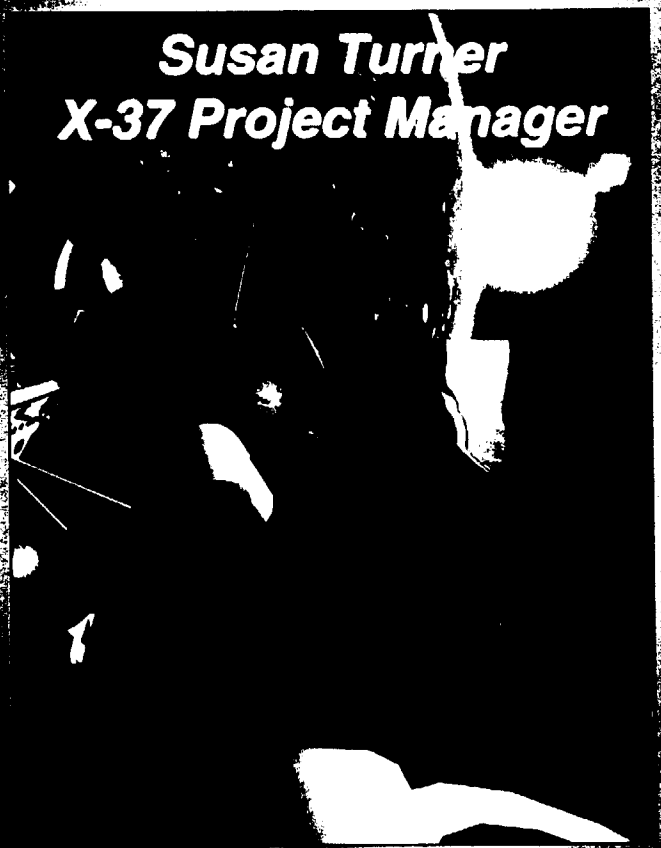
X-37 Project Overview

Susan Turner
X-37 Project Manager



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PATH FINDER

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 Funding

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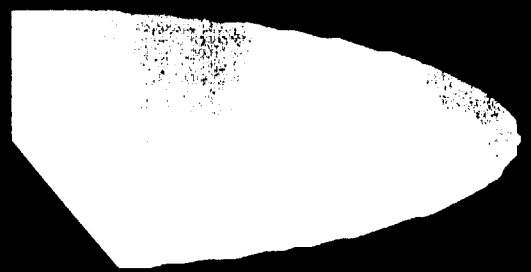
$16M

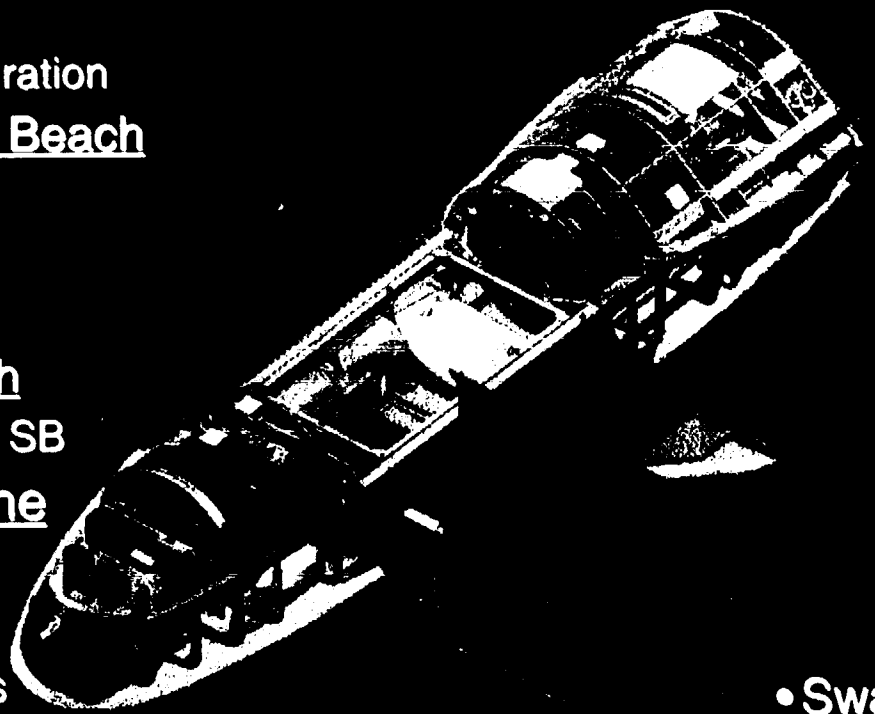
$72M



X-37 Industry - Government Team

Boeing

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



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- MSFC
  - Program Management & Insight
  - H_2O_2 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

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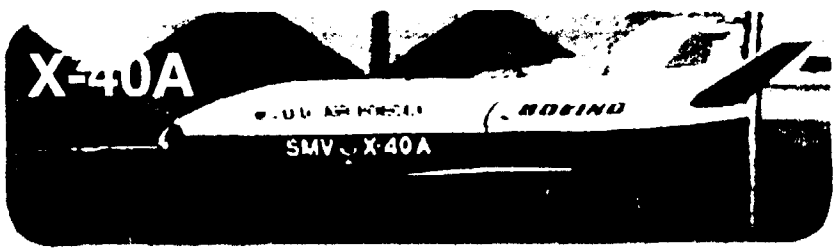
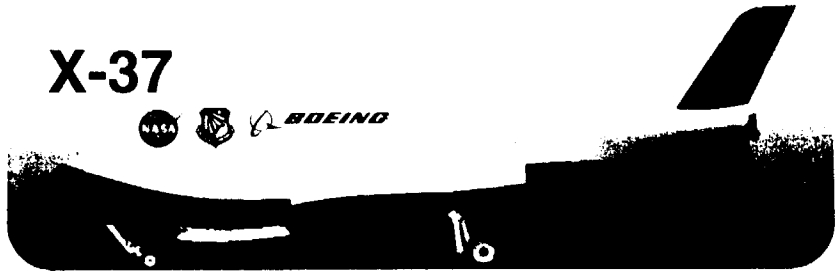
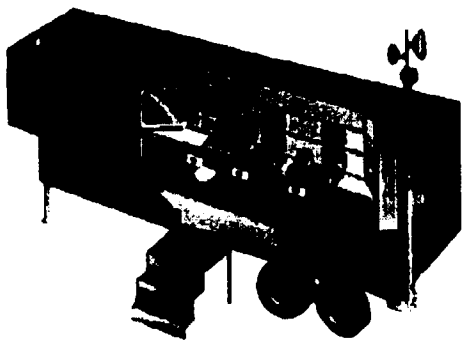
X-37 Program Products



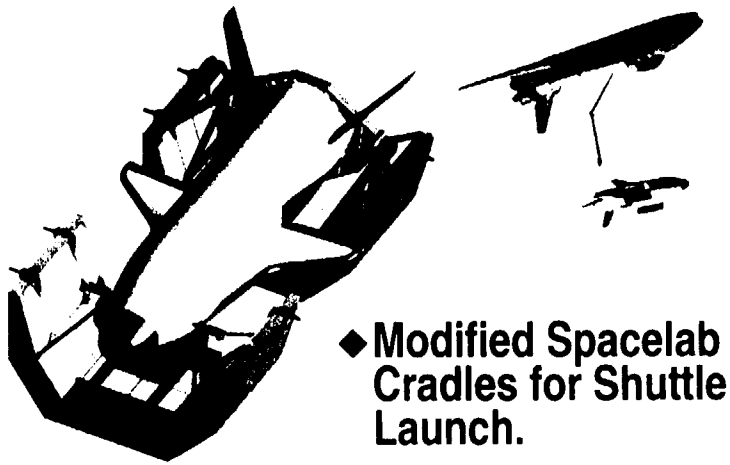
- Prior USAF Contract: Successful automated approach and landing flight in October 1998.
- Modified for early atmospheric flights to support X-37 design.



- 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.

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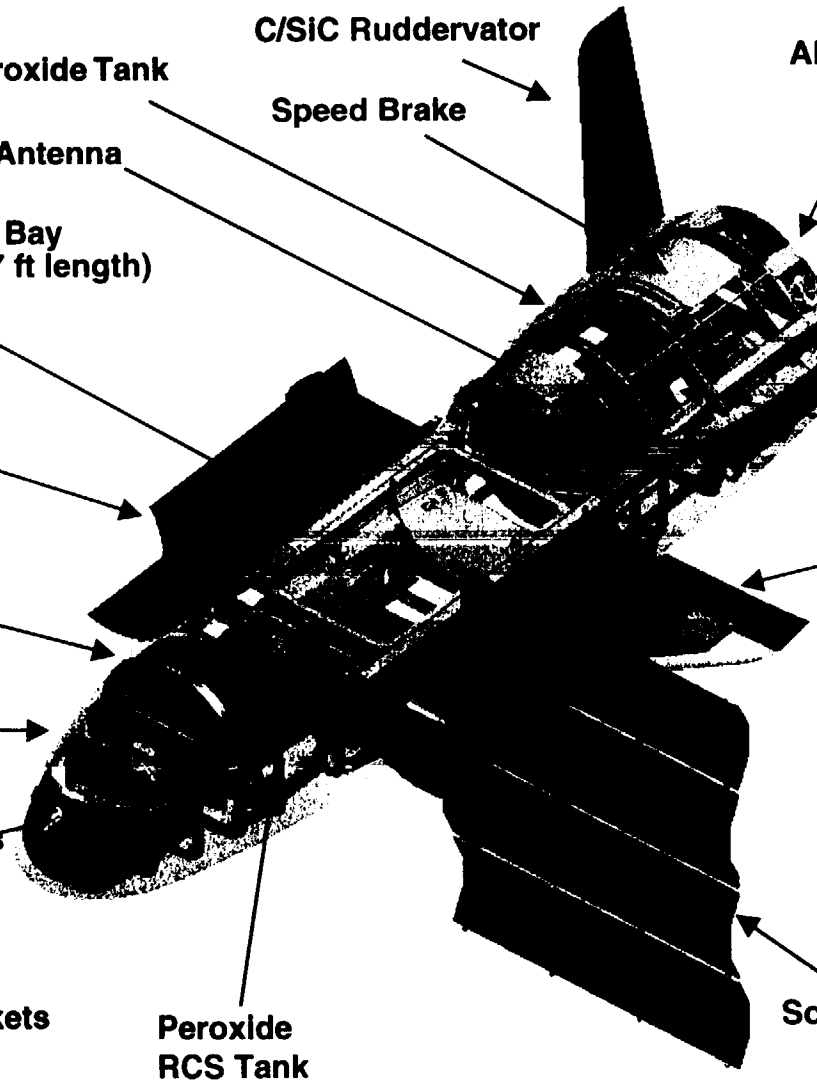
X-37 Vehicle Characteristics



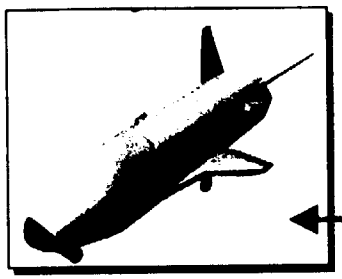
C/SiC Ruddervator
Peroxide Tank
Speed Brake
Ku-Band Antenna
Experiment/Payload Bay
45" Minimum Diameter X 7 ft length)
Radiators
JP-8 tank
Avionics Bay
Peroxide RCS Thrusters
AR2-3 Engine
Vernier Thrusters (GHe)
PETI-5 Body Flap
TDRSS Antennas
C/SiC Flaperon & Surrogate
Solar Array
Peroxide RCS Tank

Fuselage Length	27 ft
Payload	500 lbs
Max GLOW	13 klbs

- Dual Redundant Electrical Actuators
- Triple Redundant Flight Control System

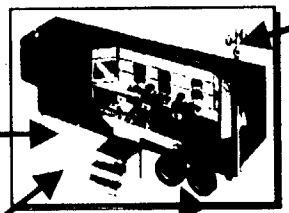
TPS
- Top - Blankets
- Bottom - Tile & Blankets

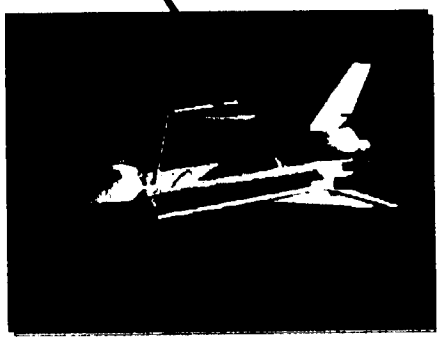
Overview of X-37 Flight Test Program



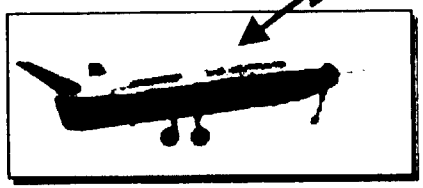
Ground Test/Simulation &
Preflight Checkout

Flight Operations
Control Center (FOCC)





X-37/Space Shuttle



X-40A

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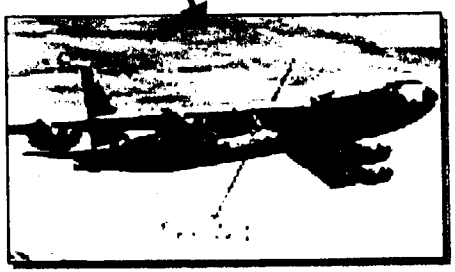

X-37/B-52

Progressive Ground and Flight Testing In Multiple Environments

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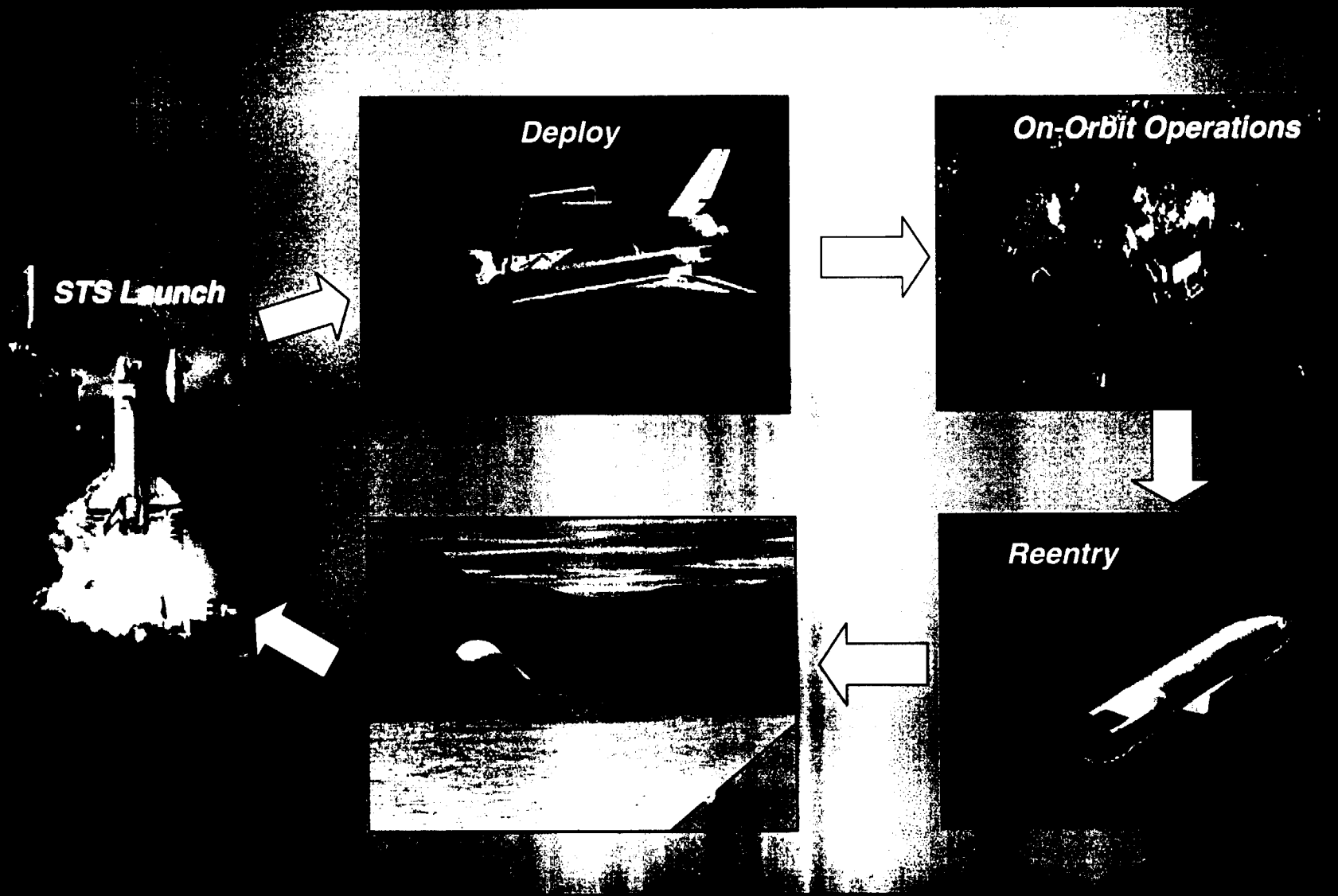
X-37 Mission Operations



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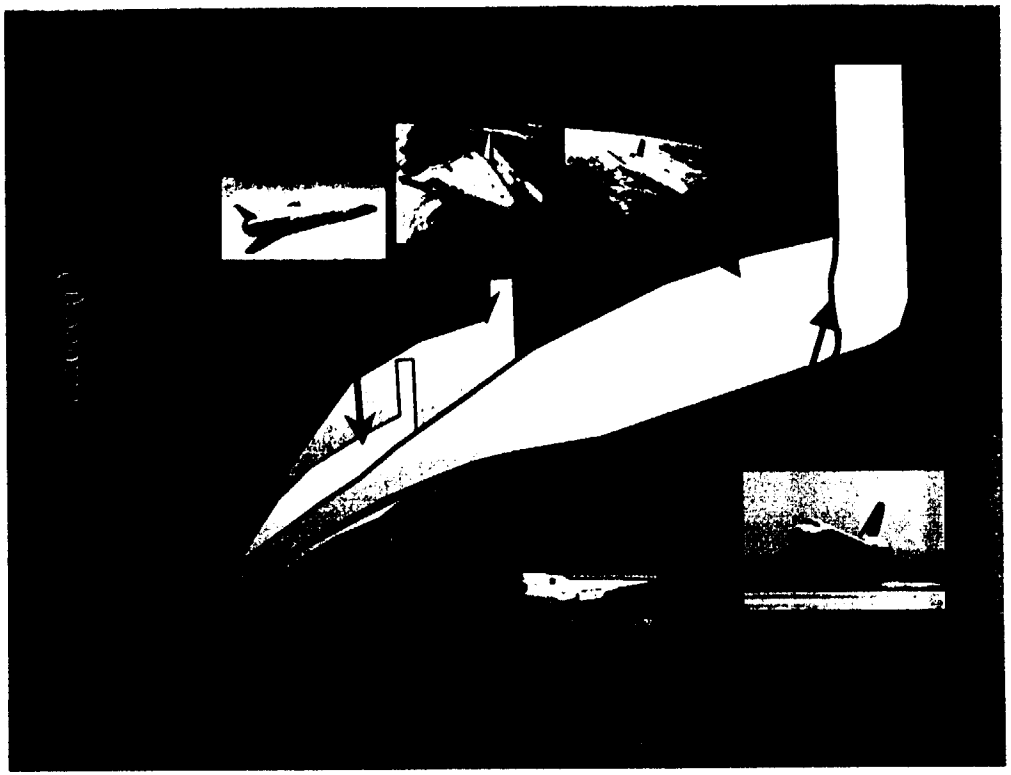
X-37 Tests RLV Flight Envelope



- X-34
- Hyper-X
- X-33
- X-37

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-13 Calculated Air Data System (CADS)*
T-17 All Weather Windward Adaptive Guidance
T-26 Rapid Mission Data Loading*
T-29 Crosswind Landing for Small RSVs*
T-30 Automated Rendezvous and Close Approach

- Thirty embedded technologies
  - Seventeen advanced vehicle technologies
  - Thirteen advanced operations technologies

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

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

Flight Sciences
T-22 High Enthalpy Flight Profile

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

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

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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

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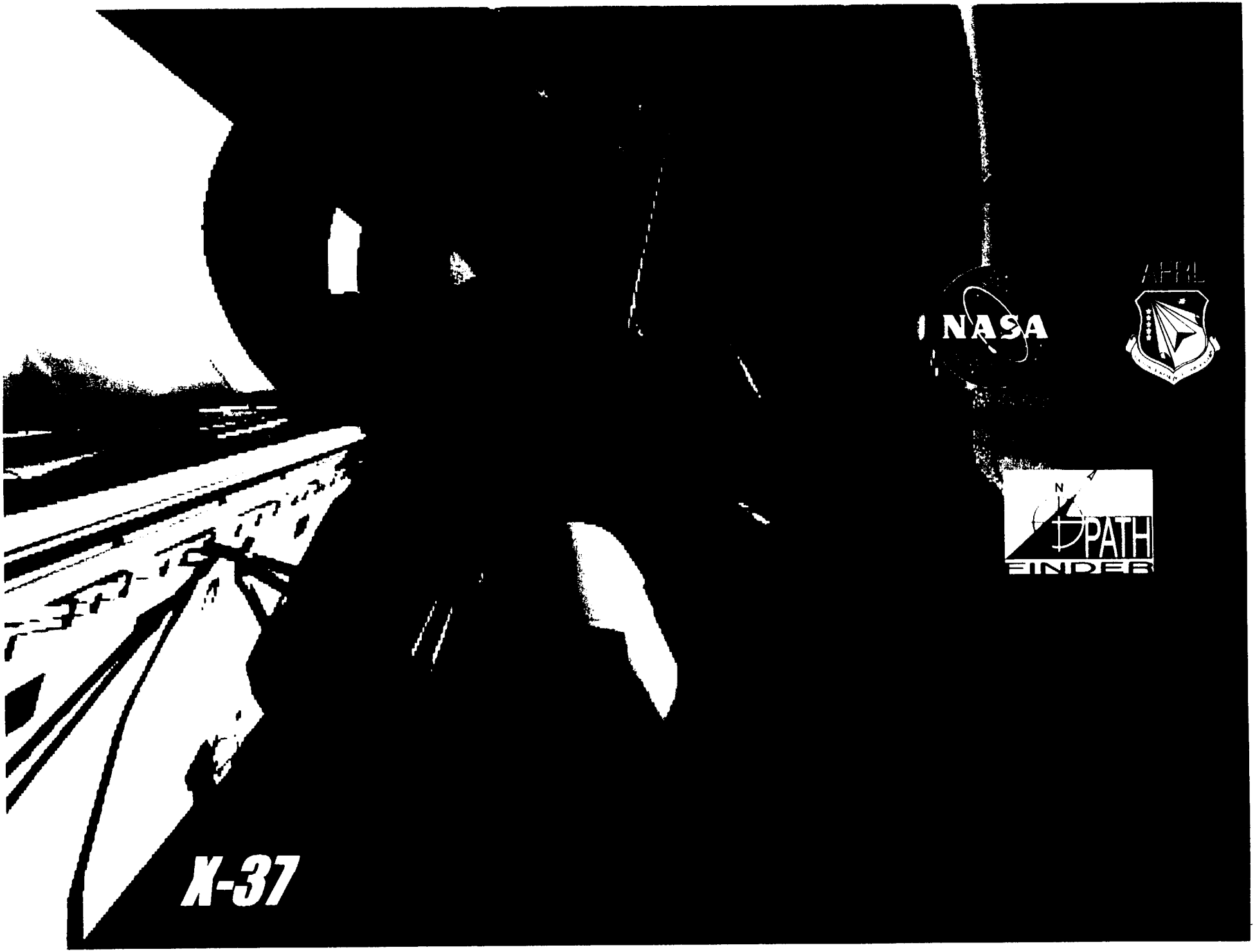
Boeing X-37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