SpaceX Overview

Tom Markusic
Director, McGregor Rocket Development Facility

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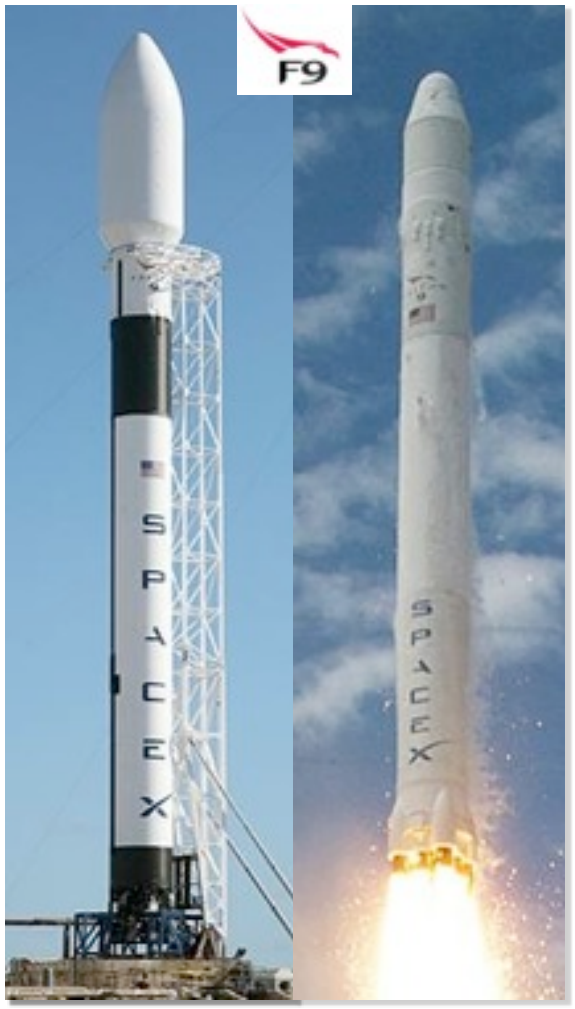
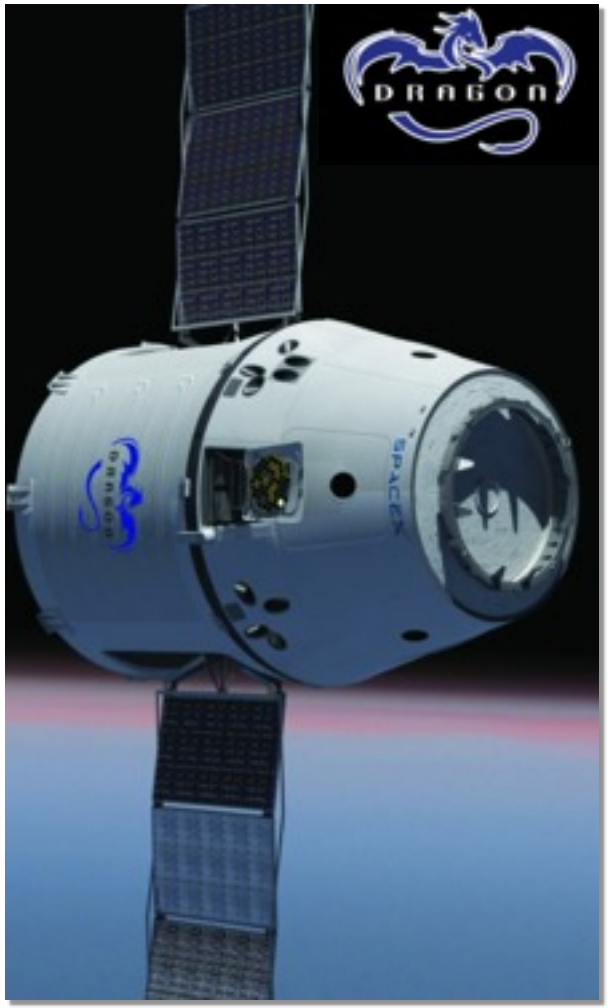
SpaceX Vehicles

Falcon 1



Falcon 9



Dragon Spacecraft

SpaceX Overview

- Founded in mid-2002 with the singular goal of providing highly reliable, low cost space transportation for both cargo and crew
- Over 1180 employees and growing
- 51,000 sq m (550,000 sq ft) of offices, manufacturing and production in Hawthorne (Los Angeles), California
- 700 acre state-of-the-art Propulsion and Structural Test Facility in central Texas
- Launch sites at Kwajalein and Cape Canaveral
- Developing launch site at Vandenberg

Omelek, Kwajalein Atoll

SLC-40, Cape Canaveral

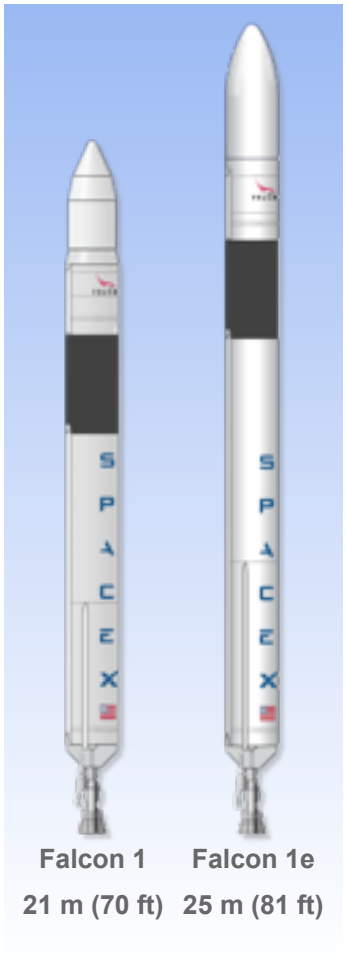
Hawthorne (Los Angeles) Headquarters

Central Texas

Falcon 1 Capabilities

- **World's lowest-cost dedicated orbital mission: ~$9M**
- 28 Sep 2008: 1st privately developed liquid fuel rocket to orbit
- 14 July 2009: Delivered 1st commercial customer to orbit

- Two-stage light-lift launch vehicle
  - 1st Stage: Merlin engine, LOX / RP-1, ~95k lbf vac.
  - 2nd Stage: Kestrel engine, LOX / RP-1, ~7k lbf vac.
- Diameter: 1.7 m (5.5 ft); Length 21 m (68 ft)
- Falcon 1 Enhanced (F1e) block upgrade starting in 2010
- Payload capability to 185 km, 9.1° circular LEO:
  - Falcon 1 (2008-09): 420 kg (925 lb)
  - Falcon 1e (2010+): 1010 kg (~2,220 lb) for ~$11M
- Highly Responsive Mission Integration and Operations



All structures, engines, most avionics and all ground systems designed and mostly built by SpaceX

Falcon 1 Launch Highlights

Falcon 9 Capabilities

- June 4, 2010: reached orbit on inaugural mission
- Lowest mission price in this vehicle class
- Over 40 launches on contract through 2016

- Two-stage EELV-class launch vehicle
  - Designed from inception to be crew-capable
  - Engine-out reliability
- 1st Stage powered by 9 Merlin engines
  - Over 4.9 MN (1.1 million lbf) thrust in vacuum
- 2nd Stage powered by Merlin Vacuum engine
  - 42.7 kN (96,000 lbf) thrust in vacuum
- Diameter 3.6 m (12 ft); Length 55 m (180 ft)
- Payload capability
  - 11,500 kg to LEO; 5.2 m (17 ft) fairing

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Falcon 9 Flight 1 Highlights

Dragon Spacecraft

Nosecone

Jettisoned after stage separation.

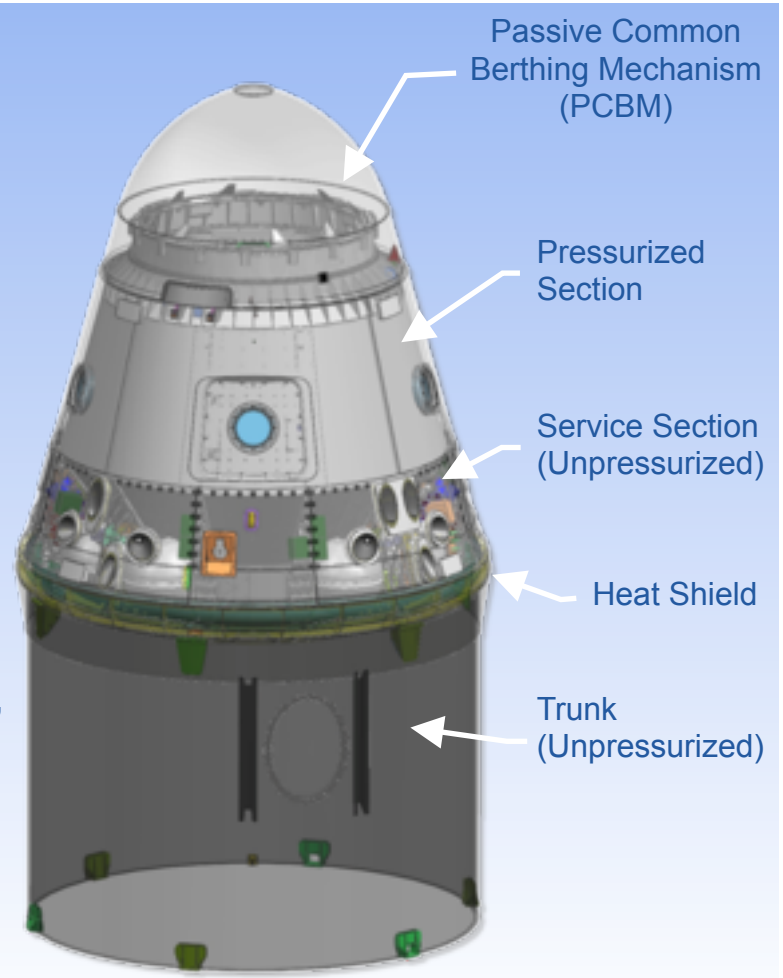
Capsule – fully recoverable

Contains pressurized cargo, experiments or crew, hatches, thrusters & propellant, parachutes and heat shield.

Trunk – not recoverable

Contains unpressurized cargo and small deployable satellites. Supports solar panels, thermal radiator. Jettisoned before reentry.

Designed from inception to be crew-capable



Total Payload Capacity: 6,000 kg to LEO
Capsule Down-mass Capability: 2500 kg

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Dragon Spacecraft

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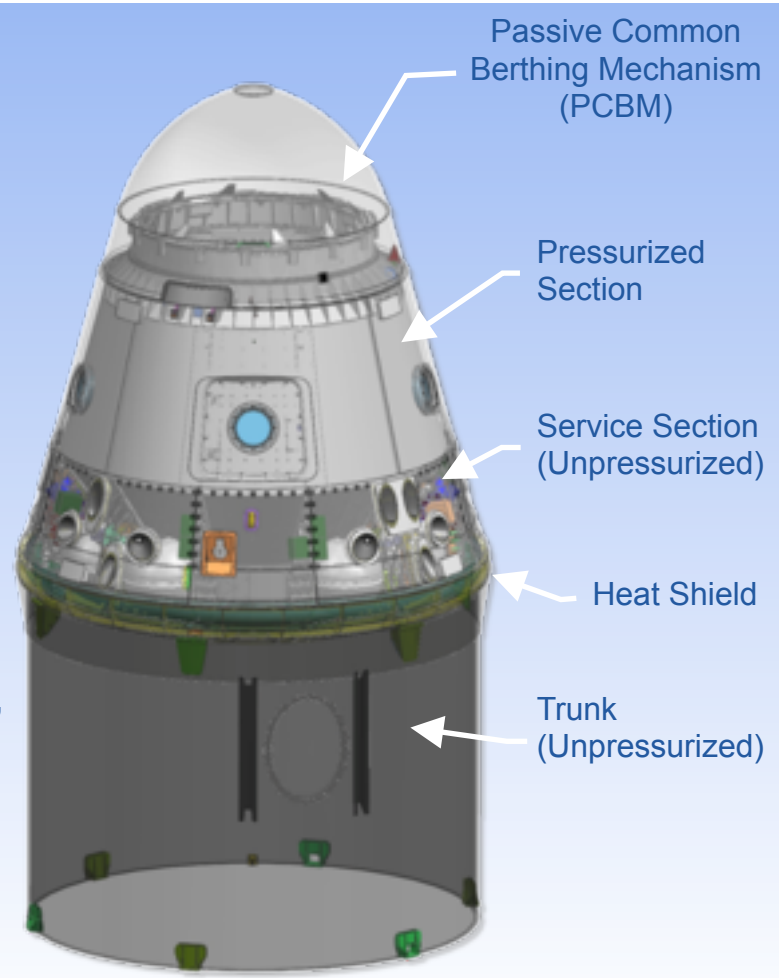

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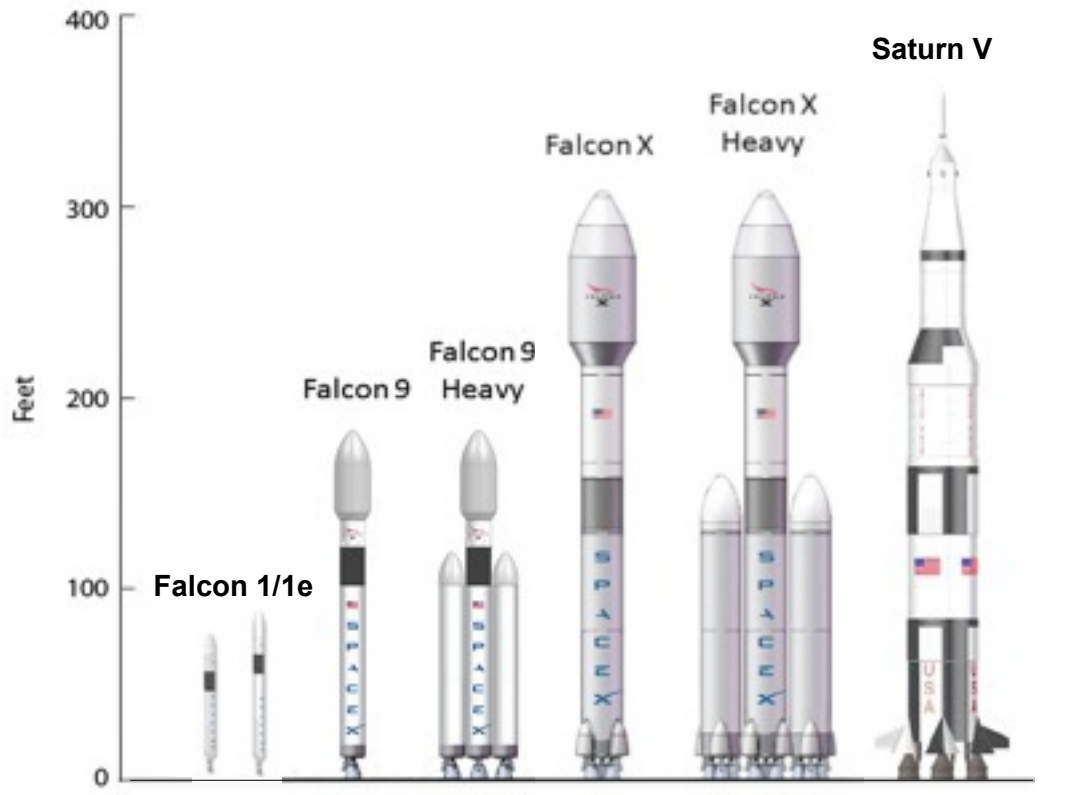
SpaceX Manifest

Customer	Date†	Vehicle	Launch Site
NASA COTS - Demo C1	2010	Falcon 9/Dragon	Cape Canaveral
NASA COTS - Demo C2	2011	Falcon 9/Dragon	Cape Canaveral
NASA COTS - Demo C3	2011	Falcon 9/Dragon	Cape Canaveral
Falcon 1e Inaugural Flight	2011	Falcon 1e	Kwajalein
ORBCOMM – *Multiple Flights*	2011 to 2014	Falcon 1e	Kwajalein
MDA Corp (Canada)	2011	Falcon 9	Cape Canaveral
NASA CRS ISS Resupply – Flight 1	2011	Falcon 9/Dragon	Cape Canaveral
DragonLab – Mission 1 & 2	2012 & 2013	Falcon 9/Dragon	Cape Canaveral
Spacecom (Israel)	2012	Falcon 9	Cape Canaveral*
CONAE (Argentina) – *Two Flights*	2012 & 2013	Falcon 9	Vandenberg*
NSPO (Taiwan)	2013	Falcon 1e	Kwajalein
Space Systems/Loral	2014	Falcon 9	Cape Canaveral*
Astrium (Europe)	2014	Falcon 1e	Kwajalein
Bigelow Aerospace	2014	Falcon 9	Cape Canaveral
NASA CRS ISS Resupply – *Flights 2 thru 12*	2011 to 2015	Falcon 9/Dragon	Cape Canaveral
Iridium – *Multiple Flights*	2015 to 2017	Falcon 9	Vandenberg

Launch Vehicle Evolution

- Falcon 1 → Falcon 1e (2011)
  - 1050 kg to LEO
- Falcon 9/Dragon crew transportation (~30mths after ATP)
- Falcon 9 → Falcon 9 Heavy (net 2013)
  - 32k kg to LEO
- Merlin 2 booster engine:
  - ~1.7M lbf LOX/RP-1
- Raptor upper stage engine
  - LOX/LH2
- Falcon X
  - All RP Heavy Lift
  - 38k kg to LEO
- Falcon X Heavy
  - All RP Super Heavy Lift
  - 125k kg to LEO



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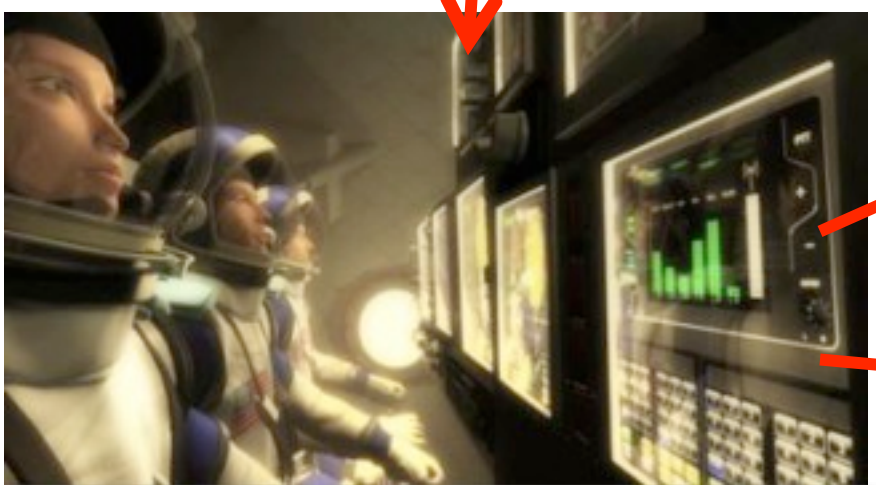
Dragon Evolution

Cargo Dragon

- ISS Cargo Delivery
- DragonLab Micro-gravity
- Rendezvous & Inspection
  - Boost/ De-Orbit
  - Robotic Servicing



Crew Dragon

- ISS Crew Service
- Life-boat
  - Crewed Servicing
  - Orbital Tourism

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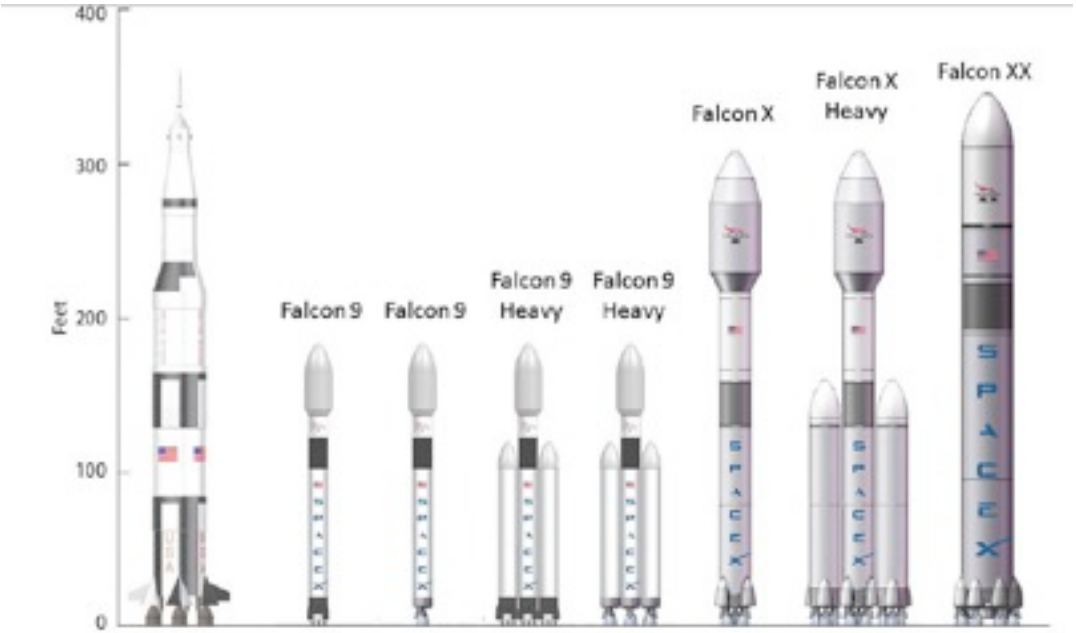
Future Vehicles



VEHICLE	Falcon 9	Falcon 9	Falcon 9 Heavy	Falcon 9 Heavy	Falcon X	Falcon X Heavy	Falcon XX
1st Stage Engines	Merlin 1D	Merlin 2	Merlin 1D	Merlin 2	Merlin 2	Merlin 2	Merlin 2
Core Diameter (meters)	3.6	3.6	3.6	3.6	6	6	10
Number of Cores	1	1	3	3	1	3	1
Engines per Core	9	1	9	1	3	3	6
Engine Thrust (sea level, lbf)	120k	1.2M	120k	1.2M	1.2M	1.2M	1.7M
Total Lift-off Thrust (lbf)	1.08M	1.2M	3.24M	3.6M	3.6M	10.8M	10.2M
Engine Out Capability?	Yes	No	Yes	No	Yes	Yes	Partial
Mass to LEO (kg)	10.5k	11.5k	32k	34k	38k	125k	140k

The Dawn of Commercial Space