# Collecting Ground Samples for Balloon-Borne Instruments

**Harpoonlike sample-collection devices would be dropped, then hauled back up.**

*NASA's Jet Propulsion Laboratory, Pasadena, California*

A proposed system in a gondola containing scientific instruments suspended by a balloon over the surface of the Saturn moon Titan would quickly acquire samples of rock or ice from the ground below. Prototypes of a sample-collecting device that would be a major part of the system have been tested under cryogenic and non-cryogenic conditions on Earth. Systems like this one could also be used in non-cryogenic environments on Earth to collect samples of rock, soil, ice, mud, or other ground material from such inaccessible or hazardous locations as sites of suspected chemical spills or biological contamination.

The sample-collecting device would be a harpoonlike device that would be connected to the balloon-borne gondola by a tether long enough to reach the ground (see Figure 1). The device would be dropped from the gondola to acquire a sample, then would be reeled back up to the gondola, where the sample would be analyzed by the onboard instruments.

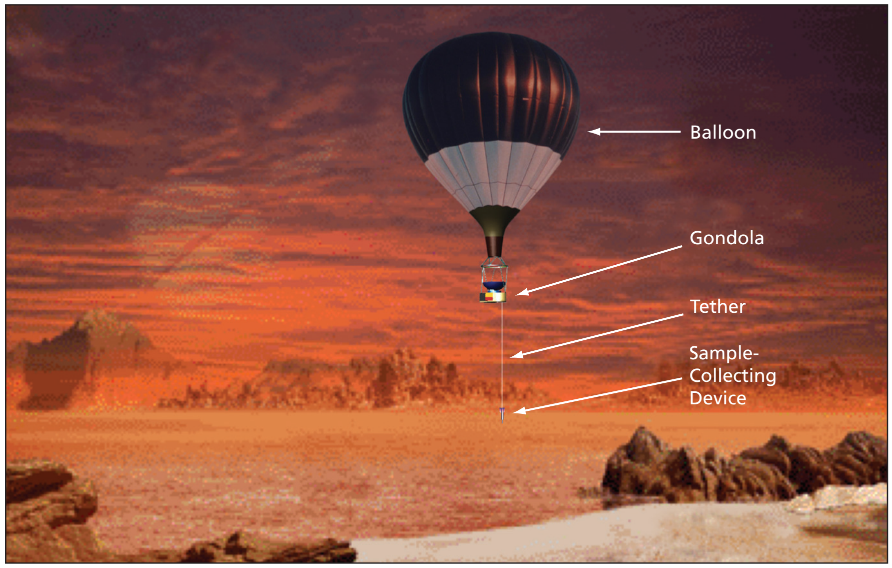



Figure 1. A **Tethered Sample-Collecting Device** would be dropped from a balloon-borne gondola to collect a sample of ground material, then reeled back up to the gondola to enable analysis of the sample.

Each prototype of the sample-collecting device (see Figure 2) has a sharp front (lower) end, a hollow core for retaining a sample, a spring (not shown in the figure) for holding the sample in the hollow core, and a rear (upper) annular cavity for retaining liquid sample material. Aerodynamic fins at the rear help to keep the front end pointed downward. In tests, these prototype devices were dropped from various heights and used to gather samples of dry sand, moist sand, cryogenic water ice, and warmer water ice.

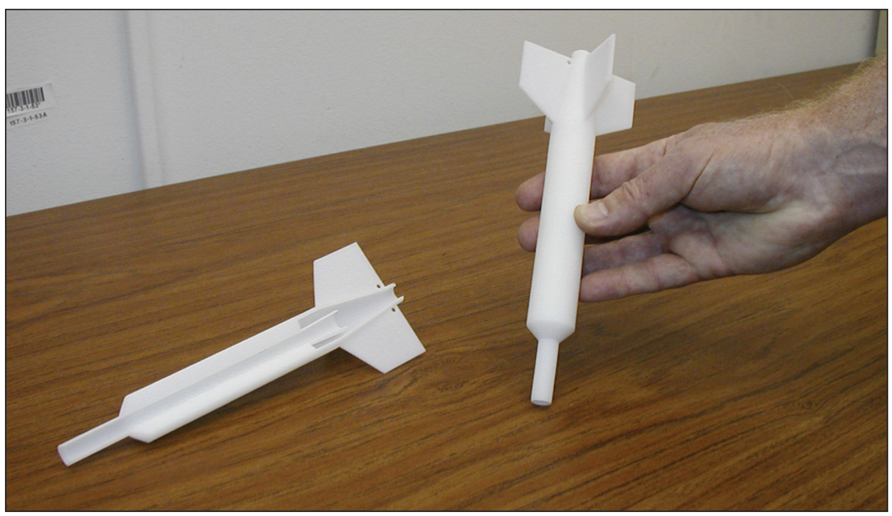


Figure 2. These **Prototype Sample-Collecting Devices** are basically harpoons with smooth, sharp front ends, rear stabilizing fins, and interior cavities for capturing and retaining samples.

*This work was done by Jack Jones, Wayne Zimmerman, and Jiunn Jenq Wu of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).*
*NPO-44444*

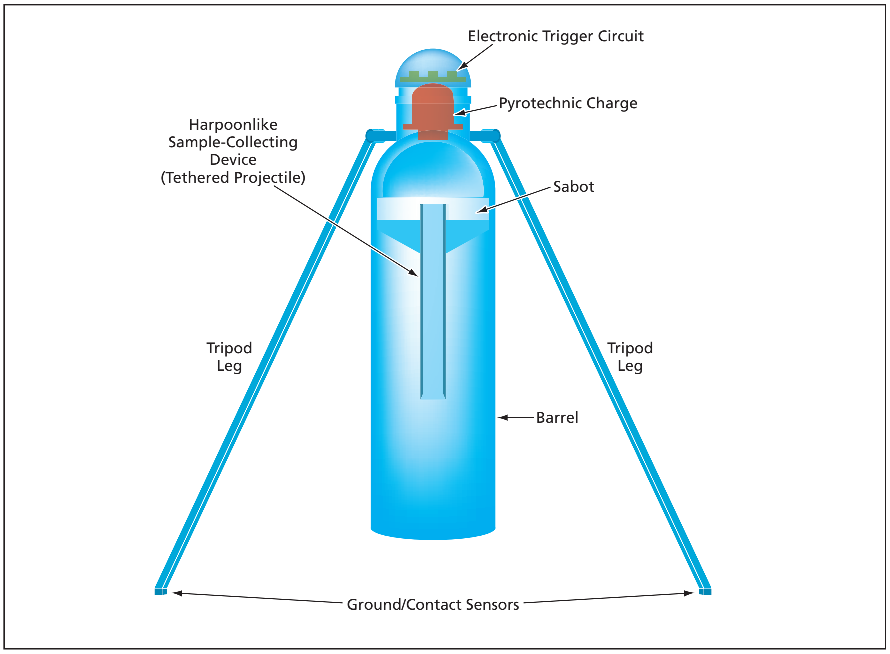
# Tethered Pyrotechnic Apparatus for Acquiring a Ground Sample

**A tethered projectile would be pyrotechnically driven into the ground.**

*NASA's Jet Propulsion Laboratory, Pasadena, California*

A proposed alternative design for the balloon-borne ground-sampling system described in the immediately preceding article would not rely on free fall to drive a harpoonlike sample-collecting device into the ground. Instead, the harpoon-like sample-collecting device would be a pyrotechnically driven, tethered projectile.

The apparatus would include a tripod that would be tethered to the gondola. A gun for shooting the projectile into the ground would be mounted at the apex of the tripod (see figure). The gun would include an electronic trigger circuit, a chamber at the breech end containing a pyrotechnic charge, and a barrel. A sabot would be placed in the




A **Gun Aimed Downward From the Top of a Tripod** would fire a tethered projectile into the ground to collect a sample when all three feet of the tripod simultaneously touch the ground.

barrel just below the pyrotechnic charge, and the tethered projectile would be placed in the barrel just below the sabot. The tripod feet would be equipped with contact sensors connected to the trigger circuit.

In operation, the tripod would be lowered to the ground on its tether. Once contact with the ground was detected by the sensors on all three tripod feet, the trigger circuit would fire the pyrotechnic charge to drive the projectile into the ground. (Requiring contact among all three tripod feet and the ground would ensure that the projectile would be fired into the ground, rather than up toward the gondola or the balloon.) The tethered projectile would then be reeled back up to the gondola for analysis of the sample.

*This work was done by Jack Jones, Wayne Zimmerman, Jiunn Jenq Wu, Mircea Badescu, and Stewart Sherrit of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-44445*

# Enhanced Video-Oculography System

*Lyndon B. Johnson Space Center, Houston, Texas*

A previously developed video-oculography system has been enhanced for use in measuring vestibulo-ocular reflexes of a human subject in a centrifuge, motor vehicle, or other setting. The system as previously developed included a lightweight digital video camera mounted on goggles. The left eye was illuminated by an infrared light-emitting diode via a dichroic mirror, and the camera captured images of the left eye in infrared light. To extract eye-movement data, the digitized video images were processed by software running in a laptop computer. Eye movements were calibrated by having the subject view a target pattern, fixed with respect to the subject's head, generated by a goggle-mounted laser with a diffraction grating.

The system as enhanced includes a second camera for imaging the scene from the subject's perspective, and two inertial measurement units (IMUs) for measuring linear accelerations and rates of rotation for computing head movements. One IMU is mounted on the goggles, the other on the centrifuge or vehicle frame. All eye-movement and head-motion data are time-stamped. In addition, the subject's point of regard is superimposed on each scene image to enable analysis of patterns of gaze in real time.

*This work was done by Steven T. Moore and Hamish G. MacDougall of Mount Sinai School of Medicine for Johnson Space Center. For further information, contact the JSC Innovation Partnerships Office at (281) 483-3809. MSC-23957-1*