Voliris airships

Peter Lobner, Updated 24 August 2021

1. Introduction

Voliris is a small French firm that has been designing and building small airships since it was founded in 2001. Under new ownership since 2008, the company has established its research and development effort at Aérodrome de Moulins - Montbeugny, Yzeure, France. The company’s website is here: http://voliris.com

2. The V900 – the first Voliris airship

Their first airship was a conventional non-rigid blimp known as the V900. The gas envelope for the Voliris V900 airship was the first Russian Au-12 blimp gas envelope manufactured in Moscow by CJSC Augur Aeronautical Center (later Augur RosAeroSystems). This envelope was produced within the framework of a joint Russian-French project named “Voliris-900,” which was commissioned by the French National Aeroclub. The first Au-12 gas envelope for the Voliris V900 was 31 meters (102 feet) long, with a volume of 996 cubic meters (35,173 cubic feet) and a cruciform tail.

Voliris V900. Source: Eric Faure, “The scientific use of airships”
The V900 airship was assembled in the historic former exhibition Hangar Y at Chalet Meudon near Paris. Craftsmen installed a suspended gondola made from a converted helicopter cockpit to complete the airship. The aerostatic center of Meudon was created in 1793 for hydrogen balloons. Hangar Y originally was built for a universal exhibition and hosted the airship La France in 1884. Thereafter, Hangar Y was disassembled and rebuilt at Meudon.

The V900 first flew in June 2003 from the Clermont-Ferrand airport. It operated for about four years, but was not developed into a commercial airship. Its maximum operating altitude was 1,000 meters (3,281 ft).


3. The V901-series prototypes

The V901 was the first hybrid airship created by Voliris. The 33 meter (108 ft) long, three-lobe gas envelope, with a nominal volume of 906 cubic meters (31,995 cubic feet), was designed to vary its volume by up to 20% with a patented mechanical “tightening module” inside the envelope. This gave the airship the ability to mechanically control shape and buoyancy. It was trimmed to be heavier-than-air on the ground. The gas envelope for this hybrid airship was designed to generate aerodynamic lift in flight.
In this section, we’ll take a look at three different hybrid airship configurations, V901C, V901D and V901RC, and the variable volume patents for the V901-series airships. All are classified in France as ULM (ultra-light motorized) airships and are limited to 100 hp.

**V901C**

The 901C made its first flight on 3 July 2012. You can watch a short (4:15 minutes) video of this flight here: https://www.youtube.com/watch?v=SB5ySwh9Uv4&feature=emb_log

![Voliris 901C. Source: Voliris](image)

Close-up of the Voliris 901C gondola and tailplanes at takeoff. Source: Voliris
V901C at takeoff. Source: Voliris.

Voliris 901C head-on view highlighting the tri-lobe envelope design. Source: Naval Airship Assoc., Noon Balloon, Winter 2012
V901C in-flight profile view. Source: Voliris.

V901C suspended gondola. Source: Voliris.
The V901D is readily identifiable by its cruciform tail fins. Its early testing program included operational tests of an automated flight system of airship piloting. It remains in operation as a flying testbed. You can watch a short (9:08 minutes) video of a V901D flight here: https://www.youtube.com/watch?v=wxMeyAu_n2s

Manned V901D, with a cruciform tail at takeoff. Source: Voliris.

V901D on landing approach. Source: Voliris.
**V901RC**

A smaller, remotely controlled version of the “D” model, the V901RC, made its maiden flight in 2012, followed by a two year test program to continue developing the automation features needed for future unmanned cargo airships. One goal of the 60 m$^3$ (2,119 ft$^3$) V901RC was to gather flight data to support Voliris in determining the flight characteristics and performance of the planned 900 m$^3$ (31,783 ft$^3$) cargo airship. The testing program enabled Voliris to refine the aerodynamic, mechanical and automatic piloting features of the planned future V930 container transport airship. The V901RC remains in operation as a flying testbed.

You can watch a short (1:47 minutes) Voliris video of a V901RC test flight here: [https://www.youtube.com/watch?v=qT_SwI2-XZo&t=4s](https://www.youtube.com/watch?v=qT_SwI2-XZo&t=4s)

The following views on the V901RC in flight are screenshots from that video.
V901RC. Source, both photos: Screenshots from Voliris video.
Voliris patents for the V901-series airships


- Filed: 7 March 2012,
- Granted: 18 August 2015

This patent describes an airship design and a means to control a variable-geometry gas envelope, enabling various configurations to be achieved on the ground and in flight. This feature enables an airship to be optimized in flight for ascent, descent and cruise. On the ground, this feature can enable an airship to be placed in a restricted-height hangar. The patent states, “The resulting hybrid aircraft can thus perform according to various flight configurations, sometimes like an aerostat (lighter-than-air) and sometimes like an aerodyne (heavier-than-air). Furthermore, the streamlined profile of the envelope, in the shape of a wing, makes it possible to reach speeds that are considerably higher than for a conventional, “cigar”-shaped aerostat.”

This patent was implemented in the tri-lobe Voliris V901-series of small airships and in the V930 heavy cargo airship concept.
Patent Figures 2A and 2B are transverse sections of a three-lobe gas envelope showing one example of geometry variation. In order to control the volume variations, two “adjustment regions” (4) are provided in this example, at the intersections between the central lobe (30) and the lateral lobes (31 and 32) of the envelope. In Figure 2B, the “adjustment regions” are tightened down relative to Figure 2A.

Patent Figure 3 is a longitudinal cross section of an “adjustment region” (4), showing the top and bottom longitudinal adjustment elements (5 & 6), the cable assembly and the tightening module (20). The tightening module (20) takes a tension on the cables to draw the adjustment elements (5 & 6) closer together, decreasing volume and buoyancy, or relaxes the tension on the cables to allow the adjustment elements to spring farther apart, increasing volume and buoyancy.

Voliris has tested the variable volume principle on a V901-series tri-lobe envelope of 900 m³, 33 meters long.

Test of the variable volume system on a tri-lobe envelope.
Source: Voliris
This invention also is addressed in the similar patent US2014/0054421A1, “Airship with a controlled variable profile”

- Filed: 7 March 2012,
- Granted: 18 August 2015

4. The V930 cargo airship concept

In this section, we’ll take a look at the V930 airship and the patent for the airship, its variable volume envelope and modular cargo handling system.

**V930**

In 2012, Voliris unveiled the design of a family of optionally-piloted, hybrid cargo-carrying airships based on the general planform of the V901’s long, three-lobe, variable volume gas envelope. The V930 was dubbed the “flying container project.” Basic characteristic of this cargo airship are as follows:

- Gas envelope nominal volume: 25,000 m³ (882,867 ft³), which corresponds to the capacity of one liquid helium container.
- Envelope volume is adjustable by about 20% to manage buoyancy.
- Designed to transport a standard 40 foot (12.2 m) long 32T container weighing up to 30 metric tons (33 short tons)
- Container Mover and Landing Gear (CMLG) module provides simple cargo container loading and unloading. CMLG also serves as the landing gear for the airship.
- No ballast exchange needed when loading or unloading cargo.
- Maximum takeoff weight: 35 metric tons (38.5 short tons)
- Six propellers; maximum 2,000 shp (1,491 kW)
- Airspeed: maximum 150 kph (93 mph)
- Short takeoff and landing (STOL) on unprepared runways of approximately 800 m (2,625 ft) length
The entire V930 airship was designed to be transported in 10 x ISO 40 ft (12.2 m) containers and assembled at the destination.

Voliris later discontinued work on the V930 and focused its heavy-lift design work on the more promising V932, which is based on the V902 buoyant delta wing planform.

V930 general arrangement. Source: adapted from Voliris.

Rendering of a V930 in flight. Source: Voliris.
Rendering of a V930 in flight showing cargo container.
Source: Voliris

Container Mover and Landing Gear (CMLG) for the V930.
Source: Voliris
(Top) Overhead view of the Voliris 930 30 metric ton cargo airship, (Bottom) A smaller variant. Source: Voliris
Voliris patent for the V930 airship and modular cargo system

Patent US2014/0255139A1, “Method and system for transporting containers by modular aircraft”

- Filed: 1 October 2012
- Published: 11 September 2014

This patent describes a system for transporting standard containers and allowing goods to be delivered in large quantities to sites that are not serviced by conventional modes of transportation such as road transport, train, or where no airport infrastructure is available. The patent describes a variable geometry airship that can serve as a fuel-efficient transport vehicle for transporting large loads and can be automated.

![Figure 2](image2.jpg)

![Figure 3](image3.jpg)
Patent Figure 2 shows the general arrangement of the Voliris V930 cargo airship design concept. The hull forms a long, slender lifting body that contributes substantial aerodynamic lift in flight. Patent Figure 3 shows the same type of variable geometry control as Voliris used on its V901-series of airships.

Patent Figure 5 is a transverse cross-section at an engine location, highlighting the relative sizes of three-lobe gas envelope. The lobes are connected internally and form a single inflation chamber.

![Figure 5](image)

Patent Figure 4B shows a modular cargo container carrier (30), known as the Container Mover and Landing Gear (CMLG), attached under the central lobe of the airship. A manned gondola could be carried in place of the cargo carrier.

![Figure 4b](image)
5. The V902 buoyant wing

The next step in development was the V902, which was a small, hybrid, semi-buoyant airship with a broad gas envelope that resembled an inflated delta wing. This design offered greater aerodynamic lift than the slender V901. In this section, we’ll take a look at several variants of the buoyant wing airship design: V902ULM, V902RC, V932 NATAC and Sea Bird.

**V902ULM**

The original piloted V902ULM, with a 30 cubic meter (1,060 cubic feet) gas envelope, holds the Guinness World Record as the world’s smallest airship. You can watch a short (2:27 minutes) video of this Guinness record flight here: https://www.youtube.com/watch?v=xOJvtaiNp5c

![Original V902ULM. Source: Mooceur via Wikipedia](image)

**V902RC**

The V902RC was a remotely-controlled adaptation of the V902 design used to test cargo-carrying configurations. The V902RC was
modified to become a 1/7-scale demonstrator (the V902 Mini) for a future heavy cargo airship to be known as NATAC.

The propulsion and cargo handling systems and landing gear were integrated in a framework that was suspended under the buoyant gas envelope. A container gripping module (CGM) was developed to facilitate attaching and carrying cargo containers. The modified V902 Mini, also known as the mini-NATAC, made its maiden flight on 30 August 2017. It demonstrated stable flight and confirmed the utility of the twin nacelle design and the cargo suspension system. You can view a short video of this flight testing here: https://www.youtube.com/watch?v=lQ86ytiuT70

The V902RC remains in operation as a flying testbed.
6. The V932 NATAC (Automatic Container Transport by Air Shuttle)

Voliris currently is focused on developing an optionally-piloted, autonomous cargo airship designed to carry one 40-foot (12.2 m) long, standard 32T international freight shipping container. Such containers are widely used in ground transportation. However, there are areas where logistical infrastructure does not exist or does not offer satisfactory quality and safety for ground transportation. For such cases, Voliris is developing the Automatic Container Transport by Air Shuttle (NATAC) to ferry a shipping container between two locations.

The unmanned NATAC V932 hybrid airship, shown in the following graphic, and the V902 Mini share the same general configuration.

![Concept drawing of an NATAC V932 hybrid airship on the ground, connected to a mooring mast. Note the suspension lines connecting the engine and landing gear nacelles to the buoyant envelope. Source: Voliris](image)

NATAC offers the following operational characteristics

- Transport a standard 40 foot (12.2 m) long 32T container weighing up to 30.5 metric tons (33.6 short tons)
• Simple cargo container loading and unloading with the container gripping module (CGM) on the airship
• No ballast exchange is needed during a load exchange.
• Takeoff and landing on unprepared runways of approximately 800 m (2,625 ft) length
• On the ground, only a single operator is needed to provide assistance during takeoff and landing approach
• Optionally-piloted or autonomous flying at low altitude and low speed
• Range of about 1,000 kilometers (621 miles)
• Unhijackable control system
• Able to operate in segregated air corridors

NATAC 5-lobe gas envelope, top view. Source: Voliris
Voliris describes the design of the NATAc 5-lobe gas envelope as follows:

“The truly original component of this flying machine is the 5-lobe envelope wing and its dynamic pressure regulation system. With a variable volume between 22,000 and 40,000 m³, it provides aerostatic lift of approximately 25 tonnes and aerodynamic lift, with a fineness (ratio) of 5.5, allowing 55 tonnes to be lifted with 10 tonnes of thrust (from the engines).

The twin beam and its payload are attached below by hangers, (with loads being) taken inside by a lacing system controlled by servomotors.

As the atmospheric pressure decreases with altitude, and therefore the volume of gas is multiplied by 1.45, the shape drag increases with the volume. At low altitude, it is therefore important that the envelope is as thin as possible.”

Voliris plans to ground test a fill size NATAc gas envelope installed next to its hangar at the Aérodrome de Moulins. Estimated cost for this ground test is about 4 million Euros.

Rendering of the inside of a five-lobe gas envelope showing the lacing in the adjustment regions between lobes (left) and a servomotor (right) Source: Voliris
Details of the NATA C engine and landing gear nacelles and a centerline mounted standard 32T shipping container engaged by a container gripping module (CGM).
Source: Voliris

Truck unloading a standard 32T shipping container directly onto the airship. Source: Voliris
Voliris describes an NATAC mission as follows:

“Once NATAC has been programmed, it is limited to back and forth journeys from a given departure base to a given destination base. NATAC adapts to different wind directions as long as weather condition are within the limits defined by the test pilot who did the programming. On arrival, the operator needs to check that the runway is clear. He can order the machine to make 360° rounds above a safety altitude to clear the runway if necessary.

NATAC sends its position by satellite, but is not radio-controlled during the flight. This is an important feature to prevent misuse or terrorist hijack. The trajectory is defined according to a license granted by the government. As many waypoints as necessary can be programmed on the trajectory which does not necessarily need to be a straight line.”

You can watch a video of an NATAC mission here: [http://voliris.com/flying-container-project/](http://voliris.com/flying-container-project/)

![Concept drawing of an NATAC V932 hybrid airship in flight. Source: Voliris](image)

In May 2018, the Voliris team made a presentation on the NATAC concept to the French Army as a means to automatically deliver a 30 metric ton (33 short tons) payload to a destination 500 km (311 miles) away.
Voliris is offering a hydrogen fueled version of the NATAC. You'll find this and other autonomous and piloted NATAC versions described in the Voliris NATAC brochure, which is available online here (in French): https://voliris.com/brochure-natac-h2/

Renderings of the NATAC piloted cargo module. Source: Voliris
Renderings of the NATAC piloted passenger module. Source: Voliris

Front view (left), back view (right), interior view (below)
7. The SeaBird – a maritime adaptation of the NATAC

Seabird is a marine adaptation of the NATAC V932 hybrid airship. It was unveiled at the Monaco Yacht Show in September 2019. As shown in the following sequence of Voliris graphics, the slow flight capability of the SeaBird enables it to approach and land on a small deck on an underway ship at sea and then be moored to the ship.

Renderings of SeaBird with piloted passenger module.
Source, both graphics: Voliris
Renderings of SeaBird with piloted passenger module.
Source, both graphics: Voliris
8. For more information