X-37 Project Overview

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Successfully Achieve Orbit and Return to Earth Safely
Agenda

- What the X-37 Program is about
  - Objectives
  - Programmatics
    - Funding
    - Execution
  - Technical
    - Operations
    - Products
    - Technologies & Experiments
X-37 Program Objectives

◆ Mature the technologies for reusable space vehicles by performing flight demonstrations.
  ◆ Lower the cost for routine access to space and operations in space.
  ◆ Make next-generation space transportation system commercially viable.
  ◆ Enhance planning for future reusable launch vehicle space operations.
◆ Enable investor confidence in reusable space vehicle systems.
◆ Achieve a technology readiness level of 8 (flight proven) for critical technologies.
◆ Design and operate with an emphasis on safety.
X-37 Industry - Government Team

Boeing
- Seal Beach Phantom Works
- Huntington Beach System Test
- St. Louis Airframe
- Long Beach Body Flap & SB
- Rocketdyne Engine
- Seattle Solar Panels
- Palmdale HDAIT

NASA
- MSFC
  Program Management & Insight
  H₂O₂ Research
  Rendezvous Exp
- ARC
  TPS Testing & Exp
  Aero optimization
  IVHM
- LaRC
  Hot & Warm Structure
  Analysis and test
- GSFC
  Avionics Support

Suppliers
- Swales Aerospace
- General Dynamics Info Sys
- Honeywell
- MPC
- ABSC
X-37 Program Products

- Modified for early atmospheric flights to support X-37 design.

- Advanced Technology Flight Demonstration Vehicle.
- Linked to Space Maneuver Vehicle design.

- Flight Operations Control Center (FOCC).
- Three person operation for atmospheric and orbital flights.

- Modified Spacelab Cradles for Shuttle Launch.
X-37 Vehicle Characteristics

- Peroxide Tank
- C/Sci Ruddervator
- AR2-3 Engine
- Vernier Thrusters (GHe)
- PETI-5 Body Flap
- TDRSS Antennas
- C/Sci Flaperon & Surrogate
- Radiators
- Experiment/Payload Bay
  45" Minimum Diameter X 7 ft length
- JP-8 tank
- Avionics Bay
- Peroxide RCS Thrusters
- TPS
  - Top - Blankets
  - Bottom - Tile & Blankets
- Peroxide RCS Tank
- Solar Array

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Value</th>
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<tr>
<td>Fuselage Length</td>
<td>27 ft</td>
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<tr>
<td>Payload</td>
<td>500 lbs</td>
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<tr>
<td>Max GLOW</td>
<td>13 klbs</td>
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- Dual Redundant Electrical Actuators
- Triple Redundant Flight Control System
Overview of X-37 Flight Test Program

Ground Test/Simulation & Preflight Checkout

Flight Operations Control Center (FOCC)

X-40A

X-37/Space Shuttle

X-37/B-52

Progressive Ground and Flight Testing In Multiple Environments
X-37 Mission Operations

1. STS Launch
2. Deploy
3. On-Orbit Operations
4. Reentry
Forty Technologies and Experiments are Being Demonstrated on the X-37

Avionics/Software
- T-12 Open Architecture Avionics
- T-14 Fiber-Optic Data Bus
- T-15 Ku-Band Phased Array Antenna
- T-16 COTS Hardware and Software
- T-19 Fault Tolerant Autonomous Ops
- T-28 Small Crew FOCC

GN&C
- T-10 Calculated Air Data System (CADS)*
- T-17 All Weather Windward Adaptive Guidance
- T-25 Rapid Mission Data Loading*
- T-29 Crosswind Landing for Small RSVs*
- T-30 Automated Rendezvous and Close Approach

Ground/Flight Operations
- T-18 Rapid-Global TPS Damage Detection
- T-21 Rapid TPS Waterproofing

Flight Sciences
- T-22 High Enthalpy Flight Profile

Structures
- T-6 High-Temp Gr/BMI Sandwich Structure
- T-8 Thin, Hot Aerosurfaces for SRSV
- T-11 Modular Airframe - Rapid Change-Out
- T-20 Lt. Wt. Std Payload Container
- T-23 Standard Payload Interfaces
- T-32 High-Temp Gr/PETI-5 Structures
- T-XX Composite Propellant Tanks

Vehicle
- T-23 Standard Payload Interfaces
- T-24 Access Doors for Operability

Mechanical Systems
- T-10 Lightweight Landing Gear
- T-31 Phase Change Brakes

Propulsion
- T-2 Peroxide RCS Thrusters
- T-27 Low Cost Propulsion System

Thermal Systems
- T-3 High-Temp Windward TPS
- T-4 High-Temp Upper/Side TPS
- T-5 Durable Leading Edge Tiles
- T-7 High-Temp, Low Cost Joints/Seals
- T-9 Loop Heat Pipe TCS

*Thirty embedded technologies
- Seventeen advanced vehicle technologies
- Thirteen advanced operations technologies
Like Prior X-Vehicles, X-37 Will 1st Develop, Fly, Measure and Discover In Many Important Aerospace Areas

- 1st Orbital X-plane
- 1st autonomous orbital X-plane
- 1st development of tile leading edge
- 1st development of a re-deployable solar array for a reusable vehicle
- 1st Flight Test Demonstration of a Low Cost, Space Integrated GPS/INS
- 1st Flight Demonstration of a Calculated Air Data System
- 1st use of phase change brakes
- 1st extensive re-use of Li-Ion Batteries in aerospace
- 1st use of carbon silicon carbide hot primary structure
- 1st use of "warm" composites integrated with TPS (PETI-5, BMI)
- 1st non-zero "g" use of loop heat pipe TCS
- 1st flight of five TPS types at high enthalpy
- Discoveries in high hypersonic flight environment at lower than Space Shuttle Reynolds numbers