JP Aerospace (JPA) – Ascender, Dark Sky Station & more

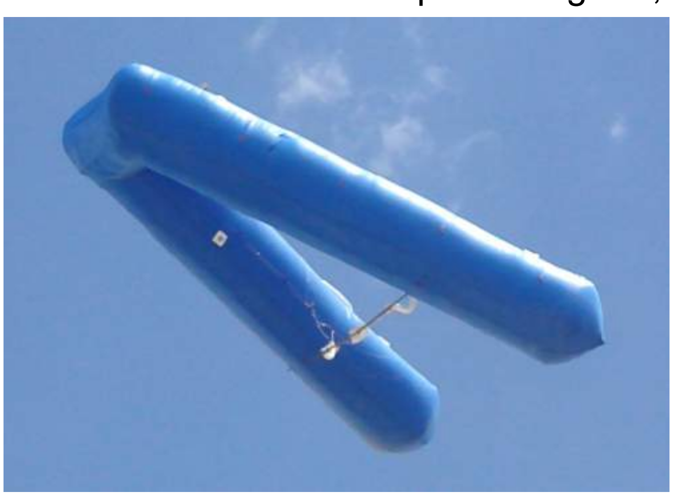
Peter Lobner, updated 28 August 2023

1. Introduction

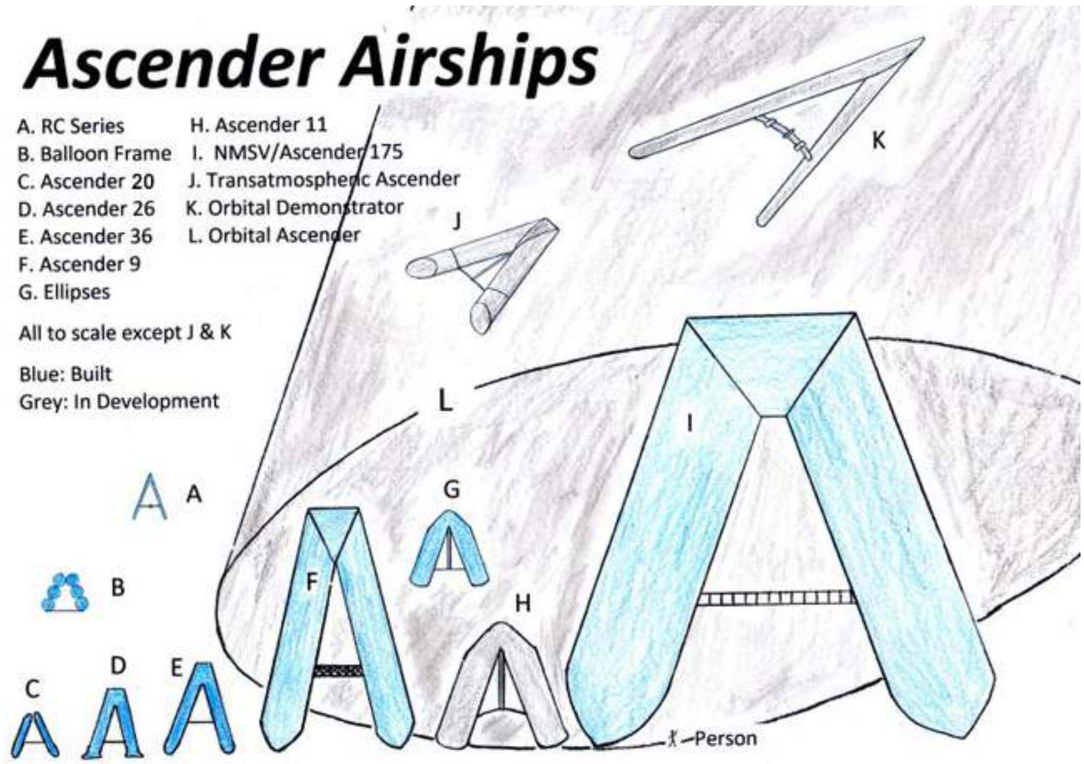
JP Aerospace (JPA) is a private company founded by its President, John Powell, in September 1977 in Rancho Cordova, CA, just east of Sacramento. The firm is best known for its radical V-shaped Ascender airships and for developing the vision and technologies for employing such airships in a unique three-stage "Airship To Orbit" (ATO) transportation system architecture, which is described in Powell's 2008 book, "Floating to Space: The Airship to Orbit Program" and his 2009 ATO patent. The company's website is here: http://www.jpaerospace.com

JP Aerospace was funded from 2002 to 2005 by the Department of Defense (DoD) to develop a "steerable" stratospheric balloon called a Near-Space Maneuvering Vehicle (NSMV) for the Air Force. This program supported the development and testing of several V-shaped Ascender-class airships, including the large Ascender 90 and 175.

Since then, JPA has continued developing its Ascender-class airships and other technical aspects of its ATO system architecture as part of "a volunteer-based DIY Space Program," with the goal of providing low-cost access to near space using lighter-than-air (LTA) vehicles. Projects for commercial and government clients provide income for operations and ongoing research and development.



Ascender 36, circa 2016. Source: JPA



Source: adapted from JPA via NASA Spaceflight.com (Sep 2020)

Ascender design #	Name	First flight	Notable features
1	RC series		1st proof-of-concept vehicles
2	Balloon series		Proof-of-concept vehicles
3	Ascender 20	2002	NSMV, 1st with inner and outer envelopes
4	Ascender 90	2003	NSMV, 1st large-scale Ascender & 1st with all 4 elements of an ATO Stage 1
5	Ascender 175	Not flown	NSMV, largest Ascender to date, delivered to USAF in 2005, damaged by windstorm.
6	Ascender 100	Not flown	1st Ascender with airfoil cross-section arms, float tested circa 2008
7	Ascender 26	2015	Small, intended as a systems test bed
8	Ascender 36	2016	System & material updates in 2019 & 2021
9	Ascender 9 (aka Ascender 28)	2018	High altitude development vehicle.
10	Ellipse	2024 (expected)	Small, elliptical cross-section & 1st with extensive air beam internal structures. Low altitude airship. Will be used for 1st flight test of JPA's magneto-hydrodynamic (MHD) hybrid engine.
Future	Elipse II (formerly Ascender 48)		Bigger than Ellipse, high altitude airship, will test JPA's MHD hybrid engine.
Future	Ascender 300		1st crewed Ascender
Future	Orbital Ascender Demonstrator		Hybrid rocket propulsion
Future	Orbital Ascender		Hybrid rocket propulsion

Other elements of JPA's DIY Space Program include:

- Ground-based engineering development programs:
    - Magneto-hydrodynamic (MHD) propulsion
    - Air beam structures
    - High altitude helium valves
- Stratospheric balloon programs:
    - Single balloon platforms
        - PongSats (free program for students)
        - MiniCubes (low cost program for public)
        - HiBot Airship platform
    - Tandem Airship multi-purpose platforms
- High altitude rocket and rocket-balloon (Rockoon) programs

In 2016, JPA established their Advanced Research Facility at a site named Area 42 (42 acres) in Northern Nevada. This facility is JPA's launch site for Ascender airships, stratospheric balloons and rockets. The Away 132 high altitude balloon mission 2022 and the 200th mission flown by the firm.

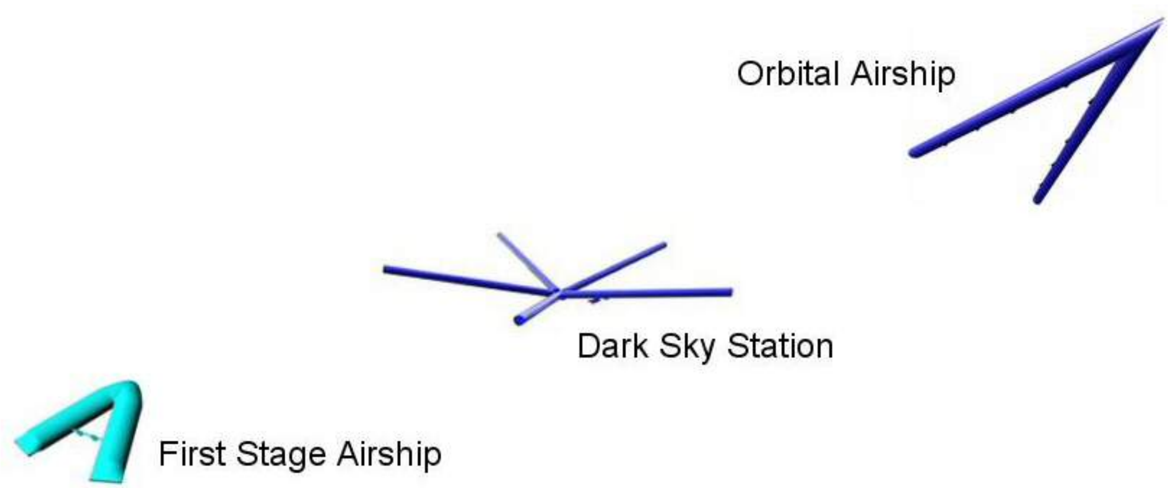
Ascender 36 at Area 42. Source: JPA blog (14 September 2016)

This articles provides an overview of the JPA's diverse space program, focusing on the Ascender and Dark Sky Station LTA vehicles and providing brief summaries of their stratospheric balloon and engineering development programs. I am grateful to John Powell for his thoughtful input for this article.

2. The Airship to Orbit (ATO) system architecture

JP Aerospace's system architecture for their Airship-to-Orbit program consists of three stages. The first stage is a large V-shaped Atmospheric Ascender airship that rises from the Earth's surface, through the lower atmosphere, to an altitude of about 140,000 feet (42,672 m), where it docks with the second stage, a buoyant Dark Sky Station floating permanently at that altitude. Several hours are required for the ascent and docking.

Personnel and cargo are transferred through the Dark Sky Station to a docked Orbital Ascender, which is the third stage on the route to orbit. This giant, hybrid rocket-powered airship operates only between the Dark Sky Station and low Earth orbit, where it can dock with an orbiting space station or release a payload directly into orbit. Several days are required for the low-acceleration ascent to orbital altitude and velocity.



ATO systems architecture. Source: JPA

For the return journey from orbit, the Orbital Ascender pitches up to a high-drag configuration and is slowed by the very thin atmosphere at orbital altitudes, enabling a gradual descent, with low friction heating, to 140,000 feet (42,672 m) for docking with a Dark Sky Station. From there, passengers and cargo are transferred to an Atmospheric Ascender for the return flight to ground level.

This three-stage ATO system architecture is described in detail in John Powell's patent US7614586B1, "Method for Traveling to Earth's Orbit Using Lighter Than Air Vehicles," which was filed on 10 March 2006 and granted on 10 November 2009.

3. DoD's "steerable" stratospheric balloon project and JPA's Near-Space Maneuvering Vehicle (NSMV)

JPA was funded by DoD from 2002 to 2005 to develop a "steerable" stratospheric balloon called a Near-Space Maneuvering Vehicle (NSMV), which was intended for operation at altitudes between 100,000 and 120,000 feet (30,480 and 36,576 m), where it would serve as a persistent surveillance and communications relay platform. Their DoD customer was the Air Force Space Battlelab and Space Warfare Center at Schriever Air Force Base, CO, which was created in 1997 to identify innovative operational and logistics concepts for air and space superiority. The Space Battlelab was interested in the ability of a large Ascender airship to operate persistently at high altitude, but was not interested in the other stages of JPA's ATO system architecture.

The NSMV was one of three "steerable" stratospheric balloon programs conducted by DoD. The other two programs were GNSS's Navy-sponsored StarLight and Near Space Corporation's (NSC) Army-sponsored High Altitude Shuttle System (HASS).

A 2012 DoD report described these programs as follows:

> "The primary objective of these steerable balloon efforts has been to develop a balloon with station-keeping ability that can provide capabilities similar to those desired from conventional high-altitude airships. None of the DoD programs have successfully fielded a steerable balloon under DoD funding."

Under its DoD NSMV contract, JPA developed and flew their "subscale" Ascender 20 and 90 vehicles in 2002 and 2003, respectively. Also in 2003, JPA built and float tested the full-scale Ascender 175 in a hangar at McClellan Air Force Base near Sacramento, CA. The Ascender 175 was subsequently shipped to Fort Stockton, TX and turned over to the USAF.

There was no hangar at Fort Stockton that was large enough to house the inflated Ascender 175. The first outdoor inflation by the USAF was done against the advice of range safety officials, and the Ascender 175 was damaged during a windstorm. It was not immediately repaired to permit the flight test program to continue. JPA refused a contract for Phase 2 of the NSMV contract, which was cancelled later in 2005.

The Ascender 175 airship remains the largest Ascender-class airship built by JPA.

The USAF Space Battlelab was deactivated in 2007. Nonetheless, there is a rumor that the Ascender 175 was secretly rebuilt by the Air Force and may still exist.

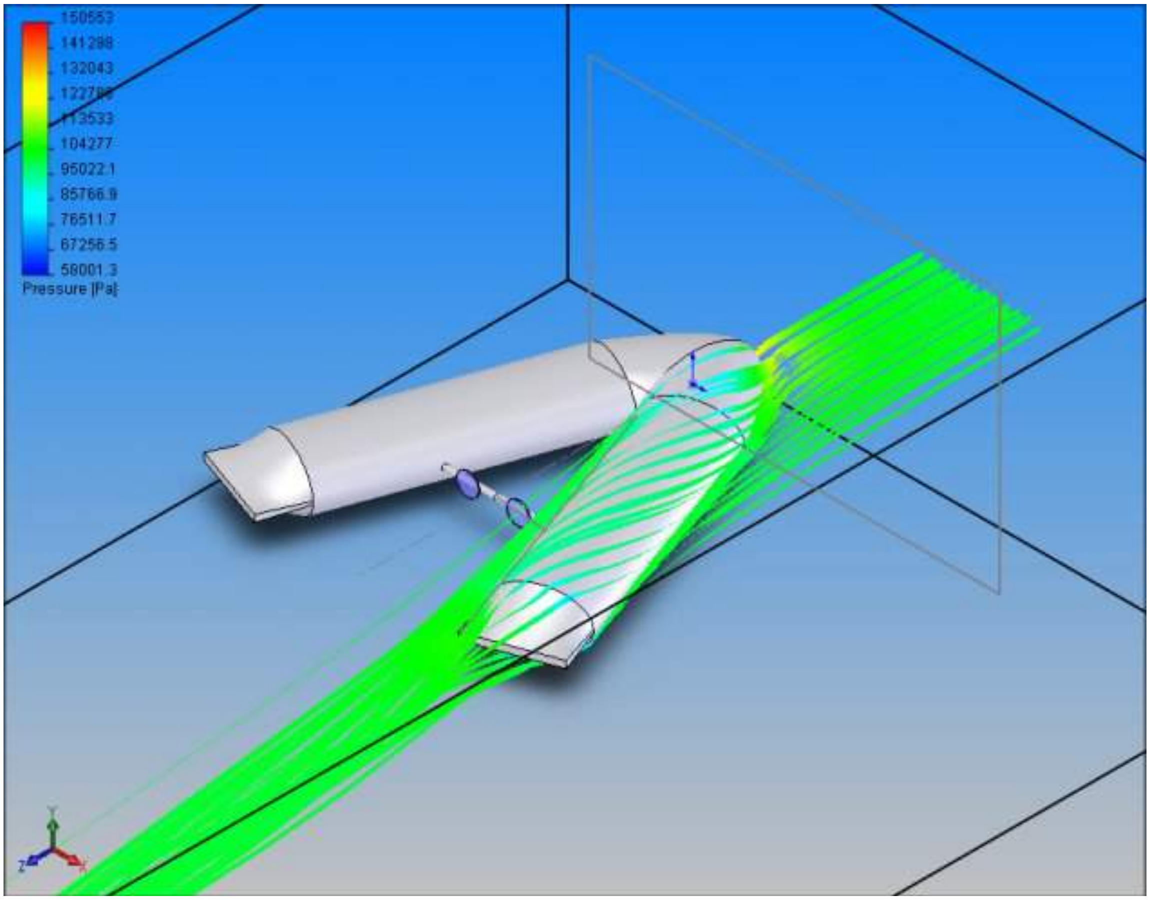
4. ATO Stage 1 vehicles – The Atmospheric Ascender airships

In John Powell's 3-stage ATO system architecture, a Stage 1 Atmospheric Ascender airship is intended to fly between a base on the ground and a Stage 2 Dark Sky Station operating permanently in the stratosphere at an altitude of about 140,000 ft (42,672 m). To date, Ascender airships have been used as engineering development and research vehicles, and have not yet flown to such a high altitude.

Ascenders are hybrid airships

Atmospheric Ascenders are hybrid airships that are designed to fly through the lower atmosphere into the stratosphere under the combined effects of their aerostatic buoyancy, aerodynamic lift generated by their forward motion through the air, and dynamic propulsion from propellers optimized for operating at high altitude.

Prior to launch, an Ascender airship is charged with the amount of helium needed to achieve a target pressure altitude. Fans keep the outer envelope inflated with air at a slight positive pressure. The airship is trimmed so it lifts off with a characteristic nose-high attitude that immediately generates a relative wind over the surface of the airship as it starts its buoyant climb. Airflow over the arms of the vehicle generates aerodynamic lift, which increases the rate of climb in a process John Powell refers to as "dynamic climbing."



Computational Fluid Dynamic (CFD) model of an Ascender in flight. Source: JPA

During ascent, the Ascender can be maneuvered with its main propulsion engines and with its helium transfer system, which can move helium among the lifting gas cells to move the center-of-lift and thereby control pitch and roll.

At the pressure altitude, the lifting gas cells are fully expanded within the outer envelope and the airship cannot fly higher on buoyant lift alone. The helium transfer system is used to establish a level flight attitude while the main propulsion engines drive the Ascender to dock at its destination, a Dark Sky Station.

To descend back to the ground, the Atmospheric Ascender vents some helium to reduce aerostatic lift enough to start the descent. As it descends, the lifting gas cells compress as ambient pressure increases and fans keep the outer envelope inflated with air at a slight positive pressure.

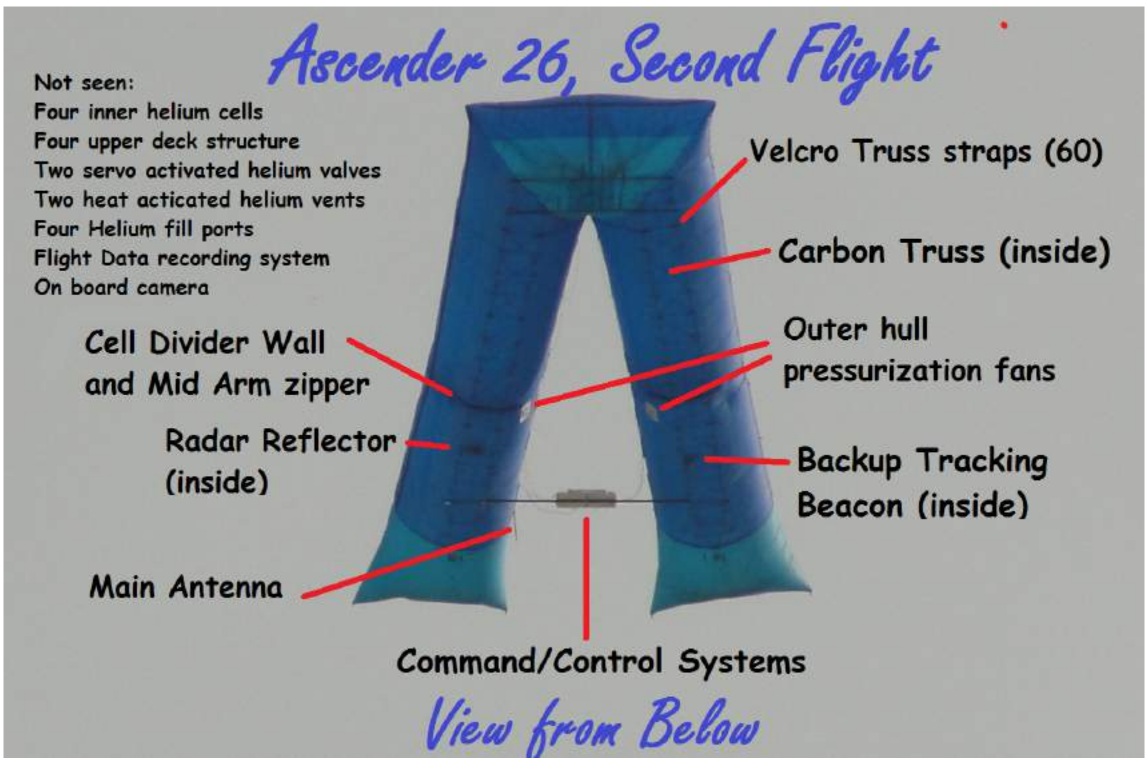
Elements on an Atmospheric Ascender

Ascender-class airships have evolved considerably over the past two decades. A modern Ascender airship is comprised of the following:

- Outer V-shaped envelope forms the hull (airframe):
    - Tough, lightweight, rip-stop synthetic material
    - Outer envelope pressurization system (fans) inflates the pressure-stabilized hull.
    - Interior divider walls provide a separation between the lifting gas cells.
    - Upper deck (outer top surface) is used for mounting fans, valves & plumbing.
    - Inflated internal ribs establish the desired cross-sectional shape of the outer envelope (i.e., ellipse, airfoil) to improve aerodynamic performance.
- Inner envelope, comprised of several helium lifting gas cells:
    - Lightweight Mylar cells are secured inside the outer envelope
    - Pressure relief valves protect the lifting gas cells from over-pressure.
    - Helium fill valves load the initial charge of helium
- Remotely-operated helium control valves:
    - Independent, remotely-operated lifting gas release system for venting & flight termination.
    - Enables the flight controller to control the climb rate, hold at peak altitude and then descend into favorable winds for an easier recovery.
- Helium transfer system comprised of pumps & helium plumbing:
    - Moves helium among the lifting gas cells in flight to provide pitch and roll control.
    - Ascenders execute a nearly vertical dynamic climb until they reach peak altitude, where the helium transfer system establishes a horizontal attitude.
- Truss structures:
    - Lightweight keel and nose trusses (carbon fiber or air beams) transfer loads to, and limit bending of the inflated, pressure-stabilized V-shaped hull (the outer envelope).

   - A cross-truss maintains the angular positioning of the arms of the V-shaped hull and provides a rigid structure for mounting the power, propulsion and control systems.
- Batteries & electric power system
- Electric propulsion motors and high-altitude propellers
   - Carbon fiber propellers provide maneuvering thrust during ascent and main propulsion at high altitude.
- Command and tracking systems

Many of these elements are shown in the following annotated diagram of the Ascender 26.



Ascender 26 view from below.
Source: JPA blog (posted 8 August 2015)

In the following sections, the Ascender airships are described in chronological sequence, starting with the earliest Ascender. John Powell reported in February 2020 that the order of upcoming vehicles was the Ascender Ellipse, Ellipse II (formerly Ascender 48) and then the crewed Ascender 300.

The earliest Ascenders

The earliest Ascenders were proof of concept vehicles with a series of helium lifting gas cells attached to an aluminum V-shaped framework that came to define the shape of JPA's family of Ascender airships.

Mylar lifting gas cells attached to an aluminum framework. There was no outer envelope. Source, both photos: Screenshot from JPA video (1 Nov 2022)

Ascender 20 – first flight 2002

The Ascender 20 (sometimes referred to as the Ascender 18) was the first Ascender vehicle with outer and inner envelopes. The pressure-stabilized nylon outer envelope was inflated with fans to established the external V-shape of the vehicle. The Mylar inner envelope formed the low-leakage lifting gas cells. Structural carbon fiber tube keels were installed under the V to stiffen each arm, while a carbon fiber cross-beam maintained the desired separation between the branches of the V and provided a rigid structure for mounting two electric propulsion motors.

The Ascender 20 made its indoor tethered float test on 5 October 2002 and made an indoor free flight (in a large hangar) on 11 November 2002.

The Ascender 20 was one of the JPA "sub-scale" vehicles that supported the DoD-funded NSMV project.

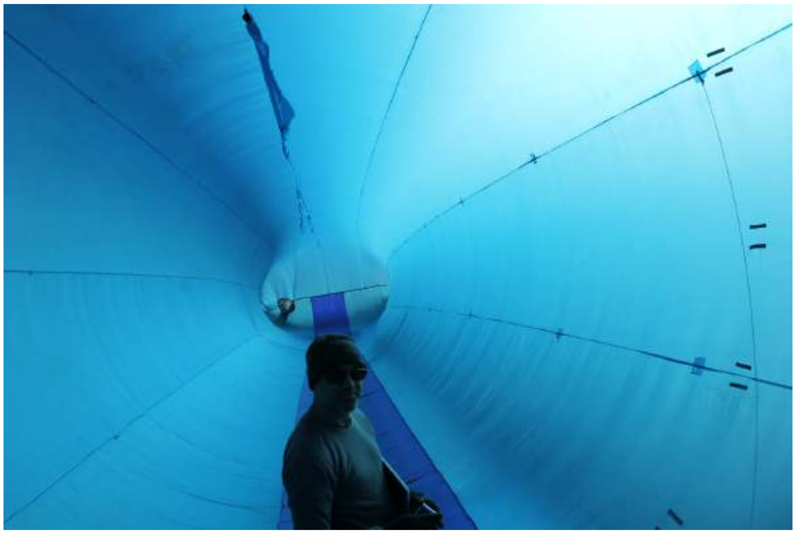
Ascender 20 flying outdoors circa 2002. Source, both photos: JPA

Ascender 90 – first flight 2003

The Ascender 90 was JPA’s first large-scale V-shaped airship and the first to have all four elements of an ATO Stage 1 airship: a durable outer shell, inner Mylar lifting gas cells, carbon fiber keels and cross-beam, and a helium management system to move lifting gas internally for pitch and roll control. The arms of the airship were 93 feet (28.3 m) long and 15 feet (4.6 m) in diameter.

The Ascender 90 was one of the JPA “sub-scale” vehicles that supported the DoD-funded NSMV project. Its indoor float test was conducted on 22 June 2003.

Ascender 90 in the hangar. Source: JPA



Inside the Ascender 90's 15 foot (4.6 m) diameter outer envelope.
Source: JPA blog (posted 13 Jan 2013)

Ascender 90 float test in hangar at McClellan Air Force Base, 22 June 2003.
Source, both photos: JPA

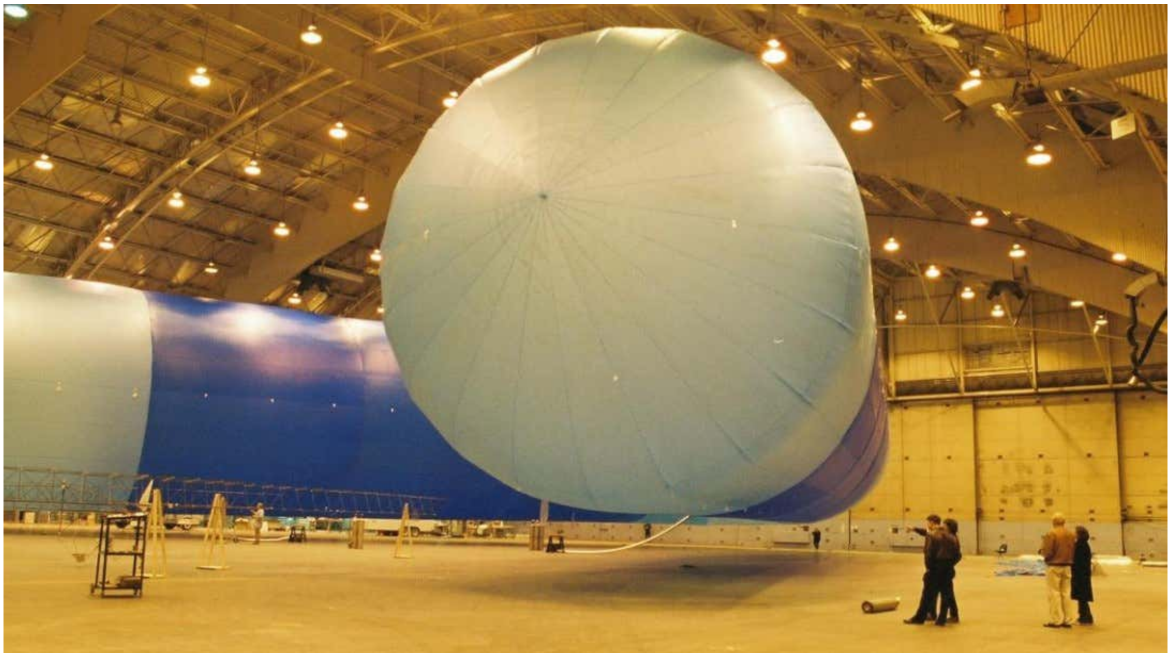
Ascender 175 – first flight attempt 2005

In 2002, the DoD funded JPA to develop their V-shaped airship design into a “steerable” Near-Space Maneuvering Vehicle (NSMV) prototype that could reach an altitude between 100,000 and 120,000 feet (30,480 and 36,576 m) and operate as a surveillance / communications relay platform for five days with a 100 lb (45.4 kg) payload. From that altitude, the airship would have a surveillance radius of 230 miles (370 km). The program’s DoD sponsor, the Air Force Space Battlelab and Space Warfare Center at Schriever Air Force Base, CO, was not interested in the broader capabilities of Powell’s ATO system architecture.

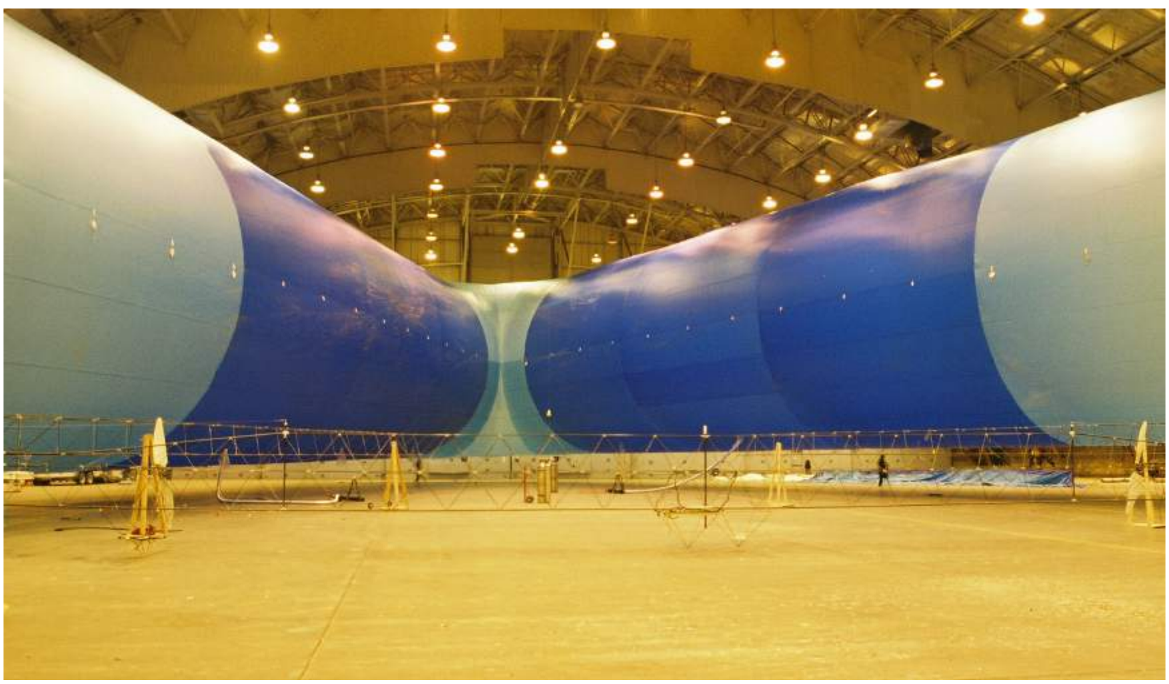
Under the NSMV project, JPA produced two sub-scale demonstrators (Ascenders 20 and 90) and the huge, full-scale Ascender 175. First flight of the full-scale NSMV originally was planned for June 2004.

The V-shaped arms on the Ascender 175 measured 175 feet (53.3 meters) long and 42 feet (12.8 m) in diameter. Each arm was supported by an external 100 foot (30.5 m) carbon fiber keel truss weighing only 20 lb (9.1 kg). A carbon fiber cross-beam joined the two keels into a rigid structure designed to maintained the angle between the arms of the V-shaped hull. Propulsion was provided by two electric motors installed on the cross-beam, driving propellers optimized for operation in the upper atmosphere. The mission payload also was mounted on the cross-beam.

Manufacturing the outer envelope exceeded JPA’s capabilities, hence that work was subcontracted. Final assembly was done in late 2003 at McClellan AFB, near Sacramento, with the first float test occurring inside a large hangar on 29 January 2004. After inflation, it was apparent that the arms of the V-shaped envelope subtended a much larger angle than planned, preventing integration of the envelope with the rigid keel and cross-beam structure. The V of the envelope was about 30 feet (9.1 m) wider than intended. The solution was to lengthen to cross-beam to widen the keel.



Ascender 175 inflated in its hangar at McClellan AFB, California, for a float test, circa January 2004. Source, both photos: JPA



Ascender 175 inflated in its hangar at McClellan AFB, California, circa early 2004. Source: JPA

After ground testing and further modifications to the vehicle at McClellan AFB, the Ascender 175 was loaded into shipping containers in 2005 and sent to Fort Stockton, Texas, where it was delivered to the Air Force.

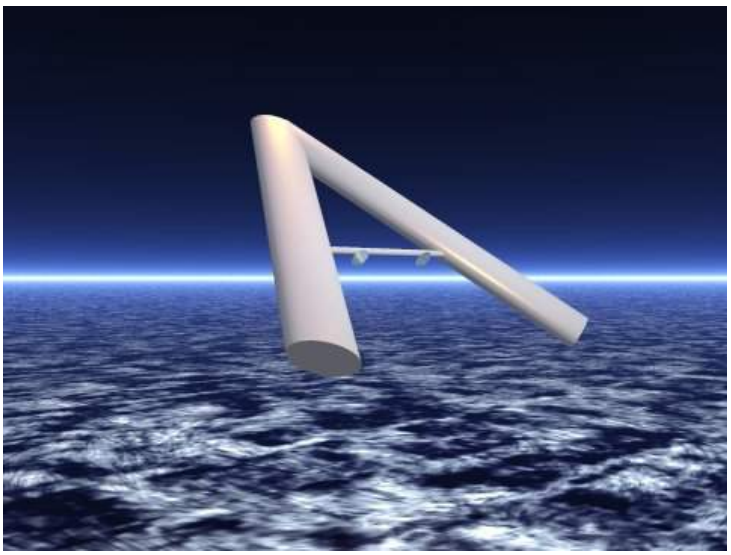
A 2005 RAND report described the planned flight test program as follows: "The test called for the airship to climb to 100,000 feet (30.5 km), navigate by remote control, maintain position for a short time, and return to earth….. The design feature that makes the altitude possible is the use of helium for lift and aerodynamic control. Some aerodynamic shape to the cylinder 'wings' and the shifting of helium between wings is intended to aid the maneuvering of the Ascender."

The Fort Stockton–Pecos County Airport (a former Army Air Force training airfield) had no hangar large enough to house the inflated Ascender 175. Therefore, the USAF had to inflate the airship outdoors. On the day of the first inflation test at Fort Stockton, tornado warning sirens sounded, but the USAF test team overrode range safety recommendations and continued to inflate the Ascender 175. John Powell said a "weak tornado" in the immediate vicinity severely damaged the airship, which was not repaired. John Powell said JPA refused to sign a contract for what would have been Phase 2 of the NSMV program. Shortly thereafter, the Air Force terminated the NSMV project in 2005, but retained and possibly rebuilt the .

Ascender 100 – circa 2008

The Ascender 100 was the first Ascender-class airship with arms that had an airfoil-shaped cross-section, rather than a circular cross-section. An elliptical airfoil shape was implemented with shaped air beam ribs installed at intervals inside the outer envelope. This is a design feature that JPA expects to include in operational Stage 1 Atmospheric Ascenders and Stage 3 Orbital Ascenders.

The Ascender 100 was intended to be a test bed vehicle. In 2008, John Powell reported, “We will build into her all the lessons learned from Ascender 175 plus everything from the drawing board over the last few years.” The Ascender 100 was float tested, but it didn’t fly.



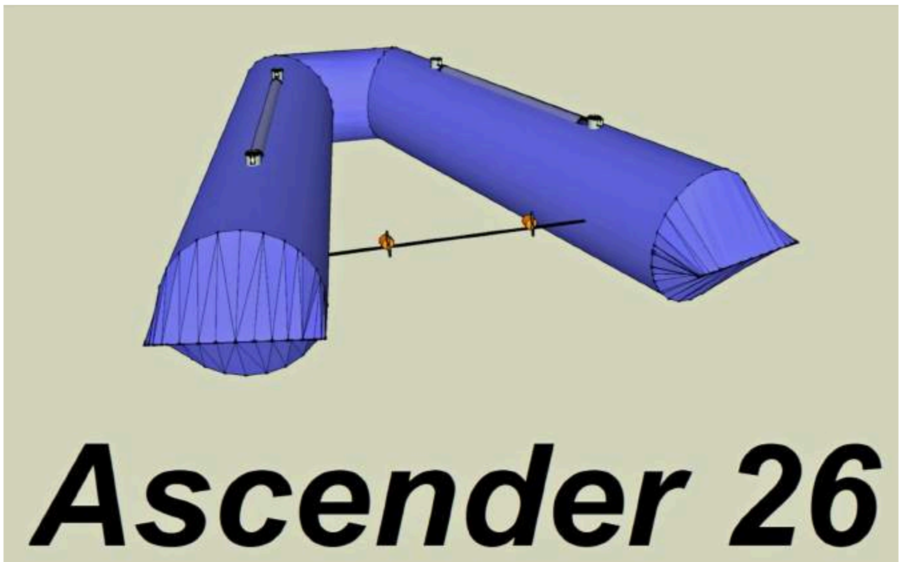
With 100 ft (30.5 m) long arms, the Ascender 100 was somewhat larger than the Ascender 90 and generally similar in its exterior design. .

Rendering of Ascender 100 in flight at high altitude. Source: JPA blog (posted 27 Oct 2008)

Air beam rib installation in Ascender 100, which has nine air beam ribs, eight this size and one larger bow rib. Source: JPA blog (posted 26 Nov 2008)

Ascender 26 - first flight 2015

Ascender 26 is a small airship intended for use as a systems test bed for the next generation of Ascenders. First flight was made on 14 June 2015. The second flight on 2 August 2015 demonstrated a steeper pitch angle and buoyancy controlled maneuvering.

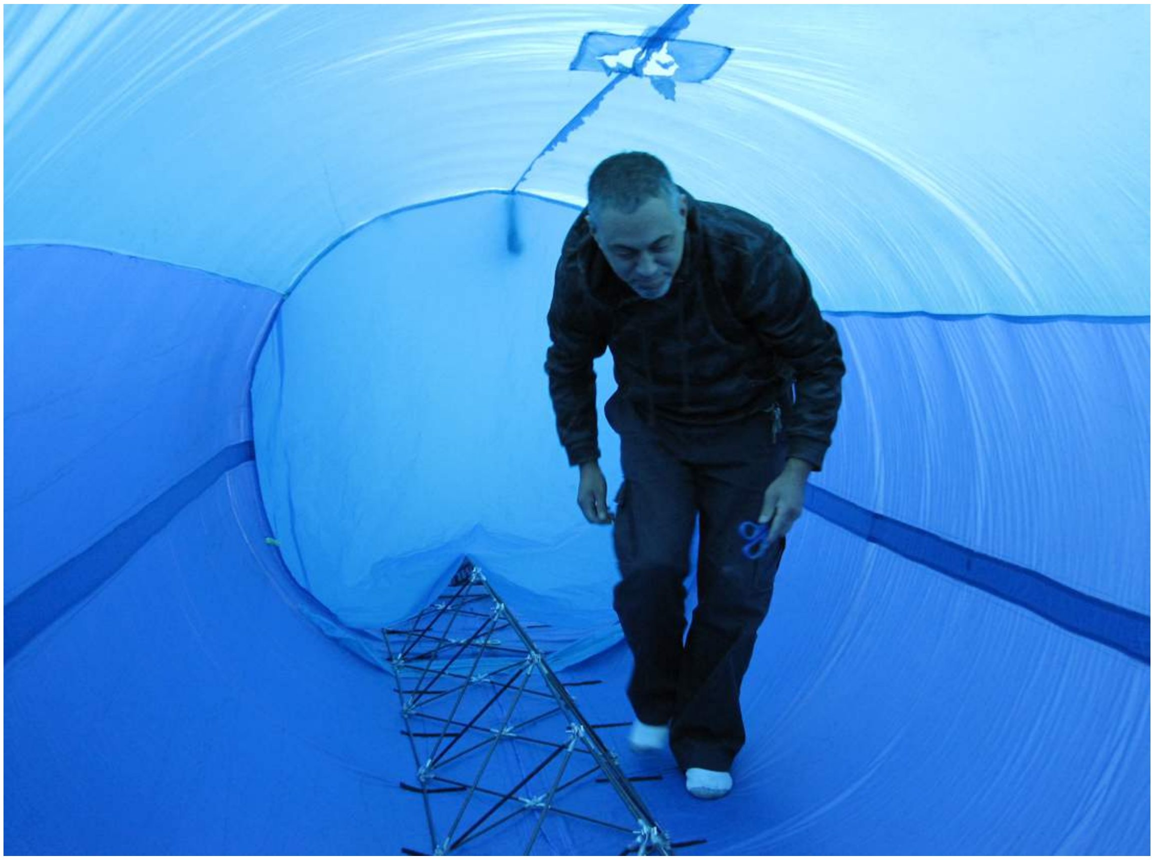


General arrangement of Ascender 26, stern view. Note two electric motor-driven propellers on the cross-beam and the helium valves & transfer tubes installed on the tops of the V-wings. Source: JPA

Ascender 26 with the starboard helium transfer tube (dark blue) installed on the top of the outer envelope (two-tone blue). Source: JPA blog (posted 10 November 2014)

Small size of Ascender 26 (left) is apparent next to the Ascender 9 (right). Source: JPA

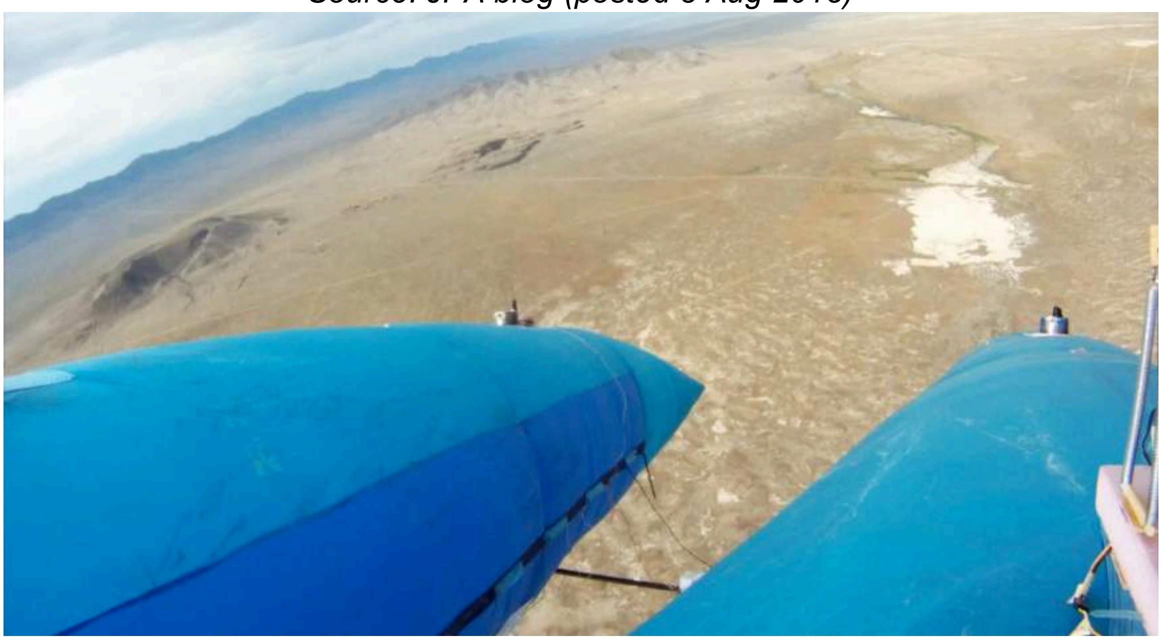
Ascender 26 internal carbon fiber keel structure is held in place with Velcro straps. Source: JPA blog (posted 10 November 2014)



Inside the inflated outer envelope, showing an internal cell divider wall and the internal keel structure. Source: JPA blog (posted 2 December 2013)

Ascender 26 in flight, showing the top deck and valve / fan locations. Source: JPA blog (posted 20 July 2015)

Ascender 26 in flight.
Source: JPA blog (posted 3 Aug 2015)



Ascender 26 climbing away from its desert launch site.
Source: Screenshot from JPA video (1 November 2022)

Ascender 36 – first flight 2016

The Ascender 36 airship was manufactured in 2015 with a carbon fiber keel structure inside the envelope.

Ascender 36 indoor ground inflation test.
Source: Screenshot from JPA video (1 November 2022)

On its second flight in 2016, the Ascender 36 demonstrated an average rate of climb of 582 feet per minute (177 meters per minute) and reached a maximum altitude of 13,512 feet (4,118 m). Since then, Ascender 36 has been extensively flight tested.

In 2019, Ascender 36 received a new command/control system, new helium valves and a new internal rigid structure. Further upgrades were made in 2021, including changing the ratio of plastic-to-fabric in the envelope material prior to its use on the forthcoming Ascender 48. The rebuilt Ascender 36 is designated the Ascender 36B.

Ascender 36 final ground inflation and system testing with all airship systems installed except the rigid cross-beam and propulsion system, prior to first flight. Source: JPA (August 2016)

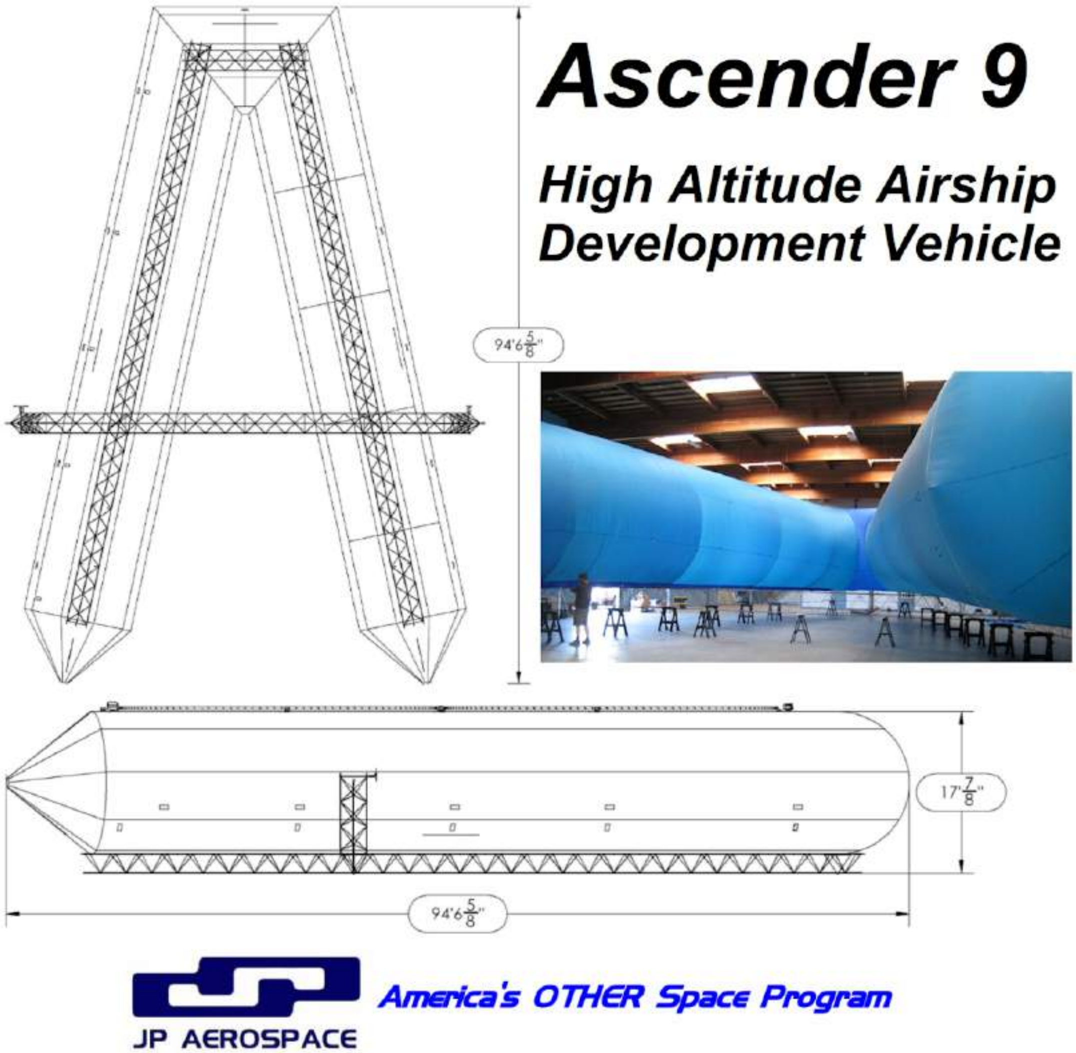
Ascender 36 climbs away in a typical nose-up flight attitude immediately after launch. Source: Screenshot from JPA video (1 November 2022)

Ascender 36 flight 14, climbing away from the Area 42 launch site in a typical nose-up flight attitude. Source: JPA (September 2016)

Ascender 36 in flight, view from behind showing the cross-beam, propellers & payload pod. Source: JPA

Ascender 9 (aka Ascender 28) – first flight 2018

Ascender 9 is the 9th Ascender-class airship built by JPA. This 340 lb (154 kg) airship was manufactured in 2017. The arms of the V-shaped hull are 94.5 ft (28.8 m) long and 17.1 ft (5.2 m) in diameter.



Source: JPA blog (posted 6 October 2017)

On 8 February 2018, the FAA issued an experimental classification certificate assigning N-number N428AV to the Ascender 9 (known to the FAA as Ascender 28 because of its 28 meter long arms). The Ascender 9 is the 1st UAV airship in the world to be so licensed. This FAA registration expired on 5 June 2021, and has not been renewed. For details, see the FAA online registry information at: https://registry.faa.gov/aircraftinquiry/Search/NNumberInquiry

The first float test was conducted on 7 October 2017, followed by a second float test and systems integration test in early 2018. During the indoor tests, JPA used drones to observe top valves, vents and fans installed on the envelope.

Ascender 9 first float test in hangar, 7 October 2017. Source: JPA blog (posted 27 Apr 2018)

Closeup view of an 80 ft (24.4 m) long external carbon fiber keel truss on Ascender 9. Source: JPA blog (posted 29 July 2017)

Ascender 9's KDE8218XF very high-efficiency, 28-pole, brushless electric motor manufactured by KDE Direct, and a two-bladed carbon fiber propeller optimized for high altitude operation. Source: JPA blog (22 May 2017)

17.1 ft (5.2 m) diameter outer envelope with divider wall being installed. Source: JPA blog (posted 14 Feb 2017)

Ascender 9 float, bow view, early 2018.
Source: Screenshot from JPA video (1 November 2022)

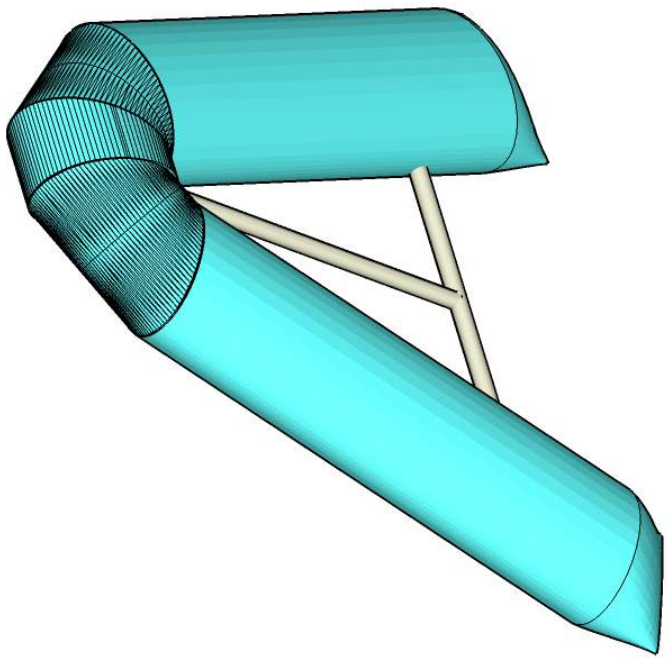
Ascender 9 second float test & systems integration tests, early 2018.
Source, two lower photos: JP Aerospace Blog (posted 22 Apr 2018)

Ascender 9 launching. Source: JPA

Ascender 9, viewed from below after launch, showing the external truss structure. Note that the propellers are at the ends of the diagonal arms extending from the cross-beam, outboard of the arms of the V-shaped envelope. Source: JPA.

Ellipse (first flight expected in late-2023 or 2024)

Ellipse has arms with an elliptical cross section and is the first Ascender airship with air beams replacing carbon fiber trusses in almost all applications. It is a small, propeller-driven vehicle, measuring just 26 ft (7.9 m) long, intended for low altitude tests of its air beam structures. The first inflation test of the outer envelope occurred in 2021. The Ellipse has been almost ready to fly, but has been delayed by several factors, including COVID.

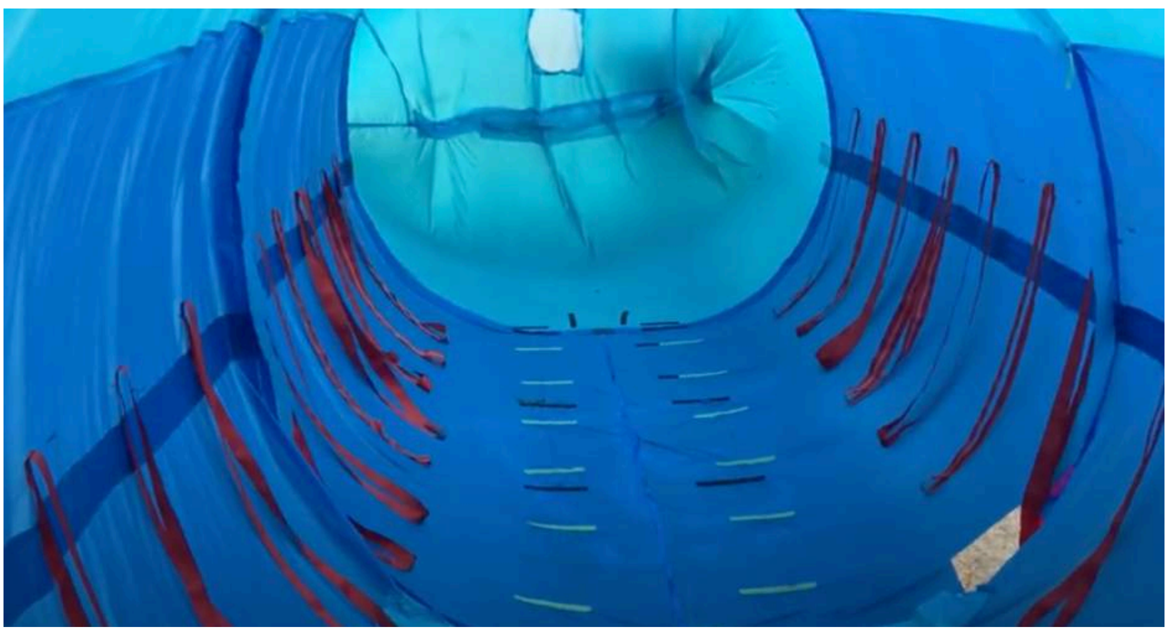


Ellipse general arrangement. Source: JPA Blog (posted 16 Oct 2019)

Ellipse inflated prior to installation of air beams. Source: Source: JPA Facebook (5 August 2023)

JPA reported that they are planning to conduct about a dozen flights with the Ellipse airship, including one or more flight tests of JPA's prototype magneto-hydrodynamic (MHD) hybrid engine.

Airbeams inflated prior to installation on the Ellipse.
Source: Source: JP Aerospace Blog (2 October 2022)



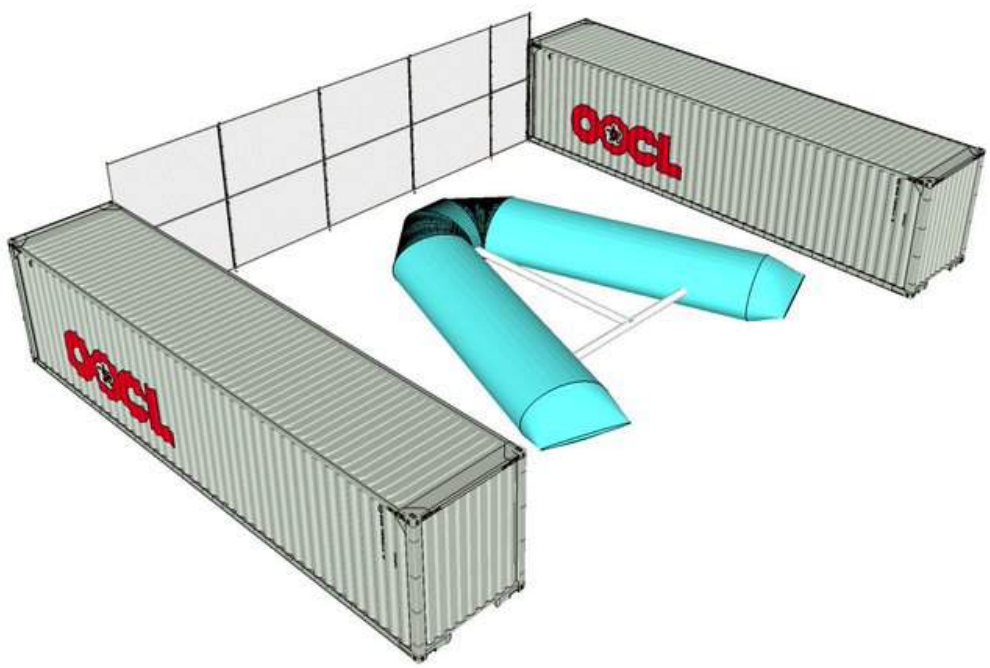
Ellipse interior prior to installation of the air beams. More than 80 red loops will hold the structural air beams in place in each arm of the Vee and across the nose of the airship. Source: Screenshot from JPA video (Sep 2021)

Airbeams fitted into a wing of the Ellipse.

Airbeams secured with straps to the shell of the Ellipse.
Next step in vehicle assembly is to test fit the helium lifting gas cells.
Source, both photos: JPA Facebook (5 August 2023)

The first manufactured helium lifting gas cell for the Ellipse. The airship will have a total of four helium lifting gas cells. Source: JP Aerospace Blog (23 August 2023)

Area 42 will have a new launch area for the Ellipse. This launch area also will fit the follow-on, larger Ellipse II (formerly Ascender 48) airship and will be expandable for larger Ascenders by moving one container, adding more fence and double stacking the containers.



Ellipse parked at Area 42. Source: JPA updates (13 March 2020)

Ellipse launching from Area 42. Source: JPA updates (13 August 2020)

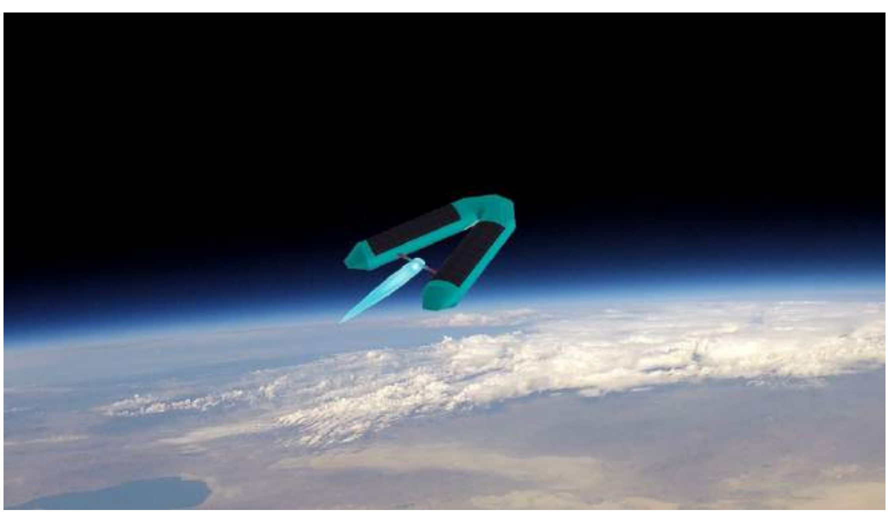
Ellipse II (formerly Ascender 48)

This airship will be about 20 ft. (6.1 m) longer than the Ellipse, but generally similar in overall shape. A significant difference is that the Ellipse II is being designed for high-altitude operation. Rather than launching from the ground, Ellipse II will be released from one of JPA's high platforms.

JP Aerospace plans to fly its MHD hybrid engine on Ellipse II, with the goal of demonstrating measurable climb under power to an altitude of 100,000 ft (30,480 m).

In late 2022, JPA announced that it was finalizing the specifications for Ellipse II. No start date has been announced for beginning manufacturing work. Technology development work on the MHD engine is an on-going project at JPA.

Rendering of Ellipse II after release from a JPA high altitude platform. Source: JP Aerospace Blog (2 October 2022)

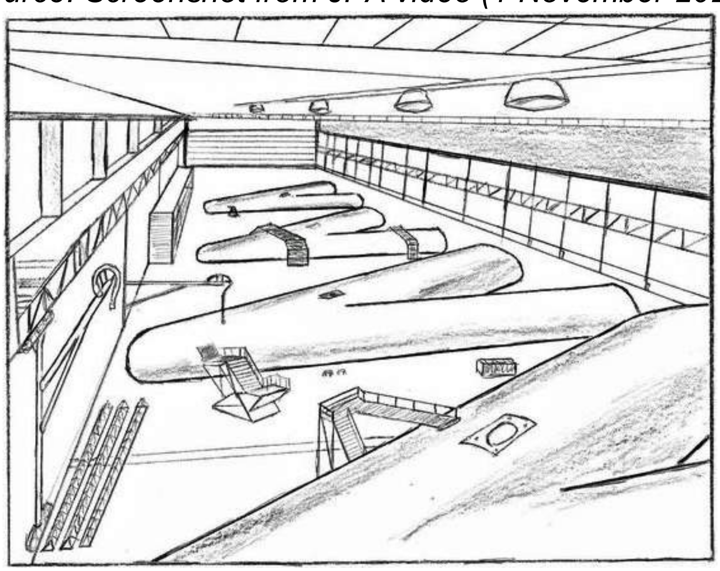


Rendering of Ellipse II in powered flight, propelled by its MHD hybrid engine. Source: JPA updates (2 February 2023)

Ascender 300 (aka Ascender Crew)

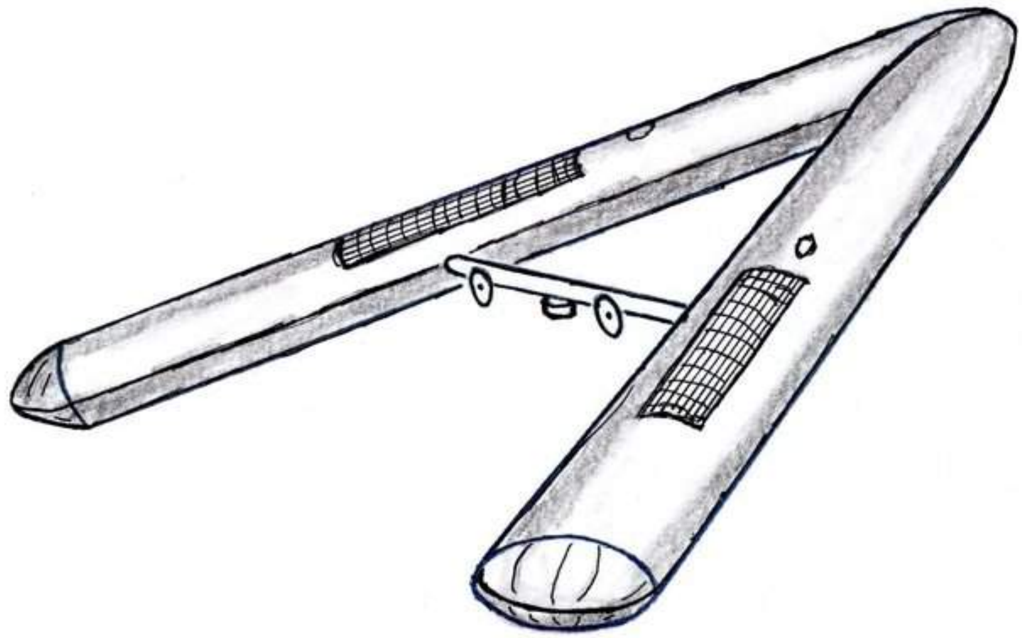
The Ascender 300 will be the first crewed Ascender and the largest Atmospheric Ascender ever built. It will be the basis for the production model large Ascender vehicles intended to routinely ferry people and cargo from the ground to Dark Sky Stations at an altitude of about 140,000 feet (42,672 m) and back again.

Rendering of Ascender 300, still climbing at high altitude.
Source: Screenshot from JPA video (1 November 2022)

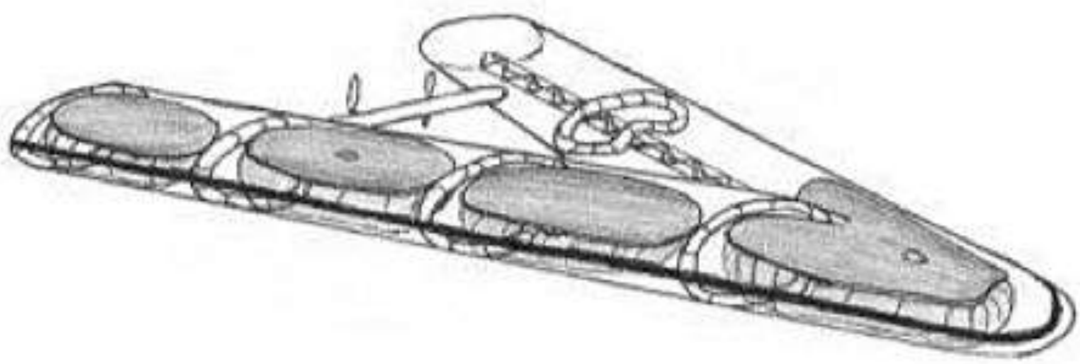


An early sketch of a production line for Ascenders Crew vehicles.

Source: JPA Facebook, 21 November 2022



Ascender 300 exterior arrangement (above) and interior arrangement (below) showing the placement of the lifting gas cells, transverse elliptical air beams ribs, the longitudinal keel and the cross-beam with two propellers.
Source, both graphics: JPA via NASA Spaceflight.com



5. The Dark Sky Station (DSS)

JP Aerospace describes their persistent, solar-powered, stratospheric station as follows: “The Dark Sky Station is our platform at the edge of space. In addition to being a key element in the Airship-To-Orbit project, Dark Sky Stations can be used as a rocket launch platform, a telecommunications hub and a research station. Large stations will also serve as a tourist destination.” With an equivalent diameter of more than a mile (1.6 km), a full-size DSS will be an enormous LTA vehicle with a total lifting gas volume of about 2 billion ft^3 (56.6 million m^3).

Two sub-scale prototypes, DSS 1 and DSS 2, have been built and flown to demonstrate the general structural design features of a Dark Sky Station buoyant platform. A third sub-scale prototype, DSS 3, has been manufactured, but has not yet been assembled for ground testing.

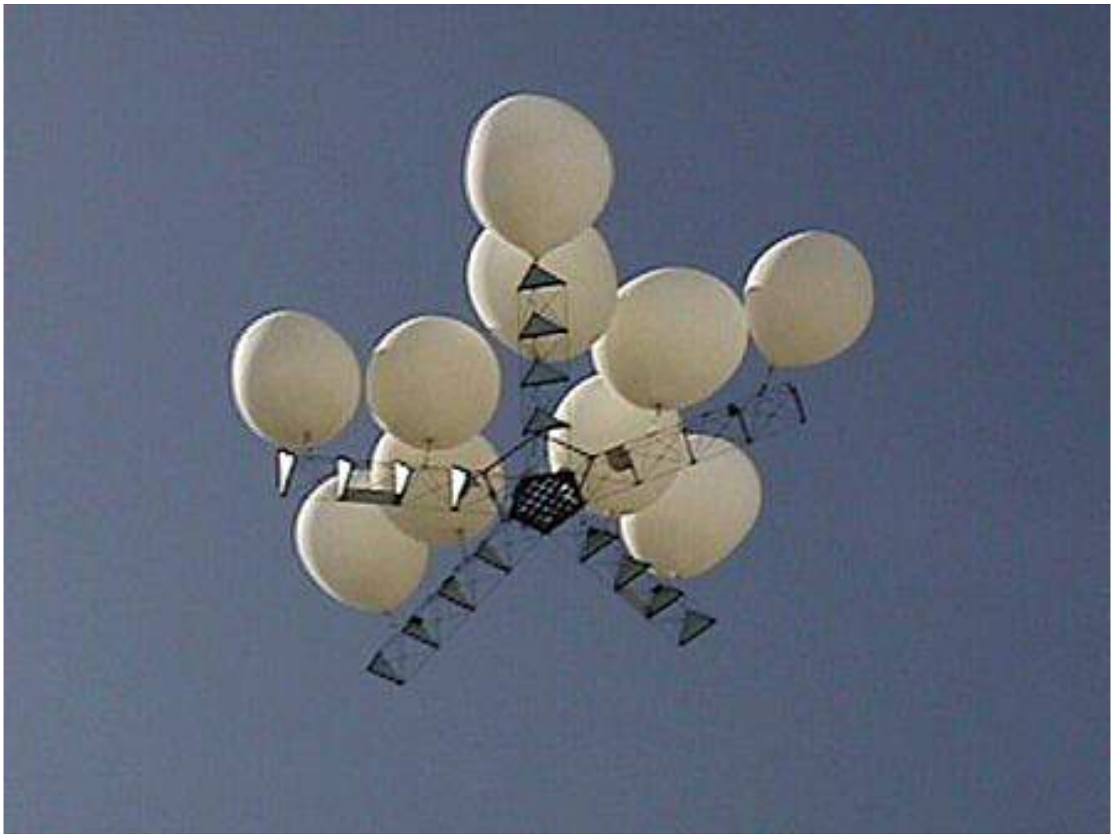
The conceptual design of the full-size, five-armed Dark Sky Station evolved to a “Block II” configuration by 2019, and to a “Block III” configuration in 2020. Hydrogen likely will be used as the lifting gas.

These modular stations are designed so that a whole arm can be removed and replaced periodically as its materials and exposed equipment reach their life limits in the harsh stratospheric environment.

DSS 1 prototype

The small DSS 1 prototype was tested on a tether in December 2000 and made its first free flight in 2001. Like a full-size DSS, this prototype had five lightweight structural arms supported by buoyant cells (carbon fiber arms and simple balloons in this case) and joined at a pentagonal hub.

DSS 1 has flown to an altitude of 45,000 ft (13,716 m).



DSS 1, circa 2001. Source: JPA

The larger DSS 2, circa 2001. Source: JPA

DSS 2 prototype

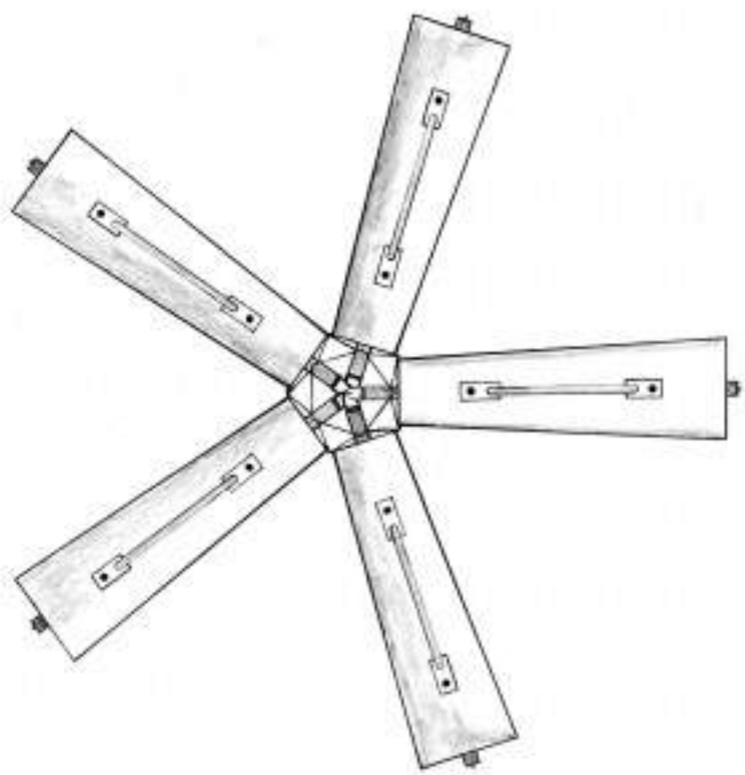
The DSS 2 prototype shared the same general configuration with DSS 1, but with longer carbon fiber beams, each supported by three balloons. It had an equivalent diameter of 70 feet (21.3 m).

DSS 2 made its first tethered and free flights in 2001, reaching a maximum altitude of about 6,000 ft (1,829 m).

DSS 3 Integrated Arm Test Vehicle

DSS 3 has arms that are similar in design of an arms of an Ascender airship, with outer and inner envelopes, an integrated structural truss and a helium transfer system to facilitate attitude control at high altitude.

Major sub-assemblies of the DSS 3 have been manufactured. However, the station has not yet been assembled for ground testing. When assembled, DSS 3 will have an equivalent diameter of 36 feet 4 inches (11.1 m). It is designed to achieved a maximum altitude of 25,000 feet (7,620 m).



DSS 3 general arrangement. Source: JP Aerospace Blog (21 Nov 2011)

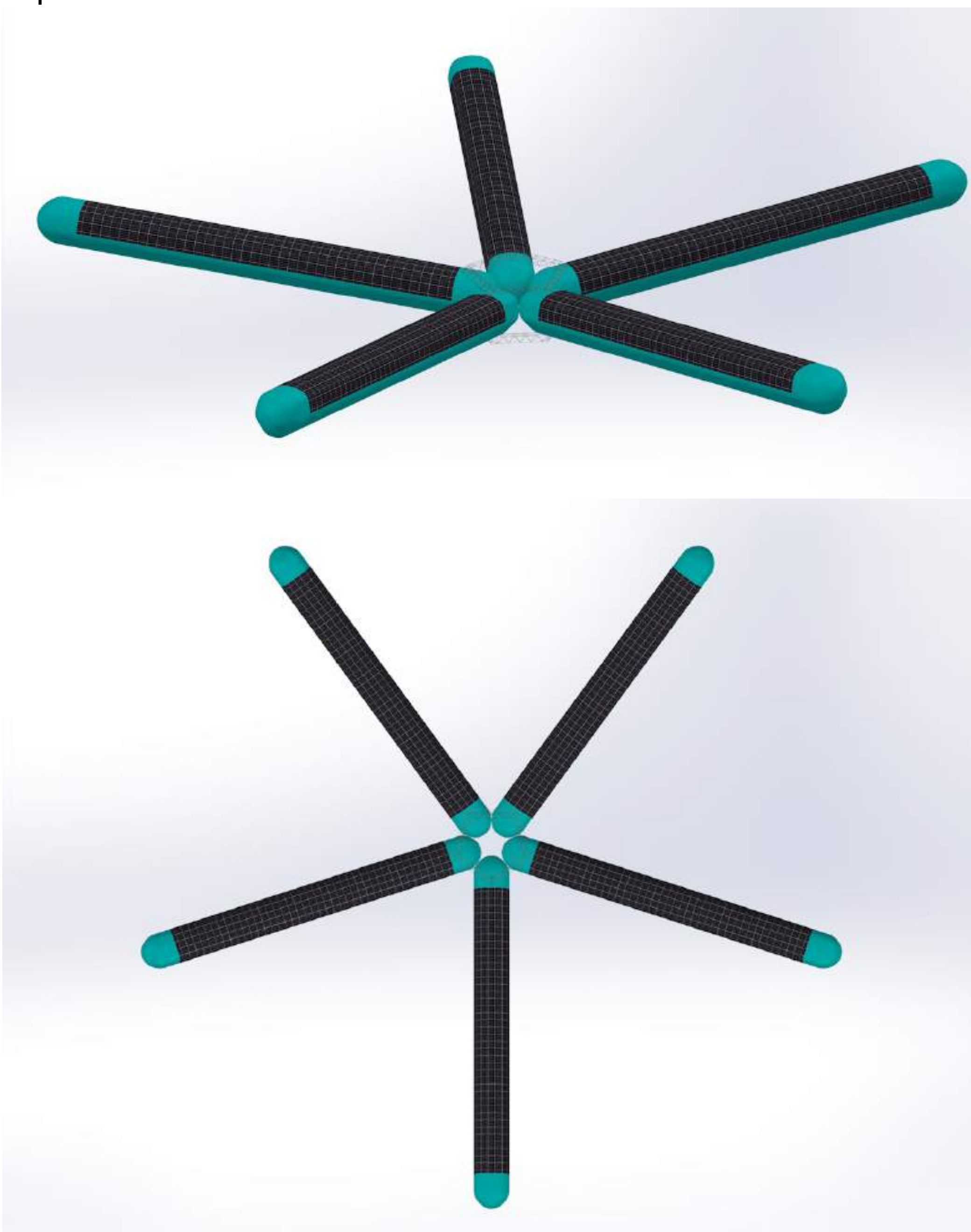
Block II Dark Sky Station

Rendering showing an Atmospheric Ascender (foreground) approaching a Dark Sky Station at 140,000 feet (42,672 m). In the upper right is an Orbital Ascender leaving the station and heading to orbit. Source: JPA Blog (30 May 2019)

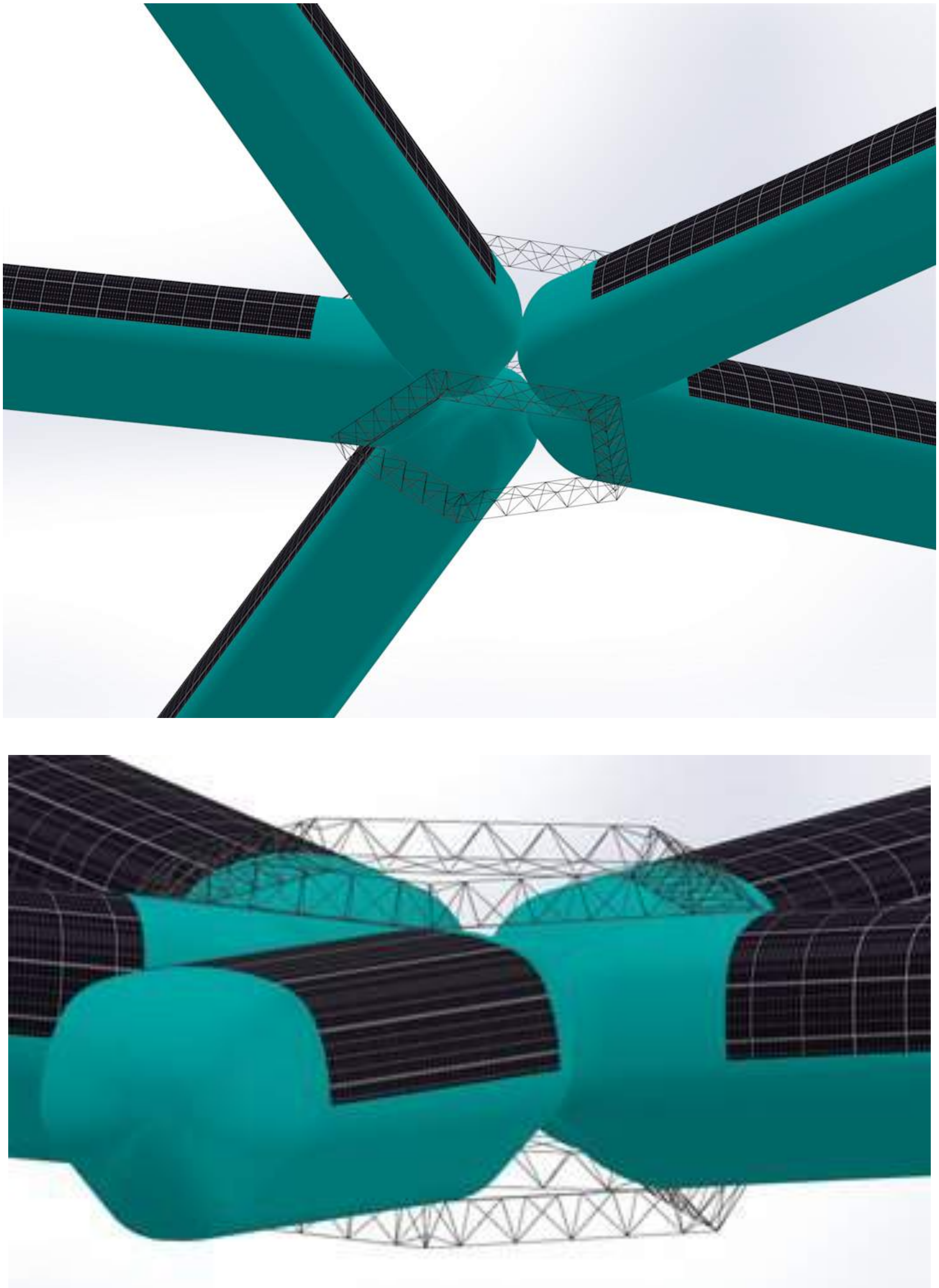
Rendering showing an Atmospheric Ascender docked at one arm of a solar-powered Dark Sky Station Block II. Source: JPA

Block III Dark Sky Station

In October 2020, John Powell reported, “This is the concept configuration for the Block III Dark Sky Station, a 14 person outpost floating at 140,000 feet (42,672 m). The 6,000 foot (1,829 m) diameter facility shares identical technology with the Ascender airships.”



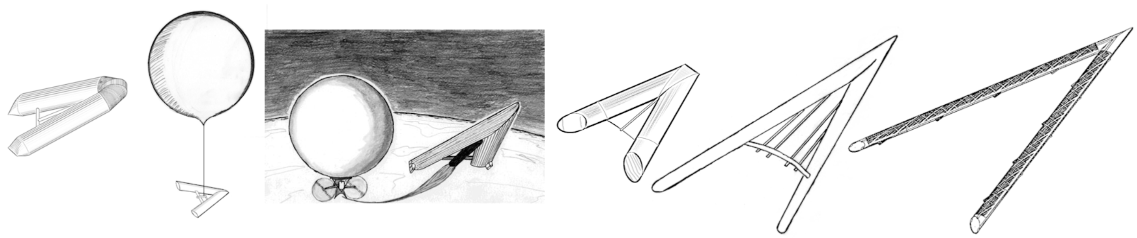
Dark Sky Station Block III general arrangement.
Source: John Powell, Twitter, 10 October 2020



Dark Sky Station Block III hub configuration details.
Source: John Powell, Twitter, 10 October 2020

6. ATO Stage 3 vehicles

JPA's planned development path to the Stage 3 Orbital Ascender is shown in the following sequence of diagrams.



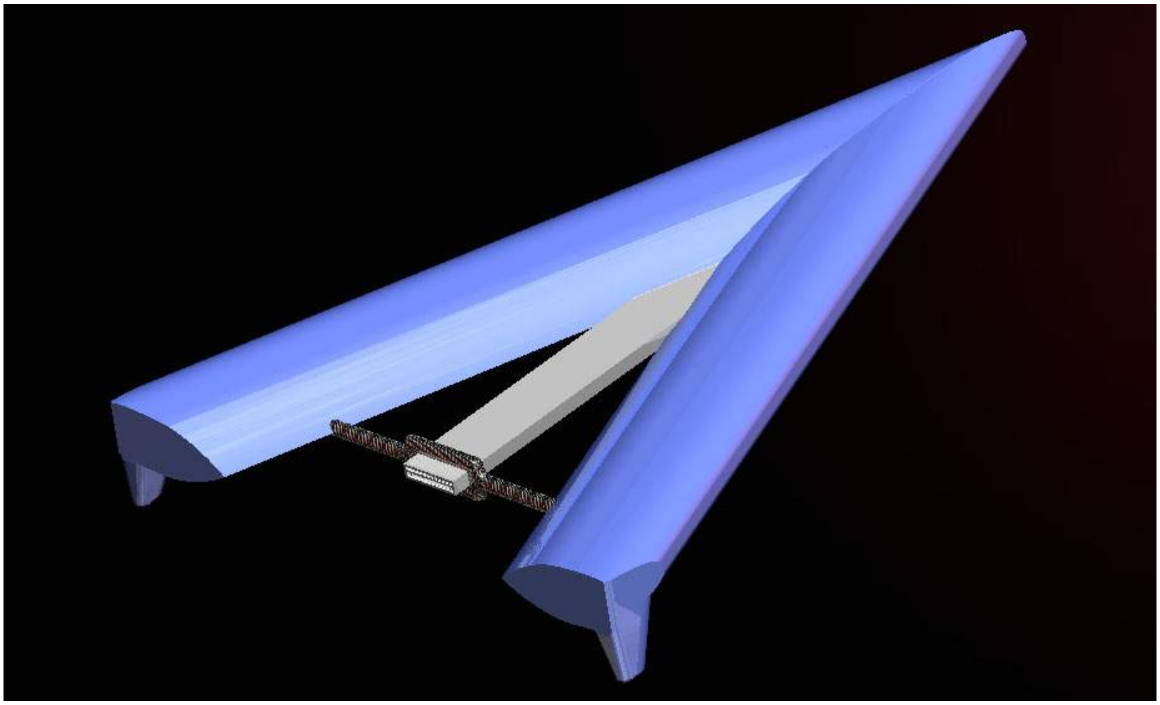
From the left: Ascender Ellipse, Mach Glider Block 2,
Mach Glider Block 4 launching from a high-altitude Tandem Airship,
Trans-Atmospheric Ascender, Initial Orbital Ascender, and
Full-Scale Orbital Ascender.
Source: JP Aerospace (Twitter, 10 Nov 2020)

The Ascender Ellipse is a small-scale Atmospheric Ascender structural test vehicle described in a previous section. Mach Gliders also are small-scale engineering test vehicles. Further development requires a huge scale-up to the Trans-Atmospheric Ascender and a further significant scale-up to a full-scale Orbital Ascender, which will have an arm length of more than one mile (1.6 km).

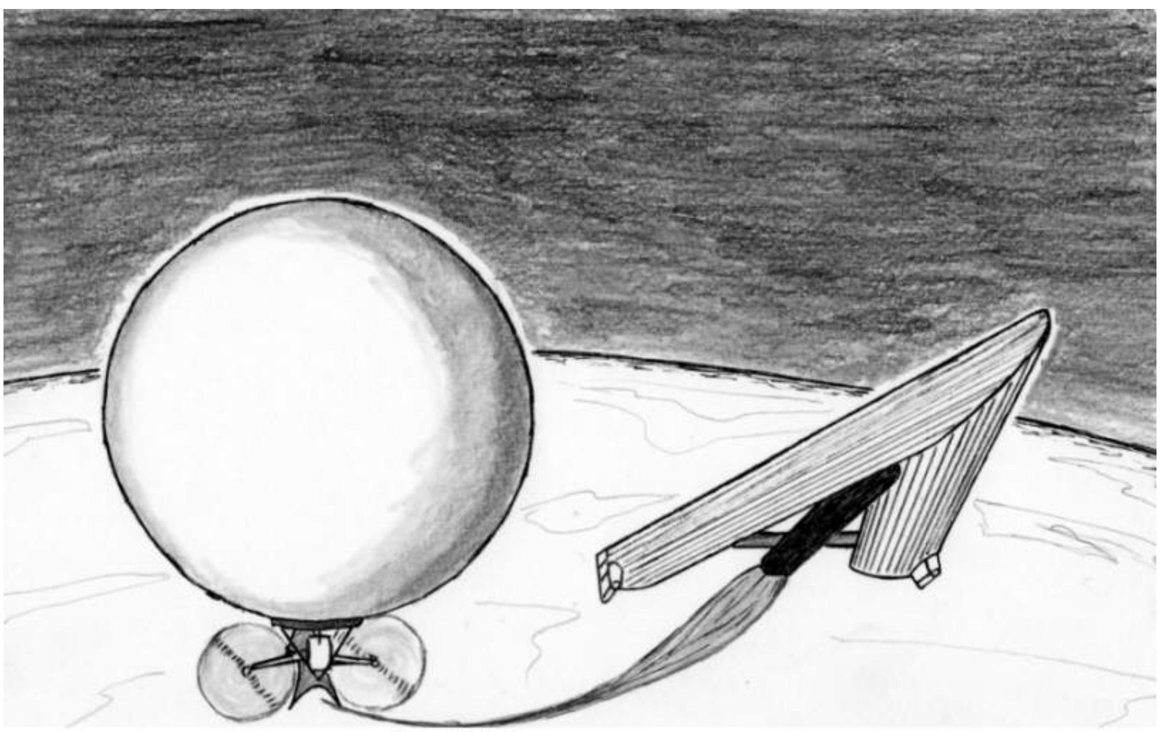
Mach Glider Blocks 2 and 4

Mach Gliders are small, inflatable, pressure-stabilized, rocket-propelled, hypersonic aircraft that will be used to test and validate design features planned for the larger Trans-Atmospheric Ascender and Orbital Ascenders.

The Block 4 Mach Glider will be about 20 feet (6.1 m) long and will be powered by JPA's quad ML rocket engine. It will be carried aloft by JPA's Tandem Airship to a launch altitude of 100,000 feet (30,480 m). The Mach Glider will fly under rocket power to an apogee of more than 160,000 feet (48,768 m) before flying back at high speed to simulate part of the reentry environment that will be experienced by an Orbital Ascender.



Mach Glider Block 4 general arrangement



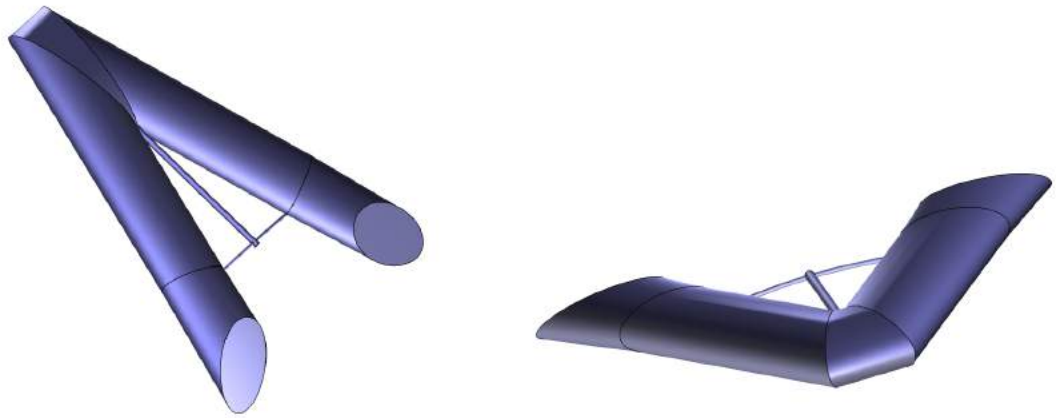
Mach Glider Block 4 launch from a Tandem Airship.
Source, both graphics: JPA blog (posted 13 Dec 2007)

Trans-Atmospheric Ascender

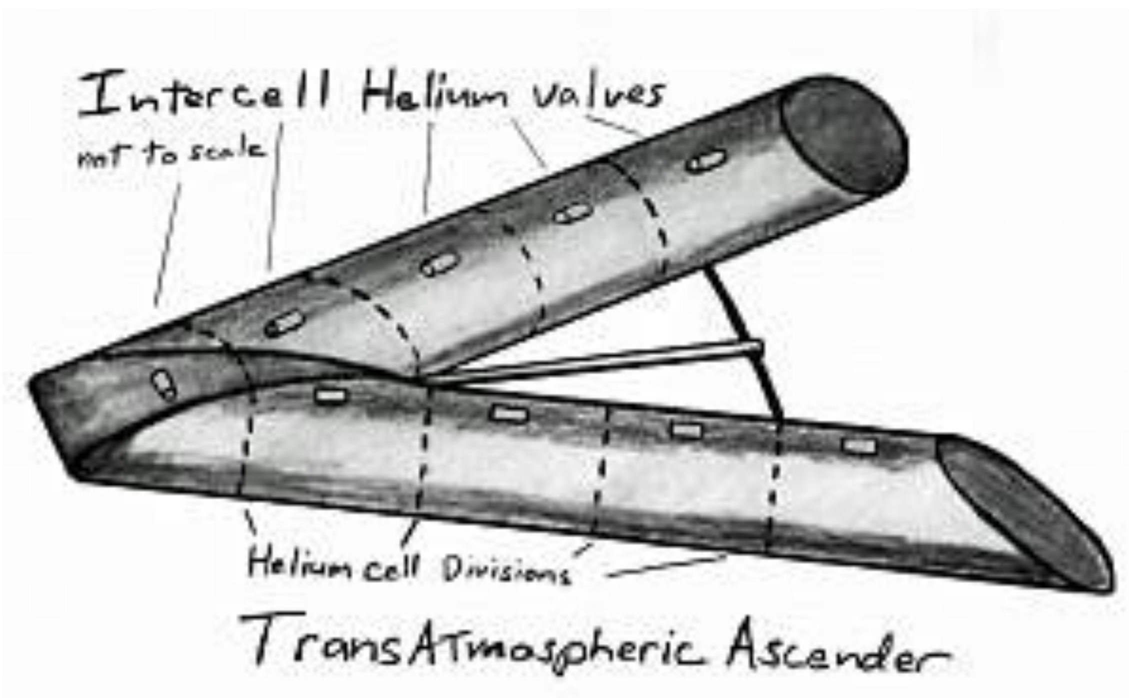
The Trans-Atmospheric Ascender is an important proof-of-concept vehicle with which JPA expects to demonstrate their ability to accelerate a large V-shaped LTA vehicle to hypersonic speed, fly to an altitude well above the point where aerostatic buoyancy contributes to lift (above about 260,000 ft / 79,248 m), and return to the starting point in the stratosphere.

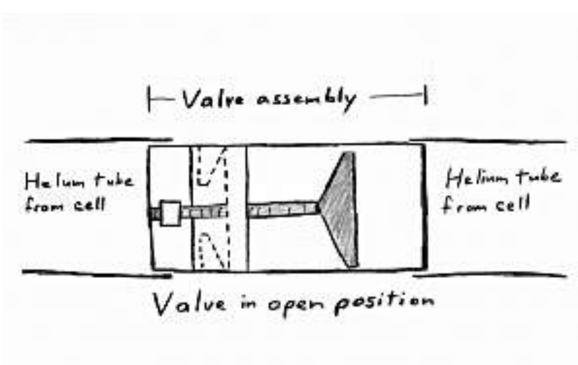
John Powell described the Trans-Atmospheric Ascender in his 23 May 2017 JP Aerospace blog:

> "The Trans-Atmospheric Ascender will be our first airship to reach space. The vehicle is 2,100 feet long and will have a crew of three. It will have a peak altitude of 350,000 feet and a maximum velocity of Mach 5. Technically, it is a hypersonic waverider. The Trans-Atmospheric Ascender is strictly a suborbital vehicle. It will fly from a Block 2 Dark Sky Station floating at 120,000 feet to space then return to the station. The airship will be driven by a single four chamber version of our Symphony hybrid chemical/electric rocket engine.
>
> The Trans-Atmospheric Ascender is still a few years away…."



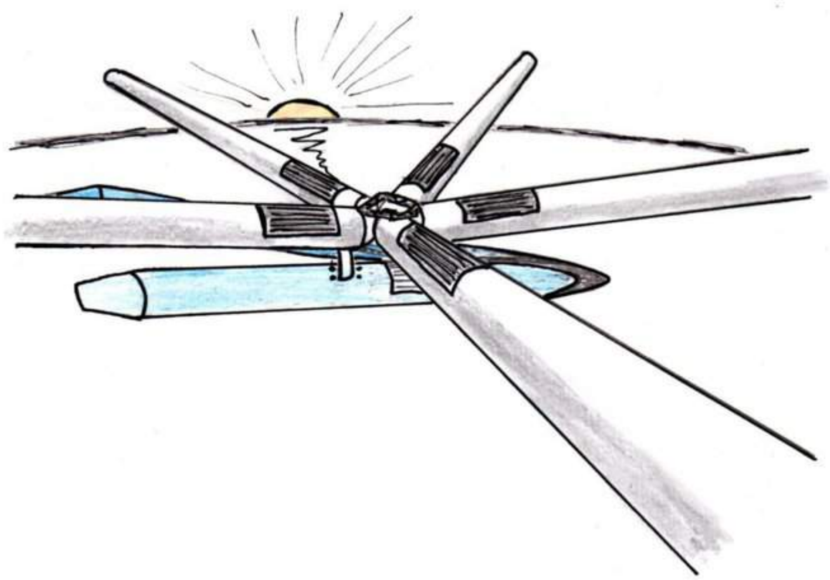
General arrangement of the Trans-Atmospheric Ascender
Source: JP Aerospace blog (posted 23 May 2017)



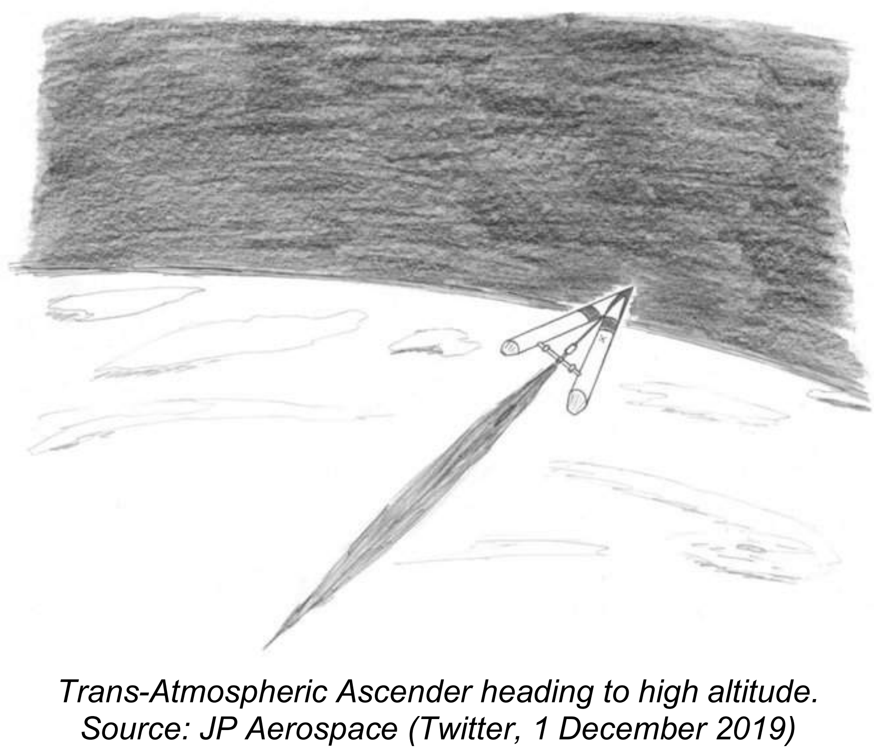


Trans-Atmospheric Ascender helium lifting gas cell divisions (above) and helium valve design (left) for controlling helium flow between the lifting gas cells. Source: JP Aerospace Blog (27 February 2020)

There is considerable controversy about the technical feasibility of JPA's plans for achieving orbit with LTA vehicles. The experience gained from developing and flying the Trans-Atmospheric Ascender will be instrumental in resolving the controversy and determining the future of JPA's ATO program.



Relative sizes of a Trans-Atmospheric Ascender and a Dark Sky Station.
Source: John Powell, Twitter, 1 December 2019



Trans-Atmospheric Ascender heading to high altitude.
Source: JP Aerospace (Twitter, 1 December 2019)

Orbital Ascender

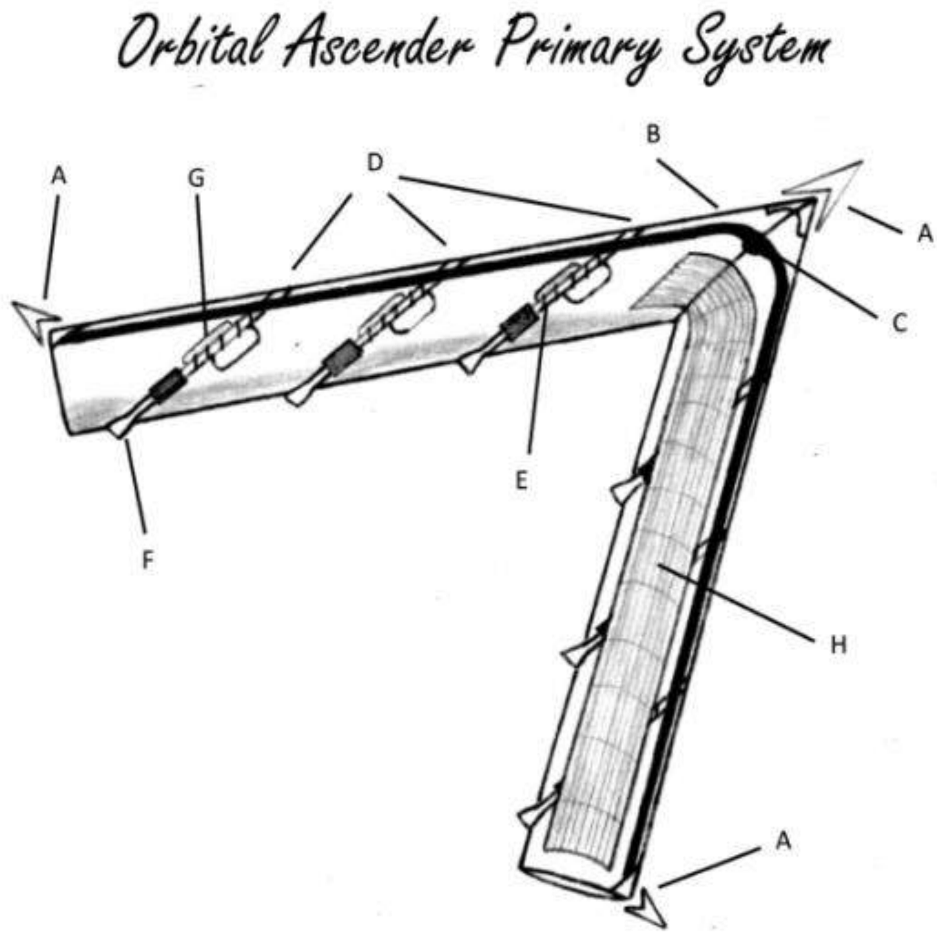
An Orbital Ascender is a V-shaped, buoyant vehicle on a much larger scale than an Atmospheric Ascender. With arms measuring more than a mile (1.61 km) long, the Orbital Ascender is optimized for operating from a Dark Sky Station at 140,000 ft (42,672 m) and flying back and forth between the station and low Earth orbit with a payload of about 20 tons (18.1 metric tons). It is not intended for flying in the lower atmosphere. It likely will use hydrogen as the lifting gas.

The journey into orbit will take nine days. It takes this long because the Orbital Ascender is propelled by low-thrust, very high specific impulse, electric/chemical hybrid plasma engines that operate continuously while the craft slowly gains altitude and accelerates through the increasingly rarified upper atmosphere into a low Earth orbit. Orbital velocity is about 17,000 mph (28,000 kph) for a circular orbit at an altitude of 120 miles (200 km).

In comparison to a stressful conventional chemical rocket launch, the flight profile of an Orbital Ascender is necessarily gentle, keeping aerodynamic, structural and thermal loads within the limits of the lightweight airship structures and materials.

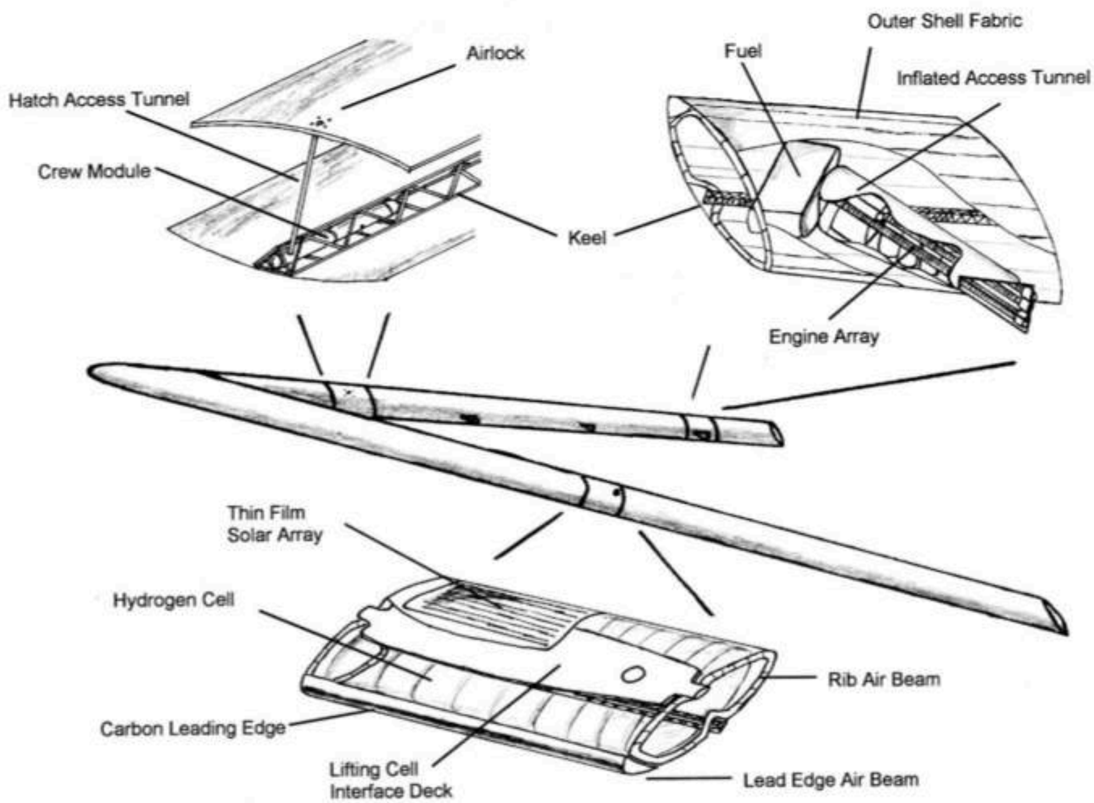
Rendering of an Orbital Ascender accelerating slowly to orbit, propelled by its MHD hybrid engines. Source: JPA via The Drive (5 Feb 2020)

To return from orbit, the Orbital Ascender will pitch up to a high-drag configuration and slowly reduce its speed at very high altitudes. The return journey from orbit will take several days. John Powell commented in his book, “By the time the vehicle is low enough in the atmosphere where heat is a problem, velocity will be low enough where heating is not a problem.”



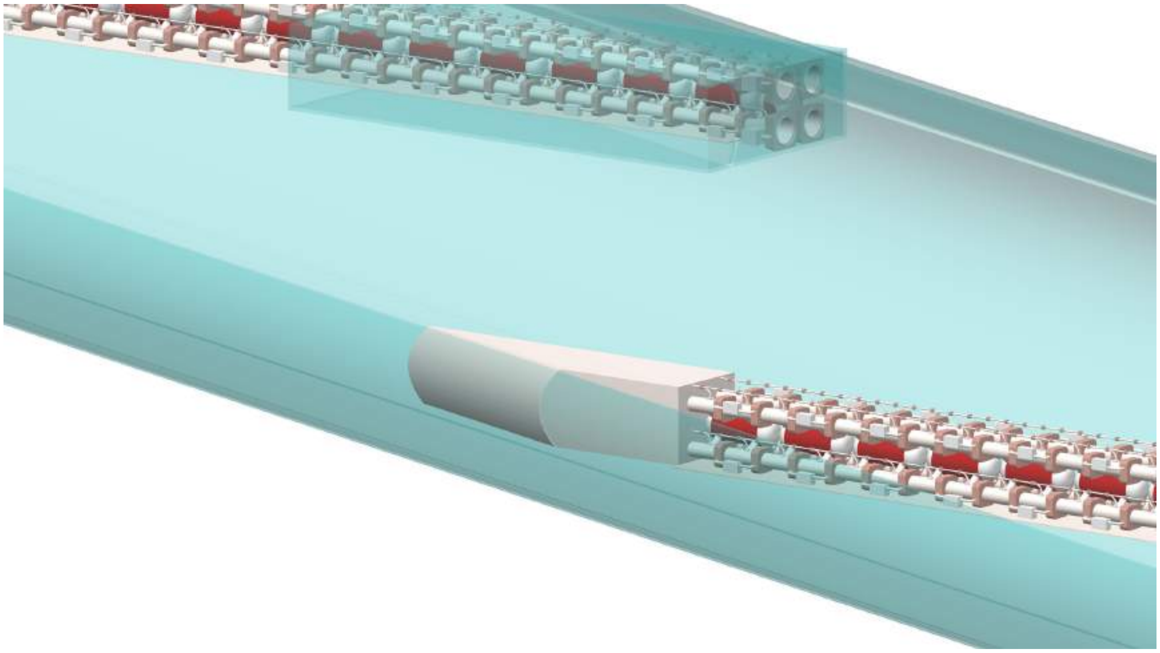
A. Projected Energy Drag Reduction for Nose and Wing Tips
B. Weak Plasma Hypersonic Boundary Layer Control (Entire Leading Edge)
C. Thin Film Hall Effect Power Reclamation
D. Engine Plasma Tap for MHD Seed Source
E. Symphony Rocket Engine
F. Magnetic Nozzle/Faraday MHD Power Generation
G. Battery Banks
H. Thin Film Solar Cells

Source: JPA blog (posted 30 June 2010)

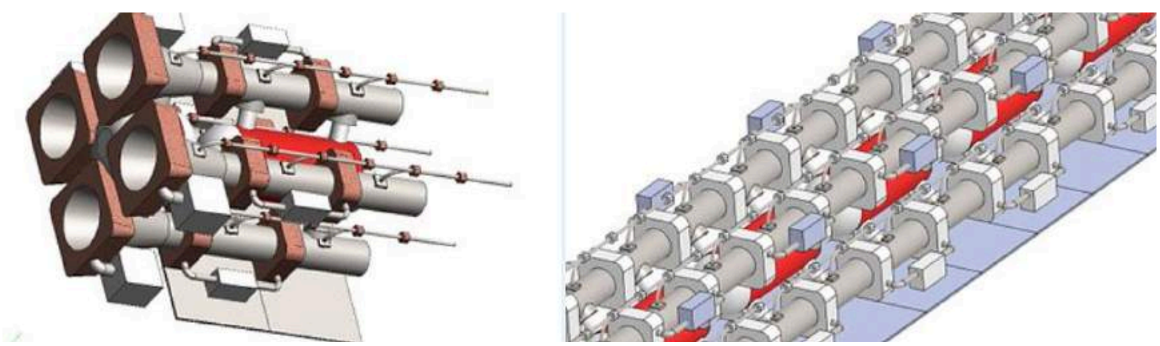


Orbital Ascender cutaway. Source: JPA ATP presentation

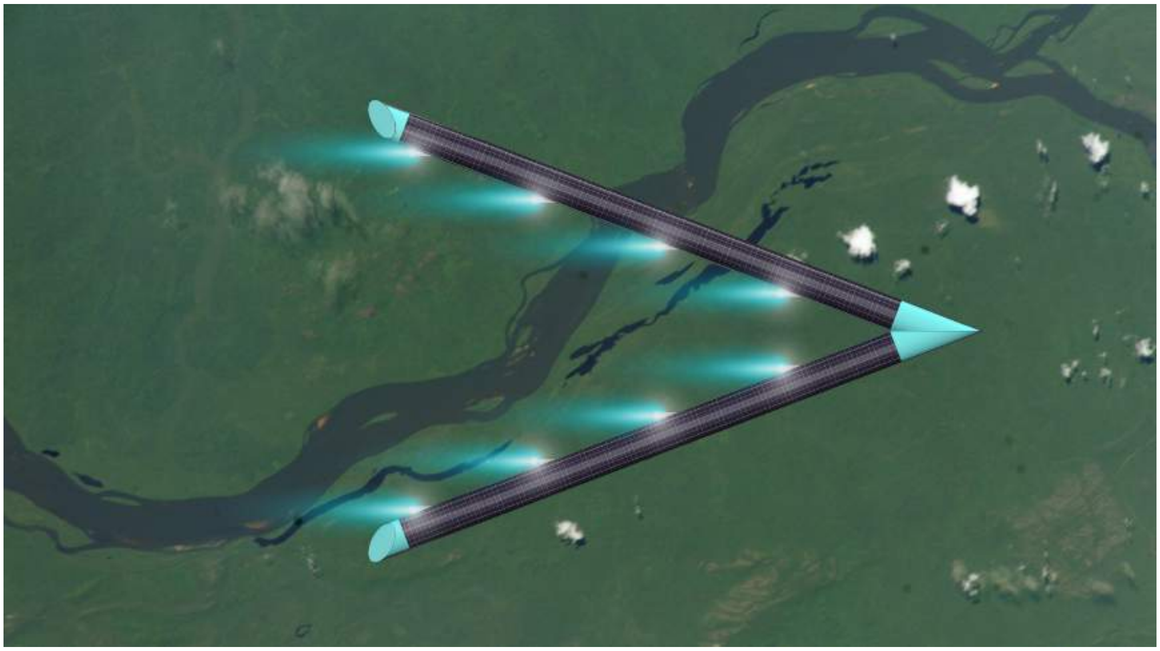
Orbital Ascender airship partial cutaway diagram showing the exterior thin-film solar array on the top arm and the interior placement of four Symphony MHD hybrid rocket modules (indicated in red) in the lower arm. Source: John Powell, Twitter (8 Nov 2019)



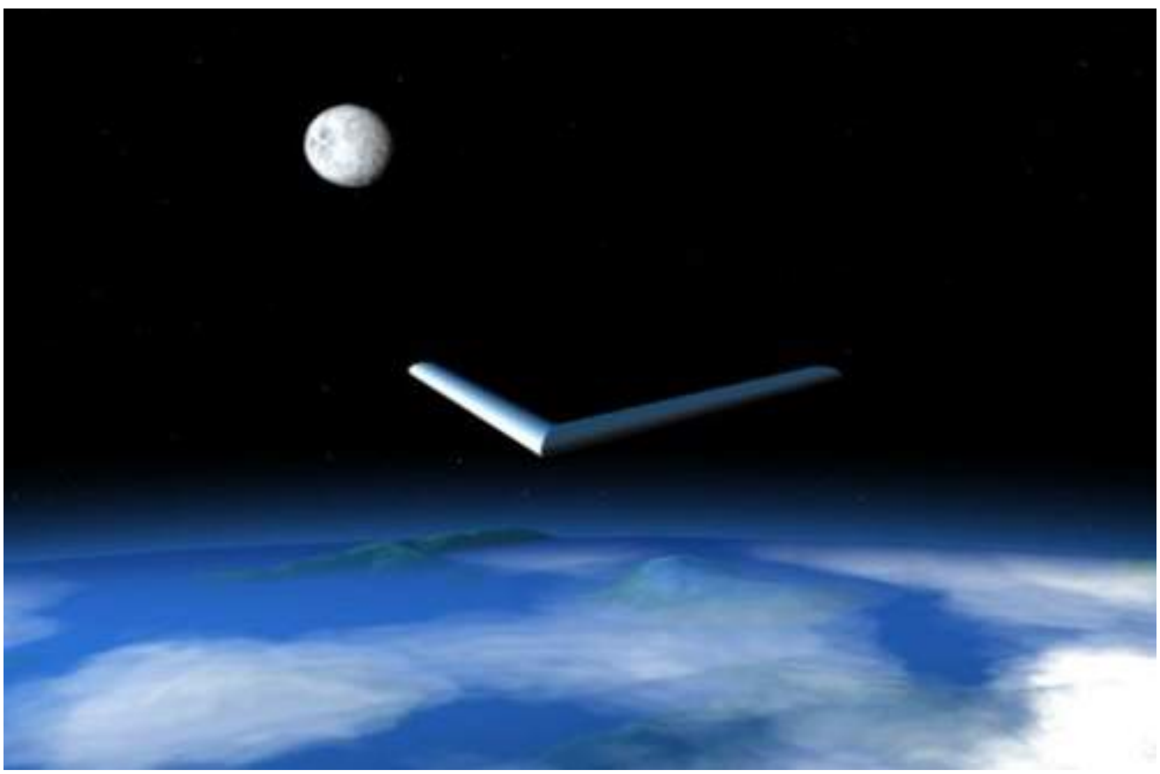
Orbital Ascender interior view showing the placement of two of the Symphony MHD hybrid rocket engines. Source: John Powell, Twitter, 8 Nov 2019



Configuration concept drawings of JPA's Symphony MHD hybrid engine for the Orbital Ascender: four chamber rocket nozzle (left) and electromagnetic accelerator (right). Source: John Powell, Twitter, 11 Nov 2019



Overhead view of an Orbital Ascender during powered flight.
Source: JP Aerospace Blog (8 Nov 2019)



Bow-on rendering of an Orbital Ascender in orbit. Source: JPA

7. Ground-based engineering development programs

Other elements of JPA's DIY Space Program are their ground-based engineering development programs for key ATO vehicle systems, including magnetohydrodynamic (MHD) hybrid plasma engines, structural air beams and high-altitude helium valve hardware. These programs are briefly described below.

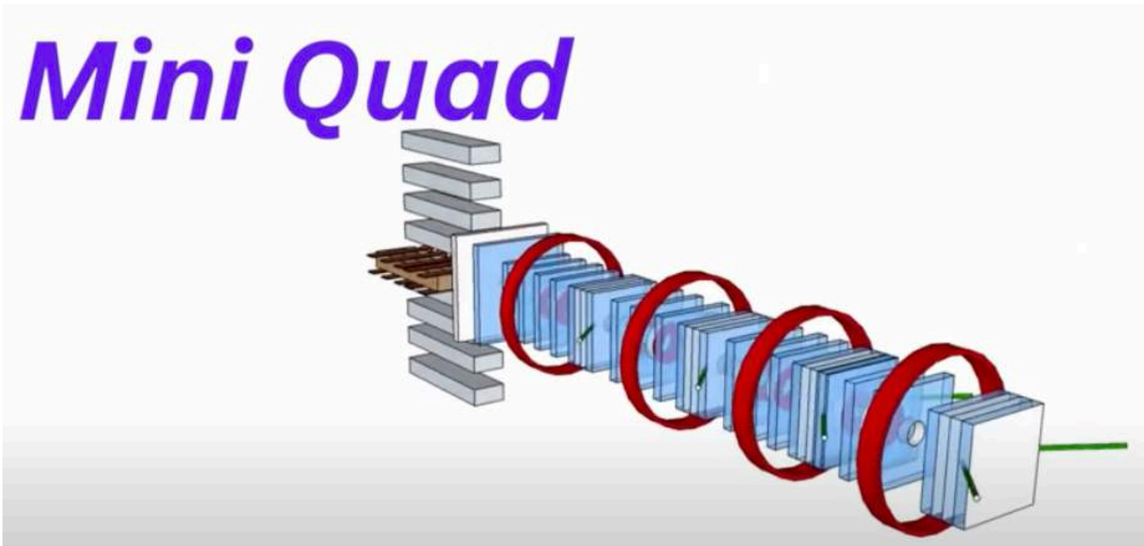
Magneto-hydrodynamic (MHD) hybrid propulsion

The Orbital Ascenders will be propelled by electric/chemical MHD hybrid plasma engines known as Quad (current generation) and Symphony (advanced engine with an additional radio-frequency plasma tuning stage). JPA has had a long-running program to develop the technology for these hybrid engines. Operation of such an engine is described in the 2021 JPA video at the following link: https://www.youtube.com/watch?v=rUW6gdIcNss

MHD 112 test. Source: JP Aerospace Blog (posted 28 January 2015)

On 28 March 2022, the JP Aerospace Blog reported the successful first test firing with 3-D printed ablative graphene electrodes in the MHD plasma engine unit. The electrodes ablated away removing fouling & kept electrically connected to the plasma during the entire run.

After performing more than 130 tests on MHD engine subassemblies, the first "all-up" tests will be performed on the Mini Quad small hybrid chemical / electric rocket engine, which is 14 inches long. Its operation is described in the JPA video here: https://www.youtube.com/watch?v=I_gYJeUCjXA



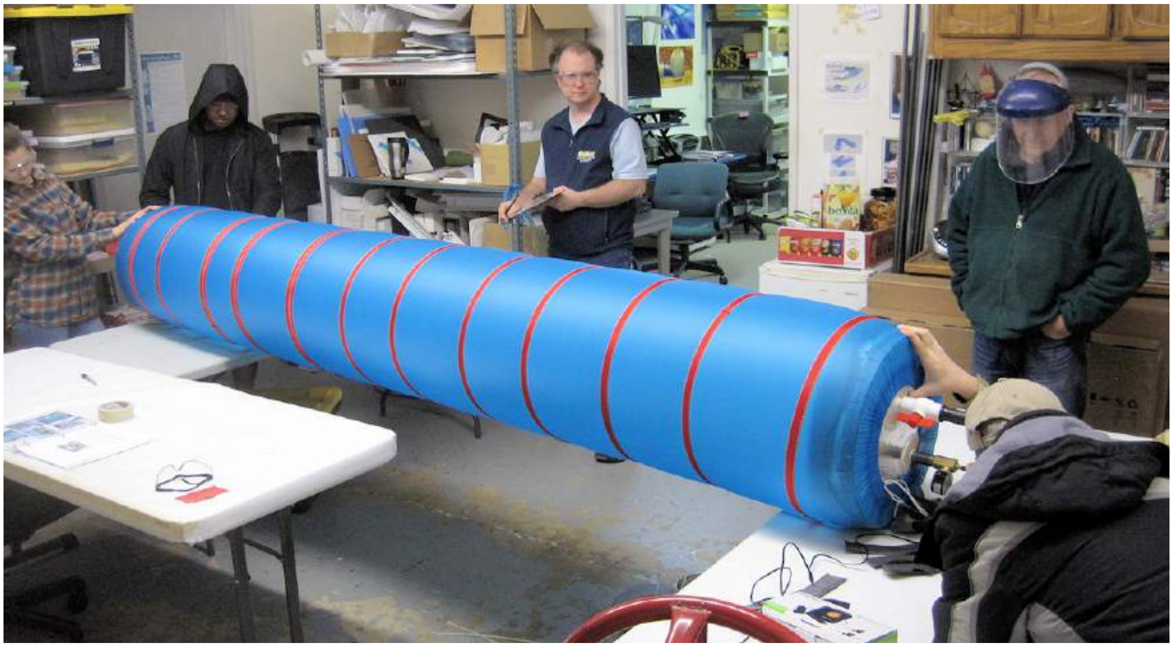
Source: Screenshot from JPA MiniQuad video (24 Feb 2023)

Structural air beams

Air beam development at JPA has been in progress for almost two decades. Tests have demonstrated that air beams with relatively low internal pressures (< 2 psi) can carry substantial loads. JPA has determined that, for their applications, air beams are lighter than carbon fiber beams up to a length of 80 feet (24.4 m). JPA has built carbon fiber beams up to a length of 170 feet (51.8 m).

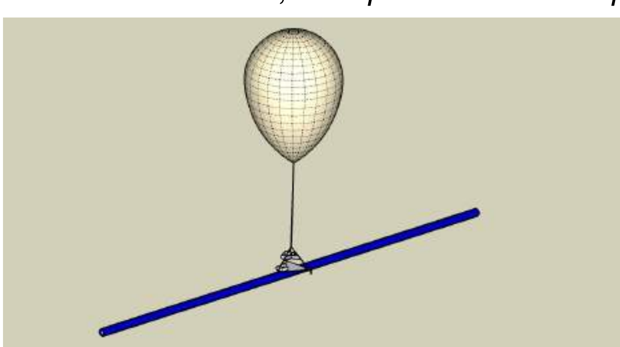
JPA plans to replace carbon fiber trusses with comparable strength, lighter air beams in their future designs for Ascender airships and Dark Sky Stations. The Ascender 100 marked the first use of air beam ribs to create V-shaped arms with an elliptical cross-section.

In the small Ascender Ellipse, air beams are used for ribs and also replace the carbon fiber keels and most of the other carbon fiber structures that have been standard features of Ascender airships.



Air beam ground test.
Source: JP Aerospace Blog (posted 5 March 2018)

Air beam used as Ascender wing rib structure.
Source, both photos: JP Aerospace Blog (5 March 2018)



To validate air beams as structural elements for use in the Ascender airships and Dark Sky Stations, JPA plans to test full-scale air beam structures at high altitude. Source: JP Aerospace blog (posted 13 Sep 2010)

High-altitude helium valve hardware

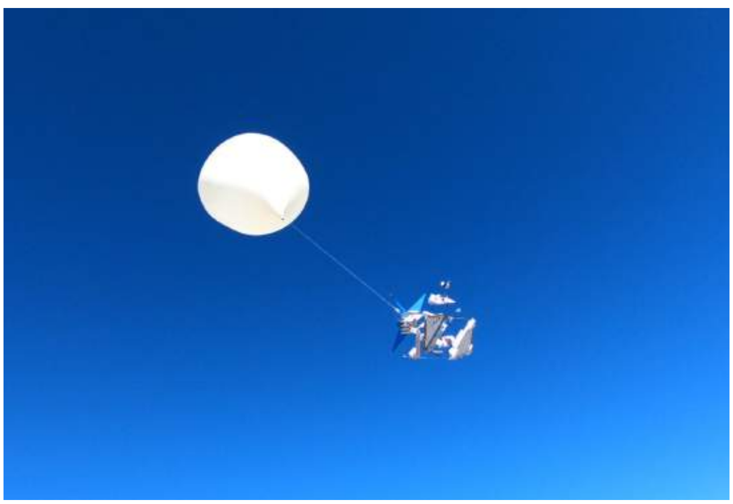
Ascender airships and the Dark Sky Stations have a variety of hardware items that require testing in the high altitude environment where they are intended to operate. JPA uses their high altitude balloon systems to carry equipment aloft for testing at high altitude and then return the items safely to the ground by parachute. For example, various types of valves are used to transfer helium among the lifting gas cells, vent lifting gas and provide protection against over-pressurizing a lifting gas cell.

Ascender actuated helium valves (left) and being tested at high altitude on the Away 129 mission (below). After further testing, the valves are intended for the Ellipse II airship (formerly Ascender 48). Source, both photos: JP Aerospace Blog (27 February 2020)

8. Stratospheric single balloon programs

PongSats

The PongSat Flight Program carries small experiments, built by students to fit inside of a ping pong ball, to the edge of space. Suspended on a platform under a high altitude superpressure balloon, the PongSats experience the near-space environment: cosmic rays, vacuum, extreme cold and even zero gravity on the descent. The PongSats stay with the balloon platform, are recovered after landing and are returned to the students. This free civilian program was started by JPA on 9 March 2002 and, by 2022, has flown over 18,000 PongSats involving over 80,000 students. The Away 132 high altitude PongSat mission in 2022 was the 200th stratospheric mission flown by the JPA. PongSat now is its own nonprofit organization. More information on PongSat is available here: http://www.jpaerospace.com/pongsat/

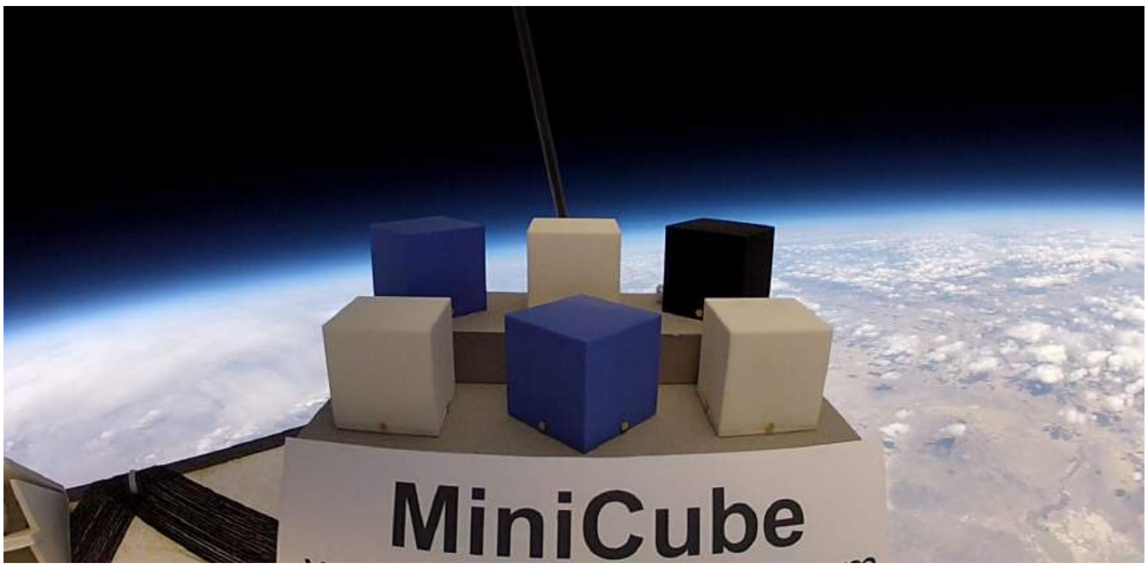


Away 129 Mission. Source: JPA

PongSats on Away 131 Mission. Source: John Powell, Twitter, 17 Aug 2021

MiniCube

MiniCube is a somewhat larger high altitude payload container measuring 2 inches (5 cm) on a side. For a modest price, JPA will launch a balloon platform with MiniCube payloads to high altitude and return them to the experimenters along with documentation on the flight. More information on MiniCube is available here: http://www.jpaerospace.com/minicube/MiniCubeoverview.pdf



MiniCube experiment packages carried to high altitude. Source: JPA

HiBot drone airship

JP Aerospace has been working for several years on a new high-altitude quad-propeller drone airship named HiBot, which is being designed to fly routinely, with a variety of payloads, at altitudes up to 140,000 feet (42,672 m) on flights lasting about 6 hours. It is designed for an all-weather launch capability in winds up to 45 mph (72 kph) using JPA's quick release launch bags.

Source: JPA

A carbon fiber composite structural ring supports the airship systems and payload platform and connects to the balloon, which expands to a diameter of 62 feet (18.9 m) at peak altitude. A fabric sleeve protects the balloon from the carbon fiber structure.


(Left) General arrangement of the carbon fiber structural ring.
(Right) Ring shown to scale with a pickup truck.

Test fitting the HiBot frame to a balloon insider the rapid launch bag.

Source, three photos: Screenshots from JPA HiBot video (20 Sep 2022)

HiBot will have two different sets of propellers that will be changed to match the mission. One set will be optimized for flights under 15,000 feet (4,572 m) and the other set will be based on the Tandem airship propellers, which are optimized for high altitude operation. First flight is expected in late 2023 or in 2024.

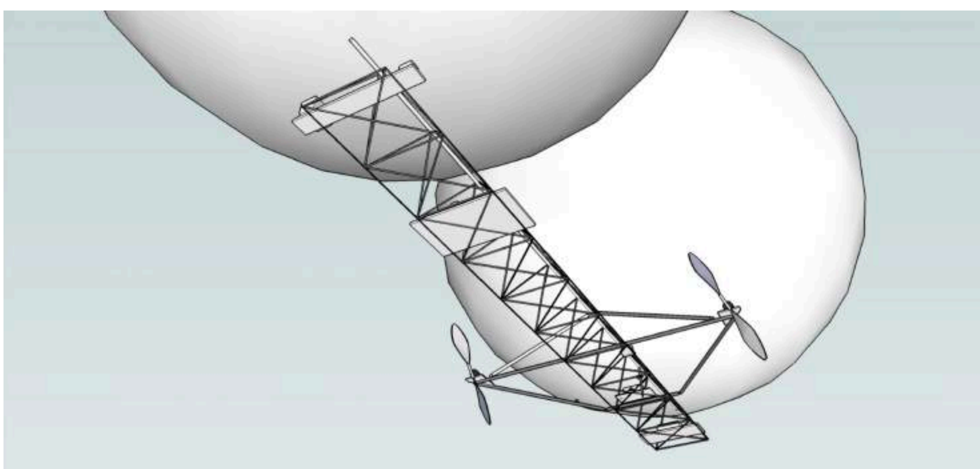
First use will be as a high altitude camera platform. It also will play an important role as a test platform supporting JPA's Airship To Orbit program. HiBot will be a surrogate for a Dark Sky Station at 140,000 ft and serve as a practice rendezvous target for high altitude Ascender airships.

9. Stratospheric Tandem-class airships

JPA's Tandem Airship is a self-propelled, multipurpose, high altitude superpressure balloon system. It was intended initially as an engineering development platform and as a launch platform for small research rockets and JPA's Mach Gliders. JPA notes that the Tandem Airship design is scalable and can be configured for a variety of high-altitude applications, including telecommunications, remote sensing, reconnaissance / surveillance, and disaster response.

The Tandem airship

A Tandem Airship consists of a platform with a longitudinal, triangular section, carbon fiber keel and a pair of electrically-powered propellers installed on a transverse support structure near the center of gravity. The platform is carried aloft by two high-altitude balloons installed at the ends of the keel. At the end of a mission, the balloons are released and the platform returns to the ground by parachute. JPA's Tandem Airship is the subject of US Patent 8,061,647, "High Altitude Two Balloon Airship," which was granted in 2011.



General arrangement of a Tandem Airship. Source: JPA

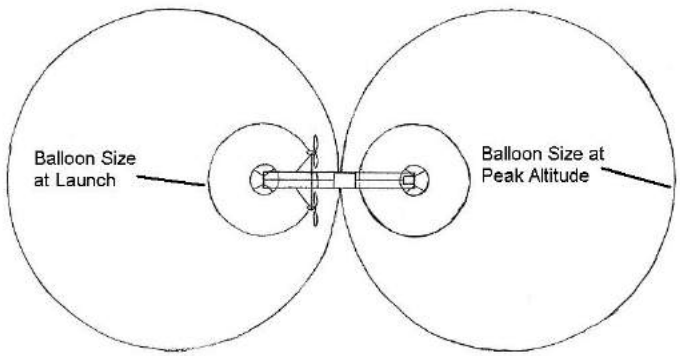
The original Tandem Airship has a 30 foot (9.1 m) carbon fiber keel and two 6-foot (1.8-meter) diameter propellers that can provide a maximum airspeed of 6 knots (11 kph). Batteries can support missions up to 12 hours. The empty weight of the complete vehicle, including the balloons, is 80 lb (36.3 kg). The platform alone weighed 60 lb (27.2 kg).

Above: Tandem Airship has a triangular section carbon fiber cross-beam with two mating cones (blue) for connecting the twin superpressure balloons to the airship structure. Source: JPA

Left & below: The battery-powered, electric motor-driven, twin propellers are optimized for operation at very high altitudes. Source, two photos: JPA

Tandem airship rapid launch sequence.
Source, top photo: JP Aerospace Blog (posted 18 Nov 2011)
Source, bottom two photos: Screenshots from JPA video (1 Nov 2022)

The Tandem Airship seen from below shortly after launch.
Source: JPA blog (posted 9 Oct 2012)



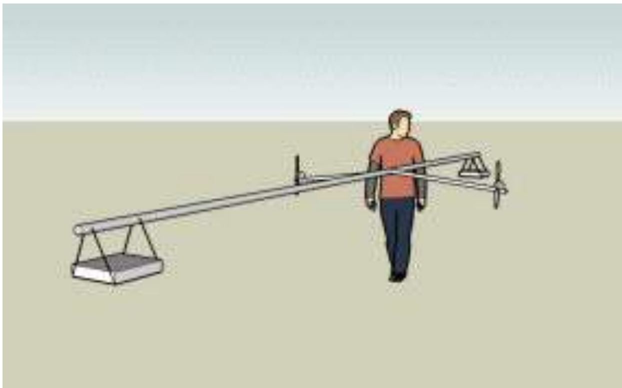
Relative sizes of the Tandem Airship balloons at ground level and at peak altitude. Source: JPA

On 22 October 2011, the Tandem Airship flew to an airship record altitude of at 95,085 ft (29,287 m). At altitude, the propulsion system was turned on and the remotely-piloted airship flew a series of controlled maneuvers before a balloon burst. The second balloon was released and the platform returned via parachute for recovery on the ground.

The Tandem Airship flying under power at high altitude. Source: JPA blog (posted 29 Nov 2011)

MicroTandem

JPA also has developed a "MicroTandem" airship for small payload applications. JPA describes this small airship as follows:



Source, three graphics: JPA

"The MicroTandem is both a testbed for the larger Tandems and an operational vehicle in its own right.

The vehicle is just over 14 feet long and weights 16 pounds…... It is driven by two electric motors mounted on the crossbar.

The MicroTandem is a very simple airship…..lifted by two latex weather balloons. This configuration makes it very slow. It only goes one knot with both motors going all out. However, it makes up for it by being cheap, easy to deploy and capable of reaching extreme altitudes."

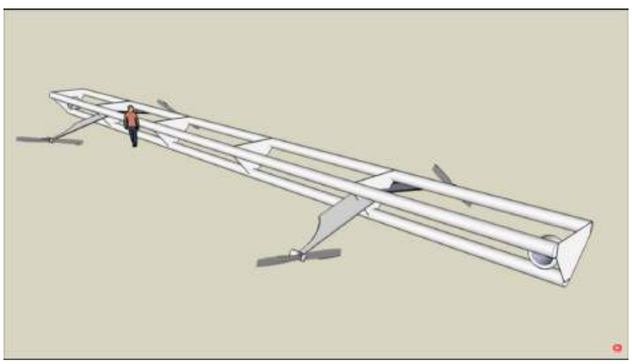
The first flight of the MicroTandem took place on 6 October 2007. It was flown to over 80,000 feet while carrying the entire systems set of the larger Tandem.

MicroTandem can be launched from quick release bags or hand launched in calm weather.

Super Tandem and Heavy Lift Tandem

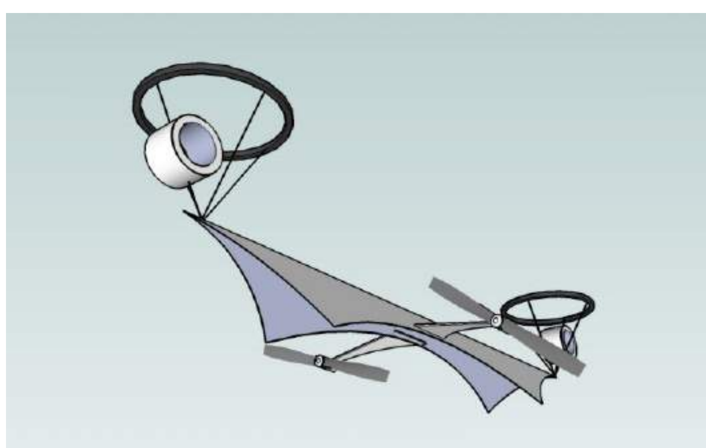
JPA anticipates that a large Tandem Airship will be used in the future as a construction “workhorse” for building Dark Sky Stations at an altitude of 140,000 ft (42,672 m).

The basic layout and scale of a design concept called Super Tandem are shown in the following two JPA graphics. The large triangular section cross-beam carries four electric motor-driven propellers. A large payload item would be suspended beneath the cross-beam. This appears to be an interim step to an even larger Heavy Lift Tandem.



Super Tandem. Source, both graphics: Screenshots from JPA video (1 Nov 2022)

JPA’s Heavy Lift Tandem design concept is 200 feet (61 m) long and is lifted by roller-mounted zero-pressure polyethylene balloons that would gradually deploy as the craft ascended and be reeled in during descent. The craft will be designed to carry loads of up to five tons (4,536 kg) to 140,000 feet. It will be capable of crewed or autonomous operation.



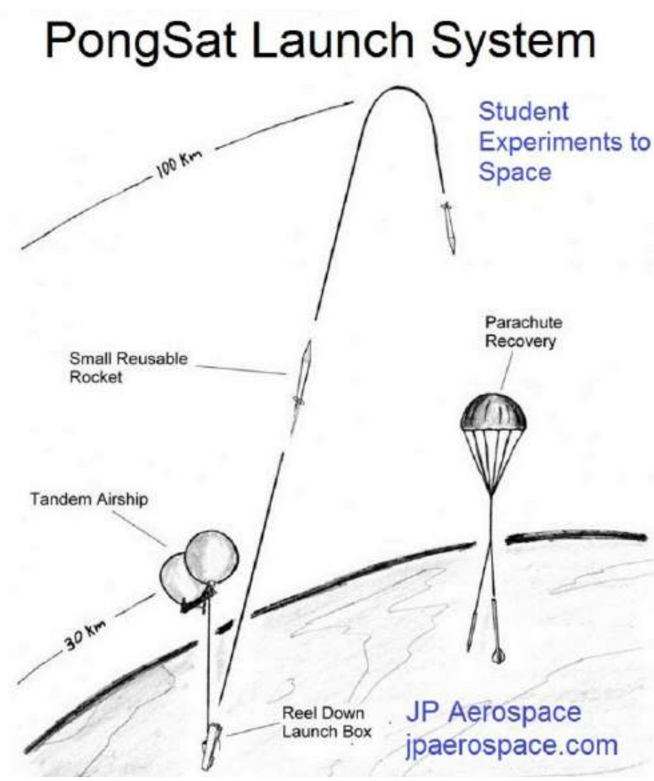
Heavy Lift Tandem airship showing fore and aft rollers for deploying polyethylene balloons (not shown). Source: JPA

10. Rocket and Rockoon programs

JP Aerospace has developed small research rockets known as the Microsatellite Launcher, or ML-class rocket, in two sizes: 3-inch (7.6 cm) and 6-inch (15.2 cm) diameter. These rockets are used for lofting research payloads and as tools for airship development. They serve as delivery vehicles for Mach Gliders and testbeds for JPA’s engine and drag reduction technologies.

Prior to 2008, the rockets had a phenolic resin airframe reinforced with Kevlar. The 3-inch diameter rocket could reach an altitude of over 72,200 ft (22,000 m). In 2008, JPA implemented the Block II 3-inch diameter airframe made of thin carbon shells over a Nomex honeycomb core, with a Kevlar nose. The 6-inch rocket was similarly upgraded later.

JPA’s first balloon-launched rocket flew in 1995.

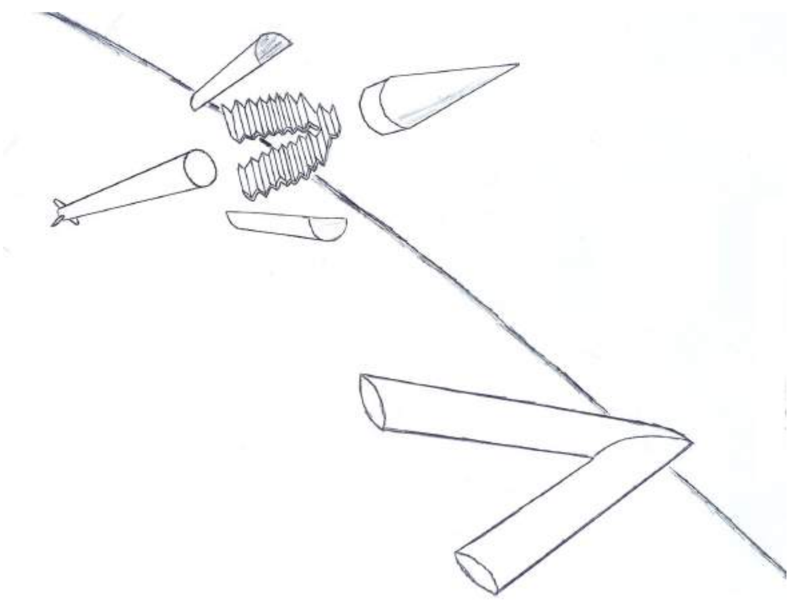


JPA rockoon launch configurations with a balloon cluster (left) and the Tandem Airship (right). Source: JPA blog (posted 6 October 2010) (left), JPA blog (posted 25 January 2013) (right)

A launch rail holds the rocket prior to launch. For a rockoon launch, a gimbaled launch rail is used. This allows the rail to swing in all directions, while keeping the rocket pointed correctly regardless of the attitude of the launch platform.

Photo of an early (1995) JPA rockoon launch. Source: JP Aerospace Blog (26 May 2019)

In December 2019, John Powell reported, “One of the steps in the Airship-to-Orbit program is to deploy miniature Vee shaped airships from our ML rocket at high altitude. This lets us do low cost partial reentry tests. We're shooting for tests in the Mach 8 to 10 range.”



Miniature V-shaped airship launched to high altitude for aerodynamic test. Source: John Powell Tweet (1 December 2019)

11. For more information

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- “JP Aerospace Blog – Our Journey Into Space:” https://www.portaltotheuniverse.org/blogs/posts/view/707129/
- “JP Aerospace Updates,” NASA Spaceflight.com: https://forum.nasaspaceflight.com/index.php?topic=27151.0
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- Robert Walker, “Can Giant Airships Accelerate To Orbit (JP Aerospace's Idea)?” Science 2.0, 2 May 2017: https://www.science20.com/robert_walker/can_giant_airships_accelerate_to_orbit_jp_aerospaces_idea-225058
- Brett Tingley, “We Talk Giant V-Shaped Airships, Space, And Phoenix Lights With JP Aerospace's Founder,” The Drive, 5 February 2020: https://www.thedrive.com/the-war-zone/32082/we-talk-giant-boomerang-shaped-airships-space-and-phoenix-lights-with-jp-aerospaces-founder

Patents

- US7614586B2, “Method for Traveling to Earth’s Orbit Using Lighter Than Air Vehicles,” Inventor: John Powell, Filed: 10 March 2006, Granted: 10 November 2009: https://patents.google.com/patent/US7614586B2/en?oq=US7614586B2
- US8061647, “High Altitude Two Balloon Airship,” Inventor: John Powell, Filed: 10 April 2008, Granted: 22 November 2011: https://patents.google.com/patent/US8061647B1/en?oq=•US8061647

Videos

- John Powell YouTube Channel: https://www.youtube.com/user/johnmpowell/videos
- “Ascender 175” (4:22 minutes), Ascender inflation test in 2004, posted by John Powell / JP Aerospace, 26 December 2007: https://www.youtube.com/watch?v=K0vLTYxNO9M
- “Airship to Orbit Animation,” (2:13 minutes), posted by John Powell / JP Aerospace, 1 June 2010: https://www.youtube.com/watch?v=iA45XcmUB8Q&t=4s
- “World's Highest Airship” (0:34 minutes), Inflight view of the Tandem airship, posted by John Powell / JP Aerospace, 24

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- "MHD Generator Test No. 115" (0:28 minutes), posted by John Powell / JP Aerospace, 18 April 2015: https://www.youtube.com/watch?v=ueHWJNUyCHA
- "Time Lapse Inflation of the Ascender 9 Airship or How to Inflate an Airship" (1:59 minutes), posted by John Powell / JP Aerospace, 30 November 2020: https://www.youtube.com/watch?v=JhL4QJHRjjU
- "Advanced MHD Generator Test," (2:21 minutes), posted by John Powell / JP Aerospace, 22 Jul 2021: https://www.youtube.com/watch?v=rUW6gdIcNss
- "JP Aerospace Update Sept 2021" (7:30 minutes), posted by John Powell / JP Aerospace, 2 September 2021: https://www.youtube.com/watch?v=N1CqSYEbj7k
- "Magneto-hydrodynamics with Ablative Graphene Electrodes," (10:09 min), posted by John Powell / JP Aerospace, 3 June 2022: https://www.youtube.com/watch?v=FD7xS3FQvDY
- "How to Build a High Altitude Drone," (HiBot, 5:17 min), posted by John Powell / JP Aerospace, 20 September 2022: https://www.youtube.com/watch?v=ZlF_SHUv0pU
- "Airships of JP Aerospace," (4:03 min), posted by John Powell / JP Aerospace, 1 November 2022: https://www.youtube.com/watch?v=8JZFaViMiSI
- "Hybrid Chemical Electric Rocket Engine Walk Through," (Mini Quad, 1:53 min), posted by John Powell / JP Aerospace, 24 February 2023: https://www.youtube.com/watch?v=I_gYJeUCjXA

Other *Modern Airships* articles

- *Modern Airships - Part 1*: https://lynceans.org/all-posts/modern-airships-part-1/
  - GNSS / ENSS – StarLight
  - Walden LTAS - Lenticular toroidal DCB airships (S.O.S.C.S)
- *Modern Airships - Part 2*: https://lynceans.org/all-posts/modern-airships-part-2/

    - Near Space Corporation (NSC) - High Altitude Shuttle System (HASS)
- *Modern Airships - Part 3*: https://lynceans.org/all-posts/modern-airships-part-3/
    - Walden LTAS - Exotic hybrid airships (W.A.V.E.S rockoon, Earth Station One, Silver Dart shuttle, HYPER, Earthball)