Mission Science Objectives and History

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IRVE-II PI

Mars Aeroshell Comparison

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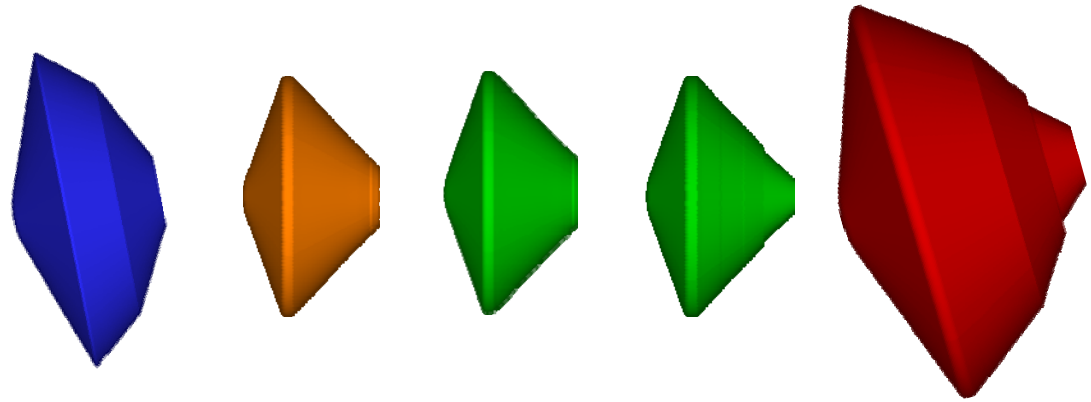


	Viking I/II (1975)	MPF (1996)	MER A/B (2003)	Phoenix (2007)	MSL (2009)
Diameter, m	3.5	2.65	2.65	2.65	4.5
Entry Velocity, km/s	4.5/4.42	7.6	5.5	5.5	5.5
Entry Mass, kg	930	585	840	602	3350
Peak Heat Rate, W/cm^2	24	106	48	56	216
Nominal α, deg	–11	0	0	0	–16
Nominal L/D	0.18	0	0	0	0.24
Control	3-axis	Spinning	Spinning	None	3-axis
Guidance	No	No	No	No	Yes

Advantages of Inflatable vs. Rigid Aeroshells

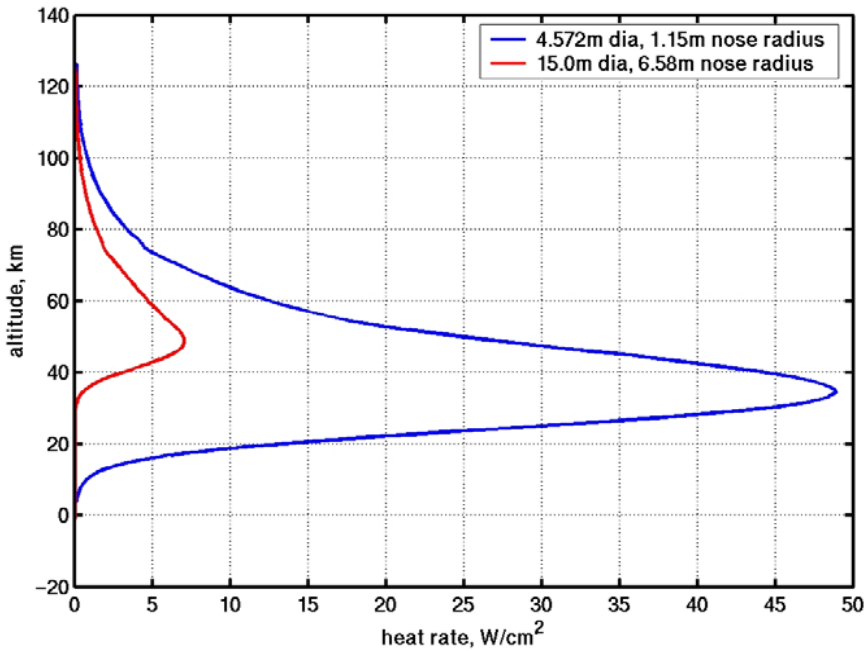
- Deflated/Stowed Inflatable Aeroshell:
  - Access to payload after vehicle is integrated for launch
  - Direct access to vehicle structure for structural attachment with launch vehicle
  - Increased payload volume fraction of the launch vehicle shroud
  - Opportunity to eliminate system duplication between the cruise stage and entry vehicle
- Inflated Aeroshell:
  - Larger sizes than those attainable by rigid aeroshells since aeroshell diameter is not limited to the launch vehicle shroud diameter
  - Larger drag area provides deceleration at higher altitudes, and the potential to:
    - Provide access to a larger percentage of the planet's surface for a given mass
    - Deliver more payload mass to a given altitude
    - Provide a less hazardous thermal environment for the total entry system

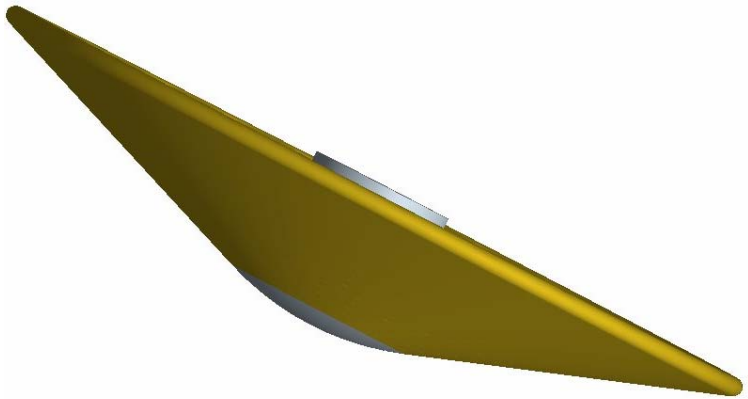
Technical Considerations for Inflatable Aeroshells

- Off-nominal drag performance or an aerostructural dynamic instability due to potential flexibility of the aeroshell
- Higher-than-anticipated aerothermal heating of the thin aeroshell membrane during planetary entry
- Susceptibility to puncture

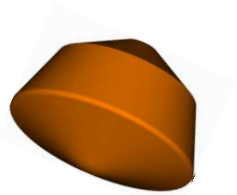
Inflatable vs. Rigid for 2200kg Mission

Direct Ballistic Entry, 6km/s

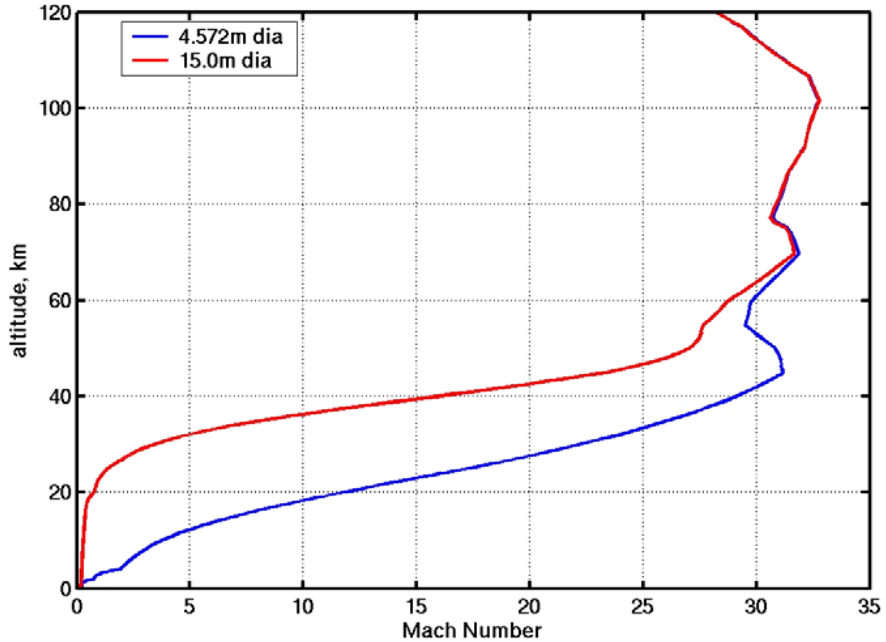




15m Inflatable 70-deg Sphere-Cone



4.572m Rigid 70-deg Sphere-Cone



IRVE History

- Definition/Purpose:
  - IRVE: Inflatable Reentry Vehicle Experiment (IRVE)
  - Demonstrate viability of hypersonic inflatable aeroshell technology in terms of inflation, reentry survivability, thermal response, and aero performance
- IRVE-I:
  - Goal: First attempt to execute flight demonstration of a hypersonic inflatable aerodynamic decelerator
  - Launch: Sept 6, 2007
  - Result: Launch vehicle anomaly prevented successful deployment of the payload – inflatable technology unproven
- IRVE-II:
  - Goal: Second attempt to execute a flight demonstration of a hypersonic inflatable aerodynamic decelerator
  - Launch: Late summer, 2009

IRVE-II Science Objectives

- Execute a flight-test that demonstrates the Inflatable Aerodynamic Decelerator inflation and reentry survivability.
- Assess the thermal response and aero performance (drag and stability) of the Reentry Vehicle.
- Collect flight data for comparison with the analysis and design techniques used in the development of the Reentry Vehicle.

There are no changes from the original IRVE-I Mission Science Objectives

Minimum Success Criteria

Minimum Success Criteria: Set up the test conditions

- The reentry vehicle is deployed from and does not re-contact the launch vehicle, nose cone, and shroud.
- The reentry vehicle inflates to the desired conical shape.
- The reentry vehicle is tracked sufficiently to evaluate the drag performance.

Comprehensive Success Criteria

Comprehensive Success Criteria: Test the reentry vehicle

- The reentry vehicle inflates to the desired conical shape before heat flux reaches 10% of predicted peak heat flux.
- The reentry vehicle maintains structural integrity and inflation through peak heating and peak pressure.
- The reentry vehicle attitude, flight path, thermal, bladder pressure data, and video data are generated and captured from launch through peak heating and peak pressure.
- The reentry vehicle is oriented at an angle-of-attack less than or equal to 35 degrees prior to reentry.
- The reentry vehicle maintains an angle-of-attack less than or equal to 35 degrees through peak heating and peak pressure.