Boeing Vertol - Deltoid VTOL hybrid lifting body airship

Peter Lobner, 27 February 2025

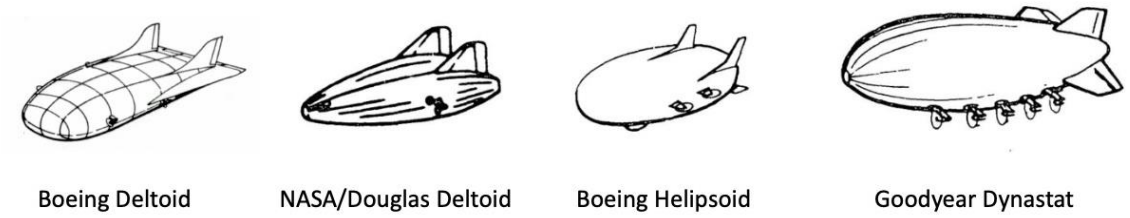
1. Introduction

In 1975, NASA sponsored a study named *Feasibility of Modern Airships – Phase I,* with Goodyear Aerospace Corp. and Boeing Vertol Company as contractors performing studies of civilian roles for lighter-than-air (LTA) craft. The following six categories of airships were considered in the NASA study:

- Fully buoyant, conventional
  - Rigid airships
  - Non-rigid airships
- Partially buoyant, vertical takeoff and landing (VTOL), hybrid
  - Lifting body concepts
  - Combined / integrated concepts
- Partially buoyant, short takeoff and landing (STOL), hybrid
  - Lifting body concepts
  - Auxiliary wing concepts

Airship designs selected to represent each of the six categories were evaluated on three different mission profiles, short-range, transcontinental and intercontinental, with the airship sized for two different payloads, 50 and 100 tons (45.4 and 90.7 metric tons).

The candidates in the partially-buoyant VTOL category of hybrid lifting body airships were the Boeing Vertol Deltoid and Helipsoid, the NASA / Douglas Deltoid, and the Goodyear Dynastat.



Boeing Deltoid | NASA/Douglas Deltoid | Boeing Helipsoid | Goodyear Dynastat

Source: Adapted from NASA CR-137691, Vol. I (1975)

The particular mission profiles are summarized in the following table.

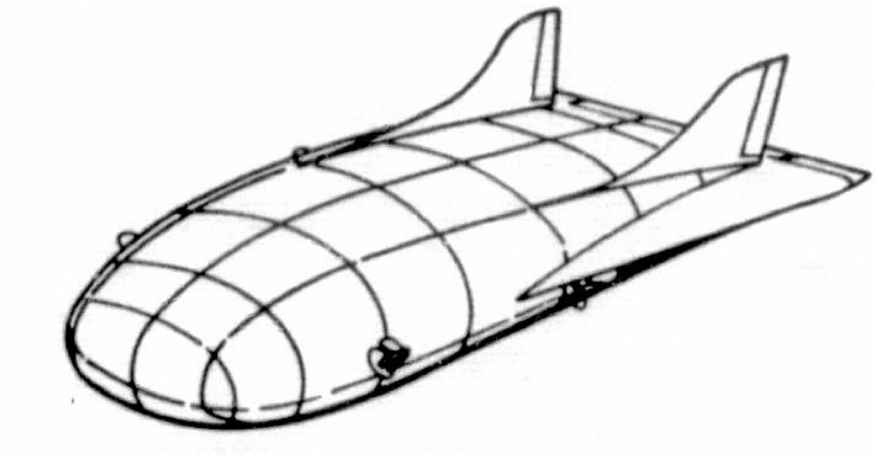
PARAMETER \ MISSION	SHORT RANGE	TRANSCONTINENTAL	INTERCONTINENTAL
RANGE (STILL AIR)	300 NM (556 km)	2,000 NM (3,704 km)	5,000 NM (9,260 km)
CRUISE ALTITUDE	2,000 ft ISA (610 m ISA)	13,000 ft ISA (3,962 m ISA)	2,000 ft ISA (610 m ISA)
CRUISE SPEED*	50, 100, 200 kt (25.7, 51.4, 102.9 m/s)	50, 100, 200 kt (25.7, 51.4, 102.9 m/s)	50, 100, 200 kt 25.7, 51.4, 102.9 m/s
RESERVES	50 NM (93 km) DIVERSION & 10% INITIAL FUEL	250 NM (463 km) DIVERSION & 10% INITIAL FUEL	250 NM (463 km) DIVERSION & 10% INITIAL FUEL
DESIRED PAYLOAD	50–100 TONS	50-100 TONS	100 TONS
DESIGN ALTITUDE (FOR HULLS, PROP/ ROTORS AND ENGINE SIZING)	5,000 ft ISA (1,524 m ISA)	15,000 ft ISA 4,572 m ISA	5,000 ft ISA (1,524 m ISA)
*CRUISE SPEED AT CRUISE ALTITUDE			

Source: NASA CR-137691, Vol. I (1975)

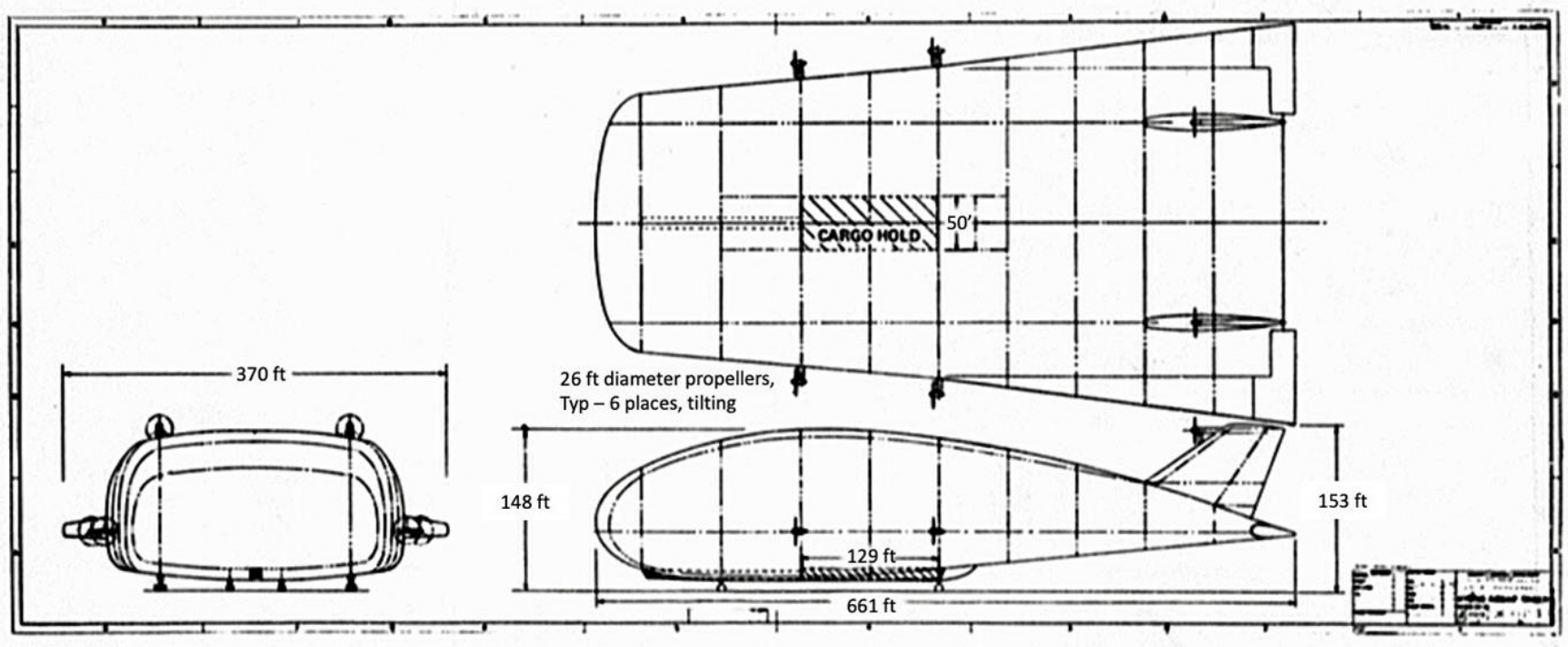
The Phase I initial screening led to the selection of the Boeing Vertol Helipsoid to represent the category of partially-buoyant VTOL hybrid lifting body airships. The Boeing Vertol Deltoid was not considered further in the NASA feasibility study. Its interesting design features are summarized in this article.

2. The Boeing Vertol Deltoid hybrid airship concept

This rigid, hybrid airship concept has a low aspect ratio, highly swept delta planform with an airfoil-shaped lifting body hull with a thickness ratio of about 21%.



General arrangement of the Boeing Vertol Deltoid hybrid airship.
Source: NASA CR-137691, Vol. I (1975)

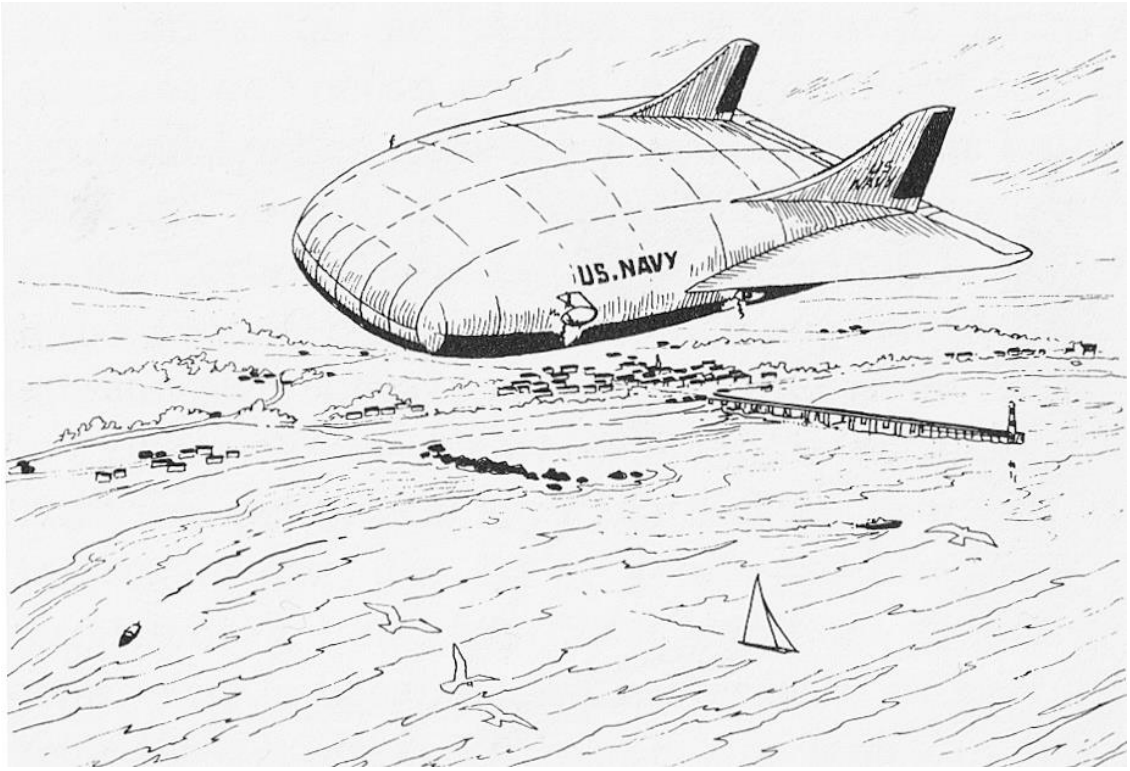


Three-view drawing of the Boeing Vertol Deltoid hybrid airship, showing its sharply-swept delta shape in the top view and the airfoil-shaped lifting body in the side view. Note the six large diameter propellers, with four mounted along the flanks of the hull and two mounted at the top of the twin tails. Other Deltoid designs only have the four flank-mounted propellers. Source: Adapted from NASA CR-137691, Vol. I, Fig. 5-12 (1975)

The rigid hull contained numerous lifting gas cells. Engines were mounted inboard and drove variable pitch, vectoring prop-rotors. Depending on the total installed power and buoyancy ratio, a Boeing Vertol Deltoid airship may be either VTOL or STOL.

General characteristics of the Boeing Vertol Deltoid hybrid airship

Parameter	Boeing Vertol Deltoid (circa 1975)
Type	Rigid, hybrid, deltoid lifting body airship
Length, OA	201.4 m (661 ft)
Width (span), OA	112.8 m (370 ft)
Height, lifting body hull	45.1 m (148 ft)
Height, tail	46.6 m (153 ft)
Buoyancy ratio	Not specified
Propulsion & maneuvering	• 4 x flank-mounted 7.9 m (26-ft) diameter, variable pitch, vectoring prop rotors • 2 x tail-mounted 7.9 m (26-ft) diameter, variable pitch, vectoring prop rotors (not included in some versions)
Internal cargo bay	Length 39.3 m x width 15.2 m (129 ft x 50 ft)
Speed, max	About 200 kph (124.2 mph)



Boeing Vertol Deltoid. Source: "Les Ballons du Futur," (1983)

3. For more information

- “Feasibility Study of Modern Airships – Phase I, Volume I – Summary and Mission Analysis,” NASA CR-137691, Volume I, Boeing Vertol Company, May 1975: https://ntrs.nasa.gov/api/citations/19750024930/downloads/19750024930.pdf
- Pierre Balaskovic & François Moizard, "Les Ballons du Futur," ACE éditeur, ISBN 2.86664.020.9, p. 53, 1983

Other *Modern Airships* articles

- *Modern Airships - Part 1*: https://lynceans.org/all-posts/modern-airships-part-1/
    - Boeing Vertol - Helipsoid hybrid airship
    - NASA / Douglas - Deltoid hybrid airship
    - Goodyear - Dynalifter hybrid airship
- *Modern Airships - Part 2*: https://lynceans.org/all-posts/modern-airships-part-2/
- *Modern Airships - Part 3*: https://lynceans.org/all-posts/modern-airships-part-3/