

## Pioneer Astronautics Demonstrates New Balloon Flight System



On February 16, Pioneer Astronautics successfully demonstrated a new kind of balloon flight system. Called the Gas Replacement System (GRS), the technology, catalytically dissociates ammonia into a gas mixture that is 25% nitrogen and 75% hydrogen to provide lighter than air float gas for balloons.

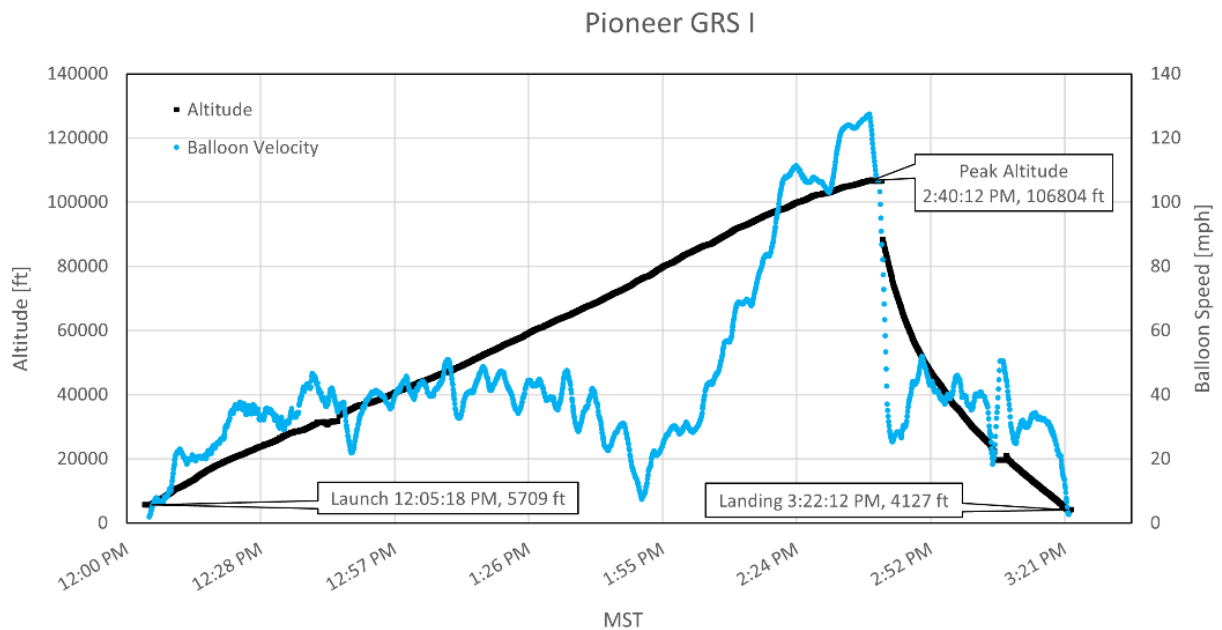
The GRS is designed to generate float gas for large scientific balloons in flight at altitudes above 100,000 ft, allowing them to double or triple the duration and scientific return of their flights by replacing helium leakage. The estimated rate of gas production required to sustain the length of a 40 million cubic ft balloon carrying a payload of three tons at 130,000 ft altitude is about 22 standard liters per minute. In the test done by Pioneer, the 5 kg GRS used 1100 Watts to generate 34 standard liters of gas per minute for 1.6 hours straight, with a constant dissociation efficiency of 99.8%. The gas output was used to inflate a 1200 gram latex balloon, carrying a camera and GPS instrumentation. Launched from Lakewood, Colorado, the balloon then ascended, catching the polar vortex at 95,000 ft which accelerated its ground track velocity to 128 mph, after which it continued its ascent to burst at 107,000 ft. The gondola then descended by parachute, and was recovered on a ranch in Kit Carson County Colorado, near the Kansas border.

Commenting on the flight, Pioneer president Dr. Robert Zubrin said, “This technology could be of extraordinary value for high altitude science. Ammonia stores as a liquid at 40 psi pressure at 10 times the density of compressed helium at 4000 psi. So a balloon carrying ammonia to make float gas can carry hundreds of times as much replacement gas in tanks of a given weight as it could using helium. This means flights will be able to stay up much longer, getting a lot more

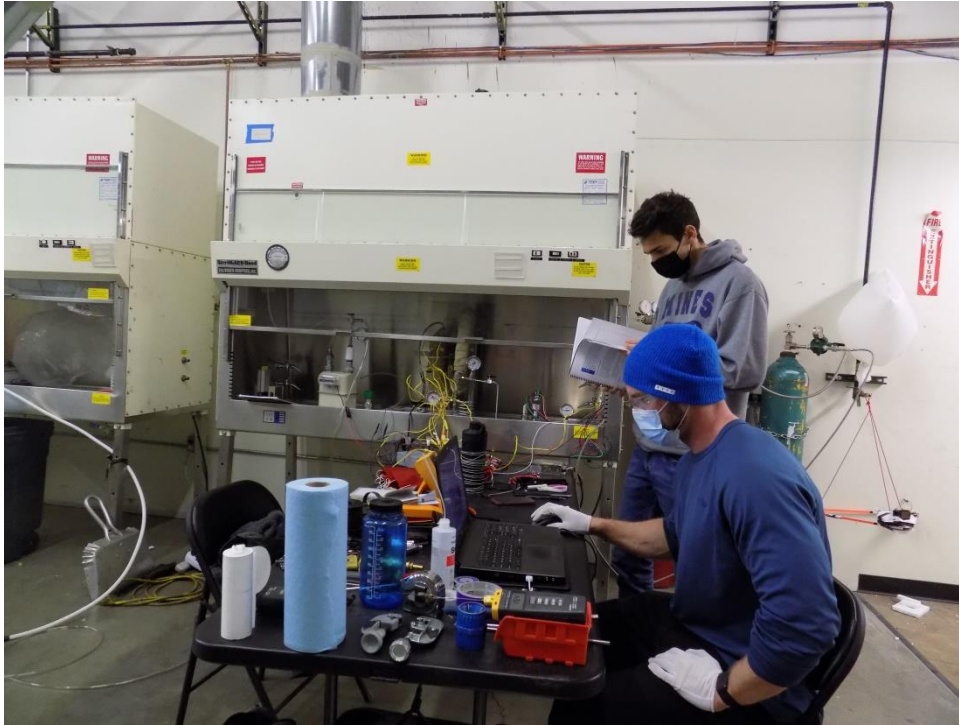
science done for the same money. And Earth is not the only planet where we could use this. I can't wait to try out GRS units on Mars, Venus, and Titan too. Congratulations to principal investigator Mark Berggren, Larsson Johnson, Vincent Workman, and the rest of the GRS team for their brilliant success, Let's fly!"

The GRS was developed by Pioneer Astronautics with SBIR Phase 1 program support from NASA Goddard Spaceflight Center. The principal investigator for the GRS SBIR Phase 1 program is Mark Berggren The Technical Monitor at NASA Goddard is Amy Canfield.

Flight data and photographs from the flight are presented below.



**Fig. 1. Altitude and velocity data from Pioneer GRS-1 Test flight**



*Team members Larson Johnson (in blue hat) and Vincent Workman operate the GRS, which is under the center of the hood. The GRS has a mass of about 5 kg, and can be used to sustain the flight of a 3000 kg balloon gondola.*



*The balloon was inflated through a long tube 30 meters away from the GRS, as it would be done in flight. In mid-ground, GRS PI Mark Berggren takes a gas chromatograph sample to verify dissociation. Measurements showed consistent 99.8% conversion of ammonia to nitrogen/hydrogen mix throughout the inflation process.*



***GRS Team members, from left to right: Vincent Workman, PI Mark Berggren, Larsson Johnson, Matt Harrison, Devon Ownbey, Robert Zubrin***



***The balloon takes flight.***



*Photograph taken by the Pioneer GRS1 Balloon at 106,000 ft.*



*The gondola is greeted by locals after landing on a ranch in in eastern Colorado.*