

Airship Industries Ltd.

Peter Lobner, updated 3 September 2022

1. Introduction

The life cycle of the UK firm Airship Industries, with its many linkages to predecessor and successor firms, is a complex tale that is outlined step-by-step in this section.

Aerospace Developments (1970 – June 1979)

Jeffrey R. (Roger) Munk and John Wood founded the UK firm Aerospace Developments (AD) in 1970 and the giant Shell methane gas transporter rigid airship became the firm's first major project until it was cancelled in 1974. You'll find details on this novel airship project in my separate article on the Shell-AD methane gas transporter.

In 1975, Roger Munk reported that AD was examining the business potential for "nonrigid, advanced technology airships in the half to ten ton payload range" for "general freight, surveying and airborne jeep" applications. A year later, Venezuelan company Aerovision had signed a contract with AD to construct and deliver in 1977 the first airship from an order for 22 airships, in a range of sizes and payload capacities, that would be delivered over a period of 10 years. The business plan was for airship production to start in the UK and be transferred later to Venezuela.

Starting in 1976, AD developed and built the first blimp, designated AD-500, which now is generally credited to be the first modern blimp because it introduced the use of vectored thrust propulsors, modern envelope materials, and lightweight composite materials in various structural components (monocoque gondola, nose cap, tail fins). The AD-500 was assembled at Cardington and made its first flight on 3 February 1979. A month later, it was severely damaged while moored outdoors during a sustained windstorm. AD's Venezuelan sponsor, Aerovision, subsequently withdrew its financial support, forcing the liquidation of AD assets on 8 June 1979.

Airship Developments, Ltd. (September 1979 – May 1980)

In September 1979, Roger Munk founded the firm Airship Developments, Ltd. (another “AD”) and acquired the liquidated assets of his former AD firm, including the AD-500 design and the damaged airship, which was not rebuilt. Between 1979 and 1980, “new” AD built on “old” AD’s previous work for Aerovision and developed ambitious plans for the following family of nonrigid airships:

- **AD15:** a small remotely piloted surveillance vehicle with an envelope volume of 150 m³ (5,300 ft³)
- **AD100:** a small utility blimp with an envelope volume of 1,000 m³ (35,000 ft³)
- **AD500:** a rebuilt version of the original AD-500 prototype, which had an envelope volume 5,153 m³ (182,000 ft³)
- **AD600:** an enlarged AD500 with an envelope volume of 6,000 m³ (210,000 ft³)
- **AD5000:** an extremely large airship with an envelope volume of 50,000 m³ (1,800,000 ft³) and a payload capacity of over 20 metric tons (22 tons). Had it been built, this would have been the largest nonrigid airship in the world, with about 22% greater envelope volume than the US Navy’s Goodyear ZPG-3W that retired from service in 1962.

Munk’s AD firms had been involved with the UK firm Mercantile Airship Transportation Limited (MAST) and its successor, Thermo-Skyships Limited (TSL), since about 1976. In May 1980, TSL acquired Munk’s second “AD” firm for £1 million.

Airship Industries Ltd. (May 1980 – September 1990)

A goal for this acquisition was to form a single firm that was large enough to produce a large rigid airship and a smaller nonrigid airship. In July 1980, TSL changed the name of the newly merged firm to Airship Industries Limited (AI).

During the next two years, AI resources were divided between nonrigid and rigid airship projects. Roger Munk led the development of the Skyship 500 nonrigid airship, which was based on the AD-500

and made its first flight on 18 September 1981. Meanwhile, the AI rigid airship team, under Major Malcolm Wren, was developing designs for two quite different, large rigid airships:

- **R40 / R130** (two designations for the same airship): a conventional rigid airship with a metal framework hull and a fabric envelope enclosing lift gas cells at atmospheric pressure.
- **R150**: a metal-clad rigid airship with a metal framework hull.

While there was significant interest from FedEx and Redcoat Air Cargo, no contracts were placed for rigid airships. Development of Wren's Thermo-Skyship hybrid thermal airship ended during this period. You'll find more information on this airship in my separate article on Thermo-Skyships Ltd. (TSL).

Airship Industries was in significant financial difficulty in 1982. While the firm worked to restructure its debt, it benefitted from investments from several sources. A 1983 UNIDO report described AI's financial situation as follows:

“The Royal Bank of Canada has invested in the company and Economic Regional Wallone (ERW), a Belgian regional development agency, has acquired 4% of the equity capital. Negotiations with ERW on a major £3 million investment, worth 39% of the present equity capital, are in progress, as are discussions with a number of other First World governments. In July 1982, the European Energy Commission awarded the company a grant of £313,000 for the demonstration of the fuel efficiency of the Skyship 500.”

In late 1982, a “de-merger” was agreed, and the former TSL rigid airship technical and management team left AI to form Wren Skyships, Ltd. on the Isle of Man with, of course, Malcolm Wren serving as Managing Director. Their focus was on developing the R.30 and the RS.1 metal-clad rigid airships. You'll find more information in my separate article on Wren Skyships Ltd.

The remainder of the AI staff continued under Roger Munk's leadership and focused on the development and sale of the nonrigid Skyship 500, 500HL and 600 airships. AI manufactured some

Skyships at Cardington, while others were manufactured in Toronto, Tokyo and in the USA. A total of 16 Skyship airships were manufactured between 1980 – 1990.

Westinghouse–Airship Industries (WAI) (1985 – September 1990)

In early 1985, AI teamed with Westinghouse and formed Westinghouse–Airship Industries (WAI) to bid on a US Navy contract to design and develop the giant Sentinel 5000 (military designation YEZ-2A) airborne early warning (AEW) airship. On 5 June 1987, the WAI team won the competition for the Sentinel 5000 and was awarded a \$168.9 million contract to build a subscale Operational Development Model (ODM), which became known as the Sentinel 1000. On this team, AI was responsible for the airship and Westinghouse was responsible for the AEW systems and other mission systems. If the Sentinel 1000 ODM was successful, the team expected an order for 40 to 50 production Sentinel 5000 airships.

After successfully developing the military version, AI planned to develop a civilian passenger version known as the Skyship 5000.

The Sentinel 5000 project did not go smoothly. The Navy funded the program for only two years before funding was cut from the fiscal year 1989 defense budget. Congress later authorized continuing funding via the Defense Advanced Research Projects Agency (DARPA) to enable work on the Sentinel 1000 ODM to continue.

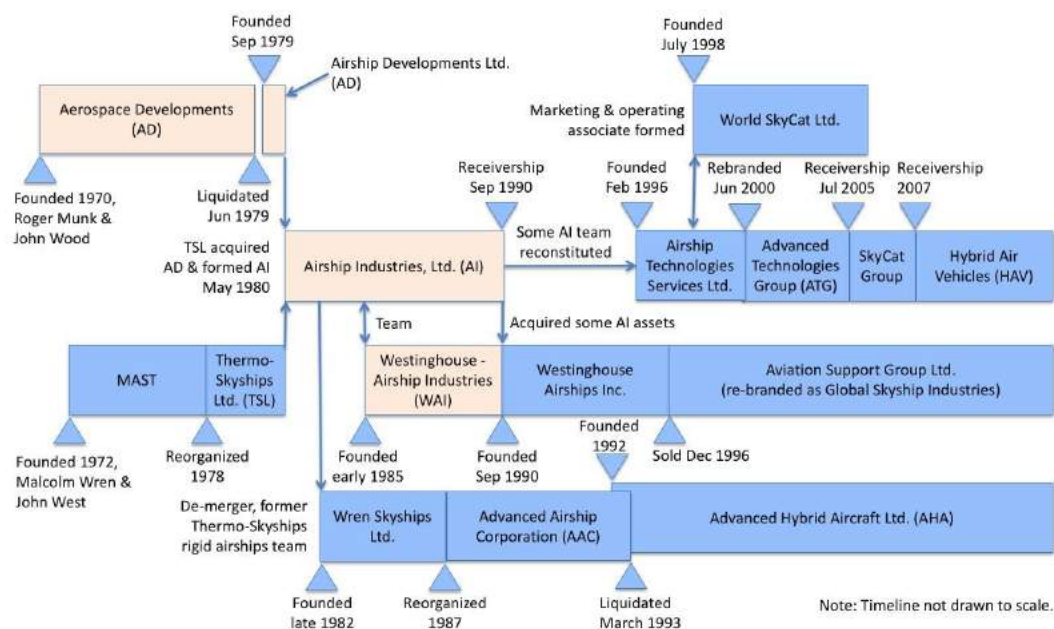
After three successive years of financial losses, Airship Industries ceased trading on the stock exchange in August 1990 and went into receivership in September 1990, resulting in the end of Airship Industries and the WAI partnership.

After the collapse of Airship Industries in 1990

Westinghouse regrouped, hired the former AI team members, and formed a new entity, Westinghouse Airships Inc. (also known as WAI), to execute the balance of the Sentinel contract and complete the Sentinel 1000 ODM airship. As part of the business settlement with Airship Industries, Westinghouse acquired rights to military variants of the Skyship airships.

UK firm Slingsby acquired rights to the civil versions of the Skyship 500, 500HL and 600, except in North America where Airship International held those rights as the appointed agent. The rights held by Airship International subsequently passed to the firm Airship Management Services (AMS). The 500HL and 600 type certificates held by Slingsby were acquired by Westinghouse in 1993.

When the Sentinel airship project was cancelled in late 1995, Roger Munk and former AI team members left Westinghouse Airships Inc. and formed Airship Technologies Services Ltd. in February 1996. This firm was rebranded in June 2000 as Advanced Technologies Group (ATG), which became well known primarily for two advanced airship projects: the SkyCat hybrid, heavy-lift airship and the StratSat stratospheric High Altitude Platform (HAP) for telecommunications. ATG also built the small AT-10 high-technology blimp and developed the design concept for the Condor high altitude surveillance airship derived from the SkyCat hybrid airship design.



Roadmap to airship firms managed or strongly influenced by M.W. Wren and Roger Munk, highlighting AD and Airship Industries.

The balance of this article addresses the AD-500 modern blimp prototype, the R40 / R130 and the R150 rigid airship design concepts, the series-produced Skyship 500, 500HL and 600 blimps, the Navy's Sentinel 1000 / 5000 program through 1990, and AI's concept for a civil derivative, the Skyship 5000. The conclusion of the Sentinel 1000 / 5000 program, from 1990 to 1995, is covered in a separate article on the US Navy's YEZ-2A program.

2. The Aerospace Developments AD-500

Design work on the nonrigid AD-500 blimp started in 1976. This blimp is generally credited with being the first modern blimp because it introduced several features that have since become commonplace in modern airships:

- Vectored thrust propulsors
- Modern envelope materials (lightweight skin of polyester and polyurethane with an inner Mylar gasproof membrane)
- Lightweight composite material structures (gondola, nose cone, tail fins)
- Kevlar suspension cables supporting the gondola



AD-500 (G-BECE) on a mobile mast outside the Cardington sheds. Source: Airships Online



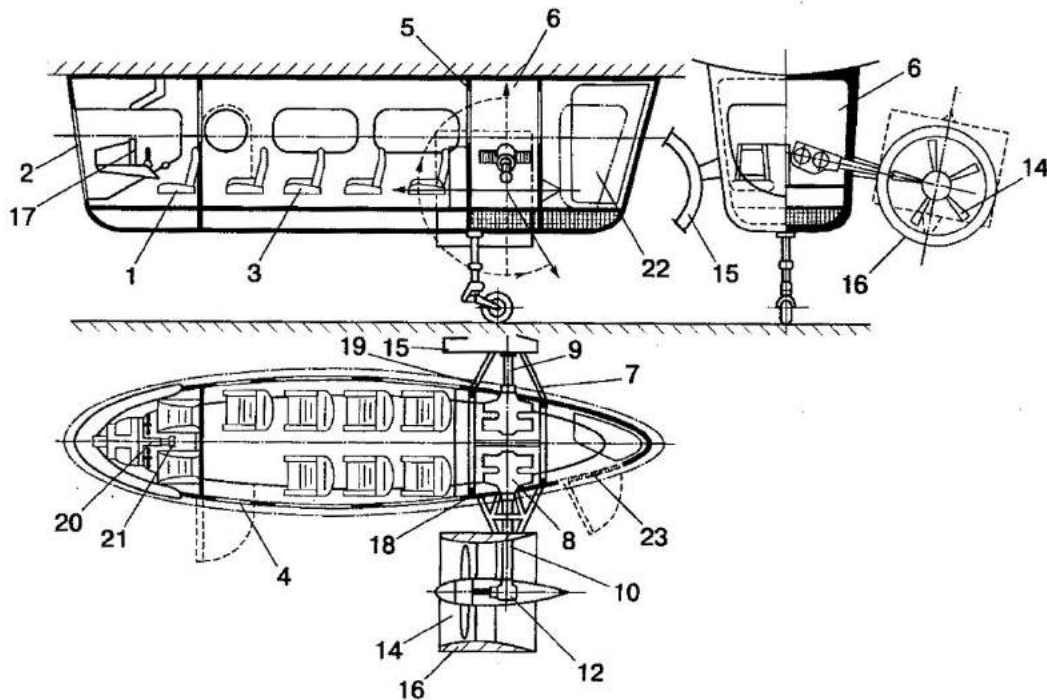
Ducted fans supported from the gondola can be tilted in the pitch plane from 90° up to 120° down to drive the airship up or down while maneuvering during takeoff and landing. During cruise flight, the ducted fans are aligned horizontally to provide forward propulsion.



The 30 ft (9.1 m) composite, monocoque gondola was manufactured by Vickers–Slingsby from molded Kevlar-reinforced plastic.

Source, both photos: Airships Online

The AD-500 was assembled in Hangar #1 at Cardington and, on 3 February 1979, G-BECE made its first flight with a vectored thrust takeoff at a steep angle.



Legend: 1 - pilot's seat; 2 – windshield; 3 - passenger seats; 4 – cabin door;
 5 - bulkhead-partition; 6 - engine compartment; 7 & 8 - engines;
 9 & 10 - transmission shafts; 11 & 12 – reduction gear; 13 & 14 - five-bladed fans;
 15 & 16 — fan shrouds (fairings); 17 - pilot's steering wheel,
 18 & 19 - electric generators; 20 & 21 - engine controls;
 22 - fuel tank; 23 – hatch to aft compartment

AD-500 gondola configuration. Source: Boyko (2001)

A month later, after a test flight in windy conditions 8 March 1979, the AD-500 was severely damaged by sustained high winds while moored outside during a storm. The airship suffered damage to the nose cone and gondola and Roger Munk deflated the envelope by operating a previously untired “emergency rip” feature. The efforts to save the airship during the storm are described in detail on the Airship Heritage Trust website here:

<https://www.airshipsonline.com/airships/AD%20500/index.html>

AD’s Venezuelan sponsor, Aerovision, subsequently withdrew its financial support. In spite of very promising performance during early flight testing of their airship, AD was forced into liquidation on 8 June 1979.

General characteristics of the AD-500 blimp

Parameter	AD-500
Length, overall	52.0 m (170.6 ft)
Diameter, max.	14.0 m (45.9 ft)
Envelope volume	5,153 m ³ (182,000 ft ³)
Ballonet volume	1,280 m ³ (45,202 ft ³), 25% of envelope volume in two ballonets, fore & aft
Propulsion	2 x Porsche air-cooled engines rated @ 152 kW (204 shp), installed inside the gondola driving 2 x thrust vectoring (90° up, 120° down), shrouded 5-bladed, reversible propellers, attached via stub wings to the gondola.
Total lift	5,160 kg (11,376 lb)
Disposable lift	1,930 kg (4,255 lb)
Gondola dimensions	9.1 L x 2.4 W meters (30.0 L x 7.9 W ft)
Accommodations	2 crew and 8 passengers
Speed, max	101 kph (63 mph)
Speed, cruise	87 kph (54 mph) @ half-power
Altitude, max	3,050 m (10,000 ft) pressure altitude
Range	870 km (540 miles), still air
Service life	8 years



*Recovering the AD500 gondola after the storm.
Source: Airships Online*

3. R40 / R130 conventional rigid airship

In July 1980, AI announced plans for the civilian freight-carrying R40 / R130 rigid airship (two different designations appear to have been used for the same airship). Redcoat Air Cargo, a small UK cargo carrier, proposed acquiring four R40 / R130 airships by 1984. The R40 / R130 was a conventional rigid airship design with a metal framework hull structure and a fabric envelope enclosing lift gas cells at atmospheric pressure.

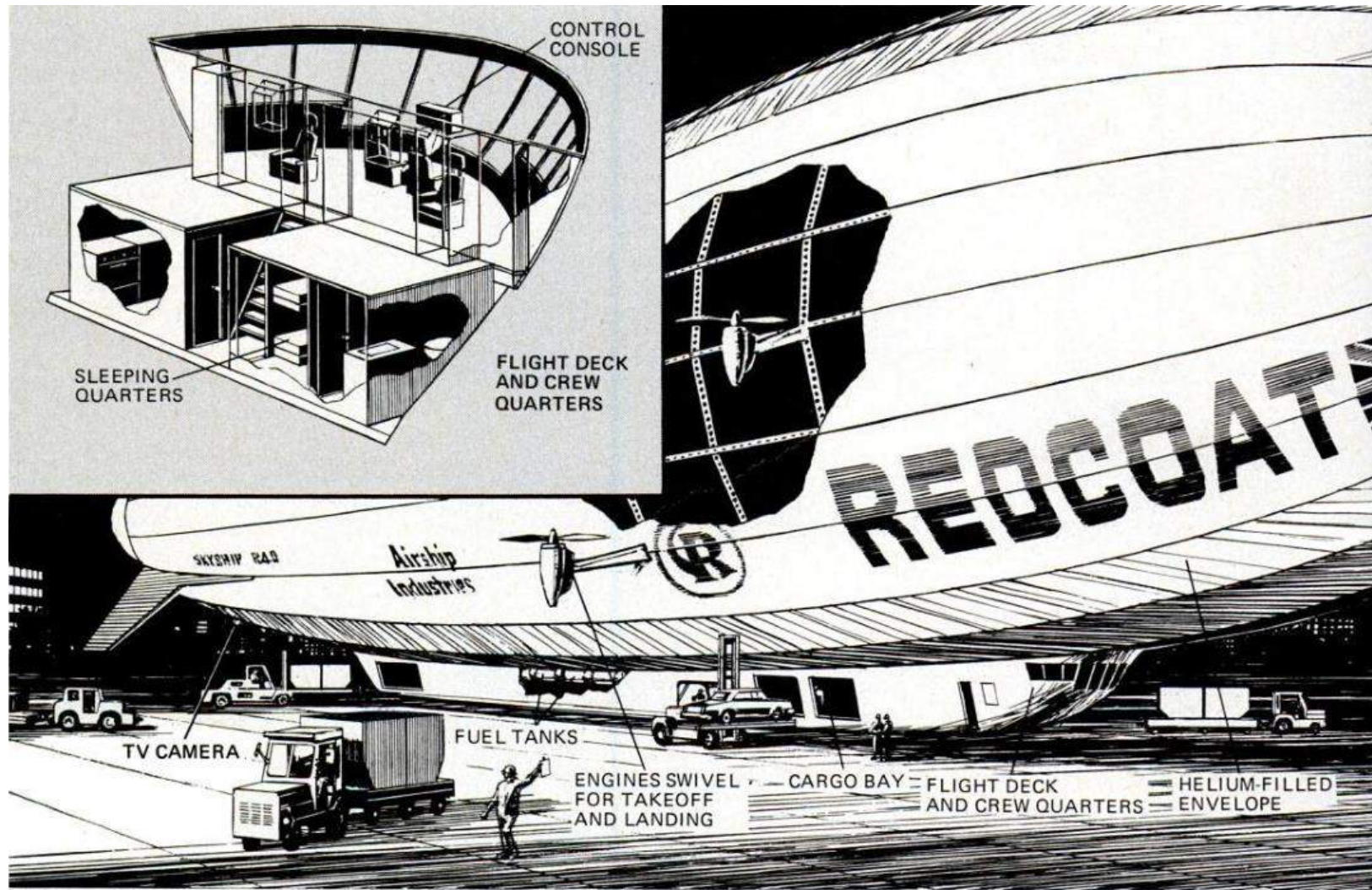
General characteristics of the R40 / R130 rigid airship

Parameter	R40 / R130
Type	Conventional rigid, fabric envelope
Length, overall	183 m (600 ft)
Diameter, max	36.6 m (120 ft)
Hull volume	120,000 m ³ (4,200,000 ft ³)
Internal pressure	Atmospheric
Propulsion	4 x Pratt & Whitney Canada PT6-50 turboprop engines rated @ 846 kW (1,135 shp) each.
Cargo compartment volume	1,170 m ³ (41,318 ft ³)
Payload, max	58 metric tons (63.8 tons)
Speed, max	137 kph (85 mph)
Operating altitude	900 m (2,953 ft)
Range	<ul style="list-style-type: none">• 800 km (497 miles) with max. payload• 3,200 km (1,988 miles) with a 45 metric ton (49.5 ton) payload

Redcoat Air Cargo switched their acquisition plans from the R40 / R130 to the R150 metal-clad rigid airship.



Rendering of Airship Industries R40 conventional rigid airship. Source: Abbot & Walmsley (1998)



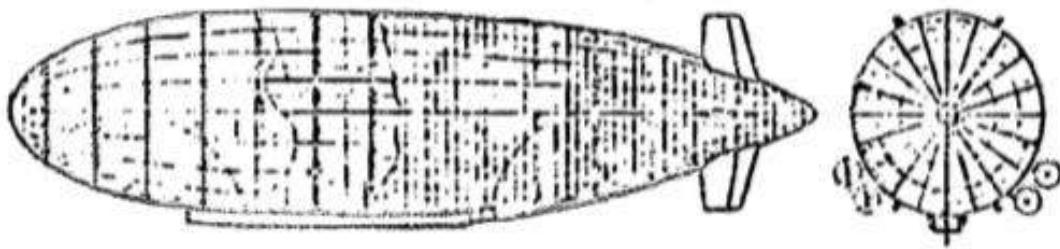
*Airship Industries R40 conventional rigid airship in Redcoat Air Cargo livery.
Source: Popular Mechanics, May 1981*

3. R150 metal-clad rigid airship

The R150 design was initiated in the early 1980s. This was a design concept for a large, metal-clad, rigid airship for civilian cargo applications and military applications such as strategic airlift, anti-submarine warfare (ASW), surveillance and patrol. It was similar in concept to the successful US Navy ZMC-2 metal-clad rigid airship built and first flown in 1929.

In a metal-clad airship, the sheet metal envelope is part of the monocoque load bearing structure that also serves as the gas-tight container for the helium lifting gas. There are no soft fabric or synthetic lift gas cells, as found in a conventional rigid airship. A slight internal helium pressure places the metal hull in tension, enabling it to carry greater bending and shear loads during flight.

Areas of the hull carrying concentrated loads (i.e., engines and cargo) are reinforced with frames that distribute the loads and maintain the circular hull cross-section. Longerons (longitudinal structural components) maintain the hull's structural integrity when the interior is at atmospheric pressure.



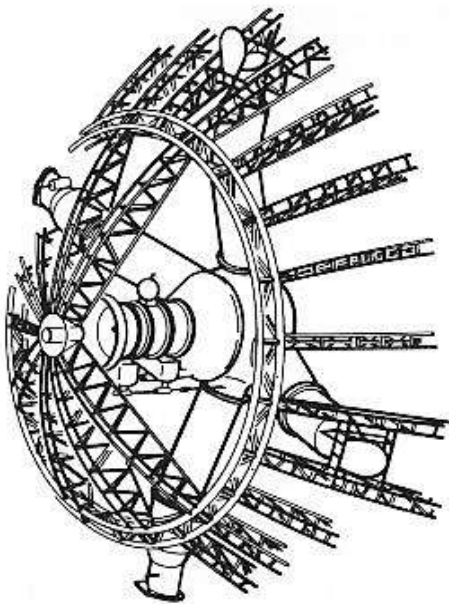
R150 general arrangement. Source: adapted from UNIDO (1983)

Work on the R150 was initiated by the Airship Industries rigid airship team headed by Major Malcolm Wren in response to requirements laid out by Redcoat Air Cargo. A 1983 UNIDO report described these requirements:

“Redcoat’s requirements specified that the airship should be able to carry a payload up to 75 (metric) tons over 1,000 nautical miles, or 46 (metric) tons over 4,000 nautical miles for

service to West Africa, the Middle East and Central America. The cruising speed should be variable between 63 – 85 knots – twice as fast as the fastest ocean freighters – depending on the range and application. The cargo to be carried was to range from machine parts to day-old chicks and low density cargos. The requirement also specified that the airship should be able to operate from relatively simple landing sites.”

R150 main propulsion was provided by four turboprop engines installed on vectoring stub wings extending from the hull and driving 5.5 m (18 ft) diameter feathering and reversing propellers. The vectoring stub wings and engines were in a horizontal position during cruise and could be pivoted to a vertical position for takeoff and landing. A natural gas (NG) fuel option was considered, with two NG cells inside the hull envelope. This reduced fuel cost, but also reduced maximum payload.



During cruise, flight control would be provided by elevators and rudders on the six tail fins. At airspeeds below 20 knots, flight control was aided by bow and stern thrusters, which each have five outlets to direct thrust up or down for pitch control, port or starboard for yaw control, and fore (bow thruster) / aft (stern thruster) along the longitudinal axis. The accompanying diagram shows a similar thruster configuration designed for the Wren Skyship RS.1.

Source: Airship Heritage Trust

Redcoat Air Cargo and Federal Express were two potential customers for the R150. Fed Ex had discussed acquiring a “training airship” and four R150s, with an option for 10 more. Redcoat estimated that the R150 could have cut their fuel costs by about one-third.

General characteristics of the R150 metal-clad rigid airship

Parameter	R150
Type	Rigid, aluminum alloy frame with aluminum alloy envelope
Length, overall	173.9 m (570.4 ft)
Diameter, max.	40.9 m (134.2 ft)
Hull volume	132,000 to 152,832 m ³ (5,397,215 ft ³)
Internal pressure	About 2 kilopascals (0.29 psi)
Lift gas volume, max	150,519 m ³ (5,316,526 ft ³)
Ballonet volume, max	21,238 m ³ (750,000 ft ³)
Propulsion and control	<ul style="list-style-type: none"> • 4 x Garrett TPE 331-5 turboprop engines rated @ 1,227 kW (1,645 shp) each, driving vectoring, 5.5 m (18 ft) diameter reversible propellers Total installed power: 4,908 kW (6,580 shp) • 1 x Allison 250-B28 turboshaft engine rated @ 373 kW (500 shp) driving an air compressor supplying the bow and stern 5-port thrusters
Weight, max takeoff	141,855 kg / 142 metric tons (312,736 lb / 156 tons)
Weight, disposable load	85,275 kg / 85.3 metric tons (188,000 lb / 94 tons)
Payload	44,452 kg / 44.5 metric tons (98,000 lb / 49 tons)
Weight, empty	56,307 kg (124,136 lb)
Speed, max	171 kph (92.3 knots)
Speed, cruise	164 kph (88.5 knots)
Range	Up to 21,773 km (13,529 mile)
Endurance	5 to 20 hours typical mission, 245 hours maximum

Fed Ex shelved their airship plans in late 1981. Redcoat went into voluntary liquidation in mid-1982 due to cash flow problems. This left AI without a customer for their rigid airship designs.

When the de-merger occurred in late-1982, the R150 project was abandoned along with preliminary plans for a larger rigid airship capable of carrying a 150 metric ton (165 ton) payload. Had it been built, the R150 would have been the largest airship since the 1930s, but still 25% smaller (by volume) than the LZ-129 Hindenburg. The newly formed firm Wren Skyships Ltd. subsequently developed designs for two smaller metal-clad rigid airships, the R.30 and the RS.1, based on the R150.

4. Skyship 500, 600 & 500HL

Starting in 1980, the Airship Industries nonrigid airship team, led by Roger Munk, used the AD-500 prototype design as the basis for their Skyship 500 series, which was scaled up later to produce the Skyship 600 series. A total of 16 Skyship airships were manufactured between 1980 – 1990: six Skyships 500s (two were later converted to 500 HLs), one original Skyship 500 HL, and nine Skyship 600s.



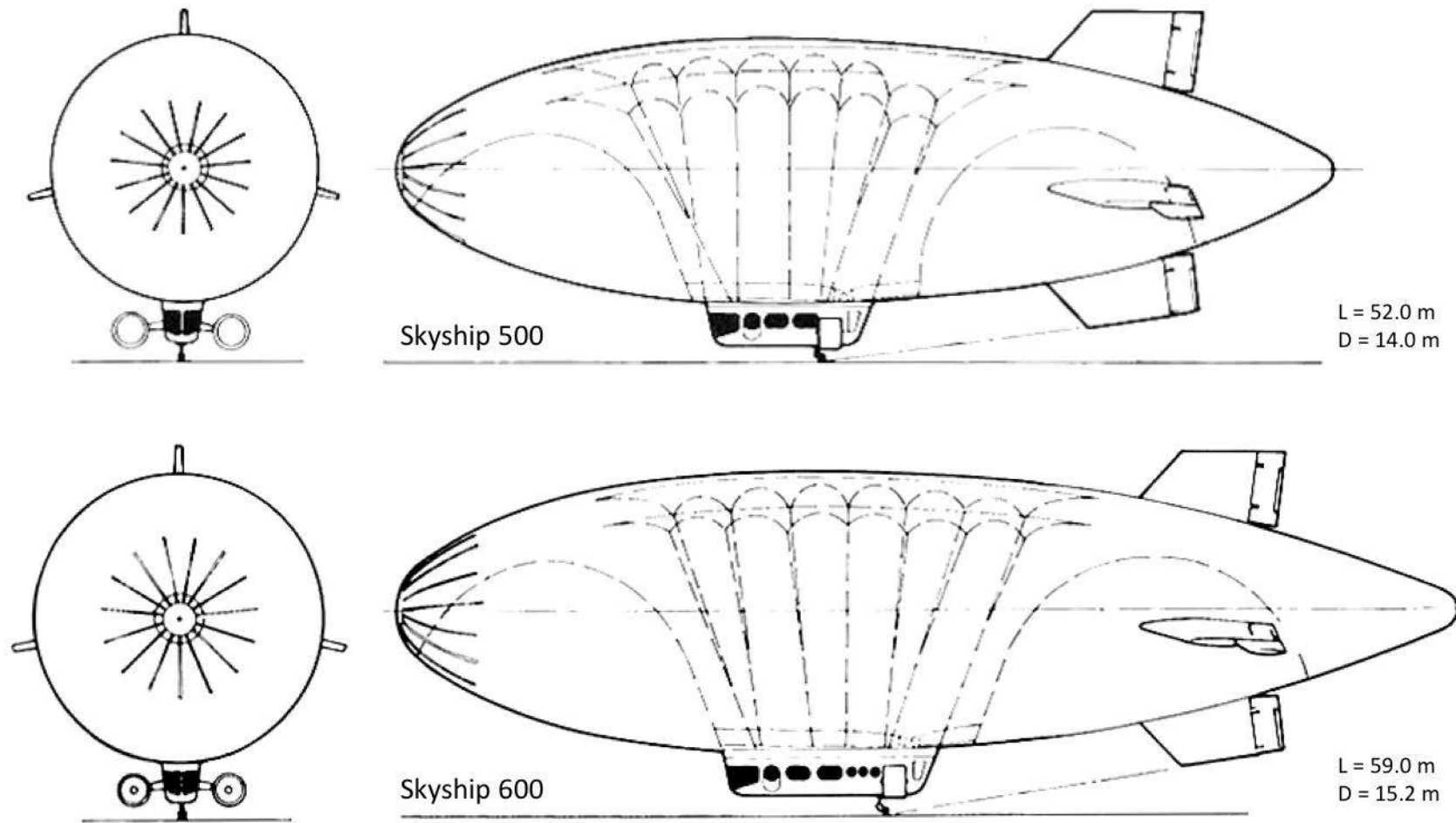
First Skyship 500, G-BIHN, at Cardington. Source: Airships Online



First Skyship 600, G-SKSC, at Cardington. Source: Airships Online

General characteristics of the Skyship 500 and 600

Parameter	Skyship 500	Skyship 600
Length	52 m (170.7 ft)	59 m (193.6 ft)
Diameter, max	14 m (45.9 ft)	15.2 m (49.4 ft)
Height, overall	18.7 m (61.2 ft)	20.3 m (66.6 ft)
Envelope volume	5,153 m ³ (182,000 ft ³)	6,666 m ³ (235,400 ft ³). 3% larger replacement envelopes from TCOM.
Envelope material	Polyester load carrier spray coated externally with titanium oxide impregnated polyurethane & sealed internally with polyurethane bonded Mylar gas retention film	Same as Skyship 500.
Ballonet volume	26% gross volume: 1,334 m ³ (47,110 ft ³)	26% gross volume, 1,800 m ³ (53,566 ft ³)
Max gross lift	4,500 kg (9,990 lb)	5,900 kg (13,007 lb)
Maximum takeoff weight	4,430 kg (9,766 lb)	6,650 kg (14,661 lb)
Empty weight	3,185 kg (7,022 lb)	3,650 kg (8,047 lb)
Payload	2,000 kg (4,409 lb)	3,000 kg (6,614 lb)
Propulsion	2 x normally aspirated 6-cylinder Porsche 930/01/A1/3 engines rated @ 152 kW (204 hp) each, installed in the gondola, driving pylon-mounted, shrouded, 5-bladed Hoffmann reversible pitch propellers 1.4 m (4.5 ft) in diameter, vectorable 90° up to 120° down	2 x turbocharged 6-cylinder Porsche 930/67/A1/3 engines rated @ 190 kW (255 hp) each, with ducted propeller configuration similar to Skybus 500, vectorable 85° up to 110° down
Gondola dimensions	9.2 L x 2.4 W meters (30.3 L x 7.9 W feet)	11.7 L x 2.56 W meters (38.3 L x 8.4 W feet)
Accommodations	2 crew + 8 passengers	2 crew + 13 passengers
Speed, max	93 kph (58 mph)	92.5 kph (57.5 mph)
Speed, cruise	56 kph (35 mph)	55.5 kph (34.5 mph)
Range	870 km (540 m) @ 74 kph (46 mph)	1,020 km (630 mi) @ 74 kph (46 mph)
Ceiling, max (pressure altitude)	2,980 m (9,770 ft)	3,050 m (10,010 ft)
Endurance	12 hours	



Skyship 500 & 600 scale comparison. Source: Adapted from R.L. Rimell, "Skyship!"

Skyship 500

Airship Industries used the AD-500 prototype design as the starting point for the Skyship 500. Both airships have the same size envelope and gondola and very similar design features. Improvements made in the Skyship 500 included bow stiffening, simpler ballonnet gas valves, flight control refinement, honeycomb sandwich tail fins with Kevlar leading edges, and an envelope design with longitudinal rather than transverse panels, reducing the number of panels needed to manufacture the envelope. A Skyship 500 weighs about 140 kg (310 lb) less than the AD-500.

The only metal used in the gondola is in the fire-proof bulkhead separating the engine compartment from the cabin, and the steel outriggers supporting the ducted fan propulsors. The only metal used in the envelope is in the pulleys that secure the gondola's Kevlar suspension cables. As a result, the Skyship 500 has a very low radar cross-section.



The first Skyship 500, G-BIHN at a mobile mooring mast.

Source: Mike Freer via Wikipedia



Skyship 500 flying in 1983 US Naval Air Development Center test of airship flying qualities, performance, and radar cross-section. Source: Wikipedia

Two and a half years after the AD-500 first flight, the first Skyship 500, G-BIHN, made its first flight at Cardington on 28 September 1981. The Skyship 500 received its Certificate of Airworthiness from the UK Civil Aviation Administration on 3 September 1983. Six Skyship 500s were built, two later being converted to 500 HLs.

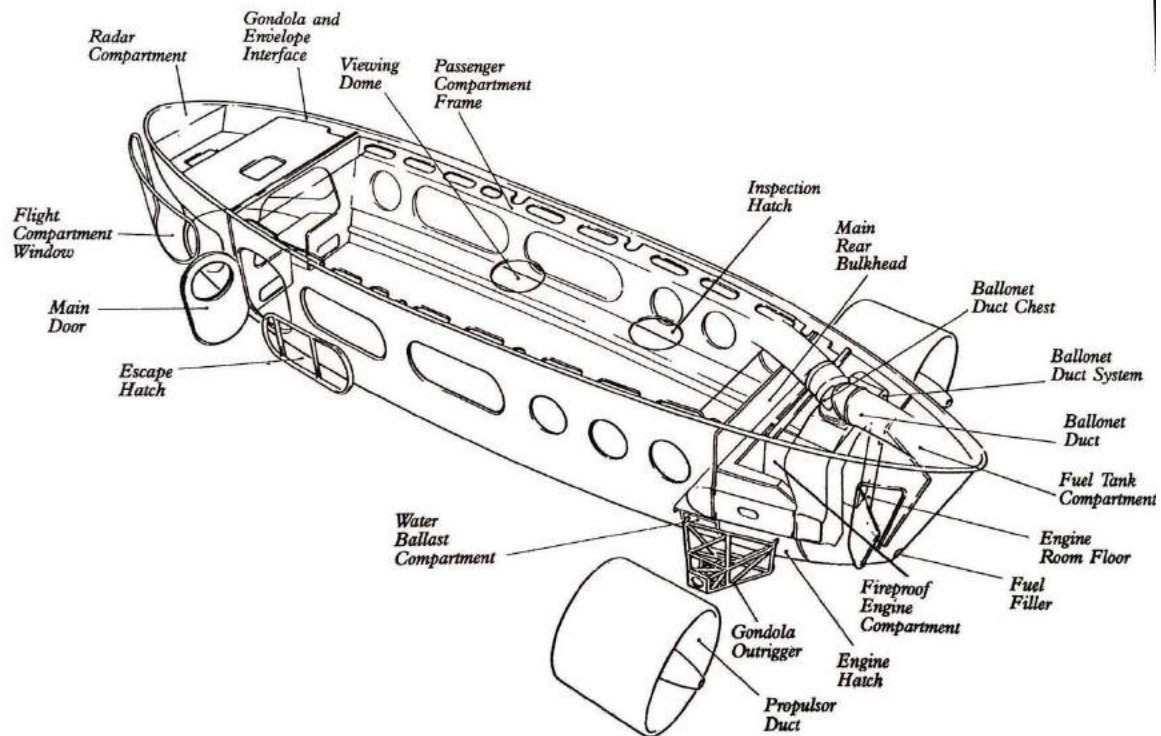
Skyship 600

The Skyship 600 is a stretched version of the Skyship 500, with a 30% increase in envelope volume and a 50% increase in disposable load. With turbocharged Porsche engines, the Skyship 600 matches the performance of the Skyship 500 with normally-aspirated engines. The airship has a larger gondola that can accommodate a crew of two and 13 passengers.

The first Skyship 600 (registration G-SKSC) made its first flight in March 1984. Nine Skyship 600s were built.



*Skyship 600 being moved from a hangar on a mobile mooring mast.
Source: Screenshots from video (2013)*



*Skyship 600 gondola and system layout.
Source: Airship Heritage Trust*



*Skyship 600 gondola details, circa 2006.
Source: Thierry Detable via Airport-Data.com*



The Skyship 600 was promoted as a naval patrol airship with a motorized, inflatable patrol boat that was deployable in flight from a stowed location under the gondola. A crew entry door in the bottom of the gondola provided inflight access to the boat. A twin winch system deployed or recovered the boat while the airship hovered above with the propulsors vectored down for added dynamic lift. Fins on the stern of the raft improved stability during the lift.

These photos show a French test in the English Channel. Source, both photos: Hybrid Pilot Services, Ltd.



Two Skyship 600 airships operated by Skycruise Switzerland were leased to aid security and surveillance efforts during the 2004 Athens Olympics. Source: Flying Magazine (2004)



Skycruise Skyship 600s in Athens for the Olympics. Source: Hybrid Pilot Services Ltd.

Skyship 500HL

AI built one high-payload Skyship 500HL from scratch, using a Skyship 500 gondola with a larger Skyship 600 envelope. In addition, two Skyship 500s (UK registration G-BIHN and US registration N501LP) were converted to the 500HL configuration.

The Skyship 500HL received US Type Certificate is AS2EU, Rev 5., which, since 23 April 2012, had been held by Skyship Services.



*Skyship 500HL & details of gondola layout.
Source, both graphics: Airship Heritage Trust*

Larger Skyships

In the early 1980s, AI prepared design concepts for two much larger nonrigid airships. The 1983 UNIDO report explains:

“Airship Industries has prepared concept designs for two much larger nonrigids, the Skyship 2000 and the Skyship 5000, of 20,000 and 50,000 cu.m. Both are conceived for long endurance maritime patrol and advanced early warning. The Skyship 5000 will be 108 m long and 30 m in diameter and able to lift a disposable load of 28 tons. It would be capable of carrying a three shift crew of 19 on week long missions. The Skyship 2000, designated *Coastguarder*, is a vessel 80 m long with a 10 ton lift capability. Although conceived for maritime patrol and AEW, both the 2000 and 5000 could be configured for the transport of passengers. The 2000 could carry up to 60 passengers while the 5000 could accommodate up to 200.”

While AI did not develop either of these large airship concepts, the exercise prepared them for bidding on the US Navy's Sentinel 5000 airborne early warning (AEW) airship program a few years later and for developing the concept for a derivative civil passenger version known as the Skyship 5000.

5. Sentinel 1000 and 5000 (YEZ-2A)

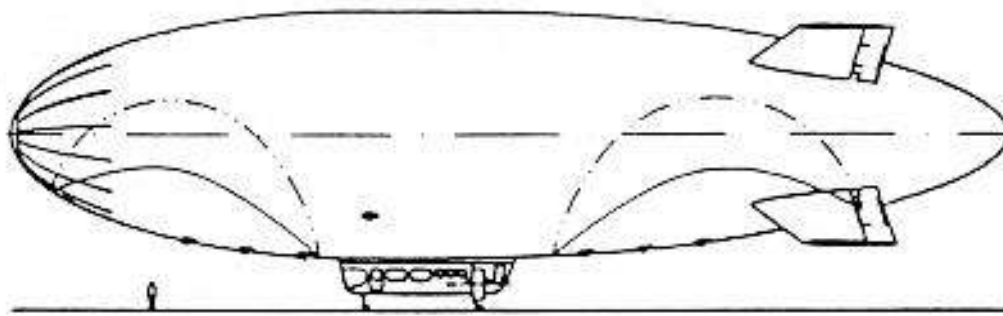
On 5 June 1987, the Westinghouse–Airship Industries (WAI) team won the competition for the Sentinel 5000 (YEZ-2A) radar surveillance and airborne early warning airship and was awarded a \$168.9 million contract to build a subscale Operational Development Model (ODM), which became known as the Sentinel 1000.

Sentinel 1000 and 5000 general characteristics

Parameter	Sentinel 1000	Sentinel 5000 (YEZ-2A)
Length	67.7 m (222 ft)	129.5 m (425 ft)
Diameter, max	16.7 m (54.7 ft)	32.0 m (105 ft)
Height, overall		46.3 m (152 ft)
Volume	10,000 m ³ (353,146 ft ³)	70,792 m ³ (2,500,000 ft ³)
Max op. weight	9,200 kg (20,240 lb)	
Max disposable load	2,704 kg (5,962 lb)	
Propulsion	<ul style="list-style-type: none"> 2 x turbocharged 6-cylinder Porsche 930/67 engines rated @ 190 kW (255 shp) each, with ducted propellers similar to Skyship 600, vectoring +110° to -80° Total installed power: 380 kW (510 shp) 	<ul style="list-style-type: none"> 2 x turbo-charged PPB marine diesels rated @ 1,342 kW (1,800 shp) each. 1 x GE T700 turboprop @ 1,268 kW (1,700 shp) in a pusher configuration for “sprint” operations Total installed power: 5,300 shp (3,952 kW)
Gondola dimensions	Similar to Skyship 600: L = 11.7 m (38.3 ft) W = 2.56 m (8.4 ft)	L = 25.9 m (85 ft) W = 5.1 m (16.3 ft) H = 7.3 m (23 ft)
Accommodations	1 x pilot and 10 passengers	10 – 15 in a partly pressurized, 3-level gondola
Speed, max	92.6 kph (50 knots)	167 kph (90 knots) “sprint,” all engines
Speed, cruise	83.3 kph (45 knots)	83.3 kph (45 knots)
Ceiling, operating	305 – 1,524 m (1,000 – 5,000 ft)	up to 3,050 m (10,000 ft)
Pressure altitude	8,000 ft (2,438 m)	4,270 m (14,000 ft)
Endurance		<ul style="list-style-type: none"> 2 - 3 days on station @ 45 knots, no refueling up to 30 days with refueling & replenishment from surface ships

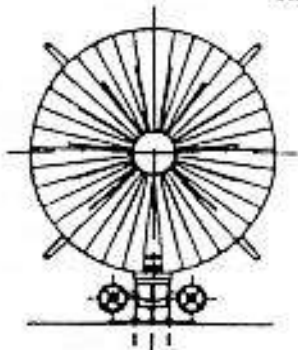
Sentinel 1000

The Sentinel 1000 was a nonrigid airship that resembled a further scale-up of the Skyship 600. It featured a modified Skyship 600 gondola with tricycle landing gear for better stability than the original single landing gear. It had a 50% larger envelope volume than the Skyship 600, with an X-tail configuration in place of the cruciform tail to permit a steeper departure angle on takeoff.

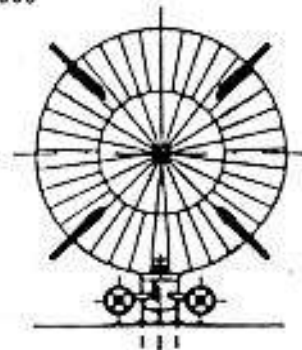


PORT SIDE ELEVATION

THREE VIEW PICTORIAL OF SENTINEL 1000



VIEW LOOKING AFT



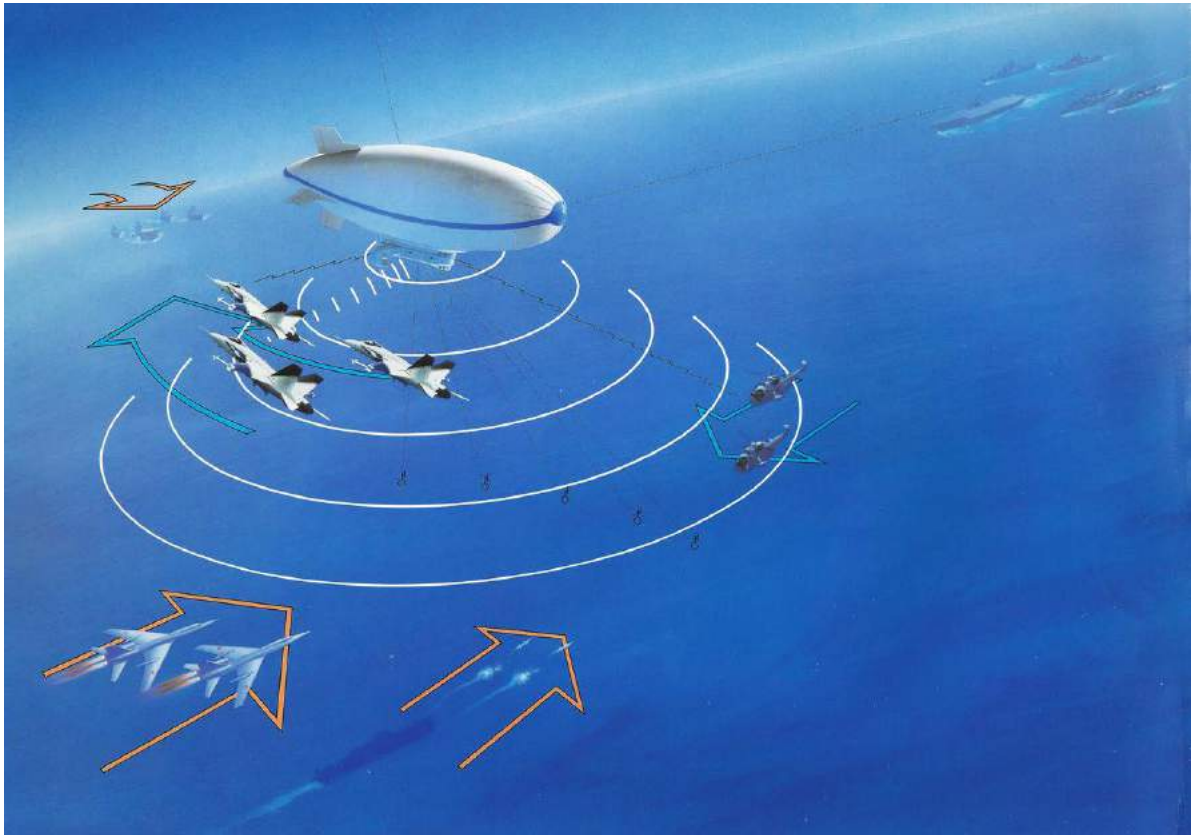
VIEW LOOKING FORWARD

Sentinel 1000 general arrangement. Source: Airship Heritage Trust

The airship was assembled in the Airdock #2 hangar at WAI's Weeksville facility at a former blimp base near Elizabeth City, North Carolina. At the time of AI's insolvency in September 1990, the Sentinel 1000 was still being assembled and was nine months from its first flight in June 1991.

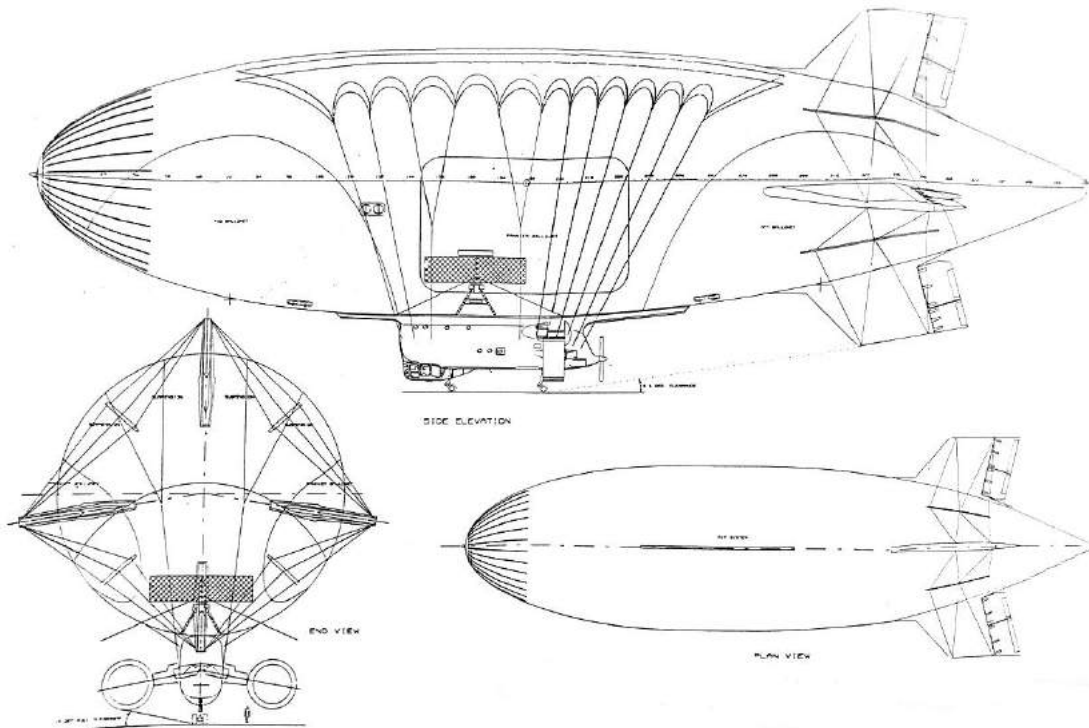
Sentinel 5000

The Navy's original mission for the Sentinel 5000 called for an independent AEW system capable of operating with naval surface attack groups anywhere in the world, serving as a radar picket to protect fleet assets from attack by bombers and low-flying cruise missiles and helping direct a response force to defend against the attack. This concept of operations is illustrated in the following diagram.



Sentinel 500 concept of operation: Airship detects incoming bombers and cruise missiles and directs fighters and ASW helicopters to engage. Source: airshiponline.com

The Sentinel 5000 would have been the largest nonrigid blimp ever built, with a gas envelope about 67% larger than the envelope on the Navy's Goodyear ZPG-3W AEW blimp, which retired from active service in 1961.

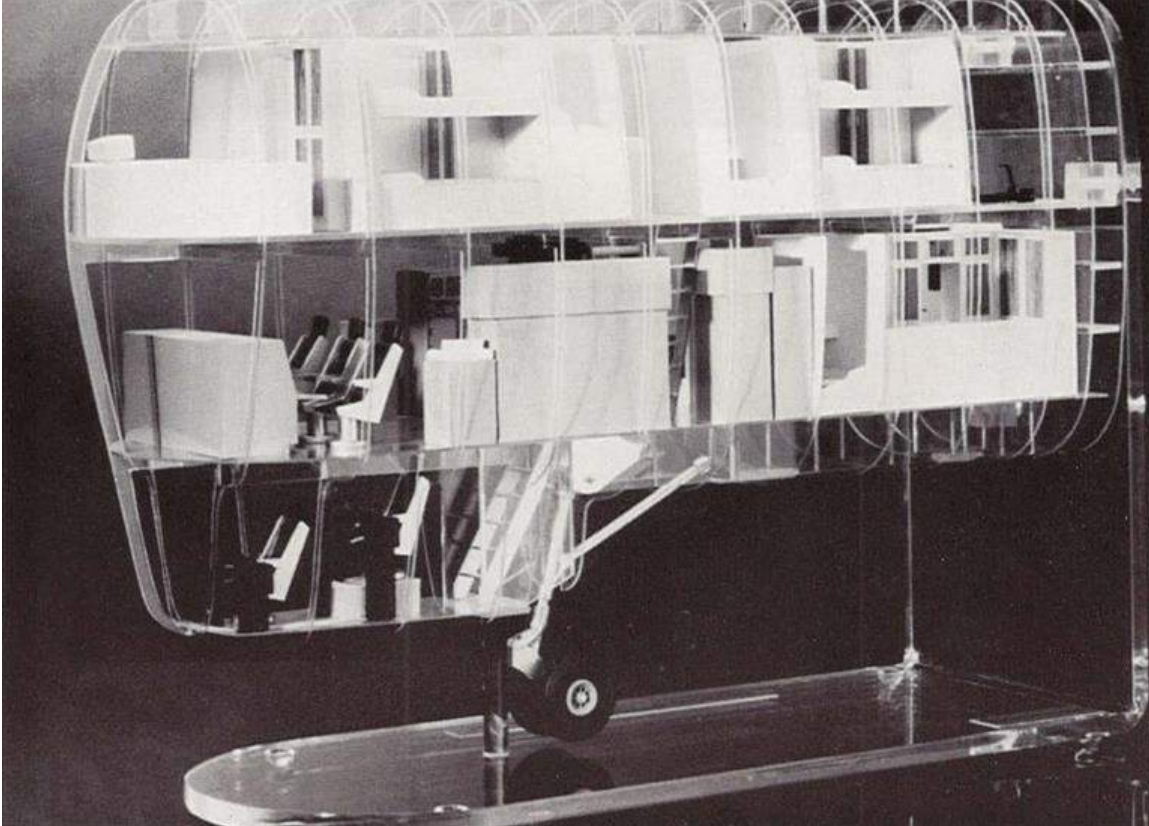


Sentinel 5000 three-view general arrangement drawing showing the location of the large radar antenna inside the gas envelope.

Source: Adapted from Airship Heritage Trust

The WAI design included the following key features:

- Pressurized gondola
- Fly-by-light controls
- Multiple lifting gas compartments
- Incorporated the Navy E-2C Hawkeye's radar (APS-125 or later APS-139), with an enlarged 12.2 m (40 ft) rotating antenna inside the envelope, installed above the gondola. Later use of a larger phased array radar was considered.
- Composite material gondola construction and composite envelope provide low radar cross-section. Engines were shielded with radar absorbent material.
- Engines were installed inside the gondola and thermally shielded to reduce their infra-red signature.
- The airship carried means to defend itself from missile attack (i.e., ECM suite and decoys).



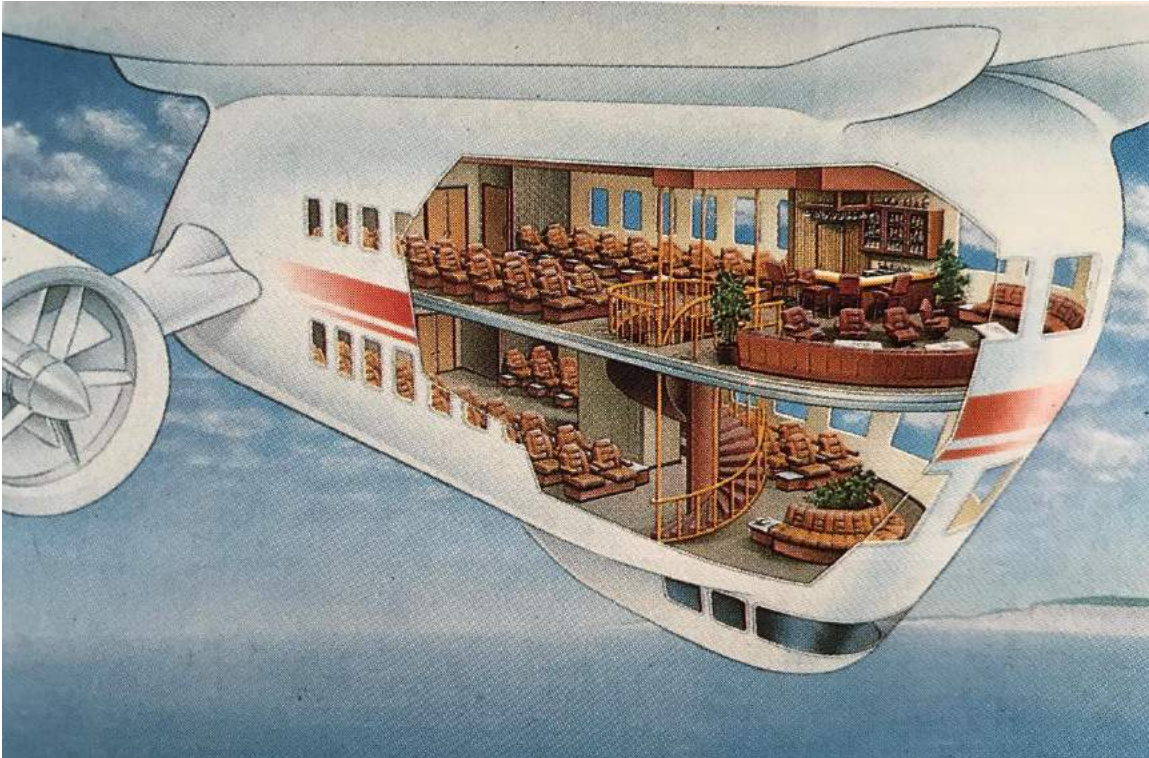
Model of three-level gondola forward section. Berthing / living area on the top deck, AEW operations on the mid deck, and flight controls on the lowest deck at the nose. Source: R.L. Rimell, Sentinel!

At the time of AI's insolvency in September 1990, the Sentinel 5000 was still in an early design phase. Work on the project continued without AI, under the reorganized firm known as Westinghouse Airships Inc. (still WAI).

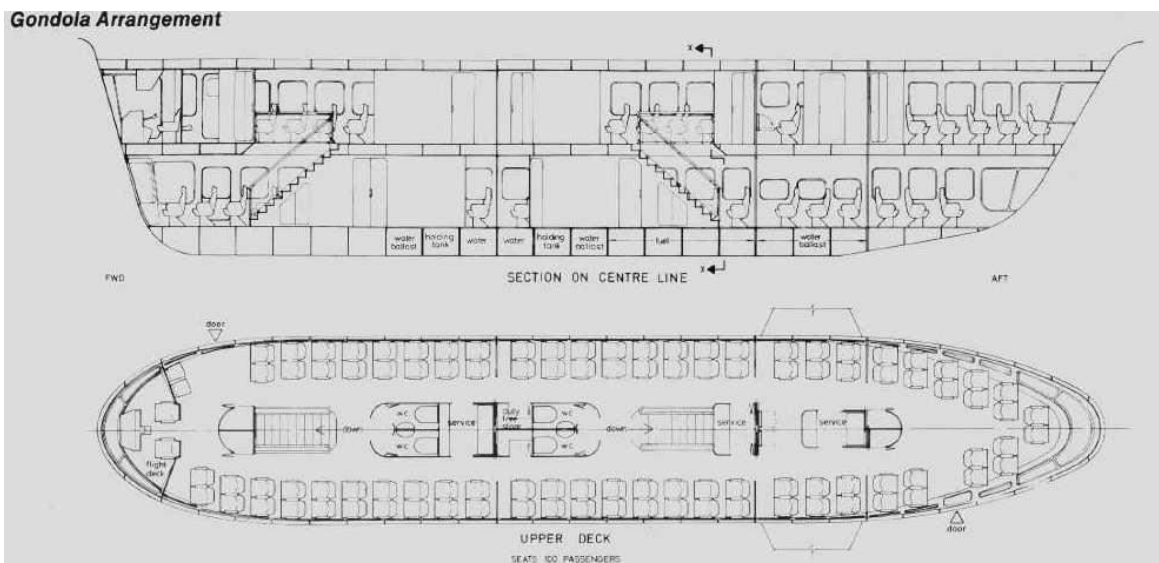
For more information on the Sentinel 1000 and 5000 airships, see my separate article on the US Navy's YEZ-2A program.

6. Skyship 5000

The Skyship 5000 was an AI concept for a civil passenger version of the Sentinel 5000 airship being developed by the Westinghouse – AI (WAI) team for the US Navy. Launch of the civilian AI Skyship 5000 program depended on the success of the Sentinel 5000 program. That business opportunity ended when AI became insolvent and failed in September 1990.



*Skyship 5000 gondola configuration for passenger service.
Source: Airship Heritage Trust*



*Skyship 5000 gondola plan and elevation layout drawings for
passenger service. Source: Airship Heritage Trust*

7. For more information

- “Aerospace Developments AD 500 – The first of the new era,” Airships Online:
<https://www.airshipsonline.com/airships/AD%20500/index.html>
- “Airship Industries SkyShip 500,” Airships Online:
<https://www.airshipsonline.com/airships/ss500/index.html>
- “SkyShip 500 HL (Heavy Lift),” Airships Online:
<https://www.airshipsonline.com/airships/SS500HL/index.html>
- “Airship Industries SkyShip 600,” Airships Online:
<https://www.airshipsonline.com/airships/ss600/index.html>
- “Sentinel 1000,” Airships Online:
https://www.airshipsonline.com/airships/Sentinel_1000/Index.htm
- “SkyShip 5000 / Sentinel 5000,” Airships Online:
https://www.airshipsonline.com/airships/Sentinel_5000/index.html
- R.L. Rimell, “Skyship! Renaissance of the British Airship Industry,” Skyship Services, Inc.:
<https://manualzz.com/doc/7401088/skyship-magazine----skyship-services--inc>
- “Airship Industries Production List,” Airport-Data.com:
https://www.airport-data.com/manuf/Airship_Industries.html
- “The 1984 Airship: Roomy, slow easy to land - and cheap,” Popular Mechanics, pp. 126 – 127, May 1981:
https://books.google.com/books?id=PNkDAAAAMBAJ&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false
- Anthony J. Dolman, “Current and Possible Future Developments in Lighter-Than-Air (LTA) System Technology,” United Nations Industrial Development Organization (UNIDO), pp. 70 - 80, 1983:
<https://open.unido.org/api/documents/4793600/download/CURRENT%20AND%20POSSIBLE%20FUTURE%20DEVELOPMENTS%20IN%20LIGHTER-THAN-AIR%20>
- Patrick Abbot & Nick Walmsley, “British Airships in Pictures, An illustrated history 1784 – 1998,” p. 97, ISBN 1 899863 48 6, Redwood Books, 1998

- Yu.S. Boyko, "Aeronautics: Tethered, Free, Managed," pp. 397 – 399, ISBN 5.8122-0233-8, Publishing house MGUP, Moscow, Russia, 2001
- Lane Wallace, "Skyship 600: To the Olympics by Blimp," Flying, 24 December 2004: <https://www.flyingmag.com/pilot-reports/pistons/skyship-600-olympics-blimp/>
- "Type Certificate is AS2EU," Rev 5., Skyship 500HL, assigned to Skyship Services, Inc., 23 April 2012, search on the FAA Type Certificate website here: https://rgl.faa.gov/Regulatory_and_Guidance_Library/rgMakeModel.nsf/MainFrame?OpenFrameSet
- "Type Certificate is AS1EU," Rev 6., Skyship 600, assigned to Skyship Services, Inc., 23 April 2012, search on the FAA Type Certificate website here: https://rgl.faa.gov/Regulatory_and_Guidance_Library/rgMakeModel.nsf/MainFrame?OpenFrameSet

Video

- "Comment C'est Fait - Les Aérostats Dirigeables," (In French), (4:57 min, Skyship 600 maintenance), posted by Qualid Hendi, 12 February 2013: <https://www.youtube.com/watch?v=D2tZp-X5NV8>
- "Airships of the 1990s," (7:23 min, includes Skyship 600, 500HL & Sentinel 1000), posted by zrsthmovie.com, 27 April 2020: <https://www.youtube.com/watch?v=9hqAKZGYZRc>
- "Build and Fly Skyship 600," (8:57 minutes), posted by zrsthmovie.com, 28 August 2020: <https://www.youtube.com/watch?v=8Zs17ktnTkk>

Modern Airships articles

- *Modern Airships - Part 1*: <https://lynceans.org/all-posts/modern-airships-part-1/>
 - Advanced Technology Group (ATG)
 - US Navy YEZ-2A (Sentinel 1000 & 5000)
 - Wren Skyships Ltd. / Advanced Airship Corporation (AAC)

- *Modern Airships - Part 2:* <https://lynceans.org/all-posts/modern-airships-part-2/>
 - Thermo-Skyships Ltd. (TSL) hybrid thermal airships
- *Modern Airships - Part 3:* <https://lynceans.org/all-posts/modern-airships-part-3/>