High Altitude Skydiving Apparatus

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2022

The High-Altitude Skydiving Apparatus (HASA) is a simple proof of concept for a single skydiver oxygen system. When looking to the commercial market to fulfill civilian or commercial needs in the high-altitude exploration world, it can be incredibly difficult to find technology that supports safe human physiology at affordable prices. Many high-altitude oxygen systems exist and are built by military contractors. These systems such as the Cobham Phantom units and Airborne Systems SOLR units have been designed for military operations and thus come with a high price point. For example, a single user unit can cost upwards of $20,000 USD or more.

As a proof of concept, the HASA uses available materials off the internet to build a similar system at an economical price point. Many iterations of this system may be made with concessions towards some system usability. For example, the previously mentioned systems use custom first stage valves on their tanks which allow for gaseous filling of the unit while in operation. This feature is also convenient for flight operations when skydivers are connected to an onboard oxygen system that "passes" oxygen through the unit to the user. The simple HASA design does not maintain these capabilities.

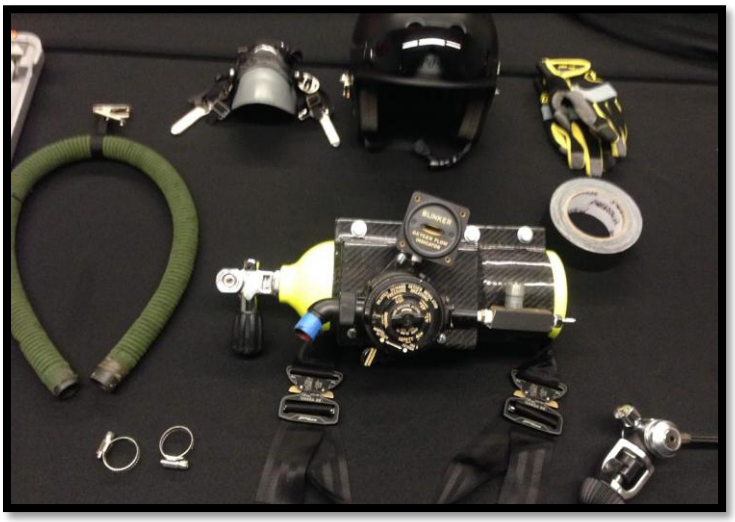
The HASA system is comprised of a storage tank. This tank can be steel, aluminum, or composite as long as it is able to be cleaned for use with high pressure oxygen. This caveat should be applied to all aspects of the system, **everything must be serviceable to be used with high pressure oxygen** (valves, fittings, hoses, tanks, etc). In this concept we used a 13 cubic foot aluminum scuba tank. From the tank we transition downstream to a standard yoke valve. A first stage regulator is used to drop the tank pressure of 3000 psi down to a usable 150 psi. From here the hose is connected so a needle valve, lowering the

pressure even further to 60 psi as it is what's required to enter our high-altitude regulator. The second stage regulator is called an A-14 which is capable of providing pressurized oxygen to a user up to 45,000ft. These regulators can be purchased offline in places like eBay or directly from the current manufacturer, Fluid Power Inc. Manuals for this regulator can be found online for free.

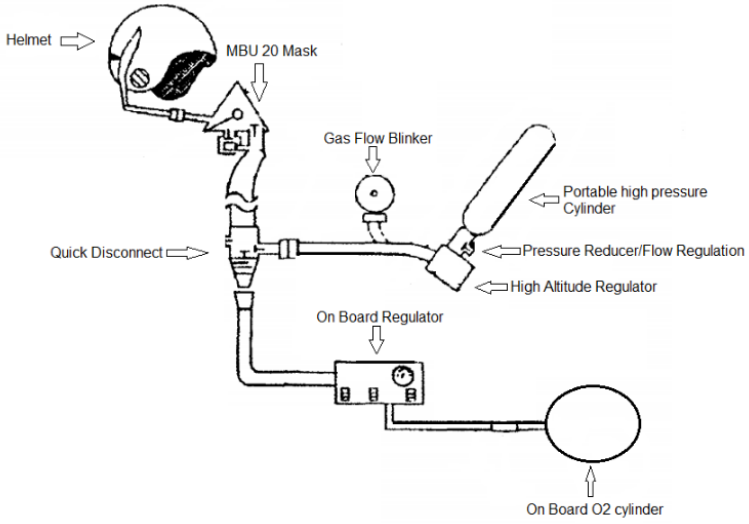
After inlet flow to the regulator, gas then moves out a military style corrugated pilots mask hose to an MBU-20p oxygen mask. The mask is secured to a Protech full cut helmet, with ear protection. Bayonet receivers are mounted to the helmets ear covers to hold the mask to the face securely. The entire system from tank to regulator was mounted to a custom carbon fiber housing worn on the waist. The system is pictured in the photos hanging from the belly, covered in an orange shroud as per requirements for an indoor skydiving wind tunnel test.

The cost of the entire unit is as follows: tank with valve ($200), first stage regulator with hose ($60), needle valve ($50), A-14 regulator ($800), corrugated hose ($20), MBU 20-p mask ($800), custom carbon fiber mount ($200), misc. clips and webbing ($100). Totaling approximately $2,200-$2,300 USD.

Learnings from this process include: no carbon fiber mount needed. A simple nylon tank bag would suffice ($50), also the A-14 is a great regulator, but the much smaller and updated CRU-79 is a better regulator if you can get your hands on one. They are incredibly expensive ($2,500) used. **Please note that all systems such as the regulators must be maintained as per manufacturer specifications to function properly.** The HASA was only built as a low-cost proof of concept for high altitude skydiving operations. It has only been tested in a controlled wind tunnel environment. Further development must be done for actual skydives, freezing temperatures, and safe oxygen use.



Side view of HASA system before wind tunnel flight.



Example military oxygen system the HASA is based off.