



Astronauts Breathe Easier with “Pioneering” Technology

NASA is continually investigating ways to improve and enhance all aspects of space exploration. Through unique partnerships with companies also committed to the same goal, collaboration leads to innovative solutions for the U.S. space program.

Colorado-based Pioneer Astronautics is a hands-on research and development company dedicated to inventing and proving new technologies to advance humanity’s reach into space and to improve life on Earth.

Among numerous innovations, the Pioneer team developed spacesuit breathing systems that could yield numerous advantages to NASA astronauts. This Nitrous Oxide-Based Oxygen Supply System (NOBOSS) is basically a method for generating breathable gases efficiently while maximizing mobility for space, terrestrial and marine applications.

Nitrous oxide is a common liquid that can be used as a convenient, low-cost, lightweight, safe and reliable source of breathing gas. The NOBOSS also allows for storage of the gas in regular temperatures with greater density, and at a much lower pressure and fire hazard than other breathing supply systems that are 100 percent oxygen.

In the NOBOSS, nitrous oxide is decomposed exothermically – through heat – in a catalytic reactor. Because of this, the nitrous oxide will continue to decompose without any further energy. The NOBOSS can then be used to supply breathing gas to existing space suits by using an air separation membrane or molecular sieve to eliminate the nitrogen.

The waste nitrogen could provide propellant gas for a Manned Maneuvering Unit (MMU), for example. The MMU is a backpack that snaps onto the back of a space suit and used on space walk and allows an astronaut to move independently from the shuttle. In addition, expansion of stored liquid nitrous oxide produces cold gas that can be used to help cool a space suit.

The primary advantage of using nitrous oxide is the small volume and low mass of the storage tanks needed to support long-duration breathing needs – such as on space walks. Compared to other high-pressure breathing gas storage containers, the same amount of nitrous oxide can be stored in one-third the amount of space. This is always a benefit for spaceflight, considering the limited amount of room for storage of supplies and equipment for the crew.



Pioneer developed the complex NOBOSS system during Phase I and Phase II of the NASA SBIR programs.

In addition, this allows for longer duration oxygen supplies with less weight and presents a much lower fire hazard than compressed or liquid oxygen. Nitrous oxide also doesn’t lose its properties over time, like oxygen and other liquids.

Through NASA’s Small Business Innovation Research (SBIR) Program at NASA’s Johnson Space Center, Pioneer conducted comprehensive in-house testing of the NOBOSS technology and delivered the final prototype in 1998. It consisted of a lightweight, efficient catalytic reactor system that utilizes simple pneumatic flow and thermal controls.

Pioneer’s unique reactor design achieves virtually complete nitrous oxide dissociation (separation) with minimal formation of gas. The nitrous oxide feed pressure is then used to deliver gas to the system and provides motive force for cooling and downstream gas cleanup systems. Product gas is delivered to the user through a self-pressurized surge tank.

In addition to NOBOSS, Pioneer continues to work on other innovative technological solutions for NASA. In 2006, the company was awarded an SBIR Phase 1 contract for an Advanced Gashopper Mobility Technology and Stratospheric Deployment Parafoil; and was awarded another SBIR Phase 1 contract in 2007 for a Lunar Sulfur Capture System & Multi-Cell Thermal Battery.

About the NASA Innovative Partnerships Program

Innovative Partnerships Program: Adding value to NASA and benefits to the nation. The Innovative Partnerships Program provides specialized technology and capabilities for NASA’s mission directorates, programs and projects through investments and partnerships with industry, academia, government agencies and national laboratories. Program supports technology transfer through dual-use partnerships and licensing, while creating socio-economic benefits for the American public.