National Aeronautics and Space Administration

The Super Pressure Balloon (SPB)

Extended duration stratospheric flights of large science instruments at mid-latitudes is a goal of the National Aeronautics and Space Administration's (NASA) Balloon Program. Balloon flights near the poles fly in almost constant sunlight. Balloon flying at mid-latitude will experience day/night cycles which limit the flight duration of conventional balloons. Super Pressure Balloons (SPB) offer the promise of extended duration mid-latitude flights. The goal of these flights is to lift a ton of science to 33.5 km (~110,000 ft).

The SPB is a balloon that maintains a positive internal pressure in relationship to the environment it is floating in. The NASA Super Pressure Balloon is a sealed structure that is filled with a measured and specific amount of helium lifting gas. The balloon rises after launch, and the helium expands as the ambient atmospheric pressure goes down. The balloon is designed to fly at a specific pressure altitude with a known mass of payload hanging from the balloon.

Super Pressure Balloon at Float

As a result of maintaining near constant volume, SPB will offer greater stability at float altitude with minimal altitude excursion during the day/night cycles when compared to that experienced on conventional or so called Zero-Pressure (ZP) balloons. This added stability and extended durations at mid-latitudes will enable new science missions that currently are not feasible with ZP balloons.

Super Pressure Balloon Launch from Wanaka, New Zealand

The Super Pressure Balloon Provides Altitude Stability and Long Duration Ballooning at mid-Latitudes

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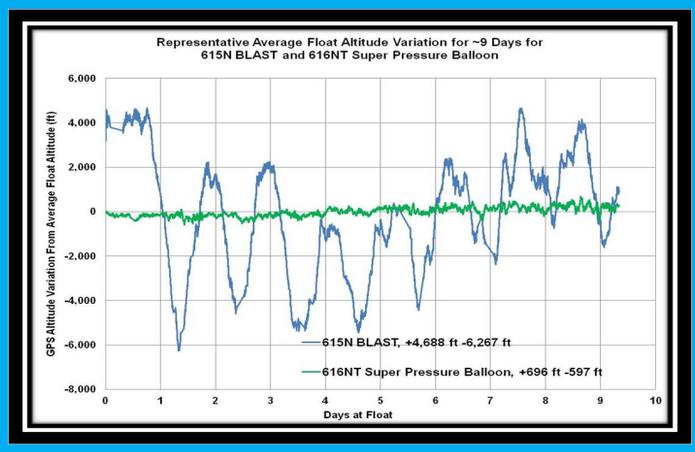
The overall shape of the NASA SPB is an oblate spheroid (like a sphere, only squashed on the top and bottom). The height is about 60% of the diameter. The balloon is made up of many separate panels called gores that run from top to bottom on the balloon. The gore edges are heat sealed together along with a tape that contains a very strong and light weight tendon or rope that runs from top to bottom on the balloon. Each of these gores is shaped such that, while under pressure, it has a slightly curved lobed shape, resulting in a "pumpkin" shape for the fully-inflated balloon structure. The SPB will enable balloon-borne science missions that can't be studied as effectively at the poles. It will also provide a platform for making measurements that can't be accomodated from space.



The SPB is designed to maintain positive pressure at all times, hence constant volume and altitude stability. The performance and stability of the SPB design have been validated through a series of successful test flights such as shown above in comparison with the performance of the Zero Pressure Balloon (ZP)

SPB launch site in Wanaka, New Zealand

Fully deployed super pressure balloon at float

SPB will also provide a platform for making some of the critical measurements that cannot be accommodated from space, or for which there are no planned satellites, with exposures comparable to short-duration spacecraft. SPB will also enable Earth Science investigations at a modest cost and for the development of instruments and subsystems for future use on Earth observing spacecraft.

The table to the right shows a comparison between the capabilities of the SPB and the convenventional and long duration ZPs.

Balloon Type	Zero Pressure (ZP)	ZP	Super Pressure (SP)
Mission Type	Conventional	LDB	ULDB (In development)
Duration	2 hours to 3 days	4-6 days for Sweden 7-15 for Antarctica up to 55+ days	Up to 100 days 2016 Mid-Latitude Flight = 46 Days
Science Payload Weight	Up to 2,948 kg (Up to 6,500 lbs.)	Up to 2,948 kg (Up to 6,500 lbs.)	18.8 MCF* – 907 kg (2,000 lbs.)
Typical Float Altitude	29.2 to 38.7 km (96 to 127 kft)	36.5 to 38.7 km (120 to 127 kft)	18.8 MCF – up to 34 km (~110 kft)
Support Package	**Consolidated Instrumentation Package (CIP)** • Line of Sight (LOS) • Up to 12 Mbps direct return	**Support Instrumentation Package (SIP)** • Line of Sight (LOS) - Up to 12 Mbps direct return • Over The Horizon (OTH) • 6 kbps / 92 kbps TDRSS Downlink** • 80 kbps Iridium option***	
	Small Launch Package • Stand-alone package for small payload support • LOS and OTH TM & Command (Iridium) 255 byte/min packets • Up to 12 Mbps LOS option • System without batteries ~20 lbs. (9 kg) * MCF – Million Cubic Feet **300kbps/1Mbps in development ***Iridium – limited support		

For more information, please contact the Balloon Program Office at (757) 824-1480; or visit https://www.nasa.gov/scientificballoons

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