The Falcon 1 Launch Vehicle Flight Results
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Space Exploration Technologies Corporation
Spacex.com
RazakSAT Mission Success!
Falcon 1 Flight 5
SpaceX Overview

• Founded in mid-2002 with the singular goal of providing **highly reliable, low-cost space transportation**
  – Expand into human transportation once technology is proven
• Over 800 employees — growing ~30% per year
• 550,000 sqft of offices, manufacturing and production in Hawthorne, CA
• 300 acre state-of-the-art Propulsion and Structural Test Facility in central Texas
• Launch sites at Kwajalein, Cape Canaveral
SpaceX Vehicles

Falcon 1

Falcon 9

Dragon
<table>
<thead>
<tr>
<th>Customer</th>
<th>Launch</th>
<th>Vehicle</th>
<th>Departure Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATSB (Malaysia)</td>
<td>Q3 2009</td>
<td>Falcon 1</td>
<td>Kwajalein</td>
</tr>
<tr>
<td>Falcon 9 Maiden Flight</td>
<td>2009</td>
<td>Falcon 9</td>
<td>Cape Canaveral</td>
</tr>
<tr>
<td>NASA COTS - Demo C1</td>
<td>2010</td>
<td>Falcon 9/Dragon</td>
<td>Cape Canaveral</td>
</tr>
<tr>
<td>NASA COTS - Demo C2</td>
<td>2010</td>
<td>Falcon 9/Dragon</td>
<td>Cape Canaveral</td>
</tr>
<tr>
<td>NASA COTS - Demo C3</td>
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<td>Cape Canaveral</td>
</tr>
<tr>
<td>NASA CRS1</td>
<td>2010</td>
<td>Falcon 9/Dragon</td>
<td>Cape Canaveral</td>
</tr>
<tr>
<td>DragonLab Mission 1</td>
<td>2010</td>
<td>Falcon 9/Dragon</td>
<td>Cape Canaveral</td>
</tr>
<tr>
<td>Swedish Space Corp. (Sweden)</td>
<td>2011</td>
<td>Falcon 1</td>
<td>Kwajalein</td>
</tr>
<tr>
<td>Bigelow Aerospace</td>
<td>2011</td>
<td>Falcon 9</td>
<td>Cape Canaveral</td>
</tr>
<tr>
<td>NASA CRS2</td>
<td>2011</td>
<td>Falcon 9/Dragon</td>
<td>Cape Canaveral</td>
</tr>
<tr>
<td>MDA Corp (Canada)</td>
<td>2011</td>
<td>Falcon 9</td>
<td>Kwajalein</td>
</tr>
<tr>
<td>DragonLab Mission 2</td>
<td>2011</td>
<td>Falcon 9/Dragon</td>
<td>Cape Canaveral</td>
</tr>
<tr>
<td>CONAE 1A (Argentina)</td>
<td>2012</td>
<td>Falcon 9</td>
<td>Kwajalein</td>
</tr>
<tr>
<td>CONAE 1B (Argentina)</td>
<td>2013</td>
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<td>Kwajalein</td>
</tr>
<tr>
<td>NASA CRS3-12 (10 additional missions)</td>
<td>2012-15</td>
<td>Falcon 9/Dragon</td>
<td>Cape Canaveral</td>
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</tbody>
</table>
Falcon 1

- The First Privately-Developed Liquid Fuel Rocket To Achieve Earth Orbit
- Reached orbit Sept 28, 2008...
- ...and again, July 13, 2009 (RazakSAT)
- World’s lowest cost dedicated orbital mission
  - $9.3M all-inclusive commercial cost
- 2-stage light-lift launch vehicle
  - 1st Stage: LOX/RP-1 Merlin engine, ~89k lbf vac.
  - 2nd Stage: LOX/RP-1 Kestrel engine, ~7k lbf vac.
- Diameter 5.5 ft (1.7 m); Length 68 ft (21 m)
- Enhanced Falcon 1 (F1e) block upgrade late 2010
- Payload capability:
  - F1: (2008-09): 925 lb (420 kg)
  - F1e (2010+): ~2,000 lb (~900 kg), $10.5M
- Launch site: Reagan Test Site in Kwajalein, RMI
- Highly Responsive Mission Integration and Operations

All structures, engines, most avionics and all ground systems designed (and mostly built) by SpaceX
Flight 4 Mission Success & Responsiveness
- > getting closer to “ship and shoot”
Flight 5 Hardware at Omelekk
Flight 5 Success - July 2009

- Mission: F1-005
- Payload: RazakSAT for ATSB of Malaysia
- Liftoff: 3:35 pm, 7/14/2009 (Kwajalein Time)
- Orbit: 673.1km x 695.9km, 9.0 degree inclination
Falcon 1 Flight 5
Mission Success Summary

All major flight events were successfully executed

Summary:
- Ground control & support systems, including highly autonomous control & operations software
- 1st stage performance and control from lift-off through Main Engine Cut-Off (MECO)
- Vehicle structural performance & margins through lift-off, transonic & max-Q
- Stage separation
- 2nd stage ignition
- Fairing separation
- 2nd stage engine performance in vacuum
- Flight software through all major flight domains
- 2nd stage engine on-orbit restart
- Guidance, navigation & control performance through orbital insertion and 2nd stage engine restart
- Payload Environments (Thermal, Shock, Vibration, Acoustic, Pressure, Acceleration) all within Interface specified limits
- Payload deployed into specified Orbit
- Collision avoidance maneuver
Falcon 1E Upgrade

- **Structures:**
  - 1st stage tank elongated and re-qualified for higher thrust levels
  - 2nd stage tank upgrade:
    - Tank material being changed to an Aluminum Lithium alloy
  - Avionics bay flare removed
  - Fairing volume increased and material changed to composite

- **Avionics:**
  - Certain components will be modified to reduce mass and increase reliability and manufacturability

- **Propulsion:**
  - First stage Merlin engine will be upgraded to the M9 version being used on the Falcon 9 for increased performance, reliability, manufacturability, and for parts commonality across the launch vehicles.

"Falcon 1E will replace Falcon 1 in Q4 2010"
SpaceX DragonLab
Fast Track to Flight

USES
- Highly Responsive payload hosting
- Sensors/apertures up to 3.5m diameter
- Instruments and sensor testing
- Spacecraft deployment
- Space physics and relativity experiments
- Radiation effects research
- Microgravity research
- Life science and biotech studies
- Earth sciences and observations
- Materials and space environments research

DRAGON SPACECRAFT SYSTEM
- Fully recoverable capsule
- Trunk jettisoned prior to reentry
- 6000 kg total combined up-mass capability
- Up to 3000 kg down mass
- Payload Volume:
  - 7 – 10 m³ pressurized
  - 14 m³ unpressurized
- Mission Duration: 1 week to 2 years
- Payload integration timeline:
  - Nominal: L-14 days
  - Late-load: 7-9 hours
- Payload Return:
  - Nominal: End-of-Mission + 7 days
  - Early Access: End-of-Mission + 6 hours

TYPICAL INTEGRATION TIMELINE

Launch
EGM + 1 Wk
1 Mth – 2 Wks
Fit Check
ICD
ATH
Payload Integration
Return

Aug 12, 2009

Space Exploration Technologies Corp
DragonLab Deployment of Spacecraft

Earth Science & Observation
Space Physics and Heliophysics
Space Weather and Radiation Observations

- Trunk can host multiple small to mid-sized spacecraft for deployment into orbit
  - Multiple P-Pods carrying CubeSats
  - Multiple ESPA-class spacecraft
  - Other 10 to 100kg+ class spacecraft
- Deployment of >2 MT spacecraft is also possible
Summary

- We did it!
- Through back to back launch successes, SpaceX has demonstrated that reliable, low cost access to space is now a reality
- SpaceX has demonstrated that responsive missions can be, and are being, executed
- Looking forward to returning next year with additional success stories to share on Falcon 1e development, Falcon 9 and Dragon!