

Prospective Concepts AG – Stingray semi-buoyant aircraft

Peter Lobner, 11 February 2022

1. Introduction

Prospective Concepts AG (PC) was incorporated in 1994 by Andreas Reinhard in St. Stephan, Bern, Switzerland. The firm

The logo for Prospective Concepts, featuring the words "prospective concepts" in a lowercase, sans-serif font. The word "prospective" is in a lighter grey color, and "concepts" is in a darker grey color.

described itself as “...an ideas

and innovation laboratory. From the outset, various innovation projects focusing on ‘use of air’ and ‘movement in the air’ were implemented.” One such project was the Stingray semi-rigid, inflated wing, light aircraft, which was developed with support from the German pneumatics company Festo AG.

The trademark “Stingray” was assigned to Prospective Concepts AG by the European Union Intellectual Property Office (EUIPO), based on Application Number #000360230, dated 18 July 1996.

Prospective Concepts AG built a modern hangar facility at St. Stephan airfield, where their pneumatic prototypes were developed and flown. From 1995 through 2000, the Stingray completed over 300 test flights in St. Stephan in the Bernese Alps and in Hradcany, Czech Republic.

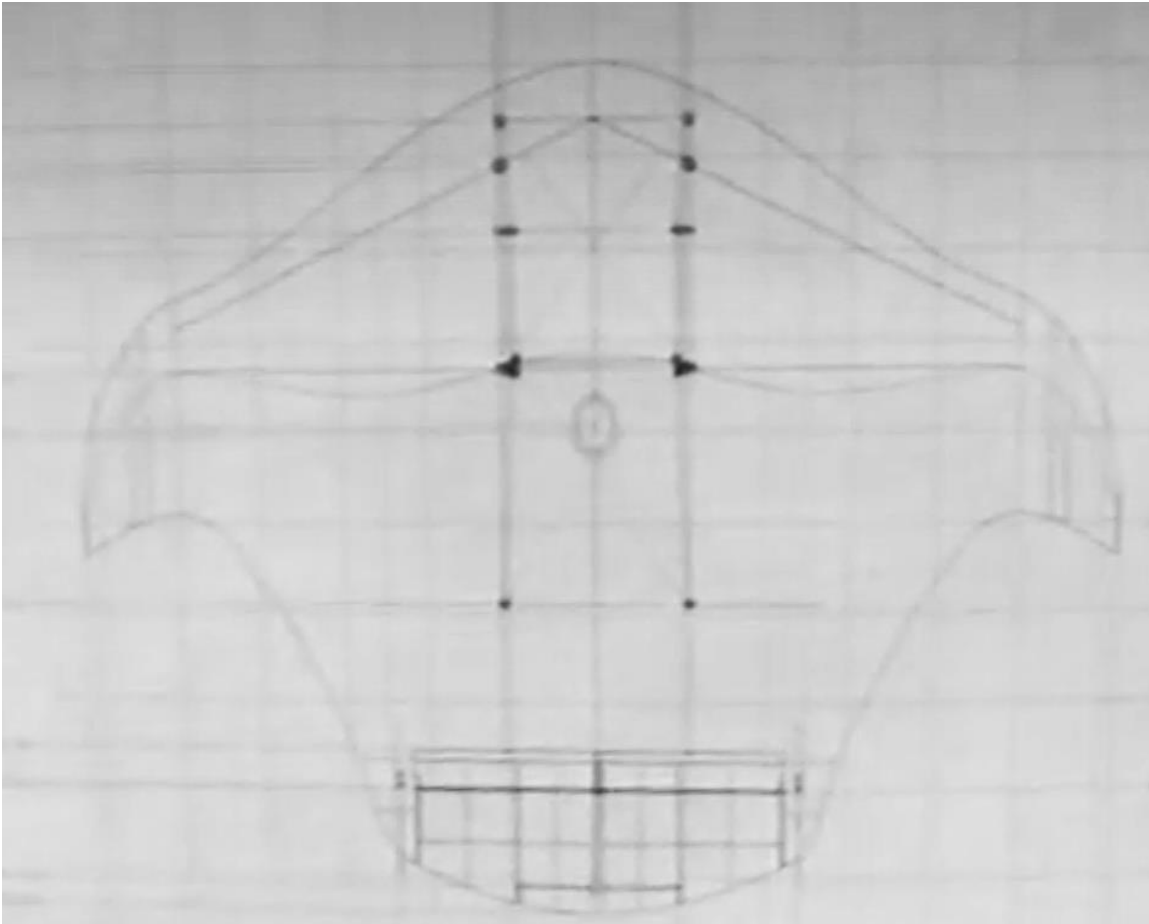
When Prospective Concepts AG was liquidated in 2009, one of their development partners, Lantal Textiles, took over responsibility for PC’s advanced aviation textile applications. PC’s research activities in the area of “tensairity” in pneumatic load-bearing structures were transferred to a newly founded “Center for Synergetic Structures” at Empa, a research establishment forming part of the Swiss Institute of Technology ETH. A successor firm, Prospective Concepts Aeronautics AG (<http://www.p-c-a.ch/index.html>) acquired PC’s facilities at St. Stephan airfield and continues to operate out of that airfield. They are not involved in further development of Stingray.

The legacy Prospective Concepts AG website is here:
http://www.prospective-concepts.ch/html/site_en.htm

2. The Stingray inflated wing light aircraft

Stingray is a semi-rigid, inflated wing aircraft with a load-bearing frame made of mechanically-joined carbon fiber tubing. The flexible, fabric inflated wing is designed for installation of this rigid carbon fiber structure after the wing has been manufactured and tested.

As shown in the following diagram, two carbon fiber longerons are attached to two chord-wise wing spars to form the primary rigid, load-bearing structure that carries the aerodynamic loads from the wing and supports a suspended gondola with attached engines. A carbon fiber tail assembly is attached and supported from the aft end of the carbon fiber longerons.



Plan view of Stingray, showing the outline of the aircraft and the internal rigid carbon fiber structure. An access port from the bottom of the wing is shown near the geometric center of the of the aircraft.

Source: Screenshot from video, Stingray Part 2 (2020)



Mechanically-joined wing spars (with endplate in the background) and longerons, with vertical supports for the gondola being installed.



*Closeup of mechanical joint for wing spar (foreground) and starboard longeron, with an attachment point for one vertical gondola support.
Source, both photos: Screenshots from video, Stingray Part 2 (2020)*



The aft end of the carbon fiber frame, from the aft wing spar (right side) to the attachment points for the tailplane assembly.



Partially completed carbon fiber tailplane assembly.

Source, both photos: Screenshots from video, Stingray Part 2 (2020)

The Stingray's wing derives much of its rigidity from compressed gas, initially air and later helium. The first air inflation test of the Stingray's pneumatic wing was conducted on 17 Feb 1995 at PC's workshop in Burgdorf, before integration with the rigid carbon fiber internal

structure. The wing was designed to operate with a low internal pressure of 0.290 to 0.725 psi (0.02 to 0.05 x 10⁵ N/m²).



*Stingray wing 1st inflation test on 17 Feb 1995. The tips of the wing are terminated with an endplate through which the spars will pass and to which wingtips will be attached later.
Source: Prospective Concepts AG video (1995)*



*A later inflation test.
Source: Screenshots from video, Stingray Part 2 (2020)*

General characteristics of the Stingray semi-buoyant aircraft

Parameter	Stingray
Wingspan	13 m (42.6 ft)
Length	9.4 m (30.8 ft)
Volume	68 m ³ (2,401 ft ³)
Wing area	70 m ² (742 ft ²)
Power	2 x 47.7 kW (64 hp) each
Max. takeoff weight	840 kg (1,852 lb)
Differential pressure	20 to 50 mb (0.290 to 0.725 psi)
g-load	4.5 g
Take off speed	47 kph (29 mph)
Cruising speed	130 kph (81 mph)
Vertical speed	2.5 m/s (8.2 ft/s)



*The completed Stingray in its hangar.
Source: Prospective Concepts AG*

Stingray test flights measured the aircraft's aerodynamics and flight characteristics, with a focus on analyzing the reaction of the pneumatic textile structures to different forces in flight. PC reported, "In the field of measurement instrumentation, new grounds were broken, too: due to a stereo photogrammetrical method, the aeroelastic deformation of the flying Stingray could be captured with an accuracy of a few millimeters from an escort helicopter. In order to capture the data, a system was developed, which is now available on the market as MSR (modular signal recorder)."

(<https://www.msr.ch/en/>)



Bow-on view of Stingray. The tubular carbon fiber longerons extend through the leading edge of the inflated wing. Note the small ailerons near the wingtips and the simple landing gear.

Source: Prospective Concepts AG



*Stingray test flight in the Bernese Alps.
Source: Prospective Concepts AG*



*Stingray test flight. Source: Screenshot from Prospective Concepts
AG video (1995)*



*Stingray on landing approach at St. Stephan airfield.
Note the yellow ailerons and the split elevator with trim tabs.
Source: Prospective Concepts AG brochure*



*Stingray on final approach, just before touchdown.
Source: Prospective Concepts AG brochure*



*Stingray on the ground with elevators fully extended.
Source: Prospective Concepts AG brochure*

3. Beyond Stingray

With support from Festo, Prospective Concepts planned to develop a significantly larger successor to the Stingray. This semi-buoyant aircraft would have had the following features:

- Approximately twice as large as Stingray.
- 25 percent of total lift would have been aerostatic lift from helium lifting gas in the wing.
- Designed to carry passengers.
- An electrically-powered ducted fan propulsion system and the crew / passenger cabin were integrated into the load-bearing structure and located within the inflated wing.
- Multifunctional landing gear for operating from various surfaces.

Unfortunately, Prospective Concepts was liquidated in 2009, before these development plans could be realized.

4. For more information

- “Flying Stingray,” Prospective Concepts AG:
http://www.prospective-concepts.ch/pdf/projekte/stingray_en.pdf
- Roland Escher, “Prospective Concepts AG,” Airship and Blimp Resources, 2003:
<http://www.myairship.com/database/prospect.html>
- Joep Breuer, Wubbo Ockels & Rolf Luchsinger, “An inflatable wing using the principle of Tensairity,” conference paper, 48th AIAA Structures, Structural Dynamics and Materials Conference, Apr 2007:
https://www.researchgate.net/publication/40631756_An_inflatable_wing_using_the_principle_of_Tensairity/figures?lo=1
- “Prospective Concepts Stingray,” All-Aero.com, 2021: <http://all-aero.com/index.php/contactus/54-planes-p-q-e-r-s/8463-prospective-concepts-stingray>

Video

- “1st Inflation of the prototype wing of Stingray,” (9:51 minutes); test performed on 17 Feb 1995 in Burgdorf, Switzerland; video posted in 2012:
<https://www.youtube.com/watch?v=ZGFI5vCUyI0>
- “Stingray inflatable aircraft, from Prospective Concepts (1995),” (0:26 minutes), posted November 2012:
<https://www.youtube.com/watch?v=scKR8j5Izqw>
- “The Swiss experimental inflatable aircraft Stingray (part 1),” (12:58 minutes), insultantable, 15 November 2020:
<https://www.youtube.com/watch?v=4jJQG7tC5aM>
- “The Swiss experimental inflatable aircraft Stingray (part 2),” (12:58 minutes), insultantable, 17 November 2020:
<https://www.youtube.com/watch?v=eYYfOcjIHcc>

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- *Modern Airships - Part 1*: <https://lynceans.org/all-posts/modern-airships-part-1/>
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