National Aeronautics and Space Administration

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Low-Density Supersonic Decelerator (LDSD)

www.nasa.gov

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Cover: An artist's concept of the Low Density Supersonic Decelerator being tested from the U.S. Navy's Pacific Missile Range Facility in Kaua'i, Hawai'i.

For more information
http://www.nasa.gov/mission_pages/tdm/ldsd

Media Services Information

NASA Television Transmission

In the continental United States, NASA Television's Public, Education and Media channels are carried by MPEG-2 digital C-band signal on AMC-6, at 72 degrees west longitude, Transponder 17C, 4040 MHz, vertical polarization. They're available in Alaska and Hawaii on an MPEG-2 digital C-band signal accessed via satellite AMC-7, transponder 18C, 137 degrees west longitude, 4060 MHz, vertical polarization. A Digital Video Broadcast-compliant Integrated Receiver Decoder with modulation of QPSK/DBV, data rate of 36.86 and FEC 3/4 is required for reception. NASA TV Multichannel Broadcast includes: Public Services Channel (Channel 101); the Education Channel (Channel 102); and the Media Services Channel (Channel 103). Analog NASA TV is no longer available.

For digital downlink information for each NASA TV channel, schedule information for LDSD activities and access to NASA TV's public channel on the Web, visit http://www.nasa.gov/ntv.

News Conferences

On Monday, June 2, reporters who have previously received access clearance from the U.S. Navy are invited to the Pacific Missile Range Facility (PMRF) in Kaua'i, Hawai'i to attend a news conference about the test. After the televised briefing at 8 a.m. Hawai'i Standard Time, reporters in attendance will be offered a behind-the-scenes tour of the facility and LDSD operations. Reporters who cannot attend may dial in remotely.

Flight Test Viewing

Journalists are invited to PMRF to watch the liftoff and flight of the balloon carrying LDSD on launch-attempt days. After the balloon launch, reporters will be able to watch events as they unfold from monitors in the LDSD media center located in the PMRF hangar.

NASA's LDSD carries several onboard cameras. It is expected that video of selected portions of the test, including the rocket-powered ascent, will be downlinked and streamed live to several NASA websites, including:

http://www.nasa.gov/nasatv
and
http://www.ustream.tv/nasajpl2

Internet Information

For more information about NASA's LDSD, visit the mission page at:
http://www.nasa.gov/mission_pages/tdm/ldsd

The LDSD program is part of the agency's Space Technology Mission Directorate, which is innovating, developing, testing and flying hardware for use in NASA's future missions. For more information about NASA's investment in space technology, visit: http://www.nasa.gov/spacetech

Mission news and updates will also be posted on Twitter at @NASA_Technology and @NASA.

Quick Facts

Test vehicle weight, with fuel: 6,878 pounds (3,120 kilograms)

Test vehicle dimensions: 15 feet, 5 inches (4.7 meters) diameter, prior to inflation of the 20 foot- (6 meter-) diameter decelerator known as a Supersonic Inflatable Aerodynamic Decelerator, or SIAD.

Parachute dimensions: 100 feet (30.5 meters) diameter – the largest supersonic parachute ever deployed

Launch balloon, at vehicle separation – 460 feet (140 meters) wide and 396 feet (120 meters) tall – would fit snugly inside a football stadium like the Rose Bowl.

Test vehicle maximum speed: Mach 4

Launch period: June 3, 5, 7, 9, 11 and 14, 2014

Duration of flight test from balloon launch to vehicle splashdown: approximately 3 hours

Key Points

- To safely land heavier spacecraft on Mars, larger parachutes and other kinds of drag devices that can be deployed at supersonic speeds are needed.
- High in Earth's stratosphere, NASA's Low-Density Supersonic Decelerator mission will test new, full-scale parachutes and drag devices at supersonic speeds to refine them for future use at Mars. Testing will be conducted through 2015.
- These new drag devices are among the first steps on the technology path to landing humans and habitats and returning rockets safely on Mars.
- Current Mars landing techniques date back to NASA's Viking mission, which put two landers on Mars in 1976. That mission's parachute design has been in use ever since — and was used again in 2012 to deliver the Curiosity rover to Mars. To conduct advanced exploration missions in the future, however, NASA must advance the technology to a new level of sophistication since Viking-style parachutes' capabilities are limited.
- This first flight is a shakeout test of the vehicle at speeds up to Mach 4. There will be two more flights next summer to test the technologies.

Why LDSD?

As NASA plans ambitious new robotic missions to Mars, laying the groundwork for even more complex human science expeditions to come, the spacecraft needed to land safely on the Red Planet's surface necessarily become increasingly massive, hauling larger payloads to accommodate extended stays on the Martian surface. Current technology for decelerating from the high speed of atmospheric entry to the final stages of landing on Mars dates back to NASA's Viking Program, which put two landers on Mars in 1976. The basic Viking parachute design has been used ever since — and was successfully used again in 2012 to deliver the Curiosity rover to Mars.

NASA seeks to use atmospheric drag as a solution, saving rocket engines and fuel for final maneuvers and landing procedures. The heavier planetary landers of tomorrow, however, will require much larger drag devices than any now in use to slow them down — and those next-generation drag devices will need to be deployed at higher supersonic speeds to safely land vehicle, crew and cargo. NASA's Low-Density Supersonic Decelerator (LDSD) Technology Demonstration Mission, led by NASA's Jet Propulsion Laboratory in Pasadena, California, will conduct full-scale, stratospheric tests of these breakthrough technologies high above Earth to prove their value for future missions to Mars.

Three devices are in development. The first two are Supersonic Inflatable Aerodynamic Decelerators, or SIADs — very large, durable, balloon-like pressure vessels that inflate around the entry vehicle and slow it from Mach 3.5 or greater to Mach 2 or lower. These decelerators are being developed in 20-foot- (6-meter-) diameter SIAD-R and 26-foot- (8-meter-) diameter SIAD-E configurations. Also in development is a 100-foot- (30.5-meter-) diameter parachute, called the Supersonic Disk Sail (SSDS) parachute, that will further slow the entry vehicle from Mach 1.5 or Mach 2 to subsonic speeds. All three devices will be the largest of their kind ever flown at speeds several times greater than the speed of sound.

Together, these new drag devices can increase payload delivery to the surface of Mars from our current capability of 3,300 pounds (1.5 metric tons) to 4,400 to 6,600 pounds (2 to 3 metric tons), depending on which inflatable decelerator is used in combination with the parachute. They will increase available landing altitudes by 1 to 2 miles (2 to 3 kilometers), increasing the accessible surface area we can explore. They also will improve landing accuracy from a margin of 6 miles (10 kilometers) to just 2 miles (3 kilometers). All these factors will increase the capabilities and robustness of robotic and human explorers on Mars.

To thoroughly test the system, the LDSD team will fly the drag devices several times — at full scale and at supersonic speeds — high in Earth's stratosphere, simulating entry into the atmosphere of Mars. The investigators conducted design verification tests of parachutes and supersonic inflatable aerodynamic decelerators through 2013. Supersonic flight tests will be conducted in 2014 and 2015 from the Pacific Missile Range Facility on Kaua'i, Hawai'i.

Once tested, the devices will enable missions that maximize the capability of current launch vehicles, and could be used in Mars missions.

A previous round of tests at the China Lake Naval Air Warfare Test Center in California, was completed.

The LDSD project is sponsored by NASA's Space Technology Mission Directorate and is managed by the Jet Propulsion Laboratory.

Illustrations of the three new drag devices being developed by the LDSD project: 30-meter Supersonic Disk Sail (SSDS) Parachute (at top), 6-meter SIAD-R (bottom left), 8-meter SIAD-E (bottom right).

LDSD Flight Test Overview

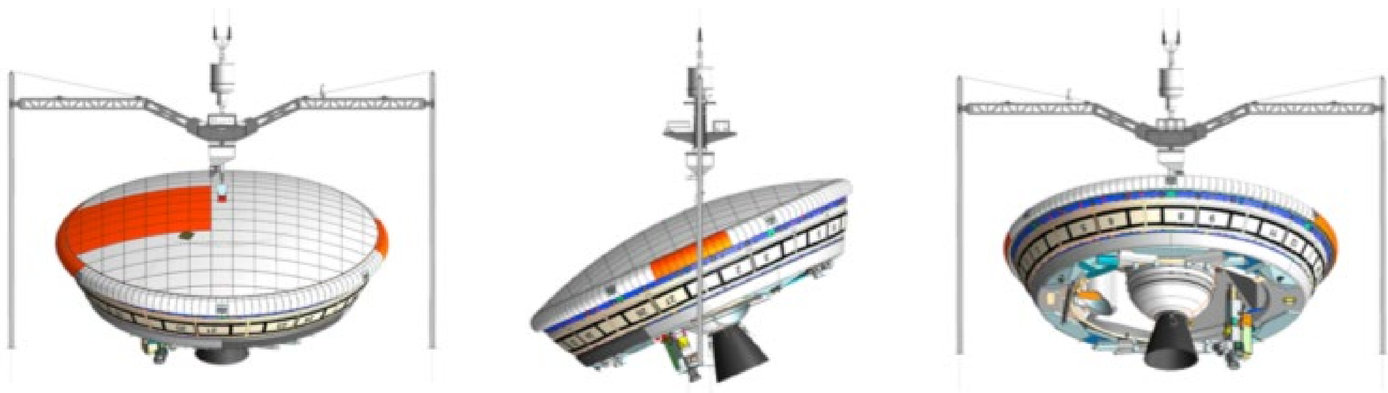
NASA will perform a supersonic flight dynamics test of the Low-Density Supersonic Decelerator (LDSD) experiment at the U.S. Navy's Pacific Missile Range Facility (PMRF) on Kaua'i, Hawai'i. During the test the LDSD project will assess two devices for landing heavy payloads on Mars: an inflatable tube and an enormous parachute.

NASA has six potential dates for launch of the high-altitude balloon carrying the LDSD experiment: June 3, 5, 7, 9, 11 and 14.

The NASA LDSD test over the Pacific Ocean will simulate descent speeds a spacecraft would be exposed to when flying through the Martian atmosphere. During the test, a large saucer-shaped vehicle carrying an inflatable Kevlar inner-tube-shaped decelerator and parachute system will be carried to an altitude of 120,000 feet (37 kilometers) by a giant balloon.

After release from the balloon, rockets will lift the vehicle to 180,000 feet (55 kilometers) and reach supersonic speeds. Traveling at 3.8 times the speed of sound, the saucer's decelerator will inflate, slowing the vehicle, and then a parachute will deploy at 2.5 times the speed of sound to carry it to the ocean's surface.

Flight Test Vehicle



These illustrations show front (at left), side (at center) and back (at right) views of the LDSD flight test vehicle as it will appear prior to launch, hanging from its launch tower.

The disk-shaped vehicle being launched is designated LDSD Supersonic Flight Dynamics Test Vehicle Number 1, and recently named Keiki o ka honua ("Boy from Earth").

This first flight is an experimental flight test of this Mach 4 vehicle, to see if it can accurately achieve the speeds and altitudes required for the demonstration of the technologies in a Mars-like environment. Two more tests are scheduled next year to collect the required data on the decelerator technologies. However, two decelerators (the SIAD-R and the Supersonic Disk Sail Parachute) are onboard this first shakeout flight, and will be deployed if the proper conditions are met.

The vehicle includes a balloon-like pressure vessel, called a Supersonic Inflatable Aerodynamic Decelerator, or SIAD. When inflated, the vehicle's disk is 20 feet (6 meters) in diameter. The decelerator is inflated with pressurized hot gas. Sized for future robotic missions, this version of the SIAD is called SIAD-R.

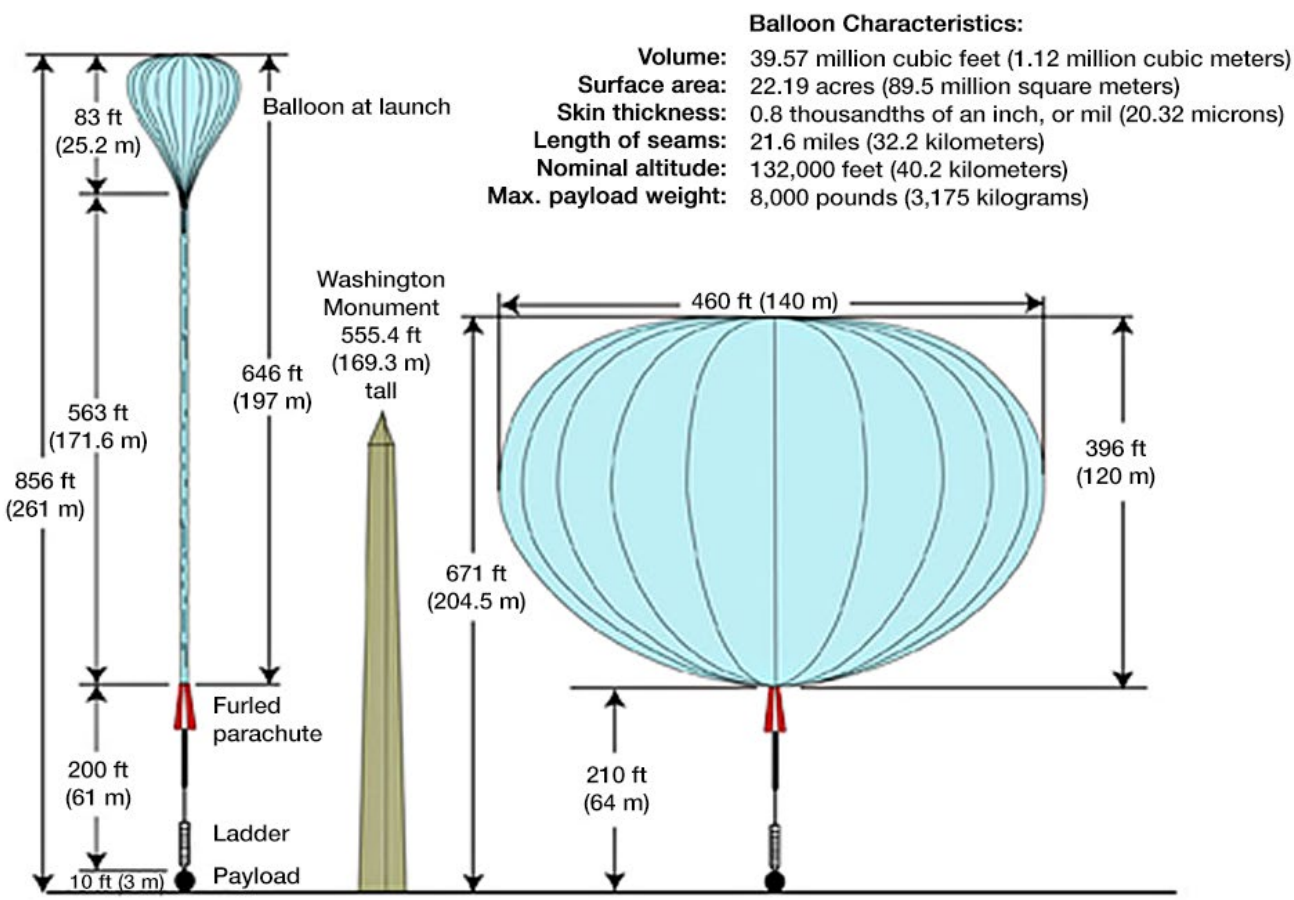
A second SIAD in development and intended to fly next year, called SIAD-E, is planned to be 26 feet (8 meters) in diameter when deployed, and would be sized for payloads related for human missions. The SIAD-E would be inflated with ram air pressure.

The vehicle is mated to a Star-48 booster rocket, which will carry the vehicle to 180,000 feet (54,900 meters), accelerating to Mach 4. Four spin-up and four de-spin motors provide stabilization during powered flight.

The drag device, which is attached to the outer rim of the capsule-like atmospheric entry vehicle, will inflate when the test vehicle is flying at Mach 3.8 and decelerate the vehicle to Mach 2.5, where it becomes safe to deploy a supersonic parachute.

The full-scale LDSD parachute is the largest parachute ever developed for use at Mars. This new parachute is approximately 100 feet (30.5 meters) in diameter – more than twice the area of the most recent Viking-based parachute used to land Curiosity.

The parachute weighs less than 300 pounds and can generate 120,000 pounds (54,400 kilograms) of drag. This is an enormous aerodynamic load, making the parachute an extremely efficient decelerator.



Key characteristics of the balloon launch platform being used for the LDSD flight test

Timeline of Events

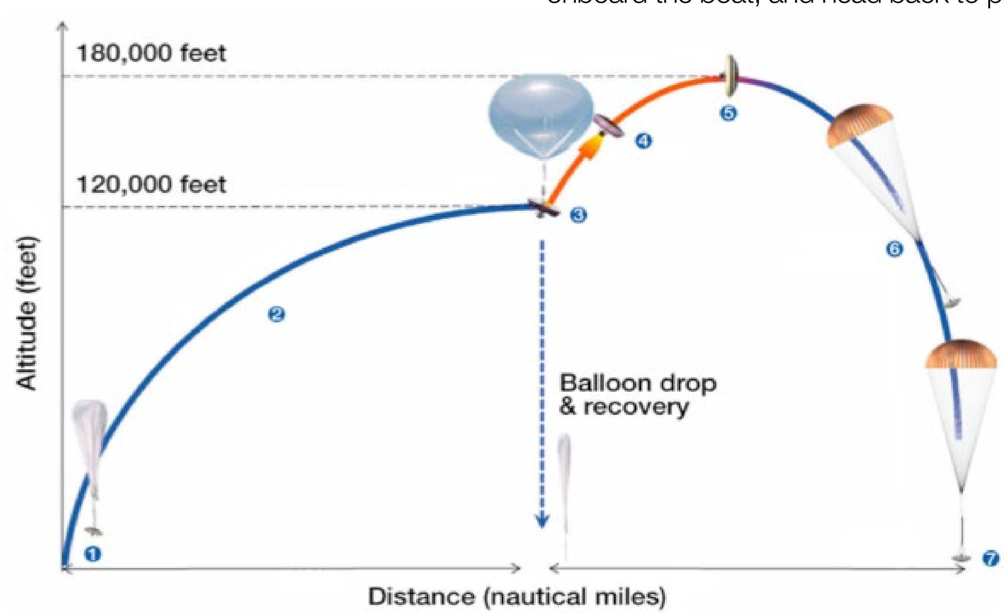
At the beginning of the flight test, the saucer-shaped LDSD vehicle hangs from a tower in preparation for launch. The launch tower helps link the vehicle to its balloon. At T-minus 0, the vehicle and balloon are released from the tower and the balloon slowly carries it to an altitude of 120,000 feet (36,600 meters), where the vehicle is released from the balloon. The float to drop altitude is expected to take slightly less than three hours.

Low-resolution images from the saucer are expected to show the vehicle dropping away from its high-altitude balloon and then rocketing up to the edge of the stratosphere.

After being released from the balloon, the vehicle's rocket kicks in and quickly takes the craft to an altitude of 180,000 feet (54,900 meters) – the top of the stratosphere – where the supersonic test begins. Small solid-fuel rocket motors spin the test vehicle for stability ahead of the main motor ignition.

Upon reaching its maximum altitude, the test vehicle is traveling at approximately Mach 4. The test vehicle will then deploy the Supersonic Inflatable Aerodynamic Decelerator (SIAD). The SIAD decelerates the test vehicle to approximately Mach 2.5. The test vehicle will deploy a mammoth parachute (the Supersonic Disk Sail Parachute), which carries it safely to a controlled water impact about 40 minutes after being dropped from the balloon.

Following the flight test, both the balloon envelope and test vehicle will be recovered. The duration of the recovery phase will be driven by how quickly boats are able to locate the items to be recovered, address any safety hazards and assess the article, pick up the article onboard the boat, and head back to port.



	Event	Time
1	Launch (balloon released)	0
2	Float to test range	2 hrs 45 mins (at earliest)
3	Test vehicle drop & rocket ignition	+3 hrs post launch (at earliest)
4	Rocket fire duration	66 sec post drop
5	Inflatable device (SIAD) deploys	73 sec post drop
6	Parachute deploys	180 sec post drop
7	Vehicle splashdown	42 mins post drop

Technology Demonstration Missions

Mission Statement

NASA's Technology Demonstration Missions Program bridges the gap between early proof-of-concept tests and the final infusion of cost-effective, revolutionary new technologies into successful NASA, government and commercial space missions.

Technology Demonstration Missions: In Depth

Bridging the gap. That's the mission of NASA's Technology Demonstration Missions, or TDM: to bridge the gap between need and means, between advanced technologies and flight-qualified systems, between early proof-of-concept tests and the final infusion of cost-effective, revolutionary new technologies into successful NASA, government and commercial space missions.

The TDM program focuses on crosscutting technologies with strong customer interest that meet the needs of NASA and industry by enabling new missions or greatly enhancing existing ones. Chosen technologies will be thoroughly ground-tested and flight-tested — reducing risks to future flight missions, gaining operational heritage and continuing NASA's long history as a technological leader. These newly proven technologies will enable future NASA missions to pursue bolder goals; make human missions safer and more rewarding; and enable new expansion of space industry in the government and commercial sectors.

The Technology Demonstration Missions Program Office at NASA's Marshall Space Flight Center in Huntsville, Alabama, is overseeing a portfolio of technology demonstration flight projects led by NASA centers and industry partners across the country. The program is part of NASA's Space Technology Mission Directorate in Washington.

More information
http://www.nasa.gov/mission_pages/tdm/main/index.html

Program/Project Management

NASA's Space Technology Mission Directorate in Washington funds the LDSD mission, a cooperative effort led by NASA's Jet Propulsion Laboratory in Pasadena, California. JPL is home to the LDSD project manager, Mark Adler, and its principal investigator, Ian Clark. NASA's Marshall Space Flight Center, in Huntsville, Alabama, manages LDSD within the Technology Demonstration Mission Program Office. NASA's Wallops Flight Facility in Virginia is coordinating support with the Pacific Missile Range Facility in Kaua'i, Hawai'i, and providing the balloon systems for the LDSD test.

About NASA's Space Technology Mission Directorate

The nation's investments in space technology enable NASA to make a difference in the world around us. The Space Technology Mission Directorate (STMD) is responsible for developing the crosscutting, pioneering, new technologies and capabilities needed by the agency to achieve its current and future missions.

STMD rapidly develops, demonstrates, and infuses revolutionary, high-payoff technologies through transparent, collaborative partnerships, expanding the boundaries of the aerospace enterprise. STMD employs a merit-based competition model with a portfolio approach, spanning a range of discipline areas and technology readiness levels. By investing in bold, broadly applicable, disruptive technology that industry cannot tackle today, STMD seeks to mature the technology required for NASA's future missions in science and exploration while proving the capabilities and lowering the cost for other government agencies and commercial space activities.

Research and technology development takes place within NASA Centers, in academia and industry, and leverages partnerships with other government agencies and international partners. STMD engages and inspires thousands of technologists and innovators creating a community of our best and brightest working on the nation's toughest challenges.

More information
http://www.nasa.gov/directorates/spacetech/home/index.html