# ANSARI X PRIZE Team Summary Sheet

# AMERICAN SCALED COMPOSITES TEAM

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## TEAM OVERVIEW

Founded in 1982, Scaled Composites, LLC set out to develop research aircraft and has become the world's most productive aerospace prototype development company. Due to the nature of their work, most of SC's current projects are proprietary to the customer. They are currently developing new composite manufacturing processes for application to general aviation, fighters and new space launch vehicles. The company currently employs 95 people at the Mojave, California airport.

### TEAM LEADER BACKGROUND

From 1965 until 1972, Burt Rutan worked for the U.S. Air Force as a Flight Test Project Engineer at Edwards Air Force Base, California. In 1972, he became director of the Bede Test Center for Bede Aircraft in Newton, Kansas. In 1974, Mr. Rutan moved to Mojave, California, and formed the Rutan Aircraft Factory (RAF). The RAF would develop light homebuilt aircraft and market technical and educational documents. By 1982, Mr. Rutan had founded Scaled Composites, LLC.

### THE TEAM AND PILOTS

Brian Binnie (upper left) was at the controls on December 17th, 2003, as *SpaceShipOne* broke the sound barrier over the desolate Mojave desert becoming the first supersonic flight conducted and operated completely independent of the government. Peter Siebold (top right) flew the *White Knight* carrier plane lifting *SpaceShipOne* and Mr. Binnie to nearly 48,000 feet before releasing them to conduct *SpaceShipOne's* first powered flight. On April 8th, 2004, Peter Siebold piloted *SpaceShipOne* through a 40 second motor burn during its second powered flight. This time, Mr. Binnie was piloting the *White Knight*, as Mr. Siebold and *SpaceShipOne* hitched a ride to approximately 45,000 feet before beginning the second powered flight.

Mike Melville (lower left) was the hero of the day on May 13th, 2004 as he exceeded Mach 2.5, boosted to 150,000 feet and then coasted *SpaceShipOne* smoothly to 211,400 feet breaking all current altitude records for private spacecraft. Safely landing despite a flight director display malfunction during a portion of the boost, Mr. Melville proved his spectacular ability to "fly stick." Doug Shane (lower right) serves as the director of flight operations, fulfilling an important and necessary role in the flight testing process.

## DATA AT-A-GLANCE

### TEAM SPECIFICATIONS

- Name: Scaled Composites, LLC
- Leader: Burt Rutan
- Place: Mojave, California, USA
- Registered with X PRIZE: 28 January 1997
- Web: www.scaled.com

### VEHICLE SPECIFICATIONS

- Name: *White Knight* (first stage), *SpaceShipOne*
- (second stage).
- Wingspan: 82 feet (first stage), 16.4 feet (second
- stage)
- Gross Take-Off Weight: Information not disclosed.
- Dry Weight: Information not disclosed.
- Crew Environment: Short-sleeved, pressurized
- cabin.
- Payload Capacity: Information not disclosed.
- No. of Engines: Two turbojet engines (first stage), one rocket engine (second stage)
- Propulsion System: afterburning J-85-GE-5 engines (first stage), hybrid engine (second stage)
- Fuel and Oxidizer: JP-1 (first stage), $N_2O$-HTPB (second stage)
- Total Thrust: 7,700 lbs. thrust (first stage), information not disclosed (second stage)
- Reaction Control System: Cold pressurized $CO_2$ gas.

### MISSION SPECIFICATIONS

- Ascent Method to Ignition Alt.: Carrier aircraft

- Ascent Duration: Approximately 60 minutes
- Alt. at Ignition: 53,000 feet
- Orientation at Ignition: 80-90 degrees
- Max. Accel. Force on Ascent: 3-4 Gs
- Alt. at Engine Cut-off: Information not disclosed.
- Time at Engine Cut-off: 65 seconds
- Max. Speed: Mach 3.5 (240 knots equivalent
- airspeed, KEAS)
- Max. Altitude: 62 miles
- Time in Weightless Conditions: 3.5 minutes
- Reentry Method: Ballistic reentry
- Accel. Forces on Descent: 5 Gs peak, >4 Gs for 20 seconds
- Landing Method: Unpowered horizontal
- Total Duration: 90 minutes
- Landing Distance from Take-off Location: 0 miles
- Time Between Missions: Information not disclosed.

# VEHICLE/LAUNCH SYSTEM DESCRIPTION

The ANSARI X PRIZE competition launch system proposed by Scaled Composites (SC) consists of two stages: a carrier aircraft, the *White Knight*, and a second stage rocket, *SpaceShipOne* (SS1).

The *White Knight* is a manned, twin-turbojet research aircraft intended for high-altitude missions. The design mission of *White Knight* is to provide a high-altitude airborne launch of a manned suborbital spacecraft, SS1. The *White Knight* is equipped to flight-qualify all the spacecraft systems, except rocket propulsion. The *White Knight*'s cockpit, avionics, electronic control system, pneumatics, trim servos, data system, and electrical system components are identical to those installed on SS1.

The *White Knight*'s high thrust-to-weight ratio and enormous speed-brakes allow the Astronauts in training to practice space flight maneuvers like boost, approach and landing, with a very realistic environment. Thus, the aircraft serves as a high-fidelity, moving-base simulator for SS1 pilot training. Other *White Knight* mission capabilities include, reconnaissance, surveillance, atmospheric research, data relay, telecommunications, imaging & booster launch for micro- satellites. *SpaceShipOne* (SS1) is a three-place, high altitude research rocket, designed for sub- orbital flights to 100 km altitude. The unique configuration allows aircraft-like qualities for boost, glide, and landing.

During descent, the ship's empennage converts (using pneumatic-actuated 'feather') to a stable, high-drag shape for atmospheric entry. This "Care- Free" configuration allows a 'hands-off' reentry and greatly reduces aero/ thermal loads. Designed for a 'shirt-sleeve' environment, the 60" diameter cabin has a space-qualified electronic control system and dual-pane windows. The ship uses three flight control systems manual- and subsonic, electric supersonic and cold-gas reaction control system.

## PROPULSION SYSTEM

A new non-toxic liquid-nitrous-oxide/rubber-fuel hybrid propulsion system was developed specifically for SS1. Its unique design simplifies mounting and reduces leak paths. The composite nitrous tank and case/throat/nozzle components were developed at SC, with Thiokol providing the tank's filament wound over-wrap, and AAE Aerospace supplying the ablative nozzle. Development of the 'rocket science'( fuel, bulkhead, controller, valve, injector, igniter and ground test program) is being competed with two rocket motor developers – eAc (Environmental Aeroscience Corp of Miami) and SpaceDev of San Diego.

# MISSION DESCRIPTION

The duration of the *White Knight-SS1* mission lasts approximately 90 minutes. Before the horizontal take-off from a traditional runway, SS1 is mounted to the underside of the *White Knight* and the nose cone is detached so the three crew members can enter SS1. The nose is reattached and the mated vehicles are ready to begin their mission.

## VEHICLE ASCENT

The *White Knight* horizontally takes off from an airport runway like a traditional airplane, powered by its twin turbojet engines. The aircraft slowly ascend to approximately 53,000 feet over a time period of approximately 60 minutes. At this time, the *White Knight* releases *SS1* and pulls away from the undocked spacecraft. *SS1* glides forward and the pilot pulls it to a nose-up attitude of approximately 85 degrees. At this

point, the pilot ignites the hybrid rocket engine and maintains a nose-up pitch as the engine accelerates *SS1* over 65 seconds through a speed of Mach 3, exposing the crew to acceleration forces of 3 Gs.

## WEIGHTLESSNESS

As soon as the engines are turned off, the crew experiences weightlessness and momentum causes SS1 to continue climbing past an apogee of 100km. The crew can control the attitude of SS1 by using carbon dioxide compressed gas thrusters. After reaching apogee, SS1 begins its return to earth. The crew continues to experience weightlessness until the density of the Earth's Atmosphere increases enough to begin decelerating the spacecraft.

While there are no atmospheric forces acting on SS1, the pilot deploys the "feather" mechanism. This will help stabilize and decelerate SS1in a controlled manner during its descent.

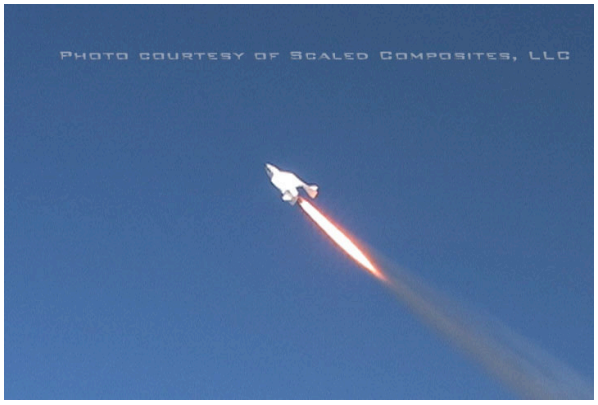

## VEHICLE DESCENT AND LANDING

As the atmospheric forces build on the vehicle, the crew experiences acceleration forces exceeding 4 Gs for over 20 seconds, with peak loads approaching 5 Gs. As SS1 descends through approximately 80,000 feet, the "feather" mechanism is reset to the horizontal position and the crew controls SS1 to an unpowered horizontal (glide) landing at the same runway from which it took off.

# HARDWARE & TESTS

Scaled Composites has built, ground tested, and flight tested all components of their ANSARI X PRIZE launch system. Below are some of the notable milestones in the development and testing of hardware.

- 1 August 2002 - First flight of *White Knight* carrier aircraft
- 18 April 2003 – Public roll-out of all launch system components, including *White Knight, SpaceShipOne*, mobile tanker, simulator, mobile mission control station and mobile test stand trailer
- 20 May 2003 – The *White Knight* plane carries *SpaceShipOne* to 45,000 feet, marking the first time that both vehicles have been put in the air together.
- 7 Aug 2003 – The *White Knight* drops *SpaceShipOne* from a height of 47,000 feet; *SpaceShipOne* glides to a smooth landing at Mojave airport, the first time the spacecraft has flown by itself.
- 18 Nov 2003 – The hybrid rocket motor, manufactured by Scaled Composites and SpaceDev, was tested for the full length of time in the Mojave Desert, meeting all performance requirements and safety limits were met. The tests qualified the engine to be used on the upcoming powered flight tests of *SpaceShipOne*.
- The *White Knight* drops *SpaceShipOne* from a height of 47,000 feet; *SpaceShipOne* glides to a smooth landing at Mojave airport, the first time the spacecraft has flown by itself.
- 17 Dec 2003 – On the 100th anniversary of the first Wright Brothers' flight, Scaled Composites conducted its most ambitious flight test to date. The *SpaceShipOne* was launched from the *White Knight* carrier aircraft high over the Mojave Desert, and then ignited its rocket motor. The spacecraft streaked across the sky, climbing at a 70 degree angle, and reached Mach 1.2 and an altitude of 67,800 feet before burnout.
- 8 Apr 2004 – The second powered test flight of




*SpaceShipOne*. Behind the controls of *SpaceShipOne*'s second successful powered flight was pilot and future astronaut, Peter Siebold. The engine burned for 40 seconds and reached a speed of approximately Mach 1.6, making it the first privately built space vehicle to accomplish this feat.

- 13 May 2004 –- The third powered flight of *SpaceShipOne*. The vehicle boosted smoothly to 150,000 feet and Mach 2.5, then coasted to apogee of 211,400 feet, setting a new record for a private built

manned space vehicle. According to CNN, pilot Mike Melville said later, "'I feel great, it was fabulous. I would pay a million dollars to do that again."

- 2 June 2004 – Scaled Composites announced that their suborbital flight attempt to fly to an altitude of 100 km on a mission to become the world's first commercial manned space vehicle will take place 21 June 2004.
- 21 June 2004 – Scaled Composites conducted its fourth powered flight of *SpaceShipOne* carrying pilot Mike Melville just above 100 km. Breaking all private spaceflight altitude records (again), Melville became the first private pilot to earn his astronaut wings by piloting the first private spacecraft into space.

## BEHIND THE SCENES

Approximately one hour before the *White Knight* taxis out at Mojave Airport, a special crew dedicated to the preservation of desert tortoises must check the runway environment for tortoises to ensure their safety.

## TEAM IDEOLOGY

### ANSARI X PRIZE QUOTE

*"I strongly feel that, if we are successful, our program will mark the beginning of a renaissance for manned space flight. This might even be similar to that wonderful time period between 1908 and 1912 when the world went from a total of ten airplane pilots to hundreds of airplane types and thousands of pilots in 39 countries. We need affordable space travel to inspire our youth, to let them know that they can experience their dreams, can set significant goals and be in a position to lead all of us to future progress in exploration, discovery and fun. Thanks to the X PRIZE [Foundation] for the inspiration."*
– Burt Rutan

### PHILOSOPHY

*"Our flight safety approach of "question, never defend" has allowed us to take courageous steps by safely flying new ideas and new performance envelopes. We are now focusing on the big step of developing a high-altitude supersonic light aircraft. This program, if successful, will result in the first non-government manned space flight (above 100 km altitude)."* – Burt Rutan

### MISSION AND GOALS

*"Our goal is to demonstrate that non-government manned space flight operations are not only feasible, but can be done at very low costs. Safety, of course is paramount, but minimum cost is critical.*
*We look to the future, hopefully within ten years, when ordinary people, for the cost of a luxury cruise, can experience a rocket flight into the black sky above the earth's atmosphere, enjoy a few minutes of weightless excitement, then feel the thunderous deceleration of the aerodynamic drag on entry."* – Burt Rutan

## THE CREW

### TEAM MEMBERS


Information not disclosed.

## CONTACT THE TEAM

Below is contact information for Scaled Composites.

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