The Falcon 1 Flight 3 - Jumpstart Mission
Integration Summary and Flight Results

Aug. 13, 2008
Founded with the singular goal of providing highly reliable, low cost space transportation.
Factory Geared for Production
Falcon 1 Overview

- 2-stage small launch vehicle
- 1\textsuperscript{st} Stage LOX/RP1 \textit{Merlin M1} engine, \(\sim\)78k lbf vac.
- 2\textsuperscript{nd} Stage LOX/RP1 \textit{Kestrel} engine, \(\sim\)7k lbf vac.
- Vehicle dia. 5.5’; Fairing dia. 5’; Length 68’
- World’s lowest cost orbital launch $7.9M
- Launch from Kwajalein (Reagan Test Site)

- 1st Stage Parachute/Water Recovery
- Enhanced Falcon 1 (F1e) block upgrade planned
  - Available early 2010
- Payload capability \(\rightarrow\) LEO (9°, 185km, circular)
  - F1: \(\sim\)1000 lbm (450 kg)
  - F1e: \(>\)2200 lbm (1000 kg)
- Updated User’s Guide at \url{www.spacex.com}

All structures, engines, most avionics and all ground systems designed (and mostly built) by SpaceX
Flight 3 and the ORS Jumpstart Mission

Launched August 3rd, 2008
Flight 3 Overview

Falcon 1 Launch August 3rd 2008

- From: RTS, Omelek Island, Kwajalein Atoll
- Primary Payload 1: DoD Operationally Responsive Space (ORS) Office
- Primary Payload 2: ATSB® of Malaysia
- Secondary Payloads:
  - NASA Ames - PRESat
  - NASA MSFC - NanoSail-D
  - Space Services Inc.
  - SpaceX

Overall Mission Objectives:

- Operationally Responsive Launch
  - Support payload decision~ 1 month prior to LO
  - Perform mission integration for 3 possible payloads
  - Rapid contract to launch
- Multi-satellite dispenser demonstration
- Demonstrate technologies leading to space based range
- Direct Injection to Payload Deploy Orbit:
  - 9°, 330 x 685 km

Space Exploration Technologies Corporation
Spacex.com
Jumpstart Mission Objectives

ORS Office Jumpstart Mission Objectives

- Rapid development, integration and checkout of the spacecraft
- Concept of operations that allows flexibility late in the payload processing flow to determine mission requirements
- Efficiencies in processes and procedures to reduce payload integration timelines

Payloads

- Air Force Research Laboratory (AFRL) Plug and Play (PnP) satellite bus – a third generation bus with multiple integrated payloads, that when flown, would be a risk reduction to future ORS missions.
- SpaceDev, Inc. Trailblazer spacecraft bus, originally developed under a Missile Defense Agency contract, which demonstrates a flexible, modular commercial bus design using off the shelf components.
- Air Force Office of Scientific Research (AFOSR)/AFRL NanoSat-4, CUSat – a Space Test Program experiment consisting of two nanosatellites developed by Cornell University in partnership with the AFRL under the University Nanosatellite Program.
Jumpstart Payloads
Project Timeline

- Kick Off 2/29
- Payload Pre-Ship Review 5/20
- System Readiness Review 5/22
- Flight Readiness Review 6/18
- Static Fire 6/25
- New Second stage skirt arrival 7/27
- Launch Readiness Review 8/1
- Launch 8/3
Flight 3 Results: the big issue

- Stage Separation:
  - Investigation is still in process but the flight data points to the effects of first stage thrust transients from engine purge in vacuum conditions being underestimated in stage separation timing and causing the first stage to re-contact the second stage shortly after stage separation.
Falcon 1 Reached Space: 217 Km but didn’t stay there.....

Validated
- New first stage engine (Regen Merlin) performance
- Structural integrity of the Malaysian secondary payload adapter
- Same stuff as Flight 2:
  - Structural performance through lift-off, transonic & max-Q
  - Aero-thermal and base-heating models
  - Stage separation device
  - Fairing separation (given harsh conditions)
  - Second stage ignition and nominal chamber pressure
  - Launch & flight environments
- Except:
  - Second stage fly out and guidance

Operational Responsive Space launch Achievements
- The agility and flexibility in the rapid buildup and integration of three separate payloads on parallel manifest paths
- Teams performed the final environmental tests, shipping, and first integration to the launch vehicle in less than 15 days
- The final integration timeline was 6 days from clean room to launch
- Executed complex payload integration in <5 months
- Stages integrated, rolled out and launched in less than 7 days
- Fastest hot-fire recycle ever demonstrated ~34 min
Responsive Integration Process Challenges

- **Documentation:**
  - Contract – need a responsive contracting mechanism
  - Worked 3 separate Mission Specific ICD’s corresponding to the 3 payload possibilities
  - Submitted FAA Commercial Launch License application package with information on all 3 payload possibilities

- **Analysis:**
  - Coupled Loads Analysis (CLA)
    - First ran for payload configuration believed to be worst case of three payloads being considered
    - Payload selected was not the same as payload analyzed, therefore another CLA was run to understand flight configuration loads
  - Performance and GNC analysis ran for all three payloads
  - Collision Avoidance Analysis ran using selected separation system and Delta V obtained from various payload configurations
### Our Customers

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<th>Launch</th>
<th>Vehicle</th>
<th>Departure Point</th>
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<td>Falcon 1</td>
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<td>DARPA Demo Launch 2-launched</td>
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<td>ORS Office and ATSB®-launched</td>
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<tr>
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* Flight hardware at launch site on this date
Summary

- We are working the issues and expect to be back at the pad in a few months.
- Continue to make progress towards getting to orbit.
- The Jumpstart mission, similar to Demo 2, is showing that Responsive missions can be, and are being, executed.
- Looking forward to returning next year with at least 2 success stories to share.
Thank You for your interest in SpaceX!