed and built by Burt Rutan and Scaled Composites in Mojave CA
- Flew to space 3 times in 2004
- The world's first private manned space vehicle
- Now displayed in the Milestones of Flight Gallery at the Smithsonian Air & Space Museum, DC between Charles Lindbergh's Spirit of St Louis and Chuck Yeager's Bell X-1

The Technology

- A completely new approach to space access for people, science and payload
- Air (horizontal) launch from the "WhiteKnight" purpose built aircraft not ground (vertical) launch - intrinsically safer and more environmentally friendly
- All composite construction (light, strong, resilient and fuel efficient) not metal.
- Hybrid rocket motor uses benign fuel and oxidiser (rubber and nitrous oxide for SpaceShipOne) and is controllable
- Re-entry controlled aerodynamically by unique wing feathering design – heat free and carefree
- Un-powered (glide) runway landing

Virgin's Involvement

- Seeking investment opportunities since late 90's when Galactic name was registered
- Knew of Burt Rutan's credentials through sponsorship of the Virgin Atlantic Global Flyer – world's most fuel efficient powered aircraft
- Agreed with Burt Rutan and Paul Allen to invest in development and construction of second generation vehicle for commercial venture – the world's first spaceline
- Ordered 5 SpaceShipTwo's and 3 WhiteKnightTwo carrier aircraft to be manufactured by The SpaceShip Company (TSC) (a Joint Venture between Scaled Composites and Virgin) and operated by Virgin Galactic
- Mission to create environmentally benign, safe and commercially viable access to space for people, science and payload. Space tourism early adopters provided proof of first available market.

SpaceShipTwo

- SpaceShipTwo 70% complete
- Uses all the same basic technology, construction and design as SpaceShipOne prototype
- Is around twice as large as SS1
- Will carry 6 passengers and 2 pilots
- Cabin approx the size of a Falcon 900 exec jet
- Whole fuselage used for passenger cabin – no "floor"
- Large windows positioned right round the cabin
- Reclining seats to maximise cabin space in zero g and for re-entry
- Dimensions:
 - Wing span: 42ft
 - Length: 60 ft
 - Tail height: 18 ft (Feather down)
- Cabin details
 - 6 passenger seats
 - 90" diameter x 12 ft long
- Construction: 100% carbon composite
- Power: after release from carrier aircraft, operates on internal power supply
- Gear
 - Tricycle gear configuration
 - 2x wheeled main gear
 - 1x nose skid, with abrading shoe, like SpaceShipOne
- Feathering wings for re-entry: same technology as SS1; improved aerodynamics
- simulator operational and already being used as pilot training and design refinement tool

Carrier Aircraft/Mothership (WhiteKnightTwo) Technical Specification

Status :

- Construction and ground testing complete
- Test flight programme underway - first flight successfully undertaken 21st December 2008
- Will be the largest 100% carbon composite plane in service (Boeing 787 Dreamliner uses composite materials for about 50% of its primary structure)
 - twin boom / fuselage construction
- Propulsion & Power : 4 X Pratt & Whitney PW308 engines. Member of PW300 series engines.
- Gear: Quadricycle gear configuration, retractable
- Dimensions:
 - Wing span: 140ft (only 16 ft less than Boeing 767-300)
 - Length: 78 ft
 - Tail height: 25ft
- Performance: SS2 ferry range: U.S. coast to coast
- Capability
 - a training vehicle for SS2 spaceflight – can simulate SpaceShipTwo g force profile
 - both cabins replicate SS2 interior
 - unique high altitude lift aircraft for various payloads

SpaceShipTwo Flight Profile

- G-Forces
 - max gx (front to back): 6g
 - max gz (head to toe): 3.8g
- SS2 release: 50,000 ft
- Planned apogee of spaceflight: at least 110 km
- Zero-g phase –out of seat
- Total flight time: all told approximately 2.0 hrs

Timeframes

- WhiteKnightTwo commenced test programme during the Summer of 2008 with first flight December 2008. Test programme will continue into 2009.
- SpaceShipTwo roll-out and test flight programme programmed for Fall 2009 depending on progress of WhiteKnightTwo test flights
- Test flight period envisaged 18 - 24 months or longer if safety dictates. Building of first commercial vehicles will commence whilst test programme is underway
- Safety first, we are not in a race, we will launch only when Scaled and Virgin are content that it is safe to do so
- We aim to fly 500 people in the first year and 50,000 in the first 10 years
- First commercial flights planned to operate from Spaceport America in New Mexico.
- First non-US flights likely to be from Spaceport Sweden near Kiruna in the north of the country at certain times of the year, once relevant licences are obtained.

SpaceShipTwo Flight Stats

- Total flight time around 2.0 hours
- G forces: rocket boost max 3.8 g (x and z); re-entry max 6 g (x only whilst reclined)
- Speed: supersonic within 8 seconds of rocket ignition and faster than Mach 3 within 30 seconds of rocket ignition
- Achieving an apogee of at least 110 kms

The Experience

- Plan for 3 days of preparation, medical checks, bonding, g force acclimatisation as part of flight cost.
- Carrier aircraft is able to act as a training platform with passenger cabins that replicate the spaceship.
- All passengers will be able to leave their seats and float in zero G should they wish and enjoy view of space and the earth stretching for around 1000 miles in every direction

Reservations

- Approximately 300 reservations with deposits from between \$20 and \$200k
- Total deposits received approximately \$40m
- Flight cost US\$200k
- Over 85,000 people from 125 countries have registered their interest in becoming a Virgin Galactic astronaut at www.virgingalactic.com
- A specialist network of Virgin Galactic Accredited Space Agents has been set up around the world to provide a local reservation service (ASA details can be found on www.virgingalactic.com)

Environmental Credentials

- Air launch means short rocket burn
- Reusable spaceship – no space debris

- The carrier aircraft uses latest highly efficient turbo fan jet engines
- SpaceShipTwo re-entry and landing are unpowered
- CO2 emissions per passenger on a spaceflight will be equivalent to approximately 60% of a per passenger return commercial London/New York flight. Around 70% of the spaceflight CO2 emissions come from the carrier aircraft. This is a clean spaceship!
- Virgin Galactic is working with the carrier aircraft's engine manufacturers, Pratt & Whitney, towards the goal of eventually flying the aircraft entirely on a renewable jet aviation fuel. This work is being carried out in conjunction with Virgin Atlantic who along with Virgin Fuels, Boeing and GE are currently developing and testing such fuels for the new Virgin Atlantic Boeing 787 Dreamliner. The first partially bio-fuelled flight by Virgin Atlantic was carried out successfully in February 2008 using one of the fleet of Boeing 747's between London and Amsterdam
- SpaceShipTwo and its carrier aircraft will provide space access, first to paying passengers and then hopefully, for science research and payload deployment, with an incomparably smaller environmental impact, lower cost and greater flexibility than anything that has gone before. We need space but we need better access to it.