



## **NATIONAL TRANSPORTATION SAFETY BOARD**

Office of Aviation Safety  
Washington, D.C. 20594

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### **Addendum 1 – Proposed SS2 Training**

# **OPERATIONAL FACTORS**

**DCA15MA019**

## **Proposed Training Program for Initial Flights of the Scaled Model 348 SpaceShipTwo**

July 2, 2010

The following procedures are proposed for the initial training of Scaled test pilots to perform initial testing of the Model 339 SpaceShipTwo. The Model 339 is a rocket powered sub-orbital glider.

The procedures described in this document are similar or identical to those successfully used in the development of the ARES Model 151 single-engine jet fighter aircraft, the Model 143 Triumph light business jet, the VisionAire Vantage prototype, the Williams International V-Jet II, Proteus Model 281, White Knight Model 318, SpaceShipOne Model 316, White Knight Two Model 348 and over 20 other new-type manned aircraft over 20 years. All of these programs have been conducted without injury to personnel or major damage to the test or other vehicles.

A key element to this safety and training process is the close association of the development and test team. During the final stages of fabrication, the pilots and flight crews will spend a large amount of time working directly with the engineering personnel who designed the vehicle and its systems, as well as the technicians who fabricated them. In fact, in many cases, the flight crew are a part of the design team.

As a normal part of this process, the following training issues are directly addressed:

The pilots will review the aerodynamic design data for the airplane, including predictions for

- Static longitudinal stability, including the predicted neutral point, elevator deflections required for various angles of attack (and airspeed), with an emphasis on the implications on stability, control power, and predicted flap effects. A review of these data will allow the flight and engineering team to determine an appropriate cg location for the first flight, as well as provide assessment criteria for test data.
- Static directional stability, including predicted rudder requirements as a function of sideslip angle.
- Maximum lift predictions, to determine appropriate target stall speeds at various gross weights. These data will be used, in turn, to determine the appropriate release, decent, approach, and touchdown speeds for the first flight.
- Aerodynamic loads criteria, and the design V-n diagrams to determine safe initial flight envelopes, maneuvering speeds, and structural margins, including the results of any static load testing.

- Predicted best climb and glide speeds, to plan initial test conditions, as well as drag predictions to allow determination of initial SFO approaches

This planning will culminate with the development of the detailed flight test cards and plans for the initial and subsequent few flights. These plans will be reviewed by the appropriate engineering test personnel, the test pilots, and the Scaled President and CEO for concurrence. The Detailed Test Plan for the Model 339 (included in this package) describes more generally the goals and overall testing requirements for the airplane. It should be noted, however, that this is a developmental testing program, and specific test plans, procedures, and foci will be defined as the results of the testing are learned.

The test pilots will prepare the preliminary pilot's operating handbook, including checklists for normal and emergency procedures, systems descriptions, and operating limitations. He will work closely with the engineering and test teams to assess and develop these normal and emergency procedures, working through expected normal and abnormal systems behavior and failure modes assessments. This document will be used as the foundation of subsequent pilot training plans, and will be kept updated to reflect the most current configuration and procedures/limitations for the test airplane.

Prior to first flight, the pilots will spend several days participating in ground tests including electrical system functional checks, control function and load tests, fuel system tests (including calibration), weight and balance determination, landing gear functional tests, and tow tests. Through these, the pilots will gain a detailed functional knowledge of the various aircraft systems. This will also provide opportunity to refine flight and ground crew checklists and detailed operating techniques and procedures.

It is anticipated that the primary test pilots will participate in these initial ground tests with secondary test pilots participating in where appropriate as observers. These secondary test pilots will perform the duties of chase pilots, control room test conductors and test directors, and White Knight Two pilots

In addition to the ground tests, each pilot will thoroughly familiarize himself with the cockpit layout, including critical circuit breaker locations, switch locations and functions, avionics features, test instrumentation requirements, and any special test equipment requirements. Heavy emphasis will be placed on appropriate actions in an emergency, especially electrical systems failure, smoke in the cockpit, engine fire warnings and extinguishing systems, and engine operations difficulties. It is expected that each pilot will spend a minimum of 5 hours in cockpit familiarization, including normal and emergency systems familiarization.

The Pilots will meet FAR Part 91 recency of experience requirements and are current in several aircraft as of this writing including (White Knight Two, Duchess, Grumman Tiger). Prior to all glide flights, pilots will utilize White Knight Two as an in flight training aircraft and will have completed no less than 25 SS2 approach and landing profiles prior to performing their first flight. In preparation all flights, the pilots will

utilize a high fidelity fixed base simulator to develop, refine, and practice the expected flight profiles in the fixed base simulator with nominal and off nominal handling characteristics. This simulation includes an instructor station and includes a data/voice interface to replicate actual flight profiles.

The primary test pilots will subsequently develop the training curriculum to transition the secondary pilots.