Request for Information

for the

Supersonic Inflatable Aerodynamic Decelerator Development Program:

Suborbital, High-Altitude Free-Flight Test Services

California Institute of Technology
Jet Propulsion Laboratory

Planned Activity Initiation: July 2010

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Introduction

1.1 Program Description

NASA and the Jet Propulsion Laboratory have begun the planning and scoping of a technology development program for maturing supersonic inflatable aerodynamic decelerators (IADs) for use in future planetary entry missions. Specifically, the program is a fast-paced development effort aimed at bringing IADs to a level of maturity sufficient for incorporation in a Mars mission launching in 2018. The development program includes both ground-based subsystem testing as well as subscale and full-scale flight testing of an IAD at conditions relevant to a future Mars robotic mission.

The goal of this document is to provide a brief overview of the technology development program with an emphasis on the planned flight test component. The RFI is being issued to determine the interest of potential flight test service providers.

1.2 IAD Description

An IAD is a deployable device typically designed to provide a large increase in the drag area (defined as the drag coefficient times the reference area) of an entry vehicle. The shape consists of a mostly closed textile surface that is pressurized with an on-board inflation system or through ram-air. IADs are often categorized based upon the environment for which they will be used. The present effort is focused on developing supersonic IADs (SIADs) that undergo deployment within the atmosphere in a post- peak heating, peak deceleration environment. Figure 1 shows an example of a rigid aeroshell with an IAD initially stowed and then deployed.

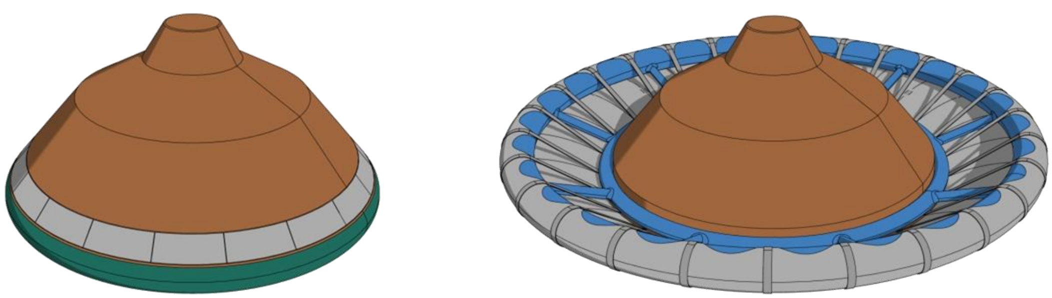

Figure 1: Rigid aeroshell with stowed IAD and deployed IAD.

RFI Area of Interest: Supersonic Flight Test

1.3 Flight Test Description

The current plans for the IAD development program include two sets of flight tests on either one or both of the candidate IAD configurations. The first set of flight tests will be for a subscale aeroshell/IAD system while the second set of tests is to be for a full-scale IAD system. Both sets of tests are intended to simulate the deployment and flight of an IAD in a Mars analog environment. JPL is interested in responses that target one or both of the test sets. The test objectives are currently envisioned as being similar to those of the Balloon Launched Decelerator Test (BLDT) program that was used to qualify the supersonic parachute for the Viking missions of the 1970's. An example of this type of test applied to the current application of IAD development is shown in figure 2. It should be noted that at this point no specific means of delivering the test vehicle to the target conditions is specified. That is, the choice of balloon ascent followed by propulsive acceleration is but one of several possible methods for achieving the desired test conditions.

Exploration of all viable, cost effective methods for achieving the desired test conditions is the objective of this RFI.

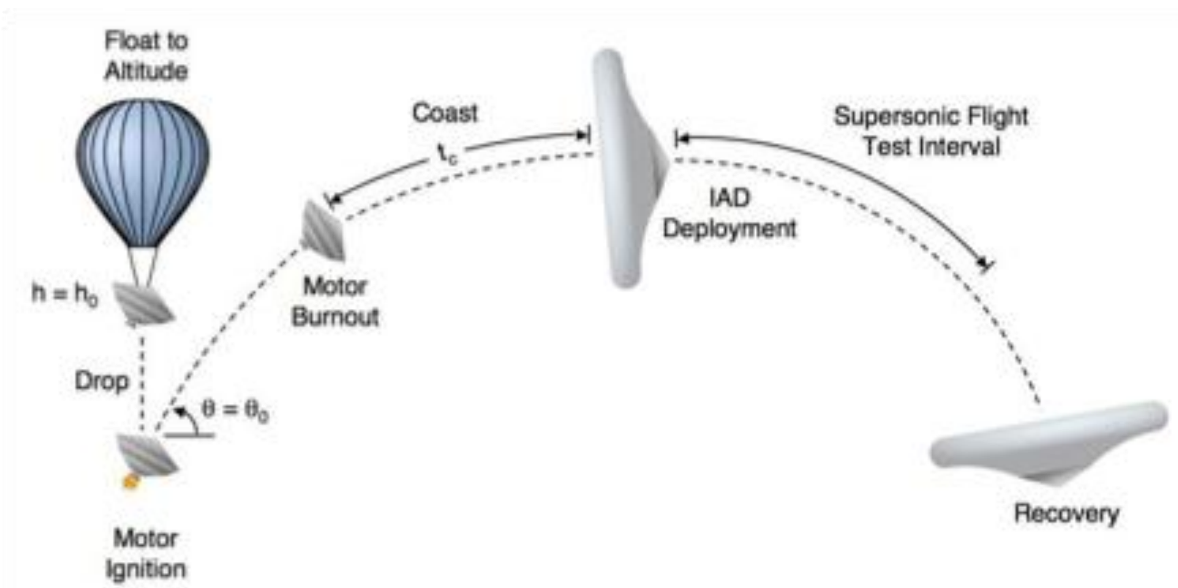

Figure 2. Example profile for the supersonic free flight test.

1.4 Subscale Test Vehicle and Deployment Conditions

Prior to performing a full-scale supersonic IAD deployment, it is desired to first perform a series of subscale flights to provide early insight into the behavior and performance of IADs in a supersonic freeflight environment. The subscale test vehicle, shown in Figure , will consist of a blunt body aeroshell similar to those previously flown at Mars.

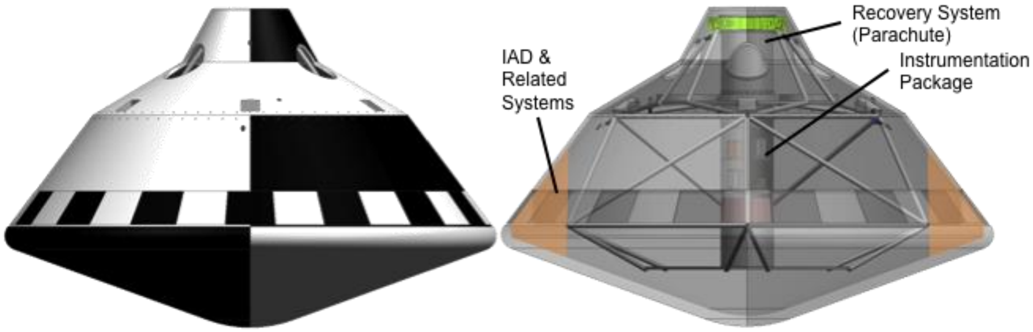

Figure 3. Subscale flight test vehicle.

The test vehicle will need to be delivered to the deployment conditions shown in **Error! Reference source not found.** (note ranges are shown as these are preliminary estimates). JPL is open to test options that include a flight test service provider delivering the test vehicle to the full list of target test conditions or a service provider only providing a subset of the conditions. For example, an option exists for JPL to provide a rocket powered test vehicle capable of providing as much as ~1600 m/sec in ΔV and therefore would only require the test service provider to deliver the test vehicle to an altitude test condition at zero velocity. Vehicle interfaces are considered highly negotiable.

Table 1. Preliminary estimates of deployment conditions for both subscale and full-scale flight tests.

Condition	Value
Mach	4 – 5
Dynamic Pressure (kPa)	2 – 5
Altitude (km)	35 – 45
Flight Path Angle (deg)	0 ± 10
Angle of Attack (deg)	0 ± 5
Roll Rate (deg/sec)	< 25 - 50

A preliminary estimate of the size and mass of the test vehicle is shown below in table 2. The vehicle center of mass is likely to be located at an axial position similar to the maximum vehicle diameter.

Table 2. Preliminary estimates of the subscale test vehicle mass and size.

Parameter	Unpowered	Powered (1600 m/sec ΔV)
Diameter of Rigid Aeroshell (m)	1.5	
Mass (kg)	200 – 400	600 - 1200
Test Vehicle Configuration	70º Sphere cone or similar blunt body	
Test Vehicle C_D (Supersonic)	~1.6	

1.5 Full-Scale Test Vehicle and Deployment Conditions

The full-scale test vehicle will be nearly similar to the subscale vehicle shown in Figure 5 with the exception of an increased diameter and increased mass. The target test conditions are also identical to those in Table 1. As with the subscale vehicle, JPL is open to proposals where it would provide a rocket powered test vehicle capable of providing 1600 m/sec ΔV. Mass and size estimates for both unpowered and powered full-scale vehicles are shown below. A visual comparison of the size of the full-scale vehicle to the subscale vehicle is shown in Figure .

Table 2. Preliminary estimates of the full-scale test vehicle mass and size.

Parameter	Unpowered	Powered (1600 m/sec ΔV)
Diameter of Rigid Aeroshell (m)	4.7	
Mass (kg)	2500 - 4000	7500 - 12000
Test Vehicle Configuration	70º Sphere cone or similar blunt body	
Test Vehicle C_D (Supersonic)	~1.6	

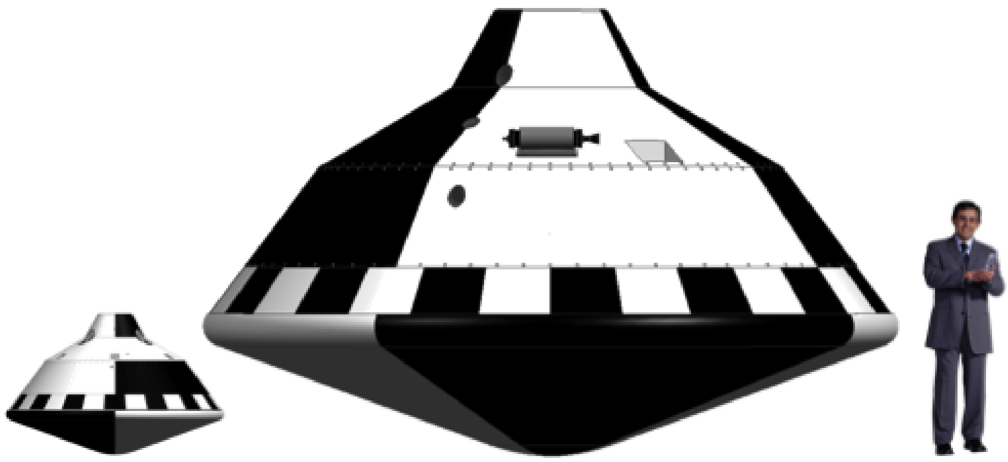

Figure 4. Relative size of subscale and full-scale test vehicles.

1.6 Range Limitations

There is a preference that the tests be conducted over land and within the United States. However, it is recognized that this may prove infeasible and alternative test locations are welcomed. The previous BLDT series required as much as 60 km in downrange after release. The current series of planned tests will likely require even more range capability.

1.7 Schedule

Initiation of the subscale flight test campaign should occur no later than December of 2011. Full-scale flight tests should be initiated no later than March of 2013.

1.8 Cost

The primary objective of this RFI and the subsequent implementation of a high altitude test system is the establishment of a cost effective method of performing aerodynamic decelerator tests at a reasonable cost. Responders are asked to focus on identifying solutions which minimize both nonrecurring as well as recurring cost for either or both test scales.

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